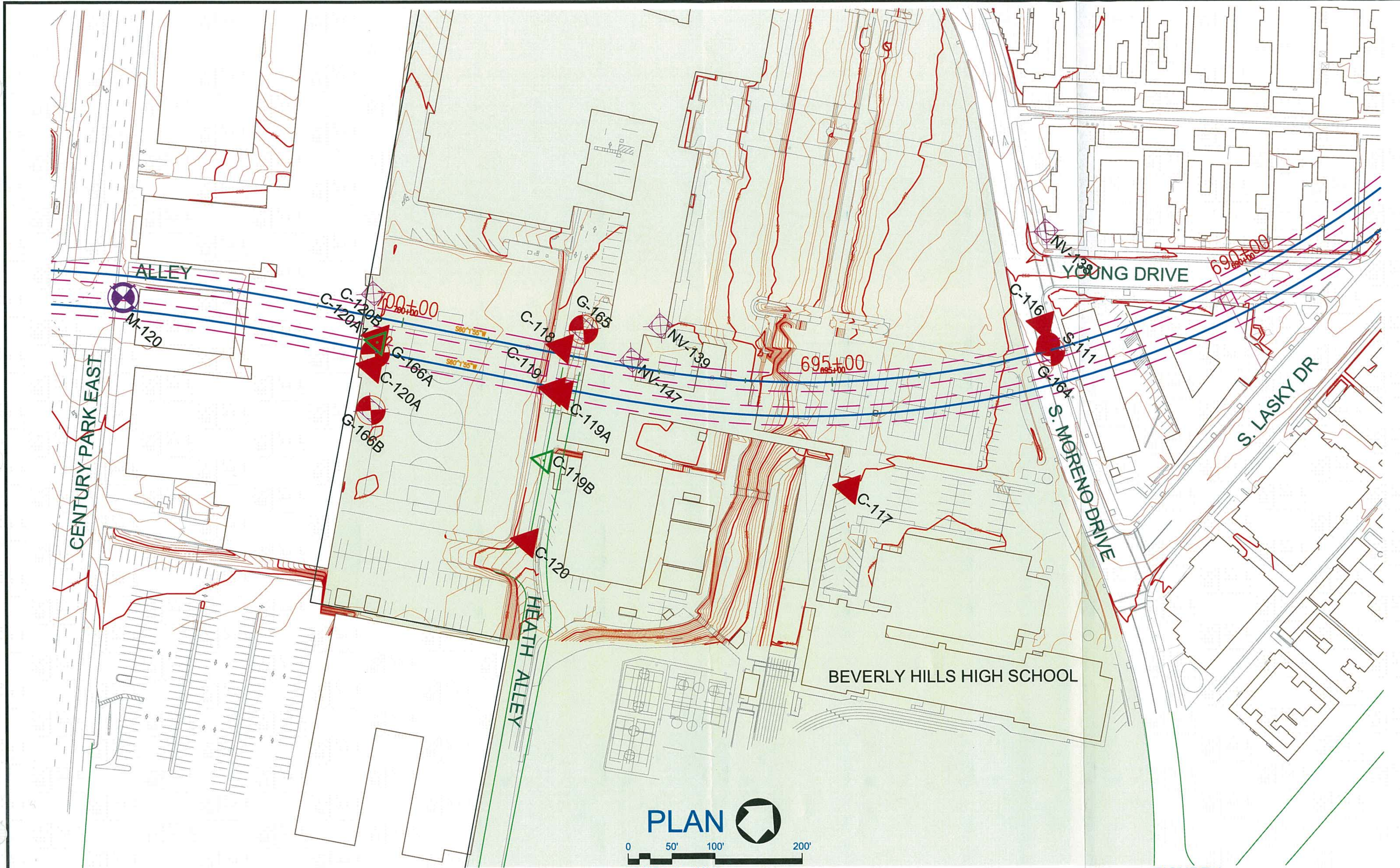
Geotechnical Investigation Data - Beverly Hills High School (BHHS)

Contents

*Also included in: Century City Tunnel Safety Report, Metro (2011)

**Also included in: Century City Area Fault Investigation Report, Metro (2011)

1. GEOTECHNICAL INVESTIGATIONS



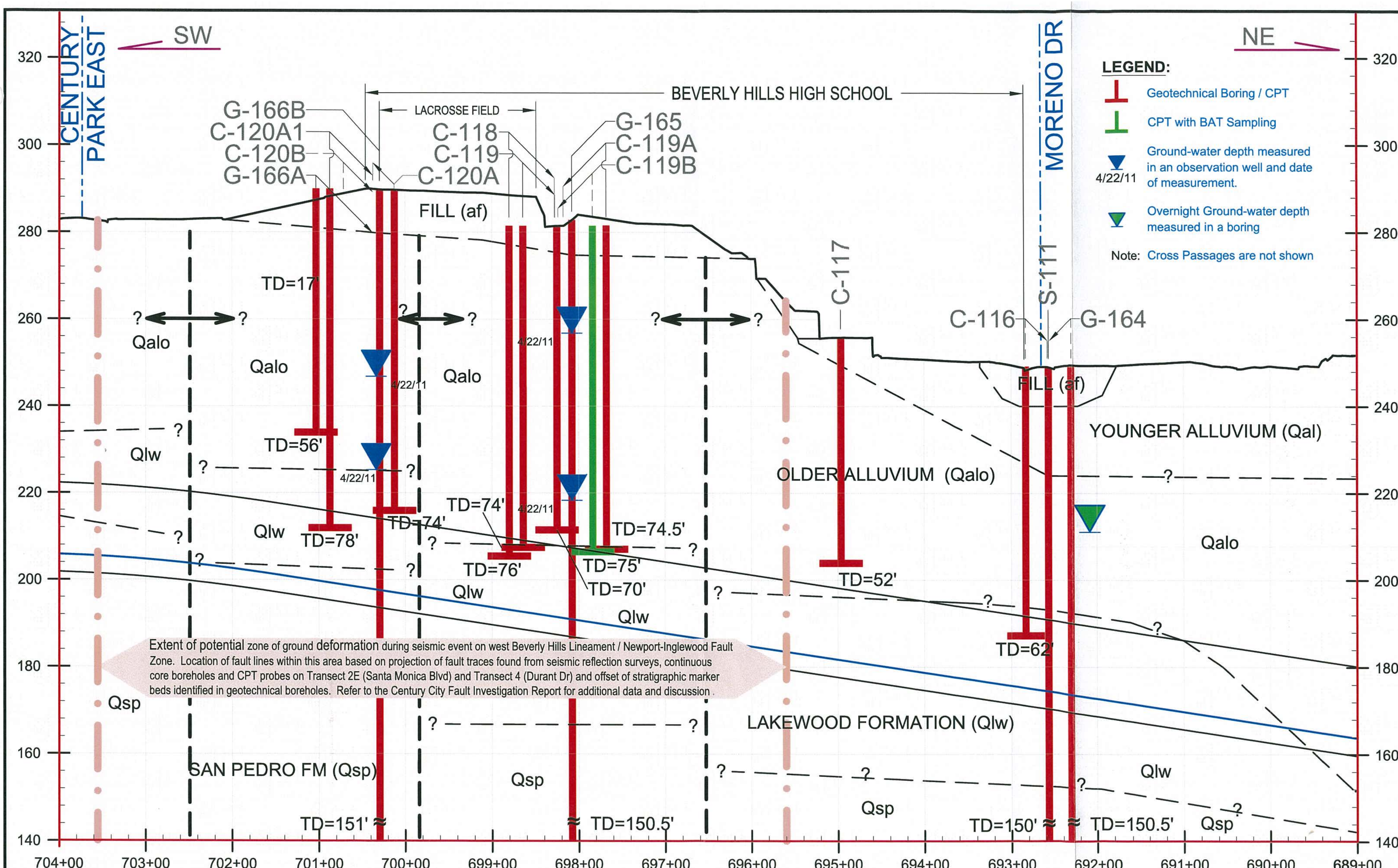
NOTE: REFER TO LEGEND FOR EXPLANATION OF SYMBOLS

FIGURE 1

SEE FIGURE 3 FOR LEGEND

DRAWN BY L. MORLEY	IN CHARGE M. HUDSON	DRAFT	Metro — LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY	PB — PROJECT MANAGER	WESTSIDE SUBWAY EXTENSION PRELIMINARY ENGINEERING	BORING PLAN MORENO DRIVE TO CENTURY PARK EAST	PLAN
CHECKED BY P.E. / R.M. / JAG	DATE SEPTEMBER, 2011						SCALE 1" = 100'

UserName: LAMORI... 23, 2011 @ 12:34pm FileName=> G:\4953_Geotech\2010\101561_Metro_Westside_Extension\CAD\DWG\BHHS-XHBT(9-20)... Plan)



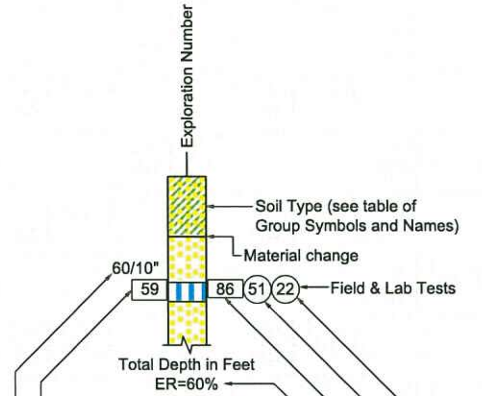
NOTE: REFER TO LEGEND FOR EXPLANATION OF SYMBOLS

PROFILE: H=100', V=20' VERTICAL EXAGGERATION = 5:1

FIGURE 2

DRAWN BY L. MORLEY	IN CHARGE M. HUDSON	Metro	LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY	PB	PROJECT MANAGER	WESTSIDE SUBWAY EXTENSION PRELIMINARY ENGINEERING	SOIL PROFILE MORENO DRIVE TO CENTURY PARK EAST	SOIL PROFILE
CHECKED BY P.E. / R.M. / JAG	DATE SEPTEMBER, 2011							SCALE AS NOTED

GROUP SYMBOLS AND NAMES	
Graphic/Symbol	Group Names
FILL	CLAYEY Artificial FILL
	SILTY SAND Artificial FILL
	SANDY Artificial FILL
CL	Lean CLAY
	SANDY lean CLAY
	Lean CLAY with GRAVEL
CL-ML	SILTY CLAY
	SILTY CLAY with GRAVEL
CL-CH	Lean to fat CLAY
	Lean to fat CLAY with GRAVEL
CH	Fat CLAY
	Fat CLAY with SAND
	Fat CLAY with GRAVEL
ML	SILT
	SILT with SAND
	SANDY SILT
MH	Elastic SILT
	Elastic SILT with GRAVEL
SM	SILTY SAND
	SILTY SAND with GRAVEL
SP-SM	Poorly graded SAND with SILT
	Poorly graded SAND with SILT and GRAVEL
SC-SM	SILTY, CLAYEY SAND
	SILTY, CLAYEY SAND with GRAVEL
SC	CLAYEY SAND
	CLAYEY SAND with GRAVEL
SP	Poorly graded SAND
	Poorly graded SAND with GRAVEL
SW	Well-graded SAND
	Well-graded SAND with GRAVEL



NOTES:

A. "N" Value Standard Penetration Test: Number of blows required to drive the SPT sampler 12 inches using a 140 pound automatic hammer falling 30 inches. Inches of penetration (if less than 12 inches) indicated after N-Values.

B. Number of blows required to drive the Crandall Sampler 12 inches using an automatic hammer falling 18 inches (hammer weight varies). Inches of penetration (if less than 12 inches) indicated after blow count.

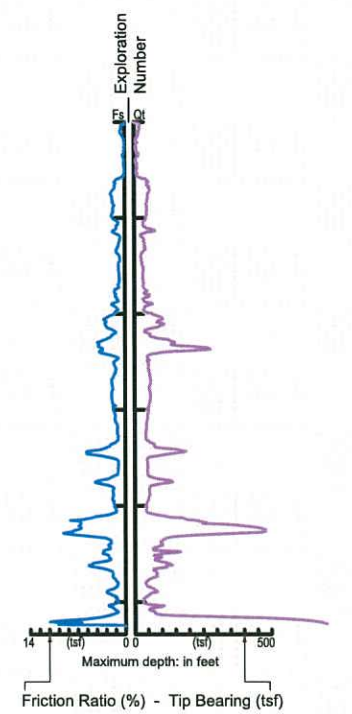
C. Hammer Energy Ratio

D. Percent passing No. 200 Sieve

E. Liquid Limit

F. Plasticity Index

ROTARY BORING



CONE PENETRATION TEST (CPT) SOUNDING

Geotechnical / Soil-Gas Investigation:

G-166 — Geotechnical Rotary-Wash Boring

C-119B — CPT [Geotechnical + Gas - BAT]

C-118 — CPT [Geotechnical]

M-120 — Gas Monitoring Well

Symbols Legend:

Site view of tracks (blue), tunnel outlines (magenta dash) with perpendicular lines representing cross passages.

4/22/11 — Ground-water depth measured during 2009 to 2011 in an observation well, drilled by MACTEC and date of measurement.

Overnight Ground-water depth measured in a 2011 boring, drilled by MACTEC.

Ground-water depth measured during drilling of a boring in 2011, by MACTEC.

— — — —?— — Geologic contact line (? where queried).

Approximate location of Fault.

Geologic Units:

af — ARTIFICIAL FILL (undocumented)

Qal — YOUNGER ALLUVIUM (Holocene) - predominantly sand, silt and clay

Qalo — OLDER ALLUVIUM - varying layers of Silty Sand, Clayey/Silty Clay, and Silt with occasional gravel

Qlw — LAKEWOOD FORMATION (late Pleistocene) - interbedded Silty sands, Silts, and Clays with clayey Sand Layers

Qsp — SAN PEDRO FORMATION (mid Pleistocene) - predominately greenish gray and bluish gray fine-grained Sands, medium to coarse Sands and some Silt Layers.

Tf — FERNANDO FORMATION (Pliocene) - predominately massive Siltstone with some Claystone interbeds

Alignment based on data provided by PB (7/15/2011)

REV	DATE	BY	APP	REG NO	EXPIRES	SEAL HOLDER	DESCRIPTION

DESIGNED BY N. HARROLD
DRAWN BY L. MORLEY
CHECKED BY JAG / H.P.
IN CHARGE M. HUDSON
DATE SEPTEMBER, 2011

Metro — LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY

PB — PROJECT MANAGER ____

FIGURE 3

WESTSIDE SUBWAY EXTENSION PRELIMINARY ENGINEERING

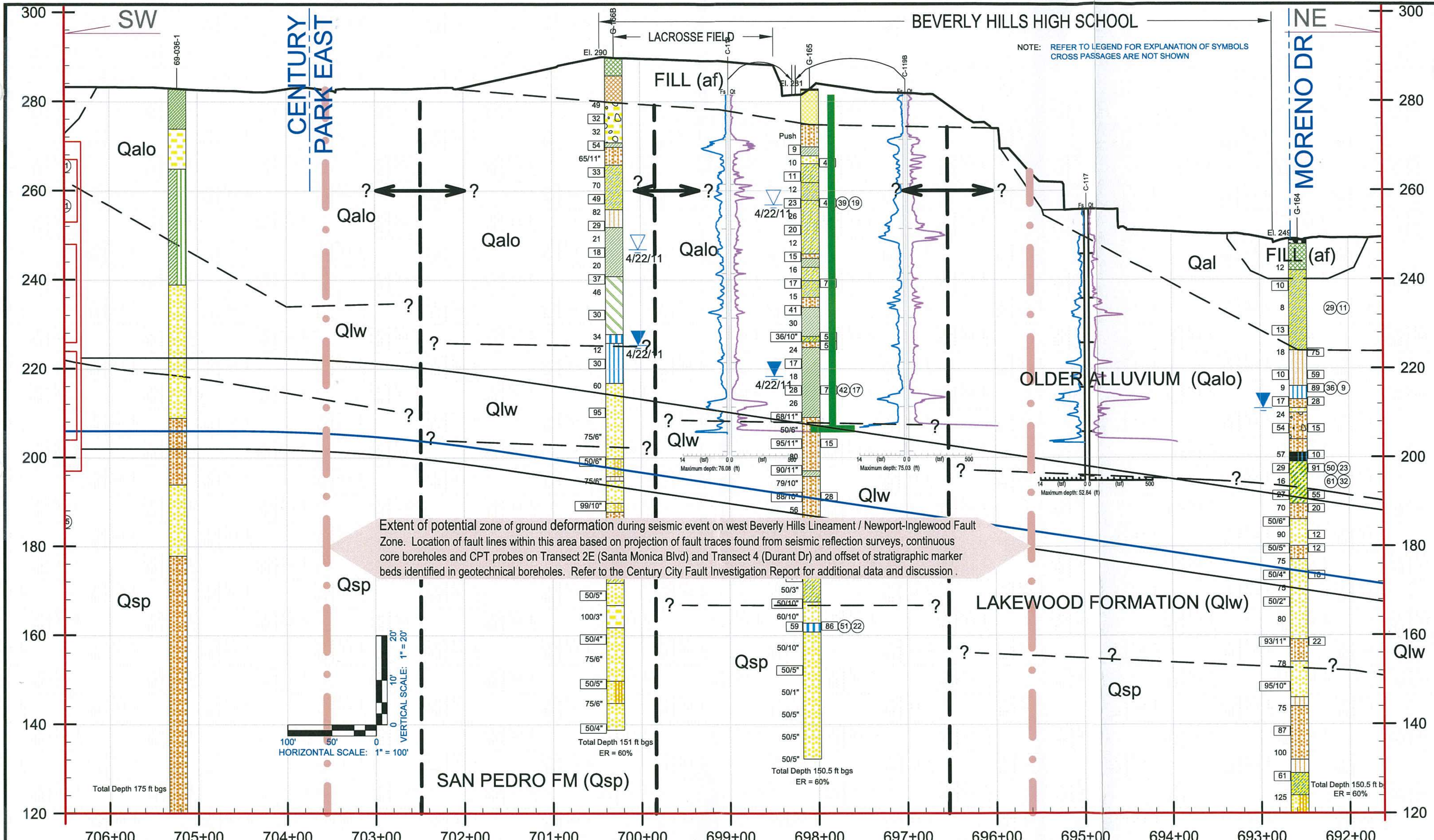
LEGEND SHEET GEOTECHNICAL INVESTIGATION

CONTRACT NO

DRAWING NO | REV

SCALE

SHEET NO



REV	DATE	BY	APP	REG NO	EXPIRES	SEAL HOLDER	DESCRIPTION

DESIGNED BY N. HARROLD
DRAWN BY L. MORLEY
CHECKED BY JAG / H.P.
IN CHARGE M. HUDSON
DATE SEPTEMBER, 2011

Metro

LOS ANGELES COUNTY
METROPOLITAN TRANSPORTATION AUTHORITY

PB

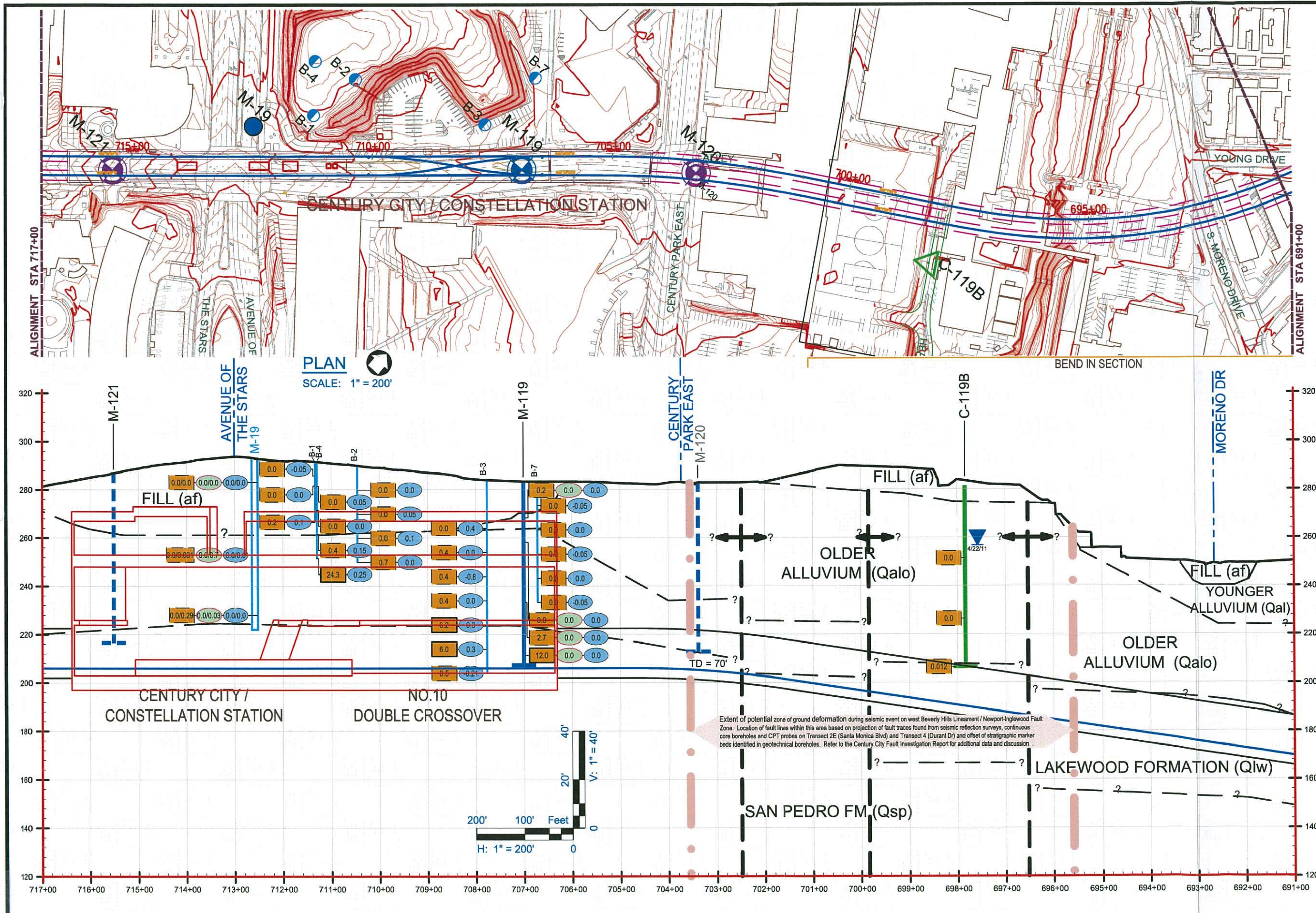
PROJECT MANAGER

FIGURE 4

WESTSIDE SUBWAY EXTENSION
PRELIMINARY ENGINEERING

SOIL PROFILE WITH
DETAILED BORING DATA

CONTRACT NO
DRAWING NO
REV
SCALE AS NOTED
SHEET NO



GAS SYMBOLS

Methane Encountered:

- 4 — < 5% by Volume
- 25 — 5 - 25% by Volume
- 100 — 26 - 100% by Volume

H_2S Encountered:

- 0.7 — 0.7 ppm (Parts Per Million by Volume)

Pressure Encountered:

- 0.7 — 0.7 inches of Water

NOTES:

1. Slash "/" indicates year taken (2011/2009) otherwise all data is 2011.
2. W = Water encountered negating Data
3. H = High (off scale)
4. NA = No Measured Data (not available)
5. 5/26/11 Ground-Water Level and Date Measured
6. M-19 is prior ACE MACTEC gas well.
7. M-119 is current PE Phase MACTEC gas well.
8. C-119B is PE Phase MACTEC CPT BAT exploration.
9. B-1 to B-7 are 2004 gas data of drill site 2 (10131 Constellation Blvd) by others.
10. For clarity purposes Geotechnical Borings are not shown on the Plan and Profile. Only Geologic Units and Contacts are shown on the Profile.
11. Cross Passages are not shown.

REV	DATE	BY	APP	REG NO	EXPIRES	SEAL HOLDER	DESCRIPTION

DESIGNED BY
DRAWN BY L. MORLEY
CHECKED BY JAG / H.P.
IN CHARGE M. HUDSON
DATE SEPTEMBER, 2011

Metro
LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY
PB
PROJECT MANAGER

WESTSIDE SUBWAY EXTENSION
PRELIMINARY ENGINEERING
SOIL PROFILE WITH GAS DATA

FIGURE 5

CONTRACT NO
DRAWING NO
REV
SCALE AS NOTED
SHEET NO

UserName: LAMORLEY 2011 @ 4:36pm FileName=> G:\4953_Geotech\2010\101561_Metro_Westside_Extension\CAD\DWG\BHS-XHBT(9-20).dwg

Beverly Hills High School - BAT® CPTs

BAT® CPT sampling was planned at three locations, identified as C-117B, C-119B and C-120B. BAT sampling was attempted at location C-119B. Due to stiff or dense soils, CPT C-120B reached refusal at a depth of about 17 feet below ground surface. Since this depth was above the groundwater level observed at the site, BAT® sampling was not attempted at this location. Due to work time restrictions at the school, BAT® sampling at CPT C-117B was also not attempted.

At C-119B, BAT® sampling was attempted at depths of about 30, 40, 55, 75 feet below ground surface. A 5-foot-thick sand zone was encountered at a depth of about 30 feet; however, water was not recovered in the sampling tubes, even after about 45 minutes had lapsed. Similarly, water samples were not obtained after a 45-minute waiting period at depths of about 40 and 55 feet because of the presence of fine-grained soils. Accordingly, the sampling wait time was increased to 90 minutes at a depth of about 75 feet; however, water samples were still not recovered. In order to characterize the gas concentrations, gas samples from BAT® tubes were tested, which were collected at depths of 30, 55 and 75 feet. Tests indicated non-detect values of methane, ethane, and propane at depths of 30 and 55 feet, and 0.012 percent of methane at a depth of 75 feet below ground surface (bgs).

2. BORING LOGS

KEY TO SYMBOLS AND DESCRIPTIONS

MAJOR DIVISIONS			GROUP SYMBOLS	TYPICAL NAMES
COARSE GRAINED SOILS (More than 50% of material is LARGER than No. 200 sieve size)	GRAVELS (More than 50% of coarse fraction is LARGER than the No. 4 sieve size)	CLEAN GRAVELS (Little or no fines)	GW	Well graded gravels, gravel - sand mixtures, little or no fines.
			GP	Poorly graded gravels or grave - sand mixtures, little or no fines.
		GRAVELS WITH FINES (Appreciable amount of fines)	GM	Silty gravels, gravel - sand - silt mixtures.
			GC	Clayey gravels, gravel - sand - clay mixtures.
	SANDS (More than 50% of coarse fraction is SMALLER than the No. 4 Sieve Size)	CLEAN SANDS (Little or no fines)	SW	Well graded sands, gravelly sands, little or no fines.
			SP	Poorly graded sands or gravelly sands, little or no fines.
		SANDS WITH FINES (Appreciable amount of fines)	SM	Silty sands, sand - silt mixtures
			SC	Clayey sands, sand - clay mixtures.
FINE GRAINED SOILS (More than 50% of material is SMALLER than No. 200 sieve size)	SILTS AND CLAYS (Liquid limit LESS than 50)		ML	Inorganic silts and very fine sands, rock flour, silty of clayey fine sands or clayey silts and with slight plasticity.
			CL	Inorganic lays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
			OL	Organic silts and organic silty clays of low plasticity.
	SILTS AND CLAYS (Liquid limit GREATER than 50)		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
			CH	Inorganic clays of high plasticity, fat clays
TAR IMPACTED SOILS				

BOUNDARY CLASSIFICATIONS: Soils possessing characteristics of two groups are designated by combinations of group symbols.

SILT OR CLAY	SAND			GRAVEL		Cobbles	Boulders
	Fine	Medium	Coarse	Fine	Coarse		

No.200 No.40 No.10 No.4 3/4" 3" 12"

U.S. STANDARD SIEVE SIZE

Reference: The Unified Soil Classification System, Corps of Engineers, U.S. Army Technical Memorandum No. 3-357, Vol. 1, March, 1953 (Revised April, 1960)

*For all other hammer weights and drop heights, field blow counts were corrected for appropiate energy factors.

	Undisturbed Sample		Auger Cuttings
	Split Spoon Sample		Bulk Sample
	Rock Core		Crandall Sampler
	Dilatometer	PMT	Pressuremeter
NV	Noise/Vibration		No Recovery
∇	Water Table at time of drilling	▼	Water Table after drilling

Correlation of Penetration Resistance with Relative Density and Consistency*

SPT Sampler (140-lb hammer, 30-inch drop)

SAND & GRAVEL		SILT & CLAY	
No. of Blows	Relative Density	No. of Blows	Consistency
0 - 4	Very Loose	0 - 1	Very Soft
5 - 10	Loose	2 - 4	Soft
11 - 30	Medium Dense	5 - 8	Medium Stiff
31 - 50	Dense	9 - 15	Stiff
Over 50	Very Dense	16 - 30	Very Stiff
		Over 30	Hard

CRANDALL Sampler (140-lb hammer, 30-inch drop)

SAND & GRAVEL		SILT & CLAY	
No. of Blows	Relative Density	No. of Blows	Consistency
0 - 7	Very Loose	0 - 2	Very Soft
8 - 16	Loose	3 - 7	Soft
17 - 47	Medium Dense	8 - 13	Medium Stiff
48 - 77	Dense	14 - 23	Stiff
Over 77	Very Dense	25 - 47	Very Stiff
		Over 47	Hard

amec

Figure A-6

DRILLING COMPANY/DRILLING EQUIPMENT		BORING NO.
C & L Drilling / Mayhew 1000		G-165
DRILLING METHOD Rotary Wash	BOREHOLE LOCATION Sta 698+10, Rt 30 feet	
DATES DRILLED 3/5/2011 and 3/19/2011	HOLE DIAMETER 4-7/8 inches	GROUND EL. 281 feet

GROUND-WATER READINGS
Ground-water level measured at 26 feet and 64½ feet below the ground surface in shallow and deep monitoring wells, respectively on 4/22/2011. See last page of this boring for details.

ELEVATION (ft)	DEPTH (ft)	"N" VALUE STD.PEN.TEST	OVA (ppm)**	MOISTURE CONTENT (% of dry wt.)	DRY DENSITY (pcf)	BLOW COUNT* (blows/ft)	PERCENT PASSING No. 200 SIEVE	SAMPLE LOC.	DOWNHOLE TESTS	USCS	DESCRIPTION
281	0									SP	4-inch thick Asphalt Concrete, No Base Course **FILL [Af]** POORLY GRADED SAND - moist, fine to medium-grained, with silt and clay, trace gravel (up to 1½ inches in size)
280											
275	5										
										SM	**QUATERNARY OLDER ALLUVIUM [Qalo]** SILTY SAND - moist, brown, fine to coarse-grained, trace fine gravel
270	10		0.3	16.8	109	Push		⊠			
		9	0.1	24.2	-			⊠		CL	LEAN CLAY - stiff, moist, light brown
265	15									SP	POORLY GRADED SAND - loose, moist, brown, fine to coarse-grained
			0.1	22.7	101	10	49	⊠		SC	CLAYEY SAND - loose, moist, brown, fine-grained, trace gravel (up to 3/8 inch in size)
	20	11	0.2	22.1	-			⊠			Thin layer of Sandy Silt
260										CL	SANDY LEAN CLAY - stiff, moist, reddish brown, trace gravel (up to 1/4 inch in size)
			0.1	17.6	106	12		⊠			Trace sand
255	25	23	0.0	13.1	-		48	⊠		SC	∇ CLAYEY SAND - medium dense, moist, brown, fine to medium-grained, trace gravel (up to 1/2 inch in size)
			0.0	18.4	112	26		⊠			
250	30	20	0.0	15.6	-			⊠			
	35		0.1	21.1	101	12		⊠			Thin layer of Silty Sand
245										SM	SILTY SAND - medium dense, moist, brown, fine to medium-grained
		15	0.1	25.4	-			⊠		CL	LEAN CLAY - stiff, moist, brown
	40										

THIS RECORD IS AN INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. LATITUDE AND LONGITUDE OF BORING LOCATION SHOWN ON LOGS ARE APPROXIMATE. SUBSURFACE CONDITIONS AND AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

(CONTINUED ON FOLLOWING FIGURE)

Field Tech: DW
Prepared/Date: JF 5/11/2011
Checked/Date: LT/RM 9/20/2011

LA METRO PB-TUNNEL ZONE S:\70131 GEOTECH\GINT\LIBRARY MACTEC JUNE2011.GLB
G:\PROJECT_DIRECTORIES\4953\2010\101561_METRO_WESTSIDE_EXTENSION\6.2.3.1 GEOTECHNICAL DESIGN\3.2 ALL FIELD NOTES\GINT LOG\NEW TEMPLATE - MARCH 14, 2011\4953-10-1561_(161-181).GPJ 10/18/11

THIS RECORD IS AN INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. LATITUDE AND LONGITUDE OF BORING LOCATION SHOWN ON LOGS ARE APPROXIMATE. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

DRILLING COMPANY/DRILLING EQUIPMENT		BORING NO.
C & L Drilling / Mayhew 1000		**G-165 (Continued)**
DRILLING METHOD	**BOREHOLE LOCATION**	
Rotary Wash	Sta 698+10, Rt 30 feet	
DATES DRILLED	**HOLE DIAMETER**	**GROUND EL.**
3/5/2011 and 3/19/2011	4-7/8 inches	281 feet

GROUND-WATER READINGS
Ground-water level measured at 26 feet and 64½ feet below the ground surface in shallow and deep monitoring wells, respectively on 4/22/2011. See last page of this boring for details.

ELEVATION (ft)	DEPTH (ft)	"N" VALUE STD.PEN.TEST	OVA (ppm)**	MOISTURE CONTENT (% of dry wt.)	DRY DENSITY (pcf)	BLOW COUNT* (blows/ft)	PERCENT PASSING No. 200 SIEVE	SAMPLE LOC.	DOWNHOLE TESTS	USCS	DESCRIPTION
240			0.1	19.6	97	16		▩		SC	CLAYEY SAND - medium dense, moist, brown and gray, fine-grained
		17	0.0	24.8	-		76	☒		CL	LEAN CLAY with SAND - very stiff, moist, brown, trace gravel (up to 3/8 inch in size)
235	45		0.0	28.9	95	15		▩		SM	SILTY SAND - medium dense, moist, brown, fine to medium-grained
	50	41	0.0	18.4	-			☒		CL	LEAN CLAY - hard, moist, brown
230			0.0	18.9	105	30		▩			Trace fine sand
225	55	36/10"	0.0	17.3	-		58	☒	NV		Alternating with layers of Sandy Lean Clay, trace gravel (up to 3/8 inch in size)
										SM	SILTY SAND - dense, moist, brown, fine-grained
			0.0	21.0	101	24		▩		CL	LEAN CLAY - very stiff, moist, light brown, with fine sand
220	60	17	0.1	31.4	-			☒			With calcium carbonate nodules and iron oxide stains
	65		0.0	19.4	97	18		▩	NV		▼
215		28	0.0	25.5	-		77	☒			With sand
210	70		0.1	37.5	82	26		▩			Becomes olive gray to olive brown, trace iron oxide stains Becomes hard
											LAKEWOOD FORMATION [Qlw]
		68/11"	0.0	16.4	-			☒	NV	SM	SILTY SAND - very dense, moist, gray, fine-grained
Tunnel	75		0.2	14.5	105	50/6"		▩			Becomes light brown and gray
	80	95/11"		16.9	-		15	☒			

(CONTINUED ON FOLLOWING FIGURE)

Field Tech: DW
Prepared/Date: JF 5/11/2011
Checked/Date: LT/RM 9/20/2011

DRILLING COMPANY/DRILLING EQUIPMENT		BORING NO.
C & L Drilling / Mayhew 1000		**G-165 (Continued)**
DRILLING METHOD	**BOREHOLE LOCATION**	
Rotary Wash	Sta 698+10, Rt 30 feet	
DATES DRILLED	**HOLE DIAMETER**	**GROUND EL.**
3/5/2011 and 3/19/2011	4-7/8 inches	281 feet

GROUND-WATER READINGS
Ground-water level measured at 26 feet and 64½ feet below the ground surface in shallow and deep monitoring wells, respectively on 4/22/2011. See last page of this boring for details.

ELEVATION (ft)	DEPTH (ft)	"N" VALUE STD.PEN.TEST	OVA (ppm)**	MOISTURE CONTENT (% of dry wt.)	DRY DENSITY (pcf)	BLOW COUNT* (blows/ft)	PERCENT PASSING No. 200 SIEVE	SAMPLE LOC.	DOWNHOLE TESTS		DESCRIPTION
Tunnel			0.1	19.1	94	80					Becomes yellowish brown, trace medium sand, trace silt
	85										Becomes dark gray, fine to coarse-grained
		90/11"	0.2	23.9	-					CL	LEAN CLAY - hard, moist, greenish gray, trace fine sand
										SM	SILTY SAND - very dense, moist, olive brown to gray, fine to medium-grained
			0.2	18.2	100	79/10"					
	90	88/10"	1.1	20.7	-		28				Becomes greenish gray to gray, trace iron oxide stains
	95		1.2	23.8	99	56					
185		97/11"	0.6	15.9	-						Becomes yellowish brown
180	100		0.4	14.1	108	75/10"					Trace coarse sand
											Brown to olive brown, fine-grained
		63	0.1	24.3	-		32				
175	105		0.1	22.6	99	42/10"					Becomes dense
	110	91	0.0	26.1	-					SC	CLAYEY SAND - very dense, moist, brown to olive brown, fine-grained
170			-	-		50/3"					(Sample not recovered)
											SAN PEDRO FORMATION [Qsp]
165	115	50/10"	0.3	20.2	-					SP	POORLY GRADED SAND - very dense, moist, gray, fine-grained
	120		0.0	18.8	106	60/10"					Trace coarse sand

THIS RECORD IS AN INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. LATITUDE AND LONGITUDE OF BORING LOCATION SHOWN ON LOGS ARE APPROXIMATE. SUBSURFACE CONDITIONS AND AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

LA METRO PB-TUNNEL ZONE S:\70131 GEOTECH\GINTW\LIBRARY MACTEC JUNE2011.GLB
G:\PROJECT_DIRECTORIES\4953\2010\101561_METRO_WESTSIDE_EXTENSION\6.2.3.1 GEOTECHNICAL DESIGN\3.2 ALL FIELD NOTES\GINT LOG\NEW TEMPLATE - MARCH 14, 2011\4953-10-1561_(161-181).GPJ 10/18/11

Field Tech: DW
Prepared/Date: JF 5/11/2011
Checked/Date: LT/RM 9/20/2011

(CONTINUED ON FOLLOWING FIGURE)

DRILLING COMPANY/DRILLING EQUIPMENT		BORING NO.
C & L Drilling / Mayhew 1000		G-165 (Continued)
DRILLING METHOD: Rotary Wash	BOREHOLE LOCATION: Sta 698+10, Rt 30 feet	
DATES DRILLED: 3/5/2011 and 3/19/2011	HOLE DIAMETER: 4-7/8 inches	GROUND EL.: 281 feet

GROUND-WATER READINGS
Ground-water level measured at 26 feet and 64½ feet below the ground surface in shallow and deep monitoring wells, respectively on 4/22/2011. See last page of this boring for details.

ELEVATION (ft)	DEPTH (ft)	"N" VALUE STD.PEN.TEST	OVA (ppm)**	MOISTURE CONTENT (% of dry wt.)	DRY DENSITY (pcf)	BLOW COUNT* (blows/ft)	PERCENT PASSING No. 200 SIEVE	SAMPLE LOC.	DOWNHOLE TESTS	USCS	DESCRIPTION
160		59	0.0	27.2	-		86	☒		MH	ELASTIC SILT - hard, moist, gray
										SP	POORLY GRADED SAND - very dense, moist, gray, fine to medium-grained
155	125		0.0	17.5	-	50/10"		○			(Sample not recovered)
											With gravel
150	130	50/5"	0.1	14.9	-			☒			Trace fine gravel, trace organic odor
145	135		4.6	13.5	97	50/1"		▩			Fine to coarse-grained, trace gravel (up to 1/2 inch in size)
140	140		3.4	18.6	94	50/5"		▩			
135	145		0.5	13.3	116	50/5"		▩			
130	150		0.4	18.9	95	50/5"		▩			
125	155										
	160										

END OF BORING AT 150½ FEET
NOTES:
Hand augered upper 8 feet to avoid damage to utilities.
Montoring well was installed on 4/22/2011. See well construction diagram for G-165.

"N" Value Standard Penetration Test: Number of blows required to drive the SPT sampler 18 inches using a 140 pound automatic hammer falling 30 inches

*Number of blows required to drive the Crandall Sampler 12 inches using a 340 pound hammer falling 18 inches

**Photo Ionization Detector used for OVA readings

Downhole Test: NV = Noise/Vibration

Field Tech: DW
Prepared/Date: JF 5/11/2011
Checked/Date: LT/RM 9/20/2011

THIS RECORD IS AN INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. LATITUDE AND LONGITUDE OF BORING LOCATION SHOWN ON LOGS ARE APPROXIMATE. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

LA METRO PB-TUNNEL ZONE S:\70131 GEOTECH\GINTW\LIBRARY MACTEC JUNE2011.GLB
G:\PROJECT_DIRECTORIES\4953\2010\101561_METRO_WESTSIDE_EXTENSION\6.2.3.1 GEOTECHNICAL DESIGN\3.2 ALL FIELD NOTES\GINT LOG\NEW TEMPLATE - MARCH 14, 2011\4953-10-1561_(161-181).GPJ 10/18/11

THIS RECORD IS AN INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. LATITUDE AND LONGITUDE OF BORING LOCATION SHOWN ON LOGS ARE APPROXIMATE. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

DRILLING COMPANY/DRILLING EQUIPMENT		BORING NO.
C & L Drilling / Mayhew 1000		G-166A/B
DRILLING METHOD	**BOREHOLE LOCATION**	
Rotary Wash	Sta 700+30, Rt 25 and 60 feet	
DATES DRILLED	**HOLE DIAMETER**	**GROUND EL.**
3/5/2011, 3/19/2011, 4/18/2011 - 4/20/2011	4-7/8 inches	290 feet

GROUND-WATER READINGS
Ground-water level measured at 43 feet and 64½ feet below the ground surface in shallow and deep monitoring wells, respectively on 4/22/2011. See last page of this boring for details.

ELEVATION (ft)	DEPTH (ft)	"N" VALUE STD.PEN.TEST	OVA (ppm)**	MOISTURE CONTENT (% of dry wt.)	DRY DENSITY (pcf)	BLOW COUNT* (blows/ft)	PERCENT PASSING No. 200 SIEVE	SAMPLE LOC.	DOWNHOLE TESTS	USCS	DESCRIPTION
										CL	**FILL [Af]** LEAN CLAY - moist, light brown and gray, trace gravel, trace brick fragments
										SM	SILTY SAND - moist, brown and gray, fine to coarse-grained, with slate gravel
285	5										
280	10										**QUATERNARY OLDER ALLUVIUM [Qalo]**
			6.6	9.3	118	49				SW	WELL GRADED SAND with GRAVEL - dense, moist, brown, fine to coarse-grained, trace silt, gravel (up to 1/4 inch in size)
		32	4.0	8.7	-		20			SM	SILTY SAND - dense, moist, brown, fine to medium-grained, some gravel (up to 3/4 inch in size)
275	15										
			3.2	7.4	114	32					Becomes medium dense, some gravel (up to 1 inch in size)
										CL	LEAN CLAY - hard, moist, light brown, trace gravel (up to 1/4 inch in size)
		54	3.2	20.9	-					SM	SILTY SAND - very dense, moist, reddish brown, fine to medium-grained, trace gravel (up to 1/8 inch in size)
270	20										
			4.5	6.8	112	65/11"					
										CL	LEAN CLAY with SAND - hard, moist, brown, fine to coarse sand, trace gravel (up to 3/8 inch in size)
265	25										
		33	4.3	12.8	-		75				
			2.9	11.0	84	70					Becomes dark reddish brown
260	30										
										CL	SANDY LEAN CLAY - hard, moist, brown, fine to medium sand
		49	5.1	10.9	-						
			4.7	10.4	118	82					Trace gravel (up to 1/4 inch in size), thin layer of Sandy Silt
255	35										
											Thin layer of Silty Sand, olive brown
		29	3.4	22.6	-					CL	LEAN CLAY - very stiff, moist, olive brown
	40										

(CONTINUED ON FOLLOWING FIGURE)

Field Tech: AR
Prepared/Date: JF 5/11/2011
Checked/Date: LT/RM 9/20/2011

DRILLING COMPANY/DRILLING EQUIPMENT		BORING NO.
C & L Drilling / Mayhew 1000		**G-166A/B (Continued)**
DRILLING METHOD Rotary Wash	**BOREHOLE LOCATION** Sta 700+30, Rt 25 and 60 feet	
DATES DRILLED 3/5/2011, 3/19/2011, 4/18/2011 - 4/20/2011	**HOLE DIAMETER** 4-7/8 inches	**GROUND EL.** 290 feet

GROUND-WATER READINGS
Ground-water level measured at 43 feet and 64½ feet below the ground surface in shallow and deep monitoring wells, respectively on 4/22/2011. See last page of this boring for details.

ELEVATION (ft)	DEPTH (ft)	"N" VALUE STD.PEN.TEST	OVA (ppm)**	MOISTURE CONTENT (% of dry wt.)	DRY DENSITY (pcf)	BLOW COUNT* (blows/ft)	PERCENT PASSING No. 200 SIEVE	SAMPLE LOC.	DOWNHOLE TESTS	USCS	DESCRIPTION
			2.5	22.2	98	21		⊠			Trace sand, trace iron oxide stains
		18	4.5	29.9	-			☒			▽
245	45										
			4.7	20.5	108	20		⊠			Becomes olive gray, trace iron oxide stains
240	50	37	4.7	19.9	-			☒			Becomes hard
				19.8	107	46	87	⊠			Becomes dark olive brown
235	55								NV		
		30		25.0	-			☒			Becomes very stiff, olive brown
230	60										
				22.0	101	34	77	⊠		CH	FAT CLAY with SAND - very stiff, moist, light gray and brown, very fine sand, calcium carbonate nodules
										MH	▼ ELASTIC SILT - stiff, moist, light gray, calcium carbonate nodules
225	65			56.7	66	12		⊠	NV		
		30		31.9	-		99	☒			Becomes very stiff, light olive gray
220	70								PMT		Thin layer of Lean to Fat Clay, gray
										SP	**LAKEWOOD FORMATION [Qlwl]** POORLY GRADED SAND - dense, wet, light brown, fine to medium-grained, trace gravel (up to 3/4 inch in size)
Tunnel				18.2	97	60		⊠			
	75								NV		
	80	95	6.3	16.0	-			☒			

(CONTINUED ON FOLLOWING FIGURE)

Field Tech: AR
Prepared/Date: JF 5/11/2011
Checked/Date: LT/RM 9/20/2011

THIS RECORD IS AN INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. LATITUDE AND LONGITUDE OF BORING LOCATION SHOWN ON LOGS ARE APPROXIMATE. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

DRILLING COMPANY/DRILLING EQUIPMENT		BORING NO.
C & L Drilling / Mayhew 1000		**G-166A/B (Continued)**
DRILLING METHOD	**BOREHOLE LOCATION**	
Rotary Wash	Sta 700+30, Rt 25 and 60 feet	
DATES DRILLED	**HOLE DIAMETER**	**GROUND EL.**
3/5/2011, 3/19/2011, 4/18/2011 - 4/20/2011	4-7/8 inches	290 feet

GROUND-WATER READINGS
Ground-water level measured at 43 feet and 64½ feet below the ground surface in shallow and deep monitoring wells, respectively on 4/22/2011. See last page of this boring for details.

ELEVATION (ft)	DEPTH (ft)	"N" VALUE STD.PEN.TEST	OVA (ppm)**	MOISTURE CONTENT (% of dry wt.)	DRY DENSITY (pcf)	BLOW COUNT* (blows/ft)	PERCENT PASSING No. 200 SIEVE	SAMPLE LOC.	DOWNHOLE TESTS	USCS	DESCRIPTION
Tunnel								☒			Becomes very dense, some coarse sand, trace silt, trace gravel
	85			23.0	89	75/6"	16	▩		SM	**SAN PEDRO FORMATION [Qsp]** SILTY SAND - very dense, moist, gray, very fine-grained
	90	50/6"	5.4	21.7	-			☒		SP-SM	POORLY GRADED SAND with SILT - very dense, moist, light gray, fine-grained
										ML	SANDY SILT - hard, moist, light greenish gray
195	95		4.9	13.3	92	75/6"		▩		SP	POORLY GRADED SAND - very dense, moist, light gray, fine to medium-grained
190	100	99/10"	9.5	20.6	-		49	☒		SM	SILTY SAND - very dense, moist, greenish gray, fine to medium-grained
											Becomes fine-grained
185	105		6.7	20.8	103	80/10"	49	▩			Becomes light brown
180	110	50/6"	4.5	17.8	-			☒		SP	POORLY GRADED SAND - very dense, moist, gray, fine to medium-grained
										SC	CLAYEY SAND - dense, moist, dark grayish green, fine to medium-grained
175	115		4.5	12.8	123	47	45	▩			
										SP	POORLY GRADED SAND - very dense, moist, greenish gray, fine to coarse-grained, with gravel
	120										

THIS RECORD IS AN INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. LATITUDE AND LONGITUDE OF BORING LOCATION SHOWN ON LOGS ARE APPROXIMATE. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Field Tech: AR
Prepared/Date: JF 5/11/2011
Checked/Date: LT/RM 9/20/2011

(CONTINUED ON FOLLOWING FIGURE)

LA METRO PB-TUNNEL ZONE S:\70131 GEOTECH\GINTW\LIBRARY MACTEC JUNE2011.GLB
G:\PROJECT_DIRECTORIES\4953\2010\101561_METRO_WESTSIDE_EXTENSION\6.2.3.1 GEOTECHNICAL DESIGN\3.2 ALL FIELD NOTES\GINT LOG\NEW TEMPLATE - MARCH 14, 2011\4953-10-1561_(161-181).GPJ 10/18/11

THIS RECORD IS AN INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. LATITUDE AND LONGITUDE OF BORING LOCATION SHOWN ON LOGS ARE APPROXIMATE. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

DRILLING COMPANY/DRILLING EQUIPMENT		BORING NO.
C & L Drilling / Mayhew 1000		**G-166A/B (Continued)**
DRILLING METHOD Rotary Wash	**BOREHOLE LOCATION** Sta 700+30, Rt 25 and 60 feet	
DATES DRILLED 3/5/2011, 3/19/2011, 4/18/2011 - 4/20/2011	**HOLE DIAMETER** 4-7/8 inches	**GROUND EL.** 290 feet

GROUND-WATER READINGS
Ground-water level measured at 43 feet and 64½ feet below the ground surface in shallow and deep monitoring wells, respectively on 4/22/2011. See last page of this boring for details.

ELEVATION (ft)	DEPTH (ft)	"N" VALUE STD.PEN.TEST	OVA (ppm)**	MOISTURE CONTENT (% of dry wt.)	DRY DENSITY (pcf)	BLOW COUNT* (blows/ft)	PERCENT PASSING No. 200 SIEVE	SAMPLE LOC.	DOWNHOLE TESTS	USCS	DESCRIPTION
		50/5"	4.7	12.2	-			☒			Becomes blueish gray, fine-grained
										SW	WELL GRADED SAND - very dense, wet, gray, fine to coarse-grained, with gravel 6-inch to 8-inch thick cobble layer
165	125		4.1	-	-	100/3"		◻			(Sample not recovered)
										SP	POORLY GRADED SAND - very dense, wet, light gray, fine-grained
160	130	50/4"	1.9	18.9	-			☒			
155	135		3.9	15.7	96	75/6"		▩			Becomes gray, moist
											Trace gravel
150	140	50/5"	3.6	20.9	-		34	☒		SM	SILTY SAND - very dense, moist, gray, fine-grained, trace gravel (up to 3/8 inch in size)
145	145		3.0	20.5	88	75/6"		▩		SP	POORLY GRADED SAND - very dense, moist, gray, fine-grained
140	150	50/4"	4.1	17.9	-			☒			
135	155										
	160										

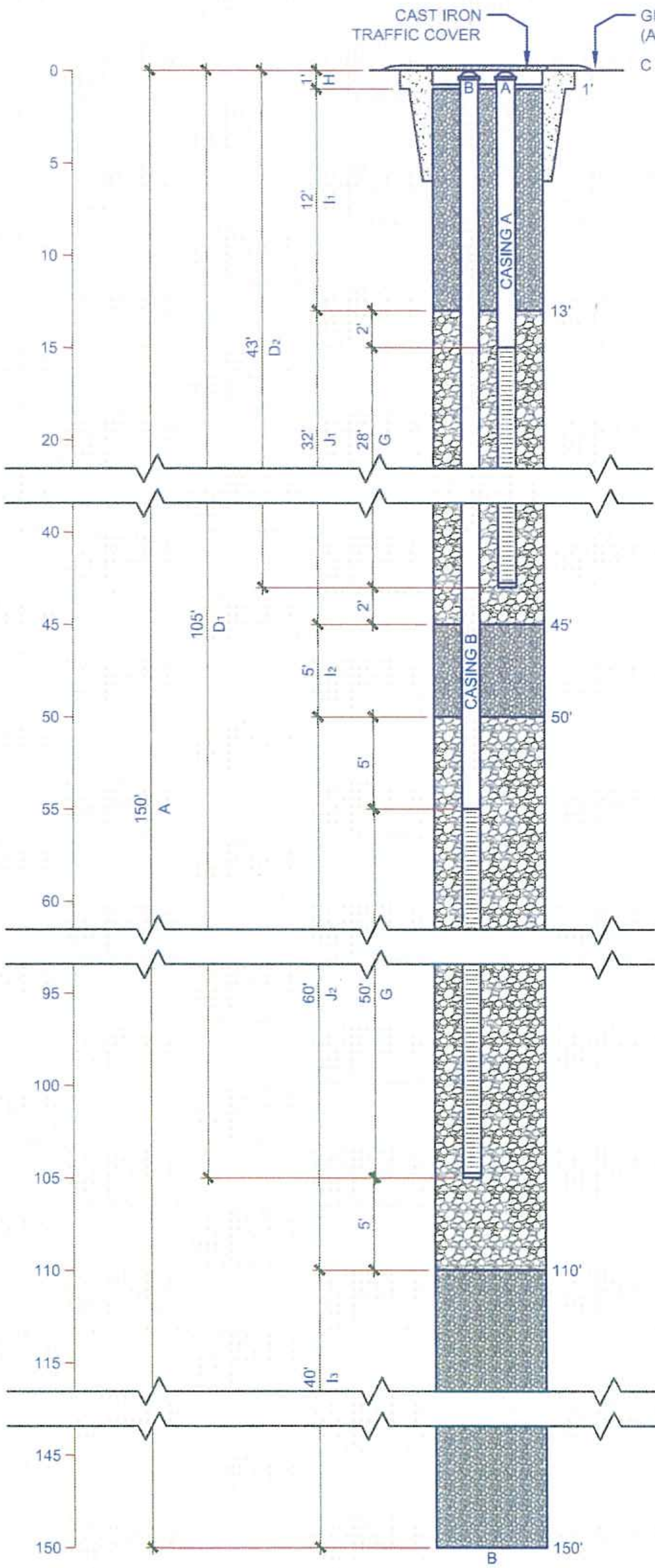
END OF BORING AT 151 FEET
NOTES:
Hand augered upper 5 feet to avoid damage to utilities. Boring G-166A was terminated at 74 feet and backfilled. Boring G-166B was sampled between 74 feet and 151 feet. Montoring well was installed on 4/20/2011. See well construction diagram for G-166.

"N" Value Standard Penetration Test: Number of blows required to drive the SPT sampler 18 inches using a 140 pound automatic hammer falling 30 inches
*Number of blows required to drive the Crandall Sampler 12 inches using a 300 pound hammer falling 18 inches
**Photo Ionization Detector used for OVA readings
Downhole Tests: PMT = Pressuremeter, NV = Noise/Vibration

Field Tech: AR
Prepared/Date: JF 5/11/2011
Checked/Date: LT/RM 9/20/2011

MTA Westside Subway Extension Los Angeles, California	amec	LOG OF BORING Project No.: 4953-10-1561 Figure: A-2.55d

GROUND-WATER OBSERVATION WELL G-165



A. TOTAL DEPTH OF BORING: 150' BGS

B. DIAMETER OF BORING: 8"Ø
DRILLING METHOD: ROTARY WASH

C. TOP OF BOX ELEVATION: NA

D. CASING LENGTH: 43' (A), 105' (B)
MATERIAL: PVC

E. CASING DIAMETER: 2"Ø (EACH)

F. DEPTH TO TOP OF SCREEN: 15' (A) & 55' (B)

G. PERFORATION LENGTH: 28' (A), 50' (B)
PERFORATION SIZE: 0.010" SLOTS

H. SUBSURFACE SEAL: 1' CONCRETE, 6' GROUT

I. SEAL: 1'-13', 45'-50', 110'-150' (BGS)
MATERIAL: HYDRATED BENTONITE (CHIPS)
- I1. 1'-13': 8' OF BENTONITE CEMENT GROUT OVER 4' OF BENTONITE CHIPS HYDRATED
- I2. 45'-50': BENTONITE CHIPS HYDRATED
- I3. 110'-150': BENTONITE CHIPS HYDRATED

J. SAND PACK: 13'-45', 50'-110' (BGS)
MATERIAL: # 3 SAND PACK
- J1. 13'-45'
- J2. 50'-110'

K. WATER LEVELS ON 04/22/2011 WERE AS FOLLOWS:
A. 26.2 FEET BELOW TOC
B. 64.5 FEET BELOW TOC

Vertical Scale: 1" = 10'-0"
Horizontal Scale Exaggerated

Key	
BGS	Below Ground Surface
TOC	Top Of Casing
'	Feet
"	Inches

amec
AMEC Environment & Infrastructure
5628 E. Slauson Avenue, Los Angeles, California 90040
Phone (323) 889-5300 Fax (323) 889-5398

WELL NO.:	G-165	DRAWN:	L. Morley
INSTALLED:	03/19/2011	CHKD:	H.P. / Jag
SCALE:	1" = 10' Vertical	DATE:	October, 2011
DRILL CO.:	C & L Drilling	TECHNIQUE:	Rotary-Wash
FIELD PERSONNEL:	Daniel Wader		
PROJECT NAME:	MTA Westside Subway Extension		
WELL LOCATION:	Los Angeles, CA		

MTA WESTSIDE SUBWAY EXTENSION
Parsons Brinckerhoff Americas, Inc.

