APPENDIX C: GEOTECHNICAL REPORT

GEOTECHNICAL INVESTIGATION REPORT
PROPOSED SMUD POCKET 69kV CABLE REPLACEMENT
SACRAMENTO, CALIFORNIA
KLEINFELDER PROJECT # 20190758.004A

FEBRUARY 15, 2019

February 15, 2019
Project No. 20190758.004A

Mr. Patrick Garvey
Sacramento Municipal Utilities District
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SUBJECT: Geotechnical Investigation Report
SMUD Pocket 69 kV Cable Replacement
Florin Road
Sacramento, California
Contract No. 4600001125; Work Order No. 30143702

Dear Mr. Garvey:

The attached report presents the results of Kleinfelder's geotechnical investigation for the Sacramento Municipal Utility District's (SMUD) proposed 69 kV underground cable replacement project located near Florin Road in the Pocket area of Sacramento, California. This report describes the study, findings, conclusions, and recommendations for use in project design and construction.

Based on the information gathered during this study, it is Kleinfelder's professional opinion that the proposed improvements are feasible from a geotechnical engineering standpoint provided the geotechnical recommendations presented in this report are incorporated into the design and construction of the project. Recommendations for open trench construction, construction dewatering, design of subsurface structures, and an evaluation of soil liquefaction potential during a design-level earthquake are included in the report. The recommendations presented herein should be incorporated into project design and construction.

Kleinfelder appreciates the opportunity to provide geotechnical engineering services to SMUD during the design phase of this project. If there are any questions concerning the information presented in this report, please contact this office at your convenience.

Respectfully submitted,

KLEINFELDER, INC.

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PROPOSED SMUD POCKET 69 KV CABLE REPLACEMENT
FLORIN ROAD
SACRAMENTO, CALIFORNIA

1 INTRODUCTION

1.1 GENERAL

In this report we present the results of our geotechnical and dewatering analyses and recommendations for the proposed Sacramento Municipal Utility District (SMUD) Pocket 69 kV Cable Replacement Project along Florin Road, Gloria Drive and Havenside Drive in Sacramento, California. The site location relative to existing streets and topographic features is shown on Figure 1.

Recommendations related to the geotechnical and dewatering aspects of project design and construction are contained herein. The conclusions and recommendations presented in this report are based on the subsurface conditions encountered at the locations of our explorations and the provisions and requirements outlined in the Additional Services and Limitations sections of this report. Recommendations presented herein should not be extrapolated to other areas or used for other projects without our prior review.

1.2 PROPOSED CONSTRUCTION

It is our understanding the project will consist of the replacement of approximately 4 miles of direct buried cable along Florin Road, Havenside Drive, and Gloria Drive in the Pocket area west of Interstate-5 in Sacramento, California. According to preliminary plans provided to Kleinfelder by SMUD, construction is anticipated to include open trenching up to about 8 feet deep and installation of new manholes/pull boxes to approximately 14 feet deep from existing grade. The cables will be placed in a series of conduits (duct bank) that are encased in concrete that is designed for use in electrical duct banks. The encased duct banks in the trench would be backfilled with concrete or a cementitious slurry mixture to the roadway subgrade elevation, followed by placement of the required aggregate base and pavement section.

Due to groundwater levels near the ground surface in this area, dewatering of open trenches and excavations will be needed during construction. We understand SMUD would like to gather geotechnical information in the vicinity of the two substations that are located in the project area for their use in the design of future improvements there. Those substations are located on the northwest and southwest ends of the cable alignment at Gloria Drive west of Florin Road and at Gloria Drive west of Havenside Drive, respectively. The project alignment is shown on Figure 1.

1.3 PURPOSE AND SCOPE OF SERVICES

The purpose of our investigation was to evaluate the subsurface conditions at various locations along the proposed alignment and at the substation sites in order to develop recommendations related to the geotechnical and dewatering aspects of project design and construction.

The scope of our services was outlined in our proposal dated August 9, 2018, and included the following:

- Review existing geologic and geotechnical data including geologic maps and nearby Caltrans test borings
- Perform subsurface explorations at four locations along the project alignment using drilled borings and convert them to groundwater test wells
- Perform aquifer testing in test wells to evaluate hydraulic conductivity values for construction dewatering evaluation
- Perform laboratory testing on soil samples collected form the borings to assess their physical and engineering properties
- Perform engineering analyses to evaluate soil liquefaction potential as well as bearing and lateral earth pressures for design of subsurface structures
- Perform dewatering analysis
- Prepare a report documenting the results of our geotechnical evaluation and aquifer testing that includes the following:
    - Vicinity map and site plan showing the proposed alignment and locations of selected historic and current subsurface explorations.

- Discussion of field activities and methods including detailed logs of the borings/wells
- Results of laboratory testing including soil corrosion potential testing.
- Discussion of the site geologic setting and any seismic hazards such as liquefaction.
- California Building Code (CBC) seismic design parameters for use in structural analysis.
- Discussion of general surface and subsurface conditions including asphalt concrete pavement and aggregate base thicknesses, depth to groundwater, and subsurface stratigraphy along the project alignment.
- Recommendations for temporary excavations and shoring.
- Recommendations for dewatering systems including discussion of slug test results, flow estimation, and radius of influence estimations
- Recommendations for conduit bedding, placement and trench backfill.
- Lateral earth pressures for design of vaults and pull boxes.
- Recommendations for observation and testing services during construction.

2 FIELD EXPLORATION AND LABORATORY TESTING PROGRAM

2.1 FIELD INVESTIGATION

2.1.1 General

Prior to drilling, each location was cleared by advancing a hand auger to an approximate depth of 5 feet for utility clearance. As required by State law, an Underground Service Alert (USA) of Northern California ticket was obtained to notify participating utility companies of the intended subsurface exploration. In addition, a private utility locator was retained to identify and mark known or suspected underground utilities.

A traffic control contractor was utilized at locations within the public right of way. Work was conducted under permit from and inspected by the City of Sacramento and the County of Sacramento. Work was performed in accordance with Kleinfelder's site-specific health and safety plan.

2.1.2 Field Explorations

Four exploratory borings were drilled to depths of about 40 to 50 feet on November 7 through 9 and December 17, 2018, by Taber Drilling of West Sacramento, California. The approximate locations of the borings drilled for this investigation, as well as previous borings drilled by Caltrans for the Florin Road Interstate 5 interchange are shown on Figure 2. The borings for this study were advanced using a truck mounted Diedrich D-120 drill rig. Each boring was initially advanced using mud-rotary drill techniques in a 4-inch-diameter hole to their total depths. Each boring was then over-drilled with 8-inch hollow stem augers to a depth of 30 feet for the installation of a test well. The boring locations were selected in the field in coordination with SMUD personnel. Surveying of each boring/test well was not performed. Therefore, the boring locations shown on the figure are considered approximate.

Kleinfelder staff, under the direction of a California Professional Geologist, maintained a log of the borings during drilling, visually classified the soils encountered according to the Unified Soil Classification System (USCS), and obtained split-spoon samples of the subsurface materials. Soil classifications made in the field from samples were in accordance with ASTM Method D2488.

These classifications were re-evaluated in the laboratory after further examination and testing in accordance with ASTM D2487. Sample classifications, blow counts recorded during sampling, and other related information were recorded on the boring logs. Boring logs from this exploration program are presented in Appendix A.

Soil cuttings were contained in 55-gallon steel drums, removed from each site, and disposed of by our drilling subcontractor.

2.1.3 Sampling Procedures

Soil samples were collected from the borings at depth intervals of approximately 5 feet. Samples were collected from the borings at selected depths by driving a 1.4-inch I.D. sampler (SPT) or 2.5-inch I.D California sampler driven 18-inches into undisturbed soil. The samplers were driven using a 140-pound automatic hammer free-falling a distance of 30-inches. Blow counts were recorded at 6-inch intervals for each sample attempt and are reported on the logs. The apparent density and consistency terminology used in the soil descriptions is based on field observations and sampler blow counts.

The SPT sampler did not contain liners. The California sampler was lined with 6-inch steel tubes. Driven soil samples obtained using these samplers may have experienced some disturbance due to hammer impact, retrieval, and handling. Following drilling, select samples were returned to a Kleinfelder soil and materials testing laboratory for further examination and analysis.

2.1.4 Test Well Installation

Following drilling, a test well was installed and developed in each boring. They were constructed with a 2-inch diameter schedule 40 PVC casing with 0.020-inch mill slotted screen. A sand pack was placed in the annulus of each well to an approximate depth of 3- to 6-inches foot above the top of the well screen. A 2-foot thick bentonite seal was placed on top of the sand pack and hydrated, followed by a neat cement grout to the surface. Each well was completed with an 8-inch flush mount vault set in concrete. The complete well construction log for each boring is reported in Appendix A and summarized below in Table 2.1.

TABLE 2.1
TEST WELL CONSTRUCTION SUMMARY

Test Well ID	Total Depth (ft bgs)	Screened Interval (ft bgs)	First Encountered Groundwater at time of construction (ft bgs)	Static Groundwater Depth post-development (ft bgs)
B-1	30	10-30	6	4.88
B-2	30	10-30	5	3.80
B-3	30	10-30	5	4.67
B-4	30	10-30	6	5.63

Total depth, screened interval and static groundwater depths below ground surface (bgs) are approximate values collected at the time of drilling/development.

The test wells were developed by Confluence Environmental Inc., of Sacramento, California. Properly developed wells are vital in reducing borehole smear and increasing the hydrologic connection of the well. The wells were developed using the surge and bail methods within the well screen interval followed by pumping until a minimum of 10 well volumes had been purged. Temperature, pH, electrical conductivity and turbidity were monitored and recorded during development. Purge water was containerized in drums, removed from each site, and disposed of by Confluence. Development logs for each well are presented in Appendix B.

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 wells were conducted in a manner to increase the effectiveness of the hydrologic connection between the test well and the in-situ (natural) soil and groundwater conditions.

2.2 AQUIFER/SLUG TESTING

Aquifer testing, in the form of slug tests, was performed on December 21, 2018 and January 2, 2019, on the newly installed test wells. 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 well (slug-in or falling head test) and removed (slug-out or rising head test) from the well 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.

2.3 LABORATORY TESTING

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

- Particle-Size Distribution Sieve Analysis (ASTM D6913)
- Unit Weight (ASTM D7263)
- Moisture Content (ASTM D2216)
- Atterberg Limits (ASTM D4318)
- Material Finer Than No. 200 Sieve (ASTM D1140)
- Corrosion Potential (Caltrans Method 643, 417, 422)

Unit weight, moisture content, particle size distribution sieve analysis, percent passing the No. 200 sieve, and Atterberg limits results are summarized on the boring logs presented in Appendix A. The test results are included in Appendix C.

2.4 PREVIOUS INVESTIGATION

Prior to this investigation, Caltrans (in 1966) performed soil borings for the Florin Road and Interstate 5 interchange located near the eastern end of the project alignment. A location map and logs of those borings are included in Appendix D.

3 GEOLOGIC AND SEISMIC CONDITIONS

3.1 REGIONAL GEOLOGY

The site is situated in the southwestern portion of Sacramento County, California, within the southern portion of the Sacramento Valley. The Sacramento Valley represents the northern portion of the Great Valley geomorphic province of California which is bordered on the east by the foothills of the Sierra Nevada geomorphic province and on the west by the Coast Range geomorphic province. The Great Valley is an asymmetrical trough approximately 400 miles long and 40 miles wide forming the broad valley along the axis of California. Erosion of the Coast Range and the Sierra Nevada has generated alluvial, overbank, and localized lacustrine sediments as thick as 50,000 feet. Subsequent deformation has folded these sediments into an asymmetrical syncline. Along the boundaries of the Sacramento Valley basin, these sediments decrease in thickness to the east and overlap older, alluvial and channel deposits associated with previous alignments of the American River and at greater depth, metamorphic terrain and crystalline basement rock of the Sierra Nevada.

3.2 SITE GEOLOGY

The project area has been mapped by a number of geologists on a regional scale, including published maps by Helley and Harwood (1985). Most recently, the study area has been mapped for the purpose of levee evaluation by Fugro William Lettis & Associates (FWLA) (2010). Their mapping is shown on the geologic map presented on Figure 3. The near-surface soils consist primarily of historical and Holocene basin deposits. These basin deposits are characterized by fine sands, silts, and clays. This is consistent with the soils encountered in the borings drilled for this study.

3.3 FAULTING AND HISTORIC SEISMICITY

Major, active fault zones of California are generally distant from the Sacramento Valley and include (from west to east as identified by Jennings, 1994):

- San Andreas Fault Zone (Historic) - 75± miles southwest
- Great Valley Fault system (e.g. Vaca Fault, etc.) - 26± miles southwest

- Sierra Nevada Frontal Fault System (Historic) - 27± miles east

Significant historic seismicity in the region includes the April 19, 1892 Vacaville earthquake which had an estimated magnitude of 6.6 along with significant seismicity associated with the San Andreas fault system (e.g. 1906 San Francisco Earthquake and 1868 Hayward Earthquake) and more recent 2014 South Napa Earthquake which had an estimated magnitude of 6.0.

Based on the above information, the primary issues regarding the effects of regional earthquakes at the site is ground shaking and soil liquefaction. Liquefaction can cause ground settlement and boils. This issue has been evaluated for this report and further discussion is provided in the following sections.

4 SITE CONDITIONS

4.1 SITE DESCRIPTION

The project alignment is located in a developed area along Florin Road, Gloria Drive and Havenside Drive in Sacramento, California. The topography of the alignment is relatively flat except at the canal crossing where Havenside Drive and Gloria Drive meet. Residential and commercial developments about the streets throughout the project alignment. Small to large trees line many of the streets in this area. Electrical substations exist at the northwest and southwest ends of the alignment along Gloria Drive.

4.2 SUBSURFACE CONDITIONS

The subsurface conditions encountered in the borings drilled for this study generally consist of lean and fat clays to depths of about 10 and 15 feet below the ground surface underlain by very soft to medium stiff silts, sandy silts, poorly-graded sands and lean clays to the total depths of the borings. These soils appear consistent with the geologic mapping of the area that shows quaternary alluvium and basin deposits.

On the far eastern edge of the alignment near Interstate 5, the soils encountered by Caltrans generally consist of silts and clays with predominantly fine-grained sand. The soil from original grade to a depth of about 10 to 15 feet was generally soft/loose and increased to very stiff/dense below that. These soils appear consistent with the mapped Riverbank formation. However, some recent alluvium appears to overlie the Riverbank formation materials. The approximate limits of the geologic units that underlie the site are shown on the geologic map presented on Figure 3.

Detailed descriptions of the subsurface conditions encountered during our field investigation are presented on the Logs of Borings in Appendix A. Logs of borings from Caltrans at the Florin Road overcrossing are presented in Appendix D.

4.3 GROUNDWATER

Groundwater was encountered in the borings drilled for this study at depths between about 5 and 6 feet below the ground surface. It is common in this area for groundwater levels to be at or near the ground surface during periods of elevated stage on the Sacramento River, since seepage under the levees contributes to the groundwater levels in this area. Further to the east near Interstate 5, groundwater levels encountered in the Caltrans borings (Caltrans, 1966) were between about 7 and 10 feet below the ground surface.

Groundwater elevations and soil moisture conditions within the project area will vary depending on seasonal rainfall, Sacramento River stage, irrigation practices, land use, and/or runoff conditions not apparent at the time of Kleinfelder's investigation. The evaluation of such factors is beyond the scope of this investigation.

4.4 SOIL CORROSION POTENTIAL

The results of soil corrosion potential evaluations performed on samples collected from the site are presented below in Table 4.1, Summary of Corrosion Test Results. While we arranged for corrosion testing to be performed on samples collected from our borings as part of this study, Kleinfelder's scope did not include corrosion engineering. We recommend a competent corrosion engineer evaluate the corrosion potential of the site to proposed improvements, recommend further testing as required, and provide specific corrosion mitigation methods appropriate for the project.

TABLE 4.1
SUMMARY OF CORROSION TEST RESULTS

Boring/ Depth (feet)	pH	Resistivity (ohm-cm x1000)	Sulfate (SO_4) (ppm)	Chloride (Cl) (ppm)
B-1+B-2 COMP / 0-10	7.30	1.77	16.4	13.9
B-3+B-4 COMP / 0-10	7.25	1.45	24.2	22.4

According to ACI 318 Section 4.3, Table 4.3.1, a sulfate concentration below 0.10 percent by weight (1,000 ppm) is negligible. A water-soluble chloride content of less than 500 ppm is generally considered non-corrosive to reinforced concrete.

One factor for evaluating soil corrosivity is electrical resistivity. The electrical resistivity of a soil is a measure of resistance to the flow of electrical current. Corrosion of buried metal is an electrochemical process in which the amount of metal loss due to corrosion is directly proportional to the flow of electrical current (DC) from the metal into the soil. As the resistivity of the soil decreases, the corrosivity generally increases. A common correlation between soil resistivity and corrosivity towards ferrous metals (Roberge, 2006) is provided in Table 4.2 below:

TABLE 4.2
TYPICAL CORROSION CORRELATION

Resistivity in Ohm-centimeters	Corrosivity Category
0 to 1,000	Severely Corrosive
1,000 to 2,000	Corrosive
2,000 to 10,000	Moderately Corrosive
over 10,000	Mildly Corrosive
Reference: NACE Corrosion Basics, 2006	

Based on the results of laboratory tests performed on the subsurface materials, resistivities ranging from 1,454 to 1,773 ohm-cm indicate these soils would generally be categorized as corrosive toward ferrous metals. Values of pH ranging from 7.2 to 7.3 indicate these soils are essentially neutral.

Based on these results, portland cement concrete and reinforcing steel used for structures should not be adversely affected by sulfates or chloride ions.

We have provided the above corrosion test results only as an indicator of potential soil corrosivity for the samples tested. Other soils found on the site may be more, less, or of a similar corrosive nature.

5 CONSTRUCTION DEWATERING ANALYSIS

This section presents the findings of Kleinfelder's analysis of aquifer testing and soil grain size 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.

5.1 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. The expanded slug test evaluations can be reviewed in Appendix E. The resulting hydraulic conductivity estimates are summarized below in Table 5.1.

TABLE 5.1
HYDRAULIC CONDUCTIVITY ESTIMATES FROM SLUG TESTING

Test Well ID	SLUG IN-1	SLUG OUT-1	SLUG IN-2	SLUG OUT-2	SLUG IN-3	SLUG OUT-3	GEOMETRIC MEAN
B-1	2.38E-03	2.08E-03	2.52E-03	2.14E-03	2.73E-03	2.39E-03	2.36E-03
B-2	6.88E-03	9.15E-03	7.80E-03	9.68E-03	6.89E-03	9.41E-03	8.22E-03
B-3	1.04E-02	1.03E-02	1.03E-02	1.01E-02	9.39E-03	1.00E-02	1.01E-02
B-4	1.91E-02	1.20E-03	1.35E-02	1.28E-03	1.25E-02	1.28E-03	4.30E-03

Units: 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 mean hydraulic conductivity values from slug test data from each well tested (B-1, B-2, B-3, B-4) ranged from 2.36 x 10^{-3} feet/minute (ft/min) to 1.01 x 10^{-2} ft/min. Each of the test wells were screened in primarily silts and clays with fine sand.

5.2 GRAIN SIZE DISTRIBUTION ANALYSIS

Kleinfelder performed grain size analysis on select samples collected from the saturated screened zone of each well. 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 F. The resulting conductivity estimates (only reported for the methods which met the qualification criteria) are summarized in Table 5.2.

TABLE 5.2
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
B-1	30	Sandy Silt (ML)	51	6.24E-06	6.30E-02	4.30E-04
B-2	15	Clayey Sand (SC)	36	1.15E-04	9.14E-02	1.63E-03
	25	Sandy Lean Clay (CL)	61	4.36E-06	8.78E-02	3.27E-04
B-3	30	Sandy Silt (ML)	55	5.36E-06	5.94E-02	4.01E-04
B-4	20	Sandy Silt (ML)	63	4.09E-06	1.22E-01	3.38E-04
	30	Silt with Sand (ML)	73	3.04E-06	1.94E-01	3.04E-04

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

5.3 VARIABILITY IN RESULTS

The slug testing generally estimates hydraulic conductivity over the entire screened interval of the test well. The displaced water returns to equilibrium radially with components of both horizontal and vertical flow. In comparison to grain size distribution analysis, the slug test is generally considered the more reliable means of estimating hydraulic conductivity due to the nature of the in-situ testing and the hydraulic effect over the entire screened interval with a radial flow.

The grain size analysis estimates hydraulic conductivity from only the discrete (potentially disturbed) sample interval, which is typically approximately 6 inches in length. The grain size analyses are based on the conditions of the samples when retrieved from the borehole which can include disturbance compared to natural, in-situ conditions. The high and low hydraulic conductivity range values noted from the grain size analysis indicate hydraulic conductivity within the interval analyzed but does not account for differences in soil type outside of the sample interval (both laterally and vertically) or within the saturated zone, such as those that might be seen for example during the slug testing. In addition, the grain size testing procedure highly alters the original physical texture (i.e., bedding, cementation, grading, etc.) of the soil.

The hydraulic conductivity estimates from the aquifer testing vary by approximately one to two orders of magnitude from the grain size distribution tests. This variability, while considerable, is within reason given the limited and theoretical nature of the laboratory tests.

5.4 LITHOLOGIC CORRELATION

The range of hydraulic conductivity estimates generally correlate with soil type. The soils in the screened section of each of the 4 borings were predominantly fine-grained (silts and clays). Published typical hydraulic conductivity values for similar unconsolidated sediments range from 1.97×10^{-5} ft/min to 1.97×10^{-2} ft/min (Fetter, 2001). The hydraulic conductivity values from slug testing and grain size analysis range from 3.04×10^{-4} ft/min to 1.01×10^{-2} ft/min.

6 ESTIMATED DEWATERING PARAMETERS

Presented in the following sections is our assessment of groundwater conditions and estimated dewatering parameters based on a limited data set.

6.1 DEWATERING FLOW CALCULATION

Kleinfelder employed the following formula for estimating dewatering flow to an open excavation in an unconfined aquifer of specified thickness (Powers, 2007), where:

$$Q = 7.48\left[\frac{\pi K(H^2 - h^2)}{ln\frac{R_0}{r_s}}\right]$$

And: Q = Flow in gallons per minute (gpm)
K = Hydraulic Conductivity in feet/minute
H = Aquifer thickness in feet
h = Dewatered aquifer thickness in feet
R_o = Radius of influence in feet
r_s = Effective radius of the dewatering system

Theoretically, the R_o is independent of the drawdown and is related to the pumping time (Powers). For the estimation of $R_{o,}$ we used the Sichart and Kryieleis formula which uses the relationship of drawdown (H-h) and hydraulic conductivity (K).

$$R_o = 3000\ (H\text{-}h)\ K^{1/2}$$

And: K = Hydraulic Conductivity in feet/minute (converted from meters per second)
H = Aquifer thickness in feet (converted from meters)
h = Dewatered aquifer thickness in feet (converted from meters)
R_o = Radius of influence in feet (converted from meters)

This calculation is an analytical model used to approximate flow to a system with the following assumptions:

- The system is in equilibrium, meaning the pumping has continued until it has recharge equal to the discharge
- The system is approximated as flow from one source (single point)
- The aquifer is unconfined, homogenous, isotropic, of uniform thickness and extends horizontally in all directions
- The dewatering system is frictionless and fully penetrates the aquifer

Although the model treats the flow from a dewatered excavation as a single source, typical large dewatering systems will consist of multiple sources.

Actual dewatering flows will vary from the theoretical calculations based on several parameters, including but not limited to:

- Depth to groundwater and amount of drawdown required
- Variations in aquifer lithology, thickness, isotropy, lateral extent and confinement
- Hydraulic conductivity
- Distance to recharge source
- Hydraulic boundaries: Positive (infiltration from precipitation, inundation or landscaping, seepage from surface bodies of water, etc.) or negative (leakage to surface bodies of water or connecting aquifers, aquitards [artificial or naturally occurring], etc.)

6.2 DEWATERING EVALUATION

This evaluation is based upon our understanding of soil conditions, groundwater observations, and data analysis from aquifer testing and grain size distribution as described above. The evaluation is made from a limited set of data.

The excavation dimensions and depths were obtained from communications with SMUD project personnel. The values for dewatering flow and radius of influence presented are shown for estimating purposes based on the limited data; however, they will likely vary from actual construction conditions. Actual dewatering flows will depend upon the actual groundwater levels at the time of construction, the actual soil conditions encountered during excavation, and the actual size and depth of the excavations. Discharge rates are expected to be higher at the start of dewatering activities and decrease over time as pumping continues and the target water level is reached.

In addition, our evaluation also did not factor in potential effects of a positive or negative recharge boundary since our scope of work did not include pumping tests or advanced groundwater modeling. A positive recharge boundary within the radius of influence of the dewatering system, such as infiltrating water or a nearby water source could increase flow rates.

It is assumed that the radius of influence extends evenly from the center of the excavation in all directions. The radius of influence of the dewatering system is a rough approximation made from several estimated and non-empirical aquifer parameters. If refinement of radius of influence is desired at sensitive locations, a pumping test can be conducted to more accurately define its extent.

It is our understanding that approximately 18 manholes and 8,871 feet of trench will be excavated. The hydraulic conductivities from slug testing at the 4 selected locations are assumed to be representative of site conditions throughout the project alignment. The high and low hydraulic conductivities are presented for each conceptual dewatering model below.

6.2.1 Manhole Excavation Conceptual Dewatering Model

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

- Unconfined aquifer thickness of 40 feet (assumed)
- Excavation size: 12 feet wide by 18 feet long by 14 feet deep (assumed)
- Water table depth of 4 feet below ground surface (assumed)
- A required drawdown of the water table of 12 feet (2 feet below the bottom of excavation) (assumed)

- Low and high hydraulic conductivity of 2.36 x 10^{-3} feet/minute (ft/min) to 1.01 x 10^{-2} ft/min, respectively
- Specific yield of 0.15 (assumed)
- Time required to reach equilibrium conditions is 1 day (assumed)
- No positive or negative hydraulic boundaries

6.2.1.1 Manhole Excavation Estimated Dewatering Flow

Using the parameters stated in our conceptual dewatering model, estimates for dewatering flow and dewatering induced radius of influence are summarized Table 6.1 below.

TABLE 6.1
MANHOLE EXCAVATION DEWATERING ESTIMATES

Assumed Depth to Groundwater (ft)	Assumed Required Drawdown (ft)	Hydraulic Conductivity (ft/min)	Flow Estimate (gallons per minute)	Daily Flow (gallons per day)	Radius of Influence Estimate (feet)
4	12	Low 2.36 x 10^{-3}	30	43,200	45
		High 1.01 x 10^{-2}	85	122,400	93

6.2.2 Trench Conceptual Dewatering Model

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

- Unconfined aquifer thickness of 40 feet (assumed)
- Excavation size: 4 feet wide by 100 feet long by 8 feet deep (assumed)
- Water table depth of 4 feet below ground surface (assumed)
- A required drawdown of the water table of 6 feet (2 feet below the bottom of excavation) (assumed)
- Low and high hydraulic conductivity of 2.36 x 10^{-3} feet/minute (ft/min) to 1.01 x 10^{-2} ft/min, respectively

- Specific yield of 0.15 (assumed)
- Time required to reach equilibrium conditions is 1 day (assumed)
- No positive or negative hydraulic boundaries

6.2.2.1 Trench Estimated Dewatering Flow

Using the parameters stated in our conceptual dewatering model, estimates for dewatering flow and dewatering induced radius of influence are summarized Table 6.2 below.

TABLE 6.2
TRENCH DEWATERING ESTIMATES

Assumed Depth to Groundwater (ft)	Assumed Required Drawdown (ft)	Hydraulic Conductivity (ft/min)	Flow Estimate (gallons per minute)	Daily Flow (gallons per day)	Radius of Influence Estimate (feet)
4	6	Low 2.36×10^{-3}	26	37,440	45
		High 1.01×10^{-2}	64	92,160	93

7 CONCLUSIONS AND RECOMMENDATIONS

7.1 GENERAL

Based on the results of our investigation, it is our professional opinion the site should be suitable for the proposed improvements using conventional open trench, shoring, dewatering, and reinforced concrete subsurface structure construction methods. However, the presence of shallow groundwater will affect construction. Excavation shoring and temporary dewatering is anticipated to be needed for all excavations. Presented in the following sections of this report are recommendations for project design and construction with regard to open trench pipeline installations and subsurface vault and pull box structures.

7.2 SOIL LIQUEFACTION

Saturated Holocene alluvial deposits subjected to seismic loading may undergo a condition known as liquefaction. Occurrence of liquefaction during an earthquake can potentially cause reduction in or loss of shear strength, seismically induced settlements, formation of boils, or lateral spreading of the liquefied soil. In order for liquefaction of soils due to ground shaking to occur, it is generally accepted that four conditions will exist:

- The subsurface soils are in a relatively loose state.
- The soils are saturated.
- The soils are sand like (e.g. non-plastic or of very low plasticity).
- The ground motion is of sufficient intensity to act as a triggering mechanism.

Potential for liquefaction is greatly reduced with increasing fines content and plasticity in the subject soil (e.g. Bray and Sancio, 2006). Geologic age and depositional environment also influence the potential for liquefaction, with younger loose fluvial deposits generally the most susceptible to liquefaction and older denser sediments generally having reduced susceptibility (Youd and Hoose, 1977). Materials of the Pleistocene Riverbank formation are generally not susceptible to liquefaction due to their characteristics and geologic age.

We evaluated the susceptibility of fine-grained soils to liquefaction using the criteria proposed by Bray and Sancio (2006). We also reviewed the depositional environment and other factors affecting liquefaction susceptibility. Based on this review, it appears that the silty and sandy soils encountered in all four borings were potentially susceptible to liquefaction.

Liquefaction triggering analyses were performed using the method of Idriss and Boulanger (2008) for drilled borings. For the purposes of this evaluation, soils were considered liquefiable if the calculated safety factor against liquefaction was less than 1.10. Liquefaction-induced settlements were estimated using the procedure recommended by Idriss and Boulanger (2008), with values of calculated settlement presented in Table 7.1 below. These values are average values assuming uniform free field conditions and neglecting the impact of bridging. Review of the borings indicates the borings did not extend into competent material, so it is possible that susceptible soils exist below the maximum depths explored. However, the potential for settlement below that depth is not likely to be severe.

TABLE 7.1
ESTIMATED LIQUEFACTION SETTLEMENTS AND DEPTHS

Boring Number	Approximate Depth Ranges of Liquefiable Materials	Approximate Liquefaction Settlement
B-1	20 to 50+ feet	10 to 14 inches
B-2	12 to 15 feet	<2 inches
B-3	20 to 50+ feet	11 to 15½ inches
B-4	15 to 40+ feet	9 to 13 inches

*Values with '+' indicate that competent material was not encountered below deepest depth explored and that additional liquefiable material may exist beyond the maximum depth evaluated.

It should be noted that liquefaction settlements of the magnitude estimated herein are large and would likely cause severe damage to improvements not supported on deep foundations. Differential ground settlement could be severe. Lateral spread, cyclic mobility, and strength loss could also occur. Differential settlement exceeding about 4 to 6 inches over 50 feet are likely to cause damage to the electrical duct banks.

Widespread liquefaction within the Pocket Area will likely significant damage in the unlikely event of a significant earthquake on a nearby fault. It should be understood that it may not be practical to mitigate severe liquefaction settlement or other effects for this project. Alternative measures such as emergency shutoffs or other risk reduction measures may be acceptable alternatives to reduce risks associated with widespread liquefaction damage.

7.3 ANTICIPATED EXCAVATION CONDITIONS

The near-surface soils encountered in the borings consist primarily of soft lean clays and silts with some clayey sands. Due to very shallow groundwater levels and very soft soils, the majority of these soils are not expected to stand near vertical and should be shored.

7.4 TEMPORARY EXCAVATIONS

7.4.1 General

All excavations must comply with applicable local, state, and federal safety regulations including the current OSHA Excavation and Trench Safety Standards. Construction site safety generally is the sole responsibility of the Contractor, who should also be solely responsible for the means, methods, and sequencing of construction operations. We understand unshored (i.e., sloped) excavations will not be permitted on this project.

7.4.2 Excavations and Slopes

The Contractor should be aware that slope height, slope inclination, or excavation depths (including utility trench excavations) should in no case exceed those specified in local, state, and/or federal safety regulations (e.g., OSHA Health and Safety Standards for Excavations, 29 CFR Part 1926, or successor regulations). Such regulations are strictly enforced and, if they are not followed, the Owner, Contractor, and/or earthwork and utility subcontractors could be liable for substantial penalties.

7.4.3 Trench Wall Stability

Trench wall stability will be dependent on the soil and groundwater conditions in the areas of excavations. Groundwater is anticipated to be near the ground surface, as the Sacramento River stage is above the ground surface in this area for most of the year. Seepage beneath the Sacramento River levees is a major contributor to the elevated groundwater levels in this area. That and the presence of low cohesion soils may render trench sidewalls unstable and temporary shoring systems are anticipated to be needed.

Our experience with trench excavation projects in similar materials in the area is that trench sidewalls will likely not stand near vertical until positive sidewall shoring/support can be installed. In all cases, the Contractor should select an excavation, dewatering, and/or shoring scheme that will protect adjacent improvements including surrounding pavements, sidewalks, and buried utilities.

All surface runoff or overland flows should be diverted by earthen berms or other methods to prevent water from entering the excavations. All runoff water and/or groundwater encountered within the excavation(s) should be collected and disposed of outside the construction limits.

