Appendix F
Geotechnical Reports

GEOTECHNICAL INVESTIGATION PROPOSED INDUSTRIAL WAREHOUSE DEVELOPMENT, PARCEL A, ASSESSOR'S PARCEL NUMBER (APN) 0472-031-08, NORTH OF FALCHION ROAD AND EAST OF INTERSTATE I-15, APPLE VALLEY, SAN BERNARDINO COUNTY, CALIFORNIA

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Project No. 13673.001

February 1, 2023

Leighton Consulting, Inc.
A Leighton Group Company

February 1, 2023

Project No. 13673.001

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Attention: Ms. Jessica Haughton

Subject: Geotechnical Exploration
Proposed Industrial Warehouse Development, Parcel A, Assessor's Parcel Number (APN) 0472-031-08, North of Falchion Road and East of Interstate I-15, Apple Valley, San Bernardino County, California

In accordance with your authorization, Leighton Consulting, Inc. (Leighton) has conducted geotechnical exploration for the proposed industrial warehouse development within Assessor's Parcel Number (APN) 0472-031-08, located north of Falchion Road and east of Highway I-15, in the town of Apple Valley in San Bernardino County, California. The project site is currently undeveloped, with the exception of a building related to the mining operation to the east, and has an approximate area of approximately 178 acres. The purpose of this study has been to collect surface and subsurface geotechnical data at the site with regard to the proposed development, evaluate the proposed development with respect to site geotechnical conditions, and provide geotechnical recommendations for design and construction of the proposed development.

Based on this geotechnical investigation, construction of the proposed warehouse development is feasible from a geotechnical standpoint. The most significant geotechnical issues at the site are those related to the potential for strong seismic shaking and potentially near-surface compressible soils. Good planning and design of the project can limit the impact of these constraints. This report presents our findings, conclusions, and geotechnical recommendations for the project.

We appreciate the opportunity to work with you on the development of this project. If you have any questions regarding this report, please call us at your convenience.

Respectfully submitted,

LEIGHTON CONSULTING, INC.

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1.0 INTRODUCTION

1.1 Site Location and Description

The property has been informally named "Parcel A" and is approximately 178 acres in area. The property is located north of Falchion Road and east of Interstate Highway I-15 in the town of Apple Valley, San Bernardino County, California. The project is within Assessor's Parcel Number (APN) 0472-231-08.

This parcel contains undeveloped, hilly terrain, with vegetation. A mining quarry is located at the eastern edge and to the east of the project site. Based on our review of available historical aerial imagery, the area has been undeveloped before 1952, when the quarry operations were outside of the project site to the east. Quarry operation expanded into the project site some time prior to 1968. The existing building related to the mine in the eastern portion of the project site was constructed sometime between 1969 and 1984. Currently, that building still exists, and mining operations have left spoil piles up to approximately 25 feet thick onsite.

Based on the elevation model of Google Earth and a review of available topographic maps, site elevations (El.) range from approximate El. 2,890 to 3,030 feet above mean sea level (msl). The site is relatively flat overall, with local variations in topography from channels and bars typical of alluvial fans.

1.2 Proposed Development

Our understanding of this project is based on email correspondence with you on June 17, 2022, discussions of grading concept changes with the project team, and information you have provided us including the *Site Map,* dated June 15, 2022, and the AutoCAD files showing the preliminary grading contours, dated June 6, 2022. Based on these, we understand that the proposed development within Parcel A consists of two new proposed warehouses, Buildings 1 and 2, with proposed footprints of 1,512,060 and 1,098,420 square feet, respectively. Also planned are drive isles, truck docking areas, associated parking areas, and four underground infiltration facilities located in the northern and southern parking areas of each building. We understand that design cuts as deep as approximately 30 feet below the ground surface (bgs) and design fills as much as 30 feet thick will be required to construct the proposed building pads, with finish pad grade elevations of El. 2,920 feet msl and El. 2,964 feet msl for Buildings 1 and 2, respectively.

Based on review of provided AutoCAD files, a proposed fill-over-cut slope approximately 40 feet in height with a gradient of 2:1 (horizontal:vertical) is planned to between the pads of the two proposed warehouses. A detailed site plan and structural loading were not available for our review during this time. We anticipate that the warehouse will be composed of concrete tilt-up walls.

1.3 Previous Work

Previous geotechnical exploration reports and environmental studies were not available to Leighton for review during the preparation of this report. Besides mining activities in the eastern portion of the project site, Leighton is not aware of any other previous earthwork activities.

1.4 Purpose of Investigation

The purpose of this study has been to evaluate the geotechnical conditions with respect to the proposed development and to provide geotechnical recommendations for design and construction of the development.

1.5 Scope of Investigation

Our geotechnical exploration included hollow-stem auger soil borings, infiltration tests, laboratory testing, surface geologic mapping, seismic refraction surveys, and geotechnical analysis to evaluate existing geotechnical conditions and to develop the conclusions and recommendations contained in this report. The scope of our study has included the following tasks:

- Background Review: We reviewed available, relevant geotechnical and geologic maps and reports and aerial photographs available from our in-house library, available online, or those provided by you.
- Utility Coordination: We contacted Dig Alert (811) prior to excavating borings so that utility companies could mark utilities onsite. We coordinated our work with you and a site representative.

- <u>Field Exploration</u>: A total of eighteen (18) hollow-stem auger borings (LB-1 through LB-19, excluding LB-11) were logged and sampled onsite on September 12 through 14, 2022, and September 21 and 22, 2022, to evaluate subsurface conditions. These borings were drilled by a subcontracted rig to depths ranging from approximately 14 to 51½ feet bgs. Relatively undisturbed soil samples were obtained at selected intervals within the borings using a Modified California split-barrel sampler lined with rings. Standard Penetration Tests (SPT) were conducted at selected depths and samples were obtained at those intervals. Representative bulk soil samples were also collected at shallow depths from the borings.

  Excavations were backfilled with soil cuttings. Logs of the geotechnical borings are presented in Appendix B. Approximate boring locations are shown on the accompanying Figure 2, *Geotechnical Map*.

  We conducted well permeameter tests at four locations (IT-1 through IT-4) to evaluate general infiltration rates of the subsurface soils at the depth and location tested. Well permeameter test locations were adjusted based on equipment access. The well permeameter tests were conducted based on the USBR 7300-89 method and in general accordance with San Bernardino County guidelines. Tests consisted of constant head infiltration using a water truck to transport water to each test location. A 2-inch slotted PVC pipe was used within each boring, with sand backfilled around the pipe within the test zone. The tests were conducted at depths ranging from 10 to 15 feet bgs. Infiltration test logs are included in Appendix B.

  Multichannel Analysis of Surface Waves (MASW) will be performed along two arrays located within the site to determine the Shear Wave Velocity (V_s) distribution within the subsurface strata.

- <u>Geotechnical Laboratory Testing:</u> Geotechnical laboratory tests were conducted on selected relatively undisturbed and bulk soil samples obtained during our field investigation. This laboratory testing program was designed to evaluate engineering characteristics of site soils. Laboratory tests conducted during this investigation include:

  - Maximum dry density and optimum moisture content
  - In-situ moisture content and density

- Sieve analysis for grain-size distribution
- Expansion Index
- Collapse/ swell-settlement
- R-Value
- Remolded direct shear
- Water-soluble sulfate concentration in the soil
- Resistivity, chloride content and pH

Laboratory tests are provided in Appendix C, Laboratory Test Results.

- Engineering Analysis: Data obtained from our background review, along with data from our field exploration and geotechnical laboratory testing was evaluated and analyzed to develop geotechnical conclusions and provide preliminary recommendations presented in this report.

- Report Preparation: Results of our geotechnical exploration have been summarized in this report, presenting our findings, conclusions and preliminary geotechnical recommendations for design and construction of the proposed development.

2.0 FINDINGS

2.1 Regional Geologic Conditions

The site is located in the western Mojave Desert, in San Bernardino County California, and is part of the Mojave Desert geomorphic province, a broad interior region of isolated mountain ranges separated by broad desert plains and deep alluvial valleys. The Mojave province is wedged between the Garlock Fault (southern boundary of the Sierra Nevada) and the San Andreas Fault, where it bends northerly from its northwest trend. The northern boundary of the Mojave province is separated from the prominent Basin and Range by the eastern extension of the Garlock Fault.

The geology of the region consists of the following rock groups: i) Surficial sediments (Qa); ii) Older alluvial sediments (Qoa); iii) Granitic and dioritic rocks (qm); iv) Metamorphic rocks (ml, mq, and ms); and v) Metamorphosed quarts latite (mql). The Pre-Tertiary and Tertiary rocks are hard, consolidated materials forming the surrounding mountains and rocky buttes that rise from the valley floors and underlie the alluvium at depths. The valley soil profile consists of up to several hundreds to thousands of feet of fine- to coarse-grained alluvial deposits underlain by consolidated rocks. The alluvial deposits consist of late Pleistocene to Holocene age (5 million years old to recent) fine- to coarse-grained soil layers formed as a result of uplift and erosion of the surrounding mountains. Figure 3, *Regional Geology Map,* presents the site location in relation to the predominate geologic materials (alluvium) of the area. Figure 4, *Regional Fault and Historical Seismicity Map,* presents the site location in relation to active faults and epicenters of relatively large (> M_w 4.0) historical earthquakes.

2.2 Subsurface Soil Conditions

Based upon our review of pertinent geotechnical literature and our subsurface exploration, the site is underlain by older alluvial sediments (Qoa) except where artificial fill was encountered (boring LB-9 to 6.5 bgs) or was observed on the surface (see Figure 2, *Geotechnical Map*). Encountered near-surface soils generally consisted of poorly graded sands (SP), poorly graded sands with silt (SP-SM), and silty sands (SM).

Older alluvial soils generally consisted of Silty Sand (SM) and Sand with Silt (SP-SM), with a few samples containing an estimated 5 to 25 percent gravel. The material was observed to be relatively consistent across the project site and to the maximum drilled depths. Undocumented artificial fill observed in boring LB-9 consisted of loose, poorly graded sand with silt. Alluvial soils encountered were generally considered dense to very dense based on field Standard Penetration Test (SPT) blow counts.

2.2.1 Compressible and Collapsible Soil

Soil compressibility refers to a soil's potential for settlement when subjected to increased loads as from a fill surcharge. Based on this study, undocumented artificial fill and the upper portion of alluvial soils are considered moderately compressible. Complete removal of undocumented fill and partial removal of near surface alluvium will be needed to reduce the potential for adverse total and differential settlement of the proposed improvements.

Collapse potential refers to the potential settlement of a soil under existing stresses upon being wetted. Laboratory tests performed on representative soil samples did not indicate significant collapse. Soil collapse and consolidation are not a significant issue considering the dense, granular nature of the on-site soils.

2.2.2 Expansive Soils

Expansive soils contain significant amounts of clay particles that swell considerably when wetted and shrink when dried. Foundations constructed on these soils are subjected to large uplifting forces caused by the swelling. Without proper measures taken, heaving and cracking of building foundations and slabs-on-grade could result.

Expansion index (EI) tests performed on a shallow bulk sample yielded a measured EI of 2, which is classified as "very low" expansion. Based on the encountered near-surface soils and laboratory test results, the onsite soils are anticipated to have "very low" expansion potential.

2.2.3 Sulfate Content

Water-soluble sulfates in soil can react adversely with concrete. However, concrete in contact with soil containing sulfate concentrations of less than 0.1 percent by weight is considered to have negligible sulfate exposure based on American Concrete Institute (ACI) provisions, adopted by the 2019 CBC (CBC, 2019, Chapter 19, and ACI 318, 2014).

Two near-surface soil samples were tested during this investigation for soluble sulfate content, yielding sulfate contents of less than 0.1 percent by weight. Based on the laboratory test results, the sulfate content of onsite soils is anticipated to be negligible (Exposure Class S0). Recommendations for concrete in contact with the soil are provided in Section 3.11.

2.2.4 Resistivity, Chloride and pH

Soil corrosivity to ferrous metals can be estimated by the soil's electrical resistivity, chloride content and pH. In general, soil having a minimum resistivity less than 1,000 ohm-cm is considered severely corrosive. Soil with a chloride content of 500 parts-per-million (ppm) or more is considered corrosive to ferrous metals.

As a screening for potentially corrosive soil, two representative soil samples were tested during this investigation to determine minimum resistivity, chloride content, and pH. The tests indicated a minimum resistivity of 1,850 ohm-cm, chloride content of 40 ppm, and pH of 8.1 to 8.8. Based on these results, the onsite soil is considered to be corrosive.

2.3 Groundwater

Groundwater was not encountered within our exploratory borings performed on September 12 through 14, 2022, and September 21 and 22, 2022.

Review *of California Department of Water Resources Groundwater Wells* indicated at State Well No. 06N04W26B001S located approximately 2,000 feet from the site, groundwater depths were approximately 190 feet bgs during the period of groundwater measurements from 1955 through 1957. According to the *Data and*

Water Table Map of the Mojave River Ground-Water Basin (Stamos and Predmore, 1995), groundwater levels in 1992 near the project site were deeper than 200 feet.

Based on our review of available groundwater data, groundwater is not a significant constraint for this project.

2.3.1 Regional Subsidence

Regional ground subsidence generally occurs due to rapid and intensive removal of subterranean fluids, typically water or oil. It is generally attributed to the consolidation of sediments as the fluid in the sediment is removed. The total load of the soils in partially saturated or saturated deposits is born by their granular structure and the fluid. When the fluid is removed, the load is born by the sediment alone and it settles.

The project site has been mapped by the U.S. Geological Society (2022) to be outside of an area of land subsidence from intense removals of significant quantities of water, peat, or oil extraction in the area. Based on this and no known reports indicating land subsidence of the site's area, the potential for ground subsidence is considered very low and less than a significant impact.

2.4 Faulting and Seismicity

In general, primary seismic hazards for sites in the region include surface rupture along active faults and strong ground shaking. The potential for fault rupture and seismic shaking are discussed below.

2.4.1 Surface Faulting

Based on our research, no active faults appear to have been mapped on or trending towards the site. The closest mapped active or potentially active faults are presented in the following table.

Fault Name	Approximate Distance from Site
Helendale-South Lockhart fault zone	7.9 miles to the northeast
North Frontal thrust system	11.0 miles to the southeast
Cleghorn fault	19.9 miles to the south

Based on our understanding of the current geologic framework, the potential for future surface rupture of active faults onsite is considered very low.

2.4.2 Seismic Design Parameters

The site has and will experience strong ground shaking during the life of the project resulting from an earthquake occurring along one or more of the major active or potentially active faults in southern California. Accordingly, the project should be designed in accordance with all applicable current codes and standards utilizing the appropriate seismic design parameters to reduce seismic risk as defined by California Geological Survey (CGS) Chapter 2 of Special Publication 117a (CGS, 2008). Through compliance with these regulatory requirements and the utilization of appropriate seismic design parameters selected by the design professionals, potential effects relating to seismic shaking can be reduced.

The following seismic parameters should be considered for design under the 2022 edition of the California Building Code (CBC). The following table lists seismic design parameters based on the 2022 CBC and ASCE 7-16 methodology:

Site Seismic Coefficients / Coordinates		Value (g)
Latitude: 34.5754	Longitude: -117.2675	
Site-Specific Analysis (ASCE 7-16)	Spectral Response – Class D (short), S_S	1.04
	Spectral Response – Class D (1 sec), S_1	0.40
	Site Modified Peak Ground Acceleration, PGA_M	0.54
	Max. Considered Earthquake Spectral Response Acceleration (short), S_{MS}	1.16
	Max. Considered Earthquake Spectral Response Acceleration – (1 sec), S_{M1}	0.58
	5% Damped Design Spectral Response Acceleration (short), S_{DS}	0.77
	5% Damped Design Spectral Response Acceleration (1 sec), S_{D1}	0.39
	Maximum Considered Earthquake Geometric Mean MCE_G PGA	0.56

The project structural engineer should review the seismic parameters. Site-specific analyses are presented in Appendix D.

Hazard deaggregation was estimated using the USGS Interactive Deaggregations utility. The results of this analysis indicate that the predominant modal earthquake has a magnitude of approximately 8 .1 (M_W) at a distance on the order of 37.7 kilometers for the Maximum Considered Earthquake (2% probability of exceedance in 50 years), with a corresponding peak ground acceleration of 0.51g.

2.4.5 Site Class

Geophysical survey lines (Arrays 2 and 3) utilizing Multi-channel Analysis of Surface Wave (MASW) methodology were performed towards the central and eastern portions of the site (line locations shown in Figure 2) and yielded a weighted average shear wave to a depth of 100 feet (V_{S100ft}) of 2,028 ft/s at the Array 2 location and 2,223 ft/s at the Array 3 location. In addition, we performed an analysis with field Standard Penetration Blowcounts (SPT) from the geotechnical borings that extended to a maximum depth of 50 feet, which yielded a weighted average N-Value of approximately 76 (with blowcount assumptions for soils below 50 feet). Therefore, based on the criteria in the 2022 CBC and ASCE 7-16, the site is classified as Site Class C, very dense soil and soft rock. A summary of Site Class evaluation is included in Appendix D. Geophysical survey data is included in Appendix E.

2.5 Secondary Seismic Hazards

In general, secondary seismic hazards for sites in the region could include soil liquefaction, earthquake-induced settlement, lateral displacement, landslides, and earthquake-induced flooding. The potential for secondary seismic hazards at the site is discussed below.

2.5.1 Liquefaction Potential

Liquefaction is the loss of soil strength due to a buildup of excess pore-water pressure during strong and long-duration ground shaking. Liquefaction is associated primarily with loose (low density), saturated, relatively uniform fine- to medium-grained, clean cohesionless soils. As shaking action of an earthquake progresses, soil granules are rearranged, and the soil densifies within a short period. This rapid densification of soil results in a buildup of pore-water pressure. When the pore-water pressure approaches the total overburden pressure, soil shear strength reduces abruptly and temporarily behaves similar to a fluid. For liquefaction to occur there must be:

(1) loose, clean granular soils,
(2) shallow groundwater, and
(3) strong, long-duration ground shaking

The site is not mapped in a liquefaction zone of required investigation on the San Bernardino County General Plan (San Bernardino, 2009).

We have performed an analysis based on the modified Seed Simplified Procedure as detailed by Youd et al. (2001) and Martin and Lew (1999), which compares the seismic demand on a soil layer (Cyclic Stress Ratio, or CSR) to the capacity of the soil to resist liquefaction (Cyclic Resistance Ratio, or CRR), (Youd el al., 2001). A minimum required factor of safety of 1.3 was used in our analysis, with factor of safety defined as CRR/CSR. As required, our analysis assumes that the design earthquake would occur while the groundwater is at its estimated design level (historically highest level).

Due to the dense nature of the granular soils encountered and lack of shallow groundwater, liquefaction is not a significant hazard at this site.

2.5.2 Seismically Induced Settlement

Seismically induced settlement consists of dry dynamic settlement (above groundwater) and liquefaction-induced settlement (below groundwater). During a strong seismic event, seismically induced settlement can occur within loose to moderately dense sandy soil due to reduction in volume during and shortly after an earthquake event. Settlement caused by ground shaking is often nonuniformly distributed, which can result in differential settlement.

Based on the dense nature of the native soils in this area, we believe the onsite soils are susceptible to low seismic settlement (less than 1 inch, with differential settlement of 0.5 inch or less over a horizontal distance of 30 feet based on the MCE).

2.5.3 Lateral Spread

Lateral spread is liquefaction-induced lateral ground movement limited to on the order of several feet, and, thus, smaller than flow failures. A consideration in lateral spread analysis is to evaluate whether laterally continuous liquefiable layers exist. Due to the lack of shallow groundwater (≤50 feet bgs), lateral spread is considered to be less than significant.

2.5.4 Flow Failures

Based on $(N_1)_{60}$ values from the borings, lack of liquefiable soils, and the relatively flat nature of the site, the site is not considered susceptible to flow slides (large transitional or rotational failures).

2.6 Infiltration Testing

Four well permeameter tests (IT-1 through IT-4) were conducted to estimate the infiltration rate at specific locations of the site. Test IT-1 was located towards the southwest corner of Building 1, test IT-2 was located directly north of Building 1, test IT-3 was located on the south side between the two buildings, and test IT-4 was located directly north of Building 2. The locations and depths of the infiltration tests are based on the approximate locations and depths of the proposed underground storage tanks, which you have provided. The well permeameter tests were conducted inside the drilled borings at depths of 10 and 15 feet bgs.

A well permeameter test is useful for field measurements of soil infiltration rates, and is suited for testing when the design depth of the basin or chamber is deeper than current existing grades. The test consists of excavating a boring to the depth of the test. A layer of clean sand is placed in the boring bottom to support temporary perforated well casing pipe. In addition, sand is poured around the outside of the well casing within the test zone to prevent the boring from caving/collapsing or eroding when water is added. The volume of water percolated during timed intervals is converted into an incremental infiltration rate, which is defined as flow divided by infiltration surface area, in inches per hour. The test was conducted based on the USBR 7300-89 test method.

Small-scale infiltration rates as summarized in the table below. Results of the infiltration testing are provided in Appendix B.

Boring	Test Depth (ft)	Soil Classification (percent fines)	Raw Infiltration Rates (in./hr) [1]
IT-1	10 to 15	Silty Sand (23% fines)	2.0
IT-2	10 to 15	Silty Sand (24% fines)	1.5
IT-3	9 to 14	Silty Sand (21% fines)	2.8
IT-4	10 to 15	Silty Sand (13-20% fines)	10.0

[1] Factor of Safety should be applied to raw rates

3.0 CONCLUSIONS AND RECOMMENDATIONS

Based on this study, construction of the proposed warehouse development is feasible from a geotechnical standpoint. No severe geologic or soils related issues were identified that would preclude development of the site for the proposed warehouses. The most significant geotechnical issues at the site are those related to the potential for strong seismic shaking and potentially compressible soils in the near-surface. Good planning and design of the project can limit the impact of these constraints. Remedial recommendations for these and other geotechnical issues are provided in the following sections.

We are unaware of environmentally sensitive areas in the project site that would warrant remedial removals from an environmental standpoint. Compressible undocumented fill should be completely removed and properly compacted during earthwork construction. Localized exposures of encountered fill material can be evaluated during grading on a case-by-case basis, and may be left in place if documentation is available and the material appears to be competent based on our field evaluation

3.1 General Earthwork and Grading

All grading should be performed in accordance with the General Earthwork and Grading Specifications presented in Appendix E, unless specifically revised or amended below or by future recommendations based on final development plans.

3.1.1 Site Preparation

Prior to construction, the site should be cleared of debris, which should be disposed of offsite. Any underground obstructions should be removed. Resulting cavities should be properly backfilled and compacted. Efforts should be made to locate existing utility lines. Those lines should be removed or rerouted if they interfere with the proposed construction, and the resulting cavities should be properly backfilled and compacted.

3.1.2 Removal of Uncontrolled Artificial Fill

Prior to overexcavation and recompaction of the onsite alluvial soil, any uncontrolled artificial fill should be removed and may be used as compacted fill for the project, provided any oversized rock is suitably handled and any deleterious materials are removed from the site. Undocumented fill is present within areas throughout the site (see Figure 2, *Geotechnical Map*), with some areas containing stockpiles of mining spoils estimated to be 20 to 30 feet in thickness, located towards the southeastern portion of the site. Undocumented fill may be thicker than what has been estimated.

3.1.3 Overexcavation and Recompaction

To reduce the potential for adverse total and differential settlement of the proposed structures, the underlying subgrade soil should be prepared in such a manner that a uniform response to the applied loads is achieved.

All undocumented artificial fill within proposed building pads should be removed. Based on preliminary plans, the proposed warehouse buildings are expected to both include cut/fill transitions roughly in the center of each building. To reduce the potential for adverse differential settlement of the proposed improvements, the underlying subgrade soil should be prepared in such a manner that a uniform response to the applied loads is achieved. Due to the potential for near-surface compressive soils observed in our borings, we recommend that onsite soils in the proposed building pad area and site walls taller than 8 feet be overexcavated to a depth of 5 feet bgs, or a depth of 3 feet below the bottoms of proposed footings, whichever is deeper.

Where possible, the removal bottom should extend horizontally a minimum of 5 feet from the outside edges of the building footprint and footings (including columns connected to the buildings), or a distance equal to the depth of overexcavation below the footings, whichever is farther. Where this is not achievable, this should be reviewed on a case-by-case basis.

During overexcavation, the soil conditions should be observed by Leighton to further evaluate these recommendations based on actual field conditions encountered. A firm removal bottom should be established across the building footprint to provide uniform foundation support for the proposed structure. Leighton should observe and test the removal bottom prior to placing fill. Deeper overexcavation and recompaction may be recommended locally until a firm removal bottom is achieved.

Areas outside of proposed structures and planned for new asphalt or concrete pavement (such as parking areas or fire lanes), flatwork (such as sidewalks), site walls up to 8 feet tall and retaining walls retaining up to 3 feet of soil (taller walls should be overexcavated per the recommendations for buildings), areas to receive fill, and other improvements, should be overexcavated to a minimum depth of 2 feet below existing grade or 18 inches below proposed subgrade (including the footing subgrade for walls), whichever is deeper.

After completion of the overexcavation, and prior to fill placement, the exposed surfaces should be scarified to a minimum depth of 6 inches, moisture conditioned to or slightly above optimum moisture content, and recompacted to a minimum 90 percent relative compaction, relative to the ASTM D1557 laboratory maximum density.

3.1.4 Fill Placement and Compaction

Onsite soil to be used for compacted structural fill should also be free of organic material debris and oversized material (greater than 8 inches in largest dimension). Any soil to be placed as fill, whether onsite or imported material, should be reviewed and possibly tested by Leighton.

All fill soil should be placed in thin, loose lifts, moisture conditioned, as necessary to at least 2 percentage points above optimum moisture content and compacted to a minimum 90 percent relative compaction. However, the upper 24 inches of fill under the building pads should be compacted to a minimum of 95 percent relative compaction. Relative compaction should be determined in accordance with ASTM Test Method D1557. Aggregate base for pavement should be compacted to a minimum of 95 percent relative compaction.

3.1.5 Import Fill Soil

Import soil to be placed as fill should be geotechnically accepted by Leighton. Preferably at least 3 working days prior to proposed import to the site, the contractor should provide Leighton pertinent information of the proposed import soil, such as location of the soil, whether stockpiled or native in place, and pertinent geotechnical reports if available. We recommend that a Leighton representative visit the proposed import site to observe the soil conditions and obtain representative soil samples. Potential issues may include soil that is more expansive than onsite soil, soil that is too wet, soil that is too rocky or too dissimilar to onsite soils, oversize material, organics, debris, etc.

3.1.6 Shrinkage and Subsidence

The change in volume of excavated and recompacted soil varies according to soil type and location. This volume change is represented as a percentage increase (bulking) or decrease (shrinkage) in volume of fill after removal and recompaction. This value does not factor in removal of debris or other materials. Subsidence occurs as in-place soil (e.g., natural ground) is moisture-conditioned and densified to receive fill, such as in processing an overexcavation bottom. Subsidence is in addition to shrinkage due to recompaction of fill soil. Field and laboratory data used in our calculations included laboratory-measured maximum dry densities for soil types encountered at the subject site, the measured in-place densities of soils encountered and our experience. We preliminarily estimate the following earth volume changes will occur during grading:

Shrinkage	Approximately 15 +/- 3 percent
Subsidence (overexcavation bottom processing)	Approximately 0.18 foot

The level of fill compaction, variations in the dry density of the existing soils and other factors influence the amount of volume change. Some adjustments to earthwork volume should be anticipated during grading of the site.

3.1.7 Rippability and Oversized Material

Oversized material (rock or rock fragments greater than 8 inches in dimension) were observed at the surface in mining stockpiles. A significant percentage of oversized material is anticipated in these spoils and should be anticipated by the grading contractor. Oversize rock should be placed in deeper fills (deeper than 5 feet below finish grade) or removed from structural fill areas. All rocks larger than 24 inches in dimension should be placed in windrows, surrounded by sandy soils, and placed with copious amounts of water. The rock windrows should be placed such that individual rocks are not nested and sandy soil can be worked completely around the rocks. It is imperative that the contractor use copious amounts of water.

Excavations for proposed utilities can be very difficult in the presence of large (greater than 24 inches) rocks. To facilitate utility construction (but not a geotechnical requirement), removing rocks larger than 24 inches in the upper 5 feet below the rough graded surface or 1 foot below the deepest utility may be considered.

3.2 Shallow Foundation Recommendations

Overexcavation and recompaction of the footing subgrade should be performed as detailed in Section 3.1. The following recommendations are based on the onsite soil conditions and soils with a very low expansion potential.

3.2.1 Minimum Embedment and Width

Based on our preliminary investigation, footings should have a minimum embedment per code requirements, with a minimum width of 24 and 12 inches for isolated and continuous footings, respectively.

3.2.2 Allowable Bearing

An allowable bearing pressure of 2,000 pounds-per-square-foot (psf) may be used, based on an assumed embedment depth of 18 inches and minimum width described above. This allowable bearing value may be increased by 250 psf per foot increase in depth or width to a maximum allowable bearing pressure of 4,500 psf. If higher bearing pressures are required, this should be reviewed on a case-by-case basis and may include additional overexcavation and/or soil reinforcement. These allowable bearing pressures are for total dead load and sustained live loads. Footing reinforcement should be designed by the structural engineer.

3.2.3 Lateral Load Resistance

Soil resistance available to withstand lateral loads on a shallow foundation is a function of the frictional resistance along the base of the footing and the passive resistance that may develop as the face of the structure tends to move into the soil. The frictional resistance between the base of the foundation and the subgrade soil may be computed using a coefficient of friction of 0.35. The passive resistance may be computed using an allowable equivalent fluid pressure of 260 pounds per cubic foot (pcf), assuming there is constant contact between the footing and undisturbed soil. The coefficient of friction and passive resistance may be combined without further reduction.

3.2.4 Increase in Bearing and Friction - Short Duration Loads

The allowable bearing pressure and coefficient of friction values may be increased by one-third when considering loads of short duration, such as those imposed by wind and seismic forces.

3.2.5 Settlement Estimates

The recommended allowable bearing pressure is generally based on a total allowable, post-construction static settlement of 1 inch. Differential settlement due to static loading is estimated at 0.2 inch over a horizontal distance of 30 feet. Since settlement is a function of footing sustained load, size and contact bearing pressure, differential settlement can be expected between adjacent columns or walls where a large differential loading condition exists.

Seismic differential settlement is assumed to be less than 0.5 inches over a horizontal distance of 30 feet for the design-level earthquake, or angular distortion of less than 0.0014L.

3.3 Recommendations for Slabs-On-Grade

Concrete slabs-on-grade should be designed by the structural engineer in accordance with the current CBC for soil with a “very low” expansion potential and considering the potential for liquefaction and seismic settlement. Where conventional light floor loading conditions exist, the following minimum recommendations should be used. More stringent requirements may be required by local agencies, the structural engineer, the architect, or the CBC. Laboratory testing should be conducted at finish grade to evaluate the expansion index of near-surface subgrade soils. In addition, slabs-on-grade should have the following minimum recommended components:

- Subgrade Moisture Conditioning: The subgrade soil should be moisture conditioned to at least 2 percentage points above optimum moisture content to a minimum depth of 12 inches prior to placing the moisture vapor retarder, steel or concrete.

- Moisture Retarder: A minimum of 10-mil moisture retarder should be placed below slabs where moisture-sensitive floor coverings or equipment is planned. The structural engineer should specify pertinent concrete design parameters and moisture migration prevention measures, such as whether a capillary break should be placed under the vapor retarder and whether or not a sand blotter layer should be placed over the vapor retarder. The moisture barrier may be placed directly on subgrade provided gravel or other protruding objects that could puncture the moisture retarder are removed from the subgrade prior to placement. A heavier vapor retarder (such as 15 mil Stego Wrap) placed directly on prepared subgrade may also be used. Moisture retarders can reduce, but not eliminate moisture vapor rise from the underlying soils up through the slab. Moisture retarders should be designed and constructed in accordance with applicable American Concrete Institute, Portland Cement Association, Post-Tensioning Institute, ASTM International, and California Building Code requirements and guidelines.

  Leighton does not practice in the field of moisture vapor transmission evaluation, since this is not specifically a geotechnical issue. Therefore, we recommend that a qualified person, such as the flooring subcontractor and/or structural engineer, be consulted with to evaluate the general and specific moisture vapor transmission paths and any impact on the proposed construction. That person should provide recommendations for mitigation of potential adverse impact of moisture vapor transmission on various components of the structures as deemed appropriate.

- Concrete Thickness and Reinforcement in Warehouse/Industrial Areas: Warehouse/industrial slabs-on-grade should be designed by the structural engineer based on anticipated wheel, equipment, and storage loads. Considering the site conditions, we recommend a minimum slab thickness of 6 inches. Crack control joints should be provided at a maximum spacing of 14 feet on center.

  The structural engineer should consider the following parameters.

  Provided that the slab subgrade soils are compacted to a minimum of 95 percent relative compaction at 1 to 2 percentage points above optimum (as measured by ASTM D 1557), an average subgrade spring constant (modulus of subgrade reaction, k) of 200 pci (with linear deflections up to ¾ inch and a non-linear response for larger deflections) may be assumed for analysis of loading on slabs-on-grade. This value should not be used for estimation of actual settlements, but is intended to estimate shears, moments, and local distortions. An alternate check may be used by assuming an allowable bearing pressure of 1,100 psf (though the modulus of subgrade reaction method is the preferred method). If soils are allowed to dry out prior to placing concrete, the upper 9 inches should be scarified, moisture conditioned to 1 to 2 percentage points above optimum moisture content, and recompacted to a minimum of 95 percent relative compaction (based on ASTM D1557) prior to placing steel or concrete.

- Concrete Thickness--Office Areas: Slabs-on-grade for office space should be at least 4 inches thick (this is referring to the actual minimum thickness, not the nominal thickness). Reinforcing steel should be designed by the structural engineer, but as a minimum (for conventionally reinforced, 4-inch-thick slabs) should be No. 4 rebar placed at 18 inches on center, each direction, mid-depth in the slab. Crack control joints should be provided at a maximum spacing of 15 feet on center for office areas.

Minor cracking of the concrete as it cures, due to drying and shrinkage, is normal and should be expected. However, cracking is often aggravated by a high water/cement ratio, high concrete temperature at the time of placement, small nominal aggregate size, and rapid moisture loss due to hot, dry, and/or windy weather conditions during placement and curing. Cracking due to temperature and moisture fluctuations can also be expected. Low slump concrete can reduce the potential for shrinkage cracking. Additionally, our experience indicates that reinforcement in slabs and foundations can generally reduce the potential for concrete cracking. The structural engineer should consider these components in slab design and specifications.

3.4 Seismic Design Parameters

Seismic parameters presented in this report should be considered during project design. In order to reduce the effects of ground shaking produced by regional seismic events, seismic design should be performed in accordance with the current CBC. The CBC seismic design parameters listed in Section 2.4.2 of this report should be considered for the seismic analysis of the subject site.

3.5 Retaining Walls

We recommend that retaining walls be backfilled with “very low” expansive soil and constructed with a backdrain in accordance with the recommendations provided on Figure 4 (rear of text). Using expansive soil as retaining wall backfill will result in higher lateral earth pressures exerted on the wall. Based on these recommendations, the following parameters may be used for the design of conventional retaining walls:

Static Equivalent Fluid Weight (pcf)	
Condition	Level Backfill
Active	35 pcf
At-Rest	55 pcf
Passive	260 pcf (allowable) (Maximum of 3,000 psf)

The above values do not contain an appreciable factor of safety unless noted, so the structural engineer should apply the applicable factors of safety and/or load factors during design, as specified by the California Building Code.

Cantilever walls that are designed to yield at least 0.001H, where H is equal to the wall height, may be designed using the active condition. Rigid walls and walls braced at the top should be designed using the at-rest condition.

Passive pressure is used to compute soil resistance to lateral structural movement. In addition, for sliding resistance, a frictional resistance coefficient of 0.35 may be used at the concrete and soil interface. The lateral passive resistance should be taken into account only if it is ensured that the soil providing passive resistance, embedded against the foundation elements, will remain intact with time.

In addition to the above lateral forces due to retained earth, surcharge due to improvements, such as an adjacent structure or traffic loading, should be considered in the design of the retaining wall. Loads applied within a 1:1 projection from the surcharging structure on the stem of the wall should be considered in the design.

For retaining walls with a retained height of more than 6 feet, an incremental seismic load applied as a uniform additive pressure of 17 pcf should be considered for a cantilever (unrestrained) wall with level backfill, and 27 pcf for a basement wall (restrained) with level backfill. This pressure is in addition to the static active earth pressures presented above. Earthquake and at-rest earth pressures need not be combined for analyses.

A soil unit weight of 120 pcf may be assumed for calculating the actual weight of the soil over the wall footing.

3.6 Pavement Design

Flexible Pavement: Based on the design procedures outlined in the 2017 Caltrans Highway Design Manual, and using a design R-value of 50, flexible pavement sections may consist of the following for the Traffic Index indicated. Final pavement design should be based on the Traffic Index determined by the project civil engineer and R-value testing provided near the end of grading.

ASPHALT PAVEMENT SECTION THICKNESS		
Traffic Index	**Asphaltic Concrete (AC) Thickness (inches)**	**Class 2 Aggregate Base Thickness (inches)**
5 or less (auto access)	3.0	4.0
7 (light truck access)	4.0	4.5
8	5.0	5.0
9	5.5	6.5
10	6.5	7.0

If the pavement is to be constructed prior to construction of the structures, we recommend that the full depth of the pavement section be placed in order to support heavy construction traffic.

Rigid Pavements**:** For onsite Portland Cement Concrete (PCC) pavement in truck drive aisles and parking areas, we recommend a minimum of 7-inch-thick concrete with dowels at construction joints, placed on compacted fill subgrade, with the upper 8 inches compacted to a minimum of 95 percent relative compaction. In areas with car traffic only, we recommend a minimum of 5-inch-thick concrete, placed on compacted fill subgrade with the upper 8 inches compacted to a minimum of 95 percent relative compaction.

The PCC pavement sections should be provided with crack-control joints spaced no more than 14 feet on center each way for 7-inch-thick concrete, and 12 feet for 5-inch-thick concrete. If sawcuts are used, they should have a minimum depth of ¼ of the slab thickness and made within 24 hours of concrete placement.

Other Pavement Recommendations**:** Irrigation adjacent to pavements without a deep curb or other cutoff to separate landscaping from the paving may result in premature pavement failure.

All pavement construction should be performed in accordance with the Standard Specifications for Public Works Construction or Caltrans Specifications. Field observations and periodic testing, as needed during placement of the base course materials, should be undertaken to ensure that the requirements of the standard specifications are fulfilled.

Prior to placement of aggregate base, the subgrade soil should be processed to a minimum depth of 6 inches, moisture-conditioned, as necessary, and recompacted to a minimum of 95 percent relative compaction. Aggregate base should be moisture conditioned, as necessary, and compacted to a minimum of 95 percent relative compaction.

3.7 Infiltration Recommendations

In general, our geotechnical exploration encountered alluvial soil deposits generally uniform consisting of granular materials Poorly Graded Sand with Silt (SP-SM) and Silty Sand (SM). Alluvial soils were relatively uniform throughout the project site. Gravels were observed within the exploratory borings, with variable percentages throughout the site. At our test locations, sieve analysis tests performed on soil samples from the infiltration test zone generally showed a percent fines (% silt and clay) ranging from 13 to 24 percent.

Based on our infiltration testing, field observations and laboratory testing, the project site is considered to be feasible for groundwater infiltration. A raw infiltration rate of 2.0 inches per hour can be utilized for infiltration system design. As site layout and infiltration system design progresses, supplemental infiltration testing could be performed to further refine our infiltration system recommendations.

We recommend that a correction factor/safety factor be applied to the infiltration rate in conformance with San Bernardino County guidelines, since monitoring of actual facility performance has shown that actual infiltration rates are lower than measured in small-scale tests. Infiltration basins are subject to siltation, which can result in reduced infiltration rates. *This small-scale infiltration rate should be divided by a design factor of at least **3** for buried chambers and at least **4** for open basins; although the design/safety factor may be higher based on project-specific aspects.* It should be noted that during periods of prolonged precipitation, underlying soils tend to become saturated to greater depths/extent. Therefore, infiltration rates tend to decrease with prolonged rainfall.

Some design considerations are presented in the following paragraphs:

- **Adjacent Structure Impact**: As infiltrating water can seep within soil strata partially horizontally, it is important to consider impact that infiltration facilities can play on nearby subterranean structures, such as basement walls or open excavations, whether onsite or offsite, and whether existing or planned. Any such nearby features should be identified and evaluated as to whether infiltrating water can impact these facilities. Infiltration facilities should not be constructed adjacent to or under buildings. Setbacks should be discussed with Leighton during the planning process, but a building setback of at least 15 feet horizontally is initially suggested.

- **Infiltration Basins Type and Geometry**: Further testing may be required depending on final design of infiltration facilities. Infiltration rates are anticipated to vary based on location and depth. Infiltration concepts should be discussed with Leighton as infiltration plans are being developed. We should review all infiltration plans, including locations and depths of proposed facilities. Further testing may be required depending on infiltration facilities design details, particularly considering type, depth and location.

- **Siltation and Soil Changes**: These infiltration rates are for a clean, un-silted infiltration surface in native, sandy alluvial soil. These values may be reduced over time as silting of the basin or chamber occurs. Furthermore, if the basin or chamber bottom is allowed to be compacted by heavy equipment, this value is expected to be reduced. Infiltration of water through soil is highly dependent on such factors as grain size distribution of soil particles, gradation (uniform versus well graded), particle shape, fines content and density. Small changes in soil conditions, including density, can cause large differences in observed infiltration rates. Infiltration is not suitable in compacted fill. For open basins and swales, vegetation within the basin bottoms and sides is expected to help reduce erosion and help maintain infiltration rates.

