Hydrocarbons detected with UVOST

- Gasoline
- Diesel
- Jet (Kerasene)
- Motor Oil
- Cutting fluids
- Hydraulic fluids
- Crude Oil

Hydrocarbons rarely detected using UVOST

- Extremely weathered gasoline
- Coal tar
- Creosote
- Bunker Oil
- Polychlorinated bi-phenols (PCB's)
- Chlorinated solvent DNAPL
- Dissolved phase (aqueous) PAH's

Potential False Positives (fluorescence observed)

- Sea-shells (weak-medium)
- Paper (medium-strong depending on color)
- Peat/meadow mat (weak)
- Calcite/calcareous sands (weak)
- Tree roots (weak-medium)
- Sewer lines (medium-strong)

Potential False Negatives (do not fluoresce)

- Extremely weathered fuels (especially gasoline)
- Aviation gasoline (weak)
- "Dry" PAHs such as aqueous phase, lamp black, purifier chips
- Creosotes (most)
- Coal tars (most) gasoline (weak)
- Most chlorinated solvents
- Benzene, toluene, zylenes (relatively pure)

DAKOTA TECHNOLOGIES
UVOST LOG REFERENCE

2008-12-12

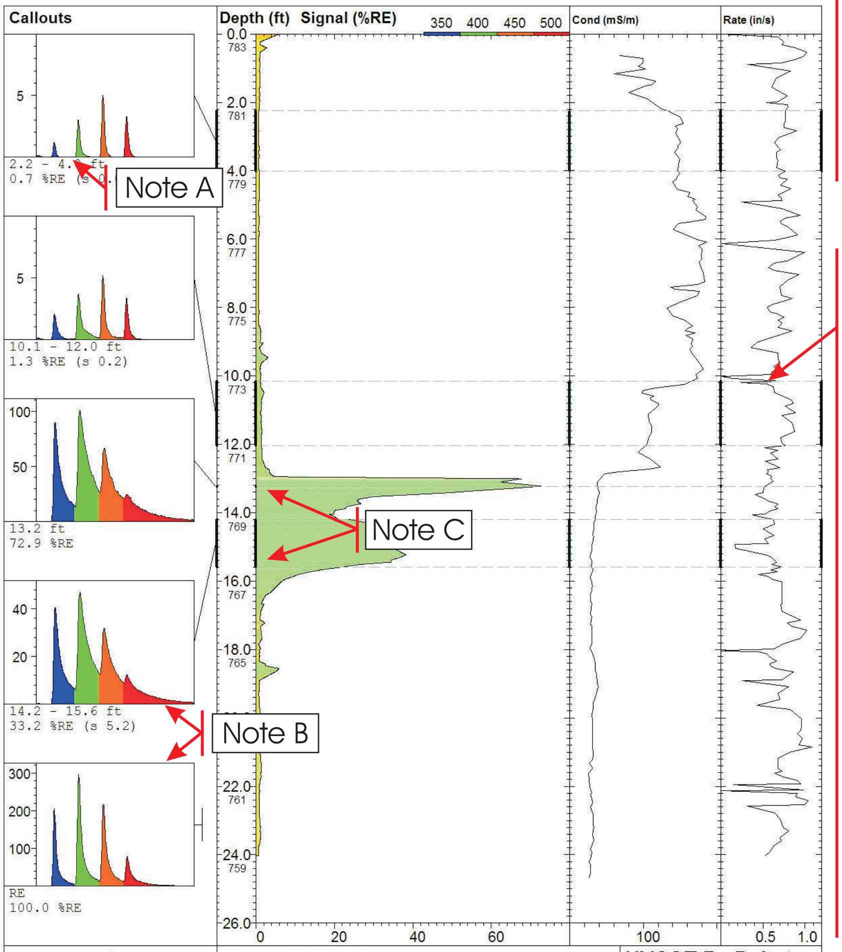
Main Plot :
Signal (total fluorescence) versus depth where signal is relative to the Reference Emitter (RE). The total area of the waveform is divided by the total area of the Reference Emitter yielding the %RE. This %RE scales with the NAPL fluorescence. The fill color is based on relative contribution of each channel's area to the total waveform area (see callout waveform). The channel-to-color relationship and corresponding wavelengths are given in the upper right corner of the main plot.

Callouts :
Waveforms from selected depths or depth ranges showing the multi-wavelength waveform for that depth.

The four peaks are due to fluorescence at four wavelengths and referred to as "channels". Each channel is assigned a color.

Various NAPLs will have a unique waveform "fingerprint" due to the relative amplitude of the four channels and/or broadening of one or more channels.

Basic waveform statistics and any operator notes are given below the callout.



DAKOTA TECHNOLOGIES Fargo, ND 701.237.4908 www.DakotaTechnologies.com	**Sample Data**		**UVOST By Dakota** www.DakotaTechnologies.com
	Site: **Fargo, ND**	*Latitude / Datum:* **46 54.430700 N / WGS-84**	*Final depth:* **24.03 ft**
	Client / Job: **ABC Consulting**	*Longitude / Fix:* **096 47.753700 W / 3D**	*Max signal:* **73.0 %RE @ 13.23 ft**
	Operator / Unit: **St. Germain / UVOST1000**	*Elevation:* **782.5 ft**	*Date & Time:* **2008-11-12 11:39 EST**

Conductivity Plot :
The Electrical Conductivity (EC) of the soil can be logged simultaneously with the UVOST data. EC often provides insight into the stratigraphy.
Note the drop in EC from 10 - 13 ft, indicating a shift from consolidated to unconsolidated stratigraphy. This correlates with the observed NAPL distribution.

Rate Plot :
The rate of probe advancement. ~ 0.8in (2cm) per second is preferred.

A noticeable decrease in the rate of advancement may be indicative of difficult probing conditions (gravel, angular sands, etc.) such as that seen here at ~5 ft.

Notice that this log was terminated arbitrarily, not due to "refusal", which would have been indicated by a sudden rate drop at final depth.

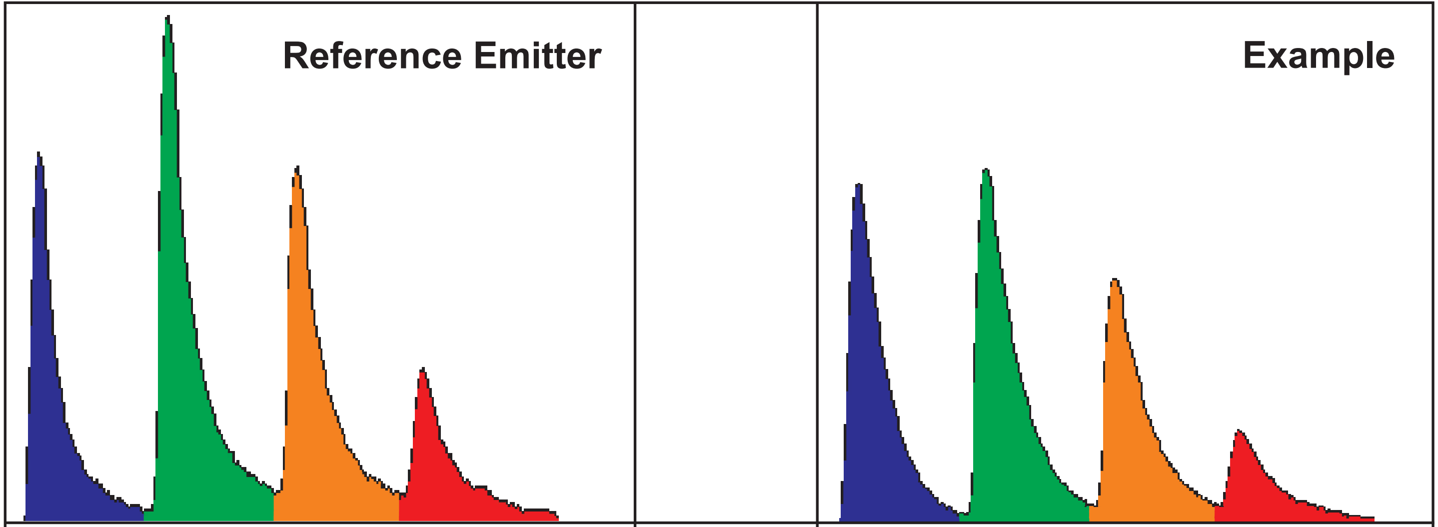
Info Box :
Contains pertinent log info including name and location.

Note A :
Time is along the x axis. No scale is given, but it is a consistent 320ns wide.
The y axis is in mV and directly corresponds to the amount of light striking the photodetector.

Note B :
These two waveforms are clearly different. The first is weathered diesel from the log itself while the second is the Reference Emitter (a blend of NAPLs) always taken before each log for calibration.

Note C :
Callouts can be a single depth (see 3rd callout) or a range (see 4th callout). The range is noted on the depth axis by a bold line. When the callout is a range, the average and standard deviation in %RE is given below the callout.

Waveform Signal Calculation



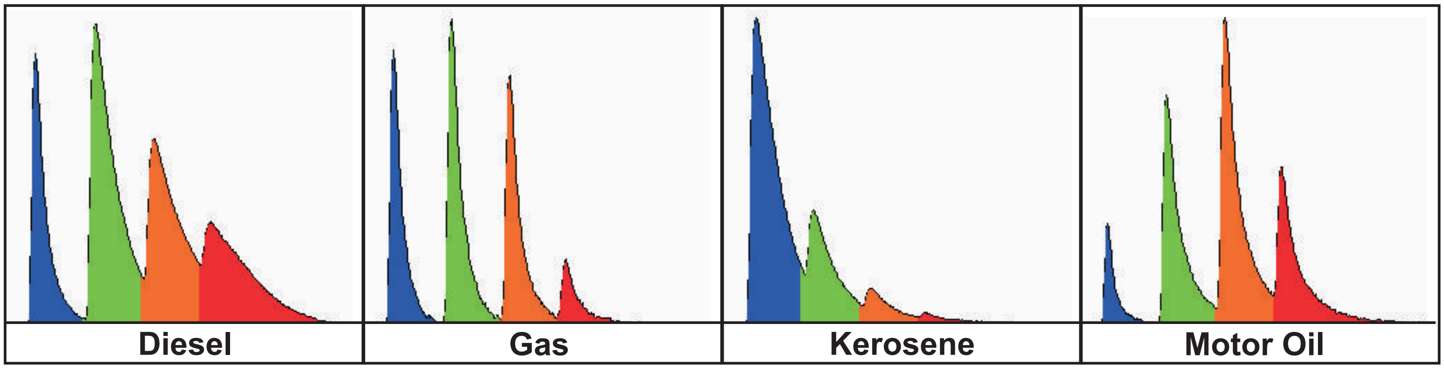
Channel	CH1		CH2		CH3		CH4		**Total**
Area (pVs)	4820	+	8108	+	6249	+	2984	=	**22161**
Percent RE	21.7		36.6		28.2		13.5		**100%**

Channel	CH1		CH2		CH3		CH4		**Total**
Area (pVs)	4923	+	5743	+	4166	+	1735	=	**16587**
Percent RE	22.3		25.9		18.8		7.8		**75%**

Data Files

***.lif.raw.bin**	Raw data file. Header is ASCII format and contains information stored when the file was initially written (e.g. date, total depth, max signal, gps, etc., and any information entered by the operator). All raw waveforms are appended to the bottom of the file in a binary format.
***.lif.plt**	Stores the plot scheme history (e.g. callout depths) for associated Raw file. Transfer along with the Raw file in order to recall previous plots.
***.lif.jpg**	A jpg image of the OST log including the main signal vs. depth plot, callouts, information, etc.
***.lif.dat.txt**	Data export of a single Raw file. ASCII tab delimited format. No string header is provided for the columns (to make importing into other programs easier). Each row is a unique depth reading. The columns are: Depth, Total Signal (%RE), Ch1%, Ch2%, Ch3%, Ch4%, Rate, Conductivity Depth, Conductivity Signal, Hammer Rate. Summing channels 1 to 4 yields the Total Signal.
***.lif.sum.txt**	A summary file for a number of Raw files. ASCII tab delimited format. The file contains a string header. The summary includes one row for each Raw file and contains information for each file including: the file name, gps coordinates, max depth, max signal, and depth at which the max signal occured.
***.lif.log.txt**	An activity log generated automatically located in the OST application directory in the 'log' subfolder. Each OST unit the computer operates will generate a separate log file per month. A log file contains much of the header information contained within each separate Raw file, including: date, total depth, max signal, etc.

Common Waveforms (highly dependent on soil, weathering, etc.)

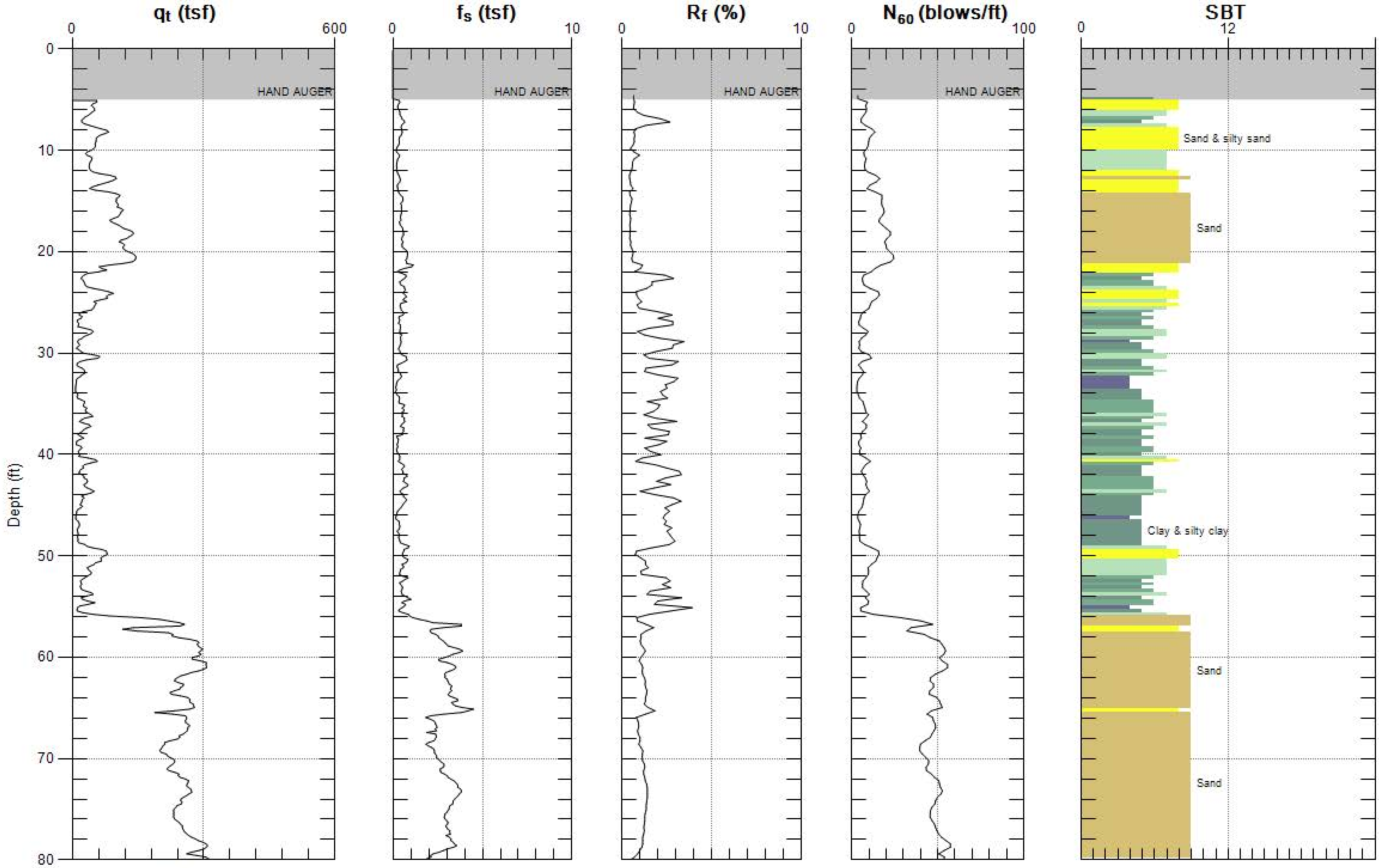


Diesel | **Gas** | **Kerosene** | **Motor Oil**

AECOM

Site: MORENA PUMP STATION Engineer: K.MARTIN

Sounding: SH-01 Date: 3/16/17 08:08



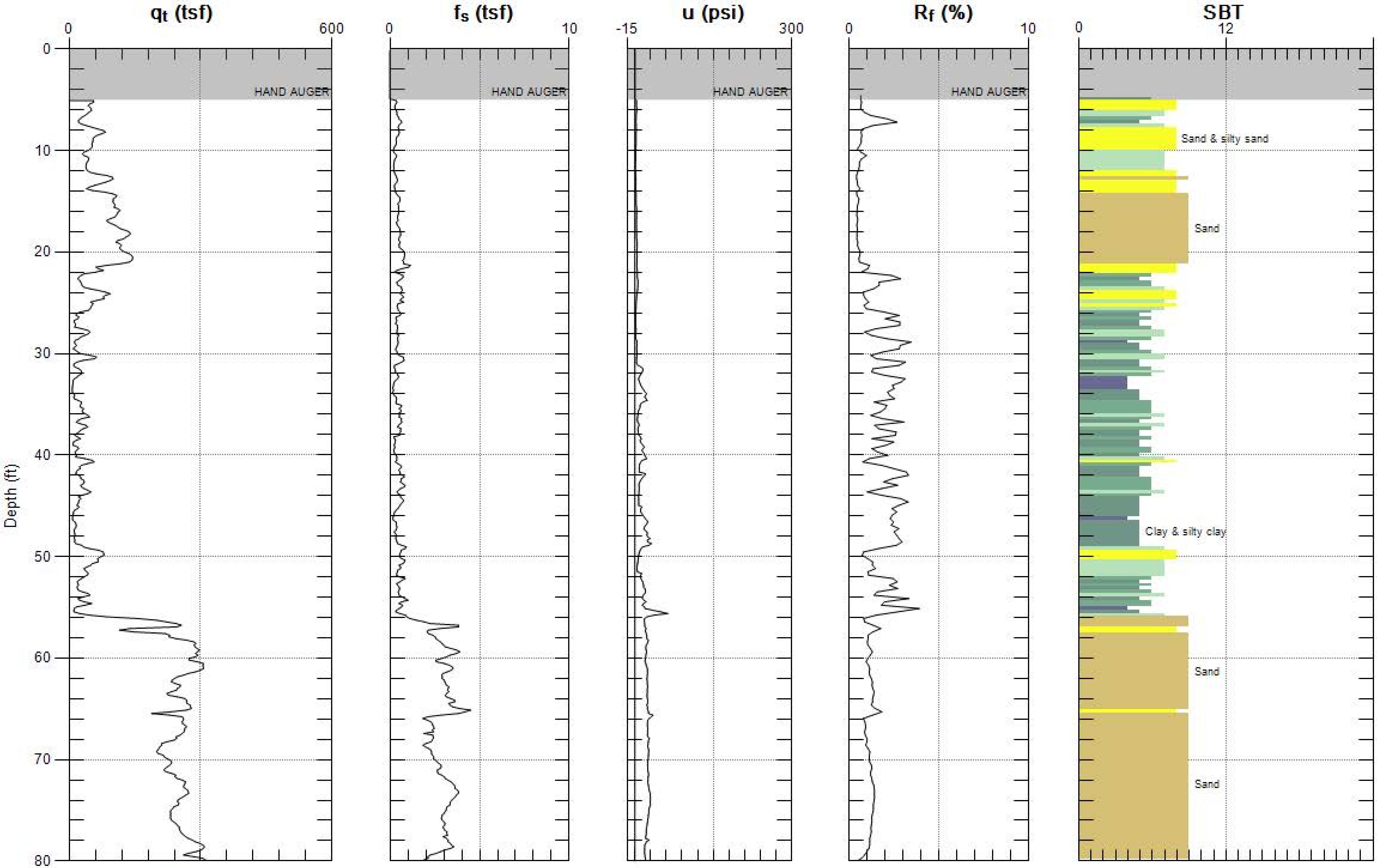
Max. Depth: 80.381 (ft)
Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)

GREGG **AECOM**

Site: MORENA PUMP STATION Engineer: K.MARTIN

Sounding: SH-01 **Date: 3/16/17 08:08**



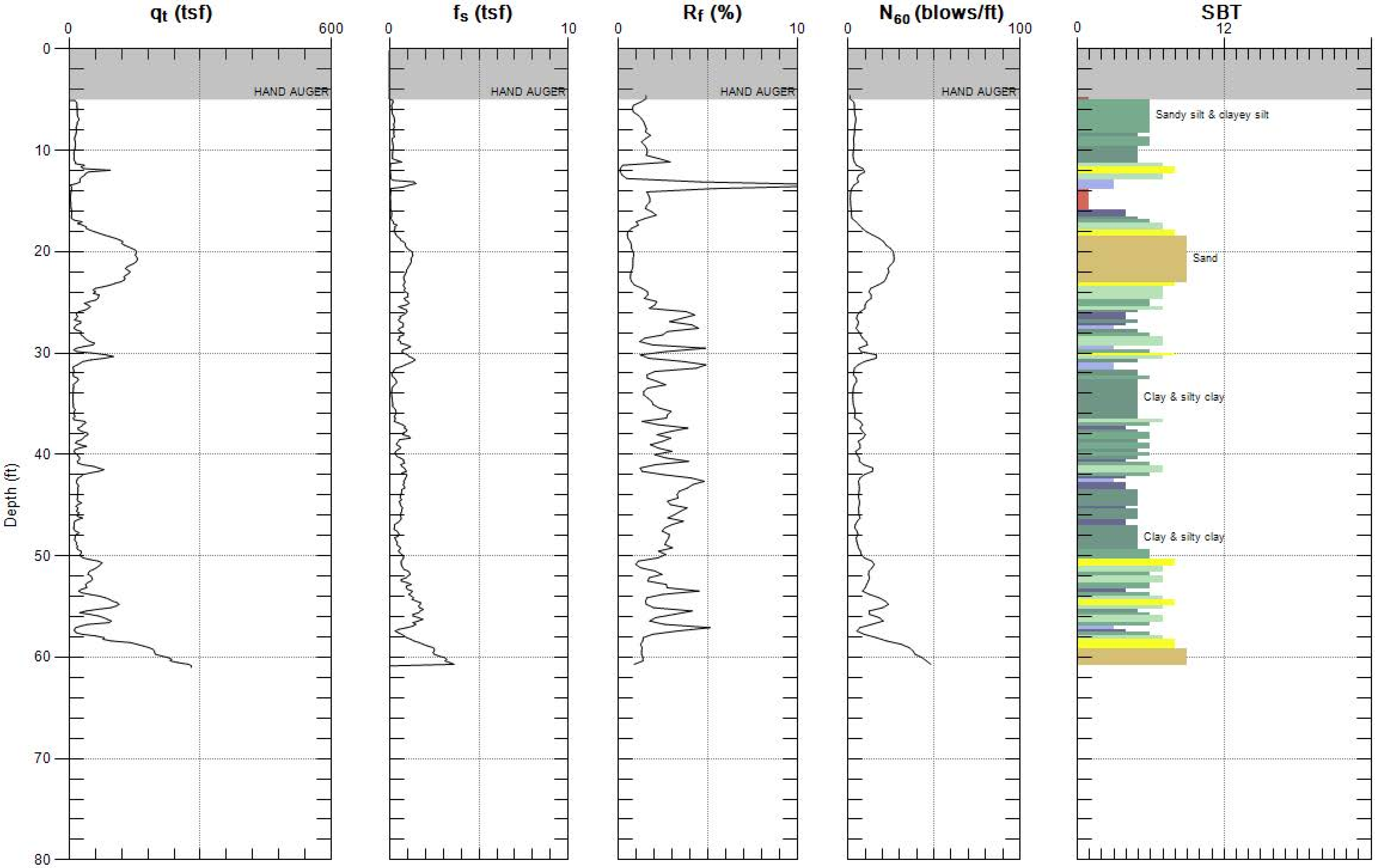
Max. Depth: 80.381 (ft)
Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)

AECOM

Site: MORENA PUMP STATION Engineer: K.MARTIN

Sounding: SH-02 Date: 3/14/17 09:07



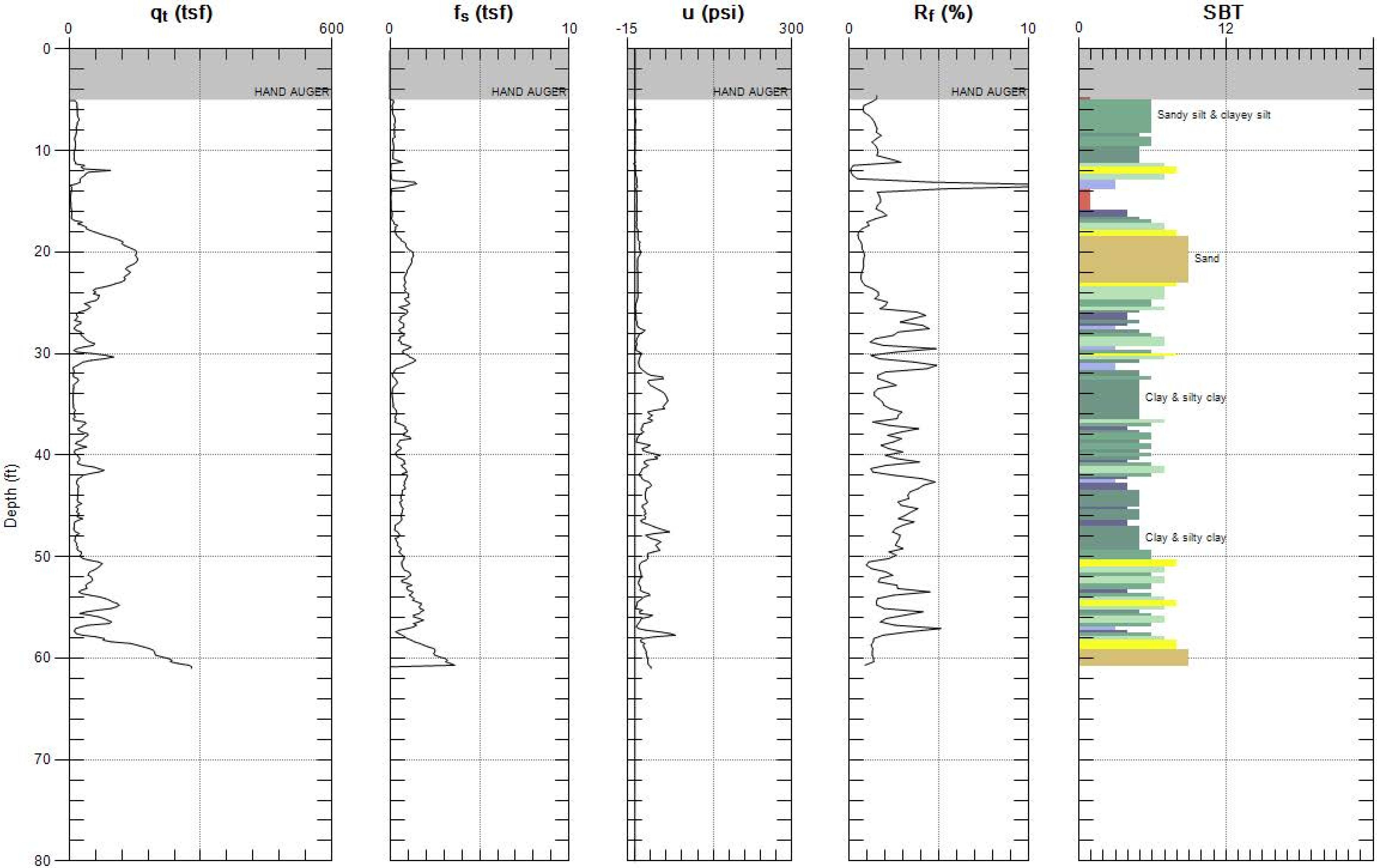
Max. Depth: 61.024 (ft)
Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)

GREGG **AECOM**

Site: MORENA PUMP STATION Engineer: K.MARTIN

Sounding: SH-02 Date: 3/14/17 09:07



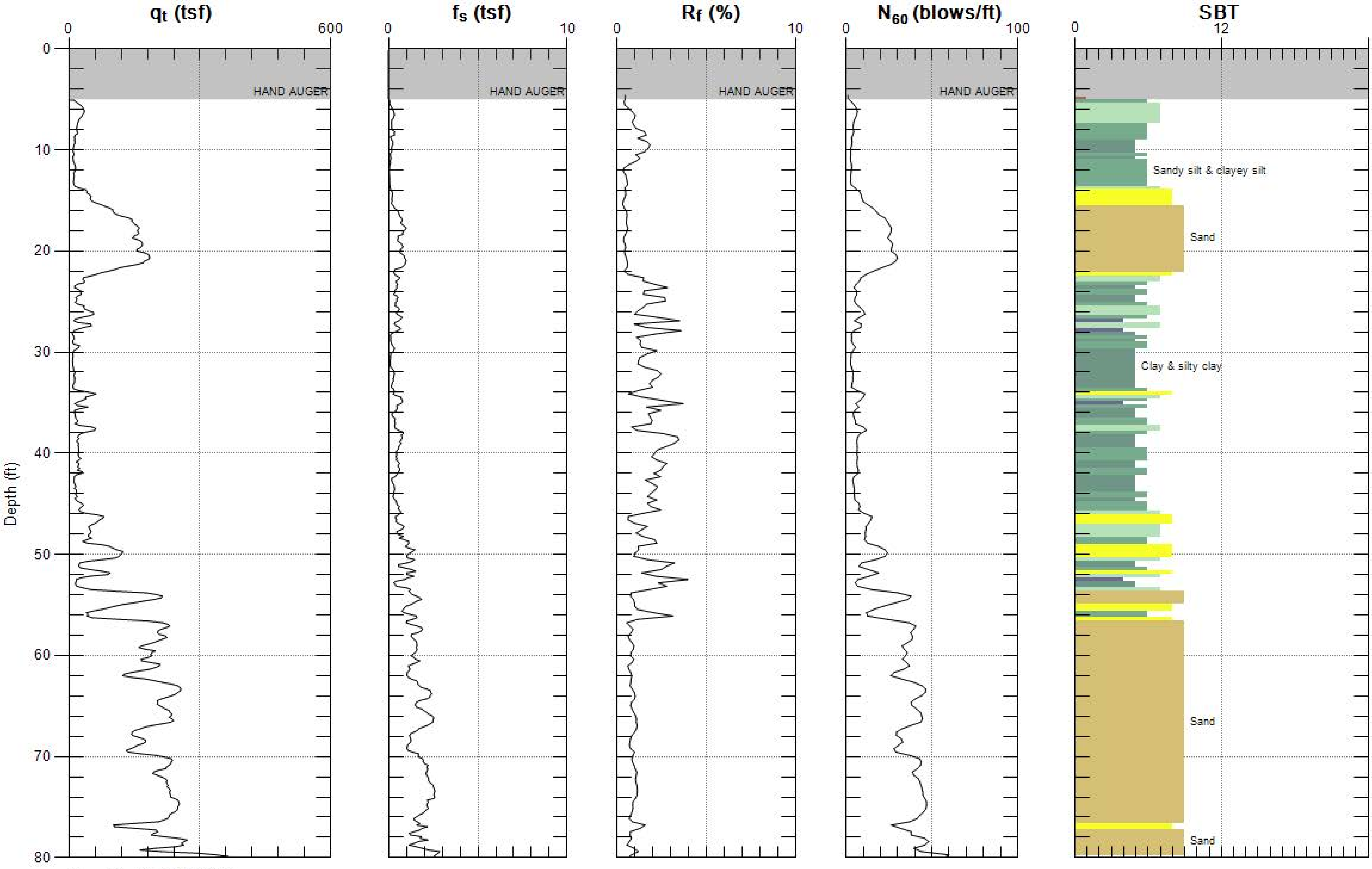
Max. Depth: 61.024 (ft)
Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)

GREGG **AECOM**

Site: MORENA PUMP STATION Engineer: K.MARTIN

Sounding: SH-03 **Date: 3/14/17 10:35**



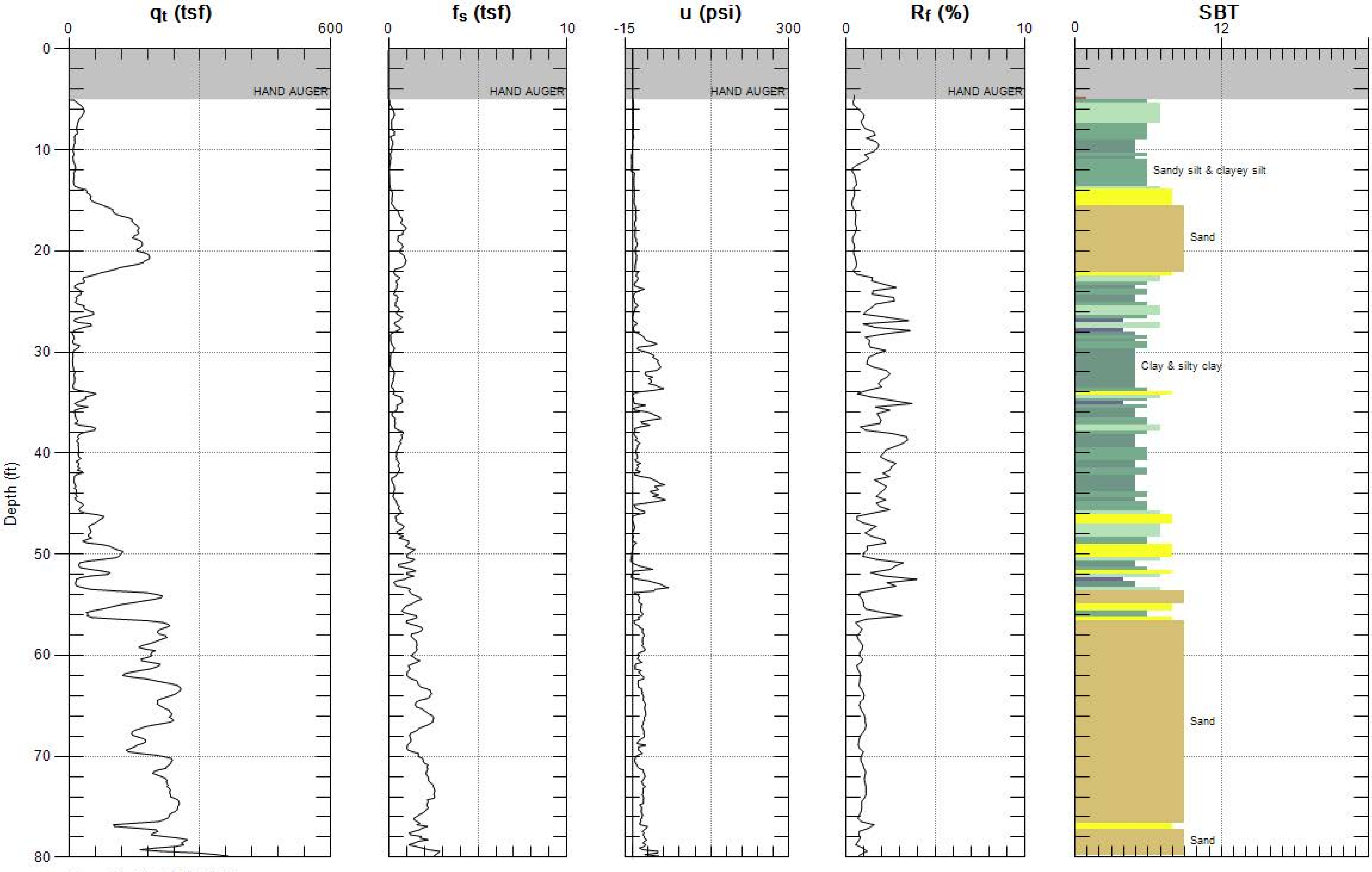
Max. Depth: 80.381 (ft)
Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)

AECOM

Site: MORENA PUMP STATION Engineer: K.MARTIN

Sounding: SH-03 **Date: 3/14/17 10:35**



Max. Depth: 80.381 (ft)
Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)

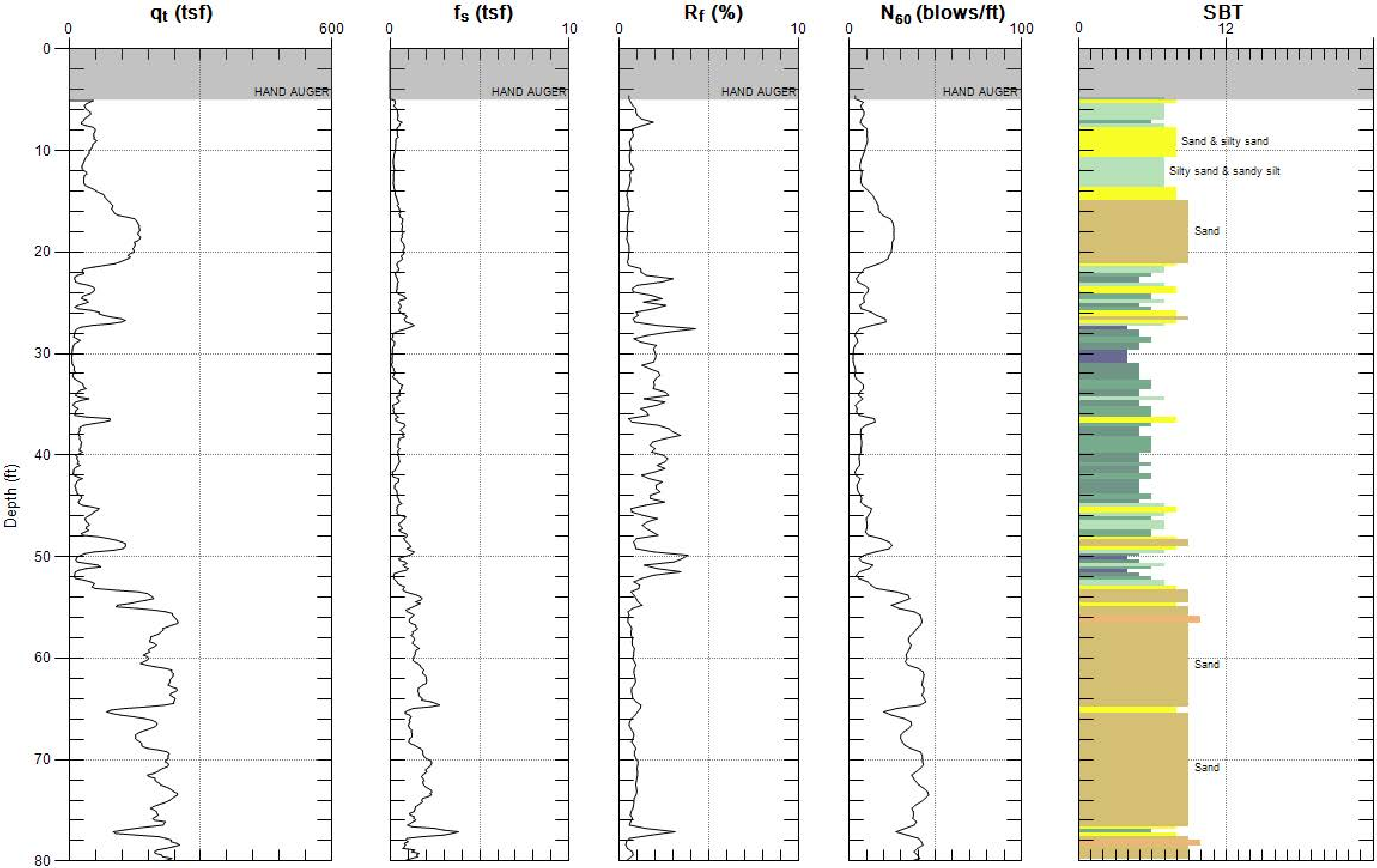
GREGG

AECOM

Site: MORENA PUMP STATION Engineer: K.MARTIN

Sounding: SH-04

Date: 3/14/17 02:10



Max. Depth: 80.381 (ft)
Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)

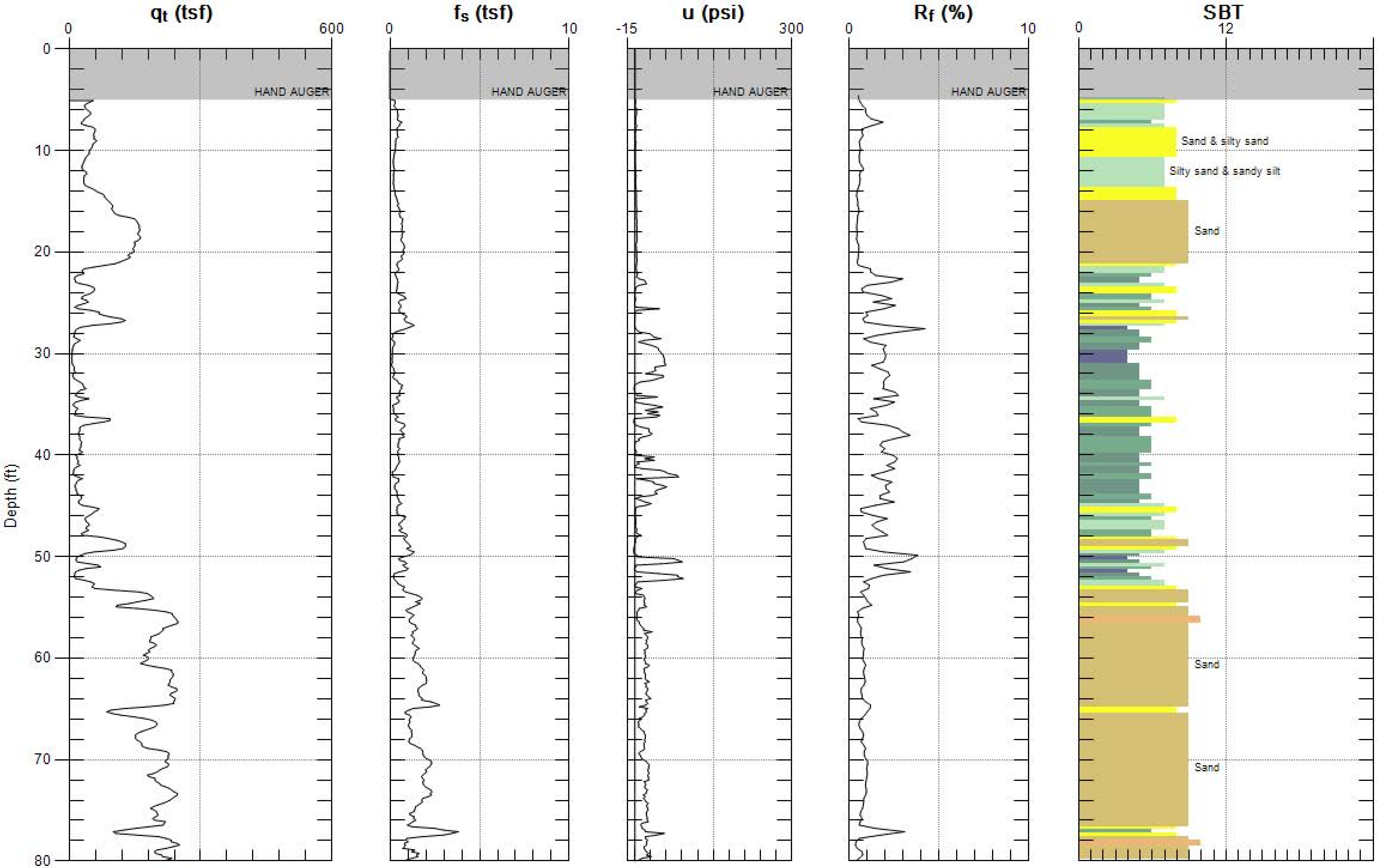
GREGG

AECOM

Site: MORENA PUMP STATION Engineer: K.MARTIN

Sounding: SH-04

Date: 3/14/17 02:10



Max. Depth: 80.381 (ft)
Avg. Interval: 0.328 (ft)

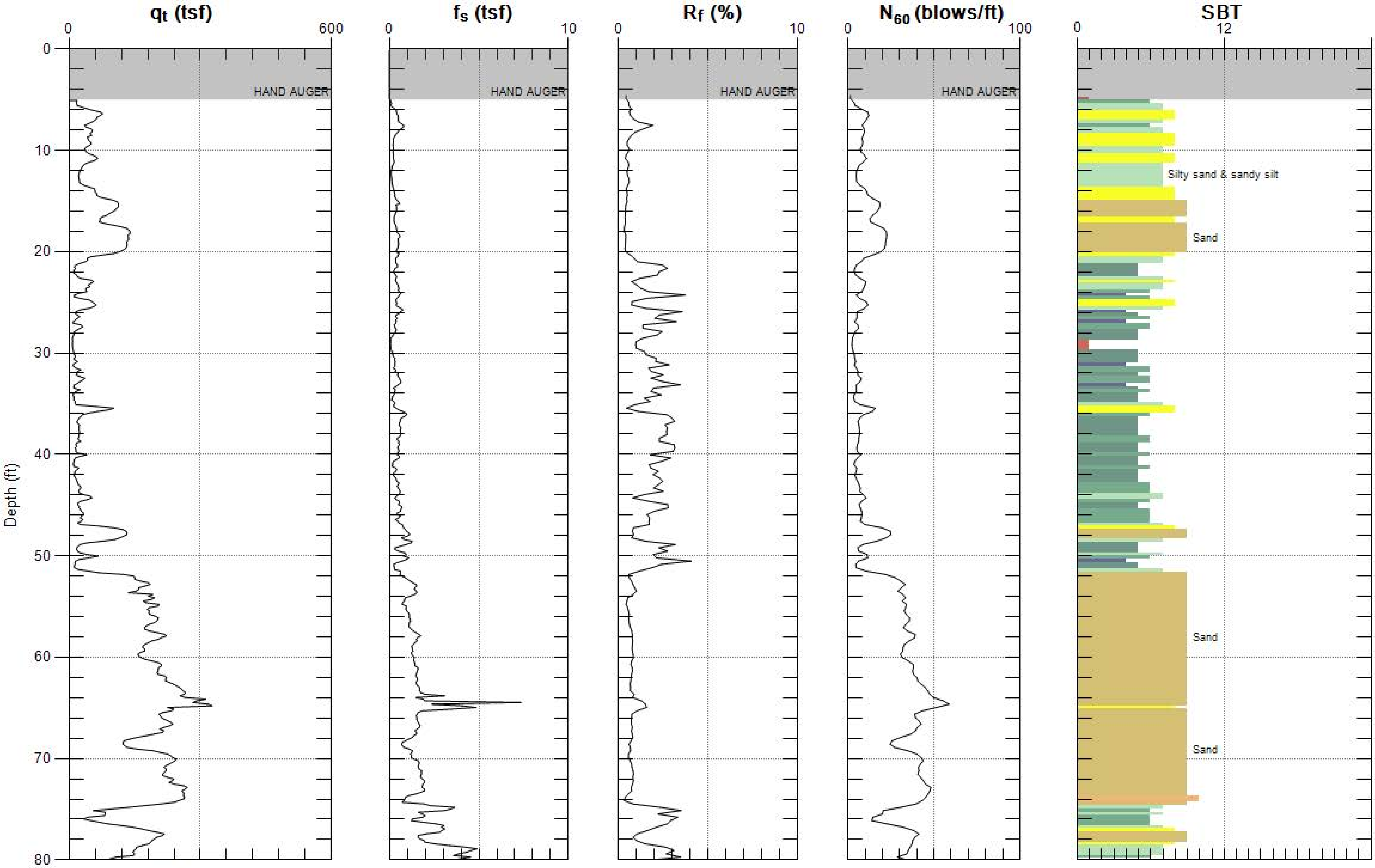
SBT: Soil Behavior Type (Robertson 1990)

GREGG

AECOM

Site: MORENA PUMP STATION Engineer: K.MARTIN

Sounding: SH-05 **Date: 3/15/17 07:53**



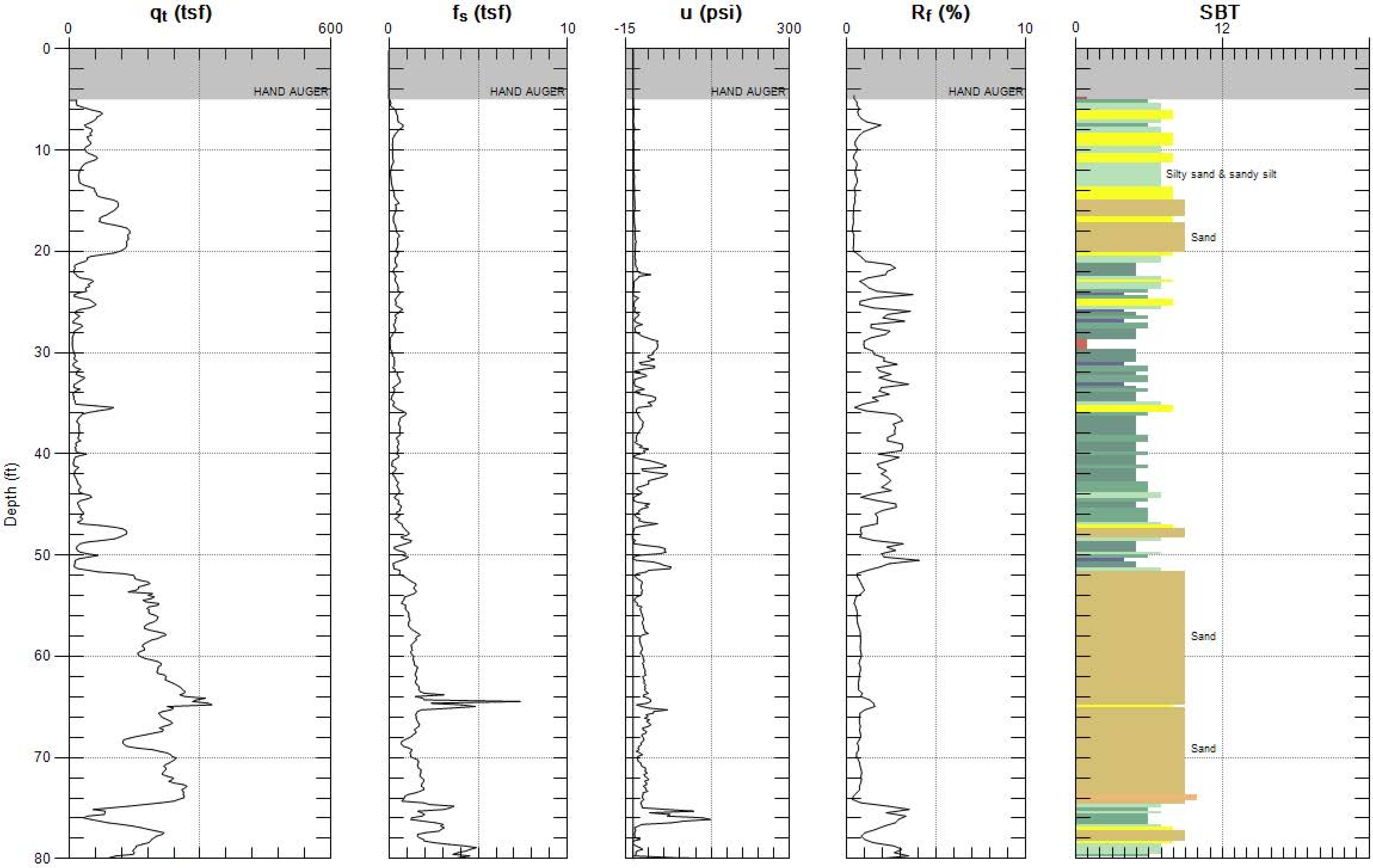
Max. Depth: 80.381 (ft)
Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)

GREGG **AECOM**

Site: MORENA PUMP STATION Engineer: K.MARTIN

Sounding: SH-05 Date: 3/15/17 07:53



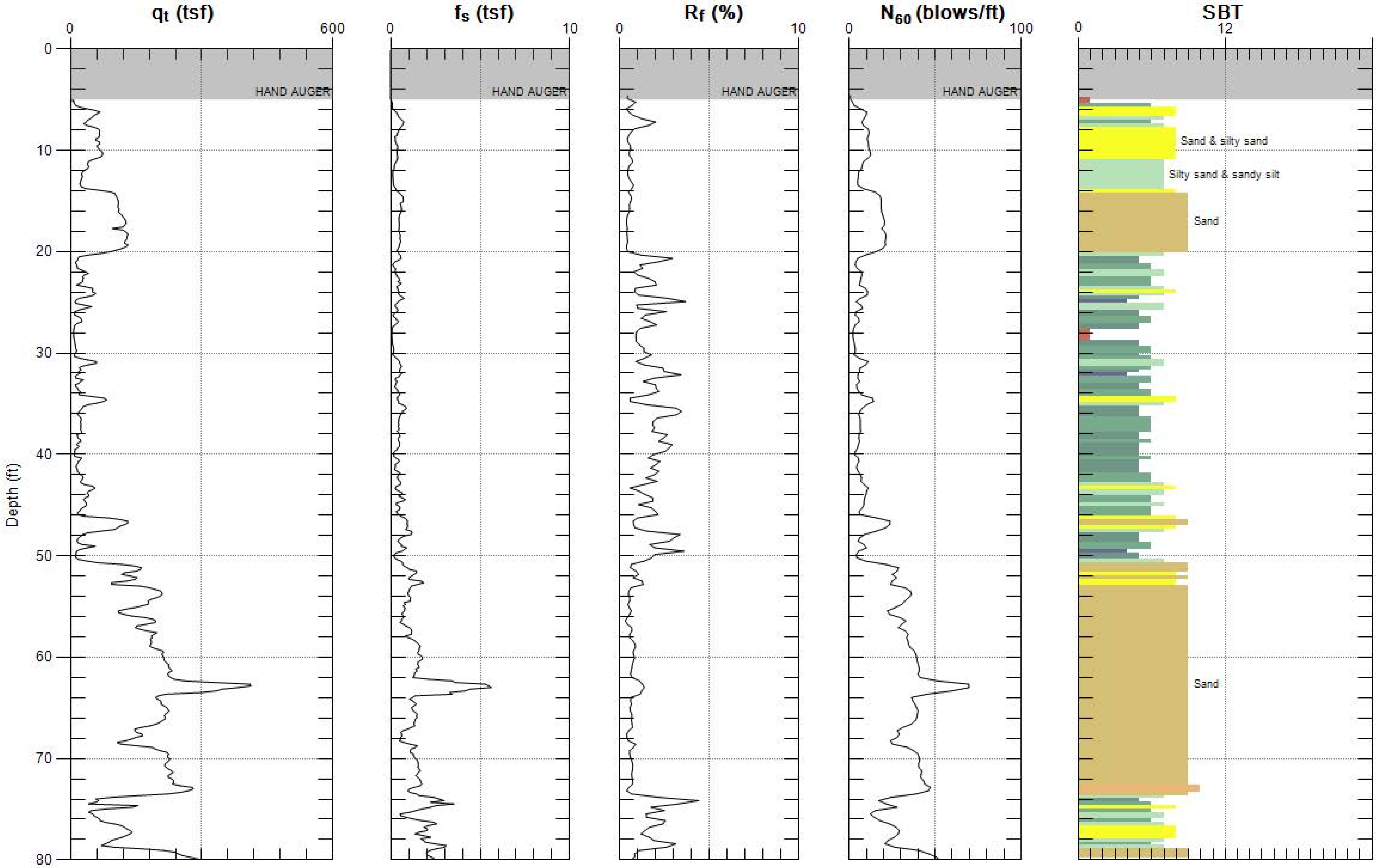
Max. Depth: 80.381 (ft)
Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)

GREGG **AECOM**

Site: MORENA PUMP STATION Engineer: K.MARTIN

Sounding: SH-06 **Date: 3/14/17 12:22**



Max. Depth: 80.381 (ft)
Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)

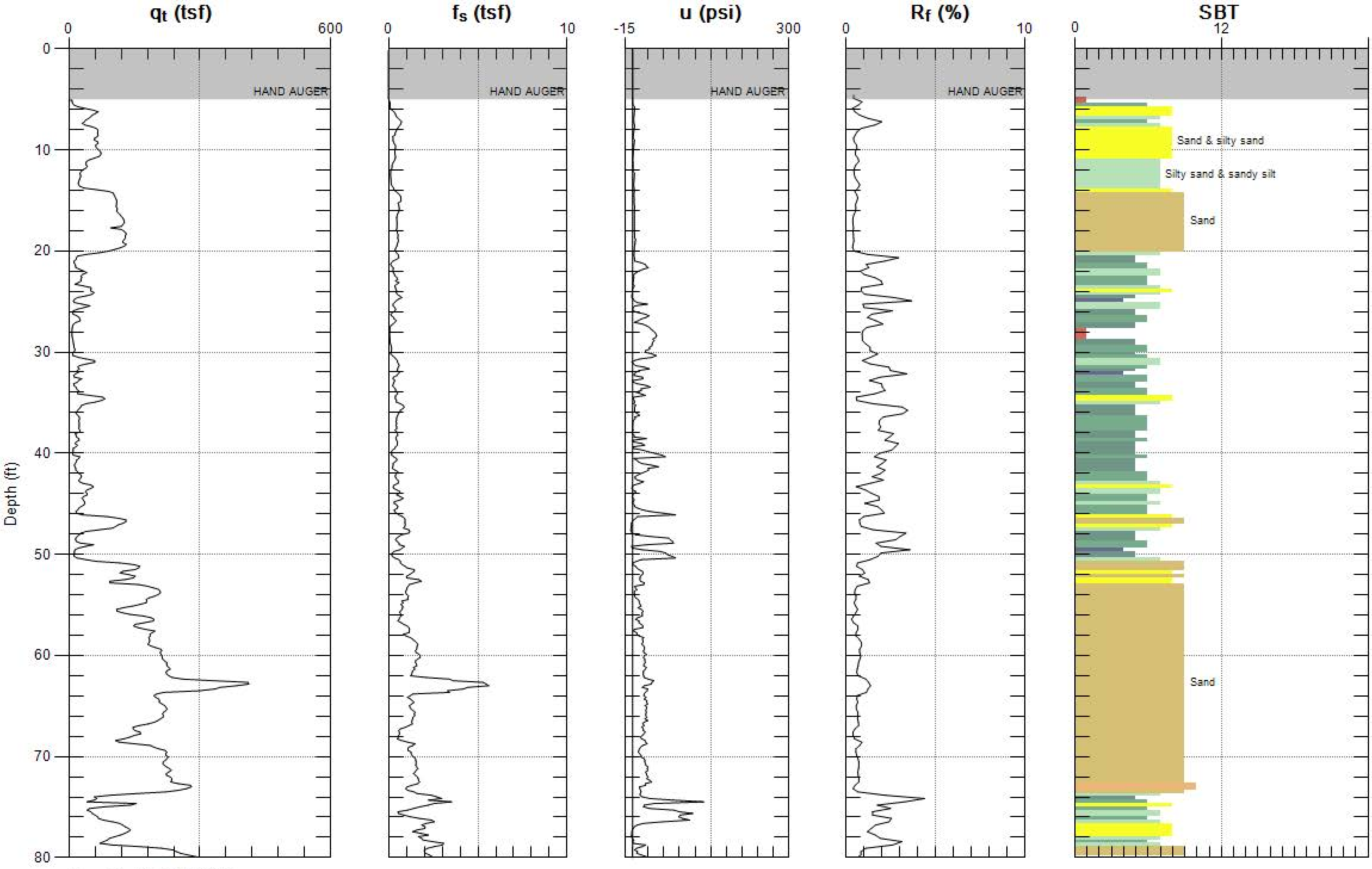
GREGG

AECOM

Site: MORENA PUMP STATION Engineer: K.MARTIN

Sounding: SH-06

Date: 3/14/17 12:22



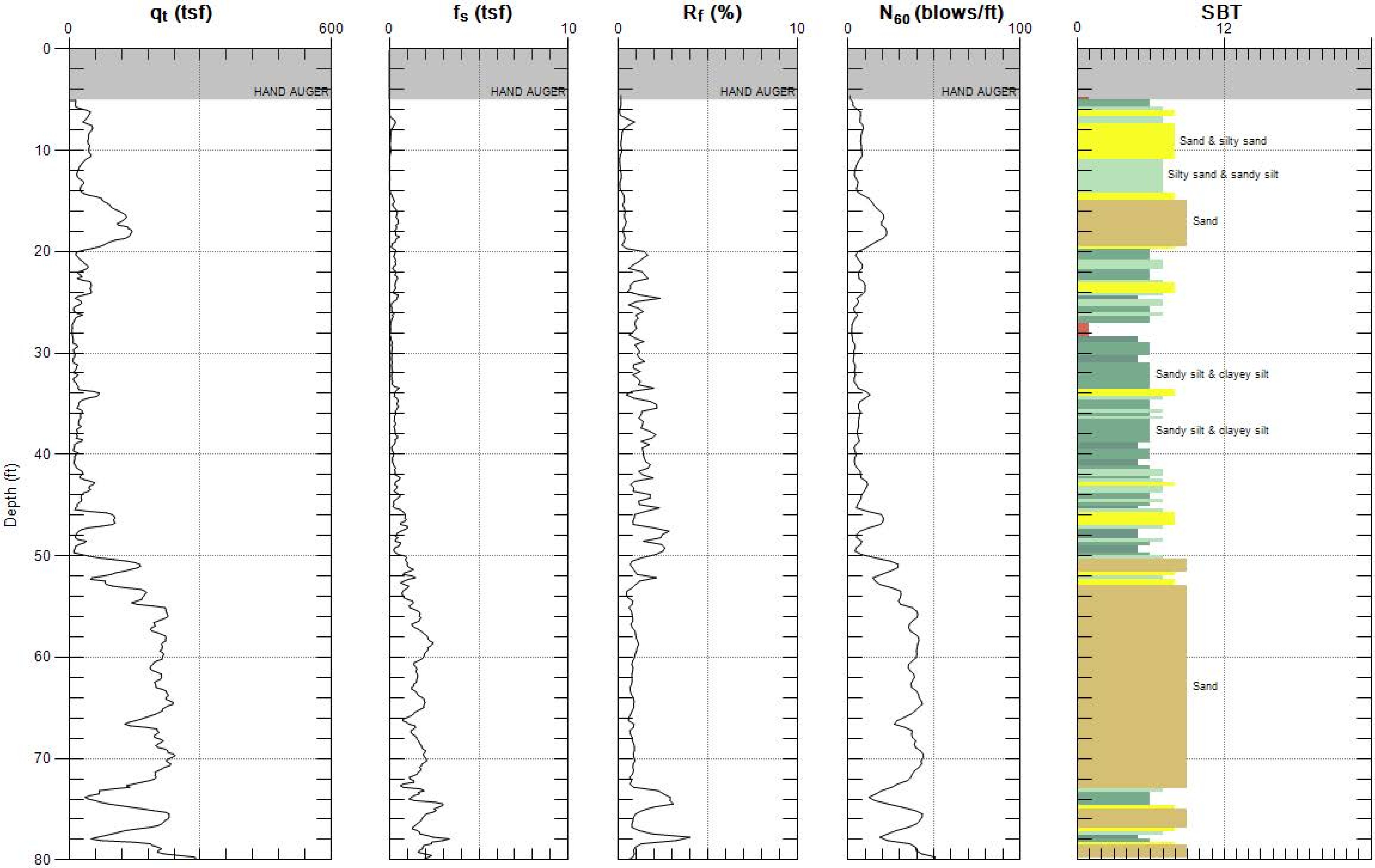
Max. Depth: 80.381 (ft)
Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)

AECOM

Site: MORENA PUMP STATION Engineer: K.MARTIN

Sounding: SH-07 **Date: 3/15/17 12:49**



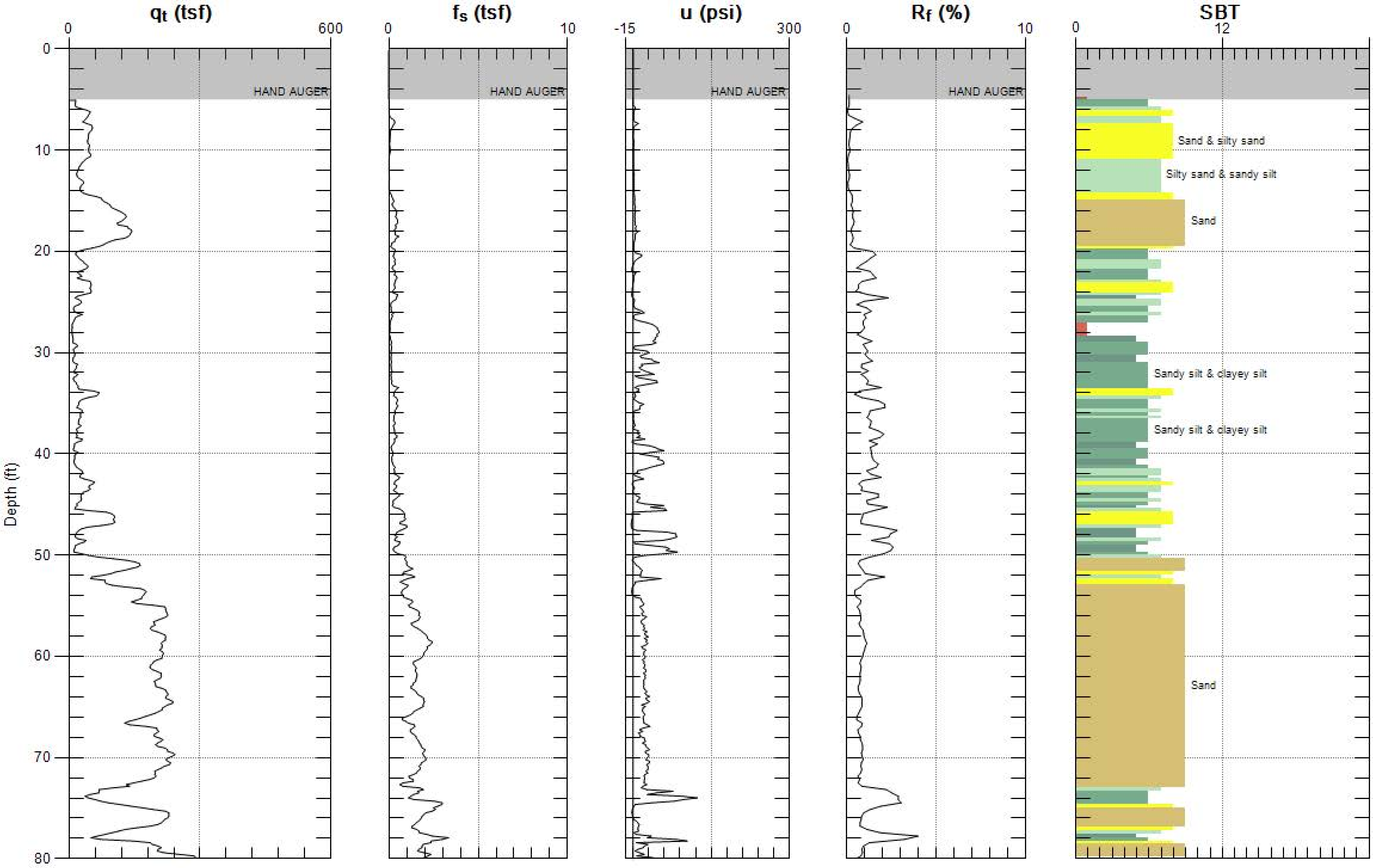
Max. Depth: 80.381 (ft)
Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)

AECOM

Site: MORENA PUMP STATION Engineer: K.MARTIN

Sounding: SH-07 **Date: 3/15/17 12:49**



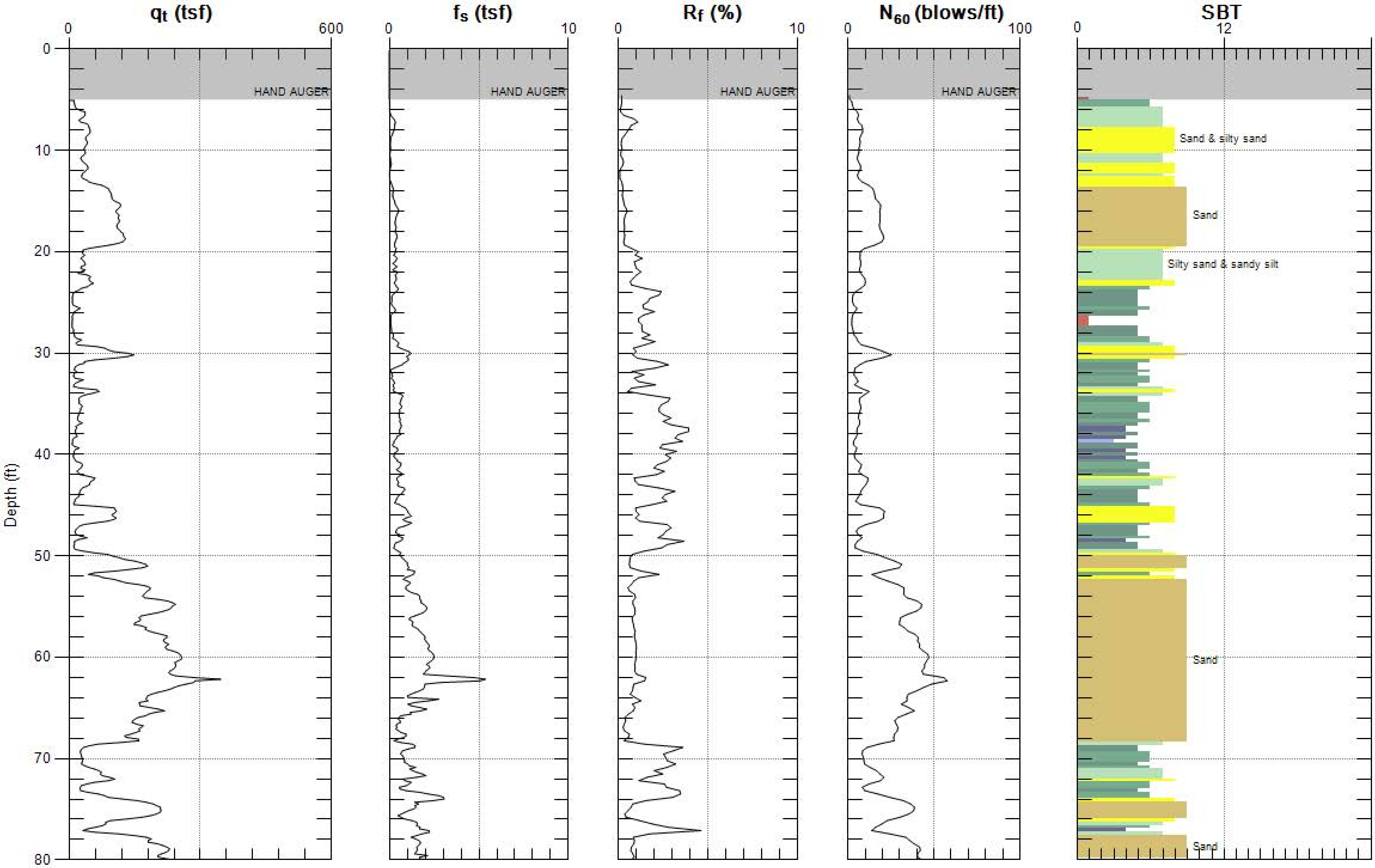
Max. Depth: 80.381 (ft)
Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)

AECOM

Site: MORENA PUMP STATION Engineer: K.MARTIN

Sounding: SH-08 Date: 3/15/17 02:18



Max. Depth: 80.381 (ft)
Avg. Interval: 0.328 (ft)

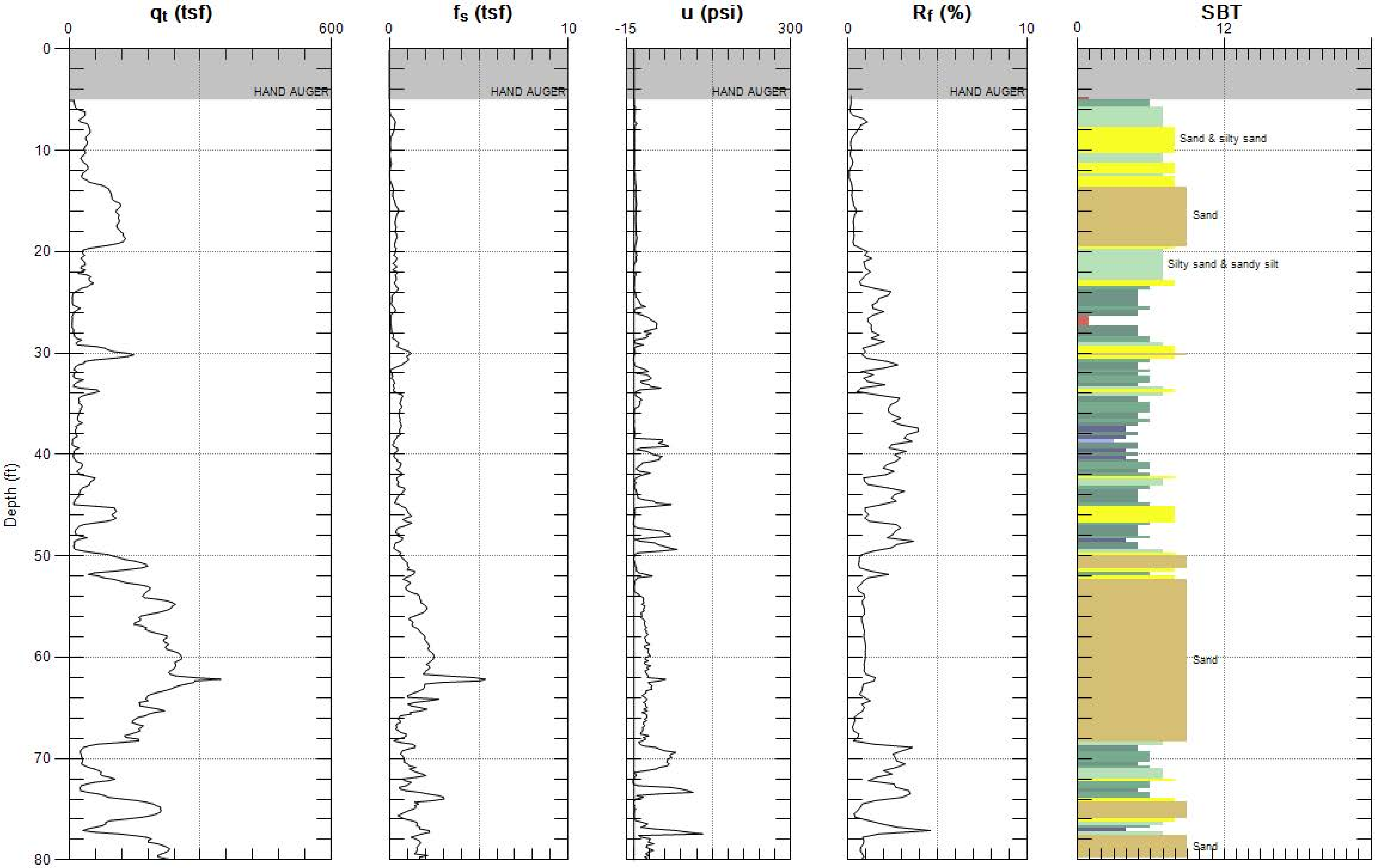
SBT: Soil Behavior Type (Robertson 1990)

GREGG

AECOM

Site: MORENA PUMP STATION Engineer: K.MARTIN

Sounding: SH-08 **Date: 3/15/17 02:18**



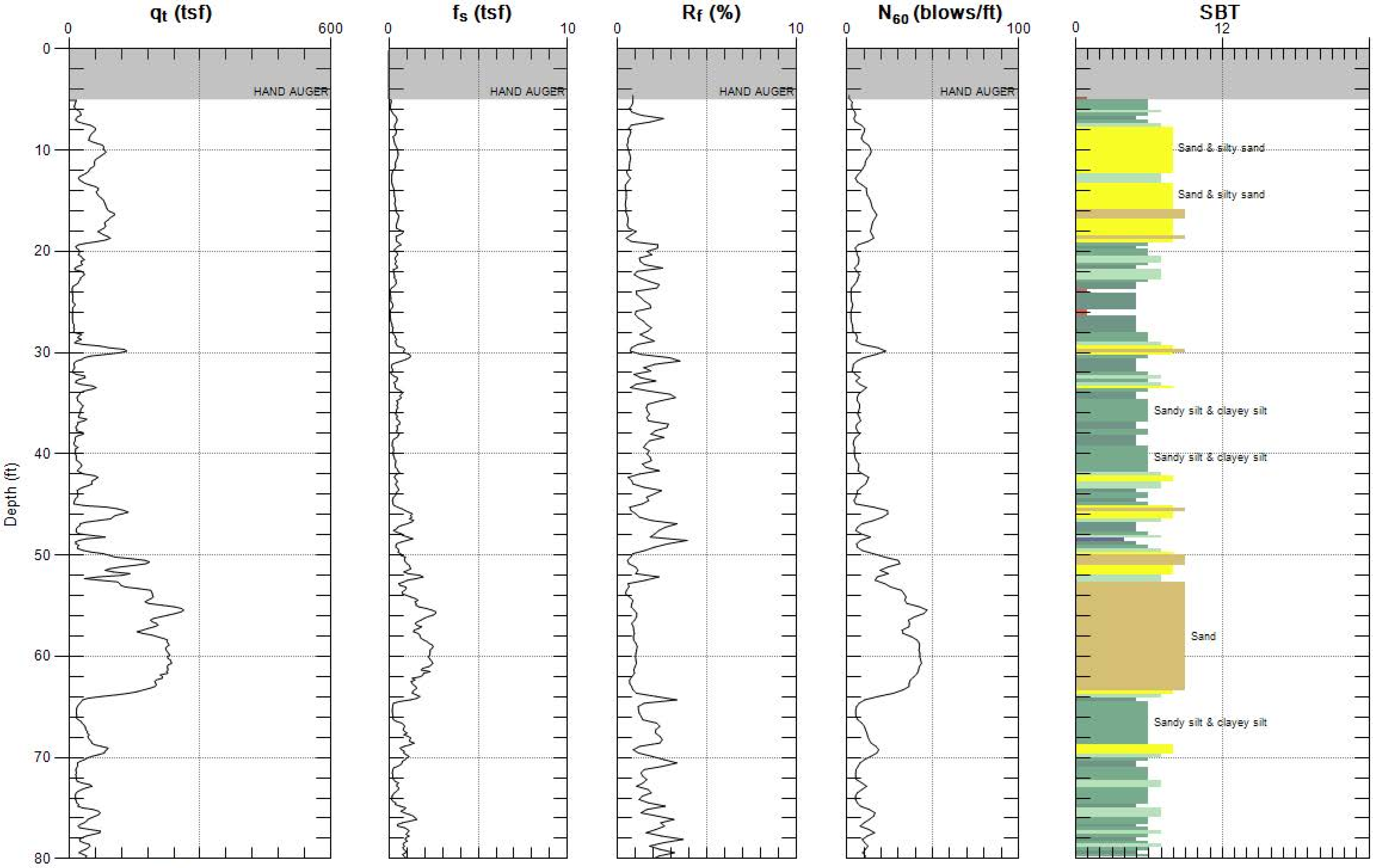
Max. Depth: 80.381 (ft)
Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)

GREGG **AECOM**

Site: MORENA PUMP STATION Engineer: K.MARTIN

Sounding: SH-09 **Date: 3/16/17 10:15**



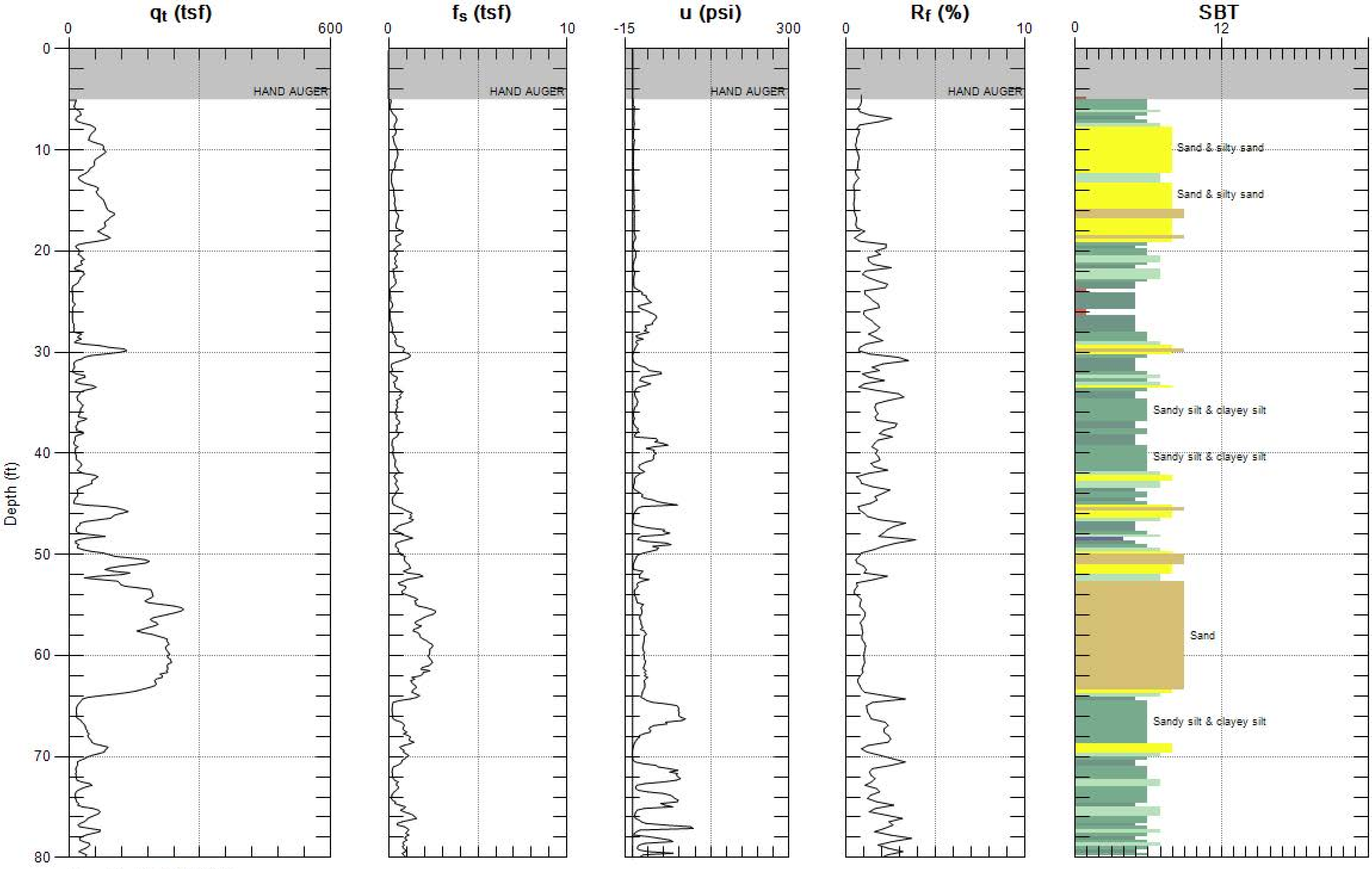
Max. Depth: 80.381 (ft)
Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)

GREGG **AECOM**

Site: MORENA PUMP STATION Engineer: K.MARTIN

Sounding: SH-09 **Date: 3/16/17 10:15**



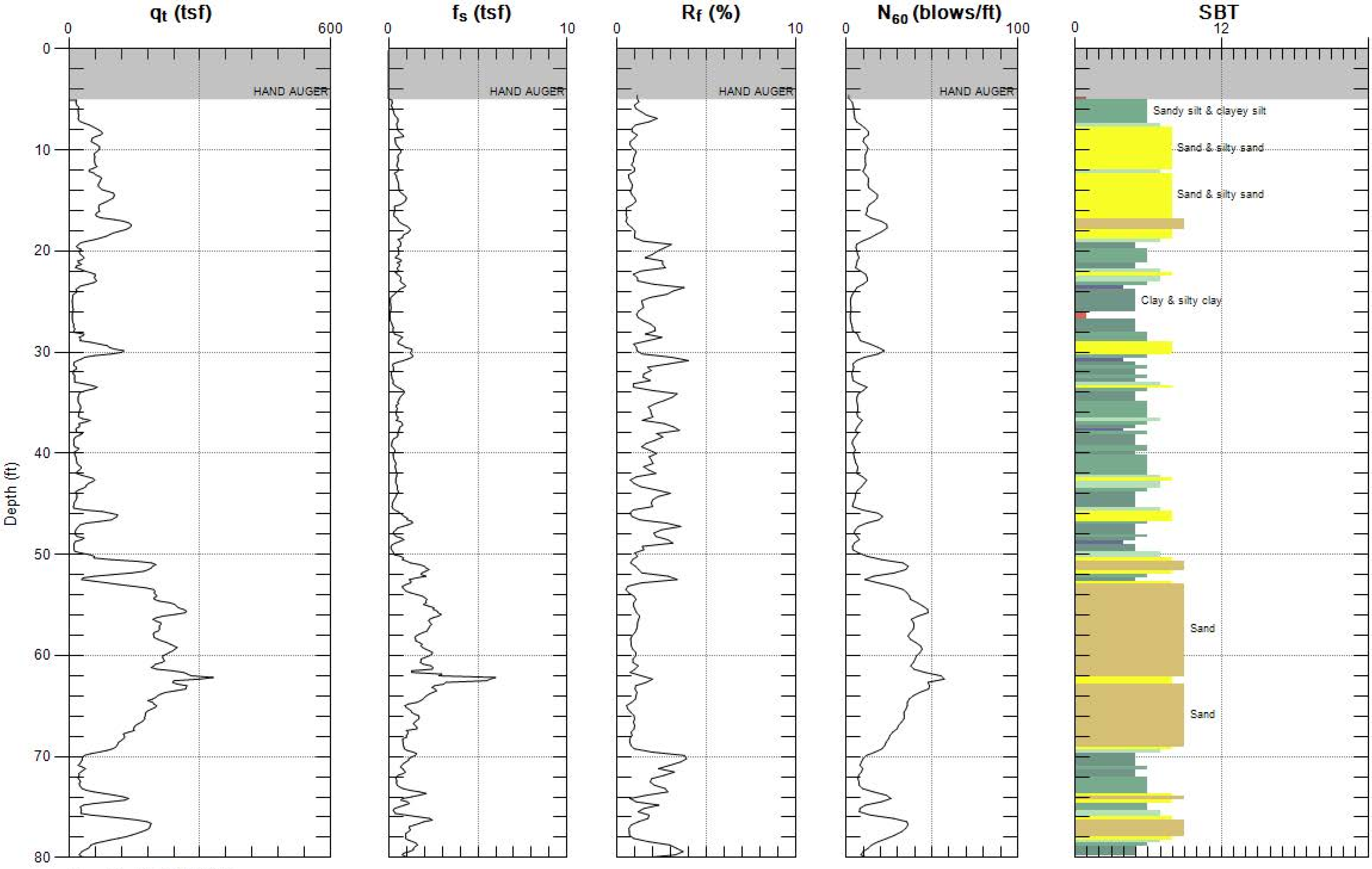
Max. Depth: 80.381 (ft)
Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)

GREGG **AECOM**

Site: MORENA PUMP STATION Engineer: K.MARTIN

Sounding: SH-10 **Date: 3/16/17 12:22**



Max. Depth: 80.381 (ft)
Avg. Interval: 0.328 (ft)

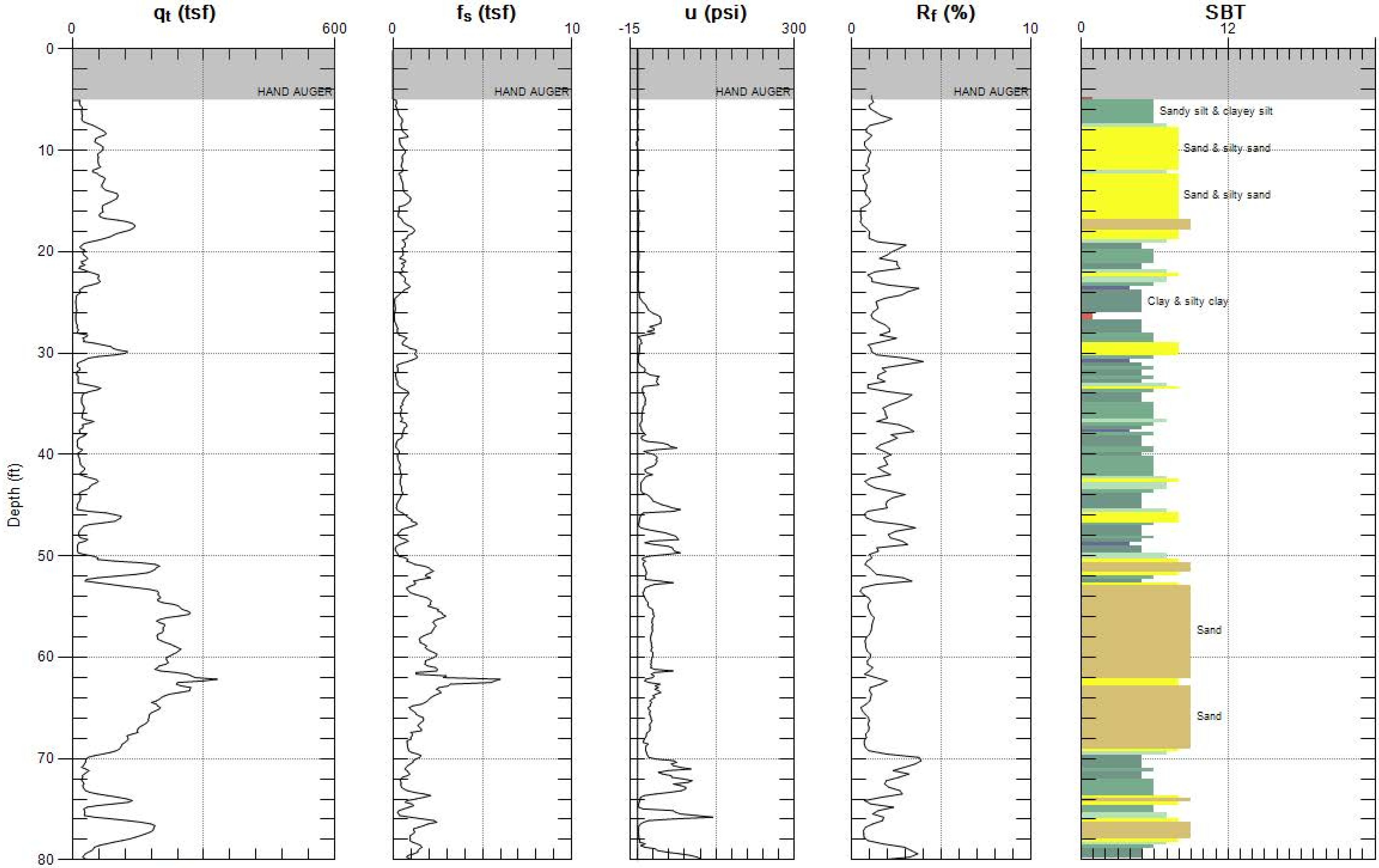
SBT: Soil Behavior Type (Robertson 1990)

GREGG

AECOM

Site: MORENA PUMP STATION Engineer: K.MARTIN

Sounding: SH-10 **Date: 3/16/17 12:22**



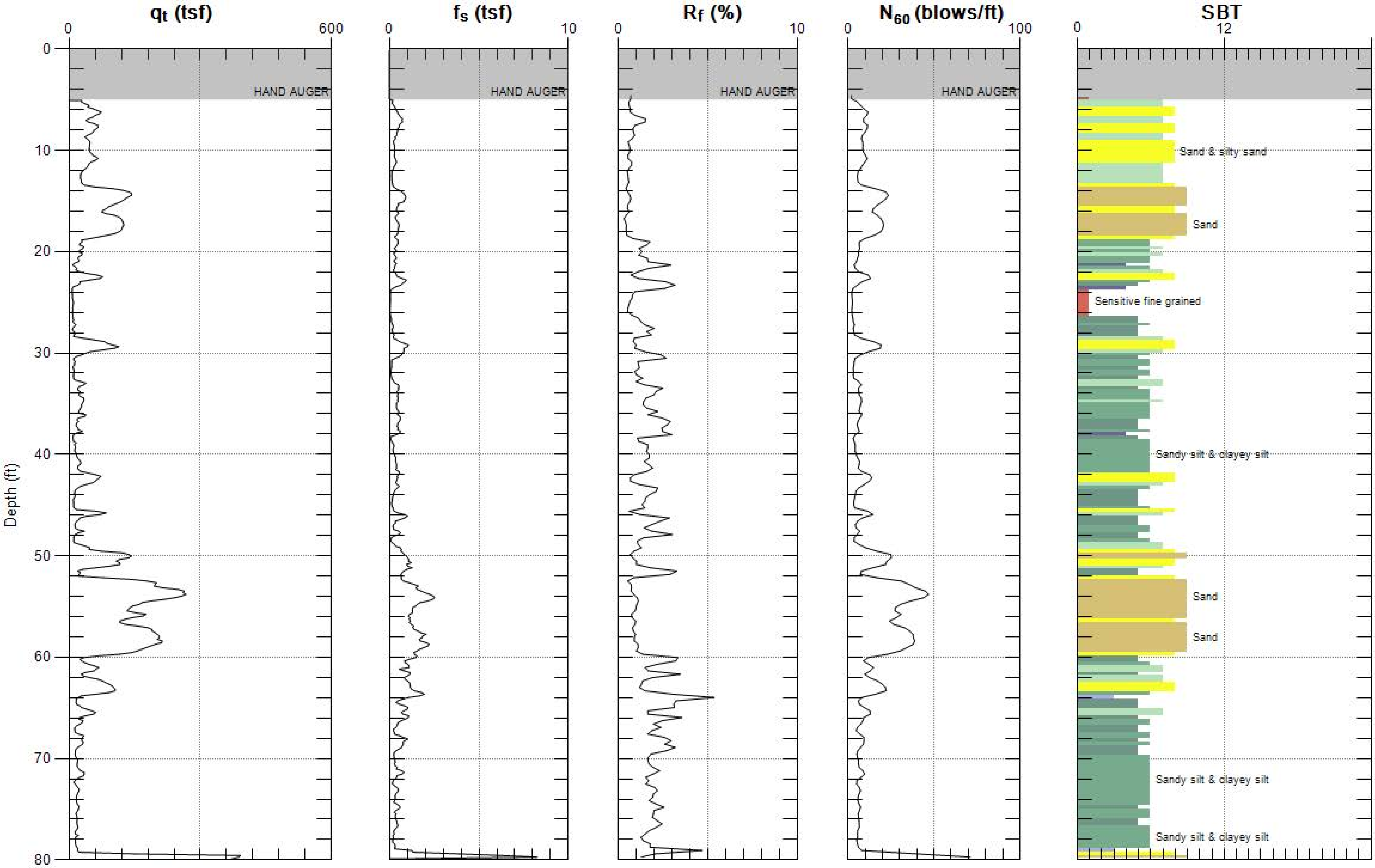
Max. Depth: 80.381 (ft)
Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)

GREGG **AECOM**

Site: MORENA PUMP STATION Engineer: K.MARTIN

Sounding: SH-11 **Date: 3/16/17 01:43**



Max. Depth: 80.052 (ft)
Avg. Interval: 0.328 (ft)

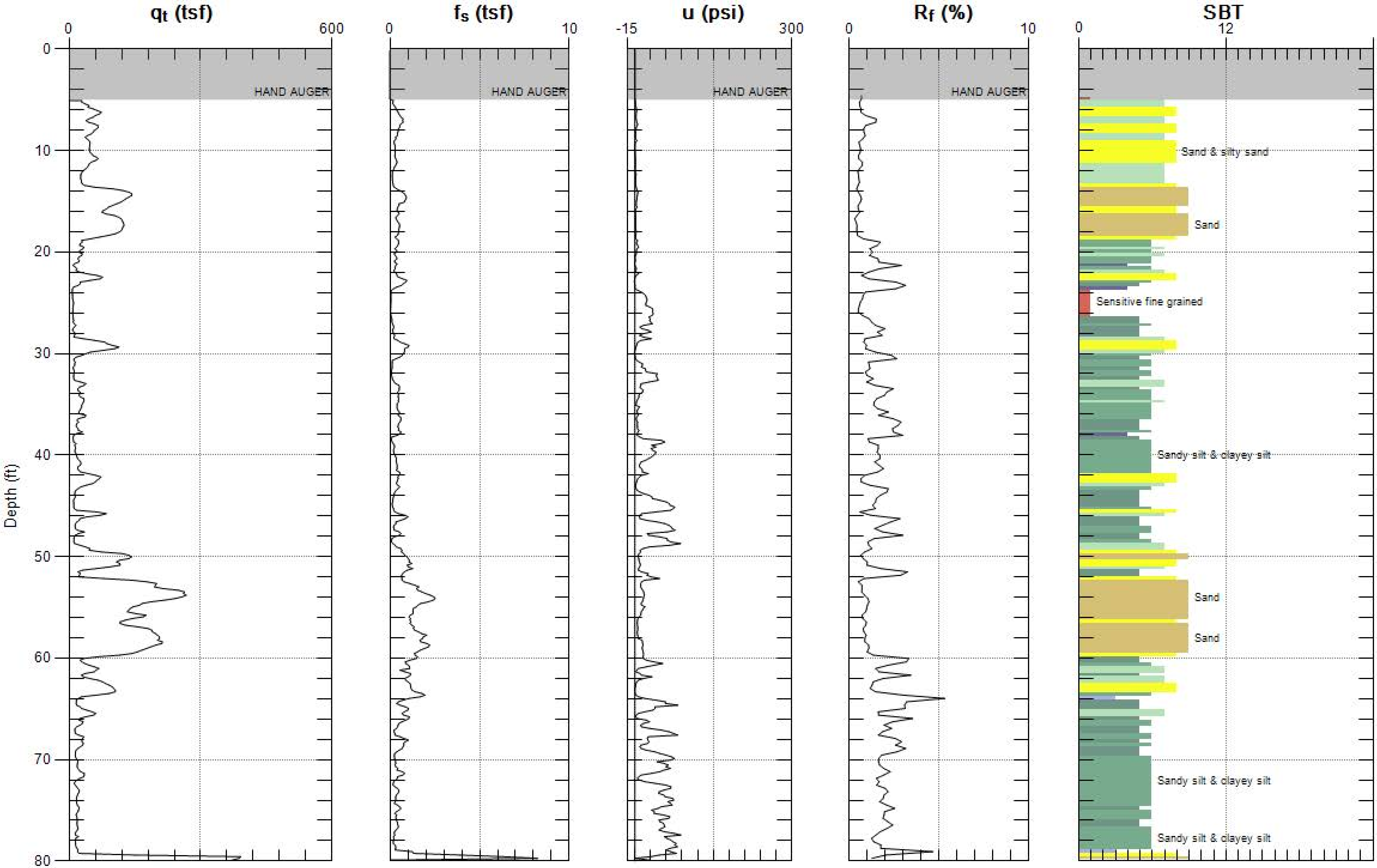
SBT: Soil Behavior Type (Robertson 1990)

AECOM

Site: MORENA PUMP STATION Engineer: K.MARTIN

Sounding: SH-11

Date: 3/16/17 01:43



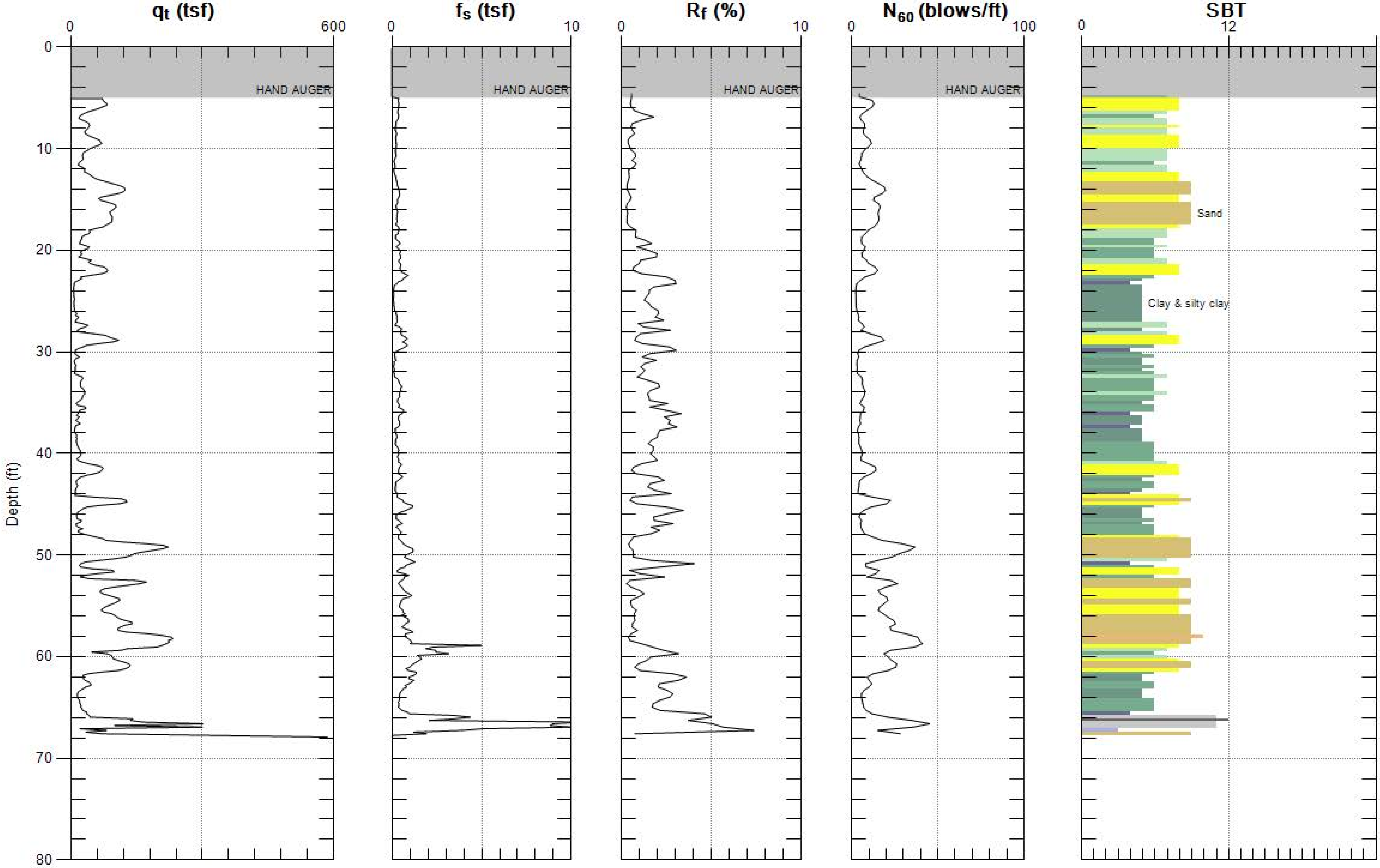
Max. Depth: 80.052 (ft)
Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)

AECOM

Site: MORENA PUMP STATION Engineer: K.MARTIN

Sounding: SH-12 **Date: 3/17/17 08:02**



Max. Depth: 67.913 (ft)
Avg. Interval: 0.328 (ft)

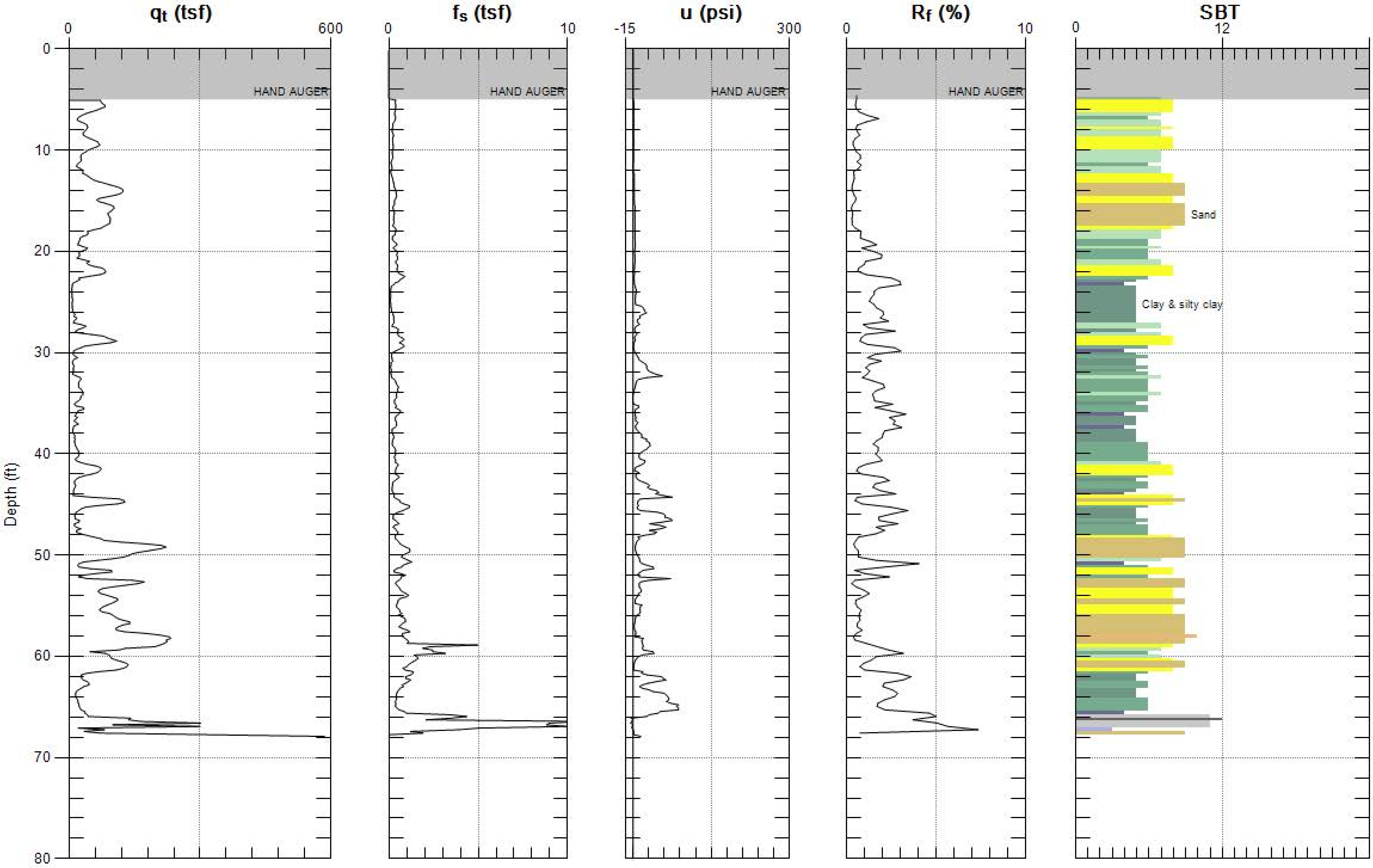
SBT: Soil Behavior Type (Robertson 1990)

AECOM

Site: MORENA PUMP STATION Engineer: K.MARTIN

Sounding: SH-12

Date: 3/17/17 08:02



Max. Depth: 67.913 (ft)
Avg. Interval: 0.328 (ft)

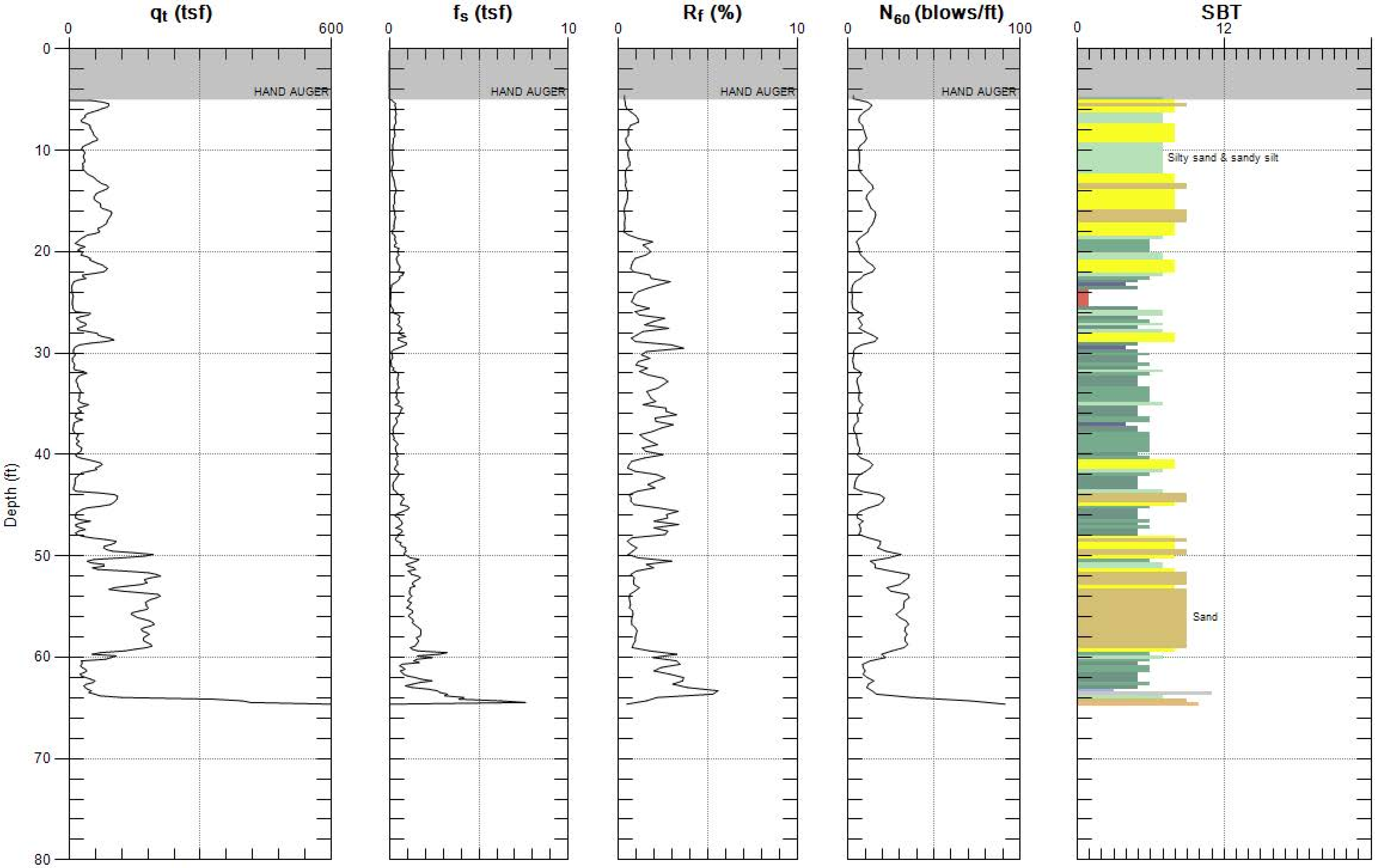
SBT: Soil Behavior Type (Robertson 1990)

GREGG

AECOM

Site: MORENA PUMP STATION Engineer: K.MARTIN

Sounding: SH-13 **Date: 3/15/17 09:27**



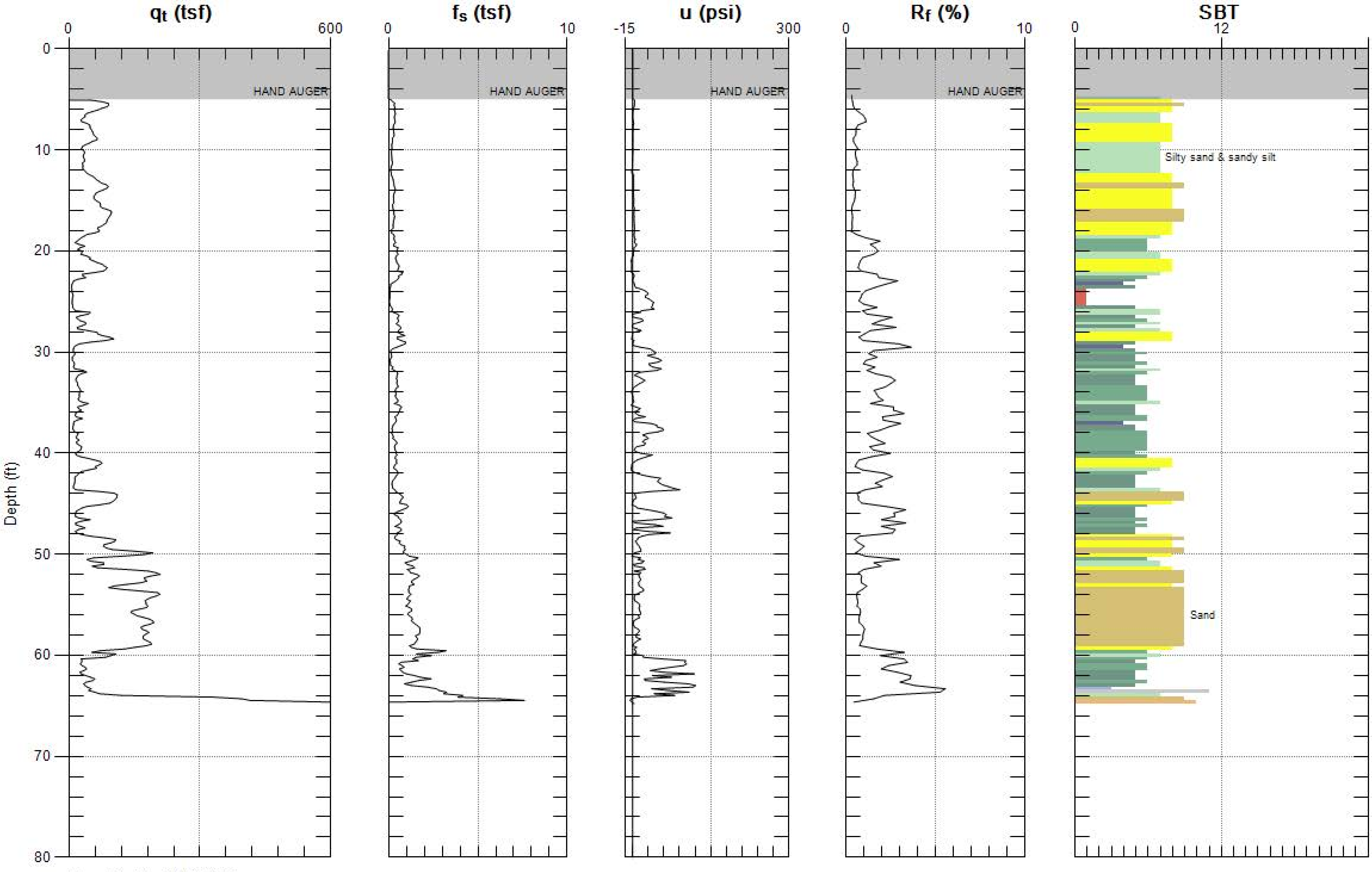
Max. Depth: 64.797 (ft)
Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)

GREGG **AECOM**

Site: MORENA PUMP STATION Engineer: K.MARTIN

Sounding: SH-13 **Date: 3/15/17 09:27**



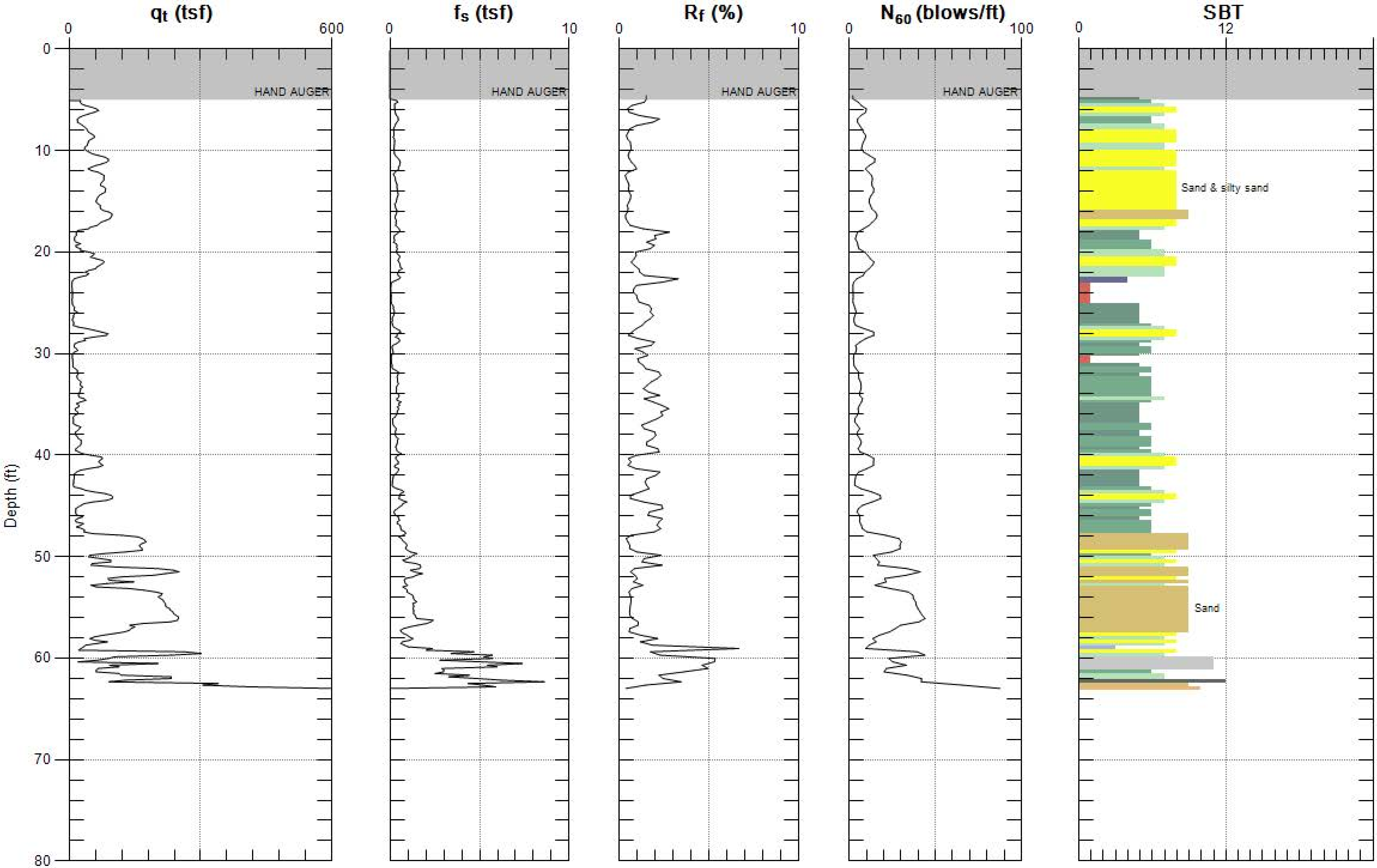
Max. Depth: 64.797 (ft)
Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)

AECOM

Site: MORENA PUMP STATION Engineer: K.MARTIN

Sounding: SH-14 **Date: 3/17/17 09:29**



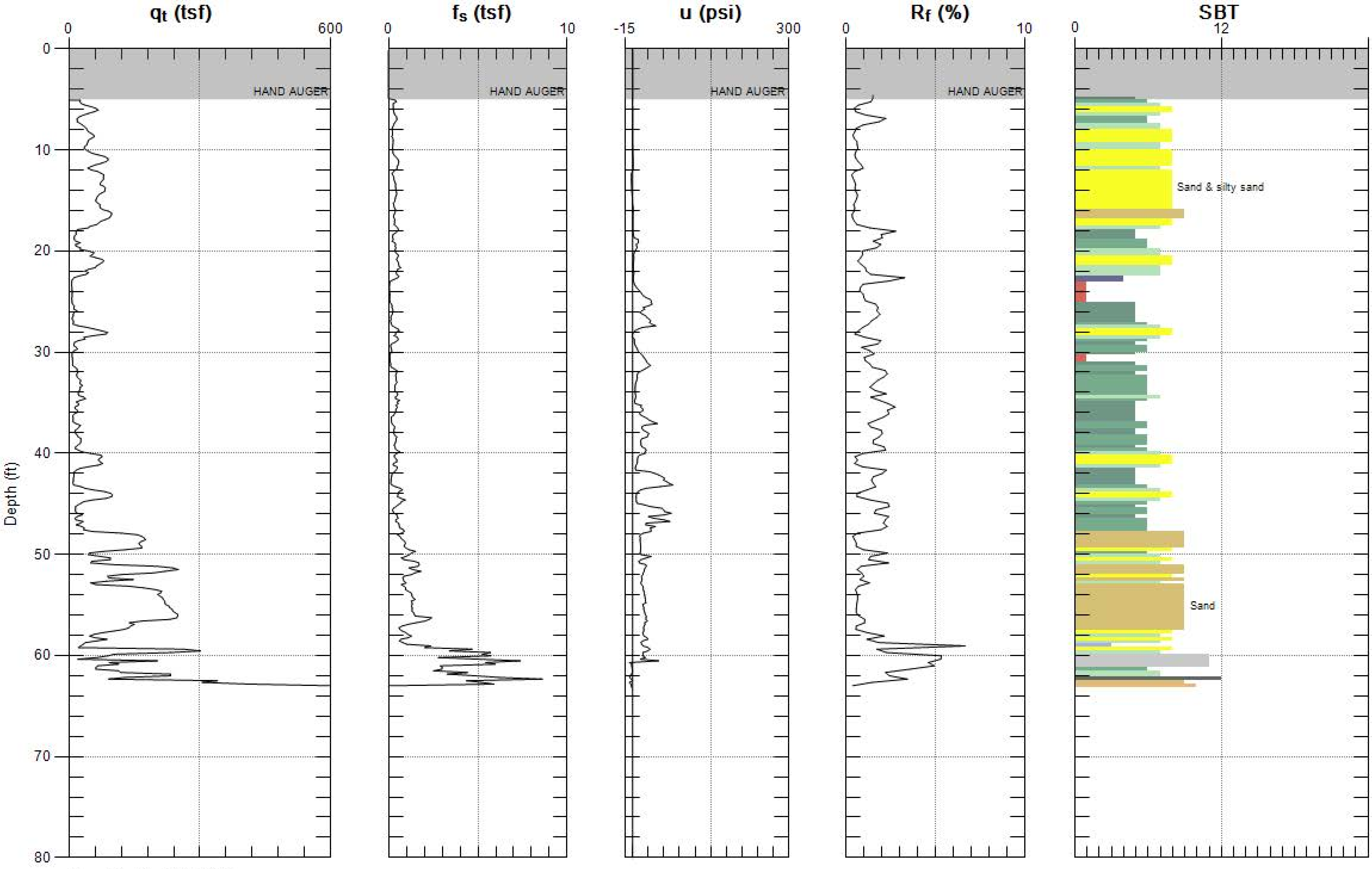
Max. Depth: 63.156 (ft)
Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)

AECOM

Site: MORENA PUMP STATION Engineer: K.MARTIN

Sounding: SH-14 **Date: 3/17/17 09:29**



Max. Depth: 63.156 (ft)
Avg. Interval: 0.328 (ft)

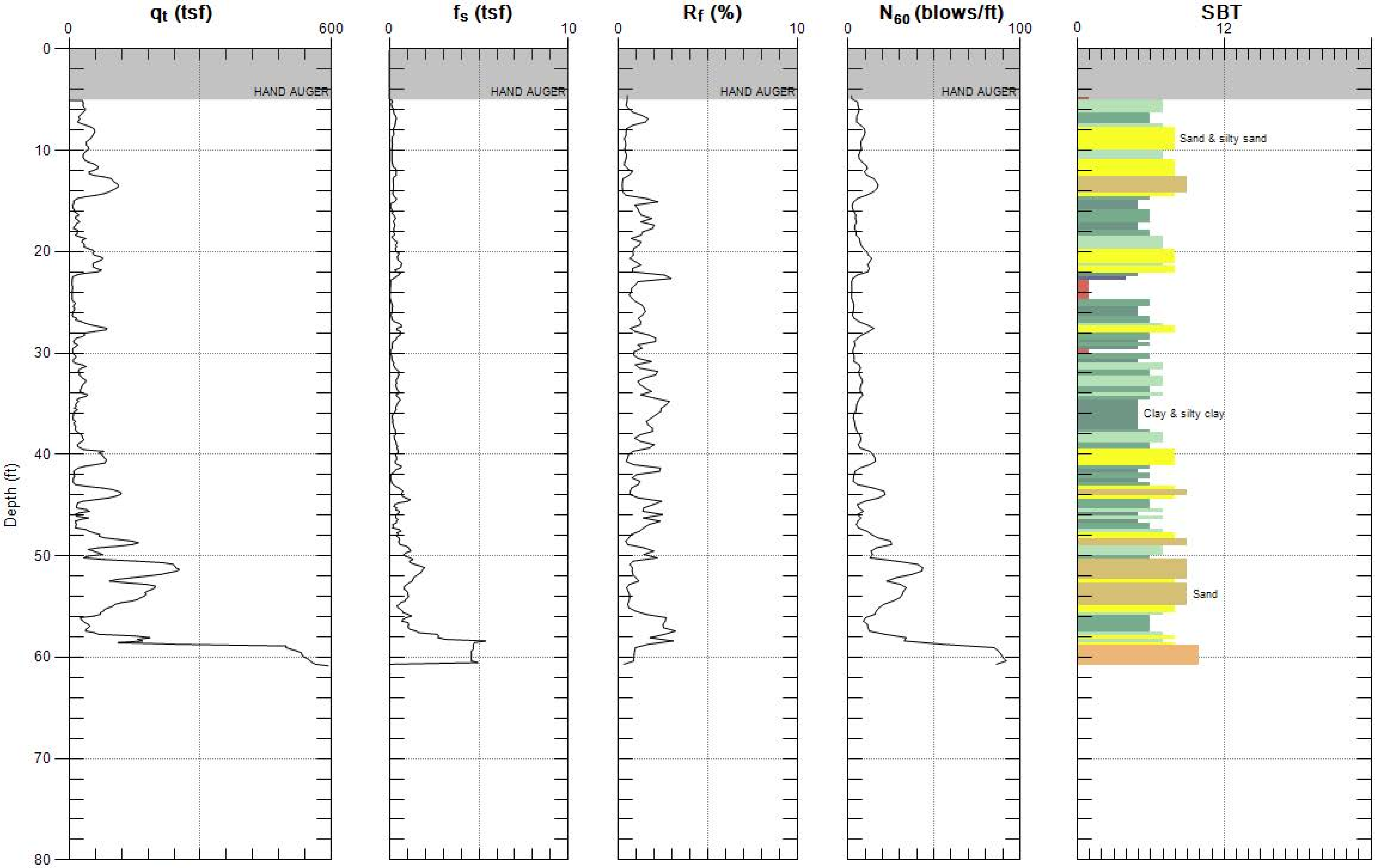
SBT: Soil Behavior Type (Robertson 1990)

GREGG

AECOM

Site: MORENA PUMP STATION Engineer: K.MARTIN

Sounding: SH-15 **Date: 3/15/17 10:51**



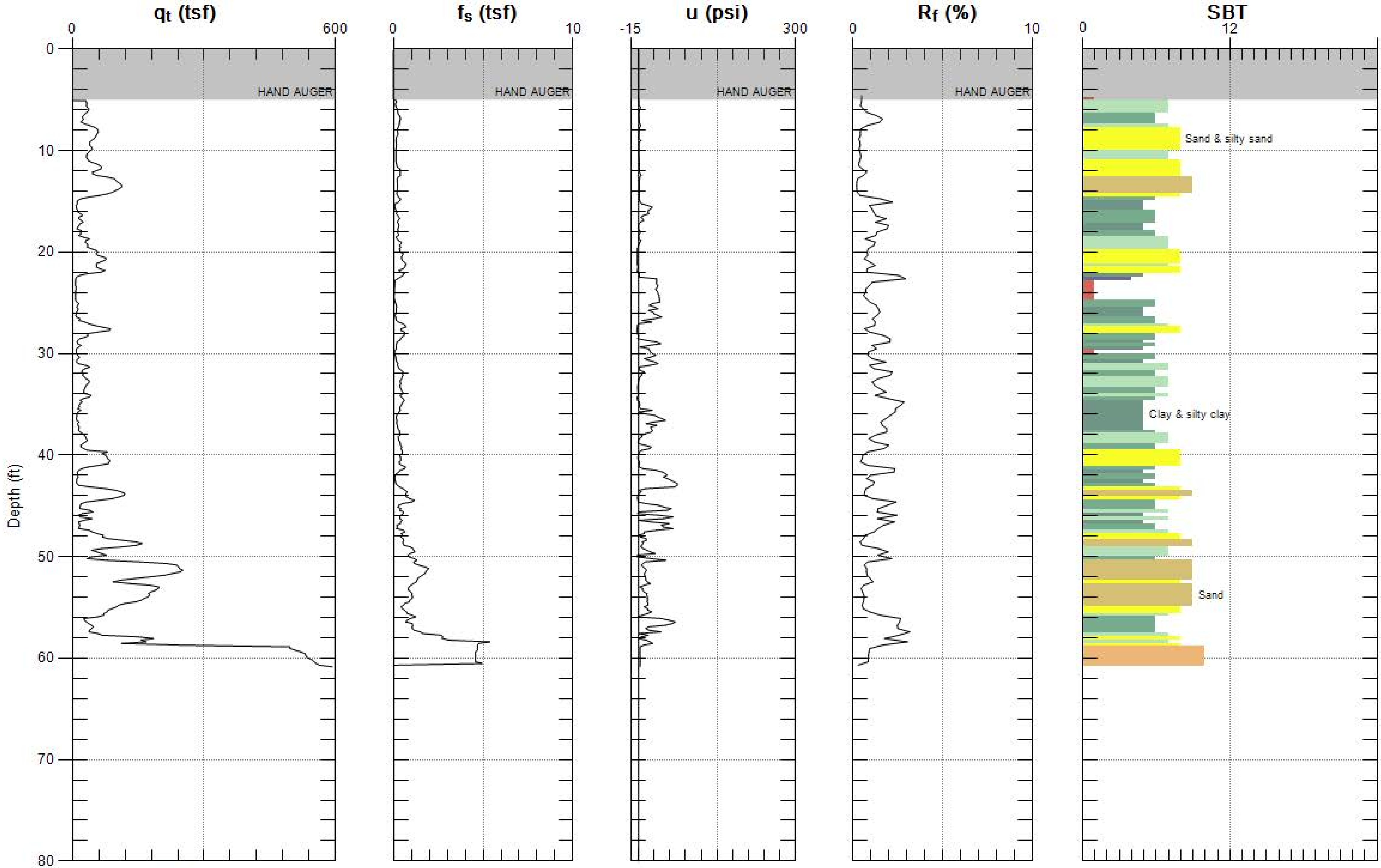
Max. Depth: 60.860 (ft)
Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)

AECOM

Site: MORENA PUMP STATION Engineer: K.MARTIN

Sounding: SH-15 **Date: 3/15/17 10:51**



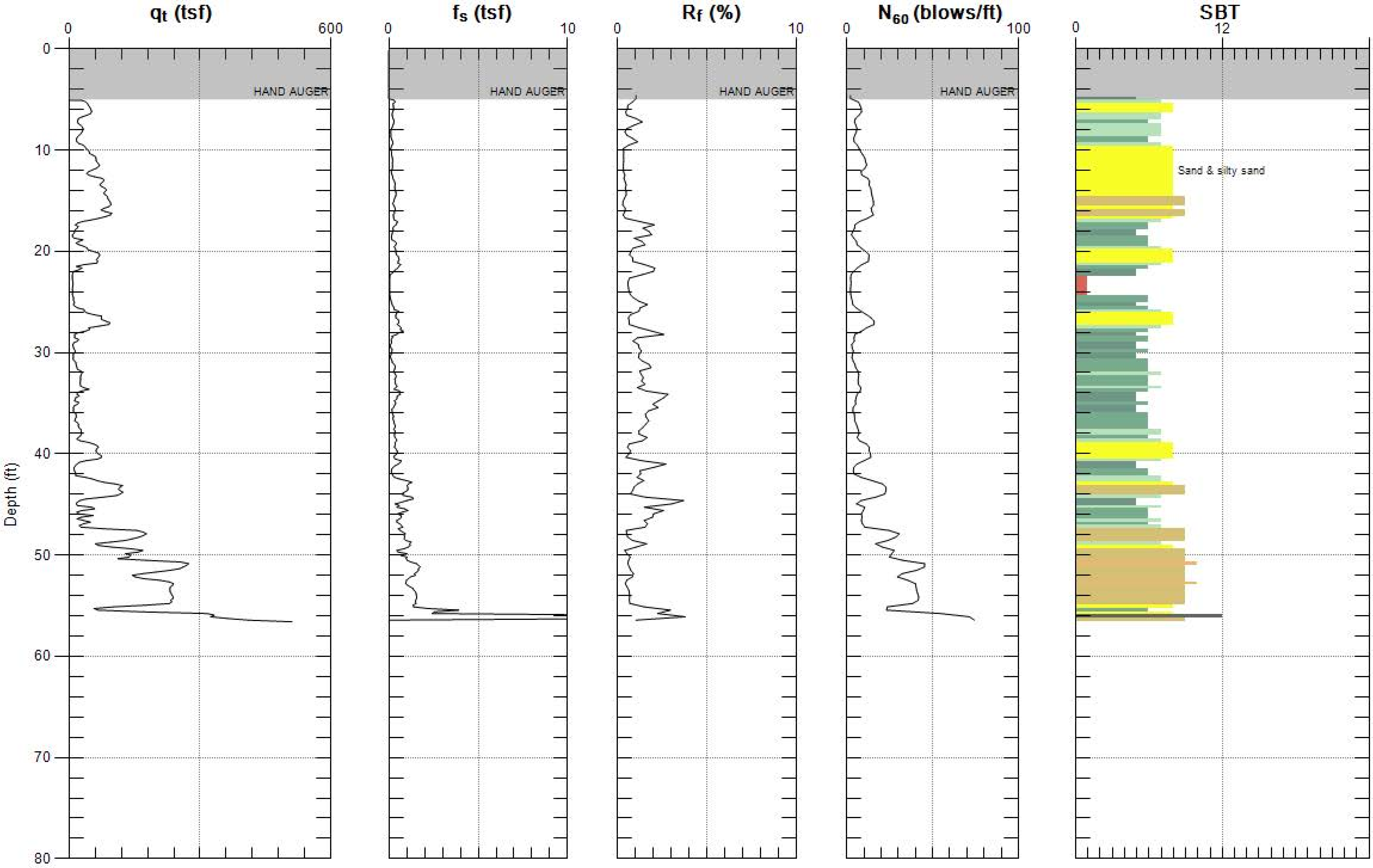
Max. Depth: 60.860 (ft)
Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)

AECOM

Site: MORENA PUMP STATION Engineer: K.MARTIN

Sounding: SH-16 **Date: 3/17/17 10:45**



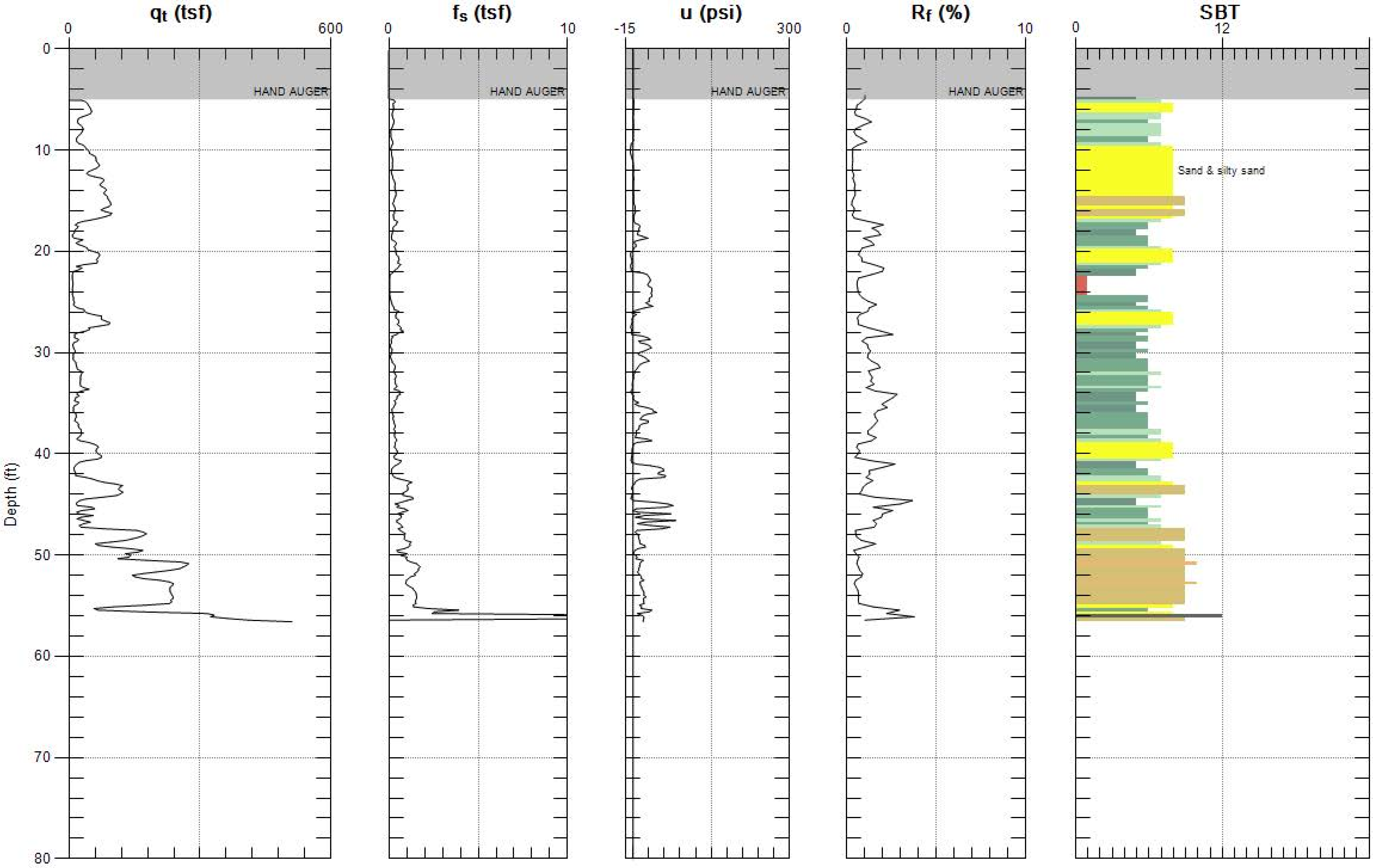
Max. Depth: 56.594 (ft)
Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)

AECOM

Site: MORENA PUMP STATION Engineer: K.MARTIN

Sounding: SH-16 **Date: 3/17/17 10:45**



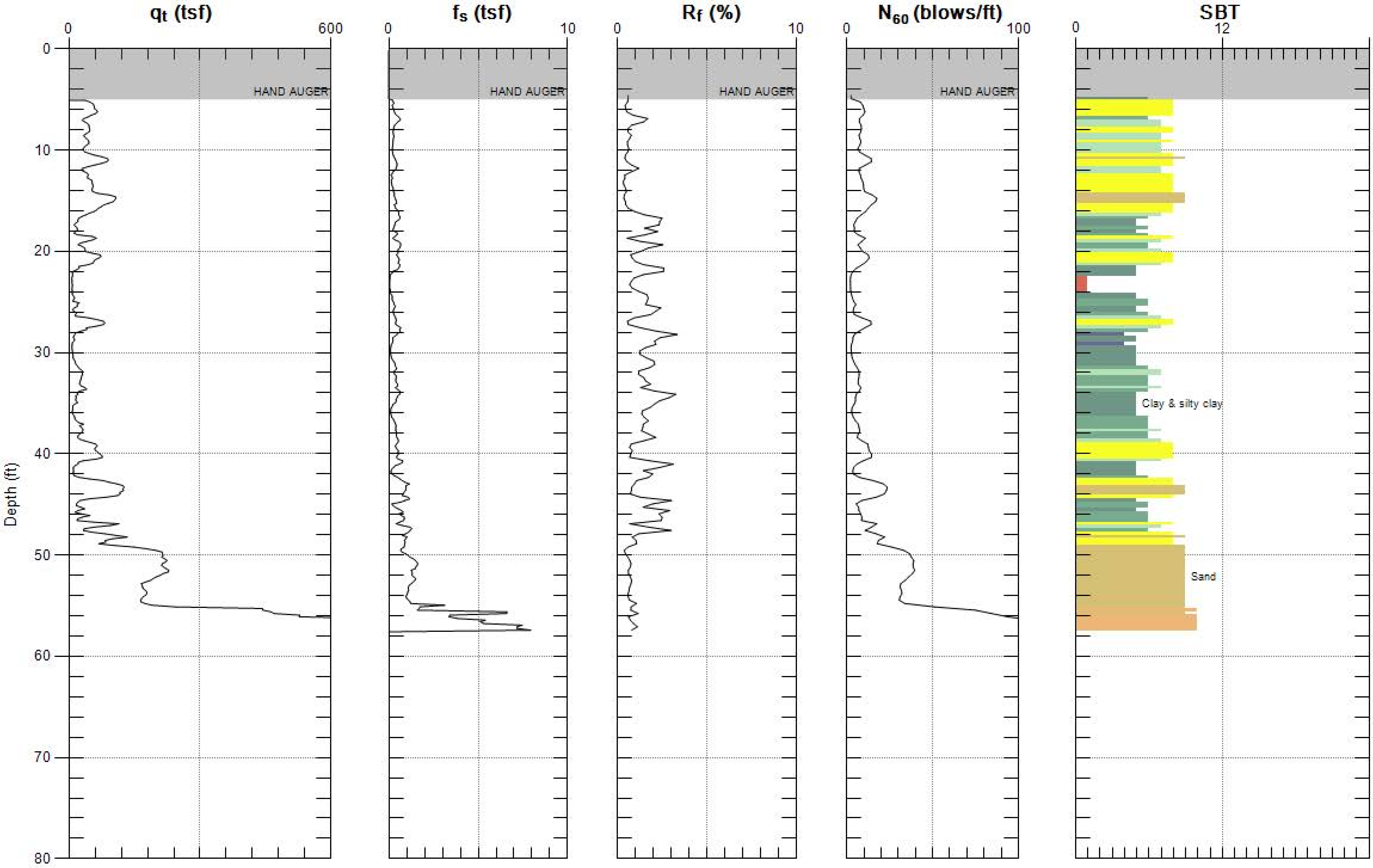
Max. Depth: 56.594 (ft)
Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)

AECOM

Site: MORENA PUMP STATION Engineer: K.MARTIN

Sounding: SH-17 **Date: 3/17/17 12:35**



Max. Depth: 57.743 (ft)
Avg. Interval: 0.328 (ft)

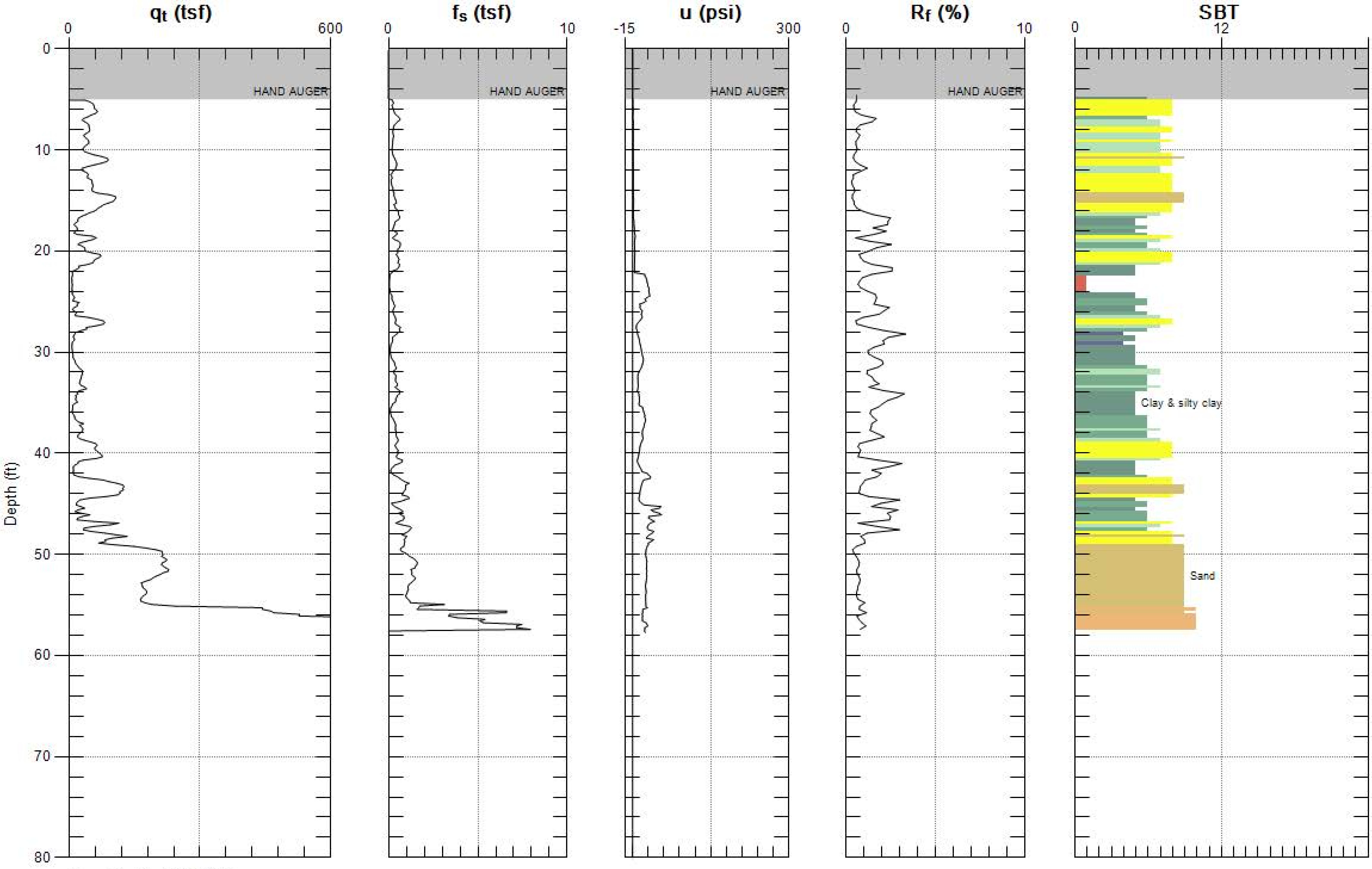
SBT: Soil Behavior Type (Robertson 1990)

GREGG

AECOM

Site: MORENA PUMP STATION Engineer: K.MARTIN

Sounding: SH-17 **Date: 3/17/17 12:35**



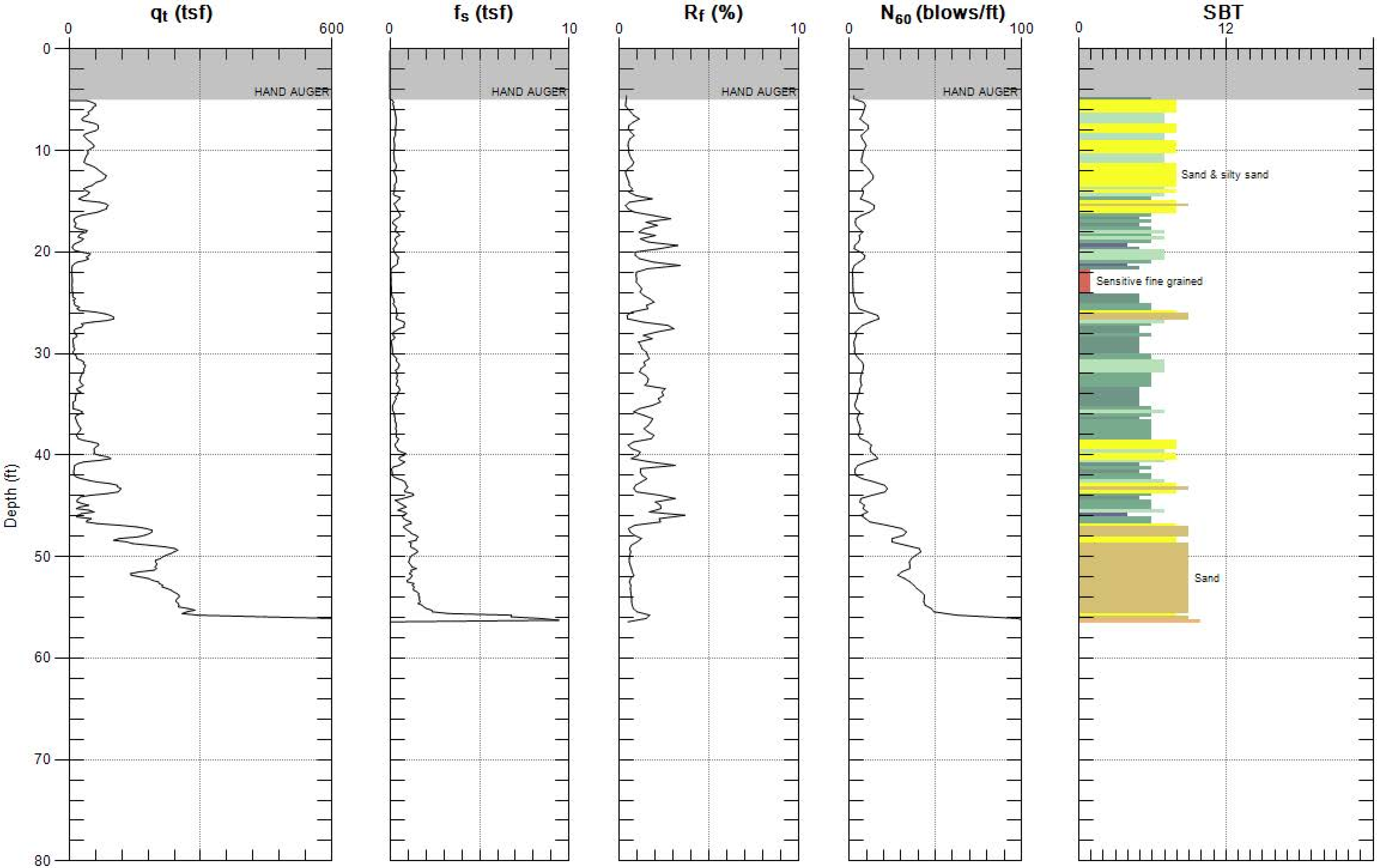
Max. Depth: 57.743 (ft)
Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)

AECOM

Site: MORENA PUMP STATION Engineer: K.MARTIN

Sounding: SH-18 **Date: 3/17/17 02:13**



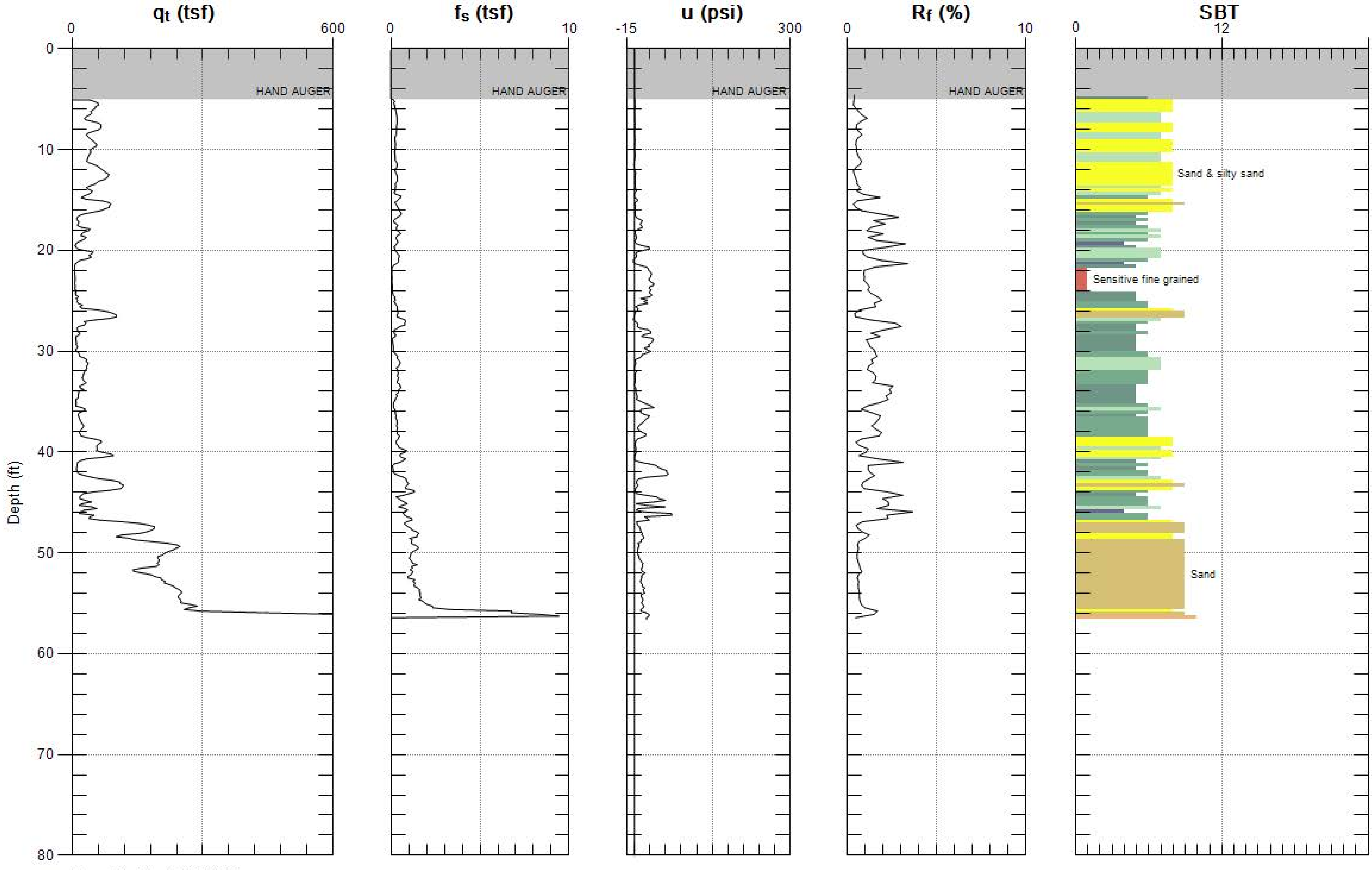
Max. Depth: 56.594 (ft)
Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)

AECOM

Site: MORENA PUMP STATION Engineer: K.MARTIN

Sounding: SH-18 **Date: 3/17/17 02:13**



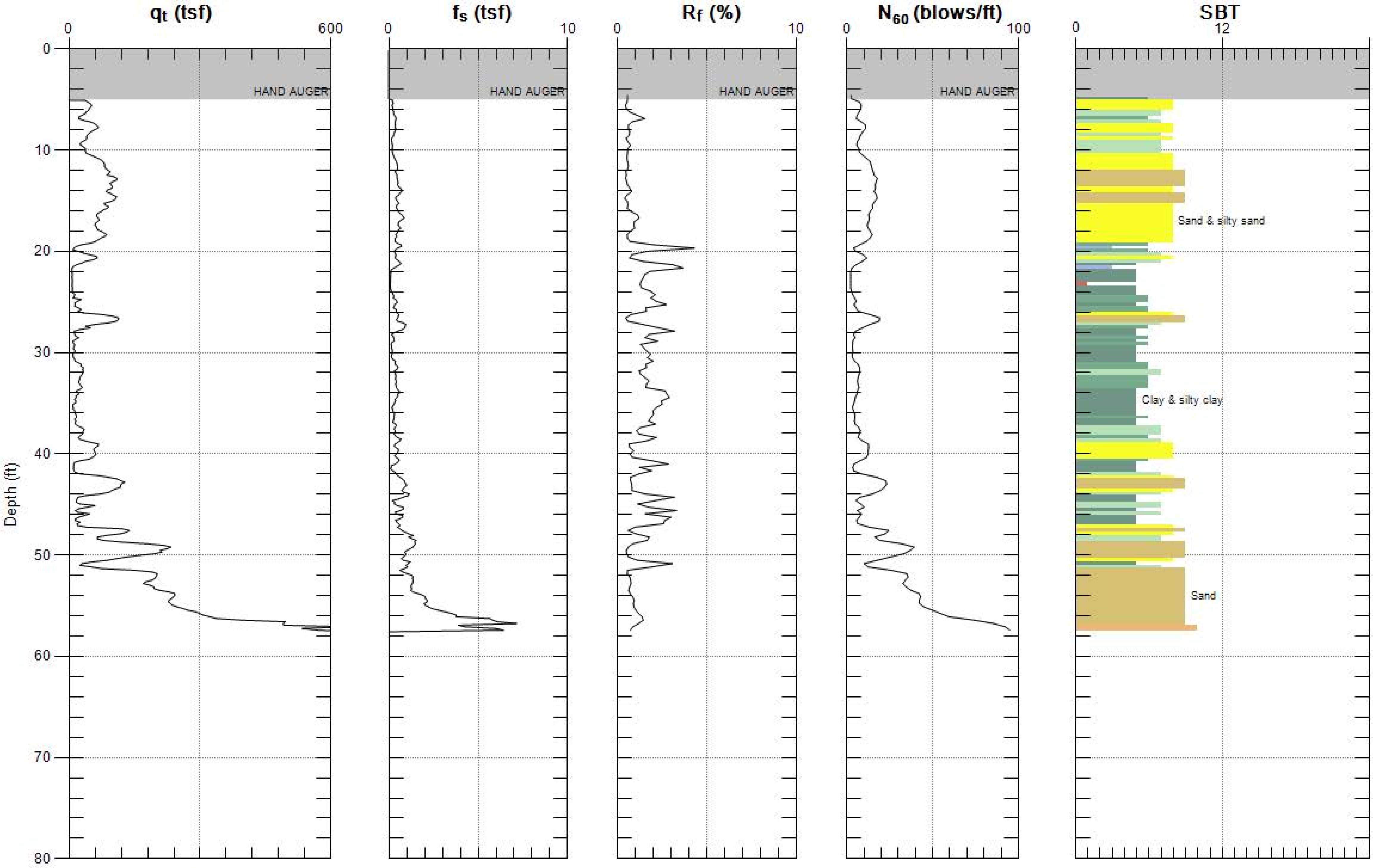
Max. Depth: 56.594 (ft)
Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)

GREGG **AECOM**

Site: MORENA PUMP STATION Engineer: K.MARTIN

Sounding: CU-01 **Date: 3/20/17 08:34**



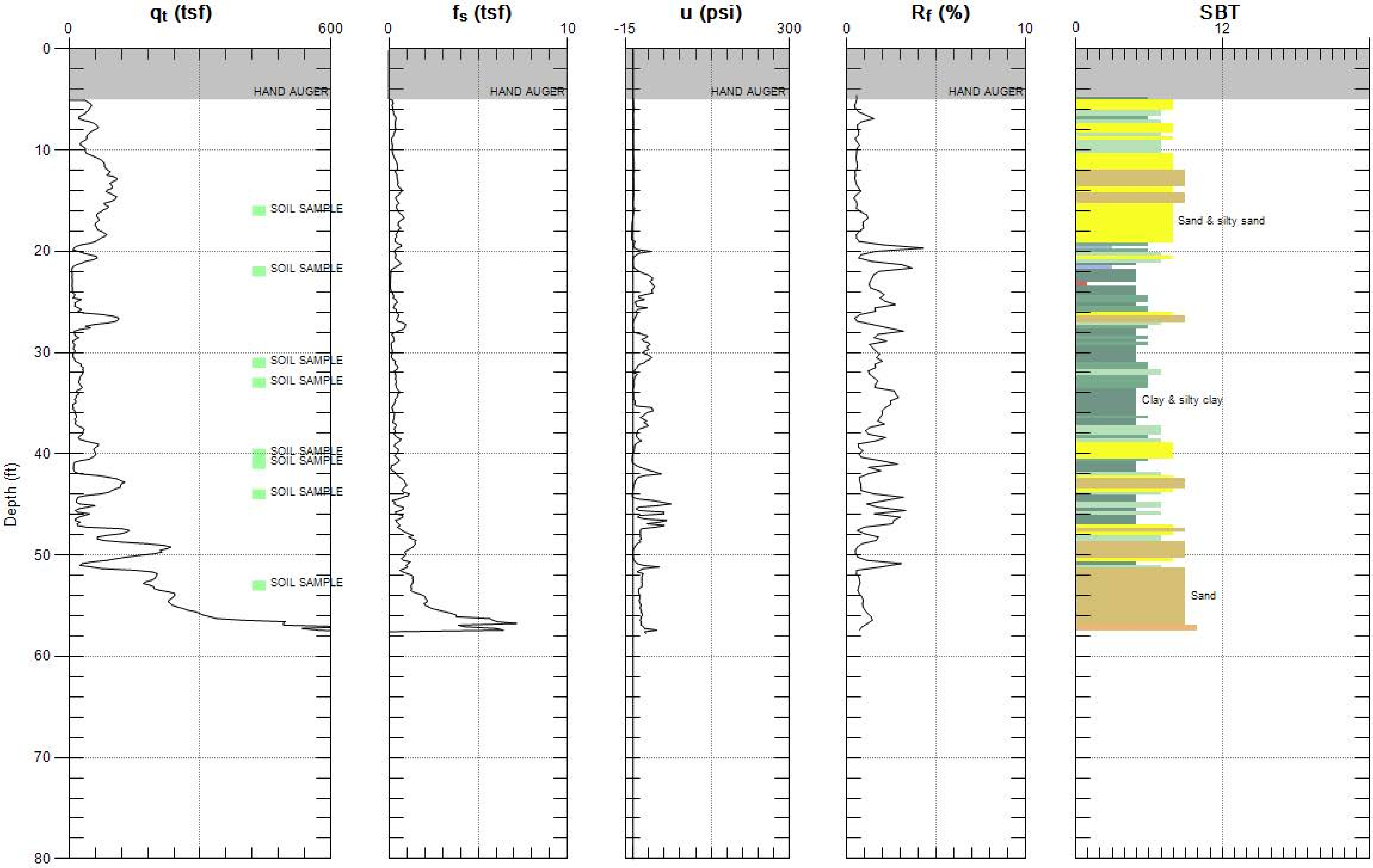
Max. Depth: 57.743 (ft)
Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)

AECOM

Site: MORENA PUMP STATION Engineer: K.MARTIN

Sounding: CU-01 **Date: 3/20/17 08:34**



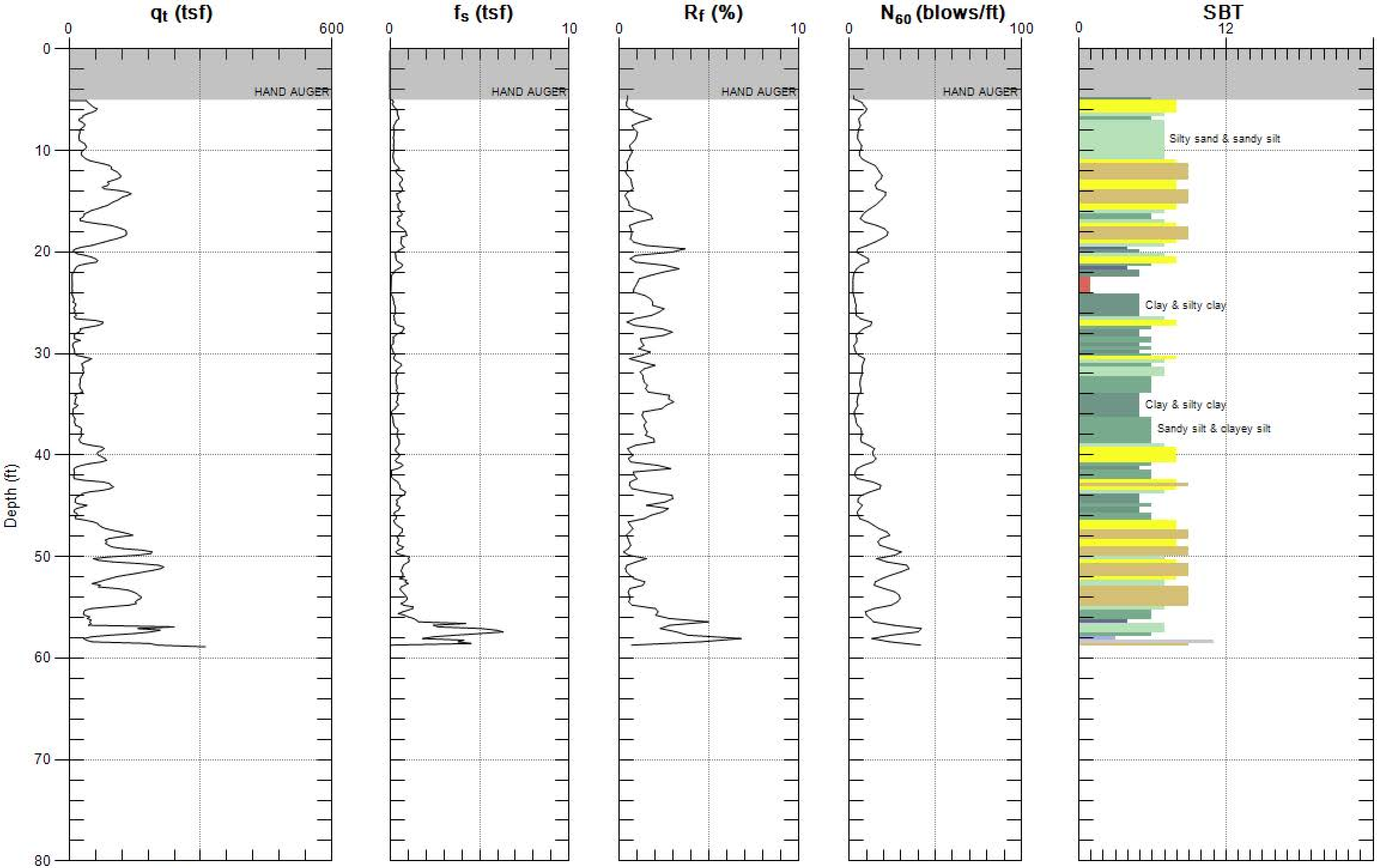
Max. Depth: 57.743 (ft)
Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)

GREGG **AECOM**

Site: MORENA PUMP STATION Engineer: K.MARTIN

Sounding: CU-02 **Date: 3/20/17 09:38**



Max. Depth: 58.891 (ft)
Avg. Interval: 0.328 (ft)

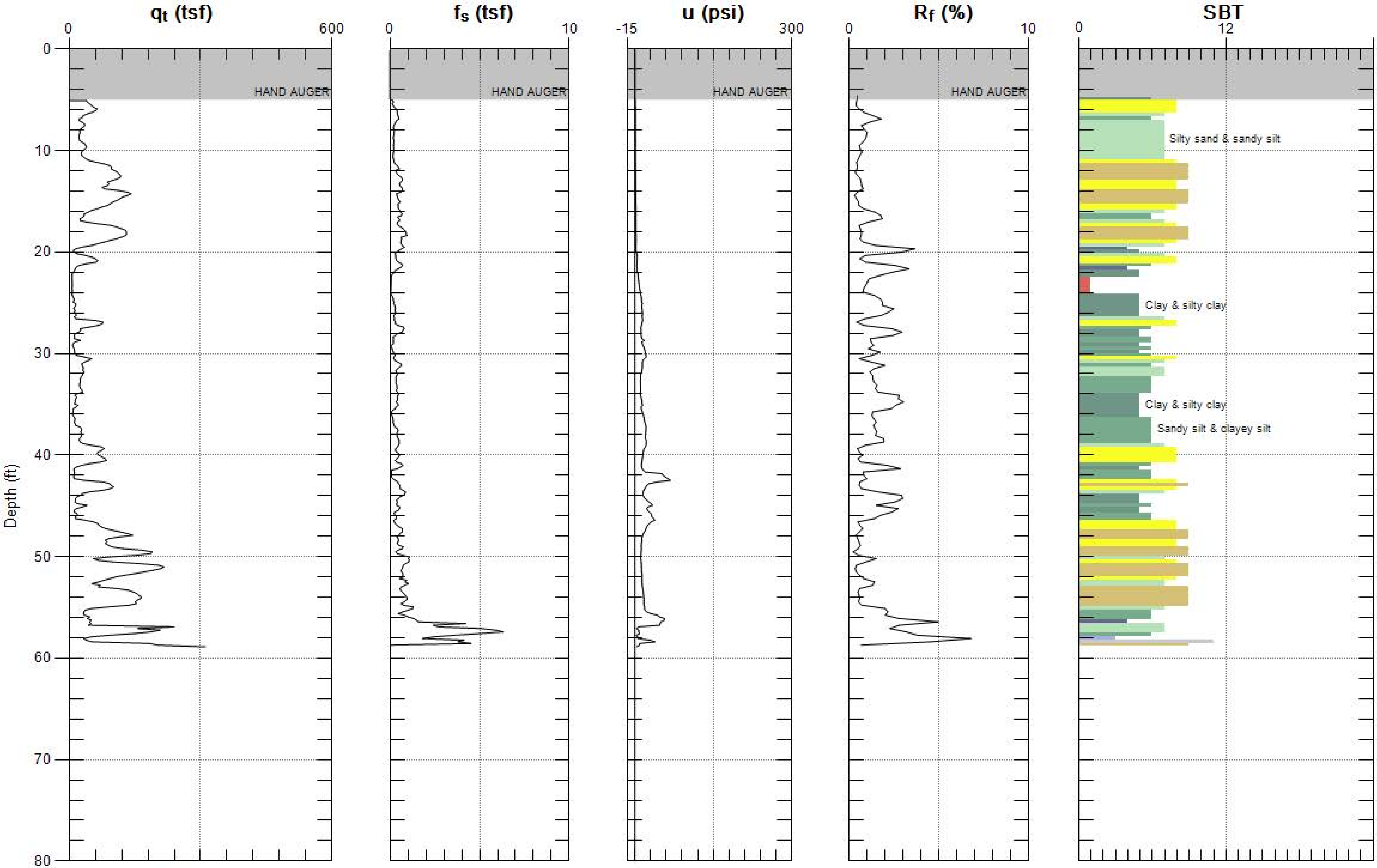
SBT: Soil Behavior Type (Robertson 1990)

GREGG

AECOM

Site: MORENA PUMP STATION Engineer: K.MARTIN

Sounding: CU-02 **Date: 3/20/17 09:38**



Max. Depth: 58.891 (ft)
Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)

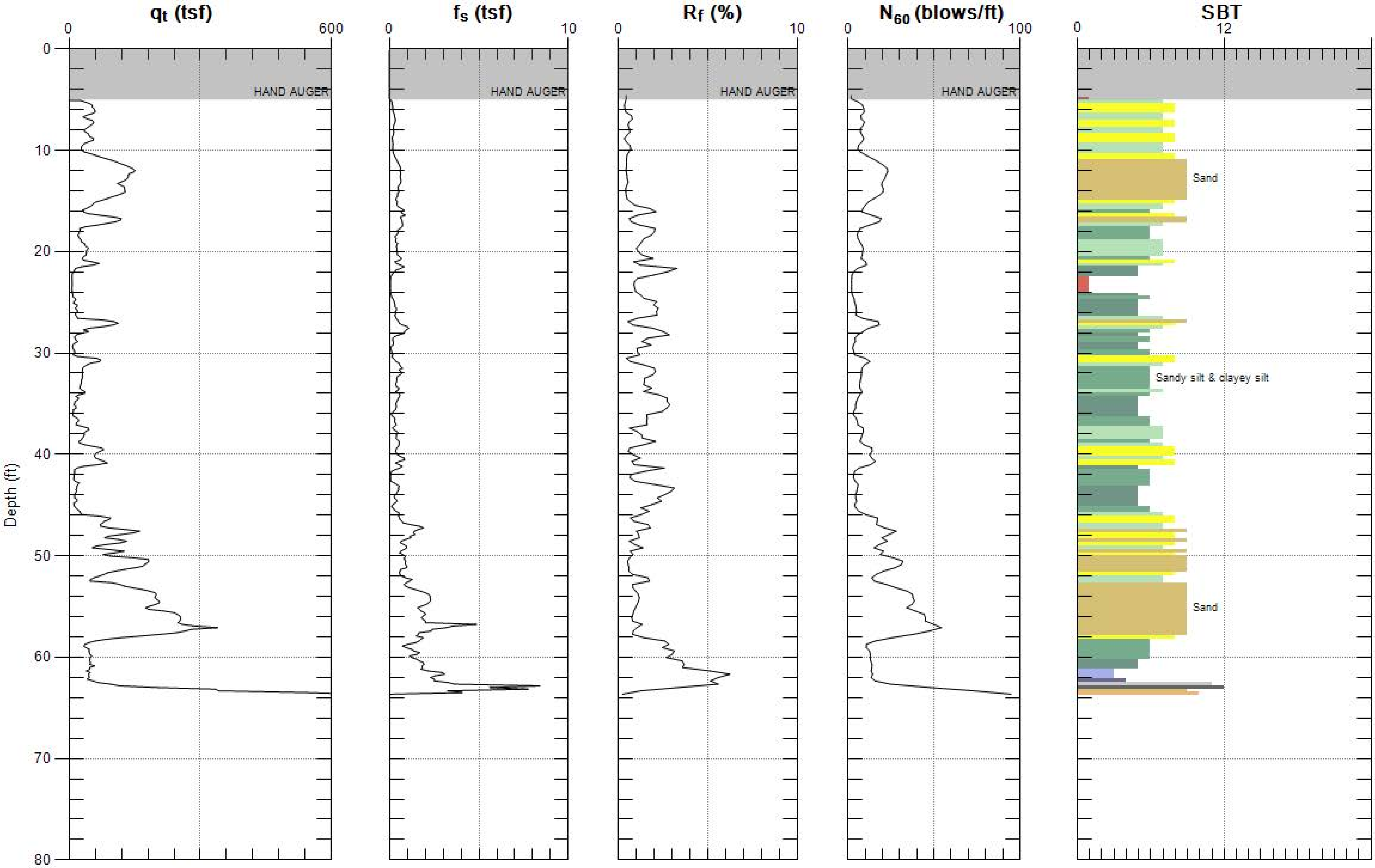
GREGG

AECOM

Site: MORENA PUMP STATION Engineer: K.MARTIN

Sounding: CU-03

Date: 3/20/17 11:02



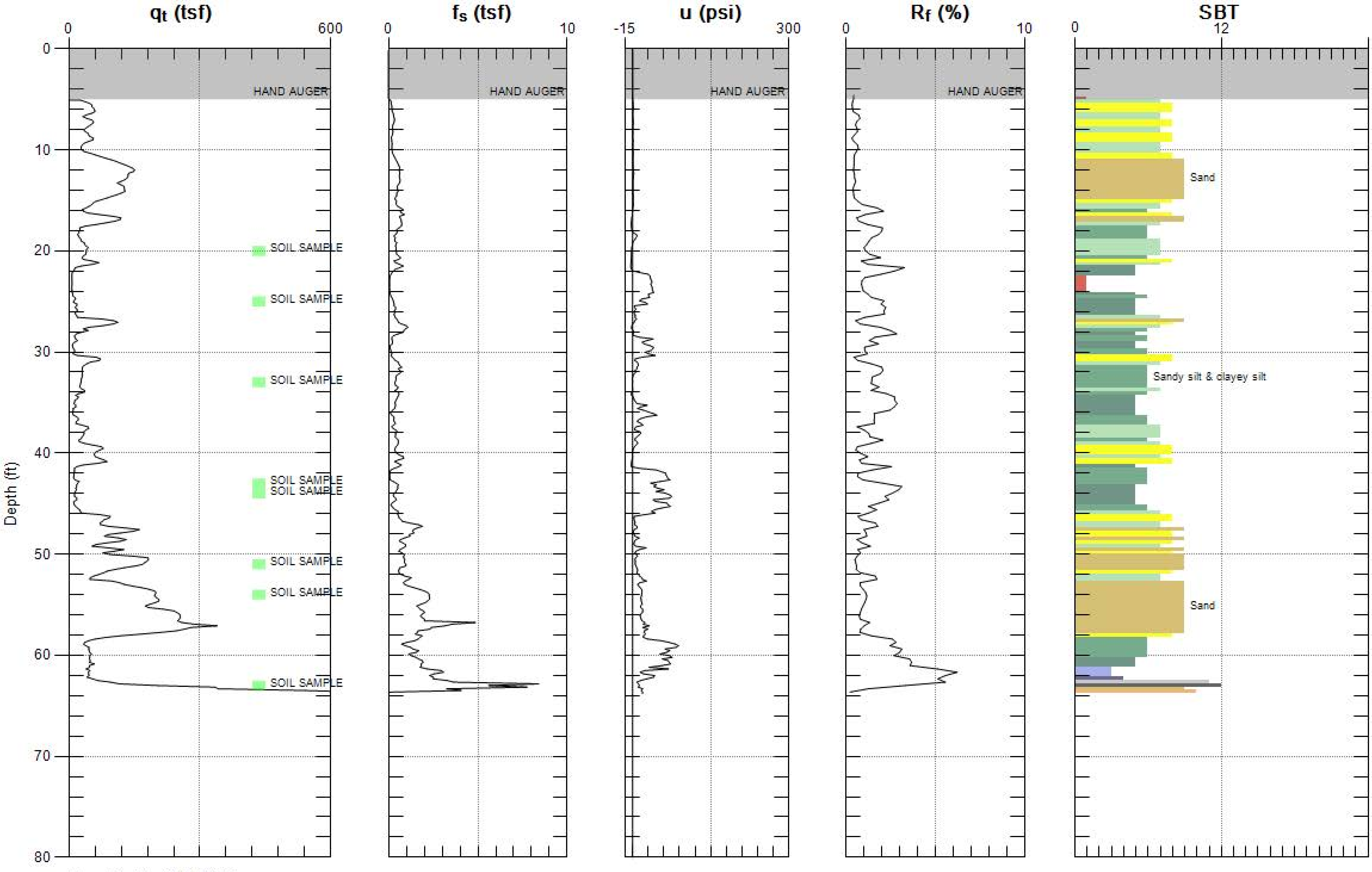
Max. Depth: 63.812 (ft)
Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)

GREGG **AECOM**

Site: MORENA PUMP STATION Engineer: K.MARTIN

Sounding: CU-03 **Date: 3/20/17 11:02**



Max. Depth: 63.812 (ft)
Avg. Interval: 0.328 (ft)

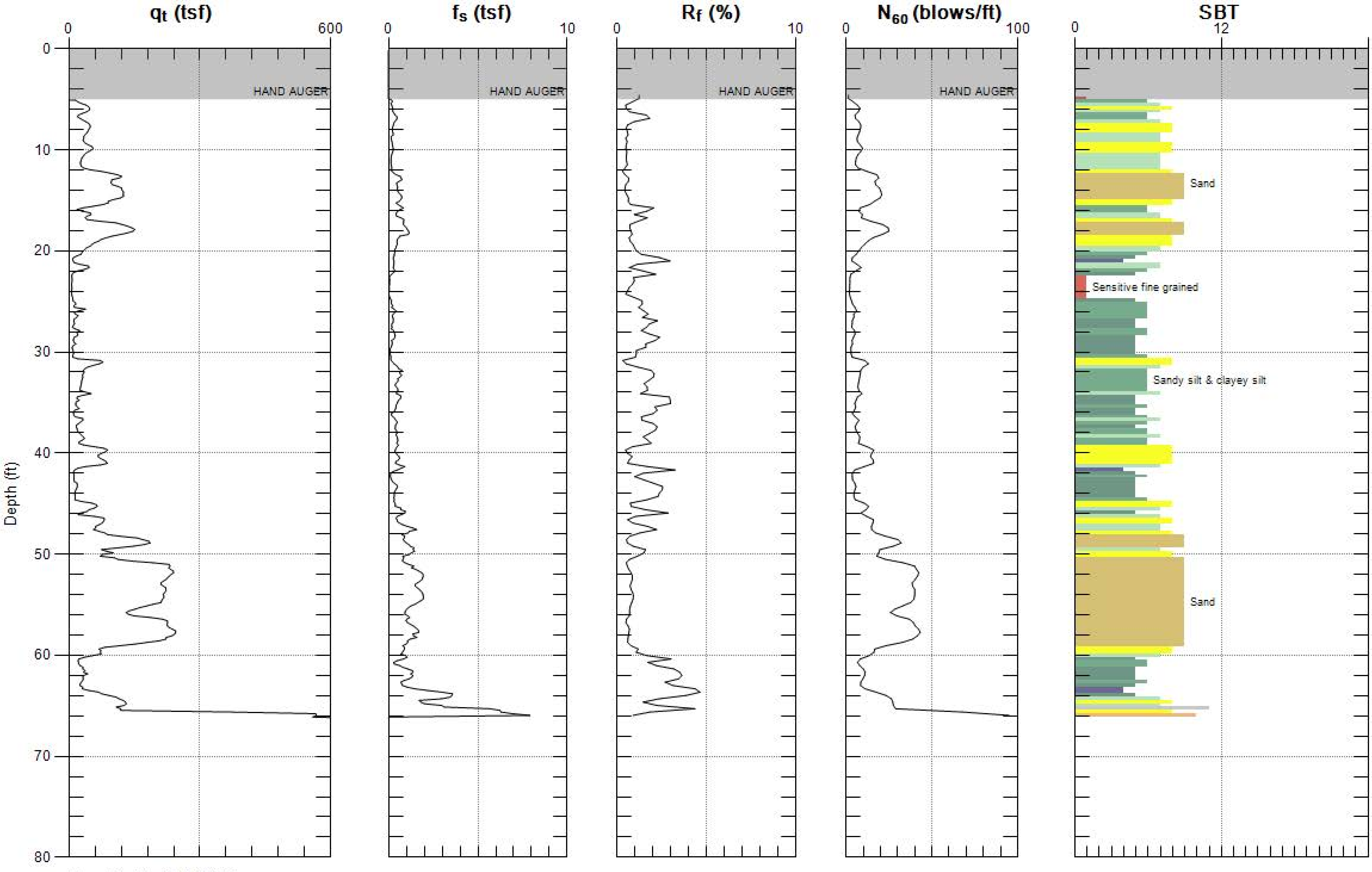
SBT: Soil Behavior Type (Robertson 1990)

GREGG

AECOM

Site: MORENA PUMP STATION Engineer: K.MARTIN

Sounding: CU-04 **Date: 3/20/17 01:02**



Max. Depth: 66.273 (ft)
Avg. Interval: 0.328 (ft)

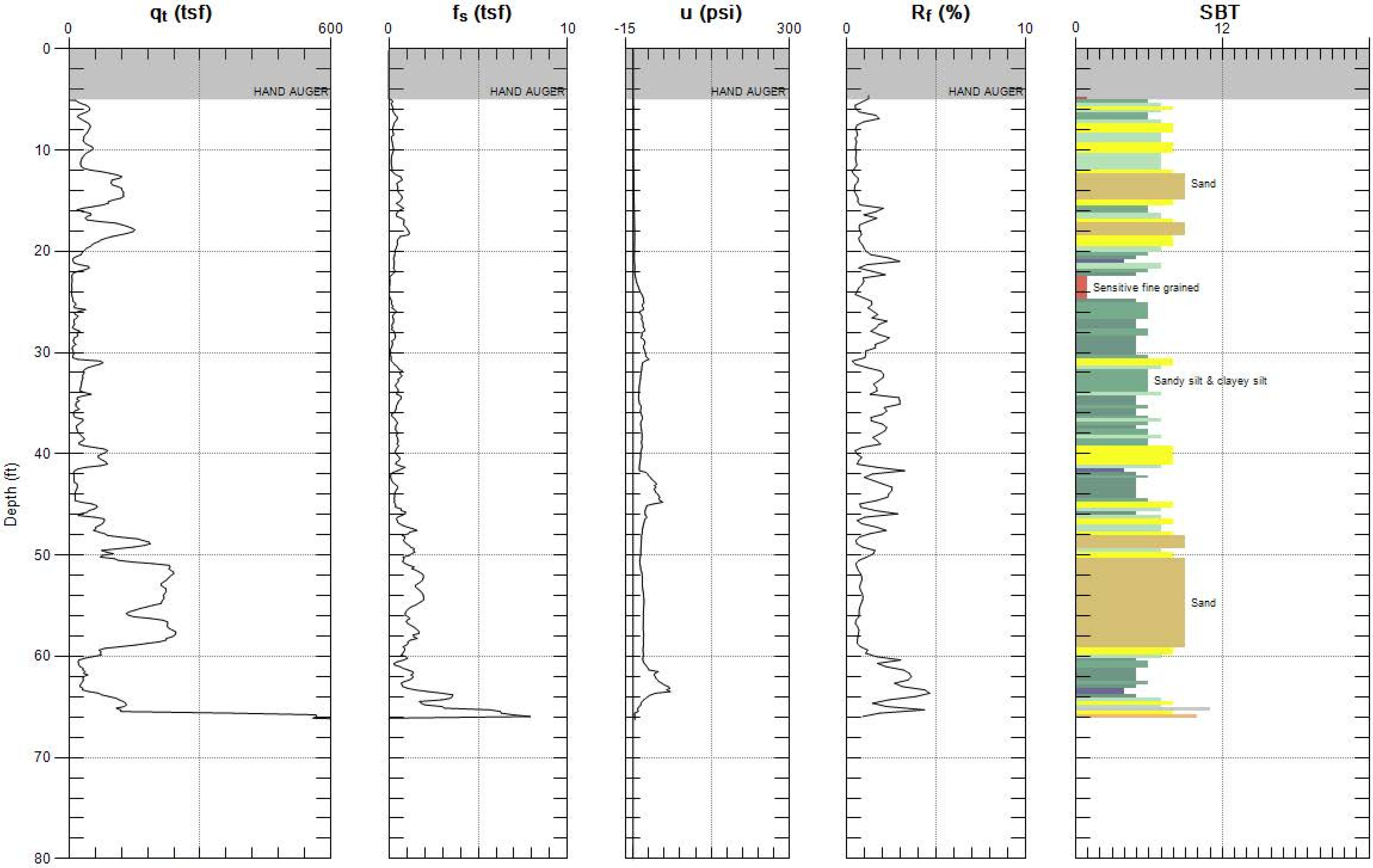
SBT: Soil Behavior Type (Robertson 1990)

GREGG

AECOM

Site: MORENA PUMP STATION Engineer: K.MARTIN

Sounding: CU-04 **Date: 3/20/17 01:02**



Max. Depth: 66.273 (ft)
Avg. Interval: 0.328 (ft)

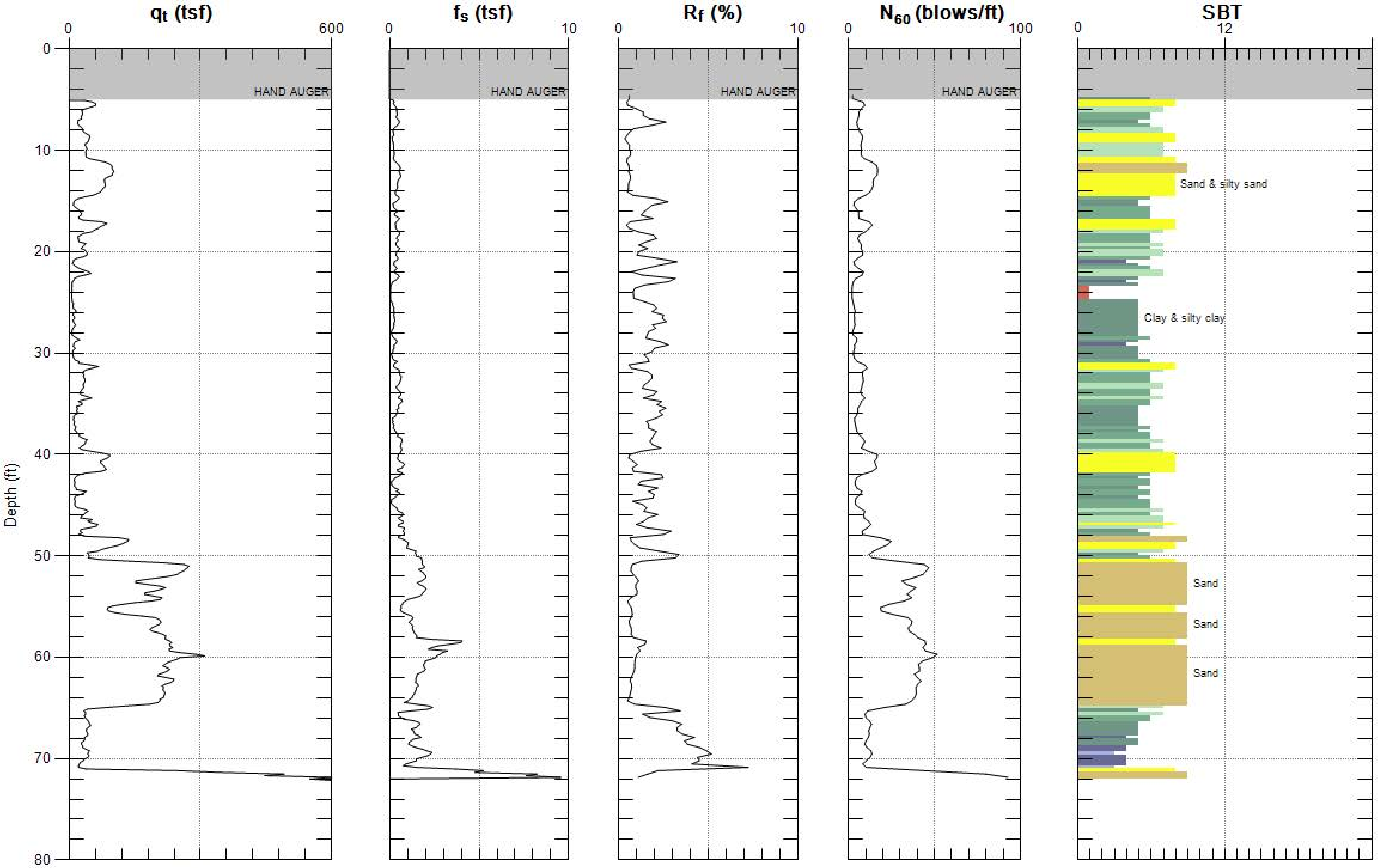
SBT: Soil Behavior Type (Robertson 1990)

GREGG

AECOM

Site: MORENA PUMP STATION Engineer: K.MARTIN

Sounding: CU-05 **Date: 3/20/17 02:14**



Max. Depth: 72.178 (ft)
Avg. Interval: 0.328 (ft)

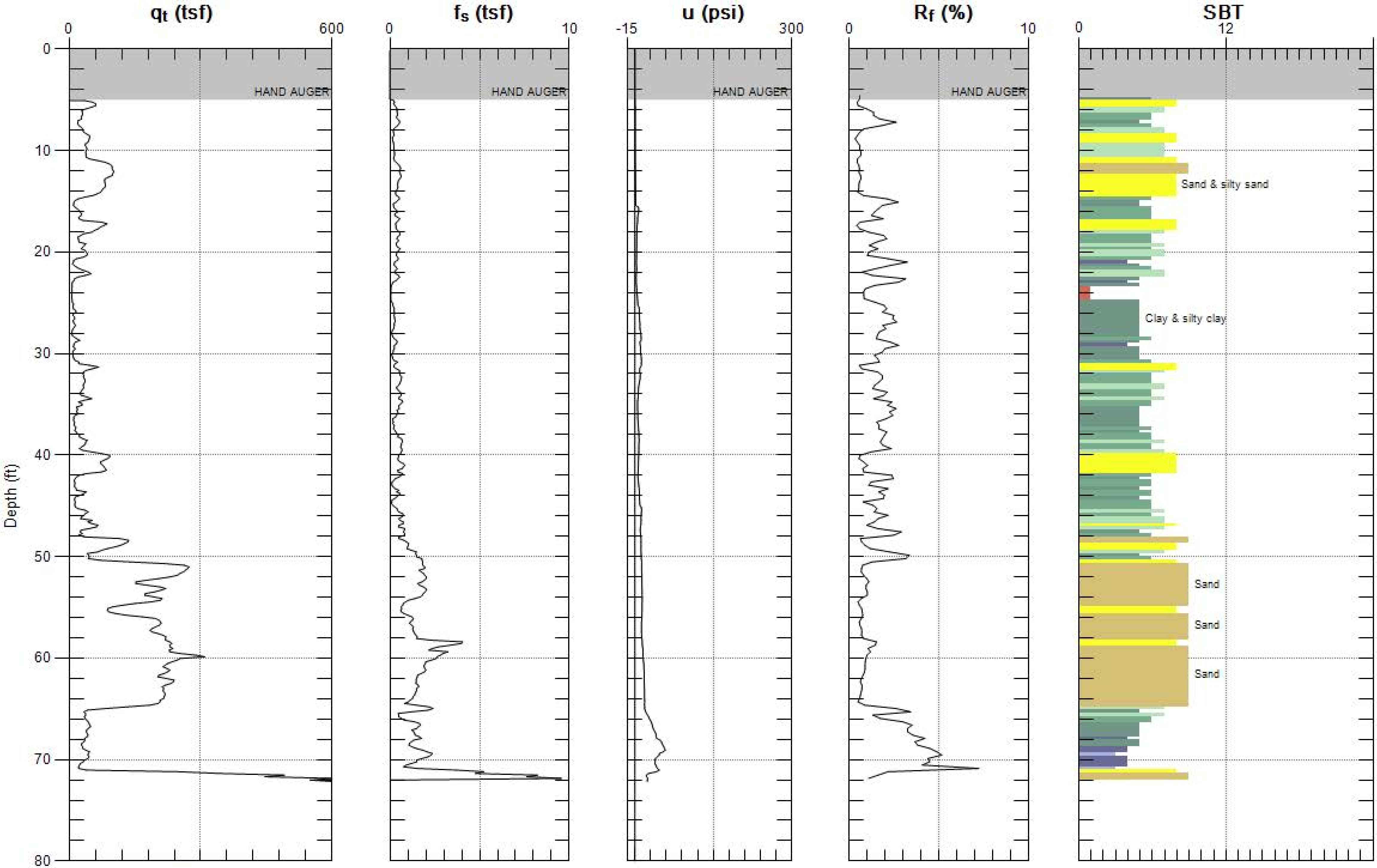
SBT: Soil Behavior Type (Robertson 1990)

GREGG

AECOM

Site: MORENA PUMP STATION Engineer: K.MARTIN

Sounding: CU-05 Date: 3/20/17 02:14



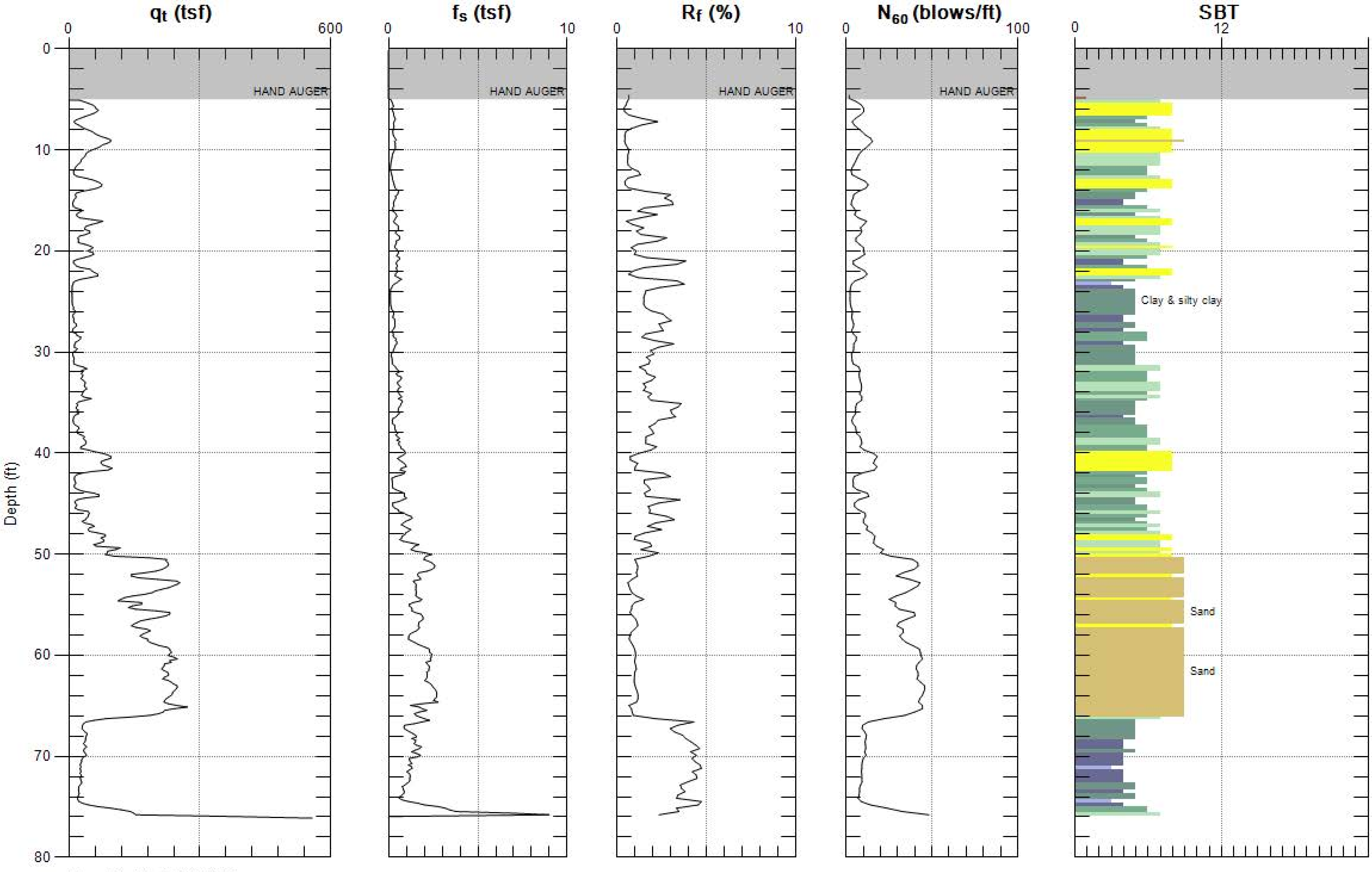
Max. Depth: 72.178 (ft)
Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)

