APPENDIX Q
GEOLOGIC HAZARD STUDY
GEOTECHNICAL INFORMATION

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APPENDIX Q

GEOLOGIC HAZARD STUDY
GEOTECHNICAL INFORMATION
COLUSA POWER PLANT

Q.1 FIELD EXPLORATION

As part of the Colusa Power Plant Geologic Hazards Study, URS performed a field exploration program consisting of four borings with the principal objective of collecting geotechnical data necessary for evaluating the engineering characteristics of the subsurface soil strata. Three borings were drilled to depths of approximately 50 feet, and one boring was drilled to 80 feet. The locations of the borings, shown on Figure Q-1, were chosen to evaluate the subsurface conditions across a broad area of the proposed site to provide a preliminary geotechnical characterization of the site. Soil samples were collected at 5-foot intervals using the Standard Penetration Test (SPT) sampler and the Dames & Moore U-sampler. The soil samples were examined in the field by a URS geologist and classified according to the Unified Soil Classification System (USCS). Logs of the borings are presented on Plates Q1-1 through Q1-4. A soil classification chart and key to the test data are presented on Plate Q1-5.

A geotechnical laboratory testing program was performed on selected samples from the field exploration program to determine the index and engineering properties of the subsurface soils. Geotechnical testing was performed by Signet Testing Labs, a URS company, at their Hayward, California facility. Results of the index and direct shear tests are summarized on Table Q-1 and are included on the boring logs on Plates Q1-1 through Q1-4. Grain size distributions are shown on Plates Q2-1 through Q2-8. Direct shear results are shown on Plate Q2-9.

Q.2 SUBSURFACE CONDITIONS

The subsurface soils to the maximum depth explored (80 feet) can be divided into two strata: the Surficial Clay and the Silty Deposit.

Surficial Clay: The Surficial Clay consists of a 2 to 8 feet thick, medium stiff to very stiff dark brown clay to sandy clay with trace amounts of roots. In borings B1, B2, and B3, the clay was classified as a lean clay (CL), and in B4 the surficial clay was a fat clay (CH). Laboratory tests indicate that the surficial clay layer has a high to very high swell potential with plasticity index results ranging from 25 to 37 percent. The natural water content of the clay was measured at 18.9 percent and 22.5 percent in borings B2 and B4, respectively, whereas the plastic limit was measured at 22 percent and 19 percent, respectively. Because the natural moisture level is very close to the plastic limit of this soil, the introduction of moisture will cause this soil to swell.

Silty Deposit: The Silty Deposit was explored to a depth of approximately 50 feet in B1, B2, and B4, and to a maximum depth of 80 feet in B3. This unit generally consists of very stiff to hard, brown, light brown, and brownish yellow silt to sandy silt with varying amounts of clay interbedded with occasional silty sand and lean clay lenses. In the deeper boring (B3), the color below 60 feet was a dark greenish gray. This may be an indication of the groundwater table, because all the soils above the depth of 60 feet were various shades of brown, which could reflect oxidation as a result of exposure to air. Laboratory tests indicate that the moisture content for the Silty Deposit above a depth of 10 feet ranged from 17 to 18 percent. Below 10 feet, the water content was slightly higher, ranging from 19 to 25 percent. Total density was more scattered, with values ranging from 108 to 130 pounds per cubic foot.

Q.3 PRELIMINARY CONCLUSIONS

The selection of the foundation support system for the proposed structures must satisfy the requirements of support for the imposed loads while controlling settlements under the proposed structures within tolerable limits.

Q.3.1 EXPANSIVE SURFICIAL CLAY

The Surficial Clay layer ranges in thickness from 2 to 8 feet and has a high to very high swell potential with a plasticity index ranging from 25 to 37 percent, and natural moisture contents at or near the plastic limit. This layer should *not* be considered as a competent foundation layer. The introduction of moisture will cause this clay to swell and exert significant and potentially damaging heave pressures on any medium to light-weight structure placed upon the clay surface. This clay should be stripped and removed prior to construction.

Q.3.2 LIQUEFACTION POTENTIAL

URS evaluated liquefaction potential for the project site based on subsurface data obtained from the field investigation. It is generally recognized that liquefaction will occur in saturated, loose to medium dense sands and silty sands during moderate to strong ground shaking from earthquakes. Conventional evaluation of liquefaction in sands involves evaluation of in situ density and resistance to cyclic stresses based on penetration resistance data (Youd and Idriss, 1996; Seed et al., 1983). This approach is valid typically for clean sands to silty sands with no greater than 35 to 45 percent fines content by weight. Based on field identification and laboratory tests, the silty sand lenses within the Silty Deposit generally have between 12 and 40 percent fines content. Based on observed typical penetration resistance values of greater than 30 blows per foot, these lenses are too dense to be subject to liquefaction under moderate to strong ground shaking.

Significant cyclic loss of strength and settlements can potentially occur in saturated, soft, non-plastic and low-plasticity plastic silts. The four borings drilled for this investigation indicated that the silts were all very stiff to hard with blow counts exceeding 40 blows per 12 inches of drive. Therefore, URS does not believe the silts within the Silty Deposit will be subject to liquefaction.

Q.3.3 PRELIMINARY FOUNDATION CONCEPTS

The Silty Deposit consists of very stiff to hard silts to sandy silts interbedded with silty sand and lean clay lenses. This layer can provide competent foundation support and does not present a liquefaction hazard.

Three options have been considered for foundation design: (1) a mat foundation; (2) a drilled pier foundation; or (3) a driven pile foundation. If a mat foundation is considered, the most important foundation design consideration will be the allowable differential settlement. Very heavy power-generating turbines may not be able to tolerate much differential foundation settlement. Therefore, the mat foundation design must carefully consider the compressibility characteristics of the underlying silts and any thin clay lenses that may be present.

Drilled piers would rely primarily on either shaft friction or end-bearing resistance in the very stiff to hard silts of the Silty Deposit. This foundation system can be installed without casing by the dry method, provided that the groundwater table is below the bottom depth of the drilled piers and the soils are not subject to caving. Based on the four preliminary borings, it appears that the drilled piers could be installed in this manner.

A driven pile foundation can rely upon the end-bearing and frictional support provided by the Silty Deposit. Based on the preliminary information, driven piles most likely would be designed as friction elements. Pre-drilling would be required to design driven piles as end-bearing elements.

Future geotechnical investigations for foundation design should focus on the strength characteristics of the silts throughout the Silty Deposit and the compressibility behavior of the shallower silts and the clay lenses.

