REPORT OF GEOTECHNICAL DUE DILIGENCE EXPLORATION, REDLANDS 38, TRACT NO. 16878, SOUTHWEST OF SAN BERNARDINO AND WABASH AVENUES, CITY OF REDLANDS, CALIFORNIA

Prepared for:

PULTE GROUP

27401 Los Altos, Suite 400
Mission Viejo, California 92691

Project No. 11745.003

June 28, 2021

Leighton and Associates, Inc.
A LEIGHTON GROUP COMPANY

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To: Pulte Group
27401 Los Altos, Suite 400
Mission Viejo, California 92691

Attention: Mr. Sohail Bokhari
Director of Land Planning & Engineering

Subject: Report of Geotechnical Due Diligence Exploration, Redlands 38, Tract No. 16878, Southwest of San Bernardino and Wabash Avenues, City of Redlands, California

In response to your request and authorization, Leighton and Associates, Inc. (Leighton) has conducted geotechnical due diligence exploration for Tract 16878, in the City of Redlands, San Bernardino County, California. The 36-acre site is located north of Capri Avenue, west of Wabash Avenue, and south of San Bernardino Avenue. The purpose of this study has been to evaluate the geotechnical conditions at the site with respect to the proposed development and to provide preliminary geotechnical recommendations for design and construction.

Based on this study, construction of the proposed residential development is feasible from a geotechnical standpoint. The most significant geotechnical issues with respect to the project are those related to the potential for strong seismic shaking, the presence of potentially compressible soil, and the presence of boulders. Good planning and design of the project can limit the impact of these constraints. This report presents our findings, conclusions, and preliminary geotechnical recommendations for the project.

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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 AND ASSOCIATES, INC.

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1.0 INTRODUCTION

1.1 Site Location and Description

The 41.22-acre site is located north of Capri Avenue, west of Wabash Avenue, and south of San Bernardino Avenue in the City of Redlands, San Bernardino County, California. To the west of this parcel is an existing residence and a vacant lot. Wabash, San Bernardino, and Capri Avenues bound the rest of the site.

Historic aerial photographs dating from 1938 show the site being used as an orchard, until approximately 2002 when the orchards were removed. Since then, it has been a vacant lot, with the exception of a small area in the northeast portion that was used as a temporary stockpile area from approximately 2006 to 2007. Currently there are no stockpiles on the site and our test pits excavated for this review did not encounter undocumented fill.

The surface of the parcel is generally covered with a light growth of grass and vegetation. The site slopes to the west with approximately 50 feet of elevation difference.

1.2 Previous Geotechnical Studies

T.K. Engineering (TKE, 2003) conducted a preliminary soils engineering feasibility investigation of the site. That investigation included the excavation, logging, and sampling of thirty-eight exploratory trenches. TKE concluded that the site was geotechnically feasible to develop provided the recommendations presented in their report were implemented.

Leighton and Associates, Inc. (Leighton, 2018) conducted a geotechnical due diligence review for the proposed development. That investigation included the excavation, logging, and sampling of ten test pits. Leighton concluded that the site was geotechnically feasible to develop, provided the recommendations presented in that report were implemented.

Those reports were provided by you and have been reviewed as part of this investigation. Pertinent findings and recommendations have been incorporated into this report.

1.3 Proposed Development

Based on the *Redlands 38, 10,000 S.F. Lot Concept Layout* prepared by Dan Guerra & Associates, plotted April 28, 2021, the site is planned for development of 107 single-family residential lots with drainage, streets, water detention basin, and other associated improvements. A rough grading plan was not available for review for the 107-lot concept layout. Review of *Tentative Tract 16878*, prepared by Dan Guerra & Associates for Lone Chang, LLC, plotted April 19, 2018, indicates design fills are expected to be up to approximately 10 feet thick in the northwestern corner of the site. Design cuts are expected to be as deep as approximately 10 feet below the current ground surface in the southeastern corner of the property.

1.4 Purpose of Investigation

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

Our geotechnical study included subsurface exploration of six backhoe test pits, laboratory testing, and geotechnical analysis to evaluate existing conditions and to develop conclusions and preliminary geotechnical recommendations for design and construction of the proposed development.

1.5 Scope of Work

Our scope of work has included the following tasks:

- Background Review: We reviewed available, relevant geotechnical/geologic maps and reports provided by you and available from our in-house library. This includes the geotechnical reports previously prepared for the site (TKE, 2003; Leighton, 2018). We also reviewed historical aerial photographs available online and from our in-house library.

- Utility Coordination: We contacted Underground Services Alert (USA) prior to excavating test pits so that onsite utilities could be marked. We also coordinated site access with you.

- Field Exploration: A total of six exploratory test pits (LTP-1 through LTP-5b) were logged and sampled onsite to evaluate subsurface conditions. The test pits were excavated to depths ranging from approximately 4.5 to 8 feet below the existing ground surface. Each test pit was logged by a member of our technical staff. Bulk samples of representative soil types were obtained from the test pits. Logs of the geotechnical test pits performed by Leighton for this study and by TKE (2003) and Leighton (2018) are provided in Appendix B. Test pit locations are shown on the accompanying *Geotechnical Map*, Figure 2.

  Two (2) open-pit infiltration tests were conducted within Test Pit LTP-5a and LTP-5b to evaluate general infiltration characteristics of subsurface soils at the depths and locations tested. Infiltration tests were conducted in general accordance with San Bernardino County guidelines. Each test was conducted at a depth of approximately 5 feet.

- Geotechnical Laboratory Testing: Geotechnical laboratory tests were conducted on selected 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:

  - Sieve analysis (percent passing #200)
  - Maximum dry density, optimum moisture content
  - Water-soluble sulfate concentration
  - Resistivity, chloride content and pH

  Laboratory test results from this and previous studies are provided in Appendix C.

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

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

2.0 FINDINGS

2.1 Regional Geologic Setting

The site lies within the southeastern portion of the San Bernardino Valley (SBV), within the Peninsular Ranges Geomorphic Province. Prominent mountain ranges surround the SBV, including the San Gabriel Mountains on the northwest, San Bernardino Mountains on the north and east, and the San Jacinto Mountains to the east, the Temescal and Santa Ana Mountain ranges to the south.

Uplift of the San Bernardino and San Gabriel mountain ranges are the result of the interaction between the North American and Pacific tectonic plates. This plate boundary is manifest as the San Andreas fault zone, which follows northwesterly along the foot of the San Bernardino Mountains near the project site. A mapped trace associated with of the San Andreas fault zone is located approximately 2.8 miles northeast of the project site.

The sediment eroded from the adjacent San Bernardino Mountains has been transported into the valley in the region of the project site by the Santa Ana River. The Santa Ana River is located approximately 3,500 feet north of the site at its nearest location.

2.2 Subsurface Conditions

The site has been mapped as being underlain by middle Holocene alluvial valley deposits (Qya) and late Holocene alluvial valley deposits (Qa). These alluvial valley deposits are described as slightly to moderately consolidated silt, sand, and gravel. Based on our recent site visit and test pit exploration, we found the surface to be covered in these alluvial deposits consisting of silty sand, gravelly sand, cobbles with boulders. Boulders observed from our test pits (Leighton, 2018 and current study) were as large as approximately 4 feet in their largest dimension. TKE (2003) encountered boulders in their test pits but did not indicate size or concentration of boulders observed. The alluvial deposits in our test pits were observed to be relatively loose in the upper 1.5 to 4 feet onsite.

TKE's (2003) report described up to 1 foot of artificial fill in two of their test pits (Test Pit No. 1 and 7) where historical aerial photographs indicate past stockpiling in the northern and northeastern portions of the site. TKE further explained in their report that thicker undocumented fills may exist onsite. No

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artificial fill was encountered in our test pit excavations (Leighton, 2018 and current study). The native subsurface soils encountered in our test pit excavations consisted mainly of sand, gravel, cobbles, and boulders.

2.2.1 Oversize Material

Oversized material will be encountered during grading and may require special handling such as size screening, breaking boulders into smaller sizes, placing oversized material in windrows during deeper fill placement, hauling offsite, and/or other handling methods.

To evaluate the potential for oversize material during grading of the proposed development, we explored the near-surface conditions within the site with test pits during this and previous studies. Several test pits reached practical refusal due to the presence of large, hard clasts in the alluvium. We found that roughly 10 percent (by volume) of material excavated from our test pits consisted of boulders (greater than 12 inches in largest dimension), with a higher concentration of boulders on the east end of the property and decreasing to the west. The locations of our test pits are depicted in Figure 3. Geotechnical test pit logs including photographs of each test pit or its spoils pile are attached.

More detailed descriptions of the subsurface earth materials are presented on the test pit logs (Appendix B).

2.2.2 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 our investigation, near-surface native soil encountered is generally considered slightly compressible. Partial removal and recompaction of this material under shallow foundations will help 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. Generally, the presence of gravel in soil indicates a high energy fluvial environment, which had deposited sediment densely, and collapse potential is considered negligible.

2.2.3 Expansive Soil

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 both building foundations and slabs-on-grade could result.

Based on the high percentage of coarse-grained material, expansion potential is expected to be very low.

2.2.4 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 the American Concrete Institute (ACI) provisions, adopted by the 2019 CBC (CBC, 2019, Chapter 19, and ACI 318, 2011, Chapter 4).

A near-surface soil sample was tested during this investigation for soluble sulfate content. The result indicated a sulfate content of less than 0.1 percent. Based on these results, soils onsite are expected to have negligible sulfate exposure.

2.2.5 Resistivity, Chloride and pH

Soil corrosivity to ferrous metals can be estimated by the soil's electrical resistivity, chloride content, and pH level. In general, soil having a minimum resistivity less than 1,000 ohm-cm is considered severely corrosive, while soil having a minimum resistivity of 2,000 to 10,000 is considered moderately corrosive. Soil with a chloride content of 500 ppm or greater is considered corrosive to ferrous metals.

As a screening for potentially corrosive soil, representative soil sample was tested during this investigation to determine minimum resistivity, chloride content, and pH of the samples. This test results indicate a pH of 7.3, soil resistivity of 6,750 ohm-cm, and a chloride content of 100 ppm. Based on the results of testing, the onsite soil is considered moderately corrosive to ferrous metals.

2.3 Groundwater

Groundwater or seepage was not encountered within TKE (2003), Leighton (2018), or this investigation test pits, to a maximum explored depth of 9 feet bgs.

Based on data from the California Department of Water Resources Water Data Library (2017), the highest historical groundwater in the area has been recorded from two nearby wells. A well located approximately ¼ mile to the north-northwest of the site indicated the highest groundwater level of approximately 140 feet below the ground surface from measurements taken between 2011 to 2017. A well located approximately ½ mile to the northeast of the site indicated the highest groundwater level of approximately 61 feet below the ground surface from measurements taken from 1928 to 1990. Based on these findings, the highest historical groundwater level for the site is approximately 60 feet below the ground surface. Groundwater is not expected to be a constraint to development.

2.4 Faulting and Seismicity

2.4.1 Surface Faulting

The proposed development is not within an Earthquake Fault Zone as designated by the State of California or County of San Bernardino for active surface faulting. No known active faults have been mapped onsite nor trending toward the site. The nearest known active faults are San Andreas fault, located about 2.8 miles to the northwest, and San Jacinto fault, located about 6.6 miles to the southwest. Based on our findings, the potential for surface rupture from active faulting is very low.