- **De-silting Weir/Facilities**: Periodic flow of water carrying sediments into the basin or chamber, plus deposition of fine wind-blown sediments and sediments from erosion of basin side walls, will eventually cause the basin bottom or chamber to accumulate a layer of silt, which has the potential to significantly reducing the overall infiltration rate of the basin or chamber. Therefore, we recommend that significant amounts of silt/sediment not be allowed to flow into the facility within stormwater, especially during construction of the project and prior to achieving a mature landscape onsite. We recommend that an easily maintained, robust silt/sediment removal system be installed to pretreat storm water before it enters the infiltration facility. Infiltration facilities should be constructed with spillways or other appropriate means that would prevent overfilling that could damage the facility or adjacent improvements.

- **Drainage/Infiltration Time Cycle**: In general, the rate of infiltration reduces as the head of water in the infiltration facility reduces, and it also reduces with prolonged periods of infiltration. As such, water typically infiltrates much faster near the beginning of and/or immediately after storm events than at times well after a storm when the water level in the facility has receded, since the infiltration rate is then slower due to both lower head and longer overall duration of infiltration. In open basins with compacted or silty bottoms, this could be problematic, in that even if the basin had already infiltrated significant amounts of storm water, the lower several inches or feet of water could remain in the basin for an extended period of time, creating prolonged open-water safety concern (such as potential for mosquitos and waterborne diseases, algae odor, etc.). In a buried/cover infiltration chamber, these conditions would be of less concern.

- **Maintenance**: Infiltration facilities should be routinely monitored, especially before and during the rainy season, and corrective measures should be implemented if and as needed. Things to check for include removal of trash or dumping, proper infiltration, absence of accumulated silt, and that de-silting filters/features are clean and functioning. Pretreatment desilting features should be cleaned and maintained as recommended by the manufacturer or designer. Even with measures to prevent silt from flowing into the infiltration facility, accumulated silt may need to be removed.

3.8 Temporary Excavations

All temporary excavations, including utility trenches, retaining wall excavations and other excavations should be performed in accordance with project plans, specifications and all OSHA requirements.

No surcharge loads should be permitted within a horizontal distance equal to the height of cut or 5 feet, whichever is greater from the top of the slope, unless the cut is shored appropriately. Excavations that extend below an imaginary plane inclined at 45 degrees below the edge of any adjacent existing site foundation should be properly shored to maintain support of the adjacent structures.

Cantilever shoring should be designed based on an active equivalent fluid pressure of 35 pcf. If excavations are braced at the top and at specific design intervals, the active pressure may then be approximated by a rectangular soil pressure distribution with the pressure per foot of width equal to 25H, where H is equal to the depth of the excavation being shored.

During construction, the soil conditions should be regularly evaluated to verify that conditions are as anticipated. The contractor should be responsible for providing the "competent person" required by OSHA, standards to evaluate soil conditions. Close coordination between the competent person and the geotechnical engineer should be maintained to facilitate construction while providing safe excavations.

3.9 Trench Backfill

Utility-type trenches onsite can be backfilled with the onsite material, provided it is free of debris, organic and oversized material. Prior to backfilling the trench, pipes should be bedded and shaded in a granular material that has a sand equivalent of 30 or greater and will allow water to sufficiently permeate. Gravel or rock cannot be used for trench backfill without written approval by Leighton. If gravel or open-graded rock is approved and used as bedding or shading, it should be wrapped in Mirafi 140N filter fabric, or equivalent, to prevent surrounding soil from washing into the pore spaces in the gap graded rock. Shading should extend at least 12 inches above the top of the pipe. The bedding/shading materials should be densified in-place by mechanical means, or in accordance with Greenbook specifications.

Subsequent to pipe bedding and shading, backfill soils should be placed in loose layers, moisture conditioned, as necessary, and mechanically compacted using a minimum standard of 90 percent relative compaction (ASTMS D1557). The thickness of layers should be based on the compaction equipment used in accordance with the Standard Specifications for Public Works Construction

(Greenbook). The upper 6 inches in pavement areas should be compacted to 95 percent compaction.

3.10 Surface Drainage

Inadequate control of runoff water and/or poorly controlled irrigation can cause the onsite soils to expand and/or shrink, producing heaving and/or settlement of foundations, flatwork, walls, and other improvements. Maintaining adequate surface drainage, proper disposal of runoff water, and control of irrigation should help reduce the potential for future soil moisture problems.

Positive surface drainage should be designed to be directed away from foundations and toward approved drainage devices, such as gutters, paved drainage swales, or watertight area drains and collector pipes.

Surface drainage should be provided to prevent ponding of water adjacent to the structures. In general, the area around the buildings should slope away from the building. We recommend that unpaved landscaped areas adjacent to the buildings be avoided. Roof runoff should be carried to suitable drainage outlets by watertight drain pipes or over paved areas.

3.11 Sulfate Attack and Corrosion Protection

Based on the results of laboratory testing, concrete structures in contact with the onsite soil will have negligible exposure to water-soluble sulfates in the soil. Therefore, common Type II cement may be used for concrete construction. The concrete should be designed in accordance with Table 19.3.2.1 of the American Concrete Institute ACI 318-14 provisions (ACI, 2014).

The onsite soil is considered to be corrosive to ferrous metals. It is recommended that any buried pipe be made of non-ferrous material, or that any ferrous pipe be protected by dielectric tape, polyethylene sleeves and/or other methods, with recommendations from a corrosion engineer. Corrosion information presented in this report should be provided to your underground utility subcontractors. Additional testing and evaluation by a corrosion engineer may be warranted if metallic utilities are planned.

3.12 Additional Geotechnical Services

The preliminary geotechnical recommendations presented in this report are based on subsurface conditions as interpreted from limited subsurface explorations and limited laboratory testing. Our supplemental geotechnical recommendations provided in this report are based on information available at the time the report was prepared and may change as plans are developed. Additional geotechnical investigation and analysis may be required based on final improvement plans. Leighton should review the site and grading plans when available and comment further on the geotechnical aspects of the project. Geotechnical observation and testing should be conducted during excavation and all phases of grading operations. Our conclusions and preliminary recommendations should be reviewed and verified by Leighton during construction and revised accordingly if geotechnical conditions encountered vary from our preliminary findings and interpretations.

Geotechnical observation and testing should be provided:

- After completion of site clearing.
- During overexcavation of compressible soil.
- During compaction of all fill materials.
- After excavation of all footings and prior to placement of concrete.
- During utility trench backfilling and compaction.
- During pavement subgrade and base preparation.
- When any unusual conditions are encountered.

4.0 LIMITATIONS

This report was based in part on data obtained from a limited number of observations, site visits, soil excavations, samples, and tests. Such information is, by necessity, incomplete. The nature of many sites is such that differing soil or geologic conditions can be present within small distances and under varying climatic conditions. Changes in subsurface conditions can and do occur over time. Therefore, our findings, conclusions, and recommendations presented in this report are based on the assumption that Leighton Consulting, Inc. will provide geotechnical observation and testing during construction.

This report was prepared for the sole use of FGFW IV, LLC, for application to the design of the proposed warehouse buildings development in accordance with generally accepted geotechnical engineering practices at this time in California.

See the GBA insert on the following page for important information about this geotechnical engineering report.

Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, clients can benefit from a lowered exposure to the subsurface problems that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed below, contact your GBA-member geotechnical engineer. Active involvement in the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Geotechnical-Engineering Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. *Those who rely on a geotechnical-engineering report prepared for a different client can be seriously misled.* No one except authorized client representatives should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one – not even you – should apply this report for any purpose or project except the one originally contemplated.*

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read it *in its entirety*. Do not rely on an executive summary. Do not read selected elements only. *Read this report in full.*

You Need to Inform Your Geotechnical Engineer about Change

Your geotechnical engineer considered unique, project-specific factors when designing the study behind this report and developing the confirmation-dependent recommendations the report conveys. A few typical factors include:

- the client's goals, objectives, budget, schedule, and risk-management preferences;
- the general nature of the structure involved, its size, configuration, and performance criteria;
- the structure's location and orientation on the site; and
- other planned or existing site improvements, such as retaining walls, access roads, parking lots, and underground utilities.

Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse;
- the elevation, configuration, location, orientation, or weight of the proposed structure;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.*

This Report May Not Be Reliable

Do not rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, that it could be unwise to rely on a geotechnical-engineering report whose reliability may have been affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If your geotechnical engineer has not indicated an "apply-by" date on the report, ask what it should be*, and, in general, *if you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying it. A minor amount of additional testing or analysis – if any is required at all – could prevent major problems.

Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface through various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing were performed.* The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgment to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team from project start to project finish, so the individual can provide informed guidance quickly, whenever needed.

This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, *they are not final*, because the geotechnical engineer who developed them relied heavily on judgment and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* revealed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a full-time member of the design team, to:

- confer with other design-team members,
- help develop specifications,
- review pertinent elements of other design professionals' plans and specifications, and
- be on hand quickly whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction observation.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for informational purposes only*. To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report, but they may rely on the factual data relative to the specific times, locations, and depths/elevations referenced. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely*. Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures*. If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. As a general rule, *do not rely on an environmental report prepared for a different client, site, or project, or that is more than six months old.*

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, none of the engineer's services were designed, conducted, or intended to prevent uncontrolled migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will not of itself be sufficient to prevent moisture infiltration.*** Confront the risk of moisture infiltration by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are not building-envelope or mold specialists.***

GEOPROFESSIONAL BUSINESS ASSOCIATION

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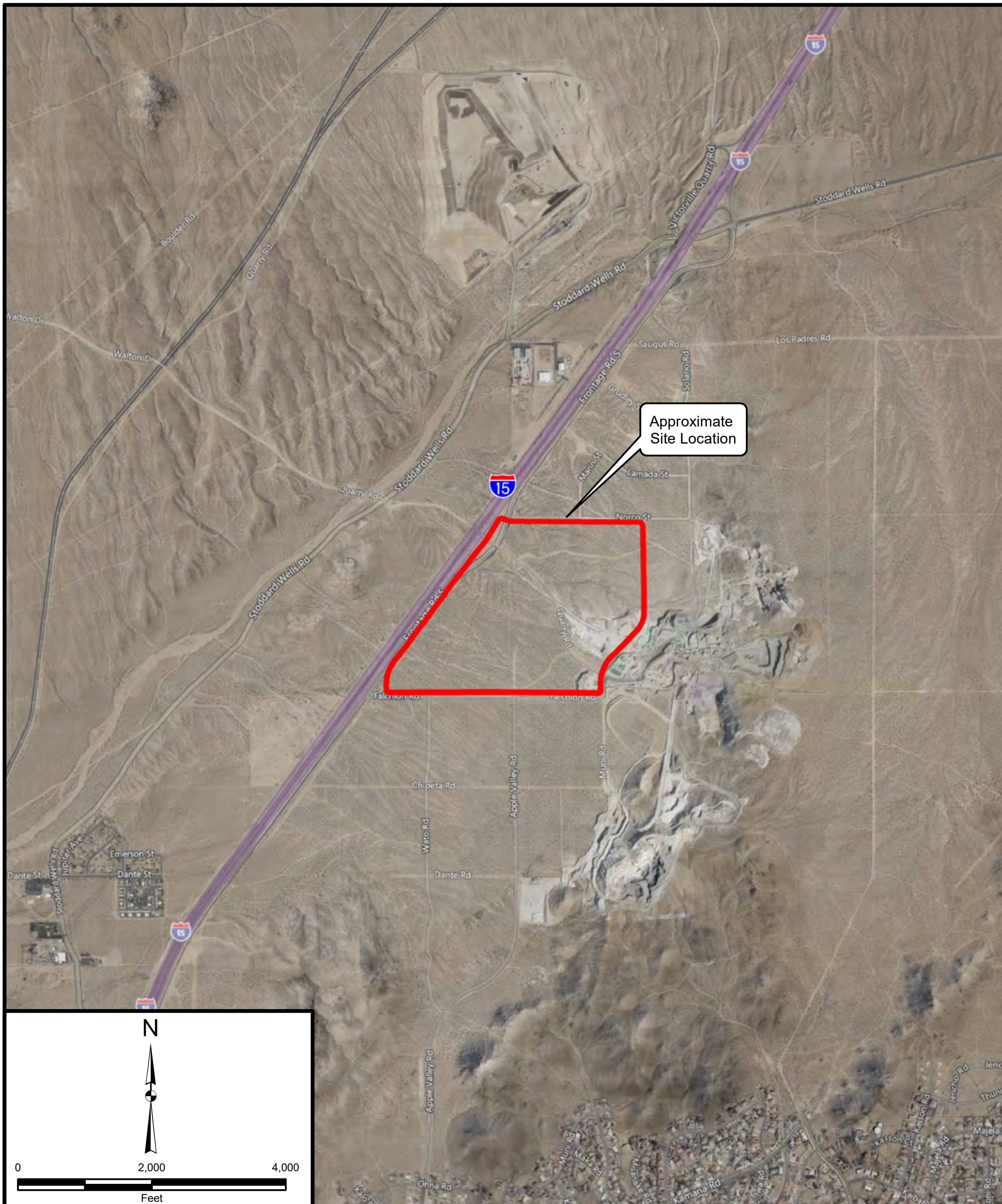

Project: 13673.001	Eng/Geol: JDH/SGO
Scale:1 " = 2,000 '	Date: February 2023

Reference: © 2022 Microsoft Corporation © 2022 Maxar ©CNES (2022) Distribution Airbus

SITE LOCATION MAP

Proposed Warehouse Building Development
Parcel A APN 0472-031-08,
Apple Valley, California

FIGURE 1

Leighton

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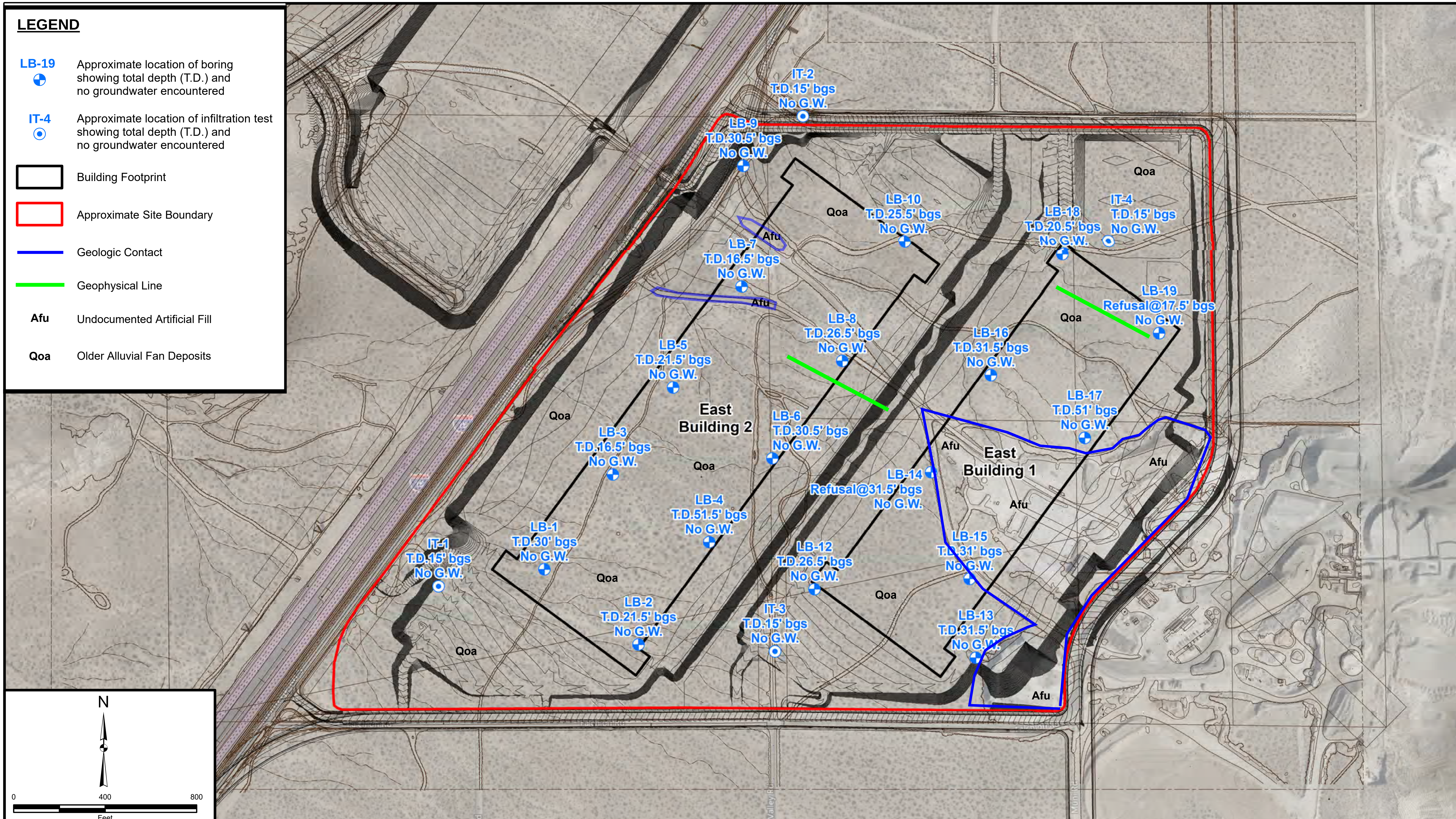

Project: 13673.001	Eng/Geol: JDH/SGO	
Scale: 1 " = 400 '	Date: February 2023	

Reference: Conceptual Site Plan, Sheet A1-0
Date: March 5, 2022 by Rexford Industrial Realty

GEOTECHNICAL MAP

Proposed Warehouse Building Development
Parcel A APN 0472-031-08,
Apple Valley, California

FIGURE 2

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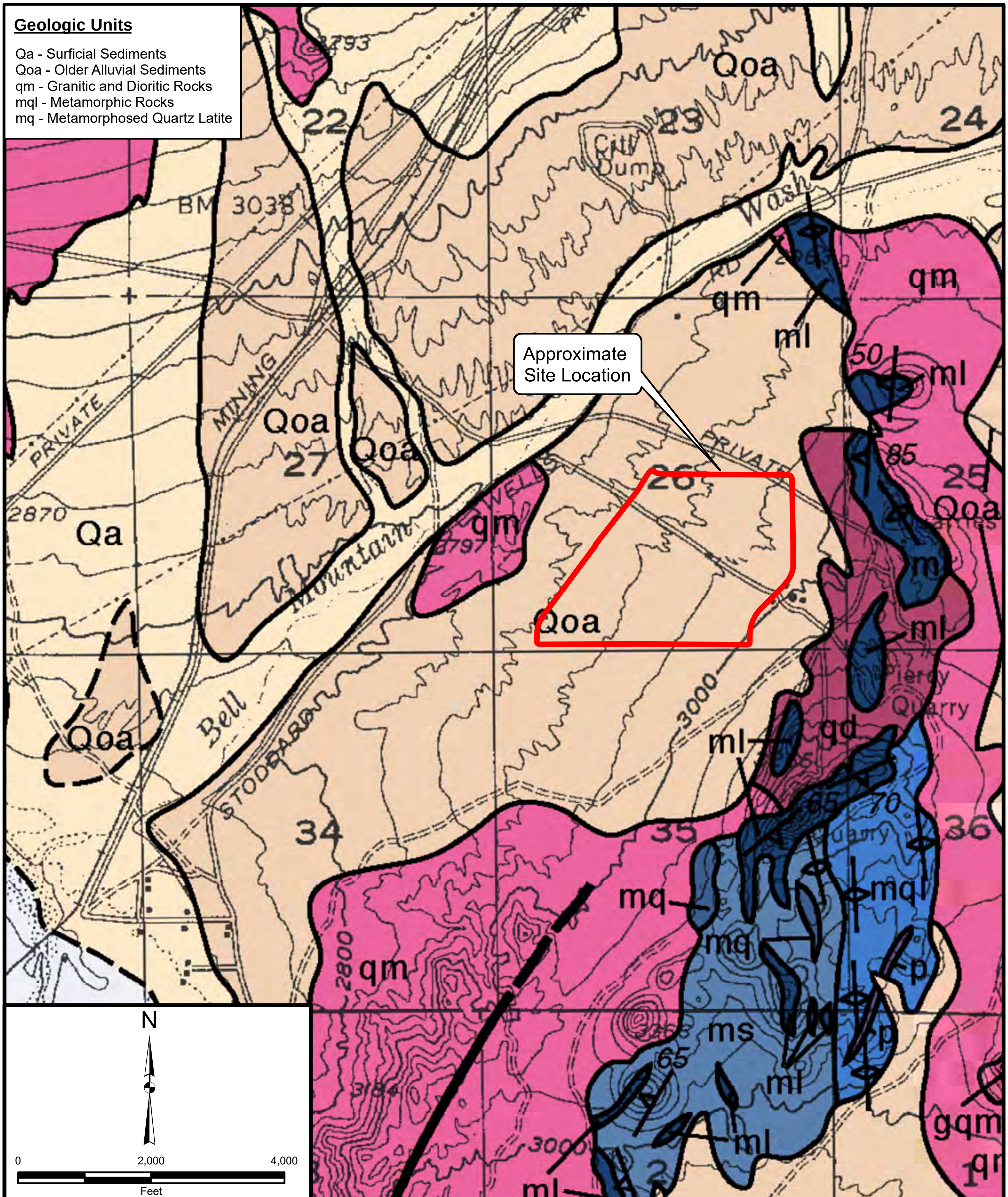

Project: 13673.001	Eng/Geol: JDH/SGO
Scale:1 " = 2,000 '	Date: February 2023

Reference:
Geologic Map of the Shadow Mountain & Victorville
by Thomas W. Dibblee, JR., 2008

REGIONAL GEOLOGY MAP

Proposed Warehouse Building Development
Parcel A APN 0472-031-08,
Apple Valley, California

FIGURE 3

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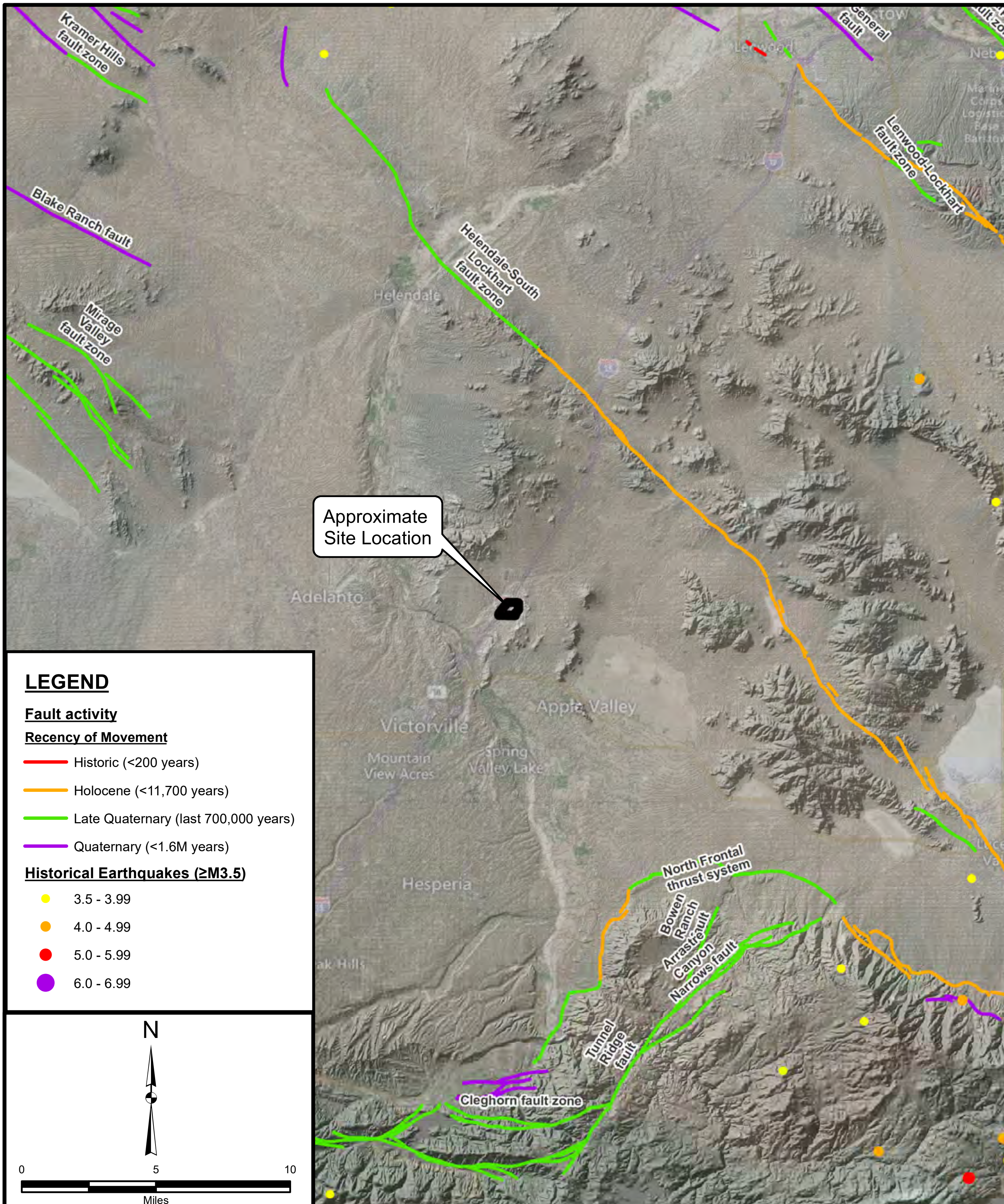

Project: 13673.001	Eng/Geol: JDH/SGO
Scale: 1 " = 5 miles	Date: February 2023

Basemap Reference: © 2022 Microsoft Corporation
Earthstar Geographics SIO © 2022 TomTom
Seismicity Data Reference: maps.conservation.ca.gov

REGIONAL FAULT AND HISTORIC SEISMICITY MAP

Proposed Warehouse Building Development
Parcel A APN 0472-031-08
Apple Valley, California

FIGURE 4

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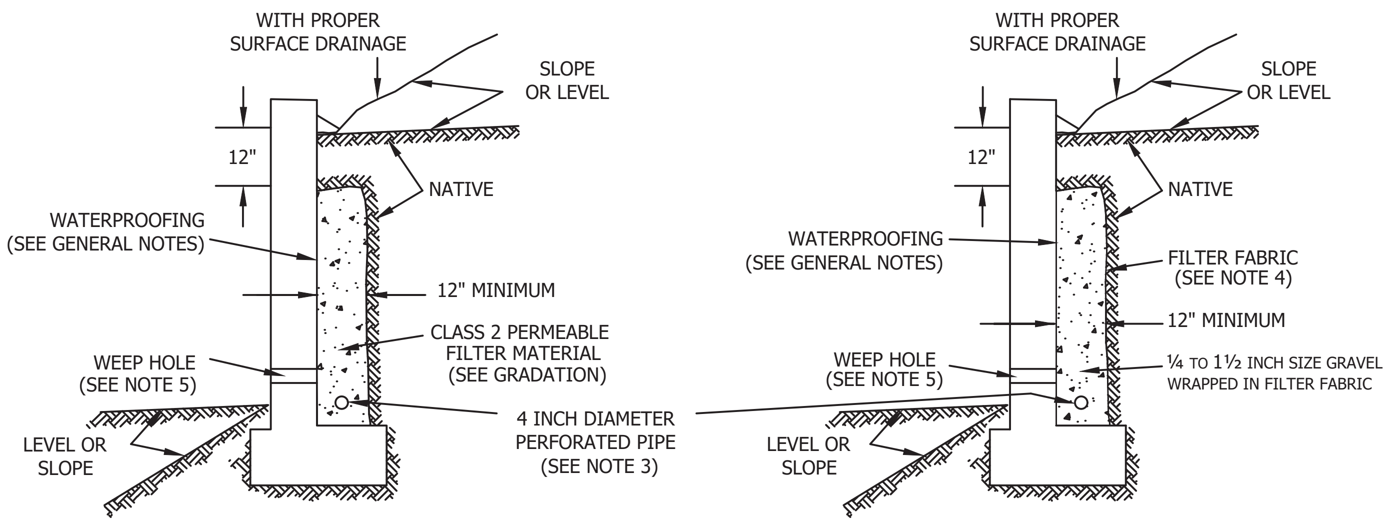
SUBDRAIN OPTIONS AND BACKFILL WHEN NATIVE MATERIAL HAS EXPANSION INDEX OF ≤50

OPTION 1: PIPE SURROUNDED WITH CLASS 2 PERMEABLE MATERIAL

OPTION 2: GRAVEL WRAPPED IN FILTER FABRIC



Class 2 Filter Permeable Material Gradation
Per Caltrans Specifications

Sieve Size	Percent Passing
1"	100
3/4"	90-100
3/8"	40-100
No. 4	25-40
No. 8	18-33
No. 30	5-15
No. 50	0-7
No. 200	0-3

GENERAL NOTES:

* Waterproofing should be provided where moisture nuisance problem through the wall is undesirable.
* Water proofing of the walls is not under purview of the geotechnical engineer
* All drains should have a gradient of 1 percent minimum
*Outlet portion of the subdrain should have a 4-inch diameter solid pipe discharged into a suitable disposal area designed by the project engineer. The subdrain pipe should be accessible for maintenance (rodding)
*Other subdrain backfill options are subject to the review by the geotechnical engineer and modification of design parameters.

Notes:
1) Sand should have a sand equivalent of 30 or greater and may be densified by water jetting.
2) 1 Cu. ft. per ft. of 1/4- to 1 1/2-inch size gravel wrapped in filter fabric
3) Pipe type should be ASTM D1527 Acrylonitrile Butadiene Styrene (ABS) SDR35 or ASTM D1785 Polyvinyl Chloride plastic (PVC), Schedule 40, Armco A2000 PVC, or approved equivalent. Pipe should be installed with perforations down. Perforations should be 3/8 inch in diameter placed at the ends of a 120-degree arc in two rows at 3-inch on center (staggered)
4) Filter fabric should be Mirafi 140NC or approved equivalent.
5) Weephole should be 3-inch minimum diameter and provided at 10-foot maximum intervals. If exposure is permitted, weepholes should be located 12 inches above finished grade. If exposure is not permitted such as for a wall adjacent to a sidewalk/curb, a pipe under the sidewalk to be discharged through the curb face or equivalent should be provided. For a basement-type wall, a proper subdrain outlet system should be provided.
6) Retaining wall plans should be reviewed and approved by the geotechnical engineer.
7) Walls over six feet in height are subject to a special review by the geotechnical engineer and modifications to the above requirements.

RETAINING WALL BACKFILL AND SUBDRAIN DETAIL FOR WALLS 6 FEET OR LESS IN HEIGHT

WHEN NATIVE MATERIAL HAS EXPANSION INDEX OF ≤50

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Figure 5

APPENDIX A

REFERENCES

APPENDIX A

References

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APPENDIX B

GEOTECHNICAL LOGS

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APPENDIX B

FIELD EXPLORATION

Our field investigation consisted of a surface reconnaissance and a subsurface exploration. Approximate exploration locations are shown on Figure 2, *Exploration Location Map*.

Borings: On September 12-14, 2022 and September 21-22, 2022, 22 hollow-stem-auger borings (LB-1 through LB-19 and IT-1 through IT-4) were drilled, logged and sampled to depths ranging from 16.5 feet to 51 feet below the ground surface. Encountered soils were logged in the field by our representative and described in accordance with the Unified Soil Classification System (ASTM D 2488). Relatively undisturbed soil samples were obtained at selected intervals within these borings using both a Modified California ring-lined and Standard Penetration Test (SPT) split-spoon sampler. Standard Penetration Test (SPT) resistance blow counts were obtained by dropping a 140-pound hammer through a 30-inch free fall. The 2-inch outside diameter split-spoon sampler was driven 18 inches and the number of blows was recorded for each 6 inches of penetration (ASTM D 1586). In addition, 2.4-inch inside diameter brass ring samples were obtained using a Modified California sampler driven into the soil with the 140-pound hammer. Near surface bulk soil samples were also collected from the borings. Representative earth-material samples obtained from these subsurface explorations were transported to our geotechnical laboratory for evaluation and appropriate testing.

GEOTECHNICAL BORING LOG LB-1

Project No.	13673.001	**Date Drilled**	9-12-22
Project	Synergy Parcel A	**Logged By**	AA
Drilling Co.	2R Drilling	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	'
Location	See Figure 2 - Exploration Location Map	**Sampled By**	AA

SOIL DESCRIPTION

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
	0								**Older Alluvial Sediments (Qoa)**	
									@Surface: POORLY GRADED SAND WITH GRAVEL (SP): Brown, dry, fine-coarse sand, 15% gravel (field estimate)	
				R-1	39 42 43	117	2	SP	@2.5: POORLY GRADED SAND WITH SILT (SP): very dense, brown, dry, fine-coarse sand, 10% fines (lab)	-200
	5			R-2	50/6"	109	4	SP	@5: POORLY GRADED SAND WITH SILT (SP): very dense, brown, dry, fine-coarse sand, 10% fines (estimate)	
				R-3	16 45 40	109	3	SM	@7.5: SILTY SAND (SM): very dense, brown, dry, fine sand, 12% fines (lab)	-200
	10			R-4	16 45 45			SP	@10: POORLY GRADED SAND WITH SILT AND GRAVEL (SP): very dense, brown, dry, fine sand, cemented, 10% fines, 15% gravel (field estimate)	CO
	15			S-1	27 27 30			SP	@15: POORLY GRADED SAND WITH SILT AND GRAVEL (SP): very dense, brown, dry, fine sand, slight cementation, 10% fines, 15% gravel (field estimate)	
	20			S-2	17 24 28			SPg	@20: POORLY GRADED GRAVELLY SAND WITH SILT (SPg): very dense, brown, dry, fine sand, cemented, 10% fines, 20% gravel (field estimate)	
	25			S-3	20 50/6"			SPg	@25: POORLY GRADED GRAVELLY SAND WITH SILT (SPg): very dense, brown, dry, fine sand, cemented, 10% fines, 25% gravel (field estimate)	
	30									

SAMPLE TYPES:
- **B** BULK SAMPLE
- **C** CORE SAMPLE
- **G** GRAB SAMPLE
- **R** RING SAMPLE
- **S** SPLIT SPOON SAMPLE
- **T** TUBE SAMPLE

TYPE OF TESTS:
- **-200** % FINES PASSING
- **AL** ATTERBERG LIMITS
- **CN** CONSOLIDATION
- **CO** COLLAPSE
- **CR** CORROSION
- **CU** UNDRAINED TRIAXIAL
- **DS** DIRECT SHEAR
- **EI** EXPANSION INDEX
- **H** HYDROMETER
- **MD** MAXIMUM DENSITY
- **PP** POCKET PENETROMETER
- **RV** R VALUE
- **SA** SIEVE ANALYSIS
- **SE** SAND EQUIVALENT
- **SG** SPECIFIC GRAVITY
- **UC** UNCONFINED COMPRESSIVE STRENGTH

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GEOTECHNICAL BORING LOG LB-1

Project No.	13673.001	**Date Drilled**	9-12-22
Project	Synergy Parcel A	**Logged By**	AA
Drilling Co.	2R Drilling	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	'
Location	See Figure 2 - Exploration Location Map	**Sampled By**	AA

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
									This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.	
	30	. . . .		S-4	50/5"			SP	@30: POORLY GRADED SAND WITH SILT AND GRAVEL (SP): very dense, brown, dry, fine sand, cemented, 10% fines, 15% gravel (field estimate) 3 inch Recovery **TOTAL DEPTH = 30 FEET** **NO GROUNDWATER ENCOUNTERED** **BACKFILLED TO SURFACE WITH SOIL CUTTINGS**	
	35									
	40									
	45									
	50									
	55									
	60									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

GEOTECHNICAL BORING LOG LB-2

Project No.	13673.001	**Date Drilled**	9-12-22
Project	Synergy Parcel A	**Logged By**	AA
Drilling Co.	2R Drilling	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	'
Location	See Figure 2 - Exploration Location Map	**Sampled By**	AA

SOIL DESCRIPTION

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
	0			B-1				SPg	**Older Alluvial Sediments (Qoa)** @ Surface: POORLY GRADED GRAVELLY SAND (SPg): Brown, dry, fine-coarse sand, 20% gravel (field estimate)	
				R-1	50/5"	111	3	SPg	@ 2.5: POORLY GRADED GRAVELLY SAND (SPg): very dense, brown, dry, fine-coarse sand, 20% gravel (field estimate)	
	5			R-2	27 37 45	113	3	SP	@5': POORLY GRADED SAND WITH SILT (SP): dense, light brown, slightly moist, fine-medium sand, 10% fines (field estimate)	
				S-1	11 17 10			SP	@7.5': POORLY GRADED SAND WITH SILT (SP): medium dense, light brown, slightly moist, fine-medium sand, 10% fines (field estimate)	
	10			S-2	37 43 34			SP	@10': POORLY GRADED SAND WITH SILT (SP): very dense, light brown, slightly moist, medium-coarse sand, 10% fines (field estimate)	
	15			S-3	22 28 34			SP	@15': POORLY GRADED SAND WITH SILT (SP): very dense, light brown, slightly moist, fine-medium sand, 10% fines (field estimate)	
	20			S-4	15 29 25			SP	@20': POORLY GRADED SAND WITH SILT (SP): very dense, light brown, slightly moist, fine-medium sand, 10% fines (field estimate)	
	25								**TOTAL DEPTH = 21.5 FEET** **NO GROUNDWATER ENCOUNTERED** **CAVE-IN DEPTH: 6 FEET** **BACKFILLED TO SURFACE WITH SOIL CUTTINGS**	
	30									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

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GEOTECHNICAL BORING LOG LB-3

Project No.	13673.001	**Date Drilled**	9-12-22
Project	Synergy Parcel A	**Logged By**	AA
Drilling Co.	2R Drilling	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	'
Location	See Figure 2 - Exploration Location Map	**Sampled By**	AA

SOIL DESCRIPTION

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
	0			B-1				SPg	**Older Alluvial Sediments (Qoa)** @Surface: POORLY GRADED GRAVELLY SAND (SPg): Brown, dry, fine-coarse sand, 20% gravel (field estimate)	
				R-1	9 14 50/5"		124	SPg	@2.5: POORLY GRADED GRAVELLY SAND (SPg): very dense, brown, dry, fine-coarse sand, 20% gravel (field estimate)	
	5				50/5"				@5': NO RECOVERY	
				R-2	8 40 43			SP	@7.5': POORLY GRADED SAND WITH GRAVEL (SP): dense, brown, dry, fine-coarse sand, 15% gravel (field estimate)	
	10			R-3	19 44 45			SPg	@10': POORLY GRADED GRAVELLY SAND (SPg): very dense, brown, dry, fine-coarse sand, slight cementation, 20% gravel (field estimate)	
	15			S-1	14 20 28			SP	@15': POORLY GRADED SAND WITH GRAVEL (SP): dense, brown, dry, fine-coarse sand, slight cementation, 15% gravel (field estimate)	
									TOTAL DEPTH = 16.5 FEET **NO GROUNDWATER ENCOUNTERED** **BACKFILLED TO SURFACE WITH SOIL CUTTINGS**	
	20									
	25									
	30									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

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GEOTECHNICAL BORING LOG LB-4

Project No.	13673.001	**Date Drilled**	9-12-22
Project	Synergy Parcel A	**Logged By**	AA
Drilling Co.	2R Drilling	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	'
Location	See Figure 2 - Exploration Location Map	**Sampled By**	AA

SOIL DESCRIPTION

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	Soil Description	Type of Tests
	0								**Older Alluvial Sediments (Qoa)**	
									@Surface: POORLY GRADED SAND (SP): Light brown, dry, fine-coarse sand, 5% fine sand (field estimate)	
				R-1	17 12 14	123	2	SP	@2.5: POORLY GRADED SAND WITH SILT (SP): medium dense, light brown, dry, fine-coarse sand, 10% fines (lab)	-200
	5			R-2	50/5"	101	4	SP	@5: POORLY GRADED SAND WITH SILT (SP-SM): very dense, light brown, dry, fine-coarse sand, 10% fines (estimate)	
				R-3	40 50/3"			SP	@7.5: POORLY GRADED SAND WITH SILT (SP): very dense, light brown, dry, fine sand, cemented, 10% fines (estimate)	
	10			R-4	29 41 50/4"	109	3	SP	@10: POORLY GRADED SAND WITH SILT (SP): very dense, light brown, dry, fine sand(rock grindings), cemented, 12% fines (lab)	-200
	15				50/6"				@15': NO RECOVERY	
	20			S-1	36 42 28			SP	@20: POORLY GRADED SAND WITH SILT (SP): very dense, light brown, slightly moist, fine-coarse sand, 10% fines (estimate)	
	25			S-2	50/5"			SM	@25: SILTY SAND (SM): very dense, white/light brown, slightly moist, fine-coarse sand, 25% fines (estimate)	
	30									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

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GEOTECHNICAL BORING LOG LB-4

Project No.	13673.001	**Date Drilled**	9-12-22
Project	Synergy Parcel A	**Logged By**	AA
Drilling Co.	2R Drilling	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	'
Location	See Figure 2 - Exploration Location Map	**Sampled By**	AA

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION *This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.*	Type of Tests
	30			S-3	14 34 40			SM	@30: SILTY SAND (SM): very dense, white/light brown, slightly moist, fine powdery sand, 24% fines (lab)	-200
	35			S-4	29 50/6"			SM	@35: SILTY SAND (SM): very dense, white/light brown, slightly moist, fine powdery sand, 25% fines (estimate)	
	40			S-5	28 40 50/3"			SM	@40: SILTY SAND (SM): very dense, white/light brown, slightly moist, fine powdery sand, 25% fines (estimate)	
	45			S-6	28 39 41			SM	@45: SILTY SAND (SM): very dense, white/light brown, slightly moist, fine powdery sand, 25% fines (estimate)	
	50			S-7	8 11 45			SM	@50: SILTY SAND (SM): very dense, white/light brown, slightly moist, fine powdery sand, 25% fines (estimate)	
									TOTAL DEPTH = 51.5 FEET **NO GROUNDWATER ENCOUNTERED** **BACKFILLED TO SURFACE WITH SOIL CUTTINGS**	
	55									
	60									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