Q.4 REFERENCES

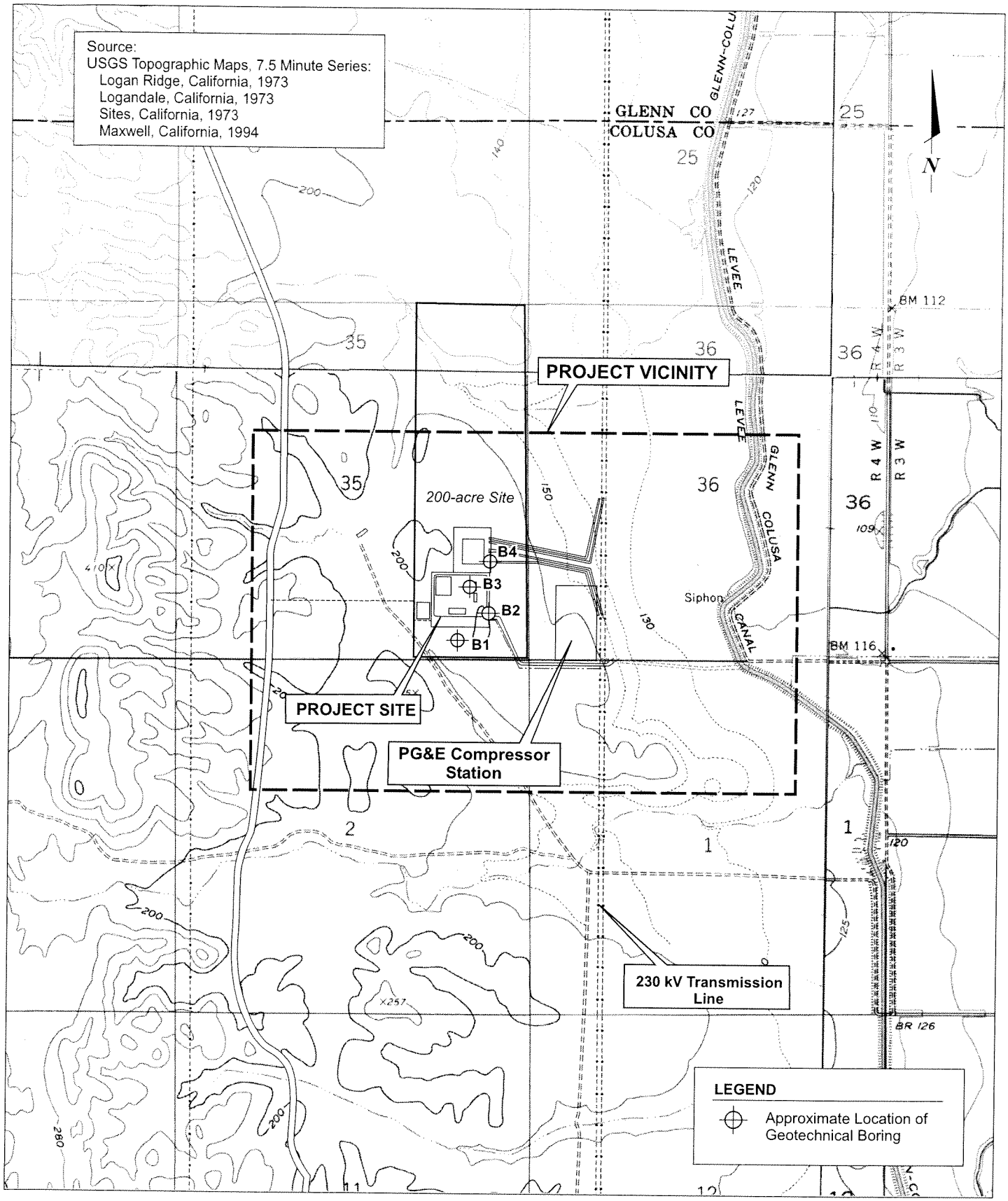
Seed, H.B., I.M. Idriss, and I. Arrango, 1983. "Evaluation of Liquefaction Potential Using Field Performance Data," Journal of Geotechnical Engineering, Vol. 111, No. 12, pp. 1425-1445.

Youd, T.L. and Idriss, I.M. (ed.), 1996. "Proceedings of the NCEER Workshop on Evaluation of Liquefaction Resistance of Soils," National Center for Earthquake Engineering Research, Salt Lake City, January 5-6, 1996.

Table Q-1
Summary of Laboratory Index Test Results

Boring	Depth (ft)	Soil Type	Moisture Content (%)	Total Density (pcf)	Dry Density (pcf)	Passing #200 Sieve (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index	Other Tests
B1	5.0	SM	13.8	113.8	100.0	40				
	10.0	ML	16.7							
	15.0	ML	24.3	125.1	100.6					
	20.0	ML	22.7							
	25.0	SM				41				SA
	30.0	SM	20.1							
	40.0	ML	23.7							
B2	3.0	CL	18.9			69	47	22	25	SA
	10.0	ML	15.1							
	15.0	ML	21.2	129.0	106.4					
	20.0	ML	24.6							
	30.0	ML	22.5							
	35.0	ML	22.1							
	50.0	ML	24.1							
B3	5.0	ML	13.2			59				SA
	10.0	ML	18.1	108.4	91.8					
	15.0	CL	22.4			79	44	26	18	
	20.0	ML	19.4	125.4	105.0					
	25.0	ML				70				SA
	25.0	ML	21.4	114.5	94.3					DSCD
	25.0	ML	22.0	114.2	93.6					DSCD
	25.0	ML	23.7	112.6	91.0					DSCD
	30.0	ML	24.5	126.6	101.7					
	35.0	ML	20.3							
	45.0	ML	25.0							
	55.0	ML	27.0							
	60.0	CL	23.5	128.1	103.7	70	39	24	15	SA
	80.0	ML	20.6							
B4	0.0	CH	22.5			83	56	19	37	SA
	5.0	ML	14.7	110.7	96.5					
	10.0	ML	13.2	120.6	106.5					
	15.0	ML	22.9							
	20.0	SM				18				SA
	25.0	ML	21.2							
	40.0	ML	22.5	129.9	106.0					
	45.0	ML	22.2							
	50.0	ML	19.3							

Notes: SA = Sieve Analysis
DSCD = Consolidated Drained Direct Shear



0 2000 4000

Scale in Feet
1:24,000

PLOT PLAN

Colusa Power Plant
Reliant Energy
Colusa County, California

43-00066841.00

URS

FIGURE Q-1

5/31/01 vsa ..\46800-930\Appendices\FigQ-1.cdr

BORING B-1

DEPTH IN FEET	LABORATORY TEST DATA: TESTS REPORTED ELSEWHERE	ATTERBERG LIMITS: LIQUID LIMIT (%)	ATTERBERG LIMITS: PLASTICITY INDEX (%)	STRENGTH DATA: TYPE OF TEST	STRENGTH DATA: NORMAL OR CONFINING PRESSURE (PSF)	STRENGTH DATA: SHEAR STRENGTH (PSF)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	SAMPLING: TYPE OF SAMPLER	SAMPLING: SAMPLING RESISTANCE	SAMPLES	SYMBOL	DESCRIPTION
0									BULK			ML	DARK BROWN CLAYEY SILT to SILTY CLAY, trace sand, roots, moist, medium stiff.
												SM	BROWN SILTY FINE SAND, trace clay, some concretions, mottled, dry to moist, dense.
5									U	64			
												ML	BROWN SILT, trace sand, trace concretions, moist, hard.
10									SPT	41			
15									U	64			Pocket Penetrometer Qu > 9,000 psf Torvane Qu = 9,000 psf
20									SPT	43			Grades less sand.
25									U				BROWNISH YELLOW SILT, trace coarse to fine sand, moist, hard. Pocket Penetrometer Qu = 5,000 psf Torvane Su = 2,500 psf
30									SPT	59			Grades trace clay.
35												ML	BROWN SILT, trace clay, sand, moist, hard.

Continued Next Page

Job No: 46800-930-043 Pt. ID: RELIANT.GPJ / B-1	URS Dames & Moore		**Log of Boring**
Date Completed: 3/23/01 Boring Depth: 51.5 ft.	Surface Elev: 168.5 feet (NGVD) Coordinates:		Location: Colusa County

BORING B-1

DEPTH IN FEET	LABORATORY TEST DATA: TESTS REPORTED ELSEWHERE	ATTERBERG LIMITS: LIQUID LIMIT (%)	ATTERBERG LIMITS: PLASTICITY INDEX (%)	STRENGTH DATA: TYPE OF TEST	STRENGTH DATA: NORMAL OR CONFINING PRESSURE (PSF)	STRENGTH DATA: SHEAR STRENGTH (PSF)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	SAMPLING: TYPE OF SAMPLER	SAMPLING: SAMPLING RESISTANCE	SAMPLES
35									U	50/3"	
40									SPT	86	
45									U	50/6"	
50									SPT	90	
55											
60											
65											
70											

SYMBOL | DESCRIPTION

Notes:

1. Boring completed to a depth of 51.5 feet on March 23, 2001, and was backfilled with cement grout.
2. Boring log indicates interpreted subsurface conditions only at the location and the time that the borehole was drilled.
3. Sampling resistance for "SPT" and "U" samplers measured in blows per foot to drive the sampler 12 inches after an initial seating depth at 6 inches, and using a 140 lb hammer dropping 30 inches.
4. Groundwater was not measured due to the drilling method.