2.4.2 Seismic Design Parameters

The site is anticipated to 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 parameters should be considered for design under the 2019 CBC:

2019 CBC Parameters (CBC or ASCE 7-16 reference)	Value 2019 CBC
Site Latitude and Longitude: 34.0772, -117.1392	
Site Class Definition (1613.2.2, ASCE 7-16 Ch 20)	D
Mapped Spectral Response Acceleration at 0.2s Period (1613.2.1), S_s	2.129 g
Mapped Spectral Response Acceleration at 1s Period (1613.2.1), S_1	0.859 g
Short Period Site Coefficient at 0.2s Period (T1613.2.3(1)), F_a	1.0
Long Period Site Coefficient at 1s Period (T1613.2.3(2)), F_v	1.700*
Adjusted Spectral Response Acceleration at 0.2s Period (1613.2.3), S_{MS}	2.129 g
Adjusted Spectral Response Acceleration at 1s Period (1613.2.3), S_{M1}	1.460* g
Design Spectral Response Acceleration at 0.2s Period (1613.2.4), S_{DS}	1.419 g
Design Spectral Response Acceleration at 1s Period (1613.2.4), S_{D1}	0.974* g
Mapped MCE_G peak ground acceleration (11.8.3.2, Fig 22-9 to 13), **PGA**	0.882 g
Site Coefficient for Mapped MCE_G *PGA* (11.8.3.2), F_{PGA}	1.100
Site-Modified Peak Ground Acceleration (1803.5.12; 11.8.3.2), PGA_M	0.970 g

* Per Table 11.4-2 of Supplement 1 of ASCE 7-16, this value of F_v may only be used to calculate T_s [that note is not included in Table 1613A.2.3(2)]; note that S_{D1} and S_{M1} are functions of F_v. In addition, per Exception 2 of 11.4.8 of ASCE 7-16, special equations for C_s are required. This is in lieu of a site-specific ground motion hazard analysis per ASCE 7-16 Chapter 21.2.

** Site Class D, and all of the resulting parameters in this table, may only be used for structures without seismic isolation or seismic damping systems.

Based on the 2019 CBC Table 1613.2.3(2) footnote c., F_v should be determined in accordance with Section 11.4.8 of ASCE 7-16, since the mapped spectral response acceleration at 1 second is greater than 0.2g for Site Class D; in accordance with Section 11.4.8 of ASCE 7-16, a site-specific seismic analysis is required. However, the values provided in the table above may be utilized if design is performed in accordance with Exception (2) in Section 11.4.8 of ASCE 7-16, with special requirements for the seismic response coefficient (C_S), and F_v is only used for calculation of T_S. This exception does not apply (and the values in the table above would not be applicable) for proposed structures with seismic isolation or seismic damping systems. The project structural engineer

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should review the seismic parameters. A site-specific seismic ground motion analysis can be performed upon request.

2.5 Secondary Seismic Hazards

In general, secondary seismic hazards for sites in the region could include soil liquefaction, earthquake-induced settlement, lateral displacement, landsliding, 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 or stiffness due to a buildup of pore-water pressure during severe ground shaking. Liquefaction is associated primarily with loose (low density), saturated, fine-to-medium grained, cohesionless soils. As the shaking action of an earthquake progresses, the soil grains are rearranged and the soil densifies within a short period of time. Rapid densification of the soil results in a buildup of pore-water pressure. When the pore-water pressure approaches the total overburden pressure, the soil reduces greatly in strength and temporarily behaves similarly to a fluid. Effects of liquefaction can include sand boils, settlement, and bearing capacity failures below structural foundations.

San Bernardino County Geologic Hazard Overlay (2010) maps this site as outside any liquefaction or landslide hazard areas. The State of California has not prepared liquefaction hazard maps for this area.

Based on the dense nature of the deposits onsite, which include cobbles and boulders, and the lack of shallow groundwater, the potential for liquefaction onsite is considered nil.

2.5.2 Seismically Induced Settlement

During a strong seismic event, seismically induced settlement can occur within loose to moderately dense, dry or saturated granular soil. Settlement caused by ground shaking is often nonuniformly distributed, which can result in differential settlement.

Alluvial deposits observed in our test pits (Leighton, 2018 and current study) consisted of silty sand, gravelly sand, cobbles with boulders up to 4 feet in their largest dimension, which indicated a relatively high stream power to reach the critical threshold for grain movement during transport. Because sediment was transported in a relatively high-energy flow environment, the stresses applied to the grains would have compacted them tightly together during deposition. Considering this depositional environment, the alluvial deposits onsite are expected to be very dense, and the potential for significant seismically induced settlement is considered very low.

2.5.3 Seismically Induced Landslides

San Bernardino County Geologic Hazard Overlay (2010) maps indicated that this site is not within an area of landslide hazard susceptibility. The State of California has not prepared maps for seismically induced landslides for this area.

Additionally, the site and its immediate surroundings are relatively flat and level. Based on this, the potential for seismically induced landsliding is considered negligible.

2.6 Infiltration Testing

Two constant head, open pit percolation tests were conducted within test pits LTP-5a and LTP-5b in the northwestern portion of the site to estimate the infiltration characteristics of native soils at those locations and depths. Open pit percolation tests were conducted at depths of approximately 5 feet below the existing ground surface within granular soils.

Conducting open pit percolation tests at the bottom of larger test pits are useful for field measurements of soil infiltration rates. It should be noted that this is a clean-water, small-scale test, and that correction factors need to be applied. Relatively large test pits were excavated approximately to the depth of the test and a smaller pit for the percolation testing was excavated at the bottom. A layer of gravel was placed in the pit bottom to support temporary perforated standpipe and a float valve within the percolation pit. In addition, gravel was poured around the outside of the standpipe within the test zone to prevent the sides of the pit from caving/collapsing or eroding when water was added. The float valve, lowered into the standpipe, controlled the flow of water into the percolation pit as the water infiltrated into the soil, while maintaining a relatively constant water head within the percolation pit. Incremental infiltration rates were then measured. The test was conducted based on the USBR 7300-89 test method.

The raw infiltration rate at the two pit locations were well over 12 inches per hour (no factor of safety or correction factors applied) at the depths tested. See Section 3.5 for recommendations for infiltration rates.

3.0 CONCLUSIONS AND RECOMMENDATIONS

Based on this investigation, construction of the proposed residential 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 improvements. The most significant geotechnical issues at the site are those related to the potential for strong seismic shaking, potentially compressible soil and generation of oversize material. 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.

Although not identified during this investigation buried structures, seepage pits, trash pits, or items related to past site uses may be present. If such items were encountered during grading, they would require further evaluation and special consideration.

3.1 General Earthwork and Grading

All grading should be performed in accordance with the General Earthwork and Grading Specifications presented in Appendix D, 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 vegetation, trash and debris, which should be disposed of offsite. Any underground obstructions should be removed, as should large trees and their root systems. 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 Overexcavation and Recompaction

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.

Prior to fill placement, we recommend that all undocumented fill onsite encountered during grading be completely removed. TKE (2003) observed undocumented fill in localized areas onsite as deep as 1 foot. Actual depths of undocumented artificial fill should be evaluated during rough grading.

Our test pits indicated relatively loose alluvial soils onsite as deep as 3.5 feet from the current ground surface. For structures with shallow foundations (including retaining walls with over 3 feet retaining), we recommend that onsite alluvial soils be overexcavated and recompacted to a minimum depth of 3 feet below the bottom of the proposed footings or 3.5 feet below existing grade, whichever is deeper. Overexcavation and recompaction should extend a minimum horizontal distance of 5 feet from perimeter edges of the proposed structures.

Local conditions including areas where test pits during this and previous studies were excavated may require that deeper overexcavation be performed; such areas should be evaluated by Leighton during grading.

Areas outside these overexcavation limits planned for asphalt or concrete pavement, flatwork, and site walls, and areas to receive fill should be overexcavated to a minimum depth of 24 inches below the existing ground surface or 12 inches below the proposed subgrade or footing bottom, whichever is deeper. In addition, any undocumented artificial fill should be overexcavated.

After completion of the overexcavation, and prior to fill placement, the exposed surfaces should be scarified to a minimum depth of 6 inches, heavily watered, and recompacted to a minimum 90 percent relative compaction, relative to the ASTM D 1557 laboratory maximum density.

These recommendations should be reviewed once a grading plan is available.

3.1.3 Fill Placement and Compaction

Onsite soil to be used for compacted structural fill should also be free of debris and oversized material (greater than 12 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, and compacted to a minimum 90 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.

3.1.4 Rippability and Oversized Material

Oversized rocks were encountered in our test pits excavated to depths extending to 8.5 feet below the existing ground surface. Any rock or rock fragments greater than 12 inches in largest dimension are considered oversized. Oversized rocks were found in our test pits to be as large as 4 feet across in greatest dimension and relatively prevalent in some layers in the near-surface (up to a field estimate of 20 percent by volume in LTP-2). The alluvium onsite should be generally rippable using conventional heavy equipment, but oversized material will be generated during grading. Oversized material excavated during grading will require special handling and/or special placement in fills.

The primary geotechnical consideration of oversized materials within compacted fill is the potential for settlement of the compacted fill and negative impacts on overlying improvements associated with improperly placed oversized materials. Settlement can occur when there are significant voids or loose soil around or between rocks, occurring, for instance, when water eventually works its way into these areas. Nesting of oversize material can cause these voids, as can inadequate quantities of water applied during fill placement, or inadequate compaction methods/equipment. The considerations contained herein are primarily intended to limit this potential, and are based on our experience in similar projects in the area. An additional consideration is to limit the potential for foundations to be located directly on top of an unusually large rock, which not only could create difficulties in foundation excavation, but could produce adverse conditions for foundation support.

During fill placement, rocks larger than 12 inches in largest dimension should be removed from within 3 feet of finish grade. No rocks larger than 24 inches in largest dimension should be placed within 5 feet of finish grade and no rocks larger than 48 inches should be placed within 10 feet of finish grade. All rocks larger than 24 inches in greatest dimension should be placed in windrows, surrounded with 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.

The actual placement of rocks should be observed by the geotechnical representative in the field and should be based on the conditions observed. Very large rocks, if encountered, may require additional measures for disposal, depending on the actual conditions. Based on the observations in our test pits, there is small but not insignificant potential for rocks larger than 48 inches being encountered onsite. Special handling of rocks greater than 48 inches may include placement in fill a minimum of 10 feet below finish grade, breaking into smaller fragments, or removal. Overexcavation to accommodate placement of very large rocks a minimum of 10 feet below finish grade may generate more oversized material. The handling of very large rocks should be determined on a case-by-case basis during grading.

We also recommended that the owner consider limiting the size of rocks placed in streets to a depth of one foot below the deepest utility. Excavations for utilities can be very difficult in the presence of large (greater than 24-inch) rocks. As a minimum, we suggest that rocks larger than 24 inches be removed from the upper 5 feet below street grade. Rocks larger than 12 inches in largest dimension will require removal from soil used as utility trench backfill. Rocks smaller than 12 inches in largest dimension may need to be removed from soil used in utility trench backfill depending on the size and type of pipe. Removal of rocks in utility trench backfill should be evaluated once plans for utilities are provided.

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. 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 to 20 percent
Subsidence (overexcavation bottom processing)	Approximately 0.10 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.

3.2 Shallow Foundation Recommendations

Overexcavation and recompaction of the footing subgrade soil 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. Additional testing of the onsite soils should be conducted at the completion of grading to confirm the expansion index of the soil present in the upper portion of pad grade.

Minimum Embedment and Width

Based on our investigation, footings should have a minimum embedment per code requirements, but no less than 12 inches below the lowest adjacent grade, with a minimum width of 24 and 12 inches for isolated and continuous footings, respectively.

Allowable Bearing

An allowable bearing pressure of 2,000 pounds-per-square-foot (psf) may be used for footings, based on the minimum embedment depth and width 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 4,000 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.

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 an allowable coefficient of friction of 0.4. The passive resistance may be computed using an allowable (factor of safety of 1.5 applied) equivalent fluid pressure of 240 pounds per cubic foot (pcf), assuming there is constant contact between the footing and undisturbed soil. Friction and passive pressure may be combined without reduction, provided the footings can move laterally sufficiently to develop passive pressure (approximately ¼ inch); otherwise, friction alone should be assumed.

Increase in Bearing and Friction - Short Duration Loads

For the case of short term loading (such as those imposed by seismic and wind loading), the allowable bearing pressure and coefficient of friction values may be increased by one-third.

Settlement

The recommended allowable bearing pressure for shallow footings is generally based on a post-construction static settlement of 1 inch. Post-construction static differential settlement is estimated to be on the order of ½ inch over a horizontal distance of 30 feet for shallow footings. Since settlement is a function of footing size and contact bearing pressure, differential settlement can be expected between adjacent columns or walls where a large differential loading condition exists.

