APPENDIX 2C

Geotechnical Report

Geotechnical Conditions and Preliminary Recommendations, Mariposa Energy Project

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Introduction

This memorandum presents the findings of the preliminary geotechnical investigation to Mariposa Energy, LLC (ME) for the proposed Mariposa Energy Project in East Alameda County, California (Figure 1, figures are provided at the end of this memorandum). This memorandum has been prepared for use by ME and the CH2M HILL team during the preliminary design and permitting phase. Results of this evaluation provide preliminary geotechnical recommendations for design and construction of the proposed improvements in accordance with our scope of work (Standard CH2M HILL agreement signed and dated January 27, 2009). Also included are recommendations and a corresponding scope of work for final design geotechnical work.

Project Description

The project site is in the northeastern corner of Alameda County, southeast of the intersection of Kelso and Bruns roads approximately 13 miles west of the city of Tracy. The approximate latitude of the site is 37.7893° and the longitude is -121.6020°.

Figure 1, Project Vicinity, shows the general location of the site. Figure 2, Geologic Map, shows the general geology and faults near the site. Figure 3, Site Plan, shows the existing topographic contours, the general arrangement, and the borehole and test pit locations. Contours of the ground surface elevation shown in Figure 3 were generated using survey data from a December 2008 survey performed by CH2M HILL. The vertical datum used was North American Vertical Datum 1983 (NAVD83).

The site is located between two gentle slopes with ridges running generally in a north and south direction. On the western side of the site, the slope gently falls from the west to east toward the project at 7.5:1 (horizontal to vertical). On the eastern side of the site, the slope gently falls from the east to west toward the project at 9:1. The elevations at the ridge tops are about 175 feet mean sea level (msl) on the western ridge and 145 feet msl on the eastern ridge. In the valley between the two ridges, the existing grade slopes from south to north at

about 63:1. The elevation change within the valley from south to north is 124 feet msl to 108 feet msl.

Planned improvements include the construction of the following features:

- A level pad at an approximate elevation of 125 feet msl
- A cut slope at 3:1 incised into the existing eastern slope
- Four turbines and associated step-up transformers and exhaust stacks
- Three water tanks: a raw water storage tank with a diameter of 45 feet and a height of 45 feet; a demineralized water tank with a diameter of 40 feet and a height of 40 feet; and a process wastewater storage tank with a diameter of 25 feet and a height of 25 feet
- A warehouse/maintenance building
- A control/administration building
- A power distribution center
- Fuel gas compressors
- A chiller air-cooled condenser
- A retention basin
- A paved entrance road
- Associated transmission lines and piping (not shown in Figure 3)

Scope of Work

The scope of work for the preliminary geotechnical investigation and evaluation included the following tasks:

- Develop and conduct an exploration program for the facilities shown in Figure 3.
- Based on the subsurface data, identify subsurface conditions with the potential to impact proposed construction and identify design parameters related to the preliminary design of the proposed facilities including the following:
  - Facility site and layout constraints
  - Seismic design criteria
  - Seismic hazards in accordance with California Geological Survey Special Publication 11 rev. 2008
  - Foundation design
  - Nature and strength of the native soils
  - Corrosion design
- Prepare this technical memorandum summarizing the preliminary geotechnical evaluation and recommendations.

Exploration and Testing

Field Investigation

In February 2009, CH2M HILL completed a geotechnical exploration program consisting of drilling three borings to depths ranging from 35 to 100 feet below the ground surface (bgs), and excavating six test pits to depths ranging from 7 to 10 feet bgs. Borings were drilled by V & W Drilling of Lodi, California using a CME 850 wire line drill rig with 8-inch, hollow-stem continuous flight augers and 8-inch mud rotary on February 24 and 25, 2009. Drilling

was directed by, and subsurface conditions were logged by, a CH2M HILL representative. Test pits were excavated by Diamond D Engineering of Woodland, California at the direction of a CH2M HILL field representative using a Komatsu PC-35 mini-excavator with a 30-inch bucket on February 19, 2009.

During drilling, soil sampling was conducted using a 2-inch-outside-diameter (OD) split-spoon sampler without liners for the Standard Penetration Tests (SPT), and a 3-inch OD split-barrel sampler with 2.5-inch OD 6-inch-long brass liners for the Modified California Sampler. Both samplers were driven using an automatic trip hammer of 140 pounds falling 30 inches, in accordance with the American Society for Testing Materials (ASTM) SPT (ASTM D1586). The number of blows required to drive the sampler 18 inches in 6-inch increments was recorded, and the number of blows required to drive the last two 6-inch intervals was summed to get the blow count (N-value). Sampling was performed at approximate 5-foot intervals. HQ coring (2.4-inch-diameter core size) techniques were used to advance through rock, where encountered.

Field measurements of unconfined compressive strength for cohesive samples were obtained during drilling using a pocket penetrometer. The results are presented in the "Comments" section of the boring logs provided in Attachment 1. Boring and test pit locations and depths are summarized in Table 1, and are shown in Figure 3. Boring and test pit locations were determined with a handheld Trimble GEO-XT GPS with sub-meter accuracy. Elevations were estimated from the topographic site map.

TABLE 1
Summary of Borings and Test Pits
Preliminary Geotechnical Design Memorandum – Mariposa Energy Project

Boring	Northing (feet)	Easting (feet)	Depth (feet)	Elevation at top of the borehole (feet)
B-1	2111298.8	6243298.0	41.5	144.0
B-2	2111636.9	6243245.3	100	119.0
B-3	2112118.7	6243314.4	35	112.0
TP-1	2111309.8	6243238.4	10	136.0
TP-2	2111370.4	6243008.8	10	132.0
TP-3	2111770.5	6243405.3	7	127.0
TP-4	2111440.5	6243125.8	9.5	123.0
TP-5	2111941.2	6243230.3	10	117.0
TP-6	2111966.5	6243410.4	10	117.0

Rain at the site the day before drilling, and subsequent soft ground conditions required the driller to lay timber mats on the ground in front of the drill rig to access the boring locations.

The first boring (B-1) was drilled to a final depth of 35 feet with an 8-inch, hollow-stem auger. During the second boring (B-3), drilling with a hollow-stem auger met refusal and broke the bit at a depth of 23 feet bgs. Unable to continue drilling through the bedrock, the driller abandoned the hole and switched to coring techniques. Because most of the material

was not recovered during the first two cores below drilling refusal, it is unclear of the material type that caused refusal. A small amount of weathered conglomerate was encountered in the last portion of the second core. Similarly to Boring B-3, the mud rotary drilling for Boring B-2 met with refusal with at depth of about 34.8 feet bgs. The driller began coring at a depth of 34.8 bgs and encountered very hard andesite.

Soil Classification

For this memorandum, soil has been classified using the Unified Soil Classification System (USCS) in accordance with ASTM D2487. In order to determine the relative density and consistency of soils represented by each sample, CH2M HILL calculated a "corrected," or N_{60}, blow count. The N_{60} blow count is standardized to account for samplers and hammers other than the standard 2-inch OD split-spoon sampler and the standard safety hammer (140 pounds falling 30 inches). Correction factors presented in Table 2 were used to adjust field blow counts shown on the boring logs for sampler and hammer type.

TABLE 2
Summary of Correction Factors to Blow Counts Shown on Boring Logs
Preliminary Geotechnical Design Memorandum – Mariposa Energy Project

	Sampler	
Drive Method	**2.0-inch OD Split Spoon**	**3.0-inch OD Split Barrel**
Automatic Trip Hammer	1.3	0.8

For granular soils, the relative density was based on the corrected blow count using the guidelines presented in Table 3. For cohesive soils, the consistency was based on the following data in order of hierarchy: laboratory measurements of unconfined compressive strength, field pocket penetrometer estimates of unconfined compressive strength, and corrected N_{60} blow counts. The soils were then assigned relative densities or consistencies based on "corrected" blow counts and the guidelines presented in Table 3.

TABLE 3
Summary of Consistency or Relative Density
Preliminary Geotechnical Design Memorandum – Mariposa Energy Project

Soil Type	Description	Corrected SPT Blow Count (bpf)	Unconfined Compressive Strength (tsf)
Cohesive (silts and clays)	Very soft	0–1	<0.25
	Soft	2–4	0.25–0.50
	Firm	5–8	0.50–1.00
	Stiff	9–15	1.00–2.00
	Very stiff	16–30	2.00–4.00
	Hard	>30	>4.00

TABLE 3
Summary of Consistency or Relative Density
Preliminary Geotechnical Design Memorandum – Mariposa Energy Project

Soil Type	Description	Corrected SPT Blow Count (bpf)	Unconfined Compressive Strength (tsf)
Non-Cohesive (sands and gravels)	Very loose	0–4	—
	Loose	5–10	—
	Medium dense	11–30	—
	Dense	31–50	—
	Very dense	>50	—

Source: Sowers, 1979
bpf = blows per foot

Laboratory Testing

Samples obtained during drilling were transported to a soil testing laboratory. The samples were tested for moisture content, dry density, gradation, Atterberg limits, unconfined compressive strength, expansion index, swell/consolidation and R-value. Results are presented on the boring logs provided in Attachment 1. Laboratory test data are presented in Attachment 2. Tables 4 and 5 summarize the geotechnical test results by primary soil type.

TABLE 4
Summary of Test Results for Characterization
Preliminary Geotechnical Design Memorandum – Mariposa Energy Project

	Percent < No. 200 Sieve		Atterberg Limits		
USCS Type	No. of Tests	Range	No. of Tests	Range of Liquid Limit	Range of Plasticity Index
Lean Clay (CL)	4	63 to 82	4	33 to 41	22 to 28
Mudstone (Claystone)	4	63 to 74	4	52 to 92	36 to 54

TABLE 5
Summary of Test Results for Strength
Preliminary Geotechnical Design Memorandum – Mariposa Energy Project

	Corrected Blow Count (bpf)		Unconfined Compressive Strength (tsf)		Pocket Penetrometer (tsf)	
USCS /Rock Type	**No. of Tests**	**Range**	**No. of Tests**	**Range**	**No. of Tests**	**Range**
Lean Clay (CL)	7	5 to 31(18)*	1	2.2	7	1.25 to 4.5 (3)*
Sandy Fat Clay (CH)	1	31	1	7.2	2	0.5 to >4.5 (2.5)*
Clayey Sand (SC)	1	49	1	—	—	—
Sandstone	21	20 to > 50/3”	1	14.4	—	—
Andesite	—	—	1	749	—	—
Mudstone (Claystone)	1	25	5	1.5-2.5	—	—

*- average value
50/3” = 50 blows for 3 inches

TABLE 6
Summary of Test Results for Swell/Consolidation
Preliminary Geotechnical Design Memorandum – Mariposa Energy Project

	Consolidation Test						
USCS/Rock Type	**No. of Tests**	**Overburden Pressure (tsf)**	**Preconsolidation Pressure (psf)**	**Swell Pressure (psf)**	**Swell (%)**	**C_v**	**C_s**
Lean Clay (CL)	1	0.39	1.60	0.46	0.1	0.06	0.01
Sandy Fat Clay (CH)	1	0.30	1.58	1.83	1.7	0.10	0.03

psf = pounds per square foot
tsf = tons per square foot

Corrosion Potential and Expansion Index of the Native Soils

Two soil samples were submitted to Environmental Technical Services of Petaluma, California, and one sample was submitted to Sunland Analytical in Rancho Cordova, California, for analysis of resistivity, pH, and chloride and sulfate concentrations to assess the corrosivity of the native soils. Composite Sample 1 was a composite of clayey soil from the test pits. Composite Sample 2 was a composite of sandy soil (sandstone) from the test pits. The third sample was from Boring B-2 at a depth of 15 feet bgs in mudstone. Additionally, two soil samples were tested for expansion index and swell potential by Sierra Testing Laboratories of El Dorado Hills, California. Results of the laboratory analyses are included in Attachment 2 and are summarized in Table 7. The soil samples submitted for this testing were collected from depths between the surface and 15 feet bgs.

TABLE 7
Summary of Test Results for Corrosivity and Expansion Index
Preliminary Geotechnical Design Memorandum – Mariposa Energy Project

Sample	Soil Type	pH	Sulfates (ppm)	Chlorides (ppm)	Resistivity (ohm-cm)	Expansion Index
B-2 @ 6.5' bgs	CL	—	—	—	—	93
B-2 @ 15' bgs	Interbedded Mudstone	7.62	64.5	45.5	990	
B-3 @ 5' bgs	CL	—	—	—	—	143
Composite Sample 1	CL	7.84	4.3	53.4	1,050	—
Composite Sample 2	Sandstone	7.84	4.3	53.4	1,050	—

ohm-cm = ohms-centimeters
ppm = parts per million

Site Conditions

Surface Conditions

As discussed previously, the site slopes to the north between two gentle sloping hills. Figure 3 shows the general topography of the project site. The site is generally open and vegetated with short grass. There are no improvements at the site; however, a number of abandoned wind turbine foundations are located on the eastern and western ridge. An existing cogeneration plant is located northeast of the site. Unpaved road access exists at the site, as can be seen in Figure 3.

Regional and Site Geology

The site is in the western portion of the San Joaquin Valley, a portion of the Great Valley, bordered by the Sierra Nevada Mountains to the east, the Coast Ranges to the west, the Transverse Ranges and the Mojave Desert to the south, and the Klamath Mountains to the north. The site is mapped as being underlain by Unit D of the Great Valley Sequence, defined as late cretaceous sandstone with adjacent units of shale as shown in Figure 2. The sandstone dips generally to the northeast from 15 to 37 degrees.

Seismicity

Faulting. The site is not within a designated Alquist-Priolo zone (Hart and Bryant, 1999). The nearest active fault is Segment 7 of the Great Valley Fault System. This fault segment is considered a reverse blind thrust fault that does not extend to the ground surface.

The Midway Fault is located approximately 1.4 miles west of the site (Unruh and Krug, 2007), but is not officially recognized by the United States Geologic Society (USGS) nor the California Geologic Society (CGS) as a quaternary fault (having movement within the last 1.6 million years). Recently published information suggests the fault should be considered active and was assigned a maximum moment magnitude of 6.3, and a slip rate of 0.2 millimeters a year (Unruh and Krug, 2007; AEG, 2005). The average recurrence interval

for the fault is 2,651 years (Wesnousky, 1986). Despite conflicting opinions, the majority of evidence suggests the Midway Fault is a right lateral structure.

Table 8 lists known CGS active faults having the most potential to cause moderate ground shaking at the site. The faults in the list were identified as generating deterministic peak site accelerations greater than 1.0g (EQFAULT, 2004).

TABLE 8
Significant Seismic Sources
Preliminary Geotechnical Design Memorandum – Mariposa Energy Project

Fault	Fault Type[a]	CGS Fault Class[a]	Slip Rate (millimeters per year)[a]	Maximum Moment Magnitude (M_w) [b]	Approximate Site-to-Source Distance (miles)[c]
Great Valley Segment 7	Thrust	B	1.5	6.7	6
Greenville (North)	Strike-Slip	B	2.0	6.7	7
Mount Diablo	Thrust	B	2.0	6.7	8
Calaveras (North, Central, South)	Strike-slip	B	6	6.9	19
Great Valley Segment 5	Thrust	B	1.5	6.5	22
Hayward (Total)	Strike-slip	B	9.0	7.3	25
San Andreas Fault (1906)	Strike-slip	A	N/A	7.9	44

[a] California Geological Survey, 2002.

[b] USGS National Seismic Hazard Maps Fault parameters (2002).

[c] EQFAULT, 2004

Seismic Hazards. The USGS Liquefaction Susceptibility Map of the San Francisco Bay Area shows that the site has very low liquefaction susceptibility (USGS, 2006). There are no other published seismic hazard maps for the site. The site is mapped as having no evidence of historic landslides (Robertson et. al, 1999) and no evidence of landslides was observed at or around the site. Areas to the south, where steeper slopes are present, such as in the vicinity of Altamont Pass, have been subject to landslides.

The seismic hazards at the site are considered to be minimal. No active faults were mapped as crossing the site and the potential for ground rupture, tectonic creep, and seismically induced settlement is considered low. Liquefaction is not anticipated to occur because no groundwater was encountered at the site and no deposits of loose sand were detected during the investigation.

Subsurface Conditions

Subsurface conditions encountered in the three borings and six test pits generally consisted of clayey soil over sandstone with interbedded mudstone (claystone) and very hard andesite layers.

Soil. In the borings, the soil consisted primarily of stiff to hard lean clay (CL) with occasional pockets of sandy fat clay (CH), clayey sand (SC), and gravelly lean clay (CL). The test pits encountered similar lean clay (CL). The clays are thought to be residual in nature, derived from weathering of the local bedrock.

Corrected blow counts for the lean clay ranged from 5 to 31 bpf with an average value of 18 bpf. Pocket penetrometer measurements of unconfined compressive strength obtained in the field in this material ranged from 1.25 to more than 4.5 tsf, with an average value of 3 tsf. A single sample of the lean clay at a depth of 5 feet in Boring B-3 reported a laboratory unconfined compressive strength of 2.2 tsf

The blow count in the sandy fat clay encountered in Boring B-2 at a depth of 5 feet was 31 bpf. The laboratory unconfined compressive strength of the sandy fat clay was 7 tsf. Using the pocket penetrometer, measurements of unconfined compressive strength obtained in the field in this material ranged from 0.5 to more than 4.5 tsf, with the average value of 2.5 tsf.

Based on the results of the expansion index testing, samples of the native clays are considered to possess high to very high expansion potential (CBC, 2002). Two consolidation tests were conducted at the site. The tests show the sandy fat clay has high swell potential, while the lean clay has low swell potential (O'Neill and Poormayed, 1980). The sandy fat clay has 1.7 swell percentage with a swell pressure of 3,650 psf. The lean clay has 0.1 swell percentage with a swell pressure of 920 psf. Both consolidation tests indicate that the sandy fat clay and the lean clay are overconsolidated, which is consistent with the residual nature of the soil at the site.

The soils should also be considered corrosive to buried ferrous metals including steel, ductile iron, cast iron, and galvanized steel due to low resistivity (Caltrans, 2003). The soils are not considered corrosive to buried concrete and cement mortar surfaces due to low chlorides and sulfate concentrations

Rock. Sandstone with interbedded mudstone (claystone), mudstone, and very hard andesite dikes were encountered underlying these surface soils in the borings. A 1-foot layer of very hard conglomerate was also encountered in boring B-3 at a depth of 23 feet bgs. Weathered sandstone was encountered in the test pits at the site. In TP-2, a dip of about 35 degrees was measured. Based on the reported dips shown in Figure 2 and the measured dip, a 35 degree dip was assumed for the site.

The laboratory unconfined compressive strength was 14.4 tsf for the sandstone and 749.0 tsf for the andesite. The andesite sample tested was from a depth of 93 feet in Boring B-2 as it was the only recovered andesite core suitable for testing. Andesite encountered at a depth of 34.8 feet and at other depths in Boring B-2 likely has a similar high strength. The hard andesite and the conglomerate encountered below elevation 84 feet will likely make installation of deep driven or drilled foundations very difficult and rock drilling may be required to allow any deep foundations to advance and develop necessary design capacity.

The laboratory unconfined compressive strength of the interbedded mudstone ranged from 1.9 to 2.3 tsf. The moisture content of the interbedded mudstone ranged from 31.3 to 38.7 percent. For the interbedded mudstone, the percent passing the number 200 sieve ranged from 62.7 to 73.8 percent.

No swell tests were conducted on the mudstone layers; however, the mudstone layers have a high liquid limit and may be expansive.

Groundwater. Groundwater was not encountered in the borings and test pits at the time of the investigation. No historic groundwater data are available for the site.

Conclusions and Recommendations

Seismic Design

The results of the probabilistic site hazard analysis were derived for the project site based on information obtained from the USGS *National Seismic Hazard Maps* (USGS, 2008a). The maximum credible earthquake (MCE) by the California Building Code (CBC, 2007) has recurrence interval of 2,475 years or 2 percent probability of exceedance in 50 years.

Design Values. The *National Seismic Hazard Maps* indicate that the peak bedrock acceleration (PBA) at the site is 0.60g for a 2,475 years recurrence interval or 2 percent probability of exceedance in 50 years. Given the shallow bedrock at the site, this value may also be considered the peak ground acceleration (PGA) for design. During the final design, the shear wave velocity should be measured to confirm this estimate. The design ground motion is based on 2/3 of the MCE per the 2007 CBC. From the *Earthquake Ground Motion Parameter Calculator* (USGS, 2008b) the following parameters in Table 9 may be used for seismic design of the improvements using the 2007 California Building Code.

TABLE 9
2007 California Building Code Site Class and Site Seismic Coefficients
Preliminary Geotechnical Design Memorandum – Mariposa Energy Project

	Designation	Value	Reference
Soil Profile Type	Site Class	C	Table 1613.5.2
Spectral Response Acceleration for MCE at 0.2 second period	S_s	1.50	Figure 1613.5 (3)
Spectral Response Acceleration for MCE at 1 second period	S_f	0.521	Figure 1613.5 (4)
Site Parameter	F_a	1.0	Table 1613.5.3 (1)
Site Parameter	F_v	1.3	Table 1613.5.3 (1)
Spectral Response Acceleration at 0.2 second period	S_{MS}	1.500	Equation 16A-37
Spectral Response Acceleration at 1 second period	S_{M1}	0.678	Equation 16A-37
Design Spectral Acceleration Parameter at 0.2 second period	S_{DS}	1.000	Equation 16A-39
Design Spectral Acceleration Parameter at 1 second period	S_{D1}	0.452	Equation 16A-40

Site Class C was calculated according to the California Building Code (2007). The field blow counts per foot were averaged to a depth of 100 feet bgs. For blow counts not recorded, the blow counts were estimated using blow counts in similar adjacent material. For the blow

counts that met with refusal and for the bedrock cores, a blow count of 100 bpf were used in the estimate.

The *National Seismic Hazard Maps* and *the Earthquake Ground Motion Parameter Calculator* does not explicitly account for the Midway Fault in the probabilistic PBA because the fault was not included in the seismic sources. However, the PBA component from the Midway Fault is likely small, as mentioned previously, the average recurrence interval is 2,651 years. In comparison, the San Andreas, the Calaveras (North), and the Greenville faults have respective recurrence intervals of 400, 300, and 550 years. For the final geotechnical work, the seismicity of the Midway Fault should be explicitly modeled and its contribution accounted for in the PBA to confirm that its contribution is considered minor.

Earthwork

The following earthwork and related activities will be performed during construction:

- Excavation and site pad preparation
- Foundation construction
- Backfill and surface restoration

Excavation and Site Pad Preparation. Construction areas should be cleared and grubbed of all surface and subsurface materials and structures, including vegetation, organic topsoil, pavement, abandoned utilities, and any other deleterious substances that conflict with the proposed construction. Cleared and grubbed material should be disposed of offsite, and should not be used as fill or backfill material.

Cuts of up to 32 feet are planned along the eastern portion of the site, and fills of up to 15 feet are planned along the central and western portions of the site. Approximately 45 percent of the proposed site will be located within bedrock cut while the remainder of the site will be underlain by compacted fill.

As discussed previously, the bedrock contains interbedded layers of sandstone and expansive mudstone that dip toward the northeast. The proposed site grading plan will expose this dipping bedrock along the majority of the eastern portion of the site, where it will constitute the finished grade. There is a potential for differential movement and swell if foundations bear directly on the interbedded bedrock. Therefore, it is recommended that the upper 2 feet of bedrock beneath the portion of the site where it represents the finished grade be removed, moisture conditioned, blended, and compacted to a minimum of 95 percent relative compaction in accordance with ASTM D1557 to provide a more uniform bearing surface.

For the areas of fill, the residual clay soils appear to possess high swell potential. At this time, it is not known whether the mudstone bedrock or the remolded composite samples of the clays, mudstones, and sandstones possess the same swell potential.

Discussed previously, the surface layer of residual clay within the existing valley appears to become thicker toward the north. At Boring B-3, approximately 15 feet of clay is present below the ground surface. Because the fills of up to 15 feet of soil at the north end of the foundation pad will place an additional pressure on the thicker clay soils, it is estimated that up to 1 inch of post-construction consolidation (settlement) or swell of the native clay soils

will occur. With laboratory test results from samples of clay obtained during final design, the actual swell or consolidation should be better defined.

For portions of the site pad fill greater than 10 feet in thickness and for fill beneath the turbines, select granular fill derived from on-site sandstone or imported material containing less than 30 percent passing the number 200 sieve should be placed and compacted to a minimum of 95 percent relative compaction. It is estimated that approximately half of the planned cut on the eastern side of the slope will encounter sandstone materials that will meet the requirements for select granular fill. This suggests that 36,000 of the required 66,000 cubic yards of fill material will likely be suitable for use in the deeper fills and beneath the turbines. Because this preliminary estimate was made using data from a single soil boring (B-1) and shallow test pits, it should be confirmed during final design with additional investigation.

The moisture content of fill materials should be adjusted as necessary to obtain the specified compaction. Loose lifts of fill should not exceed 8 inches in thickness if heavy equipment is used. If hand-operated equipment is used, loose lifts of fill should not exceed 6 inches in thickness. All excavations should be free of standing water or loose material before any fill or concrete is placed.

Cut Slope. The proposed 3:1 cut slope into the eastside slope was modeled and analyzed with the computer program Slide 5.0 (Rocscience, 2009) to evaluate stability of the slope. In the computer model, the 3:1 cut slope was made in sandstone. The sandstone was modeled with a 35 degree dip into the cut slope (favorable). At a slope height of 32 feet, the factor of safety against failure was greater than 3.

Because of the unfavorable bedrock dip on the western site slope, it is recommended to avoid cuts of more than a few feet at the toe of this slope to reduce the potential for sliding and movement of the stratified bedrock onto the site.

Fill Slope. It is recommended to slope the constructed embankment slopes at 3:1 (H:V).

Foundations and Settlement

Four gas turbines are planned for the site. Each turbine is approximately 55 feet long, 14 feet wide, and weighs approximately 350 tons. Turbines are typically founded on reinforced concrete mat foundations with a typical thickness of 3 feet. Bearing pressure would be anticipated to be approximately 1,000 psf. Based on the site grading plan, it is anticipated that the turbines and associated exhaust stacks will bear on excavated native sandstones and mudstones, with the turbines of Units 3 and 4 (northern most turbines) bearing on compacted select granular site fill ranging in thickness to 4 feet.

In a similar manner the administration building and the water tanks are planned to partially bear on both excavated bedrock and select granular fill. The compacted select granular site fill across the site will in turn bear on a layer of the expansive native lean and fat clays that range in thickness up to 4 feet. In order to mitigate the risk of differential settlement and cracking of the turbine foundations at Units 3 and 4 and the administration building and water tanks, it is recommended to overexcavate the native clay soils from beneath the turbines of Units 3 and 4, the administration building, and tanks and replace the overexcavated material with moisture conditioned and compacted select granular fill.

The warehouse, power distribution center, and fuel gas compressor are planned to bear on fills with thicknesses of over 10 feet, and therefore will be comprised per the recommendation above, of select granular fill. The transformers will instead bear on compacted native fills of thicknesses of less than 10 feet.

The maximum net allowable bearing pressure for foundations bearing in the fill shall be 2,000 psf and for foundations bearing in the select fill, it shall be 2,500 psf. For foundations bearing entirely on the excavated bedrock the net allowable bearing pressure shall be 3,000 psf. Allowable bearing pressures may be increased by one-third for transient loading conditions. Consolidation or swell of the native clay soils beneath the fill is likely to be less than 1 inch, as the applied fill pressure is less than 1,500 psf. Movement of the turbine foundations with a bearing pressure of 1,000 psf is also estimated to be less than 1 inch. These estimates should be verified by additional soils testing during final design.

For areas of shallow fill where the foundations will bear on native clays or where the native clays are within 24 inches of the foundation (such as the south end of the project and along the boundaries of cut and fill), foundations with net bearing pressures of 2,000 psf or less may experience swell equal to 1 to 2 percent of the thickness of the underlaying clay layer, or approximately 1 to 3 inches of movement. Therefore, it is recommended to remove, moisture-condition, and recompact 24 inches of the native clays beneath the lowest foundation bearing depth.

As stated previously, settlement and swell potential of the native clays across the site will need to be addressed in final design with the collection of additional swell and consolidation test data. If additional testing during final design indicates that settlement or swell is an issue for the warehouse, power distribution center, and fuel gas compressors, it is recommended to consider the following options to address post-construction movement of the tanks:

1. Overexcavate the native clay soils and replace them with suitable non-swelling fill prior to placement of the site equipment pad.
2. Install sand columns through the clay and preload the site with additional fill to speed the consolidation process and reduce the settlement potential.
3. Construct the facilities on thick mat foundations to reduce the potential for structural damage related to settlement

All of the stacks and the turbines of Units 1 and 2 are anticipated to bear on native bedrock exposed in the planned cut. As discussed previously, to reduce the potential for differential swell of the bedrock, it is also recommended to remove, moisture-condition, and recompact 24 inches of the native mudstone bedrock beneath the lowest foundation bearing depth. This requirement may be deleted if final design geotechnical data suggest that the bedrock possesses low swell potential. Net allowable bearing pressure in the areas of bedrock cut shall be 3,000 psf.

Pavement Design

For the proposed paved areas, surface restoration should include asphalt concrete (AC) pavement over an aggregate base. Two R-value tests were performed on composite samples of the surface soils from test pits TP-1 through TP-6. Composite Sample 1 included

composite samples of clayey soil and indicated an R-value of 8. Composite Sample 2 included composite samples of weathered sandstone and indicated an R-value of 22.

For private roads in unincorporated areas of Alameda County, the Alameda County Public Works Agency requires private roads to have the following minimums:

- Traffic Index (TI) of 5.5
- AC pavement thickness of 3 inches
- 10 inches of aggregate base.

Also, the pavement design shall be based on the criteria in Chapter 600 of the Caltrans Highway Design Manual. As such, the calculated pavement thicknesses are presented in Table 10 for the minimum TI, and TI equal to 7 and 9 using the Caltrans program CalFP Version 1.1. If pavement thicknesses are required for additional TIs, the geotechnical engineer should be contacted. The aggregate base material should be placed on a prepared subgraded and compacted to a minimum 95 percent relative compaction (ASTM D1557). Subgrade preparation should include clearing, grubbing, and stripping topsoil from the area to receive pavement and scarifying the upper 12 inches, moisture conditioning the soil, and compacting the native soils to at least 95 percent relative compaction.

TABLE 10
Preliminary Pavement Thicknesses
Preliminary Geotechnical Design Memorandum – Mariposa Energy Project

Traffic Index	Asphalt Concrete (Type B) (feet)	Aggregate Base (Class 2) (feet)
5.5	0.25	0.90
7	0.35	1.20
9	0.45	1.65

Detention Basin

A detention basin is planned at the northwestern corner of the site, located at the toe of the planned equipment pad. The planned basin floor elevation is 107 feet msl, which is approximately 5 feet lower than the existing ground surface near the basin discharge point. Test Pit TP-5, located on the western slope, encountered weathered sandstone (sand) at a depth of 4.5 feet bgs. This may indicate that the proposed detention basin will introduce water to the sandstone layer causing water to leak from the basin. As overall basin leakage is not a general concern, except in as far as the potential for piping of fines through sand layers, it is recommended to incorporate a cutoff collar into the discharge piping to reduce the risk of seepage around the planned pipe.

The basin should be constructed of native materials with in excess of 30-percent clay fines to reduce seepage losses.

Construction Considerations

The ground surface elevation for the proposed site pad is approximately 125 feet msl. At this elevation, the western side of the pad will be on clay soils and the eastern side will be over bedrock.

The soils beneath the site should be excavatable with an excavator of 200 horsepower, with the exception of the layers of andesite and conglomerate encountered at depth. However, the depth of these identified layers and the northeastern dip of the bedrock would suggest that the same layers would be below the proposed cut on the eastern side of the site. Regardless, it is recommended to drill additional borings on the east side to verify that these layers will not complicate excavation of the proposed cut.

Sandy site soils exposed in cut and fill slopes should be protected from erosion and revegetated as soon as possible because these soils will likely be prone to erosion.

For the proposed improvements, it is the responsibility of the contractor to implement sound construction methods and procedures in accordance with local, state, and federal safety standards. Variations in soil and geologic conditions are possible and may be encountered during construction. To permit correlation between the exploration data and the actual conditions encountered during construction, a qualified geotechnical specialist should provide onsite review, as needed, during construction. If unusual conditions are encountered, a geotechnical engineer should be consulted to determine if revisions to the recommendations are needed. It is recommended that a qualified geotechnical specialist, engineer, or engineering geologist inspect the excavation and subgrade preparation to observe the nature of the materials encountered and to verify the adequacy of the subgrade. Compaction testing and periodic fill observations should be performed during placement of engineered fill.

Recommendation for the Final Geotechnical Investigation

As stated in CH2M HILL's original proposal dated January 23, 2009, the following primary issues are to be addressed in the final design geotechnical investigation:

- Nature and strength of native soils beneath specific planned facilities and improvements
- Parameters necessary for civil earthwork calculations
- Recommendations for final design of deep and/or shallow foundations
- Earthwork values necessary for final design of on-and offsite utilities such as gas and water
- Recommendations for design of electric transmission towers
- Recommendations for design of site access and onsite access roads

The following specific topics require additional investigation and analysis based on the findings of the preliminary geotechnical design effort:

1. Contribution of nearby Midway Fault to the site seismicity
2. Swell or settlement potential of site soils, bedrock, and fill derived from the same materials
3. Potential presence of hard andesite and conglomerate in the eastern cut slope

Site Investigation

The final design investigation is planned to provide specific information necessary for final design of the project and to allow ME to obtain necessary construction permits.

Based on the preliminary design and with specific attention to the final design layout of the facilities and proximity to existing subsurface data, three soil borings and six test pits will be completed across the site to obtain samples for laboratory testing and to investigate deep subsurface conditions, and up to 10 soil borings and four test pits will be completed at the locations of transmission towers and along the gas pipeline. One of the 13 borings will be 100 feet deep, two borings will be 25 feet deep, and the remaining borings will be 50 feet deep. The borings will be completed at the specific locations of final design facilities such as the office building, turbines, transmission towers, pipeline, and inlet air cooling facilities.

Down-hole measurements of seismic shear wave velocity will be obtained at one of the boring locations to a depth of 100 feet in order to assess the potential for vibration-induced settlement and to confirm the estimated shear wave velocity at the site. A CH2M HILL geotechnical or geologic professional will log the conditions observed in the borings and will obtain samples suitable for laboratory testing.

Laboratory Testing

The assumed testing plan based on the investigation outlined above is provided in Table 11.

TABLE 11
Final Design Laboratory Testing Plan
Preliminary Geotechnical Design Memorandum – Mariposa Energy Project

Test	Standard	Frequency
Corrosivity	CAL 643, 417, and 422	4
Gradation	ASTM D422	20
Atterberg Limits	ASTM D2216 and D4318	20
In situ Unit Weight and Moisture Content	ASTM D2937	10
Swell/Collapse Potential	ASTM D4546	5
Direct Shear	ASTM D3080	15
Unconfined Compressive Strength	ASTM D2166	10

Final Design Geotechnical Memorandum

CH2M HILL will prepare a final design memorandum that will discuss the implemented field and laboratory testing programs and present the findings. A fee estimate for the final scope of work will be provided to ME in a separate letter. The report will address the following issues:

- Seismic design criteria using CBC 2007
- Foundation design for facilities (tanks, cooling facilities, office, transmission towers, stacks, and turbines)

- Nature and strength of native soils beneath specific planned facilities and improvements
- Corrosion design considerations
- Parameters necessary for civil earthwork calculations
- Recommendations for design of deep and/or shallow foundations
- Recommendations for design of the detention basin
- Earthwork values necessary for design of onsite utilities and offsite gas and water lines
- Recommendations for design of site access and onsite access roads
- Earth pressures for retaining wall and belowgrade facility design
- Swell potential of the native materials and the moisture-conditioned blend of the mudstone, sandstone, and clays.
- Detailed settlement/swell analysis depending on the final layout of improvements.
- Confirmation of the seismic shear wave velocity of the soils and bedrock beneath the site.
- Probabilistic analysis of the site seismicity in consideration of the Midway Fault

Limitations

This memorandum has been prepared for the exclusive use of ME and CH2M HILL for specific application to the design of the improvements at the Mariposa Energy Project in Alameda County, California. It has been prepared in accordance with generally accepted geotechnical engineering practice. No other warranty, expressed or implied, is made.