Heavy construction equipment, construction materials, excavated soil, and vehicular traffic should not be allowed within ½ the slope height from the top of any unshored excavation. Where the stability of adjoining buildings, walls, pavements, or other improvements is endangered by excavation operations, support systems such as shoring, bracing, or underpinning may be required to provide structural stability and to protect personnel working within the excavation. Shoring, bracing, or underpinning required for the project (if any) should be designed by a professional engineer registered in the State of California. If soft trench bottom conditions are encountered during construction, the shoring designer should confirm that the effects of soft trench bottom will not affect the performance of the shoring system.

7.5 TEMPORARY DEWATERING

7.5.1 Shallow Groundwater

Groundwater was encountered at depths between about 5 and 6 feet below the ground surface during the explorations performed for this project. Previous explorations performed by others and local groundwater level data from the California Department of Water Resources also show groundwater levels near the ground surface.

7.5.2 Dewatering

Hydraulic conductivity is the primary soil parameter governing the rate of flow through a dewatering system. Analysis of the data gathered from our investigation indicate that hydraulic conductivity values across the site range from 2.36×10^{-3} ft/min to 1.01×10^{-2} ft/min. These values fall within the general range of published values for the soil type. The depth to groundwater across the site ranged from 3.80 feet at Boring B-2 to 5.63 feet at Boring B-4.

Variations in hydraulic conductivity may lead to changes in time to achieve equilibrium, radius of influence, and rate of expected flow estimations. Given the stated assumptions and parameters in the conceptual dewatering model we anticipate the highest flow rate to reach a dewatered condition suitable for manhole excavation work (in an excavation area of 12 feet by 18 feet and 14 feet deep) to be approximately 85 gallons per minute (122,400 gallons per day) and the highest flow rate to reach a dewatered condition suitable for trench work (in an excavation area of 4 feet by 100 feet and 8 feet deep) to be approximately 64 gallons per minute (92,160 gallons per day). Multiple wells may be needed to achieve interlocking cones of depression and the overall drawdown goals depending on the actual excavation conditions.

The dewatering system utilized will be depend on the construction method. Open excavation dewatering may reasonably be accomplished (depending on the final excavation dimensions and construction factors) using a sump, drains and open pumping methods or dewatering wells, or a combination of both. Poorly-constructed sump, drain, and open pumping methods of dewatering have a high risk of pumping fine soil material which can lead to erosion, slope instability, settlement of structures, and boils and blowouts. Other dewatering methods may be feasible. Dewatering systems should be selected after careful assessment of safety, cost, efficiency, time and space concerns.

For dewatering at manhole excavations, dewatering wells will likely be the most relevant option due to the shallow water table. Pumped wells consist of large diameter holes (typically 24 to 36-inches) and large diameter casings/screens (typically 8 to 16-inch diameter), with sufficient depth to provide drawdown of the water table many feet. Each well in a system (or single well) has a pump near the bottom of the casing. These types of systems are best used in coarse-grained (high permeability) formations that provide for a large radius of influence and wide spacing of wells (typically 25 feet to 250 feet) and high volumes of dewatering discharge (25 to 250+ gpm/well). We recommend the use of one to two wells for pre-construction dewatering, allowing excavation to occur in a dry condition. Additional wells can be added as need be (e.g., installation of wells on opposite ends of the excavation). The wells should be constructed in a 24 to 30-inch borehole to a depth of 30 feet. We recommend an 8-inch diameter PVC casing with 20 feet of screen with a pea-gravel filter pack. The well should be equipped with 2 to 5 horsepower submersible pump capable of handling flows up to 100 gpm.

Interactions of shallow aquifers near large bodies of water can be complex and may be complicated by dewatering activities. The project site is in the immediate vicinity of the Pocket Canal, which may serve as a significant recharge boundary during dewatering. In addition, consideration should be given to potential impacts from construction dewatering such as settlement of existing structures, groundwater contaminant transport, and treatment of pumped discharge water. It is recommended that dewatering be performed within groundwater barriers, such as sheet pile or similar shoring systems embedded at sufficient depth to prevent hydrostatic uplift of the trench bottom. Dewatering using wells creates a cone of depression around the well. If groundwater levels are lowered below historical lows, ground settlement can occur. This can be avoided by dewatering from within groundwater barriers. Otherwise, the cones of depression will extend beyond the excavations and settlement of surrounding improvements can occur.

7.5.3 Monitoring for Construction

We suggest doing a baseline survey of existing improvements surrounding the proposed excavation sites to document existing conditions prior to dewatering. Monitoring of ground surface settlement around excavations should be performed during dewatering operations. In general, we recommend monitoring ground surface survey points daily during the first week of dewatering and about weekly thereafter. If settlement readings continue to increase over successive readings or exceed threshold levels (generally about ¼ to ½ inch), dewatering should be stopped and an evaluation made as to the causes of the observed settlement.

7.6 SHORING

7.6.1 General

Shoring system design and installation on this project should be the responsibility of the Contractor. Shoring systems should be designed by a California Registered Civil Engineer based on the conditions exposed in the areas of excavation.

Sheet piles, trench shields, speed shoring, trench jacks, internally braced systems, or other forms of shoring may be used where appropriate throughout the project provided Cal OSHA regulations are met. The shoring system should be provided with continuous sheeting so as to retain any saturated and/or cohesionless soils.

Where trenches are excavated in existing roadway areas or near existing facilities, we recommend shoring systems be designed to provide positive restraint of trench walls. Where positive restraint of trench walls is not provided, lateral deformation of the trench walls may result in ground cracks, settlement and/or other ground movements that may affect adjacent underground utilities as well as surface improvements. If trench walls deflect laterally in pavement areas, parallel cracks may develop in the pavement and underlying soils that may require repair. The Contractor should be made aware of this potential condition in order that preventative measures can be implemented, or repair measures provided for.

The shoring designer should perform a deflection analysis of the shoring system in areas adjacent to existing facilities. If movements are greater than the tolerance of existing project features (utilities, pavements, structures, etc.) tie-backs, dead-man anchors, or cross bracing may be needed to reduce deflections. Design using the at-rest pressure and/or more stringent tie-back or bracing systems may be required in the vicinity of improvements that cannot withstand lateral movements.

7.6.2 Surcharge Pressures

Lateral forces due to areal surcharges (such as stockpiled soil, equipment, etc.) placed adjacent to the shoring may impart additional loads to the shoring system. These conditions should be evaluated by the shoring designer on a case-by-case basis.

7.6.3 Shoring Removal

Shoring systems typically are removed as part of the trench backfill process. Depending on the shoring system used, the removal process may create voids along the sides of the trench excavation. If these voids are left in place and are significantly large, backfill may shift laterally into the voids resulting in settlement of the backfill and overlying pavements. Therefore, care should be taken to remove the shoring system and backfill the trench in such a way as to not create these voids. If the shoring system requires removal after backfill is in place, resulting voids should be filled with sand and cement slurry or other approved grout mix. If shoring cannot be removed without causing voids and/or disturbing pipes or structures, the shoring should be cut off above the pipe or structure and be left in place. Timber lagging to be left in place should be pressure treated.

7.7 SITE PREPARATION

7.7.1 Existing Pavements

We anticipate existing site pavements located within the proposed trench alignment will be removed and replaced. Pavement materials should be removed from the site unless they are pulverized to meet the requirements for engineered fill presented in this report. Existing aggregate base materials that do not contain any deleterious materials should be acceptable for use as trench backfill.

7.7.2 Stripping and Grubbing

Site preparation should include the stripping and removal of existing vegetation, organic topsoil, trees, existing foundations, abandoned underground utilities, debris and other deleterious materials from the areas to be excavated. We estimate the depth of stripping in undeveloped areas to be approximately 1 to 3 inches. Deeper stripping or grubbing may be required where existing structures, buried pipes, concentrations of organic soils, and tree roots require removal during site grading. Stripped topsoil (less any debris) may be stockpiled and reused for landscape purposes. However, this material should not be incorporated into any trench backfill or engineered fill.

7.7.3 In-Situ Moisture Content

In-situ soil moisture contents are expected to be well above the optimum moisture content for compaction. Consideration should be given to construction staging areas that will be needed to process and moisture condition the excavated soils for use as trench backfill. As an alternative to processing of the excavated on-site materials for use as trench backfill, Caltrans Class 2 aggregate base or imported fill materials that meet the requirements presented in this report may be used for trench backfill.

7.8 WET WEATHER CONSTRUCTION/UNSTABLE SOIL CONDITIONS

In general, the near surface soils encountered at this site have a significant portion of clay and silt and are, therefore, anticipated to be moisture sensitive. Should site grading be performed during or subsequent to wet weather, near-surface site soils may be significantly above the optimum moisture content. Additionally, it is common to encounter wet, unstable soils upon removal of site pavements or flatwork as a result of subsurface moisture becoming trapped beneath relatively impervious asphalt concrete or portland cement concrete surfaces. These conditions could hamper equipment maneuverability and efforts to compact site soils to the recommended compaction criteria. Materials removed from excavations at the site may have moisture contents above optimum. Disking to aerate, chemical treatment, replacement with drier material, or other methods may be required to reduce excessive soil moisture to facilitate earthwork operations.

7.9 TRENCH PREPARATION AND BACKFILL

7.9.1 General Considerations

The materials encountered in the borings at the elevations of the proposed trench bottoms generally consist of soft lean clays and silts. Since groundwater is expected above the proposed excavation depths of about 8 to 14 feet, the trench bottoms may be unstable and require mitigation in the form of placement of at least 12 inches of clean crushed rock bedding material underlain by a geoxtile such as Mirafi 140N or equal, or placement of a cementitious slurry base prior to conduit placement. Use of a gravel bedding course will allow the contractor to use sumps and pumps within the excavation to control nuisance groundwater.

7.9.2 Subgrade Preparation

Prior to placement of bedding, the exposed subgrade at the base of the trench excavations should be examined to detect soft, loose, or unstable areas. Loose materials at trench bottoms resulting from excavation disturbance should be removed to undisturbed soil. If soft or unstable areas are encountered, these areas should be over-excavated to a depth of at least 1 foot, or to a firm base and be replaced with additional bedding or slurry material. Where excavations cross existing trench backfill materials, the need for and extent of over-excavation or stabilization measures should be evaluated by the Geotechnical Engineer on an individual basis. If clean crushed rock bedding or backfill materials are used, the material should be completely surrounded by a non-woven filter fabric (see Section 7.9.4, Filter Fabric Envelope) to prevent migration of fines into the bedding layer.

7.9.3 Pipe Bedding and Initial Backfill Materials

Pipe bedding and initial backfill should be appropriate for the types of conduits to be installed and meet SMUD standards. Pipe bedding and initial backfill requirements may be specified by the Owner based on planned pipe types, bedding conditions, and other factors beyond the scope of this study. We anticipate a cementitious slurry or special concrete mix will be used for the initial backfill around the conduits. Accordingly, the project Civil Engineer should develop final project specifications and details.

If clean crushed rock is used for a bedding layer, we recommend it have a maximum particle size less than 1 inch and have less than 5 percent passing the No. 200 U.S. sieve. Where crushed rock is used, the material should be separated from the fill and native soils by a non-woven filter fabric.

7.9.4 Filter Fabric Envelope

To reduce the potential for migration of the fill and native soils into crushed rock bedding material, it should be completely surrounded by a filter fabric. Filter fabric should be laid-out and overlapped according to the manufacturer's recommendations. Recommended minimum filter fabric specifications are presented in Table 7.2 below.

TABLE 7.2
RECOMMENDED FILTER FABRIC SPECIFICATIONS

Property	Requirement	Test Method
Apparent Opening Size (AOS)	#100 U.S. Standard Sieve Size	ASTM D4751
Grab Tensile/Elongation	200 lbs./50%	ASTM D4632
Puncture Strength	120 lb. Minimum, Average Roll Value	ASTM D4833

Where washed sand, concrete slurry or Controlled Density Fill (CDF) material is used for bedding and initial backfill, the filter fabric wrap is not necessary.

7.9.5 Compaction of Bedding and Initial Backfill Materials

Where pipe bedding consists of clean crushed rock, compaction testing by conventional methods is not practical. Crushed rock bedding materials should be placed in lifts (appropriate thickness for compaction equipment used) with mechanical compactive effort applied until the material is firm. We recommend the lift thickness for compaction not exceed 1 foot. Use of vibroplates is recommended for compaction of clean crushed rock.

7.9.6 Trench Backfill Materials

Trench backfill (i.e., the material placed above the initial backfill) will likely consist of a cementitious slurry mixture or lean concrete. This approach may also be used for structure backfill. If soil is to be used for backfill, it should consist of on-site soil or approved imported fill material that meets the requirements presented herein. The near-surface, on-site soils will be very wet upon excavation and will require processing to dry them out for compaction.
Soils used for trench backfill should be placed and compacted in accordance with the recommendations provided in Section 7.9.8, Fill Compaction Requirements.

7.9.7 Imported and Low Expansion Fill Materials

Imported soils to be used for fill or backfill should be nearly-free of organic or other deleterious debris, essentially non-plastic, and have a maximum particle size less than 3 inches in maximum dimension. In general, well-graded mixtures of gravel, sand, non-plastic silt, and small quantities of cobbles, rock fragments, and/or clay are generally acceptable for use as intermediate trench backfill. Specific requirements for imported and low expansion fill, as well as applicable test procedures to verify material suitability, are provided in Table 7.3 below.

TABLE 7.3
IMPORTED AND LOW EXPANSION FILL REQUIREMENTS

Fill Requirement		Test Procedures	
		ASTM[1]	Caltrans[2]
Gradation			
Sieve Size	**Percent Passing**		
3 inch	100	D 422	202
¾ inch	70-100	D 422	202
No. 200	10-70	D 422	202
Plasticity			
Liquid Limit	**Plasticity Index**		
<30	<12	D 4318	204
Organic Content			
Less than 3%		D2974	---
Expansion Potential (ASTM D4829)			
Less than 20	---	---	---

[1]American Society for Testing and Materials Standards (latest edition)
[2]State of California, Department of Transportation, Standard Test Methods (latest edition)

The above specification is intended to provide a material with low expansion potential and fair to good compaction characteristics. All imported fill materials to be used for intermediate trench backfill should be sampled and tested by Kleinfelder prior to being transported to the site.

7.9.8 Fill Compaction Requirements

Engineered fill, structure backfill and trench backfill should be uniformly moisture-conditioned to between 0 and 3 percent above the optimum moisture content, placed in horizontal lifts less than 8 inches in loose thickness, and compacted to at least 90 percent relative compaction based on the ASTM D1557 test method for their full depth. The upper twelve inches of pavement subgrades should be compacted to at least 95 percent relative compaction. Fills exceeding 10 feet in thickness should be compacted to at least 95 percent relative compaction for their full depth. If imported aggregate base materials are to be used for excavation backfill, the material should be compacted to at least 95 percent relative compaction at a moisture content slightly above optimum.

Additional lifts of fill should not be placed if the previous lift did not meet the required relative compaction or if soil conditions are not stable. Thorough mixing, aeration, watering and/or blending may be required to uniformly moisture condition soils used for engineered fill or backfill. Ponding or jetting compaction methods should not be allowed. We do not recommend allowing the Contractor to place and compact materials in unshored trenches using remote equipment. Full access to testing personnel should be provided during backfilling.

7.9.9 Construction Considerations

Wetting or drying of the excavated materials is anticipated to be necessary to obtain the proper moisture content for compaction. Disking and/or blending may also be required to uniformly moisture-condition soils used for engineered fill. Ponding or jetting compaction methods are not recommended as a means of compaction. Consideration should be given to construction staging areas where excavated materials and be processed for reuse as backfill. It may not be practical to use the excavated material for backfill as it will be very wet and be somewhat difficult to compact. The excavated materials could be wasted and the excavations backfilled with imported Caltrans Class 2 aggregate base material or cementitious slurry.

7.10 SUBSURFACE STRUCTURES

7.10.1 Subgrade Preparation

Based on our findings, the native soils at the proposed subsurface structure bearing elevations appear to be relatively soft and not suitable for direct support of the proposed structures. Following excavation, the exposed subgrade should be cleaned of all loose materials. The subgrade should be over-excavated at least 12 inches, and a base course of clean crushed rock surrounded by a woven geotextile such as Mirafi 500 X should be used to support the new structures.

7.10.2 Foundations

Proposed subsurface structures may be supported on their base slabs or on spread footings constructed of reinforced concrete and founded upon subgrades prepared as recommended above. Spread footings for these structures should be a minimum of 12 inches wide. The embedment depth will depend on the structure. The bearing pressure of the new structure should not exceed the weight of the soil removed from the excavation.

7.10.3 Foundation Settlement

Total settlement of an individual foundation will vary depending on the plan dimensions of the foundation and the actual load supported. Based on anticipated foundation dimensions and loads, we estimate maximum settlement of foundations designed and constructed in accordance with the preceding recommendations to be on the order of ½-inch. Differential settlement of these structures is expected to be negligible provided footings are founded on similar materials. Settlement of all foundations is expected to occur rapidly and should be essentially complete shortly after initial application of the loads.

7.10.4 Construction Considerations

Prior to placing steel or concrete, footing excavations should be cleaned of all debris, loose or soft soil, and water. All footing excavations should be observed by the project Geotechnical Engineer just prior to placing steel or concrete to verify the recommendations contained herein are implemented during construction.

7.10.5 Lateral Earth Pressures

Below grade walls for subsurface structures should be designed to resist the earth pressure exerted by the retained, compacted backfill plus any additional lateral force that will be applied to the wall due to surface loads placed at or near the wall. Walls that are free to deflect at the top may be designed for the active earth pressure. Restrained walls (those that are not free to deflect) should be designed for the at-rest earth pressure. Since groundwater levels at the site are near the ground surface seasonally, the walls should be designed to resist hydrostatic pressures starting at the ground surface. The recommended design criteria for retaining walls are presented in Table 7.4 below.

TABLE 7.4
RECOMMENDED LATERAL EARTH PRESSURES

		Equivalent Fluid Density (pcf)		
Backfill Configuration	**Earth Pressure**	**Drained**	**Submerged**	**Surcharge factor (K)**
Level	Active At Rest	45 65	85 95	0.40 0.60
Level	Passive	250	100	

The above active and at-rest earth pressure values are ultimate values. Therefore, an appropriate factor of safety should be applied by the designer. Typical safety factors range from about 1.5 to 2 for static conditions.

The passive resistance value provided above is an allowable value derived with a factor of safety of at least 1.5. Allowable passive and sliding resistance may be combined without reduction. Passive resistance should be neglected within the upper 1 foot of soil, unless the soil is protected by concrete or pavement adjacent to the structure. An allowable sliding coefficient of 0.30 may be used to estimate sliding resistance between the bottoms of wall footings and the underlying soil, if needed. A seismic increment of earth pressure need not be applied to subsurface structure walls.

7.10.6 Wall Drainage

Retaining walls for subsurface structures will likely extend below groundwater. For those walls, drainage of the retained materials is not considered practical and the walls should be designed for hydrostatic conditions.

7.10.7 Backfill Placement

All soil backfill should be placed and compacted in accordance with recommendations provided above for engineered fill. Light equipment should be used during backfill compaction to minimize possible overstressing of the wall.

8 ADDITIONAL SERVICES

8.1 PLANS AND SPECIFICATIONS REVIEW

Kleinfelder should conduct a general review of final plans and specifications to evaluate that our earthwork recommendations have been properly interpreted and implemented during design. This service is included in our current contractual agreement. In the event Kleinfelder is not retained to perform this recommended review, we will assume no responsibility for misinterpretation of our recommendations.

8.2 CONSTRUCTION OBSERVATION AND TESTING

All earthwork during construction should be monitored by Kleinfelder, including site preparation, placement of all engineered fill and trench backfill, construction of structure and roadway subgrades, and all foundation excavations. The purpose of these services would be to observe the conditions encountered during construction, provide the required compaction testing services, evaluate the applicability of the recommendations presented in this report to the conditions encountered, and recommend appropriate changes in design or construction procedures if conditions differ from those described herein.

9 LIMITATIONS

Recommendations contained in this report are based on our field observations and subsurface explorations, laboratory tests, and our present knowledge of the proposed construction. It is possible that soil conditions could vary between or beyond the points explored. If soil conditions are encountered during construction, which differ from those, described herein, we should be notified immediately in order that a review may be made and any supplemental recommendations provided. If the scope of the proposed construction, including the proposed loads or structural locations, changes from that described in this report, our recommendations should also be reviewed.

We have prepared this report in substantial accordance with the generally accepted geotechnical engineering practice as it exists in the site area at the time of our study. No warranty is expressed or implied. The recommendations provided in this report are based on the assumption that an adequate program of tests and observations will be conducted by a qualified Geotechnical Engineer during the construction phase in order to evaluate compliance with our recommendations.

This report may be used only by the client and only for the purposes stated, within a reasonable time from its issuance. Land use, site conditions (both on site and off site) or other factors may change over time, and additional work may be required with the passage of time. Any party other than the client who wishes to use this report shall notify Kleinfelder of such intended use. Based on the intended use of the report, Kleinfelder may require that additional work be performed and that an updated report be issued. Non-compliance with any of these requirements by the client or anyone else will release Kleinfelder from any liability resulting from the use of this report by any unauthorized party.

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DRAWN:	1/24/2019
DRAWN BY:	D. Ross
CHECKED BY:	K. Sorensen
FILE NAME:	20190758.mxd

SITE VICINITY MAP

SMUD-Pocket 69kV Cable Replacement
Havenside-Canal and Gloria-Florin
Sacramento, California

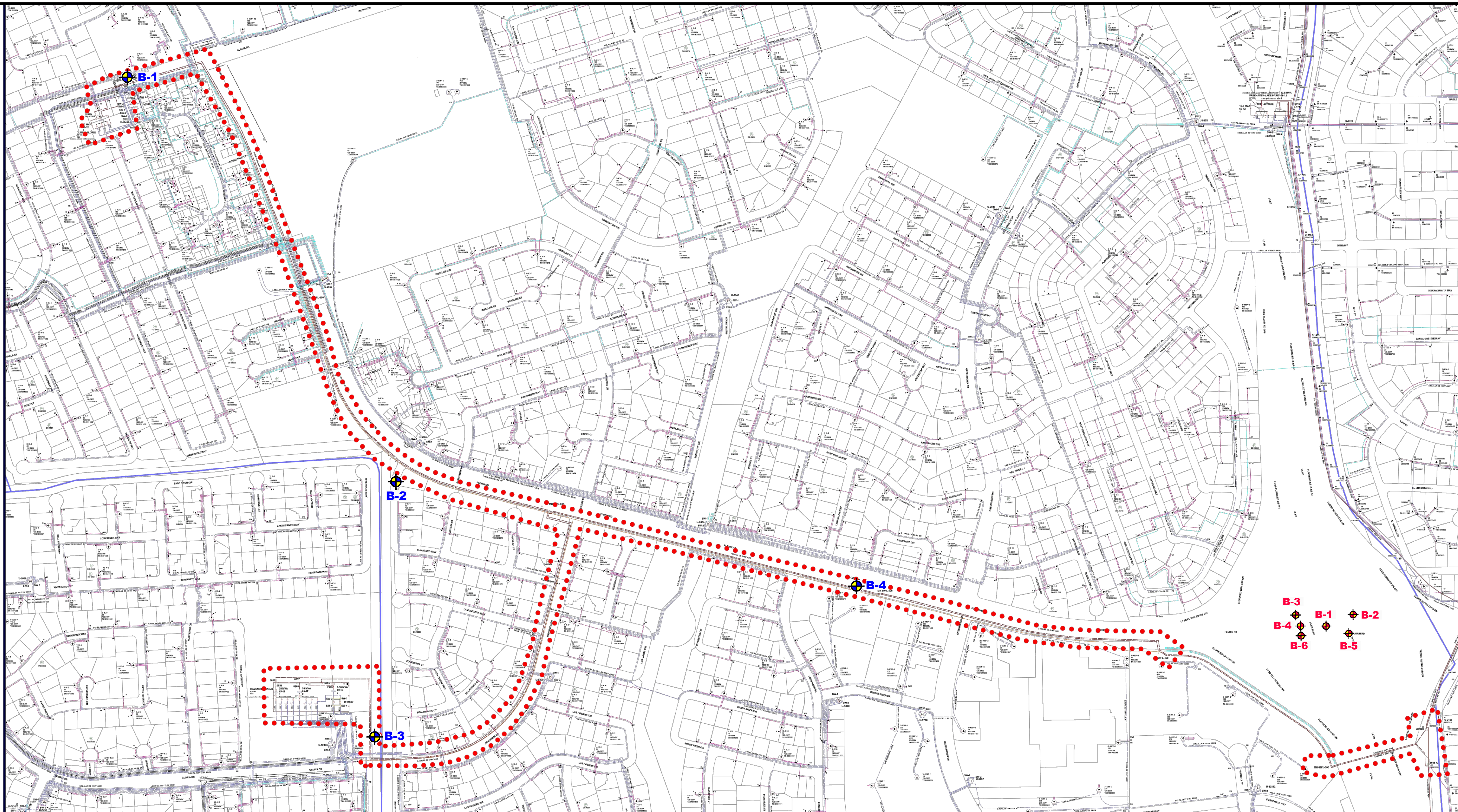
FIGURE

1

PLOTTED: 24 Jan 2019, 11:22am, DRoss

LAYOUT: Layout1

CAD FILE: K:\2018_PROJECTS\20190758.004A-SMUD-Pocket 69kV Cable Replacement\cad\



Notes:
1. Replace POCFDR8 Feeder from UD073202 to MH-69FL-500, MH-69FL-400 to HAVENSIDE-CANAL SUB.
   a. Approx. Footage = 534' of Yr. 1972.
   b. Approx. Footage = 3444' of Yr. 1976.
   c. Approx. Footage = 2871' of Yr. 1978.
2. Replace POCFDR7 Feeder from UD182859 to MH-69FL-500, MH-69FL-400 to HAVENSIDE-CANAL SUB & GLORIA-FLORIN SUB.
   a. Approx. Footage = 595' of Yr. 1972.
   b. Approx. Footage = 11648' of Yr. 1976.
   c. Approx. Footage = 3076' of Yr. 1978.
3. Replace with XLP Cable.
4. Install spare conduit for all 12kV direct-buried circuits within the Gloria-Florin and Havenside-Canal Substations for future replacement.

Rev 1: POCFDR-7 added.
Rev 2: Added note 4.

0 300 600 900 1200 1500
ft

JOB NAME: CABLE REPLACEMENT POCKET (POCFDR8)				AREA: SOUTH DATE: 2/28/2018
LOCATION: 7365 GLORIA DR SACRAMENTO 95831				ANALYSIS PKG NO.: N/A
MAP NUMBER: 302/134	THOMAS BROTHERS: 336 H 1 (SACR)	FAULTS ADDRESSED: 2	STATUS DRIVER: NFAI	FOOTAGE: 22168
SMUD SACRAMENTO MUNICIPAL UTILITY DISTRICT	JOB NUMBER: 30143702			REV. R2

LEGEND
- Approximate Boring Location (Kleinfelder, 2018)
- Approximate Boring Location (Caltrans, 1966)

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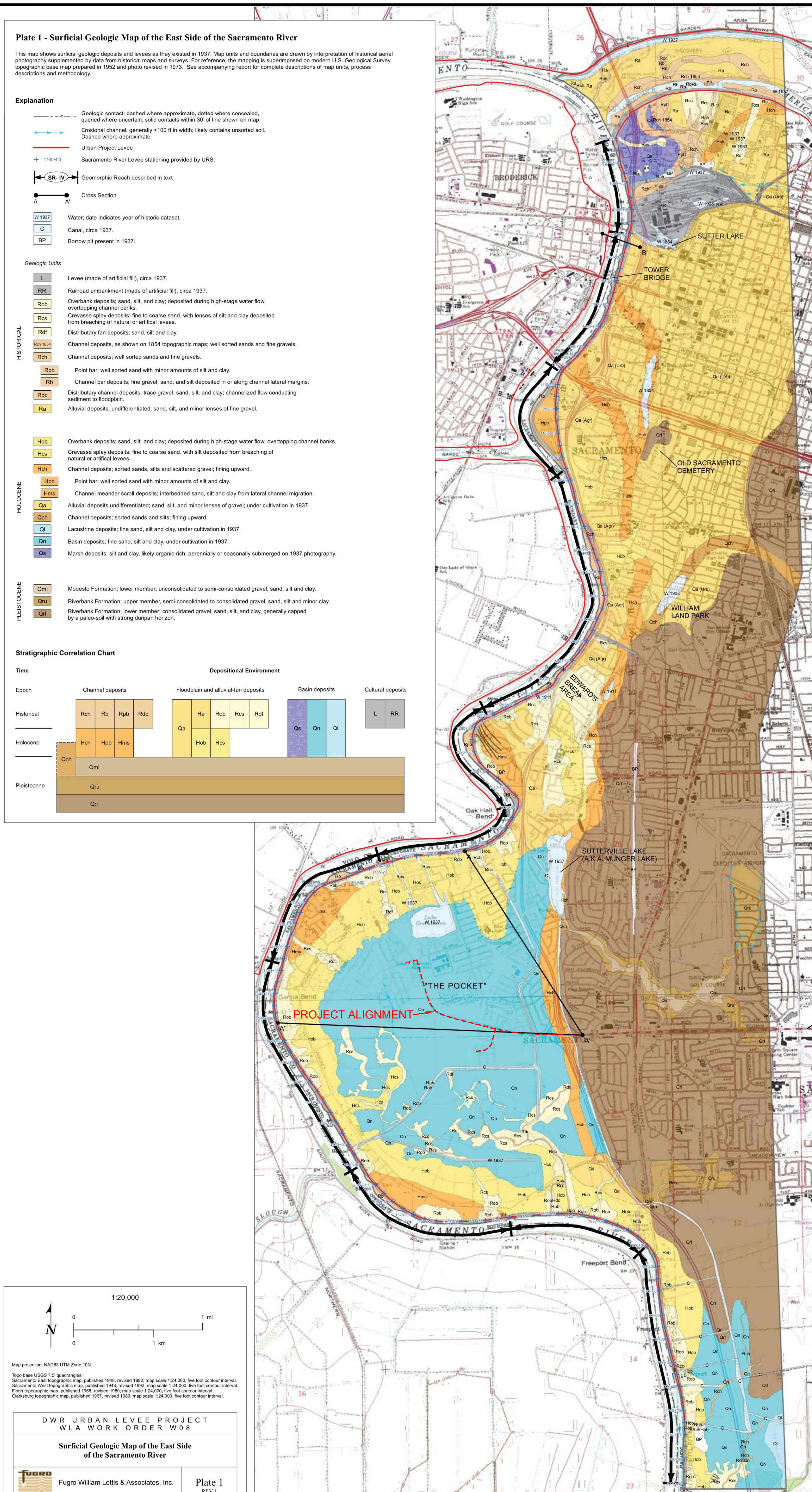
PROJECT NO.	20190758.004A
DRAWN:	01/24/2019
DRAWN BY:	D. Ross
CHECKED BY:	K. Sorensen
FILE NAME:	20190758_2.dwg

SITE MAP AND EXPLORATION LOCATIONS

SMUD-Pocket 69kV Cable Replacement
Havenside-Canal and Gloria-Florin
Sacramento, California

FIGURE
2

PLOTTED: 25 Jan 2019, 11:41am, DRoss



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PROJECT NO. 20190758.004A	
DRAWN:	01/25/2019
DRAWN BY:	D. Ross
CHECKED BY:	B. Rousseau
FILE NAME: 20190758_3.dwg	

GEOLOGIC MAP

SMUD-Pocket 69kV Cable Replacement
Havenside-Canal and Gloria-Florin
Sacramento, California

FIGURE
3

CAD FILE: K:\2018_PROJECTS\20190758.004A-SMUD-Pocket 69kV Cable Replacement\cad\ LAYOUT: Layout1

APPENDIX A
LOG OF BORINGS

SAMPLER AND DRILLING METHOD GRAPHICS

- BULK / GRAB / BAG SAMPLE
- MODIFIED CALIFORNIA SAMPLER (2 or 2-1/2 in. (50.8 or 63.5 mm.) outer diameter)
- 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)
- HQ CORE SAMPLE (2.500 in. (63.5 mm.) core diameter)
- SHELBY TUBE SAMPLER
- PUSH TYPE SAMPLER
- SONIC CONTINUOUS SAMPLER
- HAND AUGER
- AUGER CUTTINGS

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)

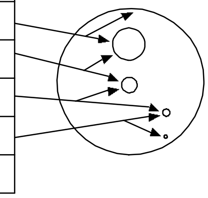
COARSE GRAINED SOILS (More than half of material is larger than the #200 sieve)	**GRAVELS** (More than half of coarse fraction is larger than the #4 sieve)	CLEAN GRAVEL WITH <5% FINES	Cu≥4 and 1≤Cc≤3	**GW**	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES
			Cu<4 and/ or 1>Cc>3	**GP**	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.: 20190758	GRAPHICS KEY	FIGURE
	DRAWN BY: DR		A-1
	CHECKED BY: BR	SMUD-Pocket 69kV Cable Replacement Havenside-Canal and Gloria-Florin Sacramento, California	
	DATE: 11/15/2018		
	REVISED: 2/15/2019		

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	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.: 20190758	SOIL DESCRIPTION KEY	FIGURE
DRAWN BY: DR		
CHECKED BY: BR	SMUD-Pocket 69kV Cable Replacement Havenside-Canal and Gloria-Florin Sacramento, California	A-2
DATE: 11/15/2018		
REVISED: 2/15/2019		

PLOTTED: 02/15/2019 12:03 PM BY: DRoss
OFFICE FILTER: SACRAMENTO
PROJECT NUMBER: 20190758.004A
gINT FILE: Klf_gint_master_2017
gINT TEMPLATE: E:KLF_STANDARD_GINT_LIBRARY_2017.GLB [LEGEND 2 (SOIL DESC KEY)]

BORING LOG B-1

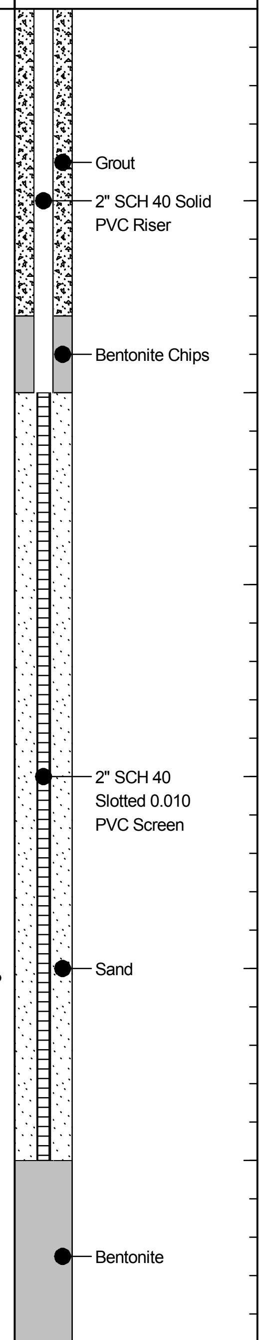
Date Begin - End:	11/07/2018	**Drilling Company:**	Taber Drilling		
Logged By:	B. Rosussau	**Drill Crew:**	Rick, Derrick		
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**		**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Mud Rotary		
Weather:	Sunny	**Auger Diameter:**	4 in. O.D.		