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*** * * This log is a part of a report by Leighton and should not be used as a stand-alone document. * * ***

GEOTECHNICAL BORING LOG LB-5

Project No.	13673.001	**Date Drilled**	9-12-22
Project	Synergy Parcel A	**Logged By**	AA
Drilling Co.	2R Drilling	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	'
Location	See Figure 2 - Exploration Location Map	**Sampled By**	AA

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
	0								**Older Alluvial Sediments (Qoa)**	
									@Surface: POORLY GRADED GRAVELLY SAND WITH SILT (SPg): Brown, dry, fine-coarse sand, 20% gravel, 10% fines (field estimate)	
				R-1	50/5"	98	7	SPg	@2.5': POORLY GRADED GRAVELLY SAND (SPg): very dense, light brown, dry, fine-coarse sand, 20% gravel (field estimate) Partial Recovery	
	5			R-2	39 35 50/5"	113	2	SMg	@5': SILTY SAND (SM): very dense, light brown, dry, fine-coarse sand, 20% fines (lab)	-200
				R-3	50/5"			SM	@8.5': SILTY SAND (SM): very dense, light brown, dry, fine-coarse sand, cemented, 15% fines (estimate)	
	10			R-4	15 50/3"			SM	@10': SILTY SAND (SM): very dense, light brown, dry, fine sand, 20% fines (estimate)	
	15			S-1	8 29 34			SM	@15': SILTY SAND (SM): very dense, light brown, dry, fine sand, 20% fines (estimate)	
	20			S-2	18 34 50/3"			SM	@20': SILTY SAND (SM): very dense, light brown, dry, fine sand, 20% fines (estimate)	
									TOTAL DEPTH = 21.5 FEET **NO GROUNDWATER ENCOUNTERED** **CAVE-IN DEPTH = 6 FEET 3 INCHES** **BACKFILLED TO SURFACE WITH SOIL CUTTINGS**	
	25									
	30									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

Leighton

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GEOTECHNICAL BORING LOG LB-6

Project No.	13673.001	**Date Drilled**	9-12-22
Project	Synergy Parcel A	**Logged By**	AA
Drilling Co.	2R Drilling	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	'
Location	See Figure 2 - Exploration Location Map	**Sampled By**	AA

SOIL DESCRIPTION

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
	0			B-1				SP	**Older Alluvial Sediments (Qoa)** @Surface: POORLY GRADED SAND WITH GRAVEL (SP): Light brown, dry, medium - coarse sand, 15% gravel (field estimate)	SA, MD, RV, CR
				R-1	21 24 21	119	2	SM	@2.5': SILTY SAND (SM): medium - dense, brown, slightly moist, fine to medium sand, 13% fines (lab)	
	5			R-2	38 50/3"	99	5	SPg	@5': POORLY GRADED GRAVELLY SAND WITH SILT (SPg): very dense, brown, slightly moist, very dense, fine to medium sand, (fine powdery sand), 10% fines, 20% gravel less than 1" in dimension (field estimate)	
					50/6"				@7.5': NO RECOVERY	
	10			R-3	8 50/5"			SP	@10': POORLY GRADED SAND WITH SILT AND GRAVEL (SP): very dense, brown, slightly moist, fine to medium sand, (fine powdery sand), 10% fines, 15% gravel (field estimate) Partial Recovery, non-cohesive sand	
	15			S-1	33 50/2"			SP	@15': POORLY GRADED SAND WITH SILT AND GRAVEL (SP): very dense, brown, slightly moist, fine to coarse sand, 10% fines, 15% gravel (field estimate)	
	20			S-2	19 23 21			SP	@20': POORLY GRADED SAND WITH SILT AND GRAVEL (SP): dense, brown, slightly moist, fine to coarse sand, 10% fines, 10% gravel (field estimate)	
	25			S-3	50/6"			SP	@25': POORLY GRADED SAND WITH SILT AND GRAVEL (SP-SM): very dense, brown, slightly moist, fine to coarse sand, 10% fines, 15% gravel (field estimate)	
	30									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

Leighton

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GEOTECHNICAL BORING LOG LB-6

Project No.	13673.001	**Date Drilled**	9-12-22
Project	Synergy Parcel A	**Logged By**	AA
Drilling Co.	2R Drilling	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	'
Location	See Figure 2 - Exploration Location Map	**Sampled By**	AA

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	**SOIL DESCRIPTION** *This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.*	Type of Tests
	30	. . . .			50/6"				@30': NO RECOVERY	
									TOTAL DEPTH = 30.5 FEET **NO GROUNDWATER ENCOUNTERED** **BACKFILLED TO SURFACE WITH SOIL CUTTINGS**	
	35									
	40									
	45									
	50									
	55									
	60									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

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GEOTECHNICAL BORING LOG LB-7

Project No.	13673.001	**Date Drilled**	9-13-22
Project	Synergy Parcel A	**Logged By**	AA
Drilling Co.	2R Drilling	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	'
Location	See Figure 2 - Exploration Location Map	**Sampled By**	AA

SOIL DESCRIPTION

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	Soil Description	Type of Tests
	0			B-1				SP	**Older Alluvial Sediments (Qoa)** @Surface: POORLY GRADED GRAVELLY SAND (SPg): Brown, dry, fine to coarse sand, 25% gravel (field estimate)	
				S-1	34 13 8			SPg	@2.5': POORLY GRADED SAND WITH SILT (SP-SM): medium dense, white/brown, dry, fine to medium sand, 10% fines (field estimate)	
	5			S-2	8 20 40			SP	@5': POORLY GRADED SAND WITH SILT (SP): very dense, white/brown, dry, fine to medium sand, 10% fines (field estimate)	
				S-3	25 50/6"			SP	@7.5': POORLY GRADED SAND WITH SILT (SP): very dense, white/brown, dry, fine to medium sand, slight cementation, 10% fines (field estimate)	
	10			S-4	10 50/5"			SP	@10': POORLY GRADED SAND WITH SILT (SP): very dense, white/brown, dry, fine to medium sand, trace of gravel, 10% fines (field estimate)	
	15			S-5	9 13 50/5"			SP	@15': POORLY GRADED SAND WITH SILT (SP): very dense, white/brown, dry, fine to medium sand, 10% fines (field estimate)	
									TOTAL DEPTH = 16.5 FEET **NO GROUNDWATER ENCOUNTERED** **BACKFILLED TO SURFACE WITH SOIL CUTTINGS**	
	20									
	25									
	30									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

Leighton

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GEOTECHNICAL BORING LOG LB-8

Project No.	13673.001	**Date Drilled**	9-12-22
Project	Synergy Parcel A	**Logged By**	AA
Drilling Co.	2R Drilling	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	'
Location	See Figure 2 - Exploration Location Map	**Sampled By**	AA

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	**SOIL DESCRIPTION** *This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.*	Type of Tests
	0								**Older Alluvial Sediments (Qoa)**	
									@Surface: POORLY GRADED GRAVELLY SAND (SPg): Light brown, dry, fine to coarse sand, 20% gravel (field estimate)	
				R-1	25 21 50/3"	118	2	SP	@2.5: POORLY GRADED SAND WITH GRAVEL (SP): very dense, light brown, dry, fine to coarse sand, cemented, 15% gravel (field estimate)	
	5			R-2	5 40 50/3"	116	4	SPg	@5: POORLY GRADED GRAVELLY SAND (SPg): very dense, light brown, dry, fine to coarse sand, 25% gravel (field estimate) less than 1" in dimension	
	10			S-1	38 50/3"			SPg	@10: POORLY GRADED GRAVELLY SAND (SPg): very dense, light brown, dry, fine to coarse sand, 20% gravel (field estimate) Partial Recovery	
	15			S-2	5 14 15			SP	@15: SAND WITH SILT (SP): medium dense, light brown, dry, fine to coarse sand, slight cementation, 13% fines (lab)	-200
	20			S-3	50/6"			SP	@20: SAND WITH SILT (SP): very dense, light brown, dry, fine to coarse sand, 10% fines (estimate)	
	25			S-4	27 42 37			SP	@25: SAND WITH SILT (SP): very dense, light brown, dry, fine to coarse sand, cemented, 10% fines (estimate)	
									TOTAL DEPTH = 26.5 FEET **NO GROUNDWATER ENCOUNTERED** **BACKFILLED TO SURFACE WITH SOIL CUTTINGS**	
	30									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

Leighton

GEOTECHNICAL BORING LOG LB-9

Project No.	13673.001	**Date Drilled**	9-13-22
Project	Synergy Parcel A	**Logged By**	AA
Drilling Co.	2R Drilling	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	'
Location	See Figure 2 - Exploration Location Map	**Sampled By**	AA

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
									This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.	
	0								**Undocumented Fill (Afu)**	
									@Surface: POORLY GRADED GRAVELLY SAND (SPg): Brown, dry, fine to coarse sand, 25% gravel (field estimate)	
				S-1	3 3 2			SP	@2.5: POORLY GRADED SAND WITH SILT (SP): loose, reddish brown, dry, medium to coarse sand, 8% fines (lab)	-200
	5			S-2	3 3 4			SP	@5: POORLY GRADED SAND WITH SILT (SP): loose, reddish brown, dry, medium to coarse sand, 10% fines (field estimate)	
									Older Alluvial Sediments (Qoa)	
				S-3	20 50/5"			SP	@7.5: POORLY GRADED SAND WITH SILT (SP): very dense, white/brown, dry, fine to medium sand, 10% fines (field estimate)	
	10			S-4	13 20 21			SP	@10: POORLY GRADED SAND WITH SILT (SP): dense, white/brown, dry, fine to medium sand, slight cementation, 10% fines (field estimate)	
	15			S-5 B-1	8 14 21			SP SP	@15: POORLY GRADED SAND WITH SILT (SP): dense, white/brown, dry, fine to medium sand, slight cementation, 10% fines (field estimate)	MD, DS
	20			S-6				SP	@20: POORLY GRADED SAND WITH SILT (SP): white/brown, dry, fine to medium sand, slight cementation, 10% fines (field estimate)	
	25			S-7	50/6"			SP	@25: POORLY GRADED SAND WITH SILT (SP): very dense, white/brown, dry, fine to medium sand, slight cementation, 10% fines (field estimate)	
	30									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

Leighton

GEOTECHNICAL BORING LOG LB-9

Project No.	13673.001	**Date Drilled**	9-13-22
Project	Synergy Parcel A	**Logged By**	AA
Drilling Co.	2R Drilling	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	'
Location	See Figure 2 - Exploration Location Map	**Sampled By**	AA

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
									This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.	
	30			S-8	50/6"			SP	@30: POORLY GRADED SAND WITH SILT (SP): very dense, white/brown, dry, fine to medium sand, 10% fines (field estimate)	
									TOTAL DEPTH = 30.5 FEET **NO GROUNDWATER ENCOUNTERED** **BACKFILLED TO SURFACE WITH SOIL CUTTINGS**	
	35									
	40									
	45									
	50									
	55									
	60									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

Leighton

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GEOTECHNICAL BORING LOG LB-10

Project No.	13673.001	**Date Drilled**	9-21-22
Project	Synergy Parcel A	**Logged By**	AA
Drilling Co.	2R Drilling	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	'
Location	See Figure 2 - Exploration Location Map	**Sampled By**	AA

SOIL DESCRIPTION

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
	0								**Older Alluvial Sediments (Qoa)**	
									@ Surface: POORLY GRADED GRAVELLY SAND WITH SILT (SPg): light brown, dry, fine to coarse sand, 10% fines, 20% gravel (field estimate)	
				S-1	17 35 50			SPg	@ 2.5: POORLY GRADED GRAVELLY SAND WITH SILT(SPg): very dense, light brown, dry, fine to coarse sand, 10% fines, 20% gravel (field estimate)	
	5			S-2	28 50/5"			SPg	@5': POORLY GRADED SAND WITH GRAVEL (SP): very dense, light brown, dry, fine to coarse sand, 15% gravel (field estimate)	
				S-3	16 27 35			SP	@7.5': SILTY SAND (SM): very dense, light brown, dry, fine to coarse sand, cemented, 21% fines (lab)	-200
	10			S-4	50/6"			SM	@10': SILTY SAND (SM): very dense, brown, slightly moist, fine to coarse sand, 13% fines (field estimate)	
	15			S-5	22 24 28			SM	@15': SILTY SAND (SM): very dense, brown, slightly moist, fine to coarse sand, 13% fines (lab)	-200
	20			S-6	50/5"			SM	@20': SILTY SAND (SM): very dense, brown, slightly moist, fine to coarse sand, 13% fines (field estimate)	
	25			S-7	28 50/3"			SM	@25': SILTY SAND (SM): very dense, brown, slightly moist, fine to coarse sand, 13% fines, (field estimate)	
									TOTAL DEPTH = 25.5 FEET **NO GROUNDWATER ENCOUNTERED** **CAVE-IN DEPTH: 8 FEET** **BACKFILLED TO SURFACE WITH SOIL CUTTINGS**	
	30									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

Leighton

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GEOTECHNICAL BORING LOG LB-12

Project No.	13673.001	**Date Drilled**	9-13-22
Project	Synergy Parcel A	**Logged By**	AA
Drilling Co.	2R Drilling	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	'
Location	See Figure 2 - Exploration Location Map	**Sampled By**	AA

SOIL DESCRIPTION

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	Soil Description	Type of Tests
	0			B-1				SPg	**Older Alluvial Sediments (Qoa)** @Surface: POORLY GRADED GRAVELLY SAND (SPg): Brown, dry, fine to coarse sand, 25% gravel (field estimate)	
				R-1	3 3 3			SPg	@2.5: POORLY GRADED SAND (SP): very loose, brown, dry, fine to coarse sand, 15% gravel (field estimate) Disturbed Sample	
	5			R-2	28 50/2"	121	2	SP	@5: POORLY GRADED SAND (SP): very dense, brown, dry, fine to coarse sand, slight cementation, 15% gravel (field estimate)	
				S-1	42 50/6"			SP	@7.5: POORLY GRADED SAND WITH SILT (SP): very dense, light brown, slightly moist, fine to medium sand, slight cementation, 10% fines (field estimate)	
	10			S-2	50/6"			SP	@10: POORLY GRADED SAND WITH SILT (SP): very dense, light brown, slightly moist, fine to medium sand, trace of gravel, 10% fines (field estimate)	
	15			S-3	50/4"			SP	@15: POORLY GRADED SAND WITH SILT (SP): very dense, light brown, slightly moist, fine to medium sand, 10% fines (field estimate) Partial Recovery	
	20			S-4	18 21 24			SP	@20': POORLY GRADED SAND WITH GRAVEL (SP): dense, light brown, slightly moist, fine-coarse sand, cemented, 15% gravel (field estimate)	
	25			S-5	7 30 45			SP	@25': POORLY GRADED SAND WITH GRAVEL (SP): very dense, light brown, slightly moist, fine-coarse sand, cemented, 15% gravel (field estimate)	
									TOTAL DEPTH = 26.5 FEET **NO GROUNDWATER ENCOUNTERED** **BACKFILLED TO SURFACE WITH SOIL CUTTINGS**	
	30									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

Leighton

GEOTECHNICAL BORING LOG LB-13

Project No.	13673.001	**Date Drilled**	9-13-22
Project	Synergy Parcel A	**Logged By**	AA
Drilling Co.	2R Drilling	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	'
Location	See Figure 2 - Exploration Location Map	**Sampled By**	AA

SOIL DESCRIPTION

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
	0								<u>Older Alluvial Sediments (Qoa)</u>	
									@Surface: POORLY GRADED GRAVELLY SAND (SPg): Brown, dry, fine to coarse sand, 30% gravel (field estimate)	
				S-1	9 11 12			SP	@2.5': POORLY GRADED SAND WITH SILT (SP): medium dense, light brown, dry, fine to coarse sand, slight cementation, 10% fines (field estimate)	
	5			S-2	16 6 13			SP	@5': POORLY GRADED SAND WITH SILT (SP): medium dense, light brown, dry, fine to coarse sand, slight cementation, 10% fines (field estimate)	
				S-3	25 45 50/3"			SP	@7.5': POORLY GRADED SAND WITH SILT (SP): very dense, light brown, dry, fine to coarse sand, 10% fines (field estimate)	
	10			S-4	25 31 21			SP	@10': POORLY GRADED SAND WITH SILT (SP): very dense, light brown, dry, fine to coarse sand, slight cementation, 10% fines (field estimate)	
	15			S-5 B-1	20 49 50			SM SM	@15': SILTY SAND (SM): very dense, light brown, dry, fine to coarse sand, trace of gravel, 26% fines (lab)	-200
	20			S-6	34 46 50/5"			SM	@20': SILTY SAND (SM): very dense, light brown, dry, fine to coarse sand, slight cementation, 25% fines (field estimate)	
	25			S-7	50/4"			SP	@25': POORLY GRADED SAND WITH GRAVEL (SP): very dense, light brown, slightly moist, fine to coarse sand, 5% fines, 15% gravel (field estimate)	
	30									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

Leighton

GEOTECHNICAL BORING LOG LB-13

Project No.	13673.001	**Date Drilled**	9-13-22
Project	Synergy Parcel A	**Logged By**	AA
Drilling Co.	2R Drilling	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	'
Location	See Figure 2 - Exploration Location Map	**Sampled By**	AA

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
									This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.	
	30			S-8	15 30 40			SP	@30': POORLY GRADED SAND WITH GRAVEL (SP): very dense, light brown, slightly moist, fine to coarse sand, 5% fines, 15% gravel (field estimate)	
									TOTAL DEPTH = 31.5 FEET **NO GROUNDWATER ENCOUNTERED** **BACKFILLED TO SURFACE WITH SOIL CUTTINGS**	
	35									
	40									
	45									
	50									
	55									
	60									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

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GEOTECHNICAL BORING LOG LB-14

Project No. 13673.001
Project Synergy Parcel A
Drilling Co. 2R Drilling
Drilling Method Hollow Stem Auger - 140lb - Autohammer - 30" Drop
Location See Figure 2 - Exploration Location Map

Date Drilled 9-13-22
Logged By AA
Hole Diameter 8"
Ground Elevation '
Sampled By AA

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION *This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.*	Type of Tests
	0								**Older Alluvial Sediments (Qoa)**	
									@Surface: POORLY GRADED SAND WITH GRAVEL (SP): Brown, dry, fine to coarse sand, 15% gravel (field estimate)	
				R-1	38 50/4"	104	7	SP	@2.5': POORLY GRADED SAND WITH SILT (SP): very dense, light brown, dry, fine-coarse sand, slight cementation, 10% fines (field estimate)	
	5			R-2	15 50/6"	114	4	SP	@5': POORLY GRADED SAND WITH SILT (SP): very dense, light brown, slightly moist, fine-coarse sand, 10% fines (field estimate)	
				S-1	15 30 50/3"			SP	@7.5': POORLY GRADED SAND WITH SILT (SP): very dense, light brown, slightly moist, fine-coarse sand, slight cementation, 10% fines (field estimate)	
	10				40 50/3"				@10': POORLY GRADED SAND WITH SILT (SP): very dense, light brown, slightly moist, fine-coarse sand, 10% fines (field estimate) NO RECOVERY	
									@14': Auger grinding on rock, met refusal	
	15								**MET REFUSAL AT 14 FEET** **NO GROUNDWATER ENCOUNTERED** **CAVE-IN DEPTH = 9 FEET 5 INCHES** **BACKFILLED TO SURFACE WITH SOIL CUTTINGS**	
	20									
	25									
	30									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

Leighton

GEOTECHNICAL BORING LOG LB-15

Project No.	13673.001	**Date Drilled**	9-13-22
Project	Synergy Parcel A	**Logged By**	AA
Drilling Co.	2R Drilling	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	'
Location	See Figure 2 - Exploration Location Map	**Sampled By**	AA

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

Elevation Feet	Depth Feet	Graphic Log	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
	0			B-1				SP-SM	**Older Alluvial Sediments (Qoa)** @Surface: POORLY GRADED GRAVELLY SAND (SPg): Brown, dry, fine to coarse sand, 20% gravel (field estimate)	
				R-1	3 35 50/2"	87	9	SM	@2.5: SILTY SAND (SM): very dense, white/tan, dry, fine to coarse sand, 20% fines (field estimate)	
	5			R-2	14 50/6"	104	5	SM	@5: SILTY SAND (SM): very dense, white/tan, dry, fine to coarse sand, slight cementation, 20% fines (field estimate)	
				S-1	10 28 15			SM	@7.5: SILTY SAND (SM): dense, white/tan, dry, fine to coarse sand, slight cementation, 20% fines (field estimate)	
	10			S-2	14 40 50/1"			SM	@10: SILTY SAND (SM): dense, reddish brown, dry, fine to coarse sand, slight cementation, 20% fines (field estimate)	
									@14': Auger grinding on a rock	
	15			S-3	4 35 40			SM	@15: SILTY SAND (SM): very dense, reddish brown, dry, fine to coarse sand, 20% fines (field estimate)	
	20			S-4	50/6"			SM	@20: SILTY SAND (SM): very dense, reddish brown, dry, fine to coarse sand, 20% fines (field estimate) Partial Recovery	
	25			S-5	14 50/4"			SM	@25: SILTY SAND (SM): very dense, reddish brown, dry, fine to coarse sand, 20% gravel (field estimate) @26': Pieces of luminouse, white, hard stone found	
	30									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

Leighton

*** * * This log is a part of a report by Leighton and should not be used as a stand-alone document. * * ***

GEOTECHNICAL BORING LOG LB-15

Project No.	13673.001	**Date Drilled**	9-13-22
Project	Synergy Parcel A	**Logged By**	AA
Drilling Co.	2R Drilling	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	'
Location	See Figure 2 - Exploration Location Map	**Sampled By**	AA

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
	30			S-6	15 50/6"			SM	@30: SILTY SAND (SM): very dense, reddish brown, dry, fine to coarse sand, slight cementation, 20% fines (field estimate)	
									TOTAL DEPTH = 31 FEET **NO GROUNDWATER ENCOUNTERED** **BACKFILLED TO SURFACE WITH SOIL CUTTINGS**	
	35									
	40									
	45									
	50									
	55									
	60									

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

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GEOTECHNICAL BORING LOG LB-16

Project No.	13673.001	**Date Drilled**	9-22-22
Project	Synergy Parcel A	**Logged By**	AA
Drilling Co.	2R Drilling	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	'
Location	See Figure 2 - Exploration Location Map	**Sampled By**	AA

SOIL DESCRIPTION

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
	0								**Older Alluvial Sediments (Qoa)**	
									@Surface: POORLY GRADED GRAVELLY SAND (SPg): Brown, dry, fine to coarse sand, 25% gravel (field estimate)	
				R-1	20 35 35	118	2	SM	@2.5: SILTY SAND WITH GRAVEL (SM): dense, brown, dry, fine to coarse sand, 20% fines, 15% gravel (field estimate)	
	5			R-2	12 20 18	124	2	SM	@5: SILTY SAND WITH GRAVEL (SM): medium dense, brown, dry, fine to coarse sand, 20% fines, 15% gravel (field estimate)	CO
				S-1	7 27 50/2"			SMg	@7.5: SILTY SAND WITH GRAVEL (SMg): very dense, brown, dry, fine to coarse sand, 20% fines, 25% gravel (field estimate)	
	10				50/2"				@10: NO RECCOVERY, gray sandstone present in shoe	
	15			S-2	50/5"			SP	@15: POORLY GRADED SAND WITH SILT AND GRAVEL (SP): very dense, light brown, slightly moist, fine to medium sand, 10% fines, 15% gravel (field estimate) Auger Grinding	
	20			S-3	50/6"			SP	@20: POORLY GRADED SAND WITH SILT AND GRAVEL (SP): very dense, light brown, slightly moist, fine to medium sand, slight cementation, 10% fines, 15% gravel (field estimate)	
	25			S-4	50/6"			SP	@25: POORLY GRADED SAND WITH SILT AND GRAVEL (SP): very dense, brown and white, slightly moist, fine to medium sand, 10% fines, 15% gravel (field estimate)	
	30									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

*** * * This log is a part of a report by Leighton and should not be used as a stand-alone document. * * ***

GEOTECHNICAL BORING LOG LB-16

Project No.	13673.001	**Date Drilled**	9-22-22
Project	Synergy Parcel A	**Logged By**	AA
Drilling Co.	2R Drilling	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	'
Location	See Figure 2 - Exploration Location Map	**Sampled By**	AA

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
	30			S-5	16 22 32			SM	@30: SILTY SAND (SM): very dense, brown, slightly moist, fine to medium sand, cemented, 40% fines (field estimate)	
									TOTAL DEPTH = 31.5 FEET **NO GROUNDWATER ENCOUNTERED** **BACKFILLED TO SURFACE WITH SOIL CUTTINGS**	
	35									
	40									
	45									
	50									
	55									
	60									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

Leighton

GEOTECHNICAL BORING LOG LB-17

Project No.	13673.001	**Date Drilled**	9-22-22
Project	Synergy Parcel A	**Logged By**	AA
Drilling Co.	2R Drilling	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	'
Location	See Figure 2 - Exploration Location Map	**Sampled By**	AA

SOIL DESCRIPTION

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
	0			B-1				ML	**Older Alluvial Sediments (Qoa)** @Surface: SANDY SILT WITH GRAVEL (ML): gray, dry, fine sand, 75% low plasticity fines, 15% gravel (field estimate)	SA, MD, RV, CR
				R-1	26 50/5"	118	2	SMg	@2.5: SILTY GRAVELLY SAND (SMg): very dense, white, slightly moist, 21% fines, 22% gravel (lab)	
	5			R-2	50/4"			SMg	@5: SILTY GRAVELLY SAND (SMg): very dense, white, slightly moist, 20% fines, 20% gravel (field estimate)	
				S-1	10 14 19			SM	@7.5: SILTY SAND WITH GRAVEL (SM): dense, brown, slightly moist, fine to coarse sand, 20% fines, 15% gravel (field estimate)	
	10			S-2	37 27 18			SPg	@10: POORLY GRADED GRAVELLY SAND WITH SILT (SPg): dense, white, slightly moist, fine to coarse sand, 10% fines, 20% gravel (field estimate) Gray sandstone present	
	15			S-3	50/6"			SPg	@15: POORLY GRADED SAND WITH SILT (SPg): very dense, white, slightly moist, fine to coarse sand, 10% fines, 20% gravel (field estimate) Poor Recovery, Auger chatter	
	20			S-4	50/6"			SPg	@20: POORLY GRADED GRAVELLY SAND WITH SILT (SPg): very dense, white, slightly moist, fine to coarse sand, 10% fines, 25% angular gravel up to 1.5" (field estimate)	
	25			S-5	25 32 35		4	SM	@25: SILTY SAND (SM): very dense, brown, slightly moist, fine to coarse sand, 26% fines (lab)	-200
	30									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

Leighton

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GEOTECHNICAL BORING LOG LB-17

Project No.	13673.001	**Date Drilled**	9-22-22
Project	Synergy Parcel A	**Logged By**	AA
Drilling Co.	2R Drilling	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	'
Location	See Figure 2 - Exploration Location Map	**Sampled By**	AA

SOIL DESCRIPTION

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
	30			S-6	20 50/6"			SM	@30: SILTY SAND WITH GRAVEL (SM): very dense, brown, slightly moist, fine to coarse sand, 20% fines, 15% fine gravel (field estimate) Poor Recovery, Auger chatter	
	35			S-7	20 36 36		2	SPg	@35: POORLY GRADED GRAVELLY SAND WITH SILT AND GRAVEL (SPg): very dense, brown, slightly moist, fine to coarse sand, 11% fines (lab), 20% gravel (field estimate)	-200
	40			S-8	50/6"			SMg	@40: SILTY GRAVELLY SAND WITH GRAVEL (SMg): very dense, brown, slightly moist, fine to coarse sand, 20% fines, 20% gravel (field estimate)	
	45			S-9	50/6"			SMg	@45: SILTY GRAVELLY SAND WITH GRAVEL (SMg): very dense, brown, slightly moist, fine to coarse sand, 30% fines, 25% gravel (field estimate) Auger chatter, gravel and cobble found in cuttings	
	50			S-10	36 50/4"			SP	@50: POORLY GRADED SAND WITH SILT AND GRAVEL (SP): very dense, light brown, slightly moist, fine to medium sand, 10% fines, 15% gravel (field estimate)	
	55								**TOTAL DEPTH = 51 FEET** **NO GROUNDWATER ENCOUNTERED** **BACKFILLED TO SURFACE WITH SOIL CUTTINGS**	
	60									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

Leighton

GEOTECHNICAL BORING LOG LB-18

Project No.	13673.001	**Date Drilled**	9-21-22
Project	Synergy Parcel A	**Logged By**	AA
Drilling Co.	2R Drilling	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	'
Location	See Figure 2 - Exploration Location Map	**Sampled By**	AA

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION *This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.*	Type of Tests
	0			B-1				SP-SM	**Older Alluvial Sediments (Qoa)** @Surface: POORLY GRADED GRAVELLY SAND WITH SILT (SPg): Light brown, dry, fine to coarse sand, 10% fines, 20% gravel (field estimate)	
				S-1	50/4"			SM	@2.5: SILTY SAND WITH AND GRAVEL (SM): very dense, white, dry, fine to medium sand, trace of gravel, 25% fines (field estimate) Poor Recovery	
	5			S-2	21 37 48			SM	@5: SILTY SAND WITH AND GRAVEL (SM): very dense, white, dry, fine to medium sand, trace of gravel, 25% fines (field estimate)	
				S-3	29 50/5"			SM	@7.5: SILTY SAND WITH AND GRAVEL (SM): very dense, white, slightly moist, fine to coarse sand, 27% fines, (lab)	-200
	10			S-4	30 50/6"			SPg	@10: POORLY GRADED GRAVELLY SAND (SPg): very dense, light brown, slightly moist, fine to coarse sand, 20% gravel (field estimate)	
	15			S-5	50/4"			SPg	@15: POORLY GRADED SAND WITH GRAVEL (SPg): very dense, white, slightly moist, fine to coarse sand, 25% gravel (field estimate) Poor Recovery	
	20			S-6	50/4"			SPg	@20: POORLY GRADED GRAVELLY SAND WITH GRAVEL (SPg): very dense, white, slightly moist, fine to coarse sand, 20% gravel (field estimate) Poor Recovery	
									TOTAL DEPTH = 20.5 FEET **NO GROUNDWATER ENCOUNTERED** **BACKFILLED TO SURFACE WITH SOIL CUTTINGS**	
	25									
	30									

SAMPLE TYPES:
- **B** BULK SAMPLE
- **C** CORE SAMPLE
- **G** GRAB SAMPLE
- **R** RING SAMPLE
- **S** SPLIT SPOON SAMPLE
- **T** TUBE SAMPLE

TYPE OF TESTS:

-200	% FINES PASSING	DS	DIRECT SHEAR	SA	SIEVE ANALYSIS
AL	ATTERBERG LIMITS	EI	EXPANSION INDEX	SE	SAND EQUIVALENT
CN	CONSOLIDATION	H	HYDROMETER	SG	SPECIFIC GRAVITY
CO	COLLAPSE	MD	MAXIMUM DENSITY	UC	UNCONFINED COMPRESSIVE STRENGTH
CR	CORROSION	PP	POCKET PENETROMETER		
CU	UNDRAINED TRIAXIAL	RV	R VALUE		

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GEOTECHNICAL BORING LOG LB-19

Project No.	13673.001	**Date Drilled**	9-22-22
Project	Synergy Parcel A	**Logged By**	AA
Drilling Co.	2R Drilling	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	'
Location	See Figure 2 - Exploration Location Map	**Sampled By**	AA

SOIL DESCRIPTION

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

Elevation Feet	Depth Feet	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	Soil Description	Type of Tests
	0							**Older Alluvial Sediments (Qoa)**	
								@Surface: POORLY GRADED GRAVELLY SAND (SPg): brown, dry, fine to coarse sand, 25% gravel (field estimate)	
			R-1	12 20 29	104	3	SPg	@2.5: POORLY GRADED GRAVELLY SAND WITH SILT (SPg): medium dense, white, dry, fine to medium sand, 10% fines, 25% gravel (field estimate)	
	5		R-2	12 40 50	104	3	SM	@5: SILTY SAND WITH GRAVEL (SM): very dense, white, slightly moist, fine to medium sand, 20% fines, 15% gravel (field estimate)	
			S-1	50/6"			SM	@7.5: SILTY SAND WITH GRAVEL (SM): very dense, white, slightly moist, fine to medium sand, 20% fines, 15% gravel (field estimate)	
	10		S-2	25 50/5"			SM	@10: SILTY SAND WITH GRAVEL (SM): very dense, white, slightly moist, fine to medium sand, 20% fines, 15% gravel (field estimate)	
	15		S-3	22 30 22			SM	@15: SILTY SAND (SM): very dense, brown, slightly moist, fine to medium sand, 20% fines (lab)	-200
								@17.5: Met Refusal, Auger grinding on rock/boulder	
	20							**MET REFUSAL AT 17.5 FEET** **NO GROUNDWATER ENCOUNTERED** **BACKFILLED TO SURFACE WITH SOIL CUTTINGS**	
	25								
	30								

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

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GEOTECHNICAL BORING LOG IT-1

Project No.	13673.001	**Date Drilled**	9-14-22
Project	Synergy Parcel A	**Logged By**	AA
Drilling Co.	2R Drilling	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	'
Location	See Figure 2 - Exploration Location Map	**Sampled By**	AA

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
	0								**Older Alluvial Sediments (Qoa)**	
									@Surface: POORLY GRADED GRAVELLY SAND (SPg): Brown, dry, fine to coarse sand, 20% gravel (field estimate)	
	5									
	10									
				S-1	31 42 50/5"			SM	@12.5': SILTY SAND (SM): very dense, light brown, slightly moist, fine to coarse sand, slight cementation, 23% fines (lab)	SA
	15								**TOTAL DEPTH = 15 FEET** **NO GROUNDWATER ENCOUNTERED** **INFILTRATION TEST PERFORMED FROM 10 TO 15 FEET**	
	20									
	25									
	30									

SOIL DESCRIPTION: This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

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GEOTECHNICAL BORING LOG IT-2

Project No.	13673.001	**Date Drilled**	9-21-22
Project	Synergy Parcel A	**Logged By**	AA
Drilling Co.	2R Drilling	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	'
Location	See Figure 2 - Exploration Location Map	**Sampled By**	AA

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION *This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.*	Type of Tests
	0								**Older Alluvial Sediments (Qoa)** @Surface: POORLY GRADED SAND WITH GRAVEL (SP): Light Brown, dry, fine to coarse sand, 10% fines, 15% gravel (field estimate)	
	5									
	10			S-1	31 33 32			SM	@10: SILTY SAND (SM): very dense, light brown, dry, fine to coarse sand, 24% fines (estimate) Slight auger chatter	
				S-2	27 36 50/6"			SM	@12.5: SILTY SAND (SM): very dense, light brown, dry, fine to coarse sand, slight cementation, 24% fines (lab)	SA
	15								**TOTAL DEPTH = 15 FEET** **NO GROUNDWATER ENCOUNTERED** **INFILTRATION TEST PERFORMED FROM 10 TO 15 FEET**	
	20									
	25									
	30									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

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GEOTECHNICAL BORING LOG IT-3

Project No.	13673.001	**Date Drilled**	9-14-22
Project	Synergy Parcel A	**Logged By**	AA
Drilling Co.	2R Drilling	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	'
Location	See Figure 2 - Exploration Location Map	**Sampled By**	AA

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION *This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.*	Type of Tests
	0								**Older Alluvial Sediments (Qoa)**	
									@Surface: POORLY GRADED GRAVELLY SAND (SPg): Brown, dry, fine-coarse sand, 25% gravel (field estimate)	
	5									
	10								@10': Auger grinding (drilled through rock)	
				S-1	19 40 50/5"			SM	@13.5': SILTY SAND (SM): very dense, light brown, slightly moist, fine-coarse sand, 21% fines (lab)	SA
	15								**TOTAL DEPTH = 15 FEET** **NO GROUNDWATER ENCOUNTERED** **INFILTRATION TEST PERFORMED FROM 10 TO 15 FEET**	
	20									
	25									
	30									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

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GEOTECHNICAL BORING LOG IT-4

Project No.	13673.001	**Date Drilled**	9-21-22
Project	Synergy Parcel A	**Logged By**	AA
Drilling Co.	2R Drilling	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	'
Location	See Figure 2 - Exploration Location Map	**Sampled By**	AA

SOIL DESCRIPTION

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
	0								**Older Alluvial Sediments (Qoa)**	
									@Surface: POORLY GRADED GRAVELLY SAND (SPg): light brown, dry, fine-coarse sand, 10% fines, 20% gravel (field estimate)	
	5									
	10			S-1	34 50/3"			SM	@10: SILTY SAND (SM): very dense, light brown, dry, fine-coarse sand, 20% fines (lab)	-200
				S-2	19 17 12			SM	@12.5: SILTY SAND WITH GRAVEL (SM): medium dense, light brown, slightly moist, medium to coarse sand, 13% fines (lab)	-200
	15									
									TOTAL DEPTH = 15 FEET **NO GROUNDWATER ENCOUNTERED** **INFILTRATION TEST PERFORMED FROM 10 TO 15 FEET**	
	20									
	25									
	30									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:

-200	% FINES PASSING	DS	DIRECT SHEAR	SA	SIEVE ANALYSIS
AL	ATTERBERG LIMITS	EI	EXPANSION INDEX	SE	SAND EQUIVALENT
CN	CONSOLIDATION	H	HYDROMETER	SG	SPECIFIC GRAVITY
CO	COLLAPSE	MD	MAXIMUM DENSITY	UC	UNCONFINED COMPRESSIVE STRENGTH
CR	CORROSION	PP	POCKET PENETROMETER		
CU	UNDRAINED TRIAXIAL	RV	R VALUE		

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Results of Well Permeameter, from USBR 7300-89 Method

Leighton 60 Anniversary

Project:	13673.001	Initial estimated Depth to Water Surface (in.):	126
Exploration #/Location:	*LI-1*	Average depth of water in well, "h" (in.):	53
Depth Boring drilled, bgs (ft):	15	approx. h/r:	13.4
Tested by:	AA	Tu (Fig. 8) (ft):	89.5
USCS Soil Type in test zone:	SP-SM	Tu>3h?:	yes, OK
Weather (start to finish):	Sunny		
Water Source/pH:	H2O		
Measured boring diameter:	8 in.	4 in. Well Radius	
Depth to GW or aquitard, bgs:	100 ft		
Well Prep:	Drill to 15', bottom 10' screen pipe, sand backfilll in test zone		

Cross-sectional area for flow calcs based on Δh

Well pack sand porosity	0.4
Casing outer diameter, in.	2.3
Casing inner diameter, in.	2.1
Cross-sectional area, in.^2	21.9

	ft	in.	Total (in.)
Depth to bottom of well measured from top of auger (or ground surfa	15.1 ft	0. in.	181
Casing stickup measured above top of auger (or ground surface) (+ i	0. ft	2. in.	2
Depth to top of sand from top of casing			

Depth of well bottom below top of casing (in): 183

Use of Barrels:	No
Use of Flow Meter:	Yes
Test Type:	Constant Head

Flow Meter ID: 2497 Meter Units: Gallons 0.05 gallons/pulse

Data logger ID:

Field Data **Calculations**

Date	Time	Data from Flow Meter: Reading (gallons)	Interval Pulse Count	Depth to WL in Boring (measured from top of casing) ft	in.	Water Temp (deg F)	Refilled? (or Comments)	Δt (min)	Total Elapsed Time (min)	Depth to WL in well (in.)	h, Height of Water in Well (in.)	Δh (in.)	Avg. h	Vol Change (in.^3) from supply	from Δh	Total	Flow (in^3/ min)	q, Flow (in^3/ hr)	Average Infiltration Surface Area, (in^2)	V (Fig 9)	K20, Coef. Of Perme-ability at 20 deg C (in./hr)	Infiltration Rate [flow/surf area] (in./hr) (FS=1)
Start Date	Start time:																					
9/27/2022	11:37	Gallons		ft	in.																	
9/27/22	11:37	1590.14		11.23					0	132.8	48.4											
9/27/22	11:40	1591.45		11.08				3	3	131.0	50.2	1.8	49	303	-39	263	88	5264	1290	0.9	0.70	3.76
9/27/22	11:45	1593.6		10.90				5	8	128.8	52.4	2.16	51	497	-47	449	90	5392	1340	0.9	0.67	3.71
9/27/22	11:53	1597.04		10.61				8	16	125.3	55.9	3.48	54	795	-76	718	90	5388	1411	0.9	0.60	3.52
9/27/22	12:03	1601.35		10.32				10	26	121.8	59.4	3.48	58	996	-76	919	92	5516	1498	0.9	0.56	3.39
9/27/22							adjust flow															
9/27/22	12:05	1601.95		10.54					28	124.5	56.7											
9/27/22	12:15	1604.3		10.97				10	38	129.6	51.6	-5.16	54	543	113	656	66	3935	1411	0.9	0.51	2.57
9/27/22	12:25	1606.67		11.00				10	48	130.0	51.2	-0.36	51	547	8	555	56	3332	1342	0.9	0.43	2.29
9/27/22	12:35	1609.04		10.95				10	58	129.4	51.8	0.6	52	547	-13	534	53	3206	1345	0.9	0.41	2.20
9/27/22	12:45	1611.38		10.90				10	68	128.8	52.4	0.6	52	541	-13	527	53	3164	1360	0.9	0.39	2.15
9/27/22	12:55	1613.73		10.83				10	78	128.0	53.2	0.84	53	543	-18	524	52	3147	1378	0.9	0.38	2.11
9/27/22	13:05	1616.08		10.80				10	88	127.6	53.6	0.36	53	543	-8	535	53	3210	1393	0.9	0.39	2.12
9/27/22	13:15	1618.44		10.78				10	98	127.4	53.8	0.24	54	545	-5	540	54	3239	1400	0.9	0.39	2.13
9/27/22	13:25	1620.78		10.71				10	108	126.5	54.7	0.84	54	541	-18	522	52	3133	1414	0.9	0.36	2.04
9/27/22	13:35	1623.12		10.70				10	118	126.4	54.8	0.12	55	541	-3	538	54	3227	1426	0.9	0.38	2.09
9/27/22	13:46	1625.69		10.69				11	129	126.3	54.9	0.12	55	594	-3	591	54	3224	1429	0.9	0.37	2.08
9/27/22	13:56	1628.03		10.68				10	139	126.2	55.0	0.12	55	541	-3	538	54	3227	1432	0.9	0.37	2.08
9/27/22	14:00	1628.95		10.68				4	143	126.2	55.0	0	55	213	0	213	53	3188	1434	0.9	0.37	2.05
																			Minimum Rate:			2.0
														Raw Rate for design, prior to application of adjustment factors:								**2.0**

