APPENDIX G

GEOLOGICAL TECHNICAL REPORT

GEOTECHNICAL INVESTIGATION REPORT
PROPOSED PACIFIC GAS & ELECTRIC COMPANY
DFM 0630-01 (R-1385) PIPELINE REPLACEMENT
SACRAMENTO RIVER CROSSING
MERIDIAN, CALIFORNIA

December 1, 2020

December 1, 2020
Project No. 20201644.013A

Clarence Li
Pacific Gas and Electric Company
6121 Bollinger Canyon Road
San Ramon, CA 94583

Subject: Geotechnical Investigation Report
Proposed Pacific Gas & Electric Company
DFM 0630-01 (R-1385) Pipeline Replacement
Sacramento River Crossing
Meridian, California

Dear Mr. Li:

Kleinfelder is pleased to present the results of our geotechnical investigation for the proposed Pacific Gas & Electric (PG&E) pipeline DFM 0630-01 (R-1385) replacement crossing the Sacramento River in Meridian, California. It is our understanding that replacement of the gas pipeline will be implemented utilizing horizontal directional drilling (HDD) techniques. The purpose of this investigation was to evaluate the subsurface conditions near the project alignment, characterize the subsurface materials, and provide geotechnical engineering recommendations for the proposed trenchless installations.

The primary geotechnical design concern associated with project is the presence of varying young alluvial soils encountered on either side of the alignment, creating the potential for design and construction issues at the site. These issues include liquefaction and lateral spreading that could cause stresses on the proposed pipe, the potential for hydraulic fracturing at various points along the trenchless alignment, and loss of drilling fluids in deep clean sand and gravel layers encountered on the western side of the Sacramento River. Although groundwater was encountered below anticipated excavation depths at the time of our investigation, the groundwater conditions can change prior to construction. If groundwater is encountered during excavation, further assessment may be warranted. The hydraulic conductivity is relatively high at this site, and any water encountered during excavation may represent a significant volume if pumped from the open excavation. The designer(s) and contractor(s) should be aware of these subsurface conditions as they will affect design and construction, as described herein. Specific recommendations regarding the geotechnical engineering aspects of project design and construction are presented in the following report.

Kleinfelder appreciates the opportunity to provide services for this project. If you have questions regarding this report, please contact the undersigned.

Respectfully submitted,

KLEINFELDER, INC.

Victoria A. Tinoco, EIT
Staff Engineer

Tyler DeSouza, PE
Project Manager

Reviewed by:

Romeo R. Shiplee, PE
Principal Professional

Kenneth G. Sorensen, PE, GE
Senior Principal Professional

TABLE OF CONTENTS

Section **Page**

TABLE OF CONTENTS (CONTINUED)

Section

1 INTRODUCTION

1.1 GENERAL

This report presents the results of a geotechnical investigation performed for the proposed Pacific Gas & Electric pipeline DFM 0630-01 (R-1385) replacement crossing the Sacramento River in Meridian, California. The purpose of this investigation was to evaluate the subsurface conditions near the project alignment, characterize the subsurface materials, and provide supporting geotechnical engineering and trenchless design consultation for the proposed trenchless crossing. The approximate location of the pipeline section to be replaced is shown on Figure 1, Site Vicinity Map.

Conclusions and recommendations presented in this report are based on the subsurface conditions encountered in two exploratory borings (MW-1 and B-2) drilled for this investigation, past borings drilled for a nearby transmission line (B-1 and B-2), and our review of published geologic data referenced in this report. Recommendations presented herein should not be extrapolated to other areas or used for other projects without our prior review. The approximate locations of our exploratory borings are shown on Figure 2, Exploration Location Map.

1.2 PROJECT DESCRIPTION

Kleinfelder's understanding of the project is that PG&E is proposing to replace existing sections of the twin, 3-inch-diameter DFM 0630-01 pipelines. The replacement pipeline will cross the Sacramento River and its levees and will be approximately 4 inches in diameter. The trenchless crossing will be on the order of 1,115 feet in installed length and extend at least 50 feet below the river and levees, per requirements from the United States Army Corp of Engineers (USACE). At this time, horizontal directional drilling (HDD) methods are being considered for installation.

1.3 SCOPE OF SERVICES

The purpose of this investigation was to explore and evaluate the subsurface conditions at the site and develop geotechnical recommendations to assist in project design, specification development, and construction. Our scope of work was outlined in our revised proposal dated May 18, 2020 (File No. MPPGE000.001C) and included the following:

- Review of available geotechnical and geologic data in the site area
- A description of the proposed project including a site vicinity map, site plan, and geology map showing the subsurface exploration locations
- A description of the site surface and subsurface conditions encountered during the field investigation, including logs of borings
- A description of the site geologic setting and potentially adverse geologic hazards
- A field exploration program consisting of drilling, sampling and logging two exploratory borings and installation of one monitoring well on the site
- Laboratory testing to evaluate relevant geotechnical engineering parameters of the subsurface soils including corrosion potential
- Engineering analysis of the data gathered including a dewatering assessment and a preliminary hydraulic fracturing analysis
- Preparation of this report

1.4 PREVIOUS STUDIES

In preparation of this report, the following geotechnical report was reviewed and was considered during the development of conclusions and recommendations for this study:

- "PG&E Mast Tower Replacement Project, Geotechnical Design Recommendations, Colusa JCT #1 60kV, Colusa and Sutter Counties, California," by Kleinfelder dated February 18, 2020.

2 FIELD INVESTIGATION AND LABORATORY TESTING

2.1 SITE DESCRIPTION

This section of the proposed pipeline replacement alignment is located in Meridian, California just north of Highway 20 (see Figure 1). The portion of the alignment being evaluated runs in the east-west direction, crossing the Sacramento River and its levees parallel to the highway, as shown on Figure 2. The project site is bounded to the west by an unoccupied open field adjacent to the landside levee toe. Agricultural fields exist farther west of the open field and exist to the north of the project site. The project site is bounded to the east by orchards north of Alameda Street and by a small residential housing tract south of Alameda Street that exists east of the landside levee toe. The site is located about 500 to 600 feet north of Highway 20.

The trenchless crossing proposed exit point is located in an unoccupied open field with tall grasses. The proposed entry point is located near the intersection of N. Meridian Road and Alameda Street. At the proposed crossing alignment, the Sacramento riverbed is at an elevation of approximately 33 feet above mean sea level, based on information provided by PG&E. The site work areas are relatively flat with the exception of canals and embankments. Elevations of the entry and exit points are both approximately 54 feet above mean sea level. The elevation of the left and right bank levee crowns are approximately 72 and 64 feet above mean seal level, respectively.

2.2 FIELD EXPLORATION

2.2.1 General

The subsurface conditions at the site were explored between October 7th through October 9, 2020 by drilling two (2) borings to depths of approximately 80 and 81½ feet below the ground surface. The boring located on the west side of the Sacramento River was converted into a monitoring well (MW-1). The well casing was set to a depth of approximately 50 feet below the ground surface.

The borings were drilled using a truck-mounted drill rig equipped with solid flight and mud rotary drilling techniques. These methods utilized a nominal 6-inch-diameter bit for solid flight drilling before switching over to a 4-inch-diameter bit for mud rotary drilling. The monitoring well was developed by our subcontractor on October 23, 2020, and a series of slug in and slug out tests were performed on October 27, 2020 to aid in a dewatering analysis. The approximate locations of borings performed for this study and previous studies nearby are shown on Figure 2, Exploration Location Map.

The borings were located in the field with a GPS unit, as well as visual sighting and/or pacing from existing site features. Therefore, the locations of the borings shown on Figure 2 should be considered approximate and may vary slightly from those indicated.

Kleinfelder professionals maintained logs of the borings, visually classified the soils encountered according to the Unified Soil Classification System (American Society for Testing and Materials International [ASTM] D2488 visual-manual procedure), and obtained samples of the subsurface materials. The Graphics Key with the Unified Soil Classification System descriptive criteria is presented on Figure A-1 in Appendix A. Following laboratory testing, the field visual classifications were revised, as appropriate, based on ASTM D2487. A Soil Description Key is provided on Figure A-2. Logs of Borings are presented on Figures A-3 and A-4.

2.2.2 Sampling Procedures

Samples were obtained from the borings at selected depths by driving a 2.5-inch inside diameter (I.D.), split-barrel, California sampler containing stainless steel liners into the soil with a 140-pound automatic hammer free-falling a distance of 30 inches. The California sampler is in general conformance with ASTM D3550.

Samples were also obtained at selected depths by driving a 1.4-inch I.D. Standard Penetration Test (SPT) sampler into undisturbed soil with a 140-pound automatic hammer free-falling a distance of 30 inches. The SPT sampler is in general conformance with ASTM D1586.

Blow counts were recorded at 6-inch depth intervals for each driven sample attempt and are reported on the logs. Blow counts shown on the boring logs have not been corrected for the effects of overburden pressure, rod length, sampler size, or hammer efficiency. Sampler size correction factors were applied to estimate the sample apparent density noted on the boring logs. The consistency terminology used in soil descriptions for cohesive soils is based on field observations (see Figure A-2). Samples obtained from the borings were packaged and sealed in the field to reduce moisture loss and disturbance and transported to our laboratory for further testing. After the borings were completed, they were backfilled with cement grout.

2.3 TEST WELL INSTALLATION

As mentioned above, following drilling of the borings, a test well was installed and developed at the MW-1 location. The well was constructed with 2-inch-diameter, schedule 40, PVC casing with 0.010-inch slotted screen. A sand pack was placed in the annulus of the well to an approximate depth of 3- to 6-inches above the top of the well screen. A 2-foot-thick bentonite chip seal was placed on top of the sand pack and hydrated, followed by a neat cement grout seal to the surface. The well was completed with an 8-inch-diameter, flush-mount, vault set in concrete. The complete well construction log is reported in Appendix A and key details are summarized below in Table 2.1.

TABLE 2.1
TEST WELL CONSTRUCTION SUMMARY

Test Well ID	Total Depth (ft bgs)	Screened Interval (ft bgs)	Static Groundwater Depth at time of construction (ft bgs)	Static Groundwater Depth post-development (ft bgs)
MW-1	50	15-50	16	18.5

Total depth, screened interval and static groundwater depths below the ground surface (bgs) are approximate values

The test well was developed by Confluence Environmental Inc., of Sacramento, California. The well was purged of a minimum of ten well volumes with a portable submersible pump. Purge water was monitored during development and development was stopped after all water quality values stayed within 10% of the previous reading. Purge water was containerized in drums and temporarily stored at the Meridian PG&E maintenance yard pending analytical results.

Several key test well construction factors can influence the effectiveness of hydraulic conductivity values estimated from aquifer testing. These factors include the filter pack gradation, the screen slot size, the drilling method and technique, and the quality of well development. The drilling, installation and development of the test well was conducted in a manner to reduce borehole smear and increase the effectiveness of the hydrologic connection between the test well and the in-situ (natural) soil and groundwater conditions.

2.4 AQUIFER/SLUG TESTING

Aquifer testing, in the form of slug tests, was performed on October 28, 2020, on the newly installed test well (MW-1). A slug test is a relatively cost-effective and efficient manner to estimate hydraulic conductivity within the immediate vicinity of the test well. The solid-slug test is conducted when a solid object of known volume (a slug) is quickly lowered into (slug-in) or pulled out (slug-out) of a water column within a well, causing the water level inside the well to rise or fall, respectively. The water level is monitored and recorded over time until it returns to equilibrium or the original observed level. The aquifer response and recovery data are used to estimate aquifer properties and provide the hydraulic conductivity estimates.

For our slug testing, the solid slug was alternately lowered into the wells (falling head test) and removed (rising head test) from the wells to create a condition of groundwater disequilibrium. The groundwater level was monitored with a pressure transducer over time as water level returned to equilibrium. A minimum of three slug-in and three slug-out tests were performed in each well. Depth to water was measured at 18½ feet below ground surface at the time of slug testing.

2.5 LABORATORY TESTING

Laboratory tests were performed on selected samples recovered from the borings to evaluate physical and engineering properties. The geotechnical laboratory testing included the following tests:

- Unit Weight (ASTM D2937)
- Moisture Content (ASTM D2216)
- Percent Finer Than No.200 Sieve (ASTM D1140)
- Sieve Analysis (ASTM D6913)
- Atterberg Limits (ASTM D4318)
- Direct Shear (ASTM D3080)
- Unconsolidated-Undrained Triaxial Compression (ASTM D2850)

The results of most of the laboratory tests are summarized on the boring logs in Appendix A. All laboratory test data are included in Appendix B.

3 SITE CONDITIONS

3.1 REGIONAL GEOLOGY

The project site lies within the northeastern portion of the Great Valley geomorphic province. The province is bordered to the north by the Cascade Range and Klamath Mountains, to the west by the structurally complex sedimentary and volcanic rock units of the Coast Ranges, to the east by the granitic and metamorphic basement rocks which form the gently sloping western foothills of the Sierra Nevada mountains, and to the south by the east-west trending Transverse Ranges. About 400 miles long and 50 miles wide, the Great Valley is an asymmetrical, synclinal trough formed by tilting of the Sierran block during the late Tertiary and Quaternary periods with the western side dropping to form the valley and the eastern side uplifting to form the Sierra Nevada Mountains. Erosion of the adjacent Sierra Nevada mountains and Coast Ranges has in-filled the Great Valley with a thick sequence of unconsolidated to semi-consolidated Quaternary (Pleistocene and Holocene) age alluvial sediments. The thickness of the valley sediments varies from a thin veneer at the edges of the valley to thousands of feet in the western portion.

3.2 PROJECT GEOLOGY

The geology of the site area has been mapped by several geologists including Helley and Harwood (1985) and Burnett and Jennings (1962). According to Helley and Harwood the exploration locations are mapped as being within Quaternary Alluvium (Qa), Burnett and Jennings have mapped the explorations as Quaternary Stream Channel Deposits (Qsc) as shown in Figure 3. The alluvium is described as generally consisting of sand, gravels, and silts deposited by present-day stream and river systems that drain the Coast Ranges, Klamath Mountains, and Sierra Nevada and the stream channel deposits are of open active stream channels and adjacent natural levees that are light tan and gray.

Detailed descriptions of the subsurface conditions encountered in our field explorations are presented on the Boring Logs in Appendix A.

3.3 SEISMICITY AND FAULTING

An active fault is defined as one that has moved within Holocene time (about the last 11,000 years). However, for the purposes of the Alquist-Priolo Earthquake Fault Zoning Act, an active fault is defined as a fault that has exhibited surface displacement within Holocene time (Bryant and Hart, 2007). A potentially active fault is defined by the State as a fault with a history of movement within Pleistocene time (between about 11,000 and 1.6 million years ago). Active faults without surface expression (buried faults) and other potentially active seismic sources that are capable of generating earthquakes are not currently zoned by the Act.

Based on the information provided in California Geological Survey (2018), the site is not located within a State-designated Alquist-Priolo Earthquake Fault Zone where site-specific studies addressing the potential for surface fault rupture are required. No mapped active faults are known to traverse the project site.

3.4 SUBSURFACE CONDITIONS

3.4.1 Current Investigation

The following descriptions provide a general summary of the subsurface conditions encountered during the field exploration program, as well as detailed descriptions of the conditions at the crossing location. For more detailed descriptions of the actual conditions encountered at specific boring locations, refer to the boring logs presented in Appendix A.

Based on information gathered from the current field explorations, the geologic site conditions are generally consistent with mapped surficial geology referenced in the Site Geology section of this report. Subsurface conditions encountered in MW-1 (western side of the crossing at approximately Sta. 10+05) consist of very stiff lean clay to a depth of approximately 9 feet below the ground surface underlain by loose fine to medium-grained silty sand to a depth of approximately 23 feet below the ground surface. The silty sand is underlain by alternating layers of medium dense to very dense, fine to coarse-grained poorly-graded sand and well-graded gravel layers with varying thicknesses to a termination depth of approximately 80 feet below the ground surface. The gravels encountered had a maximum dimension of up to about 2 inches. The final sample at 80 feet below the ground surface was not obtained due to very poor circulation of the drilling fluid escaping through the gravelly formation.

Boring B-2 (eastern side of the crossing at approximately Sta. 0+65) generally encountered alternating layers of very soft to hard lean clay with varying amounts of sand and sandy silt to a depth of approximately 18 feet below the ground surface underlain by very soft to soft clayey silt to a depth of approximately 34 feet below the ground surface. An approximately 5-foot-thick layer of very soft to soft lean clay was encountered below the clayey silt. An approximately 17-foot-thick layer of elastic silt was encountered at a depth of approximately 39 feet below the ground surface. Medium dense to very dense sands with interbedded layers of hard lean clays were encountered to the termination depth of approximately 81½ feet below the ground surface.

It should be noted that drilling fluid losses were encountered on the west side of the Sacramento River between the depths of 33 feet and 80 feet below the ground surface in MW-1 due to the presence of the clean sand and gravel materials mentioned above. Fluid loss was considered manageable and circulation was present until an approximate depth of 60 feet, at which point significant fluid losses and poor circulation continued through the boring termination depth of 80 feet. Further discussion on the impact of such conditions with regard to HDD design and construction is provided in Section 5.

3.4.2 Previous Investigation

Nearby borings were performed by Kleinfelder as part of a 2019 geotechnical investigation for the replacement of electrical transmission line towers. This data is presented in Appendix C. The two borings from the 2019 study were advanced to depths of approximately 51½ feet below the ground surface utilizing both hollow stem and mud rotary techniques. Borings B-1 and B-2 indicate interbedded alluvial soils similar to those encountered in the borings drilled for this study. Depths of sand and gravel units vary but are still in general agreement with the mapped geology. Refer to the boring logs in Appendix D for more detailed information.

3.5 GROUNDWATER CONDITIONS

According to regional well record data published by the California Department of Water Resources (DWR), current groundwater levels at the site area are between 10 and 20 feet below ground surface. Groundwater was encountered in both explorations at approximately 16 feet below the ground surface in MW-1 and at a depth of approximately 16½ feet below the ground surface in Boring B-2 during the current investigation. Groundwater was encountered in Boring B-2, as part of the 2019 study, at a depth of approximately 20 feet below the ground surface. It should be noted that the two explorations located on the west side of the river have a 3-foot elevation difference with MW-1 performed for this study sitting at the higher elevation. Groundwater was not measured in Boring B-1, as part of the 2019, study due to the drilling methods used. It is possible that groundwater conditions at the site could change due to variations in rainfall, groundwater withdrawal or recharge, current water levels within the Sacramento River, construction activities, well pumping, or other factors not apparent at the time the explorations were performed.

4 CONSTRUCTION DEWATERING EVALUATION AND CONSIDERATIONS

This section presents the findings of Kleinfelder's analysis of aquifer testing results. Hydraulic conductivity is the measure of the rate at which water can pass through a permeable medium. It serves as the primary parameter governing flow through a dewatering system. Clays and silts generally have a lower hydraulic conductivity than sands and gravels.

4.1 AQUIFER TESTING ANALYSIS

Hydraulic conductivity was estimated from evaluating slug test data using the software program AQTESOLV, created by HydroSOLVE of Reston, Virginia. Slug test data was evaluated using the Bouwer-Rice (1976) straight line method to estimate hydraulic conductivity. Slug-in data was corrected to account for the well being screened across the water table.

The expanded slug test evaluations can be reviewed in Appendix C. The resulting hydraulic conductivity estimates are summarized below in Table 4.1.

TABLE 4.1
HYDRAULIC CONDUCTIVITY ESTIMATES FROM SLUG TESTING

Test Well ID	SLUG IN-1	SLUG IN-2	SLUG IN-3	SLUG OUT-1	SLUG OUT-2	SLUG OUT-3	GEOMETRIC MEAN
MW-1	1.75E-02	1.80E-02	1.47E-02	1.53E-02	1.47E-02	1.50E-02	1.58E-02

Hydraulic conductivity estimates in feet/minute

The slug test is designed to give approximate hydraulic conductivity values over the screened section of a test well. Estimated hydraulic conductivity values from slug test data from test well B-1 ranged from 1.47 x 10^{-2} feet/minute (ft/min) to 1.80 x 10^{-2} ft/min with a geometric mean of 1.58 x 10^{-2} ft/min.

4.1.1 Grain Size Distribution Analysis

Kleinfelder performed grain size analysis on select samples collected from the saturated screened zone. Hydraulic conductivity can be estimated from an analysis of grain size distribution. The grain size distribution results were analyzed using the program HydrogeoSieveXL (Devlin, 2016). The program computes estimated hydraulic conductivity using 15 published methods. The expanded grain size analysis evaluations can be reviewed in Appendix C. The resulting conductivity estimates (only reported for the methods which met the qualification criteria) are summarized in Table 4.2.

TABLE 4.2
HYDRAULIC CONDUCTIVITY ESTIMATES FROM GRAIN SIZE ANALYSIS

Test Well ID	Sample Depth (ft)	Sample Description (USCS)	Percent Fines* (Passing #200)	Hydraulic Conductivity Range (ft/min)		
				Low	High	Geometric Mean
M-1	35-36.5	Poorly Graded Gravel with Sand (GP)	3	2.35E-02	4.81E-01	1.04E-01
	45-46.5	Poorly Graded Gravel with Sand (GP)	2	3.80E-01	1.20E+01	1.58E+00

**Fines are defined as silt and clay particles passing the #200 (0.074 millimeters) sieve*

Estimated hydraulic conductivity values from grain size analysis from test well MW-1 at 35 feet ranged from 2.35 x 10^{-2} feet/minute (ft/min) to 4.81 x 10^{-1} ft/min with a geometric mean of 1.04 x 10^{-1} ft/min, and at 45 feet ranged from 3.80 x 10^{-1} ft/min to 1.20 x 10^{-1} ft/min with a geometric mean of 1.58 x 10^{-0} ft/min.

4.1.2 Results

The two methods used to analyze mean hydraulic conductivity (aquifer testing and grain size analysis) resulted in values of 1.58 x 10^{-2} ft/min from aquifer testing and 1.04 x 10^{-1} ft/min (at 35 feet) and 1.58 x 10^{-0} ft/min (at 45 feet) from grain size analysis.

These hydraulic conductivity values are similar to the range of published typical hydraulic conductivity values for well sorted sands and gravels of 1.97 x 10^{-2} ft/min to 1.97 x 10^{-0} ft/min

(Fetter, 2001) and for well-graded and uniform gravels of 9.84×10^{-2} ft/min to 1.97×10^{-0} ft/min (Powers et al, 2007).

4.2 DEWATERING EVALUATION

Presented in the following sections is our assessment of groundwater conditions and estimated dewatering parameters. This evaluation is based upon our understanding of soil conditions, groundwater observations, and data analysis from aquifer testing as described above. The evaluation is made from a limited set of data. Kleinfelder used anticipated excavation dimensions and construction drawings provided by PG&E for our conceptual model as described below.

4.2.1 Conceptual Dewatering Model

For our conceptual dewatering model(s), the following values were used:

- Excavation depth: 10 feet (assumed)
- A required drawdown of the water table to 12 feet below ground surface (2 feet below the bottom of excavation)
- Water table depth of 18½ feet below the ground surface (bgs)

The anticipated depth to groundwater at this site exceeds the projected dewatered excavation depth. Dewatering for construction is not expected to be required at this location under the stated conditions above.