Post-Tensioned Foundations

Post-tensioned foundations should be designed by a qualified structural engineer in accordance with the 2019 CBC.

Lots with very low expansion potential may be designed by the spanability method. Although no low expansive soils are expected on this site, we recommend the following parameters if post-tensioned foundations are to be designed with that category:

Design Parameters	Category IA PI≤10 or EI≤21
Thornthwaite Moisture Index	-20
Depth to Constant Soil Suction	9.0 feet↨
Constant Soil Suction	3.9 pF
Edge Moisture Variation Distance, e_m -Edge Lift -Center Lift	 4.0 feet 7.5 feet
Soil Differential Movement, y_m -Edge Lift - Swell -Center Lift - Shrink	 0.5 inch 0.4 inch

For post-tension slab foundations, exterior footings (thickened edges) should have a minimum depth of 12 inches below the lowest adjacent soil grade and a minimum width in accordance with code requirements. These footings may be designed for a maximum allowable bearing pressure of 2,000 pounds per square foot. The allowable bearing pressure may be increased by one-third for short-term loading. The structural engineer should provide the slab with adequate stiffness to minimize potential cracking. The design of post-tensioned slab foundations should follow the procedures described in the latest edition of the Design of Post-Tensioned Slabs-on-Ground by the Post-Tensioning Institute (PTI, 2008).

To provide more uniform moisture in the subgrade, the top 12 inches of the prepared subgrade should be pre-saturated to 2 percent above optimum moisture prior to placement of concrete.

The soil-moisture around the immediate perimeter of the slab should be maintained to near-optimum moisture content (or above) during construction and up to occupancy of the homes.

The geotechnical parameters provided assume that if the areas adjacent to the foundation are planted and irrigated, these areas will be designed with proper drainage so ponding, which causes significant moisture change below the foundation, does not occur. Our recommendations do not account for excessive irrigation and incorrect landscape design. Sunken planters placed adjacent to the foundation should either be designed to prevent moisture infiltration below the foundation or have efficient drainage system liners. Some lifting of the perimeter foundation beam should be expected even with properly constructed planters. Based on the design parameters we have provided, and our experience with monitoring similar sites on these types of soils, we would expect that with overwatering, up to 1 inch of uplift would occur at the perimeter of the foundation relative to the central portion of the slab.

Future homeowners should be informed and educated regarding the importance of maintaining a constant level of soil moisture. The owners should be made aware of the potential negative consequences of both excessive watering, as well as allowing expansive soils to become too dry. The soil will undergo shrinkage as it dries up, followed by swelling during the winter, rainy season or when irrigation is resumed, resulting in distress to improvements and structures

Slab-On-Grade

Concrete slabs subjected to special loads should be designed by the structural engineer. Post-tension slabs-on-grade should be designed by the structural engineer as discussed previously.

- Conventional concrete slabs-on-grade should have a minimum slab thickness of 4 inches (actual, not nominal). Reinforcement for conventionally reinforced slabs should be designed by the structural engineer, but as a minimum should be No. 3 rebar at 18 inches on center, both directions, for lots with a very low expansion index.

- Moisture Retarder: A minimum of a 10-mil vapor retarder should be placed below slabs where moisture-sensitive floor coverings or equipment is planned. A Stego 15-mil vapor barrier would provide additional protection. Since moisture will otherwise be transmitted up from the soil through the concrete, it is important that an intact vapor retarder be installed. We recommend that the vapor retarder meet the requirements of ASTM E 1745 and be installed per ASTM E 1643. The structural engineer should specify pertinent concrete design parameters and moisture migration prevention measures, such as whether a sand blotter layer should be placed over the vapor retarder. Gravel or other protruding objects that could puncture the moisture retarder should be removed from the subgrade prior to placing the vapor retarder, or a stronger vapor retarder intended for the specific conditions present can be used.

- 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 retarder, steel or concrete.

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, aggregate that is not sufficiently clean, 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 shrinkage cracking. The structural engineer should consider these and other pertinent concrete design and construction considerations in slab design and specifications.

Moisture retarders can reduce, but not eliminate moisture vapor rise from the underlying soils up through the slab. 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. The recommendations in this report and our services in general are not intended to address mold prevention, since we, along with geotechnical consultants in general, do not practice in the area of mold prevention. If specific recommendations are desired, a professional mold prevention consultant should be contacted.

3.3 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 3 (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 up to 12 feet tall.

Retaining Wall Lateral Earth Pressures

Static Equivalent Fluid Weight (pcf)	
Conditions	Level Backfill
Active	35
At-Rest	55
Passive	240 (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.

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

We recommend that the wall designs for walls taller than 6 feet be checked seismically using an additive seismic Equivalent Fluid Pressure (EFP) of 35 pcf, which is added to the active EFP. The additive seismic EFP should be applied with a standard EFP pressure distribution.

Retaining wall footings should have a minimum width of 24 inches and a minimum embedment of 18 inches below the lowest adjacent grade. An allowable bearing capacity of 2,000 psf may be used for retaining wall footing design, based on the minimum footing width and depth. This bearing value may be increased by 250 psf per foot increase in width or depth to a maximum allowable bearing pressure of 4,000 psf. The allowable bearing includes a minimum factor of safety of 3 (though settlement is not considered in the factor of safety).

3.4 Pavement Design

Preliminary recommended pavement sections presented below were calculated using the current Caltrans Highway Design Manual and an assumed design R-value of 50. 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)	Total Pavement Section Thickness (inches)
5.5 or less	3	4	7
6	3.5	4	7.5
7	4	4	8

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.

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.

3.5 Infiltration Recommendations

Infiltration Rate:

Open pit percolation tests at LTP-5a and LTP-5b yielded small-scale, clean-water infiltration rates in excess of 12 inches per hour in the area of the planned infiltration facilities, with a depth of a minimum of 5 feet below existing grade (see Section 2.6). The subsurface soils encountered suggest infiltration will be feasible. We recommend an unfactored (small-scale) infiltration rate of 12 inches per hour be used for preliminary design. Correction factors need to be applied, as discussed below.

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 for small-scale tests. The small-scale infiltration rate should be divided by a correction factor of at least 2 for buried chambers, and at least 3 for open basins or for conditions where retained water will be exposed to the open atmosphere, but the correction/safety factor may be higher based on project-specific aspects.

The infiltration rates described herein are for a clean, unsilted infiltration surface in native, sandy alluvial soil. These values may be reduced over time as silting of the infiltration facility occurs. Furthermore, if the basin or chamber bottom is allowed to be compacted by heavy equipment, this value is expected to be significantly reduced. Infiltration of water through soil is highly dependent on such factors as grain size distribution of the soil particles, particle shape, fines content, clay 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.

It should be noted that during periods of prolonged precipitation, the underlying soils tend to become saturated to greater and greater depths/extents. Therefore, infiltration rates tend to decrease with prolonged rainfall. It is difficult to extrapolate longer-term, full-scale infiltration rates from small-scale tests, and as such, this is a significant source of uncertainty in infiltration rates.

Additional Review and Evaluation:
Infiltration rates are anticipated to vary significantly based on the location and depth. Infiltration concepts should be discussed with Leighton as infiltration plans are being developed. Leighton should review all infiltration plans, including specific locations and depths of proposed facilities. Further testing may be needed based on the design of infiltration facilities, particularly considering their type, depth and location.

General Design Considerations:
The periodic flow of water carrying sediments into the infiltration facility, plus the introduction of wind-blown sediments and sediments from erosion of basin side walls, can eventually cause the bottom of the facility to accumulate a layer of silt, which has the potential of significantly reducing the overall infiltration rate of the facility. 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 on site. We recommend that an easily maintained, robust silt/sediment removal system be installed to pretreat storm water before it enters the infiltration facility.

As infiltrating water can seep within the soil strata nearly horizontally for long distances, it is important to consider the impact that infiltration facilities can have 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. Such features should be brought to Leighton's attention as they are identified.

Infiltration facilities should not be constructed adjacent to or under buildings. Setbacks should be discussed with Leighton during the planning process.

Infiltration facilities should be constructed with spillways or other appropriate means that would cause overfilling to not be a concern to the facility or nearby improvements.

For buried chambers, control/access manhole covers should not contain holes or should be screened to prevent mosquitos from entering the chambers.

Additional Design Considerations (Particularly for Open Basins):
If open basins are planned, additional observation of the soils exposed at the bottom of the basin should be conducted, as these soils are critical to the basin's success. Soils at the bottom of buried chambers are also important, but not as critical to their success, provided the infiltration chamber cuts through sufficiently granular soils.

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 a prolonged open-water safety concern and potential for mosquitos. In a buried/covered infiltration chamber without direct access to the open atmosphere, these conditions would be of less concern.

Parks or play/recreation areas should not be constructed within basin bottoms or below the spillway level.

For open basins and swales, vegetation within the basin bottoms and sides is expected to help reduce erosion and help maintain infiltration rates.

Estimating infiltration rates, especially based on small-scale testing, is inexact and indefinite, and often involves known and unknown soil complexities, potentially resulting in a condition where actual infiltration rates of the completed facility are significantly less than design rates. In open infiltration basins, this could create nuisance water in the basin. As such, enhancements may be needed after completion of the basin if prolonged or frequent standing water is experienced. A potential basin enhancement, if needed, might be to install additional infiltration trenches or infiltration borings in the basin bottom to capture and infiltrate low flows and to help speed infiltration during/after storms; specific recommendations, such as minimum trench/boring depth, would be developed based on conditions observed.

Construction Considerations:
We recommend that Leighton evaluate the infiltration facility excavations, to confirm that granular, undisturbed alluvium is exposed in the bottoms and sides. Additional excavation or evaluation would be required if silty or clayey soils are exposed.

It is critical to infiltration that the basin or chamber bottom not be allowed to be compacted during construction or maintenance; rubber-tired equipment and vehicles should not be allowed to operate on the bottom. We recommend that at least the bottom 3 feet of the basins or chambers be excavated with an excavator or similar.

If fill material is needed to be placed in the basin, such as due to removal of uncontrolled artificial fill, the fill material should be select and free-draining sand, and should be observed and evaluated by Leighton.

Maintenance Considerations:
The infiltration facilities should be routinely monitored, especially before and during the rainy season, and corrective measures should be implemented as/when needed. Things to check for include proper upkeep, proper infiltration, absence of accumulated silt, and that de-silting filters/features are clean and functioning. Pretreatment desilting features should be cleaned and maintained per manufacturers' recommendations. Even with measures to prevent silt from flowing into the infiltration facility, accumulated silt may need to be removed occasionally as part of maintenance.

3.6 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.

3.7 Trench Backfill

Utility-type trenches onsite may be backfilled with the onsite material, provided it is free of debris, significant organic material 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. Open-graded rock should be avoided, as surrounding soil would tend to migrate into the rock. The sand should extend 12 inches above the top of the pipe. The bedding/shading sand should be densified in-place by mechanical means, or may be jetted in areas where the trench walls and bottom are in sandy soils with a minimum sand equivalent of 15. The native soil backfill should be placed in loose layers, moisture conditioned, as necessary, and mechanically compacted using a minimum standard of 90 percent relative compaction. The thickness of layers should be based on the compaction equipment used in accordance with the Standard Specifications for Public Works Construction (Greenbook).

3.8 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.

3.9 Sulfate Attack and Corrosion Protection

Based on test results and our experience in the area, concrete structures in contact with the onsite soil will have negligible exposure (Exposure Class S0) to water-soluble sulfates in the soil. 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).

Based on laboratory testing, the onsite soil may be considered moderately corrosive to ferrous metals. Use of non-ferrous buried pipe may be prudent, or ferrous pipe can be protected with manufacturer's recommendations. Corrosion information presented in this report should be provided to your underground utility subcontractors.

3.10 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 preliminary 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 and Associates, Inc. will provide geotechnical observation and testing during construction.

This report was prepared for the sole use of Pulte Group for application to the design of the proposed residential development in accordance with generally accepted geotechnical engineering practices at this time in this area.

