APPENDIX A

Field Study
Vicinity Map
Site Plans
Boring Logs
CPT Data and Interpretations
Symbols Commonly Used on Boring Logs
Unified Soil Classification

FIELD STUDY

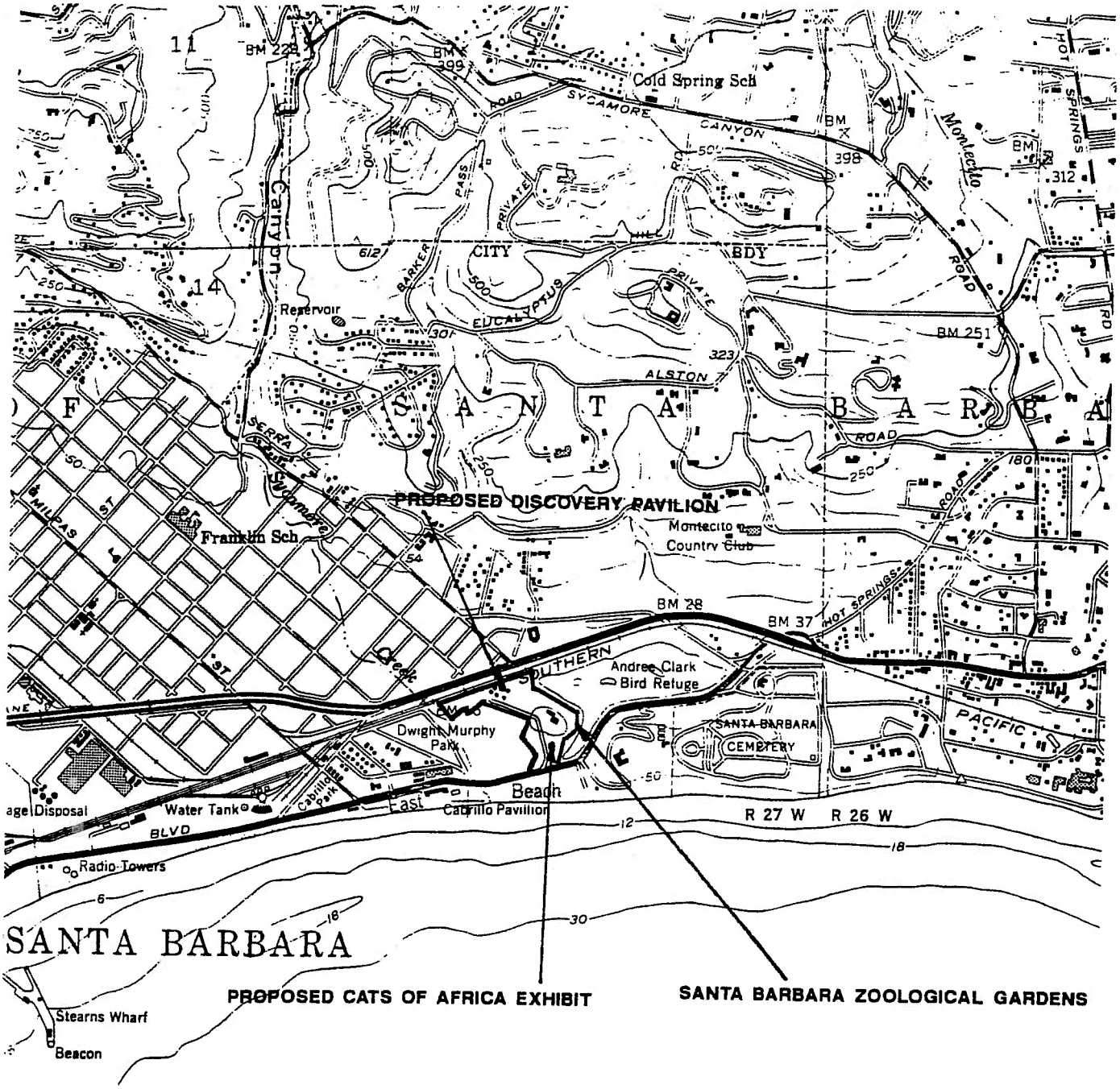
A. On June 18, 2001 through June 20, 2001, 5 borings were drilled and 2 cone penetrometer tests (CPT's) were conducted to observe the soil profile and to obtain samples for laboratory analysis. The maximum depth explored was approximately 50 feet. The borings were drilled using a 6-inch diameter, hollow stem auger powered by a Mobil Drill B-80 truck mounted drilling rig and a hand operated auger. The hammer used to obtain the samples within the drilled borings was a downhole safety hammer attached to ¼-inch cable run to a hydraulically operated Mobil Drill power reversing safety winch. During drilling below the groundwater, a constant head of water equal to or above the groundwater level was maintained. "AW" rod was used to keep the downhole hammer above the groundwater level. The approximate locations of the test borings and the CPT's were determined in the field by pacing and sighting, and are shown on the Site Plan in this Appendix.

B. Samples were obtained within the test borings with a Modified California (M.C.) ring sampler (ASTM D 3550 with shoe similar to ASTM D 1586), and with a Standard Penetration Test (SPT) sampler (ASTM D 1586). The M.C. sampler has a 3.00-inch outside diameter and a 2.37-inch inside diameter. The SPT sampler has a 2.00-inch outside diameter and a 1.37-inch inside diameter. The samples within the borings were obtained by driving the samplers with a 140-pound hammer dropping 30 inches in accordance with ASTM D 1586. The samples were obtained within the hand augered borings with a lightweight hand operated slide hammer.

C. Bulk samples of the soils encountered were gathered from the auger cuttings.

D. The final logs of the borings represent our interpretation of the contents of the field logs and the results of laboratory testing performed on the samples obtained during the subsurface study. The final logs are included in this Appendix.

E. The CPT exploration was conducted by hydraulically advancing an instrument Hogentogler 10 cm^2 conical probe into the ground at a rate of 2 cm per second using a 23-ton truck as a reaction mass. An electronic data acquisition system recorded a near-continuous log of the resistance of the soil against the cone tip (Q_c) and soil friction against the cone sleeve (f_s) as the probe was advanced. Resistance readings were recorded for every 5.08 cm (2 inches) of depth. Empirical relationships (Robertson and Campanella, 1989) were applied to the data to give a near-continuous profile of soil stratigraphy. Interpretation of CPT data provides correlations for SPT blow count, internal friction angle, undrained strength (S_u) of clays, and soil behavior type. A log of the CPT sounding is included in this Appendix.



SCALE

1" = 2,000'

NORTH

* Taken from USGS 7.5' Santa Barbara Quadrangle

EARTH SYSTEMS SOUTHERN CALIFORNIA

1731-A Walter Street, Ventura, California 93003
PH: (805) 642-6727 FAX: (805) 642-1325

VICINITY MAP *

Santa Barbara Zoological Gradens
Santa Barbara, California

July 2001 Job No. VT-22503-01

OfficeMax

Store _____ **Date:** /

Todays Tasks:

BACK TO NORMAL

TRASH - go backs- breakroom & restrooms-

C / S recovery- Furnitures- Carts-

You Must

Hello + Did you find? + Add on + Max Assurance + Can Order !