Results of Well Permeameter, from USBR 7300-89 Method

Leighton 60 Anniversary

Project: 13673.001
Exploration #/Location: *LI-2*
Depth Boring drilled, bgs (ft): 15
Tested by: AA
USCS Soil Type in test zone: SP-SM
Weather (start to finish): Sunny
Water Source/pH: H2O
Measured boring diameter: 8 in. 4 in. Well Radius
Depth to GW or aquitard, bgs: 100 ft
Well Prep: Drill to 15', bottom 5' screen pipe, sand backfilll in test zone

Initial estimated Depth to Water Surface (in.): 150
Average depth of water in well, "h" (in.): 42
approx. h/r: 10.6
Tu (Fig. 8) (ft): 87.5
Tu>3h?: yes, OK

Cross-sectional area for flow calcs based on Δh
Well pack sand porosity: 0.4
Casing outer diameter, in.: 2.3
Casing inner diameter, in.: 2.1
Cross-sectional area, in.^2: 21.9

Use of Barrels: No
Use of Flow Meter: Yes
Test Type: Constant Head

	ft	in.	Total (in.)
Depth to bottom of well measured from top of auger (or ground surfa	15.5 ft	0. in.	186
Casing stickup measured above top of auger (or ground surface) (+ i	0. ft	-6. in.	-6
Depth to top of sand from top of casing			

Depth of well bottom below top of casing (in): 180

Flow Meter ID: 2497 Meter Units: Gallons 0.05 gallons/pulse
Data logger ID:

Field Data / **Calculations**

Date	Time	Data from Flow Meter: Reading (gallons)	Data from Flow Meter: Interval Pulse Count	Depth to WL in Boring (measured from top of casing): ft	Depth to WL in Boring: in.	Water Temp (deg F)	Refilled? (or Comments)	Δt (min)	Total Elapsed Time (min)	Depth to WL in well (in.)	h, Height of Water in Well (in.)	Δh (in.)	Avg. h	Vol Change (in.^3): from supply	Vol Change: from Δh	Vol Change: Total	Flow (in^3/ min)	q, Flow (in^3/ hr)	Average Infiltration Surface Area, (in^2)	V (Fig 9)	K20, Coef. Of Perme-ability at 20 deg C (in./hr)	Infiltration Rate [flow/surf area] (in./hr) (FS=1)
Start Date	Start time:	Gallons																				
9/26/2022	14:28																					
9/26/22	14:28	1540.69		11.56					0	144.7	41.3											
9/26/22	14:30	1541.31		11.5				2	2	144.0	42.0	0.72	42	143	-16	127	64	3823	1097	0.9	0.68	3.21
9/26/22							Flow Change															
9/26/22	14:35	1542.75		11.55					7	144.6	41.4											
9/26/22	14:40	1544.72		11.07				5	12	138.8	47.2	5.76	44	455	-126	329	66	3947	1163	0.9	0.57	3.13
9/26/22	14:42	1545.48		10.5				2	14	132.0	54.0	6.84	51	176	-150	26	13	771	1321	0.9	0.09	0.54
9/26/22	14:45	1546.01		11.28			Adjust flow	3	17	141.4	44.6	-9.36	49	122	205	327	109	6550	1290	0.9	1.10	4.68
9/26/22	14:50	1546.26		11.48				5	22	143.8	42.2	-2.4	43	58	53	110	22	1324	1142	0.9	0.24	1.07
9/26/22	15:00	1547.56		11.6				10	32	145.2	40.8	-1.44	42	300	32	332	33	1991	1094	0.9	0.37	1.68
9/26/22	15:10	1548.83		11.7				10	42	146.4	39.6	-1.2	40	293	26	320	32	1918	1061	0.9	0.38	1.67
9/26/22	15:20	1550.15		11.73				10	52	146.8	39.2	-0.36	39	305	8	313	31	1877	1041	0.9	0.37	1.66
9/26/22	15:30	1551.43		11.73				10	62	146.8	39.2	0	39	296	0	296	30	1774	1036	0.9	0.35	1.58
9/26/22	15:40	1552.7		11.72				10	72	146.6	39.4	0.12	39	293	-3	291	29	1744	1038	0.9	0.34	1.55
9/26/22	15:50	1553.98		11.7				10	82	146.4	39.6	0.24	39	296	-5	290	29	1743	1043	0.9	0.34	1.54
9/26/22	16:00	1555.26		11.7				10	92	146.4	39.6	0	40	296	0	296	30	1774	1046	0.9	0.35	1.56

Minimum Rate: 1.1
Raw Rate for design, prior to application of adjustment factors: **1.5**

Results of Well Permeameter, from USBR 7300-89 Method

Leighton 60 Anniversary

Project: 13673.001
Exploration #/Location: *LI-3*
Depth Boring drilled, bgs (ft): 14
Tested by: AA
USCS Soil Type in test zone: SM / SP-SM
Weather (start to finish): Sunny
Water Source/pH: H2O
Measured boring diameter: 8 in. — 4 in. Well Radius
Depth to GW or aquitard, bgs: 100 ft
Well Prep: Drill to 14', bottom 5' screen pipe, sand backfilll in test zone

Initial estimated Depth to Water Surface (in.): 122
Average depth of water in well, "h" (in.): 38
approx. h/r: 9.5
Tu (Fig. 8) (ft): 89.8
Tu>3h?: yes, OK

Cross-sectional area for flow calcs based on Δh
Well pack sand porosity: 0.4
Casing outer diameter, in.: 2.3
Casing inner diameter, in.: 2.1
Cross-sectional area, in.^2: 21.9

Use of Barrels: No
Use of Flow Meter: Yes
Test Type: Constant Head

	ft	in.	Total (in.)
Depth to bottom of well measured from top of auger (or ground surfa	14. ft	4. in.	172
Casing stickup measured above top of auger (or ground surface) (+ i	0. ft	12. in.	12
Depth to top of sand from top of casing			

Depth of well bottom below top of casing (in): 184

Flow Meter ID: 2497 Meter Units: Gallons 0.05 gallons/pulse
Data logger ID:

Field Data — **Calculations**

Date	Time	Data from Flow Meter: Reading (gallons)	Data from Flow Meter: Interval Pulse Count	Depth to WL in Boring (measured from top of casing): ft	Depth to WL: in.	Water Temp (deg F)	Refilled? (or Comments)	Δt (min)	Total Elapsed Time (min)	Depth to WL in well (in.)	h, Height of Water in Well (in.)	Δh (in.)	Avg. h	Vol Change (in.^3): from supply	Vol Change (in.^3): from Δh	Vol Change (in.^3): Total	Flow (in^3/ min)	q, Flow (in^3/ hr)	Average Infiltration Surface Area, (in^2)	V (Fig 9)	K20, Coef. Of Perme-ability at 20 deg C (in./hr)	Infiltration Rate [flow/surf area] (in./hr) (FS=1)
Start Date	Start time:	Gallons		ft	in.																	
9/28/2022	8:42																					
9/28/22	8:42	1639.65		12.16					0	133.9	38.1											
9/28/22	8:45	1640.34		12.2				3	3	134.4	37.6	-0.48	38	159	11	170	57	3398	1001	0.9	0.72	3.13
9/28/22	8:50	1641.48		12.28				5	8	135.4	36.6	-0.96	37	263	21	284	57	3412	983	0.9	0.76	3.20
9/28/22	9:00	1643.76		12.45				10	18	137.4	34.6	-2.04	36	527	45	571	57	3428	945	0.9	0.84	3.34
9/28/22							Adjust Flow															
9/28/22	9:05	1645.32		12.21					23	134.5	37.5											
9/28/22	9:15	1648.59		12.05				10	33	132.6	39.4	1.92	38	755	-42	713	71	4280	1016	0.9	0.83	3.88
9/28/22	9:25	1651.86		11.9				10	43	130.8	41.2	1.8	40	755	-39	716	72	4296	1063	0.9	0.78	3.72
9/28/22	9:35	1655.07		11.78				10	53	129.4	42.6	1.44	42	742	-32	710	71	4260	1104	0.9	0.73	3.56
9/28/22	9:45	1657.75		11.83			Adjust Flow	10	63	130.0	42.0	-0.6	42	619	13	632	63	3793	1114	0.9	0.68	3.14
9/28/22	9:55	1659.89		12.27				10	73	135.2	36.8	-5.28	39	494	116	610	61	3660	1040	0.9	0.83	3.24
9/28/22	10:05	1662.01		12.3				10	83	135.6	36.4	-0.36	37	490	8	498	50	2986	970	0.9	0.67	2.84
9/28/22	10:15	1664.14		12.3				10	93	135.6	36.4	0	36	492	0	492	49	2952	965	0.9	0.66	2.82
9/28/22	10:25	1666.25		12.3				10	103	135.6	36.4	0	36	487	0	487	49	2924	965	0.9	0.65	2.79
9/28/22	10:35	1668.38		12.3				10	113	135.6	36.4	0	36	492	0	492	49	2952	965	0.9	0.66	2.82
9/28/22	10:45	1670.48		12.3				10	123	135.6	36.4	0	36	485	0	485	49	2911	965	0.9	0.65	2.78
																				Minimum Rate:		2.8
														Raw Rate for design, prior to application of adjustment factors:								**2.8**

Results of Well Permeameter, from USBR 7300-89 Method

Project: 13673.001

Exploration #/Location:	*LI-4*	Initial estimated Depth to Water Surface (in.):	142
Depth Boring drilled, bgs (ft):	15	Average depth of water in well, "h" (in.):	39
Tested by:	AA	approx. h/r:	9.7
USCS Soil Type in test zone:	SP	Tu (Fig. 8) (ft):	88.1
Weather (start to finish):	Sunny	Tu>3h?:	yes, OK
Water Source/pH:	H2O		
Measured boring diameter:	8 in.	4 in. Well Radius	
Depth to GW or aquitard, bgs:	100 ft		
Well Prep:	Drill to 15', bottom 5' screen pipe, sand backfilll in test zone		

Cross-sectional area for flow calcs based on Δh

Well pack sand porosity	0.4
Casing outer diameter, in.	2.3
Casing inner diameter, in.	2.1
Cross-sectional area, in.^2	21.9

Use of Barrels:	No
Use of Flow Meter:	Yes
Test Type:	Constant Head

	ft	in.	Total (in.)
Depth to bottom of well measured from top of auger (or ground surfa	15.1 ft	0. in.	181
Casing stickup measured above top of auger (or ground surface) (+ i	0. ft	0. in.	0
Depth to top of sand from top of casing			

Depth of well bottom below top of casing (in): 181

Flow Meter ID: 2497 Meter Units: Gallons 0.05 gallons/pulse Data logger ID:

Field Data / **Calculations**

Date	Time	Data from Flow Meter: Reading (gallons)	Interval Pulse Count	Depth to WL in Boring (measured from top of casing) ft	in.	Water Temp (deg F)	Refilled? (or Comments)	Δt (min)	Total Elapsed Time (min)	Depth to WL in well (in.)	h, Height of Water in Well (in.)	Δh (in.)	Avg. h	Vol Change (in.^3) from supply	from Δh	Total	Flow (in^3/ min)	q, Flow (in^3/ hr)	Average Infiltration Surface Area, (in^2)	V (Fig 9)	K20, Coef. Of Perme-ability at 20 deg C (in./hr)	Infiltration Rate [flow/surf area] (in./hr) (FS=1)
Start Date 9/26/2022	Start time: 11:55	Gallons																				
9/26/22	11:55	1433.44		12.11					0	145.3	35.9											
9/26/22	12:00	1437.29		12.07				5	5	144.8	36.4	0.48	36	889	-11	879	176	10546	958	0.9	2.34	10.15
9/26/22	12:05	1441.44		12.04				5	10	144.5	36.7	0.36	37	959	-8	951	190	11409	969	0.9	2.50	10.86
9/26/22	12:15	1450.07		11.95				10	20	143.4	37.8	1.08	37	1994	-24	1970	197	11819	987	0.9	2.46	11.04
9/26/22	12:25	1458.15		11.91				10	30	142.9	38.3	0.48	38	1866	-11	1856	186	11136	1006	0.9	2.28	10.20
9/26/22	12:35	1466.53		11.88				10	40	142.6	38.6	0.36	38	1936	-8	1928	193	11567	1017	0.9	2.34	10.49
9/26/22	12:45	1474.92		11.86				10	50	142.3	38.9	0.24	39	1938	-5	1933	193	11597	1024	0.9	2.32	10.44
9/26/22	12:55	1483.35		11.82				10	60	141.8	39.4	0.48	39	1947	-11	1937	194	11621	1033	0.9	2.28	10.37
9/26/22	13:05	1491.16		11.78				10	70	141.4	39.8	0.48	40	1804	-11	1794	179	10762	1046	0.9	2.07	9.49
9/26/22	13:15	1500.17		11.72				10	80	140.6	40.6	0.72	40	2081	-16	2066	207	12393	1061	0.9	2.32	10.77
9/26/22	13:25	1508.65		11.73				10	90	140.8	40.4	-0.12	41	1959	3	1962	196	11769	1068	0.9	2.22	10.16
9/26/22	13:35	1517.01		11.75				10	100	141.0	40.2	-0.24	40	1931	5	1936	194	11619	1064	0.9	2.22	10.07
9/26/22	13:45	1525.53		11.7				10	110	140.4	40.8	0.6	41	1968	-13	1955	195	11730	1068	0.9	2.18	10.12
9/26/22	13:55	1533.89		11.72				10	120	140.6	40.6	-0.24	41	1931	5	1936	194	11619	1073	0.9	2.18	9.99
9/26/22																						
9/26/22																						
																				Minimum Rate:		9.5
														Raw Rate for design, prior to application of adjustment factors:								**10.0**

APPENDIX C

LABORATORY TEST RESULTS

APPENDIX C

GEOTECHNICAL LABORATORY TESTING

The geotechnical laboratory testing program was directed toward a quantitative and qualitative evaluation of the physical and mechanical properties of the soils underlying the site and to aid in verifying soil classification.

In-Situ Moisture and Density: The natural water content (ASTM D 2216) and in-situ dry density (ASTM D 2937) were determined for recovered relatively undisturbed ring-lined barrel drive samples, from our subsurface explorations. Results of these tests are shown on the logs at the appropriate sample depths, in Appendix B.

Expansion Index: An Expansion Index (EI) test was performed on a bulk sample of the site soils, in general accordance with the ASTM D 4829 Standard Test Method. Results of this test are presented on the “Expansion Index” sheet in this appendix.

Sieve Analysis: Sieve analyses (ASTM D 422) were performed on selected subsurface soil samples. These tests were performed to assist in the classification of the soil. Results of these tests are presented on the “*Particle Size Analysis of Soils*” figures.

Collapse Potential: Collapse potential tests were performed on selected soil samples in general accordance with ASTM Standard Test Method D 5333. Test results are presented on the “*One Dimensional Swell or Settlement*” figure.

Modified Proctor Compaction Curve: A laboratory modified Proctor compaction test (ASTM D 1557) was performed on a bulk soil sample to determine maximum laboratory dry density and optimum moisture content. Result of this test is presented on the following “*Modified Proctor Compaction Test*” plot in this appendix.

Percent Passing No. 200 Sieve: Percent fines (silt and clay) passing the No. 200 U.S. Standard Sieve was determined for soil samples in accordance with ASTM D1140 Standard Test Method. Samples were dried and passed through a No. 4 sieve, then a No. 200 sieve. Result of grain size analyses, as percent by dry weight passing the No. 200 U.S. Standard Sieve, is tabulated in this appendix and entered on our boring logs.

R-value Test: One R-value test was performed on collected bulk soil sample to evaluate pavement support characteristics of the near-surface soils. R-value test was performed in accordance with Caltrans Standard Test Method 301. The test result is presented in this appendix.

Remolded Direct Shear: One Remolded Direct Shear test was performed on a collected bulk soil sample to determine the shear strength of soils at sloped areas. Direct Shear test was performed in accordance with ASTM D3080-04. The test result is presented in this appendix.

Corrosivity Tests: To evaluate the corrosion potential of the subsurface soils at the site, we tested representative bulk samples collected during our subsurface investigation for pH, resistivity and soluble sulfate and chloride content testing. Results of these tests are presented at the end of this appendix.

EXPANSION INDEX of SOILS
ASTM D 4829

Project Name:	Parcel A Apple Valley	Tested By:	J. Gonzalez	Date:	10/05/22
Project No.:	13673.001	Checked By:	A. Santos	Date:	10/07/22
Boring No.:	LB-17	Depth (ft.):	0-5		
Sample No.:	B-1				
Soil Identification:	Light brown silty sand with gravel (SM)g				

Dry Wt. of Soil + Cont. (g)	1000.00
Wt. of Container No. (g)	0.00
Dry Wt. of Soil (g)	1000.00
Weight Soil Retained on #4 Sieve	0.00
Percent Passing # 4	100.00

MOLDED SPECIMEN	Before Test	After Test
Specimen Diameter (in.)	4.01	4.01
Specimen Height (in.)	1.0000	1.0015
Wt. Comp. Soil + Mold (g)	583.50	393.20
Wt. of Mold (g)	201.10	0.00
Specific Gravity (Assumed)	2.70	2.70
Container No.	O	O
Wet Wt. of Soil + Cont. (g)	757.60	594.30
Dry Wt. of Soil + Cont. (g)	675.80	532.22
Wt. of Container (g)	0.00	201.10
Moisture Content (%)	12.10	18.75
Wet Density (pcf)	115.3	118.4
Dry Density (pcf)	102.9	99.7
Void Ratio	0.638	0.690
Total Porosity	0.390	0.408
Pore Volume (cc)	80.7	84.7
Degree of Saturation (%) [S_{meas}]	**51.2**	73.3

SPECIMEN INUNDATION in distilled water for the period of 24 h or expansion rate < 0.0002 in./h

Date	Time	Pressure (psi)	Elapsed Time (min.)	Dial Readings (in.)
10/05/22	11:05	1.0	0	0.5055
10/05/22	11:15	1.0	10	0.5055
Add Distilled Water to the Specimen				
10/05/22	13:30	1.0	135	0.5065
10/06/22	6:00	1.0	1125	0.5070
10/06/22	7:00	1.0	1185	0.5070

Expansion Index (EI_{meas}) = ((Final Rdg - Initial Rdg) / Initial Thick.) x 1000	**2**

MODIFIED PROCTOR COMPACTION TEST

ASTM D 1557

Leighton

Project Name:	Parcel A Apple Valley	Tested By:	J. Gonzalez	Date:	09/27/22
Project No.:	13673.001	Checked By:	A. Santos	Date:	10/07/22
Boring No.:	LB-6	Depth (ft.):	0-5		
Sample No.:	B-1				
Soil Identification:	Light brown silty sand with gravel (SM)g				

Note: Corrected dry density calculation assumes specific gravity of 2.70 and moisture content of 1.0% for oversize particles

Preparation Method:	X	Moist
		Dry
Compaction Method	X	Mechanical Ram
		Manual Ram

Scalp Fraction (%)	
#3/4	
#3/8	
#4	23.0

Rammer Weight (lb.) = 10.0
Height of Drop (in.) = 18.0
Mold Volume (ft³) 0.03330

TEST NO.	1	2	3	4	5	6
Wt. Compacted Soil + Mold (g)	3735	3829	3850	3810		
Weight of Mold (g)	1826	1826	1826	1826		
Net Weight of Soil (g)	1909	2003	2024	1984		
Wet Weight of Soil + Cont. (g)	469.4	468.7	491.9	480.1		
Dry Weight of Soil + Cont. (g)	440.0	429.3	443.2	425.2		
Weight of Container (g)	39.6	37.2	39.7	39.0		
Moisture Content (%)	7.34	10.05	12.07	14.22		
Wet Density (pcf)	126.4	132.6	134.0	131.3		
Dry Density (pcf)	117.7	120.5	119.6	115.0		

Maximum Dry Density (pcf) 120.5
Optimum Moisture Content (%) 10.5
Corrected Dry Density (pcf) 128.9
Corrected Moisture Content (%) 8.3

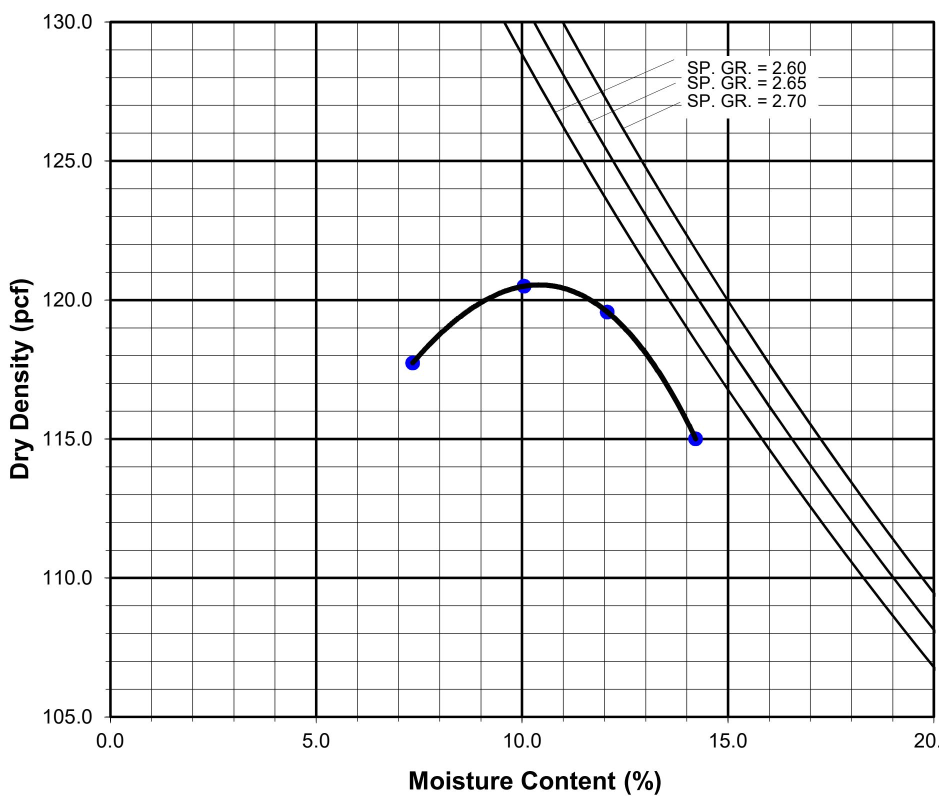
[X] **Procedure A**
Soil Passing No. 4 (4.75 mm) Sieve
Mold : 4 in. (101.6 mm) diameter
Layers : 5 (Five)
Blows per layer : 25 (twenty-five)
May be used if +#4 is 20% or less

[ ] **Procedure B**
Soil Passing 3/8 in. (9.5 mm) Sieve
Mold : 4 in. (101.6 mm) diameter
Layers : 5 (Five)
Blows per layer : 25 (twenty-five)
Use if +#4 is >20% and +3/8 in. is 20% or less

[ ] **Procedure C**
Soil Passing 3/4 in. (19.0 mm) Sieve
Mold : 6 in. (152.4 mm) diameter
Layers : 5 (Five)
Blows per layer : 56 (fifty-six)
Use if +3/8 in. is >20% and +¾ in. is <30%

Particle-Size Distribution:
GR:SA:FI

Atterberg Limits:
LL,PL,PI



MODIFIED PROCTOR COMPACTION TEST

ASTM D 1557

Project Name: Parcel A Apple Valley — Tested By: J. Gonzalez — Date: 09/27/22
Project No.: 13673.001 — Checked By: A. Santos — Date: 10/07/22
Boring No.: LB-9 — Depth (ft.): 0-5
Sample No.: B-1
Soil Identification: Light brown silty sand (SM)

Note: Corrected dry density calculation assumes specific gravity of 2.70 and moisture content of 1.0% for oversize particles

Preparation Method:	X	Moist
		Dry
Compaction Method	X	Mechanical Ram
		Manual Ram

Scalp Fraction (%)	
#3/4	
#3/8	
#4	9.8

Rammer Weight (lb.) = 10.0
Height of Drop (in.) = 18.0
Mold Volume (ft³) 0.03330

TEST NO.	1	2	3	4	5	6
Wt. Compacted Soil + Mold (g)	3780	3860	3921	3903		
Weight of Mold (g)	1826	1826	1826	1826		
Net Weight of Soil (g)	1954	2034	2095	2077		
Wet Weight of Soil + Cont. (g)	501.1	494.2	520.3	591.8		
Dry Weight of Soil + Cont. (g)	478.2	463.2	477.4	532.2		
Weight of Container (g)	37.3	37.3	39.9	39.6		
Moisture Content (%)	5.19	7.28	9.81	12.10		
Wet Density (pcf)	129.4	134.7	138.7	137.5		
Dry Density (pcf)	123.0	125.5	126.3	122.7		

Maximum Dry Density (pcf) 126.5 — **Optimum Moisture Content (%)** 9.1
Corrected Dry Density (pcf) 129.7 — **Corrected Moisture Content (%)** 8.3

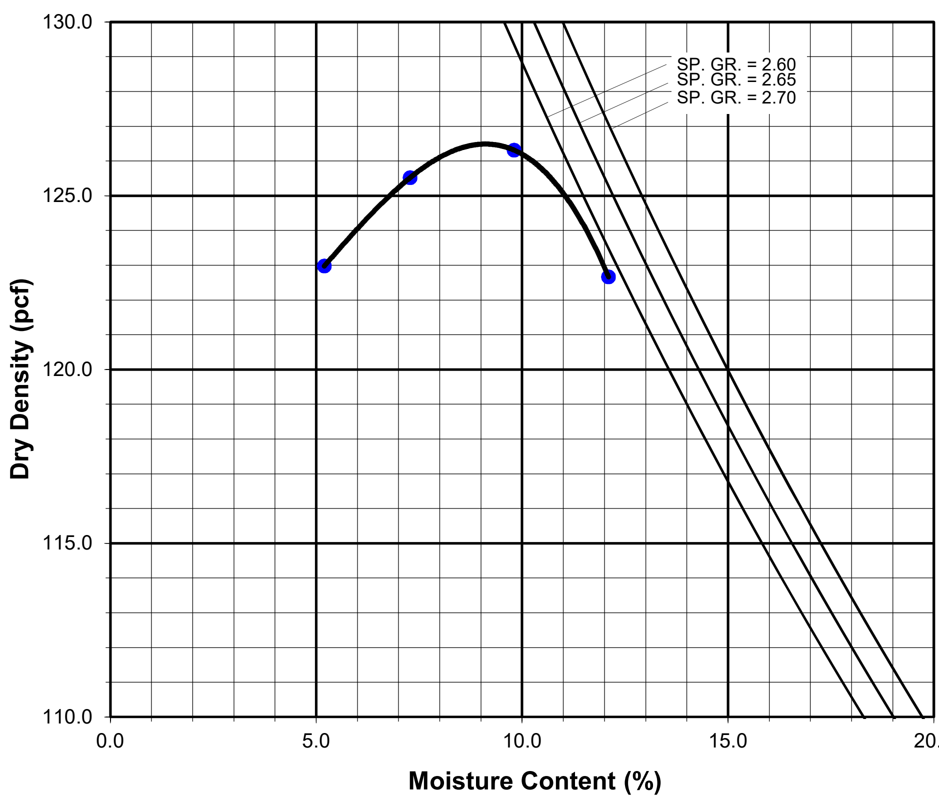
[X] **Procedure A**
Soil Passing No. 4 (4.75 mm) Sieve
Mold : 4 in. (101.6 mm) diameter
Layers : 5 (Five)
Blows per layer : 25 (twenty-five)
May be used if +#4 is 20% or less

[ ] **Procedure B**
Soil Passing 3/8 in. (9.5 mm) Sieve
Mold : 4 in. (101.6 mm) diameter
Layers : 5 (Five)
Blows per layer : 25 (twenty-five)
Use if +#4 is >20% and +3/8 in. is 20% or less

[ ] **Procedure C**
Soil Passing 3/4 in. (19.0 mm) Sieve
Mold : 6 in. (152.4 mm) diameter
Layers : 5 (Five)
Blows per layer : 56 (fifty-six)
Use if +3/8 in. is >20% and +¾ in. is <30%

Particle-Size Distribution:
GR:SA:FI

Atterberg Limits:
LL,PL,PI



Leighton

MODIFIED PROCTOR COMPACTION TEST

ASTM D 1557

Project Name:	Parcel A Apple Valley	Tested By:	J. Gonzalez	Date:	09/29/22
Project No.:	13673.001	Checked By:	A. Santos	Date:	10/07/22
Boring No.:	LB-17	Depth (ft.):	0-5		
Sample No.:	B-1				
Soil Identification:	Light brown silty sand with gravel (SM)g				

Note: Corrected dry density calculation assumes specific gravity of 2.70 and moisture content of 1.0% for oversize particles

Preparation Method:	X	Moist	Scalp Fraction (%)	
		Dry	#3/4	
Compaction Method	X	Mechanical Ram	#3/8	
		Manual Ram	#4	22.0

Rammer Weight (lb.) = 10.0

Height of Drop (in.) = 18.0

Mold Volume (ft³) 0.03330

TEST NO.	1	2	3	4	5	6
Wt. Compacted Soil + Mold (g)	3650	3717	3773	3755		
Weight of Mold (g)	1826	1826	1826	1826		
Net Weight of Soil (g)	1824	1891	1947	1929		
Wet Weight of Soil + Cont. (g)	504.2	478.4	476.3	446.6		
Dry Weight of Soil + Cont. (g)	466.2	434.3	426.3	392.1		
Weight of Container (g)	37.3	37.8	40.3	37.3		
Moisture Content (%)	8.86	11.12	12.95	15.36		
Wet Density (pcf)	120.8	125.2	128.9	127.7		
Dry Density (pcf)	110.9	112.7	114.1	110.7		

Maximum Dry Density (pcf) 114.0 **Optimum Moisture Content (%)** 13.2

Corrected Dry Density (pcf) 122.7 **Corrected Moisture Content (%)** 10.5

X **Procedure A**
Soil Passing No. 4 (4.75 mm) Sieve
Mold : 4 in. (101.6 mm) diameter
Layers : 5 (Five)
Blows per layer : 25 (twenty-five)
May be used if +#4 is 20% or less

☐ **Procedure B**
Soil Passing 3/8 in. (9.5 mm) Sieve
Mold : 4 in. (101.6 mm) diameter
Layers : 5 (Five)
Blows per layer : 25 (twenty-five)
Use if +#4 is >20% and +3/8 in. is 20% or less

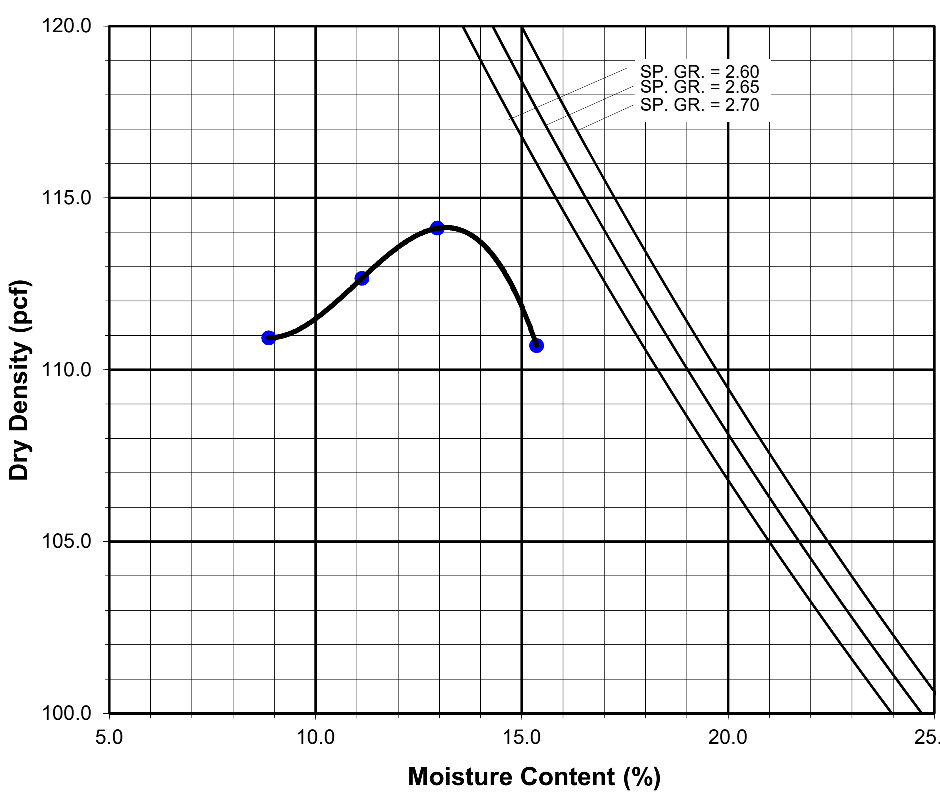
☐ **Procedure C**
Soil Passing 3/4 in. (19.0 mm) Sieve
Mold : 6 in. (152.4 mm) diameter
Layers : 5 (Five)
Blows per layer : 56 (fifty-six)
Use if +3/8 in. is >20% and +¾ in. is <30%

Particle-Size Distribution:

GR:SA:FI

Atterberg Limits:

LL,PL,PI



TESTS for SULFATE CONTENT CHLORIDE CONTENT and pH of SOILS

Project Name: Parcel A Apple Valley | Tested By : JD/KLD | Date: 10/07/22

Project No. : 13673-001 | Checked By: A. Santos | Date: 10/10/22

Boring No.	LB-6	LB-17		
Sample No.	B-1	B-1		
Sample Depth (ft)	0-5	0-5		
Soil Identification:	Light brown (SM)g	Light brown (SM)g		
Wet Weight of Soil + Container (g)	0.00	0.00		
Dry Weight of Soil + Container (g)	0.00	0.00		
Weight of Container (g)	1.00	1.00		
Moisture Content (%)	0.00	0.00		
Weight of Soaked Soil (g)	100.11	100.14		

SULFATE CONTENT, DOT California Test 417, Part II

Beaker No.	61	8		
Crucible No.	6	8		
Furnace Temperature (°C)	860	860		
Time In / Time Out	14:00/14:45	14:00/14:45		
Duration of Combustion (min)	45	45		
Wt. of Crucible + Residue (g)	25.7418	20.4021		
Wt. of Crucible (g)	25.7400	20.3991		
Wt. of Residue (g) (A)	0.0018	0.0030		
PPM of Sulfate (A) x 41150	74.07	123.45		
PPM of Sulfate, Dry Weight Basis	**74**	**123**		

CHLORIDE CONTENT, DOT California Test 422

ml of Extract For Titration (B)	15	30		
ml of AgNO3 Soln. Used in Titration (C)	0.4	0.5		
PPM of Chloride (C -0.2) * 100 * 30 / B	40	30		
PPM of Chloride, Dry Wt. Basis	**40**	**30**		

pH TEST, DOT California Test 643

pH Value	**8.80**	**8.10**		
Temperature °C	21.1	20.9		

SOIL RESISTIVITY TEST

DOT CA TEST 643

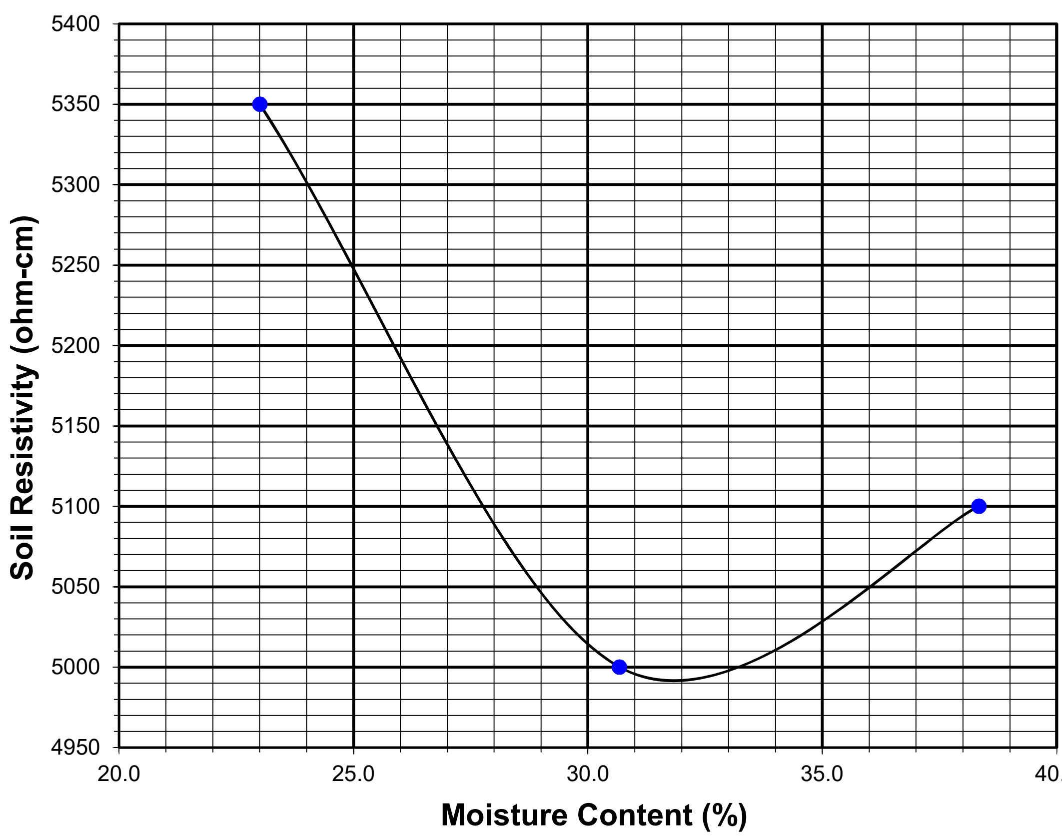
Project Name:	Parcel A Apple Valley	Tested By :	K. Doran Date: 10/07/22
Project No. :	13673-001	Checked By:	A. Santos Date: 10/10/22
Boring No.:	LB-6	Depth (ft.) :	0-5
Sample No. :	B-1		
Soil Identification:*	Light brown (SM)g		

*California Test 643 requires soil specimens to consist only of portions of samples passing through the No. 8 US Standard Sieve before resistivity testing. Therefore, this test method may not be representative for coarser materials.

Specimen No.	Water Added (ml) (Wa)	Adjusted Moisture Content (MC)	Resistance Reading (ohm)	Soil Resistivity (ohm-cm)
1	30	23.01	5350	5350
2	40	30.67	5000	5000
3	50	38.34	5100	5100
4				
5				

Moisture Content (%) (MCi)	0.00
Wet Wt. of Soil + Cont. (g)	0.00
Dry Wt. of Soil + Cont. (g)	0.00
Wt. of Container (g)	1.00
Container No.	
Initial Soil Wt. (g) (Wt)	130.40
Box Constant	1.000
MC =(((1+Mci/100)x(Wa/Wt+1))-1)x100	

Min. Resistivity (ohm-cm)	Moisture Content (%)	Sulfate Content (ppm)	Chloride Content (ppm)	Soil pH	
				pH	Temp. (°C)
DOT CA Test 643		DOT CA Test 417 Part II	DOT CA Test 422	DOT CA Test 643	
4990	**32.0**	**74**	**40**	**8.80**	**21.1**



SOIL RESISTIVITY TEST

DOT CA TEST 643

Project Name:	Parcel A Apple Valley	Tested By :	K. Doran Date: 10/07/22
Project No. :	13673-001	Checked By:	A. Santos Date: 10/10/22
Boring No.:	LB-17	Depth (ft.) :	0-5
Sample No. :	B-1		

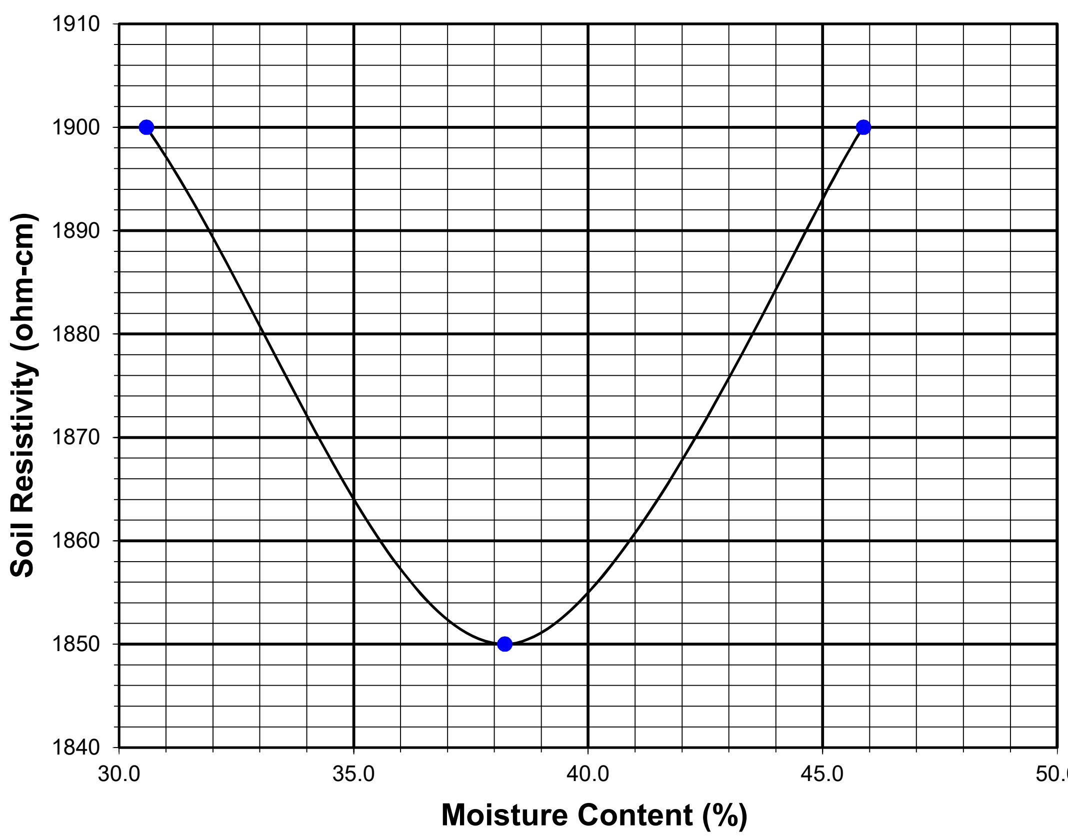
Soil Identification:* Light brown (SM)g

*California Test 643 requires soil specimens to consist only of portions of samples passing through the No. 8 US Standard Sieve before resistivity testing. Therefore, this test method may not be representative for coarser materials.