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

Project: 11745.003	Eng/Geol: SGO
Scale: 1 " = 2,000 '	Date: June 2021

Base Map: ESRI ArcGIS Online 2021
Thematic Information: Leighton
Author: Leighton Geomatics (btran)

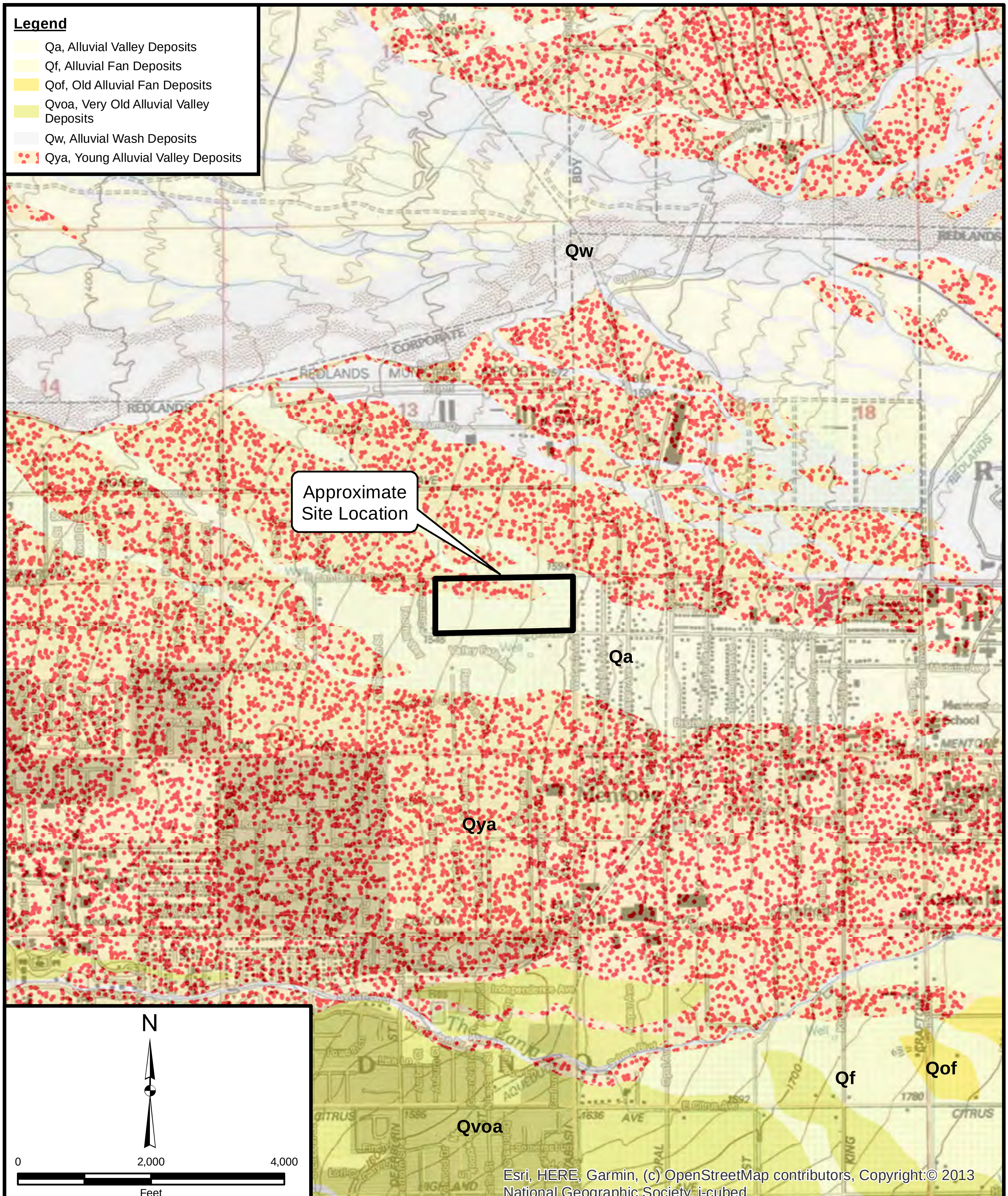
SITE LOCATION MAP

Tract 16878
Southwest of San Bernardino and Wabash Avenues
City of Redlands, California

Figure 1

Leighton

Map Saved as V:\Drafting\11745\003\Maps\11745-003_F01_SLM_2021-06-01.mxd on 6/1/2021 10:03:15 AM



Project: 11745.003	Eng/Geol: SGO
Scale: 1 " = 2,000 '	Date: June 2021

Base Map: ESRI ArcGIS Online 2021
Thematic Information: Geologic map and digital database of the Redlands 7.5' quadrangle, San Bernardino and Riverside Counties, California: U.S. Geological Survey Open-File Report 03-302, U.S. Geological Survey, Menlo Park, California.
Author: Leighton Geomatics (btran)

REGIONAL GEOLOGY MAP

Tract 16878
Southwest of San Bernardino and Wabash Avenues
City of Redlands, California

Figure 2

Leighton

Map Saved as V:\Drafting\11745\003\Maps\11745-003_F02_RGM_2021-06-01.mxd on 6/1/2021 10:05:38 AM

Project: 11745.003	Eng/Geol: SGO
Scale: 1 " = 200 '	Date: June 2021

Base Map: ESRI ArcGIS Online 2021
Thematic Information: Leighton
Author: Leighton Geomatics (btran)

TEST **PIT** LOCATION MAP

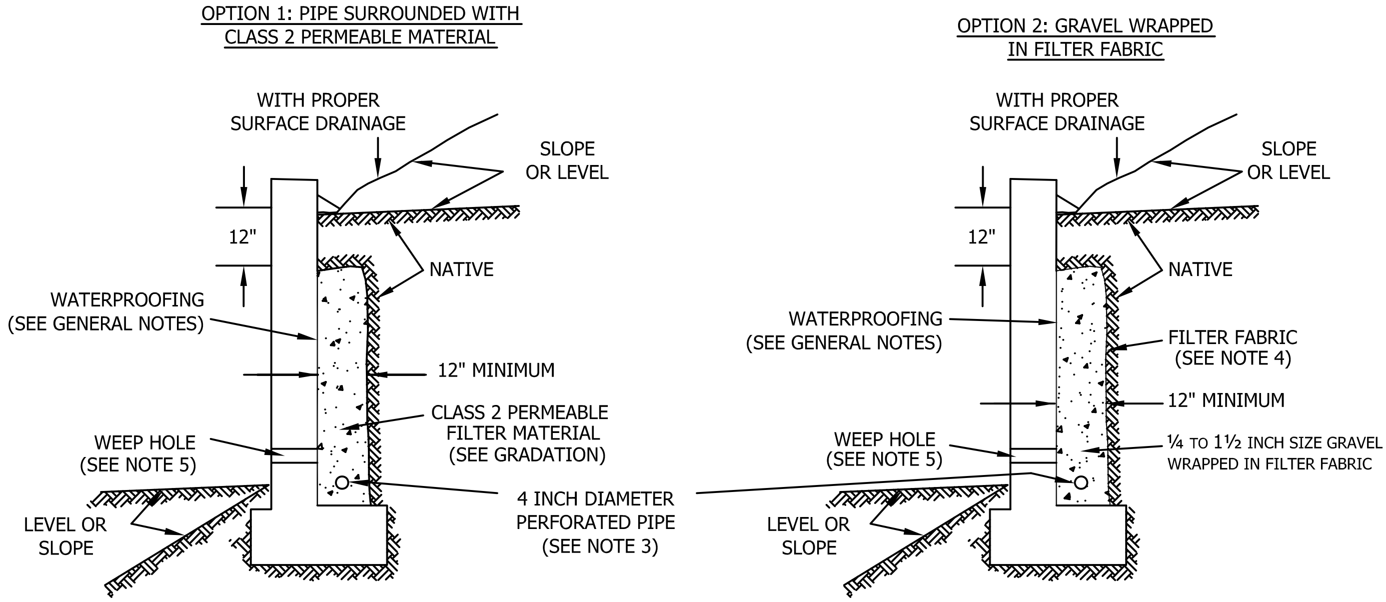
Tract 16878
Southwest of San Bernardino and Wabash Avenues
City of Redlands, California

Figure 3

Leighton

Map Saved as V:\Drafting\11745\003\Maps\11745-003_F03_BLM_2021-06-01.mxd on 6/1/2021 10:01:24 AM

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



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

Leighton

Figure 4

APPENDIX A

REFERENCES

APPENDIX A

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APPENDIX B

GEOTECHNICAL TEST PIT LOGS AND INFILTRATION TESTING

Leighton

TEST PIT LTP-1

Pulte Redlands | Project No. 11745.003
Logged By: ECB | Date Excavated: 05/12/2021
Sampled By: ECB | Elevation: 1600'

Location: (see Figure 2, *Geotechnical Exploration Map*)

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. This soil description (below) is a simplification of actual conditions encountered. Transitions between soil type may be gradual.

Depth (feet)		USCS Symbol	Soil Description	Geologic Unit	Laboratory Test Results			
Top	Bottom				Sample Number	Depth (feet)	Dry Density (pcf)	Moisture (%)
			SURFACE: sand, gravel and dried shrubs					
0.0	3.0	SW	**Alluvium (Qal):** SAND with GRAVEL, COBBLES and BOULDERS (SW): brown, slighly moist, relatively loose, fine to coarse sand, 10% cobbles and boulders, some fines, becomes relatively dense at 2.5'.	**Qal**	B1	0-3'		
3.0	6.0	SM	**Alluvium (Qal):** SILTY SAND with GRAVEL (SM): olive brown, slightly moist, fine to coarse sand, >15% fines (field estimate), 10% cobbles and 10%-15% boulders, larger boulders than material above, 2.5' max boulder dimension.	**Qal**				

Total Depth = 6 feet (practical refusal)
No groundwater encountered when excavating
Test pit back-filled and tamped with spoils on May 12, 2021.

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

TEST PIT **L**TP-2

Pulte Redlands

Logged By: ECB
Sampled By: ECB

Location: (see Figure 2, *Geotechnical Exploration Map*)

Project No. 11745.003
Date Excavated: 05/12/2021
Elevation: 1596'

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. This soil description (below) is a simplification of actual conditions encountered. Transitions between soil type may be gradual.

Depth (feet)		USCS Symbol	Soil Description	Geologic Unit	Laboratory Test Results			
Top	Bottom				Sample Number	Depth (feet)	Dry Density (pcf)	Moisture (%)
			SURFACE: sand, gravel and dried shrubs					
0.0	3.5	SP-SM	**Alluvium (Qal):** SAND with SILT and GRAVEL (SP-SM): olive brown, dry, relatively loose and unconsolidated, 10%-15% fines (field estimate), fine to medium sand, approximately 10% gravel, some rootlets.	**Qal**				
3.5	8.0	SP	**Alluvium (Qal):** SAND with GRAVEL, COBBLES and BOULDERS (SP): olive brown, dry to slightly moist, becomes more moist at 6', relatively dense, large material in a matrix of sand, subrounded gravel and cobbles, approximately 10% cobbles and 10% boulders.	**Qal**	B2	4-6'		

Total Depth = 8 feet (practical refusal)
No groundwater encountered when excavating
Test pit back-filled and tamped with spoils on May 12, 2021.

TEST PIT LTP-3

Pulte Redlands

Logged By: ECB

Sampled By: ECB

Location: (see Figure 2, *Geotechnical Exploration Map*)

Project No. 11745.003

Date Excavated: 05/12/2021

Elevation: 1581'

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. This soil description (below) is a simplification of actual conditions encountered. Transitions between soil type may be gradual.

Depth (feet)		USCS Symbol	Soil Description	Geologic Unit	Laboratory Test Results			
Top	Bottom				Sample Number	Depth (feet)	Dry Density (pcf)	Moisture (%)
			SURFACE: sand, gravel, cobbles, boulders and dry brush					
0.0	7.0	SM	**Alluvium (Qal):** SILTY SAND with GRAVEL, COBBLES and BOULDERS (SM): olive brown, dry, relatively loose in the upper 3', relatively dense below, 15%-20% fines, fine to coarse sand, 10% gravel and 10% boulders, 1' of slough at surface, walls cave-in until 3'.	**Qal**	B3	4-5'		

Total Depth = 7 feet (practical refusal)
No groundwater encountered when excavating
Test pit back-filled and tamped with spoils on May 12, 2021.