FIELD EXPLORATION / LABORATORY RESULTS

Surface Condition: Asphalt Concrete

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)
	ASPHALT CONCRETE: about 6 inches										
	AGGREGATE BASE: about 12 inches										
	Lean CLAY (CL): medium plasticity, dark brown, moist, trace fine sands	Bulk 1									
5	soft	2b 2a	BC=3 4 5 PP=0.5	18"		27.4	101.4				
10	**Lean CLAY with Sand (CL)**: medium plasticity, dark brown, moist, soft, fine sand	3b 3a	BC=2 1 1 PP=0.75	18"		26.8	101.2				
15			BC=1 1 1	NR							
20	**Sandy SILT (ML)**: non-plastic, greenish gray, moist, soft, fine sand	4	BC=2 2 3	18"					55		
25	very soft	5	BC=1 1 1	18"		25.4				NP	NP
30		6	BC=1 1 1	12"					51		

MONITORING WELL CONSTRUCTION*



KLEINFELDER Bright People. Right Solutions.	PROJECT NO.: 20190758	BORING LOG B-1	FIGURE
	DRAWN BY: DR		A-3
	CHECKED BY: MD	SMUD-Pocket 69kV Cable Replacement Havenside-Canal and Gloria-Florin Sacramento, California	
	DATE: 11/15/2018		
	REVISED: 2/15/2019		PAGE: 1 of 2

Date Begin - End:	11/07/2018	**Drilling Company:**	Taber Drilling				**BORING LOG B-1**
Logged By:	B. Rosussau	**Drill Crew:**	Rick, Derrick				
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**		**Hammer Type - Drop:**	140 lb. Auto - 30 in.		
Plunge:	-90 degrees	**Drilling Method:**	Mud Rotary				
Weather:	Sunny	**Auger Diameter:**	4 in. O.D.				

Depth (feet)	Graphical Log	FIELD EXPLORATION: Surface Condition: Asphalt Concrete / Lithologic Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. Pocket Pen(PP)= tsf	Recovery (NR=No Recovery)	LABORATORY RESULTS: USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	MONITORING WELL CONSTRUCTION*
		SILT with Sand (ML): non-plastic, greenish gray, moist, soft, fine sand	7		BC=1 1 1	12"								
40		**Silty SAND (SM)**: greenish gray, moist, very loose, fine sand, non-plastic fines	8		BC=3 3 3	6"	SM				38	NP	NP	Bentonite
45			9		BC=2 1 2	10"								
50			10		BC=1 1 1	10"								

55

60

65

The boring was terminated at approximately 51.5 ft. below ground surface. The boring was backfilled with bentonite to 30 ft. and installed monitoring well on November 07, 2018.

GROUNDWATER LEVEL INFORMATION:
▽ Groundwater was observed at approximately 6 ft. below ground surface during drilling.
▼ Static groundwater was observed at approximately 4.88 ft. below ground surface after well development

BORING LOG B-2

Date Begin - End:	12/17/2018	**Drilling Company:**	Taber Drilling
Logged By:	B. Rosussau	**Drill Crew:**	Rick
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	Diedrich D-120
Plunge:	-90 degrees	**Drilling Method:**	Mud Rotary
Weather:	Sunny	**Auger Diameter:**	4 in./8 in. O.D.

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

FIELD EXPLORATION / LABORATORY RESULTS / MONITORING WELL CONSTRUCTION*

Surface Condition: Asphalt Concrete

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)
0	**ASPHALT CONCRETE**: about 5 inches	B1									
	AGGREGATE BASE: about 2 inches										
	Sandy Lean CLAY (CL): medium plasticity, moist										
5	**Elastic SILT with Sand (MH)**: high plasticity, slow dilatancy, mottled yellow and dark brown, moist, stiff	2b 2a	BC=2 2 2	10"		43.9	79.0			50	32
10			BC=1 1 1	NR							
	SILT with Sand (ML): non-plastic, gray, wet, very soft, fine sand	3b 3a	BC=0 0 0	16"							
15	**Clayey SAND (SM)**: gray, wet, loose, fine to medium sand, medium plasticity fines	4	BC=2 4 4	18"					36		
20	very loose, fine sand	5	BC=1 0 0	18"						27	19
25	**Sandy Lean CLAY (CL)**: gray, moist, soft, fine sand	6	BC=2 1 1	NR					61		
30		7	BC=1 2 4								

Monitoring well construction:
- Grout
- 2" SCH 40 Solid PVC Riser
- Bentonite Chips
- 2" SCH 40 Slotted 0.010 PVC Screen
- Sand
- Bentonite

PLOTTED: 02/15/2019 12:18 PM BY: DRoss

Date Begin - End:	12/17/2018	**Drilling Company:**	Taber Drilling
Logged By:	B. Rosussau	**Drill Crew:**	Rick
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	Diedrich D-120
Plunge:	-90 degrees	**Drilling Method:**	Mud Rotary
Weather:	Sunny	**Auger Diameter:**	4 in./8 in. O.D.

BORING LOG B-2

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

Depth (feet)	Graphical Log	FIELD EXPLORATION: Surface Condition: Asphalt Concrete / Lithologic Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. Pocket Pen(PP)= tsf	Recovery (NR=No Recovery)	LABORATORY RESULTS: USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	MONITORING WELL CONSTRUCTION*
		Sandy Lean CLAY (CL): gray, moist, soft, fine sand	8		BC=3 2 5									Bentonite
40			9		BC=4 5 6									

The boring was terminated at approximately 41.5 ft. below ground surface. The boring was backfilled with bentonite to 30 ft. and installed monitoring well on December 17, 2018.

GROUNDWATER LEVEL INFORMATION:
∇ Groundwater was observed at approximately 5 ft. below ground surface during drilling.
▼ Static groundwater was observed at approximately 3.80 ft. below ground surface after well development

45

50

55

60

65

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PROJECT NO.:	20190758
DRAWN BY:	DR
CHECKED BY:	MD
DATE:	12/18/2018
REVISED:	2/15/2019

BORING LOG B-2

SMUD-Pocket 69kV Cable Replacement
Havenside-Canal and Gloria-Florin
Sacramento, California

FIGURE

A-4

gINT FILE: Klf_gint_master_2017 PROJECT NUMBER: 20190758.004A OFFICE FILTER: SACRAMENTO
gINT TEMPLATE: E:KLF_STANDARD_GINT_LIBRARY_2017.GLB [_KLF_BORING/TEST PIT SOIL LOG]

BORING LOG B-3

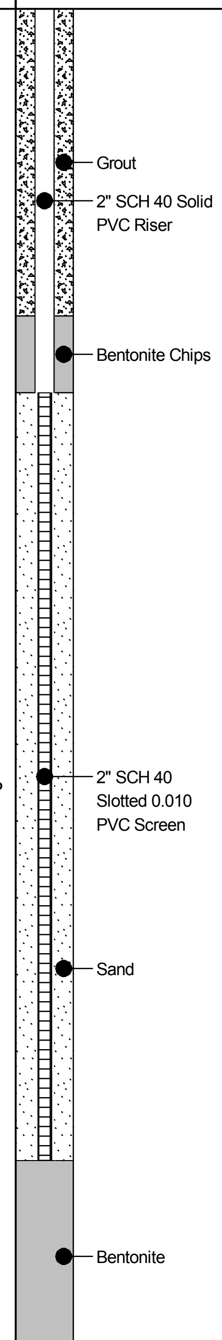
Date Begin - End:	11/09/2018	**Drilling Company:**	Taber Drilling		
Logged By:	B. Rosussau	**Drill Crew:**	Rick, Derrick		
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**		**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Mud Rotary		
Weather:	Sunny	**Auger Diameter:**	4 in. O.D.		

FIELD EXPLORATION / LABORATORY RESULTS

Surface Condition: Gravel

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)
0	**GRAVEL**	Bulk 1										
	Fat CLAY (CH): high plasticity, dark brown, moist											
5	no dilatancy, stiff	2b 2a		BC=3 4 5 PP=1.75	18"		53.8	66.6			75	40
10	**Lean CLAY (CL)**: medium plasticity, slow dilatancy, dark brown, wet, soft	3b 3a		BC=0 0 1 PP=<0.5	18"					98		
15	**SILT with Sand (ML)**: non-plastic, no dilatancy, greenish gray, wet, very soft, fine sand	4b 4a		BC=0 1 1 PP=<0.25	18"					68		
20	slow dilatancy	5		BC=0 0 0	18"		30.1				NP	NP
25	mottled greenish gray and dark brown, medium plasticity fines	6		BC=0 0 0	16"							
30	**Sandy SILT (ML)**: non-plastic, greenish gray, wet, very soft, fine sand	7		BC=1 0 1 PP=<0.25	12"					55		

MONITORING WELL CONSTRUCTION*



KLEINFELDER Bright People. Right Solutions.	PROJECT NO.: 20190758	BORING LOG B-3
	DRAWN BY: DR	
	CHECKED BY: MD	SMUD-Pocket 69kV Cable Replacement Havenside-Canal and Gloria-Florin Sacramento, California
	DATE: 11/15/2018	
	REVISED: 2/15/2019	

FIGURE A-6

BORING LOG B-3

Date Begin - End:	11/09/2018	**Drilling Company:**	Taber Drilling		
Logged By:	B. Rosussau	**Drill Crew:**	Rick, Derrick		
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**		**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Mud Rotary		
Weather:	Sunny	**Auger Diameter:**	4 in. O.D.		

FIELD EXPLORATION / LABORATORY RESULTS / MONITORING WELL CONSTRUCTION*

Surface Condition: Gravel

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)	Monitoring Well Construction*
		SILT with Sand (ML): medium plasticity, greenish gray, wet, very soft, fine sand	8		BC=1 1 1	16"								
40		loose	9		BC=1 2 3	12"								Bentonite
45			10		BC=1 1 2	8"								
		Poorly Graded SAND (SP): wet, loose, fine sand, trace fines												
50			11		BC=3 2 2	13"								
55														
60														
65														

The boring was terminated at approximately 51.5 ft. below ground surface. The boring was backfilled with bentonite to 30 ft. and installed monitoring well on November 09, 2018.

GROUNDWATER LEVEL INFORMATION:
- Groundwater was observed at approximately 5 ft. below ground surface during drilling.
- Static groundwater was observed at approximately 4.67 ft. below ground surface after well development

KLEINFELDER Bright People. Right Solutions.	PROJECT NO.: 20190758	BORING LOG B-3
	DRAWN BY: DR	
	CHECKED BY: MD	SMUD-Pocket 69kV Cable Replacement Havenside-Canal and Gloria-Florin Sacramento, California
	DATE: 11/15/2018	
	REVISED: 2/15/2019	

FIGURE

A-6

Date Begin - End: 11/08/2018 | **Drilling Company:** Taber Drilling | **BORING LOG B-4**

Logged By: B. Rosussau | **Drill Crew:** Rick, Derrick

Hor.-Vert. Datum: Not Available | **Drilling Equipment:** | **Hammer Type - Drop:** 140 lb. Auto - 30 in.

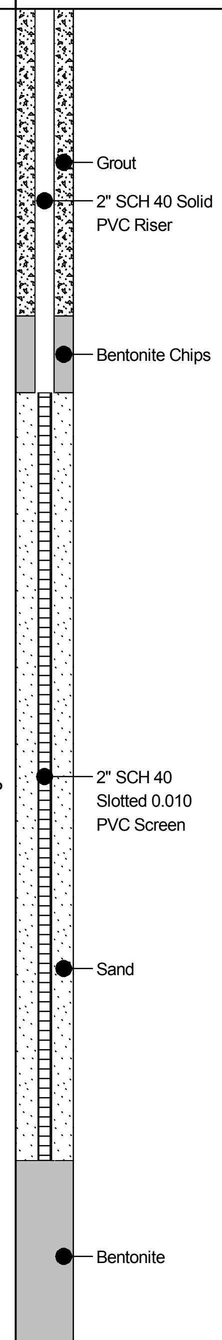
Plunge: -90 degrees | **Drilling Method:** Solid Stem Auger/Mud Rotary

Weather: Sunny | **Auger Diameter:** 4 in. O.D.

Surface Condition: Asphalt Concrete

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)
0	**ASPHALT CONCRETE**: about 6 inches											
	AGGREGATE BASE: about 12 inches											
	Lean CLAY (CL): medium plasticity, brown, moist, trace fine sand											
5 ▽▼	**Lean CLAY with Sand (CL)**: medium plasticity, olive brown, moist, very soft, fine sand	1b 1a		BC=1 2 1 PP=<0.25	18"		35.5	84.0				
10	dark brown, stiff	2b 2a		BC=5 8 9 PP=1.0	18"							
	Sandy SILT (ML): non-plastic, reddish brown, wet, soft, fine sand											
15		3		BC=2 2 2	12"					62		
20	very soft	4		BC=1 1 0	18"	ML				63	NP	NP
25	increasing fine sand	5		BC=1 1 1	15"		25.4					
30	**SILT with Sand (ML)**: non-plastic, reddish brown, wet, very soft, fine sand, trace gravel	6		BC=1 1 0	12"					73		

MONITORING WELL CONSTRUCTION*



KLEINFELDER
Bright People. Right Solutions.

PROJECT NO.:	20190758
DRAWN BY:	DR
CHECKED BY:	MD
DATE:	11/15/2018
REVISED:	2/15/2019

BORING LOG B-4

SMUD-Pocket 69kV Cable Replacement
Havenside-Canal and Gloria-Florin
Sacramento, California

FIGURE
A-6

Date Begin - End:	11/08/2018	**Drilling Company:**	Taber Drilling		**BORING LOG B-4**
Logged By:	B. Rosussau	**Drill Crew:**	Rick, Derrick		
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**		**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Solid Stem Auger/Mud Rotary		
Weather:	Sunny	**Auger Diameter:**	4 in. O.D.		

Depth (feet)	Graphical Log	FIELD EXPLORATION: Lithologic Description (Surface Condition: Asphalt Concrete)	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. Pocket Pen(PP)= tsf	Recovery (NR=No Recovery)	LABORATORY RESULTS: USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	MONITORING WELL CONSTRUCTION*
		Silty SAND (SM): greenish gray, wet, very loose, fine to coarse sand, low plasticity fines	7		BC=1 1 2	12"								Bentonite
40		loose	8		BC=1 2 2	12"								

The boring was terminated at approximately 41.5 ft. below ground surface. The boring was backfilled with bentonite to 30 ft. and installed monitoring well on November 08, 2018.

GROUNDWATER LEVEL INFORMATION:
- ∇ Groundwater was observed at approximately 6 ft. below ground surface during drilling.
- ▼ Static groundwater was observed at approximately 5.63 ft. below ground surface after well development

45

50

55

60

65

KLEINFELDER Bright People. Right Solutions.	PROJECT NO.: 20190758 DRAWN BY: DR CHECKED BY: MD DATE: 11/15/2018 REVISED: 2/15/2019	BORING LOG B-4 SMUD-Pocket 69kV Cable Replacement Havenside-Canal and Gloria-Florin Sacramento, California	FIGURE A-6

APPENDIX B
WELL DEVELOPMENT LOGS

Meter Calibration Log

EQUIPMENT MAKE	EQUIPMENT MODEL	SERIAL NUMBER	DATE	TIME	TEMP OF CALIBRATION STANDARD (°C or °F)	pH STANDAR	pH STANDAR	pH STANDAR	SPECIFIC CONDUCTANCE	ORP	DISSOLVED OXYGEN
						4	7	10	______ µS/cm	______ mV	______ mg/L or %
Myron L	Ultrameter II	6258157	12/21/18	0630		4.00	7.00	10.00	1413		

Confluence Environmental, Inc.

ORP Values (degrees in C then value): 5:257.0 10:250.5 15:244.0 20:237.5 25:231.0 30:224.5 35:218.0 40:211.5

Well Maintenance Inspection Form

Client: Kleinfelder Site: SMUD Pocket Date: 12/21/18

Job #:20190758.004A Technician: I. Hultquist Page 1 of 1

		Entry Indicates Deficiency													
Inspection Point	Well Inspected - No Corrective Action Required	Cap non-functional	Lock non-functional	Lock missing	Bolts missing (# missing / # total tabs)	Tabs stripped (# stripped / # total tabs.)	Tabs broken (# broken / # of total tabs)	Annular seal incomplete	Apron damaged	Rim / Lid broken	Trip Hazard	Below Grade	Other (explain in notes)	Well Not Inspected (explain in notes)	Notes (Note any repairs made while on site)
B-1				X											
B-2				X											
B-3				X											
B-4				X									X		water in box

Notes:

Repair codes: **rt**=retap/ bolts added or replaced **as**=annular seal repair,

Development Data Sheet

Job#: 20190758.004A	**Developer:** I. Hultquist	**Client:** Kleinfelder
Well ID: B-1	**Date:** 12/21/18	**Site:** SMUD Pocket
Well diam: 1/4" 1" 2" 3" 4" 6" Other:	**DTW:** 4.27	**TD Before:** 25.82 **TD After:** 29.71

Purge equip: ES - diam: 2 Bladder Peri Waterra Positive Air Displacement Ext. System

disp bailer teflon bailer other: SS bailer **Surge block used:** Y N

Length of time surged prior to development: 10 min

Pump depth/ intake: **Multipliers:** 1"= 0.04 2"= 0.16 3"= 0.37 4"= 0.65 5"=1.02 6"= 1.47 Radius^2 X 0.163

(TD - DTW X Multiplier = 1 Volume | 80% Recovery (TD - DTW X 0.20 + DTW)

1 Volume = 3.44 X **10** = 34.4 (Total Purge) Meter(s): Myron L ultrameter II, Hanna HI 98703

Time	Temp (°C / °F)	pH	Cond (mS / µS)	Turbidity (NTU)	Purge Rate (gal or mL/ min)	Volume Removed (gal / L)	DTW	Notes
1248	18.2	8.34	1124	>1000		3.44	10.24	SS bailer Brown/no odor
1255	19.3	8.20	1081	>1000		6.88	12.49	SS bailer
1304	19.1	8.24	1019	>1000	1.0	10.32	12.48	PAD Start 1301 Brown/no odor
1308	19.2	8.32	1028	>1000	|	13.76	13.20	Brown/no odor
1311	19.3	8.31	999.0	>1000	|	17.2	13.20	|
1315	19.3	8.18	954.0	>1000	|	20.64	13.20	|
1318	19.4	8.12	926.8	>1000	|	24.08	13.20	|
1322 ~~1323~~ IH	19.4	8.14	933.5	>1000	|	27.52	13.22	|
1325	19.4	8.09	926.9	>1000	|	30.96	13.22	|
1328	19.5	8.06	883.1	>1000		34.4	13.26	Clearing/no odor
				Paused	Development /	Switched	to DC pump	
1336	19.2	8.03	928.6	>1000	4.0	37.84	16.03	Start 1335 Brown/no odor
1337	19.4	8.30	963.3	>1000	|	41.28	27.83	Sounder hitting top of pump
				Well	Dewatered @		~ 42 gal	
				Switched	to PAD to		collect	3 stable readings

Did well dewater? YES NO | Total volume removed: 55.76 (gal / L)

Sample method (if applicable): Disp Bailer Ded. Tubing New Tubing Ext. Port Other:

Sample date:	Sample time:	DTW at sample:
Sample ID:	Lab:	Number of bottles:
Analysis:		

Development Data Sheet

Job#: 20190758.004A	Developer: I. Hultquist	Client: Kleinfelder
Well ID: B-1	Date: 12/21/18	Site: SMUD Pocket

Well diam: 1/4" 1" 2" 3" 4" 6" Other: **DTW:** 4.27 **TD Before:** 25.87 **TD After:** 29.71

Purge equip: ES - diam: 2 Bladder Peri Waterra Positive Air Displacement Ext. System disp bailer teflon bailer other: SS bailer **Surge block used:** Y N

Length of time surged prior to development: 10 min

Pump depth/ intake: **Multipliers:** 1"= 0.04 2"= 0.16 3"= 0.37 4"= 0.65 5"=1.02 6"= 1.47 Radius^2 X 0.16

(TD - DTW X Multiplier = 1 Volume | 80% Recovery (TD - DTW X 0.20 + DTW)

1 Volume = 3.44 X **10** = 34.4 (Total Purge) Meter(s): Myron L Ultrameter II, Hanna HI 98703

Time	Temp (°C / °F)	pH	Cond (mS / µS)	Turbidity (NTU)	Purge Rate (gal or mL/ min)	Volume Removed (gal / L)	DTW	Notes
1352	18.0	8.46	952.3	71000	1.0	45.44	12.24	PAD Start 1349 Brown/no odor
1356	18.7	8.36	922.6	71000	|	48.88	12.55	Brown/no odor
1359	18.7	8.29	897.8	71000	|	52.32	12.55	|
~~13~~ IH 1403	18.7	8.27	882.5	71000	|	55.76	12.56	|
			3 stable parameters					
			Development Complete				Hard bottom TD 29.71	

Development Data Sheet

Pg 1/2

Job#: 20190758.004A	**Developer:** I. Hultquist	**Client:** Kleinfelder
Well ID: B-2	**Date:** 12/21/18	**Site:** SMUD Pocket
Well diam: 1/4" 1" 2" 3" 4" 6" Other:	**DTW:** 3.20	**TD Before:** 28.10 **TD After:**
Purge equip: ES - diam: 2 Bladder Peri Waterra Positive Air Displacement Ext. System		
disp bailer teflon bailer other: SS bailer	**Surge block used:** Y N	
Length of time surged prior to development: 10min		
Pump depth/ intake:	**Multipliers:** 1"= 0.04 2"= 0.16 3"= 0.37 4"= 0.65 5"=1.02 6"= 1.47 Radius^2 X 0.163	

(TD - DTW X Multiplier = 1 Volume | 80% Recovery (TD - DTW X 0.20 + DTW)

1 Volume = 3.98 X **10** = 39.8 (Total Purge) Meter(s): Myron L Ultrameter II, Hanna HI 98703

Time	Temp (°C / °F)	pH	Cond (mS / µS)	Turbidity (NTU)	Purge Rate (gal or mL/ min)	Volume Removed (gal / L)	DTW	Notes
1043	18.4	7.34	1564	>1000		3.98	4.37	Brown/no odor / SS bailer
1053	18.5	7.31	1487	>1000	1.0	7.96	4.01	PAD Brown/no odor Start 1049
1057	19.4	7.27	1407	>1000	|	11.94	4.01	|
1101	19.5	7.29	1431	>1000	|	15.92	4.01	|
1105	19.6	7.27	1367	>1000	|	19.9	4.01	|
1109	19.5	7.76	1130	>1000	|	23.88	4.01	Clearing/no odor
1113	19.4	7.19	1133	>1000	|	27.86	4.01	|
1117	19.3	7.15	1142	>1000	|	31.84	4.01	|
1121	19.4	7.16	1157	>1000	|	35.82	4.01	|
1125	19.5	7.16	1160	>1000	|	39.8	4.01	|
1129	19.5	7.14	1160	>1000	|	43.78	4.01	|
1133	19.4	7.14	1165	>1000	|	47.76	4.01	|
1137	19.7	7.14	1271	>1000	|	51.74	4.01	|
1141	19.7	7.14	1169	>1000	|	55.72	4.01	|
1145	19.7	7.15	1151	>1000	|	59.7	4.01	|

Did well dewater? YES NO	Total volume removed: 79.6 (gal / L)
Sample method (if applicable): Disp Bailer Ded. Tubing New Tubing Ext. Port Other:	
Sample date: Sample time:	DTW at sample:
Sample ID: Lab:	Number of bottles:
Analysis:	

Development Data Sheet

Job#: 20190758.004A	**Developer:** I. Hultquist	**Client:** Kleinfelder
Well ID: B-2	**Date:** 12/21/18	**Site:** SMUD Pocket
Well diam: 1/4" 1" 2" 3" 4" 6" Other:	**DTW:** 3.20	**TD Before:** 28.10 **TD After:**
Purge equip: ES - diam: 2 Bladder Peri Waterra Positive Air Displacement Ext. System		
disp bailer teflon bailer other: SS bailer	**Surge block used:** Y N	
Length of time surged prior to development: 10min		
Pump depth/ intake:	**Multipliers:** 1"= 0.04 2"= 0.16 3"= 0.37 4"= 0.65 5"=1.02 6"= 1.47 Radius^2 X 0.16	
(TD - DTW X Multiplier = 1 Volume	80% Recovery (TD - DTW X 0.20 + DTW)	

1 Volume = 3.98 X **10** = 39.8 (Total Purge) Meter(s): Myron L Ultrameter, Hanna HI 98703

Time	Temp (°C / °F)	pH	Cond (mS / µS)	Turbidity (NTU)	Purge Rate (gal or mL/ min)	Volume Removed (gal / L)	DTW	Notes
			Paused Development / Switch to DC Pump					
1151	20.0	7.19	1165	>1000	4.0	63.68	7.67	Start 1150 Brown/no odor
1152	20.1	7.14	1137	>1000	|	67.66	7.69	clearing/no odor
1153	20.1	7.16	1128	>1000	|	71.64	7.72	|
1154	20.2	7.14	1120	>1000	|	75.62	7.68	|
1155	20.3	7.14	1118	>1000	|	79.6	7.65	|
			Development Complete Hard bottom					TD - 30.07

Development Data Sheet

Job#: 20190758.004A	Developer: I. Hultquist	Client: Kleinfelder
Well ID: B-3	Date: 12/21/18	Site: SMUD Pocket

Well diam: 1/4" 1" 2" 3" 4" 6" Other: | DTW: 4.19 | TD Before: 29.29 | TD After: 30.00

Purge equip: ES - diam: 2 Bladder Peri Waterra Positive Air Displacement Ext. System
disp bailer teflon bailer other: SS bailer **Surge block used:** Y N

Length of time surged prior to development: 10 min

Pump depth/ intake: | **Multipliers:** 1"= 0.04 2"= 0.16 3"= 0.37 4"= 0.65 5"=1.02 6"= 1.47 Radius^2 X 0.163

(TD - DTW X Multiplier = 1 Volume | 80% Recovery (TD - DTW X 0.20 + DTW)

1 Volume = 4.01 X **10** = 40.1 (Total Purge) Meter(s): Myron L Ultrameter II, Hanna HI 98703

Time	Temp (°C / °F)	pH	Cond (mS / µS)	Turbidity (NTU)	Purge Rate (gal or mL/ min)	Volume Removed (gal / L)	DTW	Notes
0835	18.4	7.17	1111	>1000		4.01	5.18	Brown/no odor SS bailer
~~0850~~	~~18.8~~	~~7.36~~	~~998.4~~	~~>1000~~	~~0.75~~	~~8.02~~	~~4.78~~	~~PAP~~ Start 0848
0852	19.1	7.20	1018	>1000	1.0	8.02	4.72	Brown/no odor PAP Start 0848
0856	19.6	7.27	1029	>1000	|	12.03	4.72	Brown/no odor
0900	19.8	7.27	1044	>1000	|	16.04	4.72	|
~~0911~~	~~19.4~~	~~7.21~~	~~948.2~~	Switched to DC Pump				
0911	19.4	7.21	948.2	>1000	4.0	20.05	6.71	Start 0910 Brown/no odor
0912	20.4	7.21	954.0	>1000	|	24.06	6.86	Brown/no odor
0913	20.5	7.14	956.8	>1000	|	28.07	6.90	|
0914	20.6	7.11	957.1	>1000	|	32.08	6.94	|
0915	20.6	7.12	958.1	>1000	|	36.09	6.91	|
0916	20.6	7.10	956.6	>1000	|	40.10	6.90	|
				Paused Development				
0920	20.4	7.12	908.8	>1000	4.0	44.11	6.81	Start 0919
0921	20.6	7.07	894.7	>1000	|	48.12	6.77	Clearing/no odor

Did well dewater? YES NO | Total volume removed: 124.31 (gal / L)

Sample method (if applicable): Disp Bailer Ded. Tubing New Tubing Ext. Port Other:

Sample date: | Sample time: | DTW at sample:

Sample ID: | Lab: | Number of bottles:

Analysis:

Development Data Sheet

Job#: 20190758.004A	**Developer:** I. Hultquist	**Client:** Kleinfelder
Well ID: B-3	**Date:** 12/21/18	**Site:** SMUD Pocket

Well diam: 1/4" 1" 2" 3" 4" 6" Other: **DTW:** 4.19 **TD Before:** 29.29 **TD After:** 30.00

Purge equip: ES - diam: 2 Bladder Peri Waterra Positive Air Displacement Ext. System
disp bailer teflon bailer other: SS bailer **Surge block used:** Y N

Length of time surged prior to development: 10 min

Pump depth/ intake: **Multipliers:** 1"= 0.04 2"= 0.16 3"= 0.37 4"= 0.65 5"=1.02 6"= 1.47 Radius² X 0.16

(TD - DTW X Multiplier = 1 Volume | 80% Recovery (TD - DTW X 0.20 + DTW)

1 Volume = 4.01 X **10** = 40.1 (Total Purge) Meter(s): Myron L Ultrameter II, Hanna HI 98703

Time	Temp (°C / °F)	pH	Cond (mS / µS)	Turbidity (NTU)	Purge Rate (gal or mL/ min)	Volume Removed (gal / L)	DTW	Notes
0922	20.6	7.07	879.3	>1000	4.0	52.13	6.97	Clearing / no odor
0923	20.6	7.04	870.2	>1000	|	56.14	6.74	|
0924	20.5	7.08	865.0	>1000	|	60.15	6.71	|
0925	20.6	7.05	862.5	>1000	|	64.16	6.69	|
0926	20.6	7.02	859.2	>1000	|	68.17	6.69	|
0927	20.7	7.02	855.5	>1000	|	72.18	6.69	|
0928	20.6	6.98	854.0	>1000	|	76.19	6.69	|
0929	20.6	7.01	857.7	>1000	|	80.2	6.69	|
0930	20.5	7.03	855.2	968	|	84.21	6.70	|
0931	20.6	6.99	853.0	889	|	88.22	6.70	|
			Paused			92.23		
0938	20.2	7.04	893.8	671	4.0	96.24	6.50	~~Brown~~ Clearing / no odor
0939	20.5	7.03	899.1	643	|	100.25	6.51	|
0940	20.6	7.01	857.5	707	|	104.26	6.51	|
0941	20.5	7.03	853.5	749	|	108.27	6.56	|
0942	20.6	6.99	856.5	711	|	112.28	~~6.68~~	6.58 DTW |
0943	20.6	7.01	860.3	676	|	116.29	6.57	|
0944	20.6	6.98	858.8	650	|	120.3	6.56	|
0945	20.6	6.98	849.6	595	|	124.31	6.57	|

Hard Bottom Development Complete TD - 30.00

Development Data Sheet

Job#: 20190758.004A	**Developer:** I. Hultquist	**Client:** Kleinfelder
Well ID: B-4	**Date:** 12/21/18	**Site:** SMUD Pocket
Well diam: 1/4" 1" 2" 3" 4" 6" Other:	**DTW:** 5.36	**TD Before:** 25.77 **TD After:** 28.51

Purge equip: ES - diam: Bladder Peri Waterra Positive Air Displacement Ext. System
disp bailer teflon bailer other: **Surge block used:** Y N

Length of time surged prior to development: 10min

Pump depth/ intake: **Multipliers:** 1"= 0.04 2"= 0.16 3"= 0.37 4"= 0.65 5"=1.02 6"= 1.47 Radius^2 X 0.163

(TD - DTW X Multiplier = 1 Volume | 80% Recovery (TD - DTW X 0.20 + DTW)

