GEOTECHNICAL INVESTIGATION

SDG&E TL649
WOOD TO STEEL IMPROVEMENTS
M.S.A. 6160015454
SAN DIEGO, CALIFORNIA

GEOCON
INCORPORATED

GEOTECHNICAL
ENVIRONMENTAL
MATERIALS

PREPARED FOR

SAN DIEGO GAS AND ELECTRIC COMPANY
SAN DIEGO, CALIFORNIA

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PROJECT NO. G1115-52-54

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San Diego Gas and Electric Company
Civil/Structural Engineering
8316 Century Park Court
San Diego, California 92123

Attention: Mr. Tyler Lonsdale

Subject: GEOTECHNICAL INVESTIGATION
SDG&E TL649 WOOD TO STEEL IMPROVEMENTS
M.S.A. 6160015454
SAN DIEGO, CALIFORNIA

Dear Mr. Lonsdale:

In accordance with your authorization of our revised Proposal No. LG-13297 dated October 31, 2013, we herein submit the results of our geotechnical investigation for the subject power poles. The accompanying report presents the results of our study and conclusions and recommendations pertaining to the geotechnical aspects of the proposed transmission line. The site is considered suitable for development provided the recommendations of this report are followed.

Should you have questions regarding this report, or if we may be of further service, please contact the undersigned at your convenience.

Very truly yours,

GEOCON INCORPORATED

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GEOTECHNICAL INVESTIGATION

1. PURPOSE AND SCOPE

This report presents the results of a geotechnical investigation performed for the proposed replacement of existing wood poles with new steel poles along approximately 8 miles of TL 649 transmission line in San Diego County, California. The purpose of the geotechnical investigation was to evaluate the surface and subsurface soil conditions and general site geology in the vicinity of each pole location, and to provide geotechnical design parameters required for foundation design of the proposed poles.

The scope of this geotechnical investigation included a review of readily available published and unpublished geologic literature and performing a field investigation, laboratory testing, engineering analyses, and the preparation of this report. Our geotechnical field investigation included drilling twenty-one (21) small-diameter exploratory borings to a maximum depth of approximately 41 feet. A geophysical survey consisted of eleven (11) seismic refraction lines was also conducted in the area where boring is not feasible due to environmental, overhead, and/or subsurface restraints.

The boring logs, and other details of the field investigation, are presented in Appendix A. We tested selected soil samples obtained during the field investigation to evaluate pertinent physical properties for engineering analyses and to assist in providing recommendations for foundation design criteria. Details of the laboratory test results are presented in Appendix B. Seismic refraction survey results are presented in Appendix C.

The recommendations presented in this report are based on an analysis of the data collected during site investigation, the results of laboratory tests performed on soil samples collected during the site investigation, and our experience with similar soil and geologic conditions.

2. PROJECT AND SITE DESCRIPTION

The project alignment is located along the SDG&E easement on the south side of the Otay River, east of I-805, in San Diego County, California. Specifically, the TL649 alignment extends approximately 5 miles eastward from its western terminus in the Ocean View Hills neighborhood to approximately 1¾ miles east of SR-125, then the alignment extends southward approximately 2 miles in the Otay Mesa area, (see *Vicinity Map*, Figure 1).

We understand that steel poles will be installed to replace the existing wooden poles along the TL649 alignment as a part of the transmission line improvements. The engineered steel poles required geotechnical explorations to provide engineering parameters for the design and construction of the

new structures. Topographically, the alignment consists of ridges and canyons that are accessed from various public roads and gated entrances along the SDG&E and local utility easements. Table 2 below lists the proposed new poles and their approximate coordinates.

TABLE 2
SUMMARY OF PROPOSED STRUCTURES

Item	Structure No.	Latitude	Longitude	Work Being Done
1	Z188716	32.58748611	-117.020811	New steel FDN (TYP) pole
2	Z188717	32.58746667	-117.018200	New steel FDN (TYP) pole
3	Z188721	32.58744167	-117.014083	New steel FDN (TYP) pole
4	Z183072	32.58607778	-117.012178	New steel FDN (TYP) pole
5	Z188723	32.58600556	-117.009308	New steel FDN (TYP) pole
6	Z188724	32.58599167	-117.007742	New steel FDN (TYP) pole
7	Z183266	32.58523333	-117.005503	New steel FDN (TYP) pole
8	Z183265	32.58509722	-117.003808	New steel FDN (TYP) pole
9	Z188726	32.58499722	-117.002344	New steel FDN (TYP) pole
10	Z188727	32.58523333	-117.001289	New steel FDN (TYP) pole
11	P81121	32.58528611	-117.000622	New steel FDN (TYP) pole
12	Z81118	32.585525	-116.998222	New steel FDN (TYP) pole
13	P81117	32.58561667	-116.997253	New steel FDN (TYP) pole
14	Z81116	32.58566389	-116.996783	New steel FDN (TYP) pole
15	P81113	32.5852	-116.994383	New steel FDN (TYP) pole
16	Z81112	32.58511111	-116.993944	New steel FDN (TYP) pole
17	Z81107	32.58521667	-116.990606	New steel FDN (TYP) pole
18	Z81104	32.58497222	-116.988764	New steel FDN (TYP) pole
19	Z81097	32.58588056	-116.982850	New steel FDN (TYP) pole
20	Z81975	32.58666111	-116.975725	New steel FDN (TYP) pole
21	Z81973	32.58679722	-116.974178	New steel FDN (TYP) pole
22	Z81081	32.58722778	-116.969417	New steel FDN (TYP) pole
23	Z118863	32.58779444	-116.966711	New steel FDN (TYP) pole
24	P204534	32.58817222	-116.964944	New steel FDN (TYP) pole
25	Z81074	32.58830556	-116.964325	New steel FDN (TYP) pole
26	Z81072	32.58930556	-116.963383	New steel FDN (TYP) pole
27	Z81069	32.59044444	-116.962297	New steel FDN (TYP) pole
28	Z81066	32.59105556	-116.959650	New steel FDN (TYP) pole
29	Z81055	32.59328889	-116.950117	New steel FDN (TYP) pole
30	Z81049	32.59557778	-116.946094	New steel FDN (TYP) pole
31	Z731392	32.59654444	-116.945064	New steel FDN (TYP) pole

TABLE 2 (Concluded)
SUMMARY OF PROPOSED STRUCTURES

Item	Structure No.	Latitude	Longitude	Work Being Done
32	Z81044	32.59813889	-116.943394	New steel FDN (TYP) pole
33	Z31723	32.59831667	-116.939369	New steel FDN (TYP) pole
34	Z31729	32.59421667	-116.939364	New steel FDN (TYP) pole
35	Z31744	32.58210278	-116.939342	New steel FDN (TYP) pole
36	Z31768	32.58211111	-116.940781	New steel FDN (TYP) pole
37	Z34102	32.582125	-116.943925	New steel FDN (TYP) pole
38	Z31745	32.58213056	-116.945111	New steel FDN (TYP) pole
39	Z31746	32.58150556	-116.945106	New steel FDN (TYP) pole
40	Z31749	32.57916944	-116.945103	New steel FDN (TYP) pole
41	Z31750	32.57849444	-116.944947	New steel FDN (TYP) pole
42	Z31753	32.57649722	-116.944942	New steel FDN (TYP) pole
43	Z31754	32.57567778	-116.944936	New steel FDN (TYP) pole
44	Z31757	32.57325278	-116.944922	New steel FDN (TYP) pole
45	Z31758	32.57243611	-116.944917	New steel FDN (TYP) pole

We understand that the proposed monopole foundations at each location will consist of a drilled, cast-in-place reinforced concrete pier that will vary in diameter and depth depending on the prevailing soil conditions and loading, but are generally on the order of 4 to 10 feet in diameter and depths of up to 40 feet.

The site description and proposed improvements are based on a site reconnaissance, the available topographic maps and plans, and discussions with you. If improvement plans differ from those described herein, Geocon Incorporated should be contacted for review of the plans and possible revisions to this report, especially with regard to changes in final grades of the top of the pole foundations.

3. FIELD INVESTIGATION

We performed our field investigation between November 11, 2013 and December 3, 2013, that consisted of drilling 21 small-diameter borings (B-2 through B-11, B-13 through B-23) to a maximum depth of approximately 41 feet. In addition, we conducted a geophysical survey including 11 seismic refraction survey lines (SL-1 through SL-11) at the locations where environmental, overhead, or subsurface constraints precluded exploratory borings. The locations of the proposed poles together with the approximate locations of the field exploration are shown on Figures 2 through 13, *Site Plans*.

Table 3 summarizes the proposed structures, approximate elevations, and associated subsurface explorations.

TABLE 3
SUMMARY OF PROPOSED STRUCTURES AND ASSOCIATED EXPLORATIONS

ID No.	Structure No.	Approximate Elevation (MSL)	Exploration No.
1	Z188716	219	SL-6
2	Z188717	228	B-2
3	Z188721	208	B-3
4	Z183072	221	B-3
5	Z188723	189	B-4
6	Z188724	199	B-4
7	Z183266	249	B-5
8	Z183265	250	B-5
9	Z188726	240	B-6
10	Z188727	223	B-6
11	P81121	212	B-7
12	Z81118	209	B-7
13	P81117	205	B-7
14	Z81116	201	B-8 & SL-7
15	P81113	212	B-8
16	Z81112	215	B-8
17	Z81107	201	B-9
18	Z81104	204	B-9
19	Z81097	211	SL-8
20	Z81975	194	B-10
21	Z81973	197	B-10
22	Z81081	224	B-11
23	Z118863	216	SL-9
24	P204534	228	B-13
25	Z81074	231	B-13
26	Z81072	221	B-14
27	Z81069	221	B-14
28	Z81066	234	B-15
29	Z81055	277	B-16
30	Z81049	285	B-17
31	Z731392	274	B-17
32	Z81044	267	B-18 & SL-10

TABLE 3 (Concluded)
SUMMARY OF PROPOSED STRUCTURES AND ASSOCIATED EXPLORATIONS

ID No.	Structure No.	Approximate Elevation (MSL)	Exploration No.
33	Z31723	264	B-19
34	Z31729	514	B-20 & SL-5
35	Z31744	554	SL-4
36	Z31768	474	SL-3
37	Z34102	440	SL-2
38	Z31745	531	B-22
39	Z31746	546	B-22
40	Z31749	592	SL-1
41	Z31750	603	SL-1
42	Z31753	583	B-23
43	Z31754	567	B-23 & SL-11
44	Z31757	577	B-21
45	Z31758	598	B-21

B = Hollow Stem Auger Boring.
SL = Seismic Refraction Line.

We advanced the borings near the proposed new steel poles to a maximum depth of 41 feet below grade using an all-terrain truck-mounted drill rig equipped with 6-inch-diameter, hollow-stem augers. We obtained relatively undisturbed samples at various depths by driving a 3-inch O.D. split-tube sampler (California Sampler) into the soil mass with a 140-pound hammer falling 30 inches. The sampler was equipped with 1-inch-high by 2⅜-inch-diameter brass sampler rings to facilitate removal and laboratory testing of the soil recovered. We also performed Standard Penetration Tests (SPTs) at selected depths in accordance with ASTM D 1586. We collected disturbed samples from the SPT sampler and drill cuttings.

We visually examined soil conditions encountered in the borings, classified, and logged in general conformance with the American Society for Testing and Materials (ASTM) Practice for Description and Identification of Soils (Visual-Manual Procedure D 2488). The logs of the exploratory borings are presented on Figures A-1 through A-21 in Appendix A.

Seismic refraction survey is a commonly used geophysical technique to estimate the depth-to-bedrock, competence of bedrock, or depth to other seismic velocity boundaries. Typical field procedures consist of a series of geophones placed along the line at a set distance or “geophone interval.” A serious of shots will be generated by hitting a sledgehammer to a strike plate to record the refraction waves returned to the surface. Thus, a profile or cross section showing the depth to

bedrock together with the seismic velocities of overburden and bedrock can be calculated. In addition, the drillability of bedrock can be estimated based on empirical relationship with the seismic velocities. The typical on-site equipment for seismic refraction survey consists of geophones, sledgehammer, strike plate, and seismographs. The results of seismic refraction survey near the proposed new steel poles are included in Appendix C of this report.

4. LABORATORY TESTING RESULTS

We performed laboratory tests on a selected sample in accordance with generally accepted test methods of the American Society for Testing and Materials (ASTM) or other suggested procedures. Selected samples were tested for their *in situ* moisture and dry density, direct shear strength, water-soluble sulfate, water-soluble chloride ion content, pH and resistivity. Additionally, we performed a grain size distribution analysis on two soil sample for potential local scour evaluation at the proposed Poles Z81973 and Z31723. The gradation curves are presented on Figure B-1. The results of the laboratory tests are presented below on Tables 4.1 through 4.5, and in Appendix B. The in-place dry density and moisture content of the samples tested are presented on the boring logs in Appendix A.

TABLE 4.1
SUMMARY OF LABORATORY DIRECT SHEAR TEST RESULTS
ASTM D 3080

Sample No.	Depth of Sample, feet (Geologic Unit)	Structure	Dry Density (pcf)	Moisture Content (%)		Unit Peak [Ultimate*] Cohesion (psf)	Angle of Peak [Ultimate*] Shear Resistance (degrees)
				Initial	Final		
B2-4	7.5 (Qls)	Z118717	102.1	17.9	23.5	625 [390]	29 [29]
B2-8	20 (To)	Z118717	115.4	15.3	18.6	600 [430]	31 [31]
B2-10	30 (To)	Z118717	104.3	22.8	25.1	980 [0]	38 [33]
B3-3	5 (Qudf)	Z118721	96.4	18.3	27.6	770 [715]	28 [26]
B3-5	10 (To)	Z118721	110.0	17.0	20.4	525 [470]	29 [28]
B3-7	15 (To)	Z118721	112.6	15.2	22.2	0 [0]	39 [38]
B4-4	10 (Qal)	Z118724	108.0	17.2	25.6	920 [700]	27 [27]
B4-8	20 (Qal)	Z118724	109.5	18.8	24.5	880 [640]	26 [26]
B4-12	40 (To)	Z118724	98.1	23.6	29.2	420 [340]	30 [29]
B5-2	5 (Qcol)	Z183266	98.1	18.1	25.3	350 [360]	29 [29]
B5-4	10 (To)	Z183266	113.3	7.8	16.0	700 [220]	33 [33]
B6-3	7.5 (Qcol)	Z188726	102.5	22.9	24.6	1500 [690]	25 [25]
B6-5	15 (To)	Z188726	109.5	11.1	18.9	920 [480]	22 [22]
B6-7	25 (To)	Z188726	104.6	15.5	23.1	550 [400]	22 [22]
B7-5	20 (To)	P81121	112.6	10.1	18.9	280 [250]	34 [34]

TABLE 4.1 (Concluded)
SUMMARY OF LABORATORY DIRECT SHEAR TEST RESULTS
ASTM D 3080

Sample No.	Depth of Sample, feet (Geologic Unit)	Structure	Dry Density (pcf)	Moisture Content (%)		Unit Peak [Ultimate*] Cohesion (psf)	Angle of Peak [Ultimate*] Shear Resistance (degrees)
				Initial	Final		
B8-3	7.5 (Qal)	P81113	101.0	23.1	28.5	750 [720]	19 [17]
B8-5	12.5 (Qt)	P81113	111.8	14.5	21.6	140 [140]	31 [31]
B8-9	25 (To)	P81113	113.9	11.5	17.1	1400 [1100]	15 [15]
B9-2	5 (Qal)	Z81104	109.6	15.9	20.1	385 [75]	32 [32]
B13-1	5 (Qal)	Z81074	107.6	14.5	20.8	710 [650]	27 [27]
B13-5	15 (To)	Z81074	98.0	23.6	30.3	390 [400]	23 [23]
B13-7	25 (To)	Z81074	106.9	19.4	24.2	750 [500]	27 [27]
B14-3	15 (To)	Z18069	104.8	21.2	27.1	330 [125]	28 [28]
B14-8	30 (To)	Z18069	111.9	15.6	17.3	225 [430]	33 [27]
B15-3	7.5 (Qt)	Z81066	112.0	14.7	18.4	860 [840]	33 [33]
B15-5	15 (To)	Z81066	109.5	14.2	19.5	680 [490]	29 [28]
B17-3	15 (To)	Z81049	113.8	14.6	17.4	940 [660]	30 [30]
B17-5	25 (To)	Z81049	117.0	13.6	15.3	1150 [325]	30 [30]
B18-2	5 (Qt)	Z81044	117.1	11.1	15.7	860 [470]	31 [31]
B19-3	10 (To)	Z31723	115.9	9.2	18.8	240 [240]	35 [31]
B19-5	20 (To)	Z31723	118.8	10.5	18.3	580 [600]	27 [24]
B19-7	30 (To)	Z31723	119.7	13.6	21.1	690 [500]	26 [25]
B21-1	5 (To)	Z31758	100.9	18.2	26.0	640 [440]	29 [28]
B21-4	15 (To)	Z31758	98.8	15.5	24.2	630 [500]	33 [32]
B21-8	35 (To)	Z31758	103.7	21.7	24.0	780 [430]	30 [30]
B22-6	25 (To)	Z31745	89.4	31.4	39.4	1200 [500]	27 [27]
B22-8	40 (To)	Z31745	79.8	38.5	44.7	940 [730]	29 [26]
B23-3	10 (To)	Z31754	101.3	18.4	20.4	930 [660]	29 [25]
B23-5	18.5 (To)	Z31754	100.8	13.3	21.7	475 [460]	35 [33]

* Ultimate values measured at end-of-test at a horizontal deflection of 0.2 inches.

TABLE 4.2
SUMMARY OF LABORATORY WATER-SOLUBLE SULFATE TEST RESULTS
CALIFORNIA TEST NO. 417

Sample No.	Water-Soluble Sulfate (%)	Water-Soluble Sulfate (ppm)	Sulfate Severity
B3-1	0.002	18	Not Applicable (S0)
B5-1	0.001	8	Not Applicable (S0)
B9-1	0.0005	5	Not Applicable (S0)
B19-1	0.0003	3	Not Applicable (S0)
B23-1	0.0004	4	Not Applicable (S0)

TABLE 4.3
SUMMARY OF LABORATORY WATER-SOLUBLE CHLORIDE ION CONTENT TEST RESULTS
CALIFORNIA TEST NO. 422

Sample No.	Chloride Ion Content (%)	Chloride Ion Content (ppm)
B3-1	0.011	109
B5-1	0.018	178
B9-1	0.025	248
B19-1	0.006	55
B23-1	0.033	331

TABLE 4.4
SUMMARY OF LABORATORY POTENTIAL OF HYDROGEN (PH) AND RESISTIVITY TEST RESULTS
CALIFORNIA TEST NO. 643

Sample No.	pH	Minimum Resistivity (ohm-centimeters)
B3-1	7.8	570
B5-1	8.1	830
B9-1	7.6	620
B19-1	7.0	5200
B23-1	7.8	570

TABLE 4.5
SUMMARY OF LABORATORY GRAIN SIZE DISTRIBUTION TEST RESULTS
ASTM D422

Sample No.	Sample Depth (ft)	% Gravel	% Sand	% Fines	USCS Classification
B10-2	14	21.3	52.1	26.6	SC
B19-1	0	53.7	35.0	11.3	GP

5. GEOLOGIC SETTING

The site is located in the coastal plain of the Peninsular Ranges province of southern California. The Peninsular Ranges is a geologic and geomorphic province that extends from the Imperial Valley to the Pacific Ocean and from the Transverse Ranges to the north and into Baja California to the south. The coastal plain of San Diego County is underlain by a thick sequence of relatively undisturbed and non-conformable sedimentary rocks that range in age from Upper Cretaceous through the Pleistocene with intermittent deposition. Geomorphically, the coastal plain is characterized by a stair-stepped series of marine terraces, which are younger to the west and have been dissected by west flowing rivers that drain the Peninsular Ranges to the east. The coastal plain is a relatively stable block that is dissected by relatively few faults consisting of the potentially active La Nacion Fault Zone and the active Rose Canyon Fault Zone. The Peninsular Ranges are also dissected by the Elsinore Fault Zone that is associated with and sub-parallel to the San Andreas Fault Zone, which is the plate boundary between the Pacific and North American Plates.

The alignment is located on the eastern portion of the coastal plain. Marine sedimentary units make up the geologic units encountered on the alignment and consist of a Pleistocene age Terrace Deposits and the Tertiary age Otay Formation. The Terrace Deposits are shallow marine and non-marine sandstone units with layers containing cobble up to 18 inches in diameter. This unit is located on the central portion of the alignment on the southern flanks of the Otay River Valley. The Otay Formation typically consists of three lithostratagraphic members composed of a basal conglomerate member, a middle gritstone member and an upper sandstone/siltstone/claystone member with a maximum reported regional thickness of roughly 400 feet. In addition, bentonitic claystone layers are common within the upper member typically deposited as highly consolidated volcanic ash deposits.

6. GEOLOGIC AND SITE SOIL CONDITIONS

The project site is not within an Alquist-Priolo Earthquake Study Zone as established by the State Geologist. Analysis using the computer program *EQFAULT* (Version 3.00) indicates that Rose Canyon Fault Zone, located approximately 10 miles west of the site, is the dominant source of

potential ground motion at the site. Earthquakes on the Rose Canyon Fault having a maximum magnitude of 7.2 are considered representative of the potential for seismic ground shaking at the site.

The regional geology is referenced to California Geologic Survey, *Geologic Map of the San Diego 30' x 60' Quadrangle, California,* prepared by Kennedy, M. P. and S. S. Tan, 2005, and *Geologic Map of the Otay Mesa 7.5' Quadrangle, San Diego County, Californa,* CGS and USGS, 2002.

The project site and vicinity are generally underlain by five surficial soil types and five geologic formations. The surficial unit consists of undocumented fill, topsoil, colluvium, alluvium, and landslide deposits. The formational materials consist of Terrace Deposits, Otay Formation, Fanglomerate Deposits, Mission Valley Formation, and Santiago Peak Volcanoes. The boring and seismic lines are shown next to each pole on Figures 2 through 13. The soil and geologic unit encountered or expected at each pole location are depicted in Appendix A. In addition, metavolcanic rock with varying degrees of weathering was also interpreted underlain the surficial soils along seismic refraction survey lines. The surficial soil types and geologic units are described below in order of increasing age.

6.1 Undocumented Fill (Qudf)

We encountered undocumented fill in 14 of the 21 borings to a maximum depth of 5 feet which was likely placed during the construction of access roads and/or installation of ground utilities. The undocumented fill consists primarily of loose to dense, dry to moist, silty sand, clayey sand, and sandy gravel and varies in consistancy to a firm to medium stiff, sandy clay with cobbles and gravel. We recommend the foundation of the proposed poles extends into the geologic units below the undocumented fill.

6.2 Topsoil (Unmapped)

We encountered topsoil in 3 of the 21 borings to a maximum depth of approximately 3 feet. The topsoil consists primarily of loose, sandy gravel and stiff sandy clay. The top few inches of this material typically has a high organic content due to vegetative growth. We recommend the foundation of the poles extend below topsoil into underlying geologic units.

6.3 Colluvium (Qcol)

We encountered colluvium below the undocumented fill in Borings B-5 and B-6 to a maximum depth of 10 feet. The composition of colluvium at these locations were firm to stiff sandy clay. We recommend the foundation of the poles extend below topsoil into underlying geologic units.

6.4 Alluvium (Qal)

We encountered alluvium in 7 of the 21 borings to a maximum depth of approximately 30 feet. The alluvium generally consists of medium dense to dense clayey sand, silty sand, clayey gravel, and sandy gravel and varies to stiff to hard sandy clay with gravel. The alluvium is considered suitable for support of the proposed steel pole foundations and can generally be excavated with moderate effort. The potential for liquefaction is considered low due to the presence of relatively dense soil and lack of near-surface permanent groundwater.

6.5 Landslide Deposits (Qls)

We encountered Quaternary-age Landslide Deposits, as mapped by Kennedy and Tan (2005), underlying undocumented fill in Boring B-2 (Z188717) to a maximum depth of approximately 20 feet. The Landslide Deposits encountered in B-2 generally consists of medium dense, silty sand with a trace of gravel. We recommend the foundation of the poles extend through the Landslide Deposits into underlying geologic unit.

6.6 Terrace Deposits (Qt)

Pleistocene-age Terrace Deposits unconformably overlie the Otay Formation in the vicinity of the Otay River basin. We encountered Terrace Deposits in 9 of the 21 boring drilled. This formation encountered in our borings generally consisted of medium dense to very dense clayey sand, clayey gravel, sandy gravel and stiff to hard sandy clay. The granular portions of the Terrace Deposits typically exhibit adequate shear strength and “low” expansive potential.

6.7 Otay Formation (To)

The Tertiary-age Otay Formation is the predominant geologic unit along the majority of the project alignment. As encountered in 16 of our 21 borings, the Otay Formation generally consisted of medium dense to very dense, silty sandstone, clayey sandstone and stiff to hard, sandy claystone, sandy siltstone with varying degree of cementation. Although the Otay Formation is exposed above the Fanglomerate Deposits, the stratigraphic relationship between the two formations can actually be described as “interfingering”.

6.8 Fanglomerate Deposits (Tof)

The Fanglomerate facies of the Otay Formation was encountered at shallow depth in Boring B-20. This unit typically consists of very dense, moderately to slightly cemented, clayey sandstone containing up to 30 to 50 percent sub-angular gravels, cobbles and boulders up to approximately 2 feet in dimension. Fanglomerate Deposits are expected along SL-2, SL-3, and SL-5. Excavations depths in excess of 10 to 15 feet in the Fanglomerate Deposits may be very difficult and require

specialized heavy-duty equipment. Both Otay Formation and the Fanglomerate facies possess relatively high shear strength parameters.

6.9 Mission Valley Formation (Tmv)

Based on a review of the geologic map by Kennedy and Tan, 2005, we expect that the mid Tertiary–age Mission Valley Formation to be encountered along portion of the alignment at SL-6. The material typically consists of interbedded sandstone, claystone and siltstone with various degree of cementation. The Mission Valley Formations in this area exhibits adequate shear strength.

6.10 Santiago Peak Volcanics (Kmzu)

We did not encounter Santiago Peak Volcanoes at the surface or in the borings, however, several seismic lines indicate the presence of hard rock bellow the sedimentary formations. The depth varies, ranging from 35 to 60 feet at some proposed pole locations. Santiago Peak Volcanics typically consist of mildly metamorphosed volcanic and meta-sedimentary rock of the Cretaceous/Jurassic-age. These materials are generally moderately strong to strong, intensely to slightly weathered, and moderately to slightly jointed. Moderately to slightly weathered and slightly jointed metavolcanic rock will likely be very difficult to excavate or be nonrippable. Excavations within this unit will likely result in the generation of oversized material, however we do not expect the new pole foundations to encounter metavolcanic rock during construction.

6.11 Groundwater

Regional groundwater level is expected to be in excess of 100 feet below site grade. We did not encounter groundwater during our field investigation within the borings or adjacent areas and do not expect groundwater to significantly impact proposed construction. However, we encountered slight seepage in Borings B-10 and B-14 at approximately depths of 18 and 30 feet, respectively. Groundwater or perched groundwater could be encountered during construction following heavy rainfall, runoff, and/or irrigation.

7. RECOMMENDED FOUNDATION DESIGN PARAMETERS

A generalized subsurface soil profile has been developed for the area surrounding each pole foundation based on the data obtained from our exploration. Soil layers have been categorized by depth below the existing grade and assigned soil parameters that may be utilized with the *MFAD* computer program used by SDG&E for pier foundation design.

Tables 7.1 through 7.45 summarize the average total unit weight, cohesive strength, angle of internal friction, and deformation modulus assigned to the soil layers beneath the proposed pole sites. The

parameters presented herein are based on current and past experience and/or testing of similar materials. We have assumed that the existing grade will not be changed significantly. If the finalized improvements are different from those currently proposed, Geocon Incorporated should be contacted for further evaluation.

TABLE 7.1
RECOMMENDED SOIL PARAMETERS FOR PIER FOUNDATION DESIGN (Z188716)

Depth (feet)	Soil/Rock Type	Unit Cohesion c (psf)	Friction Angle ϕ (degrees)	Total Moist Unit Weight γ (pcf)	Moisture Content (%)	Total Saturated Unit Weight γ (pcf)	Deformation Modulus E_p (ksi)	Strength Reduction Factor
0 to 12	Mission Valley Formation – upper	250	30	121	15	129	3.0	1.0
12 to 35	Mission Valley Formation – lower	420	35	127	10	135	4.0	1.0
35+	Metavolcanic Rock	3000	40	137	5	144	6.0	0.9

Note: Based on the subsurface conditions encountered at SL-6.

TABLE 7.2
RECOMMENDED SOIL PARAMETERS FOR PIER FOUNDATION DESIGN (Z188717)

Depth (feet)	Soil/Rock Type	Unit Cohesion c (psf)	Friction Angle ϕ (degrees)	Total Moist Unit Weight γ (pcf)	Moisture Content (%)	Total Saturated Unit Weight γ (pcf)	Deformation Modulus E_p (ksi)	Strength Reduction Factor
0 to 2	Topsoil	200	30	115	15	125	1.5	1.0
2 to 20	Landslide Deposits	300	29	123	17	129	1.5	1.0
20 to 38+	Otay Formation - Claystone	600	31	128	16	132	3.0	1.0

Note: Based on the subsurface conditions encountered in Boring B-2.

TABLE 7.3
RECOMMENDED SOIL PARAMETERS FOR PIER FOUNDATION DESIGN (Z188721)

Depth (feet)	Soil/Rock Type	Unit Cohesion c (psf)	Friction Angle ϕ (degrees)	Total Moist Unit Weight γ (pcf)	Moisture Content (%)	Total Saturated Unit Weight γ (pcf)	Deformation Modulus E_p (ksi)	Strength Reduction Factor
0 to 5½	Undocumented Fill	150	28	115	15	125	0.7	1.0
5½ to 20	Otay Formation – Sandstone	300	33	123	17	129	3.0	1.0
20 to 25	Otay Formation - Claystone	500	31	127	15	132	3.0	1.0
25 to 27+	Otay Formation – Sandstone	300	37	132	15	135	6.0	1.0

Note: Based on the subsurface conditions encountered in Boring B-3.

TABLE 7.4
RECOMMENDED SOIL PARAMETERS FOR PIER FOUNDATION DESIGN (Z183072)

Depth (feet)	Soil/Rock Type	Unit Cohesion c (psf)	Friction Angle ϕ (degrees)	Total Moist Unit Weight γ (pcf)	Moisture Content (%)	Total Saturated Unit Weight γ (pcf)	Deformation Modulus E_p (ksi)	Strength Reduction Factor
0 to 5½	Undocumented Fill	150	28	115	15	125	0.7	1.0
5½ to 20	Otay Formation – Sandstone	300	33	123	17	129	3.0	1.0
20 to 25	Otay Formation - Claystone	500	31	127	15	132	3.0	1.0
25 to 27+	Otay Formation – Sandstone	300	37	132	15	135	6.0	1.0

Note: Based on the subsurface conditions encountered in Boring B-3.

TABLE 7.5
RECOMMENDED SOIL PARAMETERS FOR PIER FOUNDATION DESIGN (Z188723)

Depth (feet)	Soil/Rock Type	Unit Cohesion c (psf)	Friction Angle ϕ (degrees)	Total Moist Unit Weight γ (pcf)	Moisture Content (%)	Total Saturated Unit Weight γ (pcf)	Deformation Modulus E_p (ksi)	Strength Reduction Factor
0 to 3	Undocumented Fill	150	28	115	15	125	0.7	1.0
3 to 30	Alluvium	400	27	129	17	132	1.5	1.0
30 to 40	Otay Formation - Claystone	500	31	127	18	130	3.0	1.0
40 to 41+	Otay Formation – Sandstone	300	33	123	23	126	3.0	1.0

Note: Based on the subsurface conditions encountered in Boring B-4.

TABLE 7.6
RECOMMENDED SOIL PARAMETERS FOR PIER FOUNDATION DESIGN (Z188724)

Depth (feet)	Soil/Rock Type	Unit Cohesion c (psf)	Friction Angle ϕ (degrees)	Total Moist Unit Weight γ (pcf)	Moisture Content (%)	Total Saturated Unit Weight γ (pcf)	Deformation Modulus E_p (ksi)	Strength Reduction Factor
0 to 3	Undocumented Fill	150	28	115	15	125	0.7	1.0
3 to 30	Alluvium	400	27	129	17	132	1.5	1.0
30 to 40	Otay Formation - Claystone	500	31	127	18	130	3.0	1.0
40 to 41+	Otay Formation – Sandstone	300	33	123	23	126	3.0	1.0

Note: Based on the subsurface conditions encountered in Boring B-4.

TABLE 7.7
RECOMMENDED SOIL PARAMETERS FOR PIER FOUNDATION DESIGN (Z183266)

Depth (feet)	Soil/Rock Type	Unit Cohesion c (psf)	Friction Angle ϕ (degrees)	Total Moist Unit Weight γ (pcf)	Moisture Content (%)	Total Saturated Unit Weight γ (pcf)	Deformation Modulus E_p (ksi)	Strength Reduction Factor
0 to 3	Undocumented Fill	150	28	115	15	125	0.7	1.0
3 to 7½	Colluvium	300	29	118	18	125	1.5	1.0
7½ to 19+	Otay Formation - Sandstone	300	33	130	15	134	3.0	1.0

Note: Based on the subsurface conditions encountered in Boring B-5.

TABLE 7.8
RECOMMENDED SOIL PARAMETERS FOR PIER FOUNDATION DESIGN (Z183265)

Depth (feet)	Soil/Rock Type	Unit Cohesion c (psf)	Friction Angle ϕ (degrees)	Total Moist Unit Weight γ (pcf)	Moisture Content (%)	Total Saturated Unit Weight γ (pcf)	Deformation Modulus E_p (ksi)	Strength Reduction Factor
0 to 3	Undocumented Fill	150	28	115	15	125	0.7	1.0
3 to 7½	Colluvium	300	29	118	18	125	1.5	1.0
7½ to 19+	Otay Formation - Sandstone	300	33	130	15	134	3.0	1.0

Note: Based on the subsurface conditions encountered in Boring B-5.

TABLE 7.9
RECOMMENDED SOIL PARAMETERS FOR PIER FOUNDATION DESIGN (Z188726)

Depth (feet)	Soil/Rock Type	Unit Cohesion c (psf)	Friction Angle ϕ (degrees)	Total Moist Unit Weight γ (pcf)	Moisture Content (%)	Total Saturated Unit Weight γ (pcf)	Deformation Modulus E_p (ksi)	Strength Reduction Factor
0 to 5	Undocumented Fill	150	28	115	15	125	0.7	1.0
5 to 10	Colluvium	600	25	124	22	127	1.5	1.0
10 to 15	Otay Formation – Claystone	480	22	122	11	132	2.8	1.0
15 to 36+	Otay Formation – Sandstone/Siltstone	400	22	122	15	130	3.2	1.0

Note: Based on the subsurface conditions encountered in Boring B-6.

TABLE 7.10
RECOMMENDED SOIL PARAMETERS FOR PIER FOUNDATION DESIGN (Z188727)

Depth (feet)	Soil/Rock Type	Unit Cohesion c (psf)	Friction Angle ϕ (degrees)	Total Moist Unit Weight γ (pcf)	Moisture Content (%)	Total Saturated Unit Weight γ (pcf)	Deformation Modulus E_p (ksi)	Strength Reduction Factor
0 to 5	Undocumented Fill	150	28	115	15	125	0.7	1.0
5 to 10	Colluvium	600	25	124	22	127	1.5	1.0
10 to 15	Otay Formation – Claystone	480	22	122	11	132	2.8	1.0
15 to 36+	Otay Formation – Sandstone/Siltstone	400	22	122	15	130	3.2	1.0

Note: Based on the subsurface conditions encountered in Boring B-6.

TABLE 7.11
RECOMMENDED SOIL PARAMETERS FOR PIER FOUNDATION DESIGN (P81121)

Depth (feet)	Soil/Rock Type	Unit Cohesion c (psf)	Friction Angle ϕ (degrees)	Total Moist Unit Weight γ (pcf)	Moisture Content (%)	Total Saturated Unit Weight γ (pcf)	Deformation Modulus E_p (ksi)	Strength Reduction Factor
0 to 20	Alluvium	250	32	121	15	129	1.8	1.0
20 to 25+	Otay Formation - Sandstone	250	34	124	10	133	3.0	1.0

Note: Based on the subsurface conditions encountered in Boring B-7.

TABLE 7.12
RECOMMENDED SOIL PARAMETERS FOR PIER FOUNDATION DESIGN (Z81118)

Depth (feet)	Soil/Rock Type	Unit Cohesion c (psf)	Friction Angle ϕ (degrees)	Total Moist Unit Weight γ (pcf)	Moisture Content (%)	Total Saturated Unit Weight γ (pcf)	Deformation Modulus E_p (ksi)	Strength Reduction Factor
0 to 20	Alluvium	250	32	121	15	129	1.8	1.0
20 to 25+	Otay Formation - Sandstone	250	34	124	10	133	3.0	1.0

Note: Based on the subsurface conditions encountered in Boring B-7.

TABLE 7.13
RECOMMENDED SOIL PARAMETERS FOR PIER FOUNDATION DESIGN (P81117)

Depth (feet)	Soil/Rock Type	Unit Cohesion c (psf)	Friction Angle ϕ (degrees)	Total Moist Unit Weight γ (pcf)	Moisture Content (%)	Total Saturated Unit Weight γ (pcf)	Deformation Modulus E_p (ksi)	Strength Reduction Factor
0 to 20	Alluvium	250	32	121	15	129	1.8	1.0
20 to 25+	Otay Formation - Sandstone	250	34	124	10	133	3.0	1.0

Note: Based on the subsurface conditions encountered in Boring B-7.

TABLE 7.14
RECOMMENDED SOIL PARAMETERS FOR PIER FOUNDATION DESIGN (Z81116)

Depth (feet)	Soil/Rock Type	Unit Cohesion c (psf)	Friction Angle ϕ (degrees)	Total Moist Unit Weight γ (pcf)	Moisture Content (%)	Total Saturated Unit Weight γ (pcf)	Deformation Modulus E_p (ksi)	Strength Reduction Factor
0 to 5½	Undocumented Fill	150	28	115	15	125	0.7	1.0
5½ to 9	Alluvium	600	19	124	23	126	1.5	1.0
9 to 18½	Terrace Deposits – Clayey Sand	140	31	129	15	133	2.0	1.0
18½ to 30	Otay Formation - Sandstone	300	33	128	12	134	3.0	1.0
30 to 35	Otay Formation - Claystone	500	31	116	10	129	3.0	1.0
35 to 38	Otay Formation - Sandstone	300	37	121	10	132	4.0	1.0
38½+	Metavolcanic Rock	3000	40	137	5	144	6.0	0.9

Note: Based on the subsurface conditions encountered in Boring B-8 and at SL-7.

TABLE 7.15
RECOMMENDED SOIL PARAMETERS FOR PIER FOUNDATION DESIGN (P81113)

Depth (feet)	Soil/Rock Type	Unit Cohesion c (psf)	Friction Angle ϕ (degrees)	Total Moist Unit Weight γ (pcf)	Moisture Content (%)	Total Saturated Unit Weight γ (pcf)	Deformation Modulus E_p (ksi)	Strength Reduction Factor
0 to 5½	Undocumented Fill	150	28	115	15	125	0.7	1.0
5½ to 9	Alluvium	600	19	124	23	126	1.5	1.0
9 to 18½	Terrace Deposits – Clayey Sand	140	31	129	15	133	2.0	1.0
18½ to 30	Otay Formation - Sandstone	300	33	128	12	134	3.0	1.0
30 to 35	Otay Formation - Claystone	500	31	116	10	129	3.0	1.0
35 to 38	Otay Formation - Sandstone	300	37	121	10	132	4.0	1.0
38½+	Metavolcanic Rock	3000	40	137	5	144	6.0	0.9

Note: Based on the subsurface conditions encountered in Boring B-8.

TABLE 7.16
RECOMMENDED SOIL PARAMETERS FOR PIER FOUNDATION DESIGN (Z81112)

Depth (feet)	Soil/Rock Type	Unit Cohesion c (psf)	Friction Angle ϕ (degrees)	Total Moist Unit Weight γ (pcf)	Moisture Content (%)	Total Saturated Unit Weight γ (pcf)	Deformation Modulus E_p (ksi)	Strength Reduction Factor
0 to 5½	Undocumented Fill	150	28	115	15	125	0.7	1.0
5½ to 9	Alluvium	600	19	124	23	126	1.5	1.0
9 to 18½	Terrace Deposits – Clayey Sand	140	31	129	15	133	2.0	1.0
18½ to 30	Otay Formation - Sandstone	300	33	128	12	134	3.0	1.0
30 to 35	Otay Formation - Claystone	500	31	116	10	129	3.0	1.0
35 to 38	Otay Formation - Sandstone	300	37	121	10	132	4.0	1.0
38½+	Metavolcanic Rock	3000	40	137	5	144	6.0	0.9

Note: Based on the subsurface conditions encountered in Boring B-8.

TABLE 7.17
RECOMMENDED SOIL PARAMETERS FOR PIER FOUNDATION DESIGN (Z81107)

Depth (feet)	Soil/Rock Type	Unit Cohesion c (psf)	Friction Angle ϕ (degrees)	Total Moist Unit Weight γ (pcf)	Moisture Content (%)	Total Saturated Unit Weight γ (pcf)	Deformation Modulus E_p (ksi)	Strength Reduction Factor
0 to 3½	Undocumented Fill	150	28	115	15	125	0.7	1.0
3½ to 8½	Alluvium	350	32	128	16	132	2.0	1.0
8½ to 15	Terrace Deposits – Sandy Gravel	140	31	129	15	133	2.0	1.0
15 to 17+	Otay Formation - Sandstone	300	33	126	10	134	3.0	1.0

Note: Based on the subsurface conditions encountered in Boring B-9.

TABLE 7.18
RECOMMENDED SOIL PARAMETERS FOR PIER FOUNDATION DESIGN (Z81104)

Depth (feet)	Soil/Rock Type	Unit Cohesion c (psf)	Friction Angle ϕ (degrees)	Total Moist Unit Weight γ (pcf)	Moisture Content (%)	Total Saturated Unit Weight γ (pcf)	Deformation Modulus E_p (ksi)	Strength Reduction Factor
0 to 3½	Undocumented Fill	150	28	115	15	125	0.7	1.0
3½ to 8½	Alluvium	350	32	128	16	132	2.0	1.0
8½ to 15	Terrace Deposits – Sandy Gravel	140	31	129	15	133	2.0	1.0
15 to 17+	Otay Formation - Sandstone	300	33	126	10	134	3.0	1.0

Note: Based on the subsurface conditions encountered in Boring B-9.

TABLE 7.19
RECOMMENDED SOIL PARAMETERS FOR PIER FOUNDATION DESIGN (Z81097)

Depth (feet)	Soil/Rock Type	Unit Cohesion c (psf)	Friction Angle ϕ (degrees)	Total Moist Unit Weight γ (pcf)	Moisture Content (%)	Total Saturated Unit Weight γ (pcf)	Deformation Modulus E_p (ksi)	Strength Reduction Factor
0 to 10	Alluvium	300	32	128	16	132	2.0	1.0
10 to 20	Terrace Deposits – Sandy Gravel	140	31	129	15	133	2.5	1.0
20 to 45	Otay Formation	300	33	126	10	134	3.0	1.0
45+	Metavolcanic Rock	3000	40	137	5	144	6.0	0.9

Note: Based on the subsurface conditions encountered at SL-8.

TABLE 7.20
RECOMMENDED SOIL PARAMETERS FOR PIER FOUNDATION DESIGN (Z81975)

Depth (feet)	Soil/Rock Type	Unit Cohesion c (psf)	Friction Angle ϕ (degrees)	Total Moist Unit Weight γ (pcf)	Moisture Content (%)	Total Saturated Unit Weight γ (pcf)	Deformation Modulus E_p (ksi)	Strength Reduction Factor
0 to 12	Alluvium	300	32	128	16	132	2.0	1.0
12 to 18	Terrace Deposits – Sandy Gravel	140	31	129	15	133	2.5	1.0
18 to 31½+	Otay Formation - Sandstone	300	33	126	10	134	3.0	1.0

Note: Based on the subsurface conditions encountered in Boring B-10.

TABLE 7.21
RECOMMENDED SOIL PARAMETERS FOR PIER FOUNDATION DESIGN (Z81973)

Depth (feet)	Soil/Rock Type	Unit Cohesion c (psf)	Friction Angle ϕ (degrees)	Total Moist Unit Weight γ (pcf)	Moisture Content (%)	Total Saturated Unit Weight γ (pcf)	Deformation Modulus E_p (ksi)	Strength Reduction Factor
0 to 12	Alluvium	300	32	128	16	132	2.0	1.0
12 to 18	Terrace Deposits – Sandy Gravel	140	31	129	15	133	2.5	1.0
18 to 31½+	Otay Formation - Sandstone	300	33	126	10	134	3.0	1.0

Note: Based on the subsurface conditions encountered in Boring B-10.

TABLE 7.22
RECOMMENDED SOIL PARAMETERS FOR PIER FOUNDATION DESIGN (Z81081)

Depth (feet)	Soil/Rock Type	Unit Cohesion c (psf)	Friction Angle ϕ (degrees)	Total Moist Unit Weight γ (pcf)	Moisture Content (%)	Total Saturated Unit Weight γ (pcf)	Deformation Modulus E_p (ksi)	Strength Reduction Factor
0 to 2	Undocumented Fill	150	28	115	15	125	0.7	1.0
2 to 19½	Terrace Deposits – Clayey/Sandy Gravel	140	31	129	15	133	2.5	1.0

Note: Based on the subsurface conditions encountered in Boring B-11.

TABLE 7.23
RECOMMENDED SOIL PARAMETERS FOR PIER FOUNDATION DESIGN (Z118863)

Depth (feet)	Soil/Rock Type	Unit Cohesion c (psf)	Friction Angle ϕ (degrees)	Total Moist Unit Weight γ (pcf)	Moisture Content (%)	Total Saturated Unit Weight γ (pcf)	Deformation Modulus E_p (ksi)	Strength Reduction Factor
0 to 8	Alluvium	300	32	128	16	132	2.0	1.0
8 to 20	Otay Formation – Siltstone/Claystone	300	33	128	12	134	3.0	1.0
20 to 38	Otay Formation - Sandstone	500	31	116	10	129	3.0	1.0
38 to 50+	Otay Formation – Siltstone/Claystone	300	37	121	10	132	4.0	1.0

Note: Based on the subsurface conditions encountered at SL-9.

TABLE 7.24
RECOMMENDED SOIL PARAMETERS FOR PIER FOUNDATION DESIGN (P204534)

Depth (feet)	Soil/Rock Type	Unit Cohesion c (psf)	Friction Angle ϕ (degrees)	Total Moist Unit Weight γ (pcf)	Moisture Content (%)	Total Saturated Unit Weight γ (pcf)	Deformation Modulus E_p (ksi)	Strength Reduction Factor
0 to 8	Alluvium	250	27	123	15	130	1.5	1.0
8 to 30½	Otay Formation – Siltstone/Claystone	400	27	125	20	128	2.0	1.0
30½ to 35	Otay Formation - Sandstone	200	37	126	18	130	3.0	1.0
35+	Otay Formation – Claystone	600	33	129	18	132	4.0	1.0

Note: Based on the subsurface conditions encountered in Boring B-13.

TABLE 7.25
RECOMMENDED SOIL PARAMETERS FOR PIER FOUNDATION DESIGN (Z81074)

Depth (feet)	Soil/Rock Type	Unit Cohesion c (psf)	Friction Angle ϕ (degrees)	Total Moist Unit Weight γ (pcf)	Moisture Content (%)	Total Saturated Unit Weight γ (pcf)	Deformation Modulus E_p (ksi)	Strength Reduction Factor
0 to 8	Alluvium	250	27	123	15	130	1.5	1.0
8 to 30½	Otay Formation – Siltstone/Claystone	400	27	125	20	128	2.0	1.0
30½ to 35	Otay Formation - Sandstone	200	37	126	18	130	3.0	1.0
35 to 35½+	Otay Formation – Claystone	600	33	129	18	132	4.0	1.0

Note: Based on the subsurface conditions encountered in Boring B-13.

TABLE 7.26
RECOMMENDED SOIL PARAMETERS FOR PIER FOUNDATION DESIGN (Z81072)

Depth (feet)	Soil/Rock Type	Unit Cohesion c (psf)	Friction Angle ϕ (degrees)	Total Moist Unit Weight γ (pcf)	Moisture Content (%)	Total Saturated Unit Weight γ (pcf)	Deformation Modulus E_p (ksi)	Strength Reduction Factor
0 to 1	Undocumented Fill	150	28	115	15	125	0.7	1.0
1 to 10	Terrace Deposits – Sandy Gravel	100	36	115	15	125	3.0	1.0
10 to 14	Terrace Deposits – Clayey Sand	330	28	124	15	128	2.8	1.0
14 to 30½+	Otay Formation – Siltstone/Sandstone	430	27	127	22	128	4.0	1.0

Note: Based on the subsurface conditions encountered in Boring B-14.

TABLE 7.27
RECOMMENDED SOIL PARAMETERS FOR PIER FOUNDATION DESIGN (Z81069)

Depth (feet)	Soil/Rock Type	Unit Cohesion c (psf)	Friction Angle ϕ (degrees)	Total Moist Unit Weight γ (pcf)	Moisture Content (%)	Total Saturated Unit Weight γ (pcf)	Deformation Modulus E_p (ksi)	Strength Reduction Factor
0 to 1	Undocumented Fill	150	28	115	15	125	0.7	1.0
1 to 10	Terrace Deposits – Sandy Gravel	100	36	115	15	125	3.0	1.0
10 to 14	Terrace Deposits – Clayey Sand	330	28	124	15	128	2.8	1.0
14 to 30½+	Otay Formation – Siltstone/Sandstone	430	27	127	22	128	4.0	1.0

Note: Based on the subsurface conditions encountered in Boring B-14.

TABLE 7.28
RECOMMENDED SOIL PARAMETERS FOR PIER FOUNDATION DESIGN (Z81066)

Depth (feet)	Soil/Rock Type	Unit Cohesion c (psf)	Friction Angle ϕ (degrees)	Total Moist Unit Weight γ (pcf)	Moisture Content (%)	Total Saturated Unit Weight γ (pcf)	Deformation Modulus E_p (ksi)	Strength Reduction Factor
0 to 2	Undocumented Fill	150	28	115	15	125	0.7	1.0
2 to 13½	Terrace Deposits – Clayey Sand	600	33	128	15	133	2.2	1.0
13 to 20+	Otay Formation - Sandstone	450	30	125	14	131	3.6	1.0

Note: Based on the subsurface conditions encountered in Boring B-15.

TABLE 7.29
RECOMMENDED SOIL PARAMETERS FOR PIER FOUNDATION DESIGN (Z81055)

Depth (feet)	Soil/Rock Type	Unit Cohesion c (psf)	Friction Angle ϕ (degrees)	Total Moist Unit Weight γ (pcf)	Moisture Content (%)	Total Saturated Unit Weight γ (pcf)	Deformation Modulus E_p (ksi)	Strength Reduction Factor
0 to 4	Undocumented Fill	150	28	115	15	125	0.7	1.0
4 to 18+	Terrace Deposits – Sandy/Clayey Gravel	150	36	129	15	133	4.0	1.0

Note: Based on the subsurface conditions encountered in current Boring B-16.

TABLE 7.30
RECOMMENDED SOIL PARAMETERS FOR PIER FOUNDATION DESIGN (Z81049)

Depth (feet)	Soil/Rock Type	Unit Cohesion c (psf)	Friction Angle ϕ (degrees)	Total Moist Unit Weight γ (pcf)	Moisture Content (%)	Total Saturated Unit Weight γ (pcf)	Deformation Modulus E_p (ksi)	Strength Reduction Factor
0 to 2	Undocumented Fill	150	28	115	15	125	0.7	1.0
2 to 12	Terrace Deposits – Sandy Clay	600	30	128	15	132	1.6	1.0
12 to 29+	Otay Formation – Sandstone/Claystone	320	30	131	14	138	3.5	1.0

Note: Based on the subsurface conditions encountered in Boring B-17.

TABLE 7.31
RECOMMENDED SOIL PARAMETERS FOR PIER FOUNDATION DESIGN (Z731392)

Depth (feet)	Soil/Rock Type	Unit Cohesion c (psf)	Friction Angle ϕ (degrees)	Total Moist Unit Weight γ (pcf)	Moisture Content (%)	Total Saturated Unit Weight γ (pcf)	Deformation Modulus E_p (ksi)	Strength Reduction Factor
0 to 2	Undocumented Fill	150	28	115	15	125	0.7	1.0
2 to 12	Terrace Deposits – Sandy Clay	600	30	128	15	132	1.6	1.0
12 to 29+	Otay Formation – Sandstone/Claystone	320	30	131	14	138	3.5	1.0

Note: Based on the subsurface conditions encountered in Boring B-17.

TABLE 7.32
RECOMMENDED SOIL PARAMETERS FOR PIER FOUNDATION DESIGN (Z81044)

Depth (feet)	Soil/Rock Type	Unit Cohesion c (psf)	Friction Angle ϕ (degrees)	Total Moist Unit Weight γ (pcf)	Moisture Content (%)	Total Saturated Unit Weight γ (pcf)	Deformation Modulus E_p (ksi)	Strength Reduction Factor
0 to 1	Undocumented Fill	150	28	115	15	125	0.7	1.0
1 to 5	Terrace Deposits – Sandy Gravel	150	36	124	11	133	3.0	1.0
5 to 15	Terrace Deposits – Clayey Sand	450	31	128	11	135	3.5	1.0
15 to 45	Otay Formation – Siltstone/Claystone	450	30	132	10	138	4.0	1.0
45+	Metavolcanic Rock	3000	40	137	5	144	6.0	0.9

Note: Based on the subsurface conditions encountered in Boring B-18 and at SL-10.

TABLE 7.33
RECOMMENDED SOIL PARAMETERS FOR PIER FOUNDATION DESIGN (Z31723)

Depth (feet)	Soil/Rock Type	Unit Cohesion c (psf)	Friction Angle ϕ (degrees)	Total Moist Unit Weight γ (pcf)	Moisture Content (%)	Total Saturated Unit Weight γ (pcf)	Deformation Modulus E_p (ksi)	Strength Reduction Factor
0 to 7½	Alluvium	150	28	115	15	125	0.7	1.0
7½ to 30	Otay Formation - Sandstone	240	32	128	10	136	4.0	1.0
30 to 36	Otay Formation – Siltstone	500	26	136	14	138	4.0	1.0
36 to 40½+	Otay Formation - Sandstone	300	37	136	14	138	6.0	1.0

Note: Based on the subsurface conditions encountered in Boring B-19.

TABLE 7.34
RECOMMENDED SOIL PARAMETERS FOR PIER FOUNDATION DESIGN (Z31729)

Depth (feet)	Soil/Rock Type	Unit Cohesion c (psf)	Friction Angle ϕ (degrees)	Total Moist Unit Weight γ (pcf)	Moisture Content (%)	Total Saturated Unit Weight γ (pcf)	Deformation Modulus E_p (ksi)	Strength Reduction Factor
0 to 3	Topsoil	200	30	115	15	125	1.5	1.0
3 to 60	Fanglomerate Deposits	300	36	127	10	135	4.0	1.0
60+	Metavolcanic Rock	3000	40	137	5	144	6.0	0.9

Note: Based on the subsurface conditions encountered in Boring B-20 and at SL-5.

TABLE 7.35
RECOMMENDED SOIL PARAMETERS FOR PIER FOUNDATION DESIGN (Z31744)

Depth (feet)	Soil/Rock Type	Unit Cohesion c (psf)	Friction Angle ϕ (degrees)	Total Moist Unit Weight γ (pcf)	Moisture Content (%)	Total Saturated Unit Weight γ (pcf)	Deformation Modulus E_p (ksi)	Strength Reduction Factor
0 to 2	Topsoil	200	30	115	15	125	1.5	1.0
2 to 20+	Otay Formation – Siltstone/Claystone	450	30	132	10	138	4.0	1.0

Note: Based on the subsurface conditions encountered at SL-4.

TABLE 7.36
RECOMMENDED SOIL PARAMETERS FOR PIER FOUNDATION DESIGN (Z31768)

Depth (feet)	Soil/Rock Type	Unit Cohesion c (psf)	Friction Angle ϕ (degrees)	Total Moist Unit Weight γ (pcf)	Moisture Content (%)	Total Saturated Unit Weight γ (pcf)	Deformation Modulus E_p (ksi)	Strength Reduction Factor
0 to 15	Undocumented Fill	150	28	115	15	125	0.7	1.0
15 to 20	Colluvium	300	30	120	15	129	2.0	1.0
20 to 45	Fanglomerate Deposits	300	36	127	10	135	4.0	1.0
45+	Metavolcanic Rock	3000	40	137	5	144	6.0	0.9

Note: Based on the subsurface conditions encountered at SL-3.

TABLE 7.37
RECOMMENDED SOIL PARAMETERS FOR PIER FOUNDATION DESIGN (Z34102)

Depth (feet)	Soil/Rock Type	Unit Cohesion c (psf)	Friction Angle ϕ (degrees)	Total Moist Unit Weight γ (pcf)	Moisture Content (%)	Total Saturated Unit Weight γ (pcf)	Deformation Modulus E_p (ksi)	Strength Reduction Factor
0 to 20	Otay Formation – Siltstone/Claystone	450	30	132	10	138	2.2	1.0
20 to 60+	Fanglomerate Deposits	300	36	127	10	135	4.0	1.0

Note: Based on the subsurface conditions encountered at SL-2.

TABLE 7.38
RECOMMENDED SOIL PARAMETERS FOR PIER FOUNDATION DESIGN (Z31745)

Depth (feet)	Soil/Rock Type	Unit Cohesion c (psf)	Friction Angle ϕ (degrees)	Total Moist Unit Weight γ (pcf)	Moisture Content (%)	Total Saturated Unit Weight γ (pcf)	Deformation Modulus E_p (ksi)	Strength Reduction Factor
0 to 1½	Topsoil	200	30	115	15	125	1.5	1.0
1½ to 5	Otay Formation - Sandstone	200	30	127	15	132	2.0	1.0
5 to 13	Otay Formation – Sandy Gravel	250	36	132	10	138	3.5	1.0
13 to 41+	Otay Formation – Siltstone	700	29	125	25	125	3.0	1.0

Note: Based on the subsurface conditions encountered in Boring B-22.