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

TEST PIT LTP-4

Pulte Redlands

Logged By: ECB
Sampled By: ECB
Location: (see Figure 2, *Geotechnical Exploration Map*)

Project No. 11745.003
Date Excavated: 05/12/2021
Elevation: 1561'

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. This soil description (below) is a simplification of actual conditions encountered. Transitions between soil type may be gradual.

Depth (feet)		USCS Symbol	Soil Description	Geologic Unit	Laboratory Test Results			
Top	Bottom				Sample Number	Depth (feet)	Dry Density (pcf)	Moisture (%)
			SURFACE: sand, gravel, cobbles, boulders and dry brush					
0.0	4.0	SM	**Alluvium (Qal):** SILTY SAND with GRAVEL, COBBLES, and BOULDERS (SM): olive brown, dry, relatively loose from 0-1.5', relatively dense below 1.5', 40% cobbles and boulders, 15% fines (field estimate), some rootlets.	**Qal**				
4.0	7.5	GW	**Alluvium (Qal):** SANDY GRAVEL (GW): olive brown, slightly moist, relatively dense, 5%-10% fines (field estimate), well-graded fine to coarse sand, high abundance of cobbles and boulders (approximately 15% boulders).	**Qal**				

Total Depth = 7.5 feet (practical refusal)
No groundwater encountered when excavating
Test pit back-filled and tamped with spoils on May 12, 2021.

TEST PIT LTP-5a

Pulte Redlands

Logged By: ECB

Sampled By: ECB

Location: (see Figure 2, *Geotechnical Exploration Map*)

Project No. 11745.003

Date Excavated: 05/12/2021

Elevation: 1555'

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. This soil description (below) is a simplification of actual conditions encountered. Transitions between soil type may be gradual.

Depth (feet)		USCS Symbol	Soil Description	Geologic Unit	Laboratory Test Results			
Top	Bottom				Sample Number	Depth (feet)	Dry Density (pcf)	Moisture (%)
			SURFACE: sand, gravel, cobbles, boulders and dry brush					
0.0	4.0	SP-SM	**Alluvium (Qal):** SAND with SILT, GRAVEL and COBBLES (SP-SM): olive brown, dry, relatively loose from surface to 2.5', relatively dense below 2.5', appromiately 15%-20% gravel (field estimate), some cobbles.	**Qal**				
4.0	5.0	SP	**Alluvium (Qal):** SAND with GRAVEL, COBBLES and BOUOLDERS (SP): olive brown, dry to slightly moist, more consolidated than material above, few fines, fine to coarse sand, 15%-20% gravel (field estimate), some cobbles, trace boulders. **Perc Test Zone: 4x4, 2' Deep**	**Qal**	B4	4-5'		

Total Depth = 5 feet (practical refusal)
No groundwater encountered when excavating
Test pit back-filled and tamped with spoils on May 12, 2021.

TEST PIT LTP-5b

Pulte Redlands

Logged By: ECB

Sampled By: ECB

Location: (see Figure 2, *Geotechnical Exploration Map*)

Project No. 11745.003

Date Excavated: 05/12/2021

Elevation: 1555'

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. This soil description (below) is a simplification of actual conditions encountered. Transitions between soil type may be gradual.

Depth (feet)		USCS Symbol	Soil Description	Geologic Unit	Laboratory Test Results			
Top	Bottom				Sample Number	Depth (feet)	Dry Density (pcf)	Moisture (%)
			SURFACE: sand, gravel, cobbles, boulders and dry brush					
0.0	2.0	SP-SM	**Alluvium (Qal):** SAND with SILT, GRAVEL and COBBLES (SP-SM): olive brown, dry, relatively loose, appromiateley 10% gravel and cobbles (field estimate), some cobbles.	**Qal**	B5	1-2'		
2.0	4.75	SP	**Alluvium (Qal):** SAND with GRAVEL, COBBLES and BOUOLDERS (SP): olive brown, dry, relatively dense, few fines, fine to coarse sand, 15% to 20% gravel (field estimate), some boulders.	**Qal**				
			Perc Test Zone: 3X3, 2' Deep					

Total Depth = 5 feet (practical refusal)
No groundwater encountered when excavating
Test pit back-filled and tamped with spoils on May 12, 2021.

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

TEST PIT TP-1

KB Redlands Tract. 16878

Project No. 11745.002

Logged By: BER

Date Excavated: 08/15/17

Sampled By BER

Location: Northeast portion of parcel (see Figure 2, *Test Pit Location Map*)

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. This soil description (below) is a simplification of actual conditions encountered. Transitions between soil type may be gradual.

Depth (feet)		USCS Symbol	Soil Description	Geologic Unit	Laboratory Test Results			
Top	Bottom				Sample Number	Depth (feet)	Dry Density (pcf)	Moisture (%)
0.0	3.5	GW	Freshly tilled gravelly sand & cobbles with minor dry grass **Alluvium (Qal):** GRAVEL/COBBLES/BOULDERS (GW), with sand, olive brown, slightly moist, non-plastic, medium-coarse, (field estimate) 20% gravel-cobbles-boulders (4' diameter max size)	Qal	B-1	0-3		

Total Depth = 3.5 feet (practical refusal)
No groundwater encountered on August 15, 2017
Test pit backfilled with excavated soil, tamped with bucket and wheel rolled at surface

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

TEST PIT TP-2

KB Redlands Tract. 16878 Project No. 11745.002

Logged By: BER Date Excavated: 08/15/17

Sampled By BER

Location: Southeast portion of parcel (see Figure 2, *Test Pit Location Map*)

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. This soil description (below) is a simplification of actual conditions encountered. Transitions between soil type may be gradual.

Depth (feet)		USCS Symbol	Soil Description	Geologic Unit	Laboratory Test Results			
Top	Bottom				Sample Number	Depth (feet)	Dry Density (pcf)	Moisture (%)
0.0	4.5	GW	Freshly tilled gravelly sand & cobbles with minor dry grass **Alluvium (Qal):** GRAVEL/COBBLES/BOULDERS (GW), with sand, olive brown, slightly moist, non-plastic, medium-coarse, (field estimate) 20% gravel-cobbles-boulders (4' diameter max size)	Qal				

Total Depth = 4.5 feet (practical refusal)
No groundwater encountered on August 15, 2017
Test pit backfilled with excavated soil, tamped with bucket and wheel rolled at surface

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

TEST PIT TP-3

KB Redlands Tract. 16878

Project No. 11745.002

Logged By: BER

Date Excavated: 08/15/17

Sampled By BER

Location: Southeast portion of parcel (see Figure 2, *Test Pit Location Map*)

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. This soil description (below) is a simplification of actual conditions encountered. Transitions between soil type may be gradual.

Depth (feet)		USCS Symbol	Soil Description	Geologic Unit	Laboratory Test Results			
Top	Bottom				Sample Number	Depth (feet)	Dry Density (pcf)	Moisture (%)
0.0	3.0	GW/SW	Freshly tilled gravelly sand & cobbles with minor dry grass **Alluvium (Qal):** GRAVEL/COBBLES/BOULDERS and SAND (GW/SW), olive brown, slightly moist, non-plastic, medium-coarse, (field estimate) 10% gravel-cobbles-boulders	Qal				
3.0	8.0	GW	GRAVEL/COBBLES/BOULDERS (GW), with sand, light brown to brown, slightly moist, non-plastic, stratified, (field estimate) 20% gravel-cobbles-boulders					

Total Depth = 8.0 feet

No groundwater encountered on August 15, 2017

Test pit backfilled with excavated soil, tamped with bucket and wheel rolled at surface

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

TEST PIT TP-4

KB Redlands Tract. 16878 Project No. 11745.002

Logged By: BER Date Excavated: 08/15/17

Sampled By BER

Location: Central portion of parcel (see Figure 2, *Test Pit Location Map*)

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. This soil description (below) is a simplification of actual conditions encountered. Transitions between soil type may be gradual.

Depth (feet)		USCS Symbol	Soil Description	Geologic Unit	Laboratory Test Results			
Top	Bottom				Sample Number	Depth (feet)	Dry Density (pcf)	Moisture (%)
0.0	6.0	GW	Freshly tilled gravelly sand & cobbles with minor dry grass **Alluvium (Qal):** GRAVEL/COBBLES/BOULDERS (GW), with sand, olive brown, slightly moist, non-plastic, medium-coarse, (field estimate) 20% gravel-cobbles-boulders	Qal	B-1	0-5		
6.0	8.0	GW/SW	GRAVEL/COBBLES/BOULDERS and SAND (GW/SW), light brownish gray to brown, coarse, (field estimate) 15% gravel-cobbles-boulders					

Total Depth = 8.0 feet

No groundwater encountered on August 15, 2017

Test pit backfilled with excavated soil, tamped with bucket and wheel rolled at surface

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

TEST PIT TP-5

KB Redlands Tract. 16878

Project No. 11745.002

Logged By: BER

Date Excavated: 08/15/17

Sampled By BER

Location: Northcentral portion of parcel (see Figure 2, *Test Pit Location Map*)

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. This soil description (below) is a simplification of actual conditions encountered. Transitions between soil type may be gradual.

Depth (feet)		USCS Symbol	Soil Description	Geologic Unit	Laboratory Test Results			
Top	Bottom				Sample Number	Depth (feet)	Dry Density (pcf)	Moisture (%)
0.0	4.0	GW	Freshly tilled gravelly sand & cobbles with minor dry grass **Alluvium (Qal):** GRAVEL/COBBLES/BOULDERS (GW), with sand, olive brown, slightly moist, non-plastic, medium-coarse, (field estimate) 15% gravel-cobbles-boulders	Qal				
4.0	8.0	GW	GRAVEL/COBBLES/BOULDERS (GW), with sand, light brown, dry to slightly moist, non-plastic, (field estimate) 20% gravel-cobbles-boulders					

Total Depth = 8.0 feet

No groundwater encountered on August 15, 2017

Test pit backfilled with excavated soil, tamped with bucket and wheel rolled at surface

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

TEST PIT TP-6

KB Redlands Tract. 16878

Project No. 11745.002

Logged By: BER

Date Excavated: 08/15/17

Sampled By BER

Location: Southcentral portion of parcel (see Figure 2, *Test Pit Location Map*)

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. This soil description (below) is a simplification of actual conditions encountered. Transitions between soil type may be gradual.

Depth (feet)		USCS Symbol	Soil Description	Geologic Unit	Laboratory Test Results			
Top	Bottom				Sample Number	Depth (feet)	Dry Density (pcf)	Moisture (%)
0.0	4.0	SW	Freshly tilled gravelly sand & cobbles with minor dry grass **Alluvium (Qal):** SAND (SW), with gravel-cobbles and some boulders, light brown, slightly moist, non-plastic, (field estimate) 5% gravel-cobbles-boulders	Qal				
4.0	8.0	GW	GRAVEL/COBBLES/BOULDERS (GW), with sand, light brown to gray, slightly moist, non-plastic, coarse, stratified, (field estimate) 15% gravel-cobbles-boulders					

Total Depth = 8.0 feet (practical refusal)

No groundwater encountered on August 15, 2017

Test pit backfilled with excavated soil, tamped with bucket and wheel rolled at surface

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

TEST PIT TP-7

KB Redlands Tract. 16878 Project No. 11745.002

Logged By: BER Date Excavated: 08/15/17

Sampled By BER

Location: Southwest portion of parcel (see Figure 2, *Test Pit Location Map*)

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. This soil description (below) is a simplification of actual conditions encountered. Transitions between soil type may be gradual.