Name	Scheduled Hours	1st Break	Lunch	2nd Break	Assignments
	/				
	/				
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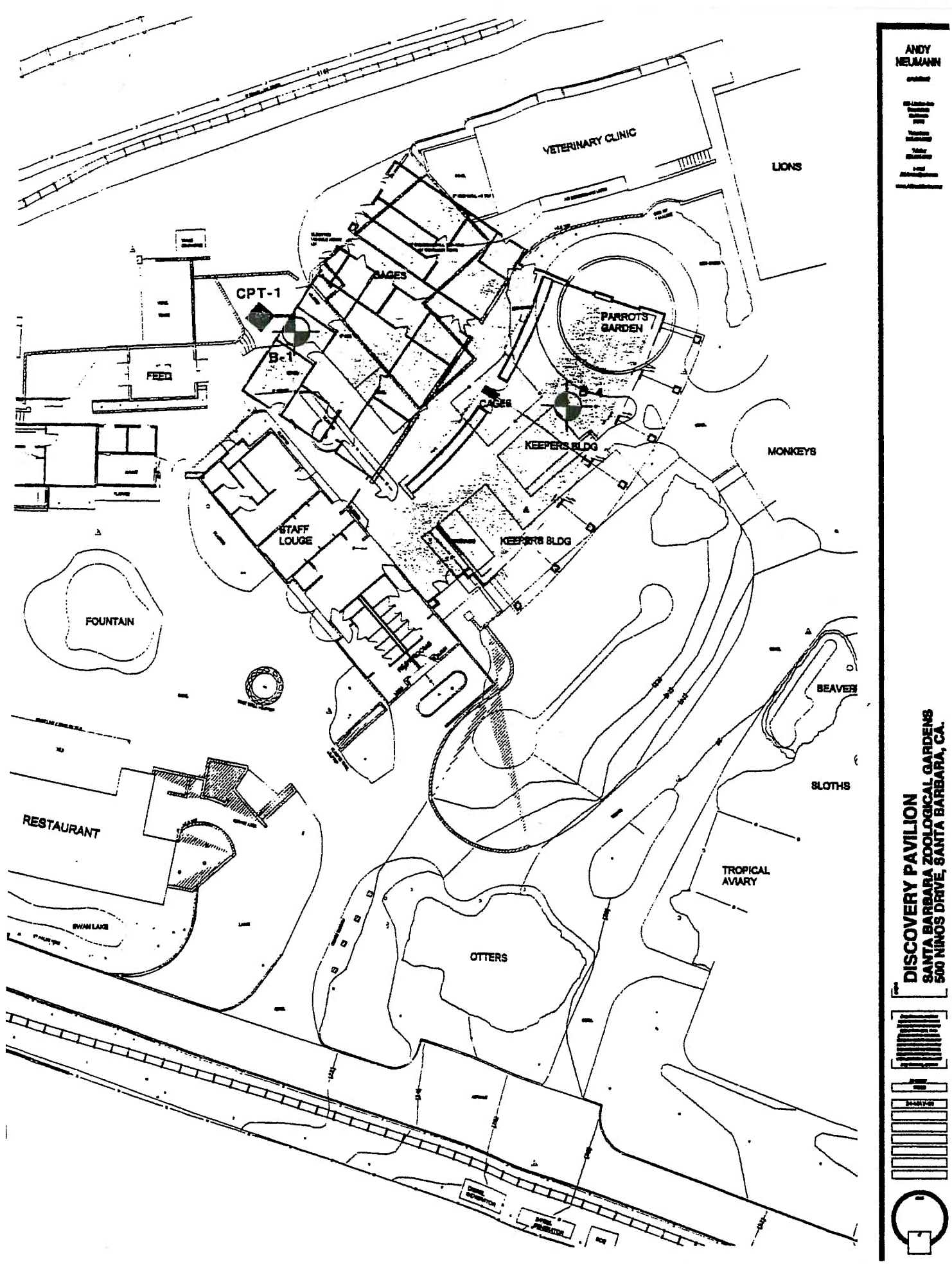

ANDY NEUMANN

DISCOVERY PAVILION
SANTA BARBARA ZOOLOGICAL GARDENS
500 NINOS DRIVE, SANTA BARBARA, CA.

Earth Systems Southern California
1731-A Walter Street. Ventura, California 93003
PHONE: (805) 642-6727 FAX: (805) 642-1325

BORING NO: 1
PROJECT NAME: Santa Barbara Zoological Gardens
PROJECT NUMBER: VT-22503-01
BORING LOCATION: Per Plan

DRILLING DATE: 6-20-01
DRILLING METHOD: 6 " Hollow Stem Auger
DRILL: Mobil Drill B-80
LOGGED BY: T.T.

VERTICAL DEPTH (feet)	SAMPLE TYPE: Bulk	SAMPLE TYPE: SPT	SAMPLE TYPE: Mod. Calif.	PENETRATION RESISTANCE (BLOWS/6")	SYMBOL	USCS CLASS	UNIT DRY WT. (pcf)	MOISTURE CONTENT (%)	DESCRIPTION OF UNITS
0									3" Asphaltic Concrete over 5" Aggregate Base
	X		■	14/15		SM	113.4	12.8	UNCERTIFIED FILL: Clayey silty fine to coarse sand with minor subrounded gravel, dense, moderate olive brown (%gravel=7.7, %sand=63.5, %silt=17.5, %clay=11.3).
5			■	12/16		CL/ML	109.2	18.7	ALLUVIAL DEPOSITS: Interlenses of clayey silt to sandy silt to silty clay, medium stiff to stiff, moderate brown.
10			■	12/16		CL/ML	119.6	17.7	ALLUVIAL DEPOSITS: Same as above.
									*Groundwater at 13 '
15			■	10/16		CL/ML	113.7	15.0	ALLUVIAL DEPOSITS: Same as above .
20			■	8/11		CL/ML	106.8	20.7	ALLUVIAL DEPOSITS: Same as above.
25		■		7/11/13		CL/ML	--	--	ALLUVIAL DEPOSITS: Same as above (%gravel=0, %sand=44.5, %silt=34.7, %clay=20.8).
30		■		11/31		SP	--	--	ALLUVIAL DEPOSITS: Fine to medium sand, dense, dark yellowish orange (%gravel=0, %sand=99.7, %silt=0.3, %clay=0).
35		■		--		SP	--	--	ALLUVIAL DEPOSITS: Same as above.
40		■		11/18/26		CL	--	--	ALLUVIAL DEPOSITS: Fine to medium sand silty clay, stiff to hard, olive gray (%gravel=0.8, %sand=45.5, %silt=27.9, %clay=25.8).

Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradual.

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1731-A Walter Street. Ventura. California 93003
PHONE: (805) 642-6727 FAX: (805) 642-1325

BORING NO: 1 (continued)
PROJECT NAME: Santa Barbara Zoological Gardens
PROJECT NUMBER: VT-22503-01
BORING LOCATION: Per Plan

DRILLING DATE: 6-20-01
DRILLING METHOD: 6" Hollow Stem Auger
DRILL: Mobil Drill B-80
LOGGED BY: T.T.

VERTICAL DEPTH (feet)	SAMPLE TYPE: Bulk	SAMPLE TYPE: SPT	SAMPLE TYPE: Mod. Calif	PENETRATION RESISTANCE (BLOWS/6")	SYMBOL	USCS CLASS	UNIT DRY WT. (pcf)	MOISTURE CONTENT (%)	DESCRIPTION OF UNITS
40		■		3/4/8		CL	--	--	ALLUVIAL DEPOSITS: Fine to medium sand silty clay, stiff to hard. olive gray (%gravel=0.8, %sand=45.5, %silt=27.9, %clay=25.8).
45		■		3/4/8		CL	--	--	ALLUVIAL DEPOSITS: Same as above.
50									
55									Total Depth = 46.5 feet Groundwater Encountered at 13 feet.
60									
65									
70									
75									
80									

Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradual.

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PHONE: (805) 642-6727 FAX: (805) 642-1325

BORING NO: 2
PROJECT NAME: Santa Barbara Zoological Gardens
PROJECT NUMBER: VT-22503-01
BORING LOCATION: Per Plan

DRILLING DATE: 6-20-01
DRILLING METHOD: 6 " Hollow Stem Auger
DRILL: Mobil Drill B-80
LOGGED BY: T.T.

VERTICAL DEPTH (feet)	SAMPLE TYPE: Bulk	SAMPLE TYPE: SPT	SAMPLE TYPE: Mod. Calif.	PENETRATION RESISTANCE (BLOWS/6")	SYMBOL	USCS CLASS	UNIT DRY WT. (pcf)	MOISTURE CONTENT (%)	DESCRIPTION OF UNITS
0									2.5" Asphaltic Concrete over 2.5" Aggregate Base
						CL	- -	- -	TOPSOIL: Fine sandy silty clay with minor subrounded gravel, stiff, dusky yellowish brown.
5			■	17/18		SP	105.2	6.4	OLDER ALLUVIAL DEPOSITS: Very slightly silty fine to medium sand, medium dense, grayish orange.
10			■	16/22		CL	112.7	15.2	OLDER ALLUVIAL DEPOSITS: Silty clay, stiff, moderate brown.
15									*Groundwater at 15 '
20			◪	8/24		SP	- -	- -	OLDER ALLUVIAL DEPOSITS: Very slightly silty fine to medium sand, medium dense, grayish orange.
			■	16/21		SP	104.6	19.9	
25									Total Depth = 23 Feet
									Groundwater Encountered at 23 Feet
30									
35									
40									

Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradual.