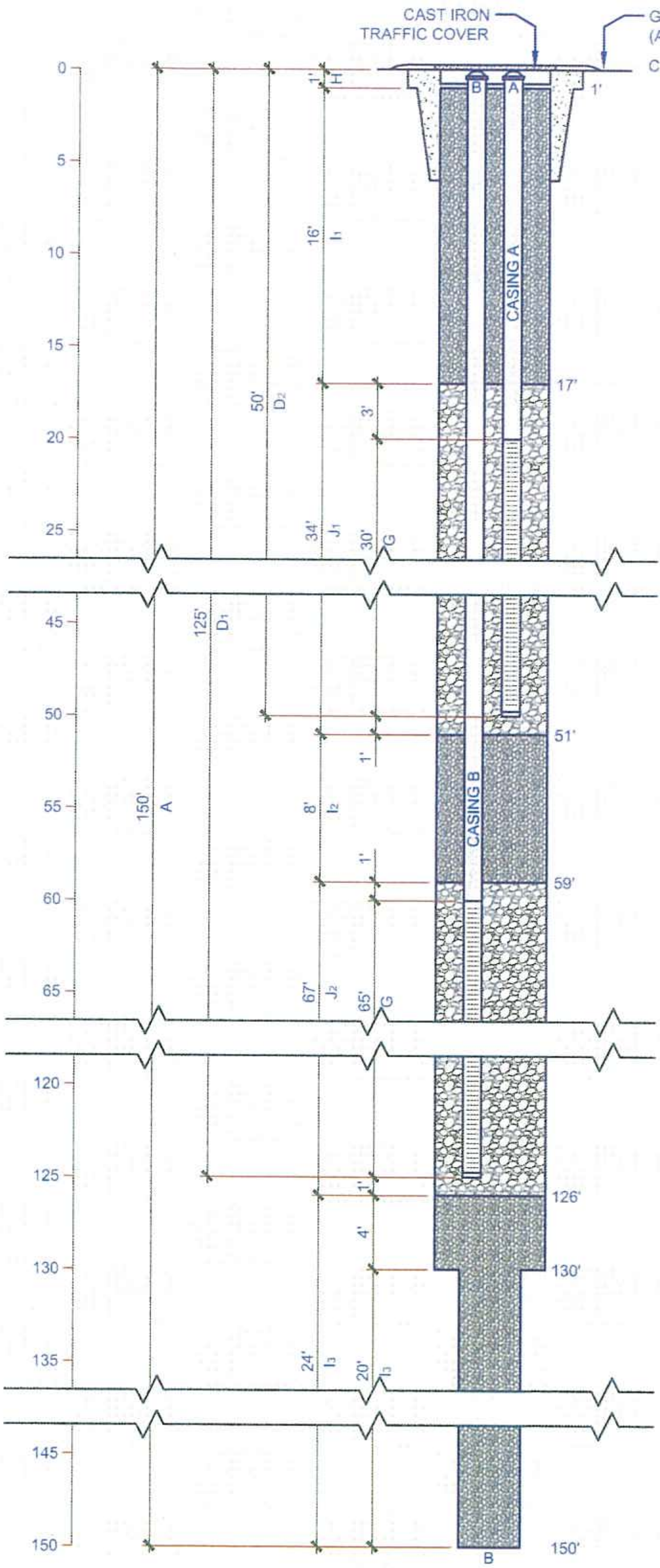
WELL CONSTRUCTION DETAIL
Ground-Water Observation Well

FIGURE NO. **A-8.5**

PROJECT NO. 4953-10-1561

Date: October 24, 2011 - 1:39pm

GROUND-WATER OBSERVATION WELL G-166



A. TOTAL DEPTH OF BORING: 150' BGS

B. DIAMETER OF BORING: 8"Ø, 4 ¾"Ø BOTTOM 20'
DRILLING METHOD: ROTARY WASH

C. TOP OF BOX ELEVATION: NA

D. CASING LENGTH: 50' (A), 125' (B)
MATERIAL: PVC

E. CASING DIAMETER: 2"Ø (EACH)

F. DEPTH TO TOP OF SCREEN: 20' (A) & 60' (B)

G. PERFORATION LENGTH: 30' (A), 65' (B)
PERFORATION SIZE: 0.010" SLOTS

H. SUBSURFACE SEAL: 1' CONCRETE, 6' GROUT

I. SEAL: 1'-17', 51'-59', 126'-150' (BGS)
MATERIAL: HYDRATED BENTONITE (CHIPS)
- I_1. 1'-17': 12' OF BENTONITE CEMENT GROUT OVER 4' OF BENTONITE CHIPS HYDRATED
- I_2. 51'-59': BENTONITE CHIPS HYDRATED
- I_3. 126'-150': BENTONITE CHIPS HYDRATED

J. SAND PACK: 17'-51', 59'-126' (BGS)
MATERIAL: # 3 SAND PACK
- J_1. 17'-51'
- J_2. 59'-126'

K. WATER LEVELS ON 04/22/2011 WERE AS FOLLOWS:
A. 42.8 FEET BELOW TOC
B. 64.5 FEET BELOW TOC

Vertical Scale: 1" = 10'-0"
Horizontal Scale Exaggerated

Key	
BGS	Below Ground Surface
TOC	Top Of Casing
'	Feet
"	Inches

amec

AMEC Environment & Infrastructure
5628 E. Slauson Avenue, Los Angeles, California 90040
Phone (323) 889-5300 Fax (323) 889-5398

WELL NO.:	G-166	DRAWN:	L. Morley
INSTALLED:	04/20/2011	CHKD:	H.P. / Jag
SCALE:	1" = 10' Vertical	DATE:	October, 2011
DRILL CO.:	C & L Drilling	TECHNIQUE:	Rotary-Wash
FIELD PERSONNEL:	Angel Recio		
PROJECT NAME:	MTA Westside Subway Extension		
WELL LOCATION:	Los Angeles, CA		

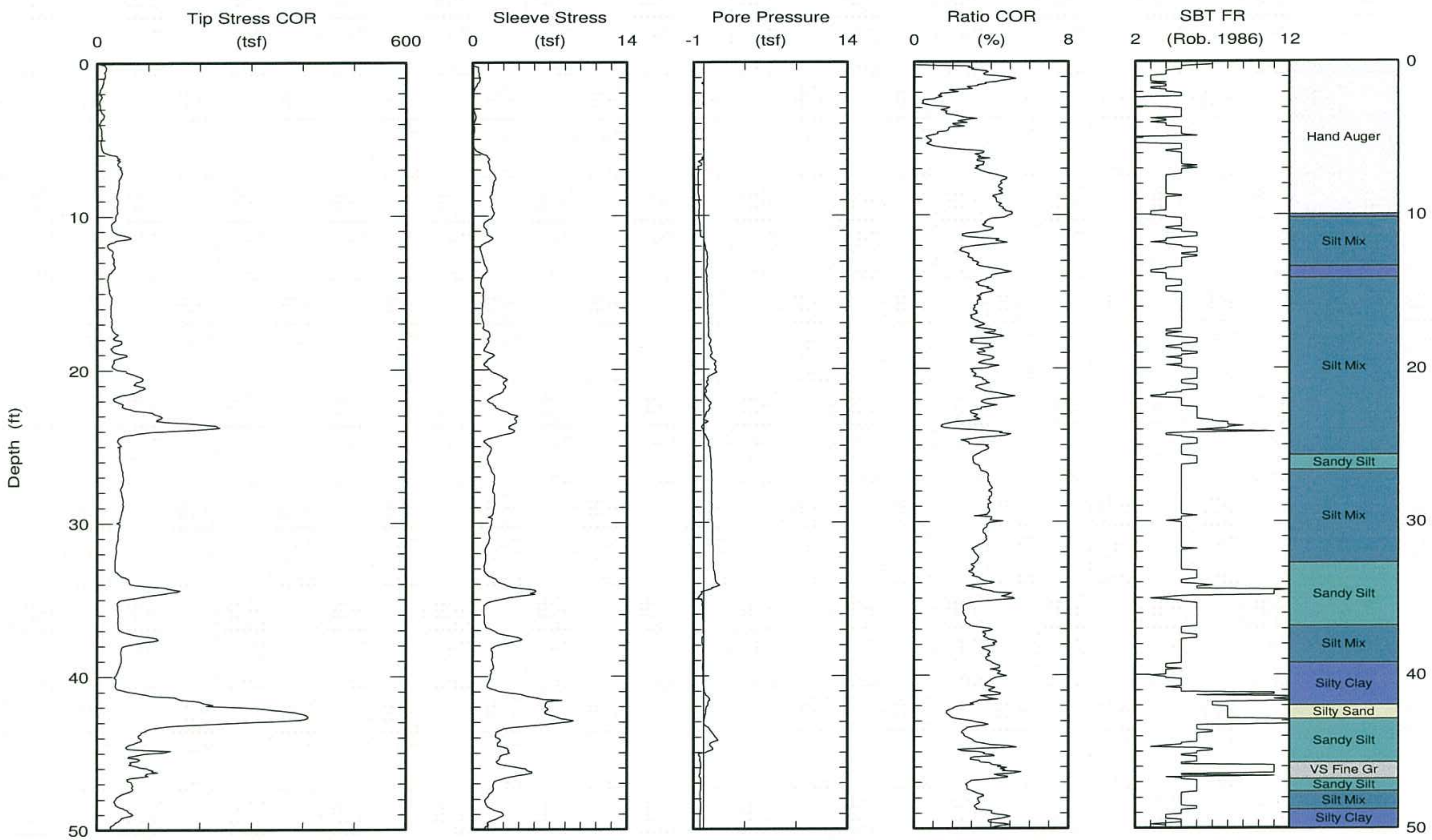
MTA WESTSIDE SUBWAY EXTENSION
Parsons Brinckerhoff Americas, Inc.

WELL CONSTRUCTION DETAIL
Ground-Water Observation Well

FIGURE NO. **A-8.6**

PROJECT NO. 4953-10-1561

Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 05/Mar/2011 Test ID: C-117 Project: LosAngeles
	Customer: MACTEC Job Site: Beverly Hills High School	



Maximum depth: 52.84 (ft)

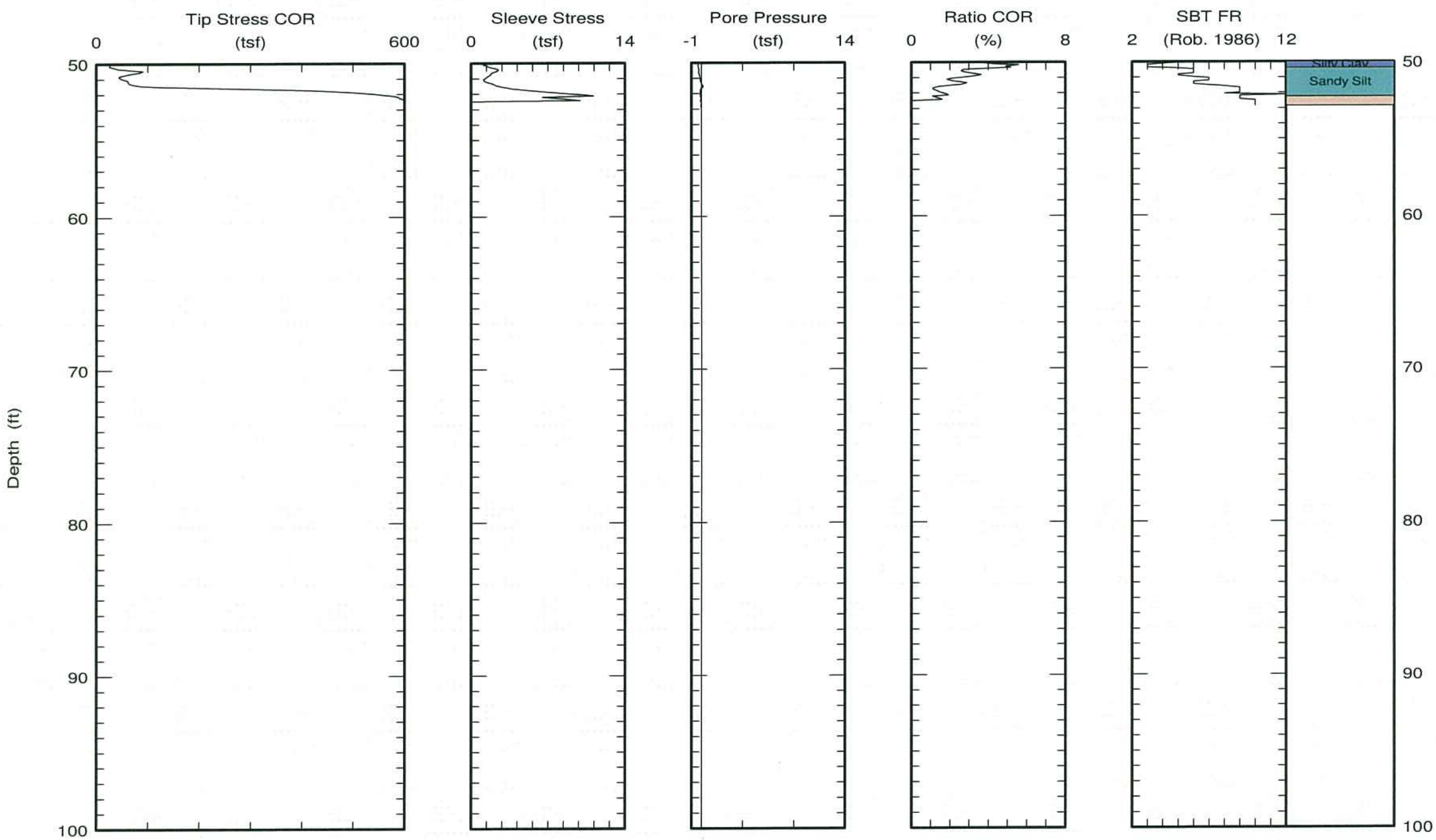
Page 1 of 2

Figure A-4.18

Test ID: C-117

File: Z05M1102C.ECP

Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 05/Mar/2011 Test ID: C-117 Project: LosAngeles
	Customer: MACTEC Job Site: Beverly Hills High School	

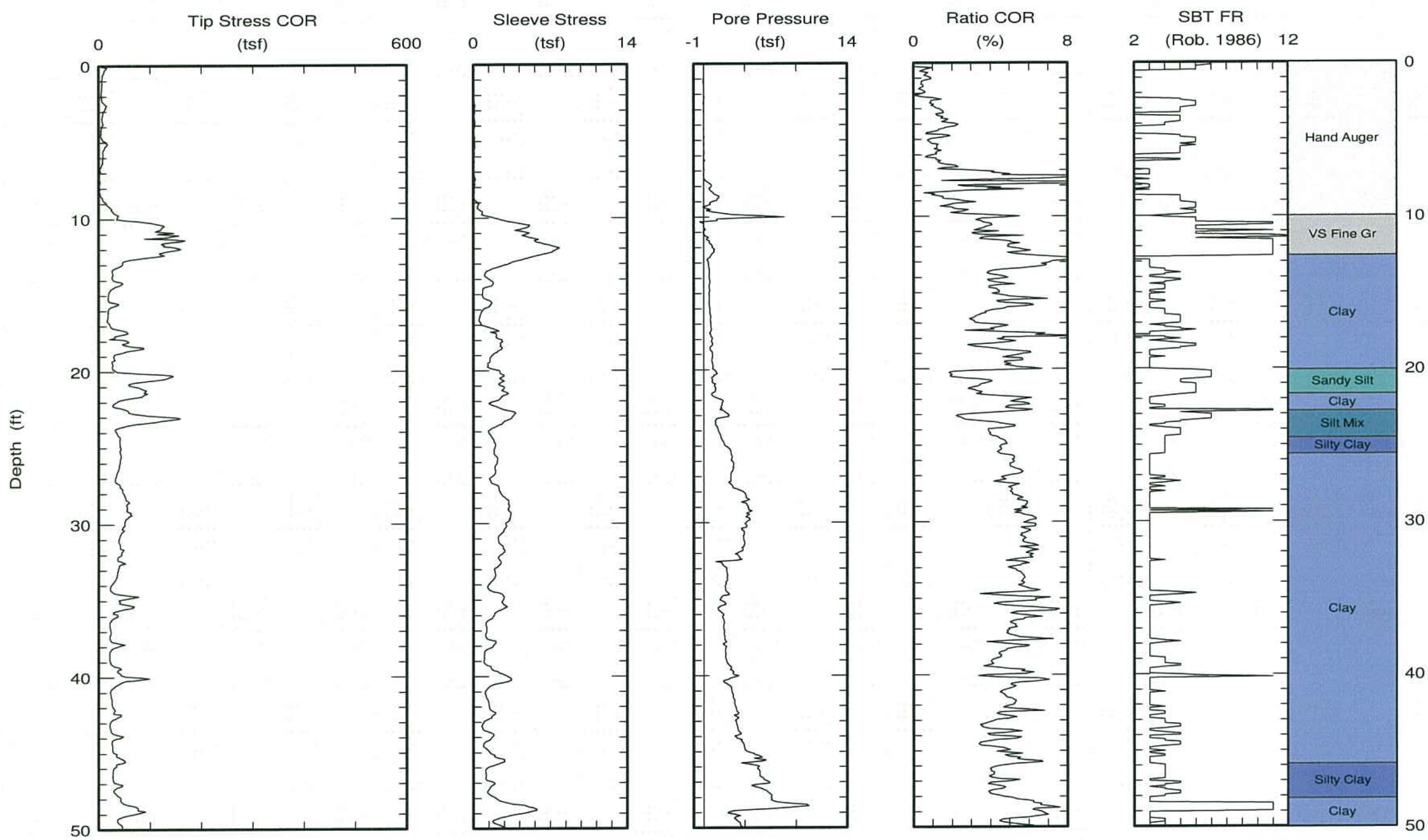


Maximum depth: 52.84 (ft)
Page 2 of 2

Figure A-4.19

Test ID: C-117
File: Z05M1102C.ECP

Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 26/Feb/2011 Test ID: C-118 Project: LosAngeles
	Customer: MACTEC Job Site: Beverly Hills High School	



Maximum depth: 76.08 (ft)

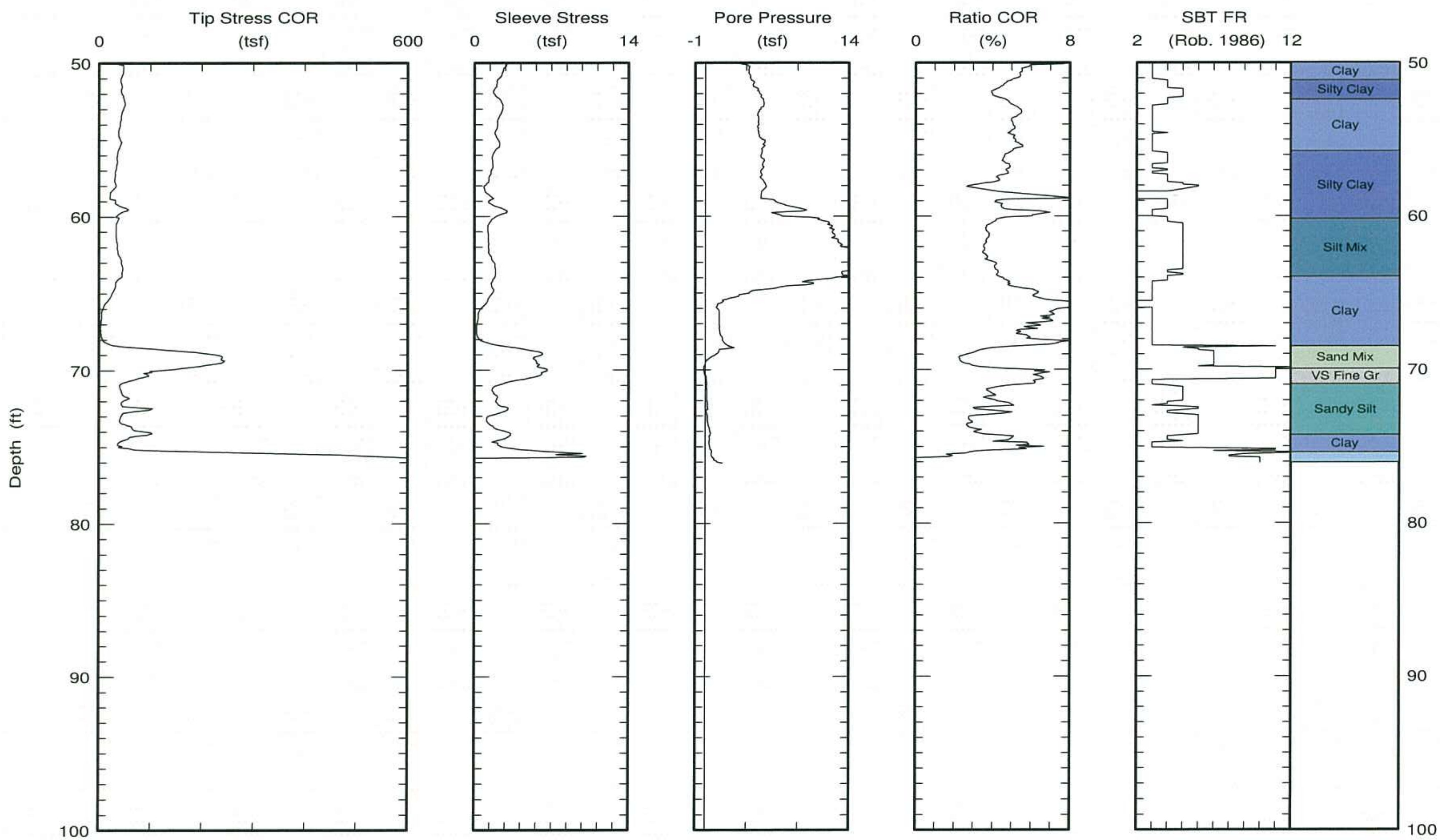
Page 1 of 2

Figure A-4.20

Test ID: C-118

File: Z26F1104C.ECP

Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 26/Feb/2011 Test ID: C-118 Project: LosAngeles
	Customer: MACTEC Job Site: Beverly Hills High School	



Maximum depth: 76.08 (ft)

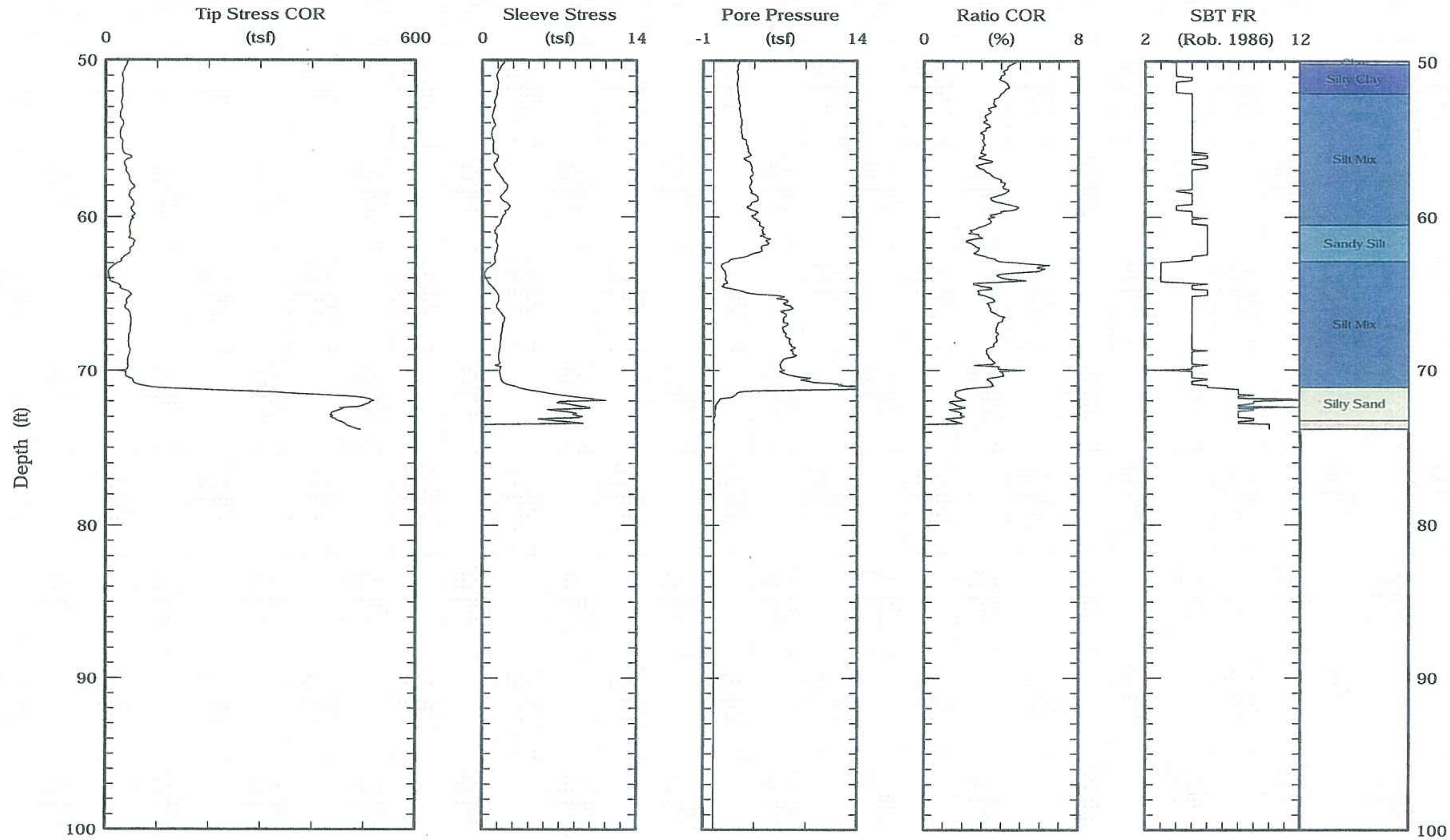
Page 2 of 2

Figure A-4.21

Test ID: C-118
File: Z26F1104C.ECP

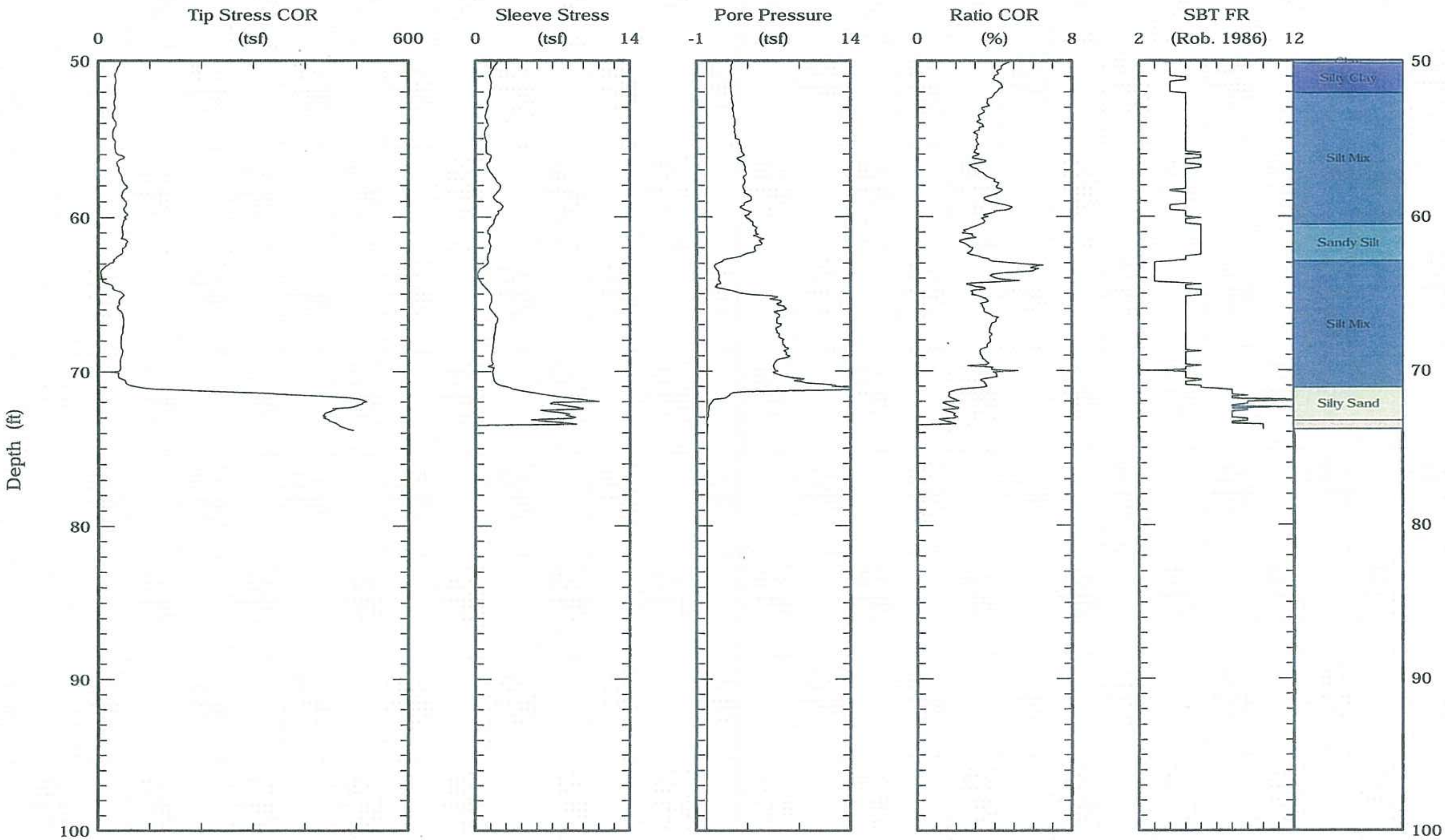
Kehoe Testing & Engineering
Office: (714) 901-7270
Fax: (714) 901-7289
rich@kehoetesting.com
www.kehoetesting.com

CPT Data 30 ton rig	Date: 05/Mar/2011 Test ID: C-119 Project: LosAngeles
Customer: MACTEC Job Site: Beverly Hills High School	



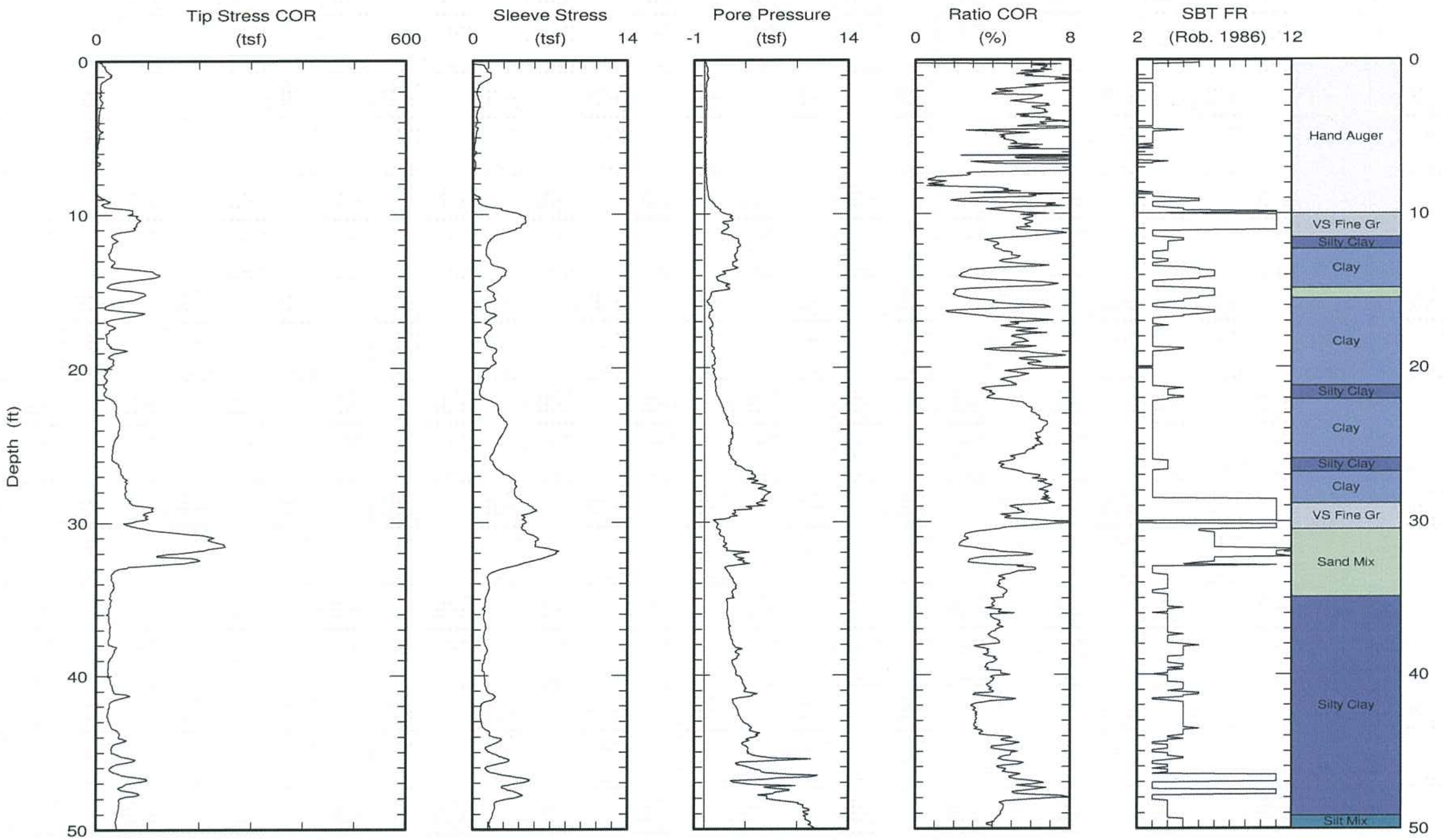
Maximum depth: 73.84 (ft)

Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 05/Mar/2011 Test ID: C-119 Project: LosAngeles
	Customer: MACTEC Job Site: Beverly Hills High School	



Maximum depth: 73.84 (ft)

Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 26/Feb/2011 Test ID: C-119A Project: LosAngeles
	Customer: MACTEC Job Site: Beverly Hills High School	



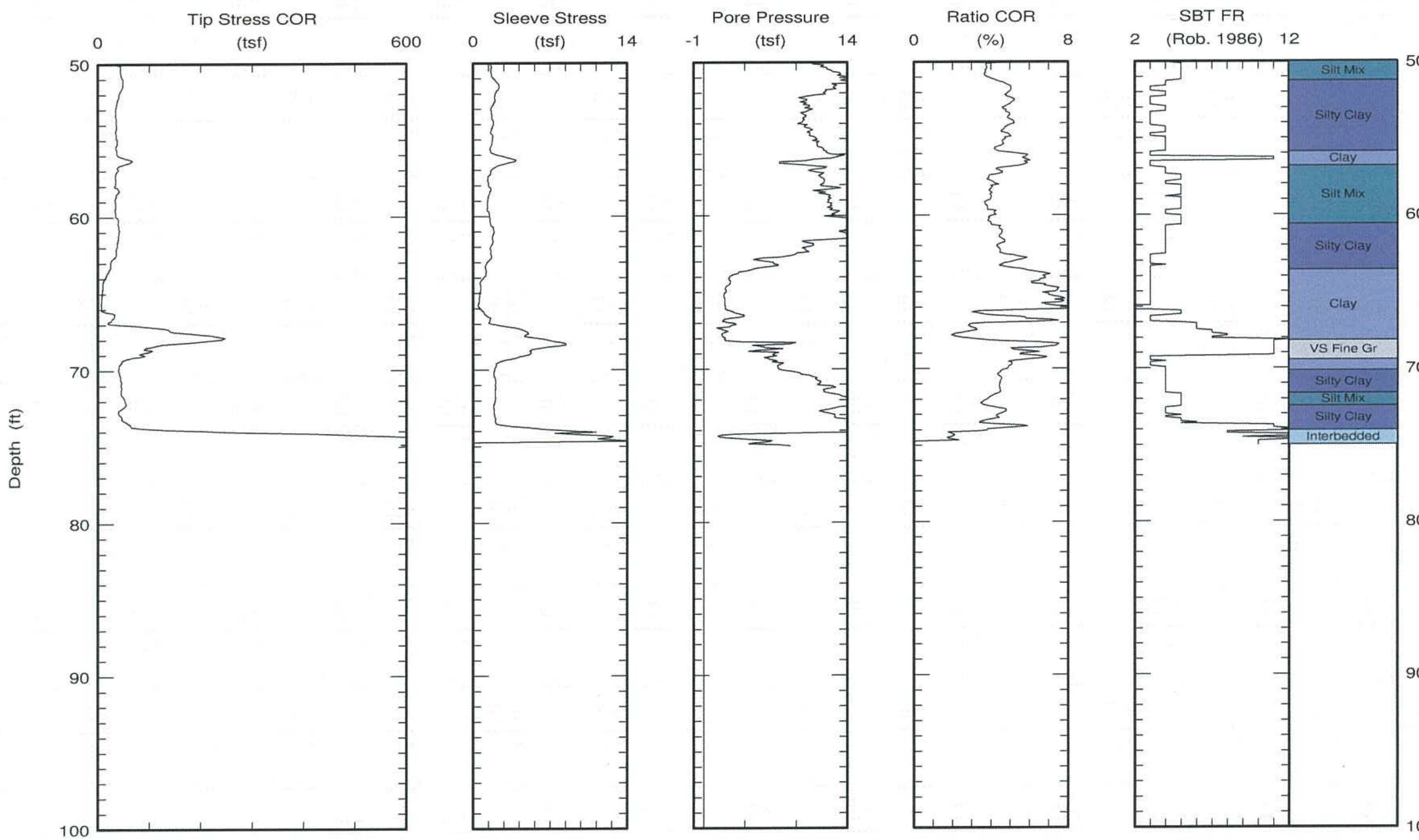
Maximum depth: 75.03 (ft)

Page 1 of 2

Figure A-4.22

Test ID: C-119B
File: Z26F1103C.ECP

Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 26/Feb/2011 Test ID: C-119**A** Project: LosAngeles
	Customer: MACTEC Job Site: Beverly Hills High School	

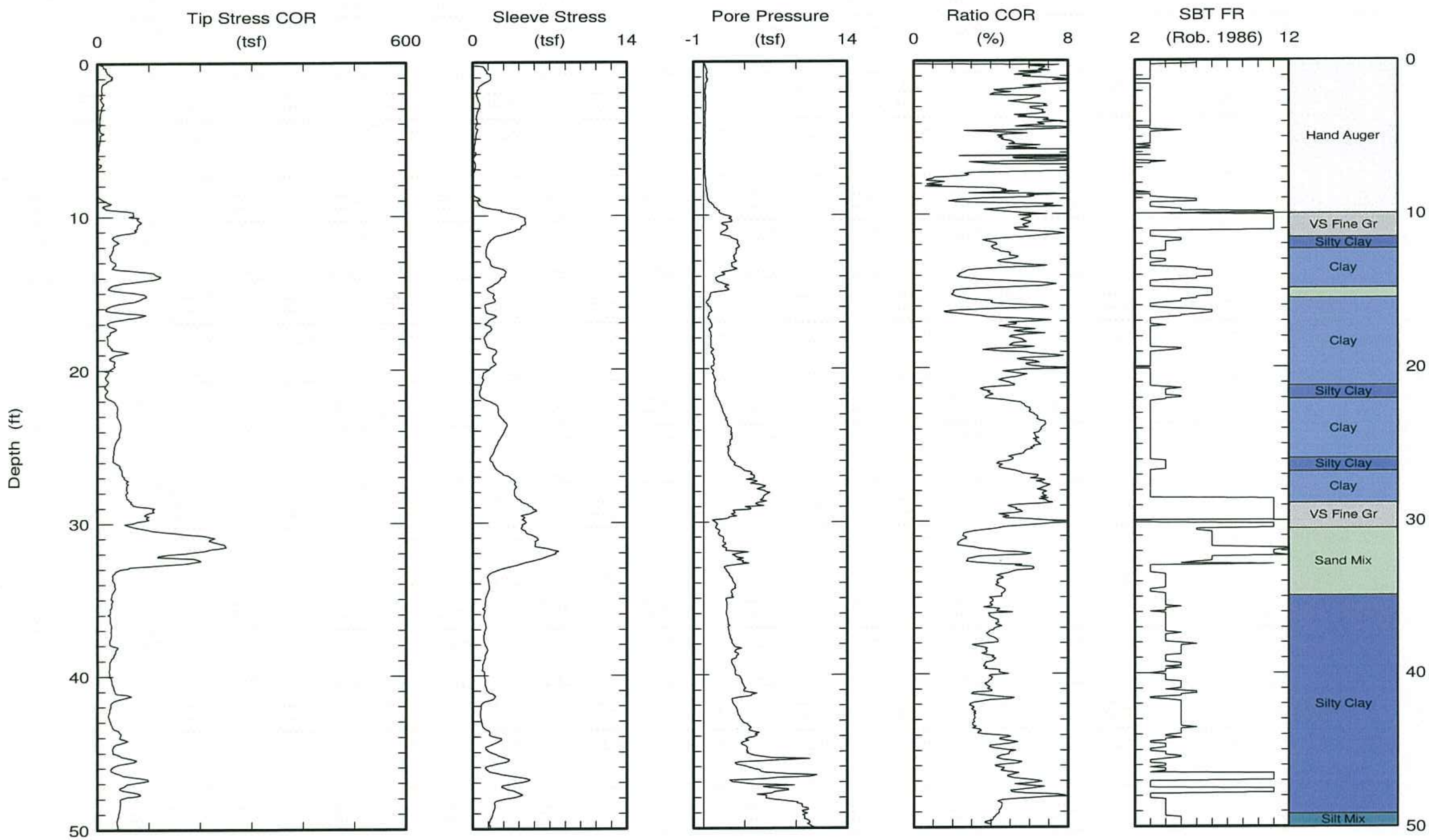


Maximum depth: 75.03 (ft)
Page 2 of 2

Figure A-4.23

Test ID: C-119B
File: Z26F1103C.ECP

Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 26/Feb/2011 Test ID: C-119B Project: LosAngeles
	Customer: MACTEC Job Site: Beverly Hills High School	



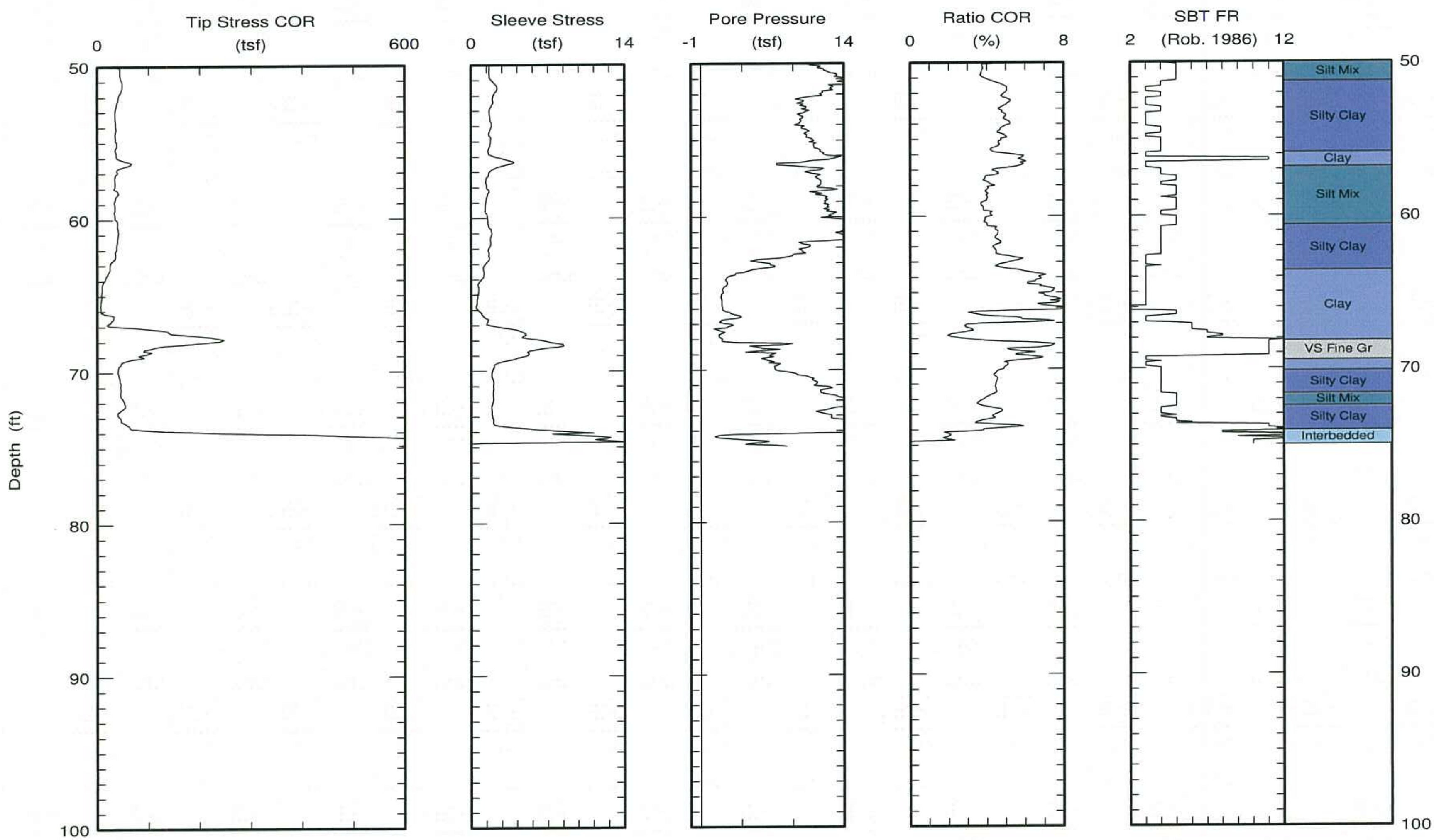
Maximum depth: 75.03 (ft)

Page 1 of 2

Figure A-4.24

Test ID: C-119B
File: Z26F1103C.ECP

Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 26/Feb/2011 Test ID: C-119B Project: LosAngeles
	Customer: MACTEC Job Site: Beverly Hills High School	



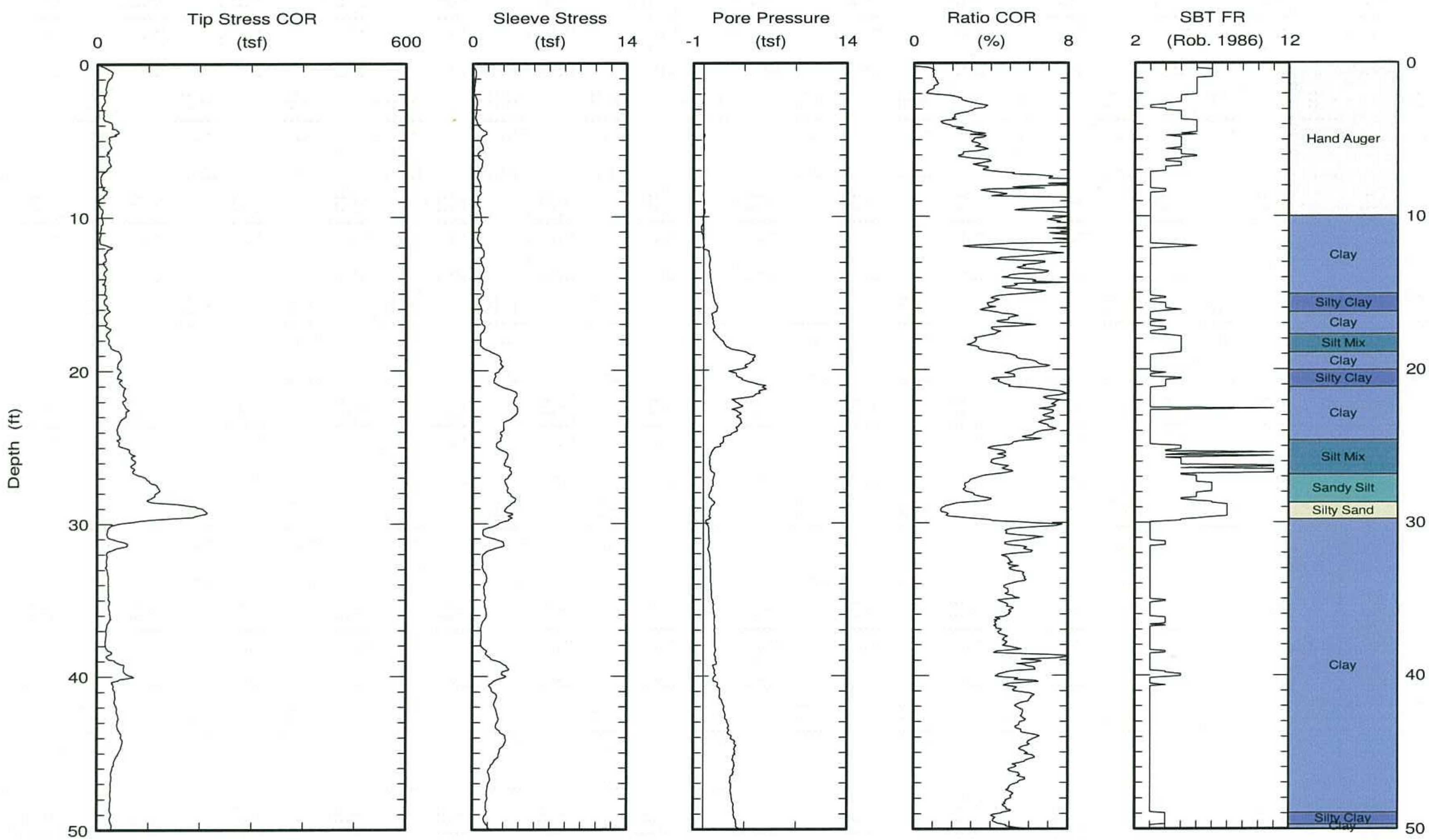
Maximum depth: 75.03 (ft)

Page 2 of 2

Figure A-4.25

Test ID: C-119B
File: Z26F1103C.ECP

KTE Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 26/Feb/2011 Test ID: C-120 Project: LosAngeles
	Customer: MACTEC Job Site: Beverly Hills High School	

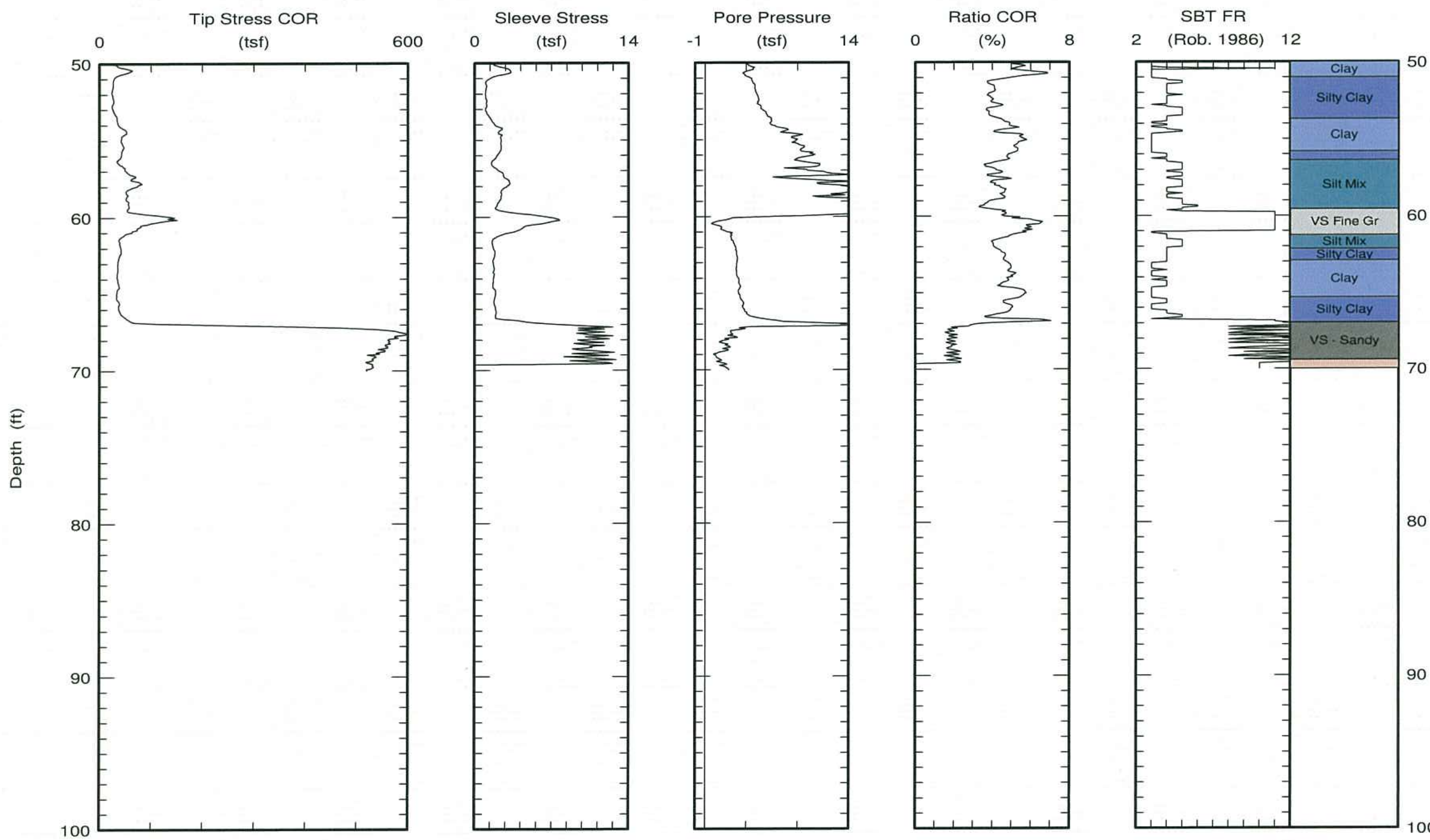


Maximum depth: 70.01 (ft)
Page 1 of 2

Figure A-4.26

Test ID: C-120
File: Z26F1102C.ECP

Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 26/Feb/2011 Test ID: C-120 Project: LosAngeles
	Customer: MACTEC Job Site: Beverly Hills High School	



Maximum depth: 70.01 (ft)

Page 2 of 2

Figure A-4.27

Test ID: C-120

File: Z26F1102C.ECP

GREGG **MACTEC**

Site: MTA
Sounding: C-120A1

Engineer: G.CITO
Date: 2/26/2011 10:47

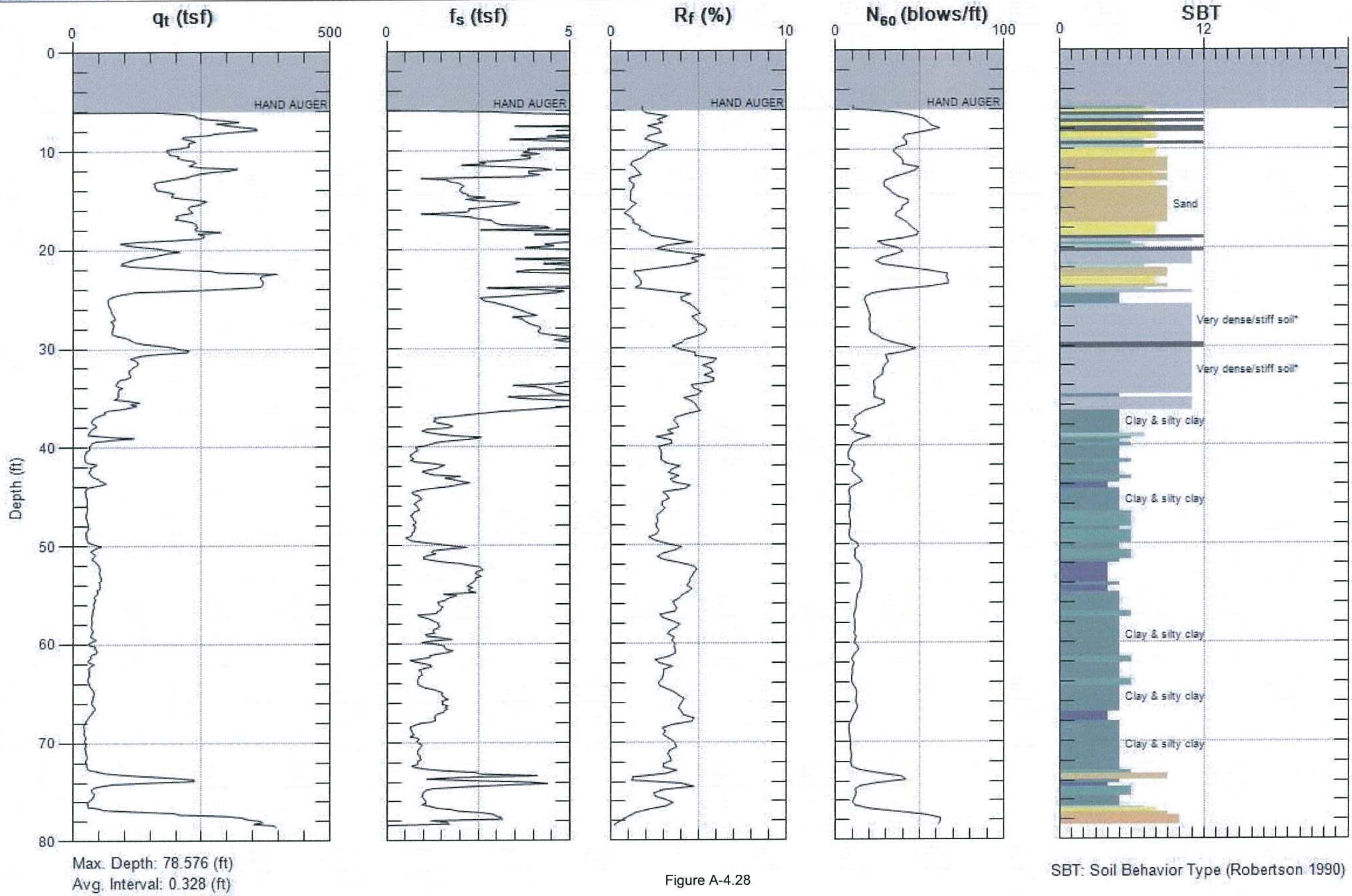


Figure A-4.28

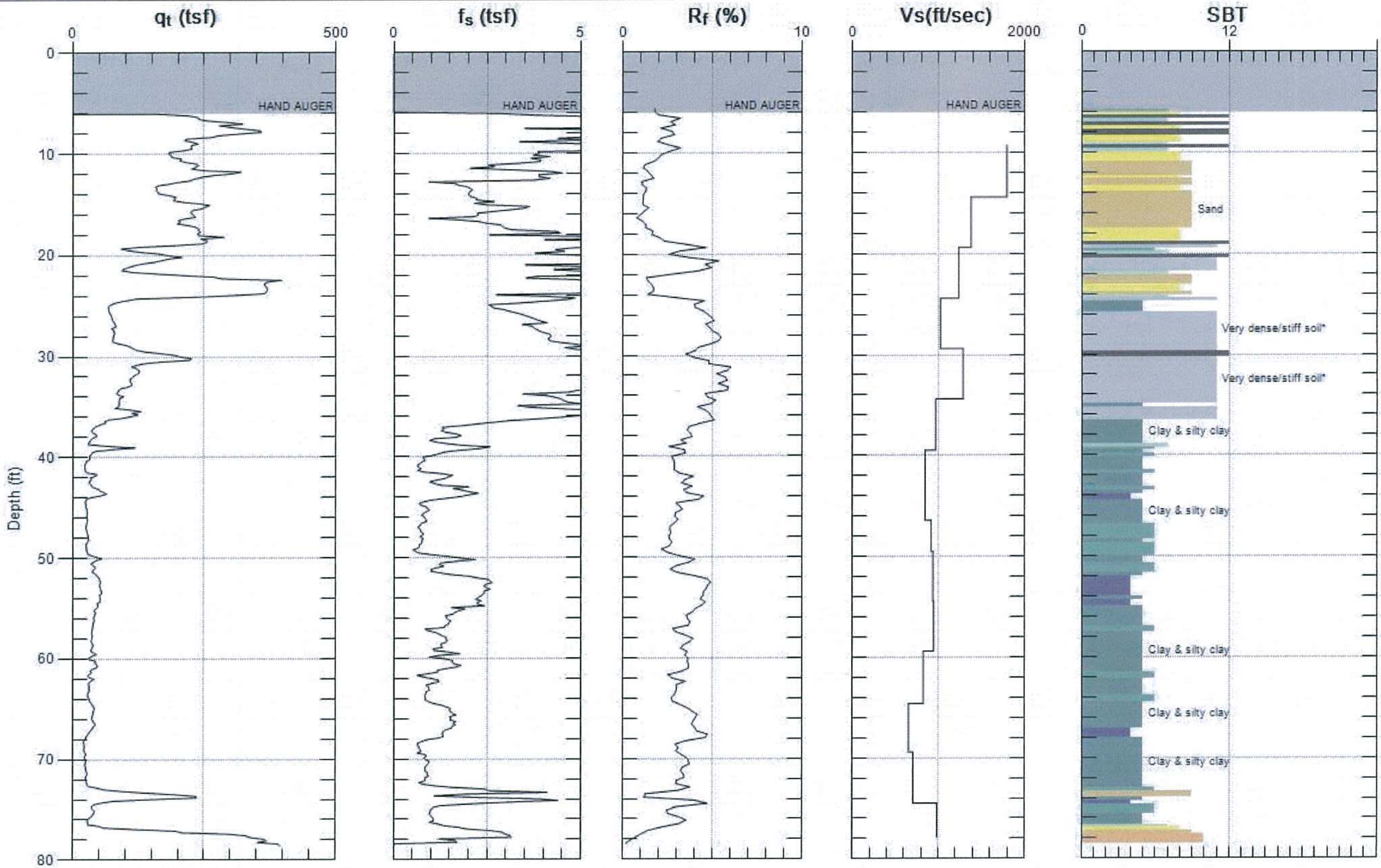
GREGG MACTEC

Site: MTA

Sounding: C-120A1

Engineer: G.CITO

Date: 2/26/2011 10:47



Max. Depth: 78.576 (ft)
Avg. Interval: 0.328 (ft)

