Sycamore Hills Distribution Center Project

Draft Environmental Impact Report (DEIR)

Appendix G – Geotechnical Engineering Investigation, Report of Preliminary Deep Percolation Testing, Paleontological Resource Assessment

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March 29, 2019
(Revised September 16, 2020)

Project Number 21022-19

Darrell Butler
3241 Alta Laguna Boulevard
Laguna Beach, California 92651

RE: **Geotechnical Engineering Investigation** - Proposed Industrial Warehouse Development - Located at the Northeast Corner of Barton Street and Alessandro Boulevard, in the City of Riverside, California

Dear Mr. Butler:

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 February 28, 2019. The purpose of this investigation is to evaluate the geotechnical conditions of the subject site and to provide recommendations for the proposed industrial warehouse 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; 5) 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 Background

The proposed project is to construct an industrial warehouse development on three parcels [Assessor Parcel Numbers (APNs) 263-060-022, 263-060-024, 263-060-026], totaling 48.64 gross acres. The property is located at the northeast corner of Barton Street and Alessandro Boulevard in the City of Riverside (City), immediately south of the Sycamore Canyon Wilderness Park. The property is spread in an east to west direction with natural rolling land descending gradually from a west to east direction. There are two jurisdictional drainages on the site. The undeveloped parcels are covered with a low to moderate growth of vegetation cover consisting of natural grasses and weeds with some granitic rock outcrops.

1.1 Project Description

The project proposes subdividing the site into two parcels (Parcels 1 and 2), and three lettered parcels (Parcels A, B, and C). Each parcel is proposed to be developed with a high cube transload short-term warehouse building (Buildings A and B). Building A, a 400,000 square foot warehouse, will be constructed on Parcel 1. Building B, a 203,100 square foot warehouse, will be constructed on Parcel 2. Associated improvements include parking, fire lanes, fencing and walls (including retaining walls), landscaping, and water quality treatment areas.

Parcels A and Parcel B consist of existing Restricted Property of natural land, with a supporting jurisdictional feature, totaling approximately 11.6 acres. A 0.67-acre driveway will be constructed through the Restricted Property to provide street access from Alessandro Boulevard to Parcel 1, which would reduce the Restricted Property to 10.93 acres. However, 1.44 acres will be added to Parcel A to mitigate this loss, resulting in a total of 12.37 acres of Restricted Property (net gain of 0.77 acres). A Conservation Easement is proposed to be placed over the amended 12.37 acres of Restricted Property.

A trailhead parking lot is proposed on Parcel C, totaling 1.18 acres, for access to the Sycamore Canyon Wilderness Park. Improvements include a parking lot, sidewalk, shade structure, bike rack, drinking fountain, fencing, and a Fire Department and access gate. Parcel C will be dedicated to the City.

The proposed concrete tilt-up buildings will be supported by a conventional slab-on-grade foundation system with perimeter-spread footings and isolated interior footings. A retaining wall on the order of 8 feet in height and retaining about 6 feet will be constructed along the east property line. Other improvements will include asphalt and concrete pavement areas, hardscape and landscaping. It is assumed that the proposed grading for the development will include cut and fill procedures both on the order of 15 feet to achieve finished grade elevations. Graded 2 to 1 (horizontal to vertical) cut and fill slopes have been planned on the order of a few feet up to a maximum of 16 feet along the north property perimeter for construction of the proposed detention basin based on the latest grading plan. 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 subject property consists of three contiguous vacant parcels (APNs 263-060-022, 024 and 026) totaling 48.6 acres, located at the northeast corner of Barton Street and Alessandro Boulevard, in the City of Riverside, immediately south of the Sycamore Canyon Wilderness Park. As part of this proposal, the three parcels will be subdivided to create a total of two parcels and three lettered lots. The generally irregular-shaped parcels is elongated in an east to west direction with topography consisting of natural rolling terrain descending gradually from a west to east direction on the order of about 30 feet. Some outcrops of granitic rock were observed throughout the property. The undeveloped parcels are covered with a low to moderate growth of vegetation cover consisting of natural grasses and weeds and borders the Sycamore Canyon Wilderness Park to the north.

3.0 Site Exploration

The investigation consisted of the placement of twenty-one (21) subsurface exploratory trenches by a backhoe to depths ranging between 5 and 15 feet below current ground elevations. The trenches were placed at accessible locations throughout the property. The explorations were visually classified and logged by a field engineer with locations of the subsurface explorations shown on the attached plan.

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

Fill: A fill soil classifying as a brown, fine to coarse grained, silty SAND was encountered across the site to depths ranging from 1 to 1½ feet below ground surface. These soils were noted to be loose and moist.

Natural: A natural undisturbed soil classifying as a brown, fine to coarse grained, silty SAND was encountered beneath the upper fill soils. The native soils as encountered were observed to be medium dense to dense and moist.

Bedrock: A granitic bedrock classifying as a grey brown, fine to coarse grained, silty SAND (Decomposed Granite) was encountered beneath the upper soils at a depth of 1 to 5 feet below ground surface. The bedrock was noted to be massive and observed to be slightly to highly weathered and dense to very dense.

The overall engineering characteristics of the earth material were relatively uniform with each excavation. Groundwater was not encountered to the depth of our trenches and no caving occurred.

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. 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 **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 III.

4.5 **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.

4.6 **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 Plates A to C.

4.7 **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 D to G.

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 San Jacinto Fault is located 14 kilometers from the site and is capable of producing a Magnitude 7.0 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 parameters are provided on the following page and are based on the 2019 California Building Code (CBC) Standard ASCE/SEI 7-16. The data was obtained from the American Society of Civil Engineers (ASCE) website, https://asce7hazardtool.online/. The ASCE 7 Hazards Report is attached in Appendix C.

Seismic Design Acceleration Parameters

Latitude	33.919
Longitude	-117.311
Site Class	D
Risk Category	III
Mapped Spectral Response Acceleration	S_S = 1.500 S_1 = 0.600
Adjusted Maximum Acceleration	S_{MS} = 1.500
Design Spectral Response Acceleration Parameters	S_{DS} = 1.000
Peak Ground Acceleration	PGA_M = 0.573

6.0 Liquefaction Evaluation

The site is expected to experience ground shaking and earthquake activity that is typical of the Southern California area. It is during severe shaking that loose, granular soils below the groundwater table can liquefy. Based on review of the *City of Riverside Public Safety Element – Liquefaction Zones (2006)*, the site is not situated in an area of generalized liquefaction susceptibility. Thus, the design of the proposed construction in conformance with the latest Building Code provisions for earthquake design is expected to provide mitigation of ground shaking hazards that are typical to Southern California.

7.0 Infiltration Characteristics

Infiltration tests within the site were performed to provide preliminary infiltration rates for the purpose of planning and design of an on-site water disposal system. The infiltration tests consisted of the double ring infiltration test per ASTM Method D 3385. The field infiltration rate was computed using a reduction factor – R_f based on the field measurements with our calculations given in Appendix D. Based upon the results of our testing, the soils/bedrock encountered in the planned on-site drainage disposal system area exhibit the following infiltration rates.

Test No.	Depth (ft)	Infiltration Rate
T-1	5'	0.5 in/hr
T-2	7.5'	0.16 in/hr
T-11	5'	0.28 in/hr
T-12	10'	0.08 in/hr
T-19	5'	0
T-20	5'	0.08 in/hr
T-21	10'	0.04 in/hr

The correction factors CF_t, CF_v and CF_s are given below based on soils/bedrock between 5 and 10 feet from our field tests.

a) $CF_t = R_f = 1.0$ for our double ring infiltration test holes.

b) $CF_v = 1.0$ based on uniform soils encountered in two trenches for infiltration tests.

c) $CF_s = 3.0$ for long-term siltation, plugging and maintenance. The subsurface soils are likely to have some plugging and regular maintenance of storm water discharge devices is required.

Based on the results of our field testing, the subsurface soils/bedrock encountered in the proposed on-site drainage disposal system from 5 to 10 feet below ground surface shall utilize a design infiltration rate of 0.05 or less in/hr. This value is less than 0.3 in/hr and indicates a very low infiltration rate for the on-site material. All systems must meet the latest city and/or county specifications and the California Regional Water Quality Control Board (CRWQCB) requirements.

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 soils 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*.

8.1.1 Removal and Recompaction Recommendations

All disturbed soils and/or fill (about 1 to 1½ 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.

It is possible that isolated areas of undiscovered fill not described in this report are present on site; if found, these areas should be removed to competent native material prior to placement of compacted fill. 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.

Based on the current preliminary grading plan, the project development plan does not plan any proposed import or export of soil. 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.

It is recommended the slope face shall be compacted and should be completely covered with deep rooted slope plantings classified as drought resistant to prevent any future erosion. 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 must be provided at all times.

8.1.2 Fill Blanket Recommendations

Due to the potential for differential settlement of foundations placed on engineered fill and the underlying bedrock, it is recommended that all foundations including floor 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. Otherwise all foundations for each individual building or site wall shall be embedded into bedrock.

8.2 Shrinkage/Bulking and Subsidence

Results of our in-place density tests reveal that the soil shrinkage will be on the order of 5 to 15% due to excavation and recompaction, based upon the assumption that the fill is compacted to 92% of the maximum dry density per ASTM standards. The bulking of the bedrock shall be between 3 to 7%. 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. 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 18 inches into approved engineered fill or bedrock with the corresponding widths:

Allowable Bearing Capacity (psf)		
Width (feet)	Continuous Foundation	Isolated Foundation
1.5	2000	2500
2.0	2075	2575
4.0	2375	2875
6.0	2500	3000

The bearing value may be increased by 500 psf for each additional foot of depth in excess of the 18-inch minimum depth, up to a maximum of 4,000 psf. A one-third increase may be used when considering short-term loading and seismic forces. A representative of this firm shall inspect all foundation excavations prior to pouring concrete.

8.5 Settlement Analysis

Resultant pressure curves for the consolidation tests are shown on Plates D to G. 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 - 0.40

Equivalent Passive Fluid Pressure = 250 lbs./cu.ft.

Maximum Passive Pressure = 2,500 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 **select imported 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). A Subdrain detail is attached.

8.8 Slab Design

All concrete slabs shall be a minimum of six inches in thickness in the proposed warehouse areas and four inches in office and hardscape and placed on approved subgrade soils. Additional 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 (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 50 and 54 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. 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.

Type of Traffic	Traffic Index	Asphalt (in.)	Base Material (in.)
Automobile Parking Stalls	4.0	3.0	3.0
Light Vehicle Circulation Areas	5.5	3.5	4.5
Heavy Truck Access Areas	7.0	4.0	8.0

Any concrete slab-on-grade in pavement areas shall be a minimum of six inches in thickness and may be placed on approved subgrade soils. 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 Riverside. 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 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

Keith D. Tucker

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

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

Scott D. Spensiero
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 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.

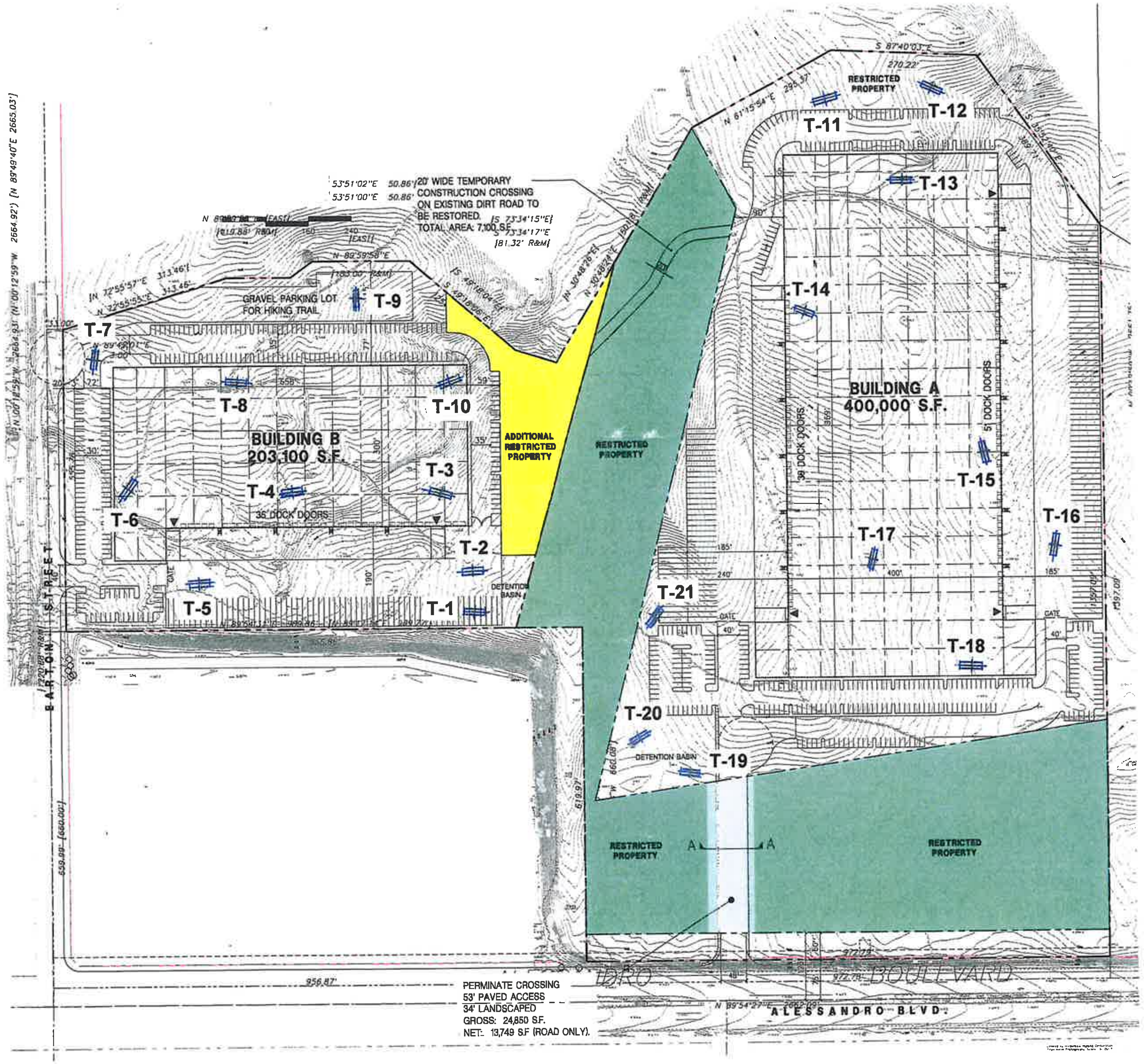
- Irrigation should be strictly controlled around building foundations, slabs and pavement and may need to be adjusted depending upon season. This control is essential to maintain a relatively uniform moisture content in the expansive soils and to prevent swelling and contracting. Over-watering adjacent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



1 INCH = 250 FEET

NorCal Engineering
SOILS AND GEOTECHNICAL CONSULTANTS

PROJECT 21022-19
DATE MARCH 2019

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 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 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)

COMPONENT PROPORTIONS

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

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: Barton & Alessandro, Riverside

Date of Drilling: 3/11/19

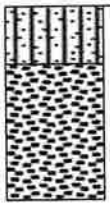
Groundwater Depth: None Encountered

Drilling Method: Backhoe

Hammer Weight:

Drop:

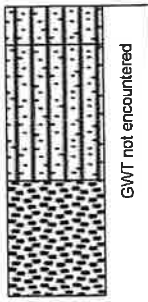
Surface Elevation: Not Measured

Depth (feet)	Lith-ology		Material Description	Samples		Laboratory		
				Type	Blow Counts	Moisture	Dry Density	Fines Content %
0		GWT not encountered	FILL Silty (fine to coarse grained) SAND Brown, loose, moist					
			BEDROCK Decomposed Granite Silty (fine to ocarse grained) SAND Grey-brown, very dense, moist					
5			Trench completed at depth of 5'					
10								
15								
20								
25								
30								
35								

Darrell Butler
21022-19

Log of Trench T-2

Boring Location: Barton & Alessandro, Riverside	
Date of Drilling: 3/11/19	**Groundwater Depth:** None Encountered
Drilling Method: Backhoe	
Hammer Weight:	**Drop:**
Surface Elevation: Not Measured	

			Samples		Laboratory		
Depth (feet)	Lith-ology	Material Description	Type	Blow Counts	Moisture	Dry Density	Fines Content %
0 5 10 15 20 25 30 35		FILL Silty (fine to coarse grained) SAND Brown, loose, moist NATURAL Silty (fine to coarse grained) SAND Brown, medium dense, moist BEDROCK Decomposed Granite Silty (fine to ocarse grained) SAND Grey-brown, very dense, moist Trench completed at depth of 7.5'					

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Log of Trench T-3

Boring Location: Barton & Alessandro, Riverside

Date of Drilling: 3/11/19

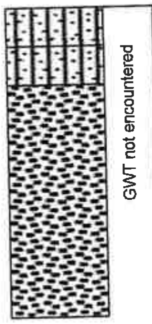
Groundwater Depth: None Encountered

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 Silty (fine to coarse grained) SAND Brown, loose, moist	■		7.0	115.0	
	NATURAL Silty (fine to coarse grained) SAND Brown, medium dense, moist					
5	BEDROCK Decomposed Granite Silty (fine to ocarse grained) SAND Grey-brown, very dense, moist	■		4.4	121.3	
	Refusal at depth of 8'					
10						
15						
20						
25						
30						
35						

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Log of Trench T-4

Boring Location: Barton & Alessandro, Riverside

Date of Drilling: 3/11/19

Groundwater Depth: None Encountered

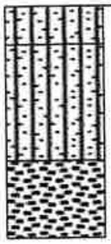
Drilling Method: Backhoe

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 Silty (fine to coarse grained) SAND Brown, loose, moist	■		10.5	113.7	
		NATURAL Silty (fine to coarse grained) SAND Brown, medium dense, moist	▽				
5		BEDROCK Decomposed Granite Silty (fine to ocarse grained) SAND Grey-brown, very dense, moist	■		3.8	124.2	
		Refusal at depth of 6'					
10							
15							
20							
25							
30							
35							



GWT not encountered

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Log of Trench T-5

Boring Location: Barton & Alessandro, Riverside

Date of Drilling: 3/11/19

Groundwater Depth: None Encountered

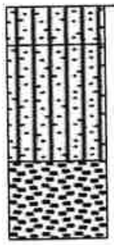
Drilling Method: Backhoe

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 Silty (fine to coarse grained) SAND Brown, loose, moist					
		NATURAL Silty (fine to coarse grained) SAND Brown, medium dense, moist					
5		BEDROCK Decomposed Granite Silty (fine to ocarse grained) SAND Grey-brown, very dense, moist Boring completed at depth of 6'					
10							
15							
20							
25							
30							
35							



GWT not encountered

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Log of Trench T-6

Boring Location: Barton & Alessandro, Riverside

Date of Drilling: 3/11/19

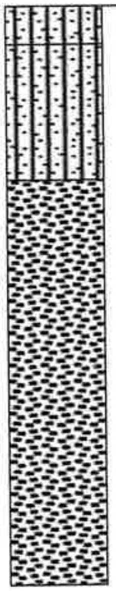
Groundwater Depth: None Encountered

Drilling Method: Backhoe

Hammer Weight:

Drop:

Surface Elevation: Not Measured



GWT not encountered

Depth (feet)	Material Description	Samples: Type	Samples: Blow Counts	Laboratory: Moisture	Laboratory: Dry Density	Laboratory: Fines Content %
0	FILL Silty (fine to coarse grained) SAND Brown, loose, moist	■		8.6	114.1	
	NATURAL Silty (fine to coarse grained) SAND Brown, medium dense, moist	▽ ☐				
5	BEDROCK Decomposed Granite Silty (fine to ocarse grained) SAND Grey-brown, very dense, moist	■		5.6	112.4	
10		■		5.6	125.1	
15	Trench completed at depth of 15'	■		4.2	127.7	
20						
25						
30						
35						

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Log of Trench T-7

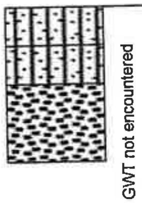
Boring Location: Barton & Alessandro, Riverside

Date of Drilling: 3/11/19 **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 Silty (fine to coarse grained) SAND Brown, loose, moist					
		NATURAL Silty (fine to coarse grained) SAND Brown, medium dense, moist					
5		BEDROCK Decomposed Granite Silty (fine to ocarse grained) SAND Grey-brown, very dense, moist					
		Trench completed at depth of 4'					
10							
15							
20							
25							
30							
35							

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Log of Trench T-8

Boring Location: Barton & Alessandro, Riverside

Date of Drilling: 3/11/19

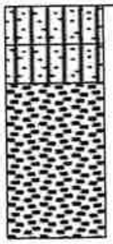
Groundwater Depth: None Encountered

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 Silty (fine to coarse grained) SAND Brown, loose, moist	■		7.3	118.8	
			NATURAL Silty (fine to coarse grained) SAND Brown, medium dense, moist	■		5.1	123.2	
5			BEDROCK Decomposed Granite Silty (fine to ocarse grained) SAND Grey-brown, very dense, moist					
			Trench completed at depth of 6'					
10								
15								
20								
25								
30								
35								

Darrell Butler
21022-19

Log of Trench T-9

Boring Location: Barton & Alessandro, Riverside

Date of Drilling: 3/11/19

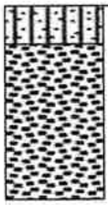
Groundwater Depth: None Encountered

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 Silty (fine to coarse grained) SAND Brown, loose, moist					
		BEDROCK Decomposed Granite Silty (fine to ocarse grained) SAND Grey-brown, very dense, moist					
5		Trench completed at depth of 5'					
10							
15							
20							
25							
30							
35							