1 Volume = 3.26 X **10** = 32.6 (Total Purge) Meter(s): Myron L ultrameter II Hanna HI 98703

Time	Temp (°C/ °F)	pH	Cond (mS / µS)	Turbidity (NTU)	Purge Rate (gal or mL/ min)	Volume Removed (gal / L)	DTW	Notes
1434	17.5	7.88	1590	>1000	0.65	3.26	5.87	Reddish brown / no odor - SS bailer
1440	15.8	7.87	1507	>1000	1.0	6.52	5.26	PAD start 1437 Reddish brown / no odor
1443	16.6	7.88	1505	>1000	|	9.78	5.26	Reddish Brown / no odor
1446	17.3	7.88	1584	>1000	|	13.04	5.26	|
1449	17.8	7.76	1746	>1000	|	16.3	5.26	|
1452	17.7	7.51	1797	>1000	|	19.56	5.23	|
1455	17.9	7.47	1789	>1000	|	22.82	5.23	|
1458	18.0	7.45	1788	>1000	|	26.08	5.23	Clearing / no odor
1501	18.0	7.44	1781	>1000	|	29.34	5.23	|
1504	18.1	7.43	1777	>1000	|	32.6	5.23	|
1507	18.0	7.42	1779	>1000	|	35.86	5.23	|
1510	18.0	7.41	1776	>1000	|	39.12	5.23	|
1513	18.1	7.42	1774	>1000	|	42.38	5.23	|
1516	18.1	7.40	1773	>1000	|	45.64	5.23	| TD 28.51
		Hard bottom Development Complete						

Did well dewater? YES NO | Total volume removed: 45.64 (gal / L)

Sample method (if applicable): Disp Bailer Ded. Tubing New Tubing Ext. Port Other:

Sample date: | Sample time: | DTW at sample:

Sample ID: | Lab: | Number of bottles:

Analysis:

APPENDIX C
ABORATORY TEST RESULTS

Laboratory Test Report

Client:	**Sacramento Municipal Utility District**	Report No.:	**19-SAC-00020 Rev. 0**	Issued:	**1/10/2019**
Project:	**20190758.004A**			Field ID:	**B-1**
	SMUD - Pocket 69kV Cable Replacement	Sampled by:	**B. Rousseau**	Date:	**11/7/2018**
	05-000L - Laboratory Services	Submitted by:	**B. Rousseau**	Date:	**1/2/2019**

Tested on **1/3/2019** by **B. Rousseau**

Material Description: **Sandy Silt**

Location: **B-1, #6 @ 30'**

Test Method: **ASTM D6913**

U.S. Standard Sieve Size		% Passing
1 Inch	25-mm	**100**
3/4 Inch	19-mm	**100**
1/2 Inch	12.5-mm	**100**
3/8 Inch	9.5-mm	**100**
No. 4	4.75-mm	**100**
No. 10	2.00-mm	**99**
No. 20	850-um	**99**
No. 40	425-um	**98**
No. 60	250-um	**92**
No. 140	106-um	**61**
No. 200	75-um	**51**

Reviewed on 1/10/2019 by Steve Rader,
Senior Technician

Laboratory Test Report

Client:	**Sacramento Municipal Utility District**	Report No.:	**19-SAC-00020 Rev. 0**	Issued:	**1/10/2019**
Project:	**20190758.004A**			Field ID:	**B-1**
	SMUD - Pocket 69kV Cable Replacement	Sampled by:	**B. Rousseau**	Date:	**11/7/2018**
	05-000L - Laboratory Services	Submitted by:	**B. Rousseau**	Date:	**1/2/2019**

Tested on **1/3/2019** by **B. Rousseau**

Test Method: **ASTM D2216 / ASTM D7263**

Boring	Sample	Depth, ft.	Water Content, %	Dry Density, pcf
B-1	**2A**	**6**	**27.4**	**101.4**
B-1	**3A**	**11**	**26.8**	**101.2**
B-1	**5**	**25**	**25.4**	**nm**
B-1	**8**	**40**	**30.9**	**nm**

Remarks:

Reviewed on 1/10/2019 by Steve Rader,
Senior Technician

Laboratory Test Report

Client:	**Sacramento Municipal Utility District**	Report No.:	**19-SAC-00020 Rev. 0**	Issued:	**1/10/2019**
Project:	**20190758.004A**			Field ID:	**B-1**
	SMUD - Pocket 69kV Cable Replacement	Sampled by:	**B. Rousseau**	Date:	**11/7/2018**
	05-000L - Laboratory Services	Submitted by:	**B. Rousseau**	Date:	**1/2/2019**

Tested on **1/3/2019** by **J. Cowley**

Test Method: **ASTM D1140**

Boring:	Sample:	Depth, ft.:	% Minus 200:
B-1	**4**	**20**	**54.5**
B-1	**9**	**45**	**38.0**

Reviewed on 1/10/2019 by Steve Rader,
Senior Technician

Laboratory Test Report

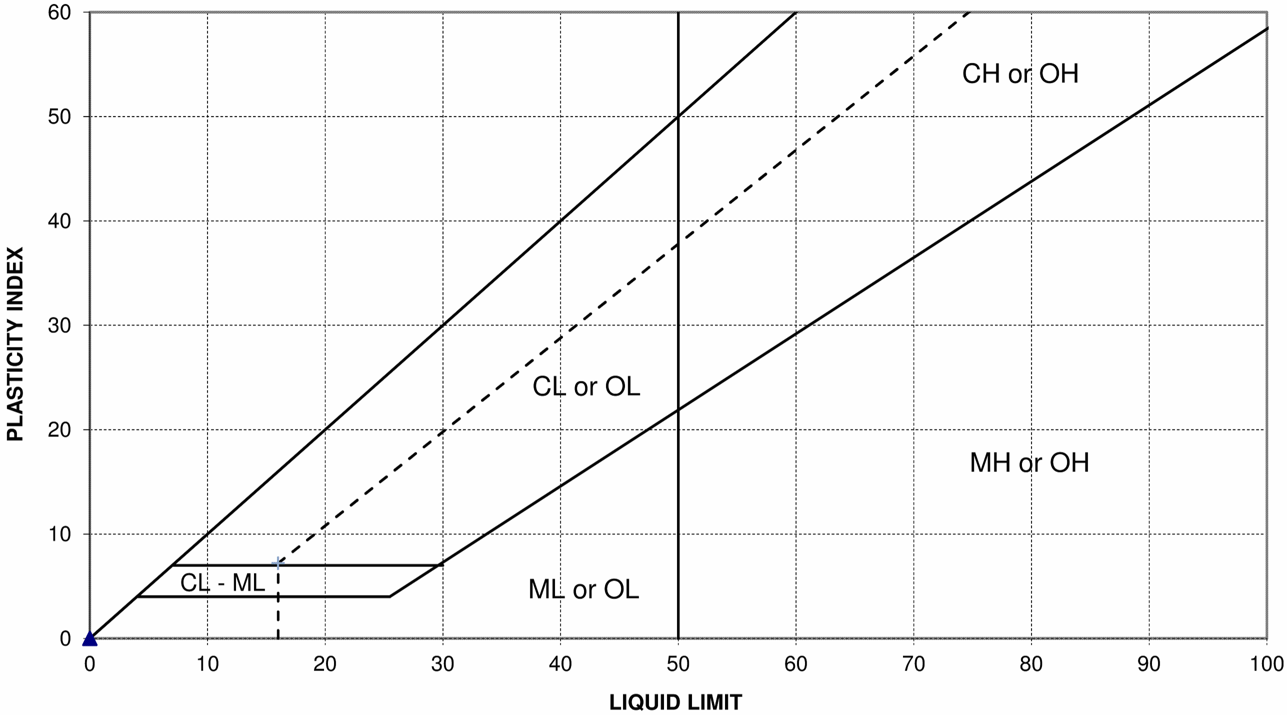
Client:	**Sacramento Municipal Utility District**	Report No.:	**19-SAC-00020 Rev. 0**	Issued:	**1/10/2019**
Project:	**20190758.004A**			Field ID:	**B-1**
	SMUD - Pocket 69kV Cable Replacement	Sampled by:	**B. Rousseau**	Date:	**11/7/2018**
	05-000L - Laboratory Services	Submitted by:	**B. Rousseau**	Date:	**1/2/2019**

Soil Test Report: Atterberg Limits

Tested on **1/3/2019** by **J. Slinkard**

Material Description: **Sandy Silt**

Sample Location: **B-1, #5 @ 25'**



Test Method	**ASTM D4318**		
Liquid Limit	**--**	Soil Classification:	**ML**
Plastic Limit	**--**		**ASTM D2487**
Plasticity Index	**NP**		

Reviewed on 1/10/2019 by Steve Rader,
Senior Technician

Laboratory Test Report

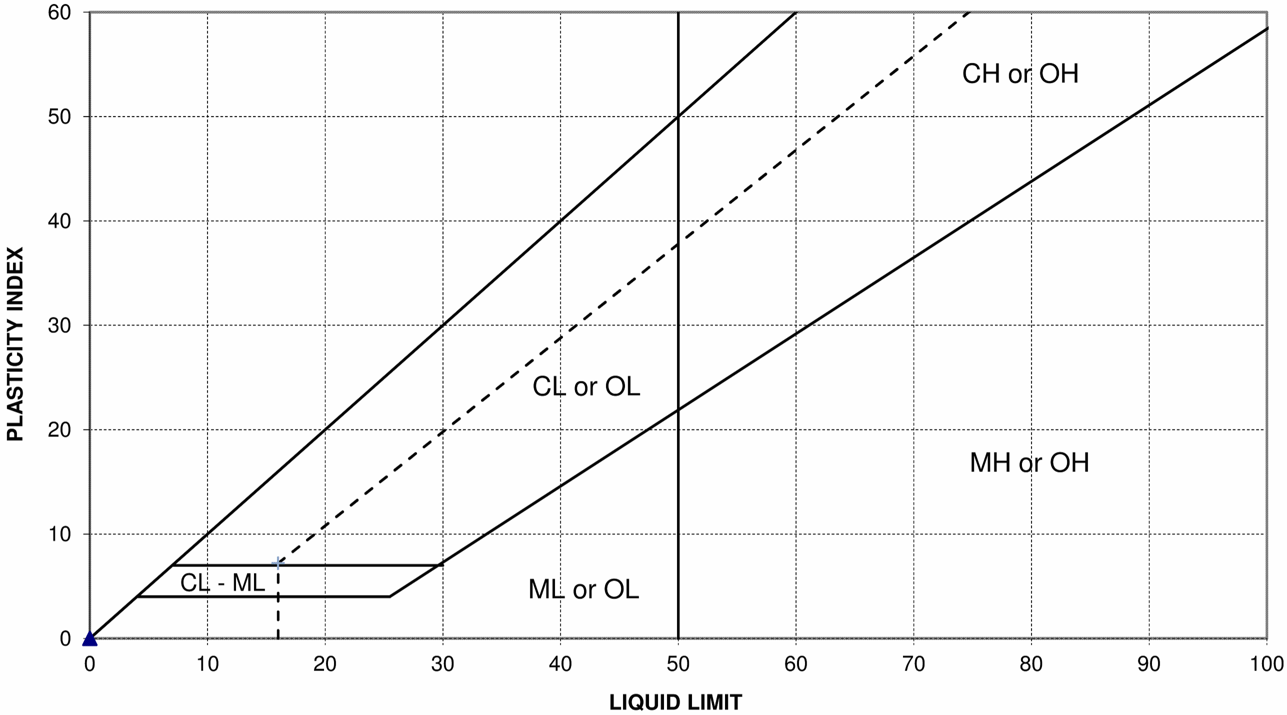
Client:	**Sacramento Municipal Utility District**	Report No.:	**19-SAC-00020 Rev. 0**	Issued:	**1/10/2019**
Project:	**20190758.004A**			Field ID:	**B-1**
	SMUD - Pocket 69kV Cable Replacement	Sampled by:	**B. Rousseau**	Date:	**11/7/2018**
	05-000L - Laboratory Services	Submitted by:	**B. Rousseau**	Date:	**1/2/2019**

Soil Test Report: Atterberg Limits

Tested on **1/3/2019** by **B. Rousseau**

Material Description: **Silt with sand**

Sample Location: **B-1, #8 @ 40'**



Test Method	**ASTM D4318**		
Liquid Limit	**--**	Soil Classification:	**ML**
Plastic Limit	**--**		**ASTM D2487**
Plasticity Index	**NP**		

Reviewed on 1/10/2019 by Steve Rader,
Senior Technician

Laboratory Test Report

Client:	**Sacramento Municipal Utility District**	Report No.:	**19-SAC-00021 Rev. 0**	Issued:	**1/10/2019**
Project:	**20190758.004A**			Field ID:	**B-2**
	SMUD - Pocket 69kV Cable Replacement	Sampled by:	**B. Rousseau**	Date:	**12/17/2018**
	05-000L - Laboratory Services	Submitted by:	**B. Rousseau**	Date:	**1/2/2019**

Tested on **1/2/2019** by **B. Rousseau**

Test Method: **ASTM D2216 / ASTM D7263**

Boring	Sample	Depth, ft.	Water Content, %	Dry Density, pcf
B-2	**2A**	**6**	**43.9**	**79.0**

Remarks:

Reviewed on 1/10/2019 by Steve Rader,
Senior Technician

Laboratory Test Report

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Client:	**Sacramento Municipal Utility District**	Report No.:	**19-SAC-00021 Rev. 0**	Issued:	**1/10/2019**
Project:	**20190758.004A**			Field ID:	**B-2**
	SMUD - Pocket 69kV Cable Replacement	Sampled by:	**B. Rousseau**	Date:	**12/17/2018**
	05-000L - Laboratory Services	Submitted by:	**B. Rousseau**	Date:	**1/2/2019**

Tested on **1/4/2019** by **J. Cowley**

Material Description: **Silty Sand**

Location: **B-2, #4 @ 15'**

Test Method: **ASTM D6913**

U.S. Standard Sieve Size		% Passing
1 Inch	25-mm	**100**
3/4 Inch	19-mm	**100**
1/2 Inch	12.5-mm	**100**
3/8 Inch	9.5-mm	**100**
No. 4	4.75-mm	**99**
No. 10	2.00-mm	**96**
No. 20	850-um	**81**
No. 40	425-um	**64**
No. 60	250-um	**54**
No. 140	106-um	**40**
No. 200	75-um	**36**

Reviewed on 1/10/2019 by Steve Rader,
Senior Technician

Laboratory Test Report

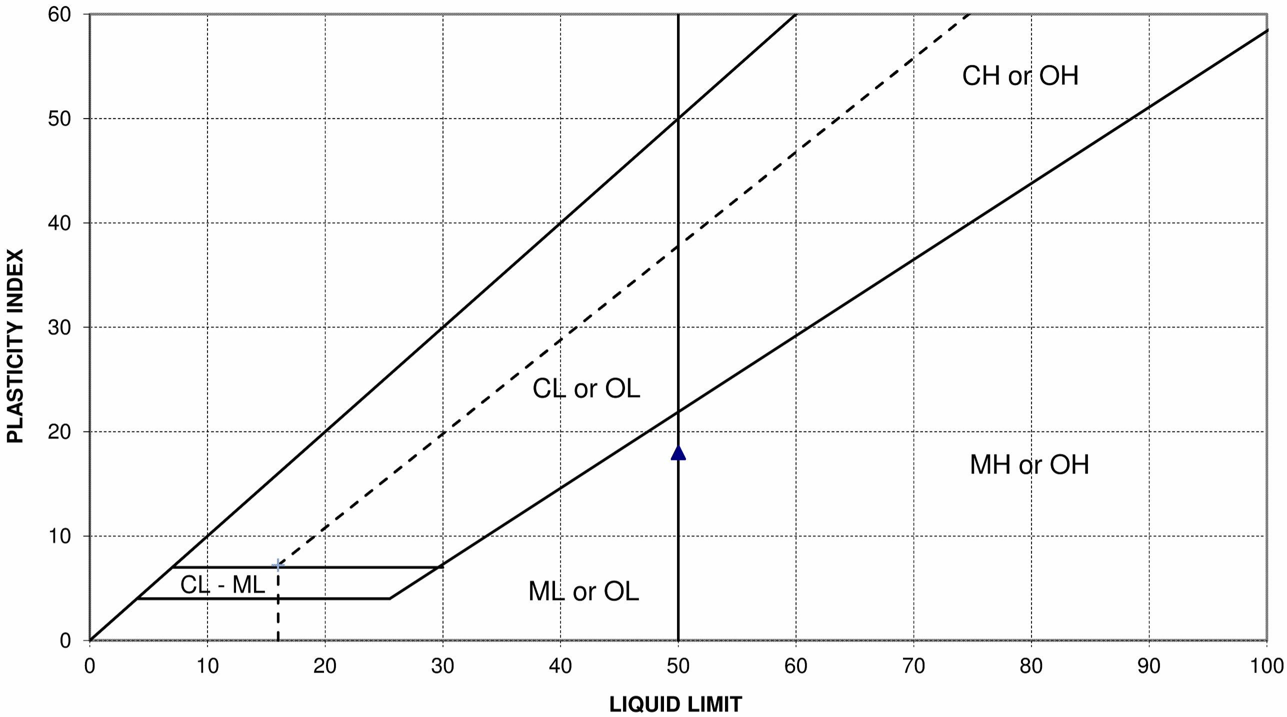
Client:	**Sacramento Municipal Utility District**	Report No.:	**19-SAC-00021 Rev. 0**	Issued:	**1/10/2019**
Project:	**20190758.004A**			Field ID:	**B-2**
	SMUD - Pocket 69kV Cable Replacement	Sampled by:	**B. Rousseau**	Date:	**12/17/2018**
	05-000L - Laboratory Services	Submitted by:	**B. Rousseau**	Date:	**1/2/2019**

Soil Test Report: Atterberg Limits

Tested on **1/3/2019** by **J. Cowley**

Material Description: **Elastic Silt**

Sample Location: **B-2, 2A @ 6'**



Test Method	**ASTM D4318**	
Liquid Limit	**50**	Soil Classification: **MH**
Plastic Limit	**32**	**ASTM D2487**
Plasticity Index	**18**	

Reviewed on 1/10/2019 by Steve Rader,
Senior Technician

Laboratory Test Report

Client:	**Sacramento Municipal Utility District**	Report No.:	**19-SAC-00021 Rev. 0**	Issued:	**1/10/2019**
Project:	**20190758.004A**			Field ID:	**B-2**
	SMUD - Pocket 69kV Cable Replacement	Sampled by:	**B. Rousseau**	Date:	**12/17/2018**
	05-000L - Laboratory Services	Submitted by:	**B. Rousseau**	Date:	**1/2/2019**

Tested on **1/4/2019** by **J. Cowley**

Material Description: **Sandy Silt**

Location: **B-2, #6 @ 25'**

Test Method: **ASTM D6913**

U.S. Standard Sieve Size		% Passing
1 Inch	25-mm	**100**
3/4 Inch	19-mm	**100**
1/2 Inch	12.5-mm	**100**
3/8 Inch	9.5-mm	**100**
No. 4	4.75-mm	**100**
No. 10	2.00-mm	**100**
No. 20	850-um	**100**
No. 40	425-um	**100**
No. 60	250-um	**99**
No. 140	106-um	**72**
No. 200	75-um	**61**

Reviewed on 1/10/2019 by Steve Rader,
Senior Technician

Laboratory Test Report

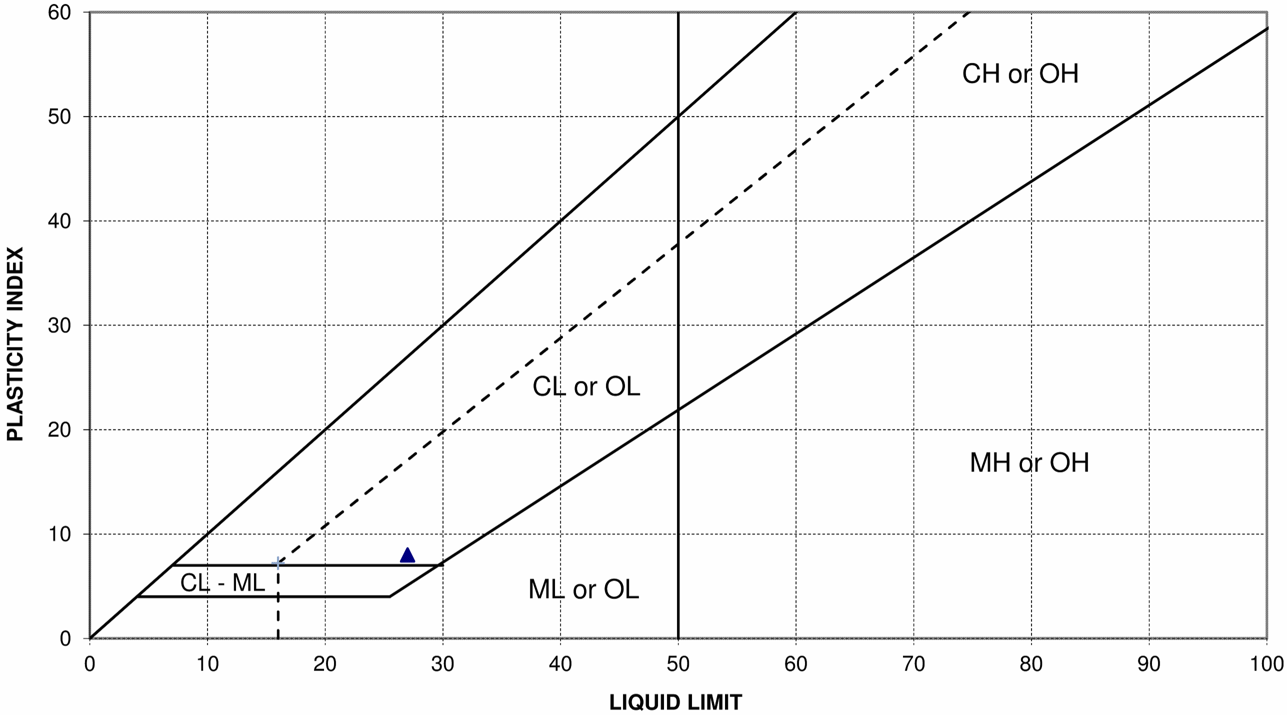
Client:	**Sacramento Municipal Utility District**	Report No.:	**19-SAC-00021 Rev. 0**	Issued:	**1/10/2019**
Project:	**20190758.004A**			Field ID:	**B-2**
	SMUD - Pocket 69kV Cable Replacement	Sampled by:	**B. Rousseau**	Date:	**12/17/2018**
	05-000L - Laboratory Services	Submitted by:	**B. Rousseau**	Date:	**1/2/2019**

Soil Test Report: Atterberg Limits

Tested on **1/3/2019** by **B. Rousseau**

Material Description: **Lean Clay with sand**

Sample Location: **B-2, #5 @ 20'**



Test Method	**ASTM D4318**
Liquid Limit	**27**
Plastic Limit	**19**
Plasticity Index	**8**

Soil Classification: **CL**
ASTM D2487

Reviewed on 1/10/2019 by Steve Rader,
Senior Technician

Laboratory Test Report

Client:	**Sacramento Municipal Utility District**	Report No.:	**19-SAC-00022 Rev. 0**	Issued:	**1/10/2019**
Project:	**20190758.004A**			Field ID:	**B-3**
	SMUD - Pocket 69kV Cable Replacement	Sampled by:	**B. Rousseau**	Date:	**11/9/2018**
	05-000L - Laboratory Services	Submitted by:	**B. Rousseau**	Date:	**1/2/2019**

Tested on **1/4/2019** by **J. Cowley**

Material Description: **Sandy Silt**

Location: **B-3, #7 @ 30'**

Test Method: **ASTM D6913**

U.S. Standard Sieve Size		% Passing
1 Inch	25-mm	**100**
3/4 Inch	19-mm	**100**
1/2 Inch	12.5-mm	**100**
3/8 Inch	9.5-mm	**100**
No. 4	4.75-mm	**100**
No. 10	2.00-mm	**100**
No. 20	850-um	**100**
No. 40	425-um	**100**
No. 60	250-um	**99**
No. 140	106-um	**70**
No. 200	75-um	**55**

Reviewed on 1/10/2019 by Steve Rader,
Senior Technician

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Laboratory Test Report

Client:	**Sacramento Municipal Utility District**	Report No.:	**19-SAC-00022 Rev. 0**	Issued:	**1/10/2019**
Project:	**20190758.004A**			Field ID:	**B-3**
	SMUD - Pocket 69kV Cable Replacement	Sampled by:	**B. Rousseau**	Date:	**11/9/2018**
	05-000L - Laboratory Services	Submitted by:	**B. Rousseau**	Date:	**1/2/2019**

Tested on **1/2/2019** by **B. Rousseau**

Test Method: **ASTM D2216 / ASTM D7263**

Boring	Sample	Depth, ft.	Water Content, %	Dry Density, pcf
B-3	**2A**	**6**	**53.8**	**66.6**
B-3	**5**	**20**	**30.1**	**nm**

Remarks:

Reviewed on 1/10/2019 by Steve Rader,
Senior Technician

Laboratory Test Report

Client:	**Sacramento Municipal Utility District**	Report No.:	**19-SAC-00022 Rev. 0**	Issued:	**1/10/2019**
Project:	**20190758.004A**			Field ID:	**B-3**
	SMUD - Pocket 69kV Cable Replacement	Sampled by:	**B. Rousseau**	Date:	**11/9/2018**
	05-000L - Laboratory Services	Submitted by:	**B. Rousseau**	Date:	**1/2/2019**

Tested on **1/3/2019** by **J. Cowley**

Test Method: **ASTM D1140**

Boring:	Sample:	Depth, ft.:	% Minus 200:
B-3	**3A**	**11**	**98.3**
B-3	**4A**	**16**	**67.9**

Reviewed on 1/10/2019 by Steve Rader,
Senior Technician

Laboratory Test Report

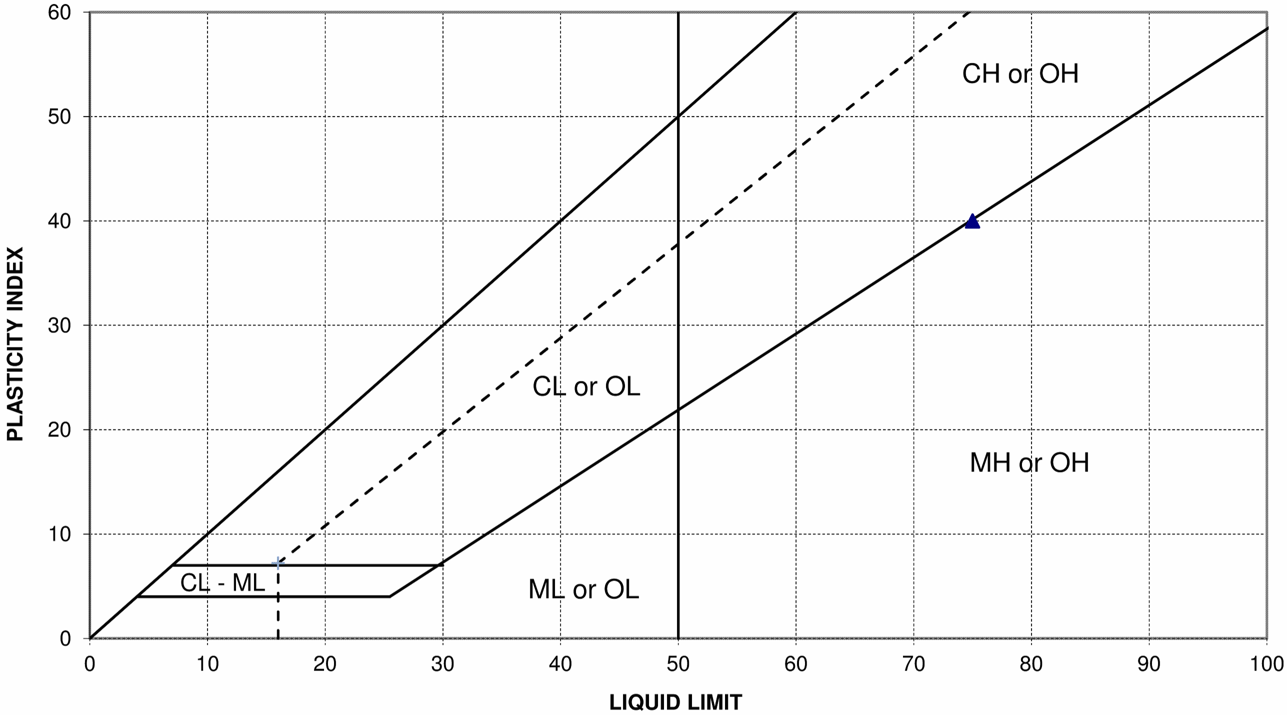
Client:	**Sacramento Municipal Utility District**	Report No.:	**19-SAC-00022 Rev. 0**	Issued:	**1/10/2019**
Project:	**20190758.004A**			Field ID:	**B-3**
	SMUD - Pocket 69kV Cable Replacement	Sampled by:	**B. Rousseau**	Date:	**11/9/2018**
	05-000L - Laboratory Services	Submitted by:	**B. Rousseau**	Date:	**1/2/2019**

Soil Test Report: Atterberg Limits

Tested on **1/3/2019** by **B. Rousseau**

Material Description: **Fat Clay**

Sample Location: **B-3, 2A @ 6'**



Test Method	**ASTM D4318**		
Liquid Limit	**75**	Soil Classification: **CH**	
Plastic Limit	**35**	**ASTM D2487**	
Plasticity Index	**40**		

Reviewed on 1/10/2019 by Steve Rader,
Senior Technician

Laboratory Test Report

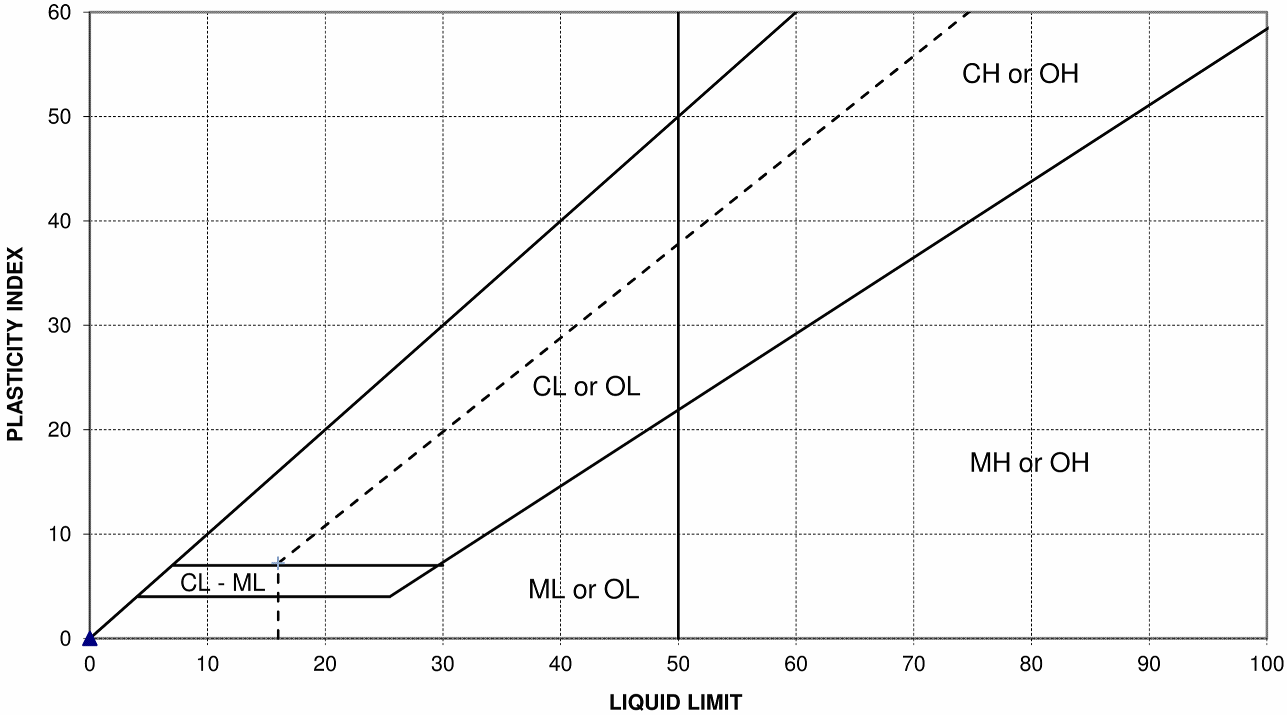
Client:	**Sacramento Municipal Utility District**	Report No.:	**19-SAC-00022 Rev. 0**	Issued:	**1/10/2019**
Project:	**20190758.004A**			Field ID:	**B-3**
	SMUD - Pocket 69kV Cable Replacement	Sampled by:	**B. Rousseau**	Date:	**11/9/2018**
	05-000L - Laboratory Services	Submitted by:	**B. Rousseau**	Date:	**1/2/2019**

Soil Test Report: Atterberg Limits

Tested on **1/3/2019** by **J. Slinkard**

Material Description: **Silt with sand**

Sample Location: **B-3, #5 @ 20'**



Test Method	**ASTM D4318**		
Liquid Limit	--	Soil Classification:	**ML**
Plastic Limit	--		**ASTM D2487**
Plasticity Index	**NP**		

Reviewed on 1/10/2019 by Steve Rader,
Senior Technician

Laboratory Test Report

Client:	**Sacramento Municipal Utility District**	Report No.:	**19-SAC-00023 Rev. 0**	Issued:	**1/10/2019**
Project:	**20190758.004A**			Field ID:	**B-4**
	SMUD - Pocket 69kV Cable Replacement	Sampled by:	**B. Rousseau**	Date:	**11/8/2018**
	05-000L - Laboratory Services	Submitted by:	**B. Rousseau**	Date:	**1/2/2019**