4.2.2 General Dewatering Conclusions

Hydraulic conductivity is the primary soil parameter governing the rate of flow of groundwater through a dewatering system. Analysis of the data gathered from our investigation indicate that hydraulic conductivity values at the site are 1.58×10^{-2} ft/min from aquifer testing and 1.04×10^{-1} ft/min (at 35 feet) and 1.58×10^{-0} ft/min (at 45 feet) from grain size analysis. These values fall within the general range of published values for similar soil type (coarse-grained sand and gravel type soils).

Groundwater is present within the project at approximately 18.5 feet below ground surface. The excavation is anticipated to be about 10-feet bgs and groundwater should be at least 2-feet beneath the bottom of the excavation for dry working conditions. Since groundwater is deeper than 2-feet beneath the anticipated excavation depth of 10 feet, dewatering at the site is not anticipated to be required.

4.2.3 Dewatering Recommendations

If groundwater is encountered during excavation, further assessment may be warranted. The hydraulic conductivity is relatively high and any water encountered during excavation may represent a significant volume if pumped from the open excavation.

If there is an anticipated risk of rising groundwater levels on a seasonal basis, we recommend the groundwater level be monitored periodically. We recommend installing a data logger in the test well and data be retrieved on at least a quarterly basis. Kleinfelder can assist with this task if requested. If after reviewing the seasonal data it becomes apparent a groundwater control system is required, Kleinfelder should be consulted to reassess the findings.

Groundwater control systems should be selected after careful assessment of safety, cost, efficiency, time and work-space concerns.

5 DISCUSSIONS, CONCLUSIONS AND DESIGN CONSIDERATIONS

5.1 GENERAL CONCLUSIONS

As mentioned above, the primary trenchless design concern associated with project is the presence of varying young alluvial soils encountered on either side of the alignment, creating the potential for construction issues at the site. These issues include liquefaction and lateral spreading that could cause stresses on the proposed pipe, the potential for hydraulic fracturing at various points along the trenchless alignment, and loss of drilling fluids in deep clean sand and gravel layers encountered on the western side of the Sacramento River. Conclusions and recommendations for trenchless design and construction are provided below.

It is recommended that the proposed HDD installation be designed and constructed in general accordance with the fourth edition of the "Horizontal Directional Drilling Good Practices Guidelines" by the HDD Consortium (2017).

5.2 LIQUEFACTION AND LATERAL SPREADING POTENTIAL

Liquefaction describes a condition in which saturated soil loses shear strength and deforms as a result of increased pore water pressure induced by strong ground shaking during an earthquake. Dissipation of the excess pore water pressures will produce volume changes within the liquefied soil layer, which causes settlement. Factors known to influence liquefaction include soil type, structure, grain size, relative density, confining pressure, depth to groundwater and the intensity and duration of ground shaking. Soils most susceptible to liquefaction are saturated, loose sandy soils, and low plasticity clays and silts. If liquefaction occurs, structures above the liquefiable layers may undergo settlement.

For layers that meet the compositional criteria, liquefaction triggering (factor of safety) analyses were performed using methodologies proposed by Youd et al. (2001), Seed et al (2003), and Idriss & Boulanger (2008). The analyses utilized sample blow count data from the rotary-wash borings drilled for this study. In order to perform liquefaction analysis, estimates of earthquake magnitude and peak ground acceleration (PGA_M) are needed. Using the U.S. Geological Survey (USGS) interactive deaggregation website, the modal earthquake magnitude M_w = 7.03 was estimated and used in the analysis. The peak ground acceleration (PGA_M) value for our analyses was calculated based on Equation 11.8-1 in Section 11.8.3 of ASCE 7-16 for the Risk-Targeted Maximum Considered Earthquake (MCE_R). The PGA_M value was calculated using the US Seismic Design Maps application assuming a Site Class D for analysis at MW-1 located on the west side of the river and a Site Class E for analysis at B-2 located on the east side of the river. The calculated PGA_M values are 0.385g and 0.476g, for MW-1 and B-2 respectively, for the MCE_R at each location.

Interpretation of the liquefaction analyses of the borings suggests post-liquefaction settlements due to the MCE at each boring site could vary on either side of the Sacramento River. Post-liquefaction settlement could be on the order of 3 to 5 inches on the west side of the river, with the majority of this settlement coming from sand layers at depths ranging from about 16 to 27 feet (Elevations ranging from 37 feet to 25 feet above mean seal level). On the east side of the river, post-liquefaction settlement was found to be negligible.

Lateral spreading is a potential hazard commonly associated with liquefaction where extensional ground cracking and settlement occur as a response to lateral migration of subsurface liquefiable material. This typically occurs on sloping ground and adjacent to free faces such as river or canal banks. Preliminary displacement analyses suggest lateral spreading displacement could occur along the west face of the Sacramento River along the pipeline alignment, ranging from about 1 to 3 inches.

A pipeline engineer should perform analyses to ensure that the pipe can withstand additional stresses as a result of the estimated, seismically-induced vertical settlement and lateral displacement, as noted above.

5.3 HDD CONSIDERATIONS

5.3.1 General

Kleinfelder created a conceptual bore profile (shown on Figures 4a & 4b) with an approximate cover depth of 50 feet (Elevation -29 feet) below the Sacramento River and its levees, per the USACE depth requirements mentioned above. This preliminary profile utilizes topographic and bathymetric survey data provided by PG&E. Based on review of the pipeline alignment, subsurface conditions, and our preliminary inadvertent returns analysis, the HDD bore path has several constructability issues that should be addressed prior to construction. Discussion of these issues can be found in the sections below.

5.3.2 Loss of Drilling Fluid Returns

Loss of drilling fluid returns typically occurs when the drill bit encounters large interstitial pore spaces in coarse soil materials (i.e. gravels and cobbles). Loss of returns is recognized by a decrease of drilling fluid returns, or a drop in drilling fluid pressure.

If interstitial pore spaces are small or discontinuous, they may fill with solids contained in the drilling fluid returns as drilling progresses beyond them. Once the pore spaces are filled, fluid will return up the bore hole again and fluid pressure will increase until another gravel layer is encountered. If open-graded gravel layers are continuous to the surface, drilling fluid may inadvertently return to the surface.

As mentioned above, drilling fluid losses were encountered on the western side of the Sacramento River between the depths of 33 and 80 feet below the ground surface in MW-1 due to the presence of clean sand and gravel materials, with significant fluid loss and poor circulation beginning at a depth of about 60 feet below the ground surface, or at an Elevation of approximately -7 feet above mean sea level. The drilling contractor should prepare for drilling fluid losses during construction activities for as long as the bore path remains within these layers of poorly-graded sands and well-graded gravels.

5.3.3 Drilling and Steering

The density and consistency of soils encountered within the exploratory borings near the HDD alignment vary greatly. The soil units encountered within the proposed bore path near MW-1 appear to consist primarily of very stiff surficial clays, underlain by medium dense to very dense clean sands with interbedded layers of well graded gravels with maximum dimensions up to 2 inches. The soil units encountered within the proposed bore path near Boring B-2 appear to consist primarily of very soft silts underlain by medium dense to very dense sands with interbedded layers of hard lean clays. These variations in density/consistency may pose difficult steering conditions along the bore path at transition points. Furthermore, steering in soft clay/silt materials may be difficult as the soil may not provide the necessary steering reaction. These soft layers were generally encountered at Elevations ranging from about 36½ feet to -4 feet above mean sea level on the eastern side of the Sacramento River. Pilot hole bits with relatively large, flat surfaces can help provide better steering reaction in such conditions.

5.3.4 Borehole Instability

The elastic silt soils encountered on the east side of the Sacramento River at Elevations ranging from about 13 feet to -4 feet above mean sea level may be prone to squeezing in the borehole and it may be necessary for the driller to trip in and out several times to keep the bore hole open at the proper size. Furthermore, layers of well-graded gravels were encountered at Elevations ranging from about 10 feet to 5 feet and -15 feet to over -23 feet above mean sea level on the west side of the Sacramento River that may be prone to instability in the HDD borehole. Gravels dislodged from the borehole walls could be an issue during drilling and removal of cuttings. Proper drilling fluid makeup or use of conductor casings can reduce the potential for borehole caving and stuck pipe during pullback.

5.3.5 Inadvertent Returns of Drilling Fluid

5.3.5.1 General

Hydraulic fracturing occurs when borehole pressure causes plastic deformation of the soil surrounding the borehole, initiating and propagating fractures in the soil mass. The resistance to plastic deformation and fracturing is a function of soil strength, overburden pressure, and pore water pressure. Hydraulic fracturing can result in drilling fluid inadvertently returning to the ground surface or running horizontally away from the borehole. Allowable borehole pressure was evaluated using the Delft Geotechnics equation, as published in “Recommended Guidelines for Installation of Pipelines Beneath Levees Using Horizontal Directional Drilling, Appendix B, CPAR-GL-98-1,” published by the Pipeline Research Council International (PRCI) and the U.S. Army Corps of Engineers, dated April 1998. The estimated allowable borehole pressure was compared to predicted borehole pressure in our analyses.

Hydraulic fracturing analyses were performed along the proposed alignment from both an easterly and westerly direction, as shown on Figures 4a & 4b. A pilot-hole diameter of 5 inches, a drill rod diameter of 3½ inches, and a mud pump output of up to 55 gallons per minute was used for analysis. Target up-hole fluid velocities in the analyses average at about 105 feet per minute in our analysis. The drilling fluid density was estimated to be about 10 to 11 pounds per gallon. Changes in the drilling fluid properties and drilling equipment affect the analysis results. Once layout of the alignment is complete and the contractor’s equipment has been selected, finalized inadvertent returns and pipe stress analyses to confirm the adequacy of the selected bore path should be performed.

Borehole instability issues and/or the contractor not maintaining a clean borehole can result in poor drilling returns and partial or complete plugging of the borehole. This will result in higher fluid pressures within the bore and can lead to hydraulic fracturing and inadvertent fluid returns to the ground surface.

The conceptual HDD profile design assembled by Kleinfelder, based on available topographic and bathymetric surveys and existing subsurface conditions, appears technically feasible based on our preliminary inadvertent returns analysis with a cover depth of 50 feet (Elevation -29 feet) under the Sacramento River. However, as mentioned previously, there is an elevated risk of fluid loss and poor circulation on the western side of the Sacramento River, below an Elevation of approximately -7 feet above mean sea level, that should be considered. Depending on contractor means and methods, if maintaining circulation at deeper depths does not appear feasible, an alternative bore alignment should be considered.

Hydraulic fracturing has the potential to occur near the bore entry point, should the drilling commence from the east side of the river. This is due to the likelihood of encountering soft clay/silt soils. Furthermore, hydrofracture is expected to occur approximately 200 feet from the bore exit point, regardless of alignment orientation. This is a common risk of HDD and countermeasures should be in place to mitigate these conditions, such as surface casings on the entry side and reducing pressure near the exit or using an exit pit to provide a path of least resistance.

Proper drilling fluid pressure should be maintained throughout the entire length of the bore and should be reduced as much as practical near entry and exit points where elevated hydrofracture risk has been noted. A pressure sensing sub several feet behind the drill bit can also be used to monitor drilling fluid pressures in the bore hole and compare them to the maximum predicted allowable pressures. This can be used to help avoid inadvertent fluid releases in critical applications. The pressure sub provides real-time monitoring of fluid pressures within the borehole and is useful in detecting a spike in drilling pressure that may result from a borehole that is not well cleaned and/or becomes blocked with the drilling solids. Furthermore, the pressure data allows the driller to understand when modifications to the drilling method may be needed to avoid a fluid release. We recommend that Kleinfelder be retained to monitor HDD operations and provide consultation based on the conditions encountered during drilling.

5.4 DRILLING FLUID PROGRAM

5.4.1 General

The drilling contractor should develop a Drilling Fluid Program (DFP) as part of the HDD Bore Plan. A properly designed drilling fluid program can substantially reduce losses due to frac-out, stuck product pipe, or loss of tooling. The drilling fluid program should take into account anticipated soil conditions, fluid selection, drill bit and reamer selection, and volume calculations.

5.4.2 Borehole Slurry Density

The density of the slurry in the borehole directly affects the buoyancy force and therefore the normal force between the pipe and the wall of the borehole. The density of drilling returns is a function of ground conditions, penetration rate, mud flow rate, drilling fluid composition, and efficiency of the mud cleaning system. In general, drilling return density varies between 9 and 11 pounds per gallon. In coarse gravel and cobbles, drilling fluid densities may approach 13 pounds per gallon.

For this project we anticipate drilling fluid return density will be on the order of 10 to 11 pounds per gallon where good returns are achieved and drilling is performed in accordance with the HDD Good Practices Guidelines (2017).

5.4.3 Soil Conditions for Drilling Fluid Design

For the purpose of drilling fluid design, earth materials are divided into two categories: Inert, including sand and gravel; and reactive, including clay. Information regarding subsurface conditions likely to be encountered at the site is provided in the Subsurface Conditions section of this report as well as in the boring logs for explorations performed for this study in Appendix A, laboratory testing contained in Appendix B, and logs of borings from previous explorations provided in Appendix C.

5.4.4 Drilling Fluid Selection

Drilling fluid program base fluid should be designed for site-specific soil conditions. The base fluid may consist of either a bentonite or polymer and water, with additives to achieve specific fluid properties.

The drilling contractor should submit a base fluid design with a list of additives, loss of circulation materials, and grouting materials that may be used on the project and SDS sheets for approval at least two weeks prior to mobilization. Assistance with drilling fluid selection can be obtained from reputable drilling fluid suppliers.

5.4.5 Drill Bit and Reamer Selection

Drill bits and reamers should be selected based on anticipated subsurface conditions and past experience. The drilling contractor should be prepared with a variety of bits and reamers that have worked well in similar soil conditions.

5.4.6 Soil and Fluid Volume

The volume of soil to be removed can be estimated as follows:

$$\frac{(\text{Hole Diameter in Inches})^2}{25} = \text{Volume in Gallons per Foot}$$

Sufficient fluid should be pumped during drilling and reaming operations to maintain flow. Drilling rates and drilling fluid flow rates may be adjusted in the field to match varying site conditions. However, an estimate of drilling fluid demand is useful when sizing drilling equipment, mud pumps, and solids removal systems, and can be particularly helpful in determining realistic drilling rates. Drilling fluid demand can be estimated based on the bore hole volume and the following ratios:

Fluid Volume: Soil Volume	Ratio
Sand, Gravel, Cobble, Rock	1:1
Above, mixed with Clay	2:1
Clay or reactive Shale	3-5:1

Drilling rates can be estimated based on the drilling fluid demand and the pump output at the design base fluid viscosity.

5.5 SOLIDS SEPARATION PLANT

Fine-grained silts and clays are generally the most difficult to remove from drilling fluids. Silts and clays are present on this site and use of desilters/centrifuges may be needed to remove the fine soils from the drilling fluids.

5.6 FLUIDIC DRAG COEFFICIENT

A fluidic drag coefficient of 0.050 psi (345 Pa) was recommended in the original Pipeline Research Council International (PRCI) design guidelines and is still routinely used by pipeline designers. Recently it has been suggested the coefficient could be decreased to 0.025 psi (172 Pa) for a stable borehole with good solids removal (Puckett, 2003). The higher value (0.050 psi) is recommended for routine calculations. The lower value (0.025 psi) may be appropriate for long bores in stable formations where significant cost saving could be realized by using a lower grade of steel or thinner pipe wall.

5.7 BOREHOLE FRICTION FACTOR AND ABRASION

A large portion of the pullback load is generated from friction between the pipe and the wall of the borehole. The pipe rubs against the borehole as it goes around sharp curves and is pushed against the top of the borehole by buoyancy and capstan forces. The friction factor is an expression of the ratio of the normal force between the pipe and the borehole wall and the axial force needed to drag the pipe along the wall. The PRCI Guidelines recommend friction factors of 0.2 to 0.3 for steel pipe. ASTM Standard F1962-99 recommends a friction factor of 0.3. An abrasion resistant coating is recommended for steel natural gas pipelines. Recommended friction factors for abrasion resistant polymer concrete coating were not found in the above literature. However, the coating material is similar in texture to smooth, formed concrete. NAVFAC DM 7.02, Chapter 3, Table 1 reports friction factors for formed concrete against various soil types, as presented in Table 5.1 below. The friction factors reported below do not account for the presence of a drilling fluid filter cake.

TABLE 5.1
ULTIMATE FRICTION FACTORS

Interface Material	Friction Factor (tanδ)	Friction angle δ (deg.)
Clean gravel, sandy gravel, coarse sand	0.55 to 0.60	29 to 31
Clean fine to medium sand, silty medium to coarse sand, silty or clayey gravel	0.45 to 0.55	24 to 29
Clean fine sand, silty or clayey fine to medium sand	0.35 to 0.45	19 to 24
Fine sandy silt, non-plastic silt	0.30 to 0.35	17 to 19
Very stiff and hard residual or pre-consolidated clay	0.40 to 0.50	22 to 26
Medium stiff and stiff clay and silty clay	0.30 to 0.35	17 to 19

5.8 DRILL PAD SUPPORT

Surface conditions in the vicinity of the western exploration (MW-1) area consists of unoccupied land with clayey surficial soils. If it is determined that the bore entry will be placed west of the Sacramento River, the contractor should conduct a pre-bid site visit to determine the suitability of site conditions for their equipment. It is common in this area for surficial clays to become soft when wet. A gravel course may be needed in areas containing fine-grained surficial soils, especially during wet weather and near the mud pit.

If the bore entry will be placed east of the Sacramento River, soil stabilization isn't likely to be required to provide a stable platform for the HDD drill rig and surrounding area, since it appears the rig will be setup on a paved surface. A gravel course may be required as a storm water pollution prevention measure to reduce track-out on adjacent roadways by construction equipment.

5.9 UTILITIES AND WELL CLEARANCE

The location of existing utilities and water wells were beyond the scope of this report. There should be an attempt to locate any underground utilities and/or wells near the alignment prior to construction and these utilities and/or wells should be protected by the Contractor so as not to be impacted by the trenchless crossings. The bore profiles should be designed to allow sufficient clearance from all underground utilities and/or wells to avoid entering into the well casing, utility trench or pipe zone materials or causing excessive settlement of the utilities above the bore. If existing utilities are within about 25 feet of the bore entry and exit pits, conductor casings should be used to help contain HDD drilling fluids and keep them out of adjacent utility areas. Further, in general, we recommend wells be located at least 100 feet from the HDD bore path for this type of installation.

5.10 CONTRACTOR SELECTION

The success of the project will be substantially dependent on the experience and performance of the specialty contractor retained to perform the work. We recommend the use of a specialty contractor with a minimum of 3 years construction experience in the field of horizontal directional drilling in similar drilling conditions on projects of similar scope (i.e. diameter, length, and depth). The HDD contractor should be familiar with the use of drilling mud and additives, washover and conductor casings and should provide examples of projects they have successfully completed installing similar utilities in similar conditions.

6 ADDITIONAL SERVICES

6.1 PLANS AND SPECIFICATIONS

It is recommended that Kleinfelder conduct a general review of final plans and specifications to evaluate that our recommendations have been properly interpreted and implemented during design. In the event Kleinfelder is not retained to perform this recommended review, no responsibility will be assumed for misinterpretation of the given recommendations.

6.2 PROJECT BID DOCUMENTS

It has been Kleinfelder's experience that contractors bidding on the project often make contact with us to discuss the geotechnical aspects of the project. Informal contacts between Kleinfelder and an individual contractor could result in misleading or incomplete information being provided to the contractor. Therefore, it is recommended that a pre-bid meeting be held to answer any questions about the report prior to submittal of bids. If this is not possible, questions or clarifications regarding this report should be directed to the project owner or his/her designated representative. After consultation with Kleinfelder, the project owner (or his/her representative) should provide clarifications or additional information to all contractors bidding the job.

6.3 EXCECUTION PLAN AND PERMIT ASSISTANCE

In order to facilitate best management practices and obtaining the required permits for the trenchless crossings, a project execution plan should be developed prior to construction. The plan should include layout of equipment, MSDS sheets for all proposed drilling fluids and additives, development of a drilling fluid containment and contingency plan in case of inadvertent fluid returns, and discussion of any other site-specific constraints relative to the project.

6.4 CONSTRUCTION OBSERVATION AND TESTING

It is recommended that all trenchless construction be monitored by a representative from Kleinfelder. The purpose of these services is to observe the soil and drill mud conditions encountered during construction, evaluate the applicability of the recommendations presented in this report to the soil conditions encountered, and recommend appropriate changes to the owner in design or construction procedures if conditions differ from those described herein.

7 LIMITATIONS

This work was performed in a manner consistent with that level of care and skill ordinarily exercised by other members of Kleinfelder's profession practicing in the same locality, under similar conditions and at the date the services are provided. Our conclusions, opinions, and recommendations are based on a limited number of observations and data. It is possible that conditions could vary between or beyond the data evaluated. Kleinfelder makes no other representation, guarantee, or warranty, express or implied, regarding the services, communication (oral or written), report, opinion, or instrument of service provided.

This report may be used only by the Client and the registered design professional in responsible charge and only for the purposes stated for this specific engagement within a reasonable time from its issuance, but in no event later than two (2) years from the date of the report. The work performed was based on project information provided by the Client. If the Client does not retain Kleinfelder to review any plans and specifications, including any revisions or modifications to the plans and specifications, Kleinfelder assumes no responsibility for the suitability of our recommendations. In addition, if there are any changes in the field to the plans and specifications, the Client must obtain written approval from Kleinfelder's engineer that such changes do not affect our recommendations. Failure to do so will vitiate Kleinfelder's recommendations.

Kleinfelder offers various levels of investigative and engineering services to suit the varying needs of different clients. Although risk can never be eliminated, more detailed and extensive studies yield more information, which may help understand and manage the level of risk. Since detailed study and analysis involves greater expense, our clients participate in determining levels of service, which provide information for their purposes at acceptable levels of risk. The client and key members of the design team should discuss the issues covered in this report with Kleinfelder, so that the issues are understood and applied in a manner consistent with the owner's budget, tolerance of risk and expectations for future performance and maintenance.

Recommendations contained in this report are based on our field observations and subsurface explorations, limited laboratory tests, and our present knowledge of the proposed construction. It is possible that soil and/or groundwater conditions could vary between or beyond the points explored. If soil or groundwater conditions are encountered during construction that differ from those described herein, Kleinfelder should be notified immediately so that we may re-evaluate the recommendations of this report as appropriate. If the scope of the proposed construction changes from that described in this report, the conclusions and recommendations contained in this report are not considered valid unless the changes are reviewed, and the conclusions of this report are modified or approved in writing, by Kleinfelder.

As the geotechnical engineering firm that performed the geotechnical evaluation for this project, Kleinfelder should be retained to confirm that the recommendations of this report are properly incorporated in the design of this project, and properly implemented during construction. This may avoid misinterpretation of the information by other parties and will allow us to review and modify our recommendations if variations in the soil conditions are encountered.

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FIGURES

LIST OF ATTACHMENTS

The following figures are attached and complete this appendix.

