Appendix IS-3

Geotechnical Report

Appendix IS-3.1

Geotechnical Investigation

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Report of Preliminary Geotechnical Investigation
(Geotechnical Services Phase A – Geotechnical Feasibility Evaluation)

Proposed Angels Landing Development

Block Bordered by Olive Street, Hill Street, 4th Street and Angels Flight
Los Angeles, California

Prepared for:

Angels Landing Partners, LLC
Los Angeles, California

Project 4953-18-0421

July 6, 2018
Revised March 11, 2019

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July 6, 2018
(Revised March 11, 2019)
Wood Project 4953-18-0421.01

Angels Landing Partners, LLC
448 South Hill Street, Suite 408
Los Angeles, California 90013
Attn: Mr. Kevin Roberts

Subject: Letter of Transmittal
Report of Preliminary Geotechnical Consultation
(Geotechnical Services Phase A – Geotechnical Feasibility Evaluation)
Proposed Angels Landing Development
Block Bordered by Olive Street, Hill Street, 4th Street, and Angels Flight
Los Angeles, California

Dear Mr. Roberts:

We are pleased to submit the results of our preliminary geotechnical investigation for the proposed Angels Landing development to be constructed at the block bordered by Olive Street, Hill Street, 4th Street, and Angels Flight in Los Angeles, California. This investigation was conducted in general accordance with our proposal dated April 2, 2018 and the Agreement between Angels Landing Partners, LLC and our firm, dated April 23, 2018.

The scope of our Phase A services summarized herein was planned based on discussions with you and your design team. This report provides preliminary geotechnical recommendations for the development. Additional explorations and analyses will need to be performed as part of Phase C services in order to provide a geotechnical report suitable for submission to the City of Los Angeles Department of Building and Safety Grading Division for obtain a building permit. In addition, we are submitting a separate report of geotechnical evaluation for entitlement documents (for our Phase B services) dated July 6, 2018.

The results of our investigation and preliminary design recommendations are presented in this report.

It has been a pleasure to be of professional service to you. Please contact us if you have any questions or if we can be of further assistance.

Sincerely,

Wood Environment & Infrastructure Solutions, Inc.

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(Electronic copies submitted)

Report of Preliminary Geotechnical Investigation
(Geotechnical Services Phase A – Geotechnical Feasibility Evaluation)
Proposed Angels Landing Development

Block Bordered by Olive Street, Hill Street, 4th Street, and Angels Flight
Los Angeles, California

Prepared for:

Angels Landing Partners, LLC

Los Angeles, California

Wood Environment & Infrastructure Solutions, Inc.

Los Angeles, California

July 6, 2018
Revised March 11, 2019

Project 4953-18-0421

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Executive Summary

This report presents the results of our preliminary geotechnical investigation (our Phase A geotechnical feasibility evaluation) for proposed Angels Landing development at the block bordered by Olive Street, Hill Street, 4th Street, and Angels Flight in Los Angeles, California. Our current explorations, prior pertinent subsurface explorations, engineering analyses, and preliminary recommendations for development are summarized below.

The proposed high-rise development project will consist of two mixed-use residential, hotel, retail, charter school, and entertainment towers. The towers will vary in height between 854 feet above grade (64-story) (Tower 'A') and 494 feet above grade (42-story) (Tower 'B'"), with up to 7 subterranean parking levels underlying the entire site.

Subsurface information at the site was available from prior geotechnical investigations performed by our predecessor legacy firm of LeRoy Crandall and Associates in 1976, 1988 and 1993. The prior pertinent borings were drilled to depths ranging from 59 to 88 feet below the ground surface (bgs). To supplement subsurface data from the previous investigations, we explored the site by drilling four additional borings: one bucket auger boring (designated BA-1) to a depth of 86 feet bgs, two continuous core borings (designated CB-1 and CB-2) to depths of 131 and 200 feet bgs, and one rotary wash boring (designated RW-1) to a depth of 220 feet bgs.

Fill soils, estimated to be 14 feet in thickness, were encountered in Boring RW-1. The fill consisted of sandy silt. Alluvial deposits were encountered below the fill between depths of 14 and 25 feet bgs, consisting of silty sand and sand with gravel and some cobbles. The fill and alluvial deposits were underlain by sedimentary bedrock of the Fernando formation. The Fernando formation generally consists of oxidized and unoxidized, massive and poorly- to moderately-well bedded clayey and sandy siltstone and silty fine sandstone. Some thin clay seams were observed in the upper 20 feet of Boring CB-1 and lower 157 feet of Boring CB-2. Cemented layers up to 1 foot thick were also encountered. Overall, the formation is generally poorly cemented and weak to very weak, while cemented zones are strong to very strong. The bedrock is oxidized to a light brownish- to yellowish-gray color near the surface. The unoxidized bedrock is a dark greenish gray color. The dip of the observed bedding ranged from 5 to 37 degrees to the south and southeast. This bedding orientation is adverse relative to the proposed northeast and northwest facing basement walls but can be mitigated by proper engineering design and construction in conformance with current building codes and engineering practice.

The results of corrosivity tests indicate that the onsite soils, at present moisture content, are mildly corrosive to moderately corrosive to ferrous metals, aggressive to copper, and moderate for sulfate attack on portland cement concrete.

The site is in the Bunker Hill area of Downtown Los Angeles and is outside the areal limits of valley fill sediments that constitute the principal water-bearing units; therefore, the site is not considered to be within the regional groundwater basin. Although the bedrock of the Fernando formation is considered non-water bearing, perched groundwater may be present locally in fractures and along bedding planes in the bedrock. A current exploratory boring drilled in the upper cut portion of the site encountered seepage at approximately Elevation 270 feet. In prior borings drilled at the site, seepage occurred at depths of 47 and 63 feet within the bedrock. In the lower portion of the site, seepage was encountered in a prior exploratory boring at approximately Elevation 266 feet within the alluvium (LAW/Crandall, 1993). Localized seepage within the wedge of alluvium overlying bedrock is representative of a perched groundwater condition that probably fluctuates with seasonal precipitation. The presence of perched groundwater will be monitored in the groundwater monitoring well constructed in RW-2.

The existing fill soils and alluvial deposits are not considered suitable for support of the proposed development. However, as part of construction activities, all existing fill soils and alluvial deposits are anticipated to be automatically removed by the planned excavation to construct the subterranean levels and the building foundation. The proposed buildings may be supported on mat foundations bearing in undisturbed bedrock.

If unsuitable or disturbed soils are present at the bottom of excavation, we recommend that the mat foundation excavation be deepened locally to extend to bedrock and structural concrete of the same strength as that in the foundation be used to replace the excavated material up to the level of the bottom of foundation. As an alternative, sand-cement slurry could be utilized if the material strength is sufficient and approval is obtained from the City of Los Angeles Department of Building and Safety (LADBS) Grading Division.

We understand that the proposed basement levels may extend about 110 feet to 170 feet below existing grade. Based on this depth of excavation, proposed high-rise buildings may be supported on mat foundations bearing in undisturbed bedrock. Pile foundations would not be required unless necessary for some tension piles to resist overturning. If tension piles are deemed necessary for overturning, drilled cast-in-place piles could be utilized or potentially other pile types. The podium structure between the high rise buildings may be able to be supported on spread footings established on the rock. The building floor slab may be supported at-grade on undisturbed bedrock material or properly compacted fill.

1.0 Scope

This report provides preliminary geotechnical design information (our Phase A geotechnical feasibility evaluation) for the proposed Angels Landing development project at the block bordered by Olive Street, Hill Street, 4th Street, and Angels Flight in Los Angeles, California. The location of the site is illustrated on Figure 1, Site Vicinity Map. The location of our current and prior exploration borings at the site are shown on Figure 2, Plot Plan.

The preliminary (Phase A) investigation was authorized to provide preliminary geotechnical evaluation of the site for feasibility of the site development including the following:

- Results of review of data from prior investigations at the site;
- Results of recent explorations and laboratory tests, with a description of the material and groundwater conditions encountered;
- Results of in-situ shear wave velocity measurement;
- Results of geologic reconnaissance;
- Results of oil well research;
- Discussion of foundation types suitable for support of the project;
- Preliminary recommendations for bearing capacities of foundations;
- Preliminary recommendations for shoring design and parameters;
- Preliminary recommendations for basement wall design;
- Preliminary results of corrosion study based on our current and prior laboratory tests;
- Considerations relative to the above for Metro structures adjacent to the site; and
- A determination of the applicable seismic design parameters based on the current California Building Code.

Our preliminary recommendations are based on the results of the current and pertinent prior explorations, laboratory tests, and engineering analyses by us. We have relied on subsurface data obtained from the following prior geotechnical investigation reports at and in the immediate vicinity of the site by our predecessor firms of LeRoy Crandall and Associates (LCA) and Law/Crandall as listed below:

- Report of Geotechnical Investigation, Proposed California Plaza, Fourth Street Between Grand Avenue and Olive Street, Los Angeles, California, report dated May 9, 199, our Project No. 88070.

- Report of Geotechnical Investigation, Proposed Angel's Flight, between Olive and Hill Streets, South of Angelus Plaza Parking Structure, Los Angeles, California, report dated October 25, 1993, our Project No. 2661.30327.0001.

- Report of Geotechnical Investigation, Phase IA, Proposed California Center Project, Bunker Hill Site, Los Angeles, California, report dated September 10, 1982, our Project No. ADE-81361.

- Report of Preliminary Geotechnical Investigation, Parcel X and Y, Bunker Hill Urban Renewal Area, Los Angeles, California, report dated July 13, 1976, our Project No. AE-76087.

- Report of Foundation Investigation, Proposed Parking Structure, Fourth and Hill Streets, Los Angeles, California, report dated July 12, 1971, our Project No. A-70233.

- Report of Soil and Foundation Investigation, Proposed Street Development, Bounded by Hope, Second, Olive, and Fourth Streets, Los Angeles, California, report dated January 11, 1973, our Project No. A-68175.

The recommendations presented in this report were developed using geotechnical information from the current and previous investigations. We acknowledge that we have reviewed the field data and the results of the laboratory tests from the previous investigations and we concur with the data and findings presented in the prior reports.

The results of the recent field explorations and laboratory tests are presented in Appendix A. The results of our prior field explorations and laboratory tests are presented in Appendix B.

2.0 Site Conditions and Project Description

The project site is bordered by Olive Street, Hill Street, 4th Street and Angels Flight in downtown Los Angeles, California. The proposed high-rise development project will consist of two mixed-use residential, hotel, retail, charter school, and entertainment towers. Tower A is proposed to be 854 feet above grade (64-story) and Tower B is proposed to be 494 feet above grade (42-story), with up to 7 subterranean parking levels and one partial subterranean level in a common basement underlying the entire site.

The structural design will be using the performance-based earthquake engineering design approach and will be reviewed by a Structural Peer Review Panel to be selected by the Los Angeles Department of Building and Safety. Structural details are not available at this time.

The site is currently occupied by the vacant Angels Knoll parcel and is located next to the Angels Flight railway. Topography generally slopes downward to the southeast (From Olive to Hill Streets) with a relief of about 90 feet across the property. The Metro Red Line tunnels are beneath South Hill Street and the one of the Metro Red Line Pershing Square Station exits is located at the southeast corner of the project site (northwest corner of 4th and Hill Streets). The Bunker Hill Transit Tunnel (part of the Downtown People Mover) was constructed through California Plaza and beneath Olive Street but we understand that it may end at the property line and does not continue into the site.

3.0 Field Explorations and Laboratory Tests

Subsurface information at the site was available from prior geotechnical investigations performed by our predecessor legacy firm of LeRoy Crandall and Associates in 1976, 1988 and 1993. The prior pertinent borings were drilled to depths ranging from 59 to 88 feet below the ground surface (bgs). To supplement subsurface data from the previous investigations, we explored the site by drilling four additional borings: one bucket auger boring (designated BA-1) to a depth of 86 feet bgs, two continuous core borings (designated CB-1 and CB-2) to depths of 131 and 200 feet bgs, and one rotary wash boring (designated RW-1) to a depth of 220 feet bgs.

After Boring BA-1 was drilled, a continuous core boring (Boring CB-1) was to be drilled to a depth of 131 feet bgs adjacent to Boring BA-1, with core obtained between the depth of the bottom of Boring BA-1 and 131 feet to obtain data below the economical depth limit of the bucket auger rig. Upon completion of drilling Boring BA-1, our engineering geologist attempted to down-hole log the boring to observe the presence and orientation of bedding planes, joints, and fractures in the bedrock as well as potential clay beds. However, because hazardous air conditions [high volatile organic compound (VOC) readings] were measured in the boring staring at a depth of 18 feet bgs, down-hole logging could not be safely performed below that depth. Therefore, the continuous core extracted from Boring CB-1 was obtained starting at a depth of 10 feet bgs. Boring CB-1 was terminated at an approximate depth of 131 feet bgs due to the presence of a hard, cemented zone. Therefore, the continuous core rig was moved approximately 30 feet west of the location of CB-1 to make a second attempt to drill to the target depth of 200 feet bgs. The second continuous core boring, designated Boring CB-2, successfully obtained continuous cores starting from a depth of 125 feet bgs down to the target depth of 200 feet bgs. The thickness of the cemented layer encountered was about 1 to 1.8 feet at the location of Boring CB-2.

For Boring RW-1, in addition to collecting samples for laboratory testing, the boring was used to obtain shear wave velocity measurements to a depth of about 205 feet bgs using suspension logging techniques; the lower approximately 15 feet of the boring was required in order to accommodate the use of the suspension logging equipment. The shear wave velocity data was used for seismic coefficient evaluation and will be used for seismic studies for the future phases. After completion of the 210-foot-deep rotary wash boring, a groundwater monitoring well was installed to measure groundwater levels, with a screening interval selected to obtain the piezometric head within the alluvium layer at the location of Boring RW-1.

The locations of the recent and prior borings are shown on Figure 2. Details of the recent explorations and the logs of the borings are presented in Appendix A. The logs of the borings from our prior investigations are presented in Appendix B.

Laboratory tests were performed on selected samples obtained from the recent borings to aid in the classification of the soils and to determine the pertinent engineering properties of the soils. The following tests were performed:

- Moisture content and dry density determinations.
- Direct shear.
- Consolidation.
- Passing #200 Sieve.
- Sieve Analysis.
- Atterberg Limit

- Soil Corrosivity.

All testing was performed in general accordance with applicable ASTM specifications at the time of testing. Details of the recent laboratory testing program and relevant test results are presented in Appendix A, and details of the prior laboratory testing program and relevant test results are presented in Appendix B.

4.0 Subsurface Conditions

4.1 Geologic Materials

According to published geologic maps, the ground at the project site is mapped as late Pleistocene- to Holocene-age alluvial deposits along the eastern margin of the site and Pliocene-age Fernando Formation sedimentary bedrock elsewhere (Lamar, 1970; Campbell et al., 2014; Bedrossian et al, 2012; Yerkes, 1997). The site is partially mantled by artificial fill materials consisting of sandy silt to clay varying from a thin veneer (less than 1 foot) in the upper portion of the site to a thickness of more than 13 feet in the lower portion, adjacent to Hill Street. The earth materials encountered in Borings BA-1, CB-1, and CB-2 consisted of approximately 3 feet of fill, underlain by sedimentary bedrock consisting of sandy and clayey siltstone and silty sandstone of the Fernando formation. Fill soils, estimated to be 14 feet in thickness, were encountered in Boring RW-1. The fill consisted of sandy silt. Deeper fill may be encountered elsewhere at the site due to prior construction or grading. Records are not currently available documenting the placement and compaction of the existing fill material within the project site. Alluvial deposits were encountered below the fill between depths of 14 and 25 feet bgs, consisting of silty sand and sand with gravel and some cobbles.

The fill and alluvial deposits were underlain by sedimentary bedrock of the Fernando formation. The Fernando formation generally consists of oxidized and unoxidized, massive and poorly- to moderately-well bedded clayey and sandy siltstone and silty fine sandstone. Some thin clay seams were observed in the upper 20 feet of Boring CB-1 and lower 157 feet of Boring CB-2. Cemented layers up to 1 foot thick were also encountered. Overall, the formation is generally poorly cemented and weak to very weak, while cemented zones are strong to very strong. The bedrock is oxidized to a light brownish- to yellowish-gray color near the surface. The unoxidized bedrock is a dark greenish gray color. The dip of the observed bedding ranged from 5 to 37 degrees to the south and southeast. This bedding orientation is adverse relative to the proposed northeast and northwest facing basement walls but can be mitigated by proper engineering design and construction in conformance with current building codes and engineering practice.

The results of corrosivity tests indicate that the onsite soils, at present moisture content, are mildly corrosive to moderately corrosive to ferrous metals, aggressive to copper, and moderate for sulfate attack on portland cement concrete.

4.2 Groundwater

The site is in the Bunker Hill area of Downtown Los Angeles and is outside the areal limits of valley fill sediments that constitute the principal water-bearing units; therefore, the site is not considered to be within the regional groundwater basin. Although the bedrock of the Fernando formation is considered non-water bearing, perched groundwater may be present locally in fractures and along bedding planes in the bedrock. A recent exploratory boring drilled in the upper cut portion of the site encountered seepage at approximately Elevation 270 feet. In prior borings drilled at the site, seepage occurred at depths of 47 and 63 feet within the bedrock (In the lower portion of the site, seepage was encountered in a prior exploratory boring at approximately Elevation 266 feet within the alluvium (LAW/Crandall, 1993). Localized seepage within the wedge of alluvium overlying the bedrock is representative of a perched groundwater condition that probably fluctuates with seasonal precipitation. The presence of perched groundwater will be monitored in the groundwater monitoring well constructed in RW-2.

4.3 Geologic Hazards

Based on the available geologic data, active or potentially active faults with the potential for surface fault rupture are not known to be located directly beneath or projecting toward the site. Therefore, the potential for surface rupture due to fault plane displacement propagating to the surface at the site during the design life of the buildings is considered low.

The location of the project site relative to known active and major quaternary faults indicates the site could be subjected to strong ground shaking in the event of an earthquake. This hazard is common in Southern California and the effects of ground shaking can be mitigated by proper engineering design and construction in conformance with current building codes and engineering practices.

Although, the project site is partially within an area identified as having a potential for liquefaction, the bedrock and alluvial materials are not anticipated to be susceptible to liquefaction. Considering the minor seepage encountered, dense alluvial deposits, and proposed excavations into bedrock, the potential for liquefaction to occur at the project site is considered low.

The project site is partially within an area identified to have a potential for seismic slope instability as designated by the California Geological Survey. There are no known landslides near the project site, nor is the project site in the path of any known or potential landslides. Basement excavations will remove all of the existing slopes. The subsurface materials are generally massive to thickly bedded siltstone and sandstone of the Fernando Formation. Bedding, where present, dips to the southeast to south. Southeast and southwest facing walls and temporary shoring should be designed considering dipping bedding planes.

Oil and gas wells are potential concerns when they seep oil or gas, are not abandoned to current regulations, or have associated surface contamination. They may also be associated with methane hazards. The project site is not located within the limits of an oil field according to the California Division of Oil, Gas and Geothermal Resources' (DOGGR) Well Finder System (DOGGR, 2018). According to DOGGR, the project site is located approximately 0.8 mile south of the Los Angeles City Oil Field, 0.6 mile northeast of the Los Angeles Downtown Oil Field, and 0.5 mile northwest of the abandoned Union Station oil Field. The closest known oil exploration wells are located approximately 0.5 mile north and south of the project site. Per DOGGR, those wells are classified as "active producer" and "dry hole," respectively. Since the project site is near active oil fields, there is a remote possibility that undocumented abandoned wells or other undocumented wells could be encountered during excavations. Any wells encountered during construction will have to be abandoned in accordance with current DOGGR standards and regulations.

The project site is not located within the defined boundaries of a City of Los Angeles Methane or Methane Buffer Zone (City of Los Angeles, 2018). A Methane Buffer Zone boundary is mapped approximately 1,000 feet north and northwest of the project site and, accordingly, the potential presence of methane gas beneath the project site cannot be discounted. During geological downhole logging as part of Wood's concurrent geotechnical investigation, volatile organic compounds (VOCs) were detected starting at a depth of approximately 18 feet below ground surface in boring BA-1 drilled within the northern section of the project site. The VOC concentrations displayed on the field instrument, a photoionization detector, registered up to 190 parts per million. No obvious odors were noted by Wood's field geologist.

The potential for other geologic hazards such as seismically-induced settlement, tsunamis, seiches, flooding, asbestos, radon gas, and subsidence affecting the site is considered low.

5.0 Recommendations

5.1 General

The existing fill soils and alluvial deposits are not considered suitable for support of the proposed development. However, as part of construction activities, all existing fill soils and alluvial deposits are anticipated to be automatically removed by the planned excavation to construct the subterranean levels and the building foundation. The proposed buildings may be supported on mat foundations bearing in undisturbed bedrock.

If unsuitable or disturbed soils are present at the bottom of excavation, we recommend that the mat foundation excavation be deepened locally to extend to bedrock and structural concrete of the same strength as that in the foundation be used to replace the excavated material up to the level of the bottom of foundation. As an alternative, sand-cement slurry could be utilized if the material strength is sufficient and approval is obtained from the LADBS Grading Division.

5.2 Foundations

We understand that the proposed basement levels may extend about 110 feet to 170 feet below existing grade. Based on this depth of excavation, proposed high-rise buildings may be supported on mat foundations bearing in undisturbed bedrock. Pile foundations would not be required unless necessary for some tension piles to resist overturning. If tension piles are deemed necessary for overturning, drilled cast-in-place piles could be utilized or potentially other pile types. The podium structure between the high rise buildings may be able to be supported on spread footings established on the rock. The building floor slab may be supported at-grade on undisturbed bedrock material or properly compacted fill.

Possible foundations types suitable for the various structures contemplated with potential positive and negative consequences of various foundation types are presented in the following table.

Possible Foundations Types Suitable for Various Structures
Shaded Cells of Table Represent Most Likely Foundation Type

Type of Structures	Consequence	Foundation Type		
		Spread Footing	Mat Foundation	Drilled Pile
Podium structures with basement	Positive	• Most cost-effective • Utilities can be placed beneath slab-on grade	• Relatively easy to waterproof • Less settlement	• Least settlement • Utilities can be placed beneath slab-on-grade
	Negative	• More settlement than mat foundation or drilled shaft – suitability will be based on column loading	• Relatively expensive compared to spread footings • Need for fill layer above mat and floor slab above fill layer if utilities are to remain accessible beneath floor slab	• Most expensive • Difficult to waterproof
High-rise buildings with basement	Positive		• Relatively easy to waterproof	• Supports very high column loads • Minimize settlement • Utilities can be placed beneath slab-on-graded
	Negative	• Unacceptable total/differential settlement	• Need for fill layer above mat and floor slab above fill layer if utilities are to remain accessible beneath floor slab	• More expensive • Possible drilling difficulty • More difficult to waterproof

Bearing Value

For preliminary design of the podium portion of the development, spread footings carried at least 2 feet below the lowest adjacent grade or floor level or a mat foundation supported on undisturbed bedrock material may be designed to impose a net dead-plus-live load pressure of 8,000 pounds per square foot.

For high-rise buildings in combination with the planned basement, the bearing value for a mat foundation may be taken as 10,000 pounds per square foot, with localized higher values of dead-plus-live load bearing value of 12,000 pounds per square foot. Higher values of bearing value may be possible based on more specific analyses based on structural loadings.

A one-third increase may be used for wind or seismic loads. The recommend bearing value is a net value, and the weight of concrete in the footings may be taken as 50 pounds per square foot; the weight of soil backfill may be neglected when determining the downward loads.

Settlement

Building settlements will depend on the magnitude of the structural loads. In general, a mat foundation can be designed to have a settlement of up to 4 inches, spread footings can be designed to have a settlement of up to 1½ inch, and pile foundations can be designed to have a settlement of up to ½ inch. Differential settlement between the various foundations will have to be computed and accommodated, possibly with a delay strip between portions of the structures.

Lateral Resistance

For preliminary design, lateral loads may be resisted by soil friction and by the passive resistance of the soils. A coefficient of friction of at least 0.38 may be used between the footings/mat and the supporting soils. The passive resistance of natural soils and/or properly compacted fill soils may be assumed to be equal to the pressure developed by a fluid with a density of 350 pounds per cubic foot. A one-third increase in the passive value may be used for wind or seismic loads. The frictional resistance and the passive resistance of the soils may be combined without reduction in determining the total lateral resistance.

5.3 Seismic Design Parameters

We determined the mapped seismic design parameters in accordance with the 2016 California Building Code (CBC) and American Society of Civil Engineers (ASCE) 7-10 Standard (ASCE, 2013) using the United States Geological Survey (USGS) Seismic Design Maps Web Application. We performed a downhole seismic survey at the site. The borehole for the downhole survey was extended to about 220 feet below ground surface and the downhole seismic survey was performed down to a depth of 205 feet below ground surface. The average shear wave velocities in the upper 100 feet below the proposed basement level (104 feet or deeper below ground surface) approximately 510 meters per second. Accordingly, we have assigned Site Class "C" for the site. The seismic site parameters are presented below.

Parameter	Mapped Value
S_S (0.2 second period, Site Class B)	2.41g
S_1 (1.0 second period, Site Class B)	0.85g
Site Class	C
F_a	1.0
F_v	1.3
$S_{MS} = F_a S_S$ (0.2 second period)	2.41g
$S_{M1} = F_v S_1$ (1.0 second period)	1.10g
$S_{DS} = 2/3 \times S_{MS}$ (0.2 second period)	1.61g
$S_{D1} = 2/3 \times S_{M1}$ (1.0 second period)	0.73g

By: EJJ 6/11/18 Checked By: LT 6/28/18

For the design of high-rise buildings, the site-specific response spectra are required in accordance with the 2017 Los Angeles Building Code (LABC), 2016 California Building Code (CBC), ASCE 7-16 and the alternative procedures of the Los Angeles Tall Building Structural Design Council (LATBSDC) alternative procedure (2017). In order to develop the ground motions for design, a Deterministic Seismic Hazard Analysis (DSHA) and a Probabilistic Seismic Hazard Analysis (PSHA) will be performed during the Phase C final design.

5.4 Excavation

We understand that it is most likely that excavation of about 110 to 170 feet will be performed for the proposed development. Where excavations are deeper than about four feet, the sides of the excavations should be sloped back at 1:1 (horizontal to vertical) or shored for safety. It may be possible to excavate slopes at a steeper inclination in the bedrock. Unshored excavations should not extend below a plane drawn at 1½:1 (horizontal to vertical) extending downward from adjacent existing footings. Where space is not available, shoring will be required. Adverse clay bedding in the bedrock should be considered for shoring design.

The mass excavation generally may be performed using conventional earth moving equipment, however at the location that cemented layers in the Fernando formation are encountered, it may require additional excavation or drilling effort such as D-10 dozers with ripper shanks or special augers; those cemented layers, if encountered such as encountered in Boring CB-2, are generally thin – on the order of 1 foot in thickness, but could potentially be thicker.

Based on the current project layout, anticipated excavation depth and proximity to adjacent buildings and structures and streets, excavations for the subterranean levels would not likely be able to be designed without shoring. Preliminary recommendations for design of shoring are presented below.

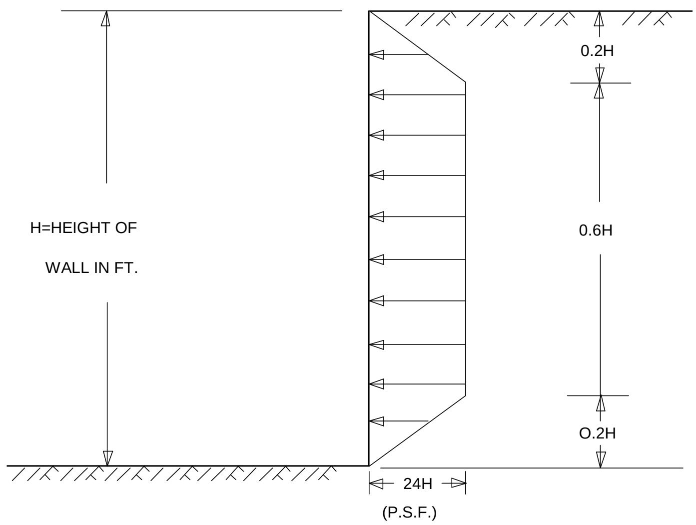
Shoring

Where there is not sufficient space for sloped embankments, temporary shoring or a temporary or permanent soil nail wall will be required. Temporary shoring may consist of a soil nail wall with a shotcrete facing, and/or steel soldier piles placed in drilled holes, backfilled with concrete, and tied back with earth anchors or braced internally with rakers. Special techniques and measures will be necessary in some areas to permit the proper installation of the soldier piles and/or tie back anchors. Soil nails would not require the use of soldier piles, but the spacing of soil nails would be closer than the spacing of tie-back anchors used with soldier beams. The use of soil nails could be considered for permanent retention, but would need approval from the LADBS Grading Division. The advantage of a permanent retention system is that the structure would not have to be designed to resist the unbalanced earth loading.

Tie-back anchors or soil nails will have to be planned to avoid utilities in the street, provide a clearance of at least 8 feet from the Metro Pershing Square Station and Metro Red Line Rail tunnel. The shoring could be designed to be as close as 5 feet from the corner of the Metro Red Line entrance structure with approval from Metro. If there is not sufficient space to install tie back anchors to the desired lengths on any side of the excavation, the soldier piles of the shoring system may be internally braced, or alternatively a soil nail system could be used if sufficient length for the soil nails is available.

Cantilevered shoring, less than 15 feet in height, can be preliminarily designed for a lateral earth pressure equivalent to that equivalent to a fluid with a density of 30 pounds per cubic foot for the south (4^{th} Street) and east (Hill Street) walls and 57 pounds per cubic foot for the west (Olive Street) and north (Angels flight) walls due to the adverse clay bedding in the upper portion of the bedrock. Where a combination of sloped embankment and shoring is used, the pressure would be greater and must be determined for each combination.

For the preliminary design of tied-back or internally-braced shoring, a trapezoidal distribution of earth pressure should be used. The recommended pressure distribution, for the case where the grade is level behind the shoring, is illustrated in the following diagram, where H is the height of the shoring in feet. The maximum pressure will be equal to 24H in pounds per square foot. This pressure distribution may be utilized on all four sides of the excavation as the adverse bedding of the upper rock was evaluated to not create a pressure above those provided below.



For preliminary design purposes, it may be assumed that the potential active wedge of failure is determined by a plane drawn at 35 degrees with vertical through the bottom of excavation. Anchors should have a minimum penetration beyond the potential active wedge of around 20 feet, but the minimum penetration should be established based on the shoring configuration. Post-grouted anchors may be designed with a preliminary friction of 1,800 pounds per square foot; this friction is a function of anchor design, which is in turn a function of anchor design load.

In addition to the recommended earth pressures, the full height of shoring adjacent to the streets should be designed to resist a uniform lateral pressure of 60 pounds per square foot surcharge for cantilever shoring and 90 pounds per square foot surcharge for tied-back shoring due to normal street traffic.

As an alternative to a shored excavation, temporary soil nail walls may be constructed. The basic concept of a soil-nail retention system is to reinforce and strengthen the existing ground by installing closely spaced steel bars into a slope or excavation as construction proceeds from the "top down." This process creates a reinforced section that is itself stable and able to retain the ground behind it. The soil nails are typically installed at 10 to 15 degrees below the horizontal and are often spaced at about 5 to 8 feet on center. Although soil nails are typically surrounded by cement grout placed under gravity, if pressure grouting is used, its use should not be allowed within 10 feet of structures, utilities, tunnels, and hardscape. The soil-nail retention system should be designed to resist the lateral surcharge pressure imposed by adjacent retaining wall footings and by any storage loads or construction traffic adjacent to the soil nail retention system.

In addition, the shoring should be designed to resist the lateral surcharge pressures imposed by adjacent building foundations established above a 1:1 (horizontal to vertical) plane rising from the base of the walls, if appropriate.

Tie-back anchor or soil nailing may be limited near the Metro Pershing Square station and Metro rail tunnel underneath Hill Street.

5.5 Walls Below Grade

Lateral Earth Pressure

For preliminary design of cantilevered retaining walls, where the surface of the backfill is level, it may be assumed that the drained soils will exert an active lateral pressure equal to that developed by a fluid with a density of 30 pounds per cubic foot for retaining earth material.

For the preliminary design of braced basement walls, where the grade is level behind the wall, it may be assumed that drained soils will exert a lateral at-rest pressure equal to that developed by a fluid with a density of 60 pounds per cubic foot. In addition to the recommended earth pressure, plus any surcharge loadings occurring as a result of adjacent foundations and storage loads.

In addition to the recommended earth pressure, the wall below grade adjacent to normal vehicular traffic should be designed to resist a uniform lateral pressure calculated from the City of Los Angeles Guidelines for determining live loads surcharge (2016).

Seismic Earth Pressure

In addition to the above-mentioned lateral earth pressures, subterranean building walls should be designed to support an active seismic lateral pressure. It is recommended to utilize a location for the resultant increment of seismic lateral earth pressure at one half of the height of the wall (i.e. a rectangular distribution of pressure). We have calculated the magnitude of seismic lateral earth pressure using the approach of Brandenberg et al. (2015). The seismic lateral pressure distribution on the wall was estimated as a uniform pressure with a magnitude of 6H (equivalent to a fluid pressure of 12 pounds per cubic foot). The seismic lateral earth pressure should be combined with the active static lateral earth pressure (not the at-rest pressure). The active lateral earth pressure may be considered equivalent to the pressure developed by a fluid with a density of 30 pounds per cubic foot.

6.0 Basis for Recommendations

The recommendations provided in this report are based upon our understanding of the described project information and on our interpretation of the data collected during our subsurface explorations. We have made our recommendations based upon experience with similar subsurface conditions under similar loading conditions. The recommendations apply to the specific project discussed in this report; therefore, any change in the structure configuration, loads, location, or the site grades should be provided to us so that we can review our conclusions and recommendations and make any necessary modifications. A final geotechnical investigation with additional explorations is recommended to be performed prior to final design.

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Tables

Table 1
Major Named Faults Considered to be Active in Southern California

Fault (in increasing distance)	Maximum Magnitude (Mw)	Fault Geometry	Slip Rate (mm/yr.)	Sources	Distance From Site (miles)	Direction From Site
Upper Elysian Park Thrust	6.4	BT	1.9	(a,b)	1*	NE
Puente Hills Blind Thrust	7.1	BT	0.9	(a,b)	3.9*	SW
Hollywood	6.4	RO	0.9	(a,b)	4.4	N
Raymond	6.5	RO	2.0	(a,b)	4.5	N
Newport-Inglewood	7.1	SS	1.0	(a,b)	6.3	WSW
Verdugo	6.9	RO	0.4	(a,b)	6.5	NNE
Santa Monica	6.6	RO	1.0	(a,b)	9.5	W
Sierra Madre	7.2	RO	2.0	(a,b)	11	NNE
Whittier	6.8	RO	2.5	(a,b)	12	ESE
Sierra Madre	7.2	RO	2.0	(a,b)	12	NE
Clamshell-Sawpit	6.5	RO	0.4	(a,b)	15	ENE
San Fernando	6.7	RO	2.0	(a,b)	16	N
Upper Duarte	7.2	RO	2.0	(a,b)	16	ENE
San Gabriel fault	7.2	SS	0.4	(a,b)	16	NNE
Compton Thrust	7.6	BT	0.6	(a,b)	0**	-
Palos Verdes	7.3	SS	3.0	(a,b)	18	SSW
Northridge Thrust	7.0	BT	1.5	(a,b)	19*	NW
San Andreas FZ, Mojave section	7.4	SS	34.0	(a,b)	34	NNE

(a) Cao et al., 2003; Field et al., 2013
(b) Southern California Earthquake Center, 2018
(c) USGS-CGS, 2006 (updated 2018)
SS Strike Slip
NO Normal Oblique
RO Reverse Oblique
BT Blind Thrust
(*) Distance from site to thrust fault upper limb
(**) Distance from thrust fault surface projection (upper limb)

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Checked by: PER 6/25/18

Table 2

Proposed Angels Landing Development
LIST OF HISTORIC EARTHQUAKES OF MAGNITUDE 4.0 OR GREATER WITHIN 100.0 KM OF THE SITE
(SCSN DATA 1932-2018)

NOTE: Q IS A FACTOR RELATING THE QUALITY OF EPICENTRAL DETERMINATION
A = + 1 km horizontal distance; + 2 km depth
B = + 2 km horizontal distance; + 5 km depth
C = + 5 km horizontal distance; no depth restriction
D = >+ 5 km horizontal distance
Event qualities are highly suspect prior to 1990. Many of these event qualities are based on incomplete information according to Caltech.

DATE	TIME	LATITUDE	LONGITUDE	Q	DIST [KM]	MAGNITUDE	DEPTH
11-01-1932	04:45:00.00	34.0000 N	117.250 W	E	092.39	4.0	00.0
03-11-1933	01:54:07.80	33.6167 N	117.967 W	A	054.96	6.4	00.0
03-11-1933	02:04:00.00	33.7500 N	118.083 W	C	036.86	4.9	00.0
03-11-1933	02:05:00.00	33.7500 N	118.083 W	C	036.86	4.3	00.0
03-11-1933	02:09:00.00	33.7500 N	118.083 W	C	036.86	5.0	00.0
03-11-1933	02:10:00.00	33.7500 N	118.083 W	C	036.86	4.6	00.0
03-11-1933	02:11:00.00	33.7500 N	118.083 W	C	036.86	4.4	00.0
03-11-1933	02:16:00.00	33.7500 N	118.083 W	C	036.86	4.8	00.0
03-11-1933	02:17:00.00	33.6000 N	118.000 W	E	055.23	4.5	00.0
03-11-1933	02:22:00.00	33.7500 N	118.083 W	C	036.86	4.0	00.0
03-11-1933	02:27:00.00	33.7500 N	118.083 W	C	036.86	4.6	00.0
03-11-1933	02:30:00.00	33.7500 N	118.083 W	C	036.86	5.1	00.0
03-11-1933	02:31:00.00	33.6000 N	118.000 W	E	055.23	4.4	00.0
03-11-1933	02:52:00.00	33.7500 N	118.083 W	C	036.86	4.0	00.0
03-11-1933	02:57:00.00	33.7500 N	118.083 W	C	036.86	4.2	00.0
03-11-1933	02:58:00.00	33.7500 N	118.083 W	C	036.86	4.0	00.0
03-11-1933	02:59:00.00	33.7500 N	118.083 W	C	036.86	4.6	00.0
03-11-1933	03:05:00.00	33.7500 N	118.083 W	C	036.86	4.2	00.0
03-11-1933	03:09:00.00	33.7500 N	118.083 W	C	036.86	4.4	00.0
03-11-1933	03:11:00.00	33.7500 N	118.083 W	C	036.86	4.2	00.0
03-11-1933	03:23:00.00	33.7500 N	118.083 W	C	036.86	5.0	00.0
03-11-1933	03:36:00.00	33.7500 N	118.083 W	C	036.86	4.0	00.0
03-11-1933	03:39:00.00	33.7500 N	118.083 W	C	036.86	4.0	00.0
03-11-1933	03:47:00.00	33.7500 N	118.083 W	C	036.86	4.1	00.0
03-11-1933	04:36:00.00	33.7500 N	118.083 W	C	036.86	4.6	00.0
03-11-1933	04:39:00.00	33.7500 N	118.083 W	C	036.86	4.9	00.0
03-11-1933	04:40:00.00	33.7500 N	118.083 W	C	036.86	4.7	00.0
03-11-1933	05:10:22.00	33.7000 N	118.067 W	C	042.56	5.1	00.0
03-11-1933	05:13:00.00	33.7500 N	118.083 W	C	036.86	4.7	00.0
03-11-1933	05:15:00.00	33.7500 N	118.083 W	C	036.86	4.0	00.0
03-11-1933	05:18:04.00	33.5750 N	117.983 W	C	058.40	5.2	00.0
03-11-1933	05:21:00.00	33.7500 N	118.083 W	C	036.86	4.4	00.0
03-11-1933	05:24:00.00	33.7500 N	118.083 W	C	036.86	4.2	00.0
03-11-1933	05:53:00.00	33.7500 N	118.083 W	C	036.86	4.0	00.0
03-11-1933	05:55:00.00	33.7500 N	118.083 W	C	036.86	4.0	00.0
03-11-1933	06:11:00.00	33.7500 N	118.083 W	C	036.86	4.4	00.0
03-11-1933	06:18:00.00	33.7500 N	118.083 W	C	036.86	4.2	00.0
03-11-1933	06:29:00.00	33.8500 N	118.267 W	C	022.40	4.4	00.0
03-11-1933	06:35:00.00	33.7500 N	118.083 W	C	036.86	4.2	00.0
03-11-1933	06:58:03.00	33.6833 N	118.050 W	C	044.88	5.5	00.0
03-11-1933	07:51:00.00	33.7500 N	118.083 W	C	036.86	4.2	00.0
03-11-1933	07:59:00.00	33.7500 N	118.083 W	C	036.86	4.1	00.0
03-11-1933	08:08:00.00	33.7500 N	118.083 W	C	036.86	4.5	00.0
03-11-1933	08:32:00.00	33.7500 N	118.083 W	C	036.86	4.2	00.0

Table 2 - continued

03-11-1933	08:37:00.00	33.7500 N	118.083 W	C	036.86	4.0	00.0
03-11-1933	08:54:57.00	33.7000 N	118.067 W	C	042.56	5.1	00.0
03-11-1933	09:10:00.00	33.7500 N	118.083 W	C	036.86	5.1	00.0
03-11-1933	09:11:00.00	33.7500 N	118.083 W	C	036.86	4.4	00.0
03-11-1933	09:26:00.00	33.7500 N	118.083 W	C	036.86	4.1	00.0
03-11-1933	10:25:00.00	33.7500 N	118.083 W	C	036.86	4.0	00.0
03-11-1933	10:45:00.00	33.7500 N	118.083 W	C	036.86	4.0	00.0
03-11-1933	11:00:00.00	33.7500 N	118.083 W	C	036.86	4.0	00.0
03-11-1933	11:04:00.00	33.7500 N	118.133 W	C	035.18	4.6	00.0
03-11-1933	11:29:00.00	33.7500 N	118.083 W	C	036.86	4.0	00.0
03-11-1933	11:38:00.00	33.7500 N	118.083 W	C	036.86	4.0	00.0
03-11-1933	11:41:00.00	33.7500 N	118.083 W	C	036.86	4.2	00.0
03-11-1933	11:47:00.00	33.7500 N	118.083 W	C	036.86	4.4	00.0
03-11-1933	12:50:00.00	33.6833 N	118.050 W	C	044.88	4.4	00.0
03-11-1933	13:50:00.00	33.7333 N	118.100 W	C	037.96	4.4	00.0
03-11-1933	13:57:00.00	33.7500 N	118.083 W	C	036.86	4.0	00.0
03-11-1933	14:25:00.00	33.8500 N	118.267 W	C	022.40	5.0	00.0
03-11-1933	14:47:00.00	33.7333 N	118.100 W	C	037.96	4.4	00.0
03-11-1933	14:57:00.00	33.8833 N	118.317 W	C	019.61	4.9	00.0
03-11-1933	15:09:00.00	33.7333 N	118.100 W	C	037.96	4.4	00.0
03-11-1933	15:47:00.00	33.7500 N	118.083 W	C	036.86	4.0	00.0
03-11-1933	16:53:00.00	33.7500 N	118.083 W	C	036.86	4.8	00.0
03-11-1933	19:44:00.00	33.7500 N	118.083 W	C	036.86	4.0	00.0
03-11-1933	19:56:00.00	33.7500 N	118.083 W	C	036.86	4.2	00.0
03-11-1933	22:00:00.00	33.7500 N	118.083 W	C	036.86	4.4	00.0
03-11-1933	22:31:00.00	33.7500 N	118.083 W	C	036.86	4.4	00.0
03-11-1933	22:32:00.00	33.7500 N	118.083 W	C	036.86	4.1	00.0
03-11-1933	22:40:00.00	33.7500 N	118.083 W	C	036.86	4.4	00.0
03-11-1933	23:05:00.00	33.7500 N	118.083 W	C	036.86	4.2	00.0
03-12-1933	00:27:00.00	33.7500 N	118.083 W	C	036.86	4.4	00.0
03-12-1933	00:34:00.00	33.7500 N	118.083 W	C	036.86	4.0	00.0
03-12-1933	04:48:00.00	33.7500 N	118.083 W	C	036.86	4.0	00.0
03-12-1933	05:46:00.00	33.7500 N	118.083 W	C	036.86	4.4	00.0
03-12-1933	06:01:00.00	33.7500 N	118.083 W	C	036.86	4.2	00.0
03-12-1933	06:16:00.00	33.7500 N	118.083 W	C	036.86	4.6	00.0
03-12-1933	07:40:00.00	33.7500 N	118.083 W	C	036.86	4.2	00.0
03-12-1933	08:35:00.00	33.7500 N	118.083 W	C	036.86	4.2	00.0
03-12-1933	15:02:00.00	33.7500 N	118.083 W	C	036.86	4.2	00.0
03-12-1933	16:51:00.00	33.7500 N	118.083 W	C	036.86	4.0	00.0
03-12-1933	17:38:00.00	33.7500 N	118.083 W	C	036.86	4.5	00.0
03-12-1933	18:25:00.00	33.7500 N	118.083 W	C	036.86	4.1	00.0
03-12-1933	21:28:00.00	33.7500 N	118.083 W	C	036.86	4.1	00.0
03-12-1933	23:54:00.00	33.7500 N	118.083 W	C	036.86	4.5	00.0
03-13-1933	03:43:00.00	33.7500 N	118.083 W	C	036.86	4.1	00.0
03-13-1933	04:32:00.00	33.7500 N	118.083 W	C	036.86	4.7	00.0
03-13-1933	06:17:00.00	33.7500 N	118.083 W	C	036.86	4.0	00.0
03-13-1933	13:18:28.00	33.7500 N	118.083 W	C	036.86	5.3	00.0
03-13-1933	15:32:00.00	33.7500 N	118.083 W	C	036.86	4.1	00.0
03-13-1933	19:29:00.00	33.7500 N	118.083 W	C	036.86	4.2	00.0
03-14-1933	00:36:00.00	33.7500 N	118.083 W	C	036.86	4.2	00.0
03-14-1933	12:19:00.00	33.7500 N	118.083 W	C	036.86	4.5	00.0
03-14-1933	19:01:50.00	33.6167 N	118.017 W	C	052.91	5.1	00.0
03-14-1933	22:42:00.00	33.7500 N	118.083 W	C	036.86	4.1	00.0
03-15-1933	02:08:00.00	33.7500 N	118.083 W	C	036.86	4.1	00.0
03-15-1933	04:32:00.00	33.7500 N	118.083 W	C	036.86	4.1	00.0
03-15-1933	05:40:00.00	33.7500 N	118.083 W	C	036.86	4.2	00.0
03-15-1933	11:13:32.00	33.6167 N	118.017 W	C	052.91	4.9	00.0
03-16-1933	14:56:00.00	33.7500 N	118.083 W	C	036.86	4.0	00.0
03-16-1933	15:29:00.00	33.7500 N	118.083 W	C	036.86	4.2	00.0
03-16-1933	15:30:00.00	33.7500 N	118.083 W	C	036.86	4.1	00.0
03-17-1933	16:51:00.00	33.7500 N	118.083 W	C	036.86	4.1	00.0

Table 2 - continued

03-18-1933	20:52:00.00	33.7500 N	118.083 W	C	036.86	4.2	00.0
03-19-1933	21:23:00.00	33.7500 N	118.083 W	C	036.86	4.2	00.0
03-20-1933	13:58:00.00	33.7500 N	118.083 W	C	036.86	4.1	00.0
03-21-1933	03:26:00.00	33.7500 N	118.083 W	C	036.86	4.1	00.0
03-23-1933	08:40:00.00	33.7500 N	118.083 W	C	036.86	4.1	00.0
03-23-1933	18:31:00.00	33.7500 N	118.083 W	C	036.86	4.1	00.0
03-25-1933	13:46:00.00	33.7500 N	118.083 W	C	036.86	4.1	00.0
03-30-1933	12:25:00.00	33.7500 N	118.083 W	C	036.86	4.4	00.0
03-31-1933	10:49:00.00	33.7500 N	118.083 W	C	036.86	4.1	00.0
04-01-1933	06:42:00.00	33.7500 N	118.083 W	C	036.86	4.2	00.0
04-02-1933	08:00:00.00	33.7500 N	118.083 W	C	036.86	4.0	00.0
04-02-1933	15:36:00.00	33.7500 N	118.083 W	C	036.86	4.0	00.0
05-16-1933	20:58:55.00	33.7500 N	118.167 W	C	034.35	4.0	00.0
08-04-1933	04:17:48.00	33.7500 N	118.183 W	C	034.04	4.0	00.0
10-02-1933	09:10:17.60	33.7833 N	118.133 W	A	031.67	5.4	00.0
10-02-1933	13:26:01.00	33.6167 N	118.017 W	C	052.91	4.0	00.0
10-25-1933	07:00:46.00	33.9500 N	118.133 W	C	015.59	4.3	00.0
11-13-1933	21:28:00.00	33.8667 N	118.200 W	C	021.02	4.0	00.0
11-20-1933	10:32:00.00	33.7833 N	118.133 W	B	031.67	4.0	00.0
01-09-1934	14:10:00.00	34.1000 N	117.683 W	A	052.53	4.5	00.0
01-18-1934	02:14:00.00	34.1000 N	117.683 W	A	052.53	4.0	00.0
01-20-1934	21:17:00.00	33.6167 N	118.117 W	B	049.85	4.5	00.0
04-17-1934	18:33:00.00	33.5667 N	117.983 W	C	059.25	4.0	00.0
10-17-1934	09:38:00.00	33.6333 N	118.400 W	B	048.45	4.0	00.0
11-16-1934	21:26:00.00	33.7500 N	118.000 W	B	040.68	4.0	00.0
06-11-1935	18:10:00.00	34.7167 N	118.967 W	B	098.98	4.0	00.0
06-19-1935	11:17:00.00	33.7167 N	117.517 W	B	077.28	4.0	00.0
07-13-1935	10:54:16.50	34.2000 N	117.900 W	A	036.28	4.7	00.0
09-03-1935	06:47:00.00	34.0333 N	117.317 W	B	086.07	4.5	00.0
12-25-1935	17:15:00.00	33.6000 N	118.017 W	B	054.61	4.5	00.0
02-23-1936	22:20:42.71	34.1275 N	117.338 W	A	084.47	4.5	10.0
02-26-1936	09:33:27.65	34.1402 N	117.340 W	A	084.48	4.0	10.0
08-22-1936	05:21:00.00	33.7667 N	117.817 W	B	051.02	4.0	00.0
10-29-1936	22:35:36.12	34.3803 N	118.624 W	C	050.17	4.0	10.0
01-15-1937	18:35:47.03	33.5610 N	118.058 W	B	057.32	4.0	10.0
03-19-1937	01:23:38.37	34.1117 N	117.426 W	A	076.27	4.0	10.0
07-07-1937	11:12:00.00	33.5667 N	117.983 W	B	059.25	4.0	00.0
09-01-1937	13:48:08.21	34.2108 N	117.530 W	A	068.68	4.5	10.0
09-01-1937	16:35:33.50	34.1830 N	117.548 W	A	066.34	4.5	10.0
05-21-1938	09:44:00.00	33.6167 N	118.033 W	B	052.30	4.0	00.0
05-31-1938	08:34:55.41	33.6988 N	117.511 W	B	078.74	5.2	10.0
07-05-1938	18:06:55.75	33.6822 N	117.553 W	A	076.33	4.5	10.0
08-06-1938	22:00:55.96	33.7167 N	117.507 W	B	078.08	4.0	10.0
08-31-1938	03:18:14.25	33.7590 N	118.253 W	A	032.47	4.5	10.0
11-29-1938	19:21:15.80	33.9033 N	118.431 W	A	023.35	4.0	10.0
12-07-1938	03:38:00.00	34.0000 N	118.417 W	B	016.32	4.0	00.0
12-27-1938	10:09:28.57	34.1273 N	117.521 W	B	067.75	4.0	10.0
04-03-1939	02:50:44.71	34.0432 N	117.228 W	A	094.17	4.0	10.0
11-04-1939	21:41:00.00	33.7667 N	118.117 W	B	033.95	4.0	00.0
11-07-1939	18:52:08.40	34.0000 N	117.283 W	A	089.32	4.7	00.0
12-27-1939	19:28:49.00	33.7833 N	118.200 W	A	030.13	4.7	00.0
01-13-1940	07:49:07.00	33.7833 N	118.133 W	B	031.67	4.0	00.0
02-08-1940	16:56:17.00	33.7000 N	118.067 W	B	042.56	4.0	00.0
02-11-1940	19:24:10.00	33.9833 N	118.300 W	B	008.79	4.0	00.0
04-18-1940	18:43:43.90	34.0333 N	117.350 W	A	083.00	4.4	00.0
05-18-1940	09:15:12.00	34.6000 N	118.900 W	C	085.34	4.0	00.0
06-05-1940	08:27:27.00	33.8333 N	117.400 W	B	082.11	4.0	00.0
07-20-1940	04:01:13.00	33.7000 N	118.067 W	B	042.56	4.0	00.0
10-11-1940	05:57:12.30	33.7667 N	118.450 W	A	036.58	4.7	00.0
10-12-1940	00:24:00.00	33.7833 N	118.417 W	B	033.48	4.0	00.0
10-14-1940	20:51:11.00	33.7833 N	118.417 W	B	033.48	4.0	00.0