TABLE 7.39
RECOMMENDED SOIL PARAMETERS FOR PIER FOUNDATION DESIGN (Z31746)

Depth (feet)	Soil/Rock Type	Unit Cohesion c (psf)	Friction Angle ϕ (degrees)	Total Moist Unit Weight γ (pcf)	Moisture Content (%)	Total Saturated Unit Weight γ (pcf)	Deformation Modulus E_p (ksi)	Strength Reduction Factor
0 to 1½	Topsoil	200	30	115	15	125	1.5	1.0
1½ to 5	Otay Formation - Sandstone	200	30	127	15	132	2.0	1.0
5 to 13	Otay Formation – Sandy Gravel	250	36	132	10	138	3.5	1.0
13 to 41+	Otay Formation – Siltstone/Claystone	700	29	125	25	125	3.0	1.0

Note: Based on the subsurface conditions encountered in Boring B-22.

TABLE 7.40
RECOMMENDED SOIL PARAMETERS FOR PIER FOUNDATION DESIGN (Z31749)

Depth (feet)	Soil/Rock Type	Unit Cohesion c (psf)	Friction Angle ϕ (degrees)	Total Moist Unit Weight γ (pcf)	Moisture Content (%)	Total Saturated Unit Weight γ (pcf)	Deformation Modulus E_p (ksi)	Strength Reduction Factor
0 to 2	Topsoil	200	30	115	15	125	1.5	1.0
2 to 35	Otay Formation - Sandstone	200	30	127	15	132	2.0	1.0
35 to 50	Fanglomerate Deposits	300	36	127	10	135	4.0	1.0
50+	Metavolcanic Rock	3000	40	137	5	144	6.0	0.9

Note: Based on the subsurface conditions encountered at SL-1.

TABLE 7.41
RECOMMENDED SOIL PARAMETERS FOR PIER FOUNDATION DESIGN (Z31750)

Depth (feet)	Soil/Rock Type	Unit Cohesion c (psf)	Friction Angle ϕ (degrees)	Total Moist Unit Weight γ (pcf)	Moisture Content (%)	Total Saturated Unit Weight γ (pcf)	Deformation Modulus E_p (ksi)	Strength Reduction Factor
0 to 2	Topsoil	200	30	115	15	125	1.5	1.0
2 to 35	Otay Formation - Sandstone	200	30	127	15	132	2.0	1.0
35 to 50	Fanglomerate Deposits	300	36	127	10	135	4.0	1.0
50+	Metavolcanic Rock	3000	40	137	5	144	6.0	0.9

Note: Based on the subsurface conditions encountered at SL-1.

TABLE 7.42
RECOMMENDED SOIL PARAMETERS FOR PIER FOUNDATION DESIGN (Z31753)

Depth (feet)	Soil/Rock Type	Unit Cohesion c (psf)	Friction Angle ϕ (degrees)	Total Moist Unit Weight γ (pcf)	Moisture Content (%)	Total Saturated Unit Weight γ (pcf)	Deformation Modulus E_p (ksi)	Strength Reduction Factor
0 to 2	Undocumented Fill	150	28	115	15	125	0.7	1.0
2 to 10	Otay Formation – Sandstone	300	32	121	15	129	3.0	1.0
10 to 15	Otay Formation – Siltstone	500	29	120	18	126	3.5	1.0
15 to 19½+	Otay Formation – Sandstone	400	36	115	13	126	4.0	1.0

Note: Based on the subsurface conditions encountered in Boring B-23.

TABLE 7.43
RECOMMENDED SOIL PARAMETERS FOR PIER FOUNDATION DESIGN (Z31754)

Depth (feet)	Soil/Rock Type	Unit Cohesion c (psf)	Friction Angle ϕ (degrees)	Total Moist Unit Weight γ (pcf)	Moisture Content (%)	Total Saturated Unit Weight γ (pcf)	Deformation Modulus E_p (ksi)	Strength Reduction Factor
0 to 2	Undocumented Fill	150	28	115	15	125	0.7	1.0
2 to 10	Otay Formation – Sandstone	300	32	121	15	129	3.0	1.0
10 to 15	Otay Formation – Siltstone	500	29	120	18	126	3.5	1.0
15 to 19½+	Otay Formation – Sandstone	400	36	115	13	126	4.0	1.0

Note: Based on the subsurface conditions encountered in Boring B-23 and SL-11.

TABLE 7.44
RECOMMENDED SOIL PARAMETERS FOR PIER FOUNDATION DESIGN (Z31757)

Depth (feet)	Soil/Rock Type	Unit Cohesion c (psf)	Friction Angle ϕ (degrees)	Total Moist Unit Weight γ (pcf)	Moisture Content (%)	Total Saturated Unit Weight γ (pcf)	Deformation Modulus E_p (ksi)	Strength Reduction Factor
0 to 5	Undocumented Fill	150	28	115	15	125	0.7	1.0
5 to 41+	Otay Formation-Sandstone/Siltstone	400	30	120	17	127	3.0	1.0

Note: Based on the subsurface conditions encountered in Boring B-21.

TABLE 7.45
RECOMMENDED SOIL PARAMETERS FOR PIER FOUNDATION DESIGN (Z31758)

Depth (feet)	Soil/Rock Type	Unit Cohesion c (psf)	Friction Angle ϕ (degrees)	Total Moist Unit Weight γ (pcf)	Moisture Content (%)	Total Saturated Unit Weight γ (pcf)	Deformation Modulus E_p (ksi)	Strength Reduction Factor
0 to 5	Undocumented Fill	150	28	115	15	125	0.7	1.0
5 to 41+	Otay Formation-Sandstone/Siltstone	400	30	120	17	127	3.0	1.0

Note: Based on the subsurface conditions encountered in Boring B-21.

We understand initially from SDG&E that the proposed poles Z81975 and Z31723 may be subject to potential scour due to the proximity to Otay River channel. Gradation analyses using representative soil samples from Borings B-10 and B-19 were performed to facilitate local scour evaluation if necessary. However, a further review of the current FEMA online flood hazards map along the TL 649 alignment indicates that no pole is located within "High Risk Area – Floodway", and only pole (Z81975) is located within the "High Risk Area" as depicted on Figure 10, *FEMA Hazards Map*.

In general, local scour is a function of the depth of water, diameter of drilled pier, gradation of surficial soil, and the velocity of flow. A hydrologic and/or hydraulic report for the project is not available at this point. Based on Figure 10, the location of Z81975 is not located within the potential active flow channel in case of a flood event. However, this location could be submerged due to potential backflow entering the locally depression pocket. The depth of backflow water would likely be limited and the velocity of the backflow, if any is expected to be relatively slow. Therefore the potential for local scour at this pole is likely low.

For the purpose of a conservative foundation design, a worst scenario assuming an active flow velocity at this pole may be considered. Using the formula by Laursen (1962), the estimated local

scour depths are summarized in Table 7.46 based on a pier diameter of 6 feet and the approximate median diameter of the surficial soil of between 0.46 mm and 2.2 mm.

TABLE 7.46
SUMMARY OF ESTIMATED LOCAL SCOUR AT Z81975

Assumed Pier Diameter, feet	Assumed Flow Depth, feet	Estimated Local Scour Depth, feet
6	4	5.5
6	6	6.5
6	8	8.0
6	10	8.5

Note: Worst scenario with active flow velocity assumed.

8. CONSTRUCTION CONSIDERATIONS

We expect very dense to hard formational materials with varying amounts of gravel, cobbles, and boulders will be encountered during some pole installations at the site. The contactor should have auger, core barrels, and excavating tools suitable for penetrating dense layers, concretions, and cemented zones on-site during the pole construction.

Slight seepage was encountered in Borings B-10 and B-14 at approximately depths of 18 and 30 feet, respectively. Ground water or perched groundwater could be encountered during construction following heavy rainfall, runoff, and/or irrigation. Sloughing or reveling could occur where relatively clean sands are encountered below the groundwater level. Casing and/or wet methods may be necessary for the installation of pole foundation below groundwater, if any.

The drilling equipment should allow maneuverability on difficult and sloped terrain, penetration and support of weak and unconsolidated soils, and/or rotary percussive drilling in obstructions including cobbles and hard formational materials.

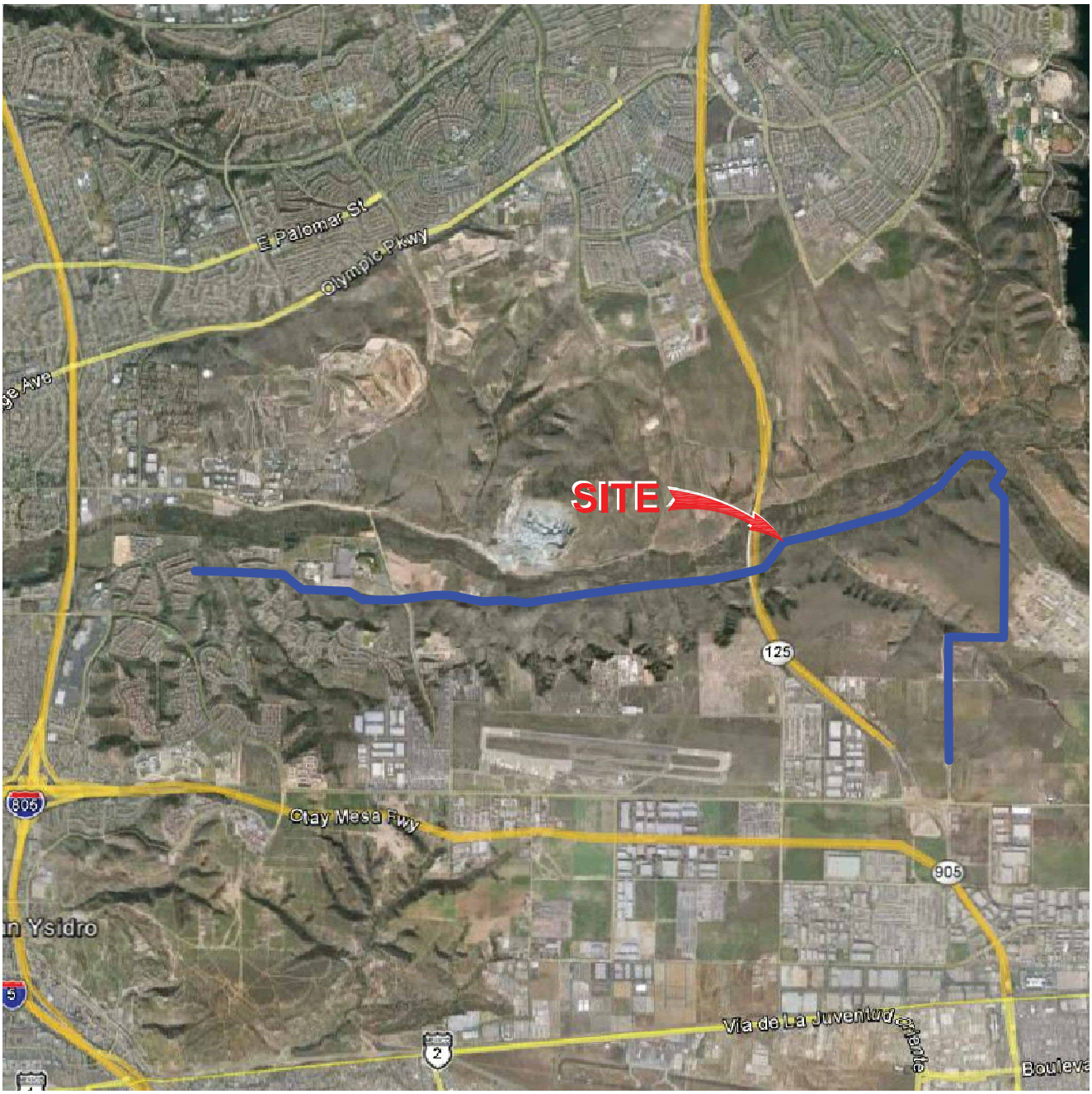
LIMITATIONS AND UNIFORMITY OF CONDITIONS

1. The firm that performed the geotechnical investigation for the project should be retained to provide testing and observation services during construction to provide continuity of geotechnical interpretation and to check that the recommendations presented for geotechnical aspects of site development are incorporated during site grading, construction of improvements, and excavation of foundations. If another geotechnical firm is selected to perform the testing and observation services during construction operations, that firm should prepare a letter indicating their intent to assume the responsibilities of project geotechnical engineer of record. A copy of the letter should be provided to the regulatory agency for their records. In addition, that firm should provide revised recommendations concerning the geotechnical aspects of the proposed development, or a written acknowledgement of their concurrence with the recommendations presented in our report. They should also perform additional analyses deemed necessary to assume the role of Geotechnical Engineer of Record.

2. The recommendations of this report pertain only to the site investigated and are based upon the assumption that the soil conditions do not deviate from those disclosed in the investigation. If any variations or undesirable conditions are encountered during construction, or if the proposed construction will differ from that anticipated herein, Geocon Incorporated should be notified so that supplemental recommendations can be given. The evaluation or identification of the potential presence of hazardous or corrosive materials was not part of the scope of services provided by Geocon Incorporated.

3. This report is issued with the understanding that it is the responsibility of the owner or his representative to ensure that the information and recommendations contained herein are brought to the attention of the architect and engineer for the project and incorporated into the plans, and the necessary steps are taken to see that the contractor and subcontractors carry out such recommendations in the field.

4. The findings of this report are valid as of the present date. However, changes in the conditions of a property can occur with the passage of time, whether they be due to natural processes or the works of man on this or adjacent properties. In addition, changes in applicable or appropriate standards may occur, whether they result from legislation or the broadening of knowledge. Accordingly, the findings of this report may be invalidated wholly or partially by changes outside our control. Therefore, this report is subject to review and should not be relied upon after a period of three years.



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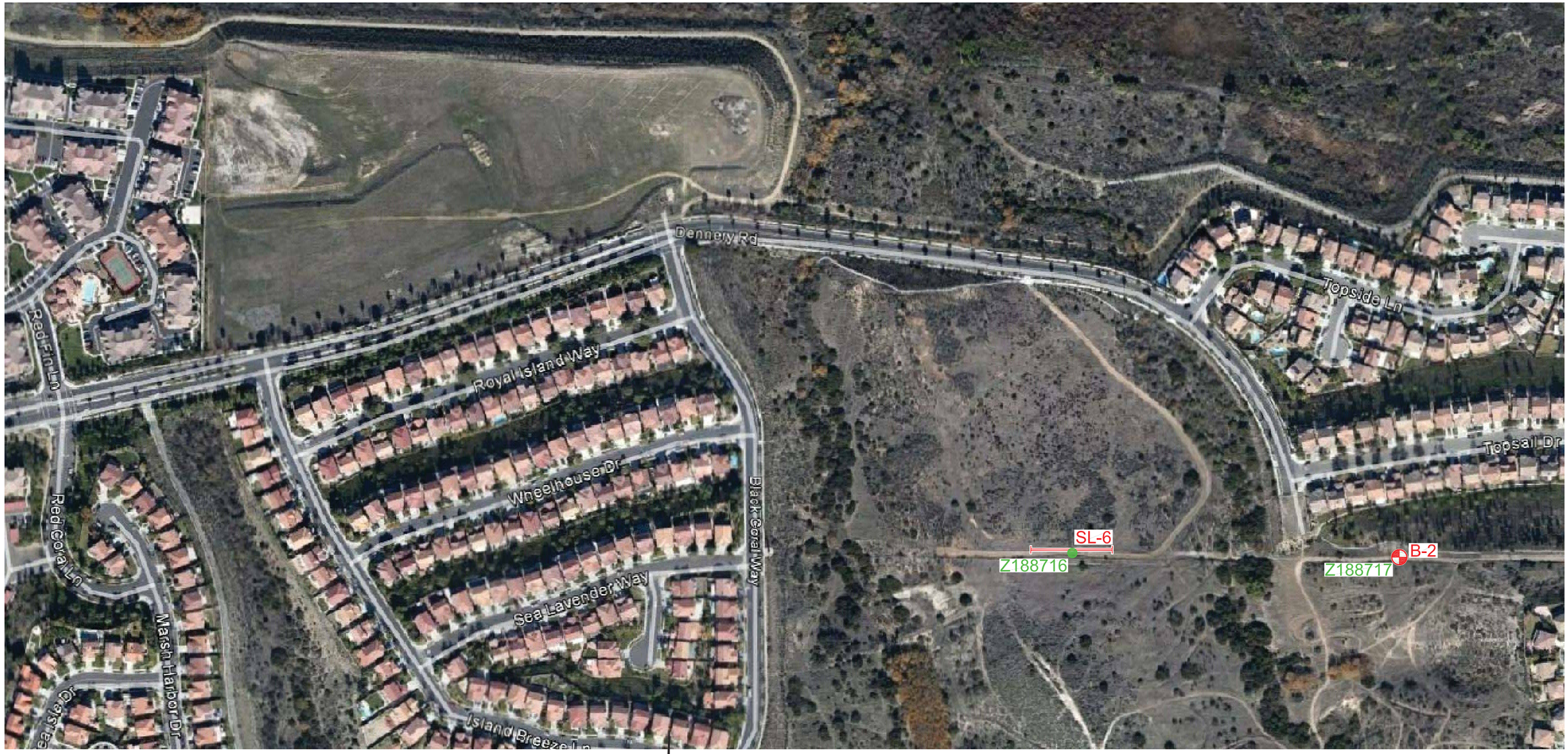
VICINITY MAP

SDG&E TL649
WOOD TO STEEL IMPROVEMENTS
SAN DIEGO COUNTY, CALIFORNIA

DATE 01 - 29 - 2014	PROJECT NO. G1115 - 52 - 54	FIG. 1

REVISED DATE 02 - 24 - 2014

SDG&E TL649
WOOD TO STEEL IMPROVEMENTS
SAN DIEGO COUNTY, CALIFORNIA



GEOCON LEGEND

Z31758 .....APPROX. LOCATION OF PROPOSED STEEL POLE

B-23 .....APPROX. LOCATION OF EXPLORATORY BORING

SL-11 .....APPROX. LOCATION OF SEISMIC REFRACTION SURVEY LINE

0' 125' 250' 375' 500'

SCALE 1"= 250'

SITE PLAN

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PROJECT NO. G1115 - 52 - 54
FIGURE 2
DATE 01 - 29 - 2014
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SAN DIEGO COUNTY, CALIFORNIA

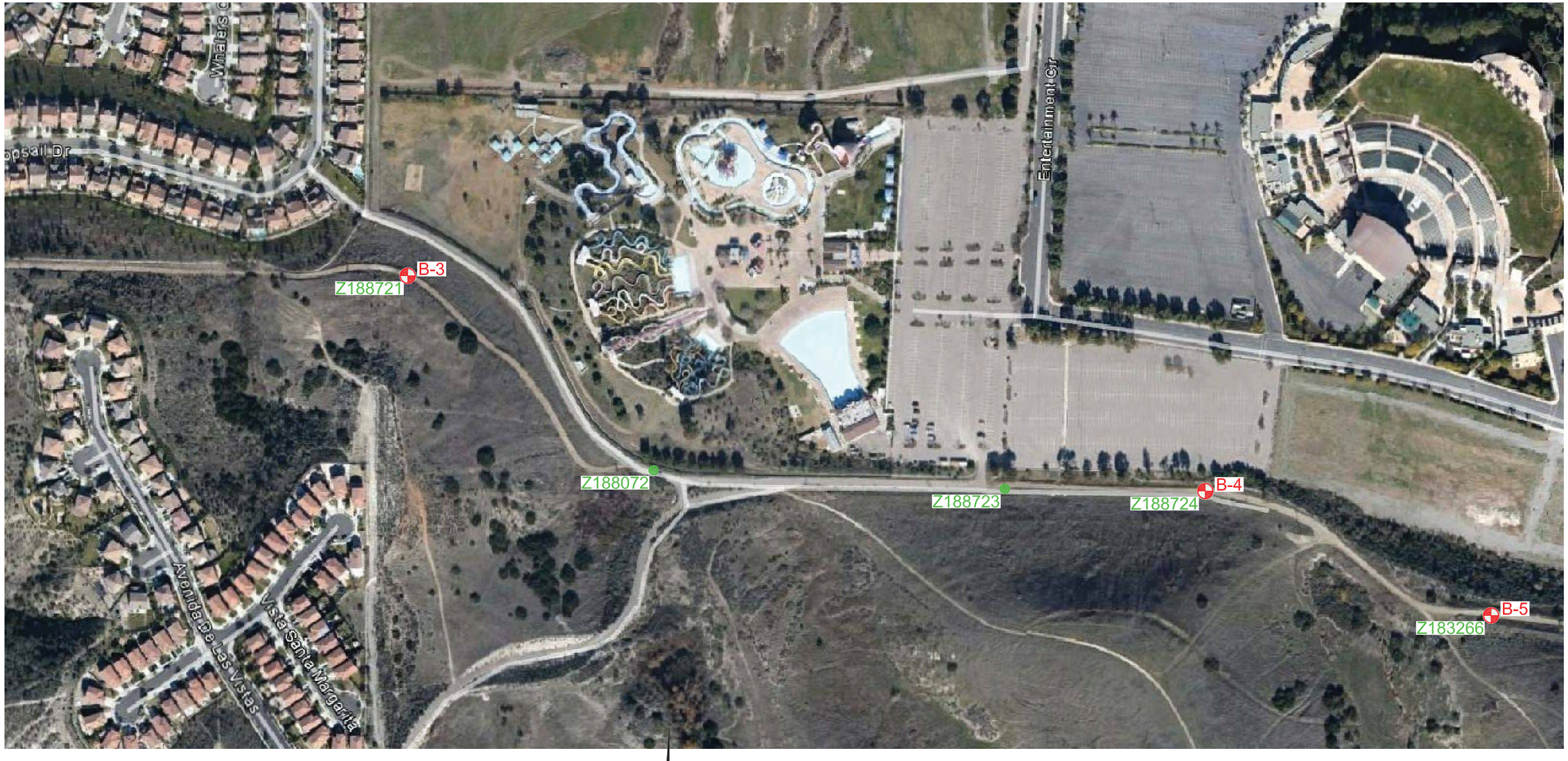

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FIGURE 3
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FIGURE 4
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FIGURE 5
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SCALE 1"= 250'

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FIGURE 6
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FIGURE 7
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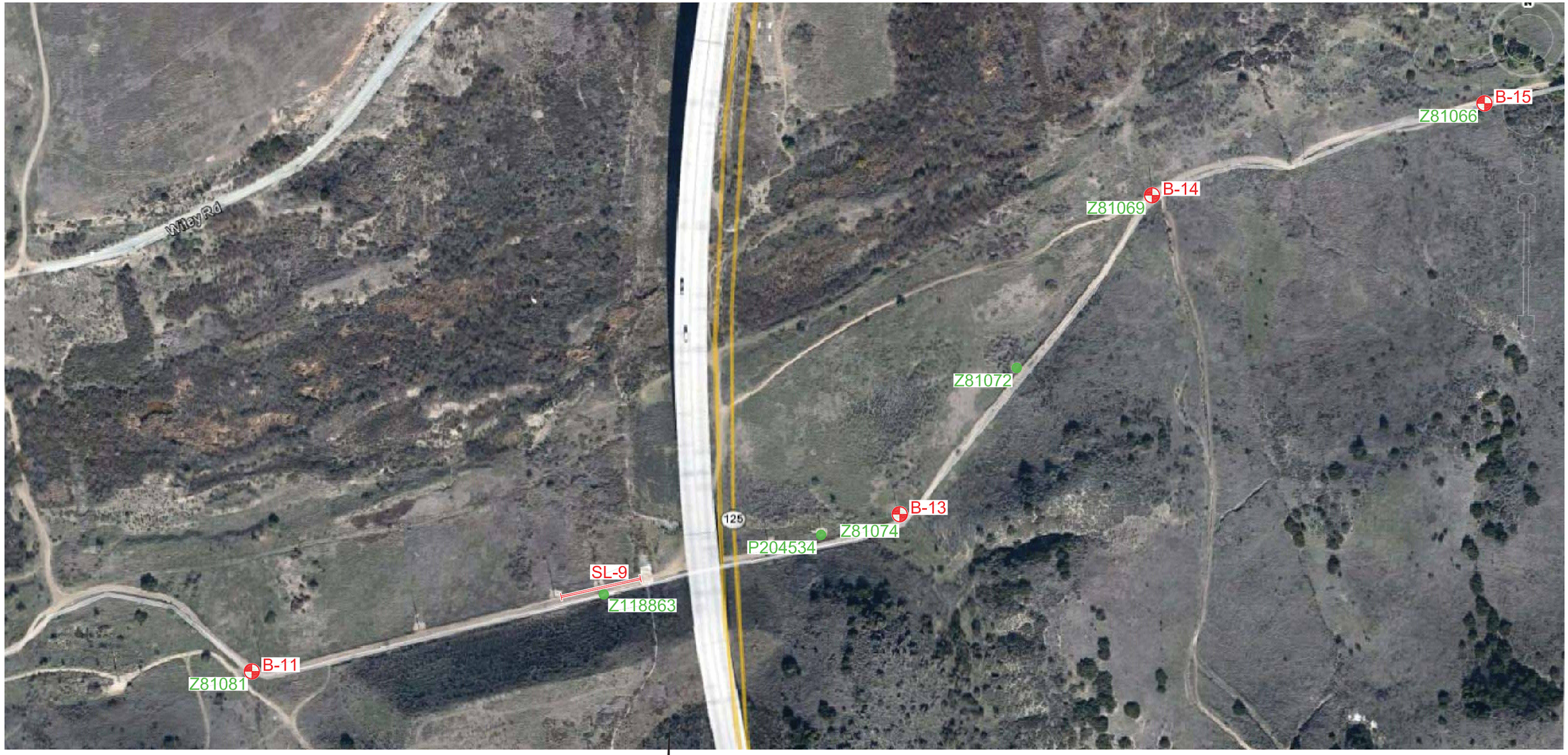

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FIGURE 8
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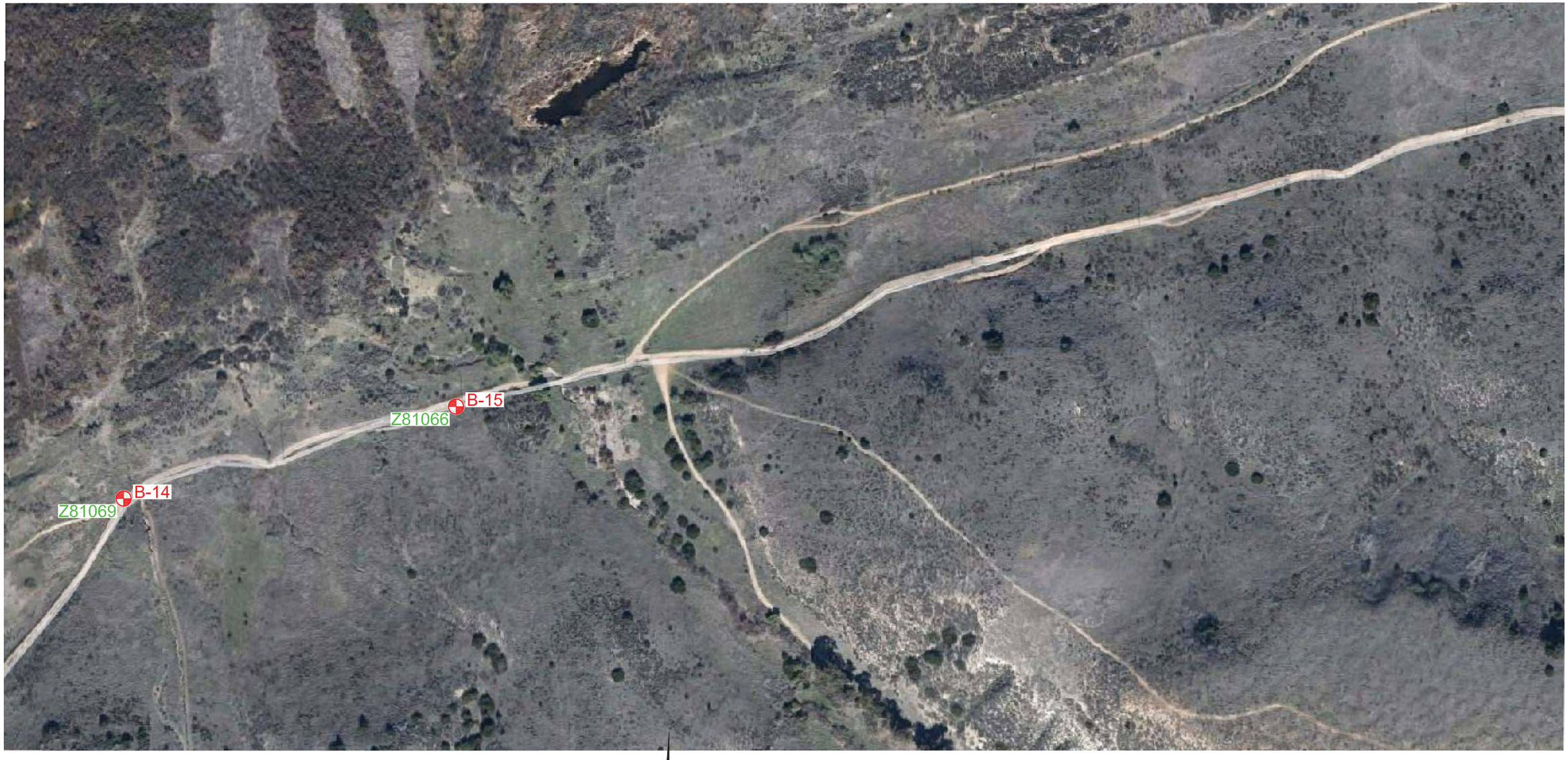

0' 125' 250' 375' 500'

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FIGURE 9
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FIGURE 10
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SDG&E TL649
WOOD TO STEEL IMPROVEMENTS
SAN DIEGO COUNTY, CALIFORNIA

0’ 125’ 250’ 375’ 500’

SCALE 1”= 250’

GEOCON LEGEND

Z31758 .....APPROX. LOCATION OF PROPOSED STEEL POLE

B-23 .....APPROX. LOCATION OF EXPLORATORY BORING

SL-11 .....APPROX. LOCATION OF SEISMIC REFRACTION SURVEY LINE

GEOCON INCORPORATED
GEOTECHNICAL ■ ENVIRONMENTAL ■ MATERIALS
6960 FLANDERS DRIVE - SAN DIEGO, CALIFORNIA 92121 - 2974
PHONE 858 558-6900 - FAX 858 558-6159

PROJECT NO. G1115 - 52 - 54
FIGURE 11
DATE 01 - 29 - 2014
REVISED DATE 02 - 24 - 2014

SITE PLAN

Ladrillono

Y:\PROJECTS\G1115-52-54 (SDG&E TL 649)\SHEETS\G1115-52-54 Map.dwg

SDG&E TL649
WOOD TO STEEL IMPROVEMENTS
SAN DIEGO COUNTY, CALIFORNIA

0’ 125’ 250’ 375’ 500’

SCALE 1”= 250’

GEOCON LEGEND

Z31758 .....APPROX. LOCATION OF PROPOSED STEEL POLE

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GEOCON INCORPORATED
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PROJECT NO. G1115 - 52 - 54
FIGURE 12
DATE 01 - 29 - 2014
REVISED DATE 02 - 24 - 2014

SITE PLAN

Ladrillono

Y:\PROJECTS\G1115-52-54 (SDG&E TL 649)\SHEETS\G1115-52-54 Map.dwg

SDG&E TL649
WOOD TO STEEL IMPROVEMENTS
SAN DIEGO COUNTY, CALIFORNIA

0' 125' 250' 375' 500'

SCALE 1"= 250'

GEOCON LEGEND

Z31758 .....APPROX. LOCATION OF PROPOSED STEEL POLE

B-23 .....APPROX. LOCATION OF EXPLORATORY BORING

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GEOCON INCORPORATED
GEOTECHNICAL ■ ENVIRONMENTAL ■ MATERIALS
6960 FLANDERS DRIVE - SAN DIEGO, CALIFORNIA 92121 - 2974
PHONE 858 558-6900 - FAX 858 558-6159

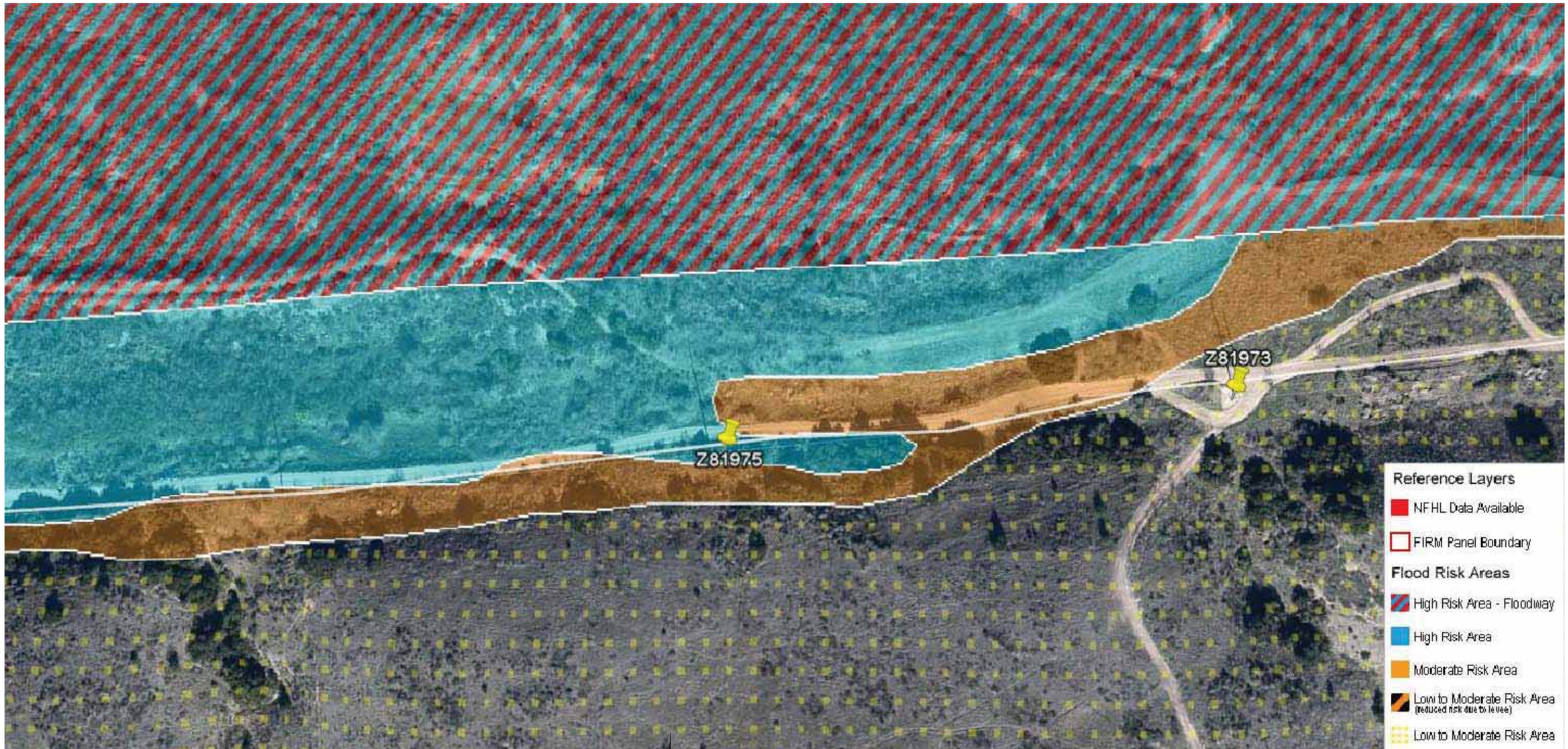
PROJECT NO. G1115 - 52 - 54
FIGURE 13
DATE 01 - 29 - 2014
REVISED DATE 02 - 24 - 2014

SITE PLAN

Ladrillono

Y:\PROJECTS\G1115-52-54 (SDG&E TL 649)\SHEETS\G1115-52-54 Map.dwg

SDG&E TL649
WOOD TO STEEL IMPROVEMENTS
SAN DIEGO COUNTY, CALIFORNIA



NO SCALE

FLOOD HAZARDS MAP

GEOCON
INCORPORATED
GEOTECHNICAL ■ ENVIRONMENTAL ■ MATERIALS
6960 FLANDERS DRIVE - SAN DIEGO, CALIFORNIA 92121 - 2974
PHONE 858 558-6900 - FAX 858 558-6159

PROJECT NO. G1115 - 52 - 54
FIGURE 14
DATE 02 - 24 - 2014

Ladrillono

Y:\PROJECTS\G1115-52-54 (SDG&E TL 649)\SHEETS\G1115-52-54 Flood Hazards Map.dwg

APPENDIX A

APPENDIX A

FIELD INVESTIGATION

We performed the current field investigation, including 21 borings (B-2 through B-11 and B-13 through B-23), on November 11, 2013 through December 3, 2013. We also performed a geophysical survey including 11 seismic refraction survey lines (SL-1 through SL-11) at the locations where environmental, overhead, and subsurface restrictions precluded drilling during our field investigation. The locations of the exploratory borings and seismic refraction lines are shown on *Site Plans*, Figures 2 through 13. Boring logs and an explanation of the geologic units encountered are presented in figures following the text in this appendix.

We obtained samples using a Modified California Sampler and/or Standard Penetration Test (SPT). The type of sample is noted on the exploratory boring logs, Figures A-1 through A-21. The laboratory tests are presented in Appendix B.

The details of the fieldwork and the results of the seismic refraction survey are presented in Appendix C.

PROJECT NO. G1115-52-54

BORING B 2

ELEV. (MSL.) **240'** DATE COMPLETED **11-11-2013**

EQUIPMENT **MARL 5 w/ 6-inch HSA** BY: **M. ERTWINE**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	B2-1			CL	**TOPSOIL** Stiff, damp, brown, Sandy CLAY			
2	B2-2			SM	**LANDSLIDE DEBRIS (Qls)** Medium dense, moist, light grayish brown, Silty, fine- to medium-grained SAND; trace carbonates	32		
4	B2-3				-Becomes dry, loose, Silty, fine- to coarse-grained	9		
6								
8	B2-4			SM	Medium dense, moist, light yellowish brown, Silty, fine- to coarse-grained SAND; some carbonates; trace clasts of cemented gravel	21	102.1	17.9
10	B2-5				-Becomes loose	7		
12	B2-6				-Becomes fine- to coarse-grained	13	104.9	16.8
14								
16	B2-7			SM	Medium dense, moist, reddish brown, Silty, fine to medium SAND	18		
18								
20	B2-8			CL	**OTAY FORMATION (To)** Very stiff, moist, olive brown, Sandy CLAYSTONE	48	115.4	15.3
22								
24								
26	B2-9			CH	Very stiff, moist, pinkish gray, Silty CLAYSTONE; ("Bentonite"), waxy texture common parting surfaces	24		
28								

Figure A-1,
Log of Boring B 2, Page 1 of 2

G1115-52-54.GPJ

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◪ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

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

GEOCON

PROJECT NO. G1115-52-54

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	**BORING B 2** ELEV. (MSL.) **240'** DATE COMPLETED **11-11-2013** EQUIPMENT **MARL 5 w/ 6-inch HSA** BY: **M. ERTWINE**	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
30	B2-10			CH	-Hard to thickly bedded, internal parting surface	65	104.3	22.8
32								
34								
36	B2-11				-Becomes hard, poorly indurated, reddish brown, Sandy CLAYSTONE with bentonite texture	67		
38					BORING REFUSAL AT 38 FEET Groundwater not encountered Backfilled with 7.5 ft³ grout slurry			

Figure A-1,
Log of Boring B 2, Page 2 of 2

G1115-52-54.GPJ

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◪ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

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

GEOCON

PROJECT NO. G1115-52-54

BORING B 3

ELEV. (MSL.) **207'** DATE COMPLETED **11-11-2013**

EQUIPMENT **MARL 5 w/ 6-inch HSA** BY: **M. ERTWINE**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	B3-1			CL	**UNDOCUMENTED FILL (Qudf)** Firm, damp, brown, Sandy CLAY			
2	B3-2					7		
4	B3-3							
6				SM	**OTAY FORMATION (To)** Medium dense, moist, yellowish brown, Silty, fine- to medium-grained SANDSTONE; abundant carbonates, weakly cemented	29	96.4	18.3
8	B3-4					31		
10	B3-5				-Becomes fine- to coarse-grained SAND	45	110.0	17.0
12	B3-6			SM	Medium dense, moist, grayish brown, Silty, fine- to coarse-grained SANDSTONE; moderately cemented	27		
14	B3-7					32	112.6	15.2
16					-Uniform, thickly bedded			
18								
20	B3-8			CL	Very stiff, moist, light brown, Sandy CLAYSTONE; few fine gravel within matrix, trace BENTONITE CLAYSTONE	22		
22								
24								
26	B3-9			SM-SC	Very dense, moist, light brown, Silty to Clayey, fine-grained SANDSTONE; well cemented, difficult drilling	50/3"		
					BORING REFUSAL AT 27 FEET Groundwater not encountered Backfilled with 5.3 ft³ grout slurry			

Figure A-2,
Log of Boring B 3, Page 1 of 1

G1115-52-54.GPJ

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◥ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

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

GEOCON

PROJECT NO. G1115-52-54

BORING B 4

ELEV. (MSL.) **199'** DATE COMPLETED **11-11-2013**

EQUIPMENT **MARL 5 w/ 6-inch HSA** BY: **M. ERTWINE**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	B4-1			SC	**UNDOCUMENTED FILL (Qudf)** Loose, dry, grayish brown, Clayey SAND			
2								
4				SC	**ALLUVIUM (Qal)** Medium dense, moist, dark brown, Clayey SAND			
6	B4-2				-Trace carbonates	27		
8	B4-3				-Uniform	15		
10	B4-4				-Uniform	23	108.0	17.2
12	B4-5				-Massive	16		
14								
16	B4-6			CL	Stiff, moist, brown, Sandy CLAY	27	114.7	16.2
18	B4-7				-Poor recovery	19		
20	B4-8				-Becomes fat CLAY	33	109.5	18.8
22								
24								
26	B4-9				-Uniform, very stiff	19		
28								

Figure A-3,
Log of Boring B 4, Page 1 of 2

G1115-52-54.GPJ

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

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

PROJECT NO. G1115-52-54

BORING B 4

ELEV. (MSL.) **199'** DATE COMPLETED **11-11-2013**

EQUIPMENT **MARL 5 w/ 6-inch HSA** BY: **M. ERTWINE**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
30	B4-10			CL	**OTAY FORMATION (To)** Stiff, moist, whitish gray, Sandy CLAYSTONE; highly weathered, trace carbonates	22	108.3	17.8
32								
34								
36	B4-11				-Becomes very stiff	21		
38								
40	B4-12			SM	Medium dense, moist, light brown, Silty, fine-grained SANDSTONE; weakly cemented	23	98.1	23.6
					BORING TERMINATED AT 41 FEET Groundwater not encountered Backfilled with 8.0 ft³ grout slurry			

Figure A-3,
Log of Boring B 4, Page 2 of 2

G1115-52-54.GPJ

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

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

GEOCON

PROJECT NO. G1115-52-54

BORING B 5

ELEV. (MSL.) **249'** DATE COMPLETED **11-13-2013**

EQUIPMENT **MARL 5 w/ 6-inch HSA** BY: **M. ERTWINE**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	B5-1			SM	**UNDOCUMENTED FILL (Qudf)** Loose, dry, gray brown, Silty, fine- to medium-grained; trace gravel			
2								
4				CL	**COLLUVIUM (Qcol)** Stiff, moist, brown, Sandy CLAY; few carbonates			
6	B5-2					18	98.1	18.1
8	B5-3			SM	**OTAY FORMATION (To)** Dense, moist, whitish gray, Silty, fine- to coarse-grained SANDSTONE; ("GRITSTONE"), moderately cemented	32		
10	B5-4				-Some fine gravel, moderately cemented	53	113.3	7.8
12								
14								
16	B5-5				-Becomes very dense, predominantly fine- to medium-grained	68		15.0
18	B5-6				-Difficult drilling, progress slow, few, coarse subrounded gravel -Becomes well cemented, practical -Refusal with hollow stem auger	54		
					BORING REFUSAL AT 19 FEET Groundwater not encountered Backfilled with 3.7 ft³ grout slurry			

Figure A-4,
Log of Boring B 5, Page 1 of 1

G1115-52-54.GPJ

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◪ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

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

GEOCON

PROJECT NO. G1115-52-54

BORING B 6

ELEV. (MSL.) **240'** DATE COMPLETED **11-13-2013**

EQUIPMENT **MARL 5 w/ 6-inch HSA** BY: **M. ERTWINE**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0								
				SM	**UNDOCUMENTED FILL (Qudf)** Medium dense, damp, light grayish brown, Silty, fine SAND; trace rootlets			
2	B6-1							
4								
6	B6-2			CL	**COLLUVIUM (Qcol)** Firm, moist, brown, Sandy CLAY	7		
8	B6-3				-Becomes stiff	26	102.5	22.9
10	B6-4			CL	**OTAY FORMATION (To)** Very stiff, moist, light grayish brown, Sandy CLAYSTONE	18		
12								
14								
	B6-5			SC	Medium dense, moist, light gray, Clayey, fine- to medium-grained SANDSTONE; weakly cemented, trace fine gravel	24	109.5	11.1
16								
18								
20	B6-6					19		
22								
24								
	B6-7			SC	Medium dense, moist, grayish brown, Clayey, fine-grained SANDSTONE; weakly cemented	16	104.6	15.5
26								
28								

Figure A-5,
Log of Boring B 6, Page 1 of 2

G1115-52-54.GPJ

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◥ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

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

GEOCON

PROJECT NO. G1115-52-54

BORING B 6

ELEV. (MSL.) **240'** DATE COMPLETED **11-13-2013**

EQUIPMENT **MARL 5 w/ 6-inch HSA** BY: **M. ERTWINE**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
30	B6-8			ML	Stiff, moist, gray, Sandy SILTSTONE	25		
32				SM	Medium dense, moist, reddish brown, Silty, fine-grained SANDSTONE; weakly cemented, friable -Difficult drilling			
34								
36	B6-9			SM	Dense, moist, reddish, brown, Silty, fine- to coarse-grained SANDSTONE; moderately cemented	71	106.5	5.3
					BORING REFUSAL AT 36 FEET Groundwater not encountered Backfilled with 7.1 ft³ grout slurry			

Figure A-5,
Log of Boring B 6, Page 2 of 2

G1115-52-54.GPJ

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◥ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

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

GEOCON

PROJECT NO. G1115-52-54

BORING B 7

ELEV. (MSL.) **212'** DATE COMPLETED **11-13-2013**

EQUIPMENT **MARL 5 w/ 6-inch HSA** BY: **M. ERTWINE**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0					**BASE**			
2	B7-1			GC	**ALLUVIUM (Qal)** Dense, moist, dark reddish brown, Clayey GRAVEL with sand, sampling not practical to approx 6 feet			
4								
6								
8	B7-2			SM-CL	Dense to hard, moist, brown to grayish brown, Silty, fine- to coarse-grained SAND to Sandy CLAY with gravel	35		
10					-Gravel lense encountered to about 13 beet			
12	B7-3							
14					-No recovery, sampling unsuccessful	46		
16								
18	B7-4				-Medium dense to very stiff	16		
20	B7-5			SC	**OTAY FORMATION (To)** Medium dense, moist, grayish brown, Clayey, fine- to coarse-grained SANDSTONE; ("GRITSTONE"); few coarse subrounded gravel, moderately cemented	23	112.6	10.1
22								
24					-Difficult drilling from 23 feet			
					BORING REFUSAL AT 25 FEET Groundwater not encountered Backfilled with 4.9 ft³ grout slurry			

Figure A-6,
Log of Boring B 7, Page 1 of 1

G1115-52-54.GPJ

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◪ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

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

GEOCON

PROJECT NO. G1115-52-54

BORING B 8

ELEV. (MSL.) **212'** DATE COMPLETED **11-14-2013**

EQUIPMENT **MARL 5 w/ 6-inch HSA** BY: **M. ERTWINE**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0					**BASE**			
2	B8-1			SC	**UNDOCUMENTED FILL (Qudf)** Medium dense, moist, brown, Clayey SAND; trace gravel			
4								
6	B8-2			CL	**ALLUVIUM (Qal)** Stiff, moist, light yellowish brown, Sandy CLAY; trace fine gravel, highly weathered	11		
8	B8-3					24	101.0	23.1
10	B8-4			SC	**TERRACE DEPOSITS (Qt)** Medium dense, moist, brown to dark reddish brown, Clayey SAND; few medium to coarse subangular gravel within matrix	18		
12	B8-5				-Becomes light grayish brown	22	111.8	14.5
14	B8-6				-Becomes brown, uniform consistency	18		
16								
18	B8-7				-Basal coarse gravel along contact	31		
20	B8-8			SM	**OTAY FORMATION (To)** Medium dense, moist, light yellowish brown to gray, Silty, fine- to coarse-grained SANDSTONE; ("GRITSTONE"), weakly cemented, friable, fine gravel within matrix	20		
22								
24								
26	B8-9			SM	Medium dense, moist, reddish brown to grayish brown, Silty, fine- to coarse-grained SANDSTONE; ("GRITSTONE"), moderately cemented	39	113.9	11.5
28								

Figure A-7,
Log of Boring B 8, Page 1 of 2

G1115-52-54.GPJ

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◥ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

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

PROJECT NO. G1115-52-54

BORING B 8

ELEV. (MSL.) **212'** DATE COMPLETED **11-14-2013**

EQUIPMENT **MARL 5 w/ 6-inch HSA** BY: **M. ERTWINE**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
30	B8-10			CH-CL	-Basal gravel along formational contact Hard, moist, brown, Silty CLAYSTONE; ("BENTONITE")	40		
32					-Grades to Sandy CLAYSTONE			
34					-Difficult drilling, slow progress			
36	B8-11			SW	Medium dense, moist, grayish mottled reddish brown, Silty, well-graded SANDSTONE; friable, low cohesive strength	27	100.8	10.2
38	B8-12				-Very dense -Becomes very difficult drilling -Poor recovery at 38.5 feet, possible rock encountered	50/6"		
					BORING REFUSAL AT 38.5 FEET Groundwater not encountered Backfilled with 7.6 ft³ grout slurry			

Figure A-7,
Log of Boring B 8, Page 2 of 2

G1115-52-54.GPJ

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◪ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

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

GEOCON

PROJECT NO. G1115-52-54

BORING B 9

ELEV. (MSL.) **205'** DATE COMPLETED **11-14-2013**

EQUIPMENT **MARL 5 w/ 6-inch HSA** BY: **M. ERTWINE**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0					**BASE**			
				CL	**UNDOCUMENTED FILL (Qudf)** Stiff, damp, dark brown, Sandy CLAY			
2	B9-1							
4				CL	**ALLUVIUM (Qal)** Stiff, moist, dark brown, Sandy CLAY; few gravel			
6	B9-2					24	109.6	15.9
8	B9-3				-Hard	37		
				GP	**TERRACE DEPOSITS (Qt)** Dense, moist, reddish brown, Sandy GRAVEL; ("CONGLOMERATE"), difficult drilling; sampling not practical			
10								
12	B9-4							
14								
	B9-5			SM	-Basal gravel along contact	25		
16					**OTAY FORMATION (To)** Dense, moist, grayish white, Silty, fine- to coarse-grained SANDSTONE; ("GRITSTONE"), some interformational fine to coarse gravel lense			

BORING REFUSAL AT 17 FEET
Groundwater not encountered
Backfilled with 7.5 ft³ grout slurry

Figure A-8,
Log of Boring B 9, Page 1 of 1

G1115-52-54.GPJ

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◥ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

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

GEOCON

PROJECT NO. G1115-52-54

BORING B 10

ELEV. (MSL.) **197'** DATE COMPLETED **11-14-2013**

EQUIPMENT **MARL 5 w/ 6-inch HSA** BY: **M. ERTWINE**

DEPTH IN FEET	SAMPLE NO.	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0			**BASE**			
		GP	**ALLUVIUM (Qal)** Dense, dry, grayish brown, Sandy GRAVEL			
2						
4						
6			-Sampling not practical			
8	B10-1	SC	Medium dense, damp, brown, Clayey, fine- to coarse-grained SAND; some coarse gravel	22		
10			-Sampling not practical			
12		GP	**TERRACE DEPOSITS (Qt)** Dense, damp, reddish brown, Sandy GRAVEL; ("CONGLOMERATE") -Massive gravel/cobble lense to about 18 feet			
14	B10-2		-Difficult drilling, Clayey SAND with gravel			
16						
18		SM	-Slight seepage along contact			
			OTAY FORMATION (To) Very dense, moist, light gray, Silty, fine- to coarse-grained SANDSTONE; ("GRITSTONE"), moderately cemented			
20	B10-3			84/11"		
22						
24			-difficult drilling, slow progress			
26	B10-4		-No recovery, dense	34		
28						

Figure A-9,
Log of Boring B 10, Page 1 of 2

G1115-52-54.GPJ

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◪ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

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PROJECT NO. G1115-52-54

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	**BORING B 10** ELEV. (MSL.) **197'** DATE COMPLETED **11-14-2013** EQUIPMENT **MARL 5 w/ 6-inch HSA** BY: **M. ERTWINE**	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
30	B10-5			SM	-No recovery, very dense	84/11"		
					BORING REFUSAL AT 31.5 FEET Slight seepage encountered at 18 feet Backfilled with 6.2 ft³ grout slurry			

Figure A-9,
Log of Boring B 10, Page 2 of 2

G1115-52-54.GPJ

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◥ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

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GEOCON

PROJECT NO. G1115-52-54

BORING B 11

ELEV. (MSL.) **224'** DATE COMPLETED **11-18-2013**

EQUIPMENT **MARL 5 w/ 6-inch HSA** BY: **M. ERTWINE**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0					**BASE**			
	B11-1			SC	**UNDOCUMENTED FILL (Qudf)** Moist, brown, Clayey SAND			
2				GC-GP	**TERRACE DEPOSITS (Qt)** Dense, moist, grayish brown, Clayey to Sandy GRAVEL			
4								
	B11-2					43		
6								
8					-Grades to yellowish brown, Sandy GRAVEL			
10	B11-3				-No recovery, sampling unsuccessful on possible gravel lense	50/5"		
12					-Difficult drilling			
14								
	B11-4				-Clasts of metavolcanic rock within sampler tip	50/3"		
16	B11-5				-Excavates to a Sandy CLAY with some gravel			
18								
	B11-6				-Sampling unsuccessful, chased with standard pen -No recovery	44		
					BORING REFUSAL AT 19.5 FEET Groundwater not encountered			

Figure A-1,
Log of Boring B 11, Page 1 of 1

G1115-52-54.GPJ

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◥ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

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

GEOCON

PROJECT NO. G1115-52-54

BORING B 13

ELEV. (MSL.) **232'** DATE COMPLETED **11-15-2013**

EQUIPMENT **MARL 5 w/ 6-inch HSA** BY: **M. ERTWINE**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0					**BASE**			
				CL	**ALLUVIUM (Qal)** Brown, damp, Sandy CLAY; some gravel			
2								
4								
6	B13-1			CL	Stiff, moist, brown to yellowish brown, Sandy CLAY; few angular gravel; trace carbonates	26	107.6	14.5
8	B13-2			ML	-Highly weathered near formational contact **OTAY FORMATION (To)** Very stiff, moist, light olive brown, Sandy SILTSTONE			
10	B13-3					26		
12	B13-4			CL	Hard, moist, reddish brown to olive brown, Silty CLAYSTONE	30		
14								
16	B13-5				-Becomes pinkish red, stiff	25	98.0	23.6
18								
20	B13-6			CL	Very stiff, moist, pinkish red, Silty CLAYSTONE; ("BENTONITE"), trace manganese oxide staining	28		
22								
24								
26	B13-7			SM-ML	-Becomes interbedded Medium dense, moist, light brown, Silty, fine-grained SANDSTONE to very stiff, Sandy SILTSTONE	46	106.9	19.4
28								

G1115-52-54.GPJ

Figure A-11,
Log of Boring B 13, Page 1 of 2

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◪ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

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GEOCON

PROJECT NO. G1115-52-54

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	**BORING B 13** ELEV. (MSL.) **232'** DATE COMPLETED **11-15-2013** EQUIPMENT **MARL 5 w/ 6-inch HSA** BY: **M. ERTWINE**	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
30	B13-8			SM	Very dense, moist, light gray, Silty, fine-grained SANDSTONE; well cemented	57		
32								
34								
	B13-9			CL	Hard, moist, gayish brown, Sandy CLAYSTONE	50/5"	109.5	18.7
					BORING TERMINATED AT 35.5 FEET Groundwater not encountered Backfilled with 7.0 ft³ grout slurry			

Figure A-11,
Log of Boring B 13, Page 2 of 2

G1115-52-54.GPJ

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◥ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

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GEOCON

PROJECT NO. G1115-52-54

BORING B 14

ELEV. (MSL.) **221'** DATE COMPLETED **11-15-2013**

EQUIPMENT **MARL 5 w/ 6-inch HSA** BY: **M. ERTWINE**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SC	**UNDOCUMENTED FILL (Qudf)** Damp, brown, Clayey SAND; few gravel			
2	B14-1			SC	**TERRACE DEPOSITS (Qt)** Grayish brown, dry, Clayey, fine- to coarse-grained SAND; some gravel			
4								
6					-Sampling unsuccessful	50/3"		
8				GP	Very dense, dry, reddish brown, Sandy GRAVEL; difficult drilling, sampling not practical at 7.5 feet, gravel lense from approx. 5-9 feet			
10	B14-2			SC	Medium dense, moist, light grayish brown to pale yellowish brown, Clayey SAND; trace subrounded to subangular gravel; possible highly weathered otay formation	22		
12						42		
14				ML	-Sampling unsuccessful			
16	B14-3				**OTAY FORMATION (To)** Stiff, moist, olive gray, Sandy SILTSTONE	38	104.8	21.2
18	B14-4			SM-ML	Very dense to hard, moist, olive to grayish brown, Silty SANDSTONE to Sandy SILTSTONE	90/10"		
20	B14-5				-Grades to Sandy SILTSTONE	72/10"	100.4	22.5
22	B14-6							
24								
26	B14-7			SM	Very dense, moist, light grayish brown, Silty, fine- to coarse-grained SANDSTONE; ("GRITSTONE")	80/11"		
28			▽					

Figure A-12,
Log of Boring B 14, Page 1 of 2

G1115-52-54.GPJ

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◪ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

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GEOCON

PROJECT NO. G1115-52-54

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	**BORING B 14** ELEV. (MSL.) **221'** DATE COMPLETED **11-15-2013** EQUIPMENT **MARL 5 w/ 6-inch HSA** BY: **M. ERTWINE**	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
30	B14-8				-Slight seepage	50/6"	111.9	15.6
					BORING REFUSAL AT 30.5 FEET Slight seepage encountered at 30 feet Backfilled with 6.0 ft³ grout slurry			