N

0 2000 4000

SCALE: 1" = 2000' SCALE IN FEET

REFERENCE:
Meridian Quadrangle California 7.5-Minute Series

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PROJECT NO. 20201644	SITE VICINITY MAP	FIGURE
DRAWN: 11/16/2020		
DRAWN BY: GG	PACIFIC GAS AND ELECTRIC COMPANY DFM 0630-01 (R-1385) HDD CROSSING AT THE SACRAMENTO RIVER MERIDIAN, CALIFORNIA	1
CHECKED BY: VT		
FILE NAME: STO20D055.CAD		

PLOTTED: 16 Nov 2020, 2:01pm, GGomez

CAD FILE: W:\2020\20201644.013A\PLANS\ LAYOUT: COLUSA Jct #1 FIGURE 1

ATTACHED IMAGES:
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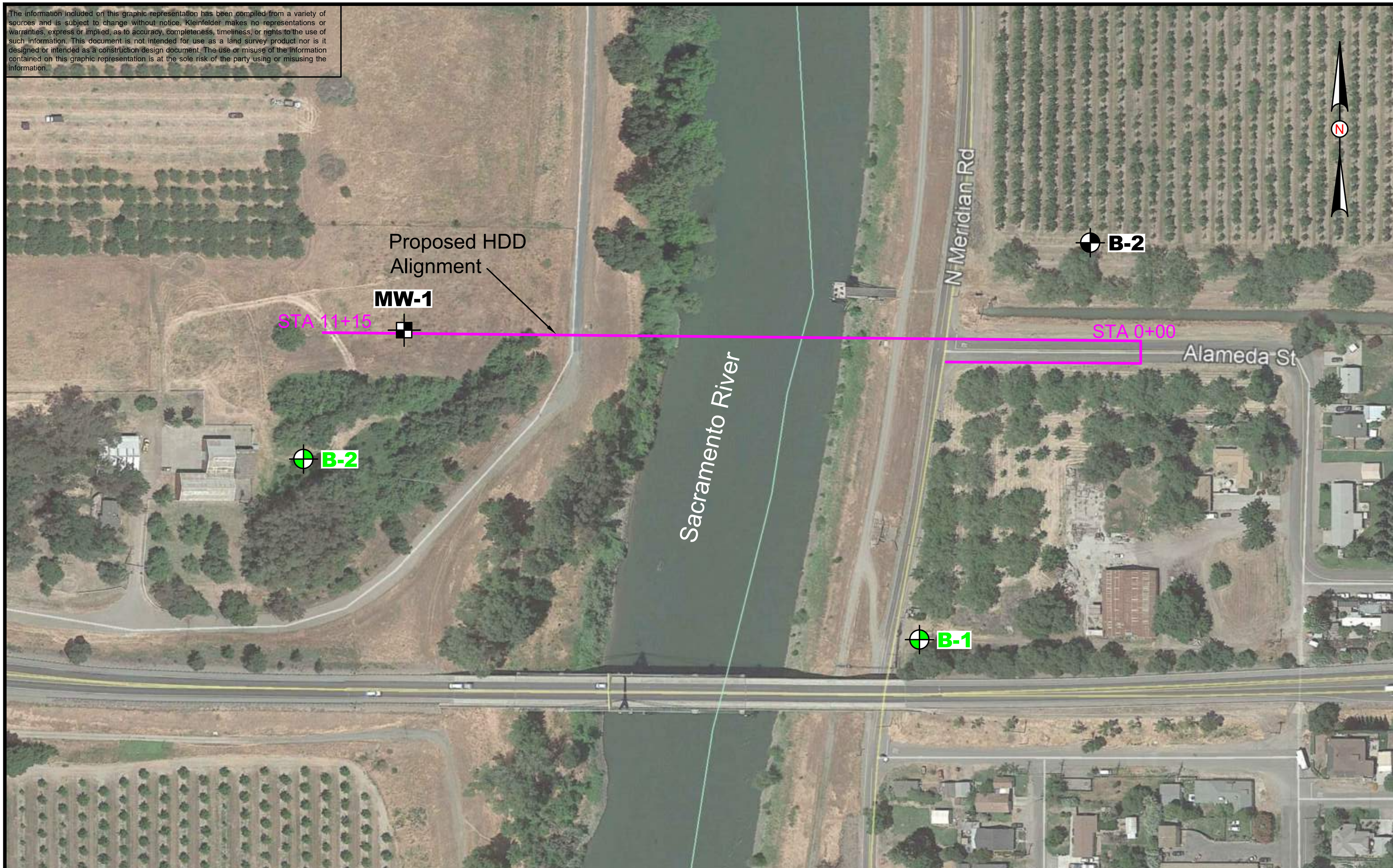
OFFICE_NAME



Denotes Number & Approximate Location of Boring Drilled For This Investigation

Denotes Number & Approximate Location of Monitoring Well For This Investigation

Denotes Numbers & Approximate Locations of 2019 Borings Drilled by Kleinfelder

0 200 400

SCALE: 1" = 200' SCALE IN FEET

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PROJECT NO. 20201644	**EXPLORATION LOCATION MAP**
DRAWN: 11/16/2020	PACIFIC GAS AND ELECTRIC COMPANY DFM 0630-01 (R-1385) HDD CROSSING AT THE SACRAMENTO RIVER MERIDIAN, CALIFORNIA
DRAWN BY: GG	
CHECKED BY: VT	
FILE NAME: STO20D055.CAD	

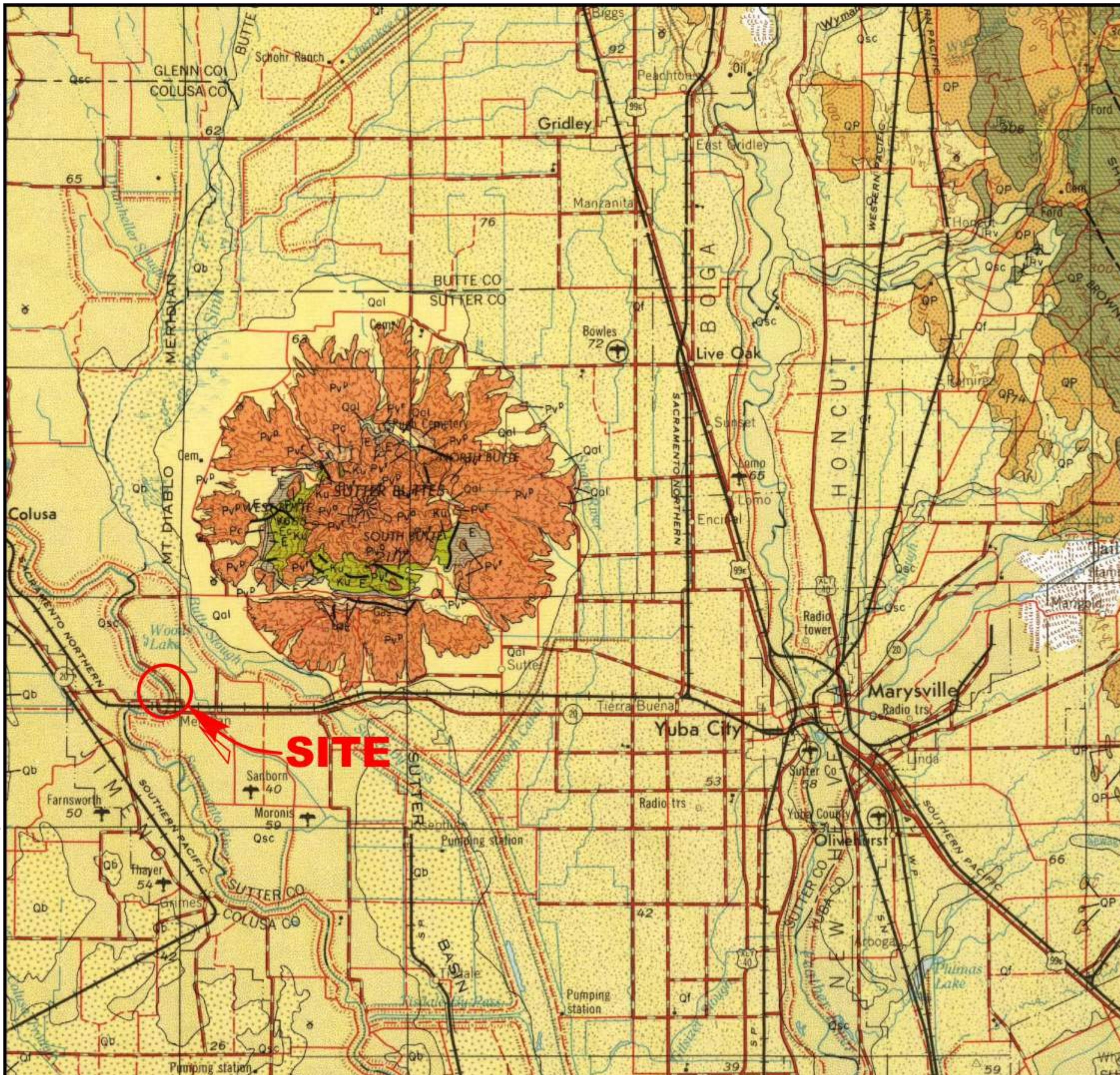
FIGURE

2

PLOTTED: 16 Nov 2020, 2:00pm, GGomez

LAYOUT: COLUSA jct #1 FIGURE 3

CAD FILE: W:\2020\20201644.013A\PLANS\



Qs	Dune Sand
Qal	Alluvium
Qsc	Stream channel deposits
Qf	Fan deposits
Qb	Basin deposits
Qst	Salt deposits
Ql	Quaternary lake deposits
Qg	Glacial deposits
Qt	Quaternary nonmarine terrace deposits
Qm	Pleistocene marine and marine terrace deposits
Qc	Pleistocene nonmarine
Pv	Pliocene volcanic: Pv^{r} - rhyolite; Pv^{a} - andesite; Pv^{b} - basalt; Pv^{p} - pyroclastic rocks
Ku	Upper Cretaceous marine

N

Scale: 1:250,000

REFERENCE: Burnett, J.L., and Jennings, C.W., 1962, Geologic Map of California, Chico sheet: California Division of Mines and Geology, scale 1:250,000

ATTACHED IMAGES:
ATTACHED XREFS:
OFFICE_NAME

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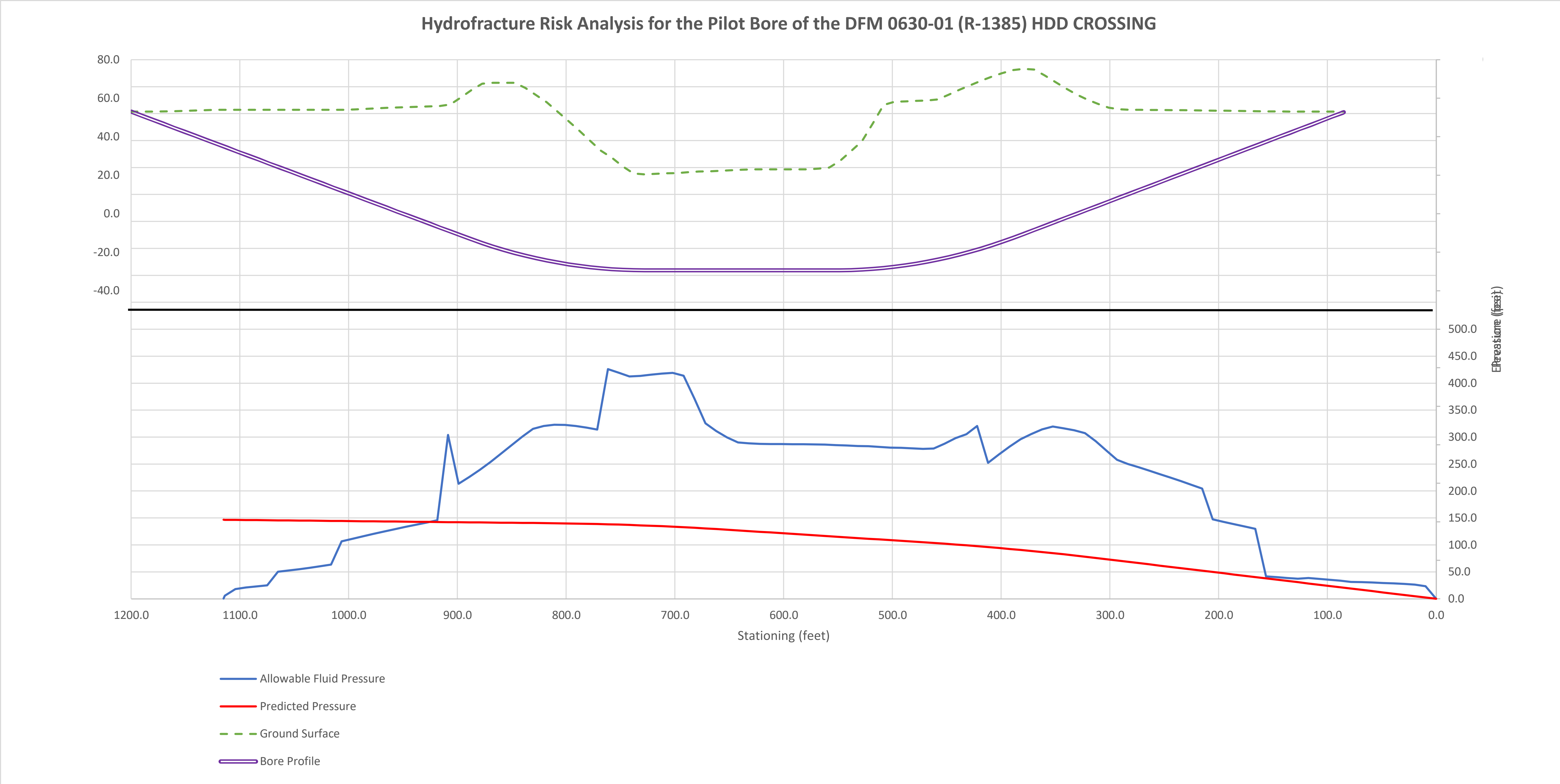
PROJECT NO. 20201644
DRAWN: 11/16/2020
DRAWN BY: GG
CHECKED BY: VT
FILE NAME:
STO20D055.CAD

GEOLOGIC MAP

PACIFIC GAS AND ELECTRIC COMPANY
DFM 0630-01 (R-1385) HDD CROSSING
AT THE SACRAMENTO RIVER
MERIDIAN, CALIFORNIA

FIGURE
3



ASSUMPTIONS

ANALYSIS WAS BASED ON:

A. ENTRY ANGLE OF 12 DEGREES.
B. EXIT ANGLE OF 12 DEGREES.
C. A PILOT HOLE DIAMETER OF 5 INCHES.
D. A DRILL ROD DIAMETER OF 3.5 INCHES.
E. A MUD PUP OUTPUT OF UP TO 55 GALLONS PER MINUTE.
F. A MUD UNIT WEIGHT OF 10 POUNDS PER GALLON.
G. TARGET UP-HOLE FLUID VELOCITIES IN THIS ANALYSIS ARE APPROXIMATELY 106 FEET PER MINUTE.
H. CHANGES IN THE DRILLING FLUID PROPERTIES AND DRILLING EQUIPMENT WILL AFFECT THE ANALYSIS RESULTS.
I. A FACTOR OF 2 WAS APPLIED TO CALCULATE THE RADIUS OF THE PLASTIC ZONE USING THE DELFT EQUATION.

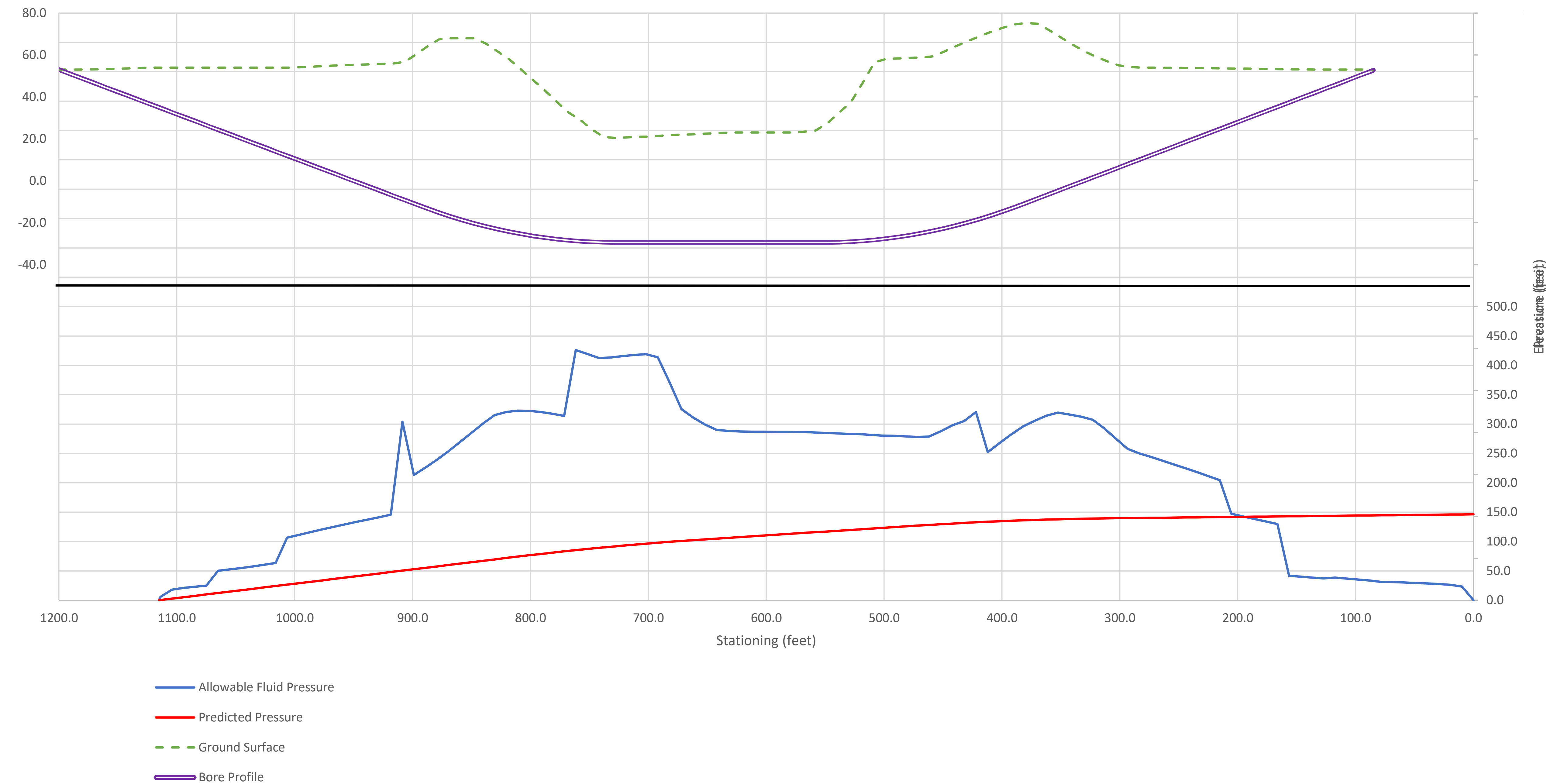
Calculation performed with HDD FRAC Version Beta 2.0.

NOTES:

Entry is located east of the Sacramento River at Station 0+00.
Bore runs in a westerly direction and exits at Station 11+15, west of the Sacramento River.

KLEINFELDER Bright People. Right Solutions.	Proj. No. 20201644.013A Drawn By VT Check By TD Date 11/13/2020	**HYDROFRACTURE RISK ANALYSIS OF THE PILOT BORE** PACIFIC GAS AND ELECTRIC COMPANY DFM 0630-01 (R-1385) HDD CROSSING AT THE SACREMENTO RIVER MERIDIAN, CALIFORNIA	FIGURE **4a**

Hydrofracture Risk Analysis for the Pilot Bore of the DFM 0630-01 (R-1385) HDD CROSSING



ASSUMPTIONS

ANALYSIS WAS BASED ON:

A. ENTRY ANGLE OF 12 DEGREES.

B. EXIT ANGLE OF 12 DEGREES.

C. A PILOT HOLE DIAMETER OF 5 INCHES.

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I. A FACTOR OF 2 WAS APPLIED TO CALCULATE THE RADIUS OF THE PLASTIC ZONE USING THE DELFT EQUATION.

Calculation performed with HDD FRAC Version Beta 2.0.

NOTES:

Entry is located west of the Sacramento River at Station 11+15.
Bore runs in a easterly direction and exits at Station 0+00, east of the Sacramento River.

KLEINFELDER Bright People. Right Solutions.	Proj. No. 20201644.013A	HYDROFRACTURE RISK ANALYSIS OF THE PILOT BORE	FIGURE
	Drawn By VT		
	Check By TD	PACIFIC GAS AND ELECTRIC COMPANY DFM 0630-01 (R-1385) HDD CROSSING AT THE SACRAMENTO RIVER MERIDIAN, CALIFORNIA	4b
	Date 11/13/2020		

APPENDIX A

LOGS OF BORINGS

LIST OF ATTACHMENTS

The following figures are attached and complete this appendix.

SAMPLE/SAMPLER TYPE GRAPHICS

BULK SAMPLE

CALIFORNIA SAMPLER
(3 in. (76.2 mm.) outer diameter)

STANDARD PENETRATION SPLIT SPOON SAMPLER
(2 in. (50.8 mm.) outer diameter and 1-3/8 in. (34.9 mm.) inner diameter)

GROUND WATER GRAPHICS

WATER LEVEL (level where first observed)

WATER LEVEL (level after exploration completion)

WATER LEVEL (additional levels after exploration)

OBSERVED SEEPAGE

NOTES

- The report and graphics key are an integral part of these logs. All data and interpretations in this log are subject to the explanations and limitations stated in the report.
- Lines separating strata on the logs represent approximate boundaries only. Actual transitions may be gradual or differ from those shown.
- No warranty is provided as to the continuity of soil or rock conditions between individual sample locations.
- Logs represent general soil or rock conditions observed at the point of exploration on the date indicated.
- In general, Unified Soil Classification System designations presented on the logs were based on visual classification in the field and were modified where appropriate based on gradation and index property testing.
- Fine grained soils that plot within the hatched area on the Plasticity Chart, and coarse grained soils with between 5% and 12% passing the No. 200 sieve require dual USCS symbols, ie., GW-GM, GP-GM, GW-GC, GP-GC, GC-GM, SW-SM, SP-SM, SW-SC, SP-SC, SC-SM.
- If sampler is not able to be driven at least 6 inches then 50/X indicates number of blows required to drive the identified sampler X inches with a 140 pound hammer falling 30 inches.