BORING B-2

DEPTH IN FEET	TESTS REPORTED ELSEWHERE	ATTERBERG LIMITS: LIQUID LIMIT (%)	ATTERBERG LIMITS: PLASTICITY INDEX (%)	STRENGTH DATA: TYPE OF TEST	STRENGTH DATA: NORMAL OR CONFINING PRESSURE (PSF)	STRENGTH DATA: SHEAR STRENGTH (PSF)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	SAMPLING: TYPE OF SAMPLER	SAMPLING: SAMPLING RESISTANCE	SAMPLES	SYMBOL	DESCRIPTION
0												ML	BROWN SILTY with sand, trace clay, very stiff, moist to dry.
5									U		■		
												ML	
10									SPT	88	▌		
15									U	13/50	■		grades to brown to light brown. Pocket Penetrometer: Su > 4,500 psf
20									SPT	47	▌	ML	BROWN TO LIGHT BROWN SILT, trace clay, trace fine sand, stiff, moist.
25									U		■		
30												CL ML	BROWN SILT, trace clay, fine sand, stiff, moist. Pocket Penetrometer Su = 3,000 psf
35													

Continued Next Page

Job No: 46800-930-043 Pt. ID: RELIANT.GPJ / B-2	URS Dames & Moore		**Log of Boring**
Date Completed: 3/23/01 Boring Depth: 51.5 ft.	Surface Elev: 193.5 feet (NGVD) Coordinates:		Location: Colusa County

BORING B-2

DEPTH IN FEET	LABORATORY TEST DATA: TESTS REPORTED ELSEWHERE	ATTERBERG LIMITS: LIQUID LIMIT (%)	ATTERBERG LIMITS: PLASTICITY INDEX (%)	STRENGTH DATA: TYPE OF TEST	STRENGTH DATA: NORMAL OR CONFINING PRESSURE (PSF)	STRENGTH DATA: SHEAR STRENGTH (PSF)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	SAMPLING: TYPE OF SAMPLER	SAMPLING: SAMPLING RESISTANCE	SAMPLES
35											
40									SPT	83	
45									SPT	80	
50									SPT	75	
55											
60											
65											
70											

SYMBOL | DESCRIPTION

Notes:

1. Boring completed to a depth of 51.5 feet on March 23, 2001, and was backfilled with cement grout.
2. Boring log indicates interpreted subsurface conditions only at the location and the time that the borehole was drilled.
3. Sampling resistance for "SPT" and "U" samplers measured in blows per foot to drive the sampler 12 inches after an initial seating depth at 6 inches. Using a 140 lb hammer dropping 30 inches.
4. Groundwater was not measured due to the drilling method.

BORING B-3

DEPTH IN FEET	LABORATORY TEST DATA: TESTS REPORTED ELSEWHERE	ATTERBERG LIMITS: LIQUID LIMIT (%)	ATTERBERG LIMITS: PLASTICITY INDEX (%)	STRENGTH DATA: TYPE OF TEST	STRENGTH DATA: NORMAL OR CONFINING PRESSURE (PSF)	STRENGTH DATA: SHEAR STRENGTH (PSF)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	SAMPLING: TYPE OF SAMPLER	SAMPLING: SAMPLING RESISTANCE	SAMPLES	SYMBOL	DESCRIPTION
0												ML	DARK BROWN CLAYEY SILT, little roots, stiff, moist.
												ML	BROWN TO LIGHT BROWN (TAN) SILT with some concretions, stiff, moist.
5									SPT				Pocket Penetrometer Su = 2,000 psf
10									U	43/50			Torvane Su = 1,250 psf
												ML	BROWN CLAYEY SILT with trace sand, very stiff, mottled reddish brown, moist.
15									SPT	66			Pocket Penetrometer Su = 3,250 psf
20									U	40/50			BROWN SILT WITH SAND.
													Torvane Su = 1,250 psf
25									U				grades to little clay
													Torvane Su = 2,000 psf
													Pocket Penetrometer Su = 2,000 psf
30									U				Pocket Penetrometer Su = 2,600 psf
													Torvane Su = 1,400 psf
												ML	BROWNISH YELLOW SANDY SILT, hard, moist.
35													

Continued Next Page

Job No: 46800-930-043 Pt. ID: RELIANT.GPJ / B-3	URS Dames & Moore		**Log of Boring**
Date Completed: 3/22/01 Boring Depth: 80.0 ft.	Surface Elev: 177.5 feet (NGVD) Coordinates:		Location: Colusa County

BORING B-3

DEPTH IN FEET	LABORATORY TEST DATA: TESTS REPORTED ELSEWHERE	ATTERBERG LIMITS: LIQUID LIMIT (%)	ATTERBERG LIMITS: PLASTICITY INDEX (%)	STRENGTH DATA: TYPE OF TEST	STRENGTH DATA: NORMAL OR CONFINING PRESSURE (PSF)	STRENGTH DATA: SHEAR STRENGTH (PSF)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	SAMPLING: TYPE OF SAMPLER	SAMPLING: SAMPLING RESISTANCE	SAMPLES	SYMBOL	DESCRIPTION
35									SPT				
40									U	35/50			BROWN CLAYEY SILT with trace sand, mottled, hard, moist. Pocket Penetrometer Su = 4,500 psf Torvane Su = 2,500 psf
45									SPT	86			Pocket Penetrometer Su = 2,500 psf
50									U	50			Pocket Penetrometer Su = 4,500 psf
55									SPT	67			grades with little sand.
60									U				DARK GREENISH GRAY SILT WITH SAND, hard, massive. Pocket Penetrometer Su = 4,500 psf
65													
												ML	DARK GREENISH GRAY SANDY SILT, hard with trace gravels.
70													

Continued Next Page

BORING B-3

DEPTH IN FEET	LABORATORY TEST DATA: TESTS REPORTED ELSEWHERE	ATTERBERG LIMITS: LIQUID LIMIT (%)	ATTERBERG LIMITS: PLASTICITY INDEX (%)	STRENGTH DATA: TYPE OF TEST	STRENGTH DATA: NORMAL OR CONFINING PRESSURE (PSF)	STRENGTH DATA: SHEAR STRENGTH (PSF)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	SAMPLING: TYPE OF SAMPLER	SAMPLING: SAMPLING RESISTANCE	SAMPLES	SYMBOL	DESCRIPTION
70									U	50	■		Torvane Su = 2,500 psf
75													
													DARK GREENISH CLAYEY SILT with sand
80									SPT	20/50	▮		Pocket Penetrometer Su = 3,000 psf
85													
90													
95													
100													
105													

Job No: 46800-930-043
Pt. ID: RELIANT.GPJ / B-3

URS Dames & Moore

Log of Boring

Log Template: 1A

May 2, 2001

PLATE Q1-3 (Cont.)

BORING B-4

DEPTH IN FEET	TESTS REPORTED ELSEWHERE	LABORATORY TEST DATA: ATTERBERG LIMITS: LIQUID LIMIT (%)	ATTERBERG LIMITS: PLASTICITY INDEX (%)	STRENGTH DATA: TYPE OF TEST	STRENGTH DATA: NORMAL OR CONFINING PRESSURE (PSF)	STRENGTH DATA: SHEAR STRENGTH (PSF)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	SAMPLING: TYPE OF SAMPLER	SAMPLING: SAMPLING RESISTANCE	SAMPLES	SYMBOL	DESCRIPTION
0												CL	DARK BROWN CLAYEY SILT TO SILTY CLAY with trace sand, trace fine roots, medium stiff, dry to moist.
												ML	LIGHT BROWN SANDY SILT with some concretion, dry, stiff, mottled. Pocket Penetrometer Su = 3,500 psf Torvane Su = 2,00 psf
5									U	73			
												ML	BROWNISH YELLOW SILT with little concretion, stiff, moist. Pocket Penetrometer Su = 4,500 psf
10									U	24/50			
												ML	BROWN SILT with little sand, mottled, dry to moist. Pocket Penetrometer Su = 3,500 psf
15									SPT	52			
												SP	YELLOWISH RED SILTY SAND with gravels and trace clay, rounded (1" gravel in shore), very dense, moist. Torvane Su = 1,250 psf
20									U	8/50			
												ML	BROWN SILT with little sand, medium stiff, mottled reddish, moist. Pocket Penetrometer Su = 2,500 psf
25									SPT	54			
30									U	50			
35													