Depth (feet)		USCS Symbol	Soil Description	Geologic Unit	Laboratory Test Results			
Top	Bottom				Sample Number	Depth (feet)	Dry Density (pcf)	Moisture (%)
			Freshly tilled gravelly sand & cobbles with minor dry grass					
0.0	3.0	SW	**Alluvium (Qal):** SAND (SW), with gravel and trace boulders, light brown, slightly moist, non-plastic, (field estimate) 10% gravel-cobbles-boulders	Qal	B-1	0-3		
3.0	7.0	GW	GRAVEL/COBBLES/BOULDERS (GW), with sand, light brown to gray, slightly moist, non-plastic, coarse, stratified, (field estimate) 20% gravel-cobbles-boulders					

Total Depth = 7.0 feet (practical refusal)

No groundwater encountered on August 15, 2017

Test pit backfilled with excavated soil, tamped with bucket and wheel rolled at surface

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

TEST PIT TP-8

KB Redlands Tract. 16878

Project No. 11745.002

Logged By: BER

Date Excavated: 08/15/17

Sampled By BER

Location: Westcentral portion of parcel (see Figure 2, *Test Pit Location Map*)

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. This soil description (below) is a simplification of actual conditions encountered. Transitions between soil type may be gradual.

Depth (feet)		USCS Symbol	Soil Description	Geologic Unit	Laboratory Test Results			
Top	Bottom				Sample Number	Depth (feet)	Dry Density (pcf)	Moisture (%)
			Freshly tilled gravelly sand & cobbles with minor dry grass					
0.0	4.0	SW	**Alluvium (Qal):** SAND (SW), with gravel-cobbles, and some boulders, olive brown, slightly moist, non-plastic, (field estimate) 5% gravel-cobbles-boulders	Qal				
4.0	8.0	GW	GRAVEL/COBBLES/BOULDERS (GW), with sand, light brown to gray, slightly moist, non-plastic, coarse, stratified, (field estimate) 10% gravel-cobbles-boulders					

Total Depth = 8.0 feet (practical refusal)
No groundwater encountered on August 15, 2017
Test pit backfilled with excavated soil, tamped with bucket and wheel rolled at surface

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

TEST PIT TP-9

KB Redlands Tract. 16878

Project No. 11745.002

Logged By: BER

Date Excavated: 08/15/17

Sampled By BER

Location: Northwest portion of parcel (see Figure 2, *Test Pit Location Map*)

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. This soil description (below) is a simplification of actual conditions encountered. Transitions between soil type may be gradual.

Depth (feet)		USCS Symbol	Soil Description	Geologic Unit	Laboratory Test Results			
Top	Bottom				Sample Number	Depth (feet)	Dry Density (pcf)	Moisture (%)
			Freshly tilled gravelly sand & cobbles with minor dry grass					
0.0	2.0	SW	**Alluvium (Qal):** SAND (SW), with gravel, olive brown, slightly moist, non-plastic	Qal				
2.0	5.0	GW/SW	GRAVEL and SAND (GW/SW), with cobbles, light brown to gray, slightly moist, non-plastic, sub-well rounded, stratified, 1.0"-3.5" average size (field estimate)					
5.0	8.5	GW/SW	GRAVEL/COBBLES/BOULDERS and SAND (GW/SW), with some boulders, brown, slightly moist, non-plastic, 4.0"-6.0" average size, (field estimate) <5% gravel-cobbles-boulders					

Total Depth = 8.5 feet

No groundwater encountered on August 15, 2017

Test pit backfilled with excavated soil, tamped with bucket and wheel rolled at surface

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

TEST PIT TP-10

KB Redlands Tract. 16878

Project No. 11745.002

Logged By: BER

Date Excavated: 08/15/17

Sampled By BER

Location: Northeast portion of parcel (see Figure 2, *Test Pit Location Map*)

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. This soil description (below) is a simplification of actual conditions encountered. Transitions between soil type may be gradual.

Depth (feet)		USCS Symbol	Soil Description	Geologic Unit	Laboratory Test Results			
Top	Bottom				Sample Number	Depth (feet)	Dry Density (pcf)	Moisture (%)
			Freshly tilled gravelly sand & cobbles with minor dry grass					
0.0	1.0	SW	**Alluvium (Qal):** SAND (SW), with gravel, olive brown, slightly moist, non-plastic	Qal				
1.0	5.0	GW	GRAVEL/COBBLES (GW), with sand and some boulders, light brown to gray, slightly moist, non-plastic, coarse, well rounded, stratified, (field estimate) <5% gravel-cobbles-boulders					
5.0	8.0	GW	GRAVEL/COBBLES/BOULDERS (GW), with sand, brown, slightly moist, non-plastic, (field estimate) 10% gravel-cobbles-boulders					

Total Depth = 8.0 feet

No groundwater encountered on August 15, 2017

Test pit backfilled with excavated soil, tamped with bucket and wheel rolled at surface

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

Results of Well Permeameter, from USBR 7300-89 Method.

Leighton

Project: 11745

Exploration #/Location: *LTP-5A*

Depth Boring drilled to (ft): 5

Tested by: EB

USCS Soil Type in test zone: SP

Weather (start to finish): Sunny

Liquid Used/pH: H2O

Measured boring diameter: 54.16 in. 27.08 in. Well Radius

Approx Depth to GW below GS: 50 ft

Well Prep: Test pit to 5', use smaller bucket for test excavation (4'Lx4'Wx2'H), total depth = 7', set perforated 4" pipe in center and backfill test area with 3/4" gravel)

Initial estimated Depth to Water Surface (in.):	55
Average depth of water in well, "h" (in.):	5
approx. h/r:	0.2
Tu (Fig. 8) (ft):	45.4
Tu>3h?:	yes, OK
Cross-sectional area for vol calcs (in.^2):	1156.1

	ft	in.	Total (in.)
Depth to Bot of well (or top of soil over Bentonite)	5. ft		60
Pilot Tube stickup (+ is above ground)	0. ft		0
Depth to top of sand outside of casing from top of pilot tube	0. ft		
Depth to top of float assembly from top of pilot tube			0
Float Assembly ID			
Float assembly Extension length (in.)			

0 Depth below GS (in.)

Flow Meter:

Meter ID: 4FLT8A

Meter Col: Black

Meter Unit: **Gallons**

DL ID:

0.05 gallons/pulse

Field Data / **Calculations**

Date	Time	Data from Flow Meter: Reading (cu-ft or gal)	Data from Flow Meter: Interval Pulse Count	Depth to WL in Boring (measured from top of pilot tube) ft	Depth to WL in Boring in.	Water Temp (deg F)	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)	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.																
5/12/2021	11:35																				
-																					
5/12/21	11:35	71719		4.5		65			0	54.0	6.0										
5/12/21	11:45	71783		4.5				10	10	54.0	6.0	0	6	14784	0	14784	1478	88704	1.0	44.22	**27.27**
5/12/21	11:50	71801		4.5				5	15	54.0	6.0	0	6	4158	0	4158	832	49896	1.0	24.87	**15.34**
5/12/21	11:55	71822		4.6				5	20	55.2	4.8	-1.2	5	4851	1387	6238	1248	74860	1.022	52.52	**23.74**
5/12/21	12:00	71841		4.6				5	25	55.2	4.8	0	5	4389	0	4389	878	52668	1.0	32.87	**17.25**
5/12/21	12:05	71865		4.5				5	30	54.0	6.0	1.2	5	5544	-1387	4157	831	49880	1.0	22.40	**15.82**
5/12/21	12:10	71887		4.5				5	35	54.0	6.0	0	6	5082	0	5082	1016	60984	1.0	30.40	**18.75**
5/12/21	12:15	71910		4.6				5	40	55.2	4.8	-1.2	5	5313	1387	6700	1340	80404	1.0	56.41	**25.50**
5/12/21	12:20	71931		4.6				5	45	55.2	4.8	0	5	4851	0	4851	970	58212	1.0	36.33	**19.07**
5/12/21	12:25	71954		4.6				5	50	55.2	4.8	0	5	5313	0	5313	1063	63756	1.0	39.79	**20.88**
5/12/21	12:30	71976		4.65				5	55	55.8	4.2	-0.6	5	5082	694	5776	1155	69308	1.0	52.98	**23.08**
5/12/21	12:35	71997		4.65				5	60	55.8	4.2	0	4	4851	0	4851	970	58212	1.0	41.54	**19.71**
5/12/21	12:40	72017		4.6				5	65	55.2	4.8	0.6	5	4620	-694	3926	785	47116	1.0	27.57	**15.69**
5/12/21	12:45	72039		4.6				5	70	55.2	4.8	0	5	5082	0	5082	1016	60984	1.0	38.06	**19.97**

template updated: 8/14/19

Results of Well Permeameter, from USBR 7300-89 Method.

Leighton

Project: 11745

Exploration #/Location: *LTP-5B*

Depth Boring drilled to (ft): 4.75

Tested by: EB

USCS Soil Type in test zone: SP

Weather (start to finish): Sunny

Liquid Used/pH: H2O

Measured boring diameter: 40.62 in. — 20.31 in. Well Radius

Approx Depth to GW below GS: 50 ft

Well Prep: Test pit to 4.75', use smaller bucket for test excavation (3'Lx3'Wx2'H), total depth = 7', set perforated 4" pipe in center and backfill test area with 3/4" gravel)

Initial estimated Depth to Water Surface (in.): 45

Average depth of water in well, "h" (in.): 12

approx. h/r: 0.6

Tu (Fig. 8) (ft): 46.3

Tu>3h?: yes, OK

Cross-sectional area for vol calcs (in.^2): 652.4

	ft	in.	Total (in.)
Depth to Bot of well (or top of soil over Bentonite)	4.75 ft		57
Pilot Tube stickup (+ is above ground)	0. ft		0
Depth to top of sand outside of casing from top of pilot tube			
Depth to top of float assembly from top of pilot tube			0 (0 Depth below GS (in.))
Float Assembly ID			
Float assembly Extension length (in.)			

Flow Meter:

Meter ID: N/A

Meter Color:

Meter Unit: Gallons

DL ID:

0.05 gallons/pulse

Field Data / **Calculations**

Date	Time	Data from Flow Meter: Reading (cu-ft or gal)	Data from Flow Meter: Interval Pulse Count	Depth to WL in Boring (measured from top of pilot tube) ft	Depth to WL in Boring in.	Water Temp (deg F)	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)	V (Fig 9)	K20, Coef. Of Permeability at 20 deg C (in./hr)	Infiltration Rate [flow/surf area] (in./hr) (FS=1)
Start Date 5/12/2021	Start time: 11:10	Gallons																			
-																					
5/12/21	11:10	0		3.75		65			0	45.0	12.0										
5/12/21	11:15	29		3.75				5	5	45.0	12.0	0	12	6794	0	6794	1359	81529	1.0	26.49	**29.47**
5/12/21	11:20	59		3.75				5	10	45.0	12.0	0	12	6794	0	6794	1359	81529	1.0	26.49	**29.47**
5/12/21	11:40	176		3.8				20	30	45.6	11.4	-0.6	12	27176	391	27568	1378	82704	1.022	29.06	**30.31**
5/12/21	11:50	236		3.75				10	40	45.0	12.0	0.6	12	13860	-391	13469	1347	80811	1.0	25.63	**29.61**
5/12/21	12:00	296		3.75				10	50	45.0	12.0	0	12	13860	0	13860	1386	83160	1.0	27.02	**30.06**
5/12/21	12:10	356		3.7				10	60	44.4	12.6	0.6	12	13860	-391	13469	1347	80811	1.0	24.38	**28.82**
5/12/21	12:20	416		3.7				10	70	44.4	12.6	0	13	13860	0	13860	1386	83160	1.0	25.67	**29.27**
5/12/21	12:30	476		3.75				10	80	45.0	12.0	-0.6	12	13860	391	14251	1425	85509	1.0	28.44	**30.50**
5/12/21	12:40	536		3.75				10	90	45.0	12.0	0	12	13860	0	13860	1386	83160	1.0	27.02	**30.06**

APPENDIX C

LABORATORY TEST RESULTS

Leighton

MODIFIED PROCTOR COMPACTION TEST
ASTM D 1557

Leighton

Project Name:	Pulte Redlands	Tested By:	J. Gonzalez	Date:	05/19/21
Project No.:	11745.003	Checked By:	A. Santos	Date:	05/24/21
Boring No.:	TP-3	Depth (ft.):	4-5		
Sample No.:	B3				
Soil Identification:	Pale olive 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	Scalp Fraction (%)		Rammer Weight (lb.) = 10.0
		Dry	#3/4		Height of Drop (in.) = 18.0
Compaction Method	X	Mechanical Ram	#3/8		
		Manual Ram	#4	9.9	Mold Volume (ft³) 0.03330