Specimen No.	Water Added (ml) (Wa)	Adjusted Moisture Content (MC)	Resistance Reading (ohm)	Soil Resistivity (ohm-cm)
1	40	30.58	1900	1900
2	50	38.23	1850	1850
3	60	45.87	1900	1900
4				
5				

Moisture Content (%) (MCi)	0.00
Wet Wt. of Soil + Cont. (g)	0.00
Dry Wt. of Soil + Cont. (g)	0.00
Wt. of Container (g)	1.00
Container No.	
Initial Soil Wt. (g) (Wt)	130.80
Box Constant	1.000
MC =(((1+Mci/100)x(Wa/Wt+1))-1)x100	

Min. Resistivity (ohm-cm)	Moisture Content (%)	Sulfate Content (ppm)	Chloride Content (ppm)	Soil pH	
				pH	Temp. (°C)
DOT CA Test 643		DOT CA Test 417 Part II	DOT CA Test 422	DOT CA Test 643	
1850	**38.2**	**123**	**30**	**8.10**	**20.9**



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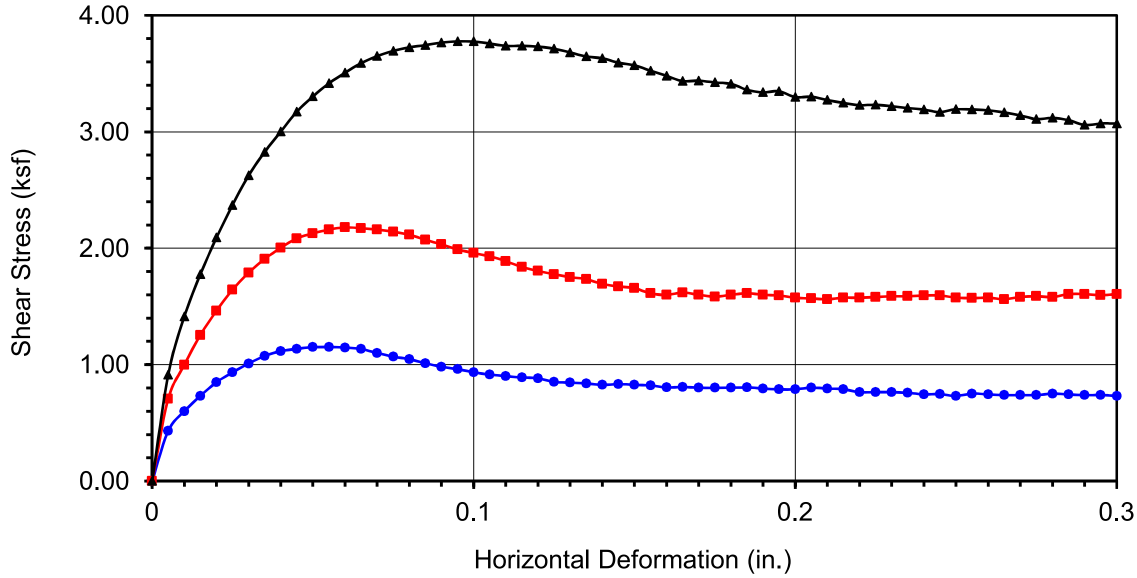
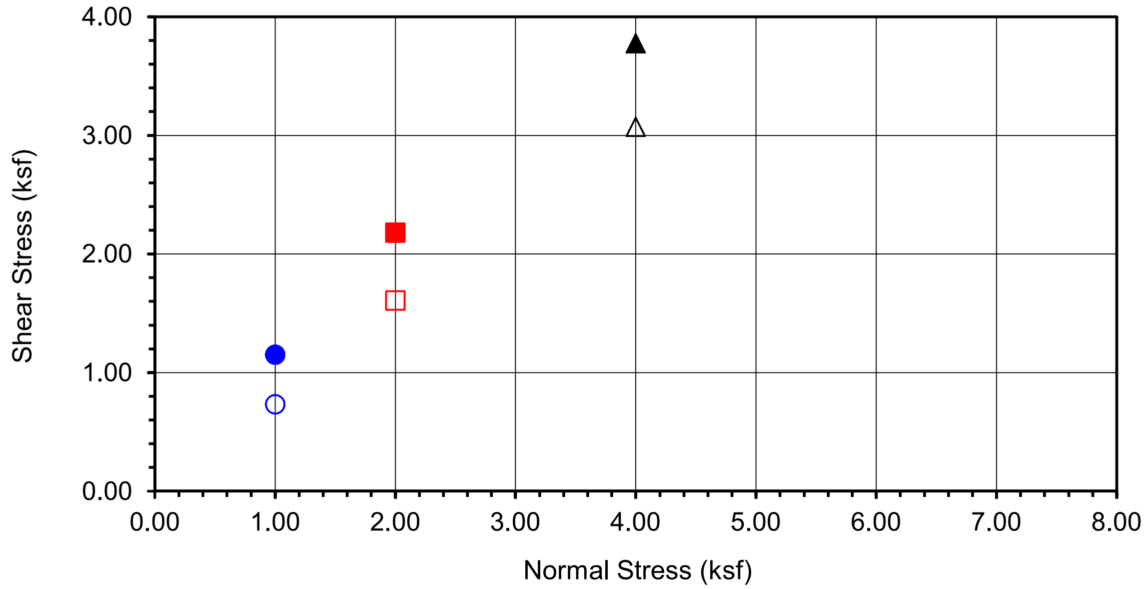
DIRECT SHEAR TEST

Consolidated Drained - ASTM D 3080

Project Name:	Parcel A Apple Valley	Tested By:	G. Bathala	Date:	09/29/22
Project No.:	13673.001	Checked By:	A. Santos	Date:	10/09/22
Boring No.:	LB-9	Sample Type:	90% Remold		
Sample No.:	B-1	Depth (ft.):	15-20		
Soil Identification:	Light brown silty sand (SM)				

Sample Diameter(in):	2.415	2.415	2.415
Sample Thickness(in.):	1.000	1.000	1.000
Weight of Sample + ring(gm):	195.22	195.25	195.81
Weight of Ring(gm):	45.45	45.44	45.64
Before Shearing			
Weight of Wet Sample+Cont.(gm):	150.26	150.26	150.26
Weight of Dry Sample+Cont.(gm):	141.25	141.25	141.25
Weight of Container(gm):	40.03	40.03	40.03
Vertical Rdg.(in): Initial	0.0000	0.2611	0.2579
Vertical Rdg.(in): Final	-0.0083	0.2710	0.2754
After Shearing			
Weight of Wet Sample+Cont.(gm):	207.60	190.05	214.79
Weight of Dry Sample+Cont.(gm):	190.40	172.92	198.26
Weight of Container(gm):	57.16	40.03	65.57
Specific Gravity (Assumed):	2.70	2.70	2.70
Water Density(pcf):	62.43	62.43	62.43





Boring No.	**LB-9**
Sample No.	**B-1**
Depth (ft)	**15-20**

Sample Type:

90% Remold

Soil Identification:
Light brown silty sand (SM)

Normal Stress (kip/ft²)	1.000	2.000	4.000
Peak Shear Stress (kip/ft²)	● 1.151	■ 2.179	▲ 3.776
Shear Stress @ End of Test (ksf)	○ 0.732	□ 1.606	△ 3.071
Deformation Rate (in./min.)	0.0033	0.0033	0.0033
Initial Sample Height (in.)	1.000	1.000	1.000
Diameter (in.)	2.415	2.415	2.415
Initial Moisture Content (%)	8.90	8.90	8.90
Dry Density (pcf)	114.4	114.4	114.7
Saturation (%)	50.7	50.8	51.2
Soil Height Before Shearing (in.)	0.9917	0.9901	0.9825
Final Moisture Content (%)	12.9	12.9	12.5

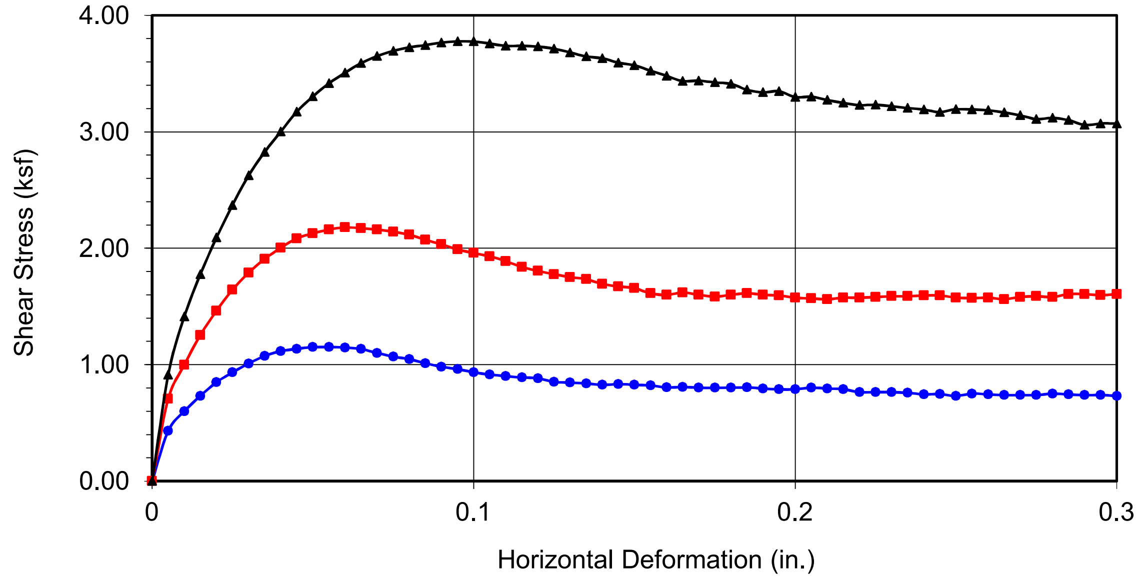
Leighton

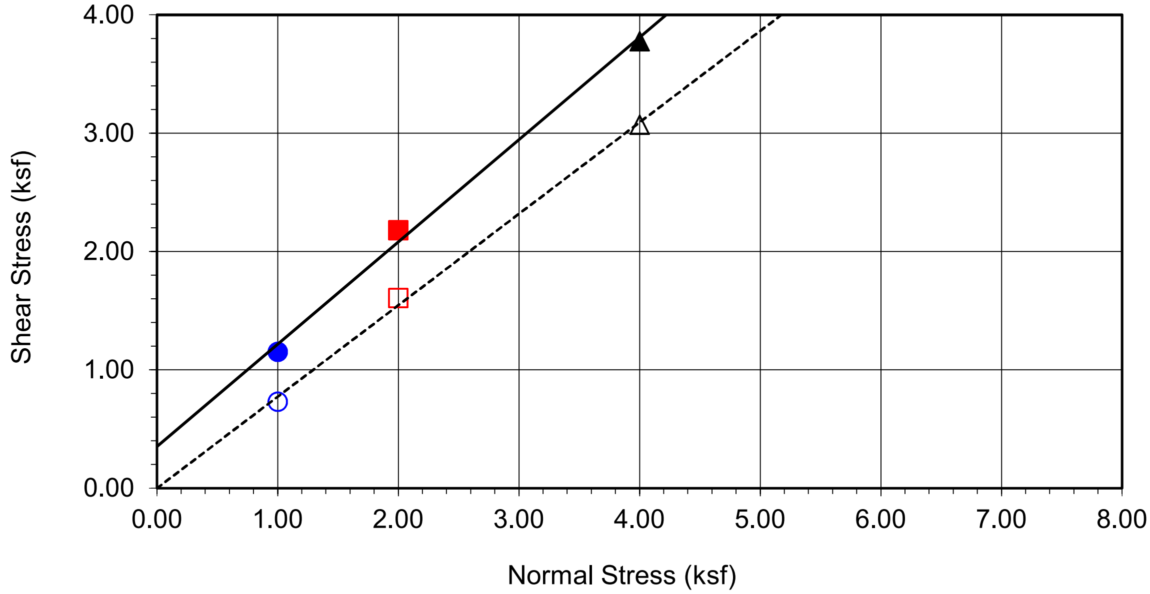
DIRECT SHEAR TEST RESULTS
Consolidated Drained - ASTM D 3080

Project No.: 13673.001

Parcel A Apple Valley

09-22





Boring No.	**LB-9**
Sample No.	**B-1**
Depth (ft)	**15-20**
Sample Type: 90% Remold	
Soil Identification: Light brown silty sand (SM)	

Strength Parameters

	C (psf)	ϕ (°)
Peak	353	41
Ultimate	0	38

Normal Stress (kip/ft²)	1.000	2.000	4.000
Peak Shear Stress (kip/ft²)	● 1.151	■ 2.179	▲ 3.776
Shear Stress @ End of Test (ksf)	○ 0.732	□ 1.606	△ 3.071
Deformation Rate (in./min.)	0.0033	0.0033	0.0033
Initial Sample Height (in.)	1.000	1.000	1.000
Diameter (in.)	2.415	2.415	2.415
Initial Moisture Content (%)	8.90	8.90	8.90
Dry Density (pcf)	114.4	114.4	114.7
Saturation (%)	50.7	50.8	51.2
Soil Height Before Shearing (in.)	0.9917	0.9901	0.9825
Final Moisture Content (%)	12.9	12.9	12.5

Leighton

DIRECT SHEAR TEST RESULTS

Consolidated Drained - ASTM D 3080

Project No.: 13673.001

Parcel A Apple Valley

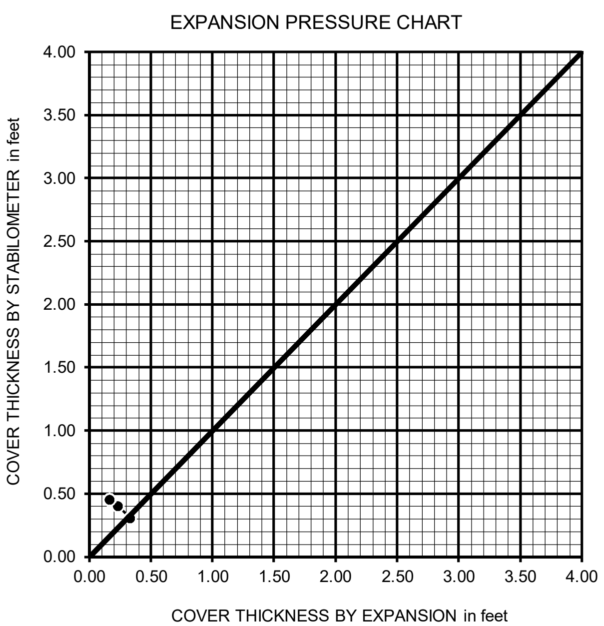
09-22

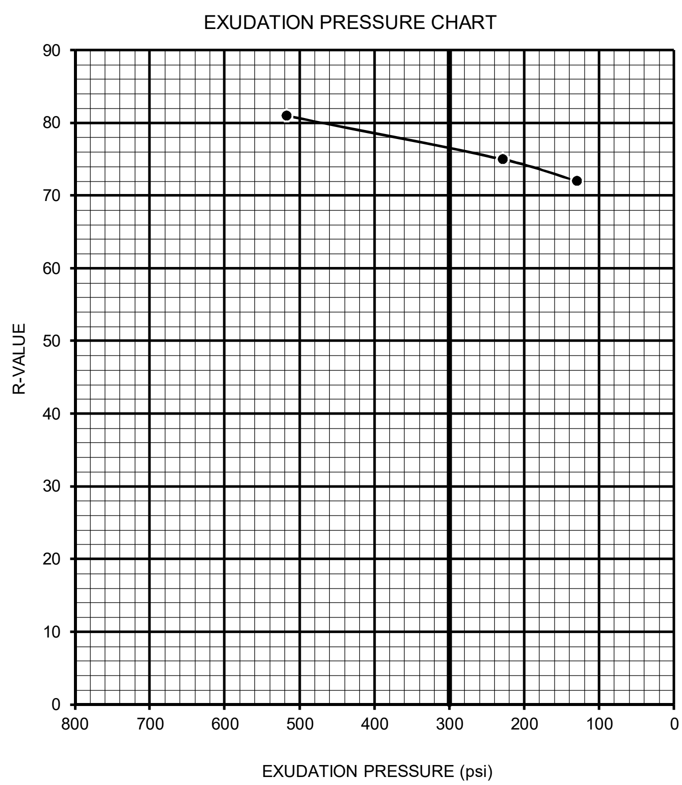
R-VALUE TEST RESULTS
DOT CA Test 301

PROJECT NAME:	Parcel A Apple Valley	PROJECT NUMBER:	13673.001
BORING NUMBER:	LB-6	DEPTH (FT.):	0-5
SAMPLE NUMBER:	B-1	TECHNICIAN:	O. Figueroa
SAMPLE DESCRIPTION:	Light brown silty sand with gravel (SM)g	DATE COMPLETED:	10/5/2022

TEST SPECIMEN	a	b	c
MOISTURE AT COMPACTION %	10.5	10.9	11.8
HEIGHT OF SAMPLE, Inches	2.50	2.51	2.59
DRY DENSITY, pcf	120.7	120.3	119.6
COMPACTOR PRESSURE, psi	300	250	200
EXUDATION PRESSURE, psi	517	229	130
EXPANSION, Inches x 10exp-4	10	7	5
STABILITY Ph 2,000 lbs (160 psi)	15	21	24
TURNS DISPLACEMENT	5.49	5.64	5.80
R-VALUE UNCORRECTED	81	75	71
R-VALUE CORRECTED	81	75	72

DESIGN CALCULATION DATA	a	b	c
GRAVEL EQUIVALENT FACTOR	1.0	1.0	1.0
TRAFFIC INDEX	5.0	5.0	5.0
STABILOMETER THICKNESS, ft.	0.30	0.40	0.45
EXPANSION PRESSURE THICKNESS, ft.	0.33	0.23	0.17





R-VALUE BY EXPANSION: 78

R-VALUE BY EXUDATION: 76

EQUILIBRIUM R-VALUE: 76

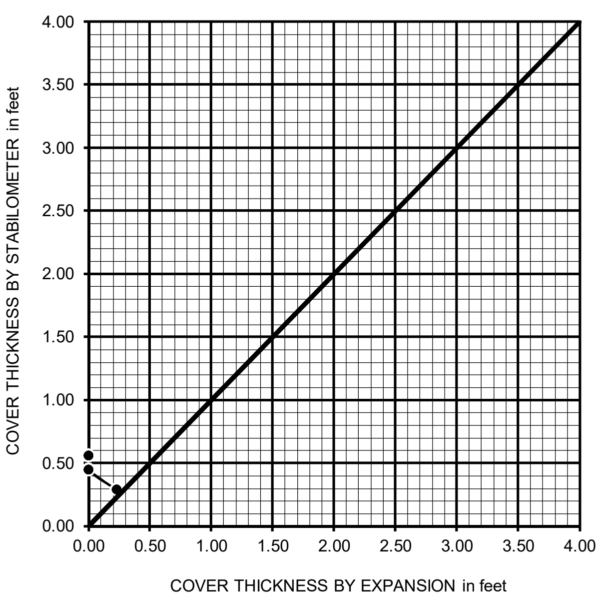
R-VALUE TEST RESULTS
DOT CA Test 301

PROJECT NAME:	Parcel A Apple Valley	PROJECT NUMBER:	13673.001
BORING NUMBER:	LB-17	DEPTH (FT.):	0-5
SAMPLE NUMBER:	B-1	TECHNICIAN:	O. Figueroa
SAMPLE DESCRIPTION:	Light brown silty sand with gravel (SM)g	DATE COMPLETED:	10/5/2022

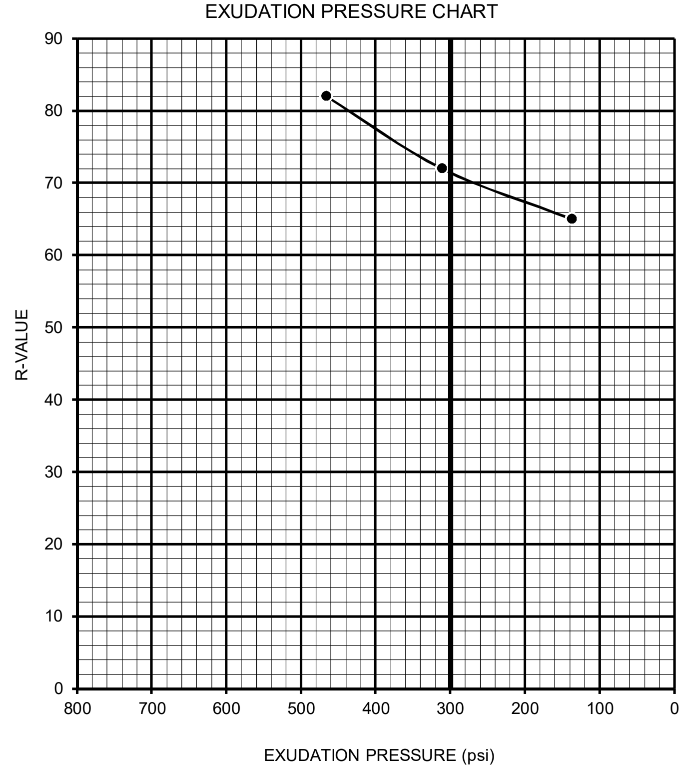
TEST SPECIMEN	a	b	c
MOISTURE AT COMPACTION %	12.4	12.8	13.2
HEIGHT OF SAMPLE, Inches	2.49	2.54	2.59
DRY DENSITY, pcf	115.8	114.1	113.5
COMPACTOR PRESSURE, psi	275	250	225
EXUDATION PRESSURE, psi	466	311	137
EXPANSION, Inches x 10exp-4	7	0	0
STABILITY Ph 2,000 lbs (160 psi)	17	23	29
TURNS DISPLACEMENT	4.72	5.75	6.40
R-VALUE UNCORRECTED	82	72	64
R-VALUE CORRECTED	82	72	65

DESIGN CALCULATION DATA	a	b	c
GRAVEL EQUIVALENT FACTOR	1.0	1.0	1.0
TRAFFIC INDEX	5.0	5.0	5.0
STABILOMETER THICKNESS, ft.	0.29	0.45	0.56
EXPANSION PRESSURE THICKNESS, ft.	0.23	0.00	0.00

EXPANSION PRESSURE CHART



EXUDATION PRESSURE CHART



R-VALUE BY EXPANSION:	81
R-VALUE BY EXUDATION:	72
EQUILIBRIUM R-VALUE:	72

PARTICLE-SIZE DISTRIBUTION (GRADATION) of SOILS USING SIEVE ANALYSIS

ASTM D 6913

Project Name:	Parcel A Apple Valley	Tested By: J. Domingo	Date: 10/06/22
Project No.:	13673.001	Checked By: A. Santos	Date: 10/07/22
Boring No.:	IT-1	Depth (feet): 12.5	
Sample No.:	S-1		
Soil Identification:	Light brown silty sand (SM)		

		Moisture Content of Total Air - Dry Soil	
Container No.:	HA	Wt. of Air-Dry Soil + Cont. (g)	0.0
Wt. of Air-Dried Soil + Cont.(g)	884.0	Wt. of Dry Soil + Cont. (g)	0.0
Wt. of Container (g)	245.5	Wt. of Container No.______ (g)	1.0
Dry Wt. of Soil (g)	638.5	Moisture Content (%)	0.0

After Wet Sieve	Container No.	HA
	Wt. of Dry Soil + Container (g)	743.2
	Wt. of Container (g)	245.5
	Dry Wt. of Soil Retained on # 200 Sieve (g)	497.7

U. S. Sieve Size		Cumulative Weight Dry Soil Retained (g)	Percent Passing (%)
(in.)	(mm.)		
1 1/2"	37.5		
1"	25.0		
3/4"	19.0	0.0	100.0
1/2"	12.5	15.1	97.6
3/8"	9.5	30.6	95.2
#4	4.75	52.3	91.8
#8	2.36	103.2	83.8
#16	1.18	189.3	70.4
#30	0.600	281.6	55.9
#50	0.300	362.2	43.3
#100	0.150	423.5	33.7
#200	0.075	489.1	23.4
PAN			

GRAVEL: **8 %**

SAND: **69 %**

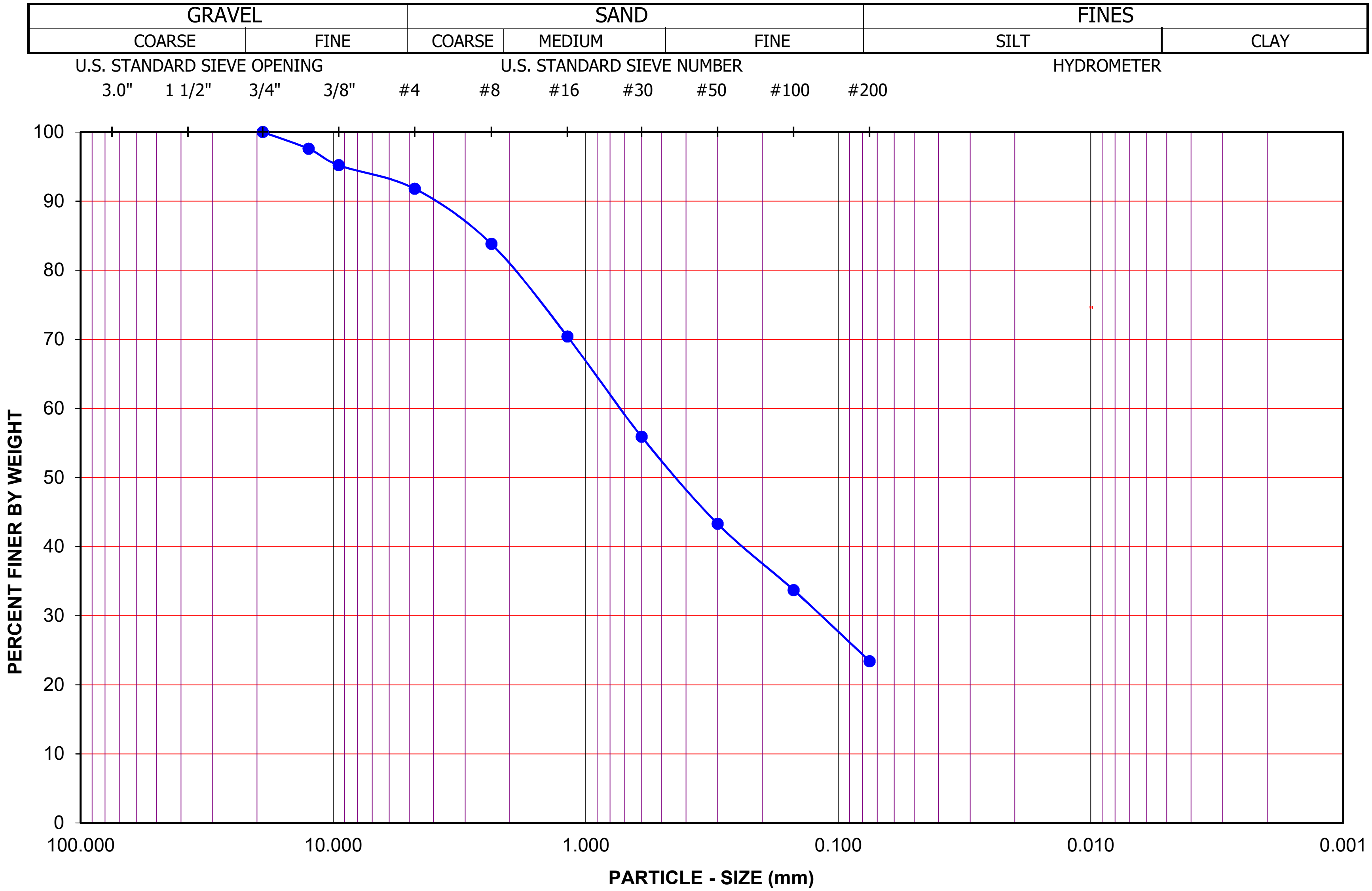
FINES: **23 %**

GROUP SYMBOL: **SM**

Cu = D60/D10 = ______

Cc = $(D30)^2/(D60*D10)$ = ______

Remarks:



Project Name: Parcel A Apple Valley

Project No.: 13673.001

Boring No.: IT-1 Sample No.: S-1

Depth (feet): 12.5 Soil Type : SM

Soil Identification: Light brown silty sand (SM)

Leighton

PARTICLE - SIZE DISTRIBUTION ASTM D 6913

GR:SA:FI : (%) 8 : 69 : 23

Oct-22

PARTICLE-SIZE DISTRIBUTION (GRADATION) of SOILS USING SIEVE ANALYSIS
ASTM D 6913

Leighton

Project Name:	Parcel A Apple Valley	Tested By:	J. Domingo	Date:	10/06/22
Project No.:	13673.001	Checked By:	A. Santos	Date:	10/09/22
Boring No.:	IT-3	Depth (feet):	13.5		
Sample No.:	S-1				
Soil Identification:	Light brown silty sand (SM)				

		Moisture Content of Total Air - Dry Soil	
Container No.:	V-O	Wt. of Air-Dry Soil + Cont. (g)	0.0
Wt. of Air-Dried Soil + Cont.(g)	880.4	Wt. of Dry Soil + Cont. (g)	0.0
Wt. of Container (g)	234.4	Wt. of Container No.______ (g)	1.0
Dry Wt. of Soil (g)	646.0	Moisture Content (%)	0.0

After Wet Sieve	Container No.	V-O
	Wt. of Dry Soil + Container (g)	750.8
	Wt. of Container (g)	234.4
	Dry Wt. of Soil Retained on # 200 Sieve (g)	516.4

U. S. Sieve Size (in.)	U. S. Sieve Size (mm.)	Cumulative Weight Dry Soil Retained (g)	Percent Passing (%)
1 1/2"	37.5		
1"	25.0		
3/4"	19.0	0.0	100.0
1/2"	12.5	21.1	96.7
3/8"	9.5	40.7	93.7
#4	4.75	81.2	87.4
#8	2.36	135.7	79.0
#16	1.18	217.9	66.3
#30	0.600	307.7	52.4
#50	0.300	393.6	39.1
#100	0.150	459.9	28.8
#200	0.075	509.7	21.1
PAN			

GRAVEL: **13 %**

SAND: **66 %**

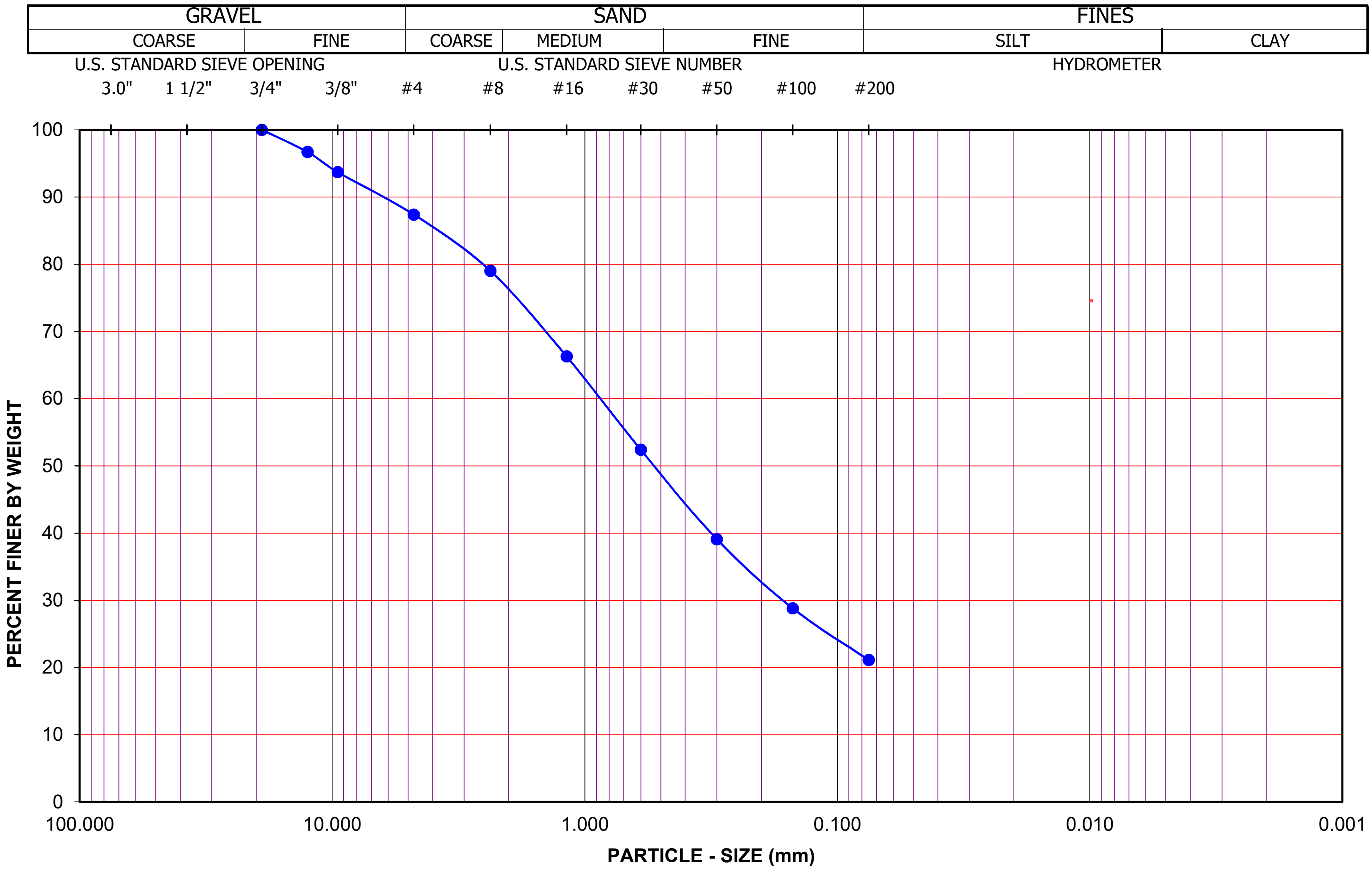
FINES: **21 %**

GROUP SYMBOL: **SM**

Cu = D60/D10 = ______

Cc = $(D30)^2/(D60*D10)$ = ______

Remarks: ______



Project Name: Parcel A Apple Valley

Project No.: 13673.001

Leighton

PARTICLE - SIZE DISTRIBUTION ASTM D 6913

Boring No.: IT-3 Sample No.: S-1

Depth (feet): 13.5 Soil Type : SM

Soil Identification: Light brown silty sand (SM)

GR:SA:FI : (%) 13 : 66 : 21

Oct-22

Leighton

PARTICLE-SIZE DISTRIBUTION (GRADATION) of SOILS USING SIEVE ANALYSIS

ASTM D6913

Project Name: Parcel A Apple Valley
Tested By: J. Domingo Date: 10/05/22
Project No.: 13673.001
Checked By: A. Santos Date: 10/07/22
Boring No.: LB-6
Depth (feet): 0-5
Sample No.: B-1
Soil Identification: Light brown silty sand with gravel (SM)g

Calculation of Dry Weights	Whole Sample	Sample Passing #4	Moisture Contents	Whole Sample	Sample passing #4
Container No.:	A3-1	V-1	Wt. of Air-Dry Soil + Cont.(g)	0.0	0.0
Wt. Air-Dried Soil + Cont.(g)	4141.6	648.8	Wt. of Dry Soil + Cont. (g)	0.0	0.0
Wt. of Container (g)	225.3	108.7	Wt. of Container No._____(g)	1.0	1.0
Dry Wt. of Soil (g)	3916.3	540.1	Moisture Content (%)	0.0	0.0

Passing #4 Material After Wet Sieve		
	Container No.	V-1
	Wt. of Dry Soil + Container (g)	563.3
	Wt. of Container (g)	108.7
	Dry Wt. of Soil Retained on # 200 Sieve (g)	454.6

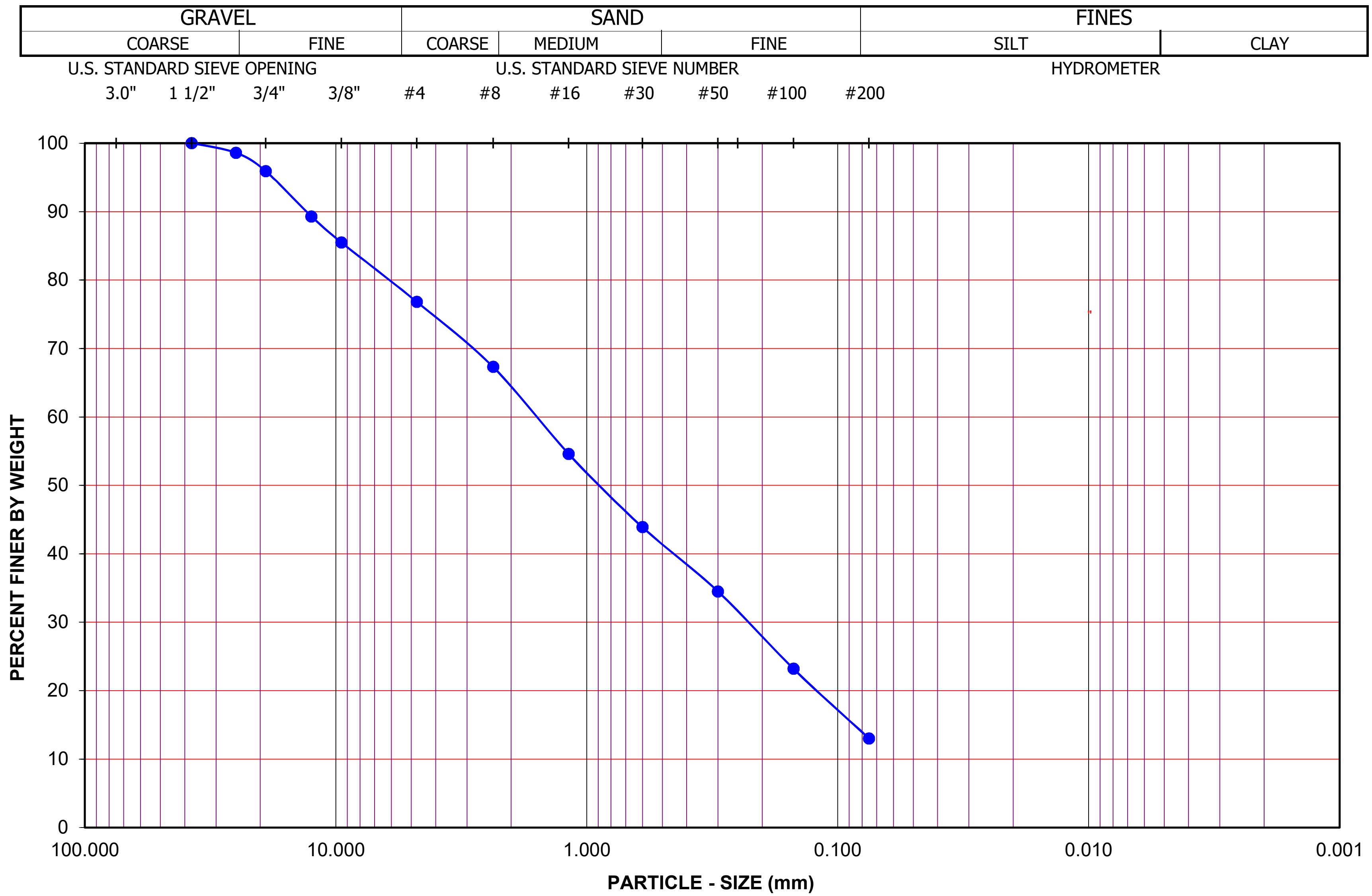
U. S. Sieve Size		Cumulative Weight of Dry Soil Retained (g)		Percent Passing (%)
	(mm.)	Whole Sample	Sample Passing #4	
3"	75.0			
1 1/2"	37.5	0.0		100.0
1"	25.0	56.3		98.6
3/4"	19.0	162.1		95.9
1/2"	12.5	418.0		89.3
3/8"	9.5	568.2		85.5
#4	4.75	907.8		76.8
#8	2.36		66.5	67.3
#16	1.18		156.0	54.6
#30	0.600		231.3	43.9
#50	0.300		297.2	34.5
#100	0.150		376.6	23.2
#200	0.075		449.0	13.0
PAN				