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1731-A Walter Street, Ventura, California 93003
PHONE: (805) 642-6727 FAX: (805) 642-1325

BORING NO: 3
PROJECT NAME: Santa Barbara Zoological Gardens
PROJECT NUMBER: VT-22503-01
BORING LOCATION: Per Plan

DRILLING DATE: 6-20-01
DRILLING METHOD: 6 " Hollow Stem Auger
DRILL: Mobil Drill B-80
LOGGED BY: T.T.

VERTICAL DEPTH (feet)	SAMPLE TYPE: Bulk	SAMPLE TYPE: SPT	SAMPLE TYPE: Mod. Calif.	PENETRATION RESISTANCE (BLOWS/6")	SYMBOL	USCS CLASS	UNIT DRY WT. (pcf)	MOISTURE CONTENT (%)	DESCRIPTION OF UNITS
0	■		■	16/33		SC/CL	98.6	12.2	UNCERTIFIED FILL: Fine sandy silty clay with minor subrounded gravel, stiff, common rootlets, mottled dusky to dark yellowish brown.
5	■		■	17/24		CL	108.3	19.6	OLDER ALLUVIAL DEPOSITS: Silty clay, stiff, moderate brown..
10			■	7/10		CL	114.7	16.4	OLDER ALLUVIAL DEPOSITS: Same as above.
15			■	15/18		SP	104.6	19.9	*Groundwater at 13.5 ' OLDER ALLUVIAL DEPOSITS: Very slightly silty fine to medium sand, medium dense, grayish orange.
20									
25									Total Depth = 16 Feet Groundwater Encountered at 13.5 Feet
30									
35									
40									

Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradual.

Earth Systems Southern California
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PHONE: (805) 642-6727 FAX: (805) 642-1325

BORING NO: 4
PROJECT NAME: Santa Barbara Zoological Gardens
PROJECT NUMBER: VT-22503-01
BORING LOCATION: Per Plan

DRILLING DATE: 6-20-01
DRILLING METHOD: Hand Auger
LOGGED BY: T.T.

VERTICAL DEPTH (feet)	SAMPLE TYPE: Bulk	SAMPLE TYPE: SPT	SAMPLE TYPE: Mod. Calif	PENETRATION RESISTANCE (BLOWS/6")	SYMBOL	USCS CLASS	UNIT DRY WT. (pcf)	MOISTURE CONTENT (%)	DESCRIPTION OF UNITS
0									2.5" Asphaltic Concrete over 2.5" Aggregate Base
			■			SM	102.9	18.0	ALLUVIAL DEPOSITS: Clayey silty fine sand with minor subrounded gravel, medium dense, dusky yellowish brown.
5			■			CL	117.1	14.2	ALLUVIAL DEPOSITS: Silty clay, stiff, moderate brown.
10			◥			CL	--	--	ALLUVIAL DEPOSITS: Same as above.
15									Total Depth = 11 Feet
									No Groundwater Encountered
20									
25									
30									
35									
40									

Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradual.

Earth Systems Southern California
1731-A Walter Street. Ventura. California 93003
PHONE: (805) 642-6727 FAX: (805) 642-1325

BORING NO: 5
PROJECT NAME: Santa Barbara Zoological Gardens
PROJECT NUMBER: VT-22503-01
BORING LOCATION: Per Plan

DRILLING DATE: 6-20-01
DRILLING METHOD: Hand Auger
LOGGED BY: T.T.

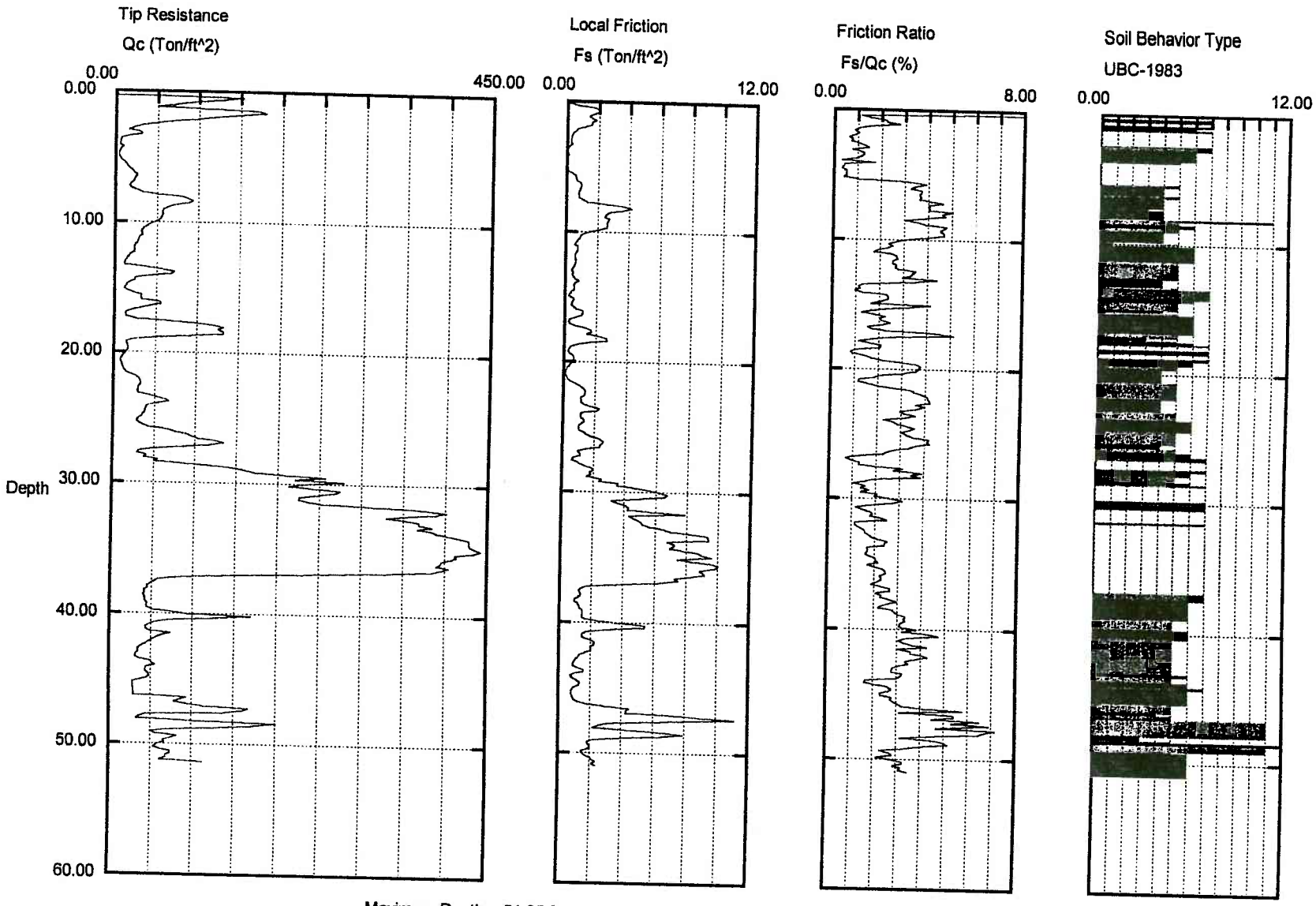
VERTICAL DEPTH (feet)	SAMPLE TYPE: Bulk	SAMPLE TYPE: SPT	SAMPLE TYPE: Mod. Calif.	PENETRATION RESISTANCE (BLOWS/6")	SYMBOL	USCS CLASS	UNIT DRY WT. (pcf)	MOISTURE CONTENT (%)	DESCRIPTION OF UNITS
0			■			SC/CL	117.1	14.2	FILL: Clayey fine sand to silty clay with minor subrounded gravel, occassional pieces of glass, beer can, medium dense, moderate brown to dark yellowish brown.
5									
10									Total Depth = 6 Feet Refusal on rock No Groundwater Encountered
15									
20									
25									
30									
35									
40									

Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradual.