GREGG **AECOM**

Site: MORENA PUMP STATION Engineer: K.MARTIN

Sounding: CU-06 Date: 3/21/17 07:27



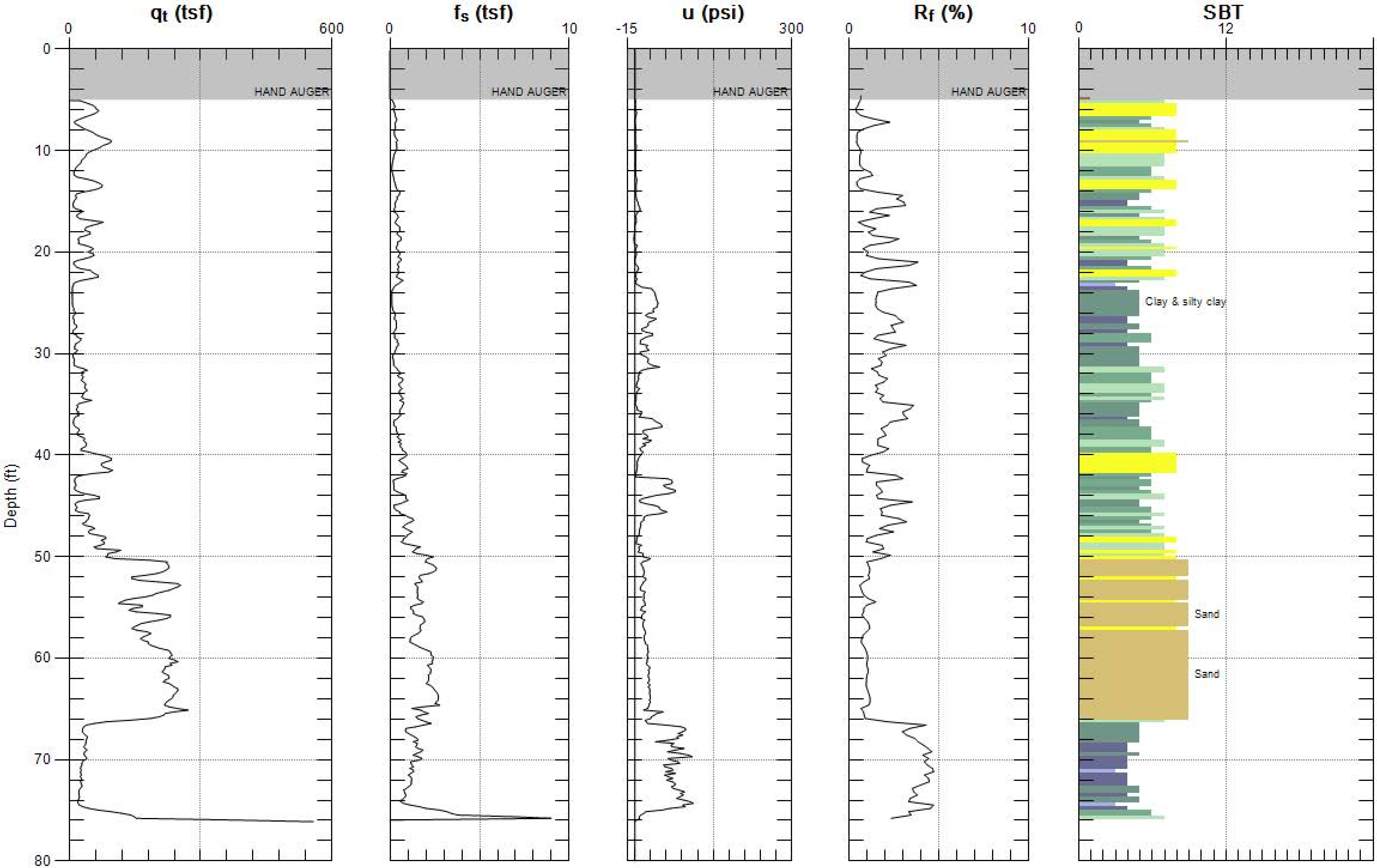
Max. Depth: 76.115 (ft)
Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)

GREGG **AECOM**

Site: MORENA PUMP STATION Engineer: K.MARTIN

Sounding: CU-06 **Date: 3/21/17 07:27**



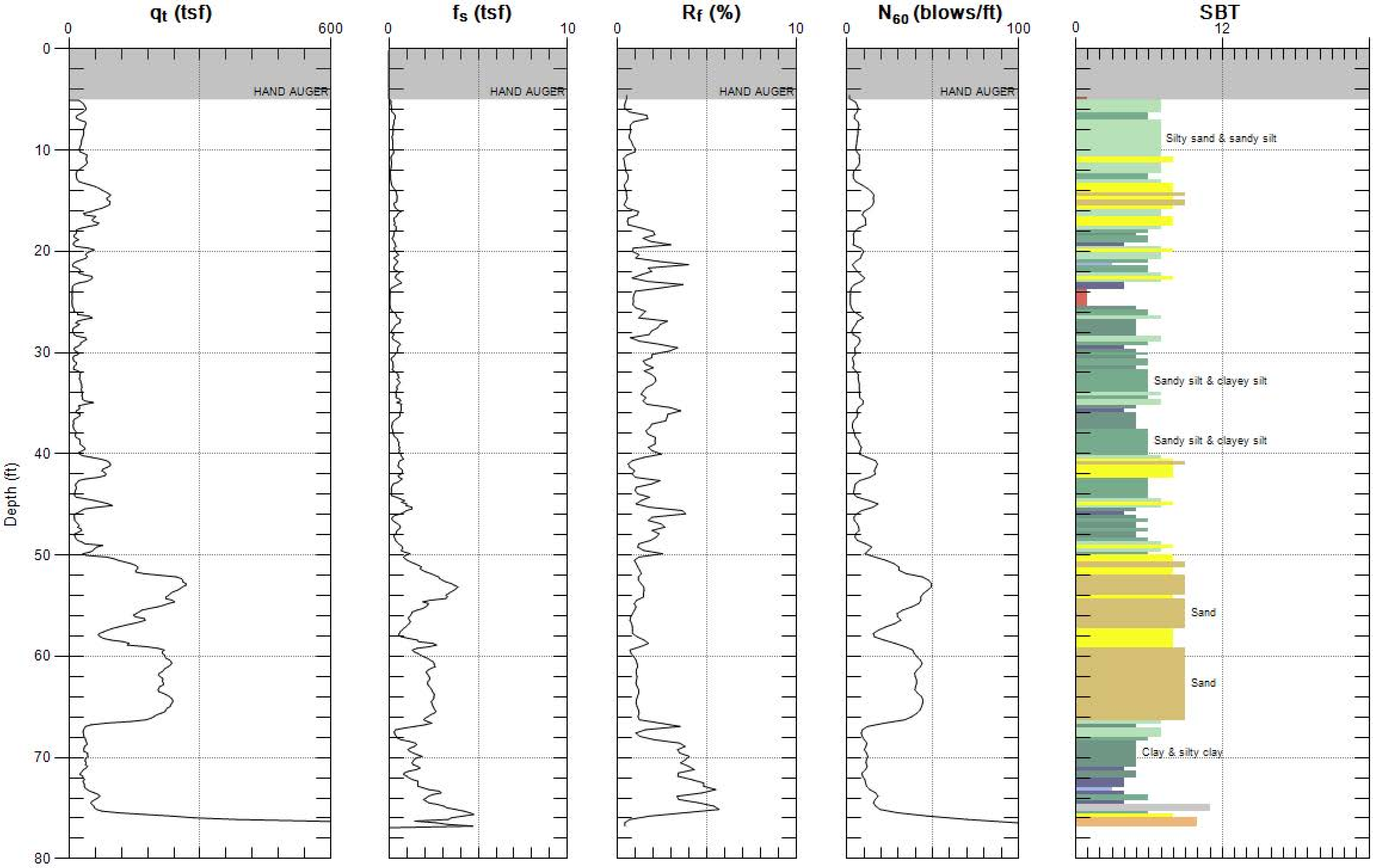
Max. Depth: 76.115 (ft)
Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)

GREGG **AECOM**

Site: MORENA PUMP STATION Engineer: K.MARTIN

Sounding: CU-07 **Date: 3/21/17 09:18**



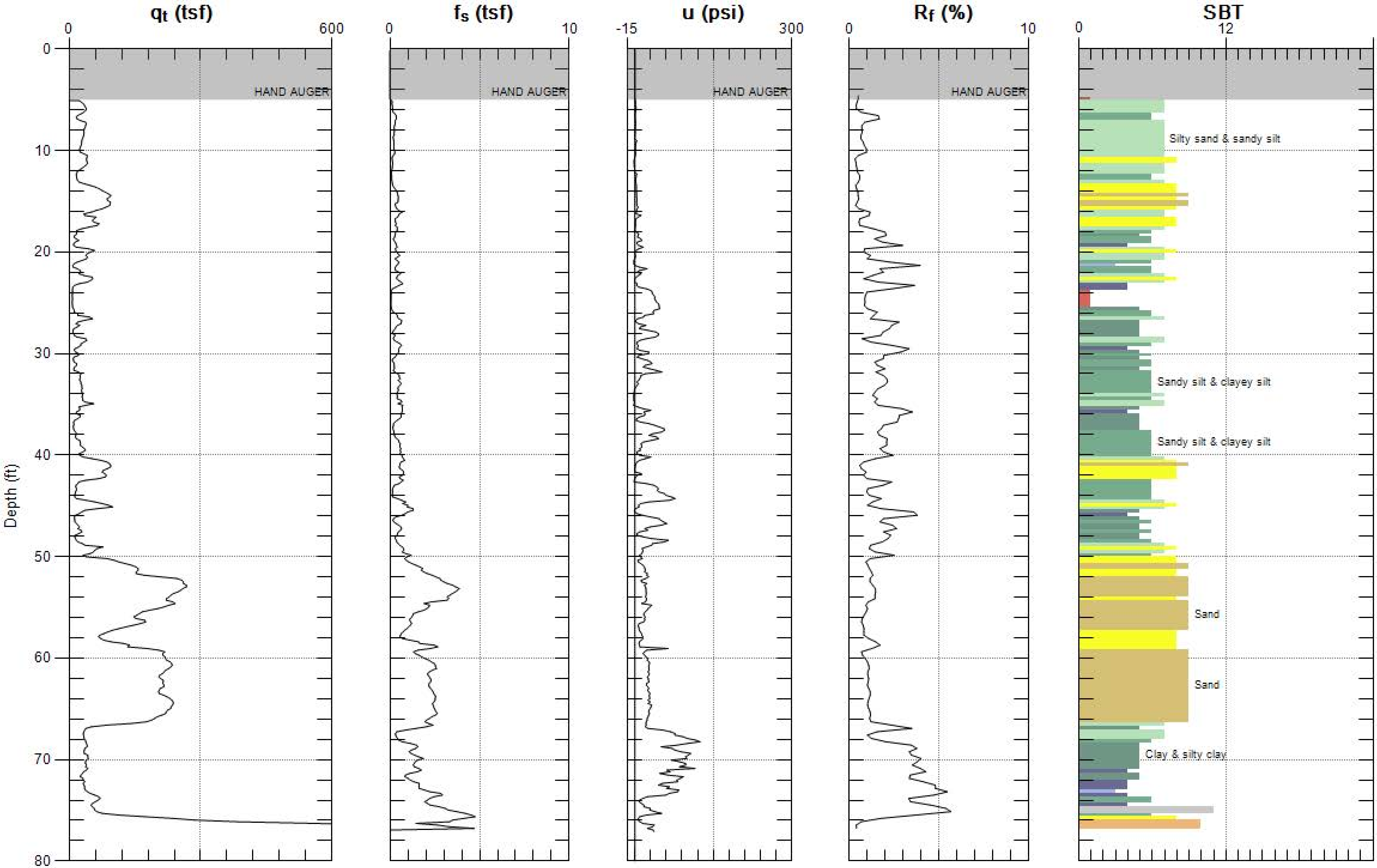
Max. Depth: 77.100 (ft)
Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)

GREGG **AECOM**

Site: MORENA PUMP STATION Engineer: K.MARTIN

Sounding: CU-07 **Date: 3/21/17 09:18**



Max. Depth: 77.100 (ft)
Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)

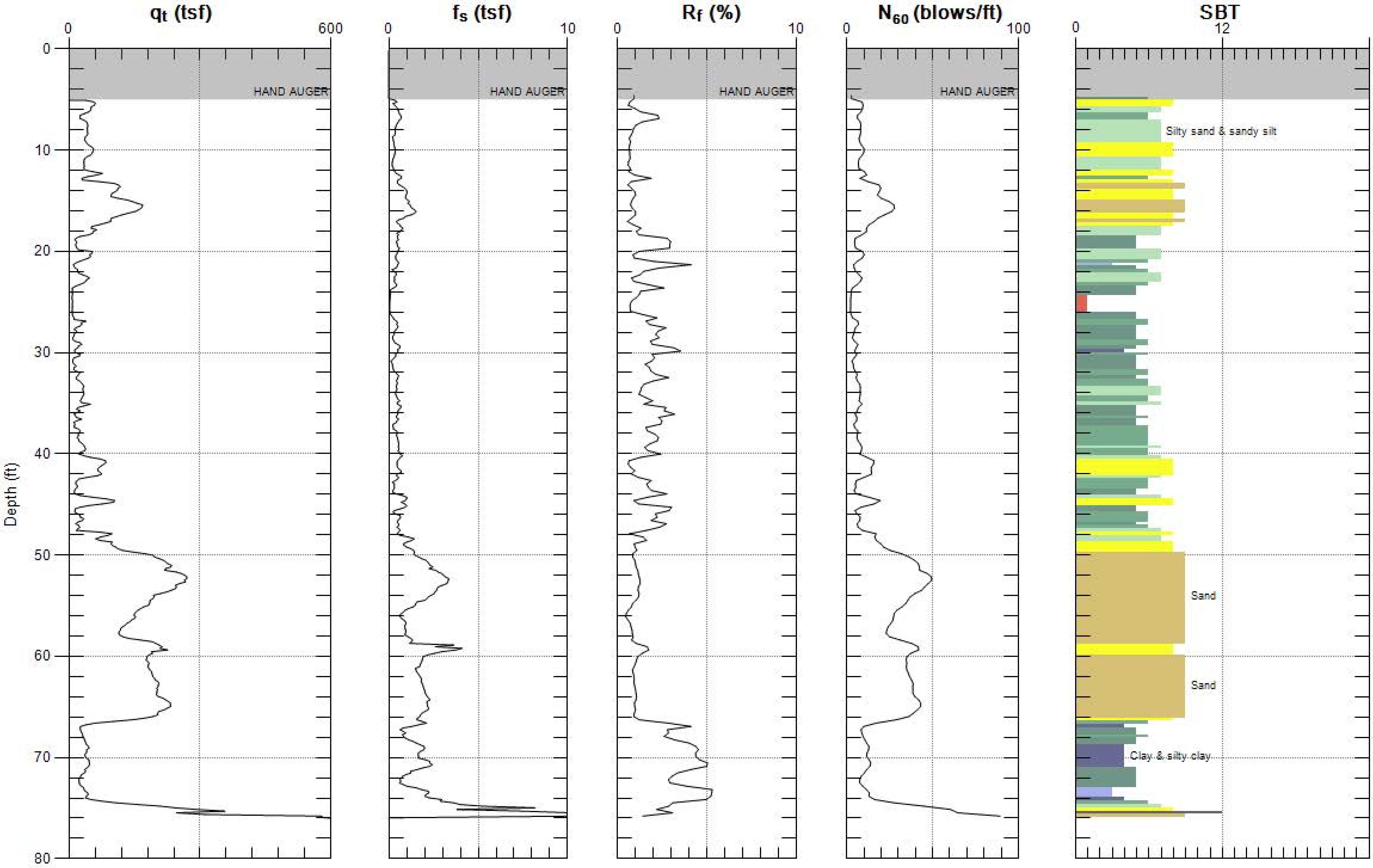
GREGG

AECOM

Site: MORENA PUMP STATION Engineer: K.MARTIN

Sounding: CU-08

Date: 3/21/17 10:50

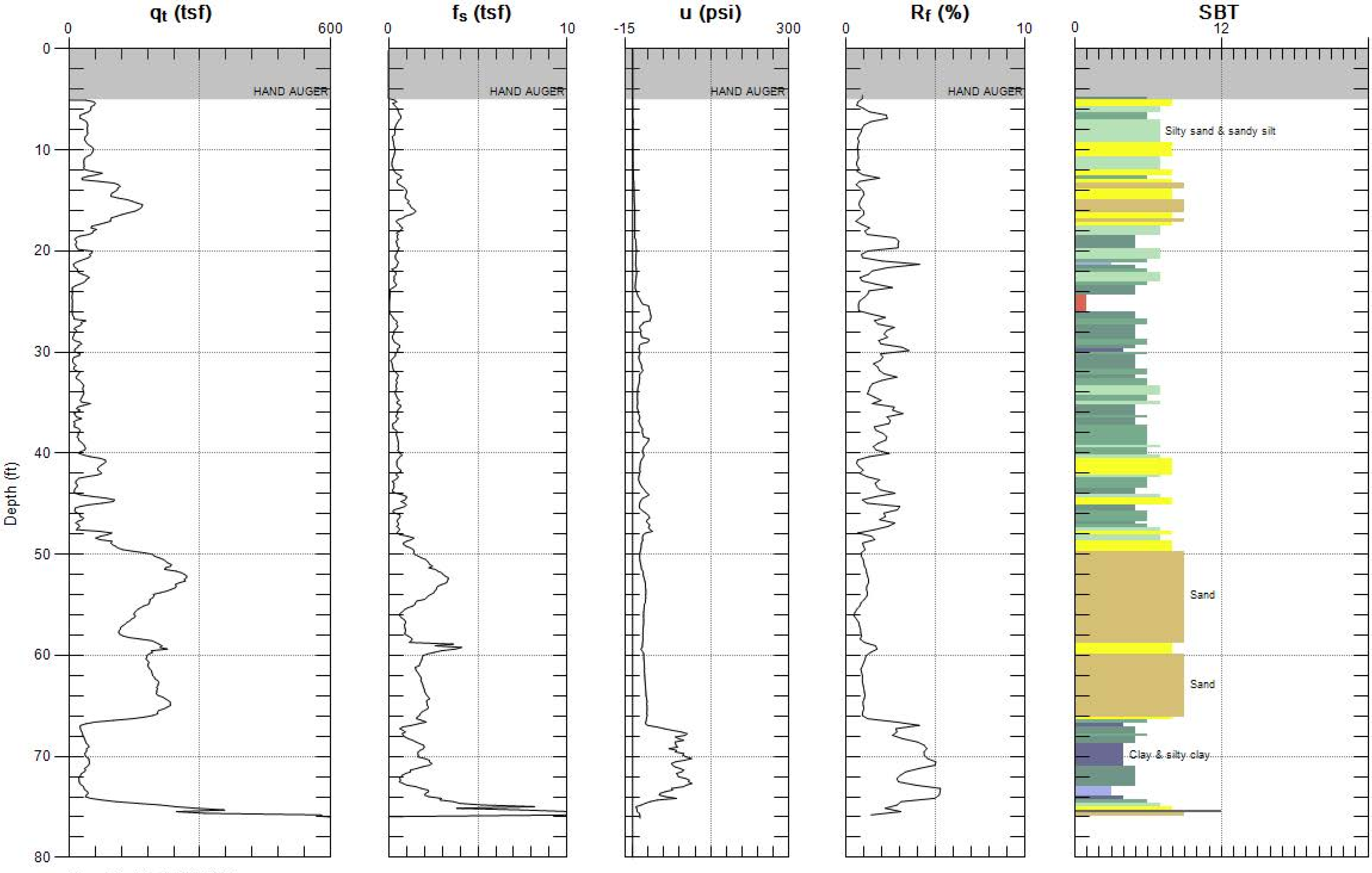


Max. Depth: 76.115 (ft)
Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)

Site: MORENA PUMP STATION Engineer: K.MARTIN

Sounding: CU-08 **Date: 3/21/17 10:50**



Max. Depth: 76.115 (ft)
Avg. Interval: 0.328 (ft)

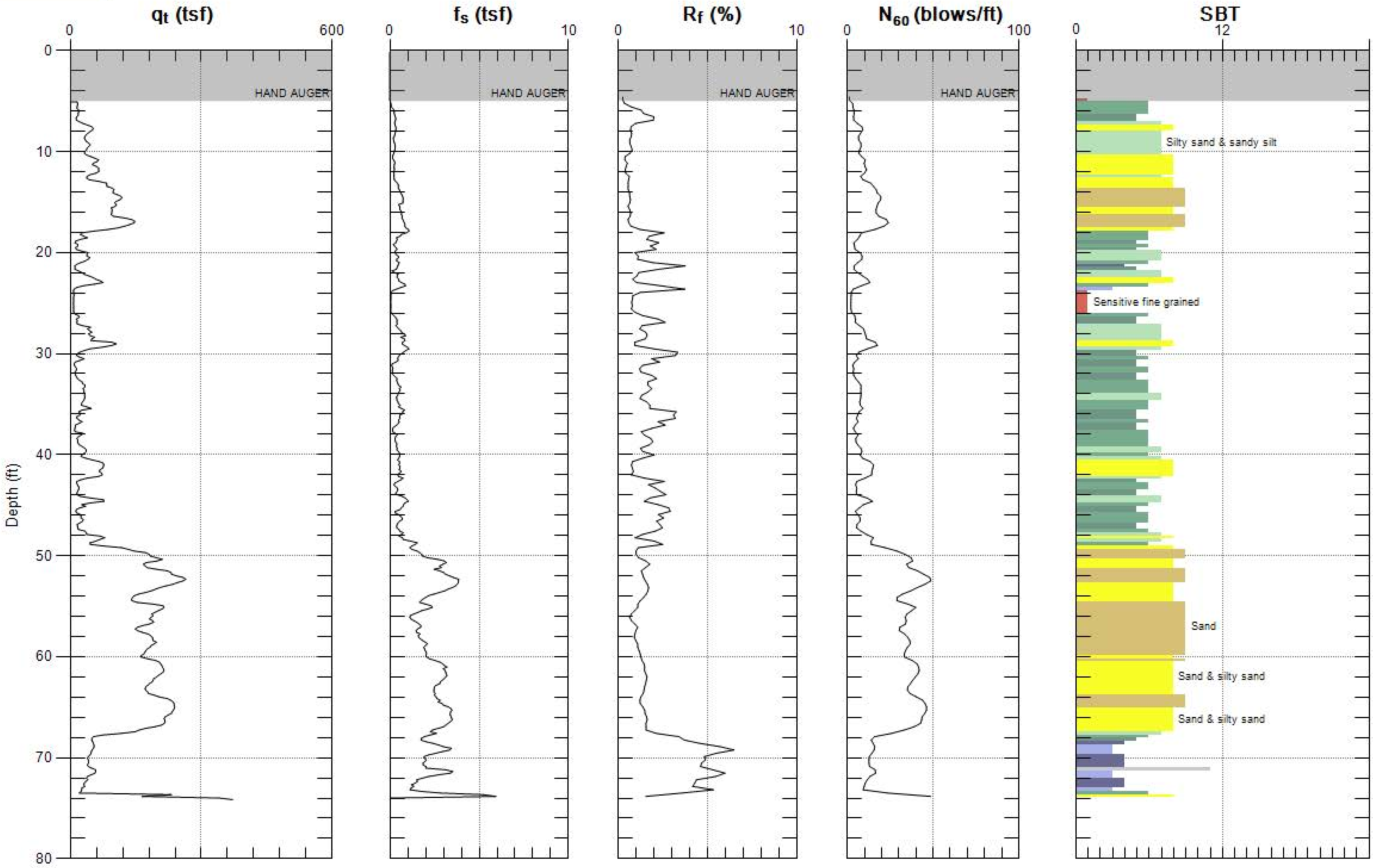
SBT: Soil Behavior Type (Robertson 1990)

GREGG

AECOM

Site: MORENA PUMP STATION Engineer: K.MARTIN

Sounding: CU-09 **Date: 3/21/17 01:01**



Max. Depth: 74.147 (ft)
Avg. Interval: 0.328 (ft)

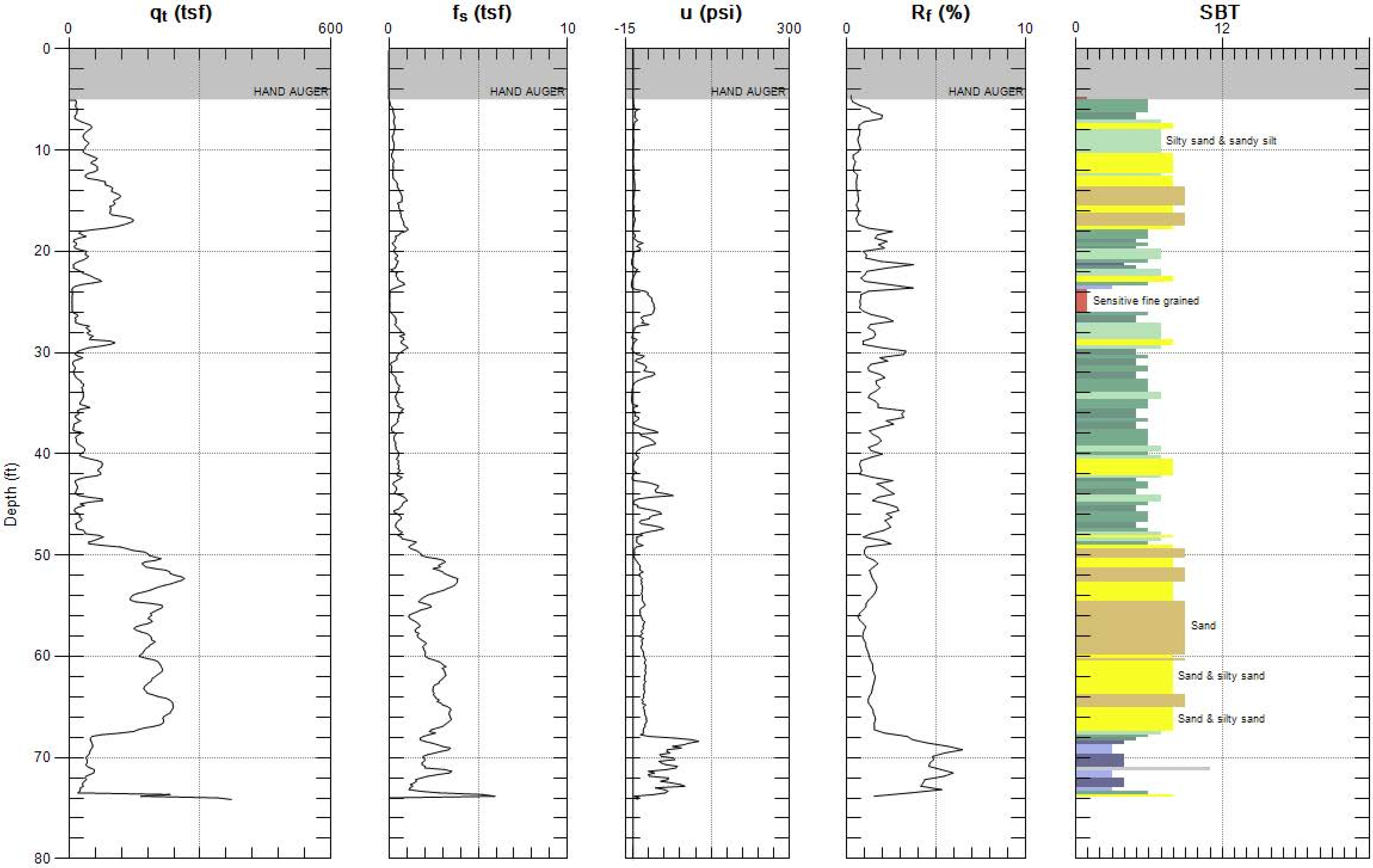
SBT: Soil Behavior Type (Robertson 1990)

GREGG

AECOM

Site: MORENA PUMP STATION Engineer: K.MARTIN

Sounding: CU-09 **Date: 3/21/17 01:01**



Max. Depth: 74.147 (ft)
Avg. Interval: 0.328 (ft)

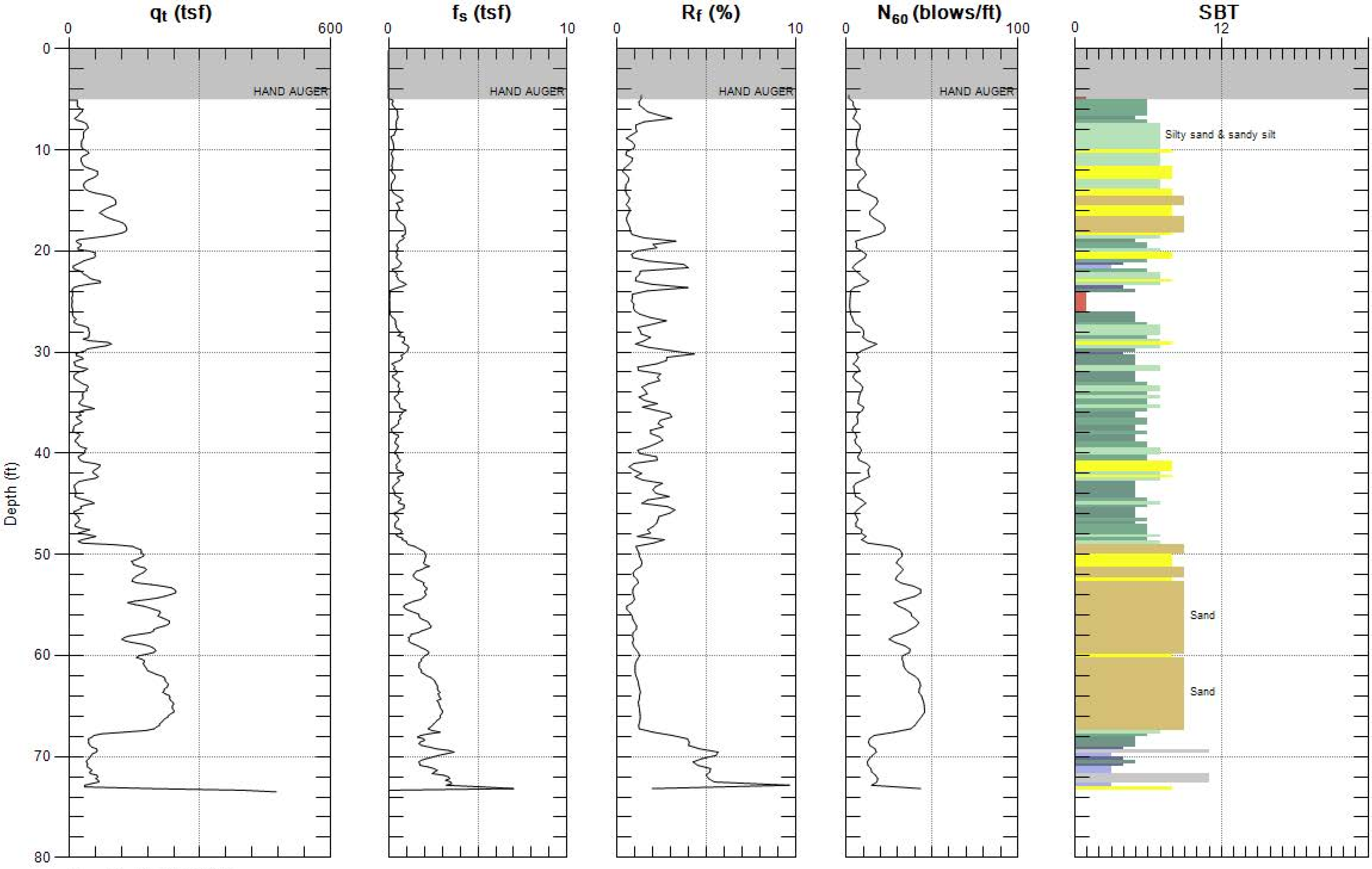
SBT: Soil Behavior Type (Robertson 1990)

GREGG

AECOM

Site: MORENA PUMP STATION Engineer: K.MARTIN

Sounding: CU-10 Date: 3/21/17 02:18



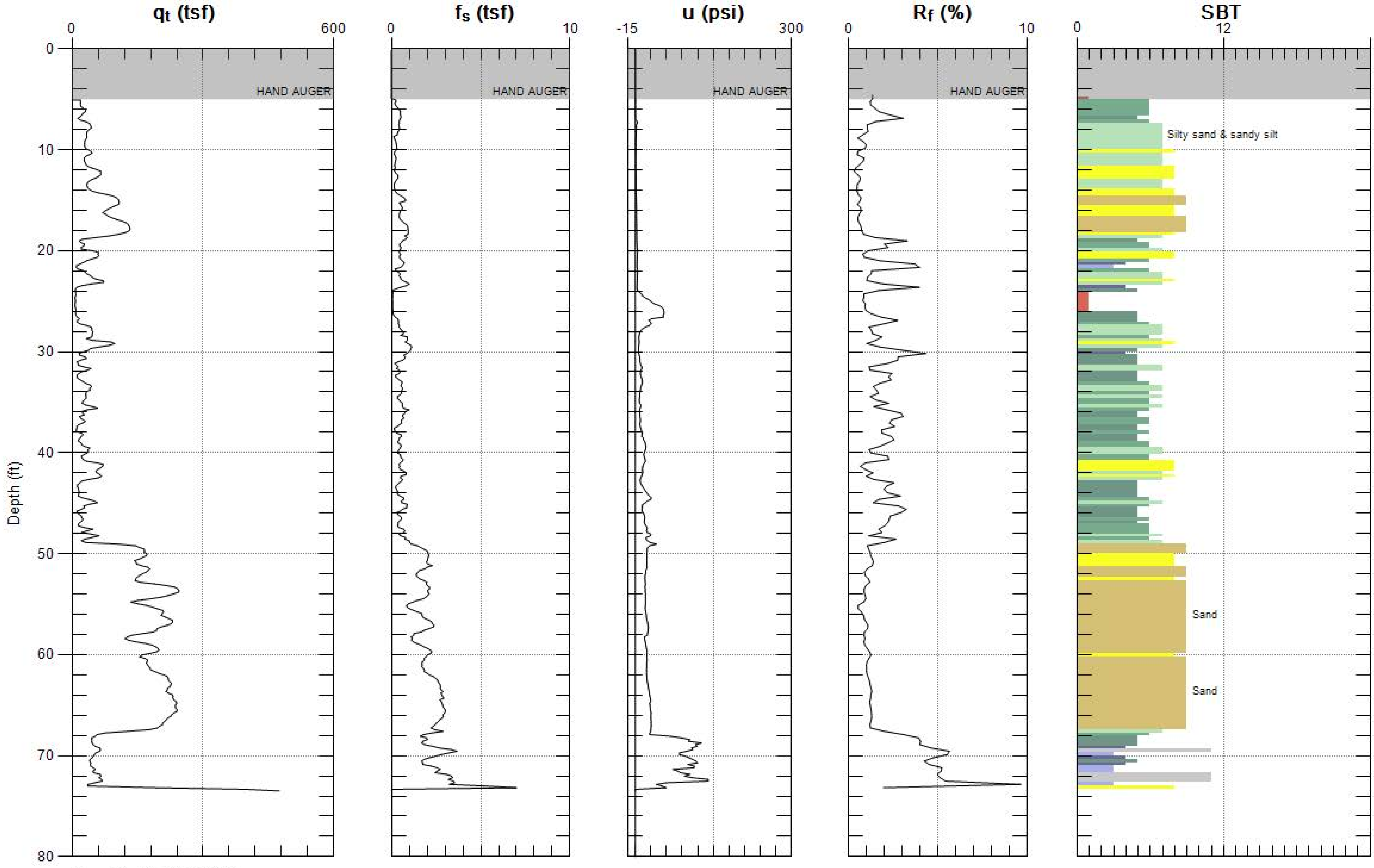
Max. Depth: 73.491 (ft)
Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)

GREGG **AECOM**

Site: MORENA PUMP STATION Engineer: K.MARTIN

Sounding: CU-10 **Date: 3/21/17 02:18**



Max. Depth: 73.491 (ft)
Avg. Interval: 0.328 (ft)

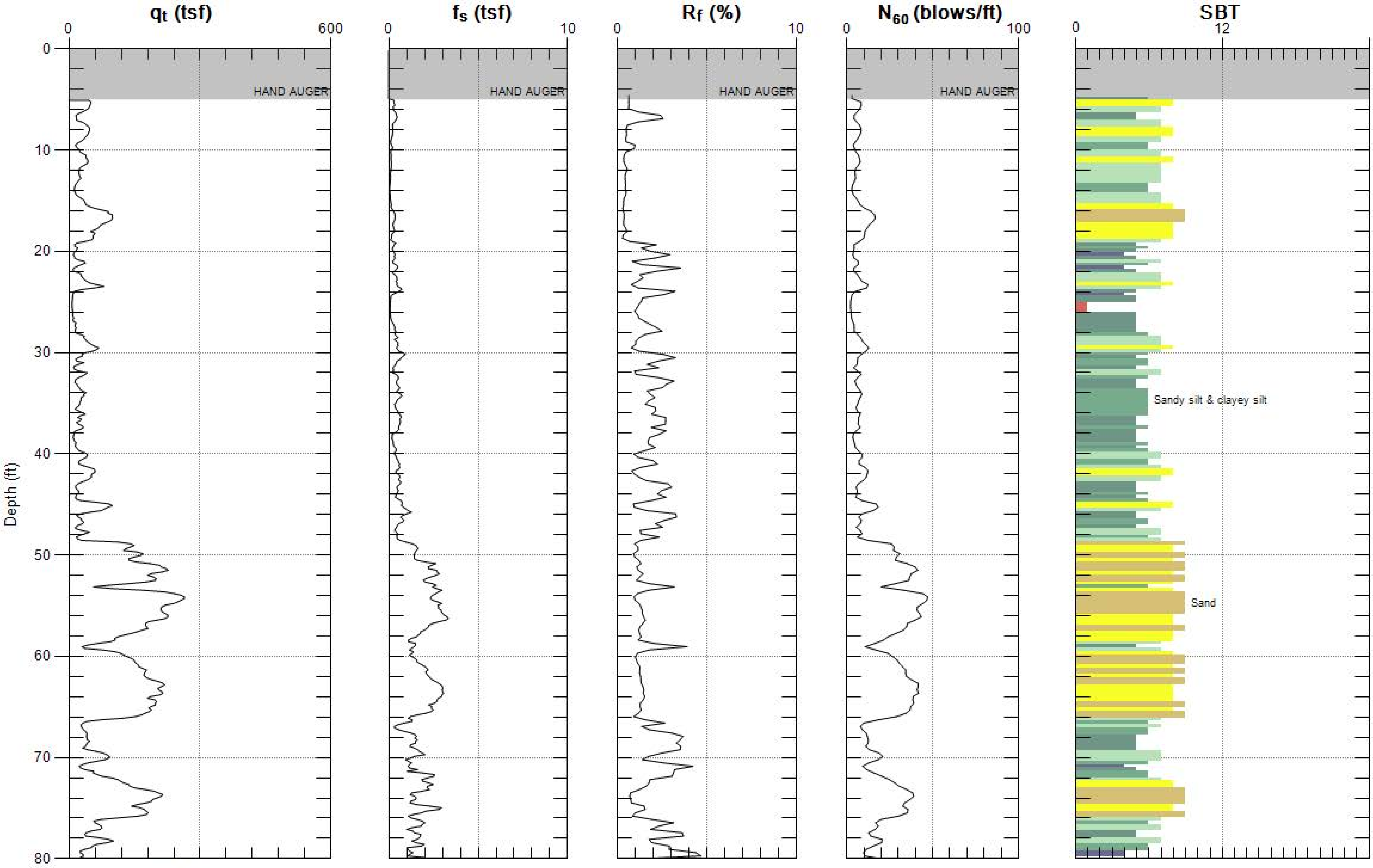
SBT: Soil Behavior Type (Robertson 1990)

GREGG

AECOM

Site: MORENA PUMP STATION Engineer: K.MARTIN

Sounding: CU-11 Date: 3/22/17 07:42



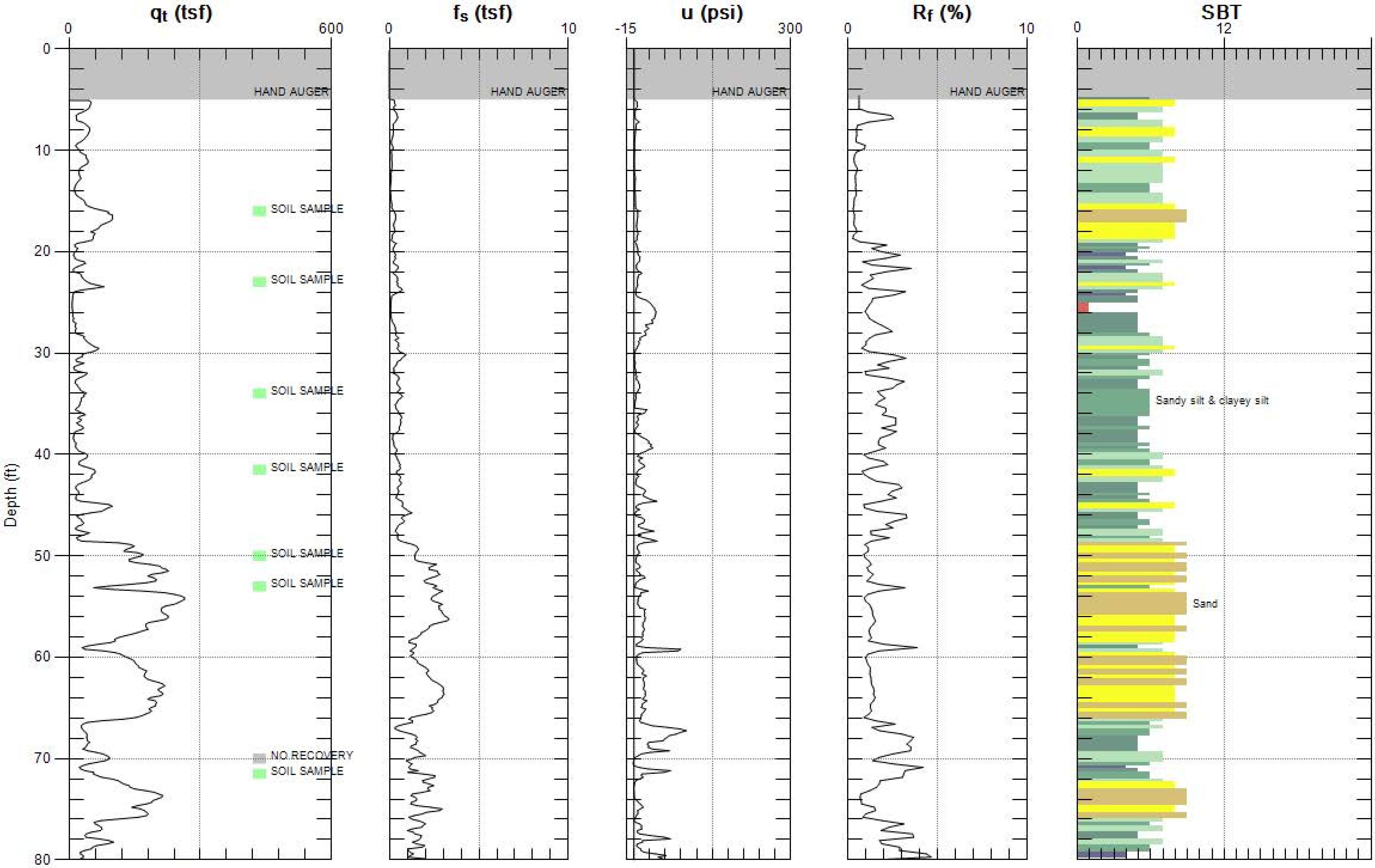
Max. Depth: 80.217 (ft)
Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)

GREGG **AECOM**

Site: MORENA PUMP STATION Engineer: K.MARTIN

Sounding: CU-11 **Date: 3/22/17 07:42**



Max. Depth: 80.217 (ft)
Avg. Interval: 0.328 (ft)

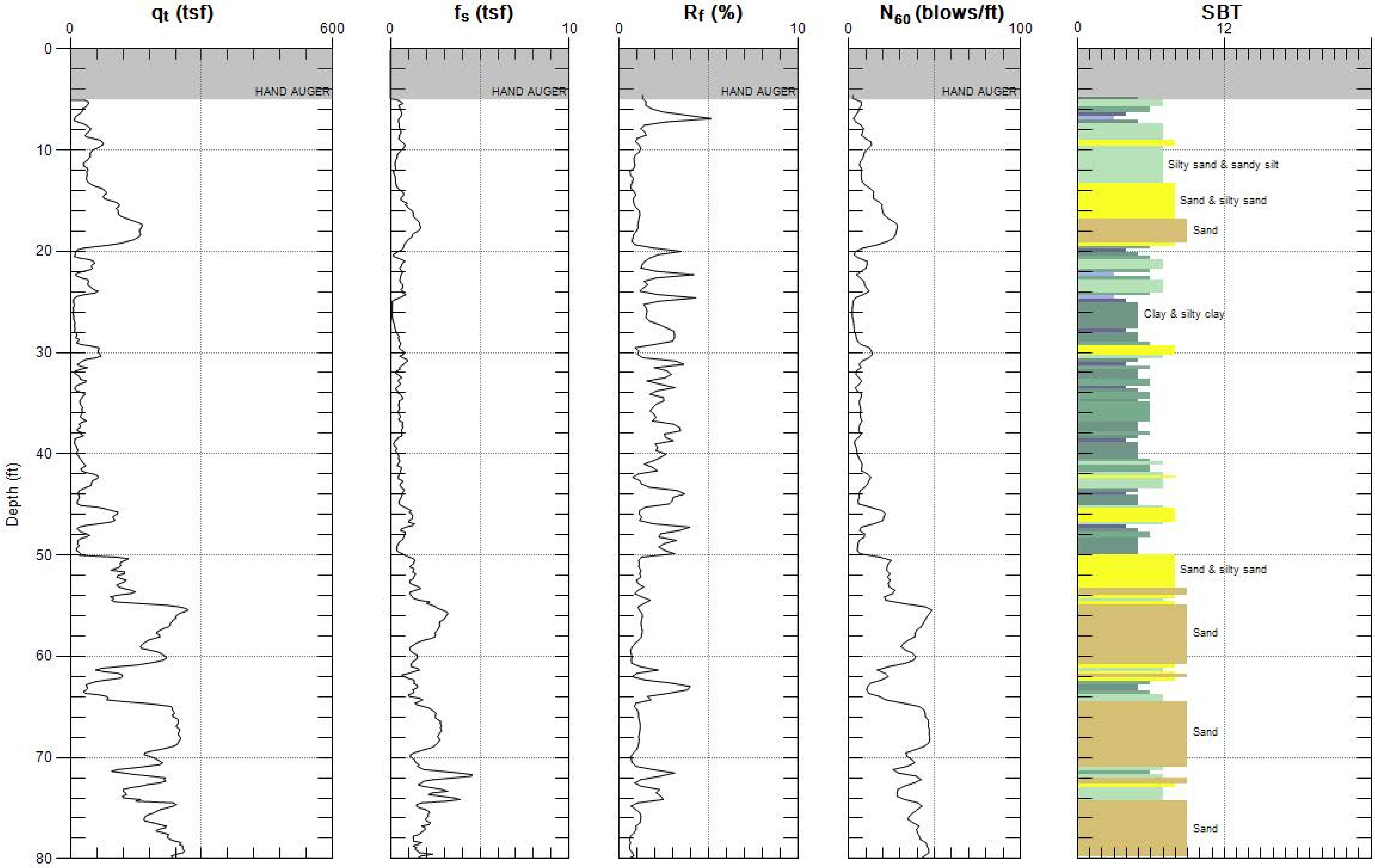
SBT: Soil Behavior Type (Robertson 1990)

GREGG

AECOM

Site: MORENA PUMP STATION Engineer: K.MARTIN

Sounding: CU-12 **Date: 3/22/17 09:25**



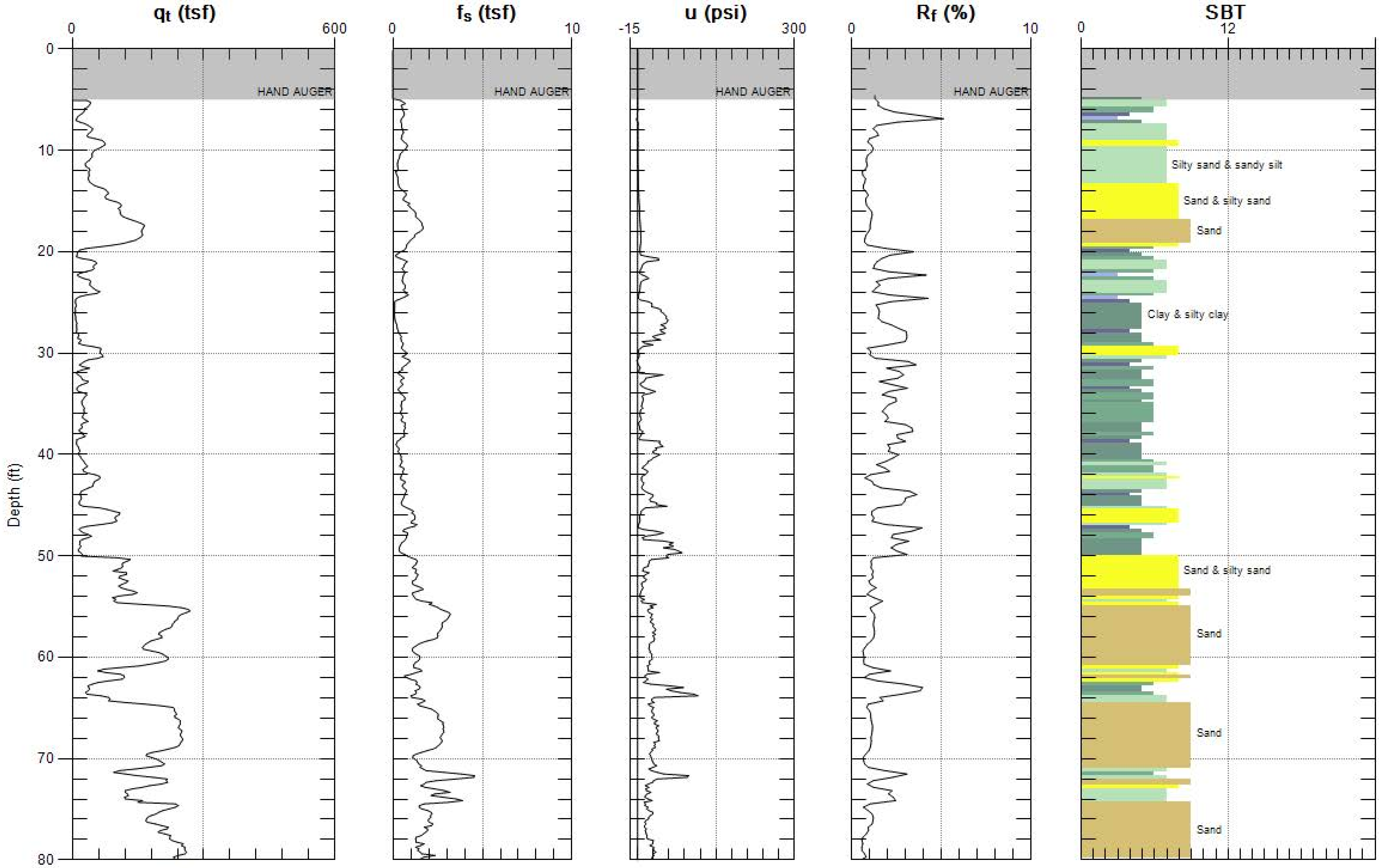
Max. Depth: 80.381 (ft)
Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)

GREGG **AECOM**

Site: MORENA PUMP STATION Engineer: K.MARTIN

Sounding: CU-12 **Date: 3/22/17 09:25**



Max. Depth: 80.381 (ft)
Avg. Interval: 0.328 (ft)

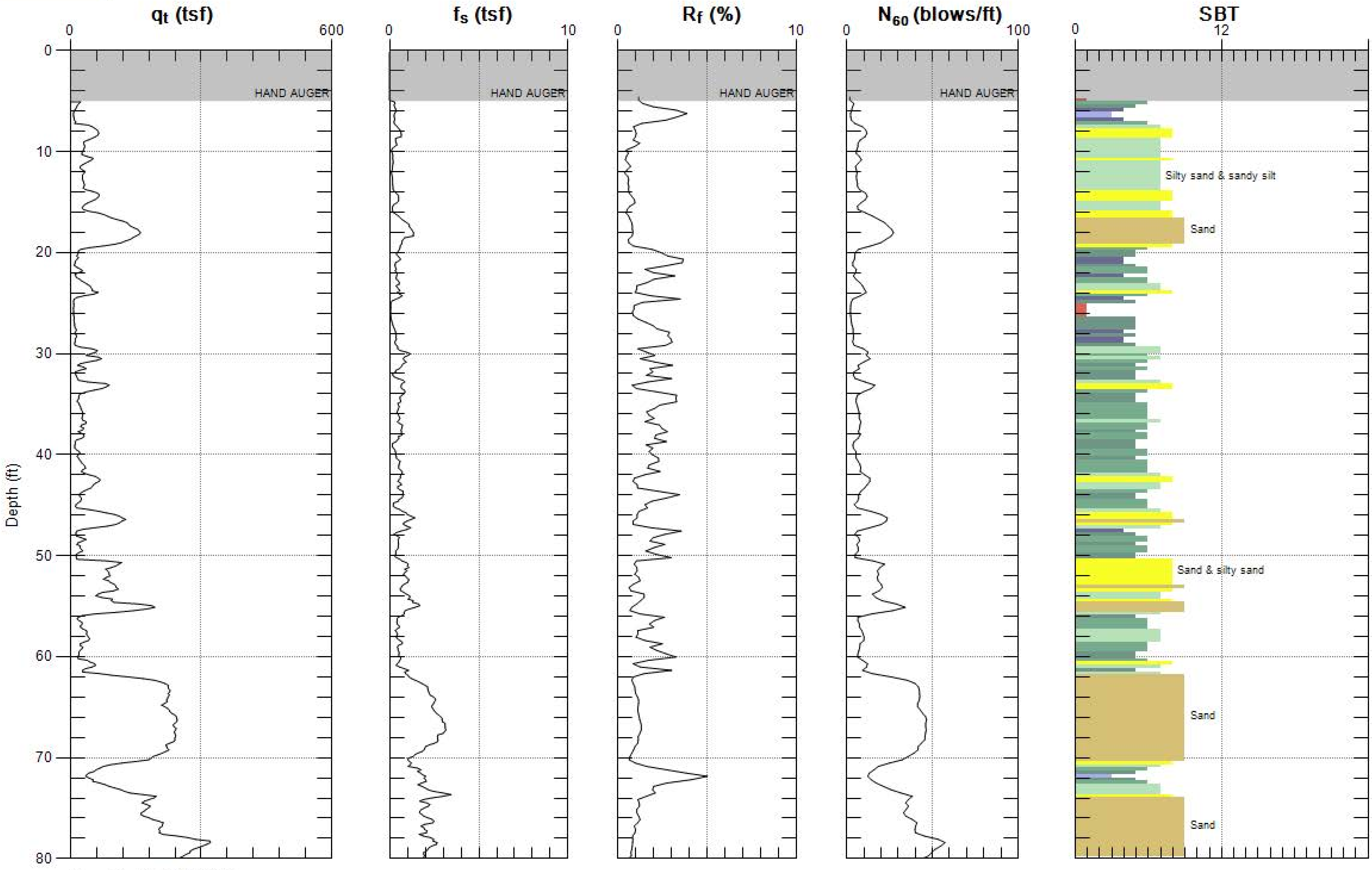
SBT: Soil Behavior Type (Robertson 1990)

GREGG

AECOM

Site: MORENA PUMP STATION Engineer: K.MARTIN

Sounding: CU-13 Date: 3/22/17 10:52



Max. Depth: 80.381 (ft)
Avg. Interval: 0.328 (ft)

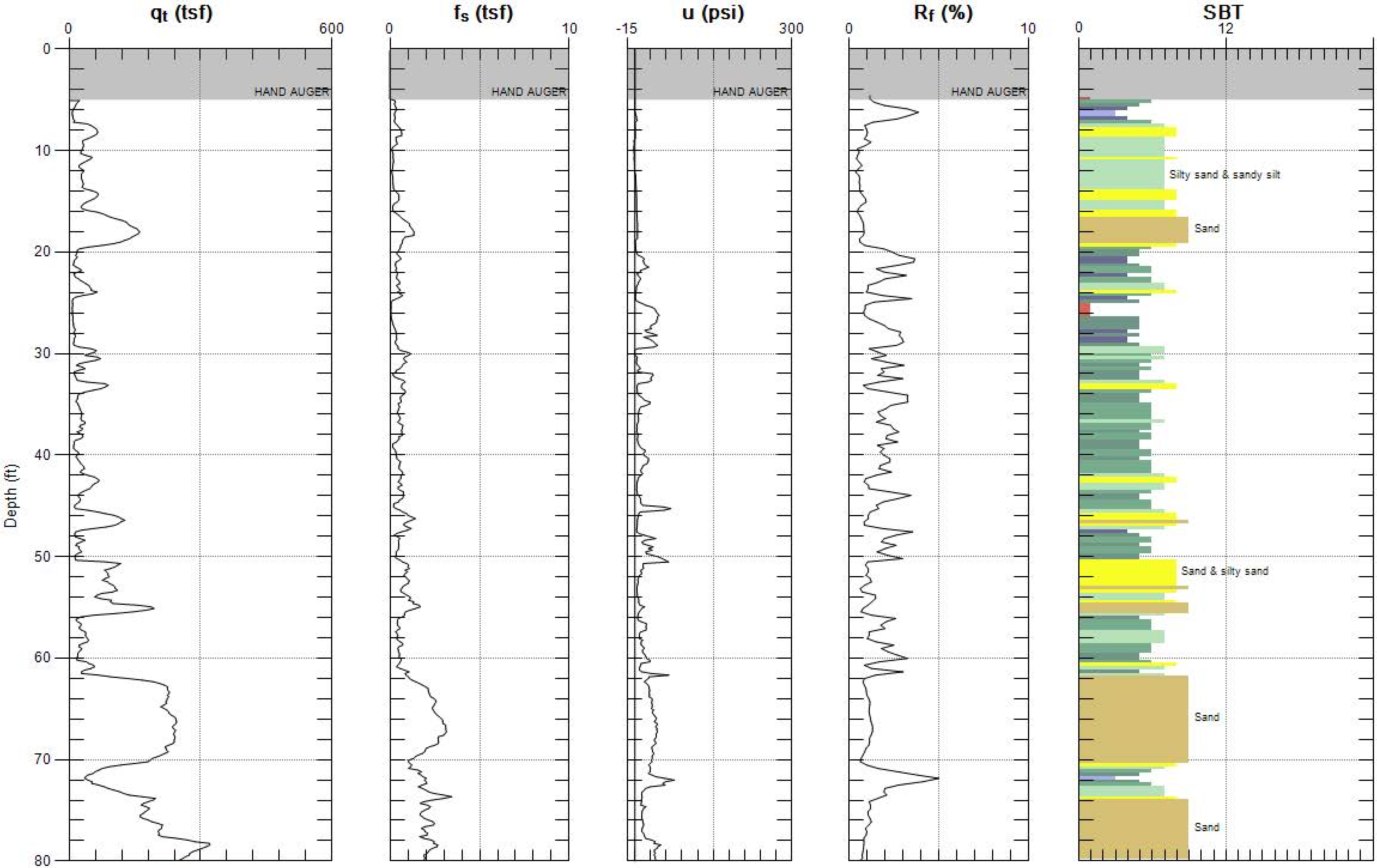
SBT: Soil Behavior Type (Robertson 1990)

GREGG

AECOM

Site: MORENA PUMP STATION Engineer: K.MARTIN

Sounding: CU-13 **Date: 3/22/17 10:52**



Max. Depth: 80.381 (ft)
Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)

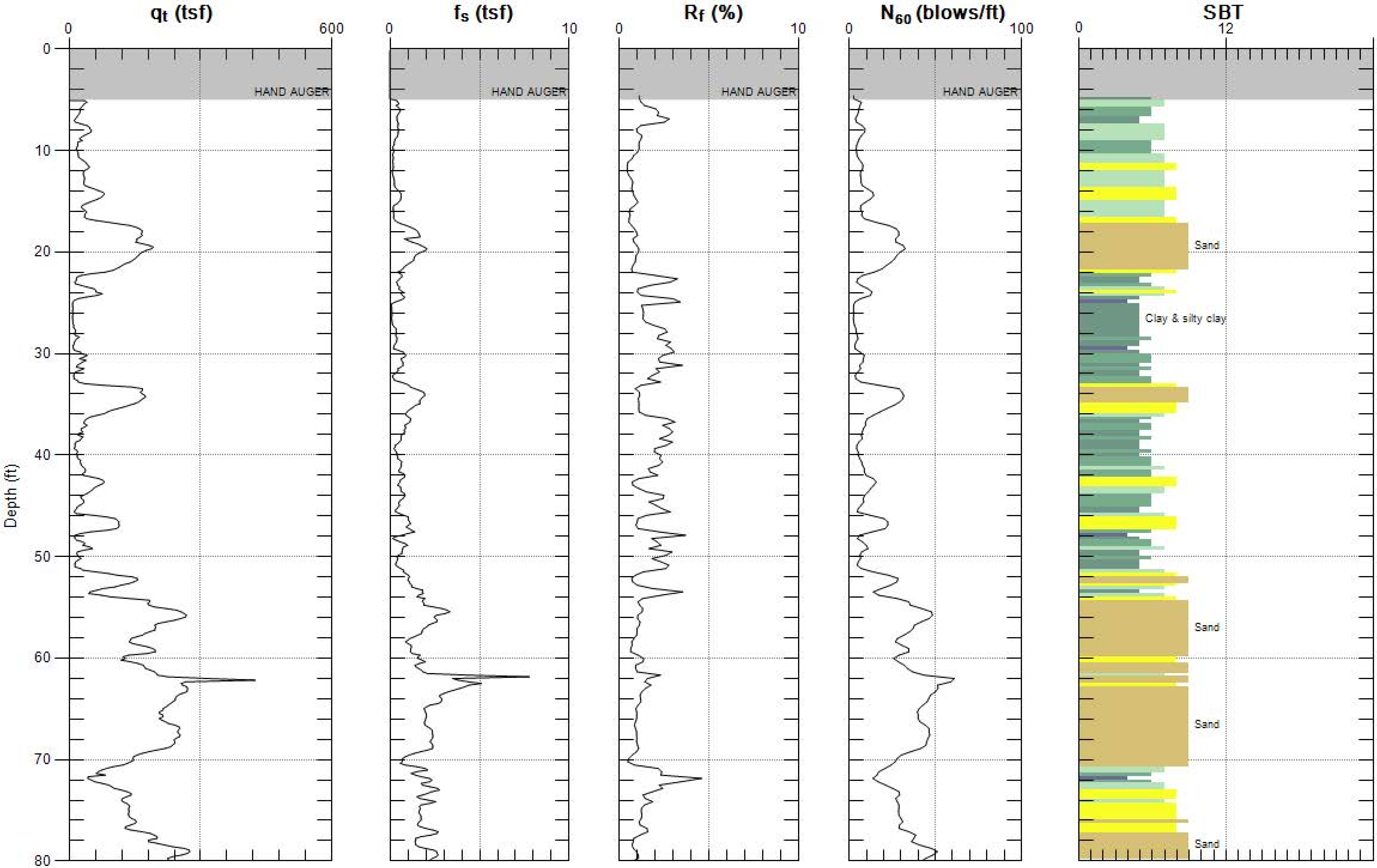
GREGG

AECOM

Site: MORENA PUMP STATION Engineer: K.MARTIN

Sounding: CU-14

Date: 3/22/17 01:04



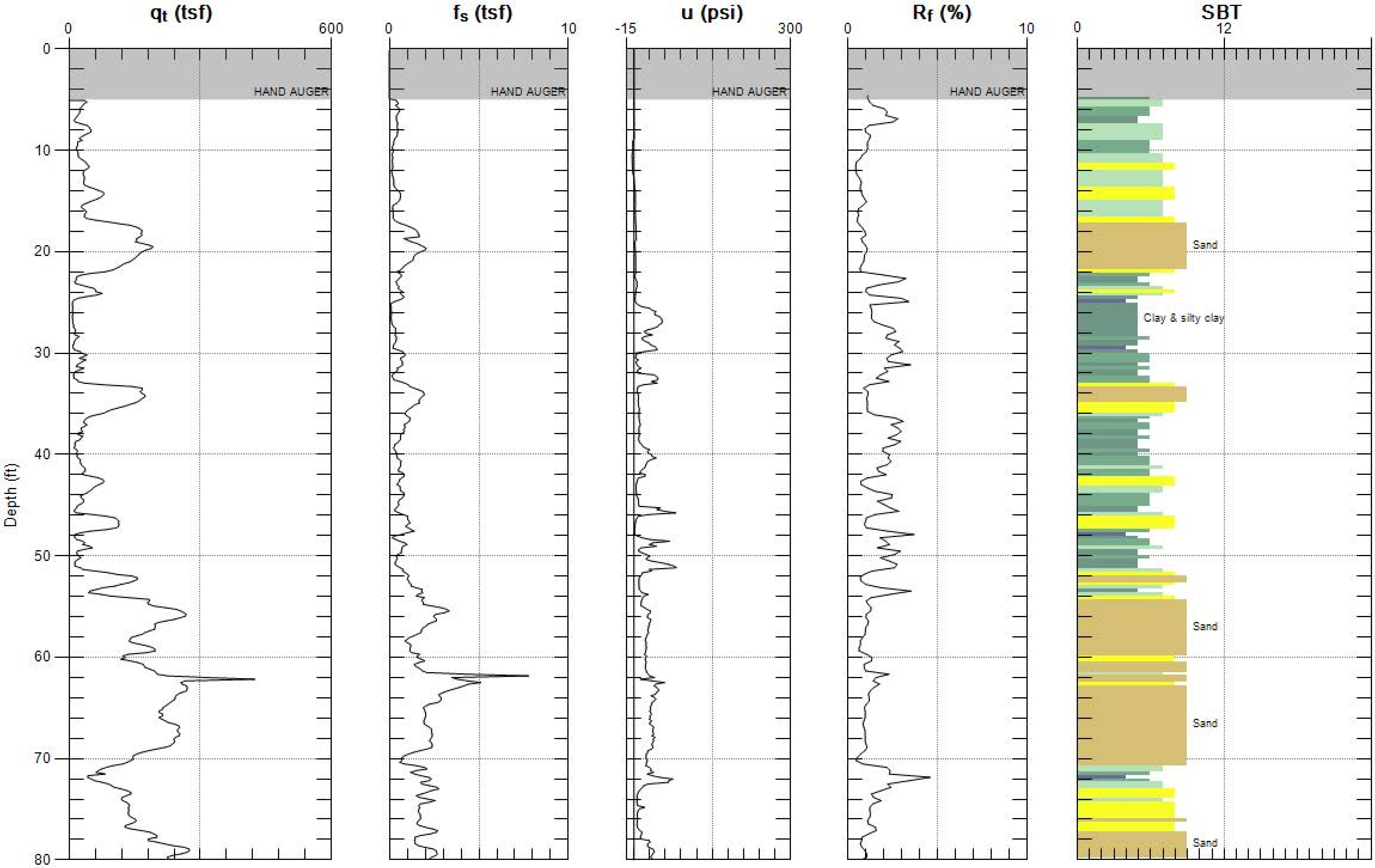
Max. Depth: 80.381 (ft)
Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)

GREGG **AECOM**

Site: MORENA PUMP STATION Engineer: K.MARTIN

Sounding: CU-14 **Date: 3/22/17 01:04**



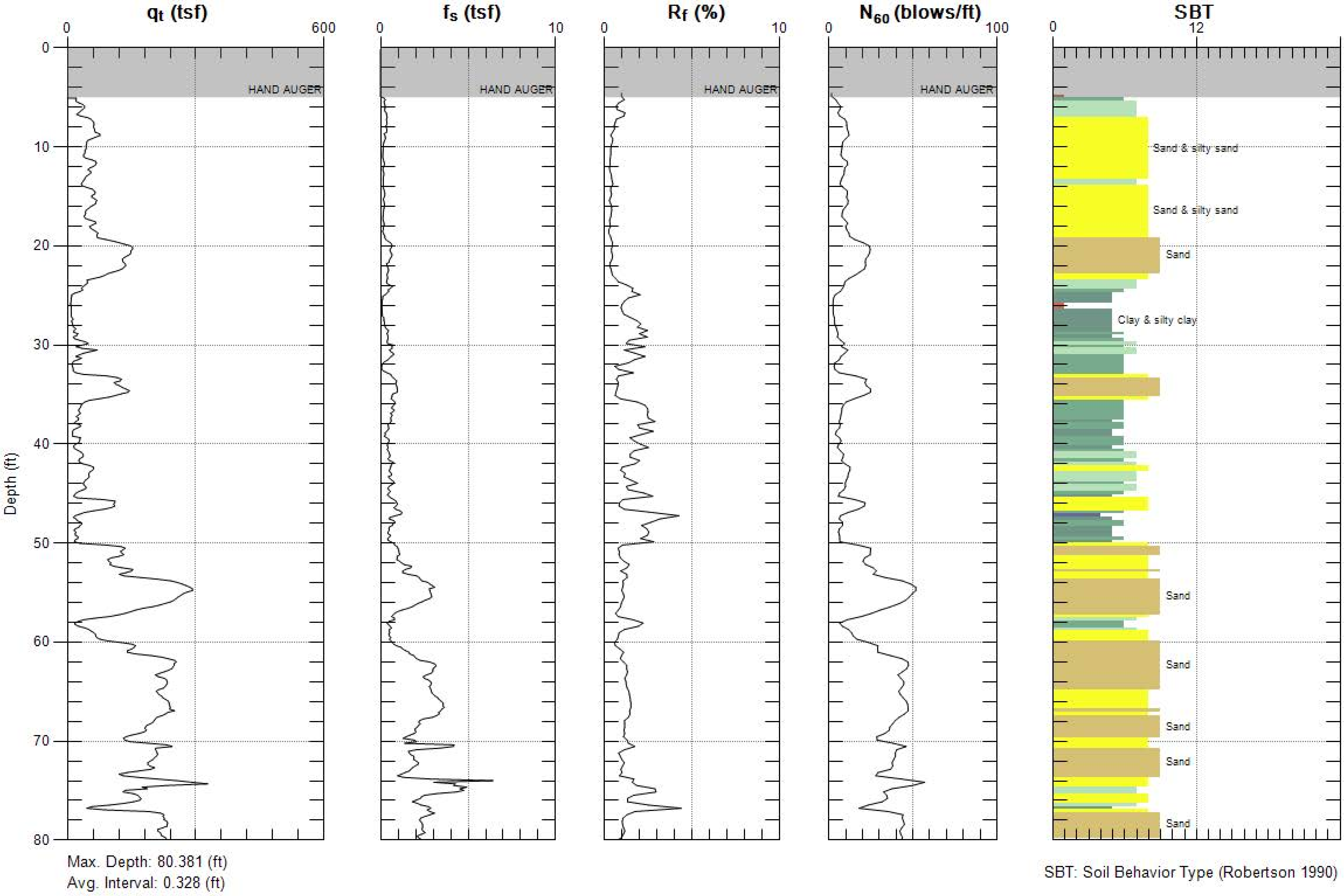
Max. Depth: 80.381 (ft)
Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)

GREGG **AECOM**

Site: MORENA PUMP STATION Engineer: K.MARTIN

Sounding: CU-15 **Date: 3/22/17 02:19**



Max. Depth: 80.381 (ft)
Avg. Interval: 0.328 (ft)

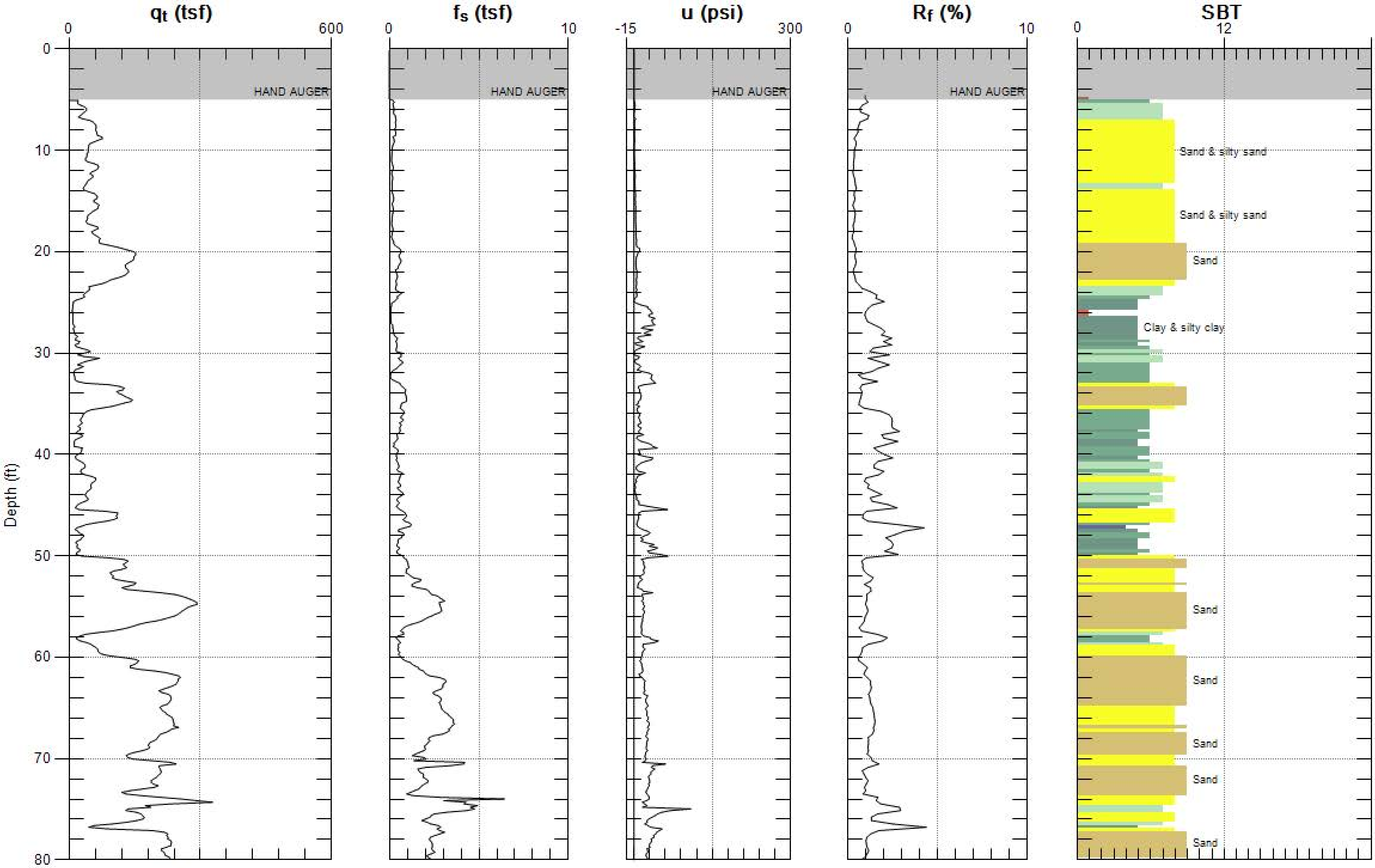
SBT: Soil Behavior Type (Robertson 1990)

GREGG

AECOM

Site: MORENA PUMP STATION Engineer: K.MARTIN

Sounding: CU-15 **Date: 3/22/17 02:19**



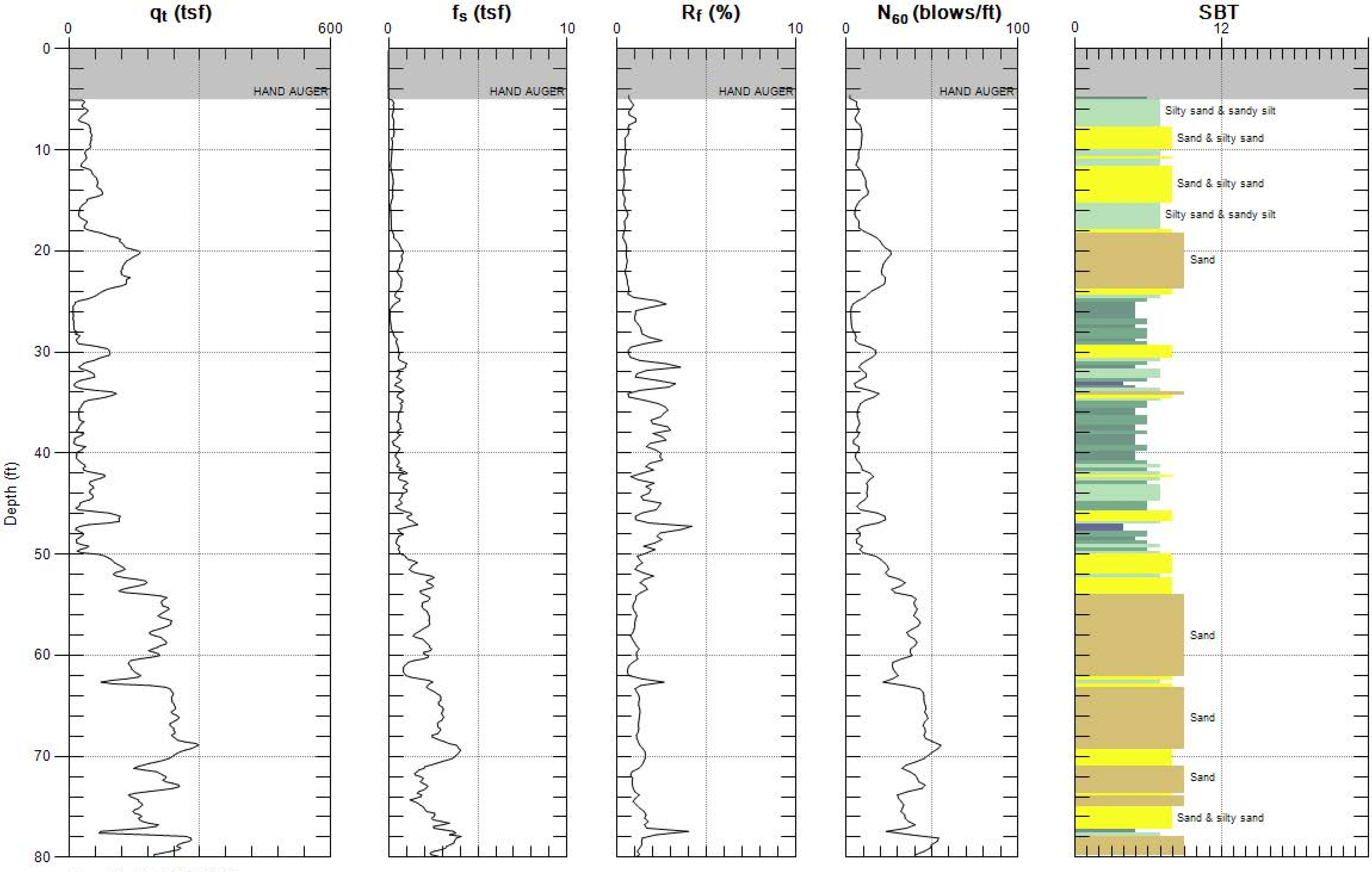
Max. Depth: 80.381 (ft)
Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)

AECOM

Site: MORENA PUMP STATION Engineer: K.MARTIN

Sounding: CU-16 **Date: 3/23/17 07:53**



Max. Depth: 80.381 (ft)
Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)

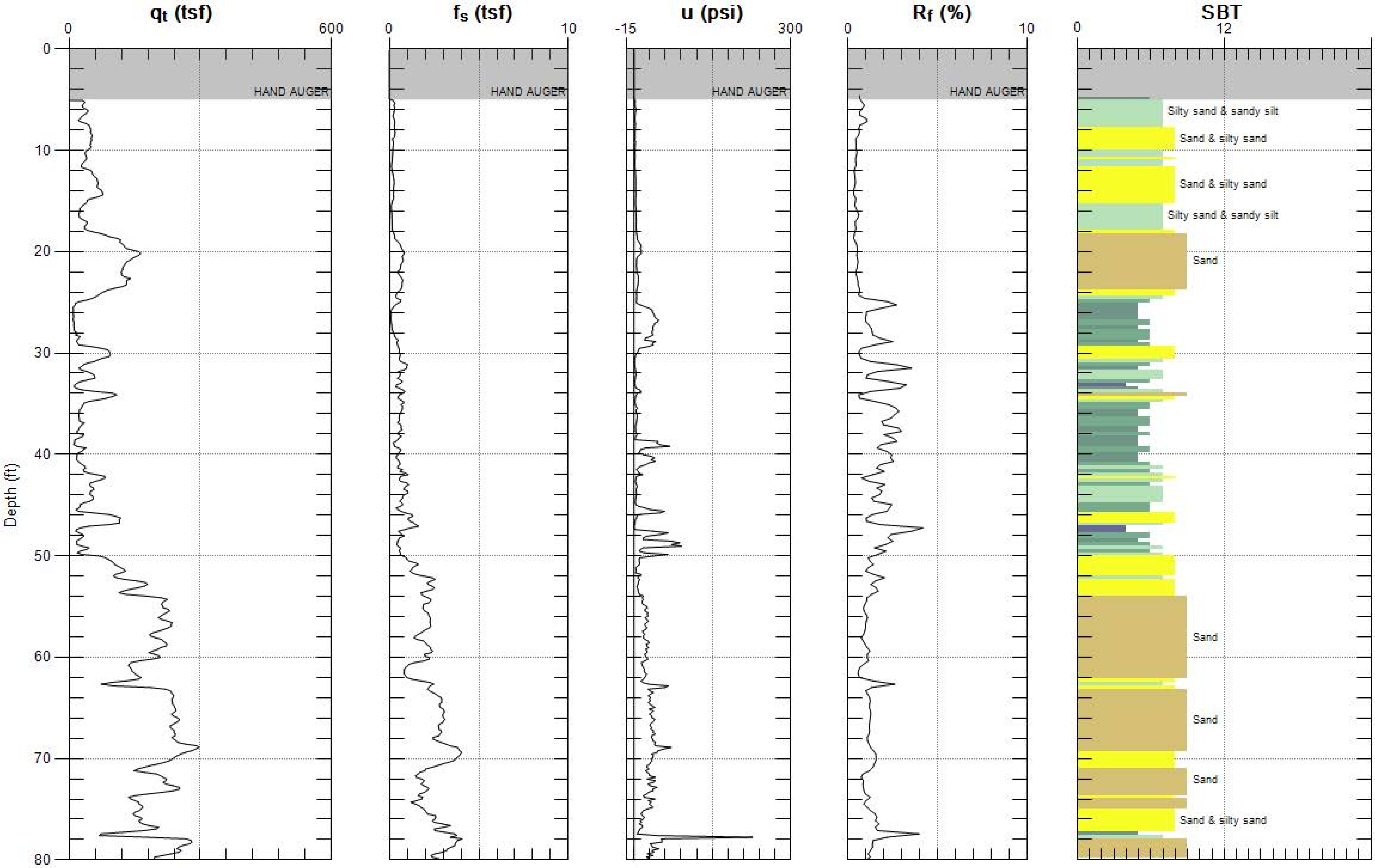
GREGG

AECOM

Site: MORENA PUMP STATION Engineer: K.MARTIN

Sounding: CU-16

Date: 3/23/17 07:53



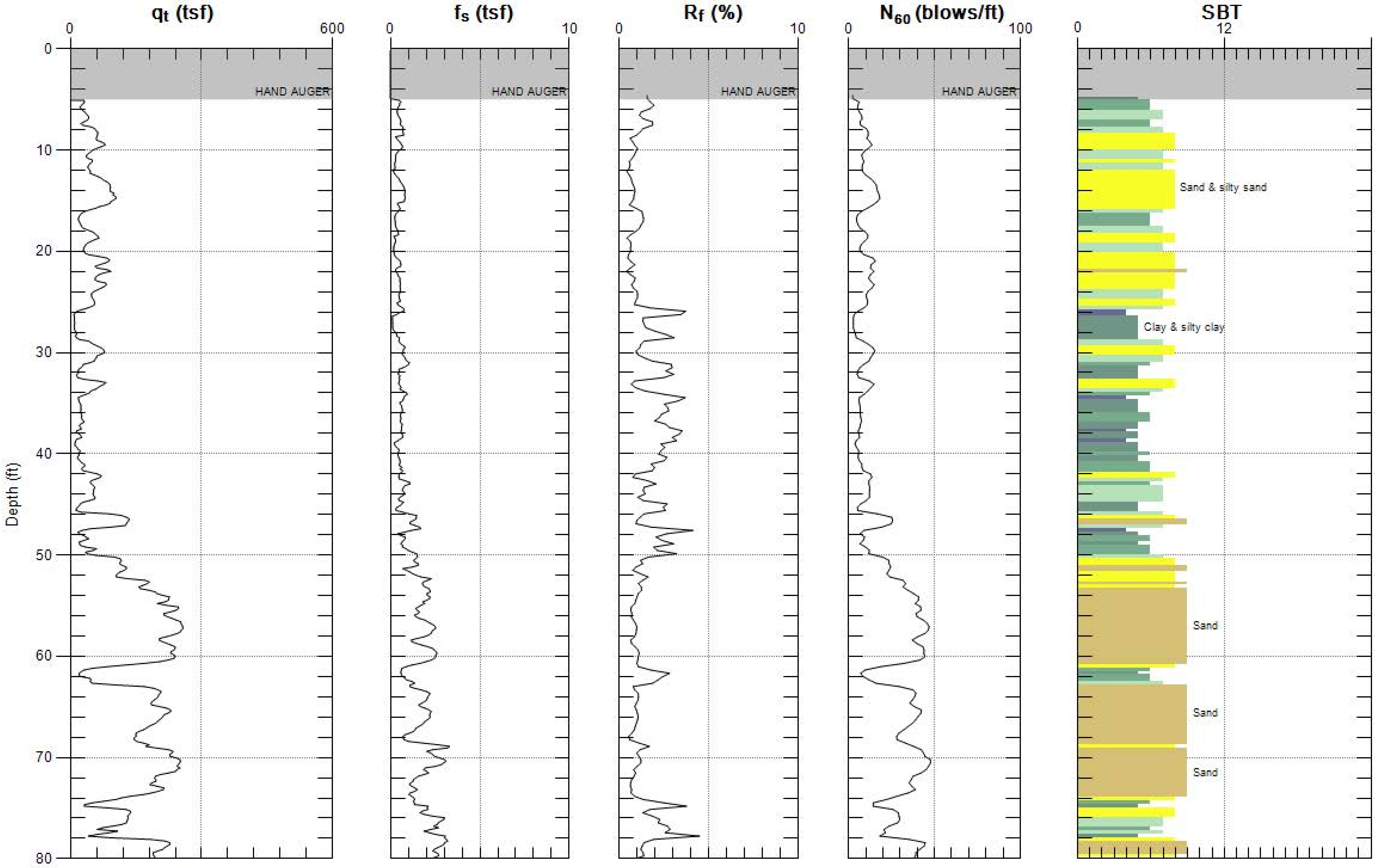
Max. Depth: 80.381 (ft)
Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)

GREGG **AECOM**

Site: MORENA PUMP STATION Engineer: K.MARTIN

Sounding: CU-17 **Date: 3/23/17 09:15**



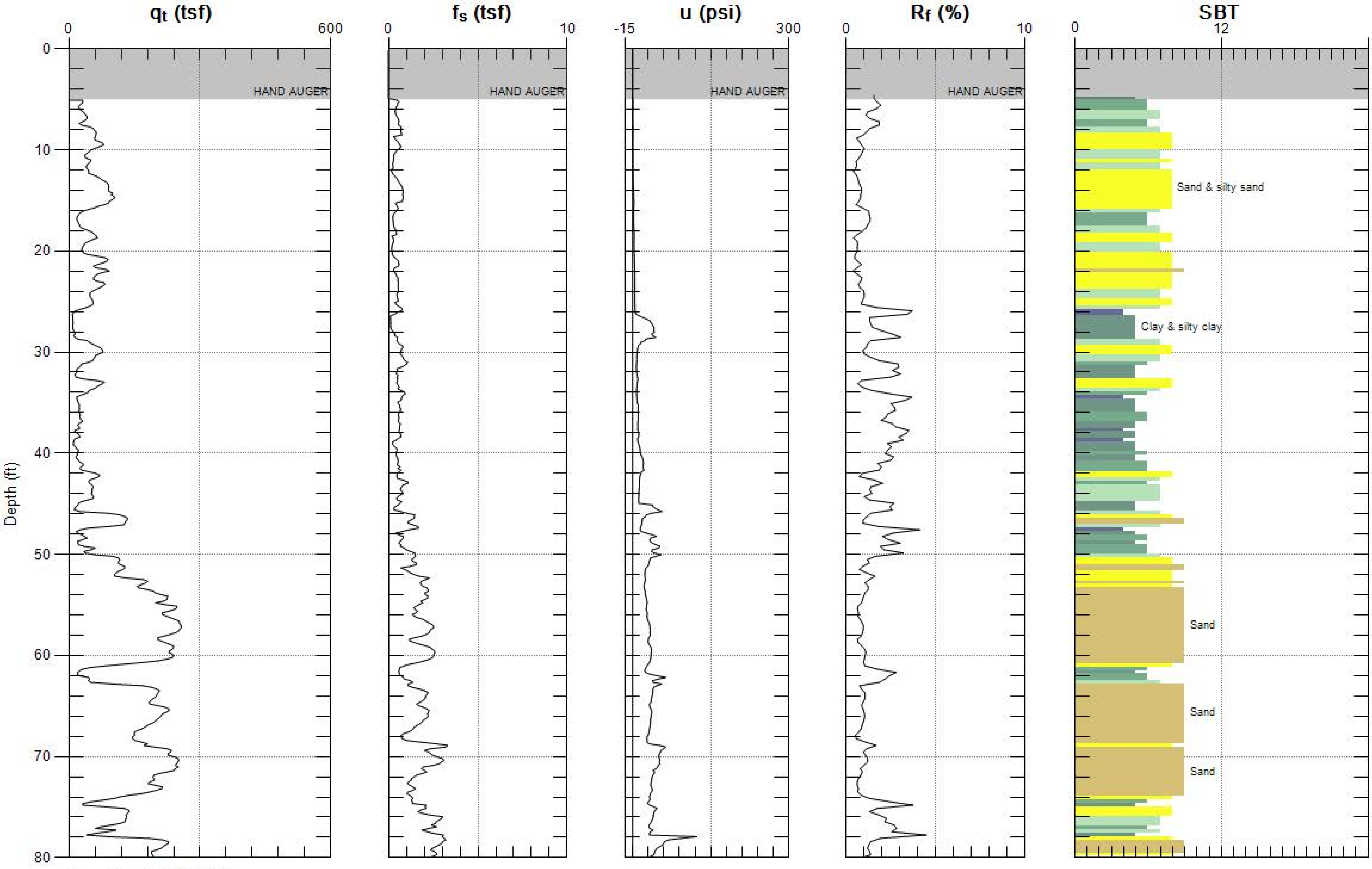
Max. Depth: 80.381 (ft)
Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)

AECOM

Site: MORENA PUMP STATION Engineer: K.MARTIN

Sounding: CU-17 **Date: 3/23/17 09:15**



Max. Depth: 80.381 (ft)
Avg. Interval: 0.328 (ft)

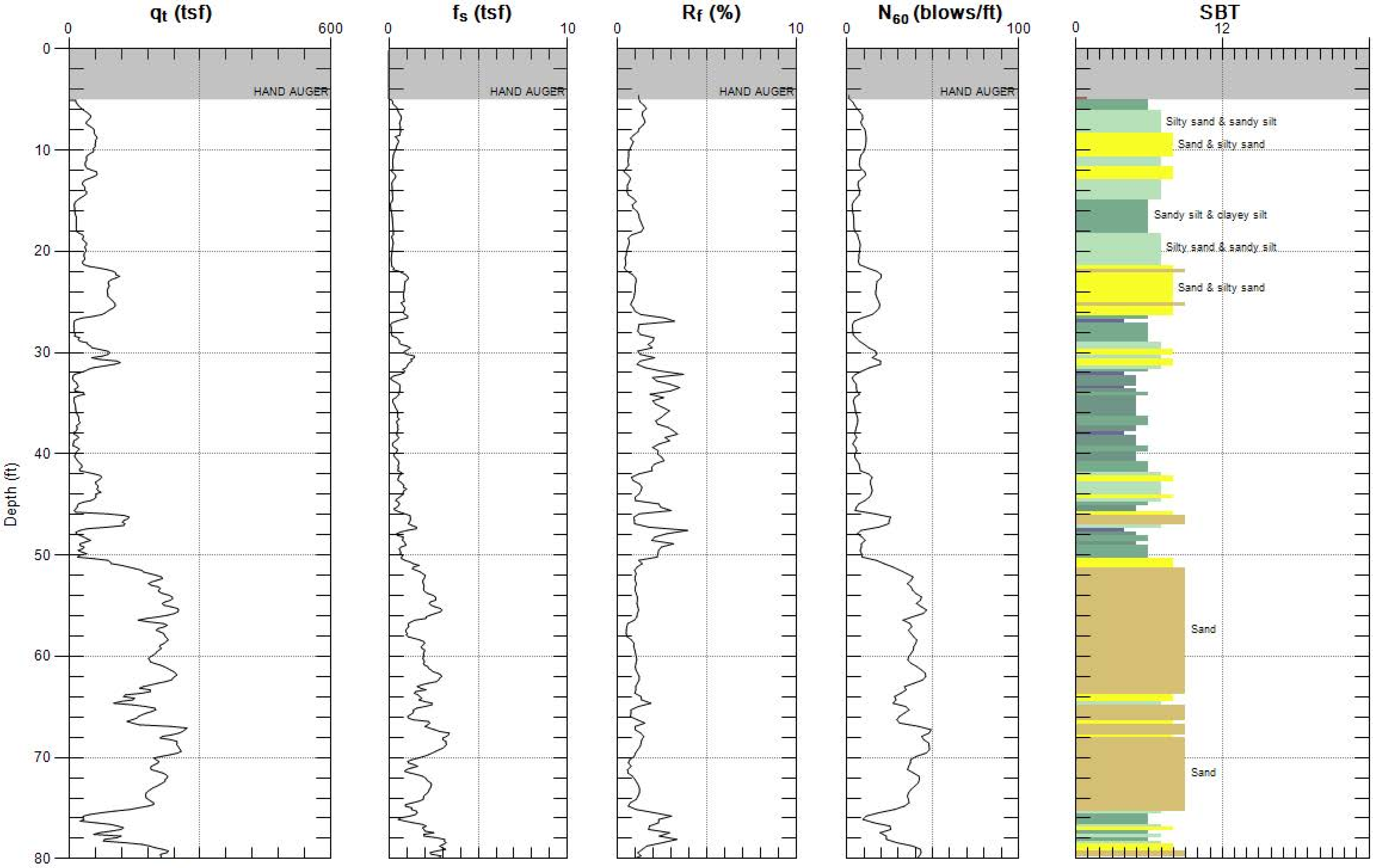
SBT: Soil Behavior Type (Robertson 1990)

GREGG

AECOM

Site: MORENA PUMP STATION Engineer: K.MARTIN

Sounding: CU-18 Date: 3/23/17 10:32



Max. Depth: 80.381 (ft)
Avg. Interval: 0.328 (ft)

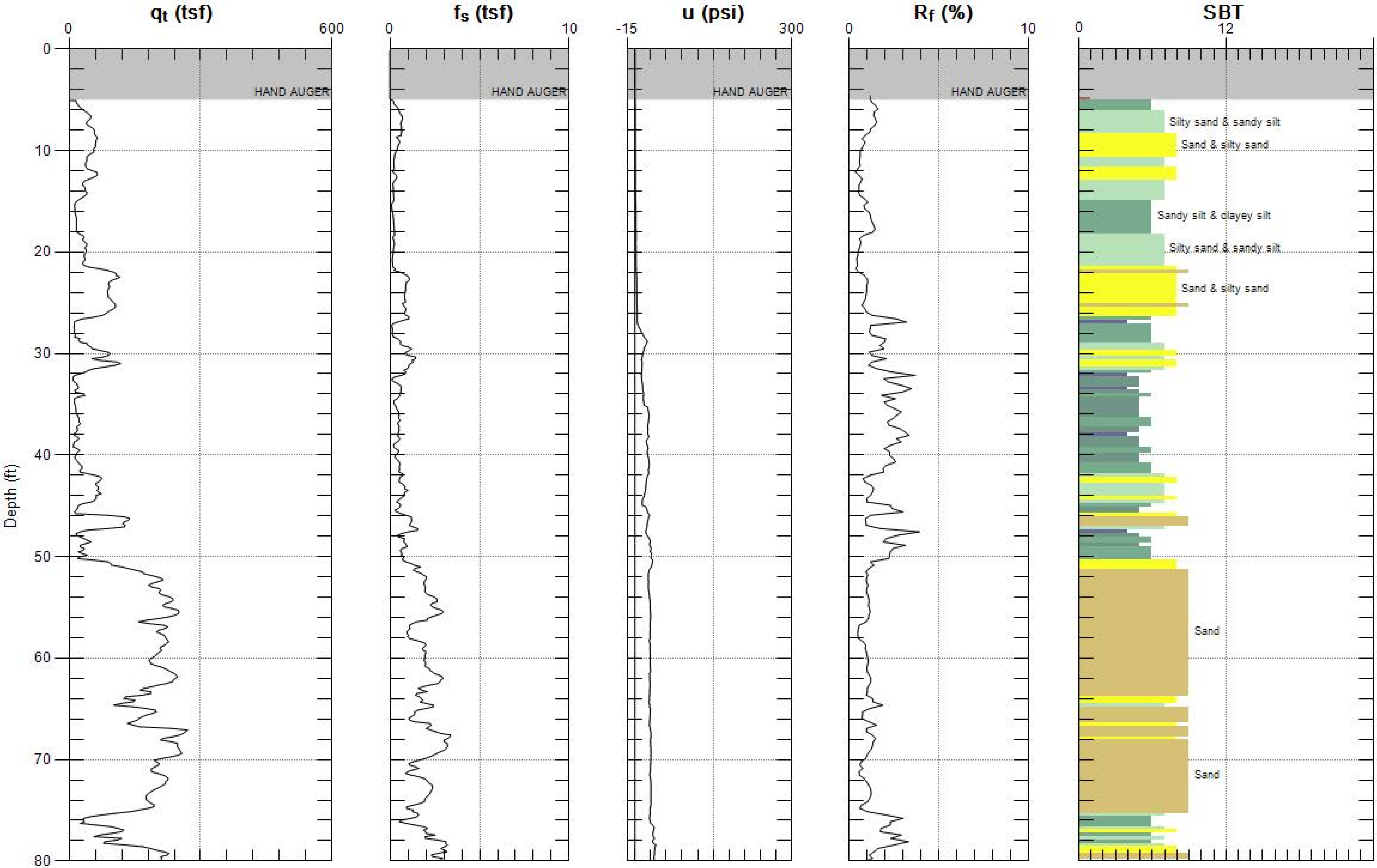
SBT: Soil Behavior Type (Robertson 1990)

GREGG

AECOM

Site: MORENA PUMP STATION Engineer: K.MARTIN

Sounding: CU-18 **Date: 3/23/17 10:32**



Max. Depth: 80.381 (ft)
Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)

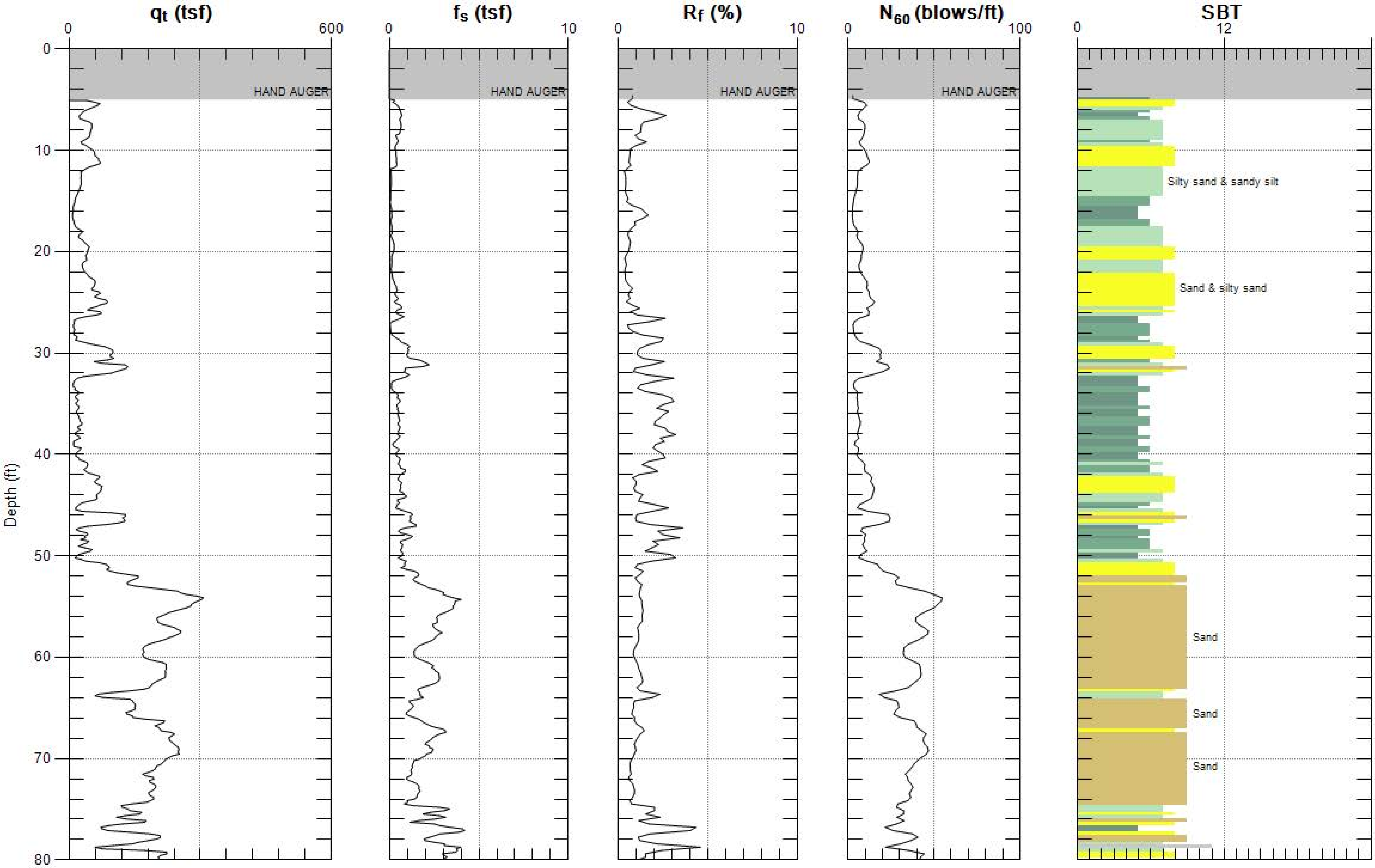
GREGG

AECOM

Site: MORENA PUMP STATION Engineer: K.MARTIN

Sounding: CU-19

Date: 3/23/17 12:38



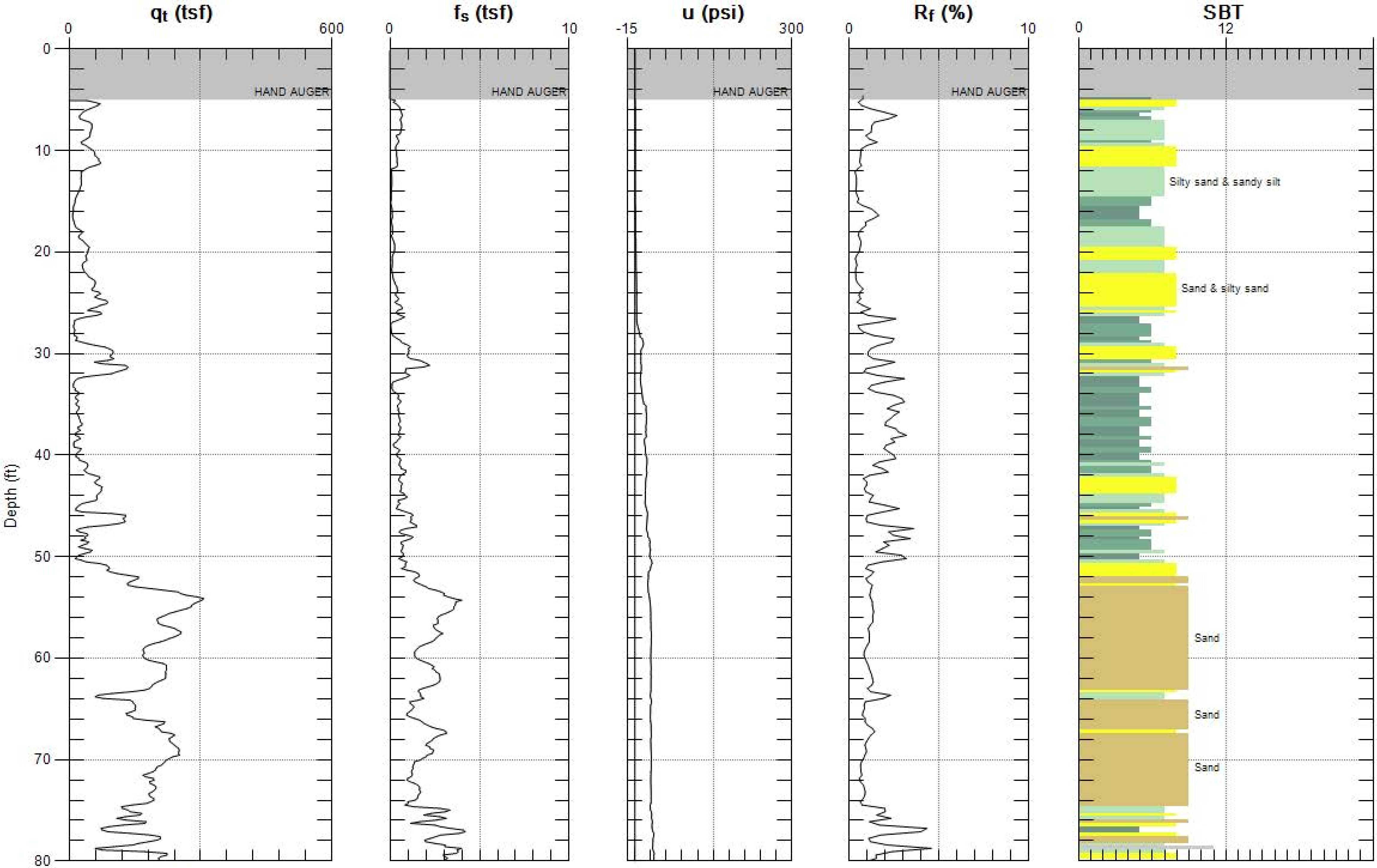
Max. Depth: 80.381 (ft)
Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)

GREGG **AECOM**

Site: MORENA PUMP STATION Engineer: K.MARTIN

Sounding: CU-19 **Date: 3/23/17 12:38**



Max. Depth: 80.381 (ft)
Avg. Interval: 0.328 (ft)

SBT: Soil Behavior Type (Robertson 1990)

60% DESIGN DEVELOPMENT REPORT

GEOTECHNICAL INVESTIGATION MORENA PIPELINE TUNNELS WW FORCE MAIN AND BRINE/CENTRATE CONVEYANCE PREDESIGN (NC01)

SAN DIEGO, CALIFORNIA

Prepared for

City of San Diego
Public Utilities Department
San Diego, California

September 19, 2017
AECOM Project No. 60530732

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Subject: 60% Design Development Report
Geotechnical Investigation
Morena Pipeline Tunnels
WW Force Main and Brine/Centrate Conveyance Predesign (NC01)
San Diego, California
AECOM Project No. 60530732

Dear Ms. Nasrawi:

This geotechnical investigation report prepared by AECOM Technical Services, Inc. supports 60% Design of the tunnels for the Morena Wastewater Force Main and Brine/Centrate Conveyance Pipeline, Pure Water San Diego. The proposed tunnels discussed in the attached report are located along the pipeline alignments between the Morena Pump Station and the North City Water Reclamation Plant at 1) San Clemente Creek Crossing, 2) Rose Canyon NCTD Rail Crossing, and 3) Interstate 805 Freeway. Smaller tunnel crossings, such as along Friars Road are presented in the geotechnical investigation report.

The purpose of this report is to provide geologic and geotechnical information for 60% design of the tunneled pipeline sections. The tunnel geologic profiles were updated based on results of subsurface explorations. Separate geotechnical investigation reports were prepared for design of the Morena Pump Station and trenched pipeline reaches; and for the fault hazard investigation.

Sincerely,

AECOM Technical Services, Inc.

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LIST OF ACRONYMS AND ABBREVIATIONS

AECOM	AECOM Technical Services, Inc.
bgs	below ground surface
ft	feet
in	inch
mgd	Million gallons per day
MPS	Morena Pump Station
MSL	Mean Sea Level
MTBM	Microtunnel Boring Machine
NCTD	North County Transit District
NCWRP	North City Water Reclamation Plant
PLWTP	Point Loma Water Treatment Plant
Project	Morena Wastewater Force Main and Brine/Centrate Conveyance Pipeline
RC	Reinforced Concrete
SPT	Standard Penetration Test
TBM	Tunnel Boring Machine
UCS	Unconfined compressive strength
USA	Underground Service Alert
WW	Wastewater

1.0 INTRODUCTION

1.1 PROJECT DESCRIPTION

This geotechnical report prepared by AECOM Technical Services, Inc. (AECOM) supports 60% Design Development for the planned tunnel components of the Morena Wastewater Force Main and Brine/Centrate Conveyance Pipeline ("Project") for Pure Water San Diego. The purpose of this report is to provide geologic and geotechnical information for design of the tunneled pipeline sections.

The Project will convey an average of 37.7 million gallons per day (mgd) of raw wastewater to the North City Water Reclamation Plant (NCWRP). Wastewater will be conveyed from Morena Pump Station (MPS) via a new 48-inch-diameter force main approximately 10.7 miles north to NCWRP. A new 30-inch-diameter brine pipeline will convey 13.5 mgd of brine/centrate (generated from the North City Water Purification Facility [NCWPF]) south, by gravity flow (by way of MPS) for treatment at the Point Loma Wastewater Treatment Plant (PLWTP). The brine line will run parallel to the force main in a joint trench for approximately 95 percent of the overall alignment.

The pipeline alignments will be constructed using trenching and tunneling techniques. This geotechnical report addresses the planned tunnel components of the project, which from north to south (NCWRP to the MPS) include:

- Executive Drive at I-805 ("I-805 Freeway Crossing")
- Genesee Avenue at Rose Canyon Creek/NCTD ("Rose Canyon NCTD Rail Crossing")
- Genesee Avenue at SR-52 EB On & Off Ramp/San Clemente Creek ("San Clemente Creek Crossing")

The tunnels are proposed to construct the force main and brine/centrate pipelines below: Interstate 805, a major freeway; the existing NCTD dual track railroad in Rose Canyon; and below San Clemente Creek in San Clemente Canyon. These tunnels will be below natural canyons, referred to in this report collectively as the "inland canyon tunnels". Tunnel construction access shafts will be located along the pipeline alignments in and near Genesee Avenue (including Marian Bear Memorial Park in San Clemente Canyon), Executive Drive and at the NCWRP. Figure 1 shows the proposed alignment for the force main and the brine/centrate pipelines with locations of the proposed tunnels. Pipeline installation using tunneling techniques for other portions of the alignments, such as along Friars Road, is presented in the geotechnical report for the project.

The pipelines will be installed within a 10-foot diameter steel casing proposed for the tunnel sections. The two carrier pipes, i.e. 48-in diameter force main and 30-in diameter brine/centrate pipe will be placed in the casing and the annulus fully grouted. For future pipeline maintenance purposes, each pipeline may be split into two smaller pipelines at the tunnel crossings.

1.2 FIELD INVESTIGATION

The investigation began with a review of available geotechnical data from AECOM project files (references below), as well as the "Desktop Geotechnical Study Report, Pure Water Program Task 7, Morena Pump Station, WW Force Main and Brine Conveyance Pre-Design, City of San Diego" prepared by Allied Geotechnical Engineers, 2015 (Allied, 2015).

The geotechnical evaluation included review of published geologic maps, City of San Diego Geotechnical maps, historical air photos and vintage topographic maps of the canyon crossing areas. The desktop review was followed by geologic reconnaissance of the proposed tunnel routes and nearby canyon areas.

1.2.1 Subsurface Explorations

The field investigation consisted of advancing nine exploratory borings (EX-1, -2; RC-1, -2, -3 and -4; and SC-1, -2 and -3) and collecting soil/core samples for more detailed review and laboratory testing. Borings were located at the approximate preliminary locations of construction shafts and/or along the general alignment of the proposed tunnel as shown on the alignment plans and profiles, Figures 2 through 8.

The boring for the planned east shaft of the I-805 Freeway crossing at the NCWRP was performed by Allied Geotechnical Engineers (AGE, 2017). The boring location (Boring H-7) is shown on Figure 2.

The borings were drilled to depths ranging between 53 and 112 feet to extend to depths at least 10 feet below the proposed tunnel invert. Drilling was performed with a truck-mounted drill rig equipped to drill with hollow-stem augers and HQ-coring. Borings for the inland canyon tunnels were expected to encounter Scripps Formation (a sedimentary formation that can be continuously sampled by coring); these borings were advanced with hollow stem augers initially through fill, alluvium and the upper weathered portion of the Scripps Formation; then continued by continuously coring (below the bottom of the augers) to the bottom of the hole, terminating in the Scripps Formation (or Ardath Shale). Test borings were drilled, logged, sampled and backfilled under supervision of an AECOM engineering geologist.

Monitoring wells were installed in Borings SC-3, SC-4 and RC-3. Well construction consisted of 2-inch diameter PVC slotted screen and blank pipe, with a flush mount well cover at the ground surface. Well screens were installed at the approximate depth of the proposed tunnel. Stabilized groundwater levels were recorded in the wells. A temporary monitoring well was installed at Boring EX-2. The well was abandoned after measuring the stabilized groundwater level and following permeability (slug) testing.

Several borings were located in the City street right-of-way in accordance with City Traffic Control Permits. Borings were performed on city owned land at Marion Bear Park and in Rose Canyon. Boring EX-2 was performed in the Caltrans Right-of-Way under an encroachment permit. Underground Service Alert was notified prior to advancing the borings. Monitoring wells were constructed and borings were backfilled in accordance with County of San Diego Department of Environmental Health requirements. Disturbed surfaces were restored to match existing conditions.

Logs of the borings are provided in Appendix A. The field exploration program is described in more detail in Appendix A. A summary of the borings is provided as Table A-1 in Appendix A.

1.2.2 Slug Tests

In-situ permeability tests (slug tests) were performed in the 2-inch monitoring wells (EX-2, RC-3 and SC-3) which were screened at depth intervals approximately corresponding with the proposed tunnel depth. Data from the slug tests is summarized in Table A-2 in Appendix A.

Permeability test results from Boring EX-2 will be provided in the final tunnel report.

1.2.3 Laboratory Testing

Laboratory tests were performed following review of the core samples and field logs of the borings. Geotechnical laboratory tests were performed on selected samples to aid in estimating soil and rock properties and verify visual classifications of the materials. The tests included grain size, plasticity characteristics and unconfined compressive strength (UCS). Test results are shown on the corresponding sample location on the logs of the borings in Appendix A. A detailed description of the laboratory testing is provided in Appendix B.

Additional test results from Boring EX-2 will be updated to the report, when available.

1.2.4 Concurrent Explorations

Allied Geotechnical Engineers, Inc. (2017) performed a geotechnical investigation for the NCWRP expansion. The investigation included a 100.5 foot deep boring (Boring H-7) near the proposed east tunnel shaft for the I-805 freeway tunnel. Boring logs are included in Appendix C.

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2.0 SITE AND GEOLOGIC CONDITIONS

This section of the report summarizes general site and geologic conditions at the proposed tunneled portions of the Project.

2.1 TUNNEL SITE CONDITIONS

These sections describe the general site plans and profiles for the proposed tunnels, along with major features and existing infrastructure along the alignments. The proposed tunnel layouts and profiles are shown on Figures 2 through 8. Table 1 provides a summary of the proposed tunnels.

2.1.1 I-805 Freeway Crossing

The proposed I-805 tunnel layout is shown on Figure 2; the proposed tunnel profile is shown on Figure 3. From west to east, the proposed tunnel below I-805 extends from the cul-de-sac at Executive Drive to the NCWRP. The alignment veers slightly north from Executive Drive passing below a private parcel between the cul-de-sac and the freeway.

The proposed shafts are both located atop developed mesas bordering the freeway at about 360 to 365 feet Mean Sea Level (MSL). The proposed west (launching) and east (receiving) shafts will be about 105 and 95 feet deep, respectively. The mesas are separated by a former southerly flowing tributary canyon of Rose Canyon; the former canyon was graded by cut and filling (cutting on the east, filling on the west) to create the I-805 highway grade. Private parcels along the west side of the freeway are also underlain by fill.

The tunnel is approximately 1,200 feet long; about 640 feet is below Caltrans right-of-way which includes eight travel lanes (4 northbound, 4 southbound) and northbound/southbound off ramps. The new tunnel will also pass under the existing North City Utility Tunnel Connector which is about 75 feet deep, invert elevation 275 ft MSL) and an existing 60-inch diameter storm drain (invert elevation 284 feet MSL) on the west side of the highway.

The lowest existing ground surface elevation within the freeway right-of-way (along the tunnel route) is between about 317 to 320 feet MSL. At this point, the top of the proposed 10-foot diameter steel casing for the tunnel beneath the freeway is about 268 feet MSL. Assuming the tunnel crown would also be at about 268 feet MSL, the minimum tunnel ground cover below the freeway would be about 49 feet (317-268 feet).

2.1.2 Rose Canyon NCTD Rail Crossing

The proposed Rose Canyon NCTD Rail Crossing tunnel layout is shown on Figure 4; the proposed tunnel profile is shown on Figures 5 and 6. From Genesee Avenue, the pipeline alignment will veer to the east (avoiding crossing below the Genesee Avenue bridge), extending below Rose Canyon and the NCTD railroad. Two tunnels (described herein as the North and South tunnels) are proposed to be constructed from a launch shaft about 200 feet east of the bridge, just north of the railroad. The launch shaft will support construction of the tunneled pipeline to the southerly and northerly receiving shafts in Genesee Avenue. The launch shaft will be approximately 65 feet deep, located along an existing unpaved access road from Genesee Avenue.

The South tunnel extends below the former confluence of Rose Creek and a tributary to Rose Creek (to the south, below the area of University High School). The former canyon topography has been mostly buried by road filling to grade Genesee Avenue. The tunnel will be about 750 feet long and will pass below twin sets of existing railroad tracks in the NCTD railroad right-of-way. The existing railroad extends east-west along the north side of Rose Canyon supported by ballast along cut-and-fill embankment. The minimum tunnel ground cover will be about 41 feet below the railroad centerline, assuming the tunnel crown would be at about 172 feet MSL. The tunnel will also pass below the existing canyon storm drain (box culvert) and the existing 42-inch sewer (invert elevation 180 feet MSL).

The southerly receiving shaft will be near the intersection of Centurion Drive and Genesee Avenue at about elevation 218 feet MSL and will be about 55 feet deep.

From the launching shaft, the North tunnel alignment will continue approximately 300 feet back to a northern shaft in Genesee Avenue. The northerly receiving shaft will be about 150 feet north of the railroad tracks (at approximate elevation 261 feet MSL) and will be about 40 feet deep.

2.1.3 San Clemente SR 52 Crossing

The proposed San Clemente SR 52 tunnel layout is shown on Figure 7; the proposed tunnel profile is shown on Figure 8. The proposed tunnel below San Clemente Canyon will veer away from (east of) Genesee Avenue between State Route 52 and the Genesee Avenue on/off ramps to SR 52. The former floodplain of San Clemente Creek has been mostly filled by grading for Genesee Avenue, and for SR 52. The bridge carrying Genesee Avenue over San Clemente Creek is supported by several rows of closely spaced piles. The tunnel profile however would veer to the east to avoid passing below the bridge.

The southerly shaft would be in the Genesee Avenue centerline median at about elevation 194 feet MSL. The tunnel would extend approximately 400 feet to a shaft located within the unpaved public parking lot for Marian Bear Memorial Park at about elevation 180 feet MSL. The pipeline alignment would continue back into Genesee Avenue with an approximate 200-foot long cut-and-cover section. The south and north shafts would be about 53 and 40 feet deep, respectively. The minimum tunnel ground cover will be about 20 feet below San Clemente Creek.

2.2 GEOLOGIC SETTING

The geologic setting of the proposed tunnels is shown on Figures 9, 10 and 11.These geologic maps show the project area geologic setting mostly prior to canyon grading and placement of fill along I-805, Rose Canyon and San Clemente Canyon.

The geologic setting of the proposed tunnels includes intermittent drainage courses within canyons bordered by coastal mesas. The canyon bottoms are underlain by alluvium and have also been partially filled for the highways, roads, bridges and railroad. Beneath fill and alluvium, the inland canyons are underlain by the Scripps Formation and Ardath Shale, described below.

2.3 GEOLOGIC UNITS

The anticipated geologic units include fill soil, recent alluvium, Quaternary terrace deposits/older alluvium, and the Scripps Formation and Ardath Shale, both Tertiary sedimentary formations. Geologic units anticipated along the tunnel alignments are indicated on the Profiles (Figures 3, 5, 6 and 8). The main geologic units anticipated in tunnels and shafts are described below, with geologic map symbol in parentheses.

2.3.1 Fill (Qf - not shown on geologic maps)

Previous grading for Genesee Avenue, Highway 52 and Interstate 805 involved filling canyons to create the road grade. The fill thickness at I-805 is estimated to be as much as 50 feet thick over the tunnel. Based on the borings, the proposed shafts will be partially in fill at I-805, Rose Canyon (south receiving shaft), and San Clemente Creek. The current tunnel profiles are not anticipated to encounter fill.

2.3.2 Alluvium (Qya)

The inland natural canyons at San Clemente Creek and Rose Creek are mapped as underlain by alluvium (Figure 6). The borings completed suggest alluvium is relatively thin, less than about 15 feet thick. Based on the borings, the current tunnel layouts at San Clemente Creek and Rose Creek appear to be deep enough to be below alluvium.

Alluvium was had not been mapped within the former natural drainage (now mostly graded by filling) at and along I-805. Below fill, Boring EX-2 penetrated alluvium about 10 feet thick; the alluvium had not been removed prior to placing fill in the canyon area.

2.3.3 Terrace Deposits/Older Alluvium/ Older Paralic Deposits (Qoa, $Qvop_6$, $Qvop_9$, $Qvop_{10}$)

Varying thicknesses of Pleistocene Terrace Deposits (also described as “Older Alluvium”) underlie the margins of the former floodplains of the inland canyons. These deposits are mostly dense mixtures of clayey sand and gravel.

Much older Pleistocene terrace deposits underlie the mesa tops at the NCWRP. AGE (2017) describes a thin layer of “Older Paralic Deposits” in the upper portion of Boring H-7.

2.3.4 Scripps Formation (Tsc)

The Scripps Formation is an Eocene sedimentary formation that underlies broad areas of Clairemont, UTC and the NCWRP. The Scripps Formation is the primary geologic unit anticipated to be encountered with the proposed tunnels at San Clemente Creek, Rose Canyon and below I-805. The Scripps Formation overlies the Eocene Ardath Shale, but the formations also tend to have similar sedimentary characteristics and interfinger in some areas. The Eocene Stadium Conglomerate, consisting of gravel and cobbles in a cemented sandstone matrix, is mapped west of I-805 near the NCWRP (Kennedy, 1975); however the Stadium Conglomerate is mostly stratigraphically above the Scripps Formation and is not expected to be encountered in the tunnels or shafts. The Scripps Formation also locally contains conglomerate, Boring EX-2 penetrated a 2-foot thick layer of conglomerate consisting of gravel with sand.

Based on the borings, the Scripps Formation typically consists of silty, fine-grained sandstone and sandy siltstone. Core recovery in the Scripps Formation was nearly 100%. The upper portions of the Scripps Formation encountered in the borings were highly weathered, becoming moderately to slightly weathered with depth. The sandstone and siltstone were described as weak to extremely weak rock in the core. Very strong cemented concretions/layers were encountered up to about 2-feet thick. Given the low dip of the formation, cemented concretions/layers could be laterally continuous for several feet up to several tens of feet in length. The sandstone/siltstone penetrated in the borings was essentially massive; few joints/fractures were observed in the core. More detailed descriptions of the Scripps Formation are provided on the boring logs.

2.3.5 Ardath Shale (Ta)

The Ardath Shale has sedimentary characteristics similar to the Scripps Formation. Like the overlying Scripps Formation, the Ardath Shale also contains randomly occurring cemented sandstone concretions ranging from a few inches to several feet thick.

Based on Boring RC-3, the northern portion of the South tunnel below Rose Canyon, and the lower portion of the launching shaft are anticipated to be in the Ardath Shale, consisting of very weak to weak siltstone and sandstone with cemented zones. The Ardath Shale is inferred to dip southerly and westerly below Rose Canyon. Given the low dip of the formation, cemented concretions/layers could be laterally continuous for several feet up to several tens of feet in length. From north to south, the South tunnel is anticipated to transition from Ardath Shale to Scripps Formation.

2.4 FAULTS

For the proposed inland canyon tunnels, there are no mapped faults projecting across or towards the tunnels which if present could contain gouge and/or shear zones. Minor faults may be encountered in the I-805 tunnel due to its length; although faults were not mapped in the Scripps Formation prior to freeway grading (Kennedy, 1975). Minor faults are anticipated to contain fairly thin gouge/shear zones wherein rock weakening is limited to the immediate area around the fault plane.

2.5 GROUNDWATER

The coastal canyons tend to have seasonal groundwater within the alluvium. During drilling, groundwater was encountered in the alluvium at Rose Canyon and San Clemente Canyon as shown on the boring logs. In Rose Canyon, groundwater was measured about 45 feet below ground surface in the alluvium during drilling. In San Clemente Canyon, groundwater was measured about 11 feet below ground surface in the alluvium within the monitoring well installed at Boring SC-3. Based on drilling Boring EX-2, the alluvium below I-805 contains groundwater.

Groundwater was encountered in the Scripps Formation and Ardath Shale as shown on the boring logs. Groundwater levels were measured in monitoring wells installed at Borings EX-2, SC-4 and RC-3 which were screened at the approximate tunnel elevation in the Scripps

Formation (EX-2, SC-4) and Ardath Shale (RC-3). These fine-grained formations have low permeability based on the slug tests, groundwater inflows are discussed below.

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3.0 LOCAL GEOLOGIC CONDITIONS

Anticipated geologic conditions specific to each tunnel are described below.

3.1 TUNNEL GEOLOGIC CONDITIONS

Anticipated subsurface geologic conditions are shown on the Tunnel Profiles, discussed below. The geologic profiles are based on geologic reconnaissance, interpretations of historical topography and the borings. The historical topography (prepared prior to canyon grading/filling) as shown on the figures is approximate due to possible map scaling differences, and the exaggerated nature of the subsurface profiles.

3.1.1 I-805 Freeway Crossing

Boring locations are shown on Figure 2. Boring EX-1 was completed at the west proposed shaft at the cul-de-sac for Executive Drive. Boring EX-2 was completed along the proposed tunnel near the westerly boundary of the Caltrans right-of-way. The borings were advanced to total depths of about 112 and 61 feet respectively, extending about 10 feet below the proposed tunnel invert. The boring for the proposed east shaft at the NCWRP (Boring H-7) was drilled to about 100 feet total depth.

Anticipated geologic conditions are shown on Figure 3. The proposed tunnel below I-805 appears to be entirely in the Scripps Formation consisting of very fine sandstone and sandy siltstone. Very strong sandstone layers/concretions up to about 1.5 feet thick were encountered in Boring EX-1. The proposed shafts are also anticipated to be entirely in the Scripps Formation, except for fill in the upper approximate 10 to 15 feet.

The west portion of the tunnel profile passes below a filled canyon along the south-bound freeway lanes. The available historical topography suggests the minimum canyon bottom elevation was at or just below about 275 feet MSL. The existing 60-inch storm drain is shown with invert elevation 284 feet MSL. Boring EX-2 was located within the deep portion of the filled canyon. The bottom of clay and sand alluvium in Boring EX-2 was at about elevation 281 feet MSL.

Based on available information, the tunnel profile appears to be below the bottom of the former canyon, the formational tunnel cover in the Scripps Formation is about 15 feet within about a 50-foot reach of the profile. Boring EX-2 indicates the upper portion of the Scripps Formation (below the former canyon) was highly weathered above the tunnel depth; the more highly weathered material is typically weaker (described as extremely weak in Boring EX-2) and contains more clay.

Groundwater was not encountered in the upper part of Boring EX-1 which was advanced by hollow stem augers to about 45 feet bgs. The core drilling method for Boring EX-1 did not allow for measuring groundwater below about 45 feet bgs. Similarly the drilling method at H-7 did not allow for measuring groundwater.

Groundwater was indicated in the Scripps Formation at tunnel depth, based on the temporary monitoring well at Boring EX-2. Groundwater may be present in the Scripps Formation in the tunnel and shafts. Inflows within the Scripps Formation are anticipated to be low based on low permeability of the formation.

Permeability test results from Boring EX-2 will be provided in the final report.

3.1.2 Rose Canyon NCTD Rail Crossing

Boring locations are shown on Figure 4. Borings RC-1 and RC-2 were advanced to depths of 73 and 103 feet, respectively. Both borings were located in Genesee Avenue. Boring RC-1 was located near the (pre-development) center of Rose Canyon, about 50 feet west of the currently proposed South tunnel alignment. Boring RC-3 was located at the proposed launching shaft east of Genesee Avenue.

Anticipated geologic conditions are shown on Figures 5 and 6 for the North and South tunnels, respectively. The existing NCTD railroad cuts expose well bedded layers of sandstone and siltstone of the Scripps Formation. Below a thin layer of Terrace Deposits, the launch shaft is anticipated to be in the Scripps Formation and Ardath Shale below a depth of about 50 feet, bgs.

As shown on Figure 5, the North tunnel and the north receiving shaft (in Genesee Avenue) are anticipated to be entirely in the Scripps Formation.

As shown on Figure 6, the proposed South tunnel is anticipated to be mostly in the Scripps Formation consisting of fine to coarse silty sandstone and sandy siltstone based on the borings. Layers of very strong cemented sandstone were encountered in the borings. The northern portion of the South tunnel profile is anticipated to be in the Ardath Shale, based on Boring NC-3, and the estimated southerly dip of the formation in the subsurface.

The South tunnel passes below road fill along the south margin of Rose Canyon. Beneath road fill, the topography of the canyon floor prior to road grading appeared fairly flat at a ground surface between approximately 190 and 200 feet, MSL. Below about 39 feet of fill, Boring RC-1 penetrated clayey sand with gravel alluvium about 8 feet thick. Based on Boring RC-1, the upper Scripps Formation (below the alluvium) appeared to be more highly weathered with increased clay. Based on available information, the South tunnel profile appears to be below the alluvium along the bottom of the former canyon, but the formational tunnel cover in the Scripps Formation appears to be less than about 10 feet. The low cover thickness of the Scripps Formation is estimated to be within about a 100-foot reach of the South tunnel profile.

The southern receiving shaft for the South tunnel is also anticipated to be in Scripps Formation below approximately 20 feet of road fill. Below the fill the shaft appears to be sited over or near a low ridge formed by Scripps Formation (or possibly Terrace Deposits) as estimated from historical topography.

Groundwater was measured in Boring RC-1 in the alluvium several feet above the top of the Scripps Formation. Groundwater was encountered in Boring RC-1 within the Scripps Formation at a depth of about 55 feet bgs. Groundwater was encountered in Boring RC-3 within the Scripps Formation and Ardath Shale at a depth of about 31 feet bgs.

3.1.3 San Clemente SR 52 Crossing

Boring locations are shown on Figure 7. Borings SC-1 and SC-2 were advanced to depths of 73 and 53 feet, respectively. Boring SC-1 was located within the Genesee Avenue median, near the approximate historical center of San Clemente Creek (Figure 4). Boring SC-2 was located in Genesse Avenue just outside the entrance to Marian Bear Memorial Park, along a previous tunnel alignment. Borings SC-3 and SC-4 were located at Marian Bear Memorial Park, at the proposed north shaft (on the north side of the creek).

Anticipated geologic conditions are shown on Figure 8. Previous grading appears to have involved filling the former natural drainage course of San Clemente Creek, and rerouting the drainage to its present location below the bridge for Genesee Avenue. Beneath the 10- to 20-foot thickness of road fill, Borings SC-1 and SC-2 both penetrated silty clayey sand alluvium up to about 10 feet thick. The topography of the canyon bottom (prior to road grading) appeared fairly flat, the lowest ground surface elevation was approximately 163 feet MSL. The alluvium within the former channel is inferred to be fairly thin and may not extend down to the tunnel depth. The tunnel profile below San Clemente Creek is anticipated within the Scripps Formation based on the borings. However, the formational tunnel cover in the Scripps Formation could be less than about 5 feet over a short portion of the tunnel within the fill-covered channel of San Clemente Creek.

The proposed tunnel is anticipated to be entirely in the Scripps Formation consisting of fine to coarse silty sandstone and sandy siltstone. Relatively thin layers of strong cemented sandstone were encountered in the borings. Nearby road cuts along Genesee Avenue (just south of Boring RC-1) expose discontinuous bedding layers up to 24-inches thick of the harder, strongly cemented siltstone/sandstone within the Scripps Formation. The formation appears to dip down to the north at a low angle. Considering the inclined bedding, strongly cemented siltstone /sandstone layers could be encountered at the depth of the tunnel.

Groundwater was measured in both borings (SC-1 and SC-2) within the alluvium during drilling. Groundwater measured at monitoring wells in Borings SC-3 and SC-4 indicates groundwater within the alluvium and within the Scripps Formation at tunnel depths.

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4.0 DESIGN AND CONSTRUCTION CONSIDERATIONS

4.1 GEOLOGIC HAZARDS

4.1.1 Fault Rupture

Active faults are not mapped or suspected at the proposed inland canyon tunnel locations (City of San Diego, 2008); fault rupture does not present a potential geologic hazard.

4.1.2 Liquefaction

Shafts within San Clemente and Rose Canyons would be in thin alluvium with minor groundwater. The potential for liquefaction induced settlement is low at the proposed inland canyon shaft locations.

4.1.3 Landslides

Landslides have not been mapped at the proposed tunneled canyon crossings. Review of historical air photos did not suggest landslide-related features in the immediate vicinity of the shafts/tunnels; although a small landslide was mapped in Rose Creek east of the alignment (Kennedy, 1975).

The borings did not penetrate shears, gouge or other discontinuity features that would suggest past landslide instability. The Ardath Shale is considered a landslide prone formation; however the shafts are not underlain by the Ardath Shale and are not within mapped landslides. The potential for instability resulting from landslides is low.

4.2 GROUND CONDITIONS

Anticipated tunneling conditions are summarized on Table 2 and discussed below. Tunnelman's Ground Classification for Soils (Heuer, 1974) is provided on Table 3.

The Scripps Formation is considered "soft" sedimentary rock; typically weak siltstone and sandstone with UCS less than about 1,500 psi. The formation also contains hard, strongly cemented layers and/or discontinuous concretions than can have UCS up to about 10,000 psi.

Results of UCS testing performed on the Scripps Formation core samples from the tunnel borings are provided in Appendix B. To date, a total of 30 UCS tests were performed on samples of the Scripps Formation and Ardath Shale. Based on this testing, the average peak compressive strength in the siltstone/sandstone was about 1,899 psi; maximum peak compressive strength was 13,078 psi within a cemented interval of the Scripps Formation. A summary of UCS tests is provided in Table B-1, Appendix B.

The Scripps Formation is not strongly jointed or fractured; rather the material would appear mostly massive at the tunnel face. Tunneling in the Scripps Formation would be considered "firm" ground. The Ardath Shale is also anticipated to be firm ground. Some "squeezing" ground could be encountered if the formations are highly weathered to clay.

The Scripps Formation and Ardath Shale are not anticipated to have appreciably different ground type behavior.

The hydraulic conductivity of the Scripps Formation is estimated to range between about 0.01 and 0.03 feet per day based on the slug tests performed in the Boring SC-3 monitoring well (screened in the Scripps Formation). The hydraulic conductivity of the Ardath Shale is estimated to range between about 0.001 and 0.004 feet per day based on the slug tests performed in the Boring RC-3 monitoring well (screened in the Ardath Shale).

Based on the hydraulic conductivity test data, tunnel groundwater inflows in the Scripps Formation are estimated to range up to between about 0.01 and 0.02 gpm/ft. A short portion of the tunnel at Rose Canyon will pass through the Ardath Shale which is mostly hard claystone. Tunnel groundwater inflows in the Ardath Shale are estimated to range up to about 0.002 gpm/ft.

Groundwater contained within the Scripps Formation and Ardath Shale is not anticipated to have a significant reduction in tunnel face stability.

4.3 TUNNEL EXCAVATION METHODS

The tunnel method will need to accommodate the 120-in diameter steel casing proposed for the tunnel sections. The two carrier pipes (48 in and 30 in diameter) will be placed in the casing and the annulus fully grouted. Since the annulus is to be fully grouted, alternative tunnel primary lining may be considered. In particular, open excavation and rib and lagging primary liner may be a method for some crossings where steel casing is not required within the Scripps Formation; the carrier pipes could be grouted into the rib and lagging tunnel.

4.3.1 Microtunneling – Closed Face

This is a pipe jacking method utilizing a pressurized closed face TBM which is an accurately guided, remote controlled microtunnel boring machine (MTBM) which supports the ground and ground water by exerting slurry and face pressure. Typically diameters of up to 144-in outside diameter are possible. Maximum drive lengths vary with pipe diameter from 400 ft at 24-in to 2500 ft at 60-in with the longest drive of over 8,000 ft for 144-in. Drive lengths of 3000 ft at 120in would be within the normal operating range for this system. Spoil removal using MTBM methods is generally performed with an automated system using circulatory slurry to remove the spoils. This provides for direct placement of the 120in steel casing and is likely to be the fastest advance rate for tunnels of the size and type considered for this Project.

Microtunneling is generally undertaken from shaft to shaft located at each end of the drive. The jacking shaft allows for a drive in two directions with smaller retrieval shafts at the end of the drives. Shafts are constructed to a depth just below the required pipe invert. Horizontal or vertical curves are also possible but only with thick walled RC or PC pipe segments

4.3.2 Pipe Jacking-Open Face

This method is similar to microtunneling in its requirements for shafts and jacking pipes but without being remote controlled and does not provide ground water control. It is suitable for use in dry conditions or with very limited water permeation. This method typically will have a steerable tunnel boring machine (TBM) shield with a mechanized powered rotating cutter and the spoil will be loaded at the face onto a conveyor which loads wheeled muck skips to transport the spoil to the Jacking shaft for removal to surface in a similar way as conventional tunneling. The advantage of this system is it has easy access to the ground face to remove any type of obstruction (cemented concretions, boulders etc.) that may be found in the face. It also allows for easy replacement of cutter tools during the drive. This system is suitable for tunneling in the Scripps Formation and Ardath Shale.

4.3.3 Conventional Tunneling – Open Face

In the Multi-Pass Shield Tunneling (TBM) methodology a larger diameter primary tunnel is constructed with a suitable temporary lining and the required casing and carrier pipes are installed inside. The cellular space between the primary tunnel support and the casing and between the casing and carrier pipe are fully filled with grout.

Where ground conditions are stable an open shield machine is an option. The tunnel face may be excavated by mechanical equipment such as an excavator, rotating cutter wheel, road-header or hand mining. The spoil is loaded by conveyor into wheeled muck cars to transport the spoil to the shaft and to supply the tunnel primary lining materials to the shield ready for erection. The shield is advanced by thrust jacks mounted in the tail shield pushing against the temporary tunnel support system. The shield may also be articulated to assist in steering and the open excavated face may have a face support system of breasting plates or sliding plates to mechanically support the face. The primary tunnel support in this case may be:

- Steel ribs with wood lagging and geotextile,
- Bolted steel liner plate rings and segmented ring beams (which can be installed quickly behind the machine),
- Steel ribs / Lattice Girder with wire mesh and shotcrete, or
- Bolts and shotcrete.

This system is suitable for tunneling in the Scripps Formation and Ardath Shale.

4.4 TUNNEL AND SHAFT CONSTRUCTION

4.4.1 I-805 Freeway Crossing

4.4.1.1 Tunnel

The entire tunnel drive is anticipated to be within the Scripps Formation. The Scripps Formation is generally firm ground which is unlikely to pose tunnel face instability which could result in ground losses into the tunnel. Based on available information, the likelihood to encounter fill and/or alluvium within the tunnel below I-805 appears to be low. The proposed boring is expected to help verify the profile would be in the Scripps Formation and would not encounter fill or alluvium.

An open face excavation method will be suitable; however minor groundwater inflow should be anticipated. However, groundwater inflows from the Scripps Formation are anticipated to be low, estimated to range up to between 10 and 20 gpm at the heading. Groundwater conditions will be further evaluated based on results of additional slug testing at EX-2.

The form of primary ground support will be determined by Caltrans. Other considerations include requirements for a steel casing, i.e., if the carrier pipes need to be within a steel casing. The proposed crossing is approximately 1,200 ft of which about 827 ft is under the freeway. The new tunnel has to also pass under the existing 19 ft diameter North City Utility Tunnel that runs to the west of the highway. There are several tunnel options depending on the requirement for a steel casing.

The whole length of the tunnel could be excavated with an open shield with excavation by a cutter wheel or back hoe or a road header. Primary support could be rib and lagging or in areas of stable ground possible ribs only with wire mesh and shotcrete. The excavation could be oversized and for the required section under the freeway the required 120 in casing placed in the tunnel followed by the carrier pipes within.

The steel casing could be installed over the entire length of the tunnel, then this could also be completed by a pipe jacking operation for the 1,200 ft drive of 120-in steel casing; which is quite long for open face pipe jacking. Depending on the sandstone strengths within the Scripps Formation, the excavation could be a wheel-type open cutter shield, or a fully open shield with backhoe or road header excavation. Permalok steel pipe connections should be used for all the jacked steel casings but welding could also be allowed, however this will slow production considerably. Correct application of bentonite lubricants on the outside of the pipe and the placement and use of interjacks will be important to ensure the casing does not lock up.

This drive could also be completed by a slurry microtunneling system with suitable cutter. The Scripps Formation is fairly impermeable so major loss of slurry into the ground is reduced and the production is likely to be double that of an open shield system due to its automation of slurry spoil removal. For longer drives microtunneling is more efficient and frequently cost effective.

4.4.1.2 Shafts

The proposed west shaft at Executive Drive will be entirely in Scripps Formation except for fill in the upper 10 feet. The proposed east shaft at the NCWRP is in similar subsurface geology based on Boring H-7 (AGE, 2017). With the current tunnel profile, shafts would be approximately 100 feet deep on the west side and 90 feet on the east side to pass under the existing North City Utility Tunnel.

The required primary support will be in relatively stable layers of siltstone and sandstone, the upper wall support in fill and weathered materials could be drilled soldier piles and lagging to approximate depths of about 30 to 40 feet bgs. Alternately upper support could be a circular shaft bolted steel segments and ring beams. It is also possible that an 80 degree cut face stabilized with rock bolts or nailing with wire mesh and with or without shotcrete could be suitable. Local contractors will be familiar with effective construction and support of shafts excavated in the Scripps Formation

The Contractor should be prepared for removal of strongly cemented materials in the Scripps formation.

The shaft excavations may have groundwater inflows. It is anticipated groundwater inflows could be sump pumped from the bottom of the excavation.

4.4.2 Rose Canyon NCTD Rail Crossing

4.4.2.1 Tunnel

The proposed North and South tunnels are anticipated to be mostly in the Scripps Formation consisting of fine to coarse silty sandstone and sandy siltstone, and partly in the Ardath Shale. For the South tunnel, the railway requires a steel casing under the tracks and may not allow even the temporary support provided by rib and lagging before the steel casing is installed and grouted; it is likely to be more economical to directly jack the 120-inch casing. This is a relatively short drive of 570 ft and tunneling in the stable Scripps Formation with low permeability allows for open shield pipe jacking. Depending on the strength of the sandstones and siltstones, excavation could be with a wheeled cutter shield which may be fitted with closure face plates or a fully open shield and back hoe and if required pneumatic hammers to break the cemented layers (concretions). A road header is also suitable for the Scripps Formation but may be costly to mobilize for such a short drive unless utilized on other tunnel drives on the project.

The open face method may have problems if there are significant groundwater flows and unstable face conditions. However, groundwater inflows from the Scripps Formation and Ardath Shale are anticipated to be low, estimated to range between 5 and 10 gpm at the heading. Groundwater contained within the Scripps Formation and Ardath Shale is not anticipated to have a significant reduction in tunnel face stability.

Formational tunnel cover in the Scripps Formation could be less than about 10 feet within about a 100-foot reach of the South profile to the south of NCTD. Tunnel cover material is entirely Ardath Shale and Scripps Formation below the NCTD right-of-way. The crown is estimated to be about 40 feet below ground surface at NCTD.

4.4.2.2 Shafts

The three proposed shafts (two receiving shafts in Genesee Avenue, one two-direction launch shaft just east of the Genesee Avenue bridge) are anticipated to have similar subsurface conditions. The upper portions of the shafts in surficial materials (fill, alluvium) and relatively weak sedimentary deposits (terrace deposits and weathered Scripps Formation) could be drilled soldier piles and lagging to approximate depths of about 30 to 40 feet bgs. The required primary support will depend on the stability and the layers of siltstone and sandstone. Possible wall support could be drilled soldier piles and lagging, or for a circular shaft bolted steel segments and ring beams. It is also possible that an 80 degree cut face stabilized with rock bolts or nailing with wire mesh and with or without shotcrete could be suitable.

Some shaft dewatering would likely be required in the setting of the filled canyon. The quantity and flow of the water at the tunnel invert and shaft base may require dewatering or grouting to reduce water flow to an acceptable level.

4.4.3 San Clemente Creek Crossing

4.4.3.1 Tunnel

The proposed tunnel is anticipated to be entirely in the Scripps Formation consisting of fine to coarse silty sandstone and sandy siltstone. However, below fill and alluvium, the formational tunnel cover in the Scripps Formation could be less than about 10 feet for a short reach of the profile, as currently planned. If necessary, the tunnel profile could be lowered to reduce the risk of a mixed face condition.

Groundwater was measured in the alluvium. Relatively minor groundwater inflows would be anticipated in the Scripps Formation along the tunnel. However, groundwater inflows from the Scripps Formation are anticipated to be low, on the order of 5 and 10 gpm at the heading. Groundwater contained within the Scripps Formation is not anticipated to have a significant reduction in tunnel face stability.

If water flows are low at tunnel level then open face pipe jacking of 120-inch steel casing pipe could be a method of choice utilizing a cutter wheel type shield, which allows access to remove obstructions from the face and can be fitted with face plates to provide closure of the face for ground support (but is not sealed from ground water inflows). If a steel casing is not required and ground conditions are suitable then a two pass system with an open tunnel shield and excavation with small diggers, with rib and lag primary support could also be applicable.

The Scripps Formation in nearby road cuts along Genesee Avenue contains discontinuous bedding layers up to 24-inches thick of the harder, strongly cemented siltstone/sandstone (further testing is planned). UCS tests performed in samples of strongly cemented sandstone from the borings ranged up to about 13,000 psi. The advantage of an open-face tunneling system is it has easy access to the ground face to remove any type of obstruction (cemented concretions, boulders, etc.) that may be found in the face; it also allows for easy replacement of cutter tools during the drive.

4.4.3.2 Shafts

The shafts have to pass through possible unstable fill and alluvium in the top 15 to 35 ft, but this ground is likely to have low water flows and stand for a period of time and not require a sealed shaft method. Possible shaft construction methods would be a drilled soldier pile and timber lagging support or a round shaft of bolted steel segment rings and ring beams. Sealed shaft methods of Secant piles or Cast in Situ RC Caisson sinking methods are also possible. Some shaft dewatering would likely be required in the setting of the filled canyon. The quantity and flow of the water at the tunnel invert and shaft base is likely to be seasonal and may require dewatering or grouting to reduce water flow to an acceptable level.

4.5 LATERAL EARTH PRESSURES FOR SHAFT DESIGN

We have evaluated lateral earth pressures for the tunnel shafts for the three tunnel crossings: I-805 Freeway Crossing, Rose Canyon NCTD Railroad Crossing, and San Clemente Creek Crossing. The following soil profiles have been developed for the seven tunnel access shafts proposed for the project as shown in the Tables 4 through 6 below.

We envision that the tunnel access shafts will be constructed using soldier beam and lagging shoring for the upper shaft construction in the fill and alluvium and soil/rock anchors and shotcrete in the formational soil. Lateral earth pressures have been developed for tieback anchor (Figure 9) and internally braced (Figure 10) shoring for the soldier beam and lagging methods. Earth pressures for cantilever shoring walls are provided in Figure 11.

Lateral earth pressures for shoring design are provided in Tables 7 through 10 below. Note that Table 10 presents at rest soil pressures for trench shoring for relatively shallow shaft excavations such as at the tunnels at Friars Road for the diversion tie-in pipelines.

For tieback design, an allowable anchor resistance of 2,000 psf can be assumed for pressure grouted anchors.

4.6 OTHER CONSIDERATIONS

4.6.1 Instrumentation and Monitoring

Settlement is the primary source of potential damage to street utilities and other structures during tunnel construction. Settlement can result from over excavation due to loss of ground at the tunnel heading, steering adjustments, and other effects. Empirical methods are available and could be provided to estimate magnitudes of surface settlement due to the soft ground tunneling.

Existing conditions should be documented prior to construction. This could consist of a reconnaissance and survey of pavement, sidewalk, structures and any other improvements within 100 feet of the centerline. The reconnaissance survey will serve as an aid in evaluating possible damage due to settlement resulting from the tunneling operations. The survey system of vertical control should be established prior to construction and elevation should be surveyed periodically during construction and according to Caltrans and NCTD railroad requirements.

4.6.2 Groundwater Handling and Muck Disposal

If contaminated soils or groundwater are encountered they should be handled in accordance with the project hazardous waste management plan.

Slurry from slurry tunneling or pipe jacking should be disposed in accordance with current regulations. Muck resulting from the shaft and tunnel excavations should be removed from the sites and property disposed at an acceptable facility. Much of the muck from the inland tunnels would be from Scripps Formation materials, which are anticipated to break down into mostly silty sand, sandy silt and clayey sand. These materials may be suitable for daily landfill cover at Miramar Landfill.

4.7 ADDITIONAL INVESTIGATIONS

Additional subsurface investigations will be performed, if needed for final design. Groundwater levels in existing monitoring wells will be re-measured.

5.0 GENERAL CONDITIONS AND LIMITATIONS

Geotechnical engineering and the geological sciences require interpretations based on limited subsurface data. Relatively small portion of the pertinent soil and groundwater conditions along the proposed tunnel alignments have been observed. The recommendations made herein are based on the assumption that soil and groundwater conditions will not deviate appreciably from those found during our field investigation. Professional judgment discussed herein is based on an understanding of the proposed construction and partly on general experience. Actual subsurface conditions encountered during construction will likely vary from those discussed in this report. If variations in subsurface conditions are encountered during construction AECOM should be consulted for further recommendations.

This report is intended for 60% design purposes. The information presented herein for this report will be updated based on additional explorations and for ongoing design. If reviewed by building contractors they should make their own interpretation of the data contained and referenced in this report.

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6.0 REFERENCES

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FIGURES

Legend

Qvop$_9$ Very old surficial deposits (Linda Vista Fm.)

Tst Stadium Conglomerate

Tsc Scripps Formation

⌖ Boring

◎ Boring (AGE 2017)

🟦 Shaft

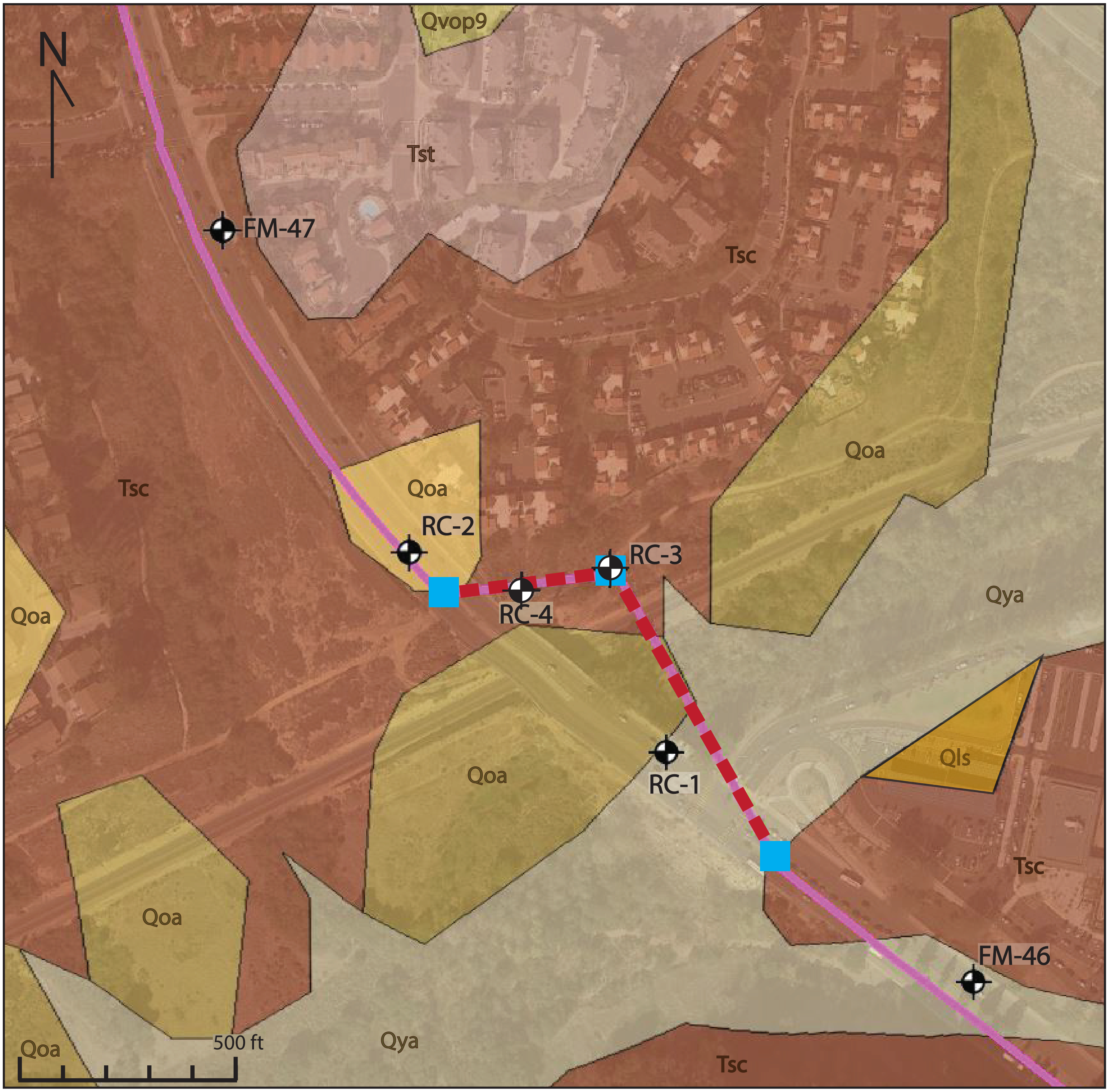
Force Main Alignment

Tunnel

TUNNEL CROSSINGS
PROPOSED I-805
ALIGNMENT PURE WATER
SAN DIEGO, CALIFORNIA

AECOM

CHECKED BY:	DATE: 08-16-17	FIG. NO. 9
PM:	NO: 60530732	



Legend

Qls	Landslide deposits
Qya	Young alluvial flood-plain deposits
Qoa	Old alluvial flood-plain deposits
Qvop$_9$	Very old surficial deposits (Linda Vista Fm.)
Tst	Stadium Conglomerate
Tsc	Scripps Formation

⊕ Boring

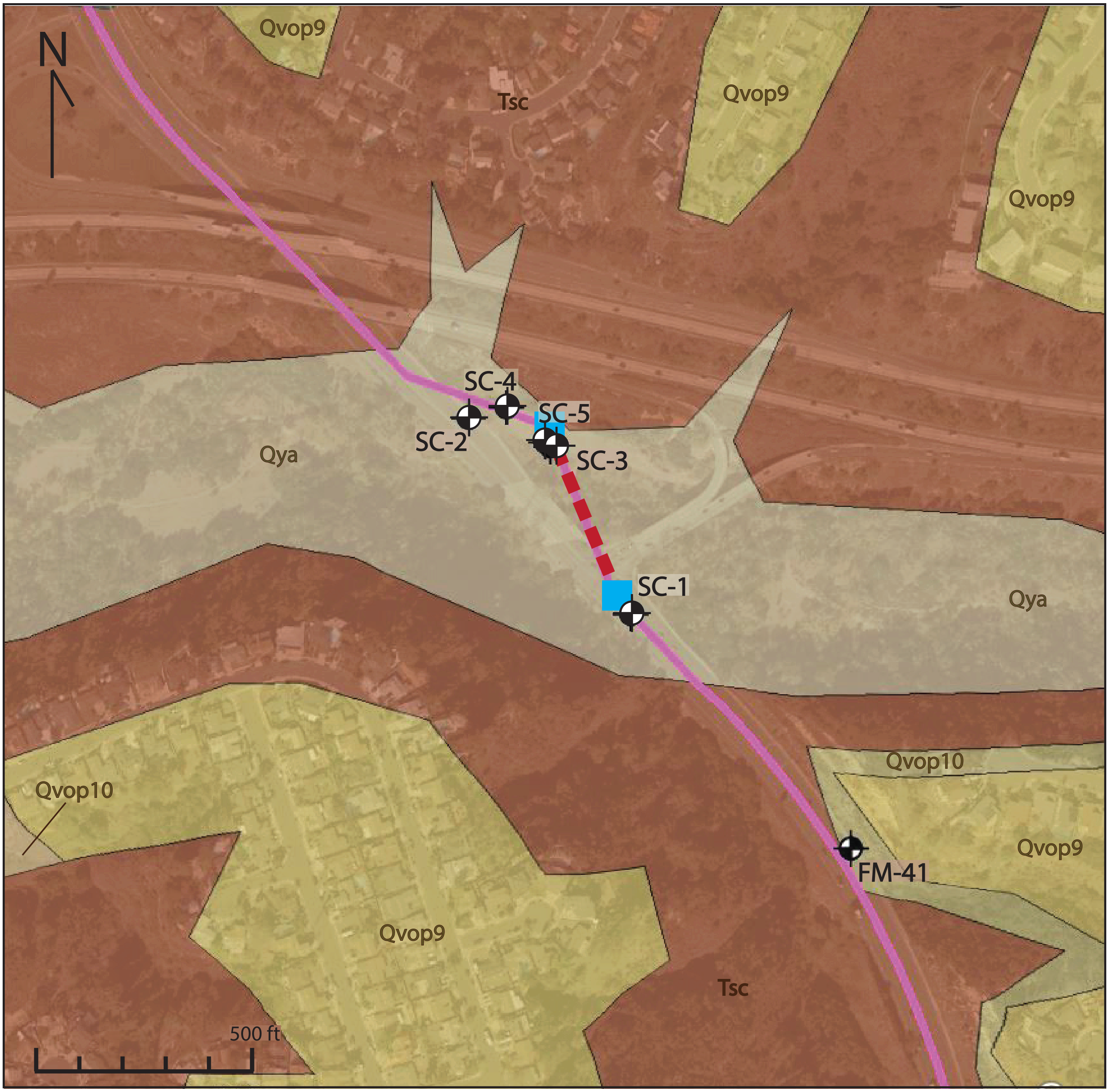
■ Shaft

Force Main Alignment

Tunnel

TUNNEL CROSSINGS
PROPOSED ROSE CANYON ALIGNMENT
PURE WATER
SAN DIEGO, CALIFORNIA

AECOM	CHECKED BY:	DATE: 08-16-17	FIG. NO. 10
	PM:	NO: 60530732	



Legend

Qya Young alluvial flood-plain deposits

$Qvop_{10}$ Very old surficial deposits (Linda Vista Fm.)

$Qvop_9$ Very old surficial deposits (Linda Vista Fm.)

Tsc Scripps Formation

⌖ Boring

■ Shaft

Force Main Alignment

Tunnel

TUNNEL CROSSINGS PROPOSED SAN CLEMENTE CANYON ALIGNMENT PURE WATER SAN DIEGO, CALIFORNIA			
AECOM	CHECKED BY:	DATE: 08-16-17	FIG. NO. 11
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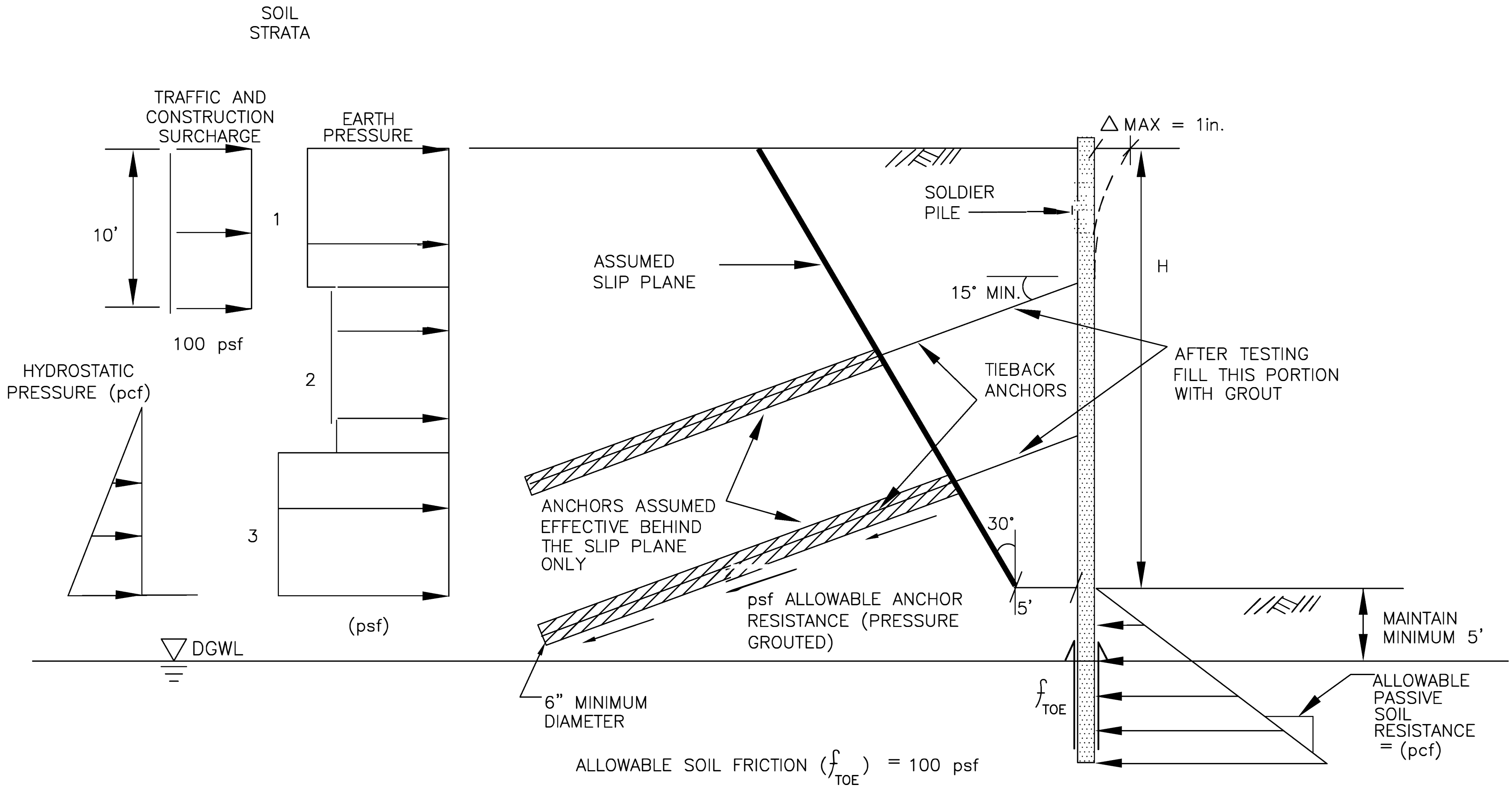

TOTAL ALLOWABLE PASSIVE RESISTANCE
PER SOLDIER PILE =
UNIT ALLOWABLE PASSIVE RESISTANCE

TWICE THE CONCRETED
SOLDIER PILE WIDTH

NOTES:

A. ASSUMES LEVEL BACKFILL

B. FOR PRELIMINARY DESIGN.

C. GWL – DESIGN GROUNDWATER LEVEL DURING CONSTRUCTION PER GEOTECHNICAL REPORT (5' BELOW BOTTOM OF EXCAVATION).

LATERAL EARTH PRESSURES AND RESISTANCES FOR TIEBACK ANCHORS
MORENA PIPELINE PROJECT
SAN DIEGO, CALIFORNIA

AECOM

NOT TO SCALE

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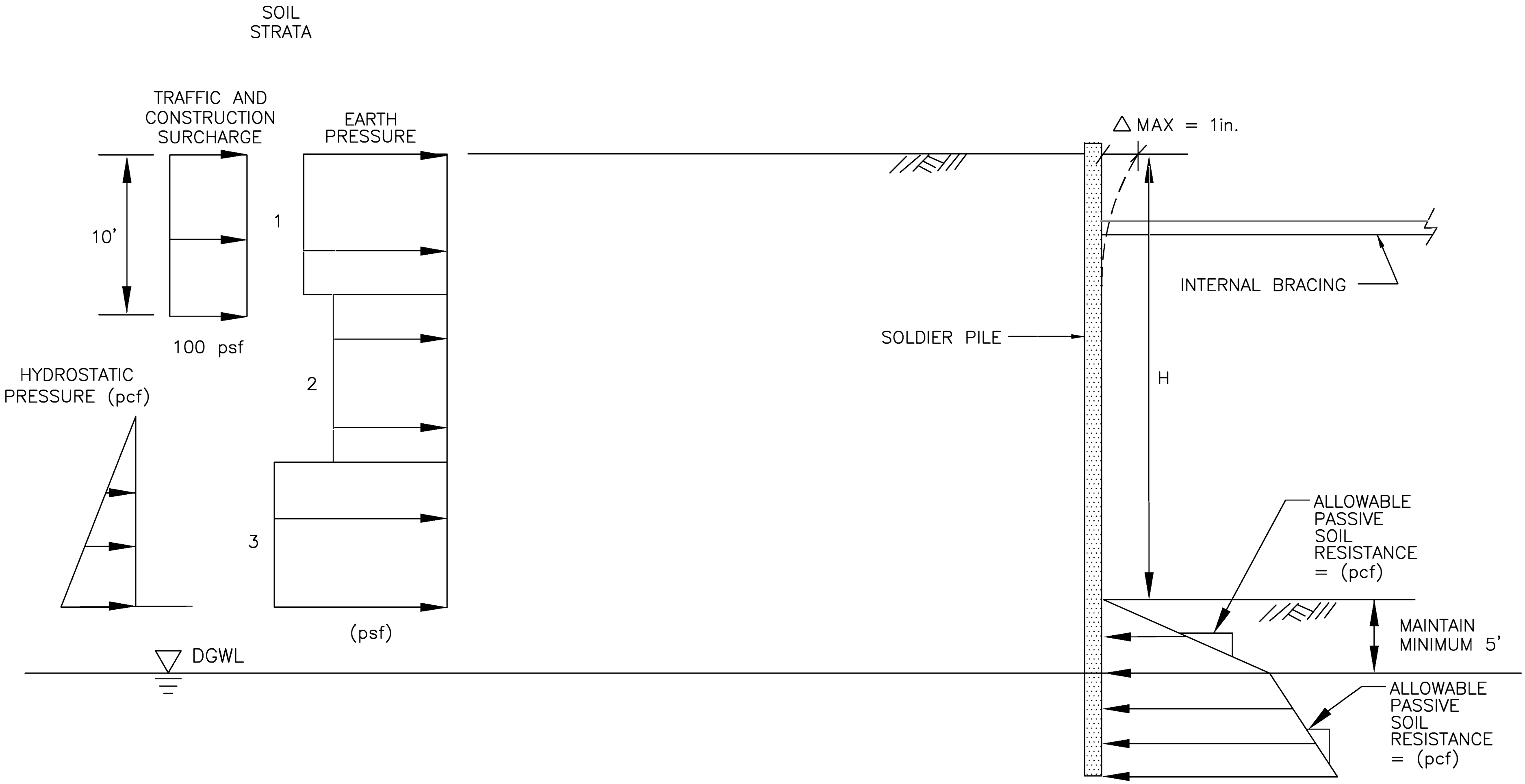
FIG. NO: 12



TOTAL ALLOWABLE PASSIVE RESISTANCE
PER SOLDIER PILE =
UNIT ALLOWABLE PASSIVE RESISTANCE

TWICE THE CONCRETED
SOLDIER PILE WIDTH

NOTES:

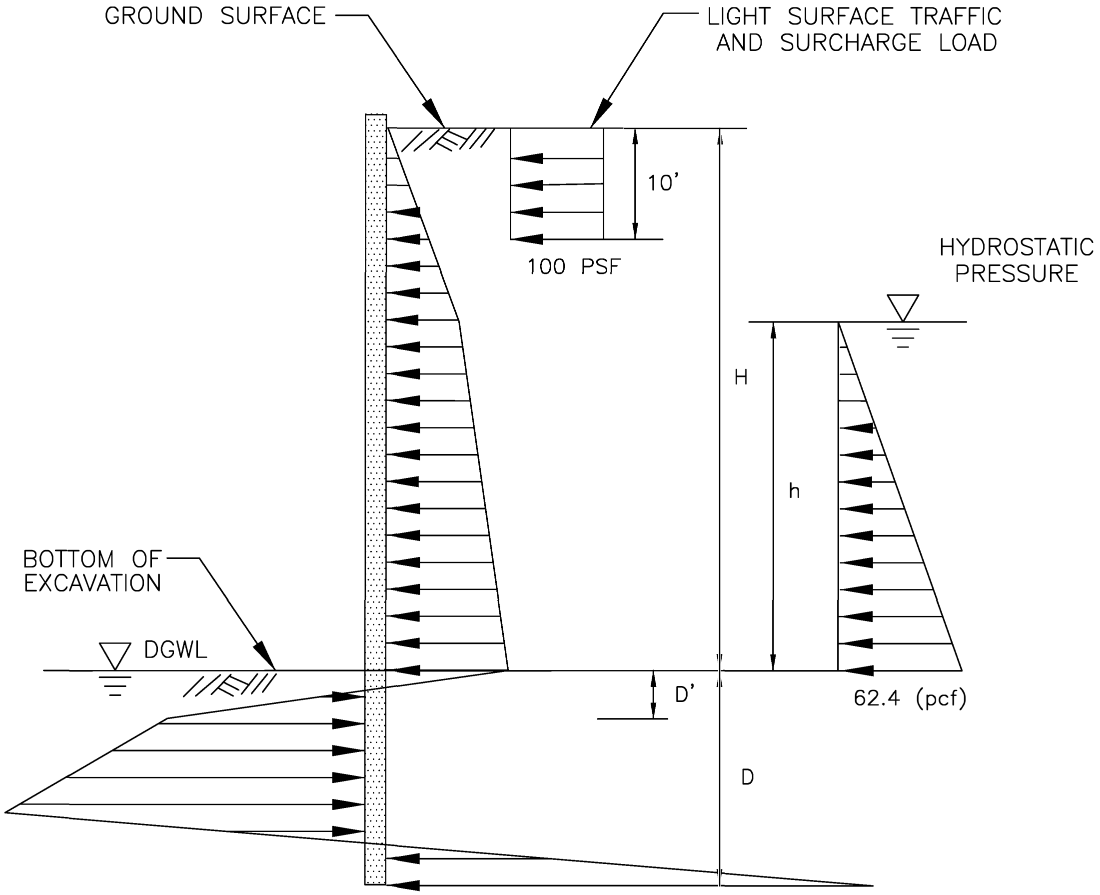
A. ASSUMES LEVEL BACKFILL

B. FOR PRELIMINARY DESIGN.

C. GWL – DESIGN GROUNDWATER LEVEL DURING CONSTRUCTION PER GEOTECHNICAL REPORT (5' BELOW BOTTOM OF EXCAVATION).

LATERAL EARTH PRESSURES AND RESISTANCES FOR TEMPORARY INTERNALLY BRACED SOLDIER PILE & LAGGING WALLS
MORENA PIPELINE PROJECT
SAN DIEGO, CALIFORNIA

AECOM	NOT TO SCALE	CHECKED BY:	DATE: 8-22-2017	FIG. NO:
		PM: SF	PROJ. NO: 60530732	13



NOTES:

1. FOR GIVEN H AND D', SOLVE SUCH THAT MOMENT EQUILIBRIUM IS SATISFIED. INCREASE CALCULATED D BY 30 PERCENT.
2. HEAVY EQUIPMENT, AND SOIL SURCHARGE LOADS SHOULD BE EVALUATED INDIVIDUALLY.
3. NEGLECT UPPER TWO FEET OF DESIGN PASSIVE RESISTANCE.
4. SEE REPORT FOR DISCUSSION.

CANTILEVERED EXCAVATION DESIGN
CRITERIA MORENA PIPELINE PROJECT
SAN DIEGO, CALIFORNIA

AECOM

NOT TO SCALE

CHECKED BY:

DATE: 8-22-2017

FIG. NO:
14

PM: SF

PROJ. NO: 60530732

TABLES

Table 1
Summary of Proposed Tunnels
(from North to South)

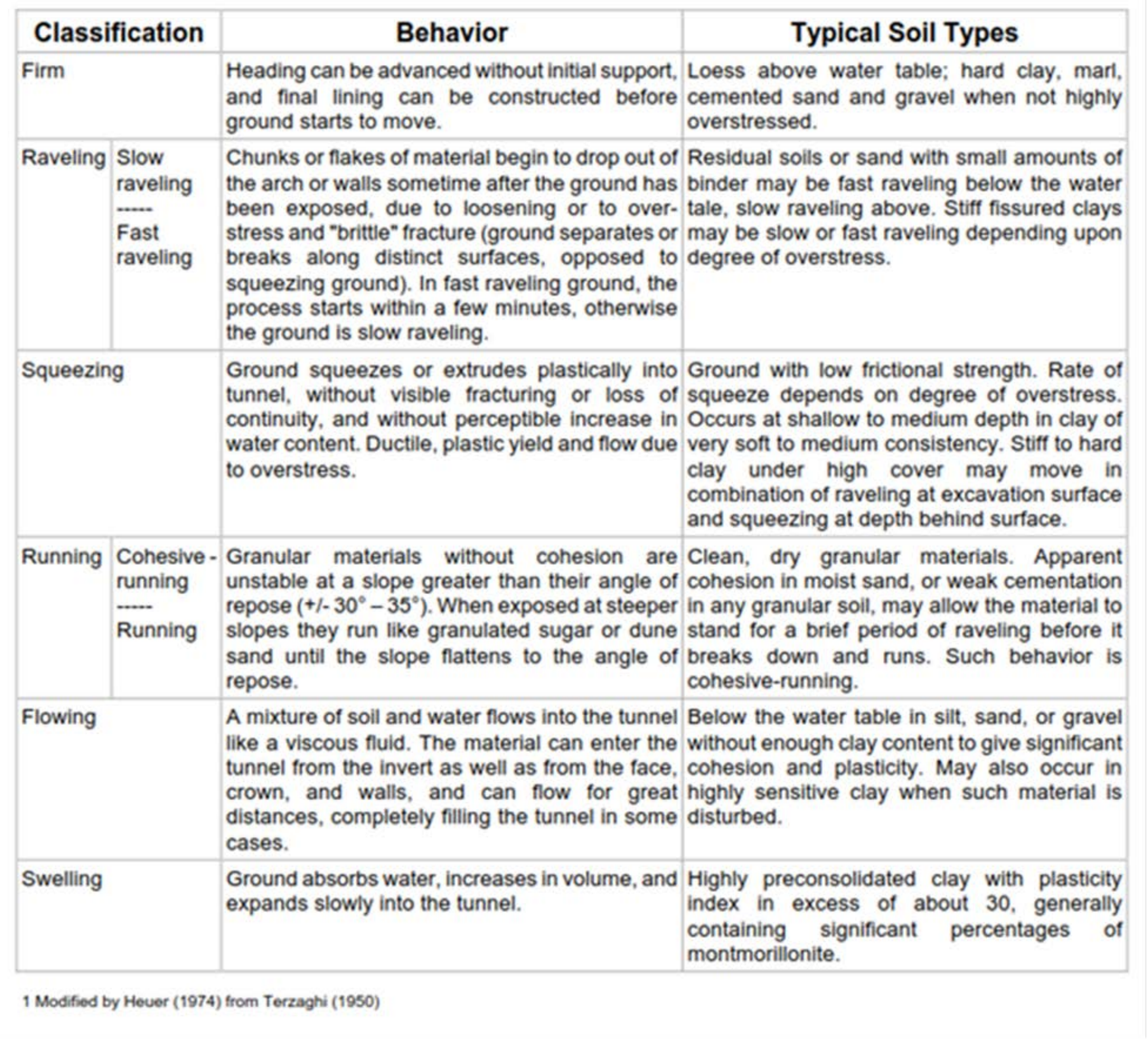
Tunnel Location	Start Station*	Invert Elevation (feet, MSL)	Approx. Existing Ground Surface elevation (feet, MSL)	End Station	Invert Elevation (feet, MSL)	Approx. Existing Ground Surface elevation (feet, MSL)	Approx. Tunnel Length (feet)	Crossing Location
I-805 Freeway Crossing	N/A	255	358	N/A	260.3	355	1,200	Below Executive Drive and Interstate 805
Rose Canyon NCTD Rail Crossing North Tunnel	N/A	214	257	N/A	199.4	232	300	From Genesee Avenue to R/R Track pit
Rose Canyon NCTD Rail Crossing South Tunnel	N/A	163	232	N/A	162.5	218	570	From R/R Track pit to Genesee Ave.
San Clemente Creek Crossing	N/A	136.5	180	N/A	138.5	194	400	From Marian Bear Park Lot below San Clemente Creek to Genesee Ave.

*Tunnel stations will be revised for the final report

Table 2
Summary of Anticipated Tunneling Conditions

Tunneled Pipeline Reach	Completed Borings	Primary Geologic Units	Anticipated Ground Type	Groundwater Inflow
I 805 Freeway Crossing	EX-1, EX-2 H-7 (AGE, 2017)	Scripps Formation	Firm	Low inflows
Rose Canyon NCTD Rail Crossing	RC-1, RC-2 and RC-3	Scripps Formation, Ardath Shale	Firm	Low inflows
San Clemente Creek Crossing	SC-1, SC-2, SC-3 and SC-5	Scripps Formation	Firm	Low inflows

Table 3
Tunnelman's Ground Classification for Soils[1]



Classification		Behavior	Typical Soil Types
Firm		Heading can be advanced without initial support, and final lining can be constructed before ground starts to move.	Loess above water table; hard clay, marl, cemented sand and gravel when not highly overstressed.
Raveling	Slow raveling ----- Fast raveling	Chunks or flakes of material begin to drop out of the arch or walls sometime after the ground has been exposed, due to loosening or to over-stress and "brittle" fracture (ground separates or breaks along distinct surfaces, opposed to squeezing ground). In fast raveling ground, the process starts within a few minutes, otherwise the ground is slow raveling.	Residual soils or sand with small amounts of binder may be fast raveling below the water tale, slow raveling above. Stiff fissured clays may be slow or fast raveling depending upon degree of overstress.
Squeezing		Ground squeezes or extrudes plastically into tunnel, without visible fracturing or loss of continuity, and without perceptible increase in water content. Ductile, plastic yield and flow due to overstress.	Ground with low frictional strength. Rate of squeeze depends on degree of overstress. Occurs at shallow to medium depth in clay of very soft to medium consistency. Stiff to hard clay under high cover may move in combination of raveling at excavation surface and squeezing at depth behind surface.
Running	Cohesive - running ----- Running	Granular materials without cohesion are unstable at a slope greater than their angle of repose (+/- 30° – 35°). When exposed at steeper slopes they run like granulated sugar or dune sand until the slope flattens to the angle of repose.	Clean, dry granular materials. Apparent cohesion in moist sand, or weak cementation in any granular soil, may allow the material to stand for a brief period of raveling before it breaks down and runs. Such behavior is cohesive-running.
Flowing		A mixture of soil and water flows into the tunnel like a viscous fluid. The material can enter the tunnel from the invert as well as from the face, crown, and walls, and can flow for great distances, completely filling the tunnel in some cases.	Below the water table in silt, sand, or gravel without enough clay content to give significant cohesion and plasticity. May also occur in highly sensitive clay when such material is disturbed.
Swelling		Ground absorbs water, increases in volume, and expands slowly into the tunnel.	Highly preconsolidated clay with plasticity index in excess of about 30, generally containing significant percentages of montmorillonite.

1 Modified by Heuer (1974) from Terzaghi (1950)

Table 4
Soil Profile – I-805 Freeway Crossing

		Western Shaft	Eastern Shaft
Soil Strata	Soil Strata	Depth (feet)	Depth (feet)
1	Fill	0 to 10	0 to 7
2	Very Old Paralic Deposits	--	7 to 12
3	Scripps Formation	10+	12+
	Groundwater	N/A	N/A

Table 5
Soil Profile – Rose Canyon NCTD Railroad Crossing

		Southern Shaft	Northeastern Shaft	Northwestern Shaft
Soil Strata	Soil Strata	Depth (feet)	Depth (feet)	Depth (feet)
1	Fill	0 to 29	0 to 2	0 to 2
2	Scripps Formation	29+	2+	2+
	Groundwater	36	28	28

Table 6
Soil Profile – San Clemente Creek Crossing

		Southern Shaft	Northern Shaft
Soil Strata	Soil Strata	Depth (feet)	Depth (feet)
1	Fill	0 to 31	0 to 3
2	Alluvium	31 to 38	3 to 15
3	Scripps Formation	38+	15+
	Groundwater	25	12

Table 7
Recommended Lateral Earth Pressures – Tieback Walls

	Design Lateral Pressure (psf)		Design Passive Pressure (psf)[2]	
Soil Strata	Above Water Table	Below Water Table[1]	Above Water Table	Below Water Table
Fill	30	15	240	115
Alluvium	30	15	240	115
Very Old Paralic Deposits	31	16	260	130
Scripps Formation	31	16	260	130

Notes:

1. Add hydrostatic fluid pressure of 62.4 pcf.
2. Disregard resistance generated by top 2 feet of soil for passive resistance.

Table 8
Recommended Lateral Earth Pressures – Internally Braced Walls

Soil Strata	Design Lateral Pressure (psf) Above Water Table	Design Lateral Pressure (psf) Below Water Table[1]	Design Passive Pressure (psf)[2] Above Water Table	Design Passive Pressure (psf)[2] Below Water Table
Fill	26	12	240	115
Alluvium	26	12	240	115
Very Old Paralic Deposits	26	13	260	130
Scripps Formation	26	13	260	130

Notes:

1. Add hydrostatic fluid pressure of 62.4 pcf.
2. Disregard resistance generated by top 2 feet of soil for passive resistance.

Table 9
Recommended Lateral Earth Pressures – Cantilever Walls

Soil Strata	Design Lateral Pressure (pcf) Above Water Table	Design Lateral Pressure (pcf) Below Water Table[1]	Design Passive Pressure (psf)[2] Above Water Table	Design Passive Pressure (psf)[2] Below Water Table
Fill	39	19	240	115
Alluvium	39	19	240	115
Very Old Paralic Deposits	39	20	260	130
Scripps Formation	39	20	260	130

Notes:

1. Add hydrostatic fluid pressure of 62.4 pcf.
2. Disregard resistance generated by top 2 feet of soil for passive resistance.

Table 10
Recommended Lateral Earth Pressures – At-Rest Pressures

Soil Strata	Design Lateral Pressure (pcf) Above Water Table	Design Lateral Pressure (pcf) Below Water Table[1]	Design Passive Pressure (psf)[2] Above Water Table	Design Passive Pressure (psf)[2] Below Water Table
Fill	60	29	240	115
Alluvium	60	29	240	115
Very Old Paralic Deposits	60	30	260	130
Scripps Formation	60	30	260	130

Notes:

1. Add hydrostatic fluid pressure of 62.4 pcf.
2. Disregard resistance generated by top 2 feet of soil for passive resistance.

APPENDIX A

FIELD EXPLORATIONS

APPENDIX A

Field Explorations

Test Borings

Field activities were performed between February and April, and between June and September 2017 under the supervision of engineering geologists from our firm. Locations of the field explorations are presented in Figures 2 through 5.

Procedures performed prior to any field activities included:

- Notifying Underground Service Alert (USA) 48 hrs prior to drilling to mark out for subsurface utilities.
- Obtaining required County of San Diego Department of Environmental Health boring permits.
- Obtaining any necessary City of San Diego Right-of-Way permits.
- Generating plans and acquiring approved permits for traffic control. Time and duration of field explorations varied based on traffic control permit constraints (typically 8:30 to 3:30 week days).
- Obtaining a Caltrans encroachment permit for advancing Boring EX-2 at the I-805 tunnel crossing. The permit conditions required field work take place between 9:00pm and 5:00am.

Drilling was performed by Cascade Drilling using a combination of hollow stem auger and coring methods. A truck-mounted CME-85 drill rig with an 8-inch hollow stem auger and an HQ3 coring bit was used to advance the borings. Each boring was initially augered from the surface down to depths ranging from 30 feet to 65 feet. The remaining depth of the hole was drilled with continuous coring methods. The table below outlines the details of the borings.

Relatively undisturbed samples of the subsurface materials were obtained within the exploratory borings using both a modified California sampler (2.5-inch outside diameter and 2-inch inside diameter) with thin stainless steel liners and a Standard Penetration Test (SPT) sampler (2.0-inch outside diameter and 1.5-inch inside diameter). Samples were typically obtained in the augered and mud-rotary drilled sections at 5-foot depth intervals except where prevented by heavy gravels and cobbles. The sampler was generally driven 18-inches into the material at the bottom of the boring by a 140-pound hammer falling 30-inches, and the blows required to advance the sampler was recorded in 6-inch increments for density correlations. The soil samples obtained were removed from the sampler, classified in the field, sealed to preserve the natural moisture content of the sample, and returned to the laboratory for further examination and testing.

In the sections drilled using coring methods, core samples were recovered in runs typically five feet in length. The retrieved core samples were logged and photographed in the field by an engineering geologist. The core samples were boxed in plastic core boxes and placed in storage. Representative core samples were collected from the interval ranging from approximately ten feet above to feet below the proposed tunnel interval for laboratory testing. Core box photos are provided below.

The borings were backfilled according to San Diego County SAM Manual guidelines. The borings were finished with concrete or asphalt to approximately match the original surface. Soil cutting collected from the borings were collected in 55 gallon steel drums and labelled with non-hazardous labels. The drums were transported to a local City designated temporary storage location.

Monitoring wells were installed in Borings SC-3, SC-4 and RC-3. Well construction consisted of 2-inch diameter PVC slotted screen and blank pipe, with a flush mount well cover at the ground surface. Well screens were installed at the approximate depth of the tunnel. Stabilized groundwater levels were recorded in the wells.

A key of boring logs and the boring are presented in this Appendix.

Table A-1
Summary of Tunnel Borings

Boring	Date Drilled	Approximate Surface Elevation (feet, MSL)	Total Depth (feet, bgs)	Drilling Method	Augered Depth (feet, bgs)	Cored depth (feet, bgs)	Approximate Depth to Groundwater (feet, bgs)
EX-1	3/30/17	366	103.0	Auger/Coring	0.0 - 45.0	45.0-103.0	NM
EX-2	9/5/17	320	61.0	Auger/Coring	0.0 – 51.0	51.0 – 61.0	27.8
RC-1	3/28/17	233	73.0	Auger/Coring	0.0 - 55.0	55.0 - 73.0	45.2
RC-2	4/5/17	263	103.0	Auger/Coring	0.0 - 65.0	65.0 - 103.0	55.1
RC-3	7/5/17	237	90.5	Auger/Coring	0.0 – 35.0	35.0-90.5	31
SC-1	2/28/17	198	73.0	Auger/Coring	0.0 - 45.0	45.0 - 73.0	26.7
SC-2	3/2/17	185	58.0	Auger/Coring	0.0 - 30.0	30.0 - 58.0	14.5
SC-3	6/26/17	181	53.0	Auger/Coring	0.0 – 21.5	21.5 – 53.0	11.7
SC-5	6/28/17	181	17.5	Auger	17.5	Not cored	11.7

Notes: NM Not Measured

Slug Tests

Monitoring wells were installed in Borings SC-3, SC- and RC-3. Well construction consisted of 2-inch diameter PVC slotted screen and blank pipe, with a flush mount well cover at the ground surface. A temporary monitoring well was installed at Boring EX-2. The well was abandoned after measuring the stabilized groundwater level and following permeability testing.

In-situ permeability tests (slug tests) were performed in the 2-inch monitoring wells which were screened at intervals approximately corresponding with the proposed tunnel depth. Data from the slug tests was analyzed using the Bouwer-Rice (1976) method, summarized in the table below.

Permeability test results from Boring EX-2 will be provided in the final tunnel report.

Table A-2
Summary of Permeability Tests

Location	Well	Date	Analysis Method[1]	Test	Top of Casing ft. MSL	Screen Top ft BTOC	Screen Base ft BTOC	Screen Length ft.	Bore Diam. ft	Casing Diam. ft	Stabilized Depth to Water ft	Adopted Saturated Thickness ft	Pre-Test Pressure ft	Start Test Pressure ft	Initial Displace ft.	Storage -	Hydraulic Cond. ft/sec	Hydraulic Cond. ft/day
San Clemente	**SC-3**	7/17/2017	B&R	Slug In	181	24	34	10	**0.5**	**0.17**	11.7	39	16.88	13.37	3.51	-	3.87E-07	0.03
			B&R	Slug Out								39	14.77	11.23	3.53	-	1.99E-07	0.02
			KGS	Slug In								39	16.88	13.37	3.51	1.E-05	3.91E-07	0.03
			KGS	Slug Out								39	14.77	11.23	3.53	1.E-03	1.12E-07	0.01
Rose Canyon	**RC-3**	7/18/2017	B&R	Slug Out	237	66	86	20	**0.67**	**0.17**	31.5	100	20.79	17.05	3.74	-	4.48E-08	0.004
			KGS	Slug Out								100				5.E-05	1.56E-08	0.001

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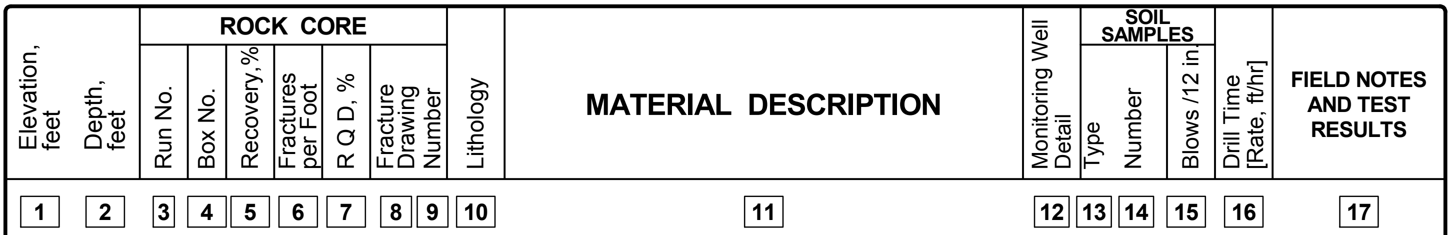
Key to Log

Sheet 1 of 2



COLUMN DESCRIPTIONS

1 **Elevation:** Elevation (in feet) referenced to mean sea level (MSL).

2 **Depth:** Distance (in feet) below the collar of the borehole.

3 **Run No.:** Number of the individual coring interval.

4 **Box No.:** Number of the core box which contains core from the corresponding run.

5 **Recovery:** Amount (in percent) of core recovered from the coring interval; calculated as length of core recovered divided by length of run.

6 **Fractures per Foot:** (Fracture Frequency) The number of naturally occurring fractures in each foot of core; does not include mechanical breaks (induced by drilling) or healed fractures. "NA" indicates not applicable due to lack of core recovery.

7 **R Q D:** (Rock Quality Designation) Amount (in percent) of intact core (pieces of sound core greater than 4 inches in length) in each coring interval; calculated as the sum of lengths of intact core divided by length of core run. RQD of moderately weathered/altered rock does not meet soundness requirements, but provides some indication of rock quality with respect to the degree of fracturing.

8 **Fracture Drawing:** Sketch of the naturally occurring fractures and mechanical breaks, showing the angle of the fractures relative to the cross-sectional axis of the core. "NR" indicates no recovery.

9 **Fracture Number:** Location of each naturally occurring fracture (numbered) and mechanical break (labeled "M"). Naturally occurring fractures are described in Column 11 (keyed by number) using descriptive terms defined on Sheet 2 (Items a through g).

10 **Lithology:** A graphic log of material encountered using symbols to represent differing soil and types; graphic symbols are explained below.

11 **Description:** Lithologic description in this order: rock type, color (Munsel), texture, grain size, weathering, strength, and other features; descriptive terms are defined on Sheet 2. Also, abbreviated description of fractures numbered in Column 9 using terms defined on Sheet 2.

12 **Monitoring Well Detail:** Schematic of piezometer, inclinometer or well installation; graphic symbols are explained below.

13 **Sample Type:** Type of soil sample collected at depth interval shown; sampler symbols are explained below.

14 **Sample Number:** Sample identification number.

15 **Blows /12 in.:** Number of blows required to advance sampler 12 inches beyond first 6 inch interval or distance noted, using a 140-lb hammer with a 30-inch drop (unless otherwise noted).

16 **Drill Time [Rate]:** Time (in 24-hour clock) marking start and finish of each run; drill rate (in feet per hour) is reported in brackets.

17 **Field Notes and Test Results:** Comments and observations regarding drilling or sampling made by driller or field personnel. Field and lab tests are indicated using abbreviations explained below.

TYPICAL MATERIAL GRAPHIC SYMBOLS

▨ SANDSTONE	▨ SILTSTONE	▨ CLAYSTONE	▨ Sandy SILTSTONE
▨ Silty SANDSTONE	▨ Poorly-graded SAND (SP)	▨ SILT (ML)	▨ CLAY (CL)

TYPICAL SAMPLER GRAPHIC SYMBOLS

- ◩ 2.5" I.D. sampler
- ▯ Standard Penetration samper
- ■ Core Sample

TYPICAL WELL GRAPHIC SYMBOLS

- ▨ Blank well pipe with concrete
- ▨ Blank well pipe with hydrated bentonite chips
- ▨ Blank well pipe with filter sand
- ▨ .020-inch well screen with filter sand
- ▨ Filter sand

OTHER GRAPHIC SYMBOLS

- ▽ First water encountered at time of drilling and sampling (ATD)
- ▼ Water level measured at specified time after completion of drilling and sampling
- ↓ Minor change in material properties within a stratum
- — — Inferred or gradational contact between strata

FIELD AND LABORATORY TEST ABBREVIATIONS

WC	Water content of soil sample measured in laboratory, expressed as percentage of dry weight of specimen.
DD	Dry density of soil sample measured in laboratory, in pounds per cubic foot.
UC	Peak compressive stress of soil sample measured in laboratory, in pounds
SA	Sieve analysis, %<#200 sieve
LL	Liquid limit (from Atterberg limits test), %
PI	Plasticity Index [LL - PL], %; NP=nonplastic
PLT	Point load test, psi

Soil classifications are based on the Unified Soil Classification System. Descriptions and stratum lines are interpretive; field descriptions may have been modified to reflect lab test results. Descriptions on these logs apply only at the specific boring locations and at the time the borings were advanced; they are not warranted to be representative of subsurface conditions at other locations or times.