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Log of Trench T-10

Boring Location: Barton & Alessandro, Riverside

Date of Drilling: 3/11/19

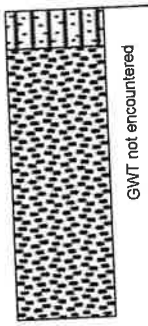
Groundwater Depth: None Encountered

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 Silty (fine to coarse grained) SAND Brown, loose, moist	■		6.1	122.2	
		BEDROCK Decomposed Granite Silty (fine to ocarse grained) SAND Grey-brown, very dense, moist	■		5.7	124.3	
5							
		Trench completed at depth of 8'					
10							
15							
20							
25							
30							
35							

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Log of Trench T-11

Boring Location: Barton & Alessandro, Riverside

Date of Drilling: 3/11/19 | **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 Silty (fine to coarse grained) SAND Brown, loose, moist					
	▨		NATURAL Silty (fine to coarse grained) SAND Brown, medium dense, moist					
5			BEDROCK Decomposed Granite Silty (fine to ocarse grained) SAND Grey-brown, very dense, moist					
			Trench completed at depth of 5'					
10								
15								
20								
25								
30								
35								

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Log of Trench T-12

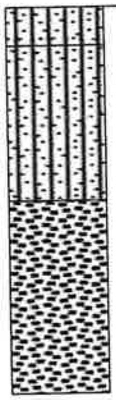
Boring Location: Barton & Alessandro, Riverside

Date of Drilling: 3/11/19 **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 Silty (fine to coarse grained) SAND Brown, loose, moist					
			NATURAL Silty (fine to coarse grained) SAND Brown, medium dense, moist					
5			BEDROCK Decomposed Granite Silty (fine to ocarse grained) SAND Grey-brown, very dense, moist					
10			Trench completed at depth of 10'					
15								
20								
25								
30								
35								

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Log of Trench T-13

Boring Location: Barton & Alessandro, Riverside

Date of Drilling: 3/11/19

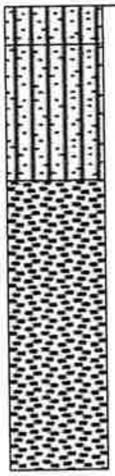
Groundwater Depth: None Encountered

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 Silty (fine to coarse grained) SAND Brown, loose, moist					
		NATURAL Silty (fine to coarse grained) SAND Brown, medium dense, moist	■ ▽		8.2	108.5	
5		BEDROCK Decomposed Granite Silty (fine to ocarse grained) SAND Grey-brown, very dense, moist	■		2.8	125.1	
10			■		4.8	130.8	
		Trench completed at depth of 12'					
15							
20							
25							
30							
35							

Darrell Butler
21022-19

Log of Trench T-14

Boring Location: Barton & Alessandro, Riverside

Date of Drilling: 3/11/19

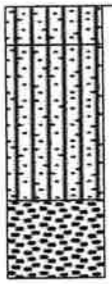
Groundwater Depth: None Encountered

Drilling Method: Backhoe

Hammer Weight:

Drop:

Surface Elevation: Not Measured



			Samples		Laboratory		
Depth (feet)	Lith-ology	Material Description	Type	Blow Counts	Moisture	Dry Density	Fines Content %
0	GWT not encountered	FILL Silty (fine to coarse grained) SAND Brown, loose, moist	■		11.2	111.4	
		NATURAL Silty (fine to coarse grained) SAND Brown, medium dense, moist					
5		BEDROCK Decomposed Granite Silty (fine to ocarse grained) SAND Grey-brown, very dense, moist	■		4.8	124.8	
		Refusal at depth of 7'					
10							
15							
20							
25							
30							
35							

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Log of Trench T-15

Boring Location: Barton & Alessandro, Riverside

Date of Drilling: 3/11/19

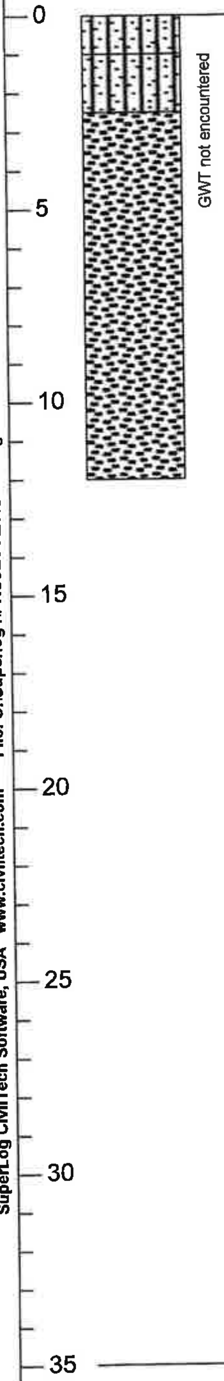
Groundwater Depth: None Encountered

Drilling Method: Backhoe

Hammer Weight:

Drop:

Surface Elevation: Not Measured



Material Description	Samples: Type	Samples: Blow Counts	Laboratory: Moisture	Laboratory: Dry Density	Laboratory: Fines Content %
FILL Silty (fine to coarse grained) SAND Brown, loose, moist	■		12.1	116.1	
NATURAL Silty (fine to coarse grained) SAND Brown, medium dense, moist	■		2.3	118.4	
BEDROCK Decomposed Granite Silty (fine to ocarse grained) SAND Grey-brown, very dense, moist	■		5.9	125.7	

Boring completed at depth of 12'

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Log of Trench T-16

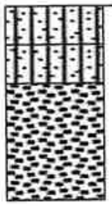
Boring Location: Barton & Alessandro, Riverside

Date of Drilling: 3/11/19 **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 Silty (fine to coarse grained) SAND Brown, loose, moist					
			NATURAL Silty (fine to coarse grained) SAND Brown, medium dense, moist					
5			BEDROCK Decomposed Granite Silty (fine to ocarse grained) SAND Grey-brown, very dense, moist Refusal completed at depth of 5'					
10								
15								
20								
25								
30								
35								

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21022-19

Log of Trench T-17

Boring Location: Barton & Alessandro, Riverside

Date of Drilling: 3/11/19

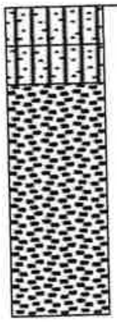
Groundwater Depth: None Encountered

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 Silty (fine to coarse grained) SAND Brown, loose, moist	■ ▽		8.3	125.1	
		NATURAL Silty (fine to coarse grained) SAND Brown, medium dense, moist	■		3.9	117.1	
5		BEDROCK Decomposed Granite Silty (fine to ocarse grained) SAND Grey-brown, very dense, moist Refusal at depth of 8'					
10							
15							
20							
25							
30							
35							

SuperLog CivilTech Software, USA www.civiltech.com File: C:\Superlog4\PROJECT\21022-19.log Date: 4/2/2019

NorCal Engineering

Darrell Butler
21022-19

Log of Trench T-18

Boring Location: Barton & Alessandro, Riverside

Date of Drilling: 3/11/19

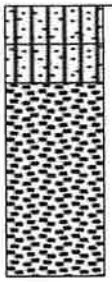
Groundwater Depth: None Encountered

Drilling Method: Backhoe

Hammer Weight:

Drop:

Surface Elevation: Not Measured



GWT not encountered

Depth (feet)	Lith- ology	Material Description	Samples: Type	Samples: Blow Counts	Laboratory: Moisture	Laboratory: Dry Density	Laboratory: Fines Content %
0		FILL Silty (fine to coarse grained) SAND Brown, loose, moist	■		3.7	116.0	
		NATURAL Silty (fine to coarse grained) SAND Brown, medium dense, damp					
5		BEDROCK Decomposed Granite Silty (fine to ocarse grained) SAND Grey-brown, very dense, damp	■		2.9	122.3	
		Trench completed at depth of 7'					
10							
15							
20							
25							
30							
35							

NorCal Engineering

Darrell Butler
21022-19

Log of Trench T-19

Boring Location: Barton & Alessandro, Riverside

Date of Drilling: 3/11/19

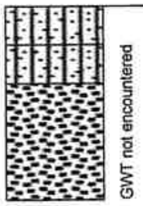
Groundwater Depth: None Encountered

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 Silty (fine to coarse grained) SAND Brown, loose, moist					
		NATURAL Silty (fine to coarse grained) SAND Brown, medium dense, moist					
5		BEDROCK Decomposed Granite Silty (fine to ocarse grained) SAND Grey-brown, very dense, moist					
		Trench completed at depth of 5'					
10							
15							
20							
25							
30							
35							

NorCal Engineering

Darrell Butler
21022-19

Log of Trench T-20

Boring Location: Barton & Alessandro, Riverside

Date of Drilling: 3/11/19

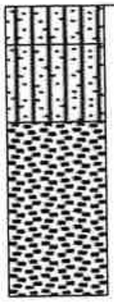
Groundwater Depth: None Encountered

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 Silty (fine to coarse grained) SAND Brown, loose, moist					
			NATURAL Silty (fine to coarse grained) SAND Brown, medium dense, moist					
5			BEDROCK Decomposed Granite Silty (fine to ocarse grained) SAND Grey-brown, very dense, moist Trench completed at depth of 7.5'					
10								
15								
20								
25								
30								
35								

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Darrell Butler
21022-19

Log of Trench T-21

Boring Location: Barton & Alessandro, Riverside

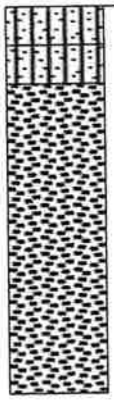
Date of Drilling: 3/11/19 **Groundwater Depth:** None Encountered

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 Silty (fine to coarse grained) SAND Brown, loose, moist					
		NATURAL Silty (fine to coarse grained) SAND Brown, medium dense, moist					
5		BEDROCK Decomposed Granite Silty (fine to ocarse grained) SAND Grey-brown, very dense, moist					
10		Boring completed at depth of 10'					
15							
20							
25							
30							
35							



GWT not encountered

Appendix B
Laboratory Tests

TABLE I
MAXIMUM DENSITY TESTS

Sample	Classification	Optimum Moisture	Maximum Dry Density (lbs./cu.ft.)
T-4 @ 2'	Silty SAND	9.5	130.0
T-6 @ 2'	Silty SAND	9.0	131.0
T-13 @ 2'	Silty SAND	10.0	127.0
T-17 @ 2'	Silty SAND	8.5	133.0

TABLE II
EXPANSION TESTS

Sample	Classification	Expansion Index
T-4 @ 2'	Silty SAND	3
T-13 @ 2'	Silty SAND	4

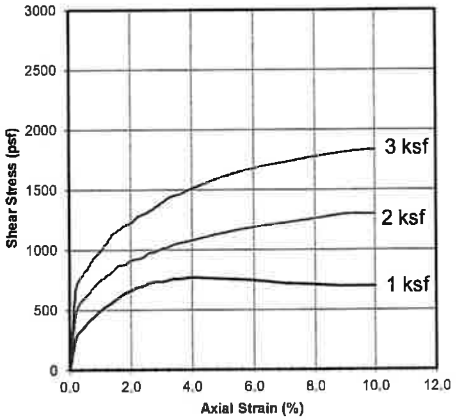
TABLE III
CORROSION TESTS

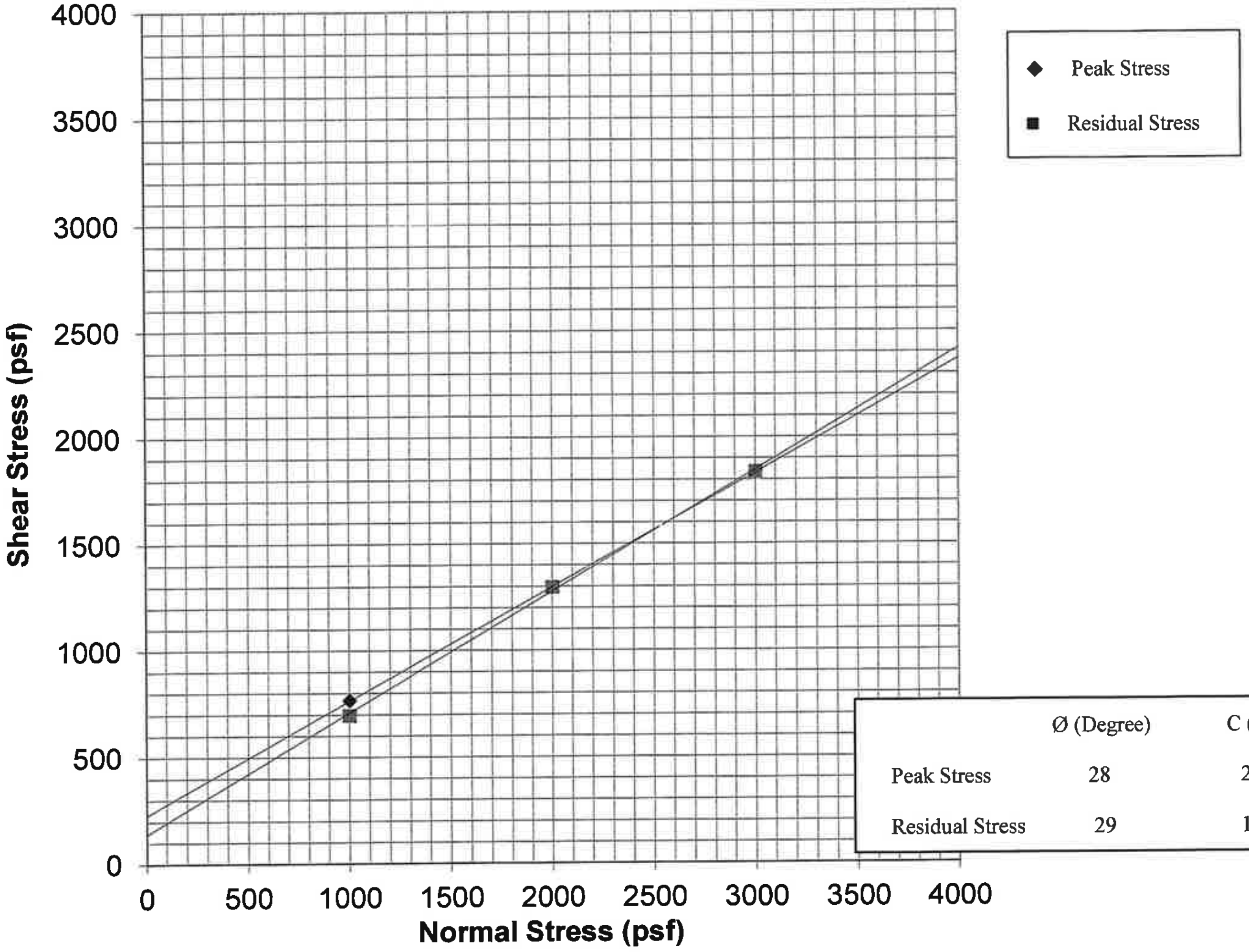
Sample	pH	Electrical Resistivity	Sulfate (%)	Chloride (ppm)
T-6 @ 2'	7.1	3,190	0.003	190
T-17 @ 4'	7.2	4,082	0.003	173

% by weight
ppm – mg/kg

Sample No. T4@2'
Sample Type: Undisturbed/Saturated
Soil Description:

		1	2	3
Normal Stress	(psf)	1000	2000	3000
Peak Stress	(psf)	768	1296	1836
Displacement	(in)	0.100	0.225	0.250
Residual Stress	(psf)	696	1296	1836
Displacement	(in.)	0.250	0.250	0.250
In Situ Dry Density	(pcf)	113.7	113.7	113.7
In Situ Water Content	(%)	10.5	10.5	10.5
Saturated Water Content	(%)	17.8	17.8	17.8
Strain Rate	(in/min)	0.020	0.020	0.020





	Ø (Degree)	C (psf)
Peak Stress	28	230
Residual Stress	29	140

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SOILS AND GEOTECHNICAL CONSULTANTS

Darrell Butler

PROJECT NUMBER: 21022-19 DATE: 3/27/2019

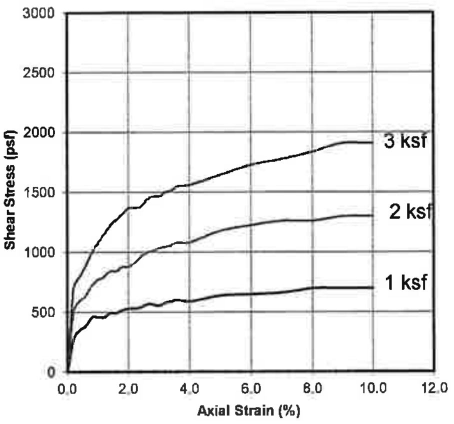
DIRECT SHEAR TEST

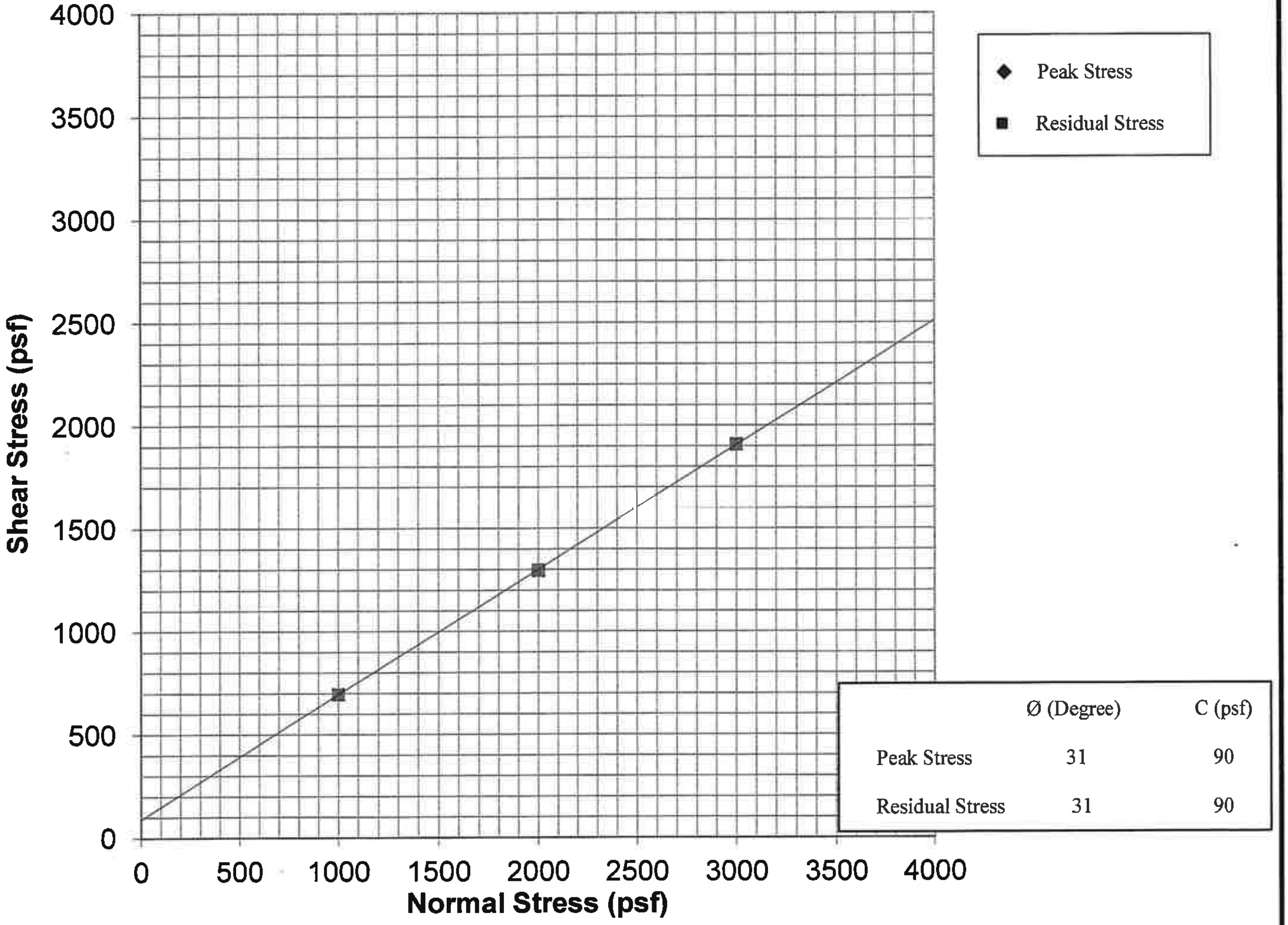
ASTM D3080

Plate A

Sample No. T13@2'
Sample Type: Undisturbed/Saturated
Soil Description:

		1	2	3
Normal Stress	(psf)	1000	2000	3000
Peak Stress	(psf)	696	1296	1908
Displacement	(in.)	0.200	0.225	0.225
Residual Stress	(psf)	696	1296	1908
Displacement	(in.)	0.250	0.250	0.250
In Situ Dry Density	(pcf)	108.5	108.5	108.5
In Situ Water Content	(%)	8.2	8.2	8.2
Saturated Water Content	(%)	20.4	20.4	20.4
Strain Rate	(in/min)	0.020	0.020	0.020