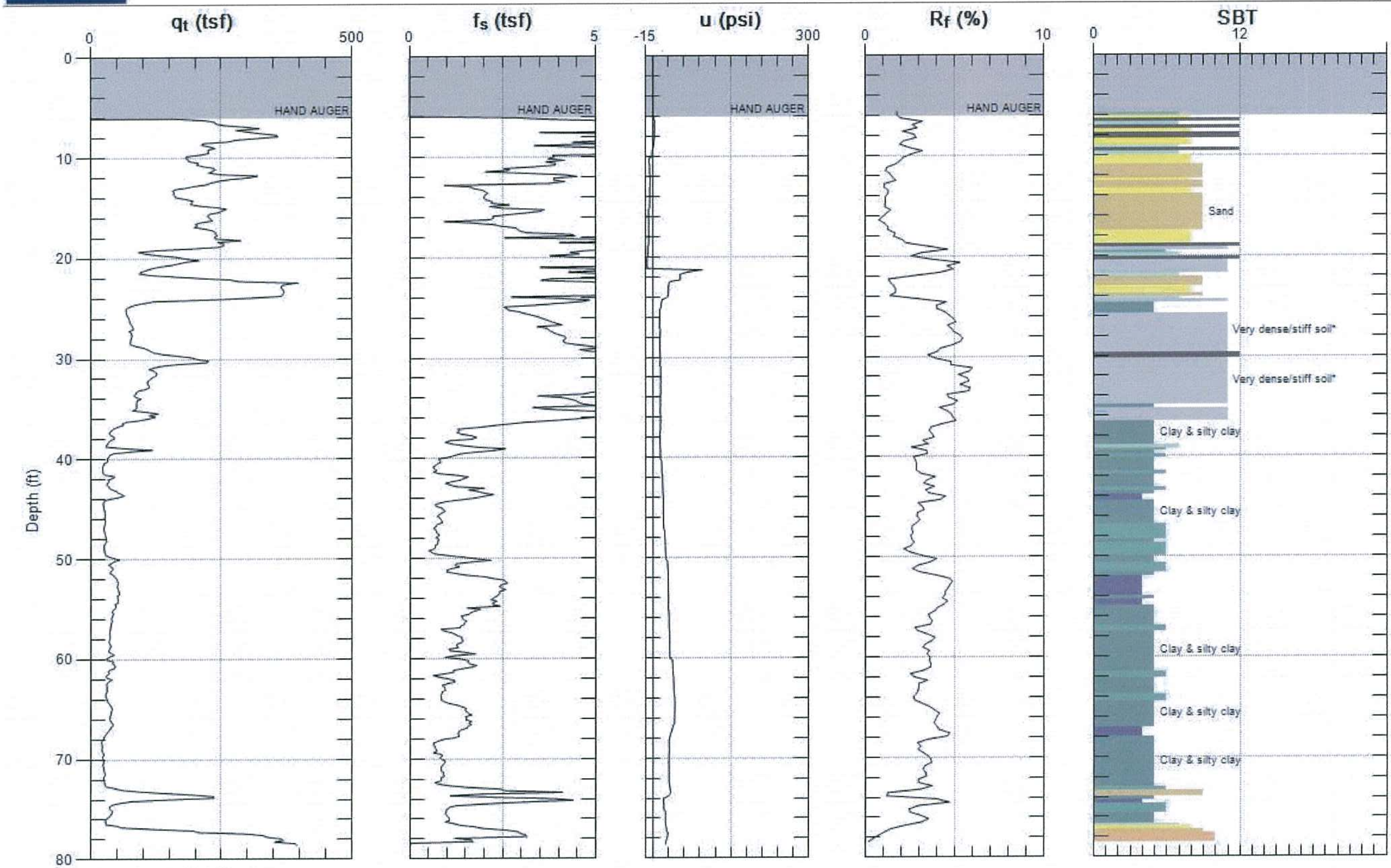
Figure A-4.29

SBT: Soil Behavior Type (Robertson 1990)

GREGG MACTEC

Site: MTA
Sounding: C-120A1

Engineer: G.CITO
Date: 2/26/2011 10:47



Max. Depth: 78.576 (ft)
Avg. Interval: 0.328 (ft)

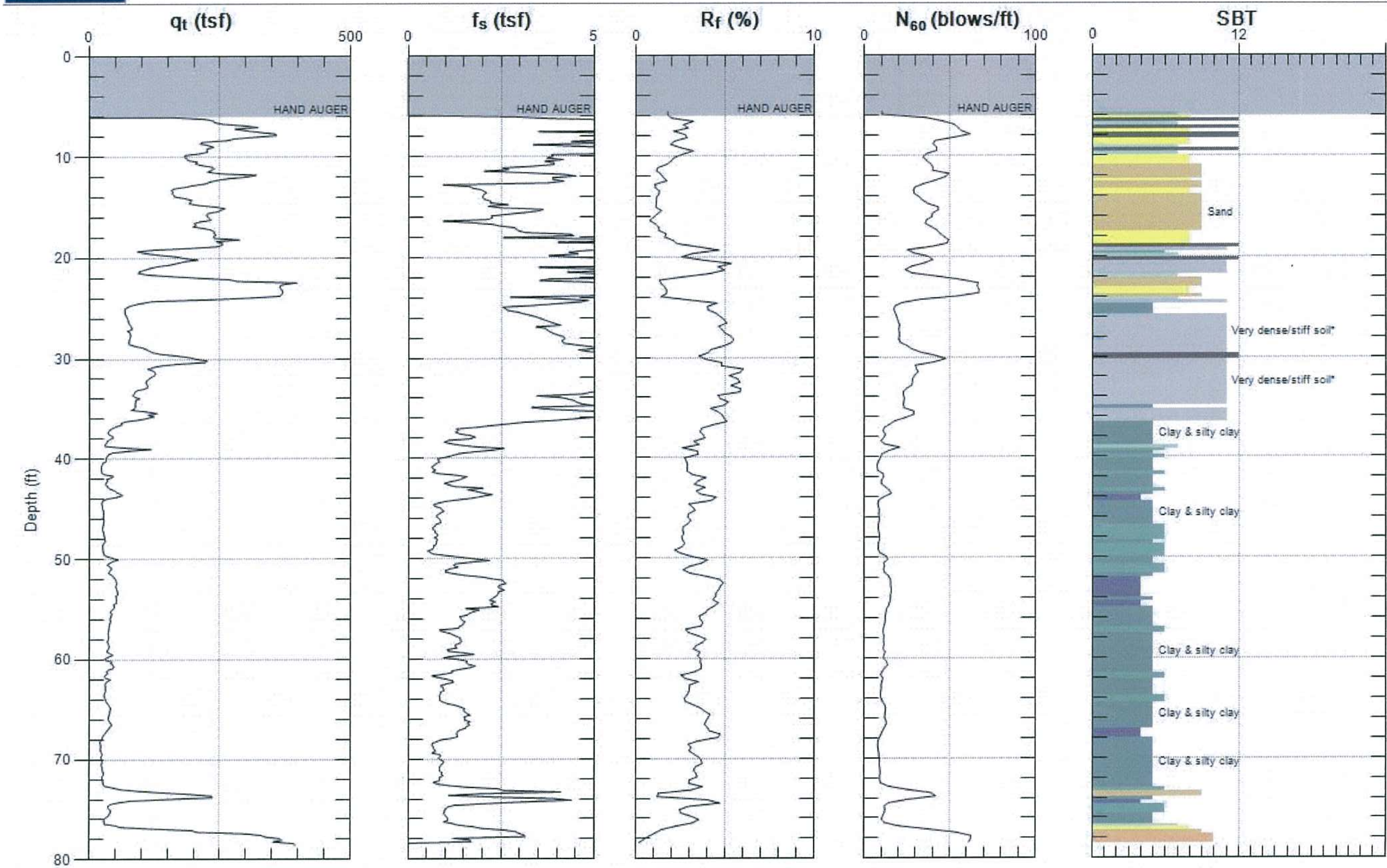
SBT: Soil Behavior Type (Robertson 1990)

Figure A-4.30

GREGG MACTEC

Site: MTA
Sounding: C-120B

Engineer: G.CITO
Date: 2/26/2011 10:47



Max. Depth: 78.576 (ft)
Avg. Interval: 0.328 (ft)

Figure A-4.31

SBT: Soil Behavior Type (Robertson 1990)

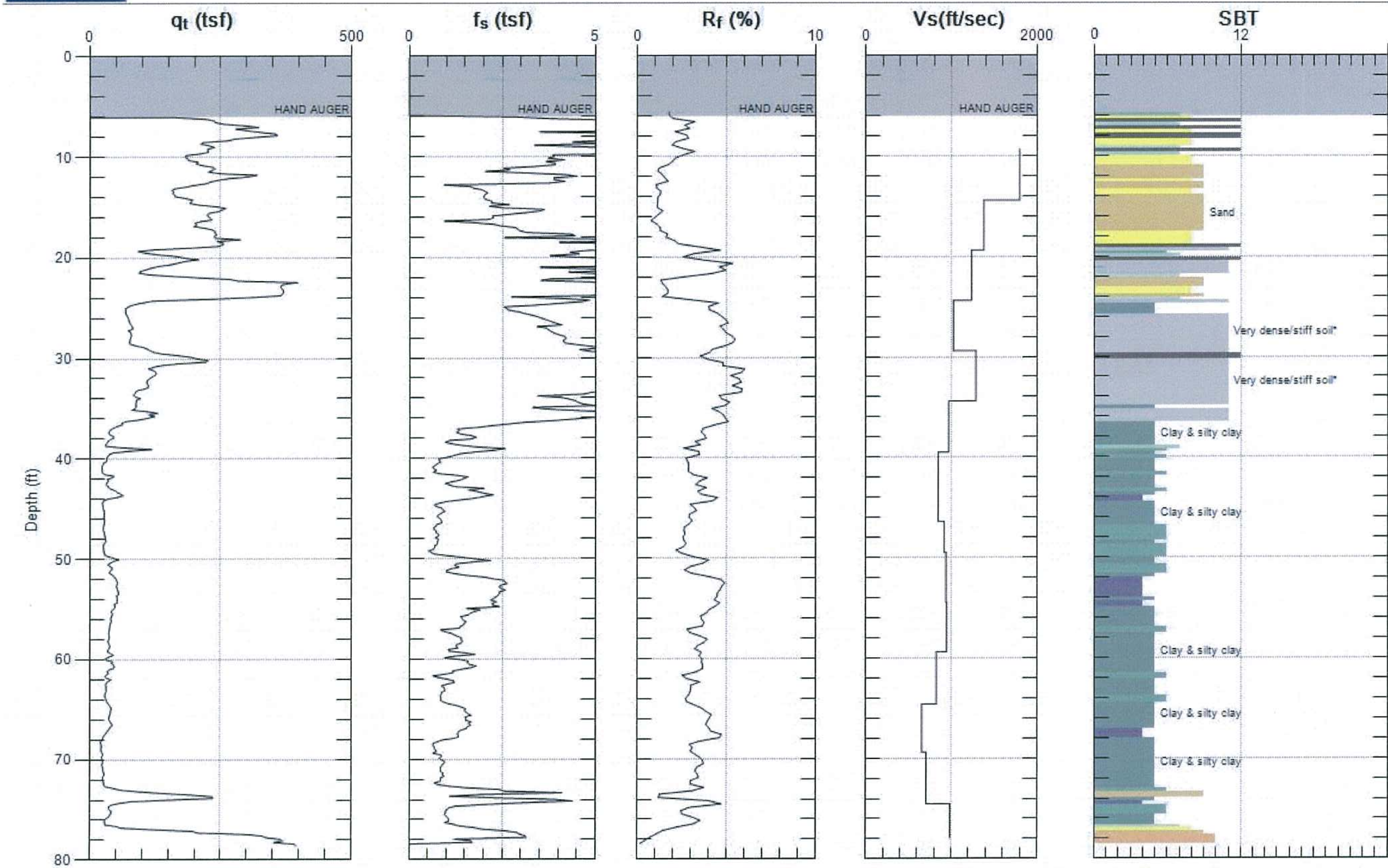
GREGG MACTEC

Site: MTA

Sounding: C-120B

Engineer: G.CITO

Date: 2/26/2011 10:47



Max. Depth: 78.576 (ft)
Avg. Interval: 0.328 (ft)

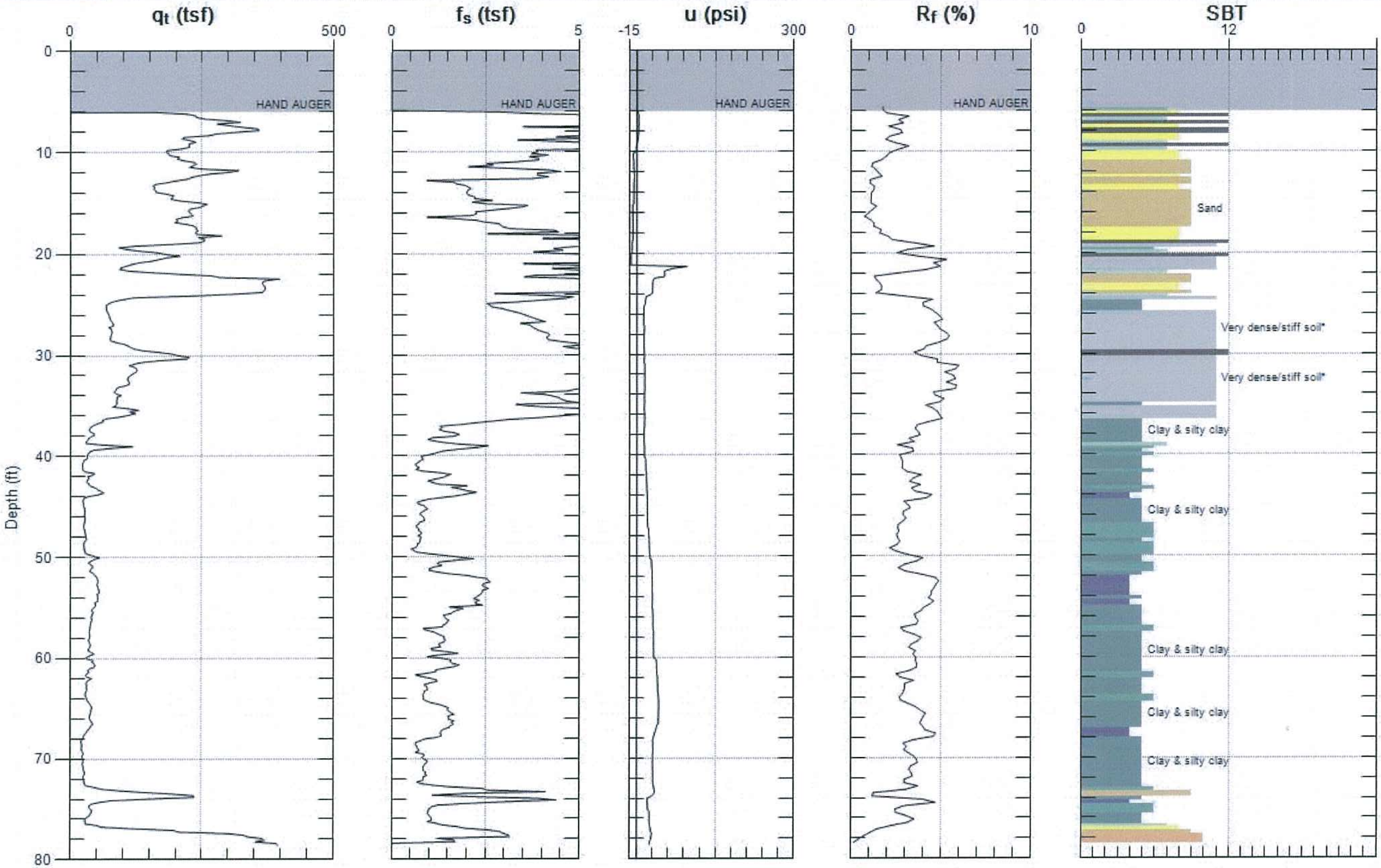
Figure A-4.32

SBT: Soil Behavior Type (Robertson 1990)

GREGG MACTEC

Site: MTA
Sounding: C-120B

Engineer: G.CITO
Date: 2/26/2011 10:47



Max. Depth: 78.576 (ft)
Avg. Interval: 0.328 (ft)

Figure A-4.33

SBT: Soil Behavior Type (Robertson 1990)

TABLE F-1.2 (CONTINUED) - SOIL LABORATORY TESTING SUMMARY (Rotary-Wash Borings)
MTA WESTSIDE SUBWAY EXTENSION
GEOTECHNICAL DESIGN REPORT

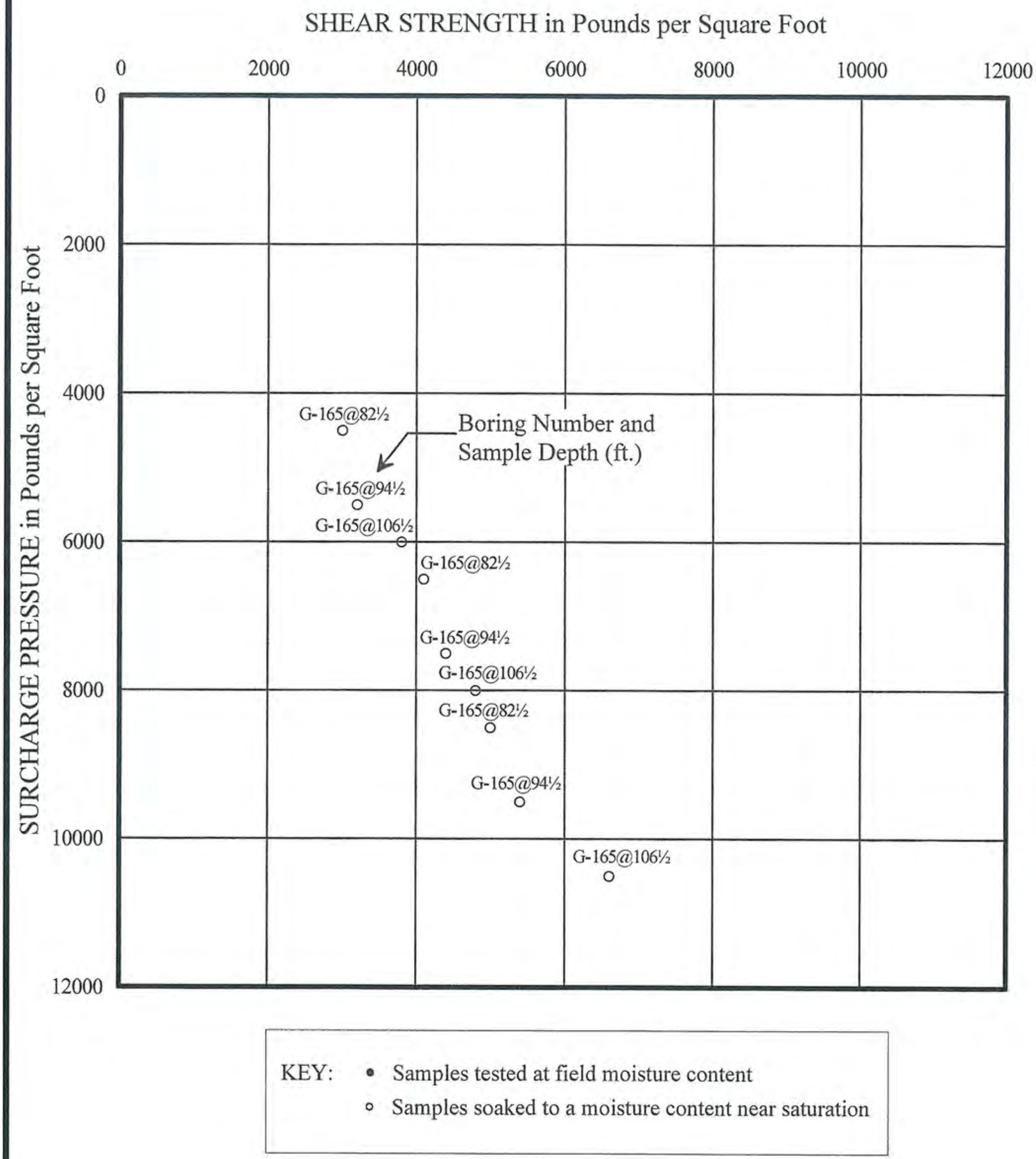
Boring No.	Sample Depth (ft)	Sample Type	USCS Group Symbol	Geologic Formation	Raw Blow Count (blows/ft)	Moisture Content (%)	Dry Density (pcf)	Grain Size			Atterberg Limits			Expansion / Collapse	Specific Gravity	Corrosion				Compression Indices		Tar Content	Void Ratio	Triaxial Consolidated-Undrained	
								Gravel (%)	Sand (%)	Fines (%)	LL	PL	PI			pH	Sulfate (ppm)	Chloride (ppm)	Minimum Resistivity (ohm-cm)	C_c	C_r			Effective cohesion (psf)	Effective Friction Angle (degrees)
	140.5	SPT	SP	San Pedro	50/4"	16.9	-																		
	145.5	CR	SM	San Pedro	100/5"	12.5	116																0.436		
	150.5	SPT	SM	San Pedro	50/5"	14.0	-																		
G-165	10.5	CR	SM	ternary Older Alluv	Push	16.8	109																0.529		
	13.5	SPT	CL	ternary Older Alluv	9	24.2	-																		
	16.5	CR	SC/SP	ternary Older Alluv	10	22.7	101	2	49	49													0.65		
	19.5	SPT	SC	ternary Older Alluv	11	22.1	-																		
	22.5	CR	CL	ternary Older Alluv	12	17.6	106																0.584		
	25.5	SPT	SC	ternary Older Alluv	23	13.1	-	11	41	48	39	20	19												
	28.5	CR	SC	ternary Older Alluv	26	18.4	112													0.1235	0.01934		0.488		
	31.5	SPT	SC	ternary Older Alluv	20	15.6	-																		
	34.5	CR	SC	ternary Older Alluv	12	21.1	101																0.65		
	37.5	SPT	SM/CL	ternary Older Alluv	15	25.4	-																		
	40.5	CR	SC	ternary Older Alluv	16	19.6	97																0.718		
	43.5	SPT	CL	ternary Older Alluv	17	24.8	-	0	24	76															
	46.5	CR	CL/SM	ternary Older Alluv	15	28.9	95																0.767		
	49.5	SPT	CL	ternary Older Alluv	41	18.4	-																		
	52.5	CR	CL	ternary Older Alluv	30	18.9	105																0.599		
	55.5	SPT	CL	ternary Older Alluv	36/10"	17.3	-	1	41	58															
	58.5	CR	CL	ternary Older Alluv	24	21.0	101																0.662		
	61.5	SPT	CL	ternary Older Alluv	17	31.4	-																		
	64.5	CR	CL	ternary Older Alluv	18	19.4	97																0.73		
	67.5	SPT	CL	ternary Older Alluv	28	25.5	-	0	23	77	42	25	17			7.7	8.8	172	600						
	70.5	CR	CL	ternary Older Alluv	26	37.5	82								2.69					0.09621	0.04503		1.047		
	73.5	SPT	CL/SM	Lakewood	68/11"	16.4	-																		
	76.5	CR	SM	Lakewood	50/6"	14.5	105																0.587		
	79.5	SPT	SM	Lakewood	95/11"	16.9	-	0	85	15															
	82.5	CR	SM	Lakewood	80	19.1	94								2.67								0.772		
	85.5	SPT	SM/CL	Lakewood	90/11"	23.9	-																		
	88.5	CR	SM	Lakewood	79/10"	18.2	100													0.0833	0.00833		0.666		
	91.5	SPT	SM	Lakewood	88/10"	20.7	-	0	72	28															
	94.5	CR	SM	Lakewood	56	23.8	99																0.683		
	97.5	SPT	SM	Lakewood	97/11"	15.9	-																		
	100.5	CR	SM	Lakewood	75/10"	14.1	108																0.543		
	103.5	SPT	SM	Lakewood	63	24.3	-	0	68	32															
	106.5	CR	SM	Lakewood	42/10"	22.6	99								2.63								0.658		
	109.5	SPT	SC	Lakewood	91	26.1	-									7.8	53.0	432	680						
	112.5	NR	SC	Lakewood	50/3"	-	-																		
	115.5	SPT	SP	San Pedro	50/10"	20.2	-																		
	118.5	CR	SP	San Pedro	60/10"	18.8	106																0.572		
	120.5	SPT	MH	San Pedro	59	27.2	-	0	14	86	51	30	21												
	125.5	NR	SP	San Pedro	50/10"	17.5	-																		
	130.5	SPT	SP	San Pedro	50/5"	14.9	-																		
	135.5	CR	SP	San Pedro	50/1"	13.5	97																0.718		
	140.5	CR	SP	San Pedro	50/5"	18.6	94																0.772		
	145.5	CR	SP	San Pedro	50/5"	13.3	116																0.436		
	150.5	CR	SP	San Pedro	50/5"	18.9	95																0.754		
G-166A/B	10.5	CR	SW	ternary Older Alluv	49	9.3	118																0.412		
	13.5	SPT	SM	ternary Older Alluv	32	8.7	-	15	65	20															
	16.5	CR	SM	ternary Older Alluv	32	7.4	114																0.461		
	19.5	SPT	CL/SM	ternary Older Alluv	54	20.9	-																		
	22.5	CR	SM	ternary Older Alluv	65/11"	6.8	112																0.488		
	25.5	SPT	CL	ternary Older Alluv	33	12.8	-	0	25	75															
	28.5	CR	CL	ternary Older Alluv	70	11.0	84																0.998		
	31.5	SPT	CL	ternary Older Alluv	49	10.9	-				38	13	25												
	34.5	CR	CL	ternary Older Alluv	82	10.4	118																0.423		
	37.5	SPT	CL	ternary Older Alluv	29	22.6	-																		
	40.5	CR	CL	ternary Older Alluv	21	22.2	98	3	63	34										0.13019	0.04283		0.713		
	43.5	SPT	CL	ternary Older Alluv	18	29.9	-																		
	46.5	CR	CL	ternary Older Alluv	20	20.5	108																0.554		
	49.5	SPT	CL	ternary Older Alluv	37	19.9	-																		
	52.5	CR	CL	ternary Older Alluv	46	19.8	107	0	13	87	46	18	28		2.61								0.522		
	57.5	SPT	CL	ternary Older Alluv	30	25.0	-									6.5	79.0	23	1040						
	62.5	CR	CH	ternary Older Alluv	34	22.0	101	0	23	77	55	28	27		2.61								0.613		
	65.5	CR	MH	ternary Older Alluv	12	56.7	66																1.505		
	68.5	SPT	MH	ternary Older Alluv	30	31.9	-	0	1	99	82	43	39												
	73.5	CR	SP	Lakewood	60	18.2	97																0.718		
	79.5	SPT	SP	Lakewood	95	16.0	-																		

By: WL 9/29/2011
Checked By: JF 10/16/2011

TABLE F-1.2 (CONTINUED) - SOIL LABORATORY TESTING SUMMARY (Rotary-Wash Borings)
MTA WESTSIDE SUBWAY EXTENSION
GEOTECHNICAL DESIGN REPORT

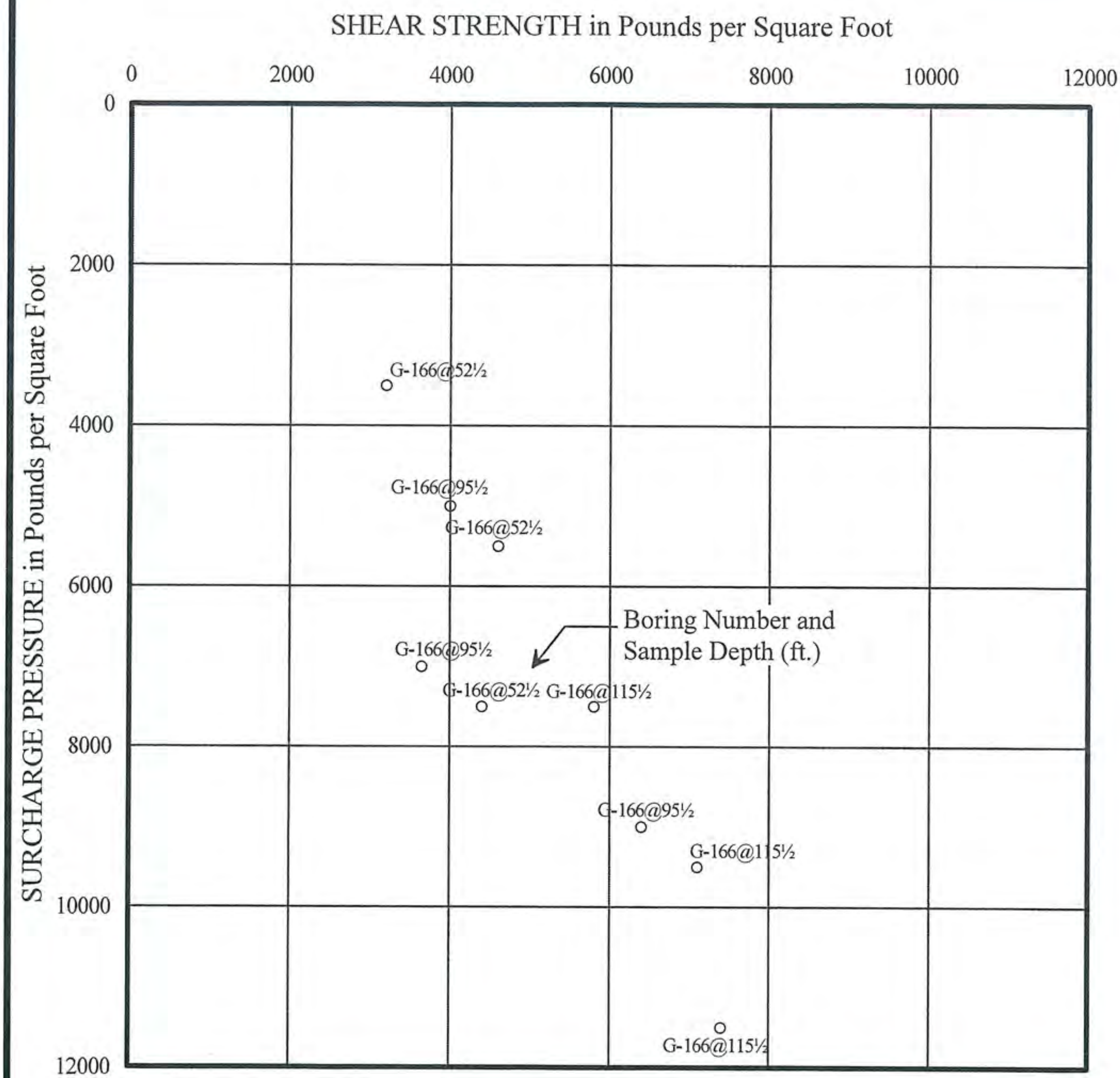
Boring No.	Sample Depth (ft)	Sample Type	USCS Group Symbol	Geologic Formation	Raw Blow Count (blows/ft)	Moisture Content (%)	Dry Density (pcf)	Grain Size			Atterberg Limits			Expansion / Collapse	Specific Gravity	Corrosion				Compression Indices		Tar Content	Void Ratio	Triaxial Consolidated-Undrained	
								Gravel (%)	Sand (%)	Fines (%)	LL	PL	PI			pH	Sulfate (ppm)	Chloride (ppm)	Minimum Resistivity (ohm-cm)	C_c	C_r			Effective cohesion (psf)	Effective Friction Angle (degrees)
	85.5	CR	SM	San Pedro	75/6"	23.0	89	0	84	16					2.62					0.07899	0.01286		0.837		
	90.5	SPT	SP-SM	San Pedro	50/6"	21.7	-																		
	95.5	CR	SP	San Pedro	75/6"	13.3	92																0.825		
	100.5	SPT	SM	San Pedro	99/10"	20.6	-	0	51	49															
	105.5	CR	SM	San Pedro	80/10"	20.8	103	0	51	49	NP	NP	NP										0.618		
	110	SPT	SP	San Pedro	50/6"	17.8	-																		
	115.5	CR	SC	San Pedro	47	12.8	123	0	54	46	24	13	11		2.72								0.38		
	120	SPT	SP	San Pedro	50/5"	12.2	-																		
	125.5	NR	SW	San Pedro	100/3"	-	-																		
	130.5	SPT	SP	San Pedro	50/4"	18.9	-																		
	135.5	CR	SP	San Pedro	75/6"	15.7	96																0.736		
	140.5	SPT	SM	San Pedro	50/5"	20.9	-	3	63	34															
	145.5	CR	SP	San Pedro	75/6"	20.5	88																0.893		
	150.5	SPT	SP	San Pedro	50/4"	17.9	-																		
G-168	5.5	CR	SC	FILL	30	15.3	118																		
	8.5	SPT	SM	ternary Older Alluv	26	13.7	-																		
	11.5	CR	SM	ternary Older Alluv	13	12.2	113																0.474		
	14.5	SPT	CL	ternary Older Alluv	15	22.1	-																		
	17.5	CR	CL	ternary Older Alluv	19	26.7	95				49	28	21										0.767		
	20.5	SPT	CL	ternary Older Alluv	16	31.5	-																		
	23.5	CR	CL	ternary Older Alluv	34	23.7	-																		
	26.5	SPT	CL	ternary Older Alluv	30	26.6	-				41	20	21												
	29.5	CR	CL	ternary Older Alluv	37	17.3	107																0.569		
	32.5	SPT	CL	ternary Older Alluv	28	29.7	-																		
	35.5	CR	CL	ternary Older Alluv	36	18.7	113																0.485		
	38.5	SPT	CL	ternary Older Alluv	24	17.2	-	0	13	87						7.3	25.0	21	840						
	41.5	CR	CL	ternary Older Alluv	50	32.1	87																0.929		
	45.5	SPT	ML	Lakewood	68	25.8	-																		
	49.5	CR	SM	Lakewood	75/9"	18.4	105																0.587		
	53.5	SPT	SP	Lakewood	97/9"	17.9	-																		
	57.5	CR	SM	Lakewood	100/5"	12.7	112			15													0.488		
	62.5	SPT	SP	San Pedro	93/9"	10.2	-																		
	67.5	CR	SM	San Pedro	50/5"	22.0	100	0	79	21										0.05998	0.01		0.666		
	72.5	SPT	SP	San Pedro	50/5"	18.0	-									8.2	51.0	13	3040						
	77.5	CR	SP	San Pedro	50/3"	14.4	100							0.14%									0.666		
	82.5	SPT	SM	San Pedro	50/3"	13.1	-	0	77	23					2.69										
	87.5	NR	SM	San Pedro	100/4.5"	-	-																		
	90.5	CR	SP	San Pedro	70/5"	27.2	92																0.811		
	97.5	SPT	CH	San Pedro	43	10.3	-	0	19	81	51	27	24												
	104.5	CR	SM	San Pedro	75/5"	9.9	119																0.4		
	111.5	SPT	SM	San Pedro	50/4"	13.8	-	26	55	19															
G-169	1-5'	BULK	CL-ML	FILL	-	-	-									8.2	27.0	4	1680						
	5.5	CR	CL	FILL	15	25.7	93																0.805		
	8.5	SPT	SM	FILL	14	14.2	-																		
	11.5	CR	CL	FILL	10	17.5	109																0.54		
	14.5	SPT	CL	FILL	4/6"	21.1	-				39	20	19												
	17.5	CR	CL	FILL	11	25.9	101																0.662		
	20.5	SPT	CL	FILL	15	21.2	-																		
	23.5	CR	CL	FILL	17	27.3	97																0.73		
	26.5	SPT	CL	FILL	25	27.2	-									7.9	672.0	99	920						
	29.5	CR	SC	Lakewood	41	13.0	120				26	15	11										0.388		
	32.5	SPT	SM	Lakewood	43	15.7	-			43															
	35.5	CR	SM	Lakewood	72/11"	14.7	109																0.529		
	38.5	SPT	SP-SM	Lakewood	90	14.9	-	0	88	12															
	41.5	CR	SP-SM	Lakewood	94/8"	19.0	101																		
	44.5	SPT	SP-SM	Lakewood	96/11"	18.4	-																		
	47.5	CR	SP-SM	Lakewood	50/5"	12.8	106																		
	52.5	SPT	SM	Lakewood	84	24.2	-																		
	57.5	CR	SP-SM	Lakewood	93/10"	17.7	107			26															
	62.5	SPT	SM	Lakewood	63	21.8	-																		
	67.5	CR	SM	San Pedro	93/10"	18.3	94	0	67	33				0.05%									0.8		
	72.5	SPT	SP-SM	San Pedro	50/6"	22.9	-								2.67	7.8	358.0	58	960						
	77.5	CR	SM	San Pedro	66	30.5	86	0	85	15										0.1	0.0		0.9		
	82.5	SPT	SM	San Pedro	93	14.6	-																		
	85.5	CR	SW-SM	San Pedro	90/11"	19.0	103	22	67	11															
	90.5	SPT	SP	San Pedro	50/4"	29.4	-								2.64										
	95.5	CR	CL	San Pedro	51	17.3	112	1	44	55	36	19	17							0.1	0.0		0.5		
	100.5	SPT	ML	San Pedro	44	13.4	-									7.7	968.0	45	640						

By: WL 9/29/2011
Checked By: JF 10/16/2011



Prepared/Date: YN 10/3/11
Checked/Date: LT 10/3/11

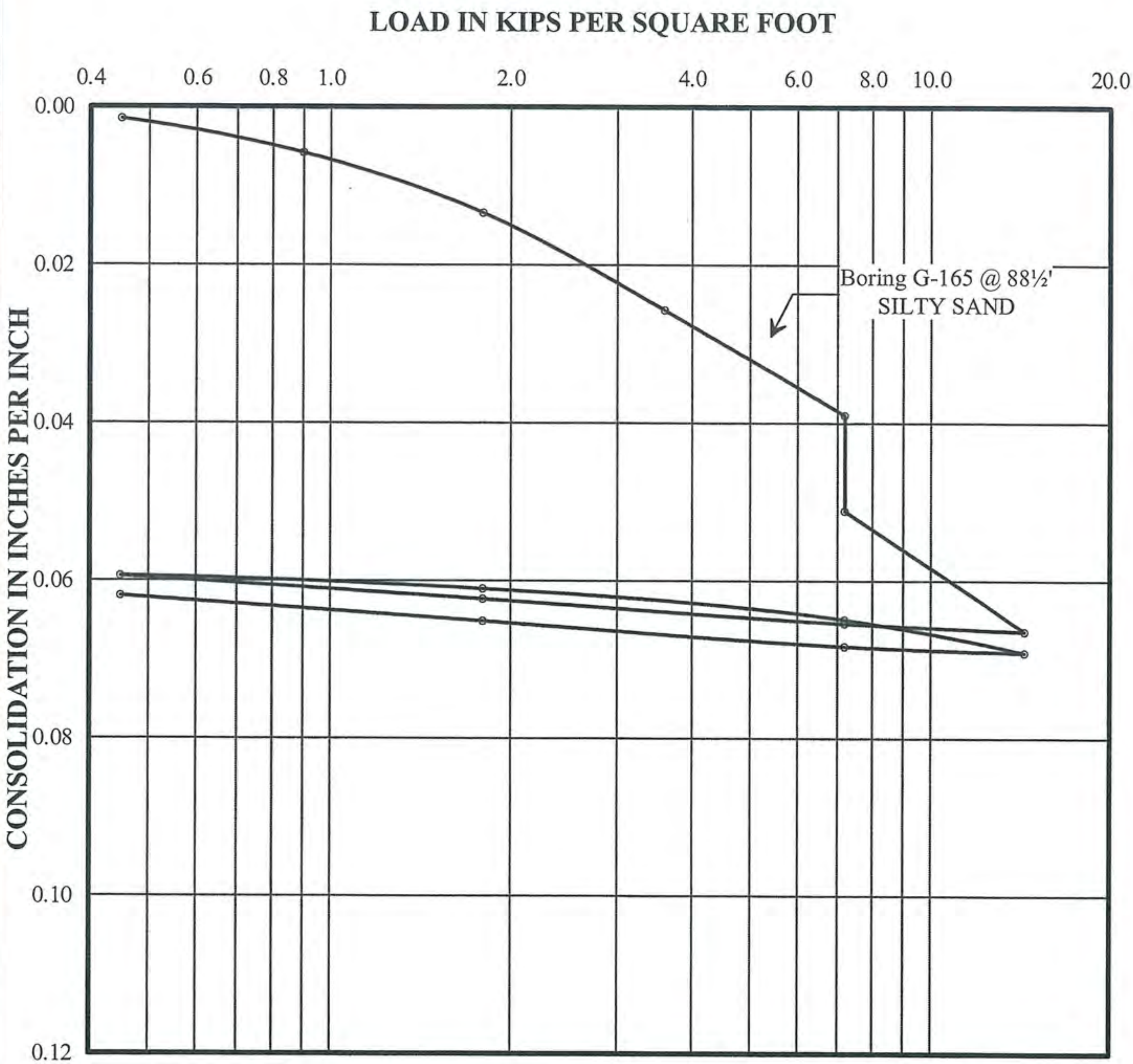
MTA Westside Subway Extension Los Angeles, California	amec	DIRECT SHEAR TEST DATA Project No.: 4953-10-1561 Figure F-1.43



KEY:
- • Samples tested at field moisture content
- ○ Samples soaked to a moisture content near saturation

Prepared/Date: YN 10/3/11
Checked/Date: LT 10/3/11

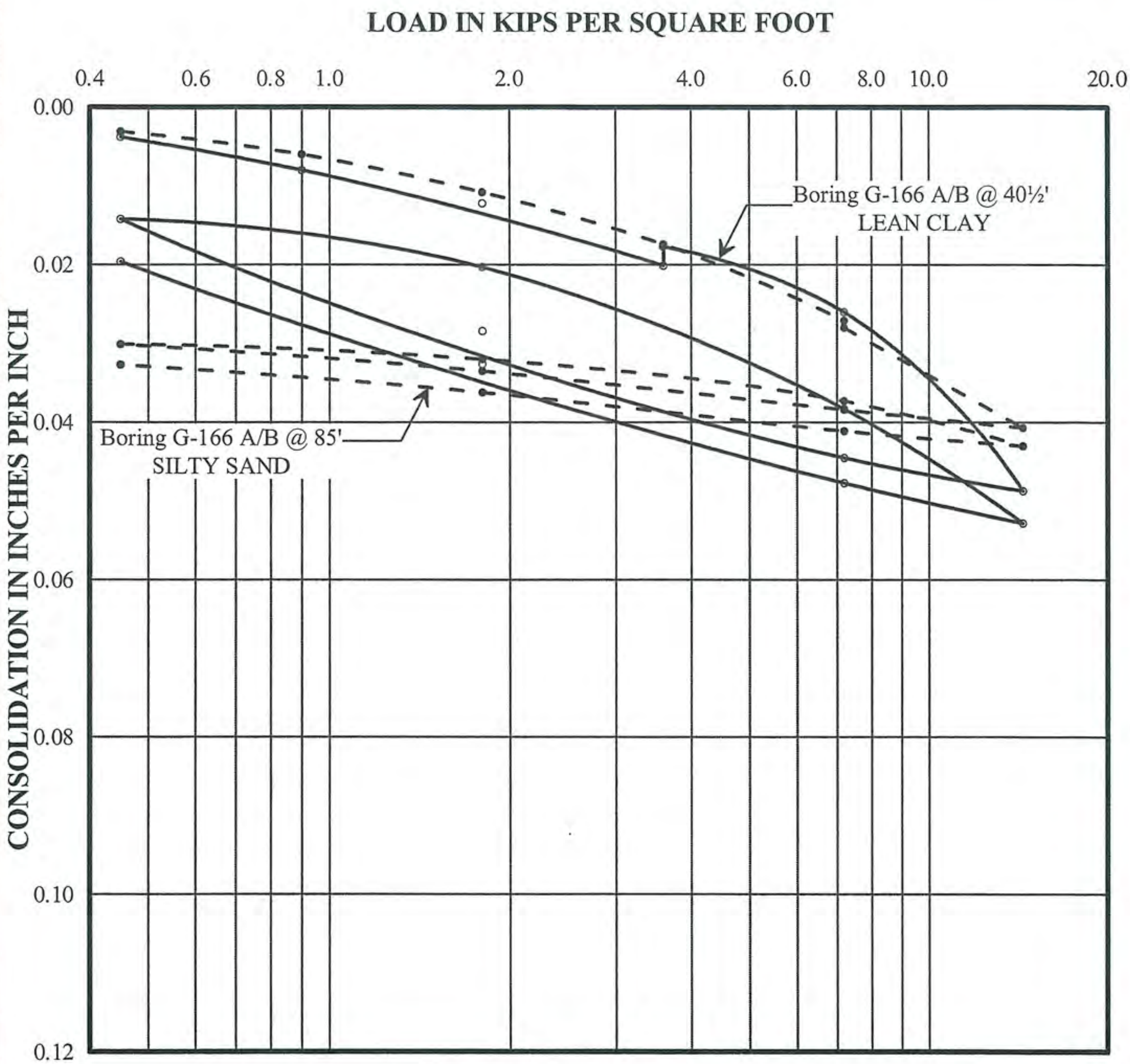
MTA Westside Subway Extension Los Angeles, California	amec	DIRECT SHEAR TEST DATA Project No.: 4953-10-1561 Figure F-1.44



Note: Water added to sample after consolidation under a load of 7.2 kips per square foot.

Prepared/Date: JF 9/27/11
Checked/Date: JF 9/28/11

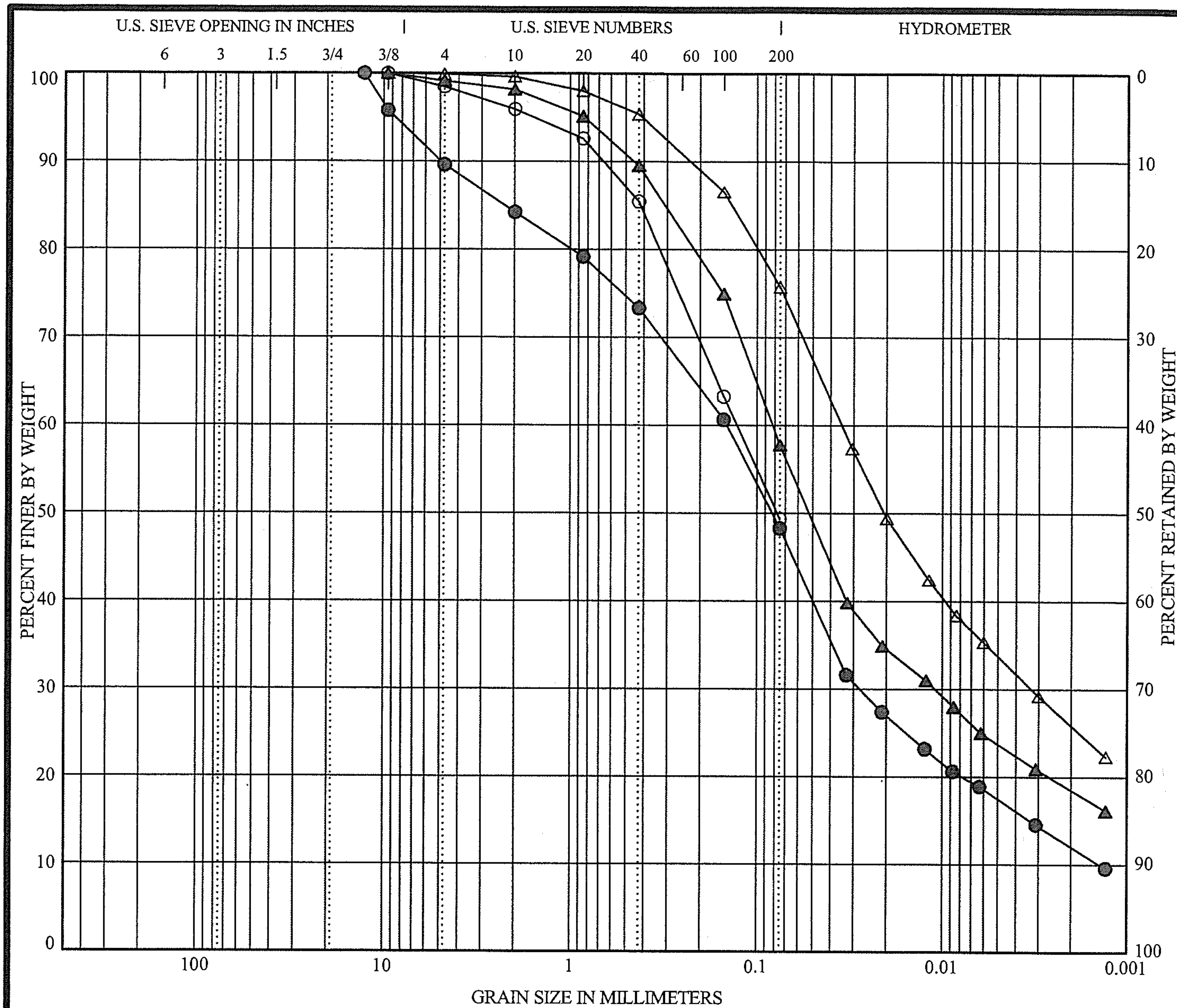
MTA Westside Subway Extension Los Angeles, California	amec	CONSOLIDATION TEST DATA Project No.: 4953-10-1561 Figure F-4.65



Note: Water added to samples at 40½' and 85' after consolidation under a load of 3.6 and 7.2 kips per square foot, respectively.

Prepared/Date: AH 9/23/11
Checked/Date: LT 9/23/11

MTA Westside Subway Extension Los Angeles, California	amec	CONSOLIDATION TEST DATA Project No.: 4953-10-1561 Figure F-4.66



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

SYMBOL	BORING	DEPTH (ft)	CLASSIFICATION	LL (%)*	PL (%)*	PI (%)*	C_c	C_u
○	G-165	16.5	CLAYEY SAND (SC)	--	--	--	--	--
●	G-165	25.5	CLAYEY SAND (SC)	39	20	19	3.8	103.7
△	G-165	43.5	LEAN CLAY with SAND (CL)	--	--	--	--	--
▲	G-165	55.5	SANDY LEAN CLAY (CL)	--	--	--	--	--

SYMBOL	BORING	DEPTH (ft)	D_{100} (mm)	D_{60} (mm)	D_{30} (mm)	D_{10} (mm)	% Gravel	% Sand	% Silt or % Clay
○	G-165	16.5	9.52	0.127	--	--	1.5	49.1	49.4
●	G-165	25.5	12.70	0.145	0.028	0.001	10.4	41.3	48.3
△	G-165	43.5	9.52	0.035	0.003	--	0.1	24.2	75.7
▲	G-165	55.5	9.52	0.082	0.011	--	0.8	41.4	57.8

Laboratory Test Method: ASTM D 422

*As determined by ASTM D 4318; see attached Atterberg Limits Test Results.

Prepared/Date: JF 6/14/2011
Checked/Date: JAG 6/27/2011

MTA Westside Subway Extension

Los Angeles, California

amec

PARTICLE SIZE DISTRIBUTION
Project No.: 4953-10-1561
Figure: F-6.117

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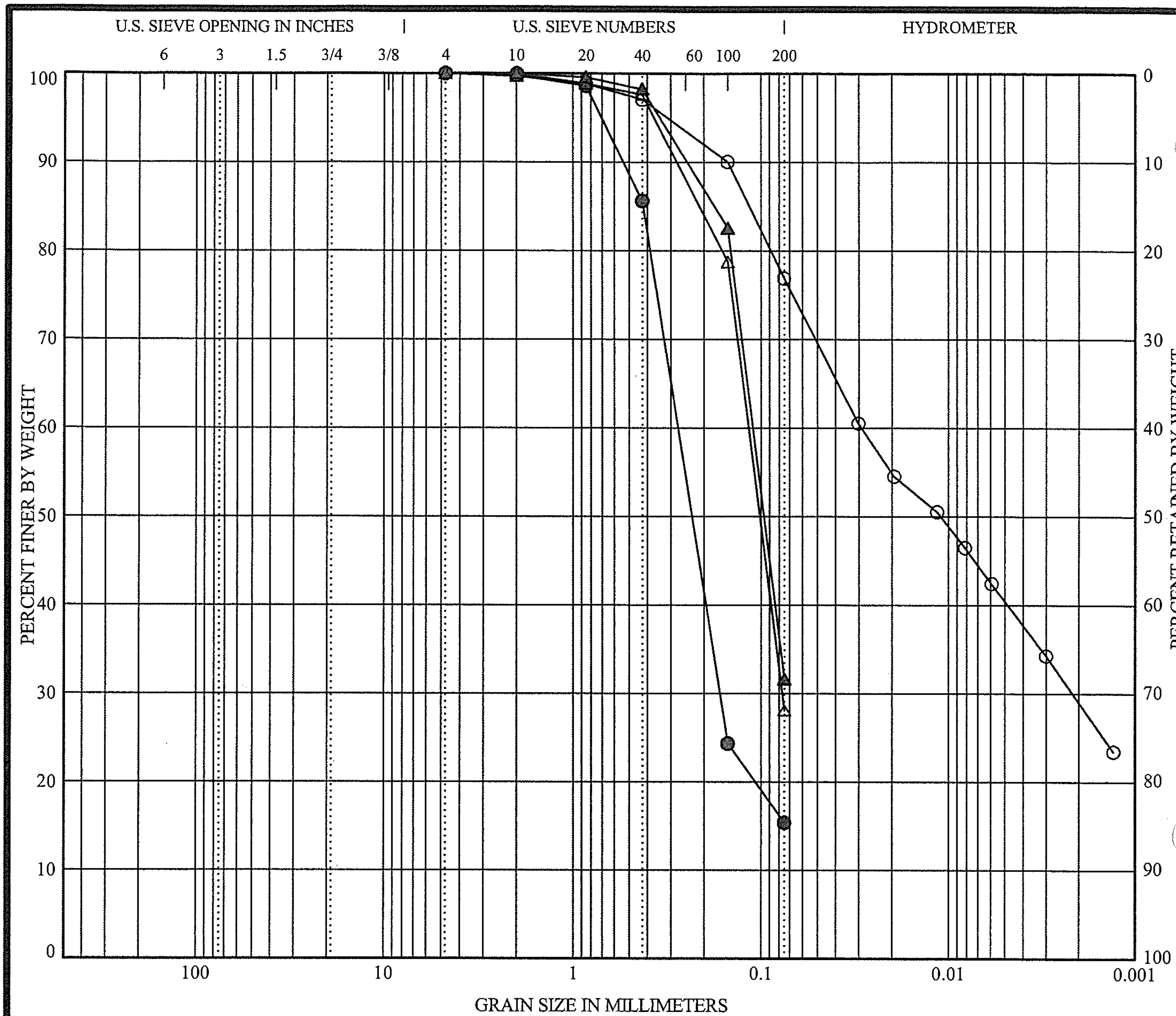


COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

SYMBOL	BORING	DEPTH (ft)	CLASSIFICATION	LL (%)*	PL (%)*	PI (%)*	C_c	C_u
○	G-165	67.5	LEAN CLAY with SAND (CL)	42	25	17	--	--
●	G-165	79.5	SILTY SAND (SM)	--	--	--	--	--
△	G-165	91.5	SILTY SAND (SM)	--	--	--	--	--
▲	G-165	103.5	SILTY SAND (SM)	--	--	--	--	--

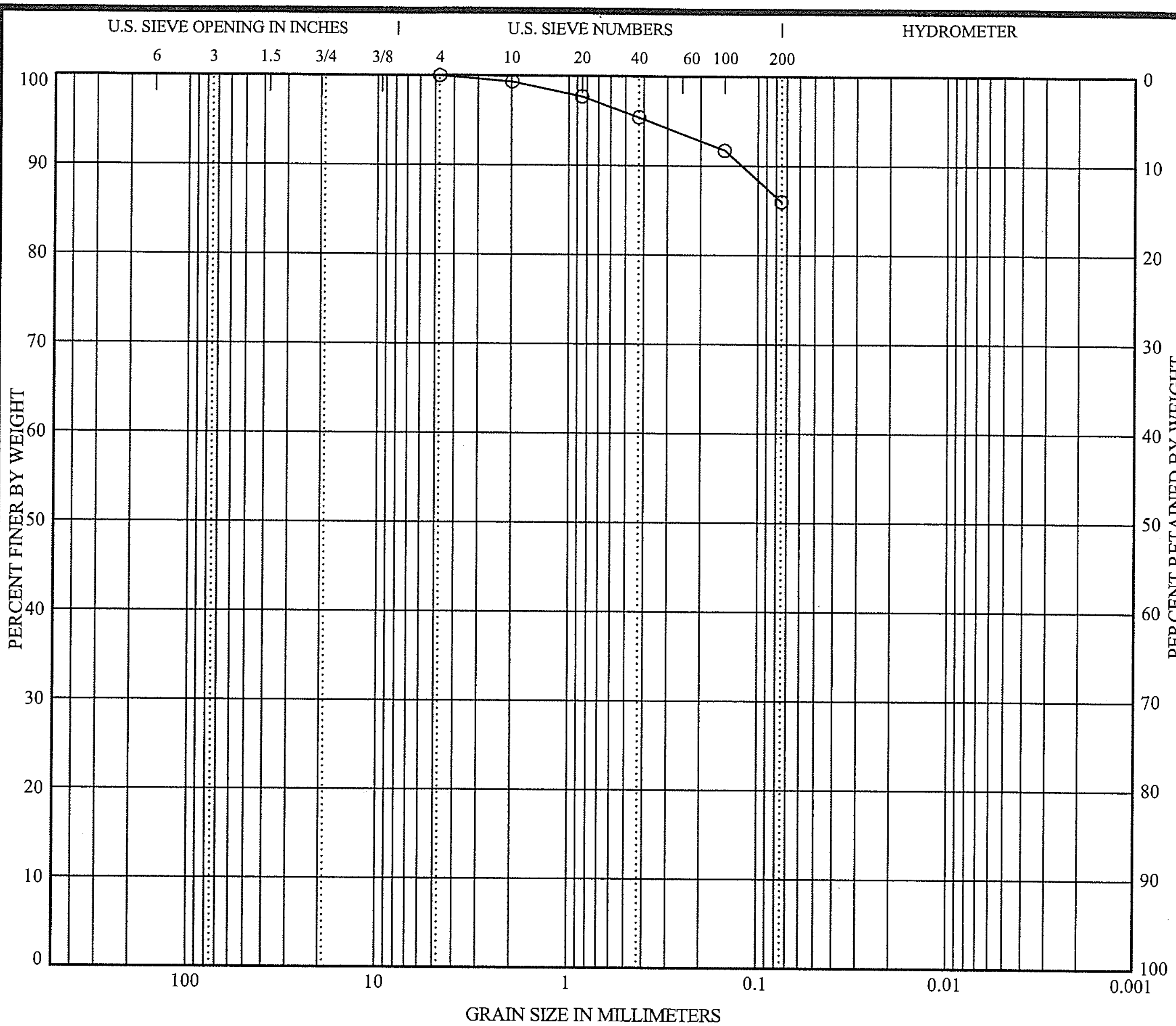
SYMBOL	BORING	DEPTH (ft)	D_{100} (mm)	D_{60} (mm)	D_{30} (mm)	D_{10} (mm)	% Gravel	% Sand	% Silt or % Clay
○	G-165	67.5	1.98	0.029	0.002	--	0.0	23.1	76.9
●	G-165	79.5	4.75	0.275	0.165	--	0.0	84.6	15.4
△	G-165	91.5	4.75	0.116	0.077	--	0.0	71.9	28.1
▲	G-165	103.5	1.98	0.110	--	--	0.0	68.3	31.7

Laboratory Test Method: ASTM D 422

*As determined by ASTM D 4318; see attached Atterberg Limits Test Results.