Earth Systems S California

Operator: SANTA BARBARA ZO
Sounding: SDF-07
Cone Used: 491#1 JH-GO

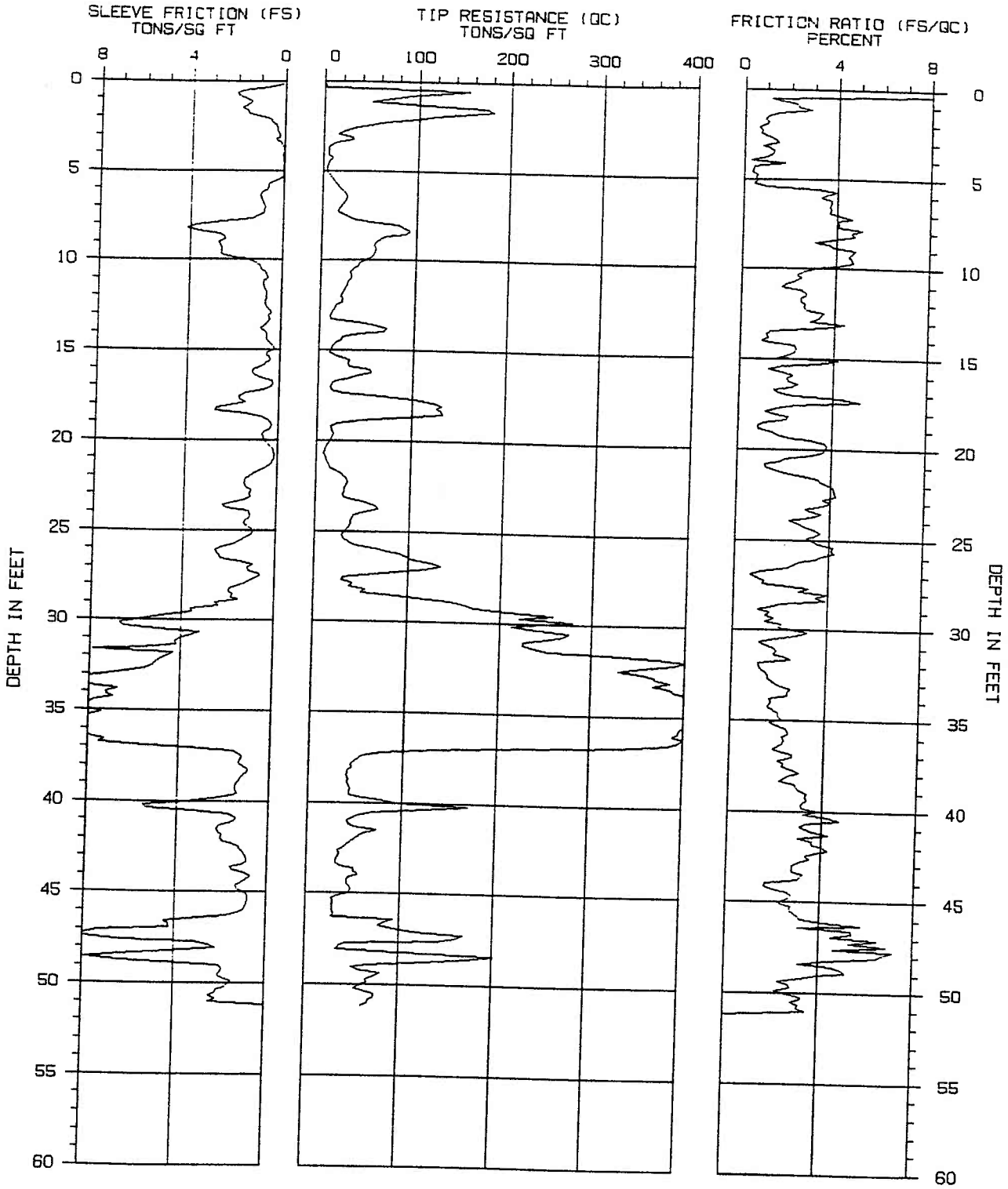
CPT Date/Time: 06-18-01 14:55
Location: CPT-01
Job Number: VT-22503-01



Maximum Depth = 51.35 feet

Depth Increment = 0.16 feet

1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty clay
6 sandy silt to clayey silt
7 silty sand to sandy silt
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)



TIP RESISTANCE NOT CORRECTED FOR END AREA EFFECT

CONE PENETRATION TEST

SOUNDING NUMBER: CPT-01

PROJECT NAME : SANTA BARBARA ZO

PROJECT NUMBER : VT-22503-01

CONE/RIG : 491#1 JH-GO

DATE/TIME: 06-18-01 14:55

HFA

CPT INTERPRETATIONS

SOUNDING : CPT-01
PROJECT : SANTA BARBARA ZO
DATE/TIME: 06-18-01 14:55

PROJECT No.: VT-22503-01
CONE/RIG : 491#1 JH-GO

DEPTH (m)	DEPTH (ft)	TIP RESISTANCE (tsf)	FRICTION RATIO (%)	SOIL BEHAVIOR TYPE	N(60)	N1(60)	Dr (%)	Su (tsf)	PHI (Degrees)
.150	.49	152.88	1.16	SAND to SILTY SAND	38	61	89		
.300	.98	71.38	2.27	SILTY SAND to SANDY SILT	24	38	67		
.450	1.48	172.17	1.05	SAND to SILTY SAND	43	69	92		
.600	1.97	118.86	.93	SAND to SILTY SAND	30	48	81		
.750	2.46	48.78	.74	SILTY SAND to SANDY SILT	16	26	56		
.900	2.95	15.68	1.49	SANDY SILT to CLAYEY SILT	6	10		1.2	46.0
1.050	3.44	15.19	1.29	SANDY SILT to CLAYEY SILT	6	10		1.2	
1.200	3.94	5.99	.34	SENSITIVE FINE GRAINED	3	5		.6	
1.350	4.43	6.76	.43	SENSITIVE FINE GRAINED	3	5		.6	
1.500	4.92	4.44	.53	SENSITIVE FINE GRAINED	2	4		.4	
1.650	5.41	10.41	1.05	CLAYEY SILT to SILTY CLAY	5	8		1.0	
1.800	5.91	17.87	3.48	CLAY to SILTY CLAY	12	19		1.2	
1.950	6.40	26.24	3.72	CLAY to SILTY CLAY	17	28		1.7	
2.100	6.89	21.88	3.64	CLAY to SILTY CLAY	15	23		1.4	
2.250	7.38	19.80	4.02	CLAY to SILTY CLAY	13	20		1.3	
2.400	7.87	50.67	5.05	CLAY to SILTY CLAY	34	49		3.0	
2.550	8.37	93.52	3.86	CLAYEY SILT to SILTY CLAY	47	66		5.5	
2.700	8.86	62.46	3.92	CLAYEY SILT to SILTY CLAY	31	43		3.6	
2.850	9.35	57.55	4.54	CLAY to SILTY CLAY	38	51		3.4	
3.000	9.84	52.64	4.05	CLAYEY SILT to SILTY CLAY	26	34		3.1	
3.150	10.33	38.90	2.38	SANDY SILT to CLAYEY SILT	16	20		2.6	
3.300	10.83	32.42	1.93	SANDY SILT to CLAYEY SILT	13	16		2.5	
3.450	11.32	28.04	2.71	CLAYEY SILT to SILTY CLAY	14	18		1.8	
3.600	11.81	23.77	2.55	CLAYEY SILT to SILTY CLAY	12	15		1.5	
3.750	12.30	24.07	2.79	CLAYEY SILT to SILTY CLAY	12	15		1.6	
3.900	12.80	14.72	3.31	CLAY to SILTY CLAY	10	12		.9	
4.050	13.29	12.41	3.52	CLAY to SILTY CLAY	8	10		.8	
4.200	13.78	71.51	1.20	SILTY SAND to SANDY SILT	24	28	62		40.0
4.350	14.27	24.94	2.32	CLAYEY SILT to SILTY CLAY	12	15		1.6	
4.500	14.76	14.62	2.10	CLAYEY SILT to SILTY CLAY	7	9		1.1	
4.650	15.26	17.06	3.28	CLAY to SILTY CLAY	11	13		1.1	
4.800	15.75	31.36	1.85	SANDY SILT to CLAYEY SILT	13	14		2.4	
4.950	16.24	55.45	2.10	SANDY SILT to CLAYEY SILT	22	25		3.6	
5.100	16.73	19.74	1.54	SANDY SILT to CLAYEY SILT	8	9		1.5	
5.250	17.22	14.98	4.32	CLAY	15	17		.9	
5.400	17.72	101.76	1.67	SILTY SAND to SANDY SILT	34	37	70		41.5
5.550	18.21	125.45	2.12	SILTY SAND to SANDY SILT	42	46	76		42.5
5.700	18.70	92.16	.84	SAND to SILTY SAND	23	25	67		40.5
5.850	19.19	15.42	1.69	CLAYEY SILT to SILTY CLAY	8	8		1.1	
6.000	19.69	17.63	3.66	CLAY to SILTY CLAY	12	13		1.1	
6.150	20.18	12.79	3.60	CLAY to SILTY CLAY	9	9		.8	