	Ø (Degree)	C (psf)
Peak Stress	31	90
Residual Stress	31	90

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Darrell Butler

PROJECT NUMBER: 21022-19 DATE: 3/27/2019

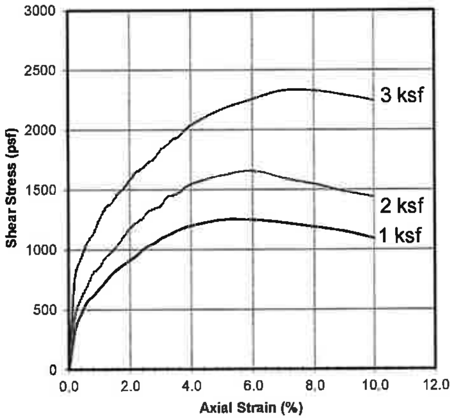
DIRECT SHEAR TEST

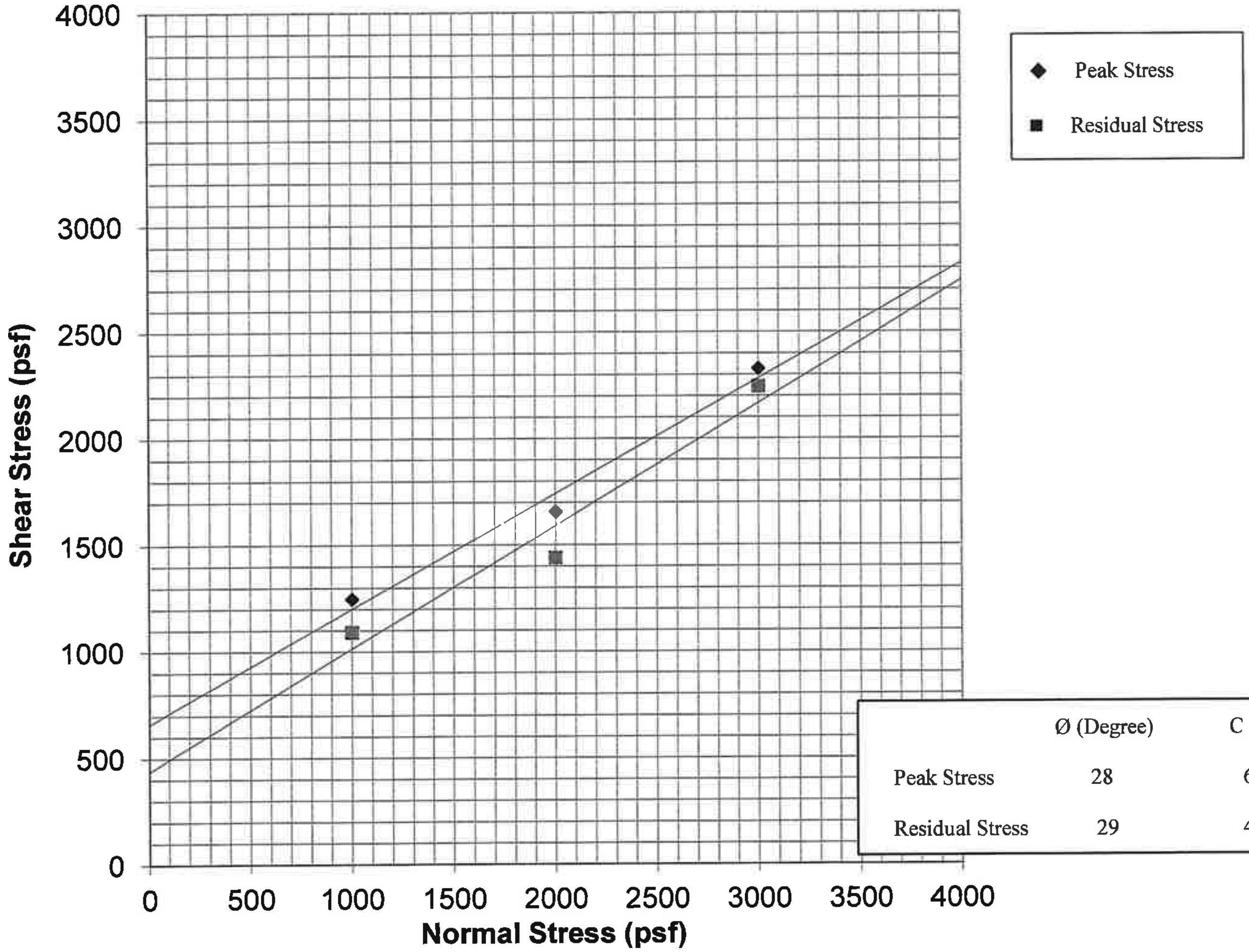
ASTM D3080

Plate B

Sample No. T17@2'
Sample Type: Undisturbed/Saturated
Soil Description: Silty Fine-Coarse Grained Sand

		1	2	3
Normal Stress	(psf)	1000	2000	3000
Peak Stress	(psf)	1248	1656	2328
Displacement	(in)	0.125	0.150	0.175
Residual Stress	(psf)	1092	1440	2244
Displacement	(in.)	0.250	0.250	0.250
In Situ Dry Density	(pcf)	125.1	125.1	125.1
In Situ Water Content	(%)	8.3	8.3	8.3
Saturated Water Content	(%)	12.6	12.6	12.6
Strain Rate	(in/min)	0.020	0.020	0.020





	Ø (Degree)	C (psf)
Peak Stress	28	660
Residual Stress	29	440

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Darrell Butler

PROJECT NUMBER: 21022-19 DATE: 3/27/2019

DIRECT SHEAR TEST
ASTM D3080
Plate C

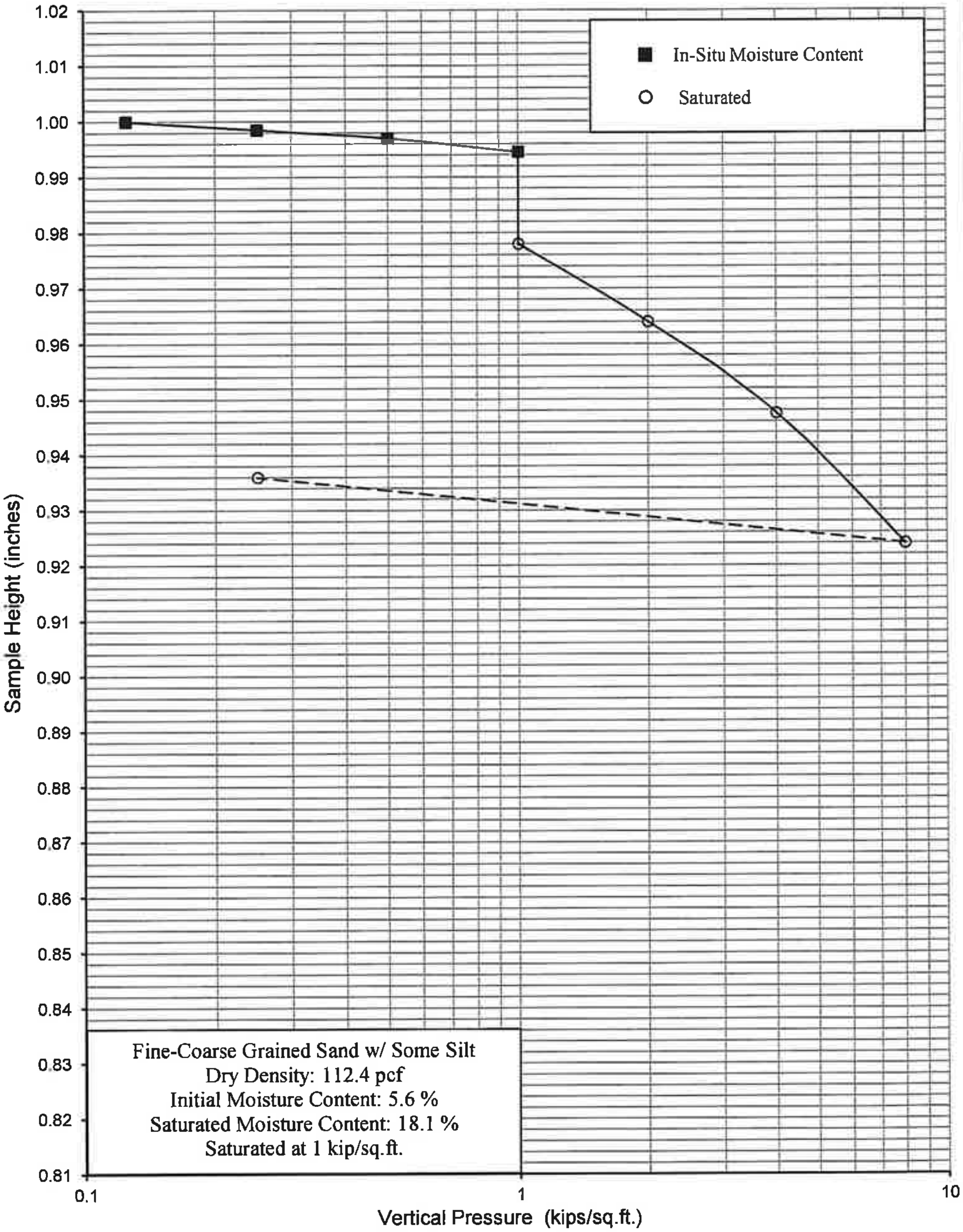
Sample No. T6

Depth 5'

Date 3/27/2019

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	**0.9945**	**0.6**	
1	**0.9780**	**2.2**	**Saturated**
2	**0.9640**	**3.6**	
4	**0.9475**	**5.3**	
8	**0.9240**	**7.6**	
0.25	**0.9360**	**6.4**	

Date Tested:	**3/25/2019**
Sample:	**T6**
Depth:	**5'**



Fine-Coarse Grained Sand w/ Some Silt
Dry Density: 112.4 pcf
Initial Moisture Content: 5.6 %
Saturated Moisture Content: 18.1 %
Saturated at 1 kip/sq.ft.

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SOILS AND GEOTECHNICAL CONSULTANTS

Darrell Butler

PROJECT NUMBER: 21022-19 DATE: 3/27/2019

CONSOLIDATION TEST

ASTM D2435

Plate D

Sample No. T6

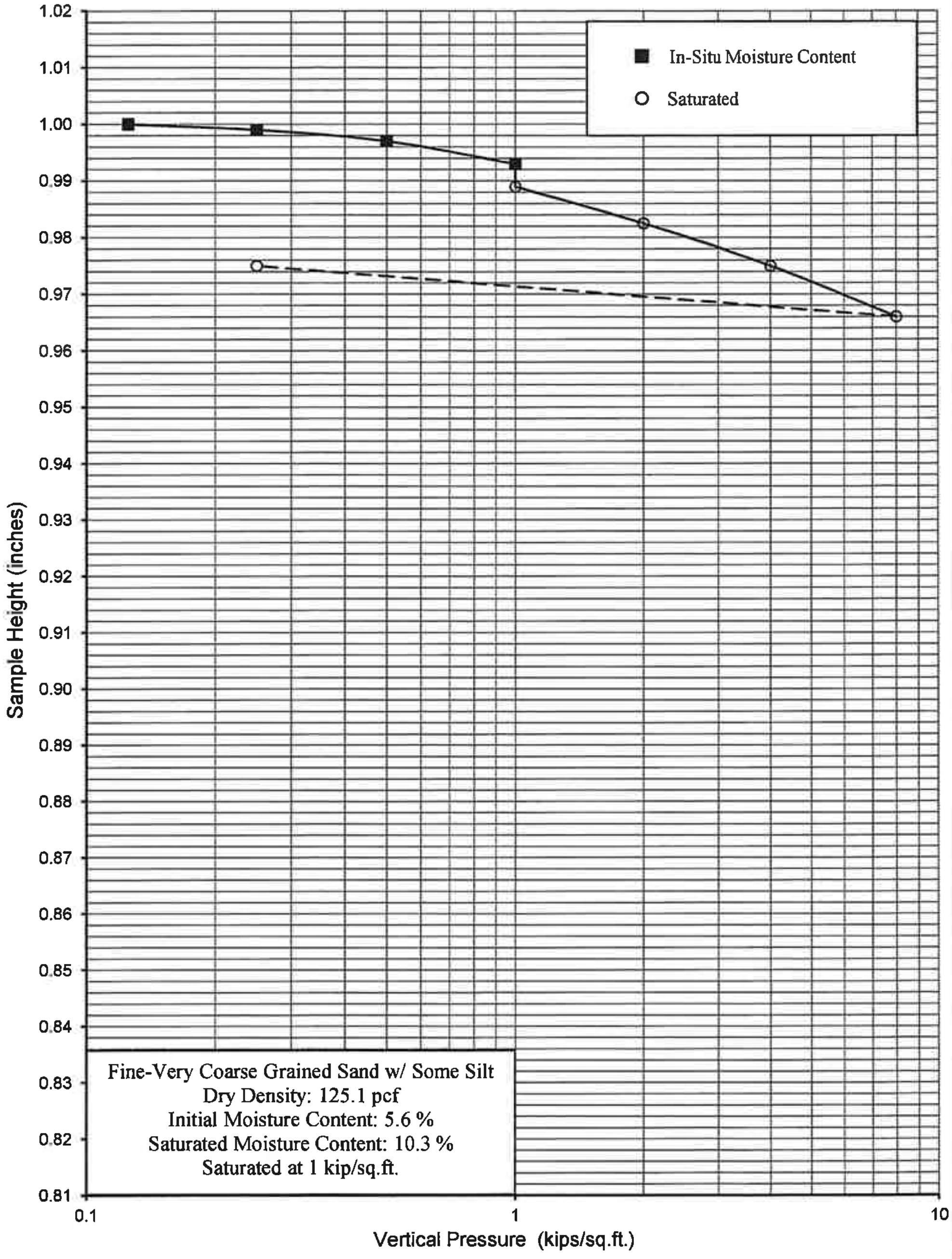
Depth 10'

Date 3/27/2019

Vertical Pressure (kips/sq.ft.)	Sample Height (inches)	Consolidation (percent)
0.125	**1.0000**	**0.0**
0.25	**0.9990**	**0.1**
0.5	**0.9970**	**0.3**
1	**0.9930**	**0.7**
1	**0.9890**	**1.1**
2	**0.9825**	**1.8**
4	**0.9750**	**2.5**
8	**0.9660**	**3.4**
0.25	**0.9750**	**2.5**

Saturated

Date Tested: 3/25/2019
Sample: T6
Depth: 10'



Fine-Very Coarse Grained Sand w/ Some Silt
Dry Density: 125.1 pcf
Initial Moisture Content: 5.6 %
Saturated Moisture Content: 10.3 %
Saturated at 1 kip/sq.ft.

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SOILS AND GEOTECHNICAL CONSULTANTS

Darrell Butler

PROJECT NUMBER: 21022-19 DATE: 3/27/2019

CONSOLIDATION TEST

ASTM D2435

Plate E

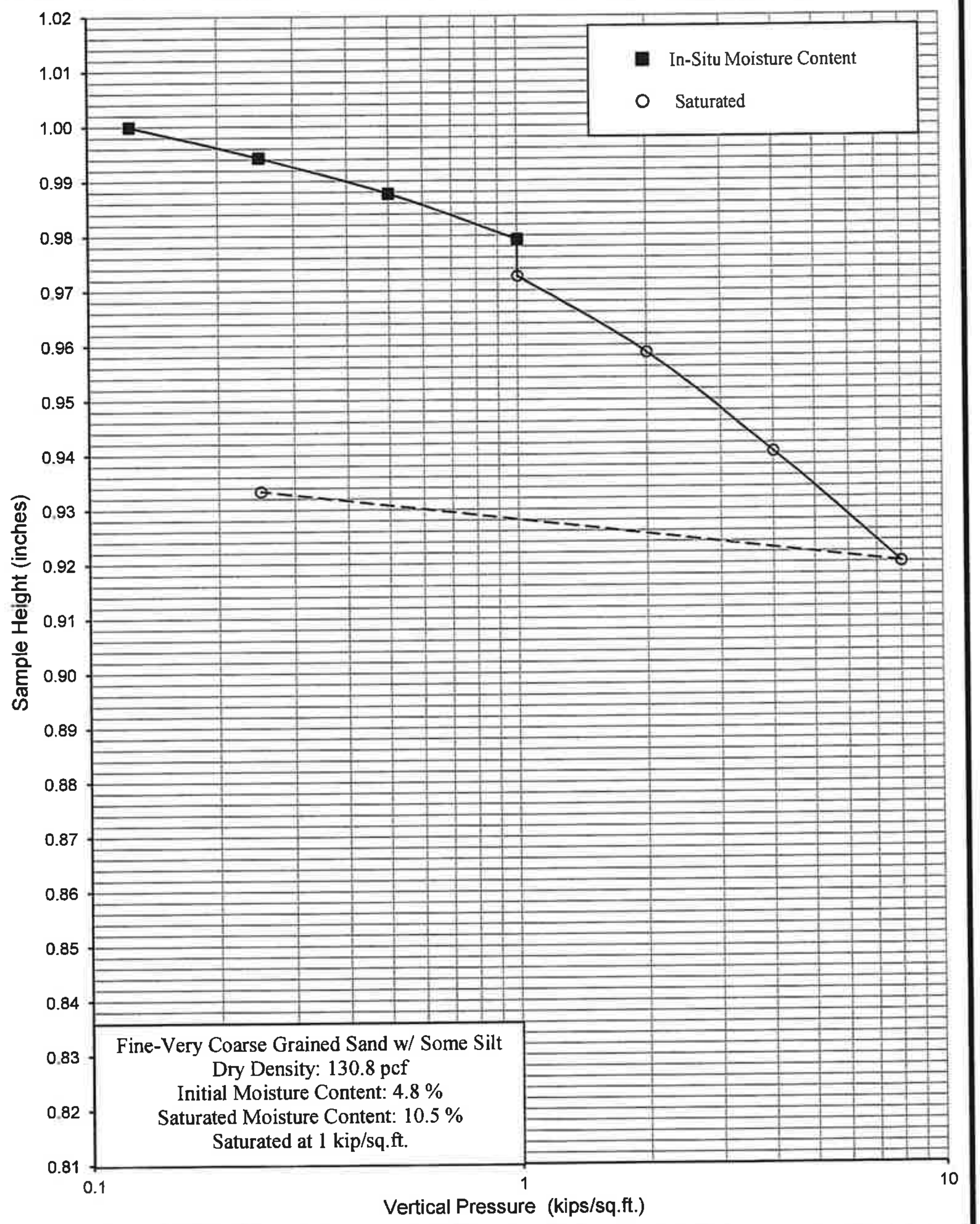
Sample No. T13 | Depth 10' | Date 3/27/2019

Vertical Pressure (kips/sq.ft.)	Sample Height (inches)	Consolidation (percent)	
0.125	1.0000	0.0	
0.25	0.9943	0.6	
0.5	0.9877	1.2	
1	0.9793	2.1	
1	0.9726	2.7	Saturated
2	0.9586	4.1	
4	0.9404	6.0	
8	0.9201	8.0	
0.25	0.9334	6.7	

Date Tested: 3/25/2019

Sample: T13

Depth: 10'



Fine-Very Coarse Grained Sand w/ Some Silt
Dry Density: 130.8 pcf
Initial Moisture Content: 4.8 %
Saturated Moisture Content: 10.5 %
Saturated at 1 kip/sq.ft.

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SOILS AND GEOTECHNICAL CONSULTANTS

Darrell Butler

PROJECT NUMBER: 21022-19 DATE: 3/27/2019

CONSOLIDATION TEST

ASTM D2435

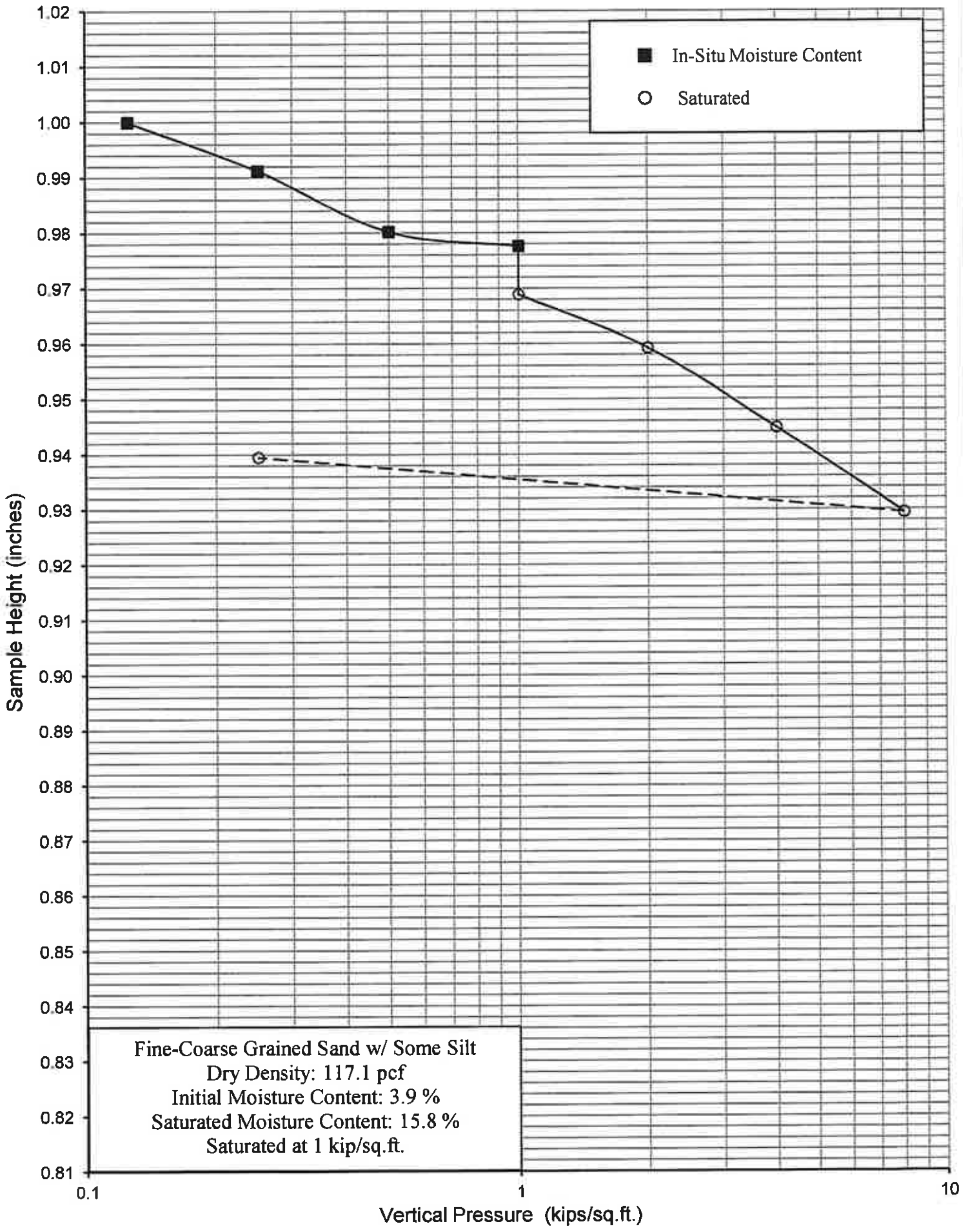
Plate F

Sample No. T17 | Depth 5' | Date 3/27/2019

Vertical Pressure (kips/sq.ft.)	Sample Height (inches)	Consolidation (percent)
0.125	1.0000	0.0
0.25	0.9912	0.9
0.5	0.9802	2.0
1	0.9776	2.2
1	0.9689	3.1
2	0.9592	4.1
4	0.9448	5.5
8	0.9294	7.1
0.25	0.9395	6.1

Saturated

Date Tested:	**3/26/2019**
Sample:	**T17**
Depth:	**5'**



Fine-Coarse Grained Sand w/ Some Silt
Dry Density: 117.1 pcf
Initial Moisture Content: 3.9 %
Saturated Moisture Content: 15.8 %
Saturated at 1 kip/sq.ft.