Continued Next Page

Job No: 46800-930-043 Pt. ID: RELIANT.GPJ / B-4	URS Dames & Moore		**Log of Boring**
Date Completed: 3/22/01 Boring Depth: 51.0 ft.	Surface Elev: 188.0 feet (NGVD) Coordinates:		Location: Colusa County

BORING B-4

DEPTH IN FEET	TESTS REPORTED ELSEWHERE	LABORATORY TEST DATA: ATTERBERG LIMITS: LIQUID LIMIT (%)	ATTERBERG LIMITS: PLASTICITY INDEX (%)	STRENGTH DATA: TYPE OF TEST	STRENGTH DATA: NORMAL OR CONFINING PRESSURE (PSF)	STRENGTH DATA: SHEAR STRENGTH (PSF)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	SAMPLING: TYPE OF SAMPLER	SAMPLING: SAMPLING RESISTANCE	SAMPLES	SYMBOL	DESCRIPTION
35									SPT	72			BROWN SILT with some sand, moist, very stiff.
												ML	BROWN CLAYEY SILT with trace sand, stiff, moist, mottled.
40									U	50			Pocket Penetrometer Su = 2,750 psf
45									SPT	84			grades to little sand.
50									SPT	28/50			Torvane Su = 4,350 psf
													Pocket Penetrometer Su = 4,500 psf
55													
60													
65													
70													

Notes:

1. Boring completed at a depth of 51 feet on March 22, 2001.
2. Boring log indicates interpreted subsurface conditions only at the location and the time that the borehole was drilled.
3. Sampling resistance for "SPT" and "U" samplers measured in blows per foot to drive the sampler 12 inches after an initial seating depth at 6 inches. Using a 140 lb hammer dropping 30 inches.
4. Groundwater was not measured due to the drilling method.

Job No: 46800-930-043
Pt. ID: RELIANT.GPJ / B-4

URS Dames & Moore

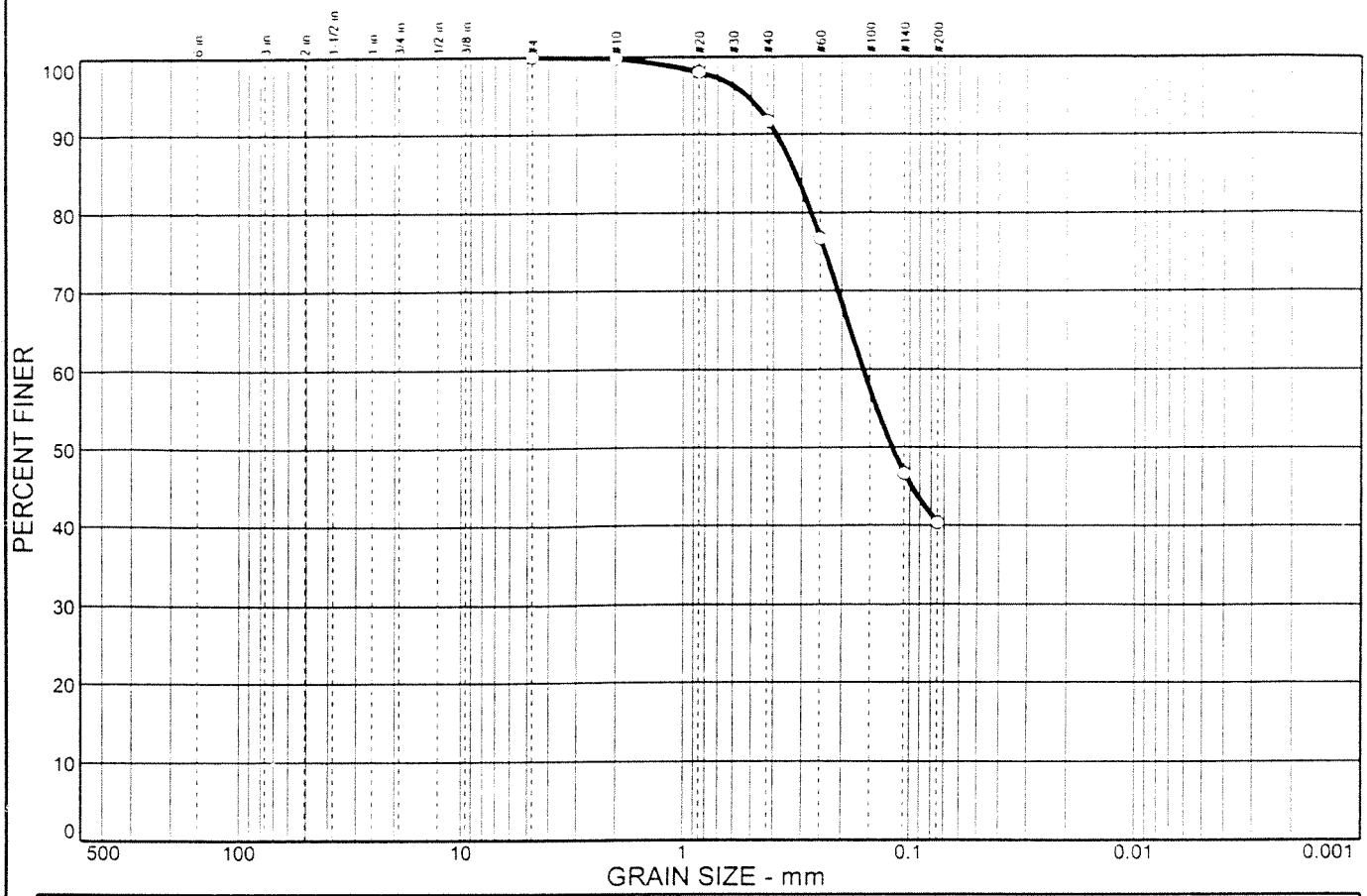
Log of Boring

Log Template: 1A

May 2, 2001

PLATE Q1-4 (Cont.)

Particle Size Distribution Report



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.0	0.2	8.1	51.4	40.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	99.8		
#20	98.0		
#40	91.7		
#60	76.7		
#140	46.6		
#200	40.3		

* (no specification provided)

Soil Description

Yellowish brown Silty sand

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 0.322 D_{60}= 0.161 D_{50}= 0.120
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= SM AASHTO=