Prepared/Date: JF 6/14/2011
Checked/Date: JAG 6/27/2011

MTA Westside Subway Extension Los Angeles, California	amec	PARTICLE SIZE DISTRIBUTION Project No.: 4953-10-1561 Figure: F-6.118



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

SYMBOL	BORING	DEPTH (ft)	CLASSIFICATION	LL (%)*	PL (%)*	PI (%)*	C_c	C_u
O	G-165	120.5	ELASTIC SILT (MH)	51	30	21	--	--

SYMBOL	BORING	DEPTH (ft)	D_{100} (mm)	D_{60} (mm)	D_{30} (mm)	D_{10} (mm)	% Gravel	% Sand	% Silt or % Clay
O	G-165	120.5	4.75	--	--	--	0.0	14.0	86.0

Laboratory Test Method: ASTM D 422

*As determined by ASTM D 4318; see attached Atterberg Limits Test Results.

Prepared/Date: JF 6/14/2011
Checked/Date: JAG 6/27/2011

MTA Westside Subway Extension

Los Angeles, California

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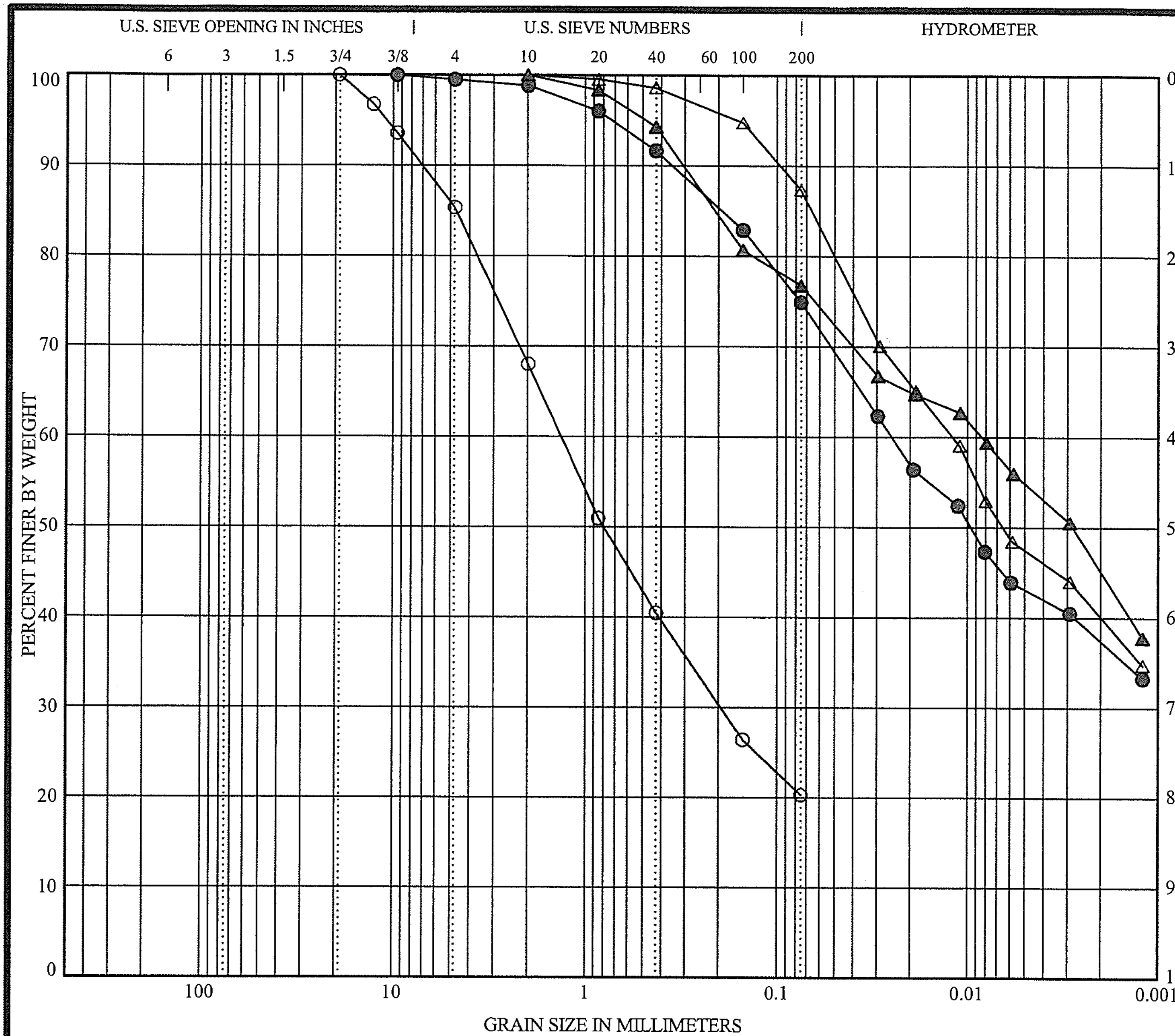
PARTICLE SIZE DISTRIBUTION
Project No.: 4953-10-1561
Figure: F-6.119



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

SYMBOL	BORING	DEPTH (ft)	CLASSIFICATION	LL (%)*	PL (%)*	PI (%)*	C_c	C_u
○	G-166A/B	13.5	SILTY SAND (SM)	--	--	--	--	--
●	G-166A/B	25.5	LEAN CLAY with SAND (CL)	--	--	--	--	--
△	G-166A/B	52.5	LEAN CLAY (CL)	46	18	28	--	--
▲	G-166A/B	62.5	FAT CLAY with SAND (CH)	55	28	27	--	--

SYMBOL	BORING	DEPTH (ft)	D_{100} (mm)	D_{60} (mm)	D_{30} (mm)	D_{10} (mm)	% Gravel	% Sand	% Silt or % Clay
○	G-166A/B	13.5	19.10	1.330	0.195	--	14.6	65.1	20.3
●	G-166A/B	25.5	9.52	0.025	--	--	0.5	24.6	74.9
△	G-166A/B	52.5	1.98	0.012	--	--	0.0	12.7	87.3
▲	G-166A/B	62.5	1.98	0.008	--	--	0.0	23.2	76.8

Laboratory Test Method: ASTM D 422

*As determined by ASTM D 4318; see attached Atterberg Limits Test Results.

Prepared/Date: JF 7/17/2011
Checked/Date: LT 8/3/2011

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PARTICLE SIZE DISTRIBUTION
Project No.: 4953-10-1561
Figure: F-6.120

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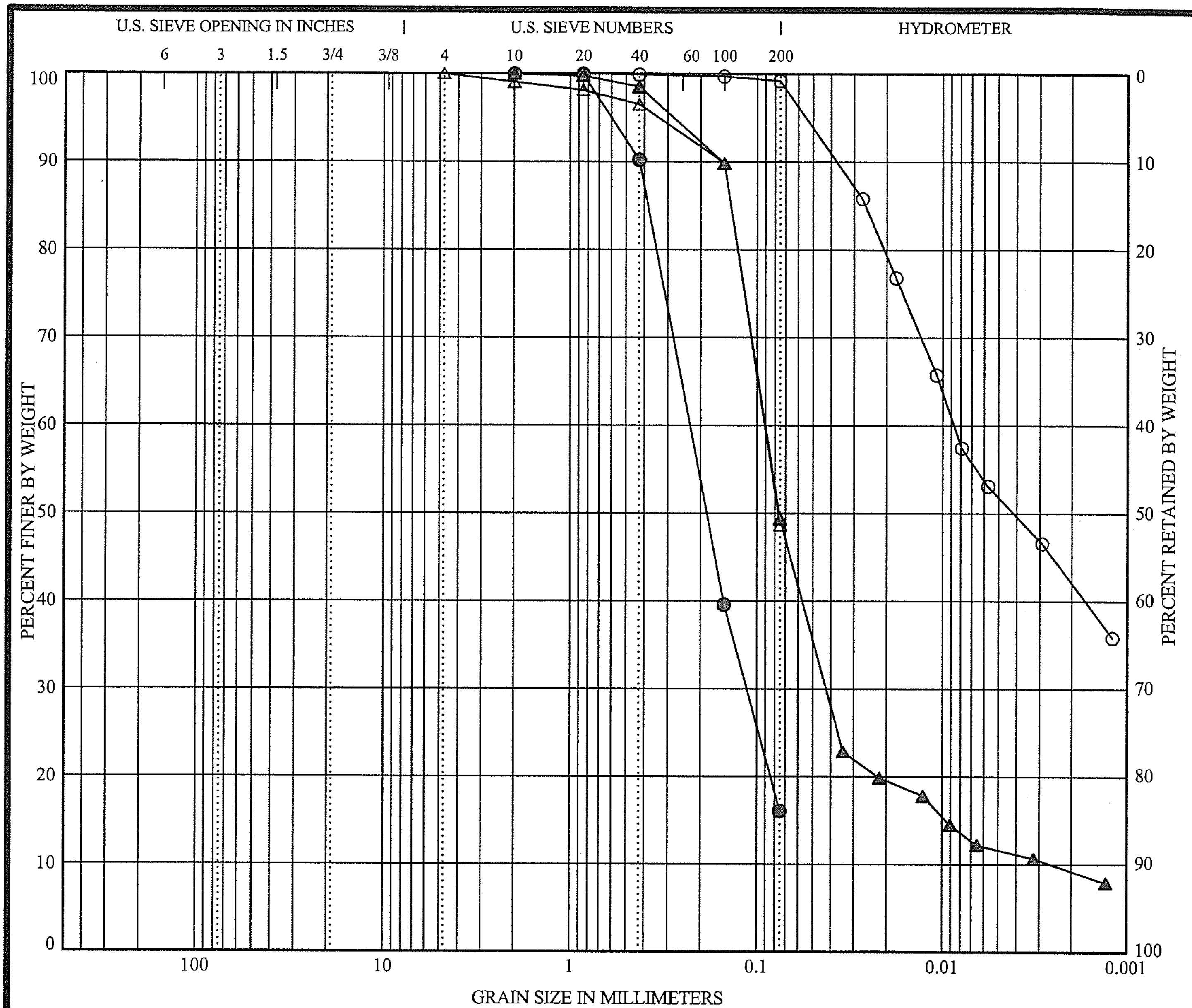

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

SYMBOL	BORING	DEPTH (ft)	CLASSIFICATION	LL (%)*	PL (%)*	PI (%)*	C_c	C_u
○	G-166A/B	68.5	ELASTIC SILT (MH)	82	43	39	--	--
●	G-166A/B	85.0	SILTY SAND (SM)	--	--	--	--	--
△	G-166A/B	100.5	SILTY SAND (SM)	--	--	--	--	--
▲	G-166A/B	105.5	SILTY SAND (SM)	NP	NP	NP	7.6	34.8

SYMBOL	BORING	DEPTH (ft)	D_{100} (mm)	D_{60} (mm)	D_{30} (mm)	D_{10} (mm)	% Gravel	% Sand	% Silt or % Clay
○	G-166A/B	68.5	1.98	0.009	--	--	0.0	0.8	99.2
●	G-166A/B	85.0	1.98	0.228	0.113	--	0.0	83.9	16.1
△	G-166A/B	100.5	4.75	0.091	--	--	0.0	51.4	48.6
▲	G-166A/B	105.5	1.98	0.090	0.042	0.003	0.0	50.7	49.3

Laboratory Test Method: ASTM D 422

*As determined by ASTM D 4318; see attached Atterberg Limits Test Results.

Prepared/Date: JF 7/17/2011
Checked/Date: LT 8/3/2011

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Los Angeles, California

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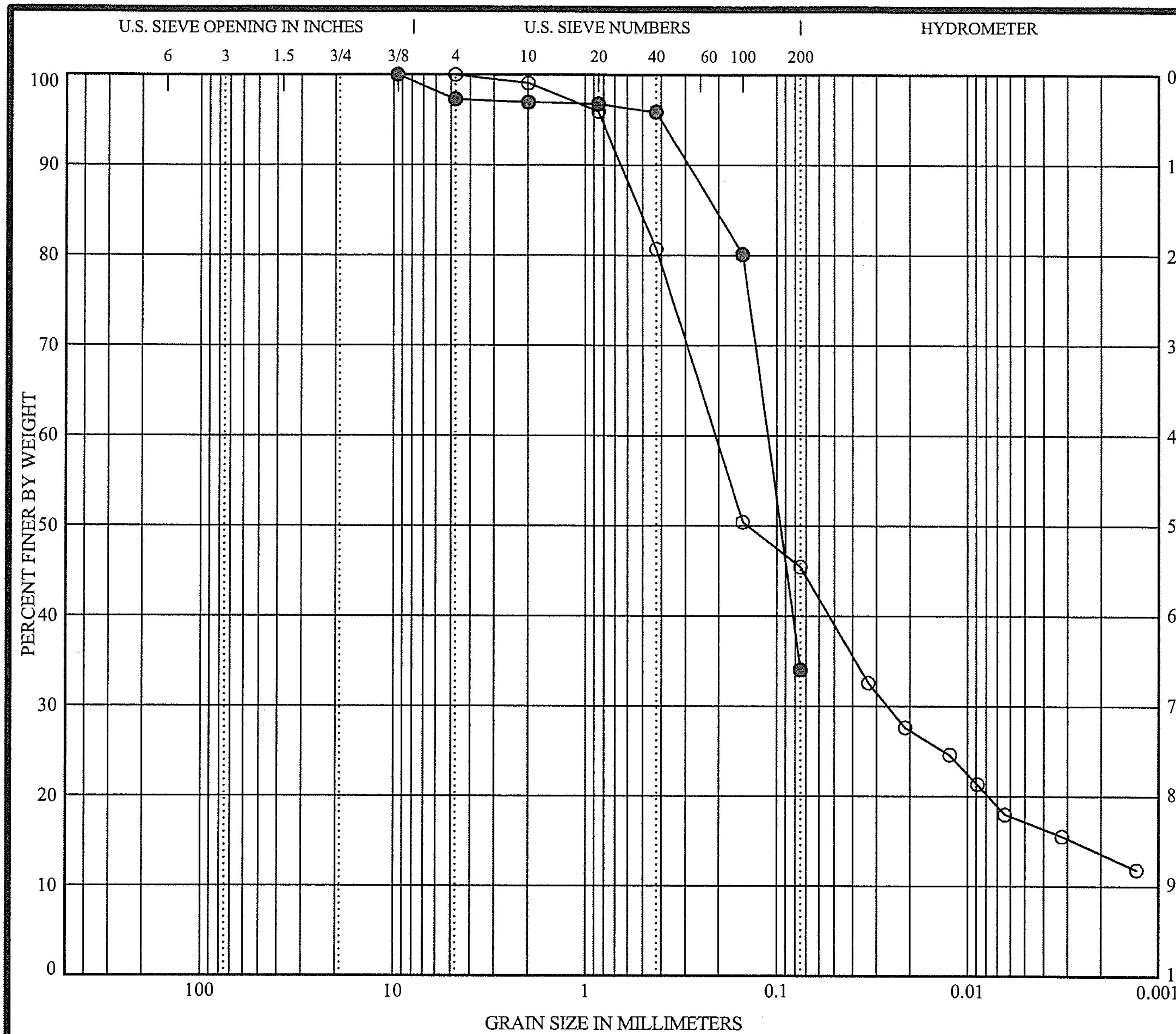
PARTICLE SIZE DISTRIBUTION
Project No.: 4953-10-1561
Figure: F-6.121



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

SYMBOL	BORING	DEPTH (ft)	CLASSIFICATION	LL (%)*	PL (%)*	PI (%)*	C_c	C_u
○	G-166A/B	115.5	CLAYEY SAND (SC)	24	13	11	--	--
●	G-166A/B	140.5	SILTY SAND (SM)	--	--	--	--	--

SYMBOL	BORING	DEPTH (ft)	D_{100} (mm)	D_{60} (mm)	D_{30} (mm)	D_{10} (mm)	% Gravel	% Sand	% Silt or % Clay
○	G-166A/B	115.5	4.75	0.209	0.026	--	0.0	54.5	45.5
●	G-166A/B	140.5	9.52	0.111	--	--	2.7	63.3	34.0

Laboratory Test Method: ASTM D 422

*As determined by ASTM D 4318; see attached Atterberg Limits Test Results.

Prepared/Date: JF 7/17/2011
Checked/Date: LT 8/3/2011

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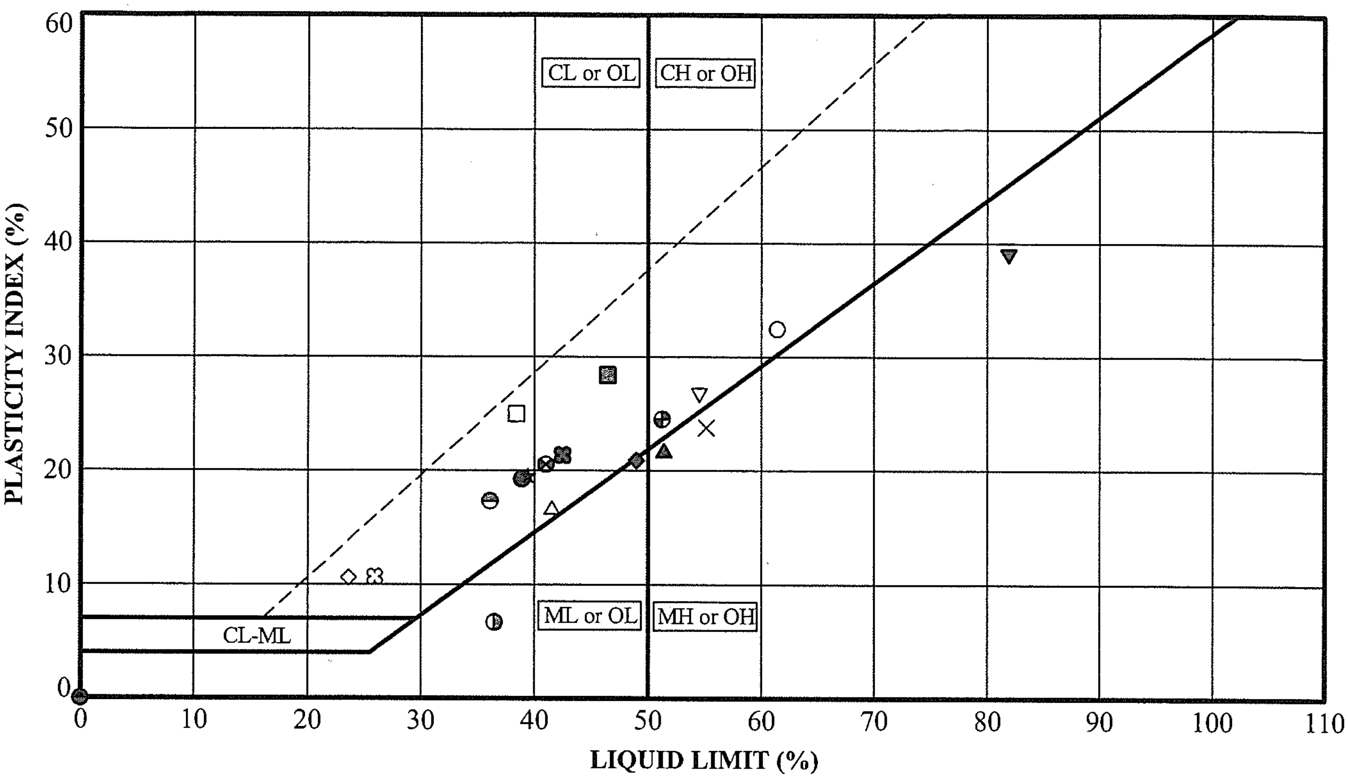
MTA Westside Subway Extension Los Angeles, California	amec	PARTICLE SIZE DISTRIBUTION Project No.: 4953-10-1561 Figure: F-6.122



SYMBOL	BORING	DEPTH (ft)	LL (%)	PL (%)	PI (%)	CLASSIFICATION
○	G-164	54.5	61	29	32	FAT CLAY (CH)
●	G-165	25.5	39	20	19	CLAYEY SAND (SC)
△	G-165	67.5	42	25	17	LEAN CLAY with SAND (CL)
▲	G-165	120.5	51	30	21	ELASTIC SILT (MH)
□	G-166A/B	31.5	38	13	25	SANDY LEAN CLAY (CL)
■	G-166A/B	52.5	46	18	28	LEAN CLAY (CL)
▽	G-166A/B	62.5	55	28	27	FAT CLAY with SAND (CH)
▼	G-166A/B	68.5	82	43	39	ELASTIC SILT (MH)
◉	G-166A/B	105.5	NP	NP	NP	SILTY SAND (SM)
◇	G-166A/B	115.5	24	13	11	CLAYEY SAND (SC)
◆	G-168	17.5	49	28	21	LEAN CLAY (CL)
⊗	G-168	26.5	41	20	21	LEAN CLAY (CL)
⊕	G-168	97.5	51	27	24	FAT CLAY with SAND (CH)
☆	G-169	14.5	39	20	19	LEAN CLAY (CL)
☒	G-169	29.5	26	15	11	CLAYEY SAND (SC)
⊖	G-169	95.5	36	19	17	SANDY LEAN CLAY (CL)
⊖	G-171	80.5	NP	NP	NP	SILT with SAND (ML)
◑	G-173	80.5	36	30	6	SILT (ML)
×	G-173	100.5	55	31	24	ELASTIC SILT with SAND (MH)
✖	G-174A	60.5	42	21	21	LEAN CLAY (CL)

Laboratory Test Method: ASTM D 4318 "NP" indicates Non-Plastic

Prepared/Date: JF 6/14/2011
Checked/Date: JAG 6/27/2011

MTA Westside Subway Extension
Los Angeles, California

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ATTERBERG LIMITS TEST RESULTS
Project No.: 4953-10-1561
Figure: F-7.2.14

Client:	MACTEC Engineering
Attn:	S. V. (Jag) Jagannath

Client's Project: Metro WSE; 4953-10-1561
Date Received: 6/10/2011
Matrix: Air
Units: % v/v

Natural Gas Analysis by ASTM-D1945

Lab No.:		C061007-01		C061007-02		C061007-03					
Client Sample I.D.:		C119B - 30		C119B - 55		C119B - 75					
Date Sampled:		6/10/2011		6/10/2011		6/10/2011					
Fixed Gases Date Analyzed:		6/15/2011		6/15/2011		6/15/2011					
Hydrocarbon Date Analyzed:		6/15/2011		6/15/2011		6/15/2011					
Analyst Initials:		ZK		ZK		ZK					
QC Batch #:		110614GC11A2		110614GC11A2		110614GC11A2					
Dilution Factor:		1.0		1.0		1.0					
ANALYTE	PQL	RL	Results	RL	Results	RL	Results				
Methane	0.0010	0.0010	ND	0.0010	ND	0.0010	0.012				
Ethane	0.010	0.010	ND	0.010	ND	0.010	ND				
n-Butane	0.010	0.010	ND	0.010	ND	0.010	ND				

PQL = Practical Quantitation Limit
ND = Not Detected (Below RL).
RL = PQL X Dilution Factor

Reviewed/Approved By: ______________________
Mark J. Johnson
Operations Manager

Date: 6/23/11

The cover letter is an integral part of this analytical report.

AMERICAN SCIENTIFIC LABORATORIES, LLC
Environmental Testing Services
2520 N. San Fernando Rd., Los Angeles, CA 90065 Tel: (323) 223-9700 Fax: (323) 223-9500

ANALYTICAL RESULTS

Ordered By

MACTEC Engineering & Consulting Inc
5628 East Slauson Ave.
Los Angeles, CA 90040-

Site

241 Moreno Drive
Beverly Hills, CA

Telephone: (323)889-5300
Attn: Marty Hudson

Page: 2

Project ID: 4953-10-1531 G165-66
Project Name: MTA Westside Extension

ASL Job Number	Submitted	Client
49598	04/22/2011	MACTEC

Method: 1664, Revision A, Oil and Grease (HEM)

QC Batch No: 042611-1

Our Lab I.D.		267815	267817			
Client Sample I.D.		G-166-D	G-165-D			
Date Sampled		04/22/2011	04/22/2011			
Date Prepared		04/26/2011	04/26/2011			
Preparation Method						
Date Analyzed		04/26/2011	04/26/2011			
Matrix		Water	Water			
Units		mg/L	mg/L			
Dilution Factor		1	1			
Analytes	**PQL**	**Results**	**Results**			
Conventionals						
Oil and Grease	5.00	ND	ND			

QUALITY CONTROL REPORT

QC Batch No: 042611-1

Analytes	LCS % REC	LCS DUP % REC	LCS RPD % REC	LCS/LCSD % Limit	LCS RPD % Limit					
Conventionals										
Oil and Grease	92	95	3.2	80-120	<20					

FIGURE F-11.7

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ANALYTICAL RESULTS

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Los Angeles, CA 90040-

Site

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Beverly Hills, CA

Telephone: (323)889-5300
Attn: Marty Hudson

Page: 3

Project ID: 4953-10-1531 G165-66
Project Name: MTA Westside Extension

ASL Job Number	Submitted	Client
49598	04/22/2011	MACTEC

Method: 418.1, TRPH

QC Batch No: W-042811-1

Our Lab I.D.		267815	267817			
Client Sample I.D.		G-166-D	G-165-D			
Date Sampled		04/22/2011	04/22/2011			
Date Prepared		04/27/2011	04/27/2011			
Preparation Method						
Date Analyzed		04/28/2011	04/28/2011			
Matrix		Water	Water			
Units		mg/L	mg/L			
Dilution Factor		1	1			
Analytes	**PQL**	**Results**	**Results**			
Total Recoverable Petroleum Hydrocarbons	0.500	ND	ND			

QUALITY CONTROL REPORT

QC Batch No: W-042811-1

Analytes	MS % REC	MS DUP % REC	RPD %	MS/MSD % Limit	MS RPD % Limit					
Total Recoverable Petroleum Hydrocarbons	104	103	<1	70-130	15					

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Beverly Hills, CA

Telephone: (323)889-5300
Attn: Marty Hudson

Page: 4

Project ID: 4953-10-1531 G165-66
Project Name: MTA Westside Extension

ASL Job Number	Submitted	Client
49598	04/22/2011	MACTEC

Method: 600, General Minerals

QC Batch No: 042211-1

Our Lab I.D.		267815	267816	267817		
Client Sample I.D.		G-166-D	G-166-S	G-165-D		
Date Sampled		04/22/2011	04/22/2011	04/22/2011		
Date Prepared		04/22/2011	04/22/2011	04/22/2011		
Preparation Method						
Date Analyzed		04/22/2011	04/22/2011	04/22/2011		
Matrix		Water	Water	Water		
Units		mg/L	mg/L	mg/L		
Dilution Factor		1	1	1		
Analytes	**PQL**	**Results**	**Results**	**Results**		
Conventionals						
Alkalinity,Total	10.0	215	135	145		
Bicarbonate (as CaCO3)	10.0	215	135	145		
Carbonate (as CaCO3)	10.0	ND	ND	ND		
Hydroxide (as CaCO3)	10.0	ND	ND	ND		
Chloride	1.00	352	599	753		
Conductivity (umho/cm @77F)	1.00	1620	2350	2780		
Fluoride	0.100	0.500	1.15	1.25		
Hardness (Ca,Mg) as CaCO3	10.0	440	260	900		
Nitrate as N	0.100	4.17	1.18	6.95		
pH	1.00	7.53	8.01	7.10		
Sulfate	1.00	45.4	268	54.4		
Surfactants(MBAS)	0.0500	ND	ND	ND		
Total Dissolved Solids(TDS)	10.0	1070	1510	1800		
ICP Metals						
Calcium	1.00	715	644	394		
Copper	0.0100	ND	ND	0.0177		
Iron	0.0500	1.70	0.787	1.73		
Magnesium	0.250	95.2	10.6	7.70		
Manganese	0.0200	1.74	1.15	1.23		
Potassium	1.00	15.5	23.9	4.80		
Sodium	1.00	189	492	167		
Zinc	0.0100	0.0630	0.0198	0.0687		

QUALITY CONTROL REPORT

QC Batch No: 042211-1

Analytes	LCS % REC	LCS/LCSD % Limit							
Conventionals									

FIGURE F-11.9

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ANALYTICAL RESULTS

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Project ID: 4953-10-1531 G165-66
Project Name: MTA Westside Extension

ASL Job Number	Submitted	Client
49598	04/22/2011	MACTEC

Method: 600, General Minerals

QUALITY CONTROL REPORT

QC Batch No: 042211-1

Analytes	LCS % REC	LCS/LCSD % Limit							
Conventionals									
Alkalinity,Total	95	80-120							
Bicarbonate (as CaCO3)	95	80-120							
Carbonate (as CaCO3)	95	80-120							
Hydroxide (as CaCO3)	95	80-120							
Chloride	98	80-120							
Conductivity (umho/cm @77F)	97	80-120							
Fluoride	98	80-120							
Hardness (Ca,Mg) as CaCO3	100	80-120							
Nitrate as N	100	80-120							
pH	100	80-120							
Sulfate	95	80-120							
Surfactants(MBAS)	92	80-120							
Total Dissolved Solids(TDS)	102	80-120							
ICP Metals									
Calcium	106	80-120							
Copper	109	80-120							
Iron	105	80-120							
Magnesium	101	80-120							
Manganese	113	80-120							
Potassium	98	80-120							
Sodium	111	80-120							
Zinc	112	80-120							

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Beverly Hills, CA

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Attn: Marty Hudson

Page: 6

Project ID: 4953-10-1531 G165-66
Project Name: MTA Westside Extension

ASL Job Number	Submitted	Client
49598	04/22/2011	MACTEC

Method: 6010B/7470A, CCR Title 22 Metals (TTLC)

QC Batch No: 042611-1

Our Lab I.D.		267815	267816	267817		
Client Sample I.D.		G-166-D	G-166-S	G-165-D		
Date Sampled		04/22/2011	04/22/2011	04/22/2011		
Date Prepared		04/26/2011	04/26/2011	04/26/2011		
Preparation Method						
Date Analyzed		04/26/2011	04/26/2011	04/26/2011		
Matrix		Water	Water	Water		
Units		mg/L	mg/L	mg/L		
Dilution Factor		1	1	1		
Analytes	**PQL**	**Results**	**Results**	**Results**		
AA Metals						
Mercury	0.0005	ND	ND	ND		
ICP Metals						
Antimony	0.0100	ND	ND	ND		
Arsenic	0.0100	0.0258	0.0267	0.0120		
Barium	0.0100	1.21	0.921	0.840		
Beryllium	0.0050	ND	ND	ND		
Cadmium	0.0050	ND	ND	ND		
Chromium	0.0100	ND	ND	ND		
Cobalt	0.0100	ND	0.0164	0.0160		
Copper	0.0100	ND	ND	0.0177		
Lead	0.0050	ND	ND	ND		
Molybdenum	0.0100	0.0260	0.0706	ND		
Nickel	0.0100	0.0646	0.0626	0.0490		
Selenium	0.0100	0.0209	0.0192	ND		
Silver	0.0100	ND	ND	ND		
Thallium	0.0100	ND	ND	ND		
Vanadium	0.0100	ND	ND	ND		
Zinc	0.0100	0.0630	0.0198	0.0687		

QUALITY CONTROL REPORT

QC Batch No: 042611-1

Analytes	LCS % REC	LCS/LCSD % Limit								
AA Metals										
Mercury	107	80-120								
ICP Metals										
Antimony	100	80-120								
Arsenic	101	80-120								

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ANALYTICAL RESULTS

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Project ID: 4953-10-1531 G165-66
Project Name: MTA Westside Extension

ASL Job Number	Submitted	Client
49598	04/22/2011	MACTEC

Method: 6010B/7470A, CCR Title 22 Metals (TTLC)

QUALITY CONTROL REPORT

QC Batch No: 042611-1

Analytes	LCS % REC	LCS/LCSD % Limit							
ICP Metals									
Barium	105	80-120							
Beryllium	107	80-120							
Cadmium	104	80-120							
Chromium	103	80-120							
Cobalt	102	80-120							
Copper	104	80-120							
Lead	105	80-120							
Molybdenum	100	80-120							
Nickel	106	80-120							
Selenium	100	80-120							
Silver	100	80-120							
Thallium	104	80-120							
Vanadium	100	80-120							
Zinc	106	80-120							

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Attn: Marty Hudson

Site

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Beverly Hills, CA

Page: 8

Project ID: 4953-10-1531 G165-66
Project Name: MTA Westside Extension

ASL Job Number	Submitted	Client
49598	04/22/2011	MACTEC

Method: 8015B, TPH DROs and OROs (Diesel and Oil Range Organics)

QC Batch No: W-042711-1P

Our Lab I.D.		267815	267816	267817		
Client Sample I.D.		G-166-D	G-166-S	G-165-D		
Date Sampled		04/22/2011	04/22/2011	04/22/2011		
Date Prepared		04/27/2011	04/27/2011	04/27/2011		
Preparation Method						
Date Analyzed		04/27/2011	04/27/2011	04/27/2011		
Matrix		Water	Water	Water		
Units		mg/L	mg/L	mg/L		
Dilution Factor		1	1	1		
Analytes	**PQL**	**Results**	**Results**	**Results**		
TPH DROs (C10 to C28)	0.500	ND	ND	ND		
TPH OROs (C28+)	0.500	ND	ND	ND		

Our Lab I.D.		267815	267816	267817		
Surrogates	**% Rec.Limit**	**% Rec.**	**% Rec.**	**% Rec.**		
Surrogate Percent Recovery						
Chlorobenzene	70-120	116	95	116		

QUALITY CONTROL REPORT

QC Batch No: W-042711-1P

Analytes	MS % REC	MS DUP % REC	RPD %	MS/MSD % Limit	MS RPD % Limit					
Diesel	102	101	<1	75-120	<20					

FIGURE F-11.13

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ANALYTICAL RESULTS

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Attn: Marty Hudson

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Project ID: 4953-10-1531 G165-66
Project Name: MTA Westside Extension

ASL Job Number	Submitted	Client
49598	04/22/2011	MACTEC

Method: 8081A, Organochlorine Pesticides

QC Batch No: 042711-1

Our Lab I.D.		267815	267817			
Client Sample I.D.		G-166-D	G-165-D			
Date Sampled		04/22/2011	04/22/2011			
Date Prepared		04/27/2011	04/27/2011			
Preparation Method						
Date Analyzed		04/27/2011	04/27/2011			
Matrix		Water	Water			
Units		ug/L	ug/L			
Dilution Factor		1	1			
Analytes	**PQL**	**Results**	**Results**			
Aldrin	0.0400	ND	ND			
alpha-Hexachlorocyclohexane (Alpha-BHC)	0.120	ND	ND			
Beta-Hexachlorocyclohexane (Beta-BHC)	0.110	ND	ND			
Gamma-Chlordane	0.400	ND	ND			
alpha-Chlordane	0.400	ND	ND			
4,4'-DDD (DDD)	0.100	ND	ND			
4,4'-DDE (DDE)	0.0900	ND	ND			
4,4'-DDT (DDT)	0.0400	ND	ND			
delta-Hexachlorocyclohexane (Delta-BHC)	0.110	ND	ND			
dieldrin	0.0500	ND	ND			
Endosulfan 1	0.0600	ND	ND			
Endosulfan 11	0.0900	ND	ND			
Endosulfan sulfate	0.0700	ND	ND			
Endrin	0.0800	ND	ND			
Endrin aldehyde	0.0900	ND	ND			
Endrin ketone	0.0700	ND	ND			
gamma-Hexachlorocyclohexane (Gamma-BHC, Lindane)	0.0600	ND	ND			
Heptachlor	0.0300	ND	ND			
Heptachlor epoxide	0.0700	ND	ND			
Methoxychlor	0.100	ND	ND			
Toxaphene	10.0	ND	ND			

Our Lab I.D.		267815	267817			
Surrogates	**% Rec.Limit**	**% Rec.**	**% Rec.**			
Surrogate Percent Recovery						
Decachlorobiphenyl	43-169	63	60			

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ANALYTICAL RESULTS

Project ID: 4953-10-1531 G165-66
Project Name: MTA Westside Extension

ASL Job Number	Submitted	Client
49598	04/22/2011	MACTEC

Method: 8081A, Organochlorine Pesticides

QUALITY CONTROL REPORT

QC Batch No: 042711-1

Analytes	LCS % REC	LCS DUP % REC	LCS RPD % REC	LCS/LCSD % Limit	LCS RPD % Limit					
Aldrin	116	105	10.0	42-122	<30					
4,4'-DDT (DDT)	109	107	1.9	25-160	<30					
dieldrin	119	115	3.4	36-146	<30					
Endrin	115	113	1.8	30-147	<30					
gamma-Hexachlorocyclohexane (Gamma-BHC, Lindane)	106	113	6.4	32-127	<30					
Heptachlor	119	108	9.7	34-111	<30					

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Project ID: 4953-10-1531 G165-66
Project Name: MTA Westside Extension

ASL Job Number	Submitted	Client
49598	04/22/2011	MACTEC

Method: 8082, Polychlorinated Biphenyls(PCBs) by Gas Chromatography

QC Batch No: 042711-1

Our Lab I.D.		267815	267817			
Client Sample I.D.		G-166-D	G-165-D			
Date Sampled		04/22/2011	04/22/2011			
Date Prepared		04/27/2011	04/27/2011			
Preparation Method						
Date Analyzed		04/27/2011	04/27/2011			
Matrix		Water	Water			
Units		ug/L	ug/L			
Dilution Factor		1	1			
Analytes	**PQL**	**Results**	**Results**			
Aroclor-1016 (PCB-1016)	0.650	ND	ND			
Aroclor-1221 (PCB-1221)	1.00	ND	ND			
Aroclor-1232 (PCB-1232)	0.650	ND	ND			
Aroclor-1242 (PCB-1242)	0.650	ND	ND			
Aroclor-1248 (PCB-1248)	0.650	ND	ND			
Aroclor-1254 (PCB-1254)	0.650	ND	ND			
Aroclor-1260 (PCB-1260)	0.650	ND	ND			

Our Lab I.D.		267815	267817			
Surrogates	**% Rec.Limit**	**% Rec.**	**% Rec.**			
Surrogate Percent Recovery						
Decachlorobiphenyl	43-169	63	60			

QUALITY CONTROL REPORT

QC Batch No: 042711-1

Analytes	LCS % REC	LCS DUP % REC	LCS RPD % REC	LCS/LCSD % Limit	LCS RPD % Limit					
Aroclor-1260 (PCB-1260)	106	100	5.8	39-150	<30					

FIGURE F-11.16

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Project ID: 4953-10-1531 G165-66
Project Name: MTA Westside Extension

ASL Job Number	Submitted	Client
49598	04/22/2011	MACTEC

Method: 8260B, Volatile Organic Compounds

QC Batch No: W-042611-2B

Our Lab I.D.		267814	267815	267816	267817	
Client Sample I.D.		G-165-S	G-166-D	G-166-S	G-165-D	
Date Sampled		04/22/2011	04/22/2011	04/22/2011	04/22/2011	
Date Prepared		04/27/2011	04/27/2011	04/27/2011	04/27/2011	
Preparation Method						
Date Analyzed		04/27/2011	04/27/2011	04/27/2011	04/27/2011	
Matrix		Water	Water	Water	Water	
Units		ug/L	ug/L	ug/L	ug/L	
Dilution Factor		1	1	1	1	
Analytes	PQL	Results	Results	Results	Results	
Acetone	5.00	ND	ND	ND	ND	
Benzene	1.00	ND	ND	ND	ND	
Bromobenzene (Phenyl bromide)	1.00	ND	ND	ND	ND	
Bromochloromethane (Chlorobromomethane)	1.00	ND	ND	ND	ND	
Bromodichloromethane (Dichlorobromomethane)	1.00	2.81	ND	1.23	ND	
Bromoform (Tribromomethane)	5.00	ND	ND	ND	ND	
Bromomethane (Methyl bromide)	3.00	ND	ND	ND	ND	
2-Butanone (MEK, Methyl ethyl ketone)	5.00	ND	ND	ND	ND	
n-Butylbenzene	1.00	ND	ND	ND	ND	
sec-Butylbenzene	1.00	ND	ND	ND	ND	
tert-Butylbenzene	1.00	ND	ND	ND	ND	
Carbon disulfide	1.00	ND	ND	ND	ND	
Carbon tetrachloride (Tetrachloromethane)	1.00	ND	ND	ND	ND	
Chlorobenzene	1.00	ND	ND	ND	ND	
Chloroethane	3.00	ND	ND	ND	ND	
2-Chloroethyl vinyl ether	5.00	ND	ND	ND	ND	
Chloroform (Trichloromethane)	1.00	2.87	1.14	1.47	ND	
Chloromethane (Methyl chloride)	3.00	ND	ND	ND	ND	
4-Chlorotoluene (p-Chlorotoluene)	1.00	ND	ND	ND	ND	
2-Chlorotoluene (o-Chlorotoluene)	1.00	ND	ND	ND	ND	
1,2-Dibromo-3-chloropropane (DBCP)	5.00	ND	ND	ND	ND	
Dibromochloromethane	1.00	4.32	ND	2.43	ND	
1,2-Dibromoethane (EDB, Ethylene dibromide)	1.00	ND	ND	ND	ND	
Dibromomethane	1.00	ND	ND	ND	ND	
1,2-Dichlorobenzene (o-Dichlorobenzene)	1.00	ND	ND	ND	ND	
1,3-Dichlorobenzene (m-Dichlorobenzene)	1.00	ND	ND	ND	ND	
1,4-Dichlorobenzene (p-Dichlorobenzene)	1.00	ND	ND	ND	ND	
Dichlorodifluoromethane	3.00	ND	ND	ND	ND	
1,1-Dichloroethane	1.00	ND	ND	ND	ND	

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ANALYTICAL RESULTS

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Project ID: 4953-10-1531 G165-66
Project Name: MTA Westside Extension

ASL Job Number	Submitted	Client
49598	04/22/2011	MACTEC

Method: 8260B, Volatile Organic Compounds

QC Batch No: W-042611-2B

Our Lab I.D.		267814	267815	267816	267817	
Client Sample I.D.		G-165-S	G-166-D	G-166-S	G-165-D	
Date Sampled		04/22/2011	04/22/2011	04/22/2011	04/22/2011	
Date Prepared		04/27/2011	04/27/2011	04/27/2011	04/27/2011	
Preparation Method						
Date Analyzed		04/27/2011	04/27/2011	04/27/2011	04/27/2011	
Matrix		Water	Water	Water	Water	
Units		ug/L	ug/L	ug/L	ug/L	
Dilution Factor		1	1	1	1	
Analytes	PQL	Results	Results	Results	Results	
1,2-Dichloroethane	1.00	ND	ND	ND	ND	
1,1-Dichloroethene (1,1-Dichloroethylene)	1.00	ND	ND	ND	ND	
cis-1,2-Dichloroethene	1.00	ND	ND	ND	ND	
trans-1,2-Dichloroethene	1.00	ND	ND	ND	ND	
1,2-Dichloropropane	1.00	ND	ND	ND	ND	
1,3-Dichloropropane	1.00	ND	ND	ND	ND	
2,2-Dichloropropane	1.00	ND	ND	ND	ND	
1,1-Dichloropropene	1.00	ND	ND	ND	ND	
cis-1,3-Dichloropropene	1.00	ND	ND	ND	ND	
trans-1,3-Dichloropropene	1.00	ND	ND	ND	ND	
Ethylbenzene	1.00	ND	ND	ND	ND	
Hexachlorobutadiene (1,3-Hexachlorobutadiene)	3.00	ND	ND	ND	ND	
2-Hexanone	5.00	ND	ND	ND	ND	
Isopropylbenzene	1.00	ND	ND	ND	ND	
p-Isopropyltoluene (4-Isopropyltoluene)	1.00	ND	ND	ND	ND	
MTBE	2.00	ND	ND	ND	ND	
4-Methyl-2-pentanone (MIBK, Methyl isobutyl ketone)	5.00	ND	ND	ND	ND	
Methylene chloride (Dichloromethane, DCM)	5.00	ND	ND	ND	ND	
Naphthalene	1.00	ND	ND	ND	ND	
n-Propylbenzene	1.00	ND	ND	ND	ND	
Styrene	1.00	ND	ND	ND	ND	
1,1,1,2-Tetrachloroethane	1.00	ND	ND	ND	ND	
1,1,2,2-Tetrachloroethane	1.00	ND	ND	ND	ND	
Tetrachloroethene (Tetrachloroethylene)	1.00	ND	ND	ND	ND	
Toluene (Methyl benzene)	1.00	ND	ND	ND	ND	
1,2,3-Trichlorobenzene	1.00	ND	ND	ND	ND	
1,2,4-Trichlorobenzene	1.00	ND	ND	ND	ND	
1,1,1-Trichloroethane	1.00	ND	ND	ND	ND	
1,1,2-Trichloroethane	1.00	ND	ND	ND	ND	
Trichloroethene (TCE)	1.00	ND	ND	ND	ND	
Trichlorofluoromethane	1.00	ND	ND	ND	ND	
1,2,3-Trichloropropane	1.00	ND	ND	ND	ND	
1,2,4-Trimethylbenzene	1.00	ND	ND	ND	ND	
1,3,5-Trimethylbenzene	1.00	ND	ND	ND	ND	
Vinyl acetate	5.00	ND	ND	ND	ND	

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ANALYTICAL RESULTS

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Project ID: 4953-10-1531 G165-66

Project Name: MTA Westside Extension

ASL Job Number	Submitted	Client
49598	04/22/2011	MACTEC

Method: 8260B, Volatile Organic Compounds

QC Batch No: W-042611-2B

Our Lab I.D.		267814	267815	267816	267817	
Client Sample I.D.		G-165-S	G-166-D	G-166-S	G-165-D	
Date Sampled		04/22/2011	04/22/2011	04/22/2011	04/22/2011	
Date Prepared		04/27/2011	04/27/2011	04/27/2011	04/27/2011	
Preparation Method						
Date Analyzed		04/27/2011	04/27/2011	04/27/2011	04/27/2011	
Matrix		Water	Water	Water	Water	
Units		ug/L	ug/L	ug/L	ug/L	
Dilution Factor		1	1	1	1	
Analytes	PQL	Results	Results	Results	Results	
Vinyl chloride (Chloroethene)	3.00	ND	ND	ND	ND	
o-Xylene	1.00	ND	ND	ND	ND	
m- & p-Xylenes	2.00	ND	ND	ND	ND	

Our Lab I.D.		267814	267815	267816	267817	
Surrogates	% Rec.Limit	% Rec.	% Rec.	% Rec.	% Rec.	
Surrogate Percent Recovery						
Bromofluorobenzene	70-120	100	101	100	101	
Dibromofluoromethane	70-120	86	89	88	90	
Toluene-d8	70-120	96	97	96	98	

QUALITY CONTROL REPORT

QC Batch No: W-042611-2B

Analytes	MS % REC	MS DUP % REC	RPD %	MS/MSD % Limit	MS RPD % Limit					
Benzene	91	85	6.8	75-120	15					
Chlorobenzene	111	105	5.6	75-120	15					
1,1-Dichloroethene (1,1-Dichloroethylene)	80	76	5.1	75-120	15					
MTBE	102	103	<1	75-120	15					
Toluene (Methyl benzene)	109	103	5.7	75-120	15					
Trichloroethene (TCE)	98	91	7.4	75-120	15					

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ANALYTICAL RESULTS

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Project ID: 4953-10-1531 G165-66
Project Name: MTA Westside Extension

ASL Job Number	Submitted	Client
49598	04/22/2011	MACTEC

Method: 8260B, TPH GROs(Gasoline Range Organics)

QC Batch No: W-042611-2B

Our Lab I.D.		267814	267815	267816	267817	
Client Sample I.D.		G-165-S	G-166-D	G-166-S	G-165-D	
Date Sampled		04/22/2011	04/22/2011	04/22/2011	04/22/2011	
Date Prepared		04/27/2011	04/27/2011	04/27/2011	04/27/2011	
Preparation Method						
Date Analyzed		04/27/2011	04/27/2011	04/27/2011	04/27/2011	
Matrix		Water	Water	Water	Water	
Units		ug/L	ug/L	ug/L	ug/L	
Dilution Factor		1	1	1	1	
Analytes	**PQL**	**Results**	**Results**	**Results**	**Results**	
TPH GROs (C6 to C10)	50.0	ND	ND	ND	ND	

Our Lab I.D.		267814	267815	267816	267817	
Surrogates	% Rec.Limit	% Rec.	% Rec.	% Rec.	% Rec.	
Surrogate Percent Recovery						
Bromofluorobenzene	70-120	100	101	100	101	
Dibromofluoromethane	70-120	86	89	88	90	
Toluene-d8	70-120	96	97	96	98	

QUALITY CONTROL REPORT

QC Batch No: W-042611-2B

Analytes	MS % REC	MS DUP % REC	RPD %	MS/MSD % Limit	MS RPD % Limit					
Benzene	91	85	6.8	75-120	15					
Chlorobenzene	111	105	5.6	75-120	15					
1,1-Dichloroethene (1,1-Dichloroethylene)	80	76	5.1	75-120	15					
Toluene (Methyl benzene)	109	103	5.7	75-120	15					
Trichloroethene (TCE)	98	91	7.4	75-120	15					

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Project ID: 4953-10-1531 G165-66
Project Name: MTA Westside Extension

ASL Job Number	Submitted	Client
49598	04/22/2011	MACTEC

Method: 8270C, Semivolatile Organics

QC Batch No: 042711-1

Our Lab I.D.		267815	267816	267817		
Client Sample I.D.		G-166-D	G-166-S	G-165-D		
Date Sampled		04/22/2011	04/22/2011	04/22/2011		
Date Prepared		04/27/2011	04/27/2011	04/27/2011		
Preparation Method						
Date Analyzed		04/27/2011	04/27/2011	04/27/2011		
Matrix		Water	Water	Water		
Units		ug/L	ug/L	ug/L		
Dilution Factor		1	1	1		
Analytes	**PQL**	**Results**	**Results**	**Results**		
Acenaphthene	10.0	ND	ND	ND		
Acenaphthylene	10.0	ND	ND	ND		
Anthracene	10.0	ND	ND	ND		
Benz(a)anthracene (Benzo(a)anthracene)	10.0	ND	ND	ND		
Benzo(a)pyrene	10.0	ND	ND	ND		
Benzo(b)fluoranthene	10.0	ND	ND	ND		
Benzo(ghi)perylene	10.0	ND	ND	ND		
Benzo(k)fluoranthene	10.0	ND	ND	ND		
Benzidine	20.0	ND	ND	ND		
Benzoic acid	10.0	ND	ND	ND		
Benzyl alcohol	10.0	ND	ND	ND		
Bis(2-chloroethoxy)methane	10.0	ND	ND	ND		
Bis(2-chloroethyl)ether	10.0	ND	ND	ND		
Bis(2-chloroisopropyl) ether	10.0	ND	ND	ND		
Bis(2-ethylhexyl) phthalate	10.0	ND	ND	ND		
4-Bromophenyl phenyl ether	10.0	ND	ND	ND		
Butyl benzyl phthalate (Benzyl butyl phthalate)	10.0	ND	ND	ND		
4-Chloro-3-methylphenol (p-Chloro-m-cresol)	1.00	ND	ND	ND		
4-Chloroaniline	10.0	ND	ND	ND		
2-Chloronaphthalene	10.0	ND	ND	ND		
2-Chlorophenol (o-Chlorophenol)	1.00	ND	ND	ND		
4-Chlorophenyl phenyl ether	10.0	ND	ND	ND		
Chrysene	10.0	ND	ND	ND		
Di-n-butyl phthalate	10.0	ND	ND	ND		
Di-n-octyl phthalate (Dioctyl ester)	10.0	ND	ND	ND		
Dibenz(a,h)anthracene	10.0	ND	ND	ND		
Dibenzofuran	10.0	ND	ND	ND		
1,3-Dichlorobenzene (m-Dichlorobenzene)	10.0	ND	ND	ND		
1,2-Dichlorobenzene (o-Dichlorobenzene)	10.0	ND	ND	ND		

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ANALYTICAL RESULTS

Project ID: 4953-10-1531 G165-66
Project Name: MTA Westside Extension

ASL Job Number	Submitted	Client
49598	04/22/2011	MACTEC

Method: 8270C, Semivolatile Organics

QC Batch No: 042711-1

Our Lab I.D.		267815	267816	267817		
Client Sample I.D.		G-166-D	G-166-S	G-165-D		
Date Sampled		04/22/2011	04/22/2011	04/22/2011		
Date Prepared		04/27/2011	04/27/2011	04/27/2011		
Preparation Method						
Date Analyzed		04/27/2011	04/27/2011	04/27/2011		
Matrix		Water	Water	Water		
Units		ug/L	ug/L	ug/L		
Dilution Factor		1	1	1		
Analytes	**PQL**	**Results**	**Results**	**Results**		
1,4-Dichlorobenzene	10.0	ND	ND	ND		
3,3'-Dichlorobenzidine	20.0	ND	ND	ND		
2,4-Dichlorophenol	1.00	ND	ND	ND		
Diethyl phthalate (Diethyl ester)	10.0	ND	ND	ND		
2,4-Dimethylphenol	1.00	ND	ND	ND		
Dimethyl phthalate (Dimethyl ester)	10.0	ND	ND	ND		
2,4-Dinitrophenol	1.00	ND	ND	ND		
2,4-Dinitrotoluene	10.0	ND	ND	ND		
2,6-Dinitrotoluene (2,6-DNT)	10.0	ND	ND	ND		
1,2-Diphenylhydrazine	10.0	ND	ND	ND		
Fluoranthene	10.0	ND	ND	ND		
Fluorene	10.0	ND	ND	ND		
Hexachlorobenzene	10.0	ND	ND	ND		
Hexachlorobutadiene (1,3-Hexachlorobutadiene)	20.0	ND	ND	ND		
Hexachlorocyclopentadiene	10.0	ND	ND	ND		
Hexachloroethane	10.0	ND	ND	ND		
Indeno(1,2,3-cd)pyrene	10.0	ND	ND	ND		
Isophorone	10.0	ND	ND	ND		
2-methyl-4,6-Dinitrophenol	1.00	ND	ND	ND		
2-Methylnaphthalene	10.0	ND	ND	ND		
2-Methylphenol (o-Cresol, 2-Cresol)	1.00	ND	ND	ND		
4-Methylphenol (p-Cresol, 4-Cresol)	1.00	ND	ND	ND		
N-Nitroso-Di-n-propylamine	10.0	ND	ND	ND		
N-Nitrosodimethylamine (NDMA)	10.0	ND	ND	ND		
N-Nitrosodiphenylamine	10.0	ND	ND	ND		
Naphthalene	10.0	ND	ND	ND		
2-Nitroaniline	10.0	ND	ND	ND		
3-Nitroaniline	10.0	ND	ND	ND		
4-Nitroaniline	10.0	ND	ND	ND		
Nitrobenzene (NB)	10.0	ND	ND	ND		
2-Nitrophenol (o-Nitrophenol)	1.00	ND	ND	ND		
4-Nitrophenol	1.00	ND	ND	ND		
Pentachlorophenol	1.00	ND	ND	ND		
Phenanthrene	10.0	ND	ND	ND		
Phenol	1.00	ND	ND	ND		

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ANALYTICAL RESULTS

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Project ID: 4953-10-1531 G165-66
Project Name: MTA Westside Extension

ASL Job Number	Submitted	Client
49598	04/22/2011	MACTEC

Method: 8270C, Semivolatile Organics

QC Batch No: 042711-1

Our Lab I.D.		267815	267816	267817		
Client Sample I.D.		G-166-D	G-166-S	G-165-D		
Date Sampled		04/22/2011	04/22/2011	04/22/2011		
Date Prepared		04/27/2011	04/27/2011	04/27/2011		
Preparation Method						
Date Analyzed		04/27/2011	04/27/2011	04/27/2011		
Matrix		Water	Water	Water		
Units		ug/L	ug/L	ug/L		
Dilution Factor		1	1	1		
Analytes	**PQL**	**Results**	**Results**	**Results**		
Pyrene	10.0	ND	ND	ND		
1,2,4-Trichlorobenzene	10.0	ND	ND	ND		
2,4,5-Trichlorophenol	1.00	ND	ND	ND		
2,4,6-Trichlorophenol	1.00	ND	ND	ND		

Our Lab I.D.		267815	267816	267817		
Surrogates	**% Rec.Limit**	**% Rec.**	**% Rec.**	**% Rec.**		
Surrogate Percent Recovery						
2-Fluorophenol	21-105	27	35	29		
Phenol-d6	10-107	29	34	29		
2,4,6-Tribromophenol	10-123	69	77	59		
Nitrobenzene-d5	35-114	64	55	53		
2-Fluorobiphenyl	18-116	52	54	52		
Terphenyl-d14	33-141	93	102	99		

QUALITY CONTROL REPORT

QC Batch No: 042711-1

Analytes	LCS % REC	LCS DUP % REC	LCS RPD % REC	LCS/LCSD % Limit	LCS RPD % Limit					
Acenaphthene	64	68	6.1	43-118	<30					
4-Chloro-3-methylphenol (p-Chloro-m-cresol)	65	64	1.6	23-117	<30					
2-Chlorophenol (o-Chlorophenol)	49	54	9.7	27-113	<30					
1,4-Dichlorobenzene	50	55	9.5	36-105	<30					
2,4-Dinitrotoluene	102	102	<1	24-120	<30					
N-Nitroso-Di-n-propylamine	75	81	7.7	41-116	<30					
4-Nitrophenol	63	56	11.8	10-133	<30					
Pentachlorophenol	64	65	1.6	9-118	<30					
Phenol	35	40	13.3	12-110	<30					
Pyrene	115	113	1.8	26-127	<30					
1,2,4-Trichlorobenzene	64	71	10.4	39-98	<30					

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ANALYTICAL RESULTS

Ordered By

MACTEC Engineering & Consulting Inc
5628 East Slauson Ave.
Los Angeles, CA 90040-

Site

241 Moreno Drive
Beverly Hills, CA

Telephone: (323)889-5300
Attn: Marty Hudson

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Project ID: 4953-10-1531 G165-66
Project Name: MTA Westside Extension

ASL Job Number	Submitted	Client
49598	04/22/2011	MACTEC

Method: RSKSOP-175, Dissolved Gases

QC Batch No: 042911-1

Our Lab I.D.		267814	267815	267816	267817	
Client Sample I.D.		G-165-S	G-166-D	G-166-S	G-165-D	
Date Sampled		04/22/2011	04/22/2011	04/22/2011	04/22/2011	
Date Prepared		04/29/2011	04/29/2011	04/29/2011	04/29/2011	
Preparation Method						
Date Analyzed		04/29/2011	04/29/2011	04/29/2011	04/29/2011	
Matrix		Water	Water	Water	Water	
Units		ug/L	ug/L	ug/L	ug/L	
Dilution Factor		1	1	1	1	
Analytes	**PQL**	**Results**	**Results**	**Results**	**Results**	
Methane	1.00	ND	2.50	4.92	5.91	

QUALITY CONTROL REPORT

QC Batch No: 042911-1

Analytes	LCS % REC	LCS DUP % REC	LCS RPD % REC	LCS/LCSD % Limit	LCS RPD % Limit					
Methane	90	93	3.3	70-130	<30					

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Project ID: 4953-10-1531 G165-66
Project Name: MTA Westside Extension

ASL Job Number	Submitted	Client
49598	04/22/2011	MACTEC

Method: SM2540-D, Total Suspended Solids (TSS)

QC Batch No: 042711-1

Our Lab I.D.		267815	267816	267817		
Client Sample I.D.		G-166-D	G-166-S	G-165-D		
Date Sampled		04/22/2011	04/22/2011	04/22/2011		
Date Prepared		04/27/2011	04/27/2011	04/27/2011		
Preparation Method						
Date Analyzed		04/27/2011	04/27/2011	04/27/2011		
Matrix		Water	Water	Water		
Units		mg/L	mg/L	mg/L		
Dilution Factor		1	1	1		
Analytes	**PQL**	**Results**	**Results**	**Results**		
Conventionals						
Solids, Total Suspended (TSS)	10.0	163000	164000	7970		

QUALITY CONTROL REPORT

QC Batch No: 042711-1

Analytes	LCS % REC	LCS DUP % REC	LCS RPD % REC	LCS/LCSD % Limit	LCS RPD % Limit					
Conventionals										
Solids, Total Suspended (TSS)	104	101	2.9	80-120	20					

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ANALYTICAL RESULTS

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Attn: Marty Hudson

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Project ID: 4953-10-1531 G165-66
Project Name: MTA Westside Extension

ASL Job Number	Submitted	Client
49598	04/22/2011	MACTEC

Method: SM4500-S-2-D, Sulfide (Methylene Blue Method)

QC Batch No: 042211-1

Our Lab I.D.		267815	267816	267817		
Client Sample I.D.		G-166-D	G-166-S	G-165-D		
Date Sampled		04/22/2011	04/22/2011	04/22/2011		
Date Prepared		04/22/2011	04/22/2011	04/22/2011		
Preparation Method						
Date Analyzed		04/22/2011	04/22/2011	04/22/2011		
Matrix		Water	Water	Water		
Units		mg/L	mg/L	mg/L		
Dilution Factor		1	1	1		
Analytes	**PQL**	**Results**	**Results**	**Results**		
Conventionals						
Sulfide, total	0.0200	ND	ND	ND		

QUALITY CONTROL REPORT

QC Batch No: 042211-1

Analytes	SM Result	SM DUP Result	RPD %	SM RPD % Limit						
Conventionals										
Sulfide, total	ND	ND	<1	20						

FIGURE F-11.26

3. OIL WELL GEOPHYSICAL INVESTIGATION

REPORT
GEOPHYSICAL INVESTIGATION

Geophysical Survey for the MTA Westside Extension Beverly Hills, California

GEO*Vision* Project No. 11065

Prepared for:

MACTEC Engineering and Consulting, Inc.
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Report 11065-001

April 8, 2011

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1 INTRODUCTION

A geophysical investigation was conducted on February 27th, March 5th and March 19th, 2011, for MACTEC Engineering and Consulting, Inc. in Beverly Hills, California. The purpose of the investigation was to locate any existing abandoned oil wells in the alignment right of way of the MTA Westside Extension at three locations at Beverly Hills High School: the tennis courts and front lawn, the football field and the lacrosse field (Figure 1).