GRAVEL: **23 %**
SAND: **64 %**
FINES: **13 %**
GROUP SYMBOL: **(SM)g**

Cu = D60/D10 = _______

Cc = $(D30)^2/(D60*D10)$ = _______

Remarks:



Project Name: Parcel A Apple Valley

Project No.: 13673.001

Leighton

PARTICLE - SIZE DISTRIBUTION ASTM D 6913

Boring No.: LB-6 | Sample No.: B-1

Depth (feet): 0-5 | Soil Type : (SM)g

Soil Identification: Light brown silty sand with gravel (SM)g

GR:SA:FI : (%) 23 : 64 : 13

Oct-22

PARTICLE-SIZE DISTRIBUTION (GRADATION) of SOILS USING SIEVE ANALYSIS

ASTM D6913

Leighton

Project Name:	Parcel A Apple Valley	Tested By:	J. Domingo	Date:	10/04/22
Project No.:	13673.001	Checked By:	A. Santos	Date:	10/07/22
Boring No.:	LB-17	Depth (feet):	0-5		
Sample No.:	B-1				
Soil Identification:	Light brown silty sand with gravel (SM)g				

Calculation of Dry Weights	Whole Sample	Sample Passing #4	Moisture Contents	Whole Sample	Sample passing #4
Container No.:	P-16	916	Wt. of Air-Dry Soil + Cont.(g)	0.0	0.0
Wt. Air-Dried Soil + Cont.(g)	2402.7	607.6	Wt. of Dry Soil + Cont. (g)	0.0	0.0
Wt. of Container (g)	278.3	109.2	Wt. of Container No._____(g)	1.0	1.0
Dry Wt. of Soil (g)	2124.4	498.4	Moisture Content (%)	0.0	0.0

Passing #4 Material After Wet Sieve		
	Container No.	916
	Wt. of Dry Soil + Container (g)	481.8
	Wt. of Container (g)	109.2
	Dry Wt. of Soil Retained on # 200 Sieve (g)	372.6

U. S. Sieve Size		Cumulative Weight of Dry Soil Retained (g)		Percent Passing (%)
	(mm.)	Whole Sample	Sample Passing #4	
3"	75.0			
1 1/2"	37.5	0.0		100.0
1"	25.0	37.8		98.2
3/4"	19.0	71.7		96.6
1/2"	12.5	177.0		91.7
3/8"	9.5	269.5		87.3
#4	4.75	458.3		78.4
#8	2.36		62.6	68.6
#16	1.18		134.2	57.3
#30	0.600		202.8	46.5
#50	0.300		269.0	36.1
#100	0.150		323.5	27.5
#200	0.075		367.8	20.5
PAN				

GRAVEL: **22 %**

SAND: **57 %**

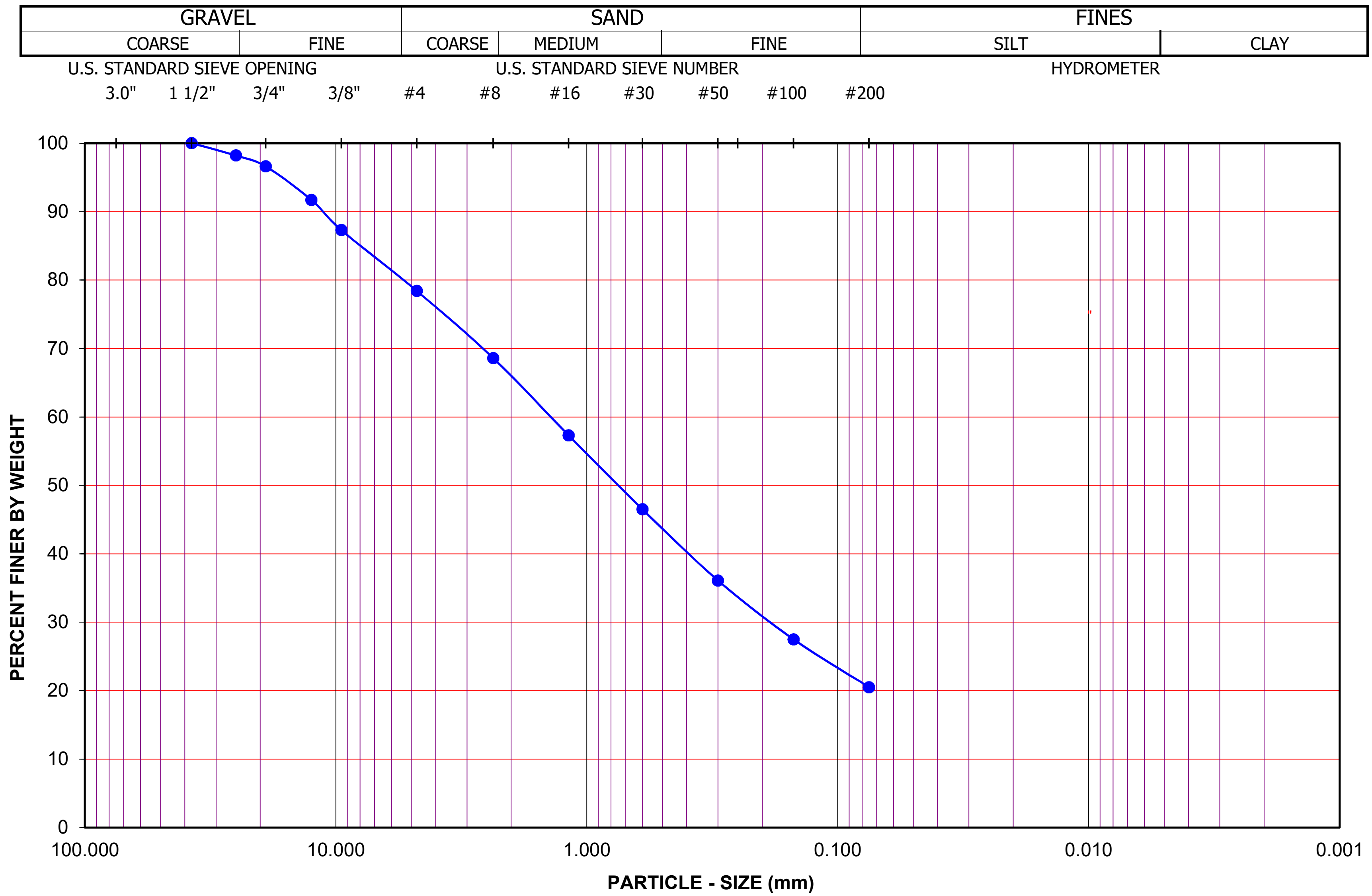
FINES: **21 %**

GROUP SYMBOL: **(SM)g**

Cu = D60/D10 = ________

Cc = (D30)²/(D60*D10) = ________

Remarks:



Project Name: Parcel A Apple Valley

Project No.: 13673.001

Boring No.: LB-17 Sample No.: B-1

Depth (feet): 0-5 Soil Type : (SM)g

Soil Identification: Light brown silty sand with gravel (SM)g

Leighton

PARTICLE - SIZE DISTRIBUTION ASTM D 6913

GR:SA:FI : (%) 22 : 57 : 21

Oct-22

Leighton

PARTICLE-SIZE DISTRIBUTION (GRADATION) of SOILS USING SIEVE ANALYSIS

ASTM D 6913

Project Name: Parcel A Apple Valley
Project No.: 13673.001
Boring No.: LI-2
Sample No.: S-2
Soil Identification: Light brown silty sand (SM)

Tested By: J. Domingo Date: 10/06/22
Checked By: A. Santos Date: 10/07/22
Depth (feet): 12.5

		Moisture Content of Total Air - Dry Soil	
Container No.:	778	Wt. of Air-Dry Soil + Cont. (g)	0.0
Wt. of Air-Dried Soil + Cont.(g)	618.8	Wt. of Dry Soil + Cont. (g)	0.0
Wt. of Container (g)	75.9	Wt. of Container No.______ (g)	1.0
Dry Wt. of Soil (g)	542.9	Moisture Content (%)	0.0

After Wet Sieve	Container No.	778
	Wt. of Dry Soil + Container (g)	495.5
	Wt. of Container (g)	75.9
	Dry Wt. of Soil Retained on # 200 Sieve (g)	419.6

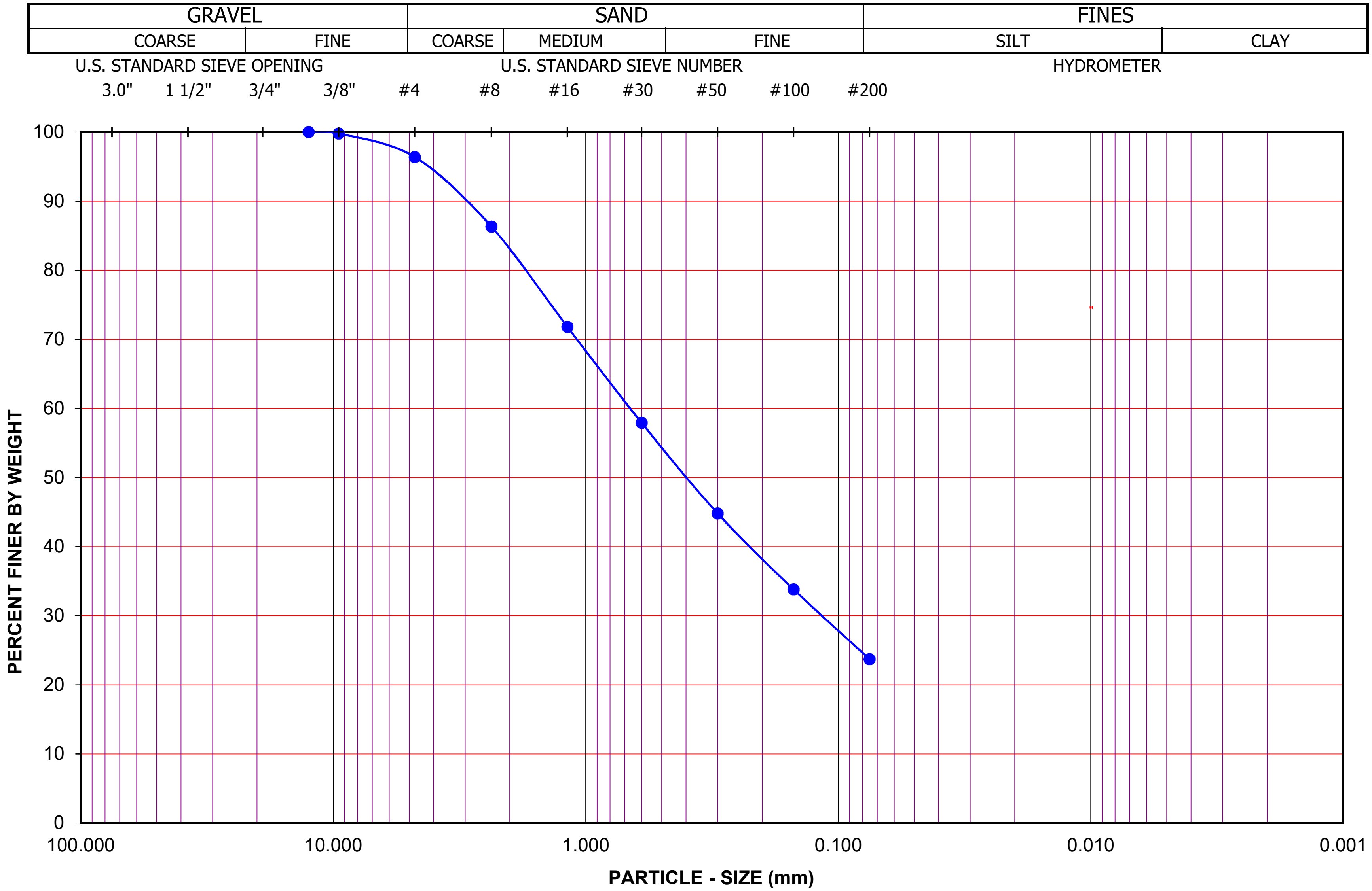
U. S. Sieve Size		Cumulative Weight Dry Soil Retained (g)	Percent Passing (%)
(in.)	(mm.)		
1 1/2"	37.5		
1"	25.0		
3/4"	19.0		
1/2"	12.5	0.0	100.0
3/8"	9.5	1.2	99.8
#4	4.75	19.4	96.4
#8	2.36	74.4	86.3
#16	1.18	153.2	71.8
#30	0.600	228.3	57.9
#50	0.300	299.7	44.8
#100	0.150	359.6	33.8
#200	0.075	414.0	23.7
PAN			

GRAVEL: **4 %**
SAND: **72 %**
FINES: **24 %**
GROUP SYMBOL: **SM**

Cu = D60/D10 = ______

Cc = $(D30)^2/(D60*D10)$ = ______

Remarks: ______



Project Name: Parcel A Apple Valley

Project No.: 13673.001

Leighton

PARTICLE - SIZE DISTRIBUTION ASTM D 6913

Boring No.: LI-2

Sample No.: S-2

Depth (feet): 12.5

Soil Type : SM

Soil Identification: Light brown silty sand (SM)

GR:SA:FI : (%) 4 : 72 : 24

Oct-22

ONE-DIMENSIONAL SWELL OR SETTLEMENT POTENTIAL OF COHESIVE SOILS

ASTM D 4546

Leighton

Project Name:	Parcel A Apple Valley	Tested By:	A. Santos
Project No.:	13673.001	Checked By:	J. Ward
Boring No.:	LB-1	Sample Type:	Ring
Sample No.:	R-4	Depth (ft.)	10.0

Date: 10/04/22
Date: 10/09/22

Sample Description: Brown poorly-graded sand with silt and gravel (SP-SM)g

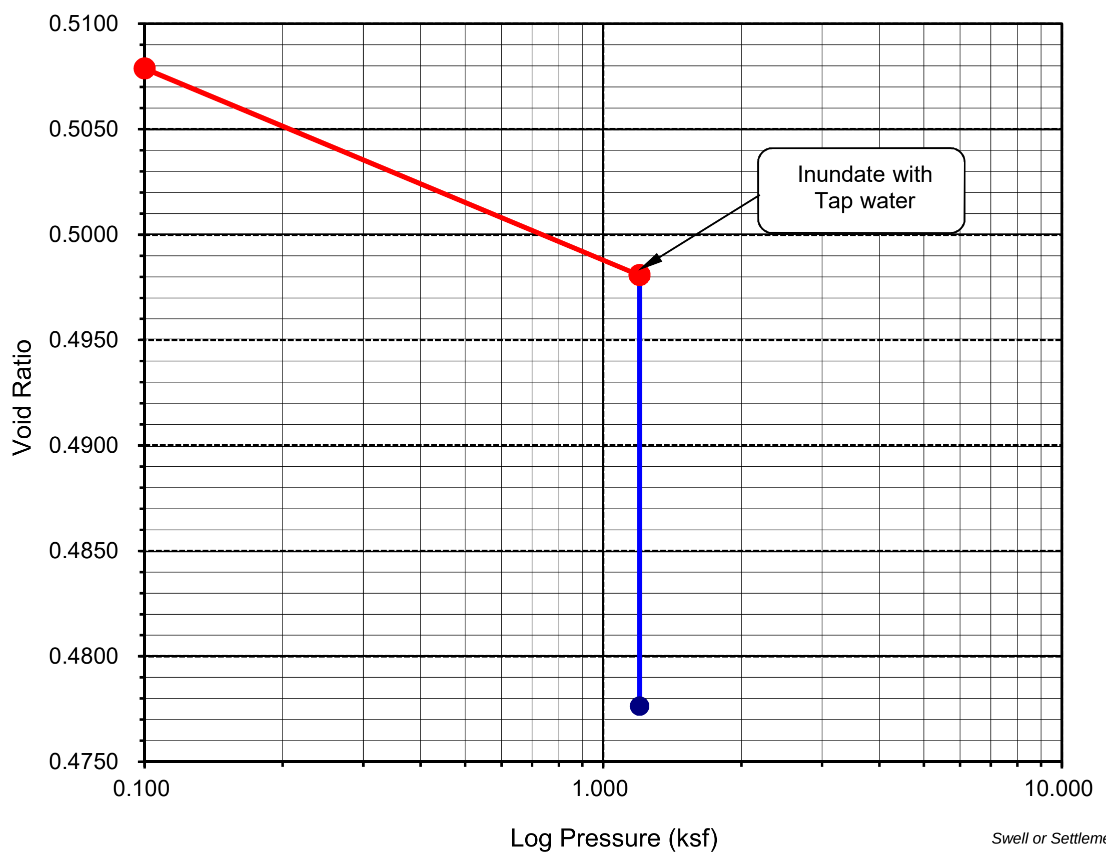
Initial Dry Density (pcf):	111.8
Initial Moisture (%):	1.59
Initial Length (in.):	1.0000
Initial Dial Reading:	0.2611
Diameter(in):	2.415

Final Dry Density (pcf):	114.1
Final Moisture (%) :	17.9
Initial Void Ratio:	0.5080
Specific Gravity(assumed):	2.70
Initial Saturation (%)	8.5

Pressure (p) (ksf)	Final Reading (in)	Apparent Thickness (in)	Load Compliance (%)	Swell (+) Settlement (-) % of Sample Thickness	Void Ratio	Corrected Deformation (%)
0.100	0.2610	0.9999	0.00	-0.01	0.5079	-0.01
1.200	0.2505	0.9894	0.40	-1.06	0.4981	-0.66
H2O	0.2370	0.9759	0.40	-2.42	0.4776	-2.02

Percent Swell (+) / Settlement (-) After Inundation = -1.36

Void Ratio - Log Pressure Curve



ONE-DIMENSIONAL SWELL OR SETTLEMENT POTENTIAL OF COHESIVE SOILS
ASTM D 4546

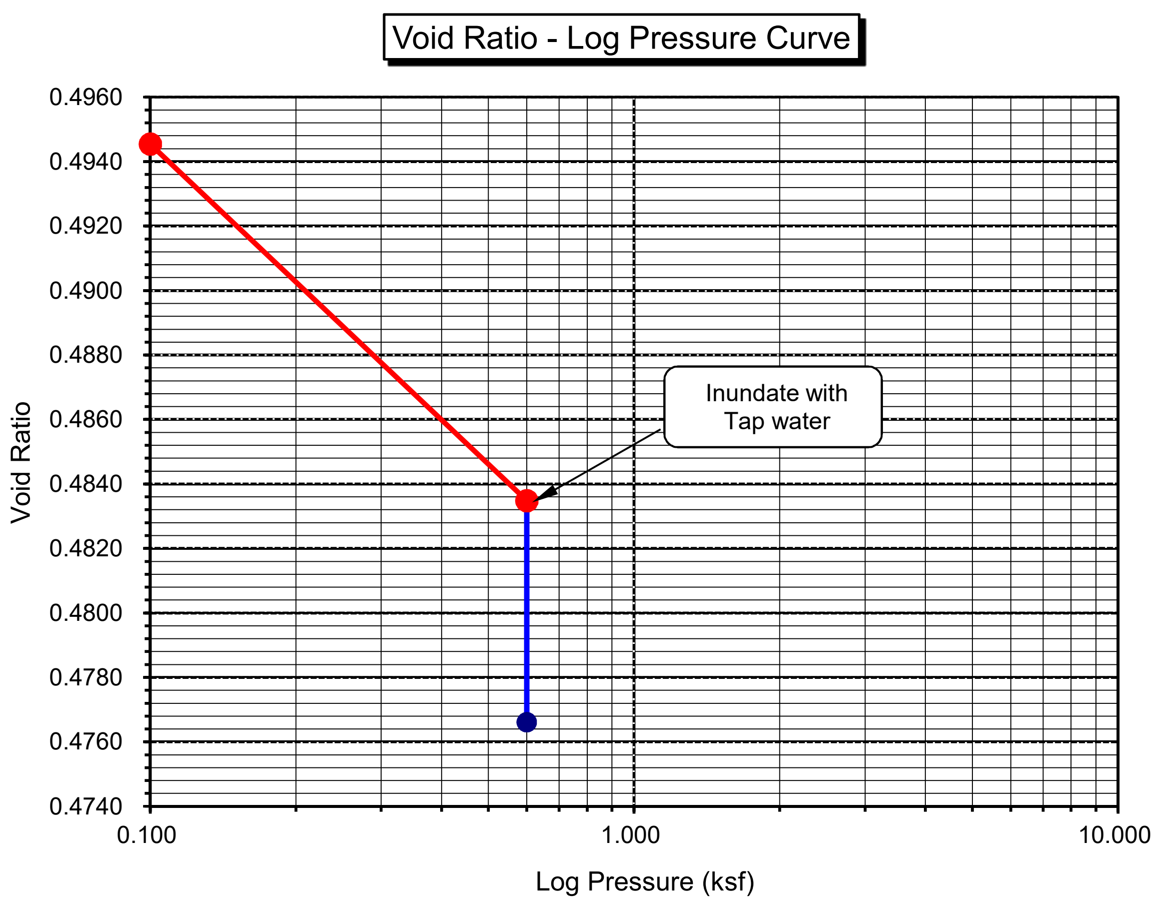
Project Name:	Parcel A Apple Valley	Tested By:	A. Santos
Project No.:	13673.001	Checked By:	J. Ward
Boring No.:	LB-16	Sample Type:	Ring
Sample No.:	R-2	Depth (ft.)	5.0
Sample Description:	Brown silty sand with gravel (SM)g		

Date: 10/04/22
Date: 10/07/22

Initial Dry Density (pcf):	112.8	Final Dry Density (pcf):	114.2
Initial Moisture (%):	2.02	Final Moisture (%) :	15.7
Initial Length (in.):	1.0000	Initial Void Ratio:	0.4947
Initial Dial Reading:	0.2938	Specific Gravity(assumed):	2.70
Diameter(in):	2.415	Initial Saturation (%)	11.0

Pressure (p) (ksf)	Final Reading (in)	Apparent Thickness (in)	Load Compliance (%)	Swell (+) Settlement (-) % of Sample Thickness	Void Ratio	Corrected Deformation (%)
0.100	0.2937	0.9999	0.00	-0.01	0.4945	-0.01
0.600	0.2853	0.9915	0.10	-0.85	0.4835	-0.75
H2O	0.2807	0.9869	0.10	-1.31	0.4766	-1.21

Percent Swell (+) / Settlement (-) After Inundation = -0.46



APPENDIX D

SUMMARY OF SEISMIC HAZARD ANALYSIS

Leighton

APPENDIX D

SITE-SPECIFIC SEISMIC ANALYSIS (ASCE 7-16)

VVLIG – Parcel A Apple Valley
(34.5754, -117.2675)

A site-specific ground motion study was performed in general conformance with Chapters 11, 20 and 21 of ASCE 7-16 and CGS Note 48.

The site is approximately 12.77 km from the surface trace of the closest element of the Helendale-South Lockhart fault zone. A Class C soil profile condition was considered for this site based on the results of our exploratory borings and geophysical survey. The site-specific response spectra in tabular and graphic forms are included herein (see Exhibits C-1 through C-6) and our specific analysis or approach is further discussed below:

<u>Exhibit C-1:</u> The probabilistic MCE spectrum was developed using spectral values obtained from USGS Unified Hazard Maps (UHGM) website, using the factors of ASCE 7-16 Section 21.1. At each spectral response period for which the acceleration is computed, ordinates of the probabilistic ground motion response spectrum is determined as the product of the risk coefficient, C_R, and the spectral response acceleration from a 5% damped acceleration response spectrum that has a 2% probability of exceedance within a 50-year period.

<u>Exhibit C-2:</u> A deterministic MCE spectrum was based on the maximum values of each period from the three most influential nearby faults. Scenario M7.39, 8.2, and 7.32 events on the Helendale-South Lockhart, San Andreas (San Bernardino section), and the North Frontal (West Sectin) fault zones consistent with the Next Generation West 2 (NGA-West 2) attenuation relations (PEER NGAW2 GMPEs) used for the 2014 USGS seismic source model at fault distances of 12.77, 37.76, and 19.2 km, respectively. The equally weighted spectral values from the attenuation relations of Abrahamson and others (ASK 2014), Boore and others (BSSA 2014), Campbell and Borzognia (CB 2014) and Chiou and Youngs (CY 2014) were used for the deterministic MCE spectrum. The MCE spectrum represents 84th-percentile, 5-percent-damped spectral response acceleration in the direction of maximum horizontal response (maximum rotated) for each period. Maximum rotated values were obtained using the scaling factors of ASCE 7-16 Section 21.2. Adjustment to the deterministic limit spectrum was applied as necessary. The Site Class C condition was modeled using Vs30 ≈ 560 meters/second, based on Multichannel Analysis of Surface Wave (MASW) methodology. The depth to bedrock ($Z_{1.0}$ km) was estimated to be around 197 feet (0.06 km), based on our geophysical survey results.

<u>Exhibit C-3:</u> The lesser of the values at any site period from the deterministic MCE_R and MCE_R probabilistic spectra forms the site-specific MCE_R spectrum. For this project site, the site-specific MCER spectrum is equivalent to the risk-modified probabilistic spectrum for site periods of .01 to 1 second and equivalent to deterministic spectrum for site periods of 2 to 5 seconds.

<u>Exhibits C-4 through C-6:</u> A design response spectrum was determined according to the procedure outlined in ASCE 7-16, Section 21.3, and is equal to two-thirds of the response spectral accelerations of the site-specific MCE_R. The design spectrum is limited by a "floor" at 80 percent of spectral acceleration determined according to ASCE 7-16, Section 11.4.6. The recommended site-specific design response spectrum is attached in tabular and graphic forms.

PROBABILISTIC RESPONSE SPECTRA

Period (S)	UHGM (g)	C_R	Ordinated Value (g)	Max Dir SF	Max Dir RTGM (g)	Probabilistic Response (g)
0.01	0.510	0.933	0.475	1.1	0.523	0.523
0.10	1.056	0.933	0.985	1.1	1.084	1.084
0.20	1.253	0.933	1.169	1.1	1.286	1.286
0.30	1.133	0.931	1.055	1.124	1.186	1.186
0.50	0.868	0.928	0.806	1.175	0.947	0.947
0.75	0.645	0.924	0.596	1.2375	0.738	0.738
1.00	0.488	0.920	0.449	1.3	0.584	0.584
2.00	0.241	0.920	0.221	1.35	0.299	0.299
3.00	0.160	0.920	0.147	1.4	0.206	0.206
4.00	0.122	0.920	0.112	1.45	0.162	0.162
5.00	0.098	0.920	0.090	1.5	0.135	0.135

Peak Sa		Fa	1.2Fa	Peak Sa < 1.2Fa	Deterministic Needed?
1.286		1.0	1.2	NO	YES

UHGM - Obtained from Unified Hazard Maps
RTGM - Risk Target Ground Motion

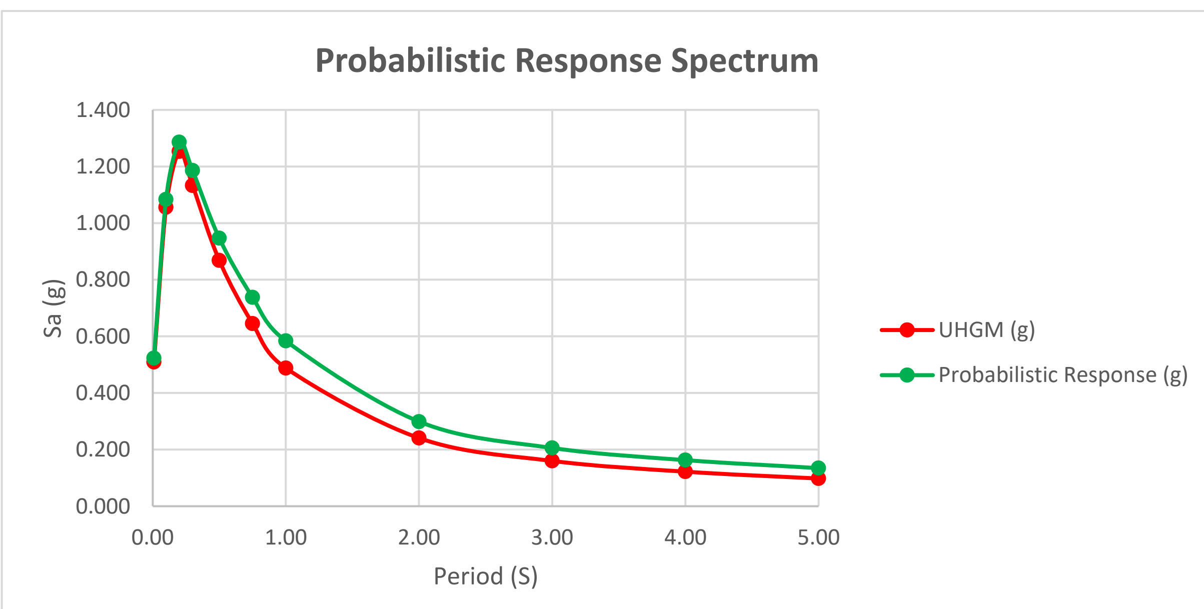


Exhibit C-1

DETERMINISTIC RESPONSE SPECTRUM

Period (S)	84th Percentile for 5% Damping	Max Dir SF	Max Dir Deterministic Sa	Scaled Max Dir Deterministic Sa
0.01	0.563	1.1	0.620	0.633
0.1	1.103	1.1	1.213	1.239
0.2	1.335	1.1	1.469	1.500
0.3	1.195	1.124	1.343	1.372
0.5	0.888	1.175	1.043	1.066
0.75	0.627	1.2375	0.776	0.793
1	0.464	1.3	0.604	0.617
2	0.206	1.35	0.278	0.284
3	0.124	1.4	0.173	0.177
4	0.085	1.45	0.124	0.126
5	0.066	1.5	0.099	0.101

Obtained from NGA West 2 GMPE Worksheet - UCERF3 fault

CALCS

Peak Sa	Fa	1.5Fa	Peak Sa < 1.5Fa	Scaling Factor
1.469	1.0	1.5	YES	1.021

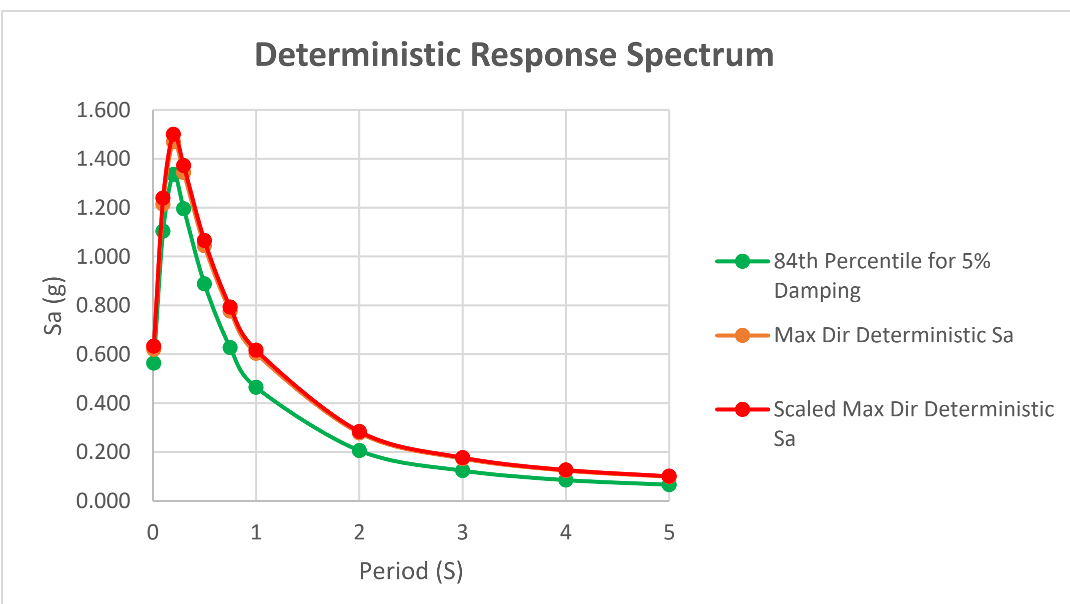


Exhibit C-2

SPECTRA COMPARISION

Period (s)	Probabilistic Response (g)	Scaled Max Dir Deterministic Sa (g)	MCE_{R*} Response Spectra S_{aM} (g)	2/3 MCER Response Spectra Sa (g)
0.01	0.523	0.633	0.523	0.349
0.1	1.084	1.239	1.084	0.723
0.2	1.286	1.500	1.286	0.857
0.3	1.186	1.372	1.186	0.791
0.5	0.947	1.066	0.947	0.631
0.75	0.738	0.793	0.738	0.492
1	0.584	0.617	0.584	0.389
2	0.299	0.284	0.284	0.189
3	0.206	0.177	0.177	0.118
4	0.162	0.126	0.126	0.084
5	0.135	0.101	0.101	0.067

MCER* is the lesser of the prbabilitic and deterministic spectra

CALCS

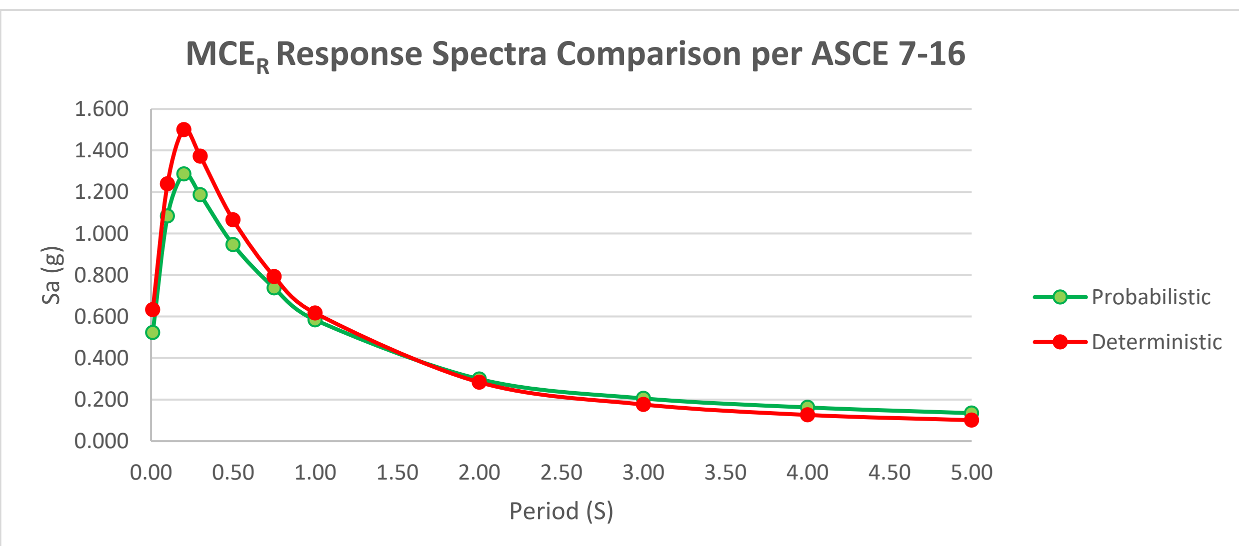


Exhibit C-3

S_s	1.037
S_1	0.401
Fa	1.2
Fv	1.5
S_{MS}	1.244
S_{M1}	0.602
S_{DS}	0.830
S_{D1}	0.401

since S_1 >0.2

T_0	0.100
T_S	0.500

PGA	0.446
PGA_M	0.535

Period (S)	Code-Based Sa (g)	80% Code-Based Sa (g)	2/3 MCER Response Spectra Sa (g)	Design Response Spectra Sa (g)
0.01	0.382	0.305	0.349	0.349
0.10	0.830	0.664	0.723	0.723
0.20	0.830	0.664	0.857	0.857
0.30	0.830	0.664	0.791	0.791
0.50	0.802	0.642	0.631	0.642
0.75	0.535	0.428	0.492	0.492
1.00	0.401	0.321	0.389	0.389
2.00	0.201	0.160	0.189	0.189
3.00	0.134	0.107	0.118	0.118
4.00	0.100	0.080	0.084	0.084
5.00	0.080	0.064	0.067	0.067

FROM SEISMIC MAPS (ATC OR OSHPD)
CALCS

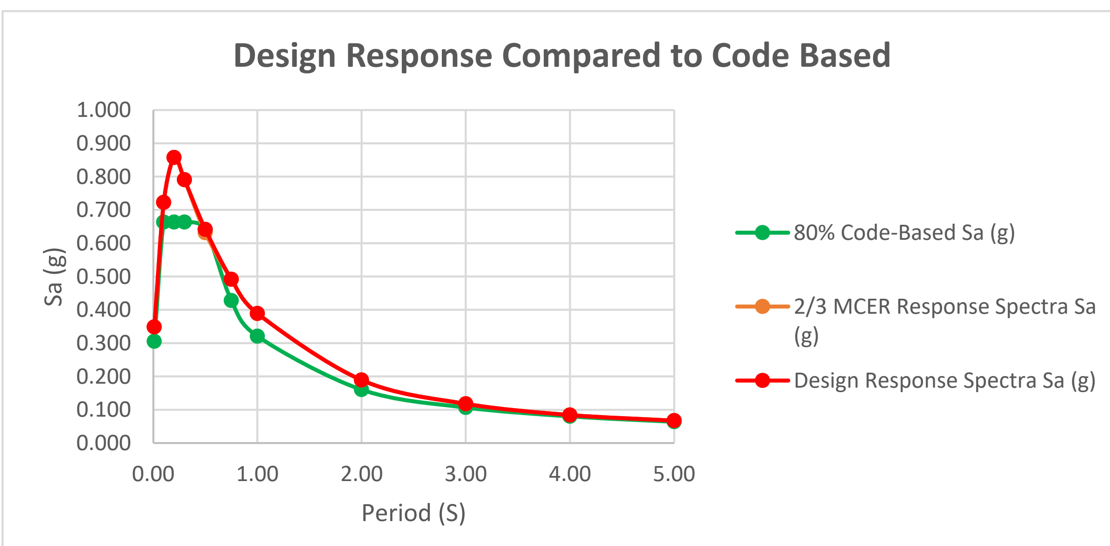


Exhibit C-4

Period (s)	MCER* Response Spectra SaM (g)	Design Response Spectra Sa (g)	Design Values (g)	
0.01	0.523	0.349	0.314	
0.10	1.084	0.723	0.650	
0.20	1.286	0.857	**0.772**	= S_{DS}
0.30	1.186	0.791	0.712	
0.50	0.947	0.642	0.577	
0.75	0.738	0.492	0.443	
1.00	0.584	0.389	**0.389**	= S_{D1}
2.00	0.284	0.189	0.379	
3.00	0.177	0.118	0.354	
4.00	0.126	0.084	0.337	
5.00	0.101	0.067	0.337	

Max Sa between T=0.2s and 5s is **0.857**

S_{DS} = 0.9 X Max Sa = **0.772**

S_{MS} = 1.5*S_{DS} = **1.158**

Short Period Spectrum

V_{S30} = 560 m/s > 365 m/s **Site Class C**

Max T*S_a between T=1s and 5s is **0.389**

Therefore, S_{D1} = **0.389**

S_{M1} = 1.5*S_{D1} = **0.584**

Long Period Spectrum

Probabilistic PGA	**0.510**
Deterministic PGA	**0.563**
80% Code-Based PGA_M	**0.428**
Site-Specific PGA	**0.563**

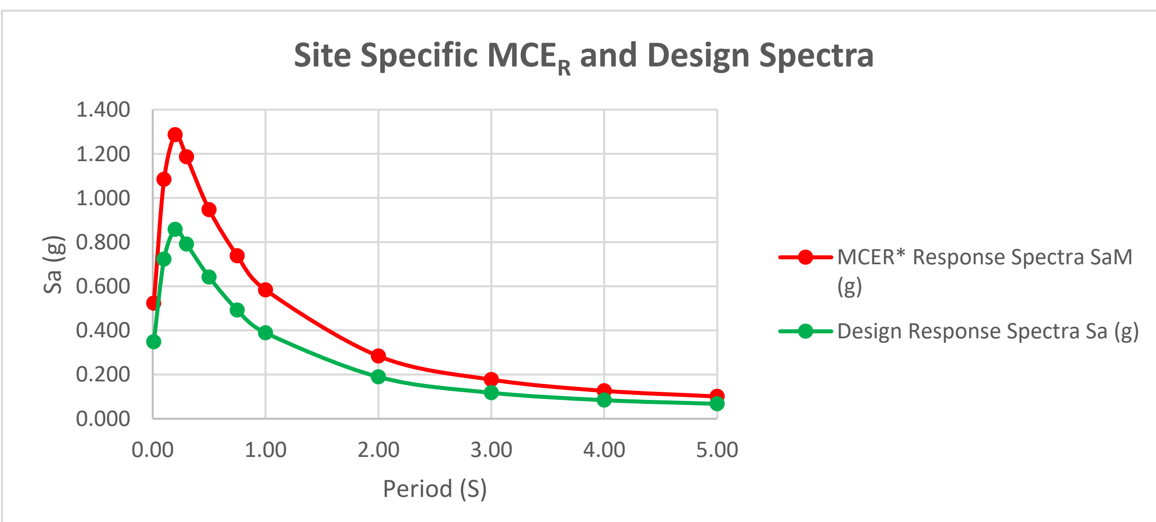


Exhibit C-5

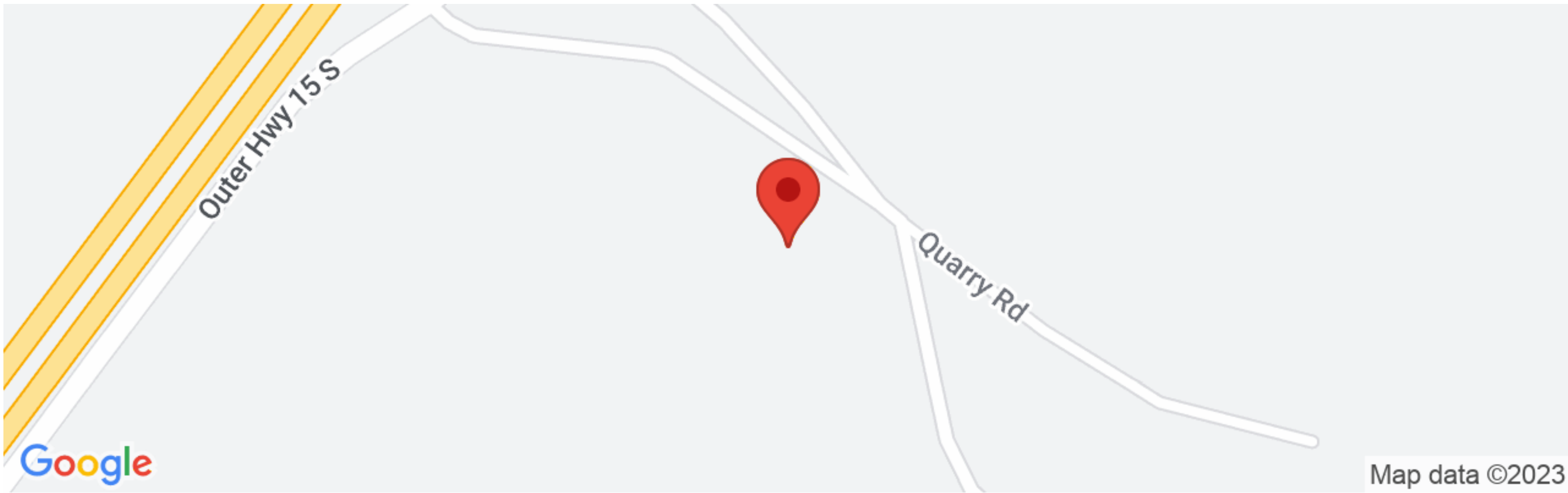
SUMMARY TABLE

Site-Specific Seismic Analysis (per ASCE 7-16)

	Site Seismic Coefficients / Coordinates	Value	
	Latitude	34.5754	
	Longitude	-117.2675	
Mapped Spectra (OSHPD)	Spectral Response – Class C (short), S_S	1.04	**Exhibit C-4**
	Spectral Response – Class C (1 sec), S_1	0.40	**Exhibit C-4**
	Site Modified Peak Ground Acceleration, PGA_M	0.54	**Exhibit C-4**
Site-Specific Response Spectra	Max. Considered Earthquake Spectral Response Acceleration (short), S_{MS}	1.16	**Exhibit C-5**
	Max. Considered Earthquake Spectral Response Acceleration – (1 sec), S_{M1}	0.58	**Exhibit C-5**
	5% Damped Design Spectral Response Acceleration (short), S_{DS}	0.77	**Exhibit C-5**
	5% Damped Design Spectral Response Acceleration (1 sec), S_{D1}	0.39	**Exhibit C-5**
	Maximum Considered Earthqauke Geometric Mean MCE_G PGA	0.56	**Exhibit C-5**

Site 2

Latitude, Longitude: 34.5754, -117.2675



Date	1/5/2023, 5:35:20 PM
Design Code Reference Document	ASCE7-16
Risk Category	II
Site Class	C - Very Dense Soil and Soft Rock

Type	Value	Description
S_S	1.037	MCE_R ground motion. (for 0.2 second period)
S_1	0.401	MCE_R ground motion. (for 1.0s period)
S_{MS}	1.245	Site-modified spectral acceleration value
S_{M1}	0.602	Site-modified spectral acceleration value
S_{DS}	0.83	Numeric seismic design value at 0.2 second SA
S_{D1}	0.401	Numeric seismic design value at 1.0 second SA

Type	Value	Description
SDC	D	Seismic design category
F_a	1.2	Site amplification factor at 0.2 second
F_v	1.5	Site amplification factor at 1.0 second
PGA	0.446	MCE_G peak ground acceleration
F_{PGA}	1.2	Site amplification factor at PGA
PGA_M	0.535	Site modified peak ground acceleration
T_L	12	Long-period transition period in seconds
SsRT	1.037	Probabilistic risk-targeted ground motion. (0.2 second)
SsUH	1.112	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	1.5	Factored deterministic acceleration value. (0.2 second)
S1RT	0.401	Probabilistic risk-targeted ground motion. (1.0 second)
S1UH	0.436	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
S1D	0.6	Factored deterministic acceleration value. (1.0 second)
PGAd	0.5	Factored deterministic acceleration value. (Peak Ground Acceleration)
PGA_{UH}	0.446	Uniform-hazard (2% probability of exceedance in 50 years) Peak Ground Acceleration
C_{RS}	0.933	Mapped value of the risk coefficient at short periods
C_{R1}	0.92	Mapped value of the risk coefficient at a period of 1 s
C_V	1.107	Vertical coefficient

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Unified Hazard Tool

Please do not use this tool to obtain ground motion parameter values for the design code reference documents covered by the U.S. Seismic Design Maps web tools (e.g., the International Building Code and the ASCE 7 or 41 Standard). The values returned by the two applications are not identical.