*INDICATES OVERCONSOLIDATED OR CEMENTED MATERIAL
ASSUMED TOTAL UNIT WT = 120 pcf
ASSUMED DEPTH OF WATER TABLE = 10.0 ft
N(60) = EQUIVALENT SPT VALUE (60% Energy)
N1(60) = OVERBURDEN NORMALIZED EQUIVALENT SPT VALUE (60% Energy)
Dr = OVERBURDEN NORMALIZED EQUIVALENT RELATIVE DENSITY
Su = OVERBURDEN NORMALIZED UNDRAINED SHEAR STRENGTH
PHI = OVERBURDEN NORMALIZED EQUIVALENT FRICTION ANGLE

Interpretations based on: Robertson and Campanella, 1989.

HOLGUIN, FAHAN & ASSOCIATES, INC.

DEPTH (m)	DEPTH (ft)	TIP RESISTANCE (tsf)	FRICTION RATIO (%)	SOIL BEHAVIOR TYPE	N(60)	N1(60)	Dr (%)	Su (tsf)	PHI (Degrees)
6.300	20.67	8.71	1.85	CLAYEY SILT to SILTY CLAY	4	5		.6	
6.450	21.16	11.88	1.61	CLAYEY SILT to SILTY CLAY	6	6		.8	
6.600	21.65	20.52	3.45	CLAY to SILTY CLAY	14	14		1.3	
6.750	22.15	32.08	4.09	CLAY to SILTY CLAY	21	22		1.8	
6.900	22.64	30.27	4.22	CLAY to SILTY CLAY	20	21		1.7	
7.050	23.13	30.34	3.64	CLAYEY SILT to SILTY CLAY	15	15		1.9	
7.200	23.62	63.56	3.63	CLAYEY SILT to SILTY CLAY	32	32		3.7	
7.350	24.11	40.94	2.67	SANDY SILT to CLAYEY SILT	16	16		2.6	
7.500	24.61	37.69	3.60	CLAYEY SILT to SILTY CLAY	19	19		2.4	
7.650	25.10	30.25	3.28	CLAYEY SILT to SILTY CLAY	15	15		1.9	
7.800	25.59	36.88	4.11	CLAY to SILTY CLAY	25	24		2.1	
7.950	26.08	76.44	3.38	SANDY SILT to CLAYEY SILT	31	30		4.4	
8.100	26.57	103.31	2.30	SILTY SAND to SANDY SILT	34	33	67		39.5
8.250	27.07	117.51	.96	SAND to SILTY SAND	29	28	70		40.5
8.400	27.56	31.61	1.95	SANDY SILT to CLAYEY SILT	13	12		2.4	
8.550	28.05	37.99	3.93	CLAYEY SILT to SILTY CLAY	19	18		2.1	
8.700	28.54	88.40	1.99	SILTY SAND to SANDY SILT	29	28	62		39.0
8.850	29.04	161.67	1.57	SAND to SILTY SAND	40	38	79		42.0
9.000	29.53	256.59	1.38	SAND to SILTY SAND	64	59	92		44.0
9.150	30.02	229.51	2.70	SILTY SAND to SANDY SILT	77	71	88		43.5
9.300	30.51	273.80	1.82	SAND to SILTY SAND	68	63	93		44.0
9.450	31.00	225.51	1.81	SAND to SILTY SAND	56	51	88		43.5
9.600	31.50	251.73	2.28	SILTY SAND to SANDY SILT	84	76	91		44.0
9.750	31.99	401.51	1.15	SAND	80	72	100		46.0
9.900	32.48	329.72	1.58	SAND to SILTY SAND	82	74	98		45.0
10.050	32.97	369.57	1.89	SAND to SILTY SAND	92	82	100		45.5
10.200	33.46	384.85	2.43	SILTY SAND to SANDY SILT	100	100	100		45.5
10.350	33.96	419.05	1.72	SAND to SILTY SAND	100	92	100		46.0
10.500	34.45	427.87	1.81	SAND to SILTY SAND	100	94	100		46.0
10.650	34.94	442.40	2.17	SAND to SILTY SAND	100	96	100		46.0
10.800	35.43	413.64	2.36	SAND to SILTY SAND	100	90	100		45.5
10.950	35.93	394.69	2.23	SAND to SILTY SAND	99	85	100		45.5
11.100	36.42	396.47	2.09	SAND to SILTY SAND	99	85	100		45.5
11.250	36.91	231.70	2.67	SILTY SAND to SANDY SILT	77	66	86		43.0
11.400	37.40	56.83	2.32	SANDY SILT to CLAYEY SILT	23	19		3.6	
11.550	37.89	44.38	2.97	SANDY SILT to CLAYEY SILT	18	15		2.8	
11.700	38.39	41.94	2.19	SANDY SILT to CLAYEY SILT	17	14		2.6	
11.850	38.88	41.92	3.04	CLAYEY SILT to SILTY CLAY	21	18		2.6	
12.000	39.37	43.96	3.34	CLAYEY SILT to SILTY CLAY	22	18		2.8	
12.150	39.86	76.55	3.17	SANDY SILT to CLAYEY SILT	31	25		4.4	
12.300	40.35	124.41	4.33	*VERY STIFF FINE GRAINED	100	100			
12.450	40.85	46.82	3.08	CLAYEY SILT to SILTY CLAY	23	19		3.0	
12.600	41.34	48.71	4.27	CLAY to SILTY CLAY	32	26		2.7	
12.750	41.83	55.13	3.60	CLAYEY SILT to SILTY CLAY	28	22		3.1	
12.900	42.32	42.96	3.77	CLAYEY SILT to SILTY CLAY	21	17		2.4	
13.050	42.81	34.65	3.07	CLAYEY SILT to SILTY CLAY	17	14		2.1	
13.200	43.31	31.19	2.80	CLAYEY SILT to SILTY CLAY	16	12		1.9	
13.350	43.80	50.58	3.02	SANDY SILT to CLAYEY SILT	20	16		3.2	
13.500	44.29	43.28	2.02	SANDY SILT to CLAYEY SILT	17	14		2.7	
13.650	44.78	48.25	2.69	SANDY SILT to CLAYEY SILT	19	15		3.0	

*INDICATES OVERCONSOLIDATED OR CEMENTED MATERIAL
ASSUMED TOTAL UNIT WT = 120 pcf
ASSUMED DEPTH OF WATER TABLE = 10.0 ft
N(60) = EQUIVALENT SPT VALUE (60% Energy)
N1(60) = OVERBURDEN NORMALIZED EQUIVALENT SPT VALUE (60% Energy)
Dr = OVERBURDEN NORMALIZED EQUIVALENT RELATIVE DENSITY
Su = OVERBURDEN NORMALIZED UNDRAINED SHEAR STRENGTH
PHI = OVERBURDEN NORMALIZED EQUIVALENT FRICTION ANGLE