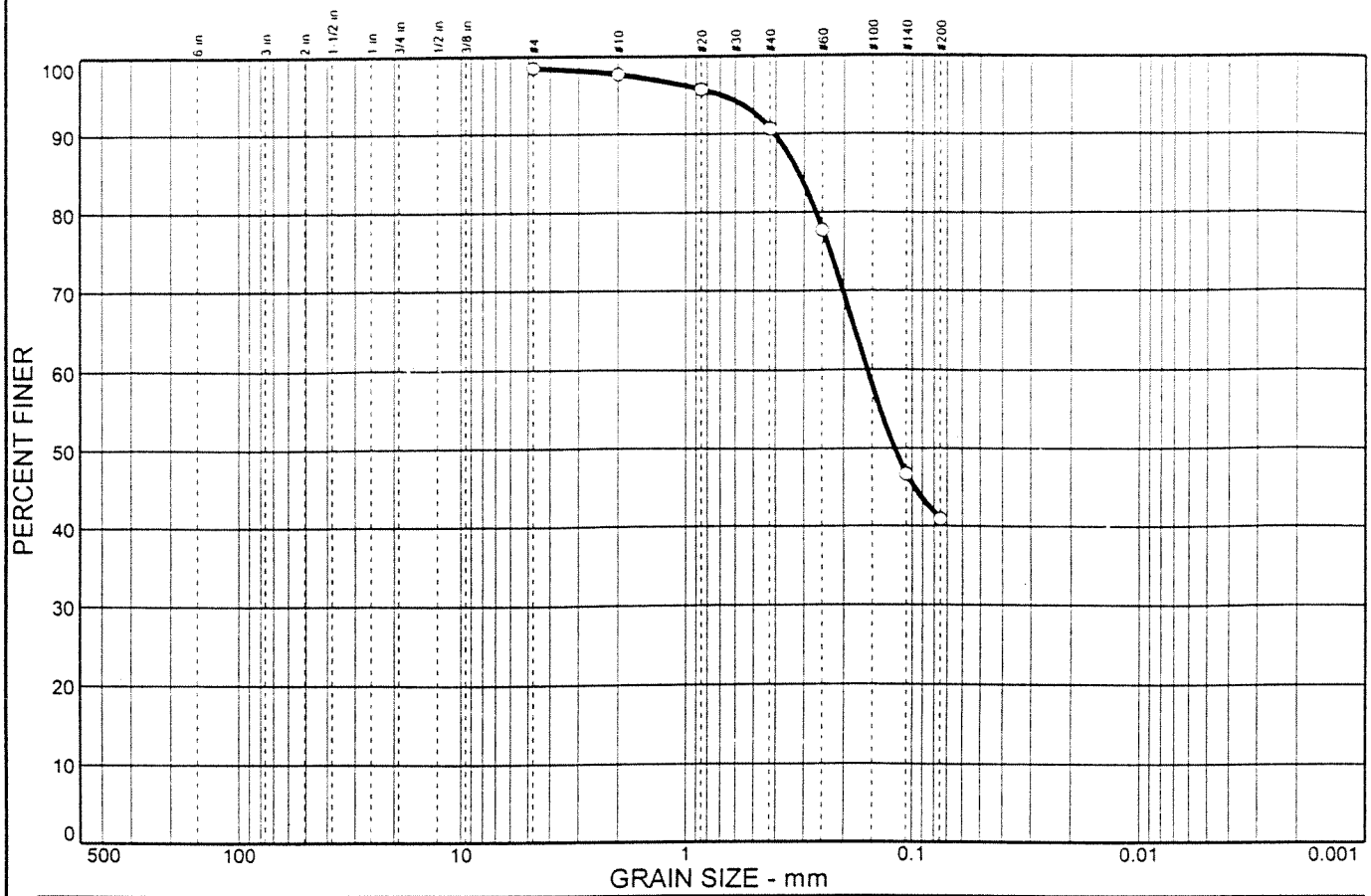
Remarks

Sample No.: 1 Source of Sample: B-1 Date: 4-9-01
Location: Elev./Depth: 5 ft

SIGNET TESTING LABS, INC.

Client: URS Dames & Moore
Project: Reliant Energy Colusa County
Project No: 46800-930-043 Plate

Particle Size Distribution Report



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
			0.8	7.1	49.7	40.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	98.5		
#10	97.7		
#20	95.7		
#40	90.6		
#60	77.7		
#140	46.7		
#200	40.9		

* (no specification provided)

Soil Description

Dark yellowish brown Silty sand

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 0.321 D_{60}= 0.158 D_{50}= 0.120
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= SM AASHTO=

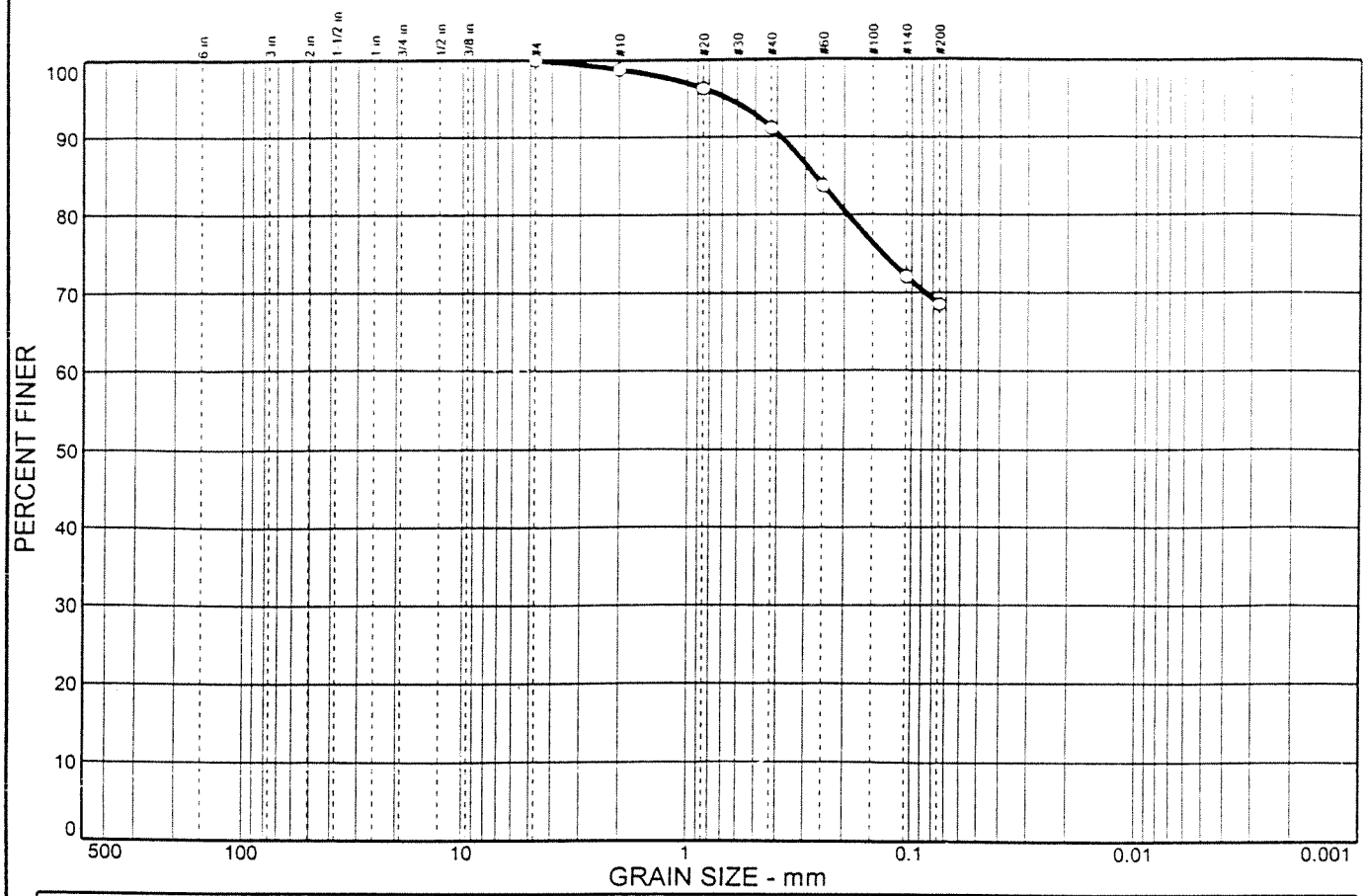
Remarks

Sample No.: 5 Source of Sample: B-1 Date: 4-9-01
Location: Elev./Depth: 25 ft

SIGNET TESTING LABS, INC.

Client: URS / Dames & Moore
Project: Reliant Energy Colusa County
Project No: 46800-930-043 Plate

Particle Size Distribution Report



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.0	1.2	7.7	22.6	68.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	98.8		
#20	96.3		
#40	91.1		
#60	83.7		
#140	72.1		
#200	68.5		

* (no specification provided)