Table 2 - continued

11-01-1940	07:25:03.00	33.7833 N	118.417 W	B	033.48	4.0	00.0
11-01-1940	20:00:46.00	33.6333 N	118.200 W	B	046.68	4.0	00.0
11-02-1940	02:58:26.00	33.7833 N	118.417 W	B	033.48	4.0	00.0
01-30-1941	01:34:46.90	33.9667 N	118.050 W	A	020.73	4.1	00.0
03-22-1941	08:22:40.00	33.5167 N	118.100 W	B	061.02	4.0	00.0
03-25-1941	23:43:41.00	34.2167 N	117.467 W	B	074.47	4.0	00.0
04-11-1941	01:20:24.00	33.9500 N	117.583 W	B	062.53	4.0	00.0
10-22-1941	06:57:18.50	33.8167 N	118.217 W	A	026.24	4.8	00.0
11-14-1941	08:41:36.30	33.7833 N	118.250 W	A	029.76	4.8	00.0
04-16-1942	07:28:33.00	33.3667 N	118.150 W	C	076.66	4.0	00.0
09-03-1942	14:06:01.00	34.4833 N	118.983 W	C	082.73	4.5	00.0
09-04-1942	06:34:33.00	34.4833 N	118.983 W	C	082.73	4.5	00.0
04-06-1943	22:36:24.00	34.6833 N	119.000 W	C	098.36	4.0	00.0
10-24-1943	00:29:21.00	33.9333 N	117.367 W	C	082.54	4.0	00.0
06-19-1944	00:03:33.00	33.8667 N	118.217 W	B	020.73	4.5	00.0
06-19-1944	03:06:07.00	33.8667 N	118.217 W	C	020.73	4.4	00.0
02-24-1946	06:07:52.00	34.4000 N	117.800 W	C	056.76	4.1	00.0
06-01-1946	11:06:31.00	34.4167 N	118.833 W	C	067.25	4.1	00.0
03-01-1948	08:12:13.00	34.1667 N	117.533 W	B	067.28	4.7	00.0
04-16-1948	22:26:24.00	34.0167 N	118.967 W	B	066.09	4.7	00.0
10-03-1948	02:46:28.00	34.1833 N	117.583 W	A	063.16	4.0	00.0
01-11-1950	21:41:35.05	33.9395 N	118.205 W	A	013.10	4.1	00.4
01-24-1950	21:56:59.00	34.6667 N	118.833 W	C	086.88	4.0	00.0
02-26-1950	00:06:22.00	34.6167 N	119.083 W	C	099.01	4.7	00.0
09-22-1951	08:22:39.06	34.1185 N	117.341 W	A	084.07	4.3	11.9
02-17-1952	12:36:58.33	33.9958 N	117.270 W	A	090.59	4.5	16.0
08-23-1952	10:09:07.15	34.5193 N	118.198 W	A	052.30	5.1	13.1
10-26-1954	16:22:26.00	33.7333 N	117.467 W	B	080.52	4.1	00.0
11-17-1954	23:03:51.00	34.5000 N	119.117 W	B	093.94	4.4	00.0
05-15-1955	17:03:25.96	34.1237 N	117.480 W	A	071.39	4.0	07.6
05-29-1955	16:43:35.41	33.9905 N	119.058 W	B	074.70	4.1	17.4
01-03-1956	00:25:48.95	33.7250 N	117.499 W	B	078.32	4.7	13.7
02-07-1956	02:16:56.53	34.5288 N	118.644 W	B	064.28	4.2	16.0
02-07-1956	03:16:38.59	34.5863 N	118.613 W	A	068.21	4.6	02.6
03-25-1956	03:32:02.34	33.6040 N	119.105 W	A	093.27	4.2	08.2
03-18-1957	18:56:28.04	34.1182 N	119.220 W	B	089.59	4.7	13.8
06-28-1960	20:00:48.00	34.1158 N	117.475 W	A	071.81	4.1	12.0
10-04-1961	02:21:31.60	33.8542 N	117.752 W	B	050.93	4.1	04.3
10-20-1961	19:49:50.50	33.6540 N	117.994 W	B	050.09	4.3	04.6
10-20-1961	20:07:14.46	33.6595 N	117.981 W	B	050.16	4.0	06.1
10-20-1961	21:42:40.74	33.6652 N	117.980 W	B	049.67	4.0	07.2
10-20-1961	22:35:34.21	33.6715 N	118.013 W	B	047.58	4.1	05.6
11-20-1961	08:53:34.66	33.6805 N	117.993 W	B	047.58	4.0	04.4
09-14-1963	03:51:16.24	33.5427 N	118.340 W	B	057.13	4.2	02.2
08-30-1964	22:57:37.11	34.2683 N	118.445 W	B	030.05	4.0	15.4
01-01-1965	08:04:18.01	34.1405 N	117.516 W	B	068.42	4.4	05.9
04-15-1965	20:08:33.27	34.1320 N	117.426 W	B	076.44	4.5	05.5
07-16-1965	07:46:22.39	34.4850 N	118.521 W	B	054.27	4.0	15.1
01-08-1967	07:37:30.40	33.6322 N	118.467 W	B	050.69	4.0	11.4
01-08-1967	07:38:05.34	33.6632 N	118.413 W	C	045.67	4.0	17.7
06-15-1967	04:58:05.52	33.9965 N	117.975 W	B	026.13	4.1	10.0
02-28-1969	04:56:12.43	34.5652 N	118.114 W	A	058.54	4.3	05.3
05-05-1969	16:02:09.64	34.3038 N	117.570 W	B	068.62	4.4	08.8
10-27-1969	13:16:02.32	33.5452 N	117.807 W	B	069.62	4.5	06.5
09-12-1970	14:10:11.19	34.2673 N	117.519 W	A	071.53	4.1	08.0
09-12-1970	14:30:52.98	34.2698 N	117.540 W	A	069.76	5.2	08.0
09-13-1970	04:47:48.63	34.2810 N	117.552 W	A	069.20	4.4	08.0
02-09-1971	14:00:41.83	34.4112 N	118.401 W	B	042.36	6.6	08.4
02-09-1971	14:01:08.00	34.4112 N	118.401 W	D	042.36	5.8	08.0
02-09-1971	14:01:33.00	34.4112 N	118.401 W	D	042.36	4.2	08.0
02-09-1971	14:01:40.00	34.4112 N	118.401 W	D	042.36	4.1	08.0

Table 2 - continued

02-09-1971	14:01:50.00	34.4112 N	118.401 W	D	042.36	4.5	08.0
02-09-1971	14:01:54.00	34.4112 N	118.401 W	D	042.36	4.2	08.0
02-09-1971	14:01:59.00	34.4112 N	118.401 W	D	042.36	4.1	08.0
02-09-1971	14:02:03.00	34.4112 N	118.401 W	D	042.36	4.1	08.0
02-09-1971	14:02:30.00	34.4112 N	118.401 W	D	042.36	4.3	08.0
02-09-1971	14:02:31.00	34.4112 N	118.401 W	D	042.36	4.7	08.0
02-09-1971	14:02:44.00	34.4112 N	118.401 W	D	042.36	5.8	08.0
02-09-1971	14:03:25.00	34.4112 N	118.401 W	D	042.36	4.4	08.0
02-09-1971	14:03:46.00	34.4112 N	118.401 W	D	042.36	4.1	08.0
02-09-1971	14:04:07.00	34.4112 N	118.401 W	D	042.36	4.1	08.0
02-09-1971	14:04:34.00	34.4112 N	118.401 W	C	042.36	4.2	08.0
02-09-1971	14:04:39.00	34.4112 N	118.401 W	D	042.36	4.1	08.0
02-09-1971	14:04:44.00	34.4112 N	118.401 W	D	042.36	4.1	08.0
02-09-1971	14:04:46.00	34.4112 N	118.401 W	D	042.36	4.2	08.0
02-09-1971	14:05:41.00	34.4112 N	118.401 W	D	042.36	4.1	08.0
02-09-1971	14:05:50.00	34.4112 N	118.401 W	D	042.36	4.1	08.0
02-09-1971	14:07:10.00	34.4112 N	118.401 W	D	042.36	4.0	08.0
02-09-1971	14:07:30.00	34.4112 N	118.401 W	D	042.36	4.0	08.0
02-09-1971	14:07:45.00	34.4112 N	118.401 W	D	042.36	4.5	08.0
02-09-1971	14:08:04.00	34.4112 N	118.401 W	D	042.36	4.0	08.0
02-09-1971	14:08:07.00	34.4112 N	118.401 W	D	042.36	4.2	08.0
02-09-1971	14:08:38.00	34.4112 N	118.401 W	D	042.36	4.5	08.0
02-09-1971	14:08:53.00	34.4112 N	118.401 W	D	042.36	4.6	08.0
02-09-1971	14:10:21.49	34.3612 N	118.306 W	B	034.87	4.7	05.0
02-09-1971	14:10:28.00	34.4112 N	118.401 W	D	042.36	5.3	08.0
02-09-1971	14:16:12.87	34.3390 N	118.332 W	C	032.89	4.1	11.1
02-09-1971	14:19:50.22	34.3575 N	118.406 W	B	036.96	4.0	11.8
02-09-1971	14:34:36.11	34.3438 N	118.636 W	C	048.15	4.9	-2.0
02-09-1971	14:39:17.76	34.3873 N	118.364 W	C	038.83	4.0	-1.6
02-09-1971	14:40:17.37	34.4333 N	118.398 W	C	044.63	4.1	-2.0
02-09-1971	14:43:46.66	34.3080 N	118.454 W	B	034.15	5.2	06.2
02-09-1971	15:58:20.69	34.3348 N	118.331 W	B	032.41	4.8	14.2
02-09-1971	16:19:26.46	34.4573 N	118.427 W	B	048.00	4.2	-1.0
02-10-1971	03:12:12.05	34.3700 N	118.302 W	B	035.78	4.0	00.8
02-10-1971	05:06:36.05	34.4112 N	118.329 W	A	040.70	4.3	04.7
02-10-1971	05:18:07.21	34.4258 N	118.414 W	A	044.31	4.5	05.8
02-10-1971	11:31:34.63	34.3843 N	118.455 W	A	041.56	4.2	06.0
02-10-1971	13:49:53.71	34.3990 N	118.419 W	A	041.67	4.3	09.7
02-10-1971	14:35:26.67	34.3615 N	118.487 W	A	040.78	4.2	04.4
02-10-1971	17:38:55.07	34.3957 N	118.366 W	A	039.77	4.2	06.2
02-10-1971	18:54:41.71	34.4458 N	118.436 W	A	047.09	4.2	08.1
02-21-1971	05:50:52.64	34.3973 N	118.439 W	A	042.21	4.7	06.9
02-21-1971	07:15:11.75	34.3920 N	118.427 W	A	041.25	4.5	07.2
03-07-1971	01:33:40.55	34.3532 N	118.456 W	A	038.54	4.5	03.3
03-25-1971	22:54:09.90	34.3563 N	118.475 W	A	039.71	4.2	04.6
03-30-1971	08:54:43.28	34.2957 N	118.464 W	A	033.55	4.1	02.6
03-31-1971	14:52:22.51	34.2858 N	118.515 W	A	035.68	4.6	02.1
04-01-1971	15:03:03.64	34.4283 N	118.413 W	A	044.53	4.1	08.0
04-02-1971	05:40:25.05	34.2837 N	118.528 W	A	036.36	4.0	03.0
04-15-1971	11:14:32.02	34.2647 N	118.577 W	B	038.29	4.2	04.2
04-25-1971	14:48:06.52	34.3682 N	118.314 W	B	035.75	4.0	-2.0
06-21-1971	16:01:08.49	34.2728 N	118.532 W	B	035.78	4.0	04.1
06-22-1971	10:41:19.01	33.7477 N	117.479 W	B	078.80	4.2	08.0
02-21-1973	14:45:57.30	34.0648 N	119.035 W	B	072.28	5.3	08.0
03-09-1974	00:54:31.91	34.3988 N	118.474 W	C	043.77	4.7	24.4
08-14-1974	14:45:55.18	34.4313 N	118.369 W	A	043.66	4.2	08.2
01-01-1976	17:20:12.94	33.9650 N	117.886 W	A	034.90	4.2	06.1
04-08-1976	15:21:38.07	34.3468 N	118.656 W	A	049.70	4.6	14.5
08-12-1977	02:19:26.08	34.3797 N	118.459 W	B	041.25	4.5	09.5
09-24-1977	21:28:24.30	34.4627 N	118.409 W	C	048.05	4.2	04.9
05-23-1978	09:16:50.83	33.9055 N	119.166 W	C	085.91	4.0	06.0

Table 2 - continued

01-01-1979	23:14:38.94	33.9443 N	118.681 W	B	041.44	5.2	11.2
10-17-1979	20:52:37.29	33.9330 N	118.669 W	C	040.79	4.2	05.5
10-19-1979	12:22:37.75	34.2107 N	117.531 W	B	068.62	4.1	04.8
09-04-1981	15:50:50.13	33.6515 N	119.093 W	C	089.58	5.5	06.0
10-23-1981	17:28:17.07	33.6385 N	119.007 W	C	083.53	4.6	06.0
10-23-1981	19:15:52.17	33.6185 N	119.017 W	A	085.59	4.6	14.8
04-13-1982	11:02:12.36	34.0628 N	118.970 W	A	066.26	4.0	12.1
05-25-1982	13:44:30.30	33.5458 N	118.206 W	A	056.32	4.3	12.6
01-08-1983	07:19:30.42	34.1328 N	117.453 W	A	073.99	4.1	07.7
02-27-1984	10:18:15.02	33.4710 N	118.061 W	C	066.83	4.0	06.0
06-12-1984	00:27:52.38	34.5407 N	118.989 W	A	087.00	4.1	11.7
10-26-1984	17:20:43.54	34.0163 N	118.988 W	A	068.09	4.6	13.3
04-03-1985	04:04:50.07	34.3800 N	119.038 W	A	081.16	4.0	24.8
10-02-1985	23:44:12.45	34.0233 N	117.245 W	A	092.70	4.8	15.2
02-21-1987	23:15:29.97	34.1322 N	117.447 W	A	074.52	4.0	08.4
10-01-1987	14:42:20.02	34.0613 N	118.079 W	A	015.90	5.9	09.5
10-01-1987	14:45:41.45	34.0488 N	118.100 W	A	013.83	4.7	13.5
10-01-1987	14:48:03.11	34.0763 N	118.090 W	A	015.04	4.1	11.6
10-01-1987	14:49:05.91	34.0598 N	118.100 W	A	013.92	4.7	11.7
10-01-1987	15:12:31.76	34.0517 N	118.091 W	A	014.75	4.7	10.8
10-01-1987	15:59:53.55	34.0500 N	118.087 W	A	015.10	4.0	10.4
10-04-1987	10:59:38.19	34.0737 N	118.098 W	A	014.28	5.3	08.2
10-24-1987	23:58:33.12	33.6758 N	119.058 W	A	085.45	4.1	12.1
02-11-1988	15:25:55.65	34.0772 N	118.047 W	A	018.93	4.7	12.5
06-26-1988	15:04:58.48	34.1362 N	117.710 W	A	050.72	4.7	07.8
11-20-1988	05:39:28.67	33.5073 N	118.071 W	C	062.69	4.9	06.0
12-03-1988	11:38:26.44	34.1510 N	118.130 W	A	015.70	5.0	14.2
01-19-1989	06:53:28.84	33.9187 N	118.627 W	A	037.74	5.0	11.8
02-18-1989	07:17:04.85	34.0063 N	117.739 W	A	047.45	4.1	03.2
04-07-1989	20:07:30.30	33.6188 N	117.902 W	A	057.84	4.7	12.8
06-12-1989	16:57:18.49	34.0275 N	118.180 W	A	007.04	4.6	15.6
06-12-1989	17:22:25.52	34.0215 N	118.178 W	A	007.41	4.4	15.5
12-28-1989	09:41:08.20	34.1923 N	117.386 W	A	081.09	4.3	14.5
02-28-1990	23:43:36.75	34.1437 N	117.697 W	A	051.98	5.4	04.4
03-01-1990	00:34:57.15	34.1267 N	117.701 W	A	051.28	4.0	04.3
03-01-1990	03:23:03.03	34.1525 N	117.720 W	A	050.13	4.7	11.4
03-02-1990	17:26:25.48	34.1450 N	117.695 W	A	052.25	4.7	05.6
04-17-1990	22:32:27.29	34.1057 N	117.722 W	A	049.09	4.8	03.5
06-28-1991	14:43:54.66	34.2698 N	117.993 W	A	033.97	5.8	09.1
06-28-1991	17:00:55.56	34.2530 N	117.992 W	A	032.72	4.3	09.4
07-05-1991	17:41:57.12	34.4970 N	118.555 W	A	056.96	4.1	10.9
01-17-1994	12:30:55.39	34.2133 N	118.537 W	A	031.95	6.7	18.4
01-17-1994	12:30:55.39	34.2157 N	118.538 W	A	032.15	6.6	17.3
01-17-1994	12:31:58.11	34.2748 N	118.493 W	C	033.39	5.9	06.0
01-17-1994	12:34:18.42	34.3075 N	118.475 W	C	035.21	4.4	06.0
01-17-1994	12:39:39.79	34.2650 N	118.540 W	C	035.72	4.9	06.0
01-17-1994	12:40:09.52	34.3202 N	118.507 W	C	038.11	4.8	06.0
01-17-1994	12:40:36.12	34.3397 N	118.614 W	C	046.36	5.2	06.0
01-17-1994	12:54:33.74	34.3068 N	118.459 W	C	034.30	4.0	06.0
01-17-1994	12:55:46.83	34.2767 N	118.578 W	C	039.19	4.1	06.0
01-17-1994	13:06:28.34	34.2513 N	118.550 W	C	035.42	4.6	06.0
01-17-1994	13:26:45.00	34.3178 N	118.457 W	C	035.20	4.7	06.0
01-17-1994	13:28:13.57	34.2670 N	118.579 W	C	038.61	4.0	06.0
01-17-1994	13:56:02.48	34.2930 N	118.621 W	C	043.42	4.4	06.0
01-17-1994	14:14:30.63	34.3315 N	118.445 W	C	035.94	4.5	06.0
01-17-1994	15:07:03.17	34.3043 N	118.474 W	A	034.86	4.2	02.5
01-17-1994	15:07:35.46	34.3075 N	118.467 W	A	034.80	4.1	01.6
01-17-1994	15:54:10.76	34.3757 N	118.627 W	A	050.01	4.8	13.0
01-17-1994	17:56:08.21	34.2277 N	118.573 W	A	035.55	4.6	19.2
01-17-1994	19:35:34.30	34.3113 N	118.456 W	A	034.58	4.0	02.3
01-17-1994	19:43:53.38	34.3675 N	118.637 W	A	050.00	4.1	13.9

Table 2 - continued

01-17-1994	20:46:02.40	34.3020 N	118.565 W	C	040.20	4.9	06.0
01-17-1994	22:31:53.73	34.3393 N	118.442 W	C	036.56	4.1	06.0
01-17-1994	23:33:30.69	34.3263 N	118.698 W	A	051.32	5.6	09.8
01-17-1994	23:49:25.36	34.3433 N	118.666 W	A	050.20	4.0	08.3
01-18-1994	00:39:35.02	34.3795 N	118.564 W	A	046.51	4.4	07.1
01-18-1994	00:40:04.09	34.3938 N	118.543 W	A	046.67	4.2	00.0
01-18-1994	00:43:08.89	34.3765 N	118.698 W	A	054.81	5.2	11.3
01-18-1994	04:01:26.72	34.3577 N	118.623 W	A	048.31	4.3	00.9
01-18-1994	07:23:56.02	34.3332 N	118.623 W	A	046.47	4.0	14.8
01-18-1994	11:35:09.90	34.2177 N	118.606 W	A	037.64	4.2	12.1
01-18-1994	13:24:44.13	34.3193 N	118.558 W	A	041.12	4.3	01.7
01-18-1994	15:23:46.89	34.3787 N	118.561 W	A	046.26	4.8	07.7
01-19-1994	04:40:48.00	34.3615 N	118.571 W	A	045.41	4.3	02.5
01-19-1994	04:43:14.57	34.3660 N	118.709 W	C	054.79	4.0	06.0
01-19-1994	09:13:10.90	34.3040 N	118.737 W	A	052.85	4.1	13.0
01-19-1994	14:09:14.83	34.2150 N	118.510 W	A	030.07	4.5	17.4
01-19-1994	21:09:28.61	34.3787 N	118.712 W	A	055.90	5.1	14.4
01-19-1994	21:11:44.90	34.3778 N	118.620 W	A	049.71	5.1	11.3
01-21-1994	18:39:15.26	34.3010 N	118.466 W	A	034.15	4.5	10.6
01-21-1994	18:39:47.08	34.2968 N	118.479 W	A	034.50	4.0	11.9
01-21-1994	18:42:28.77	34.3097 N	118.475 W	A	035.38	4.2	07.9
01-21-1994	18:52:44.23	34.3020 N	118.453 W	A	033.53	4.3	07.5
01-21-1994	18:53:44.57	34.2980 N	118.459 W	A	033.47	4.3	07.6
01-23-1994	08:55:08.66	34.3003 N	118.427 W	A	032.15	4.1	05.9
01-24-1994	04:15:18.82	34.3467 N	118.552 W	A	042.97	4.6	06.5
01-24-1994	05:50:24.34	34.3605 N	118.628 W	A	048.88	4.3	12.1
01-24-1994	05:54:21.07	34.3643 N	118.627 W	A	049.09	4.2	10.8
01-27-1994	17:19:58.83	34.2735 N	118.562 W	A	037.89	4.6	14.9
01-28-1994	20:09:53.43	34.3753 N	118.494 W	A	042.46	4.2	00.7
01-29-1994	11:20:35.97	34.3060 N	118.579 W	A	041.41	5.1	01.1
01-29-1994	12:16:56.35	34.2782 N	118.611 W	A	041.67	4.3	02.6
02-03-1994	16:23:35.37	34.2997 N	118.440 W	A	032.67	4.0	08.9
02-05-1994	08:51:29.83	34.3715 N	118.646 W	A	050.93	4.0	15.3
02-06-1994	13:19:27.02	34.2922 N	118.476 W	A	033.89	4.1	09.3
02-25-1994	12:59:12.59	34.3570 N	118.480 W	A	040.03	4.0	01.1
03-20-1994	21:20:12.26	34.2313 N	118.475 W	A	028.79	5.2	13.0
05-25-1994	12:56:57.05	34.3120 N	118.393 W	A	031.83	4.4	06.9
06-15-1994	05:59:48.63	34.3105 N	118.398 W	A	031.87	4.1	07.3
12-06-1994	03:48:34.49	34.2927 N	118.389 W	A	029.75	4.5	08.9
02-19-1995	21:24:18.07	34.0490 N	118.915 W	A	061.21	4.3	15.6
06-26-1995	08:40:28.94	34.3935 N	118.668 W	A	054.10	5.0	13.3
03-20-1996	07:37:59.76	34.3623 N	118.615 W	A	048.18	4.1	12.9
05-01-1996	19:49:56.43	34.3542 N	118.704 W	A	053.58	4.1	14.3
04-26-1997	10:37:30.67	34.3692 N	118.670 W	A	052.34	5.1	16.4
04-26-1997	10:40:29.78	34.3748 N	118.671 W	A	052.81	4.0	14.6
04-27-1997	11:09:28.38	34.3772 N	118.649 W	A	051.56	4.8	15.1
06-28-1997	21:45:25.10	34.1685 N	117.336 W	A	085.20	4.2	10.0
01-05-1998	18:14:06.47	33.9508 N	117.709 W	A	051.17	4.3	11.5
03-11-1998	12:18:51.83	34.0238 N	117.230 W	A	094.09	4.5	14.9
08-20-1998	23:49:58.44	34.3737 N	117.648 W	A	065.97	4.4	08.9
07-22-1999	09:57:24.04	34.3968 N	118.609 W	A	050.65	4.0	11.6
02-21-2000	13:49:43.13	34.0472 N	117.255 W	A	091.71	4.5	15.0
03-07-2000	00:20:28.18	33.8058 N	117.715 W	A	056.42	4.0	11.3
01-14-2001	02:26:14.05	34.2840 N	118.404 W	A	029.50	4.3	08.8
01-14-2001	02:50:53.69	34.2890 N	118.403 W	A	029.95	4.0	08.4
09-09-2001	23:59:18.04	34.0590 N	118.388 W	A	012.74	4.2	07.9
10-28-2001	16:27:45.55	33.9220 N	118.270 W	A	014.46	4.0	21.1
12-14-2001	12:01:35.52	33.9545 N	117.746 W	A	047.71	4.0	13.8
01-29-2002	05:53:28.93	34.3613 N	118.657 W	A	050.88	4.2	14.1
09-03-2002	07:08:51.87	33.9173 N	117.776 W	A	046.23	4.8	12.9
01-06-2005	14:35:27.67	34.1250 N	117.439 W	A	075.22	4.4	04.1

Table 2 - continued

08-09-2007	07:58:49.59	34.3000 N	118.062 W	A	032.67	4.7	07.6
09-02-2007	17:29:14.79	33.7320 N	117.477 W	A	079.73	4.7	12.6
10-16-2007	08:53:44.12	34.3850 N	117.635 W	A	067.70	4.2	08.1
03-09-2008	09:22:32.08	34.1390 N	117.465 W	A	073.00	4.0	03.7
06-23-2008	14:14:57.60	34.0480 N	117.246 W	A	092.56	4.0	14.4
07-29-2008	18:42:15.71	33.9530 N	117.761 W	A	046.43	5.4	14.7
01-09-2009	03:49:46.27	34.1073 N	117.304 W	A	087.39	4.5	14.2
04-24-2009	03:27:50.73	33.8940 N	117.789 W	A	045.99	4.0	04.2
05-02-2009	01:11:13.66	34.0667 N	118.882 W	A	058.24	4.4	14.1
05-08-2009	20:27:13.95	34.4402 N	119.183 W	A	095.97	4.2	07.5
05-18-2009	03:39:36.34	33.9377 N	118.336 W	A	014.84	4.7	13.8
05-19-2009	22:49:11.55	33.9338 N	118.329 W	A	014.90	4.0	12.7
03-16-2010	11:04:00.00	33.9920 N	118.082 W	A	016.87	4.4	18.9
08-24-2010	05:42:17.00	33.5150 N	119.033 W	A	093.71	4.0	16.9
09-01-2011	20:47:08.00	34.3390 N	118.475 W	A	038.10	4.2	07.3
05-30-2012	05:14:00.81	33.6918 N	119.058 W	A	084.57	4.0	16.4
06-14-2012	03:17:15.72	33.9085 N	117.792 W	A	045.19	4.0	09.7
08-08-2012	06:23:34.16	33.9048 N	117.792 W	A	045.33	4.5	10.1
08-08-2012	16:33:22.05	33.9035 N	117.791 W	A	045.47	4.5	10.3
08-29-2012	20:31:00.35	33.9060 N	117.788 W	A	045.63	4.1	09.2
05-15-2013	20:00:06.23	33.6583 N	118.372 W	A	045.08	4.1	01.2
01-15-2014	09:35:18.87	34.1430 N	117.442 W	A	075.11	4.4	03.5
03-17-2014	13:25:36.87	34.1340 N	118.486 W	A	023.57	4.4	09.4
03-29-2014	04:09:42.31	33.9325 N	117.917 W	A	033.45	5.1	04.7
03-29-2014	21:32:45.93	33.9613 N	117.892 W	A	034.50	4.1	09.4
06-02-2014	02:36:43.93	34.0958 N	118.491 W	A	022.71	4.2	04.3
01-04-2015	03:18:09.48	34.6173 N	118.630 W	A	071.97	4.3	07.8
07-25-2015	12:54:06.99	34.0920 N	117.445 W	A	074.34	4.2	05.0
12-30-2015	01:48:57.31	34.1910 N	117.413 W	A	078.64	4.4	06.9
03-12-2016	08:42:40.30	34.5217 N	119.075 W	A	092.05	4.1	19.3
01-25-2018	10:09:56.81	33.7410 N	117.491 W	A	078.11	4.0	11.1

Table 2 - continued

S E A R C H   O F   E A R T H Q U A K E   D A T A   F I L E 1

SITE: Proposed Angels Landing Development

COORDINATES OF SITE	34.0510 N 118.2506 W
DISTANCE PER DEGREE	110.9 KM-N 92.3 KM-W
MAGNITUDE LIMITS	4.0 - 8.5
TEMPORAL LIMITS	1932 - 2018
SEARCH RADIUS (KM)	100.0
NUMBER OF YEARS OF DATA	85
NUMBER OF EARTHQUAKES IN FILE	4638
NUMBER OF EARTHQUAKES IN AREA	441

WOOD ENVIRONMENT & INFRASTRUCTURE SOLUTIONS

Table 2 - continued
Proposed Angels Landing Development
LIST OF HISTORIC EARTHQUAKES OF MAGNITUDE 4.0 OR GREATER WITHIN 100.0 KM OF THE SITE
(CGS DATA 1769-1931)

DATE	LATITUDE	LONGITUDE	DIST [KM]	MAGNITUDE
07-28-1769	34.0000 N	118.000 W	023.78	6.00
04-00-1803	34.2000 N	118.100 W	021.60	5.50
12-08-1812	34.3700 N	117.650 W	065.64	7.50
09-24-1827	34.0000 N	119.000 W	069.29	6.00
07-11-1855	34.1000 N	118.100 W	014.90	6.00
01-10-1857	34.7600 N	118.710 W	089.40	5.60
01-16-1857	34.5200 N	118.040 W	055.62	6.30
12-16-1858	34.2000 N	117.400 W	080.03	6.00
04-12-1880	34.7000 N	118.400 W	073.46	5.90
08-28-1889	34.2000 N	117.900 W	036.28	5.60
06-14-1892	34.2000 N	117.500 W	071.05	5.50
04-04-1893	34.3000 N	118.600 W	042.42	5.80
07-30-1894	34.3000 N	117.600 W	065.94	6.20
07-22-1899	34.2000 N	117.400 W	080.03	5.90
07-22-1899	34.3000 N	117.500 W	074.39	6.40
09-16-1903	33.8001 N	117.600 W	066.19	4.00
07-03-1908	34.0001 N	117.500 W	069.40	4.00
05-13-1910	33.7001 N	117.400 W	087.69	5.00
05-15-1910	33.7000 N	117.400 W	087.69	6.00
05-10-1911	34.1001 N	118.800 W	050.89	4.00
10-21-1913	33.8001 N	118.000 W	036.23	4.00
11-08-1914	34.0001 N	118.500 W	023.67	4.50
03-06-1918	34.0001 N	118.500 W	023.67	4.00
06-18-1920	33.5001 N	118.250 W	061.26	4.50
06-22-1920	34.0001 N	118.500 W	023.67	4.90
07-23-1923	34.0000 N	117.250 W	092.39	6.20
08-04-1927	34.0001 N	118.500 W	023.67	5.00
07-08-1929	33.9001 N	118.100 W	021.78	4.70
09-13-1929	33.6301 N	118.200 W	047.03	4.00
08-31-1930	33.9501 N	118.632 W	036.91	5.20
02-16-1931	34.1001 N	117.300 W	087.72	4.00
03-31-1931	34.1001 N	117.800 W	041.86	4.00
04-24-1931	33.7701 N	118.480 W	037.73	4.40
11-03-1931	33.8001 N	118.300 W	028.27	4.00

Table 2 - continued

S E A R C H   O F   E A R T H Q U A K E   D A T A   F I L E 2

SITE: Proposed Angels Landing Development

COORDINATES OF SITE ...... 34.0510 N 118.2506 W

DISTANCE PER DEGREE ..... 110.9 KM-N 92.3 KM-W

MAGNITUDE LIMITS .... 4.0 - 8.5

TEMPORAL LIMITS .... 1769 - 1931

SEARCH RADIUS (KM) 100.0

NUMBER OF YEARS OF DATA 163

NUMBER OF EARTHQUAKES IN FILE 398

NUMBER OF EARTHQUAKES IN AREA 34

WOOD ENVIRONMENT & INFRASTRUCTURE SOLUTIONS

Table 2 - continued
SUMMARY OF EARTHQUAKE RESEARCH

***

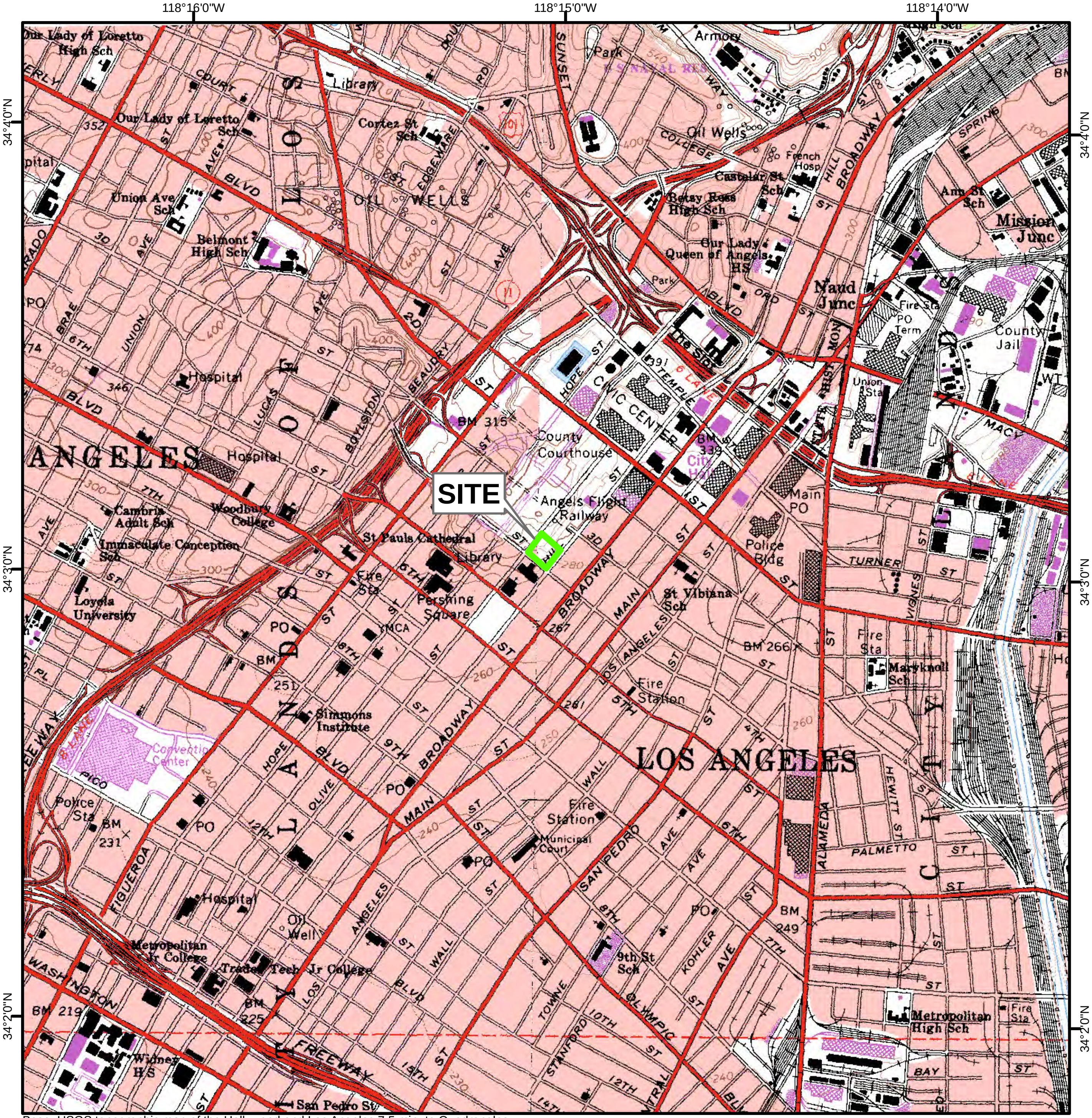
NUMBER OF HISTORIC EARTHQUAKLES WITHIN 100.0 KM RADIUS OF SITE

MAGNITUDE RANGE	NUMBER
4.0 - 4.5	305
4.5 - 5.0	106
5.0 - 5.5	35
5.5 - 6.0	15
6.0 - 6.5	10
6.5 - 7.0	3
7.0 - 7.5	0
7.5 - 8.0	1
8.0 - 8.5	0

***

WOOD ENVIRONMENT & INFRASTRUCTURE SOLUTIONS

Figures

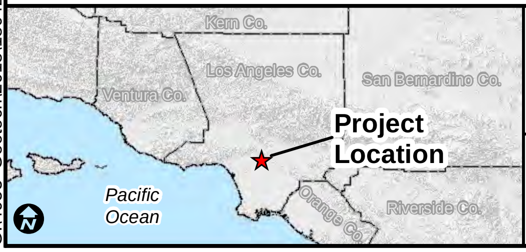


Base: USGS topographic map of the Hollywood and Los Angeles 7.5 minute Quadrangles

0 1,000 2,000 4,000 Feet

0 0.2 0.4 0.8 Miles

PLAN TRUE



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Fax: 323.721.6700

Proposed Angels Landing Development
Block Bordered by Olive Street, Hill Street, 4th Street, and Angels Flight
Los Angeles, California

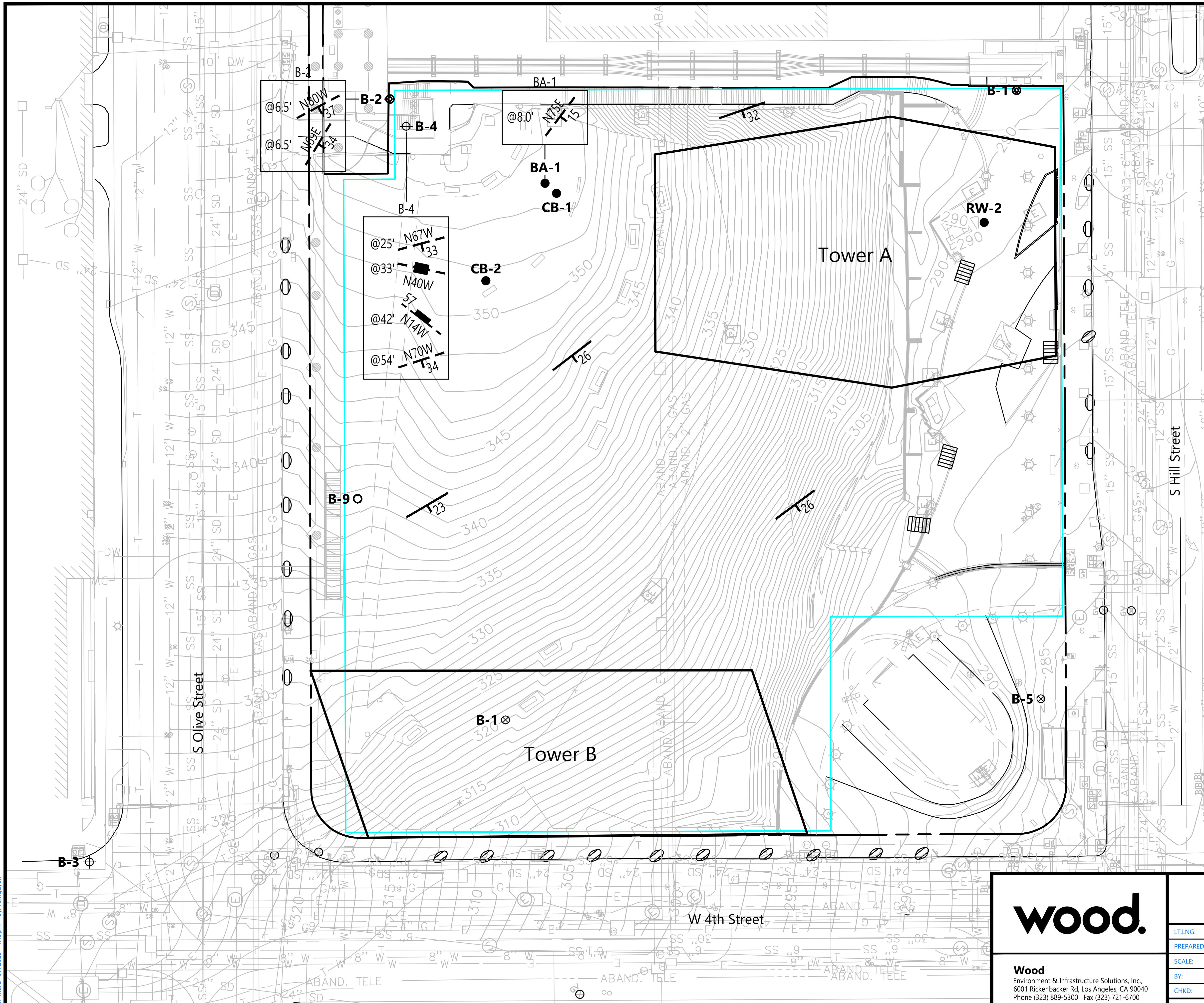
LAT: LON:	34.0510 -118.2506
SCALE:	1:24,000
DRAWN:	KSH
CHECK:	PER
DATE:	7/6/2018

SITE VICINITY MAP

FIGURE: 1

PROJECT: 4953-18-0421

G:\4953 Geotech\2018\180421 Angel's Landing Development\GIS\180421 Figure 1 Site Vicinity Map.mxd



LEGEND:

CB-2 ●	Continuous Core Boring
BA-1 ●	Bucket Auger Boring
RW-1 ●	Rotary Wash Boring
B-4 ⊕	ADE-88070
B-10 ○	ADE-80268 & A-68185
B-6 ⊗	AE-76087
B-2 ◎	2661.30327.0001
	Strike and Dip of Bedding (A-68185 and GAB 68122)
	Subsurface Joint Attitude
	Subsurface Vertical Joint Attitude
	Limits of Excavation (Approximate)
	Existing Boundary Line

Base:
Handel Architects, Angels Landing Project, Plot Plan - A005, dated 3/1/2019

PLAN NORTH
N
TRUE NORTH

0 20' 40' 80'

SCALE: 1" = 40'

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Phone (323) 889-5300 Fax (323) 721-6700

Proposed Angels Landing Project
Property Bordered by Olive Street, Hill Street,
4th Street and Angels Flight, Los Angeles, California

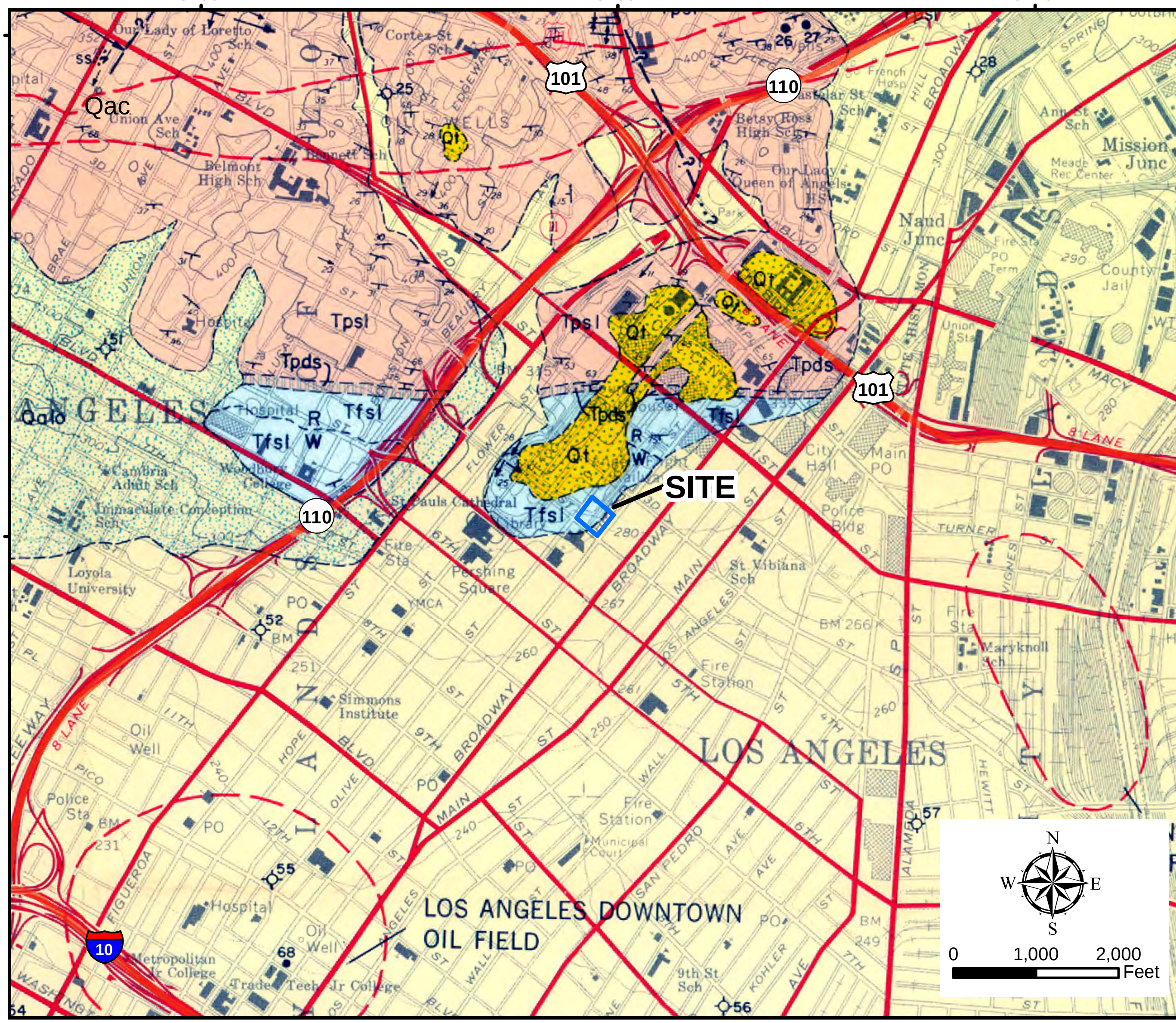
LT,LNG:	
PREPARED BY:	VMN
SCALE:	1" = 40'
BY:	KH
CHKD:	PR / RM
DATE:	03/07/2019

Plot Plan

FIGURE NO.
2

PROJECT NO.
4953-18-0421

Path: G:\4953_Geotech\2018\180421 Angel's Landing Development\CAD\DWG\4953-18-0421_Fig-2_Plot-Plan(19.03.07).dwg [B-17x11]
Date: March 07, 2019 - 4:49pm By: vo.nguyen



Geologic Units

Unit - Description (Age)

Qal - Alluvium. Silt, sand, and gravel (Holocene)

Qalo - Old alluvium. Silt, sand, and gravel forming alluvial plain and terrace deposits (Pleistocene)

Qt - Terrace Deposits. Silt, sand, and gravel forming alluvial terrace and dissected alluvial plain deposits (Pleistocene)

Tfsl - Fernando Formation. Siltstone, massive, light gray; R/W: Repettian-Wheelerian Stage boundary (Pliocene)

Tpds - Puente Formation. Diatomaceous shale, punky, dull white (Late Miocene)

Tpsl - Puente Formation. Siltstone, well bedded (Late Miocene)

Contacts:

contact, location accurate
contact, location approximate
contact, location concealed
contact, location inferred
fault, location accurate
fault, location approximate
fault, location concealed
fault, location inferred

Symbols:

23 Inclined Bedding
18 Inclined Bedding approx.
21 Overturned Bedding
Vertical Bedding
Horizontal Bedding
39 Inclined Foliation
Foliation approx.
Vertical Foliation

Folds:

Anticline
Syncline

Reference: Lamar, D.L., 1970, "Geology of the Elysian Park-Repetto Hills area, Los Angeles County, California," California Division of Mines and Geology Special Report 101, 45 p., map in pocket (1:24:000).