Figure A-12,
Log of Boring B 14, Page 2 of 2

G1115-52-54.GPJ

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◥ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

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GEOCON

PROJECT NO. G1115-52-54

BORING B 15

ELEV. (MSL.) **227'** DATE COMPLETED **11-15-2013**

EQUIPMENT **MARL 5 w/ 6-inch HSA** BY: **M. ERTWINE**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0								
	B15-1			SC	**UNDOCUMENTED FILL (Qudf)** Dry, brown, Clayey, fine- to medium-grained SAND; few gravel			
2				SC	**TERRACE DEPOSITS (Qt)** Medium dense, dry, reddish brown, Clayey SAND; trace lense of gravel			
4								
	B15-2				-Gravel lense encountered	22		
6								
8	B15-3			SC	Medium dense, moist, olive brown, Clayey SAND; some gravel	37	112.0	14.7
10					-No recovery, sampling unsuccessful, gravel in sampler shoe -Erroneous blowcount	21		
12								
	B15-4			CL	Hard, moist, reddish brown, Sandy CLAY; some gravel	77		
14				SC	**OTAY FORMATION (To)** Medium dense, moist, olive brown, Clayey, fine- to medium-grained SANDSTONE; some gravel			
	B15-5					36	109.5	14.2
16								
					-Grades to fine SAND with some gravel			
18								
20					-Gravel lense encountered at about 20 feet, sampling not practical			
					BORING REFUSAL AT 20 FEET Groundwater not encountered Backfilled with 3.9 ft³ grout slurry			

Figure A-13,
Log of Boring B 15, Page 1 of 1

G1115-52-54.GPJ

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◪ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

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GEOCON

PROJECT NO. G1115-52-54

BORING B 16

ELEV. (MSL.) **277'** DATE COMPLETED **11-18-2013**

EQUIPMENT **MARL 5 w/ 6-inch HSA** BY: **M. ERTWINE**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				GP	**UNDOCUMENTED FILL (Qudf)** Brown, dry, Sandy GRAVEL; few cobble clasts			
2								
4				GP	**TERRACE DEPOSITS (Qt)** Dense, moist, reddish to yellowish brown. Sandy GRAVEL; pulverized clasts of cobble, difficult excavation to about 10 feet; unsuccessful sampling			
6	B16-1					70/11"		
8								
10	B16-2				-Possible "CONGLOMERATE" with Clayey SAND matrix	50/2"		
12								
14					-Excavates to a Clayey SAND with pulverized gravel			
16	B16-3			GC	-Increased drill chatter Very dense, moist, reddish brown, Clayey GRAVEL; some sand laminations of cohesive clayey sand	63		
18					BORING REFUSAL AT 18 FEET Groundwater not encountered Backfilled with 3.5 ft³ grout slurry			

Figure A-14,
Log of Boring B 16, Page 1 of 1

G1115-52-54.GPJ

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◪ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

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GEOCON

PROJECT NO. G1115-52-54

BORING B 17

ELEV. (MSL.) **285'** DATE COMPLETED **11-18-2013**

EQUIPMENT **MARL 5 w/ 6-inch HSA** BY: **M. ERTWINE**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				GC	**UNDOCUMENTED FILL (Qudf)** Reddish brown, Clayey GRAVEL			
2				CL	**TERRACE DEPOSITS (Qt)** Stiff, moist, reddish brown, Sandy CLAY; few gravel; pp = 3.5 tst			
4								
6	B17-1					21		
8								
10	B17-2				-Becomes mottled grayish brown to yellowish brown, trace fine gravel with little fine- to coarse-grained SAND; trace mica	28		
12				CL	**OTAY FORMATION (To)** Stiff, moist, brown, Sandy CLAYSTONE; PP = 4.5 tsf			
14								
16	B17-3			SC	Dense, moist, olive brown to grayish brown, Clayey SANDSTONE; weakly cemented	33	113.8	14.6
18	B17-4			CL	Hard, moist, grayish, mottle pinkish red, Silty CLAYSTONE; pp = 4.5 tsf	36		
20								
22								
24								
26	B17-5			SC	Dense, moist, reddish brown, Clayey SANDSTONE; clasts of subangular gravel	46	117.0	13.6
28					-Becomes very dark			
					BORING REFUSAL AT 29 FEET			

G1115-52-54.GPJ

Figure A-15,
Log of Boring B 17, Page 1 of 2

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◪ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

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GEOCON

PROJECT NO. G1115-52-54

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	**BORING B 17** ELEV. (MSL.) **285'** DATE COMPLETED **11-18-2013** EQUIPMENT **MARL 5 w/ 6-inch HSA** BY: **M. ERTWINE**	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
					Groundwater not encountered Backfilled with 5.7 ft³ grout slurry			

Figure A-15,
Log of Boring B 17, Page 2 of 2

G1115-52-54.GPJ

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◥ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

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GEOCON

PROJECT NO. G1115-52-54

BORING B 18

ELEV. (MSL.) **267'** DATE COMPLETED **11-18-2013**

EQUIPMENT **MARL 5 w/ 6-inch HSA** BY: **M. ERTWINE**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				GP	**UNDOCUMENTED FILL (Qudf)** Reddish brown, Sandy GRAVEL			
2	B18-1			GP	**TERRACE DEPOSITS (Qt)** Dense, dry, reddish brown, Sandy GRAVEL			
4								
6	B18-2			SC	Very dense, moist, dark reddish brown, Clayey SAND; some gravel	75/11"	117.1	11.1
8								
10	B18-3			SC	Dense, moist, dark reddish brown, Clayey SAND; some gravel	38		
12								
14					-Difficult drilling -Sampler bouncing, no recovery			
					BORING REFUSAL AT 15 FEET Groundwater not encountered Backfilled with 2.9 ft³ grout slurry			

Figure A-16,
Log of Boring B 18, Page 1 of 1

G1115-52-54.GPJ

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

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GEOCON

PROJECT NO. G1115-52-54

BORING B 19

ELEV. (MSL.) **264'** DATE COMPLETED **11-19-2013**

EQUIPMENT **MARL 5 w/ 6-inch HSA** BY: **M. ERTWINE**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	B19-1			GP	**ALLUVIUM (Qal)** Medium dense, reddish brown, Sandy GRAVEL			
2								
4								
6					-Uniform, sampling not practical in upper 7 feet			
8	B19-2			SM-SC	**OTAY FORMATION (To)** Dense, moist, reddish to grayish brown, Silty to Clayey, fine SAND	51		
10	B19-3			SM	Very dense, moist, light grayish to yellowish brown, Silty, fine- to coarse-grained SANDSTONE; moderately cemented; few fine gravel within matrix	74/10"	115.9	9.2
12								
14								
16	B19-4			SC	Very dense, moist, gray to olive brown, Clayey, fine- to medium-grained SANDSTONE; moderately cemented	81/11"		
18								
20	B19-5				-Uniform	50/4"	118.8	10.5
22								
24								
26	B19-6				-Massive			
28								

Figure A-17,
Log of Boring B 19, Page 1 of 2

G1115-52-54.GPJ

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◥ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

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GEOCON

PROJECT NO. G1115-52-54

BORING B 19

ELEV. (MSL.) **264'** DATE COMPLETED **11-19-2013**

EQUIPMENT **MARL 5 w/ 6-inch HSA** BY: **M. ERTWINE**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
30	B19-7			ML	Hard, moist, olive to grayish brown, Sandy SILTSTONE	50/6"	119.7	13.6
32								
34								
36	B19-8			SM	Dense, moist, grayish brown, Silty, fine- to coarse-grained SANDSTONE; ("GRITSTONE")	50/5"		
38								
40	B19-9			SM	Very dense, moist, light grayish brown, Silty, fine-grained SANDSTONE; faint laminations of "GRITSTONE"	74		
					BORING TERMINATED AT 40.5 FEET Groundwater not encountered Backfilled with 7.9 ft³ grout slurry			

Figure A-17,
Log of Boring B 19, Page 2 of 2

G1115-52-54.GPJ

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

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

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PROJECT NO. G1115-52-54

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	**BORING B 20** ELEV. (MSL.) **514'** DATE COMPLETED **11-19-2013** EQUIPMENT **MARL 5 w/ 6-inch HSA** BY: **M. ERTWINE**	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0	B20-1			GP	**TOPSOIL** Reddish brown, Sandy GRAVEL; trace clay			
2								
4				GP	**OTAY FANGLOMERATE DEPOSITS(Tof)** Very dense, damp, grayish brown, Sandy GRAVEL; clasts of cobble, estimated ("FANGLOMERATE")			
					BORING REFUSAL AT 5 FEET Groundwater not encountered			

Figure A-18,
Log of Boring B 20, Page 1 of 1

G1115-52-54.GPJ

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◥ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

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

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PROJECT NO. G1115-52-54

BORING B 21

ELEV. (MSL.) **598'** DATE COMPLETED **11-19-2013**

EQUIPMENT **MARL 5 w/ 6-inch HSA** BY: **M. ERTWINE**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				CL	**UNDOCUMENTED FILL (Qudf)** Damp, dark brown, Sandy CLAY; with cobble and debris			
6	B21-1 B21-2			SM	**OTAY FORMATION (To)** Dense, moist, grayish brown, Silty, fine- to coarse-grained SANDSTONE	72	100.9	18.2
10	B21-3			ML	Very stiff, moist, light gray, SILTSTONE; little to no sand	27		
16	B21-4			ML	Hard, moist, light gray, Sandy SILTSTONE	75/10"	98.8	15.5
20	B21-5				-Grades to fine-grained SANDSTONE	75/8"		
				SM	Very dense, moist, light grayish brown, Silty, fine-grained SANDSTONE			
26	B21-6			ML	Hard, moist, olive brown, Sandy SILTSTONE; pp = 4.5 tsf	50/6"	104.6	19.5

Figure A-19,
Log of Boring B 21, Page 1 of 2

G1115-52-54.GPJ

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

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

GEOCON

PROJECT NO. G1115-52-54

BORING B 21

ELEV. (MSL.) **598'** DATE COMPLETED **11-19-2013**

EQUIPMENT **MARL 5 w/ 6-inch HSA** BY: **M. ERTWINE**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
30	B21-7			ML	-Massive	71/12"		
32								
34					-Grades to Silty, fine-grained SANDSTONE			
36	B21-8			SM	Very dense, moist, gray, Silty, fine-grained SANDSTONE; friable	74/12"	103.7	21.7
38								
40	B21-9			ML	Hard, moist, dark gray, Sandy SILTSTONE	8/10"		
					BORING TERMINATED AT 40.9 FEET Groundwater not encountered Backfilled with 8.0 ft³ grout slurry			

Figure A-19,
Log of Boring B 21, Page 2 of 2

G1115-52-54.GPJ

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◥ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

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

GEOCON

PROJECT NO. G1115-52-54

BORING B 22

ELEV. (MSL.) **530'** DATE COMPLETED **11-20-2013**

EQUIPMENT **MARL 5 w/ 6-inch HSA** BY: **M. ERTWINE**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	B22-1			SC	**TOPSOIL** Moist, brown, Sandy CLAY			
2				SM	**OTAY FORMATION (To)** Medium dense, dry, light, gray, Silty SANDSTONE; some gravel			
4								
6	B22-2			GP	Very dense, moist, gray, Sandy GRAVEL	80/12"		
8					-Difficult drilling			
10	B22-3				-Sampling not practical			
12					-Excavates to a Sandy GRAVEL			
14				ML	Hard, moist, gray, Sandy SILTSTONE			
16	B22-4					62		
18					-Gravel lenses encountered			
20					-CAL sampler bouncing, sampling unsuccessful			
22	B22-5				-Gravel in slough within sampler -Poor recovery	37		
24					-Grades to hard, damp, brown, Silty CLAYSTONE			
26	B22-6			ML	Stiff, moist, brown, Sandy SILTSTONE	31	89.4	31.4
28								

Figure A-20,
Log of Boring B 22, Page 1 of 2

G1115-52-54.GPJ

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◥ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

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

GEOCON

PROJECT NO. G1115-52-54

BORING B 22

ELEV. (MSL.) **530'** DATE COMPLETED **11-20-2013**

EQUIPMENT **MARL 5 w/ 6-inch HSA** BY: **M. ERTWINE**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
30	B22-7			ML	Hard, moist, dark grayish brown, Sandy SILTSTONE	66		
32								
34								
36								
38								
40	B22-8			ML	Hard, moist, gray, Sandy SILTSTONE; trace lamination of slightly Bentonite CLAYSTONE	85/10"	79.8	38.5
					BORING TERMINATED AT 41 FEET Groundwater not encountered Backfilled with 8.0 ft³ grout slurry			

Figure A-20,
Log of Boring B 22, Page 2 of 2

G1115-52-54.GPJ

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◥ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

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

GEOCON

PROJECT NO. G1115-52-54

BORING B 23

ELEV. (MSL.) **567'** DATE COMPLETED **11-20-2013**

EQUIPMENT **MARL 5 w/ 6-inch HSA** BY: **M. ERTWINE**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0								
	B23-1			SM	**UNDOCUMENTED FILL (Qudf)** Light grayish brown, Silty SAND; few gravel			
2				SM	**OTAY FORMATION (To)** Dense, moist, gray, Silty, fine-grained SANDSTONE			
4								
	B23-2					45		
6								
8								
10	B23-3			ML	Hard, moist, dark gray, Sandy SILTSTONE	43	101.3	18.4
12								
14								
	B23-4			SM	Very dense, moist, light gray, Silty, fine-grained SANDSTONE	88/10"		
16								
18								
	B23-5				-Uniform	85/9"	100.8	13.3
					BORING TERMINATED AT 19.5 FEET Groundwater not encountered Backfilled with 3.8 ft³ grout slurry			

Figure A-21,
Log of Boring B 23, Page 1 of 1

G1115-52-54.GPJ

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◪ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

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

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APPENDIX B

APPENDIX B

LABORATORY TESTING

We performed laboratory tests in accordance with the generally accepted test methods of the American Society for Testing and Materials (ASTM) or other suggested procedures. We selected ring samples for laboratory testing for dry density moisture content and shear strength. The results of our laboratory tests are presented in tabular forms hereinafter and on Figure B-1. The results of in-place density and moisture content tests are depicted on the boring logs in Appendix A. The plots of direct shear test results are also included within this Appendix B.

TABLE B-I
SUMMARY OF LABORATORY DIRECT SHEAR TEST RESULTS
ASTM D 3080

Sample No.	Dry Density (pcf)	Moisture Content (%)	Unit Peak [Ultimate*] Cohesion (psf)	Angle of Peak [Ultimate*] Shear Resistance (degrees)
B2-4	102.1	17.9	625 [390]	29 [29]
B2-8	115.4	15.3	600 [430]	31 [31]
B2-10	104.3	22.8	980 [0]	38 [33]
B3-3	96.4	18.3	770 [715]	28 [26]
B3-5	110.0	17.0	525 [470]	29 [28]
B3-7	112.6	15.2	0 [0]	39 [38]
B4-4	108.0	17.2	920 [700]	27 [27]
B4-8	109.5	18.8	880 [640]	26 [26]
B4-12	98.1	23.6	420 [340]	30 [29]
B5-2	98.1	18.1	350 [360]	29 [29]
B5-4	113.3	7.8	700 [220]	33 [33]
B6-3	102.5	22.9	1500 [690]	25 [25]
B6-5	109.5	11.1	920 [480]	22 [22]
B6-7	104.6	15.5	550 [400]	22 [22]
B7-5	112.6	10.1	280 [250]	34 [34]
B8-3	101.0	23.1	750 [720]	19 [17]
B8-5	111.8	14.5	140 [140]	31 [31]
B8-9	113.9	11.5	1400 [1100]	15 [15]
B9-2	109.6	15.9	385 [75]	32 [32]
B13-1	107.6	14.5	710 [650]	27 [27]
B13-5	98.0	23.6	390 [400]	23 [23]
B13-7	106.9	19.4	750 [500]	27 [27]
B14-3	104.8	21.2	330 [125]	28 [28]

TABLE B-I (Concluded)
SUMMARY OF LABORATORY DIRECT SHEAR TEST RESULTS
ASTM D 3080

Sample No.	Dry Density (pcf)	Moisture Content (%)	Unit Peak [Ultimate*] Cohesion (psf)	Angle of Peak [Ultimate*] Shear Resistance (degrees)
B14-8	111.9	15.6	225 [430]	33 [27]
B15-3	112.0	14.7	860 [840]	33 [33]
B15-5	109.5	14.2	680 [490]	29 [28]
B17-3	113.8	14.6	940 [660]	30 [30]
B17-5	117.0	13.6	1150 [325]	30 [30]
B18-2	117.1	11.1	860 [470]	31 [31]
B19-3	115.9	9.2	240 [240]	35 [31]
B19-5	118.8	10.5	580 [600]	27 [24]
B19-7	119.7	13.6	690 [500]	26 [25]
B21-1	100.9	18.2	640 [440]	29 [28]
B21-4	98.8	15.5	630 [500]	33 [32]
B21-8	103.7	21.7	780 [430]	30 [30]
B22-6	89.4	31.4	1200 [500]	27 [27]
B22-8	79.8	38.5	940 [730]	29 [26]
B23-3	101.3	18.4	930 [660]	29 [25]
B23-5	100.8	13.3	475 [460]	35 [33]

TABLE B-II
SUMMARY OF LABORATORY WATER-SOLUBLE SULFATE TEST RESULTS
CALIFORNIA TEST NO. 417

Sample No.	Water-Soluble Sulfate (%)	Water-Soluble Sulfate (ppm)	Sulfate Severity
B3-1	0.002	18	Not Applicable (S0)
B5-1	0.001	8	Not Applicable (S0)
B9-1	0.0005	5	Not Applicable (S0)
B19-1	0.0003	3	Not Applicable (S0)
B23-1	0.0004	4	Not Applicable (S0)

TABLE B-III
SUMMARY OF LABORATORY WATER-SOLUBLE CHLORIDE ION CONTENT TEST RESULTS
CALIFORNIA TEST NO. 422

Sample No.	Chloride Ion Content (%)	Chloride Ion Content (ppm)
B3-1	0.011	109
B5-1	0.018	178
B9-1	0.025	248
B19-1	0.006	55
B23-1	0.033	331

TABLE B-IV
SUMMARY OF LABORATORY POTENTIAL OF HYDROGEN (PH) AND RESISTIVITY TEST RESULTS
CALIFORNIA TEST NO. 643

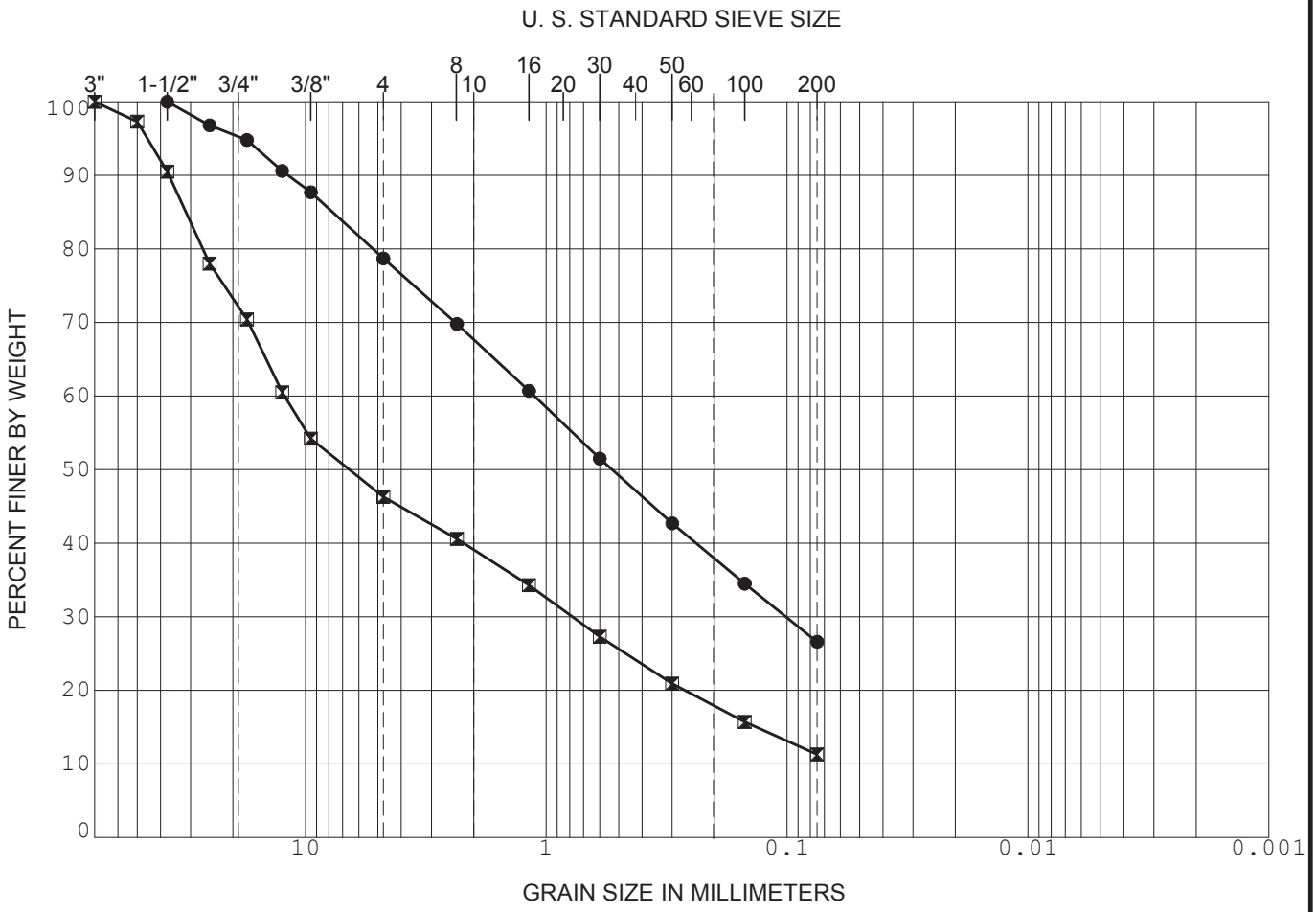
Sample No.	pH	Minimum Resistivity (ohm-centimeters)
B3-1	7.8	570
B5-1	8.1	830
B9-1	7.6	620
B19-1	7.0	5200
B23-1	7.8	570

TABLE B-V
SUMMARY OF LABORATORY GRAIN SIZE DISTRIBUTION TEST RESULTS
ASTM D422

Sample No.	Sample Depth (ft)	% Gravel	% Sand	% Fines	USCS Classification
B10-2	14	21.3	52.1	26.6	SC
B19-1	0	53.7	35.0	11.3	GP

PROJECT NO. G1115-52-54

GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	



	SAMPLE	DEPTH (ft)	CLASSIFICATION	NAT WC	LL	PL	PI
●	B10-2	14.0	(SC) brown, Clayey SAND with gravel				
⊠	B19-1	0.0	(GP) reddish brown, Sandy GRAVEL				
▲							

GRADATION CURVE

SDG&E TL 649

SAN DIEGO COUNTY, CALIFORNIA

G1115-52-54.GPJ

Figure B-1

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DIRECT SHEAR TEST REPORT

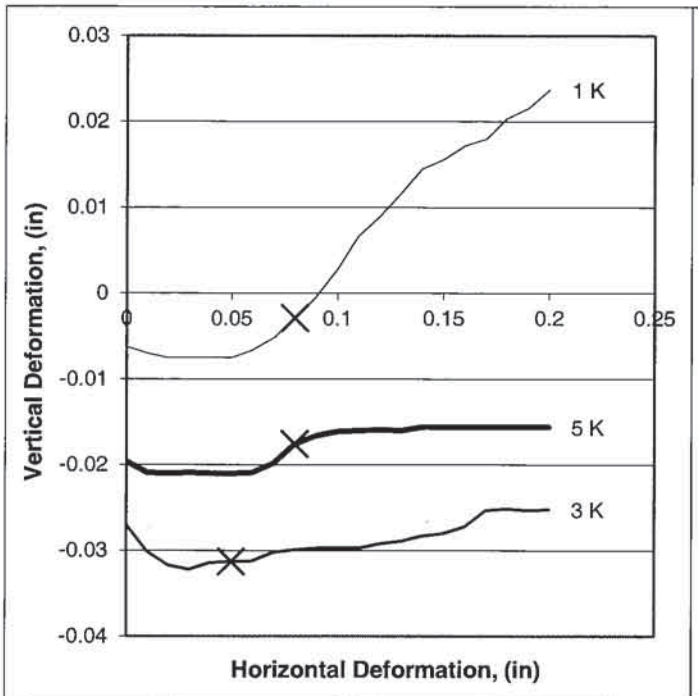
SDG&E TL 649

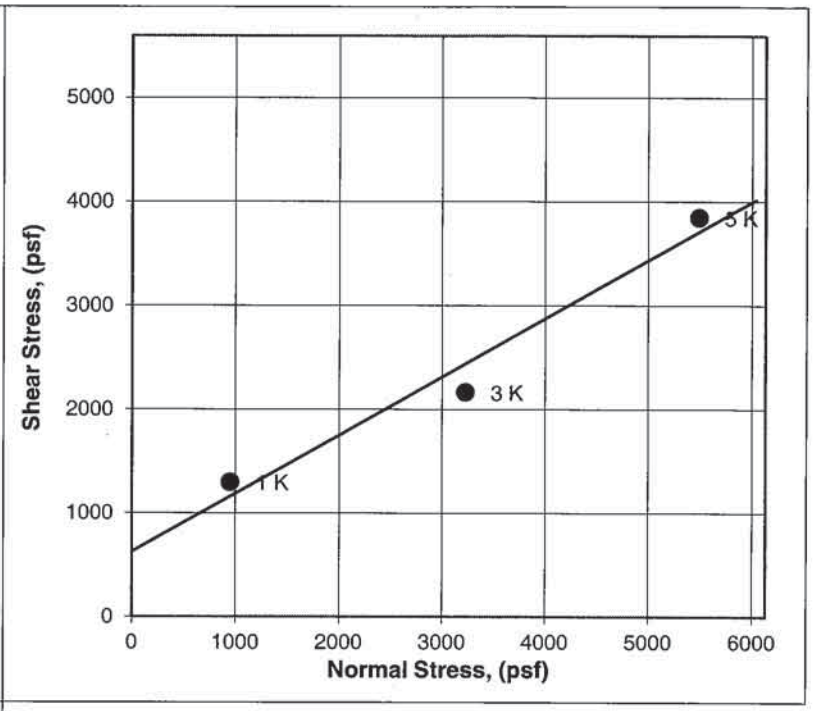
G1115-52-54 **Date:** Tuesday, November 19, 2013 **By:** PJ

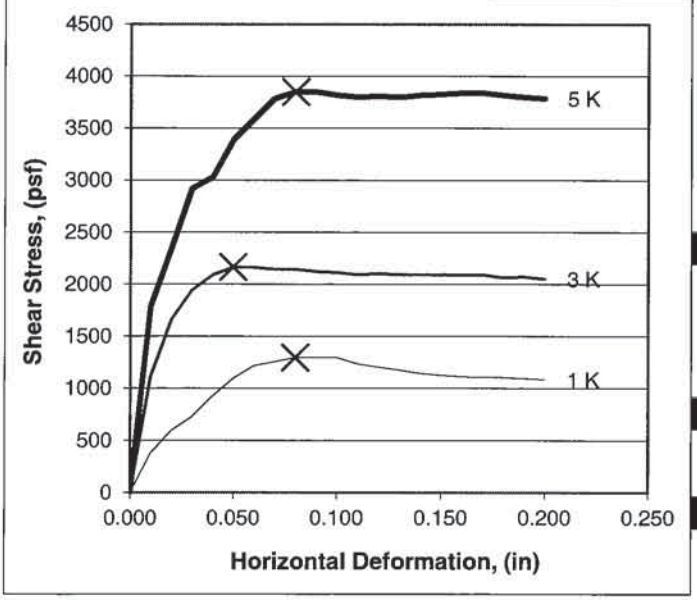
Sample No.: B2-4 **Natural or Remold:** Natural

Description: SM-Light yellowish brown, Silty, fine to coarse SAND

Remarks:







ϕ (Degrees)	29.3
c (psf)	624
Tan ϕ	0.562
Method	Calc

Load	1 K	3 K	5 K
INITIAL			
Water Content	16.6%	18.1%	19.0%
Dry Density (pcf)	105.7	99.8	100.7
Saturation*	77.8%	73.0%	78.5%
Height (inches)	1.00	1.00	1.00
AFTER TEST			
Water Content	21.6%	25.4%	23.6%
Dry Density (pcf)	103.2	102.4	102.3
FAILURE			
Normal Stress (psf)	952	3228	5494
Failure Stress (psf)	1296	2164	3849
Failure Deffinition	Max	Max	Max
Displacement (in)	0.08	0.05	0.08
Rate (in/min)	0.0050	0.0050	0.0050

* Degree of saturation calculated with a specific gravity of 2.65

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INCORPORATED

DIRECT SHEAR TEST REPORT

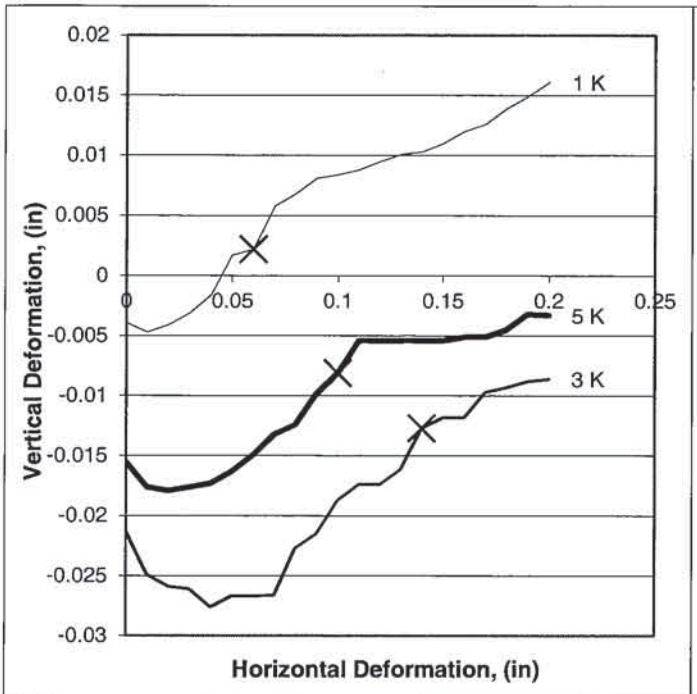
SDG&E TL 649

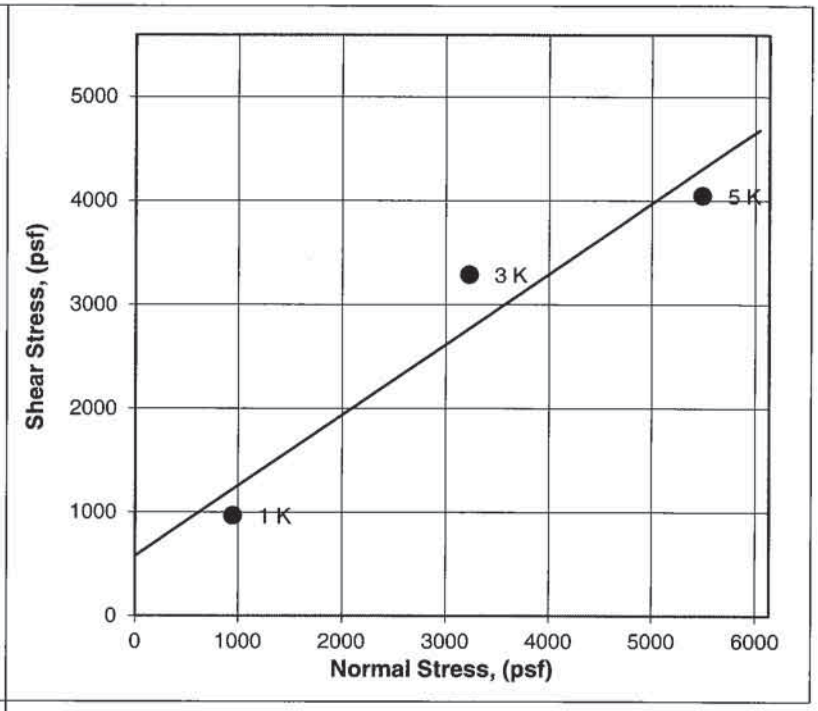
G1115-32-54 **Date:** Tuesday, November 19, 2013 **By:** PJ

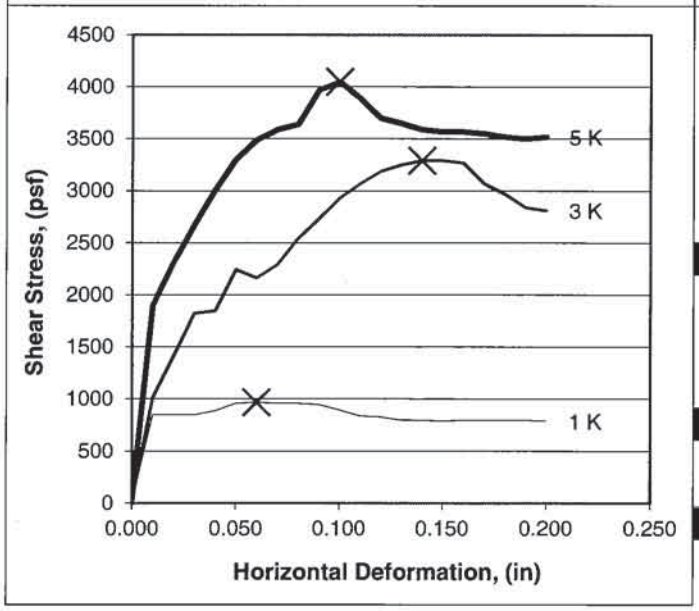
Sample No.: B2-8 **Natural or Remold:** Natural

Description: CL-Olive brown, Sandy CLAY

Remarks:







ϕ (Degrees)	34.2
c (psf)	580
Tan ϕ	0.679
Method	Calc

Load	1 K	3 K	5 K
INITIAL			
Water Content	15.9%	14.8%	15.1%
Dry Density (pcf)	114.6	116.3	115.2
Saturation*	95.1%	92.8%	92.1%
Height (inches)	1.00	1.00	1.00
AFTER TEST			
Water Content	20.8%	18.3%	16.6%
Dry Density (pcf)	112.8	117.4	115.6
FAILURE			
Normal Stress (psf)	952	3228	5494
Failure Stress (psf)	967	3290	4048
Failure Deffinition	Max	Max	Max
Displacement (in)	0.06	0.14	0.10
Rate (in/min)	0.0050	0.0050	0.0050

* Degree of saturation calculated with a specific gravity of 2.65

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INCORPORATED

DIRECT SHEAR TEST REPORT

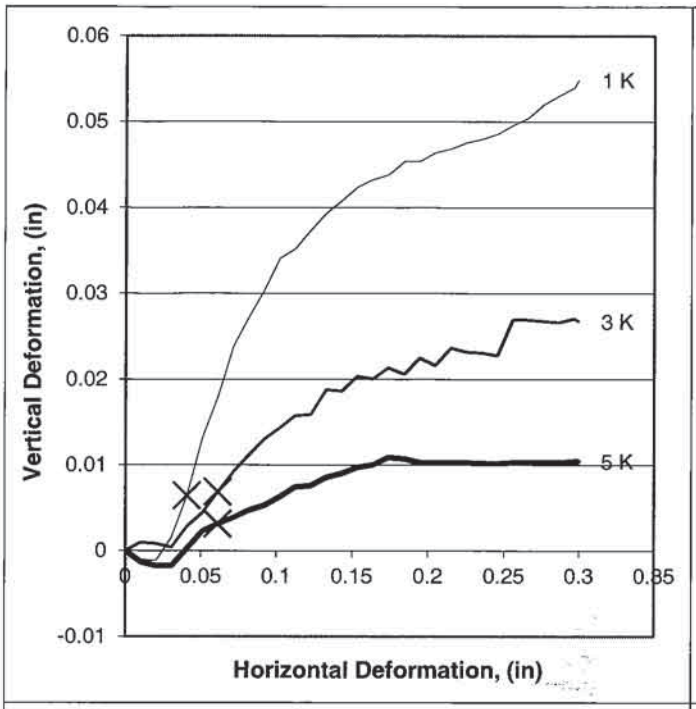
SDG&E

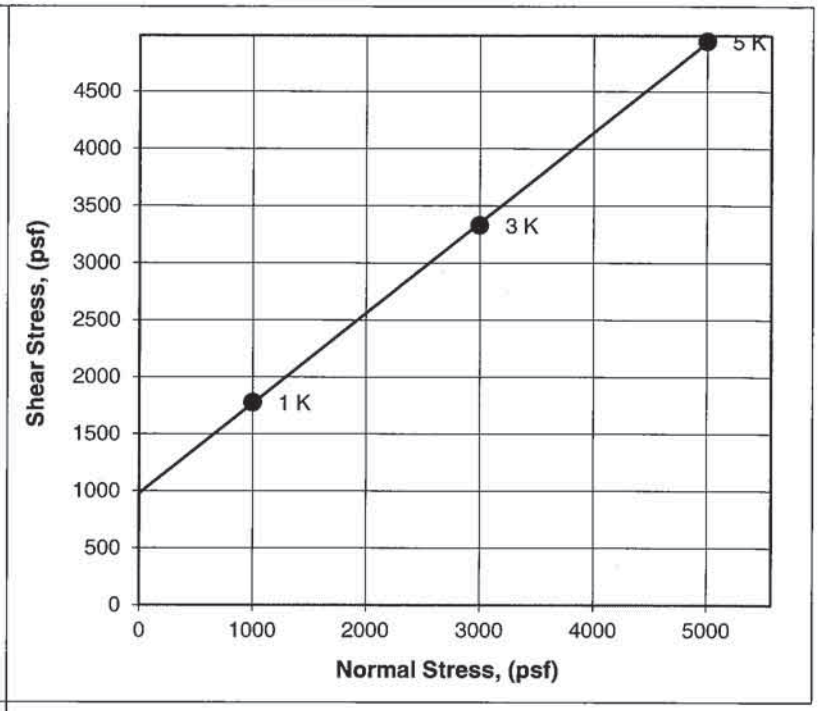
G1115-32-54 **Date:** Tuesday, November 26, 2013 **By:** PJ

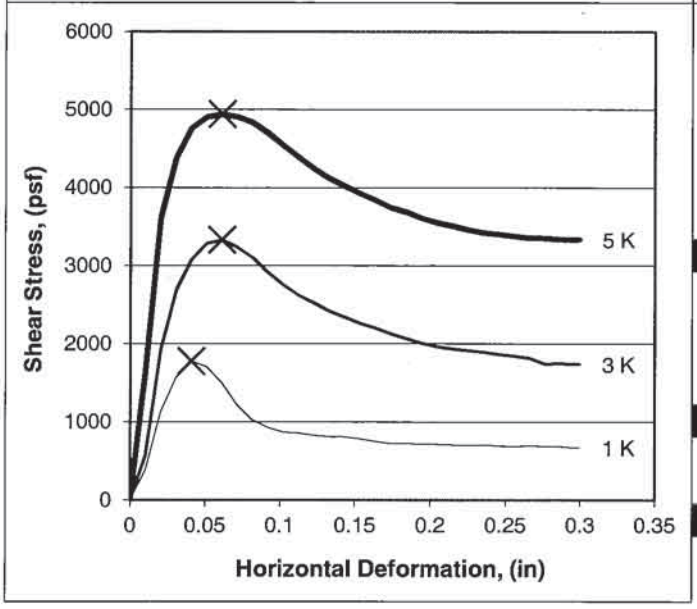
Sample No.: B2-10 **Natural or Remold:** Natural

Description: CH-Gray, Silty CLAY

Remarks:







ϕ (Degrees)	38.3
c (psf)	979
Tan ϕ	0.790
Method	Calc

Load	1 K	3 K	5 K
INITIAL			
Water Content	23.2%	22.4%	22.7%
Dry Density (pcf)	102.8	105.3	104.7
Saturation*	100.9%	103.8%	103.5%
Height (inches)	1.00	1.00	1.00
AFTER TEST			
Water Content	25.8%	24.8%	24.8%
Dry Density (pcf)	97.5	102.5	103.6
FAILURE			
Normal Stress (psf)	1000	3000	5000
Failure Stress (psf)	1779	3330	4940
Failure Deffinition	Max	Max	Max
Displacement (in)	0.04	0.06	0.06
Rate (in/min)	0.0013	0.0011	0.0011

* Degree of saturation calculated with a specific gravity of 2.65

GEOCON
INCORPORATED

DIRECT SHEAR TEST REPORT

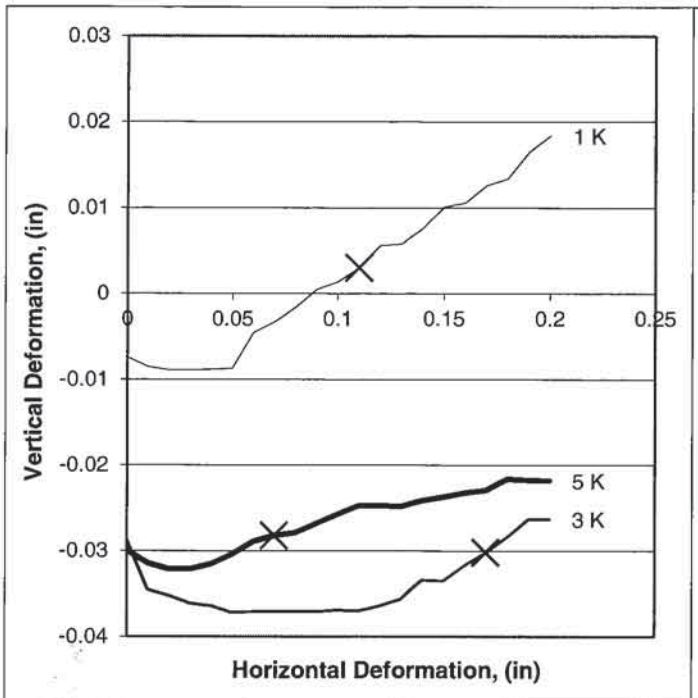
SDG&E TL 649

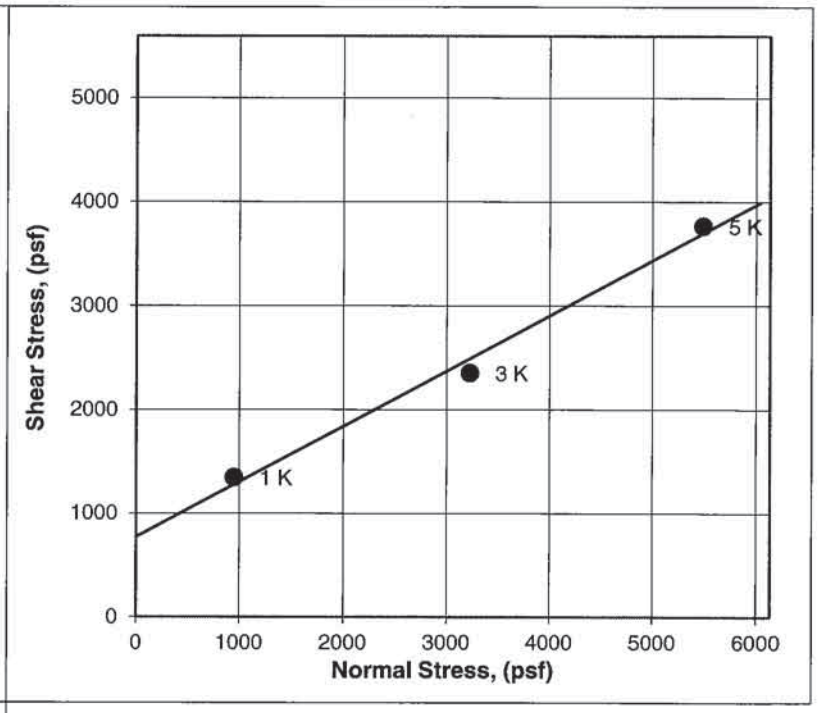
G1115-52-54 **Date:** Tuesday, November 19, 2013 **By:** PJ

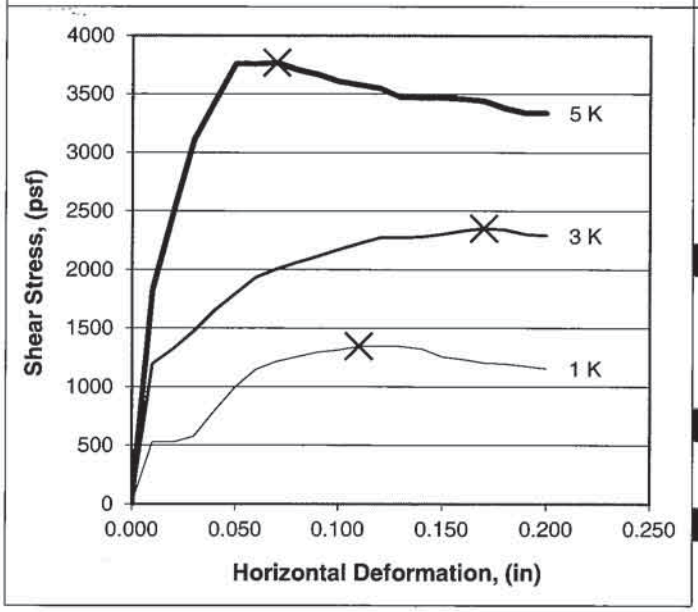
Sample No.: B3-3 **Natural or Remold:** Natural

Description: SM-Yellowish brown, Silty, fine to medium SAND

Remarks:







ϕ (Degrees)	28.1
c (psf)	769
Tan ϕ	0.533
Method	Calc

Load	1 K	3 K	5 K
INITIAL			
Water Content	22.5%	13.0%	19.5%
Dry Density (pcf)	87.3	110.2	91.8
Saturation*	66.5%	68.8%	64.3%
Height (inches)	1.00	1.00	1.00
AFTER TEST			
Water Content	33.8%	19.8%	29.2%
Dry Density (pcf)	85.7	113.1	93.8
FAILURE			
Normal Stress (psf)	952	3228	5494
Failure Stress (psf)	1346	2353	3769
Failure Deffinition	Max	Max	Max
Displacement (in)	0.11	0.17	0.07
Rate (in/min)	0.0050	0.0050	0.0050

* Degree of saturation calculated with a specific gravity of 2.65

GEOCON
INCORPORATED

DIRECT SHEAR TEST REPORT

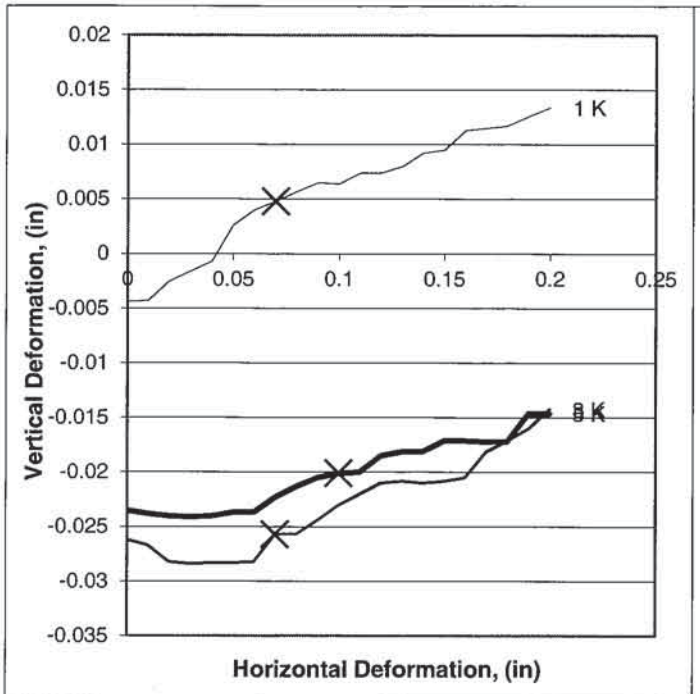
SDG&E TL 649

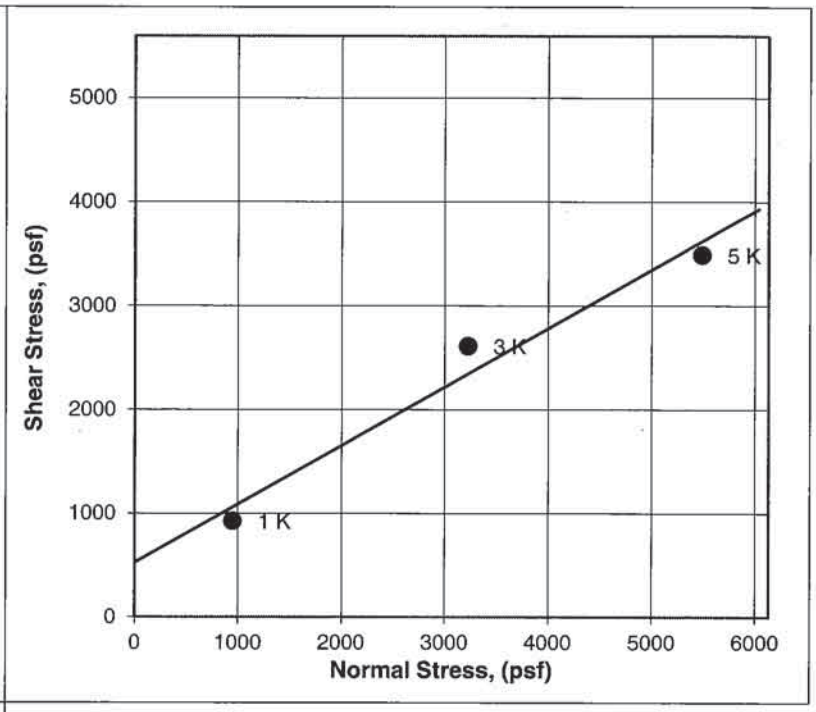
G1115-52-54 **Date:** Tuesday, November 19, 2013 **By:** PJ

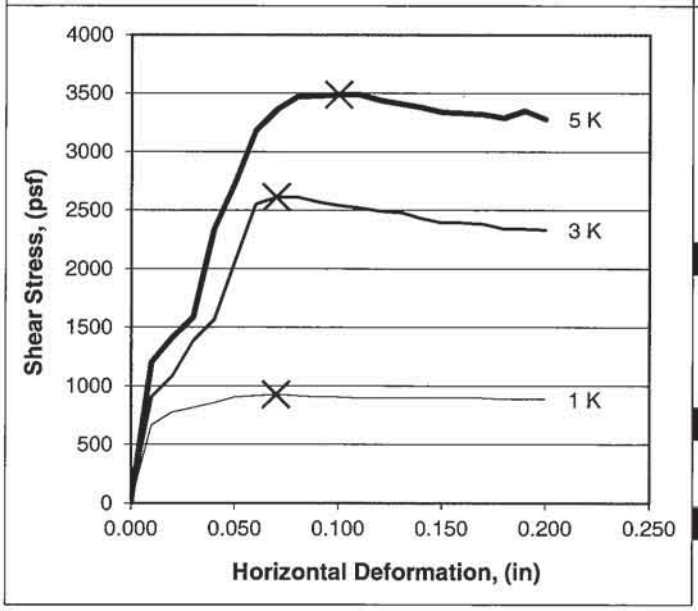
Sample No.: B3-5 **Natural or Remold:** Natural

Description: SM-Yellowish brown, Silty, fine to coarse SAND

Remarks:







ϕ (Degrees)	29.4
c (psf)	523
Tan ϕ	0.564
Method	Calc

Load	1 K	3 K	5 K
INITIAL			
Water Content	14.4%	21.4%	15.3%
Dry Density (pcf)	114.2	102.8	112.9
Saturation*	85.0%	93.1%	87.2%
Height (inches)	1.00	1.00	1.00
AFTER TEST			
Water Content	20.3%	22.1%	18.9%
Dry Density (pcf)	112.7	104.2	114.6
FAILURE			
Normal Stress (psf)	952	3228	5494
Failure Stress (psf)	927	2612	3490
Failure Deffinition	Max	Max	Max
Displacement (in)	0.07	0.07	0.10
Rate (in/min)	0.0050	0.0050	0.0050

* Degree of saturation calculated with a specific gravity of 2.65

GEOCON
INCORPORATED

DIRECT SHEAR TEST REPORT

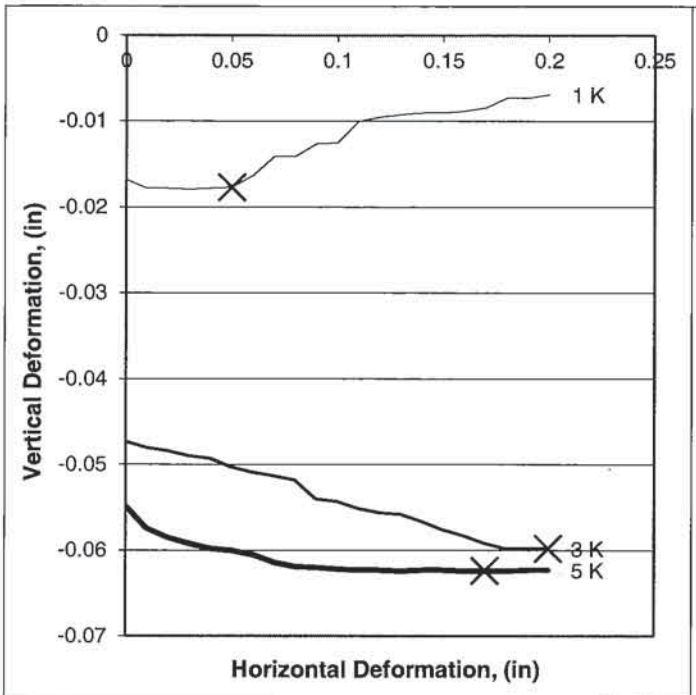
SDG&E TL 649

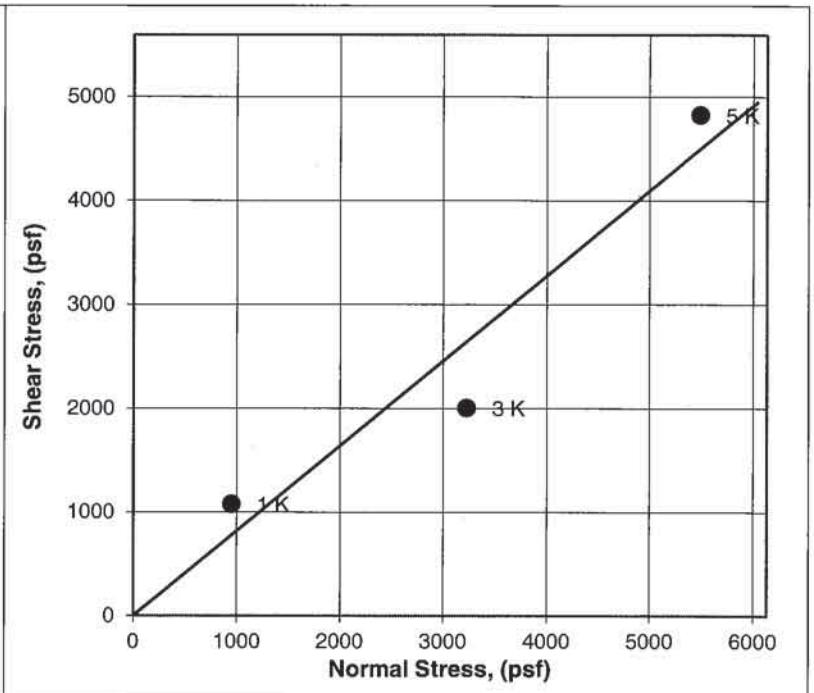
G1115-32-54 **Date:** Tuesday, November 19, 2013 **By:** JD

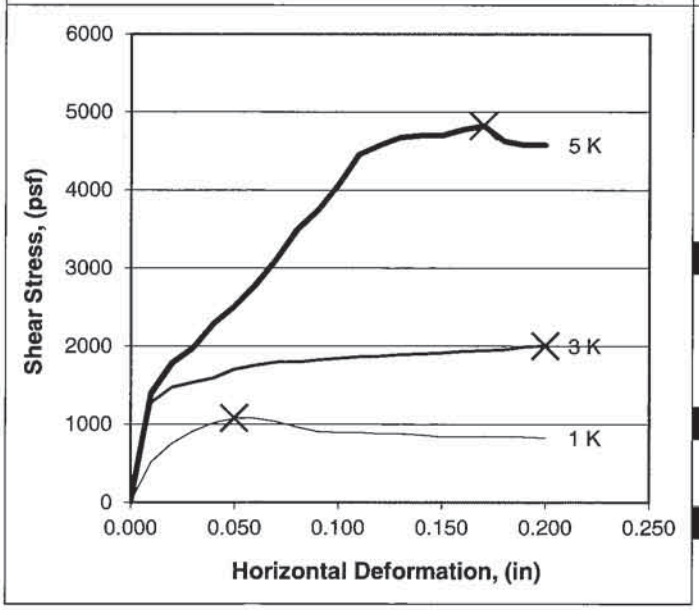
Sample No.: B3-7 **Natural or Remold:** Natural

Description: SM-Light grayish brown, Silty, fine to coarse SAND

Remarks:







ϕ (Degrees)	39.3
c (psf)	0
Tan ϕ	0.819
Method	Calc

Load	1 K	3 K	5 K
INITIAL			
Water Content	15.0%	15.9%	14.7%
Dry Density (pcf)	118.5	104.7	114.5
Saturation*	100.5%	72.7%	87.2%
Height (inches)	1.00	1.00	1.00
AFTER TEST			
Water Content	21.6%	24.2%	20.8%
Dry Density (pcf)	119.3	111.3	122.1
FAILURE			
Normal Stress (psf)	952	3228	5494
Failure Stress (psf)	1077	2004	4823
Failure Deffinition	Max	Max	Max
Displacement (in)	0.05	0.20	0.17
Rate (in/min)	0.0050	0.0050	0.0050