ABBREVIATIONS
WOH - Weight of Hammer
WOR - Weight of Rod

UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D 2487)

Major Division	Subdivision	Fines	Gradation	Symbol	Description
COARSE GRAINED SOILS (More than half of material is larger than the #200 sieve)	GRAVELS (More than half of coarse fraction is larger than the #4 sieve)	CLEAN GRAVEL WITH <5% FINES	$Cu \geq 4$ and $1 \leq Cc \leq 3$	GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES
			$Cu < 4$ and/ or $1 > Cc > 3$	GP	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES
		GRAVELS WITH 5% TO 12% FINES	$Cu \geq 4$ and $1 \leq Cc \leq 3$	GW-GM	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE FINES
				GW-GC	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE CLAY FINES
			$Cu < 4$ and/ or $1 > Cc > 3$	GP-GM	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE FINES
				GP-GC	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE CLAY FINES
		GRAVELS WITH > 12% FINES		GM	SILTY GRAVELS, GRAVEL-SILT-SAND MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
				GC-GM	CLAYEY GRAVELS, GRAVEL-SAND-CLAY-SILT MIXTURES
	SANDS (Half or more of coarse fraction is smaller than the #4 sieve)	CLEAN SANDS WITH <5% FINES	$Cu \geq 6$ and $1 \leq Cc \leq 3$	SW	WELL-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE OR NO FINES
			$Cu < 6$ and/ or $1 > Cc > 3$	SP	POORLY GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE OR NO FINES
		SANDS WITH 5% TO 12% FINES	$Cu \geq 6$ and $1 \leq Cc \leq 3$	SW-SM	WELL-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE FINES
				SW-SC	WELL-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE CLAY FINES
			$Cu < 6$ and/ or $1 > Cc > 3$	SP-SM	POORLY GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE FINES
				SP-SC	POORLY GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE CLAY FINES
		SANDS WITH > 12% FINES		SM	SILTY SANDS, SAND-GRAVEL-SILT MIXTURES
				SC	CLAYEY SANDS, SAND-GRAVEL-CLAY MIXTURES
				SC-SM	CLAYEY SANDS, SAND-SILT-CLAY MIXTURES

Major Division	Subdivision	Symbol	Description
FINE GRAINED SOILS (Half or more of material is smaller than the #200 sieve)	SILTS AND CLAYS (Liquid Limit less than 50)	ML	INORGANIC SILTS AND VERY FINE SANDS, SILTY OR CLAYEY FINE SANDS, SILTS WITH SLIGHT PLASTICITY
		CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
		CL-ML	INORGANIC CLAYS-SILTS OF LOW PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
		OL	ORGANIC SILTS & ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS (Liquid Limit 50 or greater)	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILT
		CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
		OH	ORGANIC CLAYS & ORGANIC SILTS OF MEDIUM-TO-HIGH PLASTICITY

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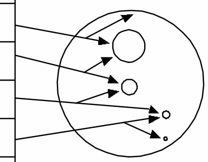
PROJECT NO.: 20201644.013A	GRAPHICS KEY	FIGURE
DRAWN BY:	PACIFIC GAS AND ELECTRIC COMPANY DFM 0630-01 (R-1385) HDD CROSSING AT THE SACRAMENTO RIVER MERIDIAN, CALIFORNIA	A-1
CHECKED BY:		
DATE:		

PLOTTED: 11/15/2020 01:30 PM BY: vtinoco
OFFICE FILTER: FRESNO
PROJECT NUMBER: 20201644.013A
gINT FILE: Klf_gint_master_2020
gINT TEMPLATE: E:KLF_STANDARD_GINT_LIBRARY_2020.GLB [_KLF_GEO-LEG1 (GRAPHICS KEY) WITH USCS]

GRAIN SIZE

DESCRIPTION		SIEVE SIZE	GRAIN SIZE	APPROXIMATE SIZE
Boulders		>12 in. (304.8 mm.)	>12 in. (304.8 mm.)	Larger than basketball-sized
Cobbles		3 - 12 in. (76.2 - 304.8 mm.)	3 - 12 in. (76.2 - 304.8 mm.)	Fist-sized to basketball-sized
Gravel	coarse	3/4 -3 in. (19 - 76.2 mm.)	3/4 -3 in. (19 - 76.2 mm.)	Thumb-sized to fist-sized
	fine	#4 - 3/4 in. (#4 - 19 mm.)	0.19 - 0.75 in. (4.8 - 19 mm.)	Pea-sized to thumb-sized
Sand	coarse	#10 - #4	0.079 - 0.19 in. (2 - 4.9 mm.)	Rock salt-sized to pea-sized
	medium	#40 - #10	0.017 - 0.079 in. (0.43 - 2 mm.)	Sugar-sized to rock salt-sized
	fine	#200 - #40	0.0029 - 0.017 in. (0.07 - 0.43 mm.)	Flour-sized to sugar-sized
Fines		Passing #200	<0.0029 in. (<0.07 mm.)	Flour-sized and smaller



SECONDARY CONSTITUENT

	AMOUNT	
Term of Use	Secondary Constituent is Fine Grained	Secondary Constituent is Coarse Grained
Trace	<5%	<15%
With	≥5 to <15%	≥15 to <30%
Modifier	≥15%	≥30%

MOISTURE CONTENT

DESCRIPTION	FIELD TEST
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

CEMENTATION

DESCRIPTION	FIELD TEST
Weakly	Crumbles or breaks with handling or slight finger pressure
Moderately	Crumbles or breaks with considerable finger pressure
Strongly	Will not crumble or break with finger pressure

CONSISTENCY - FINE-GRAINED SOIL

CONSISTENCY	SPT - N_{60} (# blows / ft)	Pocket Pen (tsf)	UNCONFINED COMPRESSIVE STRENGTH (Q_u)(psf)	VISUAL / MANUAL CRITERIA
Very Soft	<2	PP < 0.25	<500	Thumb will penetrate more than 1 inch (25 mm). Extrudes between fingers when squeezed.
Soft	2 - 4	0.25 ≤ PP <0.5	500 - 1000	Thumb will penetrate soil about 1 inch (25 mm). Remolded by light finger pressure.
Medium Stiff	4 - 8	0.5 ≤ PP <1	1000 - 2000	Thumb will penetrate soil about 1/4 inch (6 mm). Remolded by strong finger pressure.
Stiff	8 - 15	1 ≤ PP <2	2000 - 4000	Can be imprinted with considerable pressure from thumb.
Very Stiff	15 - 30	2 ≤ PP <4	4000 - 8000	Thumb will not indent soil but readily indented with thumbnail.
Hard	>30	4 ≤ PP	>8000	Thumbnail will not indent soil.

FROM TERZAGHI AND PECK, 1948; LAMBE AND WHITMAN, 1969; FHWA, 2002; AND ASTM D2488

REACTION WITH HYDROCHLORIC ACID

DESCRIPTION	FIELD TEST
None	No visible reaction
Weak	Some reaction, with bubbles forming slowly
Strong	Violent reaction, with bubbles forming immediately

APPARENT / RELATIVE DENSITY - COARSE-GRAINED SOIL

APPARENT DENSITY	SPT-N_{60} (# blows/ft)	MODIFIED CA SAMPLER (# blows/ft)	CALIFORNIA SAMPLER (# blows/ft)	RELATIVE DENSITY (%)
Very Loose	<4	<4	<5	0 - 15
Loose	4 - 10	5 - 12	5 - 15	15 - 35
Medium Dense	10 - 30	12 - 35	15 - 40	35 - 65
Dense	30 - 50	35 - 60	40 - 70	65 - 85
Very Dense	>50	>60	>70	85 - 100

FROM TERZAGHI AND PECK, 1948

PLASTICITY

DESCRIPTION	LL	FIELD TEST
Non-plastic	NP	A 1/8-in. (3 mm.) thread cannot be rolled at any water content.
Low (L)	< 30	The thread can barely be rolled and the lump or thread cannot be formed when drier than the plastic limit.
Medium (M)	30 - 50	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump or thread crumbles when drier than the plastic limit.
High (H)	> 50	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump or thread can be formed without crumbling when drier than the plastic limit.

STRUCTURE

DESCRIPTION	CRITERIA
Stratified	Alternating layers of varying material or color with layers at least 1/4-in. thick, note thickness.
Laminated	Alternating layers of varying material or color with the layer less than 1/4-in. thick, note thickness.
Fissured	Breaks along definite planes of fracture with little resistance to fracturing.
Slickensided	Fracture planes appear polished or glossy, sometimes striated.
Blocky	Cohesive soil that can be broken down into small angular lumps which resist further breakdown.
Lensed	Inclusion of small pockets of different soils, such as small lenses of sand scattered through a mass of clay; note thickness.

ANGULARITY

DESCRIPTION	CRITERIA
Angular	Particles have sharp edges and relatively plane sides with unpolished surfaces.
Subangular	Particles are similar to angular description but have rounded edges.
Subrounded	Particles have nearly plane sides but have well-rounded corners and edges.
Rounded	Particles have smoothly curved sides and no edges.

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PROJECT NO.: 20201644.013A DRAWN BY: CHECKED BY: DATE:	SOIL DESCRIPTION KEY PACIFIC GAS AND ELECTRIC COMPANY DFM 0630-01 (R-1385) HDD CROSSING AT THE SACRAMENTO RIVER MERIDIAN, CALIFORNIA	FIGURE A-2

MONITORING WELL LOG MW-1

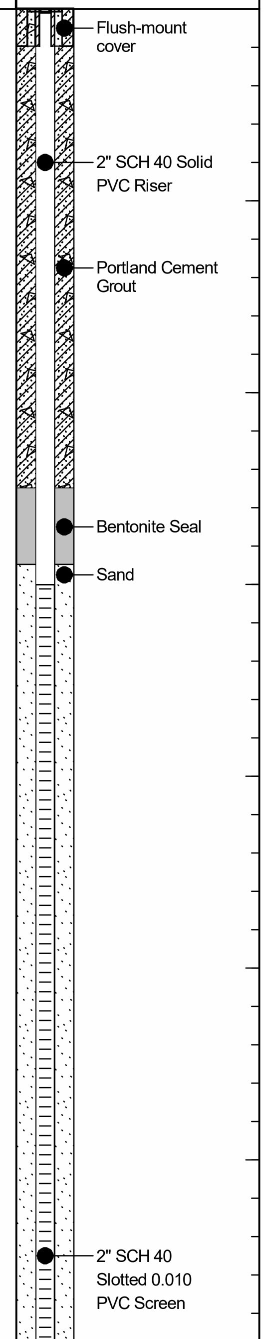
Date Begin - End:	10/07/2020 - 10/08/2020	**Drilling Company:**	Pitcher Drilling		
Logged By:	V. Tinoco	**Drill Crew:**	Oscar/Elvis/Vita		
Hor.-Vert. Datum:	WGS84	**Drilling Equipment:**	Failing 1500	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Hand Auger/SSA/Mud Rotary		
Weather:	Sunny/Warm	**Auger Diameter:**	6 in. O.D.		

Latitude: 39.14715°
Longitude: -121.91933°
Approximate Ground Surface Elevation (ft.): 53.00
Surface Condition: Grasses

Approximate Elevation (feet)	Depth (feet)	Lithologic Description (FIELD EXPLORATION)	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. Pocket Pen(PP)= tsf	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)
	0	**Lean CLAY (CL)**: low to medium plasticity, brown, moist, very stiff										
50												
	5	low plasticity, hard		BC=3 4 5 PP=4.0	18"		19.7	86.2				
45												
		Silty SAND (SM): fine to medium-grained, brown, moist, loose, some mica present										
	10			BC=3 3 3	18"							
40												
		increase in moisture										
	15	wet, very loose		BC=2 1 3	NR"							
35												
	20			BC=2 2 4	8"							
30		**Poorly Graded SAND with silt (SP-SM)**: fine to coarse-grained, bluish gray, wet, medium dense										
	25			BC=4 7 13	18"							
25		dense, trace fine subangular to subrounded gravel up to 0.5 in.										
	30			BC=10 19 19	7"					5.2		
		Poorly Graded SAND with Gravel (SP): fine to coarse-grained, muticolored, wet, dense, fine and coarse subangular to subrounded gravel up to 1 in. (creeping fluid loss beginning at 33 feet)										
20												

MONITORING WELL CONSTRUCTION*

Completion Method: Flush mount cap in concrete



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PROJECT NO.:	20201644.013A
DRAWN BY:	SD
CHECKED BY:	TD
DATE:	10/30/2020

MONITORING WELL LOG MW-1

PACIFIC GAS AND ELECTRIC COMPANY
DFM 0630-01 (R-1385) HDD CROSSING
AT THE SACRAMENTO RIVER
MERIDIAN, CALIFORNIA

FIGURE

A-3

Date Begin - End:	10/07/2020 - 10/08/2020	**Drilling Company:**	Pitcher Drilling
Logged By:	V. Tinoco	**Drill Crew:**	Oscar/Elvis/Vita
Hor.-Vert. Datum:	WGS84	**Drilling Equipment:**	Failing 1500
Plunge:	-90 degrees	**Drilling Method:**	Hand Auger/SSA/Mud Rotary
Weather:	Sunny/Warm	**Auger Diameter:**	6 in. O.D.

MONITORING WELL LOG MW-1

Hammer Type - Drop: 140 lb. Auto - 30 in.

FIELD EXPLORATION

Latitude: 39.14715°
Longitude: -121.91933°
Approximate Ground Surface Elevation (ft.): 53.00
Surface Condition: Grasses

LABORATORY RESULTS

MONITORING WELL CONSTRUCTION*

Completion Method: Flush mount cap in concrete

Approximate Elevation (feet)	Depth (feet)	Lithologic Description	Blow Counts(BC)= Uncorr. Blows/6 in. Pocket Pen(PP)= tsf	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)
			BC=17 11 11	12"	SP			58	3.0		
15		**Poorly Graded SAND (SP)**: fine to coarse-grained, bluish gray, wet, dense, trace fine subangular to subrounded gravel up to 0.75 in.									
	40		BC=15 9 9	8"							
10		**Well-Graded GRAVEL with Sand (GW)**: muticolored, wet, very dense, fine and coarse subangular to subrounded gravel up to 1.5 in.									
	45		BC=16 50/6"	18"	GW			24	2.0		
5		**Poorly Graded SAND (SP)**: medium to coarse-grained, bluish gray, wet, very dense, with fine subangular to subrounded gravel up to 0.25 in.									
	50		BC=21 37 33	8"					4.0		
0											
	55		BC=19 30 22	6"							
-5											
	60	(significant fluid loss beginning at 60 feet)	BC=28 34 20	6"							
-10											
	65	fine to coarse-grained, dense	BC=28 24 18	6"					5.7		
-15											

Portland Cement Grout

Date Begin - End:	10/07/2020 - 10/08/2020	**Drilling Company:**	Pitcher Drilling
Logged By:	V. Tinoco	**Drill Crew:**	Oscar/Elvis/Vita
Hor.-Vert. Datum:	WGS84	**Drilling Equipment:**	Failing 1500
Plunge:	-90 degrees	**Drilling Method:**	Hand Auger/SSA/Mud Rotary
Weather:	Sunny/Warm	**Auger Diameter:**	6 in. O.D.

MONITORING WELL LOG MW-1

Hammer Type - Drop: 140 lb. Auto - 30 in.

FIELD EXPLORATION — Latitude: 39.14715° Longitude: -121.91933° Approximate Ground Surface Elevation (ft.): 53.00 Surface Condition: Grasses

MONITORING WELL CONSTRUCTION* — Completion Method: Flush mount cap in concrete

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. Pocket Pen(PP)= tsf	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)
			Well-Graded GRAVEL with Sand (GW): muticolored, wet, dense, fine subangular to subrounded gravel up to 0.75 in., medium-grained sand		BC=18 20 21	6"	GW			49	4.0		
-20													
	75				BC=16 17 20	8"							
			fine subangular to subrounded gravel up to 0.25 in.										
-25													
	80												
-30													
	85												
-35													
	90												
-40													
	95												
-45													
	100												
-50													

The monitoring well was terminated at approximately 80 ft. below ground surface. Monitoring Well installed to a depth of 50 feet.

GROUNDWATER LEVEL INFORMATION:
▽ Groundwater was observed at approximately 16 ft. below ground surface during drilling.

GENERAL NOTES:
The exploration location and elevation are approximate and were estimated by Kleinfelder.

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PROJECT NO.: 20201644.013A	MONITORING WELL LOG MW-1	FIGURE
DRAWN BY: SD	PACIFIC GAS AND ELECTRIC COMPANY DFM 0630-01 (R-1385) HDD CROSSING AT THE SACRAMENTO RIVER MERIDIAN, CALIFORNIA	A-3
CHECKED BY: TD		
DATE: 10/30/2020		

Date Begin - End:	10/08/2020 - 10/09/2020	**Drilling Company:**	Pitcher Drilling	**BORING LOG B-2**
Logged By:	V. Tinoco	**Drill Crew:**	Oscar/Elvis/Vita	
Hor.-Vert. Datum:	WGS84	**Drilling Equipment:**	Failing 1500	**Hammer Type - Drop:** 140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Hand Auger/SSA/Mud Rotary	
Weather:	Sunny/Cool	**Auger Diameter:**	4 in. O.D.	

FIELD EXPLORATION / LABORATORY RESULTS

Latitude: 39.14750°
Longitude: -121.91586°
Approximate Ground Surface Elevation (ft.): 52.00
Surface Condition: Bare Earth

Approximate Elevation (feet)	Depth (feet)	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. Pocket Pen(PP)= tsf	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
	0	**Lean CLAY (CL)**: medium plasticity, dark brown, moist, hard											Hand auger upper 5 ft
50													
	5	low to medium plasticity		BC=6 7 13 PP=4.5	18"		10.3	93.4					Switch to SSA
		Sandy SILT (ML): fine-grained, non-plastic to low plasticity, light brown, moist, hard, iron oxide staining											
45													
	10	**Lean CLAY (CL)**: medium plasticity, dark brown, moist, hard, trace fine-grained sand		BC=8 16 21 PP=4.5+	18"		21.7	102.4					
40		increase in moisture											
		increase in sand content											
	15	**Lean CLAY with sand (CL)**: fine-grained, low to medium plasticity, brown, moist, very soft to soft wet		BC=P P P PP=0.5	18"		39.4	83.3					
▽ 35													Switch to mud rotary
		Clayey SILT (ML): medium plasticity, brown, wet, very soft to soft											
	20			BC=P P P PP=0.5	18"	ML				100	40	10	
30													
	25			BC=P 1 4 PP=0.5	12"								**Unconsolidated-Undrained (1-Point) Triaxial Comp.=** Total C: 890 psf
25													
	30	bluish gray, soft to stiff		BC=P P P PP=1.0	18"	ML				100	46	17	
20													

Date Begin - End:	10/08/2020 - 10/09/2020	**Drilling Company:**	Pitcher Drilling		
Logged By:	V. Tinoco	**Drill Crew:**	Oscar/Elvis/Vita		
Hor.-Vert. Datum:	WGS84	**Drilling Equipment:**	Failing 1500	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Hand Auger/SSA/Mud Rotary		
Weather:	Sunny/Cool	**Auger Diameter:**	4 in. O.D.		

FIELD EXPLORATION — Latitude: 39.14750° Longitude: -121.91586° Approximate Ground Surface Elevation (ft.): 52.00 Surface Condition: Bare Earth

Approximate Elevation (feet)	Depth (feet)	Lithologic Description	Blow Counts(BC)= Uncorr. Blows/6 in. Pocket Pen(PP)= tsf	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
		Lean CLAY (CL): medium plasticity, brown, wet, stiff	BC=2 4 8 PP=2.0	12"								
15												
		Elastic SILT with Sand (MH): high plasticity, brown, wet, very soft to soft, fine-grained sand										
	40		BC=P P P PP=0.5	15"	MH				78	70	36	
10												
	45		BC=P P P PP=0.5									**Unconsolidated-Undrained (1-Point) Triaxial Comp.=** Total C: 780 psf
5												
	50		BC=P P P PP=0.5									
0												
	55		BC=2 13 14									
		Poorly Graded SAND with Silt (SP-SM): medium to coarse-grained, bluish gray, wet, medium dense										
-5												
	60		BC=5 9 11	8"					5.0			
-10												
		Clayey SAND (SC): fine-grained, low plasticity, dark bluish gray, wet, very dense, fine subangular gravel up to 0.5 in. in soil cuttings										
	65		BC=8 25 34	18"								**Direct Shear=** Peak Cohesion: 850 psf Peak Friction Angle: 30.0°
-15												
		Lean CLAY (CL): medium plasticity, dark bluish gray, moist, hard, trace fine-grained sand										

Date Begin - End:	10/08/2020 - 10/09/2020	Drilling Company:	Pitcher Drilling	BORING LOG B-2
Logged By:	V. Tinoco	Drill Crew:	Oscar/Elvis/Vita	
Hor.-Vert. Datum:	WGS84	Drilling Equipment:	Failing 1500	Hammer Type - Drop: 140 lb. Auto - 30 in.
Plunge:	-90 degrees	Drilling Method:	Hand Auger/SSA/Mud Rotary	
Weather:	Sunny/Cool	Auger Diameter:	4 in. O.D.	

FIELD EXPLORATION — Latitude: 39.14750° Longitude: -121.91586° Approximate Ground Surface Elevation (ft.): 52.00 Surface Condition: Bare Earth

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. Pocket Pen(PP)= tsf	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
-20			**Lean CLAY (CL)**: medium plasticity, dark bluish gray, moist, hard, trace fine-grained sand		BC=15 25 33 PP=4.5+	18"						46	21	
	75		**Lean CLAY with sand (CL)**: dark bluish gray, moist, hard, fine-grained sand		BC=27 50/6" PP=4.5+	9"								
-25	80		**Silty SAND (SM)**: fine-grained, dark bluish gray, moist to wet, medium dense		BC=7 12 16	18"								
-30	85													
-35	90													
-40	95													
-45	100													
-50														

The boring was terminated at approximately 81.5 ft. below ground surface. The boring was backfilled with grout on October 08, 2020.

GROUNDWATER LEVEL INFORMATION:
Groundwater was observed at approximately 16.5 ft. below ground surface during drilling.

GENERAL NOTES:
The exploration location and elevation are approximate and were estimated by Kleinfelder.

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PROJECT NO.: 20201644.013A	BORING LOG B-2	FIGURE
DRAWN BY: SD	PACIFIC GAS AND ELECTRIC COMPANY DFM 0630-01 (R-1385) HDD CROSSING AT THE SACRAMENTO RIVER MERIDIAN, CALIFORNIA	A-4
CHECKED BY: TD		
DATE: 10/30/2020		PAGE: 3 of 3

APPENDIX B

LABORATORY TEST RESULTS

LIST OF ATTACHMENTS

The following figures are attached and complete this appendix.