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Key to Log

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KEY TO DESCRIPTIVE TERMS USED ON CORE LOGS

DISCONTINUITY DESCRIPTORS

a Dip of discontinuity, measured relative to a plane normal to the core axis.

b **Discontinuity Type:**

F - Fault
J - Joint
Sh - Shear
Fo - Foliation
V - Vein
B - Bedding

c **Aperture (inches):**

W - Wide (0.5-2.0)
MW - Moderately Wide (0.1-0.5)
N - Narrow (0.05-0.1)
VN - Very Narrow (<0.05)
T - Tight (0)

d **Type of Infilling:**

Cl - Clay
Ca - Calcite
Ch - Chlorite
Fe - Iron Oxide
Gy - Gypsum
H - Healed
Mn - Manganese Oxide
No - None
Py - Pyrite
Qz - Quartz
Sd - Sand

e **Amount of Infilling:**

Su - Surface Stain
Sp - Spotty
Pa - Partially Filled
Fi - Filled
No - None

f **Surface Shape of Joint:**

Pl - Planar
Wa - Wavy
St - Stepped
Ir - Irregular

g **Roughness of Surface:**

Slk - Slickensided [surface has smooth, glassy finish with visual evidence of striations]
S - Smooth [surface appears smooth and feels so to the touch]
SR - Slightly Rough [asperities on the discontinuity surfaces are distinguishable and can be felt]
R - Rough [some ridges and side-angle steps are evident; asperities are clearly visible, and discontinuity surface feels very abrasive]
VR - Very Rough [near-vertical steps and ridges occur on the discontinuity surface]

ROCK WEATHERING / ALTERATION

Description	Recognition
Residual Soil	Original minerals of rock have been entirely decomposed to secondary minerals, and original rock fabric is not apparent; material can be easily broken by hand
Completely Weathered/Altered	Original minerals of rock have been almost entirely decomposed to secondary minerals, although original fabric may be intact; material can be granulated by hand
Highly Weathered/Altered	More than half of the rock is decomposed; rock is weakened so that a minimum 2-inch-diameter sample can be broken readily by hand across rock fabric
Moderately Weathered/Altered	Rock is discolored and noticeably weakened, but less than half is decomposed; a minimum 2-inch-diameter sample cannot be broken readily by hand across rock fabric
Slightly Weathered/Altered	Rock is slightly discolored, but not noticeably lower in strength than fresh rock
Fresh/Unweathered	Rock shows no discoloration, loss of strength, or other effect of weathering/alteration

ROCK STRENGTH

Description	Recognition
Extremely Weak Rock	Can be indented by thumbnail
Very Weak Rock	Can be peeled by pocket knife
Weak Rock	Can be peeled with difficulty by pocket knife
Medium Strong Rock	Can be indented 5 mm with sharp end of pick
Strong Rock	Requires one hammer blow to fracture
Very Strong Rock	Requires many hammer blows to fracture
Extremely Strong Rock	Can only be chipped with hammer blows

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Log of Boring EX-1

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Date(s) Drilled	**03/30/2017 -03/31/17**	Logged By	**D. Rector / A . Avakian**	Checked By (Date)	**D. Schug**
Drilling Method	**HSA / HQ3 coring**	Drill Bit Size/Type	**8-inch / HQ-3**	Total Depth of Borehole	**103.0 feet**
Drill Rig Type	**CME 85**	Drilling Contractor	**Cascade Drilling**	Approximate Surface Elevation	**366 feet**
Groundwater Level	**not measured**	Location	**N 32.87682, W 117.20245**	Inclination from Horizontal/Bearing	**90**
Borehole Completion	**Cementl/Bentonite Grout**			Hammer Data	**140 lbs / 30-inch**

Elevation, feet	Depth, feet	ROCK CORE						Lithology	MATERIAL DESCRIPTION	Monitoring Well Detail	SOIL SAMPLES			Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
		Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number				Type	Number	Blows per foot		
366	0								5" AC over 10" AB over... **Fill** Moist, yellowish brown, CLAY (CL), little fine sand, Scripps Formation (Tsc) derived fill						
	1														
364	2														
	3														
362	4														
	5														
360	6											1	5		
	7														
358	8														
	9														
356	10								**Scripps Formation (Tsc)** Hard, moist, light olive brown (2.5YR, 5/4), sandy SILTSTONE (ML), very fine grained, moderately weathered, extremely to very weak rock, moderately soft, iron oxide staining to 13.5 feet below ground surface, mostly on bedding planes, some faint bedding laminations, hard soil						
	11											2	53		
354	12								11.5' to 13.5' - Concretion (slow drilling, cemented fragments in cuttings)			3	50 3"		
	13														

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Elevation, feet	Depth, feet	MATERIAL DESCRIPTION	Soil Samples Number	Blows per foot	FIELD NOTES AND TEST RESULTS
	13				
352	14				
	15	Some very thin to laminated fine sand interbeds, becomes dense soil			
350	16		4	38	
	17	Very dense with few interbeds of medium grained silty sand, locally oxidized (brownish yellow (10YR, 6/8))			Slower drilling
348	18				
	19				
346	20		5	50 5"	
	21				
344	22				
	23				
342	24				
	25				
340	26		6	48	
	27				
338	28				
	29				

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Elevation, feet	Depth, feet	ROCK CORE						Lithology	MATERIAL DESCRIPTION	Monitoring Well Detail	SOIL SAMPLES			Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
		Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number				Type	Number	Blows per foot		
	29														
336	30														
	31											7	50 4"		
334	32														
	33														
332	34														
	35														
330	36											8	50 5"		
	37														
328	38														
	39														
326	40														
	41								Hard, moist, light olive brown (2.5YR, 5/4), fine sandy SILTSTONE (ML)			9	50 5"		
324	42														
	43														
322	44														
	45														

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Elevation, feet	Depth, feet	Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	MATERIAL DESCRIPTION	Monitoring Well Detail	Type	Number	Blows per foot	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	45				NA		NR							Begin HQ coring
320	46	1		33	NA	33							6	
	47				0			Dark blueish grey (GLEY2, 4/1), CLAYSTONE (CH), fine grained, moderately to slightly weathered, very weak to extremely weak						
318	48				0					■	10			LL(66), PI(36), SA(100), UC=637, WC(20), DD(110)
	49				0			Dark blueish grey to yellow (GLEY2, 4/1 to 10YR, 7/6), sandy SILTSTONE (ML), fine grained, moderately to highly weathered, extremely weak, with noticeable oxidation						
316	50	2	1	100	0	100							12	
	51				0									
314	52				0			Yellow (10YR, 7/6) with dark blueish grey (GLEY2, 4/1), silty SANDSTONE (SM), medium grained, highly weathered, extremely weak						
	53				0			Dark blueish grey (GLEY2, 4/1), silty SANDSTONE (SM), fine to medium grained, moderately to slightly weathered, moderately strong to weak						
312	54				0									
	55				0			Concretion - very strong		■	11		12	UC=2741, WC(3),DD(152)
310	56	3		100	0	100								
	57				0									
308	58		2											
	59	4						Concretion - very strong Concretion - very strong						
306	60			100		100							11	
	61													

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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Monitoring Well Detail	SOIL SAMPLES: Type	Number	Blows per foot	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	61	4			0										
304	62				0		NR								
									Concretion - very strong						
	63				0				Dark grey to grey (10YR, 4/1-5/1) sandy SILTSTONE (ML), fine sand, moderately weathered, weak to very weak						
302	64				0										
	65	5		100	0	100								11	
300	66				0										
	67				0										
298	68		3		0										
	69				0				extremely weak zone - laminated sand						
296	70	6		100	0	100			Concretion - very strong					10	
	71				0				Dark grey to grey (10YR 4/1-5/1), CLAYSTONE with sand (CH), moderately weathered, weak to very weak, few fine sand						
294	72				0						■	12			LL(56), PI(28), SA(91), UC=587, WC(17), DD(113)
	73				0										
292	74				0				Yellow (10YR 7/6), silty SANDSTONE (SM), fine to medium grained, highly weathered to moderately weathered, very weak to extremely weak 1: 20°, J, MW, Fe, Fi, Pl, SR						
	75	7	4	100	1	100	1							12	
290	76				0						■	16			UC=374, WC(14), DD(116)
	77														

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Elevation, feet	Depth, feet	ROCK CORE Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing	Number	Lithology	MATERIAL DESCRIPTION	Monitoring Well Detail	SOIL SAMPLES Type	Number	Blows per foot	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	77				1			2		2: 10°, J, MW, Fe+Mn, Fi, Pl, SR						
288	78				0											
	79		4		1			1								
286	80	8		100	0	100				Blueish grey (GLEY2, 5/1), SILTSTONE (ML), fine grained, moderately to slightly weathered, very weak to weak					10	
	81				0							■	13			SA(92), UC=720, WC(18), DD(112)
284	82				0											
	83				0											
282	84				0											
	85	9		100	0	100									30	
280	86		5		0					Thin layer of medium grained sand						
	87				0											
278	88				0		NR									
	89				0											
276	90	10		92	9	92				Thin layer of medium grained sand						
	91				0											
274	92		6		0											
	93															

Project: Pure Water, City of San Diego
Project Location: San Diego, California
Project Number: 60530732

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Elevation, feet	Depth, feet	ROCK CORE Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Monitoring Well Detail	SOIL SAMPLES Type	Number	Blows per foot	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	93				0										
272	94				0										
	95	11		100	0	100					■	14		12	UC=742, WC(16), DD(115)
270	96		6		0										
	97				0										
268	98				0				Becomes weak to moderately strong						
	99				0										
266	100	12		100	0	100								12	
	101				0				Becomes weak						
264	102				0										
	103				0										
262	104				0				Becomes weak to moderately strong						
	105	13	7	100	0	100								14	
260	106				0						■	15			UC=808, WC(15), DD(116)
	107				0										
258	108				0										
	109														

Project: Pure Water, City of San Diego
Project Location: San Diego, California
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Sheet 8 of 8

Elevation, feet	Depth, feet	ROCK CORE Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Monitoring Well Detail	SOIL SAMPLES Type	Number	Blows per foot	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	109				0										
256	110	14		100	0	100								14	
	111				0										
254	112				0										
	113								Bottom of boring at 113.0 feet below ground surface						
252	114														
	115														
250	116														
	117														
248	118														
	119														
246	120														
	121														
244	122														
	123														
242	124														
	125														

Project: Pure Water, City of San Diego
Project Location: San Diego, California
Project Number: 60530732

Log of Boring EX-2

Sheet 1 of 5

Date(s) Drilled	**9/5/17 - 9/6/17**	Logged By	**A. Avakian**	Checked By (Date)	**S. Fitzwilliam**
Drilling Method	**HSA / HQ3 coring**	Drill Bit Size/Type	**8-inch / HQ-3**	Total Depth of Borehole	**61.0 feet**
Drill Rig Type	**CME 85**	Drilling Contractor	**Cascade Drilling**	Approximate Surface Elevation	**320 feet**
Groundwater Level	**27.8 fbgs**	Location	**N32.876986, W117.200796**	Inclination from Horizontal/Bearing	**90**
Borehole Completion	**Temporary well installation was augered to 61 feet, then backfilled with cement/bentonite grout**			Hammer Data	**140 lbs / 30-inch**

Elevation, feet	Depth, feet	ROCK CORE Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Monitoring Well Detail	SOIL SAMPLES Type	Number	Blows per foot	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
320	0								**FILL (Qf)** Moist, light olive brown, SILT, little fine sand, intact chunks of Scripps Formation material mixed in						
	1														
318	2														Hand auger to 5 fbgs
	3														
316	4														
	5											1	17		
314	6														
	7														
312	8								few gravel / cobble						
	9														
310	10											2	23		
	11														
308	12														
	13														

Project: Pure Water, City of San Diego
Project Location: San Diego, California
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Elevation, feet	Depth, feet	ROCK CORE Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Monitoring Well Detail	SOIL SAMPLES Type	Number	Blows per foot	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	13														
306	14														
	15											3	15		
									4" chunk of brown CLAY						
304	16														
	17														
302	18														
	19														
300	20											4	16		
	21														
298	22														
									few gravel / cobble						
	23								becomes very dark gray						
296	24														
	25											5	5		
294	26								increase moisture content						
	27									▼					
292	28														
	29														

Project: Pure Water, City of San Diego
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Elevation, feet	Depth, feet	ROCK CORE						Lithology	MATERIAL DESCRIPTION	Monitoring Well Detail	SOIL SAMPLES			Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
		Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number				Type	Number	Blows per foot		
	29								**ALLUVIUM (Qal)** Stiff, wet, dark gray, CLAY (CL), few fine sand, trace fine gravel (rounded)						
290	30											6	9		
	31														
288	32														
	33								Medium dense, wet, light olive brown, silty SAND (SM), mostly fine to coarse sand, little fines						
286	34														
	35											7	17		
284	36								Very stiff, wet, dark gray, CLAY (CL), few fine sand, trace medium to coarse sand, trace fine gravel (rounded), few manganese oxide spots and iron oxide staining						
	37														
282	38														
	39								**SCRIPPS FORMATION (Tsc)** Highly Weathered Sedimentary Rock; SILTSTONE, grayish brown mottled with olive yellow, highly weathered, extremely weak, very soft to soft, some iron oxide staining Fragments to: hard, moist, light olive brown, SILT (ML), little fine sand						Drilling becomes more difficult
280	40											8	46		
	41														
278	42														
	43														
276	44														
	45														

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Elevation, feet	Depth, feet	Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	MATERIAL DESCRIPTION	Soil Samples Number	Soil Samples Blows per foot	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	45								9	35		
274	46											
	47											
272	48							becomes very dark gray, slightly weathered, very weak to weak, soft to moderately soft				Drilling slows down and becomes more difficult
	49											
270	50								10	69		Well screen from 50.3 to 60.3 fbgs
	51				N/A							Auger refusal. Begin wireline coring
268	52				N/A		NR					
	53	1		50	N/A	40*		concretion; strong, moderately hard	11		(10)	*rock strength does not meet requirements for RQD
266	54				1			1) 30°/J/Vn/Fe/Su/Pl/Sr	12			
	55		1		0							
264	56				N/A		NR	moist, yellowish brown, poorly-graded GRAVEL (GP-GM) with silt and sand, mostly fine to coarse gravel, little fine sand, few fines, clasts are purple and volcanic, some iron oxide staining few thin to moderate interbeds of Silty SANDSTONE (SM); extremly weak, very soft, sub-horizontal dip				partial circulation loss during drilling
	57				1							
262	58	2		90	0	90*		1) 10°/J/Vn/No/N/Pl/Sr-R			(12)	
	59				0				13			
260	60				0							
	61							concretion; strong, moderately hard	14			

Project: Pure Water, City of San Diego
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Elevation, feet	Depth, feet	ROCK CORE						Lithology	MATERIAL DESCRIPTION	Monitoring Well Detail	SOIL SAMPLES			Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
		Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number				Type	Number	Blows per foot		
	61								Bottom of boring at 61.0 feet below ground surface						
258	62														
	63														
256	64														
	65														
254	66														
	67														
252	68														
	69														
250	70														
	71														
248	72														
	73														
246	74														
	75														
244	76														
	77														

Project: Pure Water, City of San Diego
Project Location: San Diego, California
Project Number: 60530732

Log of Boring RC-1

Sheet 1 of 5

Date(s) Drilled	**03/28/2017 - 03/29/2017**	Logged By	**D. Rector**	Checked By (Date)	**D. Schug**
Drilling Method	**HSA / HQ3 coring**	Drill Bit Size/Type	**8-inch / HQ-3**	Total Depth of Borehole	**73.0 feet**
Drill Rig Type	**CME 85**	Drilling Contractor	**Cascade Drilling**	Approximate Surface Elevation	**233 feet**
Groundwater Level	**45.2 ft**	Location	**N 32.86141, W 117.20996**	Inclination from Horizontal/Bearing	**90**
Borehole Completion	**Cement/Bentonite Grout**			Hammer Data	**140 lbs / 30-inch**

Elevation, feet	Depth, feet	ROCK CORE Run No.	ROCK CORE Box No.	ROCK CORE Recovery,%	ROCK CORE Fractures per Foot	ROCK CORE R Q D, %	ROCK CORE Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Monitoring Well Detail	SOIL SAMPLES Type	SOIL SAMPLES Number	SOIL SAMPLES Blows per foot	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	0								4" asphalt over... **Fill** Medium dense, moist, mottled light yellowish brown and grey, silty SAND to clayey SAND (SM-SC)						
232	1														
	2														
230	3														
	4														
228	5										▯				
	6										▯	1	22		
226	7														
	8														
224	9														
	10										▯				
222	11										▯	2	18		
	12														
220	13														

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		ROCK CORE									SOIL SAMPLES				
Elevation, feet	Depth, feet	Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Monitoring Well Detail	Type	Number	Blows per foot	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
220	13														
	14														
218	15														
	16											3	31		
216	17														
	18														
214	19														
	20														
212	21											4	23		
	22														
210	23														
	24														
208	25														
	26											5	34		
206	27														
	28														
204	29														

Project: Pure Water, City of San Diego
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Elevation, feet	Depth, feet	ROCK CORE Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Monitoring Well Detail	SOIL SAMPLES Type	Number	Blows per foot	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
204	29														
	30										▯				
202	31										▯	6	25		
	32														
200	33														
	34														
198	35										▯				
	36										▯	7	19		
196	37														
	38														
194	39							▨	**Alluvium (Qal)** Medium dense, moist, very dark grey (10YR, 3/1), clayey SAND (SC), with silt and few rounded gravels						
	40							▨			▯				
192	41							▨			▯	8	19		
	42							▨							
190	43							▨							
	44							▨							
188	45							▨							

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Elevation, feet	Depth, feet	ROCK CORE Run No.	ROCK CORE Box No.	ROCK CORE Recovery, %	ROCK CORE Fractures per Foot	ROCK CORE R Q D, %	ROCK CORE Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Monitoring Well Detail	SOIL SAMPLES Type	SOIL SAMPLES Number	SOIL SAMPLES Blows per foot	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
188	45								∇						
	46											9	9		
186	47								**Scripps Formation (Tsc)** Blueish grey (GLEY2, 6/1), SANDSTONE (SP), fine grained, highly to moderately weathered, very weak (Breaks down to a dense, moist, blueish gray silty SAND (SM))						
	48														
184	49														
	50														
182	51											10	39		
	52														
180	53														
	54														
178	55	1	1	20	NA	20	NR							8	Begin HQ coring
	56				NA							11	50 3"		
176	57				NA				Light blueish grey (GLEY2, 8/1), SILTSTONE (ML), fine grained, moderately weathered, weak rock						
	58	2		100	0	100								12	
174	59				0										
	60				0										
172	61														

Elevation, feet	Depth, feet	ROCK CORE Run No.	ROCK CORE Box No.	ROCK CORE Recovery, %	ROCK CORE Fractures per Foot	ROCK CORE R Q D, %	ROCK CORE Fracture Drawing Number	MATERIAL DESCRIPTION	Monitoring Well Detail	SOIL SAMPLES Type	SOIL SAMPLES Number	SOIL SAMPLES Blows per foot	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
172	61													
					0					■	12			SA(94), UC=531, WC(16), DD(114)
	62		1											
					0									
								Dark grey (10YR, 4/1), SANDSTONE (SP), medium grained, moderately to highly weathered, very weak						
170	63													
					0			Light blueish grey (GLEY2, 7/1), SILTSTONE (ML), fine grained, moderately weathered, weak to very weak						
	64													
					0									
168	65													
		3		96	0	96							12	
	66									■	13			SA(92), UC=763, WC(16), DD(115)
					0									
166	67													
					0		NR							
	68													
					0									
164	69													
			2		0									
	70													
		4		100	0	100							9	
162	71							Light blueish grey (GLEY2, 7/1), silty SANDSTONE (SM), moderately weathered, weak to very weak						
					0									
	72									■	14			SA(44), UC=625, WC(16), DD(115)
160	73							Bottom of boring at 73.0 feet below ground surface						
	74													
158	75													
	76													
156	77													

Project: Pure Water, City of San Diego
Project Location: San Diego, California
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Log of Boring RC-2

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Date(s) Drilled	04/05/2017 - 04/06/2017	Logged By	D. Rector	Checked By (Date)	D. Schug
Drilling Method	HSA / HQ3 coring	Drill Bit Size/Type	8-inch / HQ-3	Total Depth of Borehole	103.0 feet
Drill Rig Type	CME 85	Drilling Contractor	Cascade Drilling	Approximate Surface Elevation	263 feet
Groundwater Level	55.1 ft	Location	N 32.86234, W 117.21136	Inclination from Horizontal/Bearing	90
Borehole Completion	Cement/Bentonite Grout			Hammer Data	140 lbs / 30-inch

Elevation, feet	Depth, feet	ROCK CORE Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Monitoring Well Detail	SOIL SAMPLES Type	Number	Blows per foot	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	0								4" of asphalt over... **Fill** Medium dense, moist, light grey to brownish yellow, silty SAND (SM)						
262	1														
	2														
260	3							▨	**Scripps Formation (Tsc)** Silty SANDSTONE, breaks down to: Very dense, moist, light grey (10YR,7/2) locally oxidized to brownish yellow (10YR, 6/6), silty SAND (SM), medium grained						
	4							▨							
258	5							▨							
	6							▨				1	52		
									Sandy SILTSTONE, breaks down to: Very stiff, moist, locally oxidized to brownish yellow (10YR, 6/6), fine sandy SILT (ML)						
256	7														
	8														
254	9														
	10														
252	11											2	18		
	12														
250	13														

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Project Location: San Diego, California
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Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Monitoring Well Detail	SOIL SAMPLES: Type	Number	Blows per foot	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
250	13														
	14								Becomes hard						
248	15														
	16											3	39		
246	17														
	18														
244	19														
	20														
242	21											4	50 6"		
									Silty SANDSTONE, breaks down to: Very dense, moist, pale brown (10YR, 6/3), silty SAND (SM), fine to medium grained						
	22														
240	23														
	24														
238	25														
	26											5	50 6"		
236	27														Rig chatter (until 29.0')
	28								Gravelly zone						
234	29														

Elevation, feet	Depth, feet	ROCK CORE						Lithology	MATERIAL DESCRIPTION	Monitoring Well Detail	SOIL SAMPLES			Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
		Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number				Type	Number	Blows per foot		
234	29														
	30														
232	31											6	50 4"		
	32														
230	33														
	34														
228	35								With few thin beds of sandy SILTSTONE (ML)						
	36											7	50 2"		
226	37														
	38														
224	39														
	40														
222	41											8	50 6"		
	42														
220	43								Silty SANDSTONE, breaks down to: Very dense, brownish yellow (10YR, 6/6), silty SAND (SM), medium to coarse grained						
	44														
218	45														

Project: Pure Water, City of San Diego
Project Location: San Diego, California
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Elevation, feet	Depth, feet	ROCK CORE Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Monitoring Well Detail	SOIL SAMPLES Type	Number	Blows per foot	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
218	45											9	50 5"		
	46														
216	47														
	48														
214	49														
	50								Becomes wet			10	50 4"		Sample 10: moist to wet
212	51														
	52														
210	53														
	54														
208	55								∇			11	50 6"		WL measured at beginning of day two
	56														
206	57														Very hard drilling
	58														
204	59														
	60											12	50 5"		
202	61														

Project: Pure Water, City of San Diego
Project Location: San Diego, California
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Elevation, feet	Depth, feet	ROCK CORE Run No.	ROCK CORE Box No.	ROCK CORE Recovery, %	ROCK CORE Fractures per Foot	ROCK CORE R Q D, %	ROCK CORE Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Monitoring Well Detail	SOIL SAMPLES Type	SOIL SAMPLES Number	SOIL SAMPLES Blows per foot	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
202	61														
	62														
200	63														
	64														
												13	50 6"		
198	65														Begin HQ Coring
					NA		NR								
	66														
		1		50	NA	50*			Brownish yellow (10YR, 6/6), silty SANDSTONE (SM), medium to coarse grained, highly weathered, extremely weak					4	
196	67														
					NA										
	68														* Highly weathered rock, does not qualify for RQD calculations
					NA										
194	69														
					NA										
	70														
		2		92	NA	92*								4	
192	71		1												
					NA				Brownish yellow and dark greenish grey (10YR, 6/8 and GLEY2, 4/1), sandy SILTSTONE (ML), fine sand, highly to moderately weathered, weak to very weak						
	72						1								
					NA		NR		1: 15°, B, N to MW, No, N, Pl, Sr						
190	73								Dark greenish grey (GLEY2, 4/1), sandy SILTSTONE (ML), fine grained, moderately weathered, weak rock, massive			14			LL(57), PI(25), SA(84), UC=661, WC(16), DD(114)
					0										
	74														
					0										
188	75														
		3		100	0	100								8	
	76														
			2		0										
186	77														

Project: Pure Water, City of San Diego
Project Location: San Diego, California
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Elevation, feet	Depth, feet	ROCK CORE Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Monitoring Well Detail	SOIL SAMPLES Type	Number	Blows per foot	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
186	77				0										
	78	4	2	92	0	92	NR		Increase in strength					5	
184	79				0						■	15			LL(49), PI(21), SA(90), UC=671, WC(17), DD(113)
	80				0				Blueish grey (GLEY2, 5/1), silty SANDSTONE (SM), medium grained, moderately weathered, very weak to extremely weak						
182	81				0										
	82				0										
180	83	5		84	0	84	NR							2	
	84				0						■	16			SA(15), UC=69, WC(20), DD(105)
178	85				0										
	86		3		0										
176	87				0				Dark blueish grey (GLEY2, 4/1), sandy SILTSTONE (ML), fine grained, moderately weathered, very weak Increase in sand content						
	88	6		100	0	100			Blueish grey (GLEY2, 6/1), SANDSTONE with silt (SP-SM), fine to medium grained, moderately weathered, very weak to extremely weak					4	
174	89				0										
	90				0										
172	91				0										
	92				0										
170	93														

Project: Pure Water, City of San Diego
Project Location: San Diego, California
Project Number: 60530732

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Elevation, feet	Depth, feet	ROCK CORE Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Monitoring Well Detail	SOIL SAMPLES Type	Number	Blows per foot	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
170	93	7	3	100	0	100								3	
	94				0						■	17			SA(10), UC=51, WC(19), DD(108)
168	95		4		0										
	96				0				With few small siltstone xenoliths						
166	97				0										
	98	8		80	0	80								8	
164	99				0				Dark blueish grey (GLEY2, 4/1) brecciated SANDSTONE (SP), fine to medium grained, highly to moderately weathered, extremely weak						
	100				0										
162	101				0										
	102				NA		NR								
160	103								Bottom of boring at 103.0 feet below ground surface						
	104														
158	105														
	106														
156	107														
	108														
154	109														

Project: Pure Water, City of San Diego
Project Location: San Diego, California
Project Number: 60530732

Log of Boring RC-3

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Date(s) Drilled	**07/05/17 - 07/06/17**	Logged By	**A. Avakian**	Checked By	**S. Fitzwilliam**
Drilling Method	**HSA / Wireline Coring**	Drill Bit Size/Type	**8-inch HSA / HQ-3**	Total Depth Drilled	**90.5 feet**
Drill Rig Type	**CME 85**	Drilling Contractor	**Cascade Drilling**	Approx. Surface Elevation	**237 feet**
Water Level Depth	**31.5**	Location	**N32.862262, W117.210271**	Inclination from Horizontal/Bearing	**90**
Borehole Completion	**Well Construction Per County Well Permit Guidelines**			Hammer Data	**140 lbs / 30-inch**

Elevation, feet	Depth, feet	ROCK CORE Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	SOIL SAMPLES Type	Number	Blows/ foot	Drill Time and Rate (ft/hr)	REMARKS AND LAB TESTS
	0								<u>Fill</u> Moist, yellowish brown, silty SAND, mostly fine sand, some fines					
236	1													
	2								<u>Fluvial Terrace Deposits (Qt)</u> Dense, moist, brown (7.5YR 4/3), clayey SAND (SC) with gravel, mostly fine sand, little fines, little to some fine to coarse gravel					
234	3													
	4								Slight increase in gravel content					
232	5													
	6										1	44		
230	7								<u>Scripps Fm. (Tsc)</u> Highly weathered sedimentary rock, SILTSTONE, mottled strong brown (7.5YR 5/6) and gray (7.5YR 6/1), fine grained, highly weathered, extremely weak, very soft, little iron oxide staining Fragments to: Hard, moist, yellowish brown SILT (ML) with sand, little fine sand					
	8										2	36		
228	9													
	10													
226	11								SILTSTONE, moderately weathered, extremely to very weak, very soft to soft, little iron oxide staining, thin to moderate interbeds of silty SANDSTONE (SM), some sub-horizontal bedding laminations in finer-grained material		3	72 11"		
	12													
224	13													

Elevation, feet	Depth, feet	ROCK CORE Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	SOIL SAMPLES Type	Number	Blows/ foot	Drill Time and Rate (ft/hr)	REMARKS AND LAB TESTS
224	13													
	14													
222	15													
	16										4	64		
220	17													
	18													
218	19													
	20													
216	21								Silty SANDSTONE (SM), moderately weathered, extremely weak, very soft, fine grained, pale brown (10YR 6/3), few sub-horizontal bedding laminations of finer grained material, few iron oxide staining Fragments to: Very dense, moist, brown (10YR 5/3), silty SAND (SM), mostly fine sand, some fines		5	85 9"		
	22													
214	23													
	24													
212	25										6	50 5"		
	26													
210	27													
	28													
208	29													

Project: Pure Water, City of San Diego
Project Location: San Diego, California
Project Number: 60530732

Log of Boring RC-3

Sheet 3 of 6

Elevation, feet	Depth, feet	ROCK CORE Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	SOIL SAMPLES Type	Number	Blows/ foot	Drill Time and Rate (ft/hr)	REMARKS AND LAB TESTS
208	29													
	30								Slight increase in moisture content	☐	7	50 5"		
206	31								▼					
	32													
204	33													
	34													
202	35	1		3	N/A N/A N/A	0	NR						(90)	Begin HQ Coring
200	37													
	38	2	1	0	N/A N/A N/A N/A N/A	0	NR						(50)	
198	39													
	40													
196	41													
	42													
194	43	3		100	1 1	100	1 2		Becomes very weak, very soft to soft, few to little fines, massive, weakly cemented 1: 5°, J, T, No, N, Pl, St 2: 5°, J, T, No, N, Pl, St	■	8		(38)	WA(6)
	44													
192	45													

Project: Pure Water, City of San Diego
Project Location: San Diego, California
Project Number: 60530732

Log of Boring RC-3

Sheet 4 of 6

Elevation, feet	Depth, feet	ROCK CORE: Run No.	ROCK CORE: Box No.	ROCK CORE: Recovery, %	ROCK CORE: Fractures per Foot	ROCK CORE: R Q D, %	ROCK CORE: Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	SOIL SAMPLES: Type	SOIL SAMPLES: Number	SOIL SAMPLES: Blows/ foot	Drill Time and Rate (ft/hr)	REMARKS AND LAB TESTS
192	45	3	1	100	0	100	3		3: <5°, B, T, No, N, Pl, St Becomes extremely weak, very soft				(38)	
	46				0									
190	47				0									
	48	4		66	N/A	30	NR						(33)	
188	49				N/A				Becomes very weak, very soft to soft					
	50				0		1		Material becomes thinly bedded with some laminations and cross bedding, becomes finer grained 1: <5°, B, T, No, N, Pl, St 2: <5°, B, T, No, N, Pl, St					
186	51				0		2		**Ardath Shale (Ta)** Slightly weathered sedimentary rock, sandy SILTSTONE (ML), dark blueish gray (GLEY2 5PB 4/1), fine grained, slightly weathered, very weak to weak, soft to moderately soft, few sub-horizontal laminations, little fine sand					
	52				0									
184	53	5		70	N/A	62	NR						(38)	
	54				1					■	9			
182	55		2		0		1		1: 10°, J, Vn, Cl, Pa, Pl, St					
	56				0									
180	57				3		2 3		2: 10°,J, T, No, N, Pl, St 3: 5°, J, T, No, N, Pl, R					
	58	6		100	0	40			Shell fragments				(19)	
178	59				2		1 2							
	60				2		3 4		1: 65°, J, Vn, No, N, Pl, St to R 2: 40°, J, Vn, No, N, Pl, St to R 3: 60°, J, Vn, No, N, Pl, R 4: 65°, J, Vn, No, N, Pl, R					
176	61													

Elevation, feet	Depth, feet	ROCK CORE Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	SOIL SAMPLES Type	Number	Blows/ foot	Drill Time and Rate (ft/hr)	REMARKS AND LAB TESTS
176	61				1		5		5: 70°, J, Vn, No, N, Pl, St					
	62	6		100	1	40	1		Slightly weathered sedimentary rock, SILTSTONE, dark blueish gray (GLEY2 SPB 4/1), fine grained, slightly weathered, very weak to weak, soft to medium soft, few sub-horizontal bedding laminations, trace fine sand 1: 85°, J, Vn, No, N, Pl, St to R				(19)	
174	63				2		1		1: 85°, J, T, No, N, Pl, SR					
	64		2		0		2			■	10			UC=900
172	65	7		100	0	77	1		2: 25°, B, T, No, N, Pl, St	■	11		(25)	
	66				0									
170	67				>5		2		Silty SANDSTONE (SM) interbed Material is intensely fractured Becomes moderately soft					
	68				0		1							
168	69				0				1: <5°, B, T, No, N, Pl, St 2: 10°, J, Vn, No, N, Pl, R	■	12			
	70	8		100	1	100	2		Concretion (strongly cemented)				(25)	
166	71				0		1							
	72		3		0				Concretion (strongly cemented)	■	13			UC=705
164	73													
	74													
162	75	9		96	0	88							(23)	
	76				2		1 2		Silty SANDSTONE (SM) interbed 1: 15°, J, Vn, No, N, Pl, R 2: 15°, J, Vn, No, N, Pl, R					
160	77													

Project: Pure Water, City of San Diego
Project Location: San Diego, California
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Log of Boring RC-3

Sheet 6 of 6

Elevation, feet	Depth, feet	ROCK CORE Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing	Number	Lithology	MATERIAL DESCRIPTION	SOIL SAMPLES Type	Number	Blows/ foot	Drill Time and Rate (ft/hr)	REMARKS AND LAB TESTS
160	77	9	3	96	0	88		3		Silty SANDSTONE (SM) interbed 3: <5°, B, Vn, No, N, Pl, St				(23)	
	78	10	4	104		104								(25)	
158	79				0										
	80				0					Slightly weathered sedimentary rock, silty SANDSTONE (SM), dark blueish gray (GLEY2 5PB 4/1), fine grained, slightly weathered, very weak, moderately soft					
156	81				0										
	82				0			1		1: 5°, B, Vn, No, N, Pl, R Concretion, strong, moderately hard	■	14			UC=5132
154	83	11		92	1	92		1						(25)	
	84				0						■	15			
152	85				0										
	86				0			2		Bottom of well Slightly weathered sedimentary rock, SILTSTONE (ML), dark blueish gray (GLEY2 5PB 4/1), fine grained, slightly weathered, very weak to weak, moderately soft, some sub-horizontal bedding laminations, few fine sand 1: 10°, J, Vn, No, N, Pl, St 2: <5°, B, T, No, N, Pl, St					
150	87				N/A		NR								
	88	12		56	0	56					■	16		(25)	
148	89				N/A		NR	1		1: <5°, B, T, No, N, Pl, St					
	90				N/A										
	90.5									Bottom of boring at 90.5 feet below ground surface					
146	91														
	92														
144	93														

Project: Pure Water, City of San Diego
Project Location: San Diego, California
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Log of Boring SC-1

Sheet 1 of 5

Date(s) Drilled	**02/28/2017 - 02/29/2017**	Logged By	**D. Rector**	Checked By (Date)	**D. Schug**
Drilling Method	**HSA / HQ3 coring**	Drill Bit Size/Type	**8-inch / HQ-3**	Total Depth of Borehole	**73.0 feet**
Drill Rig Type	**CME 85**	Drilling Contractor	**Cascade Drilling**	Approximate Surface Elevation	**198 feet**
Groundwater Level	**26.7**	Location	**N 32.84453, W 117.19969**	Inclination from Horizontal/Bearing	**90**
Borehole Completion	**Cementa/Bentonite Grout**			Hammer Data	**140 lbs / 30-inch**

Elevation, feet	Depth, feet	ROCK CORE Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Monitoring Well Detail	SOIL SAMPLES Type	Number	Blows per foot	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
198	0								3" of asphalt over... **Fill** Moist, very pale brown, clayey SAND with gravel and cobble						
	1														
196	2														
	3														
194	4														
	5								Moist, mixed light brownish gray and yellow, silty SAND, fine to medium grained with few concretionary gravels; material derived from Scripps Formation						
192	6											1	26		
	7														
190	8								concretionary fragment						
	9														
188	10														
	11											2	16		
186	12								becomes yellowish brown						
	13														

Project: Pure Water, City of San Diego
Project Location: San Diego, California
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Log of Boring SC-1

Sheet 2 of 5

		ROCK CORE									SOIL SAMPLES				
Elevation, feet	Depth, feet	Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Monitoring Well Detail	Type	Number	Blows per foot	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	13														
184	14														
	15														
182	16											3	16		
	17														
180	18								becomes loose						
	19														
178	20														
	21								Moist, very dark gray, clayey SAND			4	8		
176	22														
	23														
174	24														
	25														
172	26								**Alluvium (Qal)** Loose, moist, grayish brown (10YR 5/2), silty SAND (SM) with clay, fine to medium grained, trace rounded gravel			5	7		
									∇						
	27														
170	28								Medium dense, wet, brown (10YR 5/3), well-graded SAND (SW-SM) with silt and gravel						
	29														

Report: GEO_CORE+SOIL_17W; File: 60530732.GPJ; 8/14/2017 SC-1

Elevation, feet	Depth, feet	ROCK CORE Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Monitoring Well Detail	SOIL SAMPLES Type	Number	Blows per foot	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	29														
168	30														
	31											6	20		
166	32														
	33								becomes dense						
164	34														
	35														
162	36											7	33		
	37														
160	38								**Scripps Formation (Tsc)** Blueish gray (GLEY 6/1), silty SANDSTONE (SM), highly weathered, extremely weak, fine grained						
	39														
158	40														
	41											8	51		
156	42														
	43														
154	44								with shell fragments						
	45														

Log of Boring SC-1

Elevation, feet	Depth, feet	ROCK CORE Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing	Number	MATERIAL DESCRIPTION	SOIL SAMPLES Number	Blows per foot	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	45						NR		Sandy SILTSTONE (ML), blueish grey (GLEY, 6/1), fine grained, highly weathered, extremely weak, with few shell fragments	9	50 6"		
152	46								becomes moderately weathered, very weak	10			Begin HQ coring SA(73), UC=661, WC(14), DD(116)
					0								
	47	1		77		77						(17)	
					0								
150	48								becomes extremely weak, medium grained				
					1			1	1: 0°, B, Vn, No, No, Pl, Sr				
	49												
					1			2	6-inch thick concretion, moderately strong				
148	50		1					1	Very weak, fine grained				
		2		100	4	60		3	2: 5°, B, Vn, No, No, Pl, Sr 3: 5°-10°, B, Vn, No, No, Pl, Sr 4: 10°, B, Vn, No, No, Pl, Sr 5: 5°, B, Vn, No, No, Pl, Sr			(38)	
	51							4 5					
					1				1-foot thick concretion, moderately strong	11			UC=916, WC(14), DD(119)
146	52												
					0								
	53						NR						
					0								
144	54												
					0								
	55								becomes moderately strong				
		3		96	0	94						(43)	
142	56									12			UC=5849, WC(1), DD(164)
					0								
	57							1	1: 15°-20°, J, Vn, No, No, St, Sr				
					1								
140	58												
					0								
	59		2					1					
					0								
138	60												
		4		100	0	98						(43)	
	61												

Project: Pure Water, City of San Diego
Project Location: San Diego, California
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Log of Boring SC-1

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Elevation, feet	Depth, feet	ROCK CORE Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Monitoring Well Detail	SOIL SAMPLES Type	Number	Blows per foot	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	61				0										
136	62		2		1		1		1: 10°, J, Vn, No, No, Wa, Sr						
	63				0										
134	64				0										
	65	5		100	0	100								(38)	
132	66				0										
	67				0										
130	68				0						■	13			SA(73), UC=433, WC(13), DD(118)
	69		3		0		1		becomes extremely weak						
128	70	6		100	0	98								(33)	
	71				2				1: 30°, B, Vn, No, No, Pl, Sr						
126	72				0										
	73								Bottom of boring at 73.0 feet below ground surface						
124	74														
	75														
122	76														
	77														

Project: Pure Water, City of San Diego
Project Location: San Diego, California
Project Number: 60530732

Log of Boring SC-2

Sheet 1 of 4

Date(s) Drilled	**03/02/2017 - 03/03/2017**	Logged By	**D. Rector**	Checked By (Date)	**D. Schug**
Drilling Method	**HSA / HQ3 coring**	Drill Bit Size/Type	**8-inch / HQ-3**	Total Depth of Borehole	**58.0 feet**
Drill Rig Type	**CME 85**	Drilling Contractor	**Cascade Drilling**	Approximate Surface Elevation	**185 feet**
Groundwater Level	**14.5**	Location	**N 32.84584, W 117.20098**	Inclination from Horizontal/Bearing	**90**
Borehole Completion	**Cement/Bentonite Grout**			Hammer Data	**140 lbs / 30-inch**

Elevation, feet	Depth, feet	ROCK CORE Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Monitoring Well Detail	SOIL SAMPLES Type	Number	Blows per foot	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	0								4" of asphalt over... **Fill** Moist, light yellowish brown mixed with brown, silty SAND with clay, few gravel						
184	1														
	2														
182	3														
	4														
180	5														
	6											1	9		
178	7														
	8								Moist, brown, clayey SAND						
176	9														
	10														
174	11											2	8		
	12														
172	13														

Project: Pure Water, City of San Diego
Project Location: San Diego, California
Project Number: 60530732

Log of Boring SC-2

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Elevation, feet	Depth, feet	ROCK CORE Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Monitoring Well Detail	SOIL SAMPLES Type	Number	Blows per foot	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
172	13								**Alluvium** Medium dense, moist, yellowish brown (10YR 5/4), clayey SAND (SC), fine to medium grained						
	14								∇						
170	15								Medium dense, moist, light yellowish brown (10YR 5/3), silty SAND (SM), fine to medium grained						
	16											3	10		
168	17														
	18														
166	19								Very dense, wet, brown (10YR 5/5), well-graded GRAVEL (GW-GM) with silt and sand						
	20														
164	21											4	65		
	22														
162	23								**Scripps Formation (Tsc)** Blueish gray (GLEY2 6/1), silty SANDSTONE (SM), medium grained, highly weathered, very weak						
	24														
160	25								4-inch zone of brown (10YR 5/3) coloration			5	92 4"		
	26														
158	27														
	28														
156	29														

AECOM

Elevation, feet	Depth, feet	ROCK CORE Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Monitoring Well Detail	SOIL SAMPLES Type	Number	Blows per foot	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
156	29														
	30								Dark grey (10YR 4/1), sandy SILTSTONE (ML), moderately weathered, very weak to weak, fine grained						
154	31				N/A							6	58		
	32	1		100	0	100								(58)	Begin HQ coring
152	33				1				1: 5°, B, Mw, No, No, Pl, Sr 2: 5°, B, N, No, No, Pl, Sr 3: 10°, B, Mw, No, No, Pl, Sr			7			SA(85), UC=599, WC(15), DD(115)
	34				0		1								
150	35	2		94	1	94	2							(38)	
	36		1		0										
148	37				1		3 NR								
	38				0										
146	39				1		1								
	40	3		94	0	94			1: 0°, B, N, No, No, Pl, Sr 2: 3°, B, Mw, No, No, Pl, Sr					(33)	
144	41				1		2		Gray (10YR 6/1), SANDSTONE (SP), moderately weathered, moderately strong to strong, some shell fragments, few rounded gravels and small cobbles						
	42				0		NR								
142	43		2		0							11			PLT=13,078, WC(1)
	44				0							12			PLT=9,549, WC(1)
140	45								decrease in shell fragments and gravel			8			PLT=1, WC(2)

Elevation, feet	Depth, feet	ROCK CORE Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Monitoring Well Detail	SOIL SAMPLES Type	Number	Blows per foot	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
140	45	4		100	0	100			medium grained			9		(25)	PLT=177, WC(10)
	46				0				Dark gray (10YR 4/1), SANDSTONE (SP), moderately weathered, weak, fine grained						
138	47		2		0										
	48				0										
136	49				1		1		1: 0°, B, Mw, No, No, Pl, Sr						
	50	5		100	0	100								(33)	
134	51				0				becomes very weak						
	52				0										
132	53				0				becomes very weak to weak						
	54		3		1		2		1: 5°, B, Mw, No, No, Pl, Sr						
130	55	6		100	0	100			Dark grey (10YR 4/1), sandy SILTSTONE (ML), moderately weathered, weak to very weak, fine grained					(33)	
	56				0							10			SA(82), UC=878, WC(15), DD(117)
128	57				0				concretion, strong						
	58								Bottom of boring at 58.0 feet below ground surface						
126	59														
	60														
124	61														

Project: Pure Water, City of San Diego
Project Location: San Diego, California
Project Number: 60530732

Log of Boring SC-3

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Date(s) Drilled	**6/26/17 - 6/27/17**	Logged By	**A. Avakian**	Checked By	**S. Fitzwilliam**
Drilling Method	**HSA / Wireline Coring**	Drill Bit Size/Type	**8-inch HSA / HQ-3**	Total Depth Drilled	**53.0 feet**
Drill Rig Type	**CME 85**	Drilling Contractor	**Cascade Drilling**	Approx. Surface Elevation	**181 feet**
Water Level Depth	**11.7**	Location	**N32.84565, W117.20033**	Inclination from Horizontal/Bearing	**90**
Borehole Completion	**Well Construction Per County Well Permit Guidelines**			Hammer Data	**140 lbs / 30-inch**

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	SOIL SAMPLES: Type	Number	Blows/ foot	Drill Time and Rate (ft/hr)	REMARKS AND LAB TESTS
	0								**FILL** Moist, dark grayish brown, silty SAND, mostly fine to medium sand, little fines, trace fine gravel					
180	1													
	2													
								▨	**FLUVIAL TERRACE DEPOSITS (Qt)** Medium dense, moist, dark brown, clayey SAND (SC), mostly fine sand, some fines, trace fine gravel, Bt soil development					
178	3							▨						
	4							▨						
176	5							▨			1	20		
	6							▨						
174	7								Dense, moist, brown, poorly-graded GRAVEL with clay and sand (GP-GC), mostly fine to coarse gravel, little fine to medium sand, few fines					
	8													
172	9													
	10								becomes very dense		2	93 11"		
170	11								increase moisture content					
									▼					
	12								increase gravel density and clast size					
168	13													

Project: Pure Water, City of San Diego
Project Location: San Diego, California
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Elevation, feet	Depth, feet	ROCK CORE Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	SOIL SAMPLES Type	Number	Blows/ foot	Drill Time and Rate (ft/hr)	REMARKS AND LAB TESTS
168	13													
	14								**SCRIPPS FORMATION** Highly Weathered Sedimentary Rock; SILTSTONE, mottled strong brown and gray, highly weathered, extremely weak, very soft, few bedding laminations, iron oxide staining Fragments to: very stiff, moist, yellowish brown, SILT (ML)					
166	15										3	25		
	16													
164	17													
	18													
162	19								Slightly Weathered Sedimentary Rock; SITLSTONE, bluish gray, slightly weathered, very weak, soft, few fine shells, localized weak to moderate cementation Fragments to: Hard, moist, bluish gray, SILT (ML) with sand, little fine sand					
	20										4	93		
160	21													Begin HQ Coring
	22	1		0	N/A N/A	0	NR						(30)	
158	23				N/A				Silty SANDSTONE, bluish gray, slightly weathered, very weak, soft, few fine shells, localized weak to moderate cementation					
	24				N/A									
156	25	2	1	0	N/A	0	NR						(33)	
	26				N/A									
154	27				N/A									
	28				N/A		NR							
152	29													

AECOM

Project: Pure Water, City of San Diego
Project Location: San Diego, California
Project Number: 60530732

Log of Boring SC-3

Sheet 3 of 4

Elevation, feet	Depth, feet	ROCK CORE Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing	Number	Lithology	MATERIAL DESCRIPTION	SOIL SAMPLES Type	Number	Blows/ foot	Drill Time and Rate (ft/hr)	REMARKS AND LAB TESTS
152	29														
					N/A										
	30														
		3		0	N/A	0	NR							(16)	
150	31														
					N/A										
	32														
					N/A										
148	33									Siltstone interbeds					
					0										
	34														
					N/A										
146	35														
		4		22	N/A	0								(10)	
	36		1				NR								
					N/A										
144	37														
					N/A										
	38									trace shells					
		5		130	0	50								(10)	
142	39						NR			concretion; strongly cemented, slightly weathered, strong, moderately hard, some shells	◢	5	50 2"		
					1			1 2			■	6			UC=2566
	40									1: 5°, B, T, No, N, Pl-Wa, Sr 2: <5°, J, Mw, Cl, Fi, Pl, Sr					
					N/A										
140	41	6		37		33								(13)	
					N/A		NR								
	42														
					N/A										
138	43														
					0										
	44										■	7			
					0			1		1: 5°, B, T, No, N, Pl-Wa, Sr					
136	45														

Project: Pure Water, City of San Diego
Project Location: San Diego, California
Project Number: 60530732

Log of Boring SC-3

Sheet 4 of 4

Elevation, feet	Depth, feet	ROCK CORE Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	SOIL SAMPLES Type	Number	Blows/ foot	Drill Time and Rate (ft/hr)	REMARKS AND LAB TESTS
136	45													
		7	1	100	0	50	2		2: <5°, B, T, No, N, Pl, Sr 3: 90°, J, Vn, Ca, Sp, Pl-Ir, Vr				(18)	
	46				0									
134	47				1		3		concretion; strongly cemented, slightly weathered, strong, moderately hard to hard					
	48				0					■	8			UC=1983
132	49				0		1		1: <5°, B, T, No, N, Pl, S	■	9			UC=660
	50		2											
		8		92	0	57							(18)	
130	51				0				concretion; strongly cemented, slightly weathered, strong, moderately hard to hard	■	10			UC=1821
	52				0		**NR**							
128	53								Bottom of boring at 53.0 feet below ground surface					
	54													
126	55													
	56													
124	57													
	58													
122	59													
	60													
120	61													

Core Box Photos

Pure Water, EX-01, Box 1, 45.0-55.0’

Pure Water, EX-01, Box 2, 55.0-64.0’

Pure Water, EX-01, Box 3, 64.0-73.0’

Pure Water, EX-01, Box 4, 73.0-82.0’

Pure Water, EX-01, Box 5, 82.0-91.5’

Pure Water, EX-01, Box 6, 91.5-100.4’

Pure Water, EX-01, Box 7, 100.4-109.4’

Pure Water, EX-01, Box 8, 109.4-113.0’

Pure Water, RC-01, Box 1, 55.0-66.2’

Pure Water, RC-01, Box 2, 66.2-78.0’

Pure Water, RC-02, Box 1, 65.0-76.2’

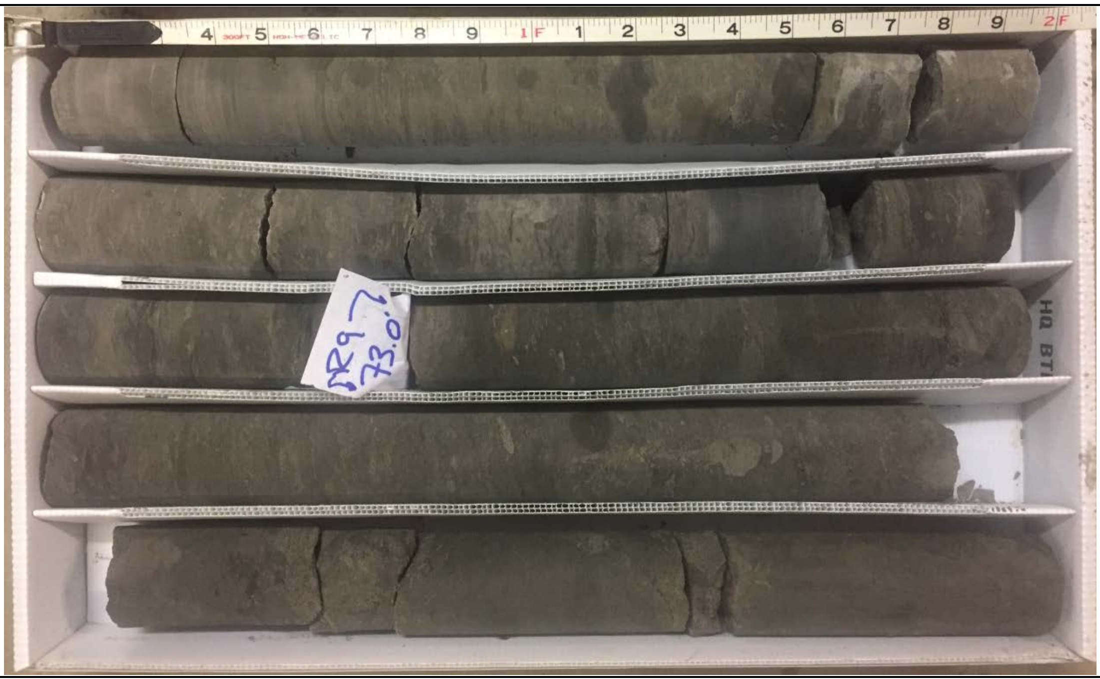
Pure Water, RC-02, Box 2, 76.2-86.2’

Pure Water, RC-02, Box 3, 86.2-95.2’

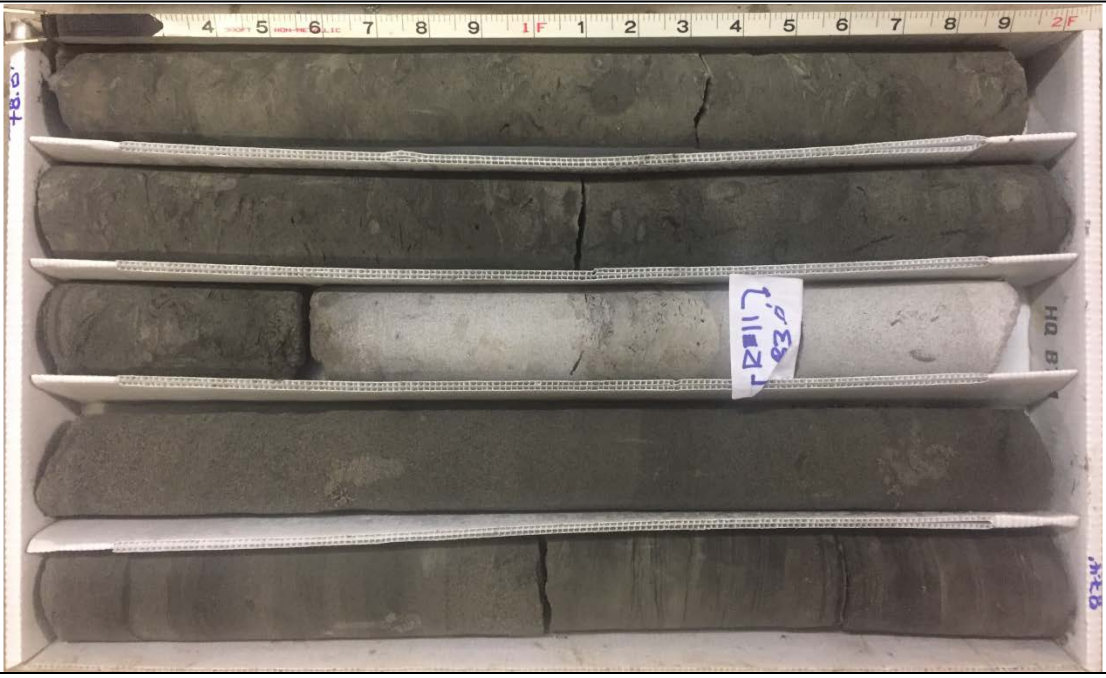
Pure Water, RC-02, Box 4, 95.2-103.0’

Pure Water, RC-03, Box 1, 35.0-55.4’

Pure Water, RC-03, Box 2, 55.4-68.7’



Pure Water, RC-03, Box 3, 68.7-78.0’



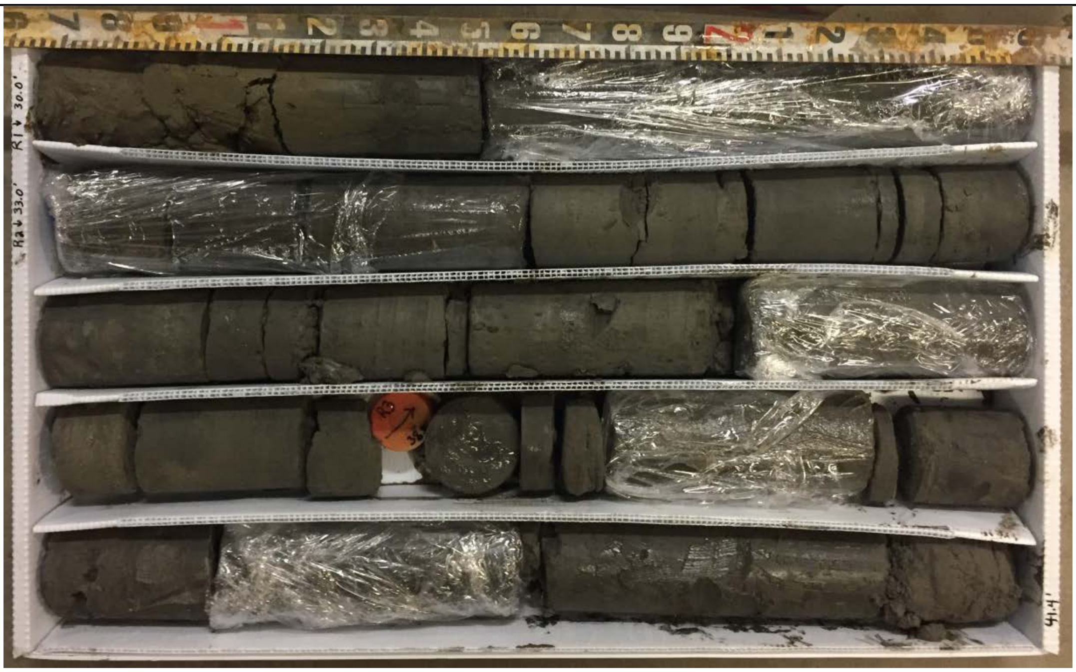
Pure Water, RC-03, Box 4, 78.0-87.4’

Pure Water, RC-03, Box 5, 87.4-90.5’ (top row) and 58.0-61.8’ (bottom 3 rows)

Pure Water, SC-01, Box 1, 45.0-55.5’

Pure Water, SC-01, Box 2, 55.5-65.0’

Pure Water, SC-01, Box 3, 65.0-73.0’



Pure Water, SC-02, Box 1, 30.0-41.4’

Pure Water, SC-02, Box 2, 41.4-50.7’

Pure Water, SC-02, Box 3, 50.7-58.0’

Pure Water, SC-03, Box 1, 21.5-46.6’

Pure Water, SC-03, Box 2, 46.6-53.0’

APPENDIX B

GEOTECHNICAL LABORATORY TEST RESULTS

APPENDIX B

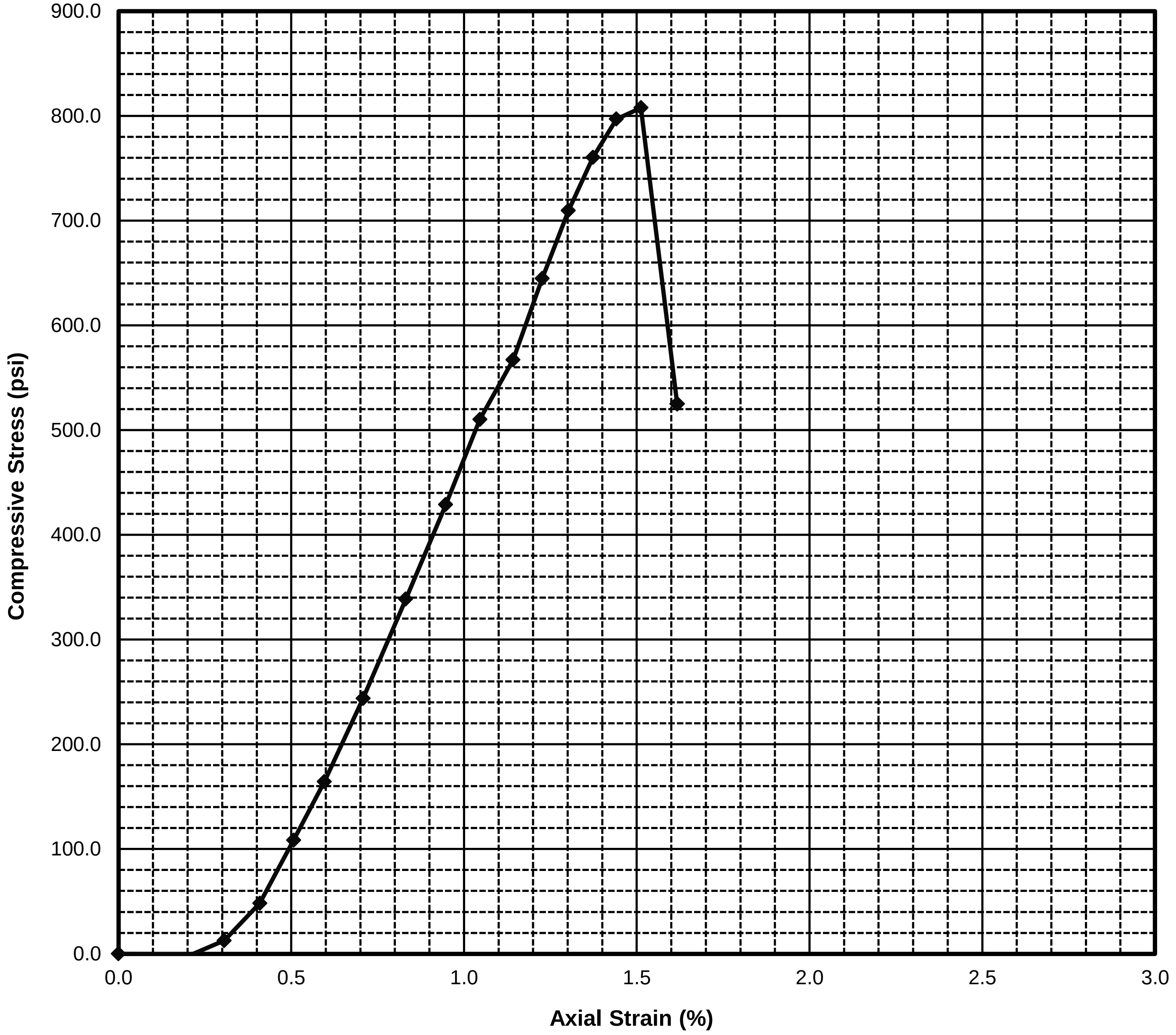
Geotechnical Laboratory Test Results

Laboratory testing was performed following more detailed review of the core samples and field logs of the borings. Geotechnical laboratory tests were performed on selected samples to aid in estimating soil properties and verify visual classifications of the materials. The tests included grain size, plasticity characteristics and unconfined strength. Test results, are shown on the corresponding sample location on the logs of the borings in Appendix A.

Table B-1
Summary of Unconfined Compression Tests
Morena Pipeline Tunnels

Exploration Number	Sample Number	Depth (ft)	Geologic Formation	Peak Compressive Strength (psi)
RC-01	1	61.2	Scripps Formation	531
RC-01	2	65.7	Scripps Formation	763
RC-01	3	71.7	Scripps Formation	625
RC-02	4	73.0	Scripps Formation	661
RC-02	5	79.0	Scripps Formation	671
RC-02	6	84.3	Scripps Formation	69
RC-02	7	94.0	Scripps Formation	51
RC-03	10	64.0	Ardath Shale	900
RC-03	13	72.5	Ardath Shale	705
RC-03	14	82.0	Ardath Shale	5132
SC-01	8	45.9	Scripps Formation	661
SC-01	9	51.5	Scripps Formation	916
SC-01	10	56.2	Scripps Formation	5849
SC-01	11	68.1	Scripps Formation	433
SC-02	12	33.0	Scripps Formation	599
SC-02[a]	13	43.0	Scripps Formation	13078
SC-02[a]	14	43.8	Scripps Formation	9549
SC-02[a]	15	45.2	Scripps Formation	177
SC-03	6	39.2	Scripps Formation	2566
SC-03	8	48.0	Scripps Formation	1983
SC-03	9	49.5	Scripps Formation	660
SC-03	10	50.8	Scripps Formation	1821
SC-02	16	56.2	Scripps Formation	878
EX-01	17	48.5	Scripps Formation	637
EX-01	18	55.5	Scripps Formation	2741
EX-01	19	71.8	Scripps Formation	587
EX-01	20	76.0	Scripps Formation	374
EX-01	21	80.9	Scripps Formation	720
EX-01	22	95.6	Scripps Formation	742
EX-01	23	106.5	Scripps Formation	808
Average Peak Compressive Strength (psi)				1899
Maximum Peak Compressive Strength (psi)				13078
Minimum Peak Compressive Strength (psi)				51

Notes – [a] Point Load Test results

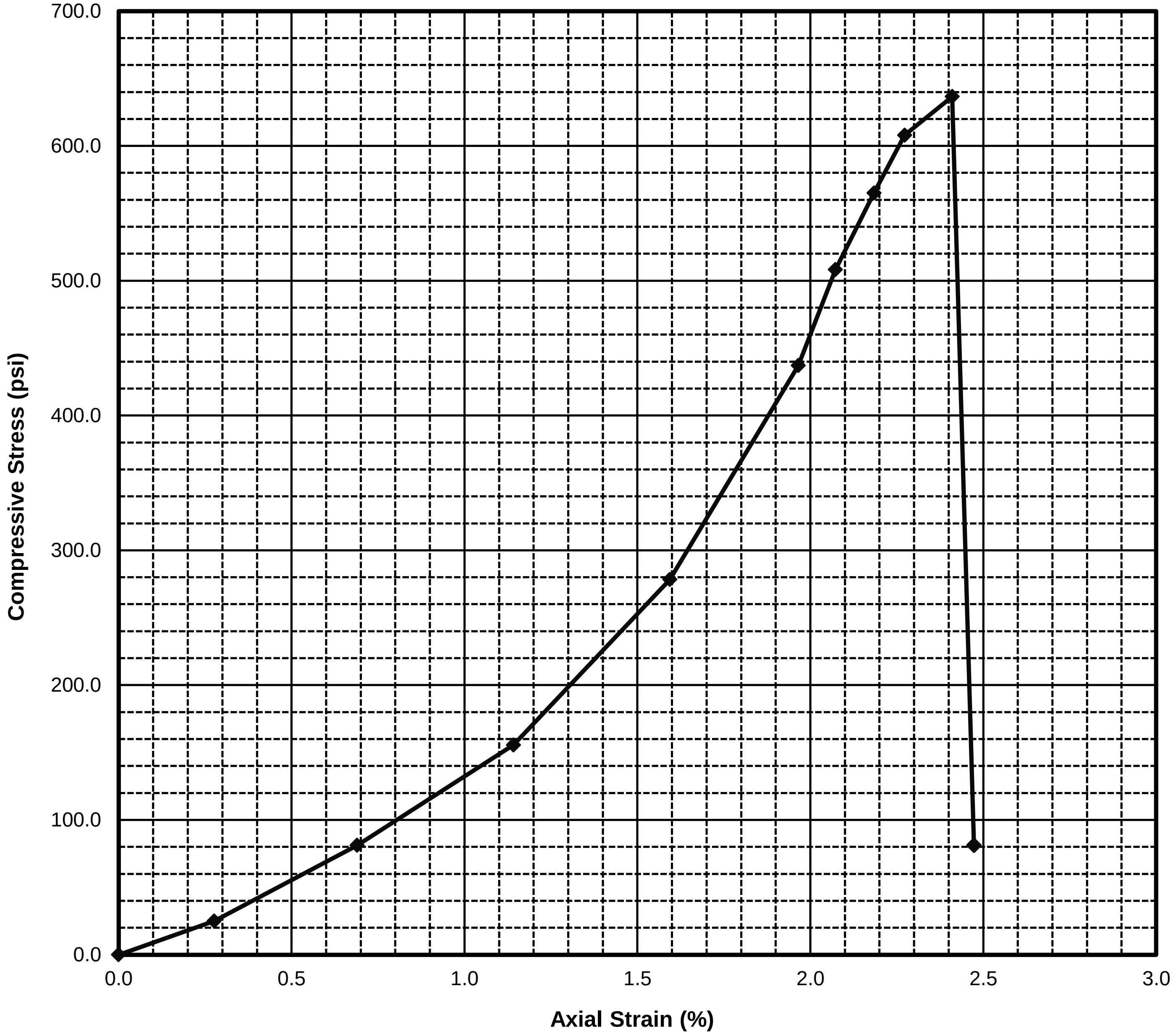


Failure Sketch

Water Content (%)	Length (in)	Diameter (in)	Wet Unit Weight (pcf)	Peak Stress (psi)
15.3	4.999	2.417	134.0	808

Project Name:	**Pure Water**
Project Number:	**60530732**
Boring Number:	**EX-01** **Depth (ft): 106.5**
Description and/or Classification:	**Dark gray Siltstone**

UNCONFINED COMPRESSION TEST
ASTM D7012



Failure Sketch

Water Content (%)	Length (in)	Diameter (in)	Wet Unit Weight (pcf)	Peak Stress (psi)
19.6	4.844	2.414	131.2	637

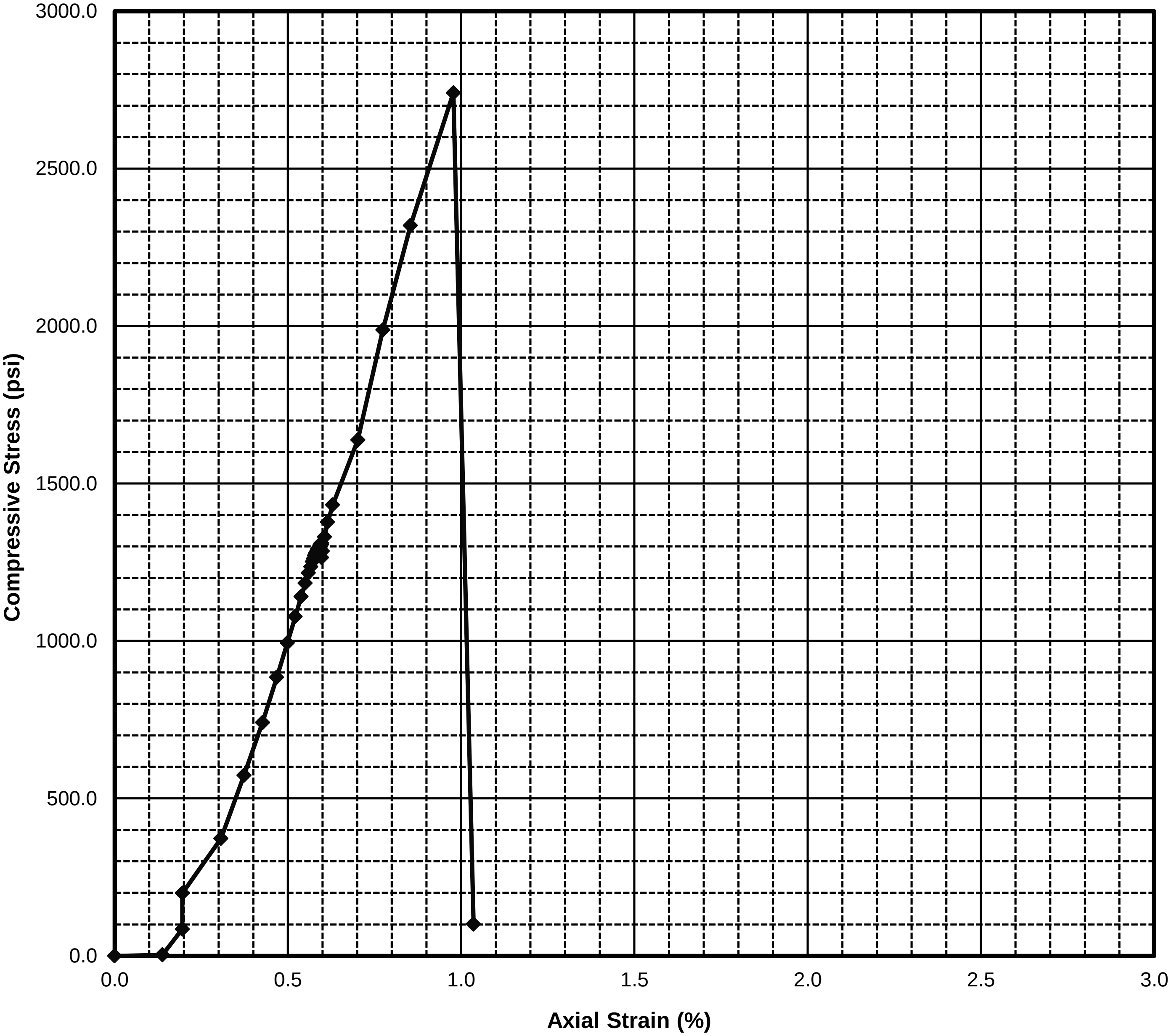
Project Name: Pure Water

Project Number: 60530732

Boring Number: EX-01 **Depth (ft):** 48.5

Description and/or Classification: Dark gray Claystone

UNCONFINED COMPRESSION TEST
ASTM D7012



Failure Sketch

Water Content (%)	Length (in)	Diameter (in)	Wet Unit Weight (pcf)	Peak Stress (psi)
3.1	5.036	2.421	156.8	2741

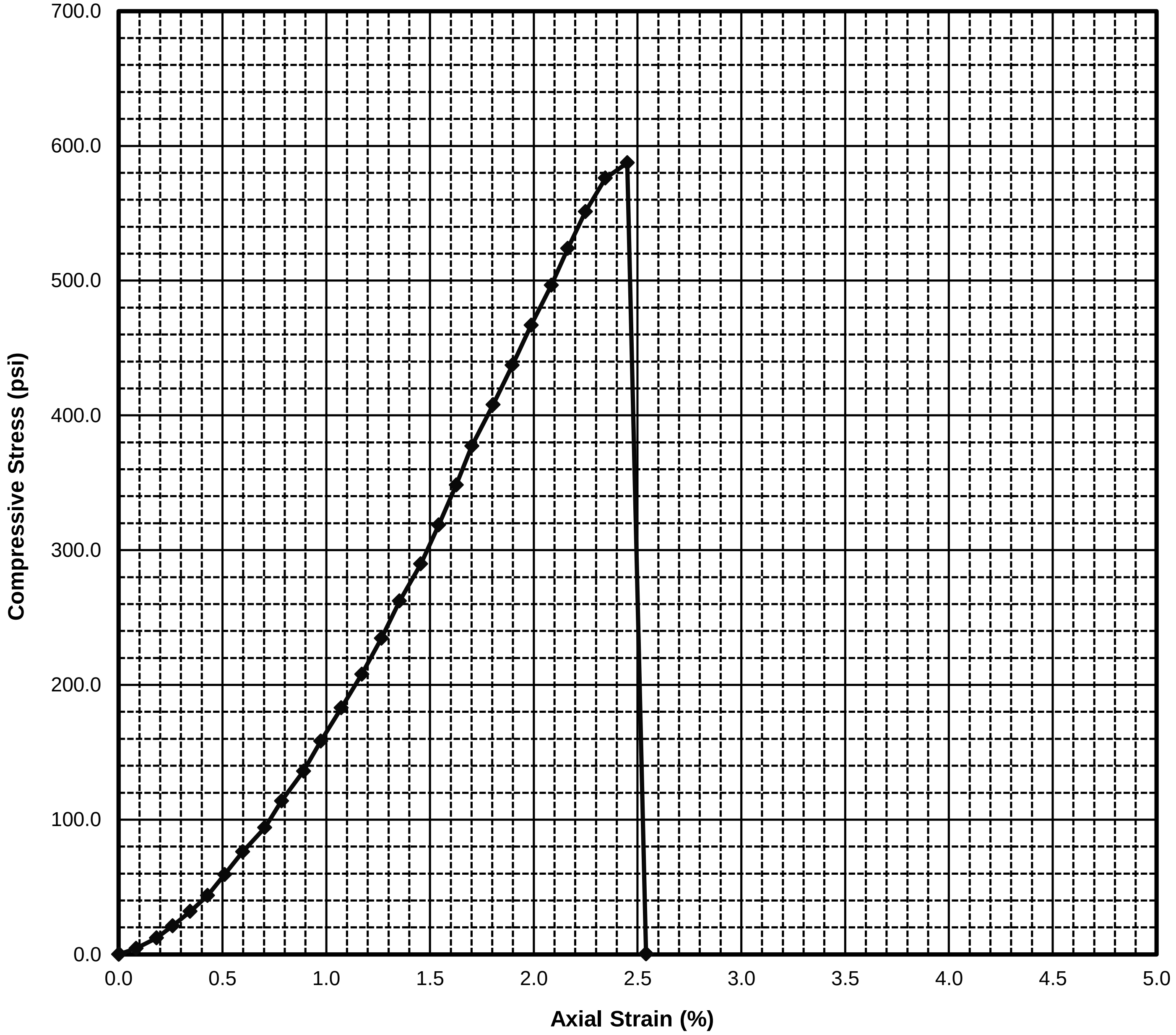
Project Name: **Pure Water**

Project Number: **60530732**

Boring Number: **EX-01** **Depth (ft):** **55.5**

Description and/or Classification: **Dark gray Siltstone**

UNCONFINED COMPRESSION TEST
ASTM D7012

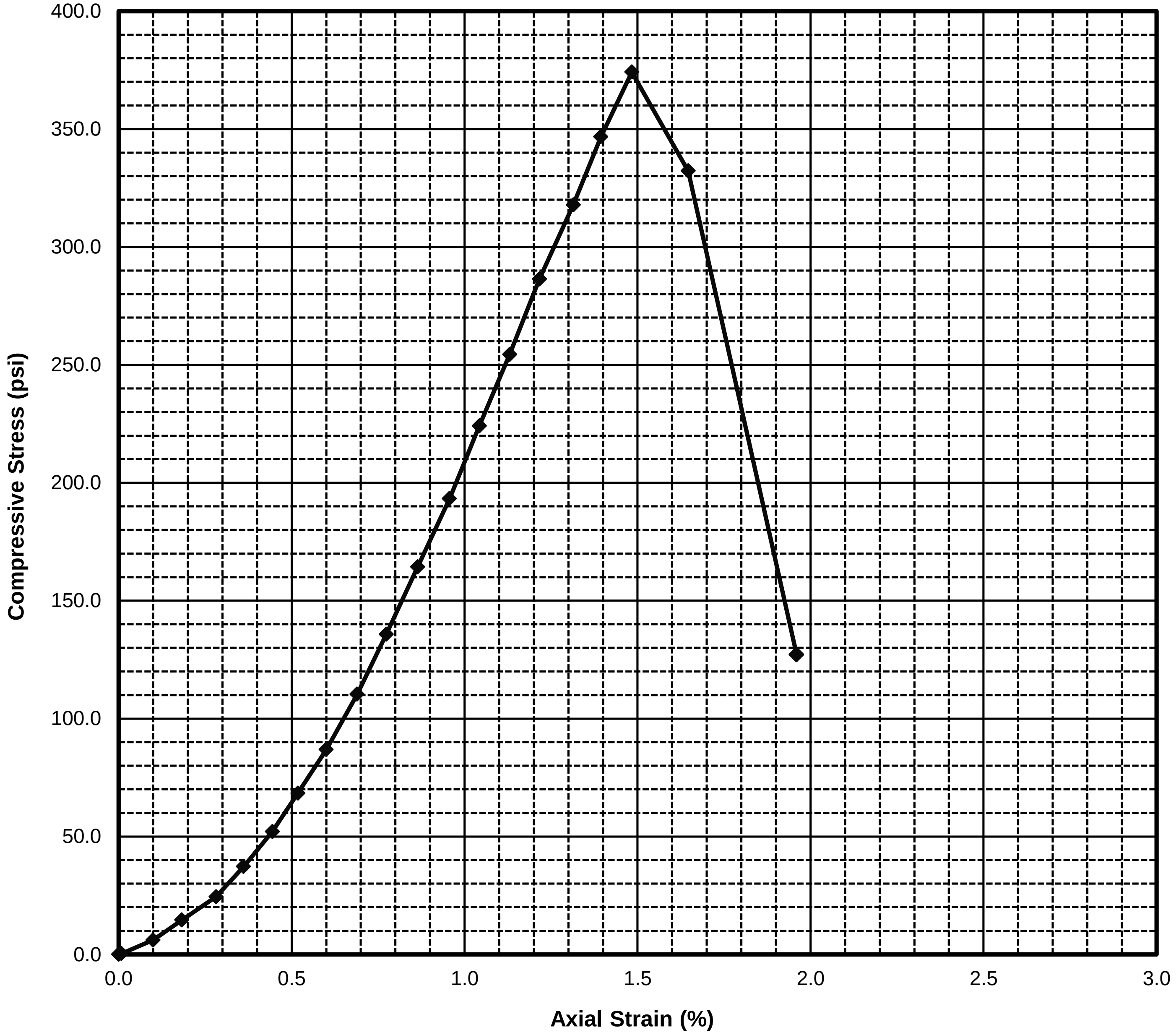


Failure Sketch

Water Content (%)	Length (in)	Diameter (in)	Wet Unit Weight (pcf)	Peak Stress (psi)
16.8	4.925	2.428	132.4	587

Project Name:	**Pure Water**
Project Number:	**60530732**
Boring Number:	**EX-01** **Depth (ft): 71.8**
Description and/or Classification:	**Greenish gray Claystone**

UNCONFINED COMPRESSION TEST
ASTM D7012

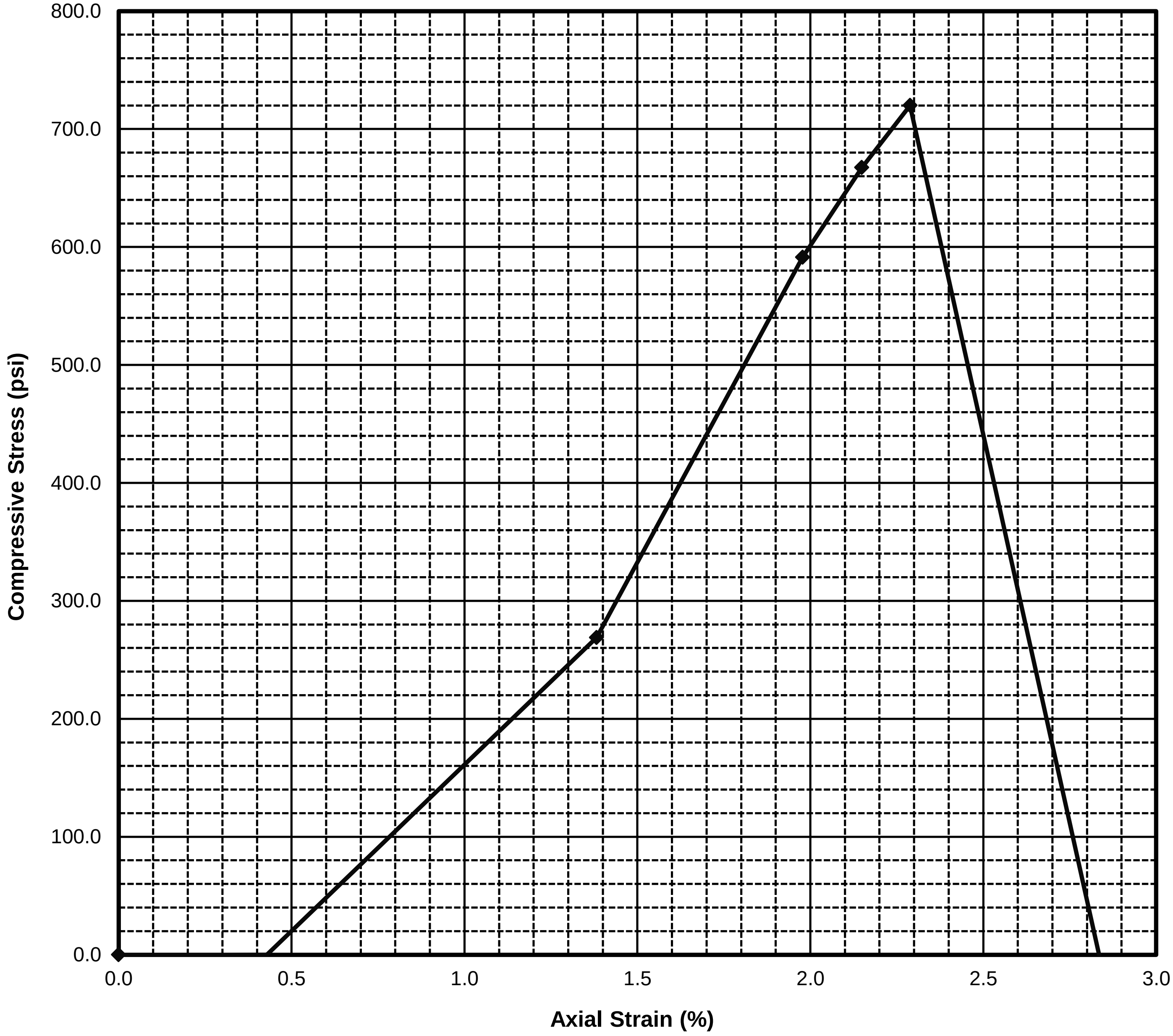


Failure Sketch

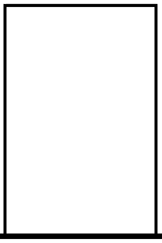
Water Content (%)	Length (in)	Diameter (in)	Wet Unit Weight (pcf)	Peak Stress (psi)
14.2	5.016	2.428	132.7	374

Project Name:	**Pure Water**
Project Number:	**60530732**
Boring Number:	**EX-01** **Depth (ft): 76.0**
Description and/or Classification:	**Brownish yellow Sandstone**

UNCONFINED COMPRESSION TEST
ASTM D7012



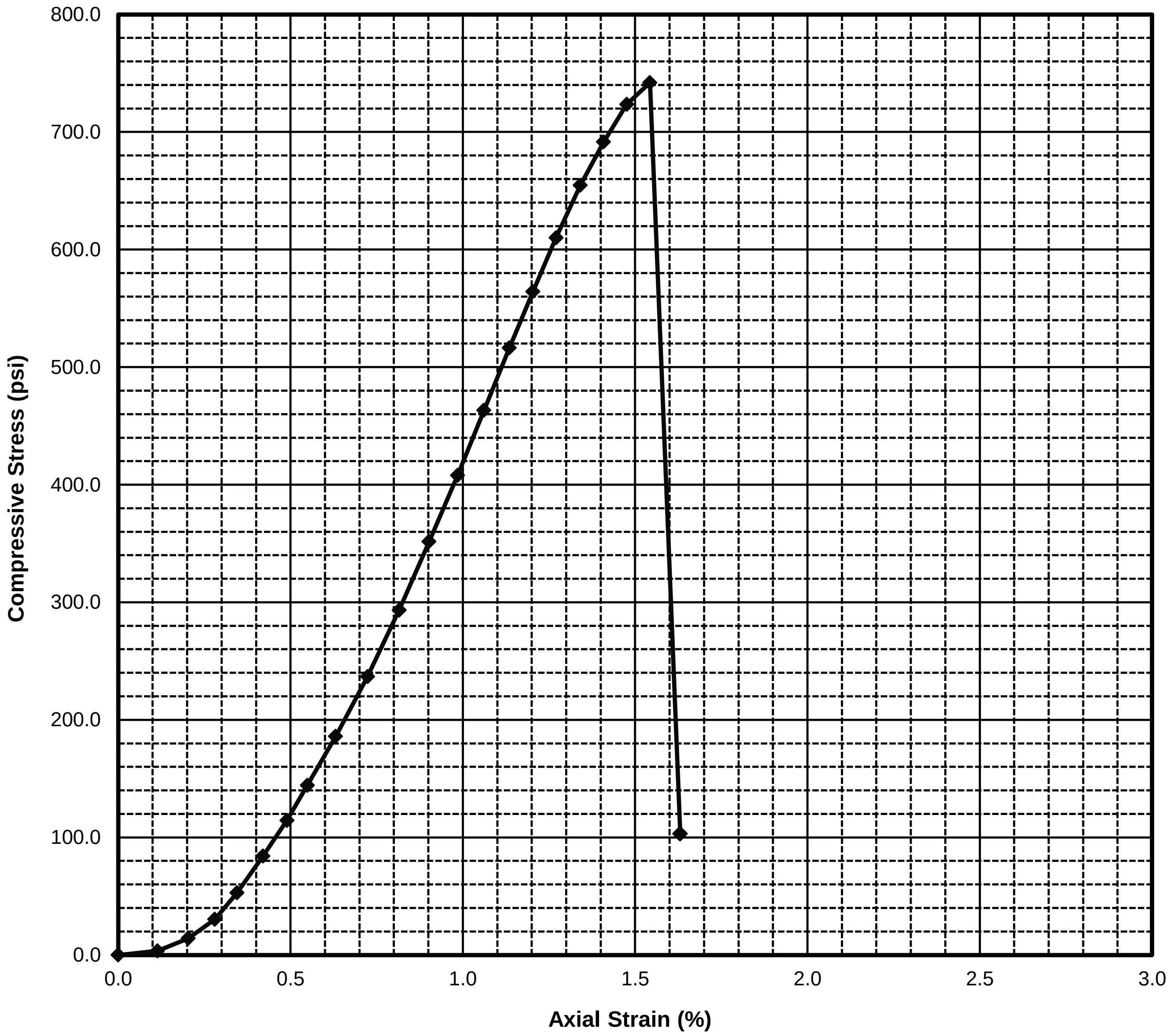
Failure Sketch



Water Content (%)	Length (in)	Diameter (in)	Wet Unit Weight (pcf)	Peak Stress (psi)
17.8	4.905	2.428	131.6	720

Project Name:	**Pure Water**
Project Number:	**60530732**
Boring Number:	**EX-01** **Depth (ft): 80.9**
Description and/or Classification:	**Dark gray Siltstone**

UNCONFINED COMPRESSION TEST
ASTM D7012

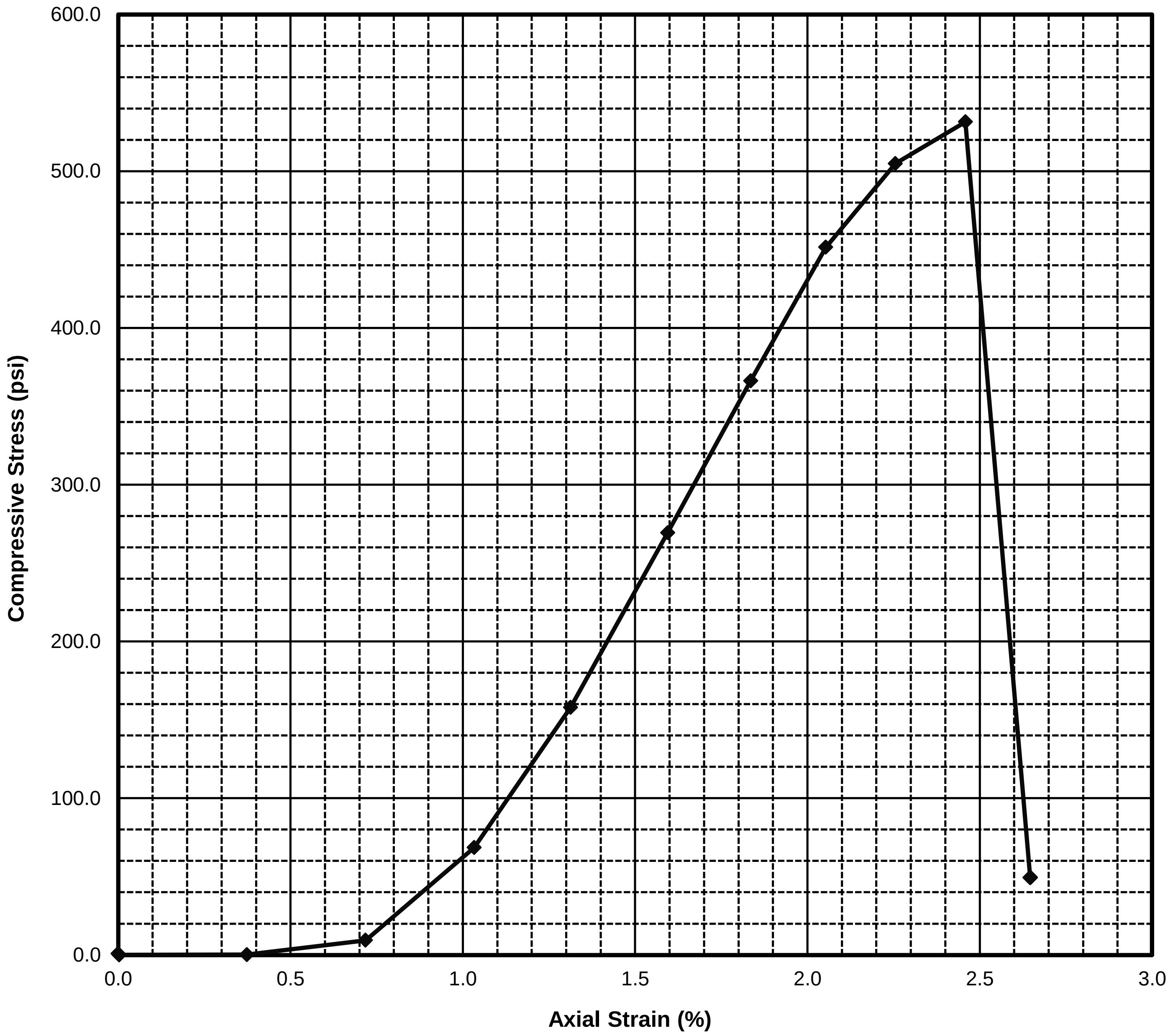


Failure Sketch

Water Content (%)	Length (in)	Diameter (in)	Wet Unit Weight (pcf)	Peak Stress (psi)
15.9	4.899	2.423	133.4	742

Project Name:	**Pure Water**
Project Number:	**60530732**
Boring Number:	**EX-01** **Depth (ft): 95.6**
Description and/or Classification:	**Dark gray Siltstone**

UNCONFINED COMPRESSION TEST
ASTM D7012



Failure Sketch

Water Content (%)	Length (in)	Diameter (in)	Wet Unit Weight (pcf)	Peak Stress (psi)
15.8	5.001	2.423	132.3	531

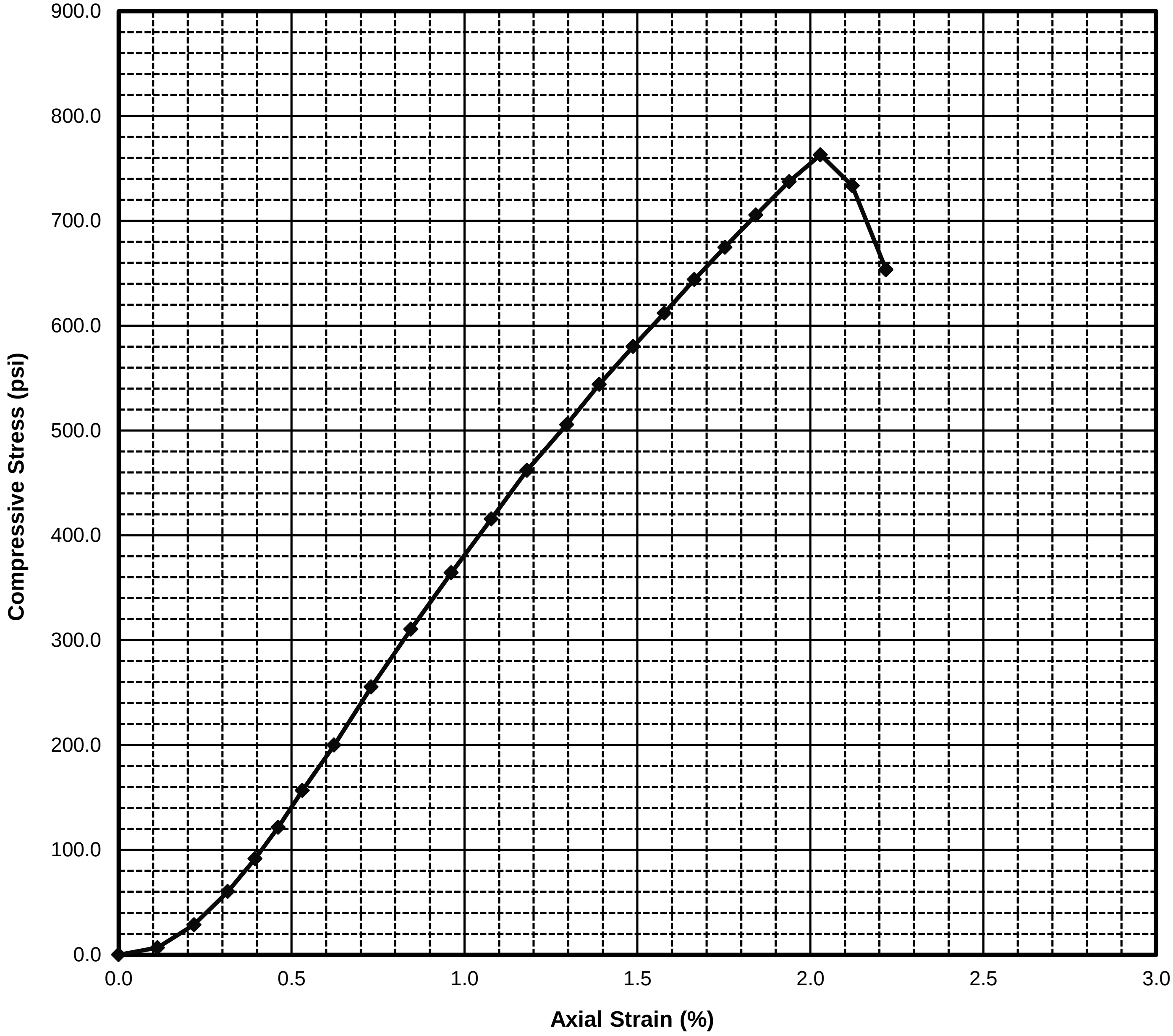
Project Name: **Pure Water**

Project Number: **60530732**

Boring Number: **RC-01** **Depth (ft):** **61.2**

Description and/or Classification: **Dark gray Siltstone**

UNCONFINED COMPRESSION TEST
ASTM D7012

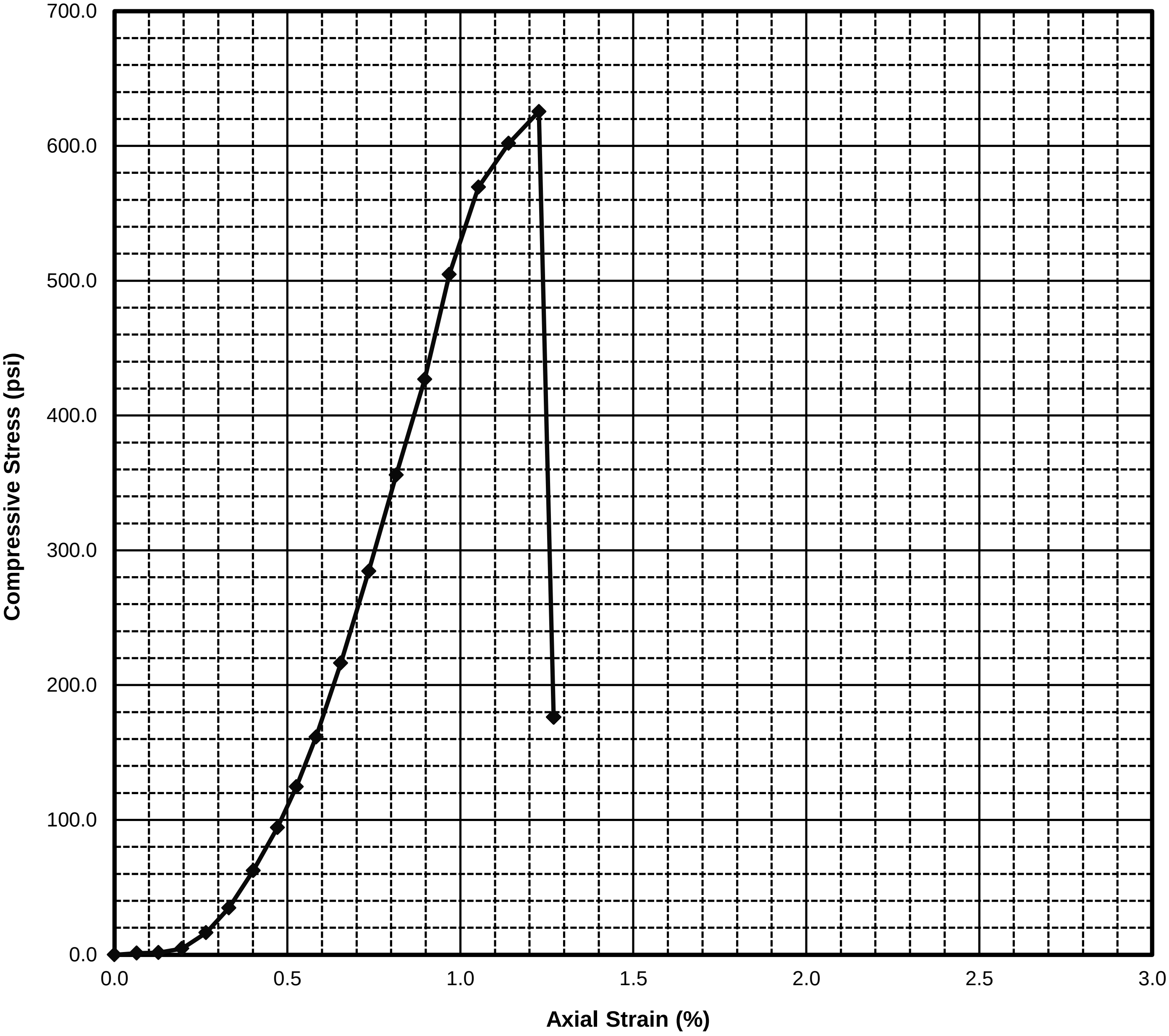


Failure Sketch

Water Content (%)	Length (in)	Diameter (in)	Wet Unit Weight (pcf)	Peak Stress (psi)
15.8	4.928	2.419	133.0	763

Project Name:	**Pure Water**
Project Number:	**60530732**
Boring Number:	**RC-01** **Depth (ft): 65.7**
Description and/or Classification:	**Gray Siltstone**

UNCONFINED COMPRESSION TEST
ASTM D7012

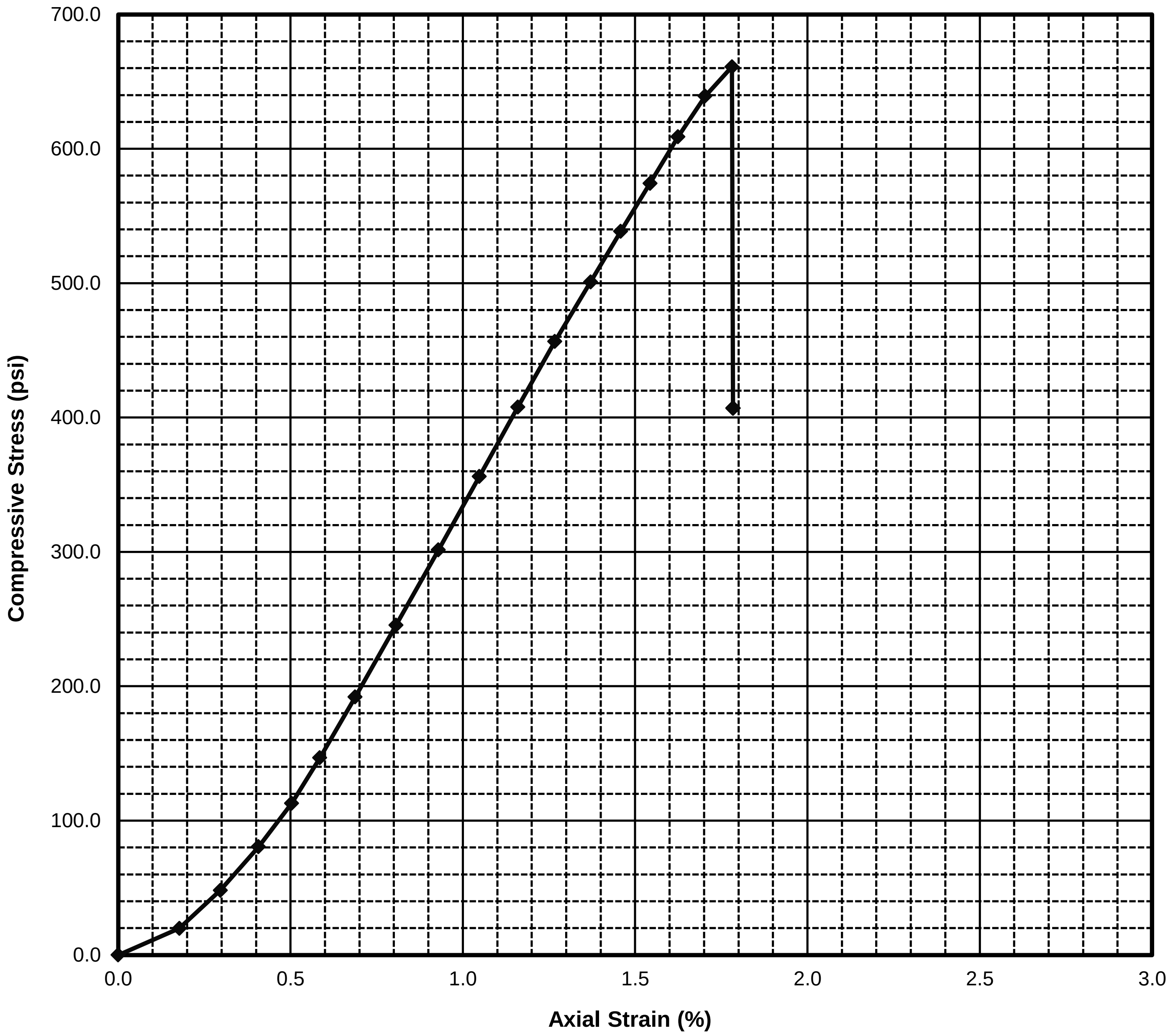


Failure Sketch

Water Content (%)	Length (in)	Diameter (in)	Wet Unit Weight (pcf)	Peak Stress (psi)
16.3	4.922	2.421	133.2	625

Project Name:	**Pure Water**
Project Number:	**60530732**
Boring Number:	**RC-01** **Depth (ft): 71.7**
Description and/or Classification:	**Dark greenish gray Sandstone**

UNCONFINED COMPRESSION TEST
ASTM D7012



Failure Sketch

Water Content (%)	Length (in)	Diameter (in)	Wet Unit Weight (pcf)	Peak Stress (psi)
16.0	4.924	2.421	131.7	661

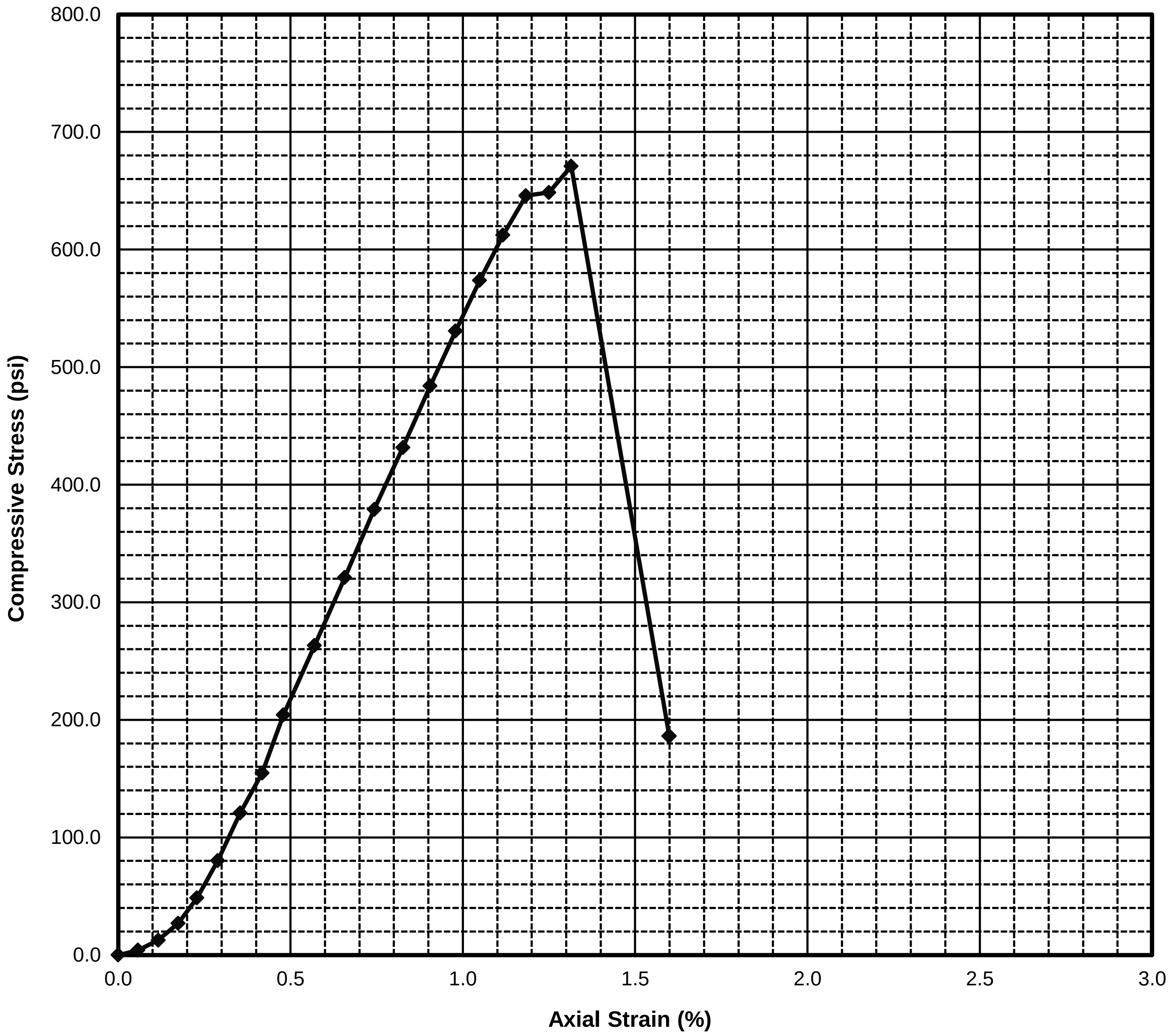
Project Name: Pure Water

Project Number: 60530732

Boring Number: RC-02 **Depth (ft):** 73.0

Description and/or Classification: Dark gray Siltstone

UNCONFINED COMPRESSION TEST
ASTM D7012

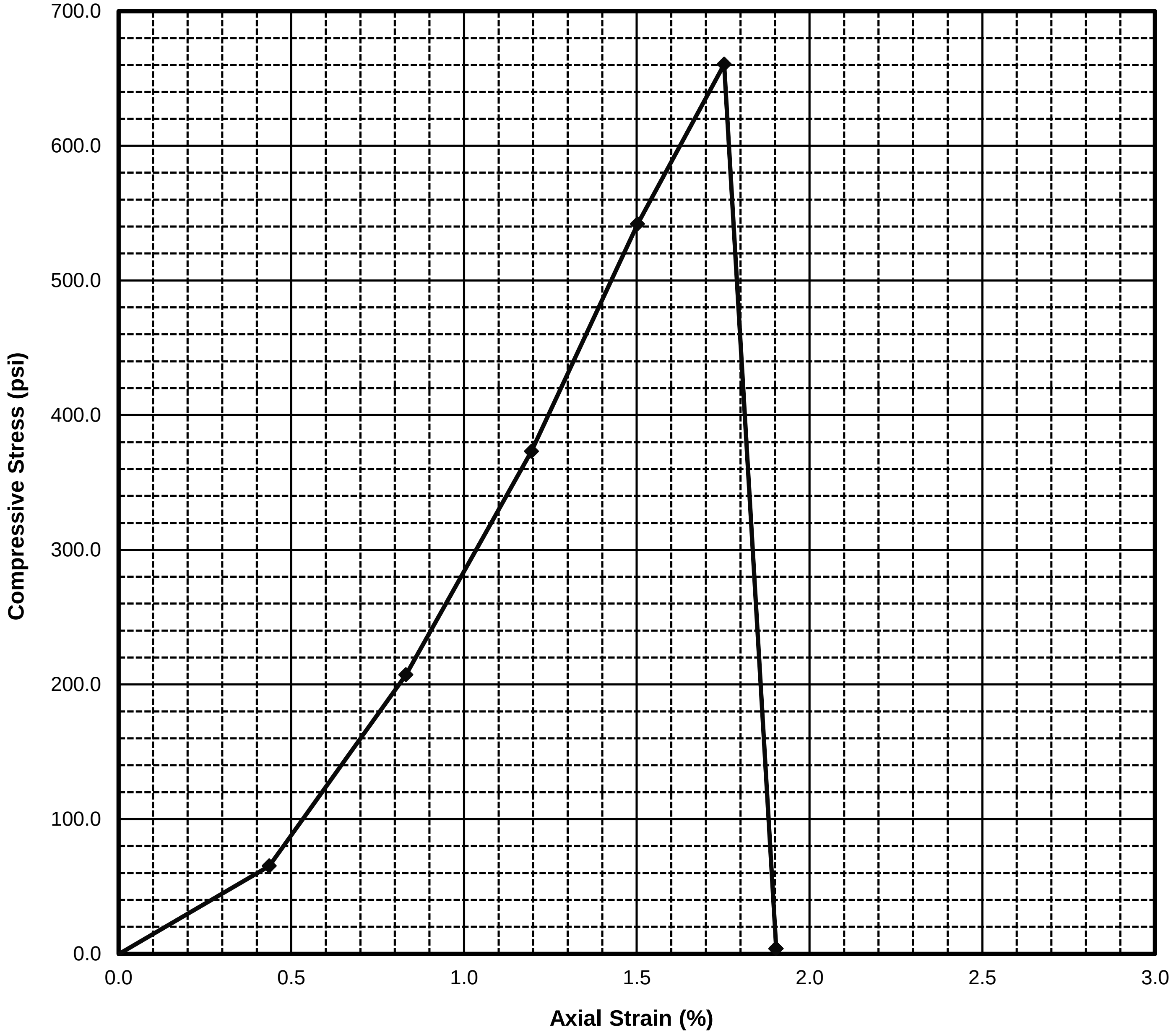


Water Content (%)	Length (in)	Diameter (in)	Wet Unit Weight (pcf)	Peak Stress (psi)
16.6	4.944	2.426	132.0	671

Failure Sketch

Project Name:	**Pure Water**		
Project Number:	**60530732**		
Boring Number:	**RC-02**	**Depth (ft):**	**79.0**
Description and/or Classification:	**Dark gray Siltstone**		

UNCONFINED COMPRESSION TEST
ASTM D7012

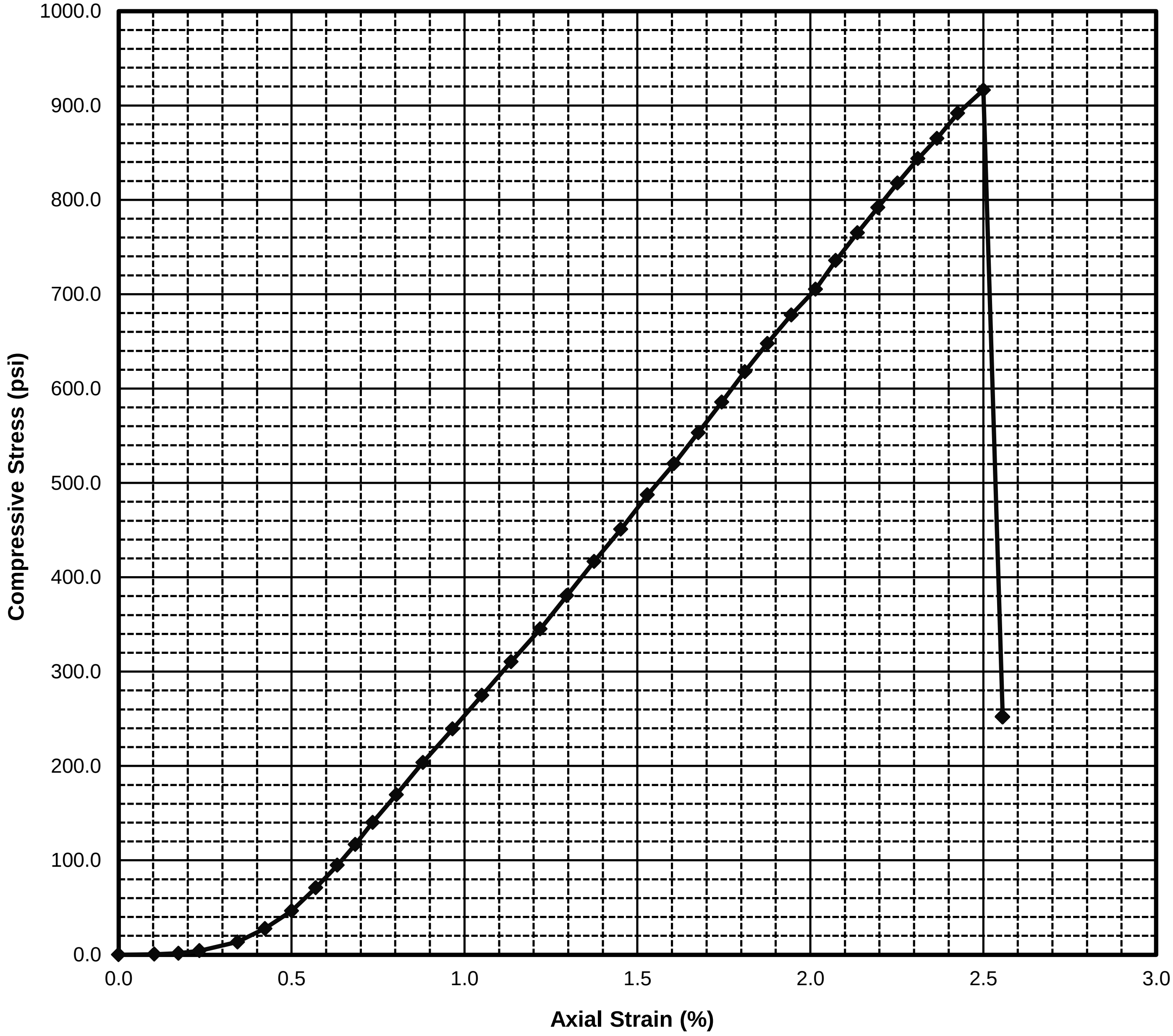


Failure Sketch

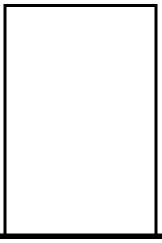
Water Content (%)	Length (in)	Diameter (in)	Wet Unit Weight (pcf)	Peak Stress (psi)
13.9	4.928	2.395	132.3	661

Project Name:	**Pure Water**
Project Number:	**60530732**
Boring Number:	**SC-01** **Depth (ft): 45.9**
Description and/or Classification:	**Dark gray Siltstone**

UNCONFINED COMPRESSION TEST
ASTM D7012



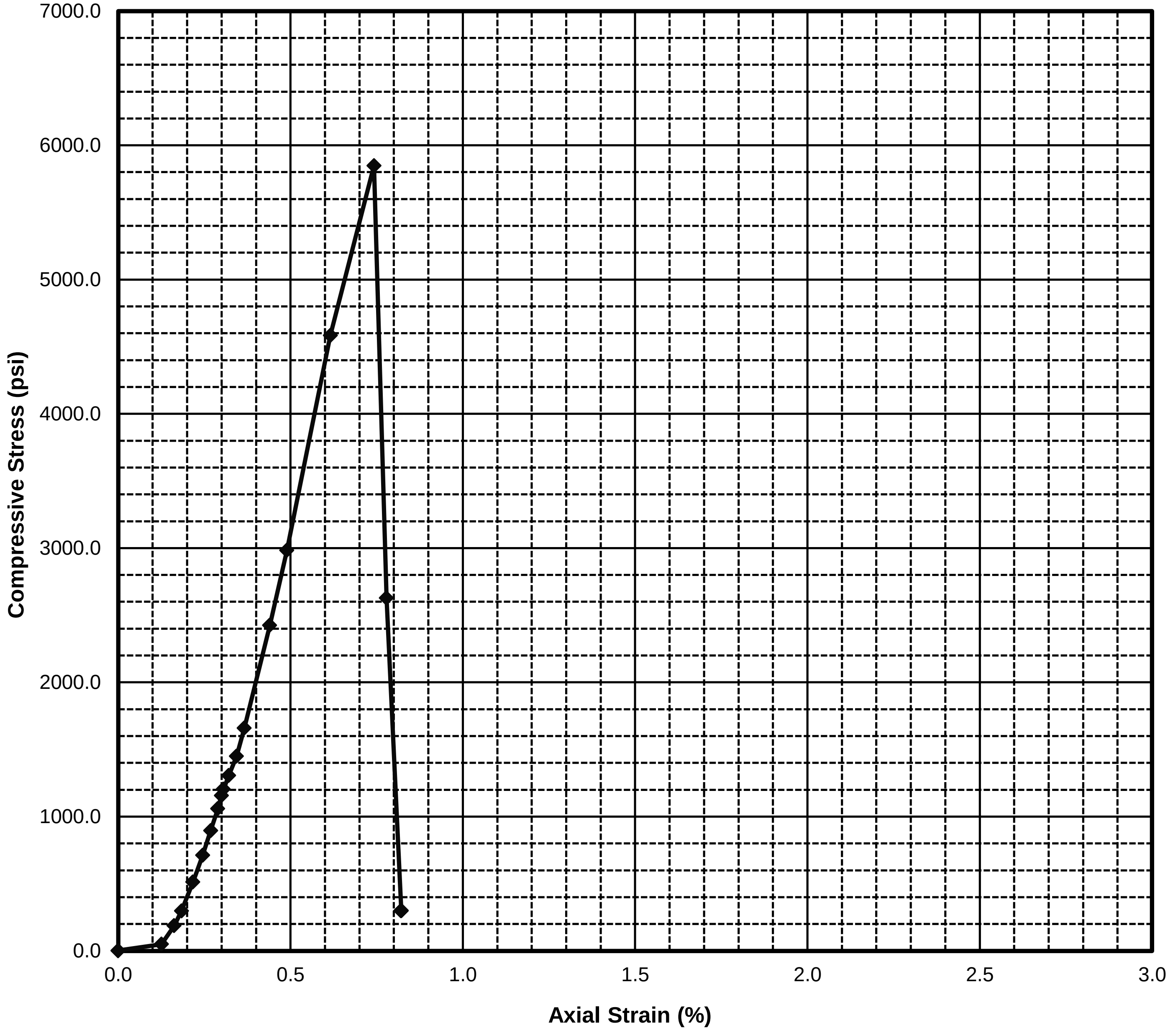
Failure Sketch



Water Content (%)	Length (in)	Diameter (in)	Wet Unit Weight (pcf)	Peak Stress (psi)
14.3	5.131	2.405	135.5	916

Project Name:	**Pure Water**
Project Number:	**60530732**
Boring Number:	**SC-01** **Depth (ft): 51.5**
Description and/or Classification:	**Dark greenish gray Sandstone**

UNCONFINED COMPRESSION TEST
ASTM D7012



Failure Sketch

Water Content (%)	Length (in)	Diameter (in)	Wet Unit Weight (pcf)	Peak Stress (psi)
0.7	5.139	2.414	165.1	5849

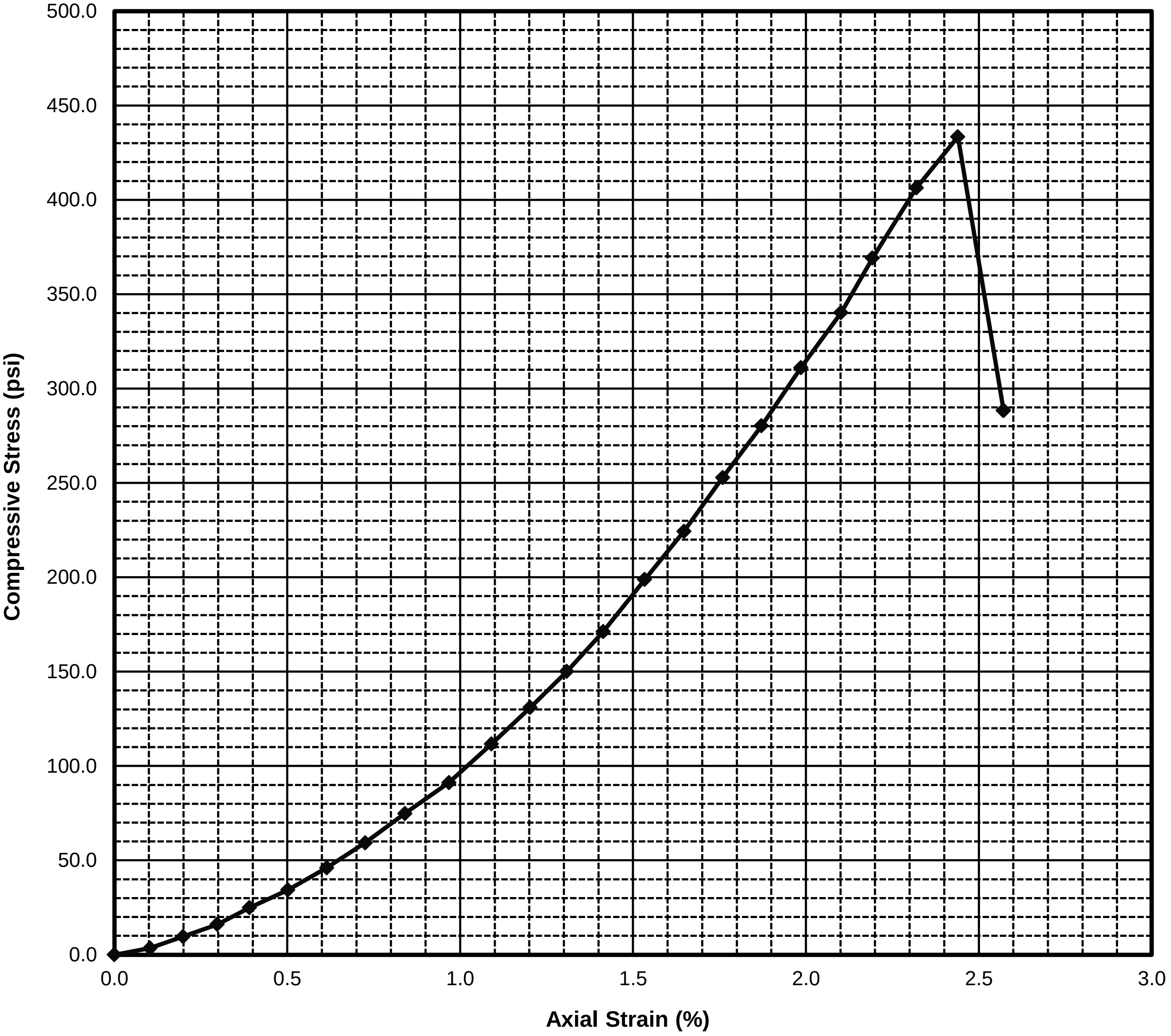
Project Name: Pure Water

Project Number: 60530732

Boring Number: SC-01 **Depth (ft):** 56.2

Description and/or Classification: Gray Sandstone

UNCONFINED COMPRESSION TEST
ASTM D7012

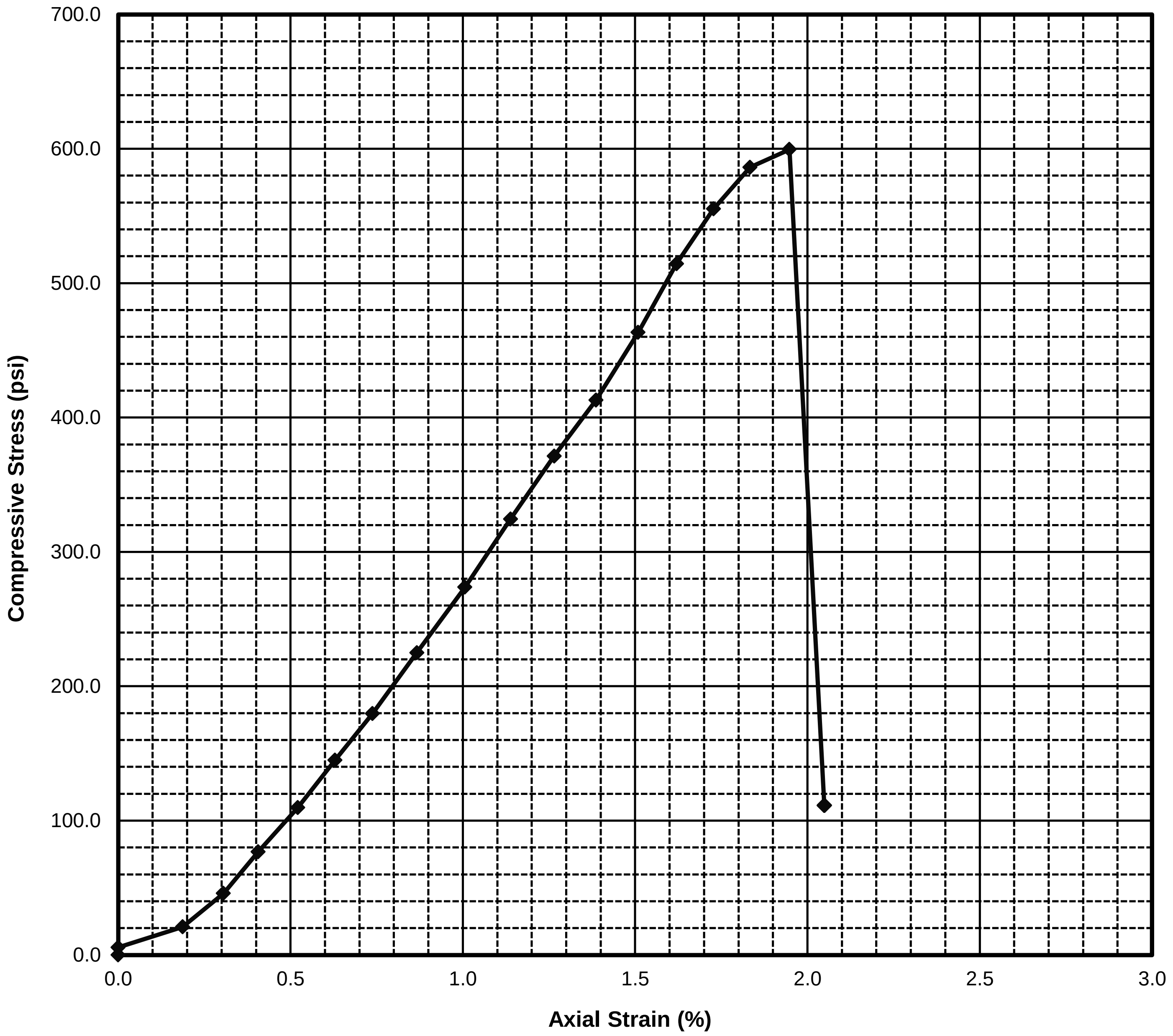


Failure Sketch

Water Content (%)	Length (in)	Diameter (in)	Wet Unit Weight (pcf)	Peak Stress (psi)
12.9	4.956	2.400	133.6	433

Project Name:	**Pure Water**		
Project Number:	**60530732**		
Boring Number:	**SC-01**	**Depth (ft):**	**68.1**
Description and/or Classification:	**Dark gray Siltstone**		

UNCONFINED COMPRESSION TEST
ASTM D7012

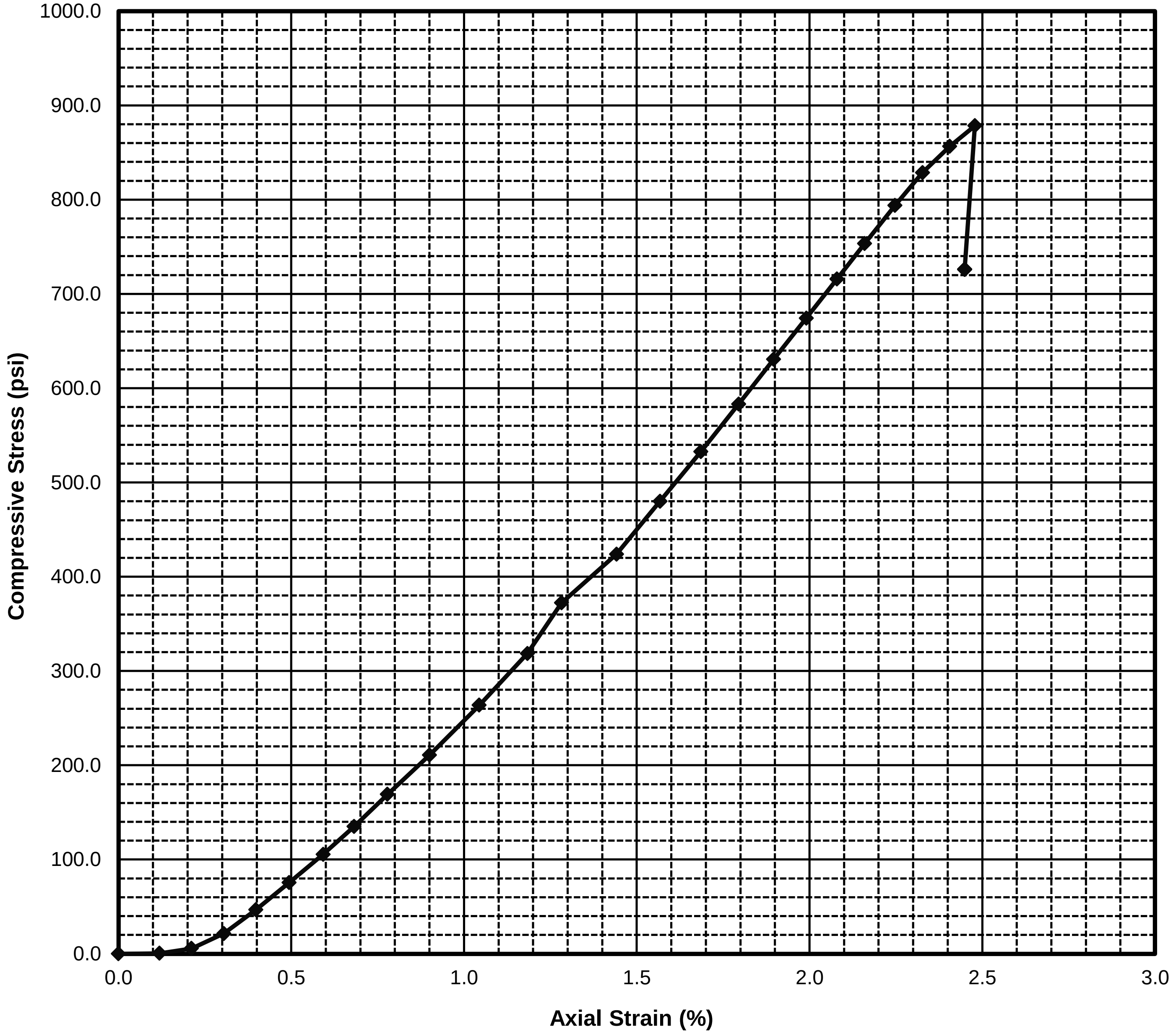


Failure Sketch

Water Content (%)	Length (in)	Diameter (in)	Wet Unit Weight (pcf)	Peak Stress (psi)
14.9	4.944	2.400	132.6	599

Project Name:	**Pure Water**
Project Number:	**60530732**
Boring Number:	**SC-02** **Depth (ft): 33.0**
Description and/or Classification:	**Dark gray Siltstone**

UNCONFINED COMPRESSION TEST
ASTM D7012

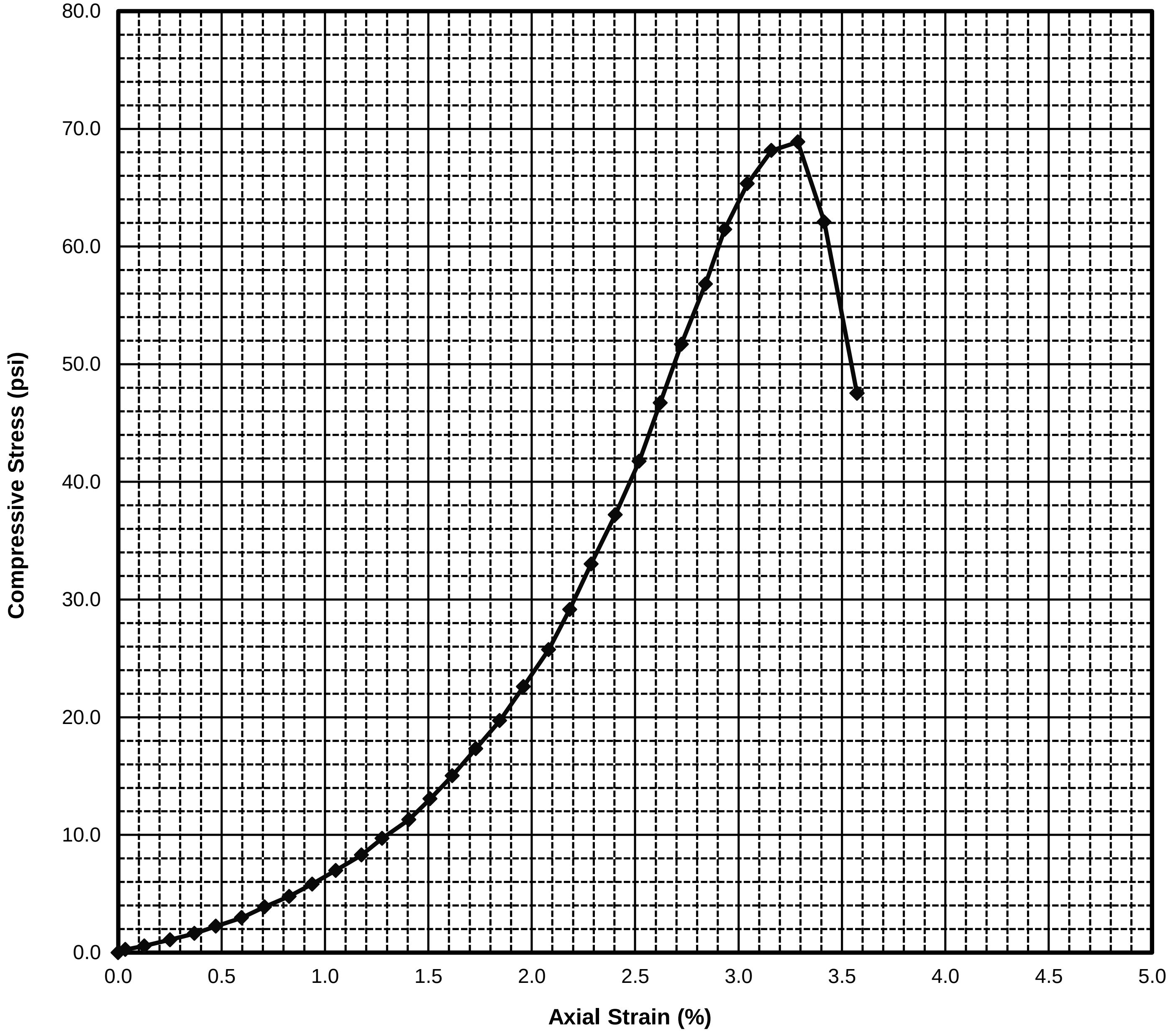


Failure Sketch

Water Content (%)	Length (in)	Diameter (in)	Wet Unit Weight (pcf)	Peak Stress (psi)
15.4	5.081	2.417	134.9	878

Project Name:	**Pure Water**
Project Number:	**60530732**
Boring Number:	**SC-02** **Depth (ft): 56.2**
Description and/or Classification:	**Dark greenish gray Siltstone**

UNCONFINED COMPRESSION TEST
ASTM D7012

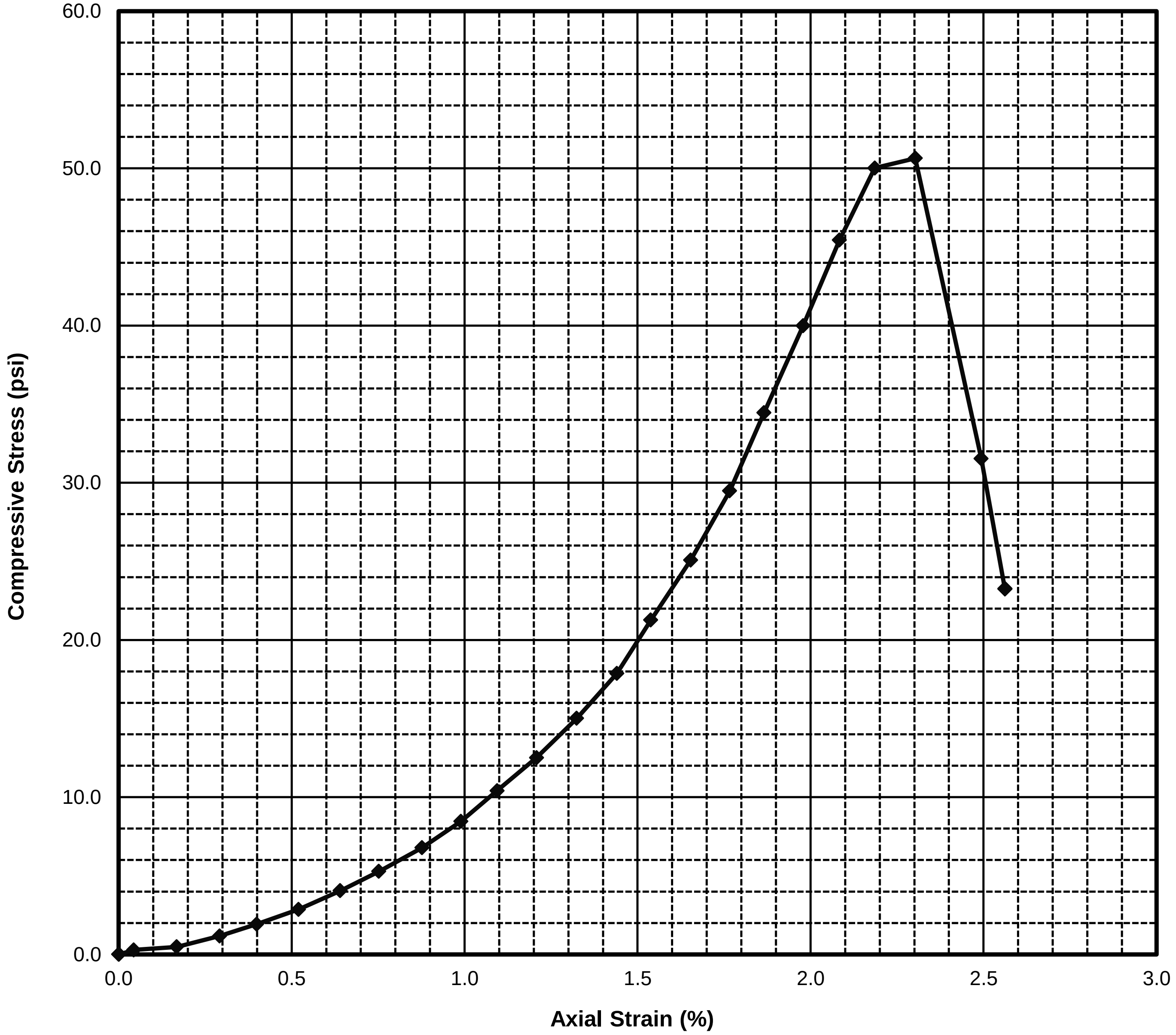


Failure Sketch

Water Content (%)	Length (in)	Diameter (in)	Wet Unit Weight (pcf)	Peak Stress (psi)
20.1	4.927	2.452	126.4	69

Project Name:	**Pure Water**
Project Number:	**60530732**
Boring Number:	**RC-02** **Depth (ft): 84.3**
Description and/or Classification:	**Dark gray Sandstone**

UNCONFINED COMPRESSION TEST
ASTM D7012



Failure Sketch

Water Content (%)	Length (in)	Diameter (in)	Wet Unit Weight (pcf)	Peak Stress (psi)
18.7	4.932	2.447	128.6	51

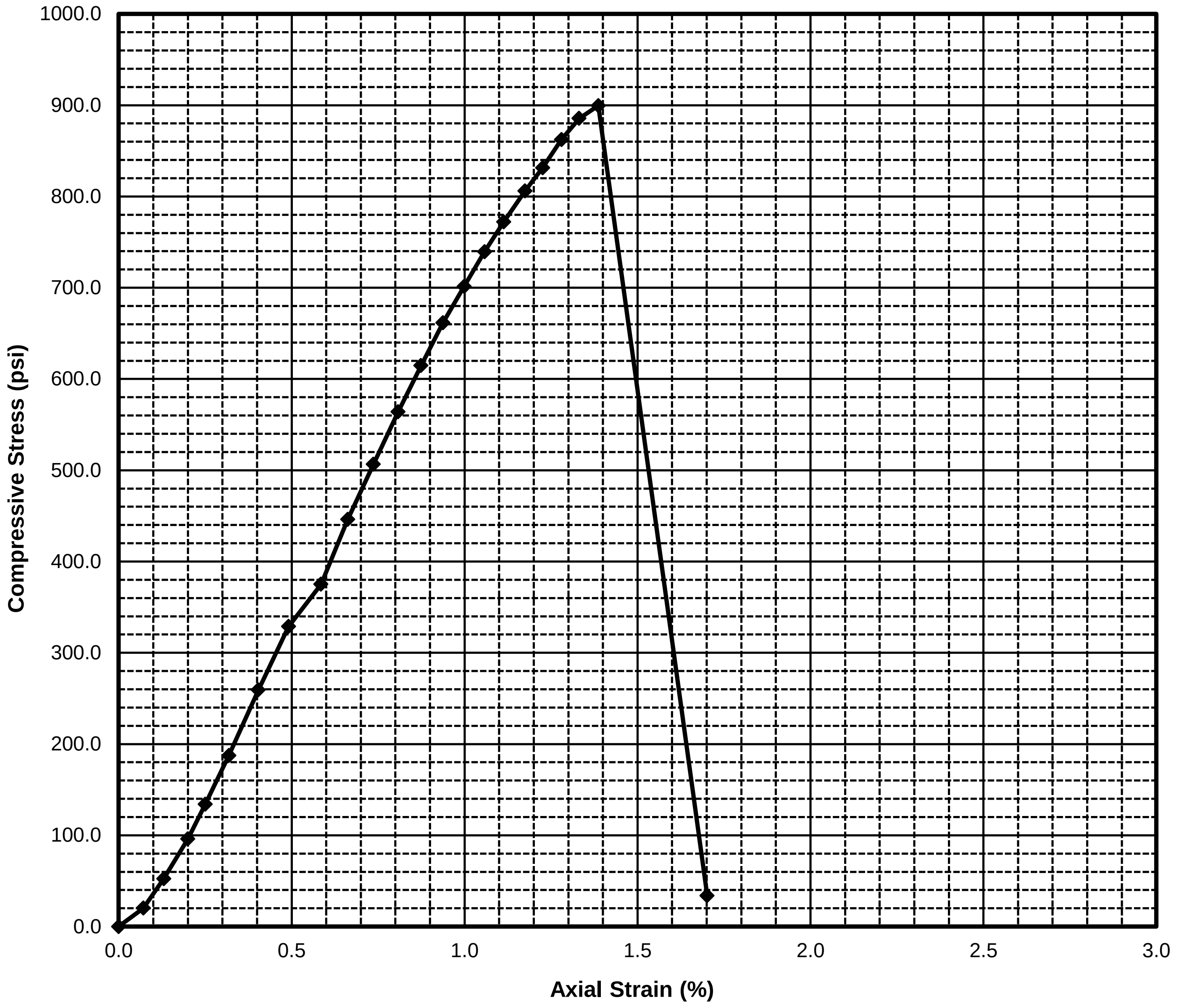
Project Name: Pure Water

Project Number: 60530732

Boring Number: RC-02 **Depth (ft):** 94.0

Description and/or Classification: Gray Sandstone

UNCONFINED COMPRESSION TEST
ASTM D7012

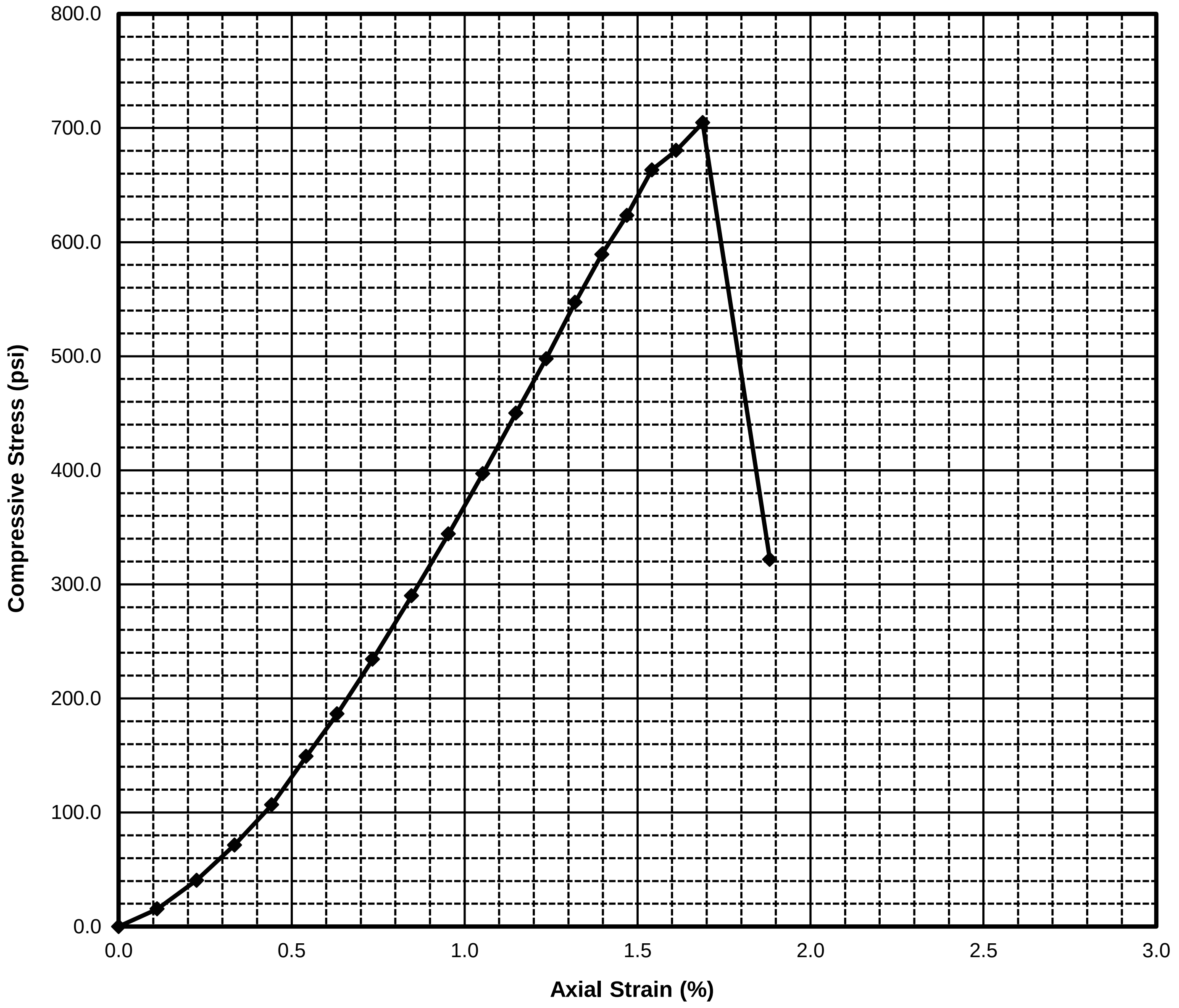


Failure Sketch

Water Content (%)	Length (in)	Diameter (in)	Wet Unit Weight (pcf)	Peak Stress (psi)
15.8	4.976	2.379	134.1	900

Project Name:	**Pure Water**
Project Number:	**60530732**
Boring Number:	**RC-03** **Depth (ft): 64.0**
Description and/or Classification:	**Gray Silstone**

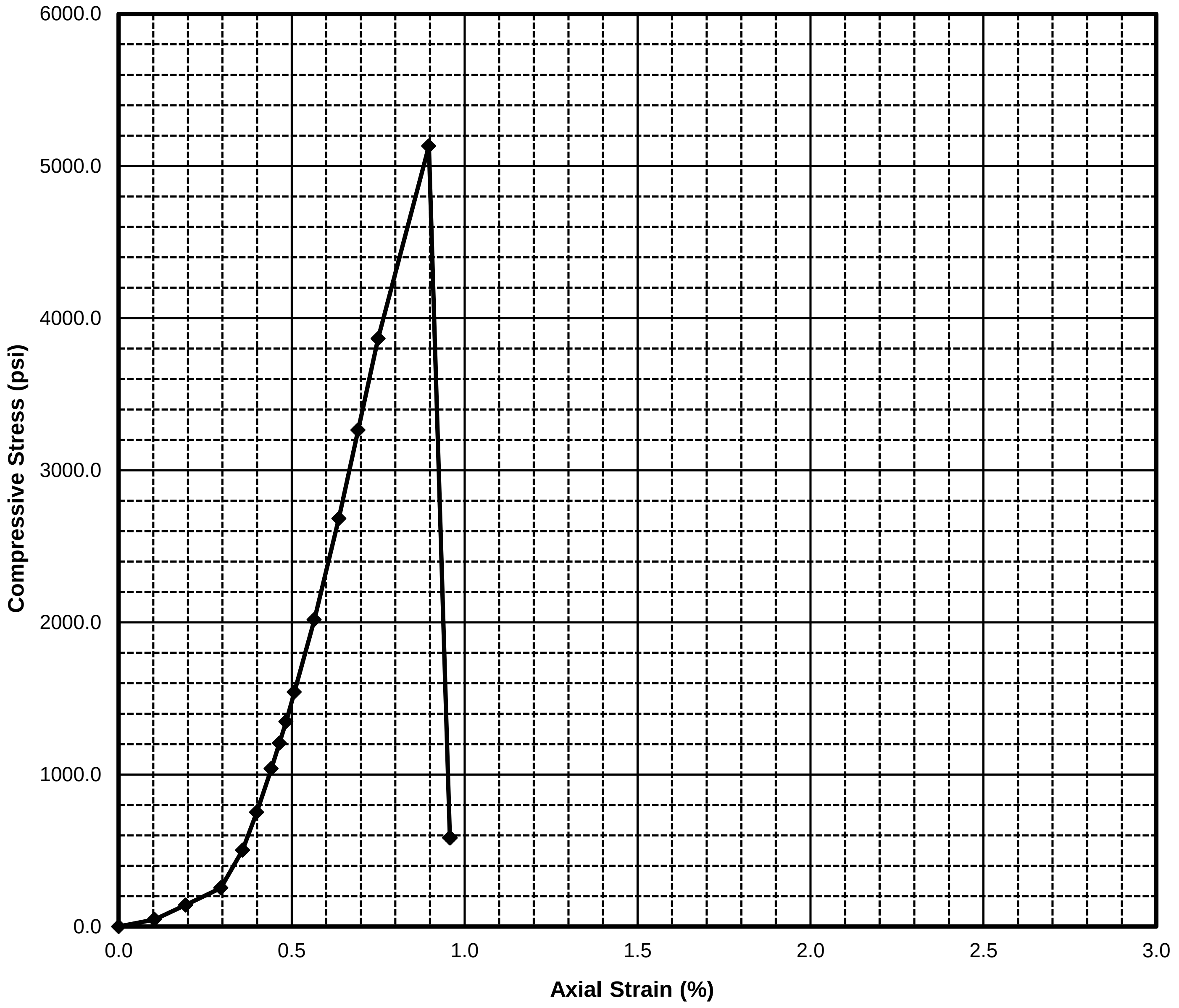
UNCONFINED COMPRESSION TEST
ASTM D7012



Failure Sketch

Water Content (%)	Length (in)	Diameter (in)	Wet Unit Weight (pcf)	Peak Stress (psi)
15.7	4.972	2.382	130.0	705

Project Name:	**Pure Water**	**UNCONFINED COMPRESSION TEST** **ASTM D7012**
Project Number:	**60530732**	
Boring Number:	**RC-03** **Depth (ft): 72.5**	
Description and/or Classification:	**Gray Siltstone**	

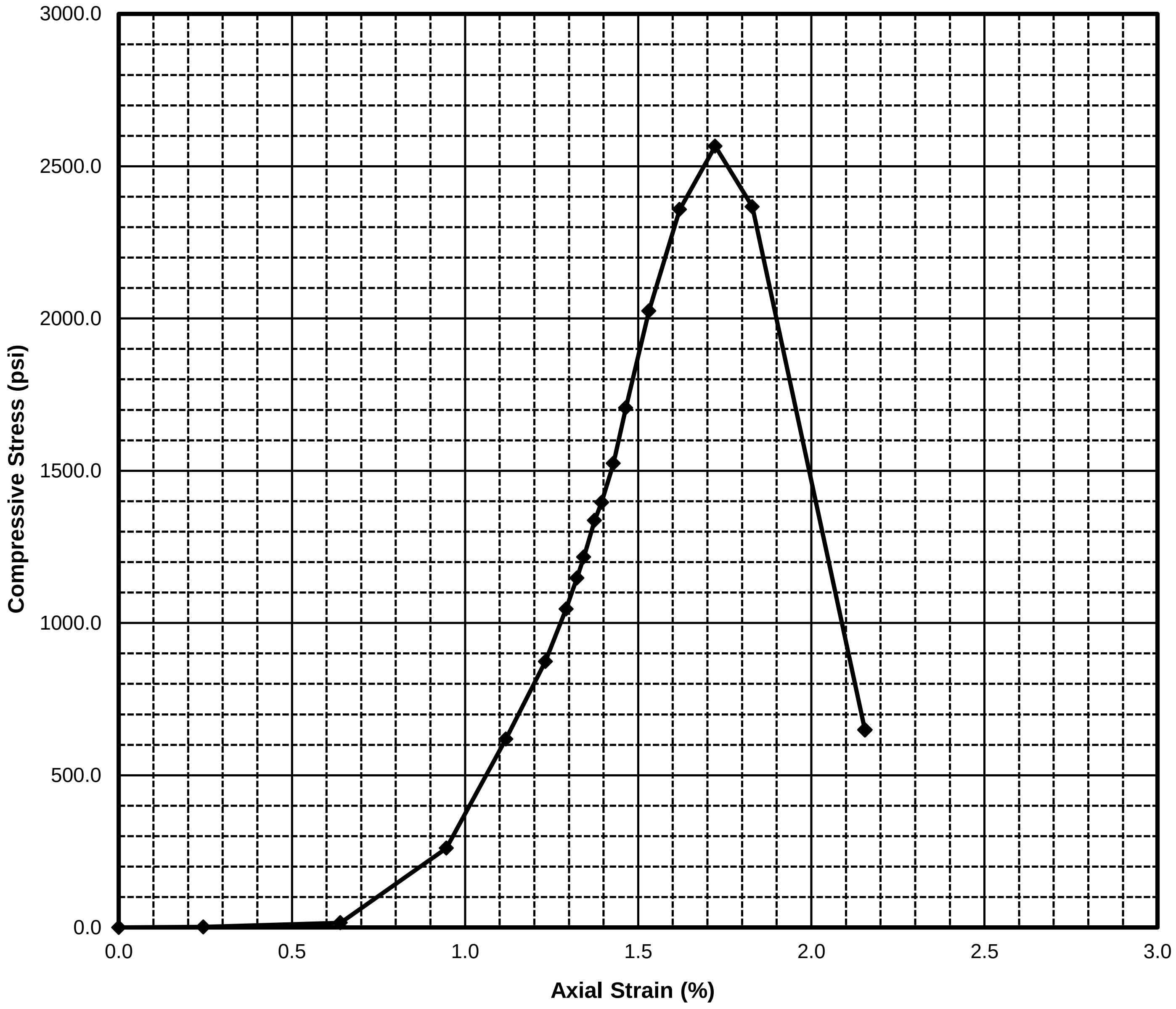


Failure Sketch

Water Content (%)	Length (in)	Diameter (in)	Wet Unit Weight (pcf)	Peak Stress (psi)
1.0	5.012	2.382	162.5	5132

Project Name:	**Pure Water**
Project Number:	**60530732**
Boring Number:	**RC-03** **Depth (ft): 82.0**
Description and/or Classification:	**Gray Sandstone**

UNCONFINED COMPRESSION TEST
ASTM D7012

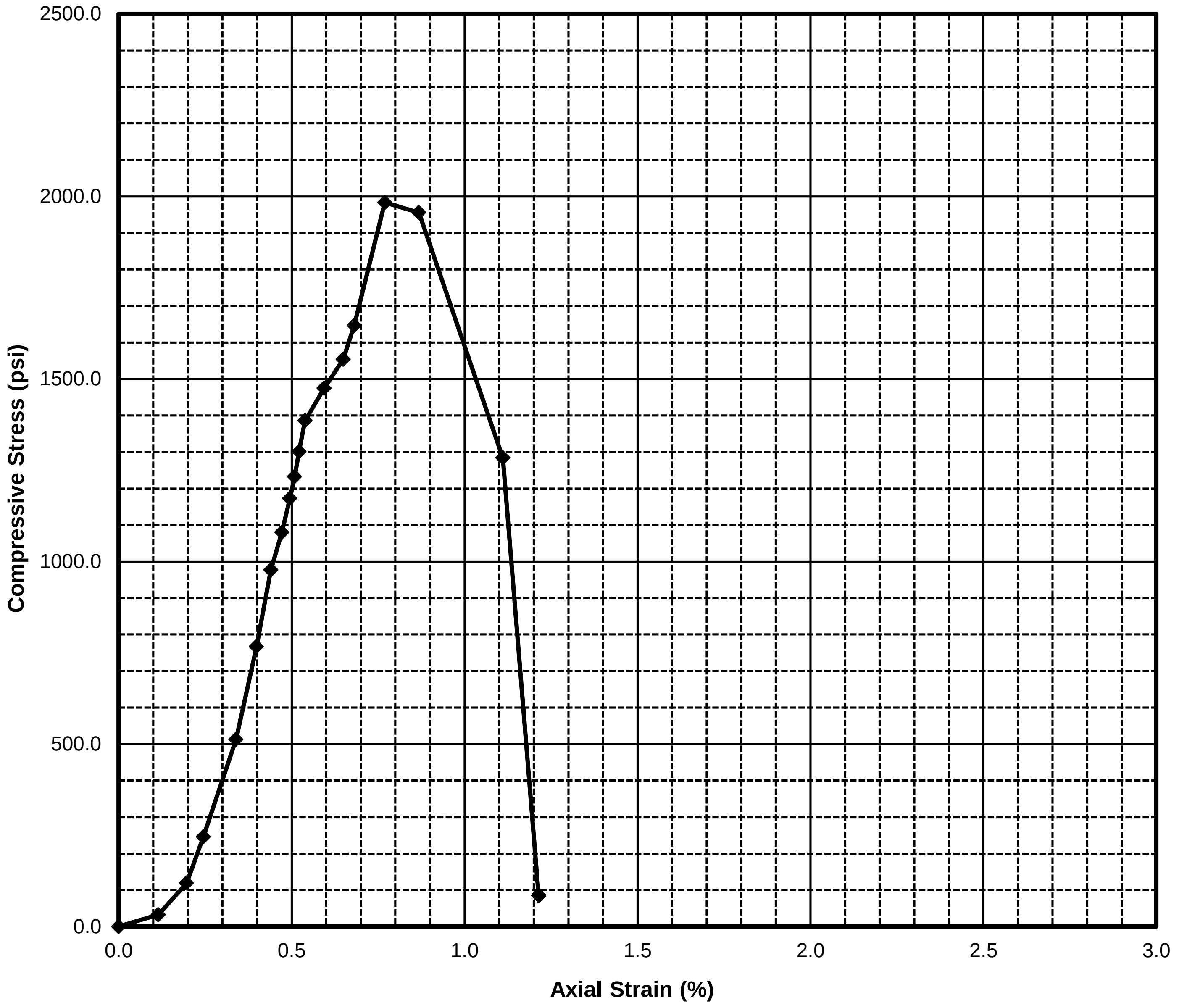


Failure Sketch

Water Content (%)	Length (in)	Diameter (in)	Wet Unit Weight (pcf)	Peak Stress (psi)
1.5	4.334	2.375	159.4	2566

Project Name:	**Pure Water**
Project Number:	**60530732**
Boring Number:	**SC-03** **Depth (ft): 39.2**
Description and/or Classification:	**Gray Sandstone**

UNCONFINED COMPRESSION TEST
ASTM D7012

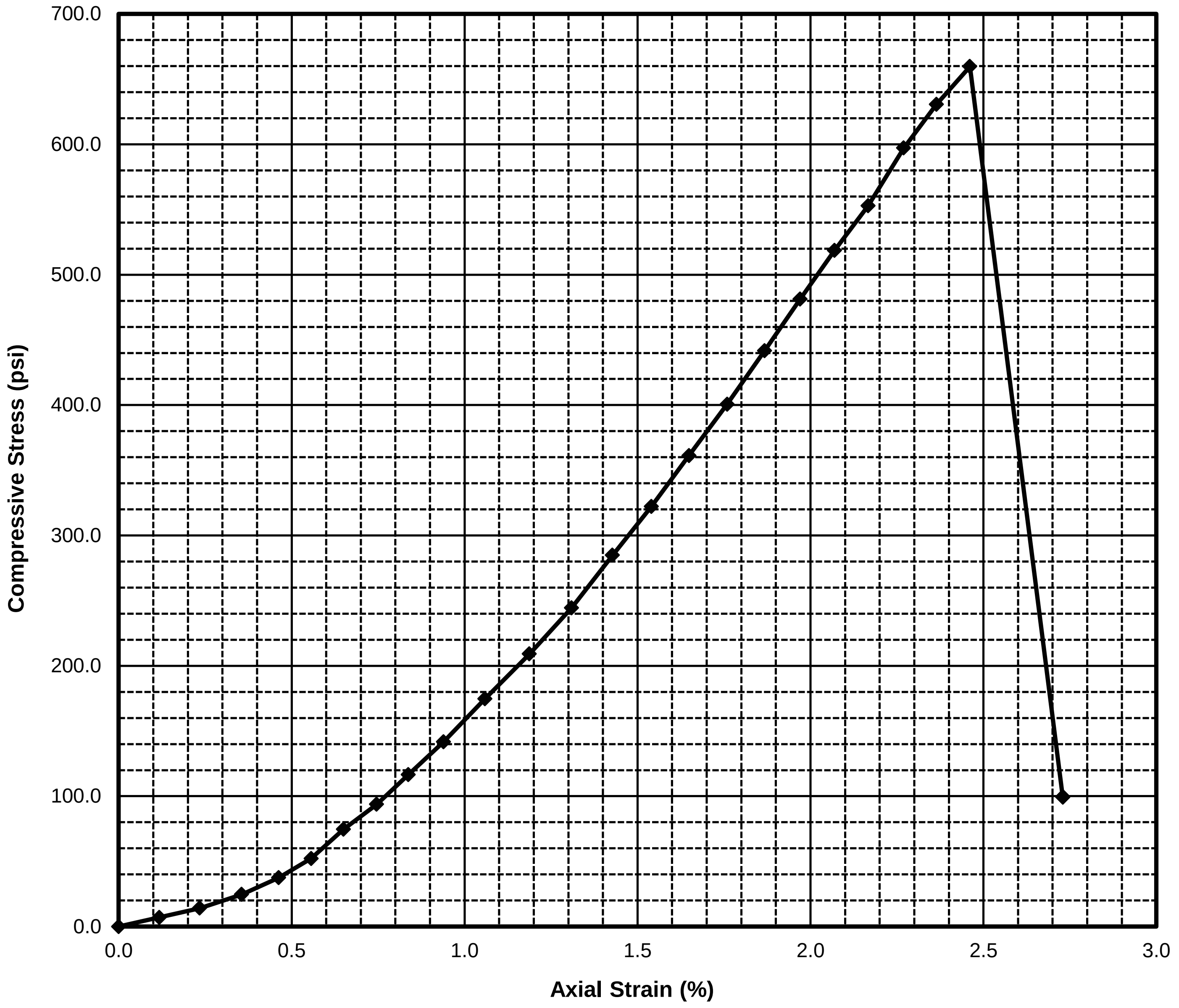


Failure Sketch

Water Content (%)	Length (in)	Diameter (in)	Wet Unit Weight (pcf)	Peak Stress (psi)
0.6	5.023	2.377	162.8	1983

Project Name:	**Pure Water**
Project Number:	**60530732**
Boring Number:	**SC-03** **Depth (ft): 48.0**
Description and/or Classification:	**Gray Sandstone**

UNCONFINED COMPRESSION TEST
ASTM D7012

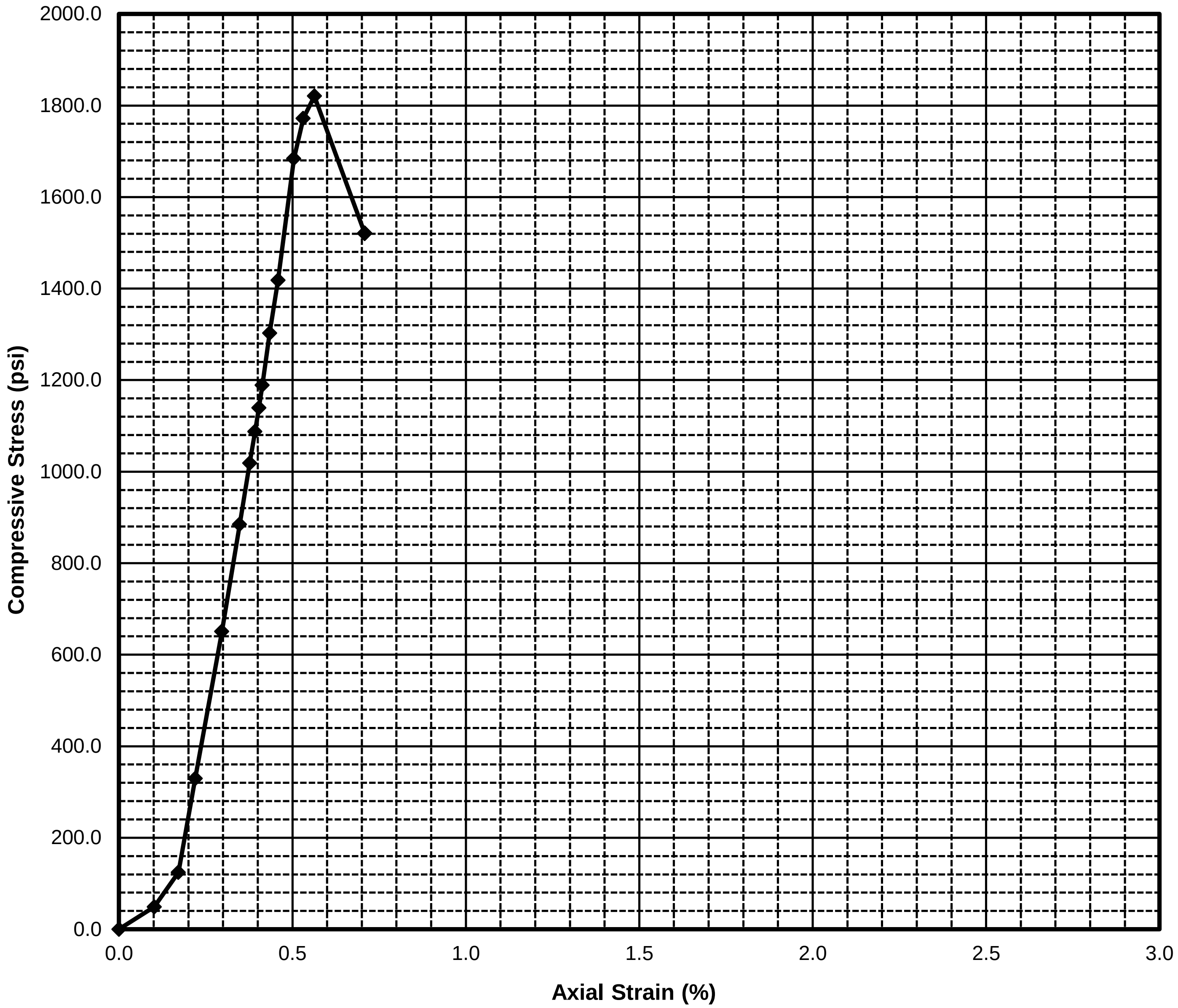


Failure Sketch

Water Content (%)	Length (in)	Diameter (in)	Wet Unit Weight (pcf)	Peak Stress (psi)
15.4	4.994	2.379	128.3	660

Project Name: **Pure Water**
Project Number: **60530732**
Boring Number: **SC-03** **Depth (ft):** **49.5**
Description and/or Classification: **Gray Siltstone**

UNCONFINED COMPRESSION TEST
ASTM D7012



Failure Sketch

Water Content (%)	Length (in)	Diameter (in)	Wet Unit Weight (pcf)	Peak Stress (psi)
11.0	4.960	2.380	161.8	1821

Project Name: **Pure Water**

Project Number: **60530732**

Boring Number: **SC-03** **Depth (ft):** **50.8**

Description and/or Classification: **Gray Siltstone**

UNCONFINED COMPRESSION TEST
ASTM D7012

POINT LOAD TEST
ASTM D 5731

Project Number: 60530732
Project Name: Pure Water
Project Engineer: DS

Tested By: ADC
Date: 5/24/2017

Test Type Legend

d = diametral
a = axial
b = block
i = irregular lump
\\ = parrallel to plane of weakness
p = perpendicular to plane of weakness

Formulas

$De^2 = D^2$ or 4A / (pi) ; A = WD (De = equivalent core diameter)

$Is = (P / De^2) * 1000$

$Is_{(50)} = F * Is$; For standard 50 mm sample, $F = [(De / 50)]^{0.5,}$ else $F = [(De / 50)]^{0.45}$

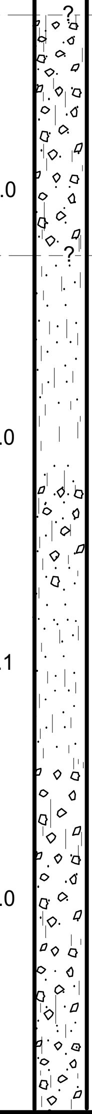
Boring Number	Depth (ft)	Water Content (%)	Test Type		Diameter (mm)	Width (mm)	Length (mm)	Load P (kN)	De (mm)	De^2 $(mm)^2$	Strength Index Is (MPa)	Corr. Strength $Is_{(50)}$ (MPa)	Corr. Strength $Is_{(50)}$ (psi)	Compressive Strength from Table 1 (Mpa)
SC-02	44.5	1.5	a		61	59		0.0	68.1	4633	0.00	0.00	0	0
SC-02	43.0	0.9	a		61	58		16.5	67.0	4492	3.68	4.20	609	90
SC-02	43.8	0.8	a		61	56		11.8	66.4	4408	2.69	3.05	443	66
SC-02	45.2	9.6	a		61	56		0.2	66.2	4379	0.05	0.06	8	1

APPENDIX C

FIELD EXPLORATIONS FROM CONCURRENT STUDIES
(ALLIED GEOTECHNICAL ENGINEERS, 2017)

BORING NO. H-7

DATE OF DRILLING: MAY 12, 2017	TOTAL BORING DEPTH: 100.5 FEET
GENERAL LOCATION: AERATION BASINS	
APPROXIMATE SURFACE ELEV.: +356 FEET MSL	DRILLING CONTRACTOR: TRI-COUNTY DRILLING. INC..
DRILLING METHOD: 8 INCH HSA	LOGGED BY: NICK BARNES



DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
1							Lawn sod in the upper 2 inches
2				**FILL**			
3				Yellow brown to reddish yellow, damp, silty sand (SM) with scattered sub-rounded gravel up to 3" in maximum dimension.			
6	1	7	0.0		10.6		
	2						
7				? ?			?
8				**VERY OLD PARALIC DEPOSITS**			
10	3	100+	0.0	Yellow brown to reddish yellow, damp, very dense, fine to medium-grained silty sand (SM) with abundant sub-rounded gravel up to 3" in maximum dimension.	8.1		
12				? ?			?
13	4			**SCRIPPS FORMATION**			Driller added water inside of auger to assist in bringing soil cuttings to ground surface
16	5	100+	0.0	Olive yellow to pale yellowish red, damp, very dense, fine to medium-grained silty sand (SM).	13.0		Sampler bouncing on rock last 1"
17				16.5' - 19', gravelly zone			
21	6	100+	0.1	Medium gray, fine-grained silty sand, grading into a light yellow brown, medium-grained, poorly graded sand with silt (SP-SM).	17.4	104.5	
24				At 23', abrupt transition into a gravel conglomerate with an olive brown to yellow brown silty sand (SM) matrix.			
26	7	100+	0.0		8.4		
27							
28							
29							

PROJECT NO. 44F1	ALLIED GEOTECHNICAL ENGINEERS, INC.	FIGURE A-17

BORING NO. H-7 (Continued)

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
31					**SCRIPPS FORMATION**			Did not attempt sampling between depth of 30' and 35' due to abundant gravel
32	8							
33					Gravel conglomerate with an olive brown to yellow brown silty sand (SM) matrix.			
36					End of conglomerate zone at 37'.			
40	9	100+						No sample recovery
45					Olive/gray to pale reddish yellow, damp, hard, sandy lean clay (CL).			
46	10	100+	0.0			23.2		
51	11	100+	0.0		Pale greenish gray to medium gray, hard, lean clay (CL).	20.8	112.7	
55	12	100+	0.0		Pale yellow brown to pale reddish yellow, damp, very dense, fine to medium grained, silty sand (SM).	21.5		
60	13	100+	0.0		Olive color.	21.3	107.6	

BORING NO. H-7 (Continued)

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
					SCRIPPS FORMATION			
63								
64								
65	14	100+	0.0		Gray to pale reddish yellow, damp, hard, lean clay (CL).	24.0		
66								
67								
68								
69								
70	15	100+	0.0			20.5	117.7	
71								
72								
73								
74								
75					74' - 76', gravel zone.			Did not attempt 75' sample due to abundant gravel.
76								
77								
78								
79								
80	16	100+	0.0		Dark gray, damp, hard, claystone (CL/CH).	22.3		
81								
82								
83								
84								
85								
86								
87								
88								
89								
90	17	100+	0.2		Similar to above.	20.6		
91								
92								
93								

PROJECT NO.
44F1

ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE A-19

BORING NO. H-7 (Continued)

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
95				▨	**SCRIPPS FORMATION** Dark gray, hard claystone (CL/CH).			
96				▨				
97				▨				
98				░				
99				░	Medium gray, damp, very dense, fine-grained silty sand (SM).			
100	18 ◩	100+	0.1	░		8.2		

NOTES:

Bottom of borehole at 100.5 feet.

Unable to determine if groundwater is present. Method of drilling required introduction of water into borehole.

APPENDIX D2

REPORT OF GEOTECHNICAL INVESTIGATION NORTH CITY WATER RECLAMATION PLANT EXPANSION CITY OF SAN DIEGO

Submitted to:
CH2M
402 West Broadway, Suite 1450
San Diego, CA 92101

Prepared By:

ALLIED GEOTECHNICAL ENGINEERS, INC.
9500 Cuyamaca Street, Suite 102
Santee, California 92071-2685

July 25, 2017
(Revised August 9, 2017)

AGE

Allied Geotechnical Engineers, Inc.

July 25, 2017
(Revised August 9, 2017)

Mr. Julian Hoyle, P.E.
CH2M
402 West Broadway, Suite 1450
San Diego, CA 92101

Subject: **REPORT OF GEOTECHNICAL INVESTIGATION**
NORTH CITY WATER RECLAMATION PLANT EXPANSION
CITY OF SAN DIEGO
AGE Project No. 44F1

Dear Mr. Hoyle:

Allied Geotechnical Engineers, Inc. (AGE) is pleased to submit the accompanying "Report" to present the findings, opinions, and recommendations of a geotechnical investigation that was performed to assist CH2M with their design of the subject project. Upon our receipt of review comments from CH2M and the City of San Diego, we will prepare and submit a "Final Report" that will incorporate our response to the review comments that we received.

If you have any questions regarding the contents of this report or if we may be of further assistance, please feel free to give us a call. We greatly appreciate the opportunity to be of service on this important project for the City of San Diego.

Respectfully submitted,

ALLIED GEOTECHNICAL ENGINEERS, INC.

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REPORT OF GEOTECHNICAL INVESTIGATION
NORTH CITY WATER RECLAMATION PLANT EXPANSION
CITY OF SAN DIEGO

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1.0 INTRODUCTION

Allied Geotechnical Engineers, Inc. (AGE) is pleased to submit this report to present the findings, opinions, and recommendations of a geotechnical investigation conducted to assist CH2M with their design of the North City Water Reclamation Plant (NCWRP) Expansion for the City of San Diego (City). The investigation was performed in conformance with the subconsultant agreement entered into by and between CH2M and AGE on February 6, 2017.

This report has been prepared for the exclusive use of CH2M and its design team subconsultants and the City in their design of the project as described herein. The information presented in this report is not sufficient for any other uses or the purposes of other parties.

2.0 SITE AND PROJECT DESCRIPTION

The existing NCWRP is located at 4949 Eastgate Mall in the Miramar area of San Diego, California (See Figure 1 - Location Map). The site is bounded by Eastgate Mall to the north, Miramar Road to the south, an SDG&E easement to the northeast and the I-805 freeway to the southwest.

The site occupies a mesa top that was dissected by two southwest trending canyons prior to site grading. The larger of these canyons traversed the central portion of the site, and was 50 to 60 feet in depth with two main tributaries entering from the south. A pre-existing 60-inch diameter storm drain was reportedly present in the bottom of the canyon. A second smaller canyon was located in the southern portion of the site, and was on the order of 40 feet in depth. This smaller canyon had previously been infilled where Miramar Road crosses the canyon. During site earthwork for the construction of NCWRP an 18-inch diameter storm drain was installed in the bottom of the smaller canyon. Original site elevations at the project site range between +315 feet to +385 feet above the mean sea level (msl). Following completion of the construction of the NCWRP, the site elevations range between + 325 feet and +390 feet msl.

Existing site improvements include an operations building, flow equalization tanks, primary, secondary and tertiary filtration basins, aeration tanks, various pump stations and electrical rooms, an advanced water treatment demonstration plant, a chemical building, various outbuildings, a cogeneration facility, asphaltic concrete (a.c.) paved roadways and parking, and landscaping. The site is fenced, with a guard shack at the entrance gate. As-built record drawings prepared by CH2M (1997) indicate that original construction of the facility was completed by 1997. A site plan showing the existing improvements is shown in Figure 2.

Prior geotechnical investigations for the design and construction of the NCWRP include studies performed by Woodward-Clyde Consultants (WCC, 1990a and b), Geotechnical Consultants (GC, 1990), and Ninyo & Moore (1991a and b).

CH2M Hill (1992) performed a geotechnical investigation for the NCWRP. The investigation included the excavation of nineteen (19) soil borings and twenty one (21) test pits. CH2M reported that the project site was underlain at depth by the Eocene age Scripps Formation, and that the Scripps Formation was overlain in areas by terrace deposits belonging to the Lindavista Formation. Topsoil and colluvial deposits reportedly mantled much of the site, with alluvial deposits present in the canyon bottoms.

The CH2M Hill report (1992) included earthwork and foundation recommendations for the design and construction of the NCWRP. The report concluded that the site was favorable for the proposed construction, but that significant grading would be required. The report further indicated that the site grading would include the placement of up to 40 feet of compacted fill materials, with the majority of the fill to be placed in the existing canyons. The report also stated that the alluvial/colluvial materials were to be removed prior to fill placement, and that these materials were considered unsuitable for use as compacted fill. The report indicated that fill materials were to be derived from on-site sources, and further stated that some processing of the fill was required to remove oversize material. The report specified that the fill was to be compacted to a minimum of 95 percent of the laboratory maximum dry density in accordance with American Society of Testing and Materials (ASTM) test method D1557. CH2M Hill also determined that on-site soils are highly corrosive to buried metals and concrete.

Earthwork specifications prepared by CH2M Hill for the construction of the NCWRP required that backfill placed within 5 feet of structural walls was to consist of clean well-graded granular material with a maximum particle size of 4-inches and no more than 5 percent passing the No. 200 sieve. Structural fill located within the zone of influence of structures and pipelines was required to have a maximum particle size of 6-inches and no more than 20 percent passing the No. 200 sieve. In addition, a 6-inch thick layer of crushed rock was required beneath foundations for the various structures. The crushed rock was to be well-graded from course to fine and contain no more than 8 percent passing the No. 200 sieve, with a maximum particle size of 1 ½ inches and compacted to at least to 95 percent of the laboratory maximum dry density in accordance with ASTM test method D1557. Documentation regarding placement of the fill materials at the project site is not available for review.

The currently proposed project consists of an expansion of the existing NCWRP and adding a pump station and pipeline conveyance for the proposed North City Pure Water Facility (NCPWF). A review of the 30% submittal project plans prepared by CH2M (May, 2017) indicates that the scope of the proposed project will include the facilities described on the next page. The proposed improvements are shown on Figure 2.

Prior geotechnical investigations for the proposed project include a 10% Draft Report of Desktop Geotechnical Investigation for the North City Plant Upgrades and AWPF Influent Pump Station (K2 Engineering, 2016) and a Preliminary Desktop Geotechnical Investigation for the Proposed Secondary Clarifiers, Equalization Basin and Chemical Storage Farm (Brown & Caldwell, 2016).

Primary Sedimentation Tanks

New primary sedimentation tanks are planned on the southeast side of the existing primary sedimentation tanks. The primary sedimentation tanks are located in the southerly portion of the NCWRP facility adjacent to the Equalization basins. The new sedimentation tanks are designated as Tank Nos. 7, 8, and 9, and are planned to be of reinforced concrete construction. The reinforced floor slabs are to be 2 feet thick, with the slab elevations varying from +355.00 to +357.00 feet msl. The top of the roof parapet is at an elevation of +396.00 feet msl. The proposed construction will require partial demolition and conversion of the existing sedimentation tanks.

Equalization Basin

A new equalization basin is to be constructed southeast of the existing equalization tanks and adjacent to Miramar Road. The proposed tank is a circular reinforced concrete structure with an outside core wall diameter of 120 feet and wall height of 30 feet - 10 inches, with a wall thickness of 12 inches. The concrete roof is to be supported by 32 interior columns, and will slope toward a central drain from an elevation of +403.83 feet msl at the perimeter parapet to the drain elevation of +403.00 feet msl. The perimeter footing and interior column footings are to be underlain with 24-inch thick crushed rock over undisturbed earth or prepared subgrade.

The high point elevation of the perimeter footing will be 372.17 feet msl with the low point elevation at the center of the tank at 368.0 feet msl. The maximum water elevation is to be 399.3 feet msl. The equalization tank will be partially subterranean.

First Stage Bioreactor Basins

New first stage bioreactor basins will be constructed along the northwest side of the existing aeration basins in the south-central portion of the site. The existing aeration basins will be modified to become part of the first stage bioreactor basins. The basins will be mostly subterranean reinforced concrete structures, with concrete footings up to 4 feet - 6 inches thick and a sloping floor slab that typically varies between elevations of +341.00 and +341.50 feet msl. The roof height is at elevation of +365.00 feet msl. A wedge-shaped area of controlled low strength material (CLSM) will be placed below a gallery attached to the northeast side of the structure.

Second Stage Bioreaction Basins

The existing secondary clarifier basins located in the central portion of the site are to be converted into new second stage bioreaction basins. The work will include adding onto the southeast side of the existing basin and extending the basin further southwest into an undeveloped portion of the site. The work will require partial demolition and conversion of the existing clarifiers, including adding concrete fill to re-level the floor slab and achieve the design elevation of the new basins.

The plans indicate that the new second stage bioreaction basins are reinforced concrete structures with an interior floor slab that is 1 foot - 10 inches thick at an elevation of 344.17 feet msl. The basins are mostly subterranean, with a roof elevation of 361.50 feet msl. A wedge-shaped area of CLSM will be placed below a gallery attached to the southwest side of the structure. A new 96-inch diameter pipeline will extend from the second stage bioreaction basins to the inlet structure for the new secondary clarifiers.

Secondary Clarifiers

A total of four (4) new secondary clarifiers are to be added in the east-central portion of the site. The clarifiers will be circular reinforced concrete structures with inside diameters of 150 feet and wall heights of approximately 21 feet. The clarifiers will be provided with premanufactured aluminum geodesic dome roofs supported by the perimeter walls. The plans indicate that the perimeter concrete walls will be 2 feet-3 inches thick, and the mat slabs will be 36 inches thick.

The plans indicate a high point elevation of the slabs at +337.75 feet msl around the perimeter walls, with a low point elevation in the central portions of the slabs of +337.25 feet msl. The leak test maximum water elevation is anticipated at elevation +357.75 feet msl. The clarifiers will be partially subterranean.

The proposed structures are located above the larger canyon. It is anticipated that the proposed structures will be partially supported on filled ground and partially on undisturbed formation.

The existing 60-inch diameter storm drain pipe is located beneath Clarifier Nos. 2 and 4 with invert elevations ranging from +305 feet to +314 feet msl. Construction of the proposed structures will also include the installation of several pipelines ranging in diameter from 48- to 96-inch in diameter, and a central influent distribution structure located between the four clarifiers. The distribution structure is approximately 29-foot square in dimension, and will be supported on a 24-inch thick mat foundation with top of slab at elevation of +340 feet msl. The plan indicate that the distribution structure will be underlain with CLSM.

Tertiary Filters Building

A new tertiary filters building will abut the southwest side of the existing tertiary filters building. The lower gullet of the new building will have a 2-foot thick floor slab at elevation of +326.00 feet msl. The upper gullet will have an 18-inch thick floor slab at elevation of +334.50 feet msl. The scope of work will require some modification of the existing tertiary filter building.

NCPWF Influent Pump Station and Pipeline

A new NCPWF influent pump station will be constructed in a lawn area located north of the existing effluent pump station. The pump station building will be supported on mat foundation with finish grade elevation of +342.5 feet msl. To minimize the potential for additional foundation surcharge loading on the existing adjacent Chlorine Contact Tanks No. 3, a 24-inch thick subterranean concrete wall will be constructed between the proposed building and existing tanks. Furthermore, the proposed pump station building will be supported on CLSM.

The 42-inch diameter influent pipeline will extend northwesterly from the new pump station, and then continue in a northerly direction along the northwest boundary of the project site. The pipeline will then turn northeast and extends through the proposed construction Primary Staging Area and Eastgate Mall, and terminate on the north side of Eastgate Mall for a future connection to the NCPWF. The pipeline will be above-grade where it exits the pump station, with the remainder of the pipeline below-grade with a minimum cover of at least 5-feet above the crown of the pipe.

Retaining Wall

The design and construction of a retaining wall along the fill slope on the east side of the proposed Secondary Clarifiers Tanks. Based on the review of the preliminary project plans, it is our understanding that the wall will have a maximum height on the order of 15 feet and support 2 : 1 (horizontal : vertical) sloping filled ground. The bottom of retaining wall foundation is estimated to be located at approximate elevation of +321 feet above the mean sea level (msl).

Chemical Building

The proposed structure will be located in the central portion of the eastern boundary of the project site, and is anticipated to consist of a light canopy supported on 12- to 16-inch thick reinforced mat slab foundation.

Other Work

The project plans indicate that the scope of the project will also include the following:

- Re-alignment of the entrance road and guard shack to match the future NCPWF;
- Re-alignment of various roadways and the addition of a new parking area located east of the operations building;
- Localized grading at the locations of new and/or upgraded facilities;
- Various renovation and upgrading of existing facilities;

- New above-grade and below-grade pipelines;
- Re-location of the power generation facility;
- Installation of various retaining structures;
- Re-location and upgrading of various underground utilities;
- Installation of BMP biofiltration basins at ten (10) separate locations in the facility. The BMP areas will comply with City of San Diego 2016 stormwater standards; and
- Various restoration work and upgrading of sidewalk ramps to meet current ADA standards.

3.0 OBJECTIVE AND SCOPE OF INVESTIGATION

The objectives of this investigation were to characterize the subsurface conditions in the project study area and to develop geotechnical recommendations for use in the design of the currently proposed project. The scope of our investigation included several tasks which are described in more detail in the following sections.

3.1 Information Review

This task involved a review of readily available information pertaining to the proposed project, including the preliminary project plans, as-built utility maps, topographic maps, published geologic literature and maps, and AGE's in-house references. A listing of references that were reviewed is presented in Section 8.0.

3.2 Geotechnical Field Exploration

The field exploration program for this project was performed during the period between May 1 and May 26, 2017. A total of twenty two (22) soil borings were performed at the approximate locations shown on Figure 3. The borings were advanced using conventional hollow-stem auger, air percussion and mud rotary drilling methods to depths ranging from 19.5 feet to 101 feet below the existing ground surface (bgs). A brief description of the location and depth, and the subsurface conditions encountered in each boring is presented in Table 1. A more detailed description of the drilling and sampling activities, and logs of the borings are presented in Appendix A.

Prior to commencement of the drilling operations, several site visits were performed to observe existing site conditions and to select suitable locations for the borings. Subsequently, clearance of the proposed boring locations with respect to existing buried utilities was coordinated through Underground Service Alert (USA) and City's personnel. In addition, Cable Pipe & Leak Detection (CPL) was retained to perform independent utility clearance services. Existing buried utilities in the project study area include: potable water and sanitary sewer pipelines; effluent and sludge lines; storm drains; natural gas and electrical transmission lines; and cable, telephone, and fiber optic lines.