* Degree of saturation calculated with a specific gravity of 2.65

GEOCON
INCORPORATED

DIRECT SHEAR TEST REPORT

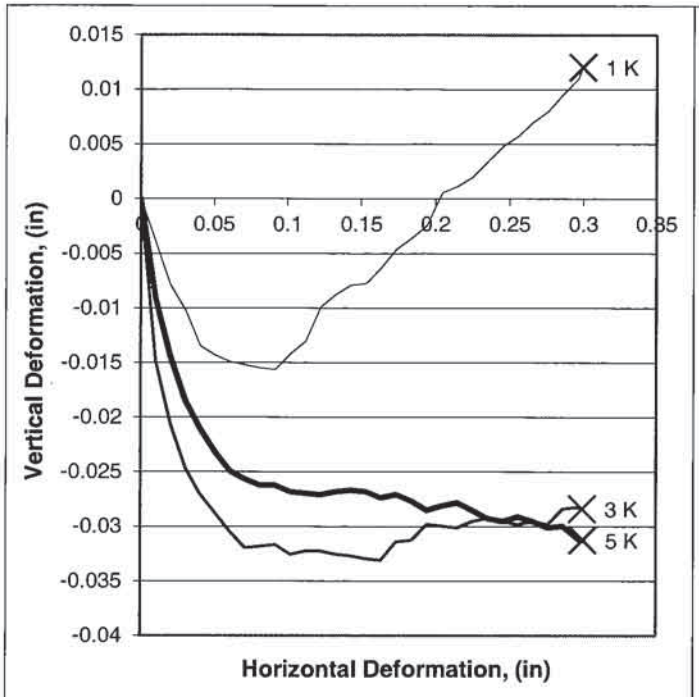
SDG@E

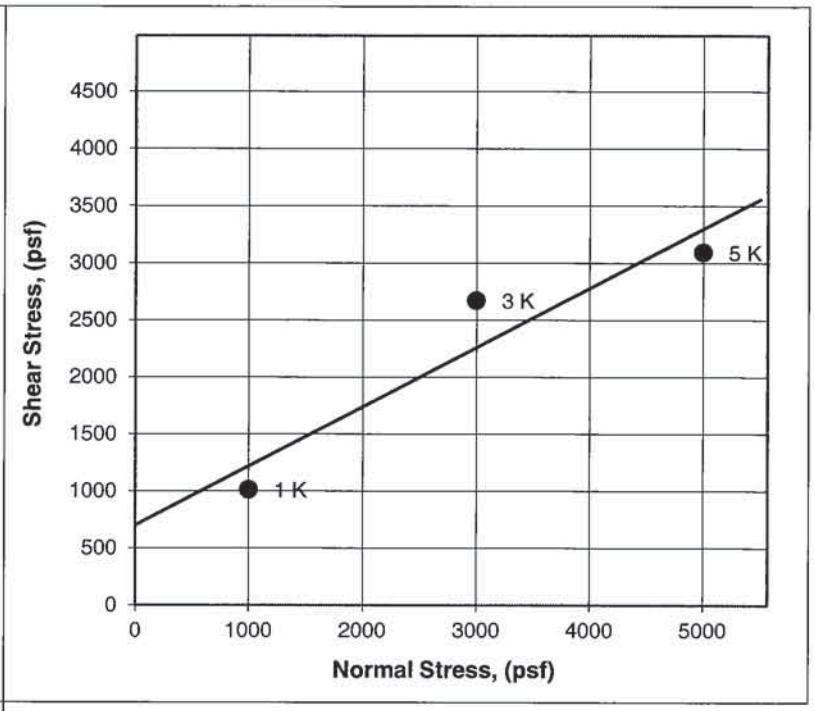
G1115-32-54 **Date:** Thursday, November 21, 2013 **By:** TG

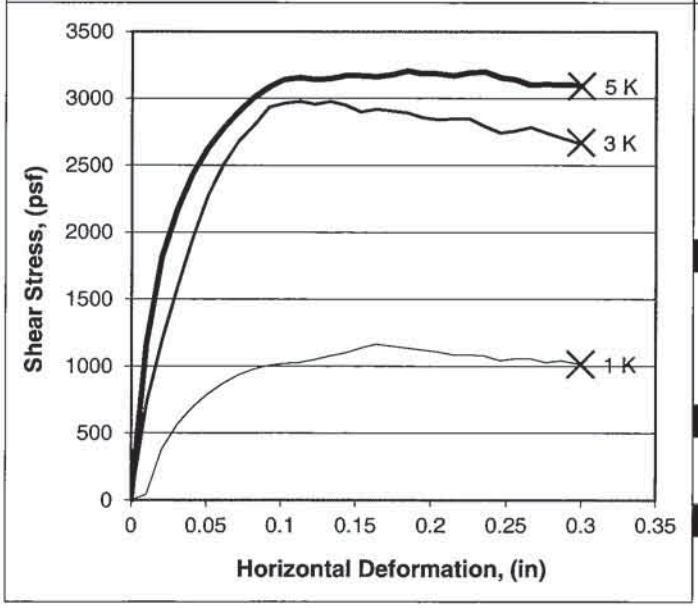
Sample No.: B4-4 **Natural or Remold:** Natural

Description: SC-Dark brown, Clayey SAND

Remarks:







ϕ (Degrees)	27.5
c (psf)	701
Tan ϕ	0.520
Method	Calc

Load	1 K	3 K	5 K
INITIAL			
Water Content	16.7%	18.1%	16.9%
Dry Density (pcf)	112.7	101.5	109.7
Saturation*	94.5%	76.2%	88.4%
Height (inches)	1.00	1.00	1.00
AFTER TEST			
Water Content	23.9%	28.2%	24.7%
Dry Density (pcf)	111.3	104.4	113.3
FAILURE			
Normal Stress (psf)	1000	3000	5000
Failure Stress (psf)	1015	2672	3094
Failure Deffinition	User	User	User
Displacement (in)	0.30	0.30	0.30
Rate (in/min)	0.0010	0.0010	0.0010

* Degree of saturation calculated with a specific gravity of 2.65

GEOCON
INCORPORATED

DIRECT SHEAR TEST REPORT

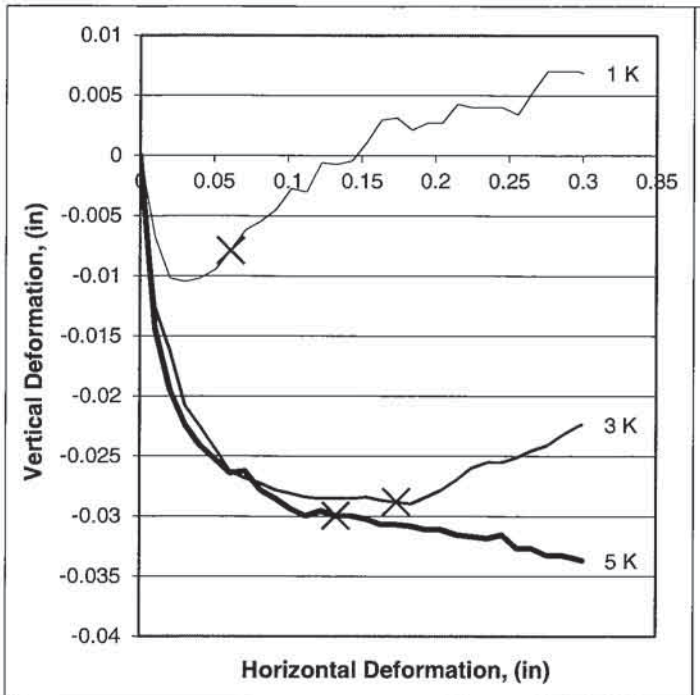
SDG&E

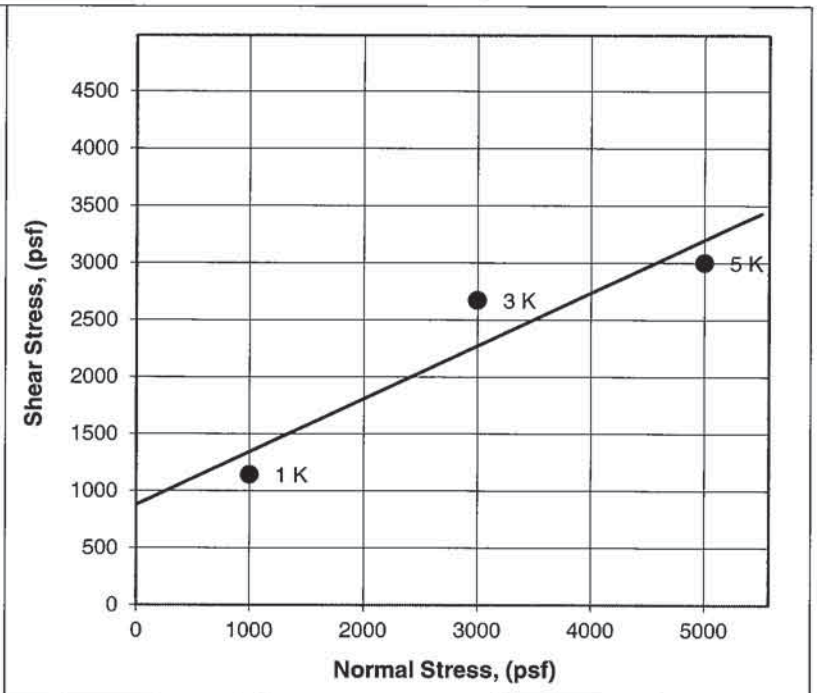
G1115-32-54 **Date:** Tuesday, November 26, 2013 **By:** JD

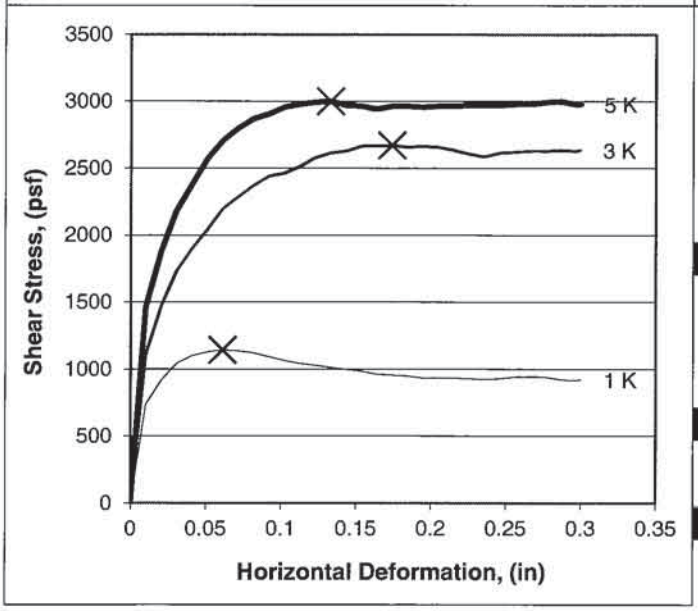
Sample No.: B4-8 **Natural or Remold:** Natural

Description: CL-Brown, Sandy CLAY

Remarks:







ϕ (Degrees)	24.9
c (psf)	879
Tan ϕ	0.464
Method	Calc

Load	1 K	3 K	5 K
INITIAL			
Water Content	19.3%	18.9%	18.2%
Dry Density (pcf)	109.3	109.5	109.6
Saturation*	99.5%	97.7%	94.8%
Height (inches)	1.00	1.00	1.00
AFTER TEST			
Water Content	25.1%	24.7%	23.6%
Dry Density (pcf)	108.5	112.0	113.5
FAILURE			
Normal Stress (psf)	1000	3000	5000
Failure Stress (psf)	1143	2672	3001
Failure Deffinition	Max	Max	Max
Displacement (in)	0.06	0.17	0.13
Rate (in/min)	0.0012	0.0010	0.0011

* Degree of saturation calculated with a specific gravity of 2.65

GEOCON
INCORPORATED

DIRECT SHEAR TEST REPORT

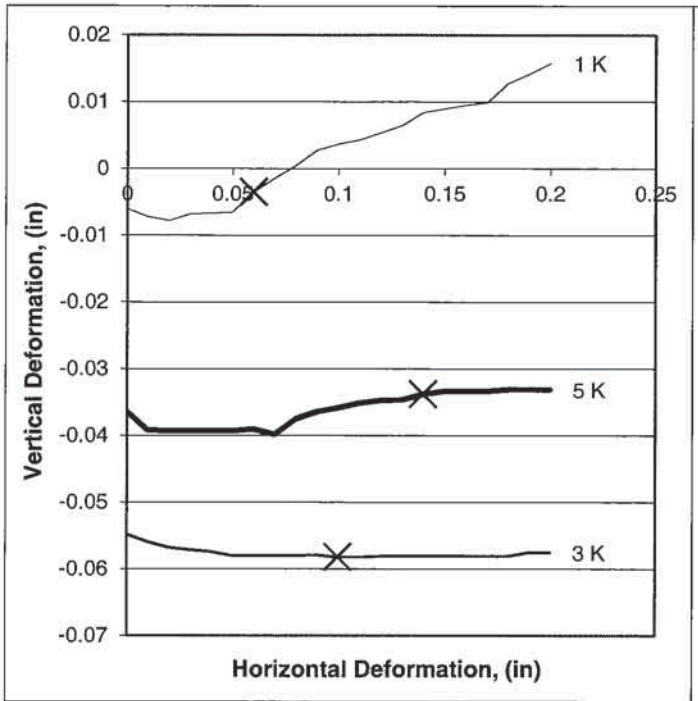
SDG&E TL 649

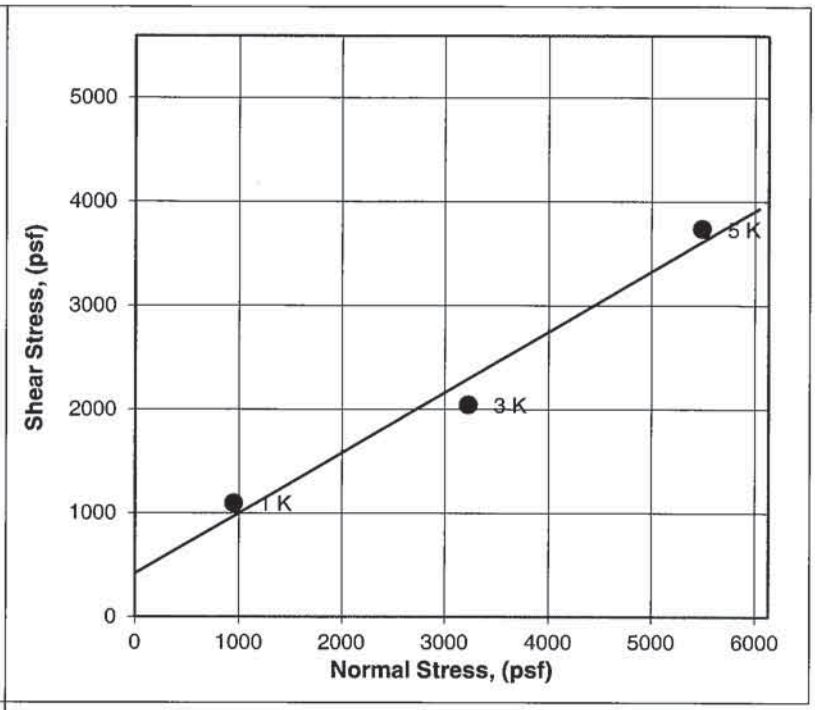
G1115-52-54 **Date:** Tuesday, November 19, 2013 **By:** JD

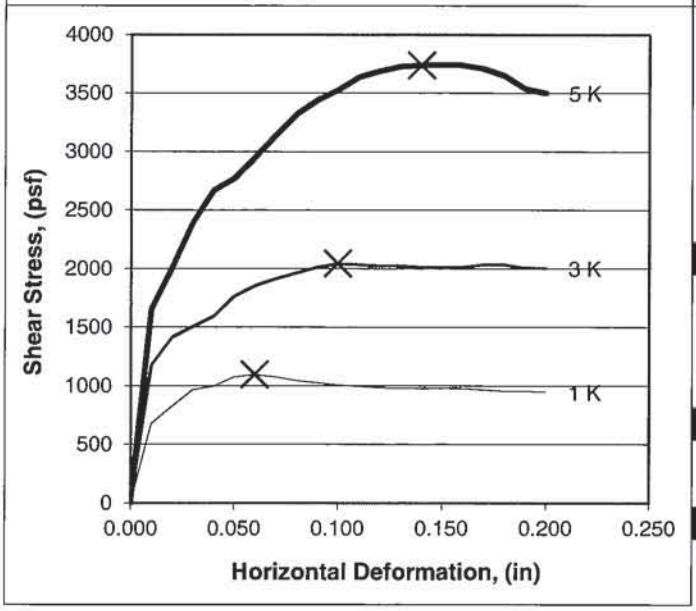
Sample No.: B4-12 **Natural or Remold:** Natural

Description: SM-Light brown, Silty, fine SAND

Remarks:







ϕ (Degrees)	30.2
c (psf)	418
Tan ϕ	0.582
Method	Calc

Load	1 K	3 K	5 K
INITIAL			
Water Content	22.5%	25.1%	23.1%
Dry Density (pcf)	102.3	93.2	98.9
Saturation*	96.8%	85.9%	91.1%
Height (inches)	1.00	1.00	1.00
AFTER TEST			
Water Content	27.1%	33.8%	26.8%
Dry Density (pcf)	100.7	98.9	102.3
FAILURE			
Normal Stress (psf)	952	3228	5494
Failure Stress (psf)	1097	2044	3739
Failure Deffinition	Max	Max	Max
Displacement (in)	0.06	0.10	0.14
Rate (in/min)	0.0050	0.0050	0.0050

* Degree of saturation calculated with a specific gravity of 2.65

GEOCON
INCORPORATED

DIRECT SHEAR TEST REPORT

SDG&E -TL 649

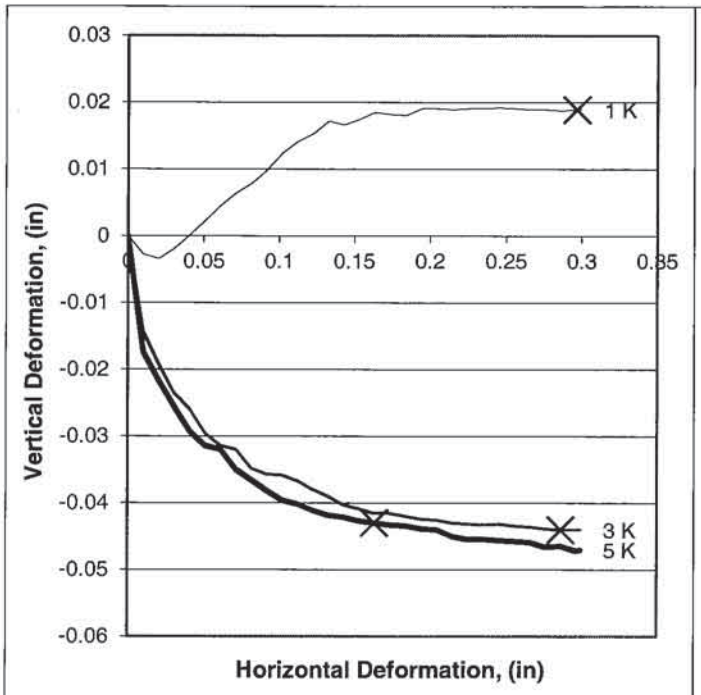
G1115-52-54

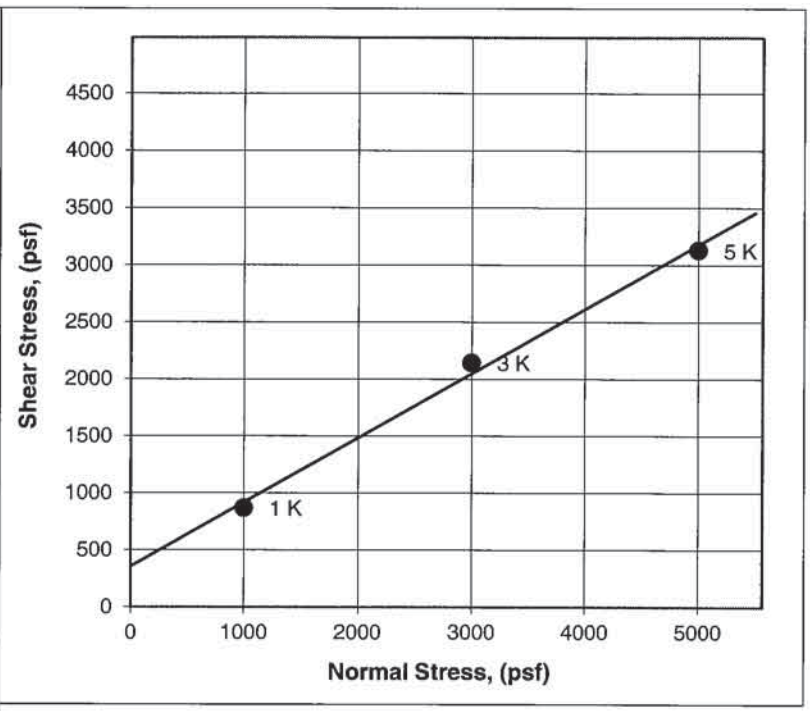
Date: Friday, November 22, 2013 **By:** TG

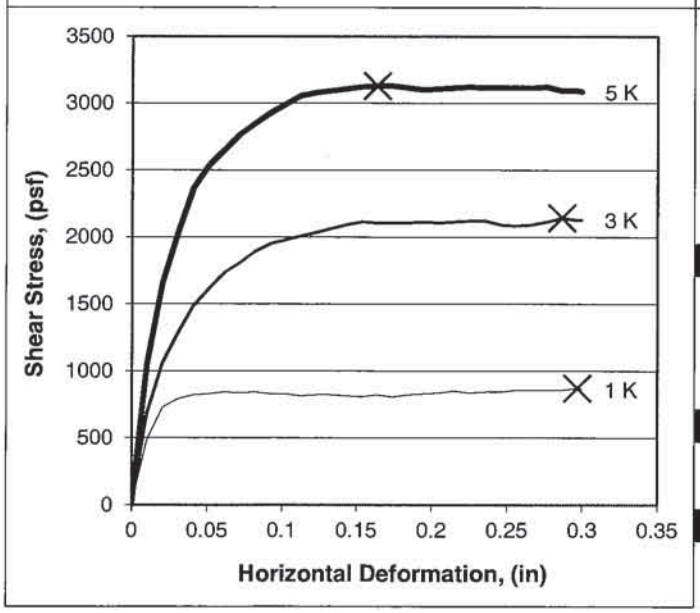
Sample No.: B5-2 **Natural or Remold:** Natural

Description: CL-Brown, Sandy CLAY

Remarks:







ϕ (Degrees)	29.4
c (psf)	355
Tan ϕ	0.564
Method	Calc

Load	1 K	3 K	5 K
INITIAL			
Water Content	17.7%	18.6%	18.0%
Dry Density (pcf)	99.3	96.4	98.7
Saturation*	70.7%	69.0%	70.7%
Height (inches)	1.00	1.00	1.00
AFTER TEST			
Water Content	23.8%	26.3%	25.7%
Dry Density (pcf)	97.5	100.8	103.6
FAILURE			
Normal Stress (psf)	1000	3000	5000
Failure Stress (psf)	872	2143	3129
Failure Deffinition	Max	Max	Max
Displacement (in)	0.30	0.29	0.16
Rate (in/min)	0.0010	0.0010	0.0011

* Degree of saturation calculated with a specific gravity of 2.65

GEOCON
INCORPORATED

DIRECT SHEAR TEST REPORT

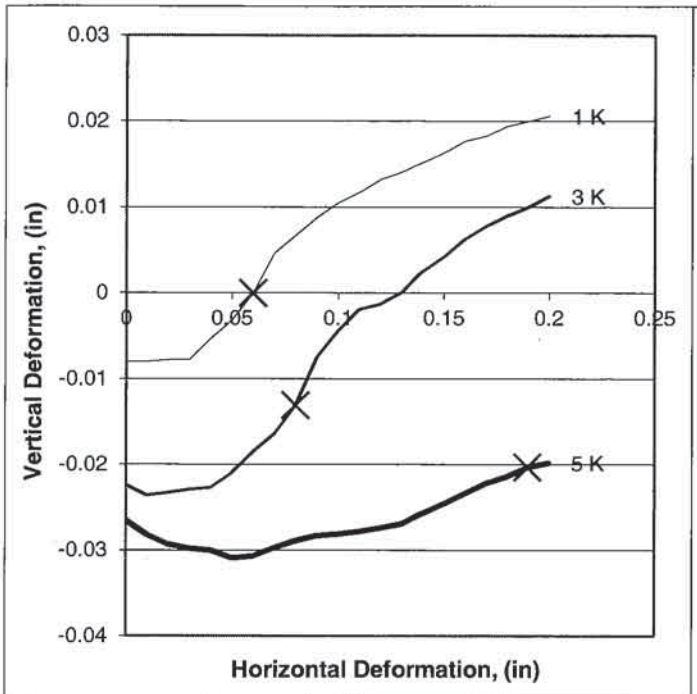
SDG&E TL 649

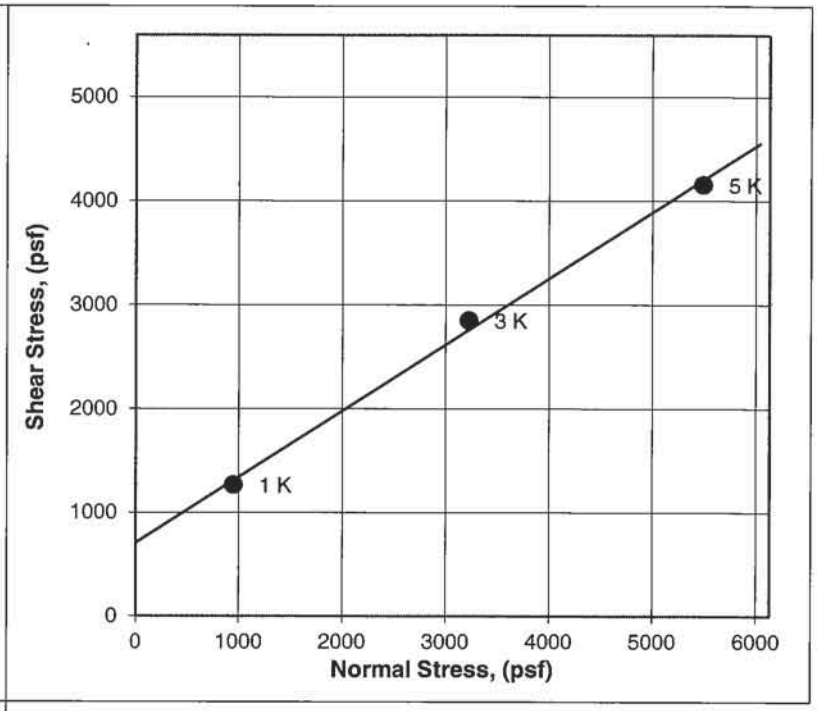
G1115-52-54 **Date:** Friday, November 22, 2013 **By:** PJ

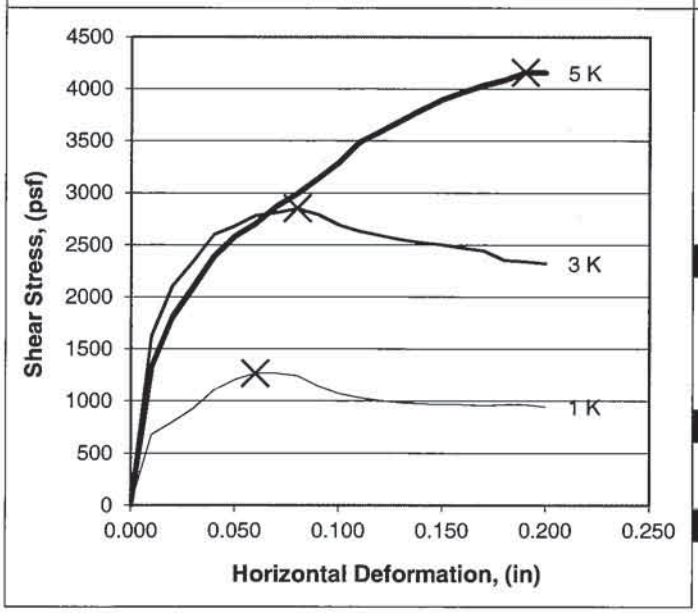
Sample No.: B5-4@10' **Natural or Remold:** Natural

Description: SM-Whitish gray, Silty, fine to coarse SAND

Remarks:







ϕ (Degrees)	32.5
c (psf)	705
Tan ϕ	0.637
Method	Calc

Load	1 K	3 K	5 K
INITIAL			
Water Content	9.3%	6.9%	7.1%
Dry Density (pcf)	109.3	116.8	113.8
Saturation*	47.9%	44.0%	41.5%
Height (inches)	1.00	1.00	1.00
AFTER TEST			
Water Content	17.2%	13.8%	16.9%
Dry Density (pcf)	107.1	115.5	116.1
FAILURE			
Normal Stress (psf)	952	3228	5494
Failure Stress (psf)	1266	2852	4158
Failure Deffinition	Max	Max	Max
Displacement (in)	0.06	0.08	0.19
Rate (in/min)	0.0100	0.0100	0.0100

* Degree of saturation calculated with a specific gravity of 2.65

GEOCON
INCORPORATED

DIRECT SHEAR TEST REPORT

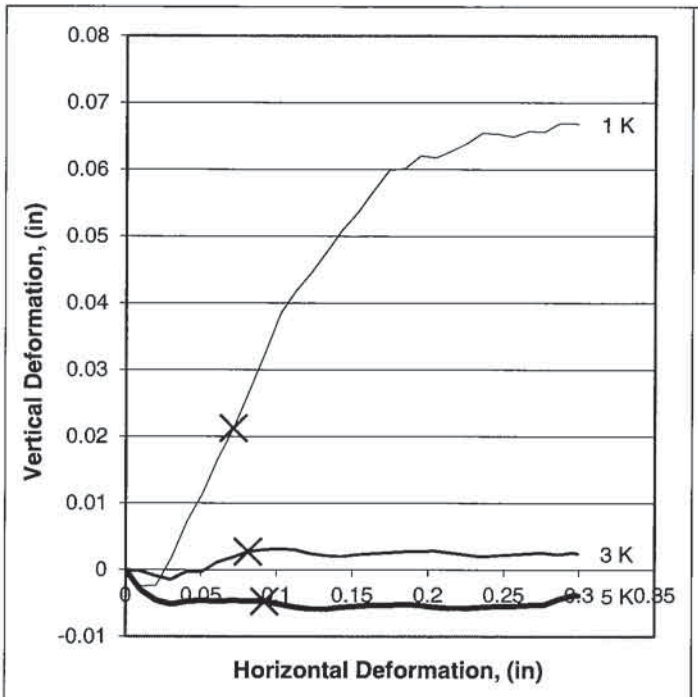
SDG&E TL-649

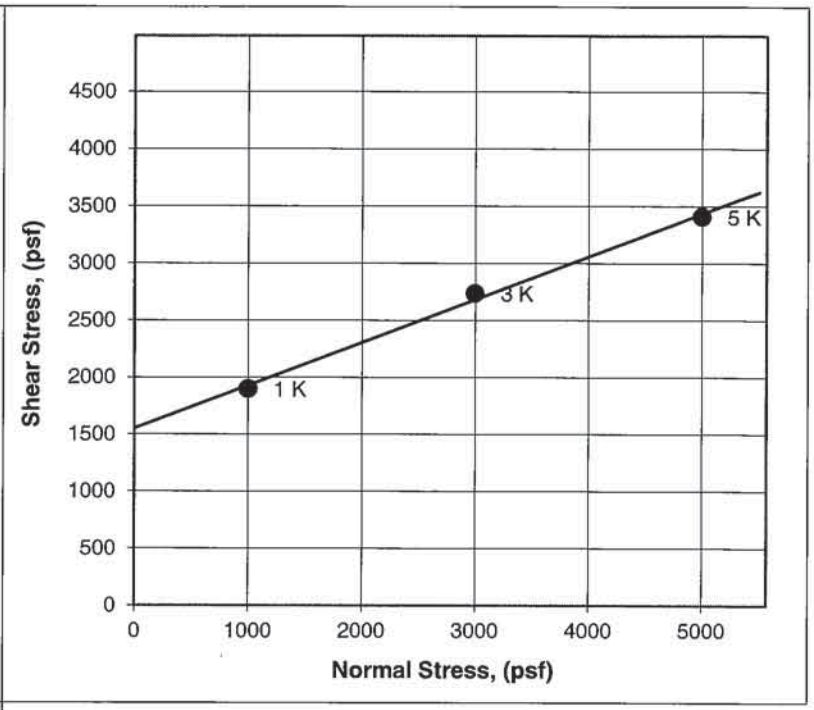
G1115-52-54 **Date:** Friday, November 22, 2013 **By:** TG

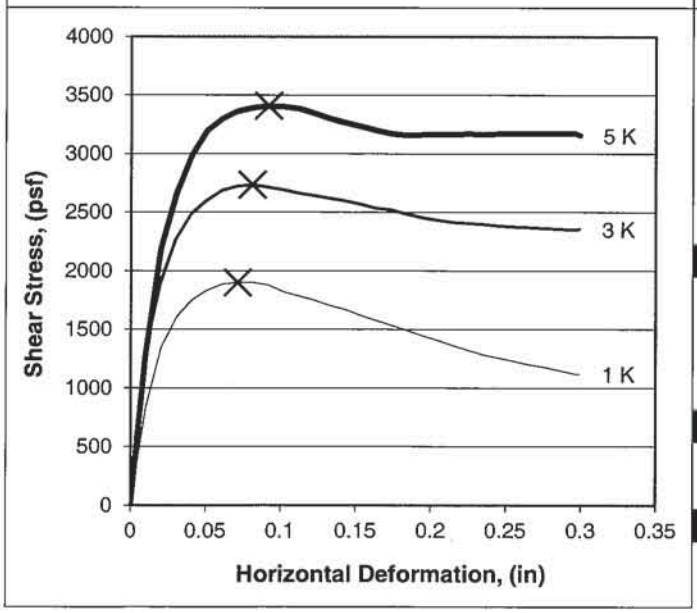
Sample No.: B6-3 **Natural or Remold:** Natural

Description: CL-Brown, Sandy CLAY

Remarks:







ϕ (Degrees)	20.7
c (psf)	1551
Tan ϕ	0.377
Method	Calc

Load	1 K	3 K	5 K
INITIAL			
Water Content	22.2%	22.9%	23.6%
Dry Density (pcf)	104.1	101.7	101.6
Saturation*	100.0%	96.9%	99.7%
Height (inches)	1.00	1.00	1.00
AFTER TEST			
Water Content	23.8%	25.1%	25.0%
Dry Density (pcf)	97.6	101.5	102.0
FAILURE			
Normal Stress (psf)	1000	3000	5000
Failure Stress (psf)	1900	2736	3408
Failure Deffinition	Max	Max	Max
Displacement (in)	0.07	0.08	0.09
Rate (in/min)	0.0011	0.0011	0.0011

* Degree of saturation calculated with a specific gravity of 2.65

GEOCON
INCORPORATED

DIRECT SHEAR TEST REPORT

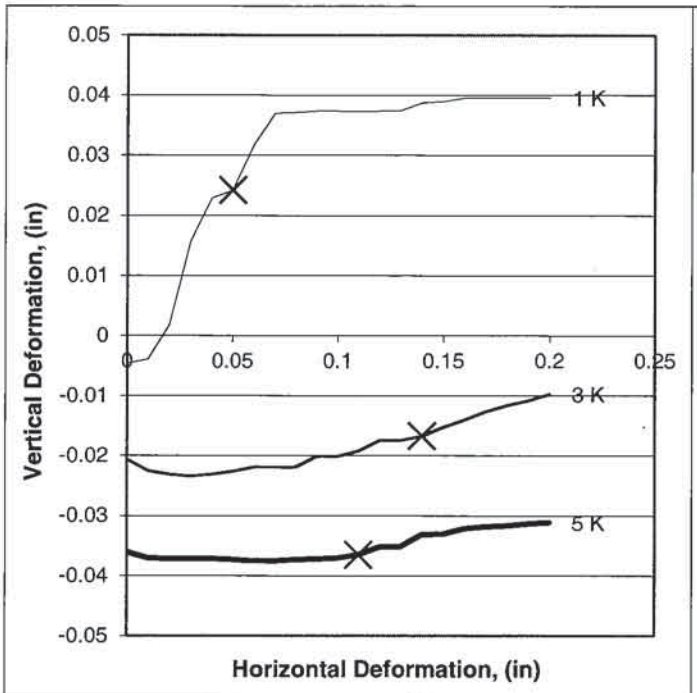
SDG&E TL649

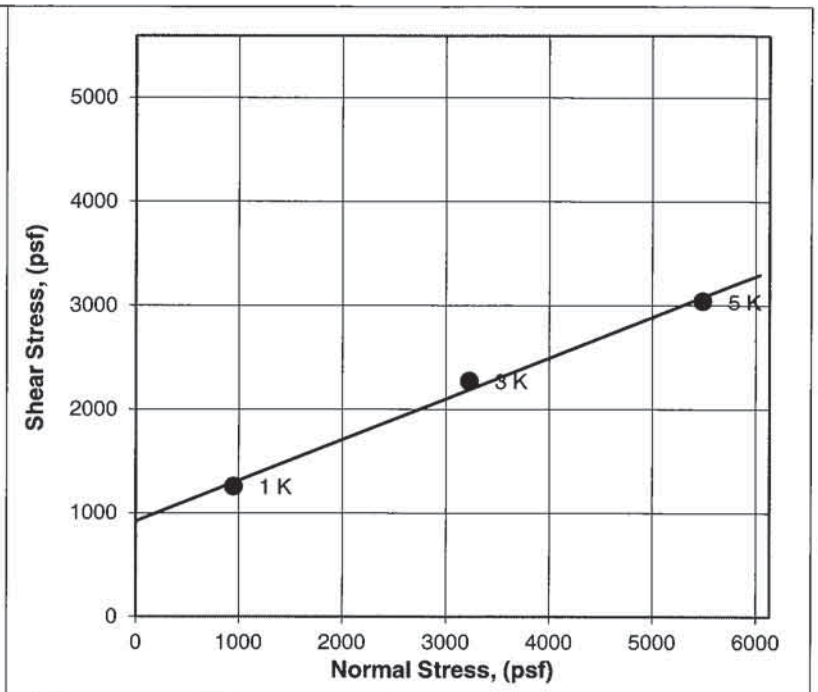
G1115-52-54 **Date:** Friday, November 22, 2013 **By:** PJ

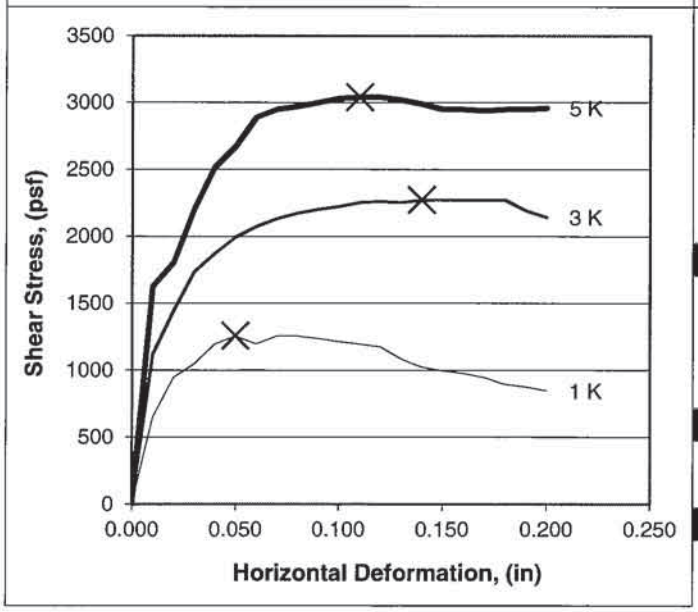
Sample No.: B6-5@15' **Natural or Remold:** Natural

Description: SC-Light gray brown clayey(f-m) sand.

Remarks:







ϕ (Degrees)	21.5
c (psf)	923
Tan ϕ	0.393
Method	Calc

Load	1 K	3 K	5 K
INITIAL			
Water Content	11.6%	12.0%	9.7%
Dry Density (pcf)	107.2	113.3	108.0
Saturation*	56.8%	69.1%	48.4%
Height (inches)	1.00	1.00	1.00
AFTER TEST			
Water Content	20.5%	17.5%	18.6%
Dry Density (pcf)	103.1	114.4	111.5
FAILURE			
Normal Stress (psf)	952	3228	5494
Failure Stress (psf)	1256	2273	3041
Failure Deffinition	Max	Max	Max
Displacement (in)	0.05	0.14	0.11
Rate (in/min)	0.0100	0.0100	0.0100

* Degree of saturation calculated with a specific gravity of 2.65

GEOCON
INCORPORATED

DIRECT SHEAR TEST REPORT

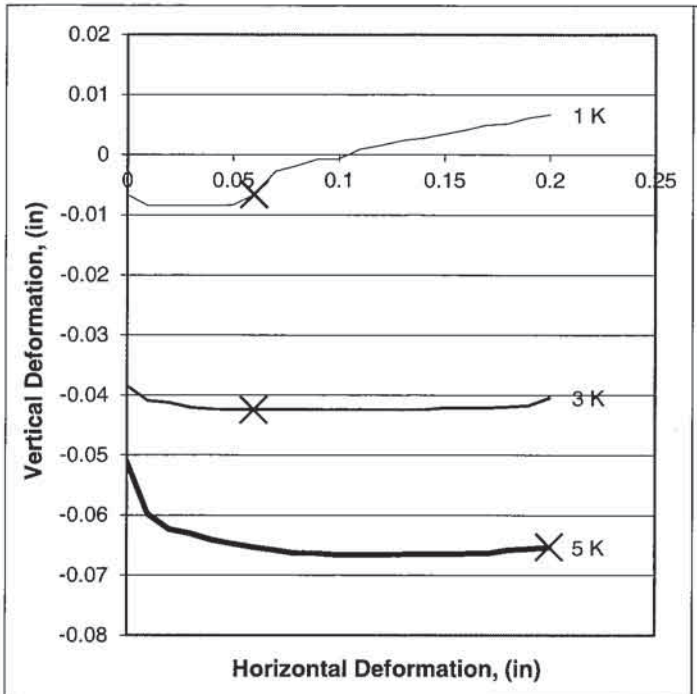
SDG&E TL 649

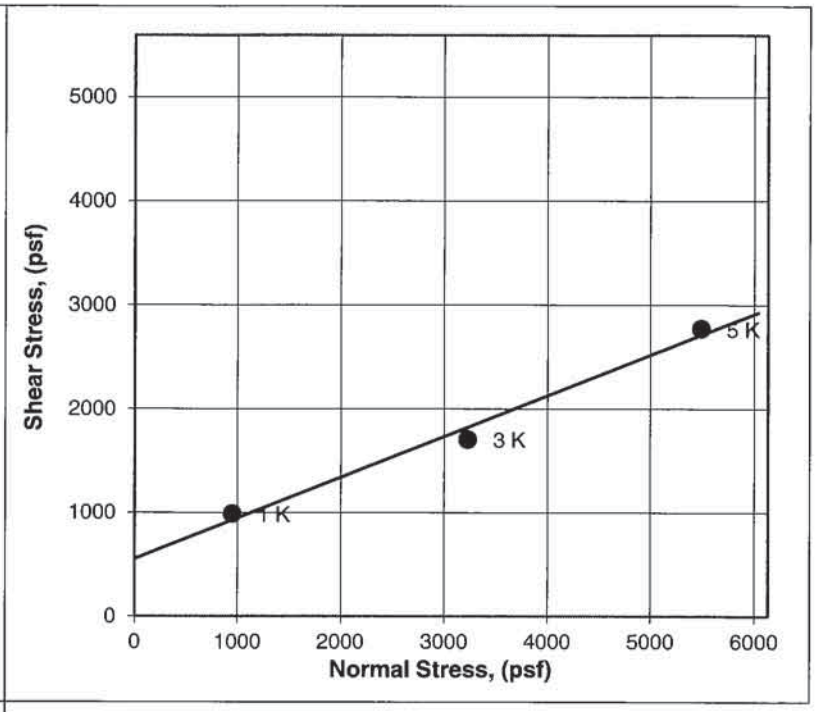
G1115-52-54 **Date:** Friday, November 22, 2013 **By:** PJ

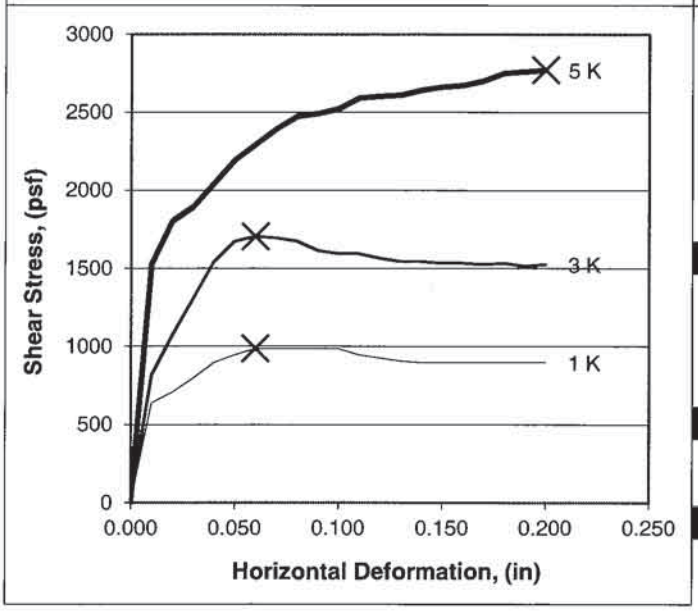
Sample No.: B6-7 **Natural or Remold:** Natural

Description: SC-Light gray brown clayey(f-m)sand.

Remarks:







ϕ (Degrees)	**21.5**
c (psf)	**554**
Tan ϕ	**0.393**
Method	**Calc**

Load	1 K	3 K	5 K
INITIAL			
Water Content	19.3%	13.8%	13.4%
Dry Density (pcf)	100.9	103.7	109.1
Saturation*	79.8%	61.3%	68.8%
Height (inches)	1.00	1.00	1.00
AFTER TEST			
Water Content	24.9%	23.8%	20.6%
Dry Density (pcf)	100.2	108.1	116.7
FAILURE			
Normal Stress (psf)	952	3228	5494
Failure Stress (psf)	987	1705	2772
Failure Deffinition	Max	Max	Max
Displacement (in)	0.06	0.06	0.20
Rate (in/min)	0.0100	0.0100	0.0100

* Degree of saturation calculated with a specific gravity of 2.65

GEOCON
INCORPORATED

DIRECT SHEAR TEST REPORT

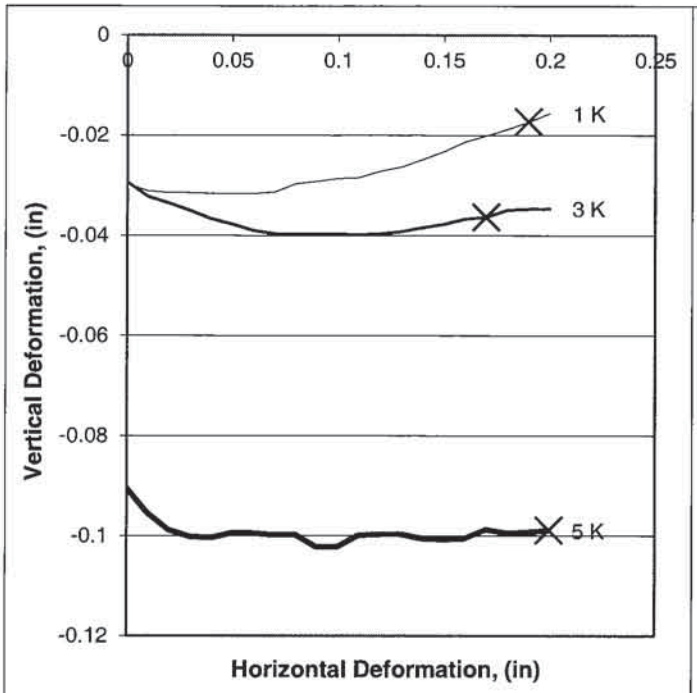
SDG&E TL649

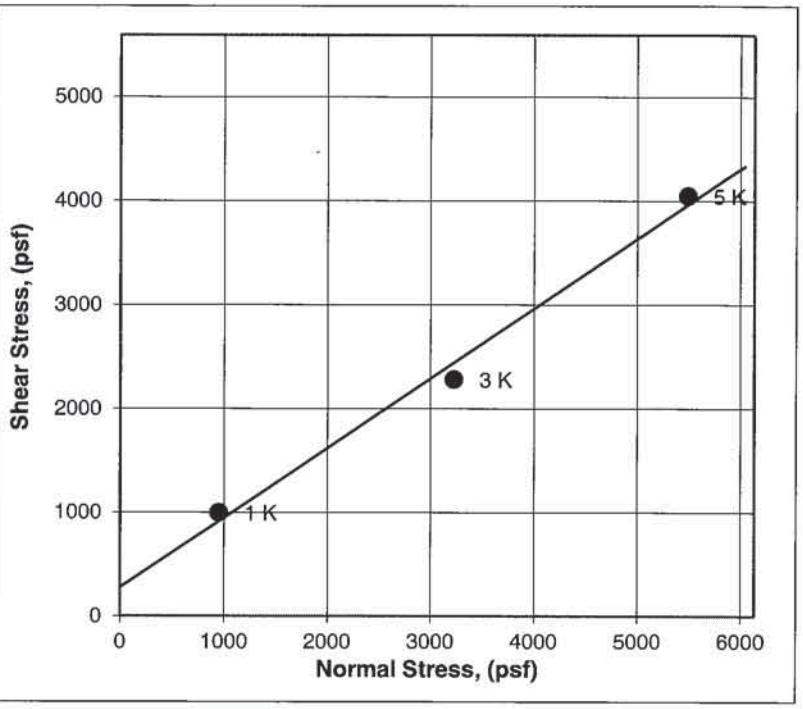
G1115-52-54 **Date:** Friday, November 22, 2013 **By:** PJ

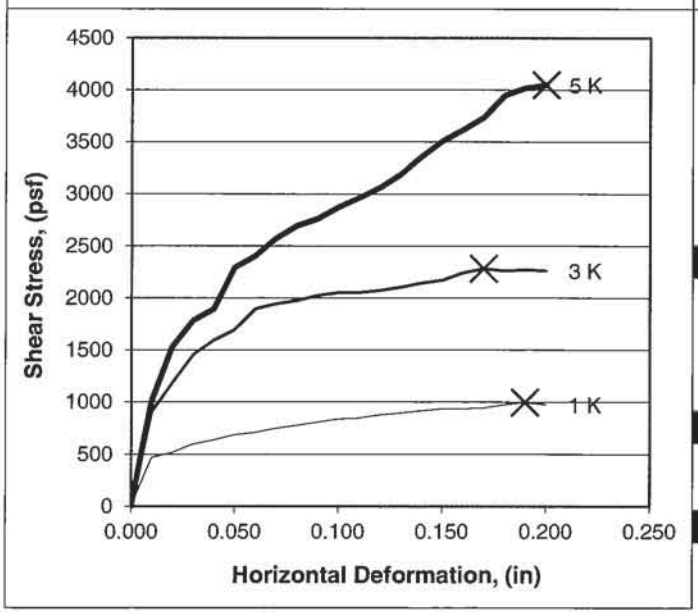
Sample No.: B7-5@20' **Natural or Remold:** Natural

Description: SC-Grayish brown, Clayey, fine to coarse SAND

Remarks:







ϕ (Degrees)	33.9
c (psf)	277
Tan ϕ	0.672
Method	Calc

Load	1 K	3 K	5 K
INITIAL			
Water Content	10.8%	10.0%	9.5%
Dry Density (pcf)	112.7	112.4	112.8
Saturation*	61.4%	56.3%	53.7%
Height (inches)	1.00	1.00	1.00
AFTER TEST			
Water Content	19.5%	18.4%	18.8%
Dry Density (pcf)	114.5	116.4	125.2
FAILURE			
Normal Stress (psf)	952	3228	5494
Failure Stress (psf)	997	2283	4048
Failure Deffinition	Max	Max	Max
Displacement (in)	0.19	0.17	0.20
Rate (in/min)	0.0100	0.0100	0.0100

* Degree of saturation calculated with a specific gravity of 2.65

GEOCON
INCORPORATED

DIRECT SHEAR TEST REPORT

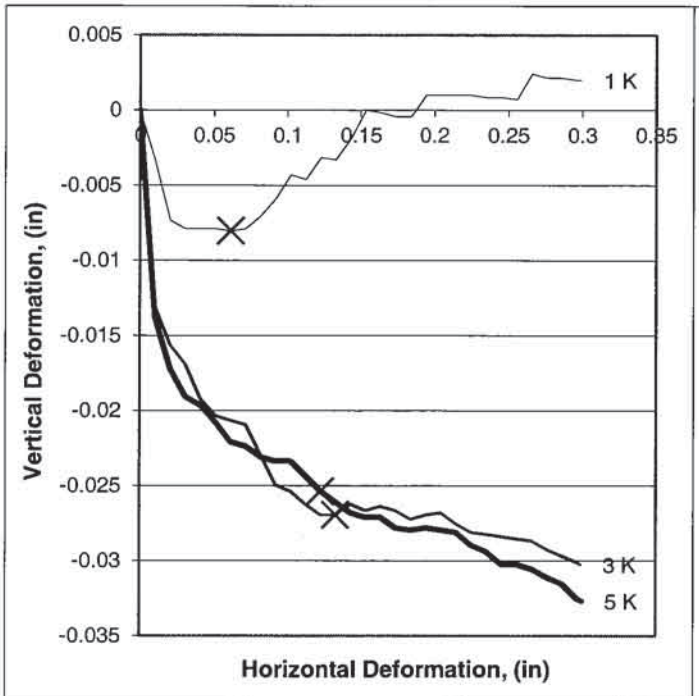
SDG&E TL-649

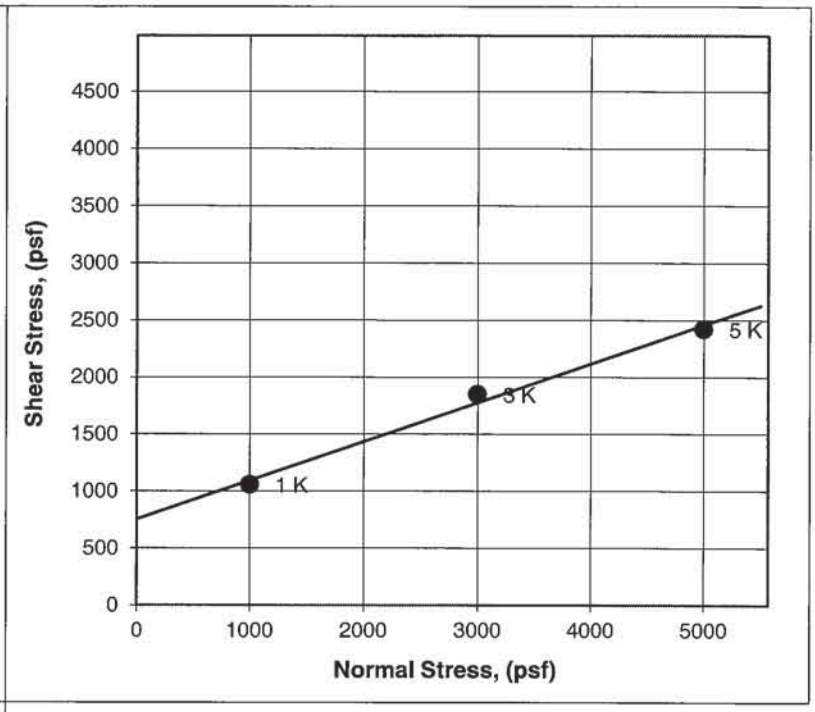
G1115-52-54 **Date:** Tuesday, December 03, 2013 **By:** TG

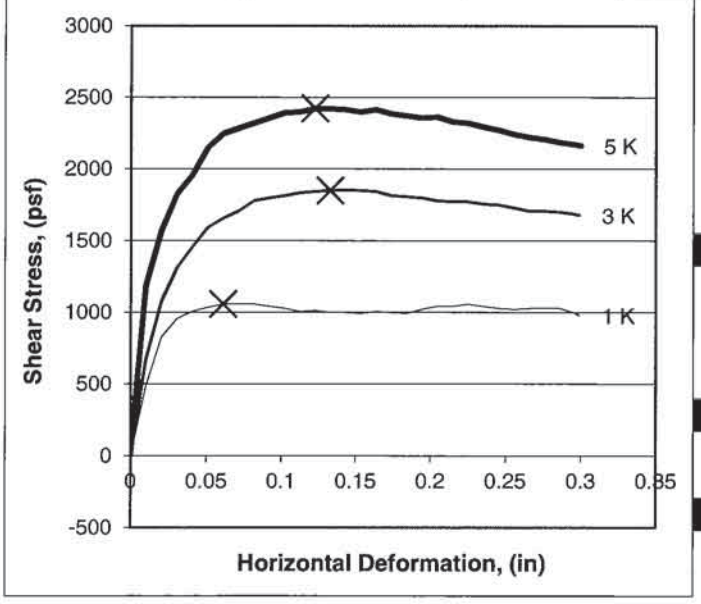
Sample No.: B8-3 **Natural or Remold:** Natural

Description: CL-Yellowish brown, Sandy CLAY

Remarks:







ϕ (Degrees)	18.8
c (psf)	753
Tan ϕ	0.341
Method	Calc

Load	1 K	3 K	5 K
INITIAL			
Water Content	23.0%	22.5%	23.7%
Dry Density (pcf)	101.1	102.7	99.1
Saturation*	96.0%	97.7%	93.7%
Height (inches)	1.00	1.00	1.00
AFTER TEST			
Water Content	28.6%	27.9%	29.1%
Dry Density (pcf)	100.9	105.9	102.4
FAILURE			
Normal Stress (psf)	1000	3000	5000
Failure Stress (psf)	1057	1850	2422
Failure Deffinition	Max	Max	Max
Displacement (in)	0.06	0.13	0.12
Rate (in/min)	0.0012	0.0010	0.0011