The portions of Beverly Hills High School surveyed during this investigation consisted of: natural and artificial grass fields, reinforced concrete tennis courts, an asphalt road and a reinforced concrete sidewalk (Figure 1).

The geophysical techniques used during this investigation were the magnetic method and the electromagnetic (EM) method. These methods complement one another as each responds to different physical properties and has different strengths and limitations. The magnetic method is the most commonly used geophysical technique for locating abandoned oil wells because the magnetic anomalies associated with oil wells have very high amplitudes, large spatial dimensions and a different signature from many other types of buried metallic objects. The electromagnetic (EM) method was used to scan selected areas for metallic pipes and to further characterize anomalies found in the magnetic data.

The geophysical techniques used during the investigation are discussed in Section 2. Field procedures are described in Section 3. Data processing and interpretation are discussed in Section 4. The results of the geophysical survey are presented in Section 5 and our professional certification is presented in Section 6.

2 GEOPHYSICAL TECHNIQUES

This section presents background information on the magnetic and electromagnetic methods used during this investigation. A description of the geophysical methods used during this investigation, common applications of the method, photographs of the instruments and example applications are included in Appendix A.

2.1 Magnetic Method

The magnetometer used during this investigation consisted of a Geometrics G-858 optically pumped cesium-vapor magnetometer (G-858). This instrument measures the intensity of the earth's magnetic field in nanoteslas (nT) and, optionally, the vertical gradient of the earth's magnetic field in nanoteslas per meter (nT/m). The vertical magnetic gradient is calculated by measuring the total magnetic field with two sensors at different heights, subtracting the top sensor reading from the bottom sensor reading and dividing by the sensor separation. The vertical magnetic gradient has better lateral resolution than total magnetic field measurements and is less sensitive to deep (e.g. geologic) structure.

The earth's magnetic field is believed to originate in convection currents in the earth's liquid outer core. The magnetic field varies in intensity from about 25,000 nT at the equator, where it is parallel to the earth's surface, to about 70,000 nT at the poles where it is perpendicular to the earth's surface. The intensity of the earth's magnetic field in North America varies from about 48,000 to 60,000 nT, and has an associated inclination that varies from about 60 to 75 degrees.

The earth's magnetic field undergoes low-frequency diurnal variations (drift) caused by the earth's rotation. The magnetic field can also undergo short-period, high-amplitude variations during periods of sunspot activity called magnetic storms. Often magnetic field intensity can be so variable during a magnetic storm that meaningful magnetic data cannot be acquired. When necessary to correct for magnetic drift, a base station magnetometer is set up in a quiet portion of the site and programmed to record total magnetic field intensity at fixed increments (i.e. 5-second intervals) throughout the day. This base station data is then used to remove the effects of drift from the field data. In small survey areas, where the data is acquired over a small amount of time and the anomalies have large amplitudes, correction for magnetic drift is not necessary.

Buried ferromagnetic objects give rise to local perturbations (anomalies) in the earth's magnetic field. There are two types of magnetic anomalies: an anomaly induced in an object or rock by the earth's magnetic field (induced magnetic anomaly) and an anomaly associated with remnant or permanent magnetism. In North America, the induced magnetic anomaly associated with an oil well consists of a very high amplitude, positive magnetic anomaly with the maximum response (peak) about 1- foot, or more, south of the well. In very rare cases, the conductor casing or oil well casing may have a permanent magnetism in the opposite direction of the earth's magnetic field, which, therefore subtracts from the induced magnetic field. If the permanent magnetic field associated with the well casing is stronger than the induced magnetic field then a negative magnetic anomaly may result. These cases have been observed and documented on very few sites previously by **GEO***Vision* and such wells can be difficult to detect, especially in the presence of other subsurface infrastructure, due to the atypical nature of the magnetic response. Other buried ferrous metallic objects; such as pipes, drums, tanks and debris, generally give rise to dipolar anomalies with a positive response south of the object and a negative response north of the object. The dimensions and amplitude of a magnetic anomaly are a function of the size, mass, depth and magnetic properties of the source. The magnetic anomaly over a buried oil well often has a diameter of over 50 feet and amplitude of several thousand nanoteslas above background, depending on depth and casing characteristics. A magnetometer can typically locate an abandoned oil well to a depth of over 20 feet providing background noise levels are not too high and the well casing is not significantly corroded. Magnetometers are not able to detect nonferrous metals such as aluminum or brass.

Typical applications of the magnetic method include:

- Locating pits and trenches containing ferrous metallic debris
- Locating buried drums, tanks and pipes
- Delineating boundaries of landfills containing ferrous debris
- Locating abandoned steel well casing
- Detecting unexploded ordnance
- Mapping basement faults and geology
- Mapping archeological sites

Some advantages of magnetic surveys are:

- Rapid – modern instruments can acquire up to 10 readings per second as the operator walks down survey lines
- Depth of investigation – magnetometers can often locate buried ferrous metallic objects to greater depths than other methods
- Anomalies are much larger than the source allowing for larger line spacing in some situations

Some limitations of the magnetic surveys are:

- Unable to detect non-ferrous metals such as aluminum or brass
- Magnetic anomalies may be asymmetrical and much larger than the source and it can, therefore, be difficult to determine the precise locations and size of the source
- Ineffective in areas having extensive metallic debris at the surface, as no distinction can be made between anomalies caused by surface and buried debris
- Metallic structures such as buildings, fences, reinforced concrete and light posts interfere with the measurements
- High voltage power lines can often strongly interfere with the measurements
- Data can be very noisy in areas containing volcanic rock, specifically basalt

2.2 Electromagnetic Method

EM equipment used during this investigation consisted of a Geonics EM-61 Mk2A high-resolution digital metal detector (EM-61). The EM-61 has a single transmitter and two receiver coils. The bottom coil is the transmitter during the current on-time and receiver during current off-time. The top coil, mounted 40-cm above the bottom coil, is a receiver coil only. The transmitter and receiver electronics controls are mounted on a backpack or on the instrument handle. A hand-held data logger is used to store field measurements. During operation, a half-duty cycle waveform is applied to the transmitter coil. During the off-time, the receiver coils measure the decay of eddy currents, in millivolts (mV), produced in subsurface metallic objects by the pulsed primary EM field. The top coil is gained in such a manner that the instrument response to a metallic object lying on the ground surface will be approximately equal at both the top and bottom coils. The effects of surface debris can, therefore, be suppressed by calculating the differential response (subtraction of the bottom coil from top coil response). Positive EM-61 anomalies centered over the source are typically observed over buried metallic objects. Above ground metallic objects will often give rise to a negative differential response, as the top coil response is larger than the bottom coil response.

3 FIELD PROCEDURES

This section describes the field procedures used during the investigation, including site preparation and the magnetometer and EM-61 Mk2A survey procedures.

3.1 Site Preparation

Before conducting the geophysical investigation, the suspected well locations in each area were marked by a representative from MACTEC Engineering and Consulting, Inc. Each area was then visually inspected for anything that may interfere with the survey and, if possible, it was removed from the survey area. The magnetometer and the EM-61 were used in conjunction with a Trimble ProXRS GPS system with OmniSTAR real-time, submeter corrections as discussed below. GPS data were collected in the geodetic coordinate system and then converted to California State Plane 1983, NAD83, Zone V (0405) in US Survey Feet during data processing. Data were not collected in areas where there were surface obstructions or other limiting features, or where the GPS did not have sufficient satellite coverage. Obvious surface cultural features that could potentially affect the geophysical data (e.g. metal fences, goalposts and other surface metallic objects) were identified in the field and their positions recorded using the submeter GPS system. Color contour maps showing surface metallic objects and the geophysical anomalies are presented as Figures 2 through 6.

3.2 Geometrics G-858 Survey

Prior to data acquisition, the G-858 was programmed with the appropriate sampling interval and GPS input settings. Measurements of the earth's total magnetic field and vertical magnetic gradient were made in accessible areas at 0.2-second intervals as the operator walked along approximately south to north (S-N) survey lines nominally spaced 5 feet apart. A Trimble ProXRS GPS system with OmniSTAR differential corrections was used for spatial control. Real-time submeter corrections were input every second into the data collector of the magnetometer using a serial cable and a GGA NMEA stream GPS output. The magnetic data were stored in the internal memory of the magnetometer, along with GPS statistics and location data. If a location error was made on a survey line (large data gap, etc.) the line was repeated to attain desired coverage. Magnetic data were downloaded to a laptop computer at the end of the survey using the program MAGMAP 2000 by Geometrics, Inc.

3.3 Geonics EM-61 Mk2A Survey

The EM-61 was assembled and battery levels were checked and found to be within acceptable levels. The EM-61 digital data logger was then programmed with the appropriate file name and sample rate (10 readings/sec). EM-61 measurements were made in accessible areas, along approximately S-N survey lines nominally spaced 5 feet apart for each area where deemed necessary. EM-61 measurements were not collected in areas containing reinforced concrete (e.g. the tennis courts and the small area southeast of the lacrosse field) due to the interference of surface metal. EM-61 data were also not collected in the front lawn area, as the magnetic data indicated no significant subsurface anomalies warranting further investigation. A Trimble ProXRS GPS system with OmniSTAR differential corrections was used for spatial control. Real-time submeter corrections were input every second into the data collector of the EM-61 using a serial cable and a GGA NMEA stream GPS output. The EM-61 data were stored in a digital data logger, along with GPS statistics and location data. If a location error was made on a survey line (large data gap, etc.) the line was repeated to attain desired coverage. EM-61 data were downloaded to a laptop computer at the end of the survey using the computer program Trackmaker61 by Geomar Software, Inc. The EM-61 is a wheel mounted system and data coverage was limited to areas where the instrument was able to be pushed, where there was no metal reinforcement and where there was sufficient GPS satellite coverage.

4 DATA PROCESSING AND INTERPRETATION

This section presents the data processing procedures and interpretation of the geophysical data.

4.1 Data Processing

Color-enhanced contour maps of the magnetic data were generated using the GEOSOFT® Oasis montaj ™ geophysical mapping system. The maps were color-enhanced to aid in the interpretation of subtle anomalies. Prior to map generation, a number of preprocessing steps were completed and included:

- Backup of all original field data files to computer.
- Correcting of all data acquisition errors (typically removing null data and erroneous GPS points).
- Reformatting field data files to free format XYZ files containing at a minimum GPS time and field measurements.
- Merging GPS position data and geophysical data using commercial and in-house software.
- Merging of multiple data files into a single file and sorting, if necessary.
- Converting of data files to State Plane northings and eastings.

These data adjustments were made using a combination of commercial and in-house software. All adjustments made to data files and resulting file names were documented and are retained in project files. The outputs of the data preprocessing were data files containing the various data measurements. The magnetic data file contained total field and vertical gradient response.

Data processing steps included the following:

- Reformatting of data files to GEOSOFT® format.
- Generating final map scale.
- Gridding data using down- and cross-line splines or minimum curvature.
- Masking grid in areas where data not acquired (i.e. around site perimeter or building).
- Applying Hanning filter to smooth the data, as necessary.
- Generating color zone file describing color for different data ranges.
- Contouring the data.
- Generating map surrounds (title block, legend, scale, color bar, north arrow, etc.).
- Annotating anomalies.
- Merging various plot files and plotting final map.

The names of the files generated and the processing parameters used were documented and are retained in project files. All files generated during the processing sequence were archived on a backup drive.

4.2 Interpretation

Color-enhanced contour maps of the magnetic total field response generated for each area (the tennis courts and front lawn area, the football field and the lacrosse field) are presented as Figures 2, 3 and 5, respectively. For the football and lacrosse field areas, color-enhanced contour maps of the EM-61 Mk2A Channel 3 response are presented as Figures 4 and 6, respectively. The coordinates shown on all figures reference the California State Plane 1983, NAD83, Zone V (0405) coordinate system, in US Survey Feet. The color bar indicates the amplitude of the measured quantity with the magenta and cyan colors representing high and low amplitudes, respectively. The light orange, yellow and light green colors indicate average "background" values of the measured quantity.

An example magnetic anomaly from an oil well is presented in Appendix A. The typical magnetic anomaly characteristics of an oil well are: a monopolar response (large positive peak with only a minor negative response to the north); a large diameter anomaly (50 to 100 ft typical) and a large amplitude for shallow wells. However, in very rare cases, a monopolar, magnetic low have been observed for an oil well response. In these cases, the permanent magnetic field of the oil well casing is stronger than the induced magnetic field and a magnetic low is observed.

4.2.1 Tennis Courts and Front Lawn

The color-enhanced contour map of the total magnetic field response is presented as Figure 2. No abandoned oil well anomalies are interpreted in the magnetic data. The top portion of the site consists of a grass lawn with sidewalks and some surface metal, such as signage, posts or rails. The tennis courts in the lower portion of the area consist of reinforced concrete bounded by metallic chain link fencing on all sides. All magnetic anomalies are accounted for by surface metallic objects at this location.

4.2.2 Football Field – "Rodeo" 114

The color-enhanced contour map of the total magnetic field response is presented as Figure 3. The color-enhanced contour map of the EM-61 Mk2A Channel 3 response is presented as Figure 4. No abandoned oil well anomalies are interpreted in the magnetic data. Several linear anomalies were interpreted in both the total magnetic field response and EM-61 Channel 3 response and are marked with a "P" on both figures. These anomalies bear responses that are indicative of buried metallic pipes or utilities. There are also several small monopolar anomalies in the total magnetic field response that correlate with small amplitude anomalies in the EM-61 Channel 3 response. These anomalies are indicative of small buried metallic objects and are marked with a "B" on the figures.

4.2.3 Lacrosse Field – "Wolfskill" 23 and "Rodeo" 107

The color-enhanced contour maps of the total magnetic field response and the EM-61 Mk2A Channel 3 response are presented as Figures 5 and 6, respectively. Several linear anomalies were interpreted in both the total magnetic field response and EM-61 Channel 3 response and are marked with a "P" on both figures. These anomalies bear responses that are indicative of buried metallic pipes, utilities or previous building footings. There are also several small dipolar anomalies in the total magnetic field response that correlate with small amplitude anomalies in the EM-61 Channel 3 data. These anomalies are indicative of small buried metallic objects, marked with a "B" on the figures.

Four large magnetic anomalies are present in the total magnetic field data, and are labeled as anomalies A-1 through A-4 (Figure 5). Anomalies A-1 through A-3 are located on or near the grass lacrosse field, which is surrounded by a metallic chain link fence to the north, south and east and a block retaining wall to the west, south and east. Anomaly A-4 is located southeast of the lacrosse field, in a small area adjacent to an asphalt road with utility vaults, chain link fencing, reinforced concrete, a building and a retaining wall.

The western most anomaly, A-1, located at 6,436,652E, 1,844,819N, presents with a strong dipolar magnetic response (a low of 45,300 nT and a high of 49,000 nT) and a strong EM-61 response (4,200 mV). This anomaly may be related to a pipe segment or previous building infrastructure. However, it cannot be fully discounted that this anomaly is related to an abandoned oil well or its infrastructure.

The southwestern most anomaly, A-2, located at 6,436,780E, 1,844,724N, also presents as a strong, dipolar magnetic response (a low of 45,550 nT and a high of 49,650 nT), but as a weaker EM-61 response (196 mV). This may indicate that the source of this anomaly is deeper than the source of anomaly A-1. This anomaly may be related to a pipe segment or previous building infrastructure. However, it cannot be fully discounted that this anomaly is related to an abandoned oil well or its infrastructure.

The northeastern most anomaly, A-3, located at 6,436,897E, 1,844,758N, presents as a broad positive magnetic response (greater than 48,000 nT), but is not evident in the EM-61 data. However, it cannot be fully discounted that this anomaly is related to a steel-cased abandoned oil well due to the large magnetic response. It is estimated that the source of this anomaly is east of the fencing and retaining wall surrounding the lacrosse field. An additional survey would be needed to further characterize this anomaly. Due to the proximity of the anomaly to surface metallic features (e.g. metal fencing, retaining walls and reinforced concrete), there is no guarantee that results from a further investigation would be conclusive.

The southeastern most anomaly, A-4, located at 6,437,017E, 1,844,638N on asphalt, presents with a strong positive magnetic response (greater than 52,000 nT). The suspected location of abandoned oil well "Rodeo" 107 was surveyed and marked on the ground near the retaining wall in this area. The source of this anomaly is located outside of the survey boundary in an area that could not be surveyed due to poor satellite coverage. However, due to the intensity of the magnetic response, it cannot be fully discounted that this anomaly is related to a steel-cased abandoned oil well. An additional gridded survey would need to be conducted on the asphalt road to further characterize this anomaly.

5 CONCLUSIONS

A geophysical survey was conducted at Beverly Hills High School in Beverly Hills, California. The purpose of the survey was to screen three areas: the tennis courts and front lawn, the football field and the lacrosse field, for multiple suspected abandoned, steel-cased oil wells in the alignment right of way of the MTA Westside Extension.

In the area consisting of the tennis courts and the front lawn, there was no indication of any abandoned oil wells in the magnetic data. In the area consisting of the football field, where the suspected location of abandoned oil well "Rodeo" 114 was marked, there was no indication of any abandoned oil wells in the magnetic or EM data. Four anomalies were interpreted in the magnetic and EM data, in the area consisting of the lacrosse field and adjacent area where suspected abandoned oil well "Rodeo" 107 was marked. Anomalies A-1 and A-2 may be related to abandoned oil well infrastructure or other buried metallic debris. Anomalies A-3 and A-4 may be related to steel-cased abandoned oil wells. However, further investigation would be needed to fully characterize anomalies A-3 and A-4.

The geophysical survey was designed to map abandoned wells with ferrous metallic pipe in the upper 15 feet. It is our opinion that the geophysical survey was appropriately designed to locate such objects less than about 15 feet deep; except in portions of the survey area where data were affected by surface structures, such as reinforced concrete, utility corridors, obstructing foliage and other large surface metallic objects.

6 CERTIFICATION

All geophysical data, analysis, interpretations, conclusions and recommendations in this document have been prepared under the supervision of and reviewed by a **GEO*Vision*** California Professional Geophysicist.

Prepared by

04/08/11

Emily Feldman | Date
Staff Geophysicist
GEO*Vision* Geophysical Services

Reviewed and approved by

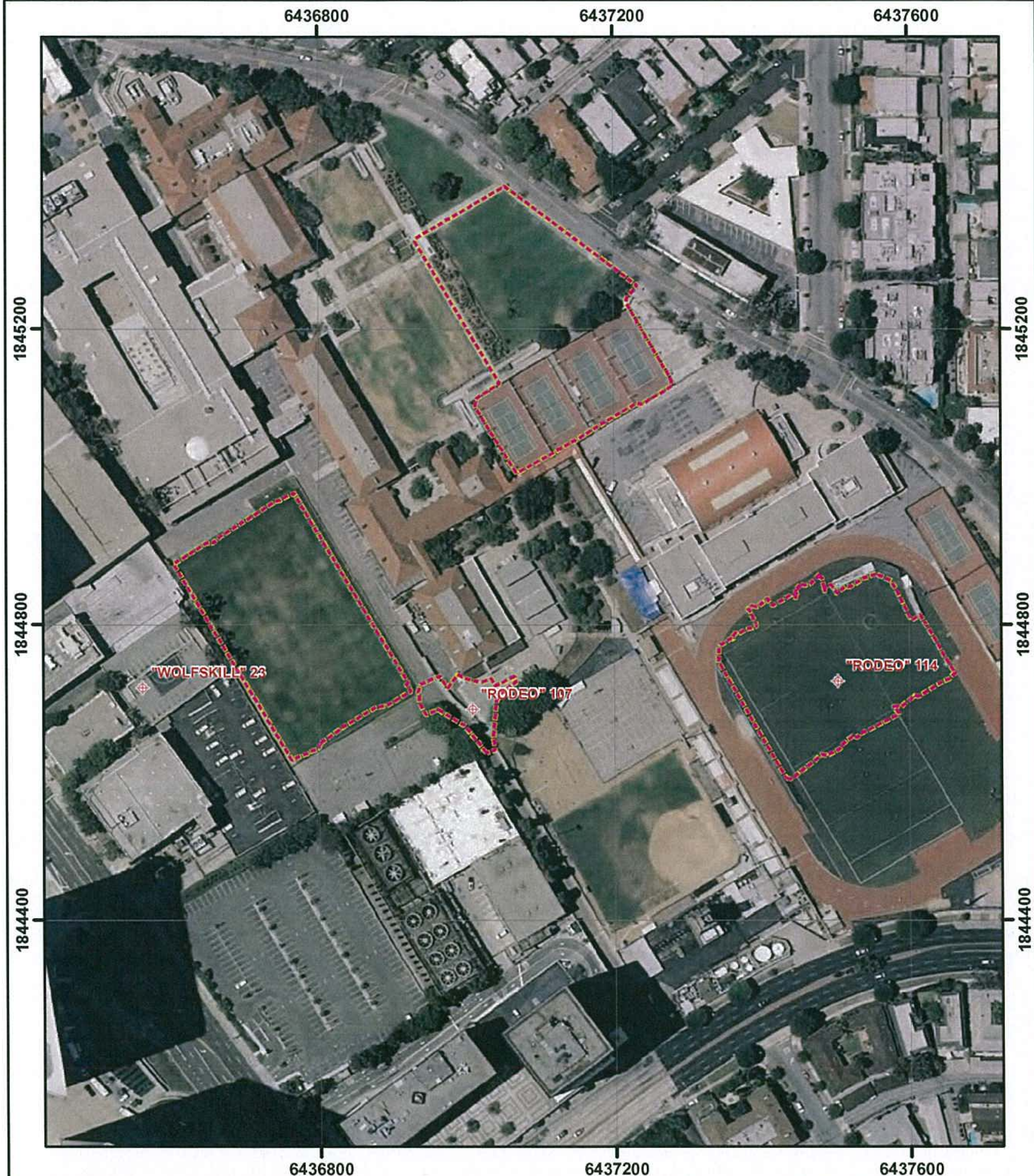
04/08/11

Antony Martin | Date
California Professional Geophysicist, P.GP 989
GEO*Vision* Geophysical Services

* This geophysical investigation was conducted under the supervision of a California Professional Geophysicist using industry standard methods and equipment. A high degree of professionalism was maintained during all aspects of the project from the field investigation and data acquisition, through data processing interpretation and reporting. All original field data files, field notes and observations, and other pertinent information are maintained in the project files and are available for the client to review for a period of at least one year.

A professional geophysicist's certification of interpreted geophysical conditions comprises a declaration of his/her professional judgment. It does not constitute a warranty or guarantee, expressed or implied, nor does it relieve any other party of its responsibility to abide by contract documents, applicable codes, standards, regulations or ordinances.

FIGURES



Legend

- Geophysical survey boundary
- Suspected location of abandoned oil well

90 0 90 180
Feet

N

NOTES:
1. California State Plane Coordinate System NAD 83, Zone V (0405), US Survey Feet
2. Image Source: ESRI, i-cubed, UDSA FSA, USGS, AEX, GeoEye, Getmapping, Aerogrid, IG

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Date:	4/7/2011
GV Project:	11065
Developed by:	E Feldman
Drawn by:	T Rodriguez
Approved by:	L Demine
File Name:	11065-1

FIGURE 1
SITE MAP

BEVERLY HILLS HIGH SCHOOL
BEVERLY HILLS, CALIFORNIA

PREPARED FOR
MACTEC ENGINEERING AND CONSULTING, INC.

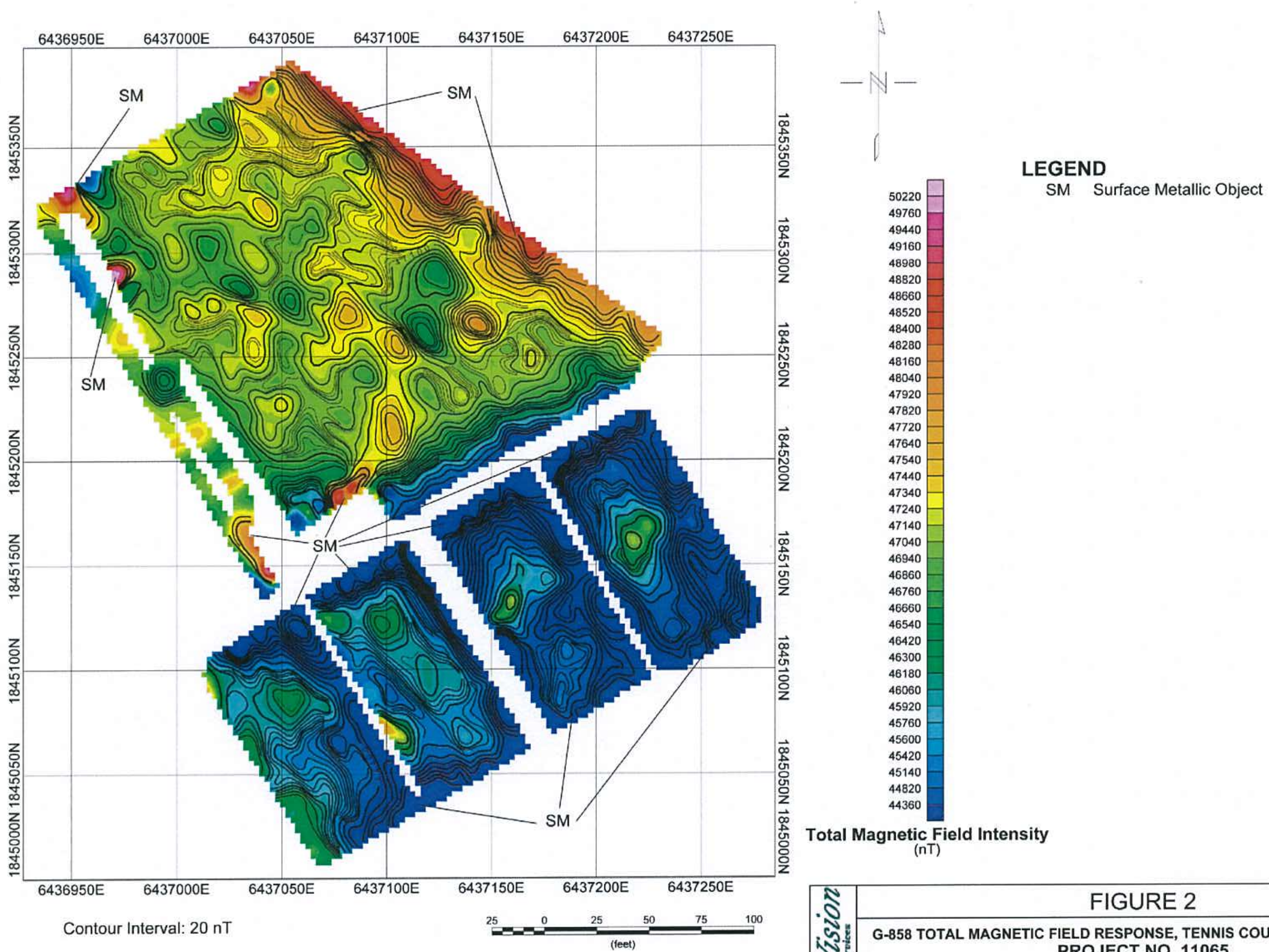

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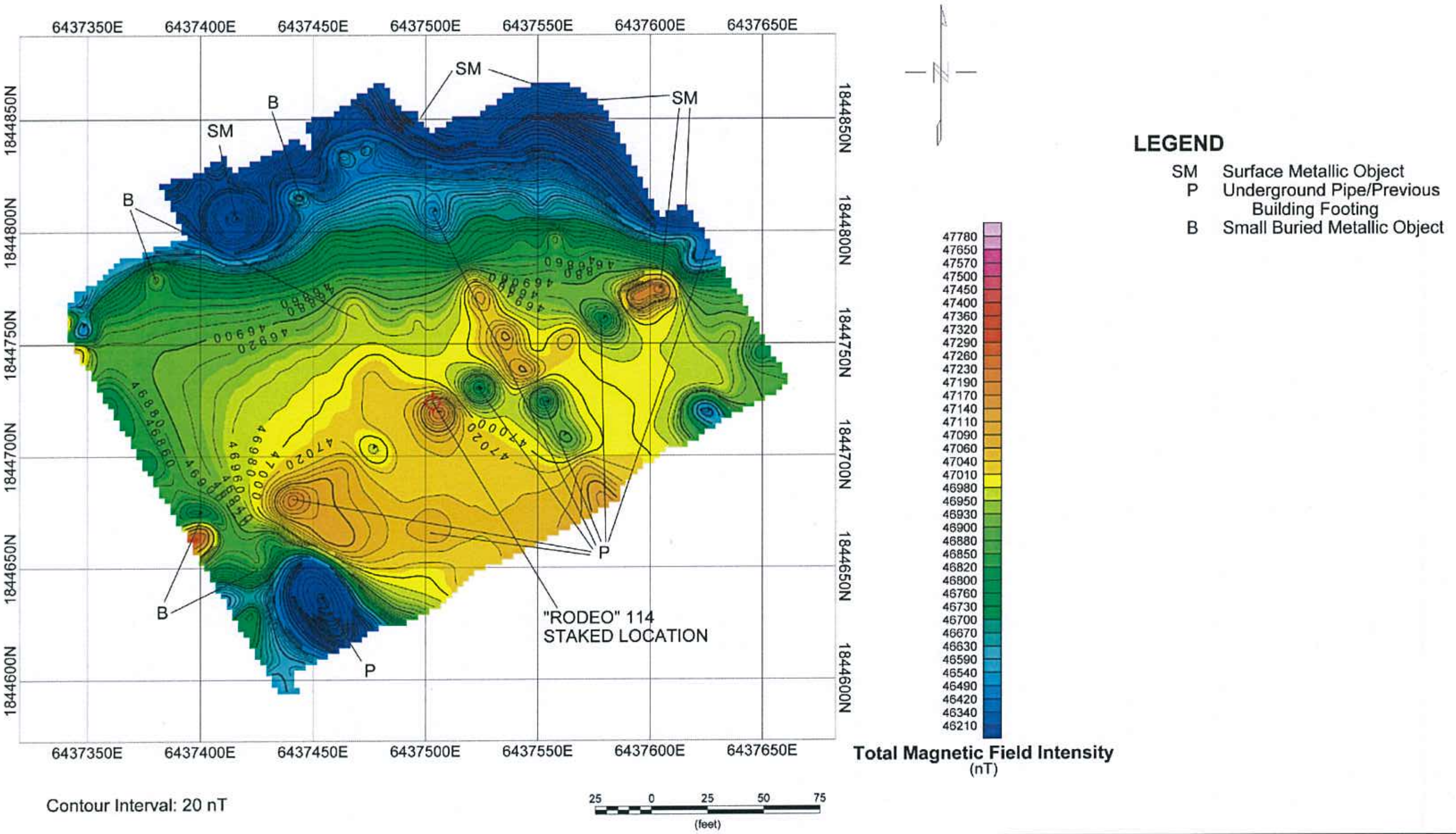
FIGURE 2

G-858 TOTAL MAGNETIC FIELD RESPONSE, TENNIS COURTS & FRONT LAWN
PROJECT NO. 11065

BEVERLY HILLS HIGH SCHOOL
BEVERLY HILLS, CALIFORNIA

PREPARED FOR MACTEC ENGINEERING AND CONSULTING, INC.

Notes: 1. Coordinate System California State Plane, NAD83, Zone V (0405), US Survey Feet
2. Positions collected using a Trimble ProXRS GPS with OmniSTAR real-time, submeter differential corrections



Notes: 1. Coordinate System California State Plane, NAD83, Zone V (0405), US Survey Feet
2. Positions collected using a Trimble ProXRS GPS with OmniSTAR real-time, submeter differential corrections

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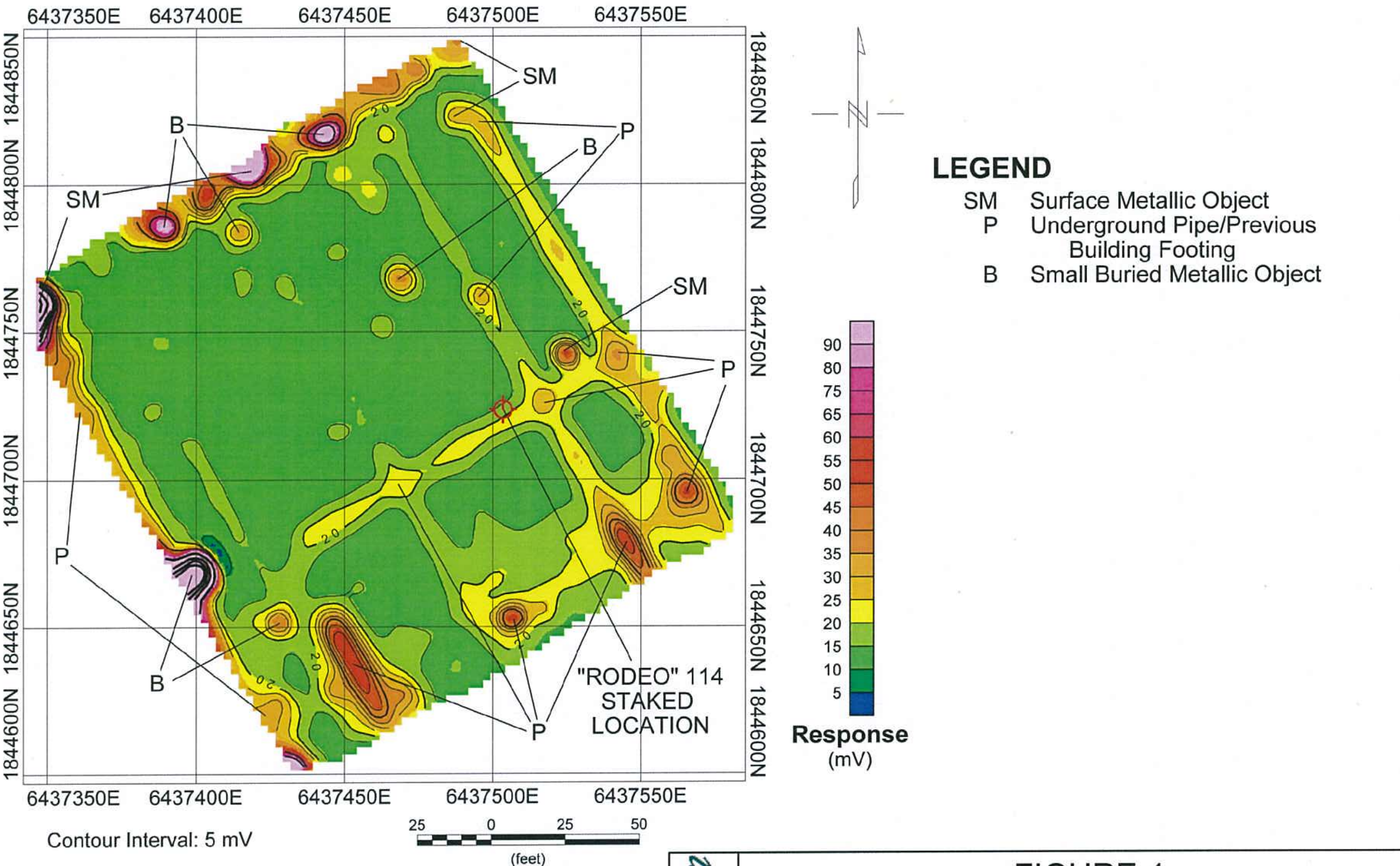
FIGURE 3

G-858 TOTAL MAGNETIC FIELD RESPONSE, FOOTBALL FIELD
PROJECT NO. 11065

BEVERLY HILLS HIGH SCHOOL
BEVERLY HILLS, CALIFORNIA

PREPARED FOR MACTEC ENGINEERING AND CONSULTING, INC.



Notes: 1. Coordinate System California State Plane, NAD83, Zone V (0405), US Survey Feet
2. Positions collected using a Trimble ProXRS GPS with OmniSTAR real-time, submeter differential corrections

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FIGURE 4

EM-61 MK2A CHANNEL 3 RESPONSE, FOOTBALL FIELD
PROJECT NO. 11065

BEVERLY HILLS HIGH SCHOOL
BEVERLY HILLS, CALIFORNIA

PREPARED FOR MACTEC ENGINEERING AND CONSULTING, INC.

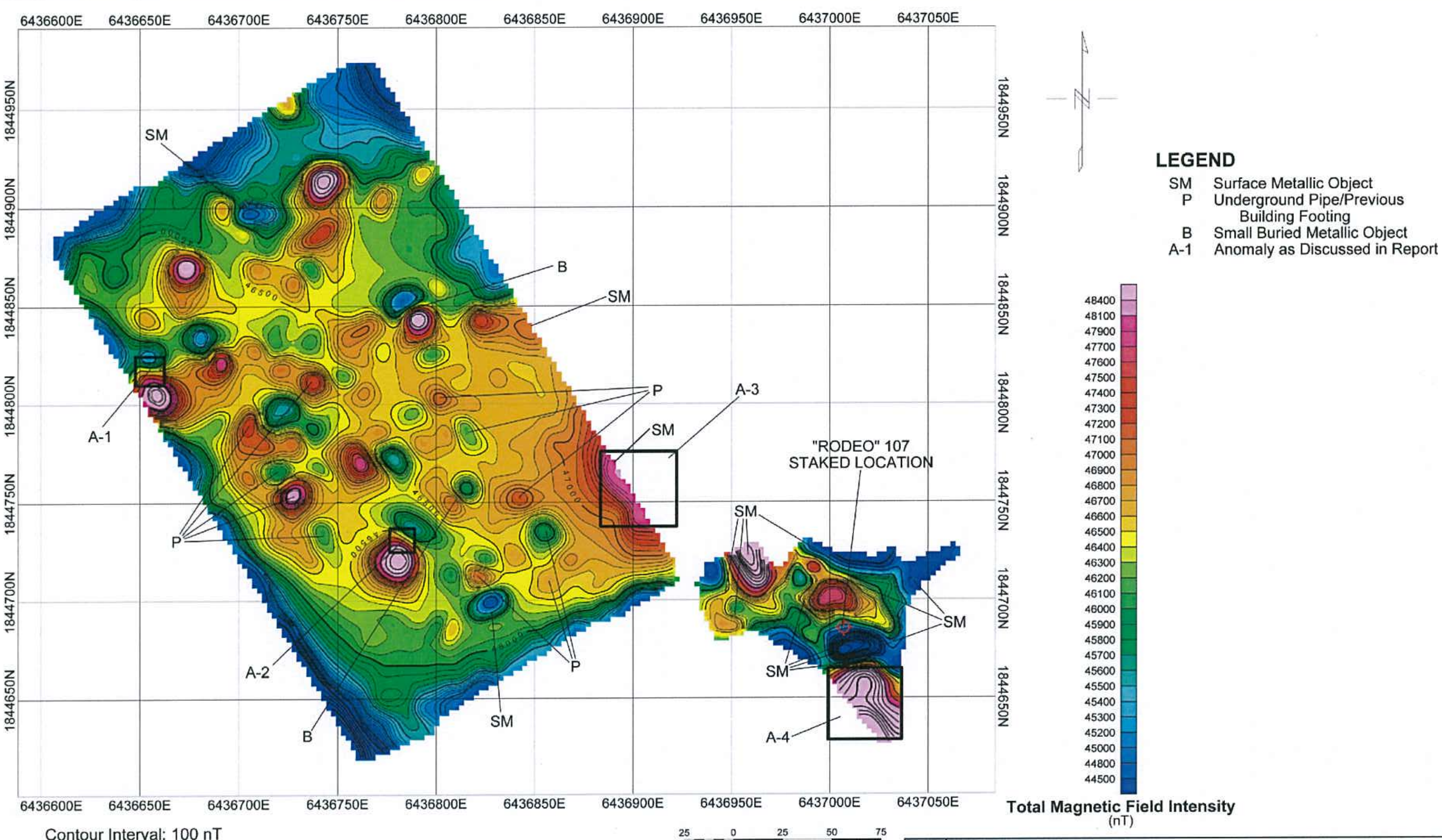

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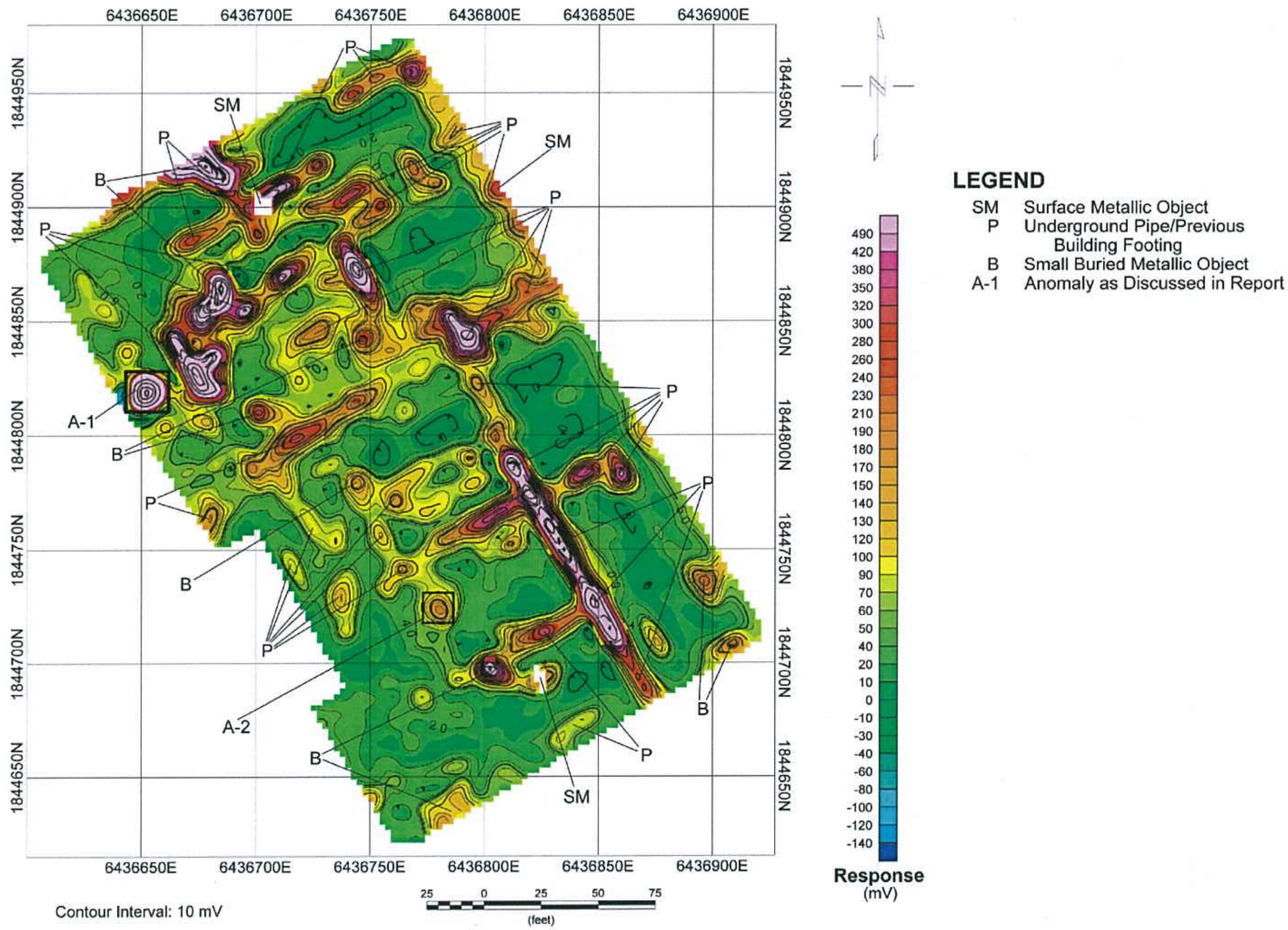
FIGURE 5

G-858 TOTAL MAGNETIC FIELD RESPONSE, LACROSSE FIELD
PROJECT NO. 11065

BEVERLY HILLS HIGH SCHOOL
BEVERLY HILLS, CALIFORNIA

PREPARED FOR MACTEC ENGINEERING AND CONSULTING, INC.

Notes: 1. Coordinate System California State Plane, NAD83, Zone V (0405), US Survey Feet
2. Positions collected using a Trimble ProXRS GPS with OmniSTAR real-time, submeter differential corrections



Notes: 1. Coordinate System California State Plane, NAD83, Zone V (0405), US Survey Feet
2. Positions collected using a Trimble ProXRS GPS with OmniSTAR real-time, submeter differential corrections

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FIGURE 6

EM-61 MK2A CHANNEL 3 RESPONSE, LACROSSE FIELD
PROJECT NO. 11065

BEVERLY HILLS HIGH SCHOOL
BEVERLY HILLS, CALIFORNIA

PREPARED FOR MACTEC ENGINEERING AND CONSULTING, INC.

APPENDICES

GEOPHYSICAL TECHNIQUES FOR SHALLOW ENVIRONMENTAL INVESTIGATIONS

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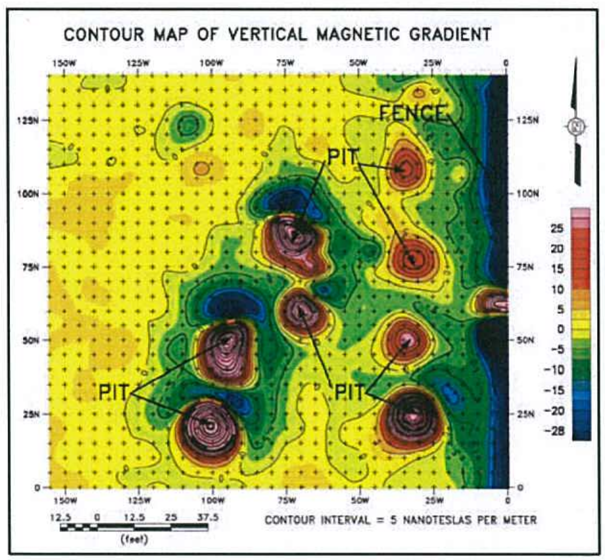
MAGNETIC METHOD

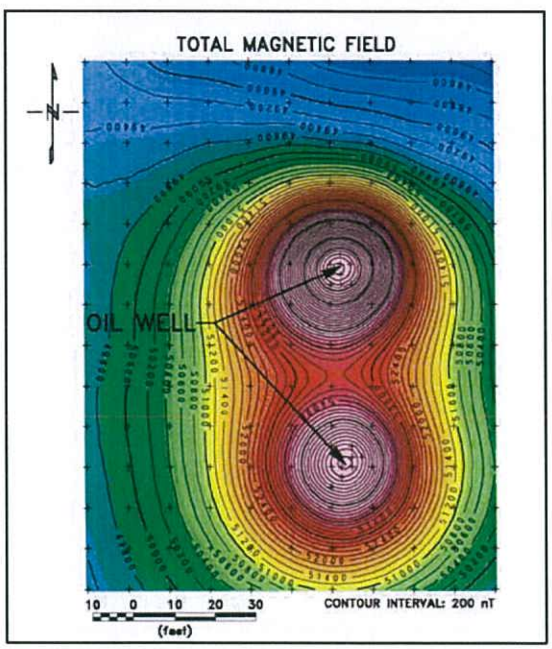
The magnetic method generally involves the measurement of the earth's magnetic field intensity or vertical gradient of the earth's magnetic field. Anomalies in the earth's magnetic field are caused by induced or remanent magnetism. Induced magnetic anomalies are the result of secondary magnetization induced in a ferrous body by the earth's magnetic field. The shape and amplitude of an induced magnetic anomaly is a function of the orientation, geometry, size, depth, and magnetic susceptibility of the body as well as the intensity and inclination of the earth's magnetic field in the survey area. The magnetic method is an effective way to search for small metallic objects, such as buried ordnance and drums, because magnetic anomalies have spatial dimensions much larger than those of the objects themselves. Typically, a single buried drum can be detected to a depth of about 10 feet. Larger metallic objects can often be located to greater depths. Induced magnetic anomalies over buried objects such as drums, pipes, tanks, and buried metallic debris generally exhibit an asymmetrical, south up/north down signature (positive response south of the object and negative response to the north).

Geometrics G858 Cesium Magnetic Gradiometer

Magnetic data is typically acquired along a grid with results being presented as color-enhanced contour maps generated by the Geosoft™ Mapping System or OASIS montaj. The approximate location and depth of magnetic objects can be calculated using the Geosoft™ UXO System.



Magnetic Survey to Locate Pits Containing Buried Metallic Containers



Magnetic Survey to Locate Abandoned Oil Wells

Magnetic surveys are typically conducted to:

- Locate abandoned steel well casings
- Locate buried tanks and pipes
- Locate pits and trenches containing buried metallic debris
- Detect buried unexploded ordnance (UXO)
- Map old waste sites and landfill boundaries
- Clear drilling locations
- Map basement faults and geology
- Investigate archaeological sites

1124 Olympic Drive, Corona, California 92881, ph. 951-549-1234, fx. 951-549-123 www.geovision.com

ELECTROMAGNETIC METHODS

Electromagnetic (EM) methods typically applied to shallow environmental investigations include frequency domain EM methods, such as EM induction and EM utility location methods, time domain electromagnetic (TDEM) metal detection methods, and ground penetrating radar (GPR) methods.

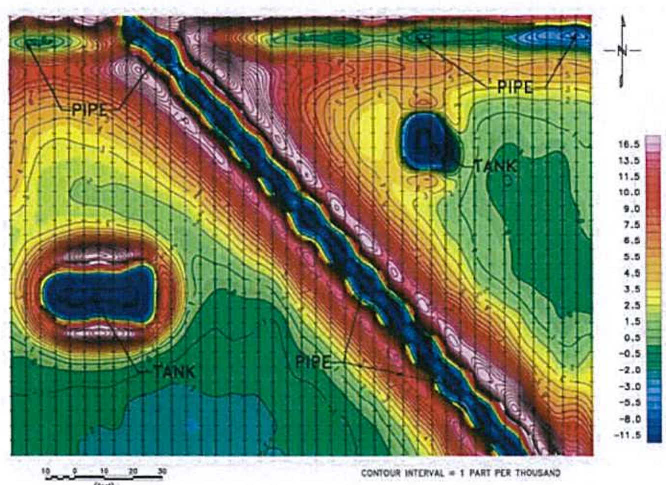
EM Induction Method

EM induction surveys are often conducted using the Geonics EM-31 terrain conductivity meter (EM-31). The EM-31 consists of a transmitter coil mounted at one end and a receiver coil mounted at the other end of a 3.7-meter long plastic boom. Electrical conductivity and in-phase component field strength are measured and stored along with line and station numbers in a digital data logger. In-phase component measurements generally only respond to buried metallic objects; whereas conductivity measurements also respond to conductivity variations caused by changes in soil type, moisture or salinity and the presence of nonmetallic bulk wastes. The EM-31 must pass over or immediately adjacent to a buried metallic object to detect it. Typical EM-31 anomalies over small, buried metallic objects consist of a negative response centered over the object and a lower amplitude positive response to the sides of the object. When the instrument boom is oriented parallel to long, linear conductors such as pipelines a strong positive response is observed. The EM-31 can explore to depths of about 6 meters, but is most sensitive to materials about 1 meter below ground surface. Single buried drums can typically be detected to depths of about 5 feet.

Geonics EM-31 Terrain Conductivity Meter

EM-31 surveys are typically conducted to:

- Locate buried tanks and pipes
- Locate pits and trenches containing metallic and/or nonmetallic debris
- Delineate landfill boundaries
- Delineate oil production sumps and mud pits
- Map conductive soil and groundwater contamination
- Map soil salinity in agricultural areas
- Characterize shallow subsurface hydrogeology
  - ➢ Map buried channel deposits
  - ➢ Locate sand and gravel deposits
  - ➢ Locate conductive fault and fracture zones



Geonics EM-31 Survey to Locate Underground Storage Tanks

EM Utility Location Methods

EM utility locators; such as the Metrotech 810, Metrotech 9890 and Radiodetection RD400, are designed to accurately trace metallic pipes and utility cables and clear drilling/excavation locations. These utility locators consist of a separate transmitter and a receiver. The transmitter emits a radio frequency EM field that induces secondary fields in nearby metallic pipes and cables. The receiver detects these fields and is used to accurately locate and trace the pipes, often to distances over 200 feet from the transmitter. Many of the utility locators have a passive 60Hz mode to locate live electrical lines. Modern utility locators are also capable of providing rough depth estimates of the pipes.

Metrotech EM Utility Locator

TDEM Metal Detection Methods

A Geonics EM-61 (EM-61) is a high sensitivity, time-domain, digital metal detector which is often used to detect both ferrous and non-ferrous metallic objects. It is designed specifically to locate buried metallic objects such as drums, tanks, pipes, UXO, and metallic debris and to be relatively insensitive to above ground structures such as fences, buildings, and vehicles.

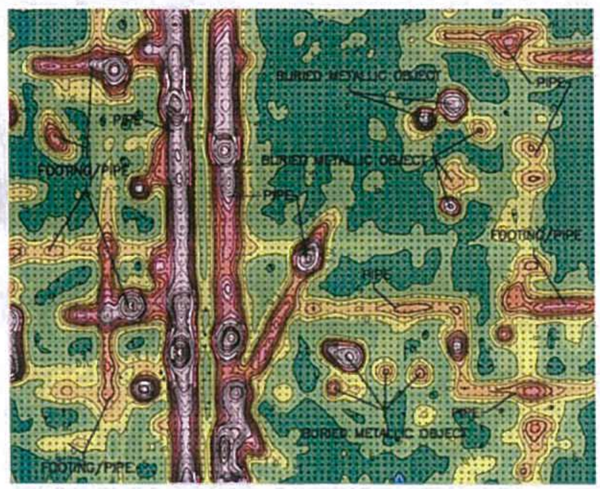
Geonics EM-61 Digital Metal Detector

The EM-61 consists of two square, 1-meter coils, one mounted over the other and arranged on a hand-towed cart. The bottom coil acts as both a transmitter and receiver while the top coil is a receiver only. While transmitting the bottom coil generates a pulsed primary magnetic field, which induces eddy currents into nearby metallic objects. When the transmitter is in its off cycle both coils measure the decay of these eddy currents in millivolts (mV) with the results being stored in a digital data logger along with position information. The decay of the eddy currents is proportional to the size and depth of the metallic target. A symmetrical positive anomaly is recorded over metallic objects with the peak centered over the object.

The signal from the top coil is amplified in such a way that both coils record effectively the same response for a metallic object on the surface and the top coil records a larger response for buried metallic objects. The response of near surface objects can, therefore, be suppressed by subtracting the lower coil response from the upper coil response (differential response).