Table 1

Summary of Borings

Boring ID	**Proposed Facility**	**Boring Depth (feet)**	**Existing Pavement Section**	**Subsurface Conditions**	**Estimated G.W. Depth (feet bgs)**
H-1	New EQ Basin	81	N/A	Qaf to 8 feet, Qvop to 13 feet and Tsc to the maximum depth of exploration	N/A*
H-2	New EQ Basin	51	N/A	Qaf to 15 feet and Tsc to the maximum depth of exploration	N/A*
H-3	New Primary Clarifier	80.5	N/A	Qaf to 7 feet, Qvop to 13 feet and Tsc to the maximum depth of exploration	N/A*

Table 1

Summary of Borings

(continued)

Boring ID	Proposed Facility	Boring Depth (feet)	Existing Pavement Section	Subsurface Conditions	Estimated G.W. Depth (feet bgs)
H-4	New Primary Clarifier	51	N/A	Qaf to 3 feet, Qvop to 14 feet and Tsc to the maximum depth of exploration	N/A*
H-5	New Aeration Basins	51.5	7.5" A.C., no base	Qaf to 22 feet and Tsc to the maximum depth of exploration	N/A*
H-6	New Aeration Basins	50.5	8" A.C., no base	Qaf to 25 feet and Tsc to the maximum depth of exploration	N/A*
H-7	New Aeration Basins	100.5	N/A	Qaf to 7 feet, Qvop to 12 feet and Tsc to the maximum depth of exploration	N/A*
H-8	New Tertiary Filters	56.5	N/A	Qaf to 49 feet and Tsc to the maximum depth of exploration	N/A*
H-9	New NCPWF IPS	80.5	N/A	Qaf to 34 feet and Tsc to the maximum depth of exploration	N/A*
H-10	New NCPWF IPS	80.5	N/A	Qaf to 32 feet and Tsc to the maximum depth of exploration	N/A*

Table 1

Summary of Borings

(continued)

Boring ID	Proposed Facility	Boring Depth (feet)	Existing Pavement Section	Subsurface Conditions	Estimated G.W. Depth (feet bgs)
H-11	New Secondary Clarifier	81.5	N/A	Qaf to 15 feet and Tsc to the maximum depth of exploration	N/A*
H-12	New Secondary Clarifier	100.5	N/A	Qaf to 28 feet and Tsc to the maximum depth of exploration	N/A*
H-13	New Secondary Clarifier	101	N/A	Qaf to 29 feet and Tsc to the maximum depth of exploration	N/A*
H-14	New Secondary Clarifier	100.5	N/A	Qaf to 28 feet and Tsc to the maximum depth of exploration	N/A*
H-15	Western Pipeline Corridor	21.5	4.5" A.C. over 4" miscellaneous base	Qaf to 3 feet and Tsc to the maximum depth of exploration	Not encountered during drilling
H-16	Western Pipeline Corridor	21.5	7" A.C., no base	Qaf to 1.5 feet and Tsc to the maximum depth of exploration	Not encountered during drilling
H-17	Western Pipeline Corridor	19.5	N/A	Qyc to 3.5 feet and Tsc to the maximum depth of exploration	Not encountered during drilling
H-18	Eastern Pipeline Corridor	21	N/A	Qaf to 2.5 feet and Tsc to the maximum depth of exploration	Not encountered during drilling
H-19	Eastern Pipeline Corridor	21.5	N/A	Qaf to 3 feet and Tsc to the maximum depth of exploration	Not encountered during drilling

Table 1

Summary of Borings

(continued)

Boring ID	Proposed Facility	Boring Depth (feet)	Existing Pavement Section	Subsurface Conditions	Estimated G.W. Depth (feet bgs)
H-20	New Renewable Energy Facility	80.5	4" A.C. over 12" miscellaneous base	Tsc to the maximum depth of exploration	N/A*
H-21	Chemical Storage Facility	21.5	N/A	Qaf to 3 feet, Qvop to 8 feet and Tsc to the maximum depth of exploration	Not encountered during drilling
H-22	New Renewable Energy Facility	80.5	3" gravel	Qaf to 6 feet and Tsc to the maximum depth of exploration	N/A*

Explanation of Abbreviations and Symbols

A.C.	Asphalt Concrete
Qaf	Artificial Fill Materials
Qyc	Young Colluvial Deposits
Qvop	Very Old Paralic Deposits
Tsc	Scripps Formation
*	Unable to determine if groundwater present (Method of drilling required introduction of water into borehole)

3.3 Laboratory Testing

Selected soil samples obtained from the borings were tested in the laboratory to verify field classifications and evaluate certain engineering characteristics. The geotechnical laboratory tests were performed in general conformance with the American Society for Testing and Materials (ASTM) or other generally accepted testing procedures.

The laboratory tests included: in-place density and moisture content, maximum density and optimum moisture content, sieve (wash) analysis, Atterberg Limits, expansion index, shear strength, and consolidation. In addition, representative samples of the onsite soil materials were collected and delivered to Clarkson Laboratories and Supply, Inc. for chemical (analytical) testing to determine soil pH and resistivity, soluble sulfate and chloride concentrations, and bicarbonate content. A brief description of the tests that were performed and the final test results are presented in Appendix B.

4.0 GEOLOGIC CONDITIONS

4.1 Geologic Setting and Site Physiography

The project study area is located in the western portion of the San Diego Embayment, a deep sedimentary-filled basin which is underlain at depth by a basement rock complex of Cretaceous age batholithic and metavolcanic and metasedimentary rocks of Jurassic age. The sedimentary formations consist of nearly flat-lying to gently southwest dipping, marine and non-marine sediments which range from Cretaceous to Holocene in age.

The project site is situated on the Linda Vista marine terrace, a relatively level wave-cut platform. The terrace is deeply eroded, and two tributaries of Rose Creek traverse the site. Grading operations performed during development of the NCWRP site included the partial in-filling of these canyons. Nearby land uses include residential and commercial developments, USMC Air Station Miramar, the Miramar Landfill, and open spaces.

4.2 Tectonic Setting

Tectonically, the San Diego region is situated in a broad zone of northwest-trending, predominantly right-slip faults that span the width of the Peninsular Ranges and extend offshore into the California Continental Borderland Province west of California and northern Baja California. At the latitude of San Diego, this zone extends from the San Clemente fault zone, located approximately 60 miles to the west, and the San Andreas fault located about 95 miles to the east.

Major active regional faults of tectonic significance include the Coronado Bank, San Diego Trough, San Clemente, and Newport Inglewood/Rose Canyon fault zones which are located offshore; the faults in Baja California, including the San Miguel-Vallecitos and Agua Blanca fault zones; and the faults located further to the east in Imperial Valley which include the Elsinore, San Jacinto and San Andreas fault zones.

4.3 Geologic Units

Based on their origin and compositional characteristics, the soil types encountered in the exploratory borings can be categorized into four geologic units which include (in order of increasing age) fill materials; young colluvial deposits; very old paralic deposits; and Scripps Formation. A brief description of each unit (in order of increasing age) is presented below. A generalized geologic map of the project study area is shown on Figure 4. A site specific geologic map is shown on Figure 5, and the geologic cross-sections are shown on Figures 6, 7 and 8 for Cross-Sections A-A’, B-B’ and C-C’, respectively.

4.3.1 Fill Materials

Fill materials, ranging in thickness from 1.5 feet to 49 feet, were encountered in all of the exploratory borings, with the exception of borings H-17 and H-20. The fill materials generally consist of silty sands, sandy silts, clayey sands, and sandy clays with scattered to locally abundant gravel and cobbles. The fill was also found to contain intermixed sandstone and siltstone chunks.

It is our understanding that the fill was placed during development for the NCWRP facility, and that the fill materials were derived from on-site excavations. Although documentation pertaining to the original placement of the fill materials is unavailable, the blow counts and in-situ soil density obtained during the field exploration phase indicate that fill materials may be classified as medium dense to dense.

4.3.2 Young Colluvial Deposits

Young colluvial deposits of Holocene age (Kennedy and Tan, 2008), were encountered in boring H-17 to a depth of 3.5 feet bgs. The deposits consist of dark yellow brown highly plastic and expansive clay containing scattered sub-rounded and fractured gravel and cobbles.

4.3.3 Very Old Paralic Deposits

Portions of the study area are underlain by very old paralic deposits of middle to early Pleistocene age (Kennedy and Tan, 2008). These deposits are also referred to as the Lindavista Formation (Kennedy, 1975) of early Pleistocene age. The formation consists of interfingered strandline, beach, estuarine and colluvial deposits composed of siltstone, sandstone and conglomerate with a distinct reddish-brown color due to ferruginous cement. The combination of strong cementation and locally abundant gravels and cobbles pose difficult excavation conditions even for heavy duty construction equipment.

Very old paralic deposits were encountered below the fill materials in borings H-1, H-3, H-4, H-7 and H-21. The deposits extended to a maximum depth of 14 feet bgs. The deposits generally consist of yellowish red to reddish yellow silty sand with locally abundant sub-rounded gravel and cobbles. The formation is generally damp and very dense.

4.3.4 Scripps Formation

The Scripps Formation is a middle Eocene age sandstone with occasional cobble-conglomerate interbeds (Kennedy, 1975). The combination of local cobble-conglomerate zones and strong cementation pose difficult excavation conditions even for heavy-duty construction equipment. The Scripps Formation is in disconformable contact with the very old paralic deposits in the study area, and in conformable contact with the underlying Ardath Shale. However, the Ardath Shale was not encountered in any of our borings.

The Scripps Formation encountered in our borings generally consists of interbedded fine to medium grained sandstone and siltstone, with claystone and cobble-conglomerate interbeds. The Scripps Formation was found to be dense to very dense/very stiff to hard, and damp to wet. The formation was generally massive, with no bedding planes evident in samples obtained from our soil borings. Observation of the Scripps Formation in a cut slope along the east side of the co-generation plant indicates that the formation is nearly flat-lying, with a southerly dip of 5 degrees or less.

4.4 Groundwater

No groundwater or seepage was encountered in the shallow borings H-15 through H-19, and in H-21. These borings were extended to depths ranging from 19.5 feet bgs to 21.5 feet bgs. Drilling methods utilized for the remainder of soil borings required the introduction of water into the boreholes, which precluded our ability to measure if groundwater was present.

The depth of the regional groundwater table beneath the project site is unknown but may be assumed to be in excess of 100 feet bgs. However, localized shallow perched water conditions may occur, particularly during the wet (rainy) season. Perching would most likely be encountered in fill materials above the contact with the relatively impermeable formational materials. Pipe leaks, overflows, and landscape irrigation at the NCWRP facility could potentially contribute to groundwater perching.

The Geotracker website (www.Geotracker.com) contains a groundwater monitoring report by Geo-Logic Associates (2014) for the West Miramar Landfill. The landfill is located approximately 2 miles southeast of the NCWRP site, and is situated on the Linda Vista Terrace. The report states that both a perched (alluvial) and regional (bedrock) aquifer exist at the landfill site. Monitoring of eight deep wells during the period from 2002 through 2014 determined that the regional water table varied from approximately 70 to 253 feet bgs (elevations of 161 to 203 feet msl). The perched water table reportedly varied from approximately 10 to 50 feet bgs (elevations of 222 to 305 feet msl) during the period between 1996 to 2014.

5.0 DISCUSSIONS, OPINIONS, AND RECOMMENDATIONS

5.1 Potential Geologic Hazards

5.1.1 Faulting

A concealed northwesterly trending fault is mapped approximately 300 feet east of the NCWRP entrance on Eastgate Mall (Kennedy, 1975; City of San Diego, 2008). This fault is a strand of the Torrey Pines fault, a high-angle fault with mostly vertical displacement trending in a general eastwest orientation between the coastline and the USMC Air Station Miramar. The fault is classified as “potentially active, inactive, presumed inactive, or activity unknown” by the City of San Diego (2008).

The fault traverses the NCPWF site north of Eastgate Mall. K2 Engineering , Inc. (2016) observed sheared sediments of the Scripps Formation in a west-facing slope above the I-805 freeway west of the NCPWF site, and tentatively identified the shear zone as the Torrey Pines fault. Review of aerial photos did not reveal evidence of this fault where it traverses beneath very old paralic deposits on the mesa top. This fault strand is part of a system of roughly east-west trending faults which include the Salk and the Torrey Pines faults. None of these faults are known to offset geologic units that are younger than Eocene in age and are, therefore, not considered to pose a significant seismic risk to the proposed project.

The nearest mapped major active fault to the project site is the RCFZ, located approximately 3.7 miles southwest of the NCWRP. The RCFZ is a complex set of anastomosing and en-echelon, predominantly strike slip faults that extend from off the coast near Carlsbad to offshore south of downtown San Diego. Investigations of the RCFZ in the Rose Creek area (Rockwell et al, 1991) and in downtown San Diego (Patterson et al, 1986 and Woodward Clyde Con) found evidence of multiple Holocene earthquakes. Based on these studies, several fault strands within the RCFZ have been classified as active faults, and are included in Alquist-Priolo Special Studies Zones. Within San Diego Bay, this fault zone is believed to splay into multiple, subparallel strands; the most pronounced of which are the Silver Strand, Coronado, and Spanish Bight faults. The project site is not located within any Special Studies Zone.

The location of the project site in relation to the active faults in the region is shown on the Regional Fault Map (Figure 9). California Department of Transportation ARS Online (V2.3.09) was used to approximate the distance of the closest ten (10) known faults to the project site. A summary of seismic source characteristics for faults that present the most significant seismic hazard potential to the site is presented in Table 2 on the next page.

Table 2

Summary of Seismic Source Characteristics

Fault	Maximum Magnitude (MMax)	Deterministic Peak Site Acceleration (g)	Closest Distance to Site (mile)
Rose Canyon fault zone (San Diego section)	6.8	0.353	3.7
Rose Canyon fault zone (Del Mar section)	6.8	0.340	4.1
Rose Canyon fault zone (Silver Strand section-Spanish Bight fault)	6.8	0.201	8.82
Rose Canyon fault zone (Silver Strand section-Downtown Graben fault)	6.8	0.166	11.06
Point Loma Fault Zone	6.3	0.211	6.82
Rose Canyon fault zone (Silver Strand section-Silver Strand fault)	6.8	0.165	11.12
Coronado Bank (alt2)	7.4	0.142	17.38
Rose Canyon fault zone (Silver Strand section-Coronado fault)	6.8	0.158	11.65
Rose Canyon fault zone (Oceanside section)	6.8	0.151	12.32
Elsinore (Julian)	7.7	0.094	33.56

5.1.2 Fault Ground Rupture & Ground Lurching

There are no known (mapped) active or potentially active faults crossing the project site (Kennedy, 1975; City of San Diego, 2008). Therefore, the potential for fault ground rupture and ground lurching is considered insignificant.

5.1.3 Liquefaction Potential

Seismically induced soil liquefaction is a phenomenon in which loose to medium dense, saturated granular materials undergo matrix rearrangement, develop high pore water pressure, and lose shear strength due to cyclic ground vibrations. Manifestations of soil liquefaction can include loss of bearing capacity below foundations, surface settlements and tilting in level ground, and instabilities in sloping ground. Soil liquefaction can also result in an increase in lateral and uplift pressures on buried structures.

The findings of our investigation determined that the project site is underlain with medium dense to dense/stiff compacted fill and formational soils and deep groundwater conditions that are considered to have a very low to negligible liquefaction potential.

5.1.4 Landslides

A review of the published geologic maps indicates that the project site is not located on or near any known (mapped) ancient landslides. The geologic units underlying the project area are generally considered competent and not prone to landslide hazards, and review of the State of California Seismic Hazard Zones (2009) and City of San Diego Seismic Safety Study Geologic Hazards and Faults map (2008) indicates that the site is not located in an area that is susceptible to landslide hazards. Therefore, it is our opinion that the potential for landslides at the project site is considered very low.

5.1.5 Lateral Spreading

The project site is underlain by competent geologic units which are not considered susceptible to seismic-induced lateral spreading.

5.1.6 Differential Seismic-Induced Settlement

Differential seismic settlement occurs when seismic shaking causes one type of soil to settle more than another type. It may also occur within a soil deposit with largely homogeneous properties if the seismic shaking is uneven due to variable geometry or thickness of the soil deposit. Based on the results of our investigation, it is our opinion that there is a slight potential of differential settlement in areas underlain by deep mechanically placed man-made fills.

5.1.7 Compressible Soil

The project study area is underlain by competent formational materials that are considered noncompressible. There is a low compressible potential in fill materials and in surficial soils.

5.1.8 Secondary Hazards

The elevation of the project site and distance from any large open water bodies precludes the potential of property damage from seismic-induced tsunamis and/or seiches. The project site is not located within the 100- and/or 500-year flood zone (FEMA Flood Insurance Rate Map, 2012).

5.2 Soil Corrosivity

In accordance with the City of San Diego Water Facility Design Guidelines, Book 2, Chapter 7, soil is generally considered aggressive to concrete if its chloride concentration is greater than 300 parts per million (ppm) or sulfate concentration is greater than 1,000 ppm, or if the pH is 5.5 or less.

Analytical testing was performed on representative samples of the onsite soil materials to determine pH, resistivity, soluble sulfate, chlorides and bicarbonates content. The tests were performed in accordance with California Test Method Nos. 643, 417 and 422. A summary of the test results is presented in Table 3 on the next page. Copies of the analytical laboratory test reports are included in Appendix B.

Table 3

Summary of Corrosivity Test Results

Sample ID	pH	Resistivity (ohm-cm)	Sulfate Conc. (ppm)	Chloride Conc. (ppm)	Bicarbonates Conc. (ppm)
H-1 #2 @4'-5'	6.5	680	480	170	N/A
H-2 #6 @22'-23'	4.8	930	130	190	4
H-3 #2 @4'-5'	5.7	650	210	160	6
H-4 #1 @3'-6'	6.8	550	340	300	32
H-4 #5 @17'-18'	10.5	780	270	260	12
H-5 #3@8'-9'	7.1	450	440	310	30
H-5 #8@25'-28'	7.3	440	210	440	14
H-6 #4@12'-13'	7.9	410	1,080	430	27
H-7 #2@5'-8'	8.9	1,100	140	64	N/A
H-7 #4@13'-14'	8.9	950	140	110	N/A
H-8 #3@8'-9'	7.9	290	500	1,170	24
H-9 #4@14'-15'	7.9	840	150	130	28
H-9 #15@55'-59'	8.3	680	160	190	52
H-10 #3@7'-8'	7.9	840	180	90	50
H-10 #11@40'-43'	8.2	750	340	140	48
H-11 #3@12'-13'	8.2	580	200	230	54
H-11 #10@37'-38'	7.9	440	280	560	48
H-12 #4@12'-13'	8.2	420	340	430	54
H-13 #4@12'-13'	8.9	400	450	470	22
H-13 #9@33'-34'	8.3	300	240	800	30
H-14 #3@9'-10'	7.8	320	320	680	46

Table 3

Summary of Corrosivity Test Results

(Continued)

Sample ID	pH	Resistivity (ohm-cm)	Sulfate Conc. (ppm)	Chloride Conc. (ppm)	Bicarbonates Conc. (ppm)
H-14 #8@25'-26'	7.8	350	230	420	44
H-14 #17@56'-59'	7.7	290	3,420	850	26
H-15 #4@12'-13'	8.3	520	190	300	57
H-16 #3 @12'-13'	8.3	370	270	500	26
H-17 #1@1'-2'	7.7	500	140	43	N/A
H-18 #2@7'-8'	8.1	300	950	620	70
H-19 #2@7'-8'	8.2	480	540	310	18
H-20 #3@8'-9'	6.4	280	220	1,070	8
H-21 #4@13'-14'	7.3	430	290	450	8
H-22 #2@9'-10'	6.9	220	430	1,440	11
H-22 #10@35'-40'	7.4	280	200	960	6

NOTE:

N/A = Unable to extract due to high clay content.

The test results indicate that the on-site materials can be highly aggressive against concrete. Therefore, we recommend that Type V Portland Cement Concrete (high sulfate resistance) be used for the proposed facilities at the project site. It should be noted here that the most effective way to prevent sulfate attack is to keep the sulfate ions from entering the concrete in the first place. This can be done by using mix designs that give a low permeability (mainly by keeping the water/cement ratio low) and, if practical, by placing moisture barriers between the concrete and the soil.

AGE does not practice in the field of corrosion engineering. In the event that corrosion sensitive facilities are planned, we recommend that a corrosion engineer be retained to perform the necessary corrosion protection evaluation and design.

5.3 Expansive Soil

The majority of the onsite soil materials are considered non-expansive. Based on visual observations and laboratory test results, the Scripps Formation was found to contain lenses and/or zones of soil materials which are considered moderately expansive.

5.4 Seismic Design Parameters

The shear wave velocity for the upper 100 feet (V_S) at the project site was estimated based on the corrected blow counts in AGE's borings, and using the correlation method developed by Ohta and Gotto (1978) for cohesive soil and David Boore (2004) extrapolation equation.

$$V_S = 86.9\,(N_{60})^{0.333} \qquad \text{(Ohta \& Goto, 1978)}$$

$$V_S = [1.45 - (0.015 \text{ x } d)] \text{ x } V_{s(d)} \qquad \text{(David Boore, 2004)}$$

A summary of the results of the shear wave analysis based on the normalized blow counts, site classification and remarks are shown in Table 4 on the next page. The calculations are shown in Appendix C.1.

Table 4

Summary of Shear Wave Velocity Analysis

Boring ID	V_S (fps)	Site Classification	Remarks
H-1	1304	C	8' of fill over Very Old Paralic Deposits and Scripps Formation.
H-2	1344	C	15' of fill over Very Old Paralic Deposits and Scripps Formation.
H-3	1318	C	7' of fill over Very Old Paralic Deposits and Scripps Formation.
H-4	1390	C	3' of fill over Very Old Paralic Deposits and Scripps Formation.
H-5	1347	D	22' of fill over Very Old Paralic Deposits and Scripps Formation. Due to the presence of gravels in the fill, actual blow counts are likely lower than recorded blow counts. Despite the calculated shear wave velocity, we recommend that Site Class D be used in the design of structures located in this area.
H-6	1300	D	25' of fill over Very Old Paralic Deposits and Scripps Formation. Due to the presence of gravels in the fill, actual blow counts are likely lower than recorded blow counts. Despite the calculated shear wave velocity, we recommend that Site Class D be used in the design of structures located in this area.
H-7	1234	D	7' of fill over Very Old Paralic Deposits and Scripps Formation.
H-8	1196	D	49' of fill over Scripps Formation.
H-9	1179	D	34' of fill over Scripps Formation.
H-10	1172	D	32' of fill over Scripps Formation.
H-11	1204	D	15' of fill over Scripps Formation.
H-12	1227	D	28' of fill over Scripps Formation.
H-13	1203	D	29' of fill over Scripps Formation.
H-14	1202	D	28' of fill over Scripps Formation.
H-15	1318	C	3' of fill over Scripps Formation.
H-16	1318	C	1.5' of fill over Scripps Formation.
H-17	1318	C	3' of fill over Scripps Formation.
H-18	1318	C	2.5' of fill over Scripps Formation.
H-19	1318	C	3' of fill over Scripps Formation.
H-20	1318	C	1' of fill over Scripps Formation.
H-21	1318	C	3' of fill over Scripps Formation.
H-22	1318	C	6' of fill over Scripps Formation.

Both CBC 2016 and ASCE 7-10 classify sites with V_S of higher than 1,200 feet per second (fps) but lower than 2,500 fps as Site Class C. However, due to uncertainties of the fill thickness and consistency, and that the calculated V_S values for the areas underlain by deep fill are borderline Site Class C and D, we recommend that Site Class D classification be used for areas underlain by soil/bedrock materials with V_S of less than 1,250 fps. Site Class C may be used for areas underlain by soil/bedrock materials with V_S of 1,250 fps or higher. With the exception of the area in the vicinity of borings H-5 and H-6 which is underlain by filled ground in excess of 20 feet thick and should be classified as Site Class D.

The approximate boundaries of Site Class C and Site Class D within the project site is shown on Figure 10. Structures located within Site Class D area with foundation extended into the bedrock may be designed using Site Class C classification. Site Class D parameters, which are more conservative, may be used for design of structures located in Site Class C area. A summary of the recommended site classification for use in seismic design for the individual structures is shown on Table 5 on the next page.

Table 5

Summary of Site Classification for Seismic Design

Proposed Facility	Recommended Site Classification
Primary Sedimentation Tanks	Site Class C
Equalization Basins	Site Class C
First Stage Bioreactor Basins	Site Class C (Although the area is underlain by 22' to 25' of fill, the bottom of the structure is located at approximate elevation +338' msl on the Scripps Formation)
Second Stage Bioreactor Basins	Site Class C (Foundation for proposed structure is supported on either Very Old Paralic Deposits or Scripps Formation)
Secondary Clarifiers	Site Class D (Foundation for proposed structures will be supported on mixed filled ground and Scripps Formation)
Tertiary Filter Building	Site Class D
NCPWF Influent Pump Station	Site Class D
Chemical Building	Site Class C

For structural design in accordance with the ASCE 7-10 procedures (ASCE 7-10), the United States Geological Survey Design Maps (USGS, 2016) were used to calculate ground motion parameters for the project site. The Risk-Targeted Maximum Considered Earthquake (MCE_R) ground motion response acceleration is calculated based on the most severe earthquake effects considered by ASCE 7-10 determined for the orientation that resulted in the largest maximum response to the horizontal ground motions and with adjustment to the targeted risk. The Maximum Considered Earthquake Geometric Mean (MCE_G) is determined for the geometric peak ground acceleration and without adjustment for the targeted risk. The MCE_G Peak Ground Acceleration (PGA) adjusted for site effects (PGA_M) should be used for design and evaluation of liquefaction, lateral spreading, seismic settlements, and other soil related issues.

The calculated seismic design parameters are presented in Tables 6 and 7 on the next page for Site Class C and Site Class D, respectively. The design criteria are based on the soil profile type as determined by existing subsurface geologic conditions, on the proximity of the site to a nearby fault and on the maximum moment magnitude and slip rate of the nearby fault.

Table 6

Summary of Seismic Design Parameters (Site Class C)

REFERENCE	PARAMETER
Table 20.3-1 Site Classification	Site Class = C
Figure 22-1	Ss = 1.065 g
Table 11.4-1 Site Coefficient Fa	Fa = 1.000
Figure 22-2	S_1 = 0.408 g
Table 11.4-2 Site Coefficient Fv	Fv = 1.392
Equation 11.4-1	S_{MS} = 1.065 g
Equation 11.4-2	S_{M1} = 0.568 g
Equation 11.4-3	S_{DS} = 0.710 g
Equation 11.4-5	S_{D1} = 0.379 g
Figure 22-12	T_L = 8 seconds
Figure 22-7	PGA = 0.444 g
Equation 11.8-1	PGA_M = 0.444 g
Figure 22-17	C_{RS} = 0.904
Figure 22-18	C_{R1} = 0.961

Table 7

Summary of Seismic Design Parameters (Site Class D)

REFERENCE	PARAMETER
Table 20.3-1 Site Classification	Site Class = D
Figure 22-1	Ss = 1.065 g
Table 11.4-1 Site Coefficient Fa	Fa = 1.074
Figure 22-2	S_1 = 0.408 g
Table 11.4-2 Site Coefficient Fv	Fv = 1.592
Equation 11.4-1	S_{MS} = 1.144 g
Equation 11.4-2	S_{M1} = 0.650 g
Equation 11.4-3	S_{DS} = 0.763 g
Equation 11.4-5	S_{D1} = 0.433 g
Figure 22-12	T_L = 8 seconds
Figure 22-7	PGA = 0.444 g
Equation 11.8-1	PGA_M = 0.469 g
Figure 22-17	C_{RS} = 0.904
Figure 22-18	C_{R1} = 0.961

Figure 22-1	Ss Risk-Targeted Maximum Considered Earthquake (MCER) Ground Motion Parameter for the Conterminous United States for 0.2 s Spectral Response Acceleration (5% of Critical Damping), Site Class B.
Figure 22-2	S1Risk-Targeted Maximum Considered Earthquake (MCER) Ground Motion Parameter for the Conterminous United States for 1.0 s Spectral Response Acceleration (5% of Critical Damping), Site Class B.
Figure 22-12	Mapped Long-Period Transition Period, TL (s), for the Conterminous United States.
Figure 22-7	Maximum Considered Earthquake Geometric Mean (MCEG) PGA, %g, Site Class B for the Conterminous United States.
Figure 22-17	Mapped Risk Coefficient at 0.2 s Spectral Response Period, CRS.
Figure 22-18	Mapped Risk Coefficient at 1.0 s Spectral Response Period, CR1.

5.5 Earthwork

5.5.1 General Requirements

The earthwork operations for the project should be performed in accordance with the approved plans and specifications for the project, the applicable provisions of the City of San Diego Grading Ordinance, and Section 300 of the latest edition of Standard Specifications for Public Works Construction (SSPWC, known as the "Green Book").

5.5.2 Soil Excavation Characteristics

Based on our experience with similar geologic units, we anticipate that excavations in the majority of the on-site soil materials can be easily accomplished using conventional heavy-duty excavation equipment. Difficult excavation conditions may be encountered within the highly cemented and/or highly conglomeratic zones of the very old paralic deposits and Scripps Formation, and may require the use of rock breaker and/or jackhammer.

5.5.3 Fill Materials

Soil materials generated from excavation in the young colluvial deposits may be highly plastic and expansive, and may not considered suitable for use as compacted fill. Soil materials generated from the very old paralic deposits and the conglomerate facies of the Scripps Formation are likely to contain abundant gravel and cobbles, and may require selective screening of oversize materials if they are utilized as compacted fill. In lieu of screening, it may be more practical and economical for the Contractor to use select import fill materials.

The remainder of soil materials generated from excavations at the project site are considered suitable for use and placement as structural fill in the proposed building areas. Fill materials should be free of biodegradable materials, hazardous substance contamination, other deleterious debris, and shall have no rock and/or cobbles larger than 6 inches in any dimensions. If the fill materials contain rocks or hard lumps, at least 70 percent (by weight) of its particles shall pass a U.S. Standard 3/4-inch sieve. Fill materials should consist of predominantly granular soil (less than 40 percent passing the U.S. Standard #200 sieve) with Expansion Index of less than 50.

5.5.4 Fill Placement and Compaction

Prior to placement of fill materials, the firm competent ground which is determined to be satisfactory for the support of filled ground shall be plowed or scarified to a depth of at least 6 inches until the surface is free from ruts, hummocks, or other uneven features which would tend to prevent uniform compaction by the equipment to be used. Fill placed on slope steeper than 5 : 1 (horizontal : vertical) should be keyed and benched into properly compacted fill materials or competent formational materials. The key should consists of a minimum 10 feet wide by 2-foot deep bench which should be excavated into the slope with a minimum inclination of 2 percent.

Additional horizontal benches shall be cut into the existing slope in order to provide both lateral and vertical stability for the new fill materials. The purpose of the benches is to provide a horizontal base so that each layer is placed and compacted on a horizontal plane. The width and frequency of all benches should be determined in the field during the earthwork operation based on the actual soil conditions and the gradient of the existing slope.

The fill materials should be moisture-conditioned, placed and uniformly compacted in layers until final elevations are reached. Each layer should be no thicker than that will allow for adequate bonding and compaction, but shall not exceed 8 inches in loose (uncompacted) thickness. Unless otherwise specified, all fills shall be compacted to at least 90 percent of maximum dry density as determined in the laboratory by the ASTM D1557-00 test method. Field density testing shall be performed in accordance with either the Sand Cone Method (ASTM D1556) or the Nuclear Gauge Method (ASTM D2922 and D3017).

5.6 Controlled Low Strength Material

CLSM refers to a cementitious slurry consisting of a mixture of fine aggregate or filler, water, and cementitious material(s), which is used as a fill or backfill in lieu of compacted earth. The mixture is capable of filling all voids in irregular excavations and hard to reach places, self-leveling, and hardens in a matter of a few hours without the need for compaction.

CLSM for the subject project should be designed with a compressive strength that will allow excavation with heavy machinery at maximum compressive strengths of 50 psi at 4 days, 150 psi at 28 days, and 200 psi at 1 year and maximum unit weight not to exceed 115 pounds per cubic foot (pcf). The coefficient of permeability of the CLSM should be equal or greater than that of the surrounding soil.

CLSM should have minimal subsidence and bleed water shrinkage. Evaporation of bleed water should not result in shrinkage of more than 1/8 inch per foot of CLSM depth (for mixes containing high fly ash content) when measured in accordance with ASTM C 940 test method "Standard Test Method for Expansion and Bleeding of Freshly Mixed Grouts for Preplaced-Aggregate Concrete in the Laboratory”.

CLSM should be sampled and tested in the field in conformance with either ASTM C 94 or C 685. Samples for tests should be taken for every 150 cubic yards of material, or fraction thereof, for each day's placement. Tests should include temperature reading and four compressive strength cylinders. Compressive strength sampling and testing should conform to ASTM D 4832 with one specimen tested at 7 days, two at 28 days, and one held for each batch of four specimens.

Installation of CLSM should only be performed when existing and forecasted weather conditions are within the limits established by the manufacturer of the materials and products used. The mix design should produce a consistency that will result in a flowable product at the time of placement which does not require manual means to move it into place. Placement of the CLSM should be performed in accordance with the manufacturer’s mix design specifications. CLSM is also considered suitable for use as trenched excavation backfill.

5.7 General Foundation Recommendations

An allowable soil bearing capacity of 4,000 psf and 2,500 psf may be use for design of foundations which are founded on undisturbed formational soil (Very Old Paralic Deposits and Scripps Formation) and properly compacted filled ground, respectively. An allowable soil bearing capacity of 4,000 psf may be used for design of foundations which are supported on CLSM.

For design of mat foundations, a modulus subgrade reaction (k) value of 275 pounds per cubic inch (pci) and 225 pci may be used for mats placed directly on firm native soils and properly compacted filled ground, respectively. Modulus subgrade reaction (k) values of 300 pci and 350 pci may be used for mat foundations placed on Class II Aggregate Base (or equivalent) and crushed rock materials wrapped in geofabric, respectively. A modulus subgrade reaction (k) value of 275 pci may be used for design of mats which are supported on CLSM.

Under static condition, total settlement of the foundation designed as recommended herein is estimated to be less than 0.25 inch. Differential settlement between the center and the edge of the mat foundation is expected not to exceed 0.25 inch over a horizontal distance of 50 feet. No permanent deformation and/or post-construction settlement is anticipated, provided that backfill around the structures is properly compacted in accordance with the project specifications.

Resistance to lateral loads may be developed by a combination of friction acting at the base of the foundation and passive earth pressure developed against the sides of the foundations below grade. Passive pressure and friction may be used in combination, without reduction, in determining the total resistance to lateral loads.

An allowable passive earth resistance of 350 psf per foot of foundation embedment below grade may be used for the sides of foundations placed against competent native soils and CLSM. The maximum recommended allowable passive pressure is 3,500 psf. An allowable passive earth pressure of 350 psf per foot of foundation embedment below grade may be used for the sides of foundations placed against properly compacted filled ground. The maximum recommended allowable passive pressure is 2,500 psf. A coefficient of friction of 0.40 , 0.35 and 0.30 may be used for foundations cast directly on competent native soils, properly compacted fill and visqueen moisture barrier, respectively. Based on Portland Cement Association Concrete Masonry Handbook for Architects, Engineers, Builders (2008), a friction coefficient of 0.4 may be used for design of concrete against CLSM. A coefficient of friction of 0.4 may be used for foundations cast directly on Class II Aggregate Base (or equivalent) and crushed aggregate rock materials wrapped in geofabric.

A summary of the general foundation recommendations are presented in Table 8 on the next page.

Table 8

Summary of General Foundation Recommendations

Recommended Design Parameters	Properly Compacted Fill	Undisturbed Formation	CLSM	Class II Aggregate Base	Crushed Rock Wrapped in Geofabric	Visqueen Moisture Barrier
Allowable Bearing (psf)	2,500	4,000	4,000	N/A	N/A	N/A
Modulus of Subgrade Reaction (pci)	225	275	275	300	350	N/A
Passive Resistance	350 pcf equivalent fluid weight not to exceed 2,500 psf	350 pcf equivalent fluid weight not to exceed 3,500 psf	350 pcf equivalent fluid weight not to exceed 3,500 psf	N/A	N/A	N/A
Coefficient of Friction	0.35	0.40	0.40	0.40	0.40	0.30

5.8 Subterranean and Retaining Walls

We recommend that all subterranean and retaining walls be backfilled with soil materials which have less than 40 percent passing the standard #200 sieve and not less than 70 percent passing the U.S. standard 3/4-inch sieve, expansion index of less than 30 and minimum internal friction angle of 35°. In addition, the backfill materials should not contain any organic debris, rocks or hard lumps greater than 6 inches, or other deleterious materials. All backfill soils should be compacted to at least 90 percent of maximum dry density as determined in the laboratory by the ASTM D1557 testing procedure. In lieu of soil materials, walls may also be backfilled with CLSM.

For design of properly backfilled subterranean and retaining walls, an active soil pressure equivalent to that generated by a fluid weighing 35 and 61 pounds per cubic foot, for level and 2:1 (horizontal : vertical) sloped backfill, respectively, may be used for design of the wall assuming that they are free to rotate at the top at least 0.001H (where H is the height of the wall). An at-rest soil pressure equivalent to that generated by a fluid weighing 60 pounds per cubic foot may be used for design of wall restrained at the top. Traffic surcharge occurring within a horizontal distance equal to the wall height should be added as lateral pressure equal to a uniformly distributed load of 75 psf along the entire face of the wall.

Subterranean and retaining walls should be designed to resist the lateral earth pressures presented in Figures 11 and 12 provided that the wall backfill materials are properly placed and compacted in conformance with the recommendations presented in this report. The at-rest soil pressure on Figure 12 is shown as a combination of the earth pressure and restrained additive term. Surcharge and foundation loads occurring within a horizontal distance equal to the wall height should be added to the lateral pressures presented in Figures 13 and 14.

Calculation for the Seismic Active Earth Pressure was performed in accordance with the procedure outlined in Section 11.6.5.3 of the AASHTO LRFD Bridge Design Specifications 6th Edition (2012) using the Mononobe-Okabe (M-O) Method. The Horizontal Acceleration Coefficient (K_h) is estimated to be 1/2 of PGA_M and equal to 0.234 (Site Class D) and 0.222 (Site Class C), Vertical Acceleration Coefficient (K_v) is assumed to be zero. The backfill material is assumed to have a unit weight of 120 pcf, friction angle of 35° and cohesion value of 500 psf. The calculated Seismic Active Earth Pressure Coefficient (K_{AE}) is equal to 0.15 for retaining structures up to 25 feet in height.

Based on the conditions described above, a triangular pressure distribution of 12 pcf (equivalent fluid pressure) may be used for the Seismic Active Earth Pressure for both Site Class C and Site Class D. This seismic earth pressures may be assumed to act at 0.4H from the bottom of the wall and are applicable for both cantilever and braced conditions. Forces resulting from wall inertia effects are expected to be relatively minor for non-gravity walls and/or walls retaining less than 5 feet of backfill materials, and may be ignored in estimating the seismic lateral earth pressure.

An active soil pressure equivalent to that generated by a fluid weighing 20 pounds per cubic foot may be used for walls backfilled with CLSM, assuming that they are free to rotate at the top at least 0.001H (where H is the height of the wall). An at-rest soil pressure equivalent to that generated by a fluid weighing 40 pounds per cubic foot may be used for the design of walls backfilled with CLSM. Forces resulting from the CLSM inertia effects are expected to be relatively minor, and may be ignored in estimating the seismic lateral earth pressure.

Based on the subsurface conditions observed within the borings, it is anticipated that foundations for the proposed retaining wall along the fill slope on the east side of the proposed Secondary Clarifiers Tanks will be underlain partially by the existing canyon fill and partially by the the Scripps Formation. In order to reduce the potential for differential soil settlement, we recommend that foundations for the proposed retaining wall be embedded in uniformly compacted filled ground. The filled ground should extend a minimum depth of 24 inches below the elevation of the bottom of the wall foundations and a minimum lateral distance of 12 inches beyond the face of the wall foundation. The over-excavated area should then be backfilled with uniformly compacted fill materials to the proposed finish grade elevations. The fill materials should be moisture-conditioned, and recompacted to at least 95 percent of maximum dry density as determined in the laboratory by the ASTM D1557 testing method.

The safe allowable bearing capacities, passive earth pressures and coefficient of frictions presented in Section 5.7 of this report may be used for design of walls as described herein. Where practical, it is recommended that a foundation setback of at least 6 feet be observed from the wall foundations to the face of any slope. Where the wall foundations are located closer than 6 feet from the face of the slope, it is recommended that the foundations in those areas be deepened such that the exterior face of the footing at its bottom level is at least 6 feet away from the face/surface of the slope at the same level. No reduction in friction and passive pressure is required for walls designed as above.

5.9 Secondary Clarifiers

Based on the subsurface conditions observed in borings H-11 through H-14, both the filled ground and Scripps Formation are considered capable of providing competent support for the proposed secondary clarifiers. Therefore, it is our opinion that reinforced mat foundation may be used to provide support for the proposed secondary clarifiers. To reduce the potential for differential settlement due to variable fill thickness and mixed condition (between the fill and Scripps Formation), we recommend that a 12-inch thick Class II Aggregagte Base material compacted to 95% relative compaction or 12-inch thick 3/4-inch crushed rock materials wrapped in geofabric be placed beneath the bottom of the secondary clarifiers. A geologic cross-section (D-D’) of the Secondary Clarifiers area is shown on Figure 15 and the location of the cross-section is shown on Figure 5.

We further understand that the proposed southern secondary clarifiers will be underlain by an existing 60-inch diameter storm drain pipeline. To reduce the potential for excessive settlement and damage to the existing pipeline, we recommend that the design load for the mat foundation be limited to 2,000 psf or less. The same modulus of subgrade reaction, passive resistance, coefficient of friction, active pressure and seismic active earth pressure values presented in Sections 5.7 and 5.8 of this report may be used in the design of the Secondary Clarifiers.

AGE has performed an analysis of the loading impact from the secondary clarifiers and proposed grading on the existing storm drain pipeline in general accordance with Holl's and Newmark's modifications to Boussinesq's equation (Spangler, 1946) as described in Section 9.3.1.2 - Distributed Loads of the ASCE Manuals and Reports on Engineering Practice No. 60 - Gravity Sanitary Sewer Design and Construction, Second Edition -MOP 60, 2007. The design assumptions, procedures and results are shown in Appendix C.2. The results of the analysis indicate that the two southern secondary clarifiers will generate additional loading on the storm drain pipeline ranging between 65 psf to 680 psf. The analysis further indicates that no additional loading is imposed on the storm drain pipeline by the two northern secondary clarifiers.

It is our understanding that to protect the existing storm drain pipeline from the additional loading impact, a system which consists of a protective slab over the pipeline is proposed. The protective slab will be supported on 36-inch diameter Cast-In-Drilled-Hole (CIDH) piles on both sides of the existing storm drain pipeline. We further understand that the protective slab will extend beneath the proposed retaining wall located on the east side of the secondary clarifiers. The conceptual drawings of the proposed system prepared by Kleinfelder, the structural engineer for the Secondary Clarifiers, is shown on Figures 16 and 17. The pile design recommendations are presented in Section 5.10 below.

5.10 36-Inch CIDH Pile Design Recommendations

AGE has performed an analysis of the proposed CIDH piles using the following assumptions.

Pile Type		=	36-inch CIDH	
Approximate Pile Cut-off Elevation (ft. msl)		=	+319	
Approximate Bottom of Fill (ft. msl)		=	+311	Note: Assumed to be 2' below the invert elevation of the 60-inch stormdrain pipe. Actual elevation during construction may vary.
Approximate Top of Scripps Formation (ft. msl)		=	+311	Note: Actual elevation during construction may vary.
Approximate Tip Elevation(ft. msl)		=	+294	Note: Required verification during construction that minimum embedment in Scripps Formation requirement specified below is met.
Minimum Pile Length (ft.)		=	25	
Minimum Embedment into Scripps Formation (ft.)		=	10	
Fill Soil Parameters	Density (pcf)	=	100	
	Shear Angle (degree)	=	30	
	Cohesion (psf)	=	0	
Scripps Formation Parameters	Density (pcf)	=	100	
	Shear Angle (degree)	=	35	
	Cohesion (psf)	=	500	

Resistance to lateral loads may be developed by the passive earth pressures developed against the sides of the pile caps or spread footings. For design purposes, an allowable passive earth resistance of 350 psf per foot of depth, up to a maximum of 2,500 psf, may be used for pile caps and footings placed against properly compacted fill material. The upper 12 inches of soil materials in areas not protected by slabs or pavements should be excluded in the calculation for passive resistance to lateral loads.

As an alternate, for piles, resistance to lateral loads may be developed by the bending strength of the pile. The lateral capacity of the piles depends on the amount of deflection and the condition of fixity at the top of the pile. A fixed-head condition denotes that the pile cap is free to translate but fixed against rotation. Whereas a free-head condition denotes that the pile cap is free both to translate and rotate. The response of the pile is assumed to be linearly elastic, whereas the soil behavior is modeled as an elasto-plastic material using soil resistance-deflection (P-Y) curves.

We recommend that the values in Table 9 below be used for preliminary structural design purposes. Pile calculations are shown on Appendix C.3.

Table 9

36-Inch CIDH Pile Design Parameters

	36-inch Diameter CIDH Pile
Factor of Safety	End Bearing = Skin friction = 2.0
Working Axial Resistance (kips)	375
Free-Head Working Lateral Resistance (kips)	28
Fixed-Head Working Lateral Resistance (kips)	47

The lateral pile capacities are applicable for the case where the lateral loads are applied at the pile cap and maximum allowable pile cap deflection of 0.25 inch. If greater deflection can be tolerated, pile lateral loads can be increased directly in proportion to the deflection, up to a maximum deflection of 1 inch. If the actual pile conditions are substantially different, AGE should be contacted to provide additional analyses.

To evaluate the installation procedure and actual pile capacity, we recommend the installation of at least 4 indicator piles prior to production pile construction. We further recommend that at least two static pile load test be performed to confirm the axial load capacity of the piles. The load tests should be performed in general accordance with ASTM D1143, "Standard Test Method for Deep Foundations under Static Axial Compressive Load." The static pile load test should be loaded to the ultimate load demand of twice the design service load (750 kips). As an alternative to the static pile load tests, force pulse testing (rapid load tests) may be performed. If force pulse testing is selected, we recommend that all 4 indicator piles be tested. Force pulse load test should be performed in general accordance with ASTM D7383, "Standard Test Methods for Axial Compressive Force Pulse (Rapid) Testing of Deep Foundations". Provided that the test piles were not tested to failure (more than 1 inch total deflection at the top of pile), the test piles may be used as production piles.

5.11 Concrete Slab-on-Grade

Conventional concrete slabs-on-grade may be used at the project site. New concrete slabs-on-grade should be 6 inches thick underlain by 6 inches of Class II Aggregate Base. Where moisture-sensitive floor coverings are planned, the slabs should also be underlain by a 10 Mil visqueen moisture barrier. Steel reinforcement for concrete slabs-on-grade shall be determined by the project structural engineer based on the actual thickness of the slabs, anticipated loading conditions and possible concrete shrinkage.

For slabs underlain by compacted fill, and mixed ground condition (partially on fill and partially on formational material), it is recommended that at least the upper 24 inches of the subgrade beneath all concrete slabs-on-grade and the base layer be uniformly compacted to a minimum of 95 percent of maximum dry density as determined in the laboratory by the ASTM D1557 testing procedure. For design of concrete slabs-on-grade, modulus subgrade reaction (k) values presented in Section 5.7 of the report may be used.

5.12 Drainage Control

Proper control and maintenance of site drainage is critical to the future performance of the project. Infiltration of irrigation and/or storm water into the subsurface soils could adversely affect the performance of the soils.

It is recommended that positive drainage be provided around the perimeter of all proposed buildings. Positive drainage is generally defined as a minimum 2 percent slope over a horizontal distance of at least 5 feet away from the perimeter foundations of a structure. No surface water should be allowed to collect or pond anywhere in the building areas, especially adjacent to or near foundations and slabs. Roof runoff should be controlled by using eave gutters and downdrains, and the discharge from the downdrains should be collected in a system of subdrain pipes which carry the water directly into a suitable on-site drainage facility.

Landscape irrigation should be monitored and controlled to determine the appropriate amount of irrigation necessary to maintain the landscaping without overwatering.

5.13 Cut-and-Cover Pipeline Construction

It is our understanding that construction of underground utilities for the proposed project will be performed using conventional open cut excavation methods. Since no changes are planned to the existing ground surface along the pipeline alignment, the net stress change in the underlying soils is considered negligible.

Furthermore, the fill materials are expected to provide a stable trench bottom under static conditions. In the event that loose or disturbed soils are encountered at the trench bottom, it is recommended that they be over-excavated and replaced with pipe bedding or other approved materials. The actual limits/extent of over-excavation of loose or soft materials at the bottom of the trench excavations should be evaluated by City's Resident Engineer during construction.

5.13.1 Soil and Excavation Characteristics

Based on our experience with similar geologic units, we anticipate that excavations in the majority of the on-site soil materials can be easily accomplished using conventional heavy-duty excavation equipment. Difficult excavation conditions may be encountered within the highly cemented and/or conglemeratic zones of the very old paralic deposits and Scripps Formation, and may require the use of rock breaker and/or jackhammer.

5.13.2 Fill Materials

Soil materials generated from excavation in the young colluvial deposits may be highly plastic and expansive, and may not considered suitable for use as compacted fill. Soil materials generated from the very old paralic deposits and the conglomerate facies of the Scripps Formation are likely to contain abundant gravel and cobbles, and may require selective screening of oversize materials if they are utilized as compacted fill. In lieu of screening, it may be more practical and economical for the Contractor to use select import fill materials.

The remainder of soil materials generated from excavations at the project site are considered suitable for use and placement as structural fill in the proposed building areas. Fill materials should be free of biodegradable materials, hazardous substance contamination, other deleterious debris, and shall have no rock and/or cobbles larger than 6 inches in any dimensions. If the fill materials contain rocks or hard lumps, at least 70 percent (by weight) of its particles shall pass a U.S. Standard 3/4-inch sieve. Fill materials should consist of predominantly granular soil (less than 40 percent passing the U.S. Standard #200 sieve) with Expansion Index of less than 50.

5.13.3 Pipe Loads and Settlement

Pipes should be designed for all loads applied by surrounding soils including dead load from soils, loads applied at the ground surface, uplift loads, and earthquake loads. Soil loading may be estimated assuming a density of 125 pcf for the backfill materials. Where a pipe changes direction abruptly, resistance to thrust forces can be provided by means of thrust blocks. For design purposes, the passive resistance against thrust blocks embedded in properly compacted fill and undisturbed formational soil may be estimated using an equivalent fluid density of 200 pcf and 300 pcf, respectively. Thrust blocks should be embedded a minimum of 3 feet beneath the ground surface.

As an alternate method, restrained joints may be used to provide resistance to thrust forces. Our analysis is based on the assumption that the pipe backfill materials are considered cohesionless. A restrained joint system is subjected to the same thrust forces as in a thrust block system, however the forces are distributed over the restrained pipe length. A friction angle between the pipe and soil (M) of 20^{o}, Coefficient of Friction against sides of trench (μ) of 0.3 and Rankine's Ratio (K) of 0.37 may be used to design the necessary length of the restrained pipe.

Simplified (non finite element analysis) analysis methods for estimation of the additional soil pressure that will act on pipes during earthquake loading are not available. In general, unless the pipeline is located in a zone with potential for high differential movement such as a fault zone crossing, liquefiable zone, shear plane, or transition zone where the pipe enters a structure, flexible pipelines will conform to the ground movement during a seismic event without failure. To further reduce the risk of pipe damage that could occur as a result of earthquake loading, we recommend that design vertical and horizontal loads on pipes that result from soil dead loads be increased by 50 percent.

Buried flexible pipes are generally designed to limit deflections caused by applied loads. The deflections can be estimated using the Modified Spangler equation. A modulus of soil reaction, E', equal to 1,000 psi may be used to represent backfill soils of medium to low plasticity (LL < 50) with less than 50 percent fines passing the #200 standard sieve.

5.13.4 Trench Backfill

It is recommended that installation of sewer, water and storm drain pipelines be performed in accordance with Drawing No. SDS-110, SDW-110 and SDD-110, respectively, of the City of San Diego Regional Standard Drawings.

5.13.5 Placement and Compaction of Backfill

Prior to placement, all backfill materials should be moisture- conditioned, spread and placed in lifts (layers) not-to-exceed 6 inches in loose (uncompacted) thickness, and uniformly compacted to at least 90 percent relative compaction. During backfilling, the soil moisture content should be maintained at or within 2 percent above the optimum moisture content of the backfill materials. It is recommended that the upper 24 inches directly beneath proposed paved areas be compacted to at least 95 percent relative compaction. The maximum dry density and optimum moisture content of the backfill materials should be determined in the laboratory in accordance with the ASTM D1557 testing procedure.

Small hand-operated compacting equipment should be used for compaction of the backfill materials to an elevation of at least 3 feet above the top (crown) of the pipes. Flooding or jetting should not be used to densify the backfill.

5.14 Pavement Design for Driveways and Parking Lot

For the design of new pavement sections we have utilized the design procedures outlined in Asphalt Institute MS-1 and MS-23, and Portland Cement Association EB068. For preliminary design purposes, we have used a subgrade design R-value of 30. The actual R-value should be verified at the time of construction by sampling the final elevation subgrade material and performing R-value testing in the laboratory for verification. A summary of the recommended pavement sections is presented in Table 10 on the next page. These pavement sections assume a pavement life of approximately 20 years with normal maintenance.

Table 10

Recommended Pavement Sections

TRAFFIC TYPE	DESIGN LOAD	REINFORCED P.C.C. PAVEMENT	A.C. PAVEMENT	
			A.C.	CLASS II AGGREGATE BASE (min R-value of 78)
Parking Aisles & Driveway	TI = 6.5	7"	4.0"	6.0"

NOTES:

(1) Mix design for Portland Cement Concrete and asphalt concrete be prepared by an engineering company specializing in this type of work, and that the paving operations be inspected by a qualified testing laboratory.

(2) Aggregate base course should conform to the requirements of the Caltrans Standard Specifications.

(3) Prior to the construction of the pavement sections, R-value tests should be performed on representative samples of the subgrade soil materials to verify the R-value assumed for the design of the pavement sections.

For delivery truck areas subjected to stopping and impact loading, we recommend a minimum section of 8 inches of P.C.C. over 4 inches of Class II Aggregate Base. The P.C.C. pavement sections should be provided with steel reinforcement and crack-control joints designed by the structural engineer. Crack-control joints should extend a minimum depth of 1/3 of the thickness of the pavement section. A concrete mix with minimum 28-day modules of rupture (MOR) of 620 psi should be used in the design of the pavement section.

P.C.C. pavement should be constructed with thickened edges. Thickened edges should be at least 1.2 times the pavement thickness, and taper back to the recommended slab thickness three feet behind the edge of the slab. To control the location and spread of concrete shrinkage cracks, it is recommended that crack control joints (weakened plane joints) be included in the design of the concrete pavement. Crack control joints should be constructed at a spacing distance, in feet, of not less than three times the recommended slab thickness in inches, and should be sealed with an appropriate sealant to prevent migration of water through the control joint to the subgrade materials.

It is recommended that all structural pavement sections be constructed in accordance with the guidelines and procedures set forth in Section 302 of the "Green Book". Both concrete and asphalt pavement sections should be placed on a prepared subgrade. We recommend that the upper 24 inches of the subgrade and aggregate base be uniformly compacted to a minimum of 95 percent of maximum dry density as determined in the laboratory by the ASTM D1557 testing procedure.

We recommend that adequate surface drainage be provided to reduce ponding and infiltration of water in the subgrade materials. All paved areas should have a minimum gradient of 1 percent. As much as possible, irrigated areas next to pavement should be avoided; otherwise subdrains should be used to drain the areas to appropriate outlets. It is important to provide adequate drainage to reduce ponding and possible future distress of the pavement sections.

5.15 Stormwater Infiltration

AGE did not perform a percolation testing program at the project site. However, based on our experience with other projects in the general area and similar soil types, and analysis based of particle size distribution (Appendix C.4), it is anticipated that infiltration rates of less than 0.2 inches per hour for Very Old Paralic Deposits and less than 0.1 inch per hour in the silt and clay facies to a high of 0.5 inches per hour in the sandstone unit of the Scripps Formation may be used for design of Best Management Practice (BMP) storm water facilities at the project site. Infiltration rates within the fill materials at the project site are expected to vary widely for preliminary evaluation. Infiltration rates of 0.1 to 0.5 inches per hour may be used for the fill materials for preliminary design purposes. We recommend that field infiltration testing be performed for the final design of proposed BMP storm water facilities.

Infiltrated water is anticipated to flow in the direction of the infilled canyons at the project site. The City should verify the presence of trenches in close proximity to any proposed BMP storm water facilities and/or deep trenches which may intercept the flow of the infiltrated water from BMP facilities.

The proposed storm water infiltration is not anticipated to adversely impact the groundwater quality in the general area of the project site. Vertical distance to the regional groundwater table is anticipated to be 100 feet or greater. A search of the Geotracker data base does not reveal the presence of any water supply wells within 100 feet of the project site.

6.0 CONSTRUCTION-RELATED CONSIDERATIONS

6.1 Temporary Excavations

Excavation and safety during construction are the sole responsibility of the contractor. Excavations should be performed in accordance with applicable Local, State, and prevailing Federal and Cal OSHA safety regulations to prevent excessive ground movement and failure. Unsupported temporary excavations in the fill materials similar to those encountered in the exploratory borings may be constructed at an inclination no steeper than 1.5 : 1 (horizontal to vertical), or flatter, up to a maximum height of 15 feet. Unsupported temporary excavations in the formational materials similar to those encountered in the exploratory borings may be constructed at an inclination no steeper than 3/4 : 1 (horizontal to vertical), or flatter, up to a maximum height of 15 feet. Temporary construction slopes are considered to have a factor of safety against deep-seated failure in excess of 1.2 under static conditions.

Observations will need to be performed during site grading to check that no adverse conditions, geologic features or discontinuities are exposed in the excavation which may necessitate shoring or tie-backs. The contractor should exercise caution and provide adequate safety measures during excavations to protect equipment and/or personnel working directly below any excavation. Adequate safety measures include, but are not limited to, providing proper drainage control above and below the excavation, and elimination of any surcharge within a lateral distance equal to the height of the excavations.

6.2 Temporary Shoring

The contractor shall be responsible for the design and installation of temporary shoring for all vertical excavations in excess of 4 feet in height. Design and installation of shoring should be in accordance with the requirements specified by the State of California, Division of Occupational Safety and Health, Department of Industrial Relations (CAL OSHA). Furthermore, it should be the contractor's responsibility to provide adequate and safe support for all excavations and nearby located improvements which could be damaged by earth movement.

Settlement of existing street improvements and/or utilties adjacent to the shoring may occur in proportion to both the distance between shoring system and adjacent structures or utilities and the amount of horizontal deflection of the shoring system. Vertical settlement will be maximum directly adjacent to the shoring system, and decreases as the distance from the shoring increases. At a distance equal to the height of the shoring, settlement is expected to be negligible. Maximum vertical settlement is estimated to be on the order of 75 percent of the horizontal deflection of the shoring system. It is recommended that shoring be designed to limit the maximum horizontal deflection to 1/2-inch or less where existing structures or utilities are to be protected.

Temporary shoring should be designed to resist the pressure exerted by the retained soils and any additional lateral forces due to loads placed near the top of the excavation. For design of braced shorings supporting fill materials, the recommended lateral earth pressure should be 32H psf, where H is equal to the height of the retained earth in feet. For braced shoring supporting formational materials, the recommended lateral earth pressures may be reduced to 20H psf. Any surcharge loads would impose uniform lateral pressure of 0.3q, where "q" equals the uniform surcharge pressure. The surcharge pressure should be applied starting at a depth equal to the distance of the surcharge load from the top of the excavation.

Resistance to lateral loads will be provided by passive soil resistance. The allowable passive pressure for the fill materials and colluvial deposits may be assumed to be equivalent to a fluid weighing 250 pcf. Allowable lateral bearing pressure in fill material should not exceed 2,500 psf. Allowable passive pressure for undisturbed formational materials may be assumed to be equivalent to a fluid weighing 350 pcf, with maximum allowable lateral bearing pressure of 3,500 psf.

6.3 Construction Dewatering

The depth of the local groundwater table is expected to be well below the anticipated depth of the proposed excavations for this project. No groundwater or seepage was encountered in any of our exploratory borings.

We therefore do not anticipate the need for dewatering of excavations made during construction. The contractor should, however, anticipate the possible need for sump pumps in the event that localized perched water conditions are encountered during construction. Localized perched water conditions would most likely occur at the interface between fill materials and formational materials. The design, installation, and operation of any construction dewatering measures necessary for the project shall be the sole responsibility of the contractor.

6.4 CIDH Piles Construction Considerations

It is anticipated that standard continuous flight rotary augers may be used for construction of the proposed CIDH piles. The need for the use of drilling fluids and or slurry displacement method for the installation of the proposed CIDH piles are not anticipated.

Zones with abundance gravels and cobbles were encountered during the subsurface investigation. The contractor should be prepared to use drilling buckets in the event that the augers are unable to extract the cuttings from the drilled shafts. No boulders and/or hard rocks were encountered during the subsurface investigation. Therefore, the need for rock coring is not anticipated on this project. The use of temporary steel casings may be required within portions of the drilled shafts which are located in fill and/or zones with abundant gravels and cobbles. In the event that steel casings are required, the casings may be extracted from the shafts as the concrete is placed.

It is recommended that prior to placement of reinforcing steel, all footing shafts be downhole inspected to confirm and verify the soil type at the bottom of the shafts and minimum depth embedment into the Scripps Formation. Furthermore, prior to placement of concrete, it is recommended that the shafts be cleaned of all loose materials with a cleanout bucket. Concrete should be placed by using a tremie or pump pipe which can be adjusted to permit free discharge of concrete and lowered rapidly, if needed, without excessive contact with the sides of the shaft.

6.5 Environmental Considerations

The scope of AGE's investigation did not include the performance of a Phase I Environmental Site Assessment (Phase I ESA) to evaluate the possible presence of soil and/or groundwater contamination beneath the project site. During our subsurface investigation soil samples were field screened for the presence of volatile organics using a RAE Systems MiniRAE 3000 organic vapor meter (OVM). The field screening did not reveal elevated levels of volatile organics in the samples. In the event that hazardous or toxic materials are encountered during the construction phase, the contractor should immediately notify the City and be prepared to handle and dispose of such materials in accordance with current industry practices and applicable Local, State and Federal regulations.

7.0 GENERAL CONDITIONS

7.1 Post-Investigation Services

Post-investigation geotechnical services are an important continuation of this investigation, and we recommend that the City's Construction Inspection Division performs the necessary geotechnical observation and testing services during construction. In the event that the City is unable to perform said services, it is recommended that our firm be retained to provide the services.

Sufficient and timely observation and testing should be performed during excavation, subgrade preparation, pipeline installation, backfilling and other related earthwork operations. The purpose of the geotechnical observation and testing is to correlate findings of this investigation with the actual subsurface conditions encountered during construction and/or to provide supplemental recommendations, if necessary. The geotechnical observation and testing are also intended to confirm that the structures and pipelines are placed on competent soil materials, and that suitable bedding and backfill materials have been properly placed and compacted to meet the project specifications.

7.2 Uncertainties and Limitations

The information presented in this report is intended to for the sole use of the CH2M Design Team, and the City of San Diego for project design purposes only and may not provide sufficient data to prepare an accurate bid.

Our firm has observed and investigated only a very limited portion of the subsurface conditions at the project site. The findings and recommendations presented in this report are based on the assumption that the subsurface conditions beneath the entire project site do not deviate substantially from those encountered in the exploratory soil borings. Consequently, modifications or changes to the recommendations presented herein may be necessary based on the actual subsurface conditions encountered during the project construction phase.

California, including San Diego County, is in an area of high seismic risk. It is generally considered economically unfeasible to build a totally earthquake-resistant project and it is, therefore, possible that a nearby large magnitude earthquake could cause damage at the project site.

Geotechnical engineering and geologic sciences are characterized by uncertainty. Professional judgments and opinions presented in this report are based partly on our evaluation and analysis of the technical data gathered during our present study, partly on our understanding of the scope of the proposed project, and partly on our general experience in geotechnical engineering.

In the performance of our professional services, we have complied with that level of care and skill ordinarily exercised by other members of the geotechnical engineering profession currently practicing under similar circumstances in southern California. Our services consist of professional consultation only, and no warranty of any kind whatsoever, expressed or implied, is made or intended in connection with the work performed. Furthermore, our firm does not guarantee the performance of the project in any respect.

Our firm does not practice or consult in the field of safety engineering. The contractor will be responsible for the health and safety of his/her personnel and all Subcontractors at the construction site. The contractor should notify the City if he or she considers any of the recommendations presented in this report to be unsafe.

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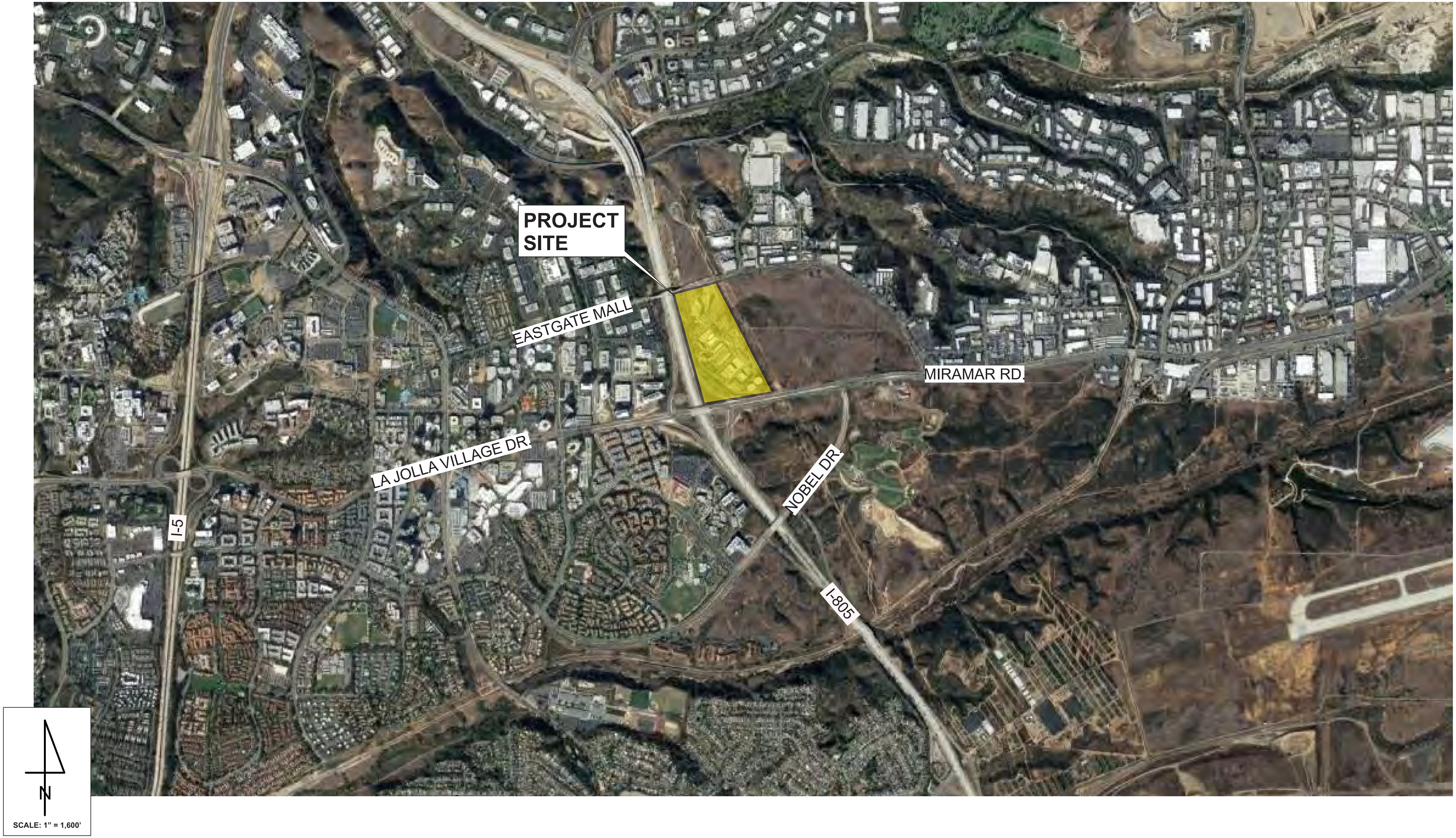
FIGURES

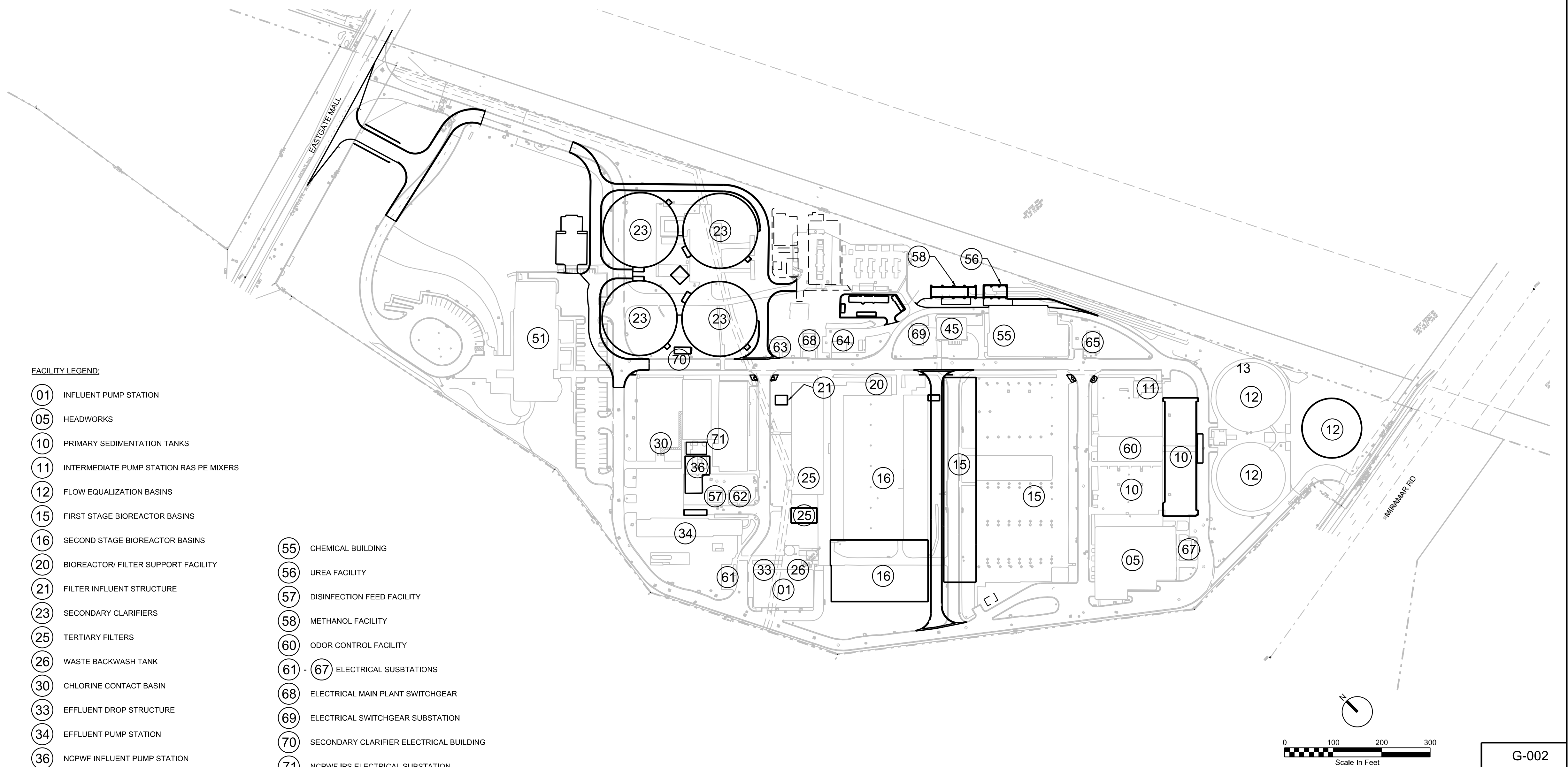


NORTH CITY WATER RECLAMATION PLANT EXPANSION | **LOCATION MAP**

PROJECT NO.
44F1

ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE 1



FACILITY LEGEND:

01	INFLUENT PUMP STATION
05	HEADWORKS
10	PRIMARY SEDIMENTATION TANKS
11	INTERMEDIATE PUMP STATION RAS PE MIXERS
12	FLOW EQUALIZATION BASINS
15	FIRST STAGE BIOREACTOR BASINS
16	SECOND STAGE BIOREACTOR BASINS
20	BIOREACTOR/ FILTER SUPPORT FACILITY
21	FILTER INFLUENT STRUCTURE
23	SECONDARY CLARIFIERS
25	TERTIARY FILTERS
26	WASTE BACKWASH TANK
30	CHLORINE CONTACT BASIN
33	EFFLUENT DROP STRUCTURE
34	EFFLUENT PUMP STATION
36	NCPWF INFLUENT PUMP STATION
45	BLENDED SLUDGE PUMP STATION
51	OPERATIONS BUILDING
55	CHEMICAL BUILDING
56	UREA FACILITY
57	DISINFECTION FEED FACILITY
58	METHANOL FACILITY
60	ODOR CONTROL FACILITY
61 - 67	ELECTRICAL SUSBTATIONS
68	ELECTRICAL MAIN PLANT SWITCHGEAR
69	ELECTRICAL SWITCHGEAR SUBSTATION
70	SECONDARY CLARIFIER ELECTRICAL BUILDING
71	NCPWF IPS ELECTRICAL SUBSTATION

NORTH CITY WATER RECLAMATION PLANT

G-002

SAN DIEGO NCWRP EXPANSION AND
NCPWF INFLUENT CONVEYANCE

GENERAL
PROJECT KEY PLAN

CITY OF SAN DIEGO, CALIFORNIA
PUBLIC UTILITIES DEPARTMENT
SHEET XXXX OF XXX SHEETS

WBS

APPROVED:
FOR CITY ENGINEER
DATE
PRINT DCE NAME
RCE#

SUBMITTED BY:
J HOYLE
PROJECT MANAGER

CHECKED BY:
M BALDWIN
PROJECT ENGINEER

CCS27 COORDINATE

CCS83 COORDINATE

DESCRIPTION	BY	APPROVED	DATE	FILM

CONSULTANT

ch2m

MATTHEW JOHN
BALDWIN
CA C71817

NOT FOR
CONSTRUCTION

CONTRACTOR
INSPECTOR
DATE STARTED
DATE COMPLETED

CONSTRUCTION CHANGE / ADDENDUM

CHANGE	DATE	AFFECTED OR ADDED SHEET NUMBERS	APPROVAL NO.

WARNING
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IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE

The City of
SAN DIEGO Public Utilities

FILENAME: G-002_684476.dgn PLOT DATE: 2017\05\15 PLOT TIME: 4:00:22 PM

30% DESIGN

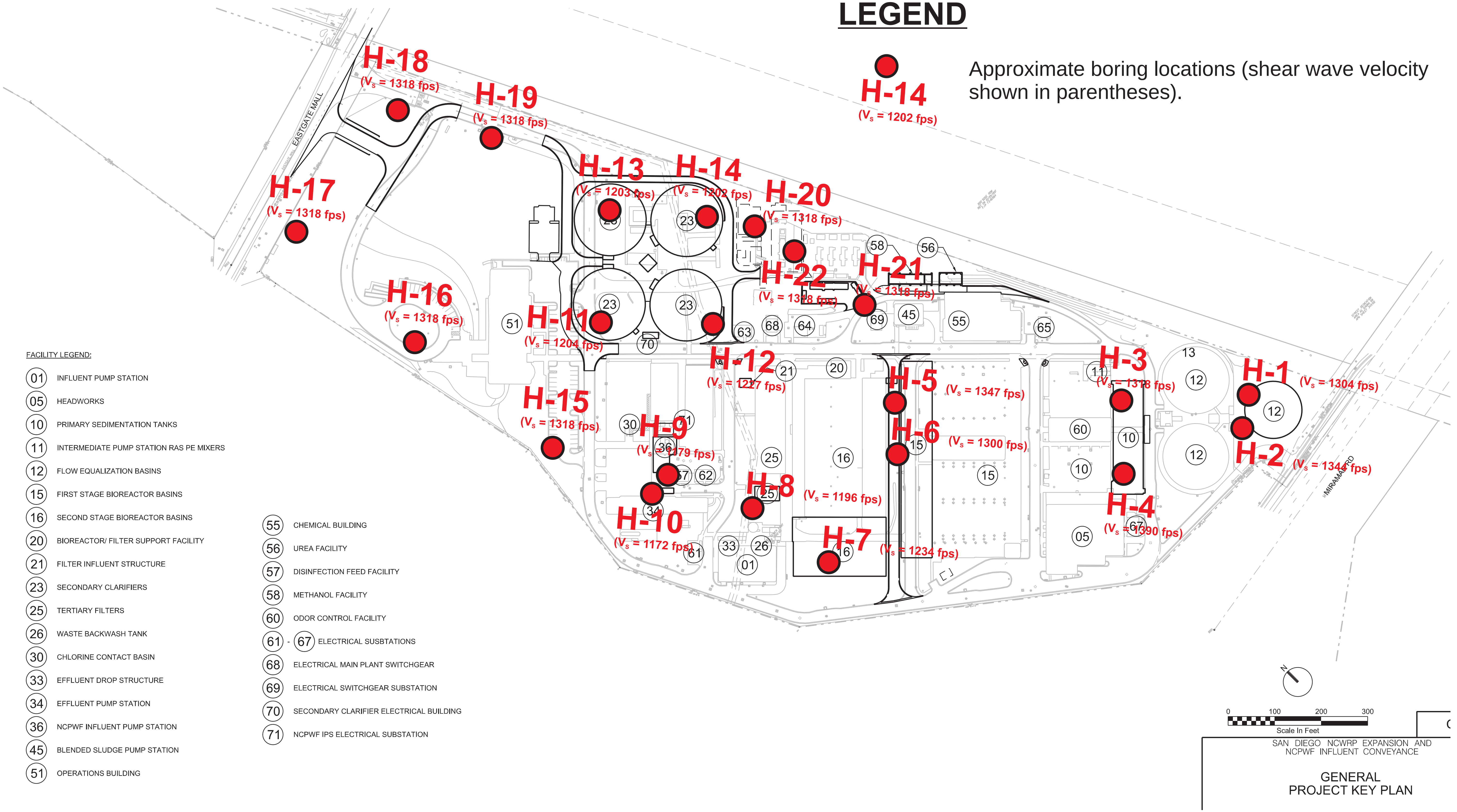
NORTH CITY WATER RECLAMATION PLANT EXPANSION

SITE PLAN

PROJECT NO. 44F1

ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE 2



LEGEND

● H-14 (V$_s$ = 1202 fps) Approximate boring locations (shear wave velocity shown in parentheses).

FACILITY LEGEND:

01	INFLUENT PUMP STATION
05	HEADWORKS
10	PRIMARY SEDIMENTATION TANKS
11	INTERMEDIATE PUMP STATION RAS PE MIXERS
12	FLOW EQUALIZATION BASINS
15	FIRST STAGE BIOREACTOR BASINS
16	SECOND STAGE BIOREACTOR BASINS
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SAN DIEGO NCWRP EXPANSION AND
NCPWF INFLUENT CONVEYANCE

GENERAL
PROJECT KEY PLAN

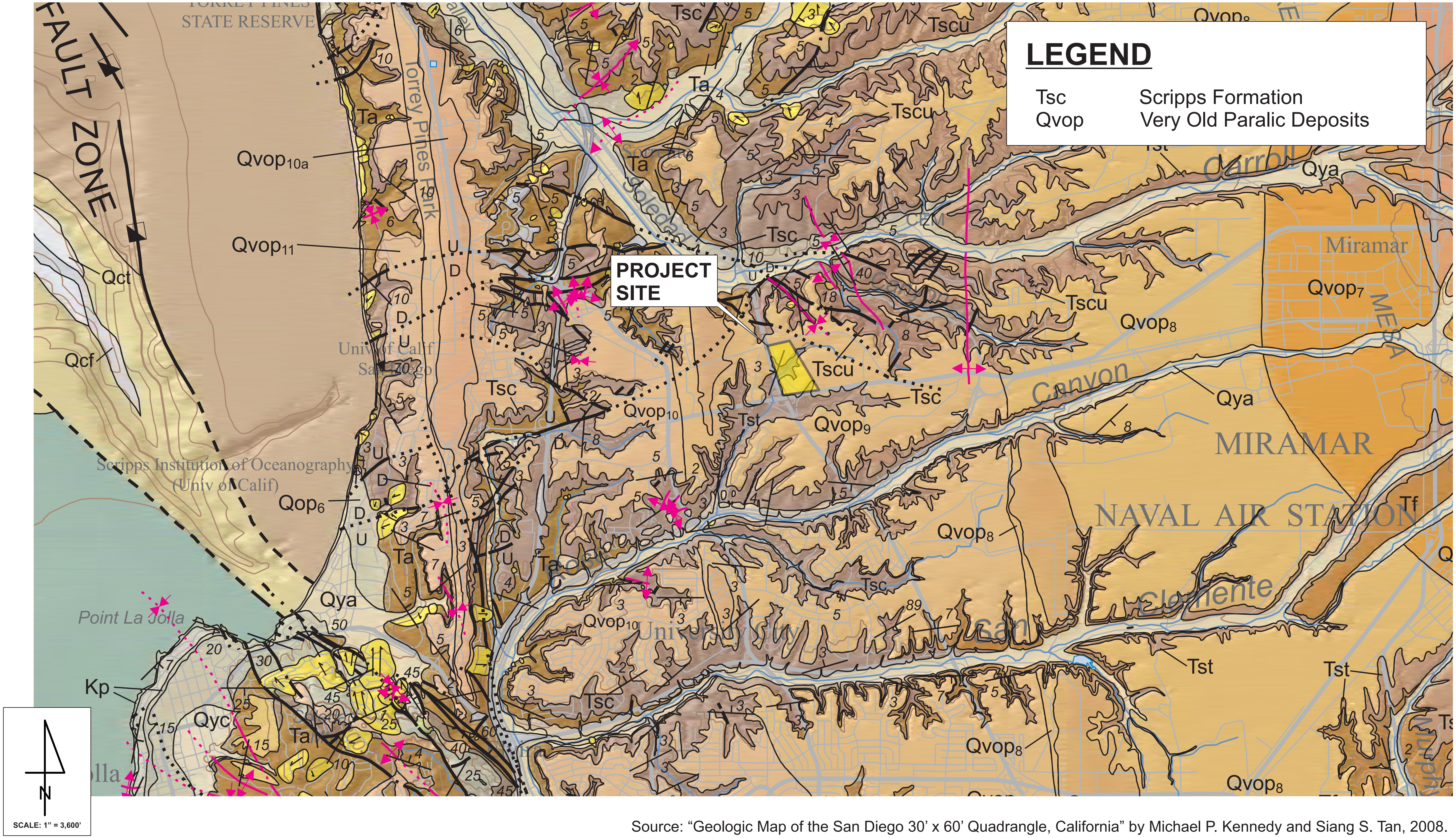
NORTH CITY WATER RECLAMATION PLANT EXPANSION

SITE PLAN SHOWING APPROXIMATE BORING LOCATIONS

PROJECT NO.
44F1

ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE 3



LEGEND

Tsc	Scripps Formation
Qvop	Very Old Paralic Deposits

Source: "Geologic Map of the San Diego 30' x 60' Quadrangle, California" by Michael P. Kennedy and Siang S. Tan, 2008.

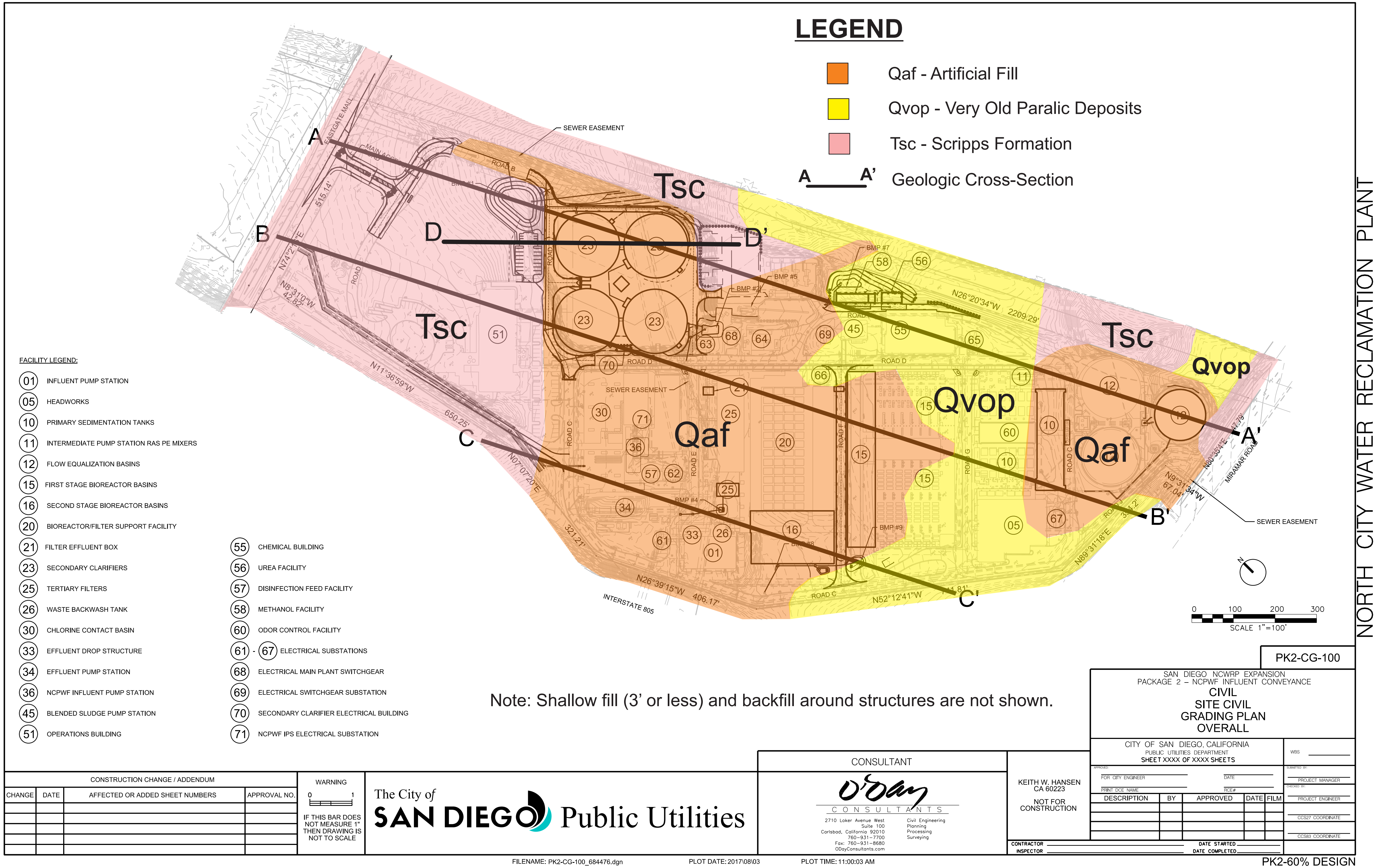
NORTH CITY WATER RECLAMATION PLANT EXPANSION

GENERALIZED GEOLOGIC MAP

PROJECT NO.
44F1

ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE 4



LEGEND

🟧	Qaf - Artificial Fill
🟨	Qvop - Very Old Paralic Deposits
🟥	Tsc - Scripps Formation
A____A'	Geologic Cross-Section

FACILITY LEGEND:

(01)	INFLUENT PUMP STATION
(05)	HEADWORKS
(10)	PRIMARY SEDIMENTATION TANKS
(11)	INTERMEDIATE PUMP STATION RAS PE MIXERS
(12)	FLOW EQUALIZATION BASINS
(15)	FIRST STAGE BIOREACTOR BASINS
(16)	SECOND STAGE BIOREACTOR BASINS
(20)	BIOREACTOR/FILTER SUPPORT FACILITY
(21)	FILTER EFFLUENT BOX
(23)	SECONDARY CLARIFIERS
(25)	TERTIARY FILTERS
(26)	WASTE BACKWASH TANK
(30)	CHLORINE CONTACT BASIN
(33)	EFFLUENT DROP STRUCTURE
(34)	EFFLUENT PUMP STATION
(36)	NCPWF INFLUENT PUMP STATION
(45)	BLENDED SLUDGE PUMP STATION
(51)	OPERATIONS BUILDING
(55)	CHEMICAL BUILDING
(56)	UREA FACILITY
(57)	DISINFECTION FEED FACILITY
(58)	METHANOL FACILITY
(60)	ODOR CONTROL FACILITY
(61) - (67)	ELECTRICAL SUBSTATIONS
(68)	ELECTRICAL MAIN PLANT SWITCHGEAR
(69)	ELECTRICAL SWITCHGEAR SUBSTATION
(70)	SECONDARY CLARIFIER ELECTRICAL BUILDING
(71)	NCPWF IPS ELECTRICAL SUBSTATION

Note: Shallow fill (3' or less) and backfill around structures are not shown.

PK2-CG-100

SAN DIEGO NCWRP EXPANSION
PACKAGE 2 – NCPWF INFLUENT CONVEYANCE
CIVIL
SITE CIVIL
GRADING PLAN
OVERALL

CITY OF SAN DIEGO, CALIFORNIA
PUBLIC UTILITIES DEPARTMENT
SHEET XXXX OF XXXX SHEETS

WBS ______

APPROVED:
FOR CITY ENGINEER ______ DATE ______
PRINT DCE NAME ______ RCE# ______

SUBMITTED BY: ______ PROJECT MANAGER
CHECKED BY: ______ PROJECT ENGINEER
______ CCS27 COORDINATE
______ CCS83 COORDINATE

DESCRIPTION	BY	APPROVED	DATE	FILM

CONSTRUCTION CHANGE / ADDENDUM

CHANGE	DATE	AFFECTED OR ADDED SHEET NUMBERS	APPROVAL NO.

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The City of
SAN DIEGO Public Utilities

CONSULTANT
O'Day
CONSULTANTS
2710 Loker Avenue West
Suite 100
Carlsbad, California 92010
760–931–7700
Fax: 760–931–8680
ODayConsultants.com

Civil Engineering
Planning
Processing
Surveying

KEITH W. HANSEN
CA 60223

NOT FOR CONSTRUCTION

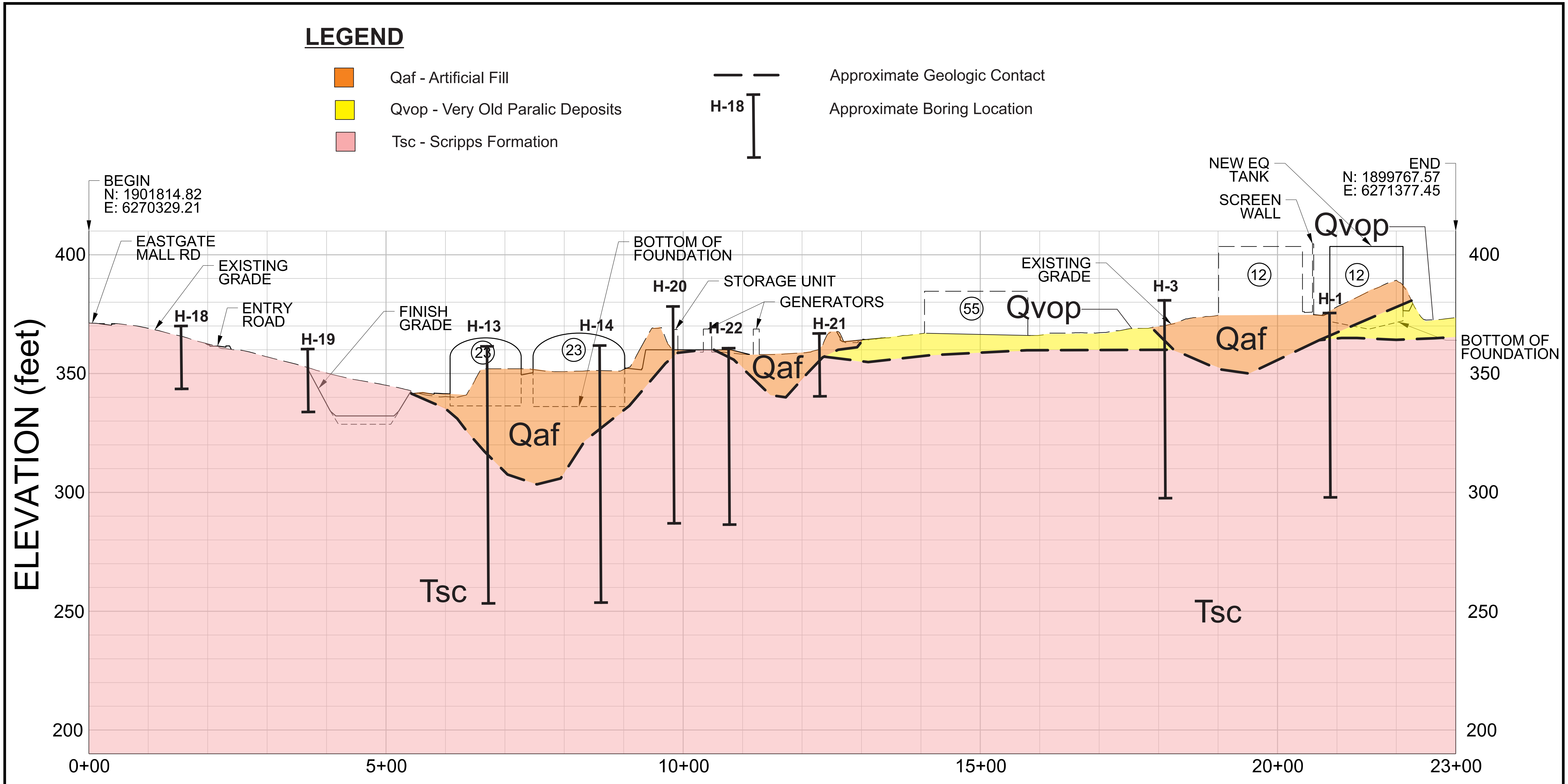
CONTRACTOR ______ DATE STARTED ______
INSPECTOR ______ DATE COMPLETED ______

FILENAME: PK2-CG-100_684476.dgn PLOT DATE: 2017\08\03 PLOT TIME: 11:00:03 AM

PK2-60% DESIGN

NORTH CITY WATER RECLAMATION PLANT EXPANSION	**SITE SPECIFIC GEOLOGIC MAP**

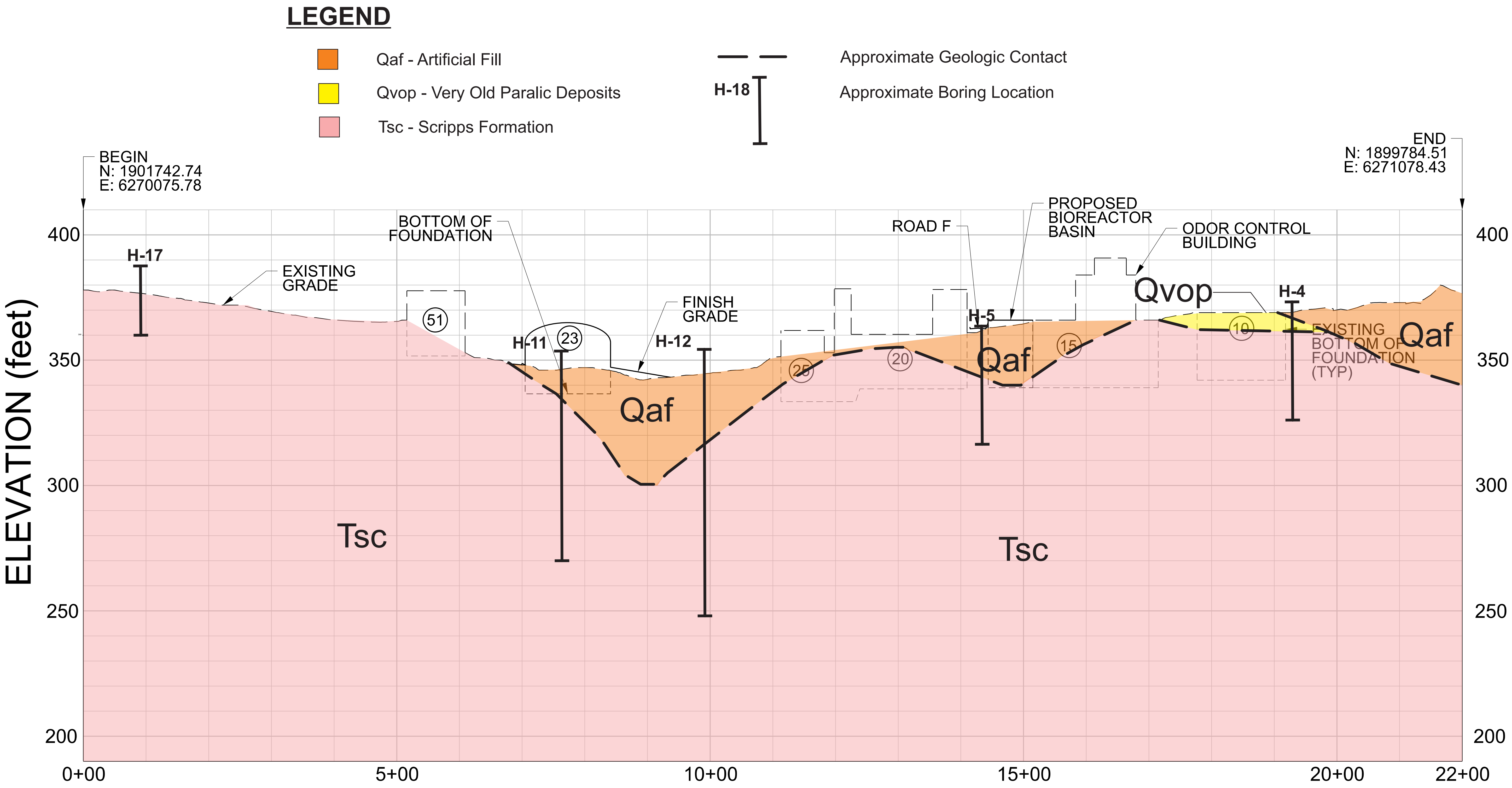
PROJECT NO. 44F1	**ALLIED GEOTECHNICAL ENGINEERS, INC.**	**FIGURE 5**



SECTION A-A'

SCALE: H: 1" = 160'
V: 1" = 40'

NORTH CITY WATER RECLAMATION PLANT EXPANSION		CROSS-SECTION A-A'
PROJECT NO. 44F1	**ALLIED GEOTECHNICAL ENGINEERS, INC.**	**FIGURE 6**



SECTION B-B'

SCALE: H: 1" = 160'
V: 1" = 40'

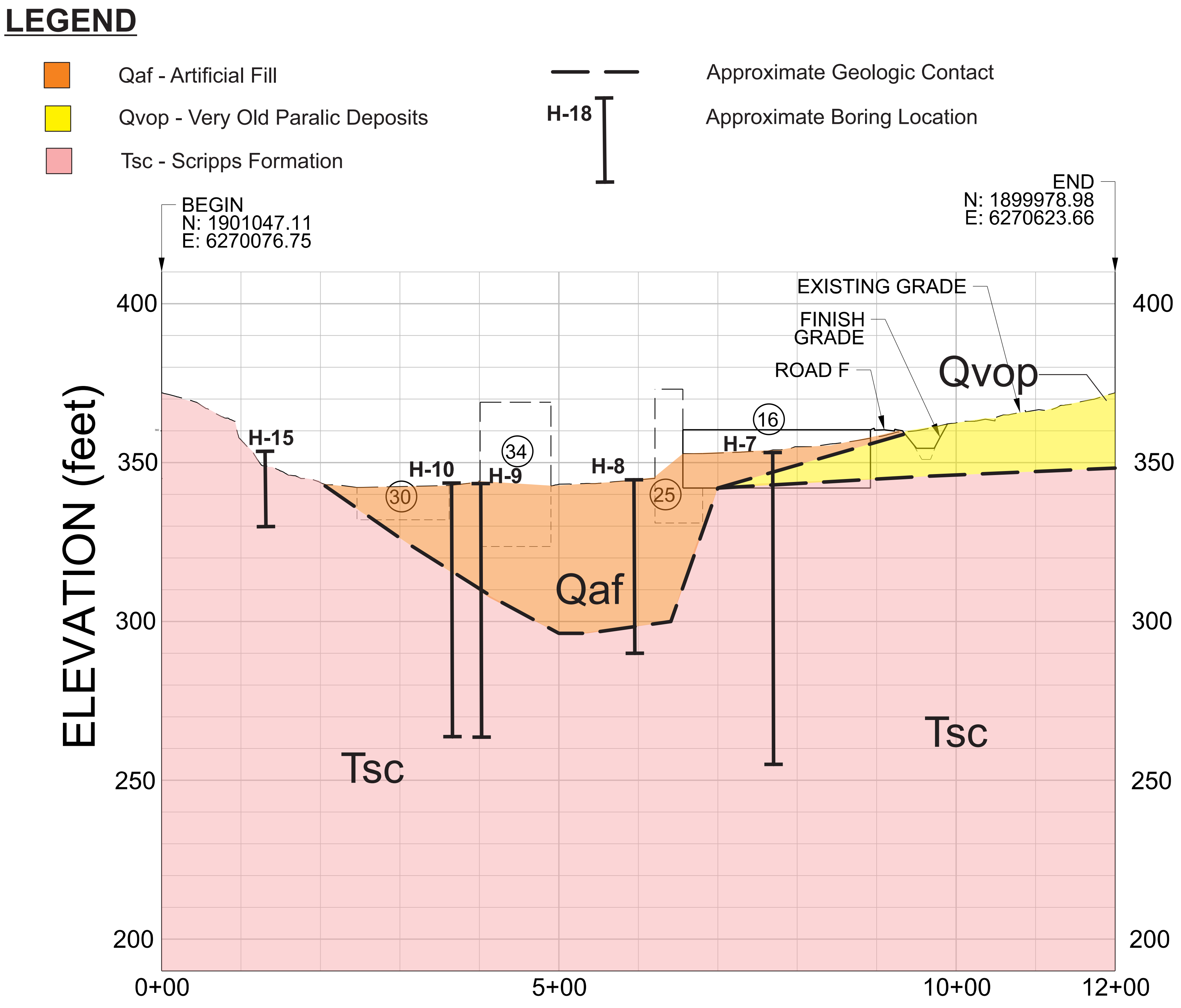
NORTH CITY WATER RECLAMATION PLANT EXPANSION

CROSS-SECTION B-B'

PROJECT NO.
44F1

ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE 7



SECTION C-C'

SCALE: H: 1" = 160'
V: 1" = 40'

NORTH CITY WATER RECLAMATION PLANT EXPANSION | **CROSS-SECTION C-C'**

PROJECT NO.
44F1

ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE 8

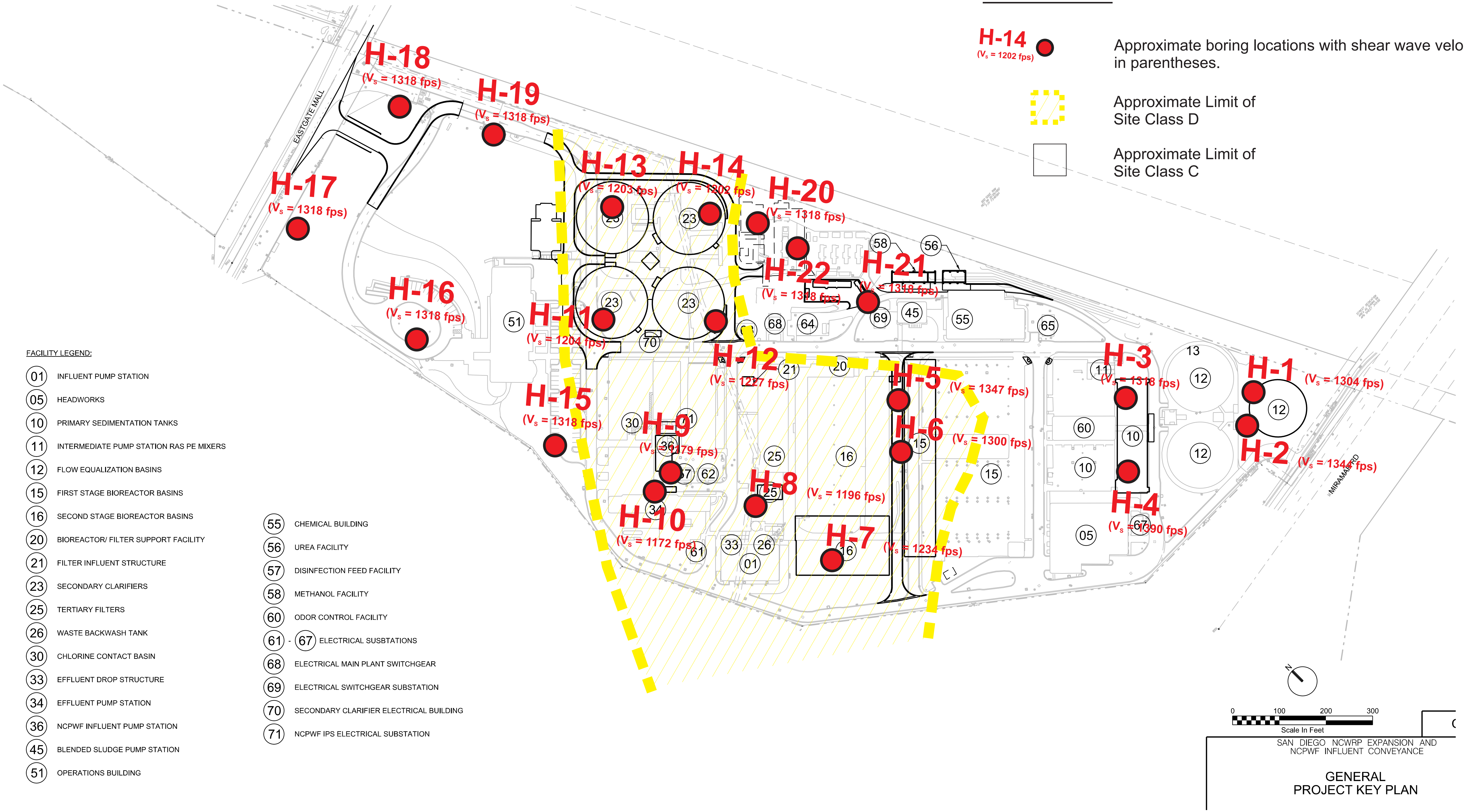
NORTH CITY WATER RECLAMATION PLANT EXPANSION

REGIONAL FAULT MAP

PROJECT NO. 44F1

ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE 9



LEGEND

H-14 ● (V_s = 1202 fps) Approximate boring locations with shear wave velocity in parentheses.

▨ Approximate Limit of Site Class D

☐ Approximate Limit of Site Class C

FACILITY LEGEND:

01	INFLUENT PUMP STATION
05	HEADWORKS
10	PRIMARY SEDIMENTATION TANKS
11	INTERMEDIATE PUMP STATION RAS PE MIXERS
12	FLOW EQUALIZATION BASINS
15	FIRST STAGE BIOREACTOR BASINS
16	SECOND STAGE BIOREACTOR BASINS
20	BIOREACTOR/ FILTER SUPPORT FACILITY
21	FILTER INFLUENT STRUCTURE
23	SECONDARY CLARIFIERS
25	TERTIARY FILTERS
26	WASTE BACKWASH TANK
30	CHLORINE CONTACT BASIN
33	EFFLUENT DROP STRUCTURE
34	EFFLUENT PUMP STATION
36	NCPWF INFLUENT PUMP STATION
45	BLENDED SLUDGE PUMP STATION
51	OPERATIONS BUILDING
55	CHEMICAL BUILDING
56	UREA FACILITY
57	DISINFECTION FEED FACILITY
58	METHANOL FACILITY
60	ODOR CONTROL FACILITY
61 - 67	ELECTRICAL SUSBTATIONS
68	ELECTRICAL MAIN PLANT SWITCHGEAR
69	ELECTRICAL SWITCHGEAR SUBSTATION
70	SECONDARY CLARIFIER ELECTRICAL BUILDING
71	NCPWF IPS ELECTRICAL SUBSTATION

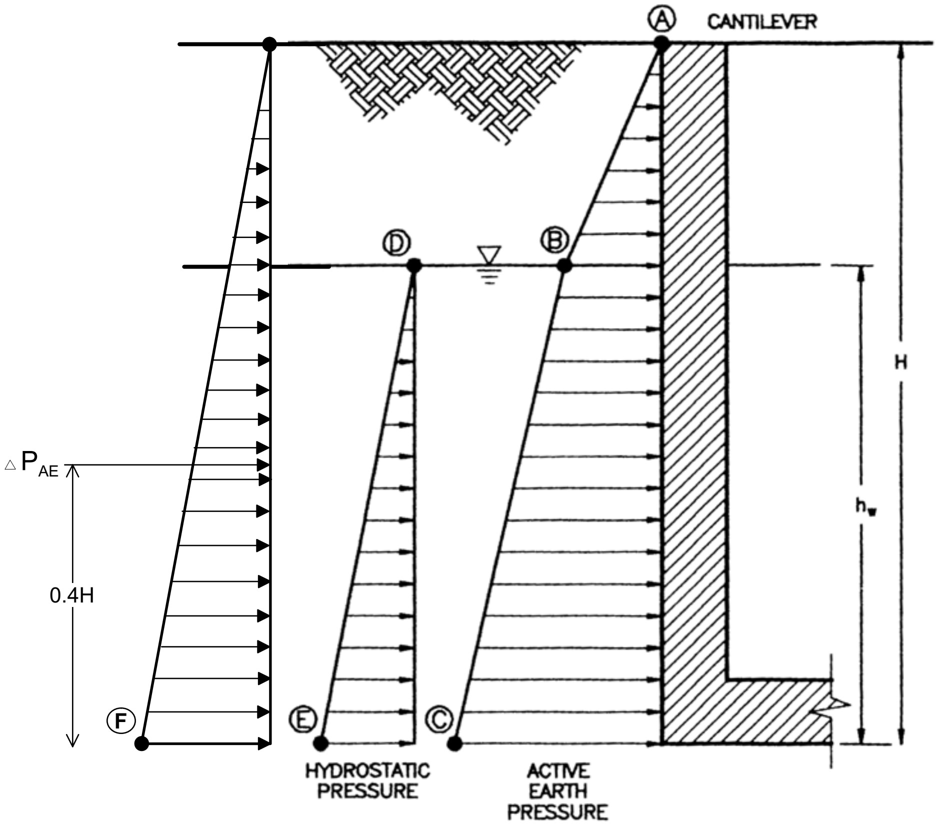
NORTH CITY WATER RECLAMATION PLANT EXPANSION

SITE PLAN SHOWING SITE CLASSIFICATIONS

PROJECT NO.
44F1

ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE 10



NOTES

H = wall height in feet

h_w = water height above bottom of structure in feet

Lateral pressure values presented herein are based on the assumption that non-expansive backfill materials will be used to backfill behind walls

LATERAL PRESSURES

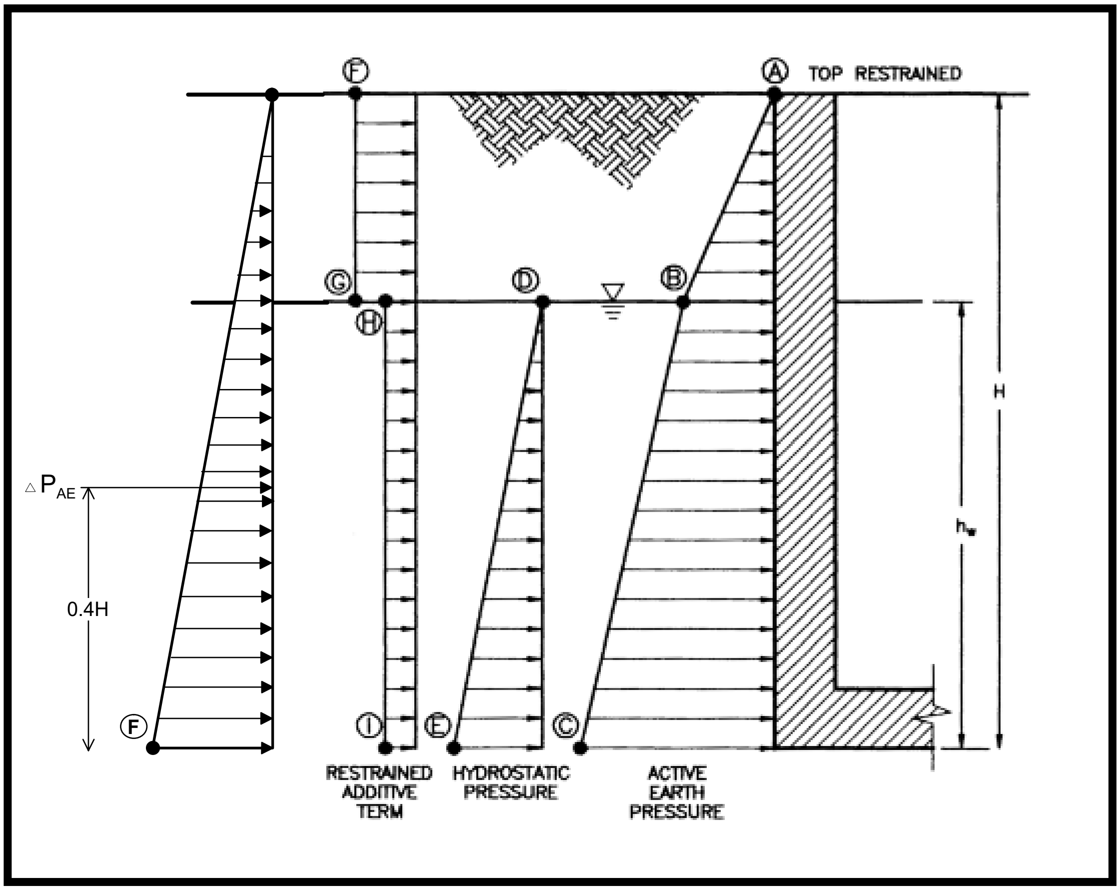
Earth Pressure
Ⓐ = 0
Ⓑ = 35 $(H-h_w)$, psf for level backfill &
61 $(H-h_w)$, psf for 2 : 1 (H : V) sloping backfill
Ⓒ = 35 $(H-h_w) + 20h_w$, psf

Hydrostatic Pressure
Ⓓ = 0
Ⓔ = $62.4h_w$

Dynamic Resultant Force
Ⓕ = 12H
△ P_{AE} = $6H^2$, lb/ft @ 0.4H

LATERAL PRESSURES FOR CANTILEVER WALLS
NORTH CITY WATER RECLAMATION PLANT EXPANSION

PROJECT NO. 44F1	ALLIED GEOTECHNICAL ENGINEERS, INC.	FIGURE 11



NOTES

H = wall height in feet

h_w = water height above bottom of structure in feet

Lateral pressure values presented herein are based on the assumption that non-expansive backfill materials will be used to backfill behind walls

LATERAL PRESSURES

Earth Pressure
Ⓐ = 0
Ⓑ = 35 $(H-h_w)$, psf
Ⓒ = 35 $(H-h_w) + 20h_w$, psf

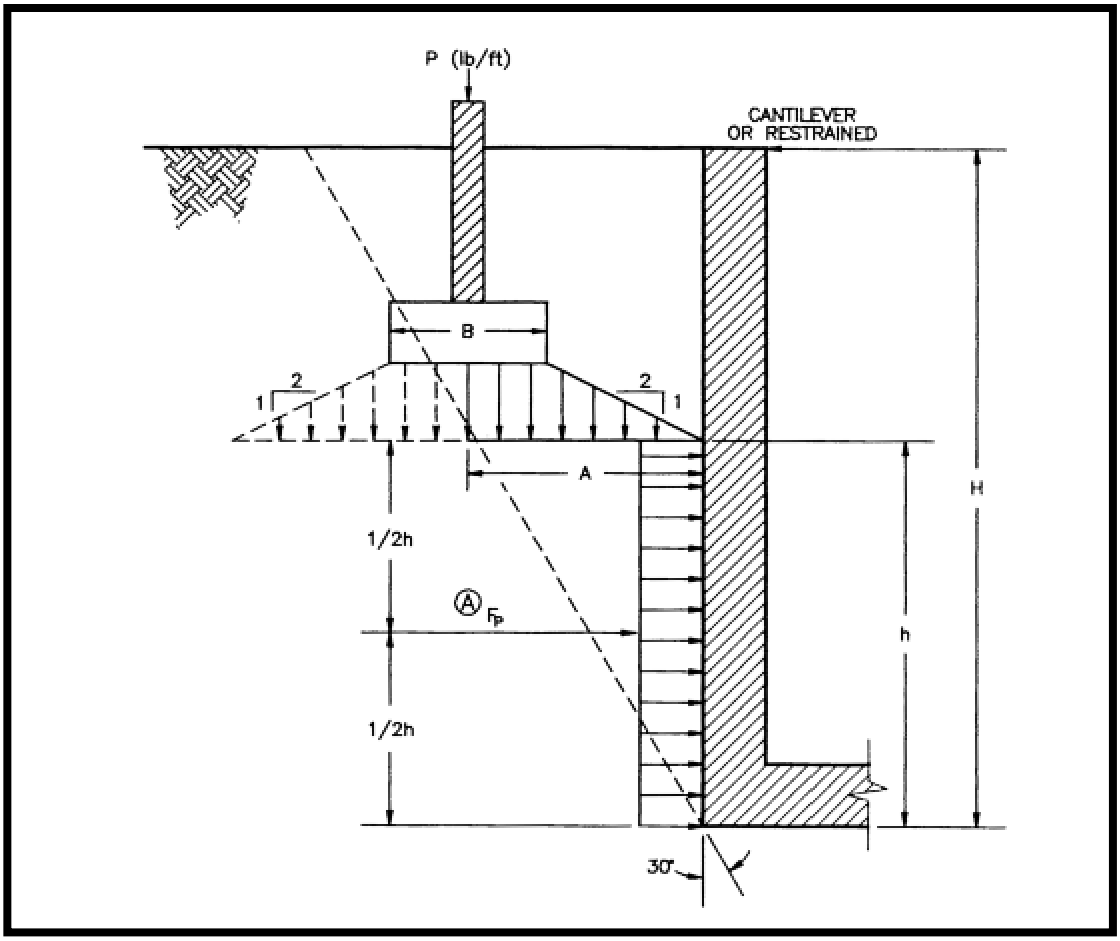
Hydrostatic Pressure
Ⓓ = 0
Ⓔ = $62.4h_w$

Restrained Additive Term
Ⓕ = Ⓖ = 25H, psf
Ⓗ = Ⓘ = 10H, psf

Dynamic Resultant Force
Ⓕ = 12H
$\triangle P_{AE} = 6H^2$, lb/ft @ 0.4H

LATERAL PRESSURES FOR RESTRAINED WALLS
NORTH CITY WATER RECLAMATION PLANT EXPANSION

PROJECT NO. 44F1	ALLIED GEOTECHNICAL ENGINEERS, INC.	FIGURE 12



NON-EXPANSIVE BACKFILL

$F_p = M\,(A/B)\,P$, lb/ft

A = h tan 30°, ft
M = 0.3 for cantilever wall
M = 0.4 for restrained wall

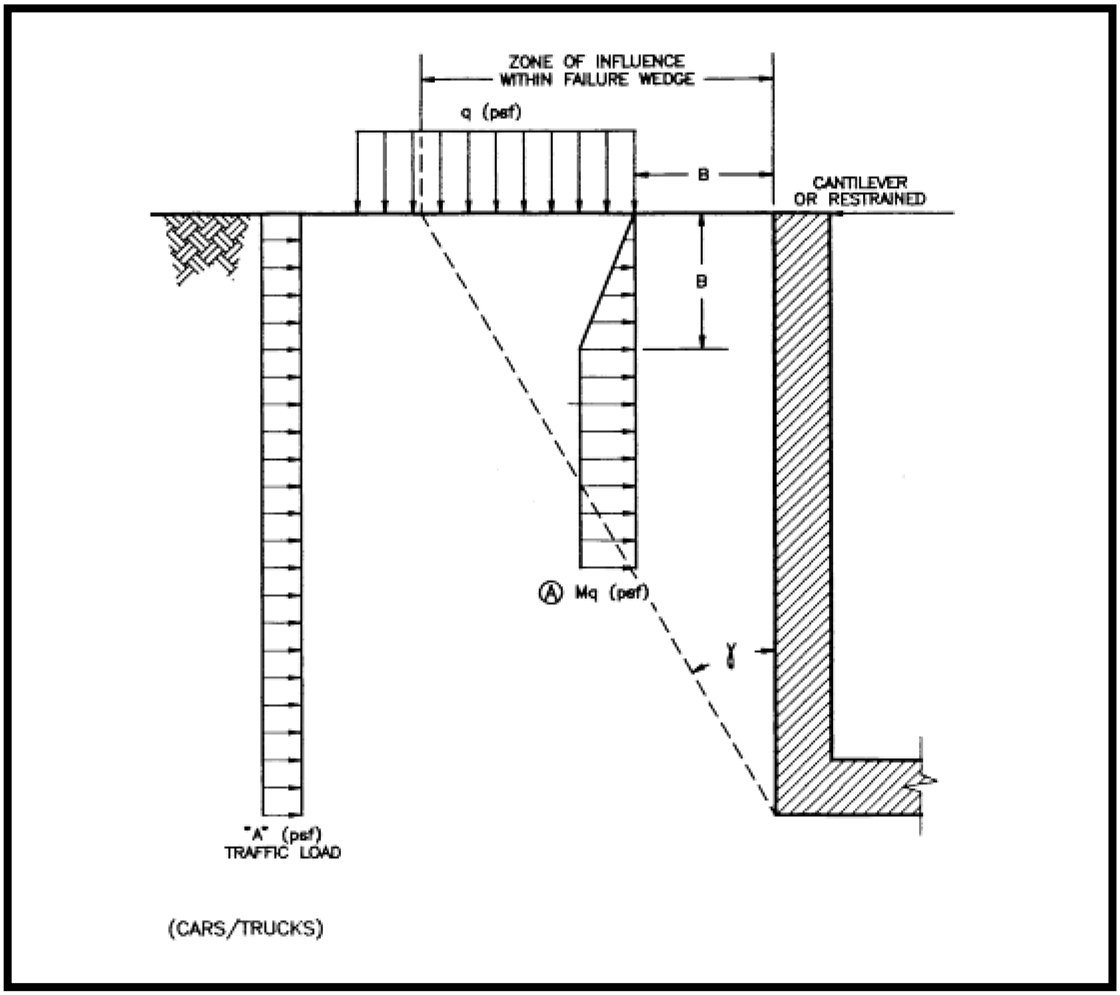
Angle of Internal Friction (φ) = 35°
Zone of Influence (γ) = 30°

NOTES:

1. Surcharge pressure acting on wall is not affected by groundwater elevation.
2. Surcharge pressures shown are applicable for continuous footing only. Spread footings need to be evaluated individually.

FOUNDATION INDUCED WALL PRESSURES
NORTH CITY WATER RECLAMATION PLANT EXPANSION

PROJECT NO. **44F1**	**ALLIED GEOTECHNICAL ENGINEERS, INC.**	**FIGURE13**



NON-EXPANSIVE BACKFILL

q = surcharge load (psf)
B = distance between wall and surcharge load, ft
M = 0.3 for cantilever wall
M = 0.4 for restrained wall
Ⓐ= Mq, psf
"A" = 75 psf
Angle of Internal Friction (φ) = 35°
Zone of Influence (γ) = 30°

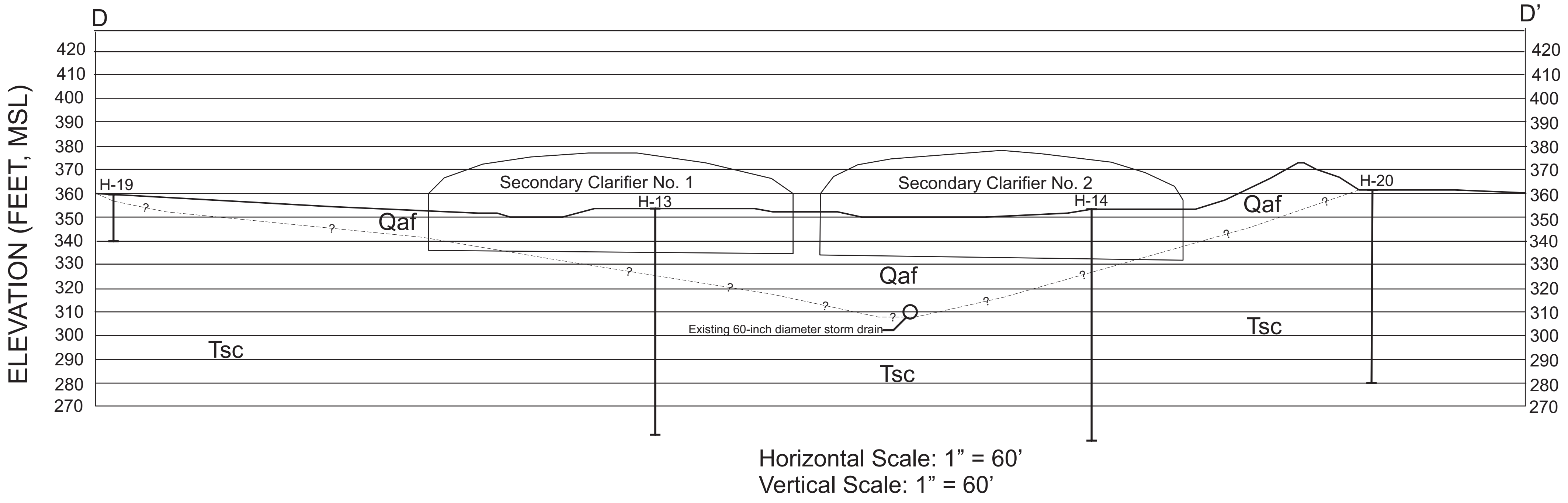
NOTE: Surcharge pressure acting on wall is not affected by groundwater elevation.

TRAFFIC AND SURCHARGE PRESSURES
NORTH CITY WATER RECLAMATION PLANT EXPANSION

PROJECT NO.
44F1

ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE 14



LEGEND

I Approximate boring location

---?--- Approximate geologic interface (queried where inferred)

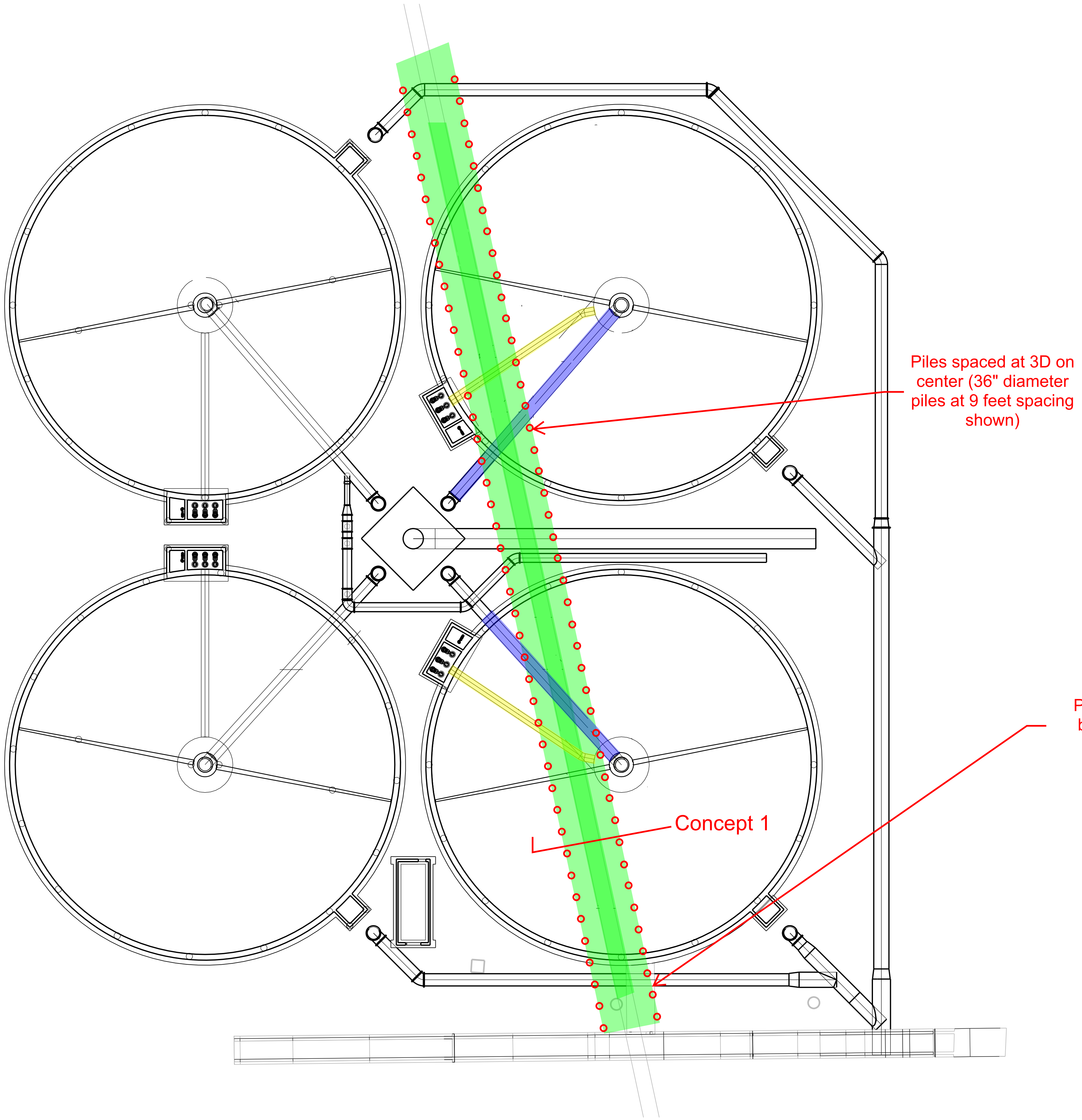
NORTH CITY WATER RECLAMATION PLANT EXPANSION

CROSS-SECTION D-D'

PROJECT NO.
44F1

ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE 15



Source: Sketch prepared by Kleinfelder, undated.

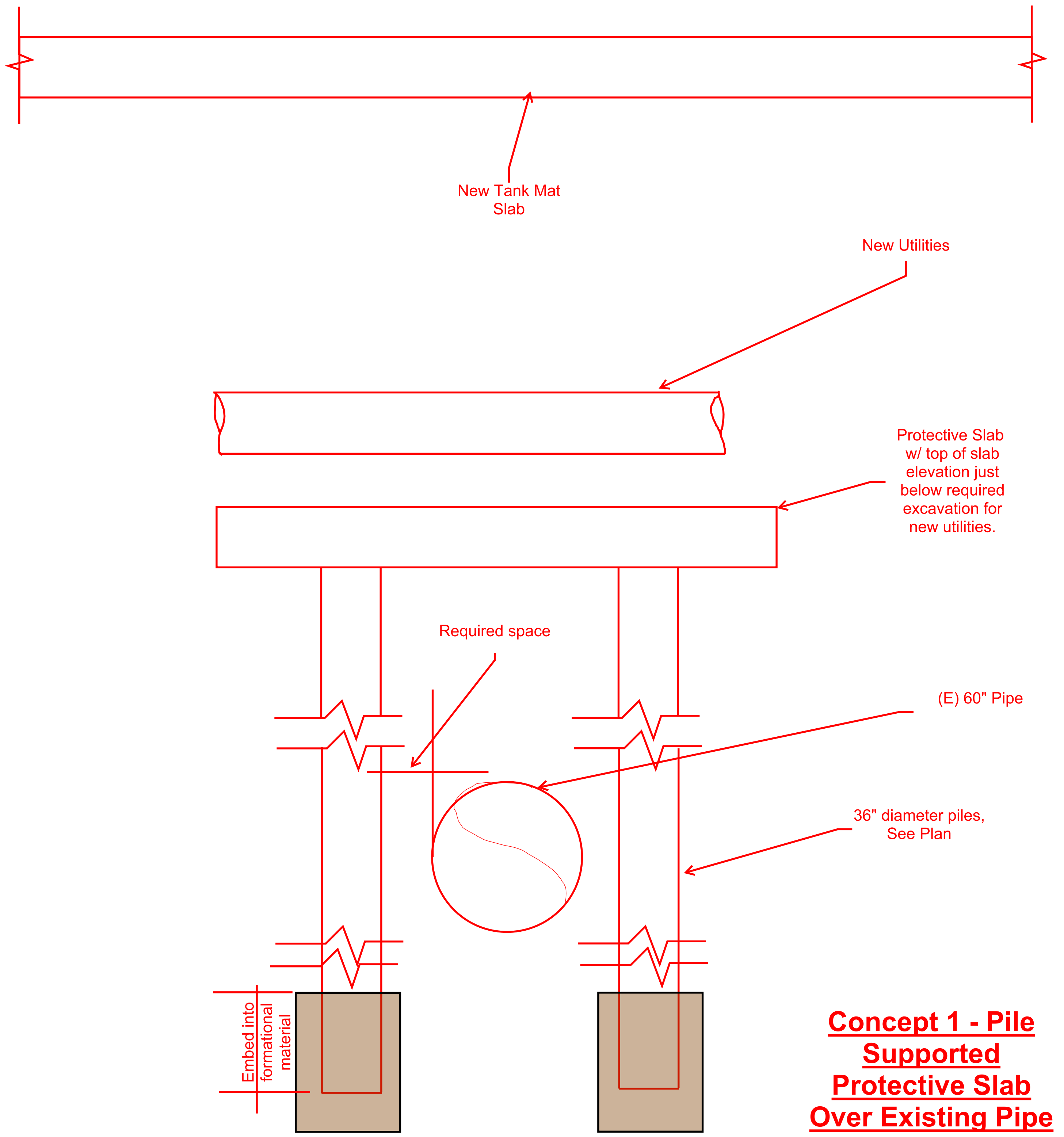
NORTH CITY WATER RECLAMATION PLANT EXPANSION

60-INCH STORM DRAIN PROTECTION - PLAN VIEW

PROJECT NO. 44F1

ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE 16



Concept 1 - Pile Supported Protective Slab Over Existing Pipe

Source: Sketch prepared by Kleinfelder, undated.

NORTH CITY WATER RECLAMATION PLANT EXPANSION	60-INCH STORM DRAIN PROTECTION - PROFILE

PROJECT NO. 44F1	ALLIED GEOTECHNICAL ENGINEERS, INC.	FIGURE 17

APPENDIX A

FIELD EXPLORATION PROGRAM

APPENDIX A

FIELD EXPLORATION PROGRAM

The field exploration program for this project was performed during the period between May 1 and May 26, 2017. A total of twenty two (22) soil borings were performed at the approximate locations shown on Figure 3. The borings were advanced using conventional hollow-stem auger, air percussion and mud rotary drilling methods to depths ranging from 19.5 feet to 101 feet below the existing ground surface (bgs).

Prior to commencement of the drilling operations, several site visits were performed to observe existing site conditions and to select suitable locations for the borings. Subsequently, clearance of the proposed boring locations with respect to existing buried utilities was coordinated through Underground Service Alert (USA) and City's personnel. In addition, Cable Pipe & Leak Detection (CPL) was retained to perform independent utility clearance services. A more detailed description of the drilling, sampling and testing activities, and logs of the borings are presented in Appendix A. The soils encountered in the borings were visually classified and logged by an experienced field geologist from AGE. Representative samples of the various soil types encountered in the borings were collected for laboratory testing and analysis. A Key to Logs is presented on Figures A-1 and A-2, and the boring logs are presented in Figures A-3 through A-55.

During drilling, Standard Penetration Tests (SPT) were performed at selected depth intervals. The SPT tests involve the use of a specially manufactured "split spoon" sampler which is driven into the soils at the bottom of the borehole by dropping a 140-pound weight from a height of 30 inches. The number of blows required to drive the sampler 18 inches into the soil was recorded. As the first 6-inch increment of penetration is considered to be a "seating interval" in disturbed soils at the bottom of the borehole, the corresponding blow count is not taken into consideration. The total number of blows for the last 12 inches of penetration are shown on the boring logs, and have been used to evaluate the relative density and consistency of the materials.

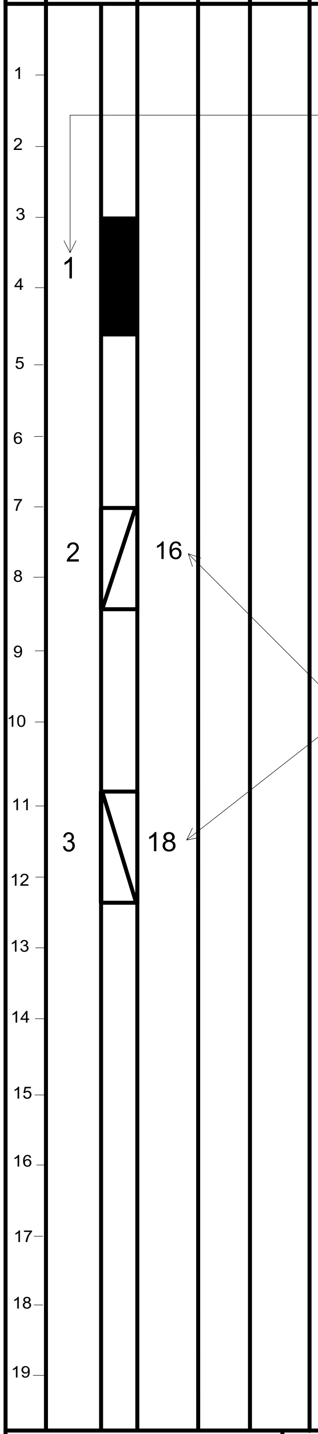
Relatively undisturbed samples were obtained by driving a 3-inch (OD) diameter modified California

split-spoon sampler with a special cutting tip and inside lining of thin brass rings into the soils at the bottom of the borehole. The sampler is driven a distance of 12 inches into the soils at the bottom of the borehole by dropping a 140-pound weight from a height of 30 inches. A 6-inch long section of the soil samples that were retained in the brass rings were extracted from the sampling tube and transported to our laboratory in close-fitting, waterproof containers. In addition, loose bulk samples were also collected and stored in plastic sacks for transport to AGE's laboratory. Soil cuttings obtained from the samplers were field screened for the presence of volatile organics using a RAE Systems MiniRAE 3000 organic vapor meter (OVM). The OVM readings are also indicated on the boring logs.

Following completion of the drilling and sampling activities, the borings were backfilled using bentonite grout and bentonite chips to approximately 12 inches below the ground surface. Borings performed in paved areas were capped with rapid-set concrete to match the adjacent pavement surface, and borings performed in landscape areas were capped with soil cuttings.

KEY TO LOG OF BORING

DEPTH (FEET)	SAMPLES	BLOW COUNTS (BLOWS/FOOT)	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE (% DRY WT.)	DRY DENSITY (PCF)	REMARKS



Sample identification number

Approximate interval of bulk sample

Approximate interval of Standard California Sampler (SCS).

Number of blows required to advance sampler for the last foot, or distance indicated.

Approximate interval of Standard Penetration Test (SPT).

(KEY TO LOG OF BORING CONTINUED ON FIGURE A-2)

PROJECT NO.
44F1

ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE A-1

KEY TO LOG OF BORING
(CONTINUED)

DEPTH (FEET)	SAMPLES	BLOW COUNTS (BLOWS/FOOT)	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE (% DRY WT.)	DRY DENSITY (PCF)	REMARKS
1					—?— —?— APPROXIMATE GEOLOGIC CONTACT			
2				☐	FILL			
3				∴	SAND			
4				‖	SILT			
5				▨	CLAY			
6				⋄	GRAVELS & COBBLES			
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								

GENERAL NOTES

1. Approximate elevations and locations of borings are based on GoogleEarth, 2017.
2. Soil descriptions are based on visual classification made during the field exploration and, where deemed appropriate, have been modified based on the results of laboratory tests.
3. Descriptions on the boring logs apply only at the specific boring locations and at the time the borings were performed. They are not warranted to be representative of subsurface conditions at other locations or times.

PROJECT NO. **44F1**	**ALLIED GEOTECHNICAL ENGINEERS, INC.**	**FIGURE A-2**

BORING NO. H-1

DATE OF DRILLING: MAY 26, 2017
TOTAL BORING DEPTH: 81 FEET
GENERAL LOCATION: EQUALIZATION BASINS
APPROXIMATE SURFACE ELEV.: +380 FEET MSL
DRILLING CONTRACTOR: TRI-COUNTY DRILLING. INC..
DRILLING METHOD: 4 - INCH AIR PERCUSSION
LOGGED BY: NICK BARNES

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
1								Grasses and weeds in the upper 2 inches
2					**FILL**			Drilled to 5-feet using 8-inch HSA, then switched to 4-inch air percussion.
3	1				Reddish yellow to yellowish red, damp, silty sand (SM) and clayey sand (SC) with scattered sub-rounded gravel up to 2" in maximum dimension.			
4								
5	2							
6	3	54	0.0			8.2	112.7	
7								
8				?	? ?			?
9					**VERY OLD PARALIC DEPOSITS**			
10					Yellow to pale reddish yellow, damp, very dense, silty sand (SM) with abundant sub-rounded gravel up to 2" in maximum dimension.			
11	4	100+	0.1			5.1		
12								
13				?	? ?			?
14					**SCRIPPS FORMATION**			
15								
16	5	75	0.0		Greenish gray to reddish yellow, wet, fine-grained, hard, sandy lean clay(CL).	20.1	101.1	
17								
18								
19								
20								
21					At 19', sharp transition into a gravel - cobble conglomerate with a yellowish brown to reddish brown, fine to medium-grained, silty sand (SM) matrix.			Did not attempt sampling at 20 feet and 25 feet due to abundant gravels and cobbles.
22								
23	6							
24								
25								
26								
27								
28								
29								

PROJECT NO. 44F1

ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE A-3

BORING NO. H-1 (Continued)

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
31	7	100+			**SCRIPPS FORMATION** Gravel - cobble conglomerate with a yellowish brown to Reddish brown, fine to medium-grained silty sand (SM) matrix.			No sample recovery
32								
33								
34								
35								
36								
37								Did not attempt sampling at 35 feet and 45 feet due to abundant gravels and cobbles.
38								
39								
40								
41								
42								
43								
44								
45								
46								
47								
48					Sharp transition out of conglomerate at 48'.			
49								
50	8	100+						Sample contains only slough and fractured gravel
51								
52								
53								
54								
55					Light gray to pale yellowish brown, damp, hard, sandy lean clay (CL).	18.2		
56	9	100+	0.1					
57								
58								
59								
60	10	100+	0.0		Olive brown, damp, very dense, medium grained, silty sand (SM).	19.3		
61								

PROJECT NO. 44F1

ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE A-4

BORING NO. H-1 (Continued)

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
					SCRIPPS FORMATION			
63								
64								
65								
	11	100+	0.3		Olive brown, fine-grained silty sand (SM).	23.1		
66								
67								
68								
69								
70								
	12	100+	0.0		Yellow brown to reddish yellow, and fine to medium grain size.	18.1	114.3	
71								
72								
73								
74								
75								
	13	100+	0.2			21.0		
76								
77								
78								
79								
80					Light gray to pale reddish yellow, damp, hard, sandy lean clay (CL).			
81	14	100+	0.0			20.1		

NOTES:

Bottom of borehole at 81 feet.

Unable to determine if groundwater is present. Method of drilling required introduction of water into borehole.

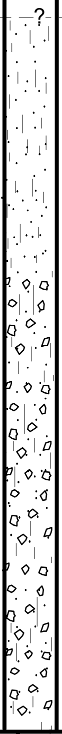
PROJECT NO. 44F1

ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE A-5

BORING NO. H-2

DATE OF DRILLING: MAY 10 AND 11, 2017	TOTAL BORING DEPTH: 51 FEET
GENERAL LOCATION: EQUALIZATION BASINS	
APPROXIMATE SURFACE ELEV.: +380 FEET MSL	DRILLING CONTRACTOR: TRI-COUNTY DRILLING. INC..
DRILLING METHOD: 4- INCH AIR PERCUSSION	LOGGED BY: NICK BARNES

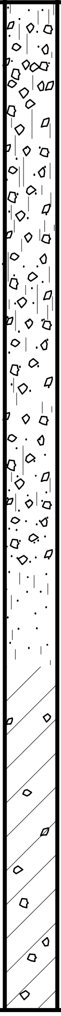
DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
1								Grasses and weeds in the upper 2 inches
2					**FILL**			Drilled to 5-feet using 8-inch HSA, then switched to 4-inch air percussion.
3								
4								
5					Brown to yellow brown, damp, silty sand (SM) and clayey sand (SC) with abundant gravel and scattered cobbles.			
6	1	63	0.2			10.9		
7								
8								
9								
10	2	21	0.0		Mottled reddish brown, reddish yellow and olive yellow, and wet.			
11								
12								
13	3							
14								
15				? 	? ?			?
16	4	51	0.1		**SCRIPPS FORMATION**	20.1		
17					Pale olive yellow to pale reddish yellow, damp, very dense, fine-grained, silty sand (SM).			
18								
19								
20								
21	5	100+	0.2		At 20', sharp transition to a gravel - cobble conglomerate with a greenish gray to pale reddish yellow, fine to medium-grained silty sand (SM) matrix.	9.8	106.1	
22	6							
23								
24								
25	7	100+						No sample recovery
26								
27								
28								
29								

PROJECT NO. 44F1

ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE A-6

BORING NO. H-2 (Continued)



DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
31	8	100+	0.1	**SCRIPPS FORMATION**	4.7		
32	9						
33							
34				Gravel - cobble conglomerate with a yellowish brown, fine to medium-grained, silty sand (SM) matrix.			
35							Did not attempt to sample at 35 feet due to abundant gravel and cobbles.
36							
37							
38							
39							
40							
41	10	100+					Slough only in sampler
42				Sharp transition out of the conglomerate facies at 42'.			
43							
44							
45	11	100+	0.0	Olive yellow to pale reddish yellow, damp, hard, sandy lean clay (CL) with traces of sub-rounded gravel up to 1/2" in maximum dimension.	19.9	104.8	
46							
47							
48							
49							
50							
51	12	100+	0.0		18.2		

NOTES:

Bottom of borehole at 51 feet.

Unable to determine if groundwater is present.
Method of drilling required introduction of water into borehole.

BORING NO. H-3

DATE OF DRILLING: MAY 24 AND 25, 2017	TOTAL BORING DEPTH: 80.5 FEET
GENERAL LOCATION: PRIMARY CLARIFIER	
APPROXIMATE SURFACE ELEV.: +377 FEET MSL	DRILLING CONTRACTOR: TRI-COUNTY DRILLING. INC..
DRILLING METHOD: 4- INCH AIR PERCUSSION	LOGGED BY: NICK BARNES

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
1								Drilled to 5-feet using 8-inch HSA, then switched to 4-inch air percussion.
2					**FILL**			
3	1				Yellow brown to reddish yellow, damp, silty sand (SM) containing locally abundant sub-rounded and locally fractured gravel up to 3" in maximum dimension.			
4	2							
5								
6	3	100+	0.1			5.2		
7				?	? ?			?
8					**VERY OLD PARALIC DEPOSITS**			
9					Reddish yellow, damp, very dense, medium-grained, silty sand (SM) with abundant sub-rounded gravel up to 3" in maximum dimension.			
10	4	100+						No sample recovery, sampler bouncing on rock
11								
12								
13				?	? ?			?
14								
15					**SCRIPPS FORMATION**			
16	5	100+	0.0			13.8		
17					Gravel conglomerate with pale yellow to yellowish red, dense, silty sand (SM) matrix. Gravel is sub-rounded, up to 2" in maximum dimension.			
18								
19								
20								
21	6	100+	0.1			1.4		
22								
23								
24								
25	7	100+	0.1			3.6		
26								
27								
28								
29								

PROJECT NO.
44F1

ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE A-8

BORING NO. H-3 (Continued)

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
31	8	100+			**SCRIPPS FORMATION** Gravel - cobble conglomerate with a yellowish brown to reddish brown, fine to medium-grained silty sand (SM) matrix.			Did not attempt sampling at 30 feet and 35 feet due to abundant gravels and cobbles.
32								
33								
34								
35								
36								
37								
38					Sharp transition out of conglomerate at 38'.			
39								
40								
41	9	100+	0.1		Reddish yellow to pale gray, damp, hard, sandy lean clay (CL).	20.6	113.9	
42								
43								
44								
45								
46	10	56	0.2			18.8		
47								
48								
49								
50								
51	11	100+	0.1			18.8	110.9	
52								
53								
54								
55								
56	12	100+	0.0			22.9		
57								
58								
59								
60	13	100+	0.0		Medium gray, damp, very dense, fine to medium-grained, silty sandstone (SM).	14.2	90.1	
61								

BORING NO. H-3 (Continued)

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
63					**SCRIPPS FORMATION**			
64								
65								
66	14	100+	0.0		Pale yellow brown to pale reddish yellow, damp, very dense, fine to medium grained, poorly graded sand with silt (SP-SM).	20.1		
67								
68								
69								
70					Light gray to pale yellow brown, silty sandstone (SM).			
71	15	100+	0.1			12.5	99.0	
72								
73								
74								
75					Reddish yellow, damp, hard, sandy lean clay (CL).			
76	16	100+	0.1			21.1		
77								
78								
79								
80	17	100+	0.2		Reddish yellow to medium gray color.	22.3	104.9	
81								

NOTES:

Bottom of borehole at 80.5 feet.

Unable to determine if groundwater is present. Method of drilling required introduction of water into borehole.

PROJECT NO.
44F1

ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE A-10

BORING NO. H-4

DATE OF DRILLING: MAY 9 AND 10, 2017
TOTAL BORING DEPTH: 51 FEET
GENERAL LOCATION: PRIMARY CLARIFIER
APPROXIMATE SURFACE ELEV.: +374 FEET MSL
DRILLING CONTRACTOR: TRI-COUNTY DRILLING. INC..
DRILLING METHOD: 4- INCH AIR PERCUSSION
LOGGED BY: NICK BARNES

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
1					**FILL**			Drilled to 12-feet using 8-inch HSA, then switched to 4-inch air percussion.
2					Yellow brown, damp, silty sand (SM) with scattered to locally abundant sub-rounded gravel up to 3" in maximum dimension.			
3				?	? ?			?
4	1				**VERY OLD PARALIC DEPOSITS**			
5								
6	2	100+	0.2		Yellowish red, damp, dense to very dense, medium-grained, silty sand (SM) with abundant sub-rounded gravel up to 3" in maximum dimension.	13.5	105.9	
7								
8								
9								
10	3	100+	0.0			6.2		Poor sample recovery, mostly fractured gravel
11								
12								
13								
14				?	? ?			?
15					**SCRIPPS FORMATION**			
16	4	100+	0.2		Gravel conglomerate with yellow brown to olive brown silty sand (SM) matrix.	11.0	100.8	Driller added water inside of auger to assist in bringing soil cuttings to ground surface
17	5							
18								
19								
20								
21	6	100+	0.0			2.5		Poor sample recovery, mostly fractured gravel
22								
23								
24								
25	7	100+						No sample recovery
26								
27								
28								
29								

PROJECT NO. 44F1

ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE A-11

BORING NO. H-4 (Continued)

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
31	8	100+	0.2		**SCRIPPS FORMATION** Gravel conglomerate with yellow brown, medium-grained, silty sand (SM) matrix.			No sample recovery
33	9							
35								Did not attempt to sample at 35 feet due to abundant gravels.
36					End of conglomerate zone at 36'.			
41	10	100+	0.2		Olive yellow to pale reddish yellow, damp, very dense, fine-grained, silty sand (SM) with traces of sub-rounded gravel up to 1/2" in maximum dimension.	21.5	104.9	
46	11	100+	0.0		Olive brown color, and fine to medium grain size.	16.2		
51	12	100+	0.0		Olive gray to pale reddish yellow, fine-grained silty sand (SM).	17.0	111.8	

NOTES:

Bottom of borehole at 51 feet.

Unable to determine if groundwater is present. Method of drilling required introduction of water into borehole.

PROJECT NO. 44F1

ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE A-12

BORING NO. H-5

DATE OF DRILLING: MAY 16, 2017	TOTAL BORING DEPTH: 51.5 FEET
GENERAL LOCATION: AERATION BASINS	
APPROXIMATE SURFACE ELEV.: +367 FEET MSL	DRILLING CONTRACTOR: TRI-COUNTY DRILLING. INC..
DRILLING METHOD: 8- INCH HSA	LOGGED BY: NICK BARNES

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
					EXISTING PAVEMENT: 7.5" A.C. and no base.			
1								
2					**FILL**			
3					Yellow brown to olive/grayish brown, damp to wet, sandy clay (CL) with scattered sub-rounded and locally fractured gravel up to 3" in maximum dimension. Fill also contains scattered chunks of olive yellow sandstone and greenish gray siltstone up to 1/2" in maximum dimension.			
4								
5								
6	1	44	0.0			20.6	102.7	
7	2							
8								
9	3							
10								
11	4	23	0.3		Olive brown to gray brown, damp to wet, clayey sand (SC) with scattered gravel.	9.9		
12								
13								
14					Abundant gravel between 14' and 15'.			
15								
16	5	68	0.0			11.2	113.2	
17								
18								
19					Abundant gravel between 18' and 22'.			
20								
21	6	100+						No sample recovery, sampler bouncing on gravel
22				?	? ?			?
23					**SCRIPPS FORMATION**			
24								
25								
26	7	100+	0.0		Olive yellow, damp, very dense, fine-grained, silty sand (SM). Sand is uncemented.	10.4		
27	8							
28								
29								

PROJECT NO. 44F1

ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE A-13

BORING NO. H-5 (Continued)

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
31	9	100+	0.0		**SCRIPPS FORMATION**	19.6		Driller adding water inside of auger to assist in bringing soil cuttings to ground surface
32								
33	10							
34								
35	11	100+	0.0		Olive yellow to olive gray, damp, hard, lean clay (CL), grading into reddish yellow, very dense, fine-grained silty sand (SM) at 36'.	20.2	113.3	
36								
37								
38								
39								
40								
41	12	100+	0.0		Pale yellow brown to reddish yellow color.	21.1		
42								
43								
44								
45	13	100+	0.0		Pale yellow brown, damp, very dense, medium grained, poorly graded sand with silt (SP-SM).	15.9	96.7	
46								
47								
48								
49								
50					Similar to above, with a 2" wide interlayer of pale gray tp olive yellow siltstone (ML).			
51	14	100+	0.1			17.4		

NOTES:

Bottom of borehole at 51.5 feet.

Unable to determine if groundwater is present.
Method of drilling required introduction of water
into borehole.

BORING NO. H-6

DATE OF DRILLING: MAY 9, 2017
TOTAL BORING DEPTH: 50.5 FEET
GENERAL LOCATION: AERATION BASINS
APPROXIMATE SURFACE ELEV.: +365 FEET MSL
DRILLING CONTRACTOR: TRI-COUNTY DRILLING. INC..
DRILLING METHOD: 8- INCH HSA
LOGGED BY: NICK BARNES

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
					EXISTING PAVEMENT: 8" A.C. and no base.			
2					**FILL**			
4					Olive, olive yellow to greenish gray, damp to wet, clayey sand (SC) with scattered sub-rounded and fractured gravel up to 3" in maximum dimension.			
5	1							
6	2	18	0.4			15.8		
10					Olive to grayish brown clayey sand (SC), with scattered gravel up to 1" in maximum dimension. Fill also contains chunks of cemented siltstone up to 1.5" in maximum dimension.			
11	3	50	0.1			18.6	109.8	
13	4							
16	5	33						No sample recovery, large gravel clast wedged in sampler shoe
21	6	100+	0.0		Olive yellow to olive, damp, fine-grained silty sand (SM) with scattered sub-rounded and locally fractured gravel up to 1" in maximum dimension, and scattered chunks of cemented siltstone and sandstone.	20.1	106.4	
23	7							
25				?	? ?			?
26	8	54	0.1		**SCRIPPS FORMATION**	18.6		
27					Reddish yellow, damp, very dense, fine to medium-grained silty sand (SM).			

PROJECT NO. 44F1

ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE A-15

BORING NO. H-6 (Continued)

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
31	9	100+	0.0		**SCRIPPS FORMATION**	18.0	102.0	Driller adding water inside of auger to assist in bringing soil cuttings to ground surface
32					Pale olive yellow to pale olive brown, damp, hard, sandy lean clay (CL).			
33								
34								
35	10	100+	0.3			19.1		
36								
37								
38								
39								
40	11	100+	0.0		Reddish yellow, damp, medium grained silty sand (SM).	10.5	99.2	
41								
42								
43								
44								
45	12	100+			Pale yellow brown, fine grained, silty sand (SM).	10.9		
46								
47								
48								
49								
50	13	100+	0.0		Pale yellow brown to reddish yellow.	13.8		
51								

NOTES:

Bottom of borehole at 50.5 feet.

Unable to determine if groundwater is present. Method of drilling required introduction of water into borehole.

BORING NO. H-7

DATE OF DRILLING: MAY 12, 2017
TOTAL BORING DEPTH: 100.5 FEET
GENERAL LOCATION: AERATION BASINS
APPROXIMATE SURFACE ELEV.: +356 FEET MSL
DRILLING CONTRACTOR: TRI-COUNTY DRILLING. INC..
DRILLING METHOD: 8 INCH HSA
LOGGED BY: NICK BARNES

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
1								Lawn sod in the upper 2 inches
2					**FILL**			
3					Yellow brown to reddish yellow, damp, silty sand (SM) with scattered sub-rounded gravel up to 3" in maximum dimension.			
4								
5								
6	1	7	0.0			10.6		
	2							
7				?	? — — — ?			?
8					**VERY OLD PARALIC DEPOSITS**			
9								
10					Yellow brown to reddish yellow, damp, very dense, fine to medium-grained silty sand (SM) with abundant sub-rounded gravel up to 3" in maximum dimension.			
11	3	100+	0.0			8.1		
12				?	? — — — ?			?
13	4				**SCRIPPS FORMATION**			Driller added water inside of auger to assist in bringing soil cuttings to ground surface
14								
15								
16	5	100+	0.0		Olive yellow to pale yellowish red, damp, very dense, fine to medium-grained silty sand (SM).	13.0		Sampler bouncing on rock last 1"
17					16.5' - 19', gravelly zone			
18								
19								
20					Medium gray, fine-grained silty sand, grading into a light yellow brown, medium-grained, poorly graded sand with silt (SP-SM).			
21	6	100+	0.1			17.4	104.5	
22								
23								
24					At 23', abrupt transition into a gravel conglomerate with an olive brown to yellow brown silty sand (SM) matrix.			
25	7	100+	0.0			8.4		
26								
27								
28								
29								

PROJECT NO. 44F1

ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE A-17

BORING NO. H-7 (Continued)

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
31					**SCRIPPS FORMATION**			Did not attempt sampling between depth of 30' and 35' due to abundant gravel
32	8							
33					Gravel conglomerate with an olive brown to yellow brown silty sand (SM) matrix.			
34								
35								
36					End of conglomerate zone at 37'.			
37								
38								
39								
40	9	100+						No sample recovery
41								
42								
43								
44								
45					Olive/gray to pale reddish yellow, damp, hard, sandy lean clay (CL).			
46	10	100+	0.0			23.2		
47								
48								
49								
50	11	100+	0.0		Pale greenish gray to medium gray, hard, lean clay (CL).	20.8	112.7	
51								
52								
53								
54								
55	12	100+	0.0		Pale yellow brown to pale reddish yellow, damp, very dense, fine to medium grained, silty sand (SM).	21.5		
56								
57								
58								
59								
60	13	100+	0.0		Olive color.	21.3	107.6	
61								

BORING NO. H-7 (Continued)

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
63					**SCRIPPS FORMATION**			
64								
65	14	100+	0.0		Gray to pale reddish yellow, damp, hard, lean clay (CL).	24.0		
66								
67								
68								
69								
70	15	100+	0.0			20.5	117.7	
71								
72								
73								
74								
75					74' - 76', gravel zone.			Did not attempt 75' sample due to abundant gravel.
76								
77								
78								
79								
80	16	100+	0.0		Dark gray, damp, hard, claystone (CL/CH).	22.3		
81								
82								
83								
84								
85								
86								
87								
88								
89								
90	17	100+	0.2		Similar to above.	20.6		
91								
92								
93								

BORING NO. H-7 (Continued)

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
95				▨	**SCRIPPS FORMATION** Dark gray, hard claystone (CL/CH).			
96				▨				
97				▨				
98				░				
99				░	Medium gray, damp, very dense, fine-grained silty sand (SM).			
100	18 ◩	100+	0.1	░		8.2		

NOTES:

Bottom of borehole at 100.5 feet.

Unable to determine if groundwater is present. Method of drilling required introduction of water into borehole.

BORING NO. H-8

DATE OF DRILLING: MAY 19, 2017	TOTAL BORING DEPTH: 56.5 FEET
GENERAL LOCATION: TERTIARY FILTERS	
APPROXIMATE SURFACE ELEV.: +348 FEET MSL	DRILLING CONTRACTOR: TRI-COUNTY DRILLING. INC..
DRILLING METHOD: 8- INCH HSA	LOGGED BY: NICK BARNES

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
1								
2					**FILL**			
3								
4					Yellow brown to yellowish red, damp, gravelly silty sand (SM). Gravel is sub-rounded and locally fractured, up to 3" in maximum dimension.			
5	1							
6	2	23	0.0			9.7		
7								
8								
9	3							
10					Similar to above, fill also contains chunks of cemented siltstone up to 1/2" in maximum dimension.			
11	4	38	0.0			21.3	102.0	
12								
13								
14								
15								
16	5	32	0.1			15.7		
17								
18					Abundant gravel from 17' to 22'.			
19								
20								
21	6	100+	0.0			9.3	93.0	Disturbed sample due to abundant gravels contained in fill.
22								
23								
24								
25								
26	7	30	0.2		Reddish brown to reddish yellow, damp, fine to medium-grained silty sand (SM) and sandy silt (ML) with scattered gravel.	11.2		
27								
28								
29								

PROJECT NO.
44F1

ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE A-21

BORING NO. H-8 (Continued)

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
31	8	100+	0.0		**FILL** Olive to olive yellow, damp, fine-grained, silty sand (SM), with scattered sub-rounded gravel up to 2" in maximum dimension.	15.5	111.2	Driller added water inside of auger to assist in bringing soil cuttings to ground surface
35	9	41	0.1			13.5		
41	10	52	0.1		Olive yellow, pale yellow and yellow brown silty sand (SM), intermixed with chunks of olive yellow siltystone (ML) and dark gray clayey sand (SC). Fill also contains scattered sub-rounded gravel up to 1 1/2" in maximum dimension.	19.2	111.8	
46	11	23	1.3		Dark gray, damp to wet, silty sand (SM) and clayey sand (SC) with scattered sub-rounded gravel up to 1" in maximum dimension.	12.4		Detected decomposing vegetation odors.
47	12							
49				?	? ?			?
50	13	100+	0.0		**SCRIPPS FORMATION** Olive gray to pale olive yellow, damp, hard, sandy lean clay (CL).	21.3	109.1	
56	14	51	0.2			24.9		

NOTES:

Bottom of borehole at 56.5 feet.

Unable to determine if groundwater is present. Method of drilling required introduction of water into borehole.

PROJECT NO. 44F1

ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE A-22

BORING NO. H-9

DATE OF DRILLING: MAY 22, 2017	TOTAL BORING DEPTH: 80.5 FEET
GENERAL LOCATION: NEW AWPF IPS	
APPROXIMATE SURFACE ELEV.: +345 FEET MSL	DRILLING CONTRACTOR: TRI-COUNTY DRILLING. INC..
DRILLING METHOD: 8- INCH HSA	LOGGED BY: NICK BARNES

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
1								Lawn sod in the upper 2 inches
2					**FILL**			
3					Olive yellow to yellowish brown, damp, fine-grained silty sand (SM) and sandy silt (ML) with scattered sub-rounded and locally fractured gravel up to 3" in maximum dimension.			
4								
5								
6	1	25	0.0			20.3	99.0	
7								
8								
9								
10	2							
11	3	15	0.0			23.3		
12								
13								
14	4							
15								
16	5	20	0.0		Olive brown to pale gray, damp, fine-grained silty sand (SM) and sandy silt (ML) with intermixed chunks of siltstone and sandstone that appear to be derived from excavation into the Scripps Formation.	26.4	91.6	
17								
18								
19					Between17'-28', encountered scattered to locally abundant gravel in fill. Gravel sub-rounded and locally fractured, up to 3" in maximum dimension.			
20								
21	6	74	0.0		Olive yellow to medium brown, damp, silty sand (SM) and clayey sand (SC) with abundant gravel.	9.6		High blow counts in 20' and 25' samples due to abundant gravel in fill.
22								
23	7							
24								
25	8	100+	0.1			15.5	113.7	
26								
27								
28								
29								

PROJECT NO.
44F1

ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE A-23

BORING NO. H-9 (Continued)

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
31	9	100+	0.1		**FILL**	21.9		
32					Yellowish brown, damp, fine to medium-grained, silty sand (SM).			
33								
34				?	? ?			?
35	10	100+	0.0			18.3		Sampler bouncing on gravel.
36					**SCRIPPS FORMATION**			
37					Gravel conglomerate with medium gray to pale reddish yellow, silty sand (SM) and sandy silt (ML) matrix.			
38								Driller added water inside of auger to assist in bringing soil cuttings to ground surface.
39					Sharp transition out of conglomerate at 38'.			
40								
41	11	100+	0.2		Medium gray to pale reddish yellow, damp, hard, sandy lean clay (CL).	23.1		
42								
43								
44								
45								
46	12	56	0.0			21.7	107.6	
47								
48								
49								
50								
51	13	100+	0.1		Medium gray to greenish gray, hard, lean clay (CL).	25.2		
52								
53								
54								
55								
56	14	100+	0.2		Alternating laminations consisting of reddish yellow silty sandstone (SM) and medium gray clay (CL). Laminations on the order of 1/8" in thickness.	25.5		
57	15							
58								
59								
60								
61	16	100+	0.1			20.5	112.4	

PROJECT NO. 44F1	**ALLIED GEOTECHNICAL ENGINEERS, INC.**	**FIGURE A-24**

BORING NO. H-9 (Continued)

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
63					**SCRIPPS FORMATION**			
64								
65								
66	17	100+	0.2		Dark gray, damp, hard, sandy claystone (CL/CH).	19.3		
67								
68								
69								
70	18	100+	0.2		Reddish yellow silty sandstone (SM) and sandy siltstone (ML), transitioning into a dark gray claystone (CL/CH).	18.4		
71								
72								
73								
74								
75								
76	19	100+	0.1		Dark gray claystone (CL/CH), similar to above.	23.4		
77								
78								
79					Dark gray, very dense, silty sandstone (SM). Sandstone is strongly cemented.			
80	20	100+	0.0			5.2		
81								

NOTES:

Bottom of borehole at 80.5 feet.

Unable to determine if groundwater is present. Method of drilling required introduction of water into borehole.

BORING NO. H-10

DATE OF DRILLING: MAY 23, 2017
TOTAL BORING DEPTH: 80.5 FEET
GENERAL LOCATION: NEW AWPF IPS
APPROXIMATE SURFACE ELEV.: +345 FEET MSL
DRILLING CONTRACTOR: TRI-COUNTY DRILLING. INC..
DRILLING METHOD: 8- INCH HSA
LOGGED BY: NICK BARNES

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
1								Lawn sod in the upper 2 inches
2					**FILL**			
3					Yellow brown to olive yellow, damp, fine-grained silty sand (SM) and sandy lean clay (CL) with scattered sub-rounded and locally fractured gravel up to 3" in maximum dimension.			
4	1							
5								
6	2	10	0.2			18.1		
7								
8	3							
9								
10								
11	4	29	0.0		Similar to above, with traces of gravel up to 1" in maximum dimension. Fill also contains intermixed chunks of gray claystone (CL) and reddish yellow sandstone (SM) up to 1/2" in maximum dimension.	15.8	103.9	
12								
13								
14								
15								
16	5	15	0.1			18.9		
17								
18								
19								
20								
21	6	26	0.0			26.3	97.5	High blow counts in the 20' and 25' drive samples due to abundant gravel in fill.
22								
23								
24								
25								
26	7	21	0.4		Similar to above, sample also contains a 3" wide zone of dark gray, wet silty sand (SM) containing organic matter including grass and rootlets, and traces of sub-rounded gravel up to 3/4" in maximum dimension.	13.9		
27								
28								
29								

**PROJECT NO.
44F1**

ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE A-26

BORING NO. H-10 (Continued)

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
31	8	100+	0.1		**FILL** Olive, damp, silty sand (SM) and sandy silt (ML) with abundant gravel/cobble.	15.2		Sampler bouncing on gravel/cobble.
32				?	? ?			?
33					**SCRIPPS FORMATION**			
34								Driller added water inside of auger to assist in bringing soil cuttings to ground surface.
35	9	100+	0.1		Reddish yellow to olive brown, damp, very dense, fine-grained silty sandstone (SM).	21.7		
36								
37								
38								
39								
40	10	100+	0.1			20.6	103.2	
41								
42	11							
43								
44								
45	12	100+	0.3		Grayish brown to reddish yellow, damp, hard, sandy lean clay (CL).	23.6		
46								
47								
48								
49								
50								
51	13	100+	0.0			20.8	106.7	
52					Gravel zone between 52' and 54'.			
53								
54								
55	14	100+	0.0			25.5	90.5	
56								
57								
58								
59								
60	15	100+	0.3			24.6		
61								

BORING NO. H-10 (Continued)

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
					SCRIPPS FORMATION			
63								
64					Grayish brown to reddish yellow, sandy lean clay (CL).			
65	16	100+						No sample recovery
66								
67								
68								
69								
70	17	100+	0.2		Similar to above, transitions into a dark gray, hard claystone (CL/CH) at 70.5'.	19.7		
71								
72								
73								
74								
75	18	100+			Olive brown to reddish yellow, damp, sandy siltstone (ML), transitioning into dark gray claystone (CL/CH) at 75.5'.	18.1	115.4	
76								
77								
78								
79								
80	19	100+	0.3		Dark gray, hard, claystone (CL/CH).	24.4		
81								

NOTES:

Bottom of borehole at 80.5 feet.

Unable to determine if groundwater is present. Method of drilling required introduction of water into borehole.

BORING NO. H-11

DATE OF DRILLING: MAY 2 AND 3, 2017
TOTAL BORING DEPTH: 81.5 FEET
GENERAL LOCATION: SECONDARY CLARIFIERS
APPROXIMATE SURFACE ELEV.: +349 FEET MSL
DRILLING CONTRACTOR: TRI-COUNTY DRILLING. INC..
DRILLING METHOD: 8- INCH HSA
LOGGED BY: NICK BARNES

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
1								Lawn sod in the upper 2 inches
2					**FILL**			
3					Yellow brown to olive yellow, damp,silty sand (SM).			
4								
5								
6	1	30	0.0			23.5	98.0	
7								
8								
9								
10					Yellow brown to olive yellow, damp to wet, sandy clay (CL). Fill contains intermixed chunks of claystone (CL) and siltstone (ML) up to 2" in maximum dimension.			
11	2	14	0.1			25.8		Poor recovery, sampler hit large gravel clasts in fill.
12								
13	3							
14								
15				?	? ?			?
16	4	39	0.0	▨	**SCRIPPS FORMATION**	24.0	97.5	
17				▨	Olive yellow to pale greenish gray, wet, very stiff, slightly micaceous, sandy lean clay (CL).			
18				▨				
19				▨				
20				▨				
21	5	40	0.2	▨		22.6		
22				▨				
23	6			▨				
24				▨				
25				▨				
26	7	100+	0.0	▨		21.5	103.4	
27				▨				
28				▨				
29				▨				

PROJECT NO. 44F1

ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE A-29

BORING NO. H-11 (Continued)

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
31	8	100+	0.5		**SCRIPPS FORMATION**	24.5		Driller added water inside of auger to assist in bringing soil cuttings to ground surface.
32								
33								
34								
35					Olive yellow to pale greenish gray, very dense, fine-grained, silty sandstone (SM).			
36	9	100+	0.6			19.0	104.0	
37								
38	10							
39								
40					Olive to olive yellow, damp, hard, sandy lean clay (CL).			
41	11	60	0.6			22.4		
42								
43								
44								
45					Olive to pale gray, silty sandstone (SM).			
46	12	100+	0.1			20.1	108.2	
47								
48								
49								
50								
51	13	88	0.4			11.8		
52								
53								
54					53' - 55', gravel zone.			
55								
56	14	100+	0.0			17.5	106.9	
57								
58								
59								
60								
61	15	100+	0.7			26.7		

PROJECT NO. 44F1	ALLIED GEOTECHNICAL ENGINEERS, INC.	FIGURE A-30

BORING NO. H-11 (Continued)

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
					SCRIPPS FORMATION			
63								
64					Grayish brown to reddish yellow sandy lean clay (CL).			
65	16	100+	0.0			21.4		
66								
67								
68								
69								
70	17	100+						No sample recovery
71								
72								
73								
74								
75	18	100+	0.2		Medium gray, damp, hard, claystone (CL/CH).	26.1		
76								
77								
78								
79								
80	19	100+	0.3			21.3		
81								

NOTES:

Bottom of borehole at 81.5 feet.

Unable to determine if groundwater is present.
Method of drilling required introduction of water
into borehole.

BORING NO. H-12

DATE OF DRILLING: MAY 3 AND 4, 2017
TOTAL BORING DEPTH: 100.5 FEET
GENERAL LOCATION: SECONDARY CLARIFIER
APPROXIMATE SURFACE ELEV.: +348 FEET MSL
DRILLING CONTRACTOR: TRI-COUNTY DRILLING. INC..
DRILLING METHOD: 8 INCH HSA
LOGGED BY: NICK BARNES

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
1								Lawn sod in the upper 2 inches
2					**FILL**			
3					Yellow brown, olive to reddish brown, damp to wet, gravelly silty sand (SM) containing chunks of olive yellow claystone. Gravel is sub-rounded to sub-angular and locally fractured, up to 3" in maximum dimension.			
4	1							
5								
6	2	53	0.2			14.3	102.3	
7								
8								
9								
10					Olive yellow to olive gray, wet, fine-grained, micaceous. Little to no gravel.			
11	3	14	0.0			22.0		
12	4							
13								
14								
15					Similar to above, soil is intermixed with 1" to 2" chunks of fine-grained, cemented sandstone.			
16	5	30	0.1			23.9	100.3	
17								
18								
19								
20								
21	6	20	0.0			21.4		
22								
23	7							
24								
25								
26	8	44	0.1			23.2	107.3	
27				?	? ?			?
28					**SCRIPPS FORMATION**			
29					Reddish yellow, damp, very dense, fine-grained, silty sand (SM), grading into olive gray, hard, sandy lean clay (CL).			

PROJECT NO. 44F1

ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE A-32

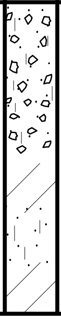
BORING NO. H-12 (Continued)

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
31	9	100+	0.2		**SCRIPPS FORMATION**	19.7		Driller added water inside of auger to assist in bringing soil cuttings to ground surface
32								
33								
34								
35	10	100+	0.7		Reddish yellow, damp, very dense, medium-grained, poorly graded sand with silt (SP-SM). Soil is uncemented.	9.5	94.3	
36								
37								
38								
39								
40								
41	11	100+	0.1			12.0		
42								
43								
44								
45	12	100+						No sample recovery
46								
47								
48								
49								
50	13	100+	0.0					
51					Reddish yellow, fine to medium grained silty sand (SM), interlayered with olive yellow to olive gray lean clay (CL).	22.1		
52					Gravel zone between 51' and 52.5'.			
53								
54								
55	14	100+	0.0			7.3	107.8	
56					Light gray to pale yellow brown, fine to medium grained, silty sand (SM).			
57								
58								
59					Reddish yellow, fine to medium grained, poorly graded sand with silt (SP-SM).			
60	15	100+	0.1			15.1		
61								

BORING NO. H-12 (Continued)

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
					SCRIPPS FORMATION			
63								
64								
65	16	100+	0.2		Abundant gravels and cobbles from 65' to 69'.	19.7		
66								
67								
68								
69								
70	17	100+	0.2		Reddish yellow, fine to medium grained, poorly graded sand with silt (SP-SM), interlayered with olive to olive gray claystone (CL). Interlayers up to 2" in thickness.	29.2		
71								
72								
73								
74								
75	18	100+	0.2			21.3		
76								
77								
78								
79					Gravel zone from 79' to 81'.			
80	19	100+						No sample recovery, sampler bouncing on rock.
81								
82								
83								
84					Yellowish red, damp, very dense, fine to medium grained, poorly graded sand with silt (SP-SM).			
85	20	100+	0.2			22.1		
86								
87								
88								
89								
90	21	100+	0.3			22.0		
91								
92								
93								

BORING NO. H-12 (Continued)

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
95					**SCRIPPS FORMATION** Abundant gravels and cobbles from 94' to 97'.			Did not attempt sampling at 95' due to abundant gravel and cobble.
96								
97								
98								
99					Medium gray to dark gray claystone (CL/CH), interlayered with yellow brown silty sand (SM).			
100	22	100+	0.4			25.8		

NOTES:

Bottom of borehole at 100.5 feet.

Unable to determine if groundwater is present. Method of drilling required introduction of water into borehole.

BORING NO. H-13

DATE OF DRILLING: MAY 4 AND 5, 2017
TOTAL BORING DEPTH: 101 FEET
GENERAL LOCATION: SECONDARY CLARIFIER
APPROXIMATE SURFACE ELEV.: +354 FEET MSL
DRILLING CONTRACTOR: TRI-COUNTY DRILLING. INC..
DRILLING METHOD: 8 INCH HSA
LOGGED BY: NICK BARNES

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
1								
2					**FILL**			
3					Yellow brown, damp, sand lean clay (CL) with scattered sub-rounded and locally fractured gravel up to 3" in maximum dimension.			
4	1							
5								
6	2	40	0.2			13.7	111.5	
7								
8								
9								
10								
11	3	21	0.4		Similar to above, soil is intermixed with angular chunks of cemented sandstone and claystone up to 2" in size.	20.5		
12	4							
13								
14								
15					Mottled olive to pale gray color.			
16	5	45	0.2			22.6	98.2	
17								
18								
19								
20								
21	6	19	0.3			20.4		
22								
23								
24								
25								
26	7	33	0.2			22.5	102.2	
27								
28				?	? ?			?
29					**SCRIPPS FORMATION -** Olive gray to pale yellowish red, damp, hard, sandy lean clay (CL).			

PROJECT NO. 44F1

ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE A-36

BORING NO. H-13 (Continued)

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
31	8	49	0.4		**SCRIPPS FORMATION**	21.2		Driller added water inside of auger to assist in bringing soil cuttings to ground surface
32					Olive gray to pale yellowish red sandy lean clay (CL).			
33								
34	9							
35								
36	10	100+	0.7			21.5	108.5	
37								
38								
39								
40								
41	11	61	0.2		Similar to above, pale olive brown to pale reddish yellow in color.	21.4		
42								
43	12							
44								
45								
46	13	100+	0.0			22.3	106.3	
47								
48								
49								
50								
51	14	100+	0.1		Similar to above, pale olive gray and brown to pale reddish yellow in color.	24.3		
52								
53								
54								
55								
56	15	100+	0.1		Medium gray to olive gray, damp, hard, claystone (CL/CH) with narrow laminations of pale reddish yellow silty sandstone (SM).	22.4		
57								
58					Abundant gravels and cobbles from 58' to 59.5'.			
59								
60					Pale reddish yellow silty sandstone (SM).			
61	16	74	0.0			20.8		

PROJECT NO. 44F1	ALLIED GEOTECHNICAL ENGINEERS, INC.	FIGURE A-37

BORING NO. H-13 (Continued)

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
					SCRIPPS FORMATION			
63								
64								
65	17	100+	0.1		Olive to olive gray sandy lean clay (CL).	20.4	110.5	
66								
67								
68								
69								
70								
71	18	88	0.2			22.0		
72								
73								
74								
75	19	100+	0.1		Similar to above, grading into medium to dark gray, hard claystone (CL/CH).	21.3	98.3	
76								
77								
78								
79								
80								
81	20	100+	0.1			20.7		
82								
83								
84								
85	21	100+	0.3			17.4	112.7	
86								
87								
88	25							
89								
90	22	100+	0.1			17.7		
91								
92								
93								

BORING NO. H-13 (Continued)

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
95	23	100+	0.0	▨	**SCRIPPS FORMATION** Medium gray to dark gray, hard claystone (CL/CH).	22.6		
96								
97								
98								
99								
100	24	100+	0.0			23.6		
101								

NOTES:

Bottom of borehole at 101 feet.

Unable to determine if groundwater is present. Method of drilling required introduction of water into borehole.

PROJECT NO.
44F1

ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE A-39

BORING NO. H-14

DATE OF DRILLING: MAY 1 AND 2, 2017
TOTAL BORING DEPTH: 100.5 FEET
GENERAL LOCATION: SECONDARY CLARIFIER
APPROXIMATE SURFACE ELEV.: +353 FEET MSL
DRILLING CONTRACTOR: TRI-COUNTY DRILLING. INC..
DRILLING METHOD: 8 INCH HSA
LOGGED BY: NICK BARNES

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
1								
2					**FILL**			
3					Olive yellow, olive green and yellow brown, damp to wet, sandy clay (CL).			
4	1							
5								
6	2	14	2.1			22.0		
7								
8								
9								
10	3				Very dark gray, wet, sandy clay (CL) with scattered sub-angular and locally fractured gravel up to 2" in maximum dimension.			
11	4	30	2.4			20.4	107.4	
12								
13								
14								
15					Yellow brown to olive yellow to olive, wet, clayey sand (SC) and fine-grained silty sand (SM).	17.3		
16	5	14	2.6					
17								
18								
19								
20								
21	6	58	0.2		Dark gray to very dark grayish brown, wet, sandy clay (CL) with scattered gravel and intermixed chunks of olive green cemented sandstone. Gravel and sandstone chunks up to 2" in maximum dimension.	17.3	113.5	
22								
23	7							
24								
25	8					15.2		
26	9	21	2.1					
27								
28				?	? ?			?
29					**SCRIPPS FORMATION -** Olive yellow to pale olive, damp, hard, sandy lean clay (CL).			

PROJECT NO. 44F1

ALLIED GEOTECHNICAL ENGINEERS, INC.

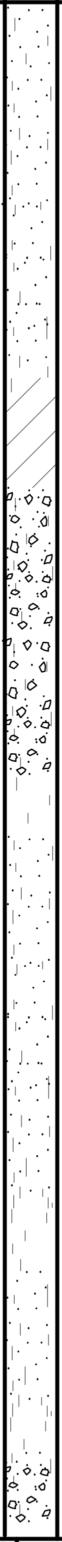
FIGURE A-40

BORING NO. H-14 (Continued)

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
31	10	100+	0.1		**SCRIPPS FORMATION**	20.6	102.5	
32					Olive yellow to pale olive sandy lean clay (CL).			
33								
34								
35								Driller added water inside of auger to assist in bringing soil cuttings to ground surface
36	11	96	0.3			23.6		
37								
38								
39								
40								
41	12	100+	0.1			19.7	110.7	
42								
43	13							
44								
45								
46	14	86	0.0			20.6		
47								
48								
49								
50	15	100+	0.1			21.4	98.2	
51								
52								
53								
54								
55	16	100+	0.0			17.1		
56					Reddish yellow to olive, damp, very dense, fine-grained silty sandstone (SM).			
57	17							
58								
59								
60	18	100+	0.1		Olive to olive yellow with local reddish yellow oxide staining, damp, very dense, silty sandstone (SM).	13.1	84.2	
61								

PROJECT NO. 44F1	ALLIED GEOTECHNICAL ENGINEERS, INC.	FIGURE A-41

BORING NO. H-14 (Continued)



DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
63				**SCRIPPS FORMATION**			
64							
65	19	100+	0.3	Olive yellow, very dense, silty sandstone (SM).	17.4		
66							
67							
68							
69							
70	20	100+	0.2	Olive yellow to gray, hard, sandy lean clay (CL).	20.5	100.1	
71							
72							
73							
74				72' - 78', gravel zone.			
75	21	100+					No sample recovery
76							
77							
78							
79							
80	22	100+	0.2	Yellow brown, wet, very dense, medium-grained, poorly graded sand with silt (SP-SM).	18.1	113.6	
81							
82							
83							
84							
85	23	100+	0.0		23.9		
86							
87							
88							
89							
90	24	100+	0.1	Olive to reddish yellow, damp, very dense, fine-grained, silty sandstone (SM).	24.9		
91							
92							
93				Abundant gravels and cobbles from 92' to 98'.			

BORING NO. H-14 (Continued)

DEPTH (FEET)	SAMPLES		BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
						SCRIPPS FORMATION			
95									
96									
97									
98									
99									
100	25	⧅	100+	0.2		Gray, damp, hard sandy lean clay (CL).	18.9		

NOTES:

Bottom of borehole at 100.5 feet.

Unable to determine if groundwater is present.
Method of drilling required introduction of water
into borehole.

BORING NO. H-15

DATE OF DRILLING: MAY 8, 2017
TOTAL BORING DEPTH: 21.5 FEET
GENERAL LOCATION: WESTERN PIPELINE CORRIDOR
APPROXIMATE SURFACE ELEV.: +349 FEET MSL
DRILLING CONTRACTOR: TRI-COUNTY DRILLING. INC..
DRILLING METHOD: 8 INCH HSA
LOGGED BY: NICK BARNES

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
1					**EXISTING PAVEMENT:** 4.5" A.C. over 4" misc. base			
2					**FILL:** Medium brown to yellow brown, damp, silty sand (SM) with scattered sub-rounded gravel up to 3" in maximum dimension.			
3				?				? ?
4					**SCRIPPS FORMATION**			
5								
6	1 2	100+	0.0		Olive yellow to olive gray to pale reddish yellow, damp, hard, highly plastic clay (CH).	21.7	102.8	
7								
8								
9								
10					Very dense, silty sandstone (SM).			
11	3	79	0.2			19.8		
12								
13	4							
14								
15								
16	5	100+	0.0			18.6	102.9	
17								
18								
19								
20								
21	6	88	0.2			17.8		
22								

NOTES:

Bottom of borehole at 21.5'

No groundwater or seepage encountered during drilling operations

BORING NO. H-16

DATE OF DRILLING: MAY 8, 2017	TOTAL BORING DEPTH: 21.5 FEET
GENERAL LOCATION: WESTERN PIPELINE CORRIDOR	
APPROXIMATE SURFACE ELEV.: +370 FEET MSL	DRILLING CONTRACTOR: TRI-COUNTY DRILLING. INC..
DRILLING METHOD: 8 INCH HSA	LOGGED BY: NICK BARNES

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
1					**EXISTING PAVEMENT: 7"** A.C., no base			
					FILL - Yellow brown, damp, silty sand (SM).			
2				?	? ?			? ?
3					**SCRIPPS FORMATION**			
4					Olive to olive yellow, damp, hard, sandy siltstone (ML).			
5								
6	1	75	0.0			21.0	103.5	
7								
8								
9								
10								
11	2	53	0.0			19.9		
12								
13	3							
14								
15								
16	4	98	0.0		Very dense, fine-grained, silty sandstone (SM).	21.0	106.2	
17								
18								
19								
20								
21	5	100+	0.0			21.1		
22								

NOTES:

Bottom of borehole at 21.5'

No groundwater or seepage encountered during drilling operations

PROJECT NO. 44F1	**ALLIED GEOTECHNICAL ENGINEERS, INC.**	**FIGURE A-45**

BORING NO. H-17

DATE OF DRILLING: MAY 11, 2017
TOTAL BORING DEPTH: 19.5 FEET
GENERAL LOCATION: WESTERN PIPELINE CORRIDOR
APPROXIMATE SURFACE ELEV.: +381 FEET MSL
DRILLING CONTRACTOR: TRI-COUNTY DRILLING. INC..
DRILLING METHOD: 8 INCH HSA
LOGGED BY: NICK BARNES

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
					Bark & wood chips in the upper 6"			
1 2 3	1				**COLLUVIAL DEPOSITS -** Dark yellow brown, wet, stiff, highly plastic clay (CH) with scattered sub-rounded and fractured gravel and cobbles up to 4" in max. dimension.			
				?	? ?			? ?
4 5					**SCRIPPS FORMATION**			
6	2	80	0.0		Olive yellow to pale reddish yellow, damp, hard, lean clay (CL).	22.3	102.1	
7 8 9	3							
10 11	4	100+	0.0			20.7		
12 13 14 15								
16	5	100+	0.0		Pale reddish yellow to reddish brown, damp, very dense, fine to medium-grained, silty sandstone (SM).	20.5	83.2	
17 18					Abundant gravel/cobbles from 17' to 19.5'.			
19	6	100+						No sample recovery

20
21
22

NOTES:

Bottom of borehole at 19.5'

No groundwater or seepage encountered during drilling operations

BORING NO. H-18

DATE OF DRILLING: MAY 8, 2017
TOTAL BORING DEPTH: 21 FEET
GENERAL LOCATION: EASTERN PIPELINE CORRIDOR
APPROXIMATE SURFACE ELEV.: +368 FEET MSL
DRILLING CONTRACTOR: TRI-COUNTY DRILLING. INC..
DRILLING METHOD: 8 INCH HSA
LOGGED BY: NICK BARNES

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
1–2					**FILL -** Pale yellow to yellow brown, damp, silty sand (SM) with scattered sub-rounded and locally fractured gravel up to 3" in maximum dimension.			
				?	? ?			? ?
3–4					**SCRIPPS FORMATION**			
5–6	1	73	0.0		Olive to pale olive yellow to pale reddish yellow, damp, very dense, fine-grained, silty sandstone (SM).	21.4		
7–8	2							
10–11	3	100+			Abundant gravel between 10' and 11.5'.			Sampler bouncing on rock, no recovery
12–14	4							
15–16	5	57	0.0			21.4		
20–21	6	100+	0.0		Very dense, fine-grained, silty sandstone (SM).	20.6	105.4	

NOTES:

Bottom of borehole at 21'

No groundwater or seepage encountered during drilling operations

PROJECT NO. 44F1

ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE A-47

BORING NO. H-19

DATE OF DRILLING: MAY 11 AND 25, 2017	TOTAL BORING DEPTH: 21.5 FEET
GENERAL LOCATION: EASTERN PIPELINE CORRIDOR	
APPROXIMATE SURFACE ELEV.: +353 FEET MSL	DRILLING CONTRACTOR: TRI-COUNTY DRILLING. INC..
DRILLING METHOD: 8 INCH HSA/4" AIR PERCUSSION	LOGGED BY: NICK BARNES

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
					Bark & wood chips in the upper 6"			
1								
2					**FILL:** Yellow/olive brown, damp, fine-grained silty sand (SM) with scattered sub-angular gravel up to 2" in maximum dimension.			
3				?	? ?			? ?
4								
5					**SCRIPPS FORMATION**			
6	1	52	0.1		Pale olive to pale reddish yellow, damp, dense to very dense, fine-grained, silty sandstone (SM).	20.2		
7	2							
8					Abundant gravels and cobbles between 8' and 10'.			5/11/17, refusal on gravel/cobbles. Relocate boring 5' east and resume drilling on 5/25/17 using 4" air rotary.
9								
10					Gray to pale reddish yellow, damp, hard, sandy lean clay (CL).			
11	3	54	0.1			24.7		
12								
13								
14								
15					Olive brown to olive gray, hard, claystone (CL/CH).			
16	4	82	0.0			21.9	109.4	
17								
18								
19								
20					Medium gray to pale reddish yellow, sandy lean clay (CL).			
21	5	66	0.0			20.8		
22								

NOTES:

Bottom of borehole at 21.5'

No groundwater or seepage encountered during drilling operations

PROJECT NO. 44F1	**ALLIED GEOTECHNICAL ENGINEERS, INC.**	**FIGURE A-48**

BORING NO. H-20

DATE OF DRILLING: MAY 18, 2017
TOTAL BORING DEPTH: 80.5 FEET
GENERAL LOCATION: NEW RENEWABLE ENERGY FACILITY
APPROXIMATE SURFACE ELEV.: +367 FEET MSL
DRILLING CONTRACTOR: TRI-COUNTY DRILLING. INC..
DRILLING METHOD: 4- INCH MUD ROTARY
LOGGED BY: NICK BARNES

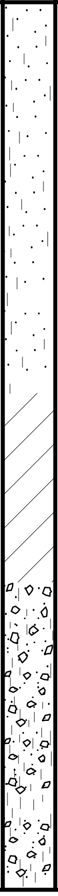
DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
1					**EXISTING PAVEMENT:** 4" A.C. over 12" misc. base			
2								Drill to 10' using 8-inch HSA, then switch to 4" mud rotary.
3					**SCRIPPS FORMATION**			
4	1				Light gray to pale yellowish red, damp, hard, lean clay (CL).			
5								
6	2	55	0.1			19.3		
7								
8								
9	3							
10								
11	4	100+	0.0			13.4	106.8	
12					Gravel bed between 12' and 13'.			
13								
14								
15								
16	5	100+	0.1		Olive gray, damp, hard, lean clay (CL).	22.0		
17								
18								
19								
20	6	100+	0.2			18.2	113.5	
21								
22								
23								
24								
25								
26	7	100+	0.0		Olive gray to pale reddish yellow.	21.6		
27								
28								
29								

BORING NO. H-20 (Continued)

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
	8	100+	0.0	▨	**SCRIPPS FORMATION**	18.7	108.0	
31								
32					Olive gray to reddish yellow, damp, hard, sandy lean clay (CL).			
33								
34								
35								
36	9	80	0.2			21.6		
37								
38								
39								
40								
41	10	100+	0.3			16.4	112.0	
42								
43								
44								
45								
46	11	100+	0.4			23.7		
47								
48								
49								
50	12	100+	0.0			19.6	112.8	
51								
52								
53								
54								
55								
56	13	99	0.3			18.8		
57								
58								
59								
60	14	100+	0.0		Olive brown, hard, medium to highly plastic claystone (CL/CH).	21.4	114.4	
61								

PROJECT NO. 44F1	ALLIED GEOTECHNICAL ENGINEERS, INC.	FIGURE A-50

BORING NO. H-20 (Continued)

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
63 64 65					**SCRIPPS FORMATION**			
66 67 68 69	15	100+	0.0		Olive gray to pale yellowish red, damp, hard, sandy lean clay (CL). Grades into reddish yellow, medium-grained silty sandstone (SM) at 66.5'.	21.1		
70 71 72 73 74	16	100+	0.1		Olive gray to pale reddish yellow, silty sandstone (SM) and sandy siltstone (ML), grading into olive brown claystone (CL/CH) at 70.5'.	18.3	114.4	
75 76 77 78 79					Scattered to locally abundant gravels from 74' to 80.5'.			
80	17	100+	0.3			24.2		
81								

NOTES:

Bottom of borehole at 80.5 feet.

Unable to determine if groundwater is present.
Method of drilling required introduction of water
into borehole.

BORING NO. H-21

DATE OF DRILLING: MAY 16, 2017	TOTAL BORING DEPTH: 21.5 FEET
GENERAL LOCATION: CHEMICAL STORAGE FACILITY	
APPROXIMATE SURFACE ELEV.: +366 FEET MSL	DRILLING CONTRACTOR: TRI-COUNTY DRILLING. INC..
DRILLING METHOD: 8 INCH HSA	LOGGED BY: NICK BARNES

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
1					**FILL:** Medium brown to yellow brown, damp to wet, clayey sand (SC) and silty sand (SM) with scattered sub-rounded and locally fractured gravel/cobbles up to 4" in maximum dimension.			
3				?	? ?			? ?
4	1				**VERY OLD PARALIC DEPOSITS**			
6	2	79	0.0		Reddish brown, damp, very dense, gravelly silty sand (SM). Gravel is sub-rounded, up to 2" in maximum dimension.	6.0		
8				?	? ?			? ?
9					**SCRIPPS FORMATION**			
11	3	100+	0.1		Olive yellow to olive brown, damp, hard, sandy lean clay (CL).	19.7	105.5	
14	4							
16	5	75	0.1			17.5		
21	6	53	0.0		Olive yellow to light olive gray, damp, very stiff to hard, sandy lean clay (CL).	19.4	112.1	
22								

NOTES:

Bottom of borehole at 21.5'

No groundwater or seepage encountered during drilling operations

BORING NO. H-22

DATE OF DRILLING: MAY 17, 2017	TOTAL BORING DEPTH: 80.5 FEET
GENERAL LOCATION: NEW RENEWABLE ENERGY FACILITY	
APPROXIMATE SURFACE ELEV.: +371 FEET MSL	DRILLING CONTRACTOR: TRI-COUNTY DRILLING. INC..
DRILLING METHOD: 8 - INCH HSA	LOGGED BY: NICK BARNES

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
1								Gravels in the upper 3"
2					**FILL**			
3					Yellow brown to dark brown, damp, gravelly silty sand (SM) and clayey sand (SC). Fill is intermixed with chunks of pale yellow sandstone and olive gray siltstone.			
5					(transition in sample)			
6	1	46	0.1	?	? ?	12.5	113.1	? ?
8					**SCRIPPS FORMATION**			
9	2							
11	3	70	0.5		Pale olive yellow to reddish yellow, damp, very dense, fine-grained silty sandstone (SM).	19.2		
16	4	100+	0.0		Olive gray to pale gray, damp, hard, sandy lean clay (CL).	20.5	106.6	Driller added water to assist in bringing soil cuttings to ground surface.
18	5							
21	6	51	0.1		Claystone contains 1/8" to 1/4" wide laminations of reddish yellow silty sandstone (SM).	20.9		
26	7	100+	0.0			17.6	106.9	
29								

PROJECT NO. 44F1	**ALLIED GEOTECHNICAL ENGINEERS, INC.**	**FIGURE A-53**

BORING NO. H-22 (Continued)

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
31	8	87	0.3		**SCRIPPS FORMATION**	22.5		
32					Olive gray, reddish yellow and olive brown, damp, very dense/hard,laminated silty sandstone (SM) and sandy lean clay (CL).			
33								
34								
35								
36	9	100+	0.0			14.8	110.9	
37								
38	10							
39								
40					Yellowish red, damp, very dense, fine to medium-grained, silty sandstone (SM).			
41	11	100+	0.4			17.0		
42								
43								
44								
45	12	100+	0.0		Pale yellow brown, damp, medium-grained, poorly graded sand with silt (SP-SM).	6.1	112.4	
46								
47								
48								
49								
50					Pale gray to reddish yellow, very stiff to hard, sandy lean clay (CL).			
51	13	65	0.3			19.0		
52								
53								
54								
55					Pale gray, hard, lean clay (CL).			
56	14	100+	0.2			20.2	109.5	
57								
58								
59								
60	15	100+	0.0			13.3		
61								

BORING NO. H-22 (Continued)

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
					SCRIPPS FORMATION			
63								
64								
65								
66					Pale gray to pale reddish yellow, damp, hard, sandy lean clay (CL).			
67								
68								
69								
70	16	100+	0.0		Reddish yellow, silty sandstone (SM).	5.6		
71								
72								
73								
74								
75								
76								
77								
78								
79								
80	17	100+	0.1		Interbedded pale gray sandy claystone (CL) and reddish yellow silty sandstone (SM).	24.9		
81								

NOTES:

Bottom of borehole at 80.5 feet.