Exploration ID	Depth (ft.)	Sample Description	Water Content (%)	Dry Unit Wt. (pcf)	Sieve Analysis (%)			Atterberg Limits			Additional Tests
					Passing 3/4"	Passing #4	Passing #200	Liquid Limit	Plastic Limit	Plasticity Index	
B-2	5.5	LEAN CLAY (CL)	10.3	93.4							
B-2	11.0	LEAN CLAY (CL)	21.7	102.4							
B-2	16.0	LEAN CLAY WITH SAND (CL)	39.4	83.3							
B-2	20.0	CLAYEY SILT (ML)					100	40	30	10	
B-2	26.0	CLAYEY SILT (ML)									**Unconsolidated-Undrained (1-Point) Triaxial**
											Comp.=
											Total Cohesion: 890 psf
B-2	30.0	CLAYEY SILT (ML)					100	46	29	17	
B-2	40.0	ELASTIC SILT WITH SAND (MH)					78	70	34	36	
B-2	46.0	ELASTIC SILT WITH SAND (MH)									**Unconsolidated-Undrained (1-Point) Triaxial**
											Comp.=
											Total Cohesion: 780 psf
B-2	60.0	POORLY GRADED SAND WITH SILT (SP-SM)					5.0				
B-2	66.0	CLAYEY SAND (SC)									**Direct Shear=**
											Peak Cohesion: 850 psf
											Peak Friction Angle: 30.0°
B-2	70.0	LEAN CLAY (CL)						46	25	21	
MW-1	6.0	LEAN CLAY (CL)	19.7	86.2							
MW-1	30.0	POORLY GRADED SAND WITH SILT (SP-SM)					5.2				
MW-1	35.5	POORLY GRADED SAND			94	58	3.0				
MW-1	46.0	WELL-GRADED GRAVEL WITH SAND (GW)			58	24	2.0				
MW-1	50.0	POORLY GRADED SAND (SP)					4.0				
MW-1	65.0	POORLY GRADED SAND (SP)					5.7				
MW-1	70.0	WELL-GRADED GRAVEL WITH SAND (GW)			90	49	4.0				

Refer to the Geotechnical Evaluation Report or the supplemental plates for the method used for the testing performed above.
NP = NonPlastic

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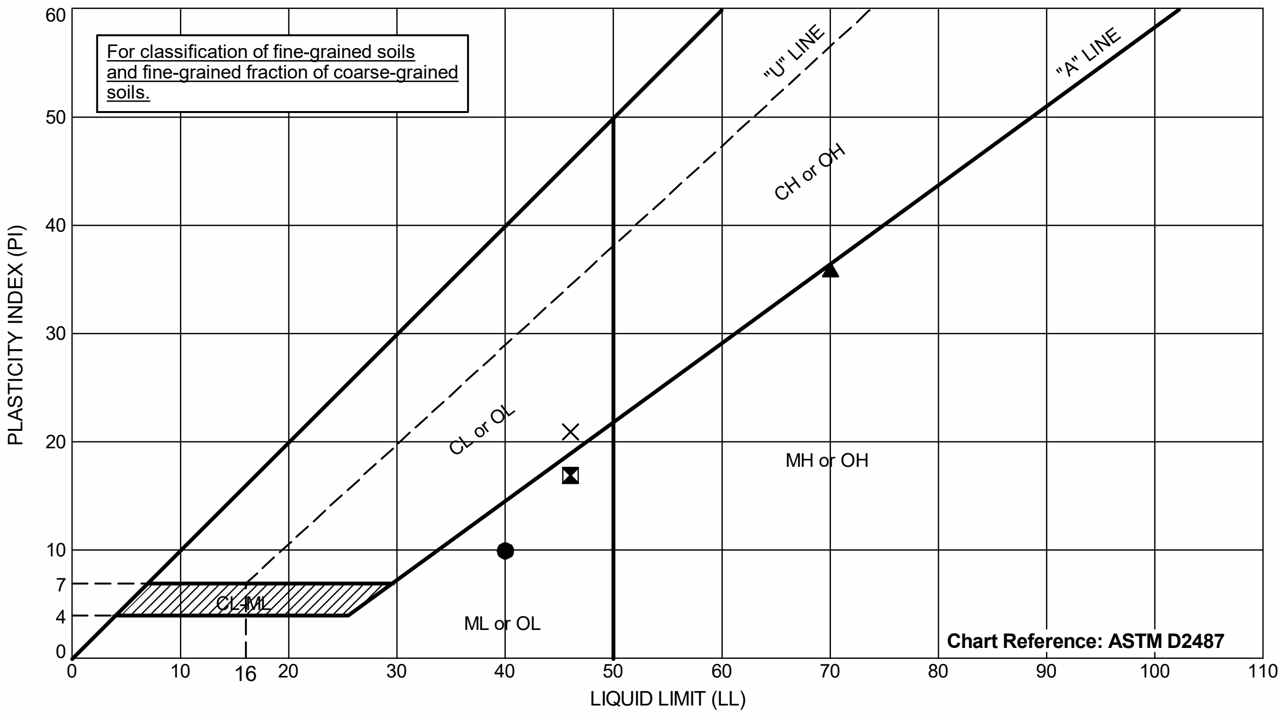
PROJECT NO.: 20201644.013A
DRAWN BY:
CHECKED BY:
DATE:

LABORATORY TEST RESULT SUMMARY

PACIFIC GAS AND ELECTRIC COMPANY
DFM 0630-01 (R-1385) HDD CROSSING
AT THE SACRAMENTO RIVER
MERIDIAN, CALIFORNIA

FIGURE
B-1



	Exploration ID	Depth (ft.)	Sample Description	Passing #200	LL	PL	PI
●	B-2	20 - 21.5	CLAYEY SILT (ML)	100	40	30	10
⊠	B-2	30 - 31.5	CLAYEY SILT (ML)	100	46	29	17
▲	B-2	40 - 41.5	ELASTIC SILT WITH SAND (MH)	78	70	34	36
×	B-2	70 - 71.5	LEAN CLAY (CL)	NM	46	25	21

Testing performed in general accordance with ASTM D4318.
NP = Nonplastic
NM = Not Measured

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PROJECT NO.: 20201644.013A
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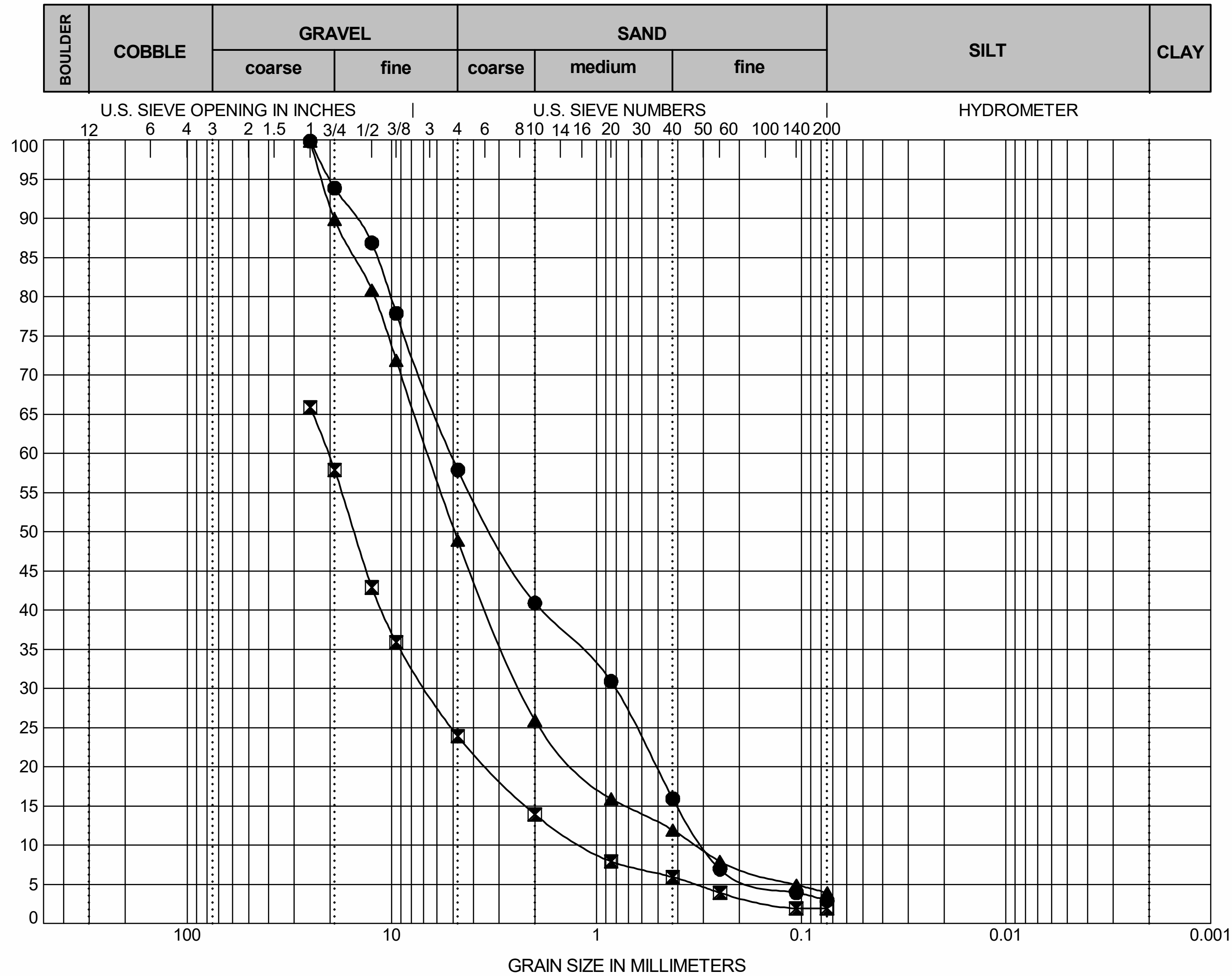
CHECKED BY: TD
DATE: 10/30/2020

ATTERBERG LIMITS

PACIFIC GAS AND ELECTRIC COMPANY
DFM 0630-01 (R-1385) HDD CROSSING
AT THE SACRAMENTO RIVER
MERIDIAN, CALIFORNIA

FIGURE
B-2



	Exploration ID	Depth (ft.)	Sample Description	LL	PL	PI
●	MW-1	35.5 - 36	POORLY GRADED SAND	NM	NM	NM
⊠	MW-1	46 - 46.5	WELL-GRADED GRAVEL WITH SAND (GW)	NM	NM	NM
▲	MW-1	70 - 71.5	WELL-GRADED GRAVEL WITH SAND (GW)	NM	NM	NM

	Exploration ID	Depth (ft.)	D_{100}	D_{60}	D_{30}	D_{10}	Cc	Cu	Passing 3/4"	Passing #4	Passing #200	%Silt*	%Clay*
●	MW-1	35.5 - 36	25	5.091	0.812	0.298	0.43	17.06	94	58	3.0	NM	NM
⊠	MW-1	46 - 46.5	25	20.349	6.718	1.131	1.96	18.00	58	24	2.0	NM	NM
▲	MW-1	70 - 71.5	25	6.617	2.325	0.326	2.51	20.30	90	49	4.0	NM	NM

*These numbers represent silt-sized and clay-sized content but may not indicate the percentage of the material with the engineering properties of silt or clay.
Sieve Analysis and Hydrometer Analysis testing performed in general accordance with ASTM D6913(Sieve Analysis) and ASTM D7928 (Hydrometer Analysis).
NP = Nonplastic
NM = Not Measured

Coefficients of Uniformity - $C_u = D_{60} / D_{10}$
Coefficients of Curvature - $C_C = (D_{30})^2 / D_{60}\ D_{10}$
D_{60} = Grain diameter at 60% passing
D_{30} = Grain diameter at 30% passing
D_{10} = Grain diameter at 10% passing

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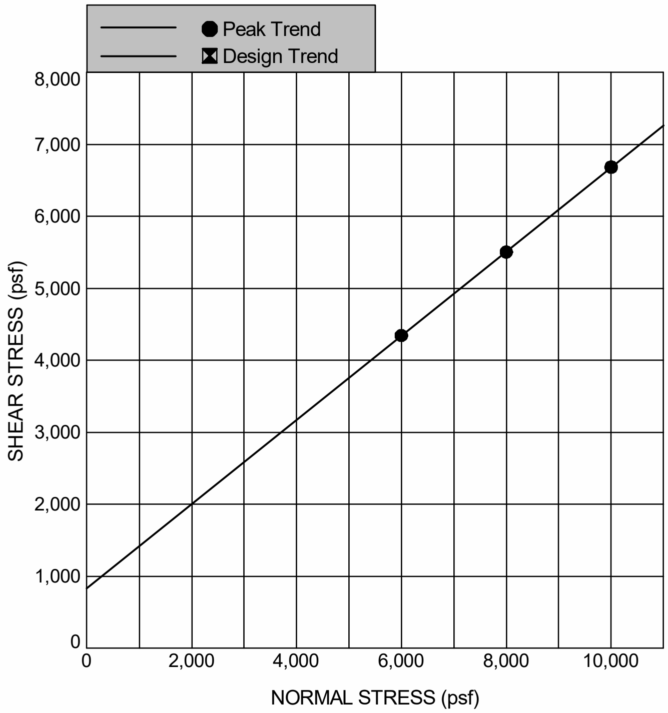
PROJECT NO.: 20201644.013A	SIEVE ANALYSIS	FIGURE
DRAWN BY: SD	PACIFIC GAS AND ELECTRIC COMPANY DFM 0630-01 (R-1385) HDD CROSSING AT THE SACRAMENTO RIVER MERIDIAN, CALIFORNIA	B-3
CHECKED BY: TD		
DATE: 10/30/2020		



Exploration ID	Depth (ft.)	Sample Description
B-2	66 - 66.5	CLAYEY SAND (SC)

Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plastic Limit	Plasticity Index	Specific Gravity
NM	NM	NM	NM	NM	

	Specimen No.	Water Content (%)	Dry Unit Weight (pcf)	Saturation (%)	Void Ratio	Area (in^2)	Height (in)
Initial	1	27.0	93.7	91.2	0.798	4.60	0.96
	2	25.9	98.7	99.2	0.706	4.60	0.96
	3	23.0	102.5	96.8	0.643	4.60	0.96
At Test	1	29.6	99.0		0.798	4.60	0.96
	2	28.9	105.2		0.706	4.60	0.96
	3	25.9	111.1		0.643	4.60	0.96

Specimen No.	Peak Shear Stress (psf)	Design Shear Stress (psf)	Horizontal Displacement (in)	Normal Stress (psf)	Strain Rate (in/min)
1	4360		0.1000	6000	0.01
2	5520		0.1000	8000	0.01
3	6700		0.1200	10000	0.01

Results	Cohesion (psf)	Friction ϕ (deg)	Tan ϕ (deg)
Peak	850	30	
Design			

Testing perfomed in general accordance with ASTM D3080.
NP = Nonplastic
NM = Not Measured

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PROJECT NO.: 20201644.013A
DRAWN BY: SD
CHECKED BY: TD
DATE: 10/30/2020

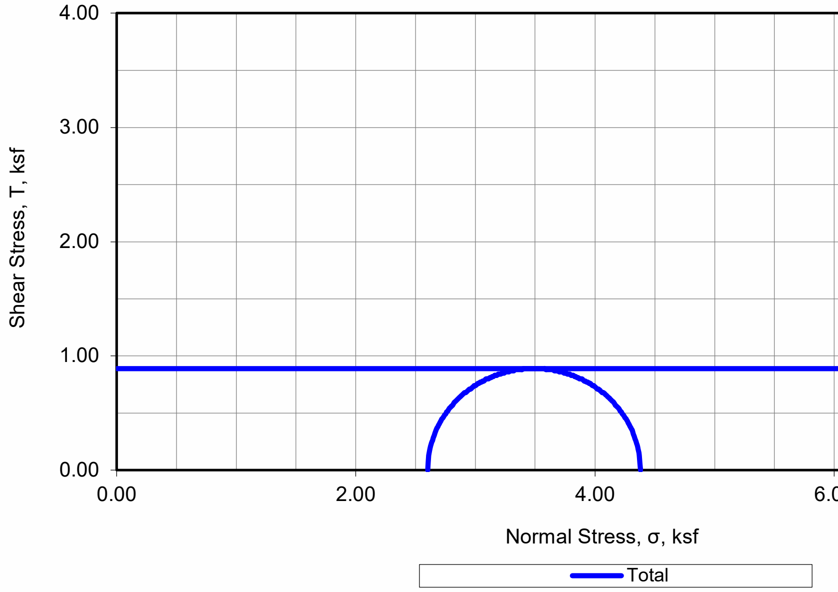
DIRECT SHEAR

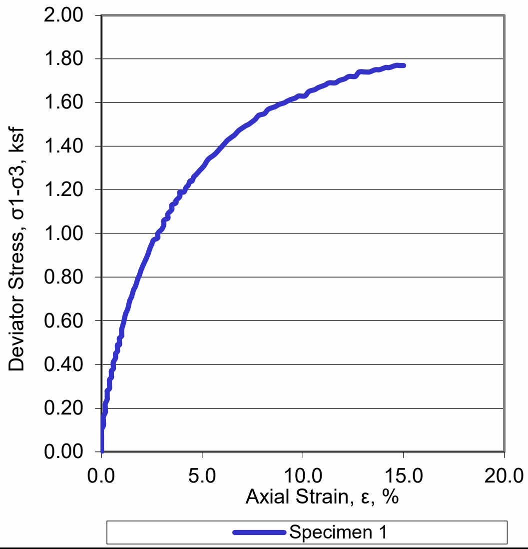
PACIFIC GAS AND ELECTRIC COMPANY
DFM 0630-01 (R-1385) HDD CROSSING
AT THE SACRAMENTO RIVER
MERIDIAN, CALIFORNIA

FIGURE B-4

Total	
c = 0.89	ksf

Specimen Shear Picture





Specimen No.			1
Initial	Diameter, in	D_O	2.379
	Height, in	H_O	5.088
	Water Content, %	ω_O	35.3
	Dry Density, lbs/ft^3	γd_o	87.2
	Saturation, %	S_O	100
	Void Ratio	e_O	0.974
Minor Principal Stress, ksf		σ_3	2.60
Maximum Deviator Stress, ksf		$(\sigma1-\sigma3)_{max}$	1.77
Time to $(\sigma_1$-$\sigma_3)_{max}$, min		t_f	14.83
Deviator Stress @ 15% Axial Strain, ksf		$(\sigma_1-\sigma_3)_{15\%}$	1.77
Ultimate Deviator Stress, ksf		$(\sigma_1-\sigma_3)_{ult}$	na
Rate of strain, %/min		'ε	1.00
Axial Strain at Failure, %		ε_f	14.83

Description of Specimen: Light Brown Clayey Silt

Amount of Material Finer than the No. 200, %: nm

LL: nm | PL: nm | PI: nm | G_S: 2.76 Assumed | Specimen Type: Undisturbed | Test Method: ASTM D2850

Membrane correction applied

Boring:	B-2
Sample:	6A
Depth, ft:	26.0
Test Date:	10/21/2020

Remarks: nm= not measured, na = not applicable

KLEINFELDER
Bright People. Right Solutions.
9969 Horn Rd., Sacramento, CA 95827

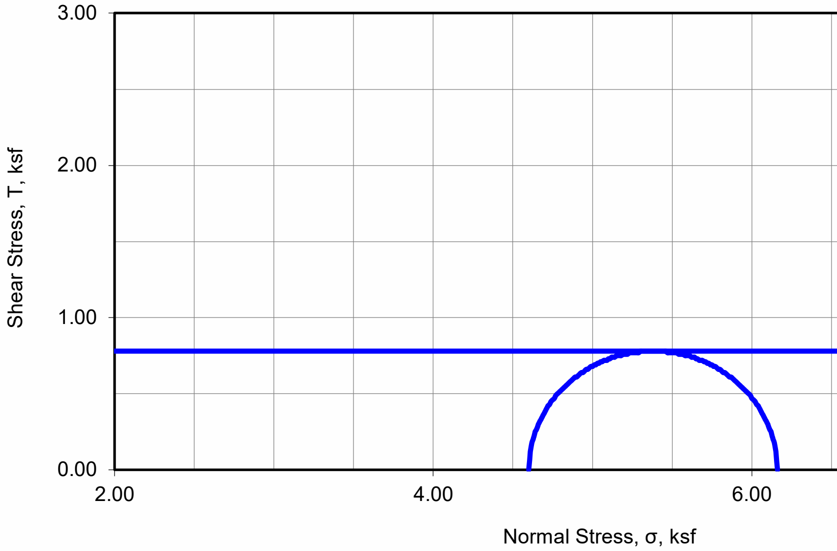
PROJECT NO.:	20201644
ENTRY BY:	J. Slinkard
CHECKED BY:	J. Slinkard
DATE:	11/6/2020

TRIAXIAL COMPRESSION TEST (UU)

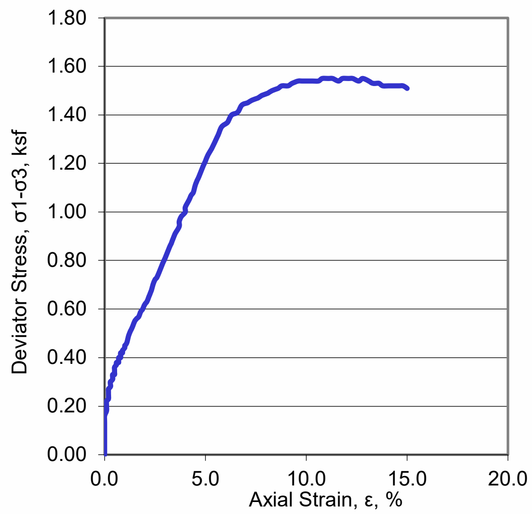
PACIFIC GAS AND ELECTRIC COMPANY
DFM 0630-01 (R-1385) HDD CROSSING
AT THE SACRAMENTO RIVER
MERIDIAN, CALIFORNIA

FIGURE
B-5

Total	
c = 0.78	ksf



Specimen Shear Picture



Specimen No.			1
Initial	Diameter, in	D_O	2.380
Initial	Height, in	H_O	5.119
Initial	Water Content, %	ω_O	56.0
Initial	Dry Density, lbs/ft^3	γd_o	67.7
Initial	Saturation, %	S_O	100
Initial	Void Ratio	e_O	1.544
Minor Principal Stress, ksf		σ_3	4.60
Maximum Deviator Stress, ksf		$(\sigma_1-\sigma_3)_{max}$	1.55
Time to $(\sigma_1-\sigma_3)_{max}$, min		t_f	12.08
Deviator Stress @ 15% Axial Strain, ksf		$(\sigma_1-\sigma_3)_{15\%}$	1.51
Ultimate Deviator Stress, ksf		$(\sigma_1-\sigma_3)_{ult}$	na
Rate of strain, %/min		$'\varepsilon$	1.00
Axial Strain at Failure, %		ε_f	12.08

Description of Specimen: Greenish Gray Elastic Silt with Sand

Amount of Material Finer than the No. 200, %: nm

LL: nm | PL: nm | PI: nm | G_S: 2.76 Assumed | Specimen Type: Undisturbed | Test Method: ASTM D2850

Membrane correction applied

Boring:	B-2
Sample:	10A
Depth, ft:	46.0
Test Date:	10/21/2020

Remarks: nm= not measured, na = not applicable

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Bright People. Right Solutions.
9969 Horn Rd., Sacramento, CA 95827

PROJECT NO.:	20201644
ENTRY BY:	J. Slinkard
CHECKED BY:	J. Slinkard
DATE:	11/6/2020

TRIAXIAL COMPRESSION TEST (UU)

PACIFIC GAS AND ELECTRIC COMPANY
DFM 0630-01 (R-1385) HDD CROSSING
AT THE SACRAMENTO RIVER
MERIDIAN, CALIFORNIA

FIGURE

B-6

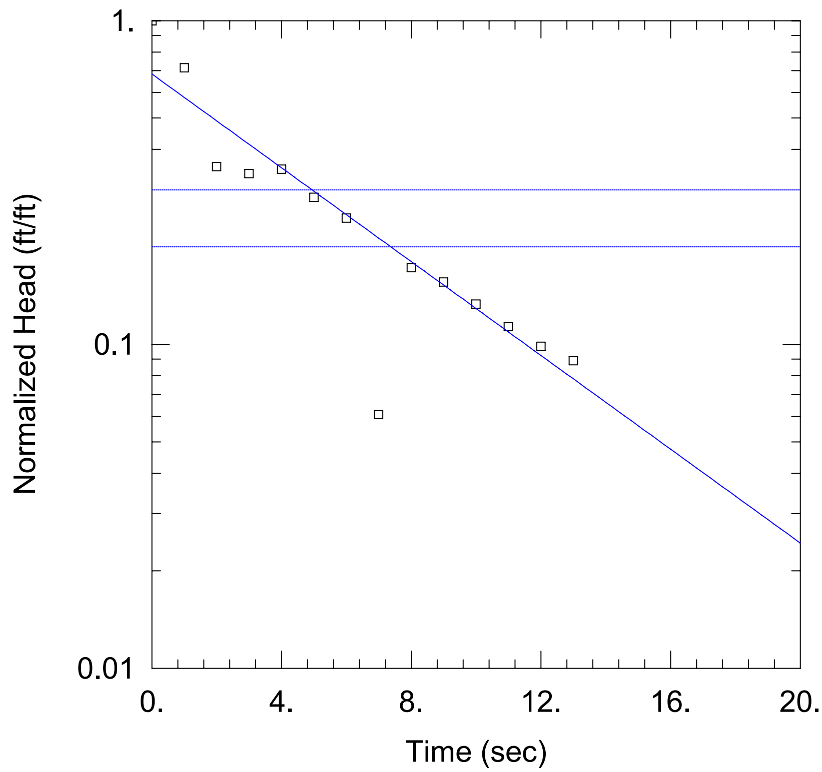
APPENDIX C

SLUG TEST ANALYSES

LIST OF ATTACHMENTS

The following are attached and complete this appendix.
Aquifer Testing Analyses
Grain Size Distribution Analyses