TEST NO.	1	2	3	4	5	6
Wt. Compacted Soil + Mold (g)	3744	3808	3874	3828		
Weight of Mold (g)	1850	1850	1850	1850		
Net Weight of Soil (g)	1894	1958	2024	1978		
Wet Weight of Soil + Cont. (g)	398.2	422.5	436.6	451.3		
Dry Weight of Soil + Cont. (g)	383.1	398.4	403.1	408.7		
Weight of Container (g)	39.2	38.4	39.7	37.7		
Moisture Content (%)	4.39	6.69	9.22	11.48		
Wet Density (pcf)	125.4	129.6	134.0	131.0		
Dry Density (pcf)	120.1	121.5	122.7	117.5		

Maximum Dry Density (pcf) 122.8 **Optimum Moisture Content (%)** 8.7

Corrected Dry Density (pcf) 126.2 **Corrected Moisture Content (%)** 7.9

☒ **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

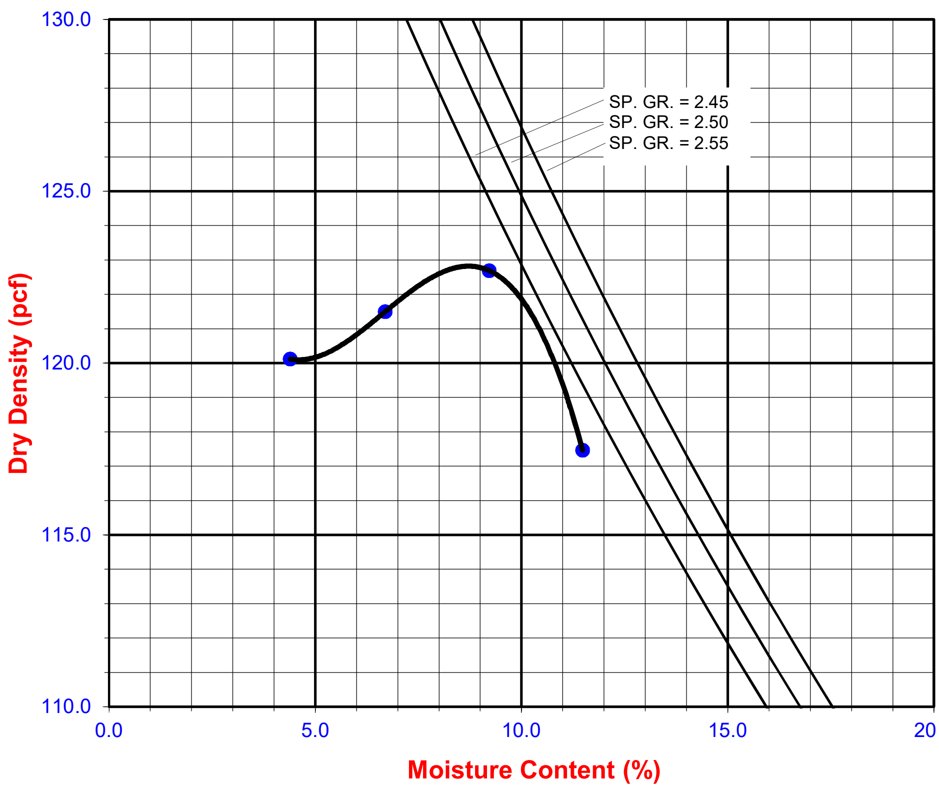
☐ **Procedure C**
Soil Passing 3/4 in. (19.0 mm) Sieve
Mold : 6 in. (152.4 mm) diameter
Layers : 5 (Five)
Blows per layer : 56 (fifty-six)
Use if +3/8 in. is >20% and +¾ in. is <30%

Particle-Size Distribution:

GR:SA:FI

Atterberg Limits:

LL,PL,PI



Boring No.	TP-3								
Sample No.	B3								
Depth (ft.)	4-5								
Sample Type	Bulk								
Soil Identification	Pale olive silty sand (SM)								
No Moisture Correction; ASTM D 1140 modified to include splitting the sample on the #4 sieve									
Total Sample Dry Weight Determination									
Dry Weight of Soil + Container (g)	4036.70								
Weight of Container (g)	709.90								
Dry Weight of Soil (g)	3326.80								
Sample Dry Weight Determination, Retained on Sieve #4									
Dry Weight of Sample + Cont. (g)	1038.30								
Weight of Container (g)	709.90								
Weight of Dry Sample (g)	328.40								
Sample Dry Weight Determination, Passing Sieve #4									
Dry Weight of Sample + Cont. (g)	611.20								
Weight of Container (g)	107.60								
Weight of Dry Sample (g)	503.60								
After Wash									
Method (A or B)	A								
Dry Weight of Sample + Cont. (g)	537.40								
Weight of Container (g)	107.60								
Weight of Dry Sample (g)	429.80								
% Passing No. 4 Sieve	90.1								
% Retained No. 4 Sieve	9.9								
% Passing No. 200 Sieve	**13.2**								

Leighton

PERCENT PASSING
No. 200 SIEVE
ASTM D 1140

Project Name: Pulte Redlands
Project No.: 11745.003
Client Name:
Tested By: A. Santos Date: 05/19/21

TESTS for SULFATE CONTENT
CHLORIDE CONTENT and pH of SOILS

Leighton

Project Name:	Pulte Redlands	Tested By :	GEB/GB	Date:	05/20/21
Project No. :	11745.003	Checked By:	A. Santos	Date:	05/25/21

Boring No.	TP-3			
Sample No.	B-3			
Sample Depth (ft)	4-5			
Soil Identification:	Pale olive (SM)			
Wet Weight of Soil + Container (g)	0.00			
Dry Weight of Soil + Container (g)	0.00			
Weight of Container (g)	1.00			
Moisture Content (%)	0.00			
Weight of Soaked Soil (g)	100.26			

SULFATE CONTENT, DOT California Test 417, Part II

Beaker No.	303			
Crucible No.	12			
Furnace Temperature (°C)	860			
Time In / Time Out	9:40/10:45			
Duration of Combustion (min)	45			
Wt. of Crucible + Residue (g)	20.7476			
Wt. of Crucible (g)	20.7468			
Wt. of Residue (g) (A)	0.0008			
PPM of Sulfate (A) x 41150	32.92			
PPM of Sulfate, Dry Weight Basis	**33**			

CHLORIDE CONTENT, DOT California Test 422

ml of Extract For Titration (B)	15			
ml of AgNO3 Soln. Used in Titration (C)	0.7			
PPM of Chloride (C -0.2) * 100 * 30 / B	100			
PPM of Chloride, Dry Wt. Basis	**100**			

pH TEST, DOT California Test 643

pH Value	**7.34**			
Temperature °C	23.6			

SOIL RESISTIVITY TEST

DOT CA TEST 643

Leighton

Project Name:	Pulte Redlands	Tested By :	G. Berdy	Date:	05/13/21
Project No. :	11745.003	Checked By:	A. Santos	Date:	05/25/21
Boring No.:	TP-3	Depth (ft.) :	4-5		
Sample No. :	B-3				

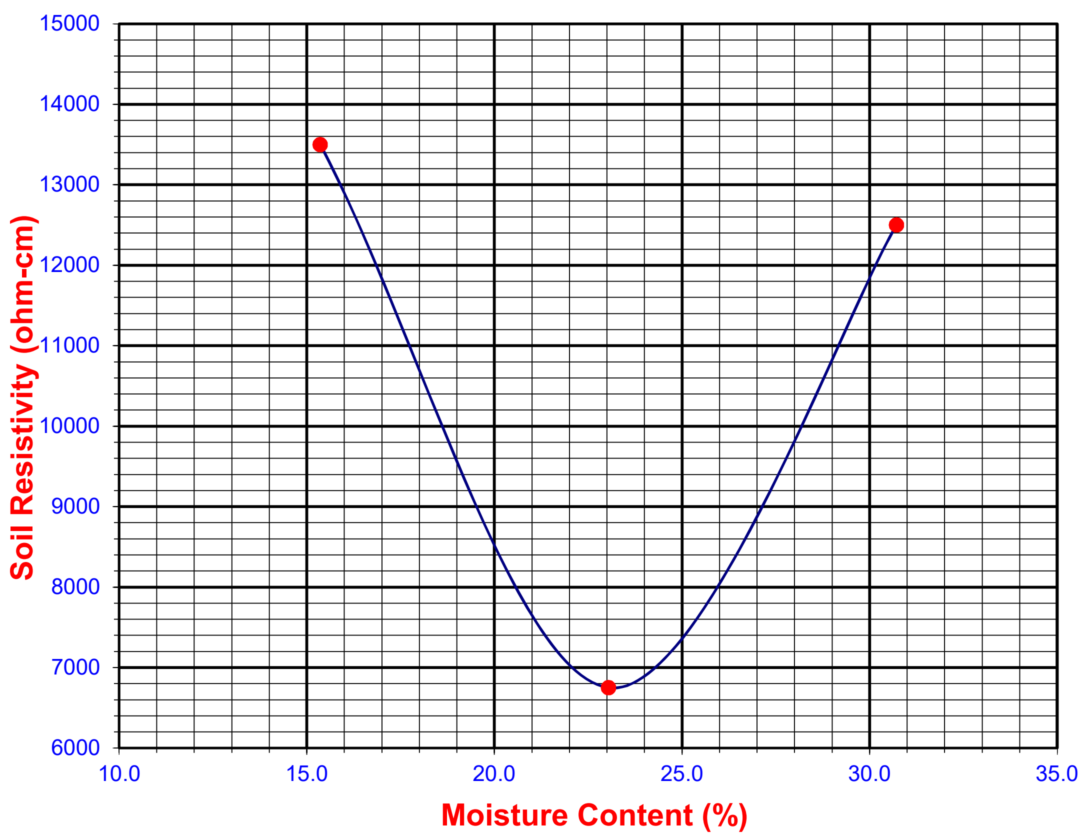
Soil Identification:* Pale olive (SM)

*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	20	15.36	13500	13500
2	30	23.04	6750	6750
3	40	30.72	12500	12500
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)	130.20
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	
6750	**23.2**	**33**	**100**	**7.34**	**23.6**



APPENDIX D

GENERAL EARTHWORK AND GRADING SPECIFICATIONS

Leighton

LEIGHTON AND ASSOCIATES, INC.

GENERAL EARTHWORK AND GRADING SPECIFICATIONS FOR ROUGH GRADING

Table of Contents

1.0 General

1.1 Intent: These General Earthwork and Grading Specifications are for the grading and earthwork shown on the approved grading plan(s) and/or indicated in the geotechnical report(s). These Specifications are a part of the recommendations contained in the geotechnical report(s). In case of conflict, the specific recommendations in the geotechnical report shall supersede these more general Specifications. Observations of the earthwork by the project Geotechnical Consultant during the course of grading may result in new or revised recommendations that could supersede these specifications or the recommendations in the geotechnical report(s).

1.2 The Geotechnical Consultant of Record: Prior to commencement of work, the owner shall employ the Geotechnical Consultant of Record (Geotechnical Consultant). The Geotechnical Consultants shall be responsible for reviewing the approved geotechnical report(s) and accepting the adequacy of the preliminary geotechnical findings, conclusions, and recommendations prior to the commencement of the grading.

Prior to commencement of grading, the Geotechnical Consultant shall review the "work plan" prepared by the Earthwork Contractor (Contractor) and schedule sufficient personnel to perform the appropriate level of observation, mapping, and compaction testing.

During the grading and earthwork operations, the Geotechnical Consultant shall observe, map, and document the subsurface exposures to verify the geotechnical design assumptions. If the observed conditions are found to be significantly different than the interpreted assumptions during the design phase, the Geotechnical Consultant shall inform the owner, recommend appropriate changes in design to accommodate the observed conditions, and notify the review agency where required. Subsurface areas to be geotechnically observed, mapped, elevations recorded, and/or tested include natural ground after it has been cleared for receiving fill but before fill is placed, bottoms of all "remedial removal" areas, all key bottoms, and benches made on sloping ground to receive fill.