Unable to determine if groundwater is present. Method of drilling required introduction of water into borehole.

APPENDIX B

LABORATORY TESTING

APPENDIX B

LABORATORY TESTING

Selected soil samples were tested in the laboratory to verify visual field classifications and to evaluate certain engineering characteristics. The testing was performed in accordance with the American Society for Testing and Materials (ASTM) or other generally accepted test methods, and included the following:

- Determination of in-place moisture content (ASTM D2216). The final test results are presented on the boring logs;
- Determination of in-place dry density and moisture content (ASTM D2937) based on relatively undisturbed drive samples. The final test results are presented on the boring logs;
- Compaction test (ASTM D1557) on representative bulk samples. The test results are presented on Figures B-1 through B-16;
- Mechanical and hydrometer analyses (ASTM D422). The final test results are plotted as gradation curves on Figure B-17 through B-22;
- Direct shear tests (ASTM D3080). The final test results are presented on Figures B-23 through B-45;
- Atterberg limits (ASTM D4318). The final test results are presented on Figures 17 through B-22.
- Consolidation tests (ASTM D2435). The final test results are presented on Figures B-46 through B-53; and
- Expansion Index (ASTM D4829). The final test results are presented in Table B-1 on the next page.

In addition, representative samples of the soil materials encountered in the soil borings were delivered to Clarkson Laboratory & Supply, Inc. for chemical (analytical) testing to determine soil pH, resistivity, soluble sulfate and chloride concentrations. Copies of Clarkson's laboratory test data reports are included in this appendix.

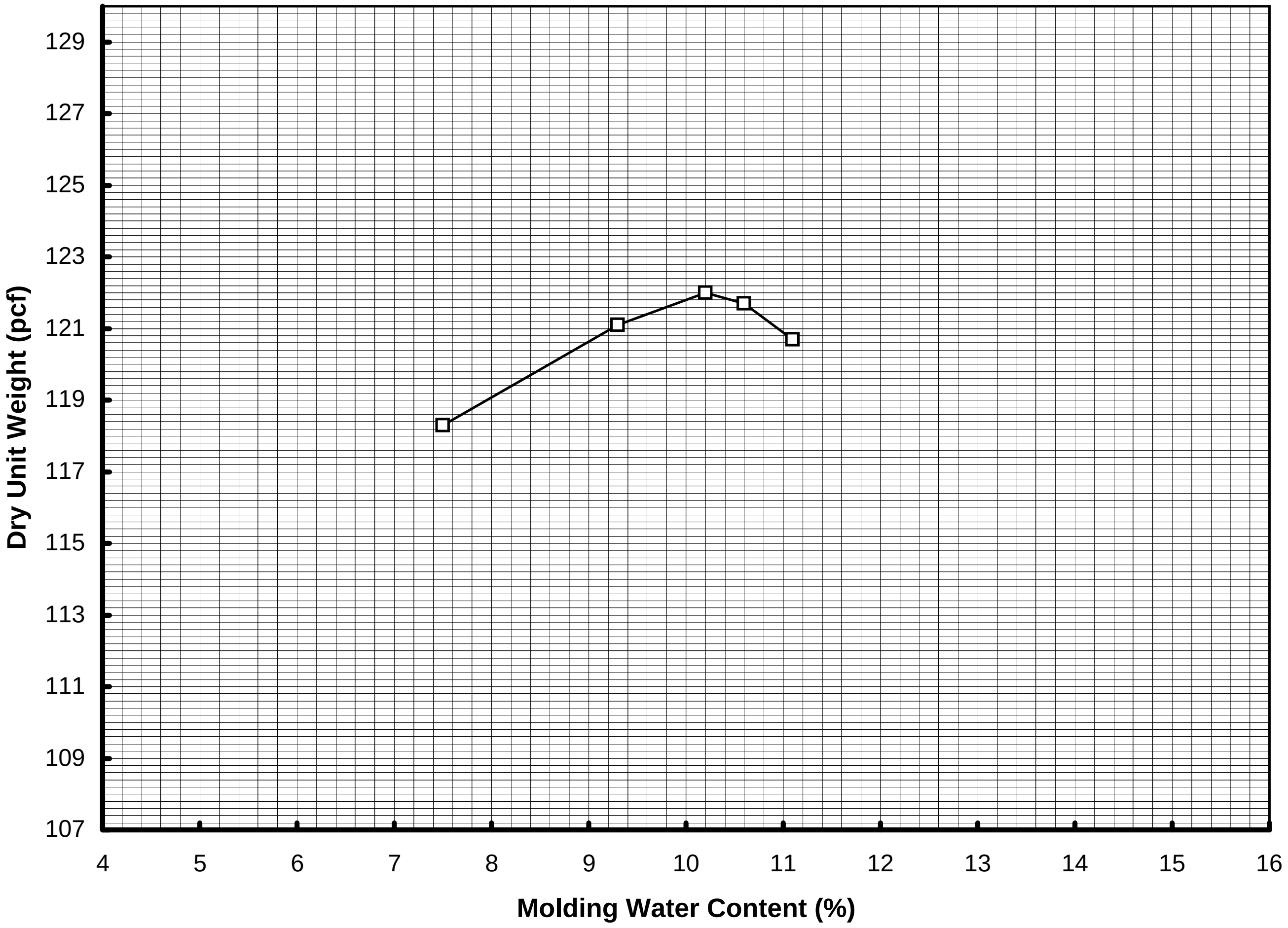
Table B-1
Summary of Expansion Index Test Results

Sample ID	Soil Classification	Expansion Index (%)
H-9 #2 @9'-12'	Silty sand (SM)/sandy silt (ML)	43
H-11 #6 @21'-24'	Sandy lean clay (CL)	71
H-13 #25 @90'-100'	Claystone (CL/CH)	78
H-14 #7 @20'-24'	Sandy clay (CL)	55
H-15 #2 @4'-7'	Fat clay (CH)	75
H-16 #1 @6'-6.5'	Sandy siltstone (ML)	67
H-19 #4 @16'-16.5'	Claystone (CL/CH)	82
H-20 #1 @3'-5'	Lean clay (CL)	40

COMPACTION CURVE

Test Method: ASTM D 1557

Compaction Procedure: A Specimen Preparation Method: ☒ Moist or ☐ Dry



Sample No.	Sample Type	Depth (ft)	OPT. WC (%)	MAX. DUW (pcf)	%ROCK %	ROCK CORR. (pcf)	Description and/or Classification
H-1 #1	Bulk	1-4	10.2	122.0	7.5	131.0	Silty sand (SM) and clayey sand (SC) with gravels.

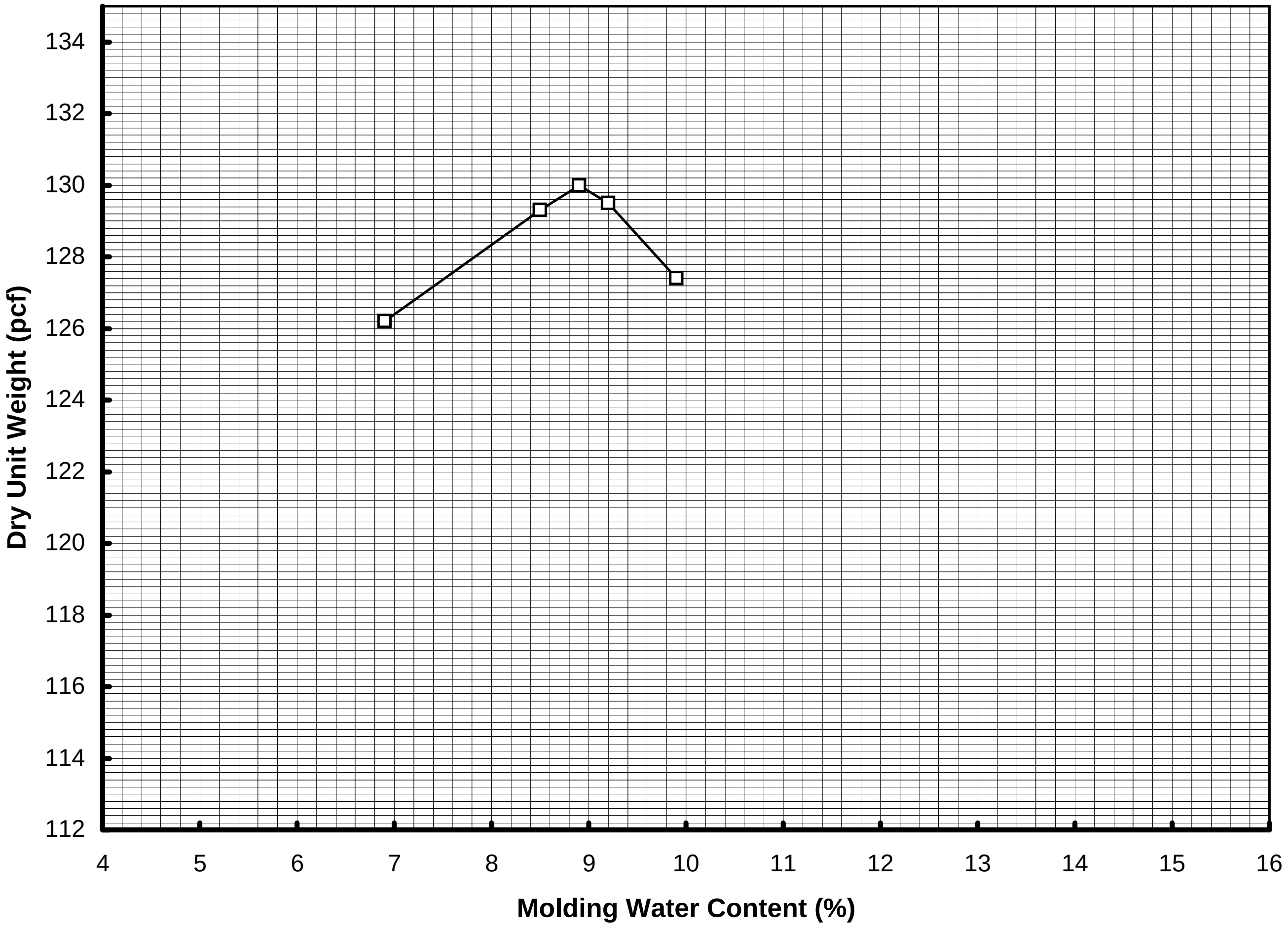
NORTH CITY WATER RECLAMATION PLANT EXPANSION
SAN DIEGO, CALIFORNIA

PROJECT NO. 44 F1	**ALLIED GEOTECHNICAL ENGINEERS, INC.**	**FIGURE B-1**

COMPACTION CURVE

Test Method: ASTM D 1557

Compaction Procedure: C Specimen Preparation Method: ☒ Moist or ☐ Dry



Sample No.	Sample Type	Depth (ft)	OPT. WC (%)	MAX. DUW (pcf)	%ROCK %	ROCK CORR. (pcf)	Description and/or Classification
H-2 #3	Bulk	11-15	8.9	130.0			Silty sand and clayey sand (SM/SC)

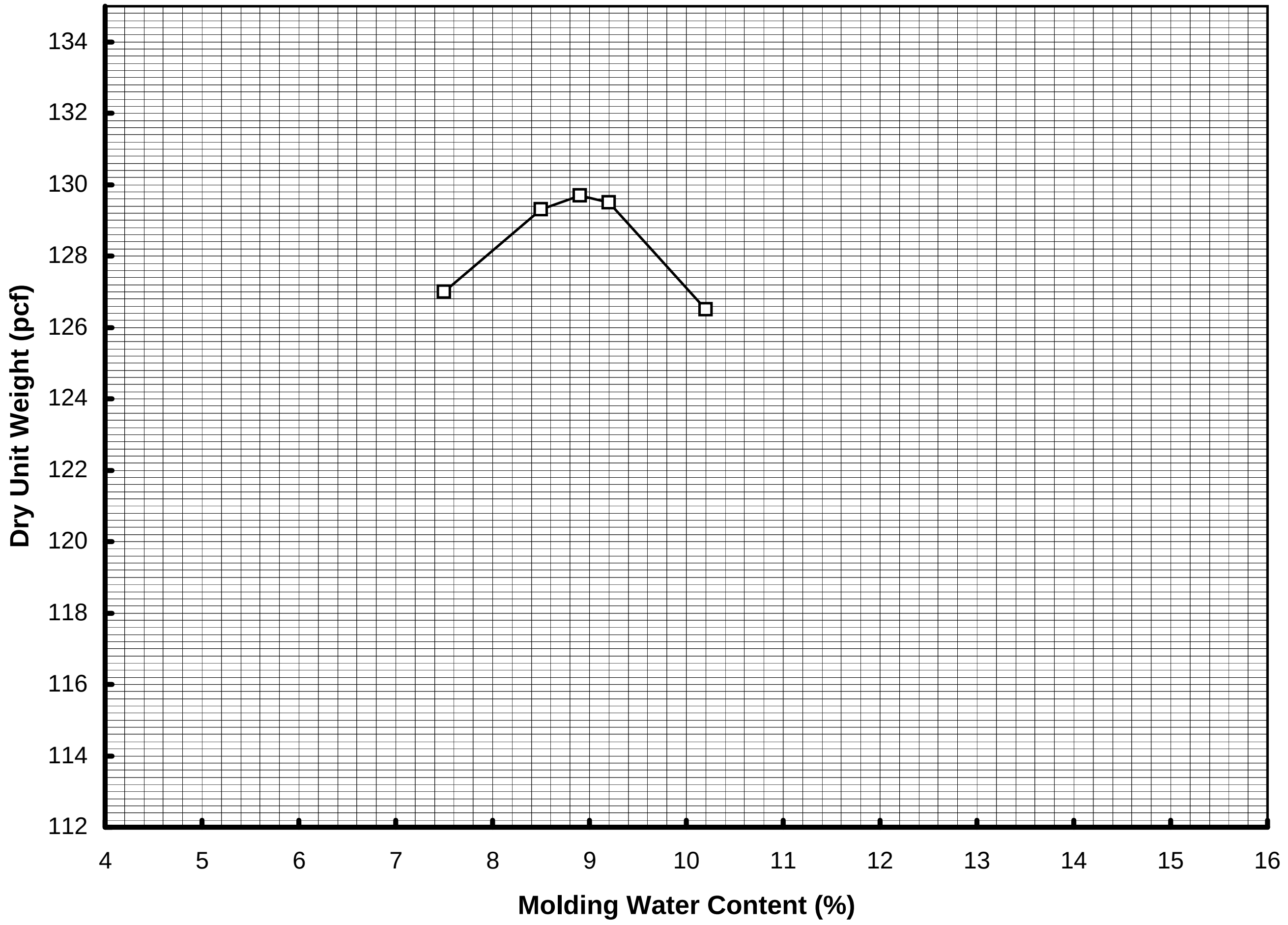
NORTH CITY WATER RECLAMATION PLANT EXPANSION
SAN DIEGO, CALIFORNIA

PROJECT NO. 44 F1	ALLIED GEOTECHNICAL ENGINEERS, INC.	FIGURE B-2

COMPACTION CURVE

Test Method: ASTM D 1557

Compaction Procedure: A Specimen Preparation Method: ☒ Moist or ☐ Dry



Sample No.	Sample Type	Depth (ft)	OPT. WC (%)	MAX. DUW (pcf)	%ROCK %	ROCK CORR. (pcf)	Description and/or Classification
H-4 #1	Bulk	3-6	8.9	129.7			Silty sand (SM) with scattered gravels

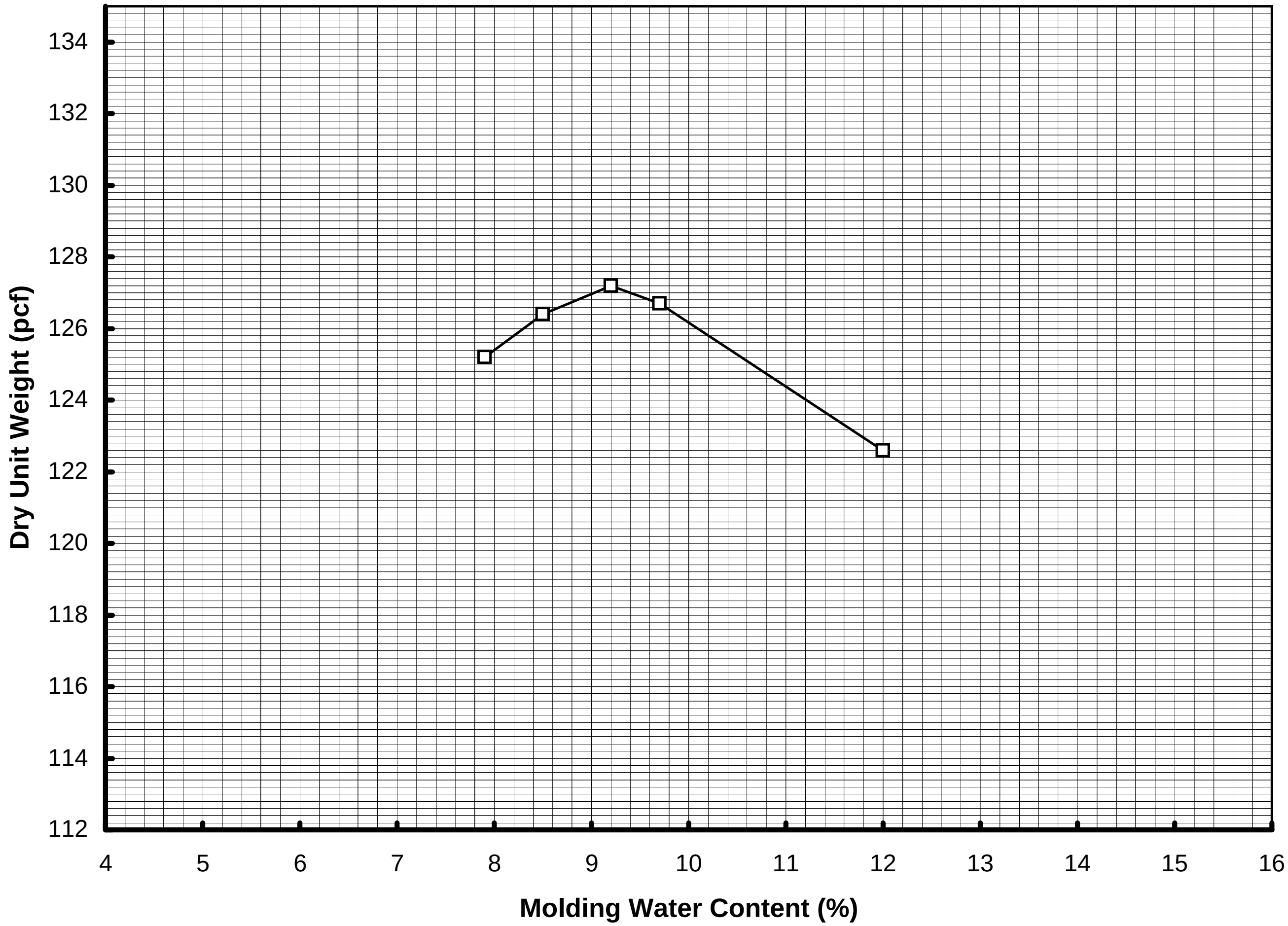
NORTH CITY WATER RECLAMATION PLANT EXPANSION
SAN DIEGO, CALIFORNIA

PROJECT NO. 44 F1	**ALLIED GEOTECHNICAL ENGINEERS, INC.**	**FIGURE B-3**

COMPACTION CURVE

Test Method: ASTM D 1557

Compaction Procedure: A Specimen Preparation Method: ☒ Moist or ☐ Dry



Sample No.	Sample Type	Depth (ft)	OPT. WC (%)	MAX. DUW (pcf)	%ROCK %	ROCK CORR. (pcf)	Description and/or Classification
H-5 #2	Bulk	4-7	9.2	127.2	1.9	129.3	Clayey sand (SC) with scattered gravels

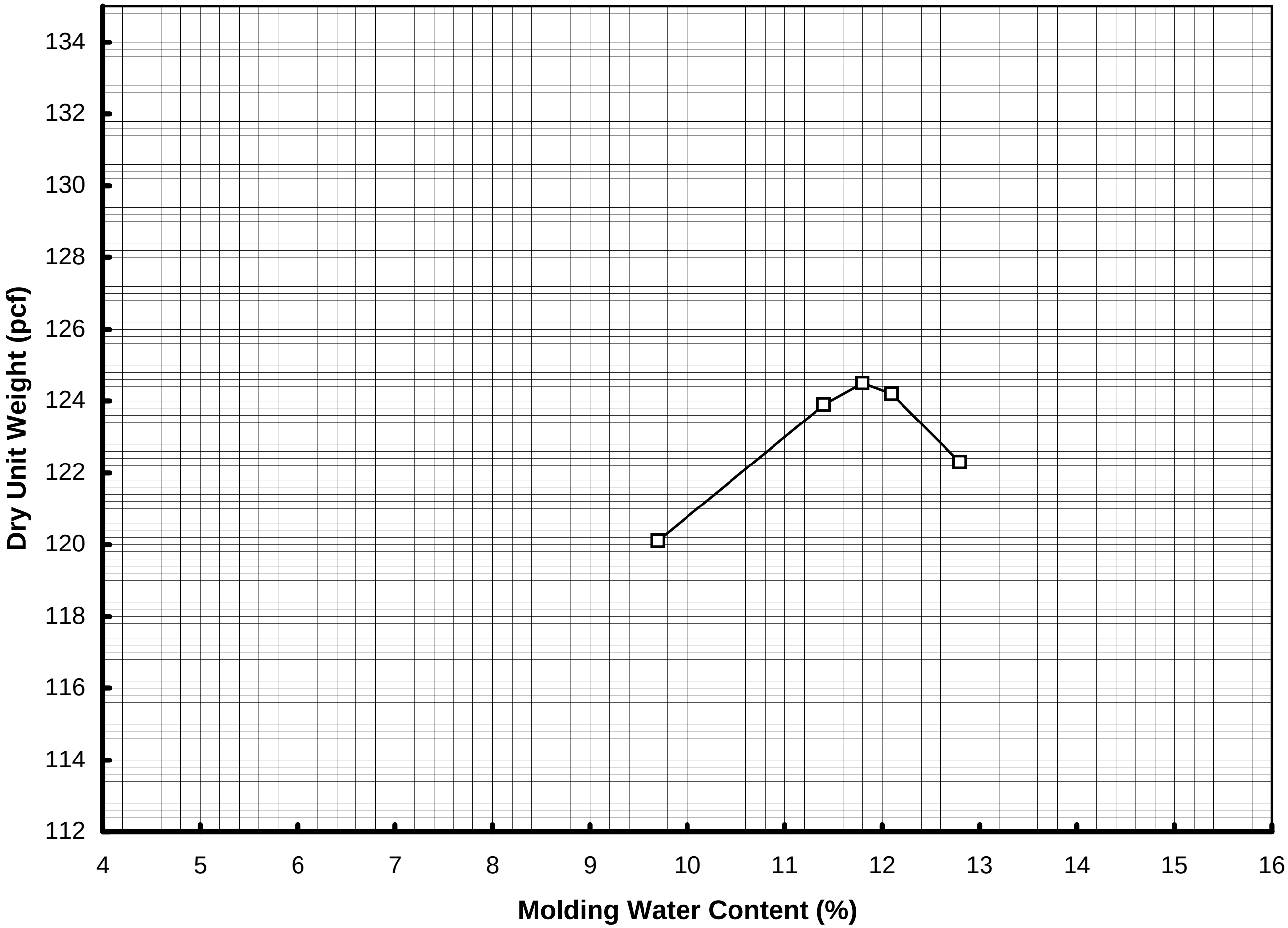
NORTH CITY WATER RECLAMATION PLANT EXPANSION
SAN DIEGO, CALIFORNIA

PROJECT NO. 44 F1	ALLIED GEOTECHNICAL ENGINEERS, INC.	FIGURE B-4

COMPACTION CURVE

Test Method: ASTM D 1557

Compaction Procedure: A Specimen Preparation Method: ☒ Moist or ☐ Dry



Sample No.	Sample Type	Depth (ft)	OPT. WC (%)	MAX. DUW (pcf)	%ROCK %	ROCK CORR. (pcf)	Description and/or Classification
H-6 #1	Bulk	4-7	11.8	124.5			Clayey sand (SC) with scattered gravels

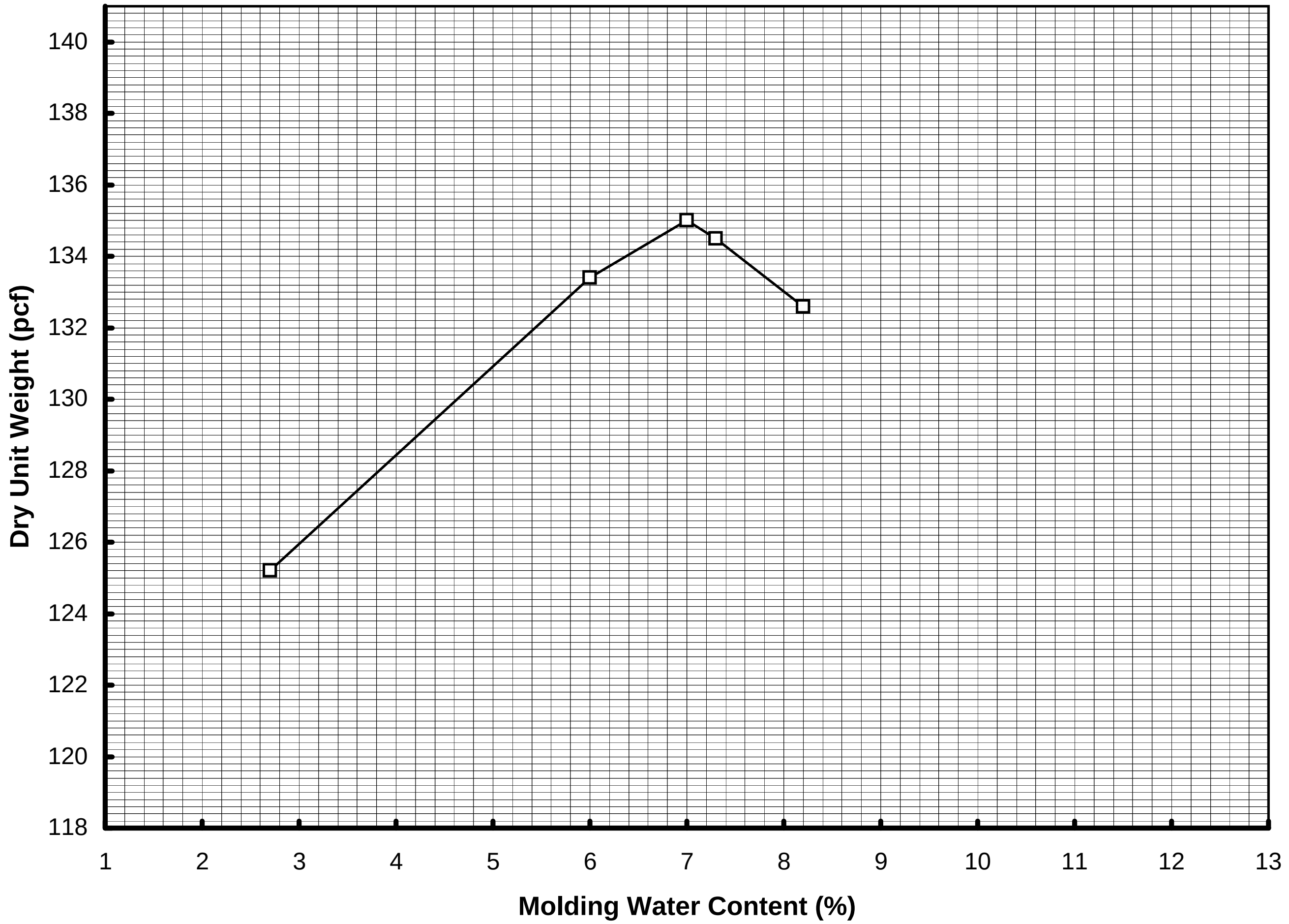
NORTH CITY WATER RECLAMATION PLANT EXPANSION
SAN DIEGO, CALIFORNIA

PROJECT NO. 44 F1	**ALLIED GEOTECHNICAL ENGINEERS, INC.**	**FIGURE B-5**

COMPACTION CURVE

Test Method: ASTM D 1557

Compaction Procedure: C Specimen Preparation Method: ☒ Moist or ☐ Dry



Sample No.	Sample Type	Depth (ft)	OPT. WC (%)	MAX. DUW (pcf)	%ROCK %	ROCK CORR. (pcf)	Description and/or Classification
H-7 #2	Bulk	5-8	7.0	135.0			Silty sand (SM) with some gravels

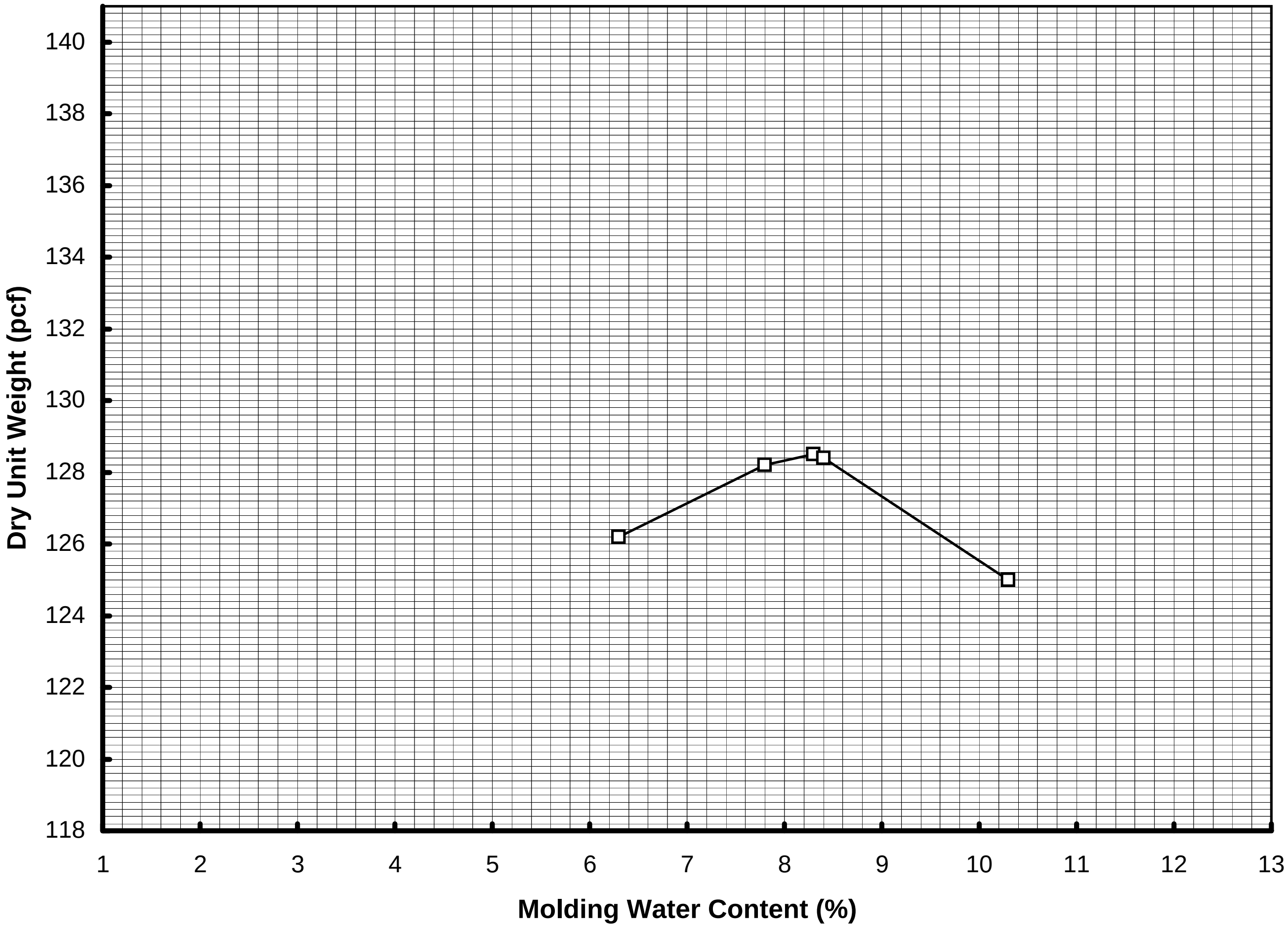
NORTH CITY WATER RECLAMATION PLANT EXPANSION
SAN DIEGO, CALIFORNIA

PROJECT NO. 44 F1 | **ALLIED GEOTECHNICAL ENGINEERS, INC.** | **FIGURE B-6**

COMPACTION CURVE

Test Method: ASTM D 1557

Compaction Procedure: C Specimen Preparation Method: ☒ Moist or ☐ Dry



Sample No.	Sample Type	Depth (ft)	OPT. WC (%)	MAX. DUW (pcf)	%ROCK %	ROCK CORR. (pcf)	Description and/or Classification
H-8 #1	Bulk	4-7	8.3	128.5			Silty sand (SM) with some gravels

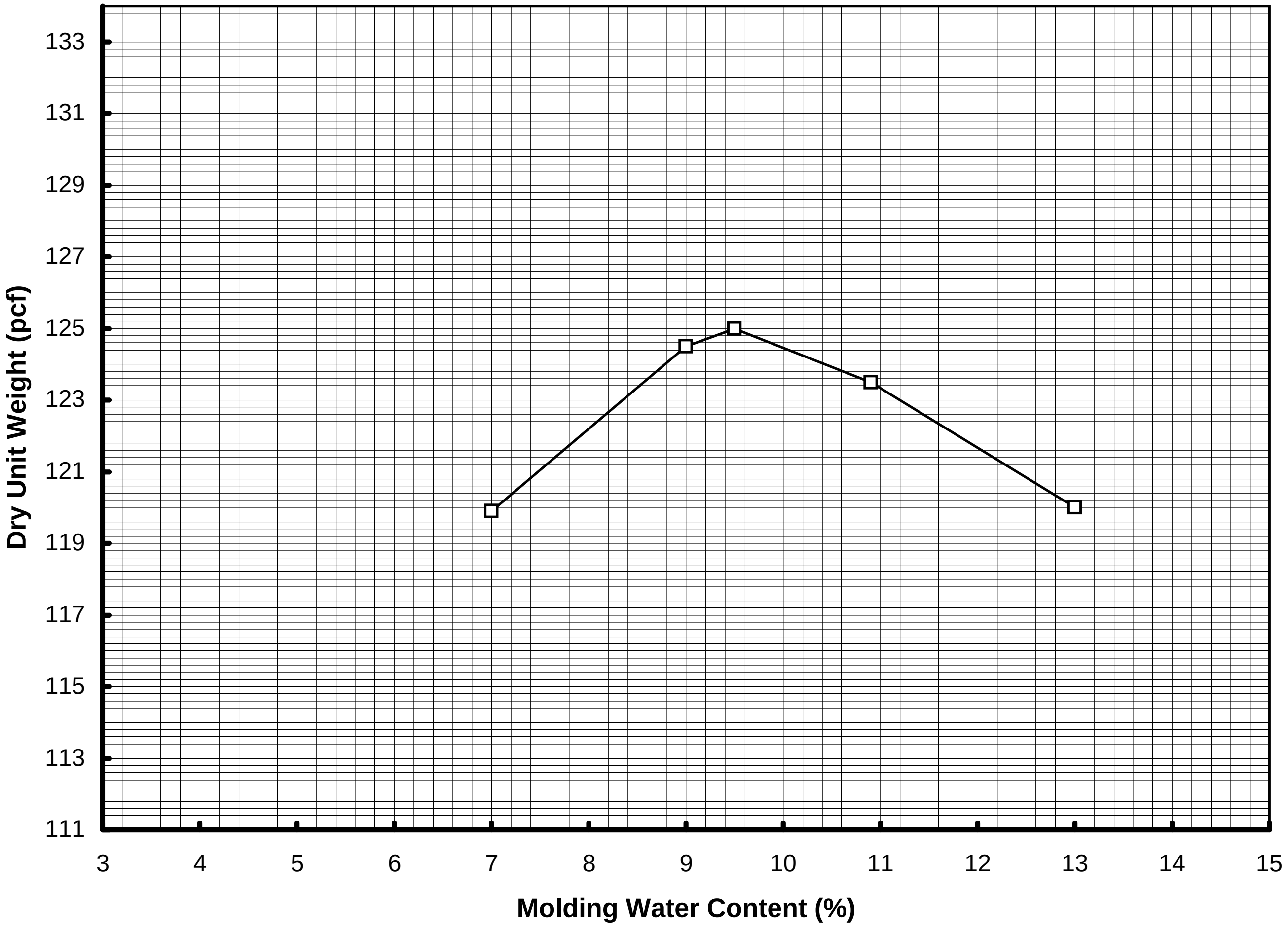
NORTH CITY WATER RECLAMATION PLANT EXPANSION
SAN DIEGO, CALIFORNIA

PROJECT NO. 44 F1	**ALLIED GEOTECHNICAL ENGINEERS, INC.**	**FIGURE B-7**

COMPACTION CURVE

Test Method: ASTM D 1557

Compaction Procedure: A Specimen Preparation Method: ☒ Moist or ☐ Dry



Sample No.	Sample Type	Depth (ft)	OPT. WC (%)	MAX. DUW (pcf)	%ROCK %	ROCK CORR. (pcf)	Description and/or Classification
H-9 #2	Bulk	9-12	9.5	125.0			Silty sand and sandy silt (SM/ML) with some gravels

NORTH CITY WATER RECLAMATION PLANT EXPANSION
SAN DIEGO, CALIFORNIA

PROJECT NO. 44 F1

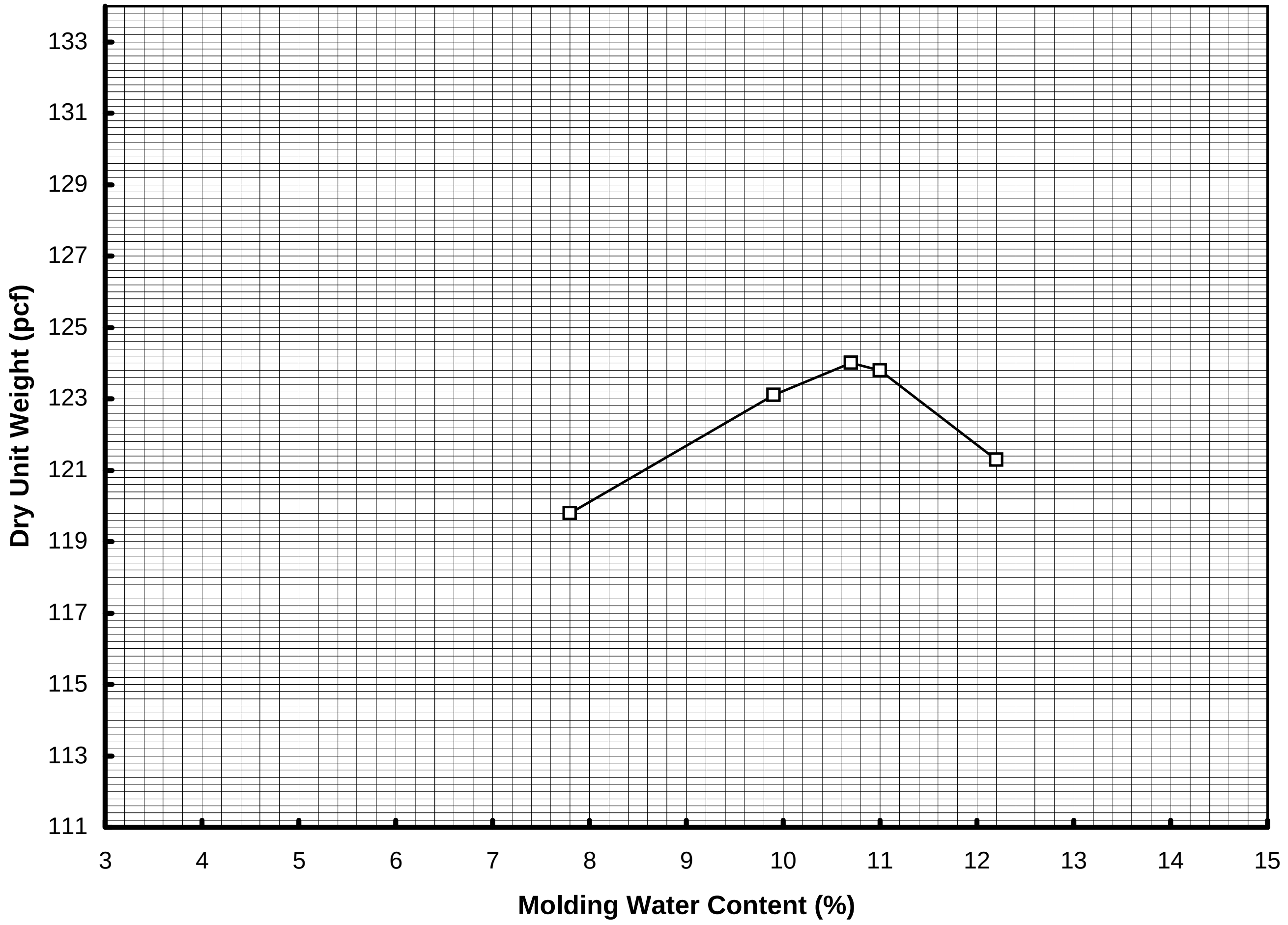
ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE B-8

COMPACTION CURVE

Test Method: ASTM D 1557

Compaction Procedure: C Specimen Preparation Method: ☒ Moist or ☐ Dry



Sample No.	Sample Type	Depth (ft)	OPT. WC (%)	MAX. DUW (pcf)	%ROCK %	ROCK CORR. (pcf)	Description and/or Classification
H-10 #1	Bulk	3-7	10.7	124.0			Silty sand and clayey sand (SM/SC) with gravels

NORTH CITY WATER RECLAMATION PLANT EXPANSION
SAN DIEGO, CALIFORNIA

PROJECT NO. 44 F1

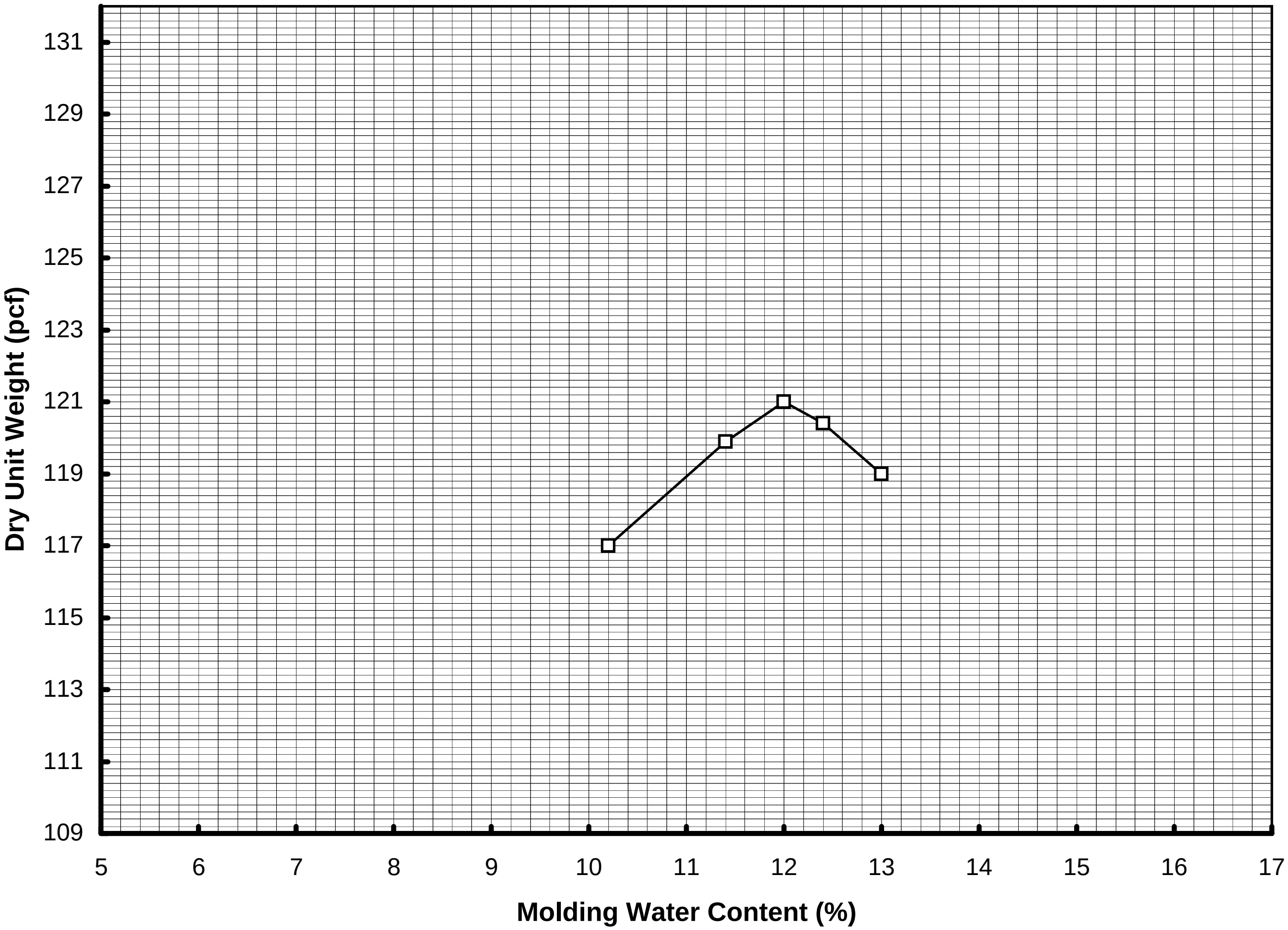
ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE B-9

COMPACTION CURVE

Test Method: ASTM D 1557

Compaction Procedure: A Specimen Preparation Method: ☒ Moist or ☐ Dry



Sample No.	Sample Type	Depth (ft)	OPT. WC (%)	MAX. DUW (pcf)	%ROCK %	ROCK CORR. (pcf)	Description and/or Classification
H-11 #6	Bulk	21-24	12.0	121.0			Lean clay (CL)

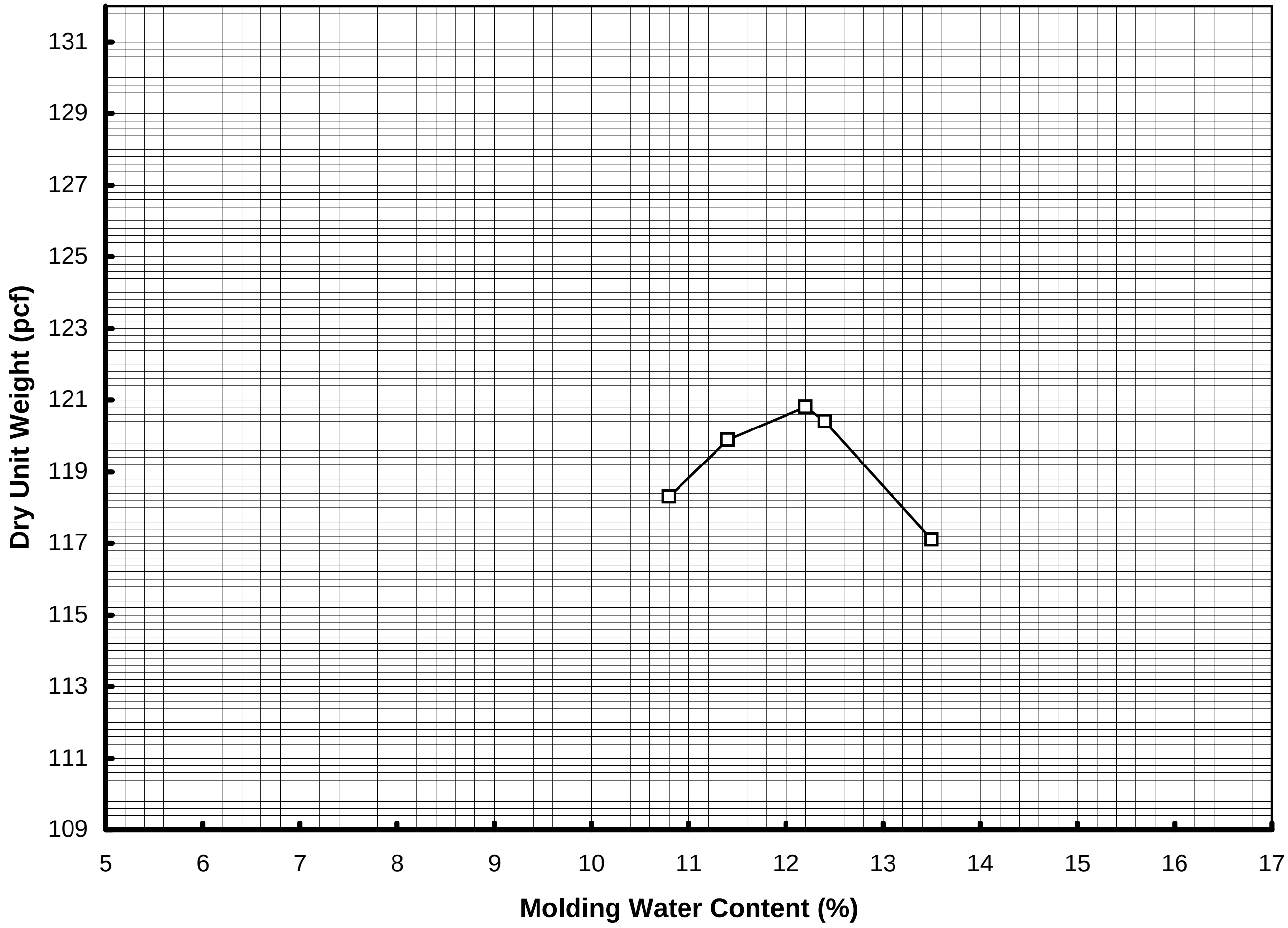
NORTH CITY WATER RECLAMATION PLANT EXPANSION
SAN DIEGO, CALIFORNIA

PROJECT NO. 44 F1	**ALLIED GEOTECHNICAL ENGINEERS, INC.**	**FIGURE B-10**

COMPACTION CURVE

Test Method: ASTM D 1557

Compaction Procedure: A Specimen Preparation Method: ☒ Moist or ☐ Dry



Sample No.	Sample Type	Depth (ft)	OPT. WC (%)	MAX. DUW (pcf)	%ROCK %	ROCK CORR. (pcf)	Description and/or Classification
H-12 #7	Bulk	21-24	12.2	120.8			Sandy clay (CL)

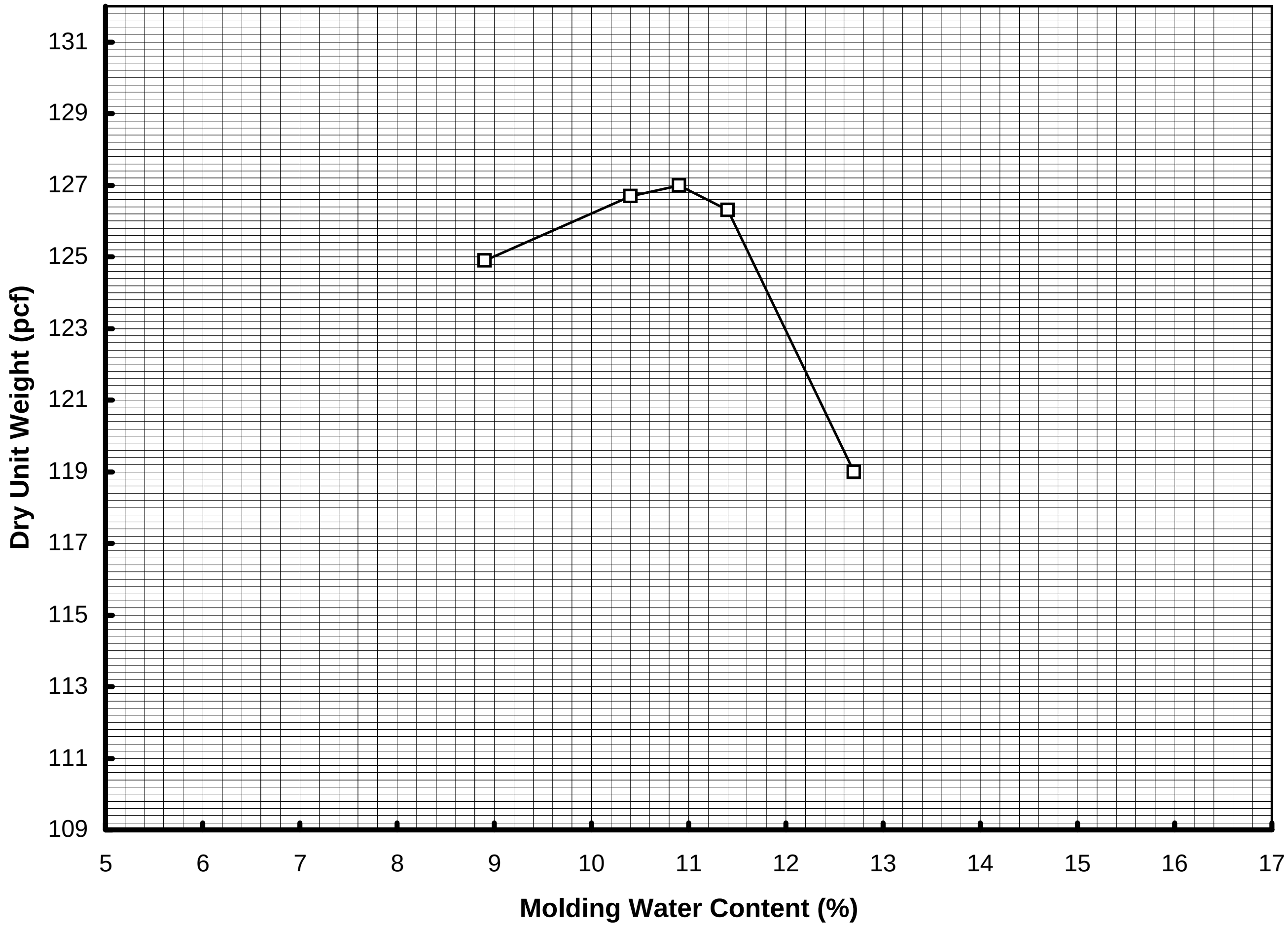
NORTH CITY WATER RECLAMATION PLANT EXPANSION
SAN DIEGO, CALIFORNIA

PROJECT NO. 44 F1	**ALLIED GEOTECHNICAL ENGINEERS, INC.**	**FIGURE B-11**

COMPACTION CURVE

Test Method: ASTM D 1557

Compaction Procedure: A Specimen Preparation Method: ☒ Moist or ☐ Dry



Sample No.	Sample Type	Depth (ft)	OPT. WC (%)	MAX. DUW (pcf)	%ROCK %	ROCK CORR. (pcf)	Description and/or Classification
H-13 #1	Bulk	3-7	10.0	127.0			Lean clay with gravels

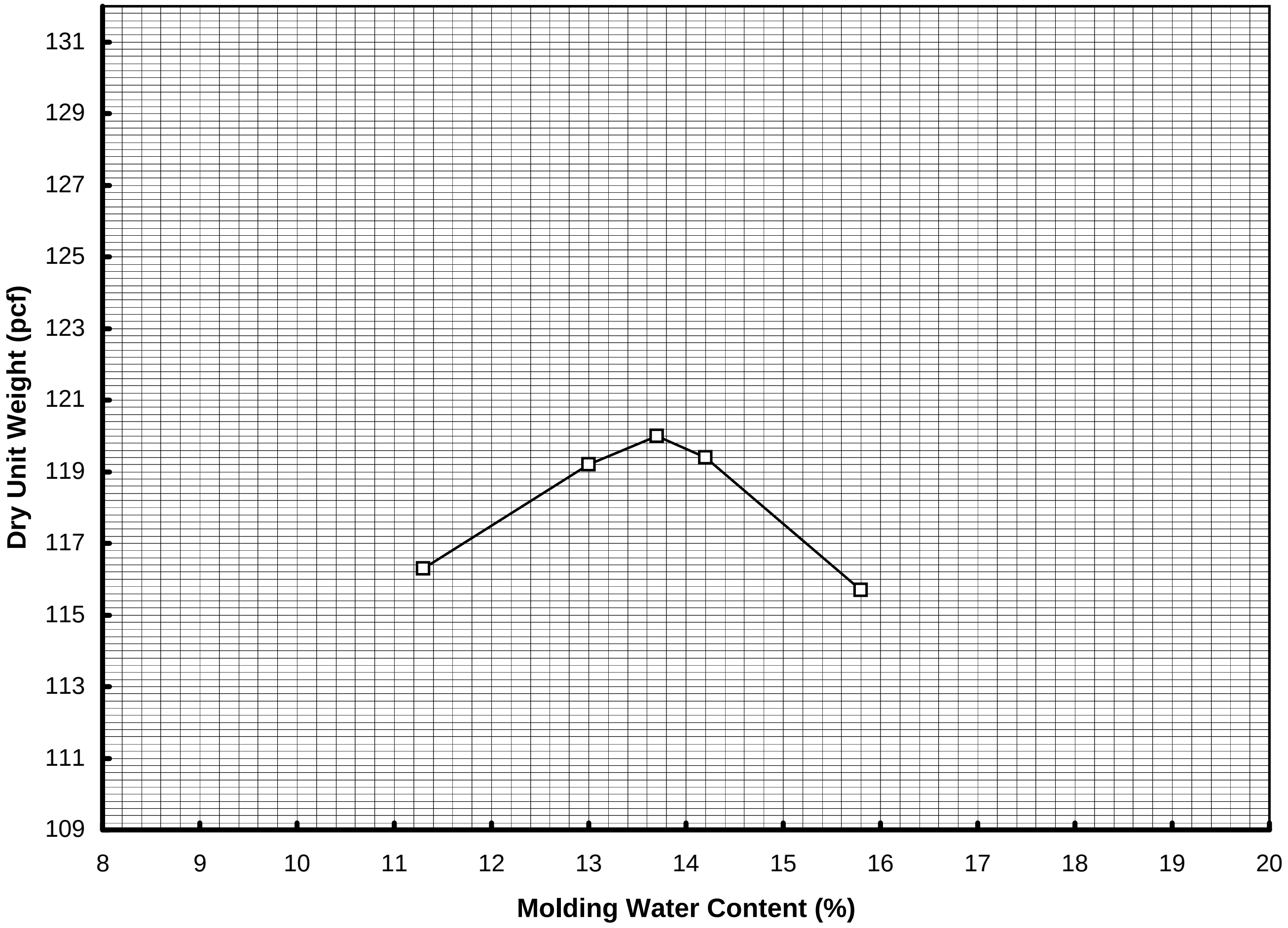
NORTH CITY WATER RECLAMATION PLANT EXPANSION
SAN DIEGO, CALIFORNIA

PROJECT NO. 44 F1	**ALLIED GEOTECHNICAL ENGINEERS, INC.**	**FIGURE B-12**

COMPACTION CURVE

Test Method: ASTM D 1557

Compaction Procedure: A Specimen Preparation Method: ☒ Moist or ☐ Dry



Sample No.	Sample Type	Depth (ft)	OPT. WC (%)	MAX. DUW (pcf)	%ROCK %	ROCK CORR. (pcf)	Description and/or Classification
H-14 #2	Bulk	4-7	13.7	120.0			Sandy clay (CL)

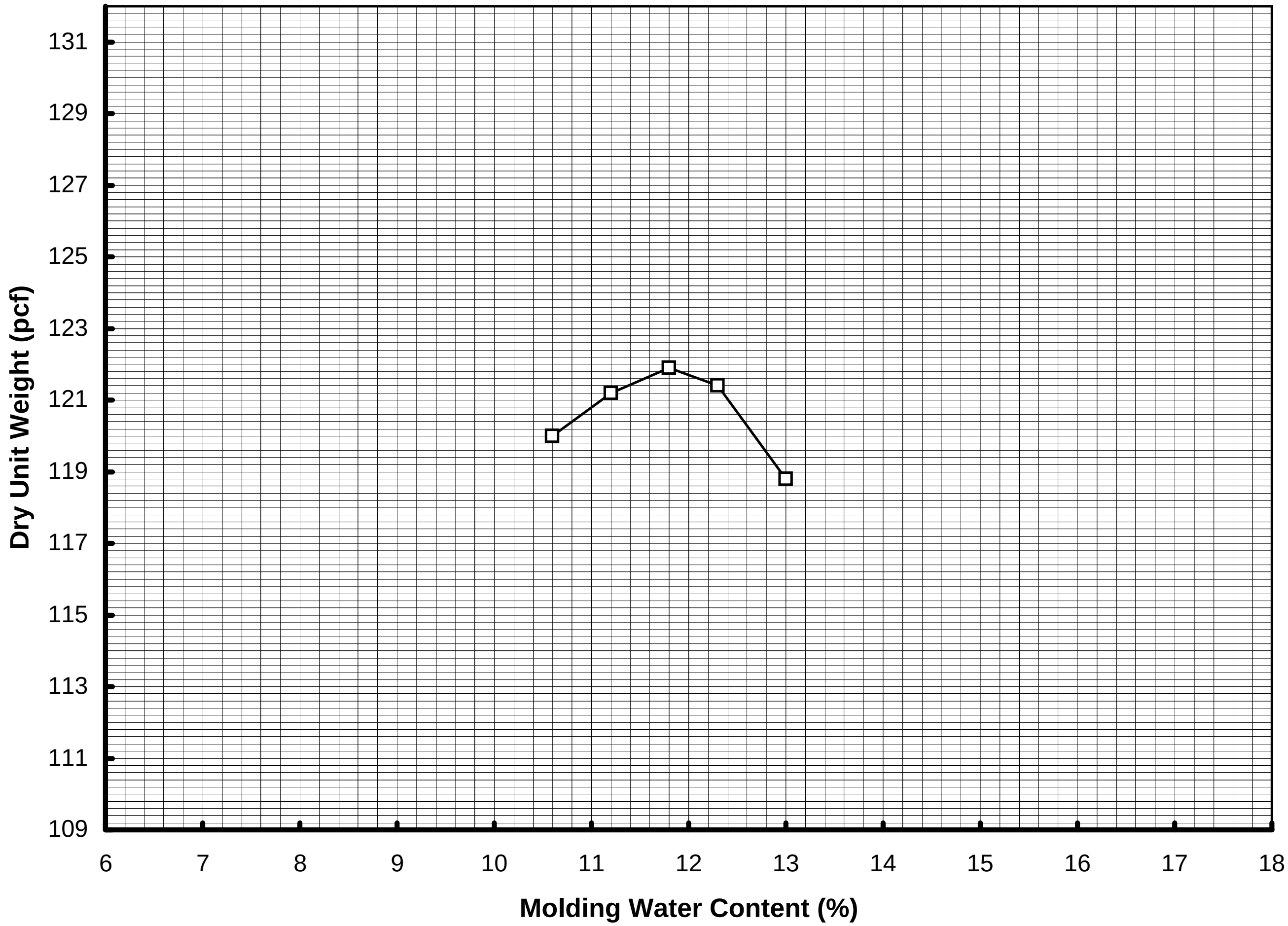
NORTH CITY WATER RECLAMATION PLANT EXPANSION
SAN DIEGO, CALIFORNIA

PROJECT NO. 44 F1	ALLIED GEOTECHNICAL ENGINEERS, INC.	FIGURE B-13

COMPACTION CURVE

Test Method: ASTM D 1557

Compaction Procedure: A Specimen Preparation Method: ☒ Moist or ☐ Dry



Sample No.	Sample Type	Depth (ft)	OPT. WC (%)	MAX. DUW (pcf)	%ROCK %	ROCK CORR. (pcf)	Description and/or Classification
H-14 #7	Bulk	20-24	11.8	121.9			Sandy clay (CL)

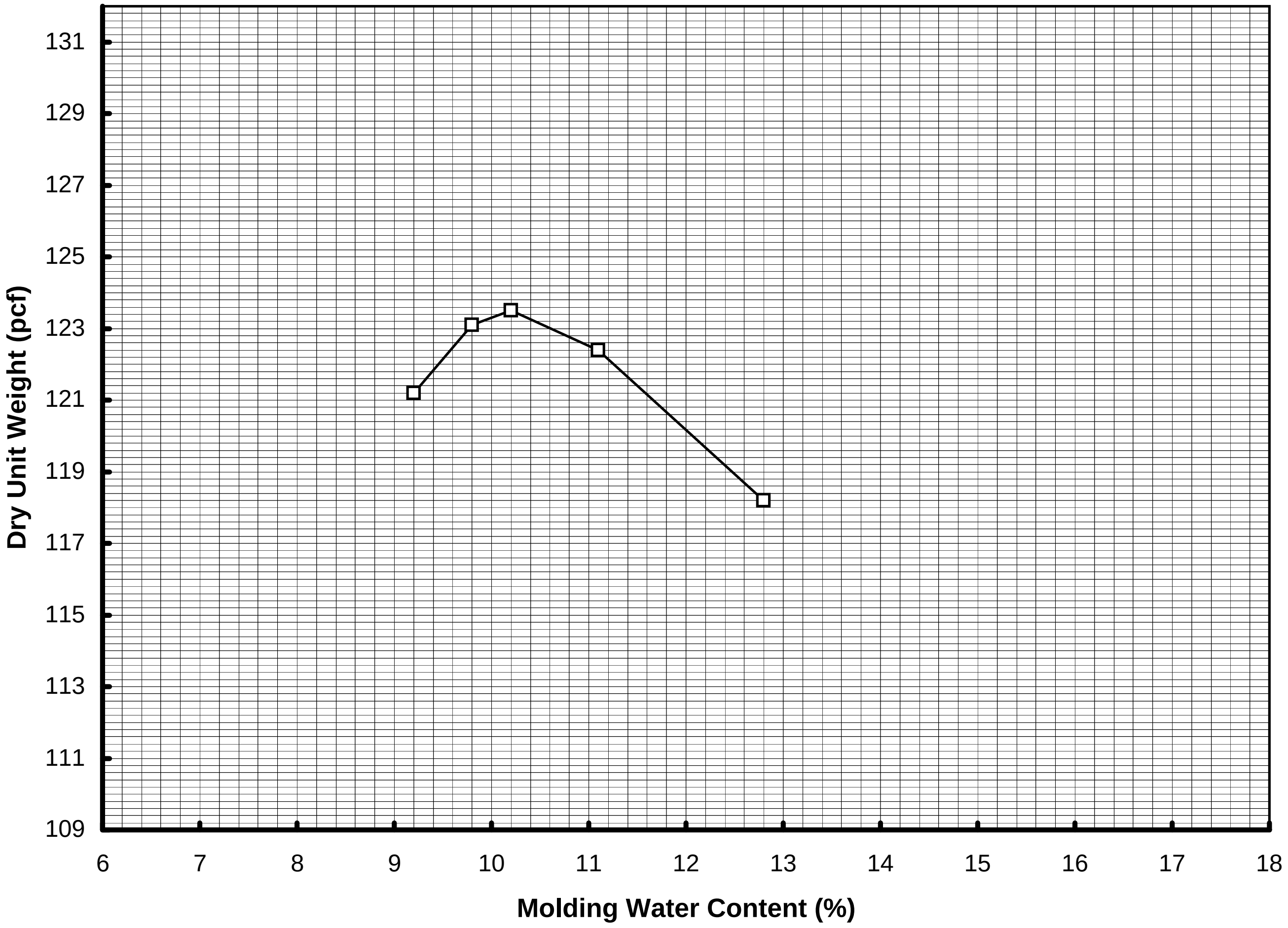
NORTH CITY WATER RECLAMATION PLANT EXPANSION
SAN DIEGO, CALIFORNIA

PROJECT NO. 44 F1	ALLIED GEOTECHNICAL ENGINEERS, INC.	FIGURE B-14

COMPACTION CURVE

Test Method: ASTM D 1557

Compaction Procedure: A Specimen Preparation Method: ☒ Moist or ☐ Dry



Sample No.	Sample Type	Depth (ft)	OPT. WC (%)	MAX. DUW (pcf)	%ROCK %	ROCK CORR. (pcf)	Description and/or Classification
H-17 #3	Bulk	7-10	10.3	123.5			Lean clay (CL)

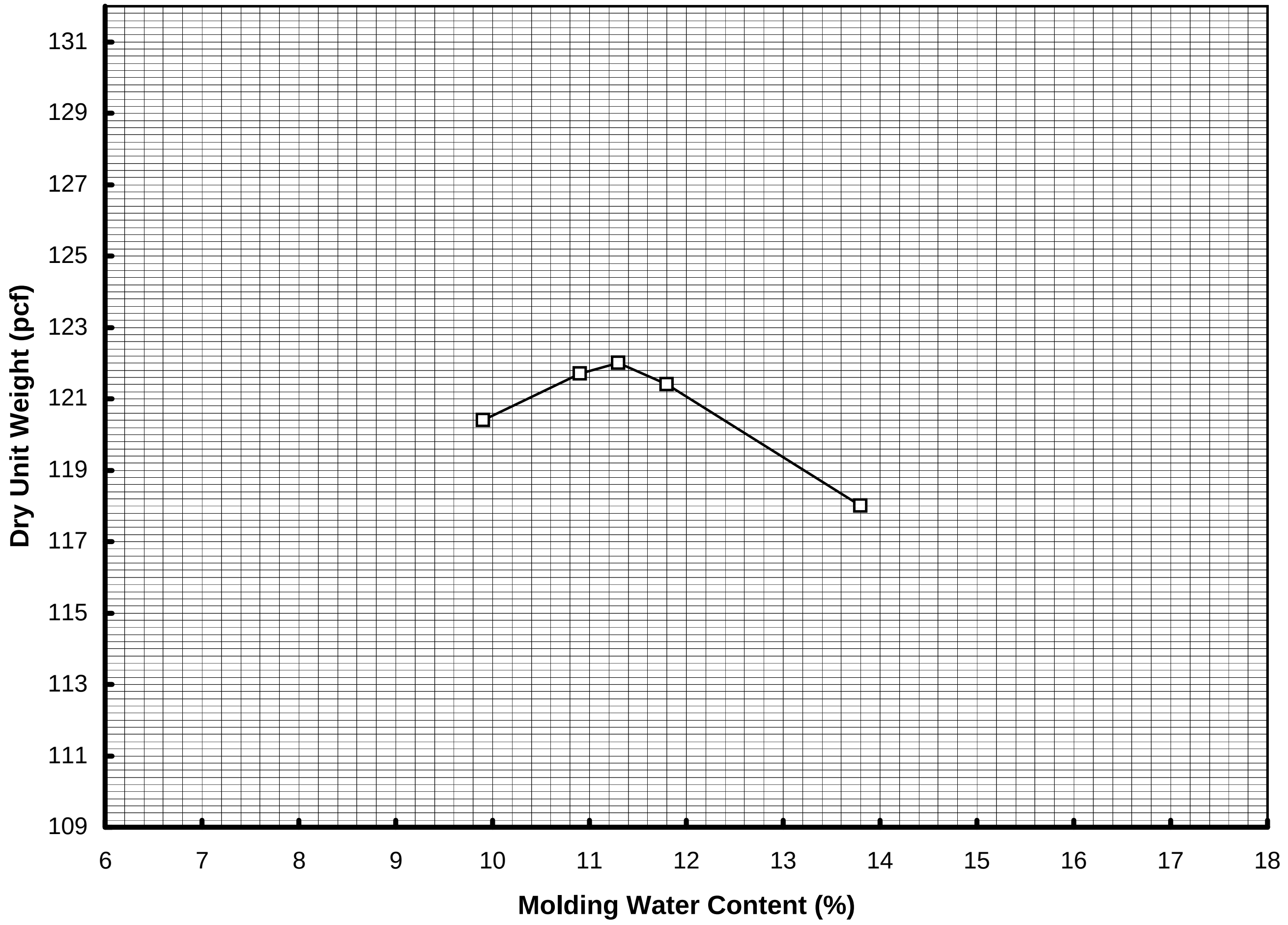
NORTH CITY WATER RECLAMATION PLANT EXPANSION
SAN DIEGO, CALIFORNIA

PROJECT NO. 44 F1 | **ALLIED GEOTECHNICAL ENGINEERS, INC.** | **FIGURE B-15**

COMPACTION CURVE

Test Method: ASTM D 1557

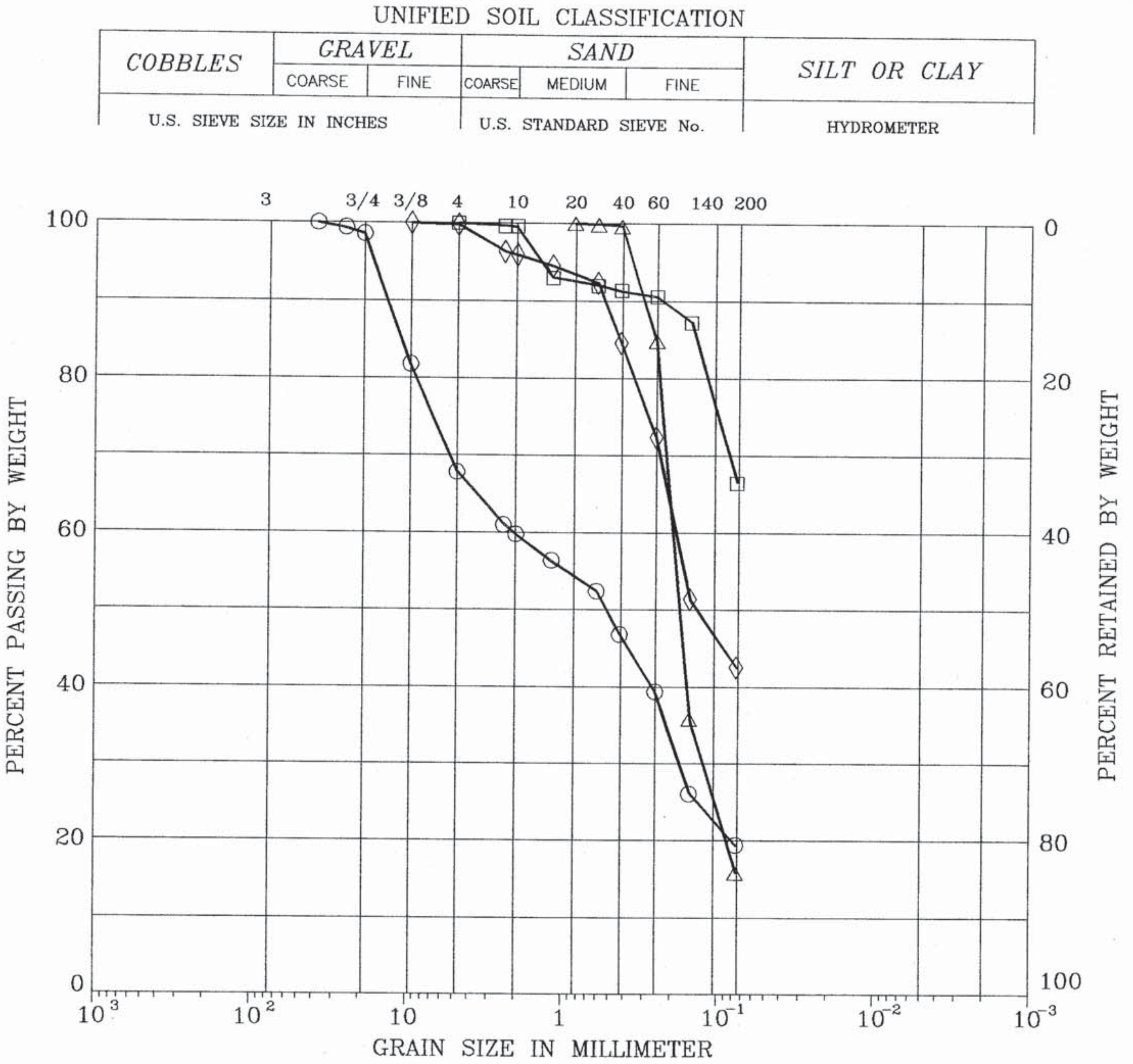
Compaction Procedure: A Specimen Preparation Method: ☒ Moist or ☐ Dry



Sample No.	Sample Type	Depth (ft)	OPT. WC (%)	MAX. DUW (pcf)	%ROCK %	ROCK CORR. (pcf)	Description and/or Classification
H-20 #1	Bulk	3-5	11.3	122.0			Lean clay (CL)

NORTH CITY WATER RECLAMATION PLANT EXPANSION
SAN DIEGO, CALIFORNIA

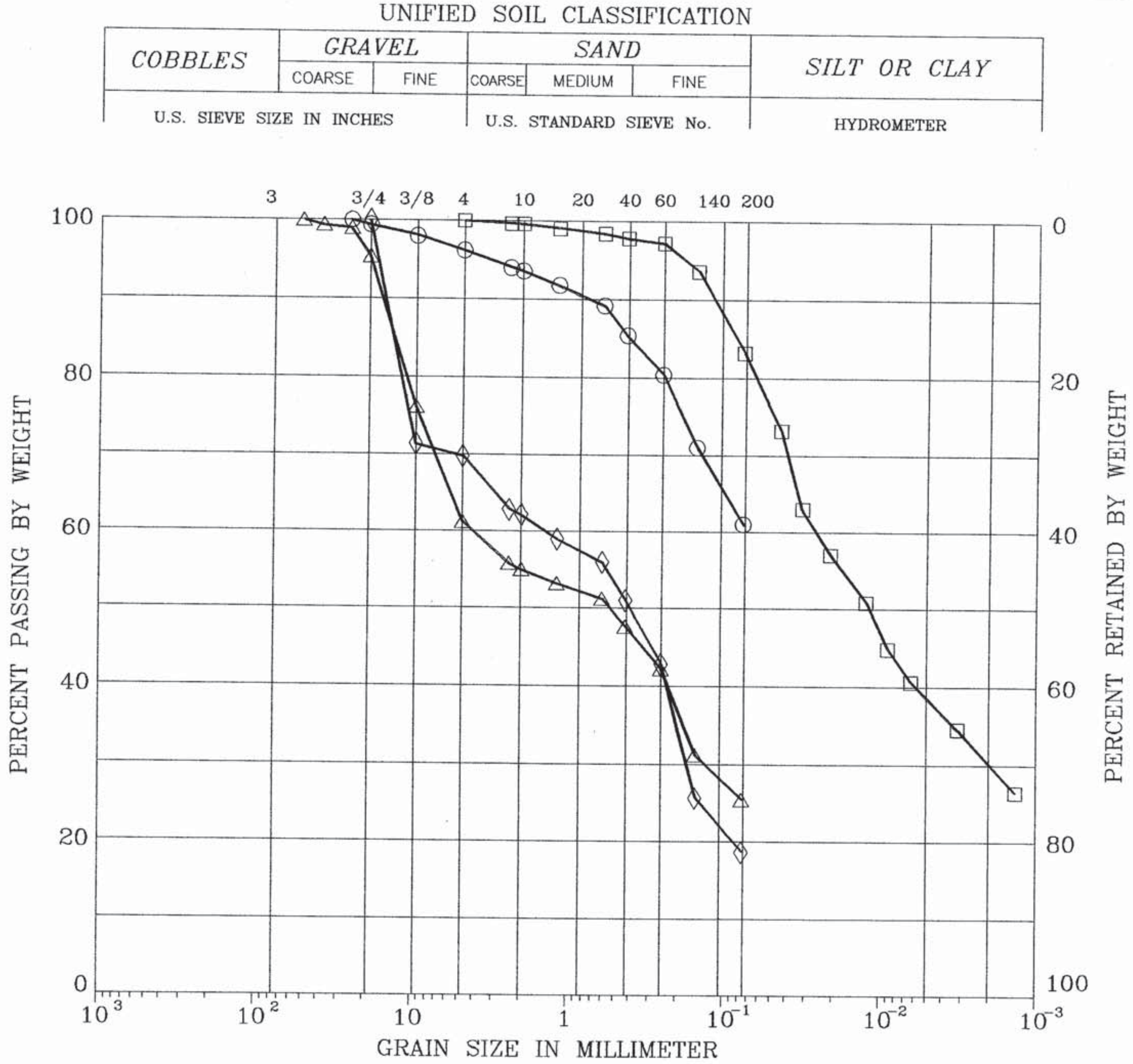
PROJECT NO. 44 F1	**ALLIED GEOTECHNICAL ENGINEERS, INC.**	**FIGURE B-16**



SYMBOL	BORING	DEPTH (ft)	LL (%)	PI (%)	DESCRIPTION
○	H-2 #3	11-15			SILTY SAND (SM)
□	H-3 #8	41-41.5			CLAYS (CH)
△	H-3 #13	65.5-66			SILTY SAND (SM)
◇	H-4 #1	3-6			SILTY SAND (SM)

Remark :

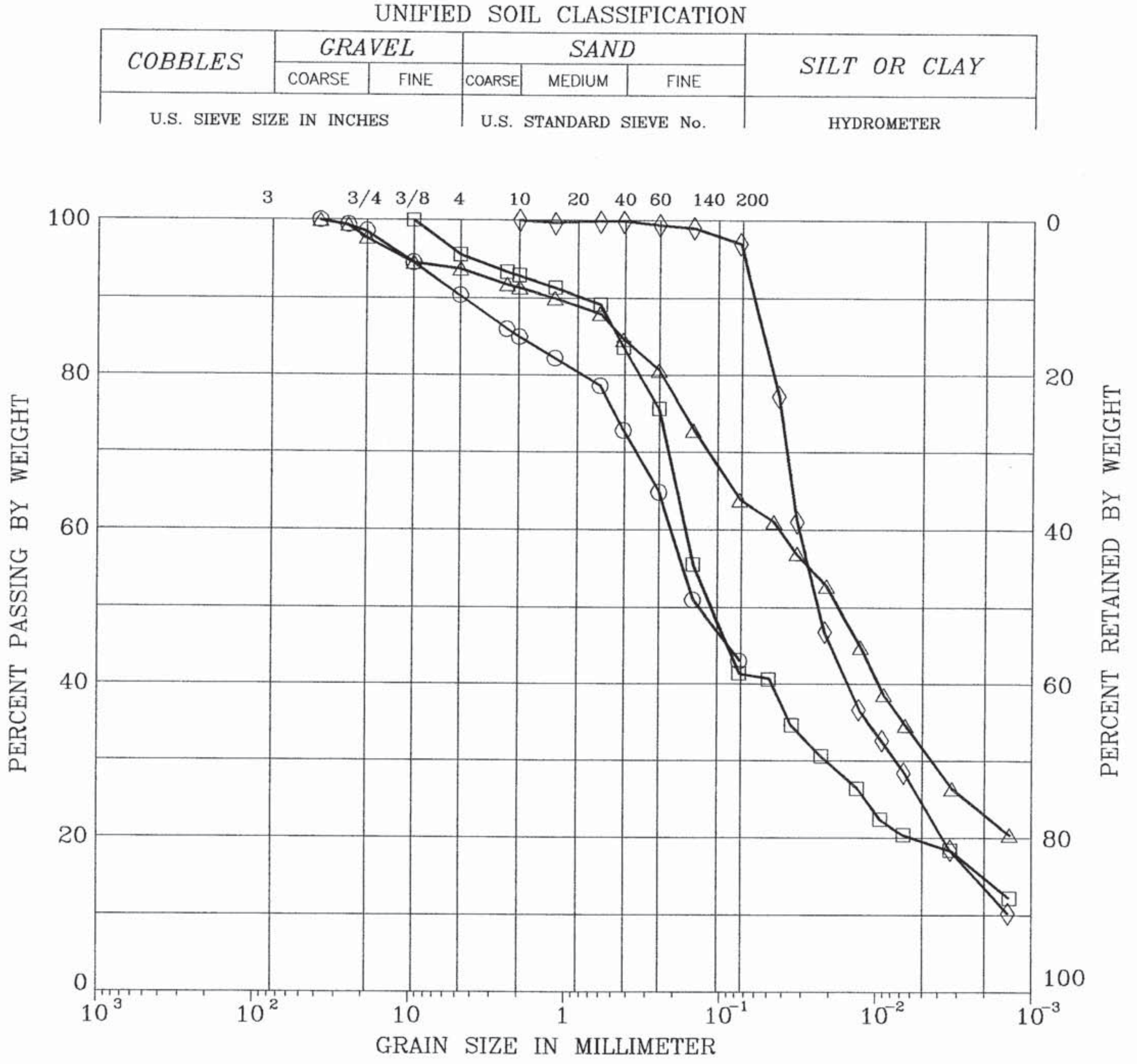
Project No. 44F1	NORTH CITY WATER RECLAMATION PLANT EXPANSION
ALLIED GEOTECHNICAL ENGINEERS, INC.	GRAIN SIZE DISTRIBUTION Figure B-17



SYMBOL	BORING	DEPTH (ft)	LL (%)	PI (%)	DESCRIPTION
○	H-5 #2	4-7			CLAYS (CH)
□	H-5 #10	30-35	35	20	CLAYS (CL)
△	H-7 #2	5-8			SILTY GRAVEL (GM)
◇	H-7 #3	10-10.5			SILTY SAND (SM)

Remark :

Project No. 44F1	NORTH CITY WATER RECLAMATION PLANT EXPANSION
ALLIED GEOTECHNICAL ENGINEERS, INC.	GRAIN SIZE DISTRIBUTION Figure B-18



SYMBOL	BORING	DEPTH (ft)	LL (%)	PI (%)	DESCRIPTION
○	H-8 #1	4-7			SILTY SAND (SM)
□	H-8 #8	31-31.5			SILTY SAND (SM)
△	H-9 #2	9-12			CLAYS (CL)
◇	H-9 #19	75-76			CLAYS (CL)

Remark :

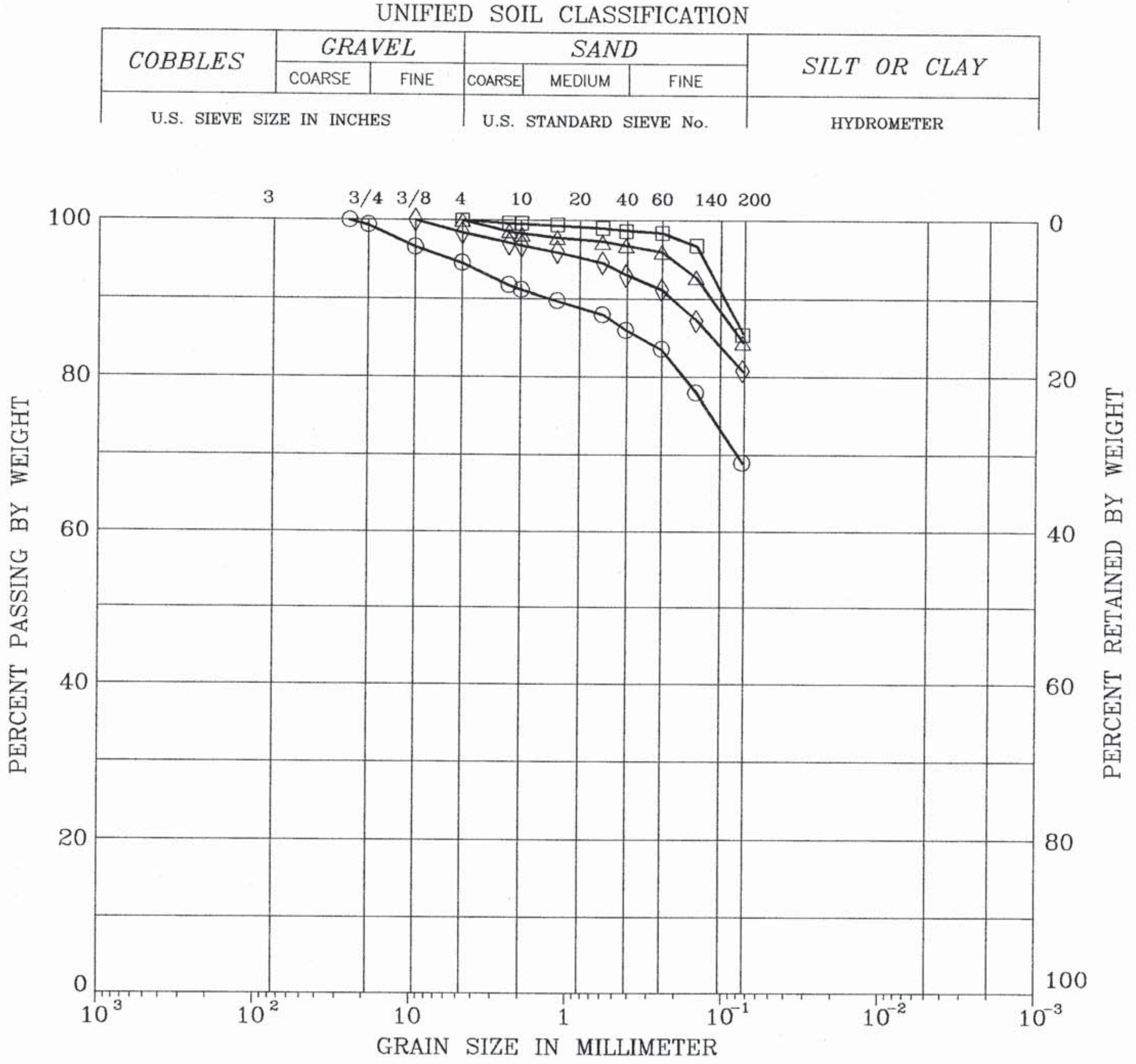
Project No. 44F1

NORTH CITY WATER RECLAMATION PLANT EXPANSION

ALLIED GEOTECHNICAL ENGINEERS, INC.

GRAIN SIZE DISTRIBUTION

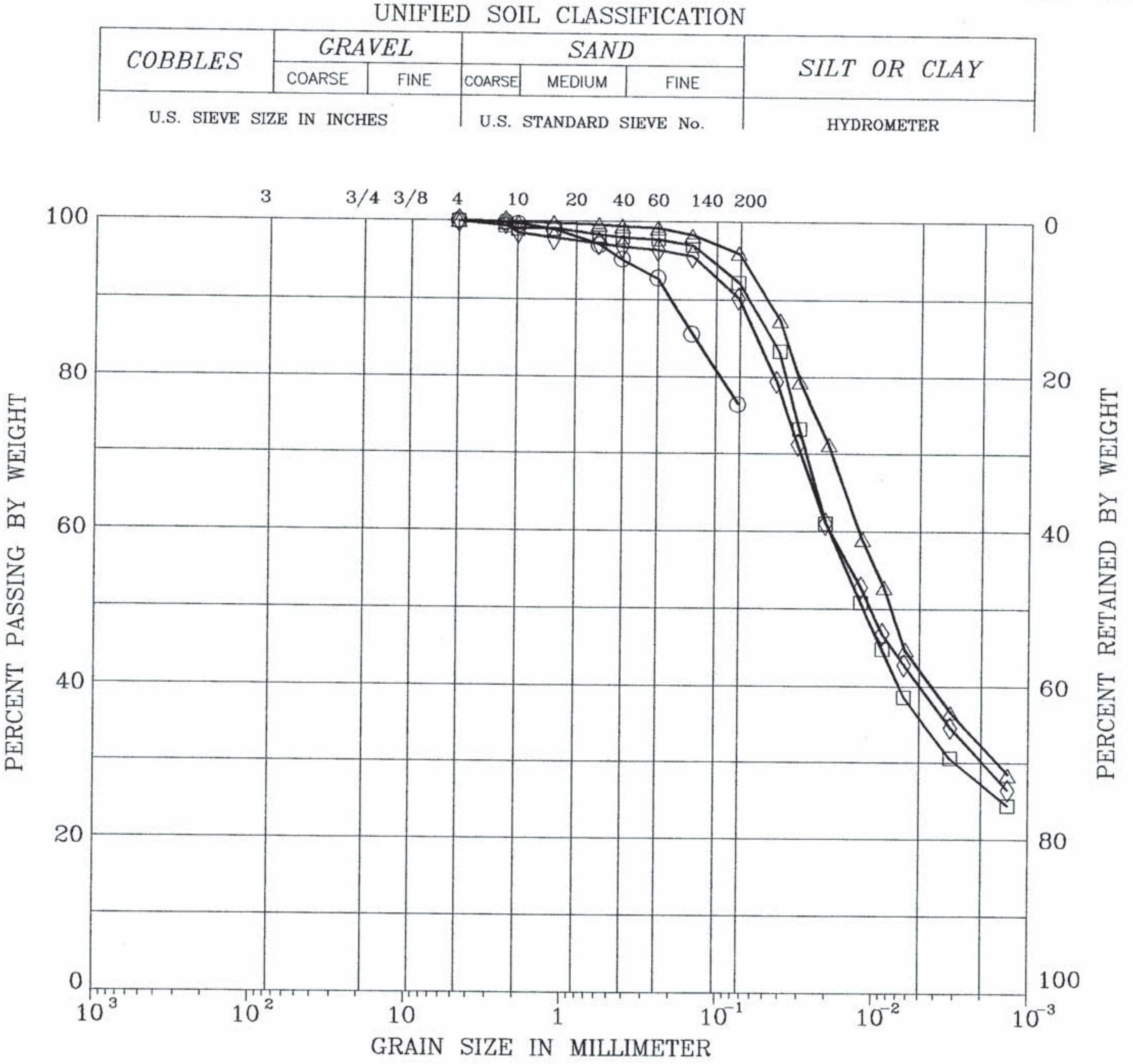
Figure B-19



SYMBOL	BORING	DEPTH (ft)	LL (%)	PI (%)	DESCRIPTION
○	H-10 #1	3-7			CLAYS (CL)
□	H-11 #6	21-24	43	27	CLAYS (CL)
△	H-11 #2	11-11.5			CLAYS (CL)
◇	H-12 #7	21-24			CLAYS (CL)

Remark :

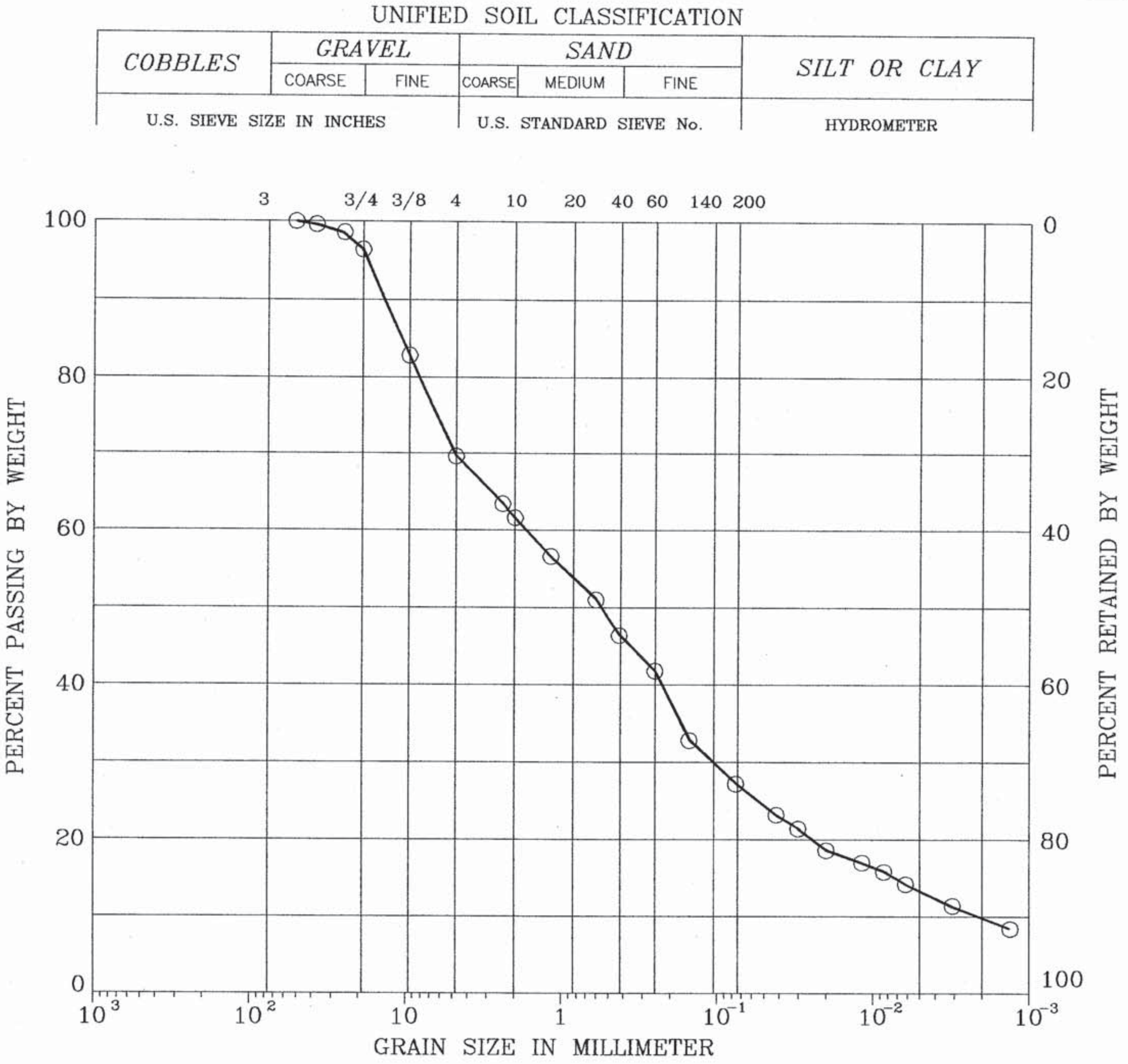
Project No. 44F1	NORTH CITY WATER RECLAMATION PLANT EXPANSION
ALLIED GEOTECHNICAL ENGINEERS, INC.	GRAIN SIZE DISTRIBUTION Figure B-20



SYMBOL	BORING	DEPTH (ft)	LL (%)	PI (%)	DESCRIPTION
○	H-16 #1	6-6.5	50	18	SILTS (ML)
□	H-15 #2	4-7	57	32	CLAYS (CH)
△	H-17 #3	7-10	42	25	CLAYS (CL)
◇	H-20 #1	3-5	41	23	CLAYS (CL)

Remark :

Project No. 44F1	NORTH CITY WATER RECLAMATION PLANT EXPANSION
ALLIED GEOTECHNICAL ENGINEERS, INC.	GRAIN SIZE DISTRIBUTION Figure B-21



SYMBOL	BORING	DEPTH (ft)	LL (%)	PI (%)	DESCRIPTION
○	H-21 #1	4-7			SILTY SAND (SM)

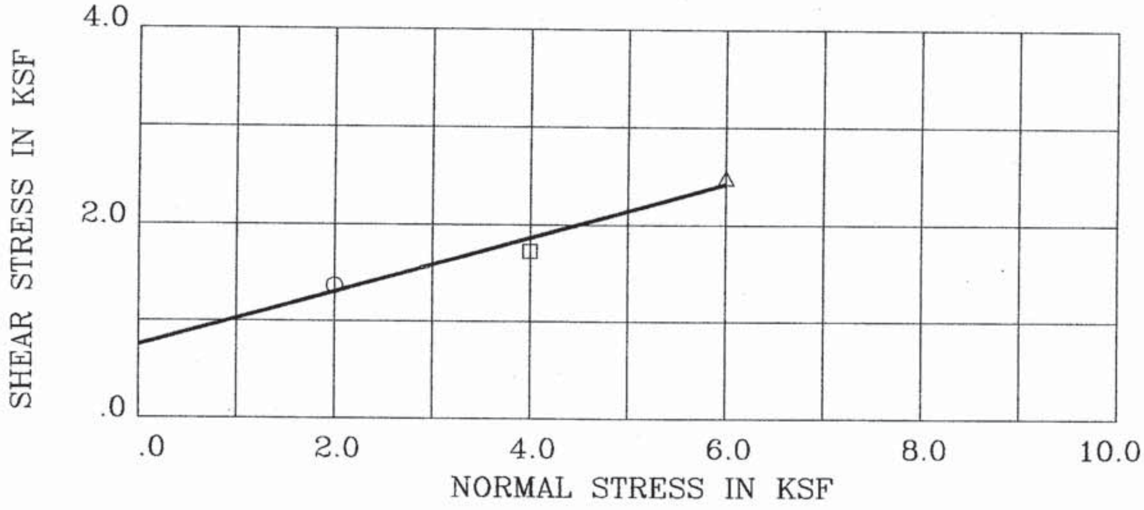
Remark :

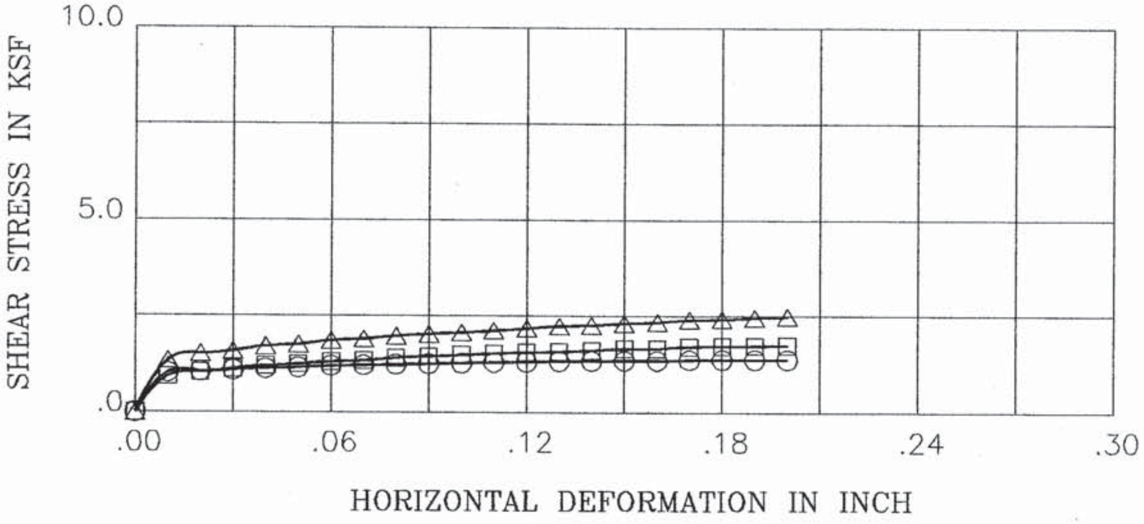
Project 44F1

NORTH CITY WATER RECLAMATION PLANT EXPANSION

ALLIED GEOTECHNICAL ENGINEERS, INC.

GRAIN SIZE DISTRIBUTION Figure B-22





BORING/SAMPLE : H-1 #1 DEPTH (ft) : 1-4
DESCRIPTION : Silty/clayey sand (SM/SC)
STRENGTH INTERCEPT (C) : .750 KSF
FRICTION ANGLE (PHI) : 15.6 DEG
(PEAK STRENGTH)

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	VOID RATIO	NORMAL STRESS (ksf)	PEAK SHEAR (ksf)	RESIDUAL SHEAR (ksf)
○	9.7	110.8	.465	2.00	1.37	1.37
□	9.7	110.8	.464	4.00	1.73	1.73
△	9.1	110.4	.469	6.00	2.48	2.48

Remark :

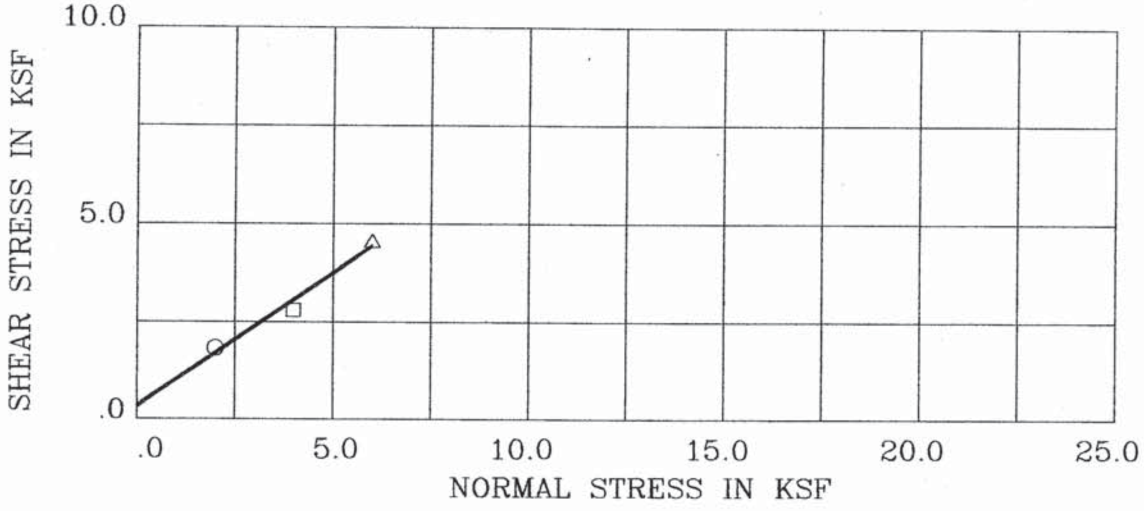
Project No. 44F1

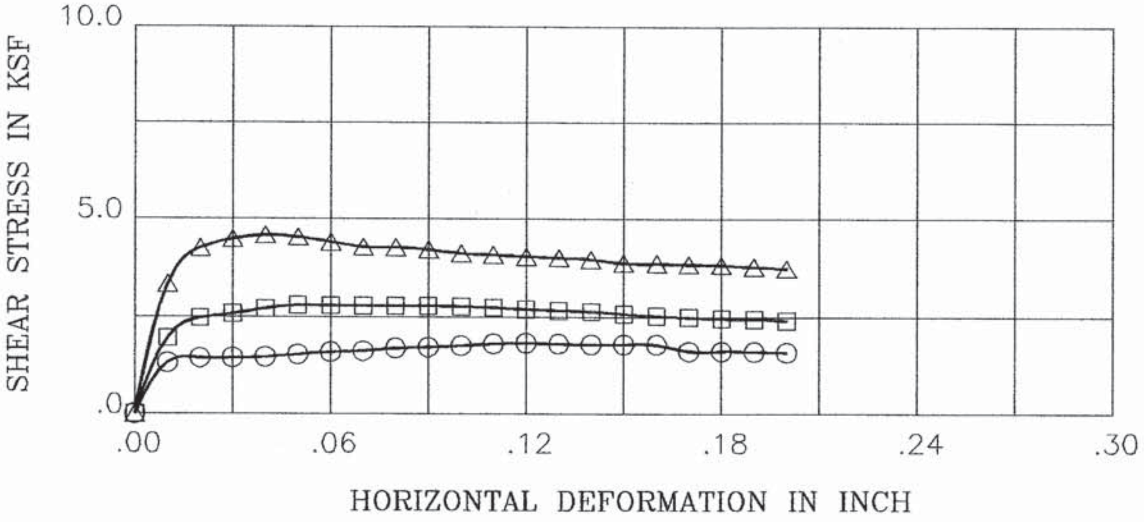
NORTH CITY WATER RECLAMATION PLANT EXPANSION

ALLIED GEOTECHNICAL ENGINEERS, INC.

DIRECT SHEAR TEST

Figure B-23





BORING/SAMPLE : H-1 #5 DEPTH (ft) : 16-16.5

DESCRIPTION : Lean clay (CL)

STRENGTH INTERCEPT (C) : .330 KSF

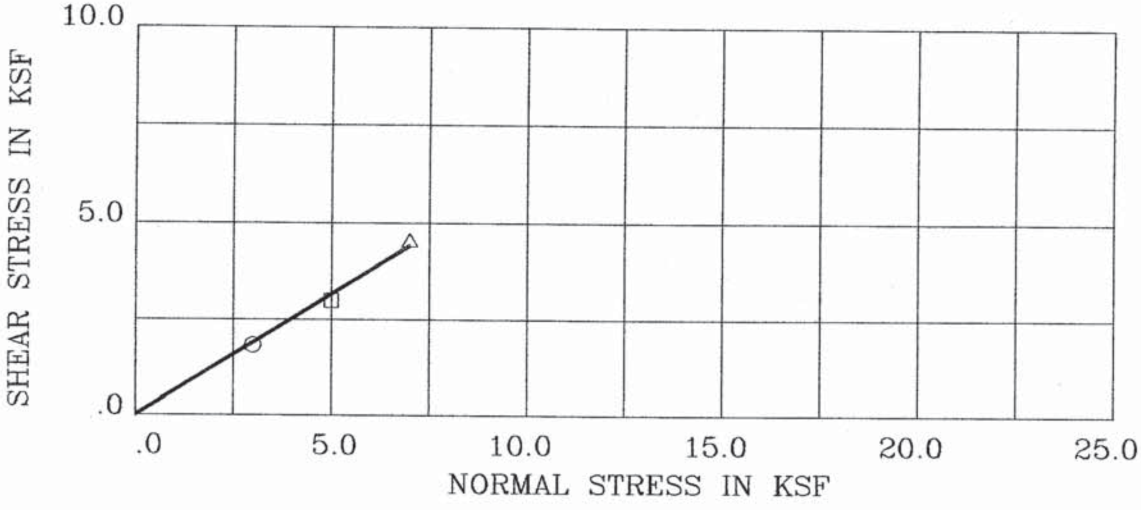
FRICTION ANGLE (PHI) : 34.4 DEG

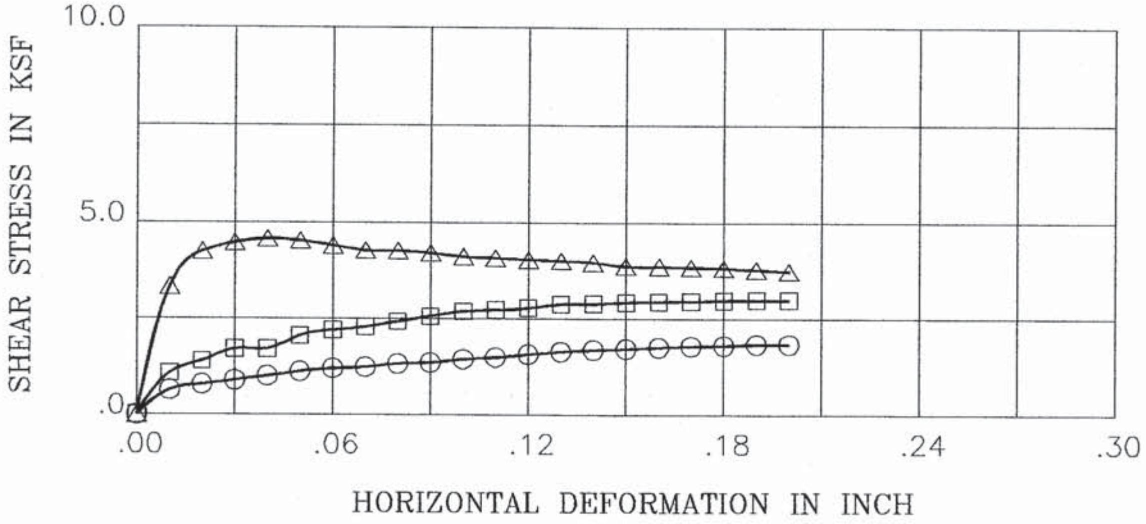
(PEAK STRENGTH)

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	VOID RATIO	NORMAL STRESS (ksf)	PEAK SHEAR (ksf)	RESIDUAL SHEAR (ksf)
○	19.8	100.4	.617	2.00	1.83	1.60
□	20.9	98.5	.646	4.00	2.80	2.41
△	19.5	105.2	.543	6.00	4.57	3.75

Remark :

Project No. 44F1	NORTH CITY WATER RECLAMATION PLANT EXPANSION
ALLIED GEOTECHNICAL ENGINEERS, INC.	DIRECT SHEAR TEST Figure B-24





BORING/SAMPLE : H-2 #2 DEPTH (ft) : 11-11.5
DESCRIPTION : Silty/clayey sand (SM/SC)
STRENGTH INTERCEPT (C) : .000 KSF
FRICTION ANGLE (PHI) : 32.3 DEG (PEAK STRENGTH)

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	VOID RATIO	NORMAL STRESS (ksf)	PEAK SHEAR (ksf)	RESIDUAL SHEAR (ksf)
○	21.0	98.0	.655	3.00	1.84	1.83
□	23.1	99.4	.632	5.00	3.00	3.00
△	18.9	104.3	.555	7.00	4.57	3.75

Remark :

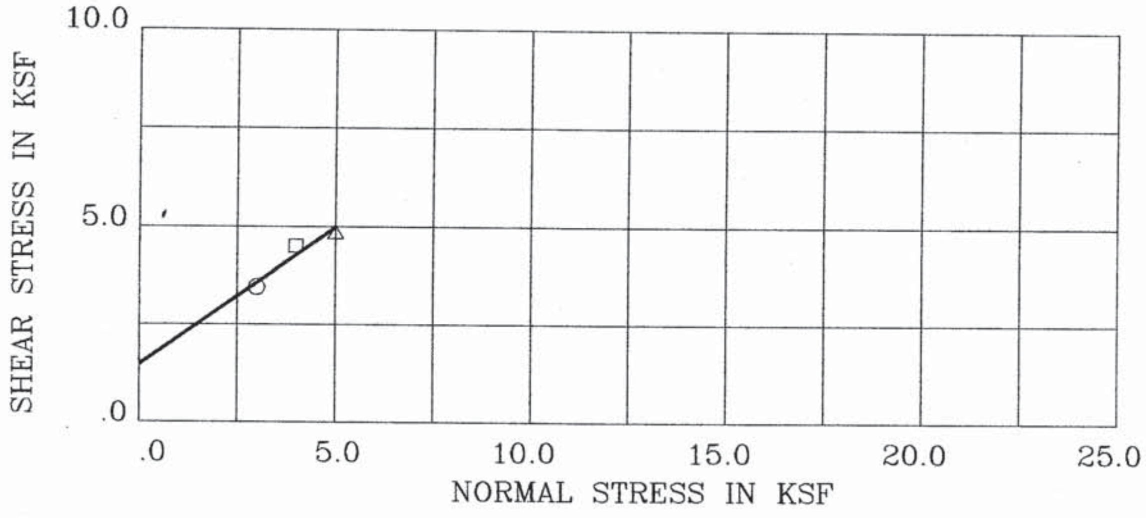
Project No. 44F1

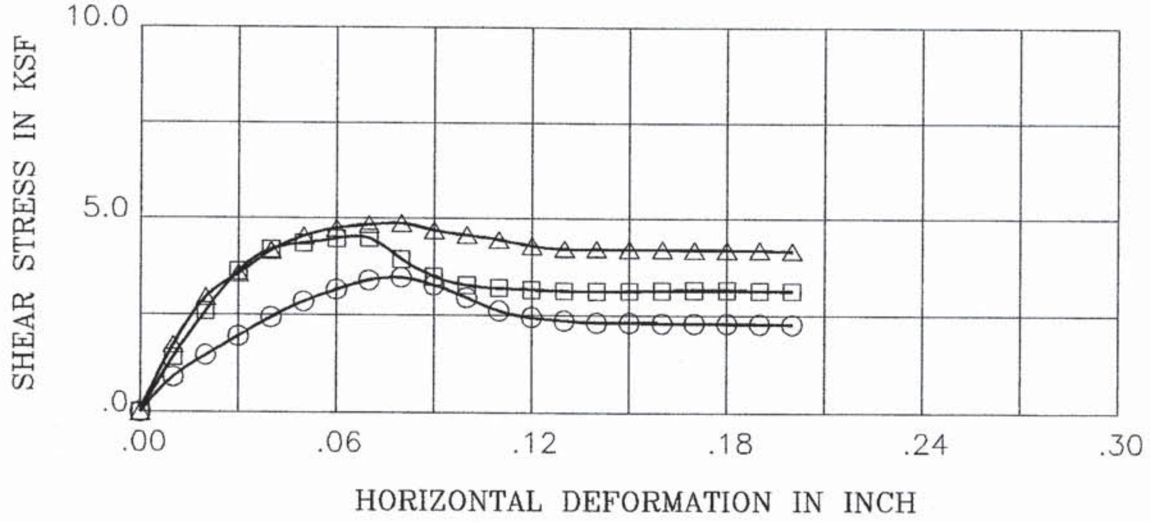
NORTH CITY WATER RECLAMATION PLANT EXPANSION

ALLIED GEOTECHNICAL
ENGINEERS, INC.

DIRECT SHEAR TEST

Figure B-25



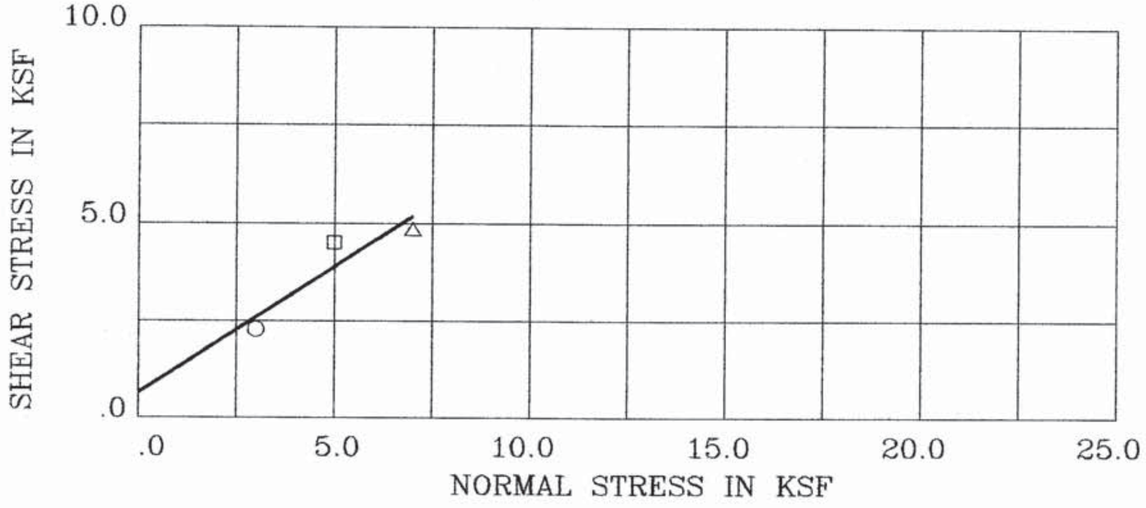


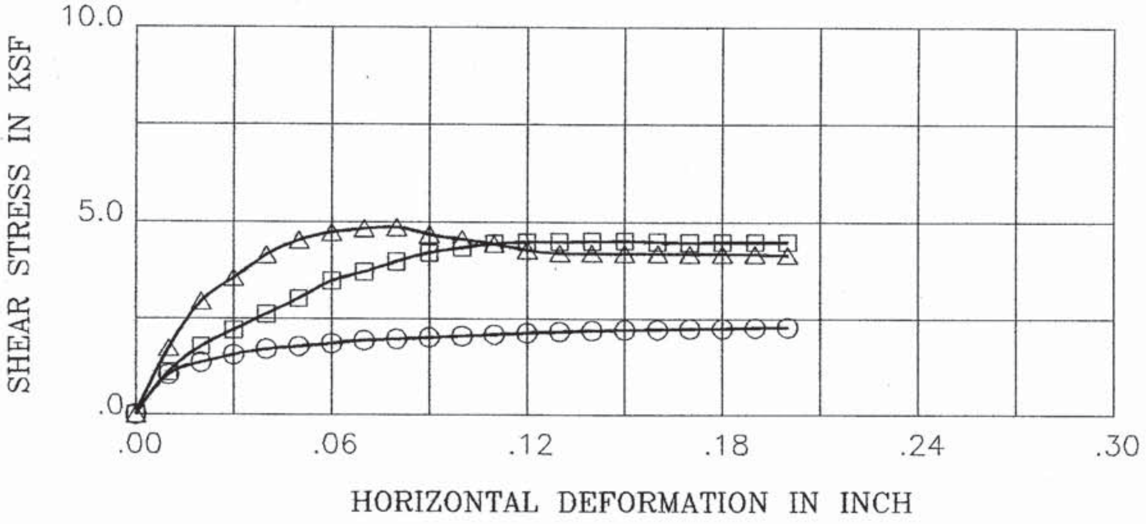
BORING/SAMPLE : H–4 #2 DEPTH (ft) : 5–6
DESCRIPTION : Silty sand (SM) w/ gravel
STRENGTH INTERCEPT (C) : 1.468 KSF
FRICTION ANGLE (PHI) : 35.2 DEG
(PEAK STRENGTH)

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	VOID RATIO	NORMAL STRESS (ksf)	PEAK SHEAR (ksf)	RESIDUAL SHEAR (ksf)
○	13.3	104.7	.549	3.00	3.47	2.28
□	12.8	106.4	.525	4.00	4.53	3.11
△	14.1	107.8	.505	5.00	4.88	4.16

Remark :

Project No. 44F1	NORTH CITY WATER RECLAMATION PLANT EXPANSION
ALLIED GEOTECHNICAL ENGINEERS, INC.	DIRECT SHEAR TEST Figure B–26





BORING/SAMPLE : H-5 #1 DEPTH (ft) : 6-6.5
DESCRIPTION : Sandy clay (CL)
STRENGTH INTERCEPT (C) : .657 KSF
FRICTION ANGLE (PHI) : 32.9 DEG
(PEAK STRENGTH)

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	VOID RATIO	NORMAL STRESS (ksf)	PEAK SHEAR (ksf)	RESIDUAL SHEAR (ksf)
○	20.2	102.8	.578	3.00	2.29	2.29
□	20.9	103.3	.571	5.00	4.52	4.48
△	17.5	98.5	.648	7.00	4.88	4.16

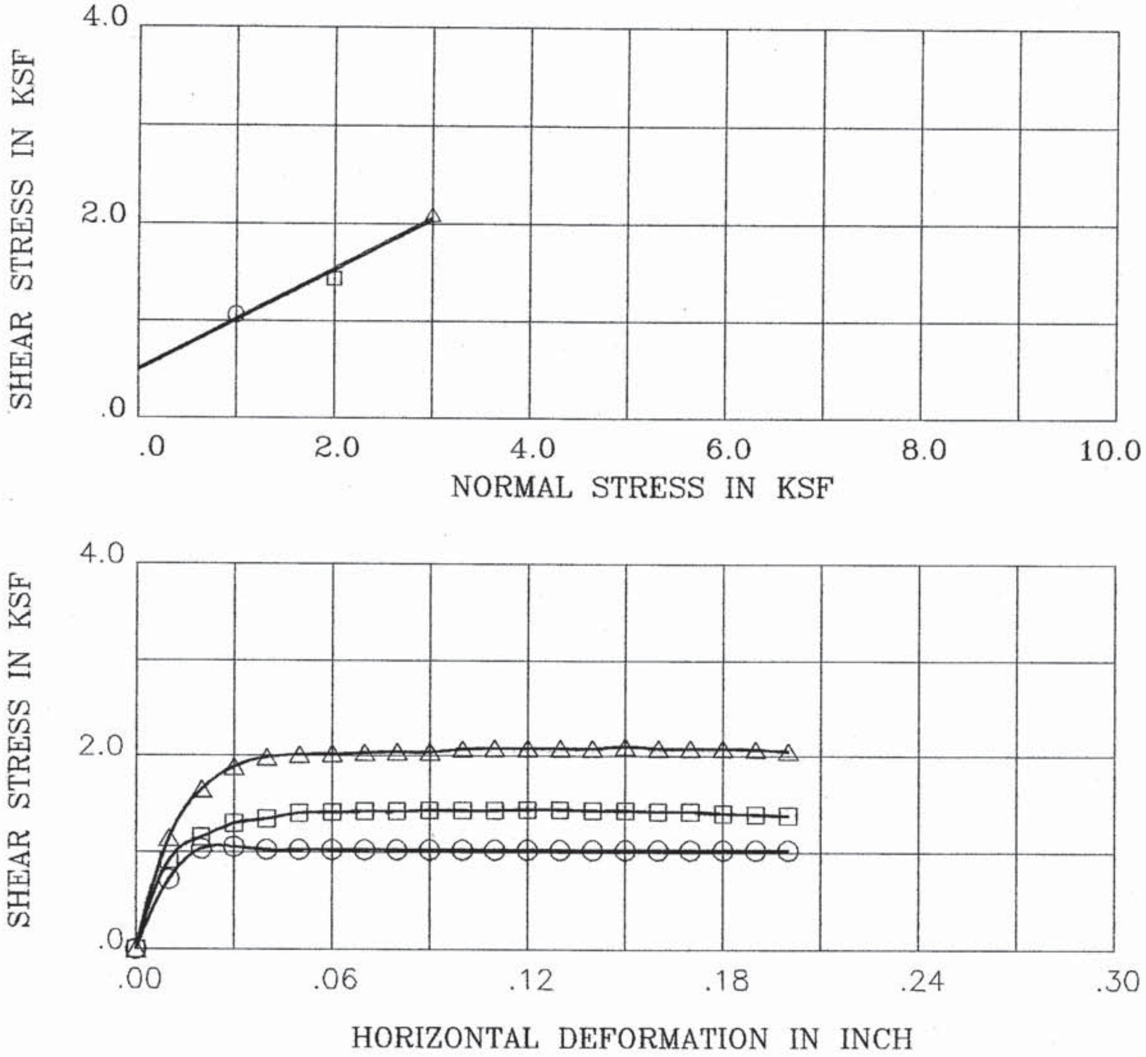
Remark :

Project No. 44F1
NORTH CITY WATER RECLAMATION PLANT EXPANSION

ALLIED GEOTECHNICAL ENGINEERS, INC.

DIRECT SHEAR TEST

Figure B-27



BORING/SAMPLE : H–6 #1 DEPTH (ft) : 4–7
DESCRIPTION : Clayey sand (SC)
STRENGTH INTERCEPT (C) : .502 KSF
FRICTION ANGLE (PHI) : 27.3 DEG
(PEAK STRENGTH)

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	VOID RATIO	NORMAL STRESS (ksf)	PEAK SHEAR (ksf)	RESIDUAL SHEAR (ksf)
○	14.8	108.6	.494	1.00	1.07	1.02
□	15.3	108.9	.490	2.00	1.44	1.38
△	15.3	109.5	.482	3.00	2.10	2.05

Remark :

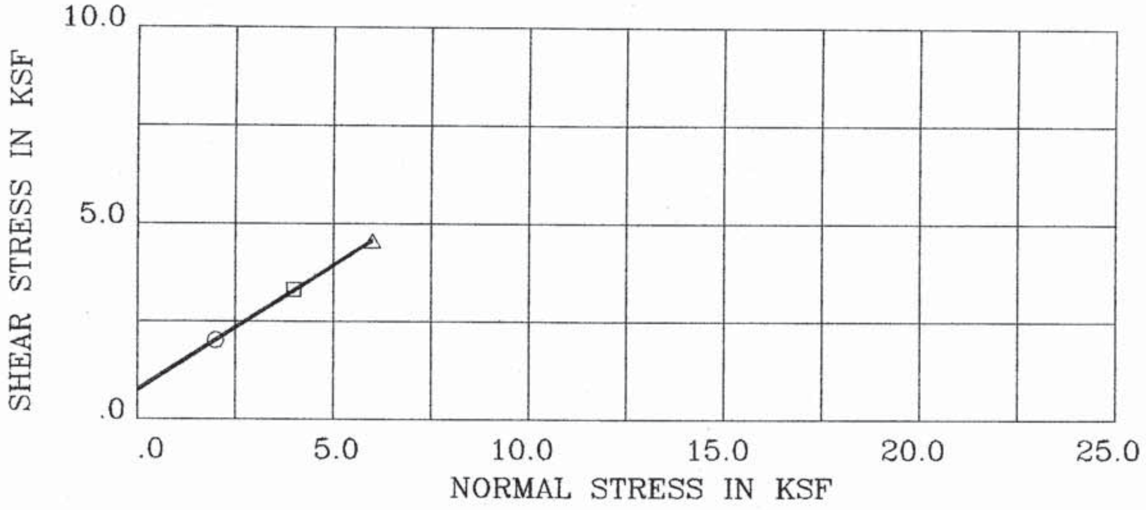
Project No. 44F1

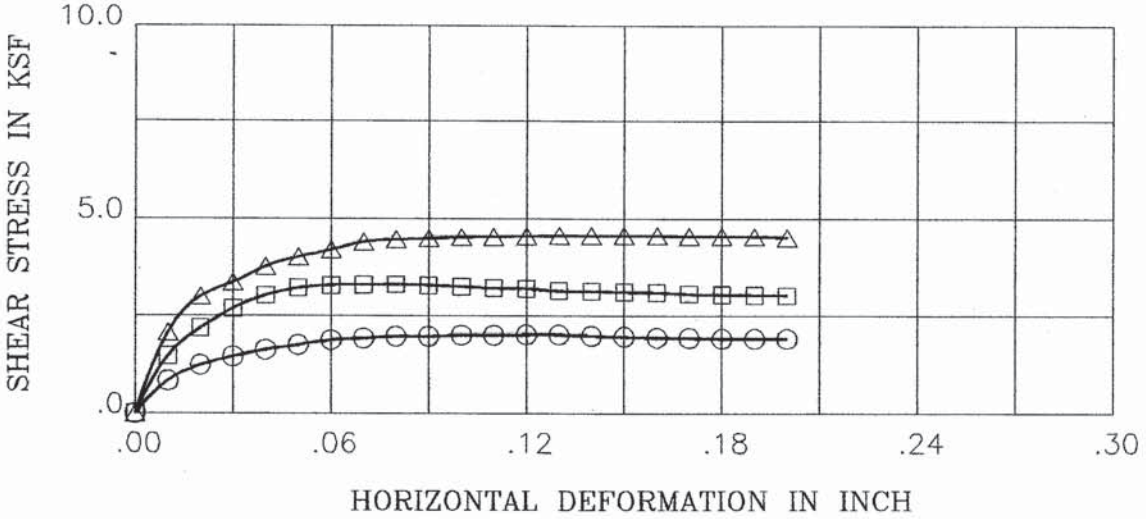
NORTH CITY WATER RECLAMATION PLANT EXPANSION

ALLIED GEOTECHNICAL
ENGINEERS, INC.

DIRECT SHEAR TEST

Figure B–28





BORING/SAMPLE : H-8 #4 DEPTH (ft) : 11-11.5
DESCRIPTION : Silty sand (SM)
STRENGTH INTERCEPT (C) : .747 KSF
FRICTION ANGLE (PHI) : 32.5 DEG
(PEAK STRENGTH)

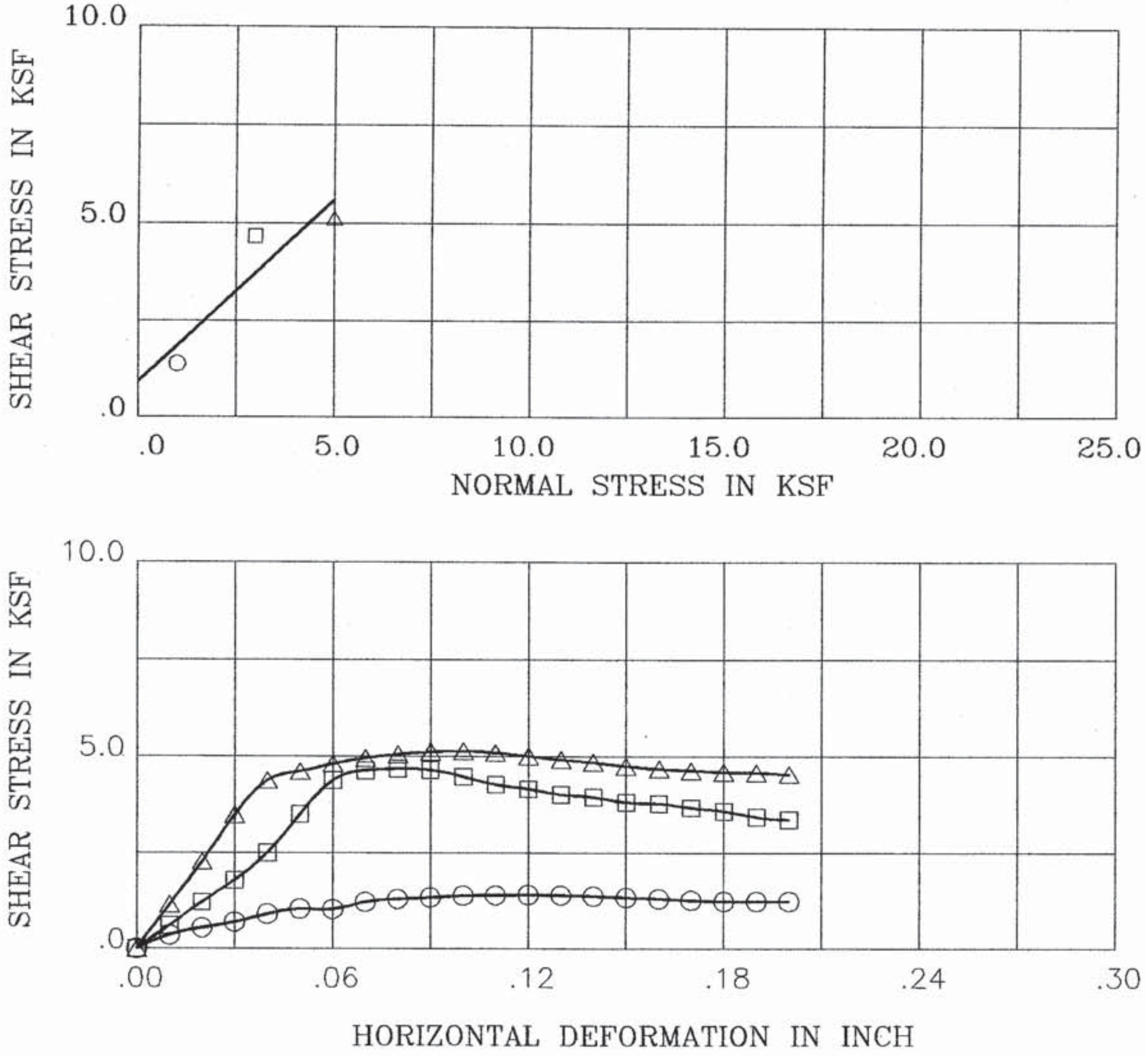
SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	VOID RATIO	NORMAL STRESS (ksf)	PEAK SHEAR (ksf)	RESIDUAL SHEAR (ksf)
○	21.1	100.9	.608	2.00	2.01	1.91
□	21.9	100.5	.614	4.00	3.31	3.03
△	20.9	105.5	.538	6.00	4.56	4.51

Remark :

Project No. 44F1
NORTH CITY WATER RECLAMATION PLANT EXPANSION

ALLIED GEOTECHNICAL ENGINEERS, INC.

DIRECT SHEAR TEST Figure B-29

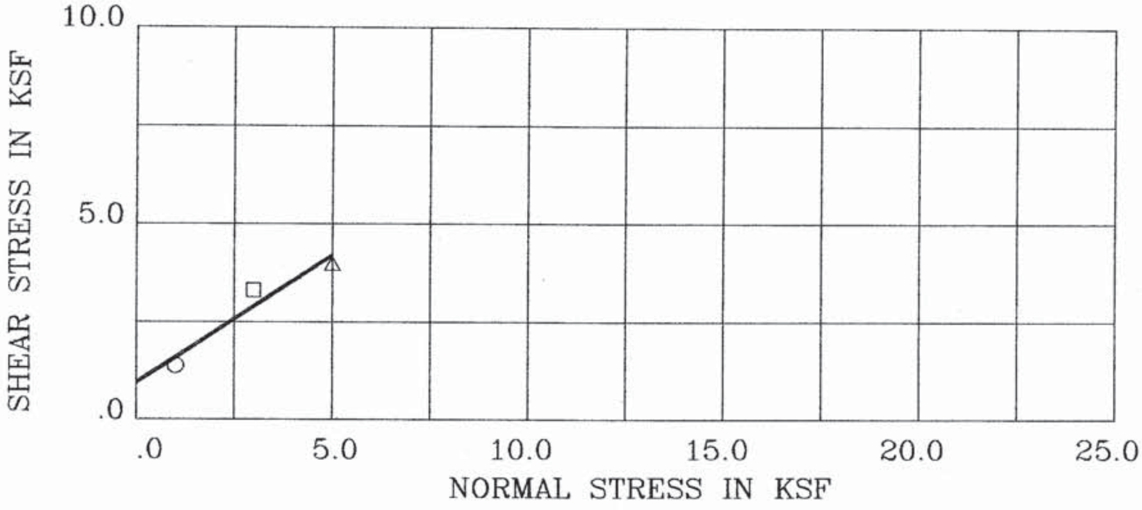


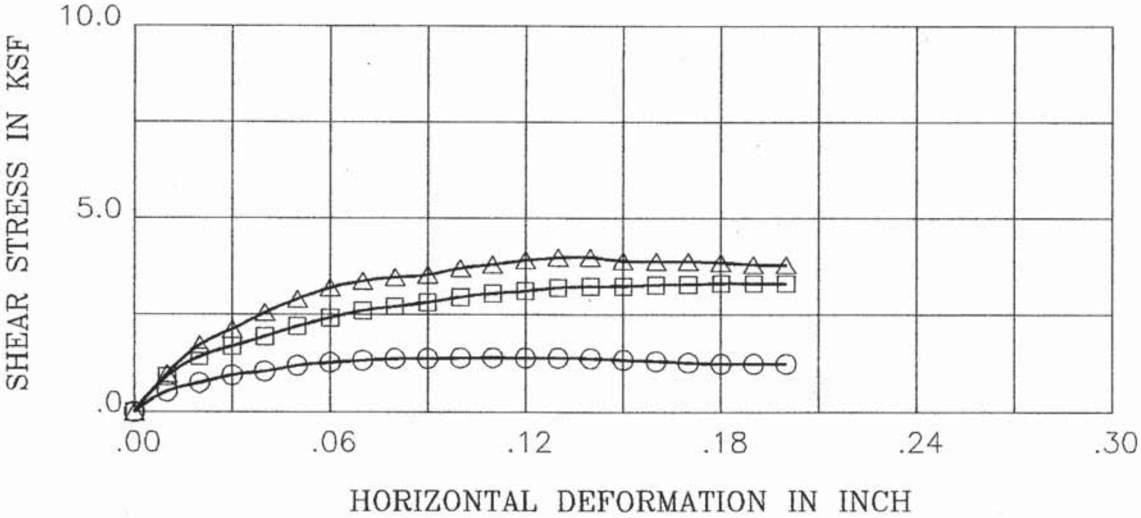
BORING/SAMPLE : H-9 #1 DEPTH (ft) : 6-6.5
DESCRIPTION : Silty sand (SM)
STRENGTH INTERCEPT (C) : .938 KSF
FRICTION ANGLE (PHI) : 43.0 DEG
(PEAK STRENGTH)

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	VOID RATIO	NORMAL STRESS (ksf)	PEAK SHEAR (ksf)	RESIDUAL SHEAR (ksf)
○	24.6	93.6	.734	1.00	1.40	1.23
□	20.5	99.3	.634	3.00	4.68	3.37
△	15.9	105.3	.541	5.00	5.13	4.54

Remark :

Project No. 44F1	NORTH CITY WATER RECLAMATION PLANT EXPANSION
ALLIED GEOTECHNICAL ENGINEERS, INC.	DIRECT SHEAR TEST Figure B-30



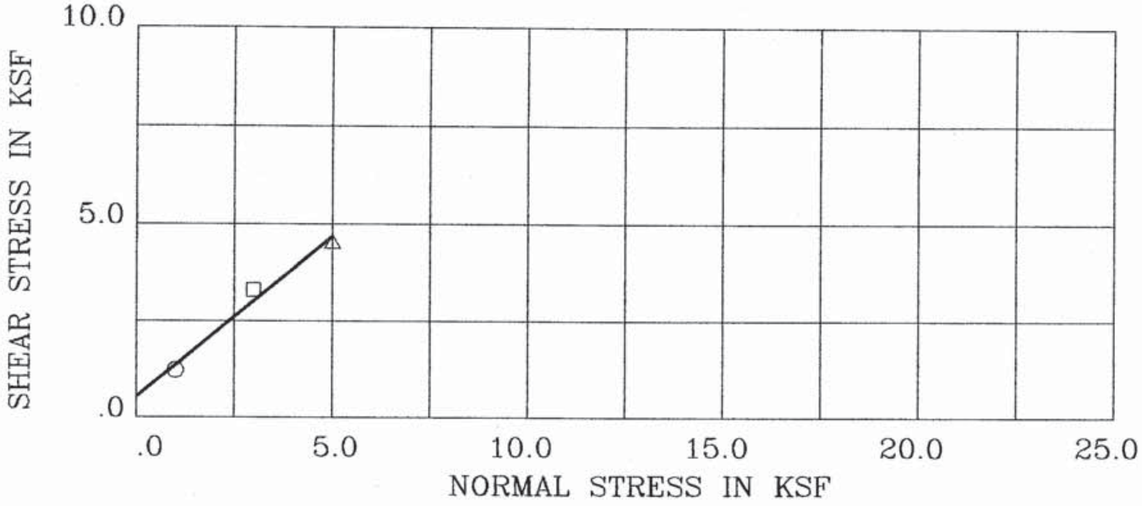


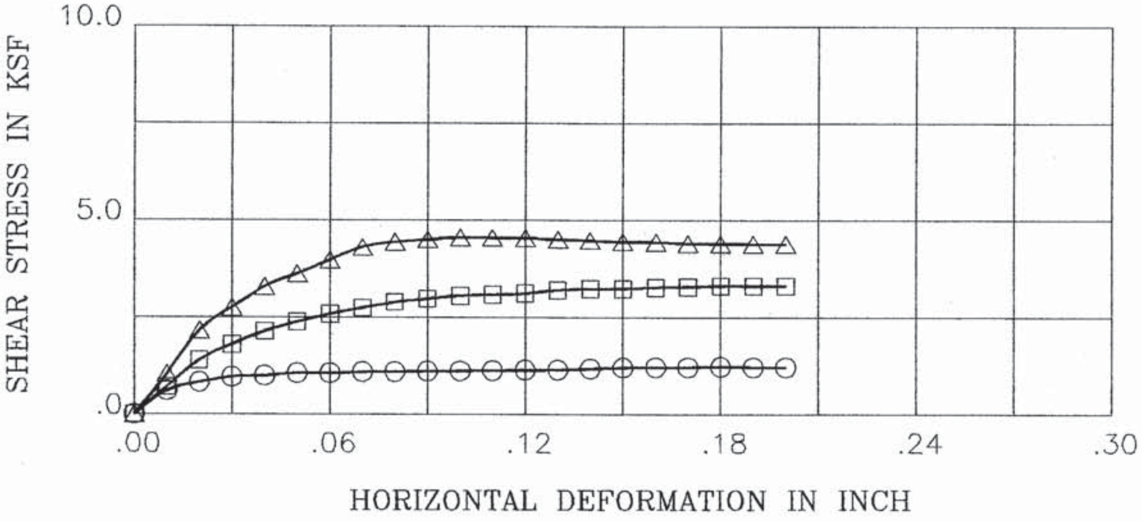
BORING/SAMPLE : H–9 #5 DEPTH (ft) : 16–16.5
DESCRIPTION : Silty sand (SM)
STRENGTH INTERCEPT (C) : .943 KSF
FRICTION ANGLE (PHI) : 33.1 DEG
(PEAK STRENGTH)

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	VOID RATIO	NORMAL STRESS (ksf)	PEAK SHEAR (ksf)	RESIDUAL SHEAR (ksf)
○	25.6	90.5	.792	1.00	1.39	1.23
□	27.5	91.9	.765	3.00	3.31	3.31
△	26.1	93.5	.736	5.00	4.00	3.79

Remark :

Project No. 44F1	NORTH CITY WATER RECLAMATION PLANT EXPANSION
ALLIED GEOTECHNICAL ENGINEERS, INC.	DIRECT SHEAR TEST Figure B–31





BORING/SAMPLE : H-10 #6 DEPTH (ft) : 21-21.5
DESCRIPTION : Claystone (CL)
STRENGTH INTERCEPT (C) : .541 KSF
FRICTION ANGLE (PHI) : 39.7 DEG
(PEAK STRENGTH)

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	VOID RATIO	NORMAL STRESS (ksf)	PEAK SHEAR (ksf)	RESIDUAL SHEAR (ksf)
○	27.0	96.2	.686	1.00	1.23	1.22
□	27.0	95.9	.692	3.00	3.31	3.31
△	25.0	101.3	.602	5.00	4.56	4.38

Remark :

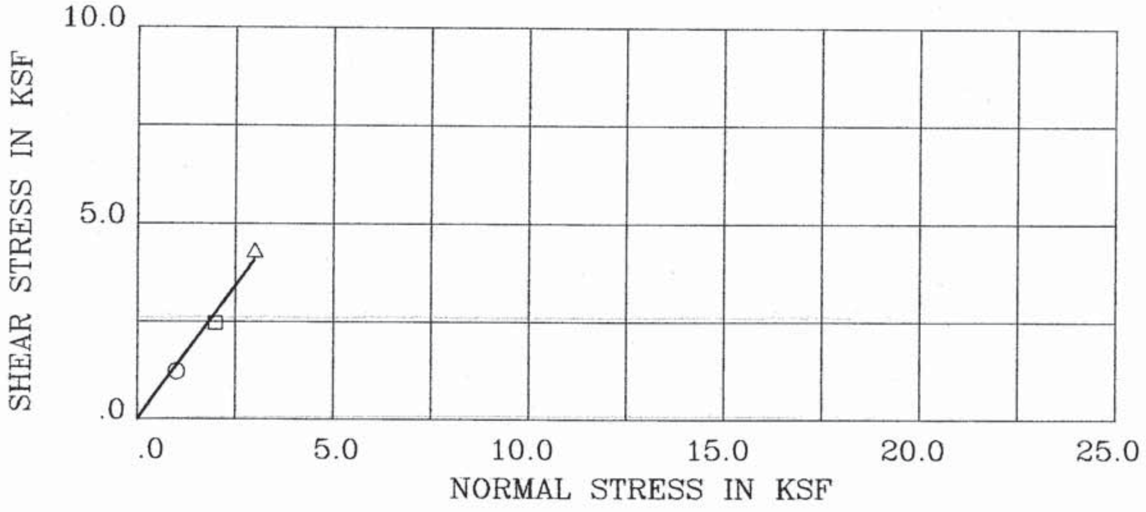
Project No. 44F1

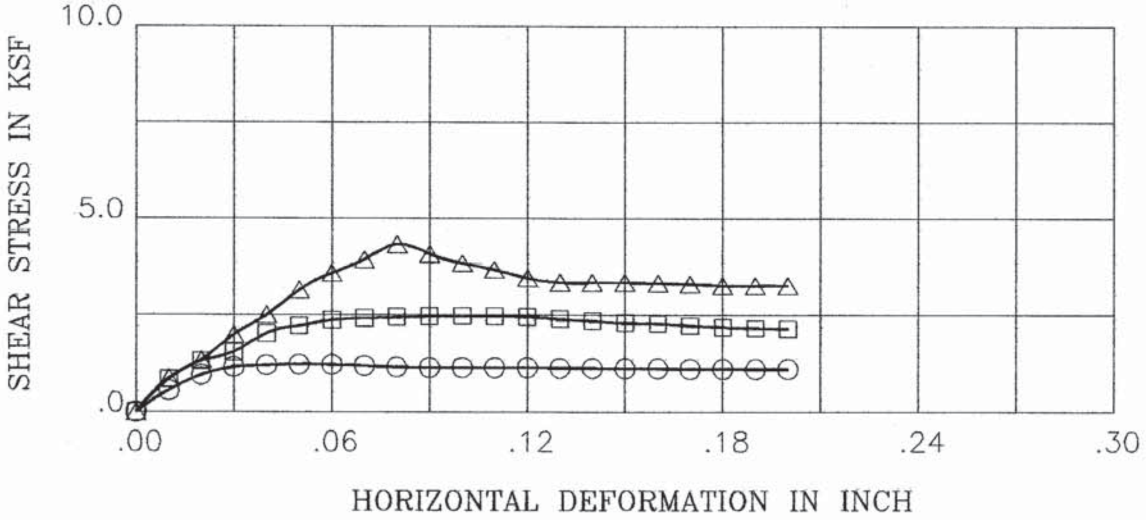
NORTH CITY WATER RECLAMATION PLANT EXPANSION

ALLIED GEOTECHNICAL ENGINEERS, INC.

DIRECT SHEAR TEST

Figure B-32



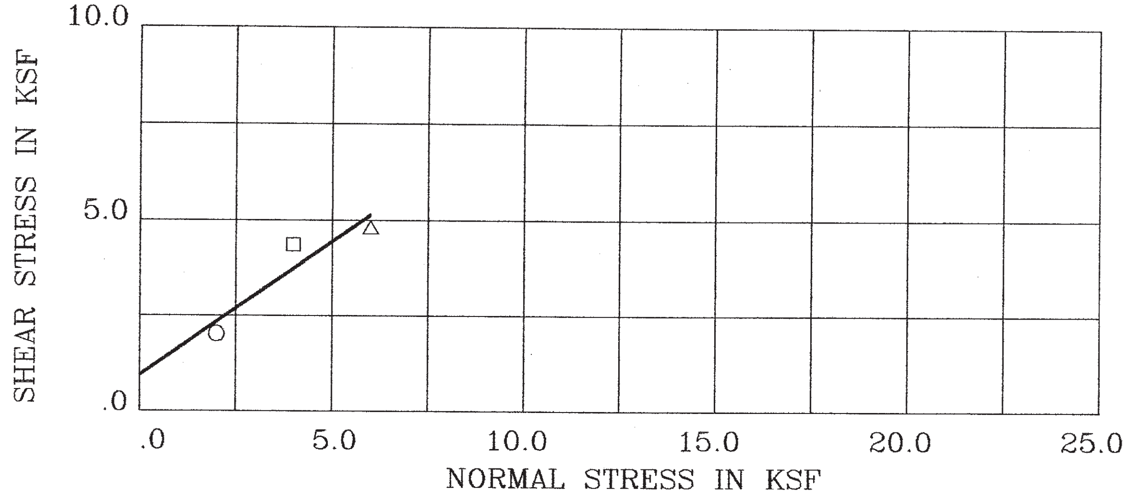


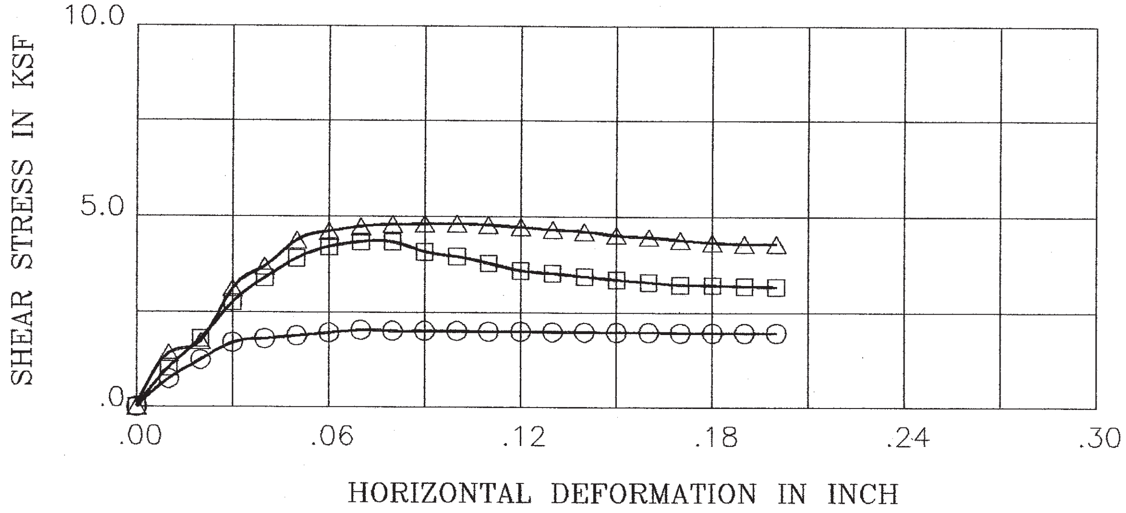
BORING/SAMPLE : H−11 #1 DEPTH (ft) : 6−6.5
DESCRIPTION : Silty sand (SM)
STRENGTH INTERCEPT (C) : .000 KSF
FRICTION ANGLE (PHI) : 53.9 DEG
(PEAK STRENGTH)

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	VOID RATIO	NORMAL STRESS (ksf)	PEAK SHEAR (ksf)	RESIDUAL SHEAR (ksf)
○	23.5	96.4	.683	1.00	1.22	1.09
□	23.4	96.7	.677	2.00	2.47	2.14
△	23.4	100.4	.615	3.00	4.34	3.27

Remark :

Project No. 44F1	NORTH CITY WATER RECLAMATION PLANT EXPANSION
ALLIED GEOTECHNICAL ENGINEERS, INC.	DIRECT SHEAR TEST Figure B−33





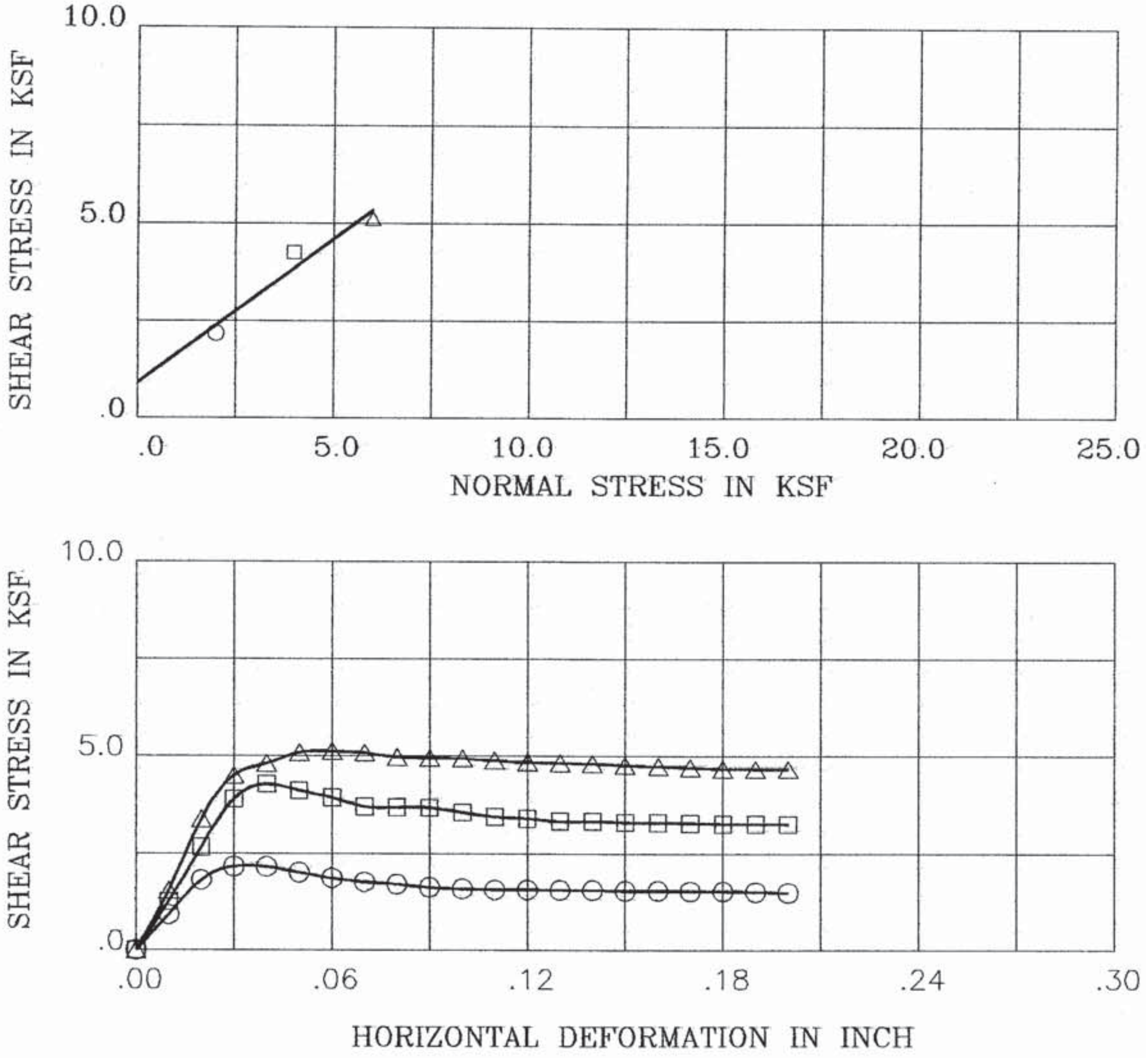
BORING/SAMPLE : H-11 #4 DEPTH (ft) : 16-16.5
DESCRIPTION : Sandy Lean Clay (CL)
STRENGTH INTERCEPT (C) : .954 KSF
FRICTION ANGLE (PHI) : 34.9 DEG

(PEAK STRENGTH)

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	VOID RATIO	NORMAL STRESS (ksf)	PEAK SHEAR (ksf)	RESIDUAL SHEAR (ksf)
○	23.2	99.8	.625	2.00	2.03	1.97
□	25.0	96.1	.688	4.00	4.38	3.18
△	25.3	97.9	.656	6.00	4.82	4.30

Remark :

Project No. 44F1	NORTH CITY WATER RECLAMATION PLANT EXPANSION
ALLIED GEOTECHNICAL ENGINEERS, INC.	DIRECT SHEAR TEST Figure B-34



BORING/SAMPLE : H-11 #9 DEPTH (ft) : 35.5-36

DESCRIPTION : Silty sandstone (SM)

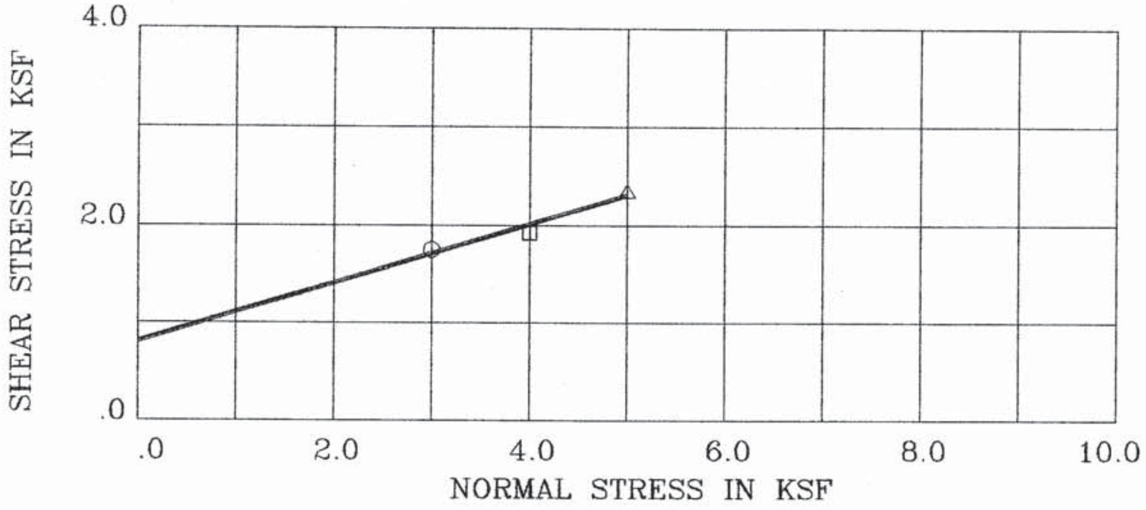
STRENGTH INTERCEPT (C) : .927 KSF (PEAK STRENGTH)

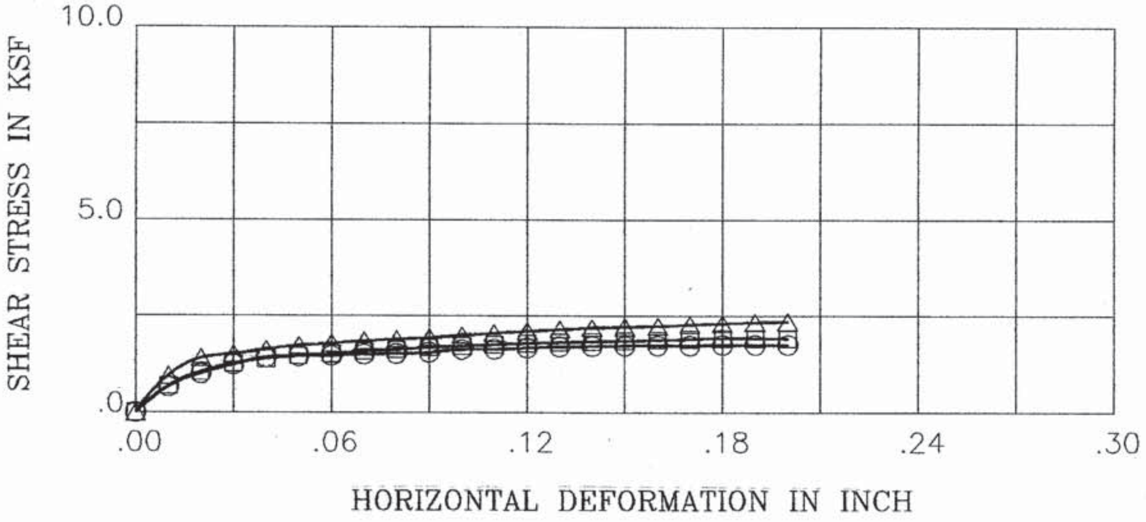
FRICTION ANGLE (PHI) : 36.3 DEG

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	VOID RATIO	NORMAL STRESS (ksf)	PEAK SHEAR (ksf)	RESIDUAL SHEAR (ksf)
○	19.5	103.9	.562	2.00	2.19	1.50
□	18.9	101.0	.606	4.00	4.28	3.26
△	19.1	109.1	.487	6.00	5.13	4.66

Remark :

Project No. 44F1	NORTH CITY WATER RECLAMATION PLANT EXPANSION
ALLIED GEOTECHNICAL ENGINEERS, INC.	DIRECT SHEAR TEST Figure B-35



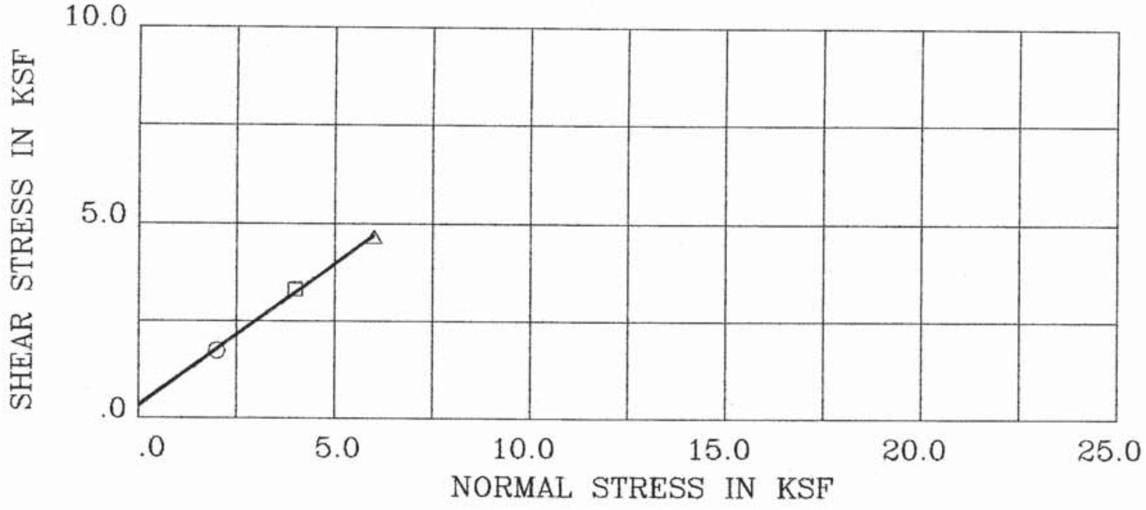


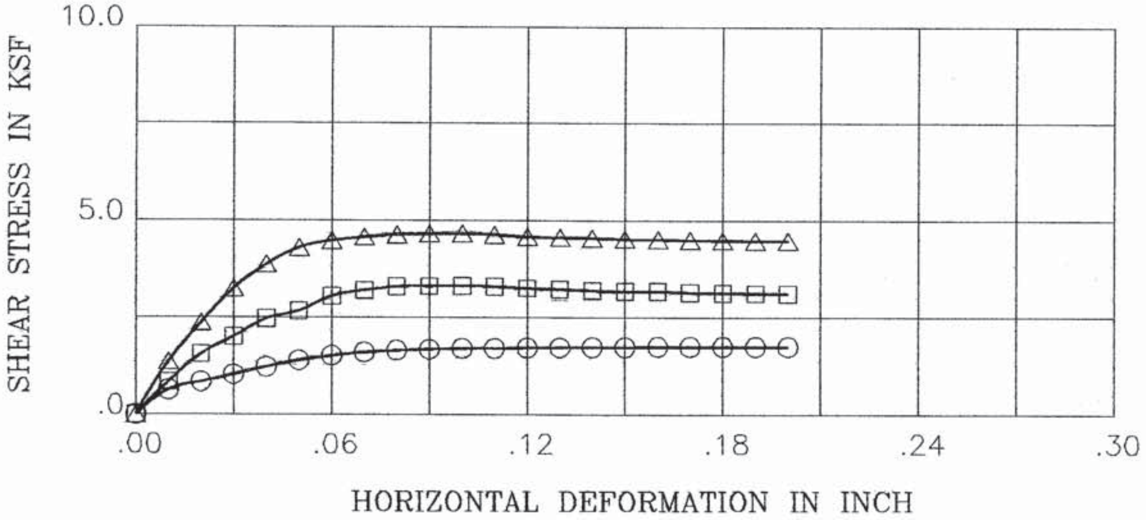
BORING/SAMPLE : H-12 #7 DEPTH (ft) : 21-24
DESCRIPTION : Silty sandstone (SM)
STRENGTH INTERCEPT (C) : .812 KSF
FRICTION ANGLE (PHI) : 16.7 DEG
(PEAK STRENGTH)

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	VOID RATIO	NORMAL STRESS (ksf)	PEAK SHEAR (ksf)	RESIDUAL SHEAR (ksf)
○	13.3	107.7	.506	3.00	1.76	1.75
□	13.8	108.1	.501	4.00	1.92	1.91
△	12.9	107.5	.509	5.00	2.36	2.36

Remark :

Project No. 44F1	NORTH CITY WATER RECLAMATION PLANT EXPANSION
ALLIED GEOTECHNICAL ENGINEERS, INC.	DIRECT SHEAR TEST Figure B-36



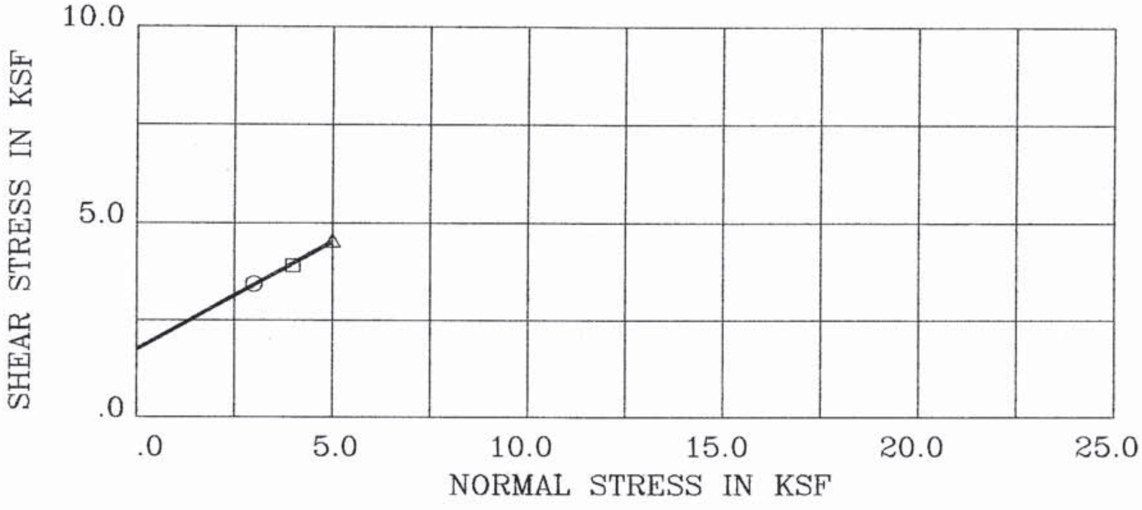


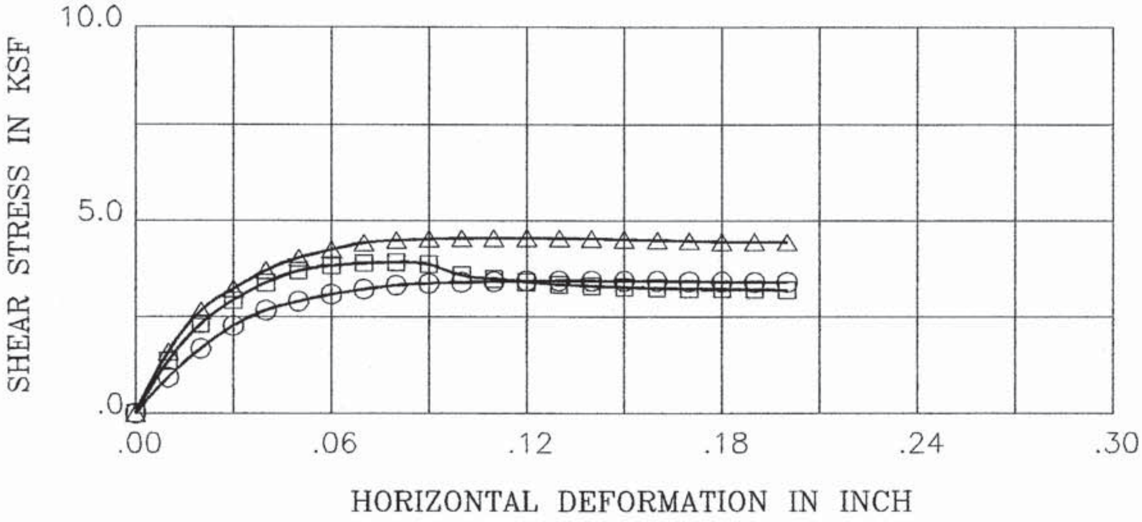
BORING/SAMPLE : H-12 #10 DEPTH (ft) : 35-35.5
DESCRIPTION : Poorly graded sand (SP)
STRENGTH INTERCEPT (C) : .320 KSF
FRICTION ANGLE (PHI) : 36.2 DEG
(PEAK STRENGTH)

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	VOID RATIO	NORMAL STRESS (ksf)	PEAK SHEAR (ksf)	RESIDUAL SHEAR (ksf)
○	9.5	94.5	.717	2.00	1.75	1.74
□	9.8	96.1	.689	4.00	3.32	3.11
△	10.1	97.5	.664	6.00	4.67	4.48

Remark :

Project No. 44F1	NORTH CITY WATER RECLAMATION PLANT EXPANSION
ALLIED GEOTECHNICAL ENGINEERS, INC.	DIRECT SHEAR TEST Figure B-37





BORING/SAMPLE : H-13 #5 DEPTH (ft) : 16-16.5
DESCRIPTION : Lean clay (CL)
STRENGTH INTERCEPT (C) : 1.748 KSF
FRICTION ANGLE (PHI) : 29.1 DEG
(PEAK STRENGTH)

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	VOID RATIO	NORMAL STRESS (ksf)	PEAK SHEAR (ksf)	RESIDUAL SHEAR (ksf)
○	23.2	96.8	.676	3.00	3.44	3.40
□	22.1	99.1	.636	4.00	3.93	3.20
△	22.4	99.7	.628	5.00	4.55	4.44

Remark :

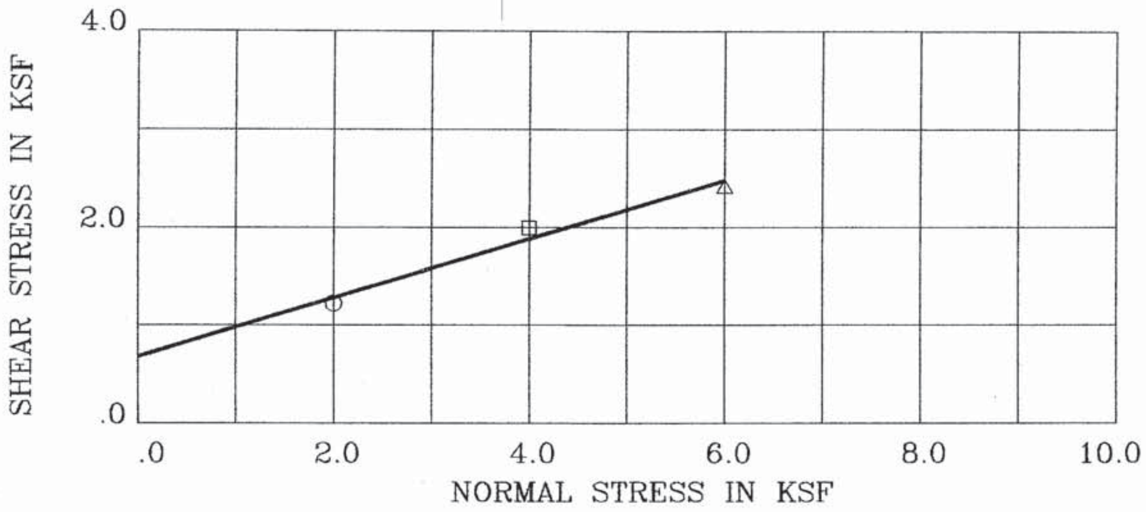
Project No. 44F1

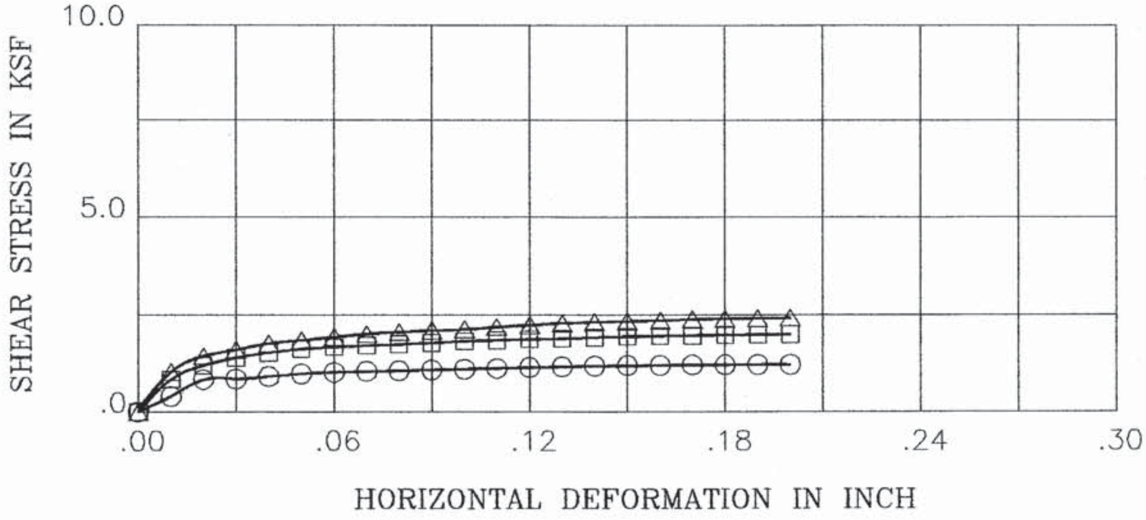
NORTH CITY WATER RECLAMATION PLANT EXPANSION

ALLIED GEOTECHNICAL ENGINEERS, INC.

DIRECT SHEAR TEST

Figure B-38



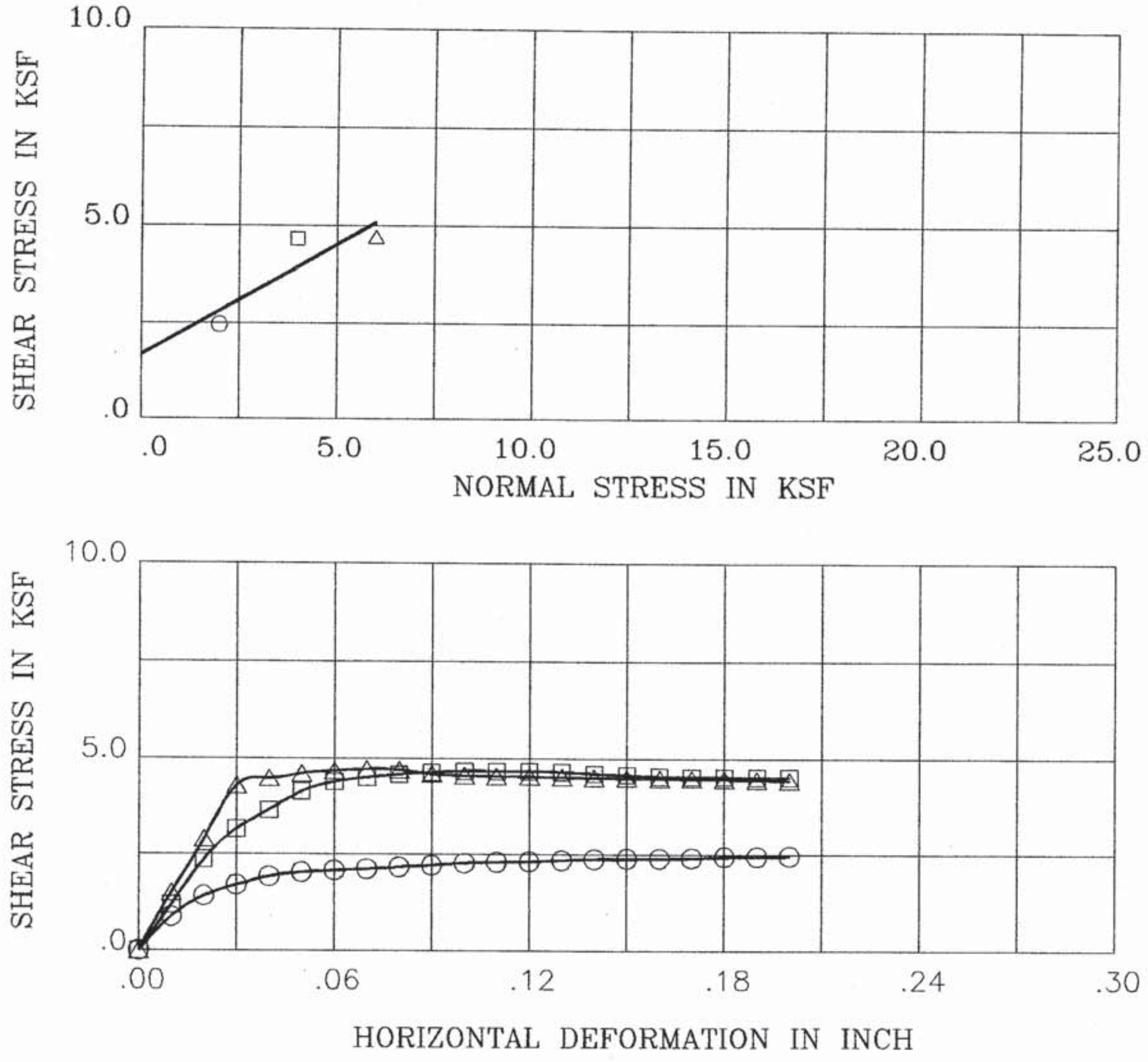


BORING/SAMPLE : H-14 #2 DEPTH (ft) : 4-7
DESCRIPTION : Sandy clay (CL)
STRENGTH INTERCEPT (C) : .682 KSF
FRICTION ANGLE (PHI) : 16.7 DEG
(PEAK STRENGTH)

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	VOID RATIO	NORMAL STRESS (ksf)	PEAK SHEAR (ksf)	RESIDUAL SHEAR (ksf)
○	15.3	103.1	.574	2.00	1.22	1.22
□	15.5	105.8	.534	4.00	2.00	2.00
△	15.4	106.9	.518	6.00	2.42	2.42

Remark :

Project No. 44F1	NORTH CITY WATER RECLAMATION PLANT EXPANSION
ALLIED GEOTECHNICAL ENGINEERS, INC.	DIRECT SHEAR TEST Figure B-39



BORING/SAMPLE : H-14 #15 DEPTH (ft) : 50-50.5

DESCRIPTION : Lean clay (CL)

STRENGTH INTERCEPT (C) : 1.692 KSF

FRICTION ANGLE (PHI) : 29.5 DEG

(PEAK STRENGTH)

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	VOID RATIO	NORMAL STRESS (ksf)	PEAK SHEAR (ksf)	RESIDUAL SHEAR (ksf)
○	21.3	95.9	.692	2.00	2.46	2.46
□	19.9	99.3	.634	4.00	4.67	4.51
△	21.8	101.1	.604	6.00	4.73	4.43

Remark :

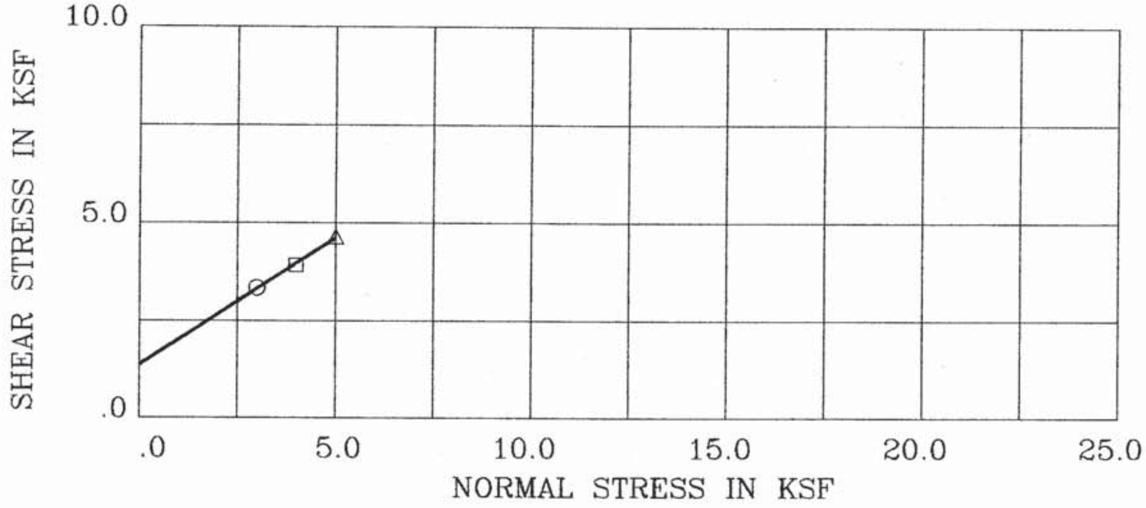
Project No. 44F1

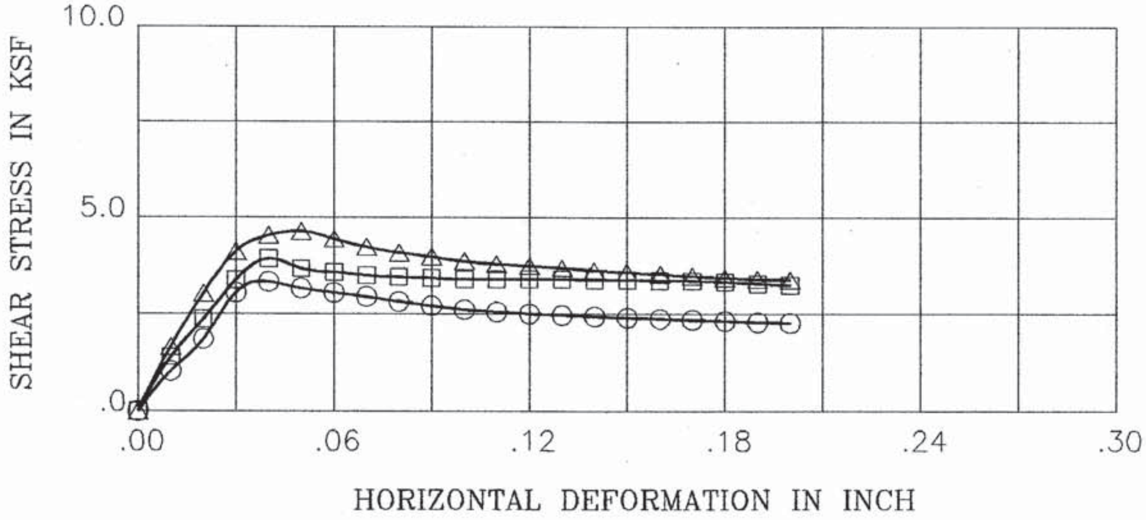
NORTH CITY WATER RECLAMATION PLANT EXPANSION

ALLIED GEOTECHNICAL ENGINEERS, INC.

DIRECT SHEAR TEST

Figure B-40





BORING/SAMPLE : H-15 #1 DEPTH (ft) : 6-6.5

DESCRIPTION : Plastic clay (CH)

STRENGTH INTERCEPT (C) : 1.369 KSF

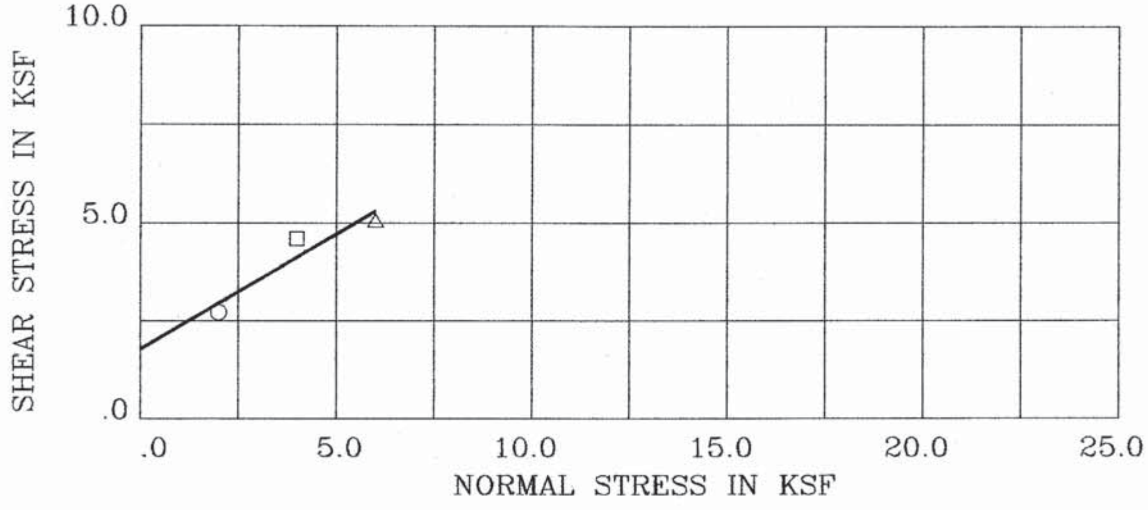
FRICTION ANGLE (PHI) : 33.1 DEG

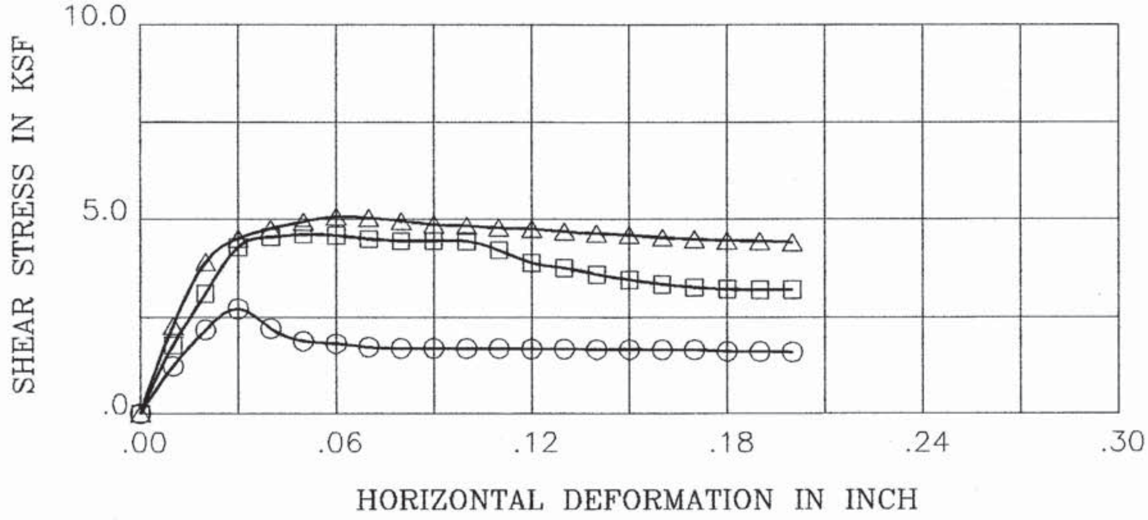
(PEAK STRENGTH)

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	VOID RATIO	NORMAL STRESS (ksf)	PEAK SHEAR (ksf)	RESIDUAL SHEAR (ksf)
○	21.9	103.1	.574	3.00	3.34	2.27
□	21.5	102.1	.589	4.00	3.93	3.25
△	22.0	104.1	.558	5.00	4.64	3.39

Remark :

Project No. 44F1	NORTH CITY WATER RECLAMATION PLANT EXPANSION
ALLIED GEOTECHNICAL ENGINEERS, INC.	DIRECT SHEAR TEST Figure B-41





BORING/SAMPLE : H–16 #1 DEPTH (ft) : 6–6.5

DESCRIPTION : Siltstone (ML)

STRENGTH INTERCEPT (C) : 1.785 KSF

FRICTION ANGLE (PHI) : 30.4 DEG

(PEAK STRENGTH)

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	VOID RATIO	NORMAL STRESS (ksf)	PEAK SHEAR (ksf)	RESIDUAL SHEAR (ksf)
○	22.4	102.2	.587	2.00	2.72	1.61
□	20.4	105.6	.536	4.00	4.62	3.20
△	22.0	104.5	.553	6.00	5.07	4.41

Remark :

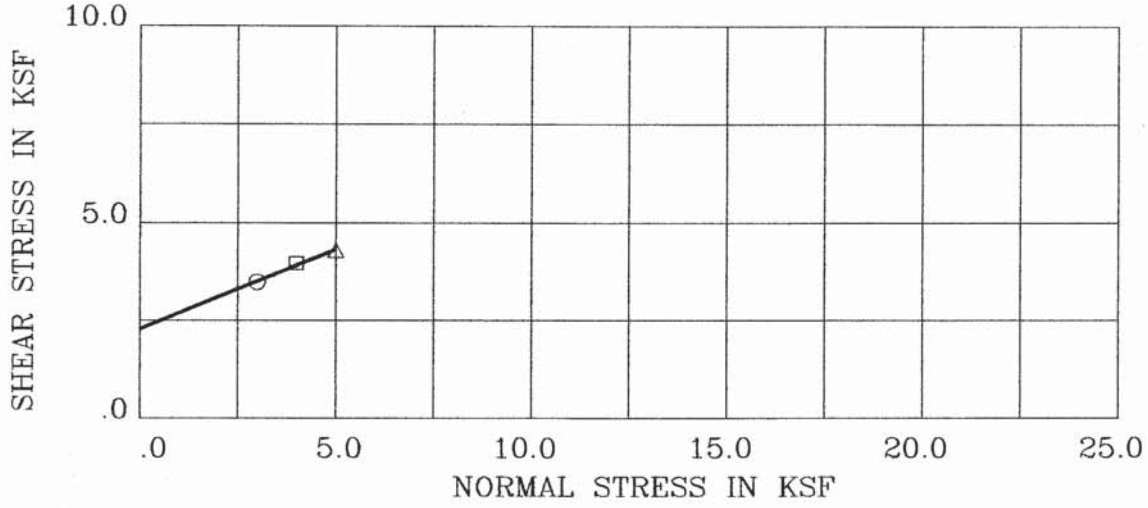
Project No. 44F1

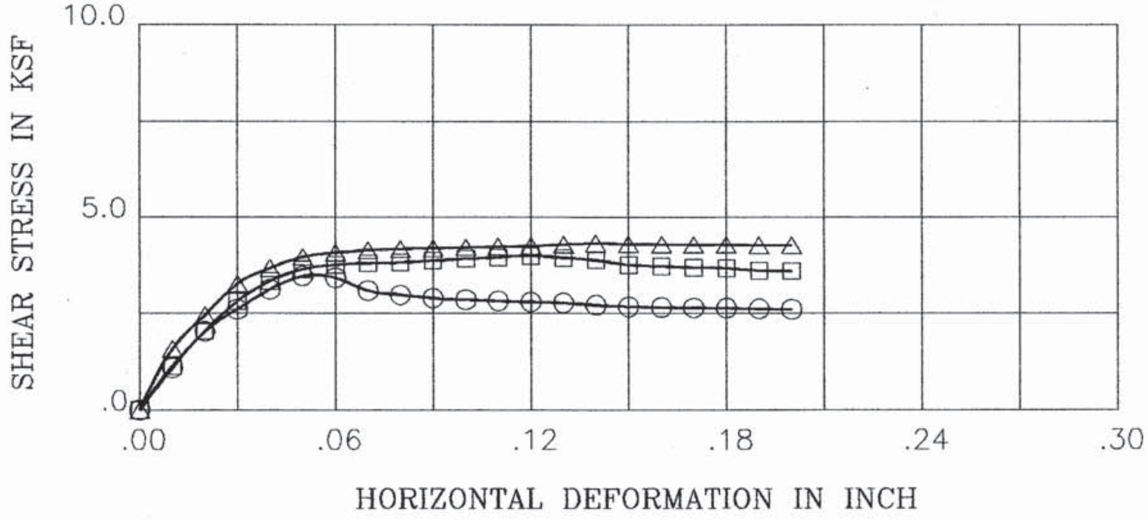
NORTH CITY WATER RECLAMATION PLANT EXPANSION

ALLIED GEOTECHNICAL ENGINEERS, INC.