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Los Angeles, California

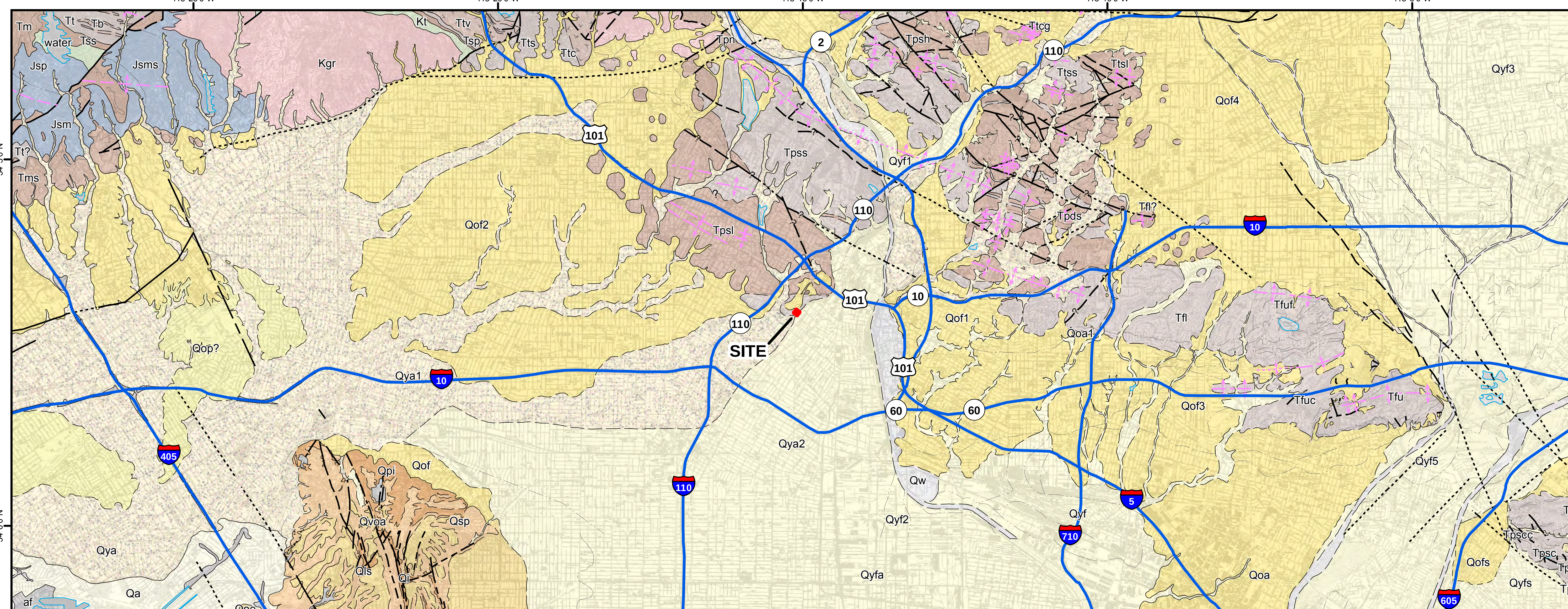
LAT: LON:	34.0510 -118.2506
SCALE:	1:24,000
DRAWN:	KSH
CHECK:	PER
DATE:	6/21/2018

LOCAL GEOLOGIC MAP

3

PROJECT: 4953-18-0421

Path: G:\4953 Geotech\2018\180421 Angel's Landing Development\GIS\180421 Figure 3 Local Geology Map.mxd



Geologic Units

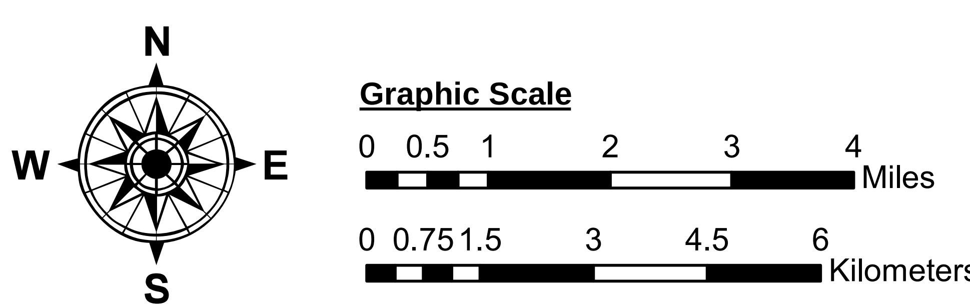
af - artificial fill (late Holocene)
Qa - Alluvial flood-plain deposits (late Holocene)
Qw - Active channel and wash deposits (late Holocene)
Qls - Landslide deposits (Holocene and Pleistocene)
Qya - Young alluvial flood-plain deposits (Holocene and Late Pleistocene)
Qyf - Young alluvial fan and valley deposits, undivided (Holocene and late Pleistocene)
Qoa - Old alluvial flood-plain deposits, undivided (late to middle Pleistocene)
Qoe - Old eolian deposits (late to middle Pleistocene)
Qof - Old alluvial fan deposits, undivided (late to middle Pleistocene)
Qop - Old paralic deposits (late to middle Pleistocene)
Qvoa - Very old alluvium, undivided (middle to early Pleistocene)
Qi - Inglewood Formation, siltstone (early Pleistocene)
Qpi - Inglewood Formation, siltstone, fine sandstone (early Pleistocene)
Tf - Fernando Formation, undivided; conglomerate, sandstone (Pliocene)
Qsp - San Pedro Formation, undivided; sand and silty sand (early Pleistocene)
Tp - Puente Formation, undivided, siltstone, sandstone, shale (early Pliocene and late Miocene)
Tm - Modelo Formation, undivided, mudstone, siltstone, shale (late Miocene)
Tb - Basalt dikes, flows and breccias (Miocene)
Tt - Topanga Group, undivided (middle Miocene)
Ttcg - Topanga Group, conglomerate (middle Miocene)
Tts - Topanga Canyon Formation, Saddle Peak Member, sandstone and conglomerate (middle and early Miocene)
Ttsl - Topanga Canyon Formation, siltstone, sandstone and siliceous shale (middle Miocene)
Ttc - Topanga Canyon Formation, undivided, sandstone with interbedded siltstone (early middle Miocene)
Ttss - Topanga Canyon Formation, sandstone (middle Miocene)
Ttv - Topanga Canyon Formation, andesite and basalt flows (middle and early Miocene)
Tsp - Sespe Formation, Piuma Member, sandstone (early Miocene to late Eocene)
Tss - Santa Susana Formation, clay and mudrock (early to late Paleocene)
Kgr - Granitic rocks (late Cretaceous)
Kt - Tuna Canyon Formation, undivided marine sandstone, siltstone, conglomerate (late Cretaceous)
Jsm - Santa Monica Slate (late Jurassic)
Jsms - Santa Monica Slate, spotted (late Jurassic)
Jsp - Santa Monica Slate, phyllite (late Jurassic)

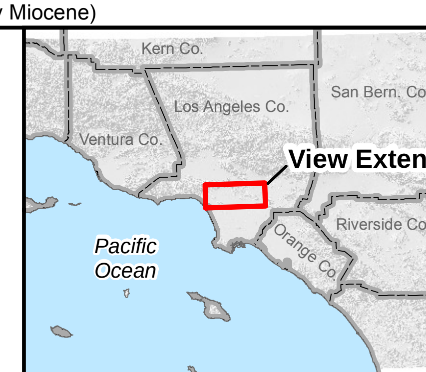
Note: Some geologic units may have sub-units shown on map

Geologic Contacts

contact, identity and existence certain, location accurate
contact, identity and existence certain, location approximate
contact, identity and existence certain, location concealed
contact, identity and existence certain, location inferred
fault, identity and existence certain, location accurate
fault, identity and existence certain, location approximate
fault, identity and existence certain, location concealed
fault, identity and existence certain, location inferred

(Queried where contacts are questionable)





References:
Bedrossian, T.L., Roffers, P., Hayhurst, C.A., 2012, "Geologic Compilation of Quaternary Surficial Deposits in Southern California", California Geological Survey, vector spatial data, Special Report 217, December 2012.

wood.
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Fax: 323.721.6700

Proposed Angels Landing Development
Block Bordered by Olive Street, Hill Street, 4th Street, and Angel's Flight
Los Angeles, California

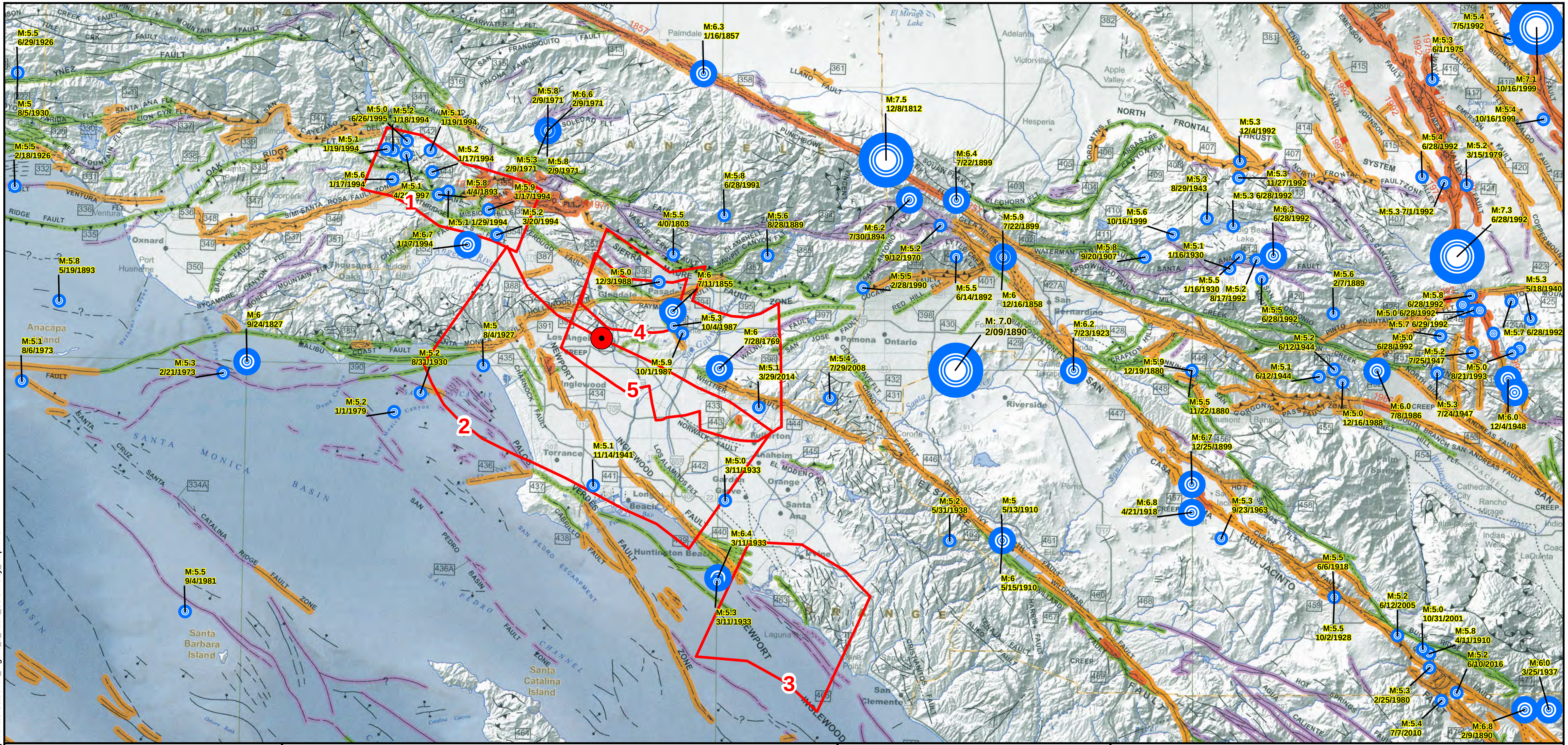
LAT:	34.0510
LON:	-118.2506
SCALE:	1:100,000
DRAWN:	KSH
CHECK:	PER
DATE:	6/21/2018

REGIONAL GEOLOGIC MAP

FIGURE: 4

PROJECT: 4953-18-0421

Path: G:\4953_Geotech\2018\180421 Angel's Landing Development\GIS\180421_Figure_4_Regional_Geologic_Map2.mxd



Earthquakes

Approximate Epicentral Area of Earthquake

- Events ≥ 7.0
- Events 6.0 - 6.9
- Events 5.0 - 5.9

Faults

- Historic Fault Displacement
- Holocene Fault Displacement
- Evidence of Late Quaternary Fault Displacement
- Undivided Quaternary Faults

Bar and ball on downthrown side (relative or apparent)

Arrows along fault indicate relative or apparent direction of lateral movement

Arrows on fault indicates direction of dip

Low angle fault identified with barbs on upper plate. Fault surface generally dips less than 45°but locally may have been subsequently steepened.

Blind Thrust Faults (surface projection)

Blind Thrust Index:

1 Northridge Thrust
2 Compton Thrust
3 San Joaquin Hills Thrust
4 Upper Elysian Park Thrust
5 Puente Hills Thrust

SITE

N
W E
S

0 4 8 16 24 32 Kilometers

0 3 6 12 18 24 Miles

REFERENCES:

Jennings, C.W. and Bryant, W.A., 2010,"Fault Activity Map of California," California Geological Survey, GDM-006, May 2010

Earthquake Catalogs: California Geological Survey, 1769-1932; Southern California Earthquake Center, 1932-2017.

Working Group on California Earthquake Probabilities (WGCEP), 2016, Fault Database Tools, <http://www.wgcep.org/tools-fault_db>

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Proposed Angels Landing Development
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Los Angeles, California

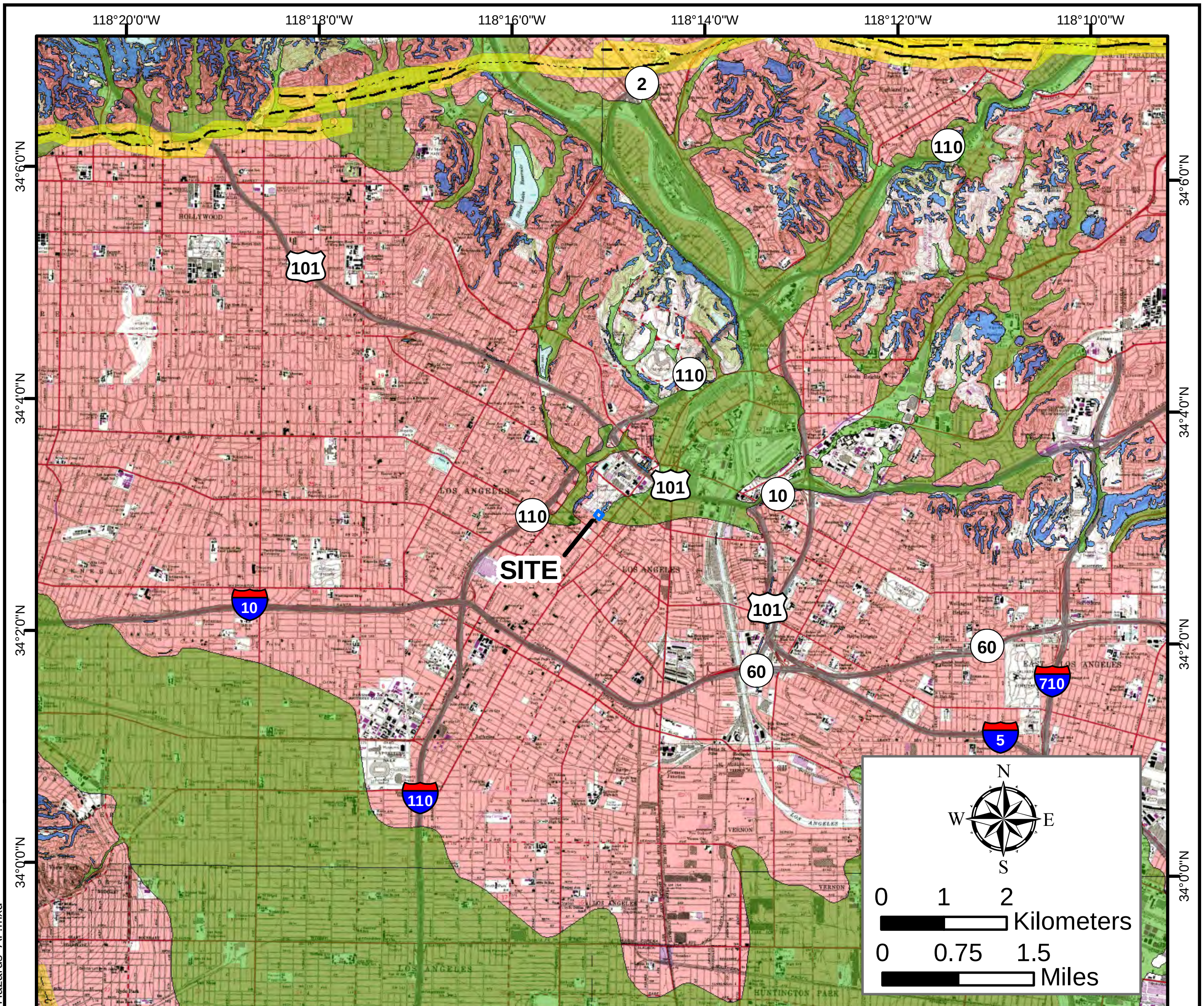
LAT:	34.0510
LON:	-118.2506
SCALE:	1:750,000
DRAWN:	KSH
CHECK:	PER
DATE:	6/21/2018

REGIONAL FAULT AND SEISMICITY MAP

FIGURE: 5

PROJECT: 4953-18-0421

Path: G:\4953_Geotech\2018\180421 Angel's Landing Development\GIS\180421_Figure_5_Fault_Seismicity_Map.mxd



Base: USGS 7.5 minute topographic maps of the Hollywood, Inglewood, Los Angeles and South Gate Quadrangles

Seismic Hazards

Earthquake-induced landslide - Areas where Holocene occurrence of landslide movement, or local slope of terrain, and geological, geotechnical and ground moisture conditions indicate a potential for permanent ground displacements such that mitigation as defined in Public Resources Code Section 2693(c) would be required.

Liquefaction hazard zones shall be delineated as areas where historic occurrence of liquefaction, or local geological, geotechnical and ground water conditions indicate a potential for permanent ground displacements such that mitigation as defined in Public Resources Code Section 2693(c) would be required.

Fault Zones

Accurately Located Fault Traces

?

Approximately Located Fault Traces

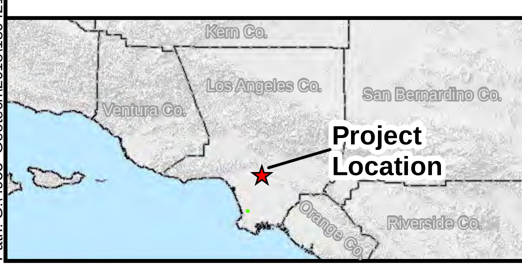
Inferred Fault Traces

Concealed Fault Traces

Aerial Photo Lineament

Alquist Priolo EFZ Boundary

References:
CGS, 2017, GIS Files of Official Map of Alquist-Priolo Earthquake Fault Zones, Los Angeles Quadrangle," June 15, 2017.
CGS, 2014, GIS Files of Official Map of Alquist-Priolo Earthquake Fault Zones, Hollywood Quadrangle," November 6, 2014.
CGS, 2002, "GIS Files of Official Alquist Priolo Earthquake Fault Zones, Southern Region," May 31, 2002, CGS CD 2001-05.



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Proposed Angels Landing Development
Block Bordered by Olive Street, Hill Street, 4th Street, and Angels Flight
Los Angeles, California

LAT:	34.0510	
LON:	-118.2506	
SCALE:	1:100,000	
DRAWN:	KSH	
CHECK:	PER	
DATE:	6/21/2018	

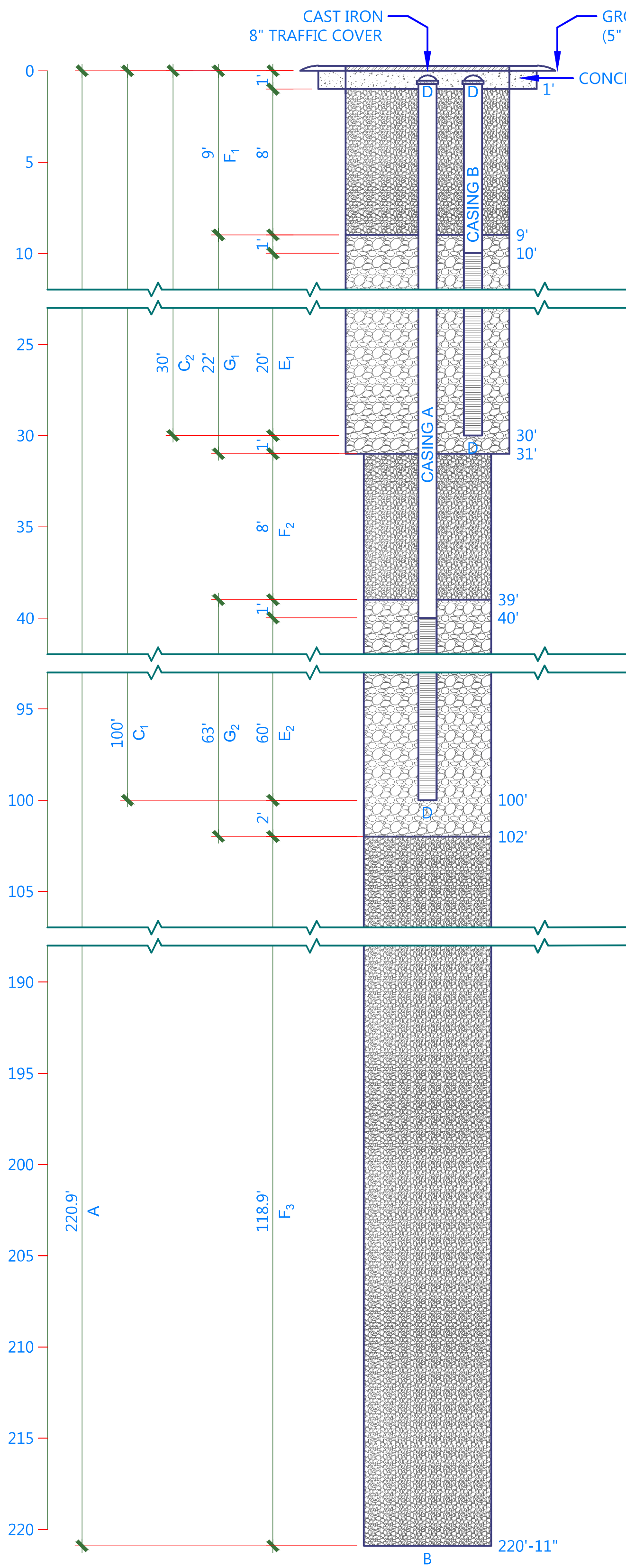
SEISMIC HAZARDS MAP

FIGURE: 6

PROJECT: 4953-18-0421

Path: G:\4953_Geotech\2018\180421 Angel's Landing Development\GIS\180421_Figure_6_Seismic_Hazards_AP.mxd

GROUNDWATER MONITORING WELL AT RW-1



A. TOTAL DEPTH OF BORING: 220'-11" BGS

B. DIAMETER OF BORING: 8"ø FROM 0'-31', 4 7/8"ø FROM 40'-220' 11"

C. CASING LENGTH:
- C_1: 1'-100' A
- C_2: 1'-30' B

D. CASING DIAMETER: 2"ø EACH

E. PERFORATION SIZE: 0.020" SLITS
PERFORATION ZONE:
- E_1: 10'-30' (BGS)
- E_2: 40'-100' (BGS)

F: SEAL MATERIAL: HYDISTED BETONITE (CHIPS)
SEAL DEPTH:
- F_1: 1'-9' (BGS)
- F_2: 31'-39' (BGS)
- F_3: 102'-220' (BGS)

G. MATERIAL: #3 SAND PACK
DEPTH:
- G_1: 9'-31' (BGS)
- G_2: 39'-102' (BGS)

Vertical Scale: 1" = 10'-0"
Horizontal Scale Exaggerated

Key	
BGS	Below Ground Surface
TOC	Top Of Casing
'	Feet
"	Inches

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WELL NO.:	RW-1	PREPARED BY:	VMN
INSTALLED:	AR	CHKD:	EJJ
SCALE:	1" = 10' vertical	DATE:	07/02/2018
DRILL CO.:	SoCal Drilling	TECHNIQUE:	Rotary Wash
FIELD PERSONNEL:	A. Recio		
PROJECT NAME:	Proposed Angels Landing Development		
WELL LOCATION:	Los Angeles, California		

Proposed Angels Landing Development
Los Angeles, California

WELL CONSTRUCTION DETAIL
Groundwater Monitoring Well Diagram

FIGURE NO.
7

PROJECT NO.
4953-18-0421

Path: G:\4953_Geotech\2018\180421 Angel's Landing Development\CAD\DWG\4953-18-0421_Fig-7_Well-Detail(18.05.29).dwg [RW-1]
Date: July 06, 2018 - 1:29pm By: vo.nguyen

Appendix A

Current Field Explorations and Laboratory Test Results

Appendix A Current Field Explorations and Laboratory Test Results

Current Exploration Borings

The soil conditions beneath the site were explored by drilling four borings including one bucket auger boring (designated BA-1) to depths of 86 feet bgs, two continuous core borings (designated CB-1 and CB-2) to depths of 131 and 200 feet bgs, and one Rotary-wash boring (designated RW-1) to a depth of 220 feet bgs at the locations shown on Figure 2.

Boring BA-1 was drilled using truck-mounted bucket-auger equipment to a depth of 86 feet bgs. After Boring BA-1 was drilled, a continuous core boring (Boring CB-1) was to be drilled to a depth of 131 feet bgs adjacent to Boring BA-1, with core obtained between the depth of the bottom of Boring BA-1 and 131 feet to obtain data below the economical depth limit of the bucket auger rig. Upon completion of drilling Boring BA-1, our engineering geologist attempted to down-hole log the boring to observe the presence and orientation of bedding planes, joints, and fractures in the bedrock as well as potential clay beds. However, because hazardous air conditions [high volatile organic compound (VOC) readings] were measured in the boring staring at a depth of 18 feet bgs, down-hole logging could not be safely performed below that depth. Therefore, the continuous core extracted from Boring CB-1 was obtained starting at a depth of 10 feet bgs. Boring CB-1 was terminated at an approximate depth of 131 feet bgs due to the presence of a hard, cemented zone. Therefore, the continuous core rig was moved approximately 30 feet west of the location of CB-1 to make a second attempt to drill to the target depth of 200 feet bgs. The second continuous core boring, designated Boring CB-2, successfully obtained continuous cores starting from a depth of 125 feet bgs down to the target depth of 200 feet bgs. The thickness of the cemented layer encountered was about 1 to 1.8 feet at the location of Boring CB-2.

Boring RW-1 was drilled using rotary wash-type drilling equipment to a depth of about 220 feet bgs. In addition to collecting samples for laboratory testing, he rotary wash boring was used to obtain shear wave velocity measurements to a depth of about 205 feet bgs using suspension logging techniques; the lower approximately 15 feet of the boring was required in order to accommodate the use of the suspension logging equipment. The shear wave velocity data will be used for seismic coefficient evaluation and for seismic studies for the future phases. After completion of the 210-foot-deep rotary wash boring, a groundwater monitoring well was installed to measure groundwater levels, with a screening interval selected to obtain the piezometric head within the alluvium layer at the location of Boring RW-1.

The soils encountered were logged by our field technician and undisturbed and bulk samples were obtained for laboratory inspection and testing. The logs of the current borings are presented on Figures A 1.1 through A-1.4; the depths at which undisturbed samples were obtained are indicated on the left side of the boring logs. The number of blows required to drive the Crandall sampler 12 inches using a 140 pound hammer falling 30 inches is indicated on the log. In addition to obtaining undisturbed samples, standard penetration tests (SPT) were also performed; the results of the tests are indicated on the logs. The soils are classified in the accordance with the Unified Soil Classification System described on Figure A-2.

Suspension logging was performed by GEOVision in Boring RW-1 to obtain shear and compressive wave velocities. The results of the suspension logging are presented in a report prepared by GEOVision, included as Appendix C.

Laboratory Test Results

Laboratory tests were performed on selected samples obtained from the borings to aid in the classification of the soils and to determine their engineering properties.

The field moisture content and dry density of the soils encountered were determined by performing tests on the undisturbed samples. The results of the tests are shown on the left side of the boring logs.

Tests to determine the percentage of fines (material passing through a No.200 sieve) in selected samples were performed. The results of these tests are presented on the boring logs.

To aid in classification of the soils and to define the plasticity characteristics of the materials, Atterberg Limits tests were performed to determine the liquid limit and plastic limit of several of the samples. The testing procedure was in general accordance with ASTM Designation D4318. The results of the tests are shown on the boring logs.

Direct shear tests were performed on selected undisturbed samples to determine the strength of the soils. The tests were performed at field moisture content and after soaking to near saturated moisture content and at various surcharge pressures. The values determined from the direct shear tests are presented on Figure A-3, Direct Shear Test Data.

Confined consolidation tests were performed on six undisturbed samples at field moisture content to determine the compressibility of the soils. The results of the tests are presented on Figure A-4.

To determine the particle size distribution of the soils and to aid in classifying the soils, mechanical analyses were performed on selected samples in accordance with the ASTM D 6913 test method. The results of the mechanical analyses are presented on the boring logs and Figure A-5.

Soil corrosivity tests were performed on samples of the on-site soils to determine their corrosion potential. The tests were performed for us by HDR. The test results are presented on Figures A-6.1 and A-6.2.

BORING BA-1

DATE DRILLED: 5/10/2018
EQUIPMENT USED: Bucket Auger
HOLE DIAMETER (in.): 24
G.S. ELEVATION: 352.5**

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. LATITUDE AND LONGITUDE OF BORING LOCATION SHOWN ON LOGS ARE APPROXIMATE; REFER TO PLOT PLAN FOR MORE ACCURATE LOCATION INFORMATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

ELEVATION (ft)	DEPTH (ft)	"N" VALUE STD. PEN. TEST	BLOWS/1 INCH	MOISTURE (% of dry wt.)	DRY DENSITY (pcf)	BLOW COUNTS* (blows/ft)	SAMPLE LOC.	DESCRIPTION
352.5	0							FILL - SANDY SILT - moist, light brown, fine sand, trace clay
350								FERNANDO FORMATION - SILTY SANDSTONE - moist, light brownish gray with orange brown iron oxide stains ,fine sand, some forams, irregular iron stained near-vertical joint to 6 feet
	5			13.2	106	3	X	
345								Sandy, light gray, massive, slightly friable, crude bed, B; N70-80E; 15S Mottled with abundant iron oxide stains
	10			10.3	105	3	X	Light yellowish brown
340								Light gray and light orangish brown Rootlet
	15			16.2	100	2	X	SILTSTONE - moist, light to medium greenish gray, minor iron staining, forams, few sandier beds (95% Passing No. 200 Sieve) Trace clay
335								
	20			17.8	103	2	X	
330								
	25			23.8	100	2	X	Light to medium orangish gray, massive
325								
	30					3	X	Slight seepage, cemented nodule top ring, medium greenish gray with iron staining, fine sand
320								
	35			27.3	95	3	X	Worm tube or cast, few forams, minor dispersed iron staining
315								
	40							

(CONTINUED ON FOLLOWING FIGURE)

Field Tech: AR
Prepared By: GA/KSH
Checked By: JF/RM

BORING BA-1 (Continued)

DATE DRILLED: 5/10/2018
EQUIPMENT USED: Bucket Auger
HOLE DIAMETER (in.): 24
G.S. ELEVATION: 352.5**

ELEVATION (ft)	DEPTH (ft)	"N" VALUE STD. PEN. TEST	BLOWS/1 INCH	MOISTURE (% of dry wt.)	DRY DENSITY (pcf)	BLOW COUNTS* (blows/ft)	SAMPLE LOC.	DESCRIPTION
				25.2	98	2		Silty fine sandstone bottom ring
310								
	45			24.9	100	2		
305								
	50			25.0	95	2		Seepage
300								
	55			26.4	97	2		Some unoxidized zones
295								
	60			24.2	98	3		Unoxidized, dark grayish green
290								
	65			25.3	96	3		(99% Passing No. 200 Sieve) (LL = 44, PI = 16)
285								
	70			25.0	98	3		Organic odor
280								
	75			24.9	98	6		
275								
	80							

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. LATITUDE AND LONGITUDE OF BORING LOCATION SHOWN ON LOGS ARE APPROXIMATE; REFER TO PLOT PLAN FOR MORE ACCURATE LOCATION INFORMATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

(CONTINUED ON FOLLOWING FIGURE)

Field Tech: AR
Prepared By: GA/KSH
Checked By: JF/RM

BORING BA-1 (Continued)

DATE DRILLED: 5/10/2018
EQUIPMENT USED: Bucket Auger
HOLE DIAMETER (in.): 24
G.S. ELEVATION: 352.5**

ELEVATION (ft)	DEPTH (ft)	"N" VALUE STD. PEN. TEST	BLOWS/1 INCH	MOISTURE (% of dry wt.)	DRY DENSITY (pcf)	BLOW COUNTS* (blows/ft)	SAMPLE LOC.	DESCRIPTION
				25.5	98	7		Rare forams
270								
	85			25.3	95	7		
								END OF BORING AT 86 FEET
265								
	90							
260								
	95							
255								
	100							
250								
	105							
245								
	110							
240								
	115							
235								
	120							

NOTES:

Hand auger upper 5 feet to avoid damage to underground utilities. Water seepage encountered at depths of 30 and 50 feet. Backfilled with soil cuttings and tamped. Downhole logged to 18 feet due to high VOC readings by Rosalind Munro CEG # 1269.

*Number of blows required to drive the Crandall sampler 12 inches using Kelly Bars weighing:

4,800 pounds from 0 to 29 feet
3,350 pounds from 30 to 58 feet
2,045 pounds from 59 to 86 feet

**Elevation based on ALTA/NSPS Survey provided by kpff, dated May 24, 2018.

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Field Tech: AR
Prepared By: GA/KSH
Checked By: JF/RM

BORING RW-1

DATE DRILLED: May 14 and May 15, 2018
EQUIPMENT USED: Mud Rotary
HOLE DIAMETER (in.): 4-7/8
G.S. ELEVATION: 290.0**

ELEVATION (ft)	DEPTH (ft)	"N" VALUE STD. PEN. TEST	BLOWS/1 INCH	MOISTURE (% of dry wt.)	DRY DENSITY (pcf)	BLOW COUNTS* (blows/ft)	SAMPLE LOC.	USCS	DESCRIPTION
	0								5-inch thick Portland Cement Concrete over 3-inch thick Base Course
									FILL - SANDY SILT - moist, light to medium brown, fine sand, seams of sand
285	5								
		18							
				15.5	100	16			
280	10								
		17							
								SM	ALLUVIUM - SILTY SAND - dense, moist, light brown, fine to medium grained, sample disturbed, (Sample disturbed)
275	15					69			
								SW-SM	WELL GRADED SAND with SILT - dense, moist, light brown, fine to coarse grained, trace silt, little gravel up to 1 inch in diameter
		34							(7% Passing No. 200 Sieve)
270	20								
				8.3	127	62			Sample disturbed (5% Passing No. 200 Sieve)
									Becomes wet, little to some gravel, with iron stains
		50/5½"							(Sample not recovered)
									Cobble up to 8 inches in diameter
									FERNANDO FORMATION - SILTSTONE - moist, dark grayish green, fine sand, unoxidized
265	25								
				24.9	97	34			
260	30								Dark greenish gray
						63			
									Approximately 2-inch thick cemented layer
255	35								
				24.7	101	40			
	40								

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B20SOIL_BLOWS_PER_INCH L:\70131 GEOTECH\GINTW\LIBRARY AMEC JUNE2012.GLB P:\4953 GEOTECH\2018-PROJ\180421 ANGEL'S LANDING DEVELOPMENT\3.2 ALL FIELD NOTES\4953-18-0421 GINT LOGS.GPJ 7/6/18

(CONTINUED ON FOLLOWING FIGURE)

Field Tech: AR
Prepared By: GA/KSH
Checked By: JF/RM

Proposed Angels Landing Development
Block Bordered by Olive Street, Hill Street, 4th Street, and Angel's Flight
Los Angeles, California

wood.

LOG OF BORING
Project: 4953-18-0421 Figure: A-1.2a

BORING RW-1 (Continued)

DATE DRILLED: May 14 and May 15, 2018
EQUIPMENT USED: Mud Rotary
HOLE DIAMETER (in.): 4-7/8
G.S. ELEVATION: 290.0**

ELEVATION (ft)	DEPTH (ft)	"N" VALUE STD. PEN. TEST	BLOWS/1 INCH	MOISTURE (% of dry wt.)	DRY DENSITY (pcf)	BLOW COUNTS* (blows/ft)	SAMPLE LOC.	DESCRIPTION
				24.8	97	38		Alternating sand layers
245	45			24.2	98	60		
240	50			24.6	98	41		
235	55			24.9	99	67		(97% Passing No. 200 Sieve) (LL = 40, PI = 12)
230	60			25.4	98	56		
225	65			25.2	97	64		
220	70			27.8	94	52		
215	75			27.0	93	69		
	80							

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B20SOIL_BLOWS_PER_INCH L:\70131 GEOTECH\GINTW\LIBRARY AMEC JUNE2012.GLB
P:\4953 GEOTECH\2018-PROJ\180421 ANGEL'S LANDING DEVELOPMENT\3.2 ALL FIELD NOTES\4953-18-0421 GINT LOGS.GPJ 7/6/18

(CONTINUED ON FOLLOWING FIGURE)

Field Tech: AR
Prepared By: GA/KSH
Checked By: JF/RM

BORING RW-1 (Continued)

DATE DRILLED: May 14 and May 15, 2018
EQUIPMENT USED: Mud Rotary
HOLE DIAMETER (in.): 4-7/8
G.S. ELEVATION: 290.0**

ELEVATION (ft)	DEPTH (ft)	"N" VALUE STD. PEN. TEST	BLOWS/1 INCH	MOISTURE (% of dry wt.)	DRY DENSITY (pcf)	BLOW COUNTS* (blows/ft)	SAMPLE LOC.	DESCRIPTION
				25.6	94	67		
205	85							Less sand
				26.7	94	78		
200	90							
				26.1	96	68		
195	95							
190	100							
				23.8	95	66		
185	105							
180	110							
				24.3	98	75		
175	115							
	120							

(CONTINUED ON FOLLOWING FIGURE)

Field Tech: AR
Prepared By: GA/KSH
Checked By: JF/RM

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. LATITUDE AND LONGITUDE OF BORING LOCATION SHOWN ON LOGS ARE APPROXIMATE; REFER TO PLOT PLAN FOR MORE ACCURATE LOCATION INFORMATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

**Proposed Angels Landing Development
Block Bordered by Olive Street, Hill Street,
4th Street, and Angel's Flight
Los Angeles, California**

wood.

LOG OF BORING
Project: 4953-18-0421 Figure: A-1.2c

BORING RW-1 (Continued)

DATE DRILLED: May 14 and May 15, 2018
EQUIPMENT USED: Mud Rotary
HOLE DIAMETER (in.): 4-7/8
G.S. ELEVATION: 290.0**

ELEVATION (ft)	DEPTH (ft)	"N" VALUE STD. PEN. TEST	BLOWS/1 INCH	MOISTURE (% of dry wt.)	DRY DENSITY (pcf)	BLOW COUNTS* (blows/ft)	SAMPLE LOC.	DESCRIPTION
						80/4"		(Sample not recovered)
165	125							
160	130					50/3"		(Sample not recovered)
								Approximately 1 foot thick cemented layer
155	135			23.1	101	83/10½"		Organic odor
150	140			23.8	98	80/9"		Few carbonate blebs, slight organic odor
145	145							
140	150			23.8	101	94/10"		CLAYSTONE - trace fine sand, (98% Passing No. 200 Sieve) (LL = 48, PI = 21)
135	155							
	160							

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. LATITUDE AND LONGITUDE OF BORING LOCATION SHOWN ON LOGS ARE APPROXIMATE; REFER TO PLOT PLAN FOR MORE ACCURATE LOCATION INFORMATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

B20SOIL_BLOWS_PER_INCH L:\70131 GEOTECH\GINTW\LIBRARY AMEC JUNE2012.GLB
P:\4953 GEOTECH\2018-PROJ\180421 ANGEL'S LANDING DEVELOPMENT\3.2 ALL FIELD NOTES\4953-18-0421 GINT LOGS.GPJ 7/6/18

(CONTINUED ON FOLLOWING FIGURE)

Field Tech: AR
Prepared By: GA/KSH
Checked By: JF/RM

BORING RW-1 (Continued)

DATE DRILLED: May 14 and May 15, 2018
EQUIPMENT USED: Mud Rotary
HOLE DIAMETER (in.): 4-7/8
G.S. ELEVATION: 290.0**

ELEVATION (ft)	DEPTH (ft)	"N" VALUE STD. PEN. TEST	BLOWS/1 INCH	MOISTURE (% of dry wt.)	DRY DENSITY (pcf)	BLOW COUNTS* (blows/ft)	SAMPLE LOC.	DESCRIPTION
				24.2	101	82/10"		
125	165							
120	170			23.4	101	77/10½"		
115	175							
110	180			23.6	98	76/10"		SILTSTONE - moist, gray to dark olive gray, fine sand
105	185							
100	190			24.0	99	79/10"		
95	195							
	200							

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(CONTINUED ON FOLLOWING FIGURE)

Field Tech: AR
Prepared By: GA/KSH
Checked By: JF/RM

BORING RW-1 (Continued)

DATE DRILLED: May 14 and May 15, 2018
EQUIPMENT USED: Mud Rotary
HOLE DIAMETER (in.): 4-7/8
G.S. ELEVATION: 290.0**

ELEVATION (ft)	DEPTH (ft)	"N" VALUE STD. PEN. TEST	BLOWS/1 INCH	MOISTURE (% of dry wt.)	DRY DENSITY (pcf)	BLOW COUNTS* (blows/ft)	SAMPLE LOC.	DESCRIPTION
				23.2	101	88/10½"	⊠	
85	205							
80	210							Trace clay
				23.0	100	89/10"	⊠	
75	215							
70	220							
				24.6	96	82/11"	⊠	END OF BORING AT 220 FEET, 11 INCHES
65	225							
60	230							
55	235							
	240							

END OF BORING AT 220 FEET, 11 INCHES

NOTES:
Hand auger upper 5 feet to avoid damage to underground utilities. Groundwater was not meausered. Suspension logging performed from 0 to 125 feet. After completion of initial drilling, borehole was reamed to a diameter of 8 inches to a depth of 31 feet below ground surface. Monitoring wells were installed in borehole on 5/21/2018. Refer to well construction diagram for further details.

* Number of blows required to drive the Crandall sampler 12 inches using 140-pound automatic hammer falling 30 inches.

**Elevation based on ALTA/NSPS Survey provided by kpff, dated May 24, 2018.

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. LATITUDE AND LONGITUDE OF BORING LOCATION SHOWN ON LOGS ARE APPROXIMATE; REFER TO PLOT PLAN FOR MORE ACCURATE LOCATION INFORMATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Field Tech: AR
Prepared By: GA/KSH
Checked By: JF/RM

BORING CB-1

DATE DRILLED: May 14, 2018
EQUIPMENT USED: CME-75: Continuous Core System
BOREHOLE SIZE (in.): 8-inch diameter
ELEVATION: 352 *

ELEVATION (ft)	DEPTH (ft)	RUN #	% RECOVERY	SAMPLE LOC.		DESCRIPTION
					SM	Top Soil/Grass FILL - SANDY SILT
350						**FERNANDO FORMATION** SILTSTONE - moist, tan to light brown, fine sand, trace medium, clayey
	5					
345						
	10	1	90			10-10.5: No recovery 10.5-14.1: very fine to fine sand, mottled orange and light brown, very soft, massive, moderately weathered, 2.5Y 6/4 light yellowish brown
340						14.1-14.7: increased clay content, mottled olive/brown/orange, weakly laminated, iron/magnesium banding, alternating layer of siltstone, sandstone, and claystone, bedding is subhorizontal, 5-15 degrees, 1/16 inch lenses 14.7-16.1: less clay
	15	2	100			16.1-17: more clay, mottled orange/gray 17-17.7: less clay
335						SILTSTONE - very fine sand and silt, mottled orange and olive gray, massive, slightly weathered, very soft to soft, 5Y5/2 olive gray 17.7-18.9: subvertical fracture, oxidized 19.2-19.7: laminated zone of Siltstone, Sandstone, and Claystone, 1/16-1/8 inch lenses, subhorizontal, dipping approximately 5-10 degrees
	20					

Geologist: PER
Prepared By: KSH
Checked By: PER/RM

(CONTINUED ON FOLLOWING FIGURE)

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

BORING CB-1 (Continued)

DATE DRILLED: May 14, 2018
EQUIPMENT USED: CME-75: Continuous Core System
BOREHOLE SIZE (in.): 8-inch diameter
ELEVATION: 352 *

ELEVATION (ft)	DEPTH (ft)	RUN #	% RECOVERY	SAMPLE LOC.	DESCRIPTION
		3	100		SILTSTONE - fine sand, rare medium sand, mottled orange/olive gray with iron/magnesium staining, massive, slightly weathered to moderately weathered, very soft, 5Y5/2 olive gray
330					
					23.7-23.9: clayey zone, olive gray
	25	4	100		Clayey zone, 5Y5/2 olive gray
325					SILTSTONE - very fine to fine sand, olive with iron/magnesium staining, massive, very soft, moderately weathered, 2.5Y5/4 light olive brown
	30	5	92		
320					32.6-32.8: clayey zone - very soft, moist, massive, 10YR5/6 yellowish brown
					32.8-33: cemented/siliceous zone, hard, yellowish brown
					33-33.4: laminated zone, subhorizontal
					33.4-34: SILTSTONE - massive, mottled olive and orange, carbonate stringers, very soft to soft
					34-34.5: cemented/siliceous conglomerate zone, very hard, rounded gravel clasts, ooids
	35	6	100		35-35.9: SILTSTONE - laminated sand, silt, and clay, sand bed dipping approximately 15-20 degrees
					35.8: alternating oxidized laminations, dipping approximately 20 degrees 35.9-36.1: Fissile zone 35.9: contact dipping approximately 10 degrees SILTSTONE - very fine sand, clayey, generally olive color, orange mottling, carbonate nodules or fossils, moist, very soft, moderately weathered, massive, iron/magnesium staining, 2.5Y4/4 olive brown
315					
	40				

Geologist: PER
Prepared By: KSH
Checked By: PER/RM

(CONTINUED ON FOLLOWING FIGURE)

Proposed Angels Landing Development
Block Bordered by Olive Street, Hill Street, 4th Street, and Angel's Flight
Los Angeles, California

wood.

LOG OF BORING
Project: 4953-18-0421 Figure: A-1.3b

BORING CB-1 (Continued)

DATE DRILLED: May 14, 2018
EQUIPMENT USED: CME-75: Continuous Core System
BOREHOLE SIZE (in.): 8-inch diameter
ELEVATION: 352 *

ELEVATION (ft)	DEPTH (ft)	RUN #	% RECOVERY	SAMPLE LOC.
		7	100	
310				
	45	8	100	
305				
	50	9	100	
300				
	55	10	100	
295				
	60			

41.1: iron/magnesium staining subparallel to bedding

41.8: low angle fracturing with oxidation planes dipping approximately 10-15 degrees
42.2-43.5: very soft, slightly more clay content

44-45: faint gradational bedding, alternating siltstone and clayey siltstone, dipping approximately 15 degrees

46.8: oxidized laminations, possible bedding, dipping approximately 30-35 degrees

47.4: clay nodule ¾ inch in diameter
47.7: discontinuous fracture, oxidized

48.9: fracture, oxidized, dipping approximately 20 degrees

49.4-49.7: carbonate/fossil banding, dipping approximately 20 degrees, probable relict bedding
49.7-50: bedded zone, alternating Siltstone, fine Sandstone, dipping approximately 25 degrees
50-52: increase in medium sand, abundant iron/magnesium staining, slightly cemented

SILTSTONE - massive, mottled olive and orange, very soft, slightly to moderately weathered, oxidized where granular, slightly micaceous, 2.5Y4/3-5/3 light olive brown to olive brown

54-55: zone of discontinuous laminations, dipping approximately 10-20 degrees, Siltstone and Sandstone

58.2-58.5: transition from oxidized to unoxidized
SILTSTONE (unoxidized) - very fine to fine sand with rare medium sand, micaceous, laminar pockets of clean fine sand, massive, rare specks of magnesium, carbonate nodules/stringers, low angle fissility, generally wavy to convoluted laminations of fine sand, 1 Gley 4/1, dark greenish gray
59.1: sandy zone, fine sand

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Geologist: PER
Prepared By: KSH
Checked By: PER/RM

(CONTINUED ON FOLLOWING FIGURE)

BORING CB-1 (Continued)

DATE DRILLED: May 14, 2018
EQUIPMENT USED: CME-75: Continuous Core System
BOREHOLE SIZE (in.): 8-inch diameter
ELEVATION: 352 *

ELEVATION (ft)	DEPTH (ft)	RUN #	% RECOVERY	SAMPLE LOC.	DESCRIPTION
		11	100		
290					
					63.3: manganese nodule 1/8 inch in diameter
	65	12	100		
285					67-69: sandy pockets, discontinuous laminations, very fine sand, dipping approximately 10 degrees
					68.3: grading slightly more clay
	70	13	100		70: cemented zone 2 inches thick
280					
					74: shell zone 74.3: abundant discontinuous sand lenses
	75	14	100		
					76.2: micaceous, subvertical sandy stringer
275					
	80				

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(CONTINUED ON FOLLOWING FIGURE)

Geologist: PER
Prepared By: KSH
Checked By: PER/RM

BORING CB-1 (Continued)

DATE DRILLED: May 14, 2018
EQUIPMENT USED: CME-75: Continuous Core System
BOREHOLE SIZE (in.): 8-inch diameter
ELEVATION: 352 *

ELEVATION (ft)	DEPTH (ft)	RUN #	% RECOVERY	SAMPLE LOC.	Description
		15	100		
270					
					84: grading clayier SILTSTONE (unoxidized) - massive, fine sand, micaceous, few to some clay, soft, nodules and stringers of fine sand, abundant mechanical fracturing, generally with wavy to convoluted laminations of fine sand, 1Gley 4/1, dark greenish gray
	85	16	100		
265					
					89: slightly less clay
	90	17	100		
					91-91.3: sandy zone, fine sand
260					
					92.4: manganese nodule 1/8 inch in diameter
					94.3: sand lens 1/8 inch thick, dipping approximately 25-30 degrees
	95	18	100		95: fine laminations with subhorizontal to 10 degrees of dip, few dipping 20-30 degrees, wavy to convoluted bedding, blocky to weak fissility
255					
					98.8: faint laminations of alternating silt and very fine sand, dipping approximately 5-10 degrees
	100				

Geologist: PER
Prepared By: KSH
Checked By: PER/RM

(CONTINUED ON FOLLOWING FIGURE)

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

BORING CB-1 (Continued)

DATE DRILLED: May 14, 2018
EQUIPMENT USED: CME-75: Continuous Core System
BOREHOLE SIZE (in.): 8-inch diameter
ELEVATION: 352 *

ELEVATION (ft)	DEPTH (ft)	RUN #	% RECOVERY	SAMPLE LOC.	DESCRIPTION
	100	19	100		100-101.6: fissile zone
					101.6-101.7: moderate cementation
250					102.3-102.8: sandy zone, fine sand, convoluted laminations
					103.7: sandy stringers, bioturbation, fine sand, subvertical or round
					104: subhorizontal laminations of very fine sand, blocky
					104.6: shells
	105	20	100		105-107: Claystone to Clayey Siltstone, blocky
					106: charcoal, 5mm in diameter
245					107: sandier, with 1/16 inch thick fine sand lenses, dipping approximately 10 degrees
					108.6: slightly sandier, fine sand
	110	21	92		110-110.4: No recovery
					110.3: sandy stringers and rings, bioturbation or wormholes
240					
					112.5: increased mica and silica content, continued sandy zone, very fine sand
					113.6-118: slight increase in clay
	115	22	96		115.2-116.2: fissile, low angle
235					
					118: increase in fine sand laminations, discontinuous, undulatory, some planar lenses dipping approximately 30 degrees
					119: grading sandier
	120				119.7: contact with fine sand layer, dipping approximately 25 degrees

Geologist: PER
Prepared By: KSH
Checked By: PER/RM

(CONTINUED ON FOLLOWING FIGURE)

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

BORING CB-1 (Continued)

DATE DRILLED: May 14, 2018
EQUIPMENT USED: CME-75: Continuous Core System
BOREHOLE SIZE (in.): 8-inch diameter
ELEVATION: 352 *

ELEVATION (ft)	DEPTH (ft)	RUN #	% RECOVERY	SAMPLE LOC.	DESCRIPTION
	120	23	100		120: SILTSTONE - very fine sand, some clay, micaceous, very soft, unoxidized, some shells, massive, discontinuous lenses of silt, clayey silt, and very fine sand to fine sand throughout, weak fissility, 1Gley 3/1, dark greenish gray
230					
					123.3-124.7: increase in clay content
	125	24	100		
					126: wormholes, bioturbation
225					
					127.2: sand lens 1/8 inch in diameter, dipping approximately 15 degrees 127.5: increasing sand content, fine sand, micaceous
					128.7: wormholes, bioturbation 129.1: fine sand lens 1/8 inch thick, subhorizontal
	130	25	0		130: rig chattering, slow advancement, cemented zone 130.5: Continued cemented zone
					END OF BORING AT 131 FEET DUE TO REFUSAL
220					
	135				
215					
	140				

NOTES:

Hand auger upper 5 feet to avoid damage to underground utilities. Groundwater was not encountered. Backfilled with bentonite grout soil mix.

*Elevations based on ALTA/NSPS Survey provided by kpff, dated May 24, 2018.

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Geologist: PER
Prepared By: KSH
Checked By: PER/RM

Proposed Angels Landing Development
Block Bordered by Olive Street, Hill Street, 4th Street, and Angel's Flight
Los Angeles, California

wood.

LOG OF BORING
Project: 4953-18-0421 Figure: A-1.3g

BORING CB-2

DATE DRILLED: May 15, 2018
EQUIPMENT USED: CME-75: Continuous Core System
BOREHOLE SIZE (in.): 8-inch diameter
ELEVATION: 350 *

ELEVATION (ft)	DEPTH (ft)	RUN #	% RECOVERY	SAMPLE LOC.	DESCRIPTION
					Blind drilled to 125 feet Potholed upper 5 feet for utility clearance Fernando Formation at 1.5 feet Cuttings are generally silty sand, fine, trace medium, moist, 2.5Y6/6, olive yellow Unoxidized cuttings at 50 feet, 5Y3/1, very dark gray Wet cuttings at 80 feet, seepage
225	125	1	100		**FERNANDO FORMATION** SILTSTONE - unoxidized, very fine sand, some clay, slightly to moderately weathered, slightly fractured, massive, very soft, contains wavy to convoluted fine sand laminations in subhorizontal cementations, micaceous, 1Gley 4/1 dark greenish gray 125-125.3: sandy zone, very fine, convoluted laminations, dipping approximately 20-25 degrees 128.3: slightly clayier, some wormholes/bioturbation
220	130	2	94		131.9: sand pocket 5 mm in diameter, very fine sand, abundant wormholes/bioturbation 132.5-132.6: laminated fine sand layer, possible lower contact dipping at approximately 15 degrees 133.8: increased sand content, very fine sand, some lenses dipping approximately 25 degrees, discontinuous 134: abundant wormholes/bioturbation
215	135	3	92		135.6-136.2: thinly bedded zone of silt, very fine sand, clayey silt, gradational contacts, beds are 1/16 inch thick, subhorizontal 136.7-137.7: cemented sand and gravel zone, gravel up to ¾ inch in diameter 137.7-138.2: thinly bedded zone, very fine sand, silt, clayey silt, 1/16 inch thick laminations, some cross bedding 138.2: increased sand content, very fine sand 138.4-141.5: pockets of fine sand, cemented bedding, and possible bioturbation, general increase in sand content
	140				

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Geologist: PER
Prepared By: KSH
Checked By: PER/RM

(CONTINUED ON FOLLOWING FIGURE)

BORING CB-2 (Continued)

DATE DRILLED: May 15, 2018
EQUIPMENT USED: CME-75: Continuous Core System
BOREHOLE SIZE (in.): 8-inch diameter
ELEVATION: 350 *

ELEVATION (ft)	DEPTH (ft)	RUN #	% RECOVERY	SAMPLE LOC.	DESCRIPTION
		4	100		141.5-141.6: bed of very fine sand, laminated, lower contact dipping approximately 30 degrees 141.6: SILTSTONE - very fine sand, some clay, slightly weathered, no fractures, very soft, few cemented zones, wavy to convoluted gradational laminations (thinly bedded), generally subhorizontal bedding, micaceous, 1Gley 4/1, dark greenish gray 142.8: bed of very fine sand, ½ inch thick, lower contact dipping approximately 20 degrees, increased sand content
205	145	5	98		144.9-150: very fine sand zone, convoluted bedding, discontinuous sand pockets 149: grading clayier
200	150	6	100		150: less sand, massive, moist 153: clay nodule, 1 inch in diameter 153.1: pocket of shells and charcoal 154: increased fine sand content
195	155	7	100		156.3: very fine sand bed, 1/16 inch thick, dipping 15 to 20 degrees 157: very fine sand bed, 1/8 inch thick, crossbedded, subhorizontal base 157.1-157.3: laminated zone of silt and clay, clay seams 1/16 inch thick, subhorizontal SILTSTONE - very fine sand, some clay, slightly weathered, very soft, unfractured to slightly fractured, faintly bedded, occasional clayey laminations, micaceous, some wormholes and bioturbation 157.5-157.7: zone of clay seams, 1/16 inch thick, subhorizontal 157.8: faintly laminated 159.7: charcoal, 1/8 inch in diameter
	160				

Geologist: PER
Prepared By: KSH
Checked By: PER/RM

(CONTINUED ON FOLLOWING FIGURE)

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

BORING CB-2 (Continued)

DATE DRILLED: May 15, 2018
EQUIPMENT USED: CME-75: Continuous Core System
BOREHOLE SIZE (in.): 8-inch diameter
ELEVATION: 350 *

ELEVATION (ft)	DEPTH (ft)	RUN #	% RECOVERY	SAMPLE LOC.	Description
		8	100		160.8: clay seam, 1/16 inch thick, subhorizontal 161: clay seam, 1/16 inch thick, subhorizontal 161.8-162: zone of laminated clay, 1/16 inch thick seams, subhorizontal 164.3-164.5: zone of laminated clay, 1/16 inch thick seams, subhorizontal
185	165	9	100		165: darker color, 1 Gley 3/1 dark greenish gray 166: grading sandier, micaceous 167-168: faint laminations, bedding dips approximately 5 to 10 degrees 168.5: fine sand pocket
180	170	10	100		171.6: clay seam, 1/16 inch thick, subhorizontal 171.7: clay seam, 1/16 inch thick, subhorizontal 171.8: clay seam, 1/16 inch thick, subhorizontal 172.5-172.6: zone of clay seams, 1/16 inch thick, subhorizontal 174: clay seam, 1/16 inch thick, subhorizontal, dipping ~5 degrees 174.1: clay seam, 1/16 inch thick, subhorizontal, dipping ~5 degrees 174.5: clay seam, 1/16 inch thick, subhorizontal, dipping ~5 degrees
175	175	11	96		176: grading sandier 176.1: clay seam, 1/16 inch thick, subhorizontal 177.1-177.3: clay seams, 1/16 inch thick, subhorizontal 177.4: clay seam, 1/16 inch thick, subhorizontal SILTSTONE - some very fine sand, some clay, very soft, slightly weathered, slightly fractured, massive, some wormholes, bioturbation, 1Gley 3/1 dark greenish gray
	180				

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

(CONTINUED ON FOLLOWING FIGURE)

Geologist: PER
Prepared By: KSH
Checked By: PER/RM

BORING CB-2 (Continued)

DATE DRILLED: May 15, 2018
EQUIPMENT USED: CME-75: Continuous Core System
BOREHOLE SIZE (in.): 8-inch diameter
ELEVATION: 350 *

ELEVATION (ft)	DEPTH (ft)	RUN #	% RECOVERY	SAMPLE LOC.	Description
		12	96		181.6: grading clayier 181.8: contact, depositional, wavy 182.9, 183.3,183.8: clay seams, 1/16 inch thick, subhorizontal 184: pockets of very fine sand
165	185	13	100		186-189.5: very thinly bedded, cyclic deposition of silt and clay seams, seams are subhorizontal, 1/16 inch thick, and spaced 1 to 2 inches apart, dipping approximately 5 to 15 degrees 189.5-193.9: thinly bedded with cyclic deposition of silt and clay seams, seams are subhorizontal and 1/16 inch thick, generally massive between seams, seams are spaced 2 to 4 inches apart, dipping approximately 5 to 15 degrees
160	190	14	100		193.9: less clay, increasing sand content SILTSTONE - massive, micaceous, slightly to moderately weathered, very soft, occasional laminated zones, 1Gley 4/1 dark greenish gray
155	195	15	100		196.5: sand lens, 1/16 inch thick, discontinuous, very fine 198.8-198.9: laminated zone, fine sand, silt and clayey laminations END OF BORING AT 200 FEET
	200				

NOTES:

Hand auger upper 5 feet to avoid damage to underground utilities. Blind drilled from 5 to 125 feet below the ground surface. Groundwater was not encountered. Seepage encountered at 80 feet below the ground surface. Backfilled with bentonite grout soil mix.