Input

Edition

Dynamic: Conterminous U.S. 2014 (update…

Latitude

Decimal degrees

34.5754

Longitude

Decimal degrees, negative values for western longitudes

-117.2675

Site Class

537 m/s (Site class C)

Spectral Period

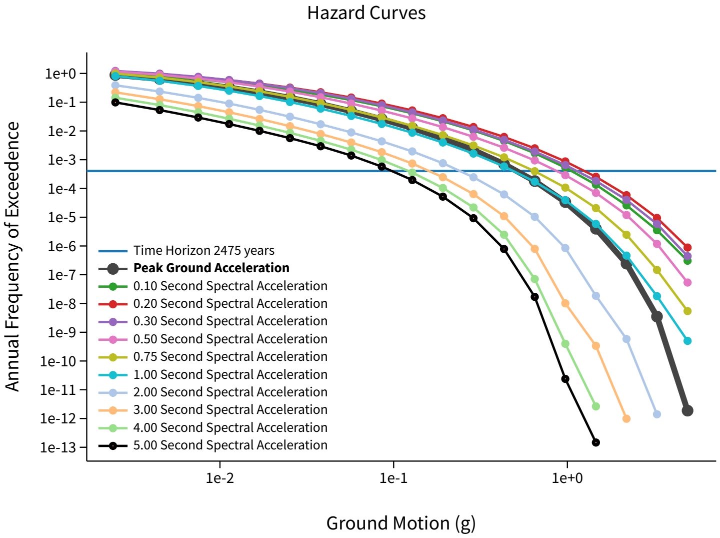
Peak Ground Acceleration

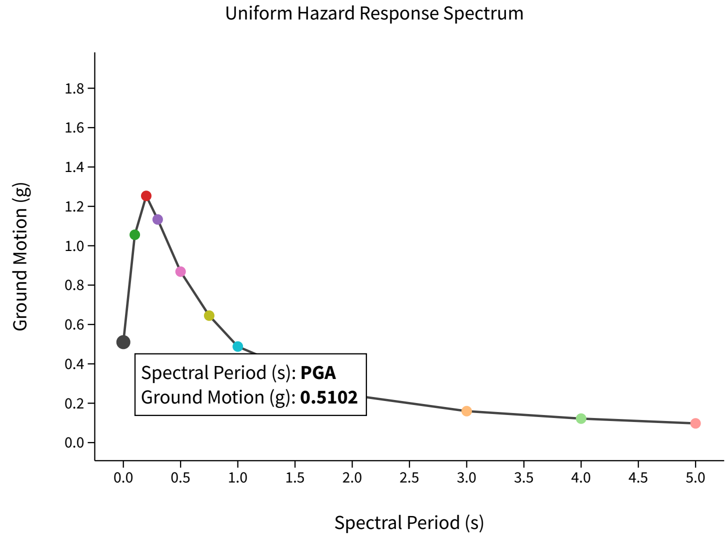
Time Horizon

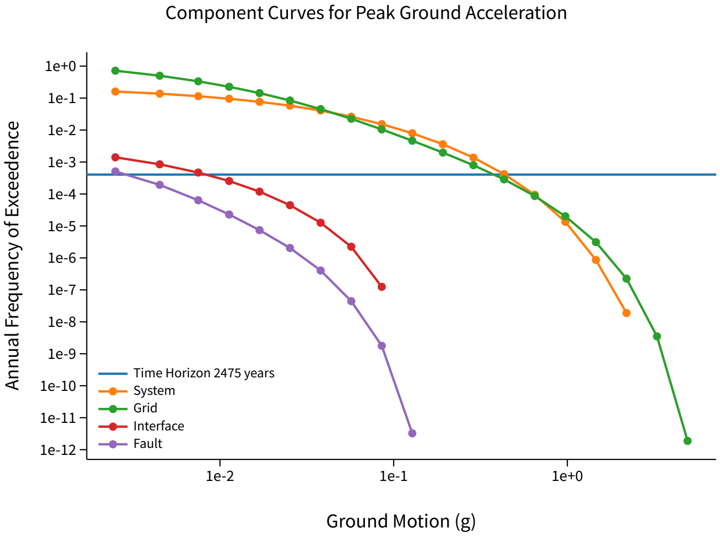
Return period in years

2475

Hazard Curve





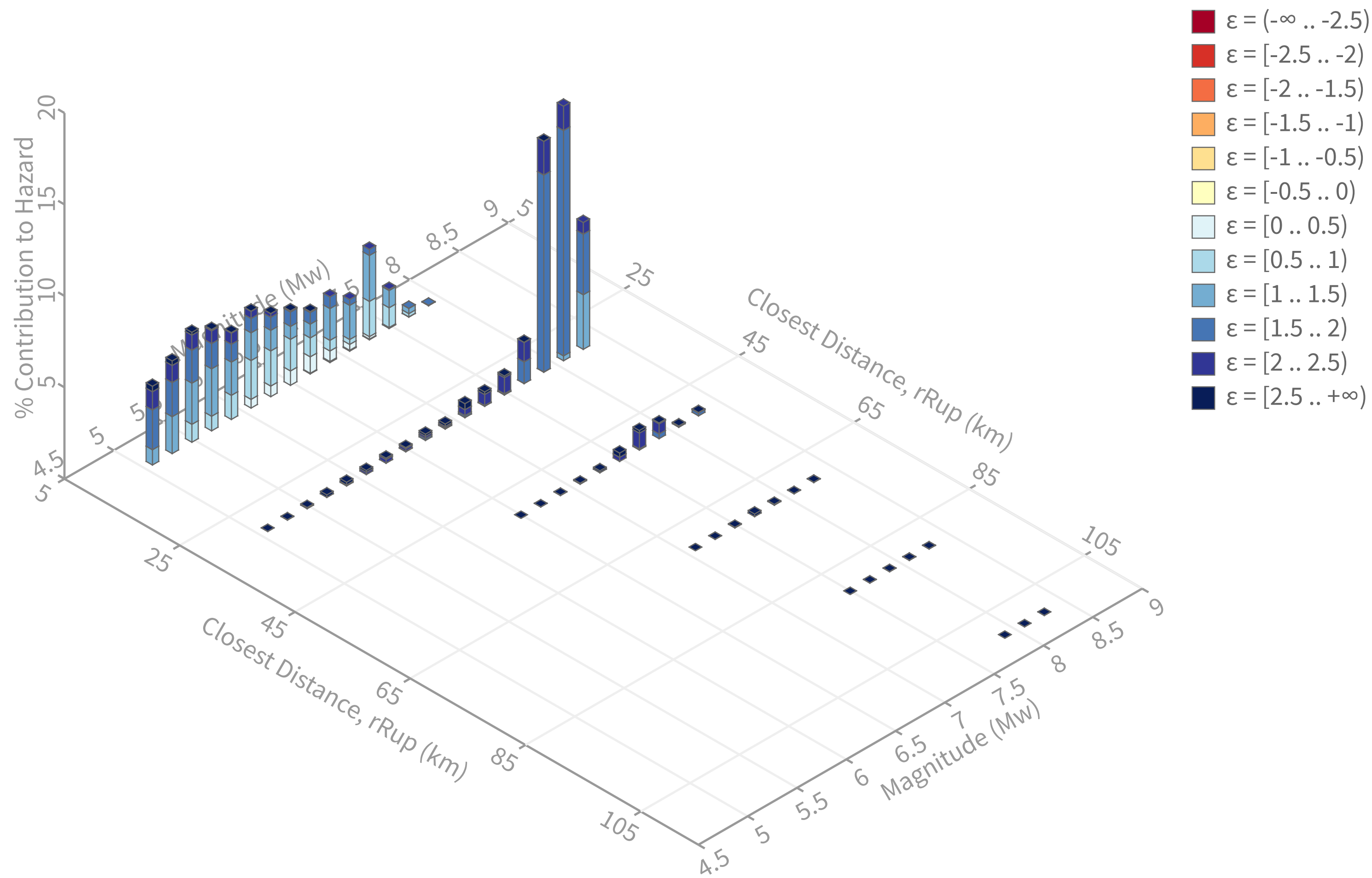


View Raw Data

Deaggregation

Component

Total



% Contribution to Hazard
20
15
10
5
Magnitude (Mw)
Closest Distance, rRup (km)
25
45
65
85
105
4.5
5
5.5
6
6.5
7
7.5
8
8.5
9
ε = (-∞ .. -2.5)
ε = [-2.5 .. -2)
ε = [-2 .. -1.5)
ε = [-1.5 .. -1)
ε = [-1 .. -0.5)
ε = [-0.5 .. 0)
ε = [0 .. 0.5)
ε = [0.5 .. 1)
ε = [1 .. 1.5)
ε = [1.5 .. 2)
ε = [2 .. 2.5)
ε = [2.5 .. +∞)

Summary statistics for, Deaggregation: Total

Deaggregation targets

Return period: 2475 yrs
Exceedance rate: 0.0004040404 yr^{-1}
PGA ground motion: 0.5102206 g

Recovered targets

Return period: 2852.2515 yrs
Exceedance rate: 0.00035060022 yr^{-1}

Totals

Binned: 100 %
Residual: 0 %
Trace: 0.1 %

Mean (over all sources)

m: 6.93
r: 22.29 km
ε_0: 1.52 σ

Mode (largest m-r bin)

m: 8.1
r: 37.75 km
ε_0: 1.71 σ
Contribution: 13.91 %

Mode (largest m-r-ε_0 bin)

m: 8.09
r: 37.76 km
ε_0: 1.67 σ
Contribution: 12.32 %

Discretization

r: min = 0.0, max = 1000.0, Δ = 20.0 km
m: min = 4.4, max = 9.4, Δ = 0.2
ε: min = -3.0, max = 3.0, Δ = 0.5 σ

Epsilon keys

ε0: [-∞ .. -2.5)
ε1: [-2.5 .. -2.0)
ε2: [-2.0 .. -1.5)
ε3: [-1.5 .. -1.0)
ε4: [-1.0 .. -0.5)
ε5: [-0.5 .. 0.0)
ε6: [0.0 .. 0.5)
ε7: [0.5 .. 1.0)
ε8: [1.0 .. 1.5)
ε9: [1.5 .. 2.0)
ε10: [2.0 .. 2.5)
ε11: [2.5 .. +∞]

Deaggregation Contributors

Source Set ↳ Source	Type	r	m	ε_0	lon	lat	az	%
UC33brAvg_FM32	System							27.12
San Andreas (San Bernardino N) [1]		37.76	8.03	1.77	117.465°W	34.277°N	208.74	17.01
Helendale-So Lockhart [7]		12.77	7.18	1.10	117.172°W	34.658°N	43.62	3.79
North Frontal (West) [1]		19.20	7.31	1.41	117.161°W	34.427°N	149.24	1.45
UC33brAvg_FM31	System							27.05
San Andreas (San Bernardino N) [1]		37.76	8.03	1.77	117.465°W	34.277°N	208.74	16.97
Helendale-So Lockhart [7]		12.77	7.18	1.10	117.172°W	34.658°N	43.62	3.82
North Frontal (West) [1]		19.20	7.32	1.41	117.161°W	34.427°N	149.24	1.43
UC33brAvg_FM31 (opt)	Grid							22.92
PointSourceFinite: -117.268, 34.616		6.64	5.74	0.98	117.267°W	34.616°N	0.00	3.32
PointSourceFinite: -117.268, 34.616		6.64	5.74	0.98	117.267°W	34.616°N	0.00	3.32
PointSourceFinite: -117.268, 34.652		8.79	6.01	1.17	117.267°W	34.652°N	0.00	2.22
PointSourceFinite: -117.268, 34.652		8.79	6.01	1.17	117.267°W	34.652°N	0.00	2.22
PointSourceFinite: -117.268, 34.634		8.31	5.57	1.38	117.267°W	34.634°N	0.00	1.75
PointSourceFinite: -117.268, 34.634		8.31	5.57	1.38	117.267°W	34.634°N	0.00	1.75
PointSourceFinite: -117.268, 34.670		10.29	6.01	1.38	117.267°W	34.670°N	0.00	1.27
PointSourceFinite: -117.268, 34.670		10.29	6.01	1.38	117.267°W	34.670°N	0.00	1.27
UC33brAvg_FM32 (opt)	Grid							22.90
PointSourceFinite: -117.268, 34.616		6.64	5.74	0.98	117.267°W	34.616°N	0.00	3.31
PointSourceFinite: -117.268, 34.616		6.64	5.74	0.98	117.267°W	34.616°N	0.00	3.31
PointSourceFinite: -117.268, 34.652		8.79	6.00	1.17	117.267°W	34.652°N	0.00	2.22
PointSourceFinite: -117.268, 34.652		8.79	6.00	1.17	117.267°W	34.652°N	0.00	2.22
PointSourceFinite: -117.268, 34.634		8.31	5.57	1.38	117.267°W	34.634°N	0.00	1.75
PointSourceFinite: -117.268, 34.634		8.31	5.57	1.38	117.267°W	34.634°N	0.00	1.75
PointSourceFinite: -117.268, 34.670		10.29	6.01	1.38	117.267°W	34.670°N	0.00	1.27
PointSourceFinite: -117.268, 34.670		10.29	6.01	1.38	117.267°W	34.670°N	0.00	1.27

PACIFIC EARTHQUAKE ENGINEERING RESEARCH CENTER

WEIGHTED AVERAGE of 2014 NGA WEST-2 GMPEs

Last updated: 04 14 15

by Emel Seyhan, PhD, PEER & UCLA -- email: emel.seyhan@gmail.com, peer_center@berkeley.edu

This excel file will be updated as necessary on the PEER website to fix any typos or other errors. Please check the website frequently for new versions at: http://peer.berkeley.edu/ngawest2/databases/

Legend	Pre-defined option	Main input variable	Calculated variable	Input var. flag	Internal variable

GMPE averaging	Geometric	*Weighted average of the natural logarithm of the spectral values*			
GMPEs	ASK14	BSSA14	CB14	CY14	I14
Weight	0.25	0.25	0.25	0.25	0
# of std. dev.	1				
Damping ratio (%)	5	*Modification factors are calculated in Sheet DSF*			

ASK14 Abrahamson & Silva & Kamai 2014 NGA West-2 Model
BSSA14 Boore & Stewart & Seyhan & Atkinson 2014 NGA West-2 Model
CB14 Campbell & Bozorgnia 2014 NGA West-2 Model
CY14 Chiou & Youngs 2014 NGA West-2 Model
I14 Idriss 2014 NGA West-2 Model

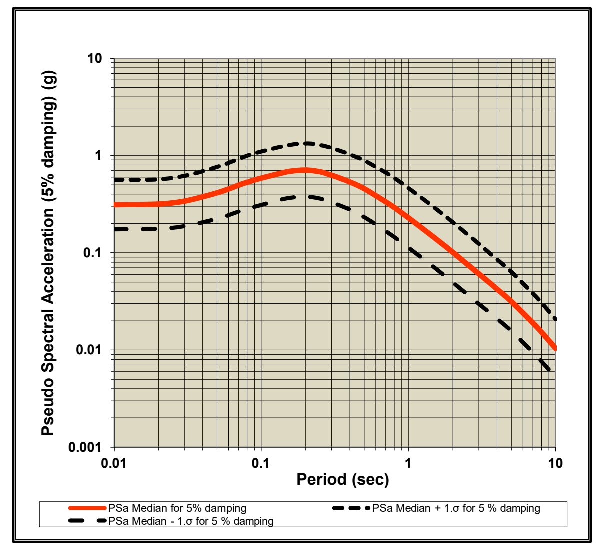
Input variables	Errors and warnings
M_w = 7.39	
R_{RUP} (km) = 15	
R_{JB} (km) = 12.7	
R_X (km) = 12.7	
Ry0 (km) = 999	*If unknown use 999*
V_{S30} (m/sec) = 560	
U (BSSA13) = 0	*1: Unspecified fault mech.*
F_{RV} = 0	*1: reverse fault*
F_{NM} = 0	*1: normal fault*
F_{HW} = 0	*1: hanging wall side*
Dip (deg) = 90	
Z_{TOR} (km) = 8.2	*If unknown use 999*
Z_{HYP} (km) = 999	*If unknown use 999*
$Z_{1.0}$ (km) = 0.06	*If unknown use 999*
$Z_{2.5}$ (km) = 0.26	*If unknown use 999*
W (km) = 11.5	*If unknown use 999*
Vs30Flag = inferred	*Choose options for V_{S30} from the list*
F_{AS} = no	*Aftershock effect is not applicable.*
Region = California	*Choose region from the list*

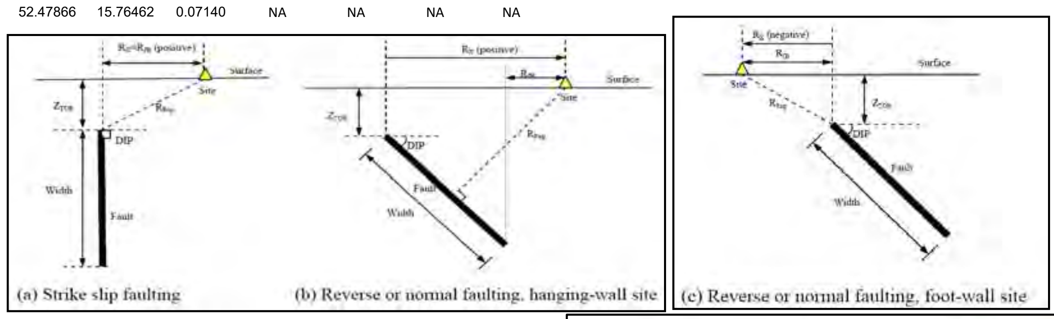
Calculated Variables/Flags

ΔDPP = 0	*Always 0 for median calcs.*
PGA_r (g) = 0.237	
Z_{BOT} (km) (CB14) = 15	*Enter for default W calcs*
SS = 1	*auto calculated*
$V_{s30Flag}$ = 0	*inferred*
F_{AS} = 0	*Aftershock effect is not applicable.*
Region = 0	*California*
Option for Sa value = 1	*Weighted average of the natural logarithm of the spectral values*

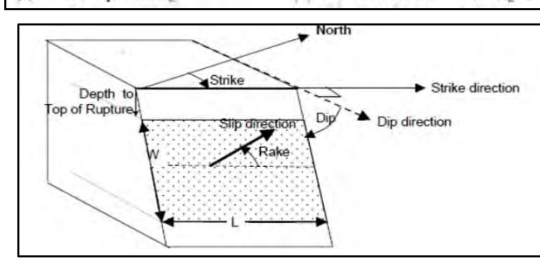
RotD50 Horizontal Component of PGA, PGV and *IMs*

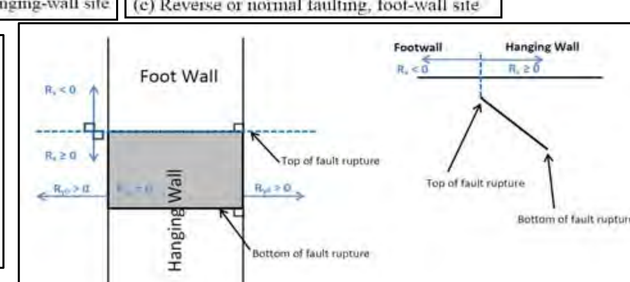
GMP	T (s)	Baseline: 5% Damping PSa Median for 5% damping	PSa Median + 1.σ for 5% damping	PSa Median - 1.σ for 5% damping	S_d Median for 5% damping	User defined: 5% Damping PSa Median for 5% damping	PSa Median + 1.σ for 5 % damping	PSa Median - 1.σ for 5 % damping	Sd Median for 5 % damping
PSa (g), S_d (cm)	0.01	0.31362	0.56333	0.17460	0.00078	0.31362	0.56333	0.17460	0.00078
	0.02	0.31777	0.57160	0.17666	0.00316	0.31777	0.57160	0.17666	0.00316
	0.03	0.34147	0.61891	0.18840	0.00763	0.34113	0.61829	0.18821	0.00762
	0.05	0.41358	0.76252	0.22433	0.02567	0.41358	0.76252	0.22433	0.02567
	0.075	0.51299	0.96120	0.27378	0.07163	0.51452	0.96408	0.27460	0.07184
	0.1	0.58436	1.09984	0.31048	0.14506	0.58611	1.10314	0.31141	0.14550
	0.15	0.67980	1.27315	0.36298	0.37969	0.68116	1.27569	0.36371	0.38045
	0.2	0.70999	1.33272	0.37824	0.70499	0.71141	1.33538	0.37900	0.70640
	0.25	0.68004	1.27968	0.36139	1.05507	0.68140	1.28223	0.36211	1.05718
	0.3	0.62760	1.19268	0.33025	1.40215	0.62886	1.19507	0.33091	1.40495
	0.4	0.53462	1.02737	0.27821	2.12340	0.53516	1.02839	0.27848	2.12553
	0.5	0.45515	0.88720	0.23350	2.82461	0.45560	0.88808	0.23373	2.82744
	0.75	0.31293	0.62724	0.15611	4.36948	0.31293	0.62724	0.15611	4.36948
	1	0.22916	0.46441	0.11308	5.68856	0.22916	0.46441	0.11308	5.68856
	1.5	0.14368	0.29271	0.07053	8.02505	0.14382	0.29300	0.07060	8.03308
	2	0.10116	0.20616	0.04964	10.04436	0.10106	0.20595	0.04959	10.03432
	3	0.06078	0.12375	0.02985	13.57795	0.06078	0.12375	0.02985	13.57795
	4	0.04240	0.08547	0.02104	16.84176	0.04236	0.08539	0.02102	16.82491
	5	0.03167	0.06392	0.01569	19.65199	0.03157	0.06373	0.01564	19.59304
	7.5	0.01707	0.03430	0.00849	23.82858	0.01700	0.03416	0.00846	23.73326
	10	0.01049	0.02084	0.00528	26.03193	0.01044	0.02075	0.00526	25.92781
PGA (g)	0	0.31219	0.56033	0.17394	0.00077	0.31219	0.56033	0.17394	0.00077
PGV (cm/s)	-1	28.76293	52.47866	15.76462	0.07140	NA	NA	NA	NA





(a) Strike slip faulting (b) Reverse or normal faulting, hanging-wall site (c) Reverse or normal faulting, foot-wall site





Courtesy: Jennifer Donahue

Definition of Parameters

Damping ratio = Viscous damping ratio (%) See Sanaz et al. (2012) PEER Report
PSA = Pseudo-absolute acceleration response spectrum (g)
PGA = Peak ground acceleration (g)
PGV = Peak ground velocity (cm/s)
S_d = Relative displacement response spectrum (cm)
M_w = Moment magnitude
R_{RUP} = Closest distance to coseismic rupture (km), used in ASK13, CB13 and CY13. See Figures a, b and c for illustration
R_{JB} = Closest distance to surface projection of coseismic rupture (km). See Figures a, b and c for illustration
R_X = Horizontal distance from top of rupture measured perpendicular to fault strike (km). See Figures a, b and c for illustation
R_{y0} = The horizontal distance off the end of the rupture measured parallel to strike (km)
V_{S30} = The average shear-wave velocity (m/s) over a subsurface depth of 30 m
U = Unspecified-mechanism factor: 1 for unspecified; 0 otherwise
F_{RV} = Reverse-faulting factor: 0 for strike slip, normal, normal-oblique; 1 for reverse, reverse-oblique and thrust
F_{NM} = Normal-faulting factor: 0 for strike slip, reverse, reverse-oblique, thrust and normal-oblique; 1 for normal
F_{HW} = Hanging-wall factor: 1 for site on down-dip side of top of rupture; 0 otherwise
Dip = Average dip of rupture plane (degrees)
Z_{TOR} = Depth to top of coseismic rupture (km)
Z_{HYP} = Hypocentral depth from the earthquake
$Z_{1.0}$ = Depth to Vs=1 km/sec
$Z_{2.5}$ = Depth to Vs=2.5 km/sec
W = Fault rupture width (km)
$V_{s30flag}$ = 1 for measured, 0 for inferred Vs30
F_{AS} = 0 for mainshock; 1 for aftershock
Region = Specific regions considered in the models, Click on Region to see codes
ΔDPP = Directivity term, direct point parameter; uses 0 for median predictions
PGA_r (g) = Peak ground acceleration on rock (g), this specific cell is updated in the cell for BSSA14 and CB14, for others it is taken account for in the macros
Z_{BOT} (km) = The depth to the bottom of the seismogenic crust
Z_{BOR} (km) = The depth to the bottom of the rupture plane
SS = 1 for strike slip, automatically updated in the cell

Input variables with defaults (If entered 999 as input):

Red colored value: The value is used in the code when input is unknown

DEFAULTs	USER defined	ASK14	BSSA14	CB14	CY14	I14
W (km)	11.50			15.000		
$Z_{1.0}$ (km)	0.060	0.060			0.162	
$\delta Z_{1.0}$ (km)	-0.102		-0.102			
$Z_{2.5}$ (V_{S30}=1100)(km)	0.260			0.398		
$Z_{2.5}$ (V_{S30})(km)	0.260			0.861		
Z_{hyp} (km)	999.00			10.227		
Z_{tor} (km)	8.20			0.000	0.000	
Z_{BOR} (km)	-			15.000		

ACKNOWLEDGEMENTS

Nick Gregor, Bechtel
Silvia Mazzoni, Consultant

All NGA West-2 participants are acknowledged for their constructive comments and feedback.

PACIFIC EARTHQUAKE ENGINEERING RESEARCH CENTER

WEIGHTED AVERAGE of 2014 NGA WEST-2 GMPEs

Last updated: 04 14 15

by Emel Seyhan, PhD, PEER & UCLA -- email: emel.seyhan@gmail.com, peer_center@berkeley.edu

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Legend	Pre-defined option	Main input variable	Calculated variable	Input var. flag	Internal variable

GMPE averaging	Geometric	*Weighted average of the natural logarithm of the spectral values*

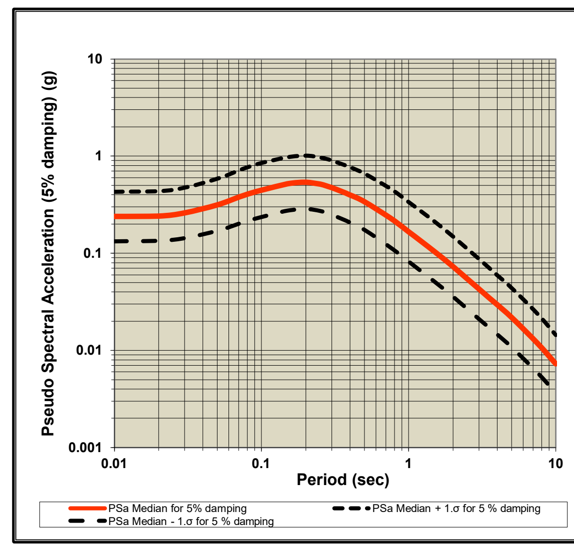
GMPEs	ASK14	BSSA14	CB14	CY14	I14
Weight	0.25	0.25	0.25	0.25	0

# of std. dev.	1	
Damping ratio (%)	5	*Modification factors are calculated in Sheet DSF*

ASK14 Abrahamson & Silva & Kamai 2014 NGA West-2 Model
BSSA14 Boore & Stewart & Seyhan & Atkinson 2014 NGA West-2 Model
CB14 Campbell & Bozorgnia 2014 NGA West-2 Model
CY14 Chiou & Youngs 2014 NGA West-2 Model
I14 Idriss 2014 NGA West-2 Model

RotD50 Horizontal Component of PGA, PGV and *IMs*

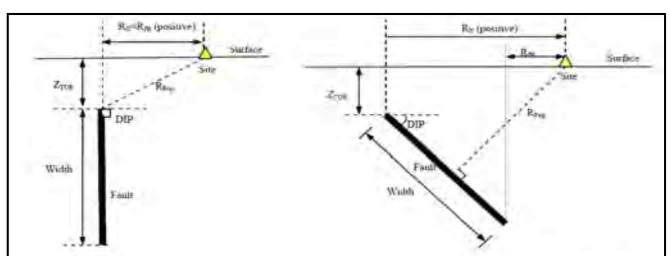
GMP	*T* (s)	PSa Median for 5% damping (Baseline: 5% Damping)	PSa Median + 1.σ for 5% damping	PSa Median - 1.σ for 5% damping	S_d Median for 5% damping	PSa Median for 5% damping (User defined: 5% Damping)	PSa Median + 1.σ for 5 % damping	PSa Median - 1.σ for 5 % damping	Sd Median for 5 % damping
PSa (g), S_d (cm)	0.01	0.23980	0.43179	0.13318	0.00060	0.23980	0.43179	0.13318	0.00060
	0.02	0.24251	0.43734	0.13447	0.00241	0.24251	0.43734	0.13447	0.00241
	0.03	0.26052	0.47373	0.14327	0.00582	0.26052	0.47373	0.14327	0.00582
	0.05	0.31592	0.58517	0.17056	0.01961	0.31592	0.58517	0.17056	0.01961
	0.075	0.39227	0.73888	0.20825	0.05477	0.39344	0.74110	0.20888	0.05494
	0.1	0.44690	0.84564	0.23617	0.11094	0.44824	0.84818	0.23688	0.11127
	0.15	0.51709	0.97290	0.27483	0.28881	0.51813	0.97485	0.27538	0.28939
	0.2	0.53738	1.01145	0.28551	0.53359	0.53846	1.01348	0.28608	0.53466
	0.25	0.51376	0.96823	0.27261	0.79709	0.51427	0.96919	0.27288	0.79789
	0.3	0.47283	0.89923	0.24862	1.05637	0.47378	0.90103	0.24912	1.05848
	0.4	0.39992	0.76880	0.20804	1.58841	0.40032	0.76957	0.20825	1.59000
	0.5	0.33888	0.66075	0.17380	2.10307	0.33922	0.66142	0.17398	2.10517
	0.75	0.23091	0.46292	0.11518	3.22423	0.23091	0.46292	0.11518	3.22423
	1	0.16713	0.33874	0.08246	4.14871	0.16713	0.33874	0.08246	4.14871
	1.5	0.10412	0.21214	0.05111	5.81570	0.10423	0.21235	0.05116	5.82151
	2	0.07291	0.14860	0.03577	7.23944	0.07284	0.14845	0.03574	7.23220
	3	0.04291	0.08739	0.02107	9.58753	0.04291	0.08739	0.02107	9.58753
	4	0.02959	0.05963	0.01468	11.75067	0.02953	0.05951	0.01465	11.72717
	5	0.02192	0.04424	0.01086	13.60237	0.02185	0.04411	0.01083	13.56156
	7.5	0.01190	0.02392	0.00592	16.61644	0.01184	0.02380	0.00589	16.53336
	10	0.00731	0.01452	0.00368	18.14183	0.00727	0.01445	0.00366	18.05112
PGA (g)	0	0.23874	0.42952	0.13269	0.00059	0.23874	0.42952	0.13269	0.00059
PGV (cm/s)	-1	20.55907	37.51310	11.26741	0.05104	NA	NA	NA	NA



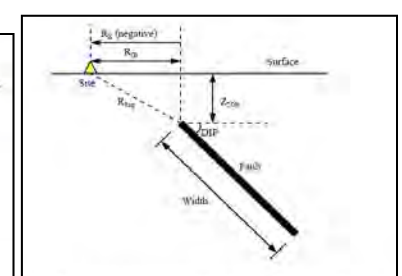
Input variables	Errors and warnings
M$_w$: 7.32	
R$_{RUP}$ ***(km)***: 22	
R$_{JB}$ ***(km)***: 19.2	
R$_X$ ***(km)***: 19.2	
Ry0 (km): 999	*If unknown use 999*
V$_{S30}$ ***(m/sec)***: 560	
U (BSSA13): 0	*1: Unspecified fault mech.*
F$_{RV}$: 0	*1: reverse fault*
F$_{NM}$: 0	*1: normal fault*
F$_{HW}$: 0	*1: hanging wall side*
Dip (deg): 49	
Z$_{TOR}$ ***(km)***: 10.1	*If unknown use 999*
Z$_{HYP}$ ***(km)***: 999	*If unknown use 999*
Z$_{1.0}$ ***(km)***: 0.06	*If unknown use 999*
Z$_{2.5}$ ***(km)***: 0.26	*If unknown use 999*
W (km): 18.72	*If unknown use 999*
Vs30Flag: inferred	*Choose options for* V_{s30} *from the list*
F$_{AS}$: no	*Aftershock effect is not applicable.*
Region: California	*Choose region from the list*

Calculated Variables/Flags

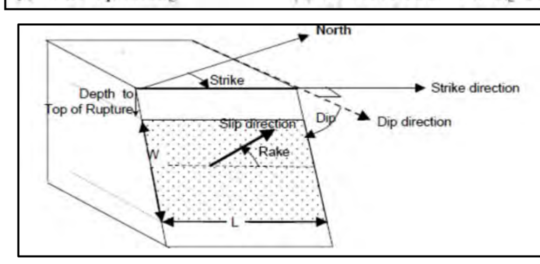
ΔDPP: 0	*Always 0 for median calcs.*
PGA$_r$ ***(g)***: 0.176	
Z$_{BOT}$ ***(km) (CB14)***: 15	*Enter for default W calcs*
SS: 1	*auto calculated*
V$_{s30Flag}$: 0	*inferred*
F$_{AS}$: 0	*Aftershock effect is not applicable.*
Region: 0	*California*
Option for Sa value: 1	*Weighted average of the natural logarithm of the spectral values*

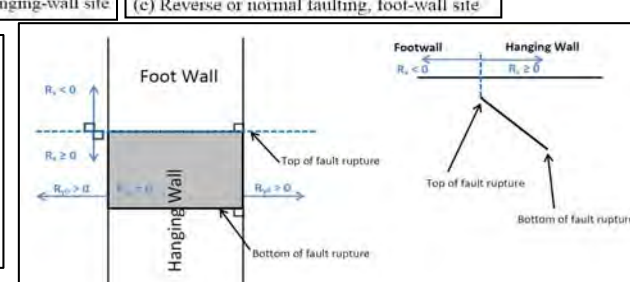


(a) Strike slip faulting (b) Reverse or normal faulting, hanging-wall site



(c) Reverse or normal faulting, foot-wall site





Courtesy: Jennifer Donahue

Definition of Parameters

Damping ratio = Viscous damping ratio (%) See Sanaz et al. (2012) PEER Report
PSA = Pseudo-absolute acceleration response spectrum (g)
PGA = Peak ground acceleration (g)
PGV = Peak ground velocity (cm/s)
S_d = Relative displacement response spectrum (cm)
M_w = Moment magnitude
R_{RUP} = Closest distance to coseismic rupture (km), used in ASK13, CB13 and CY13. See Figures a, b and c for illustation
R_{JB} = Closest distance to surface projection of coseismic rupture (km). See Figures a, b and c for illustation
R_X = Horizontal distance from top of rupture measured perpendicular to fault strike (km). See Figures a, b and c for illustation
R_{y0} = The horizontal distance off the end of the rupture measured parallel to strike (km)
V_{S30} = The average shear-wave velocity (m/s) over a subsurface depth of 30 m
U = Unspecified-mechanism factor: 1 for unspecified; 0 otherwise
F_{RV} = Reverse-faulting factor: 0 for strike slip, normal, normal-oblique; 1 for reverse, reverse-oblique and thrust
F_{NM} = Normal-faulting factor: 0 for strike slip, reverse, reverse-oblique, thrust and normal-oblique; 1 for normal
F_{HW} = Hanging-wall factor: 1 for site on down-dip side of top of rupture; 0 otherwise
Dip = Average dip of rupture plane (degrees)
Z_{TOR} = Depth to top of coseismic rupture (km)
Z_{HYP} = Hypocentral depth from the earthquake
$Z_{1.0}$ = Depth to Vs=1 km/sec
$Z_{2.5}$ = Depth to Vs=2.5 km/sec
W = Fault rupture width (km)
$V_{s30flag}$ = 1 for measured, 0 for inferred Vs30
F_{AS} = 0 for mainshock; 1 for aftershock
Region = Specific regions considered in the models, Click on Region to see codes
ΔDPP = Directivity term, direct point parameter; uses 0 for median predictions
PGA_r ***(g)*** = Peak ground acceleration on rock (g), this specific cell is updated in the cell for BSSA14 and CB14, for others it is taken account for in the macros
Z_{BOT} ***(km)*** = The depth to the bottom of the seismogenic crust
Z_{BOR} ***(km)*** = The depth to the bottom of the rupture plane
SS = 1 for strike slip, automatically updated in the cell

Input variables with defaults (If entered 999 as input):

Red colored value: The value is used in the code when input is unknown

DEFAULTs	USER defined	ASK14	BSSA14	CB14	CY14	I14
W (km)	18.72			19.875		
$Z_{1.0}$ (km)	0.060	0.060			0.162	
$\delta Z_{1.0}$ (km)	-0.102		-0.102			
$Z_{2.5}$ (V_{S30}=1100)(km)	0.260			0.398		
$Z_{2.5}$ (V_{S30})(km)	0.260			0.861		
Z_{hyp} (km)	999.00			10.227		
Z_{tor} (km)	10.10			0.000	0.000	
Z_{BOR} (km)	-			15.000		

ACKNOWLEDGEMENTS

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Caltrans
PG&E

Nick Gregor, Bechtel
Silvia Mazzoni, Consultant

All NGA West-2 participants are acknowledged for their constructive comments and feedback.