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SOILS AND GEOTECHNICAL CONSULTANTS

Darrell Butler

PROJECT NUMBER: 21022-19 DATE: 3/27/2019

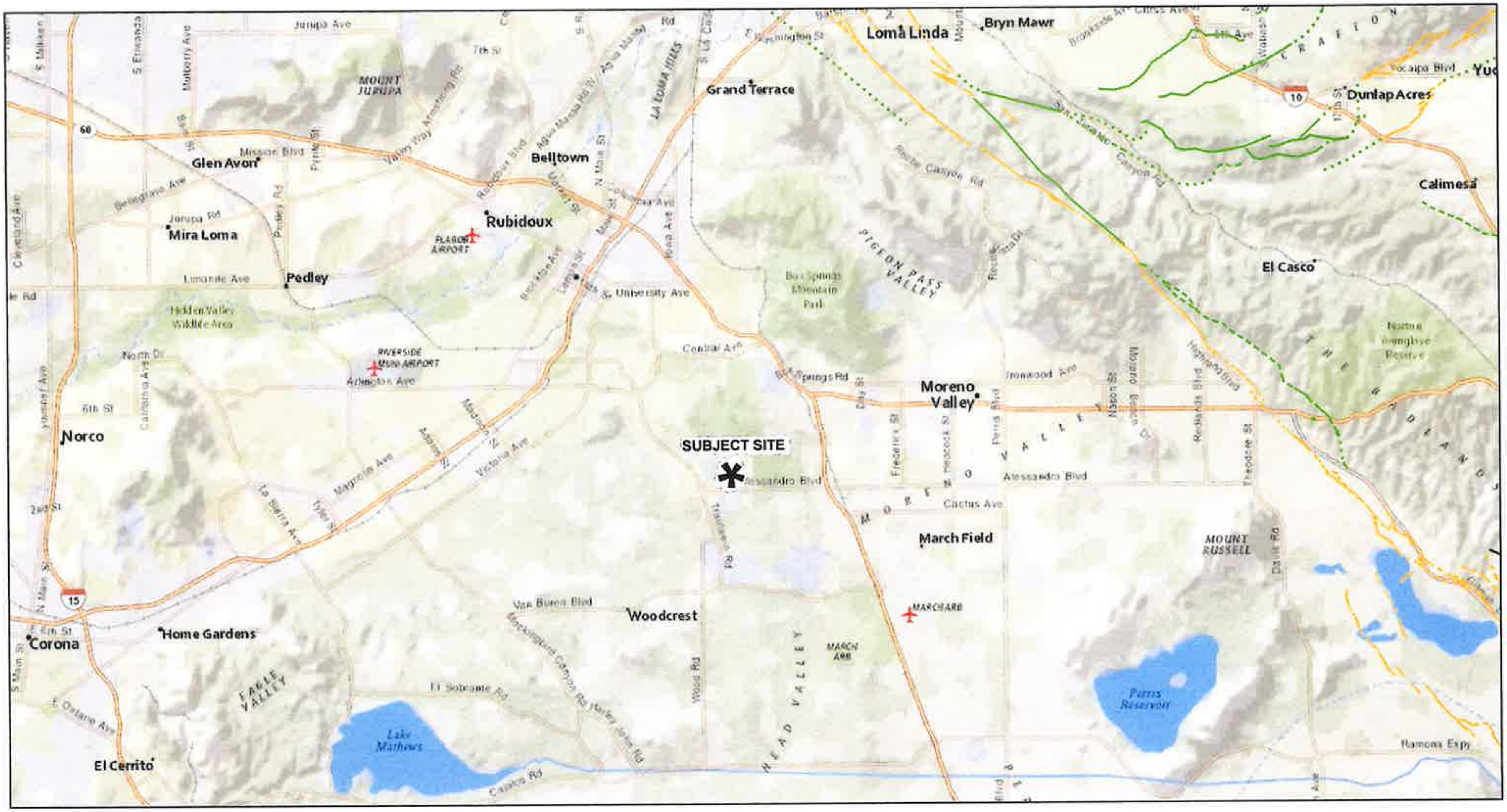
CONSOLIDATION TEST

ASTM D2435

Plate G

Appendix C
ASCE Seismic Hazards Report

U.S. Geological Survey Quaternary Faults



3/13/2019, 7:44:29 AM

Fault Areas

- ☐ Class B
- ☒ historic
- ▨ late Quaternary
- ▨ latest Quaternary
- ▨ middle and late Quaternary

U.S. Quaternary Faults

- Undifferentiated Quaternary (< 130,000 years), well constrained location
- Latest Quaternary (<15,000 years), well constrained location
- Latest Quaternary (<15,000 years), moderately constrained location
- Latest Quaternary (<15,000 years), inferred location
- Late Quaternary (< 130,000 years), well constrained location
- Late Quaternary (< 130,000 years), moderately constrained location
- Late Quaternary (< 130,000 years), inferred location

1:144,448

0 1.5 3 6 mi

0 2.25 4.5 9 km

Content may not reflect National Geographic's current map policy. Sources: National Geographic, Esri, Garmin, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp., USGS

USGS

Content may not reflect National Geographic's current map policy. Sources: National Geographic, Esri, Garmin, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp. | USGS |

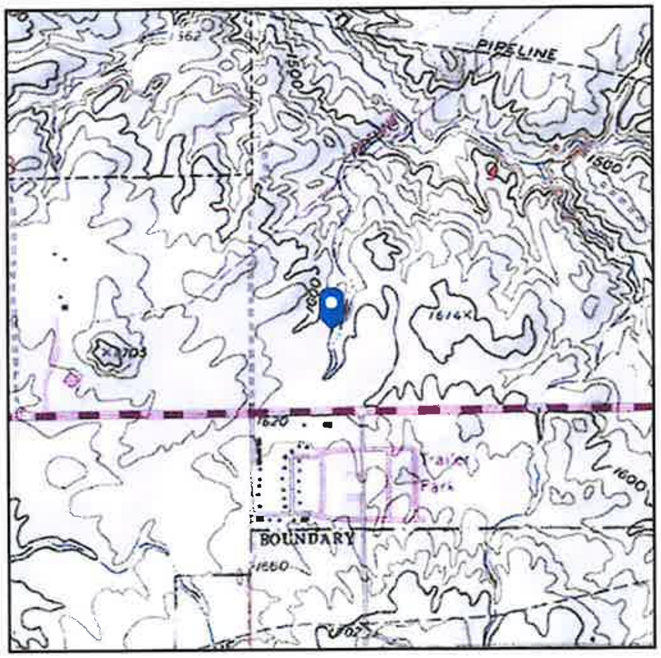
ASCE
AMERICAN SOCIETY OF CIVIL ENGINEERS

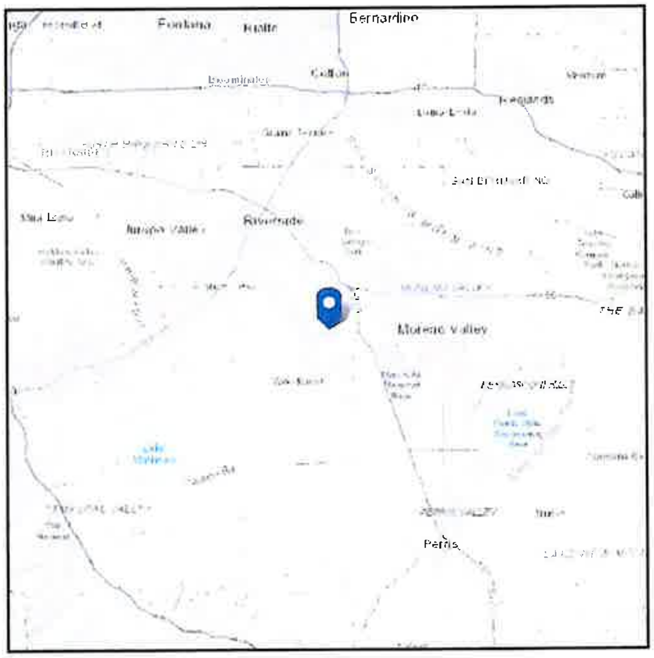
ASCE 7 Hazards Report

Address:
No Address at This Location

Standard: ASCE/SEI 7-10
Risk Category: III
Soil Class: D - Stiff Soil

Elevation: 1602.28 ft (NAVD 88)
Latitude: 33.919008
Longitude: -117.310797





ASCE
AMERICAN SOCIETY OF CIVIL ENGINEERS

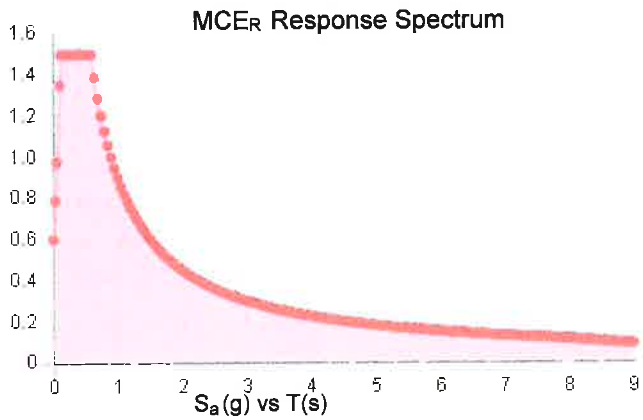
Seismic

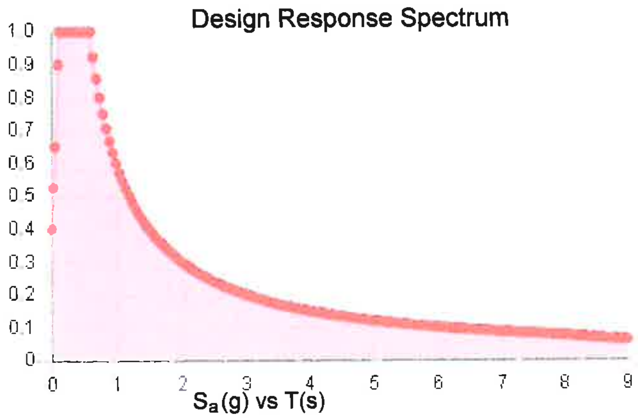
Site Soil Class: D - Stiff Soil

Results:

S_S :	1.5	S_{DS} :	1
S_1 :	0.6	S_{D1} :	0.6
F_a :	1	T_L :	8
F_v :	1.5	PGA :	0.5
S_{MS} :	1.5	PGA_M :	0.5
S_{M1} :	0.9	F_{PGA} :	1
		I_e :	1.25

Seismic Design Category D


MCE_R Response Spectrum


Design Response Spectrum

Data Accessed: Fri Mar 22 2019

Date Source: USGS Seismic Design Maps based on ASCE/SEI 7-10, incorporating Supplement 1 and errata of March 31, 2013, and ASCE/SEI 7-10 Table 1.5-2. Additional data for site-specific ground motion procedures in accordance with ASCE/SEI 7-10 Ch. 21 are available from USGS.

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Appendix D
Soil Infiltration Data

NORCAL
ENGINEERING
SOILS AND GEOTECHNICAL CONSULTANTS

Project: Darrell Butler
Project No.: 21022-19
Date: 3/11/19
Test No. T-1
Depth: 5'
Tested By: J.O.

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)
8:00			78.8			46.1					
8:10	10	10	80.0	1.2		47.4	1.3				
8:10			74.0			41.6					
8:20	10	20	75.0	1.0		42.6	1.0				
8:20			75.0			42.6					
8:30	10	30	76.0	1.0		43.6	1.0				
8:30			76.0			43.6					
8:40	10	40	76.7	0.7		44.3	0.7				
8:40			76.7			44.3					
8:50	10	50	77.1	0.4		44.7	0.4				
8:50			77.1			44.7					
9:00	10	60	77.5	0.4		45.1	0.4				
9:00			77.5			45.1					
9:10	10	70	77.7	0.2		45.5	0.4		1.2	2.4	
9:10			75.6			43.2					
9:20	10	80	75.9	0.3		43.6	0.4		1.8	2.4	
9:20			75.9			43.6					
9:30	10	90	76.1	0.2		43.9	0.3		1.2	1.8	
9:30			76.1			43.9					
9:40	10	100	76.3	0.2		44.1	0.2		1.2	1.2	
9:40			76.3			44.1					
9:50	10	110	76.5	0.2		44.3	0.2		1.2	1.2	
9:50			76.5			44.3					
10:00	10	120	76.7	0.2		44.5	0.2		1.2	1.2	

Average = 1.3 / 1.7 cm/hr

NORCAL ENGINEERING
SOILS AND GEOTECHNICAL CONSULTANTS

Project: Darrell Butler
Project No.: 21022-19
Date: 3/11/19
Test No. T-2
Depth: 7.5′
Tested By: J.O.

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)
8:50			109.2			47.2					
9:00	10	10	109.4	0.2		47.5	0.3				
9:00			109.4			47.5					
9:10	10	20	109.6	0.2		47.7	0.2				
9:10			109.6			47.7					
9:20	10	30	109.8	0.2		47.9	0.2				
9:20			108.1			46.3					
9:30	10	40	108.2	0.1		46.4	0.1				
9:30			108.2			46.4					
9:40	10	50	108.2	0.0		46.4	0.0				
9:40			108.2			46.4					
9:50	10	60	108.3	0.1		46.5	0.1				
9:50			108.3			46.5					
10:00	10	70	108.4	0.1		46.6	0.1		0.6	0.6	
10:00			108.4			46.6					
10:10	10	80	108.5	0.1		46.7	0.1		0.6	0.6	
10:10			108.5			46.7					
10:20	10	90	108.6	0.1		46.8	0.1		0.6	0.6	
10:20			108.6			46.8					
10:30	10	100	108.6	0.0		46.9	0.1		0.0	0.6	
10:30			108.6			46.9					
10:40	10	110	108.6	0.0		47.1	0.2		0.0	1.2	
10:40			108.6			47.1					
10:50	10	120	108.7	0.1		47.2	0.1		0.6	0.6	

Average = 0.4 / 0.7 cm/hr

Project: Darrell Butler
Project No.: 21022-19
Date: 3/11/19
Test No. T-11
Depth: 5'
Tested By: J.O.

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)
10:25			78.6			47.1					
10:35	10	10	79.1	0.7		47.6	0.5				
10:35			79.1			47.6					
10:45	10	20	79.5	0.4		48.1	0.5				
10:45			72.5			41.1					
10:55	10	30	73.0	0.5		41.5	0.4				
10:55			73.0			41.5					
11:05	10	40	73.2	0.2		41.8	0.3				
11:05			73.2			41.8					
11:15	10	50	73.5	0.3		42.0	0.2				
11:15			73.5			42.0					
11:25	10	60	73.7	0.2		42.1	0.1				
11:25			73.7			42.1					
11:35	10	70	73.9	0.2		42.5	0.4		1.2	2.4	
11:35			73.9			42.5					
11:45	10	80	74.2	0.3		42.7	0.2		1.8	1.2	
11:45			74.2			42.7					
11:55	10	90	74.4	0.2		42.9	0.2		1.2	1.2	
11:55			74.4			42.9					
12:05	10	100	74.4	0.0		42.9	0.0		0.0	0.0	
12:05			74.4			42.9					
12:15	10	110	74.4	0.0		42.9	0.0		0.0	0.0	
12:15			74.4			42.9					
12:25	10	120	74.4	0.0		42.9	0.0		0.0	0.0	

Average = 0.7 / 0.8 cm/hr

NORCAL
ENGINEERING
SOILS AND GEOTECHNICAL CONSULTANTS

Project: Darrell Butler
Project No.: 21022-19
Date: 3/11/19
Test No. T-12
Depth: 10'
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)
11:34			109.6			50.2					
11:44	10	10	109.8	0.2		50.6	0.4				
11:44			109.8			50.6					
11:54	10	20	109.9	0.1		50.8	0.2				
11:54			109.9			50.8					
12:04	10	30	110.0	0.1		51.0	0.2				
12:04			110.0			51.0					
12:14	10	40	110.0	0.0		51.0	0.0				
12:14			110.0			51.0					
12:24	10	50	110.1	0.1		51.1	0.1				
12:24			110.1			51.1					
12:34	10	60	110.1	0.0		51.1	0.0				
12:34			110.1			51.1					
12:44	10	70	110.1	0.0		51.1	0.0		0.0	0.0	
12:44			110.1			51.1					
12:54	10	80	110.1	0.0		51.1	0.0		0.0	0.0	
12:54			110.1			51.1					
1:04	10	90	110.2	0.1		51.2	0.1		0.6	0.6	
1:04			110.2			51.2					
1:14	10	100	110.2	0.0		51.2	0.0		0.0	0.0	
1:14			110.2			51.2					
1:24	10	110	110.3	0.1		51.3	0.1		0.6	0.6	
1:24			110.3			51.3					
1:34	10	120	110.3	0.0		51.3	0.0		0.0	0.0	

Average = 0.2 / 0.2 cm/hr

Project: Darrell Butler
Project No.: 21022-19
Date: 3/12/19
Test No. T-19
Depth: 5'
Tested By: J.O.

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)
7:30			79.9			49.5					
7:40	10	10	80.2	0.3		50.1	0.6				
7:40			80.2			50.1					
7:50	10	20	80.4	0.2		50.3	0.2				
7:50			80.4			50.3					
8:00	10	30	80.5	0.1		50.6	0.3				
8:00			80.5			50.6					
8:10	10	40	80.5	0.0		50.6	0.0				
8:10			80.5			50.6					
8:20	10	50	80.5	0.0		50.6	0.0				
8:20			80.5			50.6					
8:30	10	60	80.5	0.0		50.6	0.0				
8:30			80.5			50.6					
8:40	10	70	80.5	0.0		50.6	0.0		0.0	0.0	
8:40			80.5			50.6					
8:50	10	80	80.5	0.0		50.6	0.0		0.0	0.0	
8:50			80.5			50.6					
9:00	10	90	80.5	0.0		50.6	0.0		0.0	0.0	
9:00			80.5			50.6					
9:10	10	100	80.5	0.0		50.6	0.0		0.0	0.0	
9:10			80.5			50.6					
9:20	10	110	80.5	0.0		50.6	0.0		0.0	0.0	
9:20			80.5			50.6					
9:30	10	120	80.5	0.0		50.6	0.0		0.0	0.0	

Average = 0.0 / 0.0 cm/hr

Project: Darrell Butler	
Project No.: 21022-19	
Date: 3/12/19	
Test No. T-20	
Depth: 5'	
Tested By: J.O.	

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)
8:06			106.3			49.0					
8:16	10	10	106.4	0.1		49.1	0.1				
8:16			106.4			49.1					
8:26	10	20	106.5	0.1		49.3	0.2				
8:26			106.5			49.3					
8:36	10	30	106.6	0.1		49.5	0.2				
8:36			106.6			49.5					
8:46	10	40	106.7	0.0		49.6	0.1				
8:46			106.7			49.6					
8:56	10	50	106.8	0.1		49.6	0.0				
8:56			106.8			49.6					
9:06	10	60	106.8	0.0		49.6	0.0				
9:06			106.8			49.6					
9:16	10	70	106.9	0.1		49.6	0.0		0.6	0.0	
9:16			106.9			49.6					
9:26	10	80	107.0	0.1		49.6	0.0		0.6	0.0	
9:26			107.0			49.6					
9:36	10	90	107.0	0.0		49.6	0.0		0.0	0.0	
9:36			107.0			49.6					
9:46	10	100	107.0	0.0		49.6	0.0		0.0	0.0	
9:46			107.0			49.6					
9:56	10	110	107.0	0.0		49.6	0.0		0.0	0.0	
9:56			107.0			49.6					
10:06	10	120	107.0	0.0		49.6	0.0		0.0	0.0	

Average = 0.2 / 0.0 cm/hr

Project: Darrell Butler
Project No.: 21022-19
Date: 3/12/19
Test No. T-21
Depth: 10'
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)
1:05			77.5			46.7					
1:15	10	10	78.2	0.7		47.4	0.7				
1:15			78.2			47.4					
1:25	10	20	78.6	0.4		48.1	0.7				
1:25			78.6			48.1					
1:35	10	30	79.0	0.4		48.5	0.4				
1:35			79.0			48.5					
1:45	10	40	79.0	0.0		49.0	0.5				
1:45			79.0			49.0					
1:55	10	50	79.1	0.1		49.3	0.3				
1:55			79.1			49.3					
2:05	10	60	79.1	0.0		49.5	0.2				
2:05			79.1			49.5					
2:15	10	70	79.1	0.0		49.5	0.0		0.0	0.0	
2:15			79.1			49.5					
2:25	10	80	79.1	0.0		49.5	0.0		0.0	0.0	
2:25			79.1			49.5					
2:35	10	90	79.2	0.1		49.5	0.0		0.6	0.0	
2:35			79.2			49.5					
2:45	10	100	79.2	0.0		49.6	0.1		0.0	0.6	
2:45			79.2			49.6					
2:55	10	110	79.2	0.0		49.6	0.0		0.0	0.0	
2:55			79.2			49.6					
3:05	10	120	79.2	0.0		49.6	0.0		0.0	0.0	

Average = 0.1 / 0.1 cm/hr

geomat GeoMat Testing Laboratories, Inc.