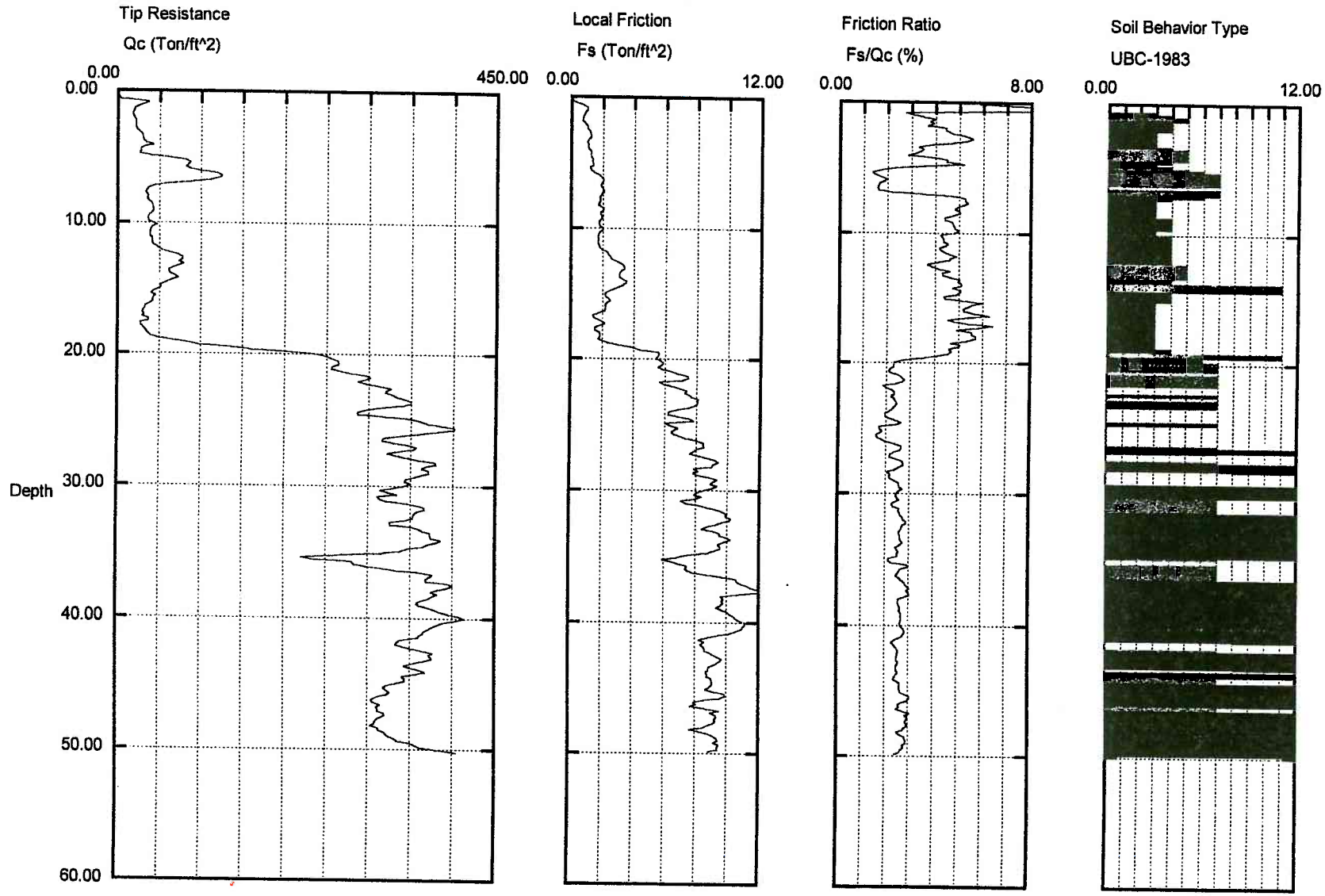
DEPTH (m)	DEPTH (ft)	TIP RESISTANCE (tsf)	FRICTION RATIO (%)	SOIL BEHAVIOR TYPE	N(60)	N1(60)	Dr (%)	Su (tsf)	PHI (Degrees)
13.800	45.28	28.21	2.80	CLAYEY SILT to SILTY CLAY	14	11		1.7	
13.950	45.77	29.30	3.07	CLAYEY SILT to SILTY CLAY	15	11		1.8	
14.100	46.26	29.74	5.79	CLAY	30	23		1.6	
14.250	46.75	78.54	5.44	*VERY STIFF FINE GRAINED	79	61			
14.400	47.24	167.43	5.34	*VERY STIFF FINE GRAINED	100	100			
14.550	47.74	43.13	7.17	CLAY	43	33		2.4	
14.700	48.23	98.66	4.36	*VERY STIFF FINE GRAINED	99	76			
14.850	48.72	127.98	5.02	*VERY STIFF FINE GRAINED	100	98			
15.000	49.21	56.43	3.27	CLAYEY SILT to SILTY CLAY	28	21		3.1	
15.150	49.70	65.29	2.85	SANDY SILT to CLAYEY SILT	26	20		4.2	
15.300	50.20	53.92	3.24	CLAYEY SILT to SILTY CLAY	27	20		3.0	
15.450	50.69	74.14	3.20	SANDY SILT to CLAYEY SILT	30	22		4.2	

*INDICATES OVERCONSOLIDATED OR CEMENTED MATERIAL
ASSUMED TOTAL UNIT WT = 120 pcf
ASSUMED DEPTH OF WATER TABLE = 10.0 ft
N(60) = EQUIVALENT SPT VALUE (60% Energy)
N1(60) = OVERBURDEN NORMALIZED EQUIVALENT SPT VALUE (60% Energy)
Dr = OVERBURDEN NORMALIZED EQUIVALENT RELATIVE DENSITY
Su = OVERBURDEN NORMALIZED UNDRAINED SHEAR STRENGTH
PHI = OVERBURDEN NORMALIZED EQUIVALENT FRICTION ANGLE

Earth Systems S California

Operator: SANTA BARBARA ZO
Sounding: SDF-08
Cone Used: 491#1 JH-GO

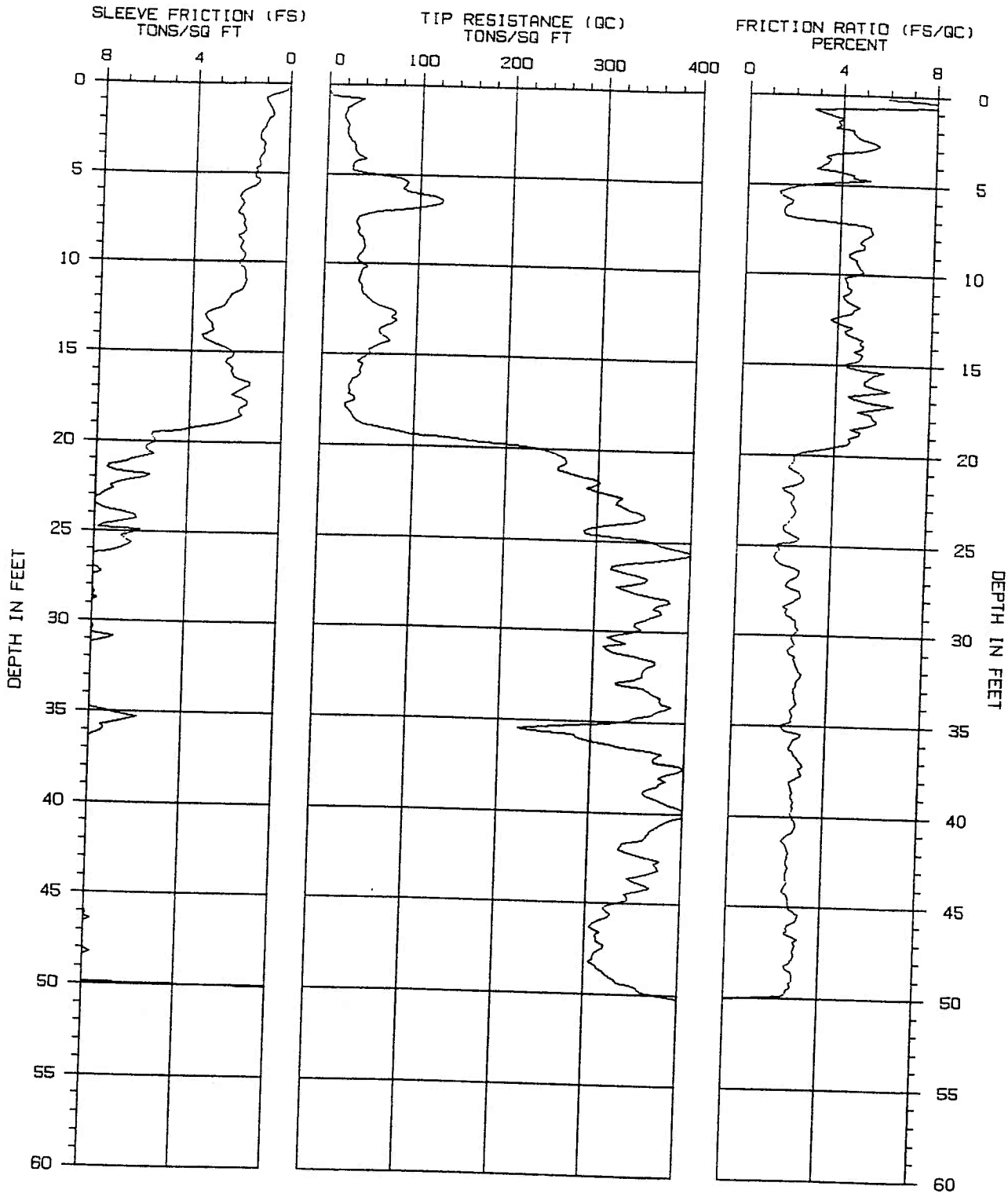
CPT Date/Time: 06-18-01 15:50
Location: CPT-02
Job Number: VT-22503-01