AQUIFER TESTING ANALYSES



PG&E R-1385 IN-1

Data Set: C:\...\IN-1.aqt
Date: 11/10/20 Time: 14:23:41

PROJECT INFORMATION

Company: Kleinfelder
Client: PG&E R-1385
Project: 20201644.013A
Location: Meridian, CA
Test Well: MW-1
Test Date: 10-28-2020

AQUIFER DATA

Saturated Thickness: 100. ft Anisotropy Ratio (Kz/Kr): 0.1

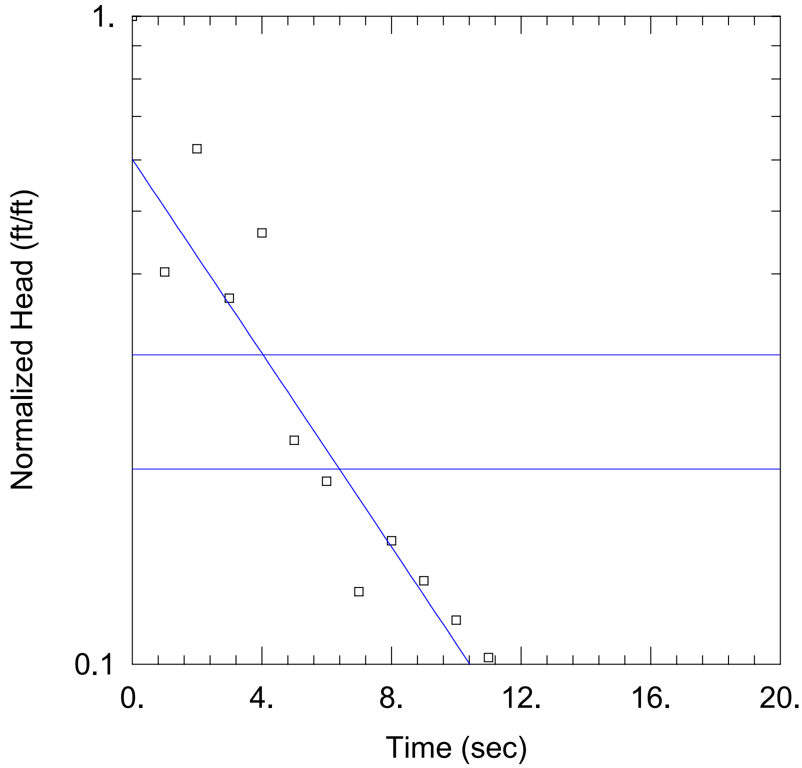
WELL DATA (MW-1)

Initial Displacement: 1.135 ft
Total Well Penetration Depth: 35. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 31.5 ft
Screen Length: 35. ft
Well Radius: 0.33 ft
Gravel Pack Porosity: 0.22

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.01745 ft/min y0 = 0.7769 ft



PG&E R-1385 IN-2

Data Set: C:\...\IN-2.aqt
Date: 11/10/20 Time: 14:24:19

PROJECT INFORMATION

Company: Kleinfelder
Client: PG&E R-1385
Project: 20201644.013A
Location: Meridian, CA
Test Well: MW-1
Test Date: 10-28-2020

AQUIFER DATA

Saturated Thickness: 100. ft Anisotropy Ratio (Kz/Kr): 0.1

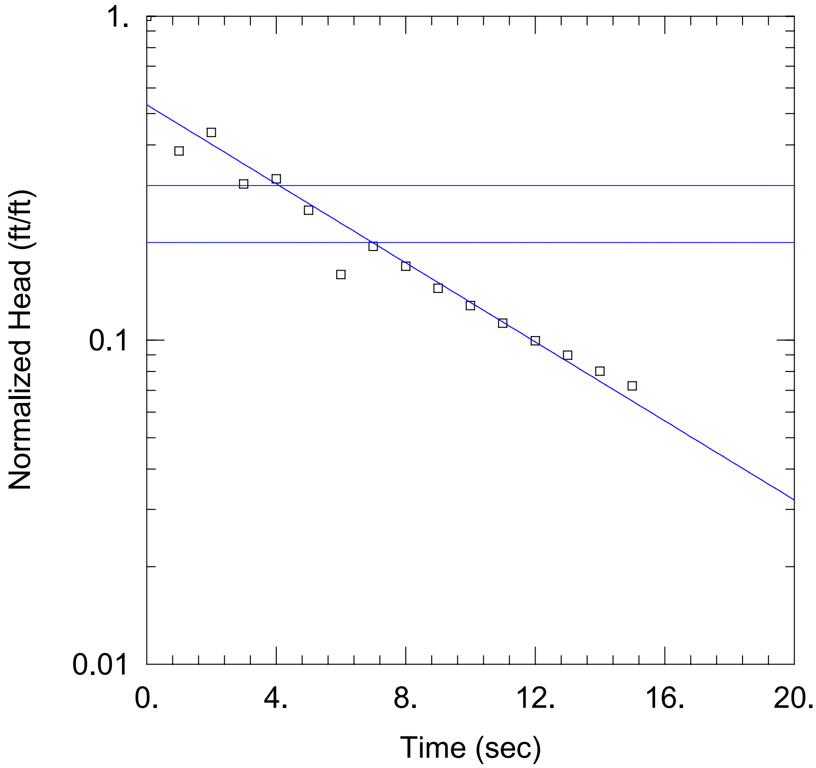
WELL DATA (MW-1)

Initial Displacement: 1.368 ft
Total Well Penetration Depth: 35. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 31.5 ft
Screen Length: 35. ft
Well Radius: 0.33 ft
Gravel Pack Porosity: 0.22

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.01802 ft/min y0 = 0.8227 ft



PG&E R-1385 IN-3

Data Set: C:\...\IN-3.aqt
Date: 11/10/20
Time: 14:24:43

PROJECT INFORMATION

Company: Kleinfelder
Client: PG&E R-1385
Project: 20201644.013A
Location: Meridian, CA
Test Well: MW-1
Test Date: 10-28-2020

AQUIFER DATA

Saturated Thickness: 100. ft
Anisotropy Ratio (Kz/Kr): 0.1

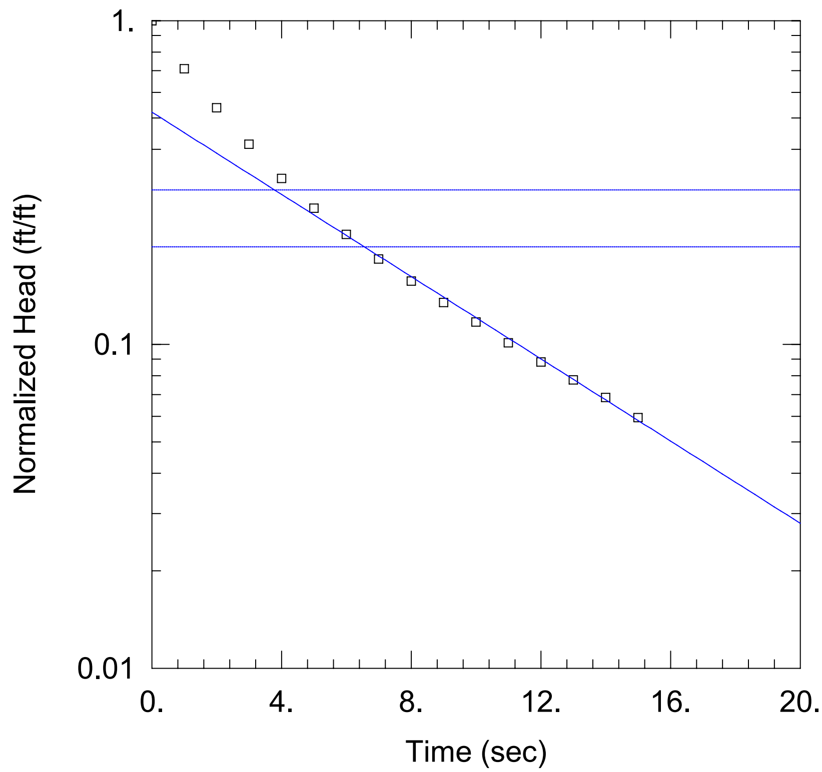
WELL DATA (MW-1)

Initial Displacement: 1.135 ft
Total Well Penetration Depth: 35. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 31.5 ft
Screen Length: 35. ft
Well Radius: 0.33 ft
Gravel Pack Porosity: 0.22

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.01469 ft/min
y0 = 0.6048 ft



PG&E R-1385 OUT-1

Data Set: C:\...\OUT-1.aqt
Date: 11/10/20
Time: 14:25:13

PROJECT INFORMATION

Company: Kleinfelder
Client: PG&E R-1385
Project: 20201644.013A
Location: Meridian, CA
Test Well: MW-1
Test Date: 10-28-2020

AQUIFER DATA

Saturated Thickness: 100. ft
Anisotropy Ratio (Kz/Kr): 0.1

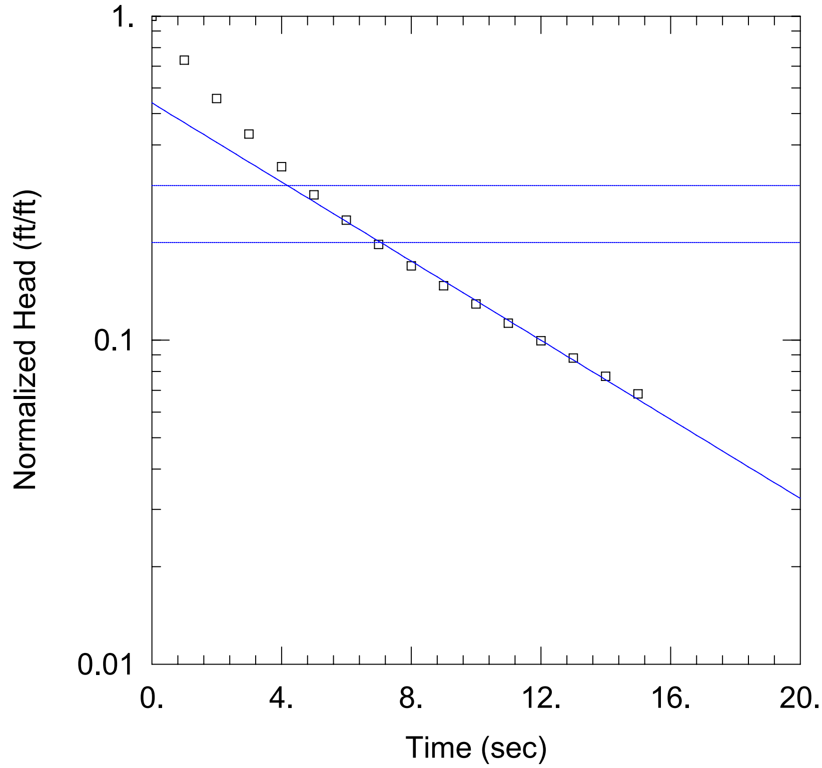
WELL DATA (MW-1)

Initial Displacement: 1.314 ft
Total Well Penetration Depth: 35. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 31.5 ft
Screen Length: 35. ft
Well Radius: 0.33 ft
Gravel Pack Porosity: 0.22

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.0153 ft/min
y0 = 0.6855 ft



PG&E R-1385 OUT-2

Data Set: C:\...\OUT-2.aqt
Date: 11/10/20 Time: 14:25:30

PROJECT INFORMATION

Company: Kleinfelder
Client: PG&E R-1385
Project: 20201644.013A
Location: Meridian, CA
Test Well: MW-1
Test Date: 10-28-2020

AQUIFER DATA

Saturated Thickness: 100. ft
Anisotropy Ratio (Kz/Kr): 0.1

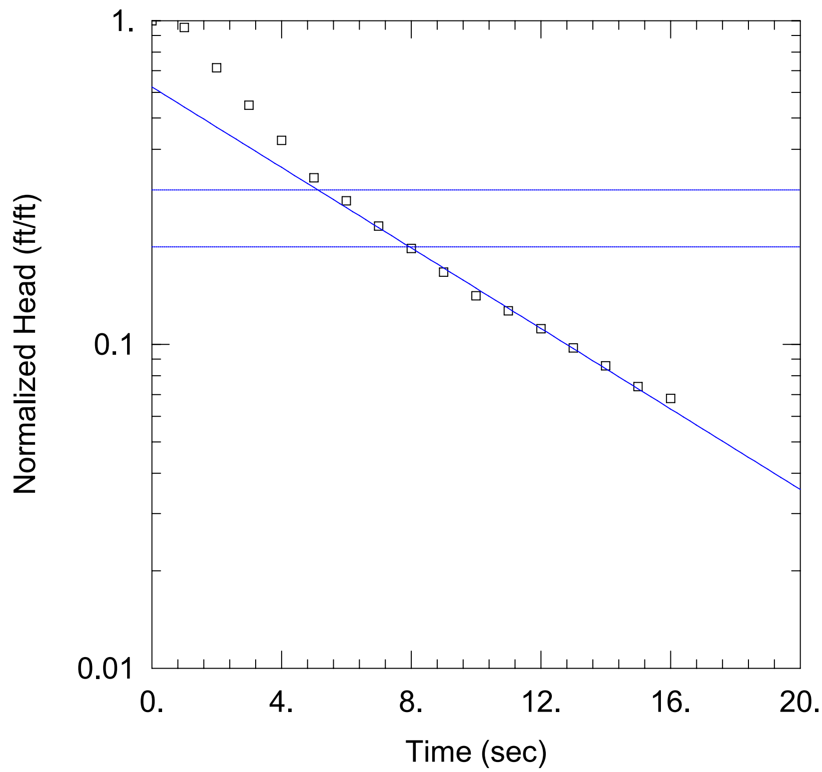
WELL DATA (MW-1)

Initial Displacement: 1.215 ft
Total Well Penetration Depth: 35. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 31.5 ft
Screen Length: 35. ft
Well Radius: 0.33 ft
Gravel Pack Porosity: 0.22

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.01471 ft/min
y0 = 0.6561 ft



PG&E R-1385 OUT-3

Data Set: C:\...\OUT-3.aqt
Date: 11/10/20 | Time: 14:25:51

PROJECT INFORMATION

Company: Kleinfelder
Client: PG&E R-1385
Project: 20201644.013A
Location: Meridian, CA
Test Well: MW-1
Test Date: 10-28-2020

AQUIFER DATA

Saturated Thickness: 100. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (MW-1)

Initial Displacement: 1.189 ft
Total Well Penetration Depth: 35. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 31.5 ft
Screen Length: 35. ft
Well Radius: 0.33 ft
Gravel Pack Porosity: 0.22

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.01498 ft/min
y0 = 0.7424 ft

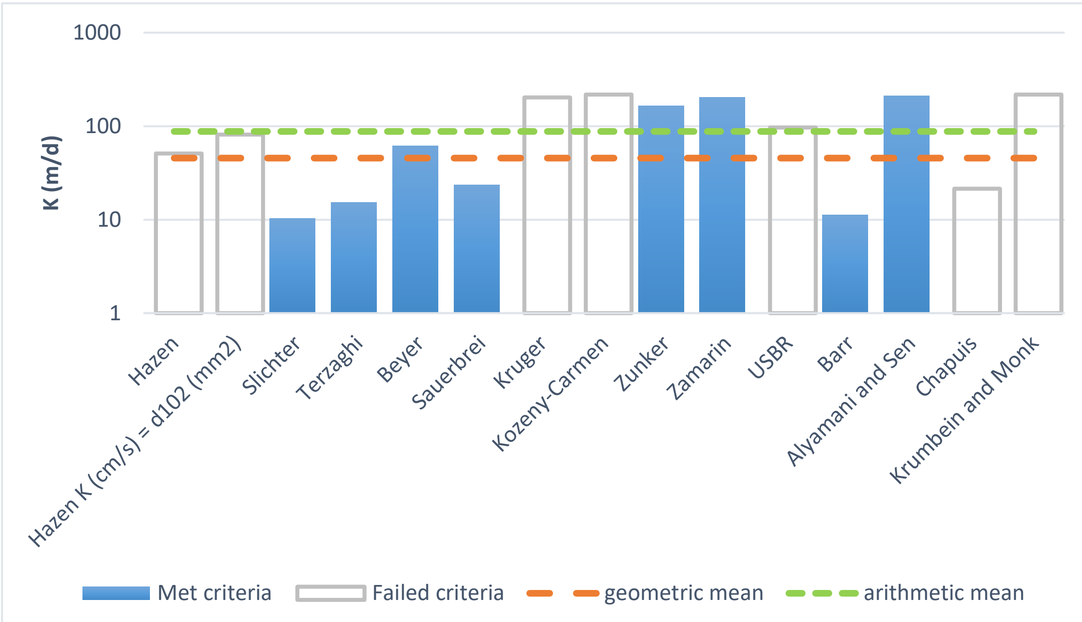
GRAIN SIZE DISTRIBUTION ANALYSES

K from Grain Size Analysis Report | Date: 10/1/2020

Sample Name: PG&E R-1385 MW-1 at 35 ft

Mass Sample (g): 100 | T (oC) 20

Poorly sorted sandy gravel low in fines



Estimation of Hydraulic Conductivity	cm/s	m/s	m/d
Hazen	.592E-01	.592E-03	51.13
Hazen K (cm/s) = d_{10} (mm)	.940E-01	.940E-03	81.25
Slichter	.120E-01	.120E-03	10.34
Terzaghi	.177E-01	.177E-03	15.31
Beyer	.712E-01	.712E-03	61.56
Sauerbrei	.274E-01	.274E-03	23.63
Kruger	.235E+00	.235E-02	203.15
Kozeny-Carmen	.253E+00	.253E-02	218.19
Zunker	.191E+00	.191E-02	165.40
Zamarin	.235E+00	.235E-02	203.39
USBR	.112E+00	.112E-02	96.59
Barr	.130E-01	.130E-03	11.27
Alyamani and Sen	.244E+00	.244E-02	211.23
Chapuis	.249E-01	.249E-03	21.50
Krumbein and Monk	.253E+00	.253E-02	218.53
geometric mean	.527E-01	.527E-03	45.52
arithmetic mean	.102E+00	.102E-02	87.77

K from Grain Size Analysis Report

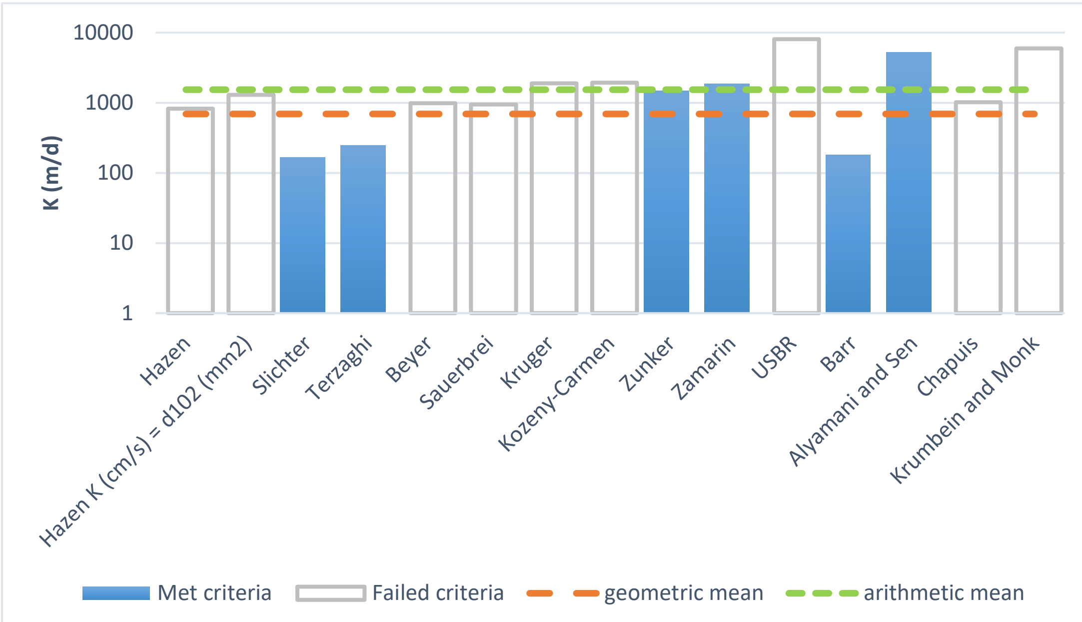
Date: 10/1/2020

Sample Name: PG&E R-1385 MW-1 at 35 ft

Mass Sample (g): 100

T (oC) 20

Poorly sorted sandy gravel low in fines



Estimation of Hydraulic Conductivity	cm/s	m/s	m/d
Hazen	.953E+00	.953E-02	823.55
Hazen K (cm/s) = d_{10} (mm)	.151E+01	.151E-01	1301.48
Slichter	.193E+00	.193E-02	166.74
Terzaghi	.286E+00	.286E-02	247.51
Beyer	.115E+01	.115E-01	990.89
Sauerbrei	.110E+01	.110E-01	949.15
Kruger	.219E+01	.219E-01	1894.25
Kozeny-Carmen	.223E+01	.223E-01	1926.85
Zunker	.172E+01	.172E-01	1485.70
Zamarin	.216E+01	.216E-01	1864.65
USBR	.940E+01	.940E-01	8123.38
Barr	.211E+00	.211E-02	182.00
Alyamani and Sen	.611E+01	.611E-01	5281.00
Chapuis	.118E+01	.118E-01	1019.78
Krumbein and Monk	.693E+01	.693E-01	5987.71
geometric mean	.801E+00	.801E-02	692.08
arithmetic mean	.178E+01	.178E-01	1537.93

APPENDIX D

LOGS OF PREVIOUS EXPLORATIONS

LOGS OF PREVIOUS EXPLORATIONS

SAMPLE/SAMPLER TYPE GRAPHICS

- BULK SAMPLE
- CALIFORNIA SAMPLER (3 in. (76.2 mm.) outer diameter)
- SHELBY TUBE SAMPLER
- STANDARD PENETRATION SPLIT SPOON SAMPLER (2 in. (50.8 mm.) outer diameter and 1-3/8 in. (34.9 mm.) inner diameter)

GROUND WATER GRAPHICS

- WATER LEVEL (level where first observed)
- WATER LEVEL (level after exploration completion)
- WATER LEVEL (additional levels after exploration)
- OBSERVED SEEPAGE

NOTES

- The report and graphics key are an integral part of these logs. All data and interpretations in this log are subject to the explanations and limitations stated in the report.
- Lines separating strata on the logs represent approximate boundaries only. Actual transitions may be gradual or differ from those shown.
- No warranty is provided as to the continuity of soil or rock conditions between individual sample locations.
- Logs represent general soil or rock conditions observed at the point of exploration on the date indicated.
- In general, Unified Soil Classification System designations presented on the logs were based on visual classification in the field and were modified where appropriate based on gradation and index property testing.
- Fine grained soils that plot within the hatched area on the Plasticity Chart, and coarse grained soils with between 5% and 12% passing the No. 200 sieve require dual USCS symbols, ie., GW-GM, GP-GM, GW-GC, GP-GC, GC-GM, SW-SM, SP-SM, SW-SC, SP-SC, SC-SM.
- If sampler is not able to be driven at least 6 inches then 50/X indicates number of blows required to drive the identified sampler X inches with a 140 pound hammer falling 30 inches.