The analyses and recommendations contained in this memorandum are based on the data obtained from exploratory borings and test pits for the proposed facility. These explorations indicate subsurface conditions only at specific locations and times, and only to the depths penetrated. They do not necessarily reflect strata variations that may exist between such locations. Subsurface conditions and water levels at other locations may differ from conditions occurring at these locations. The passage of time may result in a change in the conditions at these locations. If variations in subsurface conditions from those described are noted during construction, recommendations in this memorandum must be reevaluated.

In the event that any changes in the nature, design, or location of the facilities are planned, the conclusions and recommendations contained in this memorandum should not be considered valid unless the changes are reviewed and conclusions of this memorandum modified or verified in writing by CH2M HILL. CH2M HILL is not responsible for any claims, damages, or liability associated with the interpretations of subsurface data or reuse of the subsurface data or engineering analyses without the express written authorization of CH2M HILL.

References

Alameda County Public Works Agency, 2008, Engineering Design Guideline for Unincorporated Alameda County, Hayward, CA.

Association Engineering Geologists. 2005. An Updated Characterization of the Midway Fault, Alameda County, California. San Francisco Section Newsletter, February 2005.

Blake, T. 2004. EQFAULT V. 3.00b. Thomas F. Blake Computer Services and Software, Thousand Oaks, CA.

California Department of Transportation (Caltrans). 2003. California Department of Transportation Division of Engineering Services—Materials Engineering and Testing Services, Corrosion Technology Branch. Corrosion Guidelines. Version 1.0. September.

California Department of Transportation (Caltrans). 2009. CalFP Version 1.1

California Geological Survey (CGS). 2002. Probabilistic Seismic Hazard Assessment Maps (probabilistic site hazard analysis) http://www.conservation.ca.gov/cgs/rghm/psha/index.htm.

Hart, E. and W. A. Bryant. 1999. Fault-Rupture Hazard Zones in California (Alquist-Priolo Special Studies Zones Act of 1972 with Index to Special Studies Zones Maps), *California Division of Mines and Geology Special Publication 42*, Revision 2.

International Conference of Building Officials (ICBO). 2002. *Uniform Building Code*.

O'Neil, M.W., and N. Poormoayed. 1980. Methodology for Foundations on Expansive Clays. *Journal of Geotechnical Engineering Division,* American Society of Civil engineers, Vol. 106, No. GT12, pp. 1345-1367.

Robertson, S., Roberts, M., and Brennan, E. 1997. Landslides In Alameda County, California, A Digital Database Extracted from Preliminary Photointerpretation Maps Of Surficial Deposits By T.H. Nilsen Inusgs Open-File Report 75-277. United States Geological Survey. Open-File Report 99-504.

Rocscience. 2009. Slide 5.039. Toronto, Ontario

Seed, R.B., H.O. Cetin, R.E.S. Moss, A.M. Kammerer, J. Wu, J.M. Pestana, and M.F. Riemer. 2001. *Recent Advances in Soil Liquefaction Engineering and Seismic Site Response Evaluation*. Proceedings of the Fourth International Conference on Recent Advances in Geotechnical Earthquake Engineering and Soil Dynamics and Symposium in Honor of Professor W.D. Liam Finn. San Diego, CA. March.

Sowers, G. 1979. *Introductory Soil Mechanics and Foundations*. Fourth Edition. Prentice Hall. May.

United States Geological Survey (USGS). 1996. Preliminary Geologic Map Emphasizing Bedrock Formations in Alameda County, California. File Report 96-252

United States Geological Survey (USGS). 2002. National Seismic Hazard Maps Fault Parameters, Quaternary Fault and Fold Database of the United States http://earthquake.usgs.gov/regional/qfaults. Website accessed November 2006.

United States Geological Survey (USGS). 2005. Conterminous U.S., Gridded Data Values 2002, revised October 2003 and Interactive Deaggregation. USGS website, http://earthquake.usgs.gov/research/hazmaps/interactive/index.php. Website accessed April 2009.

United States Geological Survey (USGS). 2006. USGS Susceptibility Map of the San Francisco Bay Area, San Francisco Bay Region Geology and Geologic Hazards. USGS website, http://geomaps.wr.usgs.gov/sfgeo/liquefaction/susceptibility.html. Website accessed April 2009.

United States Geological Survey (USGS). 2008a. National Seismic Hazard Maps. http://gldims.cr.usgs.gov/nshmp2008/viewer.htm

United States Geological Survey (USGS). 2008b. Earthquake Ground Motion Parameter Calculator, Version 5.0.9, Dated 10/06/2008, http://earthquake.usgs.gov/research/hazmaps/design/

Unruh, J., and K. Krug. 2007. Assessment and Documentation of Transpressional Structures, Northeastern Diablo Range, for Quaternary Fault Map Database: Collaborative Research with William Lettis & Associates, Inc and the U.S. Geological Survey. Award Number 06HQGR0139.

Wagner D.L., E. J. Bortugno, and R.D McJunkin. 1990. Geologic map of the San Francisco-San Jose Quadrangle. California Department of Conservation. Division of Mines and Geology. Map No. 5A.

Wesnousky, S. G. 1986. Earthquakes, Quaternary Faults and Seismic Hazard in California, *Journal of Geophysical Research*, Vol. 91, No. B12, pp. 12,587-12,631.

Figures

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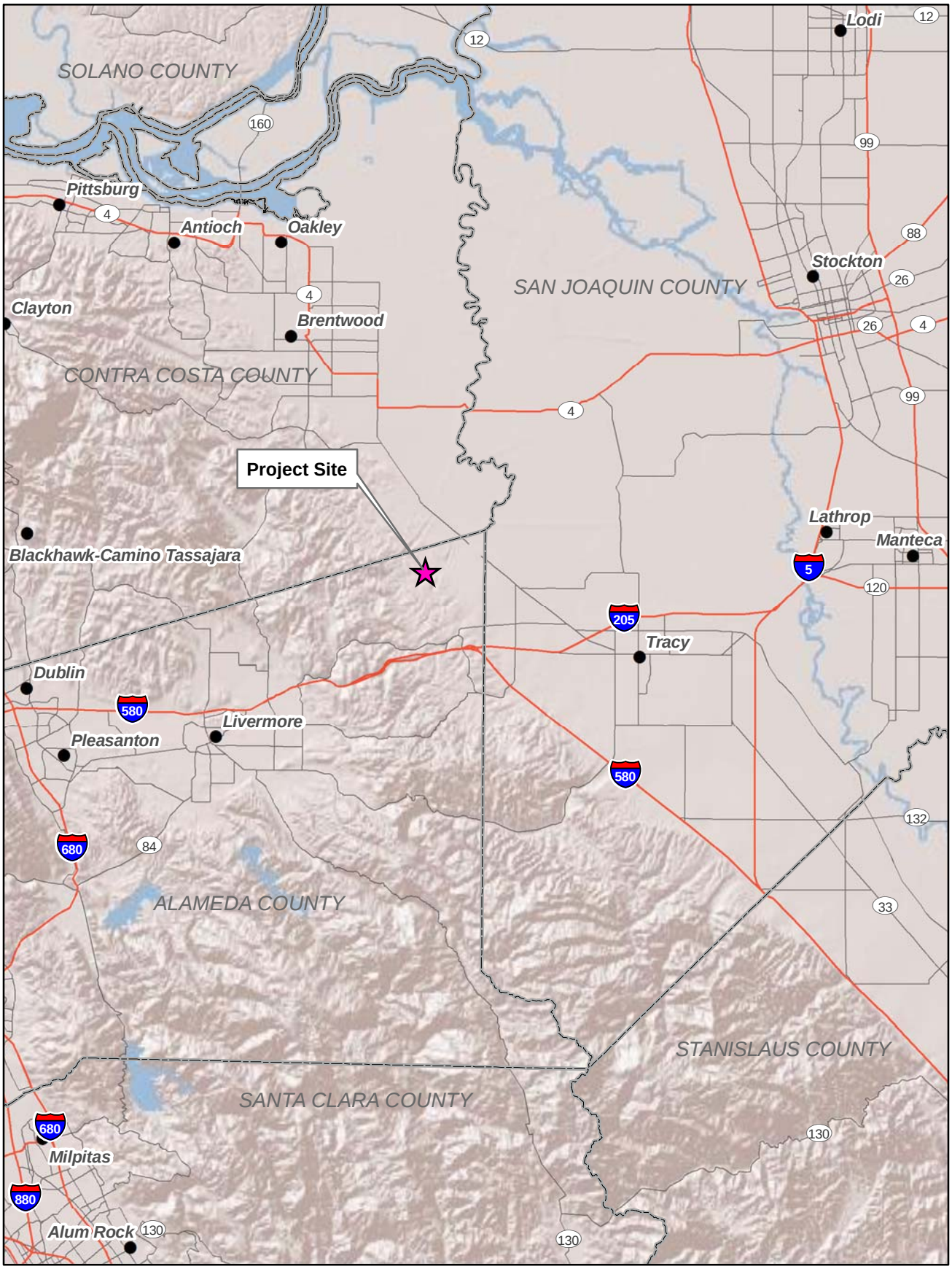

LEGEND

PROJECT SITE

COUNTY BOUNDARIES

N

0 3 6

Miles

FIGURE 1
PROJECT VICINITY
MARIPOSA ENERGY PROJECT
ALAMEDA COUNTY, CALIFORNIA

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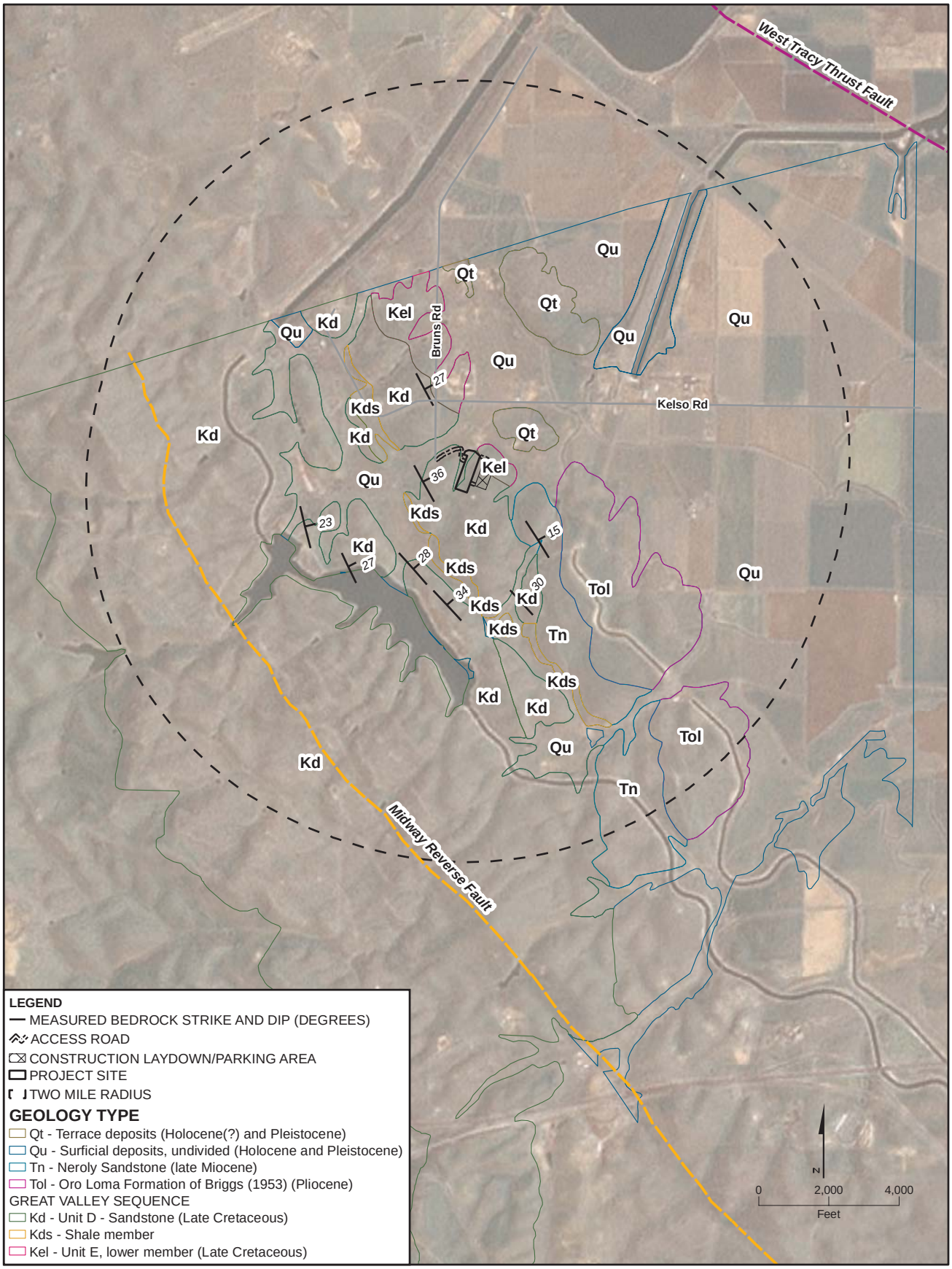

NOTE: ORIGINAL FIGURE REPRODUCED IN COLOR

Sources:
Faults: Unruh & Krug, 2007; USGS 1996a
Geology: U.S. Dept of the Interior, USGS, 1996b

This map was compiled from various scale source data and maps and is intended for use as only an approximate representation of actual locations.

FIGURE 2
GEOLOGIC MAP
MARIPOSA ENERGY PROJECT
ALAMEDA COUNTY, CALIFORNIA

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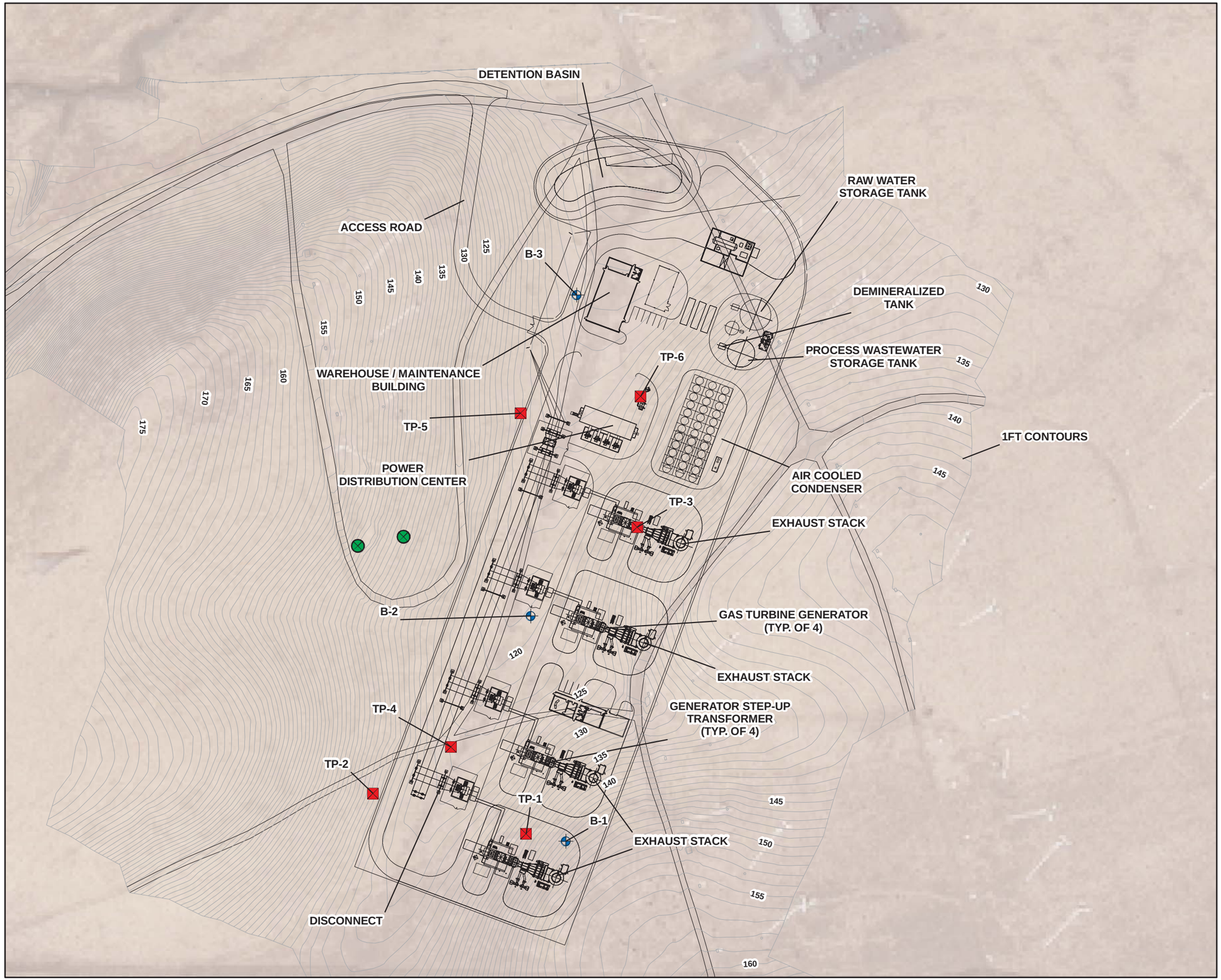

LEGEND

- APPROXIMATE SOIL BORING LOCATIONS
- EXISTING TURBINE FOUNDATIONS
- APPROXIMATE TEST PIT LOCATIONS

This map was compiled from various scale source data and maps and is intended for use as only an approximate representation of actual locations.

N

0 75 150
Feet

FIGURE 3
SITE PLAN
MARIPOSA ENERGY PROJECT
ALAMEDA COUNTY, CALIFORNIA

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ATTACHMENT 1

Project Boring and Test Pit Logs

SOIL BORING LOG LEGEND

DRILLING AND SAMPLING ABBREVIATIONS

SAMPLES:
BU: BULK SAMPLE
MC: MODIFIED CALIFORNIA SPLIT SPOON SAMPLE
SS: SPLIT SPOON SAMPLE

UNITS AND COMMENTS:
(B): BOTTOM
(T): TOP
NP: NOT PLASTIC
NV: NOT VALID
PCF: POUNDS PER CUBIC FOOT
PPM: PARTS PER MILLION
PSF: POUNDS PER SQUARE FOOT
TSF: TONS PER SQUARE FOOT

LABORATORY TESTING:
CL: CHLORIDE (ASTM D512)
CONSOL: ONE-DIMENSIONAL CONSOLIDATION (ASTM D2435)
EI: EXPANSION INDEX (ASTM D4829)
LL: LIQUID LIMIT, ATTERBERG LIMITS (ASTM D4318)
P200: PERCENT FINES, SMALLER THAN NO. 200 SIEVE
PI: PLASTICITY INDEX, ATTERBERG LIMITS (ASTM D4318)
R-VALUE: (ASTM D2844)
RES: RESISTIVITY (ASTM D1125)
SO4: SULPHATE (ASTM D516)
UCS: UNCONFINED COMPRESSIVE STRENGTH (ASTM D1633)
UWD: DRY UNIT WEIGHT (ASTM D2937)
WC: WATER (MOISTURE) CONTENT (ASTM D2216)

FIELD TESTING:
PP: UNCONFINED COMPRESSION FROM A POCKET PENETROMETER (TSF)
TORVANE: UNDRAINED SHEAR STRENGTH FROM A TORVANE DEVICE (TSF)

SPT N-VALUE (BLOWCOUNTS): THE NUMBER OF BLOWS REQUIRED TO DRIVE THE STANDARD 2-INCH O.D. SPLIT-SPOON SAMPLER (SS) 12 INCHES BEYOND THE FIRST 6 INCH INTERVAL. OF AN 18 INCH DRIVE WITH A 140 LB HAMMER FALLING 30 INCHES. THE BLOWCOUNT VALUES PROVIDED ON THE LOGS HAVE NOT BEEN CORRECTED.

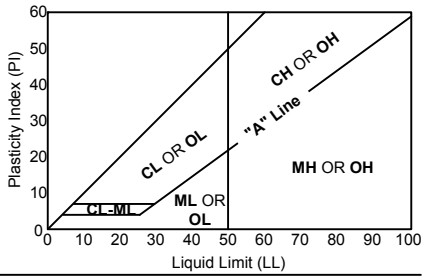
WATER LEVELS:

WATER LEVELS INDICATED ON THE BORING LOGS ARE THE LEVELS MEASURED IN THE BORINGS AT THE TIMES INDICATED. GROUNDWATER LEVELS AT OTHER TIMES AND OTHER LOCATIONS ACROSS THE SITE COULD VARY. THE ACCURACY OF THE GROUNDWATER LEVEL READINGS IS BASED ON THE TYPE OF SOIL AND THE PERIOD OF OBSERVATION.

SOIL CLASSIFICATION

ASTM STANDARD: THE SOIL CLASSIFICATIONS ON THE LOGS ARE BASED ON THE UNIFIED SOIL CLASSIFICATION SYSTEM (USCS), AND ARE IN GENERAL ACCORDANCE WITH ASTM D2488, *VISUAL-MANUAL PROCEDURE FOR DESCRIPTION OF SOILS* AND ASTM D2487, *CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES*. SEE THE ASTM STANDARD FOR A COMPLETE DESCRIPTION, SELECT SUMMARY OF THE CLASSIFICATIONS PROVIDED BELOW.

FINE-GRAINED SOILS (SILTS, CLAYS, ORGANICS): MORE THAN 50% BY WEIGHT SMALLER THAN THE NO. 200 SIEVE.
LOW-PLASTICITY (LEAN CLAY OR SILT): LIQUID LIMIT LESS THAN 50
HIGH- PLASTICITY (FAT CLAY OR ELASTIC SILT): LIQUID LIMIT GREATER THAN 50
SILT: PLASTICITY INDEX BELOW "A" LINE
CLAY: PLASTICITY INDEX ABOVE "A" LINE
WITH SAND OR WITH GRAVEL: WHEN 15% OR MORE BUT LESS THAN 30% SAND OR GRAVEL
SANDY OR GRAVELLY: WHEN 30% OR MORE SAND OR GRAVEL



CONSISTENCY OF COARSE-GRAINED SOILS (AFTER SOWERS, 1979):

SPT N-VALUE	CONSISTENCY	PP (TSF)	TORVANE (TSF)	FIELD TEST
<2	VERY SOFT	<0.25	<0.12	EASILY PENETRATED SEVERAL INCHES BY FIST
2-4	SOFT	0.25 TO 0.50	<0.12 TO 0.25	EASILY PENETRATED SEVERAL INCHES BY THUMB
5-8	FIRM	0.50 TO 1.0	0.25 TO 0.50	MODERATE EFFORT TO PENETRATE WITH THUMB
9-15	STIFF	1.0 TO 2.0	0.50 TO 1.0	INDENTED BY THUMB BUT DIFFICULT TO PENETRATE
16-30	VERY STIFF	2.0 TO 4.0	1.0 TO 2.0	READILY INDENTED BY THUMBNAIL
>30	HARD	>4.0	>2.0	INDENTED WITH DIFFICULTY BY THUMBNAIL

COARSE-GRAINED SOILS (SANDS, GRAVELS, COBBLES, BOULDERS): MORE THAN 50% BY WEIGHT RETAINED ON THE NO. 200 SIEVE.
WELL-GRADED: WIDE RANGE OF PARTICLE SIZES AND SUBSTANTIAL AMOUNTS OF INTERMEDIATE SIZES
POORLY-GRADED: PREDOMINATELY ONE SIZE, OR A WIDE RANGE MISSING THE INTERMEDIATE SIZES
BOULDER: OVER 12 INCH
COBBLE: 3 TO 12 INCH
GRAVEL: #4 SIEVE (4.75 MM) TO 3 INCH
SAND: #200 SIEVE (0.075 MM) TO #4 SIEVE (4.75 MM)
WITH SILT OR WITH CLAY: WHEN 5% OR MORE BUT 12% OR LESS SILT OR CLAY
SILTY OR CLAYEY: WHEN MORE THAN 12% SILT OR CLAY
CONSISTENCY OF COARSE-GRAINED SOILS (AFTER SOWERS, 1979):

SPT N-VALUE	RELATIVE DENSITY	FIELD TEST WITH ½-INCH STEEL ROD
0-4	VERY LOOSE	EASILY PENETRATED PUSHED BY HAND
5-10	LOOSE	EASILY PENETRATED PUSHED BY HAND
11-30	MEDIUM	EASILY PENETRATED WITH 5-LB HAMMER
31-50	DENSE	PENETRATED 1 FOOT WITH 5-LB HAMMER
>50	VERY DENSE	PENETRATED ONLY A FEW INCHES WITH 5-LB HAMMER

ASTM. American Society of Testing and Materials.
Sowers, 1979. *Introductory Soil Mechanics and Foundation: Geotechnical Engineering*. 4th Edition, Macmillan, New York.

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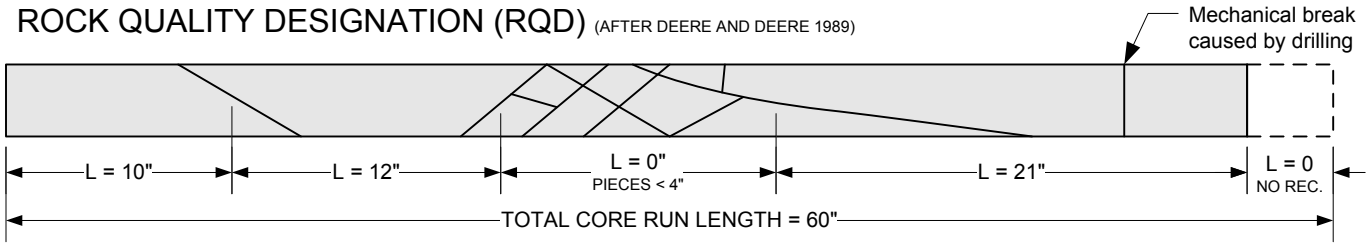
ROCK CORE LOG LEGEND

ROCK QUALITY DESIGNATION (RQD) (AFTER DEERE AND DEERE 1989)

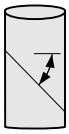


$$RQD = \frac{\sum \text{LENGTH OF SOUND CORE PIECES LONGER THAN 4" (100mm)}}{\text{TOTAL CORE RUN LENGTH}} = \frac{10+12+21}{60} = 72\%$$

RQD	DESCRIPTION OF ROCK QUALITY
0-25%	VERY POOR
25-50%	POOR
50-75%	FAIR
75-90%	GOOD
90-100%	EXCELLENT

DISCONTINUITY ORIENTATION

DISCONTINUITY ANGLES ARE MEASURED FROM THE HORIZONTAL.



TEXTURE OR GRAIN SIZE

(AFTER CORE LOGGING COMMITTEE 1978)

DESCRIPTIVE TERM	DEFINING CHARACTERISTICS
FINE-GRAIN	AVG GRAIN SIZE UP TO 0.05 INCH
MEDIUM-GRAIN	AVG GRAIN SIZE FROM 0.05 TO 0.2 INCH
COARSE-GRAIN	AVG GRAIN SIZE GREATER THAN 0.2 INCH

WEATHERING (AFTER ASCE 1976)

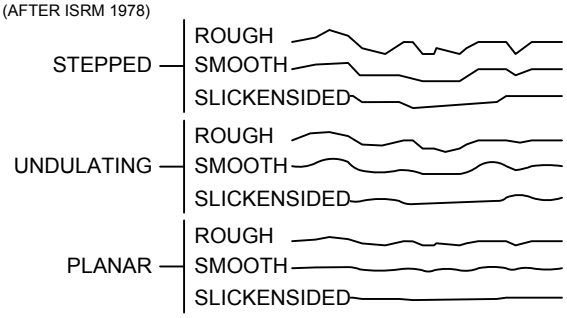
DESCRIPTIVE TERM	DEFINING CHARACTERISTICS
FRESH	ROCK AND DISCONTINUITIES ARE UNSTAINED.
SLIGHTLY	DISCONTINUITIES SHOW SOME STAINING ON SURFACE, BUT DISCOLORATION DOES NOT PENETRATE INTO THE MASS.
MODERATE	DISCONTINUITY SURFACES ARE STAINED AND DISCOLORATION EXTENDS INTO THE ROCK MASS.
HIGHLY	INDIVIDUAL ROCK FRAGMENTS ARE THOROUGHLY STAINED. FELDSPARS HAVE MOSTLY ALTERED TO CLAYS. ROCK IS BEGINNING TO TAKE ON SOIL CHARACTERISTICS.

JOINT AND BEDDING SPACING (AFTER ASCE 1976)

SPACING	JOINTS	BEDDING/FOLIATION
< 0.5 IN		LAMINATED
0.5 IN - 2 IN	VERY CLOSE	VERY THIN
2 IN - 1 FT	CLOSE	THIN
1 FT - 3 FT	MODERATELY CLOSE	MEDIUM
3 FT - 10 FT	WIDE	THICK
> 10 FT	VERY WIDE	VERY THICK (MASSIVE)

ROUGHNESS AND PLANARITY

(AFTER ISRM 1978)



HARDNESS RATING (AFTER ASCE 1976 AND ISRM 1981)

GRADE	DESCRIPTION	FIELD IDENTIFICATION
R0	EXTREMELY SOFT	CAN BE INDENTED BY FINGERNAIL.
R1	VERY SOFT	CRUMBLES UNDER FIRM BLOWS OF GEOLOGIC PICK, CAN BE PEELED BY A POCKET KNIFE, SCRATCHED WITH A FINGERNAIL.
R2	SOFT	SHALLOW INDENTATIONS MADE BY FIRM BLOW OF GEOLOGIC PICK, CAN BE PEELED WITH DIFFICULTY AND SCRATCHED BY A KNIFE.
R3	MEDIUM HARD	CAN BE FRACTURED WITH A SINGLE FIRM BLOW OF GEOLOGIC PICK HAMMER END, CANNOT BE PEELED AND DIFFICULT TO SCRATCH WITH A KNIFE.
R4	HARD	REQUIRES MORE THAN ONE BLOW WITH GEOLOGIC PICK HAMMER END TO FRACTURE, DIFFICULT TO SCRATCH WITH KNIFE.
R5	VERY HARD	REQUIRES MANY BLOWS WITH GEOLOGIC PICK HAMMER END TO FRACTURE, CANNOT BE SCRATCHED WITH KNIFE.
R6	EXTREMELY HARD	CAN ONLY BE CHIPPED WITH GEOLOGIC PICK.

ASCE, 1976. "Subsurface Investigation for Design and Construction of Foundations and Buildings." *ASCE Manual on Engineering Practice*. No. 56, p. 53.
Core Logging Committee (South Africa Section, AEG), 1978. "A Guide to Core Logging for Rock Engineering." *Bull. of the Assoc. of Engr. Geologists*. Vol. 15, No. 3. pp. 295-328.
Deere, D.U. and Deere, D.W., 1989. *Rock Quality Designation (RQD) after Twenty Years*. US Army Corp of Engr, Waterway Experiment Station. Contract Report GL-89-1.
ISRM, 1978. "Commission on Standardization of Laboratory and Field Tests." ISRM. *Inter. Jour. of Rock Mech. and Mineral Sciences and Geomech. Abstracts*. Vol. 15, pp 319-368.
ISRM, 1981. *Rock Characterization, Testing, and Monitoring: Suggested Method for Determination of Uniaxial Compressive Strength of Rock Materials*. International Society for Rock Mechanics. Pregamon Press, London, U.K.