*Elevations based on ALTA/NSPS Survey provided by kpff, dated May 24, 2018.

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Geologist: PER
Prepared By: KSH
Checked By: PER/RM

MAJOR DIVISIONS			GROUP SYMBOLS	TYPICAL NAMES
COARSE GRAINED SOILS (More than 50% of material is LARGER than No. 200 sieve size)	GRAVELS (More than 50% of coarse fraction is LARGER than the No. 4 sieve size)	CLEAN GRAVELS (Little or no fines)	GW	Well graded gravels, gravel - sand mixtures, little or no fines.
			GP	Poorly graded gravels or grave - sand mixtures, little or no fines.
		GRAVELS WITH FINES (Appreciable amount of fines)	GM	Silty gravels, gravel - sand - silt mixtures.
			GC	Clayey gravels, gravel - sand - clay mixtures.
	SANDS (More than 50% of coarse fraction is SMALLER than the No. 4 Sieve Size)	CLEAN SANDS (Little or no fines)	SW	Well graded sands, gravelly sands, little or no fines.
			SP	Poorly graded sands or gravelly sands, little or no fines.
		SANDS WITH FINES (Appreciable amount of fines)	SM	Silty sands, sand - silt mixtures
			SC	Clayey sands, sand - clay mixtures.
FINE GRAINED SOILS (More than 50% of material is SMALLER than No. 200 sieve size)	SILTS AND CLAYS (Liquid limit LESS than 50)		ML	Inorganic silts and very fine sands, rock flour, silty of clayey fine sands or clayey silts and with slight plasticity.
			CL	Inorganic lays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
			OL	Organic silts and organic silty clays of low plasticity.
	SILTS AND CLAYS (Liquid limit GREATER than 50)		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
			CH	Inorganic clays of high plasticity, fat clays
BEDROCK				SANDSTONE
				SILTSTONE
				GRANITE

Undisturbed Sample	Auger Cuttings
Split Spoon Sample	Bulk Sample
Rock Core	Crandall Sampler
Dilatometer	Modified California Sampler
Packer	No Recovery
Water Table at time of drilling	Water Table after drilling

Correlation of Penetration Resistance with Relative Density and Consistency

SAND & GRAVEL		SILT & CLAY	
No. of Blows	Relative Density	No. of Blows	Consistency
0 - 4	Very Loose	0 - 1	Very Soft
5 - 10	Loose	2 - 4	Soft
11 - 30	Medium Dense	5 - 8	Medium Stiff
31 - 50	Dense	9 - 15	Stiff
Over 50	Very Dense	16 - 30	Very Stiff
		Over 30	Hard

Reference: The Unified Soil Classification System, Corps of Engineers, U.S. Army Technical Memorandum No. 3-357, Vol. 1, March, 1953 (Revised April, 1960)

BOUNDARY CLASSIFICATIONS: Soils possessing characteristics of two groups are designated by combinations of group symbols.

SILT OR CLAY	SAND			GRAVEL		Cobbles	Boulders
	Fine	Medium	Coarse	Fine	Coarse		

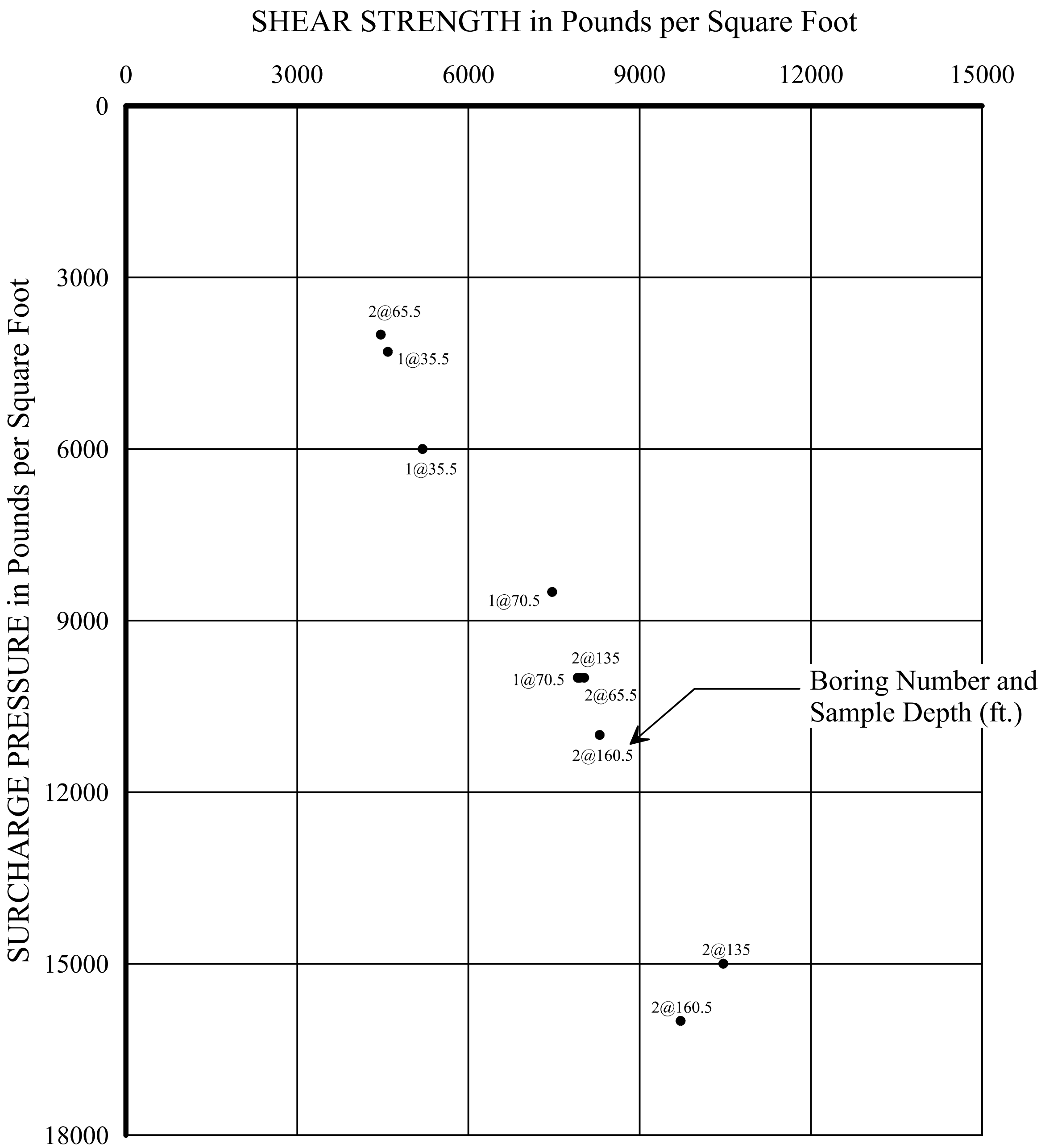
No.200 No.40 No.10 No.4 3/4" 3" 12"

U.S. STANDARD SIEVE SIZE

KEY TO SYMBOLS AND DESCRIPTIONS

wood.

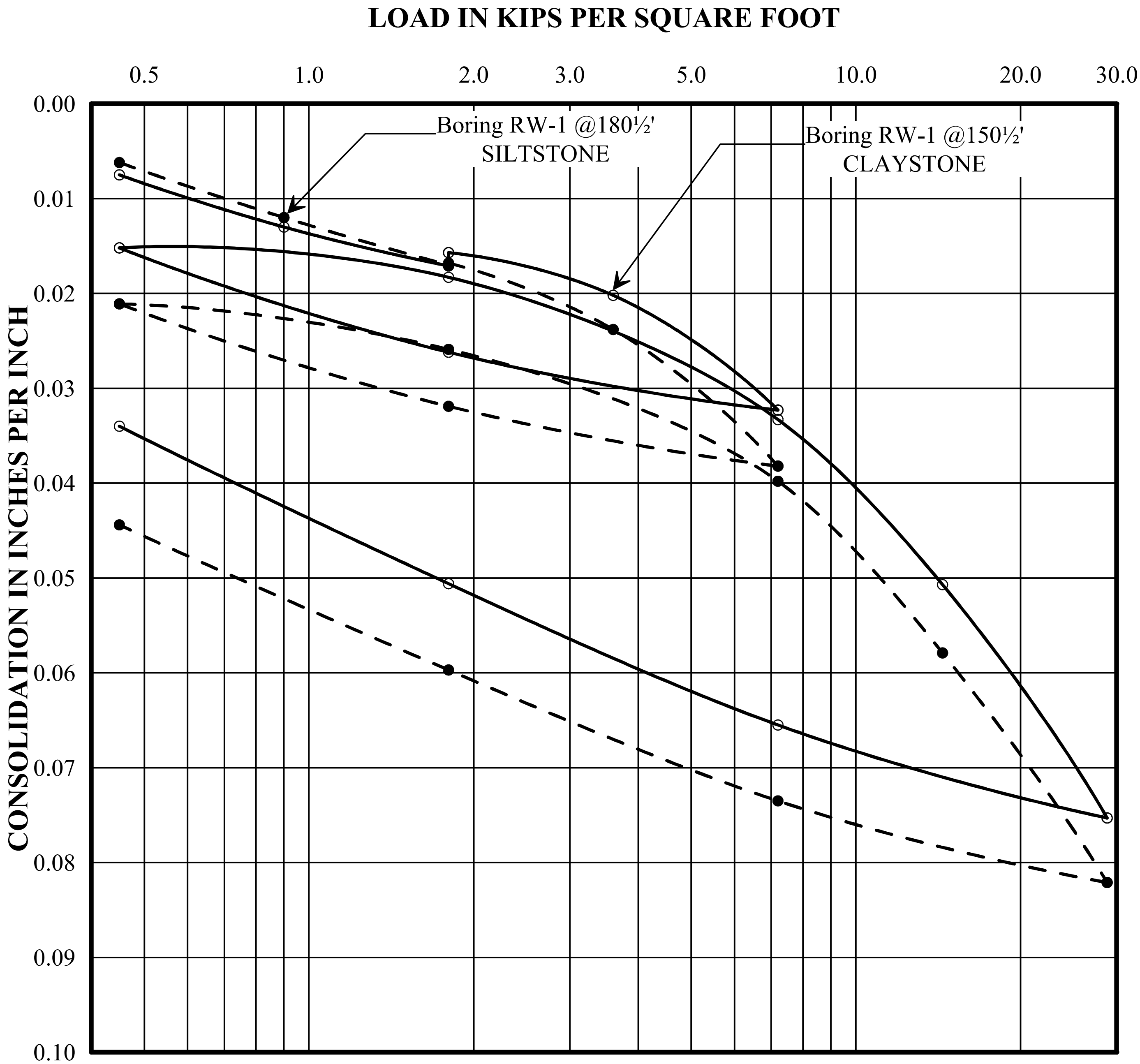
Figure A-2



● Samples tested at field moisture content
"1" indicates Boring BA-1
"2" indicates Boring RW-1
Peak shear strength shown.

Prepared/Date: KSH 6/11/2018
Checked/Date: GA 6/13/2018

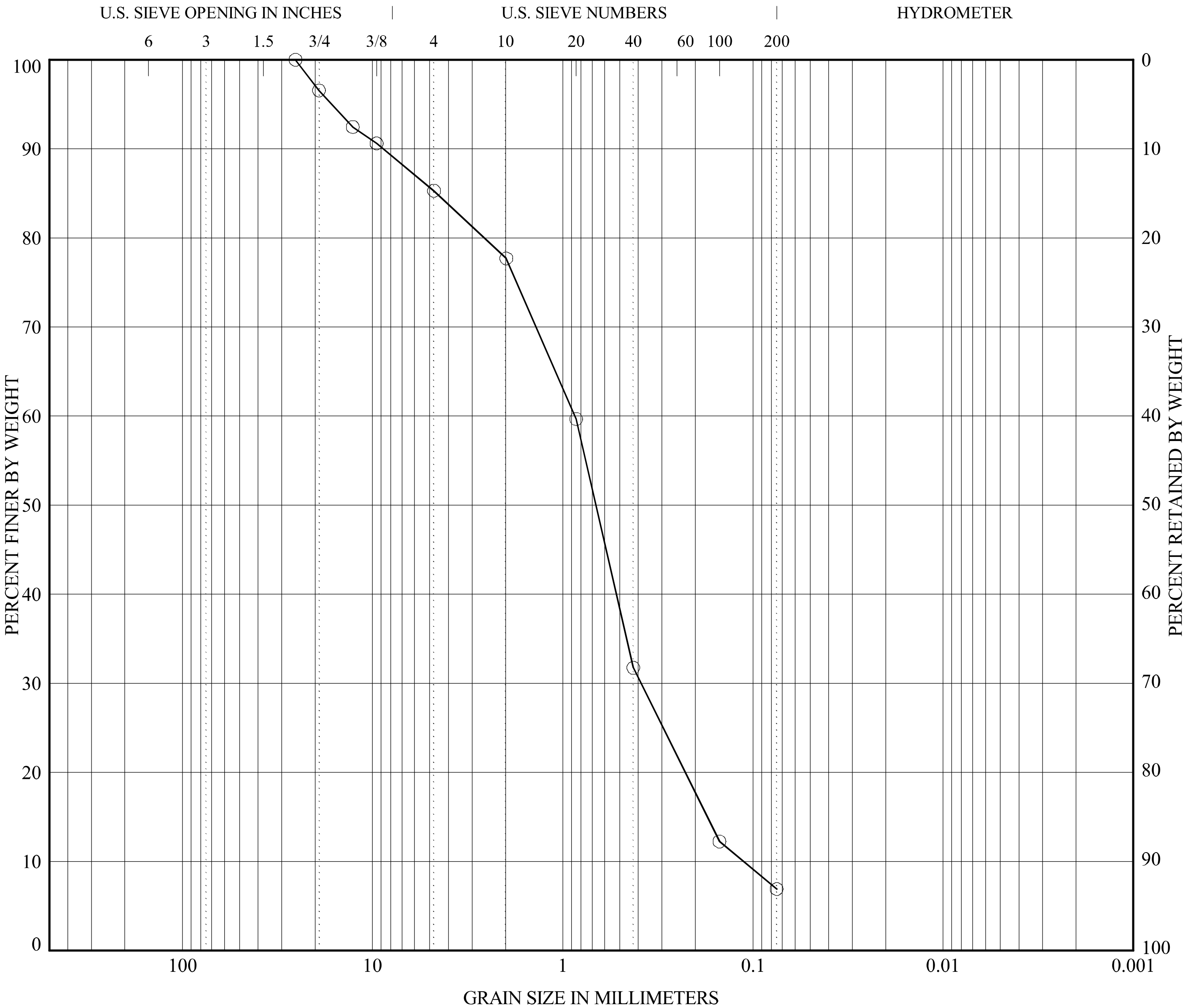
Proposed Angels Landing Development Block Bordered by Olive Street, Hill Street, 4th Street, and Angels Flight Los Angeles, California	wood.	DIRECT SHEAR TEST DATA Project No. 4953-18-0421 Figure A-3



Note: Water added to sample after consolidation under a load of 1.8 kips per square foot.

Prepared/Date: KSH 6/14/2018
Checked/Date: GA 6/18/2018

Proposed Angels Landing Development Block Bordered by Olive Street, Hill Street, 4th Street, and Angels Flight Los Angeles, California	wood.	CONSOLIDATION TEST DATA Project 4953-18-0421 Figure A-4



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

SYMBOL	BORING	DEPTH (ft)	CLASSIFICATION	LL (%)*	PL (%)*	PI (%)*	C_c	C_u
○	RW-1	17.5	WELL GRADED SAND WITH SILT	--	--	--	1.6	7.7

SYMBOL	BORING	DEPTH (ft)	D_{100} (mm)	D_{60} (mm)	D_{30} (mm)	D_{10} (mm)	% Gravel	% Sand	% Silt or % Clay
○	RW-1	17.5	25.40	0.864	0.387	0.112	14.7	78.4	6.9

Laboratory Test Method: ASTM D 422

*As determined by ASTM D 4318; see attached Atterberg Limits Test Results.

Prepared/Date: KSH 6/14/2018
Checked/Date:

Proposed Angels Landing Development
Block Bordered by Olive Street, Hill Street,
4th Street, and Angel's Flight
Los Angeles, California

wood.

PARTICLE SIZE DISTRIBUTION
Project No.: 4953-18-0421
Figure: A-5

AMEC FW_GRAIN SIZE L:\70131 GEOTECH\GINTW\LIBRARY AMEC JUNE2012.GLB
P:\4953 GEOTECH\2018-PROJ\180421 ANGEL'S LANDING DEVELOPMENT\3.2 ALL FIELD NOTES\4953-18-0421 GINT LOGS.GPJ 7/6/18

TRANSMITTAL LETTER

DATE: May 31, 2018

ATTENTION: **Gwen Arreguin**

TO: WOOD, PLC
6001 Rickenbacker Road
Los Angeles, CA 90040

SUBJECT: Laboratory Test Data
Proposed Angel's Landing Development
Your #4953-18-0421, HDR Lab #18-0373LAB

COMMENTS: Enclosed are the results for the subject project.

James T. Keegan, MD
Laboratory Services Manager

431 West Baseline Road · Claremont, CA 91711
Phone: 909.962.5485 · Fax: 909.626.3316

Table 1 - Laboratory Tests on Soil Samples

WOOD, PLC
Proposed Angel's Landing Development
Your #4953-18-0421, HDR Lab #18-0373LAB
31-May-18

Sample ID			B-1* @ 5	B-2** @ 100.5
Resistivity		**Units**		
as-received		ohm-cm	4,400	14,800
saturated		ohm-cm	840	800
pH			7.1	7.4
Electrical Conductivity		mS/cm	0.63	0.61
Chemical Analyses				
Cations				
calcium	Ca^{2+}	mg/kg	76	92
magnesium	Mg^{2+}	mg/kg	39	75
sodium	Na^{1+}	mg/kg	422	212
potassium	K^{1+}	mg/kg	9.2	155
Anions				
carbonate	CO_3^{2-}	mg/kg	ND	ND
bicarbonate	HCO_3^{1-}	mg/kg	52	390
fluoride	F^{1-}	mg/kg	ND	ND
chloride	Cl^{1-}	mg/kg	134	24
sulfate	SO_4^{2-}	mg/kg	1,170	1,020
phosphate	PO_4^{3-}	mg/kg	23	ND
Other Tests				
ammonium	NH_4^{1+}	mg/kg	ND	63
nitrate	NO_3^{1-}	mg/kg	1.6	1.7
sulfide	S^{2-}	qual	na	na
Redox		mV	na	na

Resistivity per ASTM G187, Cations per ASTM D6919, Anions per ASTM D4327, and Alkalinity per APHA 2320-B.
Electrical conductivity in millisiemens/cm and chemical analyses were made on a 1:5 soil-to-water extract.
mg/kg = milligrams per kilogram (parts per million) of dry soil.
Redox = oxidation-reduction potential in millivolts
ND = not detected
na = not analyzed
*B-1 indicates BA-1
**B-2 indicates RW-1

Appendix B

Prior Field Explorations and Laboratory Test Results

Appendix B Prior Field Explorations and Laboratory Test Results by Our Predecessor Firms

Our predecessor firms performed subsurface exploration and laboratory testing. Boring logs are presented in Figures B-1, Figures B-2.1 through B-2.3, Figures B-3.1 through B-3.3, and Figures B-4.1 through B-4.2. The following laboratory test results are presented:

- Moisture and density: presented on the boring logs.
- Direct shear: presented in Figures B-2.4, B-3.4, B-3.5, and B-4.3.
- Consolidation: presented in Figures B-2.5, B-2.6, B-3.6, B-3.7, B-4.4 and B-4.5.
- Expansion Index: presented in Figure B-2.7, B-2.8
- Compaction: presented in Figure B-4.6
- Corrosion: presented in Figures B-3.8 through B-3.11.

JOB A-68185 DATE 9-4-68 DR Maa O.E. V.L.E. CHKD JM YM

BORING 9

DATE DRILLED: August 16, 1968

EQUIPMENT USED: 18"-Diameter Bucket

ELEVATION 339.9

ELEVATION (ft.)	DEPTH (ft.)	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	SAMPLE
		13.9	90	■
				■
		22.6	98	■
330	10			
		14.7	106	■
				■
320	20	25.5	100	■
		25.6	98	■
310	30			

ML FILL - SANDY SILT - 5% to 10% pieces of brick and concrete, light brown and light grey

20% to 30% pieces of brick and concrete

CL FILL - SILTY CLAY and SANDY SILT - few pieces of brick and concrete, mottled brown

SHALE (SILTSTONE) - thickly bedded, highly fractured, light greyish-brown

Light grey and light brown

NOTE: Water not encountered. No caving.

LOG OF BORING

LEROY CRANDALL AND ASSOCIATES

PLATE B-1

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

JOB AE-76087 DATE 6-30-76 O.E. CHKD.

SW

BORING 1

DATE DRILLED: June 7, 1976

EQUIPMENT USED: 24"-Diameter Bucket

ELEVATION 307 City of Los Angeles Datum

ELEVATION (ft.)	DEPTH (ft.)	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu.ft.)	BLOWS *	SAMPLE		Description
						CL ML	FILL - CLAY and SILT - few gravel, pieces of brick and concrete, mottled brown
305		19.6	109	3	■		
		26.2	96	1	■		
	5					ML	FILL - SILT - mottled greyish-brown
		25.9	95	0	■		
							Piece of wood
300							SILTSTONE - weathered, fractured, light greyish-brown
		31.6	89	2	■		
	10						
		29.3	94	4	■		
295							
	15	27.5	95	3 (10" PEN)	■		
290							
	20	27.3	98	4 (10" PEN)	■		SILTSTONE - thickly bedded, dark grey
285							
	25	25.3	98	7 (10" PEN)	■		

(CONTINUED ON FOLLOWING PLATE)

*Number of blows required to drive sampler 12".

Driving Weight	Stroke
Rotary Wash:	
Boring 6	
300 lbs.	2½'
Bucket:	
Borings 1,2,3,4,5,6,7&8	
1' to 25' = 1600 lbs.	1'
below 25' = 800 lbs	1'

LOG OF BORING

LEROY CRANDALL AND ASSOCIATES

BORING 1 (CONTINUED)

DATE DRILLED: June 7, 1976
EQUIPMENT USED: 24"-Diameter Bucket

ELEVATION (ft.)	DEPTH (ft.)	MOISTURE (% of dry wt.)	DRY DENSITY (lbs/cu.ft.)	BLOWS	SAMPLE
280					
	30	23.8	103	10 (10" PEN)	
275					
	35	23.9	101	11 (10" PEN)	
270					
	40	24.2	102	10 (10" PEN)	

ELEVATION

NOTE: Water not encountered. No caving.

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

JOB AE-76087 DATE 6-30-76 D. RL O.E. ____ CHKD. ____ SW

LOG OF BORING

LEROY CRANDALL AND ASSOCIATES

BORING 5

DATE DRILLED: June 7, 1976
EQUIPMENT USED: 24"-Diameter Bucket

ELEVATION 281

ELEVATION (ft.)	DEPTH (ft.)	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu.ft.)	BLOWS
280				
		9.3	120	8
	5	11.5	117	3
275				
		15.8	115	3
		18.1	110	2
	10			
270				
		6.8	115	7
	15			
265				
		9.1	123	7
	20			
260				
		25.0	100	4
	25			

SAMPLE	Description
	2" Asphaltic Paving
	FILL - SILTY SAND - well graded, light brown
	FILL - SHALE - some sandstone and Clay, few pieces of brick and concrete, mottled brown
CL	FILL - SANDY CLAY - few gravel, pieces of brick, mottled brown
CL	SILTY CLAY - dark brown
CL	SANDY CLAY - brown
SC	CLAYEY SAND - well graded, about 20% gravel, brown
GW	SANDY GRAVEL - well graded, about 20% cobbles to 12" in size, greyish-brown
	SILTSTONE - thickly bedded, weathered, dark grey

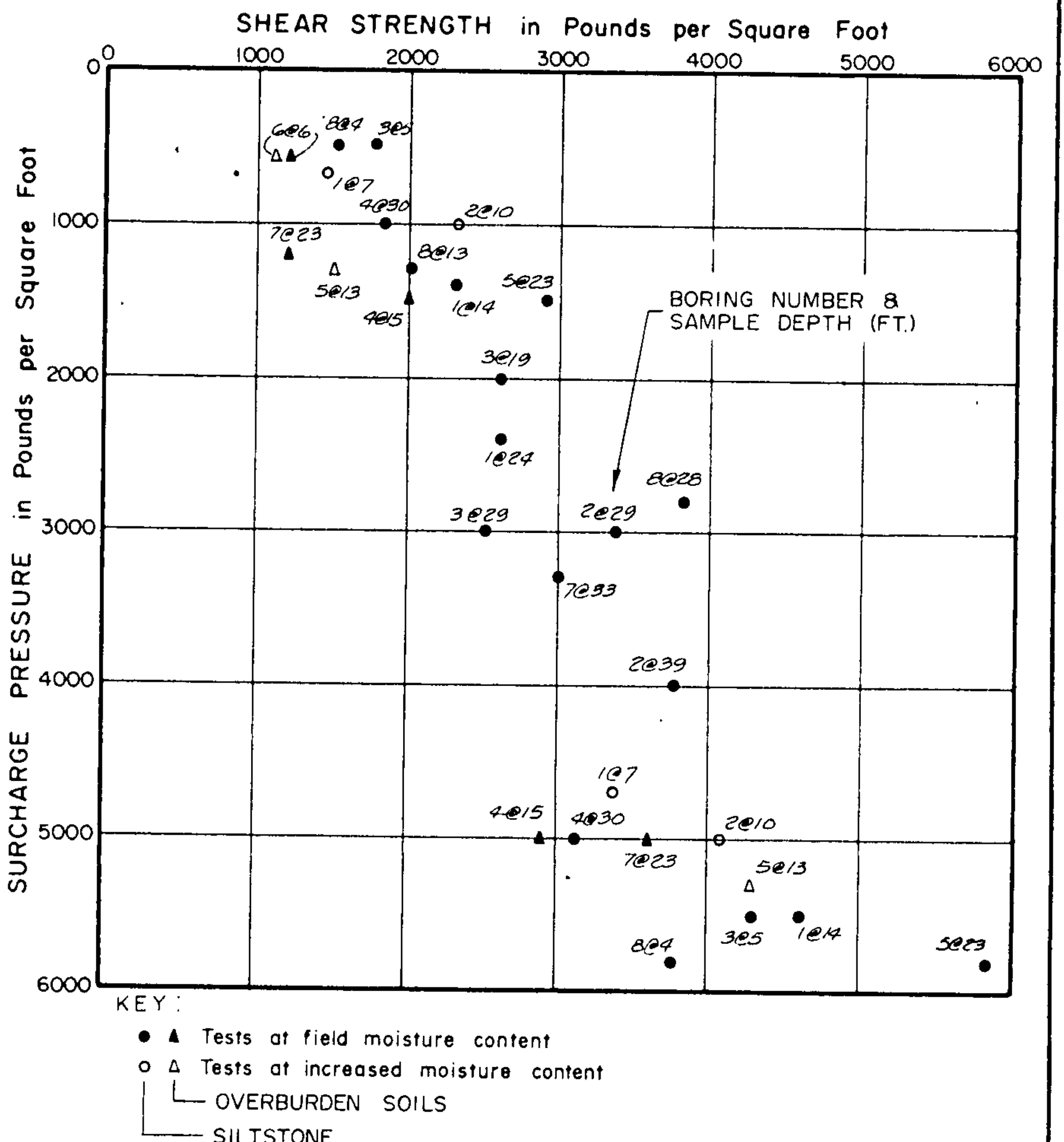
NOTE: Water seepage encountered at 17' to 21'. Water level at 21.5' 2 minutes after completion of drilling. Caving from 16' to 21' (to 48" in diameter).

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

JOB AE-76087 DATE 6-20-76 O.E. CHKD. SW

LOG OF BORING

LEROY CRANDALL AND ASSOCIATES

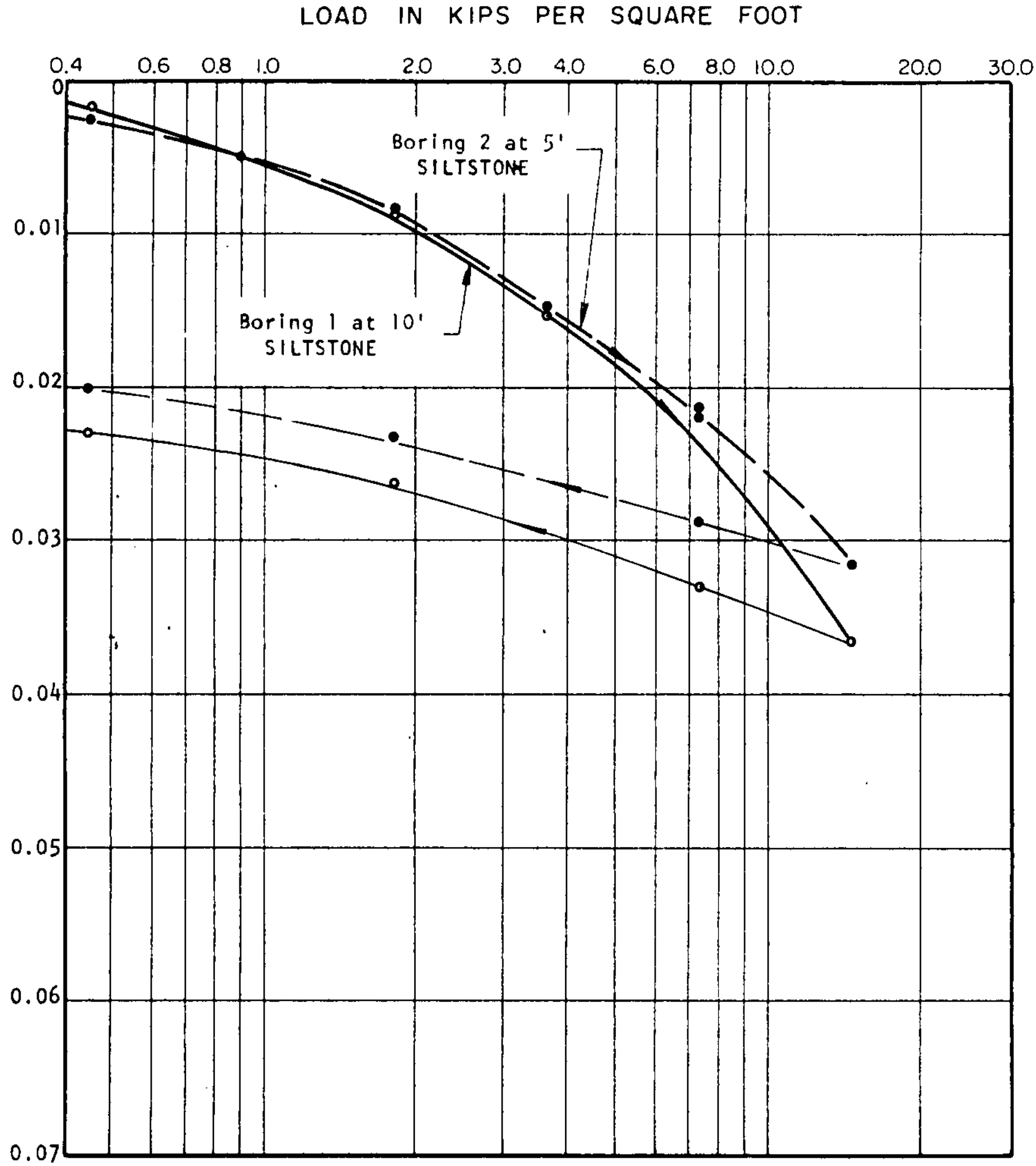


DIRECT SHEAR TEST DATA

JOB A-76087 DATE 7-1-76 O.E. CHKD

LEROY CRANDALL & ASSOCIATES

PLATE B-2.4



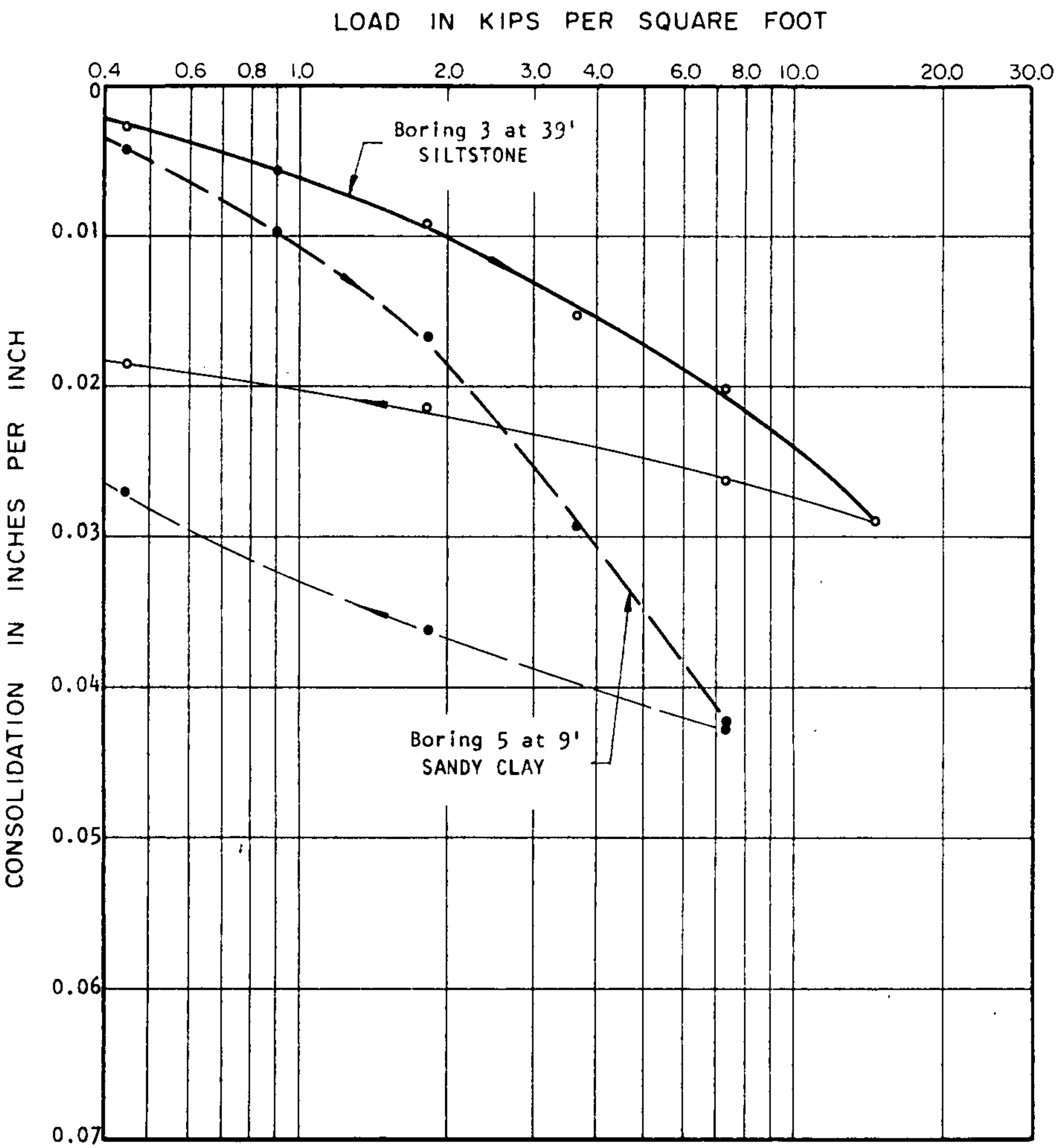
NOTE: Samples tested at field moisture content.

CONSOLIDATION TEST DATA

LEROY CRANDALL & ASSOCIATES

JOB A-76087 DATE 6-28-76 DR. [illegible] O.E. DM:SW CHKD.

PLATE B-2.5



NOTE: Water added to sample from Boring 5 after consolidation under a load of 7.2 kips per square foot. The other sample tested at field moisture content.

CONSOLIDATION TEST DATA

LEROY CRANDALL & ASSOCIATES

PLATE IB-2.6

JOB A-76087 DATE 6-28-76 DR RCL O.E. DM:sw CHKD.

BORING NUMBER AND SAMPLE DEPTH:	1 at 7'	2 at 3'	4 at 15'
SOIL TYPE:	SILTSTONE	SILTSTONE	SILTY CLAY
CONFINING PRESSURE: (Lbs./Sq.Ft.)	200	200	200
FIELD MOISTURE CONTENT: (%)	31.6	16.2	23.1
EXPANSION FROM FIELD TO SOAKED MOISTURE CONTENT: (%)	1.0	2.4	2.3
SOAKED MOISTURE CONTENT: (%)	33.5	25.6	26.0
SHRINKAGE FROM FIELD TO AIR-DRIED MOISTURE CONTENT: (%)	5.4	1.2	19.6
AIR-DRIED MOISTURE CONTENT: (%)	4.8	3.2	6.5
TOTAL VOLUME CHANGE: (%)	6.4	3.6	21.9

EXPANSION TEST DATA

LEROY CRANDALL AND ASSOCIATES

JOB A-76086 DATE 6/28/76 DR ____ OE DM:sw CHKD ____

JOB A-76086 DATE 6/28/76 DR ___ O E DM:SW CHKD ___

BORING NUMBER AND SAMPLE DEPTH:	5 at 6'	6 at 8'	7 at 4'
SOIL TYPE:	SILTY CLAY	SILTY CLAY	FILL - CLAY and SHALE
CONFINING PRESSURE: (Lbs./Sq.Ft.)	200	200	200
FIELD MOISTURE CONTENT: (%)	15.8	14.2	20.8
EXPANSION FROM FIELD TO SOAKED MOISTURE CONTENT: (%)	1.2	0.7	1.6
SOAKED MOISTURE CONTENT: (%)	17.2	18.6	22.9
SHRINKAGE FROM FIELD TO AIR-DRIED MOISTURE CONTENT: (%)	7.4	3.5	8.3
AIR-DRIED MOISTURE CONTENT: (%)	3.1	2.7	4.1
TOTAL VOLUME CHANGE: (%)	8.6	4.2	9.9

EXPANSION TEST DATA

BORING 4

DATE DRILLED: March 22 & 23, 198
EQUIPMENT USED: 24" - Diameter Bucket

ELEVATION: 348.6

ELEVATION (ft.)	DEPTH (ft.)		MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.	DESCRIPTION
							FILL - SILTSTONE FRAGMENTS - some Sand, mottled brown
			23.9	98	< 1	■	SILTSTONE - bedded, fractured, light brownish grey
345							
	5		23.2	102	10	■	
340			22.4	104	10	■	
	10						
335			23.6	103	10	■	
	15		27.6	95	6	■	
330							
	20		23.1	101	6	■	
325							
	25		25.9	100	6	■	18" Cemented bed at 25' Bedding: N67W, 33SW
320			24.9	102	7	■	
	30						
315			26.2	100	7	■	Calcite-filled fracture: N40W, 90
	35		26.6	101	7	■	
310							
	40						

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated.
It is not warranted to be representative of subsurface conditions at other locations and times.

ADE-88070 DATE 4/15/88 F.T. LS DR. dmh O.E. MS W.P. dmh CHKD

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE B-3.1

BORING 4 (Continued)

DATE DRILLED: March 22 & 23, 1988
EQUIPMENT USED: 24" - Diameter Bucket

ELEVATION	DEPTH (ft.)		MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.	
			26.9	96	7	■	Calcite-filled fracture: N14W, 57NE
305	45		26.9	100	7	■	
300	50		29.1	96	7	■	
295	55		28.5	94	7	■	Massive, dark grey 12" cemented bed at 54': Bedding: N70W, 34SW
290	60		26.5	97	10	■	
			26.6	99	10	■	
285	65		29.6	94	8	■	
280	70		26.5	99	8	■	
275	75		25.3	101	10	■	
270	80		24.4	103	10	■	

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE B-3.2

Job ADE-88070 DATE 4/15/88 F.T. LS DR. lp O.E. MS W.P. lp CHKD

BORING 4 (Continued)

DATE DRILLED: March 22 & 23, 1988
EQUIPMENT USED: 24" - Diameter Bucket

ELEVATION	DEPTH (ft.)		MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.	
265			25.2	99	9	■	
	85		24.3	99	9	■	
			23.6	99	9	■	
260			24.2	102	11	■	
	90		23.9	100	7	■	
255			23.3	101	20	■	12" cemented bed at 93-1/2'
	95		25.2	100	11	■	
250							
	100		23.5	102	8	■	
245							
	105						18" cemented bed at 105'
240			24.0	101	8	■	
	110						
235			26.0	100	7	■	
	115						

NOTE: Slight water seepage encountered at 47-1/2'. Moderate to heavy water seepage encountered at 50' and 63'. Water level measured at a depth of 63' 15 minutes after completion of drilling. No caving.

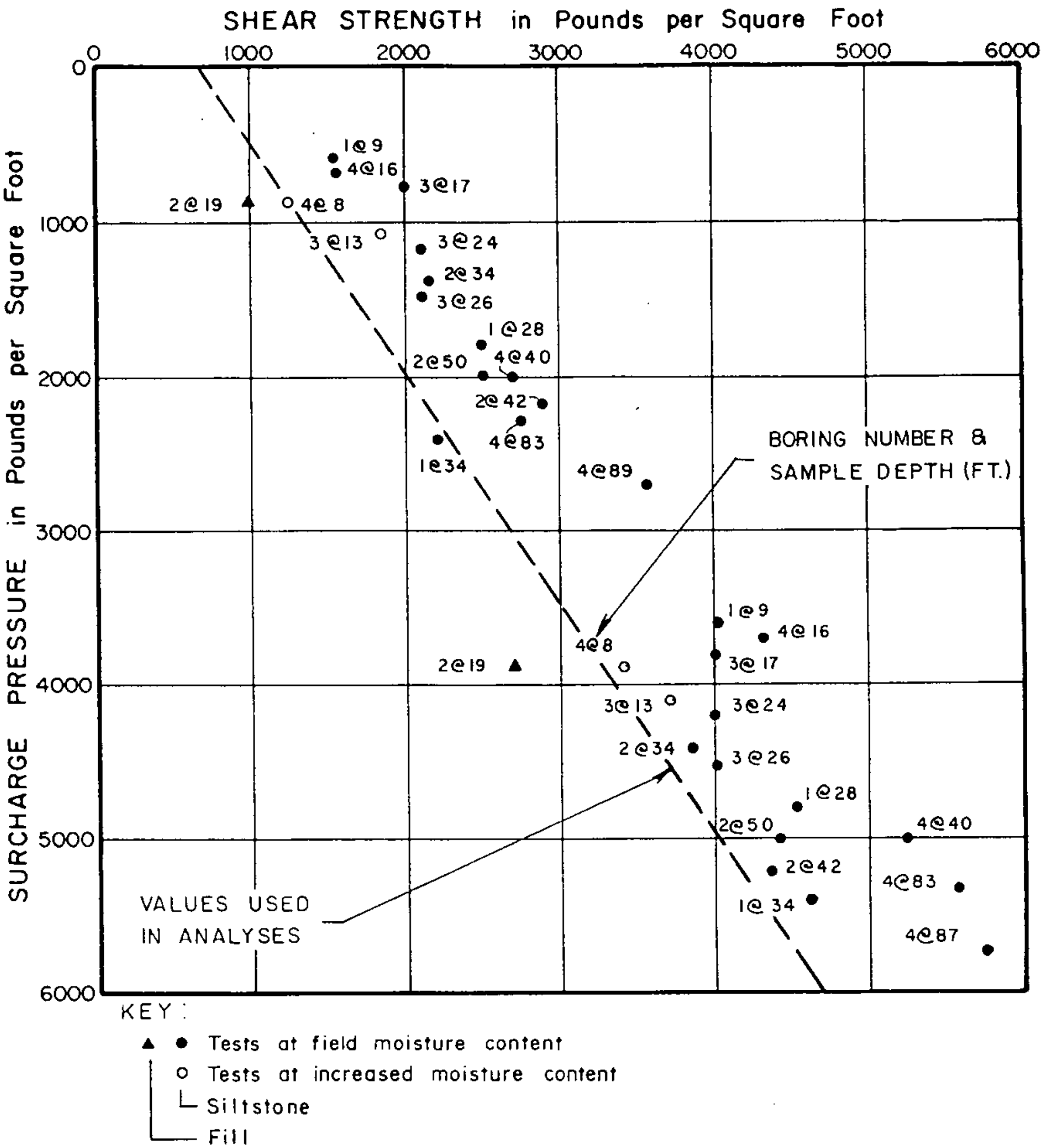
Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

JOB ADE-88070 DATE 4/15/88 F.T. LS DR. lp O.E. MS W.P. lp CHKD

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE B-3.3

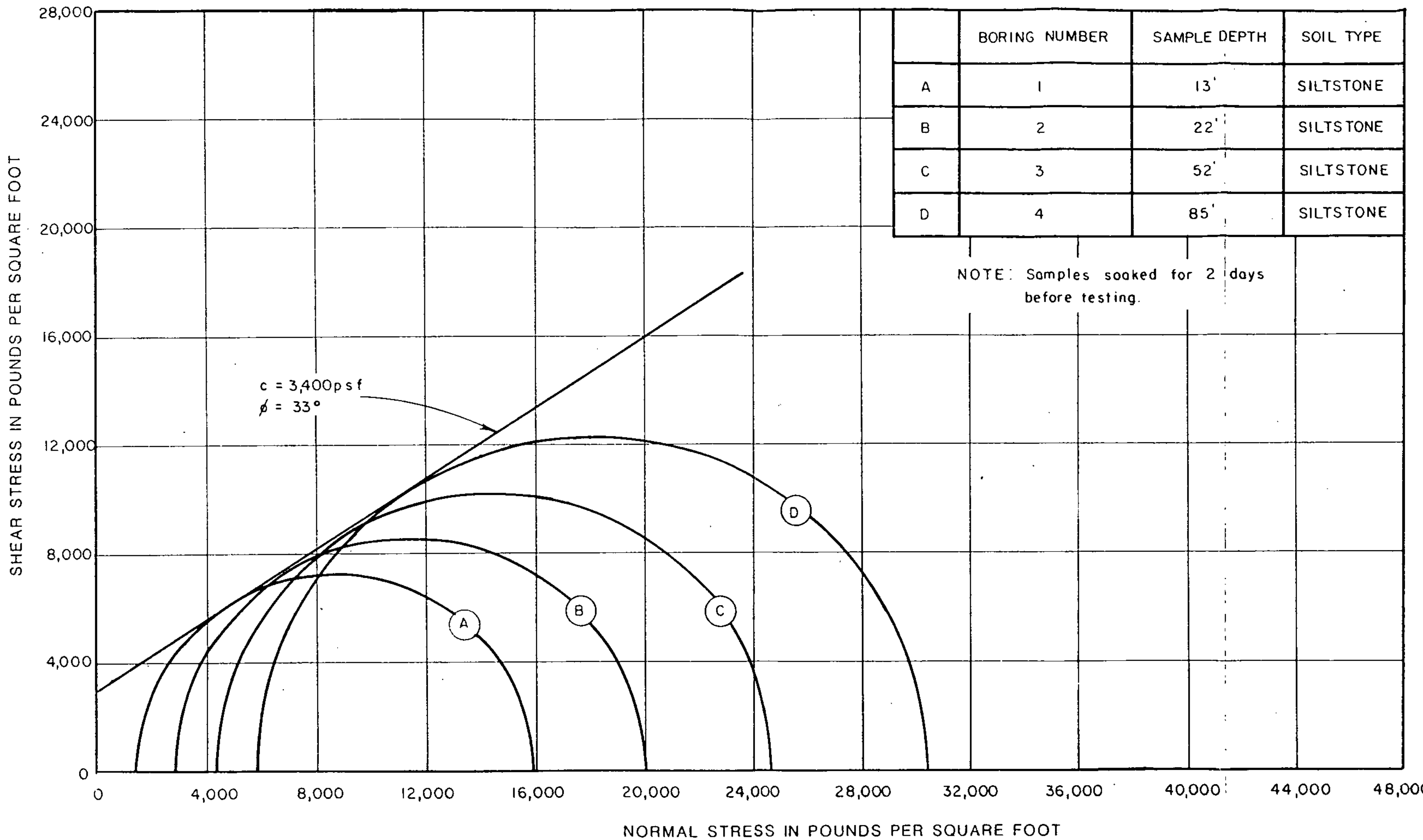


DIRECT SHEAR TEST DATA

LEROY CRANDALL & ASSOCIATES

PLATE B-3.4

111389

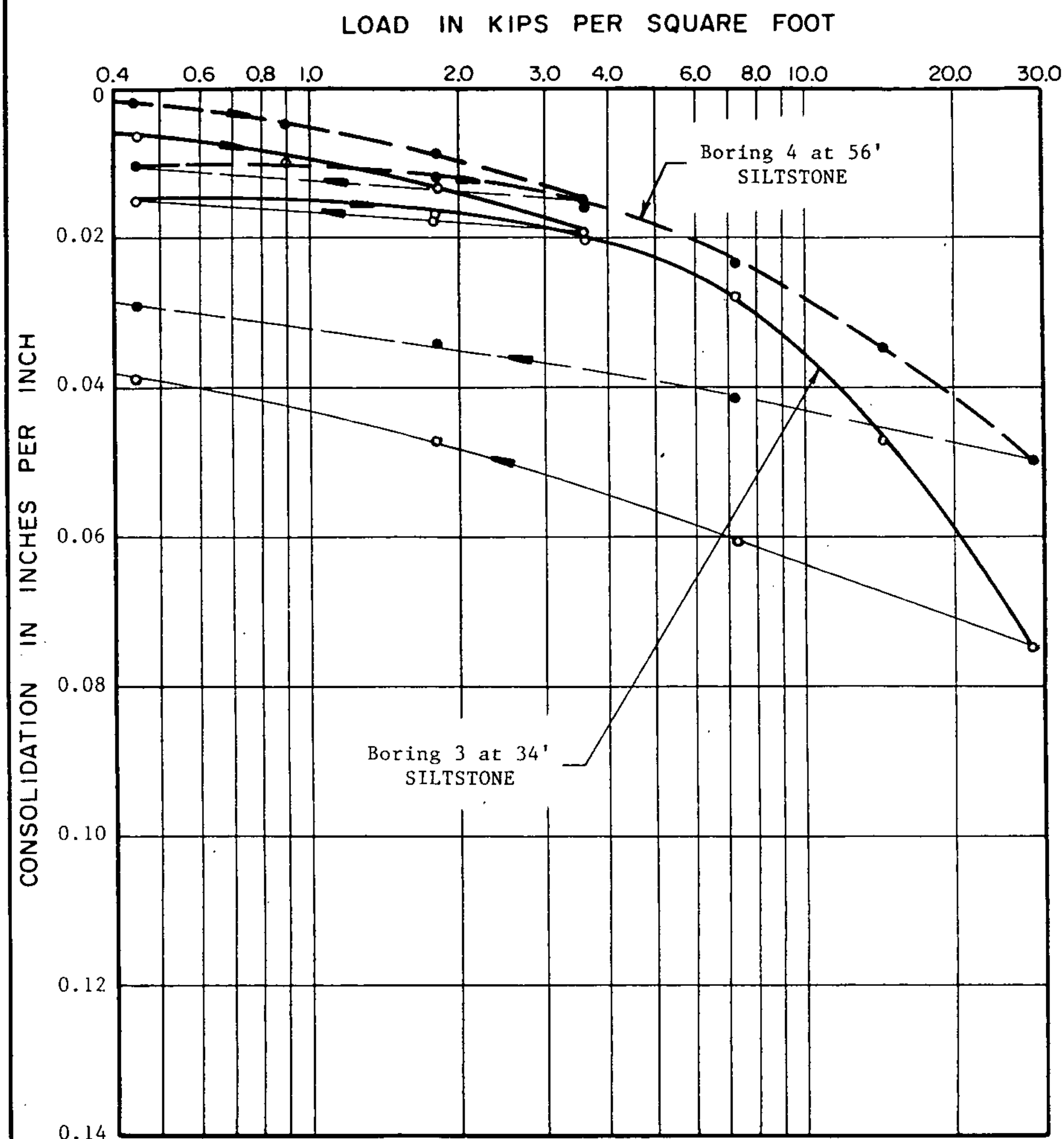


	BORING NUMBER	SAMPLE DEPTH	SOIL TYPE
A	1	13'	SILTSTONE
B	2	22'	SILTSTONE
C	3	52'	SILTSTONE
D	4	85'	SILTSTONE

NOTE: Samples soaked for 2 days before testing.