PACIFIC EARTHQUAKE ENGINEERING RESEARCH CENTER

WEIGHTED AVERAGE of 2014 NGA WEST-2 GMPEs

Last updated: 04 14 15

by Emel Seyhan, PhD, PEER & UCLA -- email: emel.seyhan@gmail.com, peer_center@berkeley.edu

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Legend	Pre-defined option	Main input variable	Calculated variable	Input var. flag	Internal variable

GMPE averaging	Geometric	*Weighted average of the natural logarithm of the spectral values*

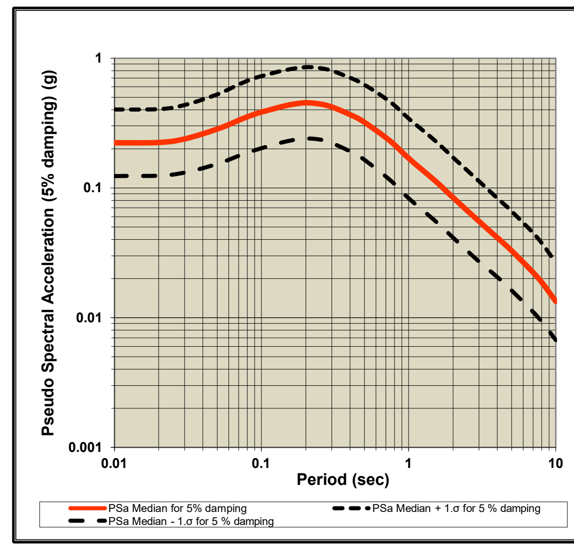
GMPEs	ASK14	BSSA14	CB14	CY14	I14
Weight	0.25	0.25	0.25	0.25	0

# of std. dev.	1	
Damping ratio (%)	5	*Modification factors are calculated in Sheet DSF*

ASK14 Abrahamson & Silva & Kamai 2014 NGA West-2 Model
BSSA14 Boore & Stewart & Seyhan & Atkinson 2014 NGA West-2 Model
CB14 Campbell & Bozorgnia 2014 NGA West-2 Model
CY14 Chiou & Youngs 2014 NGA West-2 Model
I14 Idriss 2014 NGA West-2 Model

RotD50 Horizontal Component of PGA, PGV and *IMs*

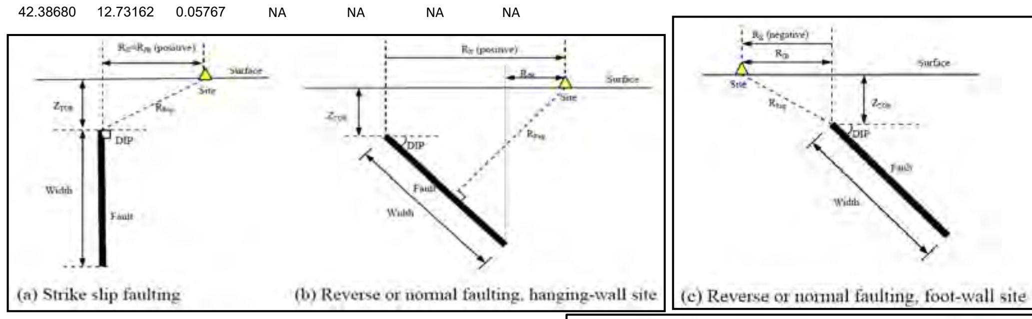
GMP	T (s)	Baseline: 5% Damping PSa Median for 5% damping	PSa Median + 1.σ for 5% damping	PSa Median - 1.σ for 5% damping	S_d Median for 5% damping	User defined: 5% Damping PSa Median for 5% damping	PSa Median + 1.σ for 5 % damping	PSa Median - 1.σ for 5 % damping	Sd Median for 5 % damping
PSa (g), S_d (cm)	0.01	0.22287	0.40160	0.12369	0.00055	0.22287	0.40160	0.12369	0.00055
	0.02	0.22442	0.40503	0.12435	0.00223	0.22442	0.40503	0.12435	0.00223
	0.03	0.23911	0.43524	0.13137	0.00534	0.23888	0.43480	0.13123	0.00534
	0.05	0.28374	0.52635	0.15295	0.01761	0.28402	0.52688	0.15310	0.01763
	0.075	0.34287	0.64704	0.18169	0.04788	0.34390	0.64898	0.18224	0.04802
	0.1	0.38256	0.72534	0.20177	0.09497	0.38409	0.72824	0.20258	0.09535
	0.15	0.43146	0.81309	0.22895	0.24098	0.43275	0.81553	0.22963	0.24170
	0.2	0.45139	0.85035	0.23961	0.44821	0.45275	0.85290	0.24033	0.44955
	0.25	0.44317	0.83560	0.23504	0.68758	0.44362	0.83644	0.23528	0.68826
	0.3	0.41957	0.79812	0.22057	0.93738	0.42083	0.80051	0.22123	0.94019
	0.4	0.36704	0.70562	0.19092	1.45779	0.36777	0.70703	0.19130	1.46071
	0.5	0.32069	0.62532	0.16447	1.99021	0.32069	0.62532	0.16447	1.99021
	0.75	0.22907	0.45923	0.11426	3.19855	0.22930	0.45969	0.11437	3.20175
	1	0.16925	0.34303	0.08350	4.20129	0.16925	0.34303	0.08350	4.20129
	1.5	0.11449	0.23325	0.05619	6.39446	0.11460	0.23348	0.05625	6.40085
	2	0.08438	0.17198	0.04140	8.37883	0.08430	0.17181	0.04136	8.37045
	3	0.05523	0.11247	0.02712	12.34014	0.05523	0.11247	0.02712	12.34014
	4	0.04150	0.08365	0.02059	16.48309	0.04142	0.08348	0.02055	16.45012
	5	0.03281	0.06623	0.01626	20.36196	0.03274	0.06609	0.01622	20.32124
	7.5	0.02062	0.04145	0.01026	28.79342	0.02048	0.04116	0.01019	28.59187
	10	0.01344	0.02671	0.00677	33.37250	0.01338	0.02658	0.00673	33.20564
PGA (g)	0	0.22190	0.39953	0.12325	0.00055	0.22190	0.39953	0.12325	0.00055
PGV (cm/s)	-1	23.23043	42.38680	12.73162	0.05767	NA	NA	NA	NA



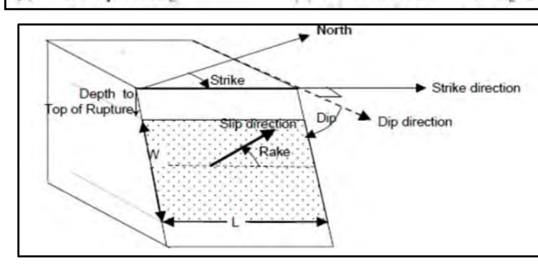
Input variables	Errors and warnings
M_w = 8.2	
R_{RUP} (km) = 38.4	
R_{JB} (km) = 37.7	
R_X (km) = 37.7	
Ry0 (km) = 999	*If unknown use 999*
V_{S30} (m/sec) = 560	
U (BSSA13) = 0	*1: Unspecified fault mech.*
F_{RV} = 0	*1: reverse fault*
F_{NM} = 0	*1: normal fault*
F_{HW} = 0	*1: hanging wall side*
Dip (deg) = 90	
Z_{TOR} (km) = 7.68	*If unknown use 999*
Z_{HYP} (km) = 999	*If unknown use 999*
$Z_{1.0}$ (km) = 0.06	*If unknown use 999*
$Z_{2.5}$ (km) = 0.26	*If unknown use 999*
W (km) = 12.8	*If unknown use 999*
Vs30Flag = inferred	*Choose options for V_{s30} from the list*
F_{AS} = no	*Aftershock effect is not applicable.*
Region = California	*Choose region from the list*

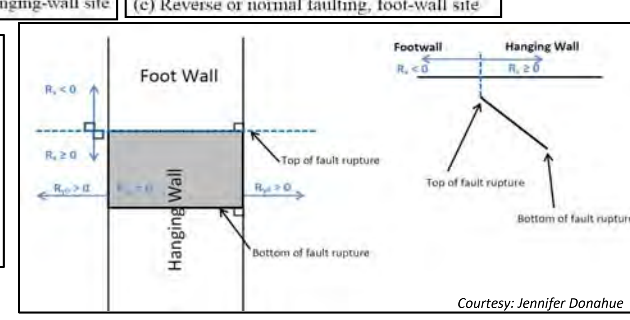
Calculated Variables/Flags

Variable	Value	Note
ΔDPP	0	*Always 0 for median calcs.*
PGA_r (g)	0.164	
Z_{BOT} (km) (CB14)	15	*Enter for default W calcs*
SS	1	*auto calculated*
$V_{s30Flag}$	0	*inferred*
F_{AS}	0	*Aftershock effect is not applicable.*
Region	0	*California*
Option for Sa value	1	*Weighted average of the natural logarithm of the spectral values*



(a) Strike slip faulting (b) Reverse or normal faulting, hanging-wall site (c) Reverse or normal faulting, foot-wall site





Courtesy: Jennifer Donahue

Definition of Parameters

- **Damping ratio** = Viscous damping ratio (%) See Sanaz et al. (2012) PEER Report
- **PSA** = Pseudo-absolute acceleration response spectrum (g)
- **PGA** = Peak ground acceleration (g)
- **PGV** = Peak ground velocity (cm/s)
- S_d = Relative displacement response spectrum (cm)
- M_w = Moment magnitude
- R_{RUP} = Closest distance to coseismic rupture (km), used in ASK13, CB13 and CY13. See Figures a, b and c for illustration
- R_{JB} = Closest distance to surface projection of coseismic rupture (km). See Figures a, b and c for illustration
- R_X = Horizontal distance from top of rupture measured perpendicular to fault strike (km). See Figures a, b and c for illustation
- R_{y0} = The horizontal distance off the end of the rupture measured parallel to strike (km)
- V_{S30} = The average shear-wave velocity (m/s) over a subsurface depth of 30 m
- **U** = Unspecified-mechanism factor: 1 for unspecified; 0 otherwise
- F_{RV} = Reverse-faulting factor: 0 for strike slip, normal, normal-oblique; 1 for reverse, reverse-oblique and thrust
- F_{NM} = Normal-faulting factor: 0 for strike slip, reverse, reverse-oblique, thrust and normal-oblique; 1 for normal
- F_{HW} = Hanging-wall factor: 1 for site on down-dip side of top of rupture; 0 otherwise
- **Dip** = Average dip of rupture plane (degrees)
- Z_{TOR} = Depth to top of coseismic rupture (km)
- Z_{HYP} = Hypocentral depth from the earthquake
- $Z_{1.0}$ = Depth to Vs=1 km/sec
- $Z_{2.5}$ = Depth to Vs=2.5 km/sec
- **W** = Fault rupture width (km)
- $V_{s30flag}$ = 1 for measured, 0 for inferred Vs30
- F_{AS} = 0 for mainshock; 1 for aftershock
- **Region** = Specific regions considered in the models, Click on Region to see codes
- **ΔDPP** = Directivity term, direct point parameter; uses 0 for median predictions
- PGA_r **(g)** = Peak ground acceleration on rock (g), this specific cell is updated in the cell for BSSA14 and CB14, for others it is taken account for in the macros
- Z_{BOT} **(km)** = The depth to the bottom of the seismogenic crust
- Z_{BOR} **(km)** = The depth to the bottom of the rupture plane
- **SS** = 1 for strike slip, automatically updated in the cell

Input variables with defaults (If entered 999 as input):

Red colored value: The value is used in the code when input is unknown

DEFAULTs	USER defined	ASK14	BSSA14	CB14	CY14	I14
W (km)	12.80			15.000		
$Z_{1.0}$ (km)	0.060	0.060			0.162	
$\delta Z_{1.0}$ (km)	-0.102		-0.102			
$Z_{2.5}$ (V_{S30}=1100)(km)	0.260			0.398		
$Z_{2.5}$ (V_{S30})(km)	0.260			0.861		
Z_{hyp} (km)	999.00			10.227		
Z_{tor} (km)	7.68			0.000	0.000	
Z_{BOR} (km)	-			15.000		

ACKNOWLEDGEMENTS

Nick Gregor, Bechtel
Silvia Mazzoni, Consultant

All NGA West-2 participants are acknowledged for their constructive comments and feedback.

Determination of Site Class and Estimation of Shear Wave Velocity

Project: 13673.001

Depth (ft)	di, Layer Thick (ft)	Field Blow Counts, Ni Corrected for Cs and sampler type Blows per foot (bpf)								Average Ni (bpf)	Ni Hammer Corr:	di / Ni
		LB-1	LB-4	LB-6	LB-9	LB-13	LB-15	LB-16	LB-17		1.3	
5	7.5	60	60	60	7	19	60	23	60	44	57	0.13
10	5	54	55	60	41	52	100	100	45	63	82	0.06
15	5	57	100	100	35	99	75	100	100	83	100	0.05
20	5	52	70	44	30	96	100	100	100	74	96	0.05
25	5	100	100	100	100	100	100	100	67	96	100	0.05
30	5	100	74	100	100	70	100	54	100	87	100	0.05
35	5		100						72	86	100	0.05
40	5		90						100	95	100	0.05
45	5		81						100	91	100	0.05
50	7.5		56						100	78	100	0.08
60	10		50	*Assumed based on blowcount at 50'						50	65	0.15
70	10		50							50	65	0.15
80	10		50							50	65	0.15
90	10		50							50	65	0.15
100	5		50							50	65	0.08
Summatior	100											1.31
											Navg = Sum(di) / Sum(di / Ni) =	**76**

Extract of ASCE 7-16 Table 20.3-1 Site Classification (2019 CBC 1613A.2.2):

Site Class	Soil Profile Name	Avg. N upper 100' from	to	Vs30 (ft/sec) from	to	Vs30 (m/s) from	to	Site Avg N	Interpolated vs30 (ft/s)
A	Hard Rock	-		5000	10000	1524	3048		
B	Rock	-		2500	5000	762	1524		
C	VD soil & soft rock	**50.001**	**100**	1200	2500	366	762	**76**	1881
D	Stiff Soil	15	50	600	1200	183	366		
E	Soft Soil	0	14.999	0	600	0	183		
F		-	-			0	0		

SITE CLASS, Table 20.3-1: C

Estimation of Average Shear Wave Velocity in upper 100 ft (Vs30):

	ft/s	m/s
Approx. Vs30 (interpolation of Table 20.3-1) =	1881	573
Approx. Vs30 sands (Imai and Tonouchi, 1982) =	1365	416
Approx. Vs30 sands (Sykora and Stokoe, 1983) =	1128	344
Approx. Vs30 (Maheswari, Boominathan, Dodagoudar, 2009) =	1112	339

APPENDIX E

GEOPHYSICAL DATA

MASW and Seismic Refraction Array
Seismic Refraction Array
MASW Array

Notes:
Coordinate System:NAD 1983 StatePlane California V FIPS 0405 Feet
Base map source: San Bernardino County, Earthstar Geographics, San Bernardino County, Maxar

GEOVision geophysical services

Date:	11/8/2022
GV Project:	22441
Developed by:	A Martin
Drawn by:	T Rodriguez
Approved by:	A Martin
File Name:	GV-22441

FIGURE 1
SITE MAP

FGFW PARCELS A AND B
VICTORVILLE AND
APPLE VALLEY, CALIFORNIA

PREPARED FOR
LEIGHTON CONSULTING, INC.

Table 2 Array 1-1 S-wave Velocity Model (FGFW Parcel B)

Depth to Top of Layer (ft)	Layer Thickness (ft)	S-Wave Velocity (ft/s)	Inferred P-Wave Velocity (ft/s)	Inferred Poisson's Ratio	Inferred Unit Weight (lb/ft^3)
0.0	5.0	570	1067	0.300	111.0
5.0	8.0	1081	2023	0.300	121.0
13.0	13.0	1461	2734	0.300	125.0
26.0	18.0	2002	3744	0.300	129.0
44.0	24.0	2041	3818	0.300	129.5
68.0	36.0	3708	6937	0.300	138.0
104.0	48.0	5601	10479	0.300	146.0
152.0	Half Space	6967	13033	0.300	151.0

Table 3 Array 2 S-wave Velocity Model (FGFW Parcel A)

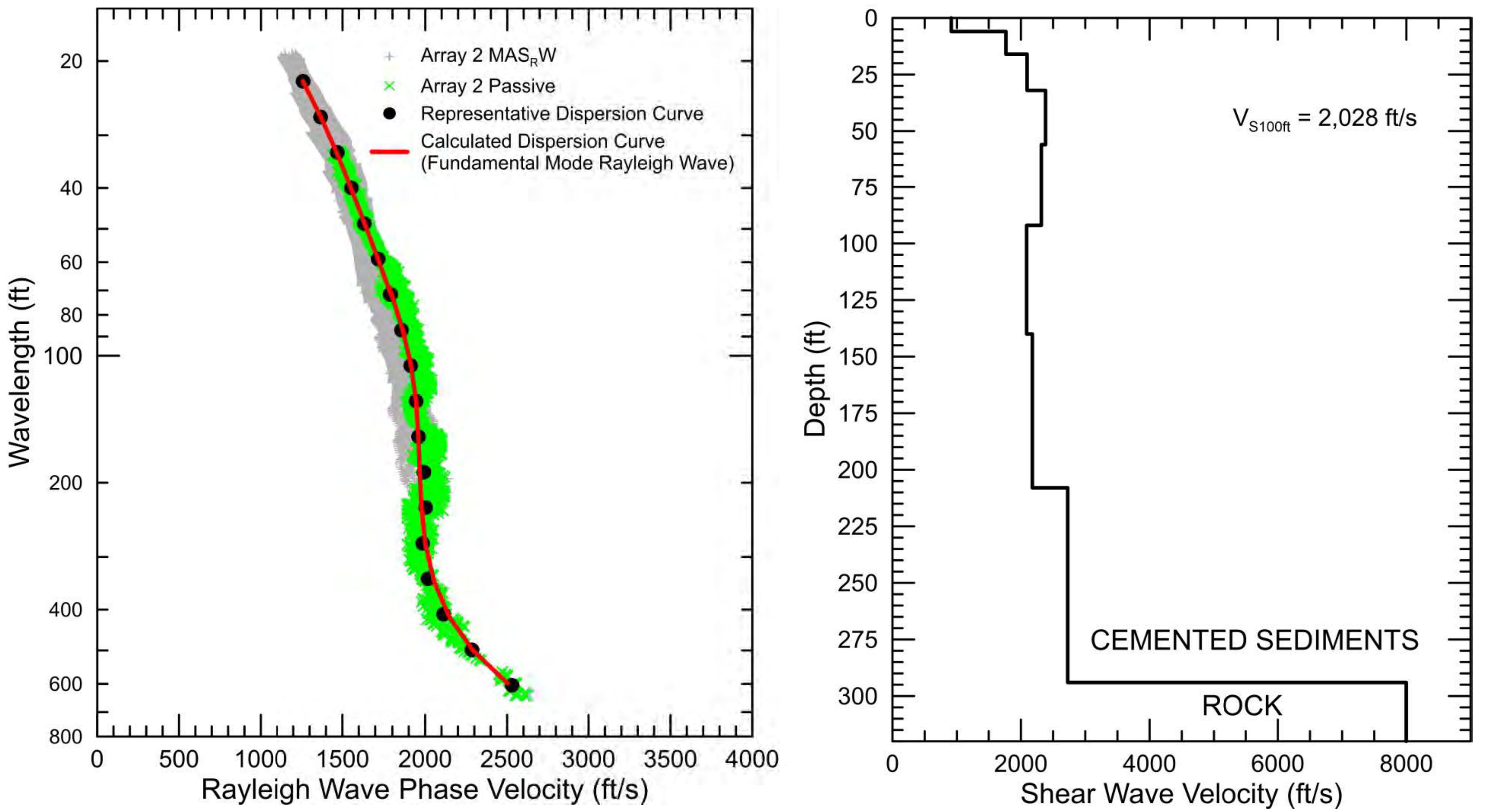
Depth to Top of Layer (ft)	Layer Thickness (ft)	S-Wave Velocity (ft/s)	Inferred P-Wave Velocity (ft/s)	Inferred Poisson's Ratio	Inferred Unit Weight (lb/ft^3)
0.0	6.0	912	1706	0.300	120.0
6.0	10.0	1767	3305	0.300	127.0
16.0	16.0	2096	3922	0.300	129.0
32.0	24.0	2383	4459	0.300	131.0
56.0	36.0	2317	4335	0.300	131.0
92.0	48.0	2089	3911	0.300	129.0
140.0	68.0	2178	4075	0.300	130.0
208.0	86.0	2727	5099	0.300	134.0
294.0	Half Space	7997	14958	0.300	153.0

Table 4 Array 3 S-wave Velocity Model (FGFW Parcel A)

Depth to Top of Layer (ft)	Layer Thickness (ft)	S-Wave Velocity (ft/s)	Inferred P-Wave Velocity (ft/s)	Inferred Poisson's Ratio	Inferred Unit Weight (lb/ft^3)
0.0	4.0	671	1255	0.300	114.0
4.0	6.0	1465	2741	0.300	125.0
10.0	8.0	2369	4430	0.300	131.0
18.0	12.0	2962	5540	0.300	135.0
30.0	16.0	2582	4831	0.300	132.0
46.0	24.0	2397	4486	0.300	131.0
70.0	30.0	2656	4969	0.300	133.0
100.0	Half Space	3037	5679	0.300	135.0

Table 5 Array 4 S-wave Velocity Model (VVLIG Cordova Road Warehouse)

Depth to Top of Layer (ft)	Layer Thickness (ft)	S-Wave Velocity (ft/s)	Inferred P-Wave Velocity (ft/s)	Inferred Poisson's Ratio	Inferred Unit Weight (lb/ft^3)
0.0	6.0	582	1088	0.300	112.0
6.0	10.0	1054	1972	0.300	120.0
16.0	16.0	1701	3182	0.300	127.0
32.0	20.0	3904	7303	0.300	139.0
52.0	30.0	5399	10100	0.300	144.0
82.0	Half Space	6209	11616	0.300	147.0



GEOVision geophysical services

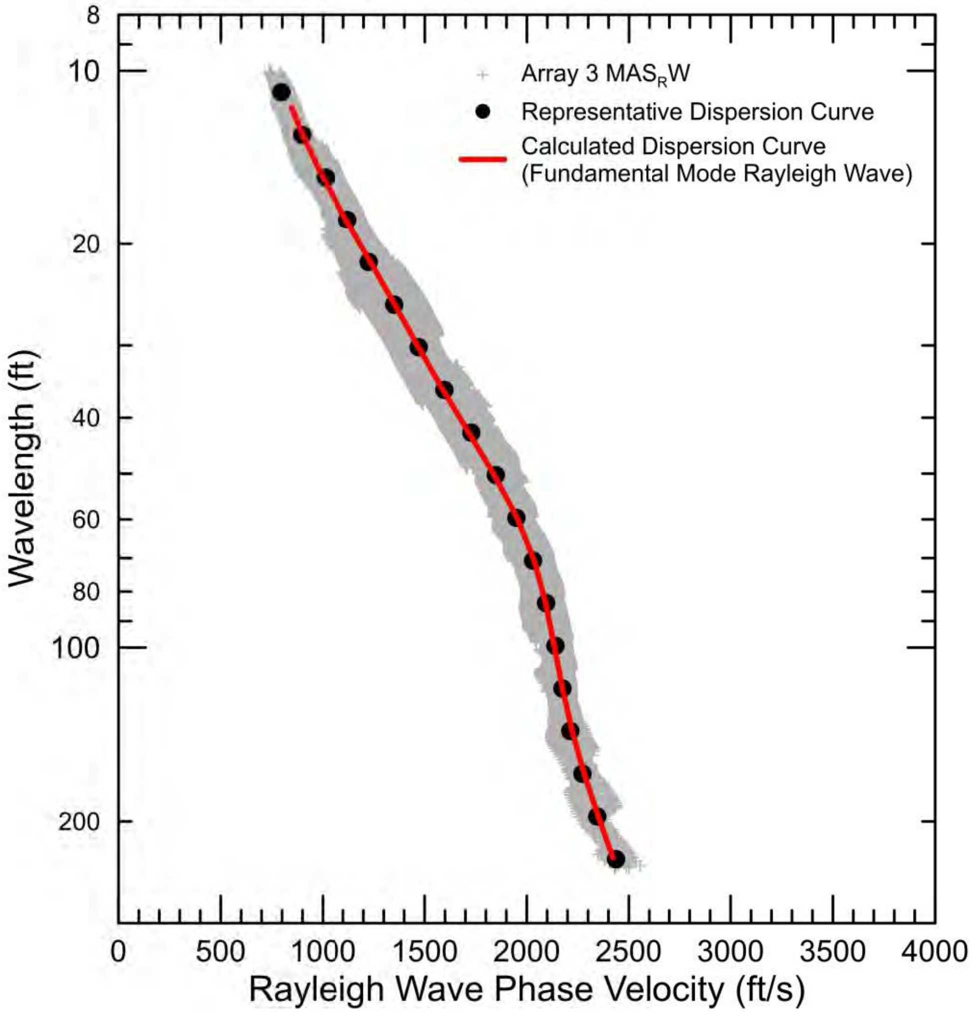
Project No: 22441
Date: NOV 4, 2022
Drawn By: A MARTIN
Approved By: Antony J Martin

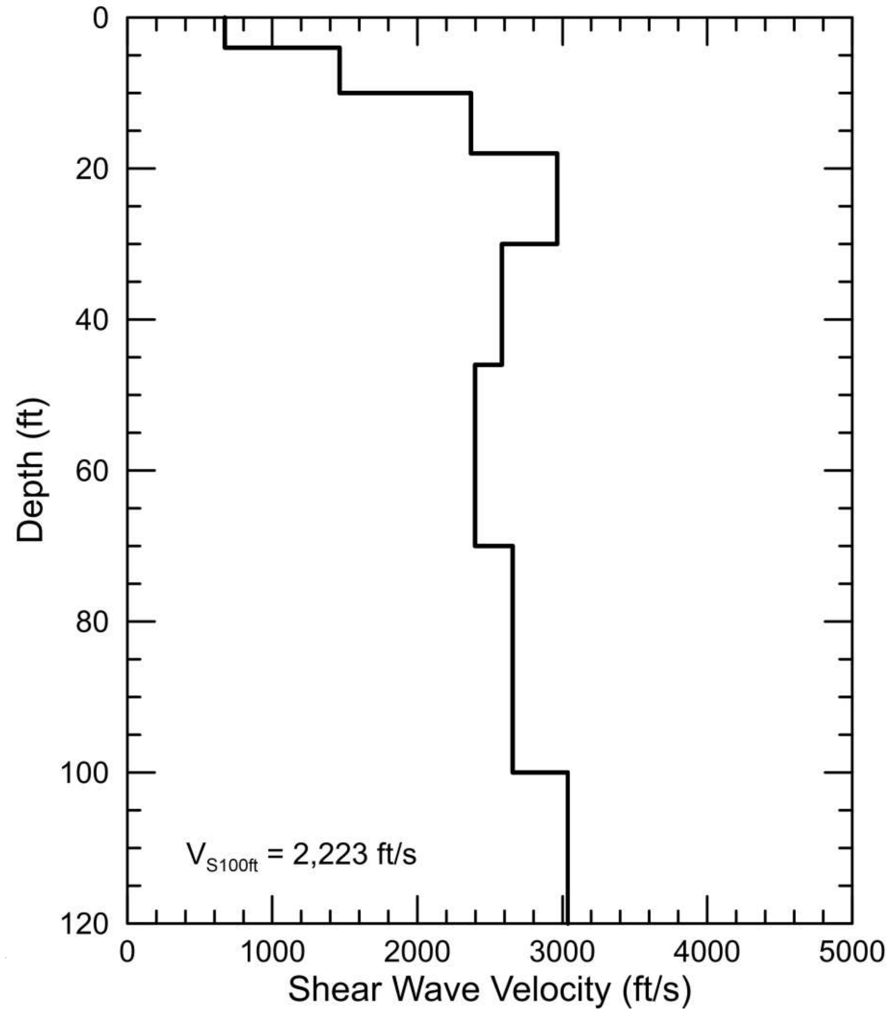
R:\GVProjects\2022\22441 - Leighton\Report\Figure 5.cdr

FIGURE 5
SURFACE WAVE MODEL - ARRAY 2

FGFW PARCEL A
APPLE VALLEY, CALIFORNIA

PREPARED FOR
LEIGHTON CONSULTING, INC.





GEOVision geophysical services

Project No: 22441
Date: NOV 4, 2022
Drawn By: A MARTIN
Approved By:
R:\GVProjects\2022\22441 - Leighton\Report\Figure 6.cdr

FIGURE 6
SURFACE WAVE MODEL - ARRAY 3

FGFW PARCEL A
APPLE VALLEY, CALIFORNIA

PREPARED FOR
LEIGHTON CONSULTING, INC.

APPENDIX F

GENERAL EARTHWORK AND GRADING SPECIFICATIONS

APPENDIX F

LEIGHTON CONSULTING, INC.

EARTHWORK AND GRADING GUIDE SPECIFICATIONS

TABLE OF CONTENTS

D-1.0 GENERAL

D-1.1 <u>Intent</u>

These Earthwork and Grading Guide Specifications are for grading and earthwork shown on the current, approved grading plan(s) and/or indicated in the Leighton Consulting, Inc. geotechnical report(s). These Guide Specifications are a part of the recommendations contained in the geotechnical report(s). In case of conflict, the project-specific recommendations in the geotechnical report shall supersede these Guide Specifications. Leighton Consulting, Inc. shall provide geotechnical observation and testing during earthwork and grading. Based on these observations and tests, Leighton Consulting, Inc. may provide new or revised recommendations that could supersede these specifications or the recommendations in the geotechnical report(s).

D-1.2 <u>Role of Leighton Consulting, Inc.</u>

Prior to commencement of earthwork and grading, Leighton Consulting, Inc. shall meet with the earthwork contractor to review the earthwork contractor's work plan, to schedule sufficient personnel to perform the appropriate level of observation, mapping and compaction testing. During earthwork and grading, Leighton Consulting, Inc. shall observe, map, and document subsurface exposures to verify geotechnical design assumptions. If observed conditions are found to be significantly different than the interpreted assumptions during the design phase, Leighton Consulting, Inc. shall inform the owner, recommend appropriate changes in design to accommodate these observed conditions, and notify the review agency where required. Subsurface areas to be geotechnically observed, mapped, elevations recorded, and/or tested include (1) natural ground after clearing to receiving fill but before fill is placed, (2) bottoms of all "remedial removal" areas, (3) all key bottoms, and (4) benches made on sloping ground to receive fill.

Leighton Consulting, Inc. shall observe moisture-conditioning and processing of the subgrade and fill materials, and perform relative compaction testing of fill to determine the attained relative compaction. Leighton Consulting, Inc. shall provide *Daily Field Reports* to the owner and the Contractor on a routine and frequent basis.

D-1.3 <u>The Earthwork Contractor</u>

The earthwork contractor (Contractor) shall be qualified, experienced and knowledgeable in earthwork logistics, preparation and processing of ground to receive fill, moisture-conditioning and processing of fill, and compacting fill. The Contractor shall review and accept the plans, geotechnical report(s), and these Guide

Specifications prior to commencement of grading. The Contractor shall be solely responsible for performing grading and backfilling in accordance with the current, approved plans and specifications.

The Contractor shall inform the owner and Leighton Consulting, Inc. of changes in work schedules at least one working day in advance of such changes so that appropriate observations and tests can be planned and accomplished. The Contractor shall not assume that Leighton Consulting, Inc. is aware of all grading operations.

The Contractor shall have the sole responsibility to provide adequate equipment and methods to accomplish earthwork and grading in accordance with the applicable grading codes and agency ordinances, these Guide Specifications, and recommendations in the approved geotechnical report(s) and grading plan(s). If, in the opinion of Leighton Consulting, Inc., unsatisfactory conditions, such as unsuitable soil, improper moisture condition, inadequate compaction, adverse weather, etc., are resulting in a quality of work less than required in these specifications, Leighton Consulting, Inc. shall reject the work and may recommend to the owner that earthwork and grading be stopped until unsatisfactory condition(s) are rectified.

D-2.0 PREPARATION OF AREAS TO BE FILLED

D-2.1 Clearing and Grubbing

Vegetation, such as brush, grass, roots and other deleterious material shall be sufficiently removed and properly disposed of in a method acceptable to the owner, governing agencies and Leighton Consulting, Inc.. Care should be taken not to encroach upon or otherwise damage native and/or historic trees designated by the Owner or appropriate agencies to remain. Pavements, flatwork or other construction should not extend under the “drip line” of designated trees to remain.

Leighton Consulting, Inc. shall evaluate the extent of these removals depending on specific site conditions. Earth fill material shall not contain more than 3 percent of organic materials (by dry weight: ASTM D2974). Nesting of the organic materials shall not be allowed.

If potentially hazardous materials are encountered, the Contractor shall stop work in the affected area, and a hazardous material specialist shall be informed immediately for proper evaluation and handling of these materials prior to continuing to work in that area. As presently defined by the State of California, most refined petroleum products (gasoline, diesel fuel, motor oil, grease, coolant, etc.) have chemical constituents that are considered to be hazardous waste. As such, the indiscriminate dumping or spillage of these fluids onto the ground may constitute a misdemeanor, punishable by fines and/or imprisonment, and shall not be allowed.

D-2.2 Processing

Existing ground that has been declared satisfactory for support of fill, by Leighton Consulting, Inc., shall be scarified to a minimum depth of 6 inches (15 cm). Existing ground that is not satisfactory shall be over-excavated as specified in the following Section D-2.3. Scarification shall continue until soils are broken down and free of large clay lumps or clods and the working surface is reasonably uniform, flat, and free of uneven features that would inhibit uniform compaction.

D-2.3 Overexcavation

In addition to removals and over-excavations recommended in the approved geotechnical report(s) and the grading plan, soft, loose, dry, saturated, spongy, organic-rich, highly fractured or otherwise unsuitable ground shall be over-excavated to competent ground as evaluated by Leighton Consulting, Inc. during grading. All undocumented fill soils under proposed structure footprints should be excavated

D-2.4 Benching

Where fills are to be placed on ground with slopes steeper than 5:1 (horizontal to vertical units), (>20 percent grade) the ground shall be stepped or benched. The lowest bench or key shall be a minimum of 15 feet (4.5 m) wide and at least 2 feet (0.6 m) deep, into competent material as evaluated by Leighton Consulting, Inc.. Other benches shall be excavated a minimum height of 4 feet (1.2 m) into competent material or as otherwise recommended by Leighton Consulting, Inc.. Fill placed on ground sloping flatter than 5:1 (horizontal to vertical units), (<20 percent grade) shall also be benched or otherwise over-excavated to provide a flat subgrade for the fill.

D-2.5 Evaluation/Acceptance of Fill Areas

All areas to receive fill, including removal and processed areas, key bottoms, and benches, shall be observed, mapped, elevations recorded, and/or tested prior to being accepted by Leighton Consulting, Inc. as suitable to receive fill. The Contractor shall obtain a written acceptance (*Daily Field Report*) from Leighton Consulting, Inc. prior to fill placement. A licensed surveyor shall provide the survey control for determining elevations of processed areas, keys and benches.

D-3.0 FILL MATERIAL

D-3.1 Fill Quality

Material to be used as fill shall be essentially free of organic matter and other deleterious substances evaluated and accepted by Leighton Consulting, Inc. prior to placement. Soils of poor quality, such as those with unacceptable gradation, high expansion potential, or low strength shall be placed in areas acceptable to Leighton Consulting, Inc. or mixed with other soils to achieve satisfactory fill material.

D-3.2 Oversize

Oversize material defined as rock, or other irreducible material with a maximum dimension greater than 6 inches (15 cm), shall not be buried or placed in fill unless location, materials and placement methods are specifically accepted by Leighton Consulting, Inc.. Placement operations shall be such that nesting of oversized material does not occur and such that oversize material is completely surrounded by compacted or densified fill. Oversize material shall not be placed within 10 feet (3 m) measured vertically from finish grade, or within 2 feet (0.61 m) of future utilities or underground construction.

D-3.3 Import

If importing of fill material is required for grading, proposed import material shall meet the requirements of Section D-3.1, and be free of hazardous materials ("contaminants") and rock larger than 3-inches (8 cm) in largest dimension. All import soils shall have an Expansion Index (EI) of 20 or less and a sulfate content no greater than (≤) 500 parts-per-million (ppm). A representative sample of a potential import source shall be given to Leighton Consulting, Inc. at least four full working days before importing begins, so that suitability of this import material can be determined and appropriate tests performed.

D-4.0 FILL PLACEMENT AND COMPACTION

D-4.1 Fill Layers

Approved fill material shall be placed in areas prepared to receive fill, as described in Section D-2.0, above, in near-horizontal layers not exceeding 8 inches (20 cm) in loose thickness. Leighton Consulting, Inc. may accept thicker layers if testing indicates the grading procedures can adequately compact the thicker layers, and only if the building officials with the appropriate jurisdiction approve. Each layer shall be spread evenly and mixed thoroughly to attain relative uniformity of material and moisture throughout.

D-4.2 Fill Moisture Conditioning

Fill soils shall be watered, dried back, blended and/or mixed, as necessary to attain a relatively uniform moisture content at or slightly over optimum. Maximum density and optimum soil moisture content tests shall be performed in accordance with the American Society of Testing and Materials (ASTM) Test Method D 1557.

D-4.3 Compaction of Fill

After each layer has been moisture-conditioned, mixed, and evenly spread, each layer shall be uniformly compacted to not-less-than (≥) 90 percent of the maximum dry density as determined by ASTM Test Method D 1557. In some cases, structural fill may be specified (see project-specific geotechnical report) to be uniformly compacted to at-least (≥) 95 percent of the ASTM D1557 modified Proctor laboratory maximum dry density. For fills thicker than (>) 15 feet (4.5 m), the portion of fill deeper than 15 feet below proposed finish grade shall be compacted to 95 percent of the ASTM D1557 laboratory maximum density. Compaction equipment shall be adequately sized and be either specifically designed for soil compaction or of proven reliability to efficiently achieve the specified level of compaction with uniformity.

D-4.4 Compaction of Fill Slopes

In addition to normal compaction procedures specified above, compaction of slopes shall be accomplished by back rolling of slopes with sheepsfoot rollers at increments of 3 to 4 feet (1 to 1.2 m) in fill elevation, or by other methods producing satisfactory results acceptable to Leighton Consulting, Inc.. Upon completion of grading, relative compaction of the fill, out to the slope face, shall be at least 90 percent of the ASTM D1557 laboratory maximum density.

D-4.5 Compaction Testing

Field-tests for moisture content and relative compaction of fill soils shall be performed by Leighton Consulting, Inc.. Location and frequency of tests shall be at the Leighton Consulting, Inc. field representative(s) discretion based on field conditions encountered. Compaction test locations will not necessarily be selected on a random basis. Test locations shall be selected to verify adequacy of compaction levels in areas that are judged to be prone to inadequate compaction (such as close to slope faces and at fill/bedrock benches).

D-4.6 Compaction Test Locations

Leighton Consulting, Inc. shall document approximate elevation and horizontal coordinates of each density test location, relying on site survey control provided by others. The Contractor shall coordinate with the project surveyor to assure that sufficient grade stakes are established so that Leighton Consulting, Inc. can determine test locations with sufficient accuracy. Adequate grade stakes shall be provided.

D-5.0 EXCAVATION

Excavations, as well as over-excavation for remedial purposes, shall be evaluated by Leighton Consulting, Inc. during grading. Remedial removal depths shown on geotechnical plans are estimates only. The actual extent of removal shall be determined by Leighton Consulting, Inc. based on the field evaluation of exposed conditions during grading. Where fill-over-cut slopes are to be graded, the cut portion of the slope shall be made, then observed and reviewed by Leighton Consulting, Inc. prior to placement of materials for construction of the fill portion of the slope, unless otherwise recommended by Leighton Consulting, Inc..

D-6.0 TRENCH BACKFILLS

D-6.1 Safety

The Contractor shall follow all OSHA and Cal/OSHA requirements for safety of trench excavations. Work should be performed in accordance with Article 6 of the *California Construction Safety Orders*, 2015 Edition or more current (see also: http://www.dir.ca.gov/title8/sb4a6.html).

D-6.2 Bedding and Backfill

All utility trench bedding and backfill shall be performed in accordance with applicable provisions of the 2018 Edition of the *Standard Specifications for Public Works Construction* (Green Book). Bedding material shall have a Sand Equivalent greater than 30 (SE>30). Bedding shall be placed to 1-foot (0.3 m) over the top of the conduit, and densified by jetting in areas of granular soils, if allowed by the permitting agency. Otherwise, the pipe-bedding zone should be backfilled with Controlled Low Strength Material (CLSM) consisting of at least (≥) one-sack of Portland cement per cubic-yard of sand, conforming to Section 201-6 of the 2018 Edition of the *Standard Specifications for Public Works Construction* (Green Book). Backfill over the bedding zone shall be placed and densified mechanically to a minimum of 90 percent of relative compaction (ASTM D1557) from 1 foot (0.3 m) above the top of the conduit to the surface. Backfill above the pipe zone shall **not** be jetted. Jetting of the bedding around the conduits shall be observed by Leighton Consulting, Inc. and backfill above the pipe zone (bedding) shall be observed and tested by Leighton Consulting, Inc..

D-6.3 Lift Thickness

Lift thickness of trench backfill shall not exceed those allowed in the *Standard Specifications for Public Works Construction* unless the Contractor can demonstrate to Leighton Consulting, Inc. and the Owner that their proposed fill lift can be compacted to the specified relative compaction using the proposed alternative equipment and method; and only if the building official, with the appropriate jurisdiction, approves this proposed lift thickness.