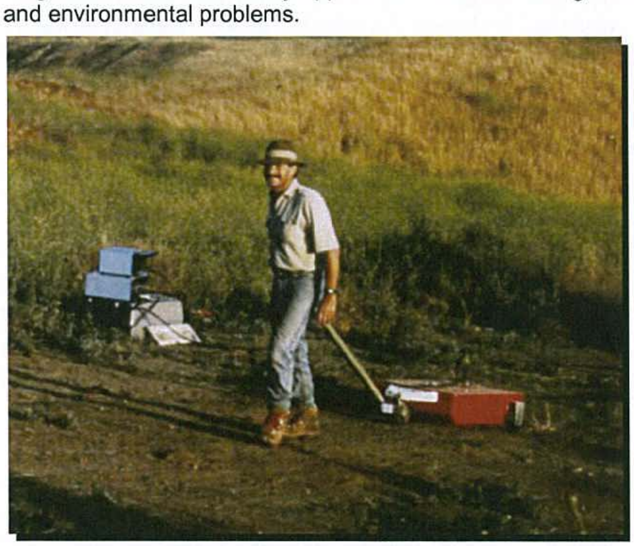
In practice, the usable depth of investigation of the EM-61 depends on the size and shape of the object and the amount of above ground interference encountered at the site. A single buried drum can often be detected at a depth of about 10 feet.

Geonics EM-61 Survey to Map Subsurface Infrastructure



GPR Methods

Ground-penetrating radar (GPR) is a high-frequency electromagnetic method commonly applied to a number of engineering and environmental problems.



GSSI SIR-10A GPR Unit

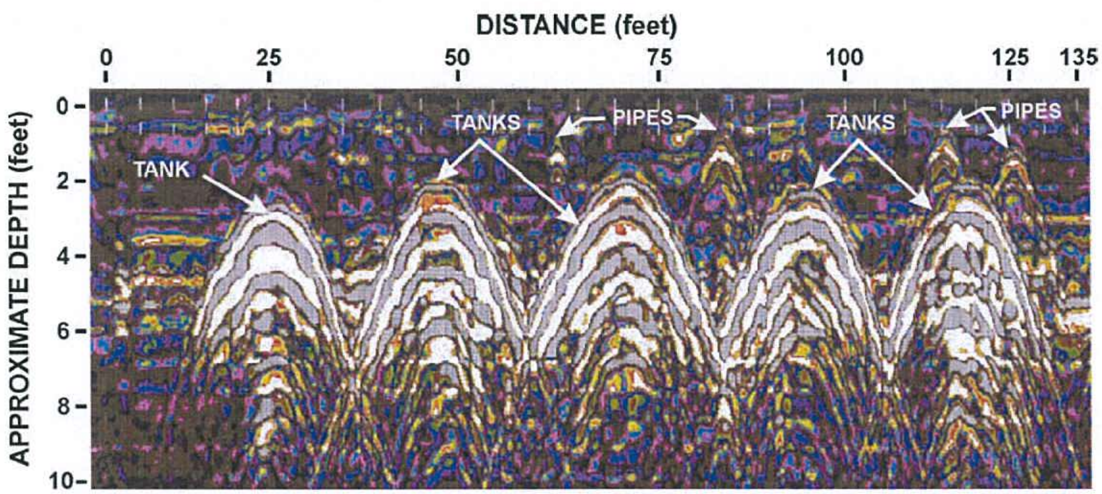
A GPR system radiates short pulses of high-frequency EM energy into the ground from a transmitting antenna. This EM wave propagates into the ground at a velocity that is primarily a function of the relative dielectric permittivity of subsurface materials. When this wave encounters the interface of two materials having different dielectric properties, a portion of the energy is reflected back to the surface, where it is detected by a receiver antenna and transmitted to a control unit for processing and display.

Depth penetration is a function of antenna frequency and the electrical conductivity of the soils in the survey area. Lower frequency antennas achieve greater depth penetration than higher frequency antennas, but have poorer spatial resolution. Conductive soils, such as clays, attenuate the radar waves much more rapidly than resistive dry sand and rock. In many environments in California, depth penetration of 500 and 300 MHz antennas is limited to 3 to 5 feet. Depth penetration may be greater if shallow soils consist of clean sands and less if shallow soils consist of clay.

GPR surveys are typically conducted to:

- Locate and delineate underground storage tanks (metallic and non-metallic)
- Locate metallic and nonmetallic pipes and utility cables
- Map rebar in concrete structures
- Map landfill boundaries
- Delineate pits and trenches containing metallic and nonmetallic debris
- Delineate leach fields and industrial cribs
- Delineate previously excavated and backfilled areas
- Map shallow groundwater tables
- Map shallow soil stratigraphy
- Map shallow bedrock topography
- Map shallow subsurface voids and cavities
- Characterize archaeological sites

Geophysical Survey Systems Inc. (GSSI) SIR-2 or SIR-10 GPR systems with antennas in the frequency range of 50 to 1,000 MHz are often used during GPR investigations. Mala Geoscience and Sensors and Software, Ltd also manufacture GPR systems. GPR data is processed using a variety of software including the RADAN™ or GRADIX software packages by GSSI and Interpex Ltd., respectively.



GPR Survey to Locate Underground Storage Tanks

4. NOISE AND VIBRATION STUDY

1. INTRODUCTION

1.1 Overview

This report presents the results of vibration propagation tests that were performed to assist in predicting the levels of groundborne vibration and noise that would be generated by the proposed Westside Subway Extension. The testing was performed as part of the Final Environmental Impact Statement and Environmental Impact Report (FEIS/EIR).

Borehole vibration tests were performed in order to determine directly the vibration propagation characteristics for subsurface vibration sources at a given site. The test method consists of generating ground vibration at the bottom of the hole using the drill rig penetration drop hammer. The impulsive forces transmitted into the soil at the bottom of the borehole are measured using a special load cell and the resulting surface acceleration measured at varying distances from the hole.

The resulting measurements are digitally processed to obtain the *transfer mobility*, which characterizes the relationship between the exciting force and the resulting ground motion. Additional details on the test procedure, equipment, and data processing is provided in Section 2.

Testing was performed at 12 sites, selected from the roughly 100 rotary-wash boreholes that were part of the overall geotechnical investigation undertaken by Mactec Engineering[1]. The locations of the test boreholes, the test dates, and the depths of the tests are given in Table 1 and Figure 1 shows the general locations of the test sites.

Table 1: Borehole Locations and Test Dates

Borehole	Location / Cross Street	Test Date(s)	Test Depths (ft)
G-106	Wilshire / Arden	24-Mar-2011	50, 60, 70
G-124	Wilshire / Fairfax	17-Mar-2011	40, 55, 60
G-134	Wilshire / Hamel	30-Mar-2011	50,60, 70
G-145	Wilshire / El Camino	14 - 15 Mar 2011	50, 60, 70
G-152	Santa Monica / Wilshire	31 Jan - 1 Feb 2011	55, 65, 75
G-164	Moreno / Young	26 - 27 Jan 2011	45, 55, 65
G-165	Beverly Hills HS (classrooms)	5-Mar-2011	55, 65, 75
G-166	Beverly Hills HS (Lacrosse field)	19-Mar-2011	55, 65, 75
G-173	Missouri / Fox Hills	21 - 22 Feb 2011	60, 70, 80
G-176	Warner / Thayer	27-Dec-2010	80, 90, 97
G-178	Wilshire / Manning	17-Jan-2011	65, 75, 85
G-203	VA Medical Center	3-May-2011	55, 65, 75

[1] MACTEC Engineering and Consulting Inc., Project 4953-10-1561

Figure 1: Overview of Vibration Test Borehole Locations

1.2 Executive Summary

The 12 borehole sites listed in Table 1 were selected for the vibration survey based on two criteria. The first consideration was to select test sites based on their proximity to vibration-sensitive sites previously identified in the draft EIS/EIR as exceeding the Federal Transit Administration (FTA) criteria. The second was to select locations that would provide a reasonably uniform sampling along the proposed subway alignment. Three of the sites selected for this study (G-164, G-165, and G-166) were located at or near Beverly Hills High School, which had been identified as a site of particular concern.

At many of the test sites, the borehole vibration measurements and the subsequent mobility calculations were affected by unexpectedly low force level being developed at the bottom of the boreholes, high ambient vibration levels, or a combination of the two. The resulting low signal-to-noise ratio levels resulted in a relatively high scatter in calculated point source transfer mobility (PSTM) values. The line source transfer mobility (LSTM) functions derived from the PSTM data have been reviewed for reasonableness and provide a good estimate of vibration propagation characteristics over frequency ranges that the coherence exceeds 0.3. However, care should be exercised applying the derived LSTM functions at low and high frequencies and at diagonal distances that are outside the 50 to 200 foot range of the measurement data.

Figure 2 provides an overview of the final LSTM curves for the twelve sites assuming a vibration line source that is the length of a 6-car train and a 100 foot receiver distance. The shapes of the 1/3 octave band spectra are all similar. There is a broad peak in the LSTM spectra between 16 and 40 Hz with the LSTM falling off at a rate of about 10 decibels per octave at higher frequencies. The LSTM curves all fall within an 18-dB wide envelope at essentially all frequencies. Sites that are toward the high side of this envelope are G-106, G-134, and G-176. Sites G-145 and G-178 fall noticeably below the mean for most of the frequency range.

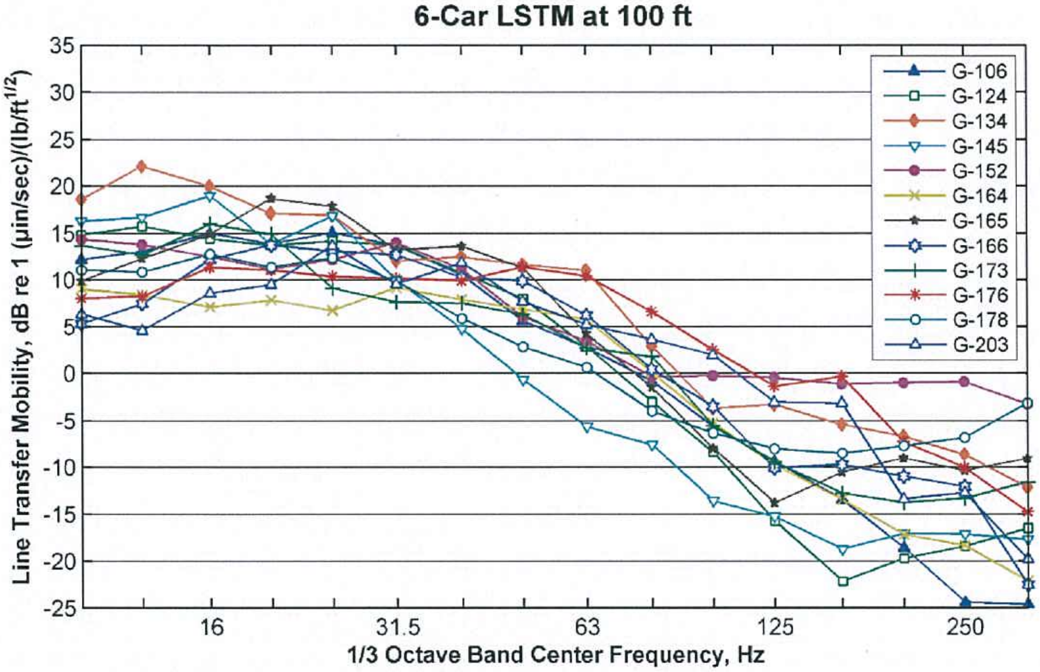


Figure 2: Cross-site Comparison of LSTM Values (6-Car trains at 100 Foot Diagonal Distance)

Additional observations from inspection of the 12 LSTM functions are:

- **Comparisons between G-164, G-165, and G-166:** These sites were closely spaced, with 475 feet separating G-164 and G-165, and only 220 feet between G-165 and G-166. The resulting LSTM spectra for these three sites are in most respects similar (particularly the LSTM spectra for G-165 and G-166), but with two notable differences. The 50-foot LSTM for G-166 is significantly elevated at 63 Hz (approximately 10 dB) with respect to the other sites. In addition, the LSTM levels in the 16-25 Hz bands vary as much as 15 dB between sites. It should be noted however that the PSTM coherence values at these frequencies were uniformly poor at these sites.
- **Comparison between G-173 and SB-2:** Site G-173 (Fox Hills Drive & Missouri Ave.) The site G-173 borehole was located only 75 feet from a prior borehole test (SB-2) conducted in June 2010. The SB-2 test results were documented in a previous report, but a top-level comparison of the results is of interest here. The SB-2 test consisted of PSTM measurements at six distances for a single test depth of 103 feet. The G-173 tests were done at depths of 60, 70, and 80 feet with the line array orthogonal to the SB-2 test. The peak force levels (35k lbs) developed during the SB-2 test were distinctly greater than for G-173, where typical levels were 20k lbs (60 ft), 15k lbs (70 ft) and 10k lbs (at 80 ft). The general shape of the PSTM spectra and the derived LSTM values are quite similar between the two tests, but the absolute levels in all cases are approximately 10 dB greater in the G-173 measurements. This is a significant difference,

particularly in view of the otherwise consistent behavior and the (relatively) good quality of the data. After carefully inspecting the data, we are confident that the results reflect variations in the vibration transmission characteristics of the soil at a depth of 100 feet at SB-2 compared to the vibration transmission characteristics of the soil at shallower depths at G-173.

- **Indoor/Outdoor results from G-165:** Indoor vibration measurements were made in three classrooms at Beverly Hills High School during the G-165 borehole test. For two of the classrooms (123 and 201), little amplification was observed, but room 107 showed significantly increased levels at low frequency. Detailed results from the indoor measurements can be found in Sections 3.7.2 and 3.7.3

The remainder of this report presents the detailed result from each downhole vibration propagation test. The field testing and data procedures are described in Section 2 and the results for each borehole are presented in Section 3. Included in Section 3 for each site are:

- A description of the site.
- Graphs of the measured PSTM spectra and the corresponding coherence values at each measurement depth.
- The LSTM spectra derived from the PSTM spectra presented in tabular as well as graphic form.

All LSTM values presented in Section 3 are for a line source corresponding to a-6-car train. Table 2 presents the approximate difference between LSTM curves for different length line sources and different distances from the tracks. The absolute values of the adjustments increase with distance from the tracks and reach the maximum at distances of 300 to 600 ft from the tracks. All other things being equal, fewer cars per train will result in lower LSTM values.

Table 2: Adjustment Factors to Approximate LSTM for Different Length Trains

Distance (feet)	LSTM Adjustment in dB*	
	2-Car	4-Car
50	-0.4	-0.5
75	-1.3	-0.7
100	-2.1	-0.9
150	-3.0	-1.2
200	-3.4	-1.3
250	-3.9	-1.4
300	-4.2	-1.5
400	-4.6	-1.7
500	-4.8	-1.8
600	-4.8	-1.8
800	-4.8	-1.8
1000	-4.8	-1.8

Note:
* Value to be added to 6-car LSTM levels for 2- or 4-- car train lengths

2. TEST PROCEDURE

2.1 Field Procedures and Equipment

The borehole vibration tests for this program involved generating subsurface vibration via hammer impacts while measuring the surface response at a number of locations, as illustrated in Figure 3. Surface vibration at each site was measured using six PCB model 393A03 seismic accelerometers, deployed on a single radial away from the hole, at (nominal) surface distances of 25, 37, 50, 75, 100, and 150 feet. These surface acceleration measurements were all made with the accelerometers oriented in the vertical direction. At two test sites (G-134 and G-145) supplemental triaxial acceleration measurements were made at one measurement location.

The driving force for the measurements was supplied by the drill rig's standard 140 lb drop hammer. A downhole load cell was used to measure the resulting impact force applied to the soil. All test signals (force and acceleration) were digitally recorded using 4-channel Rion DA-20 data recorders. The acceleration and force signals were stored in WAV files for subsequent analysis.

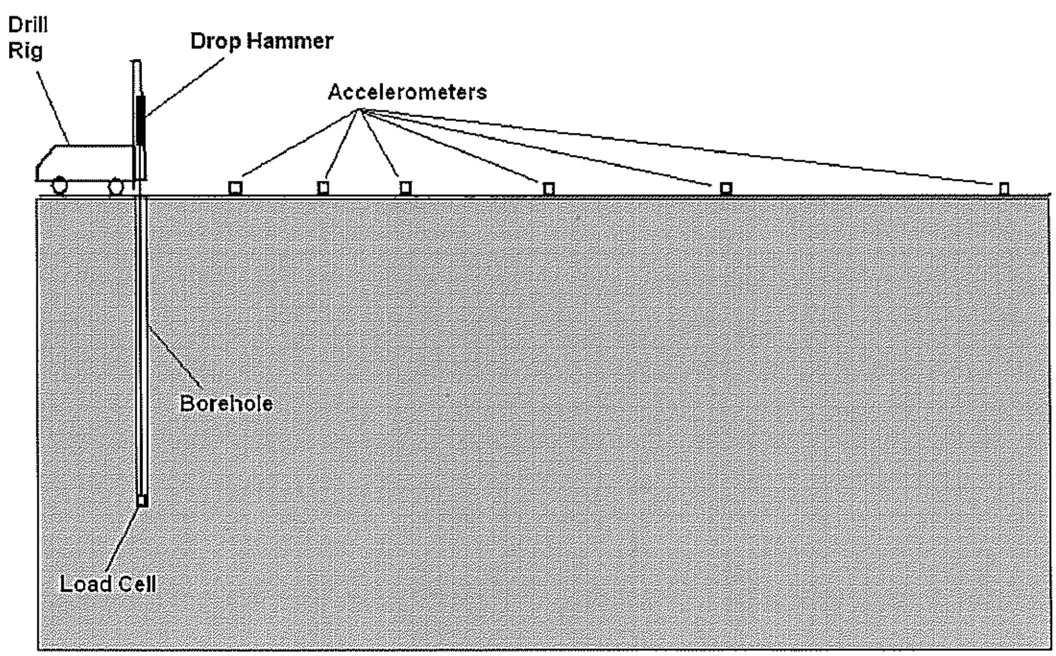


Figure 3: Borehole Test Configuration

The target test depths were set near the top, mid-plane, and bottom of the proposed tunnel structure at each site. The actual depth was usually adjusted slightly to accommodate other testing requirements such as soil sampling or pressure tests. Once on-site, the field crew would identify the measurement locations to be used, attach the accelerometers to the ground using base plates or ground stakes as appropriate, connect all transducers to the data recorders and check each data channel, making sure that the transducers were working, the channel assignments were correct, and that there are no electrical noise problems present.

Once the drilling crew reached each target test depth, the drill string would be withdrawn from the borehole, the load cell attached, and then re-inserted into the borehole. At each depth the test procedure consisted of the following steps:

1. The load cell and data recorders were powered on, and the load cell supply voltage checked.
2. One or more sets of trial impacts (of typically 5 hits each) were made to settle the load cell at the bottom of the borehole and provide a check of recording levels for the load cell and each of the accelerometer channels.
3. Once satisfied that the signal levels were correct, the data recorders were started and the drill rig operator asked to run off the desired number of hammer impacts. Typically 100 hits were requested, although in some instances an additional series of impacts were recorded where the ambient vibration levels were particularly high or the field team decided to use using alternate recording settings.
4. Once the desired number of impacts had been collected, the data recorders were stopped and the drill crew directed to bring up the load cell.

2.2 Data Processing Procedures

The data analysis was conducted in two principal phases as described in the following subsections. In the first phase all quality control and signal processing steps are performed, culminating in a set of *point source transfer mobility* (PSTM) estimates for each test site. This work was done using the MATLAB Signal Processing toolkit. The second phase of the analysis takes these individual PSTM estimates and derives *line source transfer mobility* (LSTM) values for each site. These calculations were done primarily using Excel spreadsheets.

2.2.1 Signal Processing Procedures

There were four main data steps involved in processing the recorded field data into the required PSTM estimates:

1. ***Quality Control:*** Parse the raw time history files into individual impacts and examine these individual samples for noise or other problems. Because of the large number of impacts (typically 100) and the high ambient vibration levels in many locations, we employed an automatic accept/reject function to reject samples with excessive interference from ambient vibration. The primary source of ambient vibration was vehicular traffic on Wilshire and Santa Monica Boulevards.
2. ***PSTM Estimation:*** Process the selected impact data to obtain the narrowband transfer functions between the exciting force and the response at each accelerometer position. These transfer functions are often termed *accelerance* functions. Mobility (velocity/force) is derived here from accelerance by applying a $1/\omega$ correction factor. The resulting transfer function relationship between the force and the vibration velocity response is referred to in this report as the *point source transfer mobility* (PSTM) and is the inverse of the system impedance.
3. ***One-Third Octave Levels:*** Consolidate the narrowband transfer mobility spectral values into 1/3 octave bands.
4. ***Curve Fitting:*** Pool the PSTM results at different depths and distances, and calculate a best-fit curve of transfer mobility as a function of diagonal distance from the impact location. These best-fit curves are developed for each 1/3 octave band.

2.2.2 Developing Line Source Transfer Mobility Curves

While the point source transfer mobility represents the response at the surface from a vibration source at a single subsurface point, the line source transfer mobility (LSTM) represents the response from forces distributed along a line such as a train. This more accurately represents the energy from trains that may be many feet long. For surface vibration propagation tests, it is common to measure point transfer mobility at 11 force locations in a line along the proposed alignment, and explicitly combine the point transfer mobilities to estimate the LSTM. This straightforward approach is impractical for a subway tests because it would require 11 boreholes. Therefore the contributions along the line must be calculated from one set of measurements.

To do this, the equivalent LSTM as a function of distance was derived from the measured point source transfer mobilities at the six accelerometer positions. A linear regression was first calculated for each frequency band as previously described, and used to predict the point source transfer mobility as a function of distance. Line integration of these regression functions was then used to calculate the equivalent LSTMs. The resulting LSTM functions can then be combined with separately developed *force density* functions to predict future groundborne vibration levels along the Westside alignments.

3.7 Site G-165

3.7.1 Site Description

This site was on-campus at Beverly Hills High School and was the only test site where the borehole location permitted meaningful indoor measurements. Testing was performed on 5 Mar 2011 at test depths of 55, 65, and 75 feet. Three indoor accelerometers were installed, mounted roughly center-span inside class rooms 107, 123 and 201. Details on the classroom measurement points are shown in Table 9. The PSTM spectra and indoor/outdoor PSTM differences for each of the classrooms are shown in Figure 32 through Figure 36. For the outdoor measurements the accelerometers were located at distances of 25, 37, 50, 75, 100, and 150 feet extending north from the borehole location. The line of accelerometers was offset from the borehole by 9 ft. Additional observations from the measurements include:

- At 55 ft depth, the hole advanced by 2 ft from the impacts. Force levels were in the range of 5k to 6k lbs. 100 hits were recorded.
- At 65 ft depth, 60 hits were recorded before the drill string advancement (30 inches) halted data collection. Additional drill rod was inserted and 60 more hits were recorded. The load cell failed during the second set of impacts.
- At 75 ft depth, 100 impact hits were recorded and there was no perceptible advancement. Because the load cell failure during the test at 65 ft, no force data were obtained at this test depth and transfer mobilities were not obtained.
- The accelerometer channel for Room 201 suffered from electrical interference during the entire measurement period.

Table 9: Classroom measurement locations at Beverly Hills High School

Room	Distance to Borehole	Room Description / Notes
107	100 ft; S-E of borehole	First floor classroom; basement below; floor noted as being relatively flexible
123	100 ft, N-E of borehole	First floor classroom; also suspended floor but notably stiffer than room 107
201	100 ft, N-E of borehole	Second floor classroom (directly above room 123)

3.7.2 Results for G-165

- Force levels at the 55 ft and 65 ft test depths were particularly low (3k to 8k lbs) although this was partially offset by the fact that the ambient noise levels at G-165 were lower than that encountered at the Wilshire Boulevard test sites.
- The coherences for the 55 ft test were relatively good through the 60 Hz 1/3 octave bands and still reasonable at higher frequencies.
- The coherences for the 65 ft test were good through up to the 100 Hz 1/3 octave band and then dropped off rapidly at higher frequencies.

- The best fit LSTM is flat up to 63 Hz at the 50 foot distance, and the fall off with distance is faster at the higher frequencies than the lower frequencies. The minimum drop off occurs in the 20 Hz band with only a 2 VdB loss from 50 to 200 ft.
- Comparisons of indoor and outdoor vibration levels were made by taking differences between the indoor and the closest outdoor PSTM spectra. For classroom 107 the closest accelerometer was the 100-foot position, and for classrooms 123 and 201 the 75-foot accelerometer data were used. PSTM data are shown (Figure 31, Figure 33, and Figure 35) for both the classroom and the outdoor reference measurement at each of the 3 test depths. Differences between these spectra for the three test depths are shown in Figure 32 (room 107), Figure 34 (room 123), and Figure 36 (room 201). Note that PSTM differences are plotted only at those frequencies where the PSTM coherence was above 0.1 for both the indoor and outdoor measurement.
    - **Classroom 107:** This classroom exhibited the largest outdoor/indoor level increase of the three rooms studied, with a 20-dB amplification observed at 10 Hz. Interior levels were approximately 10 dB higher than outdoor levels 25 and 50 Hz. This is consistent with the field observation that the floor in room 107 appeared to have unusually low stiffness.
    - **Classroom 123:** This classroom was also on the ground floor, and also with a suspended floor. As can be seen in Figure 34, no distinct resonances were observed, with mean differences near 0 dB at 10 Hz, falling gradually to -5 dB at 40 Hz.
    - **Classroom 201:** This second floor classroom lies directly above room 123. Here the PSTM differences suggest some amplification (5 – 10 dB) occurring in the 25 Hz band, but otherwise little amplification or attenuation with respect to the outdoor levels.

3.7.3 Plots and Tables

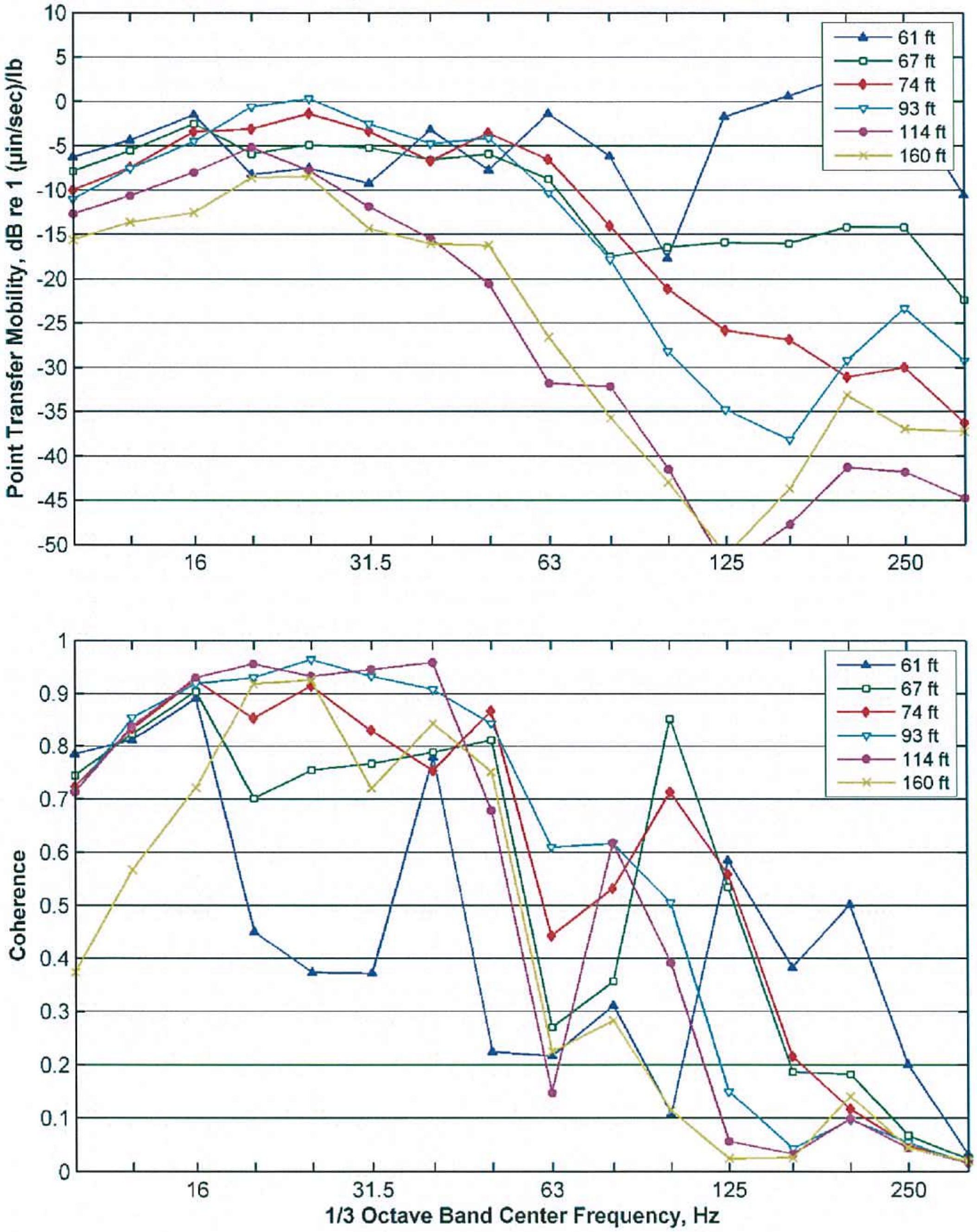


Figure 28: G-165. Measured PSTM at Depth of 55 ft

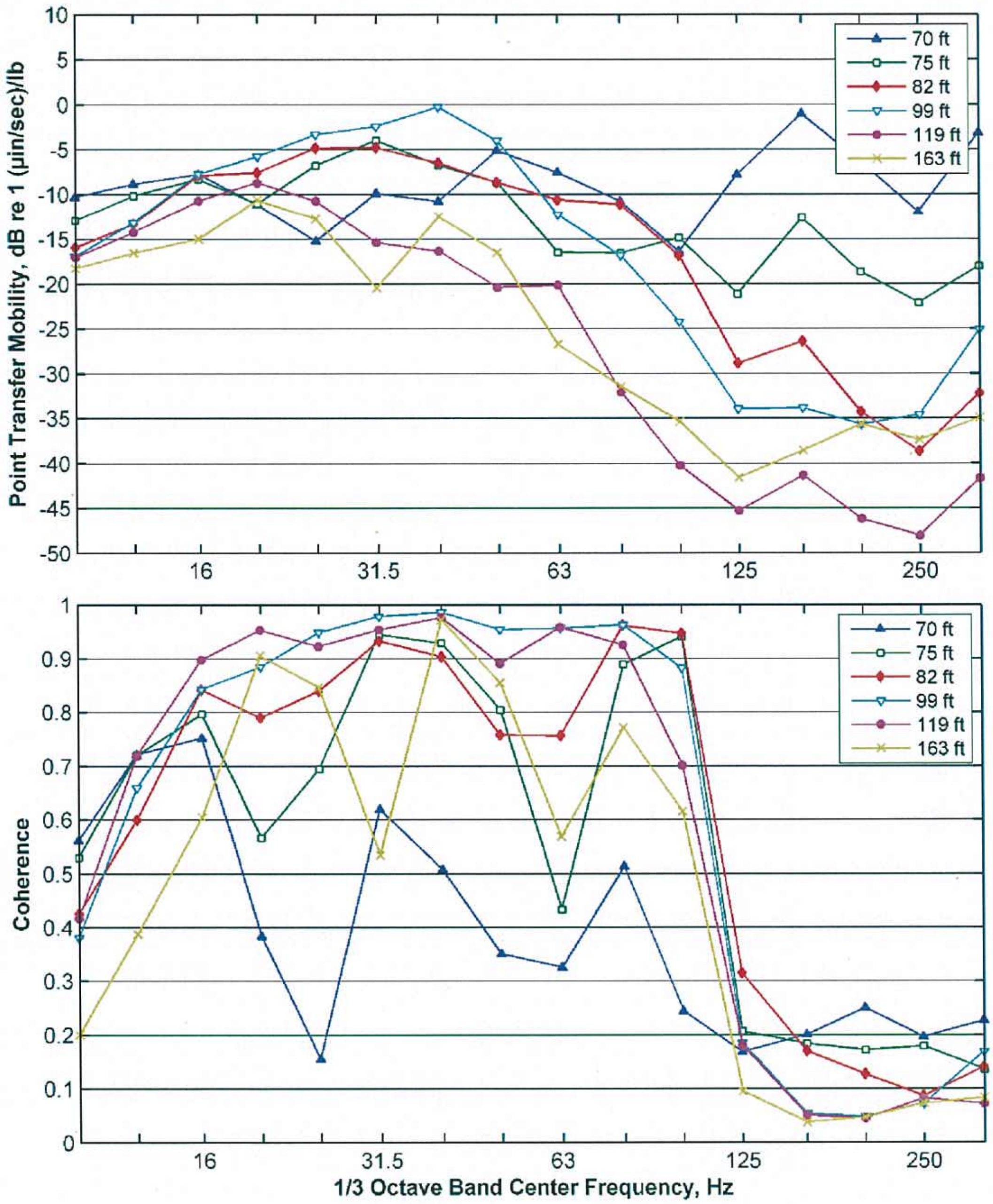


Figure 29: G-165. Measured PSTM at Depth of 65 ft

Table 10: G-165. Coefficients for Best Fit LSTM							
Freq. (Hz)	**A**	**B**	**C**	**Freq. (Hz)**	**A**	**B**	**C**
10	22.43	2.05	-4.16	**63**	87.94	-36.42	-2.73
12.5	25.30	1.83	-4.17	**80**	95.60	-43.77	-2.39
16	32.02	-0.11	-4.22	**100**	99.23	-49.28	-2.16
20	17.71	2.55	-1.03	**125**	164.63	-87.20	-1.01
25	17.67	5.40	-2.67	**160**	155.82	-80.89	-1.15
31.5	37.95	-3.96	-4.20	**200**	114.29	-58.03	-1.83
40	30.15	0.18	-4.22	**250**	112.15	-57.57	-1.84
50	43.53	-7.96	-4.08	**315**	82.78	-40.90	-2.52

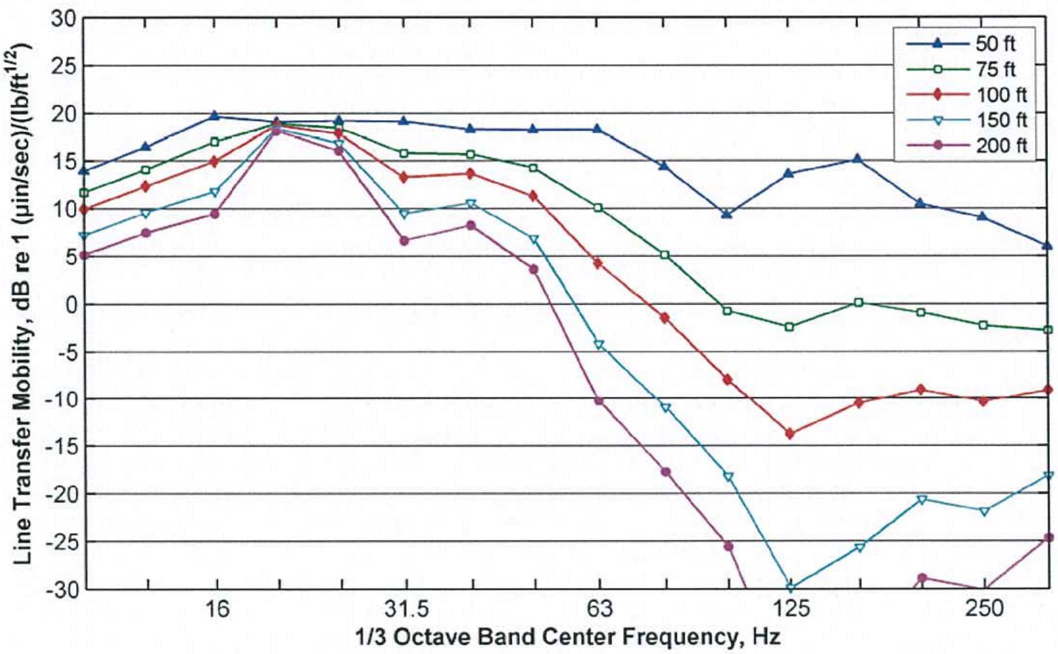


Figure 30: G-165. Best Fit LSTM

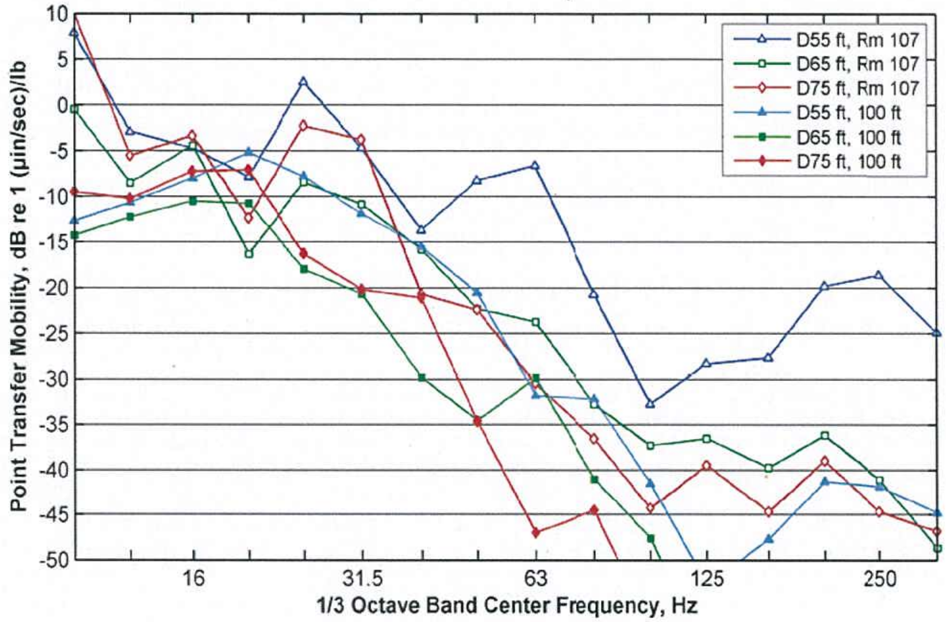


Figure 31: PSTM Spectra for Classroom 107

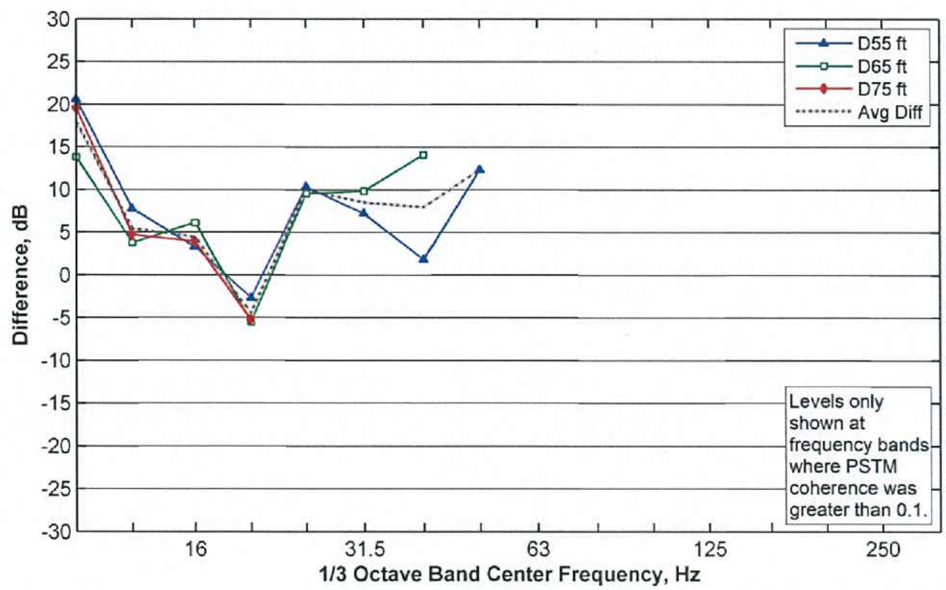


Figure 32: PSTM Difference (Indoor – Outdoor) for Room 107

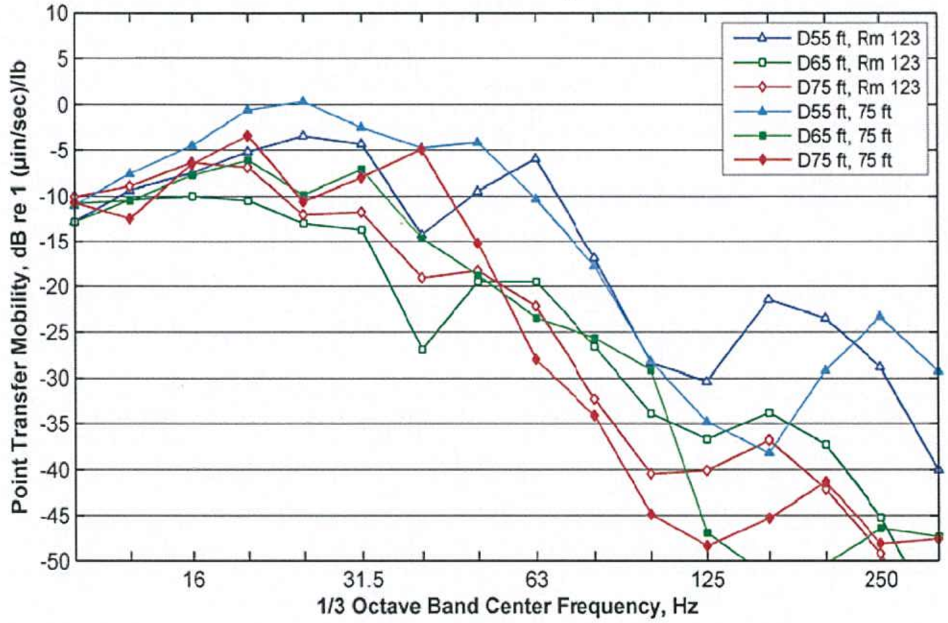


Figure 33: PSTM Spectra for Classroom 123

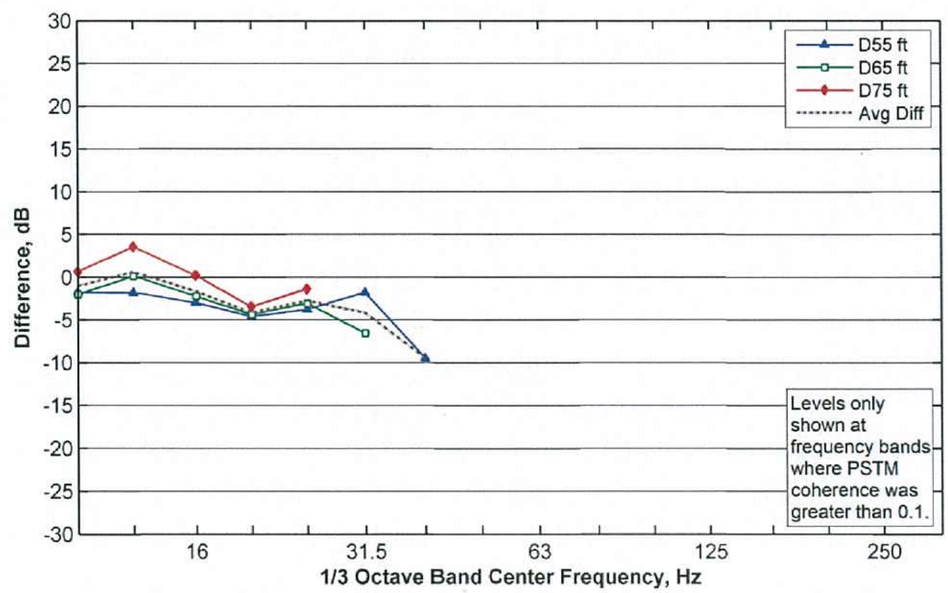


Figure 34: LSTM Difference (Indoor – Outdoor) for Room 123

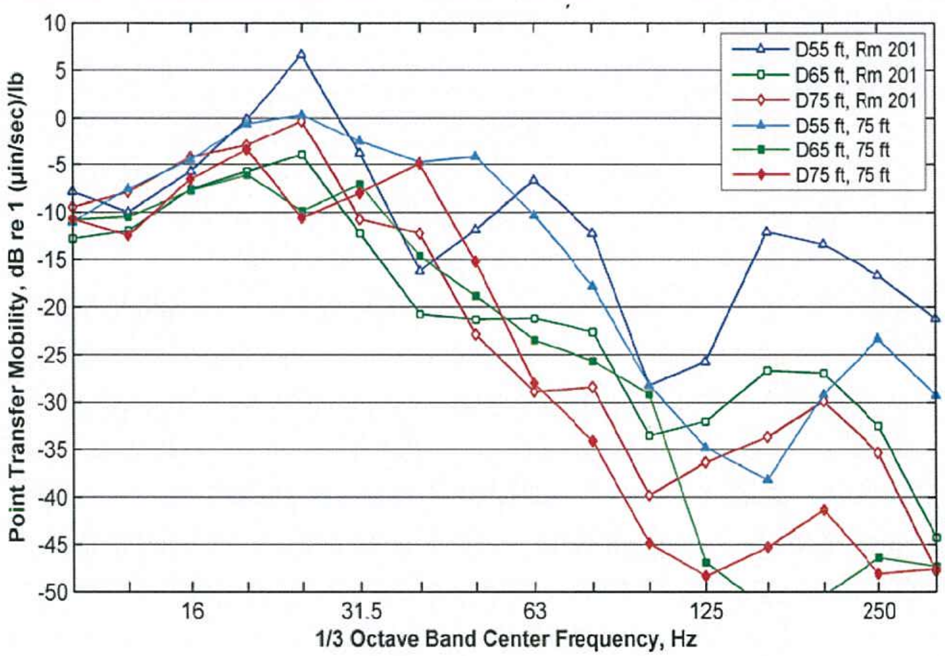


Figure 35: PSTM Spectra for Classroom 201

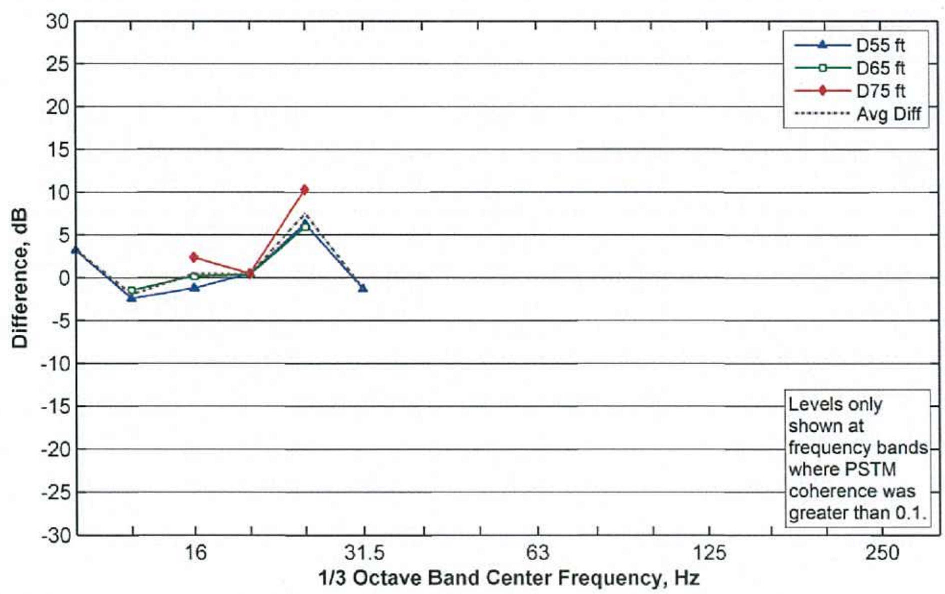


Figure 36 – PSTM Difference (Indoor – Outdoor) for Room 201

3.8 Site G-166

3.8.1 Site Description

This site was also on the Beverly Hills High School campus, along the western edge of the Lacrosse field. Testing was performed on 19 Mar 2011, at test depths of 55, 65, and 75 feet. The accelerometers were located at distances of 25, 40, 60, 90, 140, and 165 feet, extending north from the borehole location. The line of accelerometers was offset from the borehole by 4 ft. Additional observations from the measurements include:

- At the 55 ft test depth, the load cell was advanced 2 ft by the impacts. Peak force levels were 4k to 5k lbs, among the lowest observed in the 12 tests. 100 hits were recorded.
- At the 65 ft depth, 100 impact hits were recorded before the drill string advancement (30 to 36 inches) halted data collection. No force data was available for this test depth due to instrumentation problems, although the large advancement observed implies very low forces.
- At the 75 ft depth, 100 impact hits were recorded with 6 inches advancement during the first 30 hits, and no perceptible advancement for the remainder of the test. The force levels rose from 4k to 25k lbs during the test.

3.8.2 Results for G-166

- Coherences were good through 160 Hz for all the measurements except the farthest accelerometers for each depth, which still had good coherence in 1/3 octave bands below 63 Hz.
- The LSTM decreases with distance more rapidly at the higher frequencies than at lower frequencies. There minimum decrease with distance is in the 16 Hz band.
- The best fit LSTM has a spectral peak on the 63 Hz band for the 50 ft distance, which is seen in the PSTM of the closest accelerometer location at the shallowest depth. However, there is a distinct dip in coherence for that band at the 55 foot test depth. .

3.8.3 *Plots and Tables*

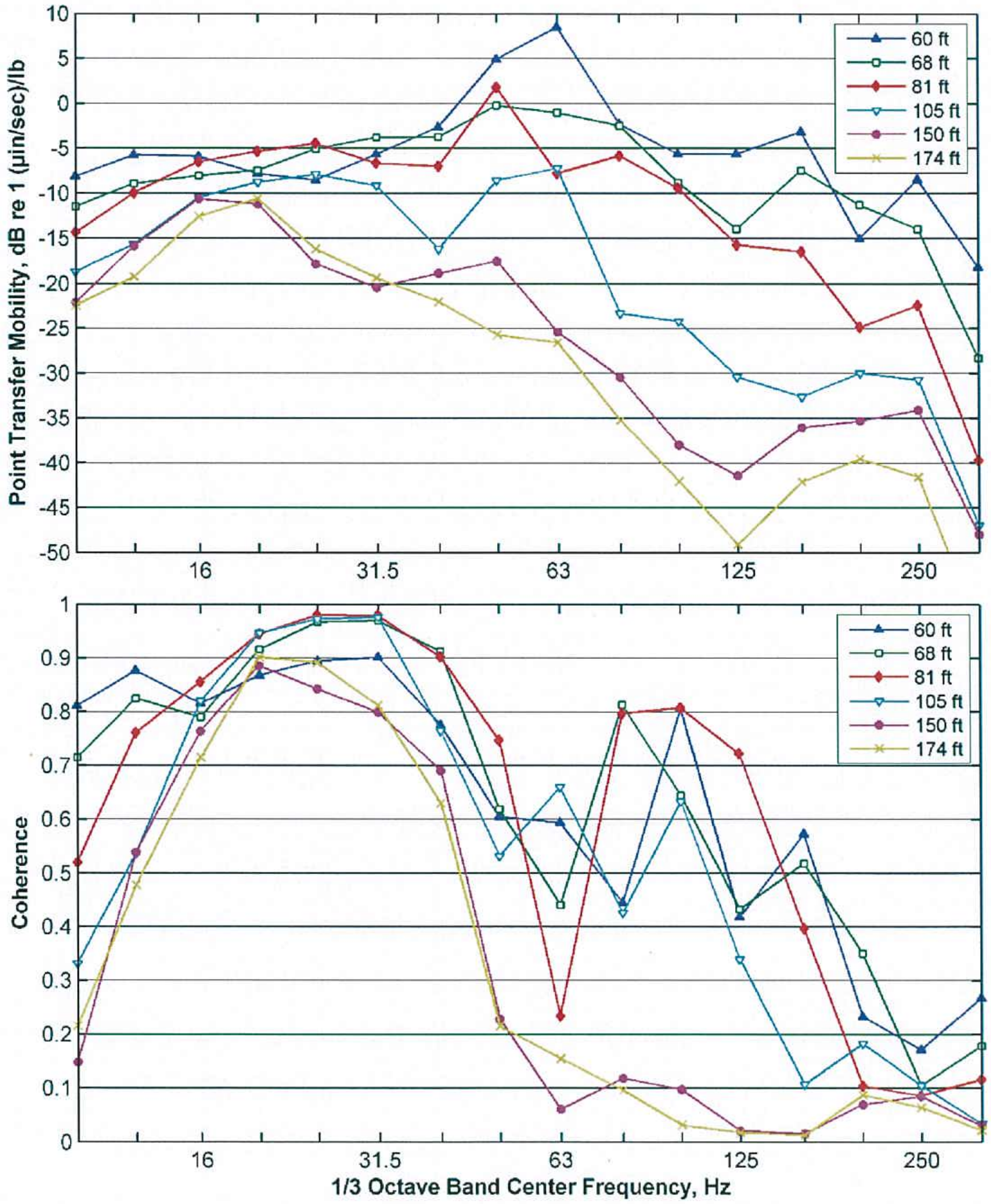


Figure 37: G-166. Measured PSTM at Depth of 55 ft

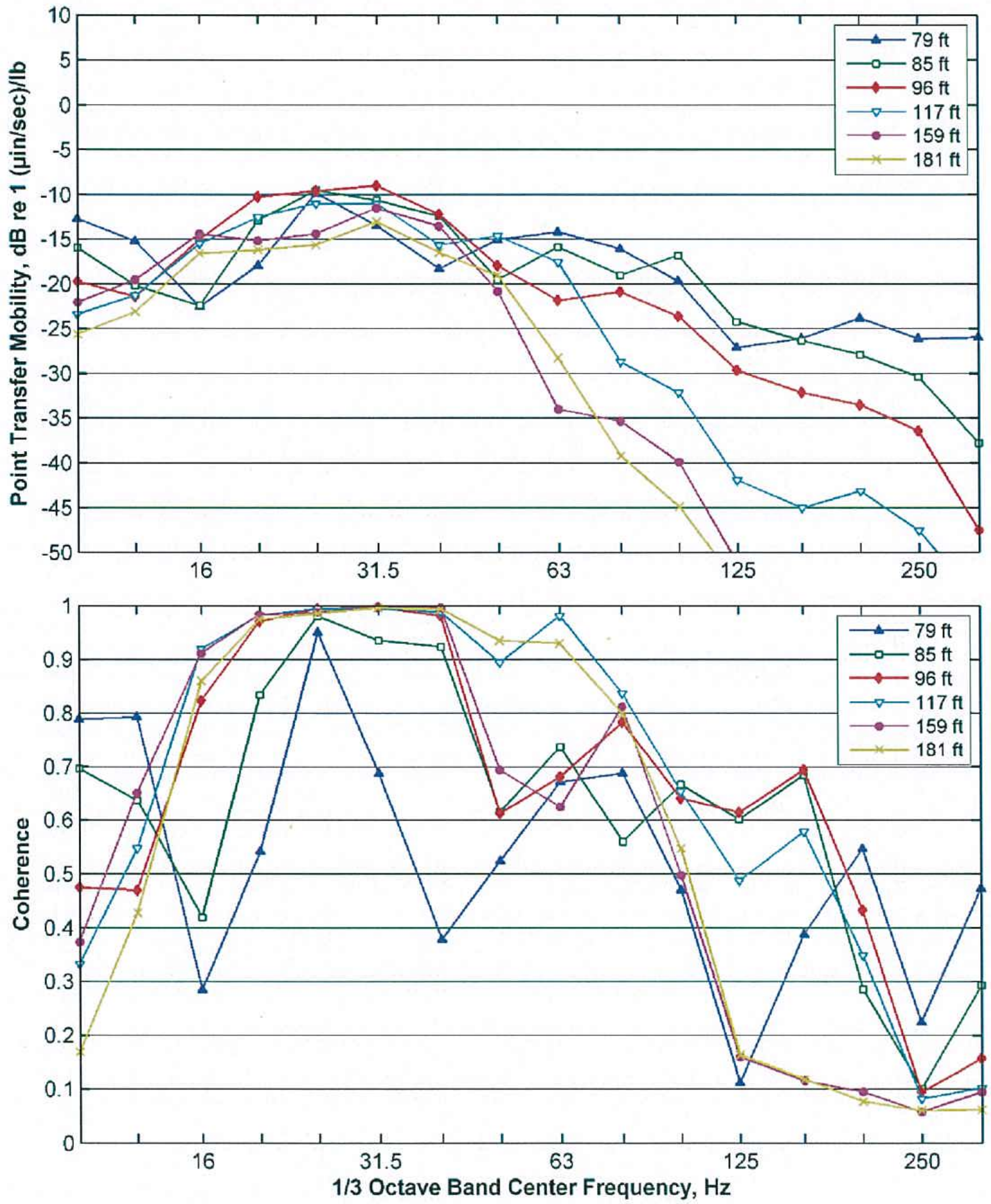


Figure 38: G-166. Measured PSTM at Depth of 75 ft

Table 11: G-166. Coefficients for Best Fit LSTM

Freq. (Hz)	A	B	C	Freq. (Hz)	A	B	C
10	34.67	-6.44	-4.13	**63**	111.57	-48.31	-2.20
12.5	24.81	-0.25	-4.23	**80**	125.44	-58.92	-1.80
16	11.27	4.73	-2.14	**100**	136.53	-66.96	-1.53
20	14.28	5.60	-2.94	**125**	150.72	-77.97	-1.22
25	27.56	1.14	-4.20	**160**	156.92	-81.03	-1.15
31.5	27.83	0.85	-4.20	**200**	117.63	-60.87	-1.73
40	33.87	-3.40	-4.21	**250**	131.87	-69.04	-1.47
50	71.55	-24.18	-3.33	**315**	121.84	-69.26	-1.46

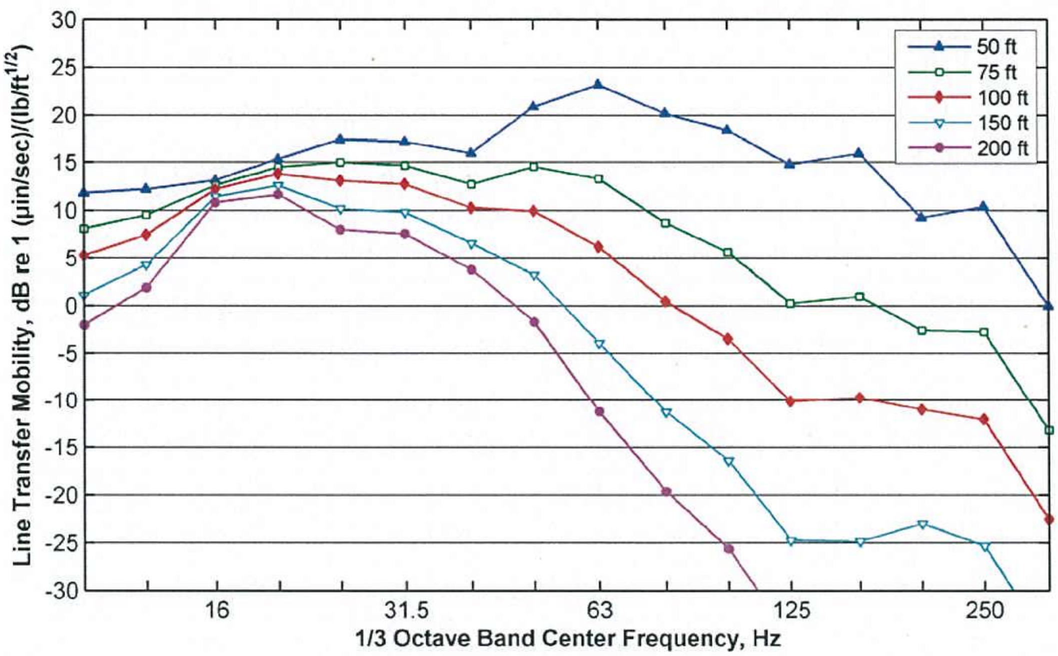
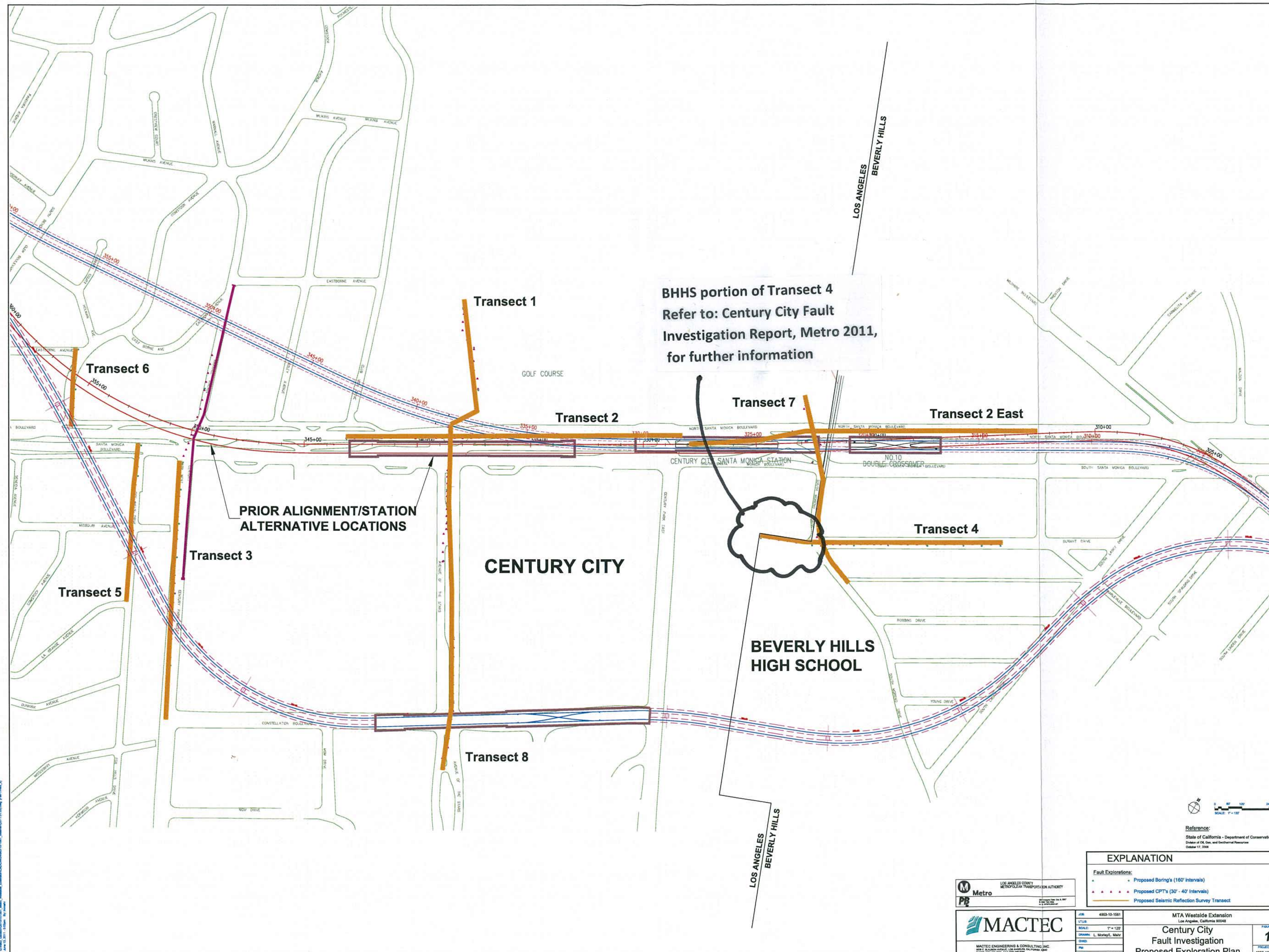


Figure 39: G-166. Best Fit LSTM

5. FAULT INVESTIGATION – TRANSECT 4


BHHS portion of Transect 4
Refer to: Century City Fault Investigation Report, Metro 2011, for further information
Transect 1
Transect 2
Transect 2 East
Transect 3
Transect 4
Transect 5
Transect 6
Transect 7
Transect 8
PRIOR ALIGNMENT/STATION ALTERNATIVE LOCATIONS
CENTURY CITY
BEVERLY HILLS HIGH SCHOOL
LOS ANGELES
BEVERLY HILLS
GOLF COURSE
CENTURY CITY SANTA MONICA STATION
NO.10 DOUBLE CROSSOVER
SCALE: 1" = 120'
Reference:
State of California - Department of Conservation
EXPLANATION
Fault Explorations:
Proposed Boring's (160' Intervals)
Proposed CPT's (30' - 40' Intervals)
Proposed Seismic Reflection Survey Transect
LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY
Metro
MACTEC
MACTEC ENGINEERING & CONSULTING INC.
JOB: 4953-10-1561
SCALE: 1" = 120'
DRAWN: L. Morley/L. Mahr
DATE: 06/13/2011
MTA Westside Extension
Los Angeles, California 90048
Century City Fault Investigation Proposed Exploration Plan
FIGURE 1
PROJECT NO. 4953-10-1561

ELEVATION (ft)	DEPTH (ft)	ROCK CORE						MATERIAL DESCRIPTION
		BOX #	RUN #	% RECOVERY	SAMPLE LOCATION	SOIL GRAPHIC	SOIL TYPE	
1	2	3	4	5	6	7	8	

COLUMN DESCRIPTIONS

1. **ELEVATION:** Elevation, in feet (ft), referenced to mean sea level (MSL).
2. **DEPTH:** Distance (in feet) below ground surface
3. **BOX #:** Recovered core box number.
4. **RUN #:** Individual coring interval number.
5. **RECOVERY:** Percentage of recovered core from the coring interval; calculated as length of recovered core divided by length of run.
6. **SAMPLE LOCATION:** Estimated depth of recovered core sample.
7. **SOIL GRAPHIC:** Graphical illustration of standardized soil type.
8. **SOIL TYPE:** Soil type label, based on the Unified Soil Classification System (USCS). No laboratory testing was performed as part of this investigation to confirm soil classifications.