TRIAXIAL SHEAR TEST DATA

LeROY CRANDALL AND ASSOCIATES

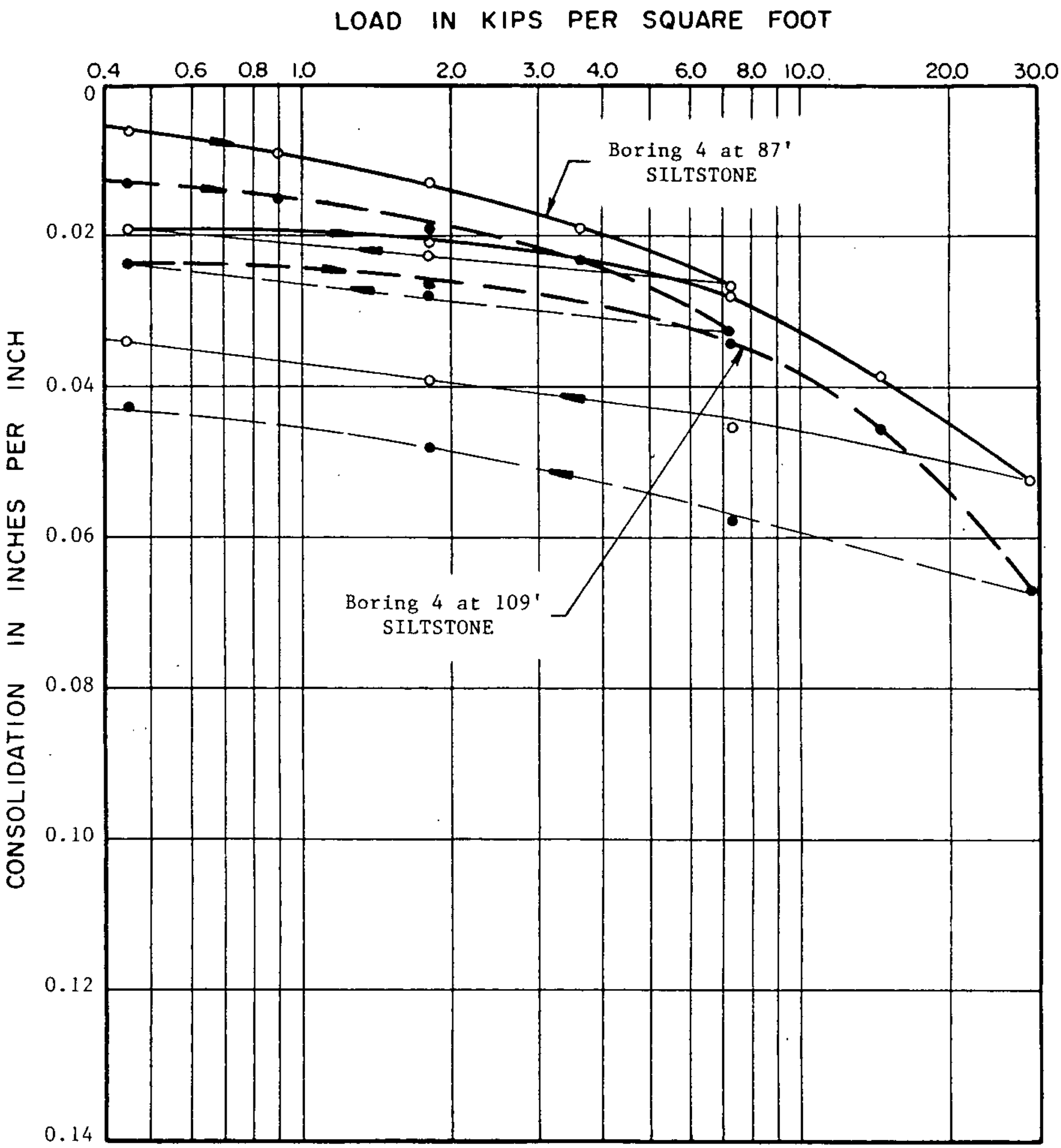


NOTE: Samples tested at field moisture content.

CONSOLIDATION TEST DATA

LEROY CRANDALL & ASSOCIATES

PLATE B-3.6



NOTE: Samples tested at field moisture content.

CONSOLIDATION TEST DATA

LEROY CRANDALL & ASSOCIATES

PLATE B-3.7

M. J. SCHIFF & ASSOCIATES

Consulting Corrosion Engineers

1291 NORTH INDIAN HILL BOULEVARD
CLAREMONT, CALIFORNIA 91711
(714) 626-0967

May 2, 1988

LeROY CRANDALL & ASSOCIATES
900 Grand Central Avenue
Glendale, California 91201-3009

Attention: Mr. Mike Shahabi

Re: Soil Corrosivity Tests
Bunker Hill Associates
Los Angeles, California
Your #ADE-88070, MJS&A #88089

Gentlemen:

Laboratory tests have been completed on four soil samples we selected from your borings for the subject office tower project on 4th Street between Grand and Hill. The purpose of these tests was to determine if the soils may have deleterious effects on underground utilities, hydraulic elevator cylinders, and concrete foundations.

The electrical resistivity of each sample was measured in its as-received condition and again with distilled water added to create the standardized condition of saturation. Resistivities are at about their lowest value when the soil is saturated. The samples were chemically analyzed for the major anions and cations, and pH was measured. Results are shown in Table 1.

One of the most useful factors in determining soil corrosivity is electrical resistivity. The electrical resistivity ofB-3.1 is a measure of its resistance to the flow of electrical current. Corrosion of buried metal is an electro-chemical process in which the amount of metal loss due to corrosion is directly related to the flow of electrical current (DC) through the soil. A soil's resistivity decreases and therefore its corrosivity increases primarily as its moisture and chemical contents increase.

A commonly accepted correlation between electrical resistivity and corrosivity toward ferrous metals is:

Soil Resistivity in ohm-centimeters	Corrosivity Category
0 - 1,000	severely corrosive
1,000 - 2,000	corrosive
2,000 - 10,000	moderately corrosive
over 10,000	mildly corrosive

Electrical resistivities measured in the laboratory with as-received moisture content were in moderately corrosive and corrosive categories. When saturated, they were in corrosive and severely corrosive categories.

pH values varied from 5.0 to 7.2 which is strongly acidic to neutral. Acid attack on concrete becomes of serious concern when soil pH is less than the 5.0 to 5.5 range. Also, copper is susceptible to acid attack if oxidizing conditions exist.

The chemical content of two of the samples was high. In these samples from borings 3 and 4, the predominant compound was calcium sulfate (gypsum).

We classify this site as severely corrosive to ferrous metals and possibly deleterious to concrete and copper. The following corrosion control measures are recommended.

Underground steel utilities should be given a high quality protective coating such as 40 mil extruded polyethylene, 20 mil plastic tape over primer per AWWA Standard C209, or hot applied coal tar enamel or tape per AWWA Standard C203.

Buried steel piping should be electrically insulated from above ground steel, dissimilar metals, and cement-mortar or concrete coated steel. Underground steel pipe should be bonded for electrical continuity if rubber gasketed, mechanical, grooved end, or other nonconductive type joints are used.

Cathodic protection is recommended for underground steel utilities.

Hydraulic elevator cylinders should be well coated as described above. Each cylinder should be isolated from building metals by installing dielectric material between the piston platen and car and also in the oil line. The oil line should be placed above ground if possible but, if underground, should be protected as described above for steel utilities. Cathodic protection is recommended for hydraulic cylinders or, as an alternate, each cylinder may be placed in a plastic casing with a plastic watertight seal at the bottom.

Cast or ductile iron pipe, valves, and fittings should be encased in an 8 mil thick polyethylene tube or wrap per AWWA Standard C105 or ANSI 21.5.

Copper in contact with acidic soil should be backfilled with alkalyzed sand (25 pounds of hydrated lime mixed with each cubic yard of sand) at least 3 inches thick surrounding the copper.

No special precautions are required for asbestos-cement or plastic utilities placed underground from a corrosion viewpoint. However, any iron valves or fittings should be protected as mentioned above.

Sand would be better than the native soils for bedding and backfill of metallic piping from a corrosion standpoint.

Where metallic pipelines penetrate concrete structures such as building floors or walls, plastic sleeves, rubber seals, or other dielectric material should be used to prevent pipe contact with the concrete and reinforcing steel.

On any type of pipe, bare steel appurtenances such as bolts, joint harnesses, or flexible couplings should be coated with a coal tar or rubber based mastic after assembly.

Standard construction practices and concrete mixes may be used for concrete in contact with these soils using type 2 (moderately sulfate resistant) cement.

Concrete may be protected from acid attack by using a plastic moisture barrier, waterproofing, a gravel capillary break or by neutralization of the acid by using an extra rich concrete mix, an extra thickness of sacrificial concrete or mixing hydrated lime into the soil. The amount of neutralization needed will depend on the amount of acid in soil which may be determined by total acidity tests. However, such a test would underestimate the amount of neutralization required if the acid is replenished by the inflow of soil moisture.

The scope of this study was limited to a determination of soil corrosivity and its general effects on materials likely to be used for construction. If the architect and/or engineers desire more specific information, designs, specifications, or review of design, we will be happy to work with them as a separate phase of this project.

Respectfully submitted,
M. J. SCHIFF & ASSOCIATES

Leon Arzumanian

Leon Arzumanian

cs

Enc: Table 1

L20

Table 1 - LABORATORY TESTS ON SOIL SAMPLES

Location and Depth	Soil Type	Soil Resistivity ohm-centimeters As Rec'd	Sat'd	pH	Chemical Analysis in mg/kg (ppm) of dry soil: Calcium Ca	Magnesium Mg	Sodium Na	Bicarbonate HCO3	Chloride Cl	Sulfate SO4
B1 3.5'	shale	3,900	1,200	5.0	80	trace	58	122	142	135
B2 46.5'	shale	2,300	1,100	6.8	120	24	58	122	212	280
B3 3.5'	fill	1,200	830	7.2	480	24	115	488	212	825
B4 44.5'	shale	3,300	820	7.2	600	trace	92	488	212	1175

Carbonates = 0 for all samples

Bunker Hill Association
Los Angeles, California
Your #ADE-88070, MJS&A #88089
F6

BORING 1

DATE DRILLED: April 23, 1993
EQUIPMENT USED: 24" - Diameter Bucket

ELEVATION 290 **

ELEVATION (ft.)	DEPTH (ft.)		MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	BLOWS/FT.*	SAMPLE LOC.		Description
							ML	ARTIFICIAL FILL (af) SILTSTONE FRAGMENTS and SANDY SILT - few rootlets, pieces of glass, wood and brick, light brown
			14.0	112	3			
			20.9	101	1			
285	5							
			12.6	119	5			
			14.9	117	4			More pieces of concrete and brick
							ML	ALLUVIUM (Qal) CLAYEY SILT - some Sand, few Gravel, brown
280	10		15.2	115	4			9" Cobble
			17.8	111	4			
275	15		10.3	118	6			Light brown
			14.3	114	4			
							SP	SAND - fine to coarse, about 10% Gravel, light brown
270	20							
			5.5	121	12			Lenses of Silt, about 20% Gravel and Cobbles (to 7" in size)
265	25		6.8	120	17			Some odor, dark grey
260	30		18.4	110	27			About 20% Gravel and Cobbles (to 8" in size)

NOTE: Water seepage encountered at 24'. Caving to 26'. Raveling from 21' to 29'.

*Penetration Resistance:
0' to 24' - 1680 pound hammer falling 12 inches.
Below 24' - 840 pound hammer falling 12 inches.

** Elevations refer to datum of reference survey; see Plate 1.

JOB 2661.30327.0001 DATE 5/11/93 F.T. AR DR. lk O.E. JB/ CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LAW/CRANDALL, INC.

BORING 2

DATE DRILLED: April 23, 1993
EQUIPMENT USED: 24" - Diameter Bucket

ELEVATION 350

ELEVATION (ft.)	DEPTH (ft.)		MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	BLOWS/FT.	SAMPLE LOC.
			22.4	99	5	■
			19.1	100	5	■
345	5		22.9	99	5	■
			25.1	98	5	■
340	10		25.7	95	6	■
335	15		22.7	99	7	■
330	20		21.5	100	7	■
325	25		24.5	99	15	■
320	30		27.4	96	15	■
315	35		25.5	98	17	■
310	40		30.5	93	19	■

SP

ARTIFICIAL FILL (af)
SAND - fine, few Gravel, light brown

FERNANDO FORMATION (Tf)
SILTSTONE - minor interbeds of Sandstone, massive to poorly bedded, moderately weathered, poorly cemented, soft, greenish grey and brown

Bedding N80W, 37SW

Bedding N69E, 34SE

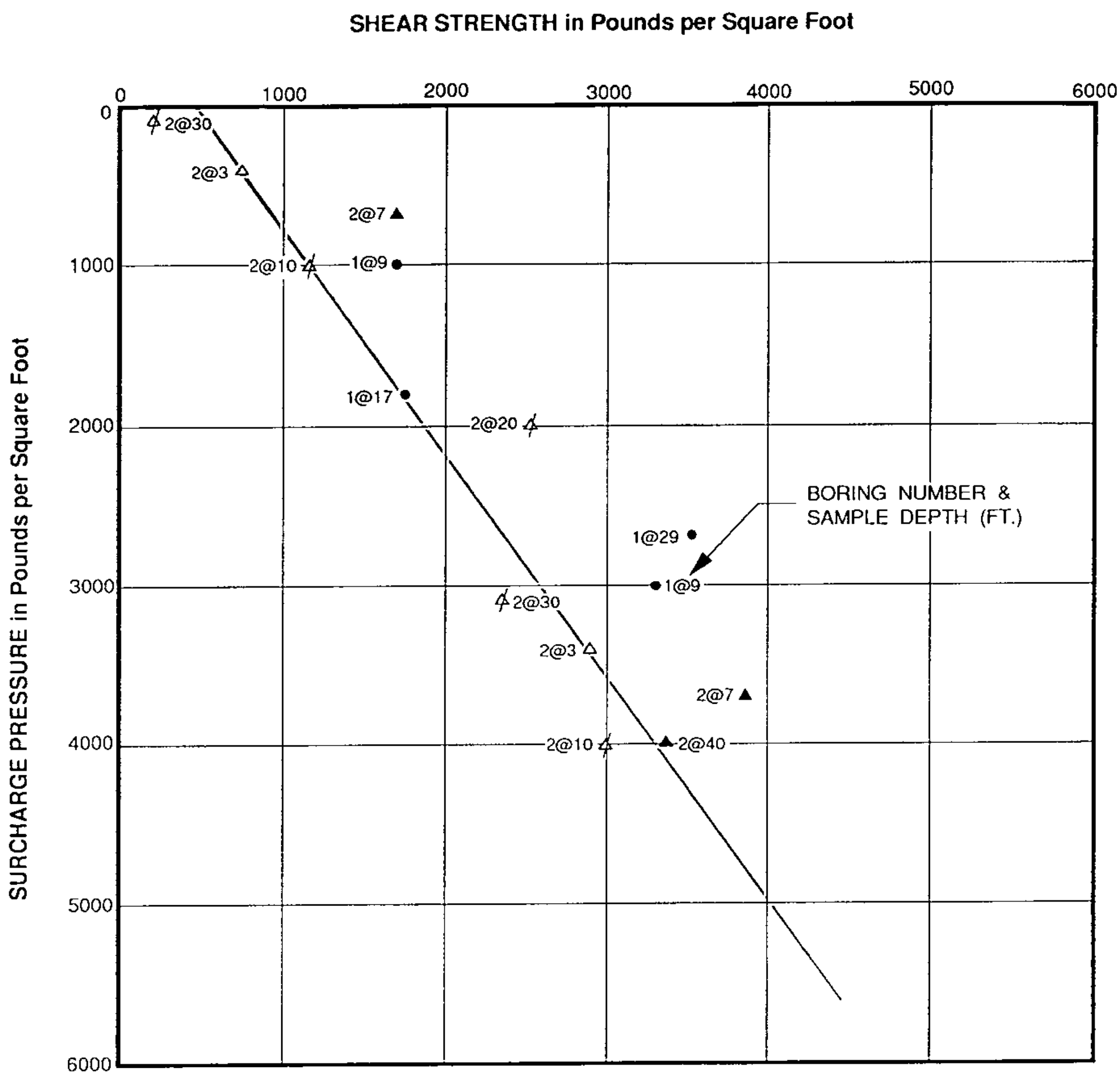
NOTE: Water not encountered. No caving.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

JOB 2661.30327.0001 DATE 5/11/93 F.T. AR DR. lk O.E. JB CHKD

LOG OF BORING

LAW/CRANDALL, INC.



KEY:

● ▲ Samples tested at field moisture content

△ Samples tested after soaking to a moisture content near saturation

└── Bedrock (∆̸ indicates samples soaked for 3 days. Cut along shear plane before testing)

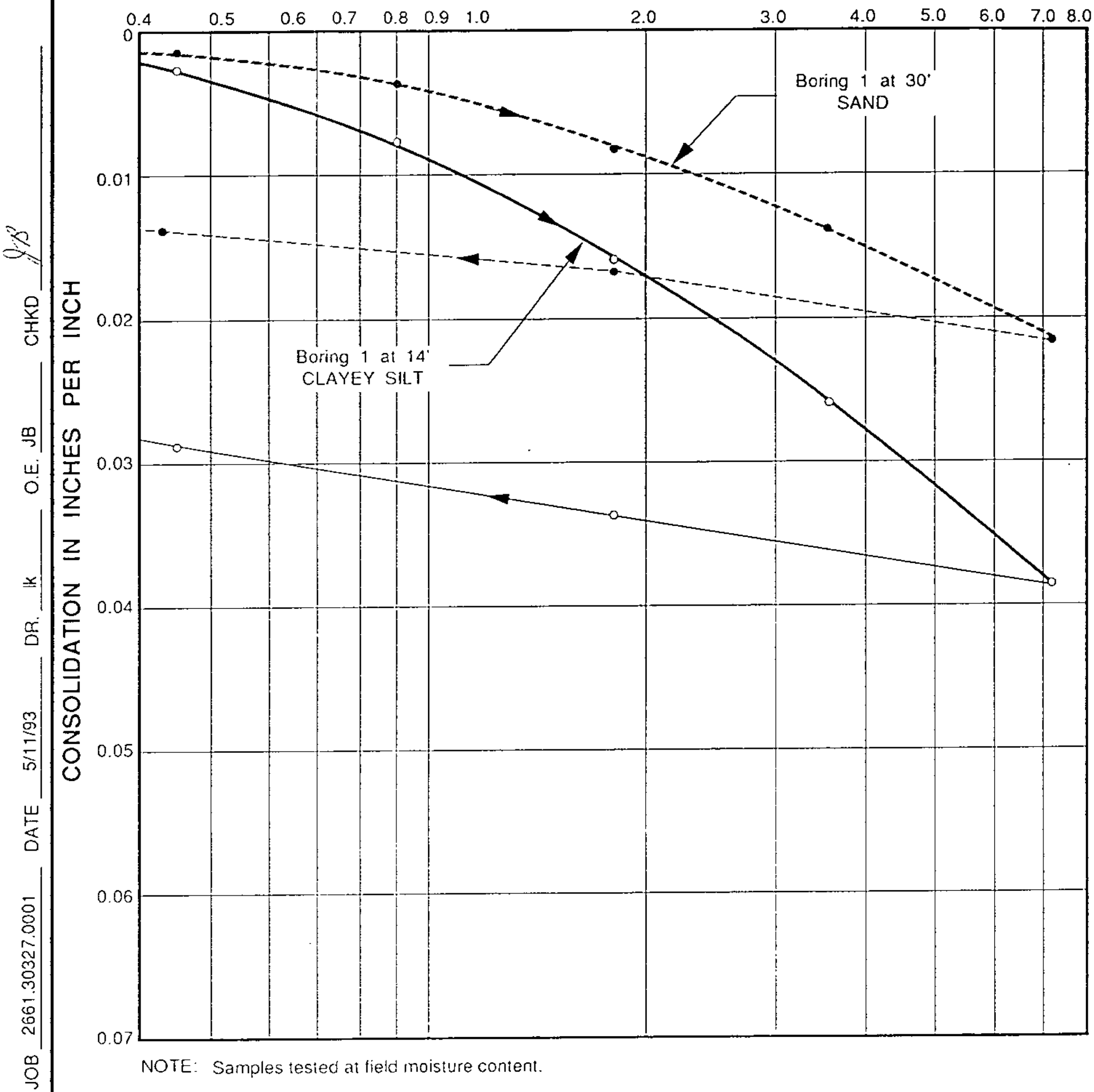
└── Overburden natural soils

JOB 2661.30327.0001 DATE 5/11/93 DR. lk O.E. JB CHKD

DIRECT SHEAR TEST DATA

LAW/CRANDALL, INC.

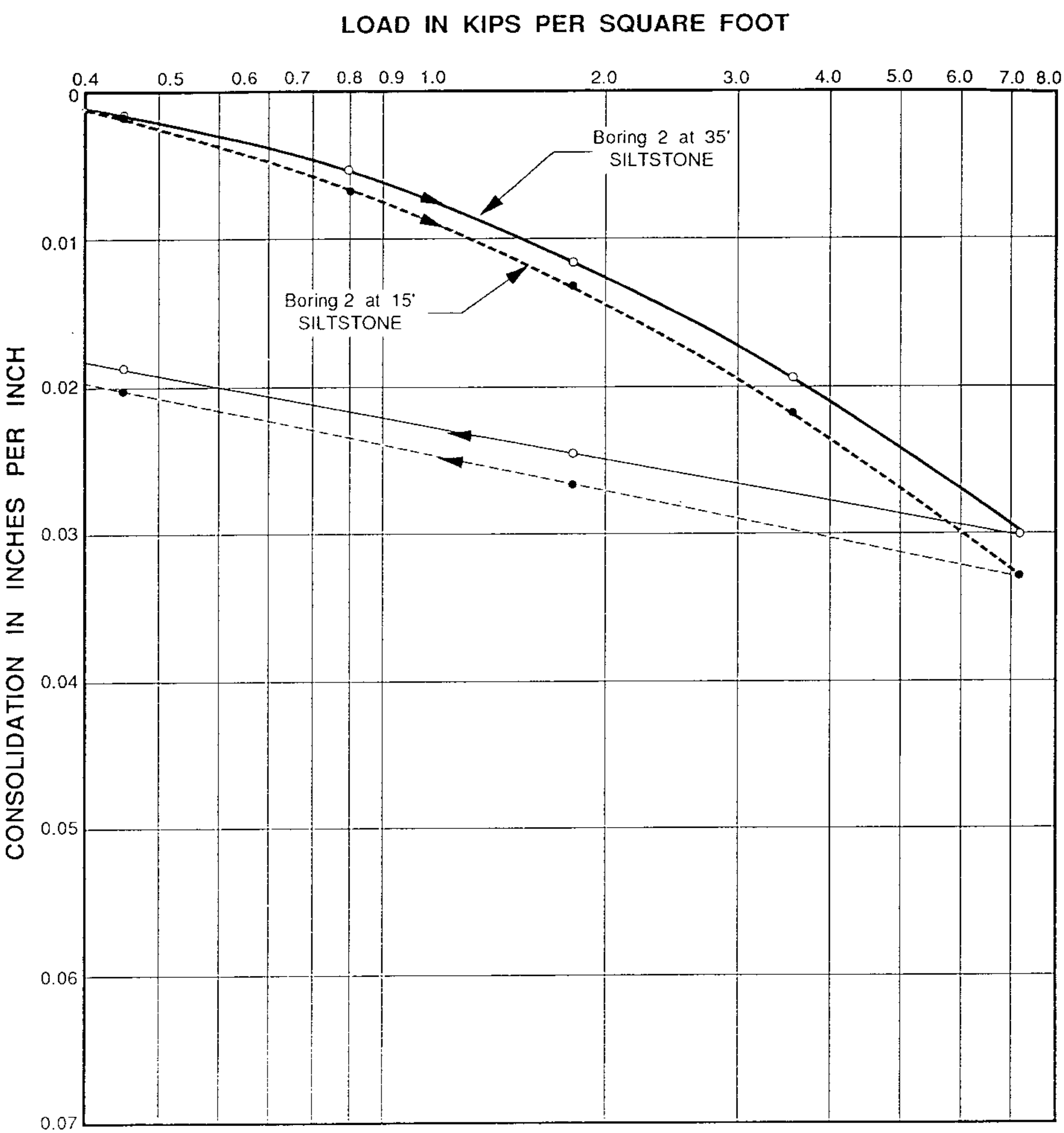
PLATE B-4.3



NOTE: Samples tested at field moisture content.

CONSOLIDATION TEST DATA

LAW/CRANDALL, INC.



NOTE: Samples tested at field moisture content.

JOB 2661.30327.0001 DATE 5/11/93 DR. lk O.E. JB CHKD JB

CONSOLIDATION TEST DATA

LAW/CRANDALL, INC.

JOB 2661.30327.0001 DATE 5/11/93 DR. lk O.E. JB CHKD

BORING NUMBER AND SAMPLE DEPTH :	1 at 0' to 5'
SOIL TYPE :	FILL - SILTSTONE FRAGMENTS and SANDY SILT
MAXIMUM DRY DENSITY : (lbs./cu. ft.)	120
OPTIMUM MOISTURE CONTENT : (% of dry wt.)	13

TEST METHOD : ASTM Designation D1557 - 78

COMPACTION TEST DATA

LAW/CRANDALL, INC.

Appendix C

Results of Suspension Logging

ANGEL'S LANDING

SUSPENSION PS VELOCITIES

LOS ANGELES, CALIFORNIA

BOREHOLE RW-1

June 18, 2018

Report 18206-01 rev 0

ANGEL'S LANDING

SUSPENSION PS VELOCITIES

LOS ANGELES, CALIFORNIA

BOREHOLE RW-1

Prepared for

Wood Environment & Infrastructure Solutions, Inc.
6001 Rickenbacker Rd
Los Angeles, CA 90040
(323) 889 - 5346

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GEOVision Geophysical Services
1124 Olympic Drive
Corona, California 92881
(951) 549-1234

June 18, 2018

Report 18206-01 rev 0

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APPENDICES

INTRODUCTION

GEO*Vision* acquired borehole geophysical data in one borehole at Angel's Landing in Los Angeles, California for the Angel's Landing Development Project. Fieldwork was performed by Victor Gonzalez. Data analysis and report preparation were performed by Emily Feldman and reviewed by John Diehl and Victor Gonzalez. The work was performed for Wood group. Data, analysis and report were reviewed by a **GEO***Vision* Professional Geophysicist or Engineer.

SCOPE OF WORK

This report presents results of Suspension PS velocity data acquired in one borehole on May 16th, 2018, as detailed in Table 1. The purpose of these measurements was to supplement stratigraphic information by acquiring shear wave and compressional wave velocities as a function of depth.

The OYO Suspension PS Logging System (Suspension System) was used to obtain in-situ horizontal shear (S_H) and compressional (P) wave velocity measurements in one uncased borehole at 1.6 foot intervals. Measurements followed **GEO***Vision* Procedure for PS Suspension Seismic Velocity Logging, revision 1.5. Acquired data were analyzed and a profile of velocity versus depth was produced for both S_H and P waves.

A detailed reference for the suspension PS velocity measurement techniques used in this study is:

> Guidelines for Determining Design Basis Ground Motions, Report TR-102293, Electric Power Research Institute, Palo Alto, California, November 1993, Sections 7 and 8.

INSTRUMENTATION

Suspension Velocity Instrumentation

Suspension velocity measurements were performed using the suspension PS logging system, manufactured by OYO Corporation, and their subsidiary, Robertson Geologging. This system directly determines the average velocity of a 3.3-foot high segment of the soil column surrounding the borehole of interest by measuring the elapsed time between arrivals of a wave propagating upward through the soil column. The receivers that detect the wave, and the source that generates the wave, are moved as a unit in the borehole producing relatively constant amplitude signals at all depths.

The suspension system probe consists of a combined reversible polarity solenoid horizontal shear-wave source and compressional-wave source, joined to two biaxial receivers by a flexible isolation cylinder, as shown in Figure 1. The separation of the two receivers is 3.3 feet, allowing average wave velocity in the region between the receivers to be determined by inversion of the wave travel time between the two receivers. The total length of the probe as used in these surveys is approximately 25 feet, with the center point of the receiver pair 12.5 feet above the bottom end of the probe.

The probe receives control signals from, and sends the digitized receiver signals to, instrumentation on the surface via an armored multi-conductor cable. The cable is wound onto the drum of a winch and is used to support the probe. Cable travel is measured to provide probe depth data using a sheave of known circumference fitted with a digital rotary encoder.

The entire probe is suspended in the borehole by the cable, therefore, source motion is not coupled directly to the borehole walls; rather, the source motion creates a horizontally propagating impulsive pressure wave in the fluid filling the borehole and surrounding the source. This pressure wave is converted to P and S_H-waves in the surrounding soil and rock as it impinges upon the wall of the borehole. These waves propagate through the soil and rock surrounding the borehole, in turn causing a pressure wave to be generated in the fluid surrounding the receivers as the soil waves pass their location. Separation of the P and S_H-waves at the receivers is performed using the following steps:

1. Orientation of the horizontal receivers is maintained parallel to the axis of the source, maximizing the amplitude of the recorded S_H -wave signals.
2. At each depth, S_H-wave signals are recorded with the source actuated in opposite directions, producing S_H-wave signals of opposite polarity, providing a characteristic S_H-wave signature distinct from the P-wave signal.
3. The 6.3 foot separation of source and receiver 1 permits the P-wave signal to pass and damp significantly before the slower S_H-wave signal arrives at the receiver. In faster soils or rock, the isolation cylinder is extended to allow greater separation of the P- and S_H-wave signals.
4. In saturated soils, the received P-wave signal is typically of much higher frequency than the received S_H-wave signal, permitting additional separation of the two signals by low pass filtering.
5. Direct arrival of the original pressure pulse in the fluid is not detected at the receivers because the wavelength of the pressure pulse in fluid is significantly greater than the dimension of the fluid annulus surrounding the probe (feet versus inches scale), preventing significant energy transmission through the fluid medium.

In operation, a distinct, repeatable pattern of impulses is generated at each depth as follows:

1. The source is fired in one direction producing dominantly horizontal shear with some vertical compression, and the signals from the horizontal receivers situated parallel to the axis of motion of the source are recorded.
2. The source is fired again in the opposite direction and the horizontal receiver signals are recorded.
3. The source is fired again and the vertical receiver signals are recorded. The repeated source pattern facilitates the picking of the P and S_H-wave arrivals; reversal of the source changes the polarity of the S_H-wave pattern but not the P-wave pattern.

The data from each receiver during each source activation is recorded as a different channel on the recording system. The Suspension PS system has six channels (two simultaneous recording channels), each with a 1024 sample record. The recorded data are displayed as six channels with a common time scale. Data are stored on disk for further processing.

Review of the displayed data on the recorder or computer screen allows the operator to set the gains, filters, delay time, pulse length (energy), and sample rate to optimize the quality of the data before recording. Verification of the calibration of the Suspension PS digital recorder is performed at least every twelve months using a NIST traceable frequency source and counter, as presented in Appendix B.

MEASUREMENT PROCEDURES

Suspension Velocity Measurement Procedures

The borehole was logged uncased and filled with fresh water mud. Measurements followed the **GEO***Vision* Procedure for P-S Suspension Seismic Velocity Logging, revision 1.5. Prior to the logging run, the probe was positioned with the top of the probe even with a stationary reference point. The electronic depth counter was set to the distance between the mid-point of the receiver and the top of the probe, minus the height of the stationary reference point, if any. Measurements were verified with a tape measure, and calculations recorded on a field log.

The probe was lowered to the bottom of the borehole, stopping at 1.6 foot intervals to collect data, as summarized in Table 2. At each measurement depth the measurement sequence of two opposite horizontal records and one vertical record was performed. Gains were adjusted as required. The data from each depth were viewed on the computer display, checked, and saved to disk before moving to the next depth.

Upon completion of the measurements, the probe was returned to the surface and the zero depth indication at the depth reference point was verified prior to removal from the borehole.

DATA ANALYSIS

Suspension Velocity Analysis

Using the proprietary OYO program PSLOG.EXE version 1.0, the recorded digital waveforms were analyzed to locate the most prominent first minima, first maxima, or first break on the vertical axis records, indicating the arrival of P-wave energy. The difference in travel time between receiver 1 and receiver 2 (R1-R2) arrivals was used to calculate the P-wave velocity for that 1.0 meter segment of the soil column. When observable, P-wave arrivals on the horizontal axis records were used to verify the velocities determined from the vertical axis data. The time picks were then transferred into a Microsoft Excel® template to complete the velocity calculations based on the arrival time picks made in PSLOG. The Microsoft Excel® analysis file accompanies this report.

The P-wave velocity over the 6.3-foot interval from source to receiver 1 (S-R1) was also picked using PSLOG, and calculated and plotted in Microsoft Excel®, for quality assurance of the velocity derived from the travel time between receivers. In this analysis, the depth values as recorded were increased by 4.8 feet to correspond to the mid-point of the 6.33-foot S-R1 interval. Travel times were obtained by picking the first break of the P-wave signal at receiver 1 and subtracting the calculated and experimentally verified delay, in milliseconds, from source trigger pulse (beginning of record) to source impact. This delay corresponds to the duration of acceleration of the solenoid before impact.

As with the P-wave records, the recorded digital waveforms were analyzed to locate clear S_H-wave pulses, as indicated by the presence of opposite polarity pulses on each pair of horizontal records. Ideally, the S_H-wave signals from the 'normal' and 'reverse' source pulses are very nearly inverted images of each other. Digital Fast Fourier Transform – Inverse Fast Fourier Transform (FFT – IFFT) lowpass filtering was used to remove the higher frequency P-wave signal from the S_H-wave signal. Different filter cutoffs were used to separate P- and S_H-waves at different depths, ranging from 600 Hz in the slowest zones to 4000 Hz in the regions of highest velocity. At each depth, the filter frequency was selected to be at least twice the fundamental frequency of the S_H-wave signal being filtered.

Generally, the first maxima were picked for the 'normal' signals and the first minima for the 'reverse' signals, although other points on the waveform were used if the first pulse was distorted. The absolute arrival time of the 'normal' and 'reverse' signals may vary by +/- 0.2 milliseconds, due to differences in the actuation time of the solenoid source caused by constant mechanical bias in the source, or by borehole inclination. This variation does not affect the R1-R2 velocity determinations, as the differential time is measured between arrivals of waves created by the same source actuation. The final velocity value is the average of the values obtained from the 'normal' and 'reverse' source actuations.

As with the P-wave data, S_H-wave velocity calculated from the travel time over the 6.33-foot interval from source to receiver 1 was calculated and plotted for verification of the velocity derived from the travel time between receivers. In this analysis, the depth values were increased by 4.8 feet to correspond to the mid-point of the 6.33-foot S-R1 interval. Travel times were obtained by picking the first break of the S_H-wave signal at the near receiver and subtracting the calculated and experimentally verified delay, in milliseconds, from the beginning of the record at the source trigger pulse to source impact.

Poisson's Ratio, **ν**, was calculated in the Microsoft Excel® template using the following formula:

$$\boldsymbol{\nu} = \frac{\left(\frac{V_s}{V_p}\right)^2 - 0.5}{\left(\frac{V_s}{V_p}\right)^2 - 1.0}$$

Figure 2 shows an example of R1 - R2 measurements on a sample filtered suspension record. In Figure 2, the time difference over the 3.3 foot interval of 1.88 milliseconds for the horizontal signals is equivalent to an S_H-wave velocity of 1745 feet/second. Whenever possible, time differences were determined from several phase points on the S_H-waveform records to verify the data obtained from the first arrival of the S_H-wave pulse. Figure 3 displays the same record before filtering of the S_H-waveform record with a 1400 Hz FFT - IFFT digital lowpass filter, illustrating the presence of higher frequency P-wave energy at the beginning of the record, and distortion of the lower frequency S_H-wave by residual P-wave signal.

Data and analyses were reviewed by a **GEO***Vision* Professional Geophysicist or Engineer as a component of the in-house data validation program.

RESULTS

Suspension Velocity Results

Suspension R1-R2 P- and S_H-wave velocities for borehole RW-1 are plotted in Figure 4, and data compiled in Table 3. The associated Microsoft Excel® analysis file accompanies this report.

P- and S_H-wave velocity data from R1-R2 analysis and quality assurance analysis of S-R1 data are plotted together in Figure A-1 in Appendix A to aid in visual comparison. Note that R1-R2 data are an average velocity over a 3.3-foot segment of the soil column; S-R1 data are an average over 6.3 feet, creating a significant smoothing relative to the R1-R2 plots. The S-R1 velocity data displayed in this figure are also compiled in Table A-1. Included in the Microsoft Excel® analysis files are Poisson's Ratio calculations, tabulated data and plots.

SUMMARY

Discussion of Suspension Velocity Results

Suspension PS velocity data are ideally collected in uncased, fluid filled boreholes drilled with rotary wash methods, as was the borehole for this project.

Overall, Suspension PS velocity data quality is judged on 5 criteria, as summarized below.

	Criteria	RW-1
1	Consistent data between receiver to receiver (R1 – R2) and source to receiver (S – R1) data.	Yes
2	Consistency between data from adjacent depth intervals.	Yes
3	Consistent relationship between P-wave and SH - wave (excluding transition to saturated soils)	Yes
4	Clarity of P-wave and SH-wave onset, as well as damping of later oscillations.	Good
5	Consistency of profile between adjacent borings, if available.	N/A

Quality Assurance

These borehole geophysical measurements were performed using industry-standard or better methods for measurements and analysis. All work was performed under **GEO***Vision* quality assurance procedures, which include:

- Use of NIST-traceable calibrations, where applicable, for field and laboratory instrumentation
- Use of standard field data logs
- Use of independent verification of velocity data by comparison of receiver-to-receiver and source-to-receiver velocities
- Independent review of calculations and results by a registered professional engineer, geologist, or geophysicist.

Suspension Velocity Data Reliability

P- and S_H-wave velocity measurement using the Suspension Method gives average velocities over a 3.3-foot interval of depth. This high resolution results in the scatter of values shown in the graphs. Individual measurements are very reliable with estimated precision of +/- 5%. Depth indications are very reliable with estimated precision of +/- 0.2 feet. Standardized field procedures and quality assurance checks contribute to the reliability of these data.

CERTIFICATION

All geophysical data, analysis, interpretations, conclusions, and recommendations in this document have been prepared under the supervision of and reviewed by a **GEO***Vision* California Professional Geophysicist or Engineer.

Prepared by

6/18/2018

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* This geophysical investigation was conducted under the supervision of a California Professional Geophysicist using industry standard methods and equipment. A high degree of professionalism was maintained during all aspects of the project from the field investigation and data acquisition, through data processing, interpretation and reporting. All original field data files, field notes and observations, and other pertinent information are maintained in the project files and are available for the client to review for a period of at least one year.

A professional geophysicist's certification of interpreted geophysical conditions comprises a declaration of his/her professional judgment. It does not constitute a warranty or guarantee, expressed or implied, nor does it relieve any other party of its responsibility to abide by contract documents, applicable codes, standards, regulations or ordinances.

Table 1. Borehole locations and logging dates

BOREHOLE	DATES	COORDINATES[1] (DEGREES)	
RW-1	5/16/2018		

[1] Location data not available at the time of report preparation

Table 2. Logging dates and depth ranges

BOREHOLE NUMBER	TOOL AND RUN NUMBER	DEPTH RANGE (FEET)	OPEN HOLE (FEET)	SAMPLE INTERVAL (FEET)	DATE LOGGED
RW-1	SUSPENSION DOWN01	1.64 – 205	220	1.6	5/16/2018

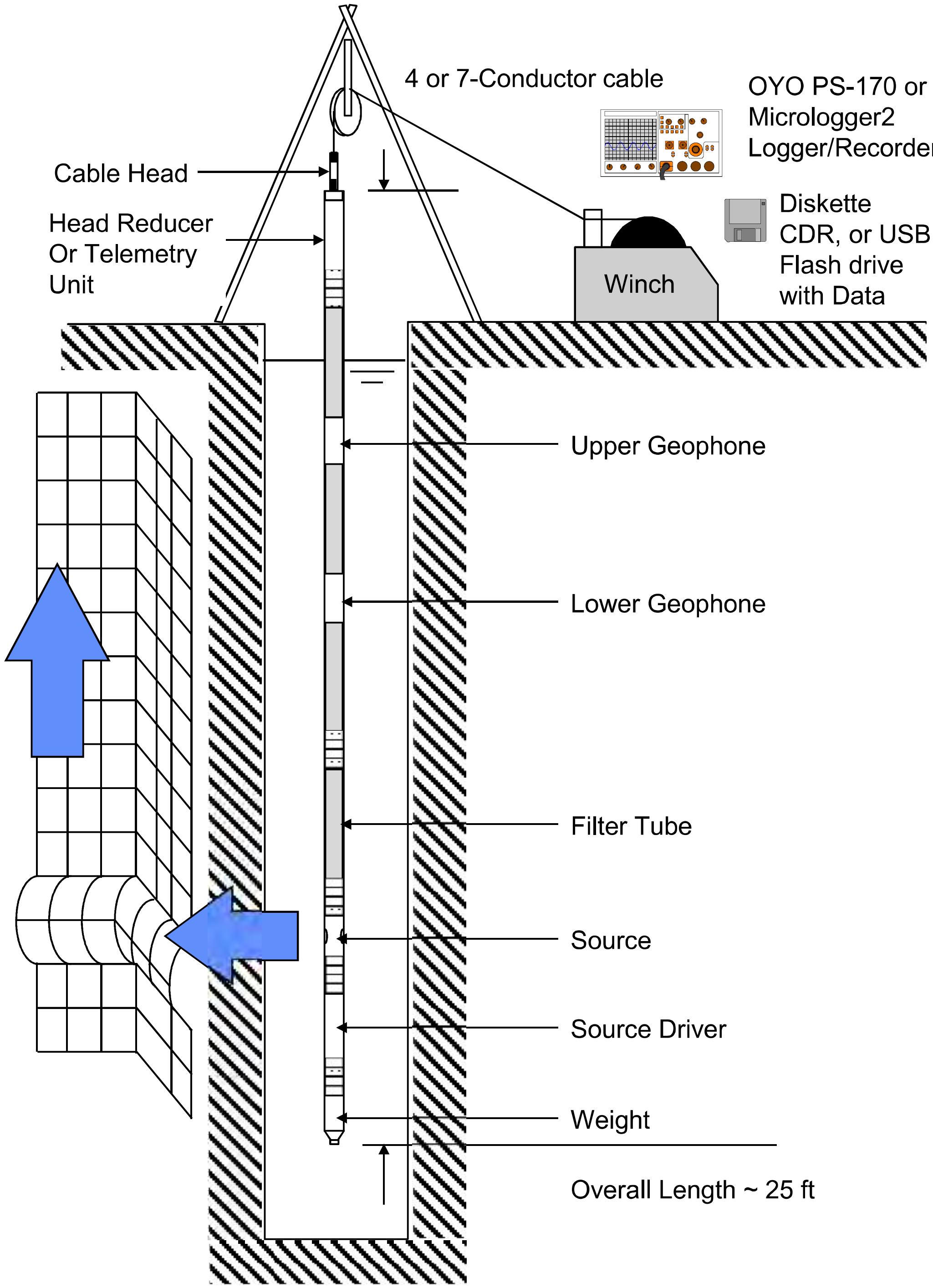

Figure 1: Concept illustration of P-S logging system

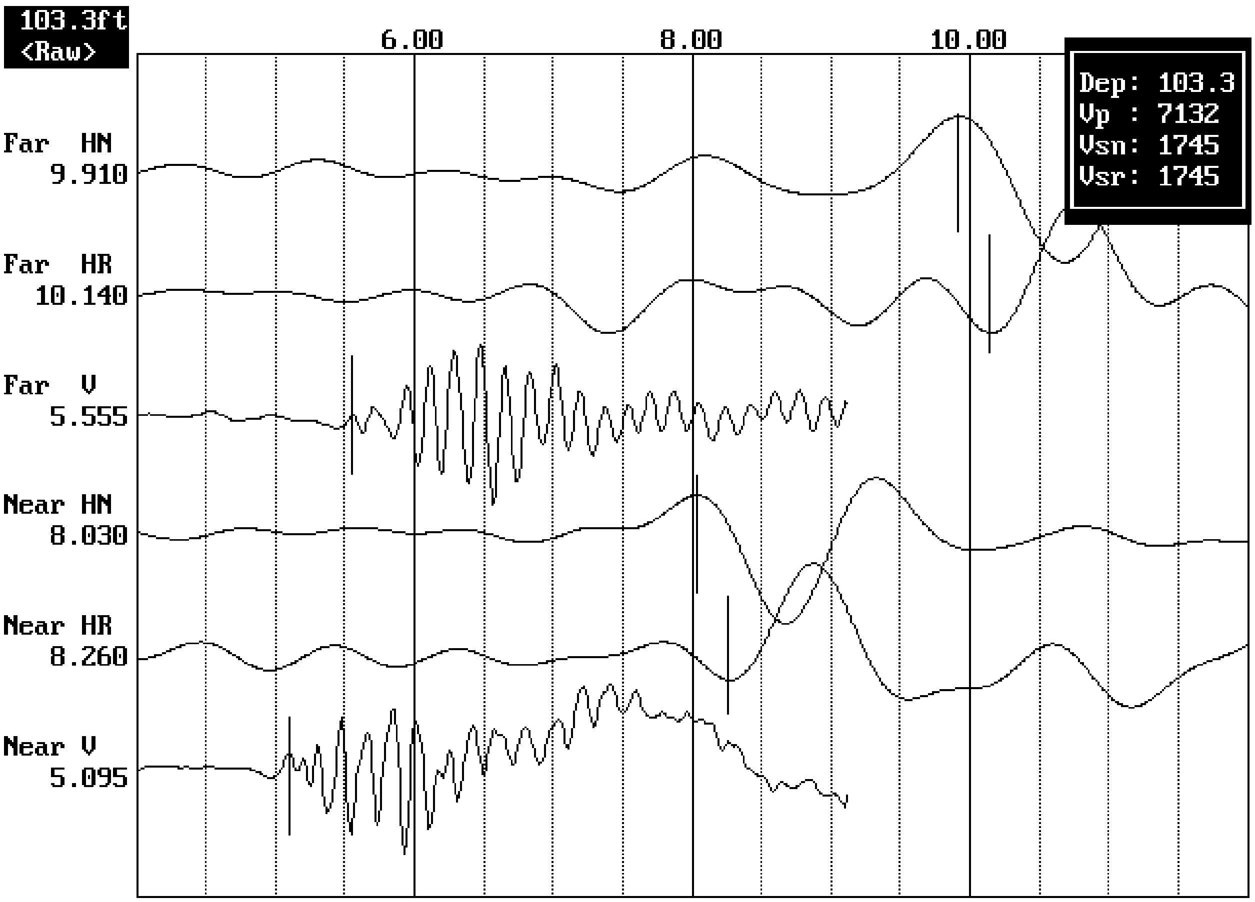

Figure 2: Example of filtered (1400 Hz lowpass) suspension record

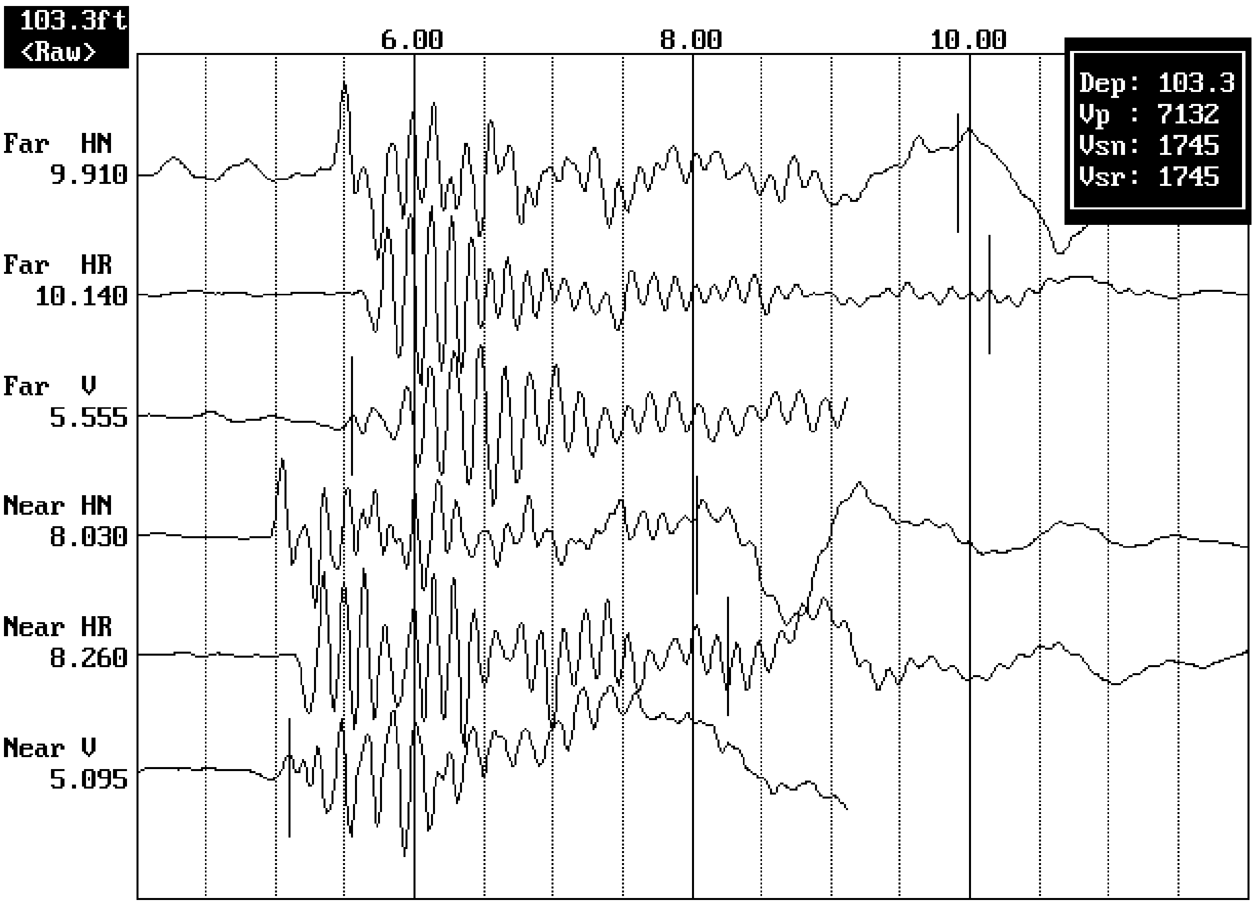

Figure 3. Example of unfiltered suspension record

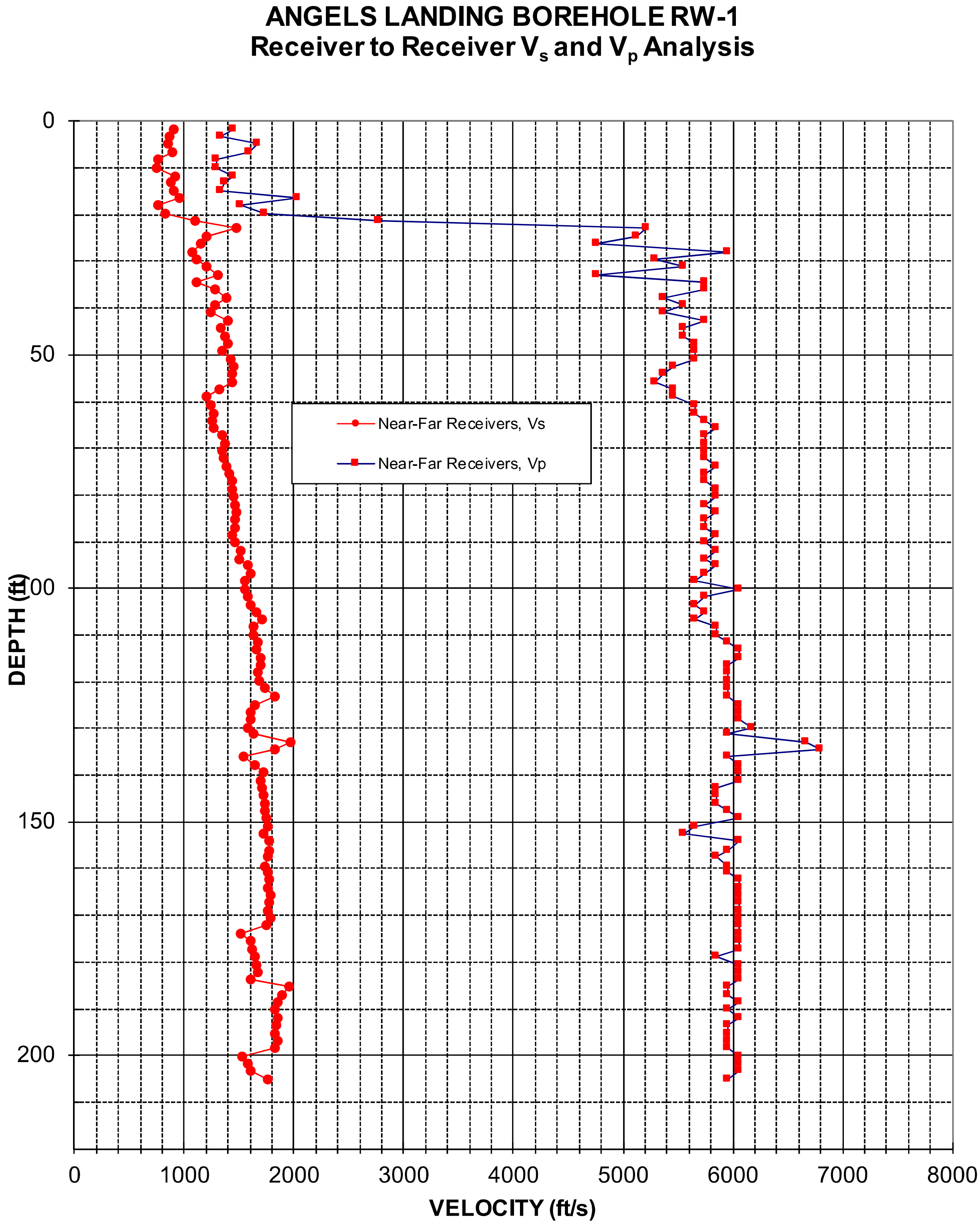

Figure 4: Borehole RW-1, Suspension R1-R2 P- and S_H-wave velocities

Table 3. Borehole RW-1, Suspension R1-R2 depths and P- and S_H-wave velocities

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio
Based on Receiver-to-Receiver Travel Time Data - Borehole RW-1