Soil Description

Dark yellowish brown Sandy lean clay

Atterberg Limits

PL= 22 LL= 47 PI= 25

Coefficients

D_{85}= 0.273 D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CL AASHTO=

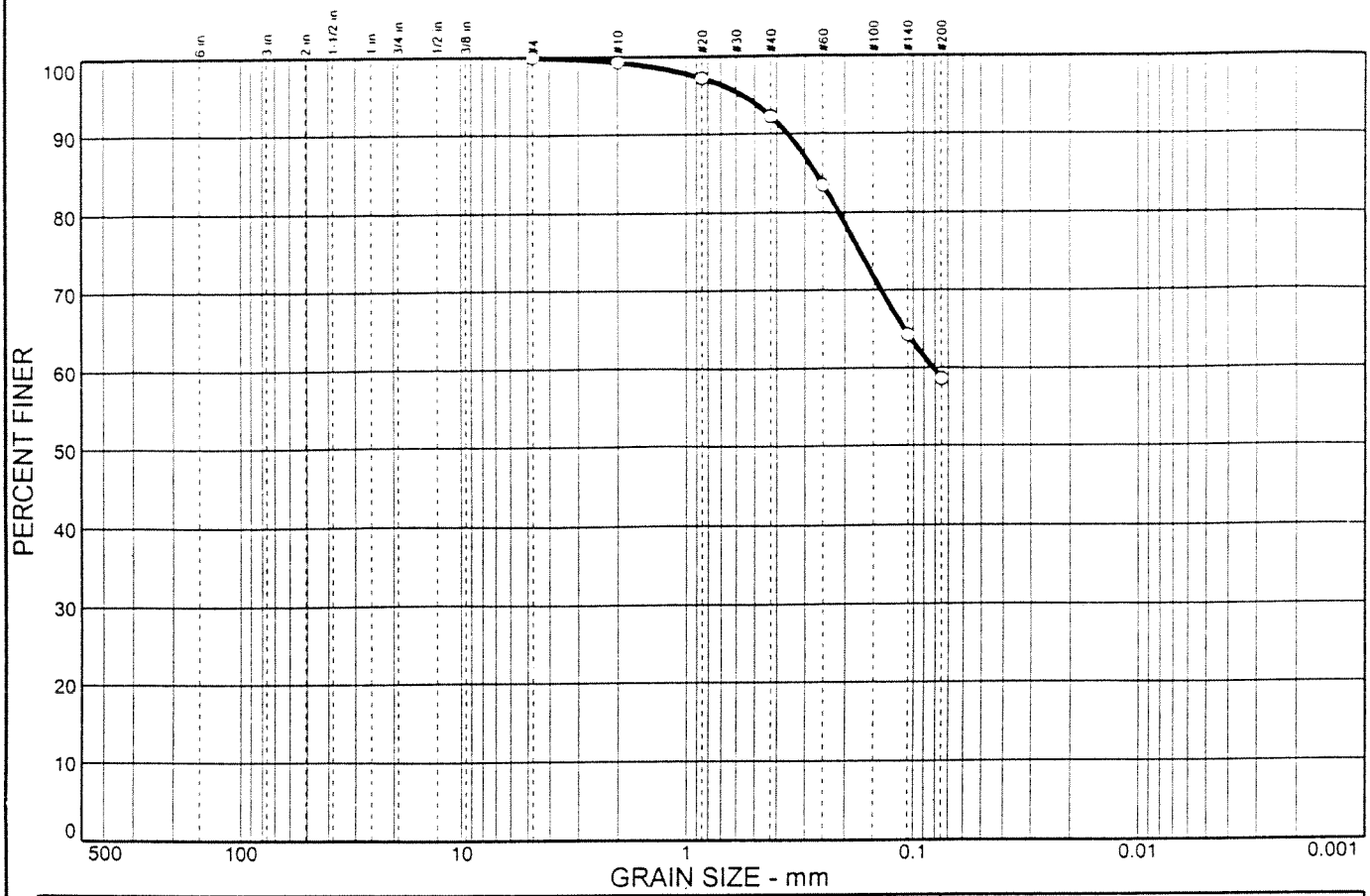
Remarks

Sample No.: Source of Sample: B-2 Date: 4-7-01
Location: Elev./Depth: 2-3 ft

SIGNET TESTING LABS, INC.

Client: URS / Dames & Moore
Project: Reliant Energy Colusa County
Project No: 46800-930-043 Plate

Particle Size Distribution Report



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.0	0.7	7.1	33.6	58.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	99.3		
#20	97.2		
#40	92.2		
#60	83.5		
#140	64.3		
#200	58.6		

* (no specification provided)

Soil Description

Olive yellow Sandy silt

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 0.269 D_{60}= 0.0821 D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= ML AASHTO=

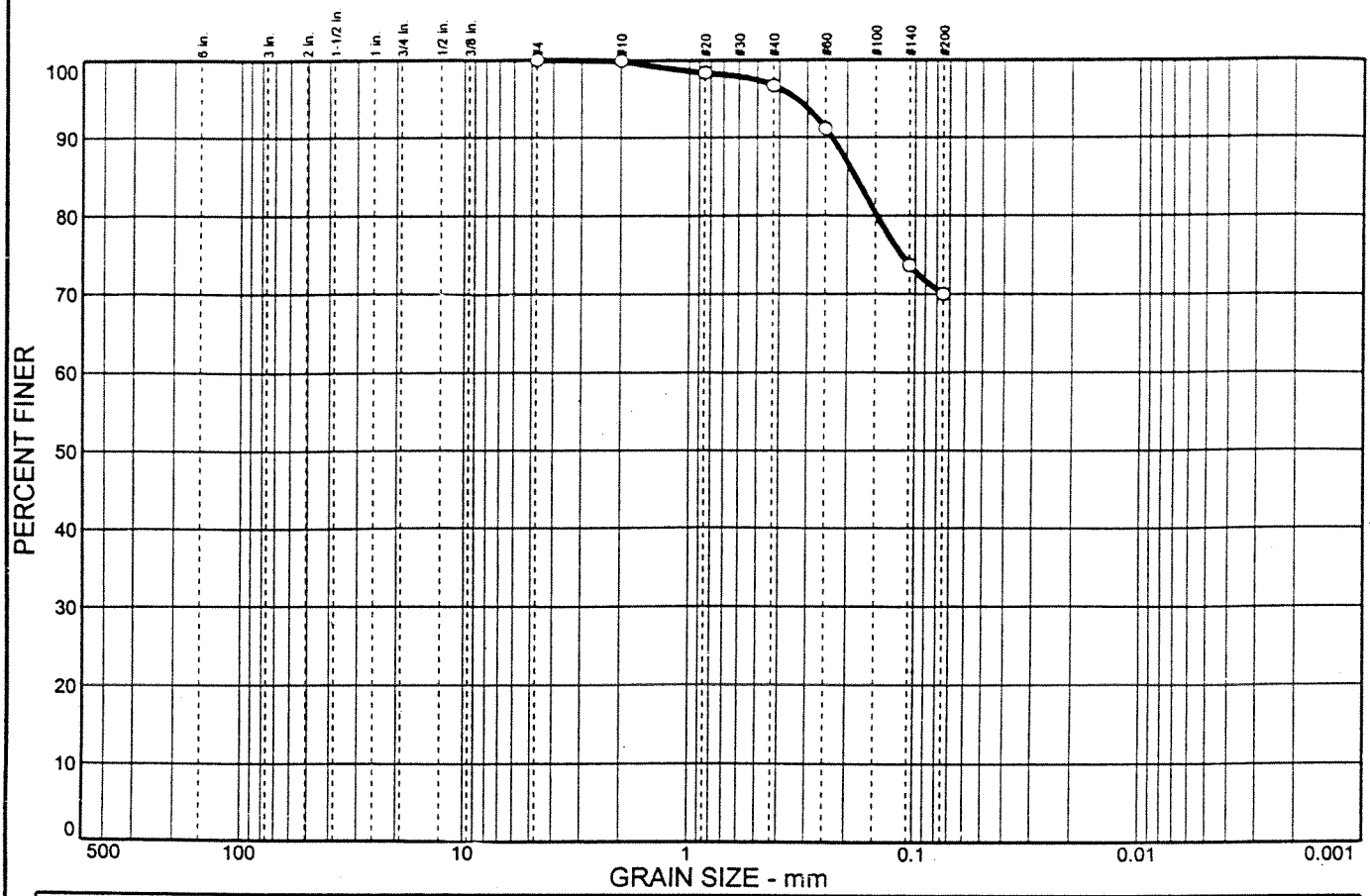
Remarks

Sample No.: 2 Source of Sample: B-3 Date: 4-7-01
Location: Elev./Depth: 5 ft

SIGNET TESTING LABS, INC.