TYPICAL MATERIAL GRAPHIC SYMBOLS

Clay	Sandy Clay	Clay with Gravel	Silt
Sandy Silt	Silt with Gravel	Well Graded Sand	Poorly Graded Sand
Clayey Sand	Clayey Sand with Gravel	Silty Sand	Silty Sand with Gravel
Sand with Gravel	Clayey Gravel	Silty Gravel	Well Graded Gravel

OTHER GRAPHIC SYMBOLS

∇ Groundwater encountered during drilling

▼ Groundwater measured during drilling

\- - - Approximate contact line between soil types and/or sub-units

—— Approximate contact line between geologic units

This log is a reasonable interpretation of subsurface conditions at the time of exploration and at the exploration location. Subsurface conditions may differ at different times and locations outside of the exploration. Depths of strata are approximate.

Key to Log of Core Boring

Sheet 1 of 1

MTA Westside Subway Extension
Los Angeles, California
Project No. 4953-10-1561

amec

Figure A-1

DRILLING COMPANY/DRILLING EQUIPMENT		BORING NO.
Jet Drilling / CME 75		**T4-B1**
DRILLING METHOD: Hollow-Stem Auger	BOREHOLE LOCATION: See Plate 3	
DATES DRILLED: 3/19/11	HOLE DIAMETER: 8 inches	GROUND EL.: 265 feet
GROUNDWATER READINGS: Encountered at 47-ft during drilling		

ELEVATION (ft)	DEPTH (ft)	BOX #	RUN #	% RECOVERY	SAMPLE LOC.	USCS	DESCRIPTION
							8 inches of asphaltic concrete over 4 inches of base
							Hand augered to 6 feet
						ML	**FILL [Af]** Clayey to Sandy Silt, trace coarse sand and fine gravel (Jsm and Tm); brown (10YR 4/3); appears moist and stiff to very stiff
							NOTE: Jsm = Santa Monica Slate; Tm = Modelo Formation; See end of log for more detailed descriptions of clasts
260	5						At 4.0 to 8.5': Becomes dark brown (10YR 3/3)
							At 6.0 to 7.0': Becomes gravelly
		1	1	100		ML	**YOUNGER/OLDER ALLUVIAL FAN DEPOSITS [Qf/Qfo]** Clayey to Sandy Silt, trace coarse sand and fine gravel (Jsm and Tm); brown (10YR 4/3); appears moist and stiff; poorly sorted; lower contact is gradational
							At 8.5': Becomes lightly mottled, color variable, mainly dark grayish brown (10YR 4/2) to light brownish yellow (10YR 6/4)
255	10						
		1	2	86			**ESTUARINE DEPOSITS [Qe]** Sandy Silt, trace to some clay; lightly mottled, grayish brown (2.5Y 5/2) to brown (7.5YR 5/4); appears moist and stiff; well sorted; lower contact is narrowly gradational
						ML	Sandy to Clayey Silt, trace coarse sand (Jsm and Tm); light olive brown (2.5Y 5/3) with variable strong brown (7.5YR 5/6) mottling; appears moist and very stiff; well sorted; some faint laminations; some calcium carbonate filaments, total calcium carbonate is about 5 to 15%
250	15						
		1	3	76			At 16.0': Calcium carbonate decreases to trace, becomes more clayey
							At 17.8 to 19.0': No recovery
							At 19.0 to 21.0': Becomes strongly mottled, yellowish brown (10YR 5/8) to gray (10YR 6/1)
	20						

THIS RECORD IS AN INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. LATITUDE AND LONGITUDE OF BORING LOCATION SHOWN ON LOGS ARE APPROXIMATE. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

(CONTINUED ON FOLLOWING FIGURE)

Geologist: DB/MF
Prepared/Date: WL/YN/AR 10/10/2011
Checked/Date: MW/MF 10/10/2011

DRILLING COMPANY/DRILLING EQUIPMENT		BORING NO.
Jet Drilling / CME 75		**T4-B1 (Continued)**
DRILLING METHOD	**BOREHOLE LOCATION**	
Hollow-Stem Auger	See Plate 3	
DATES DRILLED	**HOLE DIAMETER**	**GROUND EL.**
3/19/11	8 inches	265 feet
GROUNDWATER READINGS		
Encountered at 47-ft during drilling		

ELEVATION (ft)	DEPTH (ft)	BOX #	RUN #	% RECOVERY	SAMPLE LOC.	USCS	DESCRIPTION
		2	4	100		ML	**Qe Continued**
		2	5	100			At 22.0 to 25.0': Trace coarse sand and fine gravel (Jsm and Tm), occasional subangular slate (Jsm) up to 1 inch; strongly mottled, strong brown (7.5YR 5/8) to gray (10YR 6/1); variable faint laminations (Possible Poorly Developed Paleosol)
240	25	2	6	100		CL/ ML	**Marker Bed M_C** - Silty Clay to Clayey Silt, trace to some fine sand, trace coarse sand and fine gravel (Jsm and Tm); dark brown (7.5YR 3/4) with occasional light brownish gray (10YR 6/2) mottling, appears very moist and very stiff; generally poorly sorted; grades downward into fan deposits below, possible poorly developed paleosol
		3	7	100		ML	**FAN DEPOSITS [Qfo]** Clayey to Sandy Silt, trace coarse sand and fine gravel (Jsm and Tm); color variable; generally brown (10YR 4/3), some subhorizontal, strong brown (7.5YR 5/6) to gray (10YR 5/1) laminations in upper 6 inches of bed; generally poorly sorted; appears very moist and stiff; lower contact is narrowly gradational
235	30					SM/ ML	Silty Sand and Sandy Silt, very fine grained, trace to some clay, trace coarse sand and fine gravel (Jsm and Tm); dark yellowish brown (10YR 3/6); appears very moist and dense/stiff; lower contact occurs between runs
		3	8	52			At 31.6 to 34.0': No recovery
						SC/ SM	At 34.0 to 34.8': Fine to coarse, Clayey Silty Sand with Gravel, clasts 15-20%, up to 3/4 inch, mainly subangular to subrounded slate (Jsm) and shale (Tm); dark brown (10YR 3/3); appears moist and dense
230	35	3	9	92		ML/ CL	**ESTUARINE DEPOSITS - FINE GRAINED [Qef]** Clayey Silt and Silty Clay, fine grained, trace to some fine sand, mottled, yellowish brown (10YR 5/4) to strong brown (10YR 5/8); appears very moist and very stiff; moderately well sorted; variable manganese oxide staining, slightly micaceous; lower contact is gradational
		3	10	100			At 38.7 to 39.3': Becomes more sandy, abundant manganese oxide staining
	40						

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(CONTINUED ON FOLLOWING FIGURE)

Geologist: DB/MF
Prepared/Date: WL/YN/AR 10/10/2011
Checked/Date: MW/MF 10/10/2011

DRILLING COMPANY/DRILLING EQUIPMENT		BORING NO.
Jet Drilling / CME 75		**T4-B1 (Continued)**
DRILLING METHOD Hollow-Stem Auger	**BOREHOLE LOCATION** See Plate 3	
DATES DRILLED 3/19/11	**HOLE DIAMETER** 8 inches	**GROUND EL.** 265 feet
GROUNDWATER READINGS Encountered at 47-ft during drilling		

ELEVATION (ft)	DEPTH (ft)	BOX #	RUN #	% RECOVERY	SAMPLE LOC.	USCS	DESCRIPTION
		3	11	100		ML	**Qef Continued** Sandy Silt with Clay, rare coarse sand and fine gravel (Jsm and Tm); brown (10YR 5/3) with variable brown (7.5YR 4/4) to yellowish brown (10YR 5/6) mottling; appears very moist and very stiff; some subhorizontal laminations; lower contact is gradational
		3	12	100		SM	**ESTUARINE DEPOSITS [Qe]** Silty Sand with Gravel, fine grained, gravel 15-20%, up to 3/4 inch, mainly subangular to subrounded slate (Jsm), some subrounded shale (Tm) and granitic rock also observed; color variable; appears very moist and dense
						ML	Clayey to Sandy Silt, trace coarse sand and fine gravel (Jsm and Tm); brown with variable yellowish brown (10YR 5/6) mottling; appears very moist and very stiff; some varve-like bedding; lower contact is gradational
220	45	4	13	42			At 44.7 to 44.9' and 45.6 to 45.8': Silty Sand with Gravel, fine grained, contacts are sharp to narrowly gradational, sub-horizontal At 45.3 to 45.6' and 45.8 to 46.1': Silty Clay, trace coarse sand, contacts are narrowly gradational to sharp; sub-horizontal ▽ At 46.1 to 49.0': No recovery At 47': Groundwater encountered during drilling
215	50	4	14	20		SP-SM	At 49.0 to 49.5': Poorly Graded Sand with Silt, fine to medium grained, trace coarse sand (Jsm and Tm); dark yellowish brown (10YR 4/4); appears wet and dense; depth of contacts uncertain due to poor recovery At 49.5 to 51.5': No recovery
		4	15	100		ML	
						CL	Silty Clay, trace coarse sand (Jsm and Tm); grayish brown (2.5Y 4/2) with variable light yellowish brown (10YR 6/4) mottling; appears moist to very moist and very stiff; variable varve-like bedding; lower contact occurs between runs At 54.0 to 55.2': Clay alternates with numerous subhorizontal Silt and fine Silty Sand laminations, generally light yellowish brown (10YR 6/4) to dark yellowish brown (10YR 4/6)
210	55	4	16	100			At 55.2 to 57.0': Some (5-10%) calcium carbonate filaments
		4	17	100		CL	**ESTUARINE DEPOSITS-FINE GRAINED [Qef]** Silty Clay, ytrace coarse sand (Jsm); grayish brown with variable faint mottling; appears moist to very moist and stiff; variable varve-like bedding At 57.0 to 59.0': Variable sub-horizontal Silt and Sand laminations and irregular pockets
	60						

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(CONTINUED ON FOLLOWING FIGURE)

Geologist: DB/MF
Prepared/Date: WL/YN/AR 10/10/2011
Checked/Date: MW/MF 10/10/2011

DRILLING COMPANY/DRILLING EQUIPMENT		BORING NO.
Jet Drilling / CME 75		**T4-B1 (Continued)**
DRILLING METHOD Hollow-Stem Auger	**BOREHOLE LOCATION** See Plate 3	
DATES DRILLED 3/19/11	**HOLE DIAMETER** 8 inches	**GROUND EL.** 265 feet
GROUNDWATER READINGS Encountered at 47-ft during drilling		

ELEVATION (ft)	DEPTH (ft)	BOX #	RUN #	% RECOVERY	SAMPLE LOC.
		4	18	100	
200	65				
		5	19	100	
195	70				
		5	20	100	
190	75				
	80				

CL

Qef Continued
Silty Clay, trace coarse sand and fine gravel (Jsm and Tm), including some brick-red sandstone; clay generally dark grayish brown (10YR 4/2); silt is strong brown (7.5YR 4/6); appears very moist and stiff; irregular, oxidized silt pockets and/or lenses; lower contact is gradational
At 60.5 to 61.8': Calcium carbonate filaments increase with depth, near 5%

At 62.0 to 67.0': Coarsens with depth, oxidized silt increases, calcium carbonate ocurrs as filaments and nodules up to 1/4 inch, total calcium carbonate about 5-15%; coarse sand and fine gravel increase slightly, occasional rare gravelly beds

At 64.0 to 64.2': Gravel increases to about 10-15%, fine grained, mainly shale and fine sandstone (Tm)

ML

OLDER ALLUVIAL FAN DEPOSITS [Qfo]
Sandy to Clayey Silt, trace coarse sand and fine gravel (Jsm and Tm), rare (<1%) gravel up to 1 inch; light yellowish brown (10YR 6/4); appears moist and hard, trace calcium carbonate filaments

At 69.0 to 74.0': Becomes very moist, very stiff, mottled, brown (7.5YR 4/4) to dark grayish brown (10YR 4/2)

At 71.5 to 74.0': Gravel increases to about 5-10%, up to ½ inch, mainly subangular to subrounded shale and fine sandstone (Tm) and slate (Jsm), some brick red sandstone (Tm); trace calcium carbonate filaments and nodules up to 1/8-inch

END OF BORING AT 74 FEET

NOTES:
Boring backfilled with cement/bentonite grout from bottom up and patched.

-Munsell colors listed in order of predominance (most predominant color first).
-Where observed, contacts and bedding appear subhorizontal unless otherwise noted.
-Non-recovery intervals are assumed to occur at the bottom of run unless otherwise noted.
-Santa Monica Slate (Jsm) clasts are generally very dark gray, subangular to subrounded slate unless otherwise noted. Modelo Formation (Tm) clasts are generally white to pale yellow to tan, subangular to subrounded shale and sandstone unless otherwise noted.
-The term "clasts" herein describes gravel-size rock fragments (larger than ¼ inch).
-Beds are generally massive unless otherwise noted.

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Geologist: DB/MF
Prepared/Date: WL/YN/AR 10/10/2011
Checked/Date: MW/MF 10/10/2011

THIS RECORD IS AN INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. LATITUDE AND LONGITUDE OF BORING LOCATION SHOWN ON LOGS ARE APPROXIMATE. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

DRILLING COMPANY/DRILLING EQUIPMENT		BORING NO.
Jet Drilling / CME 75		**T4-B2**
DRILLING METHOD Hollow-Stem Auger	**BOREHOLE LOCATION** See Plate 3	
DATES DRILLED 3/5/11	**HOLE DIAMETER** 8 inches	**GROUND EL.** 263 feet
GROUNDWATER READINGS Encountered at 39.5-ft during drilling		

ELEVATION (ft)	DEPTH (ft)	BOX #	RUN #	% RECOVERY	SAMPLE LOC.	USCS	DESCRIPTION
263	0						Asphaltic concrete over base Hand augered to 6 feet NOTE: Jsm = Santa Monica Slate Tm = Modelo Formation See end of log for more detailed descriptions of clasts
260							
	5						
255		1	1	100		SC	No sampling to 8.0' **FILL [Af]** Clayey Sand, fine to coarse grained, some gravel, 10-15%, up to ½ inch; very dark grayish brown (10YR 3/2); appears very moist and medium dense
						ML/CL	**ESTUARINE DEPOSITS [Qe]** Silty Clay and Clayey Silt, trace to some fine sand, trace coarse sand (Jsm and Tm); mottled, dark grayish brown (10YR 4/2) to strong brown (7.5YR 4/6); appears very moist and stiff; variable oxidized silt laminations; well sorted; lower contact is narrowly gradational
	10						
						CL	At 12.1 to 13.0': Clay, dark grayish brown (10YR 4/2)
250		1	2	100		ML	Sandy to Clayey Silt; trace coarse sand and fine gravel (Jsm and Tm); dark gray (10YR 4/1) with occasional strong brown (7.5YR 4/6) mottling; appears moist to very moist and stiff; variable varve-like bedding and oxidized laminations; lower contact is narrowly gradational
	15						
						CL	At 17.5 to 18.0': Grades to Silty Clay
245						ML	
						SM	At 19.0 to 19.7': Grades to Silty Sand with Clay, becomes more sandy with depth, transition to gravel bed below, gravel 50-60%, up to 3/4 inch
	20					GM	At 19.7 to 20.5': Silty Gravel with Sand, mainly subangular to subrounded slate (Jsm),

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(CONTINUED ON FOLLOWING FIGURE)

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THIS RECORD IS AN INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. LATITUDE AND LONGITUDE OF BORING LOCATION SHOWN ON LOGS ARE APPROXIMATE. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

DRILLING COMPANY/DRILLING EQUIPMENT		BORING NO.
Jet Drilling / CME 75		**T4-B2 (Continued)**
DRILLING METHOD Hollow-Stem Auger	**BOREHOLE LOCATION** See Plate 3	
DATES DRILLED 3/5/11	**HOLE DIAMETER** 8 inches	**GROUND EL.** 263 feet
GROUNDWATER READINGS Encountered at 39.5-ft during drilling		

ELEVATION (ft)	DEPTH (ft)	BOX #	RUN #	% RECOVERY	SAMPLE LOC.	USCS	DESCRIPTION
		1	3	100		GM	**Qalo Continued** subrounded shale (Tm) and quartzite; soil matrix is fine to coarse silty sand with clay; very dark grayish brown (10YR 3/2); appears moist and dense; lower contact is erosional
240						SM	At 20.5 to 21.3': Color becomes dark yellowish brown (10YR 4/4) At 21.0': Thin (1/8 inch) oxidized silt lamination, approximate dip 10 degrees At 21.2 to 23.0': Becomes mottled, dark brown (10YR 3/3) to strong brown (7.5YR 4/6); some evenly spaced, subhorizontal laminations At 23.0 to 26.1': Mottled gray (10YR 5/1) to dark yellowish brown (10YR 4/4)
	25	2	4	100			
						CL/ML	**Marker Bed M_E** Silty Clay to Clayey Silt, trace to some fine sand, trace coarse sand and fine gravel (Jsm and Tm); dark brown (7.5YR 3/4) with occasional gray (10YR 5/1) mottling and laminations; appears moist and very stiff; possible weak soil development; lower contact occurs between runs
235						ML	**OLDER ALLUVIAL FAN DEPOSITS [Qfo]** Clayey to Sandy Silt; trace coarse sand and fine gravel; brown (7.5YR 4/3); appears moist and very stiff; poorly sorted; lower contact occurs between runs
	30	2	5	80			At 32.0 to 33.0': No recovery
230						SC/SM	Clayey to Silty Sand with Gravel, fine to coarse grained, clasts 15-25%, up to 2 inches, mainly subangular to subrounded slate (Jsm); shale (Tm) and brick-red fine sandstone (Tm); dark brown (10YR 3/3); appears moist and dense; lower contact is gradational
	35	2	6	60		ML	At 35.5 to 36.0': Sandy Silt with variable clay, trace coarse sand and fine gravel (Jsm and Tm); brown (7.5YR 4/3); appears very moist and stiff At 36.0 to 38.0': No recovery
225						SM	Silty Sand, fine to coarse grained, trace clay, trace fine gravel (Jsm and Tm); brown (7.5YR 4/4); appears very moist to wet and dense; lower contact occurs between runs
	40	3	7	88			▽ At 39.5': Groundwater encountered during drilling

(CONTINUED ON FOLLOWING FIGURE)

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Project No.: 4953-10-1561 Figure: T4-B2b

DRILLING COMPANY/DRILLING EQUIPMENT		BORING NO.
Jet Drilling / CME 75		**T4-B2 (Continued)**
DRILLING METHOD: Hollow-Stem Auger	BOREHOLE LOCATION: See Plate 3	
DATES DRILLED: 3/5/11	HOLE DIAMETER: 8 inches	GROUND EL.: 263 feet
GROUNDWATER READINGS: Encountered at 39.5-ft during drilling		

ELEVATION (ft)	DEPTH (ft)	BOX #	RUN #	% RECOVERY	SAMPLE LOC.	USCS	DESCRIPTION
						SM	**Qfo Continued** Silty Sand as above, increasing gravel
		3	8	16			At 40.9 - 43.0': No recovery
220						SM	
	45	3	9	20			At 43.6 - 46.0': No recovery
215		N/A	10	0			At 46.0 to 50.0': No recovery
	50					SM	At 50.0 to 51.0': Appears wet, more gravelly, gravel 15-20%, up to 3/4 inch, mainly subangular to subrounded slate (Jsm) and shale (Tm), recovery possibly slough
		3	11	33			At 51.0 - 53.0': No recovery
							At 52.0': About 15' of material heaved up into auger. Auger redrilled from about 37' to 53.0', no sampling at 52.0 to 53.0'
210						SM	At 53.0 to 65.5': No reliable intact sample obtained. Material recovered consists of fine to coarse Silty Sand with variable clay and gravel; likely drill slough/disturbed material below 53.0'
	55	3	12	40			
205						SM	At 58.0 to 59.0': Recovered only slough/disturbed material
							At 59.0 - 63.0': No recovery
	60						

(CONTINUED ON FOLLOWING FIGURE)

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THIS RECORD IS AN INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. LATITUDE AND LONGITUDE OF BORING LOCATION SHOWN ON LOGS ARE APPROXIMATE. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

DRILLING COMPANY/DRILLING EQUIPMENT		BORING NO.
Jet Drilling / CME 75		**T4-B2 (Continued)**
DRILLING METHOD: Hollow-Stem Auger	BOREHOLE LOCATION: See Plate 3	
DATES DRILLED: 3/5/11	HOLE DIAMETER: 8 inches	GROUND EL.: 263 feet
GROUNDWATER READINGS: Encountered at 39.5-ft during drilling		

ELEVATION (ft)	DEPTH (ft)	BOX #	RUN #	% RECOVERY	SAMPLE LOC.	USCS	DESCRIPTION
		3	13	20			Qfo Continued
200						SM	At 63.0 to 64.0': Recovered only slough/disturbed material
	65	3	14	40			At 64.0 - 65.5': No recovery
		N/A	15	0			At 65.5 to 72.0': No recovery
195		N/A	16	0			
	70	N/A	17	0			
190							END OF BORING AT 72 FEET
	75						
185							
	80						

END OF BORING AT 72 FEET

NOTES:
Boring backfilled with cement/bentonite grout from bottom up and patched.

-Munsell colors listed in order of predominance (most predominant color first).
-Where observed, contacts and bedding appear subhorizontal unless otherwise noted.
-Non-recovery intervals are assumed to occur at the bottom of run unless otherwise noted.
-Santa Monica Slate (Jsm) clasts are generally very dark gray, subangular to subrounded slate unless otherwise noted. Modelo Formation (Tm) clasts are generally white to pale yellow to tan, subangular to subrounded shale and sandstone unless otherwise noted.
-The term "clasts" herein describes gravel-size rock fragments (larger than ¼ inch).
-Beds are generally massive unless otherwise noted.

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Project No.: 4953-10-1561 Figure: T4-B2d

DRILLING COMPANY/DRILLING EQUIPMENT		BORING NO.
Jet Drilling / CME 75		**T4-B3**
DRILLING METHOD Hollow-Stem Auger	**BOREHOLE LOCATION** See Plate 3	
DATES DRILLED 4/20/11 - 4/22/11	**HOLE DIAMETER** 8 inches	**GROUND EL.** 260 feet
GROUNDWATER READINGS Encountered at 46-ft during drilling		

ELEVATION (ft)	DEPTH (ft)	BOX #	RUN #	% RECOVERY	SAMPLE LOC.	USCS	DESCRIPTION
	0					SM	Hand augered to 6 feet Grab sample collected at 2' **FILL [Af]** Silty Sand with Gravel, fine to coarse grained NOTE: Jsm = Santa Monica Slate Tm = Modelo Formation See end of log for more descriptions of clasts
						CL	**YOUNGER/OLDER ALLUVIAL FAN DEPOSITS [Qf/Qfo]** Clay and Silty Clay, trace coarse sand (Jsm and Tm); brown (10YR 4/3); appears wet and medium stiff
255	5						
						CL/SC	Sandy Clay and Clayey Sand with Gravel, clasts 15-20%, up to 1/2 inch, mainly subangular slate (Jsm), sandstone (Tm) and shale (Tm); dark brown (10YR 3/3); appears moist and stiff/medium dense; poorly sorted; lower contact appears narrowly gradational
		1	1	100			
						ML	**ESTUARINE DEPOSITS [Qe]** Clayey Silt, variable fine sand; lightly mottled, grayish brown (10YR 5/2) to strong brown (7.5Y 4/6); appears very moist and medium stiff; lower contact is gradational At 9.0 to 9.5': Color becomes grayish brown (10YR 5/2) to brownish yellow (10YR 6/8); trace coarse sand (Jsm and Tm)
						SM	At 9.5 to 9.9': Silty Sand, fine grained; lightly mottled, grayish brown (10YR 6/2) to strong brown (7.5YR 5/8)
250	10					ML	At 9.9 to 10.5': Sandy to Clayey Silt with Gravel, clasts 15-20%, up to 3/4 inch, mainly subangular slate (Jsm) and shale (Tm); dark grayish brown (10YR 4/2)
						SM	At 10.5 to 10.8': Silty Sand, fine grained; strong brown (7.5YR 4/6)
						CL	Clay and Silty Clay, trace coarse sand (Jsm and Tm); lightly mottled, grayish brown (2.5Y 5/2) to light yellowish brown (2.5Y 6/3) to yellowish brown (10YR 5/8); appears moist and very stiff; some varve-like bedding; lower contact is narrowly gradational
		1	2	100			
						ML	Clayey to Sandy Silt, rare (<1%) coarse sand (Jsm and Tm); lightly mottled, grayish brown (10YR 5/2) to light yellowish brown (2.5Y 6/3); appears moist and very stiff; lower contact is gradational
245	15						
		1	3	100			Clayey to Sandy Silt, rare (<1%) coarse sand (Jsm and Tm); strongly mottled, brown (10YR 5/3) to strong brown (7.5Y 5/8); appears moist and very stiff to hard; variable (0-10%) manganese oxide flecks; prominent varve-like bedding; lower contact is gradational
	20						

(CONTINUED ON FOLLOWING FIGURE)

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LOG OF BORING
Project No.: 4953-10-1561 Figure: T4-B3a

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DRILLING COMPANY/DRILLING EQUIPMENT		BORING NO.
Jet Drilling / CME 75		**T4-B3 (Continued)**
DRILLING METHOD Hollow-Stem Auger	**BOREHOLE LOCATION** See Plate 3	
DATES DRILLED 4/20/11 - 4/22/11	**HOLE DIAMETER** 8 inches	**GROUND EL.** 260 feet
GROUNDWATER READINGS Encountered at 46-ft during drilling		

ELEVATION (ft)	DEPTH (ft)	BOX #	RUN #	% RECOVERY	USCS	DESCRIPTION
		2	4	100	ML	**Qe Continued** Clayey to Sandy Silt, trace coarse sand and fine gravel (Jsm and Tm); lightly mottled, brown (10YR 5/3) to strong brown (7.5YR 5/8); appears moist and very stiff; prominent varve-like bedding; lower contact is sharp At 21.5 to 22.5': Gravel increases, 15-20%, up to 1 1/2 inches At 22.0 to 22.1': Fine Silty Sand bed, strong brown (7.5YR 4/6) At 23.5 to 25.5': Trace manganese oxide flecks, up to 1/8 inch
235	25	2	5	100	ML	**Marker Bed M_E** - Clayey Silt, trace to some fine sand, trace coarse sand (Jsm and Tm); mottled, dark reddish brown (5YR 3/4) to yellowish red (5YR 4/6) to brown (7.5YR 5/2); appears very moist and stiff; lower contact is gradational; possible weak soil development At 27.1 to 27.5': Gradational transition to fan deposits below
					ML	**OLDER ALLUVIAL FAN DEPOSITS [Qfo]** Clayey to Sandy Silt, trace to some coarse sand and fine gravel, clasts 2-15%, up to 1/2 inch, mainly subangular slate (Jsm), shale (Tm) and sandstone (Tm); strongly mottled, color variable, mainly strong brown (7.5YR 5/6) to brown (7.5YR 4/4); appears moist and very stiff to hard; generally poorly sorted; occasional fine grained beds with varve-like bedding; lower contact occurs between runs
230	30	2	6	24		At 30.2 to 34.0': No Recovery
		3	7	90	SC	At 34.0 to 34.4': Clayey Sand with Gravel, fine to coarse grained; clasts 20-30%, up to 1/2 inch, mainly subrounded slate (Jsm), shale (Tm) and sandstone (Tm), some brick-red sandstone; color variable, generally dark brown (7.5YR 3/3); appears very moist to wet and dense; lower contact is sharp, erosional
225	35				ML	Sandy to Clayey Silt, trace to some coarse sand and gravel; clasts 2-10%, up to 1/2 inch, mainly subrounded slate (Jsm), shale (Tm) and sandstone (Tm); brown (7.5YR 4/4) with variable grayish brown (10YR 5/2) mottles; appears very moist and stiff; poorly sorted; lower contact occurs between runs At 36.3 to 36.8': Fine grained bed with varve-like bedding
					SM	At 38.2 to 39.0': Grades to fine Silty Sand with Gravel, variable clay, gravel 20-30%, up to 1 inch, mainly subrounded slate (Jsm)
	40				ML	**ESTUARINE DEPOSITS [Qe]** Clayey to Sandy Silt; trace coarse sand and gravel (Jsm and Tm); color variable, mainly brown (7.5YR 4/4) to grayish brown (10YR 5/2); appears very moist and stiff;

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(CONTINUED ON FOLLOWING FIGURE)

Geologist: DB/MF
Prepared/Date: WL/YN/MW 10/11/2011
Checked/Date: MW/MF 10/11/2011

DRILLING COMPANY/DRILLING EQUIPMENT		BORING NO.
Jet Drilling / CME 75		**T4-B3 (Continued)**
DRILLING METHOD Hollow-Stem Auger	**BOREHOLE LOCATION** See Plate 3	
DATES DRILLED 4/20/11 - 4/22/11	**HOLE DIAMETER** 8 inches	**GROUND EL.** 260 feet
GROUNDWATER READINGS Encountered at 46-ft during drilling		

ELEVATION (ft)	DEPTH (ft)	BOX #	RUN #	% RECOVERY	SAMPLE LOC.	USCS	DESCRIPTION
						ML	generally well sorted; variable varve-like bedding and laminations; lower contact occurs between runs **Qe Continued** At 39.0 to 42.5': Trace manganese oxide flecks up to 1/16 inch
		3	8	100			At 42.5 to 44.0': Variable (5-20%) manganese oxide flecks and nodules up to 1/4 inch
215	45						At 44.0 to 48.0': Becomes grayish brown (10YR 5/2) with strong brown (7.5YR 5/6) mottling At 44.0 to 46.5': Only slough recovered
		3	9	50			∇ At 46': Groundwater encountered during drilling At 46.5 to 49.0': No recovery
							Depth of contact uncertain due to poor recovery
210	50					SW	**OLDER ALLUVIAL FAN DEPOSITS [Qfol]** Well Graded Sand, fine to coarse grained, variable gravel, clasts 0-20%, up to 1/2 inch, mainly subangular to subrounded slate (Jsm), shale (Tm) and sandstone (Tm); color variable, generally brown (10YR 4/3); appears wet and dense; lower contact is sharp, erosional At 49.3 to 49.5': Sandy Silt bed
		4	10	60		ML	Sandy to Clayey Silt with Gravel, clasts 25-50%, up to 3/4 inch, mainly subangular to subrounded slate (Jsm), sandstone (Tm), shale (Tm) and quartzite; brown (7.5YR 4/4) appears very moist and stiff At 51.0 to 51.5': Several quartzite clasts up to 3/4 inch At 52.0 to 54.0': No recovery
							At 54.4 to 54.9': Grades to Silty Sand, fine-medium grained
205	55	4	11	100			At 54.9 to 55.2': Grades to Silty Sand with distinct laminations; brown (7.5YR) to grayish brown (10YR 5/2), very fine grained
						CL	**ESTUARINE DEPOSITS [Qe]** At 55.2 to 55.6': Clay, strong brown (7.5YR 4/6) with some grayish brown (10YR 5/2) mottles, 1/2 inch thick manganese oxide staining at base of bed
						ML	At 55.6 to 56.4': Clasts include brick-red sandstone (Tm)
		4	12	100		CL/ CH	Clay and Silty Clay, trace coarse sand (Jsm and Tm); mottled strong brown (7.5YR 5/6) to grayish brown (2.5YR 5/2); appears very moist and stiff to very stiff; variable varve-like bedding and laminations; lower contact is narrowly gradational At 58.0 to 60.0': Shear/Fault zone; numerous steep, irregular, shears, dip 60 to 80 degrees At 58.5 to 58.7': Distinct laminations At 59.2 to 60.2': Subhorizontal lenses and irregular pockets of highly oxidized silt; dark reddish brown (5YR 3/4)
	60						

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(CONTINUED ON FOLLOWING FIGURE)

Geologist: DB/MF
Prepared/Date: WL/YN/MW 10/11/2011
Checked/Date: MW/MF 10/11/2011

DRILLING COMPANY/DRILLING EQUIPMENT		BORING NO.
Jet Drilling / CME 75		**T4-B3** (Continued)
DRILLING METHOD: Hollow-Stem Auger	BOREHOLE LOCATION: See Plate 3	
DATES DRILLED: 4/20/11 - 4/22/11	HOLE DIAMETER: 8 inches	GROUND EL.: 260 feet
GROUNDWATER READINGS: Encountered at 46-ft during drilling		

THIS RECORD IS AN INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. LATITUDE AND LONGITUDE OF BORING LOCATION SHOWN ON LOGS ARE APPROXIMATE. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

ELEVATION (ft)	DEPTH (ft)	BOX #	RUN #	% RECOVERY	SAMPLE LOC.	USCS	DESCRIPTION
						CL	**Qe Continued** At 60.2 to 60.6': Color becomes dark grayish brown (10YR 4/2), 5-10% calcium carbonate filaments up to 1/16 inch
		4	13	100		ML	At 61.2 to 61.7': Grades to Clayey to Sandy Silt
						CL	At 61.7 to 62.6': Color becomes dark grayish brown (10YR 4/2), 10-20% calcium carbonate filaments up to 1/16 inch
						ML	At 63.0 to 63.4': Grades to Sandy to clayey Silt, mottled, color variable
						CL	At 63.4 to 64.0': Distinct varve like bedding At 64.3': 1/2 inch Sandy Silt bed At 64.5 to 65.5': 10-20% calcium carbonate filaments up to 1/8 inch At 64.8': 1/2 inch Silty Sand bed
195	65					SM/ML	At 65.5 to 65.9': Silty Sand to Sandy Silt, very fine grained, distinct laminations, lower contact is sharp, appears erosional
		5	14	100		CL	Clay, dark grayish brown (10YR 4/2); appears very moist and very stiff to hard; 10-25% calcium carbonate filaments and uncemented, irregular nodules up to 1/4-inch; lower contact is gradational
						CL	Clay and Silty Clay, rare (<1%) coarse sand (Jsm and Tm); dark grayish brown (10YR 4/2) with variable strong brown (7.5YR 5/8) mottling; appears very moist and very stiff to hard; variable (2-15%) calcium carbonate filaments and cemented nodules up to 1/4-inch; occasional sandy beds; lower contact is gradational
190	70						
		5	15	100		CL/ML	Silty Clay and Clayey Silt, variable fine sand, trace coarse sand (Jsm and Tm); strongly mottled, dark grayish brown (10YR 4/2) to strong brown (7.5YR 5/8); thickly bedded; appears very moist and very stiff to hard; trace calcium carbonate filaments and cemented calcium carbonate nodules up to 1/8-inch; lower contact is narrowly gradational
						CL/CH	**ESTUARINE DEPOSITS-FINE GRAINED [Qef]** Clay and Silty Clay, trace coarse sand (Jsm and Tm); brown (7.5YR 4/4) with occasional dark grayish brown (10YR 4/2) mottles; appears very moist and hard; rare calcium carbonate filaments up to 1/16-inch; generally thickly bedded; lower contact is gradational
185	75						
		5	16	100		SM/ML	At 77.5 to 78.3': Grades to fine Silty Sand/Sandy Silt
						CL	
	80					ML	At 79.4': Possible detrital charcoal, sample collected At 79.5 to 82.0': Grades to Clayey to Sandy Silt; trace coarse sand (Jsm and Tm)

(CONTINUED ON FOLLOWING FIGURE)

Geologist: DB/MF
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DRILLING COMPANY/DRILLING EQUIPMENT		BORING NO.
Jet Drilling / CME 75		**T4-B3 (Continued)**
DRILLING METHOD Hollow-Stem Auger	**BOREHOLE LOCATION** See Plate 3	
DATES DRILLED 4/20/11 - 4/22/11	**HOLE DIAMETER** 8 inches	**GROUND EL.** 260 feet
GROUNDWATER READINGS Encountered at 46-ft during drilling		

ELEVATION (ft)	DEPTH (ft)	BOX #	RUN #	% RECOVERY	USCS	DESCRIPTION
		6	17	68	ML	**Qef Continued**
					CL/ CH	Clay and Silty Clay as above At 82.4 to 84.0': No recovery
		6	18	100		At 84.0 to 86.0': Calcium carbonate filaments increase to 5-10%, up to 1/8 inch
175	85					At 86.0': Color becomes dark grayish brown, occasional highly oxidized strong brown (7.5YR 5/6), irregular pockets up to 1/2 inch; variable (2-15%) calcium carbonate filaments up to 1/4-inch
170	90					At 89.0 to 90.5': Calcium carbonate increases, 15-20% calcium carbonate filaments and cemented nodules up to 1/4 inch
		6	19	72	ML	**ESTUARINE DEPOSITS [Qe]** Clayey to Sandy Silt, variable coarse sand and gravel, clasts 5-25%, up to 3/4 inch, mainly subangular slate (Jsm), sandstone (Tm) and shale (Tm); strongly mottled, color variable, mainly strong brown (7.5YR 5/8) to dark grayish brown (10YR 4/2); appears very moist and very stiff to hard; variable (2-20%) calcium carbonate filaments and cemented nodules up to 1/4 inch At 92.0 to 95.0': Scattered chalk clasts and sediment pockets At 92.6 to 94.0': No recovery
165	95	7	20	100		At 95.0 to 95.5': manganese oxide flecks and staining, 5-15%
					CL	Clay and Silty Clay, rare (<1%) coarse sand (Jsm and Tm); strongly mottled, color variable, mainly strong brown (7.5YR 4/6) to dark grayish brown (10YR 4/2); appears very moist and very stiff to hard; occasional sandy beds; prominent varve-like bedding; lower contact is narrowly gradational
		7	21	40	SM	At 99.0 to 99.7': Silty Sand, fine-medium grained, dark brown (7.5YR 3/4)
	100				CL	

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(CONTINUED ON FOLLOWING FIGURE)

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LOG OF BORING
Project No.: 4953-10-1561 Figure: T4-B3e

DRILLING COMPANY/DRILLING EQUIPMENT		BORING NO.
Jet Drilling / CME 75		**T4-B3 (Continued)**
DRILLING METHOD Hollow-Stem Auger	**BOREHOLE LOCATION** See Plate 3	
DATES DRILLED 4/20/11 - 4/22/11	**HOLE DIAMETER** 8 inches	**GROUND EL.** 260 feet
GROUNDWATER READINGS Encountered at 46-ft during drilling		

ELEVATION (ft)	DEPTH (ft)	BOX #	RUN #	% RECOVERY	SAMPLE LOC.	USCS	DESCRIPTION
						CL	**Qe Continued**
		7	21	64			At 101.4 to 101.9': Becomes gravelly, clasts 25-35%, up to 3/4 inch, mainly subangular to subrounded slate (Jsm), sandstone (Tm) and shale At 102.6 to 104.0': No recovery
155	105					SM	At 104.5 to 105.5': Silty Sand, fine grained; mottled, yellowish brown (10YR 5/4) to grayish brown (10YR 5/2); some laminations and varve-like bedding
		7	22	68		CL/SM	At 105.5 to 106.1': Alternating laminations Clay and fine Silty Sand; colors similar to silty sand bed above
						CL	At 106.7 to 107.5': Occasional Silt laminations and pockets At 107.4 to 114.0': No recovery
150	110	8	23	0			
145	115	8	24	80		ML	Sandy to Clayey Silt, rare (<1%) coarse sand (Jsm and Tm); grayish brown (2.5Y 5/2) with variable brownish yellow (10YR 6/6) mottling; appears very moist and very stiff to hard; lower contact is sharp At 114.0 to 114.3': Gravelly bed, clasts 20-35%, up to 3/4 inch, mainly subrounded slate (Jsm) and sandstone (Tm) At 115.5': Silty Sand bed, fine grained; ½ inch thick; light brownish gray (10YR 6/2)
						CL/ML	**ESTUARINE DEPOSITS-FINE GRAINED [Qef]** Silty Clay and Clayey Silt, variable fine sand, trace coarse sand (Jsm and Tm); mottled, grayish brown (2.5Y 5/2) to strong brown (7.5YR 5/6); appears very moist and very stiff to hard; varve like bedding; occasional beds with rare (<1%) calcium carbonate filaments At 118.0 to 119.0': No recovery
	120						

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(CONTINUED ON FOLLOWING FIGURE)

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DRILLING COMPANY/DRILLING EQUIPMENT		BORING NO.
Jet Drilling / CME 75		**T4-B3 (Continued)**
DRILLING METHOD: Hollow-Stem Auger	**BOREHOLE LOCATION**: See Plate 3	
DATES DRILLED: 4/20/11 - 4/22/11	**HOLE DIAMETER**: 8 inches	**GROUND EL.**: 260 feet
GROUNDWATER READINGS: Encountered at 46-ft during drilling		

ELEVATION (ft)	DEPTH (ft)	BOX #	RUN #	% RECOVERY	SAMPLE LOC.	USCS	DESCRIPTION
						CL/ML	**Qef Continued**
		8	25	100			
							At 123.0 to124.7': Color becomes dark brown (7.5YR 3/2) to brown (7.5YR 4/4); distinct laminations, trace manganese oxide flecks
135	125					CL/SC	**OLDER ALLUVIAL FAN/ESTUARINE DEPOSITS [Qfo/Qe]** Sandy Clay to Clayey Sand with Gravel; clasts 25-30%, up to 1/2 inch, mainly subangular slate (Jsm) and sandstone (Tm); color variable At 125.6 to 129.0': No recovery
		8	26	28			
						SC/CL	At 129.0 to 129.5': Clayey Sand to Sandy Clay with Gravel, clasts 25-35%, up to 1 inch, mainly subrounded slate (Jsm) and sandstone (Tm)
130	130					CL/ML	Silty Clay and Clayey Silt, variable fine sand, trace coarse sand and fine gravel (Jsm and Tm); mottled dark grayish brown (2.5Y 4/2) to reddish yellow (7.5YR 6/6); appears very moist and very stiff to hard; trace manganese oxide flecks; well sorted; lower contact is gradational
		9	27	66			
							At 132.3 to 134.0': No recovery
							At 134.0 to 134.0': Sand increases, gradational transition to unit below
125	135					ML	Sandy to Clayey Silt, abundant coarse sand and trace fine gravel (Jsm and Tm); mottled light olive brown (2.5Y 5/3) to strong brown (7.5YR 5/6); appears moist to very moist and very stiff to hard; poorly sorted; 10-20% calcium carbonate filaments and fine cemented and uncemented nodules up to 1/4-inch; lower contact is missing/disturbed in core
		9	28	88			
							At 137.9 to 138.4': Sandy Silt; mottled, light yellowish brown (2.5Y 6/3) to reddish yellow (7.5YR 6/6); appears moist and very stiff, rare (<1%) coarse sand (Jsm and Tm)
							END OF BORING AT 139 FEET
	140						NOTES:

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(CONTINUED ON FOLLOWING FIGURE)

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LOG OF BORING
Project No.: 4953-10-1561 Figure: T4-B3g

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DRILLING COMPANY/DRILLING EQUIPMENT		BORING NO.
Jet Drilling / CME 75		**T4-B3 (Continued)**
DRILLING METHOD Hollow-Stem Auger	**BOREHOLE LOCATION** See Plate 3	
DATES DRILLED 4/20/11 - 4/22/11	**HOLE DIAMETER** 8 inches	**GROUND EL.** 260 feet
GROUNDWATER READINGS Encountered at 46-ft during drilling		

ELEVATION (ft)	DEPTH (ft)	BOX #	RUN #	% RECOVERY	SAMPLE LOC.		DESCRIPTION
							Boring backfilled with cement/bentonite grout from bottom up and patched. -Munsell colors listed in order of predominance (most predominant color first). -Where observed, contacts and bedding appear subhorizontal unless otherwise noted. -Non-recovery intervals are assumed to occur at the bottom of run unless otherwise noted. -Santa Monica Slate (Jsm) clasts are generally very dark gray, subangular to subrounded slate unless otherwise noted. Modelo Formation (Tm) clasts are generally white to pale yellow to tan, subangular to subrounded shale and sandstone unless otherwise noted. -The term "clasts" herein describes gravel-size rock fragments (larger than ¼ inch). -Beds are generally massive unless otherwise noted.
115	145						
110	150						
105	155						
	160						

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LOG OF BORING

Project No.: 4953-10-1561 Figure: T4-B3h

DRILLING COMPANY/DRILLING EQUIPMENT		BORING NO.
Martini Drilling / CME 75		**T4-B10**
DRILLING METHOD Hollow-Stem Auger	**BOREHOLE LOCATION** See Plate 3	
DATES DRILLED 6/16/11 - 6/20/11	**HOLE DIAMETER** 8 inches	**GROUND EL.** 280 feet
GROUNDWATER READINGS		

ELEVATION (ft)	DEPTH (ft)	BOX #	RUN #	% RECOVERY	SAMPLE LOC.	USCS	DESCRIPTION
	0						8 inches of reinforced concrete
						ML	Hand augered to 6 feet **FILL [Af]** Sandy Silt, brown
						SC	At 3': Clayey Sand, fine to medium grained, brown, appears moist NOTE: Jsm = Santa Monica Slate Tm = Modelo Formation See end of log for more detailed descriptions of clasts
275	5						
		1	1	100		CL-ML/SC	At 6': Mottled Clayey Silt and Clayey Sand, fine grained, olive brown, appears moist and soft to loose; sand and gravel at lower contact
						ML	**ESTUARINE DEPOSITS [Qe]** Clayey to Sandy Silt, trace fine subangular gravel; olive gray (5Y 4/2); appears moist and stiff; discrete oxidized with interfingering laminae; lower contact occurs between runs
270	10					SP	(Sample disturbed) Poorly Graded Sand with Gravel, fine to medium grained, subangular to subrounded
						SP	(Sample less disturbed) More fines less gravel; lower contact is gradational
		1	2	100		ML	Silty Sand grading to Clayey Silt; fine grained, trace sand; olive brown (2.5Y 4/3); thin oxidized lenses/laminae; lower contact occurs between runs
265	15					SP	(Sample disturbed) Sand with Gravel, fine to very fine grained; angular clay clasts At 16': (Sample less disturbed) Silty Sand, fine grained, 5% angular gravel
		1	3	100		CL-ML	Clayey Silt with some fine sand and gravel (2-5%); dark yellowish brown (10YR 3/4); appears moist and very stiff; some varve-like bedding
	20						

(CONTINUED ON FOLLOWING FIGURE)

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DRILLING COMPANY/DRILLING EQUIPMENT		BORING NO.
Martini Drilling / CME 75		**T4-B10** **(Continued)**
DRILLING METHOD Hollow-Stem Auger	**BOREHOLE LOCATION** See Plate 3	
DATES DRILLED 6/16/11 - 6/20/11	**HOLE DIAMETER** 8 inches	**GROUND EL.** 280 feet
GROUNDWATER READINGS		

ELEVATION (ft)	DEPTH (ft)	BOX #	RUN #	% RECOVERY	SAMPLE LOC.	USCS	DESCRIPTION
	20					ML	**OLDER ALLUVIAL FAN DEPOSITS [Qfo]** At 20': (Disturbed Sample) Sandy Silt with some Clay and Gravel
						SM	At 21.1 to 21.8': Increasing Gravel and Sand, grades to Silty Sand with Gravel; lower contact is gradational
						SM	At 21.8': Silty Sand, fine to medium grained, some clay, trace fine gravel; dark yellowish brown (10YR 4/6); appears moist and moderately dense; lower contact is gradational
		2	4	100		ML	At 22.5': (less disturbed) Clayey Silt, trace gravel and sand; thin oxidized layers/lenses; lower contact is sharp At 23.5': Gravel and Sand bed (2 inches thick), fine to coarse grained, angular to rounded, thin fine sandy layers interfingering At 24': Silt, manganese stained splotches, increasing fine sand with depth, lower contact is gradational
255	25					CL-ML	At 25': (disturbed sample) Increasing Clay, dark reddish brown (5YR 3/4) mottling; depth of contact uncertain due to poor recovery
						SC	At 26': Clayey Sand with Gravel, clayey matrix, clasts are angular and fine grained, mostly slate and granitic; lower contact is narrowly gradational; (less disturbed)
		2	5	100		ML	Silt, some very fine sand and trace clay; olive brown (2.5Y 4/4) increasing clay, grades to Silty Clay with depth, trace gravel; thin oxidized layers interfingering; lower contact is gradational
250	30					SC	Clayey Sand, fine grained, some fine gravel; appears moist and medium dense; lower contact occurs between runs At 30.0-32.0': Disturbed sample
		2	6	100		SM	Silty Sand, fine grained, trace fine gravel; mottled coloring dark yellowish brown (10YR 4/6); thin oxidized layers interfingering; lower contact is narrowly gradational
						ML	Clayey Silt, trace fine to coarse gravel, fine sand, thin fine sandy interbedded At 33.7-34.0': Sand with Gravel bed, fine to coarse grained gravel, fine to medium grained sand; depth of contact uncertain due to poor recovery
245	35					SW	**OLDER FLUVIAL FAN DEPOSITS [Qfofl]** Well Graded Sand with Gravel, fine to medium sand, fine to coarse gravel, angular to subangular
							Well Graded Sand, fine to medium grained; olive brown (2.5Y 4/4); lower contact is sharp
		3	7	76		ML	Clayey Silt with Gravel; olive brown (2.5Y 4/6)
						SP/SC	At 38.4': Clayey Sand to Sand; lower contact is gradational At 38.6 to 40.0': No recovery
	40						

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(CONTINUED ON FOLLOWING FIGURE)

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LOG OF BORING

Project No.: 4953-10-1561 Figure: T4-B10b

DRILLING COMPANY/DRILLING EQUIPMENT		BORING NO.
Martini Drilling / CME 75		**T4-B10 (Continued)**
DRILLING METHOD: Hollow-Stem Auger	BOREHOLE LOCATION: See Plate 3	
DATES DRILLED: 6/16/11 - 6/20/11	HOLE DIAMETER: 8 inches	GROUND EL.: 280 feet
GROUNDWATER READINGS		

ELEVATION (ft)	DEPTH (ft)	BOX #	RUN #	% RECOVERY	SAMPLE LOC.	USCS	DESCRIPTION
							Qfofl continued Poor to no recovery (slough)
							At 41.3 to 45': No recovery
		3	8	26			
235	45					ML	**ESTUARINE DEPOSITS [Qe]** Clayey Sand grades to Clayey Silt; olive brown (2.5Y 4/4); thin oxidized interfingering layers; increasing clay with depth
						SM	At 46.5-46.8': Thin fine Silty Sand interbeds
		3	9	100		CL	Clay, very dark grayish brown (2.5Y 3/2); some silt, trace fine sand; trace calcium carbonate concretion nodules, gravel size
							At 48.5-48.7': Thin carbonate layers, near horizontal zones of calcium carbonate concretion Clay, very dark grayish brown (2.5Y 3/2); abundant fine shell fragments and calcium carbonate nodules
230	50						At 50-52.5': Sample disturbed
						SM	Silty Sand, very fine to fine grained, trace gravel, trace calcium carbonate nodules
		4	10	100		ML	Clayey Silt, some fine sand; dark grayish brown (10YR 4/2); appears moist and stiff; thin oxidized interfingering layers; trace calcium carbonate nodules; lower contact is gradational; increasing clay with depth
						CL	Clay bed
225	55					ML	Clayey Silt, some fine sand; dark brown (7.5YR 3/4); near verticle calcium carbonate vein; increasing sand to Sandy Silt with trace coarse gravel; 2 to 5% up to 1 inch in diameter, angular slate and subrounded granitics
		4	11	100		SP	Poorly Graded Sand, fine to medium grained; appears moist and medium dense
						ML	Silt to Clayey Silt; appears moist and stiff; thin oxidized interbeds; trace fine sand
	60						

(CONTINUED ON FOLLOWING FIGURE)

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DRILLING COMPANY/DRILLING EQUIPMENT		BORING NO.
Martini Drilling / CME 75		**T4-B10 (Continued)**
DRILLING METHOD Hollow-Stem Auger	**BOREHOLE LOCATION** See Plate 3	
DATES DRILLED 6/16/11 - 6/20/11	**HOLE DIAMETER** 8 inches	**GROUND EL.** 280 feet
GROUNDWATER READINGS		

ELEVATION (ft)	DEPTH (ft)	BOX #	RUN #	% RECOVERY	SAMPLE LOC.	USCS	DESCRIPTION
						ML	**OLDER ALLUVIAL FAN DEPOSITS [Qfo]**
							At 61.2-62.3': Trace gravel increasing sand grades to Sandy Silt; near vertical calcium carbonate filaments
		4	12	100			Clayey Silt, some fine to coarse gravel; dark yellowish brown (10YR 4/4); trace calcium carbonate nodules; appears very moist and soft; lower contact occurs between runs
215	65					SM	Silty Sand, fine to coarse grained; dark yellowish brown (10YR 3/4); appears moist and medium dense; fine to coarse gravel; angular to subangular
		5	13	100		SM	Increasing Silt, fine grained sand; dark yellowish brown (10YR 3/4); appears moist and medium dense, trace clay; lower contact is gradational At 67.5-68.0': Increasing Sand, fine to medium grained; trace gravel
210	70					ML	**ESTUARINE DEPOSITS - FINE GRAINED [Qef]** Clayey Silt, trace fine to medium grained gravel; dark yellowish brown (10YR 3/4); appears moist and stiff; well sorted, generally massive; trace calcium carbonate nodules; trace manganese oxide staining
		5	14	100			At 73': Color changes to very dark grayish brown (2.5Y 3/2) At 74': Color changes to dark olive gray (5Y 3/2); clayey, trace calcium carbonate filaments
205	75						
		5	15	100		CL	Clay; black (5Y 2.5/2); punky texture with waxy parting surfaces (possible shearing); appears moist and soft; splotchy oxidation At 78.6': Abundant calcium carbonate nodules; lower contact occurs between runs
	80						

(CONTINUED ON FOLLOWING FIGURE)