Soil Engineering, Environmental Engineering, Materials Testing, Geology

July 29, 2019

Project No. 16175-02

TO: Mr. Darrel Butler
c/o SDH and Associates, Inc.
5225 Canyon Crest Drive
Suite 71-439
Riverside, California 92507

SUBJECT: Report of Preliminary Deep Percolation Testing, Proposed Commercial Building, APN 263-060-022, Riverside, California

In accordance with your authorization, GeoMat Testing Laboratories, Inc. (GeoMat) has performed preliminary deep percolation testing for the subject site. The purpose of our work is to establish an average flow rate for the proposed onsite septic system.

The accompanying report presents a summary of our findings, with conclusions and recommendations for the proposed septic system. Location of field testing and system location have been plotted on Plate 1.

The site is proposed for a warehouse building with an office. Based on the provided 98 fixture units, we recommend utilizing a 3500-gallon septic tank.

Based on our drilling at existing grades, groundwater was encountered in the deep exploratory boring at 10 feet below ground surface. Percolation tests are approximately six feet above the exploratory borehole.

It should be noted that this work was for percolation testing purposes. No other warranty, expressed or implied, is made as to the conclusions and professional advice included in this report. The percolation testing and related laboratory test data are believed representative of the project site in its current condition; however, soil conditions can vary significantly. As in most projects, conditions revealed during construction may be at variance with preliminary findings. If this condition occurs, the possible variations must be evaluated by this firm. The findings of this report are valid as of the present date. However, changes in the conditions of a property can occur with the passage of time, whether they may be due to natural processes or the works of man on this or adjacent properties. In addition, changes in applicable or appropriate standards may occur, whether they result from legislation or the broadening of knowledge.

If you should have any questions regarding this report, please do not hesitate to call our office. We appreciate this opportunity to be of service.

Submitted for GeoMat Testing Laboratories, Inc.

Haytham Nabilsi, GE 2375 (exp 12/31/20)
Project Engineer

HAYTHAM NABILSI
GE 2375

Distribution: (3) Addressee

TABLE OF CONTENTS

1.0 INTRODUCTION

1.1 Assessor's Parcel Number

APN 263-060-022

1.2 Property Representative

SDH and Associates, Inc.
5225 Canyon Crest Drive, Suite 71-439
Riverside, California 92507
Phone (951)-683-3691

1.3 Land Location and Description

The subject site is located where Barton Street dead-ends, approximately 670 feet north of the Alessandro Boulevard and the Barton Street intersection, in the city of Riverside, California. Access on site is from a locked gate at the end of Barton Street (southwest corner of the site). The geographical relationship of the site and surrounding vicinity is shown on our Site Location Map, Figure 1.

The lot is generally rectangular in shape with a recorded lot size of 13.59 acres. The site is undeveloped and of natural slightly hilly terrain. The lot is lightly covered with seasonal grasses and a few trees and bushes. Rock outcroppings were noted throughout the site, predominantly in the northeast quadrangle.

The area proposed for the septic system is located on the southern section of the site.

1.4 Proposed Development

According to the Preliminary Grading Plan by SDH & Associates (Sheet 2 of 5, plan dated November 2018), the site is planned for a 203,100 square foot commercial building.

We understand that the proposed new building will utilize onsite sewage disposal following the seepage pit septic system.

2.0 SUMMARY OF GEOTECHNICAL CONDITIONS

2.1 Regional Geology

Based on the USGS Geologic map of the Riverside East/South 1/2 of the San Bernardino South Quadrangles, the regional area prior to development was mapped as quartz diorite (tonalite). This material is generally gray-weathering, relatively homogenous, massive to well-foliated, medium to coarse grained biotite-hornblende tonalite.

2.2 Subsurface Soil Characteristics

One exploratory boring was drilled for the deep percolation observation hole on July 18, 2019 utilizing a Diedrich D-50 mobile drill rig to a maximum depth of 30 feet below ground surface. The borehole location is depicted as borehole B-1 on Plate 1, Exploratory Borehole Location Map.

Based on our exploratory boring, the site generally consists of five feet of soil classified as silty sand (USCS "SM") underlain by granitic bedrock that drills like silty sand.

2.3 Groundwater

Groundwater study is not within the scope of this work. Groundwater was encountered in our exploratory boring at 10 feet below ground surface. The exploratory boring was conducted at an approximate elevation of 1602 feet above mean sea level (amsl). This would make the groundwater elevation, at this location, at approximately 1592 feet amsl.

Highest historical groundwater records for the site were researched utilizing the following resources:

- State of California, Department of Water Resources (CDWR)
- USGS National Water Information System (USGS NWIS)
- USGS Groundwater Watch (USGS GWW)
- Steve Mains' Well Monitoring Program

Highest historical groundwater documented by Steven Mains' Program in a well located approximately 1.09 miles northwest of the site (State Well No. 3S4W9A, elevation 1497 feet) was 20 feet below ground surface (water surface elevation 1477 feet) on June 20, 1997. Depth of the proposed bottom of leach field is approximately 1602 feet.

Please note that the potential for rain or irrigation water locally seeping through from elevated areas and showing up near grades cannot be precluded. Our experience indicates that surface or near-surface groundwater conditions can develop in areas where groundwater conditions did not exist prior to site development, especially in areas where a substantial increase in surface water infiltration results from landscape irrigation. Fluctuations in perched water elevations are likely to occur in the future due to variations in precipitation, temperature, consumptive uses, and other factors including mounding of perched water over bedrock. Mitigation for nuisance shallow seeps moving from elevated lower areas will be needed if encountered. These mitigations may include subdrains, horizontal drains, toe drains, french drains, heel drains or other devices.

2.4 Laboratory Testing

A sieve analysis tests were performed on bulk soil samples obtained from the exploratory boring and percolation test holes for the purpose of classification. Test results are shown in Appendix C.

3.0 PERCOLATION TESTING

GeoMat Testing Laboratories performed deep percolation testing for the proposed septic system in general accordance with the procedures of the County of Riverside, Department of Environmental Health, Onsite Wastewater Treatment Systems, Technical Guidance Manual.

3.1 Test Procedures

- Two deep percolation tests were conducted for the proposed septic system. The boreholes were tested at 20 feet and 15 feet below existing ground surface for test holes P-1 and P-2, respectively. A PVC perforated pipe covered with filter fabric was placed in the holes. A few inches of gravel was placed in the bottom of the boreholes.
- The test holes were initially tested for the sandy soil criteria. The test holes did not meet the sandy soil criteria and were presoaked and tested the next day.
- Testing began by filling the test hole to approximately four feet below ground surface. From a fixed referenced point, measurements of the drop in water level were taken every 30-minutes for a minimum of 6 hours, refilling after each measurement.

3.2 Test Results

The following table presents the actual and recommended percolation rates in gallons per square feet per day for the test hole. The recommended percolation rate was utilized in the system design.

Test No.	**Q (gal/sf/day)**	**Recommended Rate* Q (gal/sf/day**
P-1	4.4	2.2
P-2	2.2	2.2

3.3 Discussion and Design

Based on our visual observation of drilling resistance, the onsite soil is relatively homogeneous when considering a seepage pit septic system.

Based on percolation test results, the onsite soils have favorable percolation rates. Test results are appropriate to soil classification.

No restrictive layer was encountered in our exploratory boring drilled to 30 feet below ground surface.

No caving of test holes took place during testing.

The following table presents a summary of the septic system design recommendations for a 3500-gallon septic tank. Sufficient area should be set aside for 100 percent expansion.

Septic System Recommendations				
Septic Tank Size	**Pit Diameter**	**Total Pit Depth**	**Pit Inlet depth**	**No. of Pits Required**
3500 gallons	6’	11’	1’	9

Total Depth of Pit(s) Needed = Tank Size/[(Q)*(Pit Diameter)*(3.14)] = 3500/(2.2X6X3.14) = 84.4 feet.

4.0 CONCLUSIONS AND RECOMMENDATIONS

- Based on the data presented in this report and using the recommendations set forth, it is the judgment of GeoMat Testing Laboratories, Inc. that there is sufficient area on this site to support a primary and expansion of the onsite wastewater system that will meet the current standards of the Department of Environmental Health, County of Riverside and Regional Quality Control Board.

- The seepage pit should be constructed near the percolation test location at the depth of the tests performed and in natural soil to details per County of Riverside Health Department, Division of Environmental Health. All systems must meet the CRWQCB requirements.

- The natural occurring body of minerals and organic matter at the proposed wastewater disposal area contains earthen materials having more than 50% of its volume composed of particles smaller than 2mm (No. 10 sieve) in size.

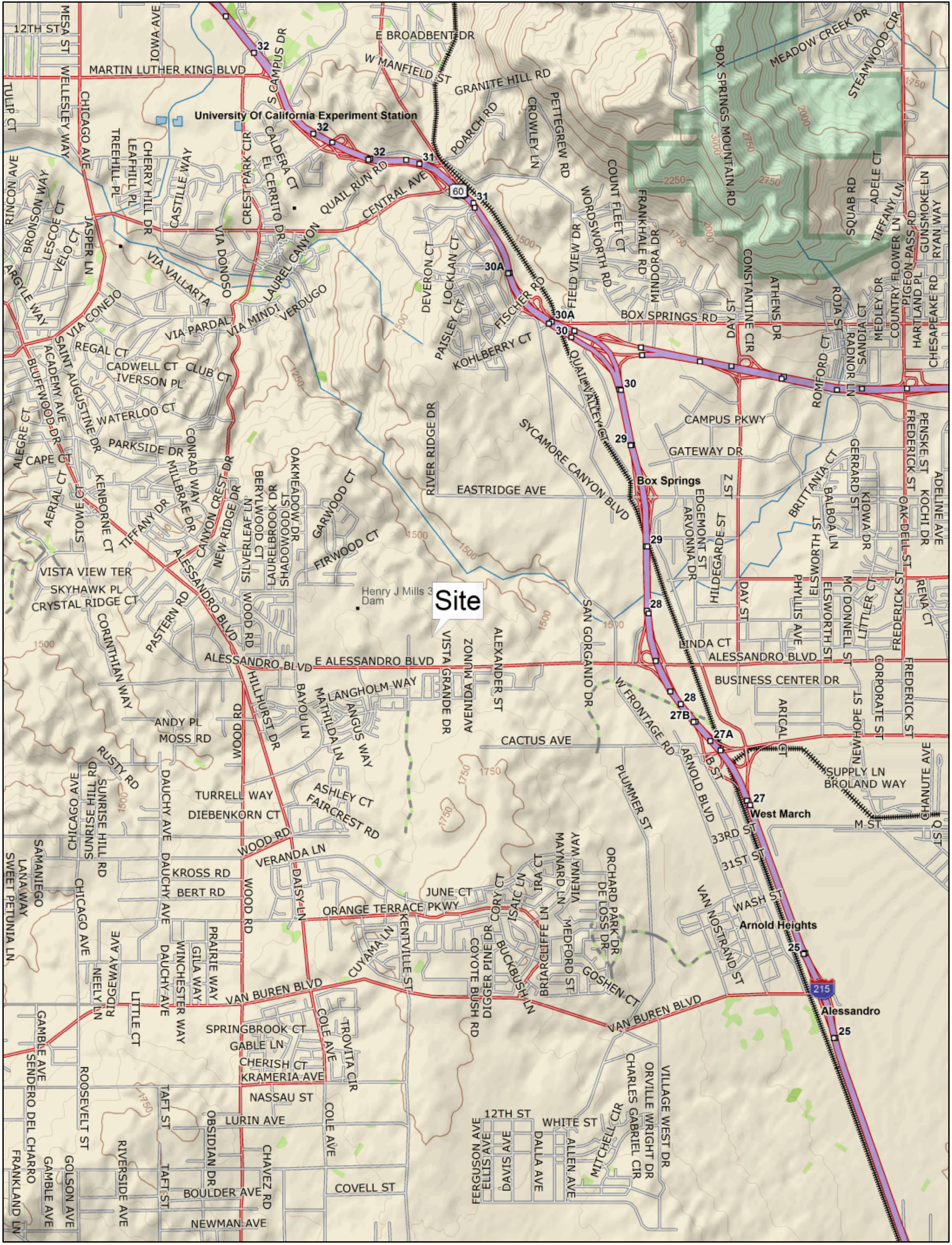
- According to our test elevations (1608) and minimum ten feet seepage pits (bottom of pit at 1597), the inlet should be no deeper than one foot below grade to maintain 5 feet separation between groundwater (elevation 1592) and bottom of seepage pit.

- Based on the data presented in this report and the testing information accumulated, it is the judgment of GeoMat Testing Laboratories, Inc. that the groundwater table will not encroach within the current allowable limit of 5 feet set forth by County requirements.

- All seepage pit excavations should be in natural ground and should be observed by GeoMat Testing Laboratories, Inc. during the time of excavation. A copy of the DEHS septic system handout “Taking Care of Your Septic System” and “Got Septic FAQ” should be obtained by the developer to provide it to owner.

5.0 LIMITATION

This report is prepared with the understanding that it is the owner's responsibility to ensure that proper construction methods are employed for the disposal system. Improper placement/construction of the system can cause premature failure regardless of soil conditions. It is also the owner's responsibility to adequately maintain the disposal system to extend its longevity. Our work was performed using the degree of care and skill ordinarily exercised, under similar circumstances, by reputable soil engineers practicing in this or similar localities. No other warranty, expressed or implied, is made as to the conclusions and professional advice included in this report. The samples taken and used for laboratory testing and the observations made are believed representative of the tested areas, however, soil conditions can vary significantly between test locations. As in most projects conditions revealed by excavation may be at variance with preliminary findings. If this occurs, the changed conditions must be evaluated by the Project Soil Engineer and design adjusted, as required, or alternate designs recommended. This report is issued with the understanding that it is the responsibility of the owner, or his representative, to ensure that the information and recommendations contained herein are brought to the attention of the architect and engineer for the project and incorporated into the plans, and the necessary steps are taken to see that the contractor and subcontractors carry out such recommendations in the field. The findings of this report are valid as of the present date. However, changes in the conditions of a property can occur with the passage of time, whether they be due to natural processes or the works of man on this or adjacent properties. In addition, changes in applicable or appropriate standards may occur whether they result from legislation or the broadening of knowledge. Accordingly, the findings of this report may be invalidated wholly or partially by changes outside our control. Therefore, this report is subject to review and revision as changed conditions are identified.



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TN

MN (11.8°E)

Figure 1

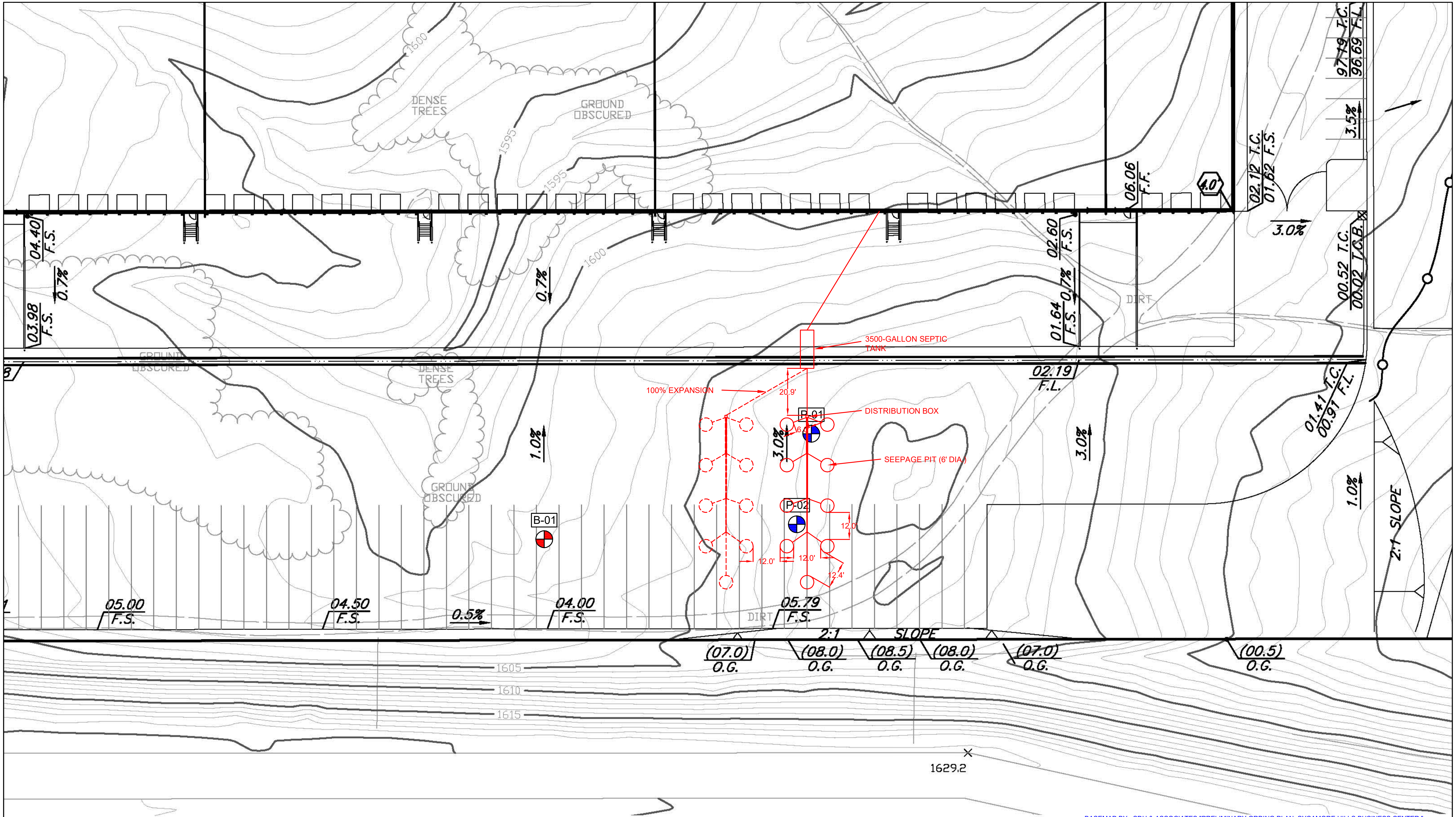
Scale 1 : 50,000

0 ¼ ½ ¾ 1 mi

0 ½ 1 1½ 2 km

1" = 4,166.7 ft

Data Zoom 12-0



BASEMAP BY: SDH & ASSOCIATES "PRELIMINARY GRDING PLAN, SYCAMORE HILLS BUSINESS CENTER," SHEET 2 OF 5, PLAN NOT DATED

LEGEND:

B-01 ⊕ EXPLORATORY BORING

P-04 ⊕ PERCOLATION TEST

ALL LOCATIONS ARE APPROXIMATE

EXPLORATORY BOREHOLE AND
PERCOLATION TEST LOCATION MAP
APN: 263-060-022
RIVERSIDE, CALIFORNIA

geomat

DRAWN BY: AM	DATE: JULY 2019	PLATE 1
SCALE: 1" = 40'	PROJECT NO.: 16175-01	

Appendix A

REFERENCES

SDH & Associates, Inc. "Preliminary Grading Plan, Sycamore Hills Business Center," Sheet 2 of 5, Plan Dated November 2018.

Norcal Engineering "Geotechnical Engineering Investigation, Proposed Industrial Warehouse Development, NEC Barton Street and Alessandro Boulevard, Riverside, California," Project No. 21022-19, Report Dated March 29, 2019.

GeoMat Testing Laboratories, Inc. "Report of Preliminary Shallow Percolation Testing, Proposed Commercial Building, APN 263-060-022, Riverside, California," Project No. 16175-01, Report Dated February 14, 2017.

Dibblee, T.W., and Minch, J.A., 2003, Geologic map of the Riverside East/south 1/2 of San Bernardino South quadrangles, San Bernardino and Riverside County, California: Dibblee Geological Foundation, Dibblee Foundation Map DF-109, scale 1:24,000

State of California, Department of Water Resources, Water Data Library.

USGS, National Water Information System

USGS, Groundwater Watch, California Active Water Level Network.

Steven Mains, Cooperative Well Measuring Program

County of Riverside Property Viewer.

County of Riverside, Community Health Agency, Department of Environmental Health, Version "A", Onsite Wastewater Treatment Systems, Technical Guidance Manual.