Client: URS / Dames & Moore
Project: Reliant Energy Colusa County
Project No: 46800-930-043 Plate

Particle Size Distribution Report



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.0	0.1	3.2	26.7	70.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	99.9		
#20	98.4		
#40	96.7		
#60	91.1		
#140	73.7		
#200	70.0		

* (no specification provided)

Soil Description

Yellowish brown sandy silt

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 0.185 D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= ML AASHTO=

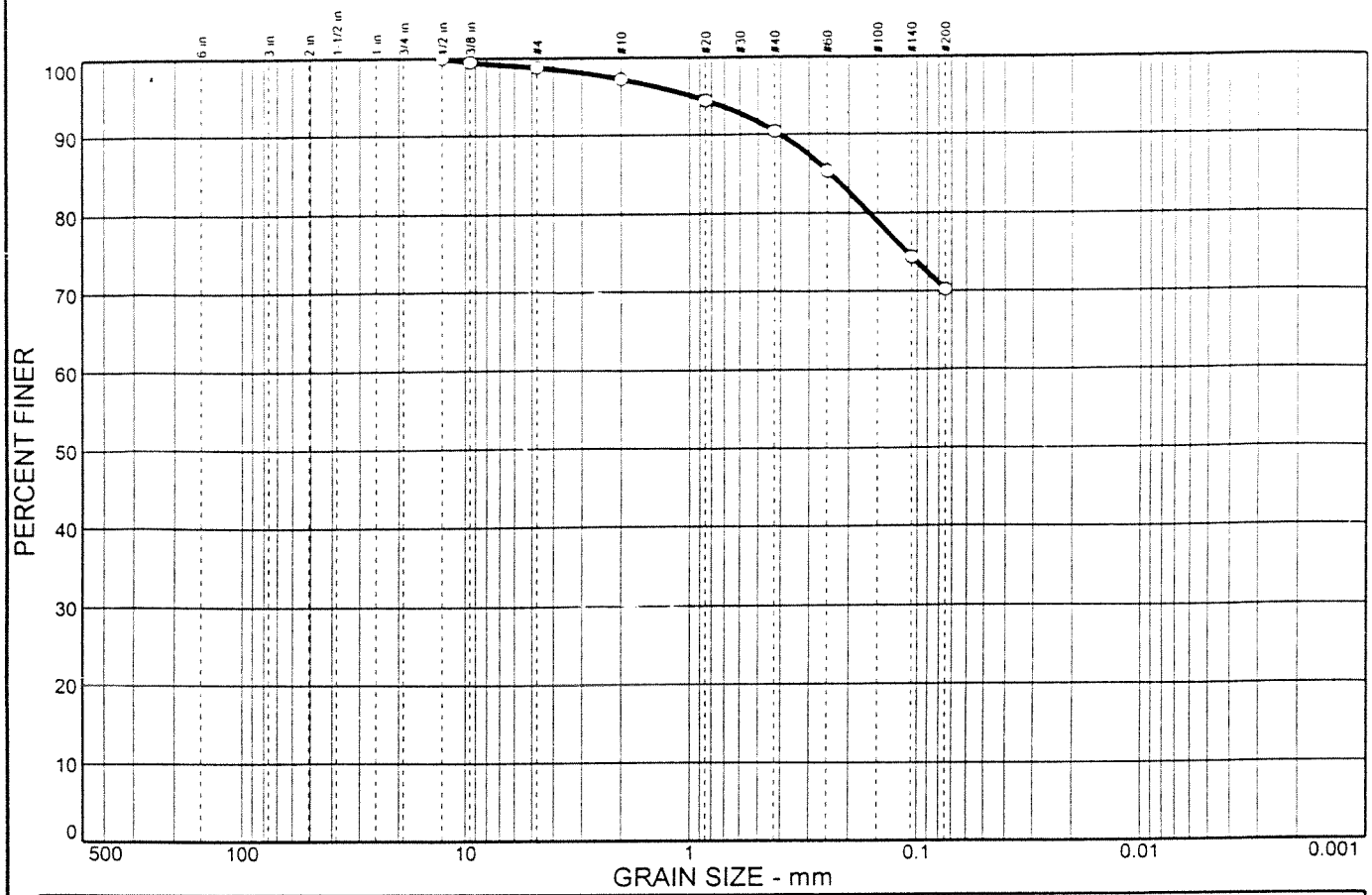
Remarks

Sample No.: 6 **Source of Sample:** B-3 **Date:** 4-13-01
Location: **Elev./Depth:** 25 ft

SIGNET TESTING LABS, INC.

Client: URS / Dames & Moore
Project: Reliant Energy Colusa County
Project No: 46800-930-043 **Plate**

Particle Size Distribution Report



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	1.2	1.6	6.8	20.2	70.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1/2 in.	100.0		
3/8 in.	99.5		
#4	98.8		
#10	97.2		
#20	94.4		
#40	90.4		
#60	85.3		
#140	74.4		
#200	70.2		

* (no specification provided)

Soil Description

Bluish gray Lean clay with sand

Atterberg Limits

PL= 24 LL= 39 PI= 15

Coefficients

D_{85}= 0.244 D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CL AASHTO=

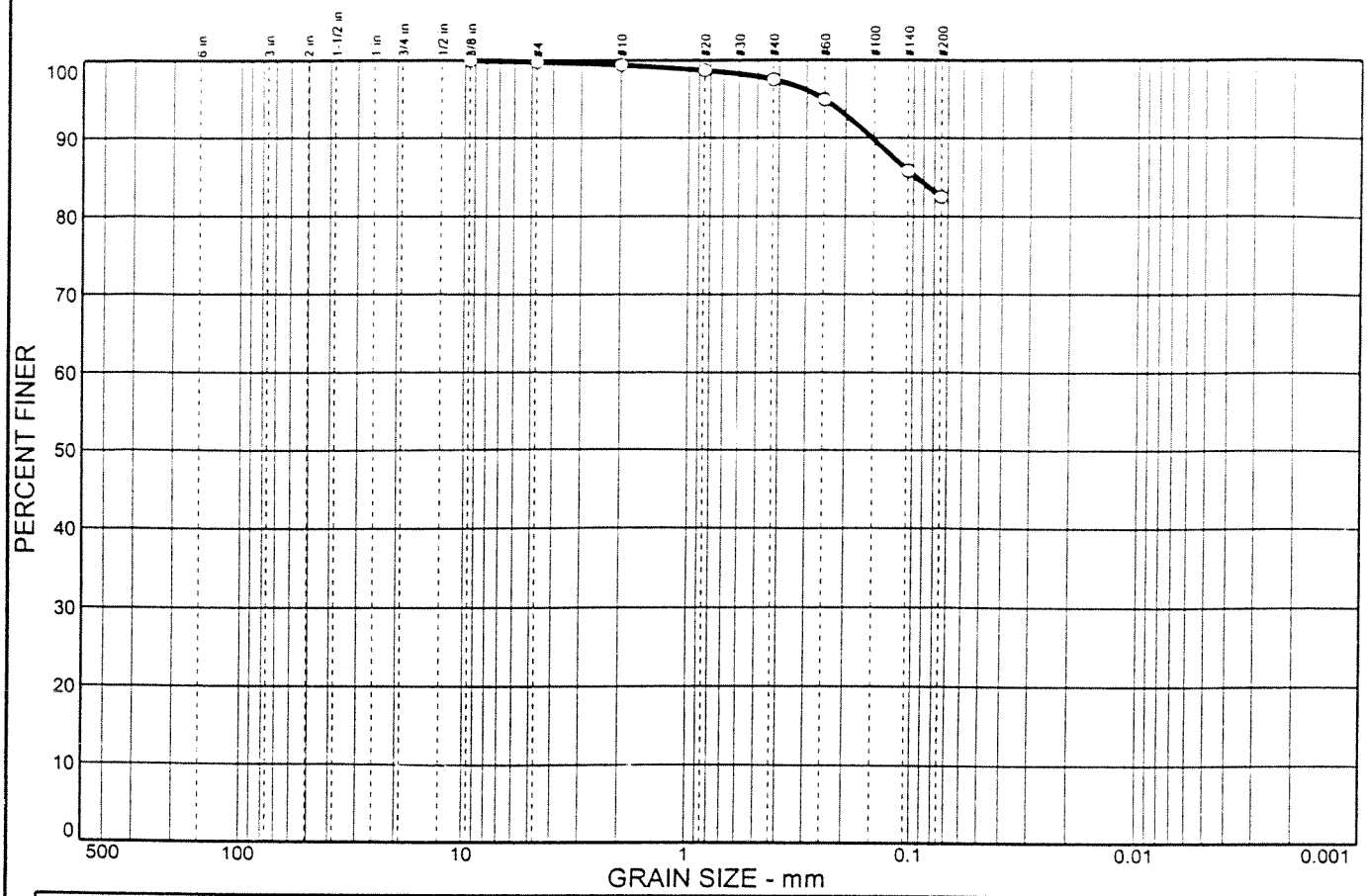
Remarks

Sample No.: 13 Source of Sample: B-3 Date: 4-7-01
Location: Elev./Depth: 60 ft

SIGNET TESTING LABS, INC.