* Degree of saturation calculated with a specific gravity of 2.65

GEOCON
INCORPORATED

DIRECT SHEAR TEST REPORT

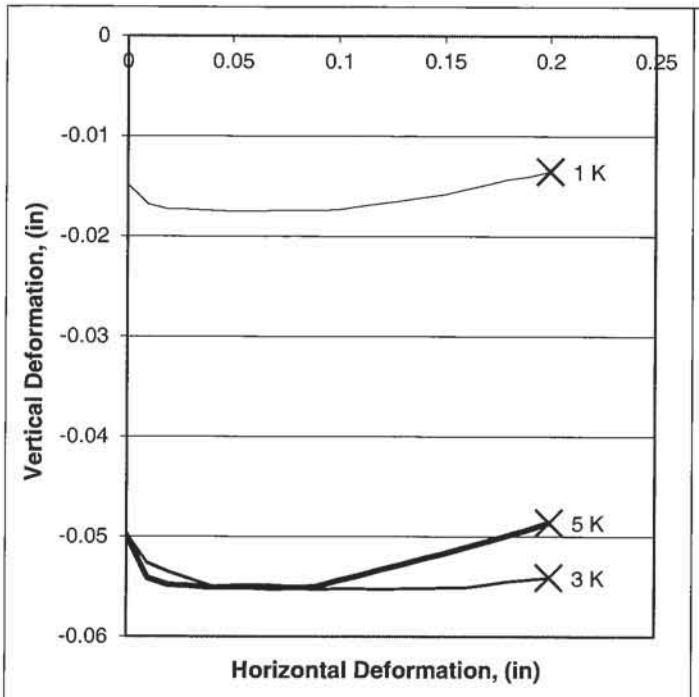
SDG&E TL 649

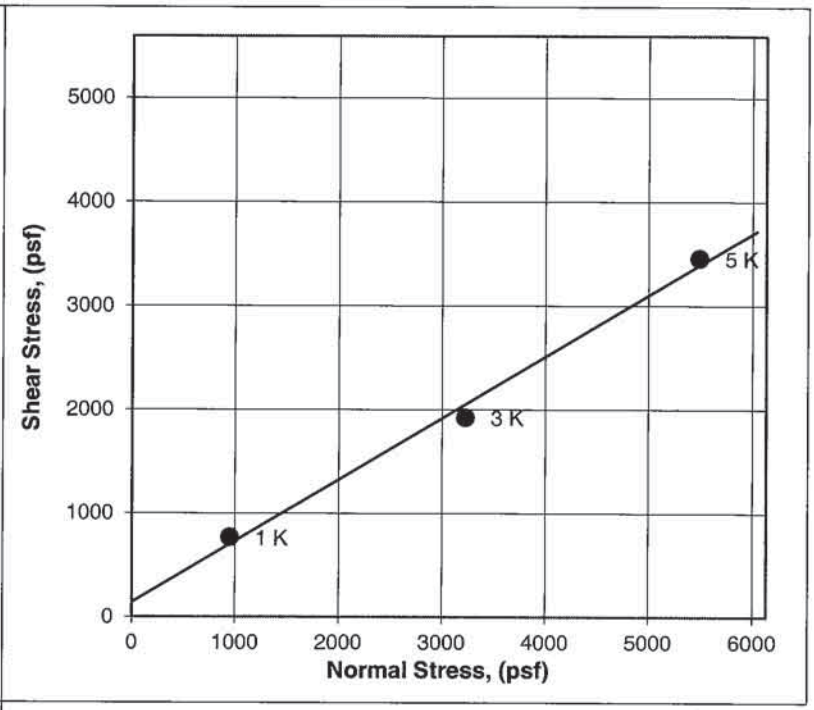
G1115-52-54 **Date:** Saturday, November 23, 2013 **By:** PJ

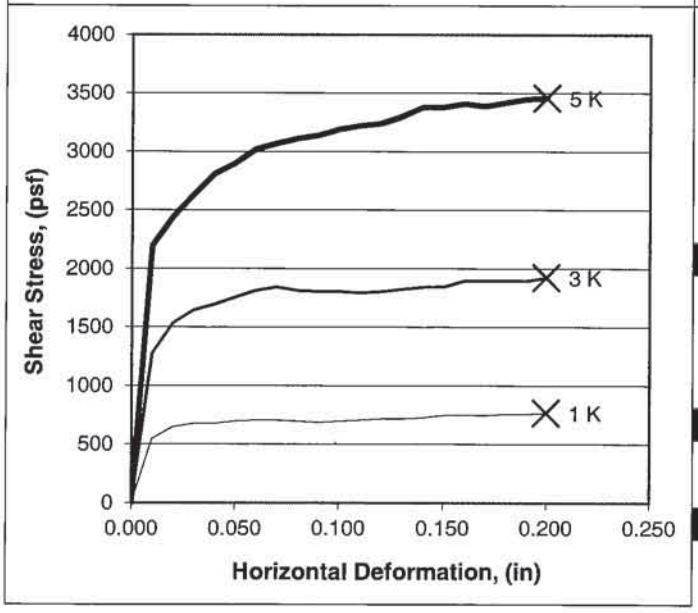
Sample No.: B8-5@12 1/2 **Natural or Remold:** Natural

Description: SC-Brown to dark reddish browm, Clayey SAND

Remarks:







ϕ (Degrees)	30.7
c (psf)	139
Tan ϕ	0.593
Method	Calc

Load	1 K	3 K	5 K
INITIAL			
Water Content	14.9%	14.9%	13.6%
Dry Density (pcf)	112.3	109.3	113.8
Saturation*	83.6%	77.1%	79.4%
Height (inches)	1.00	1.00	1.00
AFTER TEST			
Water Content	22.8%	22.6%	19.3%
Dry Density (pcf)	113.8	115.5	119.6
FAILURE			
Normal Stress (psf)	952	3228	5494
Failure Stress (psf)	768	1924	3460
Failure Deffinition	User	User	User
Displacement (in)	0.20	0.20	0.20
Rate (in/min)	0.0050	0.0050	0.0050

* Degree of saturation calculated with a specific gravity of 2.65

GEOCON
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DIRECT SHEAR TEST REPORT

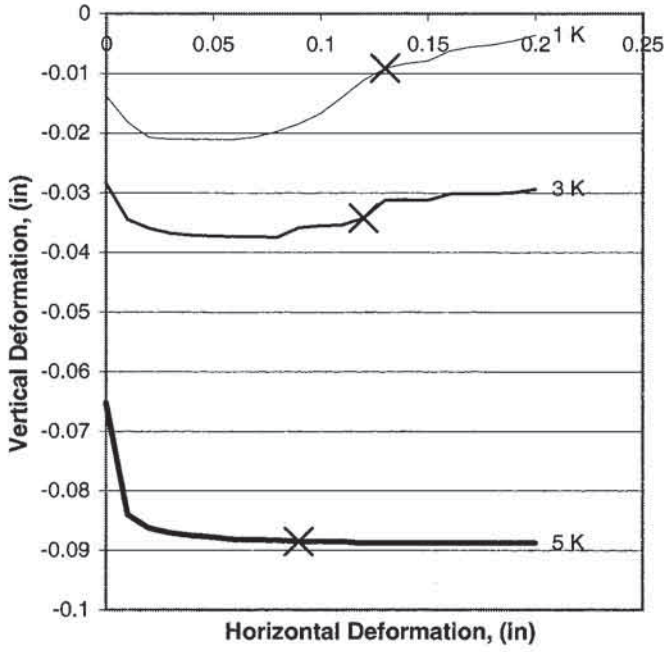
SDG&E TL 649

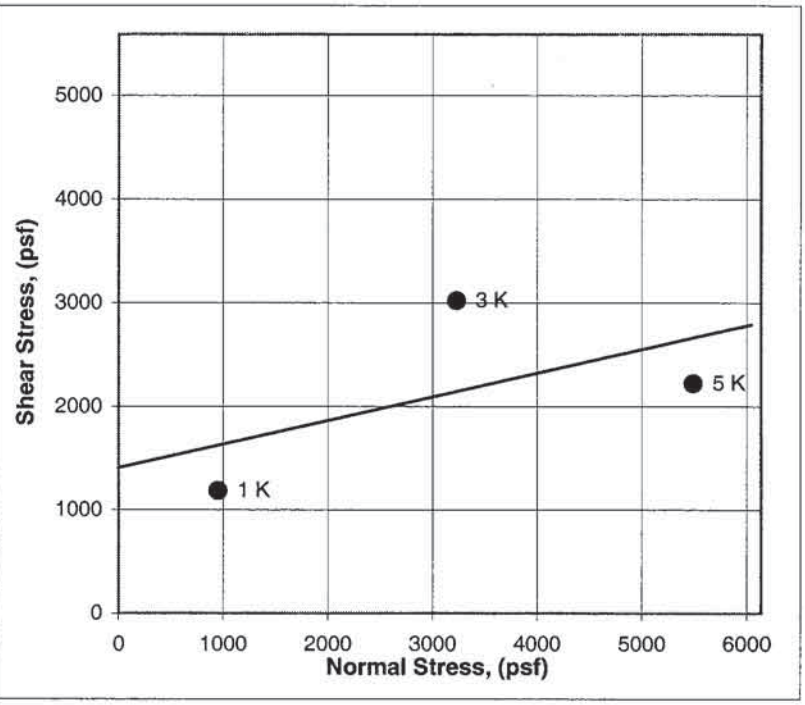
G1115-52-54 **Date:** Friday, November 22, 2013 **By:** PJ

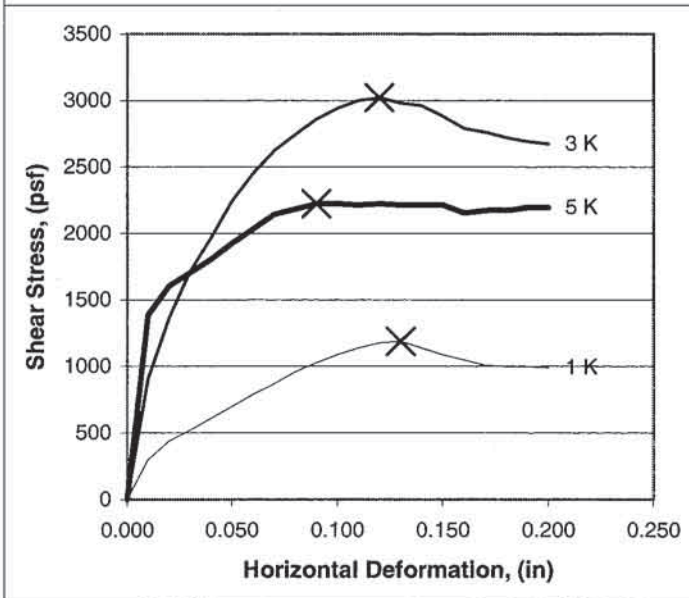
Sample No.: B8-9 @ 25' **Natural or Remold:** Natural

Description: Light yellowish brown, Silty, f-c SAND

Remarks:







ϕ (Degrees)	12.9
c (psf)	1406
Tan ϕ	0.229
Method	Calc

Load	1 K	3 K	5 K
INITIAL			
Water Content	8.9%	14.2%	11.4%
Dry Density (pcf)	116.3	110.6	114.8
Saturation*	56.1%	75.6%	68.4%
Height (inches)	1.00	1.00	1.00
AFTER TEST			
Water Content	16.0%	18.9%	16.3%
Dry Density (pcf)	116.7	113.9	126.0
FAILURE			
Normal Stress (psf)	952	3228	5494
Failure Stress (psf)	1187	3021	2223
Failure Deffinition	Max	Max	Max
Displacement (in)	0.13	0.12	0.09
Rate (in/min)	0.0100	0.0100	0.0100

* Degree of saturation calculated with a specific gravity of 2.65

GEOCON
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DIRECT SHEAR TEST REPORT

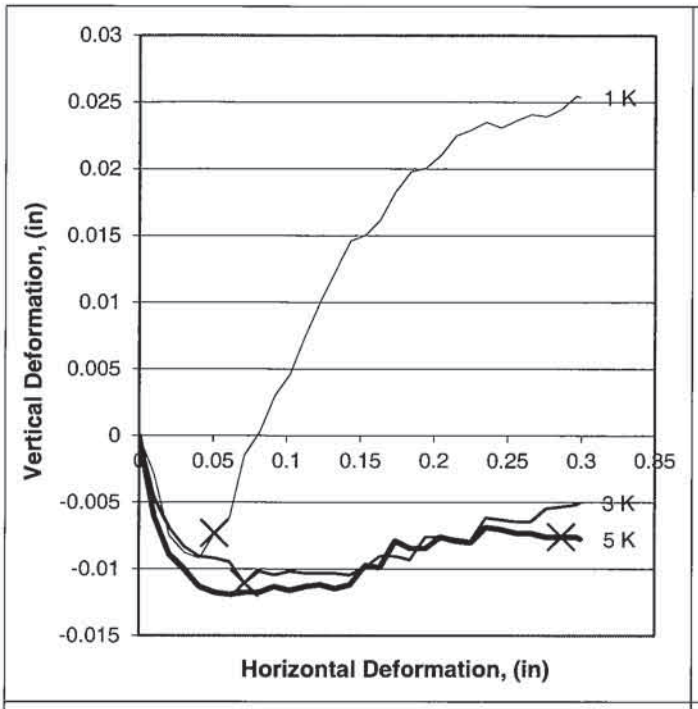
SDG&E TL-649

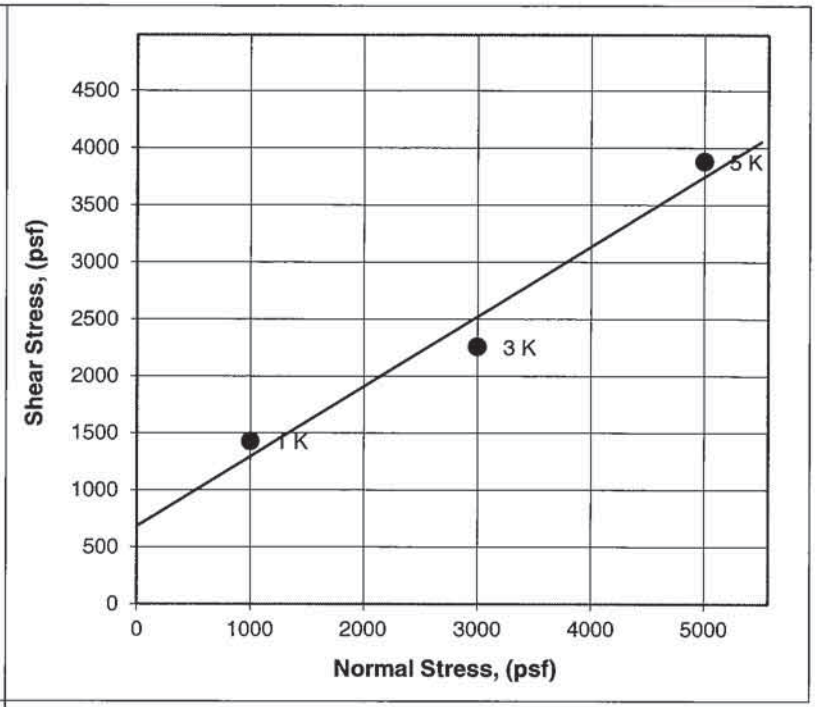
G1115-52-54 **Date:** Friday, December 13, 2013 **By:** TG

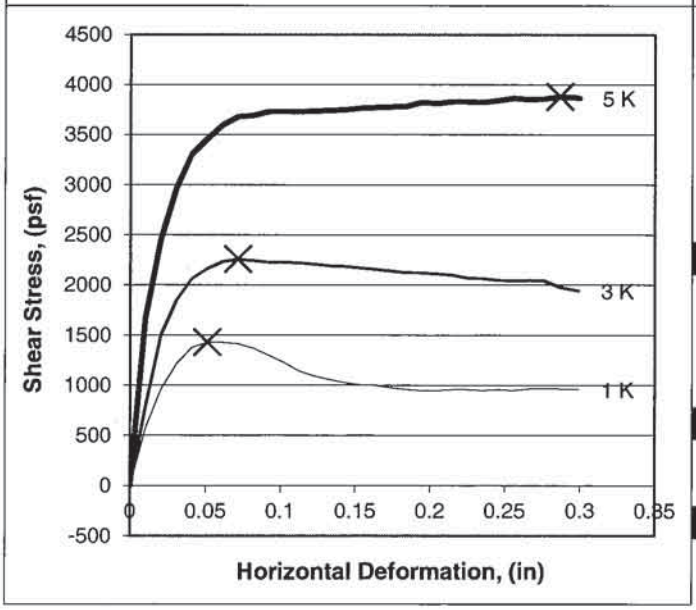
Sample No.: B9-2 **Natural or Remold:** Natural

Description: CL - Brown, Sandy CLAY

Remarks:







ϕ (Degrees)	31.5
c (psf)	684
Tan ϕ	0.613
Method	Calc

Load	1 K	3 K	5 K
INITIAL			
Water Content	15.6%	15.7%	16.3%
Dry Density (pcf)	111.6	107.5	109.7
Saturation*	85.5%	77.1%	85.1%
Height (inches)	1.00	1.00	1.00
AFTER TEST			
Water Content	19.9%	20.4%	20.1%
Dry Density (pcf)	108.9	108.0	110.6
FAILURE			
Normal Stress (psf)	1000	3000	5000
Failure Stress (psf)	1429	2258	3881
Failure Deffinition	Max	Max	Max
Displacement (in)	0.05	0.07	0.29
Rate (in/min)	0.0012	0.0011	0.0010

* Degree of saturation calculated with a specific gravity of 2.65

GEOCON
INCORPORATED

DIRECT SHEAR TEST REPORT

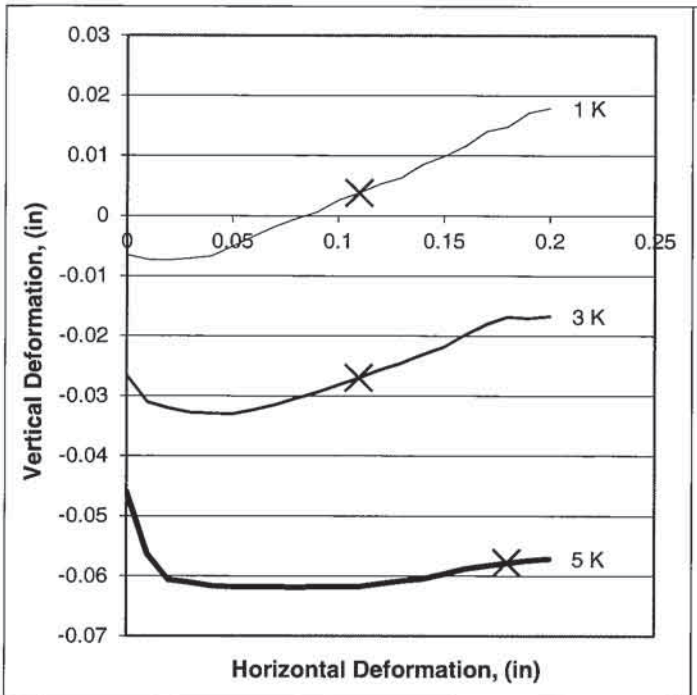
SDG&E TL 649

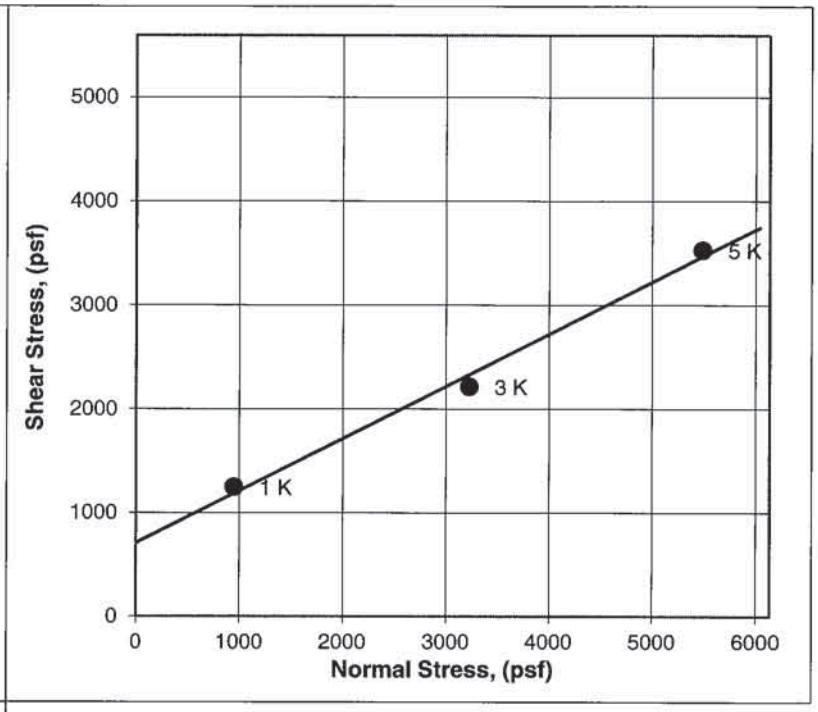
G1115-52-54 **Date:** Tuesday, December 03, 2013 **By:** NJ

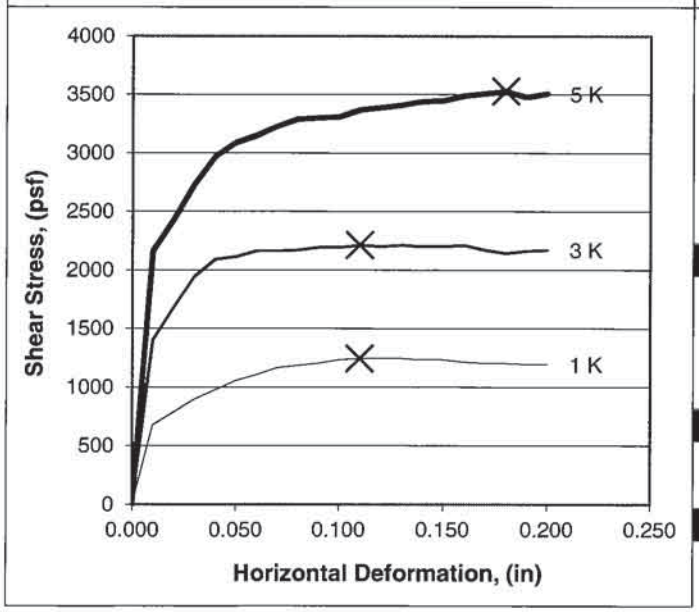
Sample No.: B13-1 **Natural or Remold:** Natural

Description: CL-Brown (f-c) sandy clay.

Remarks:







ϕ (Degrees)	26.7
c (psf)	709
Tan ϕ	0.503
Method	Calc

Load	1 K	3 K	5 K
INITIAL			
Water Content	14.7%	14.5%	14.3%
Dry Density (pcf)	108.8	107.7	106.3
Saturation*	74.8%	71.8%	68.2%
Height (inches)	1.00	1.00	1.00
AFTER TEST			
Water Content	20.6%	20.9%	21.0%
Dry Density (pcf)	106.9	109.5	112.7
FAILURE			
Normal Stress (psf)	952	3228	5494
Failure Stress (psf)	1246	2214	3530
Failure Deffinition	Max	Max	Max
Displacement (in)	0.11	0.11	0.18
Rate (in/min)	0.0050	0.0050	0.0050

* Degree of saturation calculated with a specific gravity of 2.65

GEOCON
INCORPORATED

DIRECT SHEAR TEST REPORT

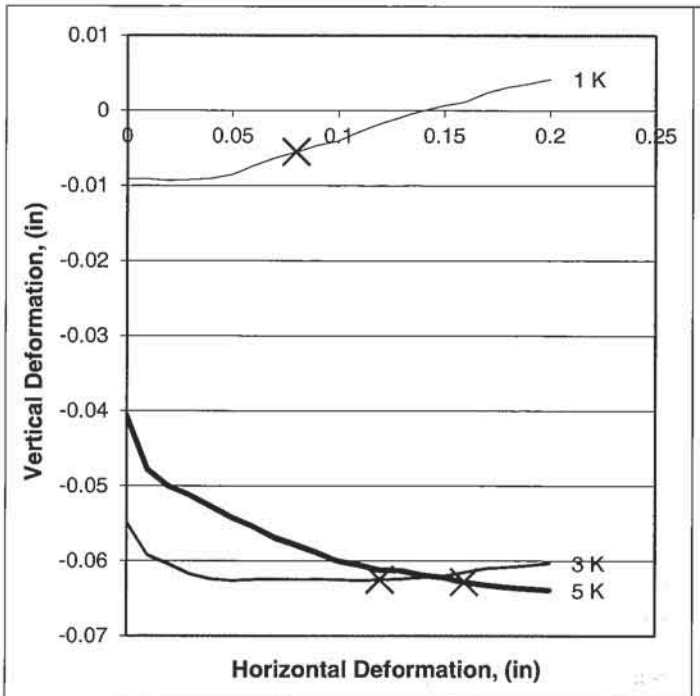
SDG&E TL 649

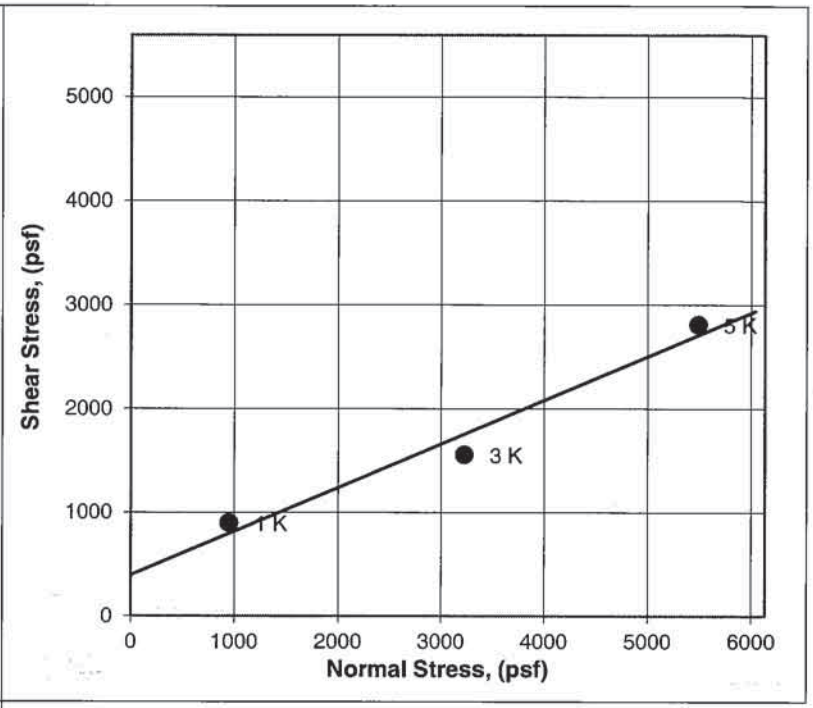
G1115-52-54 **Date:** Tuesday, December 03, 2013 **By:** NJ

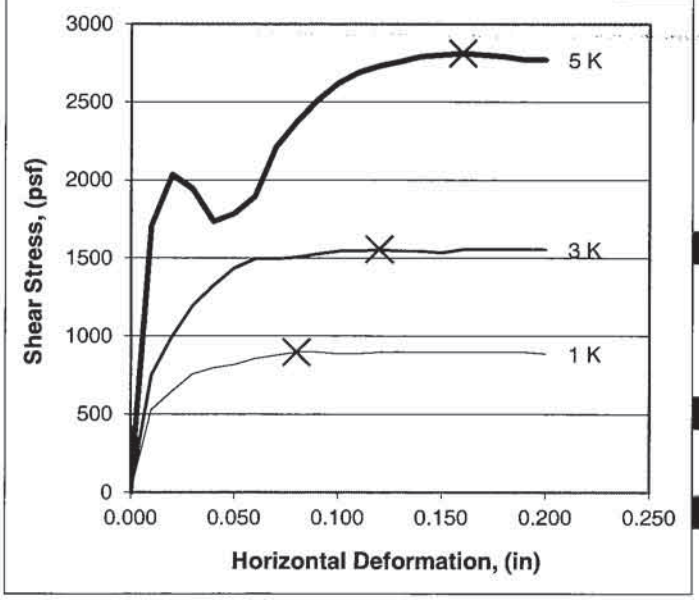
Sample No.: B13-5 **Natural or Remold:** Natural

Description: CL-Pinkish red, Silty CLAY

Remarks:







ϕ (Degrees)	22.9
c (psf)	396
Tan ϕ	0.421
Method	Calc

Load	1 K	3 K	5 K
INITIAL			
Water Content	23.7%	22.9%	24.1%
Dry Density (pcf)	100.4	96.1	97.6
Saturation*	97.1%	84.1%	91.7%
Height (inches)	1.00	1.00	1.00
AFTER TEST			
Water Content	30.3%	30.6%	29.9%
Dry Density (pcf)	100.0	102.2	104.3
FAILURE			
Normal Stress (psf)	952	3228	5494
Failure Stress (psf)	897	1555	2812
Failure Deffinition	Max	Max	Max
Displacement (in)	0.08	0.12	0.16
Rate (in/min)	0.0050	0.0050	0.0050

* Degree of saturation calculated with a specific gravity of 2.65

GEOCON
INCORPORATED

DIRECT SHEAR TEST REPORT

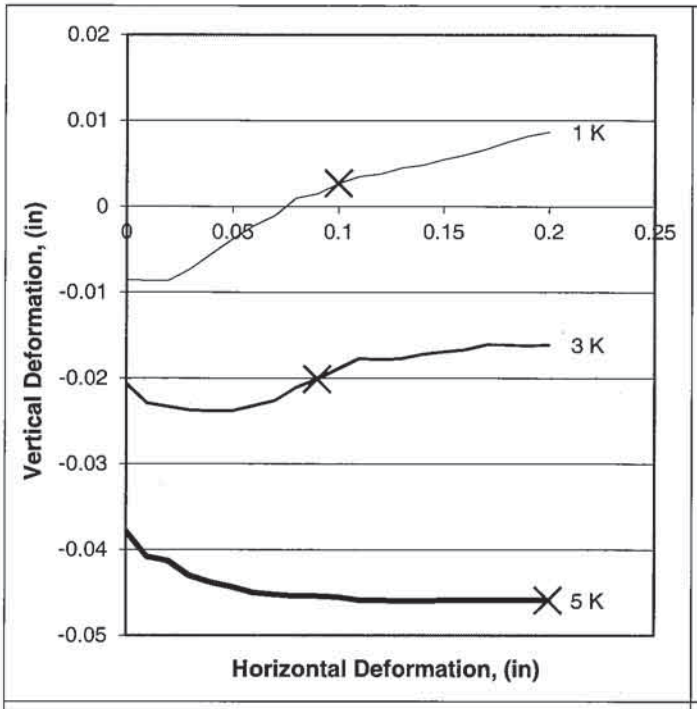
SDG&E TL 649

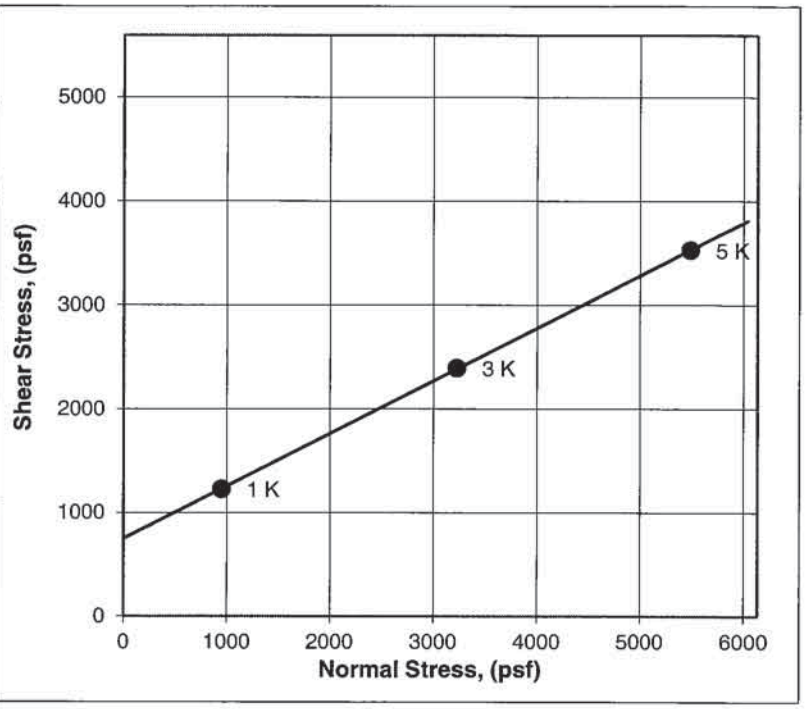
G1115-52-54 **Date:** Tuesday, December 03, 2013 **By:** NJ

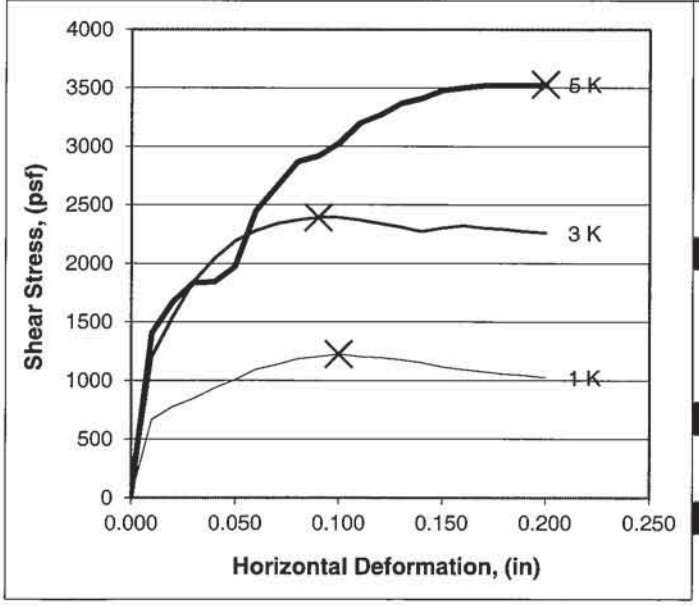
Sample No.: B13-7 **Natural or Remold:** Natural

Description: SM-ML-Light brown, Silty, fine SAND to Sandy SILT

Remarks:







ϕ (Degrees)	26.9
c (psf)	748
Tan ϕ	0.507
Method	Calc

Load	1 K	3 K	5 K
INITIAL			
Water Content	17.5%	19.6%	21.0%
Dry Density (pcf)	111.5	103.7	105.4
Saturation*	96.0%	87.1%	97.6%
Height (inches)	1.00	1.00	1.00
AFTER TEST			
Water Content	22.1%	24.8%	25.8%
Dry Density (pcf)	110.6	105.4	110.5
FAILURE			
Normal Stress (psf)	952	3228	5494
Failure Stress (psf)	1226	2393	3530
Failure Deffinition	Max	Max	Max
Displacement (in)	0.10	0.09	0.20
Rate (in/min)	0.0050	0.0050	0.0050

* Degree of saturation calculated with a specific gravity of 2.65

GEOCON
INCORPORATED

DIRECT SHEAR TEST REPORT

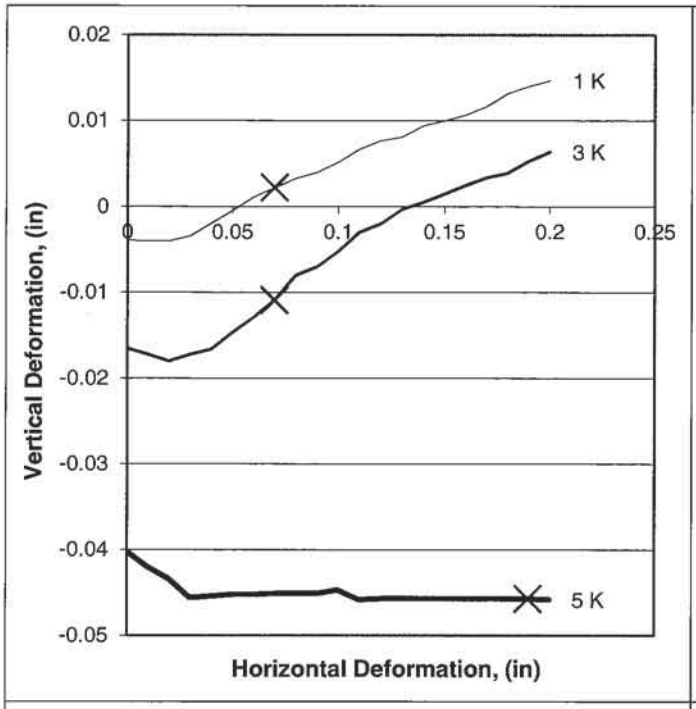
SDG&E TL 649

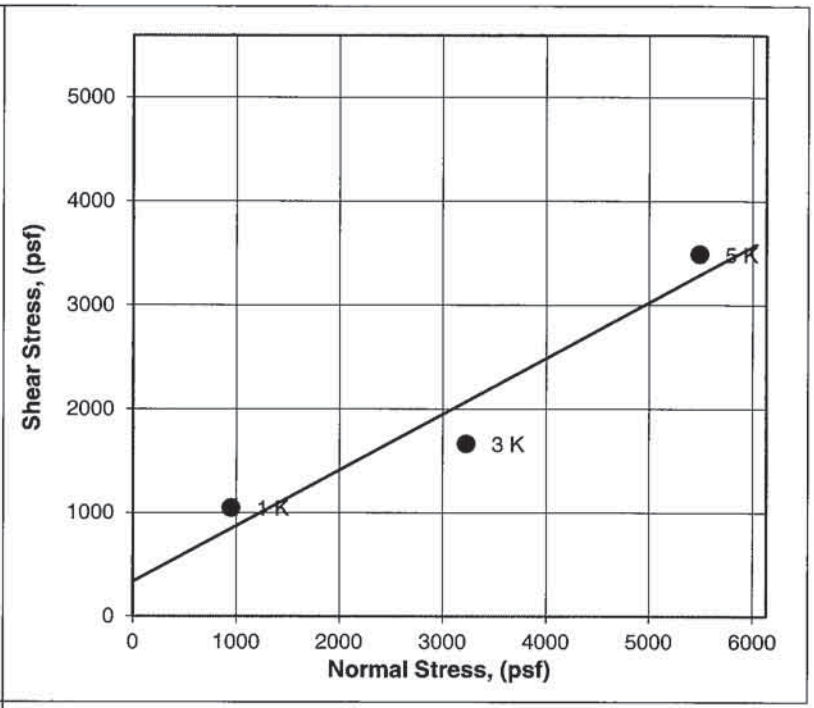
G1115-52-54 **Date:** Tuesday, December 03, 2013 **By:** NJ

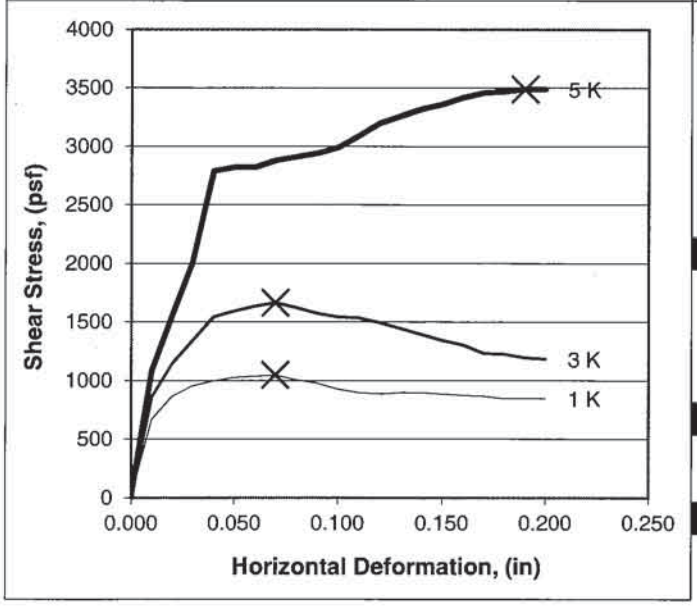
Sample No.: B14-3 **Natural or Remold:** Natural

Description: ML-Olive gray, Sandy SILT

Remarks:







ϕ (Degrees)	28.3
c (psf)	334
Tan ϕ	0.538
Method	Calc

Load	1 K	3 K	5 K
INITIAL			
Water Content	22.1%	20.8%	20.6%
Dry Density (pcf)	104.1	105.6	104.6
Saturation*	99.6%	97.1%	93.6%
Height (inches)	1.00	1.00	1.00
AFTER TEST			
Water Content	27.9%	24.9%	28.5%
Dry Density (pcf)	102.6	104.9	109.6
FAILURE			
Normal Stress (psf)	952	3228	5494
Failure Stress (psf)	1047	1665	3490
Failure Deffinition	Max	Max	Max
Displacement (in)	0.07	0.07	0.19
Rate (in/min)	0.0050	0.0050	0.0050

* Degree of saturation calculated with a specific gravity of 2.65

GEOCON
INCORPORATED

DIRECT SHEAR TEST REPORT

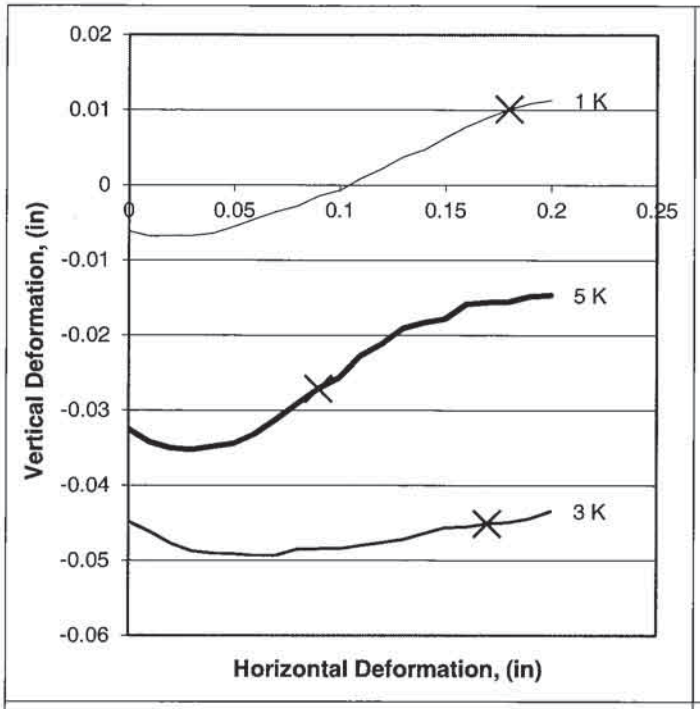
SDG&E TL 649

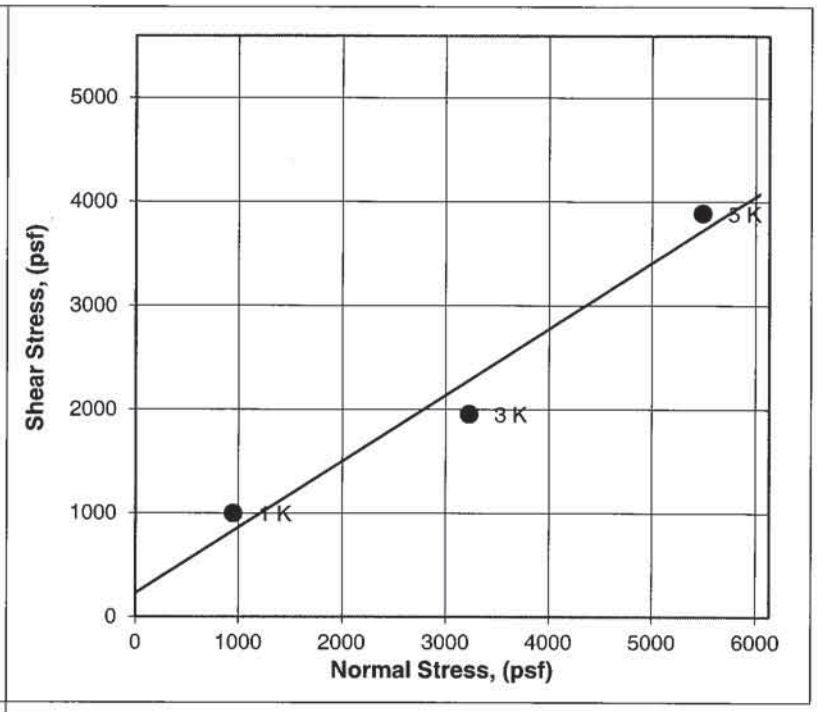
G1115-52-54 **Date:** Sunday, December 03, 2017 **By:** NJ

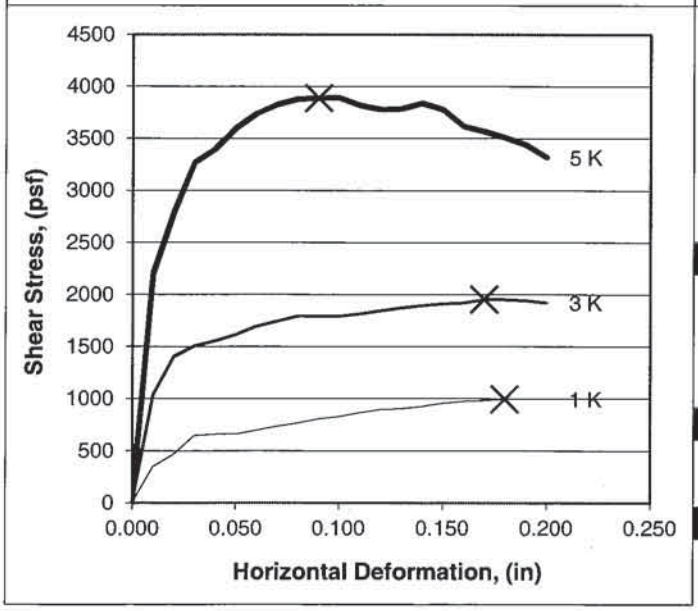
Sample No.: B14-8 **Natural or Remold:** Natural

Description: SM-Light grayish brown, Silty, fine to coarse SAND

Remarks:







ϕ (Degrees)	32.5
c (psf)	228
Tan ϕ	0.637
Method	Calc

Load	1 K	3 K	5 K
INITIAL			
Water Content	15.1%	17.9%	13.7%
Dry Density (pcf)	114.2	109.3	112.3
Saturation*	89.4%	92.6%	76.8%
Height (inches)	1.00	1.00	1.00
AFTER TEST			
Water Content	16.5%	18.7%	16.6%
Dry Density (pcf)	112.9	114.3	114.0
FAILURE			
Normal Stress (psf)	952	3228	5494
Failure Stress (psf)	997	1954	3889
Failure Deffinition	Max	Max	Max
Displacement (in)	0.18	0.17	0.09
Rate (in/min)	0.0100	0.0100	0.0100

* Degree of saturation calculated with a specific gravity of 2.65

GEOCON
INCORPORATED

DIRECT SHEAR TEST REPORT

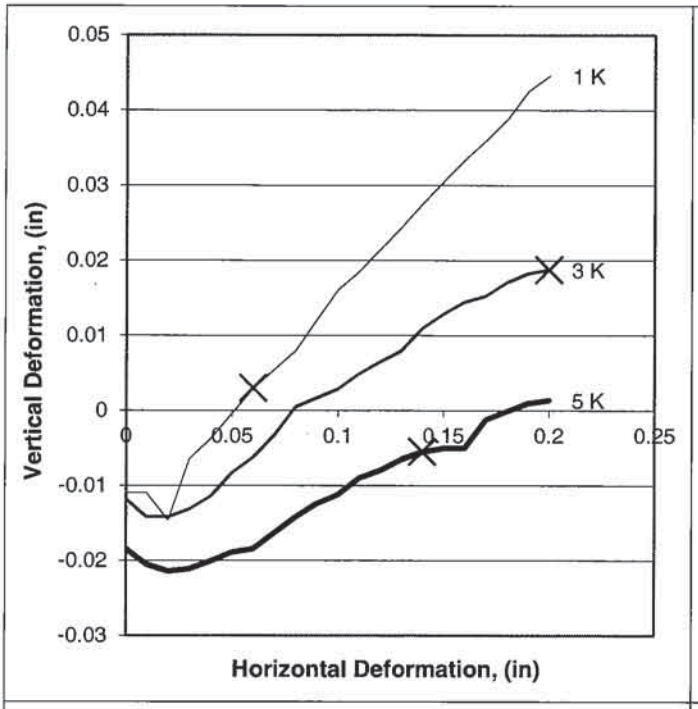
SDG&E TL 649

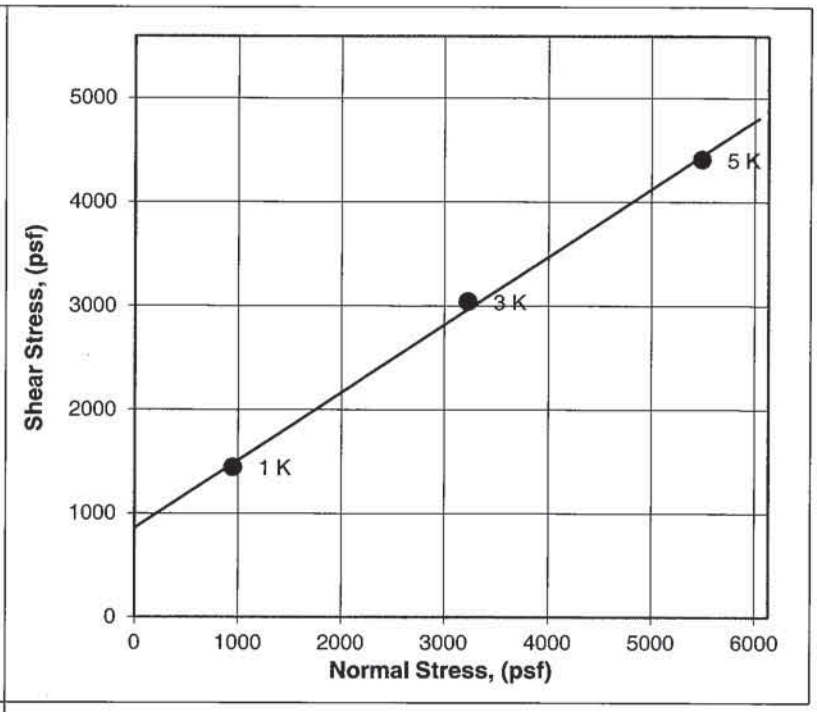
G1115-52-54 **Date:** Tuesday, December 03, 2013 **By:** NJ

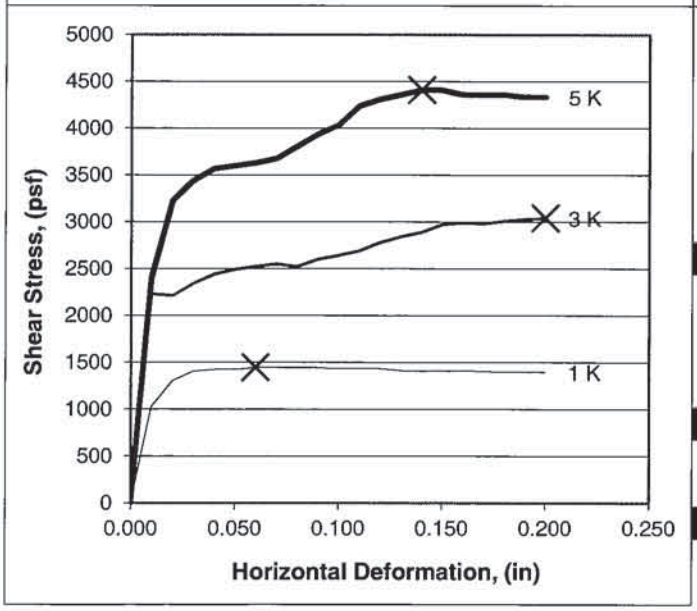
Sample No.: B15-3 **Natural or Remold:** Natural

Description: SC-Olive brown, Clayey SAND

Remarks:







ϕ (Degrees)	33.1
c (psf)	861
Tan ϕ	0.652
Method	Calc

Load	1 K	3 K	5 K
INITIAL			
Water Content	14.8%	15.7%	13.5%
Dry Density (pcf)	114.2	108.1	113.8
Saturation*	87.2%	78.3%	78.5%
Height (inches)	1.00	1.00	1.00
AFTER TEST			
Water Content	18.1%	20.4%	16.8%
Dry Density (pcf)	109.3	106.1	113.6
FAILURE			
Normal Stress (psf)	952	3228	5494
Failure Stress (psf)	1446	3041	4409
Failure Deffinition	Max	Max	Max
Displacement (in)	0.06	0.20	0.14
Rate (in/min)	0.0050	0.0050	0.0050

* Degree of saturation calculated with a specific gravity of 2.65

GEOCON
INCORPORATED

DIRECT SHEAR TEST REPORT

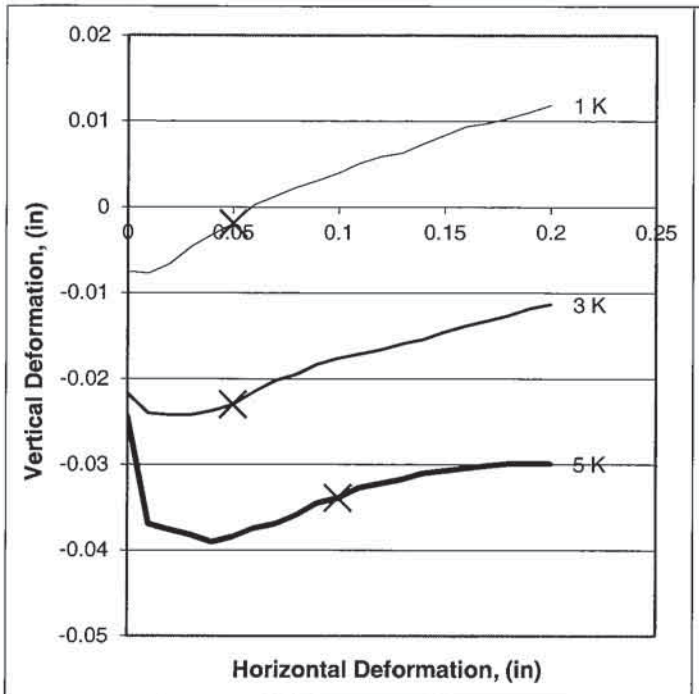
SDG&E TL 649

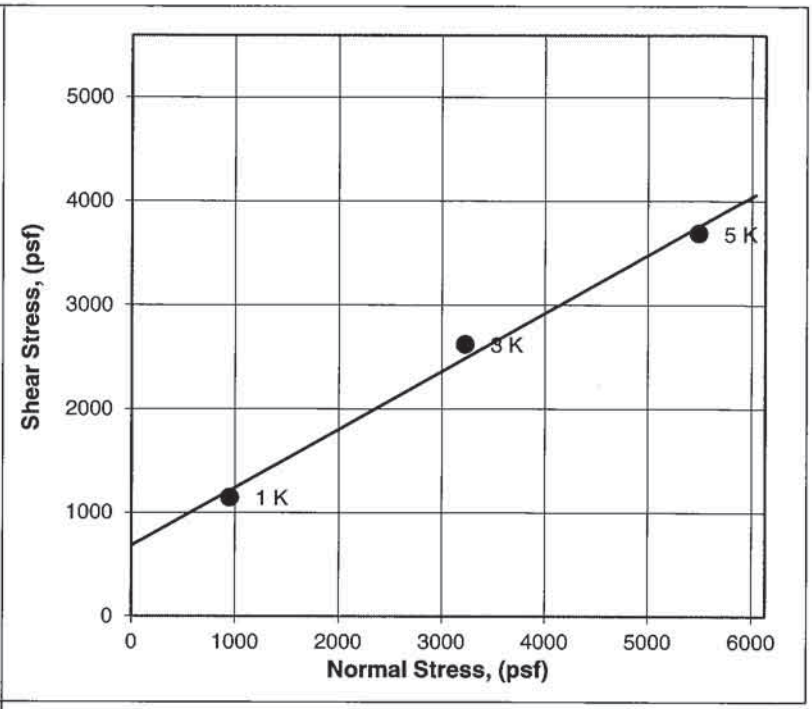
G1115-52-54 **Date:** Tuesday, December 03, 2013 **By:** NJ

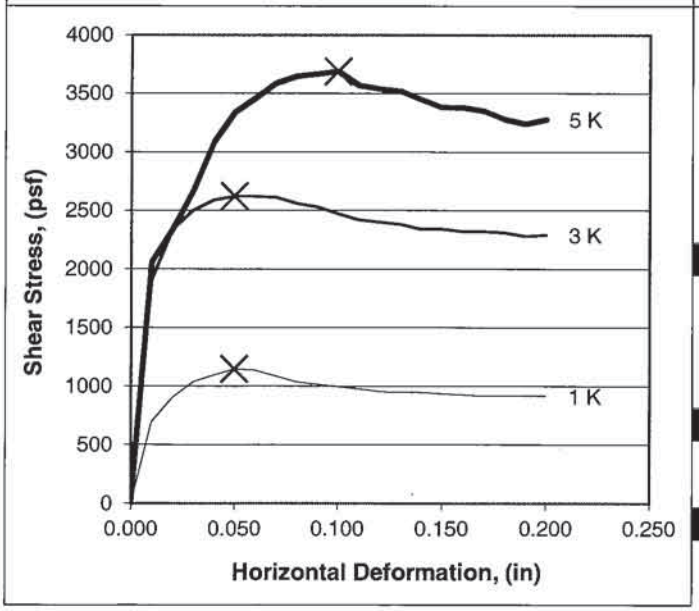
Sample No.: B15-5 **Natural or Remold:** Natural

Description: SC-Olive brown, Clayey, fine to medium SAND

Remarks:







ϕ (Degrees)	29.2
c (psf)	681
Tan ϕ	0.560
Method	Calc

Load	1 K	3 K	5 K
INITIAL			
Water Content	12.1%	17.8%	12.7%
Dry Density (pcf)	113.3	106.4	108.9
Saturation*	69.4%	84.9%	64.9%
Height (inches)	1.00	1.00	1.00
AFTER TEST			
Water Content	18.1%	22.3%	18.2%
Dry Density (pcf)	111.9	107.6	112.2
FAILURE			
Normal Stress (psf)	952	3228	5494
Failure Stress (psf)	1147	2622	3689
Failure Deffinition	Max	Max	Max
Displacement (in)	0.05	0.05	0.10
Rate (in/min)	0.0050	0.0050	0.0050