Appendix B

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS		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 NO. 4 SIEVE	CLEAN SANDS (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 FINES (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 SANDY OR SILTY SOILS, ELASTIC SILTS
			🟦	CH	INORGANIC CLAYS OF HIGH PLASTICITY
			🟦	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 gravels or sand with 5-12% fines and soils with fines classifying as CL-ML. Symbols separated by a slash

RELATIVE DENSITY	
SANDS AND GRAVELS	SPT, N
VERY LOOSE	0 - 4
LOOSE	4 -10
MEDIUM DENSE	10 - 30
DENSE	30 - 50
VERY DENSE	50+

CONSISTENCY		UNCONFINED COMPRESSIVE
SILTS AND CLAYS	SPT, N	STRENGTH, tsf
VERY SOFT	0 - 2	0 - 0.25
SOFT	2 - 4	0.25 - 0.50
MEDIUM FIRM	4 - 8	0.50 - 1.00
FIRM	8 - 15	1.00 - 2.00
VERY FIRM	15 - 30	2.00 - 4.00
HARD	30+	>4.00

MOISTURE CONDITION

DESCRIPTION	CRITERIA
DRY	Absence of moisture, dusty, dry to the touch
MOIST	Damp but no visible water
WET	Visible free water, usually soil is below water table

CONSTITUENT DESCRIPTIONS

DESCRIPTION	CRITERIA	DESCRIPTION	CRITERIA
TRACE	Less than 5%	SOME	30% to 45%
FEW	5% to 10%	MOSTLY	50% to 100%
LITTLE	15% to 25%		

Sampler and Symbol Descriptions

B	▦	Bulk "grab" sample taken from the auger cuttings or excavated soil
S	☐	1.4" I.D./2" O.D. Standard Penetration Test (ASTM D1586) sampler (SPT)
R	☒	2.5" I.D./3" O.D. Modified California Ring Sampler (Ring)
D	⬚	2.5" I.D./3" O.D. Dames and Moore Manual Ring Sampler

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KEY TO BORING LOGS

APPENDIX B

PROJECT:	APN: 263-060-022 Riverside, California

Log of Boring B-1

PAGE 1 of 1

Project No.	**16175-02**	Boring Location:	**See Plate 1**
Drill Company/Rig	**Advanced/Diedrich D-50**	Date Started:	**7/18/2019**
Drilling Method:	**Hollow Stem Auger**	Date Finished:	**7/18/2019**
Hammer Weight/Drop:	**140 lbs./30-inches**	Hammer Type:	**Automatic**

Sampler(s): California Ring (R), Standard Penetration Test (S), Bulk "Grab" Sample (B)

Logged by: **AM**

Notes: Static Groundwater @ 10' below ground surface

LABORATORY TEST DATA

DEPTH (FT)	SAMPLES Type	Sample	Blows / 6"	SPT "N" Value	Graphic Log	Classification (USCS)	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	Fines (%)	Liquid Limit	Plastic Limit	Plast. Index
					🟧	SM	**SILTY SAND** gray silt with sand very moist to saturated						
5	B	▨			▨	SM	GRANITIC BEDROCK drills like silty sand						
10					▨	▼	static groundwater measured at 10 feet bgs						
15					▨								
20					▨								
25					▨								
	B	▨			▨					26			
30													
35													
40													
45													
50													

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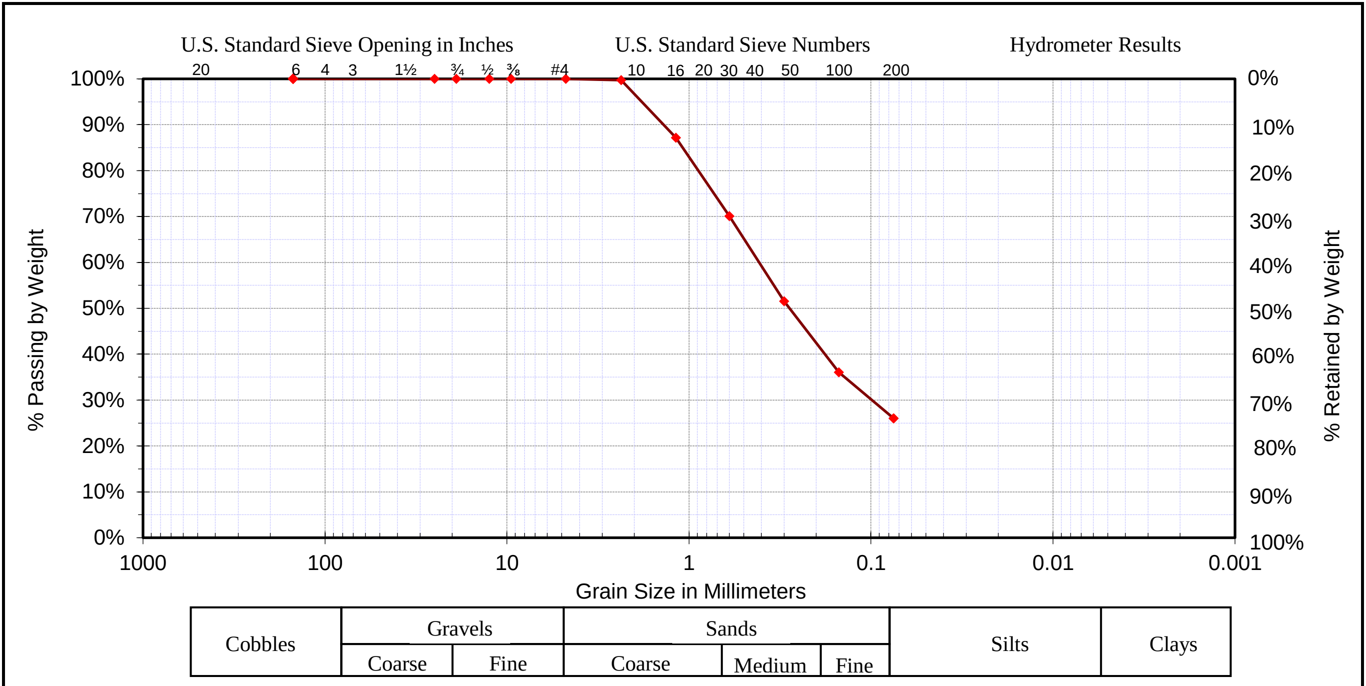
Appendix C

LABORATORY TEST RESULTS



Date : 07/18/19
Sample #:
Sample ID: B1 @ 30'
Source: Bulk
Project: APN 263-060-022
Location: Riverside, California
Boring #: B1
Depth: 30'

D_{10} = 0.03
D_{30} = 0.10
D_{60} = 0.44
C_C = 0.87
C_U = 15.16
Liquid Limit= n/a
Plastic Limit= n/a
Plasticity Index= n/a

Classification
SM, Silty Sand

Specifications
custom specs 1

Fineness Modulus
1.55

% Gravel
0.00%
% Sand
73.99%
% Silt & Clay
26.01%

Sample Moisture
#DIV/0!

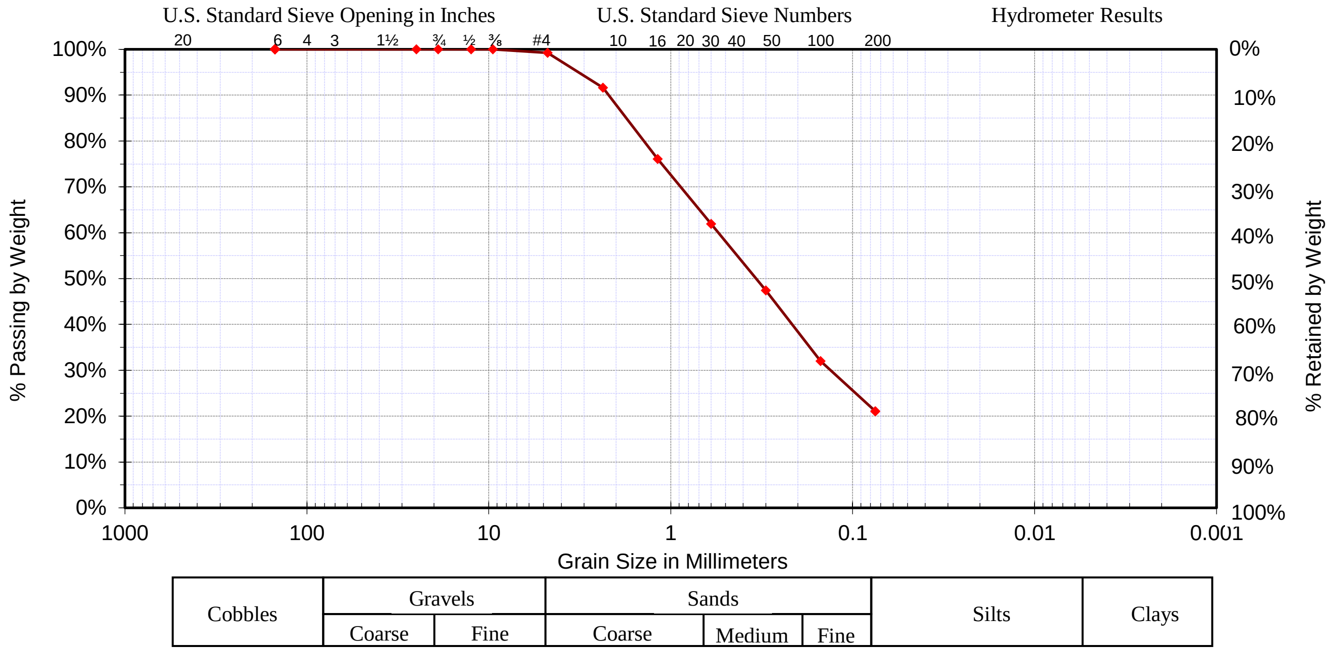
Coarse Section

Sieve Size US	Sieve Size Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min
6.00"	150.00		100.0%		
4.00"	100.00		100.0%		
3.00"	75.00		100.0%		
2.50"	63.00		100.0%		
2.00"	50.00		100.0%		
1.75"	45.00		100.0%		
1.50"	37.50		100.0%		
1.25"	31.50		100.0%		
1.00"	25.00	100.0%	100.0%		
7/8"	22.40		100.0%		
3/4"	19.00	100.0%	100.0%		
5/8"	16.00		100.0%		
1/2"	12.50	100.0%	100.0%		
3/8"	9.50	100.0%	100.0%		
1/4"	6.30		100.0%		
#4	4.75	100.0%	100.0%		

Fines Section

Sieve Size US	Sieve Size Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min
#4	4.750	100.0%	100.0%		
#8	2.360	99.7%	99.7%		
#10	2.000		95.9%		
#16	1.180	87.2%	87.2%		
#20	0.850		77.4%		
#30	0.600	70.1%	70.1%		
#40	0.425		59.2%		
#50	0.300	51.5%	51.5%		
#60	0.250		46.4%		
#80	0.180		39.2%		
#100	0.150	36.1%	36.1%		
#140	0.106		30.2%		
#170	0.090		28.0%		
#200	0.075	26.0%	26.0%		
#270	0.053				

LABORATORY TEST RESULTS



Date : 07/18/19
Sample #:
Sample ID: P1
Source: Bulk
Project: APN 263-060-022
Location: Riverside, California
Boring #: P1
Depth: 20'

D_{10} = 0.04
D_{30} = 0.14
D_{60} = 0.56
C_C = 0.93
C_U = 15.75
Liquid Limit= n/a
Plastic Limit= n/a
Plasticity Index= n/a

Classification
SM, Silty Sand

Specifications
custom specs 1

Fineness Modulus
1.92

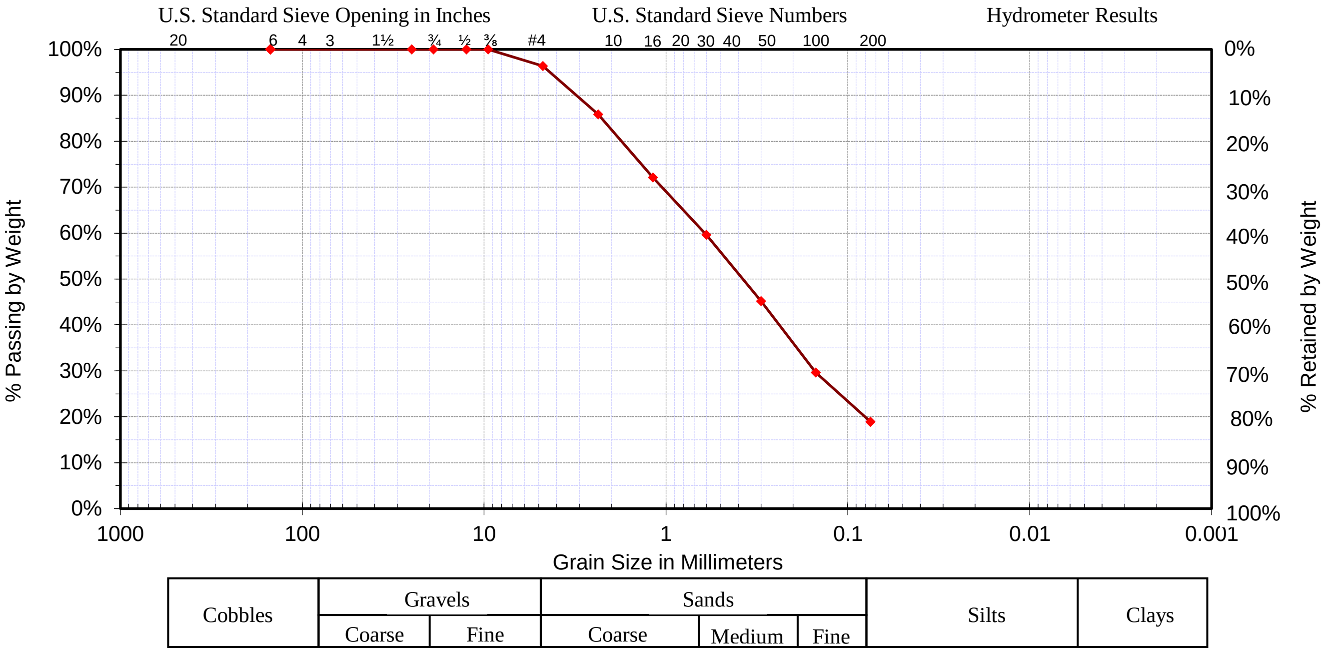
% Gravel
0.76%
% Sand
78.18%
% Silt & Clay
21.06%

Sample Moisture
3.8%

Coarse Section Sieve Size US	Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min
6.00"	150.00		100.0%		
4.00"	100.00		100.0%		
3.00"	75.00		100.0%		
2.50"	63.00		100.0%		
2.00"	50.00		100.0%		
1.75"	45.00		100.0%		
1.50"	37.50		100.0%		
1.25"	31.50		100.0%		
1.00"	25.00	100.0%	100.0%		
7/8"	22.40		100.0%		
3/4"	19.00	100.0%	100.0%		
5/8"	16.00		100.0%		
1/2"	12.50	100.0%	100.0%		
3/8"	9.50	100.0%	100.0%		
1/4"	6.30		99.5%		
#4	4.75	99.2%	99.2%		

Fines Section Sieve Size US	Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min
#4	4.750	99.2%	99.2%		
#8	2.360	91.6%	91.6%		
#10	2.000		86.9%		
#16	1.180	76.1%	76.1%		
#20	0.850		68.0%		
#30	0.600	61.9%	61.9%		
#40	0.425		53.5%		
#50	0.300	47.4%	47.4%		
#60	0.250		42.3%		
#80	0.180		35.1%		
#100	0.150	32.0%	32.0%		
#140	0.106		25.6%		
#170	0.090		23.2%		
#200	0.075	21.1%	21.1%		
#270	0.053				

LABORATORY TEST RESULTS



Date : 07/18/19
Sample #:
Sample ID: P2
Source: Bulk
Project: APN 263-060-022
Location: Riverside, California
Boring #: P2
Depth: 15'

D_{10} = 0.04
D_{30} = 0.15
D_{60} = 0.62
C_C = 0.96
C_{U} = 15.60
Liquid Limit= n/a
Plastic Limit= n/a
Plasticity Index= n/a

Classification
SM, Silty Sand

Specifications
custom specs 1

Fineness Modulus
2.11

% Gravel
3.63%
% Sand
77.46%
% Silt & Clay
18.91%

Sample Moisture
2.4%

Coarse Section Sieve Size US	Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min
6.00"	150.00		100.0%		
4.00"	100.00		100.0%		
3.00"	75.00		100.0%		
2.50"	63.00		100.0%		
2.00"	50.00		100.0%		
1.75"	45.00		100.0%		
1.50"	37.50		100.0%		
1.25"	31.50		100.0%		
1.00"	25.00	100.0%	100.0%		
7/8"	22.40		100.0%		
3/4"	19.00	100.0%	100.0%		
5/8"	16.00		100.0%		
1/2"	12.50	100.0%	100.0%		
3/8"	9.50	100.0%	100.0%		
1/4"	6.30		97.6%		
#4	4.75	96.4%	96.4%		

Fines Section Sieve Size US	Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min
#4	4.750	96.4%	96.4%		
#8	2.360	85.8%	85.8%		
#10	2.000		81.6%		
#16	1.180	72.1%	72.1%		
#20	0.850		65.0%		
#30	0.600	59.6%	59.6%		
#40	0.425		51.2%		
#50	0.300	45.2%	45.2%		
#60	0.250		40.0%		
#80	0.180		32.8%		
#100	0.150	29.6%	29.6%		
#140	0.106		23.3%		
#170	0.090		21.1%		
#200	0.075	18.9%	18.9%		
#270	0.053				

Appendix D

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Seepage Pit Percolation Data Sheet

P-1

Date Excavated:	7/18/2019
Presoak Date:	7/24/2019
Test Date:	7/25/2019

Depth of Test Hole (ft):	20
Diameter of Test Hole (in):	8
Percolation Tested by:	AA

Sandy Soil Criteria Test

Sandy soil criteria is met when 2 consecutive measurements show that more than half the wetted depth seeps away in less than 25 min.

Trial No.	Time (min)	Time (hr)	Init. Water Depth (ft)	Final Water Depth (ft)	Total Depth (ft)	Drop (ft)	Average Depth (ft)	Q (gal/ft²/day)	Pit MPI 180/Q
1									
2									

If sandy soil criteria is met, presoak for 2 hours and begin test (10 minute readings for at least 1 hour). If sandy soil criteria is not met, presoak test hole and return the next day for testing (30 minute readings for at least 6 hours).

Percolation Testing

Time	Time (min)	Time (hr)	Init. Water Depth (ft)	Final Water Depth (ft)	Total Depth (ft)	Drop (ft)	Average Depth (ft)	Q (gal/ft²/day)	Pit MPI 180/Q
0:00 0:30	30	0.50	4.0	10.0	20	6.0	13.0	5.5	32.5
0:00 0:30	30	0.50	4.0	9.5	20	5.5	13.3	5.0	36.1
0:00 0:30	30	0.50	4.0	9.4	20	5.4	13.3	4.9	36.9
0:00 0:30	30	0.50	4.0	9.4	20	5.4	13.3	4.9	36.9
0:00 0:30	30	0.50	4.0	9.0	20	5.0	13.5	4.4	40.5
0:00 0:30	30	0.50	4.0	9.0	20	5.0	13.5	4.4	40.5
0:00 0:30	30	0.50	4.0	9.0	20	5.0	13.5	4.4	40.5
0:00 0:30	30	0.50	4.0	9.0	20	5.0	13.5	4.4	40.5
0:00 0:30	30	0.50	4.0	9.0	20	5.0	13.5	4.4	40.5
0:00 0:30	30	0.50	4.0	9.0	20	5.0	13.5	4.4	40.5
0:00 0:30	30	0.50	4.0	9.0	20	5.0	13.5	4.4	40.5
0:00 0:30	30	0.50	4.0	9.0	20	5.0	13.5	4.4	40.5

Septic System Based on This Field Test Only*					
Tank (gal)	Pit Dia. (ft)	Pit Inlet (ft)	Pit Depth (ft)	No. of Pits	Tot Pit Depth
3500	6	1	42	9	6

*This is not the final recommendations for the system. Refer to report for final septic system recommendations.

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Seepage Pit Percolation Data Sheet

P-2

Date Excavated:	7/18/2019
Presoak Date:	7/25/2019
Test Date:	7/26/2019

Depth of Test Hole (ft):	15
Diameter of Test Hole (in):	8
Percolation Tested by:	AA

Sandy Soil Criteria Test

Sandy soil criteria is met when 2 consecutive measurements show that more than half the wetted depth seeps away in less than 25 min.

Trial No.	Time (min)	Time (hr)	Init. Water Depth (ft)	Final Water Depth (ft)	Total Depth (ft)	Drop (ft)	Average Depth (ft)	Q (gal/ft²/day)	Pit MPI 180/Q
1									
2									

If sandy soil criteria is met, presoak for 2 hours and begin test (10 minute readings for at least 1 hour). If sandy soil criteria is not met, presoak test hole and return the next day for testing (30 minute readings for at least 6 hours).

Percolation Testing

Time	Time (min)	Time (hr)	Init. Water Depth (ft)	Final Water Depth (ft)	Total Depth (ft)	Drop (ft)	Average Depth (ft)	Q (gal/ft²/day)	Pit MPI 180/Q
0:00 0:30	30	0.50	4.0	6.0	14.8	2.0	9.8	2.4	73.5
0:00 0:30	30	0.50	4.0	5.9	14.8	1.9	9.9	2.3	77.8
0:00 0:30	30	0.50	4.0	6.0	14.8	2.0	9.8	2.4	73.5
0:00 0:30	30	0.50	4.0	6.0	14.8	2.0	9.8	2.4	73.5
0:00 0:30	30	0.50	4.0	5.8	14.8	1.8	9.9	2.2	82.5
0:00 0:30	30	0.50	4.0	5.8	14.8	1.8	9.9	2.2	82.5
0:00 0:30	30	0.50	4.0	5.8	14.8	1.8	9.9	2.2	82.5
0:00 0:30	30	0.50	4.0	5.8	14.8	1.8	9.9	2.2	82.5
0:00 0:30	30	0.50	4.0	5.8	14.6	1.8	9.7	2.2	80.8
0:00 0:30	30	0.50	4.0	5.8	14.6	1.8	9.7	2.2	80.8
0:00 0:30	30	0.50	4.0	5.8	14.6	1.8	9.7	2.2	80.8
0:00 0:30	30	0.50	4.0	5.8	14.6	1.8	9.7	2.2	80.8

Septic System Based on This Field Test Only*

Tank (gal)	Pit Dia. (ft)	Pit Inlet (ft)	Pit Depth (ft)	No. of Pits	Tot Pit Depth
3500	6	1	86	9	11

*This is not the final recommendations for the system. Refer to report for final septic system recommendations.