ABBREVIATIONS

WOH - Weight of Hammer
WOR - Weight of Rod

UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D 2487)

COARSE GRAINED SOILS (More than half of material is larger than the #200 sieve)	**GRAVELS** (More than half of coarse fraction is larger than the #4 sieve)	CLEAN GRAVEL WITH <5% FINES	Cu ≥4 and 1≤ Cc≤3	**GW**	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES
			Cu <4 and/ or 1>Cc >3	**GP**	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES
		GRAVELS WITH 5% TO 12% FINES	Cu ≥4 and 1≤ Cc≤3	**GW-GM**	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE FINES
				GW-GC	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE CLAY FINES
			Cu <4 and/ or 1>Cc >3	**GP-GM**	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE FINES
				GP-GC	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE CLAY FINES
		GRAVELS WITH > 12% FINES		**GM**	SILTY GRAVELS, GRAVEL-SILT-SAND MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
				GC-GM	CLAYEY GRAVELS, GRAVEL-SAND-CLAY-SILT MIXTURES
	SANDS (Half or more of coarse fraction is smaller than the #4 sieve)	CLEAN SANDS WITH <5% FINES	Cu ≥6 and 1≤ Cc≤3	**SW**	WELL-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE OR NO FINES
			Cu <6 and/ or 1>Cc >3	**SP**	POORLY GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE OR NO FINES
		SANDS WITH 5% TO 12% FINES	Cu ≥6 and 1≤ Cc≤3	**SW-SM**	WELL-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE FINES
				SW-SC	WELL-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE CLAY FINES
			Cu <6 and/ or 1>Cc >3	**SP-SM**	POORLY GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE FINES
				SP-SC	POORLY GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE CLAY FINES
		SANDS WITH > 12% FINES		**SM**	SILTY SANDS, SAND-GRAVEL-SILT MIXTURES
				SC	CLAYEY SANDS, SAND-GRAVEL-CLAY MIXTURES
				SC-SM	CLAYEY SANDS, SAND-SILT-CLAY MIXTURES

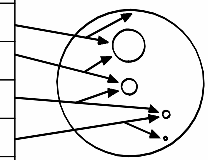
FINE GRAINED SOILS (Half or more of material is smaller than the #200 sieve)	SILTS AND CLAYS (Liquid Limit less than 50)	**ML**	INORGANIC SILTS AND VERY FINE SANDS, SILTY OR CLAYEY FINE SANDS, SILTS WITH SLIGHT PLASTICITY
		CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
		CL-ML	INORGANIC CLAYS-SILTS OF LOW PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
		OL	ORGANIC SILTS & ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS (Liquid Limit 50 or greater)	**MH**	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILT
		CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
		OH	ORGANIC CLAYS & ORGANIC SILTS OF MEDIUM-TO-HIGH PLASTICITY

KLEINFELDER Bright People. Right Solutions.	PROJECT NO.: 20200652.001A	GRAPHICS KEY	FIGURE
	DRAWN BY: GG	PG&E Mast Tower Replacement Colusa JCT #1 60kV Colusa and Sutter Counties, California	A-1
	CHECKED BY: MP		
	DATE: 7/25/2019		

PLOTTED: 12/06/2019 03:07 PM BY: GGomez
OFFICE FILTER: STOCKTON
PROJECT NUMBER: 20200652.001A
gINT FILE: Klf_gint_master_2020
gINT TEMPLATE: E:KLF_STANDARD_GINT_LIBRARY_2020.GLB [_KLF_GEO-LEG1 (GRAPHICS KEY) WITH USCS]

GRAIN SIZE

DESCRIPTION		SIEVE SIZE	GRAIN SIZE	APPROXIMATE SIZE
Boulders		>12 in. (304.8 mm.)	>12 in. (304.8 mm.)	Larger than basketball-sized
Cobbles		3 - 12 in. (76.2 - 304.8 mm.)	3 - 12 in. (76.2 - 304.8 mm.)	Fist-sized to basketball-sized
Gravel	coarse	3/4 -3 in. (19 - 76.2 mm.)	3/4 -3 in. (19 - 76.2 mm.)	Thumb-sized to fist-sized
	fine	#4 - 3/4 in. (#4 - 19 mm.)	0.19 - 0.75 in. (4.8 - 19 mm.)	Pea-sized to thumb-sized
Sand	coarse	#10 - #4	0.079 - 0.19 in. (2 - 4.9 mm.)	Rock salt-sized to pea-sized
	medium	#40 - #10	0.017 - 0.079 in. (0.43 - 2 mm.)	Sugar-sized to rock salt-sized
	fine	#200 - #40	0.0029 - 0.017 in. (0.07 - 0.43 mm.)	Flour-sized to sugar-sized
Fines		Passing #200	<0.0029 in. (<0.07 mm.)	Flour-sized and smaller



SECONDARY CONSTITUENT

Term of Use	AMOUNT: Secondary Constituent is Fine Grained	AMOUNT: Secondary Constituent is Coarse Grained
Trace	<5%	<15%
With	≥5 to <15%	≥15 to <30%
Modifier	≥15%	≥30%

MOISTURE CONTENT

DESCRIPTION	FIELD TEST
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

CEMENTATION

DESCRIPTION	FIELD TEST
Weakly	Crumbles or breaks with handling or slight finger pressure
Moderately	Crumbles or breaks with considerable finger pressure
Strongly	Will not crumble or break with finger pressure

CONSISTENCY - FINE-GRAINED SOIL

CONSISTENCY	SPT - N_{60} (# blows / ft)	Pocket Pen (tsf)	UNCONFINED COMPRESSIVE STRENGTH (Q_u)(psf)	VISUAL / MANUAL CRITERIA
Very Soft	<2	PP < 0.25	<500	Thumb will penetrate more than 1 inch (25 mm). Extrudes between fingers when squeezed.
Soft	2 - 4	0.25 ≤ PP <0.5	500 - 1000	Thumb will penetrate soil about 1 inch (25 mm). Remolded by light finger pressure.
Medium Stiff	4 - 8	0.5 ≤ PP <1	1000 - 2000	Thumb will penetrate soil about 1/4 inch (6 mm). Remolded by strong finger pressure.
Stiff	8 - 15	1 ≤ PP <2	2000 - 4000	Can be imprinted with considerable pressure from thumb.
Very Stiff	15 - 30	2 ≤ PP <4	4000 - 8000	Thumb will not indent soil but readily indented with thumbnail.
Hard	>30	4 ≤ PP	>8000	Thumbnail will not indent soil.

FROM TERZAGHI AND PECK, 1948; LAMBE AND WHITMAN, 1969; FHWA, 2002; AND ASTM D2488

REACTION WITH HYDROCHLORIC ACID

DESCRIPTION	FIELD TEST
None	No visible reaction
Weak	Some reaction, with bubbles forming slowly
Strong	Violent reaction, with bubbles forming immediately

APPARENT / RELATIVE DENSITY - COARSE-GRAINED SOIL

APPARENT DENSITY	SPT-N_{60} (# blows/ft)	MODIFIED CA SAMPLER (# blows/ft)	CALIFORNIA SAMPLER (# blows/ft)	RELATIVE DENSITY (%)
Very Loose	<4	<4	<5	0 - 15
Loose	4 - 10	5 - 12	5 - 15	15 - 35
Medium Dense	10 - 30	12 - 35	15 - 40	35 - 65
Dense	30 - 50	35 - 60	40 - 70	65 - 85
Very Dense	>50	>60	>70	85 - 100

FROM TERZAGHI AND PECK, 1948

PLASTICITY

DESCRIPTION	LL	FIELD TEST
Non-plastic	NP	A 1/8-in. (3 mm.) thread cannot be rolled at any water content.
Low (L)	< 30	The thread can barely be rolled and the lump or thread cannot be formed when drier than the plastic limit.
Medium (M)	30 - 50	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump or thread crumbles when drier than the plastic limit.
High (H)	> 50	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump or thread can be formed without crumbling when drier than the plastic limit.

STRUCTURE

DESCRIPTION	CRITERIA
Stratified	Alternating layers of varying material or color with layers at least 1/4-in. thick, note thickness.
Laminated	Alternating layers of varying material or color with the layer less than 1/4-in. thick, note thickness.
Fissured	Breaks along definite planes of fracture with little resistance to fracturing.
Slickensided	Fracture planes appear polished or glossy, sometimes striated.
Blocky	Cohesive soil that can be broken down into small angular lumps which resist further breakdown.
Lensed	Inclusion of small pockets of different soils, such as small lenses of sand scattered through a mass of clay; note thickness.

ANGULARITY

DESCRIPTION	CRITERIA
Angular	Particles have sharp edges and relatively plane sides with unpolished surfaces.
Subangular	Particles are similar to angular description but have rounded edges.
Subrounded	Particles have nearly plane sides but have well-rounded corners and edges.
Rounded	Particles have smoothly curved sides and no edges.

KLEINFELDER Bright People. Right Solutions.	PROJECT NO.: 20200652.001A	SOIL DESCRIPTION KEY	FIGURE
	DRAWN BY: GG CHECKED BY: MP DATE: 7/25/2019	PG&E Mast Tower Replacement Colusa JCT #1 60kV Colusa and Sutter Counties, California	A-2

PLOTTED: 02/04/2020 10:53 AM BY: GGomez
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PROJECT NUMBER: 20200652.001A
gINT FILE: Klf_gint_master_2020
gINT TEMPLATE: E:KLF_STANDARD_GINT_LIBRARY_2020.GLB [_KLF_BORING/TEST PIT SOIL LOG]

BORING LOG B-1

Date Begin - End:	7/22/2019	**Drilling Company:**	Gregg Drilling		
Logged By:	AA	**Drill Crew:**	Louis/Mac		
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	Mobile B-53	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Mud Rotary		
Weather:	Sunny/Clear	**Exploration Diameter:**	6 in. O.D.		

FIELD EXPLORATION / LABORATORY RESULTS

Latitude: 39.14587°
Longitude: -121.91666°
Approximate Ground Surface Elevation (ft.): 56.00
Surface Condition: Asphalt

Approximate Elevation (feet)	Depth (feet)	Lithologic Description	Sample Number	Blow Counts(BC)= Uncorr. Blows/6 in. Pocket Pen(PP)= tsf	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
	0	**ASPHALT**											Hand Auger to 5 feet
55		**Lean CLAY (CL)**: low to medium plasticity, olive brown, moist											
		Clayey SAND (SC): fine-grained, low plasticity, olive brown, moist											
	5	Loose, non-plastic	1B 1A	BC=5 3 5	14"								Mud Rotary below 5 feet
50		**Lean CLAY (CL)**: medium plasticity, olive brown, moist, very stiff									40	17	
45	10		2B 2A	BC=5 6 7 PP=2.5	16"		24.5	99.7					
40	15	**Silty SAND (SM)**: fine-grained, low plasticity, dark brown, moist, loose	3B 3A	BC=4 4 5	15"	SM				35	21	3	
			4		12"								
35	20	**Poorly Graded SAND with Silt (SP-SM)**: fine to medium-grained, non-plastic, reddish brown, moist, loose	5	BC=4 4 6	8"					8.8			
30	25	Trace fine gravel, medium dense	6	BC=5 12 16	10"		16.4						
25	30		7	BC=5 6 10	9"					5.8			

KLEINFELDER
Bright People. Right Solutions.

PROJECT NO.: 20200652.001A	BORING LOG B-1	FIGURE
DRAWN BY: GG	PG&E Mast Tower Replacement Colusa JCT #1 60kV Colusa and Sutter Counties, California	A-3
CHECKED BY: MP		
DATE: 7/25/2019		

BORING LOG B-1

Date Begin - End:	7/22/2019	**Drilling Company:**	Gregg Drilling		
Logged By:	AA	**Drill Crew:**	Louis/Mac		
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	Mobile B-53	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Mud Rotary		
Weather:	Sunny/Clear	**Exploration Diameter:**	6 in. O.D.		

Latitude: 39.14587°
Longitude: -121.91666°
Approximate Ground Surface Elevation (ft.): 56.00
Surface Condition: Asphalt

Approximate Elevation (feet)	Depth (feet)	Lithologic Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. Pocket Pen(PP)= tsf	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
20		**Poorly Graded SAND with Silt (SP-SM)**: fine to medium-grained, reddish brown, moist, medium dense	8		BC=7 8 9	10"		19.2						
15	40	Trace fine gravel	9		BC=11 15 11	12"					7.2			
10	45	**Poorly Graded SAND with Gravel (SP)**: brown, moist, very dense, fine grained sand, fine gravel	10		BC=24 32 34	14"								
5	50	Dense	11		BC=27 24 20	14"								
0	55													
-5	60													
-10	65													

The boring was terminated at approximately 51.5 ft. below ground surface. The boring was backfilled with cement/bentonite grout on July 22, 2019.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not measured within exploration due to Mud Rotary drilling method

GENERAL NOTES:
The exploration location and elevation are approximate and were estimated by Kleinfelder.

KLEINFELDER Bright People. Right Solutions.	PROJECT NO.: 20200652.001A	BORING LOG B-1	FIGURE
	DRAWN BY: GG	PG&E Mast Tower Replacement Colusa JCT #1 60kV Colusa and Sutter Counties, California	A-3
	CHECKED BY: MP		
	DATE: 7/25/2019		PAGE: 2 of 2

Date Begin - End:	11/19/2019	**Drilling Company:**	Gregg Drilling	**BORING LOG B-2**
Logged By:	M. Porter	**Drill Crew:**	Eric/Mac/Luis	
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	Fraste	**Hammer Type - Drop:** 140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	HSA/Mud Rotary	
Weather:	Sunny/Clear	**Exploration Diameter:**	6 in. O.D.	

FIELD EXPLORATION / LABORATORY RESULTS

Latitude: 39.14658°
Longitude: -121.91902°
Approximate Ground Surface Elevation (ft.): 50.00
Surface Condition: Bare Earth

Approximate Elevation (feet)	Depth (feet)	Lithologic Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. Pocket Pen(PP)= tsf	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
		Sandy SILT (ML): non-plastic, brown, moist, fine grained sand, no roots	1											Hand Auger to 5 feet
45	5	Medium stiff	2B 2A		BC=4 5 5			22.6	85.0					Hollow Stem Auger, 5 feet to 21.5 feet
40	10	Soft	3		BC=2 1 2			27.7			52			
		Silty SAND (SM): fine-grained, non-plastic, yellowish brown, moist, loose												
35	15		4		BC=2 2 3		SM				25	NP	NP	
30 ▽	20	wet	5		BC=2 2 2			31.9						Switched to Mud Rotary below 21.5 feet
		Poorly Graded SAND with Silt (SP-SM): fine to medium-grained, non-plastic, gray, moist, loose												
25	25	Trace fine gravel, subangular to subrounded, medium dense	6		BC=3 5 7			23.8			12			
20	30	Loose	7		BC=3 3 4			31.3						

KLEINFELDER
Bright People. Right Solutions.

PROJECT NO.: 20200652.001A	BORING LOG B-2		FIGURE
DRAWN BY: GG	PG&E Mast Tower Replacement Colusa JCT #1 60kV Colusa and Sutter Counties, California		A-4
CHECKED BY: MP			
DATE: 7/25/2019			PAGE: 1 of 2

BORING LOG B-2

Date Begin - End:	11/19/2019	**Drilling Company:**	Gregg Drilling		
Logged By:	M. Porter	**Drill Crew:**	Eric/Mac/Luis		
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	Fraste	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	HSA/Mud Rotary		
Weather:	Sunny/Clear	**Exploration Diameter:**	6 in. O.D.		

FIELD EXPLORATION / LABORATORY RESULTS

Latitude: 39.14658°
Longitude: -121.91902°
Approximate Ground Surface Elevation (ft.): 50.00
Surface Condition: Bare Earth

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. Pocket Pen(PP)= tsf	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
			Well-Graded SAND with Gravel (SW): non-plastic, gray, moist, medium dense, fine to coarse grained sand, fine to coarse gravel, up to 1", subangular to subrounded	8		BC=8 15 13		SW-SM	11.4		63	7.0			
10	40		**Poorly Graded GRAVEL with Sand (GP)**: fine to coarse-grained, gray, moist, medium dense, fine to coarse gravel up to 1.5", subangular to subrounded, fine to coarse sand	9		BC=4 7 11		GP	17.9		24	4.0			
5	45		**Poorly Graded GRAVEL with Silt and Sand (GP-GM)**: gray, moist, dense, fine to coarse gravel and fine to coarse sand, subangular to subrounded	10		BC=9 14 25		GP-GM			47	6.0			
			Poorly Graded GRAVEL with Sand (GP): gray, moist, dense, fine to sand coarse gravel up to 1", subangular to subrounded, fine to coarse sand												
0	50		Increase in gravel, up to 2"	11		BC=6 14 21		GP			20	3.0			
-5	55														
-10	60														
-15	65														

The boring was terminated at approximately 51.5 ft. below ground surface. The boring was backfilled with cement/bentonite grout on November 19, 2019.

GROUNDWATER LEVEL INFORMATION:
Groundwater was observed at approximately 20 ft. below ground surface during drilling.

GENERAL NOTES:
The exploration location and elevation are approximate and were estimated by Kleinfelder.

KLEINFELDER Bright People. Right Solutions.	PROJECT NO.: 20200652.001A	BORING LOG B-2	FIGURE
	DRAWN BY: GG	PG&E Mast Tower Replacement Colusa JCT #1 60kV Colusa and Sutter Counties, California	A-4
	CHECKED BY: MP		
	DATE: 7/25/2019		PAGE: 2 of 2

KLEINFELDER
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LABORATORY TESTING FROM PREVIOUS EXPLORATIONS

Exploration ID	Depth (ft.)	Sample No.	Sample Description	Water Content (%)	Dry Unit Wt. (pcf)	Sieve Analysis (%)			Atterberg Limits			Additional Tests
						Passing 3/4"	Passing #4	Passing #200	Liquid Limit	Plastic Limit	Plasticity Index	
B-1	6.0	1A	LEAN CLAY (CL)						40	23	17	
B-1	11.0	2A	LEAN CLAY (CL)	24.5	99.7							
B-1	16.0	3A	SILTY SAND (SM)					35	21	18	3	
B-1	20.0	5	POORLY GRADED SAND WITH SILT (SP-SM)					8.8				
B-1	25.0	6	POORLY GRADED SAND WITH SILT (SP-SM)	16.4								
B-1	30.0	7	POORLY GRADED SAND WITH SILT (SP-SM)					5.8				
B-1	35.0	8	POORLY GRADED SAND WITH SILT (SP-SM)	19.2								
B-1	40.0	9	POORLY GRADED SAND WITH SILT (SP-SM)					7.2				
B-2	6.0	2A	SANDY SILT (ML)	22.6	85.0							
B-2	11.0	3	SANDY SILT (ML)	27.7				52				
B-2	16.0	4	SILTY SAND (SM)					25	NP	NP	NP	
B-2	21.0	5	POORLY GRADED SAND WITH SILT (SP-SM)	31.9								
B-2	26.0	6	POORLY GRADED SAND WITH SILT (SP-SM)	23.8				12				
B-2	31.0	7	POORLY GRADED SAND WITH SILT (SP-SM)	31.3								
B-2	36.0	8	WELL-GRADED SAND WITH GRAVEL (SW)	11.4		96	63	7.0				
B-2	41.0	9	POORLY GRADED GRAVEL WITH SAND (GP)	17.9		97	24	4.0				
B-2	46.0	10	POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM)			94	47	6.0				
B-2	51.0	11	POORLY GRADED GRAVEL WITH SAND (GP)			64	20	3.0				

Refer to the Geotechnical Evaluation Report or the supplemental plates for the method used for the testing performed above.
NP = NonPlastic
NA = Not Available

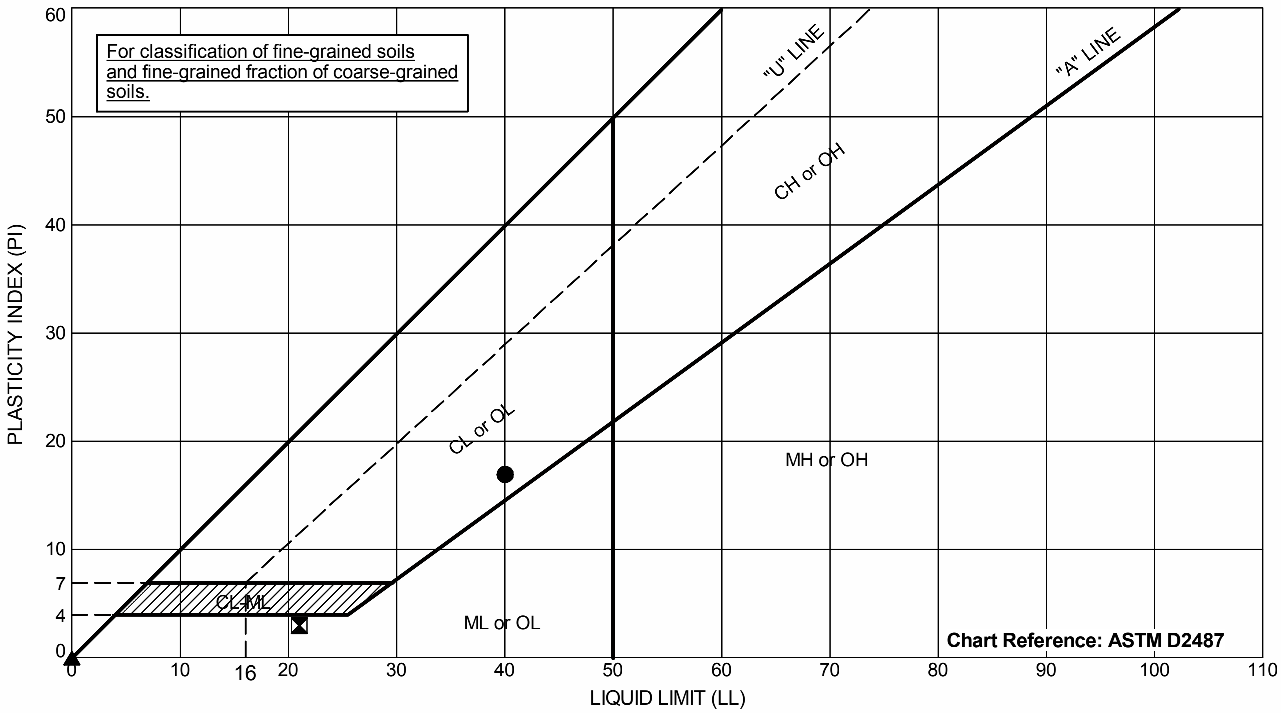
KLEINFELDER
Bright People. Right Solutions.