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DRILLING COMPANY/DRILLING EQUIPMENT		BORING NO.
Martini Drilling / CME 75		**T4-B10 (Continued)**
DRILLING METHOD Hollow-Stem Auger	**BOREHOLE LOCATION** See Plate 3	
DATES DRILLED 6/16/11 - 6/20/11	**HOLE DIAMETER** 8 inches	**GROUND EL.** 280 feet
GROUNDWATER READINGS		

ELEVATION (ft)	DEPTH (ft)	BOX #	RUN #	% RECOVERY	SAMPLE LOC.	USCS	DESCRIPTION
						SC	**ESTUARINE DEPOSITS [Qe]** At 80-81': Distubed sample Clayey Sand, fine grained, some fine to medium gravel; dark grayish brown (2.5Y 4/2); appears moist and dense; well sorted
		6	16	100			
						ML	Increasing Silt to Clayey Silt; dark grayish brown (2.5Y 4/2); lower contact is narrowly gradational
195	85					SC	At 84.8': Grades to Clayey fine Sand
							At 85.7': Grades to Clayey Silt, some very fine sand; dark yellowish brown (10Y 3/6); varying amount of sand and clay
		6	17	100			
						SW	Sand with Gravel, fine to coarse grained, fine to coarse gravel; subangular to angular; lower contact is gradational
						ML	Clayey Silt; appears moist and soft to medium stiff; very dark grayish brown (2.5Y 3/2)
190	90						
						SW	At 91-92.2': Increasing Sand and Gravel, fine to coarse grained; subrounded; lower contact occurs between runs; (sample disturbed)
							At 92.2-95': No recovery
		6	18	44			
185	95					ML	Clayey Silt; olive brown (2.5Y 4/4); thin interbedded clay; very dark grayish brown (2.5Y 3/2); lower contact is gradational
		7	19	100		SM	At 97.4-97.8': Grades to Silty Sand, fine to medium grained; dark grayish brown (2.5Y 4/2); appears moist and medium dense; slight oxidation mottling; lower contact is gradational
						ML	At 97.8': Silt; lower contact is gradational
						SM	Silty Sand, lower contact is gradational
	100						

(CONTINUED ON FOLLOWING FIGURE)

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DRILLING COMPANY/DRILLING EQUIPMENT		BORING NO.
Martini Drilling / CME 75		**T4-B10 (Continued)**
DRILLING METHOD Hollow-Stem Auger	BOREHOLE LOCATION See Plate 3	
DATES DRILLED 6/16/11 - 6/20/11	HOLE DIAMETER 8 inches	GROUND EL. 280 feet
GROUNDWATER READINGS		

ELEVATION (ft)	DEPTH (ft)	BOX #	RUN #	% RECOVERY	SAMPLE LOC.	USCS	DESCRIPTION
		7	20	100		SP	**Qe Continued** At 100-100.8': Thin Clay interbeds At 100.8': Trace fine gravel, subrounded; lower contact is gradational
						SW	Well Graded Sand with Gravel, fine to coarse grained; angular to subangular; very dark grayish brown (2.5Y 3/2)
						ML	Clayey Silt, trace fine gravel; dark gray (5Y 4/1); appears moist and stiff; lower contact occurs between runs
175	105					SC	Clayey Sand, fine to medium grained; dark grayish brown (2.5Y 4/2); trace calcium carbonate nodules, decrease quantity with depth; lower contact is narrowly gradational
		7	21	100		ML	Clayey Silt; dark grayish brown (2.5Y 3/2); some fine sand and variable clay; appears moist and stiff; slightly splotchy oxidation; lower contact is narrowly gradational
170	110	8	22	100			
165	115	8	23	100		SM	**BASAL ALLUVIAL FAN UNIT [Qfob]** Silty Sand to Sandy Silt; fine grained, trace coarse, some clay, coarse sand and gravel increasing with depth; olive brown (2.5Y 4/3); trace calcium carbonate nodules; appears moist and medium dense; poorly sorted At 116.9': Calcium carbonate becomes more abundant
						ML	
	120						

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(CONTINUED ON FOLLOWING FIGURE)

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DRILLING COMPANY/DRILLING EQUIPMENT		BORING NO.
Martini Drilling / CME 75		T4-B10 (Continued)
DRILLING METHOD: Hollow-Stem Auger	BOREHOLE LOCATION: See Plate 3	
DATES DRILLED: 6/16/11 - 6/20/11	HOLE DIAMETER: 8 inches	GROUND EL.: 280 feet
GROUNDWATER READINGS		

ELEVATION (ft)	DEPTH (ft)	BOX #	RUN #	% RECOVERY	SAMPLE LOC.	USCS	DESCRIPTION
						ML	**BASAL ALLUVIAL UNIT [Qfob]** At 119.7: Clayey Silt with some fine Sand; light yellowish brown (2.5Y 6/3); trace to some calcium carbonate nodules; appears moist and stiff; poorly sorted; lower contact is gradational
		8	24	100		SM	At 121.9': Fine Silty Sand; lower contact is narrowly gradational
						SM	At 123.0': Fine Silty Sand; dark greenish gray (5GY 4/1); lower contact is sharp
						ML	
155	125						
		9	25	100		SM	At 126.6': Silty fine Sand; dark grayish olive (10Y-5GY 4/2); variable gravel, fine to coarse ; trace silt and clay, occasional clayey silt interbeds
150	130					SP	Poorly Graded Sand, fine to medium grained; very dark greenish gray (5GY 3/1); appears moist and loose to medium dense; lower contact is sharp
						CL	**BASAL ESTUARINE UNIT [Qeb]** Silty Clay; dark greenish gray (5GY 4/1); lower contact is gradational
		9	26	100			At 131.8': Some calcium carbonate nodules; gravel ½-inch in diameter, mostly sandstone
						SM	At 132.8-133.2': Grades to fine Silty Sand
						ML	Clayey Silt; abundant calcium carbonate veins and nodules; dark olive gray (5Y 3/2); appears moist and soft; varying amounts of fine sand and clay; some fine oxidized pockets
							At 134.2': Increases consistency to very stiff to hard
145	135						
							At 135.6-137.5': Abundant coarse gravel
		9	27	100			At 137.5': Fine, irregular, oxidized pockets
	140						

(CONTINUED ON FOLLOWING FIGURE)

Geologist: DB/MW
Prepared/Date: WL/YN/MW 10/11/2011
Checked/Date: MW/MF 10/11/2011

THIS RECORD IS AN INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. LATITUDE AND LONGITUDE OF BORING LOCATION SHOWN ON LOGS ARE APPROXIMATE. SUBSURFACE CONDITIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

DRILLING COMPANY/DRILLING EQUIPMENT		BORING NO.
Martini Drilling / CME 75		**T4-B10 (Continued)**
DRILLING METHOD: Hollow-Stem Auger	BOREHOLE LOCATION: See Plate 3	
DATES DRILLED: 6/16/11 - 6/20/11	HOLE DIAMETER: 8 inches	GROUND EL.: 280 feet
GROUNDWATER READINGS		

ELEVATION (ft)	DEPTH (ft)	BOX #	RUN #	% RECOVERY	SAMPLE LOC.	USCS	DESCRIPTION
						ML	**Qeb Continued** Varying fine sand; abundant calcium carbonate; lower contact is sharp
		10	28	100			
135	145						
							At 145.5': Becomes olive gray (5Y 4/2), abundant calcium carbonate, some fine irregular oxidized pockets
		10	29	100			
							At 148.0 to 149.0': Highly oxidized, sharp contact with unit below
						CL	**SAN PEDRO FORMATION [Qsp]** At 149-149.3': Clay bed, black (5Y 2.5/1); organic-rich; lower contact is sharp
						CL	At 149.3-149.4': Sand bed; very dark gray (5Y 3/1); appears dense; lower contact is sharp
130	150					SP-SM	At 149.4-149.85': Clay bed; olive gray (5Y 4/2); appears moist and very stiff; lower contact is sharp
							Poorly Graded Sand with Silt, grades from fine to medium grained; very dark gray (5Y 3/1); appears very moist to moist and medium dense; trace subangular gravel; lower contact occurs between runs At 150.0 to 152.0': Poorly Graded Sand with Silt,
		10	30	100			
							At 152.8': Becomes fine grained; light olive gray (5Y 6/2)
125	155						
		11	31	86			
	160						

THIS RECORD IS AN INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. LATITUDE AND LONGITUDE OF BORING LOCATION SHOWN ON LOGS ARE APPROXIMATE. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

METRO SOIL CORE S:\70131 GEOTECH\GINTW\FAULT_INVESTIGATION_WSE_LIBRARY AMEC OCTOBER2011 (2).GLB
G:\PROJECT_DIRECTORIES\4953\2010\101561_METRO_WESTSIDE_EXTENSION\6.2.3.2 FAULT HAZARD INVESTIGATION\3.2 ALL FIELD NOTES\GINT LOGS\101561-TRANSECT 4.GPJ 10/14/11

(CONTINUED ON FOLLOWING FIGURE)

Geologist: DB/MW
Prepared/Date: WL/YN/MW 10/11/2011
Checked/Date: MW/MF 10/11/2011

METRO SOIL CORE S:\70131 GEOTECH\GINT\W\FAULT_INVESTIGATION_WSE_LIBRARY AMEC OCTOBER2011 (2).GLB
G:\PROJECT_DIRECTORIES\4953\2010\101561_METRO_WESTSIDE_EXTENSION\6.2.3.2 FAULT HAZARD INVESTIGATION\3.2 ALL FIELD NOTES\GINT LOGS\101561-TRANSECT 4.GPJ 10/14/11

THIS RECORD IS AN INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. LATITUDE AND LONGITUDE OF BORING LOCATION SHOWN ON LOGS ARE APPROXIMATE. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

DRILLING COMPANY/DRILLING EQUIPMENT		BORING NO.
Martini Drilling / CME 75		**T4-B10 (Continued)**
DRILLING METHOD Hollow-Stem Auger	**BOREHOLE LOCATION** See Plate 3	
DATES DRILLED 6/16/11 - 6/20/11	**HOLE DIAMETER** 8 inches	**GROUND EL.** 280 feet
GROUNDWATER READINGS		

ELEVATION (ft)	DEPTH (ft)	BOX #	RUN #	% RECOVERY	SAMPLE LOC.	USCS	DESCRIPTION
						SP-SM	**Qsp Continued**
						SW	At 160.5': Grades to Well Graded Sand, fine to coarse grained
		11	32	46			At 162.3-165.0': No recovery
115	165					SP	Poorly Graded Sand with Gravel; clasts mostly subrounded to subangular granitic rock and slate; smaller gravel is subrounded; lower contact occurs between runs
							At 166-170': No recovery
		11	33	20			
110	170					ML	Clayey Silt; dark olive gray (5Y 3/2); trace small shell fragments; interbedded sandy silt beds
		11	34	72			
							At 143.6-175': No recovery
105	175						END OF BORING AT 175 FEET
	180						

NOTES:
Boring backfilled with cement/bentonite grout from bottom up and patched.

- -Munsell colors listed in order of predominance (most predominant color first).
- -Where observed, contacts and bedding appear subhorizontal unless otherwise noted.
- -Non-recovery intervals are assumed to occur at the bottom of run unless otherwise noted.
- -Santa Monica Slate (Jsm) clasts are generally very dark gray, subangular to subrounded slate unless otherwise noted. Modelo Formation (Tm) clasts are generally white to pale yellow to tan, subangular to subrounded shale and sandstone unless otherwise noted.
- -The term "clasts" herein describes gravel-size rock fragments (larger than ¼ inch).
- -Beds are generally massive unless otherwise noted.

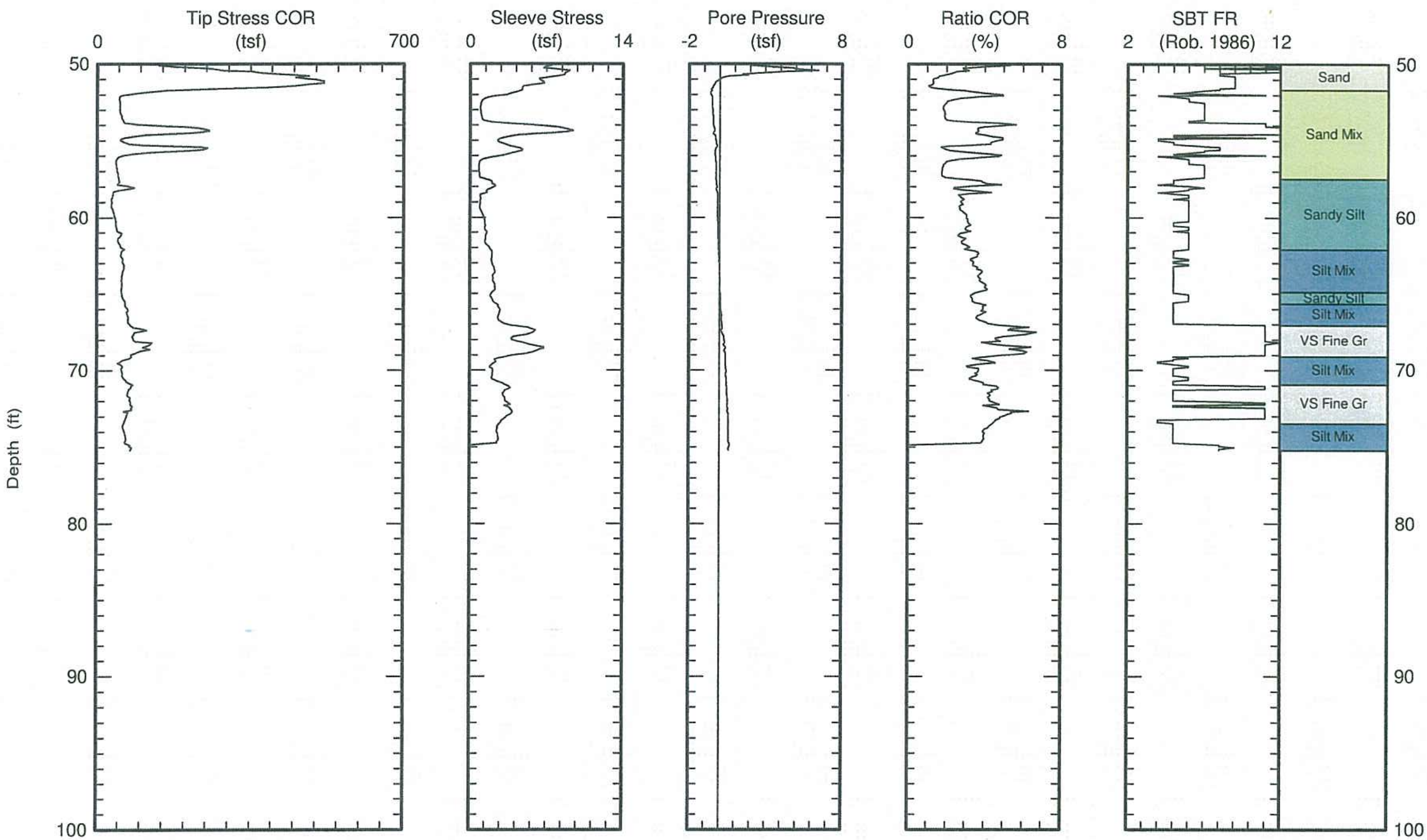
Geologist: DB/MW
Prepared/Date: WL/YN/MW 10/11/2011
Checked/Date: MW/MF 10/11/2011

MTA Westside Subway Extension
Los Angeles, California

amec

LOG OF BORING
Project No.: 4953-10-1561 Figure: T4-B10i

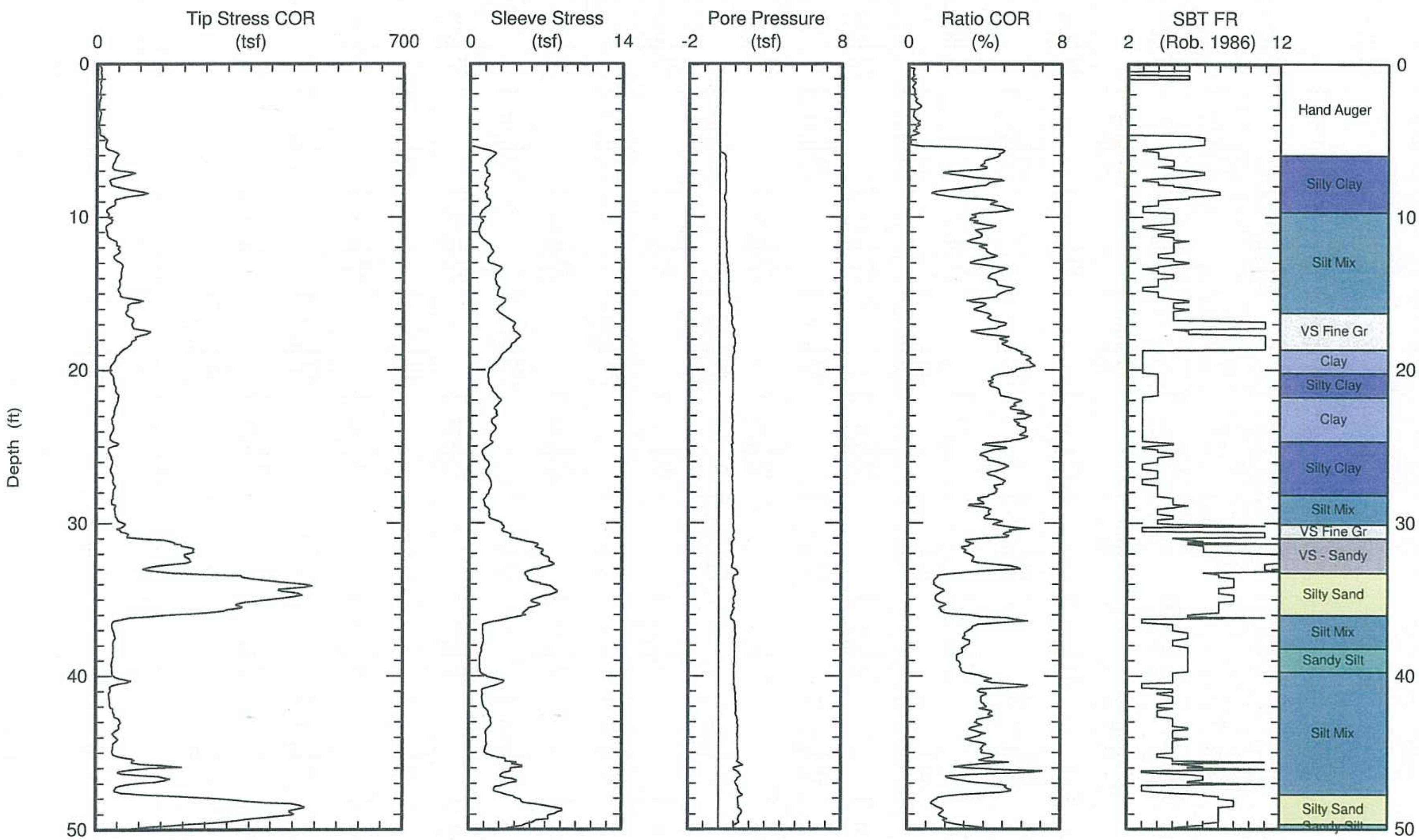
Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 26/Feb/2011 Test ID: T4-C1 Project: LosAngeles
	Customer: MACTEC Job Site: Westside Subway Extension/Durant Dr.	



Maximum depth: 75.21 (ft)
Page 2 of 2

Test ID: T4-C1
File: Z26F1101C.ECP

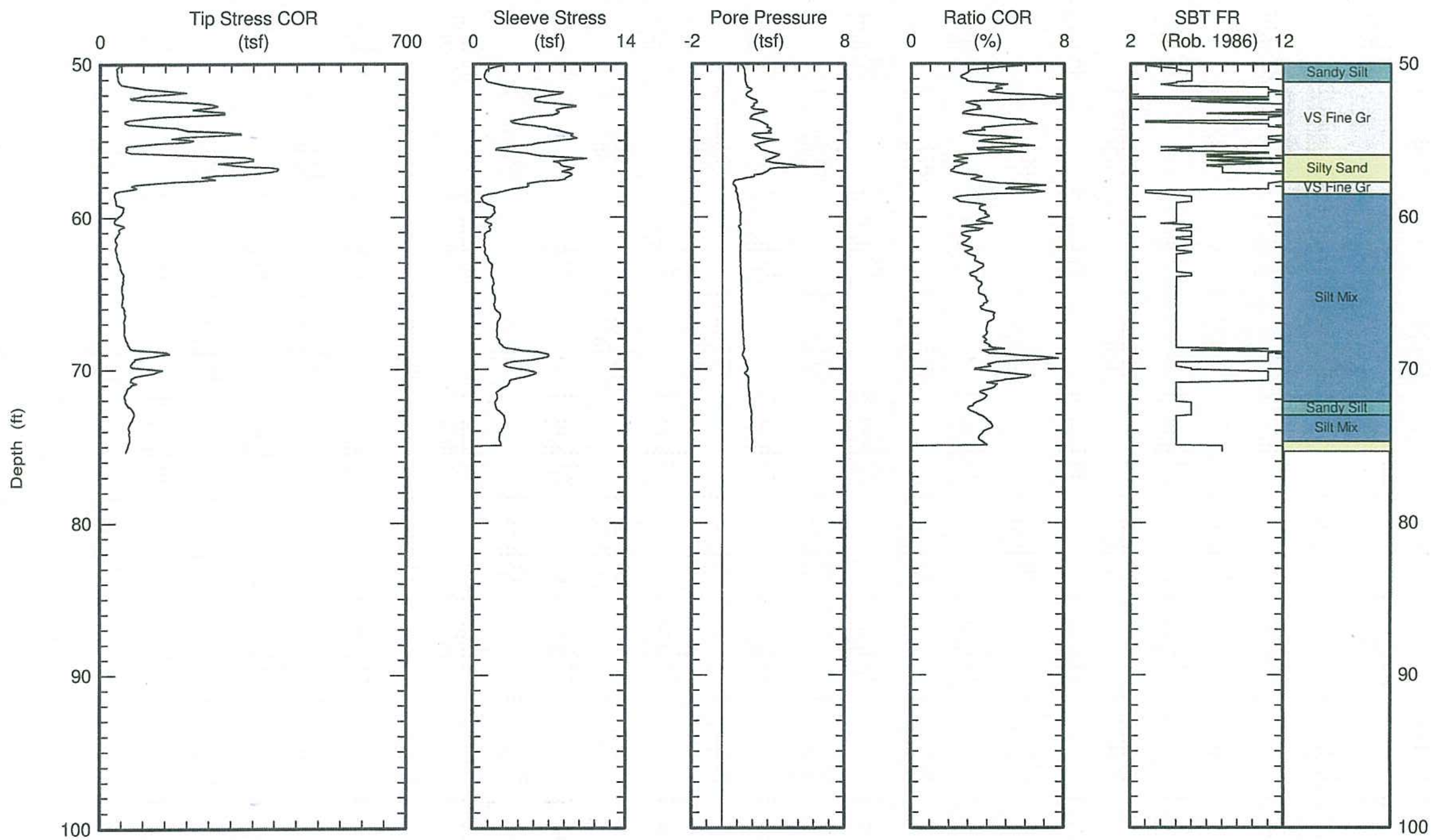
Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 26/Feb/2011 Test ID: T4-C2 Project: LosAngeles
	Customer: MACTEC Job Site: Westside Subway Extension/Durant Dr	



Maximum depth: 75.34 (ft)

Test ID: T4-C2
File: Z26F1102C.ECP

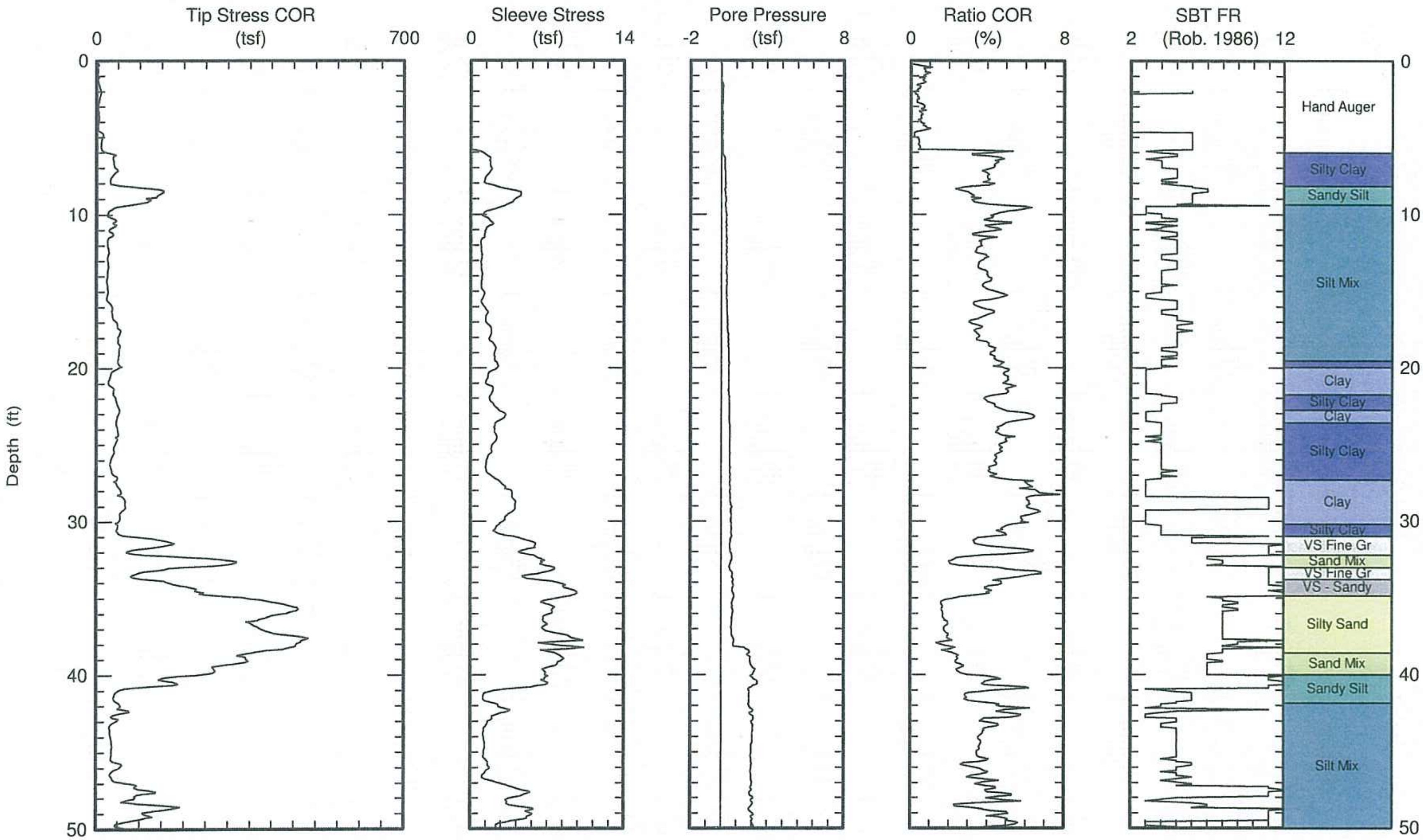
Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 26/Feb/2011 Test ID: T4-C2 Project: LosAngeles
	Customer: MACTEC Job Site: Westside Subway Extension/Durant Dr	



Maximum depth: 75.34 (ft)

Test ID: T4-C2
File: Z26F1102C.ECP

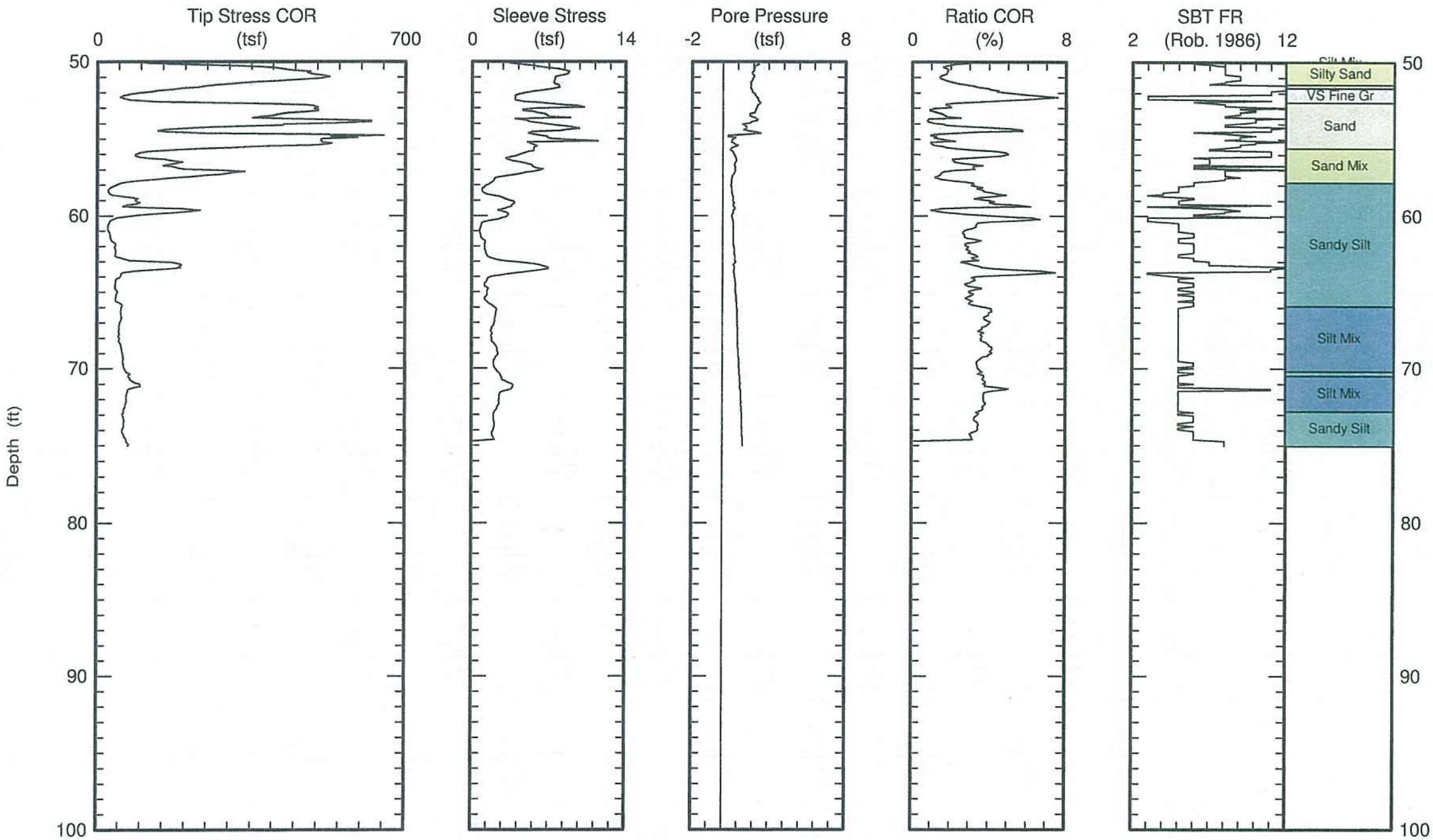
Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 26/Feb/2011 Test ID: T4-C3 Project: LosAngeles
	Customer: MACTEC Job Site: Westside Subway Extension/Durant Dr.	



Maximum depth: 75.05 (ft)
Page 1 of 2

Test ID: T4-C3
File: Z26F1103C.ECP

Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig Customer: MACTEC Job Site: Westside Subway Extension/Durant Dr.	Date: 26/Feb/2011 Test ID: T4-C3 Project: LosAngeles



Maximum depth: 75.05 (ft)

Test ID: T4-C3
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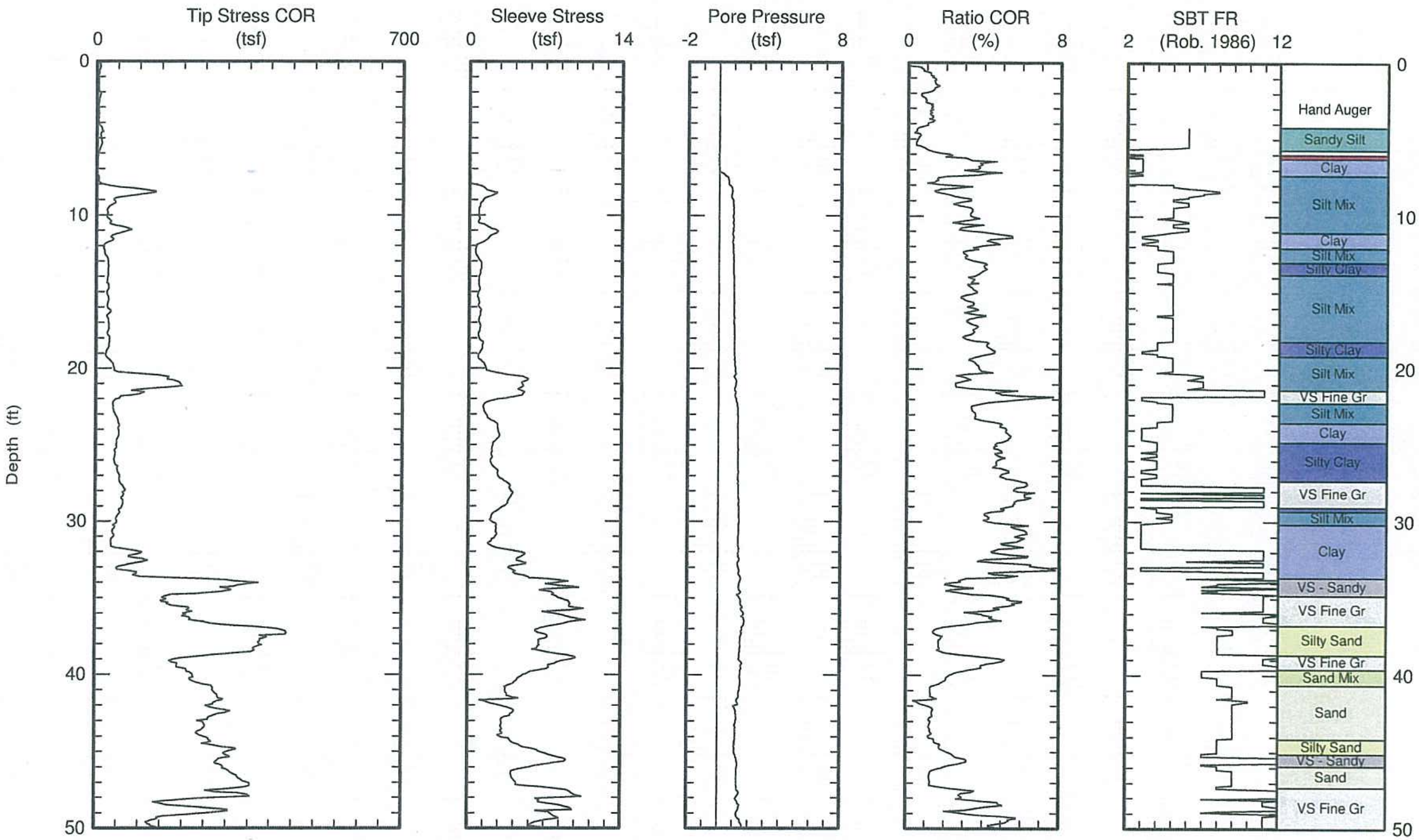
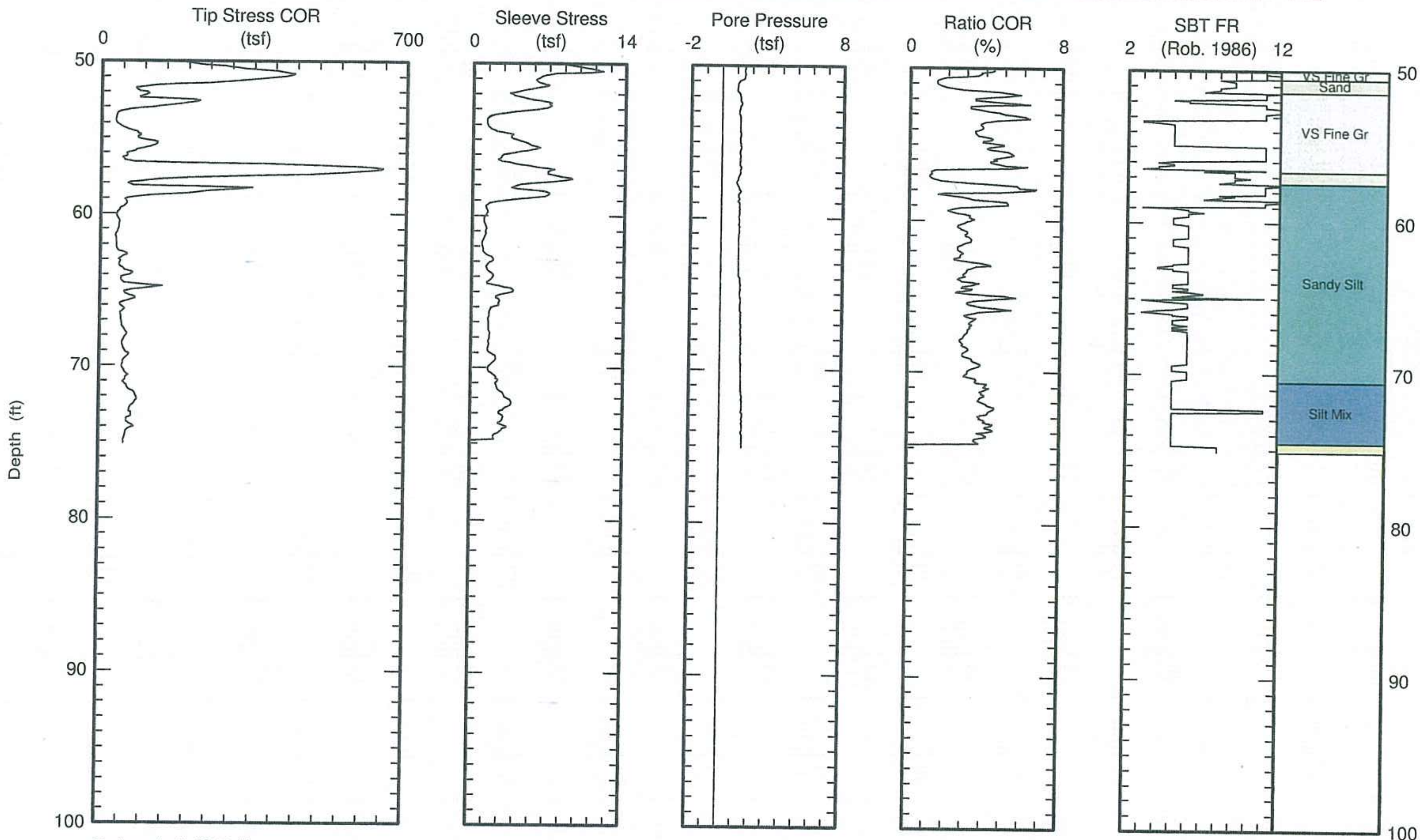
Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 26/Feb/2011 Test ID: T4-C4 Project: LosAngeles
	Customer: MACTEC Job Site: Westside Subway Extension/Durant Dr.	



Maximum depth: 75.14 (ft)
Page 1 of 2

Test ID: T4-C4
File: Z26F1104C.ECP

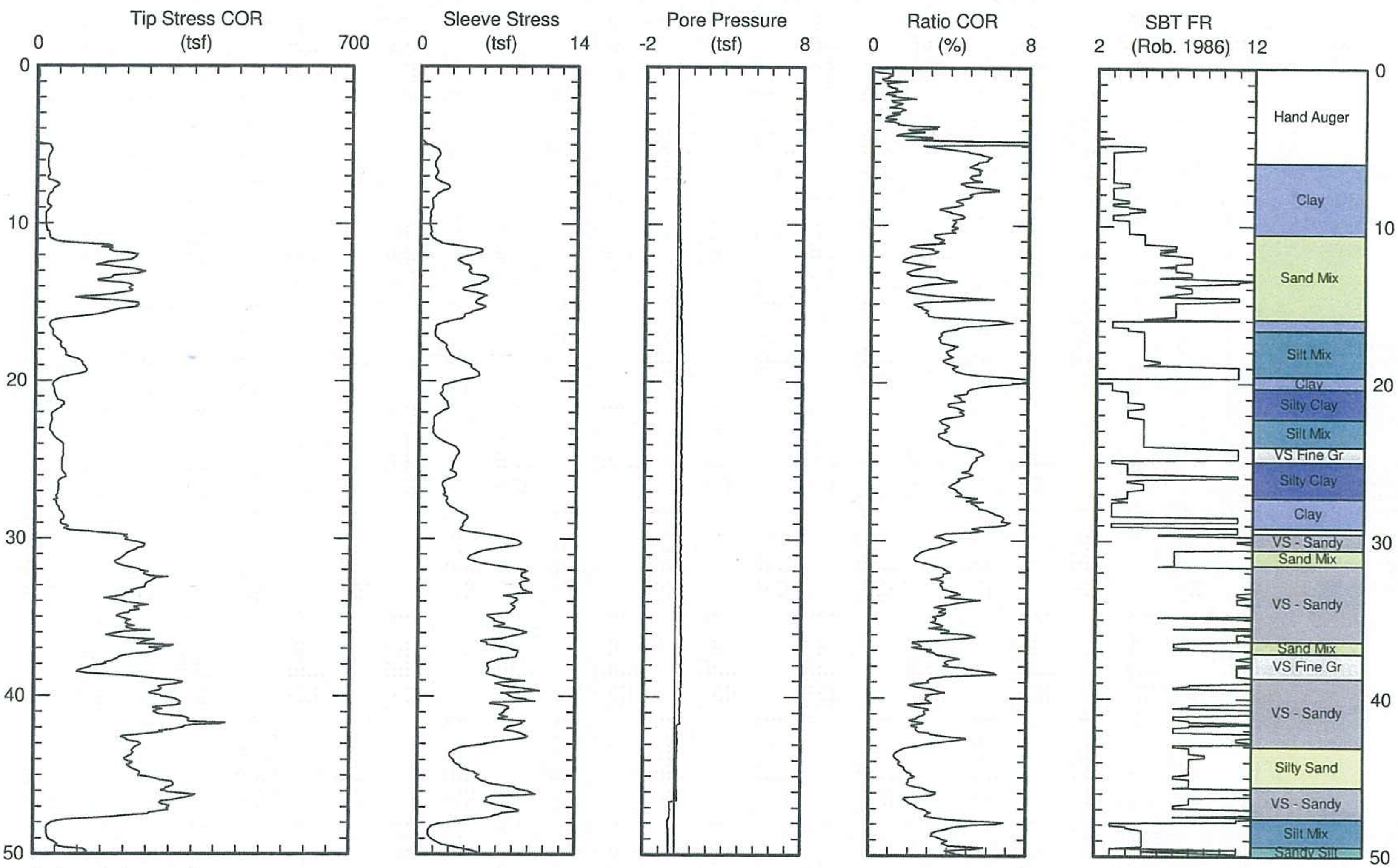
Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 26/Feb/2011 Test ID: T4-C4 Project: LosAngeles
	Customer: MACTEC Job Site: Westside Subway Extension/Durant Dr.	



Maximum depth: 75.14 (ft)

Test ID: T4-C4
File: Z26F1104C.ECP

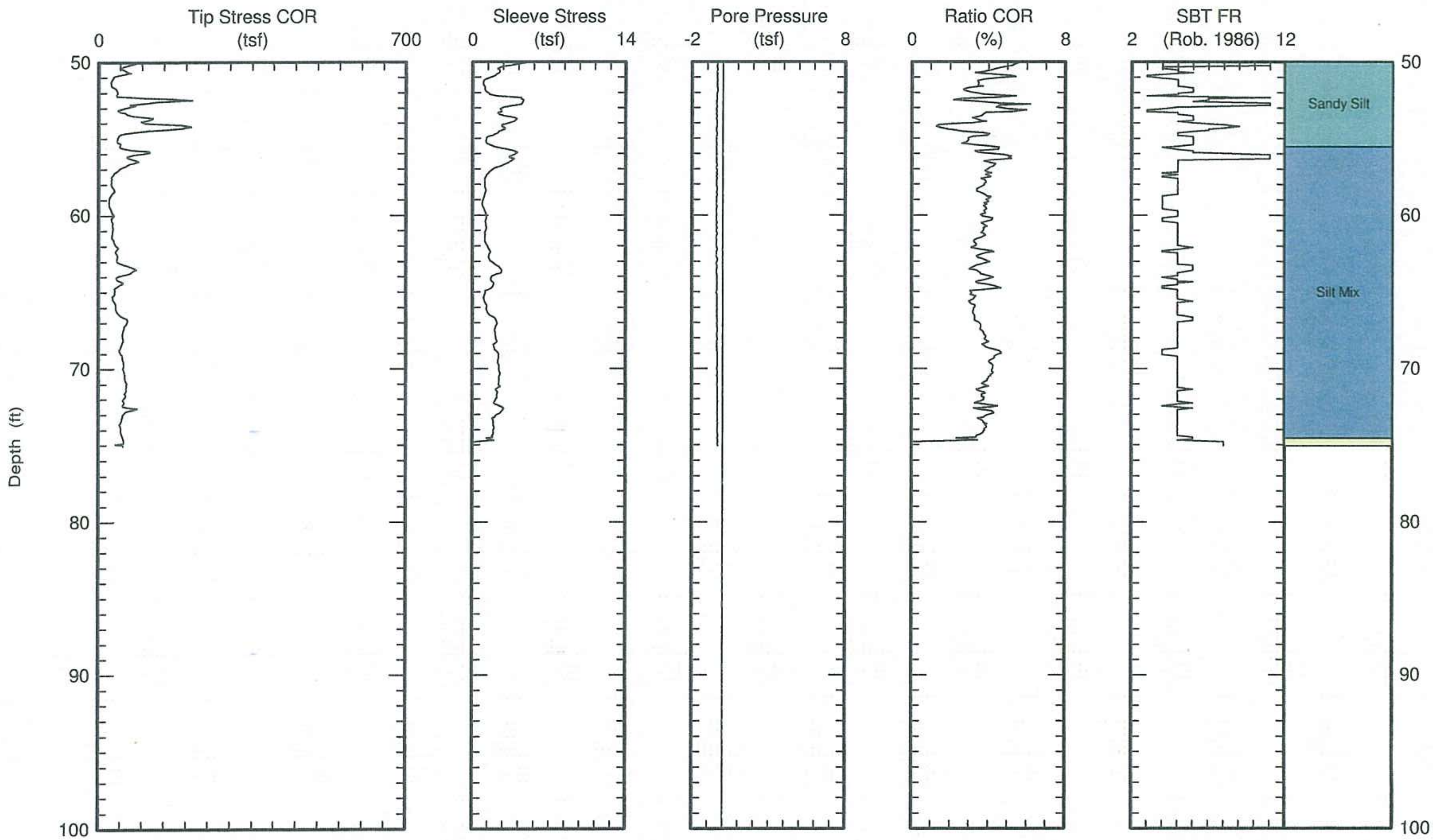
Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 26/Feb/2011 Test ID: T4-C5 Project: LosAngeles
	Customer: MACTEC Job Site: Westside Subway Extension/Durant Dr.	



Maximum depth: 75.10 (ft)

Test ID: T4-C5
File: Z26F1105C.ECP

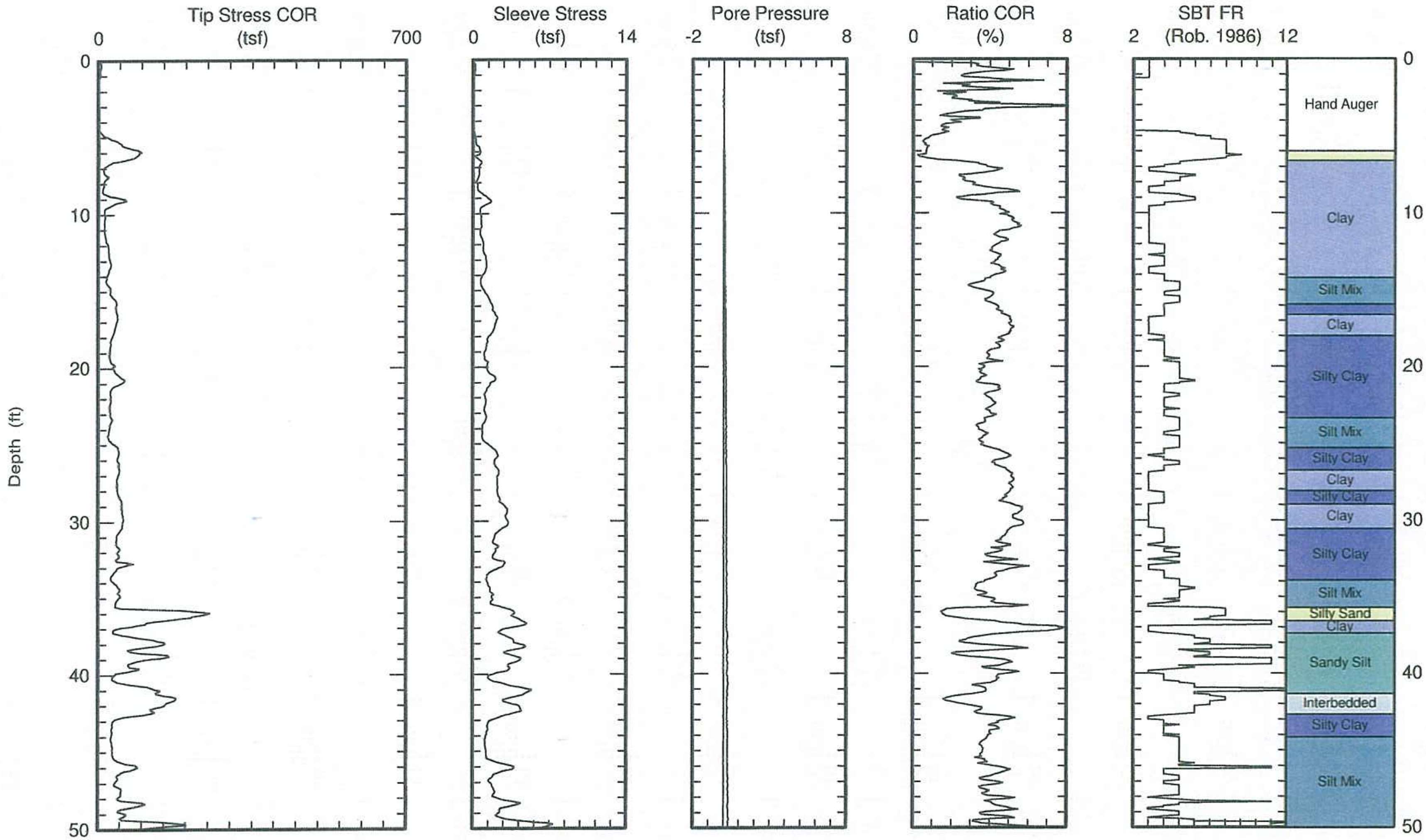
Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 26/Feb/2011 Test ID: T4-C5 Project: LosAngeles
	Customer: MACTEC Job Site: Westside Subway Extension/Durant Dr.	



Maximum depth: 75.10 (ft)
Page 2 of 2

Test ID: T4-C5
File: Z26F1105C.ECP

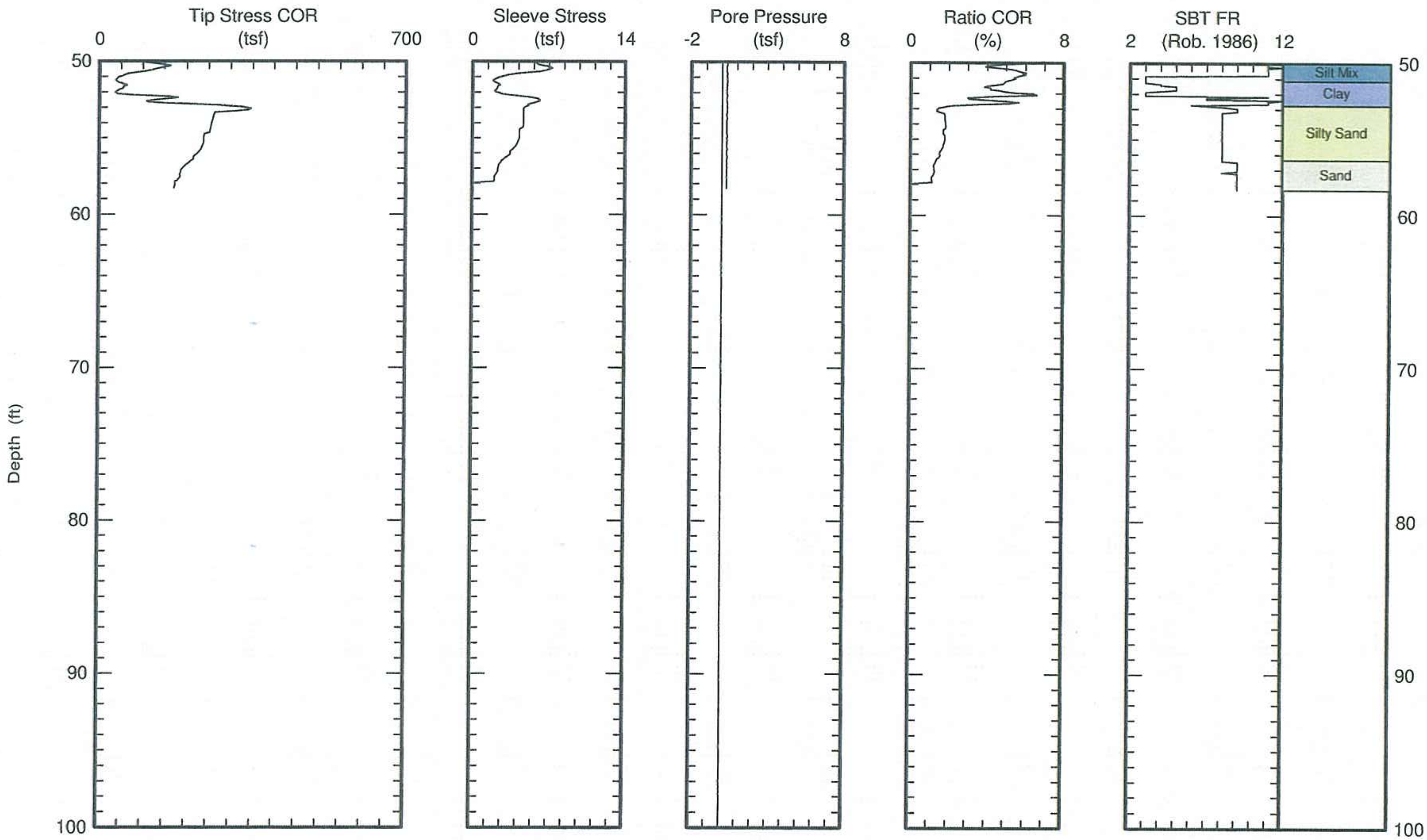
Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 26/Feb/2011 Test ID: T4-C6 Project: LosAngeles
	Customer: MACTEC Job Site: Westside Subway Extension/Durant Dr.	



Maximum depth: 58.32 (ft)

Test ID: T4-C6
File: Z26F1106C.ECP

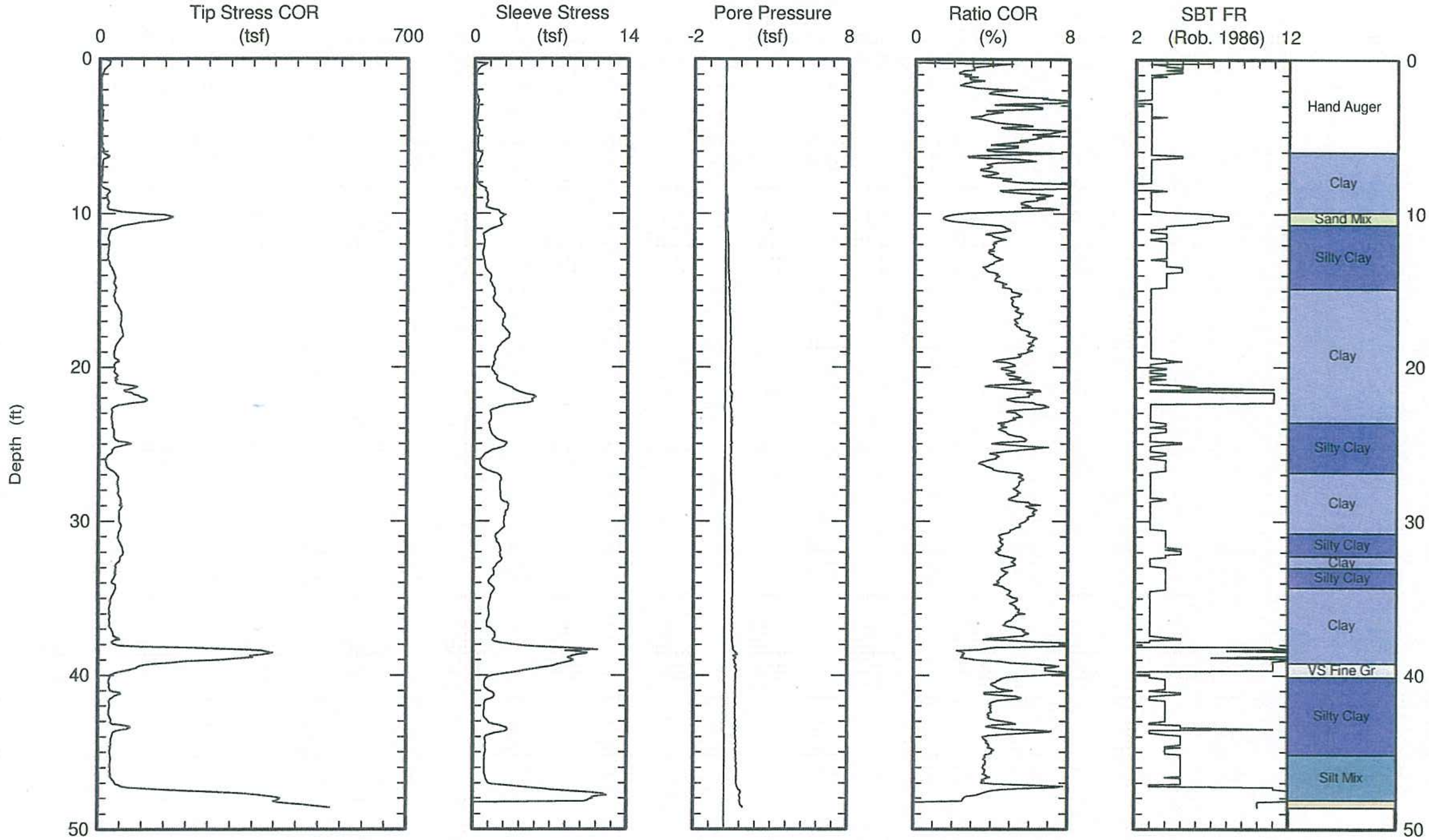
Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 26/Feb/2011 Test ID: T4-C6 Project: LosAngeles
	Customer: MACTEC Job Site: Westside Subway Extension/Durant Dr.	



Maximum depth: 58.32 (ft)

Test ID: T4-C6
File: Z26F1106C.ECP

Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 26/Feb/2011 Test ID: T4-C7 Project: LosAngeles
	Customer: MACTEC Job Site: Westside Subway Extension/Durant Dr.	



Maximum depth: 48.63 (ft)

Test ID: T4-C7
File: Z26F1107C.ECP