CH2MHILL

PROJECT NUMBER:	BORING NUMBER:
386247.01.FI	B-1 SHEET 1 OF 2

SOIL BORING LOG

PROJECT : Mariposa Energy Project, East Alameda County, CA
LOCATION : (2111298.8 N, 6243298.0 E)

ELEVATION : 144.0 ft NAD83
DRILLING CONTRACTOR : V and W Drilling

DRILLING EQUIPMENT AND METHOD: CME 850 Wire Line Rig with Automatic Hammer, 8-inch Hollow Stem Auger

WATER LEVELS : NA
START : 2/24/09 08:40
END : 2/24/09 11:10
LOGGER : T. CHAKURIAN

DEPTH BELOW GROUND SURFACE (ft)	INTERVAL (ft)	RECOVERY (ft)	#TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
	0.0 – 1.5		1-SS	2-2-2 (4)	LEAN CLAY (CL), very dark grayish brown, (10YR 3/2), damp, medium plasticity, not dilation, weak cementation, roots, soft	SS-1-B1-0 at 08:40 PP=1.25 tsf, WC =23.6%, P200=63.3%, LL=40, PI =22
5	5.0 – 6.5		2-MC	35-38-40 (78)	WEATHERED SANDTONE with interbedded mudstone, yellow (10YR 7/6), fine grained cemented, iron oxide staining, weak to moderately	MC-2-B1-5 at 09:00 WC=12.3%, P200=27.1%
	6.5 – 8.0		3-SS	10-10-16 (26)	same as above	SS-3-B1-6.5 at 09:05
10	10.0 – 11.3		4-SS	35-40-50/3" (90/9")	same as above	MC-4-B1-10 at 09:15
	11.5 – 12.5		5-SS	39-50/6" (50/6")	same as above	SS-5-B1-11.5 at 09:20
15	15.0 – 16.5		6-SS	37-39-48 (87)	same as above. yellowish brown (10YR 5/4)	SS-6-B1-15 at 09:25 WC=10.1%, P200=59.9%
20	20.0 – 20.5		7-MC	50/6" (50/6")	WEATHERED SANDTONE, very pale brown (10YR 8/3), fine to medium grained sand with rounded quartz, weakly to moderately cemented.	MC-7-B1-20 at 09:35 WC=7.9%, P200=50.5%
	21.5 – 21.8		8-SS	50/3" (50/3")	same as above, very pale brown, 10YR 7/3	SS-8-B1-21.5 at 09:40, hard drilling from 22.5 ft to 23 ft. gravel to cobbles in cuttings. soft drilling at 23 ft. LL=NV, PI=NP
25	25.0 – 25.5		9-SS	50/6" (50/6")	WEATHERED SANDTONE with interbedded mudstone, light yellowish brown 10YR 6/4, fine grained sand with rounded quartz, weakly to moderately cemented	SS-9-B1-25 at 10:00 mudstone gravel in cuttings from 27 fto to 27.5 ft
30						soft drilling at 29 ft

PROJECT NUMBER:	BORING NUMBER:
386247.01.FI	B-1 SHEET 2 OF 2

SOIL BORING LOG

PROJECT : Mariposa Energy Project, East Alameda County, CA
LOCATION : (2111298.8 N, 6243298.0 E)

ELEVATION : 144.0 ft NAD83
DRILLING CONTRACTOR : V and W Drilling

DRILLING EQUIPMENT AND METHOD: CME 850 Wire Line Rig with Automatic Hammer, 8-inch Hollow Stem Auger

WATER LEVELS : NA
START : 2/24/09 08:40
END : 2/24/09 11:10
LOGGER : T. CHAKURIAN

DEPTH BELOW GROUND SURFACE (ft)	INTERVAL (ft)	RECOVERY (ft)	#TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
	30.0 – 31.5		10-MC	19-36-44 (80)	same as above. iron oxide staining	MC-10-B1-30 at 10:25 PP=4.5 tsf (B), PP=3.25 tsf (T), WC=19.6%, UWD=101.5 pcf, ucs=2376 PSF
	31.5 – 32.5		11-SS	37-50/6" (50/6")	same as above. brownish yellow (10YR 6/6)	SS-11-B1-31.5 at 10:30
35	35.0 – 35.9		12-SS	32-50/5" (50/5")	same as above. very pale brown (10YR 7/3), less weathered, laminated bedding.	SS-12-B1-35 at 10:45
40	40.0 – 41.2		13-MC	24-37-50/2" (87/8")	same as above. dark gray (10YR 4/1), relatively unweathered, biotite grains visible, no laminated bedding.	MC-13-B1-40 at 11:05 WC=15%, UWD=119 pcf, P200=87.7%
	41.5 – 42.0		14-SS	50/6" (50/6")	same as above.	SS-14-B1-41.5 at 11:10, TD is 41.5 FT
					Bottom of Hole at 41.5 ft bgs -	
45						
50						
55						
60						

PROJECT NUMBER:	BORING NUMBER:
386247.01.FI	B-2 SHEET 1 OF 5

SOIL BORING LOG

PROJECT : Mariposa Energy Project, East Alameda County, CA
LOCATION : (2111636.9 N, 6243245.3 E)

ELEVATION : 119.0 ft NAD83
DRILLING CONTRACTOR : V and W Drilling

DRILLING EQUIPMENT AND METHOD: CME 75 Wire Line Rig with Automatic Hammer, Mud Rotary with 4 5/8 drill bit

WATER LEVELS : ---
START : 2/25/09 08:43
END : 2/25/09 17:30
LOGGER : T. CHAKURIAN

DEPTH BELOW GROUND SURFACE (ft)	INTERVAL (ft)	RECOVERY (ft)	#TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
0.0	1.5		23-SS	3-3-5 (8)	LEAN CLAY (CL), very dark grayish brown (10YR 3/2), damp, medium plasticity, no dilatancy, weak cementation, roots, firm	SS-23-B2-0 at 08:43 PP=1.75 tsf
5	5.0					
5.0	6.5		24-MC	13-18-21 (39)	SANDY FAT CLAY (CH), dark yellowish brown 10 YR 4/4; high plasticity, not dilatancy, strong cementation, fine gravel, fine sand, hard clay	MC-24-B2-6 at 09:05 PP>4.5 tsf (B), PP=0.5 tsf (T), WC=14.4%, UWD=105.5 pcf, ucs=14305 psf, Swell Press.=3,650 psf, Swell=1.7%
6.5	8.0		25-SS	8-9-10 (19)	LEAN CLAY (CL). dark yellowish brown (10 YR 4/6), no gravel, very stiff	SS-25-B2-6.5 at 09:10 PP>4.5 tsf, WC=11.9%, UWD=101.7 pcf, P200=71.4, EI=93, LL=41, PI=27
10	10.0					
10.0	11.5		26-SS	6-9-10 (19)	WEATHERED MUDSTONE, pale brown 10YR 6/3. weakly cemented	SS-26-B2-10 at 09:20 PP=2.0 tsf
15	15.0					Res= 990 ohm-cm, pH=7.62, Cl=45.5, SO4=64.5
15.0	16.5		27-MC	10-10-15 (25)	WEATHERED SANDSTONE with interbedded mudstone, yellowish brown 10YR 5/4, fine grained sand with rounded quartz, weak to moderately cemented, iron oxide	MC-27-B2-15 at 09:25
16.5	18.0		28-SS	7-7-8 (15)	same as above, brown 10YR 6/4, fine to medium grained sand	SS-28-B2-16.5 at 09:30
20	20.0					
20.0	21.0		29-SS	27-50/6" (50/6")	same as above, yellow 10YR 7/6, fine to coarse sand, fine subrounded gravel	SS-29-B2-20 at 09:40 PP=2.75 tsf, P200=40.8%
25						

PROJECT NUMBER:	BORING NUMBER:
386247.01.FI	B-2 SHEET 2 OF 5

SOIL BORING LOG

PROJECT : Mariposa Energy Project, East Alameda County, CA
LOCATION : (2111636.9 N, 6243245.3 E)

ELEVATION : 119.0 ft NAD83
DRILLING CONTRACTOR : V and W Drilling

DRILLING EQUIPMENT AND METHOD: CME 75 Wire Line Rig with Automatic Hammer, Mud Rotary with 4 5/8 drill bit

WATER LEVELS : ---
START : 2/25/09 08:43
END : 2/25/09 17:30
LOGGER : T. CHAKURIAN

DEPTH BELOW GROUND SURFACE (ft)	INTERVAL (ft)	RECOVERY (ft)	#TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
	25.0–26.5		30-MC	21-28-34 (62)	same as above, gray 10YR 5/1, relatively unweathered, biotite grains visible, laminated bedding, fine to medium grained sand	MC-30-B2-25 at 09:55
	26.5–28.0		31-SS	12-16-20 (36)	same as above, dark gray 10YR 4/1	SS-31-B2-26.5 at 10:00 PP=3.5 tsf
30	30.0–31.0		32-SS	29-50/6" (50/6")	same as above, moderately to strongly cemented	SS-32-B2-30 at 10:30 PP=3.5 tsf
	33.0–33.4		33-MC	50/5" (50/5")	same as above, weak to moderately cemented	MC-33-B2-35 at 10:45
35	34.5–34.8		34-SS	50/3" (50/3")	same as above Begin Rock Coring at 34.8 ft below ground surface See the next sheet for the rock core log	SS-34-B2-36.5 at 10:50. hard drilling at 35 ft, unable to drill further with mud rotary, switch to rock coring. logging continues on rock core log.
40						
45						
50						

PROJECT NUMBER:	BORING NUMBER:
386247.01.FI	B-2 SHEET 3 OF 5

ROCK CORE LOG

PROJECT : Mariposa Energy Project, East Alameda County, CA
LOCATION : (2111636.9 N, 6243245.3 E)

ELEVATION : 119.0 ft NAD83
DRILLING CONTRACTOR : V and W Drilling

CORING METHOD AND EQUIPMENT : CME 75 Wire Line Rig with Automatic Hammer, Mud Rotary with 4 5/8 drill bit
ORIENTATION :

WATER LEVELS : ---
START : 2/25/09 08:43
END : 2/25/09 17:30
LOGGER : T. CHAKURIAN

DEPTH BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	R Q D (%)	FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, WEATHERING, HARDNESS, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
84.0	34.8 / 35.0		>10	35.2' - 35.3' highly fractured		34.8' ANDESITE DIKE, gray (10YR 6/1), crystalline, aphanitic, fine grained quartz, biotite, plagioclase, unaltered, veinlets, localized hydrothermal attenuation	encounter core at 34.8 ft
				35.7' - 35.8' highly fractured			
			1				
	2-HQ 5 ft 80%	50	1	37.65' - 40' highly fractured		35.2' SANDSTONE with interbedded mudstone, dark gray, (10YR 4/6), fine grained sand with rounded quartz and biotite, moderately cemented	
			>10				
			>10			35.65' - 35.8' ANDESITE DIKE, gray (10YR 6/1), crystalline, aphanitic, fine grained quartz, biotite and plagioclase unaltered	
40 / 79.0	40.0						
			>10			35.8' SANDSTONE with interbedded mudstone, dark gray (10YR 4/1), fine grained sand with biotite and rounded quartz, moderately cemented.	
			3				
	3-HQ 5 ft 100%	83	2				
			1			37.65' ANDESITE DIKE, gray (10YR 6/1), crystalline, fine to coarse grained quartz, biotite and plagioclase unaltered	
			1				
45 / 74.0	45.0					39.2' SANDSTONE with interbedded mudstone, dark gray (10YR 4/1), fine grained sand with biotite and rounded quartz, moderately cemented	P200=69.6%
			1				
			3			same as above	
	4-HQ 5 ft 100%	78	>10				
			1				
			>10	49' - 49.3' highly fractured			
50 / 69.0	50.0						
			0				
			0				
	5-HQ 5 ft 100%	97	2				
			0				
			0	54.1' - 54.7' highly fractured			
55 / 64.0	55.0					54.7' - 55' laminated bedding	
			1			55' massive bedding	
			1				
	6-HQ 5 ft 91%	83	1				
			1				
			2			58.7' - 59.7' MUDSTONE, black (10YR 2/1), moderately cemented.	P200=73.5%, LL=52, PI=26, UCS=3727 psf

PROJECT NUMBER:	BORING NUMBER:
386247.01.FI	B-2 SHEET 4 OF 5

ROCK CORE LOG

PROJECT : Mariposa Energy Project, East Alameda County, CA
LOCATION : (2111636.9 N, 6243245.3 E)
ELEVATION : 119.0 ft NAD83
DRILLING CONTRACTOR : V and W Drilling
CORING METHOD AND EQUIPMENT : CME 75 Wire Line Rig with Automatic Hammer, Mud Rotary with 4 5/8 drill bit
ORIENTATION :
WATER LEVELS : ---
START : 2/25/09 08:43
END : 2/25/09 17:30
LOGGER : T. CHAKURIAN

DEPTH BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	R Q D (%)	FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, WEATHERING, HARDNESS, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
59.0	60.0			59.85' fracture, 45 degrees, planar and smooth		59.7' SANDSTONE with interbedded mudstone, dark gray (10YR 4/1), fine grained sand with biotite and rounded quartz, moderately cemented.	
			2				
			1	61.5' fracture, 43 degrees, planar, rough		same as above	
	7-HQ 5 ft 91%	85	1			61.3' MUDSTONE, black (10YR 2/1), moderately cemented	
			2			62.6' SANDSTONE with interbedded mudstone, dark gray (10YR 4/1), fine grained sand with biotite, and rounded quartz, moderately cemented	
			1				
65	65.0						rotten egg odor (H2S)
54.0			1			64.65' strongly cemented	
	8-HQ 5 ft 80%	71	2				
			1				
			NR				driller identified interval from 69 ft-70 ft as soft material. no recovery. UCS=28717 psf, WC=11.4%, UWD=1248 pcf
70	70.0						
49.0			2			70' SANDSTONE, dark gray (10YR 4/1), fine to medium grained sand with biotite and rounded quartz. moderately to strongly cemented	
			2				
	9-HQ 5 ft 100%	68	4				
			>10				
			1				
75	75.0						
44.0			1			same as above	
			3			75.8' SANDSTONE with interbedded mudstone, dark gray (10YR 4/1), fine grained sand with biotite and rounded quartz, moderately to strongly cemented	
	10-HQ 5 ft 97%	36	2				
			3				rotten egg odor (H2S)
			2				
80	80.0						
39.0			NR				rotten egg odor (H2S)
			NR				
	11-HQ 5 ft 48%	9	6				
			5				
			0				

PROJECT NUMBER:	BORING NUMBER:
386247.01.FI	B-2 SHEET 5 OF 5

ROCK CORE LOG

PROJECT : Mariposa Energy Project, East Alameda County, CA
LOCATION : (2111636.9 N, 6243245.3 E)

ELEVATION : 119.0 ft NAD83
DRILLING CONTRACTOR : V and W Drilling

CORING METHOD AND EQUIPMENT : CME 75 Wire Line Rig with Automatic Hammer, Mud Rotary with 4 5/8 drill bit
ORIENTATION :

WATER LEVELS : ---
START : 2/25/09 08:43
END : 2/25/09 17:30
LOGGER : T. CHAKURIAN

DEPTH BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	R Q D (%)	FRACTURES PER FOOT	DISCONTINUITIES – DESCRIPTION: DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS	SYMBOLIC LOG	LITHOLOGY: ROCK TYPE, COLOR, MINERALOGY, TEXTURE, WEATHERING, HARDNESS, AND ROCK MASS CHARACTERISTICS	COMMENTS: SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.
34.0	85.0						
	12-HQ 5 ft 100%	84	1	85.7, - 85.9' highly fractured		84.8 SANDSTONE, dark gray (10YR 4/1), fine to medium grained sand with biotite and rounded quartz, moderately cemented.	
			2				
			1			87.2 SANDSTONE with interbedded mudstone, dark gray (10YR 4/1), fine grained sand with biotite, and rounded quartz, moderately cemented	
			>10	88.7' - 89.45' highly fractured			
			0				
90	90.0						
29.0				89.9' - 90.3' highly fractured			
			0			90.3' SANDSTONE, dark gray (10YR 4/1), fine grained sand with biotite, and rounded quartz, moderately cemented	
			0				
	13-HQ 5 ft 98%	74	7			92.2' 92.45' ANDESITE DIKE, gray (10YR 6/1), crystalline, aphanitic, fine grained quartz, biotite, plagioclase, unaltered	
			>10	93' fracture, 60 degrees, planar and smooth 93.25' - 93.35' highly fractured			
			1			92.45' - 93' SANDSTONE interbedded with mudstone, dark gray (10YR 4/1), fine grained sand with biotite and rounded quartz, moderately cemented	WC=0.6%, UWD=166.8 pcf, UCS=1,498,320 psf
95	95.0						
24.0			3	94.95' fracture, 50 degrees, planar and smooth			
			0			93' - 93.35' ANDESITE DIKE, gray (10YR 6/1), crystalline, aphanitic, fine grained quartz, biotite, plagioclase, unaltered	
	14-HQ 5 ft 96%	80	2				
			1	98.41' - 98.5' highly fractured		93.35' - 93.95' SANDSTONE interbedded with mudstone, dark gray (10YR 4/1), fine grained sand with biotite, and rounded quartz, strongly cemented, indurated	
			1				
100	100.0						
19.0						93.95' - 94.45' ANDESITE DIKE, gray (10YR 6/1), crystalline, aphanitic, fine grained, quartz, biotite, plagioclase unaltered	total depth at 100 feet.
						94.45' SANDSTONE interbedded with mudstone, dark gray (10 YR 4/1), fine grained sand with biotite and rounded quartz, moderately cemented	
						Bottom of Hole at 100.0 ft bgs -	
105							
14.0							

PROJECT NUMBER:	BORING NUMBER:
386247.01.FI	B-3 SHEET 1 OF 3

SOIL BORING LOG

PROJECT : Mariposa Energy Project, East Alameda County, CA
LOCATION : (2112118.7 N, 6243314.4 E)

ELEVATION : 112.0 ft NAD83
DRILLING CONTRACTOR : V and W Drilling

DRILLING EQUIPMENT AND METHOD: CME 75 Wire Line Rig with Automatic Hammer, 8-inch Hollow Stem Auger

WATER LEVELS : NA
START : 2/24/09 13:15
END : 2/24/09 16:30
LOGGER : T. CHAKURIAN

DEPTH BELOW GROUND SURFACE (ft)	INTERVAL (ft)	RECOVERY (ft)	#TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
	0.0 – 1.5		15-SS	2-3-7 (10)	LEAN CLAY (CL), very dark grayish brown (10YR 3/2), damp, medium plasticity, no dilatancy, weak cementation, stiff.	SS-15-B3-0 at 11:57 PP=1.5 tsf, WC=21.8%, P200=81.6%, LL=38, PI=28
5	5.0 – 6.5		16-MC	6-10-15 (25)	same as above, dark yellowish brown (10 YR 4/4), very stiff.	MC-16-B3-5 at 12:07 PP=4.25 tsf (B), PP=4.5 tsf (T), WC=10.7%, UWD=107.7 pcf, EI=143, ucs=4403 psf
	6.5 – 8.0		17-SS	8-12-12 (24)	same as above, brown (10YR 4/3), very stiff.	SS-17-B3-6.5 at 12:10 PP=2.25 tsf, Swell Press.=920 psf, Swell=0.1%
10	10.0 – 11.5		18-SS	6-7-10 (17)	same as above.	SS-18-B3-15 at 12:15 PP=2.75 tsf, WC=16.5%, P200=66.6%, LL=33, PI=23
15						

PROJECT NUMBER:	BORING NUMBER:
386247.01.FI	B-3 SHEET 2 OF 3

SOIL BORING LOG

PROJECT : Mariposa Energy Project, East Alameda County, CA
LOCATION : (2112118.7 N, 6243314.4 E)

ELEVATION : 112.0 ft NAD83
DRILLING CONTRACTOR : V and W Drilling

DRILLING EQUIPMENT AND METHOD: CME 75 Wire Line Rig with Automatic Hammer, 8-inch Hollow Stem Auger

WATER LEVELS : NA
START : 2/24/09 13:15
END : 2/24/09 16:30
LOGGER : T. CHAKURIAN

DEPTH BELOW GROUND SURFACE (ft)	INTERVAL (ft)	RECOVERY (ft)	#TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
	15.0 – 16.5		19-MC	12-12-15 (27)	same as above. yellowish brown (10YR 5/4), very stiff	MC-19-B3-15 at 12:20 PP=3.0 tsf (B). PP=4.25 tsf (T)
	16.5 – 18.0		20-SS	16-18-20 (38)	CLAYEY SAND (SC), dark yellowish brown (10YR 4/6), wet, weak to moderate cementation, fine to medium grained sand, clay, rounded, well graded, dense	SS-20-B3-16.5 at 12:25. groundwater at 16.5 FT.
20	18.0 – 20.0					
	20.0 – 21.5		21-SS	25-37-44 (81)	GRAVELLY LEAN CLAY (CL), brown (10YR 5/3), wet, medium plasticity, no dilatancy, weak cementation, subrounded gravel, fine to coarse sand, hard.	SS-21-B3-20 at 12:30
	21.5 – 23.0					Hard drilling from 22 ft to 23 ft. likely bedrock. drill bit broke at 23 ft. borehole was abandoned. total depth is 23 ft.
25	23.0				Begin Rock Coring at 23.0 ft below ground surface See the next sheet for the rock core log	
30						

PROJECT NUMBER:	BORING NUMBER:
386247.01.FI	B-3 SHEET 3 OF 3

ROCK CORE LOG

PROJECT : Mariposa Energy Project, East Alameda County, CA
LOCATION : (2112118.7 N, 6243314.4 E)
ELEVATION : 112.0 ft NAD83
DRILLING CONTRACTOR : V and W Drilling
CORING METHOD AND EQUIPMENT : CME 75 Wire Line Rig with Automatic Hammer
ORIENTATION :
WATER LEVELS : NA
START : 2/24/09 13:15
END : 2/24/09 16:30
LOGGER : T. CHAKURIAN

DEPTH BELOW SURFACE (ft)	CORE RUN, LENGTH, AND RECOVERY (%)	DISCONTINUITIES: R Q D (%)	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION (DEPTH, TYPE, ORIENTATION, ROUGHNESS, PLANARITY, INFILLING MATERIAL AND THICKNESS, SURFACE STAINING, AND TIGHTNESS)	SYMBOLIC LOG	LITHOLOGY (ROCK TYPE, COLOR, MINERALOGY, TEXTURE, WEATHERING, HARDNESS, AND ROCK MASS CHARACTERISTICS)	COMMENTS (SIZE AND DEPTH OF CASING, FLUID LOSS, CORING RATE AND SMOOTHNESS, CAVING ROD DROPS, TEST RESULTS, ETC.)
	23.0						Gravel encountered at 23 ft appears to be associated with the conglomerate at 29 ft WC=35%, UWD=87.8 pcf, UCS=4508 psf
	1-HQ 2 ft 0%	0					
25 87.0	25.0						
	2-HQ 5 ft 18%	16					
			1			29' WEATHERED CONGLOMORATE, very pale brown (10YR 8/2), coarse grained sand to coarse gravel with subangular to rounded fragments of red and green chert, SANDSTONE and quartzite, well cemented.	WC=38.4%, UWD=83.6 pcf, LL=81, PI=54, UCS=3496 psf, P200=62.7, P40=95.2%
30 82.0	30.0						
			1			29.5' WEATHERED SANDSTONE with interbedded mudstone, yellowish brown (10YR 5/4), fine to medium grained sand, rounded, clay, weakly cemented	
			1				
	3-HQ 5 ft 97%	90	2	fracture, 70 degrees, rough undulating surface			
			2	fracture 80 degrees, smooth planar surface		33' SANDSTONE is relatively unweathered, gray (10YR 5/1).	Tan Sample (34 ft) WC=31.3%, UWD=86.6 pcf, LL=92, PI=63, UCS=3020 psf, P200=69.6%, P40=96.8%
			1				Black Sample (34 ft) WC=38.7%, UWD=81.8 pcf, LL=83, PI=36, UCS=4933 psf, P200=73.8%, P40=96%
35 77.0	35.0					Bottom of Hole at 35.0 ft bgs -	Driller notes that clay clogged the rock coring system at 35 feet. driller pulls casing and boring collapses. total depth at 35 feet.

PROJECT NUMBER:	TEST PIT NUMBER:
386247.01.FI	TP-1 SHEET 1 OF 1

TEST PIT LOG

PROJECT: Mariposa Energy Project, East Alameda County, CA
LOCATION: (2111309.8 N, 6243238.4 E)
ELEVATION: 136.0 ft NAD83
CONTRACTOR: Diamond D Engineering
EXCAVATION EQUIPMENT: PC-35 Excavator w/ 30" Bucket
DATE EXCAVATED: 02/19/2009 11:25:00 AM
LOGGER: J. DEAN
WATER LEVELS: not encountered
LENGTH:
WIDTH:
DEPTH:

SOIL DESCRIPTION				COMMENTS
DEPTH BELOW SURFACE	#TYPE	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
	1-BU	LEAN CLAY (CL), dark brown, moist, low plasticity, soft, clay with silt [topsoil]		Depth below surface values are approximate due to method of excavation.
1				
2	2-BU	SANDY SILT (ML), light brown, dry, low plasticityl, medium sandy silt		Composite Sample 1: Res=1,210 ohm-cm, Cl=75 ppm, SO4=3 ppm, R-value at 300 psi=8, Expansive index at 300 psi=22 psf
3				Composite Sample 2: Res=1,000 ohm-cm, Cl=66 ppm, SO4=306 ppm, R-value at 300 psi=22, Expansive index at 300 psi=62 psf
4	3-BU	SAND (SP), light brown, dry, poorly graded, medium dense, fine sand with occassional calcareous nodules [WEATHERED SANDTONE]		
5				
6				
7				
8				
9	4-BU	WEATHERED SANDTONE orangish brown, dry, poorly graded, medium dense fine SAND (SP)		
10		Bottom of Hole at 10.0 ft bgs -		TD at 10 ft at 12:05 pm. reached limit of excavator arm
11				Composite Sample1 consists of TP-1-1, TP-1-2, TP-2-1, TP-2-2, TP-3-1, TP-4-1, TP-4-2, TP-5-1, TP-5-2. Composite Sample 2 consists of TP-1-3, TP-1-4, TP-2-3, TP-3-2, TP-4-3, TP-5-3, TP-5-4, TP-6-3
12				
13				
14				
15				
16				

PROJECT NUMBER:	TEST PIT NUMBER:
386247.01.FI	TP-2 SHEET 1 OF 1

TEST PIT LOG

PROJECT: Mariposa Energy Project, East Alameda County, CA
LOCATION: (2111370.4 N, 6243008.8 E)
ELEVATION: 132.0 ft NAD83
CONTRACTOR: Diamond D Engineering
EXCAVATION EQUIPMENT: PC-35 Excavator w/ 30" Bucket
DATE EXCAVATED: 02/19/2009 10:40:00 AM
LOGGER: J. DEAN
WATER LEVELS: not encountered
LENGTH:
WIDTH:
DEPTH:

SOIL DESCRIPTION				COMMENTS
DEPTH BELOW SURFACE	#TYPE	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
				Depth below surface values are approximate due to method of excavation.
1	1-BU	LEAN CLAY (CL), dark brown, moist, soft, low plasticity clay [topsoil]		
2	2-BU	LEAN CLAY (CL), dark brown, moist, soft, low plasticity, clay with some silt and calcareous patches		Composite Sample 1: (See TP-1)
3				Composite Sample 2: (See TP-1)
4				
5	3-BU	WEATHERED SANDTONE, light brown, moist, poorly graded, medium dense, fine sand.		
6				
7				
8				
9		WEATHERED SANDTONE, light brown, moist, poorly-graded, medium dense sand with larger fragments of cemented rock		from surface, can see bedding dipping toward the east ~35 degrees
10		Bottom of Hole at 10.0 ft bgs -		TD at 10 ft at 12:05 pm. reached limit of excavator arm
11				
12				
13				
14				
15				
16				

PROJECT NUMBER:	TEST PIT NUMBER:
386247.01.FI	TP-3 SHEET 1 OF 1

TEST PIT LOG

PROJECT: Mariposa Energy Project, East Alameda County, CA
LOCATION: (2111770.5 N, 6243405.3 E)
ELEVATION: 127.0 ft NAD83
CONTRACTOR: Diamond D Engineering
EXCAVATION EQUIPMENT: PC-35 Excavator w/ 30" Bucket
DATE EXCAVATED: 02/19/2009 12:25:00 AM
LOGGER: J. DEAN
WATER LEVELS: not encountered
LENGTH:
WIDTH:
DEPTH:

SOIL DESCRIPTION				COMMENTS
DEPTH BELOW SURFACE	#TYPE	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
	1-BU	LEAN CLAY (CL), dark brown, moist, soft, low plasticity, clay with some silt [topsoil]		Depth below surface values are approximate due to method of excavation.
1				
2				Composite Sample 1: (see TP-1)
3				
	2-BU	WEATHERED SANDTONE, light brown, dry, medium dense, poorly graded fine sand		large fragments (up to 8") can be broken apart by hand
4				Composite Sample 2: (See TP-1)
5				
6				
7				TD at 7 ft at 12:45 pm. refusal
		Bottom of Hole at 7.0 ft bgs -		
8				
9				
10				
11				
12				
13				
14				
15				
16				

PROJECT NUMBER:	TEST PIT NUMBER:
386247.01.FI	TP-4 SHEET 1 OF 1

TEST PIT LOG

PROJECT: Mariposa Energy Project, East Alameda County, CA
LOCATION: (2111440.5 N, 6243125.8 E)
ELEVATION: 123.0 ft NAD83
CONTRACTOR: Diamond D Engineering
EXCAVATION EQUIPMENT: PC-35 Excavator w/ 30" Bucket
DATE EXCAVATED: 02/19/2009 10:00:00 AM
LOGGER: J. DEAN
WATER LEVELS: not encountered
LENGTH:
WIDTH:
DEPTH:

SOIL DESCRIPTION				COMMENTS
DEPTH BELOW SURFACE	#TYPE	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
				Depth below surface values are approximate due to method of excavation.
1	1-BU	LEAN CLAY (CL), dark brown, moist, soft, low plasticity clay with some silt and rootlets [topsoil]		
2				Composite Sample 1: (see TP-1)
3	2-BU	LEAN CLAY (CL), dark brown, moist, low plasticity, medium clay with some silt		Composite Sample 2: (See TP-1)
4				
5	3-BU	WEATHERED SANDTONE, light brown, moist, poorly graded, medium dense, fine sand becomes more yellowish brown with depth		
6				
7				
8				
9				
10		Bottom of Hole at 9.5 ft bgs -		TD at 9.5 ft at 10:30 am. reached limit of excavator arm
11				
12				
13				
14				
15				
16				

PROJECT NUMBER:	TEST PIT NUMBER:
386247.01.FI	TP-5 SHEET 1 OF 1

TEST PIT LOG

PROJECT: Mariposa Energy Project, East Alameda County, CA
LOCATION: (2111941.2 N, 6243230.3 E)
ELEVATION: 117.0 ft NAD83
CONTRACTOR: Diamond D Engineering
EXCAVATION EQUIPMENT: PC-35 Excavator w/ 30" Bucket
DATE EXCAVATED: 02/19/2009 9:00:00 AM
LOGGER: J. DEAN
WATER LEVELS: not encountered
LENGTH:
WIDTH:
DEPTH:

SOIL DESCRIPTION				COMMENTS
DEPTH BELOW SURFACE	#TYPE	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
				Depth below surface values are approximate due to method of excavation.
1	1-BU	LEAN CLAY (CL), dark brown, moist, low plasticity, soft clay with some silt. [topsoil] contains rootlets		
2				Composite Sample 1: (see TP-1)
3	2-BU	LEAN CLAY (CL),,dark brown, moist, low plasticity, medium clay with some siltt, increased white calcareous nodules with depth.		
4	3-BU			Composite Sample 2: (See TP-1)
5	4-BU	WEATHERED SANDTONE, light brown, moist, poorly graded, medium dense fine SAND (SP) with some clay		
6				
7				
8				
9				at 9 feet, became slightly harder to excavate
10				TD at 10 ft at 9:45 am. reached limit of excavator arm
		Bottom of Hole at 10.0 ft bgs -		
11				
12				
13				
14				
15				
16				

PROJECT NUMBER:	TEST PIT NUMBER:
386247.01.FI	TP-6 SHEET 1 OF 1

TEST PIT LOG

PROJECT: Mariposa Energy Project, East Alameda County, CA
LOCATION: (2111966.5 N, 6243410.4 E)
ELEVATION: 117.0 ft NAD83
CONTRACTOR: Diamond D Engineering
EXCAVATION EQUIPMENT: PC-35 Excavator w/ 30" Bucket
DATE EXCAVATED: 02/19/2009 1:00:00 PM
LOGGER: J. DEAN
WATER LEVELS: not encountered
LENGTH:
WIDTH:
DEPTH:

SOIL DESCRIPTION				COMMENTS
DEPTH BELOW SURFACE	#TYPE	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	GRAPHIC LOG	DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
	1-BU	LEAN CLAY (CL),, dark brown, moist, soft, low plasticity, clay with some silt [topsoil]		Depth below surface values are approximate due to method of excavation.
1				
2				
3	2-BU	LEAN CLAY (CL), medium brown, dry, medium, low plasticity, Lclay with some silt.		
4				Composite Sample 2: (See TP-1)
5				
6	3-BU	WEATHERED SANDTONE, light brown, dry, medium dense, poorly graded fine sand,		
7				
8				
9				
10				TD at 10ft at 13:20 due to limit of excavator arm
		Bottom of Hole at 10.0 ft bgs -		
11				
12				
13				
14				
15				
16				

ATTACHMENT 2

Laboratory Test Results

MOISTURE CONTENT & UNIT WEIGHT TEST RESULTS

Sample Identification	Depth, ft.	Wet Unit Weight, lb/ft.^{3}	Dry Unit Weight, lb/ft.^{3}	Moisture Content, %
B-1, 1-SS	0			23.6
B-1, 2-MC	5			12.3
B-1, 6-22	15			10.1
B-1, 8-SS	21.5			7.9
B-1, 10-MC	30			
B-1, 13-MC	40	136.8	119.0	15.0

Test Method: ASTM D2216, ASTM D2937

PROJECT NUMBER:	09-113	March 3, 2009	DGC Kelso Geotech

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

5040 Robert J. Mathews Blvd., El Dorado Hills, CA 95762
Phone: (916) 939-3460 FAX: (916) 939-3507

MOISTURE CONTENT & UNIT WEIGHT TEST RESULTS

Sample Identification	Depth, ft.	Wet Unit Weight, lb/ft.^{3}	Dry Unit Weight, lb/ft.^{3}	Moisture Content, %
B-2, 24-MC	5	120.6	105.5	14.4
B-2, 25-SS	6.5			10.2

Test Method: ASTM D2216, ASTM D2937

PROJECT NUMBER: **09-113** March 3, 2009

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

5040 Robert J. Mathews Blvd., El Dorado Hills, CA 95762
Phone: (916) 939-3460 FAX: (916) 939-3507

DGC Kelso Geotech

PO #932622

MOISTURE CONTENT & UNIT WEIGHT TEST RESULTS

Sample Identification	Depth, ft.	Wet Unit Weight, lb/ft.^{3}	Dry Unit Weight, lb/ft.^{3}	Moisture Content, %
B-3, 15-SS	0			21.8
B-3, 18-SS	10			16.5

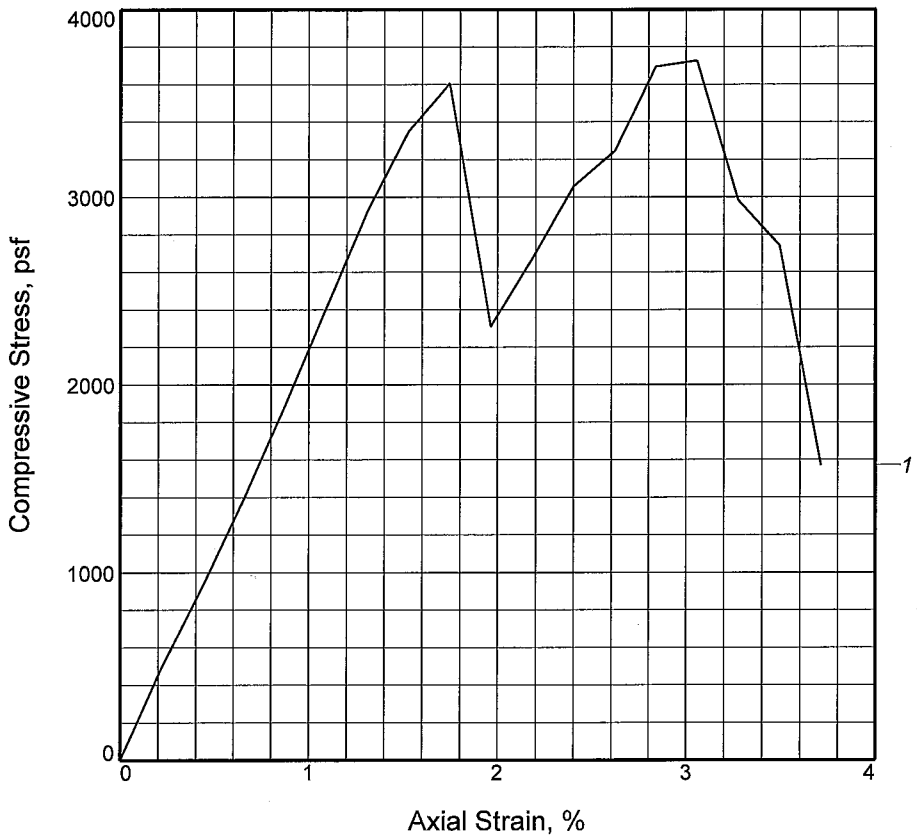
Test Method: ASTM D2216, ASTM D2937

PROJECT NUMBER:	09-113	March 3, 2009	DGC Kelso Geotech

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

5040 Robert J. Mathews Blvd., El Dorado Hills, CA 95762
Phone: (916) 939-3460 FAX: (916) 939-3507

UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, psf	3727			
Undrained shear strength, psf	1864			
Failure strain, %	3.1			
Strain rate, in./min.	0.03			
Water content, %	12.4			
Wet density, pcf	144.9			
Dry density, pcf	128.9			
Saturation, %	99.6			
Void ratio	0.3468			
Specimen diameter, in.	2.36			
Specimen height, in.	4.58			
Height/diameter ratio	1.94			

Description:

LL =	**PL =**	**PI =**	**GS=** 2.78	**Type:** Undisturbed

Project No.: 09-113
Date Sampled: 3/3/09
Remarks:

Figure _____

Client: CH2MHILL

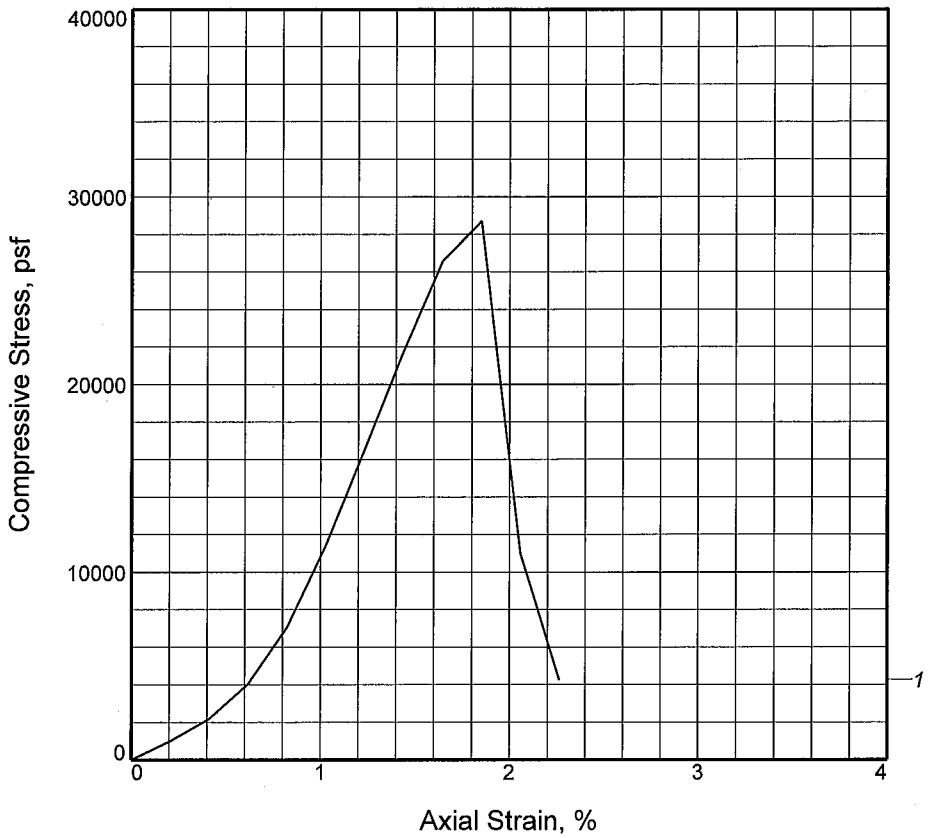
Project: DGC Kelso Geotech
#PO 932622
Location: B-2, Core (Homogenius Portion)
Sample Number: S10026 **Depth:** 58.7

UNCONFINED COMPRESSION TEST

SIERRA TESTING LABS, INC.