Paleontological Resource Assessment for the Sycamore Hills Distribution Center Project, City of Riverside, Riverside County, California

Prepared By

Applied EarthWorks, Inc.
133 North San Gabriel Boulevard, Suite 201
Pasadena, CA 91107

Prepared For
Ruth Villalobos, President
Ruth Villalobos & Associates, Inc.
3602 Inland Empire Blvd., Suite C310
Ontario, CA 91764

September 2020

Paleontological Resource Assessment for the Sycamore Hills Distribution Center Project, City of Riverside, Riverside County, California

Prepared By:

Christopher Shi, M.S., Project Paleontologist

Approved By:

Amy Ollendorf, Ph.D., M.S., RPA (#12588),
Paleontology Program Manager

September 2020

MANAGEMENT SUMMARY

The applicant, Darrell Butler for KB Development, is proposing to develop three currently vacant parcels (Assessor Parcel Numbers 263-060-022, -024, and -026) immediately south of the Sycamore Canyon Wilderness Park in the City of Riverside (City), Riverside County (County), California for the Sycamore Hills Distribution Center Project (Project). The Project will include the construction of two warehouses and associated site improvements, and the establishment of a trailhead parking lot for access to the Sycamore Canyon Wilderness Park and access to Alessandro Boulevard to the south through Restricted Property of natural land.

March Joint Powers Authority (MJPA) currently owns the land and is currently under contract with the applicant for the purchase and development of the land. As subcontracted by Ruth Villalobos & Associates, Inc., Applied EarthWorks, Inc. (Æ) completed a paleontological resource assessment for the Project in accordance with the California Environmental Quality Act (CEQA), for which the City is the lead agency.

This report summarizes the methods and results of Æ's paleontological resource assessment and provides Project-specific management recommendations. While the Historic Preservation Element of the City's General Plan includes Policy HP-1.3 for the protection of paleontological resources, no specific guidelines for resource sensitivity and management are provided. As such, Æ's recommendations are based on the guidelines specified in the County's General Plan, which include a paleontological sensitivity map of Riverside County as well as management recommendations. Æ's paleontology staff meet the qualifications standards of the Society of Vertebrate Paleontology (SVP).

Æ's paleontological resource assessment was completed through desktop and field efforts. First, Æ reviewed relevant literature and geologic maps as well as collections records maintained by the Natural History Museum of Los Angeles County. The purposes of the desktop reviews were to identify known presence or suspected likelihood of fossiliferous geologic units mapped on the ground surface, if any, and those buried at unknown depths beneath the Project area, if any. As the region is well known for vertebrate fossils, the museum records search was conducted specifically for vertebrate fossil localities. Following these desktop studies, Æ conducted a field survey during which an Æ paleontologist visually inspected the ground surface of the Project area to record the presence of exposed fossils, if any, and to evaluate all nearby geologic exposures, if any, for their potential to contain significant fossils in the subsurface of the Project area. Using the results of the desktop studies and field survey, Æ determined the paleontological resource potential of the Project area in accordance with the County's guidelines.

Published geologic maps indicate the ground surface of the Project area consists of plutonic and medium- to high-grade metamorphic bedrock, both of which do not normally yield fossils. Museum records indicate no previously recorded vertebrate fossil localities within the Project area or from the types of rocks mapped within its boundaries. As a result, the County assigned a Low level of paleontological sensitivity to the entire Project area. Since Æ found no paleontological resources in or nearby the Project area during the field survey, Æ concurs with the County's Low paleontological sensitivity ranking.

During the field survey, Æ observed the majority of the Project area is obscured by vegetation. Where the surface geology is visible, Æ's paleontologist observed plutonic rocks characteristic of the Val Verde tonalite in addition to sparse outcrops of weathered schist. Consequently, Æ concludes geological conditions conducive to fossil preservation are absent within the Project area and there is a Low likelihood of impacting scientifically significant fossils as a result of ground-disturbing activities associated with Project construction.

Per County of Riverside guidelines for areas with Low paleontological potential, Æ does not recommend mitigation unless a fossil is encountered during ground-disturbing construction activities. If an unanticipated on-site fossil is discovered, all ground-disturbing activities within the area of the find will be ceased and the applicant will retain a paleontologist who meets the SVP's qualifications standards for Project Paleontologist to oversee the documentation of the extent and potential significance of the finds as well as recovery efforts. Ground-disturbing activities may resume in the area of the finds at the discretion of the Project Paleontologist. If the fossils are significant per the SVP's criteria, then paleontological monitoring will be conducted on an as-needed basis for further ground-disturbing activities in the Project area. By implementing these measures, adverse impacts to paleontological resources can be reduced to a less than significant level pursuant to the requirements of CEQA.

CONTENTS

FIGURES

TABLES

1
INTRODUCTION

Under contract to Ruth Villalobos & Associates, Inc. (RVA), Applied EarthWorks, Inc. (Æ) completed a paleontological resource assessment for the Sycamore Hills Distribution Center Project (Project) in the City of Riverside (City), Riverside County (County), California (Figure 1-1). This report summarizes the methods and results of Æ's assessment and provides Project-specific management recommendations. The City is the lead agency for compliance with the California Environmental Quality Act (CEQA). Æ conducted this assessment in accordance with the professional standards and guidelines set forth by the County (2015a, 2015b). Æ's paleontology staff meet the qualifications standards of the Society of Vertebrate Paleontology (SVP, 2010).

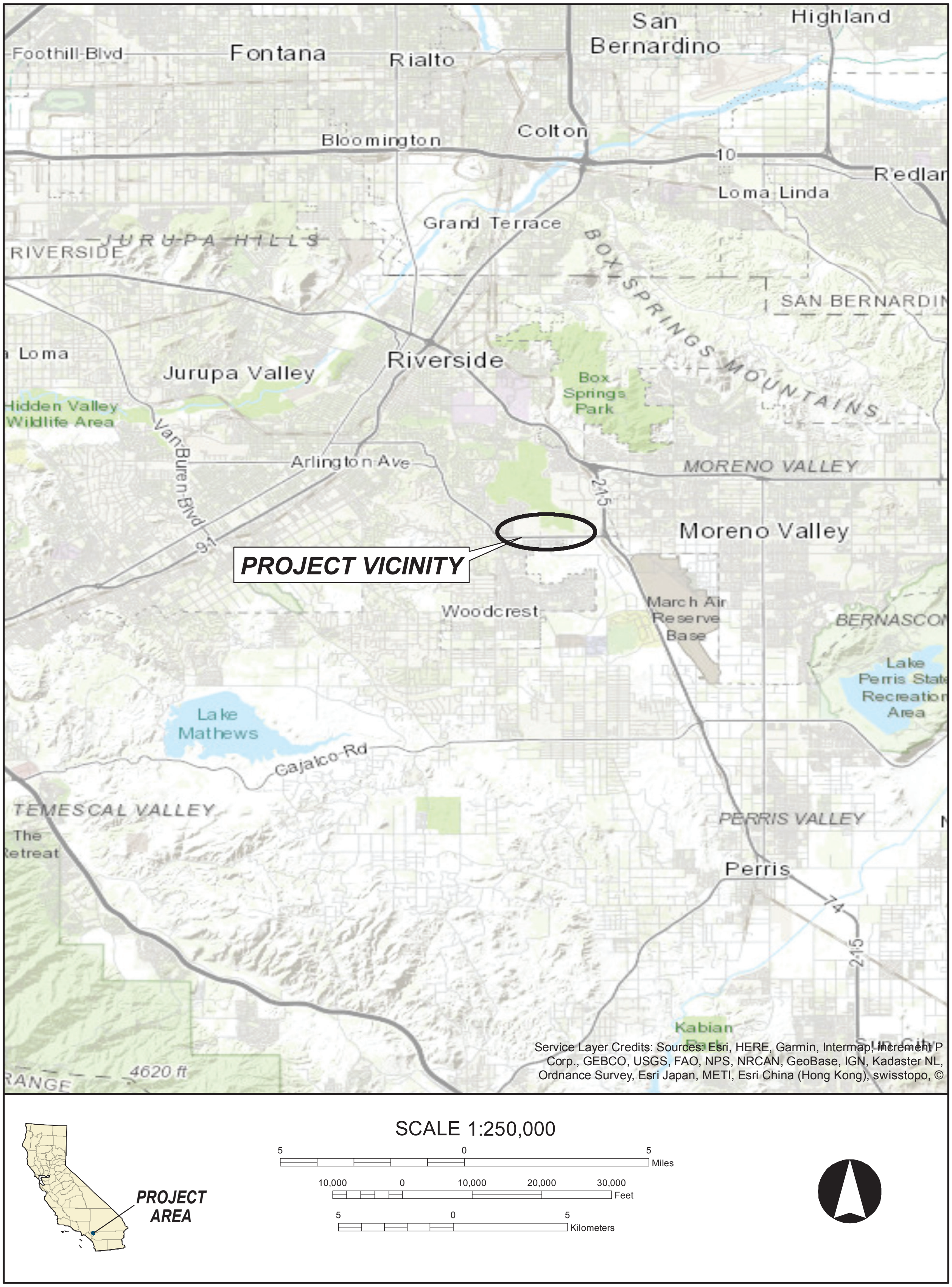
1.1 PROJECT BACKGROUND AND DESCRIPTION

The Project area currently consists of three contiguous vacant parcels: Assessor Parcel Numbers 263-060-022, -024, and -026, which encompass approximately 48.64 (gross) acres in the City. Specifically, it is mapped within Sections 8 and 9 of Township 3 South, Range 4 West on the Riverside East (1967, photo revised 1980), California 7.5′ U.S. Geological Survey (USGS) topographic quadrangle (Figure 1-2). The Project area is bordered to the south by East Alessandro Boulevard, to the west by Barton Street and the Metropolitan Water District Water Treatment Plant, and to the north by the Sycamore Canyon Wilderness Park, with unimproved privately owned land directly to the east. Currently, the Project area consists of hilly land that is vacant, covered mostly with non-native grassland and native riparian scrub.

The Project will subdivide the three parcels into two numbered parcels (Parcels 1 and 2) and three lettered parcels (Parcels A, B, and C). Building A, a 400,000 square foot warehouse, will be constructed on Parcel 1, while Building B, a 203,100 square foot warehouse, will be constructed on Parcel 2. Associated improvements include parking, fire lanes, fencing and walls (including retaining walls), landscaping, and water quality treatment areas.

Parcel A and Parcel B include existing Restricted Property of natural land with a supporting jurisdictional feature totaling approximately 11.6 acres. A 0.67-acre driveway will be constructed through the Restricted Property to provide street access from Alessandro Boulevard to Parcel 1, which would reduce the Restricted Property to 10.93 acres. However, 1.44 acres will be added to Parcel A to mitigate this loss, resulting in a total of 12.37 acres of Restricted Property – a net gain of 0.77 acres. A proposed Conservation Easement will be placed over the amended 12.37 acres of Restricted Property. A 1.18-acre trailhead parking lot is proposed on Parcel C for access to the Sycamore Canyon Wilderness Park. Improvements include a parking lot, sidewalk, shade structure, bike rack, drinking fountain, fencing, and a fire department and access gate. Parcel C will be dedicated to the City.

The design for Building A results in cut areas up to 15 feet in depth and fill areas as much as 12 feet thick; however, over-excavation is not expected to exceed 3 feet in depth. Excess excavated material will be utilized for the construction of Building B. The design for Building B results in cut areas up to 16 feet deep and fill areas as much as 8 feet thick; over-excavation also is not expected to exceed 3 feet in depth.



Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, ©

Figure 1-1 Project vicinity map.

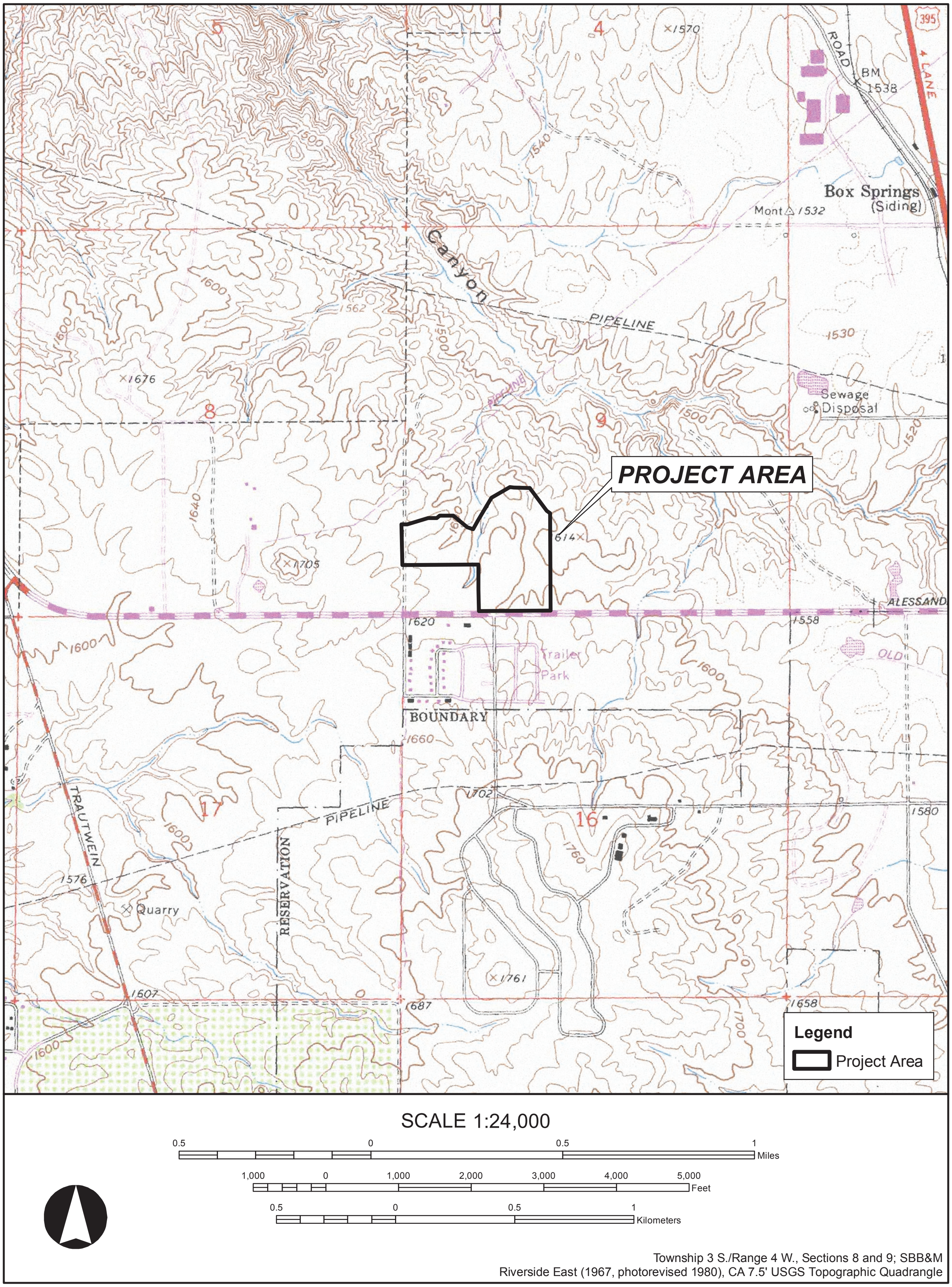


Figure 1-2 Project location map.

1.2 PURPOSE OF INVESTIGATION

The purpose of this paleontological resource assessment is to (1) identify the geologic units exposed within the Project area and those likely buried beneath the Project area at unknown depths, (2) assess the paleontological sensitivity of the geologic units, (3) evaluate whether the Project has the potential to adversely impact scientifically significant paleontological resources, and (4) provide Project-specific mitigation measures to be implemented during Project construction.

1.3 REPORT ORGANIZATION

This report documents the results of Æ's paleontological resource assessment efforts in the Project area. Chapter 1 has introduced the scope of work, identified the Project location, described the Project, and defined the purpose of the investigation. Chapter 2 outlines the regulatory framework governing the Project. Chapter 3 presents the paleontological sensitivity criteria and resource sensitivity guidelines used for this assessment. Chapter 4 describes the methods employed, and Chapter 5 provides details about the geology and paleontology of the Project area. The results of the museum records search, field survey, and paleontological sensitivity assessment are discussed in Chapter 6. Management recommendations are presented in Chapter 7 and references cited are listed in Chapter 8.

2
REGULATORY FRAMEWORK

Paleontological resources (i.e., fossils) are nonrenewable scientific resources, because when destroyed they cannot be replaced. As such, paleontological resources are afforded protection under various federal, state, and local laws and regulations. The laws and regulations that pertain to the proposed Project are briefly discussed in this chapter.

2.1 CALIFORNIA ENVIRONMENTAL QUALITY ACT

Construction of the Project requires discretionary permits and authorization from the City; thus, the Project is subject to the Guidelines for Implementation of CEQA (California Code of Regulations, Title 14, Chapter 3) Section 15002(a)(3), which states among the basic purposes of CEQA is the intention to "prevent significant, avoidable damage to the environment by requiring changes in projects through the use of alternatives or mitigation measures when the governmental agency finds the changes to be feasible." CEQA Guidelines Section 15366(3)(b) further states, "a city or county will have jurisdiction by law with respect to a project when the city or county having primary jurisdiction over the area involved is (1) the site of the project; (2) the area in which the major environmental effects will occur; and/or (3) the area in which reside those citizens most directly concerned by any such environmental effects." Under this provision, the City is the lead agency for CEQA.

The CEQA requires detailed studies that analyze the environmental effects of a proposed project. If a project is determined to have a potential significant environmental effect, the act requires that alternative plans and mitigation measures be considered. Specifically, in Section VII(f) of Appendix G of the CEQA 2019 Guidelines, the Environmental Checklist Form, the question is posed, "Will the project directly or indirectly destroy a unique paleontological resource or site or unique geologic feature?" If paleontological resources are identified as being within the proposed project area, the sponsoring agency must take those resources into consideration when evaluating project effects. The level of consideration may vary with the importance of the resource.

2.2 RIVERSIDE COUNTY

Paleontological resources are also addressed at a county level. The Multipurpose Open Space (OS) Element of the County's General Plan includes a paleontological sensitivity map of Riverside County (County of Riverside 2015b:Figure OS-8) as well as several policies covering paleontological resources (County of Riverside 2015b:OS-51):

> **OS 19.6:** Whenever existing information indicates that a site proposed for development has high paleontological sensitivity as shown on Figure OS-8, paleontological resource impact mitigation program (PRIMP) shall be filed with the Riverside County Geologist prior to site grading. The PRIMP shall specify the steps to be taken to mitigate impacts to paleontological resources.

> **OS 19.7:** Whenever existing information indicates that a site proposed for development has low paleontological sensitivity as shown on Figure OS-8, no direct mitigation is required unless a fossil is encountered during site development. Should a fossil be encountered, the Riverside County Geologist shall be notified and a paleontologist shall be retained by the project proponent. The paleontologist shall document the extent and potential significance of the paleontological resources on the site and establish appropriate mitigation measures for further site development.
>
> **OS 19.8:** Whenever existing information indicates that a site proposed for development has undetermined paleontological sensitivity as shown on Figure OS-8, a report shall be filed with the Riverside County Geologist documenting the extent and potential significance of the paleontological resources on site and identifying mitigation measures for the fossil and for impacts to significant paleontological resources prior to approval of that department.
>
> **OS 19.9:** Whenever paleontological resources are found, the County Geologist shall direct them to a facility within Riverside County for their curation, including the Western Science Center in the City of Hemet.

These policies discuss appropriate measures to be taken depending on sensitivity category, as well as the treatment of paleontological resources that are found during mitigation.

2.3 CITY OF RIVERSIDE GENERAL PLAN

The Historic Preservation Element of the *Riverside General Plan 2025*, Objective HP-1 (City of Riverside, 2012:HP-25-26) also aims to protect paleontological resources:

- **Policy HP-1.3:** The City shall protect sites of archaeological and paleontological significance and ensure compliance with all applicable State and federal cultural resources protection and management laws in its planning and project review process.

As this policy refers to other applicable protection and management laws for guidance, Æ adopts OS 19.6-19.9 of the County's General Plan for this assessment.

3

PALEONTOLOGICAL RESOURCE ASSESSMENT GUIDELINES

Protection of paleontological resources requires assessment of the potential for rocks to contain significant paleontological resources that could be directly or indirectly impacted or destroyed during Project development, and the formulation and implementation of management measures to mitigate these impacts.

3.1 DEFINITION OF PALEONTOLOGICAL RESOURCES AND SIGNIFICANCE CRITERIA

Paleontological resources are defined by the Society of Vertebrate Paleontologists (SVP) (2010) as fossils and fossiliferous deposits. Fossils are the evidence of once-living organisms as preserved in the rock record. They include both the lithified remains of ancient plants and animals and the traces thereof (trackways, imprints, burrows, etc.). In general, fossils are considered to be greater than 5,000 years old (older than middle Holocene) and are typically preserved in sedimentary rocks. Although uncommon, certain volcanic rocks and low-grade metamorphic rocks may be fossiliferous if formed under certain conditions (SVP, 2010).