American Units			
Depth at Midpoint Between Receivers	Velocity		Poisson's Ratio
	V_s	V_p	
(ft)	(ft/s)	(ft/s)	
1.6	910	1450	0.18
3.3	870	1330	0.14
4.9	850	1670	0.32
6.6	890	1590	0.27
8.2	760	1290	0.23
9.8	750	1290	0.24
11.8	910	1450	0.17
13.1	880	1370	0.14
14.8	910	1330	0.07
16.4	960	2030	0.36
18.0	770	1510	0.33
19.7	830	1740	0.35
21.3	1100	2780	0.41
23.0	1470	5210	0.46
24.6	1210	5130	0.47
26.3	1150	4760	0.47
27.9	1080	5950	0.48
29.5	1110	5290	0.48
31.2	1210	5560	0.48
32.8	1310	4760	0.46
34.5	1110	5750	0.48
36.1	1280	5750	0.47
37.7	1390	5380	0.46
39.4	1280	5560	0.47
41.0	1230	5380	0.47
42.7	1400	5750	0.47
44.3	1330	5560	0.47
45.9	1370	5560	0.47
47.6	1390	5650	0.47
49.2	1340	5650	0.47
50.9	1420	5650	0.47
52.5	1450	5460	0.46
54.1	1440	5380	0.46
55.8	1440	5290	0.46
57.4	1320	5460	0.47
59.1	1210	5460	0.47
60.7	1240	5650	0.47
62.7	1270	5650	0.47

Metric Units			
Depth at Midpoint Between Receivers	Velocity		Poisson's Ratio
	V_s	V_p	
(m)	(m/s)	(m/s)	
0.5	280	440	0.18
1.0	260	410	0.14
1.5	260	510	0.32
2.0	270	480	0.27
2.5	230	390	0.23
3.0	230	390	0.24
3.6	280	440	0.17
4.0	270	420	0.14
4.5	280	410	0.07
5.0	290	620	0.36
5.5	230	460	0.33
6.0	250	530	0.35
6.5	340	850	0.41
7.0	450	1590	0.46
7.5	370	1560	0.47
8.0	350	1450	0.47
8.5	330	1810	0.48
9.0	340	1610	0.48
9.5	370	1690	0.48
10.0	400	1450	0.46
10.5	340	1750	0.48
11.0	390	1750	0.47
11.5	420	1640	0.46
12.0	390	1690	0.47
12.5	380	1640	0.47
13.0	430	1750	0.47
13.5	410	1690	0.47
14.0	420	1690	0.47
14.5	430	1720	0.47
15.0	410	1720	0.47
15.5	430	1720	0.47
16.0	440	1670	0.46
16.5	440	1640	0.46
17.0	440	1610	0.46
17.5	400	1670	0.47
18.0	370	1670	0.47
18.5	380	1720	0.47
19.1	390	1720	0.47

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio Based on Receiver-to-Receiver Travel Time Data - Borehole RW-1

American Units				Metric Units			
Depth at Midpoint Between Receivers	Velocity		Poisson's Ratio	Depth at Midpoint Between Receivers	Velocity		Poisson's Ratio
	V_s	V_p			V_s	V_p	
(ft)	(ft/s)	(ft/s)		(m)	(m/s)	(m/s)	
64.0	1260	5750	0.47	19.5	380	1750	0.47
65.6	1270	5850	0.48	20.0	390	1780	0.48
67.3	1340	5750	0.47	20.5	410	1750	0.47
68.9	1370	5750	0.47	21.0	420	1750	0.47
70.5	1340	5750	0.47	21.5	410	1750	0.47
72.2	1360	5750	0.47	22.0	410	1750	0.47
73.8	1390	5850	0.47	22.5	420	1780	0.47
75.5	1410	5750	0.47	23.0	430	1750	0.47
77.1	1430	5750	0.47	23.5	440	1750	0.47
78.7	1430	5850	0.47	24.0	440	1780	0.47
80.4	1440	5850	0.47	24.5	440	1780	0.47
82.0	1460	5750	0.47	25.0	450	1750	0.47
83.7	1470	5850	0.47	25.5	450	1780	0.47
85.3	1460	5750	0.47	26.0	450	1750	0.47
86.9	1460	5750	0.47	26.5	450	1750	0.47
88.6	1430	5850	0.47	27.0	440	1780	0.47
90.2	1460	5750	0.47	27.5	450	1750	0.47
91.9	1520	5850	0.46	28.0	460	1780	0.46
93.8	1500	5750	0.46	28.6	460	1750	0.46
95.1	1580	5850	0.46	29.0	480	1780	0.46
96.8	1610	5750	0.46	29.5	490	1750	0.46
98.4	1550	5650	0.46	30.0	470	1720	0.46
100.1	1560	6060	0.46	30.5	470	1850	0.46
101.7	1580	5750	0.46	31.0	480	1750	0.46
103.7	1610	5650	0.46	31.6	490	1720	0.46
105.0	1660	5750	0.45	32.0	510	1750	0.45
106.6	1710	5650	0.45	32.5	520	1720	0.45
108.3	1630	5850	0.46	33.0	500	1780	0.46
109.9	1630	5850	0.46	33.5	500	1780	0.46
111.6	1670	5950	0.46	34.0	510	1810	0.46
113.2	1660	6060	0.46	34.5	510	1850	0.46
114.8	1690	6060	0.46	35.0	520	1850	0.46
116.5	1700	5950	0.46	35.5	520	1810	0.46
118.1	1670	5950	0.46	36.0	510	1810	0.46
119.8	1680	5950	0.46	36.5	510	1810	0.46
121.4	1740	5950	0.45	37.0	530	1810	0.45
123.0	1820	5950	0.45	37.5	560	1810	0.45
125.0	1640	6060	0.46	38.1	500	1850	0.46
126.6	1600	6060	0.46	38.6	490	1850	0.46

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio Based on Receiver-to-Receiver Travel Time Data - Borehole RW-1

American Units				Metric Units			
Depth at Midpoint Between Receivers	Velocity		Poisson's Ratio	Depth at Midpoint Between Receivers	Velocity		Poisson's Ratio
	V_s	V_p			V_s	V_p	
(ft)	(ft/s)	(ft/s)		(m)	(m/s)	(m/s)	
128.0	1600	6060	0.46	39.0	490	1850	0.46
129.9	1570	6170	0.47	39.6	480	1880	0.47
131.2	1630	5950	0.46	40.0	500	1810	0.46
132.9	1970	6670	0.45	40.5	600	2030	0.45
134.5	1820	6800	0.46	41.0	560	2070	0.46
136.2	1540	5950	0.46	41.5	470	1810	0.46
137.8	1640	6060	0.46	42.0	500	1850	0.46
139.4	1730	6060	0.46	42.5	530	1850	0.46
141.1	1690	6060	0.46	43.0	520	1850	0.46
142.7	1710	5850	0.45	43.5	520	1780	0.45
144.4	1720	5850	0.45	44.0	520	1780	0.45
146.0	1740	5850	0.45	44.5	530	1780	0.45
147.6	1740	5950	0.45	45.0	530	1810	0.45
149.3	1750	6060	0.45	45.5	530	1850	0.45
150.9	1750	5650	0.45	46.0	530	1720	0.45
152.6	1730	5560	0.45	46.5	530	1690	0.45
154.2	1770	6060	0.45	47.0	540	1850	0.45
156.2	1770	5950	0.45	47.6	540	1810	0.45
157.5	1750	5850	0.45	48.0	530	1780	0.45
159.5	1740	5950	0.45	48.6	530	1810	0.45
160.8	1750	5950	0.45	49.0	530	1810	0.45
162.4	1770	6060	0.45	49.5	540	1850	0.45
164.0	1750	6060	0.45	50.0	530	1850	0.45
165.7	1790	6060	0.45	50.5	550	1850	0.45
167.3	1770	6060	0.45	51.0	540	1850	0.45
169.0	1750	6060	0.45	51.5	530	1850	0.45
170.6	1790	6060	0.45	52.0	550	1850	0.45
172.2	1750	6060	0.45	52.5	530	1850	0.45
173.9	1510	6060	0.47	53.0	460	1850	0.47
175.5	1610	6060	0.46	53.5	490	1850	0.46
177.2	1620	6060	0.46	54.0	490	1850	0.46
178.8	1640	5850	0.46	54.5	500	1780	0.46
180.8	1660	6060	0.46	55.1	510	1850	0.46
182.1	1670	6060	0.46	55.5	510	1850	0.46
183.7	1600	6060	0.46	56.0	490	1850	0.46
185.4	1950	5950	0.44	56.5	590	1810	0.44
187.0	1890	5950	0.44	57.0	580	1810	0.44
188.7	1850	6060	0.45	57.5	560	1850	0.45
190.3	1830	5950	0.45	58.0	560	1810	0.45

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio Based on Receiver-to-Receiver Travel Time Data - Borehole RW-1

American Units			
Depth at Midpoint Between Receivers	Velocity		Poisson's Ratio
	V_s	V_p	
(ft)	(ft/s)	(ft/s)	
191.9	1850	6060	0.45
193.6	1840	5950	0.45
195.2	1820	5950	0.45
196.9	1850	5950	0.45
198.5	1820	5950	0.45
200.1	1520	6060	0.47
201.8	1580	6060	0.46
203.4	1600	6060	0.46
205.1	1750	5950	0.45

Metric Units			
Depth at Midpoint Between Receivers	Velocity		Poisson's Ratio
	V_s	V_p	
(m)	(m/s)	(m/s)	
58.5	560	1850	0.45
59.0	560	1810	0.45
59.5	560	1810	0.45
60.0	560	1810	0.45
60.5	560	1810	0.45
61.0	460	1850	0.47
61.5	480	1850	0.46
62.0	490	1850	0.46
62.5	530	1810	0.45

APPENDIX A

SUSPENSION VELOCITY MEASUREMENT QUALITY ASSURANCE SUSPENSION SOURCE TO RECEIVER ANALYSIS RESULTS

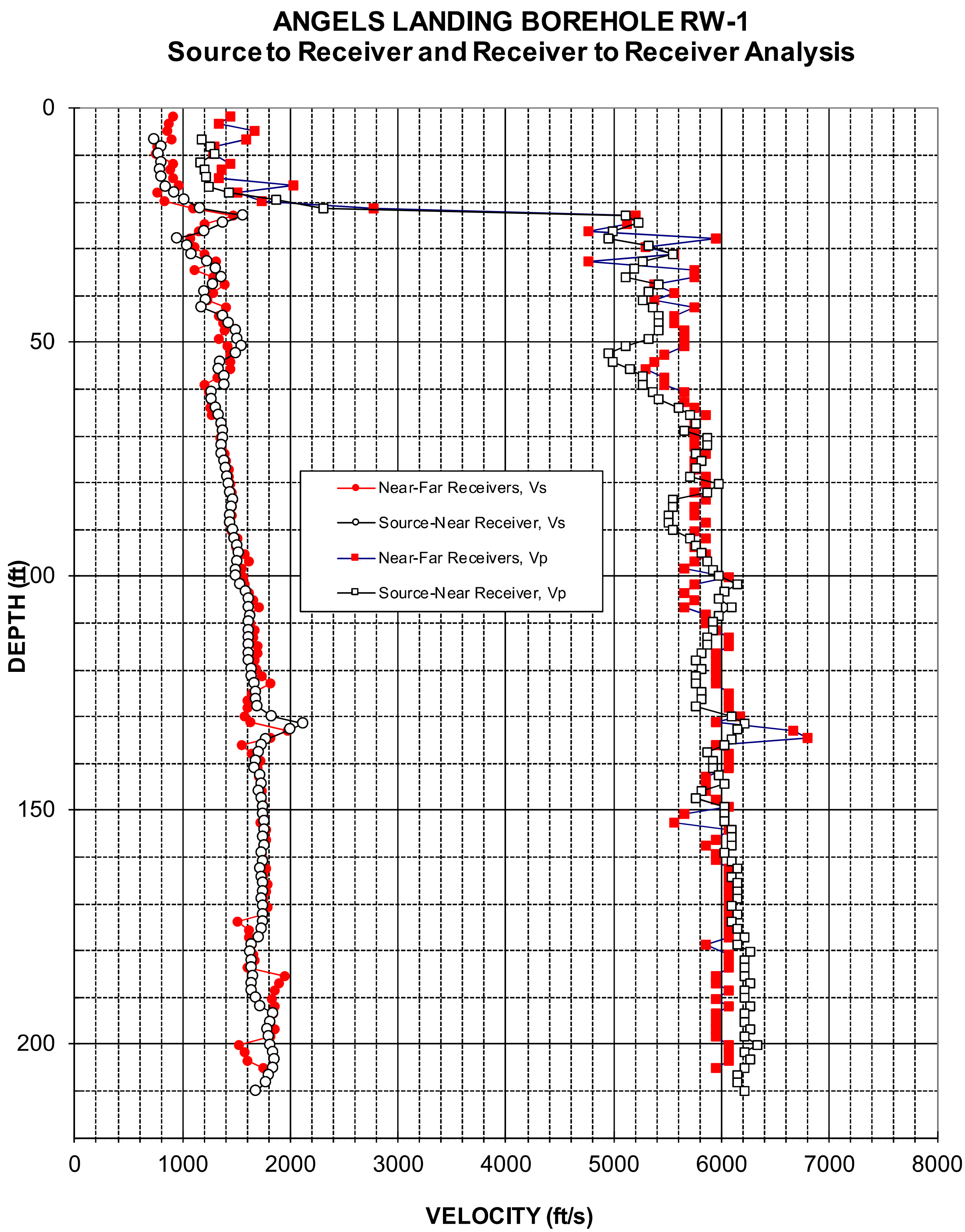

Figure A-1: Borehole RW-1, Suspension S-R1 P- and S_H-wave velocities

Table A-1. Borehole RW-1, S - R1 quality assurance analysis P- and S_H-wave data

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio
Based on Source-to-Receiver Travel Time Data - Borehole RW-1

American Units				Metric Units			
Depth at Midpoint Between Source and Near Receiver	Velocity		Poisson's Ratio	Depth at Midpoint Between Source and Near Receiver	Velocity		Poisson's Ratio
	V_s	V_p			V_s	V_p	
(ft)	(ft/s)	(ft/s)		(m)	(m/s)	(m/s)	
6.5	740	1180	0.17	2.0	230	360	0.17
8.1	810	1250	0.15	2.5	250	380	0.15
9.8	780	1300	0.22	3.0	240	400	0.22
11.4	810	1170	0.04	3.5	250	360	0.04
13.0	790	1210	0.13	4.0	240	370	0.13
14.7	810	1210	0.11	4.5	250	370	0.11
16.6	840	1240	0.08	5.1	260	380	0.08
18.0	920	1440	0.15	5.5	280	440	0.15
19.6	1020	1870	0.29	6.0	310	570	0.29
21.2	1160	2300	0.33	6.5	350	700	0.33
22.9	1560	5100	0.45	7.0	480	1560	0.45
24.5	1380	5230	0.46	7.5	420	1590	0.46
26.2	1210	4980	0.47	8.0	370	1520	0.47
27.8	950	4950	0.48	8.5	290	1510	0.48
29.4	1040	5320	0.48	9.0	320	1620	0.48
31.1	1090	5550	0.48	9.5	330	1690	0.48
32.7	1230	5280	0.47	10.0	380	1610	0.47
34.4	1310	5190	0.47	10.5	400	1580	0.47
36.0	1360	5100	0.46	11.0	410	1560	0.46
37.6	1280	5410	0.47	11.5	390	1650	0.47
39.3	1210	5320	0.47	12.0	370	1620	0.47
40.9	1210	5280	0.47	12.5	370	1610	0.47
42.6	1170	5360	0.47	13.0	360	1640	0.47
44.2	1370	5410	0.47	13.5	420	1650	0.47
45.8	1440	5410	0.46	14.0	440	1650	0.46
47.5	1490	5410	0.46	14.5	450	1650	0.46
49.1	1500	5320	0.46	15.0	460	1620	0.46
50.8	1540	5100	0.45	15.5	470	1560	0.45
52.4	1500	4950	0.45	16.0	460	1510	0.45
54.0	1360	4980	0.46	16.5	410	1520	0.46
55.7	1340	5150	0.46	17.0	410	1570	0.46
57.3	1390	5280	0.46	17.5	420	1610	0.46
59.0	1390	5280	0.46	18.0	420	1610	0.46
60.6	1270	5360	0.47	18.5	390	1640	0.47
62.2	1270	5410	0.47	19.0	390	1650	0.47
63.9	1320	5600	0.47	19.5	400	1710	0.47
65.5	1340	5700	0.47	20.0	410	1740	0.47
67.5	1370	5750	0.47	20.6	420	1750	0.47
68.8	1370	5650	0.47	21.0	420	1720	0.47

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio Based on Source-to-Receiver Travel Time Data - Borehole RW-1

American Units				Metric Units			
Depth at Midpoint Between Source and Near Receiver	Velocity		Poisson's Ratio	Depth at Midpoint Between Source and Near Receiver	Velocity		Poisson's Ratio
	V_s	V_p			V_s	V_p	
(ft)	(ft/s)	(ft/s)		(m)	(m/s)	(m/s)	
70.5	1370	5860	0.47	21.5	420	1790	0.47
72.1	1370	5860	0.47	22.0	420	1790	0.47
73.7	1370	5750	0.47	22.5	420	1750	0.47
75.4	1390	5810	0.47	23.0	420	1770	0.47
77.0	1400	5750	0.47	23.5	430	1750	0.47
78.7	1410	5700	0.47	24.0	430	1740	0.47
80.3	1440	5970	0.47	24.5	440	1820	0.47
81.9	1440	5860	0.47	25.0	440	1790	0.47
83.6	1480	5550	0.46	25.5	450	1690	0.46
85.2	1460	5550	0.46	26.0	440	1690	0.46
86.9	1450	5500	0.46	26.5	440	1680	0.46
88.5	1440	5500	0.46	27.0	440	1680	0.46
90.1	1470	5550	0.46	27.5	450	1690	0.46
91.8	1480	5700	0.46	28.0	450	1740	0.46
93.4	1500	5750	0.46	28.5	460	1750	0.46
95.1	1530	5810	0.46	29.0	460	1770	0.46
96.7	1500	5860	0.46	29.5	460	1790	0.46
98.7	1490	5920	0.47	30.1	450	1800	0.47
100.0	1500	5970	0.47	30.5	460	1820	0.47
101.6	1530	6150	0.47	31.0	470	1870	0.47
103.3	1580	6030	0.46	31.5	480	1840	0.46
104.9	1610	5970	0.46	32.0	490	1820	0.46
106.5	1620	6090	0.46	32.5	490	1860	0.46
108.5	1630	5970	0.46	33.1	500	1820	0.46
109.8	1620	5920	0.46	33.5	490	1800	0.46
111.5	1620	5920	0.46	34.0	490	1800	0.46
113.1	1620	5860	0.46	34.5	490	1790	0.46
114.7	1620	5860	0.46	35.0	490	1790	0.46
116.4	1610	5810	0.46	35.5	490	1770	0.46
118.0	1620	5750	0.46	36.0	490	1750	0.46
119.7	1640	5810	0.46	36.5	500	1770	0.46
121.3	1650	5750	0.46	37.0	500	1750	0.46
122.9	1670	5750	0.45	37.5	510	1750	0.45
124.6	1680	5810	0.45	38.0	510	1770	0.45
126.2	1680	5810	0.45	38.5	510	1770	0.45
127.9	1700	5750	0.45	39.0	520	1750	0.45
129.8	1830	6090	0.45	39.6	560	1860	0.45
131.5	2120	6210	0.43	40.1	650	1890	0.43
132.8	2000	6150	0.44	40.5	610	1870	0.44
134.8	1780	6090	0.45	41.1	540	1860	0.45

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio
Based on Source-to-Receiver Travel Time Data - Borehole RW-1

American Units			
Depth at Midpoint Between Source and Near Receiver	Velocity		Poisson's Ratio
	V_s	V_p	
(ft)	(ft/s)	(ft/s)	
136.1	1730	6030	0.45
137.7	1710	5860	0.45
139.3	1690	5920	0.46
141.0	1670	5920	0.46
142.6	1720	5970	0.46
144.3	1730	6030	0.45
145.9	1710	5810	0.45
147.6	1730	5750	0.45
149.2	1750	6030	0.45
150.8	1750	6030	0.45
152.5	1770	6030	0.45
154.1	1760	6090	0.45
155.8	1750	6090	0.45
157.4	1760	6090	0.45
159.0	1730	6030	0.45
161.0	1740	6090	0.46
162.3	1720	6150	0.46
164.3	1730	6090	0.46
165.6	1740	6150	0.46
167.2	1740	6150	0.46
168.9	1730	6150	0.46
170.5	1740	6090	0.46
172.2	1750	6150	0.46
173.8	1750	6090	0.45
175.4	1730	6150	0.46
177.1	1710	6210	0.46
178.7	1640	6150	0.46
180.4	1630	6270	0.46
182.0	1640	6210	0.46
183.6	1640	6210	0.46
185.6	1650	6210	0.46
186.9	1640	6270	0.46
188.6	1640	6210	0.46
190.2	1690	6210	0.46
191.8	1720	6270	0.46
193.5	1850	6210	0.45
195.1	1820	6210	0.45
196.8	1790	6270	0.46
198.4	1800	6210	0.45
200.0	1820	6330	0.45

Metric Units			
Depth at Midpoint Between Source and Near Receiver	Velocity		Poisson's Ratio
	V_s	V_p	
(m)	(m/s)	(m/s)	
41.5	530	1840	0.45
42.0	520	1790	0.45
42.5	510	1800	0.46
43.0	510	1800	0.46
43.5	520	1820	0.46
44.0	530	1840	0.45
44.5	520	1770	0.45
45.0	530	1750	0.45
45.5	530	1840	0.45
46.0	530	1840	0.45
46.5	540	1840	0.45
47.0	540	1860	0.45
47.5	530	1860	0.45
48.0	540	1860	0.45
48.5	530	1840	0.45
49.1	530	1860	0.46
49.5	520	1870	0.46
50.1	530	1860	0.46
50.5	530	1870	0.46
51.0	530	1870	0.46
51.5	530	1870	0.46
52.0	530	1860	0.46
52.5	530	1870	0.46
53.0	530	1860	0.45
53.5	530	1870	0.46
54.0	520	1890	0.46
54.5	500	1870	0.46
55.0	500	1910	0.46
55.5	500	1890	0.46
56.0	500	1890	0.46
56.6	500	1890	0.46
57.0	500	1910	0.46
57.5	500	1890	0.46
58.0	510	1890	0.46
58.5	530	1910	0.46
59.0	560	1890	0.45
59.5	550	1890	0.45
60.0	550	1910	0.46
60.5	550	1890	0.45
61.0	550	1930	0.45

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio Based on Source-to-Receiver Travel Time Data - Borehole RW-1

American Units			
Depth at Midpoint Between Source and Near Receiver	Velocity		Poisson's Ratio
	V_s	V_p	
(ft)	(ft/s)	(ft/s)	
201.7	1850	6210	0.45
203.3	1860	6270	0.45
205.0	1850	6210	0.45
206.6	1800	6150	0.45
208.2	1770	6150	0.45
209.9	1690	6210	0.46

Metric Units			
Depth at Midpoint Between Source and Near Receiver	Velocity		Poisson's Ratio
	V_s	V_p	
(m)	(m/s)	(m/s)	
61.5	560	1890	0.45
62.0	570	1910	0.45
62.5	560	1890	0.45
63.0	550	1870	0.45
63.5	540	1870	0.45
64.0	510	1890	0.46

APPENDIX B

BOREHOLE GEOPHYSICAL LOGGING SYSTEMS - NIST TRACEABLE CALIBRATION RECORDS

MICRO PRECISION CALIBRATION

MICRO PRECISION CALIBRATION, INC
2165 N. Glassell St.,
Orange, CA 92865
714-901-5659

ilac-MRA ANAB ACCREDITED CALIBRATION LABORATORY AC-1969.03

Certificate of Calibration

Date: Oct 31, 2017 **Cert No. 512200813090970**

Customer:
GEOVISION
1124 OLYMPIC DRIVE
CORONA CA 92881

		Work Order #:	LA-90030255
		Purchase Order #:	17341-171030-01
MPC Control #:	AM6767	Serial Number:	160023
Asset ID:	160023	Department:	N/A
Gage Type:	LOGGER	Performed By:	NIKOLAS GROHMAN
Manufacturer:	OYO	Received Condition:	IN TOLERANCE
Model Number:	3403	Returned Condition:	IN TOLERANCE
Size:	N/A	Cal. Date:	October 31, 2017
Temp/RH:	68.8°F / 40.5%	Cal. Interval:	12 MONTHS
Location:	Calibration performed at MPC facility	Cal. Due Date:	October 31, 2018

Calibration Notes:
See attached data sheet for calculations. (1 Page)
Calibrated IAW customer supplied data form Rev 2.1
Frequency measurement uncertainty = 0.0005 Hz
Unit calibrated with Laptop Panasonic Model CF-29,s/n: 5KKSA84231 and RG Micrologger II Serial No. 5772
Calibrated To 4:1 Accuracy Ratio

Calibration performed in accordance with approved GEOVision calibration procedures included in work Instruction No. 17.

Software: ML PS 4.00 Suspension Logger, GVLog.jar (2004) and pslog.exe ver 1.00 software.

Standards Used to Calibrate Equipment

I.D.	Description.	Model	Serial	Manufacturer	Cal. Due Date	Traceability #
DB8748	GPS TIME AND FREQUENCY RECEIVER	58503A	3625A01225	HEWLETT PACKARD	Jun 16, 2019	512200812919221
LAS0018	ARB / FUNC GENERATOR	33250A	US40001522	AGILENT	Dec 7, 2017	512200812632023
LAS0033	UNIVERSAL COUNTER	53131A	3546A14968	HEWLETT PACKARD	Mar 22, 2018	512200812767586

Calibrating Technician: NIKOLAS GROHMAN

QC Approval: Tyler McKeen

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for normal distribution corresponds to a coverage probability of approximately 95%. The standard uncertainty of measurement has been determined in accordance with EA's Publication and NIST Technical Note 1297, 1994 Edition. Services rendered comply with ISO/IEC 17025:2005, ANSI/NCSL Z540-1-1994, ANSI/NCSL Z540.3-2006, MPC Quality Manual, MPC CSD and with customer purchase order instructions.

Calibration cycles and resulting due dates were submitted/approved by the customer. Any number of factors may cause an instrument to drift out of tolerance before the next scheduled calibration. Recalibration cycles should be based on frequency of use, environmental conditions and customer's established systematic accuracy. The information on this report, pertains only to the instrument identified.

MICRO PRECISION CALIBRATION

MICRO PRECISION CALIBRATION, INC
2165 N. Glassell St.,
Orange, CA 92865
714-901-5659

ilac-MRA ANAB ACCREDITED CALIBRATION LABORATORY AC-1969.03

Certificate of Calibration

Date: Oct 31, 2017 **Cert No. 512200813090970**

Procedures Used in this Event

Procedure Name	Description
GEOVISION SEISMIC	Seismic Logger/Recorder Calibration Procedure, Rev. 2.1

Calibrating Technician: NIKOLAS GROHMAN

QC Approval: Tyler McKeen

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for normal distribution corresponds to a coverage probability of approximately 95%. The standard uncertainty of measurement has been determined in accordance with EA's Publication and NIST Technical Note 1297, 1994 Edition. Services rendered comply with ISO/IEC 17025:2005, ANSI/NCSL Z540-1-1994, ANSI/NCSL Z540.3-2006, MPC Quality Manual, MPC CSD and with customer purchase order instructions.

Calibration cycles and resulting due dates were submitted/approved by the customer. Any number of factors may cause an instrument to drift out of tolerance before the next scheduled calibration. Recalibration cycles should be based on frequency of use, environmental conditions and customer's established systematic accuracy. The information on this report, pertains only to the instrument identified.

All standards are traceable to SI through the National Institute of Standards and Technology (NIST) and/or recognized national or international standards laboratories. Services rendered include proper manufacturer's service instruction and are warranted for no less than thirty (30) days. This report may not be reproduced in part or in a whole without the prior written approval of the issuing MPC lab.

GEOVision geophysical services

SUSPENSION PS SEISMIC LOGGER/RECORDER CALIBRATION DATA FORM

INSTRUMENT DATA

System mfg.:	OYO	Model no.:	3403
Serial no.:	160023	Calibration date:	10/31/2017
By:	Micro Precision	Due date:	10/31/2018
Counter mfg.:	Hewlett Packard	Model no.:	53131A
Serial no.:	3546A14968	Calibration date:	3/22/2017
By:	Micro Precision	Due date:	3/22/2018
Signal generator mfg.:	Agilent	Model no.:	33250A
Serial no.:	US40001522	Calibration date:	12/07/2016
By:	Micro precision	Due date:	12/07/2017
Laptop controller mfg.:	Panasonic	Model no.:	CF-29
Serial no.:	5KKSA84231	Calibration date:	N/A

SYSTEM SETTINGS:

Gain:	2 (lowest possible)
Filter	10k / off
Range:	5 - 200 msec
Delay:	Ø
Stack (1 std)	1
System date = correct date and time	✓ 10/31, 09:40

PROCEDURE:

Set sine wave frequency to target frequency with amplitude of approximately 0.25 volt peak
Note actual frequency on data form.
Set sample period and record data file to disk. Note file name on data form.
Pick duration of 9 cycles using PSLOG.EXE program, note duration on data form, and save as .sps file. Calculate average frequency for each channel pair and note on data form.

Average frequency must be within +/- 1% of actual frequency at all data points.

Maximum error ((AVG-ACT)/ACT*100)% As found 0.22% As left 0.22%

Target Frequency (Hz)	Actual Frequency (Hz)	Sample Period (microS)	File Name	Time for 9 cycles Hn (msec)	Average Frequency Hn (Hz)	Time for 9 cycles Hr (msec)	Average Frequency Hr (Hz)	Time for 9 cycles V (msec)	Average Frequency V (Hz)
50.00	50.00	200	001	180	50.00	179.8	50.06	179.8	50.06
100.0	100.0	100	002	90	100.0	90	100.0	90.1	99.89
200.0	200.0	50	003	45.05	199.8	44.95	200.2	44.95	200.2
500.0	500.0	20	004	18	500.0	18	500.0	18	500.0
1000	1000	10	005	9.01	998.9	8.99	1001	9.01	998.9
2000	2000	5	006	4.495	2002	4.5	2000	4.495	2002

Calibrated by: Nik Grohman (Name) 10/31/2017 (Date) [signature] (Signature)

Witnessed by: Emily Feldman (Name) 10/31/2017 (Date) [signature] (Signature)

Appendix IS-3.2

Geotechnical Evaluation

wood.

Report of Geotechnical Evaluation for Entitlement Documents (Geotechnical Services Phase B)

Proposed Angels Landing Development

Block Bordered by Olive Street, Hill Street,
4th Street, and Angels Flight
Los Angeles, California

Prepared for:

Angels Landing Partners, LLC
Los Angeles, California

Project 4953-18-0421.02

July 6, 2018
Revised March 15, 2019

Wood Environment & Infrastructure Solutions, Inc.
6001 Rickenbacker Road
Los Angeles, CA 90040-3031
USA
T: +1 323.889.5300
www.woodplc.com

July 6, 2018
Revised March 15, 2019
Wood Project 4953-18-0421.02

Angels Landing Partners, LLC
448 South Hill Street, Suite 408
Los Angeles, California 90013
Attn: Mr. Kevin Roberts

Subject: Letter of Transmittal
Report of Geotechnical Evaluation for Entitlement Documents
(Geotechnical Services Phase B)
Proposed Angels Landing Development
Block Bordered by Olive Street, Hill Street, 4th Street, and Angels Flight
Los Angeles, California

Dear Mr. Roberts:

Wood Environment & Infrastructure Solutions, Inc. (Wood), formerly Amec Foster Wheeler Environment & Infrastructure, Inc., is pleased to submit the results of our geotechnical evaluation (for our Phase B services) for use in preparation of entitlement documents for the proposed Angels Landing Development project located in Los Angeles, California. This evaluation was conducted in general accordance with our proposal dated April 2, 2018, as on the Agreement between Angels Landing Partners, LLC and our firm dated April 23, 2018.

The scope of our Phase B services was based on the request for proposal from Mr. Kevin Roberts of Angels Landing Partners, LLC, dated October 31, 2017. Conceptual drawings of the proposed project were provided by Mr. Jaime Sanchez of Angels Landing Partners, LLC on March 6, 2019. This report was based on our recent subsurface investigation, a review of previous geotechnical and environmental reports, and available published and unpublished literature.

It has been a pleasure to be of professional service to you. Please contact us if you have any questions or if we can be of further assistance.

Sincerely,

Wood Environment & Infrastructure Solutions, Inc.

PROFESSIONAL GEOLOGIST
Pierre E. Romo
No. 9053
STATE OF CALIFORNIA

Pierre E. Romo
Senior Geologist

Reviewed by:

PROFESSIONAL GEOLOGIST
ROSALIND MUNRO
NO. 1269
CERTIFIED ENGINEERING GEOLOGIST
STATE OF CALIFORNIA

REGISTERED PROFESSIONAL ENGINEER
MARTIN BYRD HUDSON
2570
GEOTECHNICAL
EXP. 12-31-2019
STATE OF CALIFORNIA

Rosalind Munro
Principal Engineering Geologist

Martin B. Hudson, Ph.D.
Principal Engineer

P:\4953 Geotech\2018-proj\180421 Angel's Landing Development\4.0 Project Deliverables\4.1 Reports\Final Report\EIR\4953-18-0421R0_Angels_Landing_Phase B_rev2.docx\PER:RM,MBH

(Electronic copies submitted)

Report of Geotechnical Evaluation for Entitlement Documents
(Geotechnical Services Phase B)

Proposed Angels Landing Development
Block Bordered by S. Olive Street, Hill Street, 4th Street, and Angels Flight
Los Angeles, California

Prepared for:

Angels Landing Partners, LLC
Los Angeles, California

Wood Environment & Infrastructure Solutions, Inc.
Los Angeles, California

July 6, 2018
Revised March 15, 2019

Project 4953-18-0421.02

Table of Contents

Tables

Figures

1.0 Scope

This report presents the results of our geotechnical evaluation for the proposed Angels Landing development (project site) located on the block Bordered by Olive Street, Hill Street, 4th Street, and Angels Flight in Los Angeles, California. The location of the project site is shown on Figure 1, Site Vicinity Map. The scope of our work was performed in accordance with our proposal dated April 2, 2018 and authorized on April 23, 2018.

The primary purpose of this study is to provide geotechnical information for incorporation into entitlement documents, such as an Environmental Impact Report (EIR), planned to be filed for the proposed project. The results of our study are presented in this report. To complete the scope of services, the following tasks were performed:

- Evaluation of faulting in relation to the project site
- Evaluation of seismicity and ground shaking
- Evaluation of liquefaction and seismically-induced settlement potential
- Evaluation of expansive and corrosive soils
- Potential for slope instability including temporary and permanent slopes
- Tsunami potential
- Evaluation of soil erosion
- Subsidence potential
- Inclusion of site-specific data from our geotechnical investigation to support potential hazards and subsurface conditions, where warranted

This report is based on a current geotechnical investigation by Wood Environment & Infrastructure Solutions, Inc. (Wood), a review of previous geotechnical reports by our predecessor companies at and in the vicinity of the project site, and available published and unpublished geologic and seismic literature pertinent to the project site. The City of Los Angeles Safety Element of the General Plan (1996) and the Safety Element of the County of Los Angeles General Plan (2015 and 1990) were reviewed as part of our scope. The reports reviewed as part of our evaluation are listed in Section 6.0, References. Site-specific field work and testing of soil samples were performed as part of this work to verify site conditions and to acquire data to be used for final engineering design; data from current and prior subsurface investigations at the site were used in this evaluation.

Our professional services have been performed using that degree of care and skill ordinarily exercised, under similar circumstances, by reputable geotechnical consultants practicing in this or similar localities. No other warranty, expressed or implied, is made as to the professional advice included in this report. This report has been prepared for Angels Landing Partners, LLC to be used solely in the preparation of entitlement documents, such as an Environmental Impact Report, for the proposed development. This report has not been prepared for use by other parties and may not contain sufficient information for purposes of other parties or other uses. The assessment of general site environmental conditions for the presence of pollutants in the soils and ground water of the site was beyond the scope of this report. Wood has provided a report of Phase I Environmental Site Assessment report dated March 11, 2019 and a report of Phase II Environmental Site Assessment dated March 13, 2019. Wood has also provided a preliminary geotechnical report for Phase A services dated March 11, 2019. This report does not contain geotechnical recommendations for final design of the proposed facilities; a site-specific geotechnical investigation will be required in accordance with the requirements of the City of Los Angeles Department of Building and Safety and the Los Angeles Building Code.

2.0 Site Conditions

The site is located at the block bordered by the northeast-southwest aligned Olive Street, the northeast-southwest aligned Hill Street, the northwest-southeast aligned 4th Street, and the northwest-southeast aligned Angels Flight inclined railway in Los Angeles, California (Figure 1). The approximately square-shaped, 2.2-acre site generally slopes downward to the southeast (from Olive Street to Hill Street) with a relief of about 60 feet across the property. The site primarily consists of vacant land except for a concrete-paved/landscaped plaza area along the eastern side of the site and a Los Angeles County Metropolitan Transportation Agency (Metro) Red Line subway entrance portal for the Pershing Square station situated at the southeast corner of the site.
The site was developed primarily with residential structures from the 1880’s through the mid 1900’s. Along Hill Street, the residential structures were replaced by commercial and retail buildings in the early 1900’s. All residential and commercial structures were demolished by the 1960’s. The site was converted to a parking lot and vacant land up to its most recent use as Angels Knoll city park. The site has remained relatively unchanged between the mid-1990’s and the present. The Metro subway portal and associated plaza were constructed along the eastern portion of the site in approximately 1995. The Bunker Hill Transit Tunnel, a section of the previously planned, and since abandoned, Downtown People Mover (DPM), is located underneath California Plaza and Olive Street. Originally planned to continue beneath the site, we understand that the DPM tunnel ends at the property line and does not continue into the site.

3.0 Proposed Development

Based on our review of project plans dated March 1, 2019, Angels Landing Partners, LLC is proposing to develop two mixed-use residential, hotel, retail, and educational/cultural/civic towers at the site. The proposed towers will be 64 stories in height, approximately 854 feet above Hill Street grade, and 42 stories in height, approximately 494 feet above Hill Street grade. We understand that there will be up to seven subterranean levels for parking and one partial subterranean level in a common basement across most of the site, which may extend about 110 to 170 feet below grade. The location of the proposed development is shown on Figure 2, Plot Plan.

The structural design will be using the performance-based earthquake engineering design approach and will be reviewed by a Structural Peer Review Panel to be selected by the Los Angeles Department of Building and Safety. Structural details are not available at this time.

4.0 Geology

4.1 Geologic Setting

The project site is located in Downtown Los Angeles within the northern portion of the Los Angeles Basin. The Los Angeles Basin is within the Peninsular Ranges geomorphic province, just south of the province boundary with the southern portion of the Transverse Ranges geomorphic province. The basin is a major elongated northwest-trending structural depression that has been filled with sediments up to 13,000 feet thick since middle Miocene time (Poland, 1959). The Peninsular Ranges province is characterized by northwest/southeast trending alignments of mountains and hills and intervening basins, reflecting the influence of northwest trending major faults and folds controlling the general geologic structural fabric of the region. In contrast, the Transverse Ranges are characterized by east-west trending geologic structures and mountain ranges that include the Santa Ynez, San Gabriel, San Bernardino, and Santa Monica Mountains, Elysian Hills, and associated valleys.

Locally, the project site is located within the Bunker Hill area of Downtown Los Angeles and situated in the southern portion of the Elysian Hills with ground elevations ranging from approximately 290 to 350 feet above mean sea level (AMSL). The eastern margin of the site is underlain by young alluvial sediments deposited by the ancestral Los Angeles River. The Elysian Hills comprise the low-lying hills located southeast of the eastern end of the Santa Monica Mountains. The Elysian Hills are formed by folding above the active buried (blind) Upper Elysian Park thrust fault. The Hollywood fault separates the northwestern end of the Elysian Hills from the Santa Monica Mountains (Oskin et al, 2000; Lamar, 1970; Dibblee and Ehrenspeck, 1991 and 1989; Hoots, 1930). Bedrock underlying the Elysian Hills is comprised largely of Miocene-and Pliocene-age sedimentary bedrock.

The Bunker Hill area has been substantially modified by intense urbanization during the 1950's to early 1970's. Although still sloping to the south and east, grading has resulted in a topography ranging from gently sloping surfaces to hillside slopes of moderate relief. Excavations and associated grading have resulted in a general lowering of the Bunker Hill area. The upper portion of the site has been cut by as much as 12 feet (LeRoy Crandall and Associates, 1968). The eastern portion of the site has been filled to create the plaza area.

The project site in relation to local topography is shown on Figure 1. The limits of the project site are shown on Figure 2. Local geology is shown on Figure 3, Local Geologic Map. The regional geologic conditions around the project site, including the distribution of geologic units, are shown on Figure 4, Regional Geologic Map. The project site in relation to major regional faults and earthquake epicenters is shown on Figure 5, Regional Fault and Seismicity Map. Seismic hazards and Alquist-Priolo Earthquake Study Zones (A-P Zones) are shown in Figure 6, Seismic Hazards Map.

4.2 Geologic Materials

According to published geologic maps, the ground at the project site is mapped as late Pleistocene- to Holocene-age alluvial deposits along the eastern margin of the site and Pliocene-age Fernando Formation sedimentary bedrock elsewhere (Lamar, 1970; Campbell et al., 2014; Bedrossian et al, 2012; Yerkes, 1997a and 1997b). The site is partially mantled by artificial fill materials consisting of sandy silt to clay varying from a thin veneer (less than 1 foot) in the upper portion of the site to a thickness of more than 13 feet in the lower portion, adjacent to Hill Street. Deeper fill may be encountered elsewhere at the site due to prior construction or grading. Records are not currently available documenting the placement and compaction of the existing fill material within the project site.

In the lower portion of the site below the artificial fill, a wedge of alluvium was encountered in recent and prior exploratory borings to depths from 25 to 30 feet (Law/Crandall, 1993a). The alluvium consists of poorly to well-graded sand, silty sand, and clayey silt with variable gravel and cobble content. Bedrock of the Fernando Formation underlies the alluvium in the lower portion of the site and outcrops at the ground surface for the remainder of the site. The Fernando Formation generally consists of oxidized and unoxidized, massive and poorly- to moderately-well bedded clayey and sandy siltstone and silty fine sandstone. Cemented layers up to 1 foot thick were also encountered. Overall, the formation is generally poorly cemented and weak to very weak, while cemented zones are strong to very strong. The bedrock is oxidized to a light brownish- to yellowish-gray color near the surface. The unoxidized bedrock is a dark greenish gray color.

Bedding dips to the southeast and southwest at between approximately 5 and 37 degrees. Joints in the bedrock were not observed to have a preferred orientation and are steeply dipping. The Fernando Formation is estimated to be approximately 700 feet thick beneath the site and is underlain by the Miocene age Puente Formation.

4.3 Groundwater

The site is in the Bunker Hill area of Downtown Los Angeles and is outside the areal limits of valley fill sediments that constitute the principal water-bearing units; therefore, the site is not considered to be within the regional groundwater basin (CDMG, 1998a and 1998b; DWR, 2003). Although the bedrock of the Fernando Formation is considered non-water bearing, perched groundwater may be present locally in fractures and along bedding planes in the bedrock. A recent exploratory boring drilled in the upper cut portion of the site encountered seepage at approximately Elevation 270 feet. In a prior boring drilled at the site, seepage occurred at Elevations between 284 and 300 feet within the bedrock (LeRoy Crandall and Associates, 1988). In the lower portion of the site, seepage was encountered in a prior exploratory boring at approximately Elevation 266 feet within the alluvium (Law/Crandall, 1993a). Localized seepage within the wedge of alluvium overlying the bedrock is representative of a perched groundwater condition that probably fluctuates with seasonal precipitation.

4.4 Faults

Numerous faults in Southern California have been previously characterized as active or potentially active. The criteria for these major groups were based on criteria developed by the California Geological Survey (CGS), for the Alquist-Priolo (A-P) Earthquake Fault Zoning Program (Bryant and Hart, 2007). According to Bryant and Hart, an active fault is one with surface displacement within Holocene time (about the last 11,000 years); and a potentially active fault is a fault that has demonstrated surface displacement of Quaternary age deposits (last 1.6 million years) (Jennings and Bryant, 2010, Bryant and Hart, 2007). More recently the CGS has revised fault activity designations for the purpose of the A-P Earthquake Fault Zoning Program (CGS, 2018a). A Holocene-active fault is one that has had surface displacement within Holocene time (about the last 11,700 years). A pre-Holocene fault is a fault that has been demonstrated to not have Holocene surface displacement. An age-undetermined fault is one where the recency of fault movement has not been determined.

Many fault systems in California are considered to be active with Holocene activity (Field et al., 2013; USGS-CGS, 2006) but are not included in an A-P Zone. A list of nearby active faults (those faults included in Field et al., 2013) and the distance in miles between the site and the nearest point on the fault, the maximum magnitude, and the slip rate for the fault is given in Table 1. The faults in the vicinity of the site are shown in Figure 5. There are no active faults at the site with the potential for surface rupture.

Active Faults

Hollywood Fault

The active Hollywood fault, located 4.4 miles north of the site, trends approximately east-west along the base of the Santa Monica Mountains from the West Beverly Hills Lineament in the West Hollywood-Beverly Hills area (Dolan et al., 1997 and Dolan et Al., 2000a) to the Los Feliz area of Los Angeles. The fault is a groundwater barrier within Holocene sediments (Converse et al., 1981). Studies by several investigators (Dolan et al., 2000a; Dolan et al., 1997; and Crook et al., 1992) have indicated that the fault is active, based on geomorphic evidence, stratigraphic correlation and truncation between exploratory borings, and fault trenching studies. The Hollywood fault zone has been included in an Earthquake Fault Zone by the CGS (CGS, 2014, 2018b).

Until recently, the approximately 15 kilometer-long Hollywood fault zone was considered to be expressed as a series of linear scarps and faceted south-facing ridges along the south margin of the eastern Santa Monica Mountains and the Hollywood Hills. Multiple recent fault rupture hazard investigations have shown that the Hollywood fault zone is located south of the faceted ridges and bedrock outcrops along Sunset Boulevard (Harza, 1998, William Lettis & Associates, 1998a and 1998b). Active deposition of numerous small alluvial fans at the mountain front and a lack of fan incision suggest late Quaternary uplift of the Santa Monica Mountains along the Hollywood fault zone (Dolan et al., 2000a, Dolan et al., 1997, Crook et al., 1992 and 1987). The fault dips steeply to the north and has juxtaposed Tertiary and Cretaceous age rocks over young sedimentary deposits of the northern Los Angeles basin (Hernandez and Treiman, 2014a and 2014b, Hernandez, 2017). The Hollywood fault zone has not produced any damaging earthquakes during the historical period and has had relatively minor micro-seismic activity. An average slip rate of 0.9 millimeters per year and a maximum moment magnitude of 6.4 are estimated by the CGS (Cao et al., 2003; Field et al., 2013) for the Hollywood fault.

Raymond Fault

The active Raymond fault is located approximately 4.5 miles north of the site. The fault is primarily a left-lateral strike-slip fault with a minor component of high-angle reverse offset, placing basement rocks north of the fault over alluvial sediments south of the fault (Hernandez, 2017). The Raymond fault has long been recognized as a groundwater barrier in the Pasadena/San Marino area and numerous geomorphic features along its entire length (such as fault scarps, sag ponds, springs, and pressure ridges) attest to the fault's activity during the Holocene epoch (last 11,700 years). Within the last 36,000 to 41,000 years, five to eight separate earthquake events have been recognized along the Raymond fault (Crook et al., 1987, Weaver and Dolan, 2000). The most recent fault movement, based on radiocarbon ages from materials collected in an excavation exposing the fault, occurred sometime between 2,160 ± 105 and 1,630 ± 100 years before present (LeRoy Crandall and Associates, 1978; Crook et al., 1987; Weaver and Dolan, 2000). An average slip rate of 2.0 millimeters per year and a maximum moment magnitude of 6.5 are estimated by the CGS (Cao et al., 2003; Field et al., 2013) for the Raymond fault.

Newport-Inglewood Fault Zone

The active North Los Angeles Basin section of Newport-Inglewood fault zone is located approximately 6.3 miles to the west-southwest of the site. This fault zone is composed of a series of discontinuous northwest-trending en echelon faults extending from Ballona Gap southeastward past the Santa Ana River in Newport Beach, where it trends off-shore. This zone is reflected at the surface by a line of geomorphically young anticlinal hills and mesas formed by the folding and faulting of a thick sequence of Pleistocene age sediments and Tertiary age sedimentary rocks (Bryant, 1985; Barrows, 1974). Fault-plane solutions for 39 small earthquakes (between 1977 and 1985) show mostly strike-slip faulting with some reverse faulting along the north section (north of Dominguez Hills) and some normal faulting along the south section (south of Dominguez Hills to Newport Beach) (Treiman, 1993; Hauksson, 1987). Prior fault investigations by Law/Crandall (1993b) in the Huntington Beach area indicate that the on-shore section of the Newport-Inglewood fault zone offsets Holocene age alluvial deposits in the vicinity of the Santa Ana River. An average slip rate of 1.0 millimeters per year and a maximum moment magnitude of 7.1 are estimated by the CGS (Cao et al., 2003; Field et al., 2013) for the Newport-Inglewood fault.

Verdugo Fault Zone

The active Verdugo fault zone, located approximately 6.5 miles north-northeast of the site, is composed of several faults including the Verdugo fault, the San Rafael fault, and the Eagle Rock fault. The most recent documented activity along this fault occurs in the Holocene age alluvial deposits along the western flank of the Verdugo Mountains in the Burbank area (County of Los Angeles, 1990). Additionally, this portion of the fault is considered to have Holocene movement by the USGS and the State of California (Jennings and Bryant, 2010). An Alquist-Priolo Earthquake Fault Zone has not been established for the Verdugo fault. According to the CGS, the Verdugo fault is capable of a moment magnitude 6.9 earthquake and has a slip rate of 0.4 millimeters per year (Cao et al., 2003; Field et al., 2013).

Santa Monica Fault

The active Santa Monica fault, a left lateral, reverse oblique slip fault, is located approximately 9.5 miles west of the project site. The Santa Monica and Hollywood fault zones form a portion of the Transverse Ranges Southern Boundary fault system. The Transverse Ranges Southern Boundary fault system also includes the Malibu Coast-Anacapa-Dume faults to the west of the Santa Monica fault and the Raymond and Cucamonga faults to the east of the Hollywood fault (Dolan et al., 2000b). The Santa Monica fault zone is the western segment of the Santa Monica-Hollywood fault zone. The fault zone trends east-west from the Santa Monica coastline on the west to the Hollywood area on the east. Urbanization and development within the greater Los Angeles area has resulted in a poor understanding of the lateral extent, location, and rupture history of the Santa Monica fault zone. However, the surface expression of the Santa Monica fault zone includes fault-related geomorphic features, offset stratigraphy, and ground water barriers within late Quaternary deposits (Hill et al., 1979, and Dolan et al., 2000b).