Maximum Depth = 50.20 feet

Depth Increment = 0.16 feet

1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty clay
6 sandy silt to clayey silt
7 silty sand to sandy silt
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)



TIP RESISTANCE NOT CORRECTED FOR END AREA EFFECT

CONE PENETRATION TEST

SOUNDING NUMBER: CPT-02

PROJECT NAME : SANTA BARBARA ZO

PROJECT NUMBER : VT-22503-01

CONE/RIG : 491#1 JH-GO

DATE/TIME: 06-18-01 15:50

HFA

CPT INTERPRETATIONS

SOUNDING : CPT-02
PROJECT : SANTA BARBARA ZO
DATE/TIME: 06-18-01 15:50

PROJECT No.: VT-22503-01
CONE/RIG : 491#1 JH-GO

DEPTH (m)	DEPTH (ft)	TIP RESISTANCE (tsf)	FRICTION RATIO (%)	SOIL BEHAVIOR TYPE	N(60)	N1(60)	Dr (%)	Su (tsf)	PHI (Degrees)
.150	.49	2.17	17.51	ORGANIC MATERIAL	2	3		.2	
.300	.98	32.65	3.12	CLAYEY SILT to SILTY CLAY	16	26		2.2	
.450	1.48	20.40	3.77	CLAY to SILTY CLAY	14	22		1.4	
.600	1.97	19.84	4.44	CLAY	20	32		1.3	
.750	2.46	21.90	4.75	CLAY	22	35		1.5	
.900	2.95	23.43	5.34	CLAY	23	37		1.4	
1.050	3.44	30.57	3.30	CLAYEY SILT to SILTY CLAY	15	24		2.0	
1.200	3.94	34.88	3.18	CLAYEY SILT to SILTY CLAY	17	28		2.3	
1.350	4.43	27.92	4.51	CLAY to SILTY CLAY	19	30		1.6	
1.500	4.92	39.64	3.33	CLAYEY SILT to SILTY CLAY	20	32		2.6	
1.650	5.41	87.27	1.38	SILTY SAND to SANDY SILT	29	47	72		45.0
1.800	5.91	87.25	1.96	SILTY SAND to SANDY SILT	29	47	72		44.5
1.950	6.40	124.58	1.63	SILTY SAND to SANDY SILT	42	66	83		46.0
2.100	6.89	88.74	2.20	SILTY SAND to SANDY SILT	30	46	73		44.0
2.250	7.38	37.39	5.27	CLAY	37	56		2.2	
2.400	7.87	36.24	5.19	CLAY	36	53		2.1	
2.550	8.37	37.16	5.03	CLAY	37	52		2.2	
2.700	8.86	42.02	4.40	CLAY to SILTY CLAY	28	38		2.4	
2.850	9.35	40.15	4.73	CLAY to SILTY CLAY	27	36		2.3	
3.000	9.84	36.97	5.00	CLAY	37	48		2.1	
3.150	10.33	41.94	4.32	CLAY to SILTY CLAY	28	36		2.4	
3.300	10.83	38.45	4.55	CLAY to SILTY CLAY	26	32		2.2	
3.450	11.32	41.41	4.27	CLAY to SILTY CLAY	28	33		2.4	
3.600	11.81	47.21	4.89	CLAY to SILTY CLAY	31	37		2.7	
3.750	12.30	61.48	4.12	CLAYEY SILT to SILTY CLAY	31	36		3.6	
3.900	12.80	78.39	4.17	CLAYEY SILT to SILTY CLAY	39	45		4.6	
4.050	13.29	74.21	4.34	CLAYEY SILT to SILTY CLAY	37	42		4.3	
4.200	13.78	61.95	4.96	CLAY to SILTY CLAY	41	45		3.6	
4.350	14.27	72.87	4.73	*VERY STIFF FINE GRAINED	73	79			
4.500	14.76	50.73	4.89	CLAY to SILTY CLAY	34	36		2.9	
4.650	15.26	42.94	5.12	CLAY	43	45		2.5	
4.800	15.75	43.04	5.37	CLAY	43	45		2.5	
4.950	16.24	38.84	5.64	CLAY	39	40		2.2	
5.100	16.73	30.74	4.55	CLAY to SILTY CLAY	20	21		1.7	
5.250	17.22	30.36	6.42	CLAY	30	31		1.7	
5.400	17.72	27.53	5.52	CLAY	28	28		1.6	
5.550	18.21	32.87	5.72	CLAY	33	33		1.9	
5.700	18.70	39.77	5.08	CLAY	40	40		2.3	
5.850	19.19	83.56	4.69	*VERY STIFF FINE GRAINED	84	83			
6.000	19.69	160.27	3.51	SANDY SILT to CLAYEY SILT	64	63		9.4	
6.150	20.18	247.54	2.32	SILTY SAND to SANDY SILT	83	81	92		44.5

*INDICATES OVERCONSOLIDATED OR CEMENTED MATERIAL
ASSUMED TOTAL UNIT WT = 120 pcf
ASSUMED DEPTH OF WATER TABLE = 15.0 ft
N(60) = EQUIVALENT SPT VALUE (60% Energy)
N1(60) = OVERBURDEN NORMALIZED EQUIVALENT SPT VALUE (60% Energy)
Dr = OVERBURDEN NORMALIZED EQUIVALENT RELATIVE DENSITY
Su = OVERBURDEN NORMALIZED UNDRAINED SHEAR STRENGTH
PHI = OVERBURDEN NORMALIZED EQUIVALENT FRICTION ANGLE