* Degree of saturation calculated with a specific gravity of 2.65

GEOCON
INCORPORATED

DIRECT SHEAR TEST REPORT

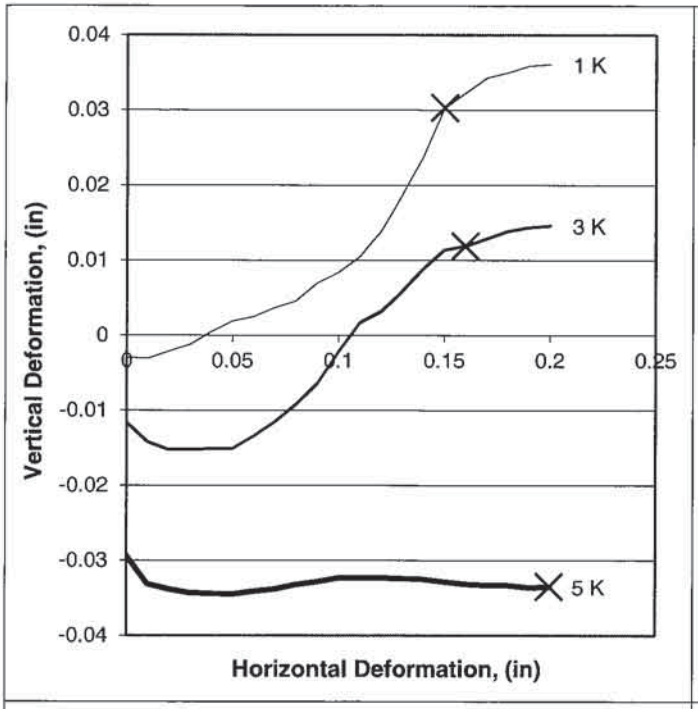
SDG&E TL 649

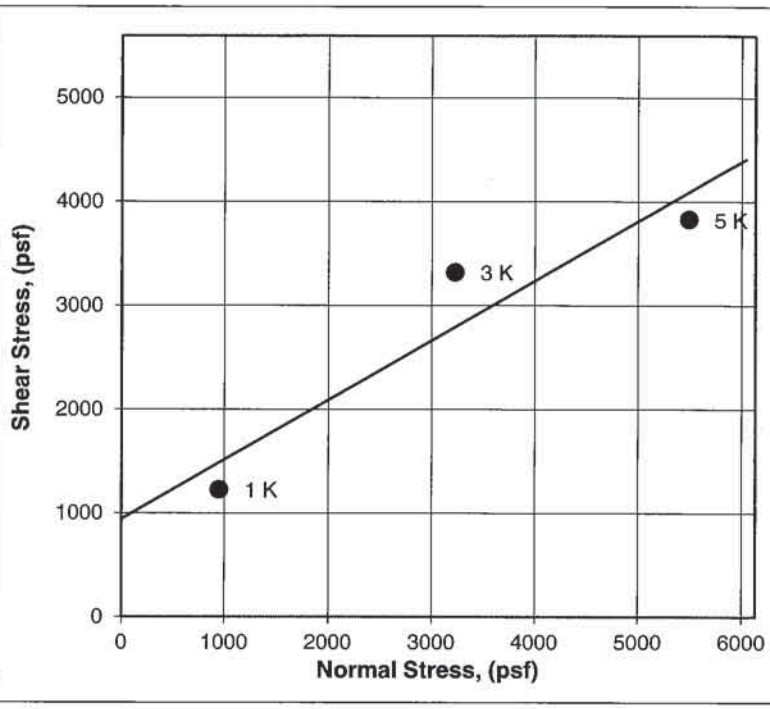
G1115-52-54 **Date:** Monday, December 09, 2013 **By:** NJ

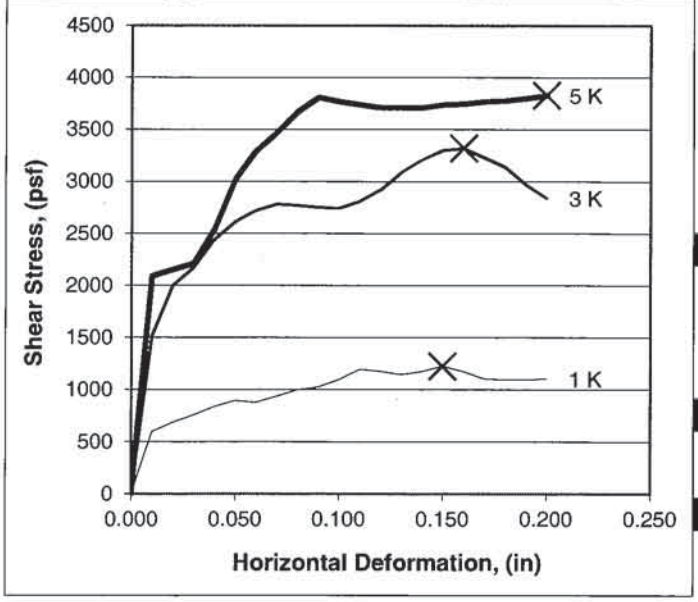
Sample No.: B17-3 **Natural or Remold:** Natural

Description: Olive brown, Clayey SAND

Remarks:







ϕ (Degrees)	29.8
c (psf)	943
Tan ϕ	0.573
Method	Calc

Load	1 K	3 K	5 K
INITIAL			
Water Content	14.6%	15.3%	14.0%
Dry Density (pcf)	114.1	113.7	113.7
Saturation*	86.1%	88.9%	81.5%
Height (inches)	1.00	1.00	1.00
AFTER TEST			
Water Content	17.6%	17.4%	17.2%
Dry Density (pcf)	110.1	112.0	117.6
FAILURE			
Normal Stress (psf)	952	3228	5494
Failure Stress (psf)	1226	3320	3829
Failure Deffinition	Max	Max	Max
Displacement (in)	0.15	0.16	0.20
Rate (in/min)	0.0100	0.0100	0.0100

* Degree of saturation calculated with a specific gravity of 2.65

GEOCON
INCORPORATED

DIRECT SHEAR TEST REPORT

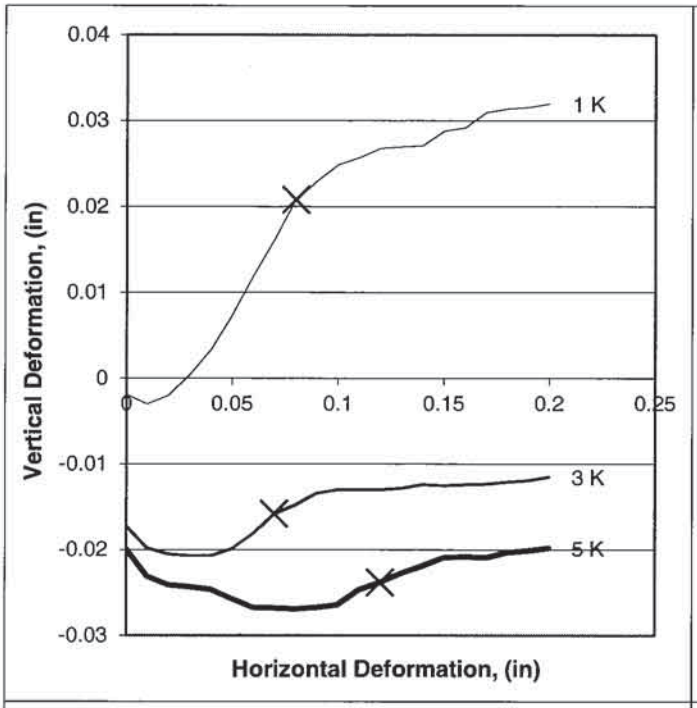
SDG&E TL 649

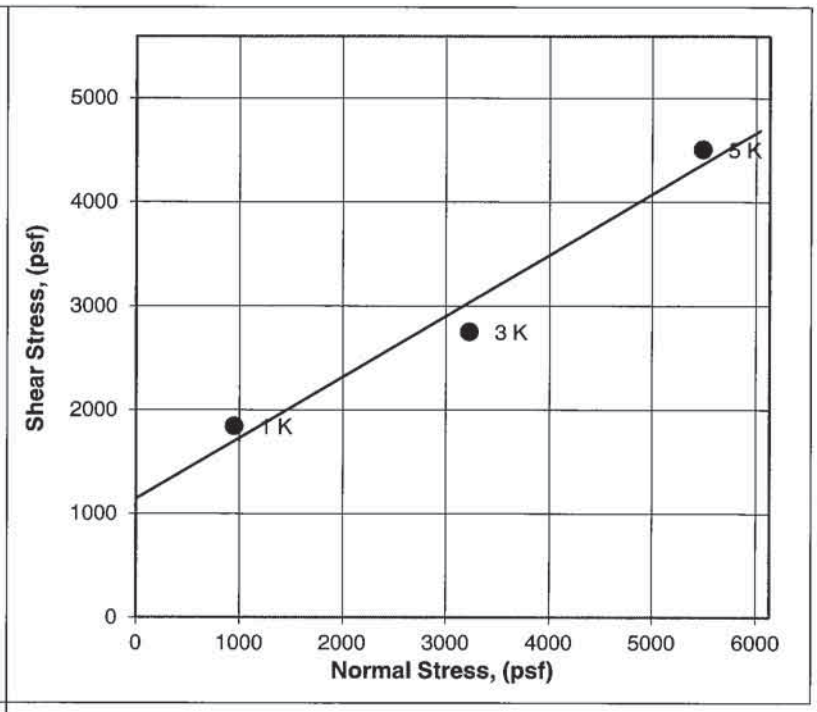
G1115-52-54 **Date:** Monday, December 09, 2013 **By:** NJ

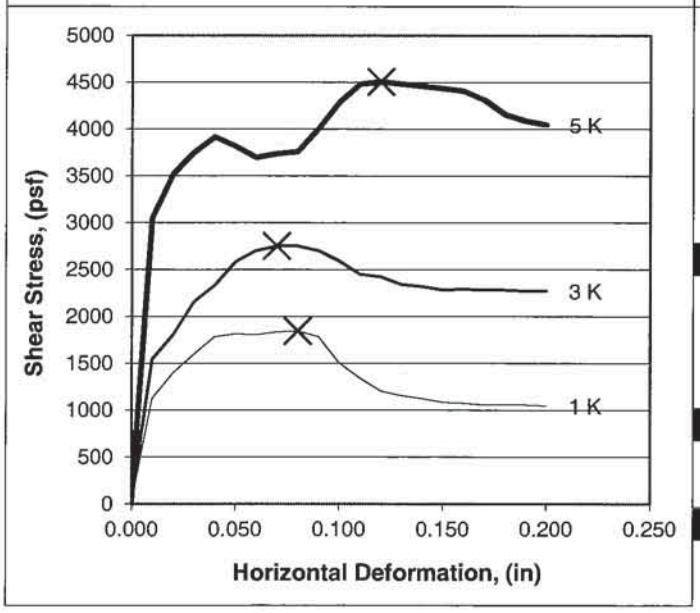
Sample No.: B17-5 **Natural or Remold:** Natural

Description: SC-Dark brown clayey(f-m)sand w/silt.

Remarks:







ϕ (Degrees)	30.4
c (psf)	1145
Tan ϕ	0.586
Method	Calc

Load	1 K	3 K	5 K
INITIAL			
Water Content	13.6%	13.6%	13.5%
Dry Density (pcf)	118.0	115.0	118.0
Saturation*	89.8%	82.2%	88.8%
Height (inches)	1.00	1.00	1.00
AFTER TEST			
Water Content	15.2%	15.8%	14.9%
Dry Density (pcf)	114.3	116.3	120.4
FAILURE			
Normal Stress (psf)	952	3228	5494
Failure Stress (psf)	1845	2752	4506
Failure Deffinition	Max	Max	Max
Displacement (in)	0.08	0.07	0.12
Rate (in/min)	0.0050	0.0050	0.0050

* Degree of saturation calculated with a specific gravity of 2.65

GEOCON
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DIRECT SHEAR TEST REPORT

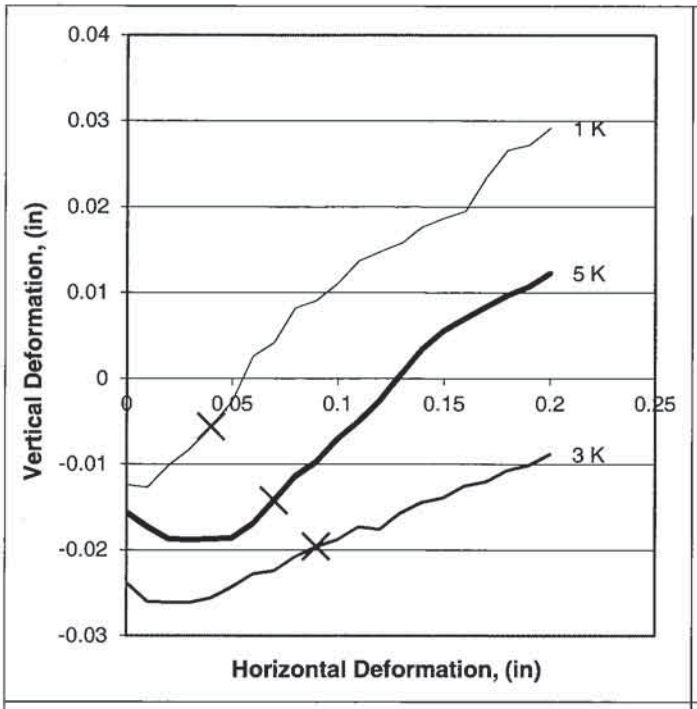
SDG&E TL 649

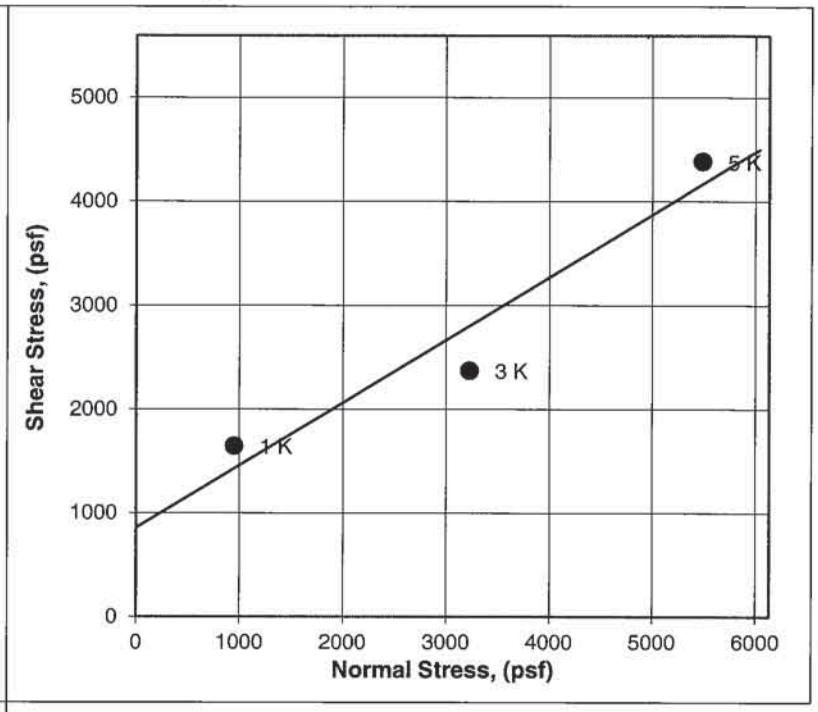
G1115-52-54 **Date:** Thursday, December 12, 2013 **By:** NJ

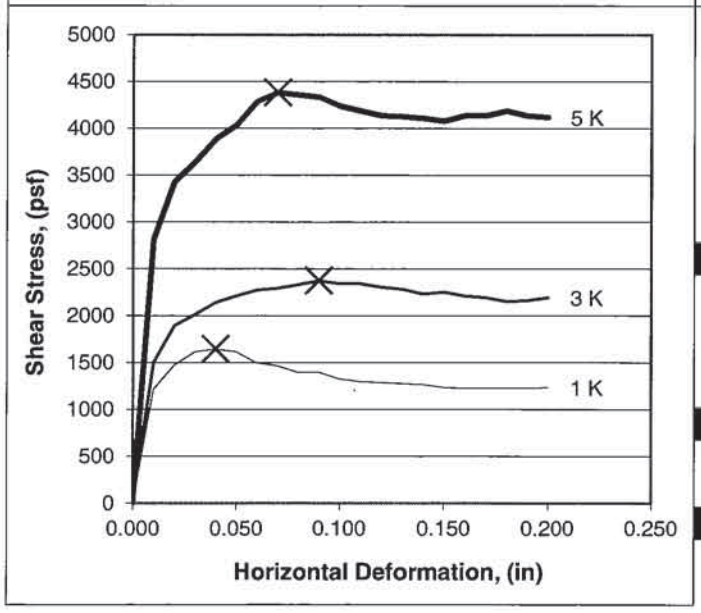
Sample No.: B18-2@5' **Natural or Remold:** Natural

Description: SC-Yellowish brown clayey(f-m)sand w/silt.

Remarks:







ϕ (Degrees)	31.1
c (psf)	857
Tan ϕ	0.603
Method	Calc

Load	1 K	3 K	5 K
INITIAL			
Water Content	10.9%	11.4%	10.9%
Dry Density (pcf)	118.1	115.9	117.2
Saturation*	71.7%	70.9%	70.4%
Height (inches)	1.00	1.00	1.00
AFTER TEST			
Water Content	15.1%	17.5%	14.6%
Dry Density (pcf)	114.7	116.9	115.8
FAILURE			
Normal Stress (psf)	952	3228	5494
Failure Stress (psf)	1645	2373	4384
Failure Deffinition	Max	Max	Max
Displacement (in)	0.04	0.09	0.07
Rate (in/min)	0.0050	0.0050	0.0050

* Degree of saturation calculated with a specific gravity of 2.65

GEOCON
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DIRECT SHEAR TEST REPORT

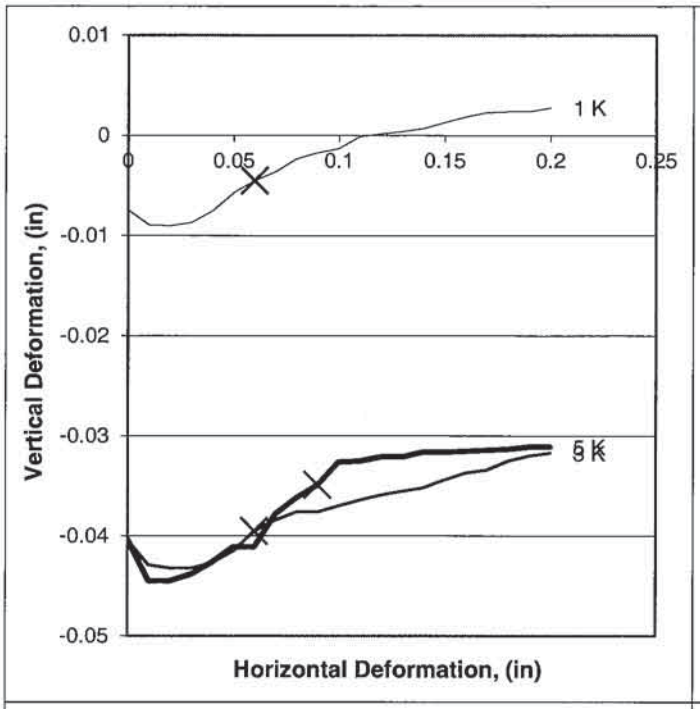
SDG&E TL 649

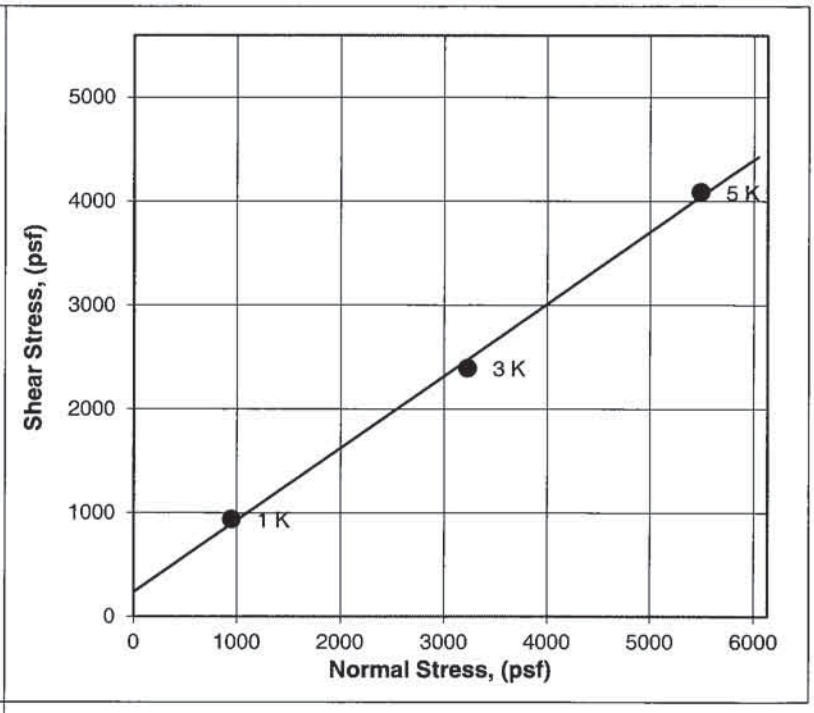
G1115-52-54 **Date:** Wednesday, December 04, 2013 **By:** NJ

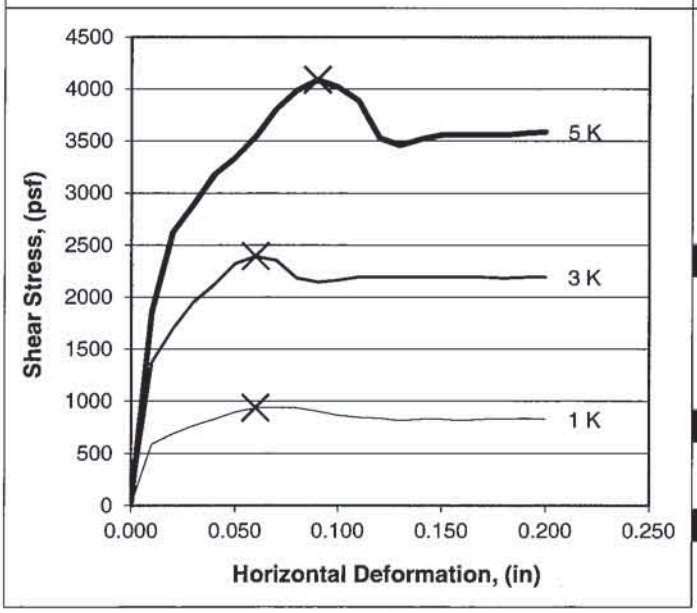
Sample No.: B19-3@10' **Natural or Remold:** Natural

Description: SM-Light yellowish to grayish brown, Silty, fine to coarse SAND

Remarks:







ϕ (Degrees)	34.8
c (psf)	236
Tan ϕ	0.694
Method	Calc

Load	1 K	3 K	5 K
INITIAL			
Water Content	9.6%	9.4%	8.7%
Dry Density (pcf)	118.8	115.9	113.0
Saturation*	64.6%	58.4%	49.5%
Height (inches)	1.00	1.00	1.00
AFTER TEST			
Water Content	18.8%	18.2%	19.3%
Dry Density (pcf)	118.5	119.7	116.6
FAILURE			
Normal Stress (psf)	952	3228	5494
Failure Stress (psf)	937	2393	4088
Failure Deffinition	Max	Max	Max
Displacement (in)	0.06	0.06	0.09
Rate (in/min)	0.0100	0.0100	0.0100

* Degree of saturation calculated with a specific gravity of 2.65

GEOCON
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DIRECT SHEAR TEST REPORT

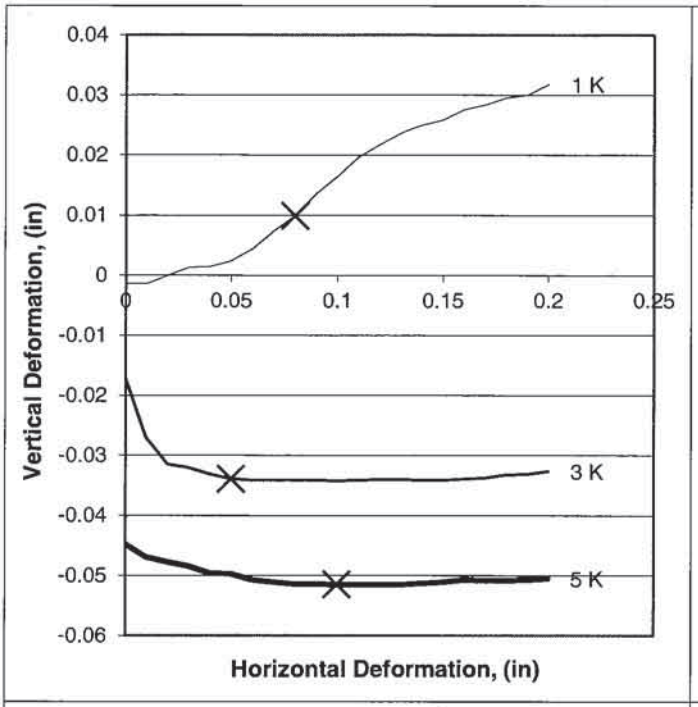
SDG&E TL 649

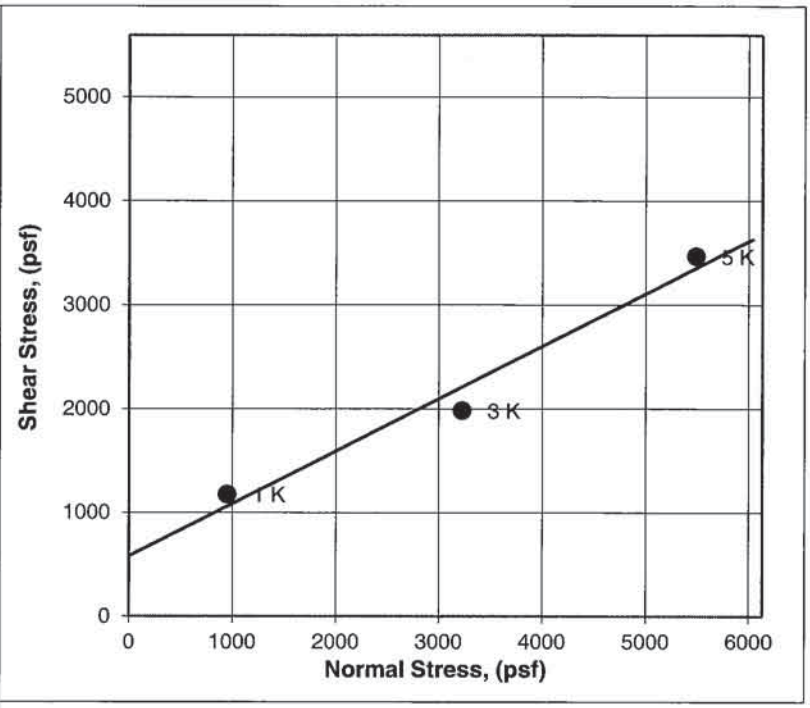
G1115-52-54 **Date:** Wednesday, December 04, 2013 **By:** NJ

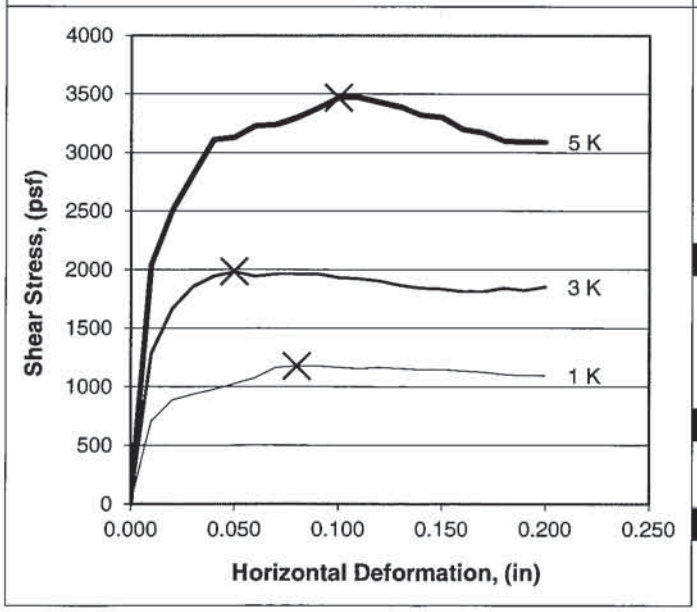
Sample No.: B19-5@20' **Natural or Remold:** Natural

Description: SC-Light brown clayey(f-m)sand w/silt.

Remarks:







ϕ (Degrees)	26.8
c (psf)	582
Tan ϕ	0.505
Method	Calc

Load	1 K	3 K	5 K
INITIAL			
Water Content	10.3%	9.8%	11.4%
Dry Density (pcf)	124.1	115.7	116.6
Saturation*	81.6%	60.4%	71.9%
Height (inches)	1.00	1.00	1.00
AFTER TEST			
Water Content	16.4%	19.0%	19.5%
Dry Density (pcf)	120.3	119.6	122.8
FAILURE			
Normal Stress (psf)	952	3228	5494
Failure Stress (psf)	1177	1984	3470
Failure Deffinition	Max	Max	Max
Displacement (in)	0.08	0.05	0.10
Rate (in/min)	0.0100	0.0100	0.0100

* Degree of saturation calculated with a specific gravity of 2.65

GEOCON
INCORPORATED

DIRECT SHEAR TEST REPORT

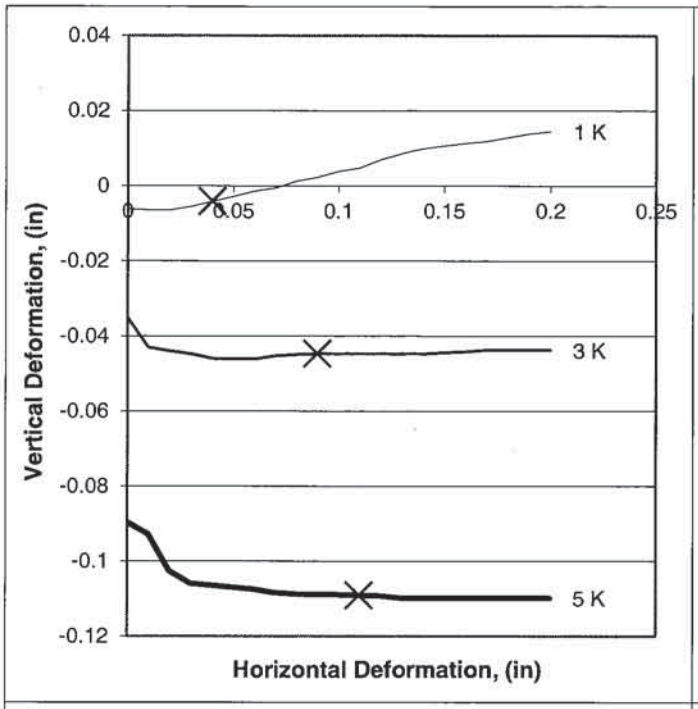
SDG&E TL 649

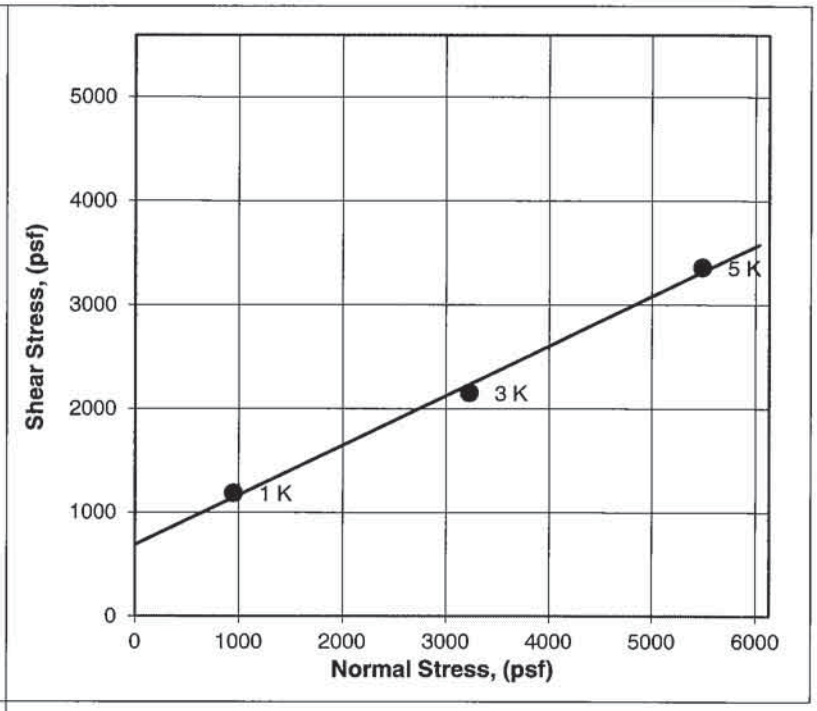
G1115-52-54 **Date:** Wednesday, December 04, 2013 **By:** NJ

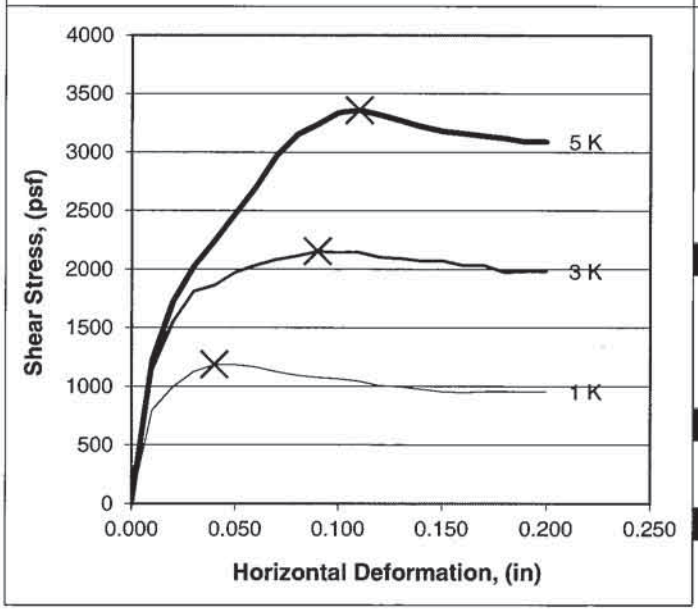
Sample No.: B19-7@30' **Natural or Remold:** Natural

Description: Olive to grayish brown, Sandy SILT

Remarks:







ϕ (Degrees)	25.6
c (psf)	690
Tan ϕ	0.479
Method	Calc

Load	1 K	3 K	5 K
INITIAL			
Water Content	13.2%	13.5%	14.2%
Dry Density (pcf)	120.0	121.2	117.9
Saturation*	92.4%	97.8%	93.0%
Height (inches)	1.00	1.00	1.00
AFTER TEST			
Water Content	19.0%	21.4%	22.8%
Dry Density (pcf)	118.3	126.7	132.4
FAILURE			
Normal Stress (psf)	952	3228	5494
Failure Stress (psf)	1187	2154	3360
Failure Deffinition	Max	Max	Max
Displacement (in)	0.04	0.09	0.11
Rate (in/min)	0.0050	0.0050	0.0050

* Degree of saturation calculated with a specific gravity of 2.65

GEOCON
INCORPORATED

DIRECT SHEAR TEST REPORT

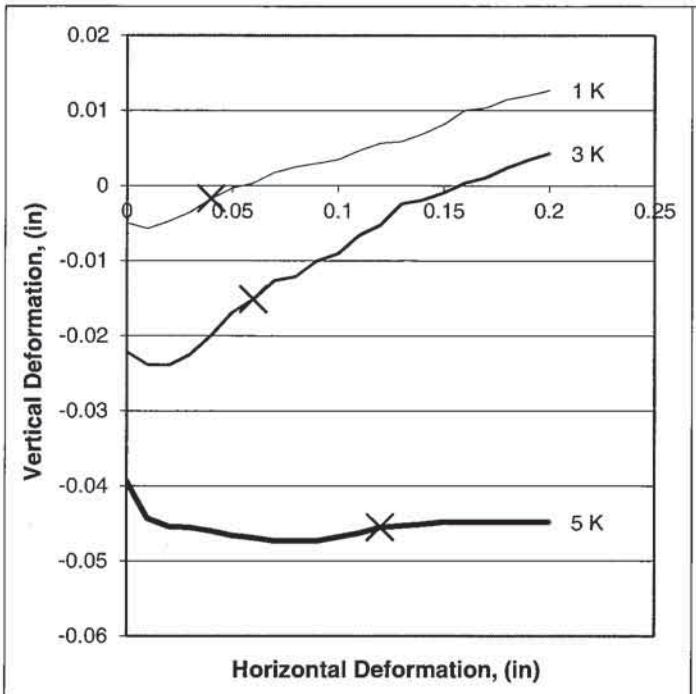
SDG&E TL 649

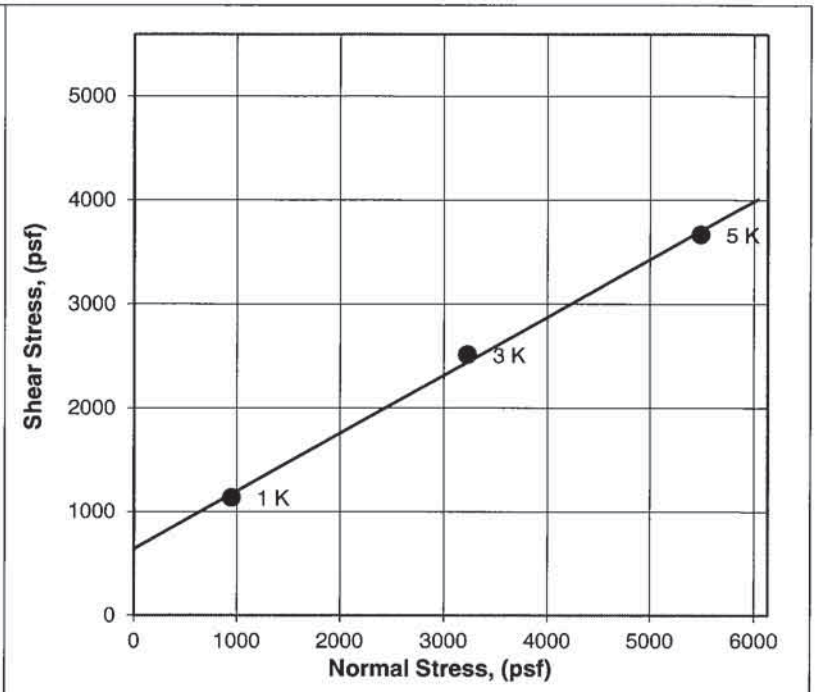
G1115-52-54 **Date:** Wednesday, December 04, 2013 **By:** NJ

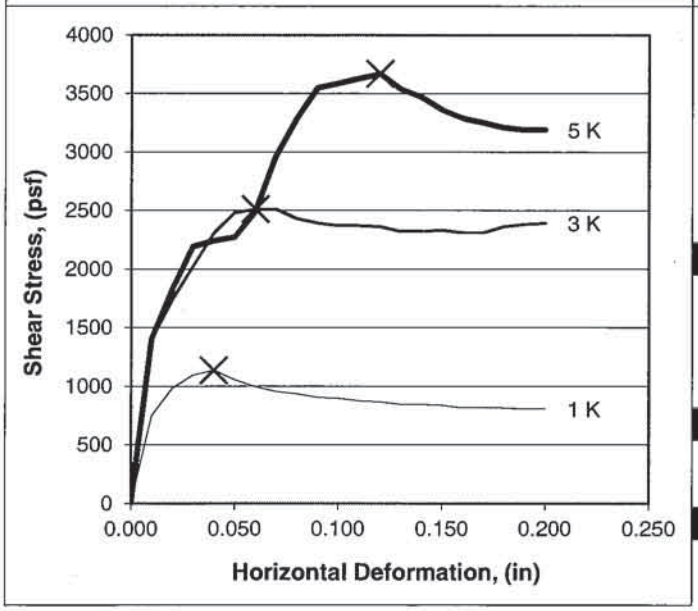
Sample No.: B21@1 **Natural or Remold:** Natural

Description: SM-Brown silty(f-m)sand w/clay.

Remarks:







ϕ (Degrees)	29.1
c (psf)	641
Tan ϕ	0.558
Method	Calc

Load	1 K	3 K	5 K
INITIAL			
Water Content	17.9%	17.5%	19.2%
Dry Density (pcf)	105.3	98.1	99.3
Saturation*	82.9%	67.7%	76.5%
Height (inches)	1.00	1.00	1.00
AFTER TEST			
Water Content	25.5%	25.2%	27.4%
Dry Density (pcf)	103.9	97.7	104.0
FAILURE			
Normal Stress (psf)	952	3228	5494
Failure Stress (psf)	1137	2513	3669
Failure Deffinition	Max	Max	Max
Displacement (in)	0.04	0.06	0.12
Rate (in/min)	0.0100	0.0100	0.0100

* Degree of saturation calculated with a specific gravity of 2.65

GEOCON
INCORPORATED

DIRECT SHEAR TEST REPORT

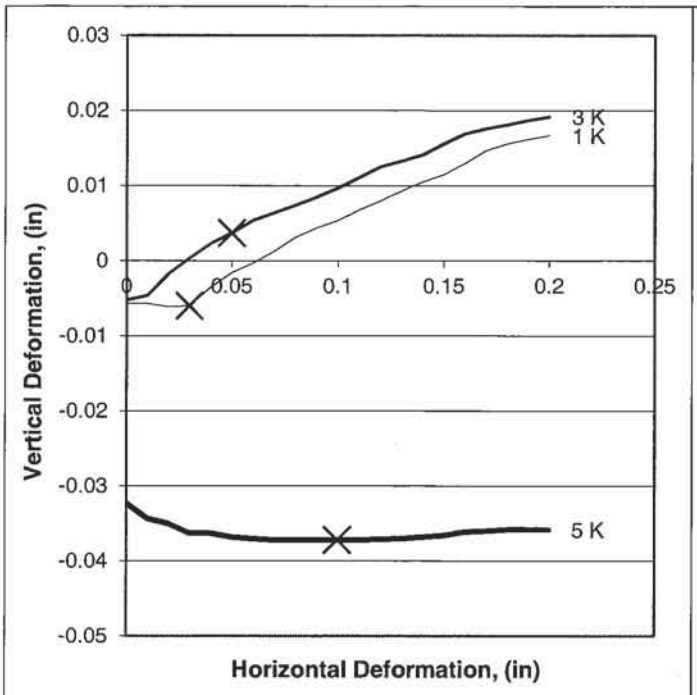
SDG&E TL 649

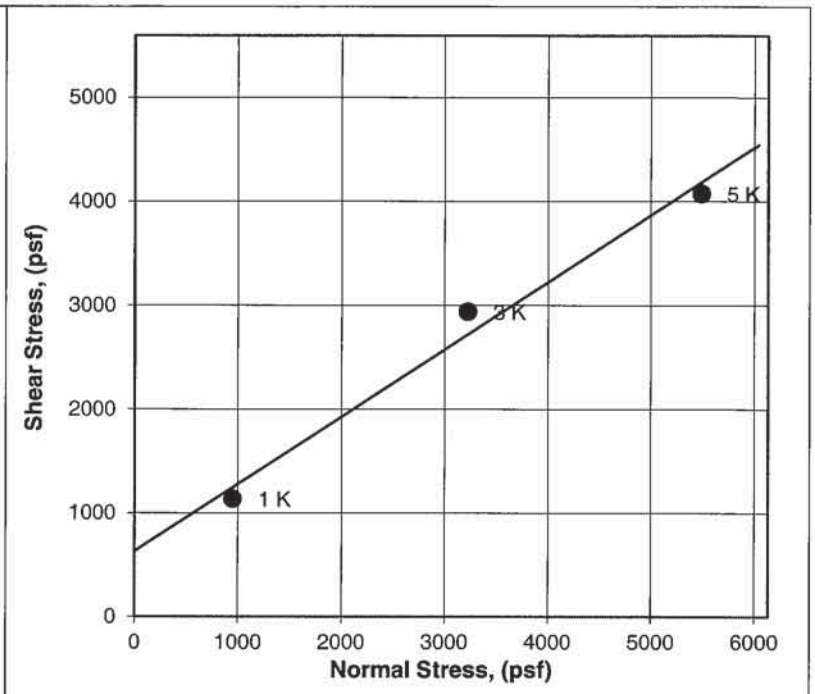
G1115-52-54 **Date:** Friday, December 06, 2013 **By:** NJ

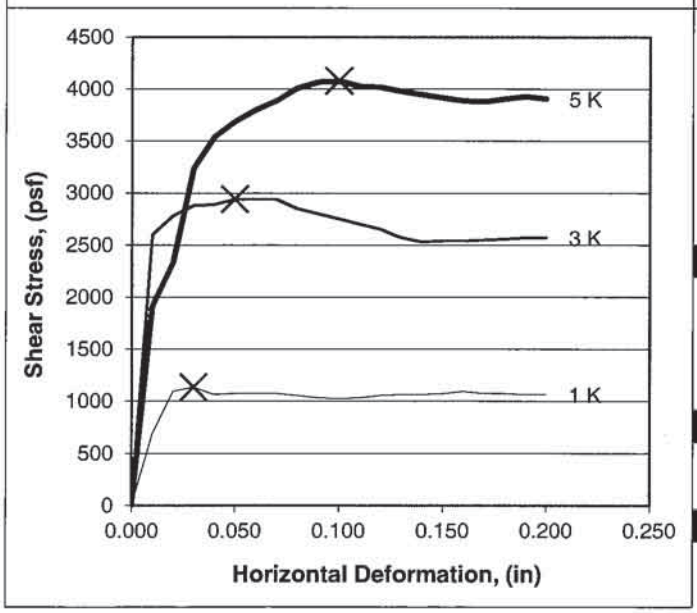
Sample No.: B21-4 **Natural or Remold:** Natural

Description: ML-Olive brown(f-m)sandy silt.

Remarks:







ϕ (Degrees)	32.9
c (psf)	630
Tan ϕ	0.648
Method	Calc

Load	1 K	3 K	5 K
INITIAL			
Water Content	13.8%	14.2%	18.6%
Dry Density (pcf)	100.7	99.9	95.8
Saturation*	57.0%	57.4%	67.7%
Height (inches)	1.00	1.00	1.00
AFTER TEST			
Water Content	22.8%	22.1%	27.6%
Dry Density (pcf)	99.0	98.0	99.4
FAILURE			
Normal Stress (psf)	952	3228	5494
Failure Stress (psf)	1137	2941	4078
Failure Deffinition	Max	Max	Max
Displacement (in)	0.03	0.05	0.10
Rate (in/min)	0.0050	0.0050	0.0050

* Degree of saturation calculated with a specific gravity of 2.65

GEOCON
INCORPORATED

DIRECT SHEAR TEST REPORT

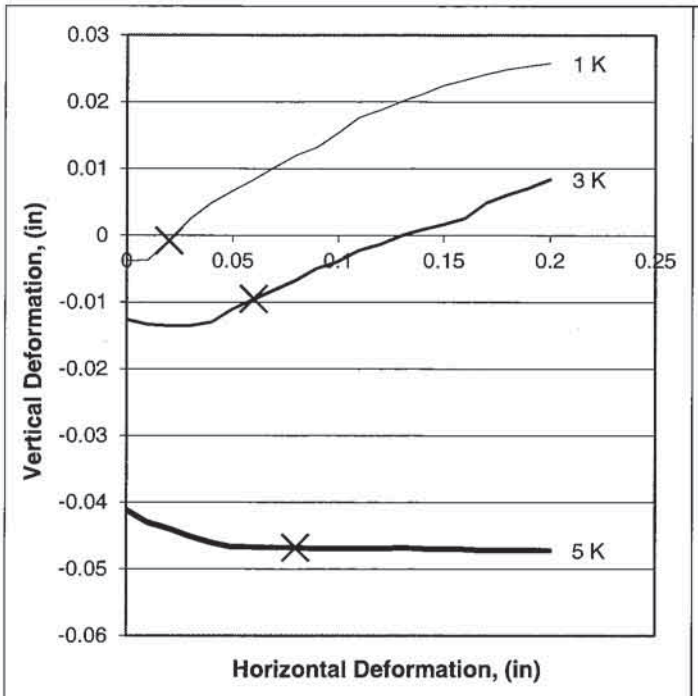
SDG&E TL 649

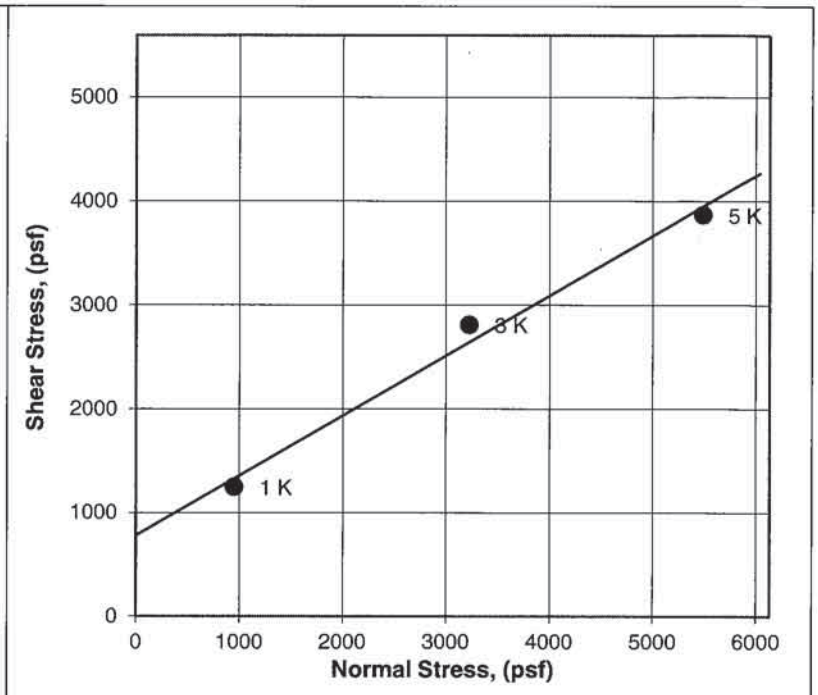
G1115-52-54 **Date:** Friday, December 06, 2013 **By:** NJ

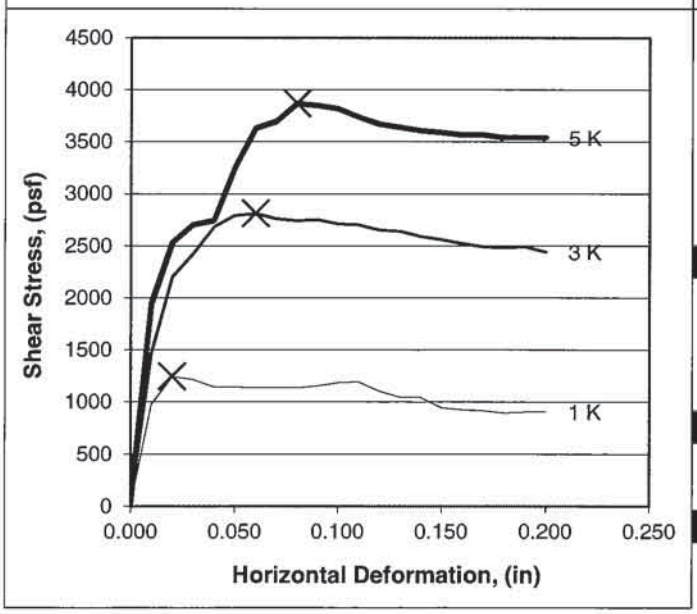
Sample No.: B21-8 **Natural or Remold:** Natural

Description: SM-Gray, Silty fine SAND

Remarks:







ϕ (Degrees)	30.0
c (psf)	780
Tan ϕ	0.577
Method	Calc

Load	1 K	3 K	5 K
INITIAL			
Water Content	21.7%	21.5%	21.8%
Dry Density (pcf)	104.7	103.0	103.5
Saturation*	99.0%	93.8%	96.8%
Height (inches)	1.00	1.00	1.00
AFTER TEST			
Water Content	24.2%	23.4%	24.3%
Dry Density (pcf)	102.0	102.2	108.7
FAILURE			
Normal Stress (psf)	952	3228	5494
Failure Stress (psf)	1246	2812	3869
Failure Deffinition	Max	Max	Max
Displacement (in)	0.02	0.06	0.08
Rate (in/min)	0.0050	0.0050	0.0050

* Degree of saturation calculated with a specific gravity of 2.65

GEOCON
INCORPORATED

DIRECT SHEAR TEST REPORT

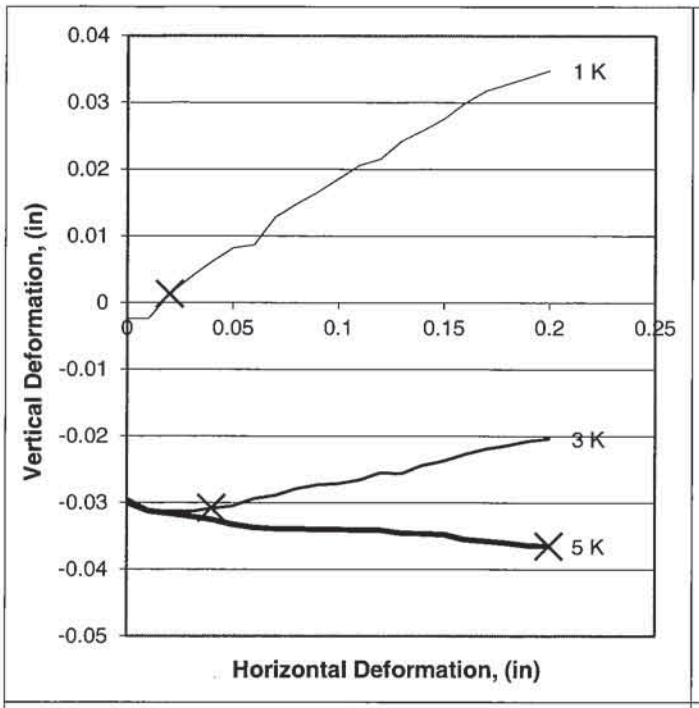
SDG&E TL 649

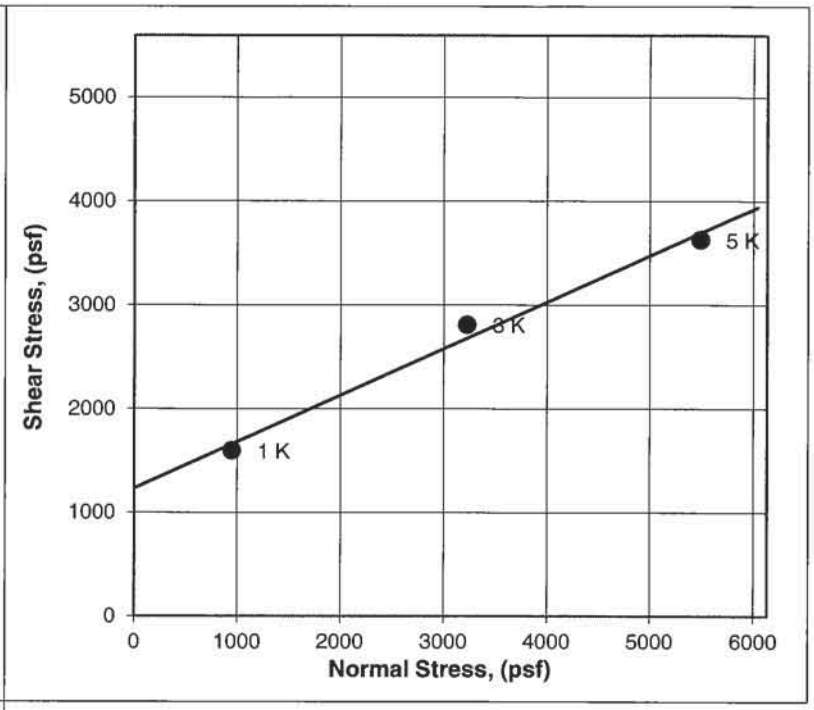
G1115-52-54 **Date:** Friday, December 06, 2013 **By:** NJ

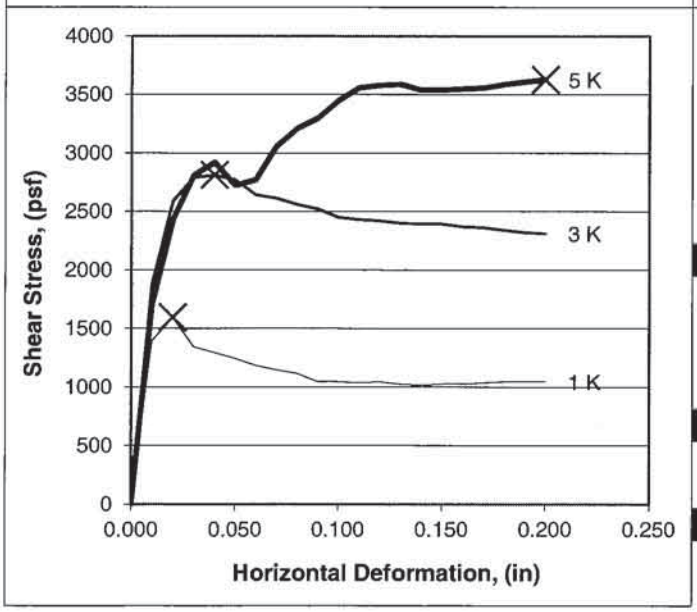
Sample No.: B22-6 **Natural or Remold:** Natural

Description: ML-Olive brown clayey silt w/fine sand.