Tested on **1/2/2019** by **B. Rousseau**

Test Method: **ASTM D2216 / ASTM D7263**

Boring	Sample	Depth, ft.	Water Content, %	Dry Density, pcf
B-4	**1A**	**6**	**35.5**	**84.0**
B-4	**5**	**25**	**25.4**	**nm**

Remarks:

Reviewed on 1/10/2019 by Steve Rader,
Senior Technician

Laboratory Test Report

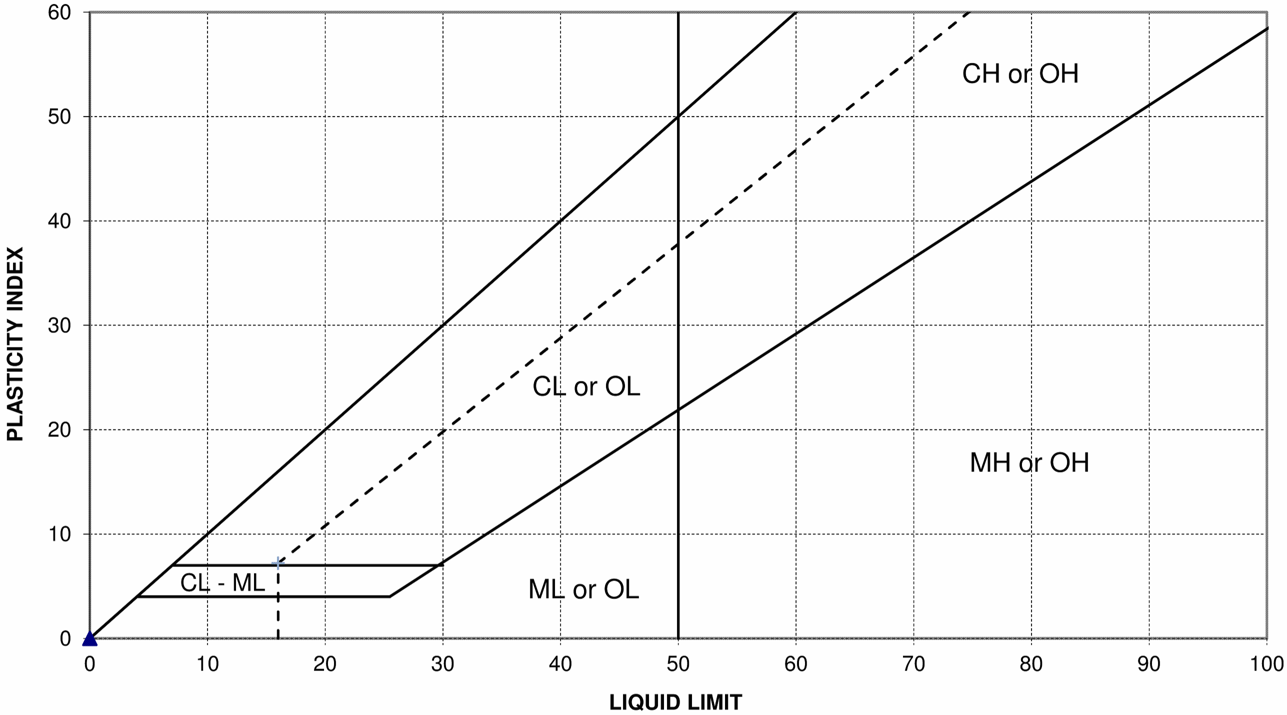
Client:	**Sacramento Municipal Utility District**	Report No.:	**19-SAC-00023 Rev. 0**	Issued:	**1/10/2019**
Project:	**20190758.004A**			Field ID:	**B-4**
	SMUD - Pocket 69kV Cable Replacement	Sampled by:	**B. Rousseau**	Date:	**11/8/2018**
	05-000L - Laboratory Services	Submitted by:	**B. Rousseau**	Date:	**1/2/2019**

Soil Test Report: Atterberg Limits

Tested on **1/3/2019** by **J. Slinkard**

Material Description: **Sandy Silt**

Sample Location: **B-4, #4 @ 20'**



Test Method	**ASTM D4318**		
Liquid Limit	**--**	Soil Classification:	**ML**
Plastic Limit	**--**		**ASTM D2487**
Plasticity Index	**NP**		

Reviewed on 1/10/2019 by Steve Rader,
Senior Technician

Laboratory Test Report

Client:	**Sacramento Municipal Utility District**	Report No.:	**19-SAC-00023 Rev. 0**	Issued:	**1/10/2019**
Project:	**20190758.004A**			Field ID:	**B-4**
	SMUD - Pocket 69kV Cable Replacement	Sampled by:	**B. Rousseau**	Date:	**11/8/2018**
	05-000L - Laboratory Services	Submitted by:	**B. Rousseau**	Date:	**1/2/2019**

Tested on **1/3/2019** by **J. Cowley**

Test Method: **ASTM D1140**

Boring:	Sample:	Depth, ft.:	% Minus 200:
B-4	**3**	**15**	**61.1**

Reviewed on 1/10/2019 by Steve Rader,
Senior Technician

Laboratory Test Report

Client:	**Sacramento Municipal Utility District**	Report No.:	**19-SAC-00023 Rev. 0**	Issued:	**1/10/2019**
Project:	**20190758.004A**			Field ID:	**B-4**
	SMUD - Pocket 69kV Cable Replacement	Sampled by:	**B. Rousseau**	Date:	**11/8/2018**
	05-000L - Laboratory Services	Submitted by:	**B. Rousseau**	Date:	**1/2/2019**

Tested on **1/4/2019** by **J. Cowley**

Material Description: **Sandy Silt**

Location: **B-4, #4 @ 20'**

Test Method: **ASTM D6913**

U.S. Standard Sieve Size		% Passing
1 Inch	25-mm	**100**
3/4 Inch	19-mm	**100**
1/2 Inch	12.5-mm	**100**
3/8 Inch	9.5-mm	**100**
No. 4	4.75-mm	**100**
No. 10	2.00-mm	**96**
No. 20	850-um	**95**
No. 40	425-um	**95**
No. 60	250-um	**93**
No. 140	106-um	**74**
No. 200	75-um	**63**

Reviewed on 1/10/2019 by Steve Rader,
Senior Technician

Laboratory Test Report

Client:	**Sacramento Municipal Utility District**	Report No.:	**19-SAC-00023 Rev. 0**	Issued:	**1/10/2019**
Project:	**20190758.004A**			Field ID:	**B-4**
	SMUD - Pocket 69kV Cable Replacement	Sampled by:	**B. Rousseau**	Date:	**11/8/2018**
	05-000L - Laboratory Services	Submitted by:	**B. Rousseau**	Date:	**1/2/2019**

Tested on **1/4/2019** by **J. Cowley**

Material Description: **Silt with sand**

Location: **B-4, #6 @ 30'**

Test Method: **ASTM D6913**

U.S. Standard Sieve Size		% Passing
1 Inch	25-mm	**100**
3/4 Inch	19-mm	**100**
1/2 Inch	12.5-mm	**100**
3/8 Inch	9.5-mm	**99**
No. 4	4.75-mm	**99**
No. 10	2.00-mm	**98**
No. 20	850-um	**98**
No. 40	425-um	**97**
No. 60	250-um	**96**
No. 140	106-um	**83**
No. 200	75-um	**73**

Reviewed on 1/10/2019 by Steve Rader,
Senior Technician

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

Date Reported 01/23/2019
Date Submitted 01/17/2019

To: Craig Riddle
Kleinfelder-Sacramento
2882 Prospect Park Dr.Ste 200
Rancho Cordova CA 95670

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

The reported analysis was requested for the following location:
Location : 20190758.004A Site ID : B1+B2 COMP 0-10.
Thank you for your business.

* For future reference to this analysis please use SUN # 78824-164814.

EVALUATION FOR SOIL CORROSION

Soil pH	7.30	
Minimum Resistivity	1.77 ohm-cm (x1000)	
Chloride	13.9 ppm	00.00139 %
Sulfate	16.4 ppm	00.00164 %

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

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

Date Reported 01/23/2019
Date Submitted 01/17/2019

To: Craig Riddle
Kleinfelder-Sacramento
2882 Prospect Park Dr.Ste 200
Rancho Cordova CA 95670

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

The reported analysis was requested for the following location:
Location : 20190758.004A Site ID : B3+B4 COMP 0-10.
Thank you for your business.

* For future reference to this analysis please use SUN # 78824-164815.

EVALUATION FOR SOIL CORROSION

Soil pH	7.25		
Minimum Resistivity	1.45 ohm-cm (x1000)		
Chloride	22.4 ppm	00.00224	%
Sulfate	24.2 ppm	00.00242	%

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

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LABORATORY TESTING PROGRAM - GEOTECHNICAL

LAB NUMBER: ____________

Test Method
☐ ASTM ☐ DOT
☐ AASHTO ☐ Other (see remarks) ____________

Project: SMUD POCKET
Date Sampled: 11/7/18 - 11/9/18 Project No.: 20190758.004A
Date Submitted: 1/15/19 Task No.: ____________
Submitted By: C. RIDDLE Report To: C. RIDDLE

Boring / Test Pit	Sample	Depth, ft.	Sample Type	CLASSIFICATN, VISUAL	WATER CONTENT	WATER/DENSITY, SOIL	SIEVE ANALYSIS, -200	SIEVE ANALYSIS, F		SIEVE ANALYSIS, C&F	HYDROMETER ANALYSIS	ATTERBERG, MULTI-PT.	ATTERBERG, ONE-PT.	SOIL ORGANIC CONTENT	SOIL SPEC. GRAV.				STANDARD PROCTOR, 4"	MODIFIED PROCTOR, 4"	R-VALUE	EXPANSION INDEX		SOIL PH	SOIL RESISTIVITY	CHLORIDE CONTENT	SULFATE CONTENT		SAMPLE MIX&PROCESS	SAMPLE PREPARATION	Remarks
B-1&B-2	COMP.	0-10	BAG																					/	/	/	/				
B-3&B4	COMP	0-10	BAG																					/	/	/	/				
Quantity of Tests																															
Unit				L00228	L00294	L00295	L00267	L00270		L00269	L00248	L00223	L00224	L00271	L00275				L00279	L00251	L00264	L00246		L00272	L00273	L00227	L00281		L00905	L00907	

Boring / Test Pit	Sample	Depth, ft.	Sample Type	UNCONFINED COMP STR.	DIRECT SHEAR, 1 PT.	DIRECT SHEAR, 3 PTS.	DIRECT SHEAR, RESID.	TRIAX, CU, 1 POINT	TRIAX, CU, 3 POINTS	TRIAX CD, 1 POINT	TRIAX CD, 3 POINTS	TRIAX, UU, 1 POINT	TRIAX, UU, 3 POINTS	TRIAX, UU SAT, 1 PT.	TRIAX, UU SAT, 3 PT.	PERMEABILITY, FLEX	PERMEABILITY, RIGID	PINHOLE DISPERSION		CONSOL. W/O TR	CONSOL. W/2 TR	CONSOL. ALL TR	CONSOL. ADD. REBOUND		ONEDIM FREE SWELL	ONEDIM SWELL % HEAVE	ONEDIMSWELL W/CONSOL		SAMPLE REMOLDING		Remarks
Quantity of Tests																															
Unit				L00293	L00242	L00243	L00244	L00286	L00287	L00285	Lo0336	L00289	L00290	L00288	L00325	L00258	L00259	L00261		L00233	L00232	L00231	L00230		L00255	L00256	L00257		L00908		

☐ Test requested ☐ Test in progress ☒ Test complete

1-7-19
2:50

LAB-30 REV 02/14

SUNLAND ANALYTICAL LAB
11419 Sunrise Gold Cr., Ste.10
Rancho Cordova, CA 95742
(916)852-8557

INVOICE

Inv.No. 98824

Kleinfelder-Sacramento
2882 Prospect Park Dr.Ste 200
Rancho Cordova CA 95670

Date 01/23/2019
Terms: NET 30, 30+ 15%
Customer P.O.#
Requestor: Riddle

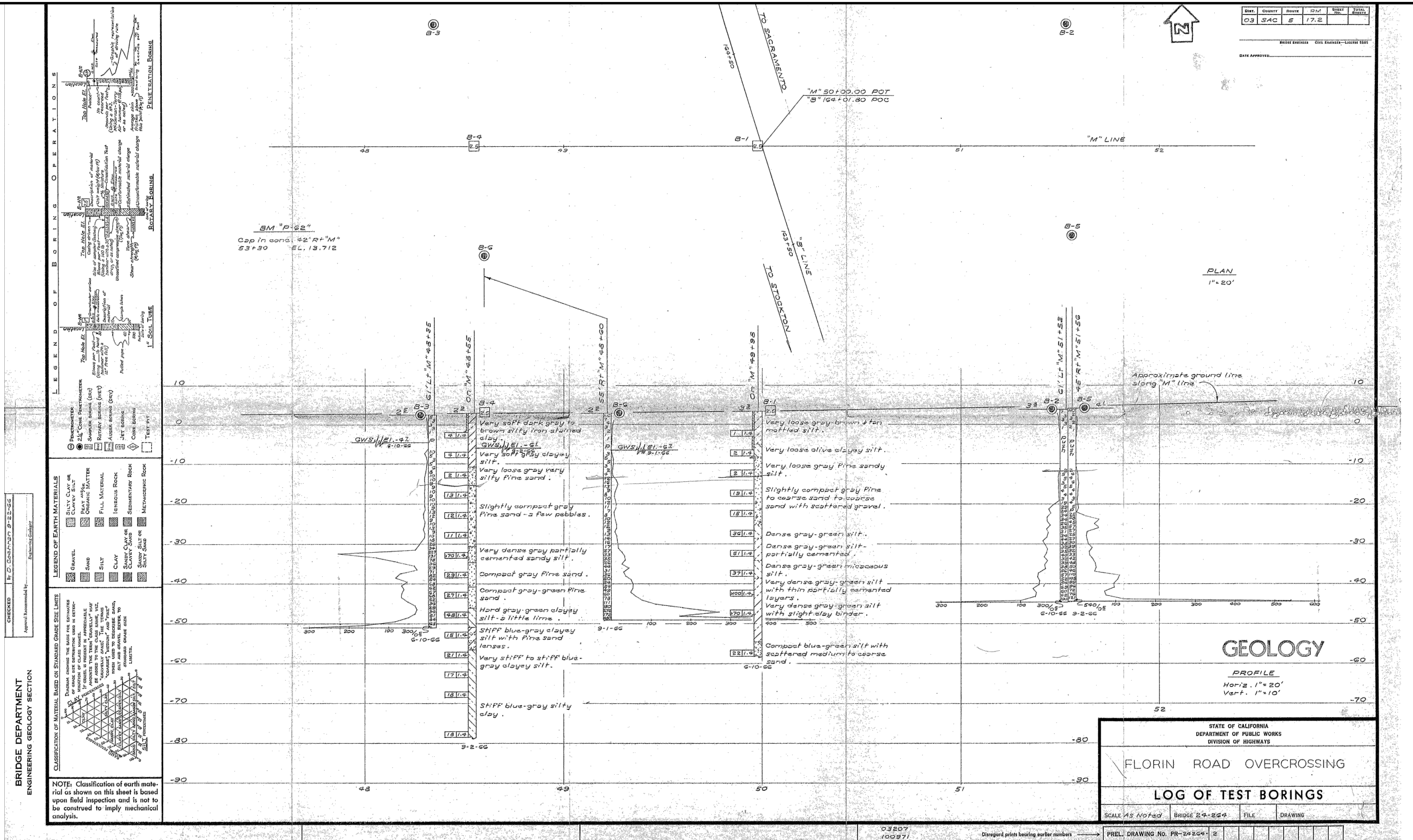
ATTENTION ACCOUNTS PAYABLE

* Please indicate Invo.# on remittance

SUN NOS.	SAMPLE LOCATION		ANALYSIS	PRICE
164814	20190758.004A	B1+B2 COMP 0-10	CTP.1	137.00
164815	20190758.004A	B3+B4 COMP 0-10	CTP.1	137.00
	********* Total *********			274.00

APPENDIX D
CALTRANS LOG OF TEST BORINGS (1966)

PLOTTED: 25 Jan 2019, 11:40am, DRoss



PROJECT NO.	20190758.004A
DRAWN:	01/25/2019
DRAWN BY:	D. Ross
CHECKED BY:	K. Sorensen
FILE NAME:	20190758_3.dwg

KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

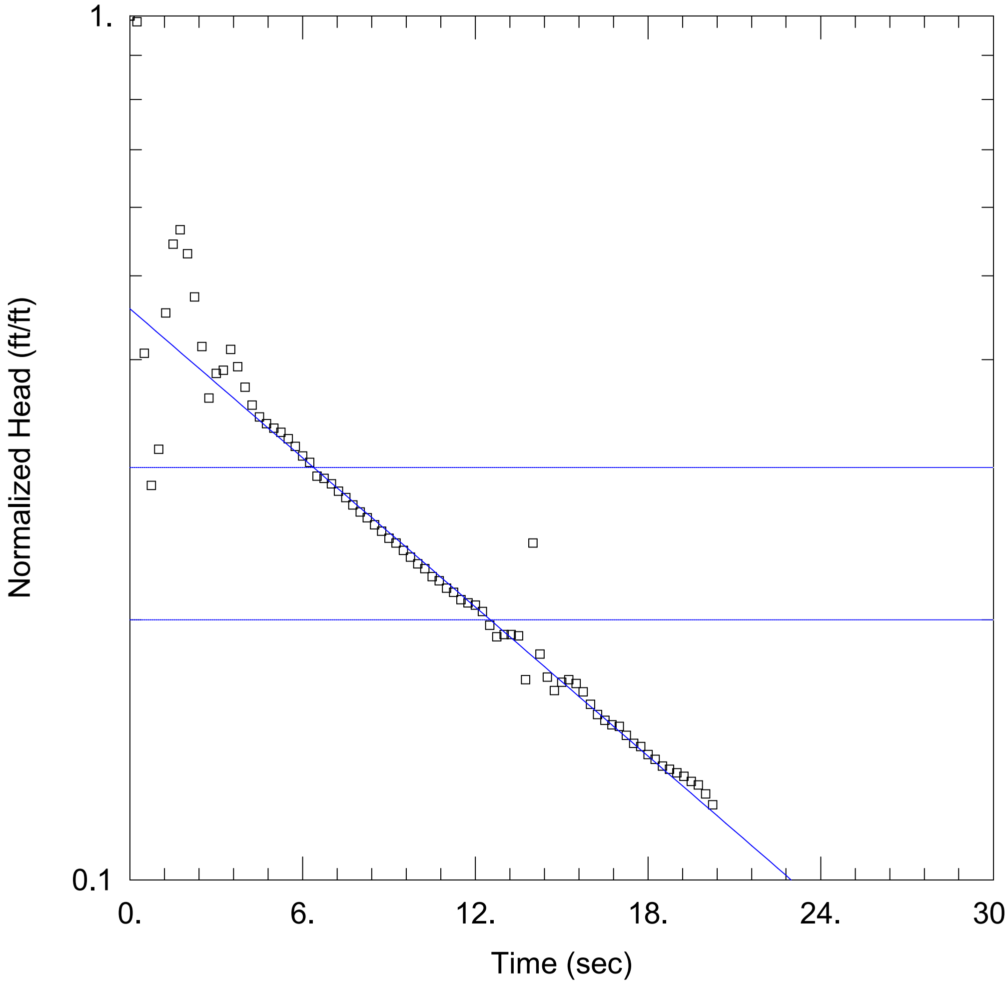
LOG OF TEST BORINGS

SMUD-Pocket 69kV Cable Replacement
Havenside-Canal and Gloria-Florin
Sacramento, California

FIGURE
D-1

CAD FILE: K:\2018_PROJECTS\20190758.004A-SMUD-Pocket 69kV Cable Replacement\cad\ LAYOUT: Layout1

APPENDIX E
SLUG TEST ANALYSIS EVALUATIONS



B-1 SLUG IN-1	
Data Set: U:\1-Projects-HYDRO\20190758.004A - SMUD Pocket\AQT\B-1 IN-1.aqt	
Date: 01/04/19	Time: 11:32:20

PROJECT INFORMATION

Company: Kleinfelder
Client: SMUD Pocket 69kV Cable Replace
Project: 20190758.004A
Location: Sacramento, CA
Test Well: B-1
Test Date: Jan 2, 2019

AQUIFER DATA

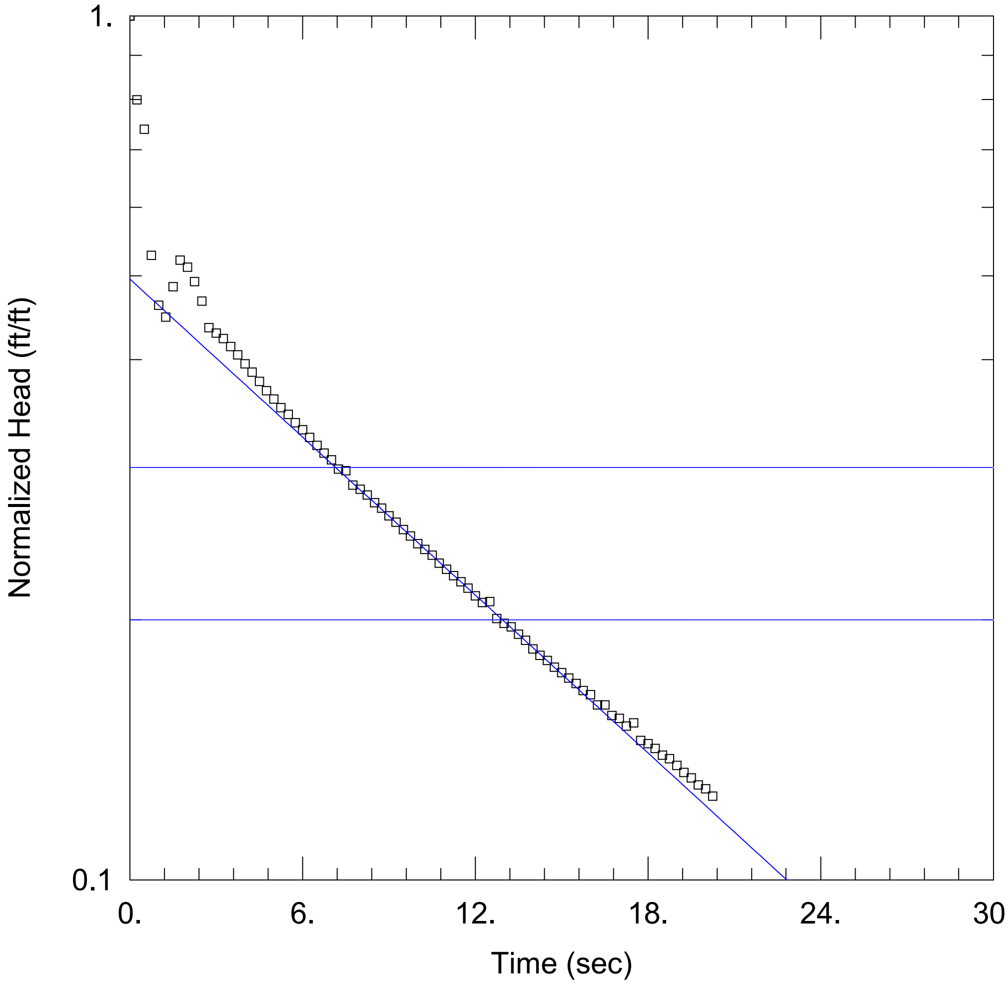
Saturated Thickness: 40. ft	Anisotropy Ratio (Kz/Kr): 0.25

WELL DATA (B-1)

Initial Displacement: 1.654 ft	Static Water Column Height: 25.12 ft
Total Well Penetration Depth: 25.12 ft	Screen Length: 20. ft
Casing Radius: 0.0833 ft	Well Radius: 0.3333 ft

SOLUTION

Aquifer Model: Unconfined	Solution Method: Bouwer-Rice
K = 0.002378 ft/min	y0 = 0.7578 ft



B-1 SLUG IN-2

Data Set: U:\1-Projects-HYDRO\20190758.004A - SMUD Pocket\AQT\B-1 IN-2.aqt
Date: 01/04/19 Time: 13:28:29

PROJECT INFORMATION

Company: Kleinfelder
Client: SMUD Pocket 69kV Cable Replace
Project: 20190758.004A
Location: Sacramento, CA
Test Well: B-1
Test Date: Jan 2, 2019

AQUIFER DATA

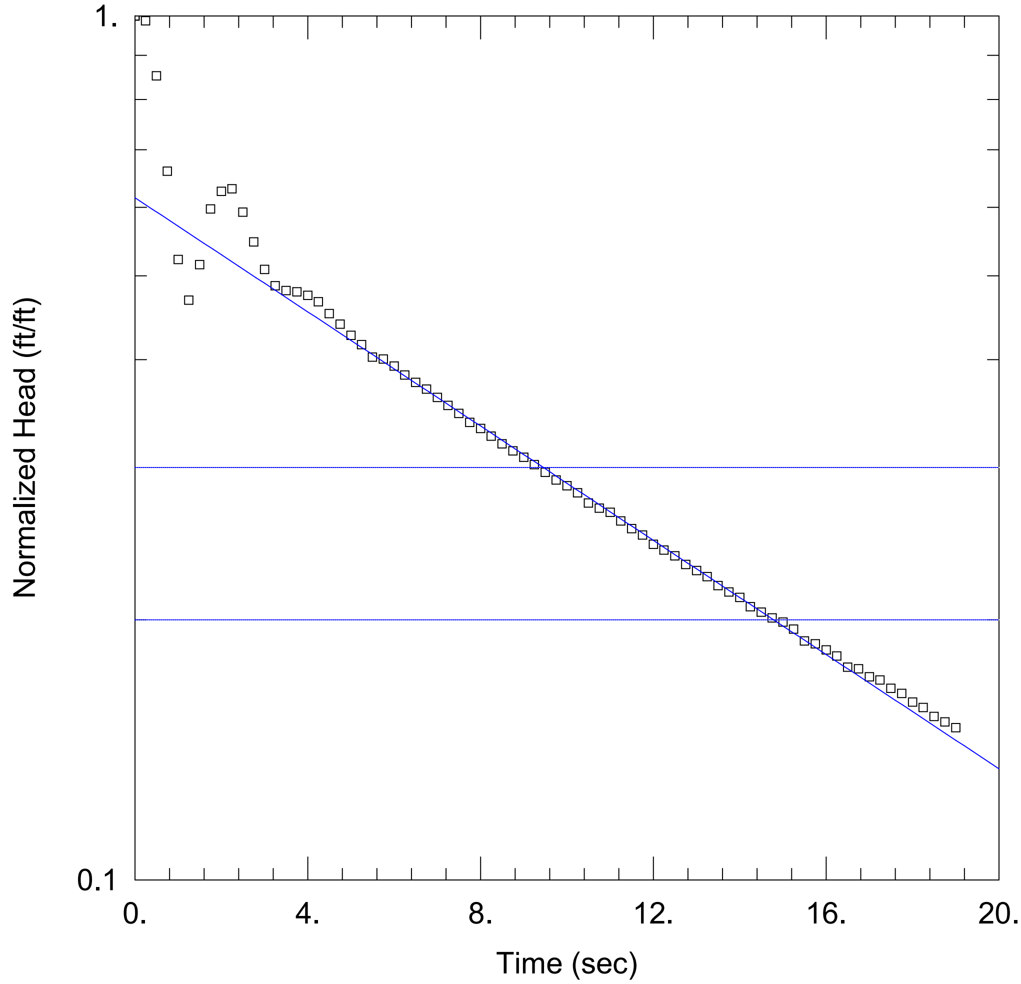
Saturated Thickness: 40. ft
Anisotropy Ratio (Kz/Kr): 0.25

WELL DATA (B-1)

Initial Displacement: 1.6 ft
Static Water Column Height: 25.12 ft
Total Well Penetration Depth: 25.12 ft
Screen Length: 20. ft
Casing Radius: 0.0833 ft
Well Radius: 0.3333 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.002518 ft/min
y0 = 0.7931 ft



B-1 SLUG IN-3

Data Set: U:\1-Projects-HYDRO\20190758.004A - SMUD Pocket\AQT\B-1 IN-3.aqt
Date: 01/04/19 Time: 13:43:12

PROJECT INFORMATION

Company: Kleinfelder
Client: SMUD Pocket 69kV Cable Replace
Project: 20190758.004A
Location: Sacramento, CA
Test Well: B-1
Test Date: Jan 2, 2019

AQUIFER DATA

Saturated Thickness: 40. ft
Anisotropy Ratio (Kz/Kr): 0.25

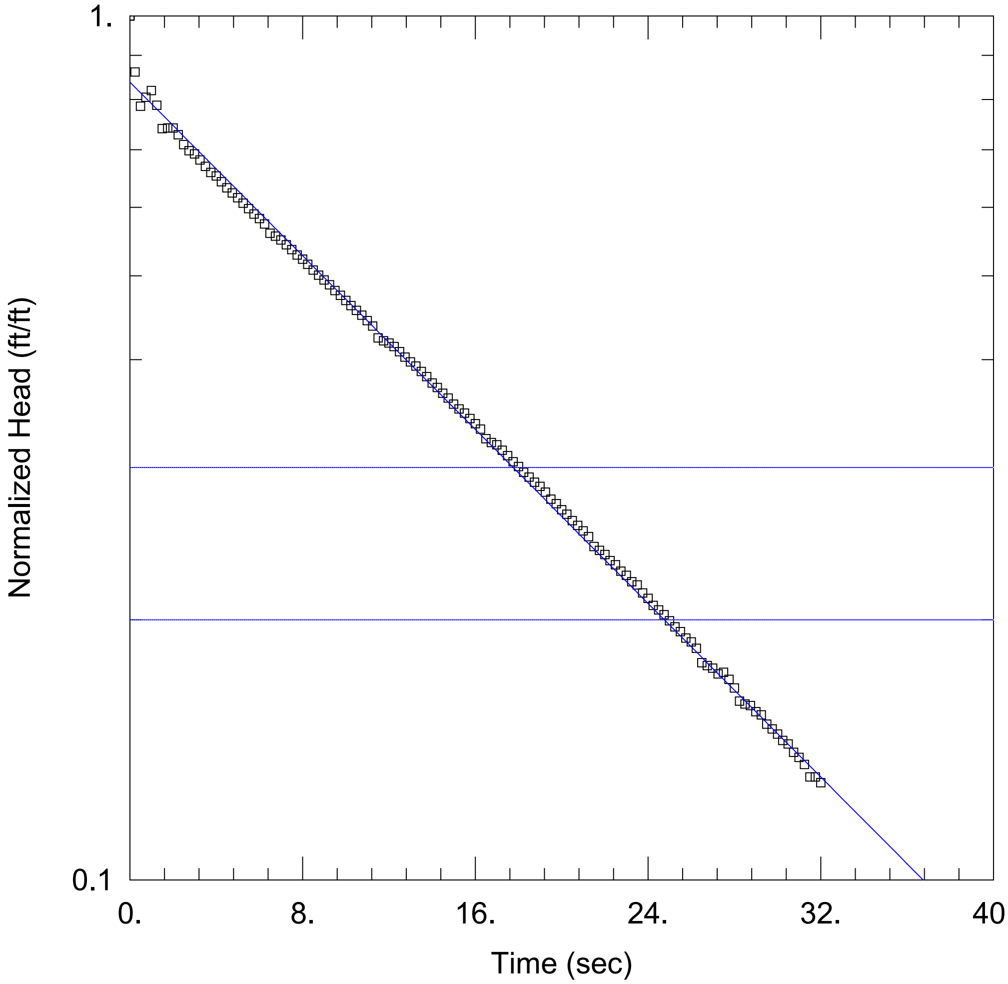
WELL DATA (B-1)

Initial Displacement: 1.333 ft
Total Well Penetration Depth: 25.12 ft
Casing Radius: 0.0833 ft
Static Water Column Height: 25.12 ft
Screen Length: 20. ft
Well Radius: 0.3333 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.00273 ft/min
y0 = 0.821 ft



B-1 SLUG OUT-1

Data Set: U:\1-Projects-HYDRO\20190758.004A - SMUD Pocket\AQT\B-1 OUT-1.aqt
Date: 01/04/19 Time: 13:26:38

PROJECT INFORMATION

Company: Kleinfelder
Client: SMUD Pocket 69kV Cable Replace
Project: 20190758.004A
Location: Sacramento, CA
Test Well: B-1
Test Date: Jan 2, 2019