PROJECT NO.: 20200652.001A
DRAWN BY: GG
CHECKED BY: MP
DATE: 7/25/2019

LABORATORY TEST RESULT SUMMARY

PG&E Mast Tower Replacement
Colusa JCT #1 60kV
Colusa and Sutter Counties, California

FIGURE
B-1



	Exploration ID	Depth (ft.)	Sample Number	Sample Description	Passing #200	LL	PL	PI
●	B-1	6	1A	LEAN CLAY (CL)	NM	40	23	17
⧗	B-1	16	3A	SILTY SAND (SM)	35	21	18	3
▲	B-2	16	NA	SILTY SAND (SM)	25	NP	NP	NP

Testing performed in general accordance with ASTM D4318.
NP = Nonplastic
NA = Not Available
NM = Not Measured

KLEINFELDER
Bright People. Right Solutions.

PROJECT NO.: 20200652.001A

DRAWN BY: GG

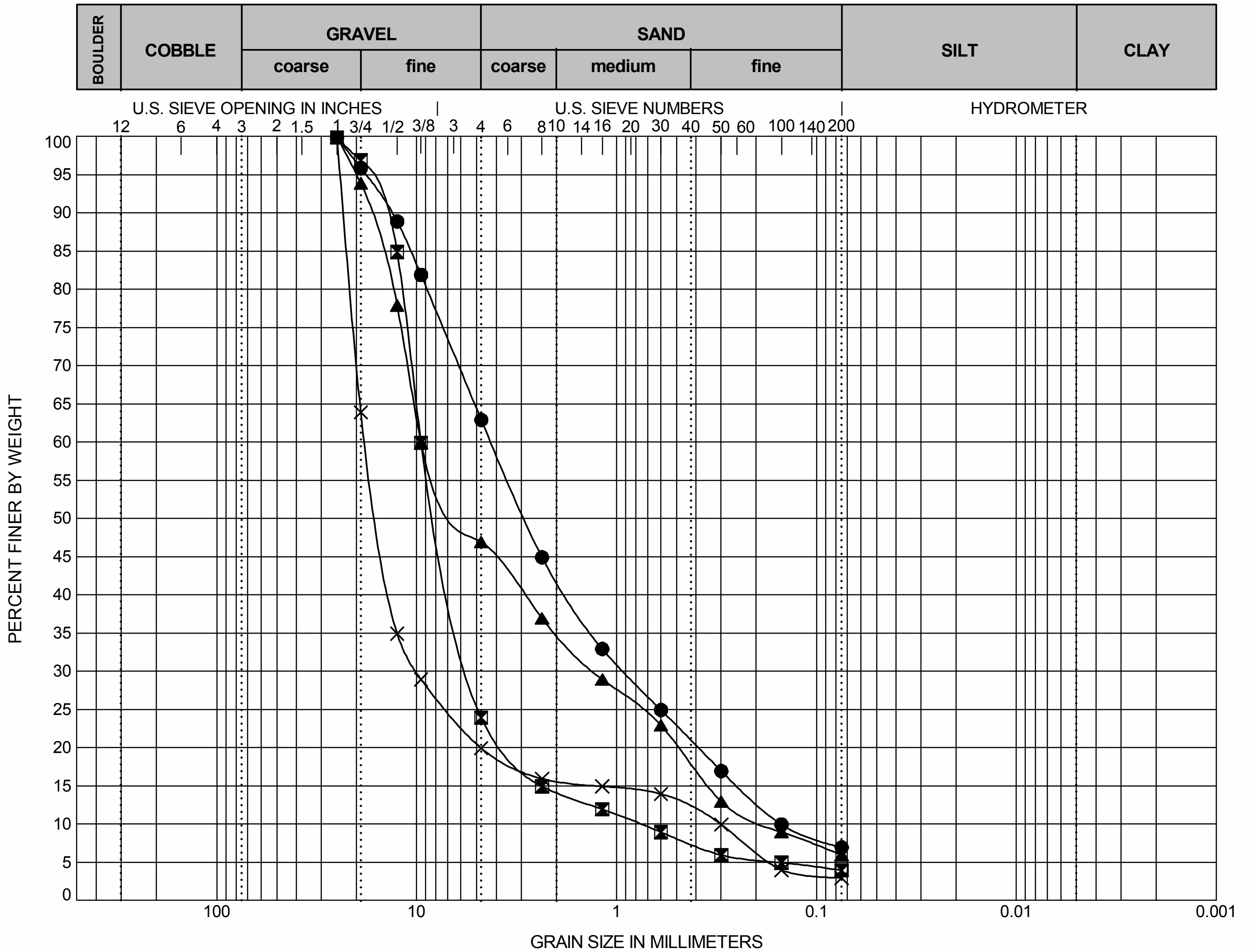
CHECKED BY: MP

DATE: 7/25/2019

ATTERBERG LIMITS

PG&E Mast Tower Replacement
Colusa JCT #1 60kV
Colusa and Sutter Counties, California

FIGURE B-2



	Exploration ID	Depth (ft.)	Sample Number	Sample Description	LL	PL	PI
●	B-2	36	NA	WELL-GRADED SAND WITH GRAVEL (SW)	NM	NM	NM
⧗	B-2	41	NA	POORLY GRADED GRAVEL WITH SAND (GP)	NM	NM	NM
▲	B-2	46	NA	POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM)	NM	NM	NM
╳	B-2	51	NA	POORLY GRADED GRAVEL WITH SAND (GP)	NM	NM	NM

	Exploration ID	Depth (ft.)	D_{100}	D_{60}	D_{30}	D_{10}	Cc	Cu	Passing 3/4"	Passing #4	Passing #200	%Silt	%Clay
●	B-2	36	25	4.227	0.916	0.15	1.32	28.18	96	63	7.0	NM	NM
⧗	B-2	41	25	9.5	5.332	0.752	3.98	12.64	97	24	4.0	NM	NM
▲	B-2	46	25	9.5	1.287	0.178	0.98	53.26	94	47	6.0	NM	NM
╳	B-2	51	25	17.934	9.945	0.3	18.38	59.78	64	20	3.0	NM	NM

Sieve Analysis and Hydrometer Analysis testing performed in general accordance with ASTM D6913(Sieve Analysis) and ASTM D7928 (Hydrometer Analysis).
NP = Nonplastic
NA = Not Available
NM = Not Measured

Coefficients of Uniformity - $C_u = D_{60} / D_{10}$
Coefficients of Curvature - $C_C = (D_{30})^2 / D_{60} D_{10}$
D_{60} = Grain diameter at 60% passing
D_{30} = Grain diameter at 30% passing
D_{10} = Grain diameter at 10% passing

KLEINFELDER
Bright People. Right Solutions.

PROJECT NO.: 20200652.001A
DRAWN BY: GG
CHECKED BY: MP
DATE: 7/25/2019

SIEVE ANALYSIS

PG&E Mast Tower Replacement
Colusa JCT #1 60kV
Colusa and Sutter Counties, California

FIGURE
B-3

PLOTTED: 01/30/2020 01:35 PM BY: GGomez
OFFICE FILTER: STOCKTON
PROJECT NUMBER: 20200652.001A
gINT FILE: Klf_gint_master_2020
gINT TEMPLATE: E:KLF_STANDARD_GINT_LIBRARY_2020.GLB [_KLF_SIEVE ANALYSIS]

Sunland Analytical

11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
(916) 852-8557

Date Reported 07/31/2019
Date Submitted 07/26/2019

To: Steven Wiesner
Kleinfelder-Sacramento
2882 Prospect Dr. Ste 200
Rancho Cordova, CA 95670

From: Gene Oliphant, Ph.D. \ Randy Horney RA
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 20200652.001A-01 Site ID : A005/112@0-5FT.
Thank you for your business.

* For future reference to this analysis please use SUN # 80224-167641.

EVALUATION FOR SOIL CORROSION

Soil pH	6.53		
Minimum Resistivity	2.65 ohm-cm (x1000)		
Chloride	5.5 ppm	00.00055	%
Sulfate	15.1 ppm	00.00151	%

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422m

FIGURE B-4

Sunland Analytical
11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
(916) 852-8557

Date Reported 01/08/2020
Date Submitted 01/03/2020

To: Victoria Tinoco
Kleinfelder-Fresno
3731 W.Ashcroft Ave
Fresno, CA 93722

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 20200652 Site ID : B-2@0-5 BULK.
Thank you for your business.

* For future reference to this analysis please use SUN # 81184-169552.

EVALUATION FOR SOIL CORROSION

Soil pH	5.52		
Minimum Resistivity	0.27	ohm-cm (x1000)	
Chloride	505.0 ppm	00.05050	%
Sulfate	1555.7 ppm	00.15557	%

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422m

FIGURE B-5

APPENDIX E

GBA INFORMATION SHEET

Important Information about This

Geotechnical-Engineering Report

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

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

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

Understand the Geotechnical-Engineering Services Provided for this Report

Geotechnical-engineering services typically include the planning, collection, interpretation, and analysis of exploratory data from widely spaced borings and/or test pits. Field data are combined with results from laboratory tests of soil and rock samples obtained from field exploration (if applicable), observations made during site reconnaissance, and historical information to form one or more models of the expected subsurface conditions beneath the site. Local geology and alterations of the site surface and subsurface by previous and proposed construction are also important considerations. Geotechnical engineers apply their engineering training, experience, and judgment to adapt the requirements of the prospective project to the subsurface model(s). Estimates are made of the subsurface conditions that will likely be exposed during construction as well as the expected performance of foundations and other structures being planned and/or affected by construction activities.

The culmination of these geotechnical-engineering services is typically a geotechnical-engineering report providing the data obtained, a discussion of the subsurface model(s), the engineering and geologic engineering assessments and analyses made, and the recommendations developed to satisfy the given requirements of the project. These reports may be titled investigations, explorations, studies, assessments, or evaluations. Regardless of the title used, the geotechnical-engineering report is an engineering interpretation of the subsurface conditions within the context of the project and does not represent a close examination, systematic inquiry, or thorough investigation of all site and subsurface conditions.

Geotechnical-Engineering Services are Performed for Specific Purposes, Persons, and Projects, and At Specific Times

Geotechnical engineers structure their services to meet the specific needs, goals, and risk management preferences of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client.

Likewise, geotechnical-engineering services are performed for a specific project and purpose. For example, it is unlikely that a geotechnical-engineering study for a refrigerated warehouse will be the same as one prepared for a parking garage; and a few borings drilled during a preliminary study to evaluate site feasibility will not be adequate to develop geotechnical design recommendations for the project.

Do not rely on this report if your geotechnical engineer prepared it:
- for a different client;
- for a different project or purpose;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, the reliability of a geotechnical-engineering report can be affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying the recommendations in it. A minor amount of additional testing or analysis after the passage of time – if any is required at all – could prevent major problems.

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read the report in its entirety. Do not rely on an executive summary. Do not read selective elements only. *Read and refer to the report in full.*

You Need to Inform Your Geotechnical Engineer About Change

Your geotechnical engineer considered unique, project-specific factors when developing the scope of study behind this report and developing the confirmation-dependent recommendations the report conveys. Typical changes that could erode the reliability of this report include those that affect:
- the site's size or shape;
- the elevation, configuration, location, orientation, function or weight of the proposed structure and the desired performance criteria;
- the composition of the design team; or
- project ownership.

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

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

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

This Report's Recommendations Are Confirmation-Dependent

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

This Report Could Be Misinterpreted

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

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

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

Give Constructors a Complete Report and Guidance

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

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. This happens in part because soil and rock on project sites are typically heterogeneous and not manufactured materials with well-defined engineering properties like steel and concrete. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are <u>Not</u> Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually provide environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures.* If you have not obtained your own environmental information about the project site, ask your geotechnical consultant for a recommendation on how to find environmental risk-management guidance.

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

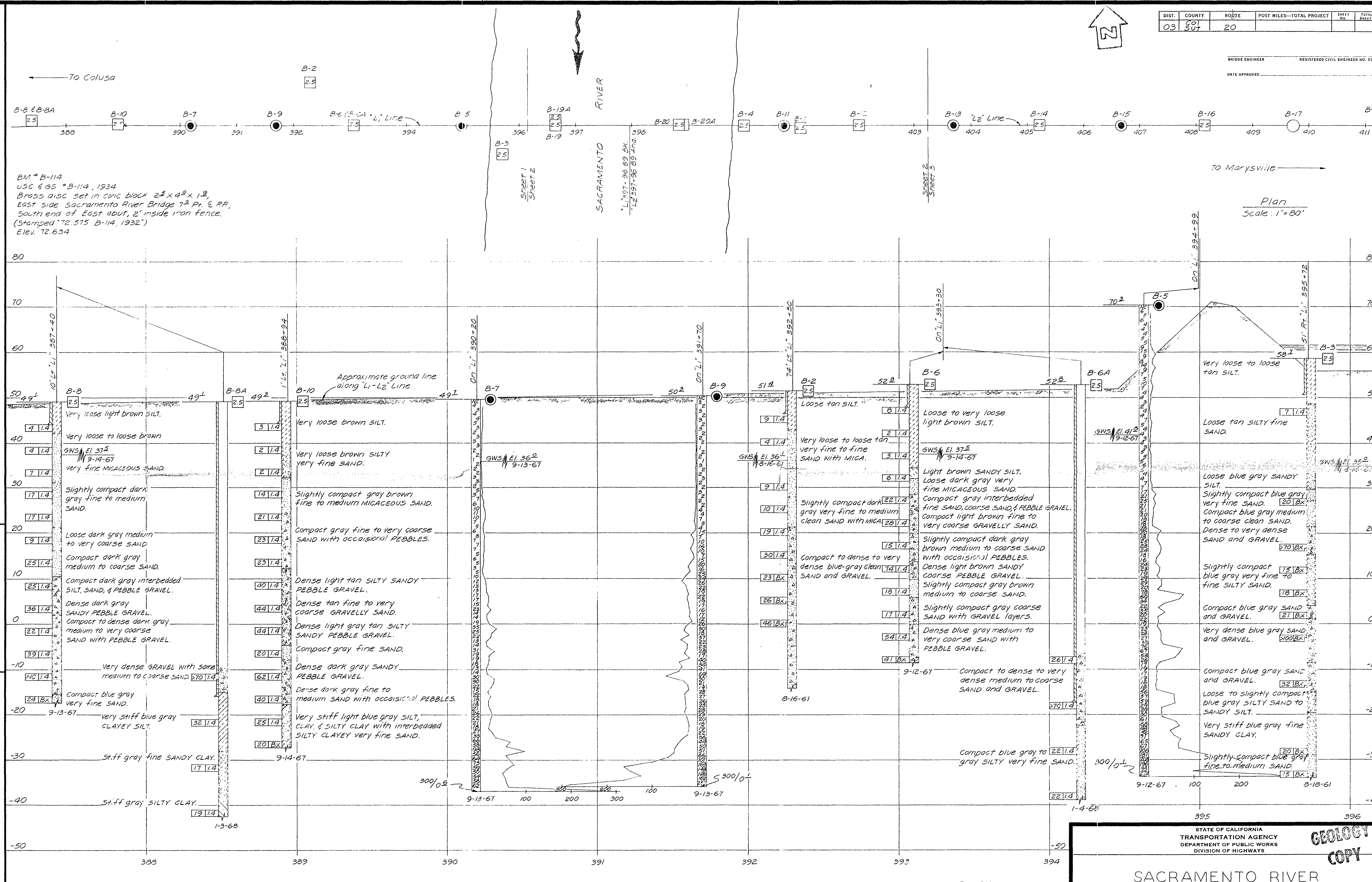
While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, the engineer's services were not designed, conducted, or intended to prevent migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will <u>not</u> of itself be sufficient to prevent moisture infiltration. Confront the risk of moisture infiltration*** by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are <u>not</u> building-envelope or mold specialists.***

GEOPROFESSIONAL BUSINESS ASSOCIATION

Telephone: 301/565-2733
e-mail: info@geoprofessional.org www.geoprofessional.org

2. Log of Test Borings

(Caltrans, 1961-1972)



LEGEND OF BORING OPERATIONS

1" SOIL TUBE — ROTARY BORING — PENETRATION BORING

Penetrometer; $2\frac{1}{2}$" Cone Penetrometer; Sampler boring (dry); Rotary boring (wet); Auger boring (dry); Jet boring; Core boring; Test pit

LEGEND OF EARTH MATERIALS

Gravel; Sand; Silt; Clay; Sandy clay or clayey sand; Sandy silt or silty sand; Silty clay or clayey silt; Peat and/or organic matter; Fill material; Igneous rock; Sedimentary rock; Metamorphic rock

CLASSIFICATION OF MATERIAL BASED ON STANDARD GRADE SIZE LIMITS

Diagram showing the basis for estimates of grade size distribution used in determination of class names. If gravel is present in appreciable amounts the term "gravelly" may be added to the class name, viz. "gravelly sand". The terms "coarse", "medium" and "fine" when used to describe sand, silt and gravel refer to standard grade size limits.

NOTE: Classification of earth material as shown on this sheet is based upon field inspection and is not to be construed to imply mechanical analysis.

BRIDGE DEPARTMENT
ENGINEERING GEOLOGY SECTION

FIELD STUDY	By J. Blanke 1-68
DRAWN	By R. Wong 2-68
CHECKED	

Approval Recommended by Engineering Geologist

DIST.	COUNTY	ROUTE	POST MILES—TOTAL PROJECT	SHEET No.	TOTAL SHEETS
03	Col / Sut	20			

BRIDGE ENGINEER — REGISTERED CIVIL ENGINEER NO. 5565
DATE APPROVED

STATE OF CALIFORNIA
TRANSPORTATION AGENCY
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

GEOLOGY COPY

SACRAMENTO RIVER

LOG OF TEST BORINGS 1 of 3

BRIDGE NO.	POST MILE	DRAWING NO.	SHEET	OF
15-55	38.2/1.8			

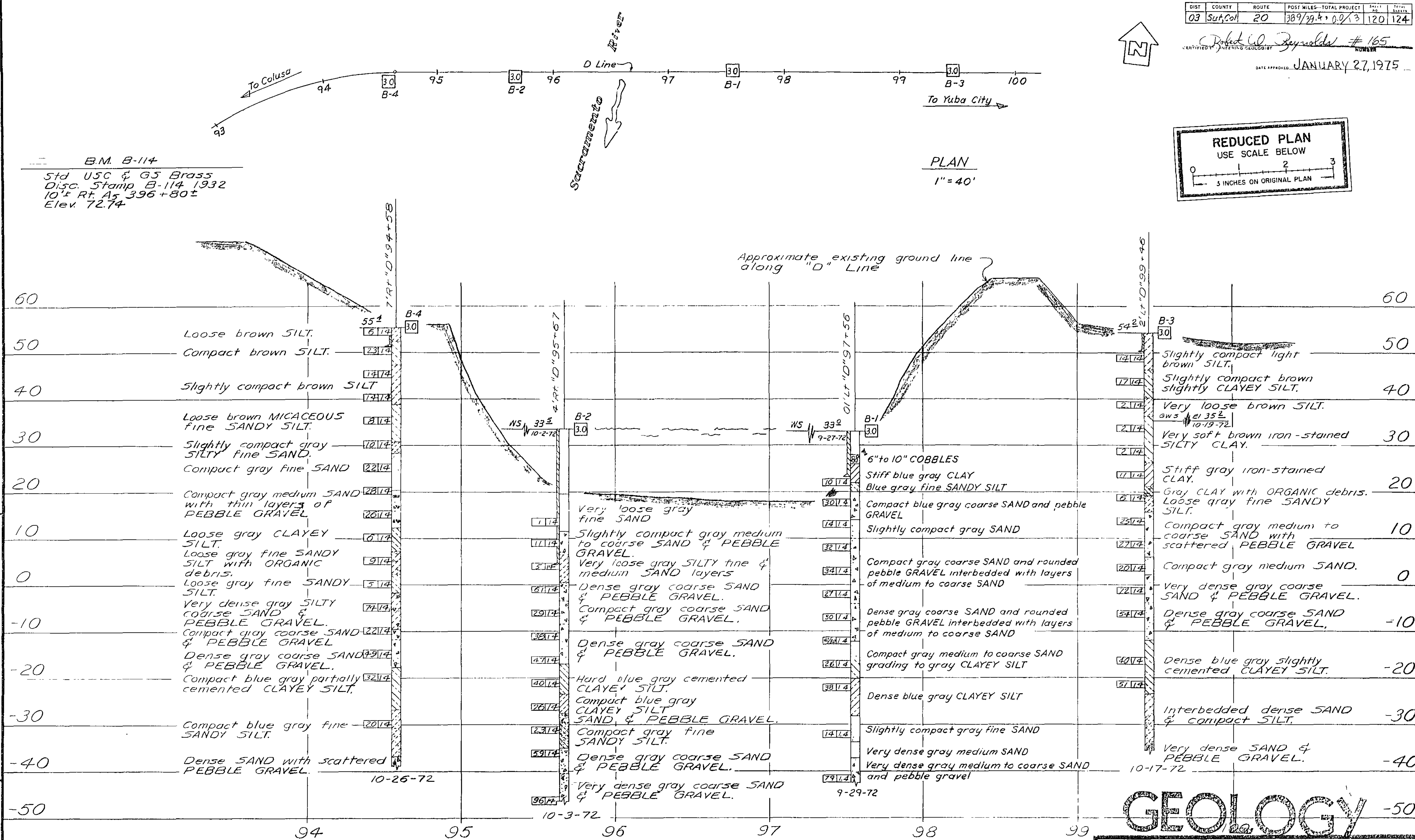
WO 050511
CU 03209
PR 1555-2A

Disregard prints bearing earlier revision dates

REVISION DATES (PRELIMINARY STAGE ONLY)

DIST	COUNTY	ROUTE	POST MILES—TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
03	Sut,Col	20	389/39.4 ; 0.0/13	120	124

Robert W. Reynolds #165
CERTIFIED ENGINEERING GEOLOGIST NUMBER
DATE APPROVED JANUARY 27, 1975



LEGEND OF BORING OPERATIONS

PENETRATION BORING · ROTARY BORING · 1" SOIL TUBE

2½" CONE PENETROMETER · SAMPLER BORING (DRY) · ROTARY BORING (WET) · ROTARY BORING (DRY) · AUGER BORING · JET BORING · CORE BORING · TEST PIT

LEGEND OF EARTH MATERIALS

GRAVEL · SAND · SILT · CLAY · SANDY CLAY or CLAYEY SAND · SANDY SILT or SILTY SAND · SILTY CLAY or CLAYEY SILT · PEAT and/or ORGANIC MATTER · FILL MATERIAL · IGNEOUS ROCK · SEDIMENTARY ROCK · METAMORPHIC ROCK

NOTE: Classification of earth material as shown on this sheet is based upon field inspection and is not to be construed to imply mechanical analysis

CONSISTENCY CLASSIFICATION FOR SOILS

According to the Standard Penetration Test

No. of blows	Granular	Cohesive
0-5	Very loose	Very soft
5-10	Loose	Soft
10-20	Slightly compact	Stiff
20-35	Compact	Very stiff
35-70	Dense	Hard
>70	Very dense	Very hard

CLASSIFICATION OF MATERIAL BASED ON STANDARD GRADE SIZE LIMITS

120

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

DETOUR BRIDGE ACROSS SACRAMENTO RIVER AT MERIDIAN

LOG OF TEST BORINGS

BRIDGE DEPARTMENT
ENGINEERING GEOLOGY SECTION

FIELD STUDY	by R.C. Wilhelms 10-72
DRAWN	by S.T. Kawamura 12-15-72
CHECKED	by J. Sandhu 2-14-73

Approval Recommended by R.C. Wilhelms, Engineering Geologist
Certified Engineering Geologist No. 560

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