DIRECT SHEAR TEST

Figure B–42





BORING/SAMPLE : H-17 #2 DEPTH (ft) : 6-6.5

DESCRIPTION : Lean clay (CL)

STRENGTH INTERCEPT (C) : 2.290 KSF

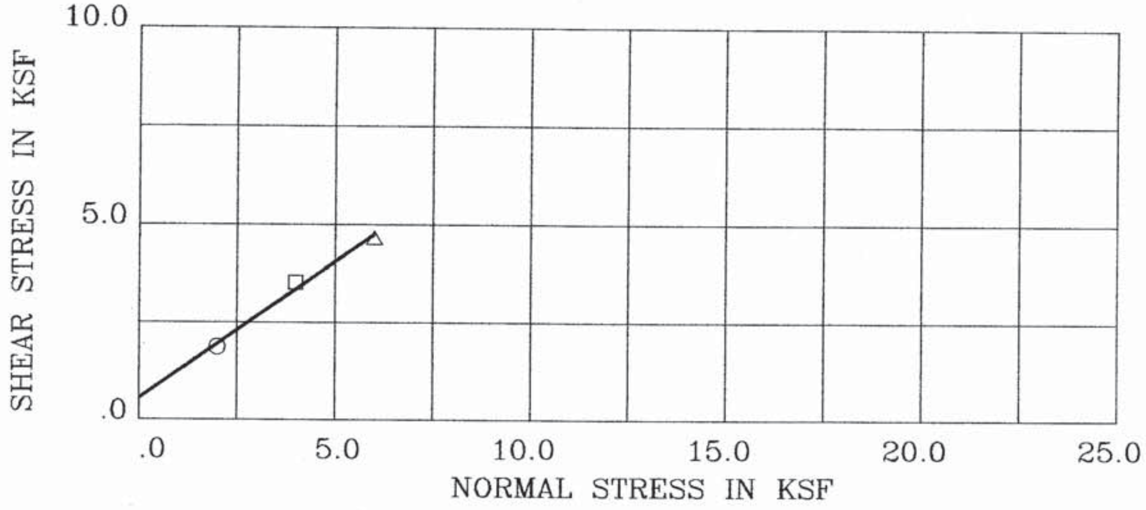
FRICTION ANGLE (PHI) : 22.3 DEG

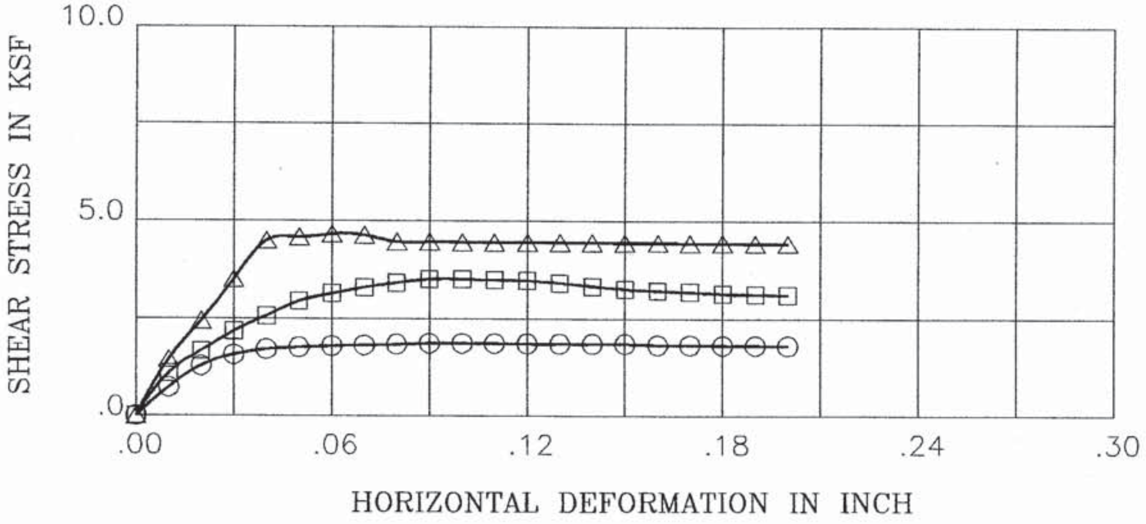
(PEAK STRENGTH)

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	VOID RATIO	NORMAL STRESS (ksf)	PEAK SHEAR (ksf)	RESIDUAL SHEAR (ksf)
○	20.6	102.7	.580	3.00	3.49	2.60
□	24.0	101.1	.604	4.00	3.99	3.59
△	22.2	103.5	.567	5.00	4.32	4.27

Remark :

Project No. 44F1	NORTH CITY WATER RECLAMATION PLANT EXPANSION
ALLIED GEOTECHNICAL ENGINEERS, INC.	DIRECT SHEAR TEST Figure B-43





BORING/SAMPLE : H–20 #4 DEPTH (ft) : 10.5–11
DESCRIPTION : Lean clay (CL)
STRENGTH INTERCEPT (C) : .559 KSF
FRICTION ANGLE (PHI) : 35.0 DEG
(PEAK STRENGTH)

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	VOID RATIO	NORMAL STRESS (ksf)	PEAK SHEAR (ksf)	RESIDUAL SHEAR (ksf)
○	11.7	106.0	.530	2.00	1.87	1.81
□	12.1	106.0	.530	4.00	3.53	3.11
△	16.3	109.5	.482	6.00	4.67	4.42

Remark :

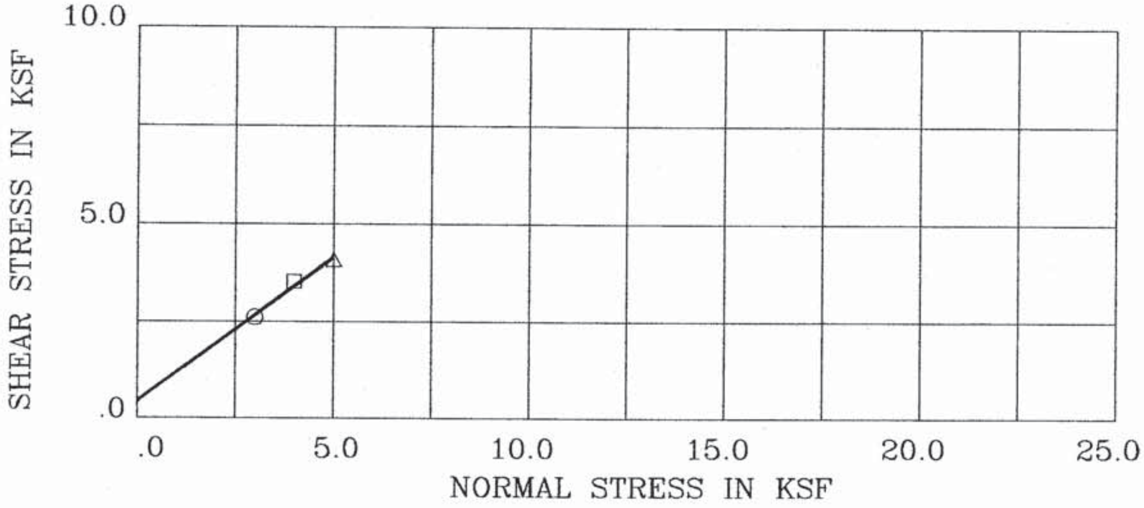
Project No. 44F1

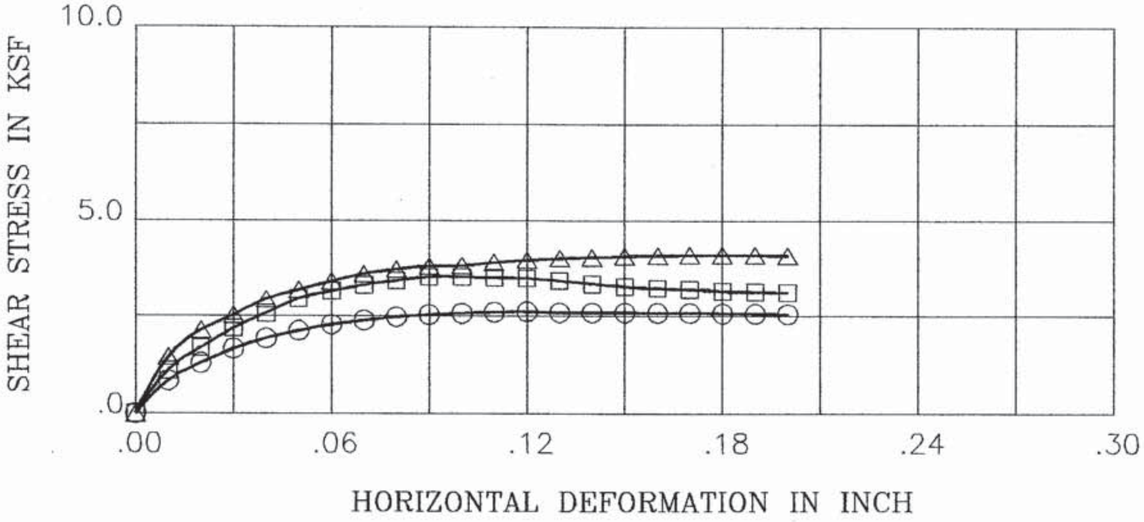
NORTH CITY WATER RECLAMATION PLANT EXPANSION

ALLIED GEOTECHNICAL ENGINEERS, INC.

DIRECT SHEAR TEST

Figure B–44





BORING/SAMPLE : H-22 #1 DEPTH (ft) : 6-6.5
DESCRIPTION : Silty/clayey sand (SM/SC)
STRENGTH INTERCEPT (C) : .438 KSF
FRICTION ANGLE (PHI) : 36.6 DEG
(PEAK STRENGTH)

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	VOID RATIO	NORMAL STRESS (ksf)	PEAK SHEAR (ksf)	RESIDUAL SHEAR (ksf)
○	12.9	113.4	.430	3.00	2.61	2.55
□	12.1	106.0	.530	4.00	3.53	3.11
△	12.2	113.5	.429	5.00	4.10	4.09

Remark :

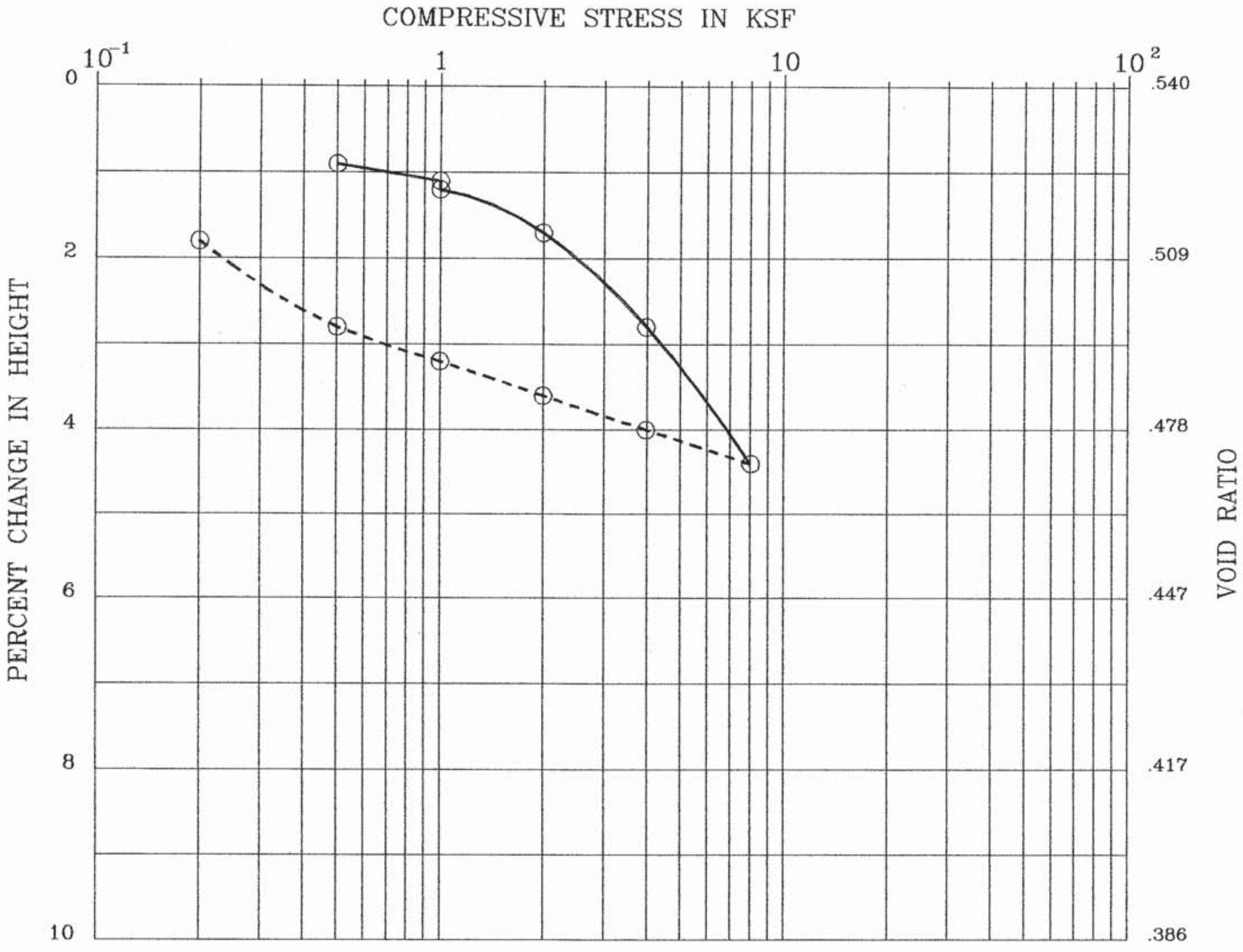
Project No. 44F1

NORTH CITY WATER RECLAMATION PLANT EXPANSION

ALLIED GEOTECHNICAL
ENGINEERS, INC.

DIRECT SHEAR TEST

Figure B-45



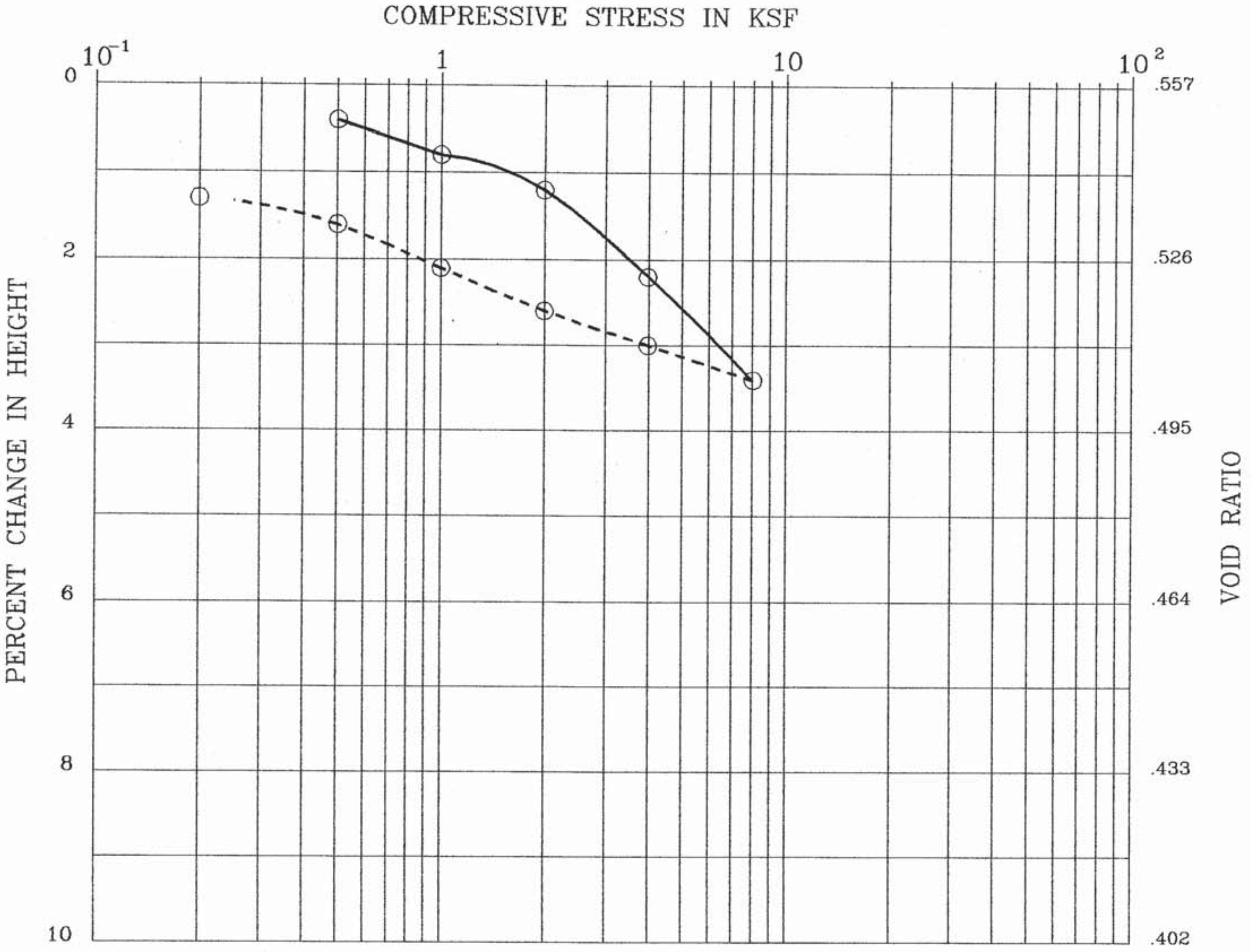
BORING : H–6 #3
DEPTH (ft) : 11–11.5
SPEC. GRAVITY : 2.71

DESCRIPTION : Clayey Sand (SC)
LIQUID LIMIT :
PLASTIC LIMIT :

	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	PERCENT SATURATION	VOID RATIO
INITIAL	16.7	110.2	84	.540
FINAL	18.6	112.6	100	.506

Remark :

Project 44F1	NCWRP EXPANSION
ALLIED GEOTECHNICAL ENGINEERS, INC.	CONSOLIDATION TEST Figure B–46



BORING : H-6 #6
DEPTH (ft) : 21-21.5
SPEC. GRAVITY : 2.66

DESCRIPTION : Silty sand (SM)
LIQUID LIMIT :
PLASTIC LIMIT :

	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	PERCENT SATURATION	VOID RATIO
INITIAL	17.6	106.7	85	.557
FINAL	20.1	108.2	100	.535

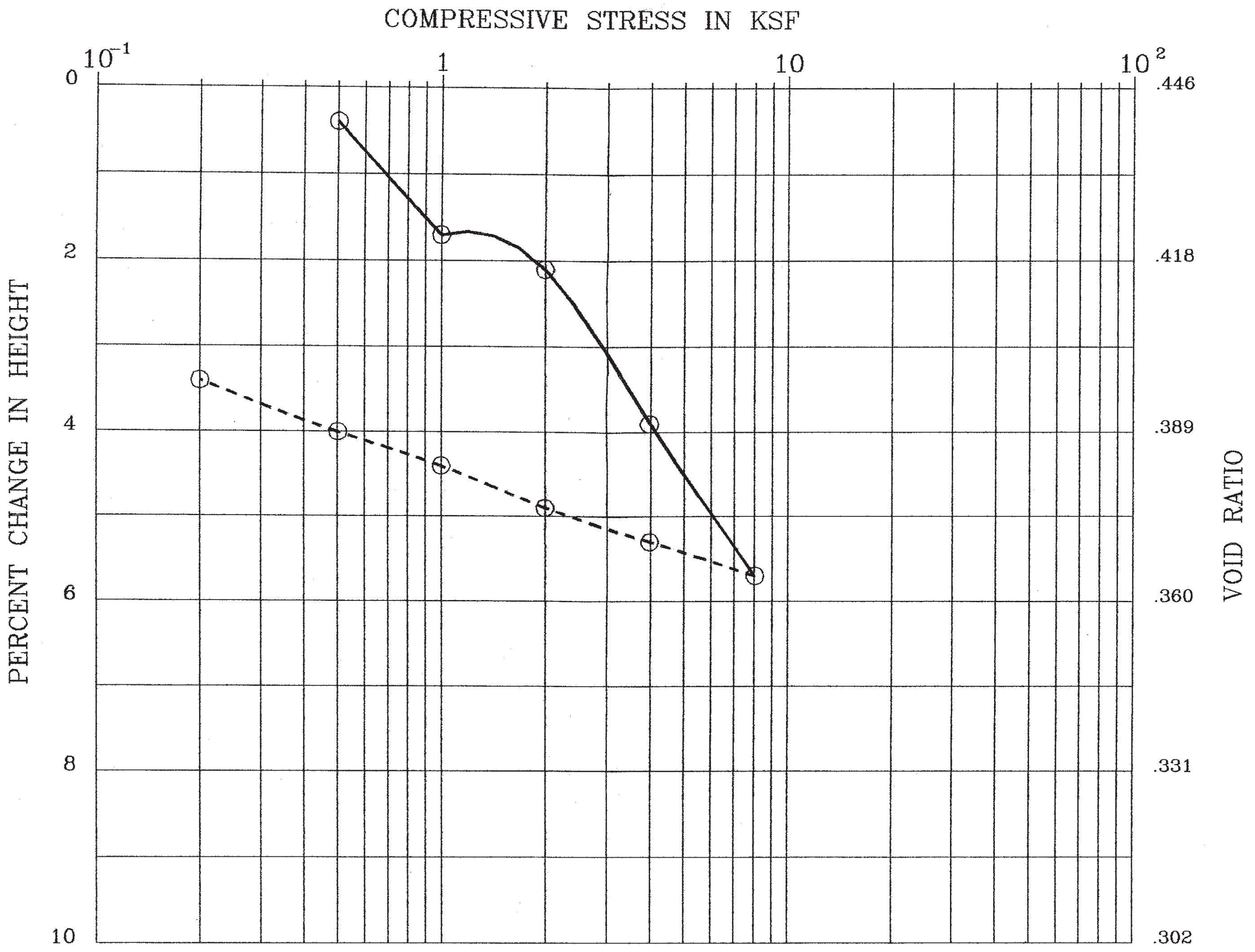
Remark :

Project 44F1 NCWRP EXPANSION

ALLIED GEOTECHNICAL ENGINEERS, INC.

CONSOLIDATION TEST

Figure B-47



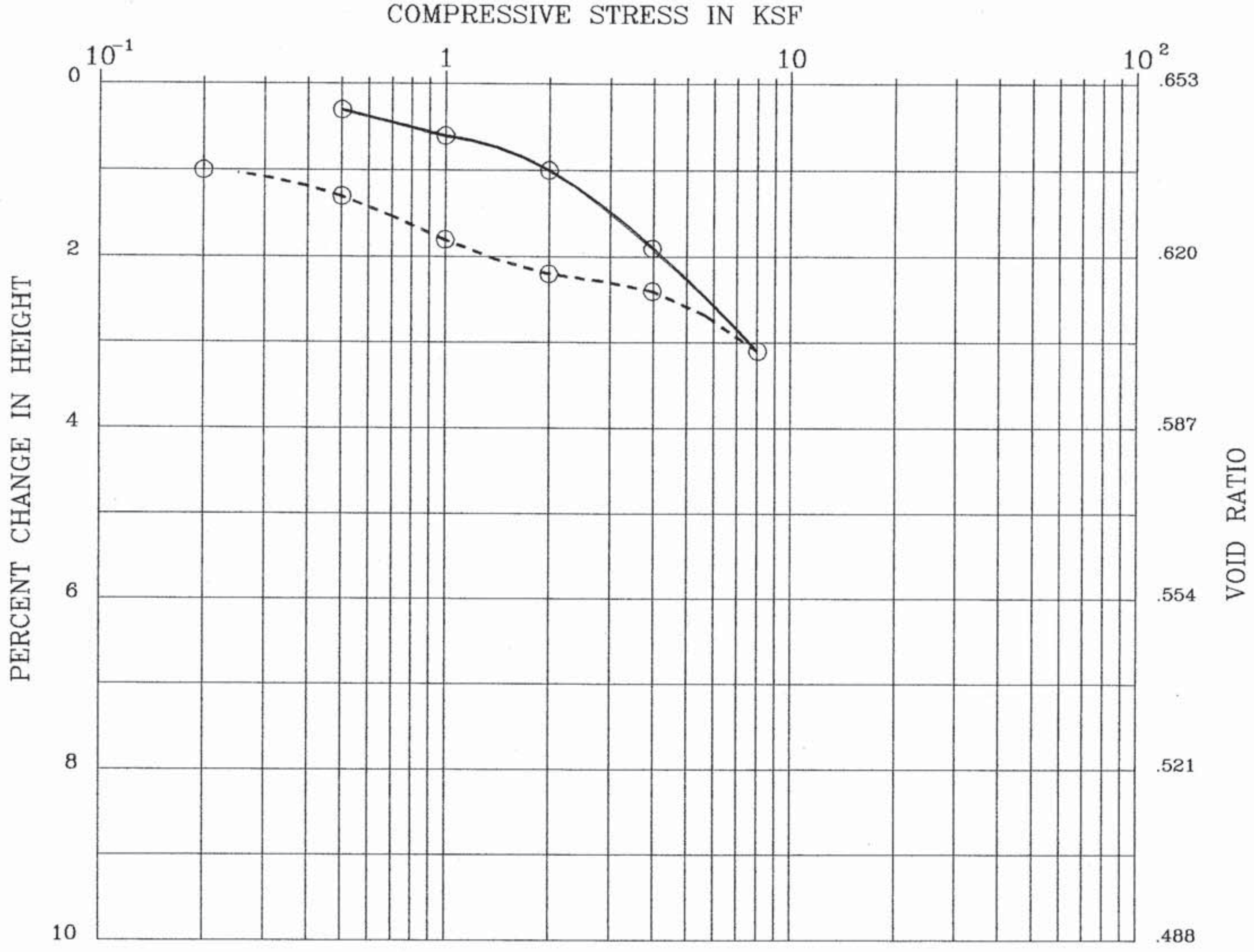
BORING : H-10 #4
DEPTH (ft) : 11-11.5
SPEC. GRAVITY : 2.41

DESCRIPTION : Silty sand/lean clay (SM/CL)
LIQUID LIMIT :
PLASTIC LIMIT :

	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	PERCENT SATURATION	VOID RATIO
INITIAL	15.8	104.2	86	.446
FINAL	16.3	108.0	100	.396

Remark :

Project 44F1	NCWRP EXPANSION
ALLIED GEOTECHNICAL ENGINEERS, INC.	CONSOLIDATION TEST Figure B-48



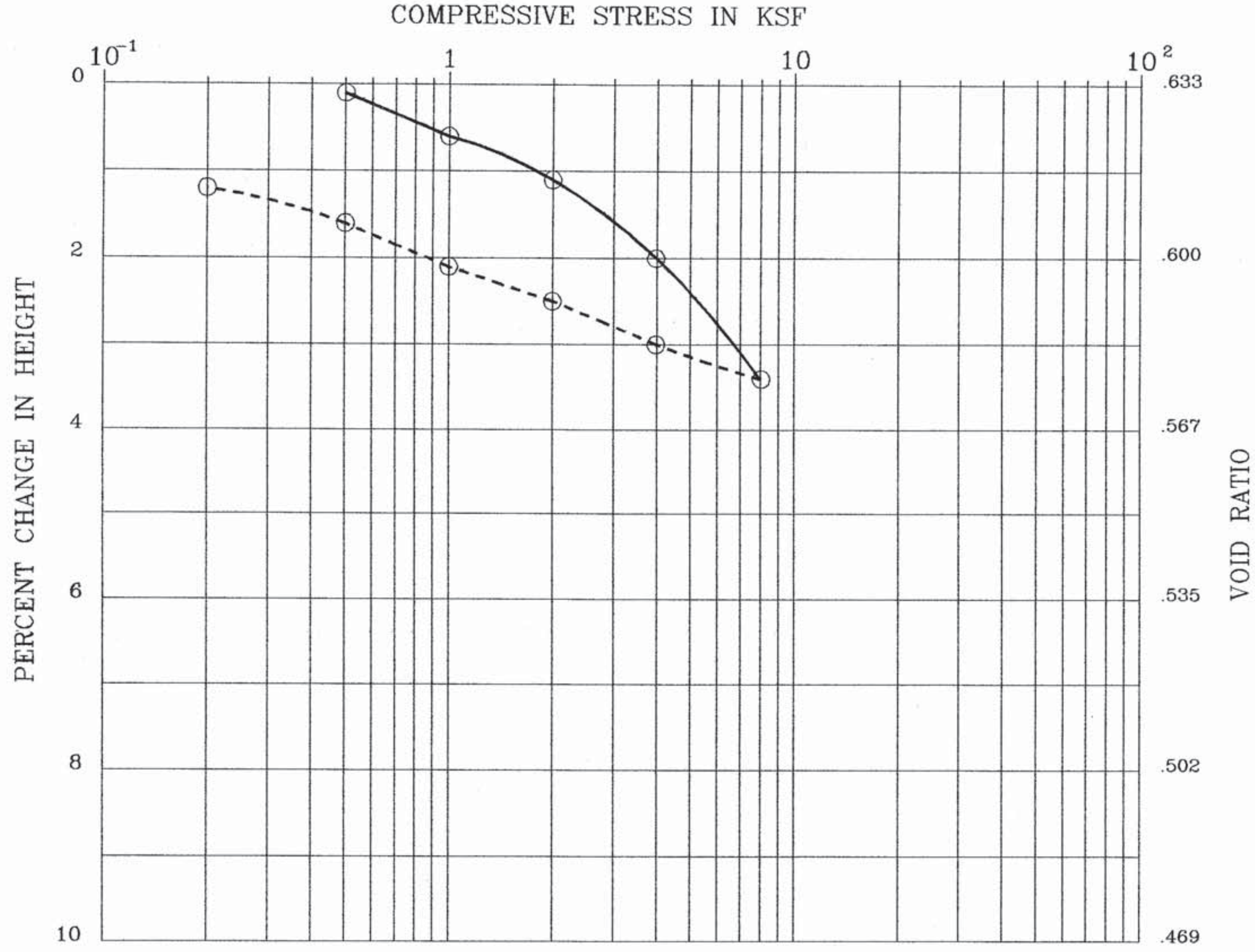
BORING : H-11 #1
DEPTH (ft) : 6-6.5
SPEC. GRAVITY : 2.59

DESCRIPTION : Silty sand (SM)
LIQUID LIMIT :
PLASTIC LIMIT :

	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	PERCENT SATURATION	VOID RATIO
INITIAL	24.6	98.0	98	.653
FINAL	24.5	99.0	100	.637

Remark :

Project 44F1	NCWRP EXPANSION
ALLIED GEOTECHNICAL ENGINEERS, INC.	CONSOLIDATION TEST Figure B-49



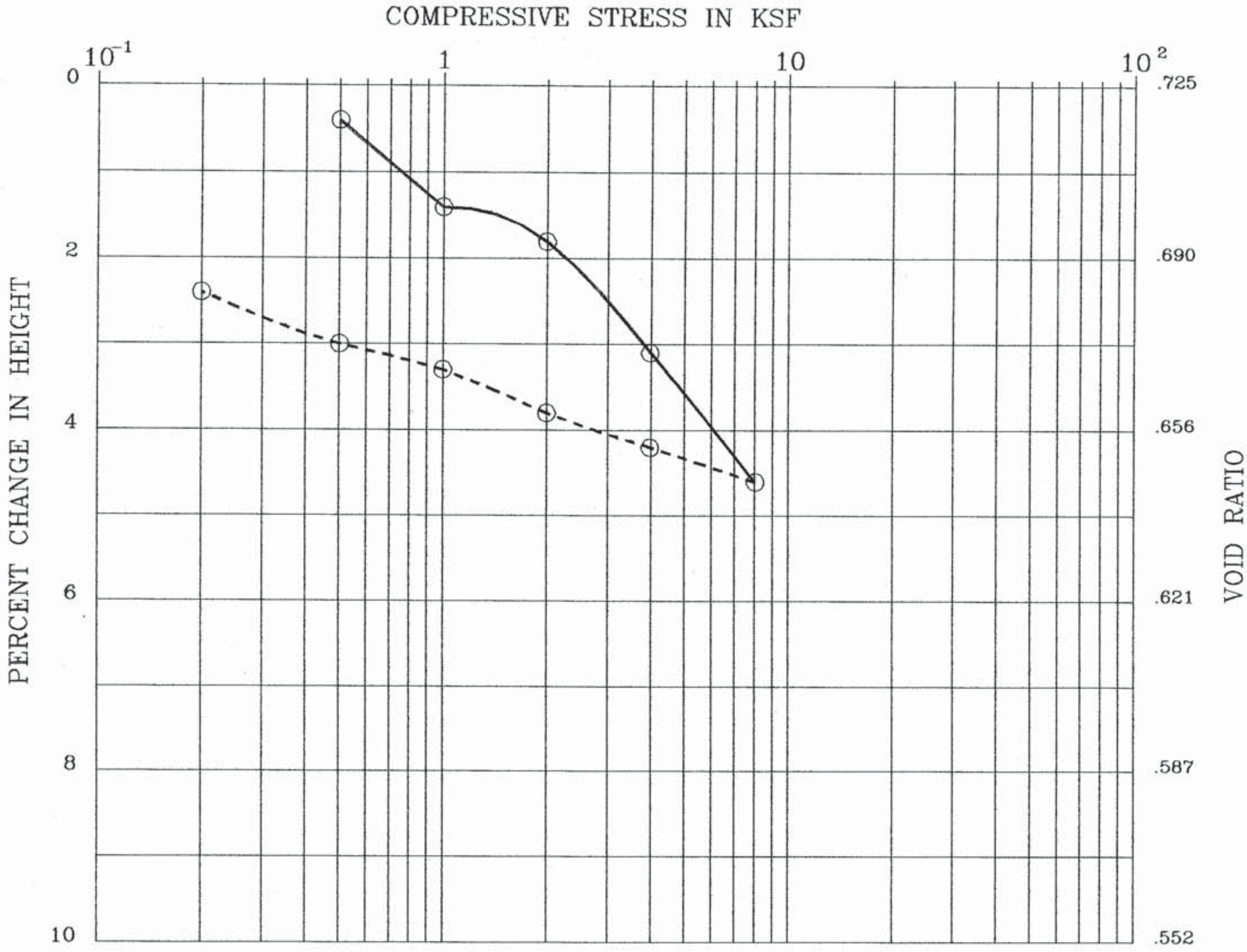
BORING : H-11 #7
DEPTH (ft) : 25.5-26
SPEC. GRAVITY : 2.71

DESCRIPTION : Sandy lean clay (CL)
LIQUID LIMIT :
PLASTIC LIMIT :

	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	PERCENT SATURATION	VOID RATIO
INITIAL	21.5	103.7	92	.633
FINAL	22.6	105.0	100	.613

Remark :

Project 44F1	NCWRP EXPANSION
ALLIED GEOTECHNICAL ENGINEERS, INC.	CONSOLIDATION TEST Figure B-50

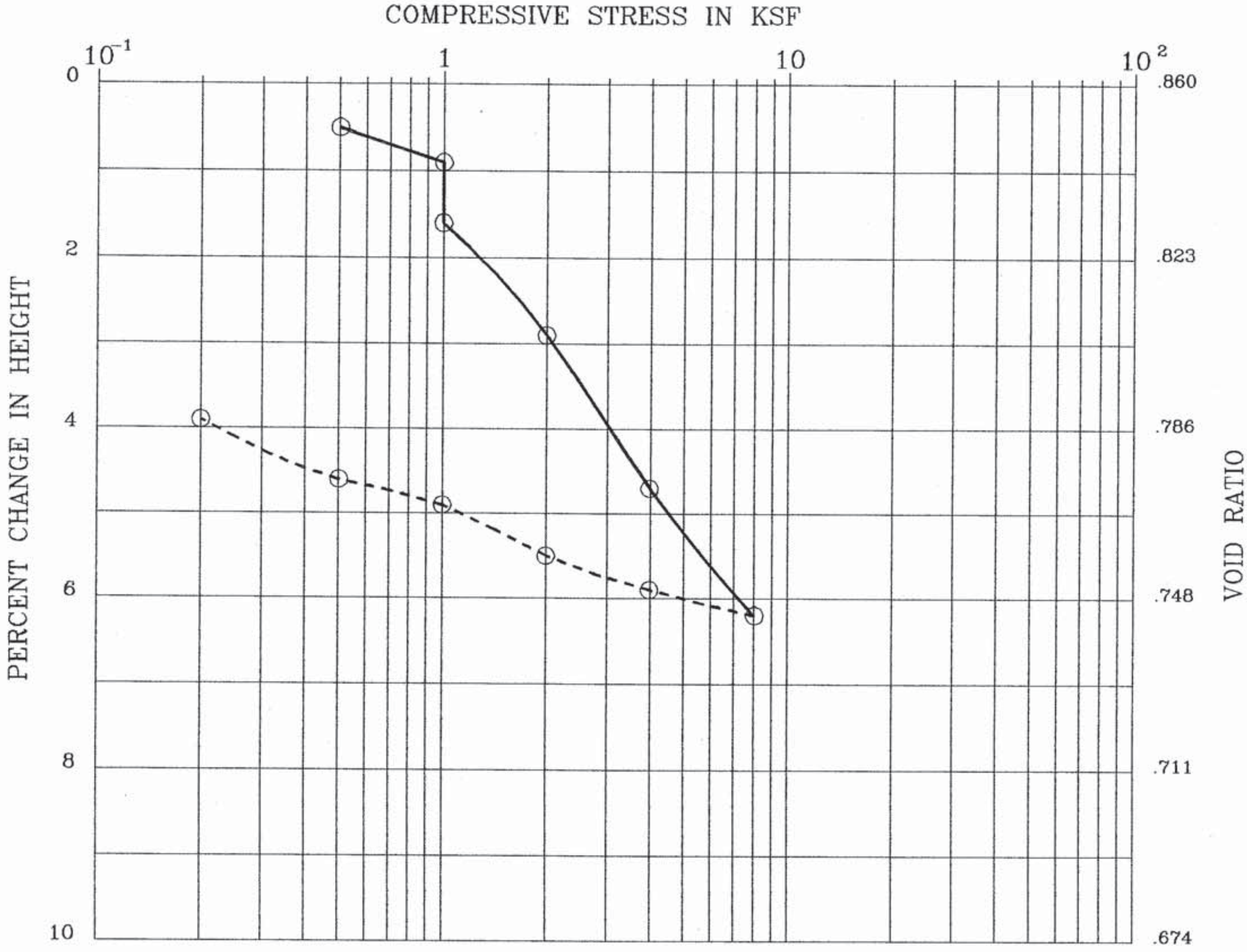


BORING	: H–12 #5	DESCRIPTION	: Silty sand (SM)
DEPTH (ft)	: 16–16.5	LIQUID LIMIT	:
SPEC. GRAVITY	: 2.78	PLASTIC LIMIT	:

	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	PERCENT SATURATION	VOID RATIO
INITIAL	23.9	100.5	92	.725
FINAL	24.6	103.0	100	.683

Remark :

Project 44F1	NCWRP EXPANSION
ALLIED GEOTECHNICAL ENGINEERS, INC.	CONSOLIDATION TEST Figure B–51



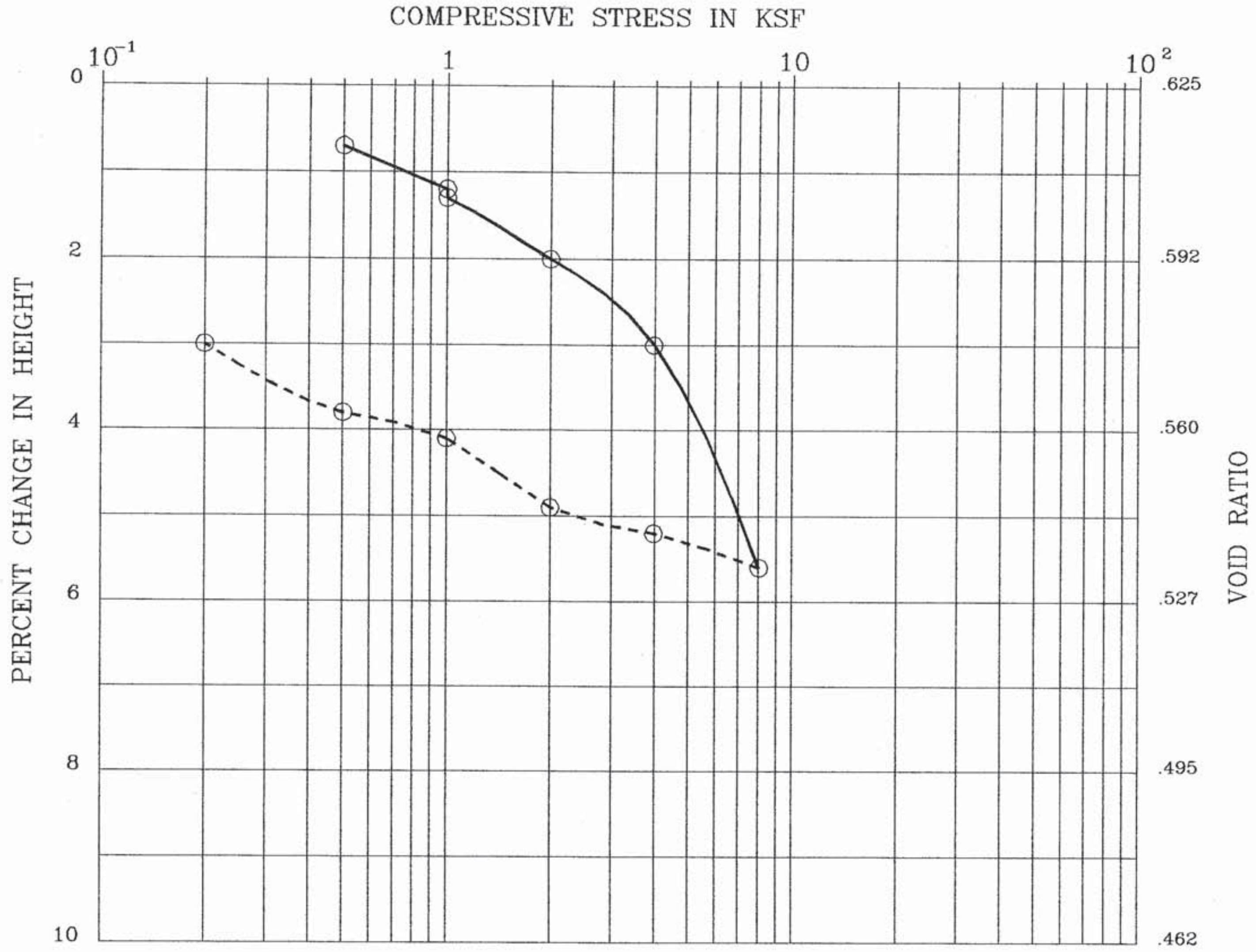
BORING : H-13 #7
DEPTH (ft) : 26-26.5
SPEC. GRAVITY : 3.05

DESCRIPTION : Lean clay (CL)
LIQUID LIMIT :
PLASTIC LIMIT :

	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	PERCENT SATURATION	VOID RATIO
INITIAL	22.5	102.6	80	.860
FINAL	25.6	106.9	100	.786

Remark :

Project 44F1	NCWRP EXPANSION
ALLIED GEOTECHNICAL ENGINEERS, INC.	CONSOLIDATION TEST Figure B-52



BORING : H-14 #4
DEPTH (ft) : 11-11.5
SPEC. GRAVITY : 2.80

DESCRIPTION : Sandy clay (CL)
LIQUID LIMIT :
PLASTIC LIMIT :

	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	PERCENT SATURATION	VOID RATIO
INITIAL	19.2	107.7	86	.625
FINAL	20.4	111.2	100	.574

Remark :

Project 44F1	NCWRP EXPANSION
ALLIED GEOTECHNICAL ENGINEERS, INC.	CONSOLIDATION TEST Figure B-53

LABORATORY REPORT

Telephone (619) 425-1993 Fax 425-7917 Established 1928

CLARKSON LABORATORY AND SUPPLY INC.
350 Trousdale Dr. Chula Vista, Ca. 91910 www.clarksonlab.com
ANALYTICAL AND CONSULTING CHEMISTS

Date: June 14, 2017
Purchase Order Number: 44F1
Sales Order Number: 36150
Account Number: ALLG

To:

Allied Geotechnical Engineers
1810 Gillespie Way Ste 104
El Cajon, CA 92020
Attention: Sani Sutanto

Laboratory Number: SO6422-1 Customers Phone: 449-5900
Fax: 449-5902

Sample Designation:

One soil sample received on 06/09/17 at 9:20am, taken on 06/05/17 from North City Wastewater Treatment Plan Expansion Project#44F1 marked as H-1 #2@4'-5'.

Analysis By California Test 643, 1999, Department of Transportation Division of Construction, Method for Estimating the Service Life of Steel Culverts.

pH 6.5

Water Added (ml)	Resistivity (ohm-cm)
10	3300
5	1500
5	830
5	680
5	680
5	720
5	740

12 years to perforation for a 16 gauge metal culvert.
15 years to perforation for a 14 gauge metal culvert.
21 years to perforation for a 12 gauge metal culvert.
27 years to perforation for a 10 gauge metal culvert.
33 years to perforation for a 8 gauge metal culvert.

Water Soluble Sulfate Calif. Test 417	0.048% (480ppm)
Water Soluble Chloride Calif. Test 422	0.017% (170ppm)
Bicarbonate (as $CaCO_3$) (In a saturated soil paste extract)	N/A

Note: N/A = Unable to determine due to the
texture of the soil (Clay).

Laura Torres

Laura Torres
LT/ilv

LABORATORY REPORT

Telephone (619) 425-1993 Fax 425-7917 Established 1928

CLARKSON LABORATORY AND SUPPLY INC.
350 Trousdale Dr. Chula Vista, Ca. 91910 www.clarksonlab.com
ANALYTICAL AND CONSULTING CHEMISTS

Date: May 25, 2017
Purchase Order Number: 44F1
Sales Order Number: 35882
Account Number: ALLG
To:

Allied Geotechnical Engineers
1810 Gillespie Way Ste 104
El Cajon, CA 92020
Attention: Sani Sutanto

Laboratory Number: SO6396-9 Customers Phone: 449-5900
Fax: 449-5902

Sample Designation:

One soil sample received on 05/18/17 at 11:30am, from North City Wastewater Treatment Plant Expansion marked as H-2#6@22-23'.

Analysis By California Test 643, 1999, Department of Transportation Division of Construction, Method for Estimating the Service Life of Steel Culverts.

pH 4.8

Water Added (ml)	Resistivity (ohm-cm)
10	5300
5	2500
5	1400
5	1000
5	930
5	1000
5	1200

5 years to perforation for a 16 gauge metal culvert.
7 years to perforation for a 14 gauge metal culvert.
10 years to perforation for a 12 gauge metal culvert.
12 years to perforation for a 10 gauge metal culvert.
15 years to perforation for a 8 gauge metal culvert.

Water Soluble Sulfate Calif. Test 417	0.013% (130ppm)
Water Soluble Chloride Calif. Test 422	0.019% (190ppm)
Bicarbonate (as $CaCO_3$) (In a 1:3 water extraction)	4ppm

Laura Torres

Laura Torres
LT/ram

LABORATORY REPORT

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CLARKSON LABORATORY AND SUPPLY INC.
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ANALYTICAL AND CONSULTING CHEMISTS

Date: June 14, 2017
Purchase Order Number: 44F1
Sales Order Number: 36150
Account Number: ALLG
To:
--
Allied Geotechnical Engineers
1810 Gillespie Way Ste 104
El Cajon, CA 92020
Attention: Sani Sutanto

Laboratory Number: SO6422-2 Customers Phone: 449-5900
Fax: 449-5902

Sample Designation:
--
One soil sample received on 06/09/17 at 9:20am, taken on 06/05/17 from North City Wastewater Treatment Plant Expansion Project#44F1 marked as H-3 #2@4'-5'.

Analysis By California Test 643, 1999, Department of Transportation Division of Construction, Method for Estimating the Service Life of Steel Culverts.

pH 5.7

Water Added (ml)	Resistivity (ohm-cm)
10	3200
5	1500
5	830
5	660
5	650
5	680
5	700

7 years to perforation for a 16 gauge metal culvert.
8 years to perforation for a 14 gauge metal culvert.
12 years to perforation for a 12 gauge metal culvert.
15 years to perforation for a 10 gauge metal culvert.
18 years to perforation for a 8 gauge metal culvert.

Water Soluble Sulfate Calif. Test 417	0.021% (210ppm)
Water Soluble Chloride Calif. Test 422	0.016% (160ppm)
Bicarbonate (as CaCO$_3$) (In a 1:3 water extraction)	6ppm

Laura Torres

Laura Torres
LT/ilv

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ANALYTICAL AND CONSULTING CHEMISTS

Date: May 25, 2017
Purchase Order Number: 44F1
Sales Order Number: 35882
Account Number: ALLG

To:

Allied Geotechnical Engineers
1810 Gillespie Way Ste 104
El Cajon, CA 92020
Attention: Sani Sutanto

Laboratory Number: SO6396-10 Customers Phone: 449-5900
Fax: 449-5902

Sample Designation:

One soil sample received on 05/18/17 at 11:30am, taken from North City Wastewater Treatment Plant Expansion marked as H-4#1@3-6'.

Analysis By California Test 643, 1999, Department of Transportation Division of Construction, Method for Estimating the Service Life of Steel Culverts.

pH 6.8

Water Added (ml)	Resistivity (ohm-cm)
10	2200
5	1100
5	620
5	560
5	550
5	570
5	590

14 years to perforation for a 16 gauge metal culvert.
18 years to perforation for a 14 gauge metal culvert.
25 years to perforation for a 12 gauge metal culvert.
32 years to perforation for a 10 gauge metal culvert.
39 years to perforation for a 8 gauge metal culvert.

Water Soluble Sulfate	Calif. Test 417	0.034% (340ppm)
Water Soluble Chloride	Calif. Test 422	0.030% (300ppm)
Bicarbonate (as $CaCO_3$) (In a 1:3 water extraction)		32ppm

Laura Torres

Laura Torres
LT/ilv

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Date: May 25, 2017
Purchase Order Number: 44F1
Sales Order Number: 35882
Account Number: ALLG

To:

Allied Geotechnical Engineers
1810 Gillespie Way Ste 104
El Cajon, CA 92020
Attention: Sani Sutanto

Laboratory Number: SO6396-11 Customers Phone: 449-5900
Fax: 449-5902

Sample Designation:

One soil sample received on 05/18/17 at 11:30am, taken from North City Wastewater Treatment Plant Expansion marked as H-4#5@17-18'.

Analysis By California Test 643, 1999, Department of Transportation Division of Construction, Method for Estimating the Service Life of Steel Culverts.

pH 10.5

Water Added (ml)	Resistivity (ohm-cm)
10	3700
5	1500
5	990
5	800
5	780
5	830
5	840

28 years to perforation for a 16 gauge metal culvert.
36 years to perforation for a 14 gauge metal culvert.
50 years to perforation for a 12 gauge metal culvert.
63 years to perforation for a 10 gauge metal culvert.
77 years to perforation for a 8 gauge metal culvert.

Water Soluble Sulfate Calif. Test 417	0.027% (270ppm)
Water Soluble Chloride Calif. Test 422	0.026% (260ppm)
Bicarbonate (as $CaCO_3$) (In a 1:3 water extraction)	12ppm

Laura Torres

Laura Torres
LT/ilv

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Date: June 14, 2017
Purchase Order Number: 44F1
Sales Order Number: 36150
Account Number: ALLG
To:

Allied Geotechnical Engineers
1810 Gillespie Way Ste 104
El Cajon, CA 92020
Attention: Sani Sutanto

Laboratory Number: SO6422-3 Customers Phone: 449-5900
Fax: 449-5902

Sample Designation:

One soil sample received on 06/09/17 at 9:20am, taken on 06/05/17 from North City Wastewater Treatment Plan Expansion Project#44F1 marked as H-5 #3@8'-9'.

Analysis By California Test 643, 1999, Department of Transportation Division of Construction, Method for Estimating the Service Life of Steel Culverts.

pH 7.1

Water Added (ml)	Resistivity (ohm-cm)
10	3400
5	1200
5	730
5	500
5	470
5	450
5	480
5	510

18 years to perforation for a 16 gauge metal culvert.
23 years to perforation for a 14 gauge metal culvert.
32 years to perforation for a 12 gauge metal culvert.
41 years to perforation for a 10 gauge metal culvert.
50 years to perforation for a 8 gauge metal culvert.

Water Soluble Sulfate Calif. Test 417	0.044% (440ppm)
Water Soluble Chloride Calif. Test 422	0.031% (310ppm)
Bicarbonate (as $CaCO_3$) (In a 1:3 water extraction)	30ppm

Laura Torres

Laura Torres
LT/ilv

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ANALYTICAL AND CONSULTING CHEMISTS

Date: June 14, 2017
Purchase Order Number: 44F1
Sales Order Number: 36150
Account Number: ALLG
To:
--
Allied Geotechnical Engineers
1810 Gillespie Way Ste 104
El Cajon, CA 92020
Attention: Sani Sutanto

Laboratory Number: SO6422-4 Customers Phone: 449-5900
Fax: 449-5902

Sample Designation:
--
One soil sample received on 06/09/17 at 9:20am, taken on 06/05/17 from North City Wastewater Treatment Plan Expansion Project#44F1 marked as H-5 #8@25'-28'.

Analysis By California Test 643, 1999, Department of Transportation Division of Construction, Method for Estimating the Service Life of Steel Culverts.

pH 7.3

Water Added (ml)	Resistivity (ohm-cm)
10	2900
5	1500
5	860
5	530
5	440
5	490
5	550

22 years to perforation for a 16 gauge metal culvert.
28 years to perforation for a 14 gauge metal culvert.
39 years to perforation for a 12 gauge metal culvert.
50 years to perforation for a 10 gauge metal culvert.
61 years to perforation for a 8 gauge metal culvert.

Water Soluble Sulfate Calif. Test 417	0.021% (210ppm)
Water Soluble Chloride Calif. Test 422	0.044% (440ppm)
Bicarbonate (as $CaCO_3$) (In a 1:3 water extraction)	14ppm

Laura Torres

Laura Torres
LT/ilv

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ANALYTICAL AND CONSULTING CHEMISTS

Date: June 16, 2017
Purchase Order Number: 44F1
Sales Order Number: 36150
Account Number: ALLG

To:

Allied Geotechnical Engineers
1810 Gillespie Way Ste 104
El Cajon, CA 92020
Attention: Sani Sutanto

Laboratory Number: SO6422-5 Customers Phone: 449-5900
Fax: 449-5902

Sample Designation:

One soil sample received on 06/09/17 at 9:20am, taken on 06/05/17 from North City Wastewater Treatment Plan Expansion Project#44F1 marked as H-6 #4@12'-13'.

Analysis By California Test 643, 1999, Department of Transportation Division of Construction, Method for Estimating the Service Life of Steel Culverts.

pH 7.9

Water Added (ml)	Resistivity (ohm-cm)
10	1500
5	730
5	530
5	500
5	450
5	410
5	440
5	470

21 years to perforation for a 16 gauge metal culvert.
28 years to perforation for a 14 gauge metal culvert.
38 years to perforation for a 12 gauge metal culvert.
49 years to perforation for a 10 gauge metal culvert.
59 years to perforation for a 8 gauge metal culvert.

Water Soluble Sulfate Calif. Test 417	0.108% (1080ppm)
Water Soluble Chloride Calif. Test 422	0.043% (430ppm)
Bicarbonate (as $CaCO_3$) (In a 1:3 water extraction)	27ppm

Rosa M. Bernal
RMB/ilv

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ANALYTICAL AND CONSULTING CHEMISTS

Date: May 25, 2017
Purchase Order Number: 44F1
Sales Order Number: 35882
Account Number: ALLG

To:

Allied Geotechnical Engineers
1810 Gillespie Way Ste 104
El Cajon, CA 92020
Attention: Sani Sutanto

Laboratory Number: SO6396-12 Customers Phone: 449-5900
Fax: 449-5902

Sample Designation:

One soil sample received on 05/18/17 at 11:30am, taken from North City Wastewater Treatment Plant Expansion marked as H-7#2@5-8'.

Analysis By California Test 643, 1999, Department of Transportation Division of Construction, Method for Estimating the Service Life of Steel Culverts.

pH 8.9

Water Added (ml)	Resistivity (ohm-cm)
10	5800
5	1800
5	1100
5	1100
5	1200
5	1500

32 years to perforation for a 16 gauge metal culvert.
41 years to perforation for a 14 gauge metal culvert.
57 years to perforation for a 12 gauge metal culvert.
73 years to perforation for a 10 gauge metal culvert.
89 years to perforation for a 8 gauge metal culvert.

Water Soluble Sulfate Calif. Test 417	0.014% (140ppm)
Water Soluble Chloride Calif. Test 422	0.006% (64ppm)
Bicarbonate (as $CaCO_3$) (In a 1:3 water extraction)	N/A

Note: N/A = Unable to determine due to the texture of the soil (Clay).

Laura Torres

Laura Torres
LT/ilv

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Date: May 25, 2017
Purchase Order Number: 44F1
Sales Order Number: 35882
Account Number: ALLG

To:

Allied Geotechnical Engineers
1810 Gillespie Way Ste 104
El Cajon, CA 92020
Attention: Sani Sutanto

Laboratory Number: SO6396-13 Customers Phone: 449-5900
Fax: 449-5902

Sample Designation:

One soil sample received on 05/18/17 at 11:30am, taken from North City Wastewater Treatment Plant Expansion marked as H-7#4@13-14'.

Analysis By California Test 643, 1999, Department of Transportation Division of Construction, Method for Estimating the Service Life of Steel Culverts.

pH 8.9

Water Added (ml)	Resistivity (ohm-cm)
10	4500
5	2100
5	1100
5	950
5	970
5	1000
5	1100
5	1300

30 years to perforation for a 16 gauge metal culvert.
39 years to perforation for a 14 gauge metal culvert.
54 years to perforation for a 12 gauge metal culvert.
69 years to perforation for a 10 gauge metal culvert.
84 years to perforation for a 8 gauge metal culvert.

Water Soluble Sulfate Calif. Test 417	0.014% (140ppm)
Water Soluble Chloride Calif. Test 422	0.011% (110ppm)
Bicarbonate (as $CaCO_3$)	N/A

(In a 1:3 water extraction)
Note: N/A = Unable to determine due to the texture of the soil (Clay).

Laura Torres

Laura Torres
LT/ilv

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Date: June 16, 2017
Purchase Order Number: 44F1
Sales Order Number: 36150
Account Number: ALLG

To:
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Allied Geotechnical Engineers
1810 Gillespie Way Ste 104
El Cajon, CA 92020
Attention: Sani Sutanto

Laboratory Number: SO6422-6 Customers Phone: 449-5900
Fax: 449-5902

Sample Designation:
--
One soil sample received on 06/09/17 at 9:20am, taken on 06/05/17 from North City Wastewater Treatment Plan Expansion Project#44F1 marked as H-8 #3@8'-9'.

Analysis By California Test 643, 1999, Department of Transportation Division of Construction, Method for Estimating the Service Life of Steel Culverts.

pH 7.9

Water Added (ml)	Resistivity (ohm-cm)
10	880
5	490
5	340
5	330
5	300
5	290
5	310
5	320

18 years to perforation for a 16 gauge metal culvert.
24 years to perforation for a 14 gauge metal culvert.
33 years to perforation for a 12 gauge metal culvert.
42 years to perforation for a 10 gauge metal culvert.
52 years to perforation for a 8 gauge metal culvert.

Water Soluble Sulfate Calif. Test 417	0.050% (500ppm)
Water Soluble Chloride Calif. Test 422	0.117% (1170ppm)
Bicarbonate (as $CaCO_3$) (In a 1:3 water extraction)	24ppm

Rosa M. Bernal
RMB/ilv

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ANALYTICAL AND CONSULTING CHEMISTS

Date: June 15, 2017
Purchase Order Number: 44F1
Sales Order Number: 36150
Account Number: ALLG
To:

Allied Geotechnical Engineers
1810 Gillespie Way Ste 104
El Cajon, CA 92020
Attention: Sani Sutanto

Laboratory Number: SO6422-7 Customers Phone: 449-5900
Fax: 449-5902

Sample Designation:

One soil sample received on 06/09/17 at 9:20am, taken on 06/05/17 from North City Wastewater Treatment Plan Expansion Project#44F1 marked as H-9 #4@14'-15'

Analysis By California Test 643, 1999, Department of Transportation Division of Construction, Method for Estimating the Service Life of Steel Culverts.

pH 7.9

Water Added (ml)	Resistivity (ohm-cm)
10	4200
5	2400
5	1400
5	980
5	870
5	840
5	860
5	890

28 years to perforation for a 16 gauge metal culvert.
37 years to perforation for a 14 gauge metal culvert.
51 years to perforation for a 12 gauge metal culvert.
65 years to perforation for a 10 gauge metal culvert.
80 years to perforation for a 8 gauge metal culvert.

Water Soluble Sulfate Calif. Test 417	0.015% (150ppm)
Water Soluble Chloride Calif. Test 422	0.013% (130ppm)
Bicarbonate (as $CaCO_3$) (In a 1:3 water extraction)	28ppm

Laura Torres

Laura Torres
LT/dbb

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ANALYTICAL AND CONSULTING CHEMISTS

Date: June 15, 2017
Purchase Order Number: 44F1
Sales Order Number: 36150
Account Number: ALLG
To:
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Allied Geotechnical Engineers
1810 Gillespie Way Ste 104
El Cajon, CA 92020
Attention: Sani Sutanto

Laboratory Number: SO6422-8 Customers Phone: 449-5900
Fax: 449-5902

Sample Designation:
--
One soil sample received on 06/09/17 at 9:20am, taken on 06/05/17 from North City Wastewater Treatment Plan Expansion Project#44F1 marked as H-9 #15@55'-59'

Analysis By California Test 643, 1999, Department of Transportation Division of Construction, Method for Estimating the Service Life of Steel Culverts.

pH 8.3

Water Added (ml)	Resistivity (ohm-cm)
10	3300
5	2000
5	1200
5	800
5	690
5	680
5	730
5	760

26 years to perforation for a 16 gauge metal culvert.
34 years to perforation for a 14 gauge metal culvert.
47 years to perforation for a 12 gauge metal culvert.
60 years to perforation for a 10 gauge metal culvert.
73 years to perforation for a 8 gauge metal culvert.

Water Soluble Sulfate Calif. Test 417	0.016% (160ppm)
Water Soluble Chloride Calif. Test 422	0.019% (190ppm)
Bicarbonate (as $CaCO_3$) (In a 1:3 water extraction)	52ppm

Laura Torres

Laura Torres
LT/dbb

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ANALYTICAL AND CONSULTING CHEMISTS

Date: June 15, 2017
Purchase Order Number: 44F1
Sales Order Number: 36150
Account Number: ALLG
To:
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Allied Geotechnical Engineers
1810 Gillespie Way Ste 104
El Cajon, CA 92020
Attention: Sani Sutanto

Laboratory Number: SO6422-9 Customers Phone: 449-5900
Fax: 449-5902

Sample Designation:
--
One soil sample received on 06/09/17 at 9:20am, taken on 06/05/17 from North City Wastewater Treatment Plan Expansion Project#44F1 marked as H-10 #3@7'-8'

Analysis By California Test 643, 1999, Department of Transportation Division of Construction, Method for Estimating the Service Life of Steel Culverts.

pH 7.9

Water Added (ml)	Resistivity (ohm-cm)
10	6700
5	2800
5	1000
5	840
5	880
5	920
5	970

28 years to perforation for a 16 gauge metal culvert.
37 years to perforation for a 14 gauge metal culvert.
51 years to perforation for a 12 gauge metal culvert.
65 years to perforation for a 10 gauge metal culvert.
80 years to perforation for a 8 gauge metal culvert.

Water Soluble Sulfate Calif. Test 417 0.018% (180ppm)

Water Soluble Chloride Calif. Test 422 0.009% (90ppm)

Bicarbonate (as $CaCO_3$) 50ppm
(In a 1:3 water extraction)

Laura Torres

Laura Torres
LT/dbb

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ANALYTICAL AND CONSULTING CHEMISTS

Date: June 15, 2017
Purchase Order Number: 44F1
Sales Order Number: 36150
Account Number: ALLG
To:

Allied Geotechnical Engineers
1810 Gillespie Way Ste 104
El Cajon, CA 92020
Attention: Sani Sutanto

Laboratory Number: SO6422-10   Customers Phone: 449-5900
Fax: 449-5902

Sample Designation:

One soil sample received on 06/09/17 at 9:20am, taken on 06/05/17 from North City Wastewater Treatment Plan Expansion Project#44F1 marked as H-10 #11@40'-43'

Analysis By California Test 643, 1999, Department of Transportation Division of Construction, Method for Estimating the Service Life of Steel Culverts.

pH 8.2

Water Added (ml)	Resistivity (ohm-cm)
10	4000
5	2100
5	1100
5	920
5	770
5	750
5	790
5	810

27 years to perforation for a 16 gauge metal culvert.
35 years to perforation for a 14 gauge metal culvert.
49 years to perforation for a 12 gauge metal culvert.
62 years to perforation for a 10 gauge metal culvert.
76 years to perforation for a 8 gauge metal culvert.

Water Soluble Sulfate Calif. Test 417	0.034% (340ppm)
Water Soluble Chloride Calif. Test 422	0.014% (140ppm)
Bicarbonate (as $CaCO_3$) (In a 1:3 water extraction)	48ppm

Laura Torres

Laura Torres
LT/dbb

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ANALYTICAL AND CONSULTING CHEMISTS

Date: May 24, 2017
Purchase Order Number: 44F1
Sales Order Number: 35882
Account Number: ALLG

To:

Allied Geotechnical Engineers
1810 Gillespie Way Ste 104
El Cajon, CA 92020
Attention: Sani Sutanto

Laboratory Number: SO6396-1 Customers Phone: 449-5900
Fax: 449-5902

Sample Designation:

One soil sample received on 05/18/17 at 11:30am, taken from North City Wastewater Treatment Plant Expansion marked as H-11#3@12-13'.

Analysis By California Test 643, 1999, Department of Transportation Division of Construction, Method for Estimating the Service Life of Steel Culverts.

pH 8.2

Water Added (ml)	Resistivity (ohm-cm)
20	1200
5	870
5	610
5	600
5	590
5	590
5	580
5	610
5	630

24 years to perforation for a 16 gauge metal culvert.
32 years to perforation for a 14 gauge metal culvert.
44 years to perforation for a 12 gauge metal culvert.
56 years to perforation for a 10 gauge metal culvert.
68 years to perforation for a 8 gauge metal culvert.

Water Soluble Sulfate Calif. Test 417	0.020% (200ppm)
Water Soluble Chloride Calif. Test 422	0.023% (230ppm)
Bicarbonate (as $CaCO_3$) (In a 1:3 water extraction)	54ppm

Laura Torres

Laura Torres
LT/ilv

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Sales Order Number: 35882
Account Number: ALLG

To:

Allied Geotechnical Engineers
1810 Gillespie Way Ste 104
El Cajon, CA 92020
Attention: Sani Sutanto

Laboratory Number: SO6396-2 Customers Phone: 449-5900
Fax: 449-5902

Sample Designation:

One soil sample received on 05/18/17 at 11:30am, taken from North City Wastewater Treatment Plant Expansion marked as H-11#10@37-38'.

Analysis By California Test 643, 1999, Department of Transportation Division of Construction, Method for Estimating the Service Life of Steel Culverts.

pH 7.9

Water Added (ml)	Resistivity (ohm-cm)
10	3600
5	1800
5	900
5	640
5	470
5	450
5	440
5	450
5	480

22 years to perforation for a 16 gauge metal culvert.
28 years to perforation for a 14 gauge metal culvert.
39 years to perforation for a 12 gauge metal culvert.
50 years to perforation for a 10 gauge metal culvert.
61 years to perforation for a 8 gauge metal culvert.

Water Soluble Sulfate Calif. Test 417	0.028% (280ppm)
Water Soluble Chloride Calif. Test 422	0.056% (560ppm)
Bicarbonate (as $CaCO_3$) (In a 1:3 water extraction)	48ppm

Laura Torres

Laura Torres
LT/ilv

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Date: May 24, 2017
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Account Number: ALLG

To:
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Allied Geotechnical Engineers
1810 Gillespie Way Ste 104
El Cajon, CA 92020
Attention: Sani Sutanto

Laboratory Number: SO6396-3 Customers Phone: 449-5900
Fax: 449-5902

Sample Designation:
--
One soil sample received on 05/18/17 at 11:30am, taken from North City Wastewater Treatment Plant Expansion marked as H-12#4@12-13'.

Analysis By California Test 643, 1999, Department of Transportation Division of Construction, Method for Estimating the Service Life of Steel Culverts.

pH 8.2

Water Added (ml)	Resistivity (ohm-cm)
10	3500
5	1500
5	870
5	560
5	450
5	420
5	440
5	460

21 years to perforation for a 16 gauge metal culvert.
28 years to perforation for a 14 gauge metal culvert.
39 years to perforation for a 12 gauge metal culvert.
49 years to perforation for a 10 gauge metal culvert.
60 years to perforation for a 8 gauge metal culvert.

Water Soluble Sulfate Calif. Test 417	0.034% (340ppm)
Water Soluble Chloride Calif. Test 422	0.043% (430ppm)
Bicarbonate (as $CaCO_3$) (In a 1:3 water extraction)	54ppm

Laura Torres

Laura Torres
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ANALYTICAL AND CONSULTING CHEMISTS

Date: June 15, 2017
Purchase Order Number: 44F1
Sales Order Number: 36150
Account Number: ALLG
To:

Allied Geotechnical Engineers
1810 Gillespie Way Ste 104
El Cajon, CA 92020
Attention: Sani Sutanto

Laboratory Number: SO6422-11 Customers Phone: 449-5900
Fax: 449-5902

Sample Designation:

One soil sample received on 06/09/17 at 9:20am, taken on 06/05/17 from North City Wastewater Treatment Plan Expansion Project#44F1 marked as H-13 #4@12'-13'

Analysis By California Test 643, 1999, Department of Transportation Division of Construction, Method for Estimating the Service Life of Steel Culverts.

pH 8.9

Water Added (ml)	Resistivity (ohm-cm)
10	2100
5	1100
5	720
5	490
5	410
5	400
5	420
5	440

21 years to perforation for a 16 gauge metal culvert.
27 years to perforation for a 14 gauge metal culvert.
38 years to perforation for a 12 gauge metal culvert.
48 years to perforation for a 10 gauge metal culvert.
59 years to perforation for a 8 gauge metal culvert.

Water Soluble Sulfate Calif. Test 417	0.045% (450ppm)
Water Soluble Chloride Calif. Test 422	0.047% (470ppm)
Bicarbonate (as $CaCO_3$) (In a 1:3 water extraction)	22ppm

Laura Torres

Laura Torres
LT/dbb

LABORATORY REPORT

Telephone (619) 425-1993 Fax 425-7917 Established 1928

CLARKSON LABORATORY AND SUPPLY INC.
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ANALYTICAL AND CONSULTING CHEMISTS

Date: June 16, 2017
Purchase Order Number: 44F1
Sales Order Number: 36150
Account Number: ALLG

To:

Allied Geotechnical Engineers
1810 Gillespie Way Ste 104
El Cajon, CA 92020
Attention: Sani Sutanto

Laboratory Number: SO6422-12 Customers Phone: 449-5900
Fax: 449-5902

Sample Designation:

One soil sample received on 06/09/17 at 9:20am, taken on 06/05/17 from North City Wastewater Treatment Plan Expansion Project#44F1 marked as H-13 #9@33'-34'.

Analysis By California Test 643, 1999, Department of Transportation Division of Construction, Method for Estimating the Service Life of Steel Culverts.

pH 8.3

Water Added (ml)	Resistivity (ohm-cm)
10	1600
5	900
5	570
5	300
5	330
5	350

19 years to perforation for a 16 gauge metal culvert.
24 years to perforation for a 14 gauge metal culvert.
34 years to perforation for a 12 gauge metal culvert.
43 years to perforation for a 10 gauge metal culvert.
52 years to perforation for a 8 gauge metal culvert.

Water Soluble Sulfate Calif. Test 417	0.024% (240ppm)
Water Soluble Chloride Calif. Test 422	0.080% (800ppm)
Bicarbonate (as $CaCO_3$) (In a 1:3 water extraction)	30ppm

Rosa M. Bernal
RMB/ilv

L A B O R A T O R Y   R E P O R T

Telephone (619) 425-1993 Fax 425-7917 Established 1928

CLARKSON LABORATORY AND SUPPLY INC.
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ANALYTICAL AND CONSULTING CHEMISTS

Date: May 24, 2017
Purchase Order Number: 44F1
Sales Order Number: 35882
Account Number: ALLG

To:

Allied Geotechnical Engineers
1810 Gillespie Way Ste 104
El Cajon, CA 92020
Attention: Sani Sutanto

Laboratory Number: SO6396-4 Customers Phone: 449-5900
Fax: 449-5902

Sample Designation:

One soil sample received on 05/18/17 at 11:30am, taken from North City Wastewater Treatment Plant Expansion marked as H-14#3@9-10'.

Analysis By California Test 643, 1999, Department of Transportation Division of Construction, Method for Estimating the Service Life of Steel Culverts.

pH 7.8

Water Added (ml)	Resistivity (ohm-cm)
10	2500
5	1100
5	580
5	390
5	320
5	350
5	370

19 years to perforation for a 16 gauge metal culvert.
25 years to perforation for a 14 gauge metal culvert.
34 years to perforation for a 12 gauge metal culvert.
44 years to perforation for a 10 gauge metal culvert.
54 years to perforation for a 8 gauge metal culvert.

Water Soluble Sulfate Calif. Test 417	0.032% (320ppm)
Water Soluble Chloride Calif. Test 422	0.068% (680ppm)
Bicarbonate (as $CaCO_3$) (In a 1:3 water extraction)	46ppm

Laura Torres

Laura Torres
LT/ilv

LABORATORY REPORT

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ANALYTICAL AND CONSULTING CHEMISTS

Date: May 24, 2017
Purchase Order Number: 44F1
Sales Order Number: 35882
Account Number: ALLG

To:

Allied Geotechnical Engineers
1810 Gillespie Way Ste 104
El Cajon, CA 92020
Attention: Sani Sutanto

Laboratory Number: SO6396-5 Customers Phone: 449-5900
Fax: 449-5902

Sample Designation:

One soil sample received on 05/18/17 at 11:30am, taken from North City Wastewater Treatment Plant Expansion marked as H-14#8@25-26'.

Analysis By California Test 643, 1999, Department of Transportation Division of Construction, Method for Estimating the Service Life of Steel Culverts.

pH 7.8

Water Added (ml)	Resistivity (ohm-cm)
10	3000
5	1400
5	770
5	500
5	400
5	350
5	380
5	400

20 years to perforation for a 16 gauge metal culvert.
26 years to perforation for a 14 gauge metal culvert.
36 years to perforation for a 12 gauge metal culvert.
46 years to perforation for a 10 gauge metal culvert.
56 years to perforation for a 8 gauge metal culvert.

Water Soluble Sulfate Calif. Test 417	0.023% (230ppm)
Water Soluble Chloride Calif. Test 422	0.042% (420ppm)
Bicarbonate (as $CaCO_3$) (In a 1:3 water extraction)	44ppm

Laura Torres

Laura Torres
LT/ilv

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ANALYTICAL AND CONSULTING CHEMISTS

Date: May 24, 2017
Purchase Order Number: 44F1
Sales Order Number: 35882
Account Number: ALLG

To:

Allied Geotechnical Engineers
1810 Gillespie Way Ste 104
El Cajon, CA 92020
Attention: Sani Sutanto

Laboratory Number: SO6396-6 Customers Phone: 449-5900
Fax: 449-5902

Sample Designation:

One soil sample received on 05/18/17 at 11:30am, taken from North City Wastewater Treatment Plant Expansion marked as H-14#17@56-59'.

Analysis By California Test 643, 1999, Department of Transportation Division of Construction, Method for Estimating the Service Life of Steel Culverts.

pH 7.7

Water Added (ml)	Resistivity (ohm-cm)
10	3100
5	1400
5	670
5	410
5	320
5	290
5	330
5	370

18 years to perforation for a 16 gauge metal culvert.
24 years to perforation for a 14 gauge metal culvert.
33 years to perforation for a 12 gauge metal culvert.
42 years to perforation for a 10 gauge metal culvert.
52 years to perforation for a 8 gauge metal culvert.

Water Soluble Sulfate Calif. Test 417	0.342% (3420ppm)
Water Soluble Chloride Calif. Test 422	0.085% (850ppm)
Bicarbonate (as $CaCO_3$) (In a 1:3 water extraction)	26ppm

Laura Torres

Laura Torres
LT/ilv

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ANALYTICAL AND CONSULTING CHEMISTS

Date: May 24, 2017
Purchase Order Number: 44F1
Sales Order Number: 35882
Account Number: ALLG

To:

Allied Geotechnical Engineers
1810 Gillespie Way Ste 104
El Cajon, CA 92020
Attention: Sani Sutanto

Laboratory Number: SO6396-7 Customers Phone: 449-5900
Fax: 449-5902

Sample Designation:

One soil sample received on 05/18/17 at 11:30am, taken from North City Wastewater Treatment Plant Expansion marked as H-15#4@12-13'.

Analysis By California Test 643, 1999, Department of Transportation Division of Construction, Method for Estimating the Service Life of Steel Culverts.

pH 8.3

Water Added (ml)	Resistivity (ohm-cm)
10	4600
5	3400
5	1300
5	780
5	590
5	530
5	520
5	590
5	640

23 years to perforation for a 16 gauge metal culvert.
30 years to perforation for a 14 gauge metal culvert.
42 years to perforation for a 12 gauge metal culvert.
54 years to perforation for a 10 gauge metal culvert.
65 years to perforation for a 8 gauge metal culvert.

Water Soluble Sulfate Calif. Test 417	0.019% (190ppm)
Water Soluble Chloride Calif. Test 422	0.030% (300ppm)
Bicarbonate (as $CaCO_3$) (In a 1:3 water extraction)	57ppm

Laura Torres

Laura Torres
LT/ilv

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ANALYTICAL AND CONSULTING CHEMISTS

Date: June 15, 2017
Purchase Order Number: 44F1
Sales Order Number: 36150
Account Number: ALLG
To:
--
Allied Geotechnical Engineers
1810 Gillespie Way Ste 104
El Cajon, CA 92020
Attention: Sani Sutanto

Laboratory Number: SO6422-13 Customers Phone: 449-5900
Fax: 449-5902
Sample Designation:
--
One soil sample received on 06/09/17 at 9:20am, taken on 06/05/17 from North City Wastewater Treatment Plan Expansion Project#44F1 marked as H-16 #3@12'-13'

Analysis By California Test 643, 1999, Department of Transportation Division of Construction, Method for Estimating the Service Life of Steel Culverts.

pH 8.3

Water Added (ml)	Resistivity (ohm-cm)
10	2800
5	1300
5	720
5	480
5	370
5	390
5	420

20 years to perforation for a 16 gauge metal culvert.
26 years to perforation for a 14 gauge metal culvert.
37 years to perforation for a 12 gauge metal culvert.
47 years to perforation for a 10 gauge metal culvert.
57 years to perforation for a 8 gauge metal culvert.

Water Soluble Sulfate Calif. Test 417	0.027% (270ppm)
Water Soluble Chloride Calif. Test 422	0.050% (500ppm)
Bicarbonate (as $CaCO_3$) (In a 1:3 water extraction)	26ppm

Laura Torres

Laura Torres
LT/dbb

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ANALYTICAL AND CONSULTING CHEMISTS

Date: May 25, 2017
Purchase Order Number: 44F1
Sales Order Number: 35882
Account Number: ALLG
To:

Allied Geotechnical Engineers
1810 Gillespie Way Ste 104
El Cajon, CA 92020
Attention: Sani Sutanto

Laboratory Number: SO6396-14 Customers Phone: 449-5900
Fax: 449-5902

Sample Designation:

One soil sample received on 05/18/17 at 11:30am, taken from North City Wastewater Treatment Plant Expansion marked as H-17#1@1-2'.

Analysis By California Test 643, 1999, Department of Transportation Division of Construction, Method for Estimating the Service Life of Steel Culverts.

pH 7.7

Water Added (ml)	Resistivity (ohm-cm)
10	5500
5	2500
5	1000
5	660
5	560
5	520
5	500
5	530
5	550

23 years to perforation for a 16 gauge metal culvert.
30 years to perforation for a 14 gauge metal culvert.
41 years to perforation for a 12 gauge metal culvert.
53 years to perforation for a 10 gauge metal culvert.
64 years to perforation for a 8 gauge metal culvert.

Water Soluble Sulfate Calif. Test 417	0.014% (140ppm)
Water Soluble Chloride Calif. Test 422	0.004% (43ppm)
Bicarbonate (as $CaCO_3$) (In a 1:3 water extraction)	N/A

Note: N/A = Unable to determine due to the texture of the soil (Clay).

Laura Torres

Laura Torres
LT/ilv

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CLARKSON LABORATORY AND SUPPLY INC.
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ANALYTICAL AND CONSULTING CHEMISTS

Date: May 24, 2017
Purchase Order Number: 44F1
Sales Order Number: 35882
Account Number: ALLG

To:

Allied Geotechnical Engineers
1810 Gillespie Way Ste 104
El Cajon, CA 92020
Attention: Sani Sutanto

Laboratory Number: SO6396-8   Customers Phone: 449-5900
Fax: 449-5902

Sample Designation:

One soil sample received on 05/18/17 at 11:30am, taken from North City Wastewater Treatment Plant Expansion marked as H-18#2@7-8'.

Analysis By California Test 643, 1999, Department of Transportation Division of Construction, Method for Estimating the Service Life of Steel Culverts.

pH 8.1

Water Added (ml)	Resistivity (ohm-cm)
10	3100
5	1500
5	840
5	450
5	350
5	300
5	340
5	370

19 years to perforation for a 16 gauge metal culvert.
24 years to perforation for a 14 gauge metal culvert.
34 years to perforation for a 12 gauge metal culvert.
43 years to perforation for a 10 gauge metal culvert.
52 years to perforation for a 8 gauge metal culvert.

Water Soluble Sulfate Calif. Test 417	0.095% (950ppm)
Water Soluble Chloride Calif. Test 422	0.062% (620ppm)
Bicarbonate (as $CaCO_3$) (In a 1:3 water extraction)	70ppm

Laura Torres

Laura Torres
LT/ilv

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ANALYTICAL AND CONSULTING CHEMISTS

Date: June 16, 2017
Purchase Order Number: 44F1
Sales Order Number: 36150
Account Number: ALLG

To:

Allied Geotechnical Engineers
1810 Gillespie Way Ste 104
El Cajon, CA 92020
Attention: Sani Sutanto

Laboratory Number: SO6422-14 Customers Phone: 449-5900
Fax: 449-5902

Sample Designation:

One soil sample received on 06/09/17 at 9:20am, taken on 06/05/17 from North City Wastewater Treatment Plan Expansion Project#44F1 marked as H-19 #2@7'-8'.

Analysis By California Test 643, 1999, Department of Transportation Division of Construction, Method for Estimating the Service Life of Steel Culverts.

pH 8.2

Water Added (ml)	Resistivity (ohm-cm)
10	1300
5	830
5	620
5	480
5	510
5	530

23 years to perforation for a 16 gauge metal culvert.
29 years to perforation for a 14 gauge metal culvert.
41 years to perforation for a 12 gauge metal culvert.
52 years to perforation for a 10 gauge metal culvert.
63 years to perforation for a 8 gauge metal culvert.

Water Soluble Sulfate Calif. Test 417	0.054% (540ppm)
Water Soluble Chloride Calif. Test 422	0.031% (310ppm)
Bicarbonate (as $CaCO_3$) (In a 1:3 water extraction)	18ppm

Rosa M. Bernal
RMB/ilv

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ANALYTICAL AND CONSULTING CHEMISTS

Date: June 16, 2017
Purchase Order Number: 44F1
Sales Order Number: 36150
Account Number: ALLG

To:

Allied Geotechnical Engineers
1810 Gillespie Way Ste 104
El Cajon, CA 92020
Attention: Sani Sutanto

Laboratory Number: SO6422-18 Customers Phone: 449-5900
Fax: 449-5902

Sample Designation:

One soil sample received on 06/09/17 at 9:20am, taken on 06/05/17 from North City Wastewater Treatment Plan Expansion Project#44F1 marked as H-20 #3@8'-9'.

Analysis By California Test 643, 1999, Department of Transportation Division of Construction, Method for Estimating the Service Life of Steel Culverts.

pH 6.4

Water Added (ml)	Resistivity (ohm-cm)
10	1100
5	640
5	430
5	320
5	300
5	280
5	340
5	390

Less than 5 years to perforation for a 16 gauge metal culvert.
6 years to perforation for a 14 gauge metal culvert.
9 years to perforation for a 12 gauge metal culvert.
11 years to perforation for a 10 gauge metal culvert.
14 years to perforation for a 8 gauge metal culvert.

Water Soluble Sulfate Calif. Test 417	0.022% (220ppm)
Water Soluble Chloride Calif. Test 422	0.107% (1070ppm)
Bicarbonate (as $CaCO_3$) (In a 1:3 water extraction)	8ppm

Rosa M. Bernal
RMB/ilv

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ANALYTICAL AND CONSULTING CHEMISTS

Date: June 16, 2017
Purchase Order Number: 44F1
Sales Order Number: 36150
Account Number: ALLG

To:
--
Allied Geotechnical Engineers
1810 Gillespie Way Ste 104
El Cajon, CA 92020
Attention: Sani Sutanto

Laboratory Number: SO6422-15 Customers Phone: 449-5900
Fax: 449-5902

Sample Designation:
--
One soil sample received on 06/09/17 at 9:20am, taken on 06/05/17 from North City Wastewater Treatment Plan Expansion Project#44F1 marked as H-21 #4@13'-14'.

Analysis By California Test 643, 1999, Department of Transportation Division of Construction, Method for Estimating the Service Life of Steel Culverts.

pH 7.3

Water Added (ml)	Resistivity (ohm-cm)
10	1500
5	920
5	580
5	460
5	430
5	480
5	560

28 years to perforation for a 16 gauge metal culvert.
36 years to perforation for a 14 gauge metal culvert.
50 years to perforation for a 12 gauge metal culvert.
64 years to perforation for a 10 gauge metal culvert.
78 years to perforation for a 8 gauge metal culvert.

Water Soluble Sulfate Calif. Test 417	0.029% (290ppm)
Water Soluble Chloride Calif. Test 422	0.045% (450ppm)
Bicarbonate (as $CaCO_3$) (In a 1:3 water extraction)	8ppm

Rosa M. Bernal
RMB/ilv

LABORATORY REPORT

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ANALYTICAL AND CONSULTING CHEMISTS

Date: June 16, 2017
Purchase Order Number: 44F1
Sales Order Number: 36150
Account Number: ALLG

To:

Allied Geotechnical Engineers
1810 Gillespie Way Ste 104
El Cajon, CA 92020
Attention: Sani Sutanto

Laboratory Number: SO6422-16 Customers Phone: 449-5900
Fax: 449-5902

Sample Designation:

One soil sample received on 06/09/17 at 9:20am, taken on 06/05/17 from North City Wastewater Treatment Plan Expansion Project#44F1 marked as H-22 #2@9'-10'.

Analysis By California Test 643, 1999, Department of Transportation Division of Construction, Method for Estimating the Service Life of Steel Culverts.

pH 6.9

Water Added (ml)	Resistivity (ohm-cm)
15	680
5	370
5	300
5	250
5	230
5	220
5	220
5	240
5	270

8 years to perforation for a 16 gauge metal culvert.
10 years to perforation for a 14 gauge metal culvert.
14 years to perforation for a 12 gauge metal culvert.
18 years to perforation for a 10 gauge metal culvert.
21 years to perforation for a 8 gauge metal culvert.

Water Soluble Sulfate Calif. Test 417	0.043% (430ppm)
Water Soluble Chloride Calif. Test 422	0.144% (1440ppm)
Bicarbonate (as $CaCO_3$) (In a 1:3 water extraction)	11ppm

Rosa M. Bernal
RMB/ilv

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ANALYTICAL AND CONSULTING CHEMISTS

Date: June 15, 2017
Purchase Order Number: 44F1
Sales Order Number: 36150
Account Number: ALLG
To:

Allied Geotechnical Engineers
1810 Gillespie Way Ste 104
El Cajon, CA 92020
Attention: Sani Sutanto

Laboratory Number: SO6422-17 Customers Phone: 449-5900
Fax: 449-5902
Sample Designation:

One soil sample received on 06/09/17 at 9:20am, taken on 06/05/17 from North City Wastewater Treatment Plan Expansion Project#44F1 marked as H-22 #10@35'-40'

Analysis By California Test 643, 1999, Department of Transportation Division of Construction, Method for Estimating the Service Life of Steel Culverts.

pH 7.4

Water Added (ml)	Resistivity (ohm-cm)
10	1700
5	1100
5	630
5	410
5	280
5	310
5	360

18 years to perforation for a 16 gauge metal culvert.
24 years to perforation for a 14 gauge metal culvert.
33 years to perforation for a 12 gauge metal culvert.
42 years to perforation for a 10 gauge metal culvert.
51 years to perforation for a 8 gauge metal culvert.

Water Soluble Sulfate Calif. Test 417	0.020% (200ppm)
Water Soluble Chloride Calif. Test 422	0.096% (960ppm)
Bicarbonate (as $CaCO_3$) (In a 1:3 water extraction)	6ppm

Laura Torres

Laura Torres
LT/ram

APPENDIX C

ANALYSES AND CALCULATIONS

APPENDIX C.1

SHEAR WAVE ANALYSIS CALCULATIONS

Boring H-1

Depth (ft)	N60 (BPF)	VS(fps)	Vsint (fps)	Vsover (fps)
5	30	1264.14213	1264.142134	1264.142134
10	50	1474.77317	1369.45765	1369.45765
15	50	1450.76562	1462.769394	1396.560307
20	50	1426.75808	1438.761849	1404.10975
25	50	1402.75053	1414.754305	1403.837906
30	50	1378.74299	1390.74676	1399.65542
35	50	1354.73544	1366.739216	1393.23828
40	50	1330.7279	1342.731671	1385.424483
45	50	1306.72035	1318.724127	1376.679579
50	50	1282.71281	1294.716582	1367.282903
55	50	1258.70527	1270.709038	1357.412208
60	50	1234.69772	1246.701493	1347.186001
65	50	1210.69018	1222.693949	1336.686322
70	50	1186.68263	1198.686404	1325.971773
75	50	1162.67509	1174.67886	1315.085327
80	50	1138.66754	1150.671315	1304.059216

Boring H-2

Depth (ft)	N60 (BPF)	VS(fps)	Vsint (fps)	Vsover (fps)
5	50	1498.781	1498.78071	1498.78071
10	21	1104.471	1301.625726	1301.625726
15	41	1357.911	1231.191037	1320.387594
20	50	1426.758	1392.334704	1346.980215
25	50	1402.751	1414.754305	1358.134279
30	50	1378.743	1390.74676	1361.569063
35	50	1354.735	1366.739216	1360.592832
40	50	1330.728	1342.731671	1356.859715
45	50	1306.72	1318.724127	1351.288675
50	50	1282.713	1294.716582	1344.431089

Boring H-3

Depth (ft)	N60 (BPF)	VS(fps)	Vsint (fps)	Vsover (fps)
5	50	1498.781	1498.78071	1498.78071
10	50	1474.773	1486.776938	1486.776938
15	50	1450.766	1462.769394	1474.773166
20	50	1426.758	1438.761849	1462.769394
25	50	1402.751	1414.754305	1450.765621
30	50	1378.743	1390.74676	1438.761849
35	50	1354.735	1366.739216	1426.758077
40	50	1330.728	1342.731671	1414.754305
45	50	1306.72	1318.724127	1402.750532
50	50	1282.713	1294.716582	1390.74676
55	50	1258.705	1270.709038	1378.742988
60	50	1234.698	1246.701493	1366.739216
65	50	1210.69	1222.693949	1354.735443
70	50	1186.683	1198.686404	1342.731671
75	50	1162.675	1174.67886	1330.727899
80	50	1138.668	1150.671315	1318.724127

Boring H-4

Depth (ft)	N60 (BPF)	VS(fps)	Vsint (fps)	Vsover (fps)
5	50	1498.78071	1498.78071	1498.78071
10	50	1474.77317	1486.776938	1486.776938
15	50	1450.76562	1462.769394	1474.773166
20	50	1426.75808	1438.761849	1462.769394
25	50	1402.75053	1414.754305	1450.765621
30	50	1378.74299	1390.74676	1438.761849
35	50	1354.73544	1366.739216	1426.758077
40	50	1330.7279	1342.731671	1414.754305
45	50	1306.72035	1318.724127	1402.750532
50	50	1282.71281	1294.716582	1390.74676

Boring H-5

Depth (ft)	N60 (BPF)	VS(fps)	Vsint (fps)	Vsover (fps)
5	44	1436.264	1436.263651	1436.263651
10	23	1138.472	1287.367902	1287.367902
15	47	1421.153	1279.812467	1331.962862
20	50	1426.758	1423.955429	1355.661665
25	50	1402.751	1414.754305	1365.079439
30	50	1378.743	1390.74676	1367.356697
35	50	1354.735	1366.739216	1365.553661
40	50	1330.728	1342.731671	1361.200441
45	50	1306.72	1318.724127	1355.147098
50	50	1282.713	1294.716582	1347.903669

Boring H-6

Depth (ft)	N60 (BPF)	VS(fps)	Vsint (fps)	Vsover (fps)
5	18	1066.237	1066.236925	1066.236925
10	37	1333.952	1200.094396	1200.094396
15	33	1263.139	1298.545586	1221.109365
20	42	1346.209	1304.674364	1252.38438
25	44	1344.239	1345.22425	1270.755319
30	50	1378.743	1361.491033	1288.753264
35	50	1354.735	1366.739216	1298.17929
40	50	1330.728	1342.731671	1302.247866
45	50	1306.72	1318.724127	1302.744809
50	50	1282.713	1294.716582	1300.741609

Boring H-7

Depth (ft)	N60 (BPF)	VS(fps)	Vsint (fps)	Vsover (fps)
5	7	778.292005	778.2920052	778.2920052
10	50	1474.77317	1126.532585	1126.532585
15	50	1450.76562	1462.769394	1234.610264
20	50	1426.75808	1438.761849	1282.647217
25	50	1402.75053	1414.754305	1306.66788
30	50	1378.74299	1390.74676	1318.680398
35	50	1354.73544	1366.739216	1323.831119
40	50	1330.7279	1342.731671	1324.693216
45	50	1306.72035	1318.724127	1322.696232
50	50	1282.71281	1294.716582	1318.69789
55	50	1258.70527	1270.709038	1313.244015
60	50	1234.69772	1246.701493	1306.69849
65	50	1210.69018	1222.693949	1299.313235
70	50	1186.68263	1198.686404	1291.268192
75	50	1162.67509	1174.67886	1282.695319
80	50	1138.66754	1150.671315	1273.693583
85	50	1114.66	1126.663771	1264.338666
90	50	1090.65245	1102.656226	1254.689432
95	50	1066.64491	1078.648682	1244.792352
100	50	1042.63737	1054.641137	1234.684602

Boring H-8

Depth (ft)	N60 (BPF)	VS(fps)	Vsint (fps)	Vsover (fps)
5	23	1157.005	1157.005119	1157.005119
10	28	1215.616	1186.310403	1186.310403
15	32	1250.251	1232.9331	1207.623773
20	32	1229.561	1239.90582	1213.108112
25	30	1183.146	1206.353448	1207.115643
30	44	1321.233	1252.189351	1226.135192
35	32	1167.493	1244.362959	1217.757733
40	42	1255.601	1211.546839	1222.488104
45	23	1008.741	1132.171044	1198.738469
50	40	1190.774	1099.75767	1197.942017
55	41	1178.144	1184.458744	1196.142155

Boring H-9

Depth (ft)	N60 (BPF)	VS(fps)	Vsint (fps)	Vsover (fps)
5	25	1189.611	1189.610524	1189.610524
10	15	987.3014	1088.455948	1088.455948
15	20	1068.966	1028.133636	1081.959265
20	44	1367.245	1218.10556	1153.280754
25	50	1402.751	1384.997877	1203.17471
30	50	1378.743	1390.74676	1232.43609
35	50	1354.735	1366.739216	1249.907426
40	50	1330.728	1342.731671	1260.009985
45	50	1306.72	1318.724127	1265.200026
50	31	1093.789	1200.254716	1248.058931
55	50	1258.705	1176.247171	1249.02678
60	50	1234.698	1246.701493	1247.832691
65	50	1210.69	1222.693949	1244.975575
70	50	1186.683	1198.686404	1240.811793
75	50	1162.675	1174.67886	1235.60268
80	50	1138.668	1150.671315	1229.544234

Boring H-10

Depth (ft)	N60 (BPF)	VS(fps)	Vsint (fps)	Vsover (fps)
5	10	876.5393	876.5392998	876.5392998
10	29	1229.91692	1053.228111	1053.228111
15	15	971.229287	1100.573105	1025.89517
20	26	1147.3456	1059.287443	1056.257777
25	21	1050.53235	1098.938975	1055.112692
30	20	1015.89755	1033.214949	1048.576834
35	50	1354.73544	1185.316495	1092.313778
40	50	1330.7279	1342.731671	1122.115544
45	50	1306.72035	1318.724127	1142.627189
50	50	1282.71281	1294.716582	1156.635751
55	50	1258.70527	1270.709038	1165.914798
60	50	1234.69772	1246.701493	1171.646708
65	50	1210.69018	1222.693949	1174.650052
70	50	1186.68263	1198.686404	1175.509522
75	50	1162.67509	1174.67886	1174.653893
80	50	1138.66754	1150.671315	1172.404746

Boring H-11

Depth (ft)	N60 (BPF)	VS(fps)	Vsint (fps)	Vsover (fps)
5	30	1264.142	1264.142134	1264.142134
10	14	964.8571	1114.499619	1114.499619
15	31	1237.09	1100.973708	1155.363183
20	30	1203.395	1220.242585	1167.371102
25	30	1183.146	1193.270312	1170.526035
30	30	1162.897	1173.02122	1169.254475
35	30	1142.648	1152.772128	1165.45349
40	50	1330.728	1236.687741	1186.112791
45	50	1306.72	1318.724127	1199.513631
50	50	1282.713	1294.716582	1207.833549
55	50	1258.705	1270.709038	1212.458251
60	50	1234.698	1246.701493	1214.31154
65	50	1210.69	1222.693949	1214.032974
70	50	1186.683	1198.686404	1212.079378
75	50	1162.675	1174.67886	1208.785758
80	50	1138.668	1150.671315	1204.40337

Boring H-12

Depth (ft)	N60 (BPF)	VS(fps)	Vsint (fps)	Vsover (fps)
5	42	1414.166	1414.165966	1414.165966
10	14	964.8571	1189.511535	1189.511535
15	17	1012.603	988.7300156	1130.541999
20	20	1051.276	1031.939688	1110.725611
25	44	1344.239	1197.757763	1157.428305
30	50	1378.743	1361.491033	1194.314085
35	50	1354.735	1366.739216	1217.231422
40	50	1330.728	1342.731671	1231.418482
45	50	1306.72	1318.724127	1239.785357
50	50	1282.713	1294.716582	1244.078102
55	50	1258.705	1270.709038	1245.407844
60	50	1234.698	1246.701493	1244.515334
65	50	1210.69	1222.693949	1241.913399
70	50	1186.683	1198.686404	1237.968344
75	50	1162.675	1174.67886	1232.948793
80	50	1138.668	1150.671315	1227.056215

Boring H-13

Depth (ft)	N60 (BPF)	VS(fps)	Vsint (fps)	Vsover (fps)
5	20	1104.3448	1104.344799	1104.344799
10	21	1104.47074	1104.40777	1104.40777
15	30	1223.64395	1164.057346	1144.153163
20	19	1033.45653	1128.550239	1116.479004
25	33	1221.33397	1127.395247	1137.449997
30	39	1269.16605	1245.250011	1159.402673
35	34	1191.32351	1230.244784	1163.962793
40	50	1330.7279	1261.025706	1184.808432
45	50	1306.72035	1318.724127	1198.354201
50	50	1282.71281	1294.716582	1206.790062
55	50	1258.70527	1270.709038	1211.509626
60	50	1234.69772	1246.701493	1213.441967
65	50	1210.69018	1222.693949	1213.230291
70	50	1186.68263	1198.686404	1211.334029
75	50	1162.67509	1174.67886	1208.0901
80	50	1138.66754	1150.671315	1203.75119

Boring H-14

Depth (ft)	N60 (BPF)	VS(fps)	Vsint (fps)	Vsover (fps)
5	14	980.5638	980.5638242	980.5638242
10	15	987.3014	983.9325986	983.9325986
15	14	949.1504	968.2258782	972.3385268
20	50	1426.758	1187.95423	1085.943414
25	21	1050.532	1238.645214	1078.861202
30	50	1378.743	1214.637669	1128.841499
35	50	1354.735	1366.739216	1161.112063
40	50	1330.728	1342.731671	1182.314042
45	50	1306.72	1318.724127	1196.136966
50	50	1282.713	1294.716582	1204.79455
55	50	1258.705	1270.709038	1209.695524
60	50	1234.698	1246.701493	1211.779041
65	50	1210.69	1222.693949	1211.695282
70	50	1186.683	1198.686404	1209.908664
75	50	1162.675	1174.67886	1206.759759
80	50	1138.668	1150.671315	1202.503995

Boring H-15

Depth (ft)	N60 (BPF)	VS(fps)	Vsint (fps)	Vsover (fps)
5	50	1498.781	1498.78071	1498.78071
10	50	1474.773	1486.776938	1486.776938
15	50	1450.766	1462.769394	1474.773166
20	50	1426.758	1438.761849	1462.769394
25	50	1402.751	1414.754305	1450.765621
30	50	1378.743	1390.74676	1438.761849
35	50	1354.735	1366.739216	1426.758077
40	50	1330.728	1342.731671	1414.754305
45	50	1306.72	1318.724127	1402.750532
50	50	1282.713	1294.716582	1390.74676
55	50	1258.705	1270.709038	1378.742988
60	50	1234.698	1246.701493	1366.739216
65	50	1210.69	1222.693949	1354.735443
70	50	1186.683	1198.686404	1342.731671
75	50	1162.675	1174.67886	1330.727899
80	50	1138.668	1150.671315	1318.724127

Boring H-16

Depth (ft)	N60 (BPF)	VS(fps)	Vsint (fps)	Vsover (fps)
5	50	1498.78071	1498.78071	1498.78071
10	50	1474.77317	1486.776938	1486.776938
15	50	1450.76562	1462.769394	1474.773166
20	50	1426.75808	1438.761849	1462.769394
25	50	1402.75053	1414.754305	1450.765621
30	50	1378.74299	1390.74676	1438.761849
35	50	1354.73544	1366.739216	1426.758077
40	50	1330.7279	1342.731671	1414.754305
45	50	1306.72035	1318.724127	1402.750532
50	50	1282.71281	1294.716582	1390.74676
55	50	1258.70527	1270.709038	1378.742988
60	50	1234.69772	1246.701493	1366.739216
65	50	1210.69018	1222.693949	1354.735443
70	50	1186.68263	1198.686404	1342.731671
75	50	1162.67509	1174.67886	1330.727899
80	50	1138.66754	1150.671315	1318.724127

Boring H-17

Depth (ft)	N60 (BPF)	VS(fps)	Vsint (fps)	Vsover (fps)
5	50	1498.781	1498.78071	1498.78071
10	50	1474.773	1486.776938	1486.776938
15	50	1450.766	1462.769394	1474.773166
20	50	1426.758	1438.761849	1462.769394
25	50	1402.751	1414.754305	1450.765621
30	50	1378.743	1390.74676	1438.761849
35	50	1354.735	1366.739216	1426.758077
40	50	1330.728	1342.731671	1414.754305
45	50	1306.72	1318.724127	1402.750532
50	50	1282.713	1294.716582	1390.74676
55	50	1258.705	1270.709038	1378.742988
60	50	1234.698	1246.701493	1366.739216
65	50	1210.69	1222.693949	1354.735443
70	50	1186.683	1198.686404	1342.731671
75	50	1162.675	1174.67886	1330.727899
80	50	1138.668	1150.671315	1318.724127

Boring H-18

Depth (ft)	N60 (BPF)	VS(fps)	Vsint (fps)	Vsover (fps)
5	50	1498.781	1498.78071	1498.78071
10	50	1474.773	1486.776938	1486.776938
15	50	1450.766	1462.769394	1474.773166
20	50	1426.758	1438.761849	1462.769394
25	50	1402.751	1414.754305	1450.765621
30	50	1378.743	1390.74676	1438.761849
35	50	1354.735	1366.739216	1426.758077
40	50	1330.728	1342.731671	1414.754305
45	50	1306.72	1318.724127	1402.750532
50	50	1282.713	1294.716582	1390.74676
55	50	1258.705	1270.709038	1378.742988
60	50	1234.698	1246.701493	1366.739216
65	50	1210.69	1222.693949	1354.735443
70	50	1186.683	1198.686404	1342.731671
75	50	1162.675	1174.67886	1330.727899
80	50	1138.668	1150.671315	1318.724127

Boring H-19

Depth (ft)	N60 (BPF)	VS(fps)	Vsint (fps)	Vsover (fps)
5	50	1498.78071	1498.78071	1498.78071
10	50	1474.77317	1486.776938	1486.776938
15	50	1450.76562	1462.769394	1474.773166
20	50	1426.75808	1438.761849	1462.769394
25	50	1402.75053	1414.754305	1450.765621
30	50	1378.74299	1390.74676	1438.761849
35	50	1354.73544	1366.739216	1426.758077
40	50	1330.7279	1342.731671	1414.754305
45	50	1306.72035	1318.724127	1402.750532
50	50	1282.71281	1294.716582	1390.74676
55	50	1258.70527	1270.709038	1378.742988
60	50	1234.69772	1246.701493	1366.739216
65	50	1210.69018	1222.693949	1354.735443
70	50	1186.68263	1198.686404	1342.731671
75	50	1162.67509	1174.67886	1330.727899
80	50	1138.66754	1150.671315	1318.724127

Boring H-20

Depth (ft)	N60 (BPF)	VS(fps)	Vsint (fps)	Vsover (fps)
5	50	1498.781	1498.78071	1498.78071
10	50	1474.773	1486.776938	1486.776938
15	50	1450.766	1462.769394	1474.773166
20	50	1426.758	1438.761849	1462.769394
25	50	1402.751	1414.754305	1450.765621
30	50	1378.743	1390.74676	1438.761849
35	50	1354.735	1366.739216	1426.758077
40	50	1330.728	1342.731671	1414.754305
45	50	1306.72	1318.724127	1402.750532
50	50	1282.713	1294.716582	1390.74676
55	50	1258.705	1270.709038	1378.742988
60	50	1234.698	1246.701493	1366.739216
65	50	1210.69	1222.693949	1354.735443
70	50	1186.683	1198.686404	1342.731671
75	50	1162.675	1174.67886	1330.727899
80	50	1138.668	1150.671315	1318.724127

Boring H-21

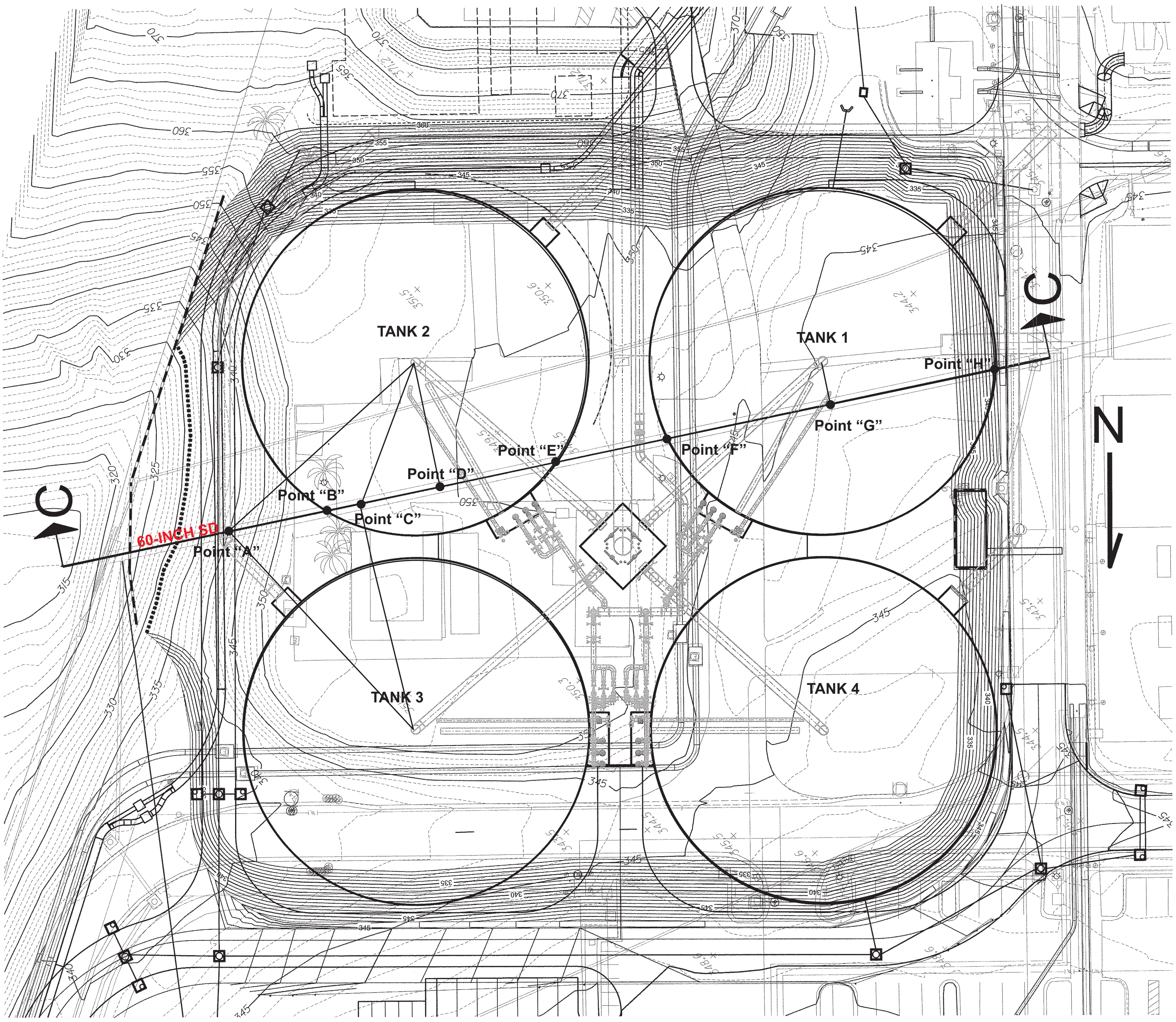
Depth (ft)	N60 (BPF)	VS(fps)	Vsint (fps)	Vsover (fps)
5	50	1498.781	1498.78071	1498.78071
10	50	1474.773	1486.776938	1486.776938
15	50	1450.766	1462.769394	1474.773166
20	50	1426.758	1438.761849	1462.769394
25	50	1402.751	1414.754305	1450.765621
30	50	1378.743	1390.74676	1438.761849
35	50	1354.735	1366.739216	1426.758077
40	50	1330.728	1342.731671	1414.754305
45	50	1306.72	1318.724127	1402.750532
50	50	1282.713	1294.716582	1390.74676
55	50	1258.705	1270.709038	1378.742988
60	50	1234.698	1246.701493	1366.739216
65	50	1210.69	1222.693949	1354.735443
70	50	1186.683	1198.686404	1342.731671
75	50	1162.675	1174.67886	1330.727899
80	50	1138.668	1150.671315	1318.724127

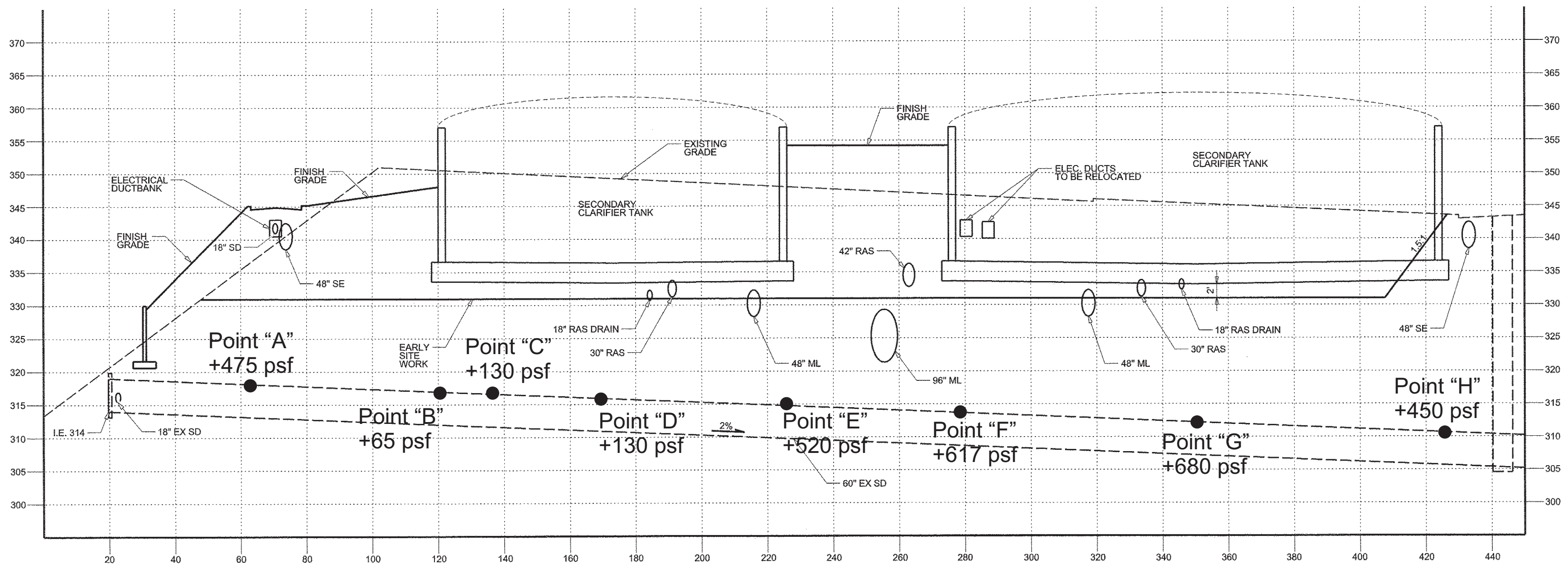
Boring H-22

Depth (ft)	N60 (BPF)	VS(fps)	Vsint (fps)	Vsover (fps)
5	50	1498.78071	1498.78071	1498.78071
10	50	1474.77317	1486.776938	1486.776938
15	50	1450.76562	1462.769394	1474.773166
20	50	1426.75808	1438.761849	1462.769394
25	50	1402.75053	1414.754305	1450.765621
30	50	1378.74299	1390.74676	1438.761849
35	50	1354.73544	1366.739216	1426.758077
40	50	1330.7279	1342.731671	1414.754305
45	50	1306.72035	1318.724127	1402.750532
50	50	1282.71281	1294.716582	1390.74676
55	50	1258.70527	1270.709038	1378.742988
60	50	1234.69772	1246.701493	1366.739216
65	50	1210.69018	1222.693949	1354.735443
70	50	1186.68263	1198.686404	1342.731671
75	50	1162.67509	1174.67886	1330.727899
80	50	1138.66754	1150.671315	1318.724127

APPENDIX C.2

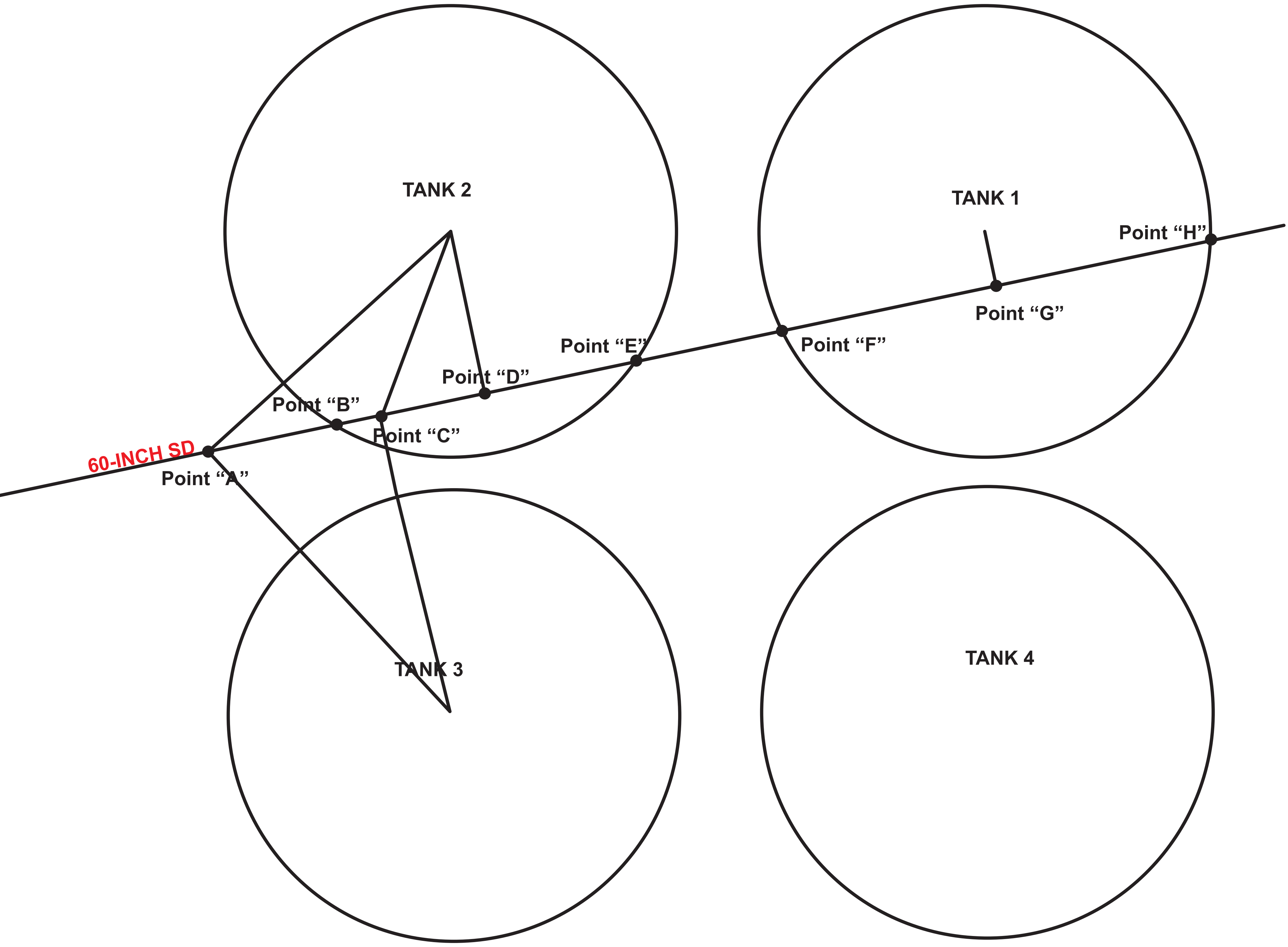
CALCULATIONS OF ADDITIONAL LOAD ON 60-INCH DIAMETER STORM DRAIN





SECTION C-C

SCALE H: 1" = 20' V: 1" = 10'



Calculation Performed By: Sani Sutanto
Calculation Performed On: May 19, 2017
Project Name: North City Wastewater Treatment Plant Expansion
Project No. 44F1
Page 1 of 9
ALLIED GEOTECHNICAL ENGINEERS, INC.

Point "A"

Load from additional fill treated as edge load of uniformly loaded rectangular area.
q = 10' x 110 pcf = 1,100 psf
Horizontal dimensions: a = 20' & b = 100'
Distance between bottom of new fill and top of pipe = 17'
m = a/z = 20/17 = 1.2
n = (b/2)/z = 50/17 = 3
Fz = 0.21633 (Boussinesq)
Load from additional fill = 2 x 0.21633 x 1,100 psf = 475 psf

Contribution from Tank 2
Radius (r) = 80'
Depth from bottom of raft foundation to top of pipe (z) = 15'
Distance from center to Point "A" (a) = 114'
Additional foundation load = 2,000 psf - (16 x 110 psf) = 240 psf
m = z/r = 15/80 = 0.19
n = a/r = 114/80 = 1.425
Nz = 0% (Foster and Ahlvin, 1954)
Qz = pressure at Point "A" due to foundation load =
240 psf x 0% = 0 psf.

Contribution from Tank 3
Radius (r) = 80'
Depth from bottom of raft foundation to top of pipe (z) = 15'
Distance from center to Point "A" (a) = 110'
Foundation Pressure = 240 psf (assume the same as Tank 2)
m = z/r = 15/80 = 0.19
n = a/r = 110/80 = 1.375
Nz = 0% (Foster and Ahlvin, 1954)
Qz = pressure at Point "A" due to foundation load =
240 psf x 0% = 0 psf.

Conclusion:

Additional foundation load at Point "A" is estimated to be 475 psf

Point “B”

Contribution from Tank 2
Radius (r) = 80’
Depth from bottom of raft foundation to top of pipe (z) = 15’
Distance from center to Point “B” (a) = 80’
Foundation Pressure = 2,000 psf
m = z/r = 15/80 = 0.19
n = a/r = 80/80 = 1.0
Nz = 50% (Foster and Ahlvin, 1954)
Qz = pressure at Point “B” due to foundation load =
2,000 psf x 50% = 1,000 psf.

Contribution from Tank 3
Radius (r) = 80’
Depth from bottom of raft foundation to top of pipe (z) = 15’
Distance from center to Point “B” (a) = 106’
m = z/r = 15/80 = 0.19
n = a/r = 106/80 = 1.325
Nz = 0% (Foster and Ahlvin, 1954) - no contribution

Soil surcharge load removed = (17’ x 110 pcf)/2 = 935 psf

Conclusion:
Additional foundation load at Point “B” is estimated to be 1,000 psf - 935 psf = 65 psf

Point “C”

Contribution from Tank 2
Radius (r) = 80’
Depth from bottom of raft foundation to top of pipe (z) = 15’
Distance from center to Point “C” (a) = 66’
Foundation Pressure = 2,000 psf
m = z/r = 15/80 = 0.19
n = a/r = 66/80 = 0.825
Nz = 100% (Foster and Ahlvin, 1954)
Qz = pressure at Point “C” due to foundation load =
2,000 psf x 100% = 2,000 psf.

Contribution from Tank 3
Radius (r) = 80’
Depth from bottom of raft foundation to top of pipe (z) = 15’
Distance from center to Point “C” (a) = 104’
m = z/r = 15/80 = 0.19
n = a/r = 104/80 = 1.3
Nz = 0% (Foster and Ahlvin, 1954) - no contribution

Soil surcharge load removed = 17’ x 110 pcf = 1,870 psf

Conclusion:

Additional foundation load at Point “C” is estimated to be 2,000 psf - 1,870 psf = 130 psf

Point “D”

Radius (r) = 80’
Depth from bottom of raft foundation to top of pipe (z) = 17’
Distance from center to Point “D” (a) = 54’
Foundation Pressure = 2,000 psf
$m = z/r = 17/80 = 0.21$
$n = a/r = 54/80 = 0.675$
Nz = 100% (Foster and Ahlvin, 1954)
Qz = pressure at Point “D” due to foundation load =
2,000 psf x 100% = 2,000 psf.
Soil surcharge load removed = 17’ x 110 pcf = 1,870 psf

Conclusion:

Additional foundation load at Point “D” is estimated to be 2,000 psf - 1,870 psf = 130 psf

Point “E”

Radius (r) = 80’
Depth from bottom of raft foundation to top of pipe (z) = 19’
Distance from center to Point “E” (a) = 80’
Foundation Pressure = 2,000 psf
m = z/r = 19/80 = 0.2375
n = a/r = 80/80 = 1
Nz = 50% (Foster and Ahlvin, 1954)
Qz = pressure at Point “E” due to foundation load =
2,000 psf x 50% = 1,000 psf.

Soil surcharge load removed = (14’ x 110 pcf)/2 = 770 psf

Load from additional fill treated as edge load of uniformly loaded rectangular area.
q = 6’ x 110 pcf = 660 psf
Depth from bottom of new fill to top of pipe (z) = 33’
Horizontal dimensions: a = 50 feet and b = 100 feet
m = a/z = 50/33 = 1.52
n = (b/2)/z = 50/33 = 1.52
Fz = 0.22025 (Boussinesq)
Load from additional fill = 2 x 0.22025 x 660 psf = 290 psf

Conclusion:

Additional load at Point “E” is estimated to be equal to:
1,000 psf + 290 psf - 770 psf = 520 psf.

Point "F"
Radius (r) = 80'
Depth from bottom of raft foundation to top of pipe (z) = 19'
Distance from center to Point "F" = 80'
Foundation Pressure = 2,000 psf
m = z/r = 19/80 = 0.2375
n = a/r = 80/80 = 1
Nz = 50% (Foster and Ahlvin, 1954)
Qz = pressure at Point "F" due to foundation load =
2,000 psf x 50% = 1,000 psf.

Soil surcharge load removed = (14' x 110 pcf)/2 = 770 psf

Load from additional fill treated as edge load of uniformly loaded rectangular area.
q = 8' x 110 pcf = 880 psf
Depth from bottom of new fill to top of pipe (z) = 32'
Horizontal dimensions: a = 50 feet and b = 100 feet
m = a/z = 50/32 = 1.56
n = (b/2)/z = 50/32 = 1.56
Fz = 0.22025 (Boussinesq)
Load from additional fill = 2 x 0.22025 x 880 psf = 387 psf

Conclusion:
Additional load at Point "F" is estimated to be equal to:
1,000 psf + 387 psf - 770 psf = 617 psf.

<u>Point “G”</u>

Radius (r) = 80’
Depth from bottom of raft foundation to top of pipe (z) = 20’
Distance from center to Point “G” (a) = 18’
Foundation Pressure = 2,000 psf
m = z/r = 20/80 = 0.25
n = a/r = 18/80 = 0.225
Nz = 100% (Foster and Ahlvin, 1954)
Qz = pressure at Point “G” due to foundation load =
2,000 psf x 100% = 2,000 psf.
Soil surcharge load removed = 12’ x 110 pcf = 1,320 psf

<u>Conclusion:</u>

Additional foundation load at Point “G” is estimated to be 2,000 psf - 1,320 psf = 680 psf

Point “H”

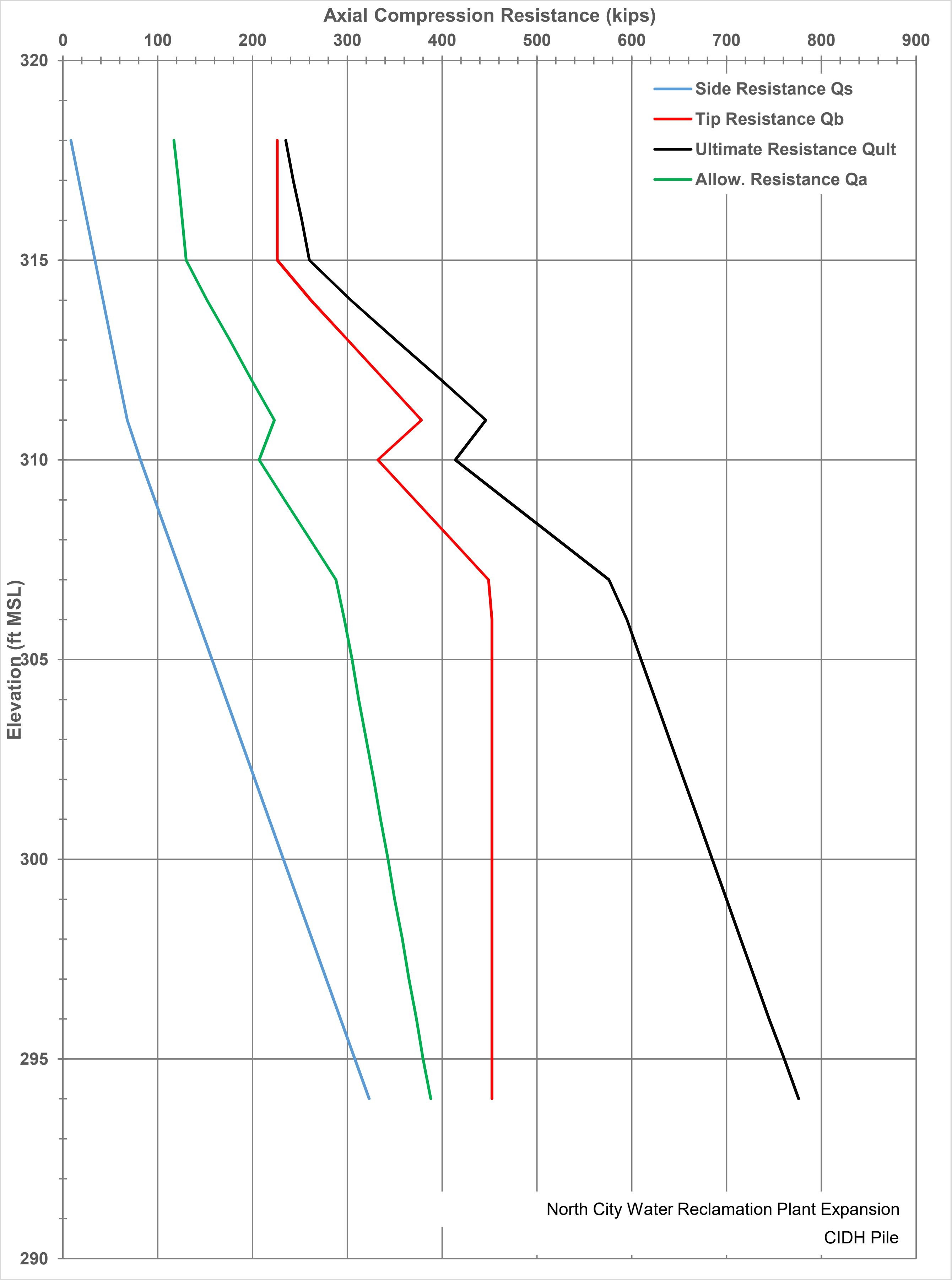
Radius (r) = 80’
Depth from bottom of raft foundation to top of pipe (z) = 23’
Distance from center to Point “H” (a) = 80’
Foundation Pressure = 2,000 psf
m = z/r = 23/80 = 0.2875
n = a/r = 80/80 = 1
Nz = 50% (Foster and Ahlvin, 1954)
Qz = pressure at Point “H” due to foundation load =
2,000 psf x 50% = 1,000 psf.
Soil surcharge load removed = (10’ x 110 pcf)/2 = 550 psf

Conclusion:

Additional foundation load at Point “H” is estimated to be 1,000 psf - 550 psf = 450 psf

APPENDIX C.3

36-INCH DIAMETER CIDH PILE CALCULATIONS



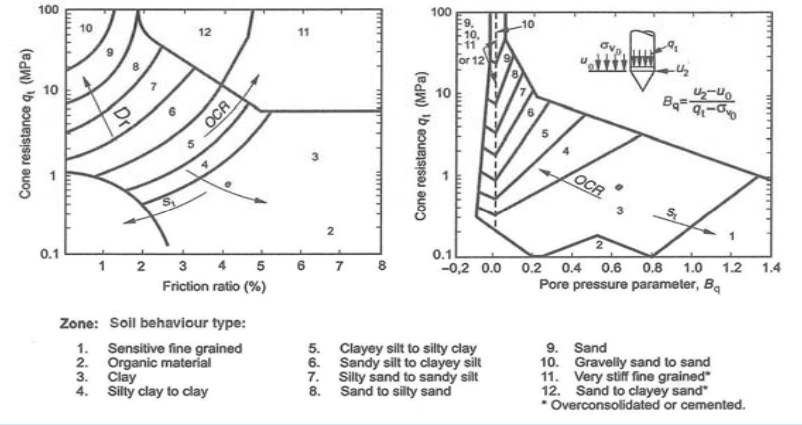
North City Water Reclamation Plant Expansion

CIDH Pile

CIDH PILE CALCULATION

Project No:	44F1	**Analysis Title:**	CIDH Pile	Rev. No:	0
Project:	North City Water Reclamation Plant Expansion	**By:**	SS	Date:	5/20/2017
Location:	North City Water Reclamation Plant	**Checked By:**		Date:	

Soil Behavior Type	1986 SBT	q_t (tsf)/N_{60}	W_s	W_t
Sensitive Fine-Grained	1	2	0	0
Organic Material	2	1	0	0
Clay	3	1	0	0
Silty Clay to Clay	4	1.5	0	0
Clayey Silt to Silty Clay	5	2	0	0
Sandy Silt to Clayey Silt	6	2.3	0.1	3
Silty Sand to Sandy Silt	7	3	0.2	6
Sand to Silty Sand	8	4	0.3	9
Sand	9	5	0.4	12
Gravelly Sand to Sand	10	6	0.5	15
Very Stiff Fine Grained	11	1	0.2	6
Sand to Clayey Sand	12	2	0.15	4.5



D_{pile} (in.)	36
$4D_{pile}$ (ft)	12.0
A_s (ft^2)	9.42
A_t (ft^2)	7.07

FS (Side)	2
FS (Tip)	2
Target R_a	375 kips

Depth (ft)	Elev. (ft)	1986 SBT	CPT q_t (tsf)	Lim. q_t (tsf)	f_{s1} (ksf)	W_s (tsf)	f_s (ksf)	R_{si} (kips)	ΣR_{si} (kips)	Toe Ave. q_t (tsf)	q_{b1} (ksf)	W_t (tsf)	q_b (ksf)	R_t (kips)	R_{ult} (kips)	R_a (kips)
0	319		0	0												
1	318	7	25	25	0.50	0.2	0.90	8.48	8.48	25.00	20.00	6	32.00	226.24	235	117
2	317	7	25	25	0.50	0.2	0.90	8.48	16.96	25.00	20.00	6	32.00	226.24	243	122
3	316	7	25	25	0.50	0.2	0.90	8.48	25.43	25.00	20.00	6	32.00	226.24	252	126
4	315	7	25	25	0.50	0.2	0.90	8.48	33.91	25.00	20.00	6	32.00	226.24	260	130
5	314	7	25	25	0.50	0.2	0.90	8.48	42.39	31.25	25.00	6	37.00	261.59	304	152
6	313	7	25	25	0.50	0.2	0.90	8.48	50.87	38.13	30.50	6	42.50	300.48	351	176
7	312	7	25	25	0.50	0.2	0.90	8.48	59.35	45.00	36.00	6	48.00	339.36	399	199
8	311	7	25	25	0.50	0.2	0.90	8.48	67.82	51.88	41.50	6	53.50	378.25	446	223
9	310	5	75	75	1.50	0	1.50	14.13	81.95	58.75	47.00	0	47.00	332.29	414	207
10	309	5	80	80	1.60	0	1.60	15.07	97.03	65.63	52.50	0	52.50	371.18	468	234
11	308	5	80	80	1.60	0	1.60	15.07	112.10	72.50	58.00	0	58.00	410.06	522	261
12	307	5	80	80	1.60	0	1.60	15.07	127.17	79.38	63.50	0	63.50	448.95	576	288
13	306	5	80	80	1.60	0	1.60	15.07	142.24	80.00	64.00	0	64.00	452.48	595	297
14	305	5	80	80	1.60	0	1.60	15.07	157.31	80.00	64.00	0	64.00	452.48	610	305
15	304	5	80	80	1.60	0	1.60	15.07	172.39	80.00	64.00	0	64.00	452.48	625	312
16	303	5	80	80	1.60	0	1.60	15.07	187.46	80.00	64.00	0	64.00	452.48	640	320
17	302	5	80	80	1.60	0	1.60	15.07	202.53	80.00	64.00	0	64.00	452.48	655	328
18	301	5	80	80	1.60	0	1.60	15.07	217.60	80.00	64.00	0	64.00	452.48	670	335
19	300	5	80	80	1.60	0	1.60	15.07	232.67	80.00	64.00	0	64.00	452.48	685	343
20	299	5	80	80	1.60	0	1.60	15.07	247.75	80.00	64.00	0	64.00	452.48	700	350
21	298	5	80	80	1.60	0	1.60	15.07	262.82	80.00	64.00	0	64.00	452.48	715	358
22	297	5	80	80	1.60	0	1.60	15.07	277.89	80.00	64.00	0	64.00	452.48	730	365
23	296	5	80	80	1.60	0	1.60	15.07	292.96	80.00	64.00	0	64.00	452.48	745	373
24	295	5	80	80	1.60	0	1.60	15.07	308.03	80.00	64.00	0	64.00	452.48	761	**380**
25	294	5	80	80	1.60	0	1.60	15.07	323.11	80.00	64.00	0	64.00	452.48	776	**388**

APPENDIX C.4

INFILTRATION RATE BASED ON PARTICLE SIZE DISTRIBUTION

Project Name: **North City Water Reclamation Plant Expansion**
Project No. **44F1**

Subject: **Soil Infiltration Rate Estimate (Hazen 1892 & Cronican and Gribb 2004)**

Formula: Ks = c (d10^2)
Ks = Hydraulic Conductivity (cm/sec)
c = Constant which varies between 1.0 and 1.5. A value of 1.0 is selected for this project.
d10 = Particle size diameter for which 10% (by mass) of the particles in a soil sample are finer (mm)

	Min Inf Rate	**Max Inf. Rate**	**Median Inf. Rate**
Soil ID	**(inch/hour)**		
Fill	0.0024	1.45	0.0028
Qvop	0.0028	0.6073	*
Scripps	0.0017	1.45	0.0024

NOTE:
* Insufficient sample size

Boring #	**H-2**
Sample #	**3**
Depth	**11-15 ft**
Soil ID	**Fill**

Dia (mm)	**% pass**
152.4	
127	
101.6	
76.2	
50.8	100
38.1	99.3
19.05	98.6
12.7	89.7
9.525	81.7
4.75 (#4)	67.8
2.38 (#8)	61.1
2.0 (#10)	59.8
1.18 (#16)	56.3
0.6 (#30)	52.4
0.42 (#40)	46.8
0.3 (#50)	39.3
0.15 (#100)	26.1
.075 (#200)	19.3

Cu = 214.2
Cc= 4.9
D10= 0.032
Ks= 0.001024 cm/sec
Ks= 1.4513 inch/hour

Boring #	**H-3**
Sample #	**8**
Depth	**41-41.5 ft.**
Soil ID	**Scripps**

Dia (mm)	**% pass**
152.4	
127	
101.6	
76.2	
50.8	
38.1	
19.05	
12.7	
9.525	
4.75 (#4)	100
2.38 (#8)	99.7
2.0 (#10)	99.5
1.18 (#16)	93.1
0.6 (#30)	92.1
0.42 (#40)	91.3
0.3 (#50)	90.6
0.15 (#100)	87.3
.075 (#200)	66.5

Cu = 25.7
Cc= 0.5
D10= 0.0014
Ks= 1.96E-06 cm/sec
Ks= 0.0028 inch/hour

Boring #	**H-3**
Sample #	**13**
Depth	**65.5-66 ft.**
Soil ID	**Scripps**

Dia (mm)	**% pass**
152.4	
127	
101.6	
76.2	
50.8	
38.1	
19.05	
12.7	
9.525	
4.75 (#4)	
2.38 (#8)	
2.0 (#10)	
1.18 (#16)	100
0.6 (#30)	99.9
0.42 (#40)	99.7
0.3 (#50)	84.8
0.15 (#100)	35.8
.075 (#200)	15.8

Cu =	12.6	
Cc=	5.1	
D10=	0.032	
Ks=	0.001024	cm/sec
Ks=	1.4513	inch/hour

Boring # **H-4**
Sample # **1**
Depth **3-6 ft.**
Soil ID **Qvop**

Dia (mm)	**% pass**
152.4	
127	
101.6	
76.2	
50.8	
38.1	
19.05	
12.7	
9.525	100
4.75 (#4)	98.8
2.38 (#8)	96.4
2.0 (#10)	96
1.18 (#16)	94.6
0.6 (#30)	92.4
0.42 (#40)	84.6
0.3 (#50)	72.3
0.15 (#100)	51.3
.075 (#200)	42.5

Cu =	72.4	
Cc=	0.8	
D10=	0.0014	
Ks=	1.96E-06	cm/sec
Ks=	0.0028	inch/hour

Boring # **H-5**
Sample # **2**
Depth **4-7 ft.**
Soil ID **Fill**

Dia (mm)	**% pass**
152.4	
127	
101.6	
76.2	
50.8	
38.1	100
19.05	99.4
12.7	98.9
9.525	98.1
4.75 (#4)	96.2
2.38 (#8)	94.1
2.0 (#10)	93.6
1.18 (#16)	91.8
0.6 (#30)	89.2
0.42 (#40)	85.3
0.3 (#50)	80.5
0.15 (#100)	71
.075 (#200)	60.9

Cu =	34.6	
Cc=	0.5	
D10=	0.0014	
Ks=	1.96E-06	cm/sec
Ks=	0.0028	inch/hour

Boring # **H-5**
Sample # **10**
Depth **30-35 ft.**
Soil ID **Scripps**

Dia (mm)	**% pass**
152.4	
127	
101.6	
76.2	
50.8	
38.1	
19.05	
12.7	
9.525	
4.75 (#4)	100
2.38 (#8)	99.7
2.0 (#10)	99.6
1.18 (#16)	99.1
0.6 (#30)	98.4
0.42 (#40)	97.8
0.3 (#50)	97.2
0.15 (#100)	93.7
.075 (#200)	83.2
0.0434	73.2
0.032	63.1
0.0207	57
0.0122	50.8
0.0088	44.7
0.0063	40.7
0.0032	34.6
0.0013	26.4

Cu =	23	
Cc=	0.1	
D10=	0.0013	
Ks=	1.69E-06	cm/sec
Ks=	0.0024	inch/hour
LL=	35	
PL=	15	
PI =	20	
Class:	Sandy Clay (CL)	

Boring # **H-7**
Sample # **2**
Depth **5-8 ft.**
Soil ID **Qvop**

Dia (mm)	**% pass**
152.4	
127	
101.6	
76.2	100
50.8	99.3
38.1	99
19.05	95.4
12.7	86
9.525	76.2
4.75 (#4)	61.2
2.38 (#8)	55.7
2.0 (#10)	55
1.18 (#16)	53.2
0.6 (#30)	51.2
0.42 (#40)	47.6
0.3 (#50)	42.2
0.15 (#100)	31.2
.075 (#200)	25.4

Cu =	23	
Cc=	0.1	
D10=	0.0207	
Ks=	0.000428	cm/sec
Ks=	0.6073	inch/hour

Boring # **H-8**
Sample # **1**
Depth **4-7 ft.**
Soil ID **Fill**

Dia (mm)	**% pass**
152.4	
127	
101.6	
76.2	
50.8	100
38.1	99.3
19.05	98.5
12.7	96.2
9.525	94.6
4.75 (#4)	90.3
2.38 (#8)	86
2.0 (#10)	85
1.18 (#16)	82.2
0.6 (#30)	78.6
0.42 (#40)	72.8
0.3 (#50)	64.9
0.15 (#100)	51
.075 (#200)	43

Cu =	23	
Cc=	0.1	
D10=	0.0125	
Ks=	0.000156	cm/sec
Ks=	0.2215	inch/hour

Boring # **H-8**
Sample # **8**
Depth **31-31.5 ft.**
Soil ID **Fill**

Dia (mm)	**% pass**
152.4	
127	
101.6	
76.2	
50.8	
38.1	
19.05	
12.7	
9.525	100
4.75 (#4)	95.6
2.38 (#8)	93.4
2.0 (#10)	92.9
1.18 (#16)	91.4
0.6 (#30)	89.2
0.42 (#40)	83.6
0.3 (#50)	75.5
0.15 (#100)	55.5
.075 (#200)	41.3
0.0486	40.7
0.0351	34.6
0.0225	30.5
0.0131	26.4
0.0094	22.4
0.0067	20.3
0.0033	18.3
0.0014	12.2

Cu =	133.4	
Cc=	1.9	
D10=	0.0014	
Ks=	1.96E-06	cm/sec
Ks=	0.0028	inch/hour

Boring # **H-9**
Sample # **2**
Depth **9-12 ft.**
Soil ID **Fill**

Dia (mm)	**% pass**
152.4	
127	
101.6	
76.2	
50.8	100
38.1	99.4
19.05	97.7
12.7	95.8
9.525	94.6
4.75 (#4)	93.8
2.38 (#8)	91.8
2.0 (#10)	91.4
1.18 (#16)	90
0.6 (#30)	88
0.42 (#40)	84.7
0.3 (#50)	80.6
0.15 (#100)	72.9
.075 (#200)	63.8
0.0456	61
0.0327	57
0.021	52.9
0.0125	44.7
0.009	38.6
0.0064	34.6
0.0032	26.4
0.0014	20.3

Cu =	35.9	
Cc=	0.4	
D10=	0.0013	
Ks=	1.69E-06	cm/sec
Ks=	0.0024	inch/hour

Boring # **H-9**
Sample # **19**
Depth **75-76.3 ft.**
Soil ID **Scripps**

Dia (mm)	% pass
152.4	
127	
101.6	
76.2	
50.8	
38.1	
19.05	
12.7	
9.525	
4.75 (#4)	
2.38 (#8)	
2.0 (#10)	100
1.18 (#16)	99.7
0.6 (#30)	99.6
0.42 (#40)	99.5
0.3 (#50)	99.4
0.15 (#100)	99
.075 (#200)	97
0.0427	77.3
0.0322	61
0.0214	46.8
0.0128	86.6
0.0092	32.5
0.0066	28.5
0.0033	18.3
0.0014	10.2

Cu =	22.3	
Cc=	1.3	
D10=	0.0014	
Ks=	1.96E-06	cm/sec
Ks=	0.0028	inch/hour

Boring # **H-10**
Sample # **1**
Depth **3-7'**
Soil ID **Fill**

Dia (mm)	**% pass**
152.4	
127	
101.6	
76.2	
50.8	
38.1	100
19.05	99.3
12.7	97.6
9.525	96.6
4.75 (#4)	94.5
2.38 (#8)	91.7
2.0 (#10)	91.2
1.18 (#16)	89.7
0.6 (#30)	88
0.42 (#40)	86
0.3 (#50)	83.5
0.15 (#100)	78
.075 (#200)	68.9

Cu =	22.3	
Cc=	1.3	
D10=	0.0014	
Ks=	1.96E-06	cm/sec
Ks=	0.0028	inch/hour

Boring #	**H-11**
Sample #	**2**
Depth	**10-11.5 ft.**
Soil ID	**Fill**

Dia (mm)	**% pass**
152.4	
127	
101.6	
76.2	
50.8	
38.1	
19.05	
12.7	
9.525	
4.75 (#4)	100
2.38 (#8)	98.5
2.0 (#10)	98.3
1.18 (#16)	97.8
0.6 (#30)	97.3
0.42 (#40)	96.8
0.3 (#50)	96
0.15 (#100)	93.7
.075 (#200)	84.4

Cu =	22.3	
Cc=	1.3	
D10=	0.0013	
Ks=	1.69E-06	cm/sec
Ks=	0.0024	inch/hour

Boring #	**H-11**
Sample #	**6**
Depth	**21-24 ft.**
Soil ID	**Scripps**

Dia (mm)	**% pass**
152.4	
127	
101.6	
76.2	
50.8	
38.1	
19.05	
12.7	
9.525	
4.75 (#4)	100
2.38 (#8)	99.6
2.0 (#10)	99.5
1.18 (#16)	99.3
0.6 (#30)	99
0.42 (#40)	98.7
0.3 (#50)	98.4
0.15 (#100)	96.7
.075 (#200)	85.5

Cu =	22.3	
Cc=	1.3	
D10=	0.0013	
Ks=	1.69E-06	cm/sec
Ks=	0.0024	inch/hour
LL=	43	
PL=	16	
PI =	27	
Class:	Sandy Clay (CL)	

Boring # **H-12**
Sample # **7**
Depth **21-24 ft.**
Soil ID **Fill**

Dia (mm)	% pass
152.4	
127	
101.6	
76.2	
50.8	
38.1	
19.05	
12.7	
9.525	100
4.75 (#4)	98.4
2.38 (#8)	97.1
2.0 (#10)	96.8
1.18 (#16)	95.9
0.6 (#30)	94.6
0.42 (#40)	93.1
0.3 (#50)	91.2
0.15 (#100)	87.3
.075 (#200)	80.7

Cu =	22.3	
Cc=	1.3	
D10=	0.0013	
Ks=	1.69E-06	cm/sec
Ks=	0.0024	inch/hour

Boring #	**H-13**
Sample #	**1**
Depth	**3-7 ft.**
Soil ID	**Fill**

Dia (mm)	**% pass**
152.4	
127	
101.6	
76.2	
50.8	
38.1	
19.05	100
12.7	99.6
9.525	99
4.75 (#4)	97.3
2.38 (#8)	95.1
2.0 (#10)	94.7
1.18 (#16)	93.5
0.6 (#30)	92
0.42 (#40)	89.8
0.3 (#50)	86.9
0.15 (#100)	80.6
.075 (#200)	73.3

Cu =	22.3	
Cc=	1.3	
D10=	0.0013	
Ks=	1.69E-06	cm/sec
Ks=	0.0024	inch/hour

Boring #	**H-13**
Sample #	**25**
Depth	**90-100 ft.**
Soil ID	**Scripps**

Dia (mm)	**% pass**
152.4	
127	
101.6	
76.2	
50.8	
38.1	
19.05	
12.7	
9.525	
4.75 (#4)	100
2.38 (#8)	91.6
2.0 (#10)	91.4
1.18 (#16)	90.9
0.6 (#30)	90.4
0.42 (#40)	90
0.3 (#50)	89.7
0.15 (#100)	89
.075 (#200)	87.4
0.0416	81.4
0.0307	71.2
0.0201	63.1
0.012	52.9
0.0088	44.7
0.0063	40.7
0.0032	28.5
0.0014	20.3

Cu =	14.8	
Cc=	0.6	
D10=	0.0013	
Ks=	1.69E-06	cm/sec
Ks=	0.0024	inch/hour
LL=	42	
PL=	17	
PI =	25	
Class:	Sandy Clay (CL)	

Boring # **H-14**
Sample # **2**
Depth **4-7 ft.**
Soil ID **Fill**

Dia (mm)	**% pass**
152.4	
127	
101.6	
76.2	
50.8	
38.1	
19.05	
12.7	
9.525	100
4.75 (#4)	99.1
2.38 (#8)	98.2
2.0 (#10)	98
1.18 (#16)	97.3
0.6 (#30)	96.4
0.42 (#40)	95.2
0.3 (#50)	93.5
0.15 (#100)	89.4
.075 (#200)	83.1

Cu =	14.8	
Cc=	0.6	
D10=	0.0013	
Ks=	1.69E-06	cm/sec
Ks=	0.0024	inch/hour
LL=	42	
PL=	16	
PI =	26	
Class:	Sandy Clay (CL)	

Boring # **H-14**
Sample # **7**
Depth **20-24 ft.**
Soil ID **Fill**

Dia (mm)	% pass
152.4	
127	
101.6	
76.2	
50.8	
38.1	
19.05	
12.7	
9.525	100
4.75 (#4)	97.3
2.38 (#8)	95.7
2.0 (#10)	95.4
1.18 (#16)	94.5
0.6 (#30)	93
0.42 (#40)	90.5
0.3 (#50)	86.9
0.15 (#100)	76.3
.075 (#200)	65

Cu =	14.8	
Cc=	0.6	
D10=	0.0014	
Ks=	1.96E-06	cm/sec
Ks=	0.0028	inch/hour
LL=	35	
PL=	13	
PI =	22	
Class:	Sandy Clay (CL)	

Boring # **H-15**
Sample # **2**
Depth **4-7 ft.**
Soil ID **Scripps**

Dia (mm)	% pass
152.4	
127	
101.6	
76.2	
50.8	
38.1	
19.05	
12.7	
9.525	100
4.75 (#4)	99.4
2.38 (#8)	99.1
2.0 (#10)	99
1.18 (#16)	98.7
0.6 (#30)	98.3
0.42 (#40)	98
0.3 (#50)	97.7
0.15 (#100)	97
.075 (#200)	92.2
0.0412	83.4
0.0304	73.2
0.0202	61
0.0121	50.8
0.0088	44.7
0.0063	38.6
0.0032	30.5
0.0013	24.4

Cu =	17.7	
Cc=	0.4	
D10=	0.0012	
Ks=	1.44E-06	cm/sec
Ks=	0.0020	inch/hour
LL=	57	
PL=	25	
PI =	22	
Class:	Fat Clay (CH)	

Boring #	**H-16**
Sample #	**1**
Depth	**5-6.5 ft.**
Soil ID	**Scripps**

Dia (mm)	**% pass**
152.4	
127	
101.6	
76.2	
50.8	
38.1	
19.05	
12.7	
9.525	
4.75 (#4)	100
2.38 (#8)	99.8
2.0 (#10)	99.7
1.18 (#16)	99
0.6 (#30)	97.1
0.42 (#40)	95.1
0.3 (#50)	92.7
0.15 (#100)	85.7
.075 (#200)	76.4

Cu =	17	
Cc=	0.4	
D10=	0.0014	
Ks=	1.96E-06	cm/sec
Ks=	0.0028	inch/hour
LL=	50	
PL=	32	
PI =	18	
Class:	Sandy Silt (ML)	

Boring # **H-17**
Sample # **3**
Depth **7-10 ft.**
Soil ID **Scripps**

Dia (mm)	**% pass**
152.4	
127	
101.6	
76.2	
50.8	
38.1	
19.05	
12.7	
9.525	
4.75 (#4)	100
2.38 (#8)	99.9
2.0 (#10)	99.9
1.18 (#16)	99.8
0.6 (#30)	99.6
0.42 (#40)	99.4
0.3 (#50)	99.2
0.15 (#100)	98.3
.075 (#200)	95.9
0.0408	87.5
0.0299	79.3
0.0196	71.2
0.0119	59
0.0086	52.9
0.0062	44.7
0.0031	36.6
0.0013	28.5

Cu = 11.2
Cc= 0.2
D10= 0.0011
Ks= 1.21E-06 cm/sec
Ks= 0.0017 inch/hour
LL= 42
PL= 17
PI = 25
Class: Sandy Clay (CL)

Boring #	**H-20**
Sample #	**1**
Depth	**3-5 ft.**
Soil ID	**Scripps**

Dia (mm)	**% pass**
152.4	
127	
101.6	
76.2	
50.8	
38.1	
19.05	
12.7	
9.525	
4.75 (#4)	100
2.38 (#8)	98.8
2.0 (#10)	98.5
1.18 (#16)	97.9
0.6 (#30)	97.2
0.42 (#40)	96.8
0.3 (#50)	96.4
0.15 (#100)	95.6
.075 (#200)	90.2
0.0423	87.5
0.031	79.3
0.0204	71.2
0.0121	59
0.0088	52.9
0.0063	44.7
0.0032	36.6
0.0013	28.5

Cu =	11.2	
Cc=	0.2	
D10=	0.0011	
Ks=	1.21E-06	cm/sec
Ks=	0.0017	inch/hour
LL=	41	
PL=	18	
PI =	23	
Class:	Sandy Clay (CL)	

Attachment No. 4

Analysis and Calculation

Infiltration Rate

San Diego North City NCWRP Expansion
Project Number: 684476
Date: 7/14/2017
Note: Data based on CH2M HILL Final Geotechnical Report (November, 1992)
Method: Soil Infiltration Rate Estimate (Hazen 1892 & Cronican and Gribb 2004)

Project Name	Boring No.	Sample No.	Depth (feet)	D10	Ks (cm/sec)	Ks (inch/hour)	Material	Soil Type
CWP - North City Site (NTP-1 & NSF-2)	T-1		3-4	0.0008	0.00000064	0.0009	Fill	SC
Eastgate Mall Site, North City Reclamation Plan and Sludge Processing Facilities	B-2		5-7	0.02	0.0004	0.5669	Fill	SM
North City Water Reclamation Plan	TP-91-12	1-B	0-6	0.02	0.0004	0.5669	Fill	GM
North City Water Reclamation Plan	TP-91-19	1-B	0-2	0.03	0.0009	1.2756	Fill	GC-GM
CWP - North City Site (NTP-1 & NSF-2)	T-7		3	0.0065	0.00004225	0.0599	Lindavista	SM
CWP - North City Site (NTP-1 & NSF-2)	T-2		8-9	0.002	0.000004	0.0057	Scripps	SC
CWP - North City Site (NTP-1 & NSF-2)	T-3		12	0.001	0.000001	0.0014	Scripps	CH
Sludge Dewatering Facility	DH-204	1	5	0.004	0.000016	0.0227	Scripps	ML

Material	Infiltration Rate (inch/hour)		
	Min	Max	Median
Fill	0.0009	1.2756	0.5669
Lindavista	0.0599	-	-
Scripps	0.0014	0.0227	0.0057

Project Name: **North City Water Reclamation Plant Expansion**
Project No. **44F1**
Subject: **Soil Infiltration Rate Estimate (Hazen 1892 & Cronican and Gribb 2004)**

Formula: $K_s = c\,(d_{10}^2)$

K_s = Hydraulic Conductivity (cm/sec)
c = Constant which varies between 1.0 and 1.5. A value of 1.0 is selected for this project.
d_{10} = Particle size diameter for which 10% (by mass) of the particles in a soil sample are finer (mm)

Soil ID	**Min Inf. Rate**	**Max Inf. Rate**	**Median Inf. Rate**
	(inch/hour)		
Fill	0.0024	1.45	0.0028
Qvop	0.0028	0.6073	*
Scripps	0.0017	1.45	0.0024

NOTE:
* Insufficient sample size

Boring #	**H-2**
Sample #	**3**
Depth	**11-15 ft**
Soil ID	**Fill**

Dia (mm)	**% pass**
152.4	
127	
101.6	
76.2	
50.8	100
38.1	99.3
19.05	98.6
12.7	89.7
9.525	81.7
4.75 (#4)	67.8
2.38 (#8)	61.1
2.0 (#10)	59.8
1.18 (#16)	56.3
0.6 (#30)	52.4
0.42 (#40)	46.8
0.3 (#50)	39.3
0.15 (#100)	26.1
.075 (#200)	19.3

Cu =	214.2	
Cc=	4.9	
D10=	0.032	
Ks=	0.001024	cm/sec
Ks=	1.4513	inch/hour

Boring # **H-3**
Sample # **8**
Depth **41-41.5 ft.**
Soil ID **Scripps**

Dia (mm)	**% pass**
152.4	
127	
101.6	
76.2	
50.8	
38.1	
19.05	
12.7	
9.525	
4.75 (#4)	100
2.38 (#8)	99.7
2.0 (#10)	99.5
1.18 (#16)	93.1
0.6 (#30)	92.1
0.42 (#40)	91.3
0.3 (#50)	90.6
0.15 (#100)	87.3
.075 (#200)	66.5

Cu =	25.7	
Cc=	0.5	
D10=	0.0014	
Ks=	1.96E-06	cm/sec
Ks=	0.0028	inch/hour

Boring #	**H-3**
Sample #	**13**
Depth	**65.5-66 ft.**
Soil ID	**Scripps**

Dia (mm)	**% pass**
152.4	
127	
101.6	
76.2	
50.8	
38.1	
19.05	
12.7	
9.525	
4.75 (#4)	
2.38 (#8)	
2.0 (#10)	
1.18 (#16)	100
0.6 (#30)	99.9
0.42 (#40)	99.7
0.3 (#50)	84.8
0.15 (#100)	35.8
.075 (#200)	15.8

Cu =	12.6	
Cc=	5.1	
D10=	0.032	
Ks=	0.001024	cm/sec
Ks=	1.4513	inch/hour

Boring # **H-4**
Sample # **1**
Depth **3-6 ft.**
Soil ID **Qvop**

Dia (mm)	**% pass**
152.4	
127	
101.6	
76.2	
50.8	
38.1	
19.05	
12.7	
9.525	100
4.75 (#4)	98.8
2.38 (#8)	96.4
2.0 (#10)	96
1.18 (#16)	94.6
0.6 (#30)	92.4
0.42 (#40)	84.6
0.3 (#50)	72.3
0.15 (#100)	51.3
.075 (#200)	42.5

Cu =	72.4	
Cc=	0.8	
D10=	0.0014	
Ks=	1.96E-06	cm/sec
Ks=	0.0028	inch/hour

Boring # **H-5**
Sample # **2**
Depth **4-7 ft.**
Soil ID **Fill**

Dia (mm)	**% pass**
152.4	
127	
101.6	
76.2	
50.8	
38.1	100
19.05	99.4
12.7	98.9
9.525	98.1
4.75 (#4)	96.2
2.38 (#8)	94.1
2.0 (#10)	93.6
1.18 (#16)	91.8
0.6 (#30)	89.2
0.42 (#40)	85.3
0.3 (#50)	80.5
0.15 (#100)	71
.075 (#200)	60.9

Cu =	34.6	
Cc=	0.5	
D10=	0.0014	
Ks=	1.96E-06	cm/sec
Ks=	0.0028	inch/hour

Boring # **H-5**
Sample # **10**
Depth **30-35 ft.**
Soil ID **Scripps**

Dia (mm)	% pass
152.4	
127	
101.6	
76.2	
50.8	
38.1	
19.05	
12.7	
9.525	
4.75 (#4)	100
2.38 (#8)	99.7
2.0 (#10)	99.6
1.18 (#16)	99.1
0.6 (#30)	98.4
0.42 (#40)	97.8
0.3 (#50)	97.2
0.15 (#100)	93.7
.075 (#200)	83.2
0.0434	73.2
0.032	63.1
0.0207	57
0.0122	50.8
0.0088	44.7
0.0063	40.7
0.0032	34.6
0.0013	26.4

Cu = 23
Cc= 0.1
D10= 0.0013
Ks= 1.69E-06 cm/sec
Ks= 0.0024 inch/hour
LL= 35
PL= 15
PI = 20
Class: Sandy Clay (CL)

Boring # **H-7**
Sample # **2**
Depth **5-8 ft.**
Soil ID **Qvop**

Dia (mm)	**% pass**
152.4	
127	
101.6	
76.2	100
50.8	99.3
38.1	99
19.05	95.4
12.7	86
9.525	76.2
4.75 (#4)	61.2
2.38 (#8)	55.7
2.0 (#10)	55
1.18 (#16)	53.2
0.6 (#30)	51.2
0.42 (#40)	47.6
0.3 (#50)	42.2
0.15 (#100)	31.2
.075 (#200)	25.4

Cu =	23	
Cc=	0.1	
D10=	0.0207	
Ks=	0.000428	cm/sec
Ks=	0.6073	inch/hour

Boring # **H-8**
Sample # **1**
Depth **4-7 ft.**
Soil ID **Fill**

Dia (mm)	**% pass**
152.4	
127	
101.6	
76.2	
50.8	100
38.1	99.3
19.05	98.5
12.7	96.2
9.525	94.6
4.75 (#4)	90.3
2.38 (#8)	86
2.0 (#10)	85
1.18 (#16)	82.2
0.6 (#30)	78.6
0.42 (#40)	72.8
0.3 (#50)	64.9
0.15 (#100)	51
.075 (#200)	43

Cu =	23	
Cc=	0.1	
D10=	0.0125	
Ks=	0.000156	cm/sec
Ks=	0.2215	inch/hour

Boring #	**H-8**
Sample #	**8**
Depth	**31-31.5 ft.**
Soil ID	**Fill**

Dia (mm)	**% pass**
152.4	
127	
101.6	
76.2	
50.8	
38.1	
19.05	
12.7	
9.525	100
4.75 (#4)	95.6
2.38 (#8)	93.4
2.0 (#10)	92.9
1.18 (#16)	91.4
0.6 (#30)	89.2
0.42 (#40)	83.6
0.3 (#50)	75.5
0.15 (#100)	55.5
.075 (#200)	41.3
0.0486	40.7
0.0351	34.6
0.0225	30.5
0.0131	26.4
0.0094	22.4
0.0067	20.3
0.0033	18.3
0.0014	12.2

Cu =	133.4	
Cc=	1.9	
D10=	0.0014	
Ks=	1.96E-06	cm/sec
Ks=	0.0028	inch/hour

Boring #	**H-9**
Sample #	**2**
Depth	**9-12 ft.**
Soil ID	**Fill**

Dia (mm)	**% pass**
152.4	
127	
101.6	
76.2	
50.8	100
38.1	99.4
19.05	97.7
12.7	95.8
9.525	94.6
4.75 (#4)	93.8
2.38 (#8)	91.8
2.0 (#10)	91.4
1.18 (#16)	90
0.6 (#30)	88
0.42 (#40)	84.7
0.3 (#50)	80.6
0.15 (#100)	72.9
.075 (#200)	63.8
0.0456	61
0.0327	57
0.021	52.9
0.0125	44.7
0.009	38.6
0.0064	34.6
0.0032	26.4
0.0014	20.3

Cu =	35.9	
Cc=	0.4	
D10=	0.0013	
Ks=	1.69E-06	cm/sec
Ks=	0.0024	inch/hour

Boring # **H-9**
Sample # **19**
Depth **75-76.3 ft.**
Soil ID **Scripps**

Dia (mm)	**% pass**
152.4	
127	
101.6	
76.2	
50.8	
38.1	
19.05	
12.7	
9.525	
4.75 (#4)	
2.38 (#8)	
2.0 (#10)	100
1.18 (#16)	99.7
0.6 (#30)	99.6
0.42 (#40)	99.5
0.3 (#50)	99.4
0.15 (#100)	99
.075 (#200)	97
0.0427	77.3
0.0322	61
0.0214	46.8
0.0128	86.6
0.0092	32.5
0.0066	28.5
0.0033	18.3
0.0014	10.2

Cu =	22.3	
Cc=	1.3	
D10=	0.0014	
Ks=	1.96E-06	cm/sec
Ks=	0.0028	inch/hour

Boring #	**H-10**
Sample #	**1**
Depth	**3-7'**
Soil ID	**Fill**

Dia (mm)	**% pass**
152.4	
127	
101.6	
76.2	
50.8	
38.1	100
19.05	99.3
12.7	97.6
9.525	96.6
4.75 (#4)	94.5
2.38 (#8)	91.7
2.0 (#10)	91.2
1.18 (#16)	89.7
0.6 (#30)	88
0.42 (#40)	86
0.3 (#50)	83.5
0.15 (#100)	78
.075 (#200)	68.9

Cu =	22.3	
Cc=	1.3	
D10=	0.0014	
Ks=	1.96E-06	cm/sec
Ks=	0.0028	inch/hour

Boring #	**H-11**
Sample #	**2**
Depth	**10-11.5 ft.**
Soil ID	**Fill**

Dia (mm)	**% pass**
152.4	
127	
101.6	
76.2	
50.8	
38.1	
19.05	
12.7	
9.525	
4.75 (#4)	100
2.38 (#8)	98.5
2.0 (#10)	98.3
1.18 (#16)	97.8
0.6 (#30)	97.3
0.42 (#40)	96.8
0.3 (#50)	96
0.15 (#100)	93.7
.075 (#200)	84.4

Cu =	22.3	
Cc=	1.3	
D10=	0.0013	
Ks=	1.69E-06	cm/sec
Ks=	0.0024	inch/hour

Boring #	**H-11**
Sample #	**6**
Depth	**21-24 ft.**
Soil ID	**Scripps**

Dia (mm)	% pass
152.4	
127	
101.6	
76.2	
50.8	
38.1	
19.05	
12.7	
9.525	
4.75 (#4)	100
2.38 (#8)	99.6
2.0 (#10)	99.5
1.18 (#16)	99.3
0.6 (#30)	99
0.42 (#40)	98.7
0.3 (#50)	98.4
0.15 (#100)	96.7
.075 (#200)	85.5

Cu =	22.3	
Cc=	1.3	
D10=	0.0013	
Ks=	1.69E-06	cm/sec
Ks=	0.0024	inch/hour
LL=	43	
PL=	16	
PI =	27	
Class:	Sandy Clay (CL)	

Boring # **H-12**
Sample # **7**
Depth **21-24 ft.**
Soil ID **Fill**

Dia (mm)	**% pass**
152.4	
127	
101.6	
76.2	
50.8	
38.1	
19.05	
12.7	
9.525	100
4.75 (#4)	98.4
2.38 (#8)	97.1
2.0 (#10)	96.8
1.18 (#16)	95.9
0.6 (#30)	94.6
0.42 (#40)	93.1
0.3 (#50)	91.2
0.15 (#100)	87.3
.075 (#200)	80.7

Cu =	22.3	
Cc=	1.3	
D10=	0.0013	
Ks=	1.69E-06	cm/sec
Ks=	0.0024	inch/hour

Boring # **H-13**
Sample # **1**
Depth **3-7 ft.**
Soil ID **Fill**

Dia (mm)	**% pass**
152.4	
127	
101.6	
76.2	
50.8	
38.1	
19.05	100
12.7	99.6
9.525	99
4.75 (#4)	97.3
2.38 (#8)	95.1
2.0 (#10)	94.7
1.18 (#16)	93.5
0.6 (#30)	92
0.42 (#40)	89.8
0.3 (#50)	86.9
0.15 (#100)	80.6
.075 (#200)	73.3

Cu =	22.3	
Cc=	1.3	
D10=	0.0013	
Ks=	1.69E-06	cm/sec
Ks=	0.0024	inch/hour

Boring #	**H-13**
Sample #	**25**
Depth	**90-100 ft.**
Soil ID	**Scripps**

Dia (mm)	**% pass**
152.4	
127	
101.6	
76.2	
50.8	
38.1	
19.05	
12.7	
9.525	
4.75 (#4)	100
2.38 (#8)	91.6
2.0 (#10)	91.4
1.18 (#16)	90.9
0.6 (#30)	90.4
0.42 (#40)	90
0.3 (#50)	89.7
0.15 (#100)	89
.075 (#200)	87.4
0.0416	81.4
0.0307	71.2
0.0201	63.1
0.012	52.9
0.0088	44.7
0.0063	40.7
0.0032	28.5
0.0014	20.3

Cu =	14.8	
Cc=	0.6	
D10=	0.0013	
Ks=	1.69E-06	cm/sec
Ks=	0.0024	inch/hour
LL=	42	
PL=	17	
PI =	25	
Class:	Sandy Clay (CL)	

Boring #	**H-14**
Sample #	**2**
Depth	**4-7 ft.**
Soil ID	**Fill**

Dia (mm)	**% pass**
152.4	
127	
101.6	
76.2	
50.8	
38.1	
19.05	
12.7	
9.525	100
4.75 (#4)	99.1
2.38 (#8)	98.2
2.0 (#10)	98
1.18 (#16)	97.3
0.6 (#30)	96.4
0.42 (#40)	95.2
0.3 (#50)	93.5
0.15 (#100)	89.4
.075 (#200)	83.1

Cu = 14.8
Cc= 0.6
D10= 0.0013
Ks= 1.69E-06 cm/sec
Ks= 0.0024 inch/hour
LL= 42
PL= 16
PI = 26
Class: Sandy Clay (CL)

Boring #	**H-14**
Sample #	**7**
Depth	**20-24 ft.**
Soil ID	**Fill**

Dia (mm)	**% pass**
152.4	
127	
101.6	
76.2	
50.8	
38.1	
19.05	
12.7	
9.525	100
4.75 (#4)	97.3
2.38 (#8)	95.7
2.0 (#10)	95.4
1.18 (#16)	94.5
0.6 (#30)	93
0.42 (#40)	90.5
0.3 (#50)	86.9
0.15 (#100)	76.3
.075 (#200)	65

Cu =	14.8	
Cc=	0.6	
D10=	0.0014	
Ks=	1.96E-06	cm/sec
Ks=	0.0028	inch/hour
LL=	35	
PL=	13	
PI =	22	
Class:	Sandy Clay (CL)	

Boring # **H-15**
Sample # **2**
Depth **4-7 ft.**
Soil ID **Scripps**

Dia (mm)	**% pass**
152.4	
127	
101.6	
76.2	
50.8	
38.1	
19.05	
12.7	
9.525	100
4.75 (#4)	99.4
2.38 (#8)	99.1
2.0 (#10)	99
1.18 (#16)	98.7
0.6 (#30)	98.3
0.42 (#40)	98
0.3 (#50)	97.7
0.15 (#100)	97
.075 (#200)	92.2
0.0412	83.4
0.0304	73.2
0.0202	61
0.0121	50.8
0.0088	44.7
0.0063	38.6
0.0032	30.5
0.0013	24.4

Cu =	17.7	
Cc=	0.4	
D10=	0.0012	
Ks=	1.44E-06	cm/sec
Ks=	0.0020	inch/hour
LL=	57	
PL=	25	
PI =	22	
Class:	Fat Clay (CH)	

Boring # **H-16**
Sample # **1**
Depth **5-6.5 ft.**
Soil ID **Scripps**

Dia (mm)	**% pass**
152.4	
127	
101.6	
76.2	
50.8	
38.1	
19.05	
12.7	
9.525	
4.75 (#4)	100
2.38 (#8)	99.8
2.0 (#10)	99.7
1.18 (#16)	99
0.6 (#30)	97.1
0.42 (#40)	95.1
0.3 (#50)	92.7
0.15 (#100)	85.7
.075 (#200)	76.4

Cu =	17	
Cc=	0.4	
D10=	0.0014	
Ks=	1.96E-06	cm/sec
Ks=	0.0028	inch/hour
LL=	50	
PL=	32	
PI =	18	
Class:	Sandy Silt (ML)	

Boring # **H-17**
Sample # **3**
Depth **7-10 ft.**
Soil ID **Scripps**

Dia (mm)	**% pass**
152.4	
127	
101.6	
76.2	
50.8	
38.1	
19.05	
12.7	
9.525	
4.75 (#4)	100
2.38 (#8)	99.9
2.0 (#10)	99.9
1.18 (#16)	99.8
0.6 (#30)	99.6
0.42 (#40)	99.4
0.3 (#50)	99.2
0.15 (#100)	98.3
.075 (#200)	95.9
0.0408	87.5
0.0299	79.3
0.0196	71.2
0.0119	59
0.0086	52.9
0.0062	44.7
0.0031	36.6
0.0013	28.5

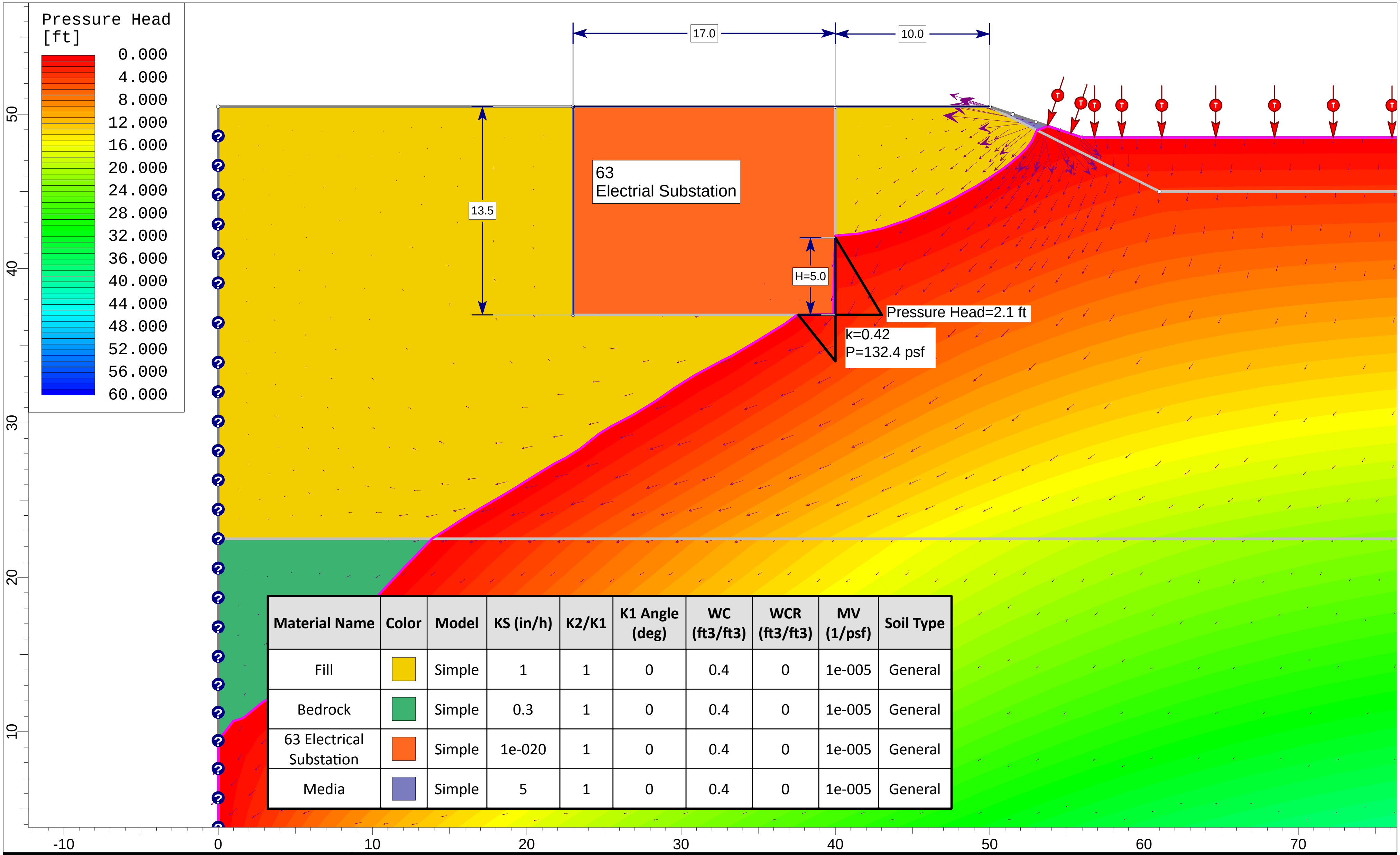
Cu =	11.2	
Cc=	0.2	
D10=	0.0011	
Ks=	1.21E-06	cm/sec
Ks=	0.0017	inch/hour
LL=	42	
PL=	17	
PI =	25	
Class:	Sandy Clay (CL)	

Boring # **H-20**
Sample # **1**
Depth **3-5 ft.**
Soil ID **Scripps**

Dia (mm)	**% pass**
152.4	
127	
101.6	
76.2	
50.8	
38.1	
19.05	
12.7	
9.525	
4.75 (#4)	100
2.38 (#8)	98.8
2.0 (#10)	98.5
1.18 (#16)	97.9
0.6 (#30)	97.2
0.42 (#40)	96.8
0.3 (#50)	96.4
0.15 (#100)	95.6
.075 (#200)	90.2
0.0423	87.5
0.031	79.3
0.0204	71.2
0.0121	59
0.0088	52.9
0.0063	44.7
0.0032	36.6
0.0013	28.5

Cu = 11.2
Cc= 0.2
D10= 0.0011
Ks= 1.21E-06 cm/sec
Ks= 0.0017 inch/hour
LL= 41
PL= 18
PI = 23
Class: Sandy Clay (CL)

Unsaturated Transient Seepage Analysis (Slide)



Material Name	Color	Model	KS (in/h)	K2/K1	K1 Angle (deg)	WC (ft3/ft3)	WCR (ft3/ft3)	MV (1/psf)	Soil Type
Fill	🟨	Simple	1	1	0	0.4	0	1e-005	General
Bedrock	🟩	Simple	0.3	1	0	0.4	0	1e-005	General
63 Electrical Substation	🟧	Simple	1e-020	1	0	0.4	0	1e-005	General
Media	🟪	Simple	5	1	0	0.4	0	1e-005	General

rocscience

SLIDEINTERPRET 7.009

Project	San Diego NCWRP Expansion
Analysis Description	BMP2 - Transient Seepage Analysis (Boring H-12)
Drawn By	GB
Scale	1:103
Company	CH2M
Date	7/12/2017, 1:44:13 PM
File Name	BMP2 - Infiltration with Time.slim

Slide Analysis Information

San Diego NCWRP Expansion

Results at Initial Stage

Project Summary

File Name:	BMP2 - infiltration with time.slim
Slide Modeler Version:	7.009
Project Title:	San Diego NCWRP Expansion
Analysis:	BMP2 - Transient Seepage Analysis (Boring H-12)
Author:	GB
Company:	CH2M
Date Created:	7/12/2017, 1:44:13 PM

General Settings

Units of Measurement:	Imperial Units
Time Units:	hours
Permeability Units:	inches/hour
Failure Direction:	Right to Left
Data Output:	Standard
Maximum Material Properties:	20
Maximum Support Properties:	20

Analysis Options

Slices Type:	Vertical

Analysis Methods Used	
	Bishop simplified
	Janbu simplified

Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Advanced Groundwater Method:	Transient FEA

Transient Settings

Stage Name	Time [h]	Calculate Safety Factor
Stage 1	14	No
Stage 2	38	No
Stage 3	182	No

Tolerance (Transient):	1e-006
Maximum number of iterations (Transient):	500
Time Steps (Transient):	Automatic
Mesh Element Type:	6 noded triangles
Number of Elements:	1186
Number of Nodes:	2529

Transient Boundary Conditions

1

Time [h]	Pressure Head [ft]
0	1
14	1
38	0

Seepage Face Condition: Yes

0.75

Time [h]	Pressure Head [ft]
0	0.75
14	0.75
38	0

Seepage Face Condition: Yes

0.5

Time [h]	Pressure Head [ft]
0	0.5
14	0.5
38	0

Seepage Face Condition: Yes

0.25

Time [h]	Pressure Head [ft]
0	0.25
14	0.25
38	0

Seepage Face Condition: Yes

Infiltration 5 inch per hour

Time [h]	Normal Infiltration [ft/h]
0	0.416667
14	0.416667
38	0.416667
38.001	0

Seepage Face Condition: Yes

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Surface Type:	Circular
Search Method:	Grid Search
Radius Increment:	10
Composite Surfaces:	Disabled
Reverse Curvature:	Invalid Surfaces
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic

Advanced Seismic Analysis:	No
Staged pseudostatic analysis:	No

Material Properties

Property	Fill	Bedrock	63 Electrical Substation	Media
Color	🟨	🟩	🟧	🟪
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	120	120	120	120
Cohesion [psf]	0.02	0.02	1e+006	0.02
Friction Angle [deg]	35	35	42	35
Water Surface	None	None	None	None
Ru Value	0	0	0	0

List Of Coordinates

External Boundary

X	Y
230	0
230	22.5
230	50.5
210	50.5
208.5	50
207	49.5
205.5	49
204	48.5
56	48.5
54.5	49
53	49.5
51.5	50
50	50.5
40	50.5
23	50.5
0	50.5
0	22.5
0	0

Material Boundary

X	Y
50	50.5
61	45

Material Boundary

X	Y
61	45
199	45

Material Boundary

X	Y
0	22.5
230	22.5

Material Boundary

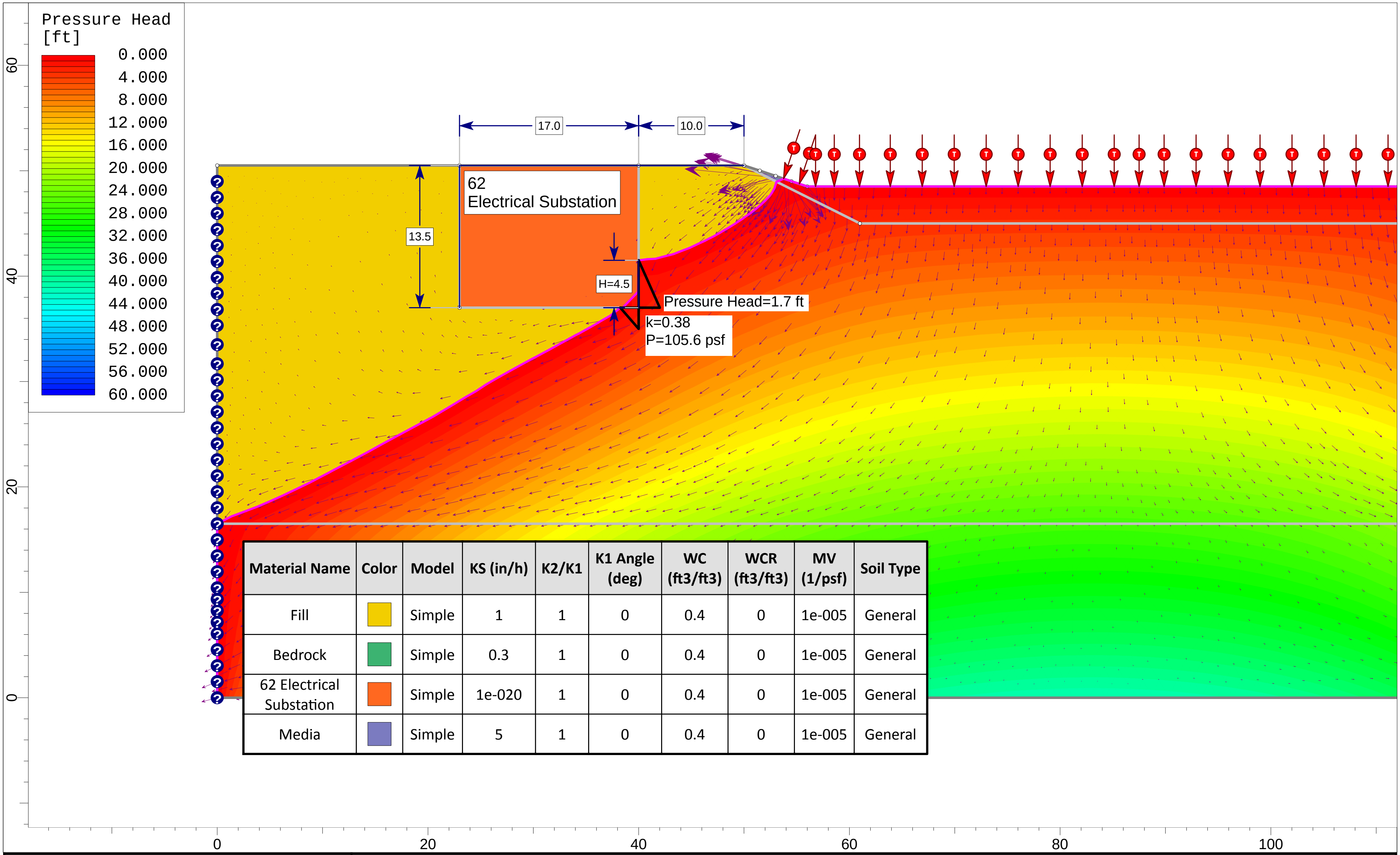
X	Y
23	50.5
23	37
40	37

Material Boundary

X	Y
40	37
40	50.5

Material Boundary

X	Y
199	45
210	50.5



Material Name	Color	Model	KS (in/h)	K2/K1	K1 Angle (deg)	WC (ft3/ft3)	WCR (ft3/ft3)	MV (1/psf)	Soil Type
Fill	🟨	Simple	1	1	0	0.4	0	1e-005	General
Bedrock	🟩	Simple	0.3	1	0	0.4	0	1e-005	General
62 Electrical Substation	🟧	Simple	1e-020	1	0	0.4	0	1e-005	General
Media	🟪	Simple	5	1	0	0.4	0	1e-005	General

Project	San Diego NCWRP Expansion
Analysis Description	BMP3 - Transient Seepage Analysis (Boring H-9)
Drawn By	GB
Scale	1:151
Company	CH2M
Date	7/12/2017, 1:44:13 PM
File Name	BMP3 - infiltration with time.slim

SLIDEINTERPRET 7.009

Slide Analysis Information

San Diego NCWRP Expansion

Results at Initial Stage

Project Summary

File Name:	BMP3 - infiltration with time.slim
Slide Modeler Version:	7.009
Project Title:	San Diego NCWRP Expansion
Analysis:	BMP3 - Transient Seepage Analysis (Boring H-9)
Author:	GB
Company:	CH2M
Date Created:	7/12/2017, 1:44:13 PM

General Settings

Units of Measurement:	Imperial Units
Time Units:	hours
Permeability Units:	inches/hour
Failure Direction:	Right to Left
Data Output:	Standard
Maximum Material Properties:	20
Maximum Support Properties:	20

Analysis Options

Slices Type:	Vertical

Analysis Methods Used	
	Bishop simplified
	Janbu simplified

Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Advanced Groundwater Method:	Transient FEA

Transient Settings

Stage Name	Time [h]	Calculate Safety Factor
Stage 1	14	No
Stage 2	38	No
Stage 3	182	No

Tolerance (Transient):	1e-006
Maximum number of iterations (Transient):	500
Time Steps (Transient):	Automatic
Mesh Element Type:	6 noded triangles
Number of Elements:	1292
Number of Nodes:	2723

Transient Boundary Conditions

1

Time [h]	Pressure Head [ft]
0	1
14	1
38	0

Seepage Face Condition: Yes

0.75

Time [h]	Pressure Head [ft]
0	0.75
14	0.75
38	0

Seepage Face Condition: Yes

0.5

Time [h]	Pressure Head [ft]
0	0.5
14	0.5
38	0

Seepage Face Condition: Yes

0.25

Time [h]	Pressure Head [ft]
0	0.25
14	0.25
38	0

Seepage Face Condition: Yes

Infiltration 5 inch per hour

Time [h]	Normal Infiltration [ft/h]
0	0.416667
14	0.416667
38	0.416667
38.001	0

Seepage Face Condition: Yes

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Surface Type:	Circular
Search Method:	Grid Search
Radius Increment:	10
Composite Surfaces:	Disabled
Reverse Curvature:	Invalid Surfaces
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic

Advanced Seismic Analysis:	No
Staged pseudostatic analysis:	No

Material Properties

Property	Fill	Bedrock	62 Electrical Substation	Media
Color	🟨	🟩	🟧	🟪
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	120	120	120	120
Cohesion [psf]	0.02	0.02	1e+006	0.02
Friction Angle [deg]	35	35	42	35
Water Surface	None	None	None	None
Ru Value	0	0	0	0

List Of Coordinates

External Boundary

X	Y
145	0
145	16.5
145	50.5
125	50.5
123.5	50
122	49.5
120.5	49
119	48.5
56	48.5
54.5	49
53	49.5
51.5	50
50	50.5
40	50.5
23	50.5
0	50.5
0	16.5
0	0

Material Boundary

X	Y
50	50.5
61	45

Material Boundary

X	Y
61	45
114	45
125	50.5

Material Boundary

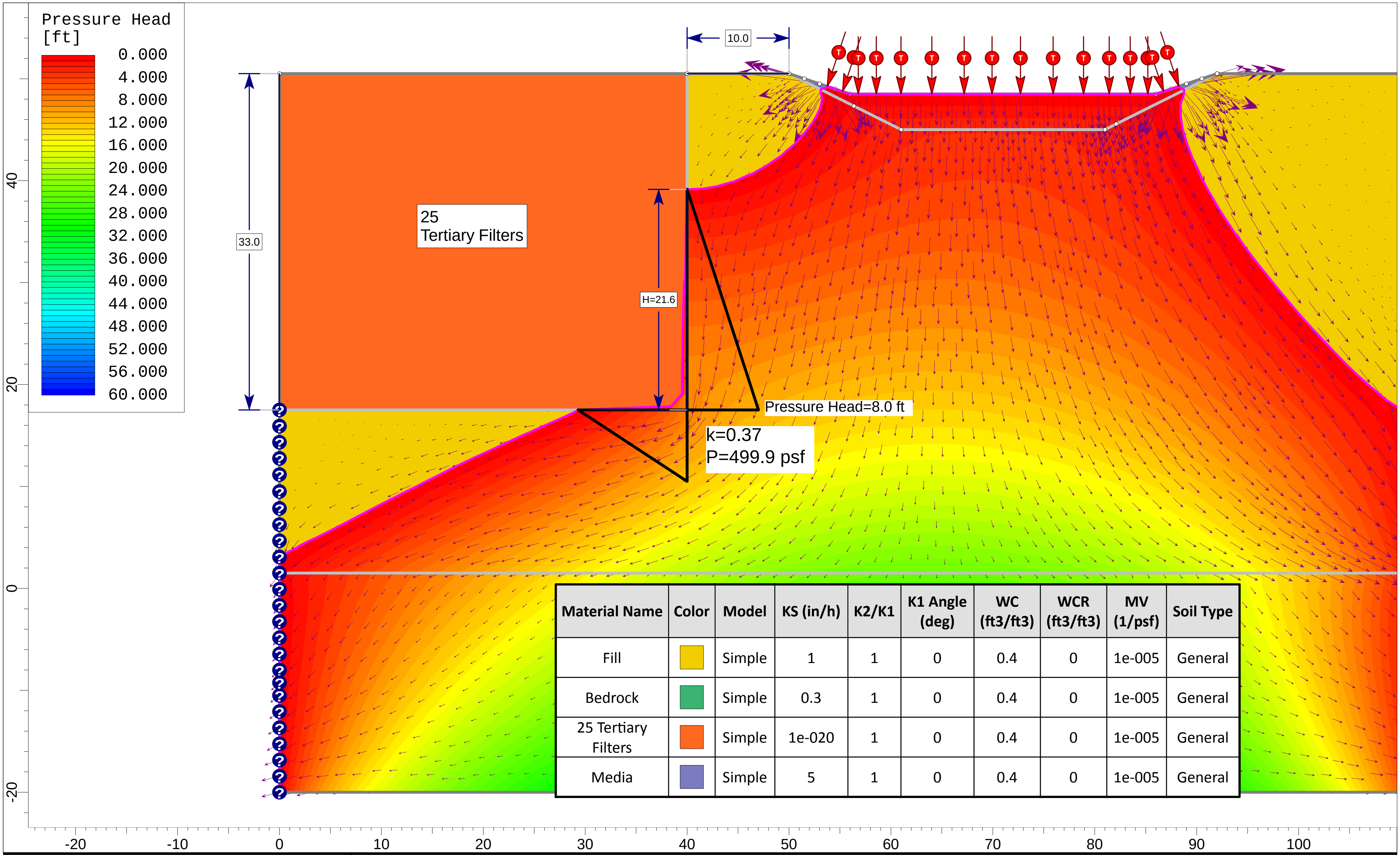
X	Y
0	16.5
145	16.5

Material Boundary

X	Y
23	50.5
23	37
40	37

Material Boundary

X	Y
40	50.5
40	37



Material Name	Color	Model	KS (in/h)	K2/K1	K1 Angle (deg)	WC (ft3/ft3)	WCR (ft3/ft3)	MV (1/psf)	Soil Type
Fill	🟨	Simple	1	1	0	0.4	0	1e-005	General
Bedrock	🟩	Simple	0.3	1	0	0.4	0	1e-005	General
25 Tertiary Filters	🟧	Simple	1e-020	1	0	0.4	0	1e-005	General
Media	🟪	Simple	5	1	0	0.4	0	1e-005	General

Project	San Diego NCWRP Expansion		
Analysis Description	BMP4 - Transient Seepage Analysis (Boring H-8)		
Drawn By GB	*Scale* 1:156	*Company*	CH2M
Date 7/12/2017, 1:44:13 PM		*File Name*	BMP4 - infiltration with time.slim

SLIDEINTERPRET 7.009

Slide Analysis Information

San Diego NCWRP Expansion

Results at Initial Stage

Project Summary

File Name:	BMP4 - infiltration with time.slim
Slide Modeler Version:	7.009
Project Title:	San Diego NCWRP Expansion
Analysis:	BMP4 - Transient Seepage Analysis (Boring H-8)
Author:	GB
Company:	CH2M
Date Created:	7/12/2017, 1:44:13 PM

General Settings

Units of Measurement:	Imperial Units
Time Units:	hours
Permeability Units:	inches/hour
Failure Direction:	Right to Left
Data Output:	Standard
Maximum Material Properties:	20
Maximum Support Properties:	20

Analysis Options

Slices Type:	Vertical

Analysis Methods Used	
	Bishop simplified
	Janbu simplified

Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Advanced Groundwater Method:	Transient FEA

Transient Settings

Stage Name	Time [h]	Calculate Safety Factor
Stage 1	14	No
Stage 2	38	No
Stage 3	182	No

Tolerance (Transient):	1e-006
Maximum number of iterations (Transient):	500
Time Steps (Transient):	Automatic
Mesh Element Type:	6 noded triangles
Number of Elements:	1428
Number of Nodes:	2981

Transient Boundary Conditions

1

Time [h]	Pressure Head [ft]
0	1
14	1
38	0

Seepage Face Condition: Yes

0.75

Time [h]	Pressure Head [ft]
0	0.75
14	0.75
38	0

Seepage Face Condition: Yes

0.5

Time [h]	Pressure Head [ft]
0	0.5
14	0.5
38	0

Seepage Face Condition: Yes

0.25

Time [h]	Pressure Head [ft]
0	0.25
14	0.25
38	0

Seepage Face Condition: Yes

Infiltration 5 inch per hour

Time [h]	Normal Infiltration [ft/h]
0	0.416667
14	0.416667
38	0.416667
38.001	0

Seepage Face Condition: Yes

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Grid Search
Radius Increment: 10
Composite Surfaces: Disabled
Reverse Curvature: Invalid Surfaces
Minimum Elevation: Not Defined
Minimum Depth: Not Defined
Minimum Area: Not Defined
Minimum Weight: Not Defined

Seismic

Advanced Seismic Analysis: No
Staged pseudostatic analysis: No

Material Properties

Property	Fill	Bedrock	25 Tertiary Filters	Media
Color	🟨	🟩	🟧	🟪
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	120	120	120	120
Cohesion [psf]	0.02	0.02	1e+006	0.02
Friction Angle [deg]	35	35	42	35
Water Surface	None	None	None	None
Ru Value	0	0	0	0

List Of Coordinates

External Boundary

X	Y
112	-20
112	1.5
112	50.5
92	50.5
90.5	50
89	49.5
87.5	49
86	48.5
56	48.5
54.5	49
53	49.5
51.5	50
50	50.5
40	50.5
0	50.5
0	17.5
0	1.5
0	-20

Material Boundary

X	Y
0	17.5
40	17.5
40	50.5

Material Boundary

X	Y
50	50.5
56.3636	47.3182
61	45
81	45
82.1034	45.5517
92	50.5

Material Boundary

X	Y
0	1.5
112	1.5

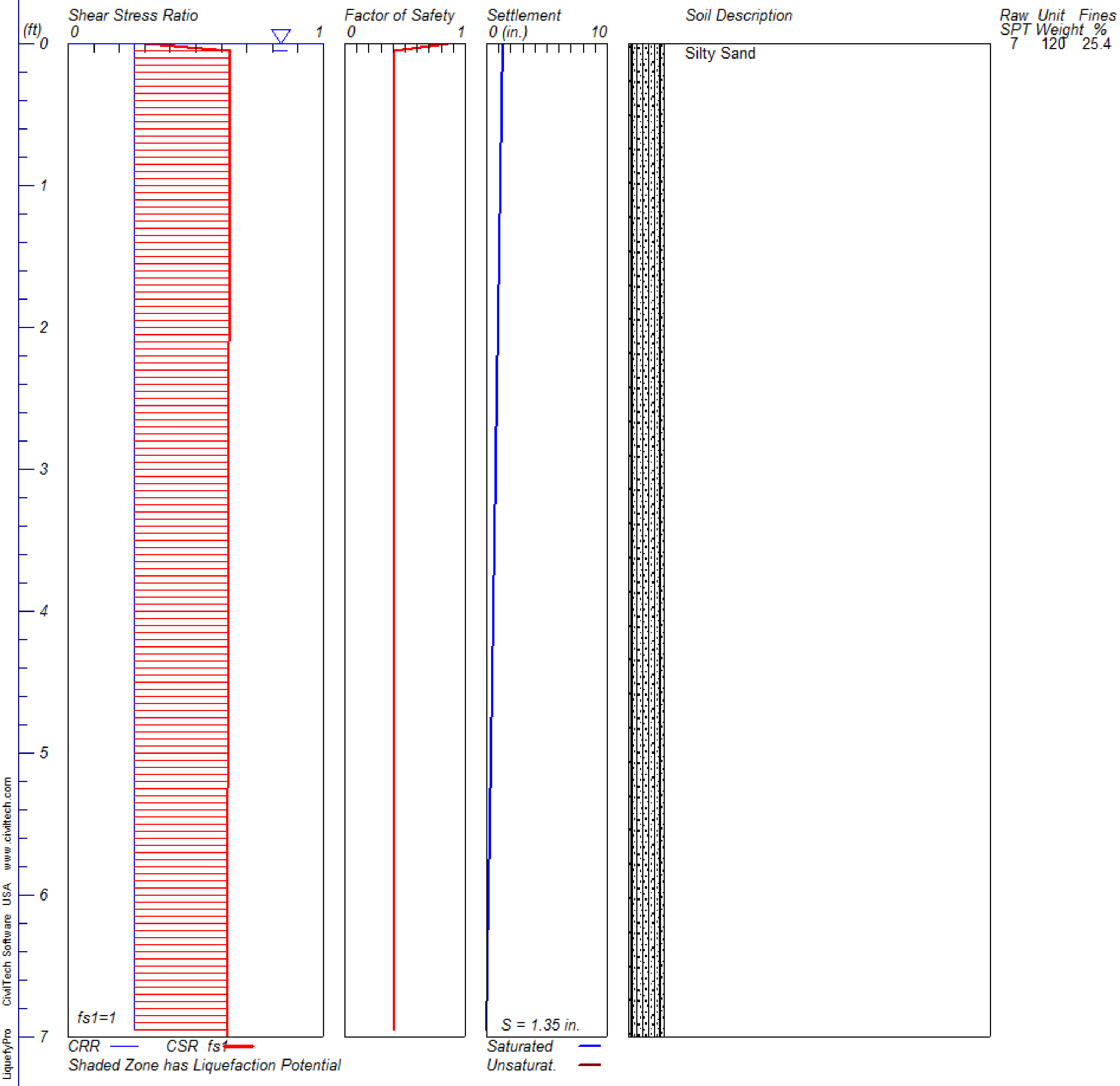
Liquefaction and Seismic Settlement (Liquefy Pro)

LIQUEFACTION ANALYSIS

San Diego North City WWTP

Hole No.=H-7 Water Depth=0 ft

Magnitude=6.8
Acceleration=0.469g

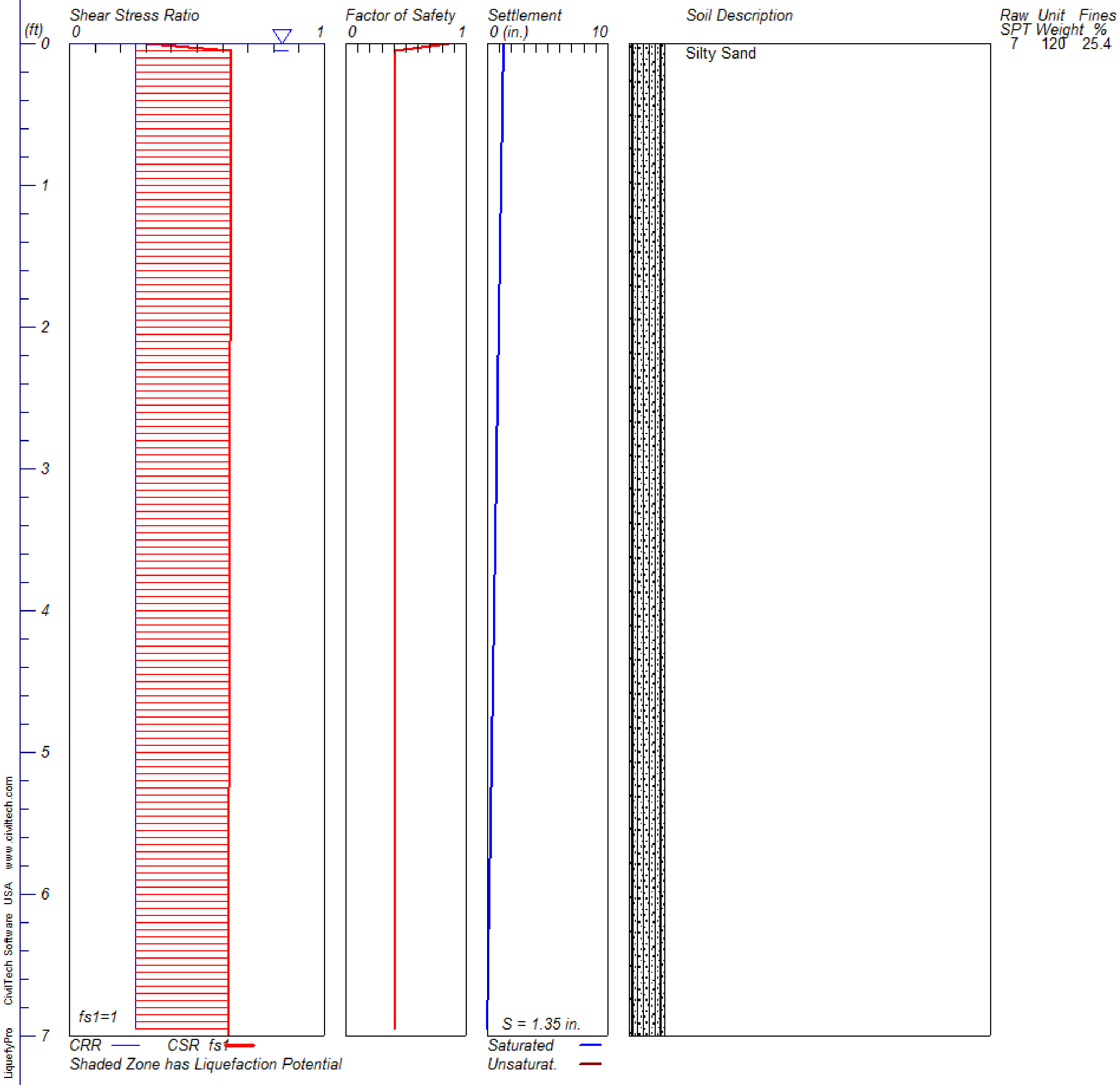


LIQUEFACTION ANALYSIS

San Diego North City WWTP

Hole No.=H-7 Water Depth=0 ft

Magnitude=6.8
Acceleration=0.469g



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November 15, 2017

Ms. Monika Smoczynski

Project Manager
Public Utilities Department
9192 Topaz Way
San Diego, CA 92123

Re: City of San Diego Public Utilities Department/ CH2M North City Water Reclamation Plant (NCWRP) Expansion/Revised Technical Memorandum for the Evaluation of Geotechnical Impacts due to BMP Partial Infiltration for the NCWRP Expansion and NCPWF Influent Conveyance Project

Dear Ms. Smoczynski,

CH2M submitted the technical memorandum "Evaluation of Geotechnical Impacts due to BMP Partial Infiltration for the NCWRP Expansion and NCPWF Influent Conveyance Project" dated July 17, 2017. The City reviewed the memorandum and provided comments on July 24, 2017. CH2M responded to the comments in a letter dated July 31, 2017 and issued a Revision 1 to the "Evaluation of Geotechnical Impacts due to BMP Partial Infiltration for the NCWRP Expansion and NCPWF Influent Conveyance Project" technical memorandum on July 31, 2017.