SOUNDING : CPT-02

DEPTH (m)	DEPTH (ft)	TIP RESISTANCE (tsf)	FRICTION RATIO (%)	SOIL BEHAVIOR TYPE	N(60)	N1(60)	Dr (%)	Su (tsf)	PHI (Degrees)
6.300	20.67	263.82	2.11	SAND to SILTY SAND	66	64	94		44.5
6.450	21.16	255.62	2.64	SILTY SAND to SANDY SILT	85	82	93		44.5
6.600	21.65	297.43	2.39	SILTY SAND to SANDY SILT	99	95	97		45.0
6.750	22.15	287.02	2.24	SILTY SAND to SANDY SILT	96	91	96		44.5
6.900	22.64	326.15	2.22	SAND to SILTY SAND	82	77	99		45.5
7.050	23.13	328.00	2.47	SILTY SAND to SANDY SILT	100	100	99		45.0
7.200	23.62	350.35	2.23	SAND to SILTY SAND	88	82	100		45.5
7.350	24.11	316.48	1.97	SAND to SILTY SAND	79	73	98		45.0
7.500	24.61	287.38	2.64	SILTY SAND to SANDY SILT	96	88	95		44.5
7.650	25.10	362.82	1.76	SAND to SILTY SAND	91	83	100		45.5
7.800	25.59	401.80	1.59	SAND to SILTY SAND	100	92	100		46.0
7.950	26.08	358.44	2.04	SAND to SILTY SAND	90	81	100		45.5
8.100	26.57	316.72	2.66	SILTY SAND to SANDY SILT	100	95	97		44.5
8.250	27.07	356.57	2.19	SAND to SILTY SAND	89	80	100		45.0
8.400	27.56	322.84	2.68	SILTY SAND to SANDY SILT	100	96	97		44.5
8.550	28.05	359.31	2.53	SILTY SAND to SANDY SILT	100	100	100		45.0
8.700	28.54	367.26	2.22	SAND to SILTY SAND	92	81	100		45.0
8.850	29.04	371.34	2.39	SILTY SAND to SANDY SILT	100	100	100		45.0
9.000	29.53	344.36	2.59	SILTY SAND to SANDY SILT	100	100	98		45.0
9.150	30.02	340.94	2.47	SILTY SAND to SANDY SILT	100	98	98		44.5
9.300	30.51	323.30	2.59	SILTY SAND to SANDY SILT	100	93	96		44.5
9.450	31.00	314.13	2.36	SILTY SAND to SANDY SILT	100	90	95		44.5
9.600	31.50	356.02	2.61	*SAND to CLAYEY SAND	100	100			
9.750	31.99	356.89	2.77	*SAND to CLAYEY SAND	100	100			
9.900	32.48	352.32	2.72	*SAND to CLAYEY SAND	100	100			
10.050	32.97	326.24	2.57	SILTY SAND to SANDY SILT	100	91	96		44.5
10.200	33.46	363.88	2.61	*SAND to CLAYEY SAND	100	100			
10.350	33.96	374.35	2.59	*SAND to CLAYEY SAND	100	100			
10.500	34.45	369.45	2.58	*SAND to CLAYEY SAND	100	100			
10.650	34.94	338.49	2.16	SAND to SILTY SAND	85	70	96		44.0
10.800	35.43	220.95	2.95	SILTY SAND to SANDY SILT	74	60	84		42.5
10.950	35.93	283.79	2.59	SILTY SAND to SANDY SILT	95	77	91		43.5
11.100	36.42	333.12	2.61	SILTY SAND to SANDY SILT	100	90	95		44.0
11.250	36.91	371.25	2.87	*SAND to CLAYEY SAND	100	100			
11.400	37.40	393.99	2.91	*SAND to CLAYEY SAND	100	100			
11.550	37.89	380.64	2.79	*SAND to CLAYEY SAND	100	100			
11.700	38.39	374.89	2.58	*SAND to CLAYEY SAND	100	100			
11.850	38.88	357.36	2.61	*SAND to CLAYEY SAND	100	100			
12.000	39.37	378.05	2.68	*SAND to CLAYEY SAND	100	100			
12.150	39.86	409.60	2.64	*SAND to CLAYEY SAND	100	100			
12.300	40.35	387.85	2.83	*SAND to CLAYEY SAND	100	100			
12.450	40.85	371.08	2.73	*SAND to CLAYEY SAND	100	100			
12.600	41.34	361.31	2.28	SAND to SILTY SAND	90	70	97		44.0
12.750	41.83	334.90	2.55	SILTY SAND to SANDY SILT	100	86	94		44.0
12.900	42.32	350.09	2.55	SILTY SAND to SANDY SILT	100	90	95		44.0
13.050	42.81	372.12	2.60	*SAND to CLAYEY SAND	100	100			
13.200	43.31	365.79	2.50	SILTY SAND to SANDY SILT	100	93	96		44.0
13.350	43.80	349.97	2.48	SILTY SAND to SANDY SILT	100	89	95		44.0
13.500	44.29	356.70	2.54	SILTY SAND to SANDY SILT	100	90	95		44.0
13.650	44.78	343.63	2.63	SILTY SAND to SANDY SILT	100	86	94		43.5

*INDICATES OVERCONSOLIDATED OR CEMENTED MATERIAL
ASSUMED TOTAL UNIT WT = 120 pcf
ASSUMED DEPTH OF WATER TABLE = 15.0 ft
N(60) = EQUIVALENT SPT VALUE (60% Energy)
N1(60) = OVERBURDEN NORMALIZED EQUIVALENT SPT VALUE (60% Energy)
Dr = OVERBURDEN NORMALIZED EQUIVALENT RELATIVE DENSITY
Su = OVERBURDEN NORMALIZED UNDRAINED SHEAR STRENGTH
PHI = OVERBURDEN NORMALIZED EQUIVALENT FRICTION ANGLE

DEPTH (m)	DEPTH (ft)	TIP RESISTANCE (tsf)	FRICTION RATIO (%)	SOIL BEHAVIOR TYPE	N(60)	N1(60)	Dr (%)	Su (tsf)	PHI (Degrees)
13.800	45.28	318.63	2.89	*SAND to CLAYEY SAND	100	100			
13.950	45.77	322.69	2.97	*SAND to CLAYEY SAND	100	100			
14.100	46.26	304.25	2.65	SILTY SAND to SANDY SILT	100	76	90		43.0
14.250	46.75	310.47	3.07	*SAND to CLAYEY SAND	100	100			
14.400	47.24	319.56	2.93	*SAND to CLAYEY SAND	100	100			
14.550	47.74	310.41	2.94	*SAND to CLAYEY SAND	100	100			
14.700	48.23	303.72	2.53	SILTY SAND to SANDY SILT	100	74	90		43.0
14.850	48.72	319.88	2.88	*SAND to CLAYEY SAND	100	100			
15.000	49.21	332.35	2.76	*SAND to CLAYEY SAND	100	100			
15.150	49.70	357.19	2.64	*SAND to CLAYEY SAND	100	100			
15.300	50.20	405.24	*****		0	0			.0

*INDICATES OVERCONSOLIDATED OR CEMENTED MATERIAL
ASSUMED TOTAL UNIT WT = 120 pcf
ASSUMED DEPTH OF WATER TABLE = 15.0 ft
N(60) = EQUIVALENT SPT VALUE (60% Energy)
N1(60) = OVERBURDEN NORMALIZED EQUIVALENT SPT VALUE (60% Energy)
Dr = OVERBURDEN NORMALIZED EQUIVALENT RELATIVE DENSITY
Su = OVERBURDEN NORMALIZED UNDRAINED SHEAR STRENGTH
PHI = OVERBURDEN NORMALIZED EQUIVALENT FRICTION ANGLE

Interpretations based on: Robertson and Campanella, 1989.

HOLGUIN, FAHAN & ASSOCIATES, INC.

Modified California Split Barrel Sampler

Modified California Split Barrel Sampler - No Recovery

Standard Penetration Test (SPT) Sampler

Standard Penetration Test (SPT) Sampler - No Recovery

Perched Water Level

Water Level First Encountered

Water Level After Drilling

Pocket Penetrometer (tsf)

Vane Shear (ksf)

1. The approximate locations of borings were determined by sighting and pacing from nearby prominent topographic or cultural features. Borehole elevations were estimated by interpolating between available plan contour intervals. The location and elevation of each boring should be considered accurate only to the degree implied by this method.

2. Stratification lines represent the approximate boundary between soil and/or rock types. The transition between statigraphic units may be gradual.

3. Water level readings taken in boreholes are approximate and apply only to the time and date of drilling. Fluctuations in the level of groundwater from the time of initial measurement may occur due to variations in rainfall, tides, barometric pressure, temperature, or other factors.

EARTH SYSTEMS SOUTHERN CALIFORNIA

1731-A Walter Street, Ventura, California 93003
PH: (805) 642-6727 FAX: (805) 642-1325

Symbols Commonly Used on Boring Logs

MAJOR DIVISIONS			GRAPH SYMBOL	LETTER SYMBOL	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS (LITTLE OR NO FINES)		G W	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
				G P	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION RETAINED ON NO 4 SIEVE	GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		G M	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES
				G C	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
MORE THAN 50% OF MATERIAL IS LARGER THAN NO 200 SIEVE SIZE	SAND AND SANDY SOILS	CLEAN SAND (LITTLE OR NO FINES)		S W	WELL-GRADED SANDS GRAVELLY SANDS, LITTLE OR NO FINES
				S P	POORLY-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION PASSING ON NO 4 SIEVE	SAND WITH FINES (APPRECIABLE AMOUNT OF FINES)		S M	SILTY SANDS, SAND-SILT MIXTURES
				S C	CLAYEY SANDS, SAND-CLAY MIXTURES
FINE GRAINED SOILS	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		M L	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				C L	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				O L	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
MORE THAN 50% OF MATERIAL IS SMALLER THAN NO 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		M H	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				C H	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
				O H	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				P T	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE. DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS.

EARTH SYSTEMS SOUTHERN CALIFORNIA

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Unified Soil Classification System (USCS)