Tested By: mpw **Checked By:** mn

UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, psf	28717			
Undrained shear strength, psf	14359			
Failure strain, %	1.9			
Strain rate, in./min.	0.03			
Water content, %	11.4			
Wet density, pcf	139.1			
Dry density, pcf	124.8			
Saturation, %	88.1			
Void ratio	0.3506			
Specimen diameter, in.	2.30			
Specimen height, in.	4.86			
Height/diameter ratio	2.11			

Description:

LL =	**PL =**	**PI =**	**GS=** 2.70	**Type:** Undisturbed

Project No.: 09-113
Date Sampled: 3/3/09
Remarks:

Figure _____

Client: CH2MHILL

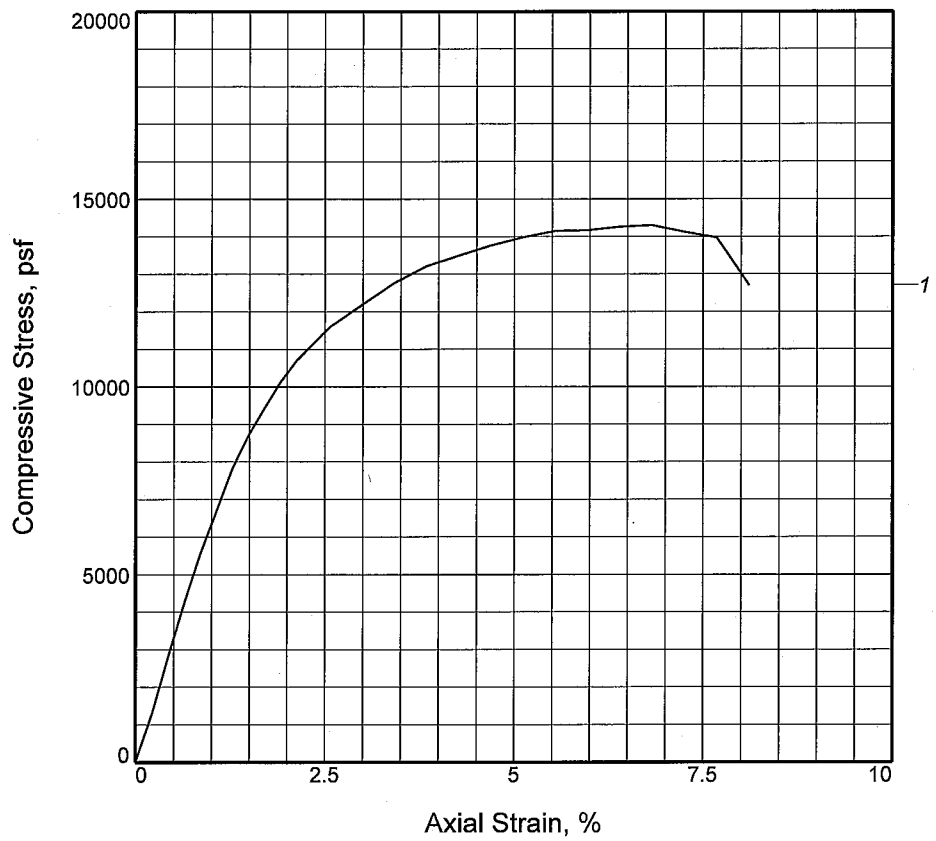
Project: DGC Kelso Geotech
#PO 932622
Location: B-2, Core
Sample Number: S10027 **Depth:** 70.0

UNCONFINED COMPRESSION TEST

SIERRA TESTING LABS, INC.

Tested By: mpw **Checked By:** mn

UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, psf	14305			
Undrained shear strength, psf	7152			
Failure strain, %	6.8			
Strain rate, in./min.	0.03			
Water content, %	14.9			
Wet density, pcf	131.8			
Dry density, pcf	114.7			
Saturation, %	85.8			
Void ratio	0.4696			
Specimen diameter, in.	2.40			
Specimen height, in.	4.69			
Height/diameter ratio	1.95			

Description:

LL =	**PL =**	**PI =**	**GS=** 2.70	**Type:** Undisturbed

Project No.: 09-113
Date Sampled: 3/3/09
Remarks:

Figure _____

Client: CH2MHILL

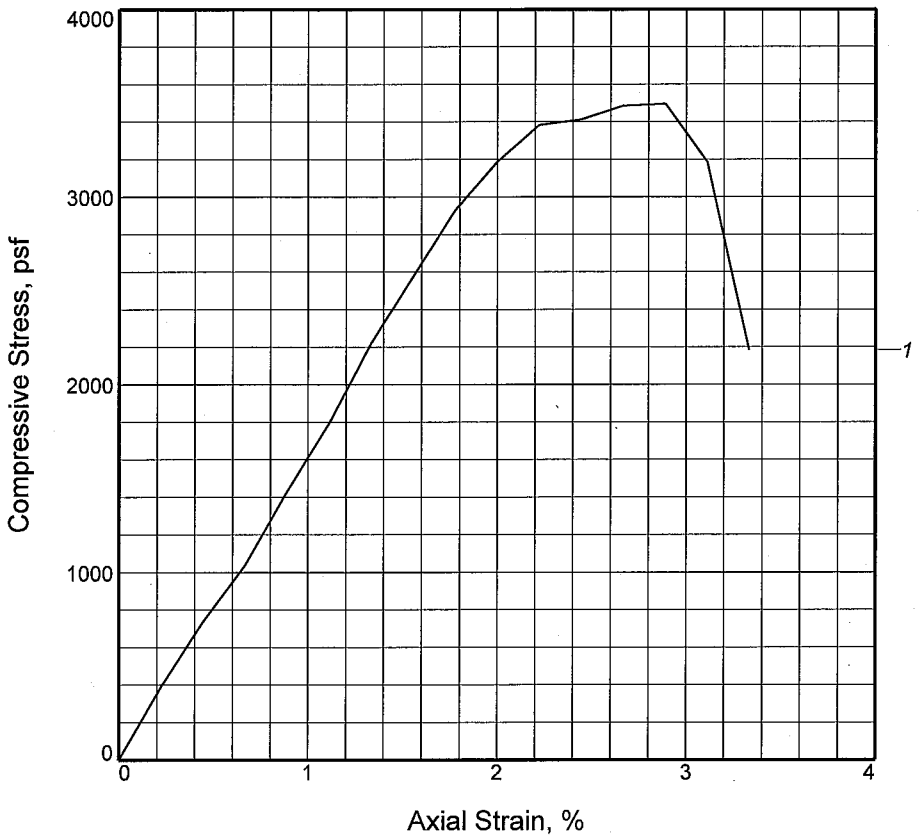
Project: DGC Kelso Geotech
#PO 932622
Location: B-2, 24-MC
Sample Number: S10021 **Depth:** 5.0

UNCONFINED COMPRESSION TEST

SIERRA TESTING LABS, INC.

Tested By: mpw **Checked By:** cmw

UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, psf	3496			
Undrained shear strength, psf	1748			
Failure strain, %	2.9			
Strain rate, in./min.	0.03			
Water content, %	38.4			
Wet density, pcf	115.8			
Dry density, pcf	83.6			
Saturation, %	99.4			
Void ratio	1.0753			
Specimen diameter, in.	2.40			
Specimen height, in.	4.50			
Height/diameter ratio	1.88			

Description:

LL =	**PL =**	**PI =**	**GS=** 2.78	**Type:** Undisturbed

Project No.: 09-113
Date Sampled: 3/3/09
Remarks:

Figure _____

Client: CH2MHILL

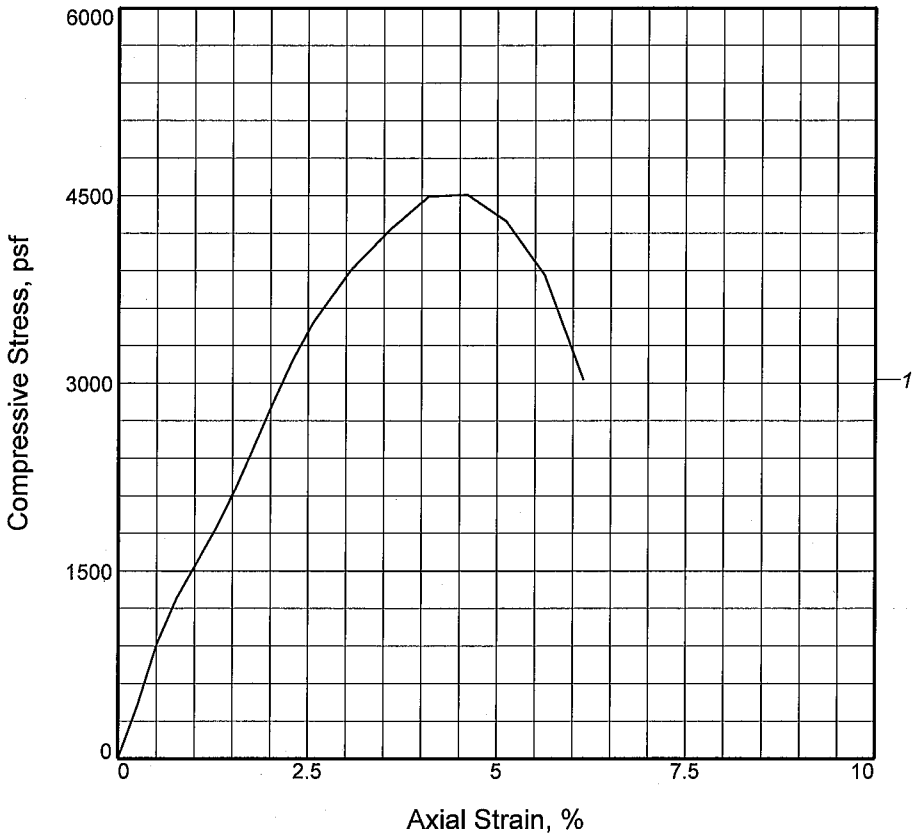
Project: DGC Kelso Geotech
#PO 932622
Location: B-3, Core
Sample Number: S10034 **Depth:** 30.0

UNCONFINED COMPRESSION TEST

SIERRA TESTING LABS, INC.

Tested By: mpw **Checked By:** cmw

UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, psf	4508			
Undrained shear strength, psf	2254			
Failure strain, %	4.6			
Strain rate, in./min.	0.03			
Water content, %	35.0			
Wet density, pcf	118.5			
Dry density, pcf	87.8			
Saturation, %	99.5			
Void ratio	0.9776			
Specimen diameter, in.	2.41			
Specimen height, in.	3.91			
Height/diameter ratio	1.62			

Description:

LL =	**PL =**	**PI =**	**GS=** 2.78	**Type:** Undisturbed

Project No.: 09-113
Date Sampled: 3/3/09
Remarks:

Figure _____

Client: CH2MHILL

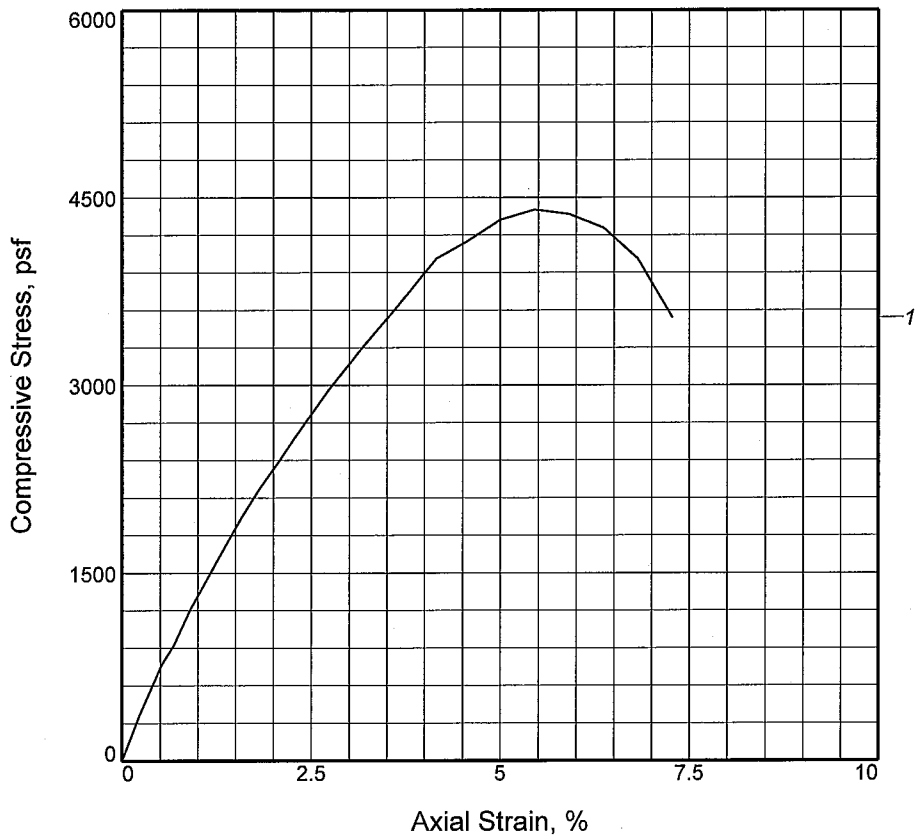
Project: DGC Kelso Geotech
#PO 932622
Location: B-3, Core
Sample Number: S10033 **Depth:** 25.0

UNCONFINED COMPRESSION TEST

SIERRA TESTING LABS, INC.

Tested By: mpw **Checked By:** cmw

UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, psf	4403			
Undrained shear strength, psf	2202			
Failure strain, %	5.5			
Strain rate, in./min.	0.03			
Water content, %	15.7			
Wet density, pcf	133.1			
Dry density, pcf	115.1			
Saturation, %	91.3			
Void ratio	0.4650			
Specimen diameter, in.	2.39			
Specimen height, in.	4.40			
Height/diameter ratio	1.84			

Description:

LL =	**PL =**	**PI =**	**GS=** 2.70	**Type:** Undisturbed

Project No.: 09-113
Date Sampled: 3/3/09
Remarks:

Figure _____

Client: CH2MHILL

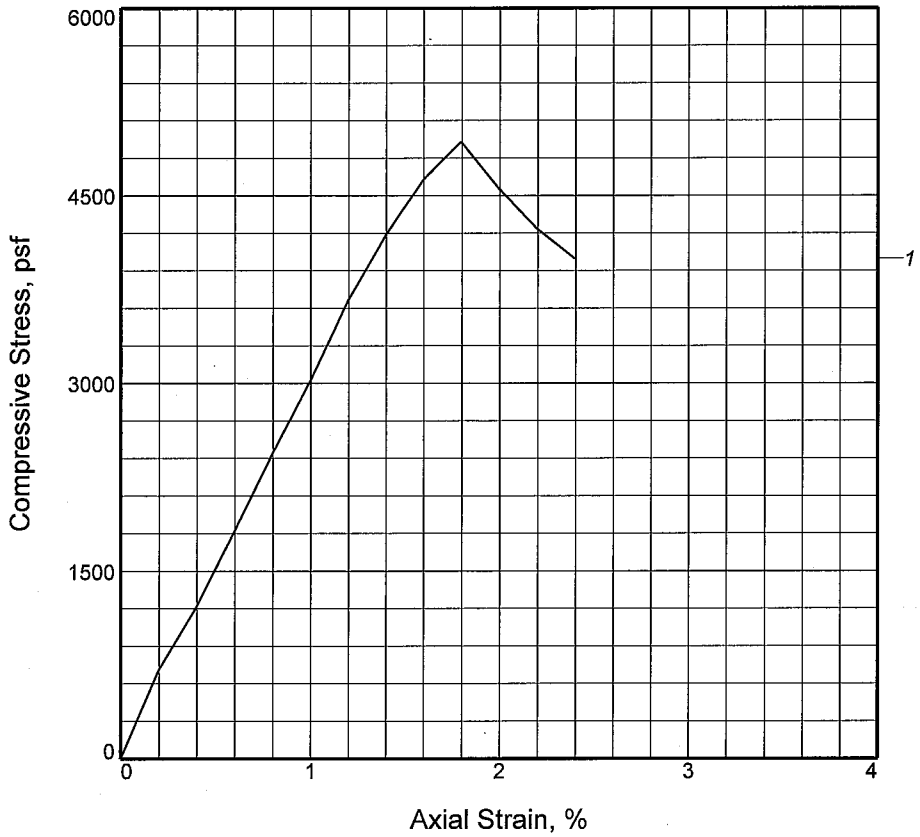
Project: DGC Kelso Geotech
#PO 932622
Location: B-3, 16-MC
Sample Number: S10030 **Depth:** 5.0

UNCONFINED COMPRESSION TEST

SIERRA TESTING LABS, INC.

Tested By: mpw **Checked By:** cmw

UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, psf	4933			
Undrained shear strength, psf	2466			
Failure strain, %	1.8			
Strain rate, in./min.	0.03			
Water content, %	31.3			
Wet density, pcf	113.7			
Dry density, pcf	86.6			
Saturation, %	89.3			
Void ratio	0.9470			
Specimen diameter, in.	2.48			
Specimen height, in.	5.01			
Height/diameter ratio	2.02			

Description:

LL =	**PL =**	**PI =**	**GS=** 2.70	**Type:** Undisturbed

Project No.: 09-113
Date Sampled: 3/3/09
Remarks:

Figure _____

Client: CH2MHILL

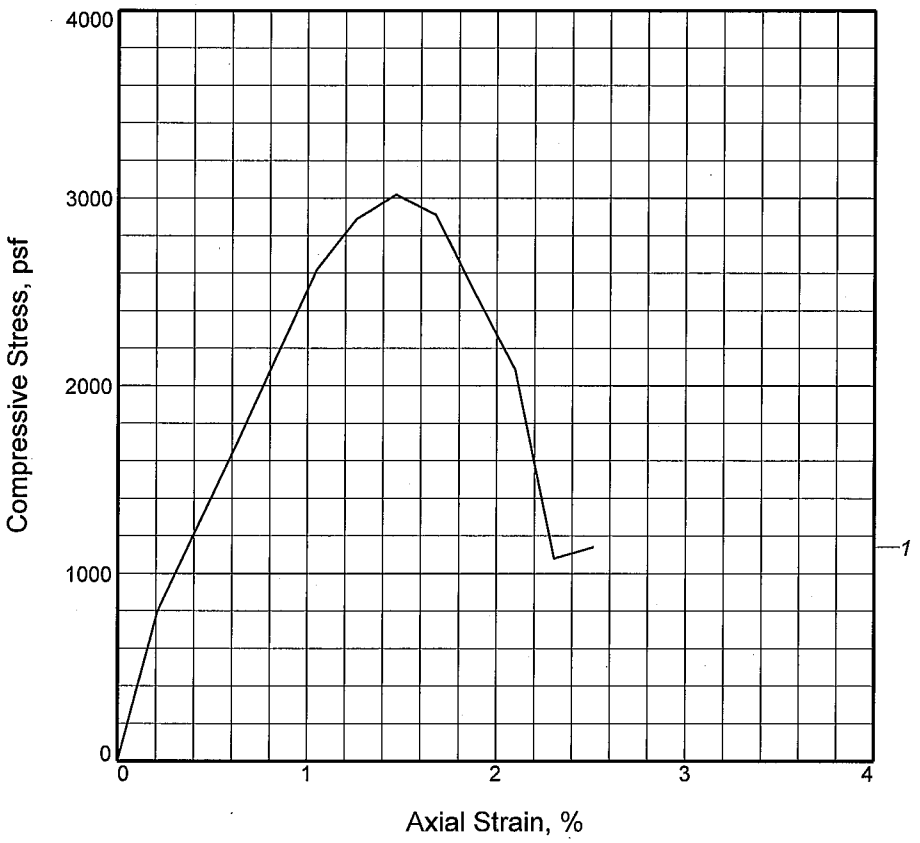
Project: DGC Kelso Geotech
#PO 932622
Location: B-3, Core (Black Sample)
Sample Number: S10035 **Depth:** 34.0

UNCONFINED COMPRESSION TEST

SIERRA TESTING LABS, INC.

Tested By: cm **Checked By:** mn

UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, psf	3020			
Undrained shear strength, psf	1510			
Failure strain, %	1.5			
Strain rate, in./min.	0.03			
Water content, %	38.7			
Wet density, pcf	113.5			
Dry density, pcf	81.8			
Saturation, %	98.6			
Void ratio	1.0600			
Specimen diameter, in.	2.43			
Specimen height, in.	4.77			
Height/diameter ratio	1.96			

Description:

LL =	**PL =**	**PI =**	**GS=** 2.70	**Type:** Undisturbed

Project No.: 09-113
Date Sampled: 3/3/09
Remarks:

Figure _____

Client: CH2MHILL

Project: DGC Kelso Geotech
#PO 932622
Location: B-3, Core (Tan Sample)
Sample Number: S10035 **Depth:** 34.0

UNCONFINED COMPRESSION TEST

SIERRA TESTING LABS, INC.

Tested By: cm **Checked By:** mn

UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: DGC Kelso Geotech
Project No.: 09-113
Report Date: March 3, 2009

Client: CH2MHILL

Material Type: Core

Depth: 94

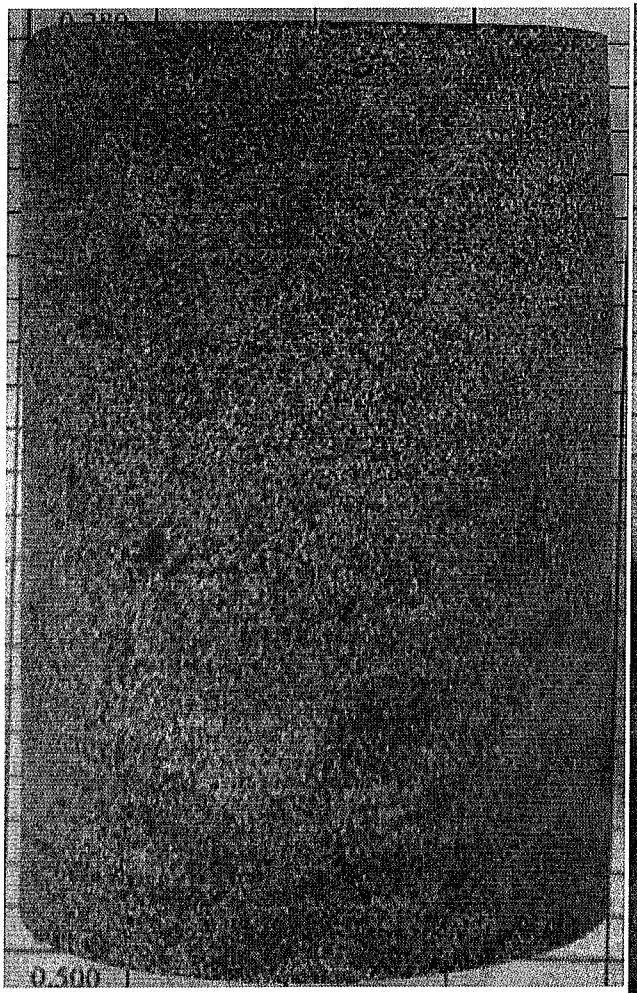
Date Tested: 3/3/09

Test Method: ASTM D4832, D1633, D2938

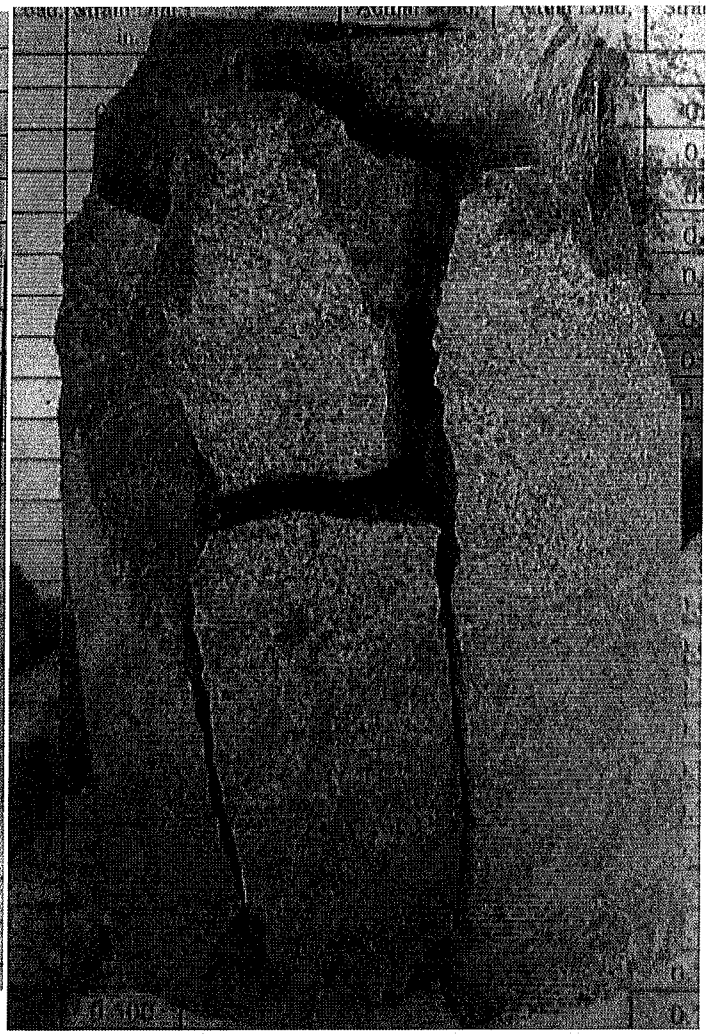
Moisture Condition At Testing: Ambient

Test Results

Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
B-2, Core		2.39	4.0	167.8	166.8	0.6	10405



Before UC



After UC

RESISTIVITY & CORROSION PACKAGE
LABORATORY TEST RESULTS

Sample ID.	pH	pH Specifications	Minimum Resistivity, ohm-cm (x1,000)	Specifications Minimum Resistivity, ohm-cm (x1,000)	Chloride, ppm	Sulfate, ppm
B-2, 27-MC	7.62	-	0.99	-	45.5	64.5

Note: Testing performed by Sunland Analytical, Rancho Cordova, CA

Test Method: AASHTO T289, T290 & T291

REMARKS:

LAB NUMBER: S10023

PROJECT NUMBER:	09-113	March 3, 2009

DGC Kelso Geotech

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

5040 Robert J. Mathews Blvd., El Dorado Hills, CA 95762
Phone: (916) 939-3460 FAX: (916) 939-3507

EXPANSION INDEX TEST

EXPANSION INDEX	93
DRY DENSITY (PCF)	101.7
MOISTURE CONTENT (%)	11.9

CLASSIFICATION OF EXPANSIVE SOIL

Expansion Index	Expansion Potential
0 - 20	Very Low
21 - 50	Low
51 - 90	Medium
91 - 130	High

Test Method: UBC 29-2

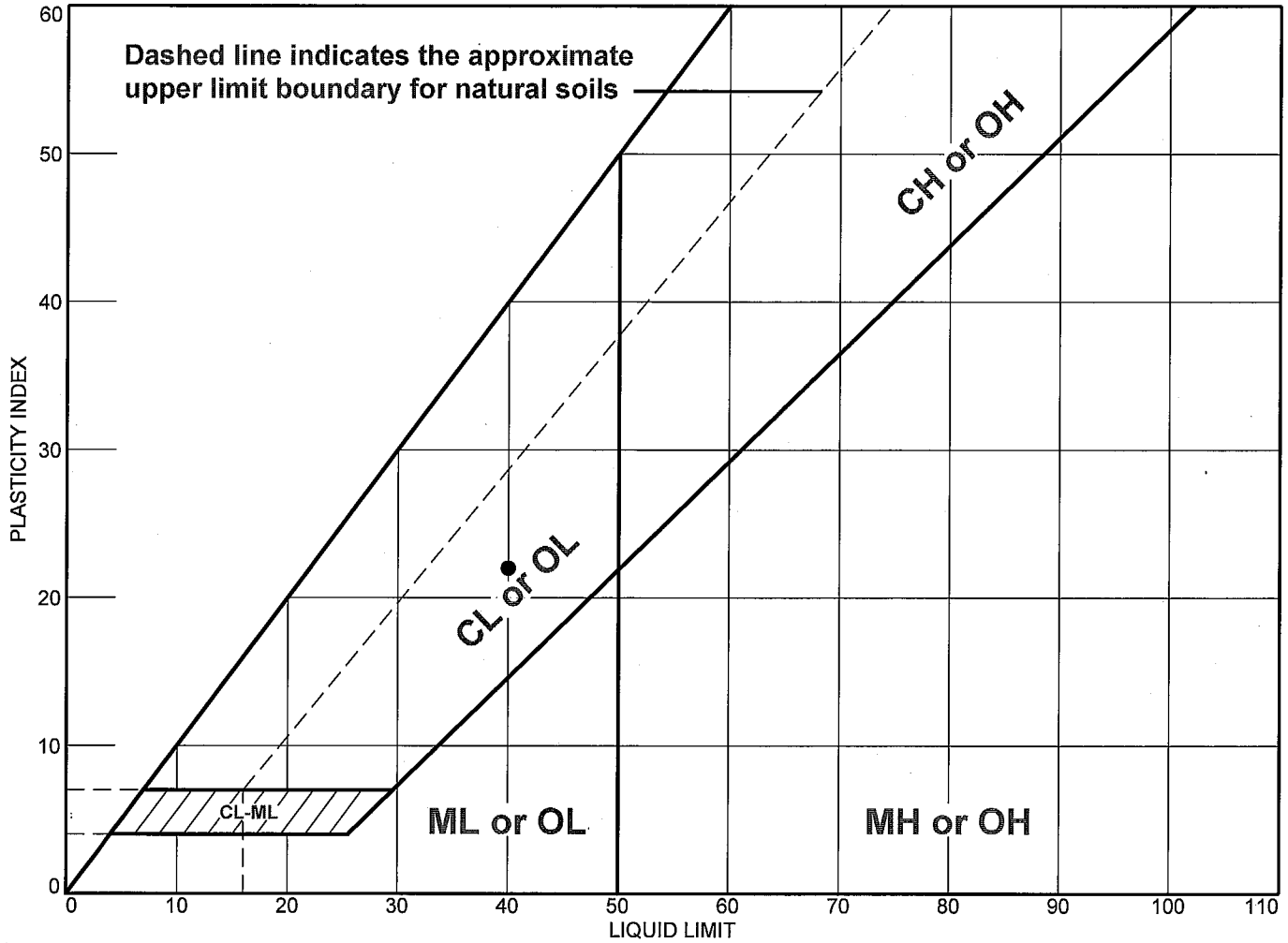
SAMPLE IDENTIFICATION: B-2, 25-SS

PROJECT NUMBER:	09-113	March 3, 2009	DGC Kelso Geotech

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

5040 Robert J. Mathews Blvd., El Dorado Hills, CA 95762
Phone: (916) 939-3460 FAX: (916) 939-3507

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●		40	18	22		63.3	

Project No. 09-113 **Client:** CH2MHILL

Project: DGC Kelso Geotech

#PO 932622

● **Location:** B-1, 1-SS **Depth:** 0 **Sample Number:** S10015

Remarks:

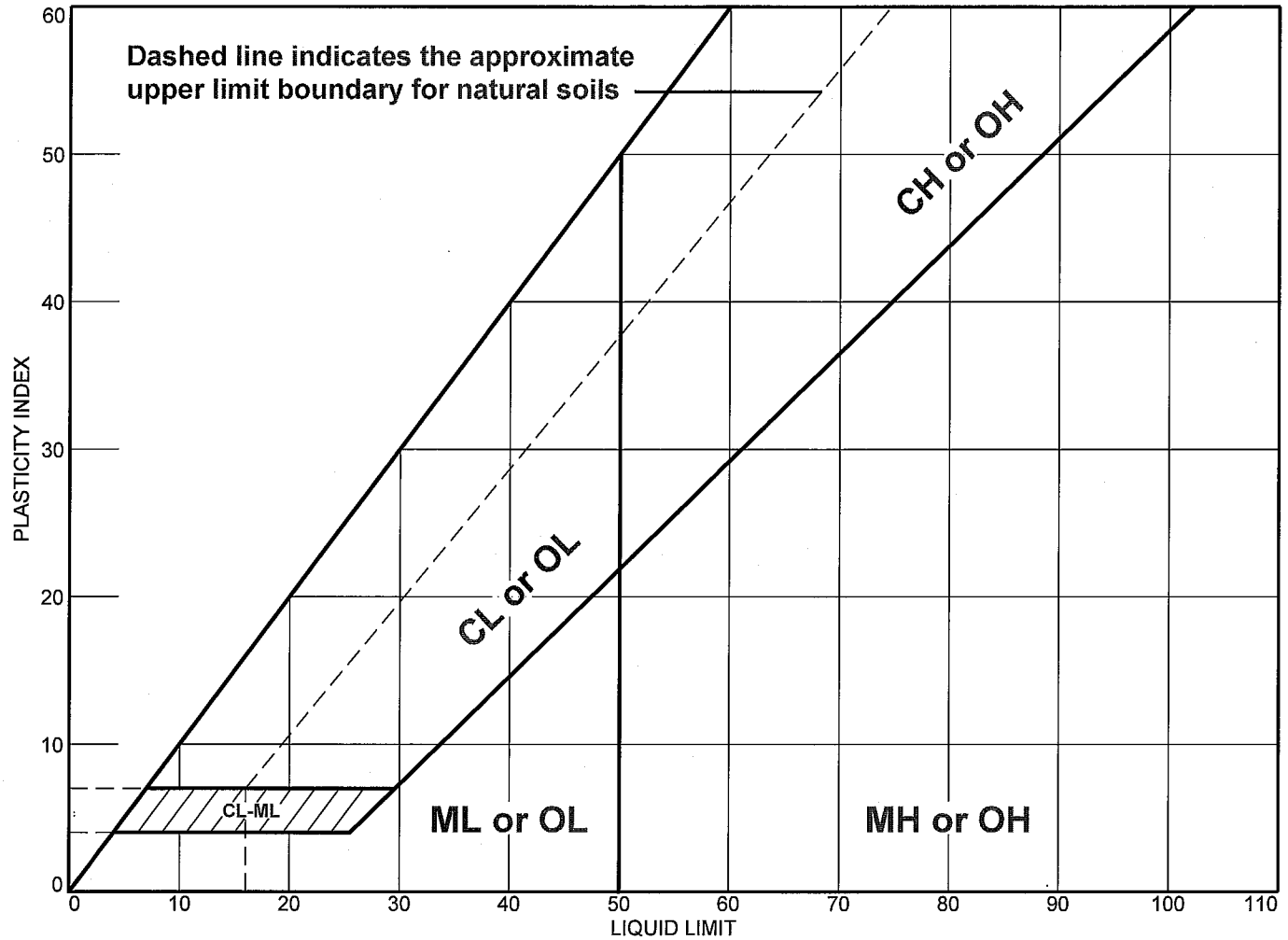
SIERRA TESTING LABS, INC.