The City reviewed the revised memorandum and comment response letter and provided further comments via an email on August 1, 2017. CH2M responded to the comments via an email on August 3, 2017, and subsequently, the City provided clarification to the comment responses and directions for the completion of the technical memorandum and associated attachments. Subsequently, CH2M issued a Revision 2 to the "Evaluation of Geotechnical Impacts due to BMP Partial Infiltration for the NCWRP Expansion and NCPWF Influent Conveyance Project" technical memorandum on August 10, 2017.

The City reviewed the revised memorandum (Revision 2) and provided comments via an email on August 14, 2017. The City's review comments indicated that the project's geotechnical consultant has adequately addressed the geologic site conditions for the purposes of environmental review of this component of the proposed project. The City also provided a note from the review that BMP 6 has been removed from the Water Quality and Hydromodification Exhibit and, therefore, Form I-8 for DMA 6 appears to be superfluous.

Based on the City's comments, CH2M, therefore, revised the technical memorandum by deleting sections associated with BMP 6 from the memorandum, including site condition and geologic hazard evaluation and Form I-8 to close out the review. Attached is this Revision 3 of the technical memorandum "Evaluation of Geotechnical Impacts due to BMP Partial Infiltration for the NCWRP Expansion and NCPWF Influent Conveyance Project" dated November 15, 2017.

Please review the attached revised technical memorandum and associated attachments, and contact us if you have any questions.

Respectfully,

CH2M

Ping Tian, GE

Geotechnical Engineer

REGISTERED PROFESSIONAL ENGINEER
PING TIAN
No. GE 2660
Exp. 12/31/17
GEOTECHNICAL
STATE OF CALIFORNIA

TECHNICAL MEMORANDUM

ch2m:

Evaluation of Geotechnical Impacts due to BMP Partial Infiltration for the NCWRP Expansion and NCPWF Influent Conveyance Project

PREPARED FOR:	City of San Diego
COPY TO:	Project File
PREPARED BY:	Ping Tian/CH2M, Geotechnical Engineer
DATE:	November 15, 2017
PROJECT NUMBER:	684476
REVISION NO.:	3
APPROVED BY:	Julian Hoyle/CH2M

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GEOTECHNICAL
STATE OF CALIFORNIA

Background

For the proposed San Diego NCWRP Expansion and NCPWF Influent Conveyance Project (NCWRP Expansion Project), nine best management practice (BMP) biofiltration basins have been proposed on the water reclamation plant site for storm water management. Due to site constraints, the proposed BMP biofiltration basins are located either adjacent to or between existing and/or proposed new facilities. The BMP locations are provided in Attachment No. 1.

The proposed BMP biofiltration basins consist of various sizes of water ponds, approximately two feet deep, with maximum side slopes varying between 2:1 to 3:1 (H:V). Constructed just below each water pond is a water filtration system, composed of various filtering material layers, including 3-inch thick mulch, 21-inch thick (minimum) bioretention soil media mix, a layer of Mirafi 140N fabric, 3-inch thick clean and washed ASTM No. 33 fine aggregate sand, 3-inch thick clean and washed ASTM No. 8 stone, and 18-inch thick crushed riprap. An 8-inch diameter perforated pipe would be placed in the middle area of the riprap layer to drain storm water.

The purpose of this technical memorandum is to evaluate any impacts to the existing and proposed new facilities on the NCWRP Expansion Project site due to infiltration of the proposed BMP biofiltration basins. If negative impacts are identified from infiltration, the bottom and/or sides of the BMP biofiltration basins can be lined with impermeable liners to prevent water from seeping into the underlying soils, and minimize any adverse impacts to the adjacent facilities. This technical memorandum also includes CH2M's recommendation if partial infiltration can be allowed or if impermeable liners should be placed at the bottom and/or sides of the BMP biofiltration basins to prevent negative impacts to the existing and proposed new facilities.

The analysis documented in this technical memorandum is based on both the original geotechnical report completed for the design of the NCWRP, which was prepared by CH2M and dated November 1992, and the recently developed geotechnical report completed for the design of the NCWRP expansion, which was prepared by Allied Geotechnical and dated August 9, 2017. It has been found that the geotechnical data included in the 1992 report is still valid for the naturally undisturbed formational soils. It appears that some of the surficial soils from the original site were removed prior to grading for construction of the existing plant. This geotechnical data is factored into the analysis that is documented in this technical memorandum. The original CH2M (1992) geotechnical report, along with a letter stating that the data included in this report is still valid for the current design, are provided in Attachment No. 2. The geotechnical report for the proposed expansion project (August 9, 2017) is provided in Attachment No. 3.

Geologic and Subsurface Conditions

The geologic and subsurface conditions of the NCWRP Expansion Project site have been determined based on review of the available information. Based on a review of the as-built record drawings, a major east-west trending canyon traversed the middle of the project site prior to the earthwork operations conducted for the construction of the original NCWRP. A second smaller east-west trending canyon was located at the southern end of the project site in the vicinity of the flow equalization basins. Significant grading was required for the construction of the original NCWRP construction, and it was estimated that as much as 50 feet of fill material was placed at the project site to fill these canyons. The drawings also indicate that removal of unsuitable alluvium/colluvium materials from the canyon bottoms was required prior to placement of fill material.

Because of this fill operation, subsurface soils at the site generally can be divided into three categories in three areas. The northern one-third area is Scripps Formation material; the middle one-third area is engineered fill on top of Scripps Formation; and the south one-third area is either fill on top of Scripps Formation or Lindavista Formation material. A brief description of each material unit (in order of increasing age), their characteristics, and groundwater conditions are presented in the following sections.

Fill Material

Fill materials associated with the construction of the original NCWRP were observed throughout the project site. Based on visual observations and field investigations completed at the site, the fill materials include a wide variety of materials, ranging from boulder to clay-size particles, and are expected to vary significantly in both lateral and vertical extent and consistency. Also, in-situ density testing indicated that the fill materials were generally placed with good engineered control, and are in medium dense to very dense conditions. The deepest fill materials are located within the alignment of the former east-west oriented canyons. Infiltration rates within the fill materials are expected to vary widely. For preliminary evaluation, infiltration rates from less than 0.1 inches per hour to 0.5 inches per hour may be used for the fill materials. The median value for infiltration in fill materials, determined from the recent borings, is 0.0028 inches per hour. Estimates of the infiltration rates based on the available data are provided in Attachment No. 4.

Very Old Paralic Deposit (Lindavista Formation) Materials

The southern section of NCWRP is underlain by very old Paralic deposits of middle to early Pleistocene age. These deposits rest on a succession of marine terraces, and were formerly referred to as the Lindavista Formation of early Pleistocene age. The formation consists of interfingered strandline, beach, estuarine and colluvial deposits composed of siltstone, sandstone and conglomerate, with a distinct reddish-brown color due to ferruginous cement. The combination of strong cementation and locally abundant gravels and cobbles pose difficult excavation conditions even for heavy duty construction equipment. The deposits are expected to have a very low infiltration rate, estimated to be less than 0.2 inches per hour. Estimates of the infiltration rate based on the existing available data are provided in Attachment No. 4.

Scripps Formation Material

The Scripps Formation material is a middle Eocene age sandstone with occasional cobble-conglomerate interbeds. The formation material is anticipated to be the underlying bedrock unit beneath the entire NCWRP site. The Scripps Formation material has a disconformable contact with the Very Old Paralic Deposits. The combination of local cobble-conglomerate zones and strong cementation pose difficult excavation conditions even for heavy-duty construction equipment. The Scripps Formation found in the geotechnical borings generally consisted of fine silty sand and sandy silt, silt, fine to coarse sand with clay and gravel layers, hardy sandy lean clay, fat clay, and claystone. Blow counts required to drive the soil sampler indicated that these materials were generally in a very stiff to hard/ dense to very dense condition. Infiltration rate for the Scripps Formation material is estimated to vary from less than 0.1 inches per hour in the silt and clay facies to a high of 0.5 inches per hour in the sandstone unit. The median value for infiltration in Scripps Formation materials, determined from the recent borings, is 0.0024 inches per hour. Estimates of the infiltration rates based on the existing available data are provided in Attachment No. 4.

Groundwater

The depth of the regional groundwater table beneath the NCWRP Expansion Project site is unknown; however, it may be assumed to be in excess of 100 feet below ground surface beneath the mesa top. Localized shallow perched water conditions are known to occur on the mesas, particularly during the wet (rainy) season; however, borings drilled at the site did not encounter groundwater to the depth of 21.5 feet below ground surface. Based on the 1992 geotechnical report prepared by CH2M, there was no evidence of groundwater in borings with an elevation of 242 feet. Based on the Geotechnical Report prepared by Allied Geotechnical (August 9, 2017), there was no evidence of groundwater in borings with an elevation of 328 feet.

Impacts of the BMP Biofiltrations (Partial Infiltration) to the Existing and the Proposed Facilities

The proposed BMP biofiltration basin locations are located adjacent to and/or between the existing or proposed new facilities at the NCWRP Expansion Project site. As discussed previously in this technical memorandum, the existing fill material is generally compacted engineered fill, and the formational material consists of various fine-grained siltstone, claystone, and sandstone or coarse grained gravel or porous conglomerates.

The 2017 geotechnical report (provided in Attachment No. 3) requires specific drainage control to protect structures and not adversely affect foundation soils. These controls include diversion of drainage away from the perimeter of structures or foundations, preventing surface water from ponding or collecting in building areas or near foundations, and providing proper monitoring and control of irrigation systems.

The approach to infiltration near existing and new facilities is also required to meet the intent of drainage control. It is expected that during a 100-year storm event, the BMP biofiltration basins will become filled with storm water, with drawdown time ranging from 4 hours to approximately 14 hours. If the sides and bottom of the BMP basins are not lined with impermeable liners, the water may seep down and form unsaturated flow or transient seepage into the material underneath the BMP biofiltration basins. Because of the variable material types underneath the basins, the path of seepage will be highly uncertain and uncontrolled. The water will seep through the coarse material, and may eventually saturate or partially saturate the granular backfill, if placed near any existing underground structural walls. If the underground walls and fill material are deep enough, the transient seepage may also create additional hydro-pressure and buoyancy, although the amount of the pressure and distribution are not equivalent to the fully saturated conditions. The water may also seep through the basin, and eventually erode the foundation soils underneath the existing and proposed facilities. Also, if any expansive clay materials are encountered, shallow structural walls or foundations may experience expansion impacts.

Based on review of the adjacent structure foundations; the distance of each BMP to the adjacent structures; materials underneath the BMPs; geotechnical analyses of unsaturated transient seepage; liquefaction potential; seismic settlement; and potentially additional unsaturated transient hydro-pressure on underground walls located within deep fills, it is CH2M's opinion that, if the bottom of the BMP basin is not lined with impermeable liners, the potential geotechnical hazards and risks are relatively low for BMP 1, 5, 7, and 10; while the potential geotechnical hazards and risks are relatively high for BMP 2, 3, 4, 8, and 9. The detailed evaluation of the potential geotechnical risks, as well as the hazards and their impacts to adjacent structures and facilities, are discussed in detail below for each of the BMP biofiltration basins.

BMP 1 – Soils Conditions and Geotechnical Hazards

The site of BMP 1 consists of approximately three feet of engineered fill material underlain by native Scripps Formational materials, including dense to very dense fine-grained silty sandstone, hard sandy siltstone, sandy lean clay, and claystone. The expected infiltration rate for this BMP ranges between 0.1 inches per hour and 0.5 inches per hour, based on its location within the Scripps Formation. A sample from Boring H-13, which is the closest boring to the BMP taken during the 2017 geotechnical assessment, indicates a calculated potential infiltration rate of 0.0024 inches per hour.

The adjacent structures and facilities to BMP 1 include the operations building, parking area, and new secondary clarifiers. Due to the rather lengthy distance from BMP 1 to the existing or proposed facilities, geotechnical hazard impacts and risks to the adjacent facilities are considered low. However, it should be noted that the proposed asphalt parking lot on the west side of BMP 1 and the access road on the east and south sides of BMP 1, may experience some earlier than expected surface cracking and roadway settlement due to potential subgrade pumping effect (pumping out of the fine subgrade particles when vehicles pass through), which may shorten their design service life. This area may require early and more frequent maintenance to provide the intended services for these facilities with the design life.

Considering the relatively low infiltration rate of the Scripps Formation material beneath the site, the risk and damage can be managed and remediated with relatively low cost if the sides of the BMP are lined. The bottom of BMP 1 can be unlined and left open for partial infiltration. Therefore, CH2M recommends that only the sides of BMP 1 are lined, while the bottom can be unlined and left open for partial infiltration.

BMP 2 – Soils Conditions and Geotechnical Hazards

The site of BMP 2 consists of approximately 27 feet of engineered fill materials underlain by native Scripps Formational materials. The engineered fill materials consist of compacted medium dense to very dense gravelly silty sand, and fine-grained and cemented sandstone. The Scripps Formational materials consist of very dense fine to medium-grained silty sand and hard sandy silt, very dense fine to medium-grained poorly graded sand with silt, abundant gravels and cobbles at various depths, and interlayered claystone. The expected infiltration rate for this BMP ranges from less than 0.1 inches per hour to 0.5 inches per hour, based on its location within the fills. A sample from Boring H-12, which is the closest boring to the BMP taken during the 2017 geotechnical assessment, indicates a calculated potential infiltration rate of 0.0024 inches per hour. While this value would indicate a very low infiltration rate, CH2M expects fill materials to have relatively wide variability in infiltration rates.

The adjacent structures and facilities to BMP 2 include the new secondary clarifiers, an existing electrical substation, and an existing main plant switchgear. If the bottom of BMP 2 is unlined, unsaturated transient seepage has the potential to flow through the relatively deep engineered fill material to the granular structural backfill beside the adjacent existing underground electrical substation wall. Also, water may seep into the structural backfill beside the new secondary clarifiers, which would increase the cost to construct the new clarifiers. Unsaturated transient seepage analysis, using the finite element model Slide software, was performed to model this seepage condition. A safety factor of 2.0 was used in the analysis to account for uncertainty and the variety of fill materials encountered. It is estimated that an additional hydro-pressure of approximately 132 pounds per square foot (psf) may potentially act against the wall of the existing electrical substation. The results of this analysis are provided in Attachment No. 4. To mitigate the potential impacts, a groundwater cut-off wall will need to be constructed around the BMP. The cost for this wall is estimated to be $2.8-$4.2 million. The impact can be technically mitigated; however, in CH2M's opinion, the cost for the mitigation is prohibitive and disproportionate to the pollution control benefits to be achieved.

Considering that BMP 2 is located closely between the adjacent structures and the potential geotechnical impacts on the existing and new facilities, CH2M recommends that the sides and bottom of BMP 2 be lined with impermeable liners with no infiltration.

BMP 3 – Soils Conditions and Geotechnical Hazards

The site of BMP 3 consists of approximately 34 feet of engineered fill material underlain by native Scripps Formational materials. The engineered fill consists of compacted medium dense to very dense fine to medium-grained silty sand and sandy silt with locally scattered, sub-rounded gravels up to 3 inches in maximum dimension, and clayey sand with locally abundant gravels. The Scripps Formational materials consist of very dense silty sand and sandy silt with gravel conglomerate matrix, very dense and hard silty sandstone and sandy siltstone, alternating laminations of silty sandstone and siltstone, and hard sandy lean clay, sandy claystone and strongly cemented siltstone. The expected infiltration rate for this BMP ranges from less than 0.1 inches per hour to 0.5 inches per hour, based on its location within the fills. A sample from Boring H-9, which is the closest boring to the BMP taken during the 2017 geotechnical assessment, indicates a calculated potential infiltration rate of 0.0024 inches per hour. While this value would indicate a very low infiltration rate, CH2M expects fill materials have relatively wide variability in infiltration rates.

The adjacent structures and facilities to BMP 3 include the new NCPWF Influent Pump Station (IPS), an existing electrical substation, and the existing water purification demonstration facility. If the bottom of BMP 3 is unlined, unsaturated transient seepage can flow through the relatively deep engineered fills to the granular structural backfill beside the adjacent existing underground electrical substation wall. Also, the water has the potential to seep into the structural backfill beside the new NCPWF IPS, which will increase the construction cost of the new pump station. Unsaturated transient seepage analysis, using the finite element model Slide software, was performed to model this seepage condition, and it is estimated that an additional hydro-pressure of approximately 106 psf may act against the wall of the existing electrical substation. The results of this analysis are provided in Attachment No. 4. To mitigate the potential impacts, a groundwater cut-off wall will need to be constructed around the BMP. The cost for this wall is estimated to be $1.3-$2.0 million. The impact can be technically mitigated; however, in CH2M's opinion, the cost for the mitigation is prohibitive and disproportionate to the pollution control benefits to be achieved. Considering the close proximity of BMP 3 to the adjacent structures and the potential geotechnical impacts on the existing and new facilities, CH2M recommends that the sides and bottom of BMP 3 be lined with impermeable liners with no infiltration.

BMP 4 – Soils Conditions and Geotechnical Hazards

The site of BMP 4 consists of approximately 49 feet of engineered fill materials underlain by Scripps Formational materials. The engineered fill material consists of compacted medium dense to very dense fine to medium-grained silty sand and sandy silt with locally scattered sub-rounded gravels up to a maximum of 2 inches, and clayey sand with locally abundant gravels. The Scripps Formational materials consist of hard sandy lean clay. The expected infiltration rate for this BMP ranges from less than 0.1 inches per hour to 0.5 inches per hour, based on its location within the fills. Two samples from Boring H-8, which is the closest boring to the BMP taken during the 2017 geotechnical assessment, indicate the calculated potential infiltration rates of 0.0028 inches per hour and 0.2215 inches per hour. While these values would indicate a very low or low infiltration rate, CH2M expects fill materials have relatively wide variability in infiltration rates.

The adjacent structures and facilities to BMP 4 include the existing and new tertiary filters and existing waste backwash tanks. If the bottom of BMP 4 is unlined, unsaturated transient seepage can flow through the relatively deep engineered fills to the granular structural backfill beside the adjacent underground wall of the tertiary filter facility. Also, the water has the potential to seep into the structural backfill beside the new tertiary filters, which will increase the construction cost for the new tertiary filters. Unsaturated transient seepage analysis, using the finite element model Slide software, was performed to model this seepage condition, and it is estimated that an additional hydro-pressure of approximately 500 psf may potentially act against the wall of the existing tertiary filters. The results of the analysis are provided in Attachment No. 4. To mitigate the potential impacts, a groundwater cut-off wall will need to be constructed around the BMP. The cost for this wall is estimated to be $0.7-$1.1 million. The impact can be technically mitigated; however, in CH2M's opinion, the cost for the mitigation is prohibitive and disproportionate to the pollution control benefits to be achieved. Considering the close proximity of BMP 4 to the adjacent structures and the potential geotechnical impacts on the existing and new facilities, CH2M recommends that the sides and bottom of BMP 4 be lined with impermeable liners with no infiltration.

BMP 5 – Soils Conditions and Geotechnical Hazards

The site of BMP 5 consists of approximately 6 feet of engineered fill material underlain by Scripps Formational materials, including very dense fine-grained silty sandstone, hard sandy siltstone, siltstone with laminations of silty sandstone, and sandy lean clay. The expected infiltration rate for this BMP ranges between 0.1 inches per hour and 0.5 inches per hour, based on its location within the Scripps Formation.

The adjacent facilities include the new and existing power generation facilities, an existing electrical substation, and an existing main plant switchgear.

Considering the relatively low infiltration rate of the Scripps Formation materials beneath the site, the foundation types of the adjacent existing and new facilities, along with the distance between BMP 5 and these facilities, the geotechnical impacts and risk of hazards to the adjacent facilities are considered low if the sides of BMP 5 are lined. The bottom of BMP 5 can be unlined and left open for partial infiltration. Therefore, CH2M recommends that only the sides of BMP 5 are lined, while the bottom can be unlined and left open for partial infiltration.

BMP 7 – Soils Conditions and Geotechnical Hazards

The site of BMP 7 consists of approximately 3 feet of engineered fill material and approximately 5 feet of native Lindavista Formational materials underlain by Scripps Formational materials. The Lindavista Formational material consists of very dense gravelly silty sand with sub-rounded gravel up to 2 inches in maximum dimension. The Scripps Formational materials consist of sandy lean clay. The expected infiltration rate for this BMP ranges between 0.1 inches per hour and 0.5 inches per hour, based on its location within the Scripps Formation.

The adjacent facilities include the existing power generation facilities and new chemical facilities.

Considering the relatively low infiltration rates of the Lindavista and Scripps Formation materials beneath the site, the foundation types of the adjacent existing and new facilities, along with the distance between BMP 7 and the adjacent facilities, the geotechnical impacts and risk of hazards to the adjacent facilities are considered low if the sides of BMP 7 are lined. The bottom of BMP 7 can be unlined and left open for partial infiltration. Therefore, CH2M recommends that only the sides of BMP 7 are lined, while the bottom can be unlined and left open for partial infiltration.

BMP 8 – Soils Conditions and Geotechnical Hazards

The site of BMP 8 consists of approximately 7 feet of fill and 5 feet of native Lindavista Formational material underlain by native Scripps Formational materials. The fill consists of yellowish brown to reddish yellow, damp, loose silty sand with scattered sub-rounded gravels up to a maximum of 3 inches. The Lindavista Formational material consists of very dense fine to medium-grained silty sand with abundant sub-rounded gravel up to a maximum of 3 inches. The Scripps Formational materials consist of very dense fine to medium-grained silty sand, medium-grained poorly graded sand with silt, gravel conglomerate with silty sand matrix, hard and very dense fine-grained sandy siltstone and silty sandstone, and hard sandy lean clay, lean clay, and claystone. The expected infiltration rate for this BMP ranges from less than 0.1 inches per hour to 0.5 inches per hour, based on its location within the fills and the Lindavista Formational materials.

The adjacent facilities include the new second stage bioreactor basins and plant's access road, which is paved with asphalt. BMP 8 is also adjacent to an existing 20-foot high slope, located to the west outside of the property boundary in Caltrans Right of Way. If the bottom of BMP 8 is unlined, seepage may flow through the top fill at the site, and has the potential to saturate the fill in a short period of time. Due to a potential loose condition, the loose fill could be liquefied and result in an estimated liquefaction-induced settlement on the order of 1.4 inches. Dry sand seismic settlement is estimated on the order of 1.0 inch for this loose fill. This shallow loose fill will be removed during excavation for newly constructed facilities and will not impact the proposed construction. However, there is a potential risk that this loose fill may impact the existing adjacent facilities, such as cracking of the access road, and negatively affect the stability of the existing slope. This assumes that the existing loose soil layer extends into the access road and the existing slope. Because CH2M is not performing a detailed investigation for all existing facilities and offsite conditions, boring locations are limited to key impact areas; therefore, potential geotechnical uncertainties exist in areas that may contain shallow loose soils. CH2M's concerns with the BMP was the proximity to the slope that is actually offsite in the Caltrans ROW. If the shallow loose fills as shown in boring B-7 are actually extended to the slope areas, it is CH2M's opinion that there is a potential of shallow surficial failure along the face of the slope, as result, a potential of destabilizing the slope, especially during an earthquake with the potential of soil liquefaction. With the BMP placed on top of the adjacent slope, it also puts the City (plant's owner) with a liability for potential claims of property damage and loss from the potential hazard. To mitigate the potential impacts, a groundwater cut-off wall will need to be constructed around the BMP. The cost for this wall is estimated to be $0.7-$1.1 million. The impact can be technically mitigated; however, in CH2M's opinion, the cost for the mitigation is prohibitive and disproportionate to the pollution control benefits to be achieved. By recommending that BMP 8 be lined to prevent infiltration, CH2M is attempting to mitigate the potential of geotechnical hazards. The results of the liquefaction analysis is provided in Attachment No. 4.

Considering the close proximity of BMP 8 to the adjacent structures, its location adjacent to the existing slope, and the potential geotechnical impacts, CH2M recommends that the sides and bottom of BMP 8 be lined with impermeable liners with no infiltration.

BMP 9 – Soils Conditions and Geotechnical Hazards

Because BMP 9 is close to BMP 8, therefore, the site of BMP 9 is expected to have similar subsurface soil conditions and infiltration rate as BMP 8.

The adjacent facilities include the new first stage as well as the second stage bioreactor basins. It is also adjacent to the existing plant's access road and an existing 20-foot high slope located to the west outside of the property boundary.

The geotechnical risk of hazards and impacts to the adjacent facilities for BMP 9 is similar to BMP 8.

Considering the close proximity of BMP 9 to the adjacent structures, its location adjacent to the existing slope, and the potential geotechnical impacts, CH2M recommends that the sides and bottom of BMP 9 be lined with impermeable liners with no infiltration.

BMP 10 – Soils Conditions and Geotechnical Hazards

The site of BMP 10 consists of approximately 15 feet of engineered fill material underlain by Scripps Formational materials. The engineered fill material consists of medium dense to very dense silty sand and clayey sand with abundant gravel and scattered cobbles. The Scripps Formational material consists of very dense fine-grained silty sand with gravel and cobble conglomerate, very dense and hard silty sandstone and sandy siltstone with traces of sub-rounded gravels up to 0.5 inches in maximum dimension, and sandy lean clay. The expected infiltration rate for this BMP ranges between 0.1 inches per hour and 0.5 inches per hour, based on its location within the fills and the Scripps Formation.

The adjacent facilities include the existing flow equalization basins and a new flow equalization basin.

Considering the relatively low infiltration rates of the Scripps Formation materials beneath the site and the foundation types of the adjacent existing and new facilities, the geotechnical impacts and risk of hazards to the adjacent facilities are considered low if the sides of BMP 10 are lined. The bottom of BMP 10 can be unlined and left open for partial infiltration. Therefore, CH2M recommends that only the sides of BMP 10 are lined, while the bottom can be unlined and left open for partial infiltration.

Recommendations

Based on the above discussion and evaluation, CH2M recommends that BMP 1, 5, 7, and 10 be lined on both sides with impermeable liners, while their bottom be unlined and left open for partial infiltration. BMP 2, 3, 4, 8, and 9 shall be fully lined with impermeable liners at their sides and bottoms to minimize their adverse impacts to the adjacent existing or the proposed new facilities.

A Form I-8 has been completed for each of the BMP, and are provided in Attachment No. 5.

Attachment No. 1

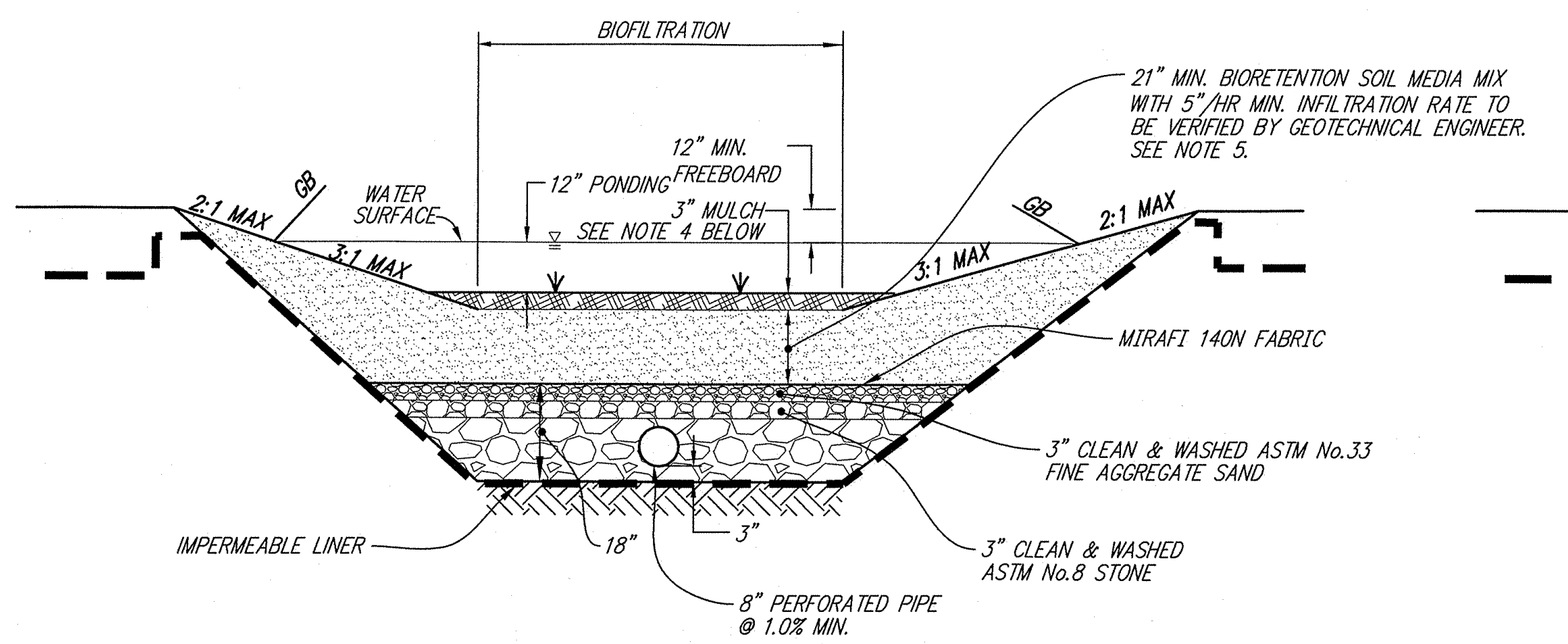
Biofiltration Drawing

BMP SIZING CALCULATIONS- FOR WATER QUALITY

BMP	New or [1] Replaced Impervious Surface (SF)	Proposed Facility	A (AC)	C (RUNOFF FACTOR) (UNITLESS)	DCV [2] (DESIGN CAPTURE VOLUME) (CF)	SURFACE PONDING (IN)	MEDIA THICKNESS (IN)	Aggregate Storage Above Underdrain (Storage)	Media [3] Infiltration Rate (IN/HR)	Baseline [4] Calculation (Depth Treated during 6 hour storm)	1.5*DCV (SF)	OPTION 1- [5] Req'd Footprint	OPTION 2- [6] Store 0.75	OPTION 3 - 3% Criteria (SF)	MINIMUM REQUIRED [7] BASIN FOOTPRINT (SF)	BMP Area Provided
1	142,015	PORTION OF SECONDARY CLARIFIER, ACCESS ROAD, PARKING LOT & POWER GENERATION AREA	3.26	0.900	6,071	12	24	15	5.00	54.00	9,107	2024	2397	3,834	3,834	3920
2	25,730	PORTION OF SECONDARY CLARIFIER AND ACCESS ROAD	0.59	0.900	1,100	12	24	15	2.47	38.82	1,650	510	434	695	695	800
3	5,450	INFLUENT PUMP STATION	0.13	0.900	233	12	24	15	2.11	36.66	349	114	92	147	147	150
4	1,645	TERTIARY FILTER EXPANSION	0.04	0.900	70	12	24	15	2.26	37.56	105	34	28	44	44	140
5	6,530	RELOCATED POWER GENERATION AREA	0.15	0.900	279	12	24	15	3.24	43.44	419	116	110	176	176	220
7	9110	CHEMICAL BUILDINGS	0.21	0.90	389	12	24	15	2.69	40.13	584	175	154	246	246	265
8	7,970	NORTH PORTION OF PROPOSED ROAD F	0.18	0.900	341	12	24	15	3.24	43.43	511	141	134	215	215	220
9	7,370	SOUTH PORTION OF PROPOSED ROAD F	0.17	0.900	315	12	24	15	3.56	45.38	473	125	124	199	199	200
10	385	CONC PAD	0.01	0.90	16	12	24	15	5.00	54.00	25	5	6	10	10	32

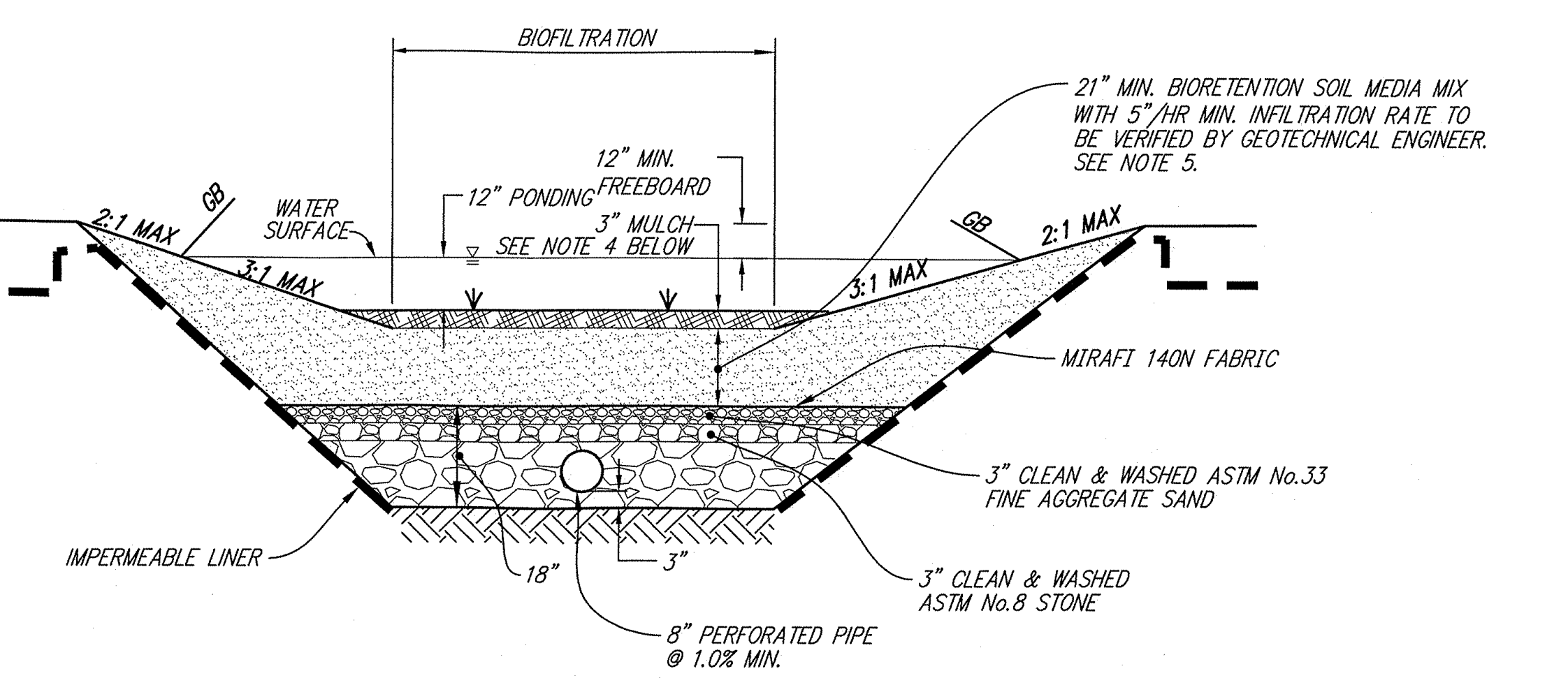
FOOTNOTES TO BMP SIZING TABLE

1. SINCE REDEVELOPMENT RESULTS IN THE CREATION OR REPLACEMENT OF IMPERVIOUS SURFACE LESS THAT 50% OF THE EXISTING IMPERVIOUS SURFACE, STRUCTURAL BMP PERFORMANCE REQUIREMENTS APPLY ONLY TO THE NEW OR REPLACED IMPERVIOUS SURFACE PER SECTION 1.7 OF THE CITY OF SAN DIEGO BMP MANUAL.
2. DESIGN CAPTURE VOLUME (DCV) = 3.630 x C x d x A, d = 85TH PERCENTILE, 24 HR STORM EVENT=0.57 IN.
3. MEDIA INFILTRATION RATE IS 5 IN/HR, OR IF CONTROLLED BY ORIFICE THAT LIMITS FLOW TO LESS THAN 5 IN/HR, ORIFICE FLOW RATE IS USED. SEE LINE 15 OF WORKSHEET B.5-1 SIMPLE SIZING METHOD FOR BIOFILTRATION BMPS FROM THE CITY OF SAN DIEGO BMP DESIGN MANUAL AND SUPPLEMENTAL GUIDANCE DATED JUNE 2017.
4. LINE 14 OF WORKSHEET B.5-1 SIZING METHOD FOR POLLUTANT REMOVAL CRITERIA FROM THE CITY OF SAN DIEGO STORM WATER STANDARDS SUPPLEMENTAL GUIDANCE DATED JUNE 2017.
5. BASED ON THE MS4 PERMIT ORDER R9 2013-001, PROVISION E.3.C, BIOFILTRATION FACILITIES MUST TREAT 1.5 TIMES THE DESIGN CAPTURE VOLUME (DCV). LINE 17 OF WORKSHEET B.5-1 SIZING METHOD FOR POLLUTANT REMOVAL CRITERIA FROM THE CITY OF SAN DIEGO STORM WATER STANDARDS SUPPLEMENTAL GUIDANCE DATED JUNE 2017.
6. BASED ON THE MS4 PERMIT ORDER R9 2013-001, PROVISION E.3.C, BIOFILTRATION FACILITIES MUST TREAT 1.0 TIMES THE PORTION OF THE DESIGN CAPTURE VOLUME (DCV) NOT RELIABLY RETAINED ONSITE; AND HAS A TOTAL STATIC STORAGE VOLUME INCLUDING PORE SPACES AND PRE-FILTER DETENTION VOLUME, EQUAL TO AT LEAST 0.75 TIMES THE PORTION OF THE DCV NOT RELIABLE RETAINED ONSITE. LINE 19 OF WORKSHEET B.5-1 SIZING METHOD FOR POLLUTANT REMOVAL CRITERIA FROM THE CITY OF SAN DIEGO STORM WATER STANDARDS SUPPLEMENTAL GUIDANCE DATED JUNE 2017.
7. MINIMUM FOOTPRINT OF THE BMP = MAX (MIN (OPTION 1, OPTION 2), OPTION 3).



NO INFILTRATION DETAIL - BIOFILTRATION AREA BMPS 2, 3, 4, 8 AND 9

NOT TO SCALE



PARTIAL INFILTRATION DETAIL - BIOFILTRATION AREA BMPS 1, 5, 7, AND 10

NOT TO SCALE

NOTES:

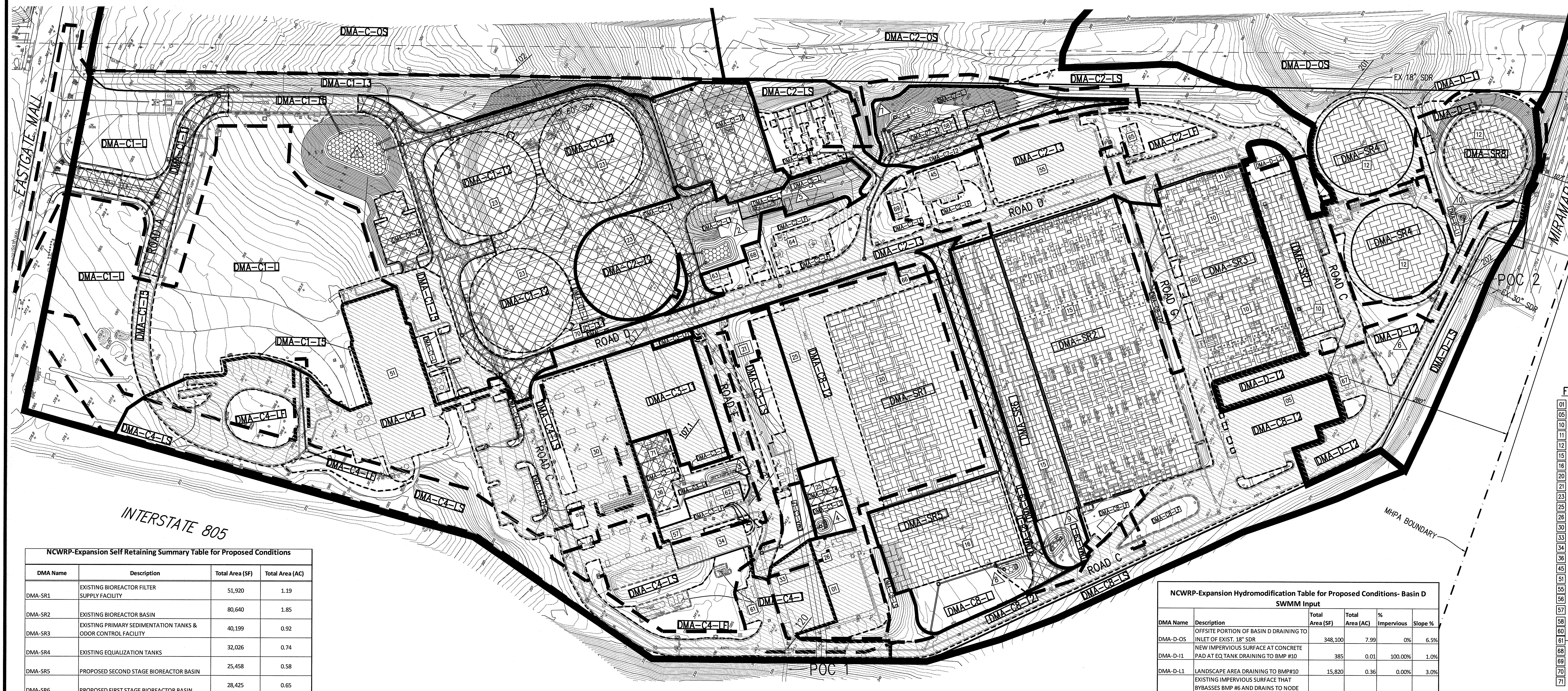
1. BMP TO COMPLY WITH CITY OF SAN DIEGO 2016 STORMWATER STANDARDS.
2. BMP SHALL BE REVIEWED AND APPROVED BY GEOTECHNICAL ENGINEER.
3. SELECTED PLANTS TO BE SUITABLE FOR CLIMATE AND EXPECTED PONDING DEPTH.
4. A MINIMUM OF 3" OF WELL-AGED, SHREDDED HARDWOOD THAT HAS BEEN STOCKPILED OR STORED FOR AT LEAST 12 MONTHS.
5. BIORETENTION SOIL MEDIA AND COMPOST SPECIFICATIONS SHALL COMPLY WITH APPENDIX F.4 OF CITY OF SAN DIEGO 2016 STORMWATER STANDARDS.

LEGEND:

Symbol	Meaning
— - - —	PROPERTY LINE
▬	DRAINAGE BASIN
▬ ▬ ▬	SUB-BASIN BOUNDARY
—	DMA BOUNDARY
▬ ▬	LIMIT OF WORK
— · — · —	MHPA BOUNDARY
100	NODE NUMBER
POC 1	POINT OF COMPLIANCE
DMA-A1-L	DMA NAME
▩	IMPERVIOUS AREA (CREATED OR REPLACED)
= = =	EXIST. STORM DRAIN
▧	EXIST. IMPERVIOUS SURFACE TO REMAIN
▦	BIOFILTRATION (W/HYDROMODIFICATION)
△1	BMP NO. SEE TABLE @ LEFT
▨	SELF-RETAINING EXISTING FACILITIES
▨	SELF-RETAINING PROPOSED FACILITIES

NCWRP-Expansion Hydromodification Table for Proposed Conditions- Basin C SWMM Input

DMA Name	Description	Total Area (SF)	Total Area (AC)	% Impervious	Slope %
DMA-C-OS	OFFSITE PORTION OF BASIN A DRAINING TO INLET OF OF EXISTING 60" SDR	3,977,873	91.32	0%	2.0%
DMA-C1-I1	NEW IMPERVIOUS SURFACE AT ACCESS ROAD ENTRANCE DRAINING TO BMP1	12750	0.29	100%	4.0%
DMA-C1-I2	NEW IMPERVIOUS SURFACE FOR 3~ CLARIFIERS DRAINING TO BMP 1	56320	1.29	100%	1.0%
DMA-C1-I3	NEW IMPERVIOUS SURFACE AT POR OF ACCESS ROAD AROUND NEW CLARIFIERS	42695	0.98	100%	5.0%
DMA-C1-I4	NEW IMPERVIOUS SURFACE AT PROPOSED PARKING LOT	6020	0.14	100%	5.0%
DMA-C1-I5	EXISTING IMPERVIOUS SURFACE THAT DRAINS TO BMP 1	24070	0.55	100%	2.0%
DMA-C1-I6	IMPERVIOUS SURFACE AT NEW POWER GENERATOR AREA THAT DRAINS TO BMP 1	24230	0.56	100%	1.0%
DMA-C1-L	LANDSCAPE AREA DRAINING TO BMP 1	209261	4.80	0%	8.0%
DMA-C2-OS	OFFSITE PORTION OF EAST SUB-BASIN DRAINING TO NODE 107	196,782	4.52	0%	6.3%
DMA-C2-I1	NEW IMPERVIOUS SURFACE FOR SW CLARIFIER TO BMP 2	18,761	0.43	100%	1.0%
DMA-C2-I2	NEW IMPERVIOUS SURFACE FOR ACCESS ROAD AT SW CLARIFER TO BMP 2	6,970	0.16	100%	8.0%
DMA-C2-L1	LANDSCAPE AREA DRAINING TO BMP 2	8,990	0.21	0%	50.0%
DMA-C5-I	NEW IMPERVIOUS SURFACE FOR RELOCATED POWER-GEN AREA TO BMP 5	6,532	0.15	100%	1.0%
DMA-C5-L	LANDSCAPE AREA TO BMP 5	1,760	0.04	0%	2.0%
DMA-C7-I	NEW IMPERVIOUS SURFACE AT NEW CHEM BLDGS & ACCESS ROAD DRAINS TO BMP 7	9,110	0.21	100%	1.5%
DMA-C7-I2	EXISTING IMPERVIOUS SURFACE AT CHEM AREA THAT DRAINS TO BMP 7	1,585	0.04	100%	1.5%
DMA-C7-L	LANDSCAPE AREA TO BMP 7	12,270	0.28	0%	50.0%
DMA-C2-I3	EXISTING IMPERVIOUS SURFACE FOR THE EAST BASIN THAT BYPASSES BMP 2 AND DRAINS TO NODE 107	93,510	2.15	100%	2.0%
DMA-C2-LS	STEEP LANDSCAPE PORTION OF EAST SUB-BASIN DRAINING TO NODE 107	26,924	0.62	0%	50.0%
DMA-C2-LF	FLAT LANDSCAPE PORTION OF EAST SUB-BASIN DRAINING TO NODE 107	35,591	0.82	0%	2.0%
DMA-C3-I1	EXISTING MPERVIOUS SURFACE FOR MCC BLDG THAT DRAINS TO NODE 107.1	21,610	0.50	100%	1.0%
DMA-C3-I2	NEW IMPERVIOUS SURFACE FOR THE PUMP STATION & ELEC SUB-STATION DRAINING TO BMP 3	5,450	0.13	100%	1.0%
DMA-C3-I3	EXISTING IMPERVIOUS SURFACE THAT DRAINS TO BMP 3	460	0.01	100%	1.0%
DMA-C3-L1	FLAT LANDSCAPE AREA DRAINING TO BMP 3	5,700	0.13	0%	2.0%
DMA-C3-I4	NEW IMPERVIOUS SURFACE FOR THE TERTIARY FILTER EXPANSION DRAINING TO BMP 4	1,645	0.04	100%	1.0%
DMA-C3-L2	FLAT LANDSCAPE AREA DRAINING TO BMP 4	4,345	0.10	0%	2.0%
DMA-C3-I5	EXISTING IMPERVIOUS PORTION OF MIDDLE SUB-BASIN DRAINING TO NODE 119 THAT BYPASSES BMPS	36,780	0.84	100%	1.2%
DMA-C3-LF	FLAT LANDSCAPE PORTION OF MIDDLE SUB-BASIN DRAINING TO NODE 119 THAT BYPASSES BMPS	5,400	0.12	0%	2.0%
DMA-C3-LS	STEEP LANDSCAPE PORTION OF MIDDLE SUB-BASIN DRAINING TO NODE 119 THAT BYPASSES BMPS	9,570	0.22	0%	50.0%
DMA-C4-I	IMPERVIOUS PORTION OF NW SUB-BASIN DRAINING TO NODE 120	136,770	3.14	100%	1.0%
DMA-C4-LS	STEEP LANDSCAPE PORTION OF NW SUB-BASIN DRAINING TO NODE 120	50,820	1.17	0%	50.0%
DMA-C4-LF	FLAT LANDSCAPE PORTION OF NW SUB-BASIN DRAINING TO NODE 120	27,600	0.63	0%	1.0%
DMA-C8-I	NEW IMPERVIOUS FOR NORTH SIDE OF RELOCATED ROAD F DRAINING TO BMP 8	7,970	0.18	100%	0.5%
DMA-C8-L	LANDSCAPE AREA DRAINING TO BMP 8	3,010	0.07	0%	2.0%
DMA-C9-L	LANDSCAPE AREA DRAINIG TO BMP 9	4,950	0.11	0%	2.0%
DMA-C9-I	NEW IMPERVIOUS FOR NORTH SIDE OF RELOCATED ROAD F DRAINING TO BMP 9	7,370	0.17	100%	0.5%
DMA-C8-I2	EXISTING IMPERVIOUS SURFACE THAT BYPASSES BMPS	101,316	2.33	100%	1.0%
DMA-C8-LS	STEEP LANDSCAPE PORTION OF SW SUB-BASIN DRAINING TO NODE 120 THAT BYPASSES BMPS 8 & 9	27,118	0.62	0%	50.0%
DMA-C8-LF	FLAT LANDSCAPE PORTION OF SW SUB-BASIN DRAINING TO NODE 120 THAT BYPASSES BMPS 8 & 9	27,570	0.63	0%	4.0%



FACILITIES LEGEND

No.	Facility
01	INFLUENT PUMP STATION
05	HEADWORKS
10	PRIMARY SEDIMENTATION TANKS
11	INTERMEDIATE PUMP STATION
12	FLOW EQUALIZATION BASINS
15	FIRST STAGE BIOREACTOR BASIN
16	SECOND STAGE BIOREACTOR BASIN
20	BIOREACTOR/FILTER SUPPORT FACILITY
21	FILTER INFLUENT STRUCTURE
23	SECONDARY CLARIFIERS
25	TERTIARY FILTERS
26	WASTE BACKWASH TANK
30	CHLORINE CONTACT TANKS
33	EFFLUENT DROP STRUCTURE
34	EFFLUENT PUMP STATION
36	NCWPF INFLUENT PUMP STATION
45	BLENDED SLUDGE PUMP STATION
51	OPERATIONS BUILDING
55	CHEMICAL BUILDING
56	UREA FACILITY
57	DISINFECTION FEED FACILITY
58	METHANOL FACILITY
60	ODOR CONTROL FACILITY
61-67	ELECTRICAL SUBSTATIONS
68	ELECTRICAL MAIN PLANT SWITCHGEAR
69	ELECTRICAL SWITCH GEAR SUBSTATION
70	SECONDARY CLARIFIER ELECTRICAL BUILDING
71	NCWPF IPS ELECTRICAL SUBSTATION

NCWRP-Expansion Self Retaining Summary Table for Proposed Conditions

DMA Name	Description	Total Area (SF)	Total Area (AC)
DMA-SR1	EXISTING BIOREACTOR FILTER SUPPLY FACILITY	51,920	1.19
DMA-SR2	EXISTING BIOREACTOR BASIN	80,640	1.85
DMA-SR3	EXISTING PRIMARY SEDIMENTATION TANKS & ODOR CONTROL FACILITY	40,199	0.92
DMA-SR4	EXISTING EQUALIZATION TANKS	32,026	0.74
DMA-SR5	PROPOSED SECOND STAGE BIOREACTOR BASIN	25,458	0.58
DMA-SR6	PROPOSED FIRST STAGE BIOREACTOR BASIN	28,425	0.65
DMA-SR7	PROPOSED PRIMARY SEDIMENTATION TANK	16,810	0.39
DMA-SR8	PROPOSED EQ TANK	11,890	0.27

NCWRP-Expansion Hydromodification Table for Proposed Conditions- Basin D SWMM Input

DMA Name	Description	Total Area (SF)	Total Area (AC)	% Impervious	Slope %
DMA-D-OS	OFFSITE PORTION OF BASIN D DRAINING TO INLET OF EXIST. 18" SDR	348,100	7.99	0%	6.5%
DMA-D-I1	NEW IMPERVIOUS SURFACE AT CONCRETE PAD AT EQ TANK DRAINING TO BMP #10	385	0.01	100.00%	1.0%
DMA-D-L1	LANDSCAPE AREA DRAINING TO BMP#10	15,820	0.36	0.00%	3.0%
DMA-D-I2	EXISTING IMPERVIOUS SURFACE THAT BYBASSES BMP #6 AND DRAINS TO NODE #202	50,760	1.17	100.00%	2.0%
DMA-D-L2	EXISTING FLAT LANDSCAPE AREA THAT BYPASSES BMP #6 AND DRAINS TO NODE #202	14100	0.32	0.00%	50.0%
DMA-D-LS	EXISTING STEEP LANDSCAPE AREA THAT BYPASSES BMP #6 AND DRAINS TO NODE #202	18035	0.41	0.00%	50.0%

0' 60' 120'
SCALE: 1" = 60'

ATTACHMENT No. 1A/1B
NORTH CITY WATER RECLAMATION PLANT EXPANSION WATER QUALITY & HYDROMODIFICATION EXHIBIT FOR PROPOSED CONDITIONS

SHEET 2 OF 2 SHEETS

REGISTERED PROFESSIONAL ENGINEER
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Civil Engineering
Planning
Processing
Surveying

DESIGNED BY: NF
DATE: FEB 2017
DRAWN BY: TG
SCALE: 1" = 60'
PROJECT MGR.: KWH
JOB NO.: 161026

ENGINEER OF WORK:
DATE:
KEITH W. HANSEN
RCE: 60223

Attachment No. 2

Existing Geotechnical Report

(CH2M HILL, November 1992)

CH2M
402 W. Broadway, Suite 1450
San Diego, CA 92101
O +1 619-687-0120
www.ch2m.com

July 31, 2017

City of San Diego

Public Utilities Department
9192 Topaz Way
San Diego, CA 92123

Re: City of San Diego Public Utilities Department/ CH2M North City Water Reclamation Plant (NCWRP) Expansion Geotechnical Report

For the development of the Technical Memorandum entitled "Evaluation of Geotechnical Impacts Due to BMP Partial Infiltration at the San Diego NCWRP Expansion and NCPWF Influent Conveyance Project", geotechnical information was obtained from the North City Water Reclamation Plant Final Geotechnical Report by CH2M HILL, dated November 1992. It appears that some of the surficial soils from the original site were removed prior to grading for construction of the existing plant. It is CH2M's opinion that the geotechnical data included in the 1992 report is still valid for the naturally undisturbed formational soils. Therefore, the applicable geotechnical data included in this report is used in this geotechnical evaluation.

Ping Tian/CH2M, Geotechnical Engineer

REGISTERED PROFESSIONAL ENGINEER
PING TIAN
No. GE 2660
Exp. 12/31/17
GEOTECHNICAL
STATE OF CALIFORNIA

CLEAN WATER PROGRAM
for Greater San Diego

NORTH CITY WATER RECLAMATION PLANT

CITY OF SAN DIEGO, CALIFORNIA

FINAL
GEOTECHNICAL REPORT
REVISED NOVEMBER, 1992

CH2M HILL
AND ASSOCIATES

NOVEMBER 1992

NORTH CITY WATER RECLAMATION PLANT
CITY OF SAN DIEGO, CALIFORNIA

FINAL GEOTECHNICAL REPORT

Prepared for
Clean Water Program of Greater San Diego

No. GE-002136
Exp. 6/30/93

Prepared by
CH2M HILL
401 "B" Street, Suite 900
San Diego, California 92101

November 1992

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Section 1
General

Section 1
General

1.1 Introduction

1.1.1 Authorization

This report and the recommendations herein were produced for the Clean Water Program for Greater San Diego by CH2M HILL's geotechnical staff. This work is authorized as Task 4.1 under the October 9, 1991, agreement for design engineering services between the City of San Diego and CH2M HILL California, Inc., for the North City Water Reclamation Plant and the Northern Sludge Processing Facility.

1.1.2 Purpose and Scope

The purpose of the current work is to develop geotechnical design recommendations for use by CH2M HILL engineers in the design of the North City Water Reclamation Plant.

The scope of work undertaken includes field exploration of the site, laboratory testing, development of recommendations for design, and preparation of reports that comply with the City of San Diego Technical Guidelines for Geotechnical Reports. The focus of this study is to provide geotechnical recommendations for the design of structures and other facilities that comprise the wastewater treatment plant.

Additionally, a geologic reconnaissance and seismic study were performed by a subconsultant to support the geotechnical design.

1.1.3 Background

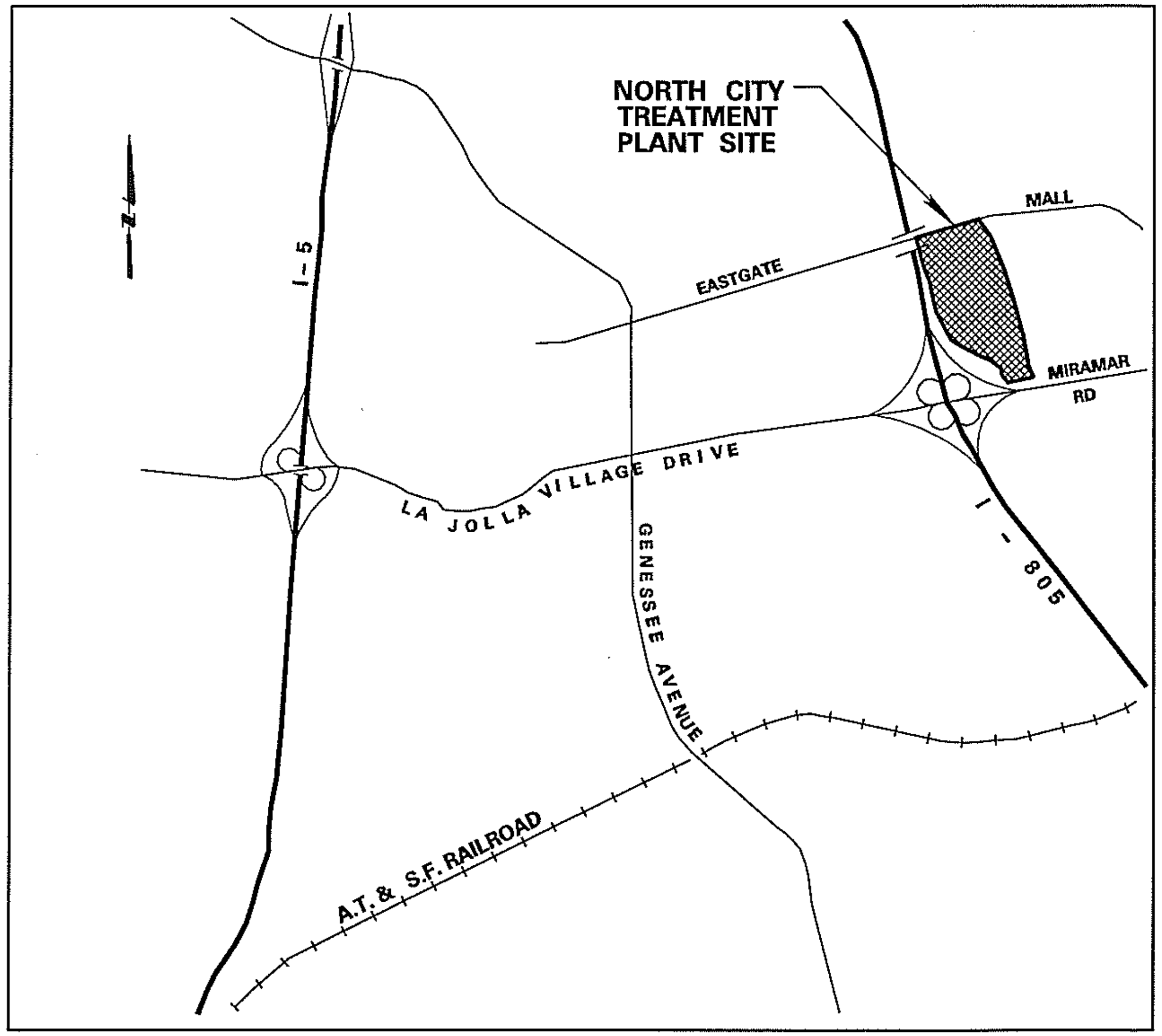
The site of the North City Water Reclamation Plant is located in the northern section of the City of San Diego, east of the City of La Jolla. The site is bordered on the north by Eastgate Mall, on the south by Miramar Road, on the east by the San Diego Gas and Electric easement, and on the west by Interstate 805. Figure 1-1 shows the project location.

The project site consists of a mesa separated by a large westward trending canyon and its tributaries. A second, smaller box canyon is located at the southern end of the site adjacent to, and roughly paralleling, Miramar Road. Elevations at the site range from 387 feet mean sea level (msl) on the top of the mesa to 298 feet msl at the canyon floor. The site, which has an area of 39 acres, is currently undeveloped and is covered in most areas with brush and tall grass.

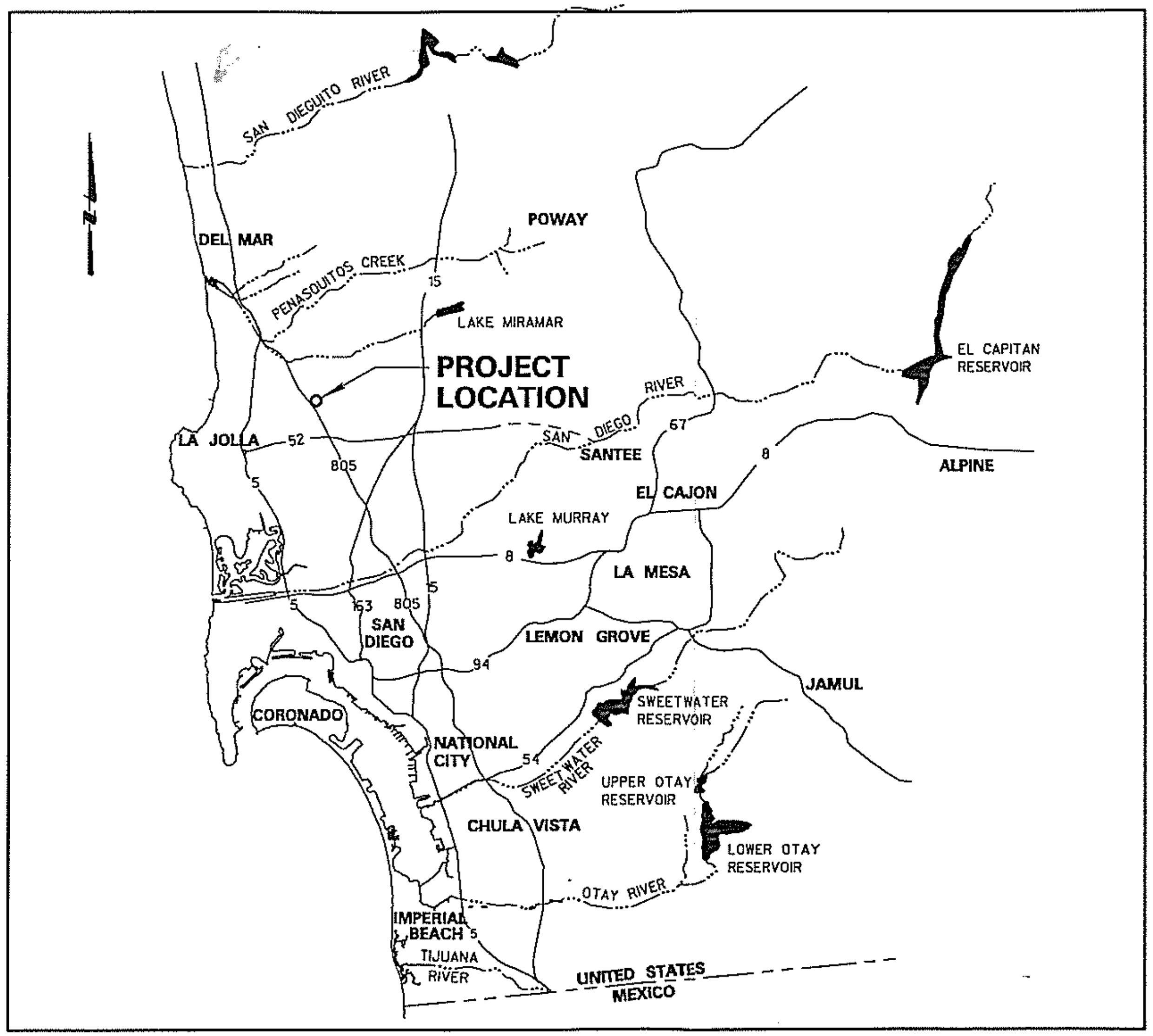
Access to the site is limited by a 4-to-6 foot tall earthen berm, which bounds the site on its north, east, and south sides. Access is restricted on the west side by a chain link fence along the length of the site. Entry to the site for the purpose of the geotechnical explora-

FIG1 .DGN 02-06-92

NORTH CITY WATER RECLAMATION PLANT



VICINITY MAP



LOCATION MAP

FIGURE 1-1
LOCATION AND VICINITY MAP
NORTH CITY WATER RECLAMATION PLANT
SAN DIEGO, CALIFORNIA

tion program was obtained through a San Diego Gas and Electric access gate along Miramar Road.

1.1.4 Project Description

The project consists of 12 main structures and numerous smaller facilities. The structures are mostly large basins and tanks although several buildings are present. The following paragraphs will discuss each structure, concentrating on its location, size, foundation type, and loads. The location of each structure is presented in Figure 1-2.

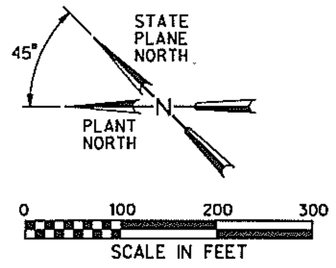
At the time of this report, structural loads were not available. The loads presented in the following paragraphs were approximated by the geotechnical staff based upon building components and water depths. Live and machinery loads were not addressed in this analysis. Unless otherwise noted, the loads defined in the building descriptions are total structural bearing pressures.

The flow equalization basins are located at the extreme southern end of the site. These reinforced concrete water holding basins measure approximately 145 feet in diameter. The maximum water depth will be approximately 25 feet. The basins are proposed to be supported by a combination of mats and spread footings. The basins will be constructed on both native material and up to 40 feet of fill. These structures are expected to produce bearing pressures in the range of 2,000 pounds per square feet (psf).

The primary sedimentation basins and grit tanks are located in the southern portion of the site, north of the flow equalization basins. These reinforced concrete water holding basins measure approximately 160 by 320 feet in plan. The water depth varies from 11 feet to approximately 30 feet. The structures are proposed to be supported by mat foundations on native material and are expected to produce bearing pressures in the range of 1,200 to 2,000 psf. Because the buildings are to be below the present grade level, it is expected that their load will be fully compensated by the removal of overburden.

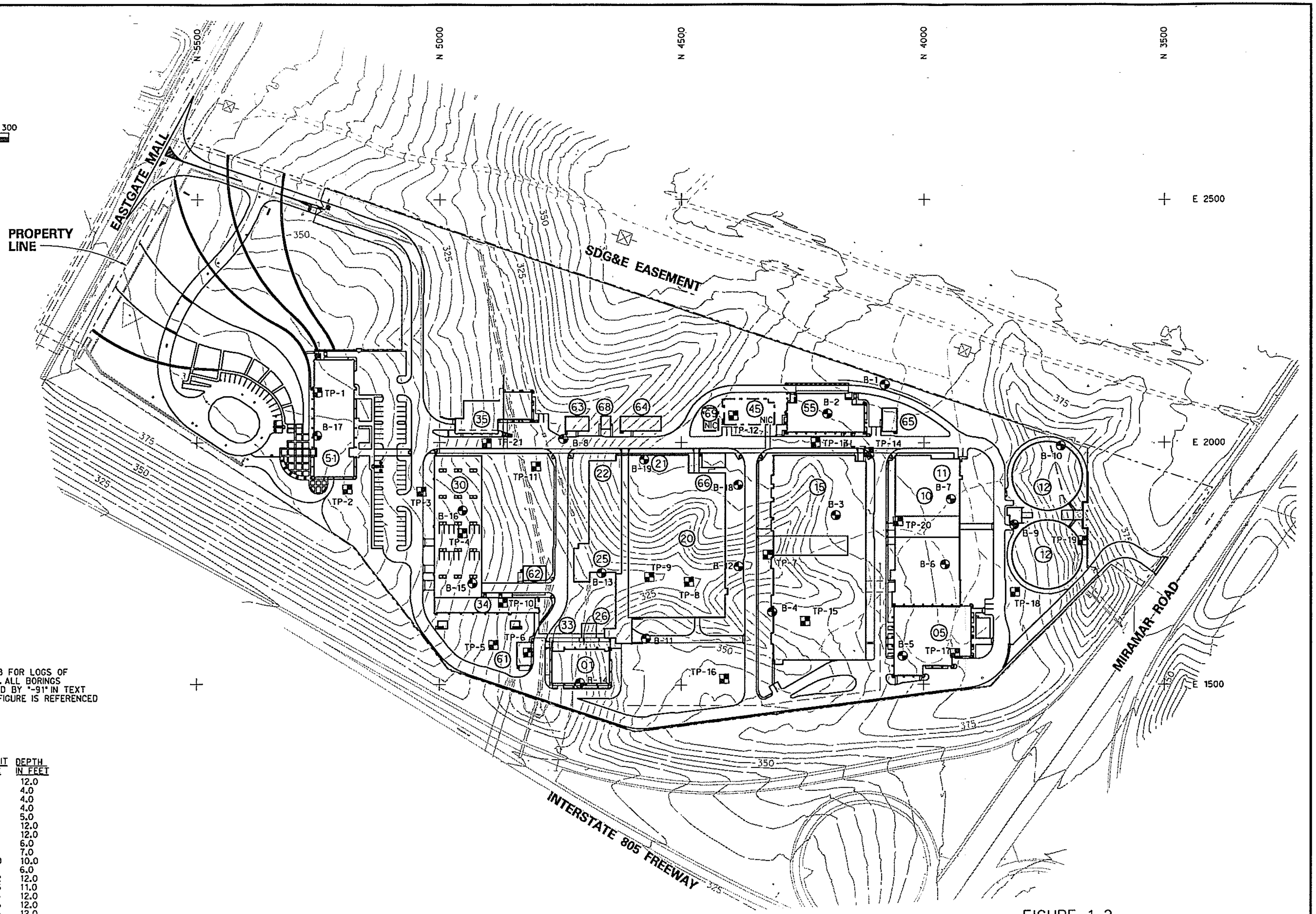
The headworks building is attached to the western end of the grit tanks. This reinforced concrete facility measures approximately 160 by 150 feet in plan. It is proposed to be supported by a mat foundation on native material and is expected to produce bearing pressures in the range of 1,200 psf. Because the building is to be constructed below the present grade level, it is expected that its load will be fully compensated by the removal of overburden.

The aeration basins are located to the north of the primary sedimentation/grit tanks/headworks complex. These reinforced concrete water holding basins measure approximately 190 by 430 feet in plan. The maximum water depth will be approximately 20 feet. They are proposed to be supported by a mat foundation on native material and are expected to produce bearing pressures in the range of 2,000 psf. Because the building is to be constructed below the present grade level, it is expected that its load will be fully compensated by the removal of overburden.



FACILITIES LEGEND

- ⓪① INFLUENT PUMP STATION
- ⓪⑤ HEADWORKS
- ⑩ PRIMARY SEDIMENTATION TANKS
- ⑪ INTERMEDIATE PUMP STATION
- ⑫ FLOW EQUALIZATION
- ⑮ AERATION BASINS
- ⑳ SECONDARY CLARIFIERS
- ㉑ SECONDARY EFFLUENT SPLITTER BOX
- ㉒ COAGULATION AND METERING
- ㉕ TERTIARY FILTERS
- ㉖ WASTE BACKWASH TANK
- ㉚ CHLORINE CONTACT TANKS
- ㉝ EFFLUENT DROP STRUCTURE
- ㉞ EFFLUENT PUMP STATION
- ㉟ CHLORINATION BUILDING
- ㊺ SLUDGE PUMP STATION (NIC)
- (51) OPERATIONS BUILDING
- (55) CHEMICAL BUILDING
- (61)-(67) ELECTRICAL SUBSTATIONS
- (68) ELECTRICAL MAIN PLANT SWITCHGEAR
- (69) ELECTRICAL SUBSTATION (NIC)



LEGEND

B-17● GEOTECHNICAL BORING

TP-1▨ GEOTECHNICAL TEST PIT

NOTE:
REFER TO APPENDIX A AND APPENDIX B FOR LOGS OF BORINGS AND TEST PITS RESPECTIVELY. ALL BORINGS AND TEST PIT NUMBERS ARE PRECEEDED BY "-91" IN TEXT AND ON LOGS EXAMPLE: B-1 ON THIS FIGURE IS REFERENCED AS B-91-1 IN TEXT AND LOGS.

BORING NUMBER	DEPTH IN FEET
B-1	66.5
B-2	57.0
B-3	51.5
B-4	36.5
B-5	36.5
B-6	46.5
B-7	71.5
B-8	41.5
B-9	36.5
B-10	26.5
B-11	26.5
B-12	36.5
B-13	31.5
B-14	71.5
B-15	23.0
B-16	36.5
B-17	41.5
B-18	51.5
B-19	51.5

TEST PIT NUMBER	DEPTH IN FEET
TP-1	12.0
TP-2	4.0
TP-3	4.0
TP-4	4.0
TP-5	5.0
TP-6	12.0
TP-7	12.0
TP-8	6.0
TP-9	7.0
TP-10	10.0
TP-11	6.0
TP-12	12.0
TP-13	11.0
TP-14	12.0
TP-15	12.0
TP-16	12.0
TP-17	12.0
TP-18	12.0
TP-19	12.0
TP-20	12.0
TP-21	6.0

FIGURE 1-2
SITE PLAN
NORTH CITY WATER RECLAMATION PLANT
SAN DIEGO, CALIFORNIA

The secondary clarifiers are located to the north of the aeration basins. These reinforced concrete water holding basins measure approximately 200 by 340 feet in plan. The maximum water depth will be approximately 26 feet. They are proposed to be supported by a mat foundation on both native material and up to 30 feet of fill. They are expected to produce bearing pressures in the range of 2,000 psf.

The tertiary filters are located to the north of the secondary clarifiers. These reinforced concrete water holding structures measure approximately 70 by 230 feet in plan. The maximum water height will be approximately 25 feet. They are proposed to be supported by a mat foundation on both native material and up to 30 feet of fill. They are expected to produce bearing pressures in the range of 2,000 psf.

The chlorine contact tanks are located to the north of the tertiary filters. These reinforced concrete tanks measure approximately 100 by 300 feet in plan. The normal water depth will be approximately 15 feet. They are proposed to be supported by a mat foundation on both native material and up to 10 feet of fill. They are expected to produce bearing pressures in the range of 2,000 psf.

The effluent pump station is located adjacent to the west end of the chlorine contact basins. This reinforced concrete structure measures approximately 30 feet by 217 feet in plan. The northern portions of the structure will be located on top of and supported by the chlorine contact basin. The remainder of the pump station will be supported on continuous spread footings at grade. Bearing pressures on the spread footings are expected to be in the range of 3,400 psf.

The operations building is located at the extreme northern end of the site. This reinforced concrete frame structure measures approximately 80 by 240 feet in plan. It is a two-story structure with a daylight first floor and is proposed to be supported by a combination of mats and spread footings. The building will be constructed on both native material and some structural fill. This structure is expected to produce bearing of approximately 4,200 psf beneath the footings.

The chemical building is located east of the aeration basins. It measures approximately 80 by 160 feet in plan. It is proposed to be supported by a combination of mats and spread footings. It is to be constructed on native material and is expected to produce bearing pressures in the range of 4,200 psf. Because the building is to be constructed below the present grade level, it is expected that its load will be partially compensated by the removal of overburden and exhibit a net bearing pressure of approximately 1,400 psf.

The chlorination building is located east of the chlorine contact tanks. This reinforced concrete frame building measures approximately 90 by 150 feet in plan. It is proposed to be supported by a combination of mats and spread footings on fill and is expected to produce bearing pressures in the range of 4,200 psf.

The influent pump station is located to the west of the tertiary filters. This reinforced concrete structure measures approximately 90 by 125 feet in plan. It is proposed to be supported by a mat foundation on native material and is expected to produce bearing pressures in the range of 7,400 psf. Because the building is to be constructed below the present grade level, it is expected that its load will be partially compensated by the removal of overburden and exhibit a net bearing pressure of approximately 1,400 psf.

The proposed final grading of the project site requires large scale earthwork. At the time this report was prepared, approximately 430,000 cubic yards of excavation will be required. The majority of the material will be processed and placed as fill.

1.1.5 Summary of Previous Reports

Five previous geotechnical explorations have been conducted at or near the site as part of the Clean Water Project. These reports were prepared by various geotechnical consulting firms and were reviewed in preparation for the geotechnical exploration and analyses. Copies of all of the reports are available at the Clean Water Program office.

Preliminary Geotechnical Reconnaissance, Proposed North City Sludge Processing Sites, was prepared by Geotechnical Consultants, Inc. for Metcalf & Eddy, Inc. (February 1990a). This study examined several sites for the sludge facilities, one of which was the site selected for the project site. A site map and soil boring logs from this report are located in Appendix D.

Pre-Design Geotechnical Investigation, North City Reclamation Plant Site (NTP-1) San Diego, California was prepared by Woodward-Clyde Consultants (November 1990a). This study examined the project site for the North City Water Reclamation Plant. Test pit logs and laboratory test results from this report are located in Appendix D.

Pre-Design Geotechnical Investigation, Long Term Sludge Processing Plant-North (NSF-2) San Diego, California was also prepared by Woodward-Clyde Consultants (November 1990b). This study examined the project site for the Long-Term Sludge Processing Plant-North. The field investigation for this report was performed in conjunction with the field investigation for the North City Water Reclamation Plant (Woodward-Clyde, 1990a), therefore only one copy of the test pit logs and laboratory test results from this report are located in Appendix D.

FIRP Sludge Dewatering and Drying Facilities, Eastgate Mall Site, was prepared by Geotechnical Consultants, Inc. for Metcalf & Eddy, Inc. in November 1990b. Two sites are examined in this report, one of which is the current project site, while the other is located adjacent to the project site, north of Eastgate Mall Road. A site map, soil boring logs, and laboratory test results from this report are located in Appendix D.

Preliminary Geotechnical Investigation, Eastgate Mall Site Development Project was prepared by Ninyo & Moore, Inc. for Metcalf & Eddy, Inc. (March 1991b). This report examined the site for possible location for the North City Reclamation Plant, the Northern Sludge Processing Facilities, and the Fiesta Island Replacement Project. A site map, test pit logs, and laboratory test results from this report are located in Appendix D.

1.1.6 Limitations

This report has been prepared for the exclusive use of the Clean Water Project of San Diego for specific application to the North City Water Reclamation Plant in accordance with generally accepted geotechnical engineering practice. No other warranty, express or implied, is made.

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

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

Section 2
Technical Data

Section 2

Technical Data

2.1 Field Exploration

2.1.1 General

The geotechnical field exploration took place from November 6 through 15, 1991 and consisted of excavating, logging, and sampling 19 soil borings and 21 test pits. During the course of the investigation, the weather was clear and warm and caused no delays. This section summarizes data obtained from the field exploration programs. Interpretation of this data is presented in Section 3.2, Subsurface Conditions.

The soil drilling and sampling was performed by A&R Drilling, Inc., Carson, California. The test pits were excavated by Merriott Excavator/Breaker Rental, Inc., Valley Center, California. Both firms were subcontracted by Ninyo & Moore, Inc., San Diego, California. The exploration program was designed and supervised by members of CH2M HILL's geotechnical staff.

2.1.2 Boring and Test Pit Locations

The locations of soil borings were chosen based upon the proposed locations of the various structures that comprise the plant. These locations were then surveyed and staked in the field by Kercheval Engineers, San Diego, California. Some borings were relocated during the field program due to obstructions or inaccessibility.

Following the completion of all borings and test pits, each location was surveyed for horizontal and vertical location by Kercheval Engineers, San Diego, California. Figure 1-2 shows the locations of each soil boring and test pit.

2.1.3 Soil Borings

The 19 exploratory soil borings were identified as B-91-01 through B-91-19. Their locations are shown in Figure 1-2. The boreholes were drilled to depths ranging between 23 and 72 feet. Boring depths are presented in Figure 1-2.

All of the exploratory borings were drilled under the direct supervision of CH2M HILL engineers, who determined location and depth of boreholes and sampling intervals for the soil borings. CH2M HILL's field engineers observed all drilling and sampling operations, visually classified all samples, selected samples for laboratory testing, and prepared boring logs describing the samples collected.

The drilling was performed using a CME 75 drill rig and 8-inch outside diameter hollow stem auger. Sampling was performed at 5-foot intervals using a California Drive Sampler driven by an automatic hammer. Upon completion of the drilling program, the boreholes were backfilled with concrete.

The soil samples were obtained from the soil borings using the California Drive Sampler following the methodology for the Standard Penetration Test (ASTM D 1586). The sampler was lined with 18 1-inch-tall, 2.5-inch outside diameter brass rings, and lowered into the boring. The sampler was then driven 18 inches and the number of blows required for each 6-inch segment were recorded. In the event that more than 50 blows were required to drive the sampler for any 6-inch length, the driving was terminated and the sampler was said to have met practical refusal.

After the sampler was removed from the borehole, laboratory samples were prepared by selecting six adjacent brass rings and placing them in a plastic tube and capping and sealing the ends of the tube. The remaining rings were used in classifying the soil in general accordance with the Visual-Manual Procedure for the Description of Soils (ASTM D 2488). Sampling intervals and classifications of soil samples are presented in the soil boring logs located in Appendix A.

Several times during the course of the field program, it became necessary to replace the teeth on the auger bit due to excessive wear. During borings B-91-07 and B-91-11, it became necessary to suspend drilling in order to retract the augers and replace the auger bit which had become excessively worn while drilling through gravel and cobble layers. Additionally, B-91-11, B-91-14, and B-91-15, were terminated before reaching the planned depth when large rocks, which could not be drilled or chiseled through, were encountered. The field engineer determined that these borings had reached a sufficient depth to provide the necessary design information, therefore they were not redrilled nor continued.

No groundwater was observed in any of the borings.

2.1.4 Test Pits

The 21 exploratory test pits were identified as TP-91-01 through TP-91-21. Their locations are shown in Figure 1-2. The test pits ranged in depth from 4 feet to 12 feet with 13 of the 21 being 10 feet or deeper. The location of the test pits were chosen by the CH2M HILL field engineer to provide information on the amount, size, and gradation of the gravels and cobbles, or to determine the thickness and composition of the overlying alluvium.

Test pit excavations were performed using a Kobleco 909 LC II excavator with a 24-inch bucket and conventional wedge shaped teeth. Upon completion, the test pits were backfilled with the excavated material and then densified by several passes of the excavator.

The excavator was able to excavate all of the test pits. One test pit contained a localized cemented zone, which required the use of rock teeth on the bucket.

No groundwater was observed in any of the test pits.

Bulk samples were obtained from the excavator bucket and stored in plastic-lined sample bags for use in the laboratory testing program. The soil was classified in general accordance with the Visual-Manual Procedure for the Description Soils (ASTM D 2488). Sampling intervals and classifications of soil samples are presented in the test pit logs located in Appendix B.

2.1.5 Corrosion Survey

In addition to the geotechnical exploration, a corrosion survey *North City Water Reclamation Plant, Corrosion Survey and Report, Design Task 4.2* (CH2M HILL, 1992) was performed at the site. The soil on the south and northwest sides of the site were found to be very corrosive to both concrete and metals. As the soil removed from these areas will be used as fill and randomly distributed throughout the site, the corrosion report recommends protection for all buried facilities. Cathodic protection is recommended for all buried metal pipes and structures and protective coatings or barrier membranes are recommended for all concrete surfaces in contact with the soil.

2.2 Laboratory Testing

2.2.1 General

Laboratory testing was performed to aid in classifying the soil and to determine soil properties for use in the subsequent engineering analyses. Testing was performed on both ring specimens obtained during drive sampling and on bulk samples collected from test pits. The samples used for testing were selected by CH2M HILL's field engineers.

Laboratory testing services were subcontracted to Ninyo & Moore of San Diego. The testing program consisted of 13 Atterberg Limits tests, 6 tests measuring the percent passing the No. 200 sieve, 10 sieve analyses, 3 expansion tests, 4 Modified Proctor tests, 4 direct shear tests, 6 consolidation tests, and 2 swell tests. Detailed results for each test are presented in Appendix C.

Soil samples from both boreholes and test pits were used for corrosion testing.

2.2.2 Atterberg Limit Tests

The Atterberg Limits include Liquid Limit (LL), Plastic Limit (PL), and Plasticity Index (PI). Atterberg Limits were determined in accordance with ASTM D 4318. They are used to assist in classification of soils, indicate soil consistency (when compared to natural or existing water content), and provide correlation to soil properties, including compressibility and strength.

Results of the Atterberg Limits are shown in Table C-1 in Appendix C.

2.2.3 Percent Passing the No. 200 Sieve Tests

The Number 200 sieve is used to define the division between coarse-grained materials, gravels and sands, and fine-grained materials, silts, and clays. The percent passing the No. 200 sieve tests were performed in accordance with ASTM D 1140. The test consists of washing the soil specimen over a No. 200 sieve and determining the percentage that washes through, and thus the percentage of fines. This information is then used in classifying the soil.

Results of the percent passing the No. 200 sieve test are shown in Table C-2 in Appendix C.

2.2.4 Sieve Analyses

Ten sieve analyses were performed in accordance with ASTM D 422. Sieve analyses are used to aid in soil classification, to correlate with other soil properties, and to help determine the suitability of the soil for use as fill material.

Results of the sieve analyses are presented in Appendix C.

2.2.5 Expansion Index Tests

The expansion index test is used to qualitatively describe the expansive potential of a soil and is performed in accordance with Uniform Building Code (UBC) Standard 29-2. Three expansion index tests were performed on bulk samples obtained from the test pits.

After the soil has been brought to approximately optimum moisture content, it is compacted into a 4-inch-diameter mold and then trimmed. The degree of saturation is determined and adjusted, and the sample is recompacted and trimmed to the proper thickness. This process is repeated until a sample of the proper thickness at 50 percent saturation is achieved. The sample is then placed in a consolidometer, a surcharge of 12.63 pounds is applied, and the sample inundated. At the end of 24 hours, the change in sample thickness, D, is measured, the expansion index is calculated as 1,000 x D, and the soil is classified according to Table No. 29-D of the UBC.

Results of these tests are included in Table C-3 in Appendix C.

2.2.6 Modified Proctor Tests

The Modified Proctor tests, performed in accordance with ASTM D 1557, was used to determine the moisture-density relationships for representative samples from the test pits.

Laboratory determinations of moisture-density relationships are used in the phase relationships of soils, in specifying densities for other laboratory tests, and for comparing in-place field densities to laboratory standard curves for construction earthwork control.

The results of the Modified Proctor tests were used in compacting the remolded samples for the consolidation, expansion index, and direct shear tests. The maximum dry density and the optimum water content determined in each test is given in Table C-4 in Appendix C.

2.2.7 Direct Shear Tests

Four sets of direct shear tests were performed on samples recovered during the geotechnical exploration in accordance with ASTM D 3080 to determine their friction angle and cohesion. Two tests were performed on ring samples obtained during drive sampling, while two were performed on remolded samples, which had been compacted at their optimum water content to 95 percent of the maximum dry density as determined in the Modified Proctor test.

The results of the direct shear test are generally used in stability and strength analyses for foundations, excavations, and embankments.

The results of the tests are presented in Table C-5 in Appendix C.

2.2.8 Consolidation Tests

The one-dimensional consolidation test is used to predict the amount of settlement in a soil mass subjected to sustained loads. Nine consolidation tests were performed on the sandy silt; four on material from drive samples, and five on the remolded samples. The tests were performed in accordance with ASTM D 2435.

Two tests were initially performed upon specimens obtained during drive sampling. The high degree of disturbance of the specimens, that occurred during sampling, produced consolidation curves, which were in contrast to the anticipated behavior of the sample based upon our comparison of field penetration records and speaking with other consultants and agencies familiar with the material. Two additional tests on drive samples from similar depths were performed in an attempt to confirm expected behavior. The results of this second set of tests are very similar to the first set. Results from all four tests are presented in Appendix C and exhibit signs of sample disturbance.

Two consolidation tests were performed on remolded samples which had been statically compacted at their optimum water content to 95 percent of the maximum density as determined in the Modified Proctor test. Both samples swelled in excess of 1 percent when inundated. While this is believed to be a function of the laboratory compaction method and not of the material, swell tests were performed on the material. The results of the consolidation tests are presented in Appendix C.

Three additional consolidation tests were performed on remolded samples that had been dynamically compacted at their optimum water content to 95 percent of the maximum dry density as determined by ASTM D 1557. The samples were inundated at pressures ranging from 0.8 ksf to 3.2 ksf. These samples swelled significantly less upon inundation than the statically compacted samples, with the amount of swell decreasing with increasing inundation pressure. The results of these tests are presented in Appendix C.

2.2.9 Swell Pressure Tests

Two swell tests were performed in accordance with ASTM D 4546, Method C, to determine the pressure required to prevent the sample from swelling. The tests were conducted on material from the test pits compacted to 95 percent of the maximum dry density determined from ASTM D 1557.

The samples were first statically compacted to the required density, and then placed in a consolidation ring. After the sample and ring were placed in the oedometer, a seating load was applied and the sample inundated. Sufficient further load was then applied to prevent the sample from swelling. The pressure necessary to prevent swelling is known as the swell pressure.

The results of these tests are given in Table C-6, Appendix C.

Section 3
Interpretation

Section 3
Interpretation

3.1 Geology and Seismicity

3.1.1 General

A complete review of regional and site geology is presented in *Geologic Site Reconnaissance, Proposed North City Water Reclamation Plant (NPT-1), City of San Diego, California* prepared by Ninyo & Moore, Inc. for CH2M HILL (December, 1991c). A complete copy of this report is enclosed in Appendix E. A brief description of the site geology and seismicity are presented below.

3.1.2 Site Geology

The project site is underlain at depth by the weakly to moderately indurated sandy silts and sandy clays of the Eocene age Scripps Formation. The Scripps Formation is overlain in areas by the moderately to well-cemented sands and gravels of the Lindavista Formation. The Scripps Formation and the Lindavista Formation typically consist of relatively competent materials. Deposits of topsoil and colluvium form the surface layer over much of the site with surficial alluvial deposits present within the canyons crossing the site and their tributary drainages.

3.1.3 Seismicity

Complete seismic information is contained in *Seismic Study For The Proposed North City Water Reclamation Plant (NPT-1), City of San Diego, California* prepared by Ninyo & Moore, Inc. for CH2M HILL (December 1991). A copy of this report is enclosed in Appendix F. A brief description of the seismicity is presented below.

There are no known active or potentially active faults crossing the site. The closest mapped fault is an inferred extension of the Torrey Pines Fault, indicated to cross within approximately 300 feet northeast of the northeast corner of the site. The Torrey Pines Fault is not considered active or potentially active.

The closest known active fault is the Rose Canyon Fault, located approximately 5.6 km (3.5 miles) west of the site. The maximum credible earthquake on this fault is a magnitude M7.0 and is predicted to produce a peak ground acceleration of 0.55g. The recurrence interval for the maximum credible earthquake has been estimated at between 500 to 1,000 years (Ninyo & Moore, 1991a). The duration of the strong phase shaking for an earthquake of this magnitude is predicted to be approximately 24 seconds.

In addition to the determination of the maximum credible earthquake, a study of the probabilistic regional seismicity was performed by evaluating the seismicity of the region based upon past earthquake records. This study was performed to evaluate the seismic risk for the project site for various project design lives.

Two levels of peak horizontal acceleration associated with 10 and 50 percent probability of being exceeded during the selected life of the project were considered for use in the seismic design of the subject facility. Seismic response spectra were constructed using the general empirical approach and amplification factors recommended by Newmark & Hall. Horizontal peak ground accelerations of 0.16g and 0.36g, having 50 and 10 percent probability of being exceeded in 100 years, respectively, were also used as characteristic events for the construction of response spectra. Additional discussion on seismic response is provided in Appendix F, Seismic Study.

3.2 Subsurface Conditions

3.2.1 General

Four distinct soil types were identified during the geotechnical exploration program. A brief description of each and its geographic distribution is presented in the following paragraphs. The following discussion is based on conditions observed in the borings and test pits. Some variations should be expected across the site. An approximate distribution of the surface deposits of the four soil types is presented in Plate 1 of *Geologic Site Reconnaissance, Proposed North City Water Reclamation Plant (NPT-1), City of San Diego, California*, (1991c) which is enclosed as Appendix E.

3.2.2 Existing Fills

Fill materials exist along the southern edge of Eastgate Mall Road and as part of the Miramar road fill. The fill material along Eastgate Mall Road has been placed in unconsolidated piles to form a perimeter berm to deter site access. These materials in their present state are unsuitable for support of structures, roadways, and other site fills. These materials should be removed where they interfere with proposed new construction. The fill material may be used as site fill elsewhere on the site provided it meets the specified qualitative and gradation requirements and is compacted to the requirements set forth elsewhere in this report.

Visual inspection of the Miramar Road fill performed during the site investigation indicates that the fill is in good condition. It is anticipated that the road fill will have no detrimental effects on the project or vice versa. At the time of this report, it appears that no structural influence will be exerted on the Miramar road fill. The effects of site fills on the road fill should be considered when details become available.

3.2.3 Alluvium

The canyon bottoms are overlain by a surface layer of alluvial material, which varies in thickness from roughly 2 to 5 feet. The alluvium generally consists of loose, dry, sandy lean clay with gravel, although fat clay was noted in test pit TP-91-10. The gravel fraction observed in the test pits consists of rounded gravel up to 3 inches in diameter and ranges from nonexistent to 30 percent of the soil mass.

An Expansion Index test was performed on a sample of the alluvial material. Its expansion index was 60, which classifies it as having a medium expansion potential according to UBC Standard 29-2.

3.2.4 Colluvium/Topsoil

The top of the mesa and the canyon sides are covered by a thin layer of topsoil or colluvium approximately 2 to 4 feet thick. These surficial materials are dry, loose, clayey sands which often contain some gravel. The gravel fraction accounts for up to 30 percent of the soil mass and are generally 1-inch maximum, although it was observed to be as large as 3 inches maximum in some test pits.

3.2.5 Lindavista Formation

The Lindavista Formation forms the upper structural unit in the mesa south of the main east/west trending canyon. It underlies the topsoil and generally varies in thickness from 20 to 50 feet, with its thickness generally increasing in a southerly direction.

The Lindavista Formation is comprised chiefly of poorly graded uniform fine sands with gravels and cobbles, with some silty sands and clayey sands present. These materials are generally very dense and often lightly to highly cemented. They vary in color from yellow to reddish brown.

A distinguishing feature of this formation is the significant quantity of gravels, cobbles, and boulders present. Exploration and sieve analyses reveal that 30 percent gravel is common and gravel fractions as high as 70 percent were noted. The gravel and cobbles tend to be nonfriable and rounded in shape. As revealed in the test pits, the gravel and cobbles range in size from 1/2 to 12 inches maximum, with 1 to 3 inches being the most common size range. Cobbles and boulders as large as 36 inches maximum were noted in existing ground cuts and on the ground surface. No strength testing was performed on the Lindavista Formation because of the high concentration of gravel and cobbles. Based upon the results of sieve analyses, visual classifications, and standard penetration tests, it is interpreted that the Lindavista Formation can be characterized by a friction angle of 38 degrees and no cohesion.

3.2.6 Scripps Formation

The Scripps Formation underlies the Lindavista Formation south of the main canyon, and is located directly below the alluvium and colluvium in the canyon, and directly below the topsoil north of the canyon. The total thickness of the formation was not determined in this investigation. By drilling boring B-91-14, it was found to extend to at least 70 feet below the bottom of the canyon.

Atterberg Limits and percent passing the No. 200 sieve tests were used to aid in classifying the Scripps Formation. Test results confirm that it consists of a silt or clay matrix with fine sand intermixed, thus its Unified Soil Classification System (USCS) symbols are ML and CL. The silt and clay components are dry to moist, gray, hard, and contain approximately 10 percent very fine sand. The fine sand component consists of clean, yellow-to-orange, uniform, fine sand. The fine sand is intermixed with the silt or clay either as distinct layers, usually less than 1/4-inch-thick, or as distinct or indistinct veins.

Two Expansion Index tests were performed on the Scripps Formation material. Its expansion indexes were 44 and 28, which classify it as having a low expansion potential in accordance with UBC Standard 29-2.

Direct shear tests were run on samples of the Scripps Formation in both its natural condition (from drive samples) and remolded and compacted to 95 percent of its maximum dry density from ASTM D 1557. The soil in its natural state exhibited a friction angle of between 37 and 39° and its cohesion ranged from 390 psf to 945 psf. The remolded soil exhibited a friction angle of approximately 28° and its cohesion ranged from 450 psf to 950 psf.

3.2.7 Groundwater Conditions

No groundwater was observed at the site, either at the surface or in the soil borings or test pits. Borings to elevation 242 feet MSL failed to reveal any evidence of the groundwater table. This finding is in agreement with previous geotechnical reports at the site and the Department of Water Resources report (1967) which indicate that groundwater in the area of the project site is at least 100 feet below the ground surface.

Due to the presence of clay seams the potential for perched water tables exists. If encountered during construction, these water tables are expected to yield only small amounts of water.

After construction, the possibility of the presence of significant groundwater, and its associated effects increases greatly. Possible sources of water at the completed plant include surface sources such as rainfall, irrigation and landscaping systems, leaks in tanks and underground pipes, and accidental overflows of the various tanks and basins.

Section 4
Design Considerations

Section 4
Design Considerations

4.1 Allowable Bearing Pressures

Due to the competent native soils at the site and the availability of suitable fill material, all of the structures at the site can be supported on shallow foundations such as mats or spread footings.

The analysis for the foundation requirements consisted of three separate approaches. First, data obtained during the field exploration was correlated to allowable bearing pressures. Next, previous recommendations were reviewed and other local engineers were consulted to determine a range of commonly used bearing pressures for the native materials. Lastly, bearing capacity and settlement analyses were performed using soil parameters determined through laboratory testing.

4.1.1 Field Penetration Test Data

Correlations to the Standard Penetration Test blow count are often used to determine bearing capacity for shallow foundations. Although the field testing was performed using a Modified California Sampler rather than a Standard Penetration Sampler, the correlations can still be used to approximate bearing capacity.

During field exploration, the number of blows required to drive the sampler 1 foot into the native formational material was consistently measured at over 100. Accounting for the difference in sampler diameter, this corresponds to a Standard Penetration Test blow count of approximately 66. Using a more conservative value of 50 blows per foot, and based upon Figure 14.4 of *Foundation Engineering* by Peck, Hanson and Thornburn, and assuming a 10-foot-wide footing, this blow count indicates that a net allowable bearing pressure (where the net allowable bearing pressure is equal to the bearing pressure minus the removed overburden divided by a factor of safety) of 10,000 psf could be used for design. At this bearing pressure, the resultant total settlement would be about 1 inch.

The Peck, Hanson, and Thornburn chart is specifically designed for sands and nonelastic silts. It applies to the Lindavista Formation as it is a granular material. The chart also applies to the Scripps Formation as Atterberg Limits testing show it to be predominately a low plasticity sandy silt.

4.1.2 Local Practice

Engineers from other local geotechnical firms and Caltrans were consulted regarding their experience with the Scripps and Lindavista materials. All individuals contacted had considerable experience with these materials. The consensus opinion was that the materials are very dense and competent, and capable of supporting very high structural loading with only minimal resultant settlement.

Pre-design Geotechnical Investigation, North City Water Reclamation Plant (NPT-1), San Diego, California prepared by Woodward-Clyde Consultants recommended a net allowable bearing pressure of 6,000 psf for foundations bearing on the undisturbed native materials.

4.1.3 Analysis Based on Laboratory Data

Bearing capacity and associated settlement were estimated based on the results of the laboratory testing program.

4.1.3.1 Scripps Formation Material

Direct shear tests and consolidation tests were performed on drive samples and remolded samples of the Scripps Formation to determine the friction angle, cohesion, and consolidation characteristics of the native and fill material.

4.1.3.1.1 Bearing Capacity

Bearing capacity for both the undisturbed and the remolded Scripps Formation material was analyzed using the classical bearing capacity equation and Meyerhof's bearing capacity factors for several depths of footing embedment. The footings and mats examined were assumed to be continuous and rigid relative to the soil. The allowable bearing capacity was determined by dividing the ultimate bearing capacity by a factor of safety of 3.

For the conditions examined, the soil's allowable bearing capacity is much larger than the structural design loads in both the undisturbed and the remolded cases. For example, the calculated allowable bearing capacity for a 10-foot-wide continuous footing with 2 feet of embedment supported on recompacted Scripps material is approximately 6,700 psf.

4.1.3.1.2 Settlement

The strain versus log pressure curves produced during the four consolidation tests on drive samples are presented in Appendix C. They range in maximum percent strain between 3.6 and 6.5 percent with all occurring at the maximum applied pressure of 12.8 ksf. Judging from the gently rounded shape of the curves, and the appreciable strain at only moderate load increments, it appears that the test samples were disturbed. This is very likely, given the dense condition of the native material as measured by the field penetration test results, and the dynamic stresses imposed on the material during the sampling process.

Based upon the available evidence, it is concluded that the specimens collected with the Modified Drive Sampler are too disturbed to produce reliable results. Therefore, the results of these consolidation tests must be considered invalid, and thus were not used in developing the allowable bearing pressure recommendations for structures supported on the undisturbed material.

Five consolidation tests were performed on specimens of the Scripps Formation material which had been remolded and compacted to 95 percent of the maximum dry density as determined by ASTM D 1557. The strain versus log pressure curves produced during these tests are presented in Appendix C.

Significant structural fill (up to 30 feet) will be required beneath the tertiary filters and the secondary clarifiers. Both of these water-holding basins will be supported on large (>100 feet wide) mats. Settlement analyses for these structures under the design loading conditions indicate the potential for movements that are significantly larger than the allowable overall design settlement of 1 inch. Additionally, because of its expansion index, use of the Scripps material as a fill may require special foundation reinforcements as outlined in UBC 29-4. Therefore the Scripps Formation material is considered to be unsuitable for use as structural fill beneath the large, heavily loaded facilities. Although the Scripps material may be suitable for use under lightly loaded structures supported on small spread footings, it is recommended for consistency that the Scripps material not be used for structural fill beneath any structures.

4.1.3.2 Linda Vista Formation Material

The allowable bearing pressure and settlement for structures founded on the Lindavista material were also estimated. Based upon the dry unit weight obtained from the Modified Proctor test, a friction angle for the Lindavista material placed as fill was estimated. Because of the density and gradation of the Lindavista Formation, it was not feasible to obtain direct laboratory determinations of the material's strength and compressibility characteristics.

4.1.3.2.1 Bearing Capacity

Based upon the estimated friction angle, a bearing capacity analysis was performed using the classical bearing capacity equation and Meyerhof's bearing capacity factors. The mats examined were assumed to be continuous and rigid relative to the soil. The allowable bearing capacity was determined by dividing the ultimate bearing capacity by a factor of safety of 3.

For the conditions examined, the soil's allowable bearing capacity is much larger than the 2,000 to 4,000 psf design loads. For example, the calculated allowable bearing capacity for a 10-foot-wide continuous footing with 2 feet of embedment supported on recompacted Linda Vista material is approximately 25,000 psf.

4.1.3.2.2 Settlement

Based upon the friction angle selected, a SPT blowcount was estimated and the bearing pressure required to produce 1 inch of settlement was determined based upon Figure 14.4 of *Foundation Engineering* by Peck, Hanson and Thornburn.

For the proposed loadings of 2,000 to 4,000 psf, the estimated settlements were well below the design allowable settlement of 1 inch.

4.1.4 Recommended Allowable Bearing Pressures

Based upon the previously discussed analyses, it is recommended that structures constructed on undisturbed native material (either the Scripps or Lindavista Formations) should be designed for an allowable net static bearing pressure of 6,000 psf.

Based upon the previous analyses, it is recommended that structures founded either completely or partially on engineered fill should be designed for an allowable net static bearing pressure of 4,000 psf. Engineered fill beneath structures should consist of granular material as described in Section 5.4.2, Structural Fill Beneath Facilities.

Table 4-1 presents a summary of the foundation conditions and allowable bearing pressures for the various structures at the site.

Table 4-1
Foundation Conditions

Structures on Native Material Allowable Net Bearing Pressure = 6,000 psf	Structures on Fill Material Allowable Net Bearing Pressure = 4,000 psf	Structures on Both Fill and Native Material Allowable Net Bearing Pressure = 4,000 psf
Influent pump station Headworks Primary sedimentation tanks Intermediate pump station Aeration basins Secondary effluent splitter box Coagulation and metering facility Waste backwash tank Effluent drop structure Effluent pump station Sludge pump building Operation building Chemical building Electrical substations on cut	Chlorination building Electrical substations on fill	Flow equalization basins Secondary clarifiers Tertiary filters Chlorine contact tanks

These bearing pressures may be increased by up to 33 percent for analyses involving transient loadings such as wind and earthquakes. These bearing pressures are expected to result in overall settlements of approximately 1 inch and differential settlements of 1/2 to 3/4 of an inch either between adjacent footings or across the mat foundation.

All footings should be embedded to a depth no less than 3 feet below grade.

4.2 Lateral Earth Pressures

Buried structures and retaining walls are subject to lateral pressures exerted on them by the adjacent soil. The magnitude of these pressures are a function of the soil properties, the presence of water, surcharge effects, and the amount and direction the wall is capable of moving. Additionally, seismic events can place significant short-term loads on the structure in addition to the static load it normally resists.

The lateral earth pressures were calculated for two backfill materials. The first is the remolded Scripps formation compacted to 95 percent of the maximum dry density as determined by ASTM D 1557 and having a friction angle of 28°. These properties were determined through direct shear tests on samples of the Scripps Formation material. The second backfill material was assumed to be a well-graded, 1"-minus granular material with a friction angle of 38°. This represents either an imported backfill material or selected onsite Lindavista material that has been suitably processed.

4.2.1 Static Earth Pressures

The active earth pressure is applicable if the top of the structure moves away from the soil mass by more than 1 inch for each 20 feet of wall height. The earth pressure against the wall in the active case can be treated as an equivalent fluid, $K_a\gamma$, where γ is the unit weight of the soil and K_a is the coefficient of active earth pressure. Equivalent fluid pressures for the design of static active conditions are given in Table 4-2.

Table 4-2
Equivalent Fluid Pressures for Static Conditions

Material	Unit Weight (pcf)	Friction Angle	Cohesion (psf)	Active (PCF)	At Rest (PCF)	Passive (PCF)
Scripps material above the water table	116	28	0	42	62	320
Scripps material below the water table	116	28	0	82	91	210
Granular backfill above the water table	130	38	0	32	49	545
Granular backfill below the water table	130	38	0	79	88	345

The at rest earth pressure is applicable if the soil and the wall do not move relative to each other. The earth pressure against the wall in the at rest case can be treated as an equivalent fluid, $K_o\gamma$, where γ is the unit weight of the soil and K_o is the coefficient of at rest earth pressure. Equivalent fluid pressures for design of static at-rest conditions are given in Table 4-2.

The passive earth pressure is applicable if the top of the structure moves into the soil mass by more than 1 inch for each 2 feet of wall height. The earth pressure against the wall in the passive case can be treated as an equivalent fluid, $K_p\gamma$, where γ is the unit weight of the soil and K_p is the coefficient of passive earth pressure. Equivalent fluid pressures for the design of static passive conditions are given in Table 4-2.

If the structure cannot tolerate the amount of movement necessary to mobilize the full passive resistance, the resistance must be reduced. Appropriate reductions in passive resistance should be considered on a case-by-case basis during design.

4.2.2 Seismic Earth Pressures

The design lateral earth pressures recommended in this report represent the greater of the at rest condition pressures or the pressures from the active condition combined with those from the seismic condition. This comparison accounts for the two possible responses of the structure during an earthquake. The structure could simply ride along in harmony with the surrounding soils, which is represented by the at rest condition, or it can move relative to the soil, in which case, it would be subjected to both the active lateral earth pressure and the incremental dynamic loads.

The effects of seismic loading on the structures were modeled using the Mononobe - Okabe Equation (Seed and Whitman, 1970). The pressures were calculated assuming a repeatable ground acceleration of 0.24 g and a level backfill. The repeatable ground acceleration is generally taken to be 65 percent of the peak horizontal acceleration.

The recommended lateral seismic earth pressures for flexible structures, those that are anticipated to move relative to the surrounding soil in a seismic event, are presented in Figures 4-1 and 4-2. Structures that are anticipated to remain rigid and undergo little, if any, movement relative to the surrounding soil should be designed to resist the static at-rest condition in accordance with Table 4-2. Where it is not possible to rationally estimate the relative movement between the structure and surrounding soil, the structure should be designed for the more severe of the two loading conditions. Determination of the more severe loading condition will depend on the geometry and fixity conditions of the structure and must be evaluated on a case by case basis.

The recommended lateral seismic earth pressures for design for backfills consisting of Scripps materials are given in Figure 4-1. These represent the combined active and seismic pressures. The undrained condition is applicable where the water in the wall backfill soils

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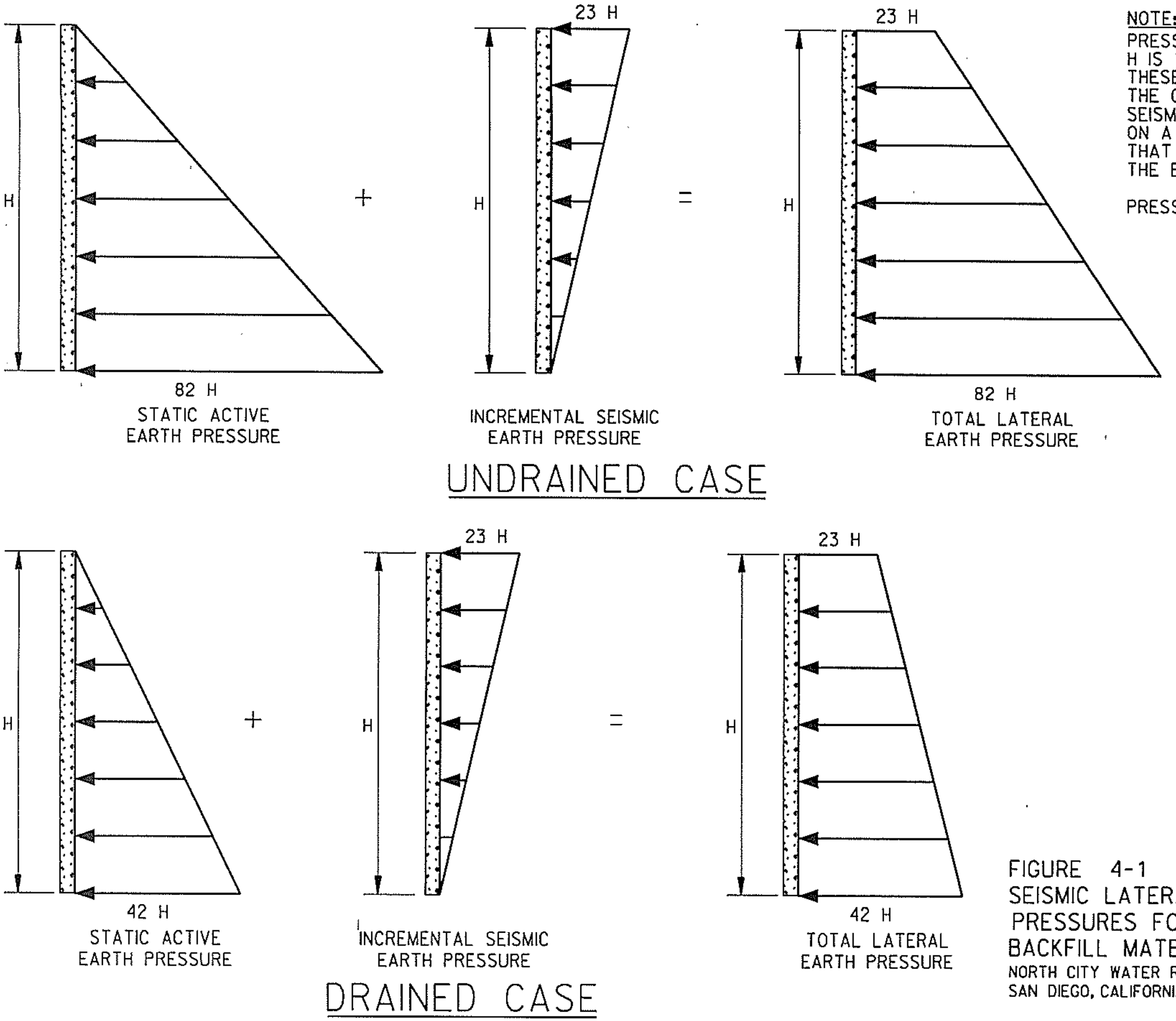

<u>NOTE:</u>
PRESSURES ARE IN PSF.
H IS WALL HEIGHT IN FEET.
THESE DIAGRAMS INDICATE THE COMBINED ACTIVE AND SEISMIC EARTH PRESSURES ON A RIGID RETAINING WALL THAT MOVES RELATIVE TO THE BACKFILL.

PRESSURES BASED ON:
ϕ=28°
C=0 PSF
γ=116 PCF

FIGURE 4-1
SEISMIC LATERAL EARTH PRESSURES FOR SCRIPPS BACKFILL MATERIAL
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is not drained away and occurs in sufficient quantity to develop full hydrostatic pressure. The native material may contain a high percentage of clay and silt-sized particles, which will tend to trap and perch downward percolating water. However, most buried structural walls will remain in a drained condition because of the placement of a perimeter drain and clean granular fill around the structure. The lower half of the influent pump station may be subject to undrained conditions because it is below the lowest storm drain and would require localized pumping to dewater the area.

The recommended lateral seismic earth pressures for design for backfills of granular material are given in Figure 4-2. These represent the combined active and seismic pressures. The undrained condition is applicable where the water in the soil is not drained away and is sufficient to develop to hydrostatic pressure.

4.2.3 Surcharges

The lateral earth pressures on certain buried structures at the site, such as grit tanks, are affected significantly by the presence of adjacent structures. The weight of these adjacent buildings act as a surcharge loading and must be taken into account when designing the wall. The incremental increase in lateral earth pressure can be estimated by multiplying the gross bearing pressure of the adjacent structure by the proper earth pressure coefficient (K_o or K_a, depending upon wall movement) and applying the result as an additional uniform load on the wall. Values of K_a, K_o, and K_p for each backfill are given in Table 4-3.

Table 4-3
Coefficients of Lateral Earth Pressure

Material	Friction Angle	K_a	K_o	K_p
Native material backfill	28°	0.36	0.53	2.77
Imported granular backfill	38°	0.24	0.38	4.20

Surcharges due to traffic loads are often modeled as an additional depth of soil. It is understood that this is to be the case for the retaining wall and roadway along the east side of the site. The lateral earth pressures due to each additional foot of soil are 62 psf and 42 psf for at rest and active conditions, respectively, assuming a backfill of native material.

4.2.4 Coefficient of Sliding Friction

A coefficient of sliding friction equal to 0.35 should be used in the design of retaining walls and buried structures. This value is based upon an assumed sliding surface between the crushed rock layer below the wall or structure and the native soil.

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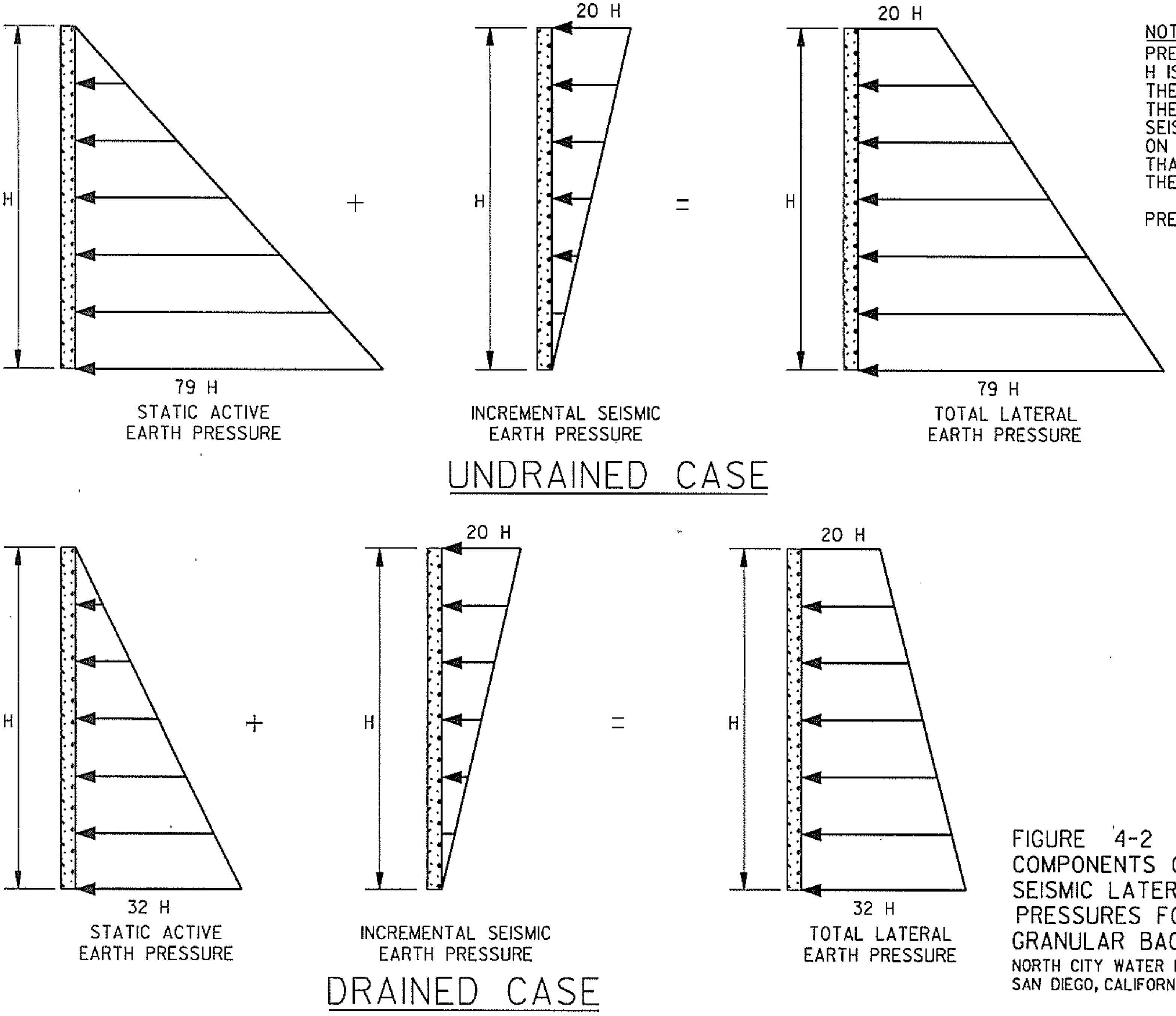

NOTE:
PRESSURES ARE IN PSF.
H IS WALL HEIGHT IN FEET.
THESE DIAGRAMS INDICATE THE COMBINED ACTIVE AND SEISMIC EARTH PRESSURES ON A RIGID RETAINING WALL THAT MOVES RELATIVE TO THE BACKFILL.

PRESSURES BASED ON:
$\phi = 38°$
C=0 PSF
$\gamma = 130$ PCF

FIGURE 4-2
COMPONENTS OF
SEISMIC LATERAL EARTH
PRESSURES FOR
GRANULAR BACKFILL
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4.2.5 Thrust Blocks

Buried pressure pipes at the plant site may require concrete thrust blocks at angle points and reducer locations. Reinforced concrete thrust blocks may be sized using an allowable soil bearing pressure of 2,000 psf. Thrust blocks for high pressure (>60 psi) or large diameter (>24-inch) pipes should be designed on an individual basis using a suitable approach such as the Ovesen and Stromann method (Ovesen & Stromann, 1972). Thrust blocks to be constructed in native undisturbed soil should be designed using a friction angle of 34° and a unit weight of 120 pcf. Thrust blocks to be constructed in engineered fill material should be designed using a friction angle of 28° and a unit weight of 116 pcf.

All thrust blocks should be cast against either undisturbed earth or compacted fill, should have a minimum bearing area of 1 square foot, and a minimum depth of embedment of 3 feet as measured from the ground surface to the top of the block.

4.3 Drainage

Water plays a significant role in the development and magnitude of lateral earth pressures, as can be seen by comparing the drained and undrained cases in Figures 4-1 and 4-2. Therefore, it is desirable to drain the soil around the structure whenever possible. This may be accomplished using side and perimeter drains.

Side drains are installed between the buried wall of the facility and the backfill material. They should consist of either a preformed geotextile drain or free draining sand or gravel separated from the backfill material by a graded soil filter or an appropriate geotextile.

Perimeter drains are placed around the base of the wall at the edge of the crushed rock base. They should consist of 4-inch-slotted polyvinyl chloride (PVC) or polyethylene pipe surrounded with 6 inches of drain rock enclosed in geotextile. The drains should drain by gravity into adjacent storm sewers or plant drains.

Structures such as the influent pump station, which are too deep to allow gravity drainage of perimeter drains into the storm sewer, must either be equipped with sumps and permanent pumps to remove the excess water or be designed to withstand the hydrostatic pressure.

The canyon that crosses the site in an east/west direction serves as the main drainage path for the site and portions of the surrounding area. Since the canyon will be filled during the grading operation, provisions must be made to provide a controlled drainage path for subsurface flow.

4.4 Permanent Slopes

Site grading is expected to require the construction of permanent cut and fill slopes. During the construction of all slopes, it is recommended that a geotechnical representative be onsite to observe the methods and work.

The stability of the proposed slopes was analyzed using Spencer's method as executed by the computer program UTEXAS3. The slopes were analyzed for both static and seismic loading conditions.

Soil properties were determined from the laboratory test program. Four direct shear tests were performed on samples of the Scripps Formation, two from drive samples and two in the remolded state. The strength properties from the drive samples were used in the analyses of cut slopes, and remolded strength properties were used in the analysis of permanent fill slopes.

UTEXAS3 is a computer program developed by Steven Wright at the University of Texas. It uses Spencer's method and automatic search mode to determine the failure surface with the minimum factor of safety. This surface may be either circular or noncircular (i.e., wedge-shaped), however due to the material type and the absence of any weak layer commonly associated with wedge failures, only circular failure surfaces were examined.

The soil profile and the various slope configurations were examined for both static and seismic loading. Initially, the slopes were analyzed for stability under static conditions. No external loads, such as surcharges or surface water, were considered.

For the seismic cases, pseudo-static analyses were performed by applying a lateral load equivalent to the weight of the soil multiplied by the seismic coefficient. These pseudo-static loads are factored into the stability analyses for each trial surface considered. For permanent cut-and-fill slopes, a seismic coefficient of 0.24 was used. This corresponds approximately to the repeatable ground acceleration that has a 10 percent chance of being exceeded during the next 50 years (Ninyo & Moore, 1991a).

The slopes examined were required to have a minimum static factor of safety of 1.50, as required by *City of San Diego Technical Guidelines for Geotechnical Reports*. Additionally, the slopes were required to have a minimum seismic factor of safety of 1.10.

After examining the stability of different slope configurations and various regulatory requirements, the following slopes were chosen as the maximum allowable slopes for the given conditions.

4.4.1 Permanent Cut Slopes

A maximum slope of 1.5 horizontal to 1 vertical (1.5H:1V) is recommended for all permanent cut slopes less than 30 feet in height. Slopes greater than 30 feet in height constructed in native material must be analyzed on an individual basis. Slopes greater than 20 feet in height must be benched in accordance with applicable codes and regulations.

During the construction of all slopes, it is recommended that a geotechnical representative be onsite to observe and interpret the exposed site conditions.

4.4.2 Permanent Fill Slopes

A maximum slope of 2:1 is recommended for all permanent fill slopes less than 30 feet in height. Fill slopes greater than 30 feet in height must be analyzed on an individual basis. Slopes greater than 20 feet in height must be benched in accordance with applicable codes and regulations.

During the construction of all slopes, it is recommended that a geotechnical representative be onsite to observe the methods and work, as well as to deal with any difficulties during earthwork.

4.4.3 Revegetation

The City of San Diego Municipal Code Section 62.0416 requires revegetation of all slopes steeper than 6:1 and greater than 5 feet in height. Some surface ravelling and erosion may occur from wind and rain until a protective vegetative cover is established. Evidence of these processes can readily be seen in the natural slopes at the site.

Section 5
Construction Considerations

Section 5
Construction Considerations

5.1 Temporary Excavations

The construction of many of the structures will require that the Contractor establish temporary excavation slopes in order to perform work below the existing grade level. Excavations are expected to range in depth from a few feet to approximately 90 feet along the south side of the influent pump station. It is anticipated that the majority of the material removed during the excavation can be retained, processed, and used as fills.

The design of all temporary excavations, either braced or sloped, should be the responsibility of the contractor. The analysis of the stability of the excavation should be made by a qualified professional engineer and should consider the depth of excavation, the material type, and the contractor's sequence and methods. Excavations should be designed to conform to applicable regulations and ordinances.

During the construction of all slopes, it is recommended that a geotechnical representative be onsite to observe the methods and work, as well as to deal with any difficulties during earthwork.

During excavation, all equipment and stockpiles should be stored far enough from the edge of the excavation so as not to produce a surcharge load, which could affect the stability of the slope.

5.2 Clearing, Grubbing, and Stripping

The first step in preparation for any site work is clearing and grubbing the site in order to remove the debris and vegetation. Once the site has been cleared, it will be necessary to strip off the undesirable surface layer of soil.

The topsoil and alluvium are not acceptable as either foundation or structural fill material. They are too compressible and, in the case of the alluvium, too expansive. The only acceptable usage for these soils is as landscaping material. If the topsoil and alluvium are not used for this purpose, they should be properly disposed of either at an onsite disposal area or hauled offsite. The onsite colluvium may be useable as nonstructural fill between structures, but is not suitable for use as structural fill beneath facilities.

5.3 Subgrade Preparation

Once stripping of the unsuitable materials has been completed, and the excavation has been made to the required grade, the subgrade should be proof-rolled using a scraper or a loaded dump truck to detect any soft zones; if any soft zones are located they should be replaced or densified. The upper 6 inches of the subgrade should be compacted to at least 95 percent of the maximum dry density at a water content of optimum plus 2 percent as determined by ASTM D 1557.

Areas in which structures will be constructed partially on fill and partially on native soil must be overexcavated within the cut area and the native material replaced with fill in order to minimize differential settlements. Structures founded solely on native material or solely on fill will not require this special treatment. The overexcavated zone should be at least 5 feet thick and extend from the point of transition between cut and fill to the outer limits of the cut section as shown in Figure 5-1. The overexcavated subgrade should be proof-rolled and densified as previously recommended. Overexcavating and backfilling within the cut zone will provide a transition section between the cut and fill portions of the subgrade to minimize angular distortion of the structure.

For structures such as the aeration basins and the operations building where only minimal fill will be required, consideration should be given to designing the slab in the fill area to accommodate additional differential settlement to avoid the necessity of overexcavating beneath the entire remaining structure. Such structures should be evaluated on a case-by-case basis.

5.4 Fill

5.4.1 General

Fills are to be placed beneath facilities, around facilities, and as general site fill. A specific numeric percentage, based on fill type and location, of the maximum dry density based on ASTM D 1557 will be require for compaction of the fill material. The compaction should be field checked using ASTM D 4914.

The fill should be keyed into the native soil by having a dozer or similar equipment cut small benches as shown in Figure 5-2. Fills placed against existing slopes steeper than 5:1 should be keyed into the existing slope as shown in Figure 5-2. The toe key should be cut at least 3 feet into competent formational material. Consideration should be given to providing back drains where new, sloping fills contact existing slopes and the likelihood of trapping water within the fill is high.

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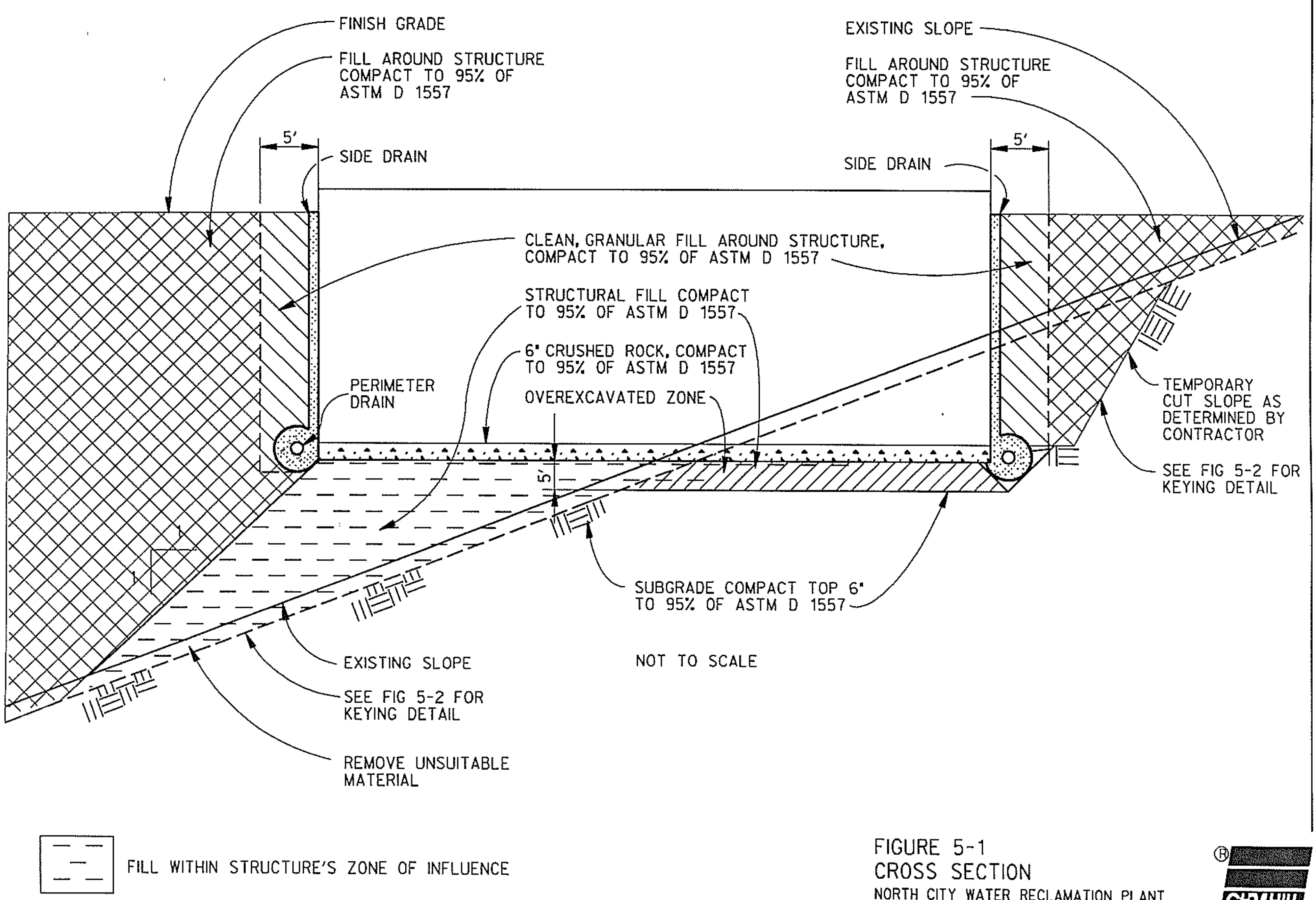

FIGURE 5-1
CROSS SECTION
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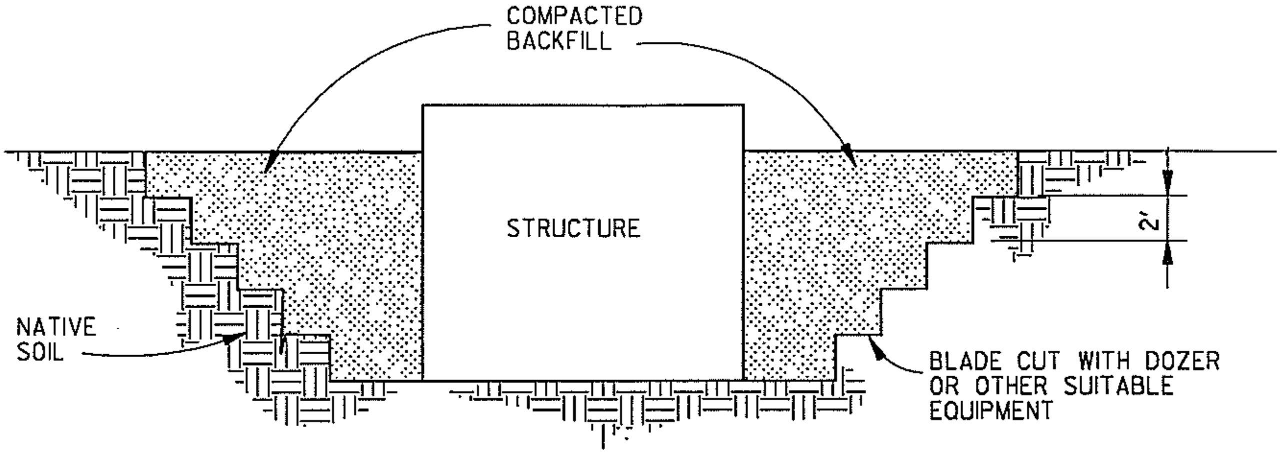
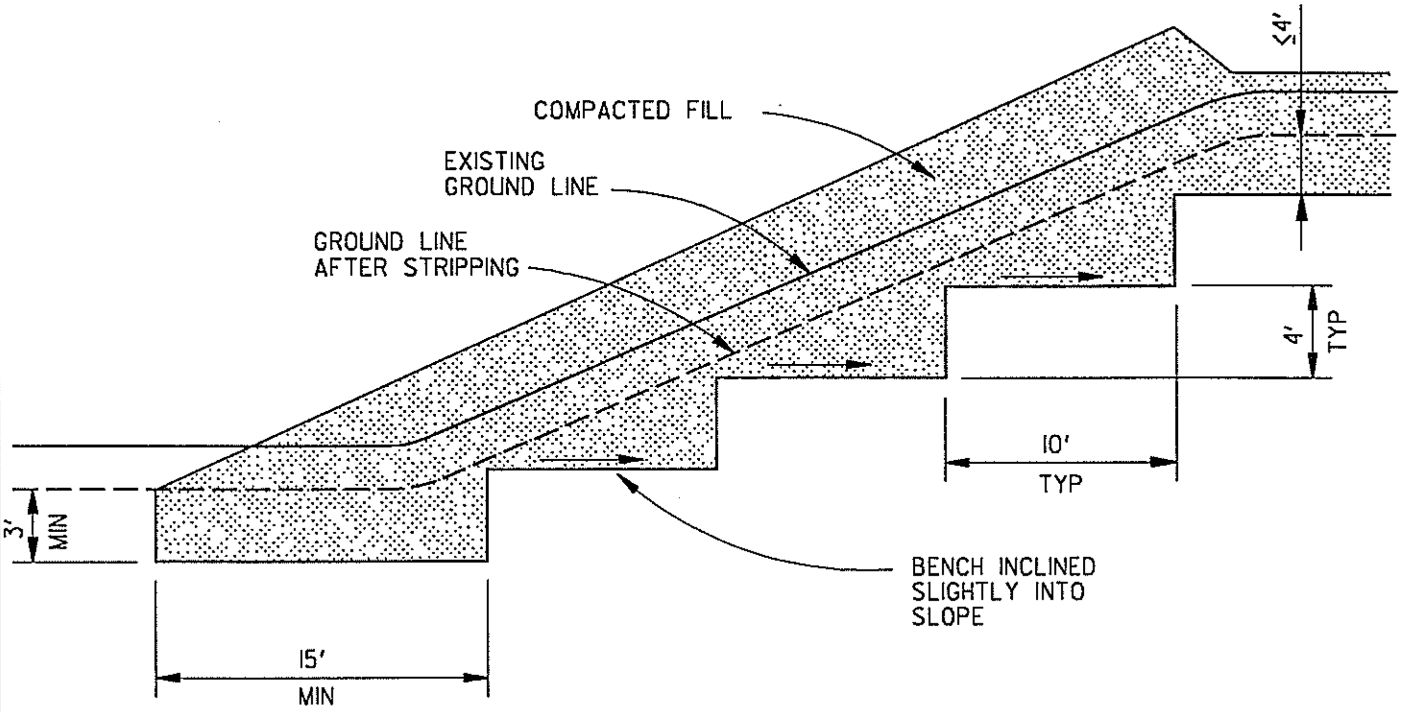


KEYING DETAIL FOR PLACEMENT OF BACKFILL AROUND STRUCTURES



FILL SLOPE OVER EXISTING SLOPE STEEPER THAN 5:1

NOTE:
NO BENCHING REQUIRED FOR SLOPES FLATTER THAN 5:1.

FIGURE 5-2
FILL PLACEMENT DETAILS
NORTH CITY WATER RECLAMATION PLANT
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5.4.2 Structural Fill Beneath Facilities

Structural fill beneath facilities includes any fill located within the zone of influence of buildings, slabs, pipes, conduits, etc. as described above in Section 5.3, Subgrade Preparation, or as shown in Figure 5-1. Structural fill will not include the crushed rock layer described in Section 5.5, which is to be placed on the prepared subgrade as a working surface.

Structural fill placed below facilities should consist of granular material from the Lindavista formation or similar material imported from offsite. The Lindavista formation is primarily a poorly graded fine sand with gravels and cobbles. The fill should have a maximum particle size no greater than 6 inches, and no more than 20 percent by weight should pass the No. 200 sieve. The fill should be compacted to at least the equivalent of 95 percent of the maximum dry density as determined by ASTM D 1557 at a water content near optimum. It shall be placed in lift thicknesses no greater than 8 inches in its loose state.

5.4.3 Backfill Around Facilities

Backfill will be placed around the buried facilities, and behind retaining walls following their construction.

Backfill within 5 feet of structural walls should consist of clean well-graded granular material with a maximum particle size of 4 inches and no more than 5 percent passing the No. 200 sieve. This material will provide a drainage way to divert water away from the structural walls.

The remaining general backfill around a facility may consist of material from either the Lindavista or Scripps formations or any combination thereof. The fill should have a maximum particle size no greater than 6 inches. It should be compacted to at least the equivalent of 95 percent of the maximum dry density as determined by ASTM D 1557 at a water content 2 percent wet of optimum. Fill should be placed in lift thicknesses no greater than 8 inches in the loose state.

It is important to note that fill around a facility that falls within the zone of influence of an adjacent structure must meet the gradation and compaction requirements for fill beneath a facility, or backfill within 5 feet of structural walls, not the requirements for backfill around facilities.

5.4.4 General Site Fills

General site fills will be placed at the site to achieve final grading elevations and shall include those areas that do not conform to the locations of "fill beneath facilities" or "backfill around facilities." They may consist of material from either the Lindavista or Scripps formations, or any combination thereof. These fills are expected to result in final fill slopes up to 30 feet high.

All general site fills should be compacted to at least 95 percent of the maximum dry density obtained from ASTM D 1557 at a water content 2 percent wet of optimum, and have a maximum particle size of 12 inches. Fill, which will form the upper 3 feet of a slope surface, should have a maximum particle size of 6 inches. Fill should be placed in lift thicknesses no greater than 12 inches in the loose state.

5.5 Crushed Rock Beneath Facilities

Once the subgrade has been prepared and the structural fill, if any, placed, a 6-inch-thick layer of crushed rock should be placed and compacted beneath the proposed foundation. The crushed rock should be well graded from coarse to fine and contain less than 8 percent passing the No. 200 sieve. The maximum particle size should be no greater than 1-1/2 inches. This layer will be used to form a dry, solid working surface for the construction of the foundation, and also serve as a drainage blanket should the facility leak. The crushed rock should also be compacted to at least the equivalent 95 percent of the maximum dry density as determined by ASTM D 1557.

5.6 Side Drains

Side drains can be used in conjunction with the clean, granular backfill around structures to drain water from the soil surrounding the structures and thus reduce the lateral pressure against the walls. The side drains should be connected to the perimeter drains or other permeable drainage materials. Side drains should be located adjacent to exterior structural wall, as shown in Figure 5-1.

The side drains should consist of either a natural drainage blanket or a preformed geotextile drainage fabric. The drainage blanket should consist of a free draining sand or gravel separated from the backfill by either a graded soil filter or an appropriate geotextile.

5.7 Dewatering

During the course of the geotechnical exploration, no evidence of water, either surficial or at depth, was detected. This agrees with published reports (Department of Water Resources, 1967) that indicate groundwater to be located at least 100 feet below the ground surface.

It should be made the Contractor's responsibility to provide a method of diverting or removing any surface or groundwater water encountered during construction so that work can proceed in a safe and timely manner.

Due to the presence of clay seams, the potential for isolated perched water tables exists. If encountered, these water tables are expected to yield only small amounts of water, which should be adequately handled with sumps and pumps. If seeps do occur, provisions should be made by the Contractor to prevent slopes adjacent to the seeps from ravelling or sloughing due to loss of support.

Section 6
Conclusions and Recommendations

Section 6
Conclusions and Recommendations

The following represents a summary of the conclusion and recommendations developed during the preparation of this report.

6.1 General

- The site is suitable for construction of the intended facility.
- Major site grading is required to produce the desired final topography.
- The soil is highly corrosive to buried metals and concrete.
- A significant seismic hazard exists. The design fault is the Rose Canyon Fault, which is 3 miles away, and is capable of producing a magnitude M7.0 earthquake with a peak ground acceleration of 0.55g.

6.2 Design Considerations

- The allowable net static bearing pressures for all facilities are given in Table 4-1.
- Lateral earth pressure recommendations are given for both static and dynamic loading conditions. Recommendations for static design are given in Table 4-2. Recommendations for dynamic lateral earth pressures are presented in Figures 4-1 and 4-2 for flexible structures and in Table 4-2 for nonyielding structures.
- The maximum recommended slope for permanent cut slopes is 1.5:1. The maximum recommended slope for permanent fill slopes is 2:1. These slopes should be benched in accordance with UBC requirements.

6.3 Construction Considerations

- Temporary excavations should be designed by a qualified professional engineer retained by the contractor. The design must consider the contractors methods and sequence of excavation.
- The cut portion of the subgrade beneath structures located on both cut and fill must be overexcavated to minimize differential settlements. The over-

excavation depth should be 5 feet at the point of transition, and extend to the outer limits of the cut area.

- The top 6 inches of subgrade should be compacted to 95 percent of maximum dry density by ASTM D 1557 below facilities.
- A working pad of 6 inches of crushed rock should be placed and compacted to 95 percent of ASTM D 1557 beneath facilities.
- Perimeter drains around the base of structure, and side drains against buried walls should be considered for the reduction of hydrostatic pressures on the walls of buried facilities.
- The Lindavista Formation is recommended for structural fill beneath facilities. The Lindavista Formation and the Scripps Formation materials are acceptable for use as fill around structures and general site fills. The alluvium and topsoil are not acceptable as fill.
- Fill beneath facilities should be well-graded and granular in nature, have a maximum particle size of 6 inches, and a maximum of 20 percent passing the No. 200 sieve.
- Fills within 5 feet of structural walls should be well-graded granular material with a maximum particle size of 6 inches and no more than 5 percent passing the No. 200 sieve.
- General fill around facilities should have a maximum particle size of 6 inches.
- General site fills should have a maximum particle size of 6 inches in the 3 feet of fill closest to the surface of a slope, and a maximum particle size of 12 inches in the rest of the fill.
- Fill beneath facilities should be compacted to at least 95 percent of maximum dry density by ASTM D 1557. Fill around facilities and general site fills should be compacted to at least 95 percent of maximum dry density by ASTM D 1557.
- Lift thicknesses should be less than 8 inches in the loose state for fills beneath and around facilities and less than 12 inches thick for general site fills.
- Backfills around facilities and all fill placed on existing slopes greater than 5:1 should be keyed in to the native soil, as shown in Figure 5-2.

- Construction dewatering is not anticipated to be a major concern. The possibility of isolated perched water tables exists, however it is anticipated that any water from these water tables could be handled with sumps and pumps. Seeps must be controlled to prevent loss of soil and undermining of adjacent slopes.

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Appendix A
Soil Boring Logs

PROJECT NUMBER	BORING NUMBER
LAO 32316.A7	B-91-01 SHEET 1 OF 3

SOIL BORING LOG

PROJECT North City Water Reclamation Plant LOCATION North City, San Diego

ELEVATION 387 MSL DRILLING CONTRACTOR A&R Drilling

DRILLING METHOD AND EQUIPMENT 8-inch Hollow Stem Augers, CME 75 rotary drill rig

WATER LEVELS Not Encountered START 11/06/91 FINISH 11/06/91 LOGGER C. Polito

DEPTH BELOW SURFACE (FT)	SAMPLE			PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6"	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
						Start Drilling @ 0940
		1-G			CLAYEY SAND (SC) reddish brown, dry, loose, trace mica	
5.0	5.0 5.6	2-C	0.7	25-50/2"	CLAYEY SAND (SC) reddish brown, dry, very dense, trace mica	Lost sample out of rings
10.0	10.0 11.5	3-C	1.3	13-24-26 (50)	SILTY SAND (SM) yellow, dry to moist, very dense, micaceous, brown clay layers (LINDAVISTA FORMATION)	
15.0	15.0 15.9	4-C	0.9	21-50/5"	POORLY GRADED SAND WITH SILT & GRAVEL (SP) yellow to reddish brown, moist, very dense, micaceous, gravel up to 3/4" (LINDAVISTA FORMATION)	
20.0	20.0 20.6	5-C	0.7	26-50/1"	POORLY GRADED SAND WITH SILT & GRAVEL (SP) yellow to reddish brown, moist, very dense, micaceous, gravel up to 3/4" (LINDAVISTA FORMATION)	Only 4 rings in lab sample
25.0	25.0 25.3	6-C	0.3	50/4"	SILTY SAND WITH GRAVEL (SM) reddish brown, moist, very dense, micaceous, gravel to 1.5" (LINDAVISTA FORMATION)	No lab sample
	30.0					

CH2M HILL

PROJECT NUMBER LAO 32316.A7

BORING NUMBER B-91-01

SHEET 2 OF 3

SOIL BORING LOG

PROJECT North City Water Reclamation Plant
LOCATION North City, San Diego
ELEVATION 387 MSL
DRILLING CONTRACTOR A&R Drilling
DRILLING METHOD AND EQUIPMENT 8-inch Hollow Stem Augers, CME 75 rotary drill rig
WATER LEVELS Not Encountered
START 11/06/91
FINISH 11/06/91
LOGGER C. Polito

DEPTH BELOW SURFACE (FT)	SAMPLE			PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6"	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	30.0 31.4	7-C	1.5	26-35 -50/5"	SILTY SAND (SM) gray with orange streaks, moist, very dense, cemented, micaceous (SCRIPPS FORMATION)	
35.0	35.0 35.9	8-C	1.3	25-50/5"	SILTY SAND (SM) gray with orange streaks, moist, very dense, cemented, micaceous (SCRIPPS FORMATION)	
40.0	40.0 40.9	9-C	1.5	40-50/5"	40.0 to 40.5 SILT (ML) gray to brown, dry, hard, trace sand, trace mica 40.5 to 41.5 SAME AS 7-C (SCRIPPS FORMATION)	
45.0	45.0 45.5	10-C	0.5	50/6"	SILT (ML) gray to brown, dry, hard, trace mica (SCRIPPS FORMATION)	
50.0	50.0 50.9	11-C	1.0	43-50/5"	50.0 to 50.5 SAME AS 7-C grades to 50.5 to 51.5 SAME AS 10-C (SCRIPPS FORMATION)	2 gallons of water added to cool bit
55.0	55.0 55.9	12-C	1.2	32-50/4.5"	POORLY GRADED SAND (SP) reddish, dry, very dense, fine sand, lenses of hard, lean, gray silt (SCRIPPS FORMATION)	
	60.0					

PROJECT NUMBER
LAO 32316.A7

BORING NUMBER
B-91-01

SHEET 3 OF 3

SOIL BORING LOG

PROJECT North City Water Reclamation Plant LOCATION North City, San Diego

ELEVATION 387 MSL DRILLING CONTRACTOR A&R Drilling

DRILLING METHOD AND EQUIPMENT 8-inch Hollow Stem Augers, CME 75 rotary drill rig

WATER LEVELS Not Encountered START 11/06/91 FINISH 11/06/91 LOGGER C. Polito

DEPTH BELOW SURFACE (FT)	SAMPLE			PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6"	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	60.0 60.8	13-C	1.3	48-50/4"	SAME AS ABOVE, except more even (4" to 6") layers (SCRIPPS FORMATION)	
65.0	65.0 65.4	14-C	0.7	50/5"	SILT (ML) gray, dry, hard, trace mica, same as clay above (SCRIPPS FORMATION) END OF BORING = 65.4 FEET @ 1230	
70.0						
75.0						
80.0						
85.0						

CH2M HILL

PROJECT NUMBER LAO 32316.A7

BORING NUMBER B-91-02

SHEET 1 OF 2

SOIL BORING LOG

PROJECT North City Water Reclamation Plant

LOCATION North City, San Diego

ELEVATION 380 MSL

DRILLING CONTRACTOR A&R Drilling

DRILLING METHOD AND EQUIPMENT 8-inch Hollow Stem Augers, CME 75 rotary drill rig

WATER LEVELS Not Encountered

START 11/06/91

FINISH 11/06/91

LOGGER C. Polito

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	PENETRATION TEST RESULTS 6" -6" -6"	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
						Start Drilling @ 1340
		1-G			CLAYEY SAND (SC) reddish brown, dry, loose, trace mica	
5.0	5.0 6.0	2-C	1.0	9-50/6"	CLAYEY SAND (SC) reddish brown, dry, very dense, trace mica	
10.0	10.0 11.5	3-C	1.5	10-33-50 (83)	CLAYEY SAND (SC) reddish brown, dry, very dense, cohesive	
15.0	15.0 16.5	4-C	1.3	11-33-50 (83)	POORLY GRADED SAND WITH SILT (SP-SM) yellow, dry, very dense, highly cemented, micaceous, some reddish brown mottling (LINDAVISTA FORMATION)	
20.0	20.0 20.3	5-C	0.0	50/3"	No recovery	Sampler on rock
25.0	25.0 26.4	6-C	1.5	7-37-50/5"	SILT (ML) gray to yellow brown, dry, hard, micaceous (SCRIPPS FORMATION)	
	30.0					

PROJECT NUMBER	BORING NUMBER
LAO 32316.A7	B-91-02 SHEET 2 OF 2

SOIL BORING LOG

PROJECT North City Water Reclamation Plant LOCATION North City, San Diego

ELEVATION 380 MSL DRILLING CONTRACTOR A&R Drilling

DRILLING METHOD AND EQUIPMENT 8-inch Hollow Stem Augers, CME 75 rotary drill rig

WATER LEVELS Not Encountered START 11/06/91 FINISH 11/06/91 LOGGER C. Poiito

DEPTH BELOW SURFACE (FT)	SAMPLE			PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6"	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	30.8	7-C	0.8	50/6"	Alternate layers @ 2" to 6" thick POORLY GRADED SAND (SM) reddish brown, dry, very dense, cemented, micaceous (SCRIPPS FORMATION) SILT (ML) gray, dry, hard, as above (SCRIPPS FORMATION)	
35.0	35.0 35.5	8-C	0.8	50/5.5"	Same as above (SCRIPPS FORMATION)	
40.0	40.0 41.0	9-C	1.2	35-50/6"	Same as 7C, except silt contains some fine sand and orange staining (SCRIPPS FORMATION)	
45.0	45.0 45.9	10-C	1.0	27-50/5"	Same as above (SCRIPPS FORMATION)	
50.0	50.0 50.5	11-C	0.5	50/5.5"	SILT (ML) gray to brown, dry, hard, trace mica (SCRIPPS FORMATION)	No recovery in 2 lowest rings
55.0	55.0 55.5	12-C	0.5	50/6"	POORLY GRADED SAND (SP) yellow to brown, dry, very dense, fine sand (SCRIPPS FORMATION) END OF BORING = 55.5 FEET @ 1600	Driller reports cobbles

CH2M HILL

PROJECT NUMBER
LAO 32316.A7

BORING NUMBER
B-91-03

SHEET 1 OF 2

SOIL BORING LOG

PROJECT North City Water Reclamation Plant LOCATION North City, San Diego

ELEVATION 372 MSL DRILLING CONTRACTOR A&R Drilling

DRILLING METHOD AND EQUIPMENT 8-inch Hollow Stem Augers, CME 75 rotary drill rig

WATER LEVELS Not Encountered START 11/07/91 FINISH 11/07/91 LOGGER C. Polito

DEPTH BELOW SURFACE (FT)	SAMPLE			PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6"	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
						Start Drilling @ 0745
5.0	5.0 5.9	1-C	0.8	31-50/4.5"	CLAYEY SAND WITH GRAVEL (SC) reddish brown, dry, very dense, gravel up to 1/2"	
10.0	10.0 10.6	2-C	0.6	27-50/1"	Same as 1C, except more gravel & gravel up to 1", sand lightly cemented (LINDAVISTA FORMATION)	
15.0	15.0 15.4	3-C	0.3	50/4.5"	Same as 2C, except sand moderately cemented (LINDAVISTA FORMATION)	No lab sample taken
20.0	20.0 20.4	4-C	0.3	50/4.5"	SILTY SAND WITH GRAVEL (SM) yellowish brown, dry, very dense, some cohesion, gravel to 1/2" (LINDAVISTA FORMATION)	No lab sample taken 2"x2"x1" rock jammed in shoe
25.0	25.0 25.8	5-C	0.7	27-50/2.5"	SILT WITH SAND (ML) gray, dry, hard, fine sand, some intermixed zones of reddish brown sand and yellow sand (SCRIPPS FORMATION)	
	30.0					

CH2M HILL

PROJECT NUMBER
LAO 32316.A7

BORING NUMBER
B-91-03

SHEET 2 OF 2

SOIL BORING LOG

PROJECT North City Water Reclamation Plant
LOCATION North City, San Diego
ELEVATION 372 MSL
DRILLING CONTRACTOR A&R Drilling
DRILLING METHOD AND EQUIPMENT 8-inch Hollow Stem Augers, CME 75 rotary drill rig
WATER LEVELS Not Encountered
START 11/07/91
FINISH 11/07/91
LOGGER C. Polito

DEPTH BELOW SURFACE (FT)	SAMPLE			PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6"	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	30.6	6-C	0.6	50/5.5"	Same as above, more yellow, less red sand (SCRIPPS FORMATION)	
35.0	35.0 35.3	7-C	0.0	50/4"	No recovery	No lab sample taken
						Driller indicates possible gravel layer
40.0	40.0 40.9	8-C	1.2	35-50/5"	Alternate layers (2"-4") Lean silt as above <u>SILTY SAND</u> (SM) reddish brown, dry, very dense, highly cemented, fine sand (SCRIPPS FORMATION)	
45.0	45.0 45.9	9-C	1.2	28-50/5"	Same as above, except silt and silty sand are swirled, not layered (SCRIPPS FORMATION)	
50.0	50.0 50.9	10-C	1.0	29-50/5"	Alternate @ 3" layers <u>SILT WITH SAND</u> (ML) gray, dry, hard, fine sand (SCRIPPS FORMATION) <u>SILT</u> (ML) and <u>Silty Sand</u> (SM) as in 9C (SCRIPPS FORMATION) END OF BORING = 50.9 FEET @ 1000	Gravel appears in cuttings as auger is removed
55.0						

CH2M HILL

PROJECT NUMBER
LAO 32316.A7

BORING NUMBER
B-91-04

SHEET 1 OF 2

SOIL BORING LOG

PROJECT North City Water Reclamation Plant LOCATION North City, San Diego
ELEVATION 357 MSL DRILLING CONTRACTOR A&R Drilling
DRILLING METHOD AND EQUIPMENT 8-inch Hollow Stem Augers, CME 75 rotary drill rig
WATER LEVELS Not Encountered START 11/07/91 FINISH 11/07/91 LOGGER C. Polito

DEPTH BELOW SURFACE (FT)	SAMPLE			PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6"	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
					Gravel and cobbles top 6'	Start Drilling @ 1035
		1-G			<u>CLAYEY SAND WITH GRAVEL</u> (SC) reddish brown, dry, gravel up to 1"	
5.0	5.0					No sample attempted, still in cobble layer
10.0	10.0 10.5	2-C	0.3	50/6"	<u>CLAYEY SAND WITH GRAVEL</u> (SC) reddish brown, moist, very dense, some cohesion, gravel up to 1" (LINDAVISTA FORMATION)	No lab sample
15.0	15.0 16.0	3-C	0.7	14-50/6"	<u>POORLY GRADED SAND</u> (SP) yellow with some red intermixed, moist, very dense, cemented (LINDAVISTA FORMATION)	
20.0	20.0 20.3	4-C	0.0	50/4"	No recovery	
						Driller indicates gravel layer
25.0	25.0 25.5	5-C	0.3	50/6"	<u>POORLY GRADED SAND WITH GRAVEL</u> (SP) light brown, moist, dense, micaceous, gravel to 1" (LINDAVISTA FORMATION)	No lab sample taken
						Driller still noting gravel
	30.0					

CH2M HILL

PROJECT NUMBER LAO 32316.A7

BORING NUMBER B-91-04

SHEET 2 OF 2

SOIL BORING LOG

PROJECT North City Water Reclamation Plant

LOCATION North City, San Diego

ELEVATION 357 MSL

DRILLING CONTRACTOR A&R Drilling

DRILLING METHOD AND EQUIPMENT 8-inch Hollow Stem Augers, CME 75 rotary drill rig

WATER LEVELS Not Encountered

START 11/07/91

FINISH 11/07/91

LOGGER C. Polito

DEPTH BELOW SURFACE (FT)	SAMPLE			PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6"	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	30.0 31.2	6-C	1.0	22-36 -50/2"	Alternate layers (2"-4") POORLY GRADED SAND WITH GRAVEL (SP) reddish brown, moist, very dense, cemented and SILTY SAND (SM) brown to orange, moist, very dense, micaceous, lenses of lean clay @ 1/8" thick (LINDAVISTA FORMATION)	
35.0	35.0 35.9	7-C	1.2	35-50/5"	SILT WITH SAND (ML) gray, dry, hard, fine sand, intermixed zones of reddish brown sand and yellow sand (SCRIPPS FORMATION) END OF BORING = 35.9 FEET @ 1140	
40.0						
45.0						
50.0						
55.0						

CH2M HILL

PROJECT NUMBER LAO 32316.A7

BORING NUMBER B-91-05

SHEET 1 OF 2

SOIL BORING LOG

PROJECT North City Water Reclamation Plant

LOCATION North City, San Diego

ELEVATION 374 MSL

DRILLING CONTRACTOR A&R Drilling

DRILLING METHOD AND EQUIPMENT 8-inch Hollow Stem Augers, CME 75 rotary drill rig

WATER LEVELS Not Encountered

START 11/07/91

FINISH 11/07/91

LOGGER C. Polito

DEPTH BELOW SURFACE (FT)	SAMPLE			PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6"	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
						Start Drilling @ 1215
		1-G			CLAYEY SAND (SC) reddish brown, dry, fine sand, some gravel to 1/2"	
5.0	5.0 6.4	2-C	1.2	12-36 -50/5"	POORLY GRADED SAND (SM) reddish brown, moist, very dense, fine sand, highly cemented (LINDAVISTA FORMATION)	
10.0	10.0 11.5	3-C	1.2	12-35-50	POORLY GRADED SAND (SP) yellow, dry, very dense, highly cemented, fine sand (LINDAVISTA FORMATION)	
15.0	15.0 16.4	4-C	1.5	8-32-50/5"	Same as 3C (LINDAVISTA FORMATION)	
20.0	20.0 21.0	5-C	1.0	12-50/6"	20.0-21.0 Same as 3C 21.0-21.5 Same as 3C except coarser sand and some orange speckling (LINDAVISTA FORMATION)	
25.0	25.0 25.3	6-C	0.0	50/4"	No recovery	
	30.0					

CH2M HILL

PROJECT NUMBER	BORING NUMBER
LAO 32316.A7	B-91-05 SHEET 2 OF 2

SOIL BORING LOG

PROJECT North City Water Reclamation Plant LOCATION North City, San Diego
ELEVATION 374 MSL DRILLING CONTRACTOR A&R Drilling
DRILLING METHOD AND EQUIPMENT 8-inch Hollow Stem Augers, CME 75 rotary drill rig
WATER LEVELS Not Encountered START 11/07/91 FINISH 11/07/91 LOGGER C. Polito

DEPTH BELOW SURFACE (FT)	SAMPLE			PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6"	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	30.0 30.3	7-C	0.3	50/4"	POORLY GRADED SAND WITH GRAVEL (SP) reddish brown, moist, very dense, 1/8" layers of lean clay Gravel to 1 1/2", broken cobbles (LINDAVISTA FORMATION)	No lab sample
						Driller reports cobbles
35.0	35.0 35.1	8-C	0.0	50/1"	No recovery END OF BORING = 35.1 FEET @ 1400	No lab sample
						Large rock below auger tip
40.0						
45.0						
50.0						
55.0						

CH2M HILL

PROJECT NUMBER LAO 32316.A7

BORING NUMBER B-91-06

SHEET 1 OF 2

SOIL BORING LOG

PROJECT North City Water Reclamation Plant

LOCATION North City, San Diego

ELEVATION 382 MSL

DRILLING CONTRACTOR A&R Drilling

DRILLING METHOD AND EQUIPMENT 8-inch Hollow Stem Augers, CME 75 rotary drill rig

WATER LEVELS Not Encountered

START 11/07/91

FINISH 11/07/91

LOGGER C. Polito

DEPTH BELOW SURFACE (FT)	SAMPLE			PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6"	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	2.0				CLAYEY SAND WITH GRAVEL (SC) reddish brown, dry, loose, gravel to 3"	Start Drilling @ 1430
	- 5.0	1-G			CLAYEY SAND (SC) yellow, dry, loose, fine sand, micaceous	No gravel in cuttings but can hear bit hitting rocks
5.0	6.5	2-C	1.2	18-30-47 (77)	SILTY SAND (SM) yellow to reddish brown, moist, very dense, highly cemented (LINDAVISTA FORMATION)	
	10.0					
10.0	11.5	3-C	1.5	19-18-44 (62)	Same as 2C except very highly cemented (LINDAVISTA FORMATION)	
	15.0					
15.0	16.5	4-C	1.3	12-25-27 (52)	Same as 3C (LINDAVISTA FORMATION)	
	20.0					
20.0	20.3	5-C	0.6	50/3.5"	POORLY GRADED SAND WITH GRAVEL (SP) reddish brown, moist, very dense, gravel to 1" (LINDAVISTA FORMATION)	Enter gravel and cobble layer
	25.0					
25.0	25.3	6-C	0.0	50/3"	No recovery	Plug of cemented silty sand in shoe. Possibly sluff
	30.0					

CH2M HILL

PROJECT NUMBER LAO 32316.A7

BORING NUMBER B-91-06

SHEET 2 OF 2

SOIL BORING LOG

PROJECT North City Water Reclamation Plant
LOCATION North City, San Diego
ELEVATION 382 MSL
DRILLING CONTRACTOR A&R Drilling
DRILLING METHOD AND EQUIPMENT 8-inch Hollow Stem Augers, CME 75 rotary drill rig
WATER LEVELS Not Encountered
START 11/07/91
FINISH 11/07/91
LOGGER C. Polito

DEPTH BELOW SURFACE (FT)	SAMPLE			PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6"	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	30.0 30.1	7-C	0.0	50/1"	No recovery	
						Still in gravel and cobble layer
35.0	35.0 35.1	8-C	0.0	-	No sample	Hammer bouncing
40.0						No sample attempted, still in gravel and cobble layer
45.0	45.0 45.1	9-C	0.5	50/1"	<u>POORLY GRADED SAND</u> (SM) light brown, moist, very dense, cemented, fine sand, orange mottling (LINDAVISTA FORMATION)	
					END OF BORING = 45.1 FEET @ 1630	
50.0						
55.0						

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
LAO 32316.A7	B-91-07	SHEET 1 OF 3

SOIL BORING LOG

PROJECT North City Water Reclamation Plant LOCATION North City, San Diego
ELEVATION 382 MSL DRILLING CONTRACTOR A&R Drilling
DRILLING METHOD AND EQUIPMENT 8-inch Hollow Stem Augers, CME 75 rotary drill rig
WATER LEVELS Not Encountered START 11/08/91 FINISH 11/08/91 LOGGER C. Polito

DEPTH BELOW SURFACE (FT)	SAMPLE			PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6"	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
						Start Drilling @ 0715
		1-G			CLAYEY SAND (SC) reddish brown, dry, loose, occasional gravel to 1/2"	
5.0	5.0 6.0	2-C	1.0	18-50/6"	SILTY SAND (SM) reddish brown, dry, very dense, cemented, fine sand, micaceous (LINDAVISTA FORMATION)	
10.0	10.0 10.7	3-C	0.8	29-50/2"	POORLY GRADED SAND (SP) yellow, moist, very dense, cemented, some gravel, fine sand (LINDAVISTA FORMATION)	Begin entering gravel and cobble layer and 10'
15.0	15.0 15.9	4-C	0.8	33-50/2.5"	CLAYEY SAND WITH GRAVEL (SC) light brown, moist, very dense, light cementation, 30% gravel to 1" (LINDAVISTA FORMATION)	
20.0	20.0 20.5	5-C	0.3	50/5.5"	Same as 4C except smaller and less gravel (LINDAVISTA FORMATION)	No lab sample
25.0						
	30.0					

CH2M HILL

PROJECT NUMBER	BORING NUMBER
LAO 32316.A7	B-91-07 SHEET 2 OF 3

SOIL BORING LOG

PROJECT North City Water Reclamation Plant LOCATION North City, San Diego
ELEVATION 382 MSL DRILLING CONTRACTOR A&R Drilling
DRILLING METHOD AND EQUIPMENT 8-inch Hollow Stem Augers, CME 75 rotary drill rig
WATER LEVELS Not Encountered START 11/08/91 FINISH 11/08/91 LOGGER C. Polito

DEPTH BELOW SURFACE (FT)	SAMPLE			PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6"	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	30.0 30.3	6-C	0.0	50/3"	No recovery	Still in gravel and cobble layer
35.0						Can hear gravel and cobble at auger bit
						Cuttings almost all gravel
40.0						No sampling attempted. Driller indicates that last several feet have been in large cobble
						2 gallons of water added to hole to cool bit
45.0						Drilling stopped at 0945 to remove augers and replace teeth Drilling resumes at 1050
50.0	50.0 50.7	7-C	1.0	48-50/2"	POORLY GRADED SAND (SP) reddish brown, moist, very dense, cemented, fine sand, @ 1/8" thick lenses of lean clay (SCRIPPS FORMATION)	Seem to have passed through gravel layer
55.0	55.0 55.7	8-C	1.3	35-50/2.5"	SANDY SILT (ML) gray to brown, moist, hard, fine sand, micaceous, some orange staining (SCRIPPS FORMATION)	
	60.0					

PROJECT NUMBER
LAO 32316.A7

BORING NUMBER
B-91-07

SHEET 3 OF 3

SOIL BORING LOG

PROJECT North City Water Reclamation Plant
LOCATION North City, San Diego
ELEVATION 382 MSL
DRILLING CONTRACTOR A&R Drilling
DRILLING METHOD AND EQUIPMENT 8-inch Hollow Stem Augers, CME 75 rotary drill rig
WATER LEVELS Not Encountered
START 11/08/91
FINISH 11/08/91
LOGGER C. Polito

DEPTH BELOW SURFACE (FT)	SAMPLE			PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6" -6" -6"	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	60.0	9-C	0.6	50/5.5"	POORLY GRADED SAND (SP) light brown, moist, very dense, fine sand, moderately cemented, micaceous (SCRIPPS FORMATION)	
65.0	65.0 65.5	10-C	0.3	50/5.5"	POORLY GRADED SAND WITH SILT (SP-SM) light brown, moist, very dense, fine sand, slightly plastic, lightly cemented, micaceous (SCRIPPS FORMATION)	No lab sample
70.0	70.0 70.5	11-C	0.7	50/5.5"	Same as 10C (SCRIPPS FORMATION)	
					END OF BORING = 71.5 FEET @ 1315	
75.0						
80.0						
85.0						

PROJECT NUMBER LAO 32316.A7	BORING NUMBER B-91-08	SHEET 1 OF 2

SOIL BORING LOG

PROJECT North City Water Reclamation Plant LOCATION North City, San Diego

ELEVATION 320 MSL DRILLING CONTRACTOR A&R Drilling

DRILLING METHOD AND EQUIPMENT 8-inch Hollow Stem Augers, CME 75 rotary drill rig

WATER LEVELS Not Encountered START 11/08/91 FINISH 11/08/91 LOGGER C. Polito

DEPTH BELOW SURFACE (FT)	SAMPLE			PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6"	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
						Start Drilling @ 1340
	5.0	1-G				
5.0	6.5	2-C	1.5	19-37-50 (87)	<u>SANDY SILT</u> (ML) gray, moist, hard, fine sand, micaceous, orange mottling of uniform fine sand, nearly 50/50 silt and sand (SCRIPPS FORMATION)	
	10.0					
10.0	11.5	3-C	1.5	11-30 -50/5.5"	Same as 2C (SCRIPPS FORMATION)	
	15.0					
15.0	16.5	4-C	1.5	11-27 -50/5.5"	Same as 2C (SCRIPPS FORMATION)	
	20.0					
20.0	21.0	5-C	0.9	9-50/6"	Same as 2C (SCRIPPS FORMATION)	
	25.0					
25.0	25.9	6-C	0.9	28-50/5"	Same as 2C (SCRIPPS FORMATION)	
						Driller felt gravel layer 28-30'
	30.0					

PROJECT NUMBER LAO 32316.A7

BORING NUMBER B-91-08

SHEET 2 OF 2

SOIL BORING LOG

PROJECT North City Water Reclamation Plant

LOCATION North City, San Diego

ELEVATION 320 MSL

DRILLING CONTRACTOR A&R Drilling

DRILLING METHOD AND EQUIPMENT 8-inch Hollow Stem Augers, CME 75 rotary drill rig

WATER LEVELS Not Encountered

START 11/08/91

FINISH 11/08/91

LOGGER C. Polito

DEPTH BELOW SURFACE (FT)	SAMPLE			PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6"	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	30.0	7-C	0.3	50/5.5"	SILTY SAND (SM) light brown, moist, very dense, fine sand (SCRIPPS FORMATION)	No lab sample
35.0	35.0 35.4	8-C	0.6	50/5"	Same as 2C, except sand is coarser (but still fine) (SCRIPPS FORMATION)	
40.0	40.0 40.4	9-C	0.6	50/4.5"	Same as 8C (SCRIPPS FORMATION) END OF BORING = 40.4 FEET @ 1530	
45.0						
50.0						
55.0						

CH2M HILL

PROJECT NUMBER	BORING NUMBER
LAO 32316.A7	B-91-09

SHEET 1 OF 2

SOIL BORING LOG

PROJECT North City Water Reclamation Plant LOCATION North City, San Diego

ELEVATION 378 MSL DRILLING CONTRACTOR A&R Drilling

DRILLING METHOD AND EQUIPMENT 8-inch Hollow Stem Augers, CME 75 rotary drill rig

WATER LEVELS Not Encountered START 11/11/91 FINISH 11/11/91 LOGGER C. Polito

DEPTH BELOW SURFACE (FT)	SAMPLE			PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6" -6" -6"	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
						Start Drilling @ 0920
		1-G			CLAYEY SAND (SC) reddish brown, dry, loose, very fine sand	Large rock at 4'
5.0	5.0 5.9	2-C	1.0	21-50/5"	CLAYEY SAND (SC) reddish brown, moist, very dense, fine sand, cohesive	
10.0	10.0 11.0	3-C	0.3	34-38-Bounce	CLAYEY SAND WITH GRAVEL (SC) reddish brown, moist, very dense, fine sand, gravel to 3/4" (LINDAVISTA FORMATION)	No lab sample
15.0	15.0 15.4	4-C	0.3	50/5"	Same as 3C (LINDAVISTA FORMATION)	No lab sample
20.0	20.0 20.6	5-C	0.8	42-50/1"	Same as 3C (LINDAVISTA FORMATION)	
25.0	25.0 25.4	6-C	0.3	50/5"	Same as 3C Gravel to 2" (LINDAVISTA FORMATION)	No lab sample
	30.0					

CH2M HILL

PROJECT NUMBER
LAO 32316.A7

BORING NUMBER
B-91-09

SHEET 2 OF 2

SOIL BORING LOG

PROJECT North City Water Reclamation Plant
LOCATION North City, San Diego
ELEVATION 378 MSL
DRILLING CONTRACTOR A&R Drilling
DRILLING METHOD AND EQUIPMENT 8-inch Hollow Stem Augers, CME 75 rotary drill rig
WATER LEVELS Not Encountered
START 11/11/91
FINISH 11/11/91
LOGGER C. Polito

DEPTH BELOW SURFACE (FT)	SAMPLE			PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6"	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	30.0 30.4	7-C	0.4	50/4.5"	Same as 6C (LINDAVISTA FORMATION)	No lab sample
35.0	35.0 35.4	8-C	0.0	50/5"	No recovery (LINDAVISTA FORMATION)	No lab sample
					END OF BORING = 36.5 FEET @ 1015	
40.0						
45.0						
50.0						
55.0						

CH2M HILL

PROJECT NUMBER LAO 32316.A7

BORING NUMBER B-91-10

SHEET 1 OF 1

SOIL BORING LOG

PROJECT North City Water Reclamation Plant LOCATION North City, San Diego

ELEVATION 353 MSL DRILLING CONTRACTOR A&R Drilling

DRILLING METHOD AND EQUIPMENT 8-inch Hollow Stem Augers, CME 75 rotary drill rig

WATER LEVELS Not Encountered START 11/11/91 FINISH 11/11/91 LOGGER C. Polito

DEPTH BELOW SURFACE (FT)	SAMPLE			PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6"	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
						Start Drilling @ 1045
		1-G			CLAYEY SAND (SC) dark brown, moist, loose, fine sand, gravel to 1/2"	
5.0	5.0 6.5	2-C	1.0	14-55-46 (101)	SANDY LEAN CLAY WITH GRAVEL (CL) reddish brown, moist, very dense, cohesive, fine sand, gravel to 1" @ 40%	
10.0	10.0 11.5	3-C	1.5	10-35-50 (85)	SANDY SILT (ML) gray to light brown, moist, hard, micaceous, orange mottling of very fine sand (SCRIPPS FORMATION)	
15.0	15.0 15.8	4-C	0.8	23-50/4"	SILTY SAND (SM) reddish brown to orangish brown, moist, very dense, micaceous, nonplastic fines, fine sand (SCRIPPS FORMATION)	
20.0	20.0 20.9	5-C	1.0	9-50/5"	Same as 4C (SCRIPPS FORMATION)	
25.0	25.0 25.9	6-C	1.0	11-50/5"	Same as 4C Sand is yellower (SCRIPPS FORMATION)	
					END OF BORING = 25.9 FEET @ 1135	

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
LAO 32316.A7	B-91-11	SHEET 1 OF 1

SOIL BORING LOG

PROJECT North City Water Reclamation Plant LOCATION North City, San Diego
ELEVATION 351 MSL DRILLING CONTRACTOR A&R Drilling
DRILLING METHOD AND EQUIPMENT 8-inch Hollow Stem Augers, CME 75 rotary drill rig
WATER LEVELS Not Encountered START 11/11/91 FINISH 11/11/91 LOGGER C. Polito

DEPTH BELOW SURFACE (FT)	SAMPLE			PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6" -6" -6"	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
		1-G			CLAYEY SAND WITH GRAVEL (SC) brown, dry, loose, fine sand, gravel to 3", cobbles to 6"	Start Drilling @ 1220 Cobbles to 6" on surface
5.0	5.0 5.8	2-C	0.9	33-50/4"	POORLY GRADED SAND WITH SILT (SP-SM) orangish brown, moist, very dense, micaceous, fine uniform sand (LINDAVISTA FORMATION)	
10.0	10.0 10.3	3-C	0.3	50/3"	CLAYEY SAND WITH GRAVEL (SC) brown, moist, very dense, some medium sand, gravel to 1" (LINDAVISTA FORMATION)	Sampler on rock No lab sampler large rock, driller chiseled through Drilling hard-gravel
15.0	15.0 15.4	4-C	0.0	50/4.5"	No recovery	Driller pulled augers to replace teeth on bit
20.0	20.0 20.5	5-C	0.3	50/5.5"	CLAYEY SAND WITH GRAVEL (SC) reddish brown, moist, very dense, well graded sand, gravel to 1/2", some clay chunks (LINDAVISTA FORMATION)	No lab sample Driller notes rocks
25.0	25.0 25.1	6-C	0.1	–	Same as 5C (LINDAVISTA FORMATION) END OF BORING = 25.1 FEET @ 1420	Sampler on rock On large rock - Teeth gone on auger bit Abandoned hole due to rock

CH2M HILL

PROJECT NUMBER LAO 32316.A7	BORING NUMBER B-91-12 SHEET 1 OF 2

SOIL BORING LOG

PROJECT North City Water Reclamation Plant LOCATION North City, San Diego

ELEVATION 328 MSL DRILLING CONTRACTOR A&R Drilling

DRILLING METHOD AND EQUIPMENT 8-inch Hollow Stem Augers, CME 75 rotary drill rig

WATER LEVELS Not Encountered START 11/11/91 FINISH 11/11/91 LOGGER C. Polito

DEPTH BELOW SURFACE (FT)	SAMPLE			PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6"	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
						Start Drilling @ 1500
		1-G			CLAYEY SAND (SC) dark brown, dry, loose, fine sand	
5.0	5.0 6.5	2-C	1.3	18-42 -50/4.5"	SANDY LEAN CLAY (SC) gray to light brown, moist, hard, orange mottling of very fine sand (SCRIPPS FORMATION)	
10.0	10.0 10.8	3-C	0.9	19-50/4"	POORLY GRADED SAND (SP) gray, moist, very dense, very fine sand (SCRIPPS FORMATION)	
15.0	15.0 15.8	4-C	0.9	22-50/4"	Same as 3C (SCRIPPS FORMATION)	
20.0	20.0 20.9	5-C	1.0	16-50/5"	POORLY GRADED SAND (SP) orangish brown, moist, very dense, fine sand (SCRIPPS FORMATION)	
25.0	25.0 25.9	6-C	1.0	13-50/5"	Same as 3C (SCRIPPS FORMATION)	
	30.0					

CH2M HILL

PROJECT NUMBER	BORING NUMBER
LAO 32316.A7	B-91-12 SHEET 2 OF 2

SOIL BORING LOG

PROJECT North City Water Reclamation Plant LOCATION North City, San Diego

ELEVATION 328 MSL DRILLING CONTRACTOR A&R Drilling

DRILLING METHOD AND EQUIPMENT 8-inch Hollow Stem Augers, CME 75 rotary drill rig

WATER LEVELS Not Encountered START 11/11/91 FINISH 11/11/91 LOGGER C. Polito

DEPTH BELOW SURFACE (FT)	SAMPLE			PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6'-6'-6"	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	30.0 30.9	7-C	0.8	22-50/4.5"	<u>SILTY SAND</u> (SM) orange, moist, very dense, fine sand, 1/4" thick lenses of hard, lean, gray clay (SCRIPPS FORMATION)	
35.0	35.0 35.7	8-C	1.0	30-50/2"	Same material as 7C more swirled, broke into 1/8" thick disks (SCRIPPS FORMATION)	No lab sample, no rings in sampler
					END OF BORING = 35.7 FEET @ 1135	
40.0						
45.0						
50.0						
55.0						

CH2M HILL

PROJECT NUMBER LAO 32316.A7

BORING NUMBER B-91-13

SHEET 1 OF 2

SOIL BORING LOG

PROJECT North City Water Reclamation Plant
LOCATION North City, San Diego
ELEVATION 311 MSL
DRILLING CONTRACTOR A&R Drilling
DRILLING METHOD AND EQUIPMENT 8-inch Hollow Stem Augers, CME 75 rotary drill rig
WATER LEVELS Not Encountered
START 11/12/91
FINISH 11/12/91
LOGGER C. Polito

DEPTH BELOW SURFACE (FT)	SAMPLE			PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6"	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
						Start Drilling @ 0715
		1-G			CLAYEY SAND (SC) brown, moist, loose, fine sand, some 1" gravel	
5.0	5.0 6.5	2-C	1.2	12-36-24 (60)	SANDY SILT (ML) gray to light brown, moist, hard, orange mottling of very fine sand (SCRIPPS FORMATION)	
10.0	10.0 10.7	3-C	0.5	12-50/2"	SANDY SILT (ML) orange, moist, hard, very fine sand (SCRIPPS FORMATION)	
15.0	15.0 16.2	4-C	1.3	15-41 -50/2"	SANDY SILT (ML) gray, moist, hard, fine sand, orange mottling of very fine sand, nearly 50/50 silt and sand (SCRIPPS FORMATION)	
20.0	20.0 20.9	5-C	1.0	13-50/5"	Same as 4C (SCRIPPS FORMATION)	
25.0	25.0 26.5	6-C	1.3	22-44 -50/5.5"	Same as 4C coarser sand (SCRIPPS FORMATION)	
	30.0					

CH2M HILL

PROJECT NUMBER	BORING NUMBER
LAO 32316.A7	B-91-13

SHEET 2 OF 2

SOIL BORING LOG

PROJECT North City Water Reclamation Plant LOCATION North City, San Diego
ELEVATION 311 MSL DRILLING CONTRACTOR A&R Drilling
DRILLING METHOD AND EQUIPMENT 8-inch Hollow Stem Augers, CME 75 rotary drill rig
WATER LEVELS Not Encountered START 11/12/91 FINISH 11/12/91 LOGGER C. Polito

DEPTH BELOW SURFACE (FT)	SAMPLE			PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6"	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	30.0 31.5	7-C			Same as 4C 4" seam of lean gray silt Silt- gray, moist, hard (SCRIPPS FORMATION)	
					END OF BORING = 31.5 FEET @ 0830	
35.0						
40.0						
45.0						
50.0						
55.0						

PROJECT NUMBER	BORING NUMBER
LAO 32316.A7	B-91-14 SHEET 1 OF 3

SOIL BORING LOG

PROJECT North City Water Reclamation Plant LOCATION North City, San Diego

ELEVATION 312 MSL DRILLING CONTRACTOR A&R Drilling

DRILLING METHOD AND EQUIPMENT 8-inch Hollow Stem Augers, CME 75 rotary drill rig

WATER LEVELS Not Encountered START 11/12/91 FINISH 11/12/91 LOGGER C. Polito

DEPTH BELOW SURFACE (FT)	SAMPLE			PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6"	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
						Start Drilling @ 0915
	5.0	1-G			CLAYEY SAND (SC) dark brown, dry, loose, occasional gravel to 1"	Gravel and cobbles
5.0	6.5	2-C	1.0	7-14-14 (28)	CLAYEY SAND (SC) dark brown, moist, medium dense, fine sand	
	10.0					
10.0	11.0	3-C	1.0	14-50/5.5"	POORLY GRADED SAND (SP) reddish brown, moist, very dense, fine uniform sand (SCRIPPS FORMATION)	
	15.0					
15.0	15.5	4-C		14-50/6"	POORLY GRADED SAND WITH SILT (SP-SM) reddish brown, moist, very dense, fine sand, lenses (1/16") and pockets of hard, lean gray silt (SCRIPPS FORMATION)	
	20.0					
20.0	21.4	5-C		12-43 -50/5"	SANDY SILT (ML) gray, moist, hard, orange mottling of fine sand, 1/8" to 1/4" lenses of silt (SCRIPPS FORMATION)	
	25.0					
25.0	25.9	6-C		17-50/5"	SANDY SILT (ML) dark gray, dry to moist, hard, very fine sand, fractures into bits when crushed (SCRIPPS FORMATION)	Large rock
	30.0					

CH2M HILL

PROJECT NUMBER LAO 32316.A7	BORING NUMBER B-91-14 SHEET 2 OF 3

SOIL BORING LOG

PROJECT North City Water Reclamation Plant LOCATION North City, San Diego

ELEVATION 312 MSL DRILLING CONTRACTOR A&R Drilling

DRILLING METHOD AND EQUIPMENT 8-inch Hollow Stem Augers, CME 75 rotary drill rig

WATER LEVELS Not Encountered START 11/12/91 FINISH 11/12/91 LOGGER C. Polito

DEPTH BELOW SURFACE (FT)	SAMPLE			PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6"	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	30.0 31.5	7-C			No sample attempted	Large rock, very hard @ 18" thick
35.0	35.0 35.5	8-C	0.7	50/5.5"	Same as 6-C (SCRIPPS FORMATION)	
40.0	40.0 40.9	9-C	1.0	30-50/4.5"	<u>SANDY SILT</u> (ML) gray, moist, hard, orange mottling of fine sand, 1/8" to 1/4" lenses of silt (SCRIPPS FORMATION)	
45.0	45.0 45.5	10-C	0.8	50/6"	Same as 6-C, except more sand, not quite as hard (SCRIPPS FORMATION)	
50.0	50.0 50.8	11-C		40-50/4"	Same as 10-C (SCRIPPS FORMATION)	
55.0	55.0 55.8	12-C		44-50/4"	Same as 6-C (SCRIPPS FORMATION)	
	60.0					

CH2M HILL

PROJECT NUMBER LAO 32316.A7

BORING NUMBER B-91-14

SHEET 3 OF 3

SOIL BORING LOG

PROJECT North City Water Reclamation Plant LOCATION North City, San Diego

ELEVATION 312 MSL DRILLING CONTRACTOR A&R Drilling

DRILLING METHOD AND EQUIPMENT 8-inch Hollow Stem Augers, CME 75 rotary drill rig

WATER LEVELS Not Encountered START 11/12/91 FINISH 11/12/91 LOGGER C. Polito

DEPTH BELOW SURFACE (FT)	SAMPLE			PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6"	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	60.0 60.8	13-C	1.0	40-50/3.5"	Same as 6-C (SCRIPPS FORMATION)	
65.0	65.0 65.8	14-C	0.9	30-50/4"	Same as 6-C (SCRIPPS FORMATION)	
70.0	70.0				END OF BORING = 70.0 FEET @ 1220	Large rock, hole terminated Entire clay layer (20-70') has intermittent 1 to 2 foot thick gravel layers
75.0						
80.0						
85.0						

CH2M HILL

PROJECT NUMBER LAO 32316.A7

BORING NUMBER B-91-15

SHEET 1 OF 1

SOIL BORING LOG

PROJECT North City Water Reclamation Plant

LOCATION North City, San Diego

ELEVATION 329 MSL

DRILLING CONTRACTOR A&R Drilling

DRILLING METHOD AND EQUIPMENT 8-inch Hollow Stem Augers, CME 75 rotary drill rig

WATER LEVELS Not Encountered

START 11/12/91

FINISH 11/12/91

LOGGER C. Polito

DEPTH BELOW SURFACE (FT)	SAMPLE			PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6"	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
						Start Drilling @ 1315
	5.0	1-G			CLAYEY SAND (SC) reddish brown, dry, loose, fine sand	
5.0	6.5	2-C	1.0	16-22-42 (64)	POORLY GRADED SAND (SP) orange, moist, very dense, fine sand, trace silt (SCRIPPS FORMATION)	
	10.0					
10.0	11.4	3-C	1.2	10-38 -50/4.5"	SANDY SILT (ML) gray, moist, hard, orange mottling of fine sand, almost 50/50 sand and silt (SCRIPPS FORMATION)	
	15.0					
15.0	16.0	4-C	1.0	16-50/5.5"	Same as 3C (SCRIPPS FORMATION)	
	20.0					
20.0	20.9	5-C	1.0	17-50/4.5"	SILT (ML) dark gray, dry to moist, hard, lenses of fine orange sand, micaceous (SCRIPPS FORMATION)	
	23.0					
					END OF BORING = 23.0 FEET @ 1420	Large rock, hole terminated
25.0						

CH2M HILL

PROJECT NUMBER	BORING NUMBER
LAO 32316.A7	B-91-16 SHEET 1 OF 2

SOIL BORING LOG

PROJECT North City Water Reclamation Plant LOCATION North City, San Diego

ELEVATION 335 MSL DRILLING CONTRACTOR A&R Drilling

DRILLING METHOD AND EQUIPMENT 8-inch Hollow Stem Augers, CME 75 rotary drill rig

WATER LEVELS Not Encountered START 11/12/91 FINISH 11/12/91 LOGGER C. Polito

DEPTH BELOW SURFACE (FT)	SAMPLE			PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6"	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
						Start Drilling @ 1455
	5.0	1-G			CLAYEY SAND (SC) reddish brown, dry, loose, fine sand	Gravel layer
5.0	6.4	2-C	1.4	17-39 -50/5"	SANDY SILT (ML) gray, moist, hard, orange mottling of fine sand, almost 50/50 sand and silt (SCRIPPS FORMATION)	
	10.0					
10.0	11.5	3-C	1.3	8-25 -50/6"	Same as 2C (SCRIPPS FORMATION)	
	15.0					
15.0	16.4	4-C	1.0	10-36 50/4.5"	Same as 2C (SCRIPPS FORMATION)	
	20.0					
20.0	20.9	5-C	0.5	24-50/5"	Same as 2C (SCRIPPS FORMATION)	No lab sample
	25.0					
25.0	25.9	6-C	0.9	46-50/5"	Same as 2C (SCRIPPS FORMATION)	
	30.0					