Remarks:







ϕ (Degrees)	24.1
c (psf)	1234
Tan ϕ	0.448
Method	Calc

Load	1 K	3 K	5 K
INITIAL			
Water Content	22.8%	36.7%	34.8%
Dry Density (pcf)	97.7	83.0	87.5
Saturation*	87.1%	97.8%	103.4%
Height (inches)	1.00	1.00	1.00
AFTER TEST			
Water Content	30.5%	46.5%	40.9%
Dry Density (pcf)	94.4	84.7	90.8
FAILURE			
Normal Stress (psf)	952	3228	5494
Failure Stress (psf)	1595	2812	3629
Failure Deffinition	Max	Max	Max
Displacement (in)	0.02	0.04	0.20
Rate (in/min)	0.0050	0.0050	0.0050

* Degree of saturation calculated with a specific gravity of 2.65

GEOCON
INCORPORATED

DIRECT SHEAR TEST REPORT

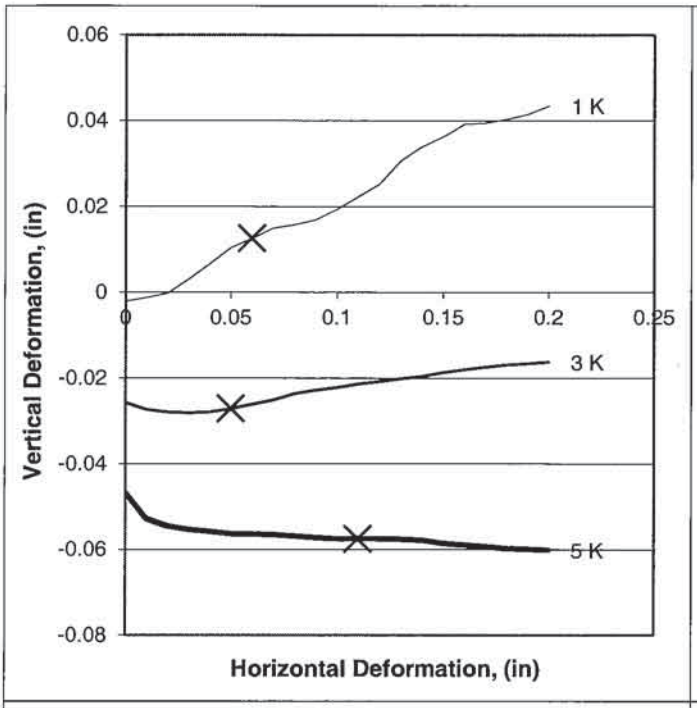
SDG&E TL 649

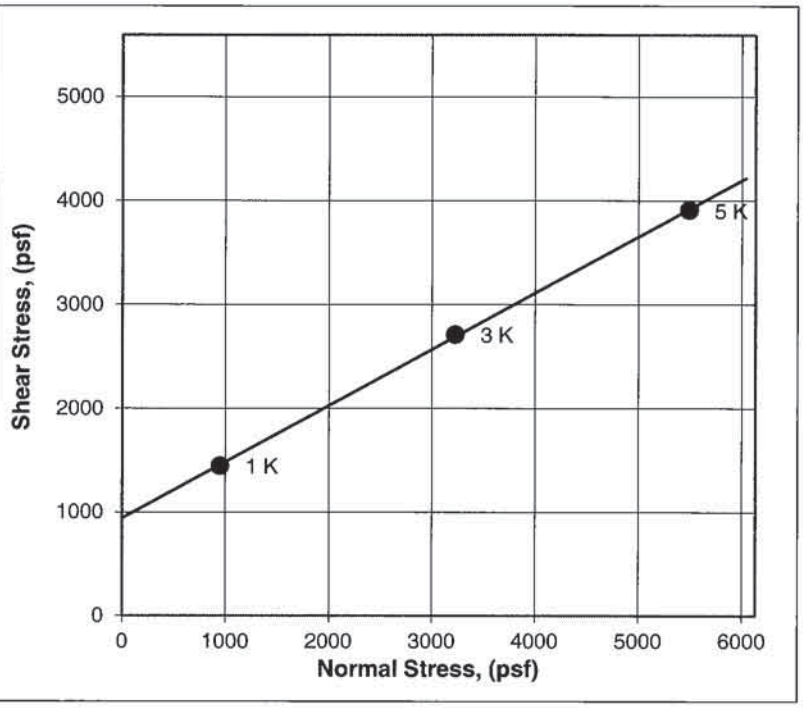
G1115-52-54 **Date:** Friday, December 06, 2013 **By:** NJ

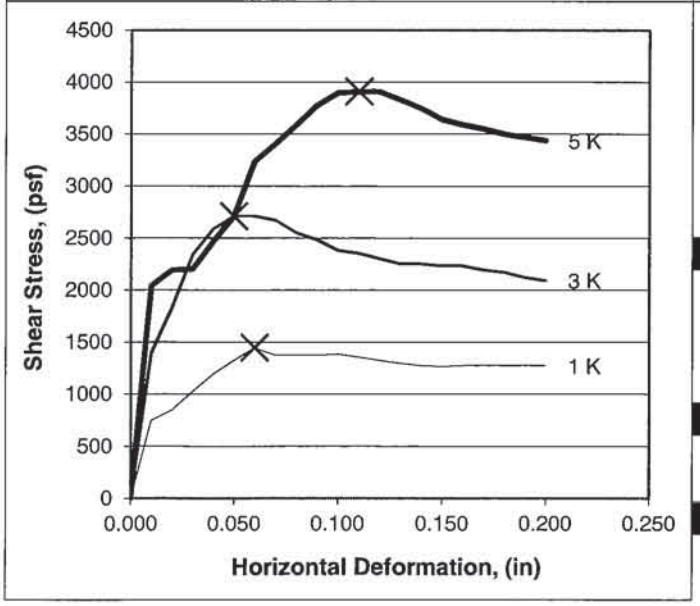
Sample No.: B-22-8 **Natural or Remold:** Natural

Description: ML-Grey brown fine sandy silt w/little clay.

Remarks:







ϕ (Degrees)	28.5
c (psf)	940
Tan ϕ	0.542
Method	Calc

Load	1 K	3 K	5 K
INITIAL			
Water Content	29.0%	49.5%	36.9%
Dry Density (pcf)	89.2	70.4	81.9
Saturation*	89.9%	97.1%	95.7%
Height (inches)	1.00	1.00	1.00
AFTER TEST			
Water Content	34.4%	56.2%	43.5%
Dry Density (pcf)	85.5	71.6	87.1
FAILURE			
Normal Stress (psf)	952	3228	5494
Failure Stress (psf)	1446	2712	3909
Failure Deffinition	Max	Max	Max
Displacement (in)	0.06	0.05	0.11
Rate (in/min)	0.0050	0.0050	0.0050

* Degree of saturation calculated with a specific gravity of 2.65

GEOCON
INCORPORATED

DIRECT SHEAR TEST REPORT

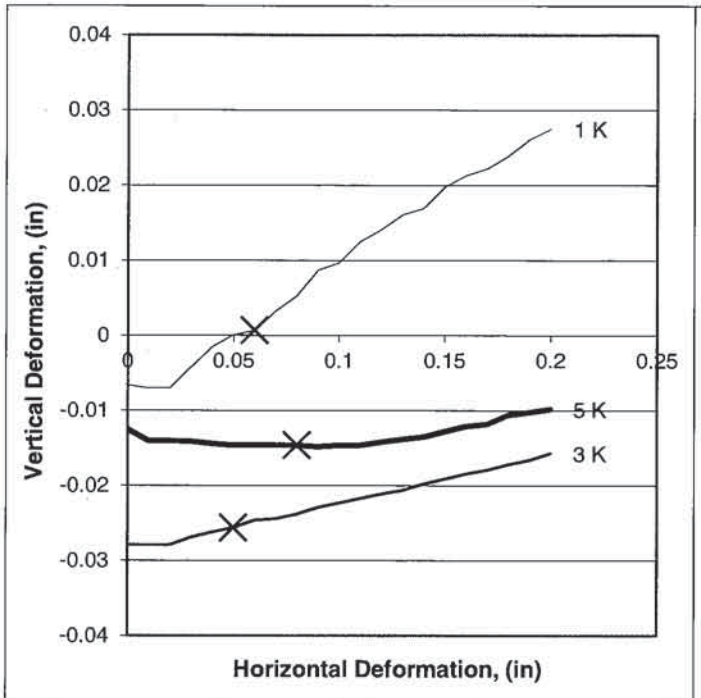
SDG&E TL 649

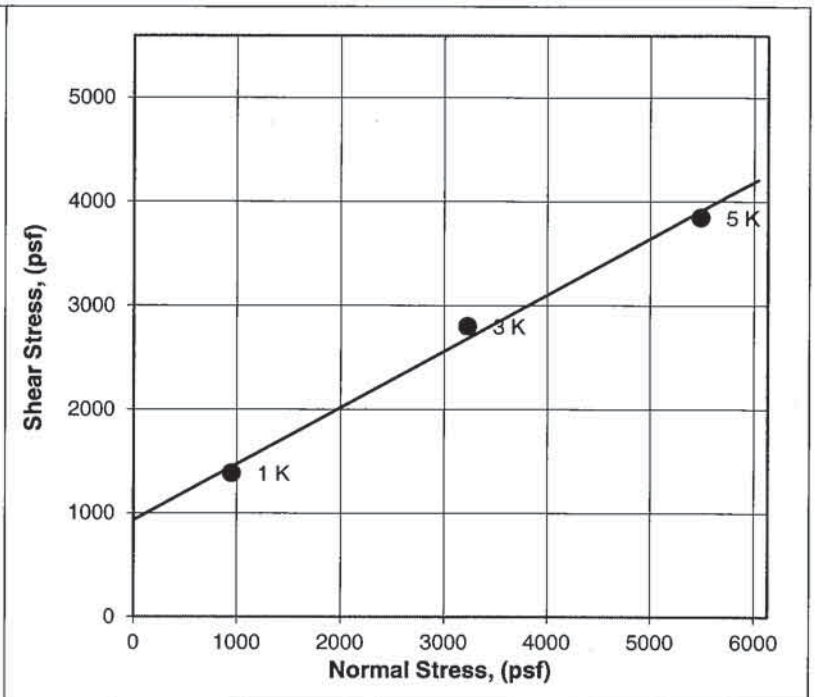
G1115-52-54 **Date:** Thursday, December 12, 2013 **By:** NJ

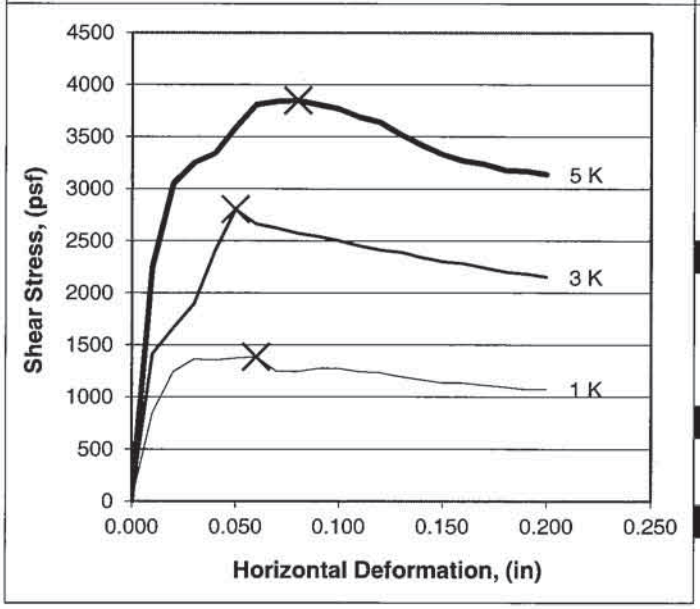
Sample No.: B23-3 **Natural or Remold:** Natural

Description: ML-Olive gray(f-m)sandy silt.

Remarks:







ϕ (Degrees)	28.5
c (psf)	930
Tan ϕ	0.542
Method	Calc

Load	1 K	3 K	5 K
INITIAL			
Water Content	17.3%	18.7%	19.2%
Dry Density (pcf)	106.3	99.2	98.3
Saturation*	82.4%	74.4%	74.3%
Height (inches)	1.00	1.00	1.00
AFTER TEST			
Water Content	19.5%	19.5%	22.1%
Dry Density (pcf)	103.4	100.8	99.3
FAILURE			
Normal Stress (psf)	952	3228	5494
Failure Stress (psf)	1386	2802	3849
Failure Deffinition	Max	Max	Max
Displacement (in)	0.06	0.05	0.08
Rate (in/min)	0.0050	0.0050	0.0050

* Degree of saturation calculated with a specific gravity of 2.65

GEOCON
INCORPORATED

DIRECT SHEAR TEST REPORT

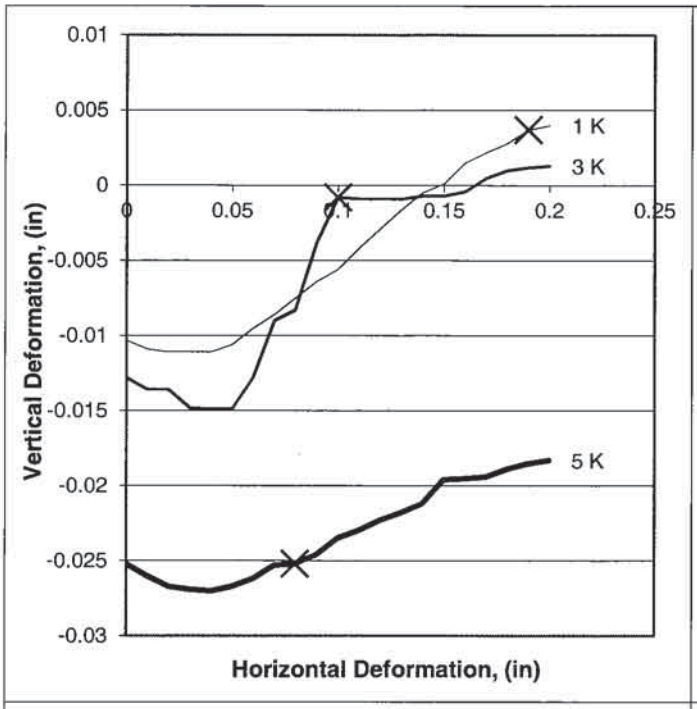
SDG&E TL 649

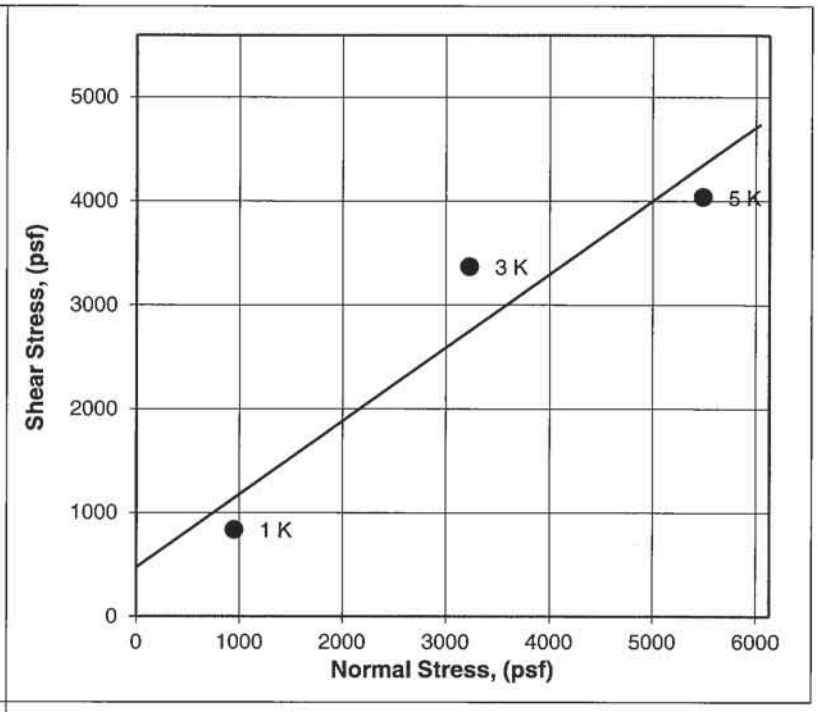
G1115-52-54 **Date:** Thursday, December 12, 2013 **By:** NJ

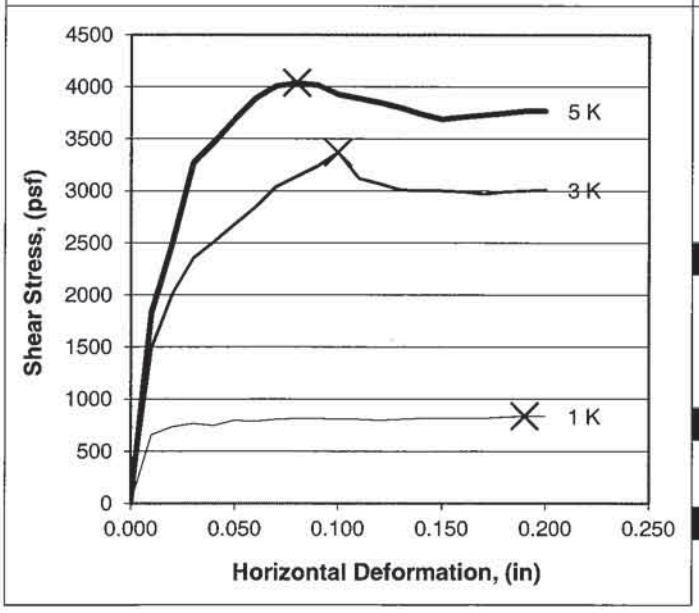
Sample No.: B23-5 **Natural or Remold:** Natural

Description: SM-Light gray, Silty, fine SAND

Remarks:







ϕ (Degrees)	35.2
c (psf)	475
Tan ϕ	0.705
Method	Calc

Load	1 K	3 K	5 K
INITIAL			
Water Content	14.3%	11.8%	13.9%
Dry Density (pcf)	96.3	108.9	97.3
Saturation*	52.7%	60.0%	52.5%
Height (inches)	1.00	1.00	1.00
AFTER TEST			
Water Content	25.1%	17.6%	22.5%
Dry Density (pcf)	95.9	108.7	99.1
FAILURE			
Normal Stress (psf)	952	3228	5494
Failure Stress (psf)	838	3370	4038
Failure Deffinition	Max	Max	Max
Displacement (in)	0.19	0.10	0.08
Rate (in/min)	0.0050	0.0050	0.0050

* Degree of saturation calculated with a specific gravity of 2.65

APPENDIX C

SEISMIC REFRACTION SURVEY
SDG&E TL649 WOOD TO STEEL IMPROVEMENTS
SAN DIEGO COUNTY, CALIFORNIA

PREPARED FOR:

Geocon. Inc.
6960 Flanders Drive
San Diego, CA 92121

PREPARED BY:

Southwest Geophysics, Inc.
8057 Raytheon Road, Suite 9
San Diego, CA 92111

December 23, 2013
Project No. 113448

SOUTHWEST GEOPHYSICS, INC.
YOUR SUBSURFACE SOLUTION

December 23, 2013
Project No. 113448

Mr. Mike Ertwine
Geocon, Inc.
6960 Flanders Drive
San Diego, CA 92121

Subject: Seismic Refraction Survey
SDG&E TL649 Wood to Steel Improvements
San Diego County, California

Dear Mr. Ertwine:

In accordance with your authorization, we have performed a seismic refraction survey pertaining to the subject project located in San Diego County, California. Specifically, our survey consisted of performing 11 seismic refraction traverses at the project site. The purpose of our study was to develop subsurface velocity profiles of the areas surveyed, and to assess the apparent rippability of the subsurface materials. This data report presents our survey methodology, equipment used, analysis, and results.

We appreciate the opportunity to be of service on this project. Should you have any questions related to this report, please contact the undersigned at your convenience.

Sincerely,
SOUTHWEST GEOPHYSICS, INC.

Aaron T. Puente
Senior Staff Geologist/Geophysicist

Hans van de Vrugt, C.E.G., P.Gp.
Principal Geologist/Geophysicist

ATP/HV/hv

Distribution: (1) Addressee (electronic)

REGISTERED GEOPHYSICIST
Hans van de Vrugt
No 1012
Exp. 2/28/14
STATE OF CALIFORNIA

8057 Raytheon Road, Suite 9 • San Diego • California 92111 • Telephone 858-527-0849 • Fax 858-225-0114

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1. INTRODUCTION

In accordance with your authorization, we have performed a seismic refraction survey pertaining to the subject project located in San Diego County, California (Figure 1). Specifically, our survey consisted of performing 11 seismic refraction traverses at the project site. The purpose of our study was to develop subsurface velocity profiles of the areas surveyed, and to assess the apparent rippability of the subsurface materials. This data report presents our survey methodology, equipment used, analysis, and results.

2. SCOPE OF SERVICES

Our scope of services included:

- Performance of 11 seismic refraction lines (SL-1 through SL-11) at the project site.
- Compilation and analysis of the data collected.
- Preparation of this data report presenting our results and conclusions.

3. SITE AND PROJECT DESCRIPTION

The project site is located east of the I-805 Freeway and north of Otay Mesa Road in San Diego County, California (Figure 1). The seismic traverse locations SL-1 through SL-11 are located next to the existing power poles Z31750, Z34102, Z31768, Z31744, Z31729, Z188716, Z81116, Z81097, Z118863, Z81044, and Z31755 respectively. The seismic lines roughly trend parallel to the power lines. The topography varies significantly across the project area and includes steep slopes, drainages and mesas. Vegetation in the project area generally consists of annual grass, brush, and scattered small trees. Outcrops of granitic and conglomerate rock were observed in several locations within the project area. Figures 2a through 2h, 3a and 3b depict the general site conditions in the area of the seismic lines.

Based on our discussions with you, it is our understanding new power poles will be installed within the project area. Information derived from our study as well as the exploratory excavations conducted by your office will be used in the foundation design for the proposed power poles.

4. SURVEY METHODOLOGY

A seismic P-wave (compression wave) refraction survey was conducted at the site to evaluate the characteristics of the subsurface materials and to develop subsurface velocity profiles of the areas surveyed. The seismic refraction method uses first-arrival times of refracted seismic waves to estimate the thicknesses and seismic velocities of subsurface layers. Seismic P-waves generated at the surface, using a hammer and plate, are refracted at boundaries separating materials of contrasting velocities. These refracted seismic waves are then detected by a series of surface vertical component geophones and recorded with a 24-channel Geometrics StrataView seismograph. The travel times of the seismic P-waves are used in conjunction with the shot-to-geophone distances to obtain thickness and velocity information on the subsurface materials.

Seismic lines SL-1 through SL-11 were oriented generally in-line with existing power lines (Figures 2a through 2h). The general line locations were selected by your office as well as the desired exploration depths. The seismic lines were 200 feet long and shot points (signal generation locations) were conducted at the ends, midpoint, and intermediate points along the lines. In general, the effective depth of evaluation for a seismic refraction traverse is approximately one-third to one-fifth the length of the traverse.

The refraction method requires that subsurface velocities increase with depth. A layer having a velocity lower than that of the layer above will not generally be detectable by the seismic refraction method and, therefore, could lead to errors in the depth calculations of subsequent layers. In addition, lateral variations in velocity, such as those caused by core stones or intrusions can also result in the misinterpretation of the subsurface conditions.

The rippability values presented in Table 1 are based on our experience with similar materials and assumes that a Caterpillar D-9 dozer ripping with a single shank is used. We emphasize that the cutoffs in this classification scheme are approximate and that rock characteristics, such as fracture spacing and orientation, play a significant role in determining rock rippability. These characteristics may also vary with location and depth. For trenching operations**,** the rippability values should be scaled downward. For example, velocities as low as 3,500 feet/second may in-

dicate difficult ripping during trenching operations. In addition, the presence of boulders, which can be troublesome in a narrow trench, should be anticipated.

Table 1 – Rippability Classification

Seismic P-wave Velocity	Rippability
0 to 2,000 feet/second	Easy
2,000 to 4,000 feet/second	Moderate
4,000 to 5,500 feet/second	Difficult, Possible Blasting
5,500 to 7,000 feet/second	Very Difficult, Probable Blasting
Greater than 7,000 feet/second	Blasting Generally Required

It should be noted that the rippability cutoffs presented in Table 1 are slightly more conservative than those published in the Caterpillar Performance Handbook (Caterpillar, 2011). Accordingly, the above classification scheme should be used with discretion, and contractors should not be relieved of making their own independent evaluation of the rippability of the on-site materials prior to submitting their bids.

5. ANALYSIS AND RESULTS

As previously indicated, 11 seismic traverses were conducted as part of our study. The collected data were processed using SIPwin (Rimrock Geophysics, 2003), a seismic interpretation program, and analyzed using SeisOpt Pro (Optim, 2008) which uses first arrival picks and elevation data to produce subsurface velocity models. SeisOpt Pro uses a nonlinear optimization technique called adaptive simulated annealing. The resulting velocity model provides a tomography image of the estimated geologic conditions. Both vertical and lateral velocity information is contained in the tomography model. Changes in layer velocity are revealed as gradients rather than discrete contacts, which typically are more representative of actual conditions.

The results from our analysis are presented in the tomography models included on Figures 4a through 4k. As depicted, the models reveal distinct low velocity materials in the near-surface and generally higher velocity materials at depth. The low velocity materials are likely topsoil, colluvium, and/or alluvium) with the higher velocity materials likely representing Otay Formation and possibly weathered granitic rock depending on the location and depth. In addition, it is our un-

derstanding that Terrace Deposits and Landslide Debris also underlie portions of the project site. These materials are likely represented by low to intermediate velocity layers or zones in the models. Also evident in the models are substantial lateral variations in velocity which may be related to buried boulders, cemented zones, and/or differential weathering of the subsurface materials.

6. LIMITATIONS

The field evaluation and geophysical analyses presented in this report have been conducted in general accordance with current practice and the standard of care exercised by consultants performing similar tasks in the project area. No warranty, express or implied, is made regarding the conclusions, recommendations, and opinions presented in this report. There is no evaluation detailed enough to reveal every subsurface condition. Variations may exist and conditions not observed or described in this report may be present. Uncertainties relative to subsurface conditions can be reduced through additional subsurface exploration. Additional subsurface surveying will be performed upon request.

This document is intended to be used only in its entirety. No portion of the document, by itself, is designed to completely represent any aspect of the project described herein. Southwest Geophysics, Inc. should be contacted if the reader requires additional information or has questions regarding the content, interpretations presented, or completeness of this document. This report is intended exclusively for use by the client. Any use or reuse of the findings, conclusions, and/or recommendations of this report by parties other than the client is undertaken at said parties' sole risk.

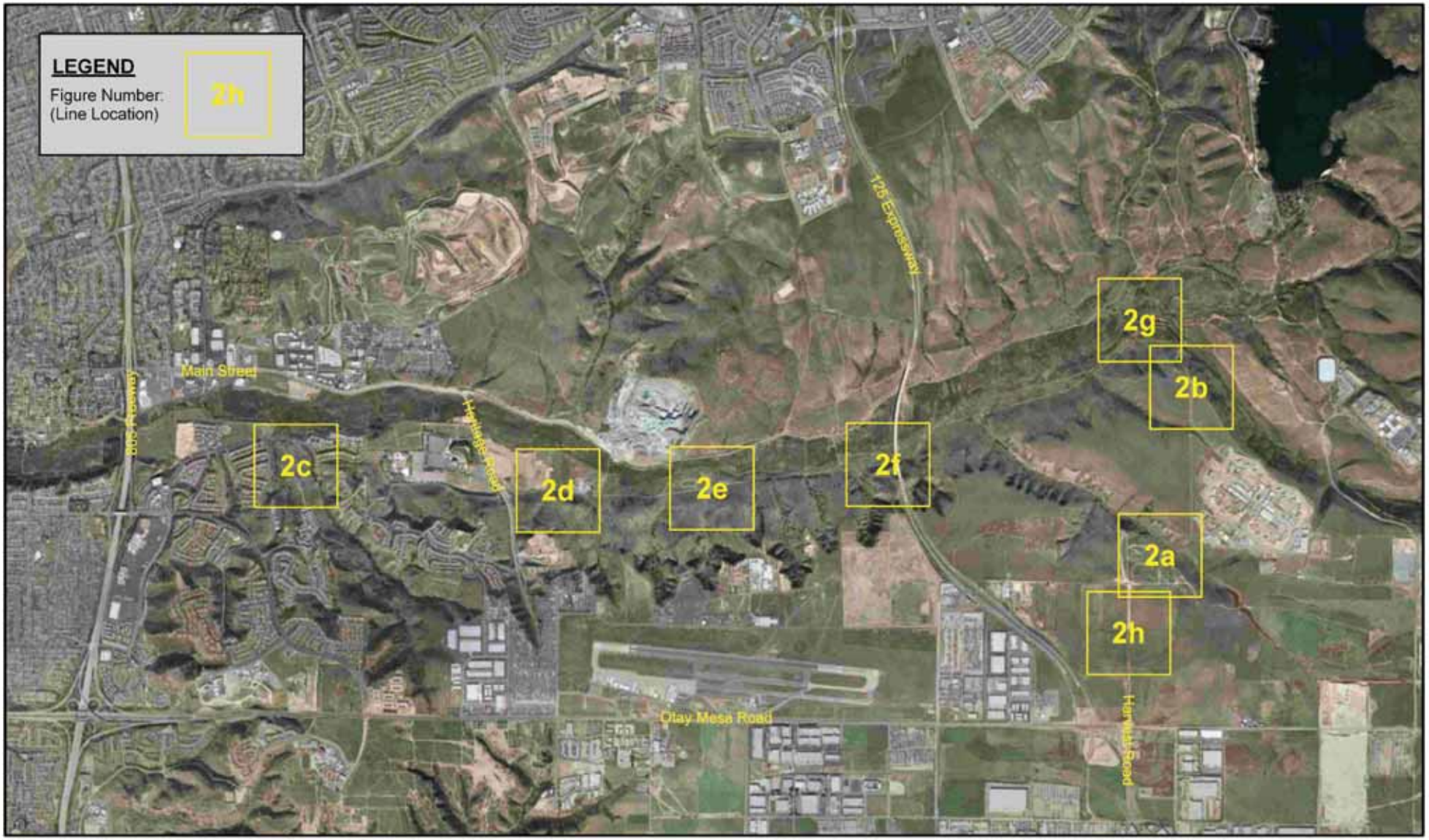
7. SELECTED REFERENCES

Mooney, H.M., 1976, Handbook of Engineering Geophysics, dated February.

Optim, Inc., 2008, SeisOpt Pro, V-5.0.

Rimrock Geophysics, 2003, Seismic Refraction Interpretation Program (SIPwin), V-2.76.

Telford, W.M., Geldart, L.P., Sheriff, R.E., and Keys, D.A., 1976, Applied Geophysics, Cambridge University Press.



SITE LOCATION MAP

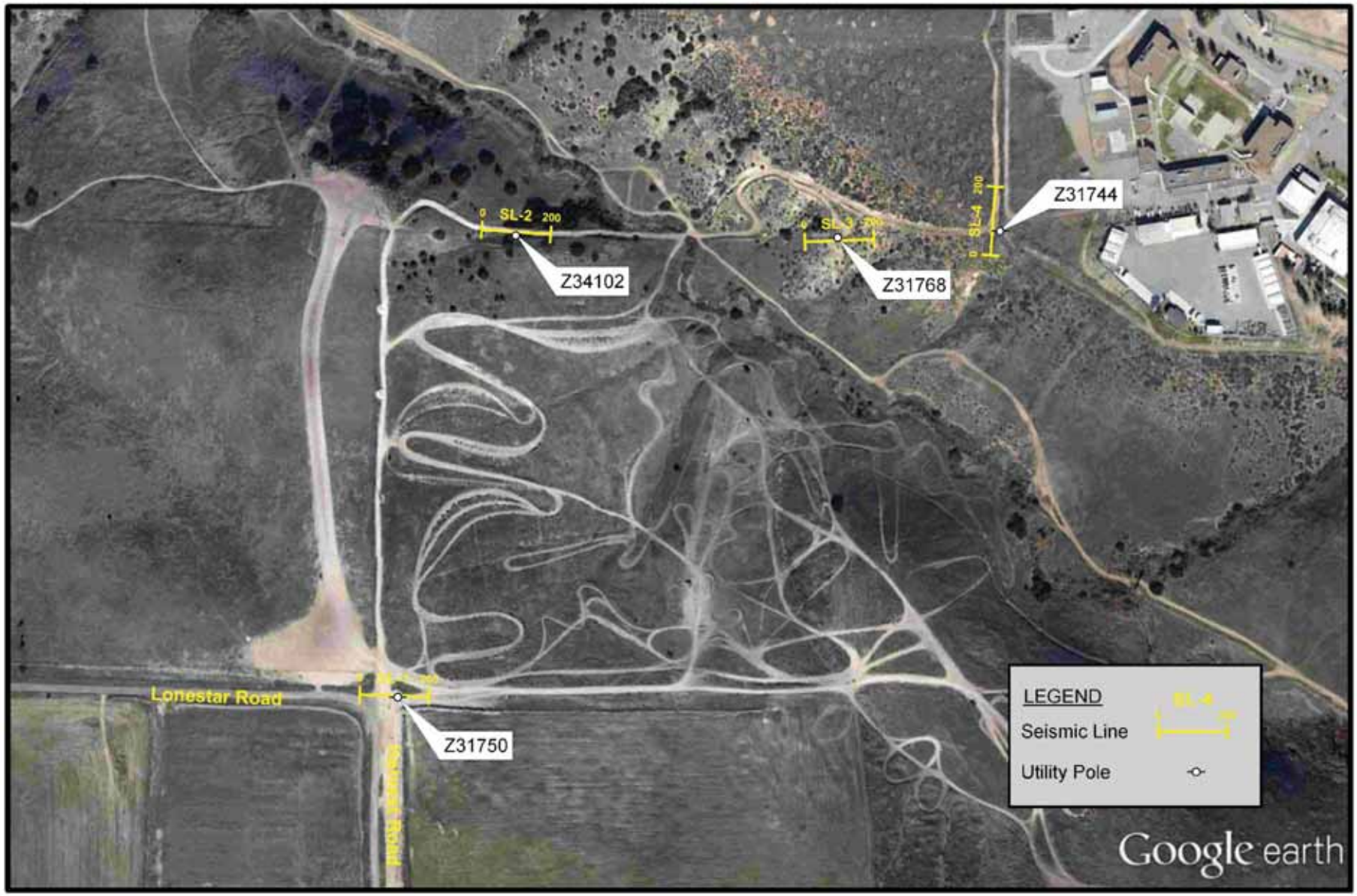
N

SDG&E TL649 Wood To Steel Improvements
San Diego County, California

Project No.: 113448 | Date: 12/13

SOUTHWEST

Figure 1



LINE LOCATION MAP
(SL-1 through SL-4)

N

SDG&E TL649 Wood To Steel Improvements
San Diego County, California

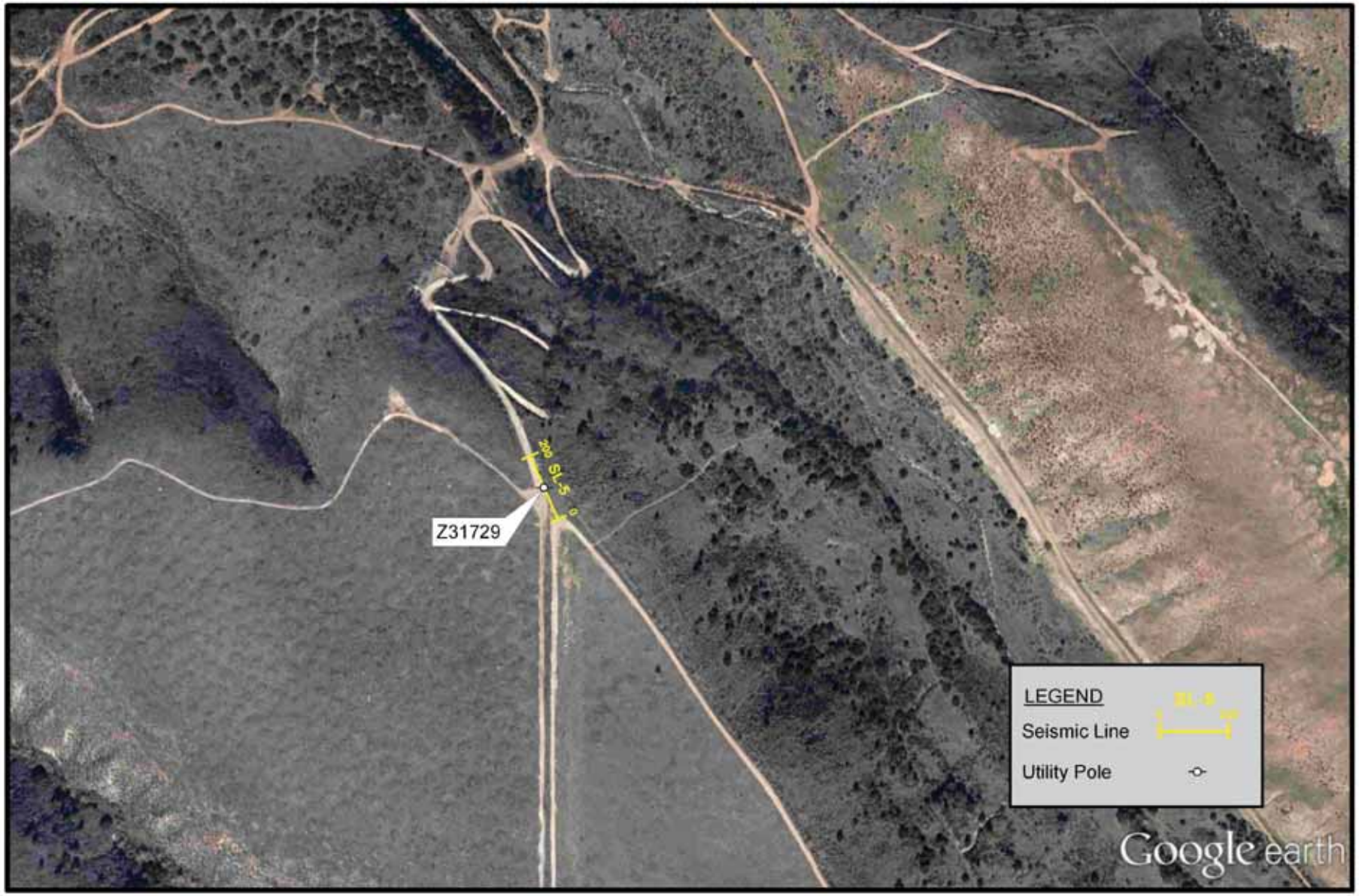
Project No.: 113448 | Date: 12/13

SOUTHWEST GEOPHYSICS INC.

Figure 2a

0 400 800

approximate scale in feet



LINE LOCATION MAP
(SL-5)

N

SDG&E TL649 Wood To Steel Improvements
San Diego County, California

Project No.: 113448 | Date: 12/13

SOUTHWEST GEOPHYSICS INC.

Figure 2b

0 400 800
approximate scale in feet

LINE LOCATION MAP
(SL-6)

N

SDG&E TL649 Wood To Steel Improvements
San Diego County, California

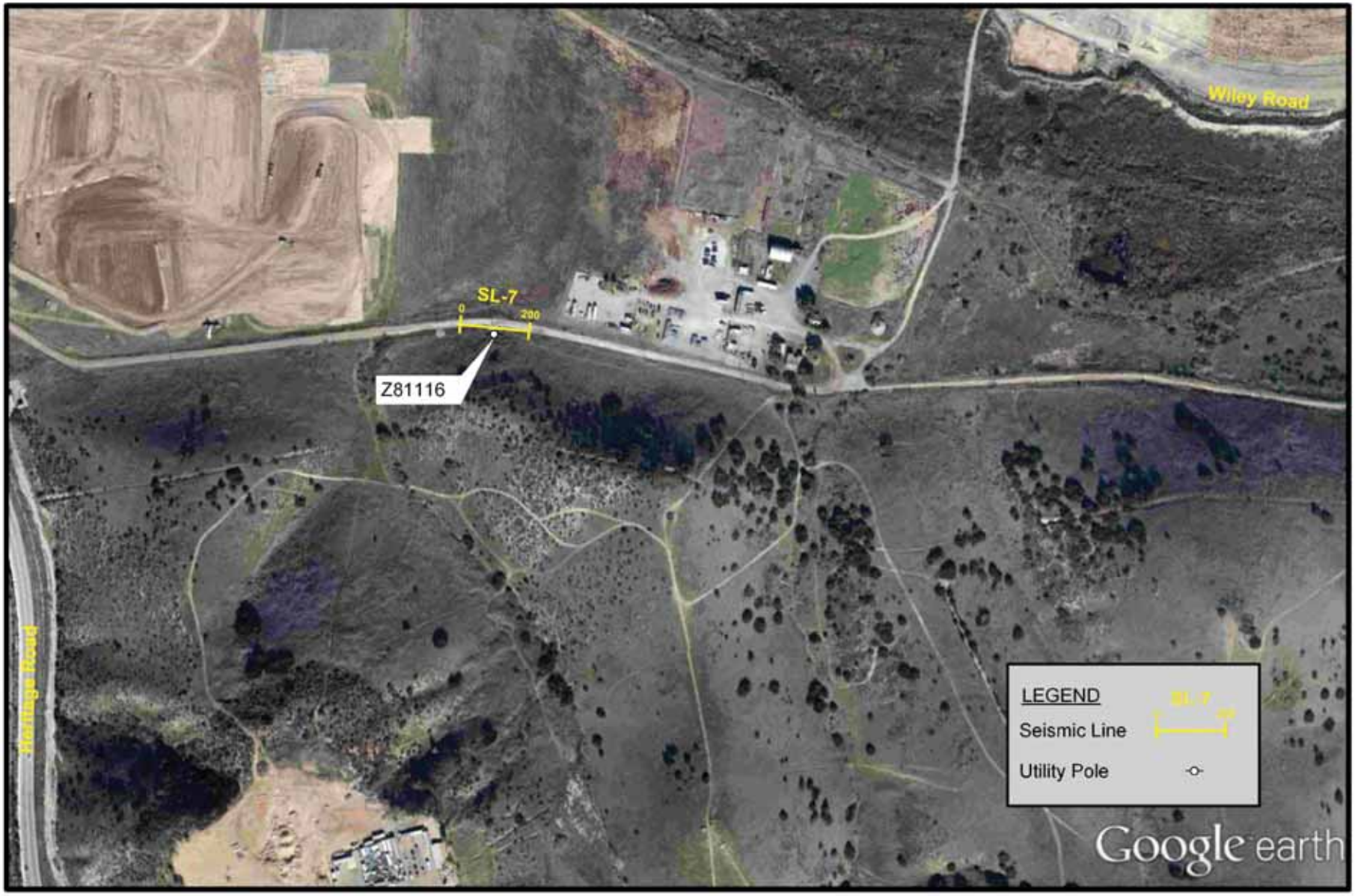
Project No.: 113448 | Date: 12/13

SOUTHWEST GEOPHYSICS INC.

Figure 2c

0 400 800

approximate scale in feet



LINE LOCATION MAP
(SL-7)

N

SDG&E TL649 Wood To Steel Improvements
San Diego County, California

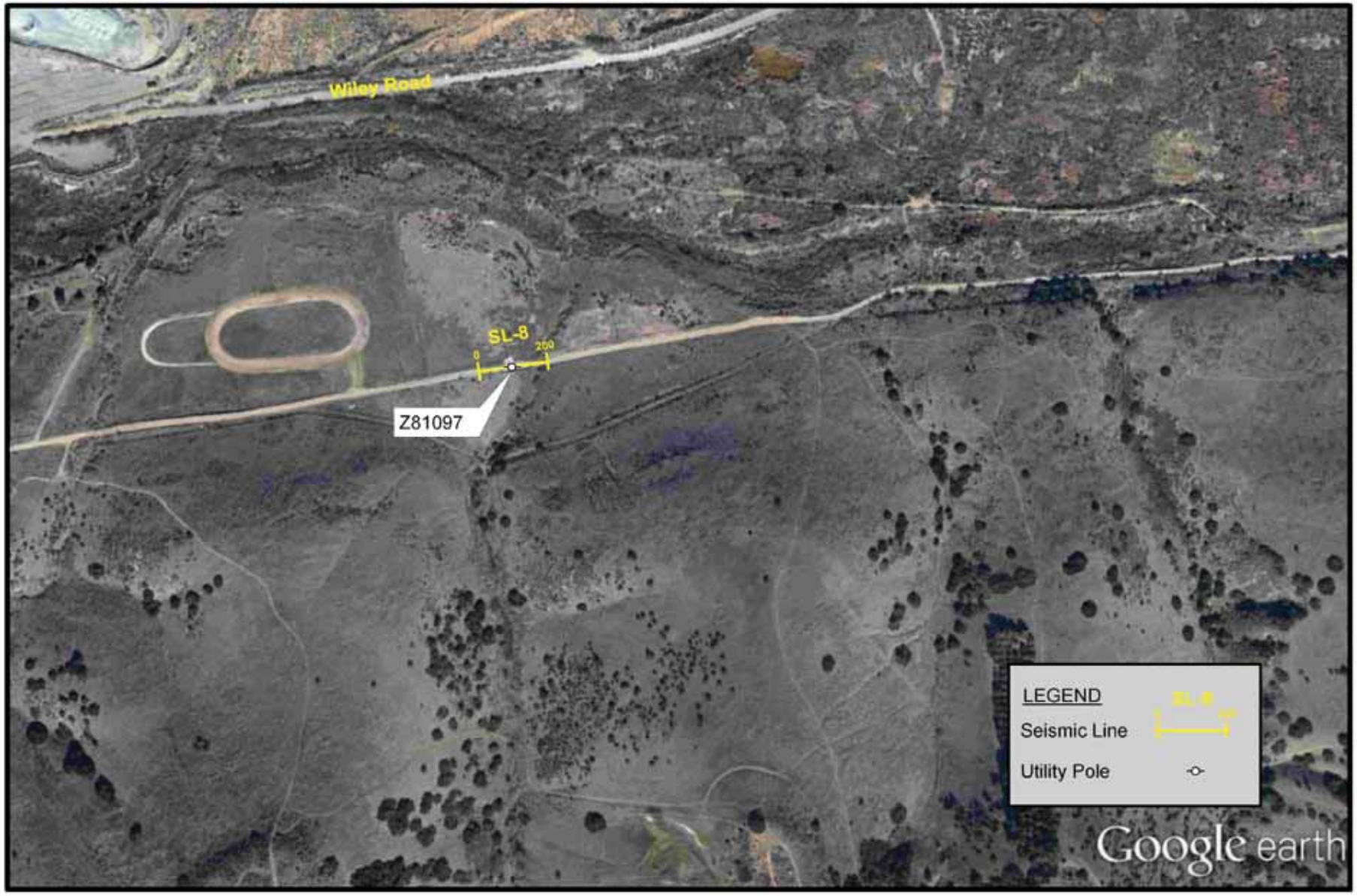
Project No.: 113448 | Date: 12/13

SOUTHWEST GEOPHYSICS INC.

Figure 2d

0 400 800

approximate scale in feet



LINE LOCATION MAP
(SL-8)

N

SDG&E TL649 Wood To Steel Improvements
San Diego County, California

Project No.: 113448 | Date: 12/13

SOUTHWEST GEOPHYSICS INC.

Figure 2e

0 400 800

approximate scale in feet

LINE LOCATION MAP
(SL-9)

N

SDG&E TL649 Wood To Steel Improvements
San Diego County, California

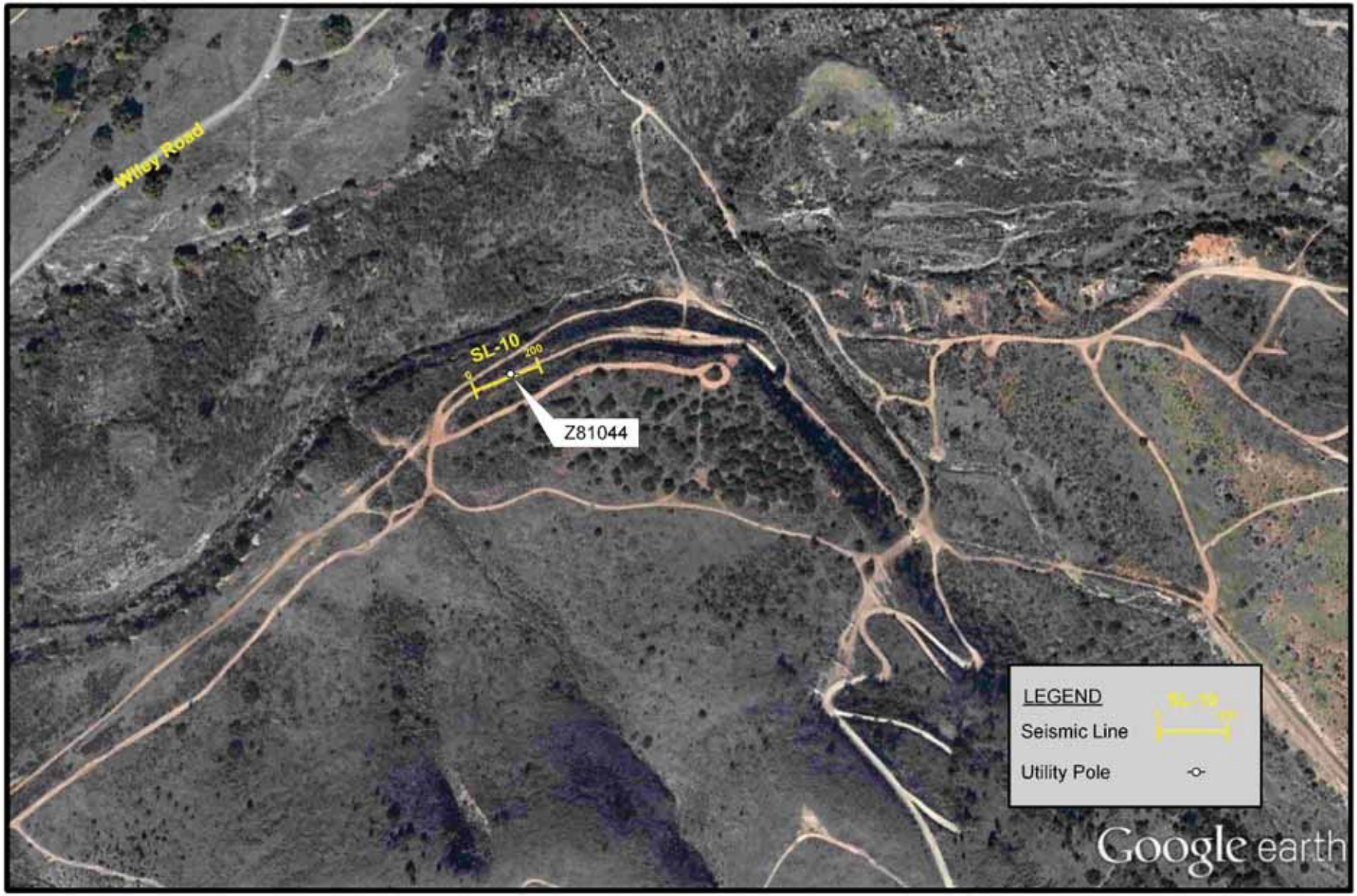
Project No.: 113448 | Date: 12/13

SOUTHWEST GEOPHYSICS INC.

Figure 2f

0 400 800

approximate scale in feet



LINE LOCATION MAP
(SL-10)

N

SDG&E TL649 Wood To Steel Improvements
San Diego County, California

Project No.: 113448 | Date: 12/13

SOUTHWEST GEOPHYSICS INC.

Figure 2g

0 400 800

approximate scale in feet

LINE LOCATION MAP
(SL-11)

N

SDG&E TL649 Wood To Steel Improvements
San Diego County, California

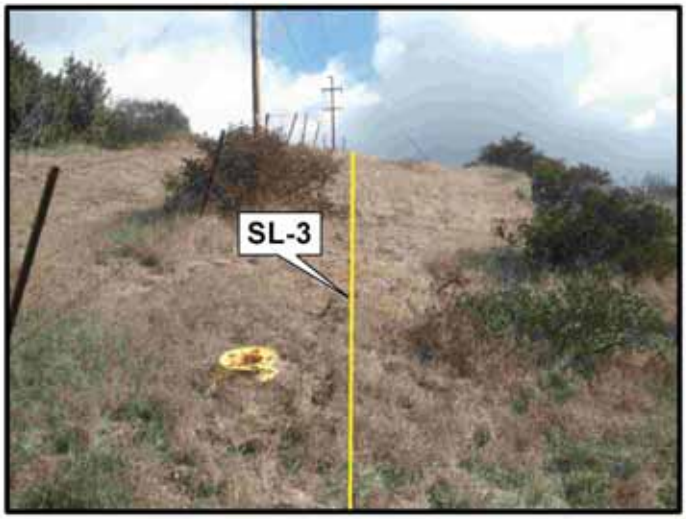
Project No.: 113448 | Date: 12/13

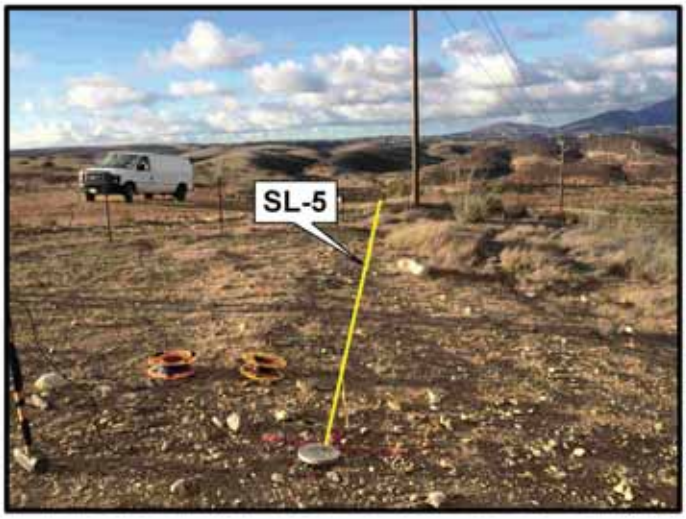
SOUTHWEST GEOPHYSICS INC.

Figure 2h

0 400 800

approximate scale in feet





SITE PHOTOGRAPHS

SDG&E TL649 Wood to Steel Improvements
San Diego County, California

Project No.: 113448 | Date: 12/13

SOUTHWEST GEOPHYSICS INC.

Figure 3a

SITE PHOTOGRAPHS

SDG&E TL649 Wood to Steel Improvements
San Diego County, California

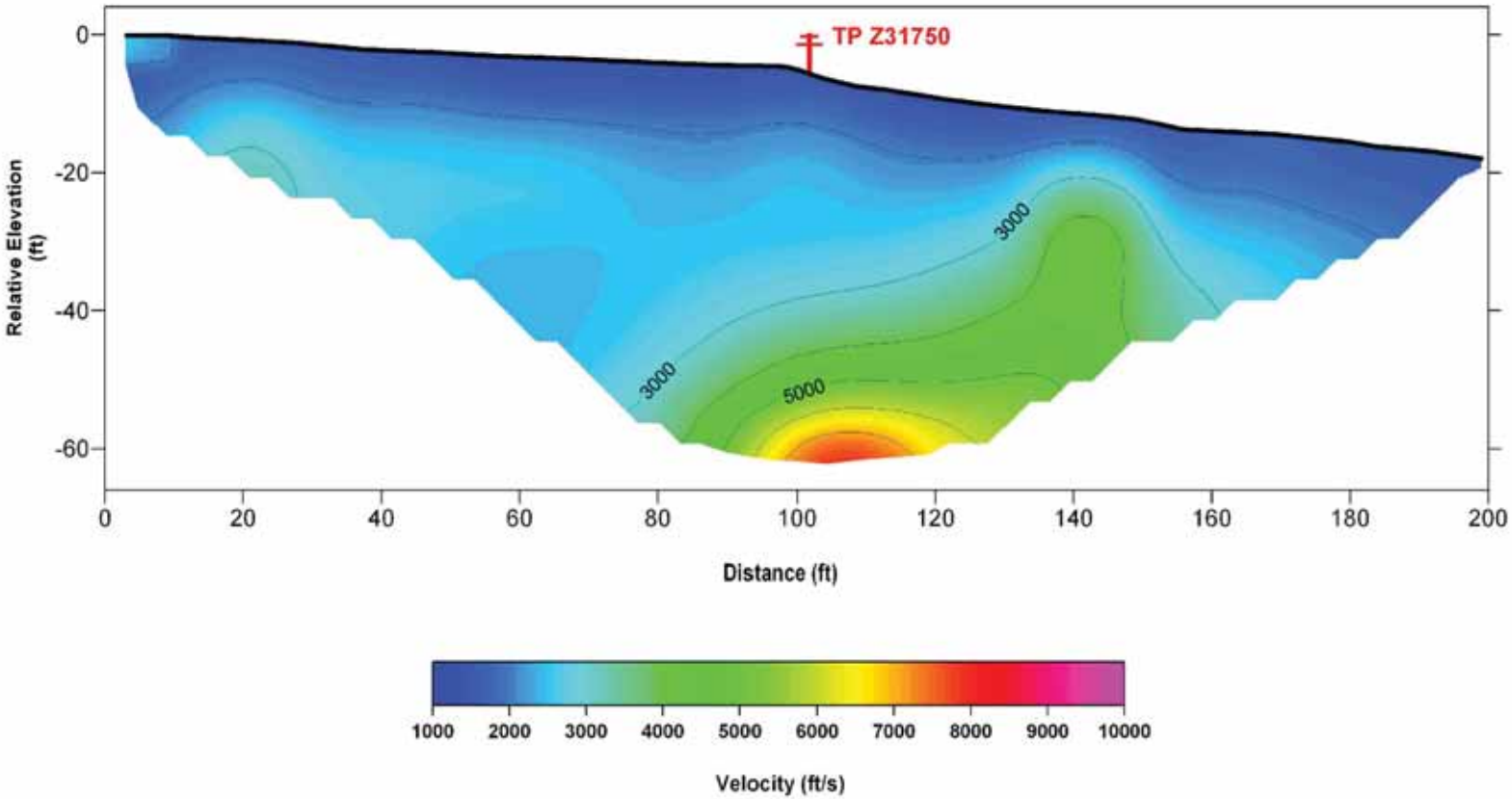
Project No.: 113448 | Date: 12/13

SOUTHWEST GEOPHYSICS INC.