El Dorado Hills, CA

Figure

Tested By: wm **Checked By:** mn

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●		NV	NP	NP		59.9	

Project No. 09-113 **Client:** CH2MHILL

Project: DGC Kelso Geotech

#PO 932622

● **Location:** B-1, 6-SS **Depth:** 15.0 **Sample Number:** S10017

Remarks:

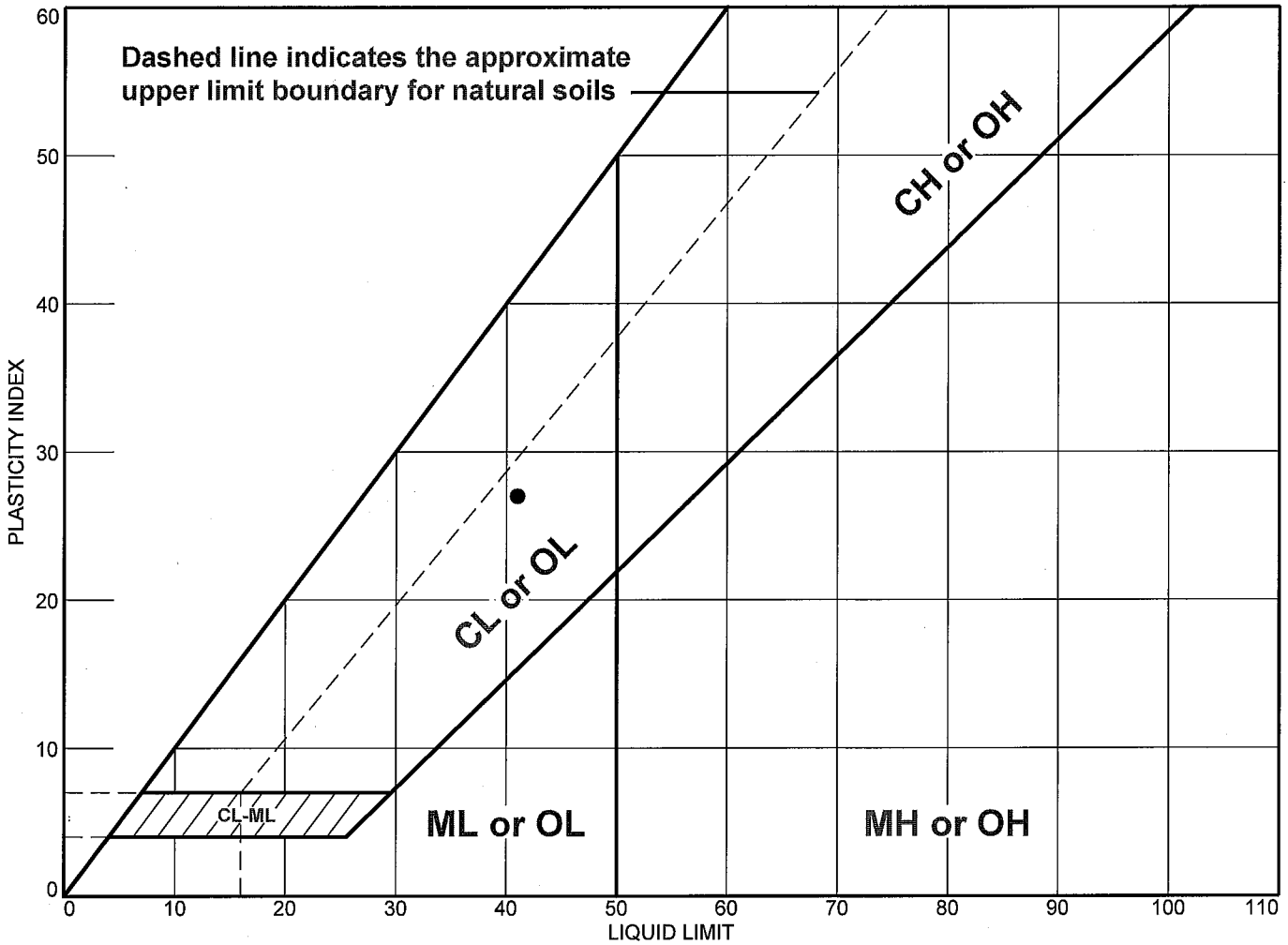
SIERRA TESTING LABS, INC.

El Dorado Hills, CA

Figure

Tested By: mw **Checked By:** mp

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●		41	14	27		71.4	

Project No. 09-113 **Client:** CH2MHILL

Project: DGC Kelso Geotech

#PO 932622

● **Location:** B-2, 25-SS **Depth:** 6.5 **Sample Number:** S10022

Remarks:

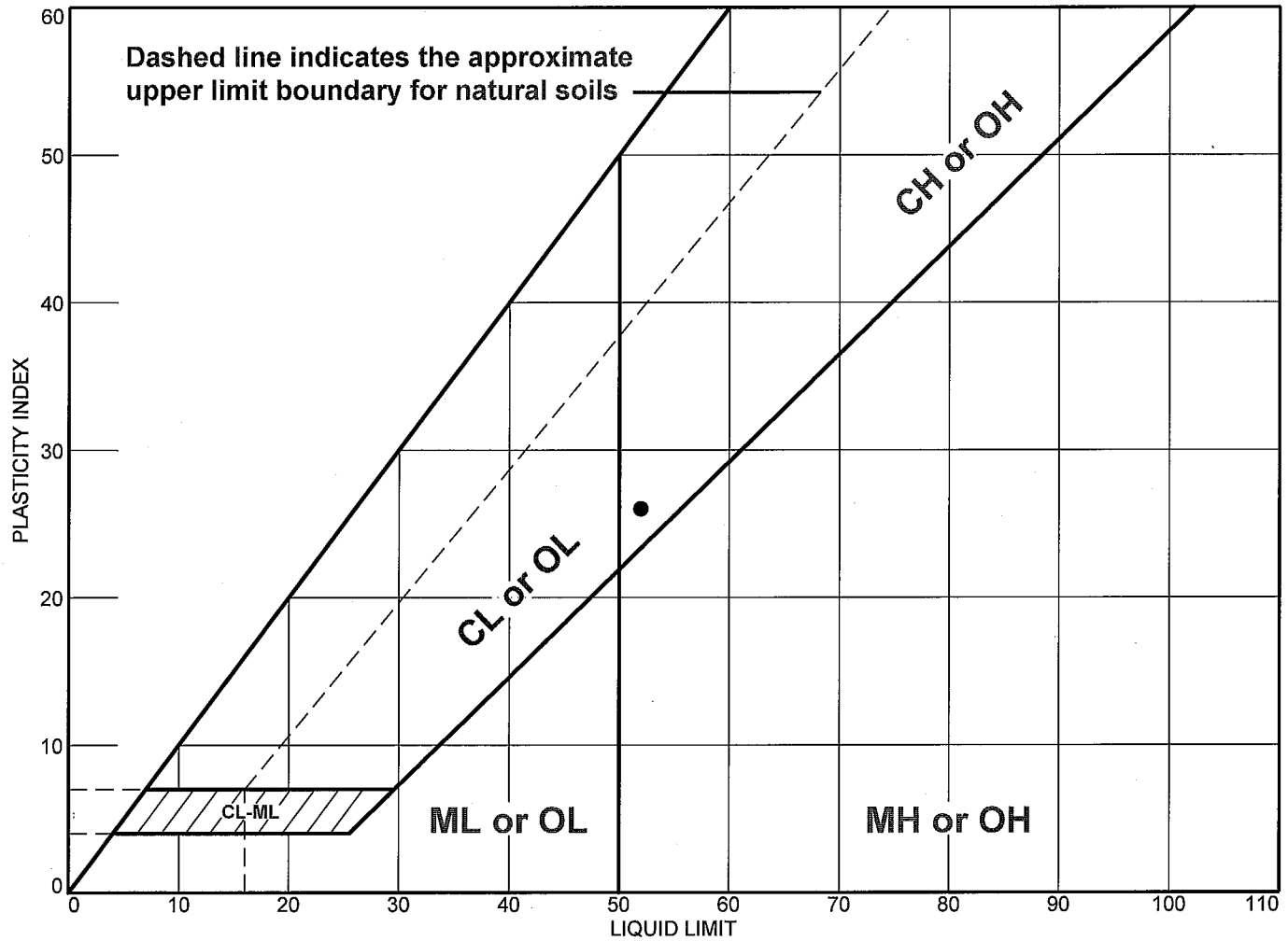
SIERRA TESTING LABS, INC.

El Dorado Hills, CA

Figure

Tested By: mjw **Checked By:** mn

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●		52	26	26		73.5	

Project No. 09-113 **Client:** CH2MHILL

Project: DGC Kelso Geotech

#PO 932622

● **Loc.:** B-2, Core (Homogenius Portion) **Depth:** 58.7 **Sample No.:** S10026

Remarks:

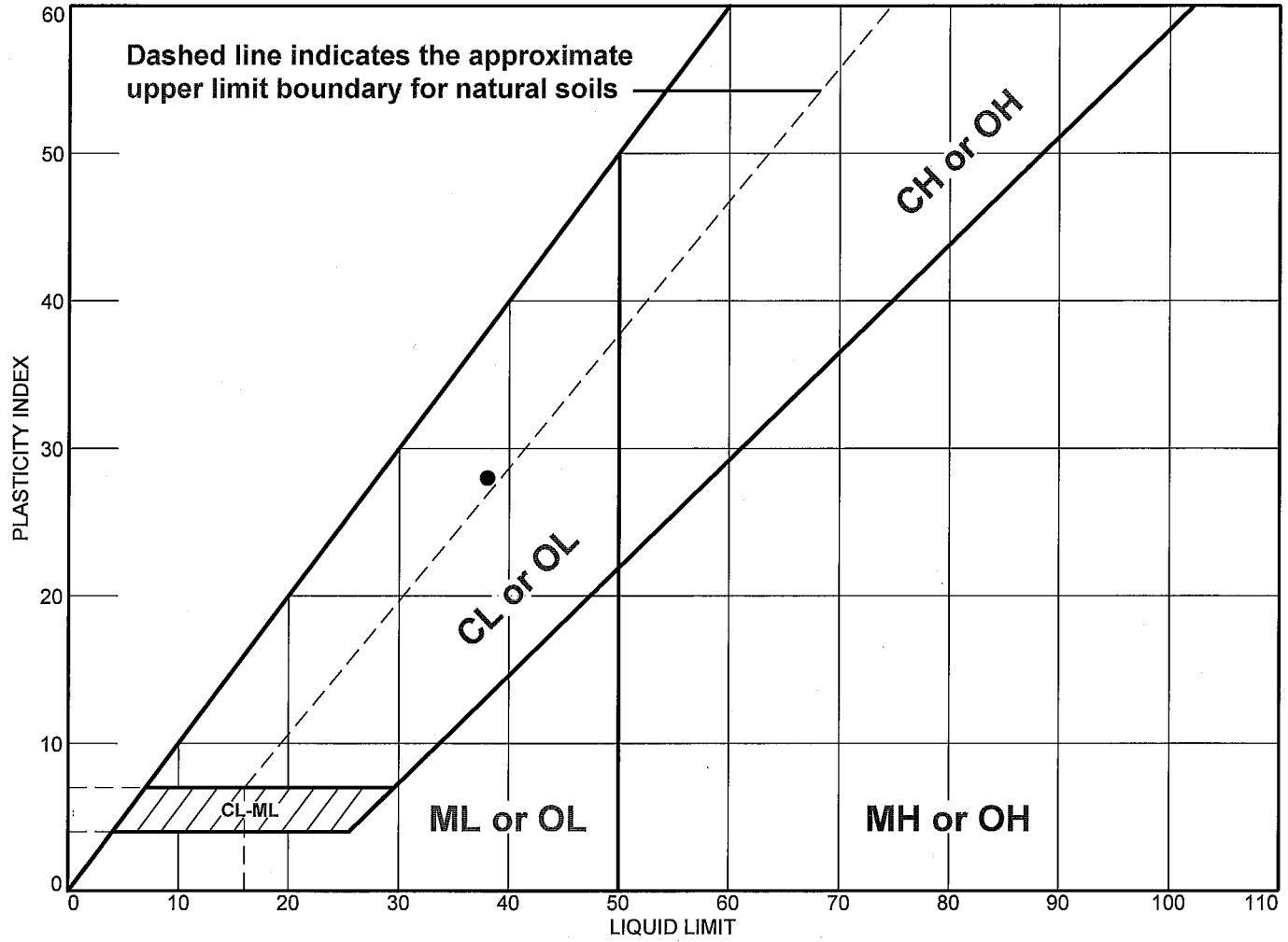
SIERRA TESTING LABS, INC.

El Dorado Hills, CA

Figure

Tested By: mjw **Checked By:** mn

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●		38	10	28		81.6	

Project No. 09-113 **Client:** CH2MHILL

Project: DGC Kelso Geotech

#PO 932622

● **Location:** B-3, 15-SS **Depth:** 0.0 **Sample Number:** S10029

Remarks:

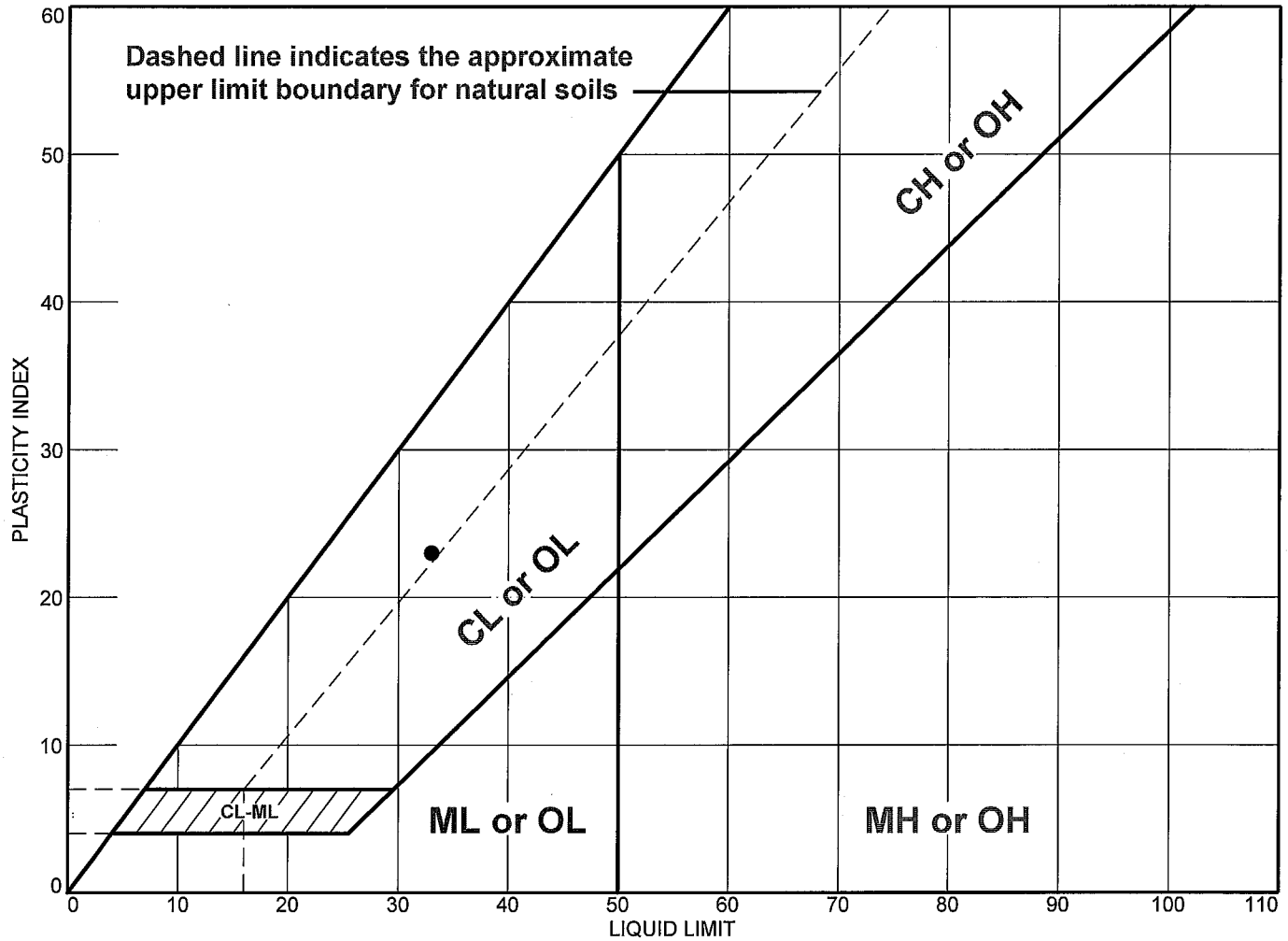
SIERRA TESTING LABS, INC.

El Dorado Hills, CA

Figure

Tested By: wm **Checked By:** cw

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●		33	10	23		66.6	

Project No. 09-113 **Client:** CH2MHILL

Project: DGC Kelso Geotech

#PO 932622

● **Location:** B-3, 18-SS **Depth:** 10.0 **Sample Number:** S10032

Remarks:

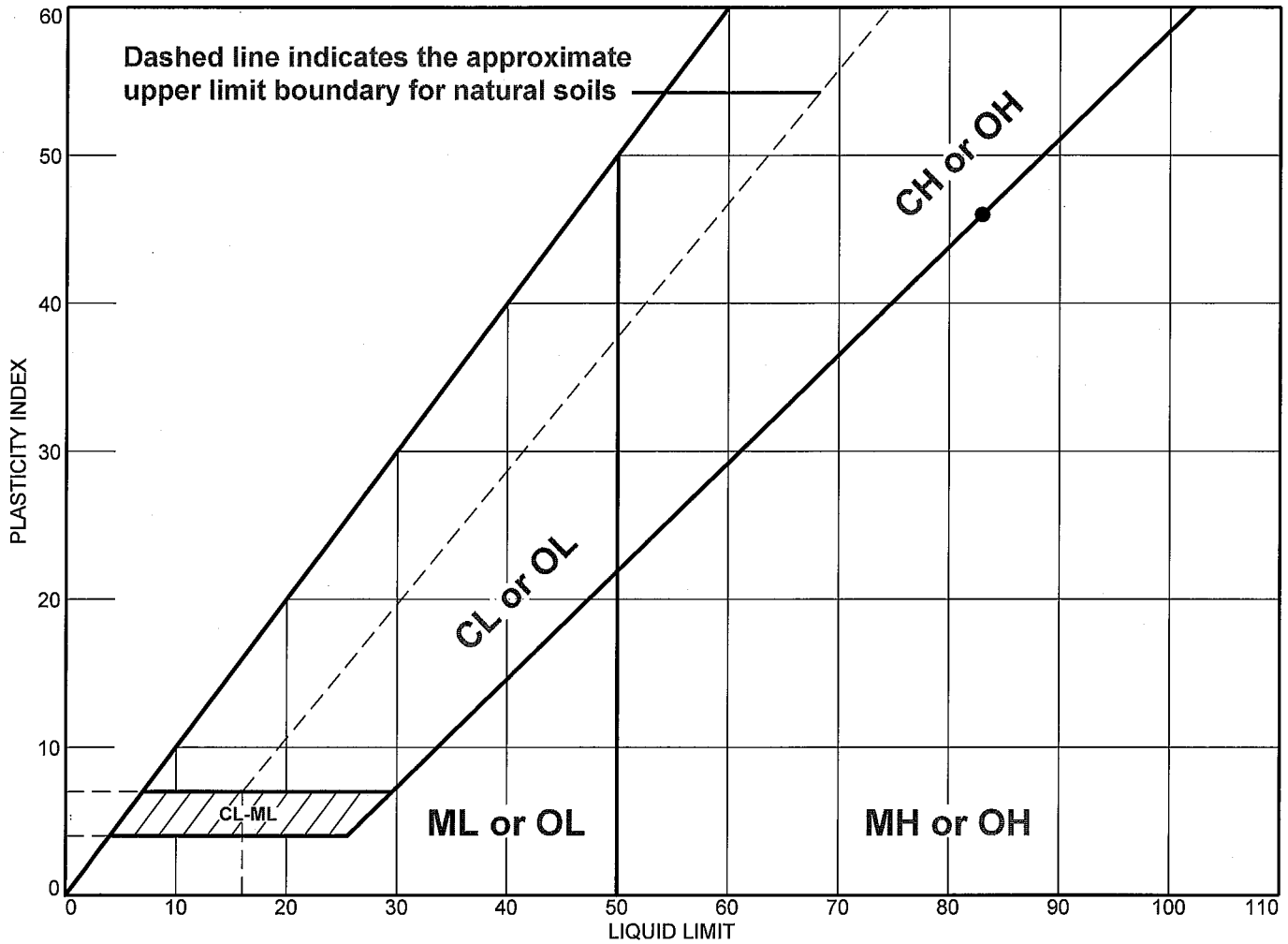
SIERRA TESTING LABS, INC.

El Dorado Hills, CA

Figure

Tested By: wm **Checked By:** cmw

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●		83	37	46	96.0	73.8	CH

Project No. 09-113 **Client:** CH2MHILL

Project: DGC Kelso Geotech

#PO 932622

● **Loc.:** B-3, Core (Black Sample) **Depth:** 34.0 **Sample No.:** S10035

Remarks:

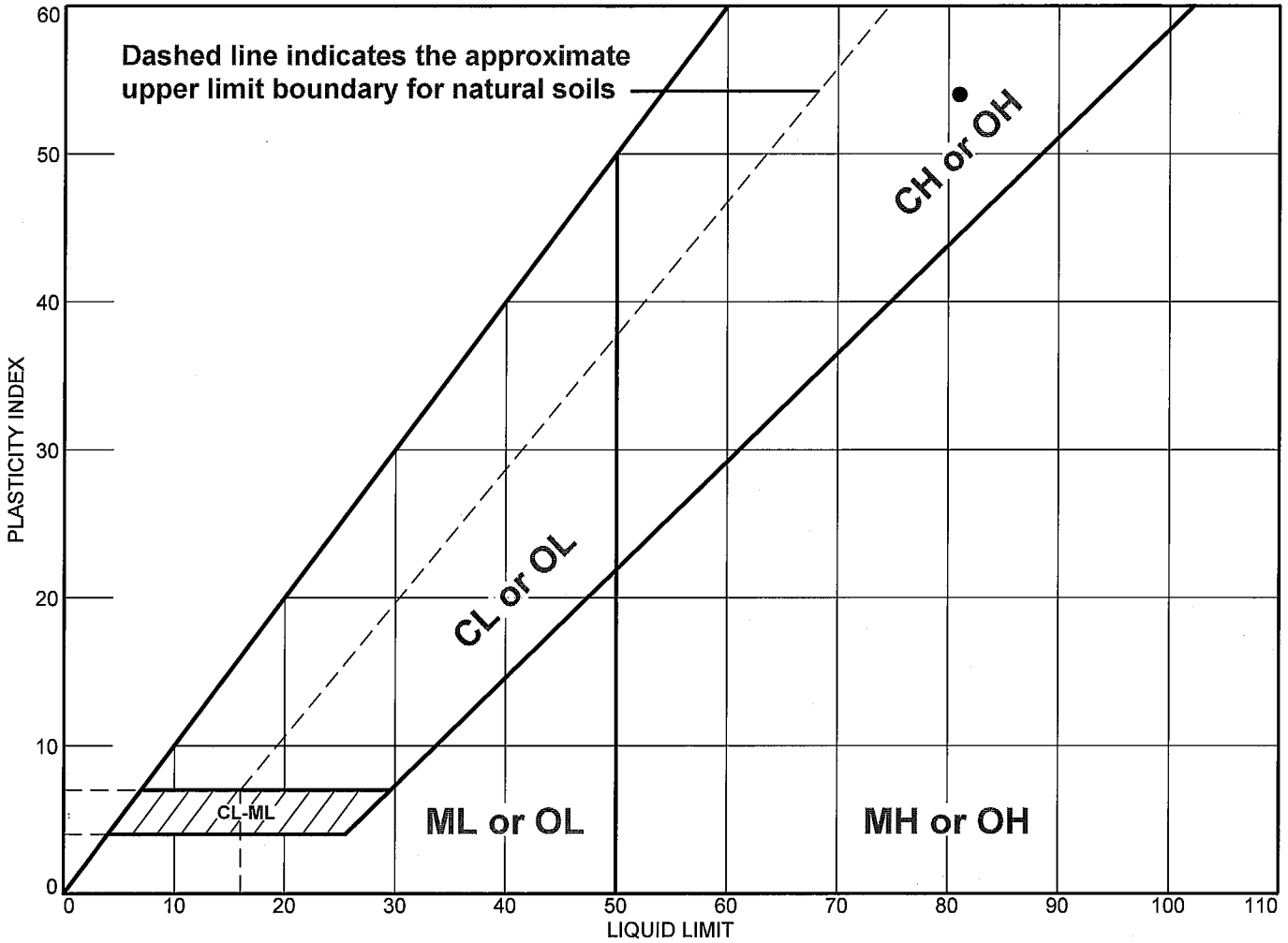
SIERRA TESTING LABS, INC.

El Dorado Hills, CA

Figure

Tested By: mjw **Checked By:** cmw

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●		81	27	54	95.2	62.7	CH

Project No. 09-113 **Client:** CH2MHILL

Project: DGC Kelso Geotech

#PO 932622

● **Location:** B-3, Core **Depth:** 30.0 **Sample Number:** S10034

Remarks:

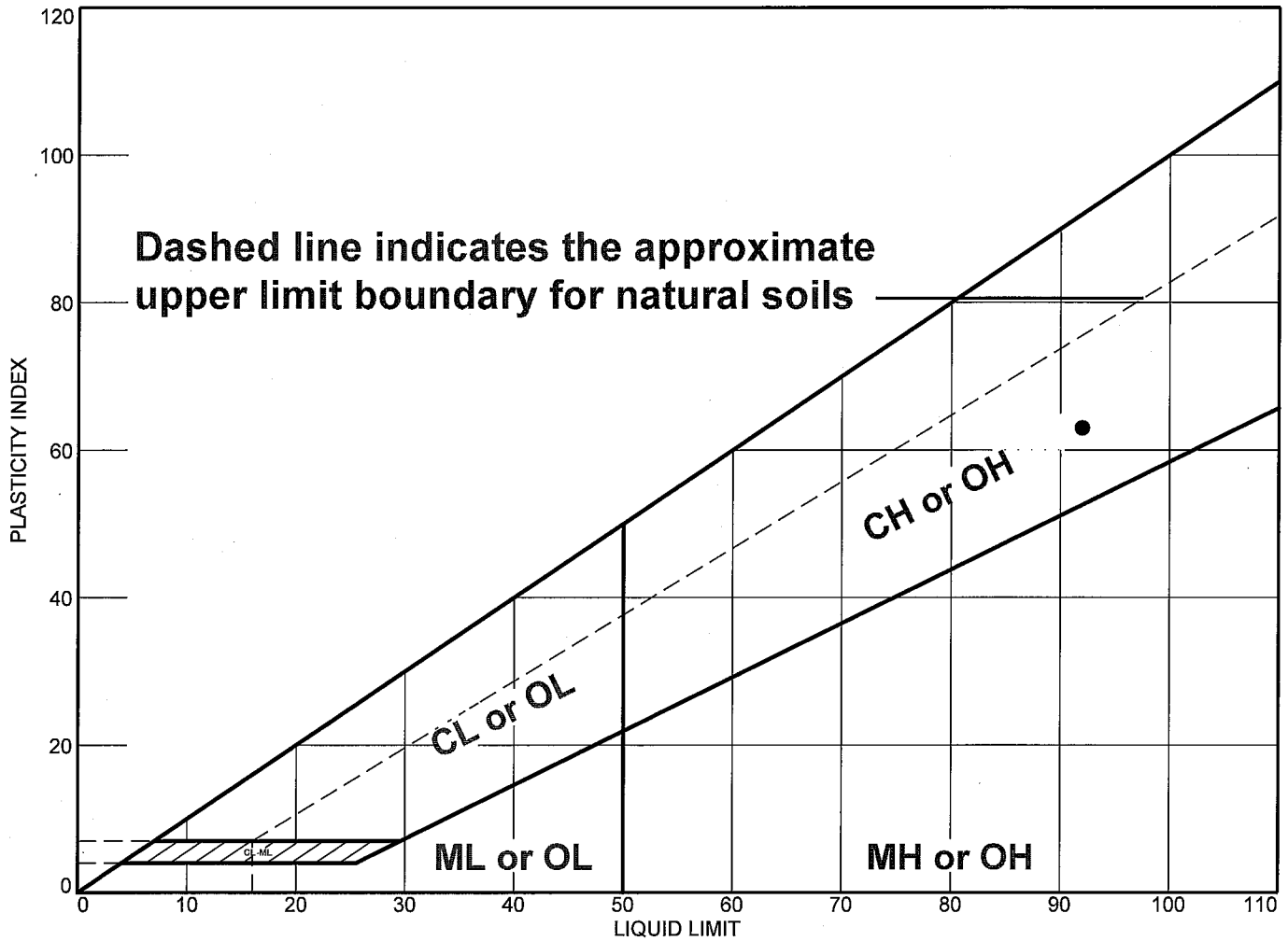
SIERRA TESTING LABS, INC.

El Dorado Hills, CA

Figure

Tested By: mjw **Checked By:** mn

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●		92	29	63	96.8	69.6	CH

Project No. 09-113 **Client:** CH2MHILL

Project: DGC Kelso Geotech

#PO 932622

● **Loc.:** B-3, Core (Tan Sample) **Depth:** 34.0 **Sample No.:** S10035

Remarks:

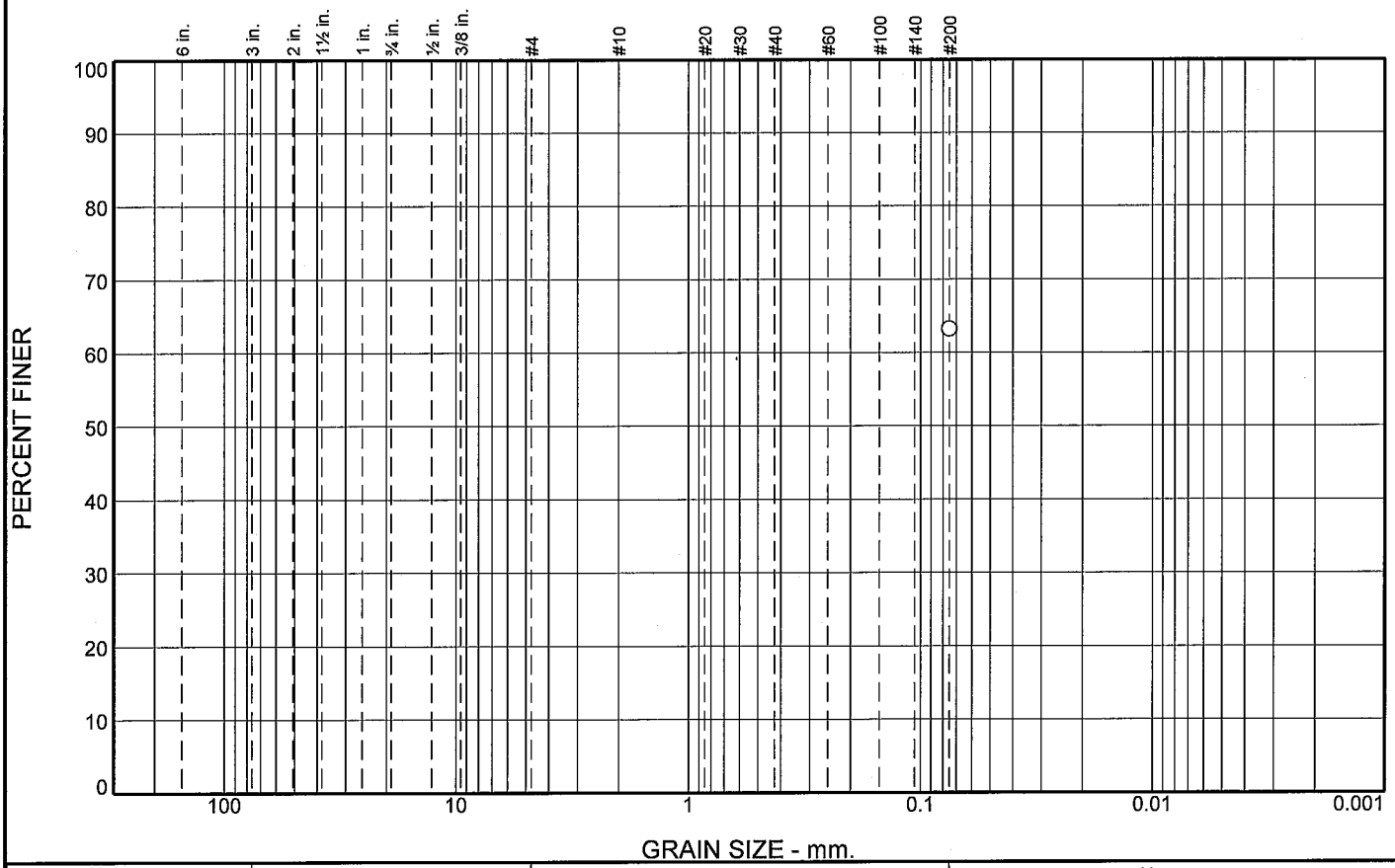
SIERRA TESTING LABS, INC.