The Geotechnical Consultant shall observe the moisture-conditioning and processing of the subgrade and fill materials and perform relative compaction testing of fill to determine the attained level of compaction. The Geotechnical Consultant shall provide the test results to the owner and the Contractor on a routine and frequent basis.

1.3 The Earthwork Contractor: 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 Specifications prior to commencement of grading. The

Contractor shall be solely responsible for performing the grading in accordance with the plans and specifications.

The Contractor shall prepare and submit to the owner and the Geotechnical Consultant a work plan that indicates the sequence of earthwork grading, the number of "spreads" of work and the estimated quantities of daily earthwork contemplated for the site prior to commencement of grading. The Contractor shall inform the owner and the Geotechnical Consultant of changes in work schedules and updates to the work plan at least 24 hours in advance of such changes so that appropriate observations and tests can be planned and accomplished. The Contractor shall not assume that the Geotechnical Consultant is aware of all grading operations.

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

2.0 Preparation of Areas to be Filled

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 the Geotechnical Consultant.

The Geotechnical Consultant shall evaluate the extent of these removals depending on specific site conditions. Earth fill material shall not contain more than 1 percent of organic materials (by volume). No fill lift shall contain more than 5 percent of organic matter. 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.

2.2 Processing: Existing ground that has been declared satisfactory for support of fill by the Geotechnical Consultant shall be scarified to a minimum depth of 6 inches. Existing ground that is not satisfactory shall be overexcavated as specified in the following section. 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.

2.3 Overexcavation: In addition to removals and overexcavations 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 overexcavated to competent ground as evaluated by the Geotechnical Consultant during grading.

2.4 Benching: Where fills are to be placed on ground with slopes steeper than 5:1 (horizontal to vertical units), the ground shall be stepped or benched. Please see the Standard Details for a graphic illustration. The lowest bench or key shall be a minimum of 15 feet wide and at least 2 feet deep, into competent material as evaluated by the Geotechnical Consultant. Other benches shall be excavated a minimum height of 4 feet into competent material or as otherwise recommended by the Geotechnical Consultant. Fill placed on ground sloping flatter than 5:1 shall also be benched or otherwise overexcavated to provide a flat subgrade for the fill.

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 the Geotechnical Consultant as suitable to receive fill. The Contractor shall obtain a written acceptance from the Geotechnical Consultant prior to fill placement. A licensed surveyor shall provide the survey control for determining elevations of processed areas, keys, and benches.

3.0 Fill Material

3.1 General: Material to be used as fill shall be essentially free of organic matter and other deleterious substances evaluated and accepted by the Geotechnical Consultant 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 the Geotechnical Consultant or mixed with other soils to achieve satisfactory fill material.

3.2 Oversize: Oversize material defined as rock, or other irreducible material with a maximum dimension greater than 8 inches, shall not be buried or placed in fill unless location, materials, and placement methods are specifically accepted by the Geotechnical Consultant. 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 vertical feet of finish grade or within 2 feet of future utilities or underground construction.

3.3 Import: If importing of fill material is required for grading, proposed import material shall meet the requirements of Section 3.1. The potential import source shall be given to the Geotechnical Consultant at least 48 hours (2 working days) before importing begins so that its suitability can be determined and appropriate tests performed.

4.0 Fill Placement and Compaction

4.1 Fill Layers: Approved fill material shall be placed in areas prepared to receive fill (per Section 3.0) in near-horizontal layers not exceeding 8 inches in loose thickness. The Geotechnical Consultant may accept thicker layers if testing indicates the grading procedures can adequately compact the thicker layers. Each layer shall be spread evenly and mixed thoroughly to attain relative uniformity of material and moisture throughout.

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 D1557-91).

4.3 Compaction of Fill: After each layer has been moisture-conditioned, mixed, and evenly spread, it shall be uniformly compacted to not less than 90 percent of maximum dry density (ASTM Test Method D1557-91). 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.

4.4 Compaction of Fill Slopes: In addition to normal compaction procedures specified above, compaction of slopes shall be accomplished by backrolling of slopes with sheepsfoot rollers at increments of 3 to 4 feet in fill elevation, or by other methods producing satisfactory results acceptable to the Geotechnical Consultant. Upon completion of grading, relative compaction of the fill, out to the slope face, shall be at least 90 percent of maximum density per ASTM Test Method D1557-91.

4.5 Compaction Testing: Field tests for moisture content and relative compaction of the fill soils shall be performed by the Geotechnical Consultant. Location and frequency of tests shall be at the Consultant'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 the fill/bedrock benches).

4.6 Frequency of Compaction Testing: Tests shall be taken at intervals not exceeding 2 feet in vertical rise and/or 1,000 cubic yards of compacted fill soils embankment. In addition, as a guideline, at least one test shall be taken on slope faces for each 5,000 square feet of slope face and/or each 10 feet of vertical height of slope. The Contractor shall assure that fill construction is such that the testing schedule can be accomplished by the Geotechnical Consultant. The Contractor shall stop or slow down the earthwork construction if these minimum standards are not met.

4.7 Compaction Test Locations: The Geotechnical Consultant shall document the approximate elevation and horizontal coordinates of each test location. The Contractor shall coordinate with the project surveyor to assure that sufficient grade stakes are established so that the Geotechnical Consultant can determine the test locations with sufficient accuracy. At a minimum, two grade stakes within a horizontal distance of 100 feet and vertically less than 5 feet apart from potential test locations shall be provided.

5.0 Subdrain Installation

Subdrain systems shall be installed in accordance with the approved geotechnical report(s), the grading plan, and the Standard Details. The Geotechnical Consultant may recommend additional subdrains and/or changes in subdrain extent, location, grade, or material depending on conditions encountered during grading. All subdrains shall be surveyed by a land surveyor/civil engineer for line and grade after installation and prior to burial. Sufficient time should be allowed by the Contractor for these surveys.

6.0 Excavation

Excavations, as well as over-excavation for remedial purposes, shall be evaluated by the Geotechnical Consultant during grading. Remedial removal depths shown on geotechnical plans are estimates only. The actual extent of removal shall be determined by the Geotechnical Consultant 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, evaluated, and accepted by the Geotechnical Consultant prior to placement of materials for construction of the fill portion of the slope, unless otherwise recommended by the Geotechnical Consultant.

7.0 Trench Backfills

7.1 Safety: The Contractor shall follow all OHSA and Cal/OSHA requirements for safety of trench excavations.

7.2 Bedding and Backfill: All bedding and backfill of utility trenches shall be done in accordance with the applicable provisions of Standard Specifications of Public Works Construction. Bedding material shall have a Sand Equivalent greater than 30 (SE>30). The bedding shall be placed to 1 foot over the top of the conduit and densified by jetting. Backfill shall be placed and densified to a minimum of 90 percent of maximum from 1 foot above the top of the conduit to the surface.

The Geotechnical Consultant shall test the trench backfill for relative compaction. At least one test should be made for every 300 feet of trench and 2 feet of fill.

7.3 Lift Thickness: Lift thickness of trench backfill shall not exceed those allowed in the Standard Specifications of Public Works Construction unless the Contractor can demonstrate to the Geotechnical Consultant that the fill lift can be compacted to the minimum relative compaction by his alternative equipment and method.

7.4 Observation and Testing: The jetting of the bedding around the conduits shall be observed by the Geotechnical Consultant.

APPENDIX E

BORINGS EVALUATION FORM AND SOILS OPINION LETTER

Leighton

SOIL BORING EVALUATION FORM

Parcel: Tract No. 16878

County: San Bernardino County

In performing the requested work, the driller should also look for and record the following condition if they occur on the parcel:

ITEMS CHECK IF LOCATION OR	Check if Found	LOCATION OR BORING #
1. Unusual Soil Coloration or Streaking (Surface or Subsurface)	________	_________
2. Disturbed Soil (Surface or Subsurface)	________	_________
3. Fill Materials		
a. Soil not Native to Site	________	_________
b. Debris Fill (metal, glass, concrete, garbage, etc.) garbage, etc.)	________	_________
4. Areas of Sparse, Sick or Dead Vegetation	________	_________
5. Drums, Storage Tanks or Other Containers	________	_________
6. Discolored/Polluted Water (ground or surface)	________	_________
7. Unusual Odors:		
a. Chemical/Solvent	________	_________
b. Gasoline	________	_________
c. Rotten Egg/Sewage	________	_________
d. Oil or Fuel Oil	________	_________

COMMENTS AND SUMMARY

Signed ____________________

Steven G. Okubo, PG, CEG 2706

Date 06/11/2021

Company Leighton and Associates, Inc.

June 11, 2021

Project No. 11745.003

To: Pulte Group
27401 Los Altos, Suite 400
Mission Viejo, California 92691

Attention: Mr. Sohail Bokhari
Director Land Planning & Engineering

Subject: Soil Opinion Letter for Proposed Residential Development, Redlands 38, Tract No. 16878, Southwest of San Bernardino and Wabash Avenues, City of Redlands, San Bernardino County, California

Leighton and Associates, Inc. (Leighton) understands that Pulte Group (Pulte) is considering the purchase of Tract 16878 located southeast of San Bernardino and Wabash Avenues in the City of Redlands, California. In order to assist in its decision whether to purchase the land, Pulte has requested our professional assistance with respect to the feasibility of using the land for a single-family-residential subdivision.

We acknowledge that:

1. We are professional geotechnical engineers licensed by the State of California.

2. We have professional liability insurance coverage with minimum limits of one million dollars ($1,000,000), per claim and in the aggregate, as evidenced by the attached certificate of insurance.

3. We have reviewed Pulte's Soils Investigation Policy, dated June, 2013 (the "Policy"). We understand that this letter is being furnished to assist Pulte in complying with the Policy.

4. We have conducted a review of existing geotechnical reports prepared by Leighton and others (see References attached) of the land described above, which Pulte purposes to purchase, for potential geotechnical hazards and adverse conditions, including adverse bedrock formations, ground water and unstable soils (expansive, collapsible or erodible) that could affect the suitability of the land for the intended purpose described above, and we have reviewed such tests as we deem appropriate to form a professional opinion that the land can be developed and used for the intended purpose. The following summarizes significant geotechnical conditions:

    - Alluvial soil deposits consisting of sand, gravel, cobbles and boulders are present across the site. TKE (2003) also described up to 1 foot of artificial fill in test pits where historical aerial photographs indicate past stockpiling in the northern and northeastern portions of the site. The fill is reportedly similar in character to the native soil. We did not find or observe this fill in our test pits. Oversize rock (greater than about 12 inches in dimension) is expected to make up about 10 percent of the earth material onsite, and will require special handling during grading and post-grading construction.
    - No active faults have been mapped onsite.
    - The potential for liquefaction and significant seismic settlement is reported to be low.
    - Previous studies found the site suitable for development with remedial grading and foundation design recommendations typical for the area, except for the presence of oversized rocks.

Based upon our geotechnical review, it is our professional opinion that the site is suitable for development, but boulders larger than 12 inches in dimension (oversize material) will be encountered during excavation. This may materially increase the cost of developing the property due to the need for handling and placement of the rock. We do not anticipate unusual designs for foundations, underground utilities, surface or subsurface drainage, paving, soil conditioning or treatment, or dewatering in order to render the land suitable for the proposed use. Other than the presence of oversize rock, we anticipate remedial measures and foundation designs to construct the development will be typical for the area as discussed in the previously prepared geotechnical reports.

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 AND ASSOCIATES, INC.

Jason D. Hertzberg, GE 2711
Principal Engineer

Steven G. Okubo, CEG 2706
Project Geologist

SGO/JDH/rsm

Attachment: References

Distribution: (1) Addressee

REFERENCES

Leighton and Associates, Inc. (Leighton), 2018, Geotechnical Due Diligence Review for the Proposed Residential Development, Tract 16878, APN 0168-132-05, Southwest of San Bernardino and Wabash Avenues, City of Redlands, California, Project No. 11745.002, dated March 20, 2018.

T.K. Engineering Corp. (TKE), 2003, Preliminary Soils Engineering Feasibility Investigation, Job No. 03-219F, dated August 8, 2003.