Figure 3b

TOMOGRAPHY MODEL

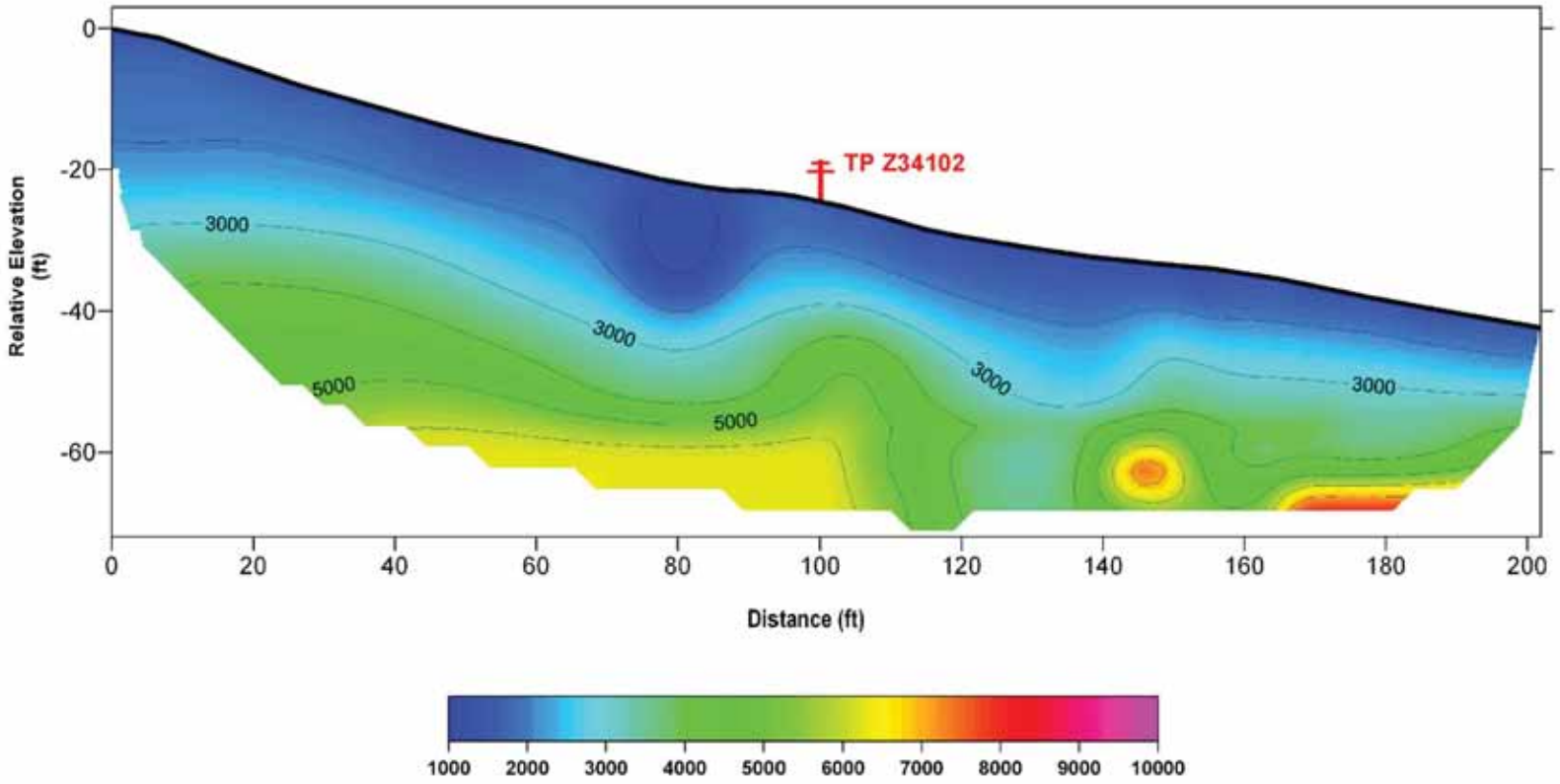
SL-1



SEISMIC PROFILE	SDG&E TL649 Wood To Steel Improvements San Diego County, California	SOUTHWEST GEOPHYSICS INC.	**Note: Contour Interval = 1,000 feet per second**
	Project No.: 113448 / Date: 12/13	Figure 4a	

TOMOGRAPHY MODEL

SL-2



SEISMIC PROFILE

SDG&E TL649 Wood To Steel Improvements
San Diego County, California

Project No.: 113448 | Date: 12/13

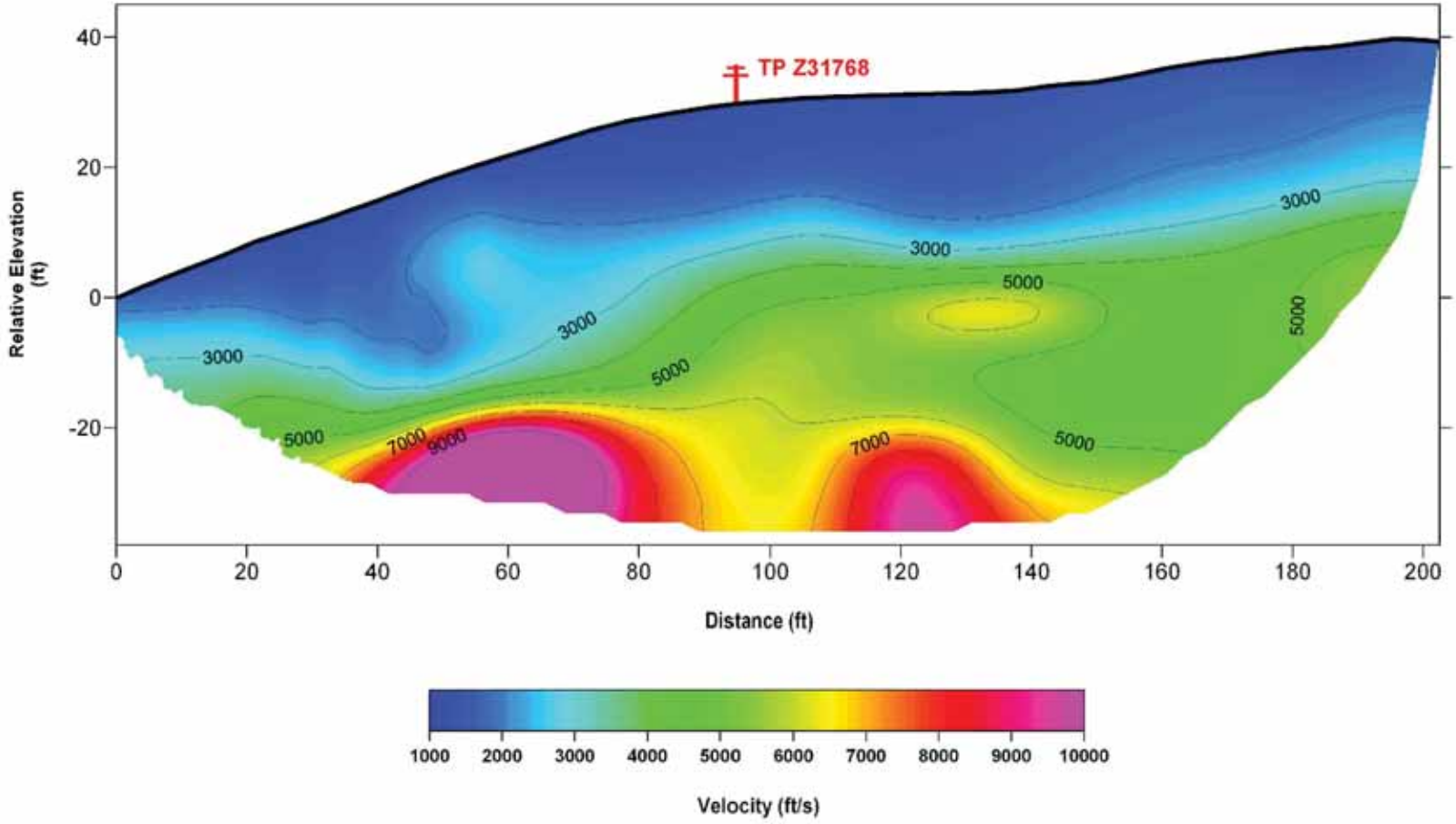
SOUTHWEST GEOPHYSICS INC.

Figure 4b

Note: Contour Interval = 1,000 feet per second

TOMOGRAPHY MODEL

SL-3



SEISMIC PROFILE

SDG&E TL649 Wood To Steel Improvements
San Diego County, California

Project No.: 113448 | Date: 12/13

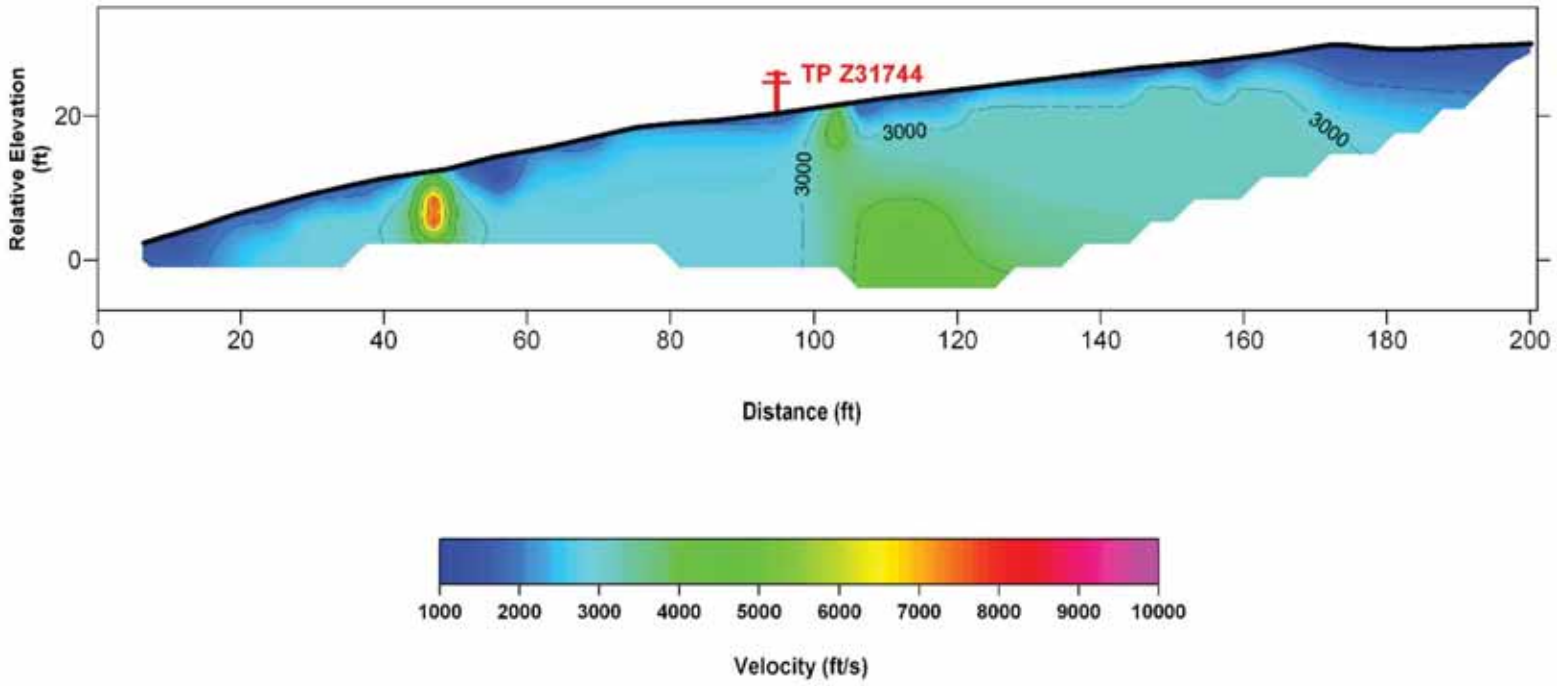
SOUTHWEST GEOPHYSICS INC.

Figure 4c

Note: Contour Interval = 1,000 feet per second

TOMOGRAPHY MODEL

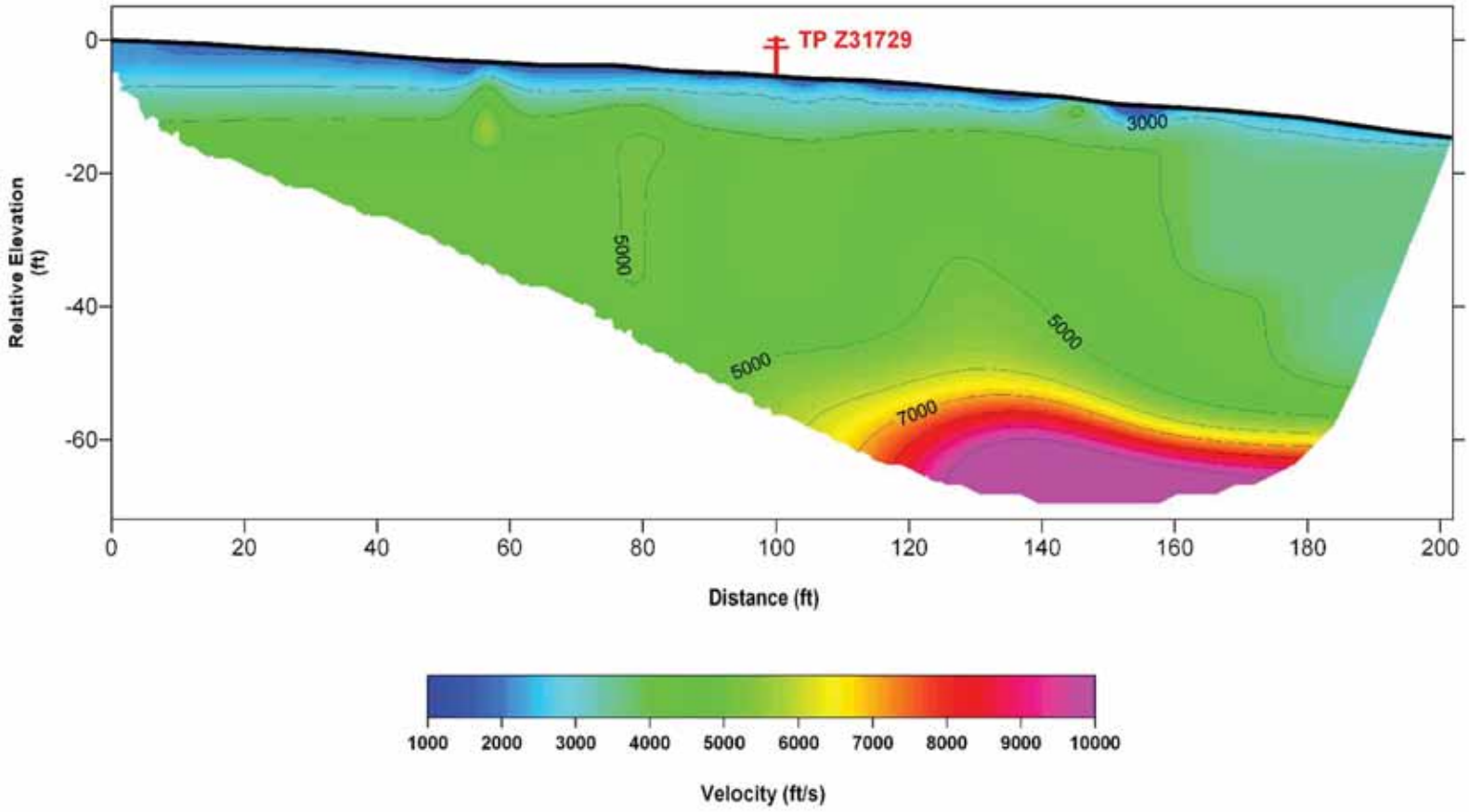
SL-4



SEISMIC PROFILE	SDG&E TL649 Wood To Steel Improvements San Diego County, California	SOUTHWEST GEOPHYSICS INC. Figure 4d	**Note: Contour Interval = 1,000 feet per second**
	Project No.: 113448 | Date: 12/13		

TOMOGRAPHY MODEL

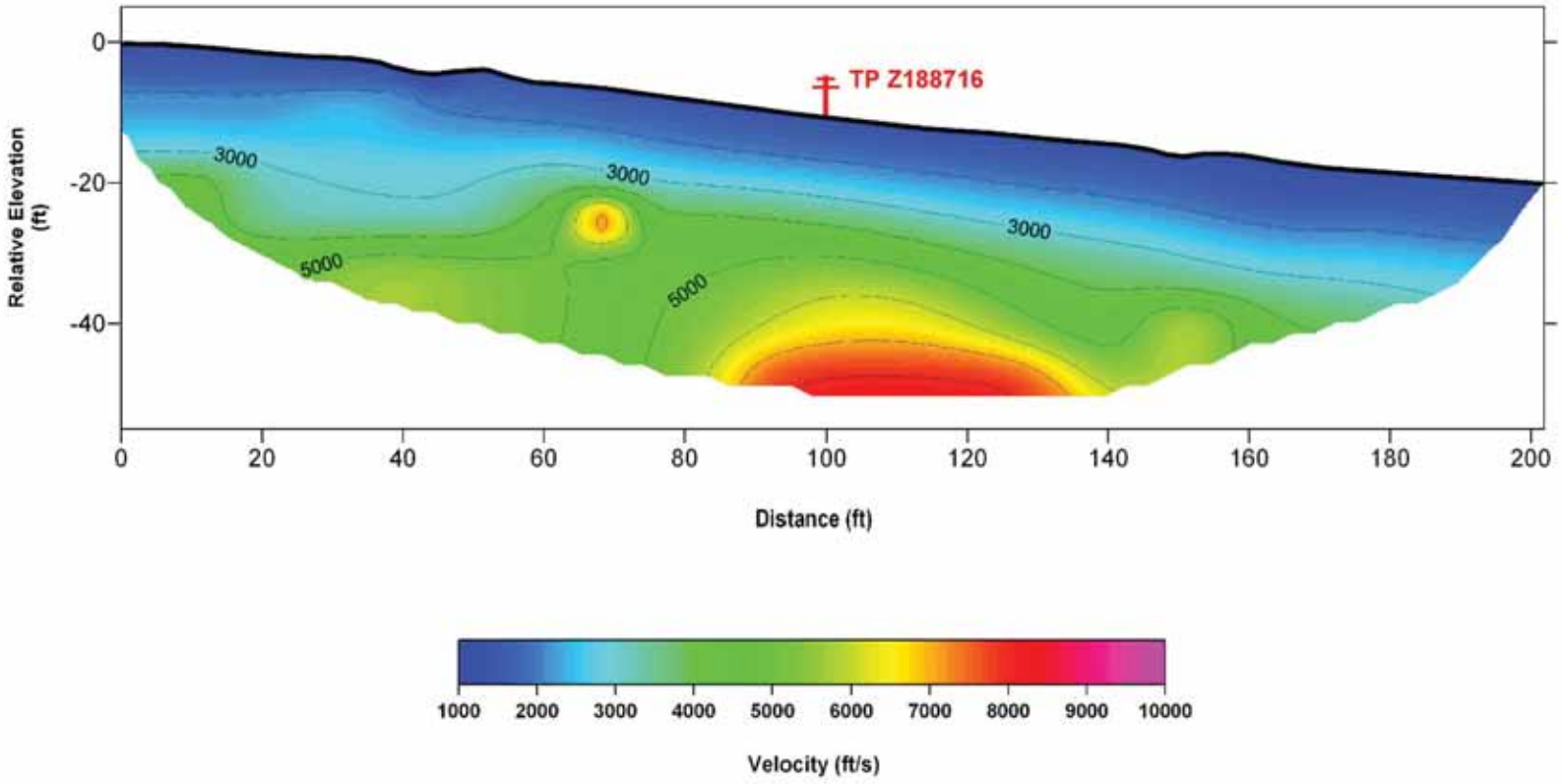
SL-5



SEISMIC PROFILE	SDG&E TL649 Wood To Steel Improvements San Diego County, California	SOUTHWEST GEOPHYSICS INC	**Note: Contour Interval = 1,000 feet per second**
	Project No.: 113448 / Date: 12/13	Figure 4e	

TOMOGRAPHY MODEL

SL-6



SEISMIC PROFILE

SDG&E TL649 Wood To Steel Improvements
San Diego County, California

Project No.: 113448 | Date: 12/13

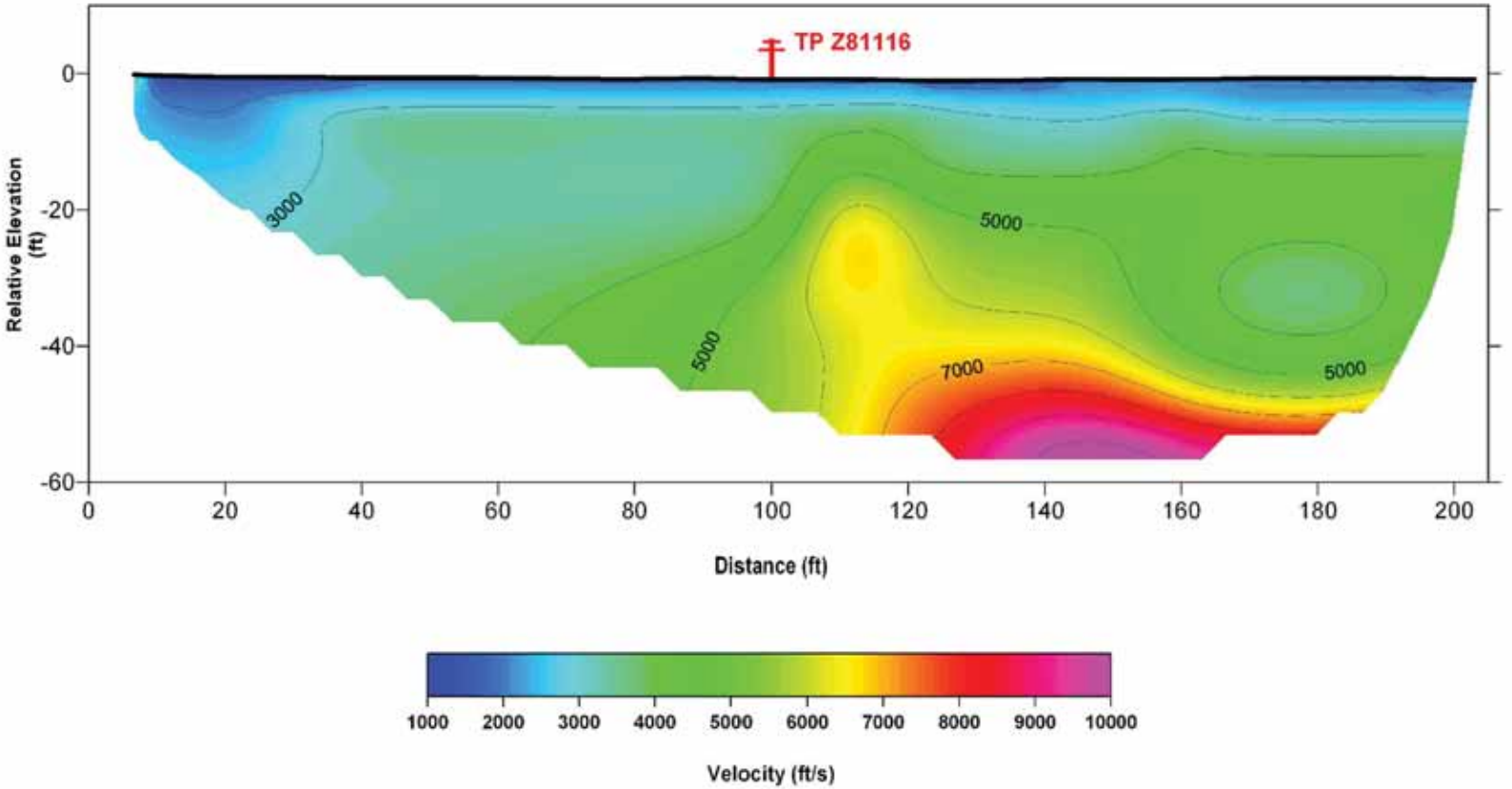
SOUTHWEST GEOPHYSICS INC.

Figure 4f

Note: Contour Interval = 1,000 feet per second

TOMOGRAPHY MODEL

SL-7



SEISMIC PROFILE

SDG&E TL649 Wood To Steel Improvements
San Diego County, California

Project No.: 113448 | Date: 12/13

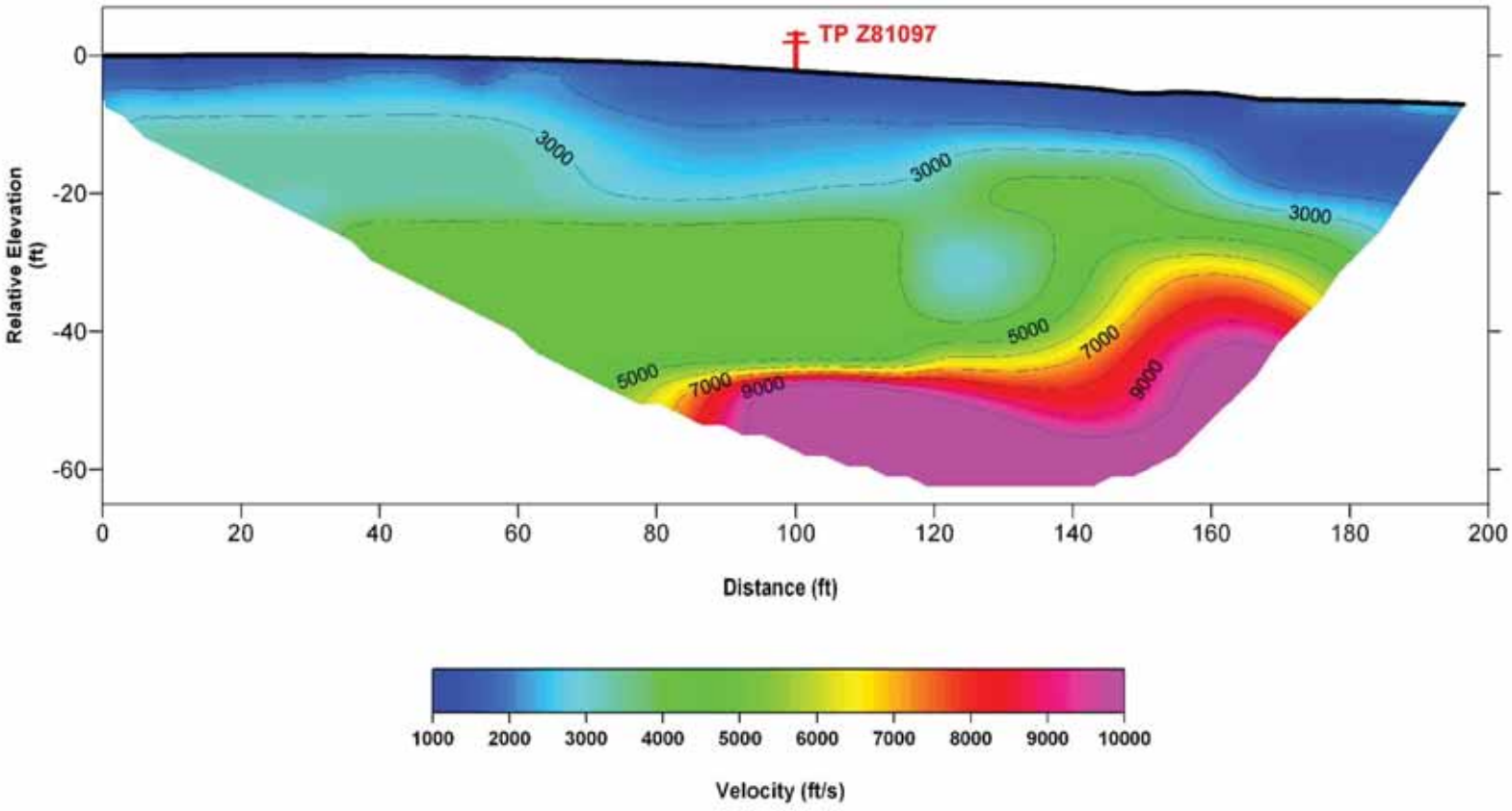
SOUTHWEST GEOPHYSICS INC.

Figure 4g

Note: Contour Interval = 1,000 feet per second

TOMOGRAPHY MODEL

SL-8



SEISMIC PROFILE

SDG&E TL649 Wood To Steel Improvements
San Diego County, California

Project No.: 113448 | Date: 12/13

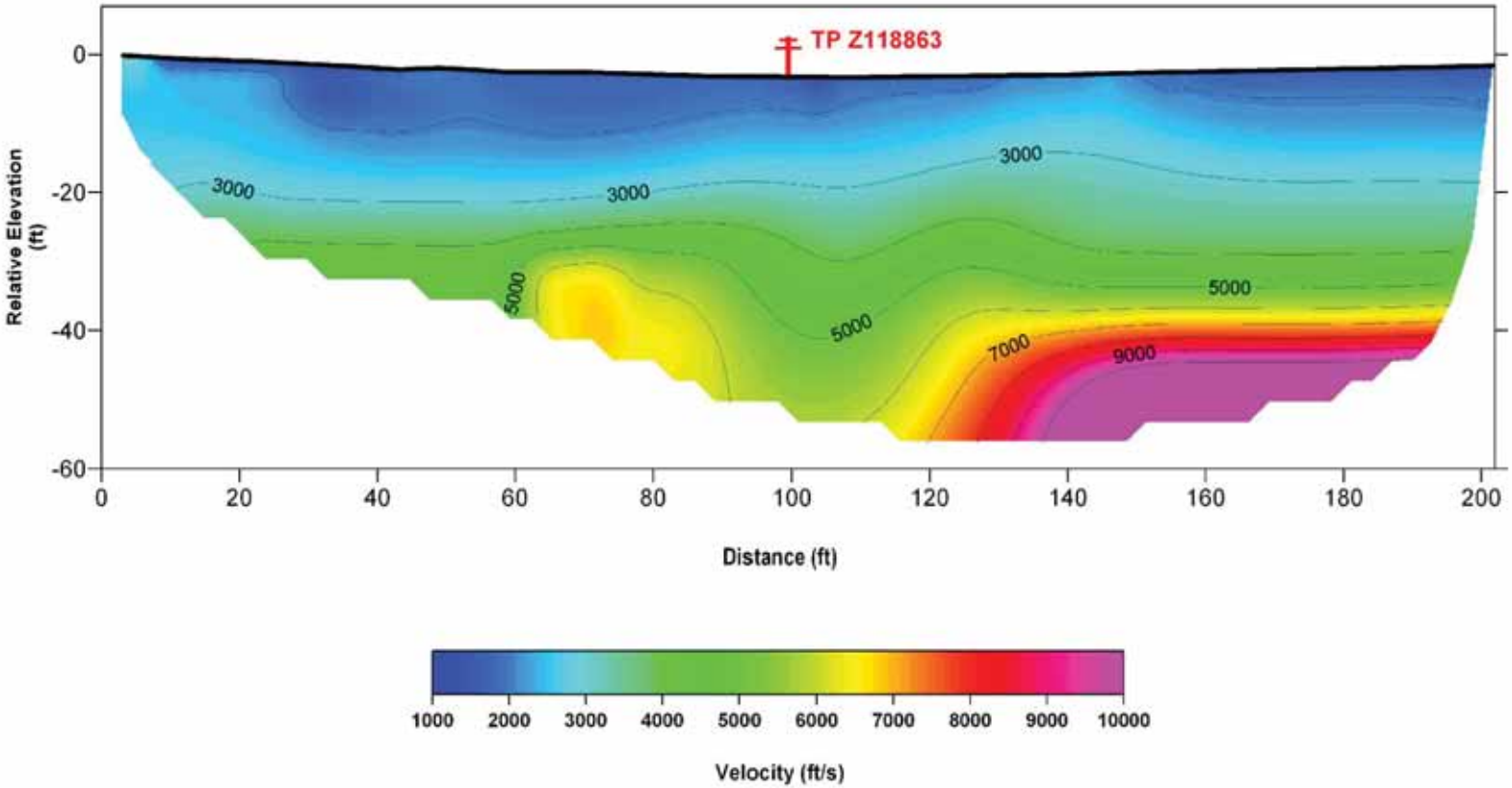
SOUTHWEST GEOPHYSICS INC.

Figure 4h

Note: Contour Interval = 1,000 feet per second

TOMOGRAPHY MODEL

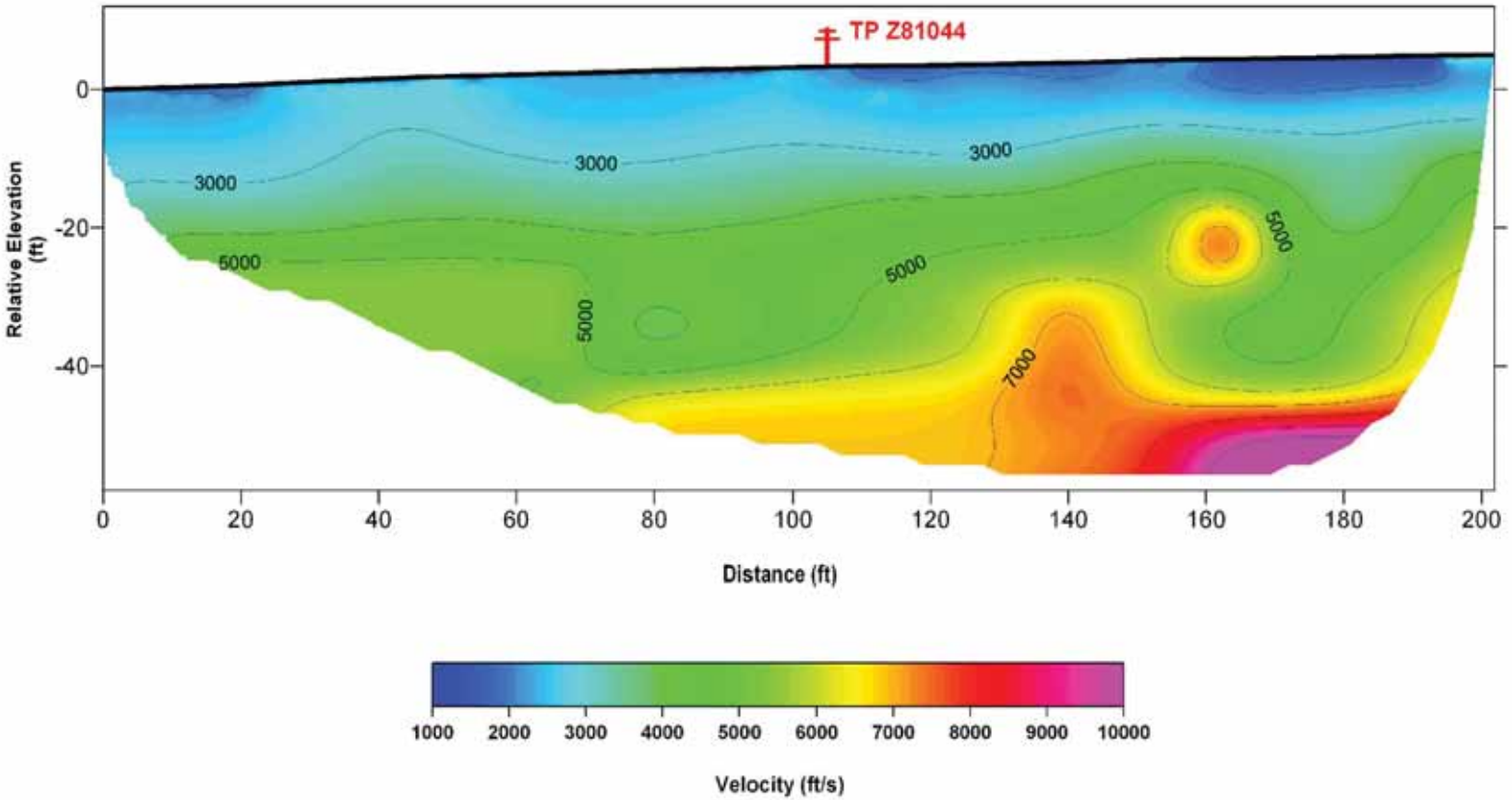
SL-9



SEISMIC PROFILE	SDG&E TL649 Wood To Steel Improvements San Diego County, California	SOUTHWEST GEOPHYSICS INC.	**Note: Contour Interval = 1,000 feet per second**
	Project No.: 113448 / Date: 12/13	Figure 4i	

TOMOGRAPHY MODEL

SL-10



SEISMIC PROFILE

SDG&E TL649 Wood To Steel Improvements
San Diego County, California

Project No.: 113448 | Date: 12/13

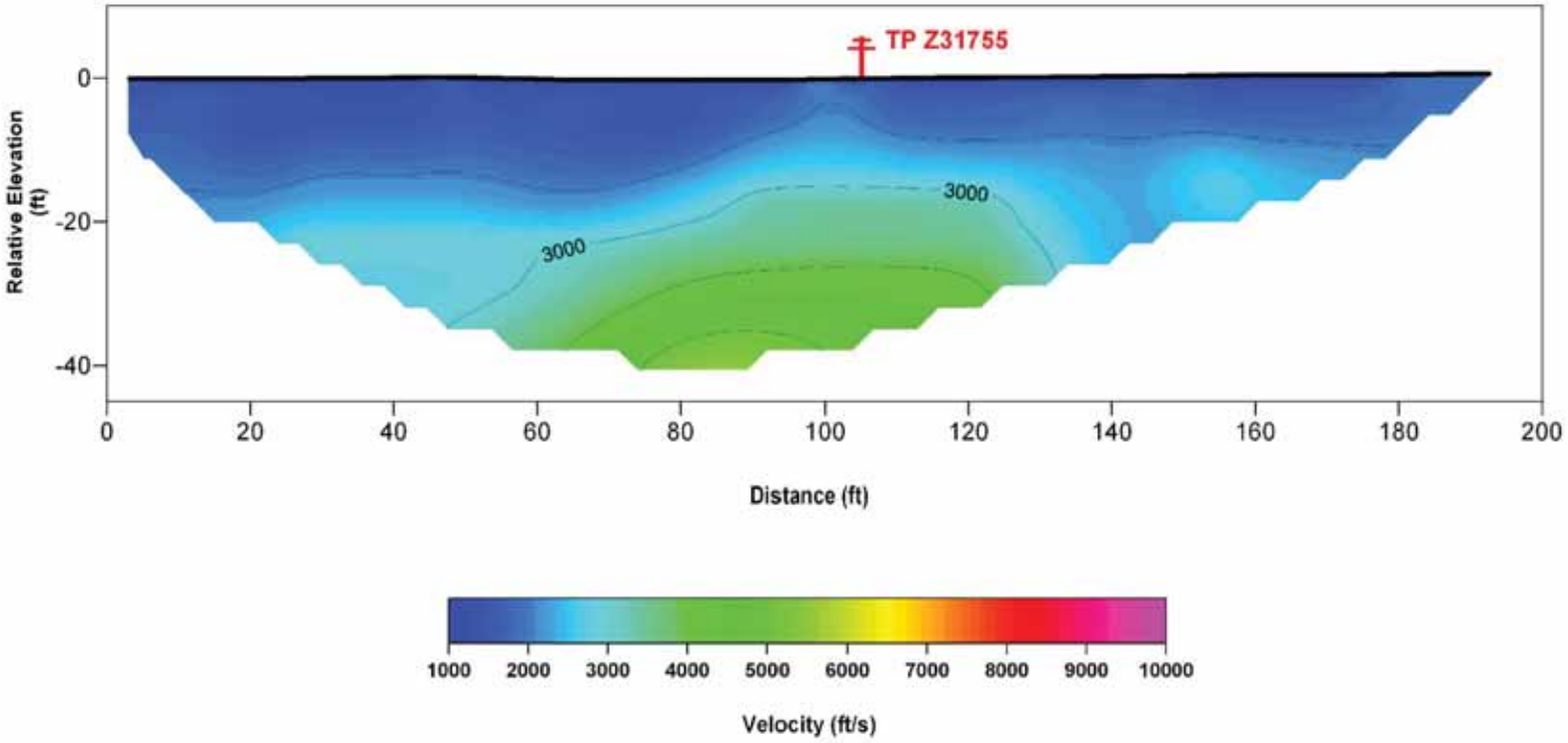
SOUTHWEST GEOPHYSICS INC.

Figure 4j

Note: Contour Interval = 1,000 feet per second

TOMOGRAPHY MODEL

SL-11



SEISMIC PROFILE	SDG&E TL649 Wood To Steel Improvements San Diego County, California	SOUTHWEST GEOPHYSICS INC.	**Note: Contour Interval = 1,000 feet per second**
	Project No.: 113448 / Date: 12/13	Figure 4k	

Project No. G1115-52-54
October 28, 2014

San Diego Gas and Electric Company
Civil/Structural Engineering
8316 Century Park Court
San Diego, California 92123

Attention: Mr. Tyler Lonsdale

Subject: SUPPLEMENTAL GEOTECHNICAL RECOMMENDATIONS
SDG&E TL649 WOOD TO STEEL IMPROVEMENTS
M.S.A. 6160015454
SAN DIEGO, CALIFORNIA

Dear Mr. Lonsdale:

In accordance with your request, this letter presents our supplemental geotechnical recommendations for steel pole foundations. Geocon Incorporated previously performed geotechnical investigation for the subject project and presented our findings and recommendations in the report titled: *Geotechnical Investigation, SDG&E TL649 Wood to Steel Improvements, M.S.A. 6160015454, San Diego, California*, dated January 29, 2014 (Revised February 24, 2014, Project No. G1115-52-54).

Table 1 below lists the proposed eight poles and their approximate coordinates. We understand that micropile foundations are considered for the first seven poles (Items 19, 21, 34 through 38), and a drilled, cast-in-place reinforced concrete pier is considered for the eighth pole (Item New).

TABLE 1
SUMMARY OF PROPOSED STRUCTURES

Item	Structure No.	Latitude	Longitude	Work Being Done
19	Z81097	32.58588056	-116.982850	New steel FDN (TYP) pole
21	Z81973	32.58679722	-116.974178	New steel FDN (TYP) pole
34	Z31729	32.59421667	-116.939364	New steel FDN (TYP) pole
35	Z31744	32.58210278	-116.939342	New steel FDN (TYP) pole
36	Z31768	32.58211111	-116.940781	New steel FDN (TYP) pole
37	Z34102	32.582125	-116.943925	New steel FDN (TYP) pole
38	Z31745	32.58213056	-116.945111	New steel FDN (TYP) pole
New	Z731391	32.59823825	-116.94130145	New steel FDN (TYP) pole

FIELD EXPLORATION

The exploration locations we performed for the entire TL649 wood to steel alignment consisted of drilling 21 small-diameter borings and 11 seismic refraction survey lines. The exploration locations with respect to the proposed poles, borings logs, seismic refraction survey line results, laboratory test results, and the recommendations were included in the above referenced report.

For the purposes of this supplemental letter, the Table 2 below summarizes the eight proposed structures, approximate elevations, and associated subsurface explorations.

TABLE 2
SUMMARY OF PROPOSED STRUCTURES AND ASSOCIATED EXPLORATIONS

ID No.	Structure No.	Approximate Elevation (MSL)	Reference Exploration
19	Z81097	211	SL-8
21	Z81973	197	B-10
34	Z31729	514	B-20 & SL-5
35	Z31744	554	SL-4
36	Z31768	474	SL-3
37	Z34102	440	SL-2
38	Z31745	531	B-22
New	Z731391	287.5	B-18 & SL-10

B = Hollow Stem Auger Boring.
SL = Seismic Refraction Line.

RECOMMENDED FOUNDATION DESIGN PARAMETERS

A generalized subsurface soil profile has been developed for the area surrounding each pole foundation based on the data obtained from our exploration. Soil layers have been categorized by depth below the existing grade and assigned soil parameters that may be utilized with the *MFAD* computer program used by SDG&E for pier and/or micropile foundation design.

Tables 3 through 10 summarize the average total unit weight, cohesive strength, angle of internal friction, and deformation modulus assigned to the soil layers beneath the proposed pole sites. The parameters presented herein are based on current and past experience and/or testing of similar materials. We have assumed that the existing grade will not be changed significantly. If the finalized improvements are different from those currently proposed, Geocon Incorporated should be contacted for further evaluation.

TABLE 3
RECOMMENDED SOIL PARAMETERS FOR PIER FOUNDATION DESIGN (Z81097)

Depth (feet)	Soil/Rock Type	Unit Cohesion c (psf)	Friction Angle ϕ (degrees)	Total Moist Unit Weight γ (pcf)	Moisture Content (%)	Total Saturated Unit Weight γ (pcf)	Deformation Modulus E_p (ksi)	Strength Reduction Factor
0 to 10	Alluvium	300	32	128	16	132	2.0	1.0
10 to 20	Terrace Deposits – Sandy Gravel	140	31	129	15	133	2.5	1.0
20 to 45	Otay Formation	300	33	126	10	134	3.0	1.0
45+	Metavolcanic Rock	3000	40	137	5	144	6.0	0.9

Note: Based on the subsurface conditions encountered at SL-8.

TABLE 4
RECOMMENDED SOIL PARAMETERS FOR PIER FOUNDATION DESIGN (Z81973)

Depth (feet)	Soil/Rock Type	Unit Cohesion c (psf)	Friction Angle ϕ (degrees)	Total Moist Unit Weight γ (pcf)	Moisture Content (%)	Total Saturated Unit Weight γ (pcf)	Deformation Modulus E_p (ksi)	Strength Reduction Factor
0 to 12	Alluvium	300	32	128	16	132	2.0	1.0
12 to 18	Terrace Deposits – Sandy Gravel	140	31	129	15	133	2.5	1.0
18 to 31½+	Otay Formation - Sandstone	300	33	126	10	134	3.0	1.0

Note: Based on the subsurface conditions encountered in Boring B-10.

TABLE 5
RECOMMENDED SOIL PARAMETERS FOR PIER FOUNDATION DESIGN (Z31729)

Depth (feet)	Soil/Rock Type	Unit Cohesion c (psf)	Friction Angle ϕ (degrees)	Total Moist Unit Weight γ (pcf)	Moisture Content (%)	Total Saturated Unit Weight γ (pcf)	Deformation Modulus E_p (ksi)	Strength Reduction Factor
0 to 3	Topsoil	200	30	115	15	125	1.5	1.0
3 to 60	Fanglomerate Deposits	300	36	127	10	135	4.0	1.0
60+	Metavolcanic Rock	3000	40	137	5	144	6.0	0.9

Note: Based on the subsurface conditions encountered in Boring B-20 and at SL-5.

TABLE 6
RECOMMENDED SOIL PARAMETERS FOR PIER FOUNDATION DESIGN (Z31744)

Depth (feet)	Soil/Rock Type	Unit Cohesion c (psf)	Friction Angle ϕ (degrees)	Total Moist Unit Weight γ (pcf)	Moisture Content (%)	Total Saturated Unit Weight γ (pcf)	Deformation Modulus E_p (ksi)	Strength Reduction Factor
0 to 2	Topsoil	200	30	115	15	125	1.5	1.0
2 to 20+	Otay Formation – Siltstone/Claystone	450	30	132	10	138	4.0	1.0

Note: Based on the subsurface conditions encountered at SL-4.

TABLE 7
RECOMMENDED SOIL PARAMETERS FOR PIER FOUNDATION DESIGN (Z31768)

Depth (feet)	Soil/Rock Type	Unit Cohesion c (psf)	Friction Angle ϕ (degrees)	Total Moist Unit Weight γ (pcf)	Moisture Content (%)	Total Saturated Unit Weight γ (pcf)	Deformation Modulus E_p (ksi)	Strength Reduction Factor
0 to 15	Undocumented Fill	150	28	115	15	125	0.7	1.0
15 to 20	Colluvium	300	30	120	15	129	2.0	1.0
20 to 45	Fanglomerate Deposits	300	36	127	10	135	4.0	1.0
45+	Metavolcanic Rock	3000	40	137	5	144	6.0	0.9

Note: Based on the subsurface conditions encountered at SL-3.

TABLE 8
RECOMMENDED SOIL PARAMETERS FOR PIER FOUNDATION DESIGN (Z34102)

Depth (feet)	Soil/Rock Type	Unit Cohesion c (psf)	Friction Angle ϕ (degrees)	Total Moist Unit Weight γ (pcf)	Moisture Content (%)	Total Saturated Unit Weight γ (pcf)	Deformation Modulus E_p (ksi)	Strength Reduction Factor
0 to 20	Otay Formation – Siltstone/Claystone	450	30	132	10	138	2.2	1.0
20 to 60+	Fanglomerate Deposits	300	36	127	10	135	4.0	1.0

Note: Based on the subsurface conditions encountered at SL-2.

TABLE 9
RECOMMENDED SOIL PARAMETERS FOR PIER FOUNDATION DESIGN (Z31745)

Depth (feet)	Soil/Rock Type	Unit Cohesion c (psf)	Friction Angle ϕ (degrees)	Total Moist Unit Weight γ (pcf)	Moisture Content (%)	Total Saturated Unit Weight γ (pcf)	Deformation Modulus E_p (ksi)	Strength Reduction Factor
0 to 1½	Topsoil	200	30	115	15	125	1.5	1.0
1½ to 5	Otay Formation - Sandstone	200	30	127	15	132	2.0	1.0
5 to 13	Otay Formation – Sandy Gravel	250	36	132	10	138	3.5	1.0
13 to 41+	Otay Formation – Siltstone	700	29	125	25	125	3.0	1.0

Note: Based on the subsurface conditions encountered in Boring B-22.

TABLE 10
RECOMMENDED SOIL PARAMETERS FOR PIER FOUNDATION DESIGN (Z731391)

Depth (feet)	Soil/Rock Type	Unit Cohesion c (psf)	Friction Angle ϕ (degrees)	Total Moist Unit Weight γ (pcf)	Moisture Content (%)	Total Saturated Unit Weight γ (pcf)	Deformation Modulus E_p (ksi)	Strength Reduction Factor
0 to 1	Undocumented Fill	150	28	115	15	125	0.7	0.3
1 to 5	Terrace Deposits – Sandy Gravel	150	36	124	11	133	3.0	0.4
5 to 17	Terrace Deposits – Clayey Sand	450	31	128	11	135	3.5	0.5
17 to 45	Otay Formation – Siltstone/Claystone	450	30	132	10	138	4.0	1.0
45+	Metavolcanic Rock	3000	40	137	5	144	6.0	0.9

Notes: (a) Based on the subsurface conditions encountered in Boring B-18 and at SL-10.
(b) Strength reduction within upper 17 feet due to adjacent slope with significant erosion.

We understand that micropile foundations are considered for the seven poles including Z81097, Z81973, Z31729, Z31744, Z31768, Z34102, and Z31745. Based on our adjacent explorations, some locations are underlain by up to 20 feet of surficial soils and or deposits over more competent formational materials. We would recommend that all micropiles be extended at least 10 feet into the competent formational materials from a geotechnical engineering standpoint. Thus, the recommended minimum embedment of micropile for each structure is listed below:

- Z81097 – minimum embedment of 30 feet.
- Z81973 – minimum embedment of 28 feet.
- Z31729 – minimum embedment of 13 feet.
- Z31744 – minimum embedment of 12 feet.
- Z31768 – minimum embedment of 30 feet.
- Z34102 – minimum embedment of 30 feet.
- Z31745 – minimum embedment of 15 feet.

Note the minimum embedment from a geotechnical engineering standpoint is not recommended in lieu of the other structural requirements, and we understand that the micropiles will be designed by a micropile specialty contractor and/or structural engineer based on the specific design requirements and our recommended soil parameters.

We understand from SDG&E that the proposed pole Z731391 may be subject to potential scour due to the proximity to Otay River channel. In general, local scour is a function of the depth of water, diameter of drilled pier, gradation of surficial soil, and the velocity of flow. A hydrologic and/or hydraulic report for the project is not available at this point. However, our review of the current FEMA online flood hazards map indicates that this pole is not located within "High Risk Area – Floodway" nor "High Risk Area", but within "Moderately Risk Area" as depicted on Figure 1, *Flood Hazards Map*. Therefore the potential for local scour at this pole is considered low.

Pole Z731391 is located adjacent to a slope where rills and gullies due to erosion processes were observed. It is our opinion that the slope is not safe under the existing condition and should be repaired together with a proper drainage system so that runoff does not flow over the top of slope. The strength reduction due to adjacent slope with significant erosion has been incorporated into our recommended soil parameters.

CONSTRUCTION CONSIDERATIONS

We expect very dense to hard formational materials with varying amounts of gravel, cobbles, and boulders will be encountered during some pole installations at the site. The contactor should have auger, core barrels, and excavating tools suitable for penetrating dense layers, concretions, and cemented zones on-site during the pole construction.

Regional groundwater level is expected to be in excess of 100 feet below site grade. Slight seepage was encountered in Boring B-10 at approximately depth of 18 feet. Ground water or perched groundwater could be encountered during construction following heavy rainfall, runoff, and/or irrigation. Sloughing or reveling could occur where relatively clean sands are encountered below the groundwater level. Casing and/or wet methods may be necessary for the installation of pole foundation below groundwater, if any.

The drilling equipment should allow maneuverability on difficult and sloped terrain, penetration and support of weak and unconsolidated soils, and/or rotary percussive drilling in obstructions including cobbles and hard formational materials.

Very dense to hard formational materials and metavolcanic rock are expected below the surficial undocumented fill, topsoil, colluvium, and terrace deposits at the site. The contractor should mobilize appropriate drilling equipment for the pier and/or micropile installation.

An experienced contractor specializing in pier and/or micropile construction and familiar with the regional geologic conditions should be selected for the project. The micropile specialty contractor is responsible for furnishing of all design, materials, products, accessories, tools, equipment, services, transportation, labor and supervision, and manufacturing techniques required for design, installation and testing of micropiles and pile top attachments for the project.

The micropile contractors should also be aware that due to the permeable nature of overburden soils and formation, grout overrun beyond the theoretical quantity of drilled hole should be expected.

The contractor should prepare and submit a full-length installation record for each micropile installed. Pile load tests including verification load tests and proof load tests, if required, should be performed in accordance with the standard procedures of *Micropile Design and Construction Guidelines* (FHWA, June 2000) or other guidelines. Grout testing should also be performed as a part of QA/AC procedures.

Should you have any questions regarding this letter, or if we may be of further service, please contact the undersigned at your convenience.

Very truly yours,

GEOCON INCORPORATED

Michael C. Ertwine
PG 9027

Yong Wang
GE 2775

YW:MCE:dmc

Enclosure: Figure 1, Flood Hazards Map

(2) Addressee

SDG&E TL649
WOOD TO STEEL IMPROVEMENTS
SAN DIEGO COUNTY, CALIFORNIA

NO SCALE

FLOOD HAZARDS MAP

GEOCON
INCORPORATED
GEOTECHNICAL ■ ENVIRONMENTAL ■ MATERIALS
6960 FLANDERS DRIVE - SAN DIEGO, CALIFORNIA 92121 - 2974
PHONE 858 558-6900 - FAX 858 558-6159
PROJECT NO. G1115 - 52 - 54
FIGURE 1
DATE 10 - 28 - 2014

Ladrillono

Y:\1_GEOTECH\G1000\G1115-52-54\2014-10-28\G1115-52-54 Flood Hazards Map.dwg

Project No. G1115-52-54
March 31, 2015

San Diego Gas and Electric Company
Civil/Structural Engineering
8316 Century Park Court
San Diego, California 92123

Attention: Mr. Tyler Lonsdale

Subject: SUPPLEMENTAL GEOTECHNICAL RECOMMENDATIONS
UPDATED LOCATION OF POLE Z731391 FOUNDATION
SDG&E TL649 WOOD TO STEEL IMPROVEMENTS
M.S.A. 6160015454
SAN DIEGO, CALIFORNIA

Dear Mr. Lonsdale:

In accordance with your request, this letter presents our supplemental geotechnical recommendations for the updated location of subject steel pole foundation (Z731391). Geocon Incorporated previously performed geotechnical investigation for the subject project and presented our findings and recommendations in the report titled: *Geotechnical Investigation, SDG&E TL649 Wood to Steel Improvements, M.S.A. 6160015454, San Diego, California*, dated January 29, 2014 (Revised February 24, 2014, Project No. G1115-52-54). Additional recommendations were provided in a letter titles: *Supplemental Geotechnical recommendation, SDG&E TL 649 Wood to Steel Improvement, M.S.A. 6160015454, San Diego, California*, dated October 28, 2014 (Project No. G1115-52-54).

We understand the proposed location for the subject pole (Z731391) has been updated per Table 1 below.

TABLE 1
PROPOSED LOCATION FOR Z731391)

Item	Structure No.	Latitude	Longitude	Work Being Done
New	Z731391	32.5982231°	-116.9417452°	New steel FDN (TYP) pole

A generalized subsurface soil profile has been developed for the area surrounding the pole foundation based on the data obtained from our exploration. Soil layers have been categorized by depth below the existing grade and assigned soil parameters that may be utilized with the *MFAD* computer program used by SDG&E for pier and/or micropile foundation design.

Table 2 summarizes the average total unit weight, cohesive strength, angle of internal friction, and deformation modulus assigned to the soil layers beneath the proposed pole site. The parameters presented herein are based on current and past experience and/or testing of similar materials. We have assumed that the existing grade will not be changed significantly. If the finalized improvements are different from those currently proposed, Geocon Incorporated should be contacted for further evaluation.

TABLE 2
RECOMMENDED SOIL PARAMETERS FOR PIER FOUNDATION DESIGN (Z731391)

Depth (feet)	Soil/Rock Type	Unit Cohesion c (psf)	Friction Angle ϕ (degrees)	Total Moist Unit Weight γ (pcf)	Moisture Content (%)	Total Saturated Unit Weight γ (pcf)	Deformation Modulus E_p (ksi)	Strength Reduction Factor
0 to 1	Undocumented Fill	150	28	115	15	125	0.7	0.3
1 to 5	Terrace Deposits – Sandy Gravel	150	36	124	11	133	3.0	0.4
5 to 17	Terrace Deposits – Clayey Sand	450	31	128	11	135	3.5	0.5
17 to 45	Otay Formation – Siltstone/Claystone	450	30	132	10	138	4.0	1.0
45+	Metavolcanic Rock	3000	40	137	5	144	6.0	0.9

Notes: (a) Based on the subsurface conditions encountered in Boring B-18 and at SL-10.
(b) Strength reduction within upper 17 feet due to adjacent slope with significant erosion.

We understand from SDG&E that the proposed location for pole Z731391 has been updated to stay outside the potential scour zone. Our review of the current FEMA online flood hazards map indicates that this pole is not located within "Moderately Risk Area" as depicted on Figure 1, *Flood Hazards Map*. Therefore the potential for local scour at this pole is considered low.

Pole Z731391 is located adjacent to a slope where rills and gullies due to erosion processes were observed. It is our opinion that the slope is not safe under the existing condition and should be repaired together with a proper drainage system so that runoff does not flow over the top of slope. The strength reduction due to adjacent slope with significant erosion has been incorporated into our recommended soil parameters.

Very dense to hard formational materials and metavolcanic rock are expected below the surficial undocumented fill, topsoil, colluvium, and terrace deposits at the site. The contactor should have auger, core barrels, and excavating tools suitable for penetrating dense layers, concretions, and cemented zones on-site during the pole construction.

Ground water or perched groundwater could be encountered during construction following heavy rainfall, runoff, and/or irrigation. Sloughing or reveling could occur where relatively clean sands are encountered below the groundwater level. Casing and/or wet methods may be necessary for the installation of pole foundation below groundwater, if any.

The drilling equipment should allow maneuverability on difficult and sloped terrain, penetration and support of weak and unconsolidated soils, and/or rotary percussive drilling in obstructions including cobbles and hard formational materials.

An experienced contractor specializing in pier and/or micropile construction and familiar with the regional geologic conditions should be selected for the project. The micropile specialty contractor is responsible for furnishing of all design, materials, products, accessories, tools, equipment, services, transportation, labor and supervision, and manufacturing techniques required for design, installation and testing of micropiles and pile top attachments for the project.

Should you have any questions regarding this letter, or if we may be of further service, please contact the undersigned at your convenience.

Very truly yours,

GEOCON INCORPORATED

Michael C. Ertwine
PG 9027

Yong Wang
GE 2775

MCE:YW:ejc

Enclosure: Figure 1, Flood Hazards Map

(2) Addressee
(e-mail) SDG&E
Attention: Ms. Risa Arai

Stay Dry

Updated Z731391 32.5982231°, -116.9417452°

Reference Layers

NFHL Data Available

FIRM Panel Boundary

Flood Risk Areas

High Risk Area - Floodway

High Risk Area

Moderate Risk Area

Low to Moderate Risk Area (reduced risk due to levee)

Low to Moderate Risk Area

Undetermined Risk Area

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PROJECT NO. G1115-52-54
FIGURE 1 - FLOOD HAZARDS MAP

©2010 Google

1994

lat 32.598193° lon -116.941537° elev 296 ft

Eye alt 2724 ft