El Dorado Hills, CA

Figure

Tested By: mjw **Checked By:** cmw

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						63.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	63.3		

* (no specification provided)

Soil Description

Atterberg Limits

PL= 18 LL= 40 PI= 22

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

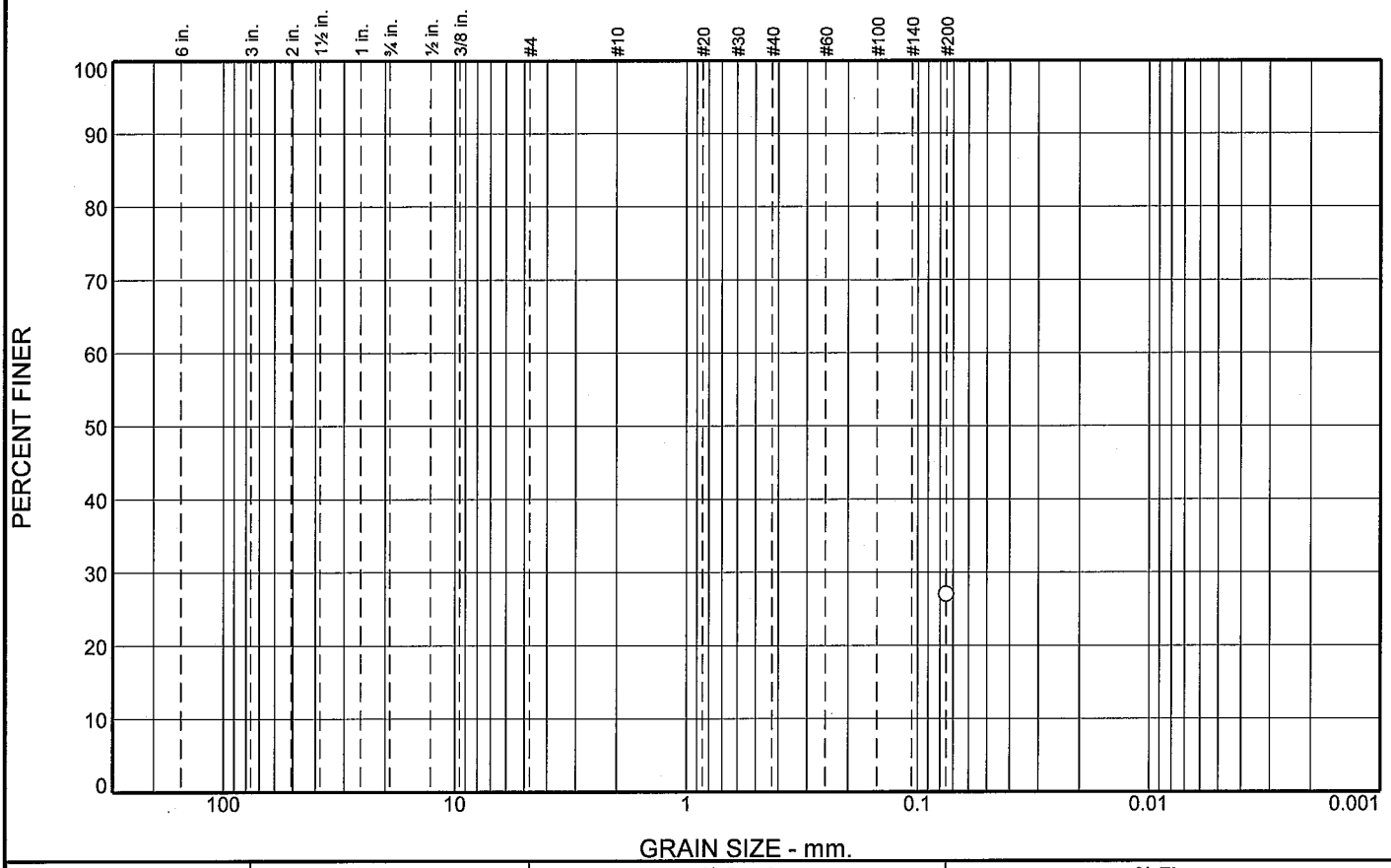
Location: B-1, 1-SS
Sample Number: S10015 **Depth:** 0 **Date:** 3/3//09

SIERRA TESTING LABS, INC.
El Dorado Hills, CA

Client: CH2MHILL
Project: DGC Kelso Geotech
#PO 932622
Project No: 09-113 **Figure**

Tested By: js **Checked By:** mn

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						27.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	27.1		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

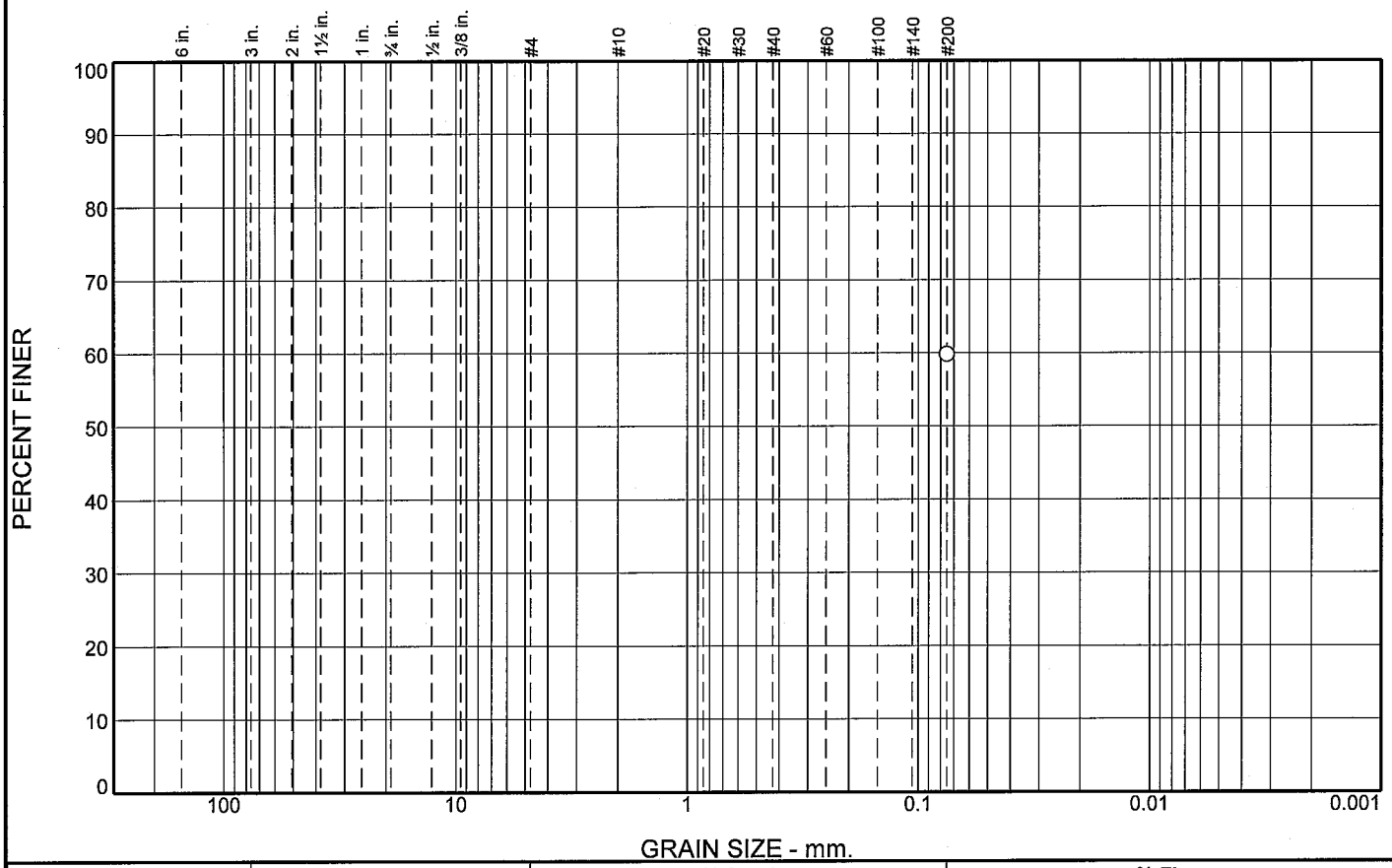
Location: B-1, 2-MC
Sample Number: S10016 **Depth:** 5.0 **Date:** 3/3/09

SIERRA TESTING LABS, INC.
El Dorado Hills, CA

Client: CH2MHILL
Project: DGC Kelso Geotech
#PO 932622
Project No: 09-113 **Figure**

Tested By: js **Checked By:** mn

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						59.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	59.9		

* (no specification provided)

Soil Description

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

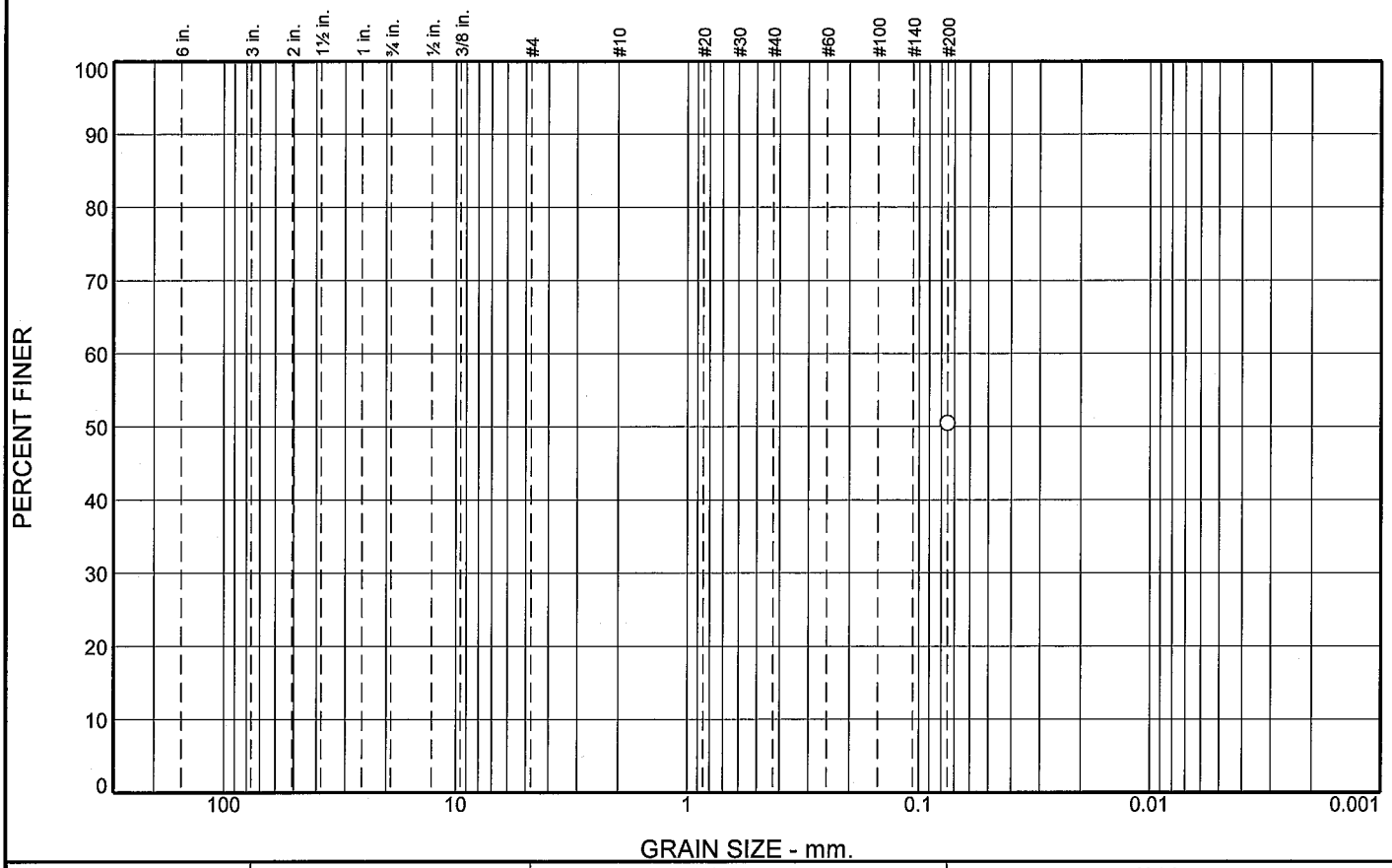
Location: B-1, 6-SS
Sample Number: S10017 **Depth:** 15.0 **Date:** 3/3/09

SIERRA TESTING LABS, INC.
El Dorado Hills, CA

Client: CH2MHILL
Project: DGC Kelso Geotech
#PO 932622
Project No: 09-113 **Figure**

Tested By: js **Checked By:** mn

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						50.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	50.5		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

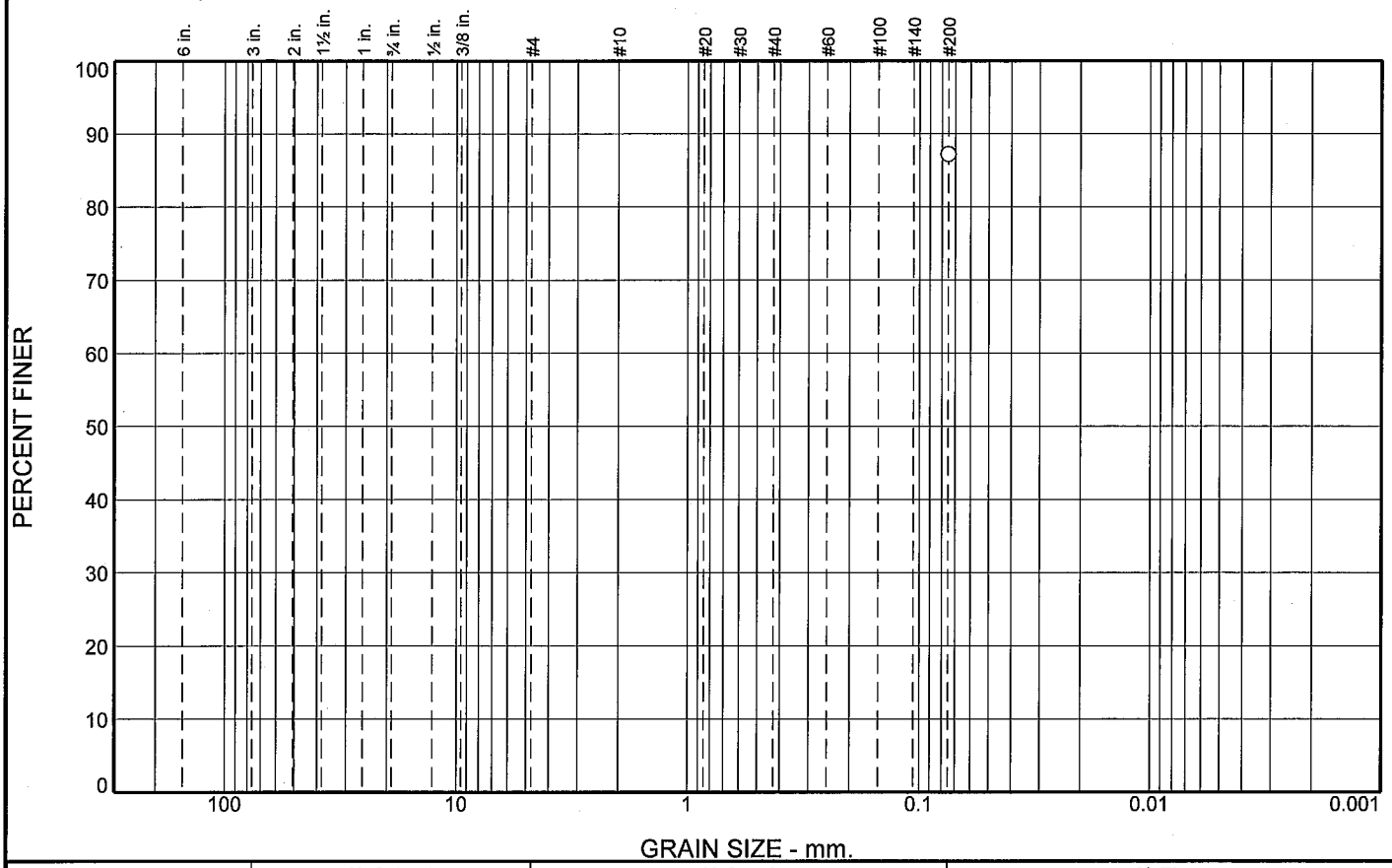
Location: B-1, 8-SS
Sample Number: S10018 **Depth:** 21.5 **Date:** 3/3/09

SIERRA TESTING LABS, INC.
El Dorado Hills, CA

Client: CH2MHILL
Project: DGC Kelso Geotech
#PO 932622
Project No: 09-113 **Figure**

Tested By: js **Checked By:** mn

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						87.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	87.3		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

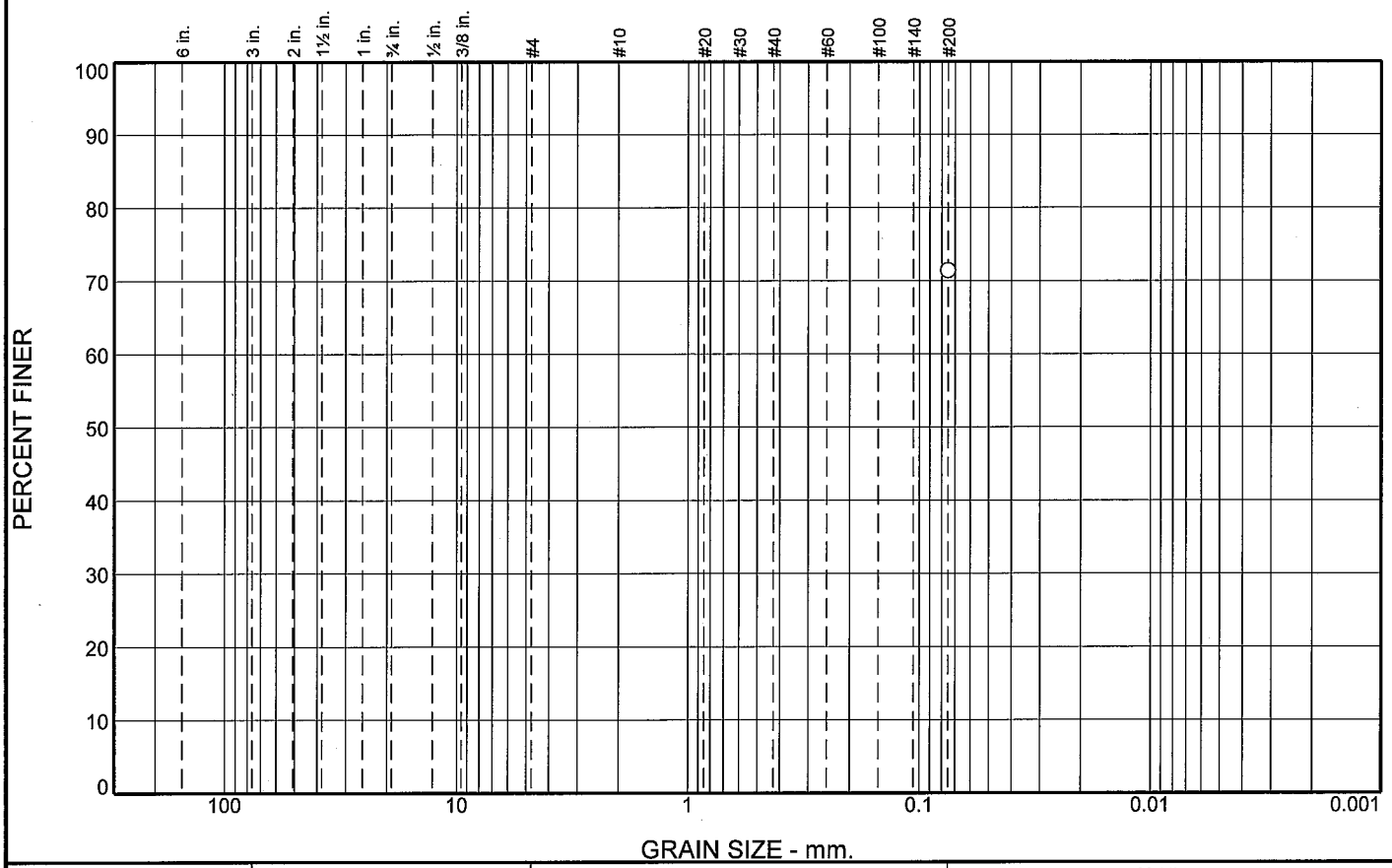
Location: B-1, 13-MC
Sample Number: S10020 **Depth:** 40.0 **Date:** 3/3/09

SIERRA TESTING LABS, INC.
El Dorado Hills, CA

Client: CH2MHILL
Project: DGC Kelso Geotech
#PO 932622
Project No: 09-113 **Figure**

Tested By: js **Checked By:** mn

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						71.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	71.4		

* (no specification provided)

Soil Description

Atterberg Limits

PL= 14 LL= 41 PI= 27

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

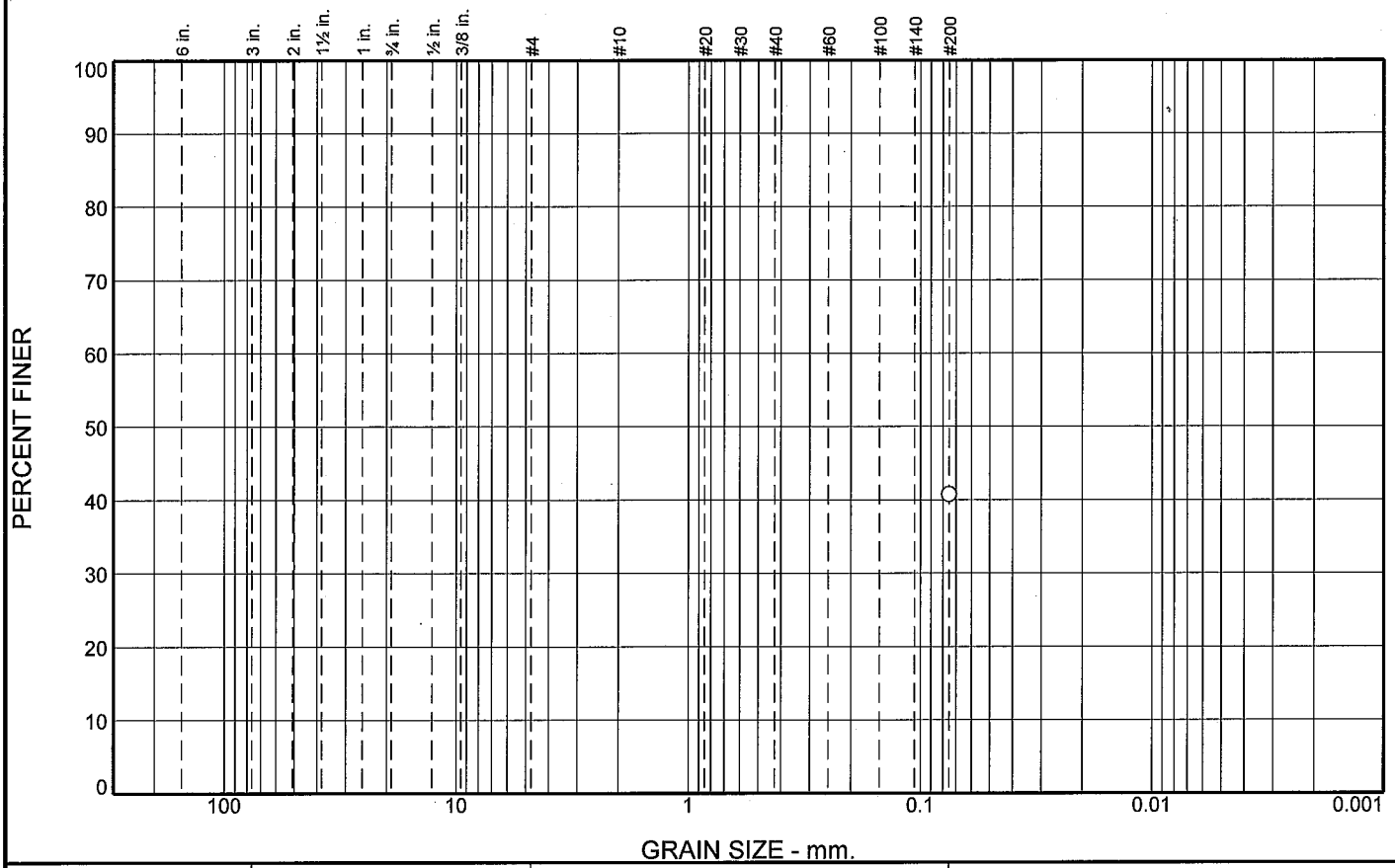
Location: B-2, 25-SS
Sample Number: S10022 **Depth:** 6.5 **Date:** 3/3/09

SIERRA TESTING LABS, INC.
El Dorado Hills, CA

Client: CH2MHILL
Project: DGC Kelso Geotech #PO 932622
Project No: 09-113 **Figure**

Tested By: mpw **Checked By:** cmw

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						40.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	40.8		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

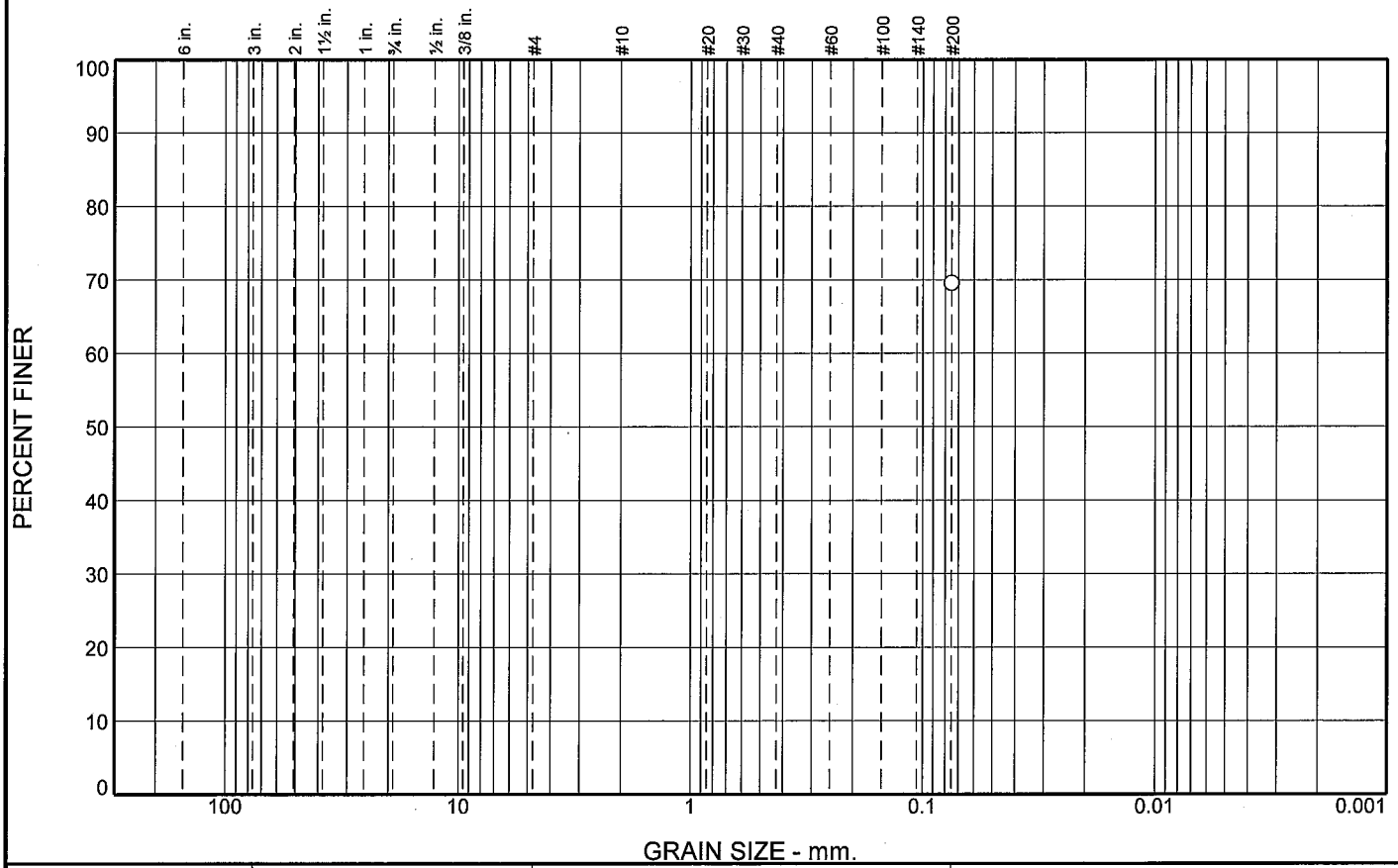
Location: B-2, 29-SS
Sample Number: S10024 **Depth:** 20.0 **Date:** 3/3/09

SIERRA TESTING LABS, INC.
El Dorado Hills, CA

Client: CH2MHILL
Project: DGC Kelso Geotech #PO 932622
Project No: 09-113 **Figure**

Tested By: js **Checked By:** mn

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						69.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	69.6		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

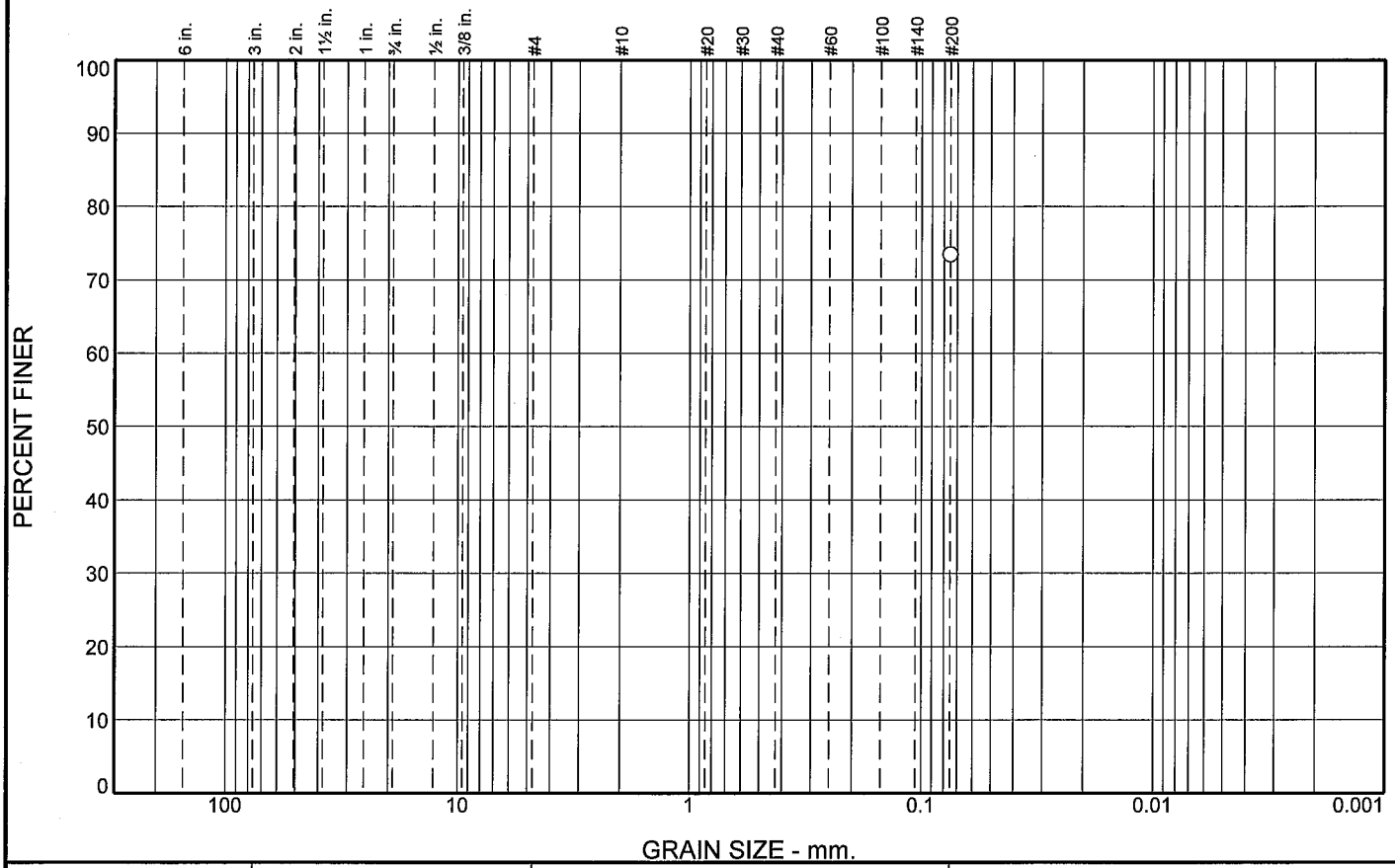
Location: B-2, Core
Sample Number: S10025 **Depth:** 45.0 **Date:** 3/3/09

SIERRA TESTING LABS, INC.
El Dorado Hills, CA

Client: CH2MHILL
Project: DGC Kelso Geotech
#PO 932622
Project No: 09-113 **Figure**

Tested By: mpw **Checked By:** cmw

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						73.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	73.5		

* (no specification provided)

Soil Description

Atterberg Limits

PL= 26 LL= 52 PI= 26

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

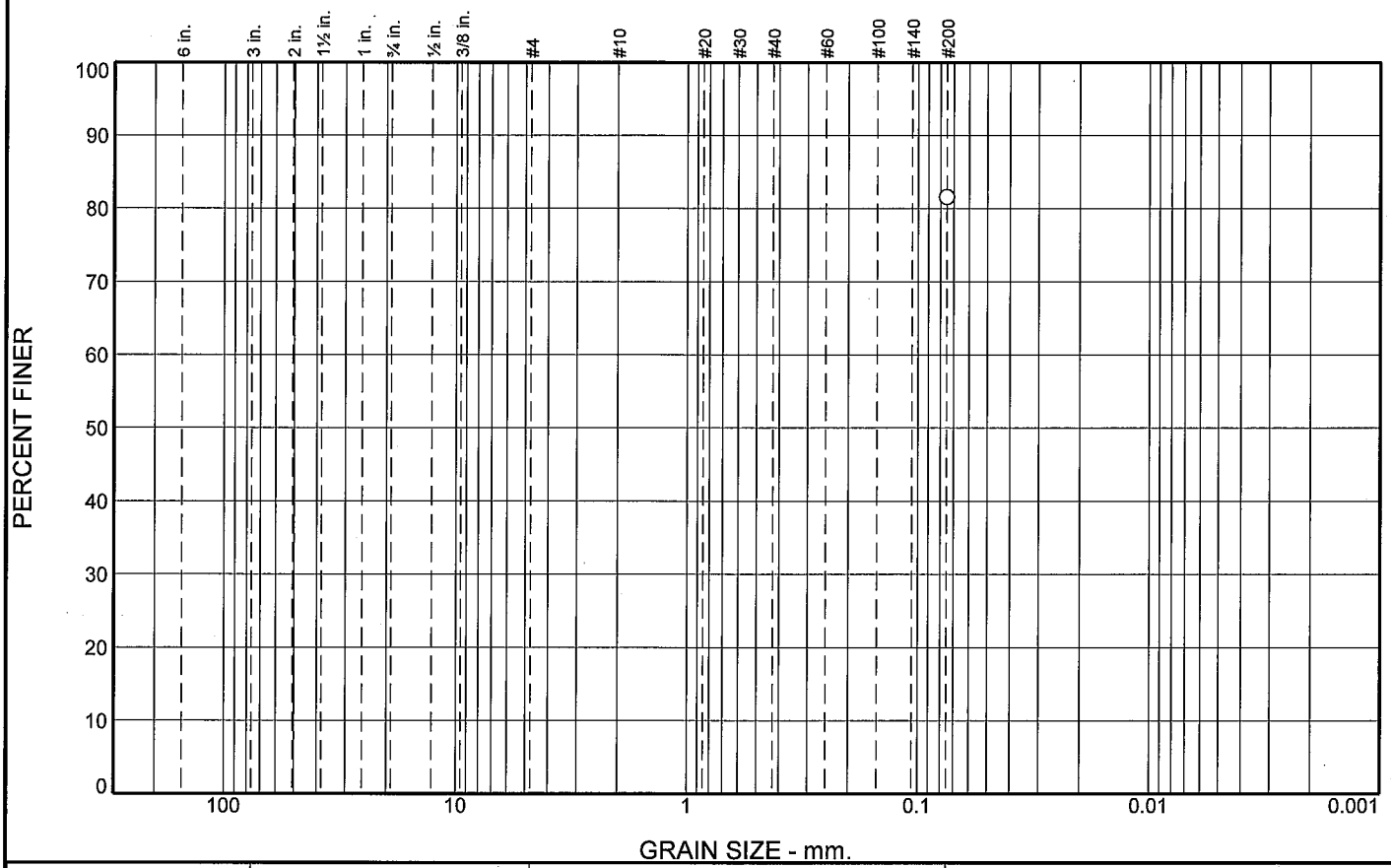
Location: B-2, Core (Homogenius Portion)
Sample Number: S10026 **Depth:** 58.7 **Date:** 3/3/09