Well-preserved and identifiable individual fossils are considered significant paleontological resources if they are a type specimen, rare, a complete specimen, or part of an important diverse fossil assemblage. Of particular importance are fossils found in situ, or undisturbed from their primary geologic context. These fossils are important, because they are used to examine evolutionary relationships, provide insight on the development of and interaction between biological communities, establish time scales for geologic studies, and for many other scientific purposes, including investigation into paleoenvironments and paleoclimates (Scott and Springer, 2003; SVP, 2010). Among the various types of fossils, intact and in situ vertebrate fossils are usually assigned a greater significance than other types as they are comparatively rare. Consequently, more attention tends to be placed on the recovery of vertebrate fossils than other types.

3.2 PALEONTOLOGICAL RESOURCE SENSITIVITY AND GUIDELINES

Most professional paleontologists in California adhere to guidelines set forth by the SVP (2010), unless others are available (e.g., Riverside County, U.S. Bureau of Land Management). Riverside County has developed its own guidelines that establish detailed protocols for the assessment of the paleontological sensitivity of a project area and outline measures to follow in order to mitigate adverse impacts to known or unknown fossil resources during project development (County of Riverside, 2015a, 2015b).

Following the County's established process, baseline information gathered during a paleontological resource assessment is used to assign the paleontological sensitivity of the geologic unit(s) (or members thereof) exposed at or distributed across the ground surface of a project area in addition to those thought to be underlying a project area at depth. It should be noted that surface geology is not always indicative of subsurface geology or the potential for paleontological resources. For instance, an area whose surface geology is mapped as non-fossiliferous sediments may cover fossil-rich Pleistocene sediments. Also, an area mapped as granite may be covered by fossil-rich Pleistocene sediments. Thus, actual paleontological sensitivity across a project area ultimately can be determined only through a combination of desktop and field efforts.

According to the County's (2015a) classification system, paleontological sensitivity is assigned to one of four categories—Low, Undetermined, and High (A and B) Potential. The criteria for each sensitivity classification, and the corresponding mitigation recommendations, are summarized in Table 3-1.

Table 3-1
Paleontological Sensitivity Classification

Resource Potential	Criteria	Mitigation Recommendations
Low	Lands for which previous field surveys and documentation demonstrate as having a low potential for containing significant paleontological resources subject to adverse impacts. The mapping of low potential was determined based on actual documentation and was not generalized to cover all areas of a particular rock unit on a geologic map.	Mitigation is not typically required unless a fossil is encountered during site development. If a fossil is encountered, the County Geologist shall be notified, and a paleontologist shall be retained by the project proponent. In such cases, the paleontologist shall document the extent and potential significance of the paleontological resources on the site and establish appropriate mitigation measures for further site development.
Undetermined	Areas underlain by sedimentary rocks for which literature or unpublished studies are not available have undetermined potential for containing significant paleontological resources.	A field survey is required *prior to the commencement of construction activities* by a qualified vertebrate paleontologist to assess the unit's paleontological potential as either High or Low.
High	Sedimentary rock units with high potential for containing significant non-renewable paleontological resources include rock units in which vertebrate or significant invertebrate fossils have been found or determined likely to be present. These units include, but are not limited to, sedimentary formations which contain significant non-renewable paleontological resources anywhere within their geographical extent and sedimentary rock units temporally or lithologically suitable for the preservation of fossils. High sensitivity includes not only the potential for yielding abundant vertebrate fossils, but also for production of a few significant fossils that may provide new and significant data. High sensitivity areas are mapped as either "High A" or "High B," according to the following criteria: **High Sensitivity A (Ha):** Based on geologic formations or mapped rock units that are known to contain or have the correct age and depositional conditions to contain significant paleontological resources. These include rocks of Silurian or Devonian age and younger that have potential to contain remains of fossil fish, and Mesozoic and Cenozoic rocks that contain fossilized body elements and trace fossils such as tracks, nests and eggs. **High Sensitivity B (Hb):** Equivalent to High A, but is based on the occurrence of fossils at a specified depth below the surface. This category indicates fossils that are likely to be encountered at or below 4 feet of depth and may be impacted during construction activities.	The qualified paleontologist approved by the County ("Project Paleontologist") will create and implement a project-specific paleontological resource impact mitigation program (PRIMP) to be approved by the County Geologist *prior to the issuance of a grading permit.* Construction monitoring and details covering the treatment of fossil discoveries are included in the PRIMP. Any significant specimens discovered will need to be prepared, identified, and curated into a museum. A final report documenting the significance of the finds will also be required.

Source: County of Riverside (2015a).

4
METHODS

The following section summarizes the desktop and field methods that Æ used to assess paleontological sensitivity of the Project area.

4.1 LITERATURE REVIEW AND RECORDS SEARCH

Chemical and physical weathering processes often cause the breakdown of bedrock, which results in natural materials from which a soil can be created through the process of pedogenesis (Boggs, 2012). Although many factors govern the thickness of the soil, it typically obscures the underlying geologic deposits. Intact and in situ paleontological resources are not found in the soil layer. Therefore, in order to ascertain whether a particular project area has the potential for significant paleontological resources in the subsurface, it is necessary to review relevant scientific literature and geologic maps to ascertain the underlying geology and stratigraphy of the area. Furthermore, in order to delineate the boundaries of paleontological sensitivity, it is necessary to determine the extent of the entire geologic unit because paleontological sensitivity is not limited to surface exposures of fossil material.

In order to determine whether fossil localities have been discovered previously within a project area or a particular rock unit, a desktop study is completed. Æ's study involved examination of readily available geologic maps (Morton et al., 2001) and professional publications (Norris and Webb, 1976; Boucot and Rumble, 1980) as well as a search of pertinent museum repositories for fossil localities within and near the Project area. As the region is known for its abundant vertebrate fossil discoveries, a museum records search for vertebrate fossil localities was conducted at the Natural History Museum of Los Angeles County (NHMLAC).

4.2 FIELDWORK

Æ's Project Paleontologist Christopher Shi completed a pedestrian reconnaissance field survey of the Project area on September 20, 2018. He accomplished the field survey by visually inspecting the ground surface within the Project area while looking for exposed fossils. He also evaluated the potential for preserved fossil material in the subsurface by examining the lithology and distribution of geologic outcrops throughout the Project area.

Shi walked in a zigzag pattern from the southwest corner to the northeast corner of the Project area for comprehensive coverage. In all but the southeast portion of the Project area where dense vegetation hindered close-interval examination of the ground surface, the survey interval of each transect was generally 15–20 feet. Shi closely examined all locations in which the ground surface was not obscured and geologic outcrops were visible.

In addition to conducting the field survey, Christopher Shi wrote this paleontological resource assessment report while Cari Inoway provided GIS mapping of the figures under his direction. Æ's Paleontology Program Manager, Dr. Amy Ollendorf, oversaw the paleontological resource assessment and completed quality assurance/quality control throughout.

Shi meets the SVP's (2010) standards for Qualified Professional Paleontologist. He has a graduate degree in geology and possesses familiarity and proficiency with paleontology, sedimentology, and stratigraphy, as well as over 2 years of paleontological monitoring experience in California. Ollendorf has interdisciplinary graduate degrees involving geology and a bachelor's degree in geology, all of which focused on paleontological subject matter. She is a Registered Professional Archaeologist (RPA #12588) with 35 years of environmental compliance experience.

5

GEOLOGY AND PALEONTOLOGY

5.1 REGIONAL GEOLOGY

The Project area is located within the northeastern part of the geologically complex Peninsular Ranges geomorphic province. The Peninsular Ranges are a northwest-southeast oriented complex of blocks that extend 125 miles from the Transverse Ranges and Los Angeles Basin to the tip of Baja California. The Peninsular Ranges are bounded to the east by the Colorado Desert and range in width from 30 to 100 miles (Norris and Webb, 1976). The Project area is approximately 3.5 miles northeast of Lake Mathews and 1.5 miles southwest of Box Springs Mountain, within the central part of the Perris Block, a relatively stable rectangular structural unit positioned between the Elsinore and San Jacinto fault zones (Morton et al., 2001). The geology in the vicinity of the Project area consists largely of Cretaceous plutonic rocks that are part of the composite Peninsular Ranges batholith (Morton et al., 2001).

5.2 GEOLOGY AND PALEONTOLOGY OF THE PROJECT AREA

The Project area is mapped at a scale of 1:24,000 by Morton et al. (2001). According to this published map, surface exposures of Cretaceous plutonic rocks intermixed with older, possibly Paleozoic metamorphic and plutonic rocks are distributed across the Project area (Figure 5-1). The geologic units that occur in the Project area are described in the following sections.

5.2.1 Val Verde tonalite (Kvt)

Much of the Project area consists of biotite-hornblende tonalite, the principal plutonic rock type of the Val Verde pluton. The tonalite is a relatively weathered, homogeneous, gray granitic rock that is mostly massive and occasionally foliated. Fossils are not found in plutonic rocks, which formed from cooled magma within Earth's mantle.

5.2.2 Intermixed Paleozoic(?[1]) metamorphic and Paleozoic(?)-Cretaceous plutonic rocks (KgP$_z$)

The Val Verde tonalite intrudes an elongate northwest-southeast oriented mass of older, possibly Paleozoic schist, gneiss, and granitic rocks (mostly tonalite and granodiorite). A portion of this intermixed mass occurs in the northeast region of the Project area. Although certain low-grade metamorphic rocks such as slate can occasionally preserve fossils, schist and gneiss are medium- to high-grade metamorphic rocks that have undergone extreme heat and pressure during formation. As such, most fossils originally preserved in their precursor rocks would have been destroyed or rendered unrecognizable. Medium- to high-grade metamorphic rocks therefore do not typically

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[1] Morton et al. (2001) describes these units with question marks because their ages have not been studied and confirmed.

yield fossils, although some rare discoveries have been reported (e.g., brachiopod fossils from schist and quartzite) (Boucot and Rumble, 1980).

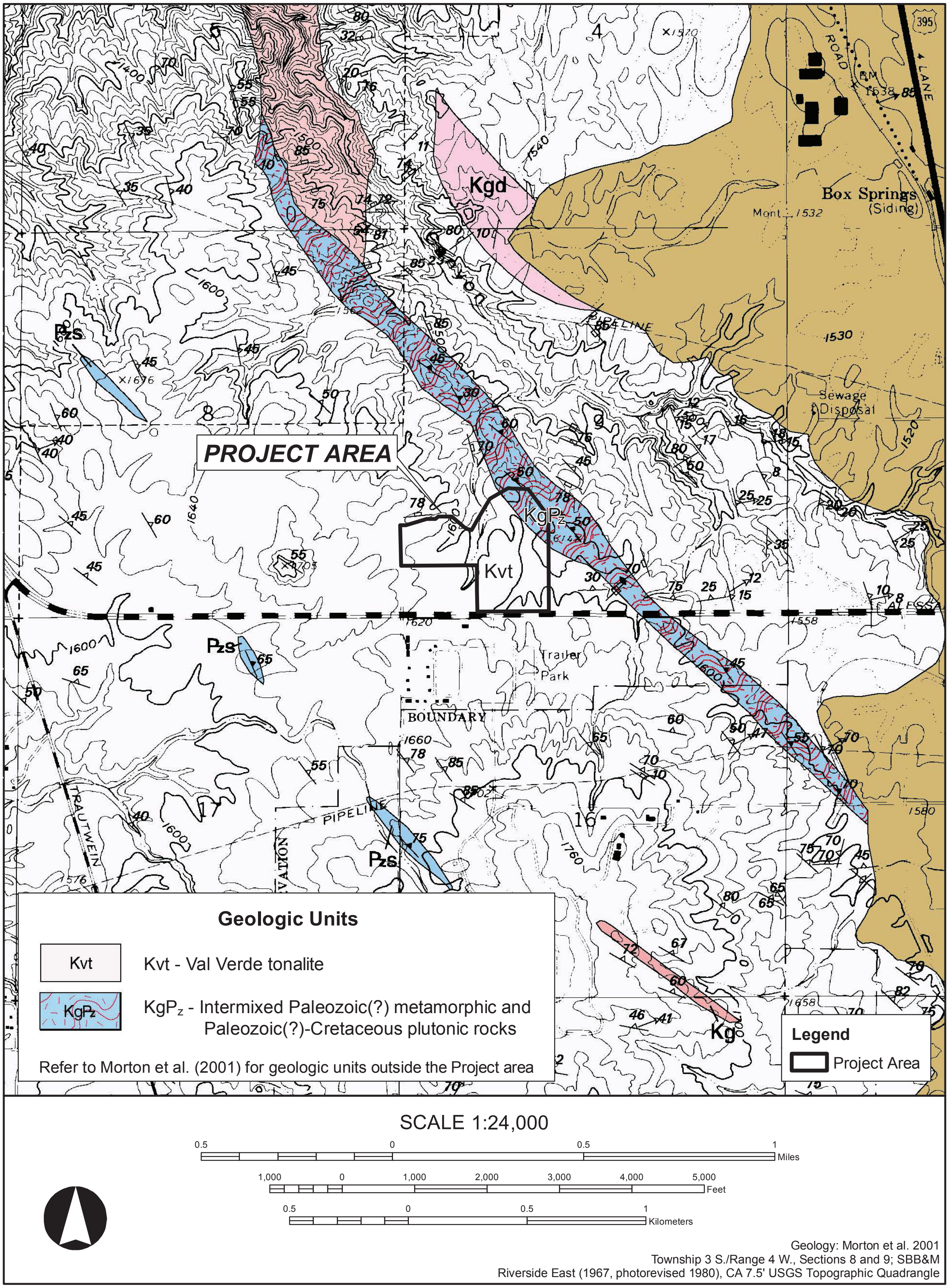


Figure 5-1 **Geologic units in the Project area.**

6
RESULTS AND ANALYSIS

The following section summarizes the results and analyses from Æ's desktop and field efforts.

6.1 MUSEUM RECORDS SEARCH RESULTS

The NHMLAC search yielded no records for previously identified vertebrate localities within the Project area or within similar geologic units elsewhere. Furthermore, McLeod (2018) states that the igneous and metamorphic rock types present in the Project area would not contain any recognizable fossils.

6.2 FIELD RESULTS

The ground surface of the Project area is largely undisturbed with the exception of on-site bike and hiking trails throughout (Figure 6-1). As also can be seen in this photo, ground visibility is poor (less than 10 percent) with much of it obscured by vegetation consisting of non-native grasses and native riparian scrub, approximately 1–3 feet in height. The thickness of the soil layer is presently unknown, though inferred to be thin due to the abundance of flat-lying bedrock exposures that crop out throughout the relatively low-relief surface topography of the Project area. However, the soil layer does appear to thicken in the southeast portion of the Project area where bedrock exposures are slightly less abundant and taller vegetation includes trees over 10 feet in height (Figure 6-2).

Figure 6-1 Overview of Project area showing bike and hiking trails, facing east.

Figure 6-2 Southeast portion of the Project area with tall vegetation, facing east.

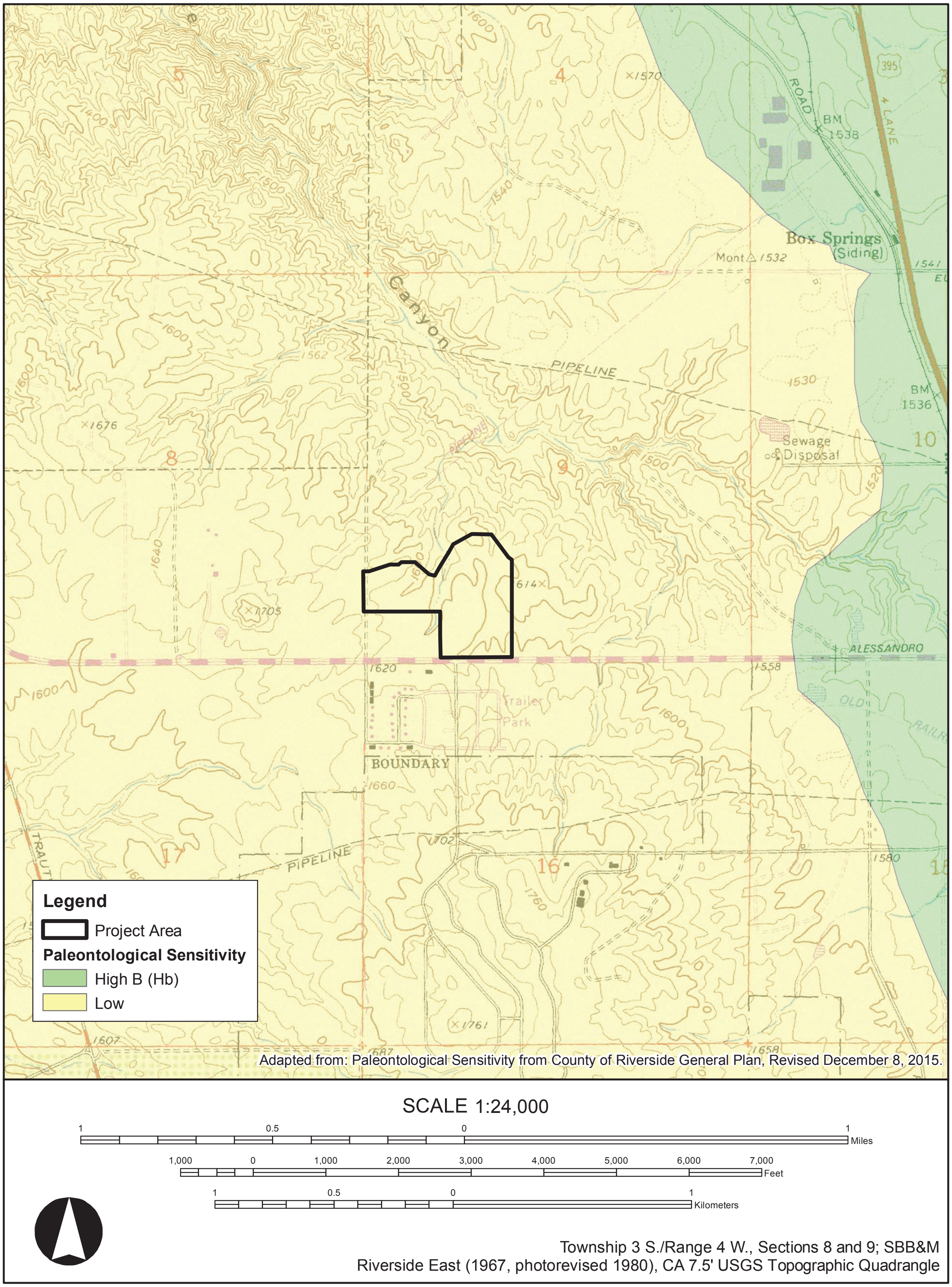
Most of the outcrops consist of gray, homogeneous, massive granitic rocks characteristic of the Val Verde tonalite (Figure 6-3). Small outcrops of weathered schist from the intermixed metamorphic and plutonic rocks also were observed near the northeast portion of the Project area (Figure 6-4). Æ did not encounter any paleontological resources or sedimentary deposits conducive to fossil preservation in any parts of the Project area.

6.3 DETERMINATION OF PALEONTOLOGICAL RESOURCE POTENTIAL FOR GEOLOGIC UNITS WITHIN THE PROJECT AREA

Based on the published paleontological sensitivity map (County of Riverside, 2015b) and the other sources utilized in Æ's desktop study, the Project area consists of geologic units with Low paleontological resource potential (Figure 6-5). Both the Val Verde tonalite and the intermixed metamorphic and plutonic rocks mapped in the Project area (Morton et al., 2001) are very unlikely to preserve recognizable fossils. Furthermore, a robust depositional environment in which fossils could be preserved appears unlikely within the Project area.

Figure 6-3 **Tonalite outcrop, facing west.**

Figure 6-4 **Schist outcrop, facing west.**



Adapted from: Paleontological Sensitivity from County of Riverside General Plan, Revised December 8, 2015.

Township 3 S./Range 4 W., Sections 8 and 9; SBB&M
Riverside East (1967, photorevised 1980), CA 7.5' USGS Topographic Quadrangle

Figure 6-5 Paleontological sensitivity of the Project area.

7
RECOMMENDATIONS

Low sensitivity geologic units are mapped from surface exposures in and near the Project area (County of Riverside, 2015b; Morton et al., 2001). The other sources in Æ's desktop review and Æ's field survey support this finding. The field survey, in fact, confirms the Project area and immediate vicinity are covered by extensive bedrock derived from the composite Peninsular Ranges batholith. Recognizable fossils are very unlikely in the plutonic and metamorphic bedrock. Æ's field survey also found it unlikely that a robust sedimentary depositional environment in which fossils could be preserved could be present above the bedrock in the Project area.

The present study indicates Project-related ground disturbance likely will not impact significant paleontological resources in the Project area. Consistent with County of Riverside (2015a, 2015b) guidelines for Low paleontological sensitivity, Æ does not recommend mitigation unless a fossil is encountered during Project construction. If an unanticipated on-site fossil is discovered during construction, all ground-disturbing activities within the area of the find will be ceased and the applicant will retain a paleontologist who meets the SVP's qualifications standards for Project Paleontologist to oversee the documentation of the extent and potential significance of the finds as well as recovery efforts. Ground-disturbing activities may resume in the area of the finds at the discretion of the Project Paleontologist. If the fossils are significant per the SVP's (2010) criteria, then paleontological monitoring will be conducted on an as-needed basis for further ground-disturbing activities in the Project area. By implementing these measures, adverse impacts to paleontological resources can be reduced to a less than significant level pursuant to the requirements of CEQA.

8
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