As of January 11, 2018, the Santa Monica fault zone has been included in an Earthquake Fault Zone within the Beverly Hills 7.5 minute Quadrangle by the CGS (2018c). An average slip rate of 1.0 millimeters per year and a maximum moment magnitude of 6.6 are estimated by the CGS (Cao et al., 2003; Field et al., 2013) for the Santa Monica fault.

Sierra Madre Fault Zone

The active Sierra Madre fault is located 11 miles north-northeast of the site. This fault zone borders the southern front of the San Gabriel Mountains and consists of a series of discontinuous reverse faults that separate pre-Tertiary crystalline rocks on the north from Tertiary and Quaternary sedimentary deposits on the south. The various faults exhibit northerly dips from 15 degrees to vertical, with the crystalline rocks thrust upward toward the south over sediments as young as mid-Pleistocene age. The Sierra Madre fault zone extends approximately 50 miles along the southern flank of the San Gabriel Mountains from Big Tujunga Canyon on the west to Cajon Pass on the east. The fault zone, which includes the active Cucamonga fault, consists of a series of reverse fault segments that are believed to have been active at different times in the geologic past (Crook et al., 1987). The moderate M5.8 1991 Sierra Madre earthquake is believed to be a result of movement on a small portion of the Sierra Madre fault zone. Recent paleoseismic investigations by Rubin et al. (1998) in Altadena have shown that the Sierra Madre fault fails in large, infrequent earthquakes. The past two ruptures in Altadena produced about 4.5 to 5 meters of slip at the ground surface and occurred within the past approximately18,000 years. Farther east in San Dimas, Tucker and Dolan (2001) documented the occurrence of two large-slip earthquakes during the period between approximately 8,000 and 24,000 years ago. The most recent event on the eastern portion of the Sierra Madre fault zone occurred prior to about 8,000 years ago. The CGS considers the Sierra Madre fault to be capable of a moment magnitude 7.2 earthquake and estimates an annual slip rate of 2 millimeters per year (Cao et al. 2003; Field et al. 2013).

Whittier Fault

The active Whittier fault is located approximately 12 miles east-southeast of the site. The northwest-trending Whittier fault extends along the south flank of the Puente Hills from the Santa Ana River on the southeast to Whittier Narrows on the northwest. According to Yeats, 2004, and Treiman, 1991, the Whittier fault turns more northwesterly at Whittier Narrows becoming the East Montebello fault beneath the Whittier Narrows towards the Alhambra Wash. The East Montebello fault is approximately 7.9 miles east of the site. The main Whittier fault trace is a high-angle reverse fault, with the north side uplifted over the south side at an angle of approximately 70 degrees, although late Quaternary movement has been nearly pure strike slip and total right displacement may be around 8 to 9 kilometers (Yeats, 2004). In the Brea-Olinda Oil Field, the Whittier fault displaces Pleistocene age alluvium, and Carbon Canyon Creek is offset in a right lateral sense by the Whittier fault. The CGS considers the Whittier fault to be capable of a moment magnitude 6.8 earthquake and estimates an annual slip rate of 2.5 millimeters per year (Cao et al. 2003; Field et al. 2013).

San Andreas Fault Zone

The active San Bernardino section of the San Andreas fault zone is located about 34 miles north-northeast of the site. This fault zone is California's most prominent structural feature, trending in a general northwest direction for almost the entire length of the state. The southern section of the fault is approximately 450 kilometers long and extends from the Transverse Ranges west of Tejon Pass on the north to the Mexican border and beyond on the south. The last major earthquake along the San Andreas fault zone in Southern California was the 1857 Magnitude 8.3 Fort Tejon earthquake. The CGS considers the San Bernardino Mojave Section to be capable of a moment magnitude 7.4 earthquake and estimates an annual slip rate of 34 millimeters per year (Cao et al., 2003; Field et al., 2013).

Blind Thrust Faults

Compton Thrust

The active Compton Thrust has been defined from seismic reflection profiles and borehole data (Leon et al., 2009) as a northeast-dipping structure. The Compton Thrust is located below the site. This blind thrust fault system extends approximately 28 miles from southwest Los Angeles County to northern Orange County in a southeastern direction. The Compton Thrust is not exposed at the ground surface and does not present a potential for surface fault rupture. Several uplift events have been observed by investigating deformed Holocene layers along buried fold scarps (Leon et al., 2009). The cumulative uplift from the observed events ranged from 2 to 6 feet or approximately 4 to 14 feet of thrust displacement with moment magnitudes of 7.0 to 7.4 (Leon et al., 2009). Slip rate is estimated to be 0.9 millimeters per year (Field et al., 2013).

Upper Elysian Park Thrust

The Upper Elysian Park fault is a blind thrust fault that overlies the Los Angeles and Santa Fe Springs sections of the Puente Hills Thrust (Oskin et al., 2000 and Shaw et al., 2002). The eastern edge of the Upper Elysian Park fault is defined by the northwest-trending Whittier fault zone. The vertical surface projection of the Upper Elysian Park fault upper limb is approximately 1 mile northeast of the site (USGS-CGS, 2006). Like other blind thrust faults in the Los Angeles area, the Upper Elysian Park fault is not exposed at the surface and does not present a potential surface rupture hazard; however, the Upper Elysian Park fault should be considered an active feature capable of generating future earthquakes. An average slip rate of 1.9 millimeters per year and a maximum moment magnitude of 6.4 are estimated by Cao et al. (2003) and Field et al. (2013) for the Upper Elysian Park fault.

Puente Hills Blind Thrust Fault

The active Puente Hills Blind Thrust (PHBT) is defined based on seismic reflection profiles, petroleum well data, and precisely located seismicity (Shaw et al., 2002). The closest point to the surface projection of the PHBT upper limb is approximately 3.9 miles southwest (USGS-CGS, 2006). This blind thrust extends eastward from downtown Los Angeles to Brea in northern Orange County. The PHBT includes three north-dipping segments, named from east to west the Coyote Hills segment, the Santa Fe Springs segment, and the Los Angeles segment. These segments are overlain by folds expressed at the surface as the Coyote Hills, Santa Fe Springs Anticline, and the Montebello Hills. The Santa Fe Springs segment of the PHBT was the causative fault of the October 1, 1987 Whittier Narrows (Shaw et al., 2002) and March 29, 2014 La Habra earthquakes. The PHBT is not exposed at the ground surface and does not present a potential for surface fault rupture. However, based on deformation of late Quaternary age sediments above this fault system and the occurrence of the Whittier Narrows earthquake, the PHBT is considered an active fault capable of generating future earthquakes beneath the Los Angeles Basin. An average slip rate of 0.9 millimeter per year and a moment magnitude of 7.1 are estimated by the CGS (Cao et al., 2003; Field et al., 2013), for a multiple segment fault rupture of the Puente Hills Blind Thrust; a single segment fault rupture may produce an earthquake of moment magnitude 6.5 to 6.6.

Northridge Thrust

The active Northridge Thrust, as defined by Petersen et al. (1996), is a deep thrust fault that is considered the eastern extension of the Oak Ridge fault. The closest point to the surface projection of the Northridge Thrust fault is approximately 19 miles northwest. The Northridge Thrust is located beneath the majority of the San Fernando Valley and was the causative fault of the January 17, 1994, moment magnitude 6.7 Northridge earthquake. This thrust fault is not exposed at the surface and does not present a potential surface fault rupture hazard. However, the Northridge Thrust is an active feature that can generate future earthquakes. According to the CGS (Cao et al., 2003; Field et al., 2013), the Northridge Thrust is capable of a moment magnitude 7.0 earthquake and has a slip rate of 1.5 millimeters per year.

4.5 Geologic-Seismic Hazards

Surface Fault Rupture

The site is not within a currently established Alquist-Priolo Earthquake Fault Zone (A-P Zone) for surface fault rupture hazard (CGS, 2017 and 2014). An A-P Zone is an area which requires geologic investigation to evaluate whether the potential for surface fault rupture is present near an active fault (CGS, 2018a). As defined by the A-P Zone Act, an active fault is a fault with surface displacement within the last 11,700 years (Holocene). The closest established A-P Zone is located approximately 4.4 miles north of the project site for a section of the Hollywood fault zone (CGS, 2017; CGS, 2014). Blind thrust faults are not exposed at the ground surface and are typically identified at depths greater than 3 kilometers. Therefore, these faults do not present a potential surface fault rupture hazard.

Based on the available geologic data, active faults with the potential for surface fault rupture are not known to be located directly beneath or projecting toward the project site. Therefore, the potential for surface rupture due to fault plane displacement propagating to the surface at the project site during the design life of the proposed development is considered low.

Seismicity

Earthquake Catalog Data

The seismicity of the region surrounding the project site was determined from research of a computer catalog of seismic data (Southern California Seismographic Network, 2018). This database includes earthquake data compiled by the California Institute of Technology for 1932 to 2018. We have also utilized data from 1769 to 1931 compiled by CGS (CDMG, 2001). The search for earthquakes that occurred within 100 kilometers (62.1 miles) of the project site indicates that 441 earthquakes of Magnitude 4.0 and greater occurred between 1932 and 2018; 34 earthquakes of Magnitude 6.0 or greater occurred between 1769 and 1931. A list of these earthquakes is presented as Table 2. Faults and epicenters of earthquakes greater than Magnitude 5 in the greater Los Angeles area are shown in Figure 5.

The information for each earthquake in Table 2 includes date and time in Coordinated Universal Time (UTC), location of the epicenter in latitude and longitude, quality of epicentral determination (Q), depth in kilometers, distance from the site in kilometers, and magnitude. Where a depth of 0.0 is given, the solution was based on an assumed 16-kilometer focal depth. The explanation of the letter code for the quality factor of the data is presented on the first page of the table.

A number of earthquakes of moderate to major magnitude have occurred in the Southern California area within about the last 85 years. A partial list of these earthquakes is included in the following table.

List of Historic Earthquakes

Earthquake (Oldest to Youngest)	Date of Earthquake	Magnitude	Distance to Epicenter (miles)	Direction to Epicenter
Long Beach	March 11, 1933	6.4	34	SSE
Tehachapi	July 21, 1952	7.5	79	NW
San Fernando	February 9, 1971	6.6	26	NW
Whittier Narrows	October 1, 1987	5.9	10	SE
Sierra Madre	June 28, 1991	5.8	21	NE
Landers	June 28, 1992	7.3	104	E
Big Bear	June 28, 1992	6.4	82	ENE
Northridge	January 17, 1994	6.7	20	NW
Hector Mine	October 16, 1999	7.1	119	NE
Sierra El Mayor	April 4, 2010	7.2	227	SE
La Habra	March 28, 2014	5.1	21	SE
Borrego Springs	June 10, 2016	5.2	112	SE
Channel Islands	April 5, 2018	5.3	86	W

Liquefaction and Seismically-Induced Settlement

Liquefaction is the process in which loose granular soils below the ground-water table temporarily lose strength during strong ground shaking as a consequence of increased pore pressure and, thereby, reduced effective stress. The vast majority of liquefaction hazards are associated with sandy soils and silty soils of low plasticity (CGS, 2008). Potentially liquefiable soils (based on composition) must be saturated or nearly saturated to be susceptible to liquefaction (CGS, 2008).

Significant factors that affect liquefaction include water level, soil type, particle size and gradation, relative density, confining pressure, intensity of shaking, and duration of shaking. These factors must be evaluated on a site-specific basis to assess the potential for ground failure caused by liquefaction at the project site. Liquefaction potential has been found to be the greatest where the ground water level is shallow and submerged loose, fine sands occur within a depth of about 50 feet or less. Liquefaction potential decreases with increasing grain size and clay and gravel content, but increases as the ground acceleration and duration of shaking increase.

According to the City of Los Angeles NavigateLA database (2018) and the California Division of Mines and Geology (CDMG, 1999), most of the project site is not within an area identified as having a potential for liquefaction. However, a small area in the southeast portion of the site is identified as having a potential for liquefaction as shown on Figure 6. Considering the proposed excavations extending through the existing fill and alluvium and into bedrock, the potential for liquefaction to occur at the project site is considered low.

Seismic-induced settlement is often caused by loose to medium-dense granular soils densified during ground shaking. Uniform settlement beneath a given structure would cause minimal damage; however, because of variations in distribution, density, and confining conditions of the soils, seismic-induced settlement is generally non-uniform and can cause serious structural damage. Dry and partially saturated soils as well as saturated granular soils are subject to seismic-induced settlement. Considering the planned excavations for the basement into bedrock, the site is not considered susceptible to seismically-induced settlement, therefore, the potential for seismically-induced settlement is considered low.

Slope Stability

The majority of the site is currently vacant land with slopes ranging from approximately 4:1 to 2:1 (horizontal to vertical) towards the south to southeast. The upper portion of the site is gently sloping to flat. The lower portion of the site, adjacent to S. Hill Street, consists of a generally level park and subway access portal. There are no known landslides at the project site, nor is the project site in the path of any known or potential landslides (CGS, 2018d). According to the City of Los Angeles (2018) and the CGS (2018c) the site is partially within an area identified as having the potential for seismic slope instability. Areas identified to have the potential for slope instability are shown on Figure 6.

Although the Fernando formation is generally massive to thickly bedded, some well bedded zones are found throughout the unit. The observed bedding in our borings generally strikes east-west and dips approximately 5 to 37 degrees to the south and southeast. These orientations are consistent with regional trends. At the site, the bedding planes generally dip out of slope at a shallow angle on south and southeast facing slopes.

There are no known landslides near the project site, nor is the project site in the path of any known or potential landslides. The site will be completely excavated and redeveloped as part of construction. The basement excavation will remove all of the existing slopes. Therefore the risk from slope stability issues is considered low.

In order to excavate for basement levels, the sides of the temporary excavations should be sloped back at 1:1 (horizontal to vertical) or shored for safety. Unshored excavations should not extend below a plane drawn at 1½:1 (horizontal to vertical) extending downward from adjacent existing footings or utilities in streets. Where space is not available, temporary shoring will be required. The subsurface materials are generally massive to thickly bedded siltstone and sandstone of the Fernando Formation. Bedding, where present, dips to the southeast to south. Southeast and southwest facing walls and temporary shoring should be designed for the potential higher lateral pressures due to dipping bedding planes.

Tsunamis, Inundation, and Seiches

The project site is located approximately 13 miles from the coastline and at an elevation of approximately 300 feet above mean sea level (NAVD 88). According to the City of Los Angeles Safety Element (1996), the project site is not located within a tsunami run-up zone.

According to the Safety Element of the City of Los Angeles (1996) and the County of Los Angeles General Plan (2015), the project site is not located within a potential dam inundation area and is not within a hazard area for seiches (wave oscillations in an enclosed or semi-enclosed body of water). Therefore, the potential for inundation at the project site as a result of an earthquake-induced dam failure is considered low.

Flooding

The project site is located outside the 0.2% annual chance floodplain, Zone X, as defined by the Federal Emergency Management Association (FEMA, 2008). Therefore, the potential for flooding to affect the project site is considered low.

Expansive and Corrosive Soils

Expansive soils shrink and swell significantly as they lose and gain moisture. The resulting volumetric changes can heave and crack lightly loaded foundations and structures. Soils are generally classified as having low, moderate, and high expansive potentials, where the type and percentage of clay particles present in the soil are indicative of the soil's expansion potential. Predominantly fine-grained soils containing a high percentage of clays are potentially expansive, whereas predominantly coarse grained soils such as sands and gravels are generally non-expansive.

The soils at the project site are anticipated to be primarily of low expansion potential. However, moderately expansive soils could be locally present.

Soil corrosivity involves the measure of the potential of corrosion for steel and concrete caused by contact with some types of soil. Knowledge of potential soil corrosivity is often critical for the effective design parameters associated with cathodic protection of buried steel and concrete mix design for plain or reinforced concrete buried project elements. Factors—including soil composition, soil and pore water chemistry, moisture content, and pH—affect the response of steel and concrete to soil corrosion. Soils with high moisture content, high electrical conductivity, high acidity, high sulfates, and high dissolved salts content are most corrosive. Generally, sands and silty sands do not present a corrosive environment. The results of corrosivity tests indicate that the onsite soils, at present moisture content, are mildly to moderately corrosive to ferrous metals, aggressive to copper, and moderate for sulfate attack on portland cement.

Soil Erosion

Erosion includes detachment and transportation of soil materials by wind or water. Rainfall and potential surface runoff may produce different types of erosion. Potentially erosive conditions are identified as areas having a combination of potentially erosive soils and uncovered slopes.

Soil erodibility depends upon many factors, including grain size, organic matter content, structure, permeability, and percentage of rock fragments. The site its current condition is susceptible to erosion, however the proposed development will remove erosion susceptible areas.

Oil Wells and Methane Gas

Oil and gas wells are potential concerns when they seep oil or gas, are not abandoned to current regulations, or have associated surface contamination. They may also be associated with methane hazards.

The project site is not located within the limits of an oil field according to the California Division of Oil, Gas and Geothermal Resources' (DOGGR) Well Finder System (DOGGR, 2018). According to DOGGR, the project site is located approximately 0.8 mile south of the Los Angeles City Oil Field, 0.6 mile northeast of the Los Angeles

Downtown Oil Field, and 0.5 mile northwest of the abandoned Union Station oil Field. The closest known oil exploration wells are located approximately 0.5 mile north and south of the project site. Per DOGGR, those wells are classified as "active producer" and "dry hole," respectively. Since the project site is near active oil fields, there is a remote possibility that undocumented abandoned wells or other undocumented wells could be encountered during excavations. Any wells encountered during construction will have to be abandoned in accordance with current DOGGR standards and regulations.

The project site is not located within the defined boundaries of a City of Los Angeles Methane or Methane Buffer Zone (City of Los Angeles, 2018). A Methane Buffer Zone boundary is mapped approximately 1,000 feet north and northwest of the project site and, accordingly, the potential presence of methane gas beneath the project site cannot be discounted. During geological downhole logging as part of Wood's concurrent geotechnical investigation, volatile organic compounds (VOCs) were detected starting at a depth of approximately 18 feet below ground surface in boring BA-1 advanced within the northern section of the project site. The VOC concentrations displayed on the field instrument, a photoionization detector, registered up to 190 parts per million. No obvious odors were noted by Wood's field geologist (Wood, 2018).

Ground Subsidence

Land subsidence is a form of ground settlement that usually results from change in fluid content within soil or rock. The volume change can result from localized dewatering of peat, organic soils, or soft silts and clay. Ongoing decomposition of organic-rich soils may also result in land subsidence. This type of subsidence generally occurs in localized areas.

A second type of land subsidence is from a regional withdrawal of groundwater, petroleum, or geothermal resources from sedimentary source rocks, which can cause the permanent collapse of the pore space previously occupied by the removed fluid. The compaction of subsurface sediment caused by fluid withdrawal can cause subsidence of the ground surface overlying a pumped reservoir or well. If the volume of water or petroleum removed is sufficiently great, the amount of resulting subsidence may suffice to cause damage to nearby engineered structures.

The project site is not located in area of known subsidence due to groundwater or oil/gas withdrawal, peat oxidation, or hydro-compaction.

Volcanic Hazards

Due to the distance between the project site and known active volcanic areas, there are no significant potential impacts related to volcanic hazards. The proposed development will not result in or expose people to significant impacts related volcanic hazards.

Radon

The project site is in a Low Potential for Indoor Radon Levels Above 4.0 Picocuries per Liter zone, defined as all areas that are not designated as High Potential or Moderate Potential (CGS, 2018d).

5.0 Summary of Potential Geologic-Seismic Impacts and Mitigation Measures

5.1 General

As part of the standard conditions of approval for the development as a whole, the proposed project will be designed and built in compliance with City of Los Angeles Building Code requirements. The City of Los Angeles will require that the results of a comprehensive geotechnical investigation, including subsurface explorations and appropriate soil testing, be submitted as part of the permitting process for the Project. The City of Los Angeles will require that the specific design recommendations presented in the comprehensive geotechnical report be incorporated into the design and construction of the proposed project, including recommendations for foundation support, grading, excavation, shoring, and seismic design parameters.

Proper engineering design and conformance with recommendations presented in the comprehensive geotechnical report for the proposed project, in compliance with current Building Codes as required by the City of Los Angeles, will ensure the identified potential geotechnical impacts are less than significant.

We understand that the basement levels for the proposed high-rise development may extend approximately 110 to 170 feet below the existing grade. The proposed high-rise buildings are anticipated to be able to be supported on conventional spread footings or mat foundations established in the undisturbed natural soils. If the building loads are greater than can be supported on the currently anticipated mat or spread footing foundations, drilled pile foundations could be used as an alternative.

5.2 Surface Fault Rupture

Based on the available geologic data, active or major quaternary faults with the potential for surface fault rupture are not known to be located directly beneath or projecting toward the project site. Therefore, the potential for surface rupture due to fault plane displacement propagating to the surface at the project site during the design life of the proposed development is considered low.

5.3 Seismicity and Ground Shaking

The location of the project site relative to known active and major quaternary faults indicates the project site could be subjected to significant ground shaking caused by earthquakes. This hazard is common in Southern California and the effects of ground shaking can be designed for with proper engineering and construction in conformance with current building codes and engineering practices.

5.4 Liquefaction

Although, the project site is partially within an area identified as having a potential for liquefaction, the bedrock and alluvial materials are not anticipated to be susceptible to liquefaction. Considering the proposed excavations through fill and alluvium into bedrock, the potential for liquefaction to occur at the project site is considered low.

5.5 Settlement

Building settlements will depend on the magnitude of the structural loads. Building foundations will be designed to result in settlement of less than the following amounts in accordance with guidelines of the City of Los Angeles Department of Building and Safety:

- Mat Foundations – 4 inches
- Spread Footing Foundations – 1.5 inches
- Pile Foundations – 0.5 inch

The maximum settlements described above will be used in design, along with an evaluation of structural performance based on computed total and differential settlement.

5.6 Slope Stability

The project site is partially within an area identified to have a potential for seismic slope instability as designated by the CGS. There are no known landslides near the project site, nor is the project site in the path of any known or potential landslides. Basement excavations will remove all of the existing slopes.

In order to excavate for basement levels, the sides of the excavations should be sloped back at 1:1 (horizontal to vertical) or shored for safety, unshored excavations should not extend below a plane drawn at 1½:1 (horizontal to vertical) extending downward from adjacent existing footings or utilities in streets. Where space is not available, temporary shoring will be required. If temporary shoring is required, excavation walls may be supported during construction of basement using conventional soldier beams with lagging and tied-back with anchors. As an alternative to tie-back anchors, rakers or cross-lot bracing could be used. Another alternative temporary or permanent lateral support methodology would be to use soil nails, which consist of reinforced concrete elements extending into the embankment at an angle of approximately 10 to 15 degrees with respect to horizontal. The nails would be spaced at around 5 feet on-center horizontally and vertically in conjunction with a facing layer restrained by the soil nail heads. The shoring should be designed to allow up to 0.5 inch movement at the top of shoring or less as necessary to protect adjacent structures or utilities in streets adjacent to the project site. The subsurface materials are generally massive to thickly bedded siltstone and sandstone of the Fernando Formation. Bedding, where present, dips to the southeast to south. Southeast and southwest facing walls and temporary shoring should be designed for the potential higher lateral pressures due to dipping bedding planes. Proper engineering design and construction will reduce potential impacts to less than significant.

5.7 Expansive and Corrosive Soils

The expansion potential of soils at the project site is expected to range from low to high. The results of corrosivity tests indicate that the onsite soils, at present moisture content, are mildly to moderately corrosive to ferrous metals, aggressive to copper, and moderate for sulfate attack on portland cement. Structures and project site improvements will need to be designed to resist the effects of expansive and corrosive soils. Design recommendations for expansive soils could include excavation and replacement of upper soils, deepening of foundations, cement treatment, and/or moisture conditioning of the upper soils. Design recommendations for corrosive soils could include isolation of utilities from soils with barriers or wrappings, cathodic isolation, and/or cathodic protection and will reduce potential impacts to less than significant.

5.8 Soil Erosion

The project site is in an area of moderate to high relief and generally covered with permeable surfaces. The proposed project design will remove potentially erodible surfaces and proper civil design will direct surface water runoff to nonerosive devices. Therefore, the potential for erosion at the project site is considered low.

5.9 Oil Wells and Methane Gas

The project site is not within an active oil field and is not located in a City of Los Angeles Methane or Methane Buffer Zone, therefore, there is low potential for methane and other volatile gases to occur within onsite subsurface materials. Any wells encountered during construction will have to be abandoned in accordance with current DOGGR standards and regulations. Proper abandonment would result in impacts that are less than significant.

6.0 References

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Tables

Table 1
Major Named Faults Considered to be Active in Southern California

Fault (in increasing distance)	Maximum Magnitude (Mw)	Fault Geometry	Slip Rate (mm/yr.)	Sources	Distance From Site (miles)	Direction From Site
Compton Thrust	7.4	BT	0.9	(a,b)	0**	-
Upper Elysian Park Thrust	6.4	BT	1.9	(a,b)	1*	NE
Puente Hills Blind Thrust	7.1	BT	0.9	(a,b)	3.9*	SW
Hollywood	6.4	RO	0.9	(a,b)	4.4	N
Raymond	6.5	RO	2.0	(a,b)	4.5	N
Newport-Inglewood	7.1	SS	1.0	(a,b)	6.3	WSW
Verdugo	6.9	RO	0.4	(a,b)	6.5	NNE
Santa Monica	6.6	RO	1.0	(a,b)	9.5	W
Sierra Madre	7.2	RO	2.0	(a,b)	11	NNE
Whittier	6.8	RO	2.5	(a,b)	12	ESE
Clamshell-Sawpit	6.5	RO	0.4	(a,b)	15	ENE
San Fernando	6.7	RO	2.0	(a,b)	16	N
Upper Duarte	7.2	RO	2.0	(a,b)	16	ENE
San Gabriel fault	7.2	SS	0.4	(a,b)	16	NNE
Palos Verdes	7.3	SS	3.0	(a,b)	18	SSW
Northridge Thrust	7.0	BT	1.5	(a,b)	19*	NW
San Andreas	7.4	SS	34.0	(a,b)	34	NNE

Prepared by: KSH 6/7/18
Checked by: PER 6/25/18

(a) Cao et al., 2003; Field et al., 2013
(b) Southern California Earthquake Center, 2018
(c) USGS-CGS, 2006 (updated 2018)
(d) Leon, 2009
SS Strike Slip
NO Normal Oblique
RO Reverse Oblique
BT Blind Thrust
(*) Distance from site to thrust fault upper limb
(**) Distance from thrust fault surface projection (upper limb)

Table 2

Proposed Angels Landing Development
LIST OF HISTORIC EARTHQUAKES OF MAGNITUDE 4.0 OR
GREATER WITHIN 100.0 KM OF THE SITE
(SCSN DATA 1932-2018)

NOTE: Q IS A FACTOR RELATING THE QUALITY OF EPICENTRAL DETERMINATION
A = + 1 km horizontal distance; + 2 km depth
B = + 2 km horizontal distance; + 5 km depth
C = + 5 km horizontal distance; no depth restriction
D = >+ 5 km horizontal distance
Event qualities are highly suspect prior to 1990. Many of these event qualities are based on incomplete information according to Caltech.

DATE	TIME	LATITUDE	LONGITUDE	Q	DIST [KM]	MAGNITUDE	DEPTH
11-01-1932	04:45:00.00	34.0000 N	117.250 W	E	092.39	4.0	00.0
03-11-1933	01:54:07.80	33.6167 N	117.967 W	A	054.96	6.4	00.0
03-11-1933	02:04:00.00	33.7500 N	118.083 W	C	036.86	4.9	00.0
03-11-1933	02:05:00.00	33.7500 N	118.083 W	C	036.86	4.3	00.0
03-11-1933	02:09:00.00	33.7500 N	118.083 W	C	036.86	5.0	00.0
03-11-1933	02:10:00.00	33.7500 N	118.083 W	C	036.86	4.6	00.0
03-11-1933	02:11:00.00	33.7500 N	118.083 W	C	036.86	4.4	00.0
03-11-1933	02:16:00.00	33.7500 N	118.083 W	C	036.86	4.8	00.0
03-11-1933	02:17:00.00	33.6000 N	118.000 W	E	055.23	4.5	00.0
03-11-1933	02:22:00.00	33.7500 N	118.083 W	C	036.86	4.0	00.0
03-11-1933	02:27:00.00	33.7500 N	118.083 W	C	036.86	4.6	00.0
03-11-1933	02:30:00.00	33.7500 N	118.083 W	C	036.86	5.1	00.0
03-11-1933	02:31:00.00	33.6000 N	118.000 W	E	055.23	4.4	00.0
03-11-1933	02:52:00.00	33.7500 N	118.083 W	C	036.86	4.0	00.0
03-11-1933	02:57:00.00	33.7500 N	118.083 W	C	036.86	4.2	00.0
03-11-1933	02:58:00.00	33.7500 N	118.083 W	C	036.86	4.0	00.0
03-11-1933	02:59:00.00	33.7500 N	118.083 W	C	036.86	4.6	00.0
03-11-1933	03:05:00.00	33.7500 N	118.083 W	C	036.86	4.2	00.0
03-11-1933	03:09:00.00	33.7500 N	118.083 W	C	036.86	4.4	00.0
03-11-1933	03:11:00.00	33.7500 N	118.083 W	C	036.86	4.2	00.0
03-11-1933	03:23:00.00	33.7500 N	118.083 W	C	036.86	5.0	00.0
03-11-1933	03:36:00.00	33.7500 N	118.083 W	C	036.86	4.0	00.0
03-11-1933	03:39:00.00	33.7500 N	118.083 W	C	036.86	4.0	00.0
03-11-1933	03:47:00.00	33.7500 N	118.083 W	C	036.86	4.1	00.0
03-11-1933	04:36:00.00	33.7500 N	118.083 W	C	036.86	4.6	00.0
03-11-1933	04:39:00.00	33.7500 N	118.083 W	C	036.86	4.9	00.0
03-11-1933	04:40:00.00	33.7500 N	118.083 W	C	036.86	4.7	00.0
03-11-1933	05:10:22.00	33.7000 N	118.067 W	C	042.56	5.1	00.0
03-11-1933	05:13:00.00	33.7500 N	118.083 W	C	036.86	4.7	00.0
03-11-1933	05:15:00.00	33.7500 N	118.083 W	C	036.86	4.0	00.0
03-11-1933	05:18:04.00	33.5750 N	117.983 W	C	058.40	5.2	00.0
03-11-1933	05:21:00.00	33.7500 N	118.083 W	C	036.86	4.4	00.0
03-11-1933	05:24:00.00	33.7500 N	118.083 W	C	036.86	4.2	00.0
03-11-1933	05:53:00.00	33.7500 N	118.083 W	C	036.86	4.0	00.0
03-11-1933	05:55:00.00	33.7500 N	118.083 W	C	036.86	4.0	00.0
03-11-1933	06:11:00.00	33.7500 N	118.083 W	C	036.86	4.4	00.0
03-11-1933	06:18:00.00	33.7500 N	118.083 W	C	036.86	4.2	00.0
03-11-1933	06:29:00.00	33.8500 N	118.267 W	C	022.40	4.4	00.0
03-11-1933	06:35:00.00	33.7500 N	118.083 W	C	036.86	4.2	00.0
03-11-1933	06:58:03.00	33.6833 N	118.050 W	C	044.88	5.5	00.0
03-11-1933	07:51:00.00	33.7500 N	118.083 W	C	036.86	4.2	00.0
03-11-1933	07:59:00.00	33.7500 N	118.083 W	C	036.86	4.1	00.0
03-11-1933	08:08:00.00	33.7500 N	118.083 W	C	036.86	4.5	00.0
03-11-1933	08:32:00.00	33.7500 N	118.083 W	C	036.86	4.2	00.0

Table 2 - continued

03-11-1933	08:37:00.00	33.7500 N	118.083 W	C	036.86	4.0	00.0
03-11-1933	08:54:57.00	33.7000 N	118.067 W	C	042.56	5.1	00.0
03-11-1933	09:10:00.00	33.7500 N	118.083 W	C	036.86	5.1	00.0
03-11-1933	09:11:00.00	33.7500 N	118.083 W	C	036.86	4.4	00.0
03-11-1933	09:26:00.00	33.7500 N	118.083 W	C	036.86	4.1	00.0
03-11-1933	10:25:00.00	33.7500 N	118.083 W	C	036.86	4.0	00.0
03-11-1933	10:45:00.00	33.7500 N	118.083 W	C	036.86	4.0	00.0
03-11-1933	11:00:00.00	33.7500 N	118.083 W	C	036.86	4.0	00.0
03-11-1933	11:04:00.00	33.7500 N	118.133 W	C	035.18	4.6	00.0
03-11-1933	11:29:00.00	33.7500 N	118.083 W	C	036.86	4.0	00.0
03-11-1933	11:38:00.00	33.7500 N	118.083 W	C	036.86	4.0	00.0
03-11-1933	11:41:00.00	33.7500 N	118.083 W	C	036.86	4.2	00.0
03-11-1933	11:47:00.00	33.7500 N	118.083 W	C	036.86	4.4	00.0
03-11-1933	12:50:00.00	33.6833 N	118.050 W	C	044.88	4.4	00.0
03-11-1933	13:50:00.00	33.7333 N	118.100 W	C	037.96	4.4	00.0
03-11-1933	13:57:00.00	33.7500 N	118.083 W	C	036.86	4.0	00.0
03-11-1933	14:25:00.00	33.8500 N	118.267 W	C	022.40	5.0	00.0
03-11-1933	14:47:00.00	33.7333 N	118.100 W	C	037.96	4.4	00.0
03-11-1933	14:57:00.00	33.8833 N	118.317 W	C	019.61	4.9	00.0
03-11-1933	15:09:00.00	33.7333 N	118.100 W	C	037.96	4.4	00.0
03-11-1933	15:47:00.00	33.7500 N	118.083 W	C	036.86	4.0	00.0
03-11-1933	16:53:00.00	33.7500 N	118.083 W	C	036.86	4.8	00.0
03-11-1933	19:44:00.00	33.7500 N	118.083 W	C	036.86	4.0	00.0
03-11-1933	19:56:00.00	33.7500 N	118.083 W	C	036.86	4.2	00.0
03-11-1933	22:00:00.00	33.7500 N	118.083 W	C	036.86	4.4	00.0
03-11-1933	22:31:00.00	33.7500 N	118.083 W	C	036.86	4.4	00.0
03-11-1933	22:32:00.00	33.7500 N	118.083 W	C	036.86	4.1	00.0
03-11-1933	22:40:00.00	33.7500 N	118.083 W	C	036.86	4.4	00.0
03-11-1933	23:05:00.00	33.7500 N	118.083 W	C	036.86	4.2	00.0
03-12-1933	00:27:00.00	33.7500 N	118.083 W	C	036.86	4.4	00.0
03-12-1933	00:34:00.00	33.7500 N	118.083 W	C	036.86	4.0	00.0
03-12-1933	04:48:00.00	33.7500 N	118.083 W	C	036.86	4.0	00.0
03-12-1933	05:46:00.00	33.7500 N	118.083 W	C	036.86	4.4	00.0
03-12-1933	06:01:00.00	33.7500 N	118.083 W	C	036.86	4.2	00.0
03-12-1933	06:16:00.00	33.7500 N	118.083 W	C	036.86	4.6	00.0
03-12-1933	07:40:00.00	33.7500 N	118.083 W	C	036.86	4.2	00.0
03-12-1933	08:35:00.00	33.7500 N	118.083 W	C	036.86	4.2	00.0
03-12-1933	15:02:00.00	33.7500 N	118.083 W	C	036.86	4.2	00.0
03-12-1933	16:51:00.00	33.7500 N	118.083 W	C	036.86	4.0	00.0
03-12-1933	17:38:00.00	33.7500 N	118.083 W	C	036.86	4.5	00.0
03-12-1933	18:25:00.00	33.7500 N	118.083 W	C	036.86	4.1	00.0
03-12-1933	21:28:00.00	33.7500 N	118.083 W	C	036.86	4.1	00.0
03-12-1933	23:54:00.00	33.7500 N	118.083 W	C	036.86	4.5	00.0
03-13-1933	03:43:00.00	33.7500 N	118.083 W	C	036.86	4.1	00.0
03-13-1933	04:32:00.00	33.7500 N	118.083 W	C	036.86	4.7	00.0
03-13-1933	06:17:00.00	33.7500 N	118.083 W	C	036.86	4.0	00.0
03-13-1933	13:18:28.00	33.7500 N	118.083 W	C	036.86	5.3	00.0
03-13-1933	15:32:00.00	33.7500 N	118.083 W	C	036.86	4.1	00.0
03-13-1933	19:29:00.00	33.7500 N	118.083 W	C	036.86	4.2	00.0
03-14-1933	00:36:00.00	33.7500 N	118.083 W	C	036.86	4.2	00.0
03-14-1933	12:19:00.00	33.7500 N	118.083 W	C	036.86	4.5	00.0
03-14-1933	19:01:50.00	33.6167 N	118.017 W	C	052.91	5.1	00.0
03-14-1933	22:42:00.00	33.7500 N	118.083 W	C	036.86	4.1	00.0
03-15-1933	02:08:00.00	33.7500 N	118.083 W	C	036.86	4.1	00.0
03-15-1933	04:32:00.00	33.7500 N	118.083 W	C	036.86	4.1	00.0
03-15-1933	05:40:00.00	33.7500 N	118.083 W	C	036.86	4.2	00.0
03-15-1933	11:13:32.00	33.6167 N	118.017 W	C	052.91	4.9	00.0
03-16-1933	14:56:00.00	33.7500 N	118.083 W	C	036.86	4.0	00.0
03-16-1933	15:29:00.00	33.7500 N	118.083 W	C	036.86	4.2	00.0
03-16-1933	15:30:00.00	33.7500 N	118.083 W	C	036.86	4.1	00.0
03-17-1933	16:51:00.00	33.7500 N	118.083 W	C	036.86	4.1	00.0

Table 2 - continued

03-18-1933	20:52:00.00	33.7500 N	118.083 W	C	036.86	4.2	00.0
03-19-1933	21:23:00.00	33.7500 N	118.083 W	C	036.86	4.2	00.0
03-20-1933	13:58:00.00	33.7500 N	118.083 W	C	036.86	4.1	00.0
03-21-1933	03:26:00.00	33.7500 N	118.083 W	C	036.86	4.1	00.0
03-23-1933	08:40:00.00	33.7500 N	118.083 W	C	036.86	4.1	00.0
03-23-1933	18:31:00.00	33.7500 N	118.083 W	C	036.86	4.1	00.0
03-25-1933	13:46:00.00	33.7500 N	118.083 W	C	036.86	4.1	00.0
03-30-1933	12:25:00.00	33.7500 N	118.083 W	C	036.86	4.4	00.0
03-31-1933	10:49:00.00	33.7500 N	118.083 W	C	036.86	4.1	00.0
04-01-1933	06:42:00.00	33.7500 N	118.083 W	C	036.86	4.2	00.0
04-02-1933	08:00:00.00	33.7500 N	118.083 W	C	036.86	4.0	00.0
04-02-1933	15:36:00.00	33.7500 N	118.083 W	C	036.86	4.0	00.0
05-16-1933	20:58:55.00	33.7500 N	118.167 W	C	034.35	4.0	00.0
08-04-1933	04:17:48.00	33.7500 N	118.183 W	C	034.04	4.0	00.0
10-02-1933	09:10:17.60	33.7833 N	118.133 W	A	031.67	5.4	00.0
10-02-1933	13:26:01.00	33.6167 N	118.017 W	C	052.91	4.0	00.0
10-25-1933	07:00:46.00	33.9500 N	118.133 W	C	015.59	4.3	00.0
11-13-1933	21:28:00.00	33.8667 N	118.200 W	C	021.02	4.0	00.0
11-20-1933	10:32:00.00	33.7833 N	118.133 W	B	031.67	4.0	00.0
01-09-1934	14:10:00.00	34.1000 N	117.683 W	A	052.53	4.5	00.0
01-18-1934	02:14:00.00	34.1000 N	117.683 W	A	052.53	4.0	00.0
01-20-1934	21:17:00.00	33.6167 N	118.117 W	B	049.85	4.5	00.0
04-17-1934	18:33:00.00	33.5667 N	117.983 W	C	059.25	4.0	00.0
10-17-1934	09:38:00.00	33.6333 N	118.400 W	B	048.45	4.0	00.0
11-16-1934	21:26:00.00	33.7500 N	118.000 W	B	040.68	4.0	00.0
06-11-1935	18:10:00.00	34.7167 N	118.967 W	B	098.98	4.0	00.0
06-19-1935	11:17:00.00	33.7167 N	117.517 W	B	077.28	4.0	00.0
07-13-1935	10:54:16.50	34.2000 N	117.900 W	A	036.28	4.7	00.0
09-03-1935	06:47:00.00	34.0333 N	117.317 W	B	086.07	4.5	00.0
12-25-1935	17:15:00.00	33.6000 N	118.017 W	B	054.61	4.5	00.0
02-23-1936	22:20:42.71	34.1275 N	117.338 W	A	084.47	4.5	10.0
02-26-1936	09:33:27.65	34.1402 N	117.340 W	A	084.48	4.0	10.0
08-22-1936	05:21:00.00	33.7667 N	117.817 W	B	051.02	4.0	00.0
10-29-1936	22:35:36.12	34.3803 N	118.624 W	C	050.17	4.0	10.0
01-15-1937	18:35:47.03	33.5610 N	118.058 W	B	057.32	4.0	10.0
03-19-1937	01:23:38.37	34.1117 N	117.426 W	A	076.27	4.0	10.0
07-07-1937	11:12:00.00	33.5667 N	117.983 W	B	059.25	4.0	00.0
09-01-1937	13:48:08.21	34.2108 N	117.530 W	A	068.68	4.5	10.0
09-01-1937	16:35:33.50	34.1830 N	117.548 W	A	066.34	4.5	10.0
05-21-1938	09:44:00.00	33.6167 N	118.033 W	B	052.30	4.0	00.0
05-31-1938	08:34:55.41	33.6988 N	117.511 W	B	078.74	5.2	10.0
07-05-1938	18:06:55.75	33.6822 N	117.553 W	A	076.33	4.5	10.0
08-06-1938	22:00:55.96	33.7167 N	117.507 W	B	078.08	4.0	10.0
08-31-1938	03:18:14.25	33.7590 N	118.253 W	A	032.47	4.5	10.0
11-29-1938	19:21:15.80	33.9033 N	118.431 W	A	023.35	4.0	10.0
12-07-1938	03:38:00.00	34.0000 N	118.417 W	B	016.32	4.0	00.0
12-27-1938	10:09:28.57	34.1273 N	117.521 W	B	067.75	4.0	10.0
04-03-1939	02:50:44.71	34.0432 N	117.228 W	A	094.17	4.0	10.0
11-04-1939	21:41:00.00	33.7667 N	118.117 W	B	033.95	4.0	00.0
11-07-1939	18:52:08.40	34.0000 N	117.283 W	A	089.32	4.7	00.0
12-27-1939	19:28:49.00	33.7833 N	118.200 W	A	030.13	4.7	00.0
01-13-1940	07:49:07.00	33.7833 N	118.133 W	B	031.67	4.0	00.0
02-08-1940	16:56:17.00	33.7000 N	118.067 W	B	042.56	4.0	00.0
02-11-1940	19:24:10.00	33.9833 N	118.300 W	B	008.79	4.0	00.0
04-18-1940	18:43:43.90	34.0333 N	117.350 W	A	083.00	4.4	00.0
05-18-1940	09:15:12.00	34.6000 N	118.900 W	C	085.34	4.0	00.0
06-05-1940	08:27:27.00	33.8333 N	117.400 W	B	082.11	4.0	00.0
07-20-1940	04:01:13.00	33.7000 N	118.067 W	B	042.56	4.0	00.0
10-11-1940	05:57:12.30	33.7667 N	118.450 W	A	036.58	4.7	00.0
10-12-1940	00:24:00.00	33.7833 N	118.417 W	B	033.48	4.0	00.0
10-14-1940	20:51:11.00	33.7833 N	118.417 W	B	033.48	4.0	00.0

Table 2 - continued

11-01-1940	07:25:03.00	33.7833 N	118.417 W	B	033.48	4.0	00.0
11-01-1940	20:00:46.00	33.6333 N	118.200 W	B	046.68	4.0	00.0
11-02-1940	02:58:26.00	33.7833 N	118.417 W	B	033.48	4.0	00.0
01-30-1941	01:34:46.90	33.9667 N	118.050 W	A	020.73	4.1	00.0
03-22-1941	08:22:40.00	33.5167 N	118.100 W	B	061.02	4.0	00.0
03-25-1941	23:43:41.00	34.2167 N	117.467 W	B	074.47	4.0	00.0
04-11-1941	01:20:24.00	33.9500 N	117.583 W	B	062.53	4.0	00.0
10-22-1941	06:57:18.50	33.8167 N	118.217 W	A	026.24	4.8	00.0
11-14-1941	08:41:36.30	33.7833 N	118.250 W	A	029.76	4.8	00.0
04-16-1942	07:28:33.00	33.3667 N	118.150 W	C	076.66	4.0	00.0
09-03-1942	14:06:01.00	34.4833 N	118.983 W	C	082.73	4.5	00.0
09-04-1942	06:34:33.00	34.4833 N	118.983 W	C	082.73	4.5	00.0
04-06-1943	22:36:24.00	34.6833 N	119.000 W	C	098.36	4.0	00.0
10-24-1943	00:29:21.00	33.9333 N	117.367 W	C	082.54	4.0	00.0
06-19-1944	00:03:33.00	33.8667 N	118.217 W	B	020.73	4.5	00.0
06-19-1944	03:06:07.00	33.8667 N	118.217 W	C	020.73	4.4	00.0
02-24-1946	06:07:52.00	34.4000 N	117.800 W	C	056.76	4.1	00.0
06-01-1946	11:06:31.00	34.4167 N	118.833 W	C	067.25	4.1	00.0
03-01-1948	08:12:13.00	34.1667 N	117.533 W	B	067.28	4.7	00.0
04-16-1948	22:26:24.00	34.0167 N	118.967 W	B	066.09	4.7	00.0
10-03-1948	02:46:28.00	34.1833 N	117.583 W	A	063.16	4.0	00.0
01-11-1950	21:41:35.05	33.9395 N	118.205 W	A	013.10	4.1	00.4
01-24-1950	21:56:59.00	34.6667 N	118.833 W	C	086.88	4.0	00.0
02-26-1950	00:06:22.00	34.6167 N	119.083 W	C	099.01	4.7	00.0
09-22-1951	08:22:39.06	34.1185 N	117.341 W	A	084.07	4.3	11.9
02-17-1952	12:36:58.33	33.9958 N	117.270 W	A	090.59	4.5	16.0
08-23-1952	10:09:07.15	34.5193 N	118.198 W	A	052.30	5.1	13.1
10-26-1954	16:22:26.00	33.7333 N	117.467 W	B	080.52	4.1	00.0
11-17-1954	23:03:51.00	34.5000 N	119.117 W	B	093.94	4.4	00.0
05-15-1955	17:03:25.96	34.1237 N	117.480 W	A	071.39	4.0	07.6
05-29-1955	16:43:35.41	33.9905 N	119.058 W	B	074.70	4.1	17.4
01-03-1956	00:25:48.95	33.7250 N	117.499 W	B	078.32	4.7	13.7
02-07-1956	02:16:56.53	34.5288 N	118.644 W	B	064.28	4.2	16.0
02-07-1956	03:16:38.59	34.5863 N	118.613 W	A	068.21	4.6	02.6
03-25-1956	03:32:02.34	33.6040 N	119.105 W	A	093.27	4.2	08.2
03-18-1957	18:56:28.04	34.1182 N	119.220 W	B	089.59	4.7	13.8
06-28-1960	20:00:48.00	34.1158 N	117.475 W	A	071.81	4.1	12.0
10-04-1961	02:21:31.60	33.8542 N	117.752 W	B	050.93	4.1	04.3
10-20-1961	19:49:50.50	33.6540 N	117.994 W	B	050.09	4.3	04.6
10-20-1961	20:07:14.46	33.6595 N	117.981 W	B	050.16	4.0	06.1
10-20-1961	21:42:40.74	33.6652 N	117.980 W	B	049.67	4.0	07.2
10-20-1961	22:35:34.21	33.6715 N	118.013 W	B	047.58	4.1	05.6
11-20-1961	08:53:34.66	33.6805 N	117.993 W	B	047.58	4.0	04.4
09-14-1963	03:51:16.24	33.5427 N	118.340 W	B	057.13	4.2	02.2
08-30-1964	22:57:37.11	34.2683 N	118.445 W	B	030.05	4.0	15.4
01-01-1965	08:04:18.01	34.1405 N	117.516 W	B	068.42	4.4	05.9
04-15-1965	20:08:33.27	34.1320 N	117.426 W	B	076.44	4.5	05.5
07-16-1965	07:46:22.39	34.4850 N	118.521 W	B	054.27	4.0	15.1
01-08-1967	07:37:30.40	33.6322 N	118.467 W	B	050.69	4.0	11.4
01-08-1967	07:38:05.34	33.6632 N	118.413 W	C	045.67	4.0	17.7
06-15-1967	04:58:05.52	33.9965 N	117.975 W	B	026.13	4.1	10.0
02-28-1969	04:56:12.43	34.5652 N	118.114 W	A	058.54	4.3	05.3
05-05-1969	16:02:09.64	34.3038 N	117.570 W	B	068.62	4.4	08.8
10-27-1969	13:16:02.32	33.5452 N	117.807 W	B	069.62	4.5	06.5
09-12-1970	14:10:11.19	34.2673 N	117.519 W	A	071.53	4.1	08.0
09-12-1970	14:30:52.98	34.2698 N	117.540 W	A	069.76	5.2	08.0
09-13-1970	04:47:48.63	34.2810 N	117.552 W	A	069.20	4.4	08.0
02-09-1971	14:00:41.83	34.4112 N	118.401 W	B	042.36	6.6	08.4
02-09-1971	14:01:08.00	34.4112 N	118.401 W	D	042.36	5.8	08.0
02-09-1971	14:01:33.00	34.4112 N	118.401 W	D	042.36	4.2	08.0
02-09-1971	14:01:40.00	34.4112 N	118.401 W	D	042.36	4.1	08.0