AQUIFER DATA

Saturated Thickness: 40. ft
Anisotropy Ratio (Kz/Kr): 0.25

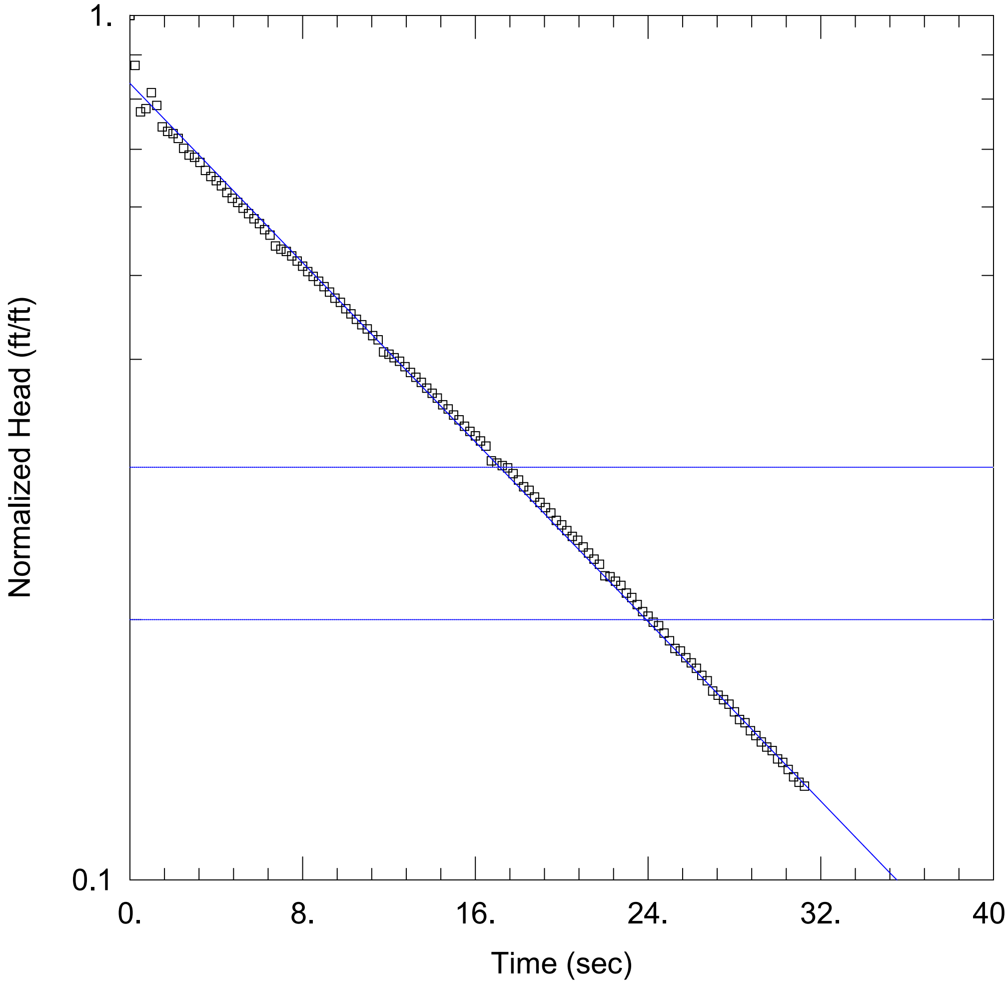
WELL DATA (B-1)

Initial Displacement: 1.559 ft
Total Well Penetration Depth: 25.12 ft
Casing Radius: 0.0833 ft
Static Water Column Height: 25.12 ft
Screen Length: 20. ft
Well Radius: 0.3333 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.002076 ft/min
y0 = 1.306 ft



B-1 SLUG OUT-2

Data Set: U:\1-Projects-HYDRO\20190758.004A - SMUD Pocket\AQT\B-1 OUT-2.aqt
Date: 01/04/19 Time: 13:30:27

PROJECT INFORMATION

Company: Kleinfelder
Client: SMUD Pocket 69kV Cable Replace
Project: 20190758.004A
Location: Sacramento, CA
Test Well: B-1
Test Date: Jan 2, 2019

AQUIFER DATA

Saturated Thickness: 40. ft
Anisotropy Ratio (Kz/Kr): 0.25

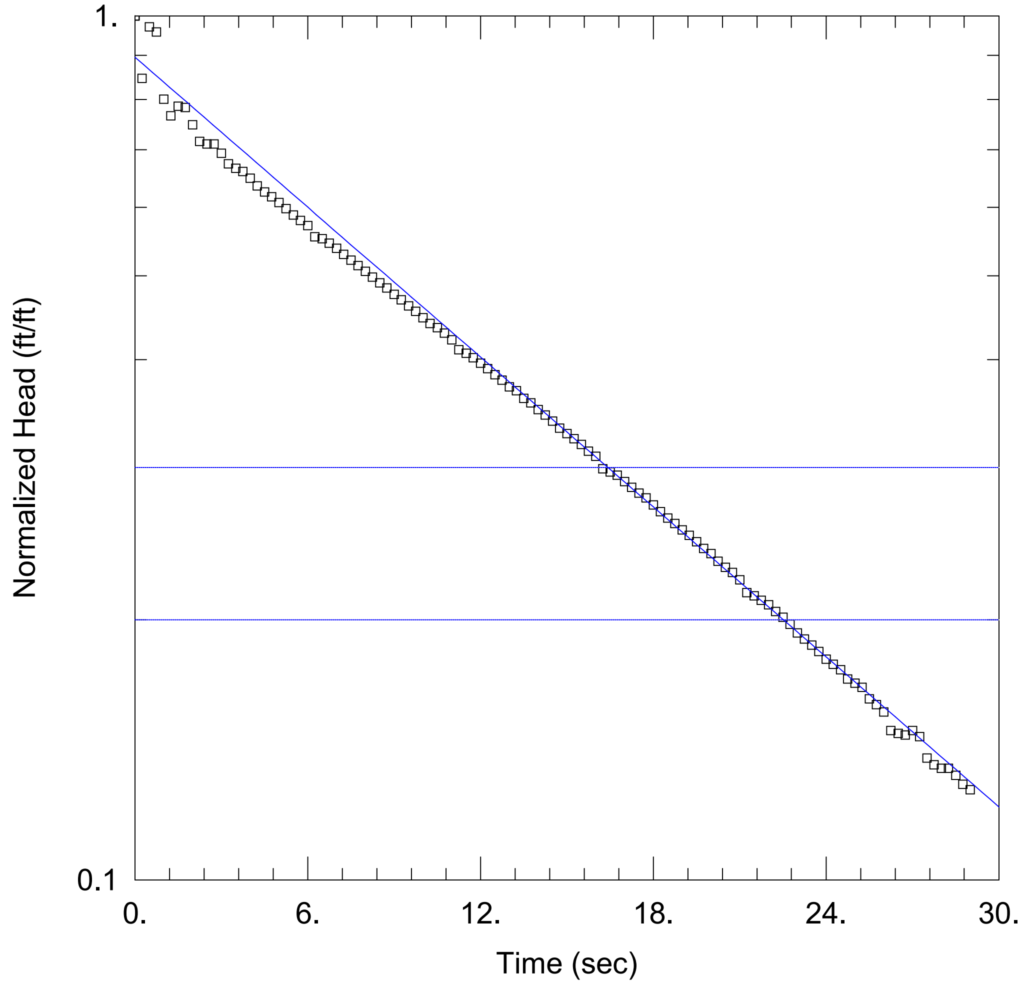
WELL DATA (B-1)

Initial Displacement: 1.566 ft
Static Water Column Height: 25.12 ft
Total Well Penetration Depth: 25.12 ft
Screen Length: 20. ft
Casing Radius: 0.0833 ft
Well Radius: 0.3333 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.002143 ft/min
y0 = 1.306 ft



B-1 SLUG OUT-3

Data Set: U:\1-Projects-HYDRO\20190758.004A - SMUD Pocket\AQT\B-1 OUT-3.aqt
Date: 01/04/19 Time: 13:45:58

PROJECT INFORMATION

Company: Kleinfelder
Client: SMUD Pocket 69kV Cable Replace
Project: 20190758.004A
Location: Sacramento, CA
Test Well: B-1
Test Date: Jan 2, 2019

AQUIFER DATA

Saturated Thickness: 40. ft Anisotropy Ratio (Kz/Kr): 0.25

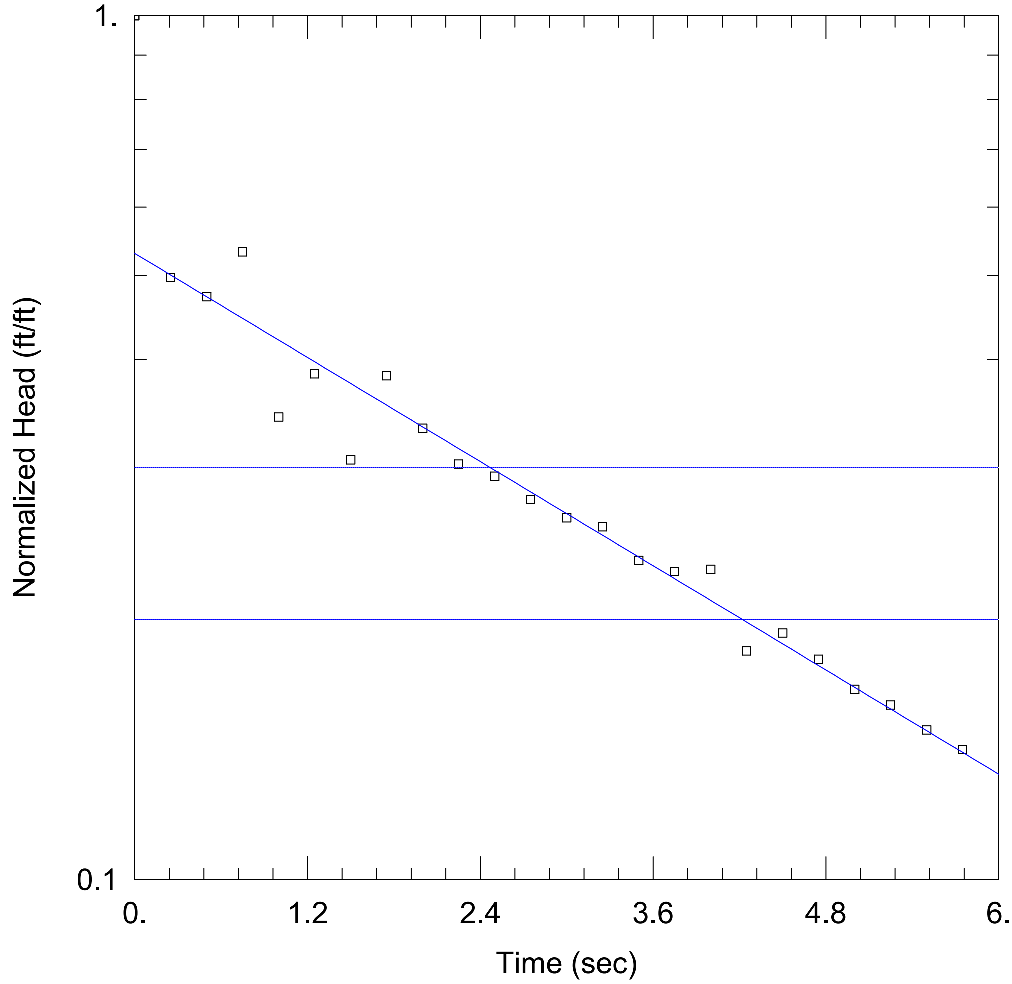
WELL DATA (B-1)

Initial Displacement: 1.605 ft Static Water Column Height: 25.12 ft
Total Well Penetration Depth: 25.12 ft Screen Length: 20. ft
Casing Radius: 0.0833 ft Well Radius: 0.3333 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.00239 ft/min y0 = 1.437 ft



B-2 SLUG IN-1

Data Set: U:\1-Projects-HYDRO\20190758.004A - SMUD Pocket\AQT\B-2 IN-1.aqt
Date: 01/04/19 Time: 13:50:27

PROJECT INFORMATION

Company: Kleinfelder
Client: SMUD Pocket 69kV Cable Replace
Project: 20190758.004A
Location: Sacramento, CA
Test Well: B-2
Test Date: Dec 21, 2018

AQUIFER DATA

Saturated Thickness: 40. ft Anisotropy Ratio (Kz/Kr): 0.25

WELL DATA (B-2)

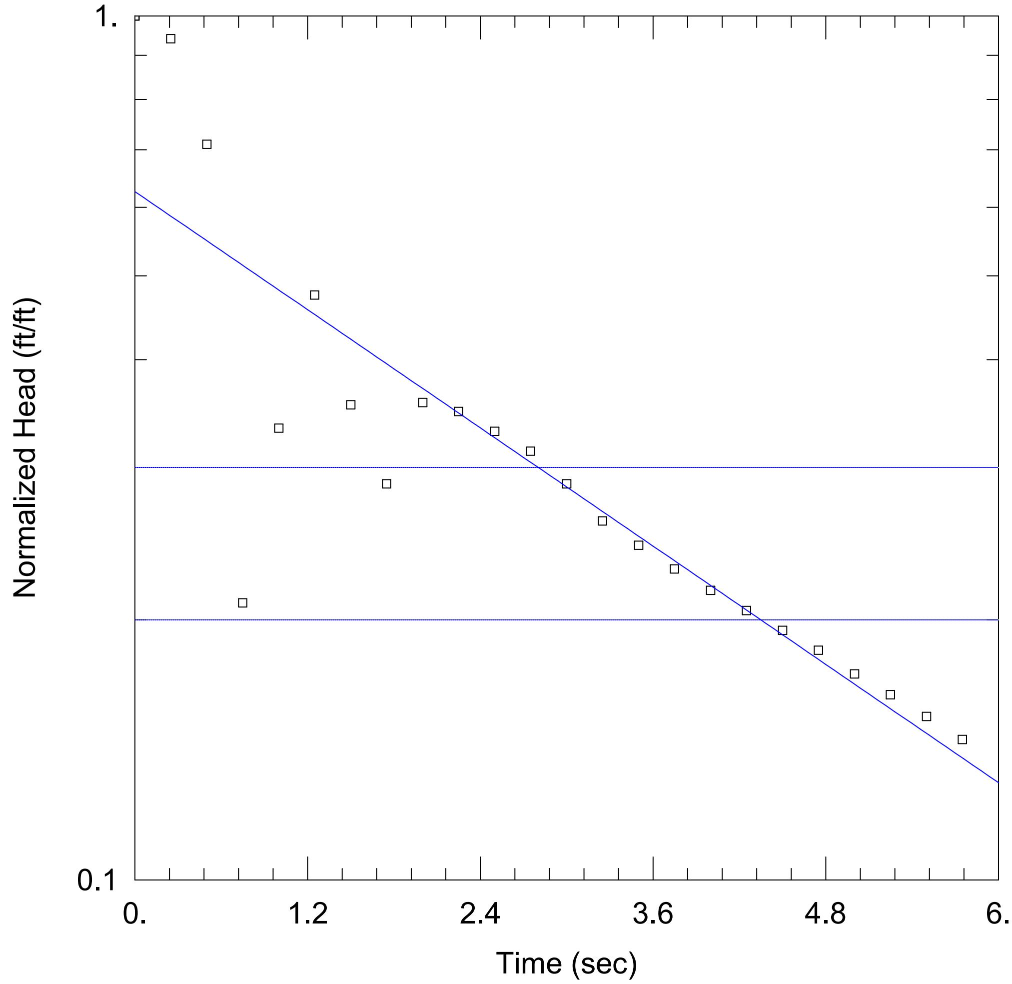
Initial Displacement: 1.457 ft
Total Well Penetration Depth: 32.4 ft
Casing Radius: 0.08333 ft

Static Water Column Height: 26.2 ft
Screen Length: 26.2 ft
Well Radius: 0.3333 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.006875 ft/min
y0 = 0.7731 ft



B-2 SLUG IN-2

Data Set: U:\1-Projects-HYDRO\20190758.004A - SMUD Pocket\AQT\B-2 IN-2.aqt
Date: 01/04/19 Time: 13:59:22

PROJECT INFORMATION

Company: Kleinfelder
Client: SMUD Pocket 69kV Cable Replace
Project: 20190758.004A
Location: Sacramento, CA
Test Well: B-2
Test Date: Dec 21, 2018

AQUIFER DATA

Saturated Thickness: 40. ft
Anisotropy Ratio (Kz/Kr): 0.25

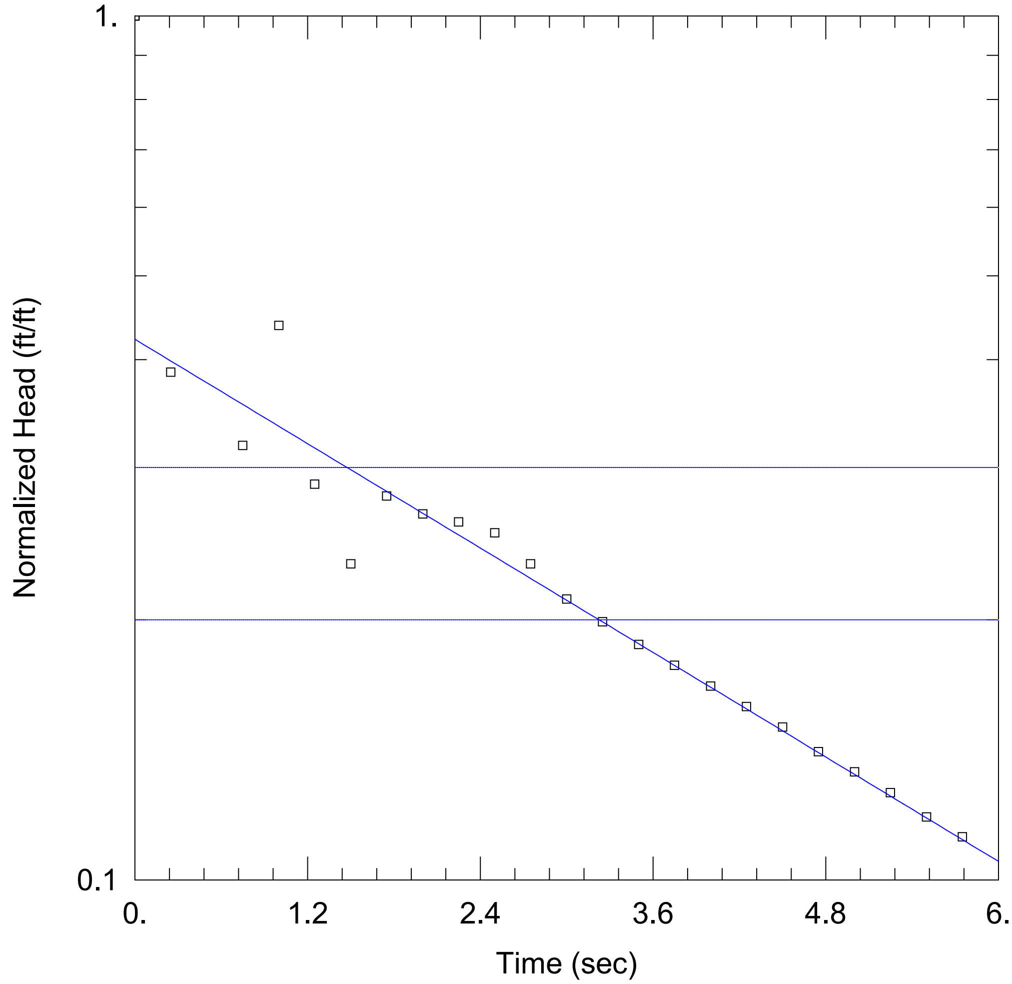
WELL DATA (B-2)

Initial Displacement: 1.41 ft
Total Well Penetration Depth: 32.4 ft
Casing Radius: 0.08333 ft
Static Water Column Height: 26.2 ft
Screen Length: 26.2 ft
Well Radius: 0.3333 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.007803 ft/min
y0 = 0.8827 ft



B-2 SLUG IN-3

Data Set: U:\1-Projects-HYDRO\20190758.004A - SMUD Pocket\AQT\B-2 IN-3.aqt
Date: 01/04/19 Time: 14:04:00

PROJECT INFORMATION

Company: Kleinfelder
Client: SMUD Pocket 69kV Cable Replace
Project: 20190758.004A
Location: Sacramento, CA
Test Well: B-2
Test Date: Dec 21, 2018

AQUIFER DATA

Saturated Thickness: 40. ft Anisotropy Ratio (Kz/Kr): 0.25

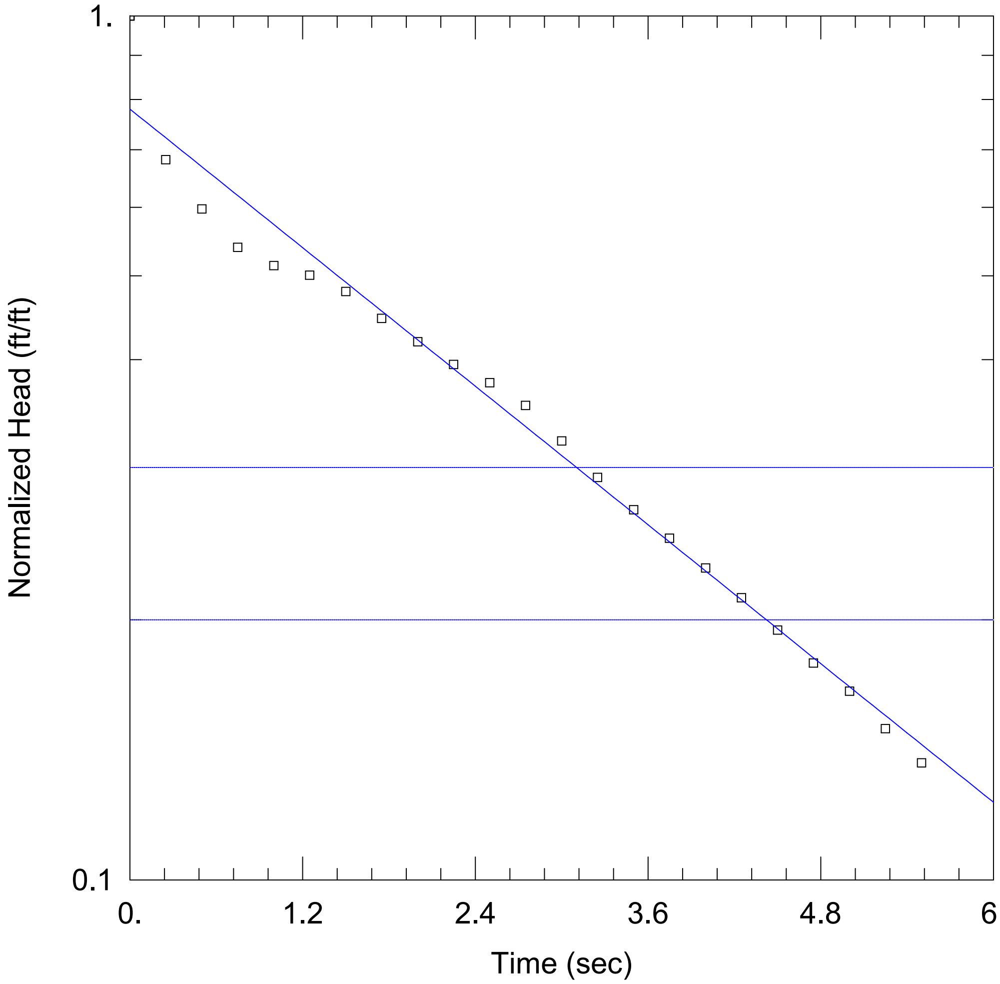
WELL DATA (B-2)

Initial Displacement: 1.784 ft
Total Well Penetration Depth: 32.4 ft
Casing Radius: 0.08333 ft
Static Water Column Height: 26.2 ft
Screen Length: 26.2 ft
Well Radius: 0.3333 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.006893 ft/min y0 = 0.7534 ft



B-2 SLUG OUT-1

Data Set: U:\1-Projects-HYDRO\20190758.004A - SMUD Pocket\AQT\B-2 OUT-1.aqt
Date: 01/04/19 Time: 13:56:44

PROJECT INFORMATION

Company: Kleinfelder
Client: SMUD Pocket 69kV Cable Replace
Project: 20190758.004A
Location: Sacramento, CA
Test Well: B-2
Test Date: Dec 21, 2018

AQUIFER DATA

Saturated Thickness: 40. ft
Anisotropy Ratio (Kz/Kr): 0.25

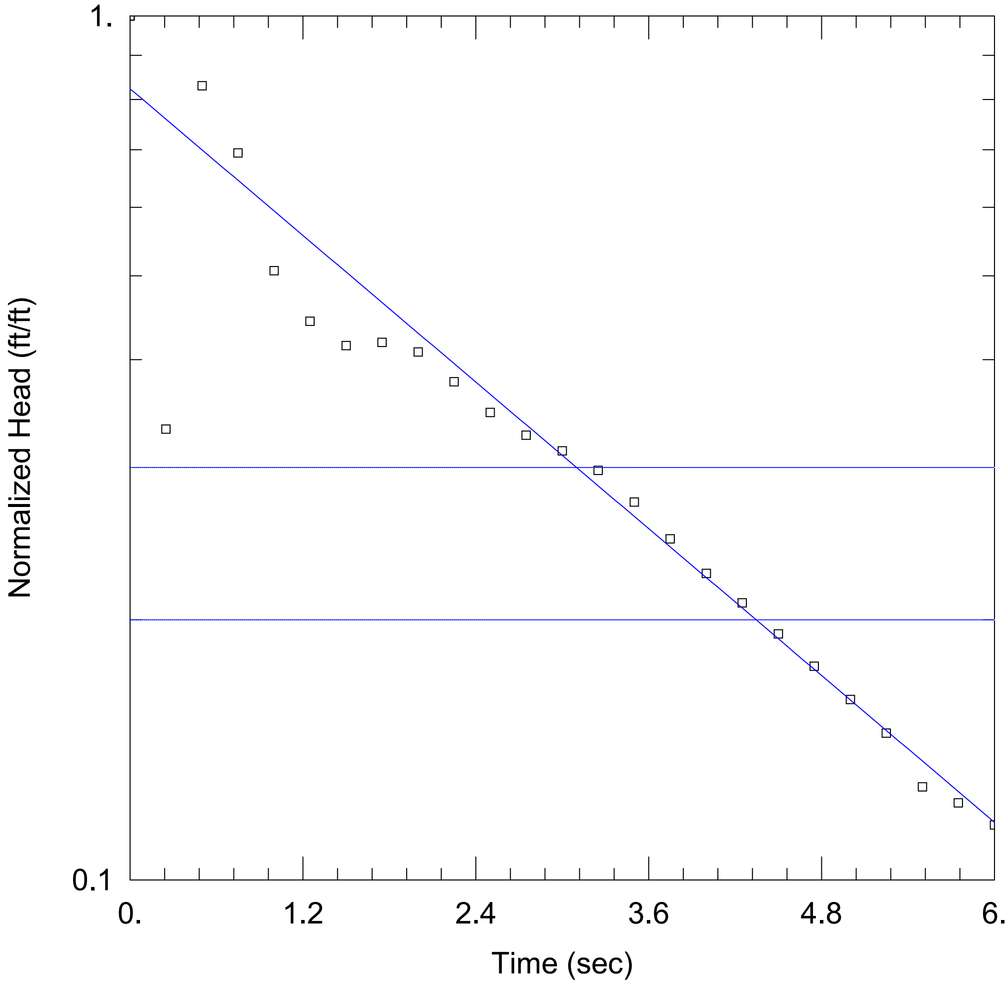
WELL DATA (B-2)

Initial Displacement: 1.537 ft
Total Well Penetration Depth: 32.4 ft
Casing Radius: 0.08333 ft
Static Water Column Height: 26.2 ft
Screen Length: 26.2 ft
Well Radius: 0.3333 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.009151 ft/min
y0 = 1.199 ft



B-2 SLUG OUT-2

Data Set: U:\1-Projects-HYDRO\20190758.004A - SMUD Pocket\AQT\B-2 OUT-2.aqt
Date: 01/04/19 Time: 14:00:53

PROJECT INFORMATION

Company: Kleinfelder
Client: SMUD Pocket 69kV Cable Replace
Project: 20190758.004A
Location: Sacramento, CA
Test Well: B-2
Test Date: Dec 21, 2018

AQUIFER DATA

Saturated Thickness: 40. ft Anisotropy Ratio (Kz/Kr): 0.25

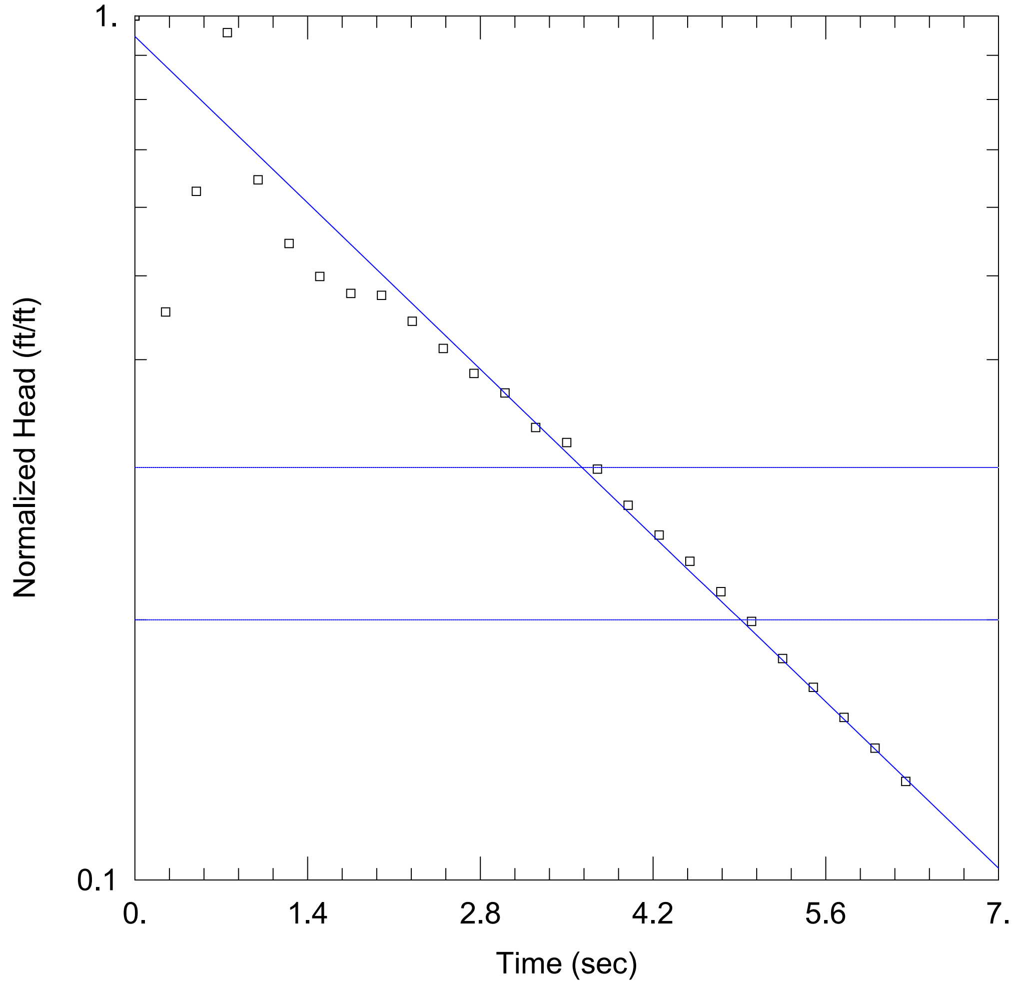
WELL DATA (B-2)

Initial Displacement: 1.874 ft
Total Well Penetration Depth: 32.4 ft
Casing Radius: 0.08333 ft
Static Water Column Height: 26.2 ft
Screen Length: 26.2 ft
Well Radius: 0.3333 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.009681 ft/min y0 = 1.543 ft



B-2 SLUG OUT-3

Data Set: U:\1-Projects-HYDRO\20190758.004A - SMUD Pocket\AQT\B-2 OUT-3.aqt
Date: 01/17/19
Time: 09:19:01

PROJECT INFORMATION

Company: Kleinfelder
Client: SMUD Pocket 69kV Cable Replace
Project: 20190758.004A
Location: Sacramento, CA
Test Well: B-2
Test Date: Dec 21, 2018

AQUIFER DATA

Saturated Thickness: 40. ft
Anisotropy Ratio (Kz/Kr): 0.25

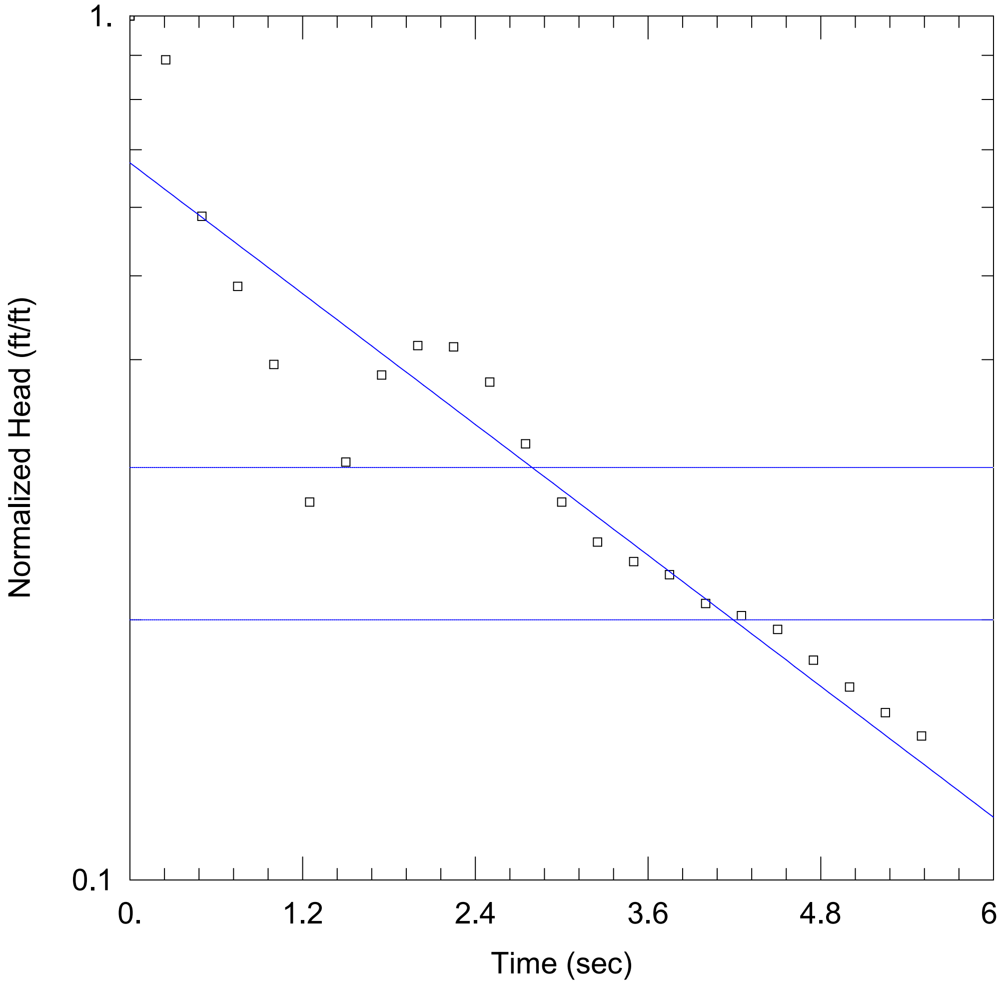
WELL DATA (B-2)