SIERRA TESTING LABS, INC.
El Dorado Hills, CA

Client: CH2MHILL
Project: DGC Kelso Geotech #PO 932622
Project No: 09-113 **Figure**

Tested By: mpw **Checked By:** cmw

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						81.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	81.6		

* (no specification provided)

Soil Description

Atterberg Limits

PL= 10 LL= 38 PI= 28

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

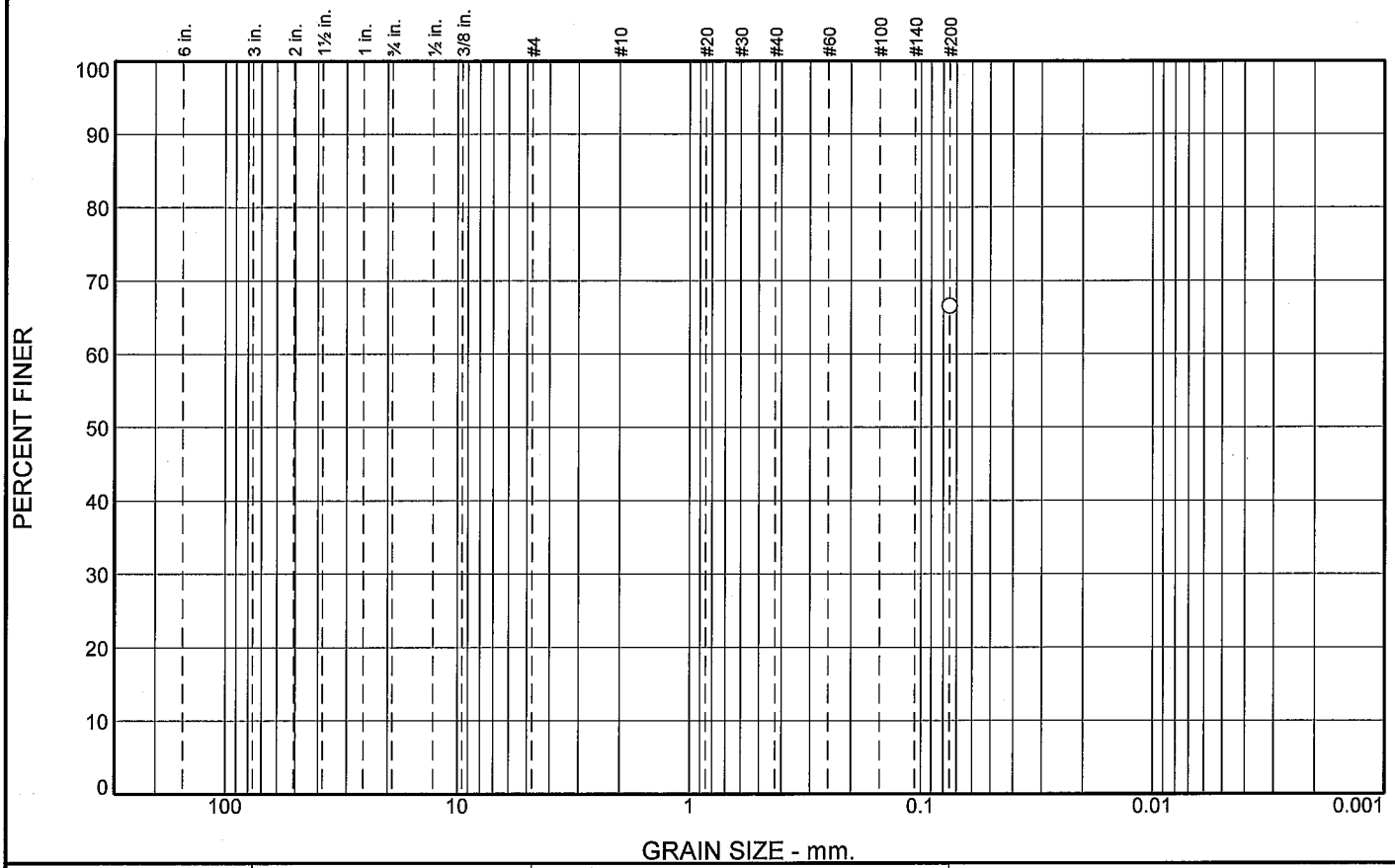
Location: B-3, 15-SS
Sample Number: S10029 **Depth:** 0.0 **Date:** 3/3/09

SIERRA TESTING LABS, INC.
El Dorado Hills, CA

Client: CH2MHILL
Project: DGC Kelso Geotech
#PO 932622
Project No: 09-113 **Figure**

Tested By: js **Checked By:** mn

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						66.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	66.6		

* (no specification provided)

Soil Description

Atterberg Limits

PL= 10 LL= 33 PI= 23

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

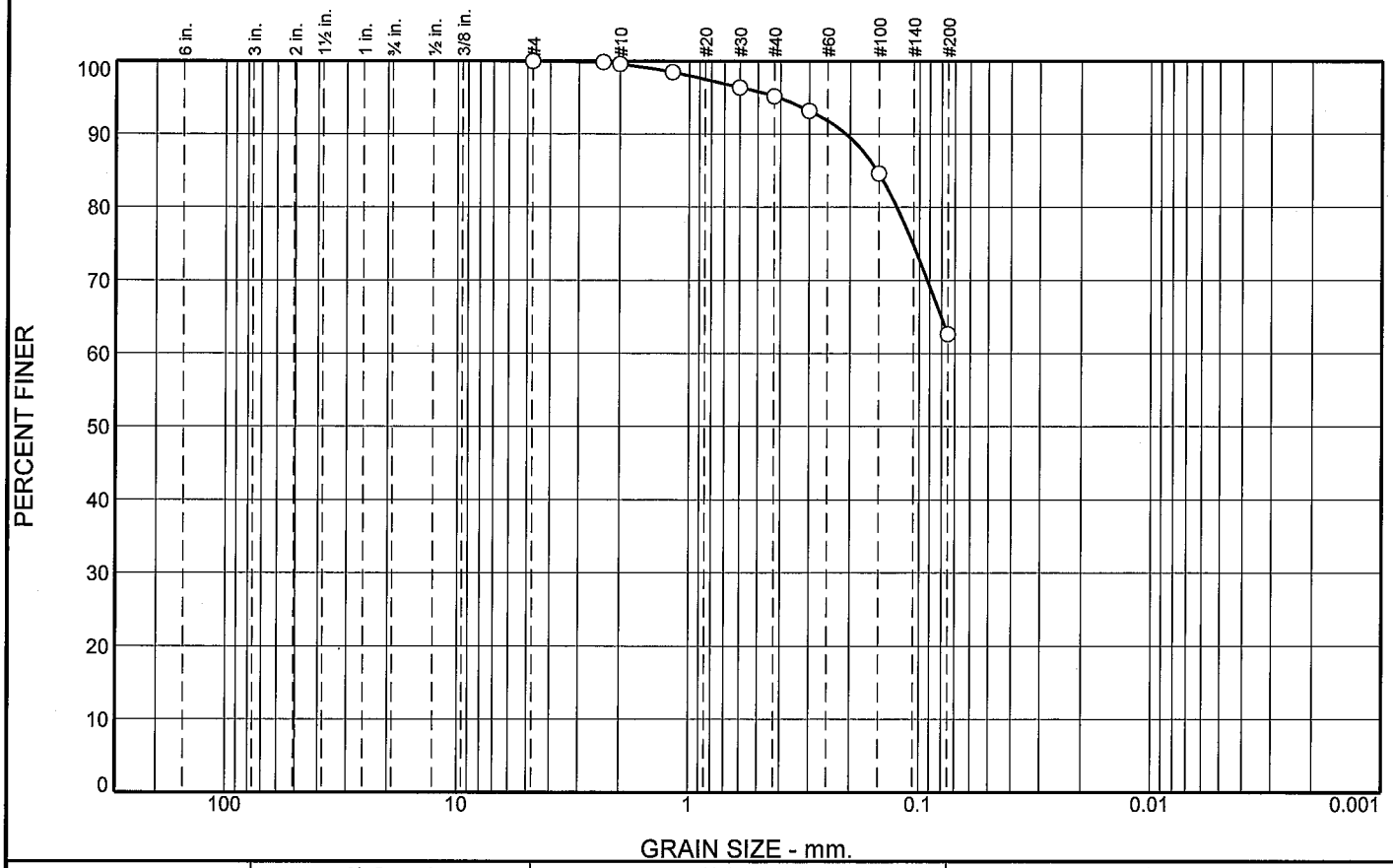
Location: B-3, 18-SS
Sample Number: S10032 **Depth:** 10.0 **Date:** 3/3/09

SIERRA TESTING LABS, INC.
El Dorado Hills, CA

Client: CH2MHILL
Project: DGC Kelso Geotech
#PO 932622
Project No: 09-113 **Figure**

Tested By: js **Checked By:** mn

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.4	4.4	32.5	62.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#8	99.9		
#10	99.6		
#16	98.5		
#30	96.4		
#40	95.2		
#50	93.2		
#100	84.6		
#200	62.7		

* (no specification provided)

Soil Description

Atterberg Limits

PL= 27 LL= 81 PI= 54

Coefficients

D_{90}= 0.2075 D_{85}= 0.1525 D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CH AASHTO= A-7-6(32)

Remarks

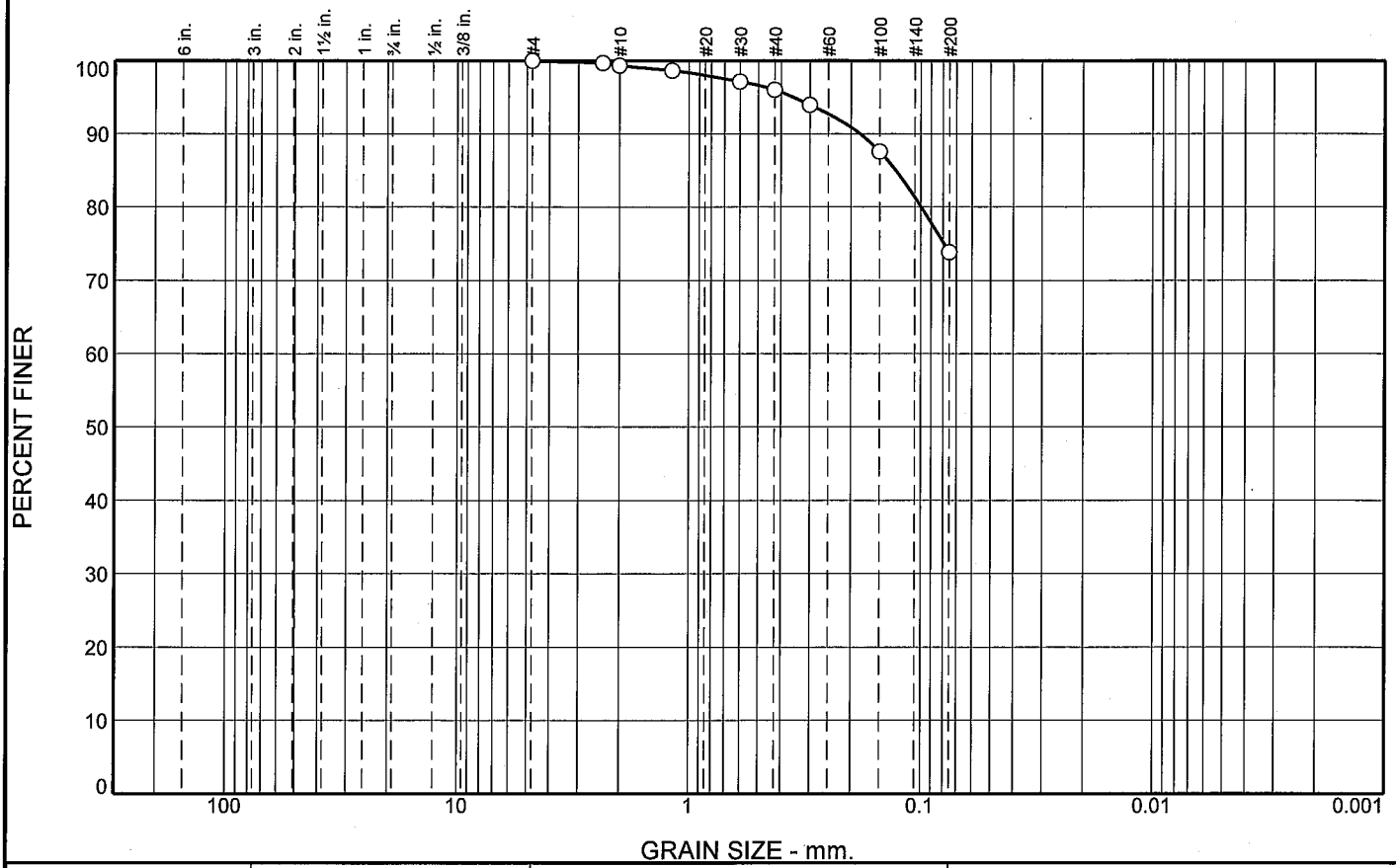
Location: B-3, Core
Sample Number: S10034 **Depth:** 30.0 **Date:** 3/3/09

SIERRA TESTING LABS, INC.
El Dorado Hills, CA

Client: CH2MHILL
Project: DGC Kelso Geotech #PO 932622
Project No: 09-113 **Figure**

Tested By: jl **Checked By:** cw

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.6	3.4	22.2	73.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#8	99.7		
#10	99.4		
#16	98.6		
#30	97.1		
#40	96.0		
#50	94.0		
#100	87.6		
#200	73.8		

* (no specification provided)

Soil Description

Atterberg Limits

PL= 37 LL= 83 PI= 46

Coefficients

D_{90}= 0.1819 D_{85}= 0.1278 D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CH AASHTO= A-7-5(37)

Remarks

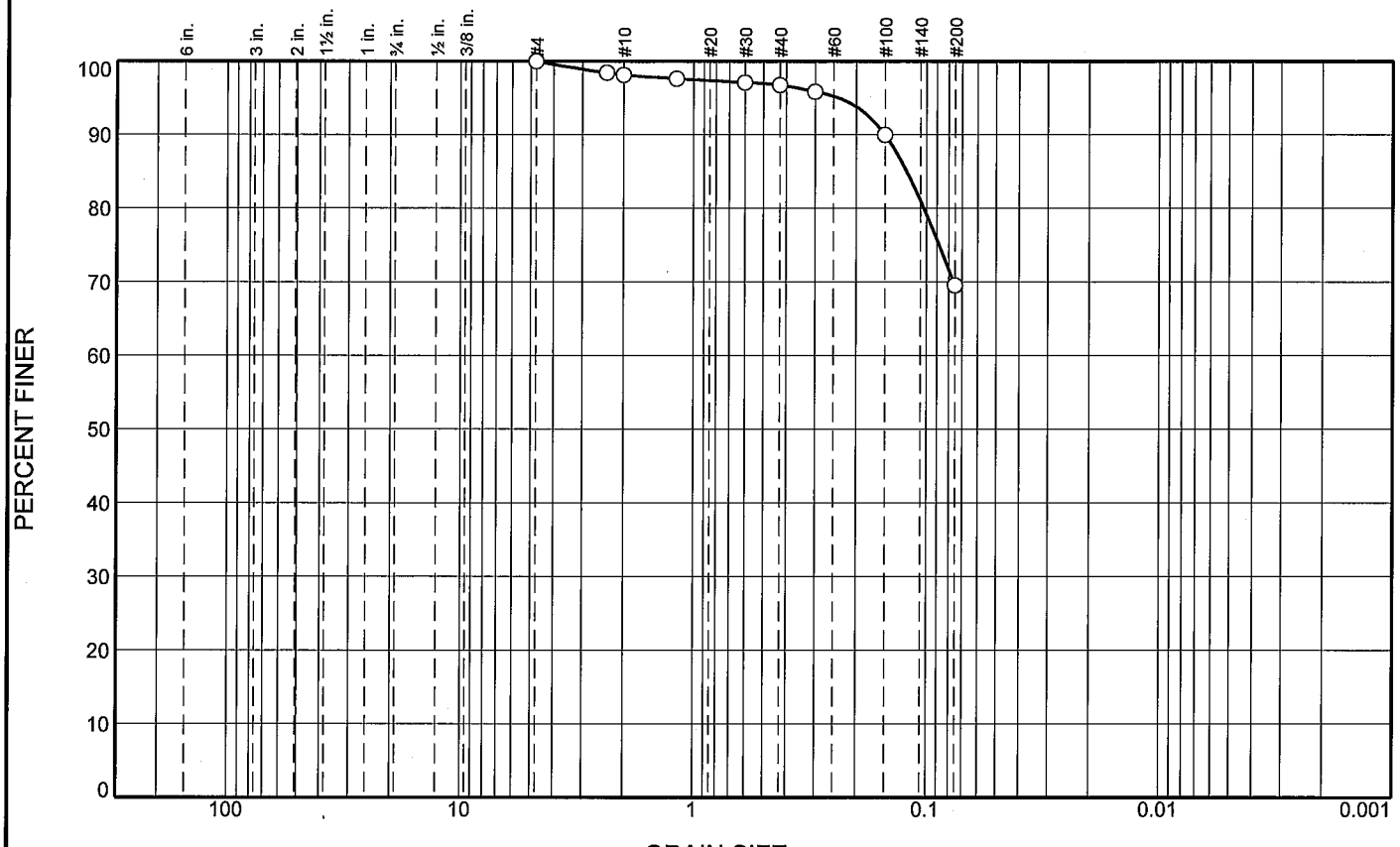
Location: B-3, Core (Black Sample)
Sample Number: S10035 **Depth:** 34.0 **Date:** 3/3/09

SIERRA TESTING LABS, INC.
El Dorado Hills, CA

Client: CH2MHILL
Project: DGC Kelso Geotech #PO 932622
Project No: 09-113 **Figure**

Tested By: rl **Checked By:** mn

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	1.8	1.4	27.2	69.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#8	98.4		
#10	98.2		
#16	97.6		
#30	97.1		
#40	96.8		
#50	95.9		
#100	90.0		
#200	69.6		

* (no specification provided)

Soil Description

Atterberg Limits

PL= 29 LL= 92 PI= 63

Coefficients

D_{90}= 0.1500 D_{85}= 0.1211 D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CH AASHTO= A-7-6(45)

Remarks

Location: B-3, Core (Tan Sample)
Sample Number: S10035 **Depth:** 34.0 **Date:** 3/3/09

SIERRA TESTING LABS, INC.
El Dorado Hills, CA

Client: CH2MHILL
Project: DGC Kelso Geotech
#PO 932622
Project No: 09-113 **Figure**

Tested By: rl **Checked By:** mn

MOISTURE CONTENT & UNIT WEIGHT TEST RESULTS

Sample Identification	Depth, ft.	Wet Unit Weight, lb/ft.^{3}	Dry Unit Weight, lb/ft.^{3}	Moisture Content, %
B-1, 1-SS	0			23.6
B-1, 2-MC	5			12.3
B-1, 6-22	15			10.1
B-1, 8-SS	21.5			7.9
B-1, 10-MC	30	121.4	101.5	19.6
B-1, 13-MC	40	136.8	119.0	15.0

Test Method: ASTM D2216, ASTM D2937

PROJECT NUMBER: **09-113** March 3, 2009

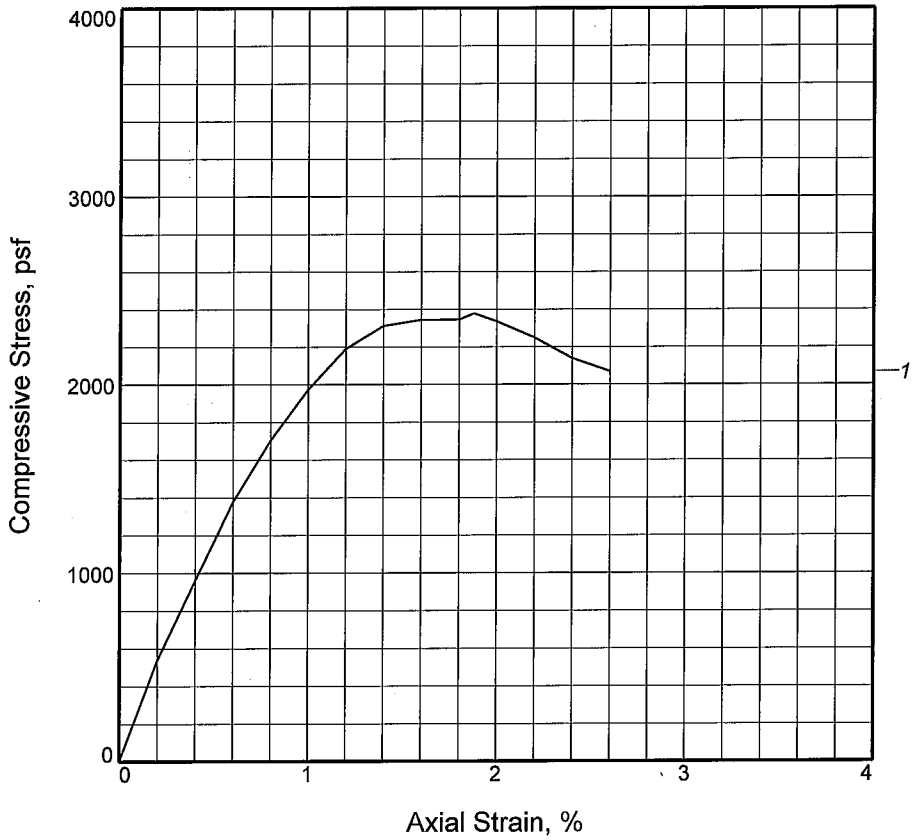
DGC Kelso Geotech

PO 932622

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

5040 Robert J. Mathews Blvd., El Dorado Hills, CA 95762
Phone: (916) 939-3460 FAX: (916) 939-3507

UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, psf	2376			
Undrained shear strength, psf	1188			
Failure strain, %	1.9			
Strain rate, in./min.	0.03			
Water content, %	18.9			
Wet density, pcf	121.4			
Dry density, pcf	102.1			
Saturation, %	78.5			
Void ratio	0.6503			
Specimen diameter, in.	2.43			
Specimen height, in.	5.00			
Height/diameter ratio	2.06			

Description:

LL =	**PL =**	**PI =**	**GS=** 2.70	**Type:** Undisturbed

Project No.: 09-113
Date Sampled: 3/3/09
Remarks:

Figure _____

Client: CH2MHILL

Project: DGC Kelso Geotech
#PO 932622
Location: B-1, 10-MC
Sample Number: S10019 **Depth:** 30.0

UNCONFINED COMPRESSION TEST

SIERRA TESTING LABS, INC.

Tested By: js **Checked By:** mn

EXPANSION INDEX TEST

EXPANSION INDEX	**143**
DRY DENSITY (PCF)	**107.7**
MOISTURE CONTENT (%)	**10.7**

CLASSIFICATION OF EXPANSIVE SOIL

Expansion Index	Expansion Potential
0 - 20	Very Low
21 - 50	Low
51 - 90	Medium
91 - 130	High

Test Method: UBC 29-2

SAMPLE IDENTIFICATION: B-3, 16-MC

PROJECT NUMBER:	09-113	March 3, 2009

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES
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Phone: (916) 939-3460 FAX: (916) 939-3507

DGC Kelso Geotech

PO 932622

UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: DGC Kelso Geotech

Client: CH2MHILL

Project No.: 09-113

Report Date: March 3, 2009

Sample No: B-1, 10-MC

Depth: 30

Date Tested: 3/3/09

UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: DGC Kelso Geotech

Client: CH2MHILL

Project No.: 09-113

Report Date: March 3, 2009

Sample No: B-2, 24-MC

Depth: 5

Date Tested: 3/3/09

Before

After

UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: DGC Kelso Geotech

Client: CH2MHILL

Project No.: 09-113

Report Date: March 3, 2009

Sample No: B-2, Core (Homogenius Portion)

Depth: 58.7

Date Tested: 3/3/09

UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: DGC Kelso Geotech

Client: CH2MHILL

Project No.: 09-113

Report Date: March 3, 2009

Sample No: B-2, Core

Depth: 70

Date Tested: 3/3/09

UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: DGC Kelso Geotech

Client: CH2MHILL

Project No.: 09-113

Report Date: March 3, 2009

Sample No: B-3, 16-MC

Depth: 5

Date Tested: 3/3/09

Before

After

UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: DGC Kelso Geotech

Client: CH2MHILL

Project No.: 09-113

Report Date: March 3, 2009

Sample No: B-3, Core

Depth: 25

Date Tested: 3/3/09

UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: DGC Kelso Geotech

Client: CH2MHILL

Project No.: 09-113

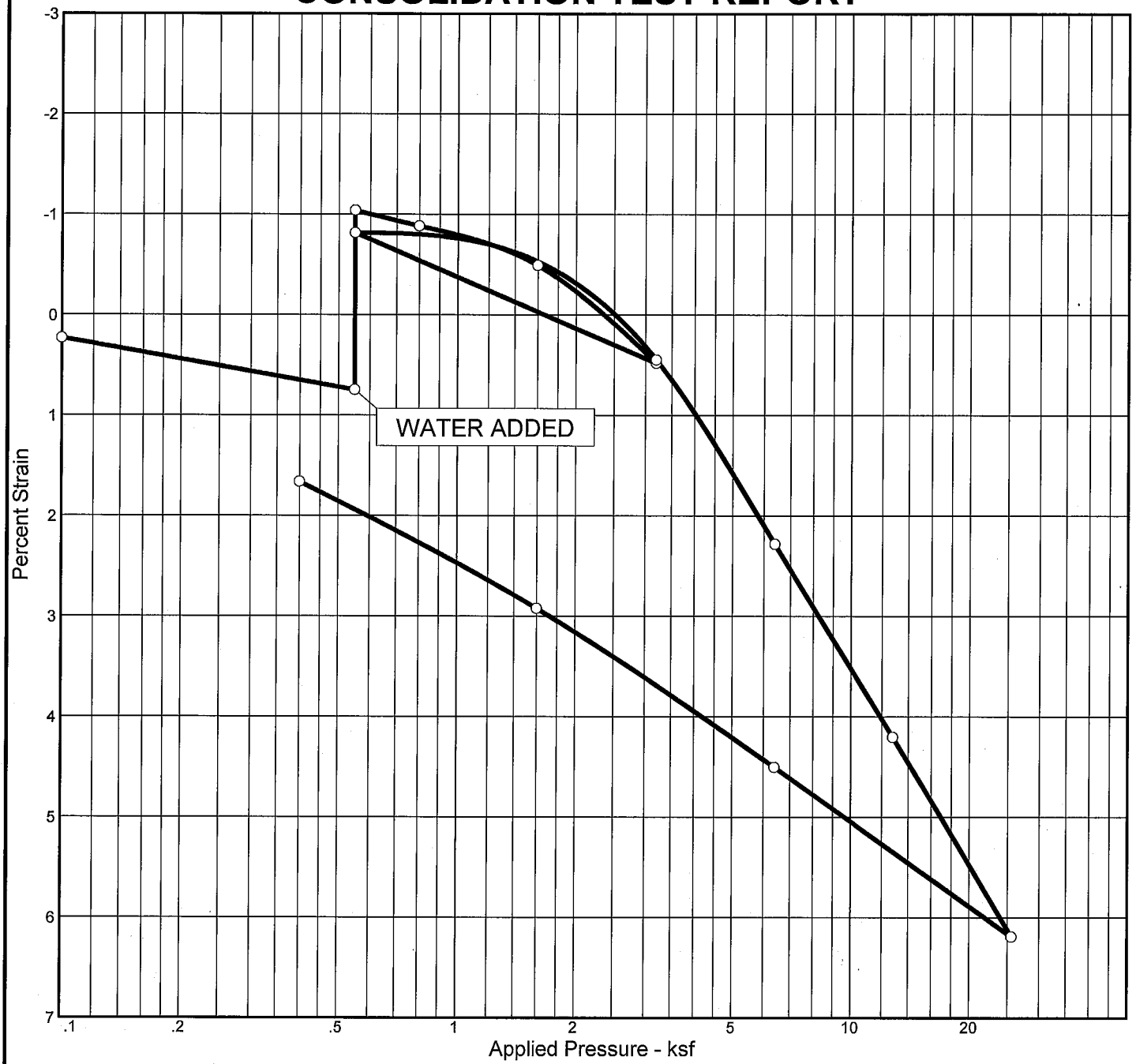
Report Date: March 3, 2009

Sample No: B-3, Core

Depth: 30

Date Tested: 3/3/09

CONSOLIDATION TEST REPORT



Natural Sat.	Natural Moist.	Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (ksf)	P_c (ksf)	C_c	C_s	Swell Press. (ksf)	Swell %	e_o
84.6 %	14.9 %	114.3			2.70		3.15	0.10	0.03	3.65	1.7	0.475

MATERIAL DESCRIPTION	USCS	AASHTO

Project No. 09-113 **Client:** CH2MHILL

Project: DGC Kelso Geotech
#PO 932622

Location: B-2, 24-MC

Remarks:

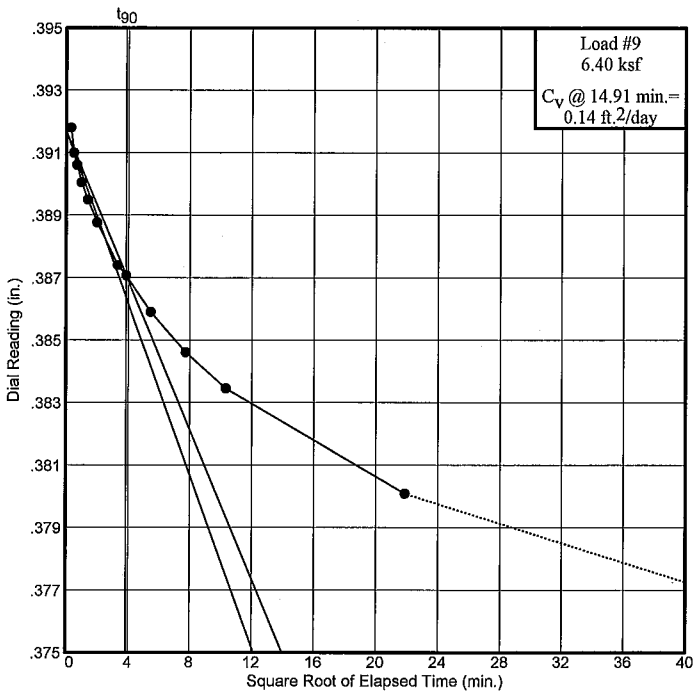
SIERRA TESTING LABS, INC.

El Dorado Hills, CA

Figure

Dial Reading vs. Time

Project No.: 09-113
Project: DGC Kelso Geotech
#PO 932622
Location: B-2, 24-MC



SIERRA TESTING LABS, INC.

El Dorado Hills, CA

Figure

SWELL/CONSOLIDATION TEST DATA

Client: CH2MHILL
Project: DGC Kelso Geotech
#PO 932622
Project Number: 09-113

Sample Data

Source: B-2
Sample No.: S10021
Elev. or Depth: 5.0
Sample Length(in./cm.):
Location: B-2, 24-MC
Description:
Liquid Limit:
Plasticity Index:
USCS:
AASHTO:
Figure No.:
Testing Remarks:

Test Specimen Data

TOTAL SAMPLE		BEFORE TEST	AFTER TEST
Wet w+t	= 518.20 g.	Consolidometer # = 1	Wet w+t = 521.90 g.
Dry w+t	= 497.50 g.		Dry w+t = 497.50 g.
Tare Wt.	= 358.40 g.	Spec. Gravity = 2.70	Tare Wt. = 358.40 g.
Height	= 1.00 in.	Height = 1.00 in.	
Diameter	= 2.43 in.	Diameter = 2.43 in.	
Weight	= 159.80 g.	Defl. Table = n/a	
Moisture	= 14.9 %	Ht. Solids = 0.6779 in.	Moisture = 17.5 %
Wet Den.	= 131.3 pcf	Dry Wt. = 139.10 g.*	Dry Wt. = 139.10 g.
Dry Den.	= 114.3 pcf	Void Ratio = 0.475	Void Ratio = 0.451
		Saturation = 84.6 %	

*** Initial dry weight used in calculations**

End-of-Load Summary

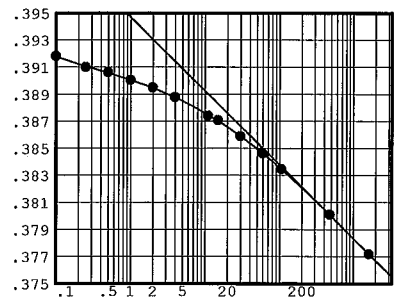
Pressure (ksf)	Final Dial (in.)	Machine Defl. (in.)	C_v (ft.^{2}/day)	C_α	Void Ratio	% Compression /Swell
start	0.40000				0.475	
0.10	0.39770	0.00000			0.472	0.2 Comprs.
0.55	0.39255	0.00000			0.464	0.7 Comprs.
water	0.41040	0.00000			0.491	1.0 Swell
0.80	0.40885	0.00000			0.488	0.9 Swell
1.60	0.40493	0.00000			0.482	0.5 Swell
3.20	0.39520	0.00000			0.468	0.5 Comprs.
0.55	0.40817	0.00000			0.487	0.8 Swell
3.20	0.39554	0.00000			0.469	0.4 Comprs.
6.40	0.37718	0.00000		0.005	0.442	2.3 Comprs.
12.80	0.35796	0.00000			0.413	4.2 Comprs.
25.60	0.33810	0.00000			0.384	6.2 Comprs.
6.40	0.35498	0.00000			0.409	4.5 Comprs.
1.60	0.37078	0.00000			0.432	2.9 Comprs.

Pressure (ksf)	Final Dial (in.)	Machine Defl. (in.)	C_v (ft.^{2}/day)	C_α	Void Ratio	% Compression /Swell
0.40	0.38339	0.00000			0.451	1.7 Comprs.