Table 2 - continued

02-09-1971	14:01:50.00	34.4112 N	118.401 W	D	042.36	4.5	08.0
02-09-1971	14:01:54.00	34.4112 N	118.401 W	D	042.36	4.2	08.0
02-09-1971	14:01:59.00	34.4112 N	118.401 W	D	042.36	4.1	08.0
02-09-1971	14:02:03.00	34.4112 N	118.401 W	D	042.36	4.1	08.0
02-09-1971	14:02:30.00	34.4112 N	118.401 W	D	042.36	4.3	08.0
02-09-1971	14:02:31.00	34.4112 N	118.401 W	D	042.36	4.7	08.0
02-09-1971	14:02:44.00	34.4112 N	118.401 W	D	042.36	5.8	08.0
02-09-1971	14:03:25.00	34.4112 N	118.401 W	D	042.36	4.4	08.0
02-09-1971	14:03:46.00	34.4112 N	118.401 W	D	042.36	4.1	08.0
02-09-1971	14:04:07.00	34.4112 N	118.401 W	D	042.36	4.1	08.0
02-09-1971	14:04:34.00	34.4112 N	118.401 W	C	042.36	4.2	08.0
02-09-1971	14:04:39.00	34.4112 N	118.401 W	D	042.36	4.1	08.0
02-09-1971	14:04:44.00	34.4112 N	118.401 W	D	042.36	4.1	08.0
02-09-1971	14:04:46.00	34.4112 N	118.401 W	D	042.36	4.2	08.0
02-09-1971	14:05:41.00	34.4112 N	118.401 W	D	042.36	4.1	08.0
02-09-1971	14:05:50.00	34.4112 N	118.401 W	D	042.36	4.1	08.0
02-09-1971	14:07:10.00	34.4112 N	118.401 W	D	042.36	4.0	08.0
02-09-1971	14:07:30.00	34.4112 N	118.401 W	D	042.36	4.0	08.0
02-09-1971	14:07:45.00	34.4112 N	118.401 W	D	042.36	4.5	08.0
02-09-1971	14:08:04.00	34.4112 N	118.401 W	D	042.36	4.0	08.0
02-09-1971	14:08:07.00	34.4112 N	118.401 W	D	042.36	4.2	08.0
02-09-1971	14:08:38.00	34.4112 N	118.401 W	D	042.36	4.5	08.0
02-09-1971	14:08:53.00	34.4112 N	118.401 W	D	042.36	4.6	08.0
02-09-1971	14:10:21.49	34.3612 N	118.306 W	B	034.87	4.7	05.0
02-09-1971	14:10:28.00	34.4112 N	118.401 W	D	042.36	5.3	08.0
02-09-1971	14:16:12.87	34.3390 N	118.332 W	C	032.89	4.1	11.1
02-09-1971	14:19:50.22	34.3575 N	118.406 W	B	036.96	4.0	11.8
02-09-1971	14:34:36.11	34.3438 N	118.636 W	C	048.15	4.9	-2.0
02-09-1971	14:39:17.76	34.3873 N	118.364 W	C	038.83	4.0	-1.6
02-09-1971	14:40:17.37	34.4333 N	118.398 W	C	044.63	4.1	-2.0
02-09-1971	14:43:46.66	34.3080 N	118.454 W	B	034.15	5.2	06.2
02-09-1971	15:58:20.69	34.3348 N	118.331 W	B	032.41	4.8	14.2
02-09-1971	16:19:26.46	34.4573 N	118.427 W	B	048.00	4.2	-1.0
02-10-1971	03:12:12.05	34.3700 N	118.302 W	B	035.78	4.0	00.8
02-10-1971	05:06:36.05	34.4112 N	118.329 W	A	040.70	4.3	04.7
02-10-1971	05:18:07.21	34.4258 N	118.414 W	A	044.31	4.5	05.8
02-10-1971	11:31:34.63	34.3843 N	118.455 W	A	041.56	4.2	06.0
02-10-1971	13:49:53.71	34.3990 N	118.419 W	A	041.67	4.3	09.7
02-10-1971	14:35:26.67	34.3615 N	118.487 W	A	040.78	4.2	04.4
02-10-1971	17:38:55.07	34.3957 N	118.366 W	A	039.77	4.2	06.2
02-10-1971	18:54:41.71	34.4458 N	118.436 W	A	047.09	4.2	08.1
02-21-1971	05:50:52.64	34.3973 N	118.439 W	A	042.21	4.7	06.9
02-21-1971	07:15:11.75	34.3920 N	118.427 W	A	041.25	4.5	07.2
03-07-1971	01:33:40.55	34.3532 N	118.456 W	A	038.54	4.5	03.3
03-25-1971	22:54:09.90	34.3563 N	118.475 W	A	039.71	4.2	04.6
03-30-1971	08:54:43.28	34.2957 N	118.464 W	A	033.55	4.1	02.6
03-31-1971	14:52:22.51	34.2858 N	118.515 W	A	035.68	4.6	02.1
04-01-1971	15:03:03.64	34.4283 N	118.413 W	A	044.53	4.1	08.0
04-02-1971	05:40:25.05	34.2837 N	118.528 W	A	036.36	4.0	03.0
04-15-1971	11:14:32.02	34.2647 N	118.577 W	B	038.29	4.2	04.2
04-25-1971	14:48:06.52	34.3682 N	118.314 W	B	035.75	4.0	-2.0
06-21-1971	16:01:08.49	34.2728 N	118.532 W	B	035.78	4.0	04.1
06-22-1971	10:41:19.01	33.7477 N	117.479 W	B	078.80	4.2	08.0
02-21-1973	14:45:57.30	34.0648 N	119.035 W	B	072.28	5.3	08.0
03-09-1974	00:54:31.91	34.3988 N	118.474 W	C	043.77	4.7	24.4
08-14-1974	14:45:55.18	34.4313 N	118.369 W	A	043.66	4.2	08.2
01-01-1976	17:20:12.94	33.9650 N	117.886 W	A	034.90	4.2	06.1
04-08-1976	15:21:38.07	34.3468 N	118.656 W	A	049.70	4.6	14.5
08-12-1977	02:19:26.08	34.3797 N	118.459 W	B	041.25	4.5	09.5
09-24-1977	21:28:24.30	34.4627 N	118.409 W	C	048.05	4.2	04.9
05-23-1978	09:16:50.83	33.9055 N	119.166 W	C	085.91	4.0	06.0

Table 2 - continued

01-01-1979	23:14:38.94	33.9443 N	118.681 W	B	041.44	5.2	11.2
10-17-1979	20:52:37.29	33.9330 N	118.669 W	C	040.79	4.2	05.5
10-19-1979	12:22:37.75	34.2107 N	117.531 W	B	068.62	4.1	04.8
09-04-1981	15:50:50.13	33.6515 N	119.093 W	C	089.58	5.5	06.0
10-23-1981	17:28:17.07	33.6385 N	119.007 W	C	083.53	4.6	06.0
10-23-1981	19:15:52.17	33.6185 N	119.017 W	A	085.59	4.6	14.8
04-13-1982	11:02:12.36	34.0628 N	118.970 W	A	066.26	4.0	12.1
05-25-1982	13:44:30.30	33.5458 N	118.206 W	A	056.32	4.3	12.6
01-08-1983	07:19:30.42	34.1328 N	117.453 W	A	073.99	4.1	07.7
02-27-1984	10:18:15.02	33.4710 N	118.061 W	C	066.83	4.0	06.0
06-12-1984	00:27:52.38	34.5407 N	118.989 W	A	087.00	4.1	11.7
10-26-1984	17:20:43.54	34.0163 N	118.988 W	A	068.09	4.6	13.3
04-03-1985	04:04:50.07	34.3800 N	119.038 W	A	081.16	4.0	24.8
10-02-1985	23:44:12.45	34.0233 N	117.245 W	A	092.70	4.8	15.2
02-21-1987	23:15:29.97	34.1322 N	117.447 W	A	074.52	4.0	08.4
10-01-1987	14:42:20.02	34.0613 N	118.079 W	A	015.90	5.9	09.5
10-01-1987	14:45:41.45	34.0488 N	118.100 W	A	013.83	4.7	13.5
10-01-1987	14:48:03.11	34.0763 N	118.090 W	A	015.04	4.1	11.6
10-01-1987	14:49:05.91	34.0598 N	118.100 W	A	013.92	4.7	11.7
10-01-1987	15:12:31.76	34.0517 N	118.091 W	A	014.75	4.7	10.8
10-01-1987	15:59:53.55	34.0500 N	118.087 W	A	015.10	4.0	10.4
10-04-1987	10:59:38.19	34.0737 N	118.098 W	A	014.28	5.3	08.2
10-24-1987	23:58:33.12	33.6758 N	119.058 W	A	085.45	4.1	12.1
02-11-1988	15:25:55.65	34.0772 N	118.047 W	A	018.93	4.7	12.5
06-26-1988	15:04:58.48	34.1362 N	117.710 W	A	050.72	4.7	07.8
11-20-1988	05:39:28.67	33.5073 N	118.071 W	C	062.69	4.9	06.0
12-03-1988	11:38:26.44	34.1510 N	118.130 W	A	015.70	5.0	14.2
01-19-1989	06:53:28.84	33.9187 N	118.627 W	A	037.74	5.0	11.8
02-18-1989	07:17:04.85	34.0063 N	117.739 W	A	047.45	4.1	03.2
04-07-1989	20:07:30.30	33.6188 N	117.902 W	A	057.84	4.7	12.8
06-12-1989	16:57:18.49	34.0275 N	118.180 W	A	007.04	4.6	15.6
06-12-1989	17:22:25.52	34.0215 N	118.178 W	A	007.41	4.4	15.5
12-28-1989	09:41:08.20	34.1923 N	117.386 W	A	081.09	4.3	14.5
02-28-1990	23:43:36.75	34.1437 N	117.697 W	A	051.98	5.4	04.4
03-01-1990	00:34:57.15	34.1267 N	117.701 W	A	051.28	4.0	04.3
03-01-1990	03:23:03.03	34.1525 N	117.720 W	A	050.13	4.7	11.4
03-02-1990	17:26:25.48	34.1450 N	117.695 W	A	052.25	4.7	05.6
04-17-1990	22:32:27.29	34.1057 N	117.722 W	A	049.09	4.8	03.5
06-28-1991	14:43:54.66	34.2698 N	117.993 W	A	033.97	5.8	09.1
06-28-1991	17:00:55.56	34.2530 N	117.992 W	A	032.72	4.3	09.4
07-05-1991	17:41:57.12	34.4970 N	118.555 W	A	056.96	4.1	10.9
01-17-1994	12:30:55.39	34.2133 N	118.537 W	A	031.95	6.7	18.4
01-17-1994	12:30:55.39	34.2157 N	118.538 W	A	032.15	6.6	17.3
01-17-1994	12:31:58.11	34.2748 N	118.493 W	C	033.39	5.9	06.0
01-17-1994	12:34:18.42	34.3075 N	118.475 W	C	035.21	4.4	06.0
01-17-1994	12:39:39.79	34.2650 N	118.540 W	C	035.72	4.9	06.0
01-17-1994	12:40:09.52	34.3202 N	118.507 W	C	038.11	4.8	06.0
01-17-1994	12:40:36.12	34.3397 N	118.614 W	C	046.36	5.2	06.0
01-17-1994	12:54:33.74	34.3068 N	118.459 W	C	034.30	4.0	06.0
01-17-1994	12:55:46.83	34.2767 N	118.578 W	C	039.19	4.1	06.0
01-17-1994	13:06:28.34	34.2513 N	118.550 W	C	035.42	4.6	06.0
01-17-1994	13:26:45.00	34.3178 N	118.457 W	C	035.20	4.7	06.0
01-17-1994	13:28:13.57	34.2670 N	118.579 W	C	038.61	4.0	06.0
01-17-1994	13:56:02.48	34.2930 N	118.621 W	C	043.42	4.4	06.0
01-17-1994	14:14:30.63	34.3315 N	118.445 W	C	035.94	4.5	06.0
01-17-1994	15:07:03.17	34.3043 N	118.474 W	A	034.86	4.2	02.5
01-17-1994	15:07:35.46	34.3075 N	118.467 W	A	034.80	4.1	01.6
01-17-1994	15:54:10.76	34.3757 N	118.627 W	A	050.01	4.8	13.0
01-17-1994	17:56:08.21	34.2277 N	118.573 W	A	035.55	4.6	19.2
01-17-1994	19:35:34.30	34.3113 N	118.456 W	A	034.58	4.0	02.3
01-17-1994	19:43:53.38	34.3675 N	118.637 W	A	050.00	4.1	13.9

Table 2 - continued

01-17-1994	20:46:02.40	34.3020 N	118.565 W	C	040.20	4.9	06.0
01-17-1994	22:31:53.73	34.3393 N	118.442 W	C	036.56	4.1	06.0
01-17-1994	23:33:30.69	34.3263 N	118.698 W	A	051.32	5.6	09.8
01-17-1994	23:49:25.36	34.3433 N	118.666 W	A	050.20	4.0	08.3
01-18-1994	00:39:35.02	34.3795 N	118.564 W	A	046.51	4.4	07.1
01-18-1994	00:40:04.09	34.3938 N	118.543 W	A	046.67	4.2	00.0
01-18-1994	00:43:08.89	34.3765 N	118.698 W	A	054.81	5.2	11.3
01-18-1994	04:01:26.72	34.3577 N	118.623 W	A	048.31	4.3	00.9
01-18-1994	07:23:56.02	34.3332 N	118.623 W	A	046.47	4.0	14.8
01-18-1994	11:35:09.90	34.2177 N	118.606 W	A	037.64	4.2	12.1
01-18-1994	13:24:44.13	34.3193 N	118.558 W	A	041.12	4.3	01.7
01-18-1994	15:23:46.89	34.3787 N	118.561 W	A	046.26	4.8	07.7
01-19-1994	04:40:48.00	34.3615 N	118.571 W	A	045.41	4.3	02.5
01-19-1994	04:43:14.57	34.3660 N	118.709 W	C	054.79	4.0	06.0
01-19-1994	09:13:10.90	34.3040 N	118.737 W	A	052.85	4.1	13.0
01-19-1994	14:09:14.83	34.2150 N	118.510 W	A	030.07	4.5	17.4
01-19-1994	21:09:28.61	34.3787 N	118.712 W	A	055.90	5.1	14.4
01-19-1994	21:11:44.90	34.3778 N	118.620 W	A	049.71	5.1	11.3
01-21-1994	18:39:15.26	34.3010 N	118.466 W	A	034.15	4.5	10.6
01-21-1994	18:39:47.08	34.2968 N	118.479 W	A	034.50	4.0	11.9
01-21-1994	18:42:28.77	34.3097 N	118.475 W	A	035.38	4.2	07.9
01-21-1994	18:52:44.23	34.3020 N	118.453 W	A	033.53	4.3	07.5
01-21-1994	18:53:44.57	34.2980 N	118.459 W	A	033.47	4.3	07.6
01-23-1994	08:55:08.66	34.3003 N	118.427 W	A	032.15	4.1	05.9
01-24-1994	04:15:18.82	34.3467 N	118.552 W	A	042.97	4.6	06.5
01-24-1994	05:50:24.34	34.3605 N	118.628 W	A	048.88	4.3	12.1
01-24-1994	05:54:21.07	34.3643 N	118.627 W	A	049.09	4.2	10.8
01-27-1994	17:19:58.83	34.2735 N	118.562 W	A	037.89	4.6	14.9
01-28-1994	20:09:53.43	34.3753 N	118.494 W	A	042.46	4.2	00.7
01-29-1994	11:20:35.97	34.3060 N	118.579 W	A	041.41	5.1	01.1
01-29-1994	12:16:56.35	34.2782 N	118.611 W	A	041.67	4.3	02.6
02-03-1994	16:23:35.37	34.2997 N	118.440 W	A	032.67	4.0	08.9
02-05-1994	08:51:29.83	34.3715 N	118.646 W	A	050.93	4.0	15.3
02-06-1994	13:19:27.02	34.2922 N	118.476 W	A	033.89	4.1	09.3
02-25-1994	12:59:12.59	34.3570 N	118.480 W	A	040.03	4.0	01.1
03-20-1994	21:20:12.26	34.2313 N	118.475 W	A	028.79	5.2	13.0
05-25-1994	12:56:57.05	34.3120 N	118.393 W	A	031.83	4.4	06.9
06-15-1994	05:59:48.63	34.3105 N	118.398 W	A	031.87	4.1	07.3
12-06-1994	03:48:34.49	34.2927 N	118.389 W	A	029.75	4.5	08.9
02-19-1995	21:24:18.07	34.0490 N	118.915 W	A	061.21	4.3	15.6
06-26-1995	08:40:28.94	34.3935 N	118.668 W	A	054.10	5.0	13.3
03-20-1996	07:37:59.76	34.3623 N	118.615 W	A	048.18	4.1	12.9
05-01-1996	19:49:56.43	34.3542 N	118.704 W	A	053.58	4.1	14.3
04-26-1997	10:37:30.67	34.3692 N	118.670 W	A	052.34	5.1	16.4
04-26-1997	10:40:29.78	34.3748 N	118.671 W	A	052.81	4.0	14.6
04-27-1997	11:09:28.38	34.3772 N	118.649 W	A	051.56	4.8	15.1
06-28-1997	21:45:25.10	34.1685 N	117.336 W	A	085.20	4.2	10.0
01-05-1998	18:14:06.47	33.9508 N	117.709 W	A	051.17	4.3	11.5
03-11-1998	12:18:51.83	34.0238 N	117.230 W	A	094.09	4.5	14.9
08-20-1998	23:49:58.44	34.3737 N	117.648 W	A	065.97	4.4	08.9
07-22-1999	09:57:24.04	34.3968 N	118.609 W	A	050.65	4.0	11.6
02-21-2000	13:49:43.13	34.0472 N	117.255 W	A	091.71	4.5	15.0
03-07-2000	00:20:28.18	33.8058 N	117.715 W	A	056.42	4.0	11.3
01-14-2001	02:26:14.05	34.2840 N	118.404 W	A	029.50	4.3	08.8
01-14-2001	02:50:53.69	34.2890 N	118.403 W	A	029.95	4.0	08.4
09-09-2001	23:59:18.04	34.0590 N	118.388 W	A	012.74	4.2	07.9
10-28-2001	16:27:45.55	33.9220 N	118.270 W	A	014.46	4.0	21.1
12-14-2001	12:01:35.52	33.9545 N	117.746 W	A	047.71	4.0	13.8
01-29-2002	05:53:28.93	34.3613 N	118.657 W	A	050.88	4.2	14.1
09-03-2002	07:08:51.87	33.9173 N	117.776 W	A	046.23	4.8	12.9
01-06-2005	14:35:27.67	34.1250 N	117.439 W	A	075.22	4.4	04.1

Table 2 - continued

08-09-2007	07:58:49.59	34.3000 N	118.062 W	A	032.67	4.7	07.6
09-02-2007	17:29:14.79	33.7320 N	117.477 W	A	079.73	4.7	12.6
10-16-2007	08:53:44.12	34.3850 N	117.635 W	A	067.70	4.2	08.1
03-09-2008	09:22:32.08	34.1390 N	117.465 W	A	073.00	4.0	03.7
06-23-2008	14:14:57.60	34.0480 N	117.246 W	A	092.56	4.0	14.4
07-29-2008	18:42:15.71	33.9530 N	117.761 W	A	046.43	5.4	14.7
01-09-2009	03:49:46.27	34.1073 N	117.304 W	A	087.39	4.5	14.2
04-24-2009	03:27:50.73	33.8940 N	117.789 W	A	045.99	4.0	04.2
05-02-2009	01:11:13.66	34.0667 N	118.882 W	A	058.24	4.4	14.1
05-08-2009	20:27:13.95	34.4402 N	119.183 W	A	095.97	4.2	07.5
05-18-2009	03:39:36.34	33.9377 N	118.336 W	A	014.84	4.7	13.8
05-19-2009	22:49:11.55	33.9338 N	118.329 W	A	014.90	4.0	12.7
03-16-2010	11:04:00.00	33.9920 N	118.082 W	A	016.87	4.4	18.9
08-24-2010	05:42:17.00	33.5150 N	119.033 W	A	093.71	4.0	16.9
09-01-2011	20:47:08.00	34.3390 N	118.475 W	A	038.10	4.2	07.3
05-30-2012	05:14:00.81	33.6918 N	119.058 W	A	084.57	4.0	16.4
06-14-2012	03:17:15.72	33.9085 N	117.792 W	A	045.19	4.0	09.7
08-08-2012	06:23:34.16	33.9048 N	117.792 W	A	045.33	4.5	10.1
08-08-2012	16:33:22.05	33.9035 N	117.791 W	A	045.47	4.5	10.3
08-29-2012	20:31:00.35	33.9060 N	117.788 W	A	045.63	4.1	09.2
05-15-2013	20:00:06.23	33.6583 N	118.372 W	A	045.08	4.1	01.2
01-15-2014	09:35:18.87	34.1430 N	117.442 W	A	075.11	4.4	03.5
03-17-2014	13:25:36.87	34.1340 N	118.486 W	A	023.57	4.4	09.4
03-29-2014	04:09:42.31	33.9325 N	117.917 W	A	033.45	5.1	04.7
03-29-2014	21:32:45.93	33.9613 N	117.892 W	A	034.50	4.1	09.4
06-02-2014	02:36:43.93	34.0958 N	118.491 W	A	022.71	4.2	04.3
01-04-2015	03:18:09.48	34.6173 N	118.630 W	A	071.97	4.3	07.8
07-25-2015	12:54:06.99	34.0920 N	117.445 W	A	074.34	4.2	05.0
12-30-2015	01:48:57.31	34.1910 N	117.413 W	A	078.64	4.4	06.9
03-12-2016	08:42:40.30	34.5217 N	119.075 W	A	092.05	4.1	19.3
01-25-2018	10:09:56.81	33.7410 N	117.491 W	A	078.11	4.0	11.1

Table 2 - continued

S E A R C H   O F   E A R T H Q U A K E   D A T A   F I L E 1

SITE: Proposed Angels Landing Development

COORDINATES OF SITE ...... 34.0510 N 118.2506 W

DISTANCE PER DEGREE ..... 110.9 KM-N   92.3 KM-W

MAGNITUDE LIMITS .... 4.0 - 8.5

TEMPORAL LIMITS .... 1932 - 2018

SEARCH RADIUS (KM) 100.0

NUMBER OF YEARS OF DATA 85

NUMBER OF EARTHQUAKES IN FILE 4638

NUMBER OF EARTHQUAKES IN AREA 441

WOOD ENVIRONMENT & INFRASTRUCTURE SOLUTIONS

Table 2 - continued
Proposed Angels Landing Development
LIST OF HISTORIC EARTHQUAKES OF MAGNITUDE 4.0 OR GREATER WITHIN 100.0 KM OF THE SITE
(CGS DATA 1769-1931)

DATE	LATITUDE	LONGITUDE	DIST [KM]	MAGNITUDE
07-28-1769	34.0000 N	118.000 W	023.78	6.00
04-00-1803	34.2000 N	118.100 W	021.60	5.50
12-08-1812	34.3700 N	117.650 W	065.64	7.50
09-24-1827	34.0000 N	119.000 W	069.29	6.00
07-11-1855	34.1000 N	118.100 W	014.90	6.00
01-10-1857	34.7600 N	118.710 W	089.40	5.60
01-16-1857	34.5200 N	118.040 W	055.62	6.30
12-16-1858	34.2000 N	117.400 W	080.03	6.00
04-12-1880	34.7000 N	118.400 W	073.46	5.90
08-28-1889	34.2000 N	117.900 W	036.28	5.60
06-14-1892	34.2000 N	117.500 W	071.05	5.50
04-04-1893	34.3000 N	118.600 W	042.42	5.80
07-30-1894	34.3000 N	117.600 W	065.94	6.20
07-22-1899	34.2000 N	117.400 W	080.03	5.90
07-22-1899	34.3000 N	117.500 W	074.39	6.40
09-16-1903	33.8001 N	117.600 W	066.19	4.00
07-03-1908	34.0001 N	117.500 W	069.40	4.00
05-13-1910	33.7001 N	117.400 W	087.69	5.00
05-15-1910	33.7000 N	117.400 W	087.69	6.00
05-10-1911	34.1001 N	118.800 W	050.89	4.00
10-21-1913	33.8001 N	118.000 W	036.23	4.00
11-08-1914	34.0001 N	118.500 W	023.67	4.50
03-06-1918	34.0001 N	118.500 W	023.67	4.00
06-18-1920	33.5001 N	118.250 W	061.26	4.50
06-22-1920	34.0001 N	118.500 W	023.67	4.90
07-23-1923	34.0000 N	117.250 W	092.39	6.20
08-04-1927	34.0001 N	118.500 W	023.67	5.00
07-08-1929	33.9001 N	118.100 W	021.78	4.70
09-13-1929	33.6301 N	118.200 W	047.03	4.00
08-31-1930	33.9501 N	118.632 W	036.91	5.20
02-16-1931	34.1001 N	117.300 W	087.72	4.00
03-31-1931	34.1001 N	117.800 W	041.86	4.00
04-24-1931	33.7701 N	118.480 W	037.73	4.40
11-03-1931	33.8001 N	118.300 W	028.27	4.00

Table 2 - continued

S E A R C H   O F   E A R T H Q U A K E   D A T A   F I L E 2

SITE: Proposed Angels Landing Development

COORDINATES OF SITE ...... 34.0510 N 118.2506 W

DISTANCE PER DEGREE ..... 110.9 KM-N   92.3 KM-W

MAGNITUDE LIMITS .... 4.0 - 8.5

TEMPORAL LIMITS .... 1769 - 1931

SEARCH RADIUS (KM) 100.0

NUMBER OF YEARS OF DATA 163

NUMBER OF EARTHQUAKES IN FILE 398

NUMBER OF EARTHQUAKES IN AREA 34

WOOD ENVIRONMENT & INFRASTRUCTURE SOLUTIONS

Table 2 - continued
SUMMARY OF EARTHQUAKE RESEARCH

***

NUMBER OF HISTORIC EARTHQUAKLES WITHIN 100.0 KM RADIUS OF SITE

MAGNITUDE RANGE	NUMBER
4.0 - 4.5	305
4.5 - 5.0	106
5.0 - 5.5	35
5.5 - 6.0	15
6.0 - 6.5	10
6.5 - 7.0	3
7.0 - 7.5	0
7.5 - 8.0	1
8.0 - 8.5	0

***

WOOD ENVIRONMENT & INFRASTRUCTURE SOLUTIONS

Figure 1

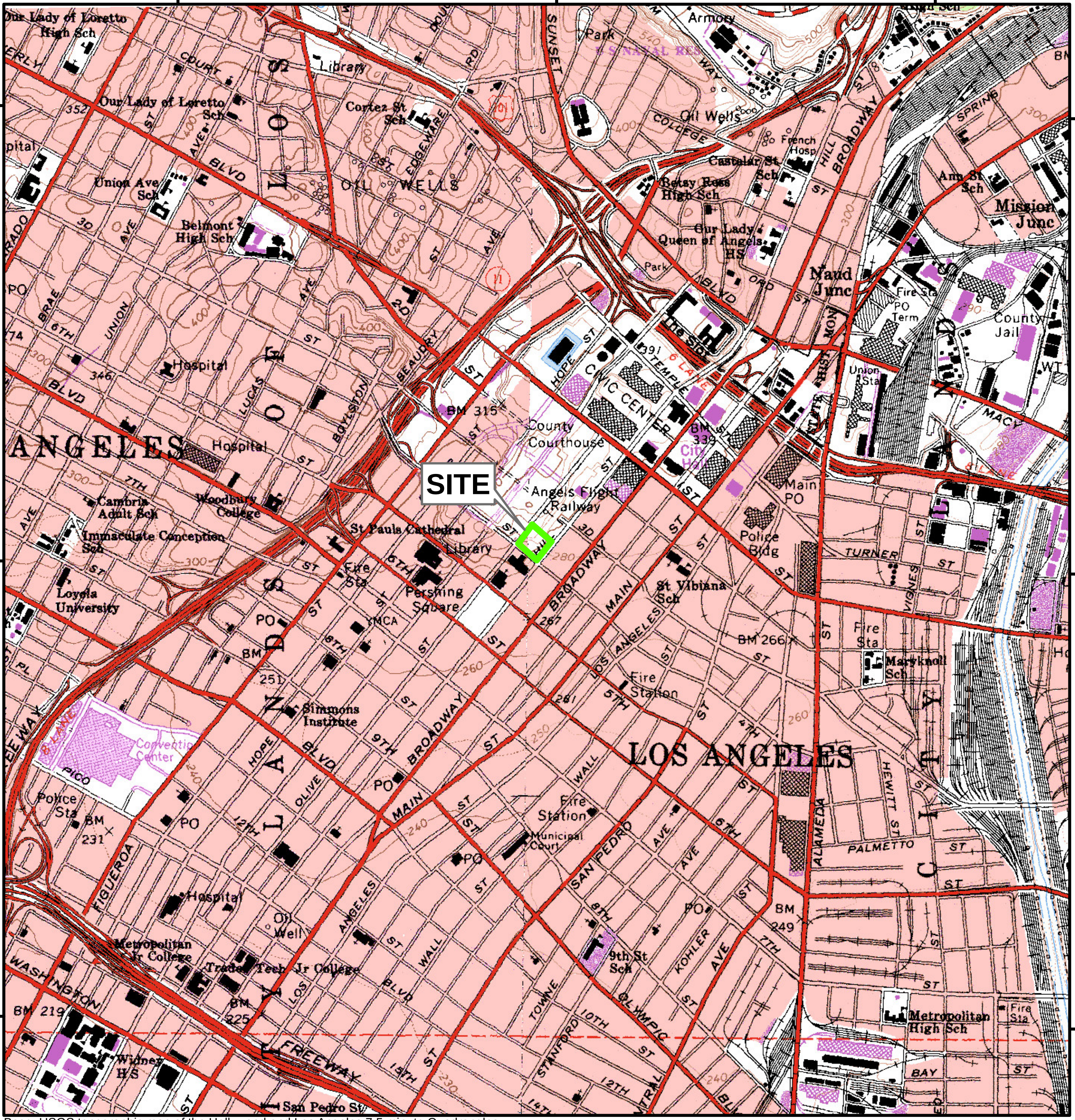
Vicinity Map

118°16'0"W 118°15'0"W 118°14'0"W

34°4'0"N

34°3'0"N

34°2'0"N

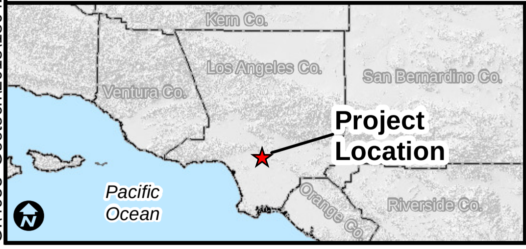


Base: USGS topographic map of the Hollywood and Los Angeles 7.5 minute Quadrangles

0 1,000 2,000 4,000 Feet

0 0.2 0.4 0.8 Miles

PLAN TRUE



wood.

Wood
Environment & Infrastructure Solutions, Inc.
6001 Rickenbacker Road
Los Angeles, California 90040
Tel: 323.889.5300
Fax: 323.721.6700

Proposed Angels Landing Development
Block Bordered by Olive Street, Hill Street, 4th Street, and Angels Flight
Los Angeles, California

LAT: LON:	34.0510 -118.2506
SCALE:	1:24,000
DRAWN:	KSH
CHECK:	PER
DATE:	7/6/2018

SITE VICINITY MAP

FIGURE: 1

PROJECT: 4953-18-0421

G:\4953 Geotech\2018\180421 Angel's Landing Development\GIS\180421 Figure 1 Site Vicinity Map.mxd

Figure 2

Plot Plan

Path: G:\4953_Geotech\2018\180421 Angel's Landing Development\CAD\DWG\4953-18-0421_Fig-2_Plot-Plan(Phase-A).dwg [B-17x11]
Date: July 06, 2018 - 1:25pm By: vo.nguyen

Wood
Environment & Infrastructure Solutions, Inc.,
6001 Rickenbacker Rd, Los Angeles, CA 90040
Phone (323) 889-5300 Fax (323) 721-6700

Proposed Angels Landing Project
Property Bordered by Olive Street, Hill Street,
4th Street and Angels Flight, Los Angeles, California

LT,LNG:	
PREPARED BY:	VMN
SCALE:	1" = 40'
BY:	KH
CHKD:	PR / RM
DATE:	07/03/2018

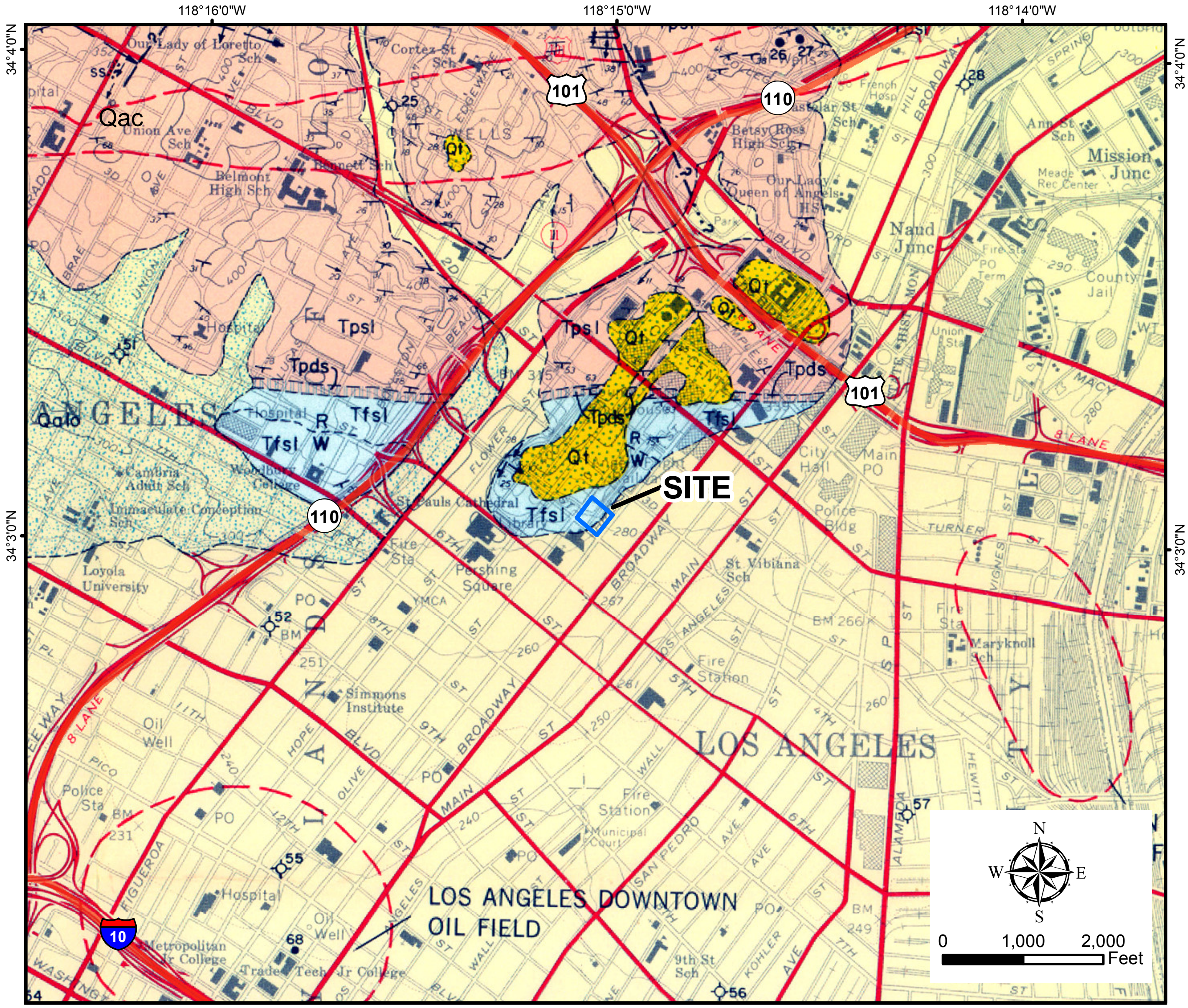
Plot Plan

FIGURE NO. 2

PROJECT NO. 4953-18-0421

Figure 3

Local Geologic Map



Geologic Units

Unit - Description (Age)

Qal - Alluvium. Silt, sand, and gravel (Holocene)
Qalo - Old alluvium. Silt, sand, and gravel forming alluvial plain and terrace deposits (Pleistocene)
Qt - Terrace Deposits. Silt, sand, and gravel forming alluvial terrace and dissected alluvial plain deposits (Pleistocene)
Tfsl - Fernando Formation. Siltstone, massive, light gray; R/W: Repettian-Wheelerian Stage boundary (Pliocene)
Tpds - Puente Formation. Diatomaceous shale, punky, dull white (Late Miocene)
Tpsl - Puente Formation. Siltstone, well bedded (Late Miocene)

Contacts:

- contact, location accurate
- contact, location approximate
- contact, location concealed
- contact, location inferred
- fault, location accurate
- fault, location approximate
- fault, location concealed
- fault, location inferred

Symbols:

- 23 Inclined Bedding
- 18 Inclined Bedding approx.
- 21 Overturned Bedding
- Vertical Bedding
- Horizontal Bedding
- 39 Inclined Foliation
- Foliation approx.
- Vertical Foliation

Folds:

- Anticline
- Syncline

Reference: Lamar, D.L., 1970, "Geology of the Elysian Park-Repetto Hills area, Los Angeles County, California," California Division of Mines and Geology Special Report 101, 45 p., map in pocket (1:24:000).

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Proposed Angels Landing Development
Block Bordered by Olive Street, Hill Street, 4th Street, and Angels Flight
Los Angeles, California

LAT:	34.0510
LON:	-118.2506
SCALE:	1:24,000
DRAWN:	KSH
CHECK:	PER
DATE:	6/21/2018

LOCAL GEOLOGIC MAP

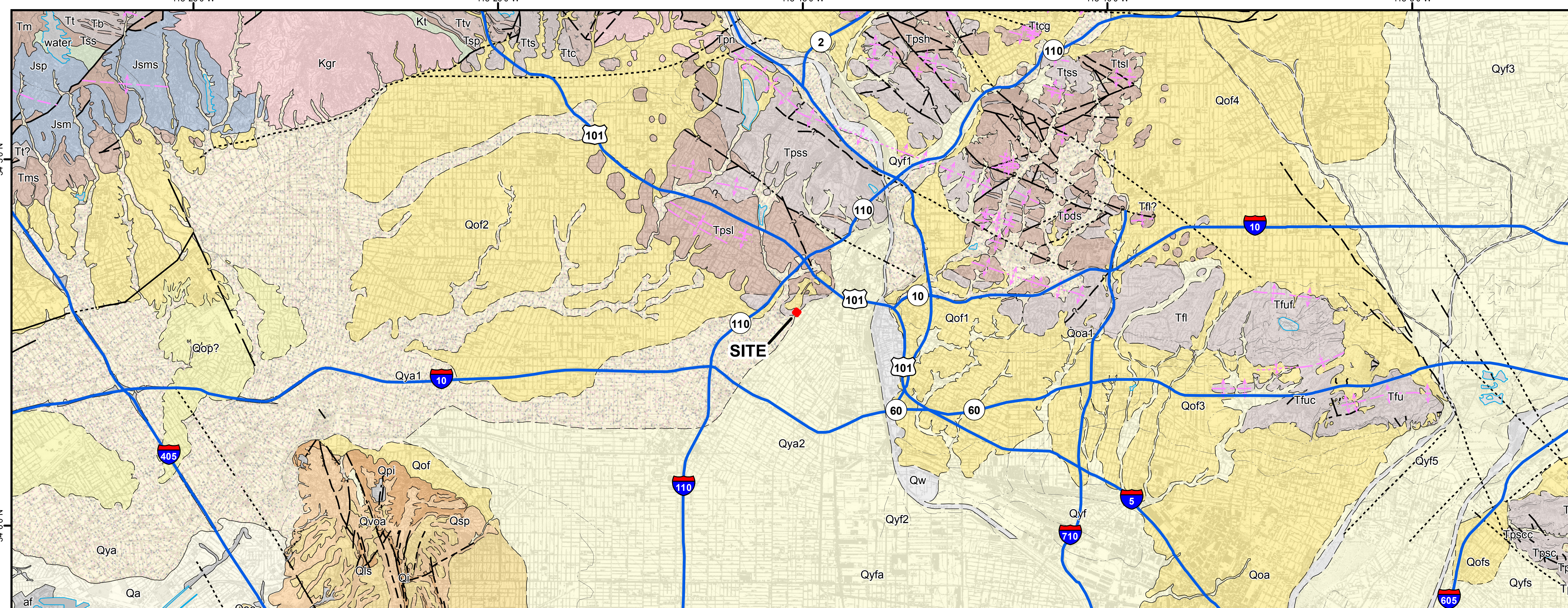
3

PROJECT:
4953-18-0421

Path: G:\4953_Geotech\2018\180421 Angel's Landing Development\GIS\180421_Figure_3_Local_Geology_Map.mxd

Figure 4

Regional Geologic Map



Geologic Units

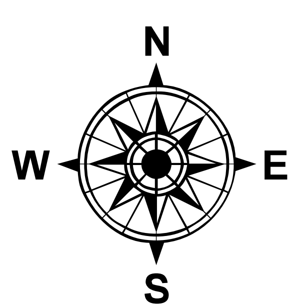
af - artificial fill (late Holocene)
Qa - Alluvial flood-plain deposits (late Holocene)
Qw - Active channel and wash deposits (late Holocene)
Qls - Landslide deposits (Holocene and Pleistocene)
Qya - Young alluvial flood-plain deposits (Holocene and Late Pleistocene)
Qyf - Young alluvial fan and valley deposits, undivided (Holocene and late Pleistocene)
Qoa - Old alluvial flood-plain deposits, undivided (late to middle Pleistocene)
Qoe - Old eolian deposits (late to middle Pleistocene)
Qof - Old alluvial fan deposits, undivided (late to middle Pleistocene)
Qop - Old paralic deposits (late to middle Pleistocene)
Qvoa - Very old alluvium, undivided (middle to early Pleistocene)
Qi - Inglewood Formation, siltstone (early Pleistocene)
Qpi - Inglewood Formation, siltstone, fine sandstone (early Pleistocene)
Tf - Fernando Formation, undivided; conglomerate, sandstone (Pliocene)
Qsp - San Pedro Formation, undivided; sand and silty sand (early Pleistocene)
Tp - Puente Formation, undivided, siltstone, sandstone, shale (early Pliocene and late Miocene)
Tm - Modelo Formation, undivided, mudstone, siltstone, shale (late Miocene)
Tb - Basalt dikes, flows and breccias (Miocene)
Tt - Topanga Group, undivided (middle Miocene)
Ttcg - Topanga Group, conglomerate (middle Miocene)
Tts - Topanga Canyon Formation, Saddle Peak Member, sandstone and conglomerate (middle and early Miocene)
Ttsl - Topanga Canyon Formation, siltstone, sandstone and siliceous shale (middle Miocene)
Ttc - Topanga Canyon Formation, undivided, sandstone with interbedded siltstone (early middle Miocene)
Ttss - Topanga Canyon Formation, sandstone (middle Miocene)
Ttv - Topanga Canyon Formation, andesite and basalt flows (middle and early Miocene)
Tsp - Sespe Formation, Piuma Member, sandstone (early Miocene to late Eocene)
Tss - Santa Susana Formation, clay and mudrock (early to late Paleocene)
Kgr - Granitic rocks (late Cretaceous)
Kt - Tuna Canyon Formation, undivided marine sandstone, siltstone, conglomerate (late Cretaceous)
Jsm - Santa Monica Slate (late Jurassic)
Jsms - Santa Monica Slate, spotted (late Jurassic)
Jsp - Santa Monica Slate, phyllite (late Jurassic)

Note: Some geologic units may have sub-units shown on map

Geologic Contacts

contact, identity and existence certain, location accurate
contact, identity and existence certain, location approximate
contact, identity and existence certain, location concealed
contact, identity and existence certain, location inferred
fault, identity and existence certain, location accurate
fault, identity and existence certain, location approximate
fault, identity and existence certain, location concealed
fault, identity and existence certain, location inferred

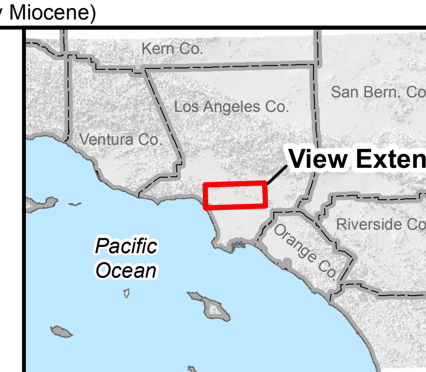
(Queried where contacts are questionable)



Graphic Scale

0 0.5 1 2 3 4 Miles

0 0.75 1.5 3 4.5 6 Kilometers



References:
Bedrossian, T.L., Roffers, P., Hayhurst, C.A., 2012, "Geologic Compilation of Quaternary Surficial Deposits in Southern California", California Geological Survey, vector spatial data, Special Report 217, December 2012.

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LON:	-118.2506
SCALE:	1:100,000
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DATE:	6/21/2018

REGIONAL GEOLOGIC MAP

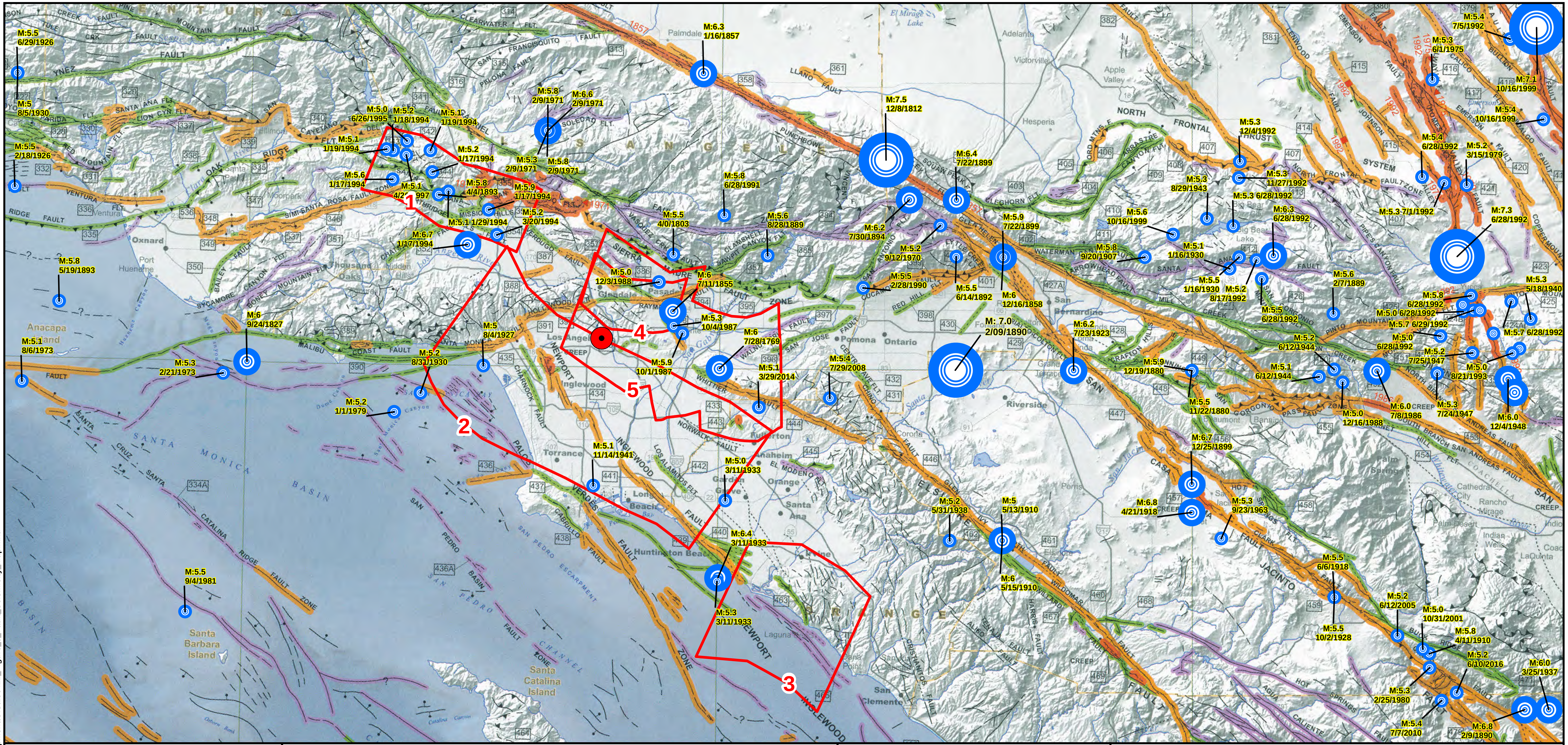
FIGURE: 4

PROJECT: 4953-18-0421

Path: G:\4953_Geotech\2018\180421 Angel's Landing Development\GIS\180421_Figure_4_Regional_Geologic_Map2.mxd

Figure 5

Regional Fault and Seismicity Map



Earthquakes

Approximate Epicentral Area of Earthquake

Events ≥ 7.0

Events 6.0 - 6.9

Events 5.0 - 5.9

Faults

Historic Fault Displacement

Holocene Fault Displacement

Evidence of Late Quaternary Fault Displacement

Undivided Quaternary Faults

Bar and ball on downthrown side (relative or apparent)

Arrows along fault indicate relative or apparent direction of lateral movement

Arrows on fault indicates direction of dip

Low angle fault identified with barbs on upper plate. Fault surface generally dips less than 45°but locally may have been subsequently steepened.

Blind Thrust Faults (surface projection)

Blind Thrust Index:

1 Northridge Thrust

2 Compton Thrust

3 San Joaquin Hills Thrust

4 Upper Elysian Park Thrust

5 Puente Hills Thrust

SITE

N S E W

0 4 8 16 24 32 Kilometers

0 3 6 12 18 24 Miles

REFERENCES:

Jennings, C.W. and Bryant, W.A., 2010,"Fault Activity Map of California," California Geological Survey, GDM-006, May 2010

Earthquake Catalogs: California Geological Survey, 1769-1932; Southern California Earthquake Center, 1932-2017.

Working Group on California Earthquake Probabilities (WGCEP), 2016, Fault Database Tools, <http://www.wgcep.org/tools-fault_db>

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REGIONAL FAULT AND SEISMICITY MAP

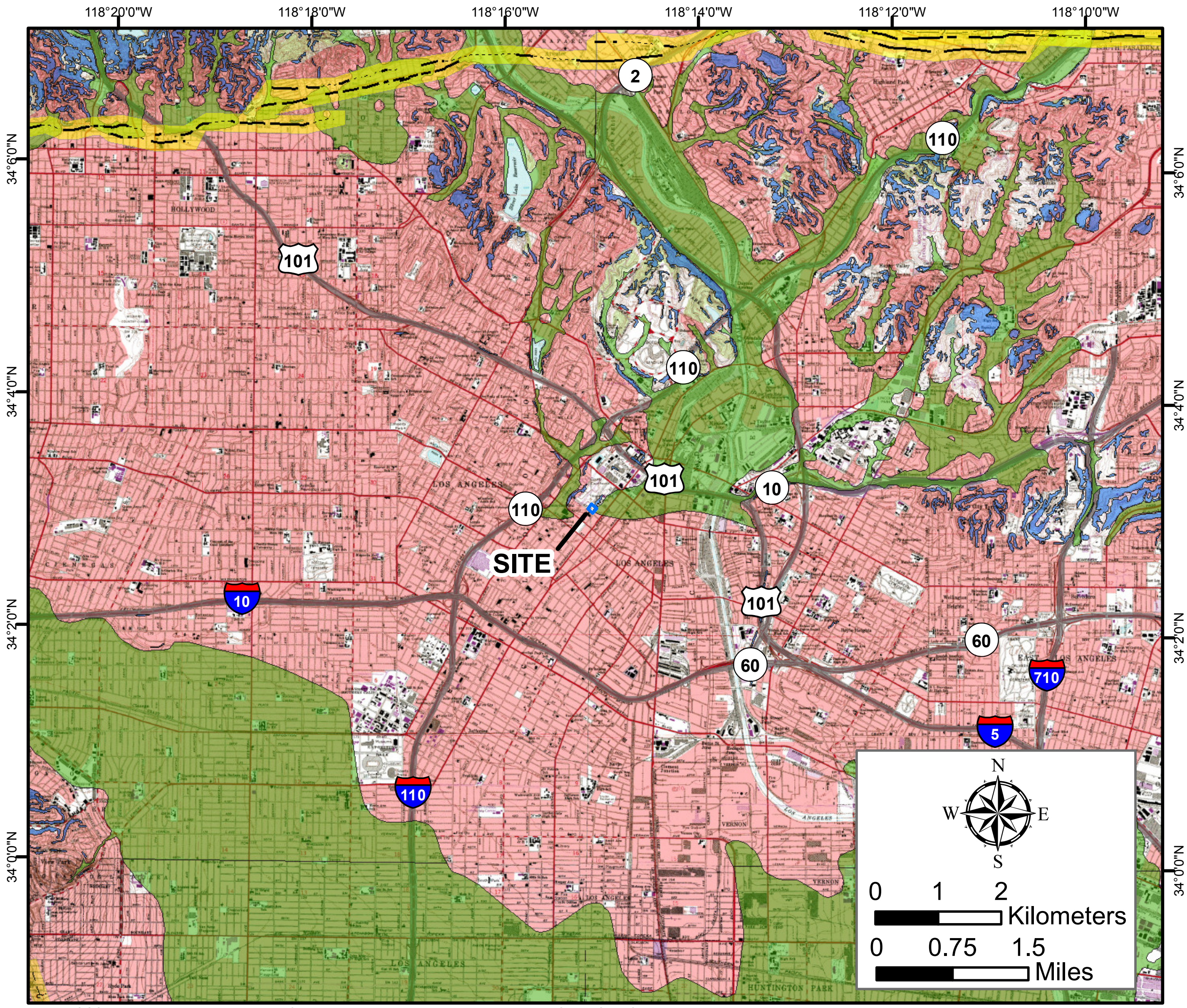
FIGURE: 5

PROJECT: 4953-18-0421

Path: G:\4953_Geotech\2018\180421 Angel's Landing Development\GIS\180421_Figure_5_Fault_Seismicity_Map.mxd

Figure 6

Seismic Hazards Map



Base: USGS 7.5 minute topographic maps of the Hollywood, Inglewood, Los Angeles and South Gate Quadrangles

Seismic Hazards

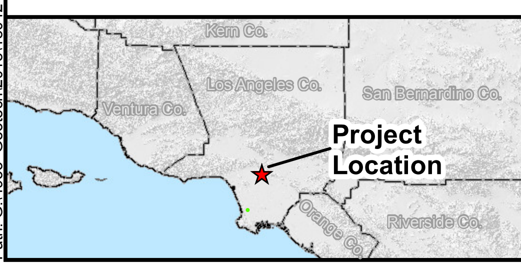
Earthquake-induced landslide - Areas where Holocene occurrence of landslide movement, or local slope of terrain, and geological, geotechnical and ground moisture conditions indicate a potential for permanent ground displacements such that mitigation as defined in Public Resources Code Section 2693(c) would be required.

Liquefaction hazard zones shall be delineated as areas where historic occurrence of liquefaction, or local geological, geotechnical and ground water conditions indicate a potential for permanent ground displacements such that mitigation as defined in Public Resources Code Section 2693(c) would be required.

Fault Zones

- Accurately Located Fault Traces
- Approximately Located Fault Traces
- Inferred Fault Traces
- Concealed Fault Traces
- Aerial Photo Lineament
- Alquist Priolo EFZ Boundary

References:
CGS, 2017, GIS Files of Official Map of Alquist-Priolo Earthquake Fault Zones, Los Angeles Quadrangle," June 15, 2017.
CGS, 2014, GIS Files of Official Map of Alquist-Priolo Earthquake Fault Zones, Hollywood Quadrangle," November 6, 2014.
CGS, 2002, "GIS Files of Official Alquist Priolo Earthquake Fault Zones, Southern Region," May 31, 2002, CGS CD 2001-05.



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SEISMIC HAZARDS MAP

FIGURE: 6

PROJECT: 4953-18-0421

Path: G:\4953_Geotech\2018\180421 Angel's Landing Development\GIS\180421_Figure_6_Seismic_Hazards_AP.mxd