Initial Displacement: 1.647 ft
Total Well Penetration Depth: 32.4 ft
Casing Radius: 0.08333 ft
Static Water Column Height: 26.2 ft
Screen Length: 26.2 ft
Well Radius: 0.3333 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.009413 ft/min
y0 = 1.558 ft



B-3 SLUG IN-1

Data Set: U:\1-Projects-HYDRO\20190758.004A - SMUD Pocket\AQT\B-3 IN-1.aqt
Date: 01/04/19 Time: 14:25:37

PROJECT INFORMATION

Company: Kleinfelder
Client: SMUD Pocket 69kV Cable Replace
Project: 20190758.004A
Location: Sacramento, CA
Test Well: B-3
Test Date: Dec 21, 2018

AQUIFER DATA

Saturated Thickness: 40. ft Anisotropy Ratio (Kz/Kr): 0.25

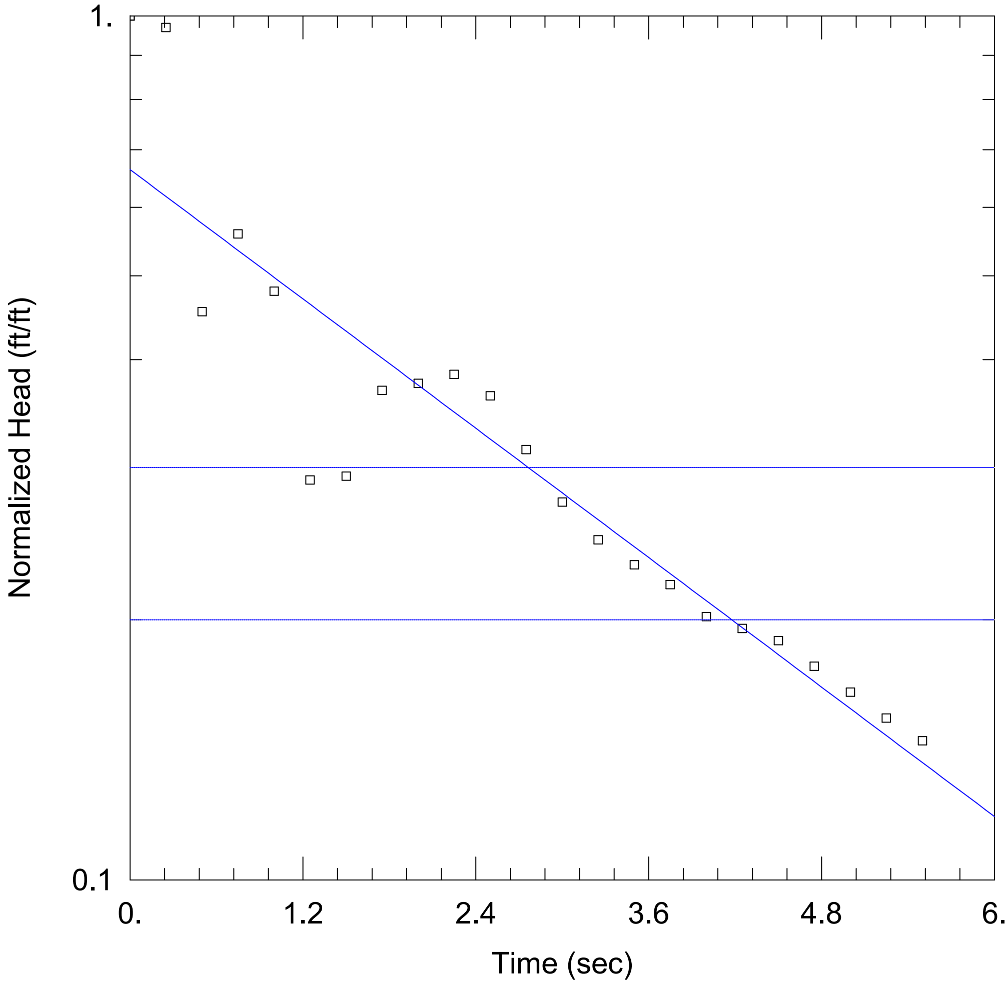
WELL DATA (B-2)

Initial Displacement: 1.37 ft
Total Well Penetration Depth: 25.33 ft
Casing Radius: 0.0833 ft
Static Water Column Height: 25.33 ft
Screen Length: 20. ft
Well Radius: 0.3333 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.01044 ft/min y0 = 0.9259 ft



B-3 SLUG IN-2

Data Set: U:\1-Projects-HYDRO\20190758.004A - SMUD Pocket\AQT\B-3 IN-2.aqt
Date: 01/04/19 Time: 14:36:47

PROJECT INFORMATION

Company: Kleinfelder
Client: SMUD Pocket 69kV Cable Replace
Project: 20190758.004A
Location: Sacramento, CA
Test Well: B-3
Test Date: Dec 21, 2018

AQUIFER DATA

Saturated Thickness: 40. ft
Anisotropy Ratio (Kz/Kr): 0.25

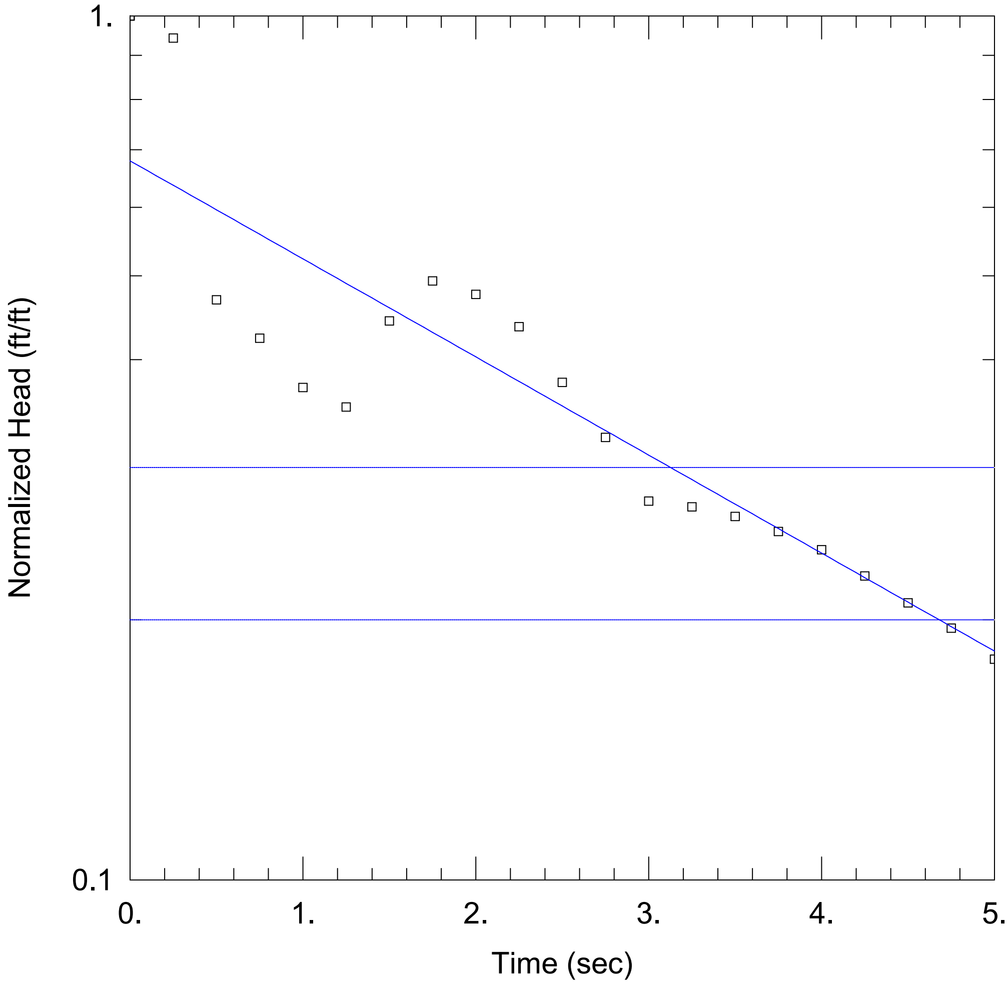
WELL DATA (B-2)

Initial Displacement: 1.443 ft
Static Water Column Height: 25.33 ft
Total Well Penetration Depth: 25.33 ft
Screen Length: 20. ft
Casing Radius: 0.0833 ft
Well Radius: 0.3333 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.01033 ft/min
y0 = 0.9578 ft



B-3 SLUG IN-3

Data Set: U:\1-Projects-HYDRO\20190758.004A - SMUD Pocket\AQT\B-3 IN-3.aqt
Date: 01/04/19 Time: 14:40:48

PROJECT INFORMATION

Company: Kleinfelder
Client: SMUD Pocket 69kV Cable Replace
Project: 20190758.004A
Location: Sacramento, CA
Test Well: B-3
Test Date: Dec 21, 2018

AQUIFER DATA

Saturated Thickness: 40. ft Anisotropy Ratio (Kz/Kr): 0.25

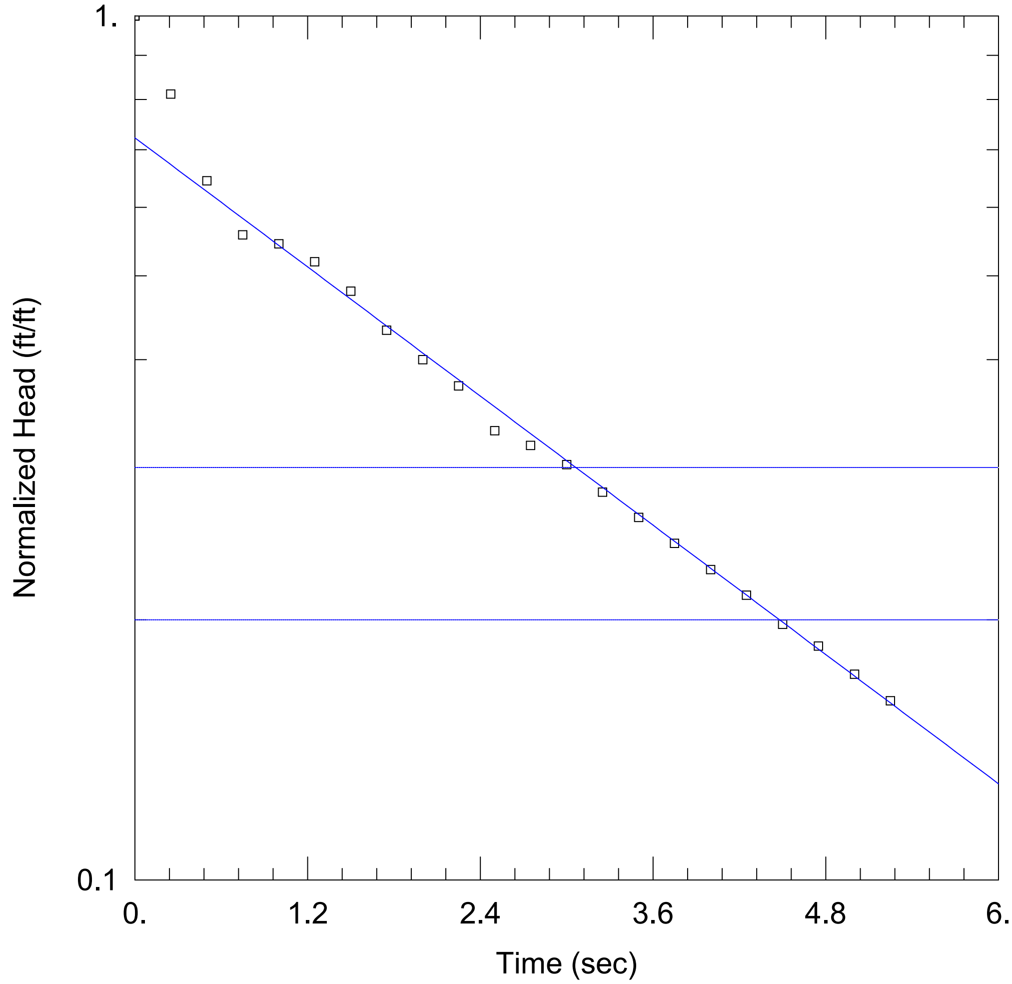
WELL DATA (B-2)

Initial Displacement: 1.166 ft
Total Well Penetration Depth: 25.33 ft
Casing Radius: 0.0833 ft
Static Water Column Height: 25.33 ft
Screen Length: 20. ft
Well Radius: 0.3333 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.009393 ft/min y0 = 0.7923 ft



B-3 SLUG OUT-1

Data Set: U:\1-Projects-HYDRO\20190758.004A - SMUD Pocket\AQT\B-3 OUT-1.aqt
Date: 01/04/19 Time: 14:33:05

PROJECT INFORMATION

Company: Kleinfelder
Client: SMUD Pocket 69kV Cable Replace
Project: 20190758.004A
Location: Sacramento, CA
Test Well: B-3
Test Date: Dec 21, 2018

AQUIFER DATA

Saturated Thickness: 40. ft
Anisotropy Ratio (Kz/Kr): 0.25

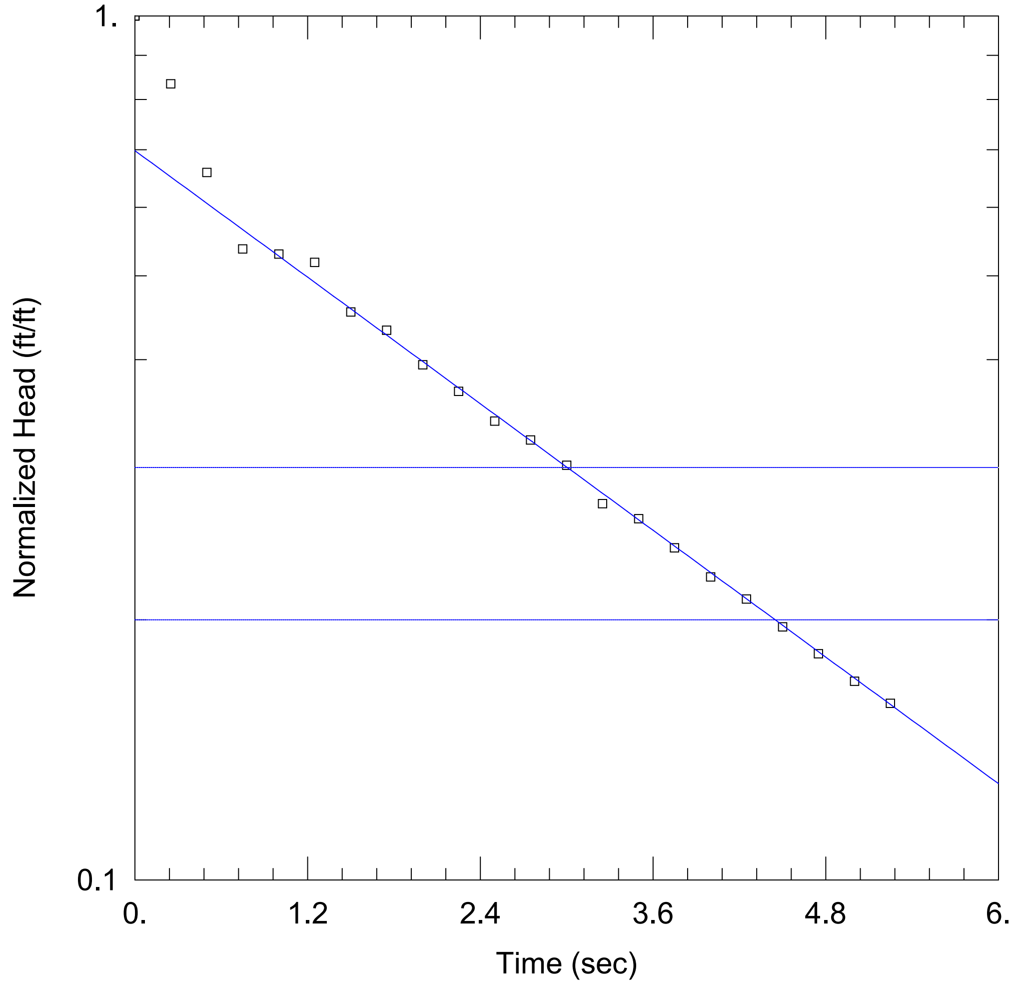
WELL DATA (B-2)

Initial Displacement: 1.26 ft
Static Water Column Height: 25.33 ft
Total Well Penetration Depth: 25.33 ft
Screen Length: 20. ft
Casing Radius: 0.0833 ft
Well Radius: 0.3333 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.01031 ft/min
y0 = 0.9103 ft



B-3 SLUG OUT-2

Data Set: U:\1-Projects-HYDRO\20190758.004A - SMUD Pocket\AQT\B-3 OUT-2.aqt
Date: 01/04/19 Time: 14:38:38

PROJECT INFORMATION

Company: Kleinfelder
Client: SMUD Pocket 69kV Cable Replace
Project: 20190758.004A
Location: Sacramento, CA
Test Well: B-3
Test Date: Dec 21, 2018

AQUIFER DATA

Saturated Thickness: 40. ft Anisotropy Ratio (Kz/Kr): 0.25

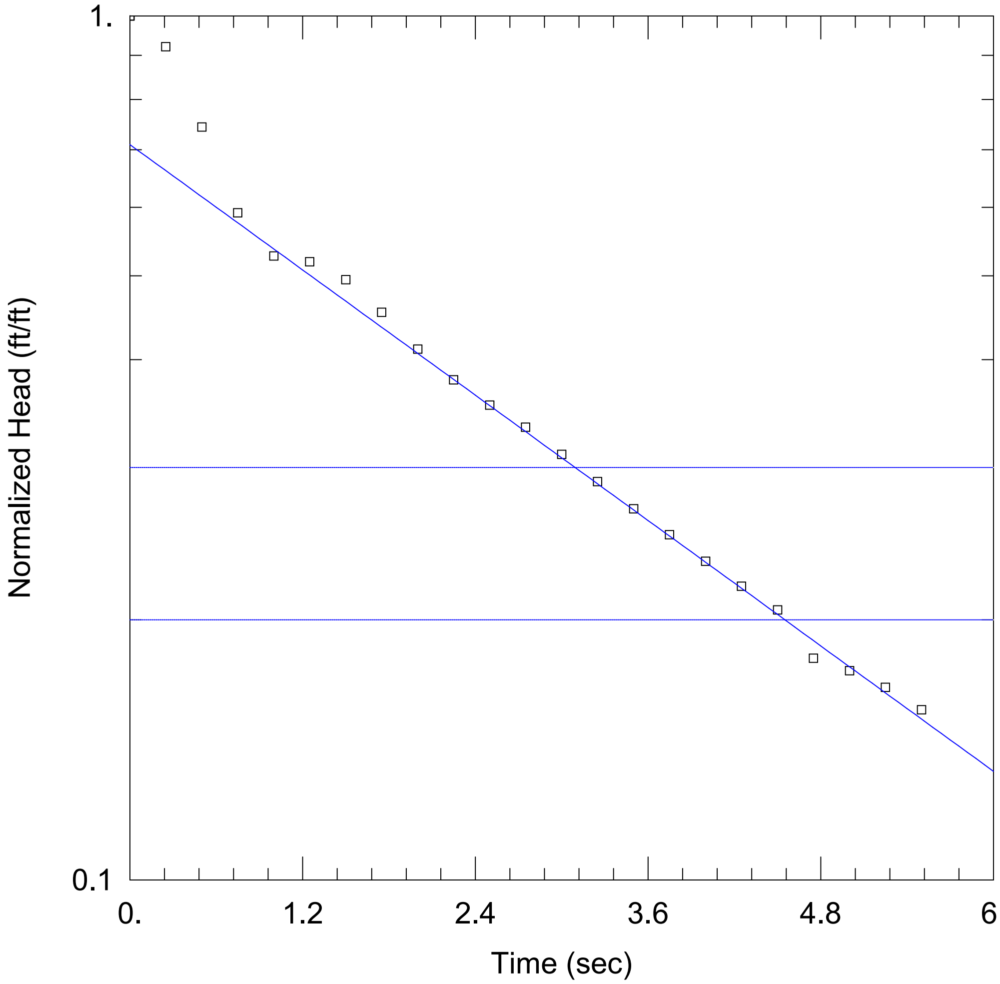
WELL DATA (B-2)

Initial Displacement: 1.325 ft
Total Well Penetration Depth: 25.33 ft
Casing Radius: 0.0833 ft
Static Water Column Height: 25.33 ft
Screen Length: 20. ft
Well Radius: 0.3333 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.0101 ft/min y0 = 0.925 ft



B-3 SLUG OUT-3

Data Set: U:\1-Projects-HYDRO\20190758.004A - SMUD Pocket\AQT\B-3 OUT-3.aqt
Date: 01/04/19 Time: 14:42:26

PROJECT INFORMATION

Company: Kleinfelder
Client: SMUD Pocket 69kV Cable Replace
Project: 20190758.004A
Location: Sacramento, CA
Test Well: B-3
Test Date: Dec 21, 2018

AQUIFER DATA

Saturated Thickness: 40. ft
Anisotropy Ratio (Kz/Kr): 0.25

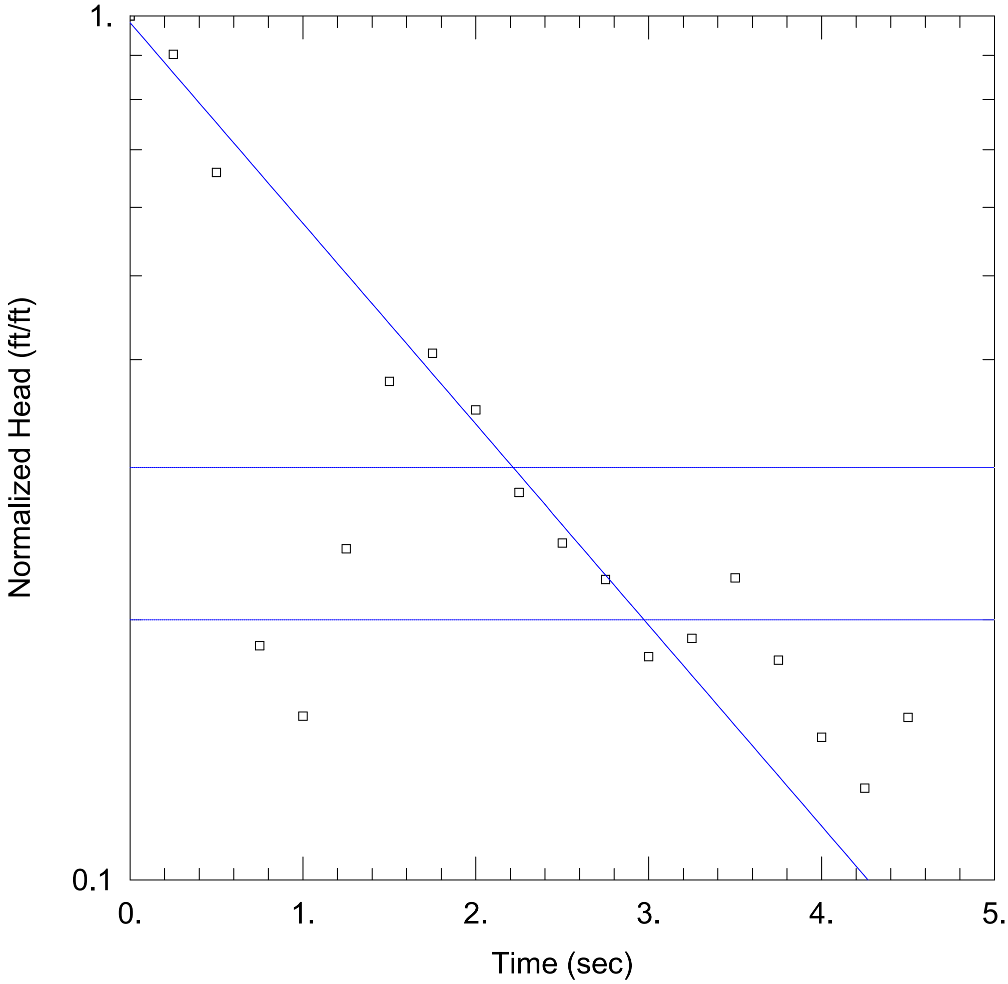
WELL DATA (B-2)

Initial Displacement: 1.335 ft
Static Water Column Height: 25.33 ft
Total Well Penetration Depth: 25.33 ft
Screen Length: 20. ft
Casing Radius: 0.0833 ft
Well Radius: 0.3333 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.01 ft/min
y0 = 0.9471 ft



B-4 SLUG IN-1

Data Set: U:\1-Projects-HYDRO\20190758.004A - SMUD Pocket\AQT\B-4 IN-1.aqt
Date: 01/15/19 Time: 08:32:38

PROJECT INFORMATION

Company: Kleinfelder
Client: SMUD Pocket 69kV Cable Replace
Project: 20190758.004A
Location: Sacramento, CA
Test Well: B-3
Test Date: Jan 2, 2019

AQUIFER DATA

Saturated Thickness: 40. ft
Anisotropy Ratio (Kz/Kr): 0.25

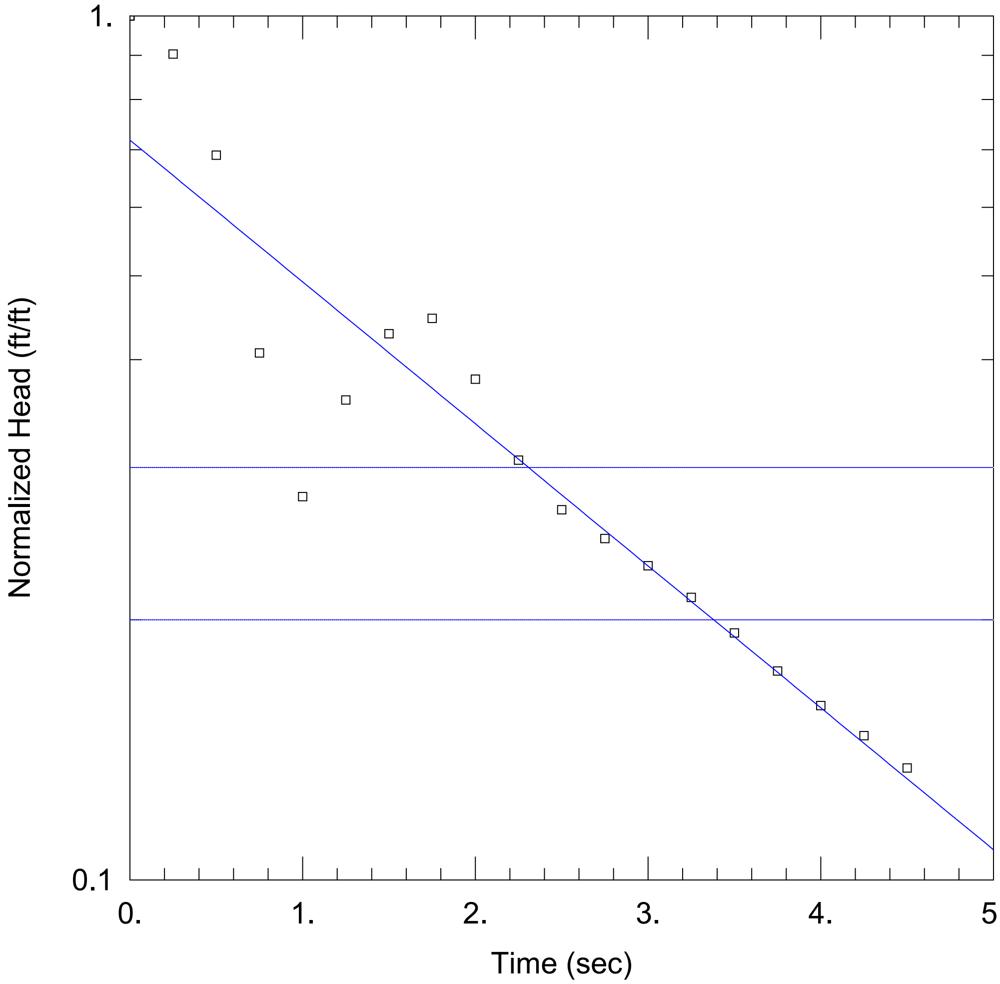
WELL DATA (B-4)

Initial Displacement: 1.887 ft
Total Well Penetration Depth: 24.37 ft
Casing Radius: 0.0833 ft
Static Water Column Height: 24.37 ft
Screen Length: 20. ft
Well Radius: 0.3333 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.01909 ft/min
y0 = 1.853 ft



B-4 SLUG IN-2

Data Set: U:\1-Projects-HYDRO\20190758.004A - SMUD Pocket\AQT\B-4 IN-2.aqt
Date: 01/15/19 Time: 08:37:53

PROJECT INFORMATION

Company: Kleinfelder
Client: SMUD Pocket 69kV Cable Replace
Project: 20190758.004A
Location: Sacramento, CA
Test Well: B-3
Test Date: Jan 2, 2019

AQUIFER DATA

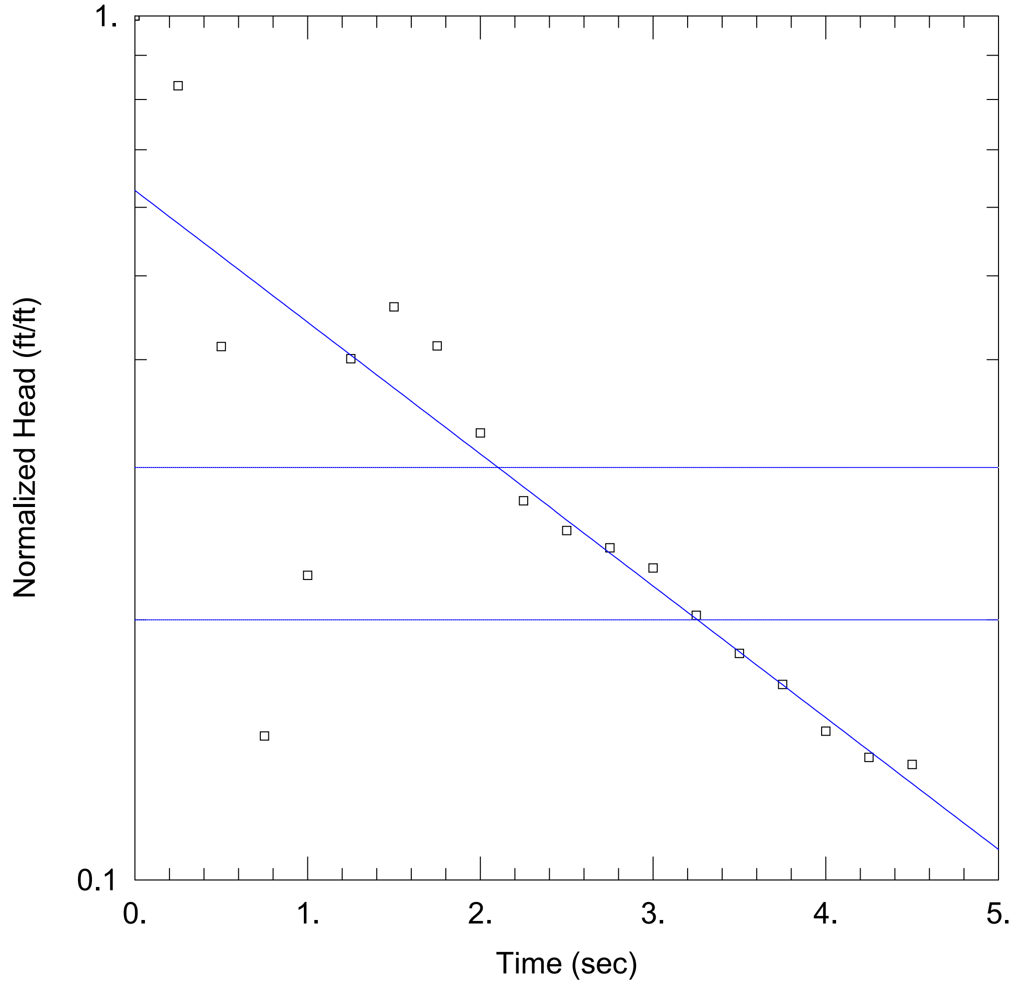
Saturated Thickness: 40. ft
Anisotropy Ratio (Kz/Kr): 0.25

WELL DATA (B-4)

Initial Displacement: 1.559 ft
Static Water Column Height: 24.37 ft
Total Well Penetration Depth: 24.37 ft
Screen Length: 20. ft
Casing Radius: 0.0833 ft
Well Radius: 0.3333 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.0135 ft/min
y0 = 1.12 ft