Client: URS / Dames & Moore
Project: Reliant Energy Colusa County
Project No: 46800-930-043 Plate

Particle Size Distribution Report



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.2	0.4	1.9	15.0	82.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8 in.	100.0		
#4	99.8		
#10	99.4		
#20	98.7		
#40	97.5		
#60	94.9		
#140	85.8		
#200	82.5		

* (no specification provided)

Soil Description

Strong brown Fat clay with sand

Atterberg Limits

PL= 19 LL= 56 PI= 37

Coefficients

D_{85}= 0.0980 D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CH AASHTO=

Remarks

Sample No.: 1 Source of Sample: B-4 Date: 4-10-01
Location: Elev./Depth: 0-5 ft

SIGNET TESTING LABS, INC.

Client: URS / Dames & Moore
Project: Reliant Energy Colusa County
Project No: 46800-930-043 Plate

Particle Size Distribution Report

% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	2.9	4.3	29.9	45.0	17.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1/2 in.	100.0		
3/8 in.	99.1		
#4	97.1		
#10	92.8		
#20	85.5		
#40	62.9		
#60	38.9		
#140	21.1		
#200	17.9		

* (no specification provided)

Soil Description

Dark yellowish brown Silty sand

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 0.829 D_{60}= 0.399 D_{50}= 0.323
D_{30}= 0.187 D_{15}= D_{10}=
C_u= C_c=

Classification

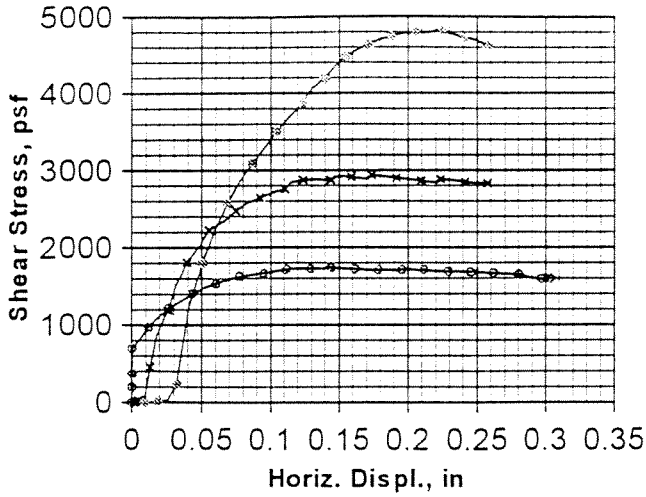
USCS= SM AASHTO=

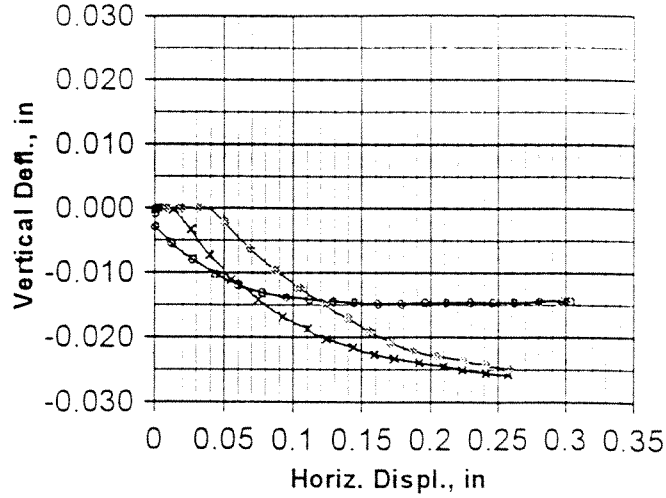
Remarks

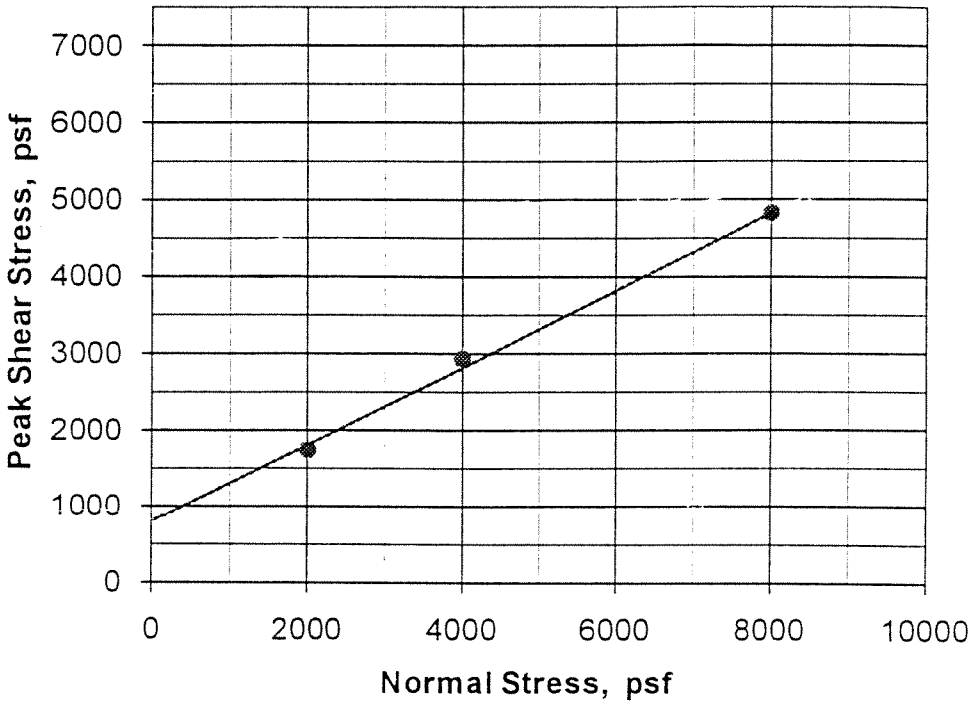
Sample No.: 5 Source of Sample: B-4 Date: 4-7-01
Location: Elev./Depth: 20 ft

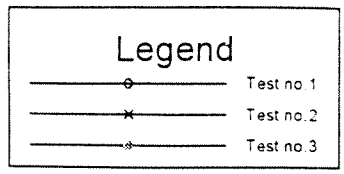
SIGNET TESTING LABS, INC.

Client: URS / Dames & Moore
Project: Reliant Energy Colusa County
Project No: 46800-930-043 Plate









Results

C = 800 psf
phi = 27 deg.

Gs = 2.70
Type = undisturbed

Test no.	SigN psf	Peak Shear str., psf	Displ. in.	Strain Rate in./hr	Initial MC %	Initial DD pcf	Initial Sat. %	Initial Void Ratio	Initial Ht. in.	Initial Dia. in.	Final MC %	Final DD pcf	Final Sat. %	Final Void Ratio	Final Ht. in.
1	2000	1740	0.144	0.05	21.4	94.3	73	0.787	1.00	2.416	26.2	97.9	98	0.721	0.963
2	4000	2935	0.174	0.05	22.0	93.6	74	0.800	1.00	2.416	25.9	101.6	106	0.659	0.922
3	8000	4822	0.224	0.05	23.7	91.0	75	0.852	1.00	2.416	28.4	101.2	115	0.665	0.899

Client: URS/Dames & Moore	Boring #: B-3 Sample #: S-6
Project: Reliant Energy Colusa County	Depth (ft): 25
Project #: 46800-930-843	Soil: Yellowish Brown Silty Clay

TEST REPORT: Direct shear - inundated, consolidated, & drained test

Signet Testing Labs, Inc.

Plate no: ___

PLATE Q2-9