C_c = 0.10 **P_c** = 3.15 ksf **C_s** = 0.03
Swell Pressure = 3.65 ksf
Swell percentage = 1.7

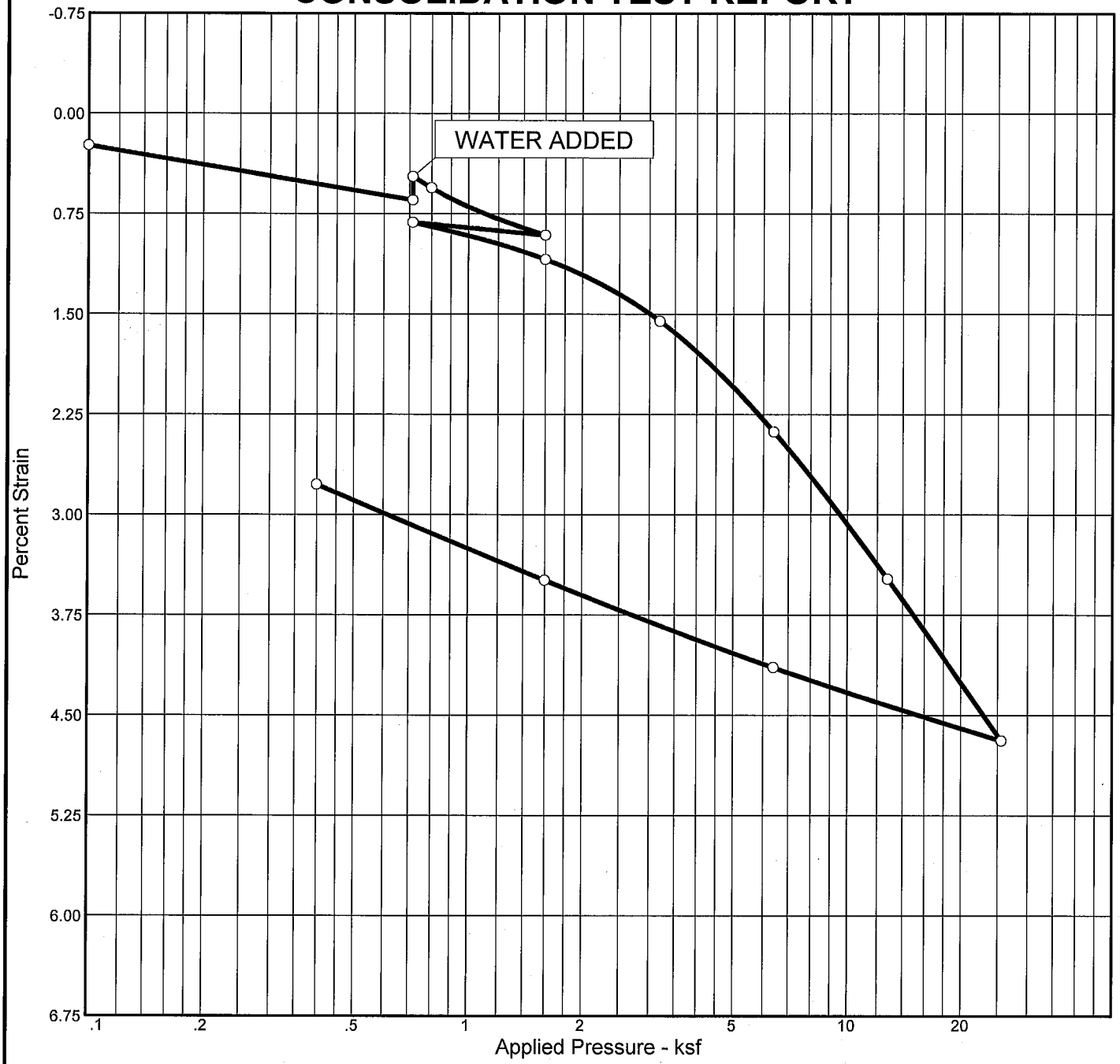
Pressure: 6.40 ksf **TEST READINGS** **Load No. 9**

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.39554	11	60.00	0.38461
2	0.10	0.39180	12	107.00	0.38346
3	0.25	0.39100	13	480.00	0.38009
4	0.50	0.39061	14	1640.00	0.37718
5	1.00	0.39005			
6	2.00	0.38949			
7	4.00	0.38877			
8	11.00	0.38740			
9	15.00	0.38707			
10	30.00	0.38590			



Void Ratio = 0.442 **Compression** = 2.3 %

CONSOLIDATION TEST REPORT



Natural Sat.	Natural Moist.	Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (ksf)	P_c (ksf)	C_c	C_s	Swell Press. (ksf)	Swell %	e_o
97.4 %	15.3 %	118.3			2.70		3.19	0.06	0.01	0.92	0.1	0.425

MATERIAL DESCRIPTION	USCS	AASHTO

Project No. 09-113 **Client:** CH2MHILL

Project: DGC Kelso Geotech
#PO 932622

Location: B-3, 17-SS

Remarks:

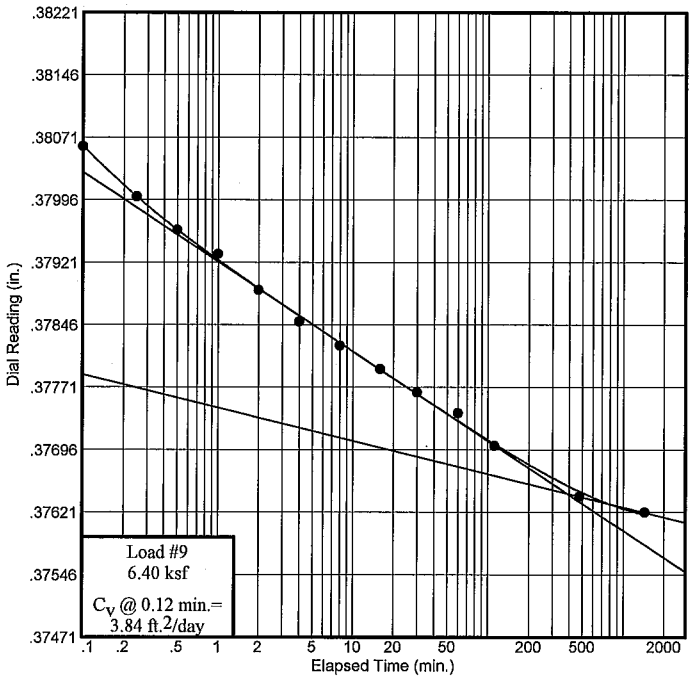
SIERRA TESTING LABS, INC.

El Dorado Hills, CA

Figure

Dial Reading vs. Time

Project No.: 09-113
Project: DGC Kelso Geotech
#PO 932622
Location: B-3, 17-SS



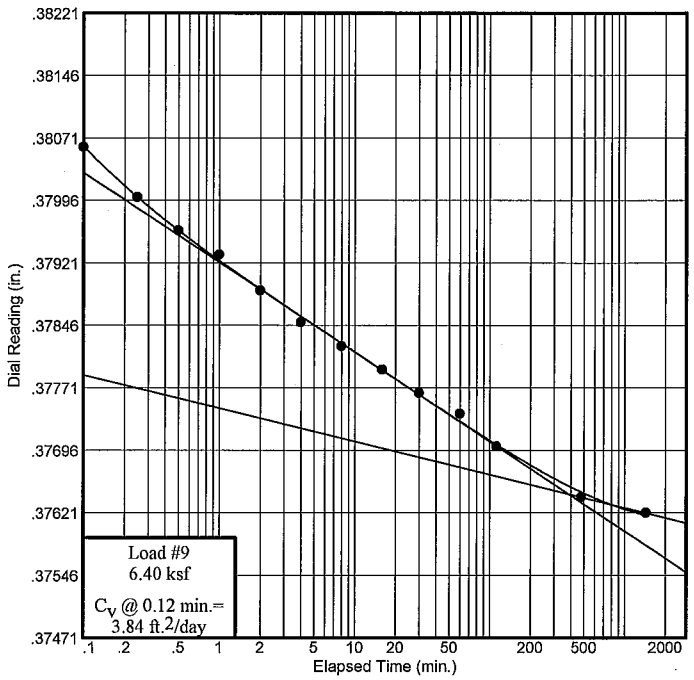
SIERRA TESTING LABS, INC.

El Dorado Hills, CA

Figure

Dial Reading vs. Time

Project No.: 09-113
Project: DGC Kelso Geotech
#PO 932622
Location: B-3, 17-SS



SIERRA TESTING LABS, INC.

El Dorado Hills, CA

Figure

CONSOLIDATION TEST DATA

Client: CH2MHILL
Project: DGC Kelso Geotech
#PO 932622
Project Number: 09-113

Sample Data

Source: B-3
Sample No.: S10031
Elev. or Depth: 6.5 **Sample Length(in./cm.):**
Location: B-3, 17-SS
Description:
Liquid Limit: **Plasticity Index:**
USCS: **AASHTO:** **Figure No.:**
Testing Remarks:

Test Specimen Data

TOTAL SAMPLE		BEFORE TEST	AFTER TEST	
Wet w+t	= 522.60 g.	**Consolidometer #** = 2	**Wet w+t**	= 520.90 g.
Dry w+t	= 500.80 g.		**Dry w+t**	= 500.80 g.
Tare Wt.	= 358.50 g.	**Spec. Gravity** = 2.70	**Tare Wt.**	= 358.50 g.
Height	= 1.00 in.	**Height** = 1.00 in.		
Diameter	= 2.43 in.	**Diameter** = 2.43 in.		
Weight	= 166.10 g.	**Defl. Table** = n/a		
Moisture	= 15.3 %	**Ht. Solids** = 0.7019 in.	**Moisture**	= 14.1 %
Wet Den.	= 136.4 pcf	**Dry Wt.** = 144.03 g.*	**Dry Wt.**	= 142.30 g.
Dry Den.	= 118.3 pcf	**Void Ratio** = 0.425	**Void Ratio**	= 0.385
		Saturation = 97.4 %		

*** Initial dry weight used in calculations**

End-of-Load Summary

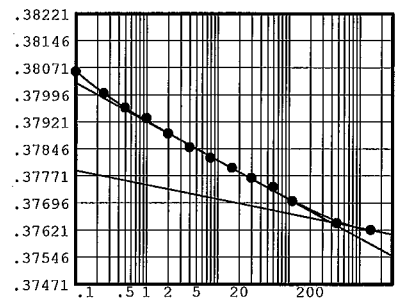
Pressure (ksf)	Final Dial (in.)	Machine Defl. (in.)	C_v (ft.^{2}/day)	C_α	Void Ratio	% Compression /Swell
start	0.40000				0.425	
0.10	0.39761	0.00000			0.421	0.2 Comprs.
0.72	0.39353	0.00000			0.415	0.6 Comprs.
water	0.39530	0.00000			0.418	0.5 Comprs.
0.80	0.39445	0.00000			0.417	0.6 Comprs.
1.60	0.39091	0.00000			0.412	0.9 Comprs.
0.72	0.39187	0.00000			0.413	0.8 Comprs.
1.60	0.38910	0.00000			0.409	1.1 Comprs.
3.20	0.38448	0.00000			0.403	1.6 Comprs.
6.40	0.37621	0.00000	3.84	0.000	0.391	2.4 Comprs.
12.80	0.36519	0.00000			0.375	3.5 Comprs.
25.60	0.35310	0.00000			0.358	4.7 Comprs.
6.40	0.35858	0.00000			0.366	4.1 Comprs.
1.60	0.36511	0.00000			0.375	3.5 Comprs.

Pressure (ksf)	Final Dial (in.)	Machine Defl. (in.)	C_v (ft.^{2}/day)	C_α	Void Ratio	% Compression /Swell
0.40	0.37226	0.00000			0.385	2.8 Comprs.

C_c = 0.06 **P_c** = 3.19 ksf **C_s** = 0.01
Swell Pressure = 0.92 ksf
Swell percentage = 0.1

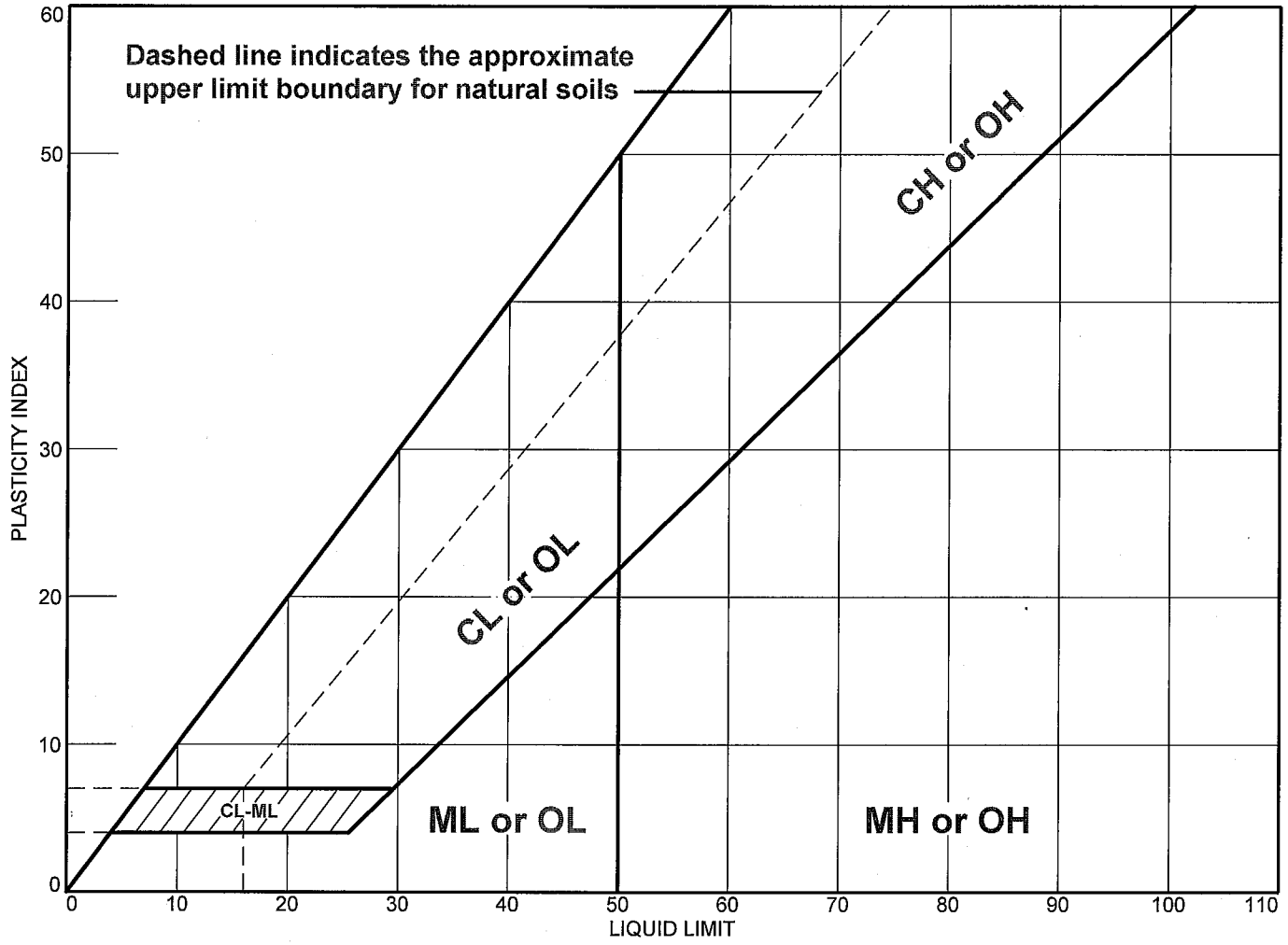
Pressure: 6.40 ksf **TEST READINGS** **Load No. 9**

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.38448	11	60.00	0.37740
2	0.10	0.38060	12	112.00	0.37701
3	0.25	0.38000	13	480.00	0.37640
4	0.50	0.37960	14	1440.00	0.37621
5	1.00	0.37931			
6	2.00	0.37888			
7	4.00	0.37850			
8	8.00	0.37821			
9	16.00	0.37793			
10	30.00	0.37765			



Void Ratio = 0.391 **Compression =** 2.4 %
D_0 = 0.38448 **D_{50}** = 0.38046 **D_{100}** = 0.37644
C_v at 0.1 min. = 3.84 ft.^{2}/day **C_α** = 0.000

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●		NV	NP	NP		59.9	

Project No. 09-113 **Client:** CH2MHILL

Project: DGC Kelso Geotech

#PO 932622

● **Location:** B-1, 6-SS **Depth:** 15.0 **Sample Number:** S10017

Wrong sample ID

Remarks:

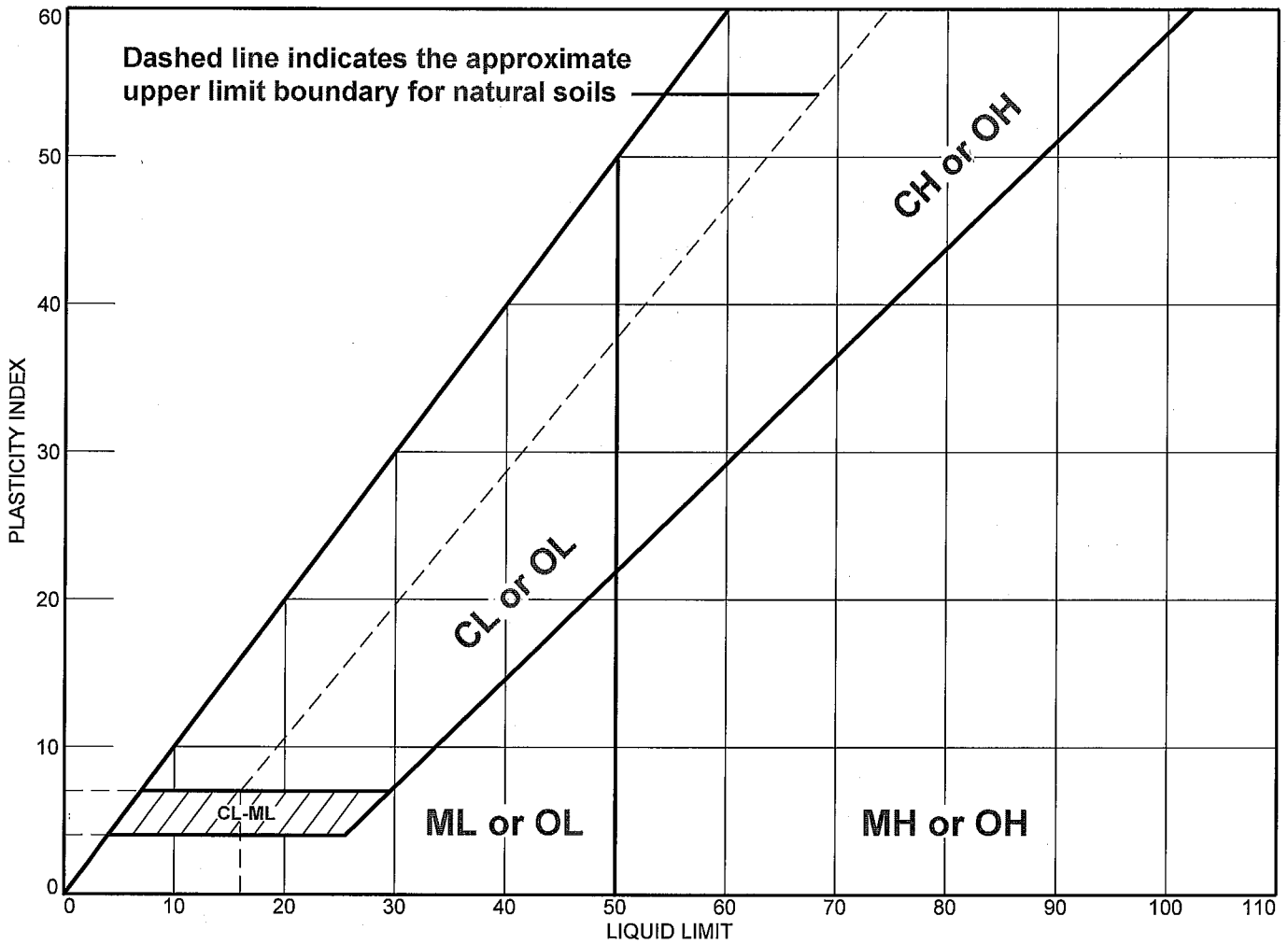
SIERRA TESTING LABS, INC.

El Dorado Hills, CA

Figure

Tested By: mw **Checked By:** mp

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●		NV	NP	NP		50.5	

Project No. 09-113 **Client:** CH2MHILL

Project: DGC Kelso Geotech

#PO 932622

● **Location:** B-1, 8-SS **Depth:** 21.5 **Sample Number:** S10018

Remarks:

SIERRA TESTING LABS, INC.

El Dorado Hills, CA

Figure

Tested By: mw **Checked By:** mn

ETS

Environmental Technical Services

975 Transport Way, Suite 2
Petaluma, CA 94954
(707) 778-9605/FAX 778-9612

-Soil, Water & Air Testing & Monitoring
-Analytical Labs
-Technical Support

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COMPANY:	RGH Geotechnical & Environmental Consultants, 1305 N. Dutton Ave., Santa Rosa, CA			ANALYST(S)	SUPERVISOR
ATTN:	Terry McCue		DATE	D. Salinas	D. Jacobson
JOB SITE:	CH2MHill, Kelso Project, bay area, California	DATE RECEIVED	COMPLETED	S. Santos	LAB DIRECTOR
JOB #:	unk	3/10/2009	3/18/2009		G.S. Conrad PhD

LAB SAMPLE NUMBER	SAMPLE ID	DESCRIPTION of SOIL and/or SEDIMENT	SOIL pH -log[H+]	NOMIINAL RESISTIVITY ohm-cm	ELECTRICAL CONDUCTIVITY µmhos/cm	SULFATE SO4 ppm	CHLORIDE Cl ppm
03511-1	K1/BA	Sample 1	**7.48**	**1,210**	**[825]**	**3**	**75**
03511-2	K2/BA	Sample 2	**8.09**	**1,000**	**[1000]**	**306**	**66**
Method	Detection	Limits --->	---	1	0.1	1	1

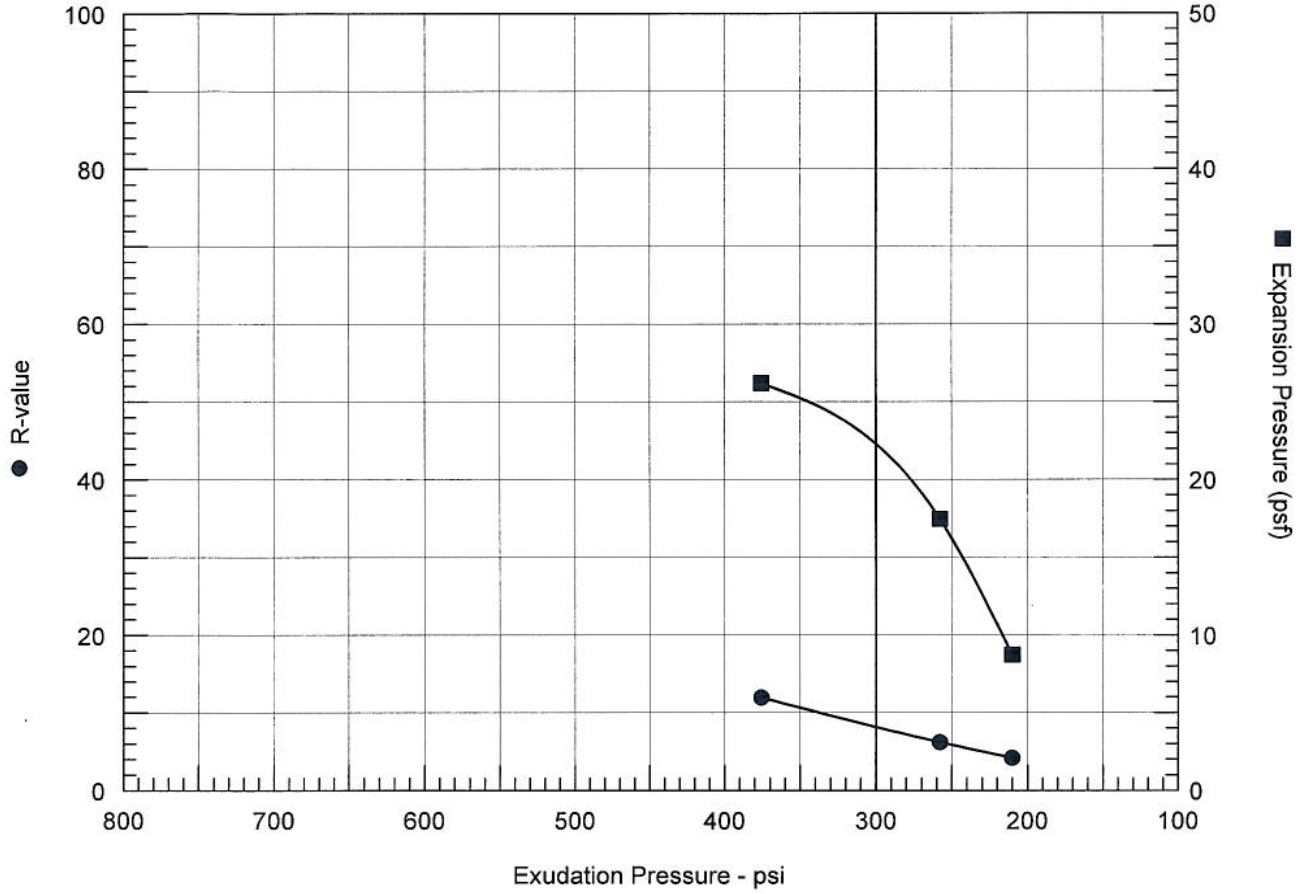
LAB SAMPLE NUMBER	SAMPLE ID	DESCRIPTION of SOIL and/or SEDIMENT	PERCENT MOISTURE %	SOLUBLE SULFIDES (S=) ppm	SOLUBLE CYANIDES (CN=) ppm	REDOX mV	GROSS TEXTURAL CLASS
03511-1	K1/BA	Sample 1				**+429.7**	
03511-2	K2/BA	Sample 2				**+384.3**	
Method	Detection	Limits --->	0.01	0.001	0.1	1	-

********** COMMENTS **********

Resistivities are in the 1,000 to 1,250 ohm-cm range, i.e., very low, but soil reactions (i.e., pHs) are alkaline enough to help; both chlorides and sulfates are low; one redox is very mild and the other soil is not reduced. The standard CalTrans times to perforation are as follows: for K1 and 18 ga steel the time is ≈27 yrs, and for 12 ga it goes up to ≈59 yrs; and for K2 the 18 ga time is ≈25 yrs, and for 12 ga the time is at ≈55 yrs. For steel the calculated average pitting rate for the K1 soil is at ≈0.1 mm/yr and for K2 it is at ≈0.115 mm/yr, thus putting the 2 mm pitting depth times at ≈20 yrs and ≈17 yrs, respectively, and the 4 mm depth times are at ≈40 yrs, and ≈34 yrs. Chlorides are so low that they would not have any measureable corrosion impact on concrete steel reinforcement; and sulfates are low enough that they should not have any adverse impact on concrete, mortar, grout or cement. One soil is not reduced and the other redox value is so mild that this would not be a issue. As for buried steels, alkaline treatment of soils would be of no benefit at all since soil pHs are already alkaline enough. To achieve greater specific metals longevities in these soils would require metals upgrading (e.g. increased gauge or resistant steels, etc.); and/or other actions (e.g. wrapping steel, increased engineering fill, cathodic protection, coatings, plastic or fiberglas pipe, etc.). Finally, standard concrete mixes should be fine in these soils based on results.

\\\\NOTES: Methods are from following sources: extractions by Cal Trans protocols as per Cal Test 417 (SO4), 422 (Cl), and 532/643 (pH & resistivity); &/or by ASTM Vol. 4.08 & ASTM Vol. 11.01 (=EPA Methods of Chemical Analysis, or Standard Methods); pH - ASTM G 51; Spec. Cond. - ASTM D 1125; resistivity - ASTM G 57; redox - Pt probe/ISE; sulfate - extraction Title 22, detection ASTM D 516 (=EPA 375.4); chloride - extraction Title 22, detection ASTM D 512 (=EPA 325.3); sulfides - extraction by Title 22, and detection EPA 376.2 (= SMEWW 4500-S D); cyanides - extraction by Title 22, and detection by ASTM D 4374 (=EPA 335.2).

R-VALUE TEST REPORT



Resistance R-Value and Expansion Pressure - Cal Test 301

No.	Compact. Pressure psi	Density pcf	Moist. %	Expansion Pressure psf	Horizontal Press. psi @ 160 psi	Sample Height in.	Exud. Pressure psi	R Value	R Value Corr.
1	70	101.6	22.7	9	146	2.52	210	4	4
2	100	102.8	21.5	17	142	2.51	258	6	6
3	140	107.1	19.5	26	130	2.46	376	12	12

Test Results	Material Description
R-value at 300 psi exudation pressure = 8 **Exp. pressure at 300 psi exudation pressure =** 22 psf	Brown Sandy Fat Clay (CH)

Project No.: 386247.01.FI
Project: Kelso
Source of Sample: Composite Sample #1 **Depth:** 0.0'
Date: 3/12/2009

Tested by: GEF
Checked by: TMc
Remarks:

R-VALUE TEST REPORT

RGH CONSULTANTS, INC.

Plate _____

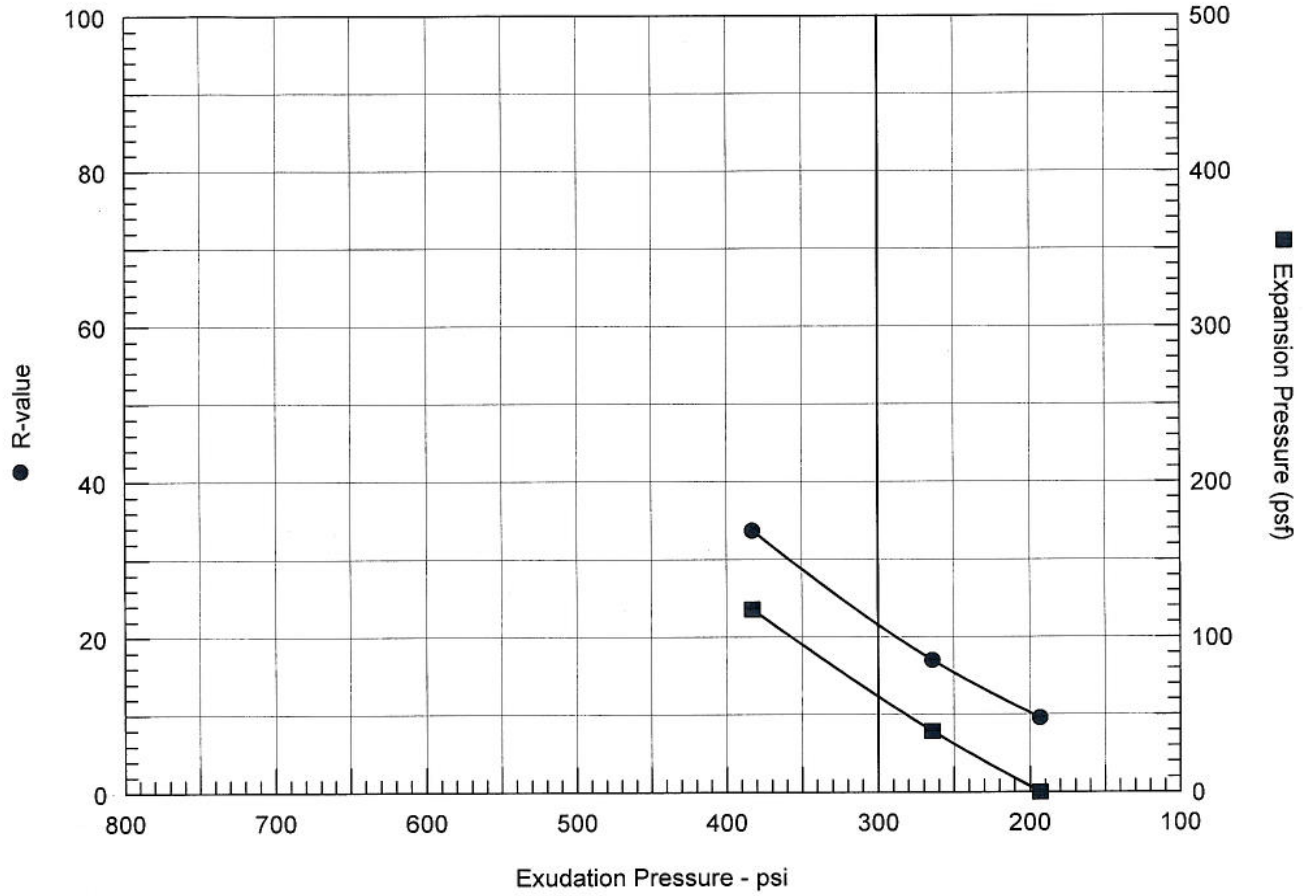
RESISTANCE R-VALUE TESTING RESULTS
(Cal Test 301)

Date:	3/12/2009
Project No.:	386247.01.FI
Project:	Kelso
Location:	Composite Sample #1
Depth:	0.0'
Material Description:	Brown Sandy Fat Clay (CH)
Tested by:	GEF
Checked by:	TMc
Remarks:	

Test specimen number	1	2	3
Compaction pressure (psi):	70	100	140
Wet weight (gms):	546.7	462.4	491.6
Dry weight (gms):	464.2	398.5	427.7
Tare weight (gms):	100.3	101.7	100.0
% Moisture:	22.7	21.5	19.5
Exudation load (lbs.):	2640	3240	4720
Exudation pressure (psi):	210	258	376
Total weight (gms.):	2993.0	3000.0	3011.0
Mold weight (gms.):	1957.0	1966.0	1972.0
Sample weight (gms.):	1036.0	1034.0	1039.0
Initial expansion (x10,000):	0	0	0
Final expansion (x10,000):	2	4	6
Expansion pressure (psf):	9	17	26
Ph at 2000 lbs.:	146	142	130
D turns:	5.50	4.80	4.25
R:	4	6	12
Height (in.):	2.52	2.51	2.46
Dry density (pcf):	101.6	102.8	107.1
Corrected R:	4	6	12

R-Value at 300 psi exudation pressure = 8
Expansion pressure at 300 psi = 22 psf

R-VALUE TEST REPORT



Resistance R-Value and Expansion Pressure - Cal Test 301

No.	Compact. Pressure psi	Density pcf	Moist. %	Expansion Pressure psf	Horizontal Press. psi @ 160 psi	Sample Height in.	Exud. Pressure psi	R Value	R Value Corr.
1	140	106.8	19.7	0	133	2.53	193	10	10
2	170	109.5	17.9	39	118	2.43	264	18	17
3	200	112.1	16.9	118	87	2.42	383	36	34

Test Results	Material Description
R-value at 300 psi exudation pressure = 22 **Exp. pressure at 300 psi exudation pressure =** 62 psf	Brown Clayey Sand (SC)

Project No.: 386247.01.FI
Project: Kelso
Source of Sample: Composite Sample #2 **Depth:** 0.0'
Date: 3/12/2009

Tested by: GEF
Checked by: TMc
Remarks:

R-VALUE TEST REPORT

RGH CONSULTANTS, INC.

Plate _____

RESISTANCE R-VALUE TESTING RESULTS
(Cal Test 301)

Date:	3/12/2009
Project No.:	386247.01.FI
Project:	Kelso
Location:	Composite Sample #2
Depth:	0.0'
Material Description:	Brown Clayey Sand (SC)
Tested by:	GEF
Checked by:	TMc
Remarks:	

Test specimen number	1	2	3
Compaction pressure (psi):	140	170	200
Wet weight (gms):	494.8	519.7	440.0
Dry weight (gms):	430.2	456.4	390.9
Tare weight (gms):	101.9	102.2	100.2
% Moisture:	19.7	17.9	16.9
Exudation load (lbs.):	2430	3320	4810
Exudation pressure (psi):	193	264	383
Total weight (gms.):	3027.0	3007.0	3005.0
Mold weight (gms.):	1960.0	1972.0	1959.0
Sample weight (gms.):	1067.0	1035.0	1046.0
Initial expansion (x10,000):	0	0	0
Final expansion (x10,000):	0	9	27
Expansion pressure (psf):	0	39	118
Ph at 2000 lbs.:	133	118	87
D turns:	4.80	4.10	3.80
R:	10	18	36
Height (in.):	2.53	2.43	2.42
Dry density (pcf):	106.8	109.5	112.1
Corrected R:	10	17	34

R-Value at 300 psi exudation pressure = 22
Expansion pressure at 300 psi = 62 psf