B-4 SLUG IN-3

Data Set: U:\1-Projects-HYDRO\20190758.004A - SMUD Pocket\AQT\B-4 IN-3.aqt
Date: 01/15/19 Time: 08:38:12

PROJECT INFORMATION

Company: Kleinfelder
Client: SMUD Pocket 69kV Cable Replace
Project: 20190758.004A
Location: Sacramento, CA
Test Well: B-3
Test Date: Jan 2, 2019

AQUIFER DATA

Saturated Thickness: 40. ft Anisotropy Ratio (Kz/Kr): 0.25

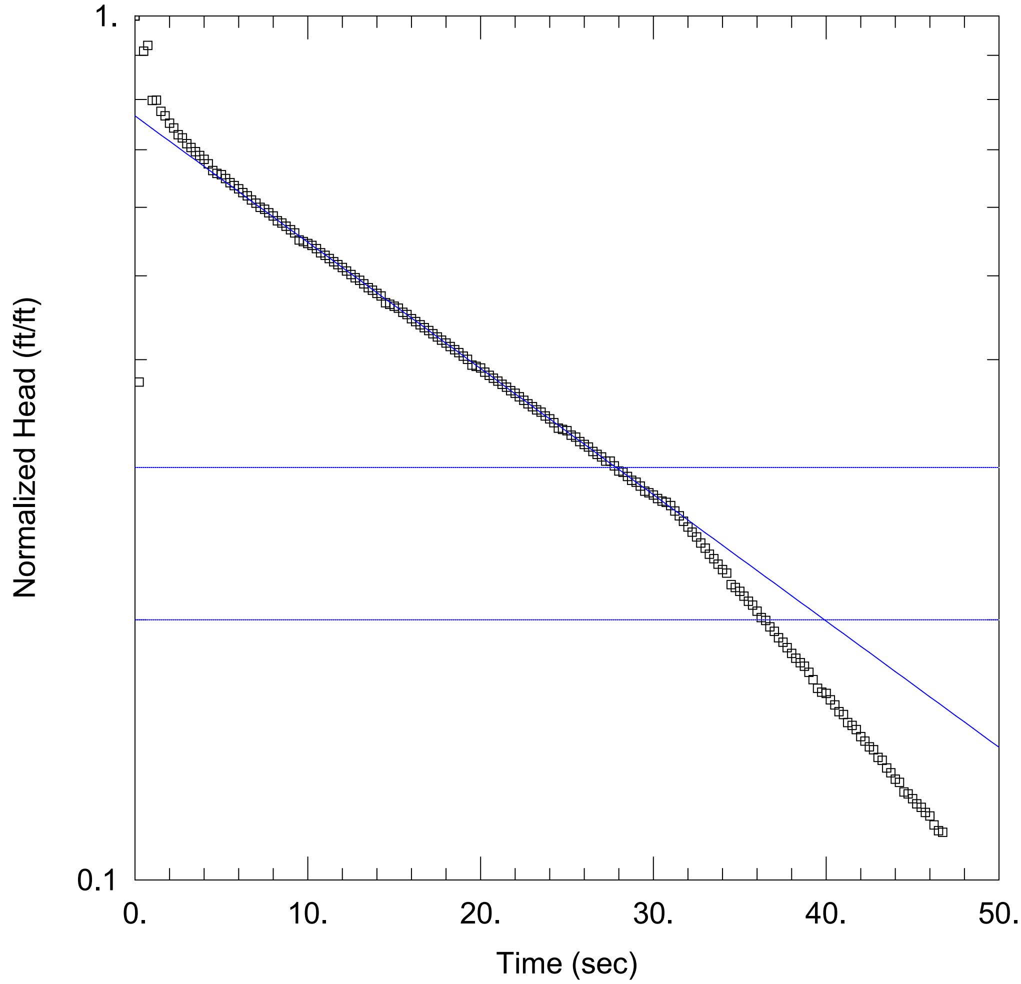
WELL DATA (B-4)

Initial Displacement: 1.581 ft
Total Well Penetration Depth: 24.37 ft
Casing Radius: 0.0833 ft
Static Water Column Height: 24.37 ft
Screen Length: 20. ft
Well Radius: 0.3333 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.01253 ft/min y0 = 0.9927 ft



B-4 SLUG OUT-1

Data Set: U:\1-Projects-HYDRO\20190758.004A - SMUD Pocket\AQT\B-4 OUT-1.aqt
Date: 01/15/19 Time: 08:39:06

PROJECT INFORMATION

Company: Kleinfelder
Client: SMUD Pocket 69kV Cable Replace
Project: 20190758.004A
Location: Sacramento, CA
Test Well: B-3
Test Date: Jan 2, 2019

AQUIFER DATA

Saturated Thickness: 40. ft Anisotropy Ratio (Kz/Kr): 0.25

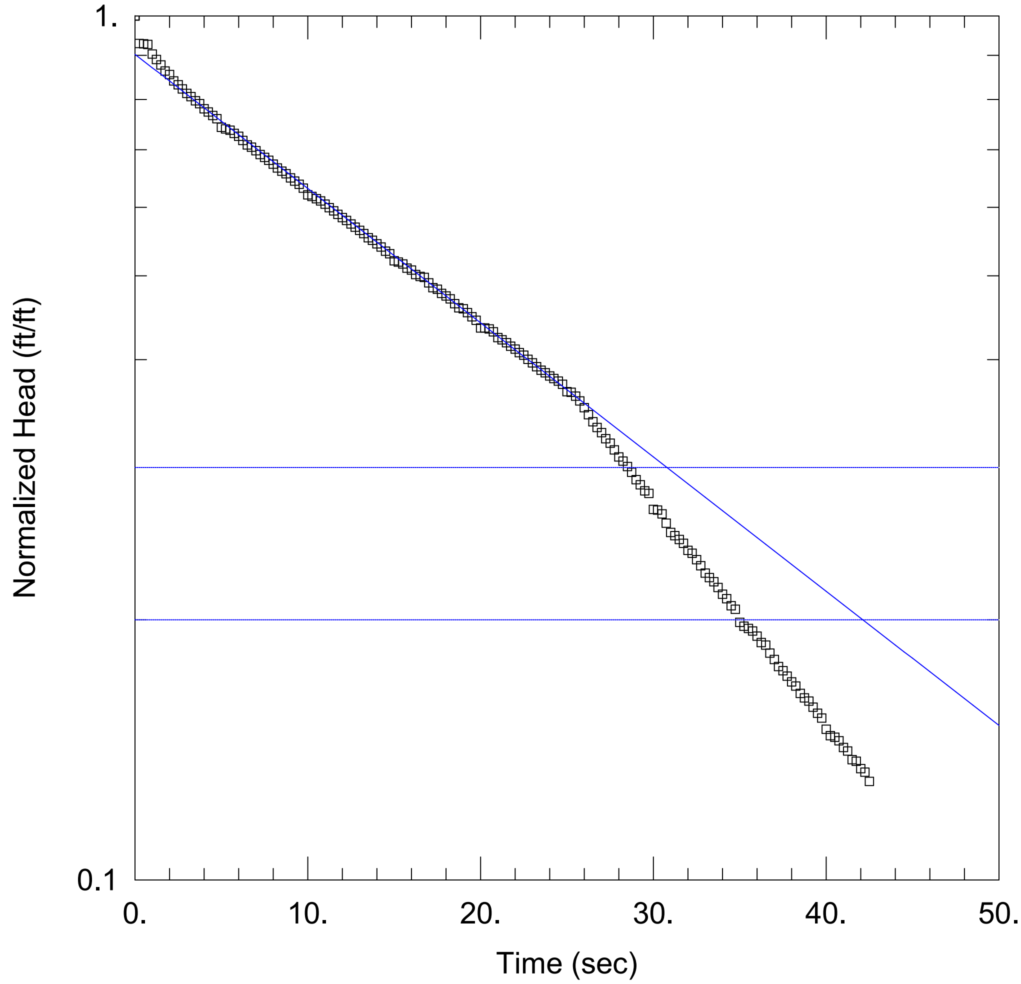
WELL DATA (B-4)

Initial Displacement: 1.789 ft Static Water Column Height: 24.37 ft
Total Well Penetration Depth: 24.37 ft Screen Length: 20. ft
Casing Radius: 0.0833 ft Well Radius: 0.3333 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.001201 ft/min y0 = 1.37 ft



B-4 SLUG OUT-2

Data Set: U:\1-Projects-HYDRO\20190758.004A - SMUD Pocket\AQT\B-4 OUT-2.aqt
Date: 01/15/19 Time: 08:39:28

PROJECT INFORMATION

Company: Kleinfelder
Client: SMUD Pocket 69kV Cable Replace
Project: 20190758.004A
Location: Sacramento, CA
Test Well: B-3
Test Date: Jan 2, 2019

AQUIFER DATA

Saturated Thickness: 40. ft
Anisotropy Ratio (Kz/Kr): 0.25

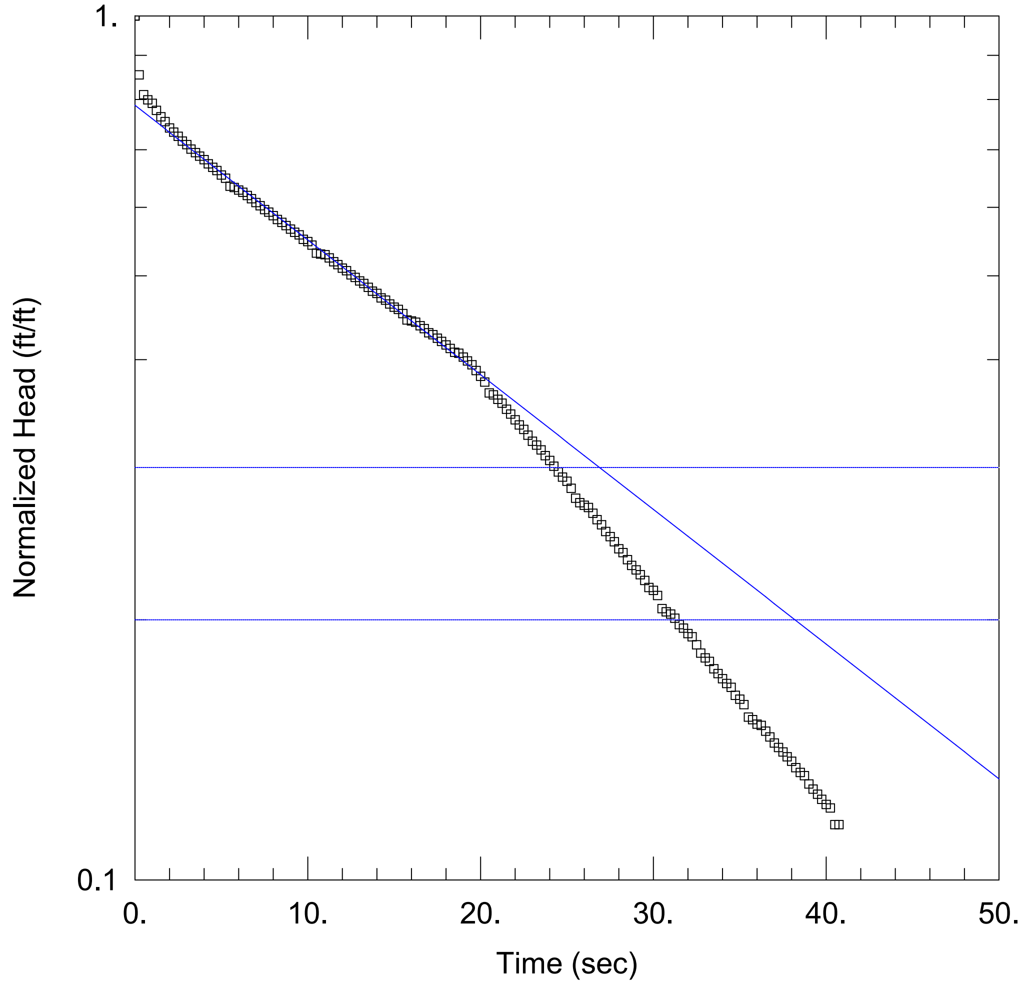
WELL DATA (B-4)

Initial Displacement: 1.546 ft
Total Well Penetration Depth: 24.37 ft
Casing Radius: 0.0833 ft
Static Water Column Height: 24.37 ft
Screen Length: 20. ft
Well Radius: 0.3333 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.001277 ft/min
y0 = 1.396 ft



B-4 SLUG OUT-3

Data Set: U:\1-Projects-HYDRO\20190758.004A - SMUD Pocket\AQT\B-4 OUT-3.aqt
Date: 01/15/19 Time: 08:40:25

PROJECT INFORMATION

Company: Kleinfelder
Client: SMUD Pocket 69kV Cable Replace
Project: 20190758.004A
Location: Sacramento, CA
Test Well: B-3
Test Date: Jan 2, 2019

AQUIFER DATA

Saturated Thickness: 40. ft
Anisotropy Ratio (Kz/Kr): 0.25

WELL DATA (B-4)

Initial Displacement: 1.743 ft
Static Water Column Height: 24.37 ft
Total Well Penetration Depth: 24.37 ft
Screen Length: 20. ft
Casing Radius: 0.0833 ft
Well Radius: 0.3333 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.001281 ft/min
y0 = 1.373 ft

APPENDIX F
GRAIN-SIZE ANALYSIS EVALUATIONS

K from Grain Size Analysis Report

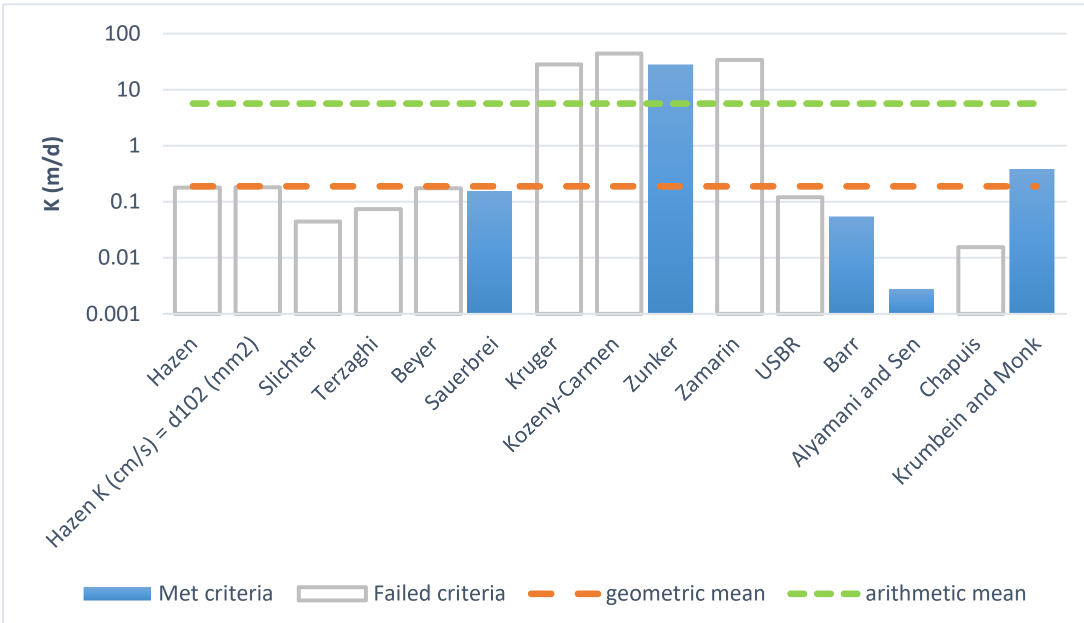
Date: 1/2/2019

Sample Name: SMUD Pocket B-1 @ 30 ft

Mass Sample (g): 100

T (oC) 20

Poorly sorted sand low in fines



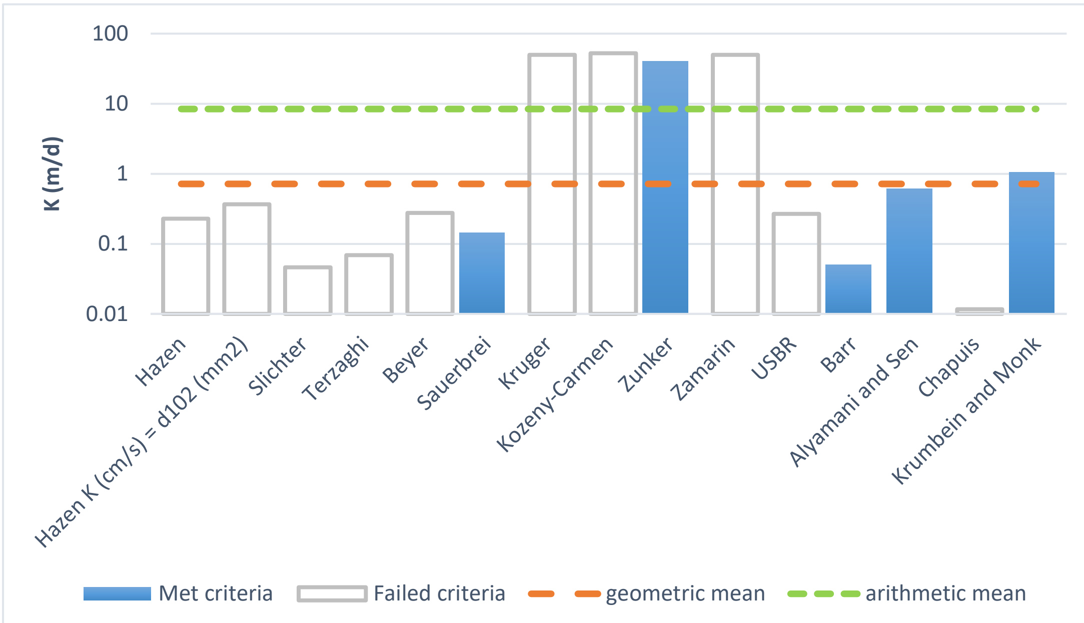
Estimation of Hydraulic Conductivity	cm/s	m/s	m/d
Hazen	.206E-03	.206E-05	0.18
Hazen K (cm/s) = d_{10} (mm)	.211E-03	.211E-05	0.18
Slichter	.514E-04	.514E-06	0.04
Terzaghi	.857E-04	.857E-06	0.07
Beyer	.201E-03	.201E-05	0.17
Sauerbrei	.177E-03	.177E-05	0.15
Kruger	.327E-01	.327E-03	28.22
Kozeny-Carmen	.512E-01	.512E-03	44.21
Zunker	.320E-01	.320E-03	27.67
Zamarin	.392E-01	.392E-03	33.86
USBR	.139E-03	.139E-05	0.12
Barr	.625E-04	.625E-06	0.05
Alyamani and Sen	.317E-05	.317E-07	0.00
Chapuis	.179E-04	.179E-06	0.02
Krumbein and Monk	.441E-03	.441E-05	0.38
geometric mean	.218E-03	.218E-05	0.19
arithmetic mean	.654E-02	.654E-04	5.65

K from Grain Size Analysis Report Date: 1/2/2019

Sample Name: SMUD Pocket B-2 @ 15 ft

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

Poorly sorted sand low in fines



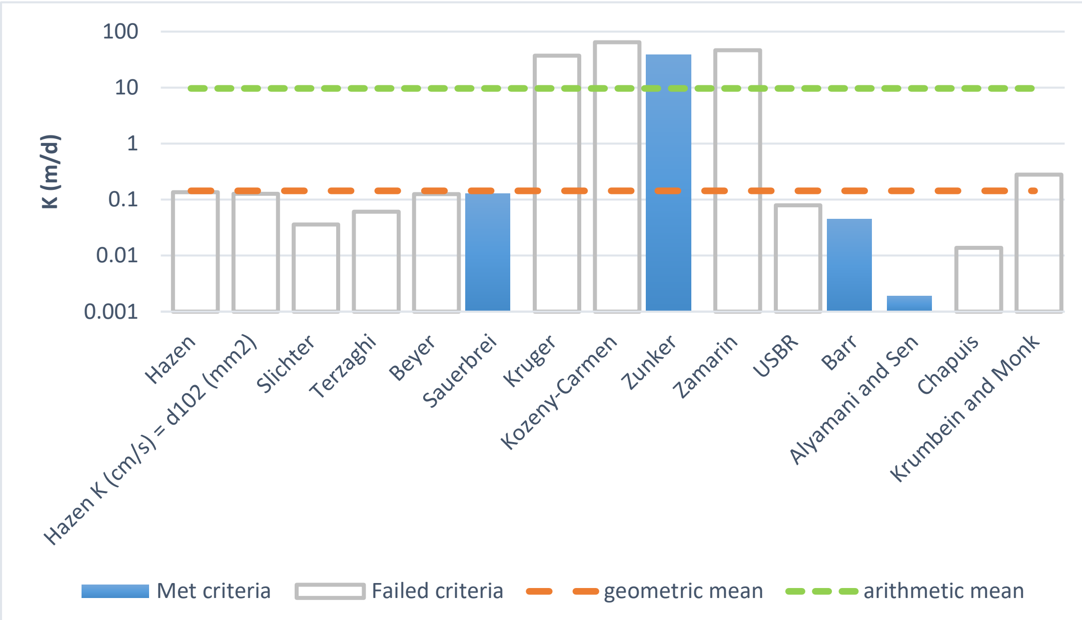
Estimation of Hydraulic Conductivity	cm/s	m/s	m/d
Hazen	.266E-03	.266E-05	0.23
Hazen K (cm/s) = d_{10} (mm)	.423E-03	.423E-05	0.37
Slichter	.537E-04	.537E-06	0.05
Terzaghi	.795E-04	.795E-06	0.07
Beyer	.320E-03	.320E-05	0.28
Sauerbrei	.166E-03	.166E-05	0.14
Kruger	.578E-01	.578E-03	49.92
Kozeny-Carmen	.609E-01	.609E-03	52.60
Zunker	.465E-01	.465E-03	40.14
Zamarin	.575E-01	.575E-03	49.67
USBR	.309E-03	.309E-05	0.27
Barr	.585E-04	.585E-06	0.05
Alyamani and Sen	.712E-03	.712E-05	0.61
Chapuis	.135E-04	.135E-06	0.01
Krumbein and Monk	.122E-02	.122E-04	1.05
geometric mean	.829E-03	.829E-05	0.72
arithmetic mean	.972E-02	.972E-04	8.40

K from Grain Size Analysis Report | Date: 1/2/2019

Sample Name: SMUD Pocket B-2 @ 25 ft

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

Poorly sorted sandy silt low in fines



Estimation of Hydraulic Conductivity	cm/s	m/s	m/d
Hazen	.156E-03	.156E-05	0.14
Hazen K (cm/s) = d_{10} (mm)	.147E-03	.147E-05	0.13
Slichter	.415E-04	.415E-06	0.04
Terzaghi	.702E-04	.702E-06	0.06
Beyer	.146E-03	.146E-05	0.13
Sauerbrei	.148E-03	.148E-05	0.13
Kruger	.432E-01	.432E-03	37.34
Kozeny-Carmen	.747E-01	.747E-03	64.56
Zunker	.446E-01	.446E-03	38.54
Zamarin	.537E-01	.537E-03	46.41
USBR	.920E-04	.920E-06	0.08
Barr	.520E-04	.520E-06	0.04
Alyamani and Sen	.221E-05	.221E-07	0.00
Chapuis	.159E-04	.159E-06	0.01
Krumbein and Monk	.324E-03	.324E-05	0.28
geometric mean	.166E-03	.166E-05	0.14
arithmetic mean	.112E-01	.112E-03	9.68

K from Grain Size Analysis Report

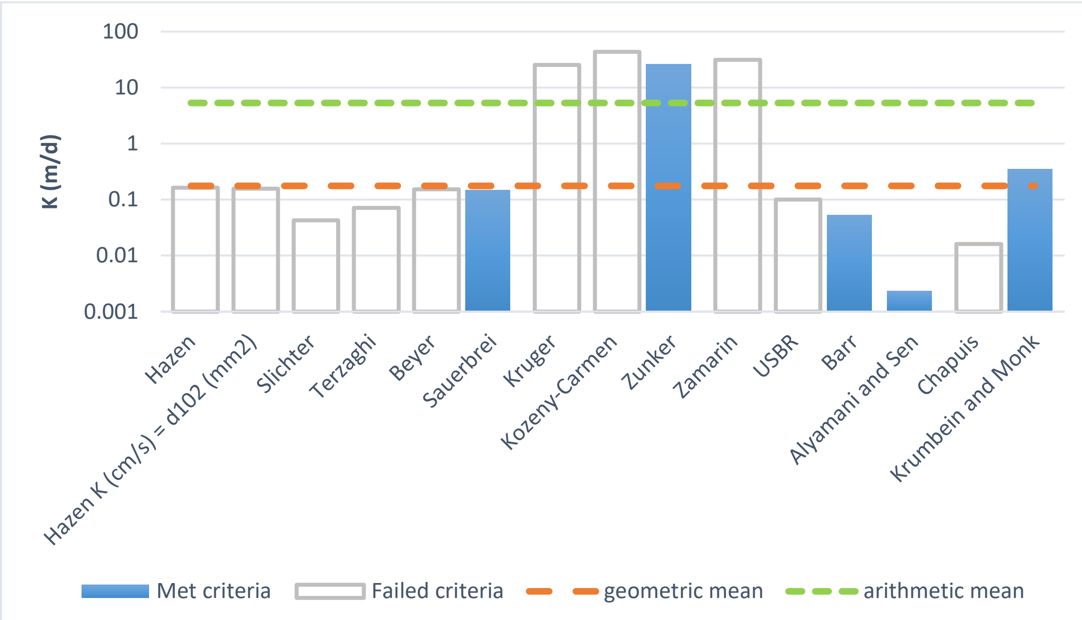
Date: 1/2/2019

Sample Name: SMUD Pocket B-3 @ 30 ft

Mass Sample (g): 100

T (oC) 20

Poorly sorted sand low in fines



Estimation of Hydraulic Conductivity	cm/s	m/s	m/d
Hazen	.188E-03	.188E-05	0.16
Hazen K (cm/s) = d_{10} (mm)	.181E-03	.181E-05	0.16
Slichter	.491E-04	.491E-06	0.04
Terzaghi	.827E-04	.827E-06	0.07
Beyer	.178E-03	.178E-05	0.15
Sauerbrei	.173E-03	.173E-05	0.15
Kruger	.292E-01	.292E-03	25.25
Kozeny-Carmen	.502E-01	.502E-03	43.38
Zunker	.302E-01	.302E-03	26.06
Zamarin	.362E-01	.362E-03	31.31
USBR	.117E-03	.117E-05	0.10
Barr	.609E-04	.609E-06	0.05
Alyamani and Sen	.272E-05	.272E-07	0.00
Chapuis	.188E-04	.188E-06	0.02
Krumbein and Monk	.404E-03	.404E-05	0.35
geometric mean	.204E-03	.204E-05	0.18
arithmetic mean	.616E-02	.616E-04	5.32

K from Grain Size Analysis Report

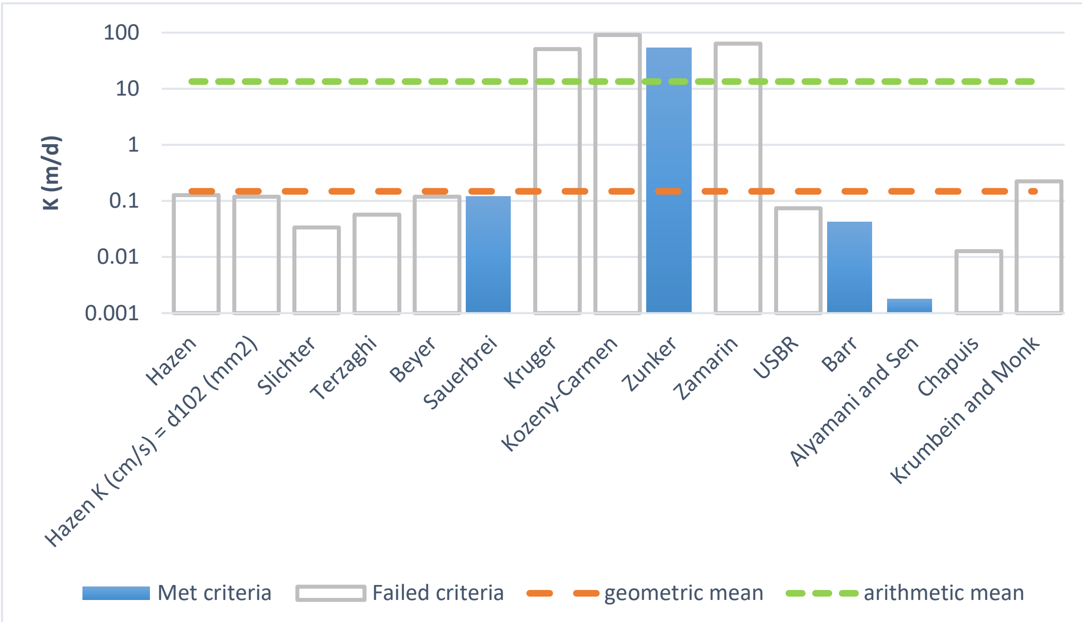
Date: 1/2/2019

Sample Name: SMUD Pocket B-4 @ 20 ft

Mass Sample (g): 100

T (oC) 20

Poorly sorted sandy silt low in fines



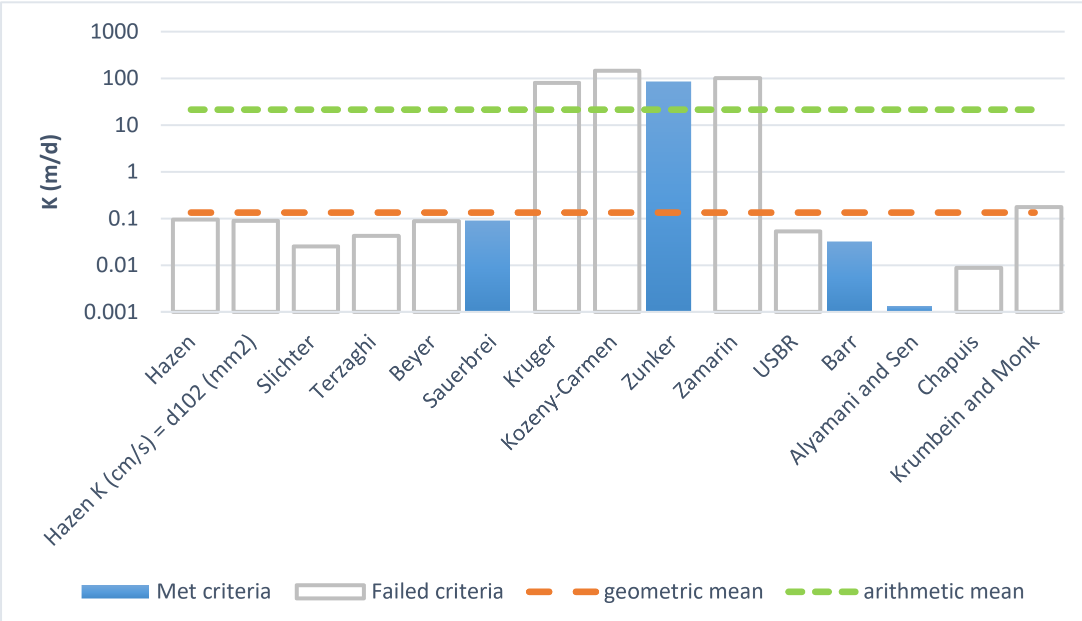
Estimation of Hydraulic Conductivity	cm/s	m/s	m/d
Hazen	.147E-03	.147E-05	0.13
Hazen K (cm/s) = d_{10} (mm)	.138E-03	.138E-05	0.12
Slichter	.389E-04	.389E-06	0.03
Terzaghi	.658E-04	.658E-06	0.06
Beyer	.137E-03	.137E-05	0.12
Sauerbrei	.138E-03	.138E-05	0.12
Kruger	.591E-01	.591E-03	51.03
Kozeny-Carmen	.105E+00	.105E-02	90.57
Zunker	.620E-01	.620E-03	53.59
Zamarin	.740E-01	.740E-03	63.97
USBR	.854E-04	.854E-06	0.07
Barr	.488E-04	.488E-06	0.04
Alyamani and Sen	.208E-05	.208E-07	0.00
Chapuis	.147E-04	.147E-06	0.01
Krumbein and Monk	.258E-03	.258E-05	0.22
geometric mean	.172E-03	.172E-05	0.15
arithmetic mean	.156E-01	.156E-03	13.44

K from Grain Size Analysis Report | Date: 1/2/2019

Sample Name: SMUD Pocket B-4 @ 30 ft

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

Poorly sorted sandy silt low in fines



Estimation of Hydraulic Conductivity	cm/s	m/s	m/d
Hazen	.109E-03	.109E-05	0.09
Hazen K (cm/s) = d_{10} (mm)	.103E-03	.103E-05	0.09
Slichter	.290E-04	.290E-06	0.03
Terzaghi	.490E-04	.490E-06	0.04
Beyer	.102E-03	.102E-05	0.09
Sauerbrei	.103E-03	.103E-05	0.09
Kruger	.927E-01	.927E-03	80.07
Kozeny-Carmen	.168E+00	.168E-02	145.12
Zunker	.987E-01	.987E-03	85.28
Zamarin	.117E+00	.117E-02	101.07
USBR	.609E-04	.609E-06	0.05
Barr	.363E-04	.363E-06	0.03
Alyamani and Sen	.155E-05	.155E-07	0.00
Chapuis	.101E-04	.101E-06	0.01
Krumbein and Monk	.204E-03	.204E-05	0.18
geometric mean	.155E-03	.155E-05	0.13
arithmetic mean	.247E-01	.247E-03	21.35