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
LAO 32316.A7	B-91-16	SHEET 2 OF 2

SOIL BORING LOG

PROJECT North City Water Reclamation Plant LOCATION North City, San Diego

ELEVATION 335 MSL DRILLING CONTRACTOR A&R Drilling

DRILLING METHOD AND EQUIPMENT 8-inch Hollow Stem Augers, CME 75 rotary drill rig

WATER LEVELS Not Encountered START 11/12/91 FINISH 11/12/91 LOGGER C. Polito

DEPTH BELOW SURFACE (FT)	SAMPLE			PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6"	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	30.0 30.8	7-C	1.0	28-50/3.5"	Same as 2C (SCRIPPS FORMATION)	
35.0	35.0 35.8	8-C	1.0	45-50/3"	Same as 2C (SCRIPPS FORMATION)	
	36.5				END OF BORING = 36.5 FEET @ 1555	
40.0						
45.0						
50.0						
55.0						

CH2M HILL

PROJECT NUMBER	BORING NUMBER
LAO 32316.A7	B-91-17 SHEET 1 OF 2

SOIL BORING LOG

PROJECT North City Water Reclamation Plant LOCATION North City, San Diego
ELEVATION 371 MSL DRILLING CONTRACTOR A&R Drilling
DRILLING METHOD AND EQUIPMENT 8-inch Hollow Stem Augers, CME 75 rotary drill rig
WATER LEVELS Not Encountered START 11/12/91 FINISH 11/12/91 LOGGER C. Polito

DEPTH BELOW SURFACE (FT)	SAMPLE			PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6"	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
						Start Drilling @ 1630
		1-G			CLAYEY SAND (SC) dark brown, dry, loose, fine sand	
5.0	5.0 6.0	2-C	1.0	22-50/6"	SANDY SILT (ML) gray to light brown, moist, hard, orange mottling of fine sand (SCRIPPS FORMATION)	
10.0	10.0 11.3	3-C	1.2	12-44 -50/4"	Same as 2C (SCRIPPS FORMATION)	
15.0						
						Gravel layer, 17 to 19'
20.0	20.0 20.9	4-C	0.8	22-50/4.5"	Same as 2C (SCRIPPS FORMATION)	
25.0						
	30.0					

CH2M HILL

PROJECT NUMBER	BORING NUMBER
LAO 32316.A7	B-91-17 SHEET 2 OF 2

SOIL BORING LOG

PROJECT North City Water Reclamation Plant LOCATION North City, San Diego
ELEVATION 371 MSL DRILLING CONTRACTOR A&R Drilling
DRILLING METHOD AND EQUIPMENT 8-inch Hollow Stem Augers, CME 75 rotary drill rig
WATER LEVELS Not Encountered START 11/12/91 FINISH 11/12/91 LOGGER C. Polito

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	PENETRATION TEST RESULTS 6"-6"-6"	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	30.0 30.9	5-C	1.1	29-50/4.5"	ELASTIC SILT (MH) gray, moist, hard, orange mottling of fine sand (SCRIPPS FORMATION)	
						1' gravel lens
35.0						
40.0	40.0 40.9	6-C	1.0	27-50/5"	Same as 5C (SCRIPPS FORMATION)	
	41.5				END OF BORING = 41.5 FEET @ 1740	
45.0						
50.0						
55.0						

PROJECT NUMBER	BORING NUMBER
LAO 32316.A7	B-91-18 SHEET 1 OF 2

SOIL BORING LOG

PROJECT North City Water Reclamation Plant LOCATION North City, San Diego

ELEVATION 368 MSL DRILLING CONTRACTOR A&R Drilling

DRILLING METHOD AND EQUIPMENT 8-inch Hollow Stem Augers, CME 75 rotary drill rig

WATER LEVELS Not Encountered START 11/13/91 FINISH 11/13/91 LOGGER C. Polito

DEPTH BELOW SURFACE (FT)	SAMPLE			PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6"	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE-DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
						Start Drilling @ 0800
		1-G			CLAYEY SAND WITH GRAVEL (SC) reddish brown, dry, loose, fine sand, gravel to 1/2"	Gravels and cobbles
5.0	5.0 5.8	2-C	0.7	18-50/2.5"	SILTY SAND WITH GRAVEL (SM) reddish brown, moist, very dense, fine sand, gravel to 1/2" (LINDAVISTA FORMATION)	
10.0	10.0 11.4	3-C	1.2	20-38 -50/5"	POORLY GRADED SAND (SP) yellow, moist, very dense, uniform fine sand (LINDAVISTA FORMATION)	
15.0	15.0 16.3	4-C	1.0	8-40 -50/2.5"	Same as 3-C (LINDAVISTA FORMATION)	
20.0	20.0 20.6	5-C	0.4	35-50/1"	Same as 3-C, except with gravel to 1/2" (LINDAVISTA FORMATION)	No lab sample
25.0	25.0 25.5	6-C	0.4	50/6"	POORLY GRADED SAND, with some silt, orange mottling, moist, very dense (SCRIPPS FORMATION)	No lab sample
	30.0					

CH2M HILL

PROJECT NUMBER LAO 32316.A7
BORING NUMBER B-91-18
SHEET 2 OF 2

SOIL BORING LOG

PROJECT North City Water Reclamation Plant LOCATION North City, San Diego
ELEVATION 368 MSL DRILLING CONTRACTOR A&R Drilling
DRILLING METHOD AND EQUIPMENT 8-inch Hollow Stem Augers, CME 75 rotary drill rig
WATER LEVELS Not Encountered START 11/13/91 FINISH 11/13/91 LOGGER C. Polito

DEPTH BELOW SURFACE (FT)	SAMPLE			PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6"	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	30.0 30.8	7-C	0.8	19-50/3.5"	Same as 6-C, very fine sand (SCRIPPS FORMATION)	
35.0	35.0 35.4	8-C	0.6	50/5"	SANDY SILT (ML) gray, moist, hard, orange mottling of fine sand (SCRIPPS FORMATION)	
40.0	40.0 40.8	9-C	1.0	46-50/6"	Same as 8-C (SCRIPPS FORMATION)	
45.0	45.0 45.8	10-C	0.8	38-50/3"	Sample same as 8-C Shoe - POORLY GRADED SAND (SP) reddish brown, moist, very dense, fine sand (SCRIPPS FORMATION)	
50.0	50.0 50.7 51.5	11-C		39-50/2"	Same as 8-C (SCRIPPS FORMATION)	
					END OF BORING = 51.5 FEET @ 0940	
55.0						

CH2M HILL

PROJECT NUMBER	BORING NUMBER
LAO 32316.A7	B-91-19 SHEET 1 OF 2

SOIL BORING LOG

PROJECT North City Water Reclamation Plant LOCATION North City, San Diego

ELEVATION 371 MSL DRILLING CONTRACTOR A&R Drilling

DRILLING METHOD AND EQUIPMENT 8-inch Hollow Stem Augers, CME 75 rotary drill rig

WATER LEVELS Not Encountered START 11/13/91 FINISH 11/13/91 LOGGER C. Polito

DEPTH BELOW SURFACE (FT)	SAMPLE			PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6"	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
						Start Drilling @ 1030
		1-G			CLAYEY SAND WITH GRAVEL (SC) reddish brown, dry, loose, fine sand, gravel to 1"	Gravels and cobbles
5.0	5.0 5.6	2-C	0.0	38-50/1"	No recovery	Large rock No lab sample
10.0	10.0 10.4	3-C	0.0	50/5"	No recovery	No lab sample
15.0	15.0 15.9	4-C	1.0	39-50/4.5"	SANDY SILT (ML) gray, moist, hard, orange mottling of fine sand (SCRIPPS FORMATION)	
20.0	20.0 21.4	5-C	1.4	13-34 50/5"	Same as 4-C, except some black mottling (SCRIPPS FORMATION)	
25.0	25.0 25.8	6-C	0.8	20-50/4"	Same as 4-C (SCRIPPS FORMATION)	
	30.0					

PROJECT NUMBER	BORING NUMBER
LAO 32316.A7	B-91-19

SHEET 2 OF 2

SOIL BORING LOG

PROJECT North City Water Reclamation Plant LOCATION North City, San Diego
ELEVATION 371 MSL DRILLING CONTRACTOR A&R Drilling
DRILLING METHOD AND EQUIPMENT 8-inch Hollow Stem Augers, CME 75 rotary drill rig
WATER LEVELS Not Encountered START 11/13/91 FINISH 11/13/91 LOGGER C. Polito

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	PENETRATION TEST RESULTS 6"-6"-6"	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	30.0 30.9	7-C	0.8	14-50/4.5"	Same as 4-C (SCRIPPS FORMATION)	
35.0	35.0 35.5	8-C	0.7	50/5.5"	Same as 4-C (SCRIPPS FORMATION)	
40.0	40.0 40.5	9-C	0.8	50/5.5"	Same as 4-C (SCRIPPS FORMATION)	
45.0	45.0 45.9	10-C	0.8	13-50/4.5"	Same as 4-C (SCRIPPS FORMATION)	
50.0	50.0 50.9	11-C	1.1	27-50/5"	Same as 4-C (SCRIPPS FORMATION)	
	51.5				END OF BORING = 51.5 FEET @ 1230	
55.0						

Appendix B
Test Pit Logs

CH2M HILL

PROJECT NUMBER LA032316.A7	TEST PIT NUMBER TP-91-01	SHEET 1 OF 1

TEST PIT LOG

PROJECT North City Water Reclamation Plant LOCATION 90 feet east of B-91-17 LOGGER C. Polito

ELEVATION 367 MSL CONTRACTOR Merriott Excavator Rental, Valley Center, CA

EXCAVATION EQUIPMENT 909 LCII Kobleco excavator w/24-in bucket DATE EXCAVATED 11/14/91

WATER LEVEL AND DATE Not encountered APPROX. DIMENSIONS: Length 20 ft Width 2 ft Max Depth 12 ft

DEPTH BELOW SURFACE (FT)	SAMPLE		SOIL DESCRIPTION	COMMENTS
	INTERVAL	NUMBER AND TYPE	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DIFFICULTY IN EXCAVATION, RUNNING GRAVEL CONDITION, COLLAPSE OF WALLS, SAND HEAVE DEBRIS ENCOUNTERED, WATER SEEPAGE GRADATIONAL CONTACTS, TESTS, INSTRUMENTATION
	1.0 2.0	1-B	CLAYEY SAND (SC) brown, dry, dense, broke into 6" chunks (SCRIPPS FORMATION)	No evidence of gravel or cobbles in top 12'
			SANDY LEAN CLAY, (CL) gray, moist, hard, orange mottling of fine sand, broke into plates @ 6"x4"x2", orange seams appear predominately horizontal in trench walls (SCRIPPS FORMATION)	
5	5.0 6.0	2-B		
10	12.0			
			END TEST PIT @ 12 FEET	
15				
20				
25				

CH2M HILL

PROJECT NUMBER	TEST PIT NUMBER
LA032316.A7	TP-91-02 SHEET 1 OF 1

TEST PIT LOG

PROJECT North City Water Reclamation Plant LOCATION 140 feet south of B-91-17 LOGGER C. Polito

ELEVATION 363 MSL CONTRACTOR Merriott Excavator Rental, Valley Center, CA

EXCAVATION EQUIPMENT 909 LCII Kobleco excavator w/24-in bucket DATE EXCAVATED 11/14/91

WATER LEVEL AND DATE Not encountered APPROX. DIMENSIONS: Length 10 ft Width 2 ft Max Depth 4 ft

DEPTH BELOW SURFACE (FT)	SAMPLE		SOIL DESCRIPTION	COMMENTS
	INTERVAL	NUMBER AND TYPE	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DIFFICULTY IN EXCAVATION, RUNNING GRAVEL CONDITION, COLLAPSE OF WALLS, SAND HEAVE DEBRIS ENCOUNTERED, WATER SEEPAGE GRADATIONAL CONTACTS, TESTS, INSTRUMENTATION
	2.0		CLAYEY SAND WITH GRAVEL (SC) brown, dry, dense, 10% 1.5" to 2" gravel	qu > 4.5 TSF (pocket penetrometer)
	4.0		SANDY SILT, (ML) gray, moist, hard, orange mottling of fine sand (SCRIPPS FORMATION)	
			END TEST PIT @ 4 FEET	
5				
10				
15				
20				
25				

CH2M HILL

PROJECT NUMBER	TEST PIT NUMBER
LA032316.A7	TP-91-03 SHEET 1 OF 1

TEST PIT LOG

PROJECT North City Water Reclamation Plant LOCATION 110 feet northwest of B-91-16 LOGGER C. Polito

ELEVATION 343 MSL CONTRACTOR Merriott Excavator Rental, Valley Center, CA

EXCAVATION EQUIPMENT 909 LCII Kobleco excavator w/24-in bucket DATE EXCAVATED 11/14/91

WATER LEVEL AND DATE Not encountered APPROX. DIMENSIONS: Length 12 ft Width 2 ft Max Depth 4 ft

DEPTH BELOW SURFACE (FT)	SAMPLE		SOIL DESCRIPTION	COMMENTS
	INTERVAL	NUMBER AND TYPE	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DIFFICULTY IN EXCAVATION, RUNNING GRAVEL CONDITION, COLLAPSE OF WALLS, SAND HEAVE DEBRIS ENCOUNTERED, WATER SEEPAGE GRADATIONAL CONTACTS, TESTS, INSTRUMENTATION
	1.75		CLAYEY SAND WITH GRAVEL (SC) brown, dry, dense, 10% 1.5" to 2" gravel	Contact varies from 1.5 to 2.0 feet
	4.0		SANDY SILT, (ML) gray, moist, hard, orange mottling of fine sand (SCRIPPS FORMATION)	qu > 4.5 TSF (pocket penetrometer)
5			END TEST PIT @ 4 FEET	
10				
15				
20				
25				

CH2M HILL

PROJECT NUMBER
LA032316.A7

TEST PIT NUMBER
TP-91-04 SHEET 1 OF 1

TEST PIT LOG

PROJECT North City Water Reclamation Plant LOCATION 50 feet west of B-91-16 LOGGER C. Polito

ELEVATION 338 MSL CONTRACTOR Merriott Excavator Rental, Valley Center, CA

EXCAVATION EQUIPMENT 909 LCII Kobleco excavator w/24-in bucket DATE EXCAVATED 11/14/91

WATER LEVEL AND DATE Not encountered APPROX. DIMENSIONS: Length 12 ft Width 2 ft Max Depth 4 ft

DEPTH BELOW SURFACE (FT)	SAMPLE		SOIL DESCRIPTION	COMMENTS
	INTERVAL	NUMBER AND TYPE	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DIFFICULTY IN EXCAVATION, RUNNING GRAVEL CONDITION, COLLAPSE OF WALLS, SAND HEAVE DEBRIS ENCOUNTERED, WATER SEEPAGE GRADATIONAL CONTACTS, TESTS, INSTRUMENTATION
	1.75		CLAYEY SAND (SC) brown, dry, hard	No gravel
	4.0		SANDY SILT, (ML) gray, moist, hard, orange mottling of fine sand (SCRIPPS FORMATION)	Contact varies from 1.5 to 2.0 feet
			END TEST PIT @ 4 FEET	
5				
10				
15				
20				
25				

PROJECT NUMBER LA032316.A7	TEST PIT NUMBER TP-91-05 SHEET 1 OF 1

TEST PIT LOG

PROJECT North City Water Reclamation Plant LOCATION 100 feet southwest of B-91-15 LOGGER C. Polito

ELEVATION 315 MSL CONTRACTOR Merriott Excavator Rental, Valley Center, CA

EXCAVATION EQUIPMENT 909 LCII Kobleco excavator w/24-in bucket DATE EXCAVATED 11/14/91

WATER LEVEL AND DATE Not encountered APPROX. DIMENSIONS: Length 10 ft Width 2 ft Max Depth 12 ft

DEPTH BELOW SURFACE (FT)	SAMPLE		SOIL DESCRIPTION	COMMENTS
	INTERVAL	NUMBER AND TYPE	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DIFFICULTY IN EXCAVATION, RUNNING GRAVEL CONDITION, COLLAPSE OF WALLS, SAND HEAVE DEBRIS ENCOUNTERED, WATER SEEPAGE GRADATIONAL CONTACTS, TESTS, INSTRUMENTATION
	3.0	1-B	CLAYEY SAND (SC) brown, moist, loose, fine sand	
5	5.0		1/16 to 1/8" layers of SANDY LEAN CLAY, (CL) gray, moist, hard and POORLY GRADED SAND (SP) orange, moist, dense, fine sand (SCRIPPS FORMATION)	Bedding slopes approximately 30 degrees towards the south (parallel to the slope) Distinct 1" to 2" thick bedding in top 3' of layer Some nearly vertical fracturing
10	12.0	2-B		
			END TEST PIT @ 12 FEET	
15				
20				
25				

CH2M HILL

PROJECT NUMBER LA032316.A7

TEST PIT NUMBER TP-91-06 SHEET 1 OF 1

TEST PIT LOG

PROJECT North City Water Reclamation Plant LOCATION 70 feet southeast of TP-91-5 LOGGER C. Polito

ELEVATION 297 MSL CONTRACTOR Merriott Excavator Rental, Valley Center, CA

EXCAVATION EQUIPMENT 909 LCII Kobleco excavator w/24-in bucket DATE EXCAVATED 11/14/91

WATER LEVEL AND DATE Not encountered APPROX. DIMENSIONS: Length 12 ft Width 2 ft Max Depth 12 ft

DEPTH BELOW SURFACE (FT)	SAMPLE		SOIL DESCRIPTION	COMMENTS
	INTERVAL	NUMBER AND TYPE	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DIFFICULTY IN EXCAVATION, RUNNING GRAVEL CONDITION, COLLAPSE OF WALLS, SAND HEAVE DEBRIS ENCOUNTERED, WATER SEEPAGE GRADATIONAL CONTACTS, TESTS, INSTRUMENTATION
	1.0 2.0	1-B	SANDY LEAN CLAY WITH GRAVEL (SC) dark brown, dry, loose, very fine sand, layers of clean medium sand, gravel to 3" 5 to 10%	
	3.5			Contact varies between 3 and 4 foot
5	5.0 6.0	2-B	SANDY LEAN CLAY, (CL) gray, moist, hard, orange mottling of fine sand, no distinct layering, bedding or fracturing (SCRIPPS FORMATION)	Single 3'x 2'x 1' rock
10	12.0		Strength increases with depth, breaks into larger chunks when excavated	Single 8"x 6"x 4" rock
			END TEST PIT @ 12 FEET	
15				
20				
25				

PROJECT NUMBER	TEST PIT NUMBER
LA032316.A7	TP-91-07 SHEET 1 OF 1

TEST PIT LOG

PROJECT North City Water Reclamation Plant
LOCATION 100 feet up draw from B-91-12
LOGGER C. Polito
ELEVATION 334 MSL
CONTRACTOR Merriott Excavator Rental, Valley Center, CA
EXCAVATION EQUIPMENT 909 LCII Kobleco excavator w/24-in bucket
DATE EXCAVATED 11/14/91
WATER LEVEL AND DATE Not encountered
APPROX. DIMENSIONS: Length 12 ft Width 2 ft Max Depth 12 ft

DEPTH BELOW SURFACE (FT)	SAMPLE		SOIL DESCRIPTION	COMMENTS
	INTERVAL	NUMBER AND TYPE	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DIFFICULTY IN EXCAVATION, RUNNING GRAVEL CONDITION, COLLAPSE OF WALLS, SAND HEAVE DEBRIS ENCOUNTERED, WATER SEEPAGE GRADATIONAL CONTACTS, TESTS, INSTRUMENTATION
	3.0		SANDY LEAN CLAY WITH GRAVEL (SC) dark brown, dry, loose, very fine sand, 30% gravel to 3"	
5	6.0		POORLY GRADED SAND WITH GRAVEL (SP) orange, moist, medium, fine uniform sand, 25% gravel and cobble to 6"	
10	12.0		SANDY SILT (ML) gray, moist, hard, orange mottling of fine sand (SCRIPPS FORMATION)	
15			END TEST PIT @ 12 FEET	
20				
25				

CH2M HILL

PROJECT NUMBER	TEST PIT NUMBER
LA032316.A7	TP-91-08 SHEET 1 OF 1

TEST PIT LOG

PROJECT North City Water Reclamation Plant LOCATION Halfway between B-91-12 and B-91-13 LOGGER C. Polito

ELEVATION 319 MSL CONTRACTOR Merriott Excavator Rental, Valley Center, CA

EXCAVATION EQUIPMENT 909 LCII Kobleco excavator w/24-in bucket DATE EXCAVATED 11/14/91

WATER LEVEL AND DATE Not encountered APPROX. DIMENSIONS: Length 12 ft Width 2 ft Max Depth 6 ft

DEPTH BELOW SURFACE (FT)	SAMPLE		SOIL DESCRIPTION	COMMENTS
	INTERVAL	NUMBER AND TYPE	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DIFFICULTY IN EXCAVATION, RUNNING GRAVEL CONDITION, COLLAPSE OF WALLS, SAND HEAVE DEBRIS ENCOUNTERED, WATER SEEPAGE GRADATIONAL CONTACTS, TESTS, INSTRUMENTATION
	1.0			
	2.0	1-B	SANDY LEAN CLAY WITH GRAVEL (SC) dark brown, dry, loose, very fine sand, 30% gravel to 3"	
	3.0			
5	5.0		POORLY GRADED SAND WITH GRAVEL (SP) orange, moist, medium, fine uniform sand, 25% gravel and cobble to 6"	
	6.0		SANDY SILT (ML) gray, moist, hard, orange mottling of fine sand (SCRIPPS FORMATION)	
			END TEST PIT @ 6 FEET	
10				
15				
20				
25				

CH2M HILL

PROJECT NUMBER LA032316.A7

TEST PIT NUMBER TP-91-09 SHEET 1 OF 1

TEST PIT LOG

PROJECT North City Water Reclamation Plant LOCATION 30 feet up draw from B-91-12 LOGGER C. Polito

ELEVATION 313 MSL CONTRACTOR Merriott Excavator Rental, Valley Center, CA

EXCAVATION EQUIPMENT 909 LCII Kobleco excavator w/24-in bucket DATE EXCAVATED 11/14/91

WATER LEVEL AND DATE Not encountered APPROX. DIMENSIONS: Length 12 ft Width 2 ft Max Depth 7 ft

DEPTH BELOW SURFACE (FT)	SAMPLE		SOIL DESCRIPTION	COMMENTS
	INTERVAL	NUMBER AND TYPE	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DIFFICULTY IN EXCAVATION, RUNNING GRAVEL CONDITION, COLLAPSE OF WALLS, SAND HEAVE DEBRIS ENCOUNTERED, WATER SEEPAGE GRADATIONAL CONTACTS, TESTS, INSTRUMENTATION
	4.0		SANDY LEAN CLAY WITH GRAVEL (SC) dark brown, dry, loose, very fine sand, 20% gravel to 3"	
5	5.0		SANDY LEAN CLAY, (CL) gray, moist, hard, orange mottling of fine sand, highly weathered (SCRIPPS FORMATION)	
	7.0		SANDY SILT (ML) gray, moist, hard, orange mottling of fine sand (SCRIPPS FORMATION)	
			END TEST PIT @ 7 FEET	
10				
15				
20				
25				

CH2M HILL

PROJECT NUMBER	TEST PIT NUMBER
LA032316.A7	TP-91-10 SHEET 1 OF 1

TEST PIT LOG

PROJECT North City Water Reclamation Plant LOCATION 50' north of TP-91-6 LOGGER C. Polito
ELEVATION 313 MSL CONTRACTOR Merriott Excavator Rental, Valley Center, CA
EXCAVATION EQUIPMENT 909 LCII Kobleco excavator w/24-in bucket DATE EXCAVATED 11/14/91
WATER LEVEL AND DATE Not encountered APPROX. DIMENSIONS: Length 20 ft Width 2 ft Max Depth 10 ft

DEPTH BELOW SURFACE (FT)	SAMPLE		SOIL DESCRIPTION	COMMENTS
	INTERVAL	NUMBER AND TYPE	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DIFFICULTY IN EXCAVATION, RUNNING GRAVEL CONDITION, COLLAPSE OF WALLS, SAND HEAVE DEBRIS ENCOUNTERED, WATER SEEPAGE GRADATIONAL CONTACTS, TESTS, INSTRUMENTATION
	2.5		SANDY FAT CLAY (CH) dark brown, moist, hard, very fine sand	Large shrinkage cracks in top 2'
5	6.0		SANDY LEAN CLAY, (CL) gray, moist, hard, orange mottling of fine sand, broke into cubes @ 6"x6"x6" (SCRIPPS FORMATION)	
10	10.0		SANDY LEAN CLAY, (CL) gray, moist, hard (SCRIPPS FORMATION)	
			END TEST PIT @ 10 FEET	
15				
20				
25				

CH2M HILL

PROJECT NUMBER LA032316.A7

TEST PIT NUMBER TP-91-11 SHEET 1 OF 1

TEST PIT LOG

PROJECT North City Water Reclamation Plant LOCATION Base of slope below B-91-16 LOGGER C. Polito

ELEVATION 309 MSL CONTRACTOR Merriott Excavator Rental, Valley Center, CA

EXCAVATION EQUIPMENT 909 LCII Kobleco excavator w/24-in bucket DATE EXCAVATED 11/14/91

WATER LEVEL AND DATE Not encountered APPROX. DIMENSIONS: Length 20 ft Width 2 ft Max Depth 6 ft

DEPTH BELOW SURFACE (FT)	SAMPLE		SOIL DESCRIPTION	COMMENTS
	INTERVAL	NUMBER AND TYPE	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DIFFICULTY IN EXCAVATION, RUNNING GRAVEL CONDITION, COLLAPSE OF WALLS, SAND HEAVE DEBRIS ENCOUNTERED, WATER SEEPAGE GRADATIONAL CONTACTS, TESTS, INSTRUMENTATION
	2.0		SANDY LEAN CLAY (CL) dark brown, dry, very fine sand	
	4.0		SANDY LEAN CLAY, (CL) reddish brown, moist, medium, fine sand	
5	4.5 6.0		POORLY GRADED SAND (SP) orange, moist, loose, uniform fine sand (SCRIPPS FORMATION)	
			SANDY LEAN CLAY, (CL) gray, moist, hard, mottling of fine orange sand (SCRIPPS FORMATION)	
			END TEST PIT @ 6 FEET	
10				
15				
20				
25				

CH2M HILL

PROJECT NUMBER	TEST PIT NUMBER
LA032316.A7	TP-91-12 SHEET 1 OF 1

TEST PIT LOG

PROJECT North City Water Reclamation Plant LOCATION 100' east of B-91-19 LOGGER C. Polito

ELEVATION 376 MSL CONTRACTOR Merriott Excavator Rental, Valley Center, CA

EXCAVATION EQUIPMENT 909 LCII Kobleco excavator w/24-in bucket DATE EXCAVATED 11/14/91

WATER LEVEL AND DATE Not encountered APPROX. DIMENSIONS: Length 20 ft Width 2 ft Max Depth 12 ft

DEPTH BELOW SURFACE (FT)	SAMPLE		SOIL DESCRIPTION	COMMENTS
	INTERVAL	NUMBER AND TYPE	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DIFFICULTY IN EXCAVATION, RUNNING GRAVEL CONDITION, COLLAPSE OF WALLS, SAND HEAVE DEBRIS ENCOUNTERED, WATER SEEPAGE GRADATIONAL CONTACTS, TESTS, INSTRUMENTATION
5	6.0	1-B	CLAYEY SAND WITH GRAVEL (SC) reddish brown, dry, dense, fine sand, highly cemented, 40 % gravel to 3"	Hard to break surface
10	12.0	2-B	POORLY GRADED SAND WITH GRAVEL (SP) orange, moist, dense, uniform fine sand, 30% gravel to 4", cobbles to 1' (LINDAVISTA FORMATION)	
15 20 25			END TEST PIT @ 12 FEET	

CH2M HILL

PROJECT NUMBER	TEST PIT NUMBER
LA032316.A7	TP-91-13 SHEET 1 OF 1

TEST PIT LOG

PROJECT North City Water Reclamation Plant LOCATION 100' north of B-91-13 LOGGER C. Polito
ELEVATION 375 MSL CONTRACTOR Merriott Excavator Rental, Valley Center, CA
EXCAVATION EQUIPMENT 909 LCII Kobleco excavator w/24-in bucket DATE EXCAVATED 11/14/91
WATER LEVEL AND DATE Not encountered APPROX. DIMENSIONS: Length 20 ft Width 2 ft Max Depth 11 ft

DEPTH BELOW SURFACE (FT)	SAMPLE		SOIL DESCRIPTION	COMMENTS
	INTERVAL	NUMBER AND TYPE	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DIFFICULTY IN EXCAVATION, RUNNING GRAVEL CONDITION, COLLAPSE OF WALLS, SAND HEAVE DEBRIS ENCOUNTERED, WATER SEEPAGE GRADATIONAL CONTACTS, TESTS, INSTRUMENTATION
	2.0		CLAYEY SAND WITH GRAVEL (SC) dark brown, dry, loose, fine sand, 30% gravel and cobbles to 6"	
5	6.0		POORLY GRADED SAND WITH GRAVEL (SP) orange, moist, dense, uniform fine sand, 30% gravel to 4" (LINDAVISTA FORMATION)	
10	11.0		POORLY GRADED SAND (SP) yellow, moist, dense, uniform fine sand (LINDAVISTA FORMATION)	
15 20 25			END TEST PIT @ 11 FEET	

CH2M HILL

PROJECT NUMBER	TEST PIT NUMBER
LA032316.A7	TP-91-14 SHEET 1 OF 1

TEST PIT LOG

PROJECT North City Water Reclamation Plant LOCATION 100' north of B-91-12 LOGGER C. Polito

ELEVATION 379 MSL CONTRACTOR Merriott Excavator Rental, Valley Center, CA

EXCAVATION EQUIPMENT 909 LCII Kobleco excavator w/24-in bucket DATE EXCAVATED 11/14/91

WATER LEVEL AND DATE Not encountered APPROX. DIMENSIONS: Length 20 ft Width 2 ft Max Depth 12 ft

DEPTH BELOW SURFACE (FT)	SAMPLE		SOIL DESCRIPTION	COMMENTS
	INTERVAL	NUMBER AND TYPE	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DIFFICULTY IN EXCAVATION, RUNNING GRAVEL CONDITION, COLLAPSE OF WALLS, SAND HEAVE DEBRIS ENCOUNTERED, WATER SEEPAGE GRADATIONAL CONTACTS, TESTS, INSTRUMENTATION
	1.0		CLAYEY SAND WITH GRAVEL (SC) reddish brown, dry, loose, fine sand, 10% gravel	
	3.0		CLAYEY SAND (SC) reddish brown, dry, dense, fine sand	
5	5.0		POORLY GRADED SAND (SP) orange to yellow, moist, dense, uniform fine sand, highly cemented zones, breaks into 1" thick plates (LINDAVISTA FORMATION)	
10	11.0		POORLY GRADED SAND WITH GRAVEL (SP) orange and yellow, moist, fine sand, gravel to 4", occasional cobble to 1' (LINDAVISTA FORMATION)	
	12.0		POORLY GRADED SAND WITH GRAVEL (SP) orange, moist, fine sand, 30% 1" gravel (LINDAVISTA FORMATION)	
			END TEST PIT @ 12 FEET	
15				
20				
25				

CH2M HILL

PROJECT NUMBER LA032316.A7	TEST PIT NUMBER TP-91-15 SHEET 1 OF 1

TEST PIT LOG

PROJECT North City Water Reclamation Plant LOCATION 50' south of B-91-12 LOGGER C. Polito

ELEVATION 358 MSL CONTRACTOR Merriott Excavator Rental, Valley Center, CA

EXCAVATION EQUIPMENT 909 LCII Kobleco excavator w/24-in bucket DATE EXCAVATED 11/15/91

WATER LEVEL AND DATE Not encountered APPROX. DIMENSIONS: Length 20 ft Width 2 ft Max Depth 10 ft

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE NUMBER AND TYPE	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS DIFFICULTY IN EXCAVATION, RUNNING GRAVEL CONDITION, COLLAPSE OF WALLS, SAND HEAVE DEBRIS ENCOUNTERED, WATER SEEPAGE GRADATIONAL CONTACTS, TESTS, INSTRUMENTATION
	2.0		CLAYEY SAND WITH GRAVEL (SC) dark brown, dry, medium dense, fine sand, 25% gravel to 3"	
	3.0	1-B	POORLY GRADED SAND WITH GRAVEL (SP) orange, moist, dense, uniform fine sand, 30% well graded (4" to 1/4") gravel (LINDAVISTA FORMATION)	
5				
	10.0			
10				
	11.0		SANDY LEAN CLAY (CL) gray, moist, hard, mottling of fine orange sand	
	12.0		POORLY GRADED SAND WITH GRAVEL (SP) yellow, moist, fine sand, 30% well graded gravel (LINDAVISTA FORMATION)	
			END TEST PIT @ 12 FEET	
15				
20				
25				

CH2M HILL

PROJECT NUMBER
LA032316.A7

TEST PIT NUMBER
TP-91-16 SHEET 1 OF 1

TEST PIT LOG

PROJECT North City Water Reclamation Plant LOCATION 150' south of B-91-2 LOGGER C. Polito

ELEVATION 357 MSL CONTRACTOR Merriott Excavator Rental, Valley Center, CA

EXCAVATION EQUIPMENT 909 LCII Kobleco excavator w/24-in bucket DATE EXCAVATED 11/14/91

WATER LEVEL AND DATE Not encountered APPROX. DIMENSIONS: Length 20 ft Width 2 ft Max Depth 12 ft

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE NUMBER AND TYPE	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS DIFFICULTY IN EXCAVATION, RUNNING GRAVEL CONDITION, COLLAPSE OF WALLS, SAND HEAVE DEBRIS ENCOUNTERED, WATER SEEPAGE GRADATIONAL CONTACTS, TESTS, INSTRUMENTATION
	2.0	1-B	LEAN CLAY WITH SAND (CL) dark brown, moist, hard, fine sand, 5% gravel to 1"	
5	5.0		POORLY GRADED SAND WITH GRAVEL (SP) orange, moist, dense, uniform fine sand, trace mica, 30% gravel to 4", cobbles to 6" (LINDAVISTA FORMATION)	
	7.0	2-B		
10	12.0			
			END TEST PIT @ 12 FEET	
15				
20				
25				

CH2M HILL

PROJECT NUMBER LA032316.A7

TEST PIT NUMBER TP-91-17 SHEET 1 OF 1

TEST PIT LOG

PROJECT North City Water Reclamation Plant
LOCATION 120' south of B-91-5
LOGGER C. Polito
ELEVATION 380 MSL
CONTRACTOR Merriott Excavator Rental, Valley Center, CA
EXCAVATION EQUIPMENT 909 LCII Kobleco excavator w/24-in bucket
DATE EXCAVATED 11/15/91
WATER LEVEL AND DATE Not encountered
APPROX. DIMENSIONS: Length 20 ft Width 2 ft Max Depth 10 ft

DEPTH BELOW SURFACE (FT)	SAMPLE		SOIL DESCRIPTION	COMMENTS
	INTERVAL	NUMBER AND TYPE	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DIFFICULTY IN EXCAVATION, RUNNING GRAVEL CONDITION, COLLAPSE OF WALLS, SAND HEAVE DEBRIS ENCOUNTERED, WATER SEEPAGE GRADATIONAL CONTACTS, TESTS, INSTRUMENTATION
	2.0		CLAYEY SAND (SC) reddish brown, dry, loose, very fine sand	
5	5.0	1-B	WELL GRADED SAND (SW) yellow, moist, dense, some highly cemented, occasional 1" gravel (LINDAVISTA FORMATION)	
	6.0		POORLY GRADED SAND (SP) orange to yellow, moist, dense, cemented, fine sand, trace mica, occasional gravel and cobbles to 8" (LINDAVISTA FORMATION)	
	8.0	2-B		
10	12.0			
15			END TEST PIT @ 12 FEET	
20				
25				

CH2M HILL

PROJECT NUMBER	TEST PIT NUMBER
LA032316.A7	TP-91-18 SHEET 1 OF 1

TEST PIT LOG

PROJECT North City Water Reclamation Plant LOCATION 150' southwest of B-91-9 LOGGER C. Polito
ELEVATION 382 MSL CONTRACTOR Merriott Excavator Rental, Valley Center, CA
EXCAVATION EQUIPMENT 909 LCII Kobleco excavator w/24-in bucket DATE EXCAVATED 11/15/91
WATER LEVEL AND DATE Not encountered APPROX. DIMENSIONS: Length 20 ft Width 2 ft Max Depth 10 ft

DEPTH BELOW SURFACE (FT)	SAMPLE		SOIL DESCRIPTION	COMMENTS
	INTERVAL	NUMBER AND TYPE	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DIFFICULTY IN EXCAVATION, RUNNING GRAVEL CONDITION, COLLAPSE OF WALLS, SAND HEAVE DEBRIS ENCOUNTERED, WATER SEEPAGE GRADATIONAL CONTACTS, TESTS, INSTRUMENTATION
	2.0	1-B	WELL GRADED GRAVEL WITH SILT AND SAND (GW-GM) reddish brown, dry, very hard, fine sand, 10% gravel to 2"	
	5.0		SANDY GRAVEL (GW-GM) gray, dry, very dense, highly cemented, sand well graded, gravel to 4" (LINDAVISTA FORMATION)	
5	6.0	2-B		
	8.0			
10	12.0		POORLY GRADED SAND (SP) orange to yellow, moist, dense, fine sand, micaceous, occasional 1" gravel (LINDAVISTA FORMATION)	
			END TEST PIT @ 12 FEET	
15				
20				
25				

PROJECT NUMBER	TEST PIT NUMBER
LA032316.A7	TP-91-19 SHEET 1 OF 1

TEST PIT LOG

PROJECT North City Water Reclamation Plant LOCATION 200' south of B-91-9 LOGGER C. Polito

ELEVATION 342 MSL CONTRACTOR Merriott Excavator Rental, Valley Center, CA

EXCAVATION EQUIPMENT 909 LCII Kobleco excavator w/24-in bucket DATE EXCAVATED 11/15/91

WATER LEVEL AND DATE Not encountered APPROX. DIMENSIONS: Length 20 ft Width 2 ft Max Depth 12 ft

DEPTH BELOW SURFACE (FT)	SAMPLE		SOIL DESCRIPTION	COMMENTS
	INTERVAL	NUMBER AND TYPE	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DIFFICULTY IN EXCAVATION, RUNNING GRAVEL CONDITION, COLLAPSE OF WALLS, SAND HEAVE DEBRIS ENCOUNTERED, WATER SEEPAGE GRADATIONAL CONTACTS, TESTS, INSTRUMENTATION
	2.0	1-B	<u>CLAYEY SAND WITH GRAVEL</u> (SC) dark brown, dry, very loose, fine sand, micaceous, 25% gravel to 4", chiefly 1"	
	3.0			
5	8.0		<u>CLAYEY SAND WITH GRAVEL</u> (SC) dark brown, dry, loose, fine sand, micaceous, 25% gravel to 4", chiefly 1"	
10	10.0	2-B	<u>POORLY GRADED SAND WITH GRAVEL</u> (SP) orange to yellow, moist, dense, mostly fine, some medium sand, 30% gravel 4" to 1/2" (LINDAVISTA FORMATION)	
	12.0			
15			END TEST PIT @ 12 FEET	
20				
25				

PROJECT NUMBER LA032316.A7

TEST PIT NUMBER TP-91-20 SHEET 1 OF 1

TEST PIT LOG

PROJECT North City Water Reclamation Plant LOCATION 120' northwest of B-91-7 LOGGER C. Polito

ELEVATION 377 MSL CONTRACTOR Merriott Excavator Rental, Valley Center, CA

EXCAVATION EQUIPMENT 909 LCII Kobleco excavator w/24-in bucket DATE EXCAVATED 11/15/91

WATER LEVEL AND DATE Not encountered APPROX. DIMENSIONS: Length 20 ft Width 2 ft Max Depth 12 ft

DEPTH BELOW SURFACE (FT)	SAMPLE		SOIL DESCRIPTION	COMMENTS
	INTERVAL	NUMBER AND TYPE	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DIFFICULTY IN EXCAVATION, RUNNING GRAVEL CONDITION, COLLAPSE OF WALLS, SAND HEAVE DEBRIS ENCOUNTERED, WATER SEEPAGE GRADATIONAL CONTACTS, TESTS, INSTRUMENTATION
	2.0		CLAYEY SAND (SC) dark brown, dry, medium, fine sand	
	3.0		POORLY GRADED SAND (SP) orange to yellow, moist, dense, fine sand	
5			POORLY GRADED SAND WITH GRAVEL (SP) orange to yellow, moist, dense, fine sand, 25-30% 1" gravel, some cobbles to 6" (LINDAVISTA FORMATION)	
10	12.0			
			END TEST PIT @ 12 FEET	
15				
20				
25				

CH2M HILL

PROJECT NUMBER	TEST PIT NUMBER
LA032316.A7	TP-21 SHEET 1 OF 1

TEST PIT LOG

PROJECT North City Water Reclamation Plant LOCATION 80 feet east of B-91-16 LOGGER C. Polito

ELEVATION 310 MSL CONTRACTOR Merriott Excavator Rental, Valley Center, CA

EXCAVATION EQUIPMENT 909 LCII Kobleco excavator w/24-in bucket DATE EXCAVATED 11/15/91

WATER LEVEL AND DATE Not encountered APPROX. DIMENSIONS: Length 12 ft Width 2 ft Max Depth 6 ft

DEPTH BELOW SURFACE (FT)	SAMPLE		SOIL DESCRIPTION	COMMENTS
	INTERVAL	NUMBER AND TYPE	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DIFFICULTY IN EXCAVATION, RUNNING GRAVEL CONDITION, COLLAPSE OF WALLS, SAND HEAVE DEBRIS ENCOUNTERED, WATER SEEPAGE GRADATIONAL CONTACTS, TESTS, INSTRUMENTATION
	4.0	1-B	<u>SANDY LEAN CLAY WITH GRAVEL</u> (CL) dark brown, dry to moist, loose, fine sand, 5 to 10 % gravel to 3"	
5	6.0	2-B	<u>SANDY LEAN CLAY</u>, (CL) gray, moist, hard, orange mottling of fine sand, no distinct layering, bedding or fracturing (SCRIPPS FORMATION)	
			END TEST PIT @ 6 FEET	
10				
15				
20				
25				

Appendix C
Laboratory Test Data

Table C-1
Atterberg Limits

Location	Depth (feet)	LL	PL	PI	Classification
B-3	25	45	30	15	ML
B-8	20	47	32	15	ML
B-13	15	39	28	11	ML
B-14	35	39	28	11	ML
B-16	15	50	34	16	ML
B-17	30	52	32	20	MH
TP-1	5	41	17	24	CL
TP-12	2	25	22	3	ML
TP-18	2	46	23	23	CL
TP-19	2	26	20	6	CL-ML
TP-21	2	33	16	17	CL
TP-1/TP-5	6	35	20	15	CL
TP-6/TP-21	6	40	22	18	CL

Table C-2 Percent Passing the No. 200 Sieve		
Location	**Depth (feet)**	**Percent Passing No. 200 Sieve**
B-3	25	36.8
B-4	35	89.2
B-13	20	40.1
B-16	5	95.2
B-16	25	95.5
B-16	35	72.6

Table C-3 Expansion Index Test			
Location	**Material**	**Expansion Index**	**Expansion Potential**
TP-1	Scripps Formation, ML	44	Low
TP-21	Alluvium, CL	60	Medium
TP-21	Scripps Formation, ML	28	Low

Table C-4 Modified Proctor Test (ASTM D 1557)			
Location	**Material**	**Maximum Dry Density (PCF)**	**Optimum Water Content (%)**
TP-1	ML	111.7	14.8
TP-6/TP-21	CL	111.9	15.7
TP-17	SM	119.6	12.2

Table C-5 Direct Shear Test					
Description	Soil Type	Location	Depth (feet)	Cohesion	Friction Angle
Native material	SM	B-8	25	390	34.0
Native material	ML-CL	B-13	20	945	37.4
Remolded native material	ML	TP-1	5	450	27.9
Remolded native material	ML	TP-6	6	950	29.1

Table C-6 Swell Pressure Test		
Location	Material	Swell Pressure (psf)
TP-1/TP-5	CL	850
TP-6/TP-21	CL	2,050

1-C

Ninyo & Moore

ATTERBERG LIMITS TEST DATA

TRS

PROJECT NAME CH2M Hill

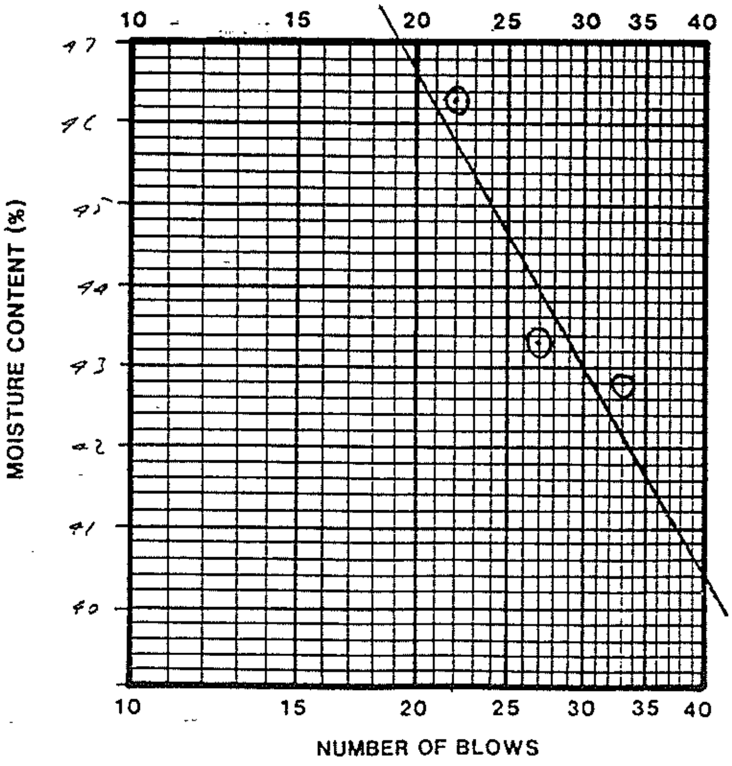
PROJECT NUMBER 102208-01

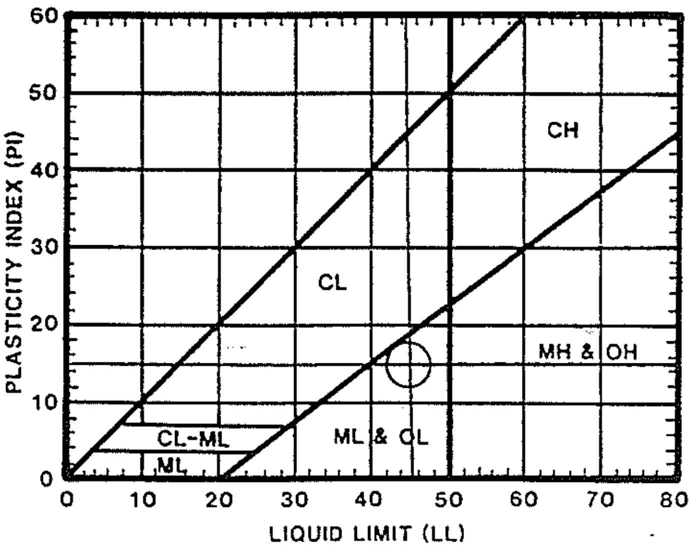
SAMPLE LOCATION B3 DEPTH 25' TECHNICIAN G.M. DATE 12-19-91

SYMBOL ⌖	LIQUID LIMIT			PLASTIC LIMIT		SUMMARY
CAN NO.	21	22	41	23	24	
WEIGHT OF WET SOIL + TARE	31.41	30.69	32.31	21.51	22.43	LL = 45
WEIGHT OF DRY SOIL + TARE	26.57	26.06	26.92	20.07	20.91	
WEIGHT OF WATER	4.84	4.63	5.39	1.44	1.52	PL = 30
TARE	15.38	15.25	15.28	15.22	15.80	
WEIGHT OF DRY SOIL	11.19	10.81	11.64	4.85	5.11	PI = 15
WATER CONTENT (%)	43.3	42.8	46.3	29.7	29.7	UNIFIED SOIL CLASSIFICATION
NO. OF BLOWS	27	33	22	—	—	ML

SAMPLE LOCATION DEPTH TECHNICIAN DATE

SYMBOL ⌖	LIQUID LIMIT			PLASTIC LIMIT		SUMMARY
CAN NO.						
WEIGHT OF WET SOIL + TARE						LL =
WEIGHT OF DRY SOIL + TARE						
WEIGHT OF WATER						PL =
TARE						
WEIGHT OF DRY SOIL						PI =
WATER CONTENT (%)						UNIFIED SOIL CLASSIFICATION
NO. OF BLOWS				—	—	





Ninyo & Moore

ATTERBERG LIMITS TEST DATA

DRS

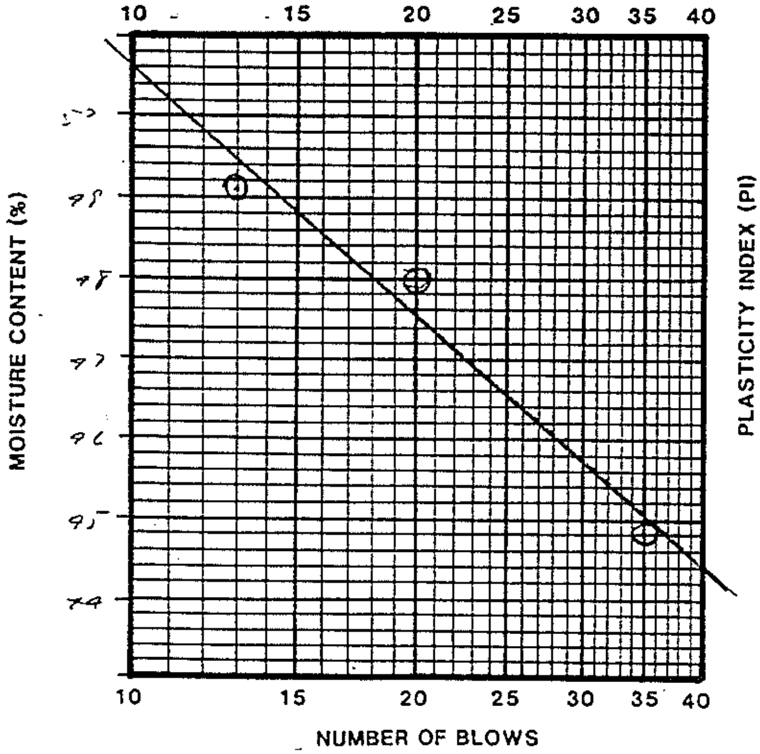
PROJECT NAME CH 2 M Hill PROJECT NUMBER 10 2208-01

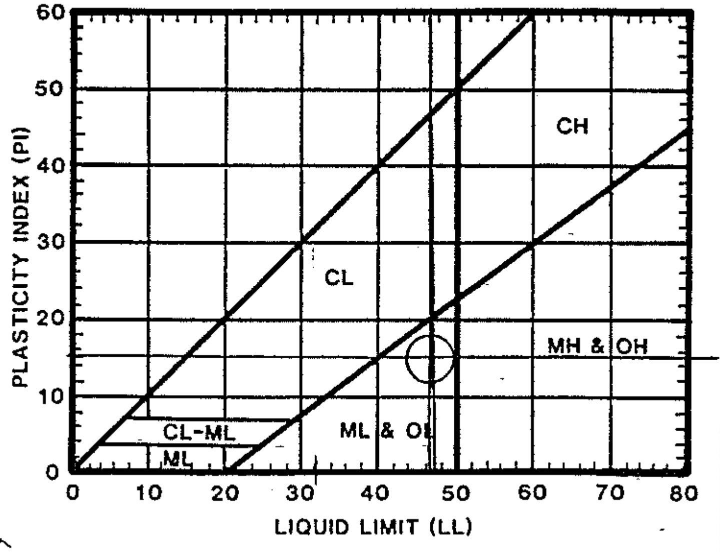
SAMPLE LOCATION B 8 DEPTH 20' TECHNICIAN G-M. DATE 12-19-91

SYMBOL ⌖	LIQUID LIMIT			PLASTIC LIMIT		SUMMARY
CAN NO.	19	20	34	33	18	
WEIGHT OF WET SOIL + TARE	30.38	30.83	33.30	22.92	22.37	LL = 47
WEIGHT OF DRY SOIL + TARE	25.48	25.66	27.87	21.12	20.53	
WEIGHT OF WATER	4.90	5.17	5.43	1.80	1.84	PL = 32
TARE	15.51	14.89	15.74	15.57	14.85	
WEIGHT OF DRY SOIL	9.97	10.77	12.13	5.55	5.68	PI = 15
WATER CONTENT (%)	49.1	48.0	44.8	32.4	32.4	UNIFIED SOIL CLASSIFICATION
NO. OF BLOWS	13	20	35	—	—	ML

SAMPLE LOCATION DEPTH TECHNICIAN DATE

SYMBOL ⌖	LIQUID LIMIT			PLASTIC LIMIT		SUMMARY
CAN NO.						
WEIGHT OF WET SOIL + TARE						LL =
WEIGHT OF DRY SOIL + TARE						
WEIGHT OF WATER						PL =
TARE						
WEIGHT OF DRY SOIL						PI =
WATER CONTENT (%)						UNIFIED SOIL CLASSIFICATION
NO. OF BLOWS				—	—	





Ninyo & Moore

ATTERBERG LIMITS TEST DATA

TRCS

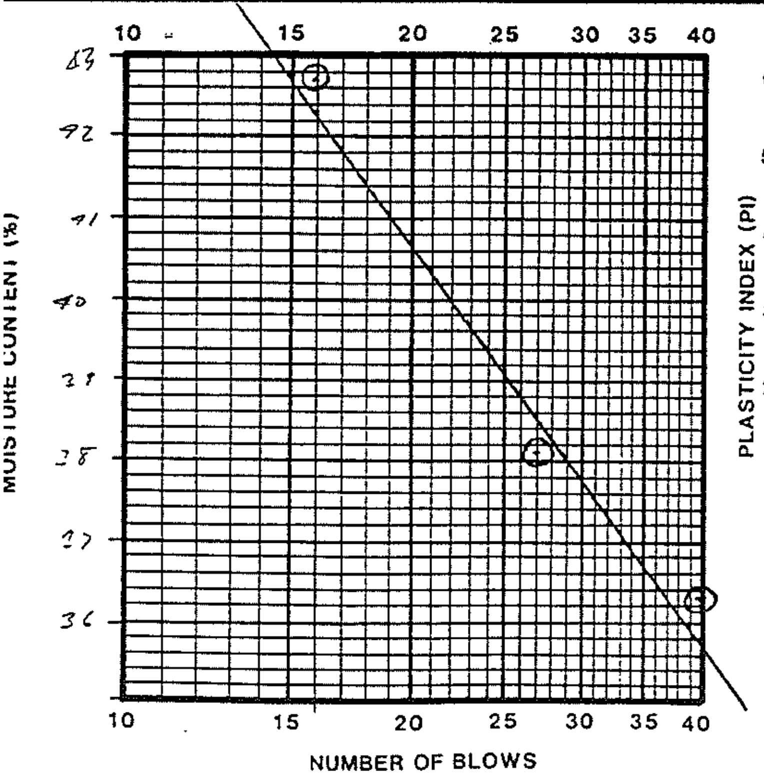
ROJECT NAME CH 2 M Hill PROJECT NUMBER 10 2208-01

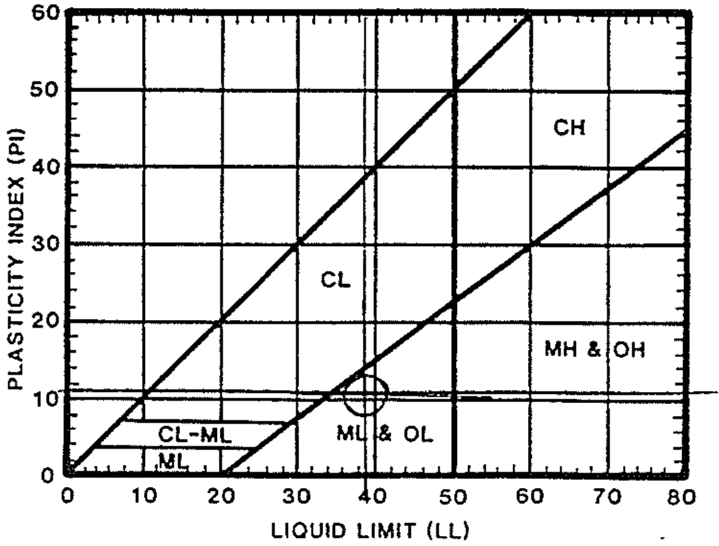
AMPLE LOCATION B 13 DEPTH 15' TECHNICIAN G. M. DATE 12-20-91

YMBOL ⊕	LIQUID LIMIT			PLASTIC LIMIT		SUMMARY
AN NO.	15	16	17	4	5	
VEIGHT OF WET SOIL+ TARE	32.69	33.47	33.57	25.51	27.39	LL = 39
VEIGHT OF DRY SOIL +TARE	27.98	28.73	28.08	22.74	24.66	
VEIGHT OF WATER	4.71	4.74	5.49	2.77	2.73	PL = 28
ARE	15.63	15.67	15.21	13.01	15.04	
VEIGHT OF DRY SOIL	12.35	13.06	12.87	9.73	9.62	PI = 11
VATER CONTENT (%)	38.1	36.3	42.7	28.5	28.4	UNIFIED SOIL CLASSIFICATION
IO. OF BLOWS	27	40	16	—	—	ML

AMPLE LOCATION DEPTH TECHNICIAN DATE

YMBOL ⊕	LIQUID LIMIT			PLASTIC LIMIT		SUMMARY
AN NO.						
VEIGHT OF WET SOIL+ TARE						LL =
VEIGHT OF DRY SOIL +TARE						
VEIGHT OF WATER						PL =
.RE						
VEIGHT OF DRY SOIL						PI =
VATER CONTENT (%)						UNIFIED SOIL CLASSIFICATION
IO. OF BLOWS				—	—	





Ninyo & Moore

ATTERBERG LIMITS TEST DATA

DRCS

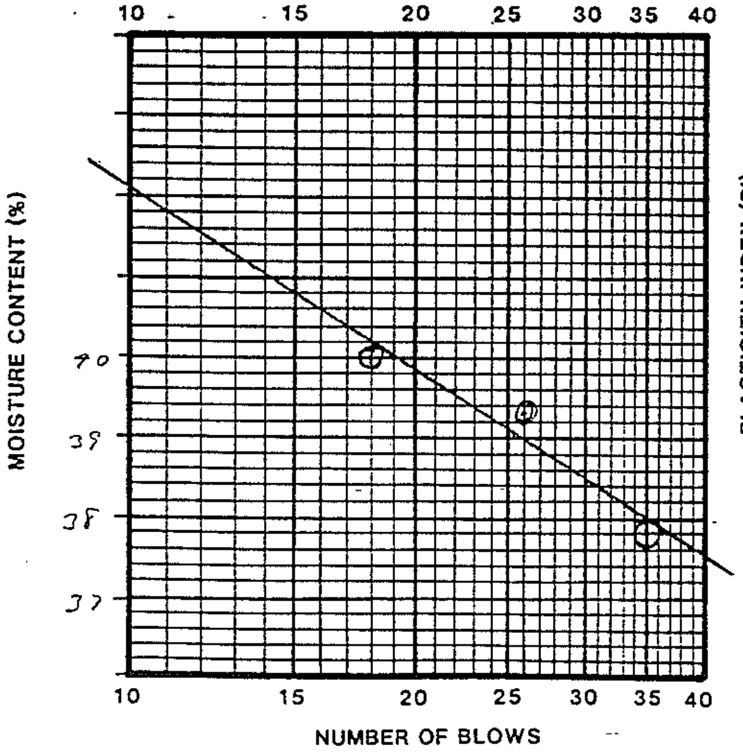
PROJECT NAME CH2M Hill PROJECT NUMBER 102208-01

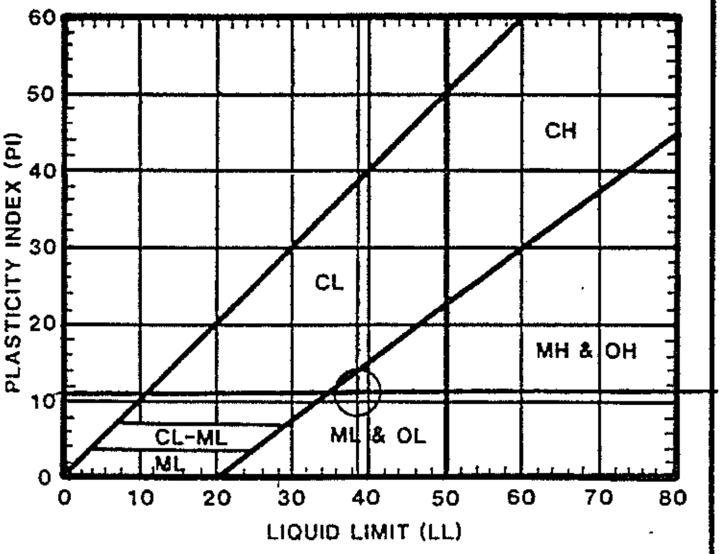
SAMPLE LOCATION B14 DEPTH 35' TECHNICIAN G.M. DATE 12-19-91

SYMBOL ⌖	LIQUID LIMIT			PLASTIC LIMIT		SUMMARY
CAN NO.	31	32	35	44	16	
WEIGHT OF WET SOIL + TARE	31.27	29.33	32.73	23.20	23.24	LL = 39
WEIGHT OF DRY SOIL + TARE	26.81	25.40	27.33	21.46	21.44	
WEIGHT OF WATER	4.46	3.93	5.40	1.74	1.80	PL = 28
TARE	15.65	15.40	13.04	15.23	15.23	
WEIGHT OF DRY SOIL	11.16	10.00	14.29	6.23	6.21	PI = 11
WATER CONTENT (%)	40.0	39.3	37.8	27.9	29.0	UNIFIED SOIL CLASSIFICATION
NO. OF BLOWS	18	26	35	—	—	ML

SAMPLE LOCATION DEPTH TECHNICIAN DATE

SYMBOL ⌖	LIQUID LIMIT			PLASTIC LIMIT		SUMMARY
CAN NO.						
WEIGHT OF WET SOIL + TARE						LL =
WEIGHT OF DRY SOIL + TARE						
WEIGHT OF WATER						PL =
ARE						
WEIGHT OF DRY SOIL						PI =
WATER CONTENT (%)						UNIFIED SOIL CLASSIFICATION
NO. OF BLOWS				—	—	





Ninyo & Moore

ATTERBERG LIMITS TEST DATA

DRS

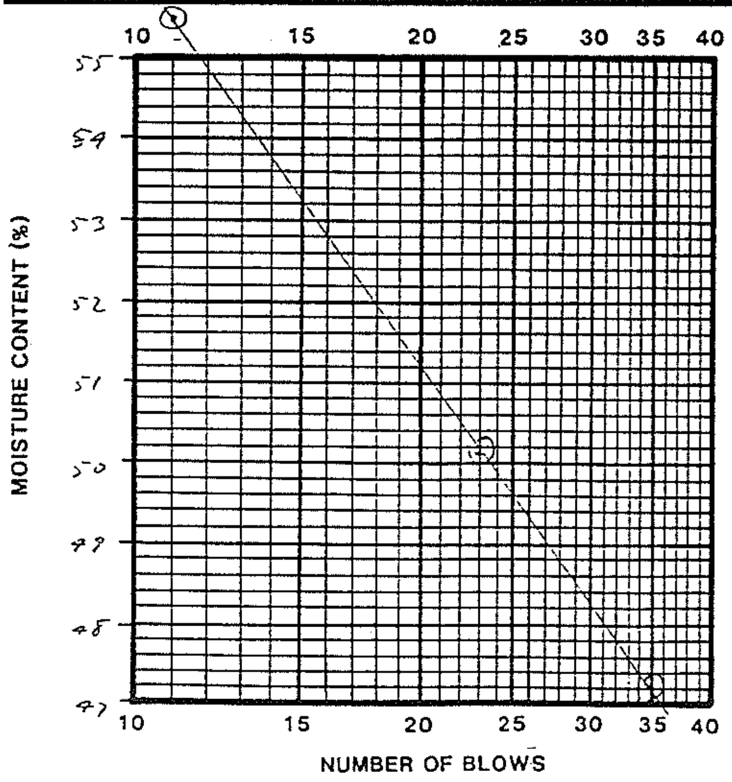
PROJECT NAME CH2 M Hill PROJECT NUMBER 102208-01

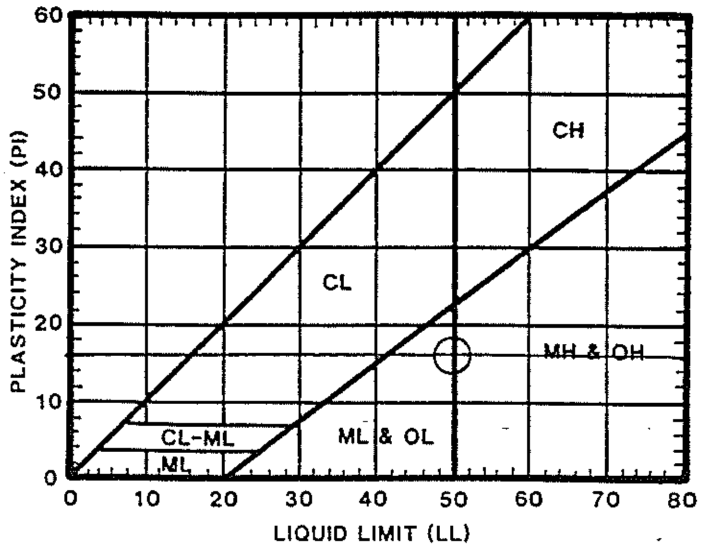
SAMPLE LOCATION B16 DEPTH 15 TECHNICIAN G.M. DATE 12-20-91

SYMBOL ⌖	LIQUID LIMIT			PLASTIC LIMIT		SUMMARY
CAN NO.	1	2	3	49	50	
WEIGHT OF WET SOIL + TARE	31.00	33.63	29.28	23.57	24.04	LL = 50
WEIGHT OF DRY SOIL + TARE	25.25	26.71	23.45	21.50	21.66	
WEIGHT OF WATER	5.75	6.92	5.83	2.07	2.38	PL = 34
TARE	13.07	12.89	12.94	15.41	14.61	
WEIGHT OF DRY SOIL	12.18	13.82	10.51	6.09	7.05	PI = 16
WATER CONTENT (%)	47.2	50.1	55.5	34.0	33.8	UNIFIED SOIL CLASSIFICATION
NO. OF BLOWS	35	23	11	—	—	ML

SAMPLE LOCATION DEPTH TECHNICIAN DATE

SYMBOL ⌖	LIQUID LIMIT			PLASTIC LIMIT		SUMMARY
CAN NO.						
WEIGHT OF WET SOIL + TARE						LL =
WEIGHT OF DRY SOIL + TARE						
WEIGHT OF WATER						PL =
TARE						
WEIGHT OF DRY SOIL						PI =
WATER CONTENT (%)						UNIFIED SOIL CLASSIFICATION
NO. OF BLOWS				—	—	





Ninyo & Moore

ATTERBERG LIMITS TEST DATA

DTCS

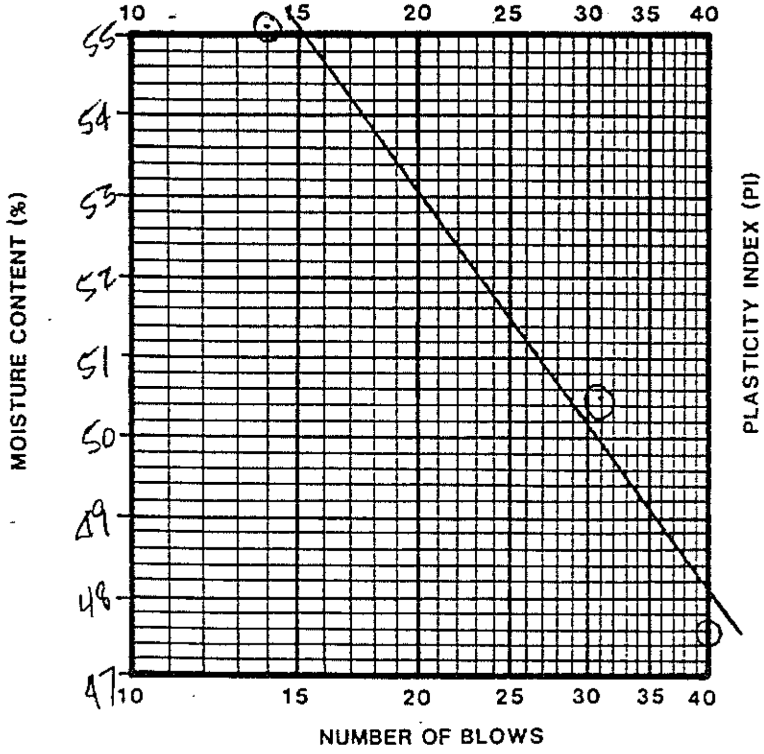
PROJECT NAME CH2M Hill PROJECT NUMBER 102208-01

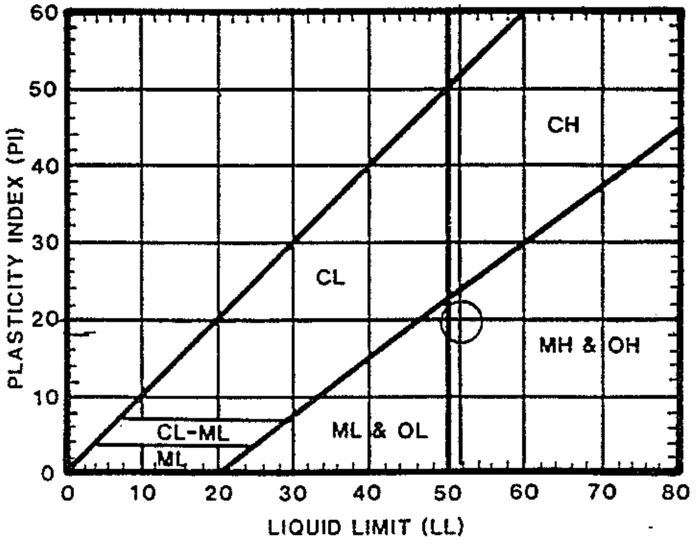
SAMPLE LOCATION B 17 DEPTH 30 TECHNICIAN G.M. DATE 12-20-91

SYMBOL ⊕	LIQUID LIMIT			PLASTIC LIMIT		SUMMARY
CAN NO.	5	8	9	14	15	
WEIGHT OF WET SOIL + TARE	30.15	32.55	33.90	24.77	24.34	LL = 52
WEIGHT OF DRY SOIL + TARE	24.57	26.78	26.34	21.89	21.53	
WEIGHT OF WATER	5.58	5.77	7.56	2.88	2.81	PL = 32
TARE	12.84	15.36	12.61	12.97	12.78	
WEIGHT OF DRY SOIL	11.73	11.42	13.73	8.92	8.75	PI = 20
WATER CONTENT (%)	47.6	50.5	55.1	32.3	32.1	UNIFIED SOIL CLASSIFICATION
NO. OF BLOWS	40	31	14	—	—	MH

SAMPLE LOCATION DEPTH TECHNICIAN DATE

SYMBOL ⊕	LIQUID LIMIT			PLASTIC LIMIT		SUMMARY
CAN NO.						
WEIGHT OF WET SOIL + TARE						LL =
WEIGHT OF DRY SOIL + TARE						
WEIGHT OF WATER						PL =
TARE						
WEIGHT OF DRY SOIL						PI =
WATER CONTENT (%)						UNIFIED SOIL CLASSIFICATION
NO. OF BLOWS				—	—	





Ninyo & Moore

ATTERBERG LIMITS TEST DATA

TRS

PROJECT NAME CH2M HILL

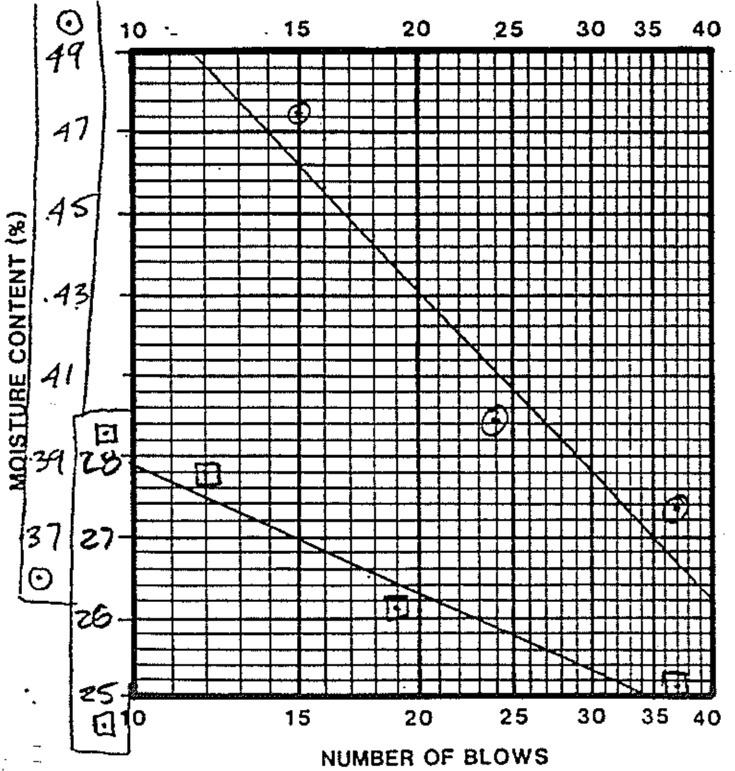
PROJECT NUMBER 2208-01

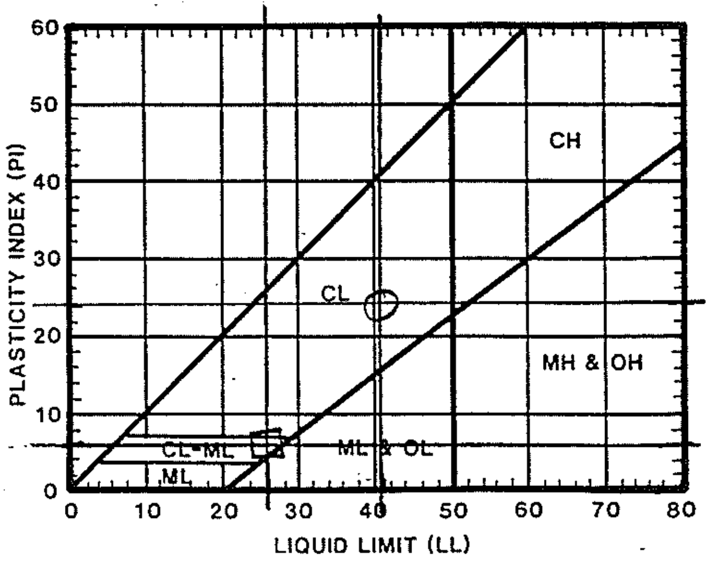
SAMPLE LOCATION TP-1 DEPTH 2B TECHNICIAN RLC DATE 11/21/91

SYMBOL ⊕	LIQUID LIMIT			PLASTIC LIMIT		SUMMARY
CAN NO.	1	2	3	4	5	
WEIGHT OF WET SOIL + TARE	31.83	33.75	28.74	25.18	24.76	LL = 41
WEIGHT OF DRY SOIL + TARE	25.80	27.81	24.42	23.39	23.10	
WEIGHT OF WATER	6.03	5.94	4.32	1.79	1.66	PL = 17
TARE	13.11	12.92	12.96	13.04	12.88	
WEIGHT OF DRY SOIL	12.69	14.89	11.46	10.35	10.22	PI = 24
WATER CONTENT (%)	47.5	39.9	37.7	17.3	16.2	UNIFIED SOIL CLASSIFICATION
NO. OF BLOWS	15	24	37	—	—	CL

SAMPLE LOCATION TP-19 DEPTH 1B TECHNICIAN RLC DATE 11/21/91

SYMBOL ⊞	LIQUID LIMIT			PLASTIC LIMIT		SUMMARY
CAN NO.	14	15	16	17	18	
WEIGHT OF WET SOIL + TARE	38.62	45.30	42.83	24.23	25.10	LL = 26
WEIGHT OF DRY SOIL + TARE	33.06	39.16	37.39	22.77	23.49	
WEIGHT OF WATER	5.56	6.14	5.44	1.46	1.61	PL = 20
TARE	13.06	15.63	15.69	15.23	15.28	
WEIGHT OF DRY SOIL	20.00	23.53	21.70	7.54	8.21	PI = 6
WATER CONTENT (%)	27.8	26.1	25.1	19.4	19.6	UNIFIED SOIL CLASSIFICATION
NO. OF BLOWS	12	19	37	—	—	CL-ML





Ninyo & Moore

ATTERBERG LIMITS TEST DATA

PES

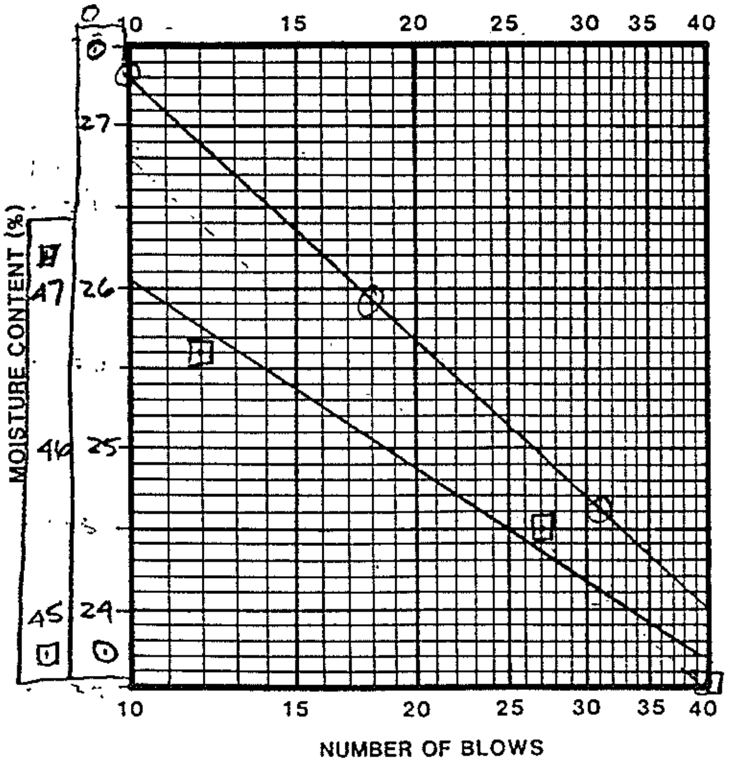
PROJECT NAME CHZM HILL PROJECT NUMBER 2208-01

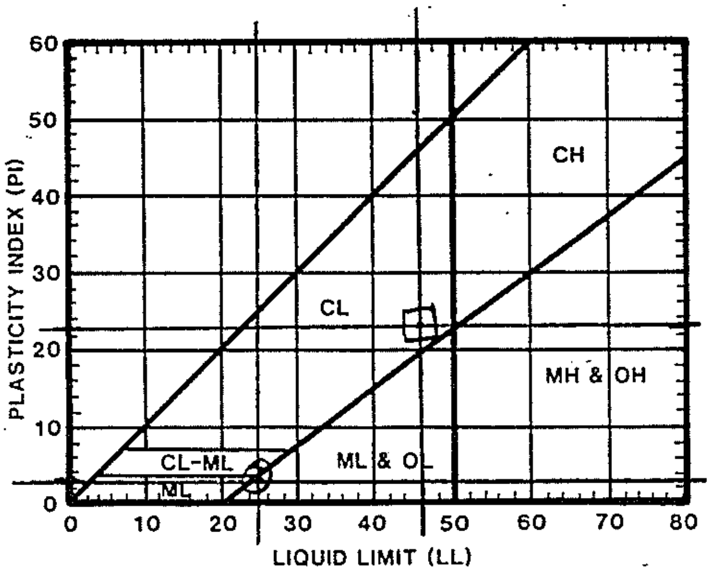
SAMPLE LOCATION TP-12 DEPTH 1B TECHNICIAN RLC DATE 11/20/91

SYMBOL ⌖	LIQUID LIMIT			PLASTIC LIMIT		SUMMARY
CAN NO.	1	2	3	4	5	
WEIGHT OF WET SOIL + TARE	38.38	41.26	37.10	29.98	32.10	LL = 25
WEIGHT OF DRY SOIL + TARE	32.96	35.44	32.33	26.90	28.68	
WEIGHT OF WATER	5.42	5.82	4.77	3.08	3.42	PL = 22
TARE	13.11	12.93	12.97	13.02	12.88	
WEIGHT OF DRY SOIL	19.85	22.51	19.36	13.88	15.80	PI = 3
WATER CONTENT (%)	27.3	25.9	24.6	22.2	21.6	UNIFIED SOIL CLASSIFICATION
NO. OF BLOWS	10	18	31	—	—	ML

SAMPLE LOCATION TP-18 DEPTH 1B TECHNICIAN RLC DATE 11/20/91

SYMBOL ⌖	LIQUID LIMIT			PLASTIC LIMIT		SUMMARY
CAN NO.	6	7	8	9	10	
WEIGHT OF WET SOIL + TARE	32.31	33.78	37.82	25.86	23.39	LL = 46
WEIGHT OF DRY SOIL + TARE	26.27	27.28	30.91	23.96	21.47	
WEIGHT OF WATER	6.04	6.50	6.91	1.90	1.92	PL = 23
TARE	13.30	12.98	15.39	15.64	13.42	
WEIGHT OF DRY SOIL	12.97	14.30	15.52	8.32	8.05	PI = 23
WATER CONTENT (%)	46.6	45.5	44.5	22.8	23.9	UNIFIED SOIL CLASSIFICATION
NO. OF BLOWS	12	27	40	—	—	CL





Ninyo & Moore

ATTERBERG LIMITS TEST DATA

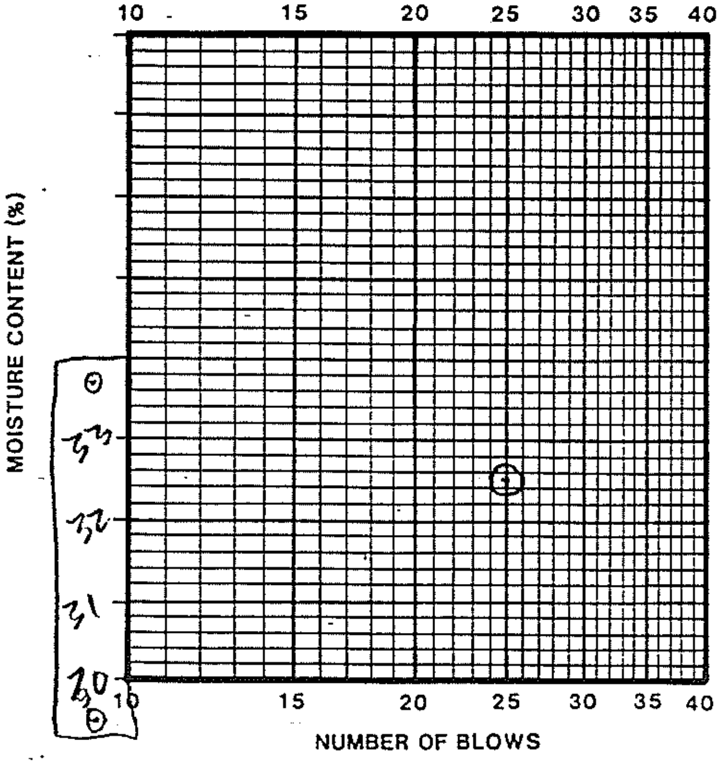
PROJECT NAME CH2M HILL PROJECT NUMBER 2208-01

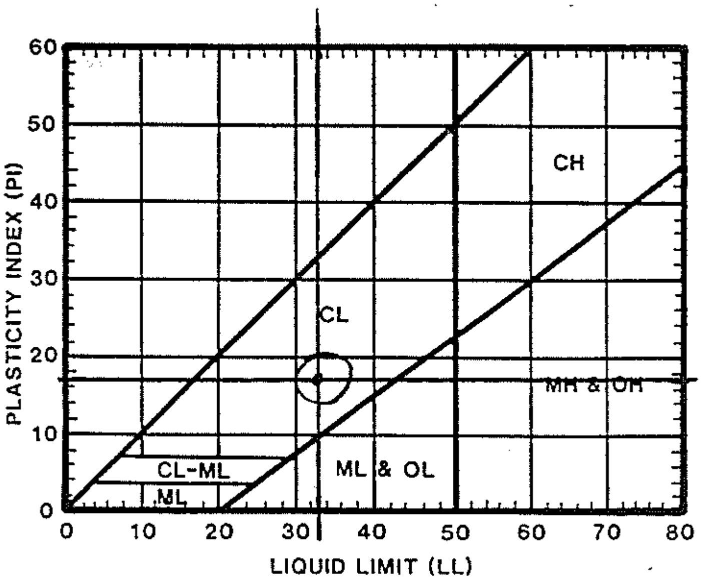
SAMPLE LOCATION TP-21 DEPTH 1B TECHNICIAN RLC DATE 11/21/91

SYMBOL ⌖	LIQUID LIMIT			PLASTIC LIMIT		SUMMARY
CAN NO.	46	47	48	49	50	
WEIGHT OF WET SOIL+ TARE		41.81		28.80	28.92	LL = 33
WEIGHT OF DRY SOIL +TARE		35.23		26.96	27.10	
WEIGHT OF WATER	-	6.58		1.84	1.82	PL = 16
TARE	15.12	15.01	15.45	15.43	15.99	
WEIGHT OF DRY SOIL		20.22		11.53	11.61	PI = 17
WATER CONTENT (%)		32.5		16.0	15.7	UNIFIED SOIL CLASSIFICATION
NO. OF BLOWS		25		—	—	CL

SAMPLE LOCATION DEPTH TECHNICIAN DATE

SYMBOL ⌖	LIQUID LIMIT			PLASTIC LIMIT		SUMMARY
CAN NO.						
WEIGHT OF WET SOIL+ TARE						LL =
WEIGHT OF DRY SOIL +TARE						
WEIGHT OF WATER						PL =
TARE						
WEIGHT OF DRY SOIL						PI =
WATER CONTENT (%)						UNIFIED SOIL CLASSIFICATION
NO. OF BLOWS				—	—	





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ATTERBERG LIMITS TEST DATA

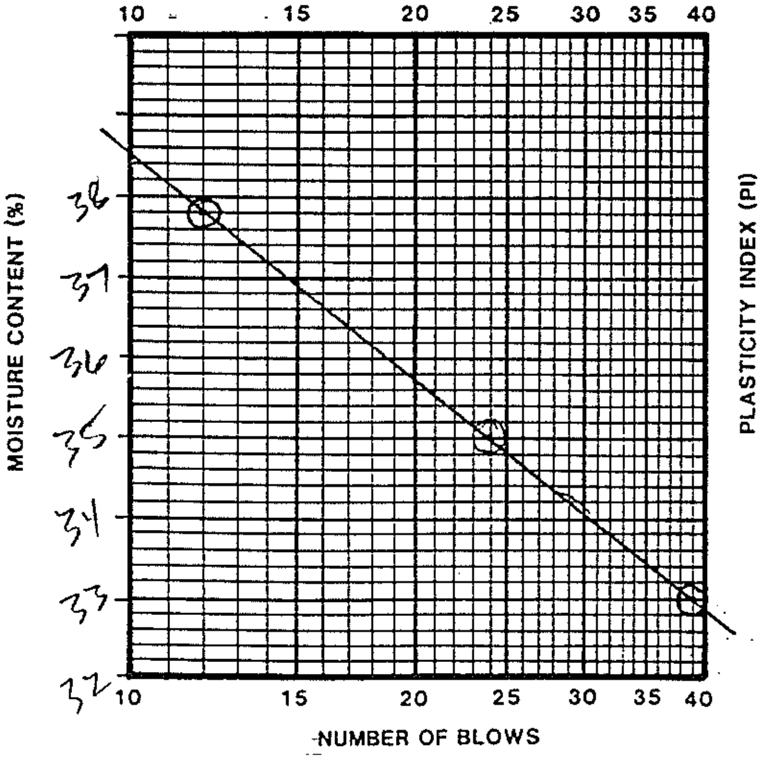
PROJECT NAME CH2m Hill / NCTP PROJECT NUMBER 102208-01

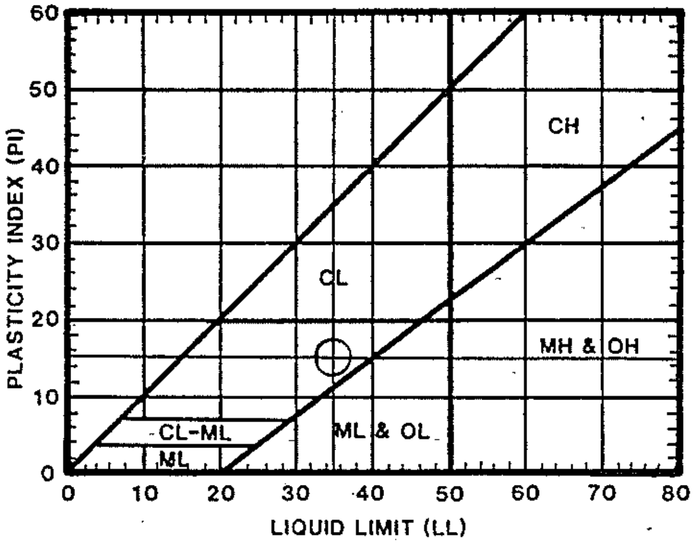
SAMPLE LOCATION TP-1 TP-5 DEPTH 2-B TECHNICIAN TS DATE 12-26-91

SYMBOL ⌖	LIQUID LIMIT			PLASTIC LIMIT		SUMMARY
CAN NO.	1	2	3	16	17	
WEIGHT OF WET SOIL + TARE	24.47	23.96	26.28	23.35	22.32	LL = 35
WEIGHT OF DRY SOIL + TARE	21.34	21.09	22.97	22.06	21.14	
WEIGHT OF WATER	3.13	2.87	3.31	1.29	1.18	PL = 20
TARE	13.06	12.88	12.93	15.66	15.21	
WEIGHT OF DRY SOIL	8.28	8.21	10.04	6.40	5.93	PI = 15
WATER CONTENT (%)	37.8	35.0	33.0	20.2	19.9	UNIFIED SOIL CLASSIFICATION
NO. OF BLOWS	12	24	39	—	—	CL

SAMPLE LOCATION DEPTH TECHNICIAN DATE

SYMBOL ⌖	LIQUID LIMIT			PLASTIC LIMIT		SUMMARY
CAN NO.						
WEIGHT OF WET SOIL + TARE						LL =
WEIGHT OF DRY SOIL + TARE						
WEIGHT OF WATER						PL =
TARE						
WEIGHT OF DRY SOIL						PI =
WATER CONTENT (%)						UNIFIED SOIL CLASSIFICATION
NO. OF BLOWS				—	—	





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ATTERBERG LIMITS TEST DATA

DTCS

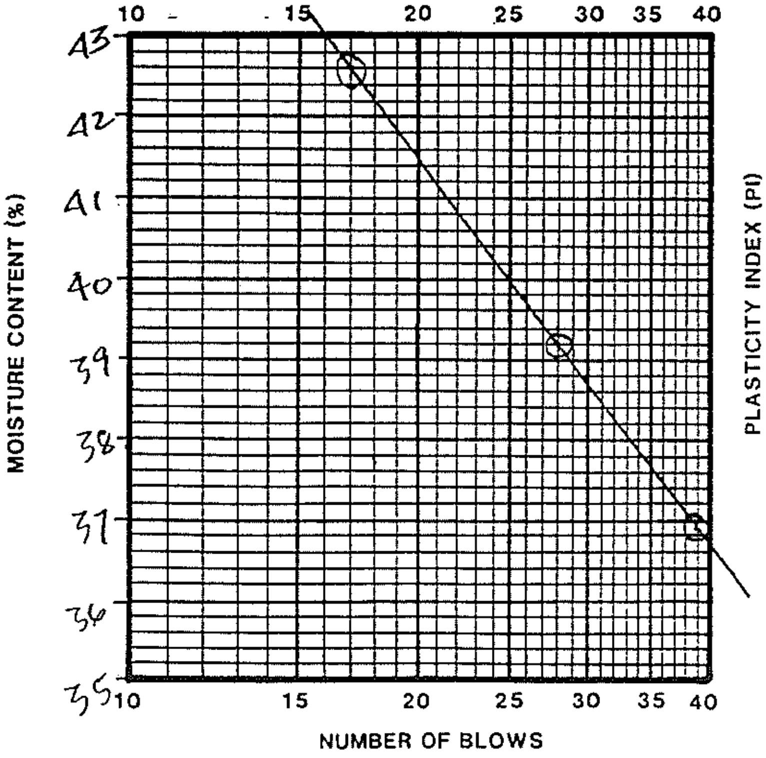
PROJECT NAME CH2M - Hill /NCTP PROJECT NUMBER 102208-01

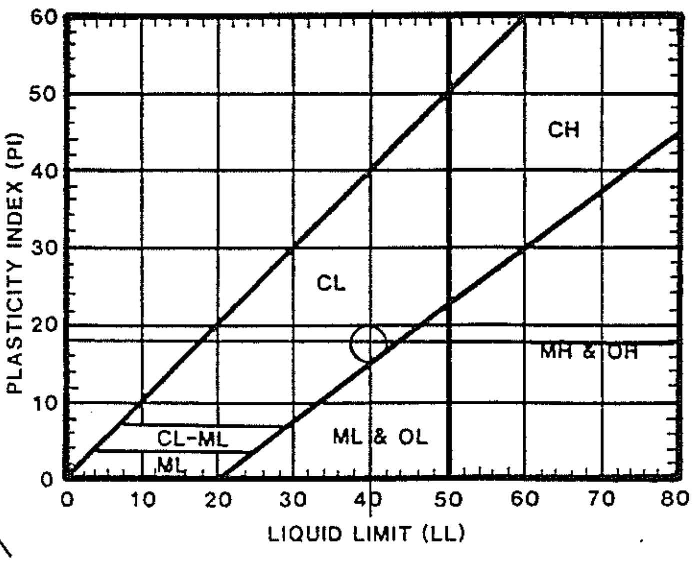
SAMPLE LOCATION TP-6 + TP-21 DEPTH 2B TECHNICIAN TS DATE 12-26-91

SYMBOL ⌖	LIQUID LIMIT			PLASTIC LIMIT		SUMMARY
CAN NO.	9	8	14	4	5	
WEIGHT OF WET SOIL + TARE	30.49	30.06	27.09	23.23	23.79	LL = 40
WEIGHT OF DRY SOIL + TARE	26.30	26.10	22.87	21.40	21.75	
WEIGHT OF WATER	4.19	3.96	4.22	1.83	2.04	PL = 22
TARE	15.62	15.38	12.97	13.01	12.86	
WEIGHT OF DRY SOIL	10.68	10.72	9.90	8.39	8.89	PI = 18
WATER CONTENT (%)	39.2	36.9	42.6	21.8	22.9	UNIFIED SOIL CLASSIFICATION
NO. OF BLOWS	28	39	17	—	—	CL

SAMPLE LOCATION DEPTH TECHNICIAN DATE

SYMBOL ⌖	LIQUID LIMIT			PLASTIC LIMIT		SUMMARY
CAN NO.						
WEIGHT OF WET SOIL + TARE						LL =
WEIGHT OF DRY SOIL + TARE						
WEIGHT OF WATER						PL =
ARE						
WEIGHT OF DRY SOIL						PI =
WATER CONTENT (%)						UNIFIED SOIL CLASSIFICATION
NO. OF BLOWS				—	—	





Ninyo & Moore

ATTERBERG LIMITS TEST DATA

DRS

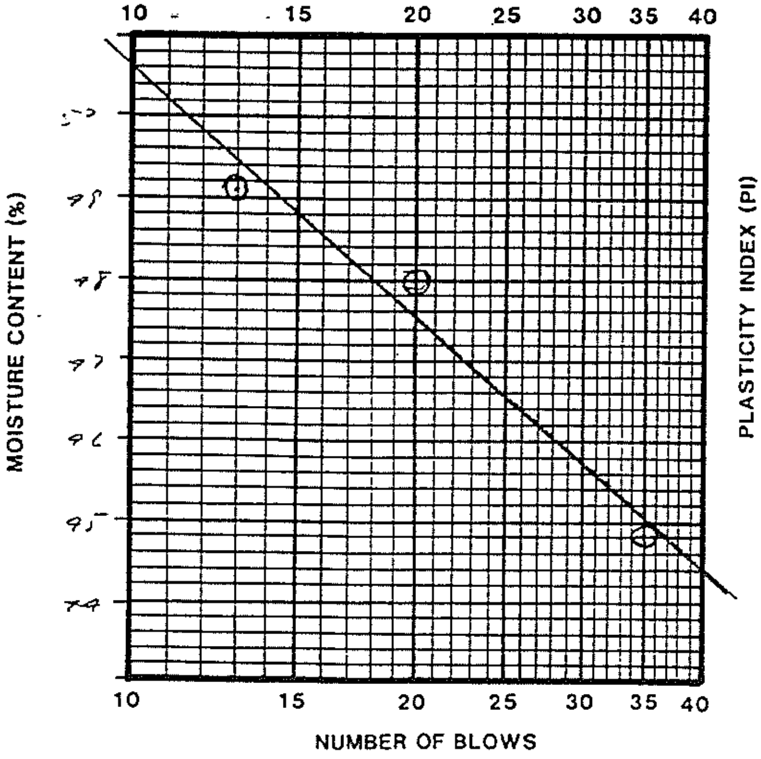
PROJECT NAME CH 2 M Hill PROJECT NUMBER 10 2208-01

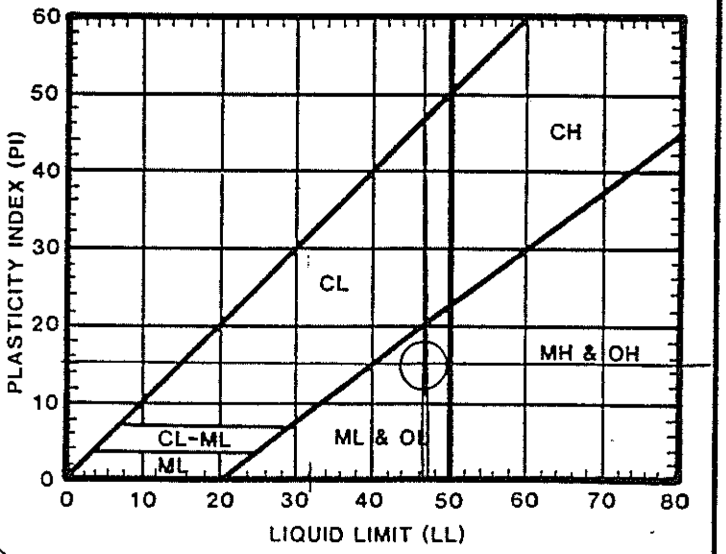
SAMPLE LOCATION C8 DEPTH 20' TECHNICIAN G.M. DATE 12-19-91

SYMBOL ⊕	LIQUID LIMIT			PLASTIC LIMIT		SUMMARY
CAN NO.	19	20	34	33	18	
WEIGHT OF WET SOIL + TARE	30.38	30.83	33.30	22.92	22.37	LL = 47
WEIGHT OF DRY SOIL + TARE	25.48	25.66	27.87	21.12	20.53	
WEIGHT OF WATER	4.90	5.17	5.43	1.80	1.84	PL = 32
TARE	15.51	14.89	15.74	15.57	14.85	
WEIGHT OF DRY SOIL	9.97	10.77	12.13	5.55	5.68	PI = 15
WATER CONTENT (%)	49.1	48.0	44.8	32.4	32.4	UNIFIED SOIL CLASSIFICATION
NO. OF BLOWS	13	20	35	—	—	ML

SAMPLE LOCATION DEPTH TECHNICIAN DATE

SYMBOL ⊕	LIQUID LIMIT			PLASTIC LIMIT		SUMMARY
CAN NO.						
WEIGHT OF WET SOIL + TARE						LL =
WEIGHT OF DRY SOIL + TARE						
WEIGHT OF WATER						PL =
TARE						
WEIGHT OF DRY SOIL						PI =
WATER CONTENT (%)						UNIFIED SOIL CLASSIFICATION
NO. OF BLOWS				—	—	





2-c

Ninyo & Moore

200 WASH

DCS

PROJECT NAME CH2 M Hill

PROJECT NUMBER 102208-01

DATE 11-18-91

SAMPLE LOCATION #4

DEPTH 35

TECHNICIAN G.M.

SAMPLE NUMBER

INITIAL WEIGHT OF DRY SOIL AND TARE	474.7
TARE WEIGHT	216.3
INITIAL WEIGHT OF DRY SOIL (W_1)	258.4
WEIGHT OF DRY SOIL AND TARE AFTER 200 WASH	252.0
WEIGHT OF DRY SOIL RETAINED ON NO. 4 SIEVE (W_4)	0.0
WEIGHT OF DRY SOIL RETAINED ON NO. 200 SIEVE (W_{200})	27.9
PERCENT RETAINED ON NO. 4 SIEVE ($P_{R4} = \frac{W_4}{W_1} \times 100$)	0.0
PERCENT PASSING A NO. 4 SIEVE ($P_{P4} = 100 - P_{R4}$)	100.0
PERCENT RETAINED ON NO. 200 SIEVE ($P_{R200} = \frac{W_{200}}{W_1} \times 100$)	10.8
PERCENT PASSING A NO. 200 SIEVE ($P_{P200} = 100 - P_{R4} - P_{R200}$)	89.2

DATE 11-18-91

SAMPLE LOCATION #3

DEPTH 25

TECHNICIAN G-M.

SAMPLE NUMBER

INITIAL WEIGHT OF DRY SOIL AND TARE	391.5
TARE WEIGHT	216.8
INITIAL WEIGHT OF DRY SOIL (W_1)	174.7
WEIGHT OF DRY SOIL AND TARE AFTER 200 WASH	330.7
WEIGHT OF DRY SOIL RETAINED ON NO. 4 SIEVE (W_4)	10.2
WEIGHT OF DRY SOIL RETAINED ON NO. 200 SIEVE (W_{200})	100.2
PERCENT RETAINED ON NO. 4 SIEVE ($P_{R4} = \frac{W_4}{W_1} \times 100$)	5.8
PERCENT PASSING A NO. 4 SIEVE ($P_{P4} = 100 - P_{R4}$)	94.2
PERCENT RETAINED ON A NO. 200 SIEVE ($P_{R200} = \frac{W_{200}}{W_1} \times 100$)	57.4
PERCENT PASSING A NO. 200 SIEVE ($P_{P200} = 100 - P_{R4} - P_{R200}$)	36.8

Ninyo & Moore

200 WASH

TRS

PROJECT NAME CH2 M Hill

PROJECT NUMBER 102208-01

DATE 11-18-91 SAMPLE LOCATION #16 DEPTH 35'

TECHNICIAN G-M. SAMPLE NUMBER

INITIAL WEIGHT OF DRY SOIL AND TARE	390.3
TARE WEIGHT	185.9
INITIAL WEIGHT OF DRY SOIL (W_I)	204.4
WEIGHT OF DRY SOIL AND TARE AFTER 200 WASH	248.2
WEIGHT OF DRY SOIL RETAINED ON NO. 4 SIEVE (W_4)	6.0
WEIGHT OF DRY SOIL RETAINED ON NO. 200 SIEVE (W_{200})	50.0
PERCENT RETAINED ON NO. 4 SIEVE ($P_{R4} = \frac{W_4}{W_I} \times 100$)	2.9
PERCENT PASSING A NO. 4 SIEVE ($P_{P4} = 100 - P_{R4}$)	97.1
PERCENT RETAINED ON NO. 200 SIEVE ($P_{R200} = \frac{W_{200}}{W_I} \times 100$)	24.5
PERCENT PASSING A NO. 200 SIEVE ($P_{P200} = 100 - P_{R4} - P_{R200}$)	72.6

DATE 11-18-91 SAMPLE LOCATION 13 DEPTH 20

TECHNICIAN G.M. SAMPLE NUMBER

INITIAL WEIGHT OF DRY SOIL AND TARE	477.5
TARE WEIGHT	211.9
INITIAL WEIGHT OF DRY SOIL (W_I)	265.6
WEIGHT OF DRY SOIL AND TARE AFTER 200 WASH	372.0
WEIGHT OF DRY SOIL RETAINED ON NO. 4 SIEVE (W_4)	62.0
WEIGHT OF DRY SOIL RETAINED ON NO. 200 SIEVE (W_{200})	97.3
PERCENT RETAINED ON NO. 4 SIEVE ($P_{R4} = \frac{W_4}{W_I} \times 100$)	23.3
PERCENT PASSING A NO. 4 SIEVE ($P_{P4} = 100 - P_{R4}$)	76.7
PERCENT RETAINED ON A NO. 200 SIEVE ($P_{R200} = \frac{W_{200}}{W_I} \times 100$)	36.6
PERCENT PASSING A NO. 200 SIEVE ($P_{P200} = 100 - P_{R4} - P_{R200}$)	40.1

Ninyo & Moore

200 WASH

TCS

PROJECT NAME CH2 M Hill PROJECT NUMBER 102208-01

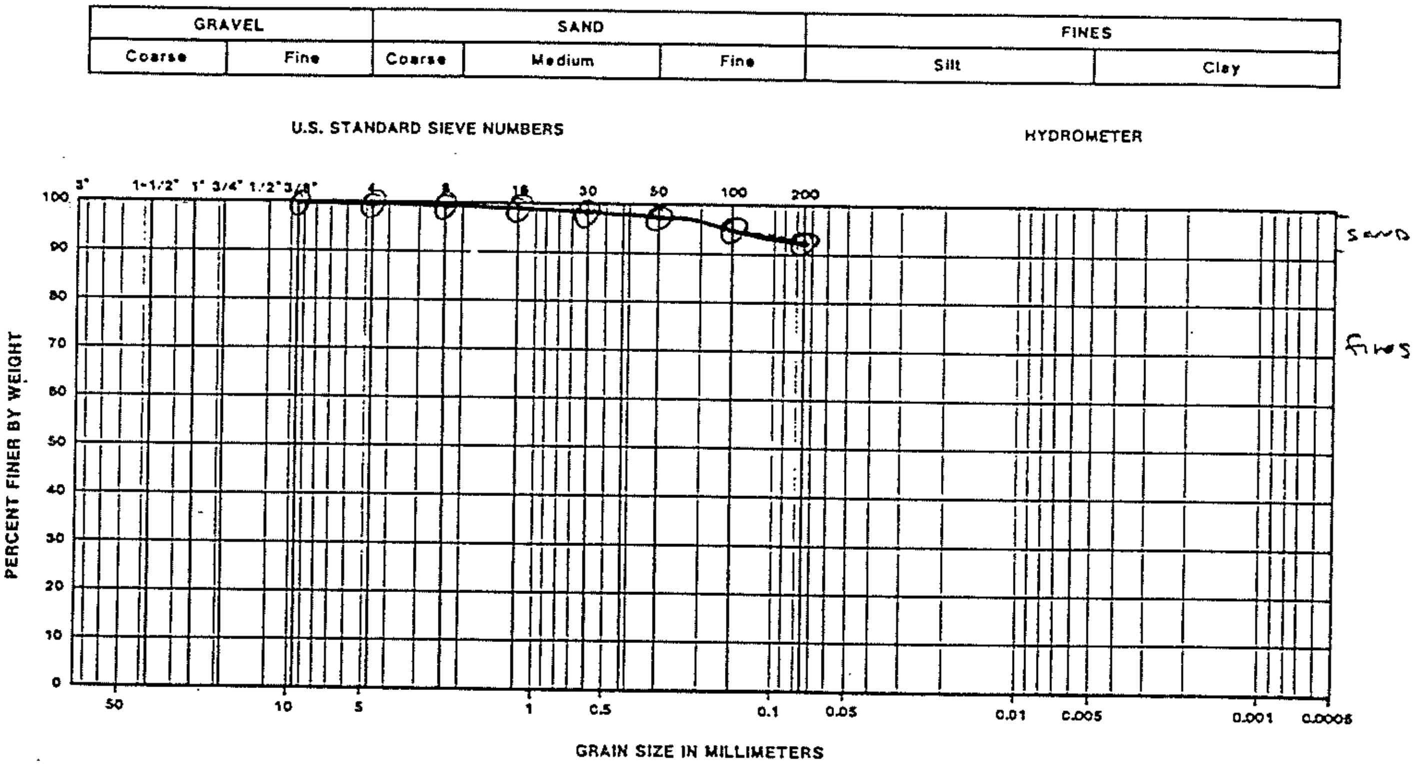
DATE 11-18-91 SAMPLE LOCATION 16 DEPTH 25
TECHNICIAN G.M. SAMPLE NUMBER

INITIAL WEIGHT OF DRY SOIL AND TARE	428.1
TARE WEIGHT	208.1
INITIAL WEIGHT OF DRY SOIL (W_I)	220.0
WEIGHT OF DRY SOIL AND TARE AFTER 200 WASH	222.4
WEIGHT OF DRY SOIL RETAINED ON NO. 4 SIEVE (W_4)	0.0
WEIGHT OF DRY SOIL RETAINED ON NO. 200 SIEVE (W_{200})	9.8
PERCENT RETAINED ON NO. 4 SIEVE ($P_{R4} = \frac{W_4}{W_I} \times 100$)	0.0
PERCENT PASSING A NO. 4 SIEVE ($P_{P4} = 100 - P_{R4}$)	100.0
PERCENT RETAINED ON NO. 200 SIEVE ($P_{R200} = \frac{W_{200}}{W_I} \times 100$)	4.5
PERCENT PASSING A NO. 200 SIEVE ($P_{P200} = 100 - P_{R4} - P_{R200}$)	95.5

DATE 11-18-91 SAMPLE LOCATION 16 DEPTH 5'
TECHNICIAN G.M. SAMPLE NUMBER

INITIAL WEIGHT OF DRY SOIL AND TARE	464.3
TARE WEIGHT	226.5
INITIAL WEIGHT OF DRY SOIL (W_I)	237.8
WEIGHT OF DRY SOIL AND TARE AFTER 200 WASH	242.0
WEIGHT OF DRY SOIL RETAINED ON NO. 4 SIEVE (W_4)	0.0
WEIGHT OF DRY SOIL RETAINED ON NO. 200 SIEVE (W_{200})	11.3
PERCENT RETAINED ON NO. 4 SIEVE ($P_{R4} = \frac{W_4}{W_I} \times 100$)	0 0
PERCENT PASSING A NO. 4 SIEVE ($P_{P4} = 100 - P_{R4}$)	100.0
PERCENT RETAINED ON A NO. 200 SIEVE ($P_{R200} = \frac{W_{200}}{W_I} \times 100$)	4.8
PERCENT PASSING A NO. 200 SIEVE ($P_{P200} = 100 - P_{R4} - P_{R200}$)	95.2

TRS



Symbol	Hole Number	Depth (Feet)	Liquid Limit	Plastic Limit	Plasticity Index	Soil Type
	TP-1	2B	41	17	24	CL

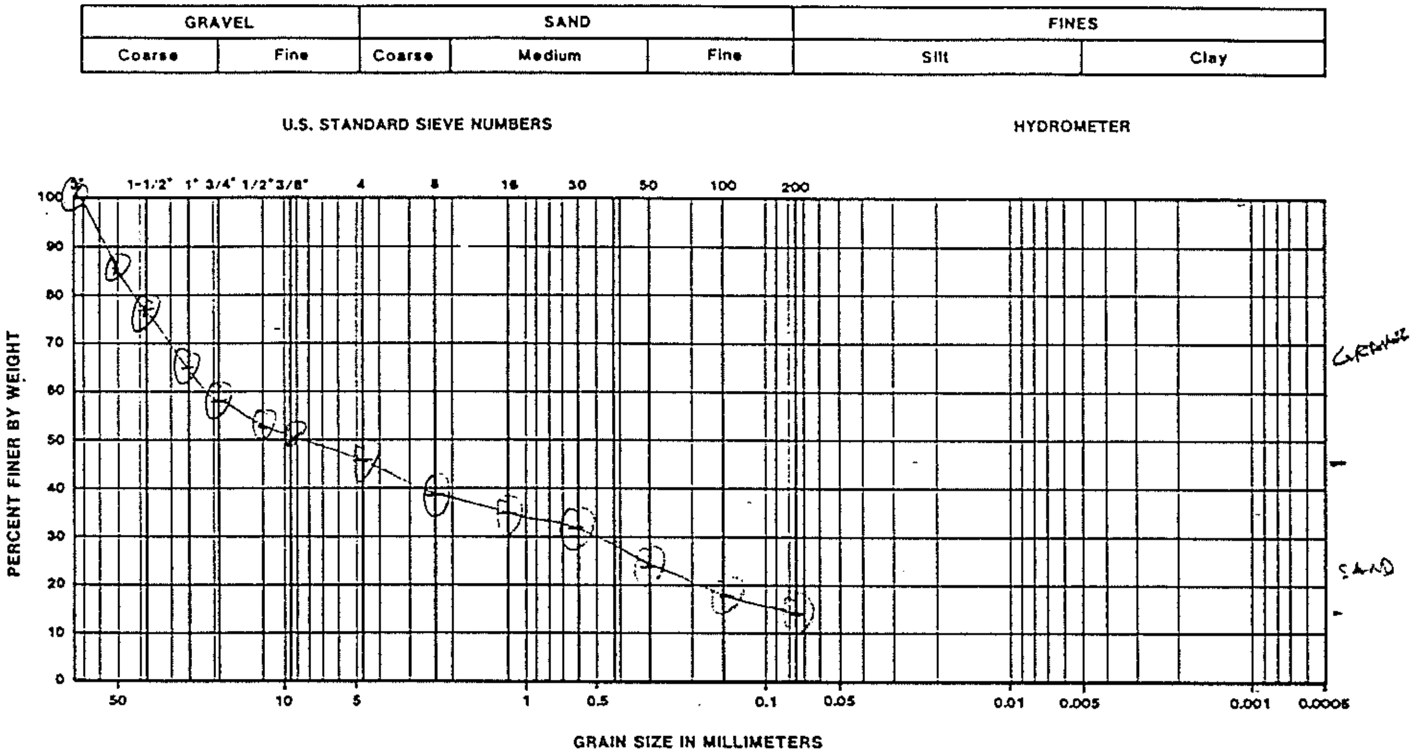
GRADATION TEST RESULTS

Ninyo & Moore

CH2M HILL

PROJECT NO.	DATE	FIGURE
22083-001	11/20/91	

DRS



Symbol	Hole Number	Depth (Feet)	Liquid Limit	Plastic Limit	Plasticity Index	Soil Type
	TP 12	1 B	25	22	3	GM

Ninyo & Moore

GRADATION TEST RESULTS

CH2M Hill

PROJECT NO.	DATE	FIGURE
102208-01	11-20-91	

$C_u = D_{60} / D_{10} > 4$ $C_c = 1 < D_{30}^2 / (D_{10} \cdot D_{60}) < 3$

DRS

D_{10} .073

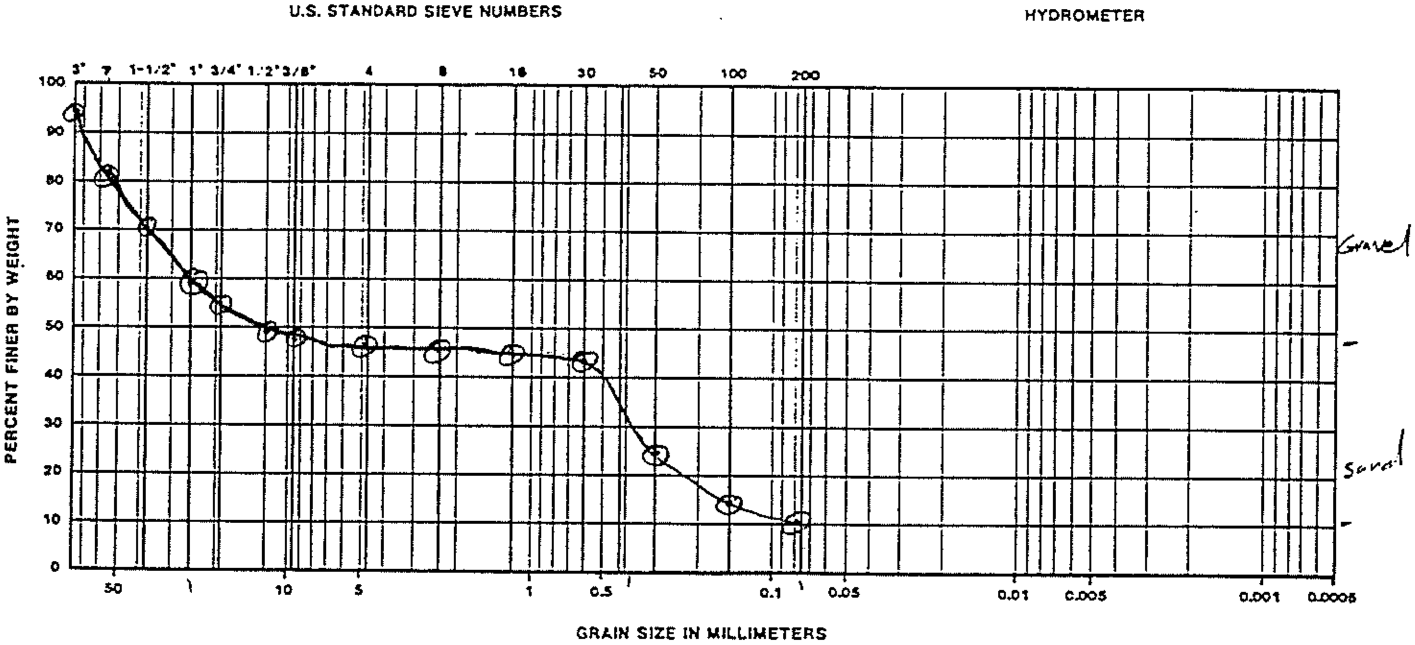
D_{30} .36

D_{60} 30

All ✓

.06

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay



Symbol	Hole Number	Depth (Feet)	Liquid Limit	Plastic Limit	Plasticity Index	Soil Type
	TP-12	2B	—	—	—	GP-GM

Ninyo & Moore

GRADATION TEST RESULTS

CH2M HILL

PROJECT NO.	DATE	FIGURE
22089-01	11/25/91	

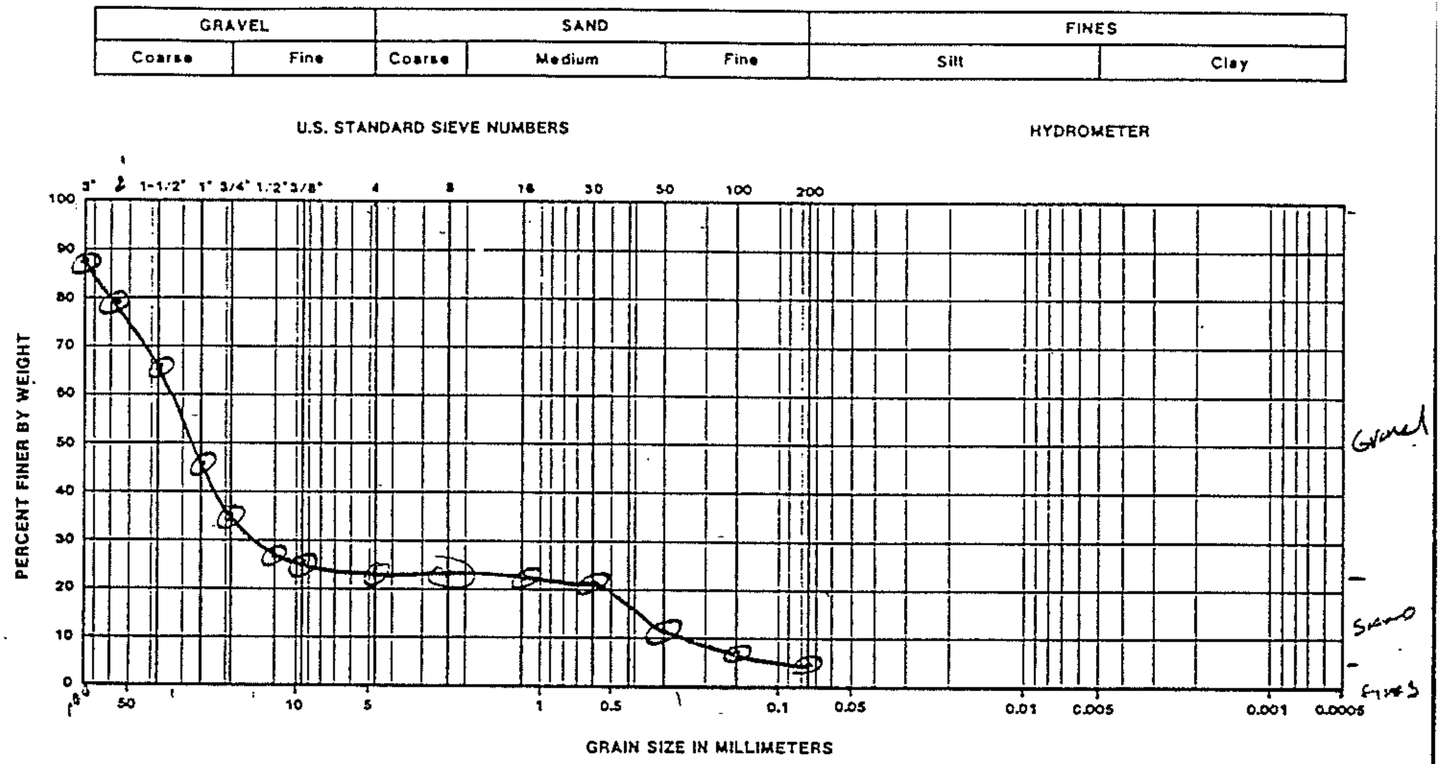
D_{60} - 34
D_{30} - 15
D_{10} - .27

$C_u = D_{60}/D_{10} > 4$

$C_c = 1 < D_{30}^2/(D_{10} \times D_{60}) < 3$

$C_u = 125.9$ ✓ $C_c =$ ~~24.5~~

TCS



Symbol	Hole Number	Depth (Feet)	Liquid Limit	Plastic Limit	Plasticity Index	Soil Type
	TP-15	18	—	—	—	GP

Ninyo & Moore

GRADATION TEST RESULTS

CH2M HILL

PROJECT NO.	DATE	FIGURE
2208-01	11/20/91	

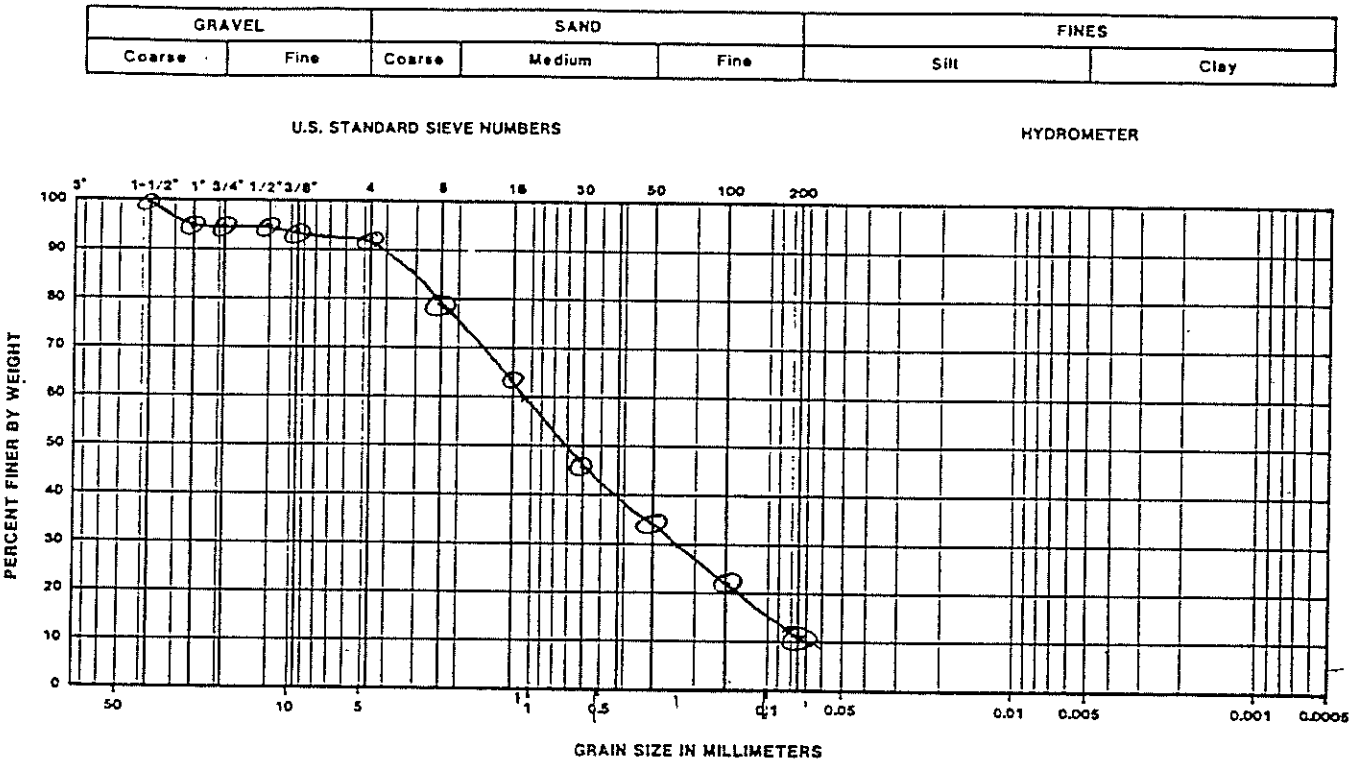
D60 1.3
D30 .25
D10 .07

cc =
1<$D_{30}^2/(D_{10} \times D_{60})$<3
~~cc = .7~~

cu = D_{60}/D_{10}>4

cu = 18.6 ✓

cu 20
cc .7
PRS



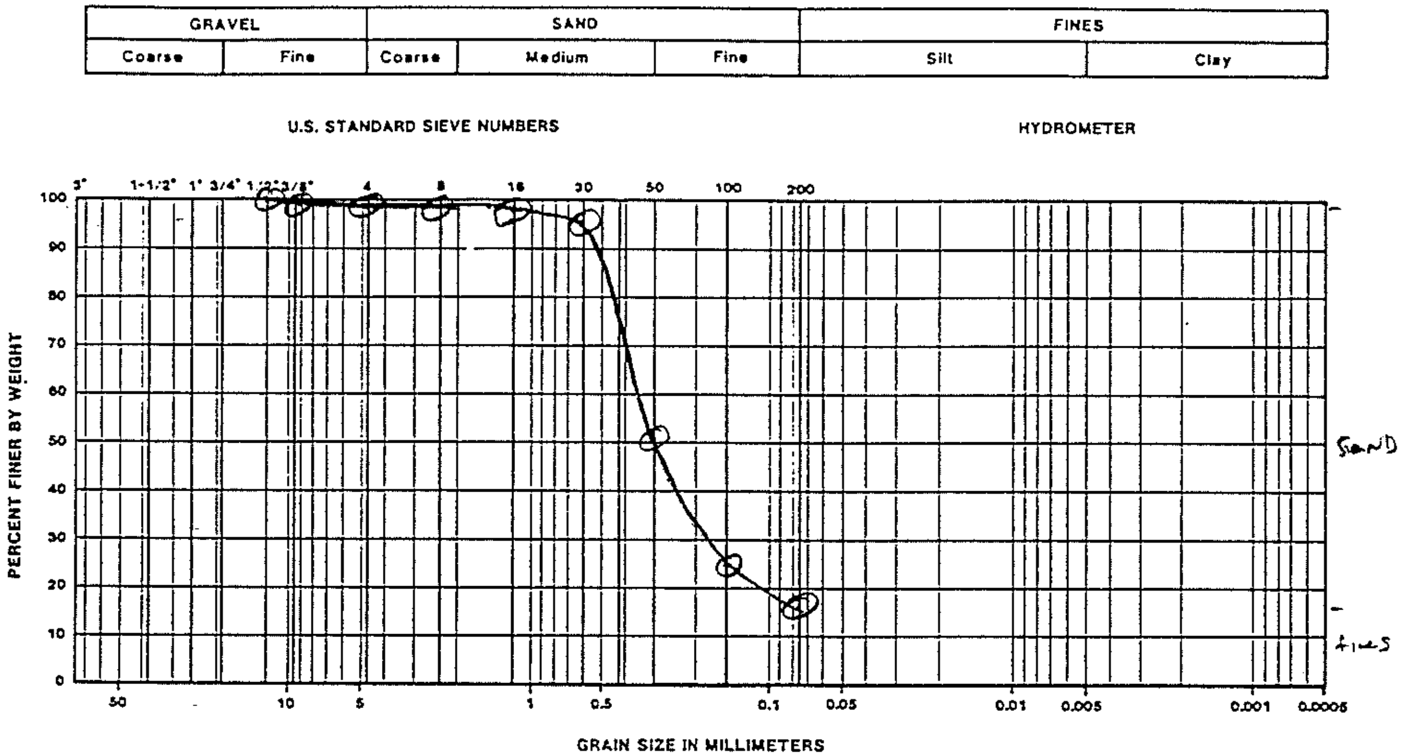
Symbol	Hole Number	Depth (Feet)	Liquid Limit	Plastic Limit	Plasticity Index	Soil Type
	TP-17	1B	—	—	—	SP-SM

Ninyo & Moore

GRADATION TEST RESULTS

CH2M HILL

PROJECT NO.	DATE	FIGURE
2208301	11/21/91	



Symbol	Hole Number	Depth (Feet)	Liquid Limit	Plastic Limit	Plasticity Index	Soil Type
	TP-17	2B	—	—	—	SM

Ninyo & Moore

GRADATION TEST RESULTS

CHZM HILL

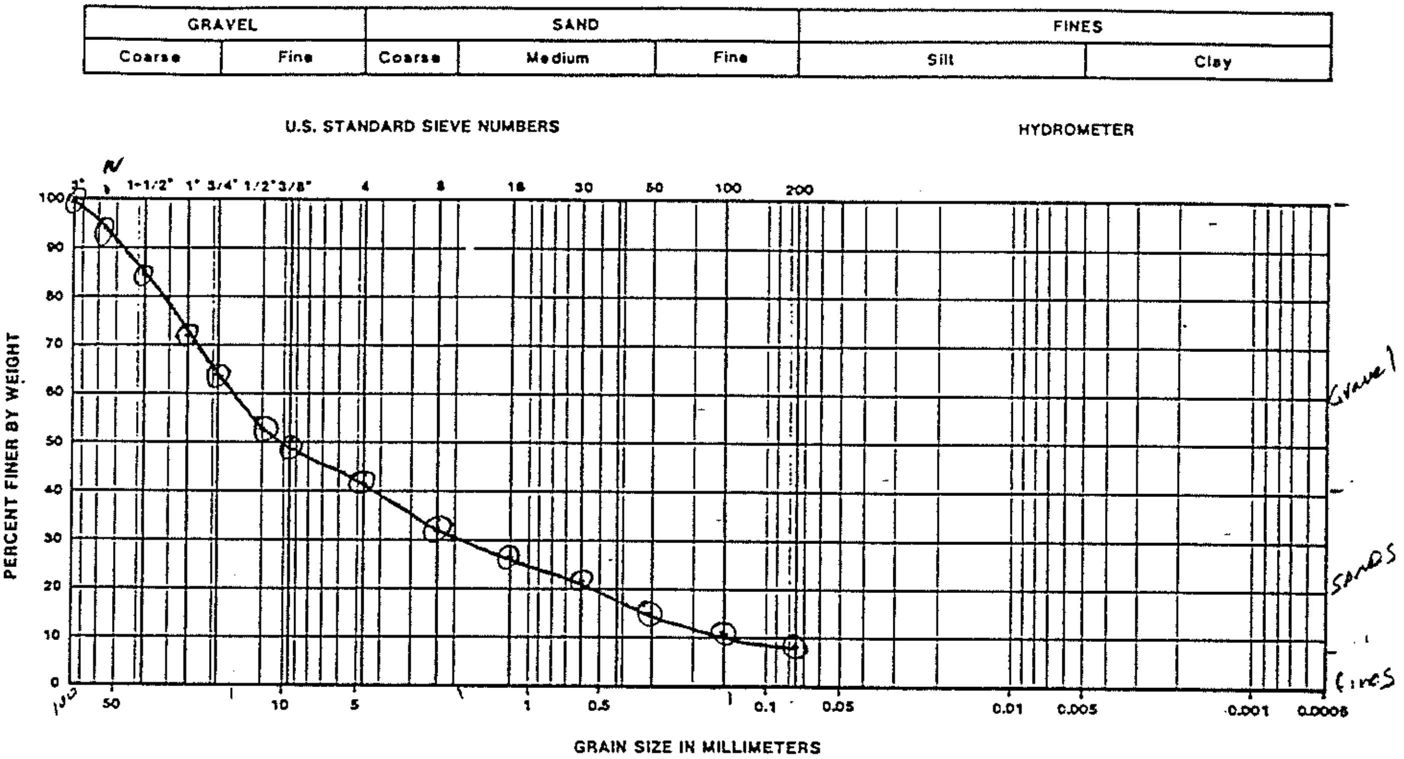
PROJECT NO.	DATE	FIGURE
2208-01	11/20/91	

D60 - 15
D30 - 2.7
D10 - .19

$C_u = D_{60}/D_{10} > 4$ $C_c = 1 < D_{30}^2/(D_{10} \cdot D_{60}) < 3$

$C_u = 78.9$ ✓ $C_c = 2.6$

PES



Symbol	Hole Number	Depth (Feet)	Liquid Limit	Plastic Limit	Plasticity Index	Soil Type
	TP-18	2B	—	—	—	GW-GM

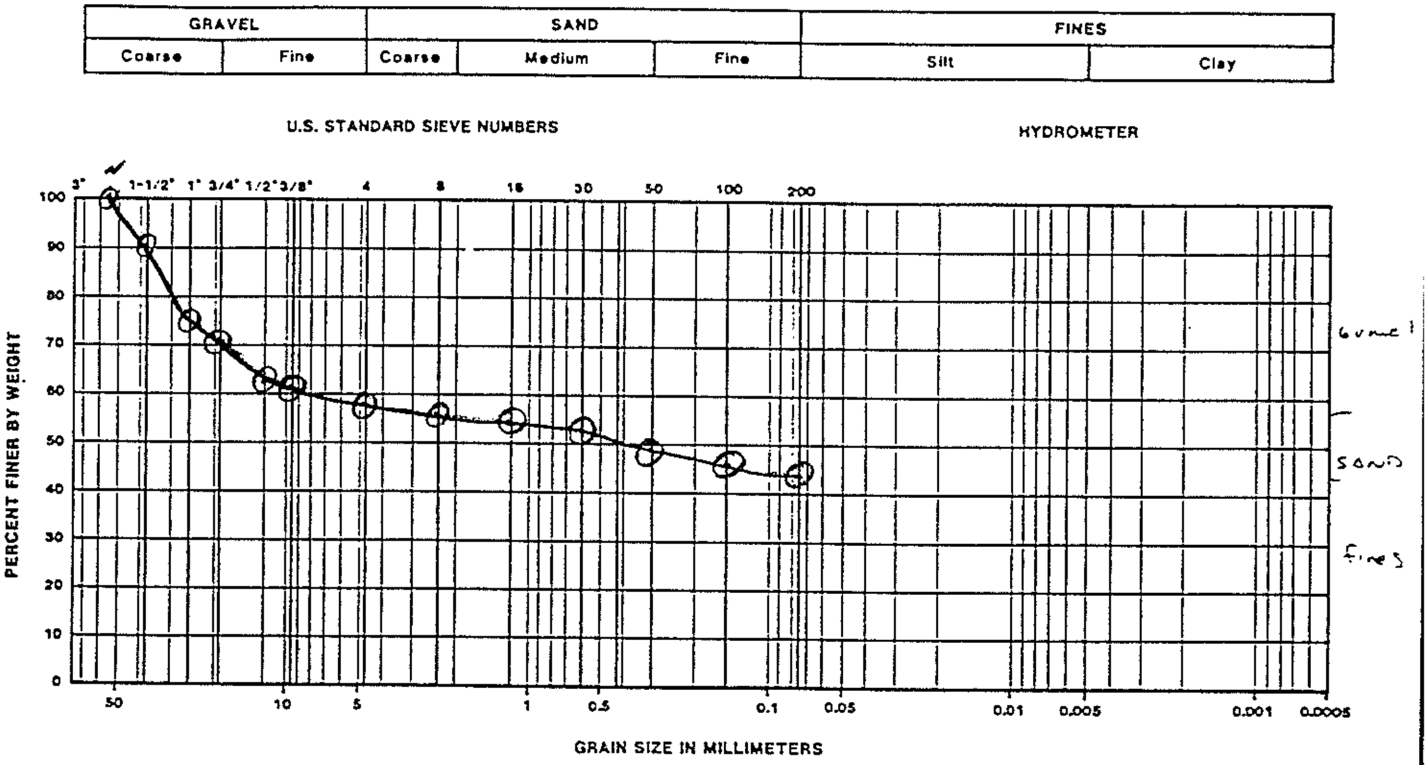
Ninyo & Moore

GRADATION TEST RESULTS

CH2M HILL

PROJECT NO.	DATE	FIGURE
2208-01	11/20/91	

TRS



Symbol	Hole Number	Depth (Feet)	Liquid Limit	Plastic Limit	Plasticity Index	Soil Type
	TP-18	18	46	23	23	GC

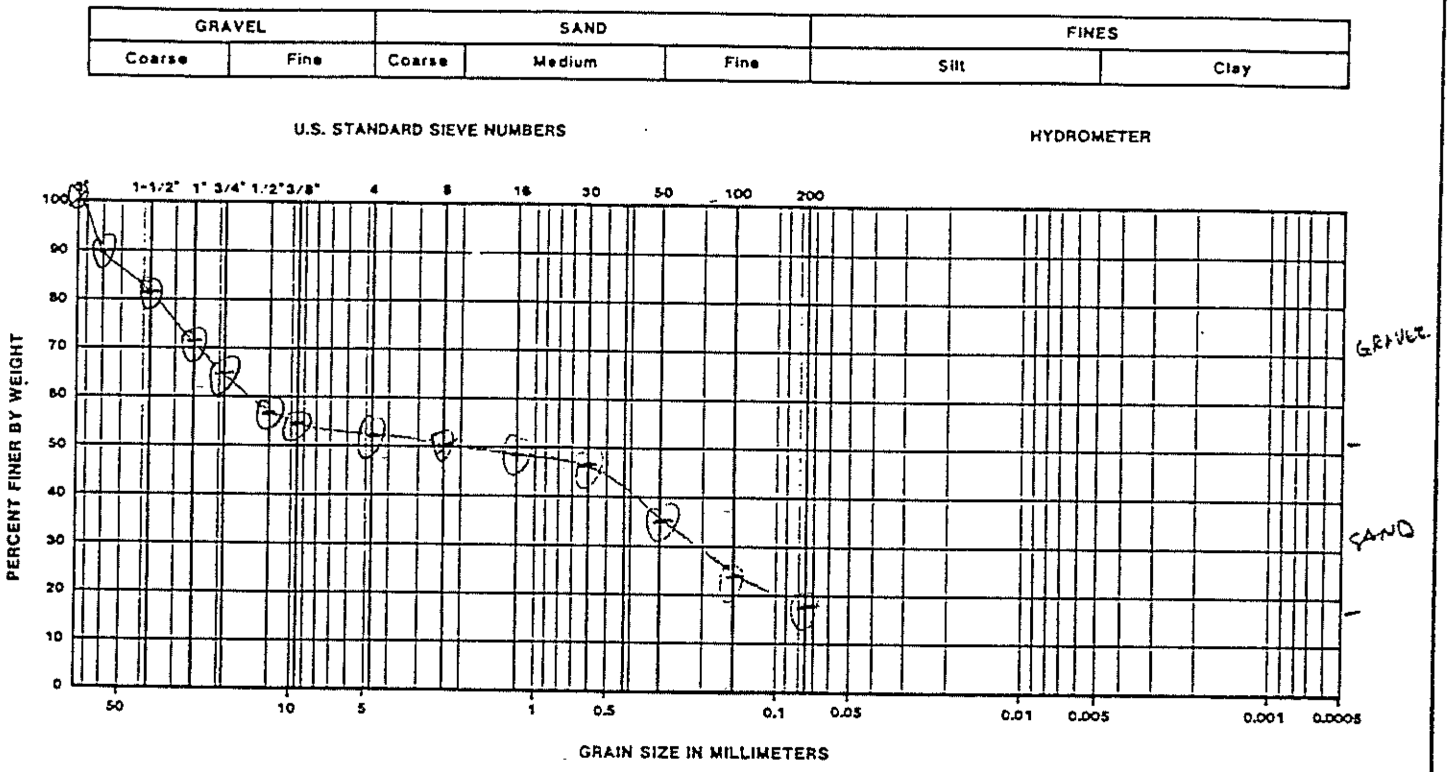
Ninyo & Moore

GRADATION TEST RESULTS

CH2M HILL

PROJECT NO.	DATE	FIGURE
220901	11/20/91	

TRCS



Symbol	Hole Number	Depth (Feet)	Liquid Limit	Plastic Limit	Plasticity Index	Soil Type
	TP-19	1 B	26	20	6	GC-GM

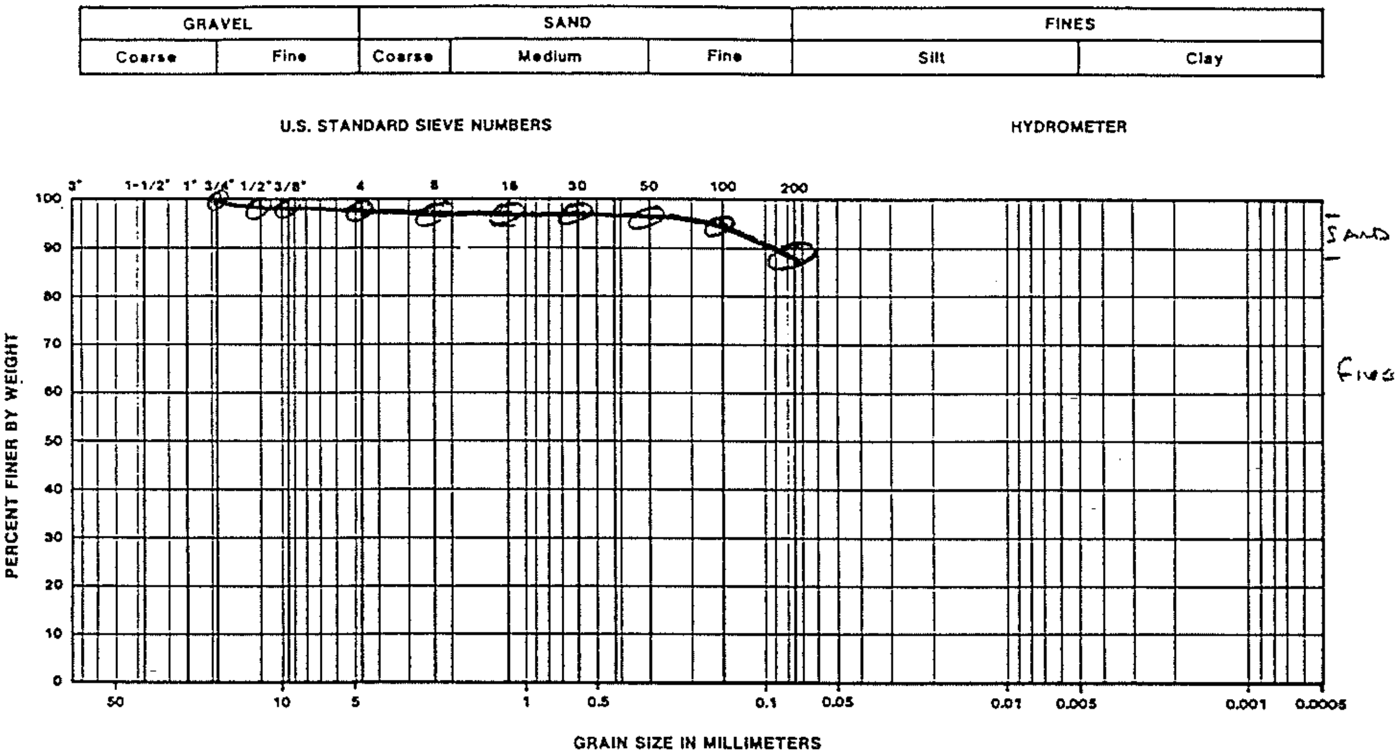
Ninyo & Moore

GRADATION TEST RESULTS

CH2M Hill

PROJECT NO.	DATE	FIGURE
102208-01	11-21-91	

TRS



Symbol	Hole Number	Depth (Feet)	Liquid Limit	Plastic Limit	Plasticity Index	Soil Type
	TP-21	1B	33	16	17	CL

GRADATION TEST RESULTS

Ninyo & Moore

CH2M HILL

PROJECT NO.	DATE	FIGURE
2208-01	11/20/90	

Ninyo & Moore

EXPANSION INDEX TEST DATA
(UBC 29-2)

TRS

PROJECT CH2M HILL / NCTP PROJECT NO. 2208-01 LOT NO.

HOLE NO. TP-1 2B DEPTH 5' DATE SAMPLED 12-3-91

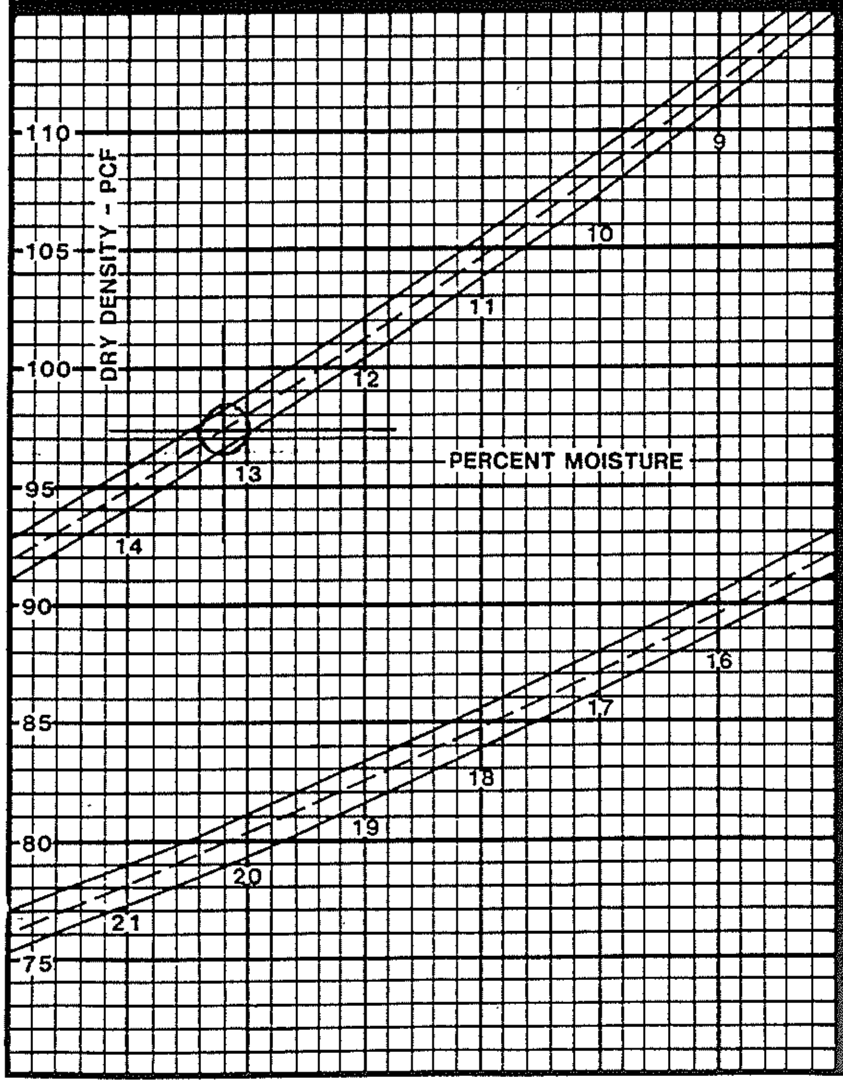
SOIL TYPE CL DATE TESTED 12-4-91

TECHNICIAN TO - G.M. MACHINE NO. 5

A. PRIOR MOISTURE CONTENT	10.2			
B. INITIAL MOISTURE CONTENT	13.2			
C. COMPACTED WEIGHT, RING+SOIL	571.3			
D. WEIGHT OF RING	206.2			
E. SPECIMEN WEIGHT, (C - D)	365.1			
F. COMPACTED WET DENSITY, (E x 0.3014)	110.0			
G. COMPACTED DRY DENSITY, (F/(1+B))	97.2			
H. DEGREE OF SATURATION, $(B/(\frac{62.4}{G} - 0.3774))$	49.9			

SWELL DATA

DATE	TIME	DIAL (D)
12-4-91	10:43	.100
	10:44	.103
	12:05	.140
12-5-91	12:07	.143
	13:07	143
VOL. SWELL (INCHES)		43
INDEX (D x 10^3)		44
EXPANSION POTENTIAL		
Low		



PRIOR MOISTURE CONTENT

a. PAN NUMBER	XXX
b. WET WEIGHT+TARE	246.6
c. DRY WEIGHT+TARE	227.0
d. WATER LOSS, (b-c)	19.6
e. WEIGHT OF TARE	34.8
f. DRY WEIGHT, (c-e)	192.2
g. PRIOR MOISTURE, (d/f)	10.2

FINAL MOISTURE CONTENT

h. PAN NUMBER	XXXV
i. WET WEIGHT+TARE	258.2
j. DRY WEIGHT+TARE	210.9
k. WATER LOSS, (i-j)	47.3
l. WEIGHT OF TARE	34.6
m. DRY WEIGHT, (j-l)	176.3
n. FINAL MOISTURE, (k/m)	26.8

REMARKS

Ninyo & Moore

EXPANSION INDEX TEST DATA
(UBC 29-2)

DES PRC

PROJECT CH2M-Hill PROJECT NO. 102208.01 LOT NO.

HOLE NO. 21-1B DEPTH DATE SAMPLED

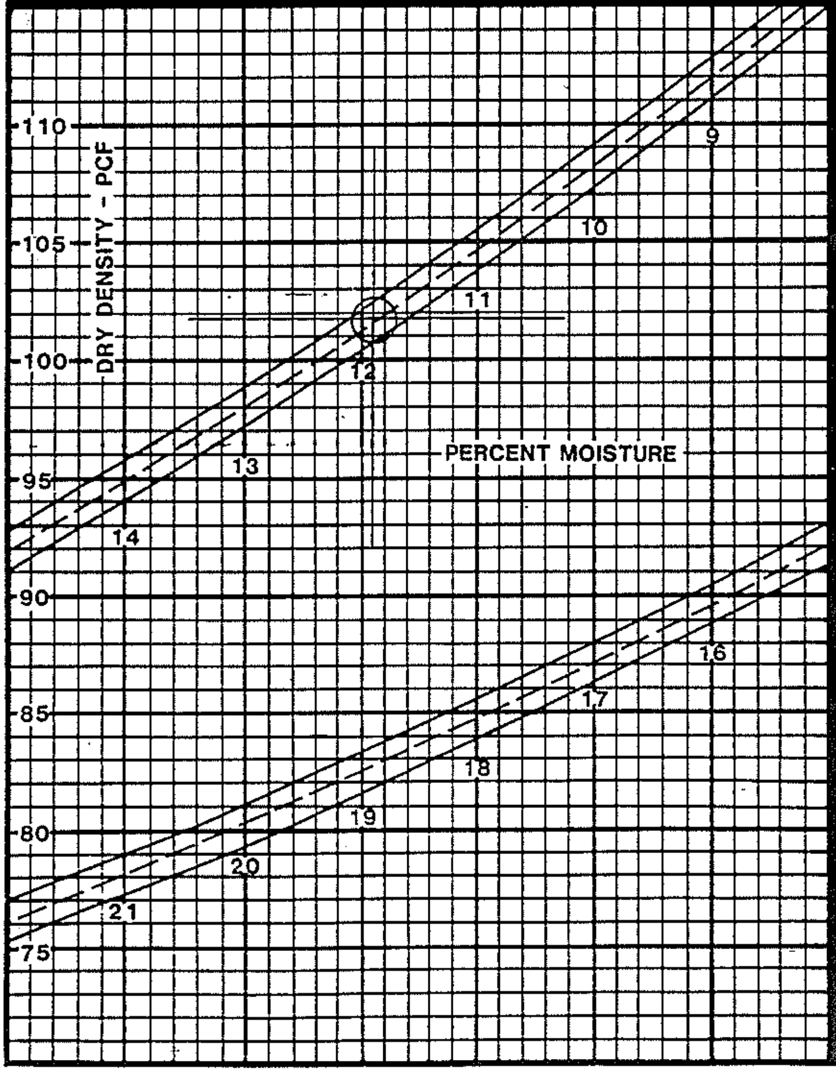
SOIL TYPE ~~[illegible]~~ CL DATE TESTED 12-4-91

TECHNICIAN SPB - G.M. MACHINE NO. 6

A. PRIOR MOISTURE CONTENT	6.8			
B. INITIAL MOISTURE CONTENT	11.9			
C. COMPACTED WEIGHT, RING + SOIL	586.5			
D. WEIGHT OF RING	208.3			
E. SPECIMEN WEIGHT, (C - D)	378.2			
F. COMPACTED WET DENSITY, (E x 0.3014)	114.0			
G. COMPACTED DRY DENSITY, (F/(1+B))	101.9			
H. DEGREE OF SATURATION, $(B/(\frac{62.4}{G} - 0.3774))$	50.6			

SWELL DATA

DATE	TIME	DIAL (D)
12-4-91	12:14	.100
-	12:15	.103
	13:17	.131½
12-5-91	13:03	.159½
	14:03	.159½
VOL. SWELL (INCHES)		59½
INDEX (D x 10^3)		60
EXPANSION POTENTIAL		
Med		



PRIOR MOISTURE CONTENT

a. PAN NUMBER	3
b. WET WEIGHT+TARE	275.3
c. DRY WEIGHT+TARE	258.2
d. WATER LOSS, (b-c)	17.1
e. WEIGHT OF TARE	8.4
f. DRY WEIGHT, (c-e)	249.8
g. PRIOR MOISTURE, (d/f)	6.8

FINAL MOISTURE CONTENT

h. PAN NUMBER	11
i. WET WEIGHT+TARE	189.7
j. DRY WEIGHT+TARE	158.5
k. WATER LOSS, (i-j)	31.2
l. WEIGHT OF TARE	29.0
m. DRY WEIGHT, (j-l)	129.5
n. FINAL MOISTURE, (k/m)	24.1

REMARKS

Ninyo & Moore

EXPANSION INDEX TEST DATA
(UBC 29-2)

TRS

PROJECT CH2M/Hill PROJECT NO. 102208-01 LOT NO.

HOLE NO. 21 2B DEPTH DATE SAMPLED

SOIL TYPE CL DATE TESTED 12-9-91

TECHNICIAN SPB -G.M. MACHINE NO. 8

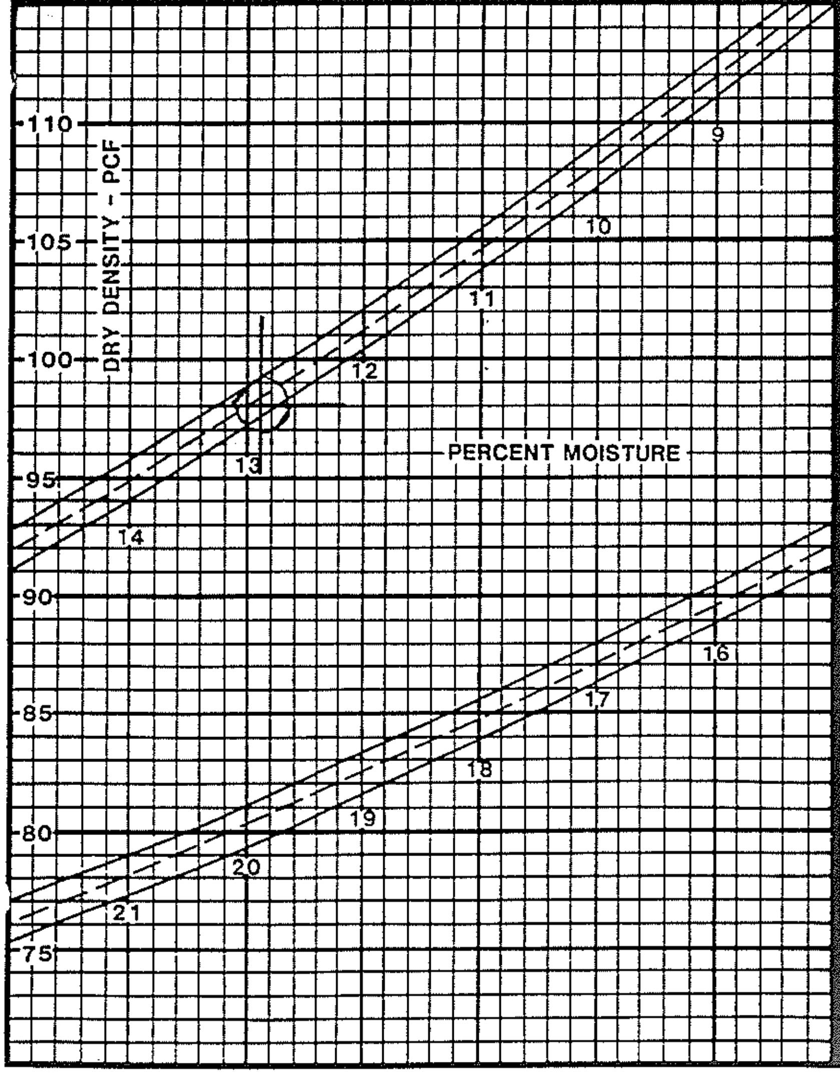
A. PRIOR MOISTURE CONTENT	10.5			
B. INITIAL MOISTURE CONTENT	12.9			
C. COMPACTED WEIGHT, RING+SOIL	574.5			
D. WEIGHT OF RING	207.5			
E. SPECIMEN WEIGHT, (C - D)	367.0			
F. COMPACTED WET DENSITY, (E x 0.3014)	110.6			
G. COMPACTED DRY DENSITY, (F/(1+B))	98.0			
H. DEGREE OF SATURATION, $(B/(\frac{62.4}{G} - 0.3774))$	49.7			

SWELL DATA

DATE	TIME	DIAL (D)
12-9-91	14:32	.100
"	1433	.108
12-5-91	19:02	.126
12-6-91	10:01	.127
-	11:01	.127
VOL. SWELL (INCHES)		27
INDEX (D x 10³)		28

EXPANSION POTENTIAL

Low



PRIOR MOISTURE CONTENT

a. PAN NUMBER	F
b. WET WEIGHT+TARE	226.6
c. DRY WEIGHT+TARE	208.3
d. WATER LOSS, (b-c)	18.3
e. WEIGHT OF TARE	34.1
f. DRY WEIGHT, (c-e)	174.2
g. PRIOR MOISTURE, (d/f)	10.5

FINAL MOISTURE CONTENT

h. PAN NUMBER	25
i. WET WEIGHT+TARE	192.4
j. DRY WEIGHT+TARE	158.6
k. WATER LOSS, (i-j)	33.8
l. WEIGHT OF TARE	28.8
m. DRY WEIGHT, (j-l)	129.8
n. FINAL MOISTURE, (k/m)	26.0

REMARKS

Ninyo & Moore

3-C

MAXIMUM DENSITY TEST DATA

TCS

PROJECT NAME CH2M Hill/NCTP
PROJECT NO. 102208-01
'ATE 12/20/91
SAMPLE LOCATION TP-1, 2B
DEPTH 5'
TECHNICIAN RLC
SOIL DESCRIPTION ML - BRN SILT

TEST RESULTS

MAXIMUM DENSITY 111.7
OPTIMUM MOISTURE 14.8

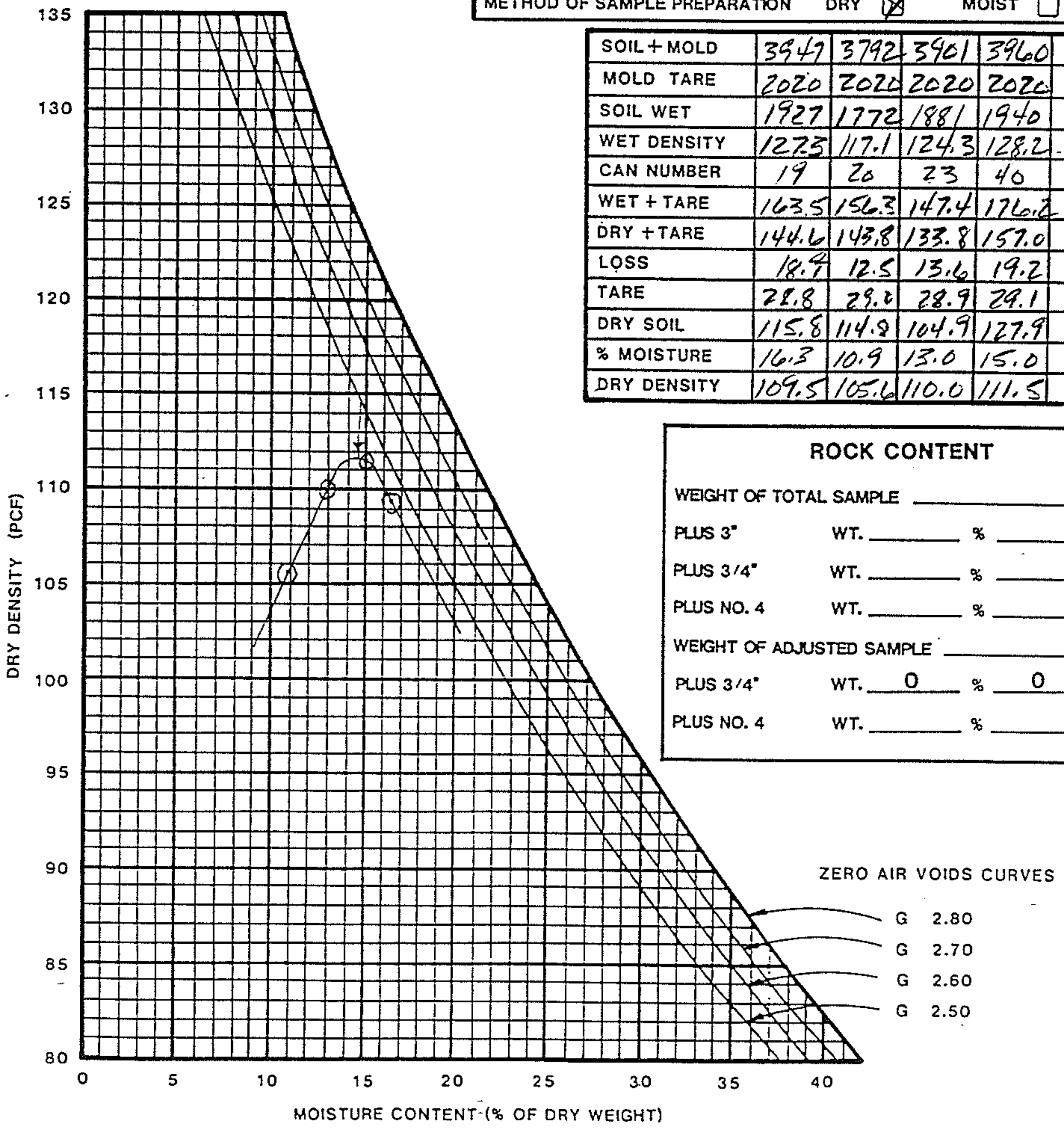
TEST PROCEDURE

ASTM DESIGNATION D1557-78 ☒ D698-78 ☐ METHOD A
AASHTO T180-86 METHOD C (MODIFIED) ☐
MAXIMUM PARTICLE SIZE NO. 4 ☒ 3/4" ☐
VOLUME OF MOLD (CU.FT.) 1/30 ☒ 1/13.33 ☐
TYPE OF RAMMER MANUAL ☐ MECHANICAL ☒
METHOD OF SAMPLE PREPARATION DRY ☒ MOIST ☐

SOIL + MOLD	3947	3792	3901	3960	
MOLD TARE	2020	2020	2020	2020	
SOIL WET	1927	1772	1881	1940	
WET DENSITY	127.5	117.1	124.3	128.2	
CAN NUMBER	19	20	23	40	
WET + TARE	163.5	156.3	147.4	176.2	
DRY + TARE	144.6	143.8	133.8	157.0	
LOSS	18.9	12.5	13.6	19.2	
TARE	28.8	29.0	28.9	29.1	
DRY SOIL	115.8	114.8	104.9	127.9	
% MOISTURE	16.3	10.9	13.0	15.0	
DRY DENSITY	109.5	105.6	110.0	111.5	✓

ROCK CONTENT

WEIGHT OF TOTAL SAMPLE ______
PLUS 3" WT. ______ % ______
PLUS 3/4" WT. ______ % ______
PLUS NO. 4 WT. ______ % ______
WEIGHT OF ADJUSTED SAMPLE ______
PLUS 3/4" WT. 0 % 0
PLUS NO. 4 WT. ______ % ______



Ninyo & Moore

MAXIMUM DENSITY TEST DATA

TDS

PROJECT NAME CH2M HILL **PROJECT NO.** 2208-01

ATE 12-19-91 **SAMPLE LOCATION** TP-17 2B **DEPTH** ______ **TECHNICIAN** TD

SOIL DESCRIPTION SM - ORANGE SILTY SAND w/GRAVEL

TEST RESULTS

MAXIMUM DENSITY 119.6

OPTIMUM MOISTURE 12.2

TEST PROCEDURE

ASTM DESIGNATION D1557-78 ☐ D698-78 ☐ METHOD ____

AASHTO T180-86 METHOD C (MODIFIED) ☑

MAXIMUM PARTICLE SIZE NO. 4 ☐ 3/4" ☑

VOLUME OF MOLD (CU.FT.) 1/30 ☐ 1/13.33 ☑

TYPE OF RAMMER MANUAL ☐ MECHANICAL ☑

METHOD OF SAMPLE PREPARATION DRY ☑ MOIST ☐

SOIL + MOLD		10891	11044	10968	
MOLD TARE		6455	6455	6455	
SOIL WET		4436	4589	4513	
WET DENSITY		130.2	134.7	132.5	
CAN NUMBER		53	50	32	
WET + TARE		496.6	421.7	479.7	
DRY + TARE		450.1	374.2	419.7	
LOSS		46.5	47.5	60.0	
TARE		8.1	8.4	8.3	
DRY SOIL		442.0	365.8	411.4	
% MOISTURE		10.5	13.0	14.6	
DRY DENSITY		117.8	119.2	115.6	✓
		+4	+6	+8	

ROCK CONTENT

WEIGHT OF TOTAL SAMPLE 26748

PLUS 3" WT. 0 % 0

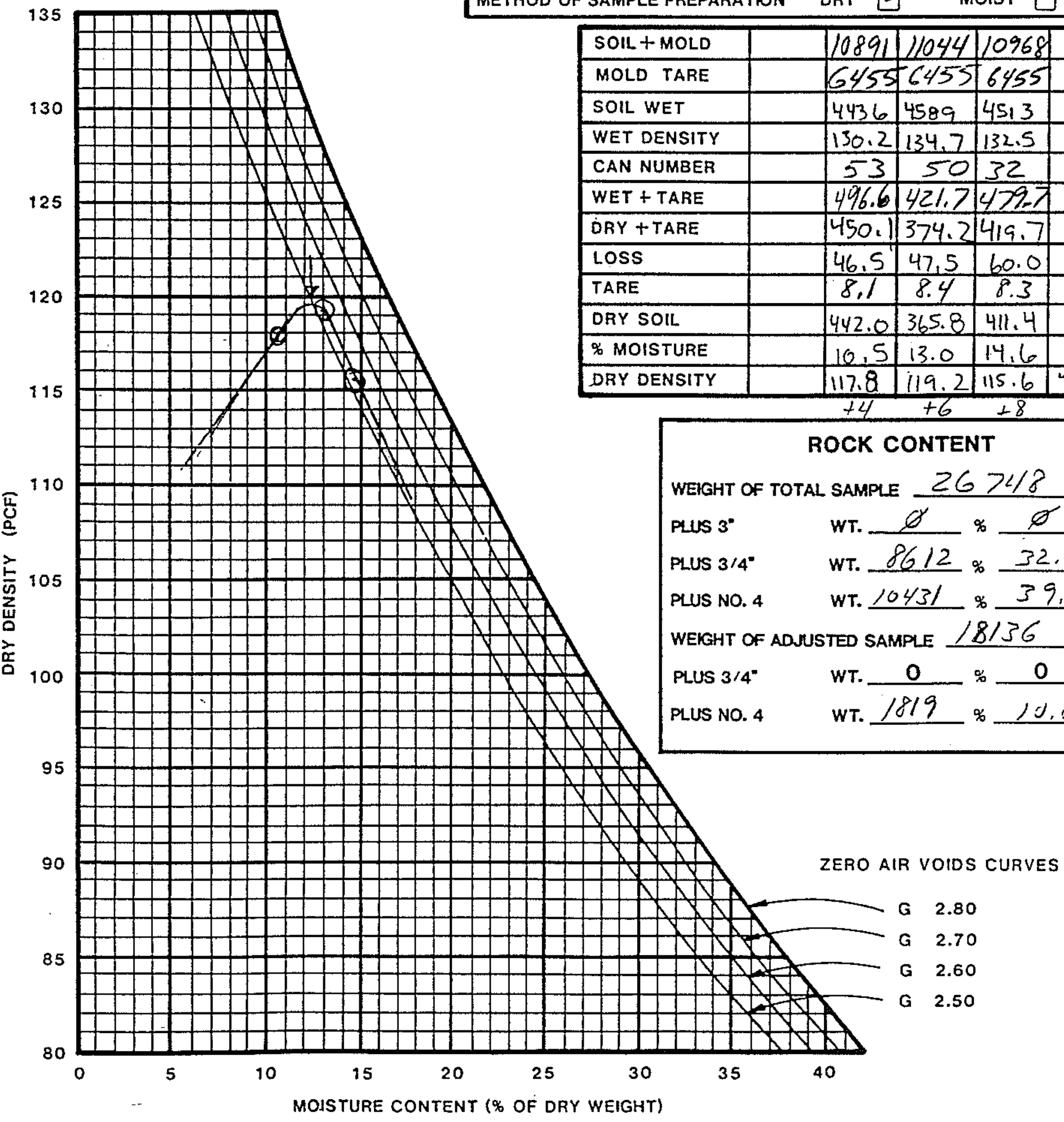
PLUS 3/4" WT. 8612 % 32.2

PLUS NO. 4 WT. 10431 % 39.0

WEIGHT OF ADJUSTED SAMPLE 18136

PLUS 3/4" WT. 0 % 0

PLUS NO. 4 WT. 1819 % 10.0



Ninyo & Moore

MAXIMUM DENSITY TEST DATA

TRS

PROJECT NAME CH2m Hill PROJECT NO. 102208 - 01

DATE ______ SAMPLE LOCATION TP-6 + TP-2 DEPTH ______ TECHNICIAN TS

SOIL DESCRIPTION ML - CL - Light Brown silty clay

TEST RESULTS

MAXIMUM DENSITY 111.9

OPTIMUM MOISTURE 15.7

TEST PROCEDURE

ASTM DESIGNATION D1557-78 ☒ D698-78 ☐ METHOD A

AASHTO T180-86 METHOD C (MODIFIED) ☐

MAXIMUM PARTICLE SIZE	NO. 4	☒	3/4"	☐
VOLUME OF MOLD (CU.FT.)	1/30	☒	1/13.33	☐
TYPE OF RAMMER	MANUAL	☒	MECHANICAL	☐
METHOD OF SAMPLE PREPARATION	DRY	☒	MOIST	☐

SOIL + MOLD	6121	6168	6165	6066	
MOLD TARE	4209	4209	4209	4209	
SOIL WET	1912	1959	1956	1857	
WET DENSITY	126.4	129.5	129.3	122.7	
CAN NUMBER	20	40	23	19	
WET + TARE	180.4	198.5	189.6	161.1	
DRY + TARE	162.0	175.5	164.8	147.2	
LOSS	18.4	23.0	24.8	13.9	
TARE	29.0	29.1	28.9	28.8	
DRY SOIL	133.0	146.4	135.9	118.4	
% MOISTURE	13.8	15.7	18.2	11.7	✓
DRY DENSITY	111.1	111.9	109.4	109.8	
	4	6	8	2	

ROCK CONTENT

WEIGHT OF TOTAL SAMPLE ______

PLUS 3" WT. ______ % ______

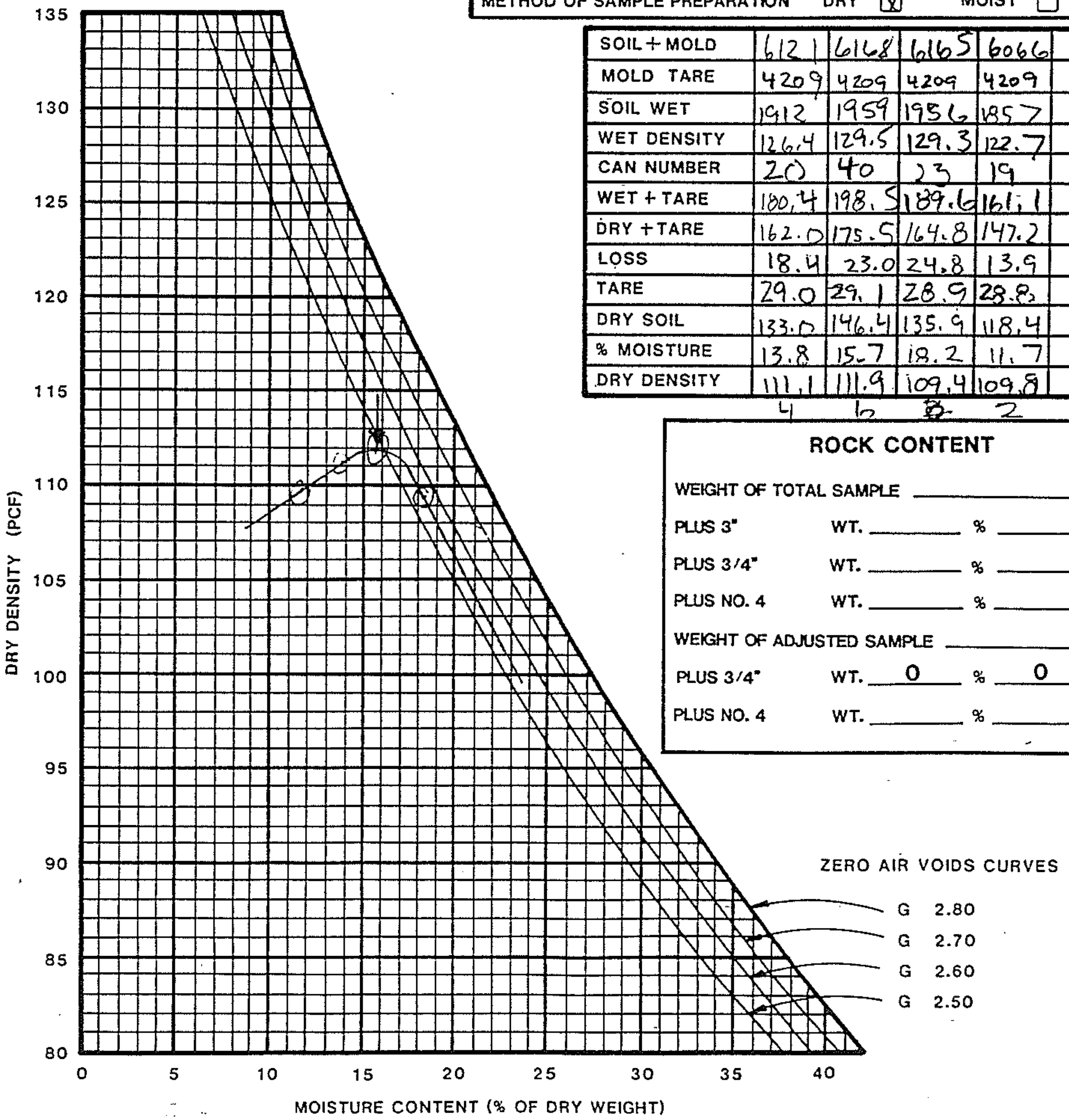
PLUS 3/4" WT. ______ % ______

PLUS NO. 4 WT. ______ % ______

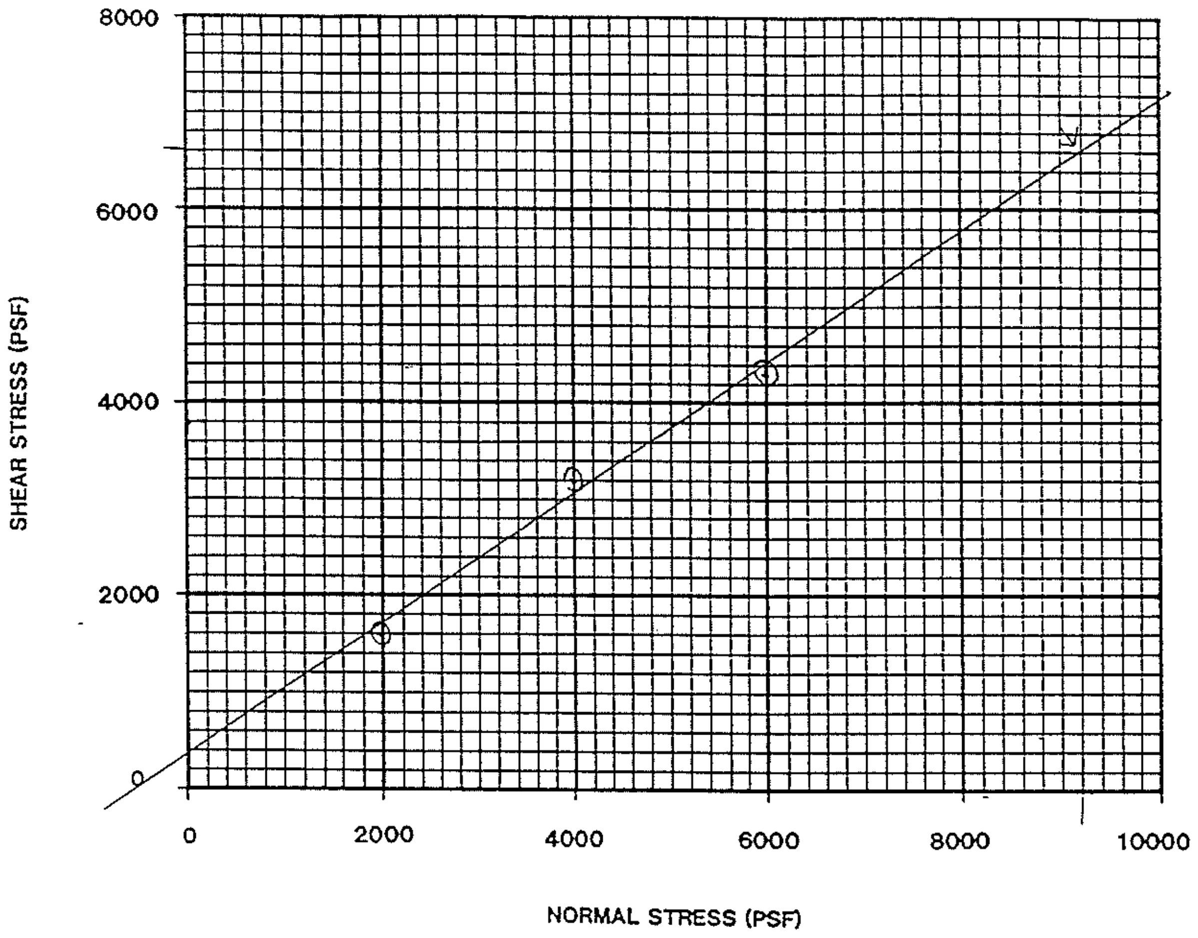
WEIGHT OF ADJUSTED SAMPLE ______

PLUS 3/4" WT. 0 % 0

PLUS NO. 4 WT. ______ % ______



DRS



Description	Symbol	Boring Number	Sample Number	Depth (Feet)	Cohesion (PSF)	Friction Angle	Soil Type
IN SITU		B8	6C	25'	390	34.0	SM

6600
390
6210 ÷ 9200

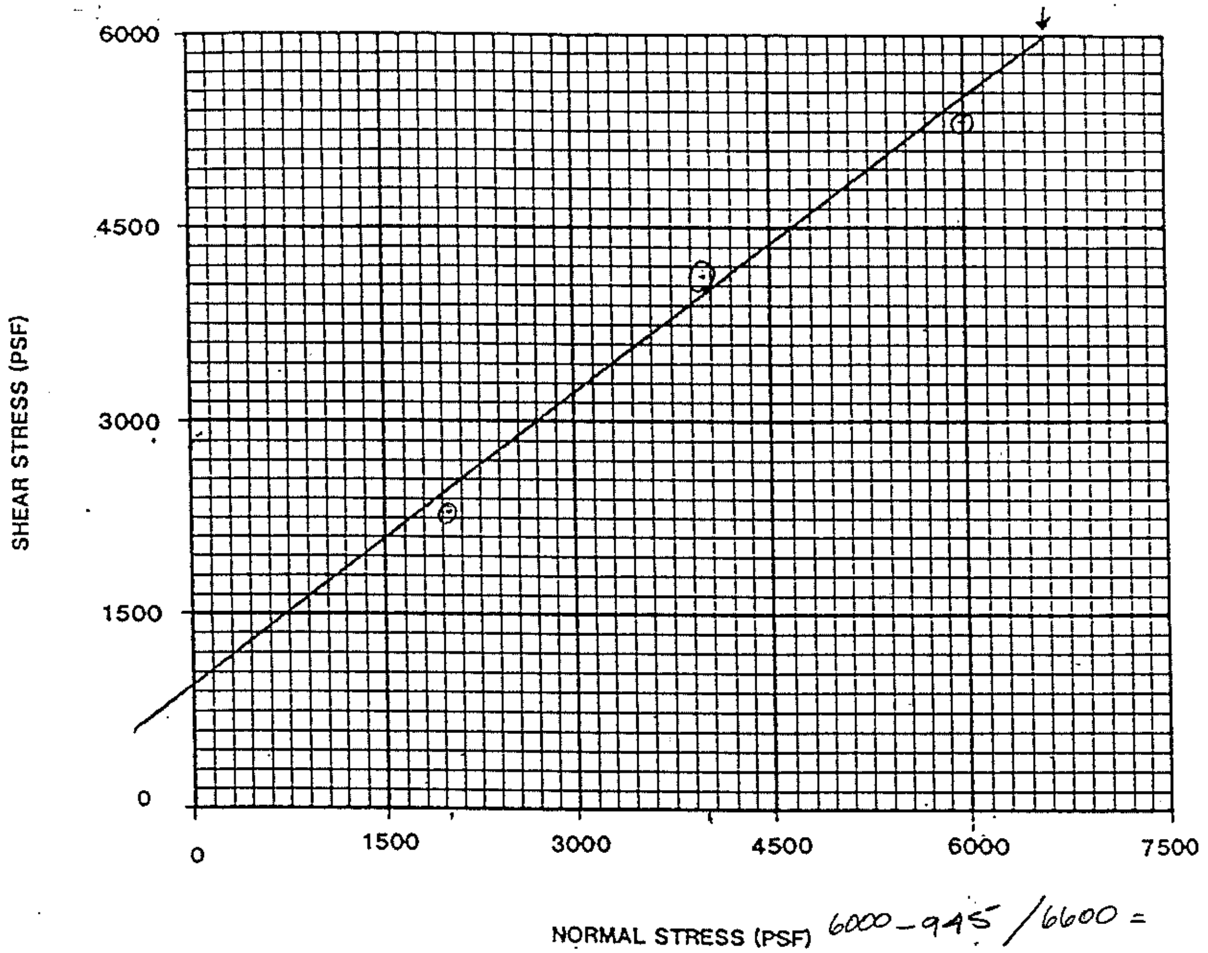
Ninyo & Moore

DIRECT SHEAR TEST RESULTS

CH2M Hill

PROJECT NO.	DATE	FIGURE
102208-01	1-8-92	

DRS



6000 - 945 / 6600 =

INV TAN

Description	Symbol	Boring Number	Sample Number	Depth (Feet)	Cohesion (PSF)	Friction Angle	Soil Type
IN SITU		B-13		20'	945	37.4	ML-CL

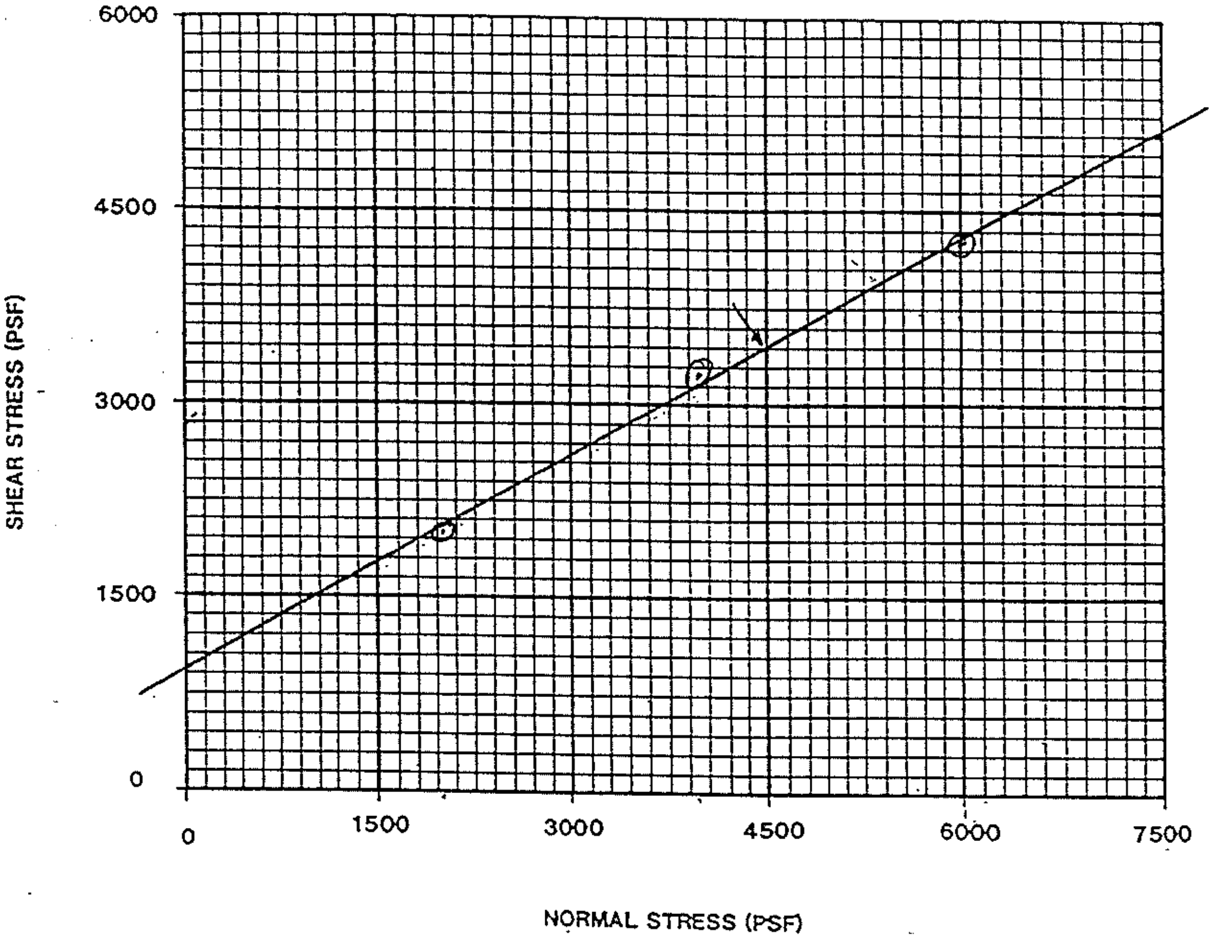
Ninyo & Moore

DIRECT SHEAR TEST RESULTS

CH2M HILL /NCTP

PROJECT NO.	DATE	FIGURE
2208-01	1/10/91	

DCS



Description	Symbol	Boring Number	Sample Number	Depth (Feet)	Cohesion (PSF)	Friction Angle	Soil Type
REMOLDED		TP-6		2B	950	29.1°	ML

3450
− 950
2500 ÷ 4500
INV TAN

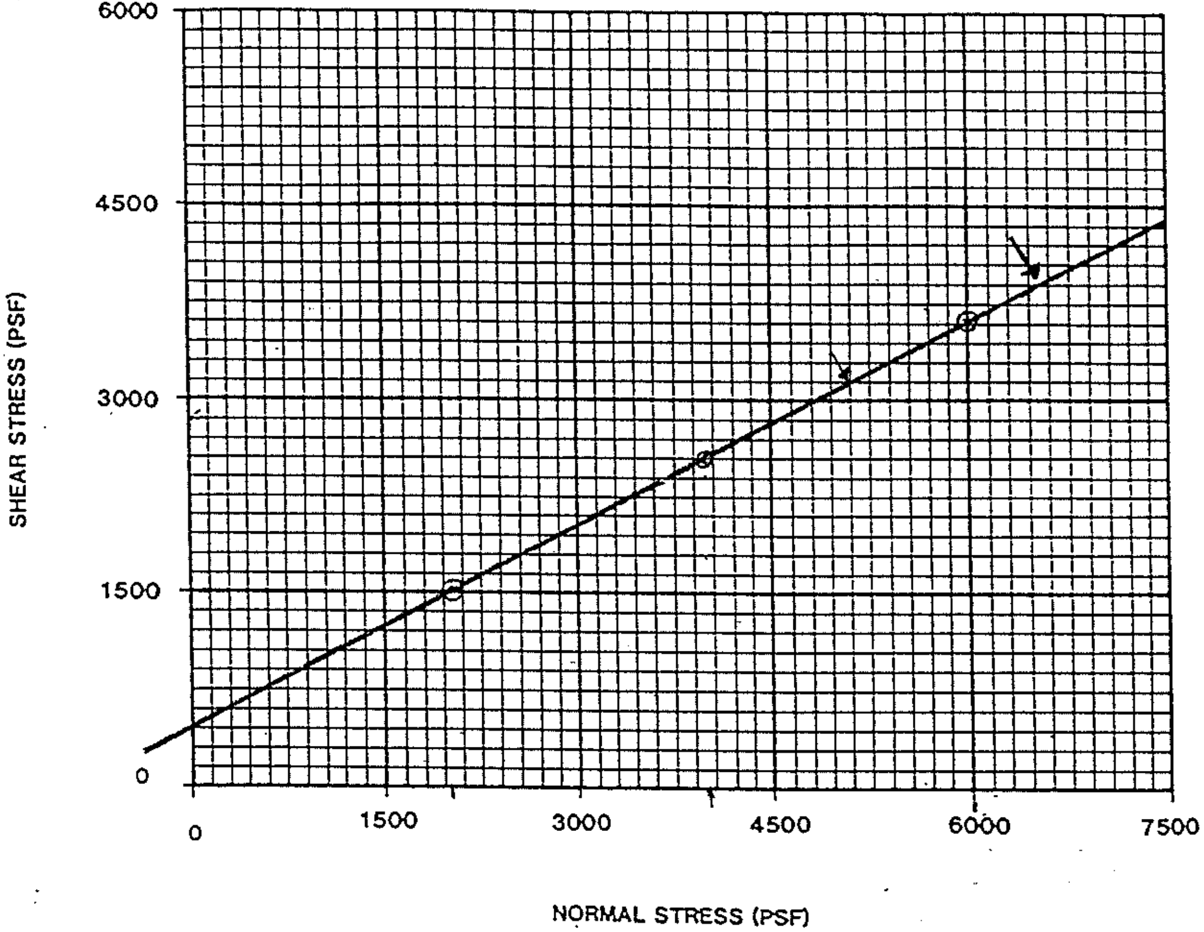
DIRECT SHEAR TEST RESULTS

Ninyo & Moore

CH2M HILL/NCTP

PROJECT NO.	DATE	FIGURE
102208-01	1/3/91	

DRS



Description	Symbol	Boring Number	Sample Number	Depth (Feet)	Cohesion (PSF)	Friction Angle	Soil Type
REMOLDED		TP-1		2B	450	27.9°	ML

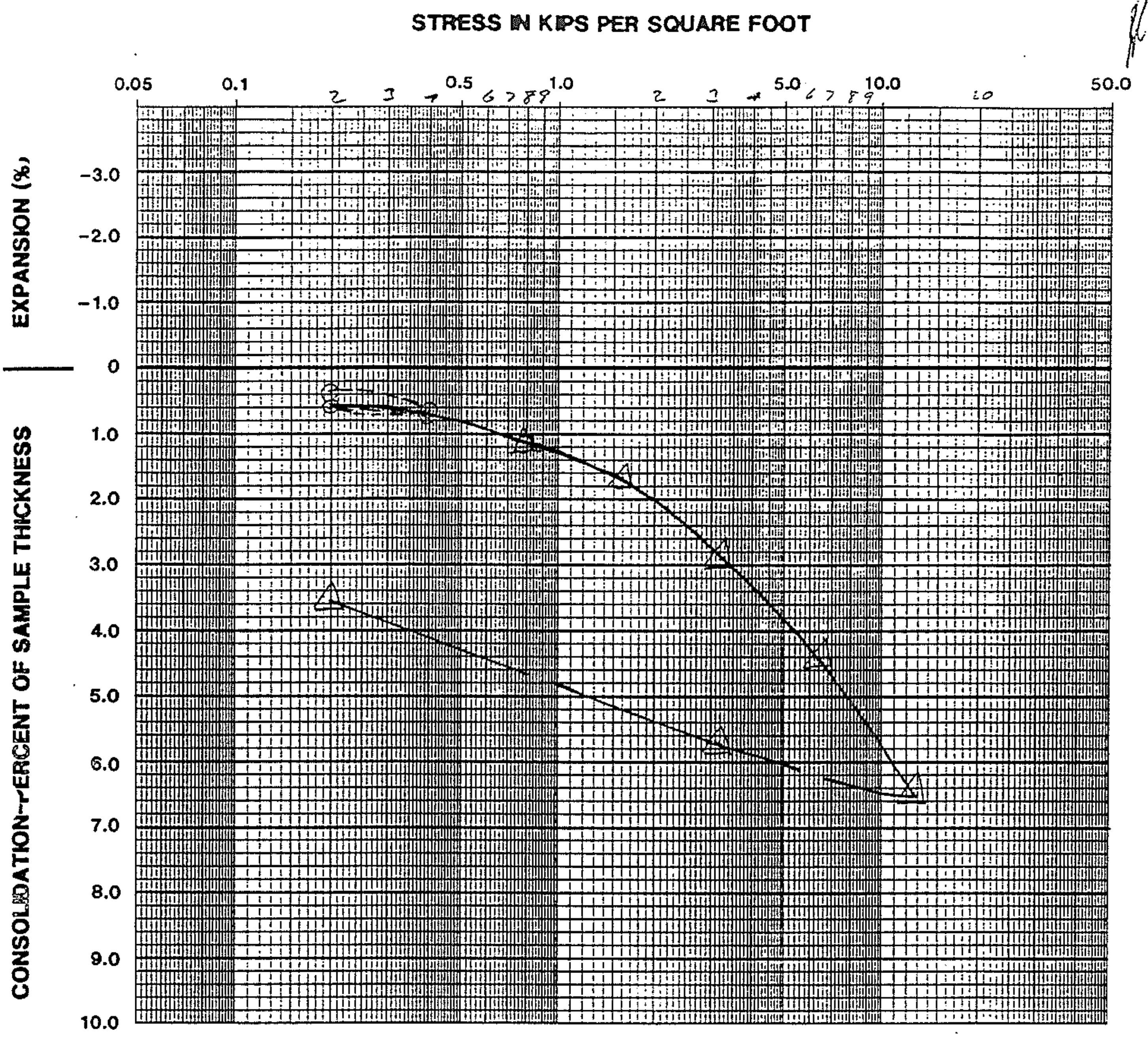
3150
450
2700 ÷ 5100
INV TAN

Ninyo & Moore

DIRECT SHEAR TEST RESULTS

CH2M HILL /NCTD

PROJECT NO.	DATE	FIGURE
102208-01	1/7/91	



● **Field Moisture** ———————— **Loading** **Boring No.** B 8

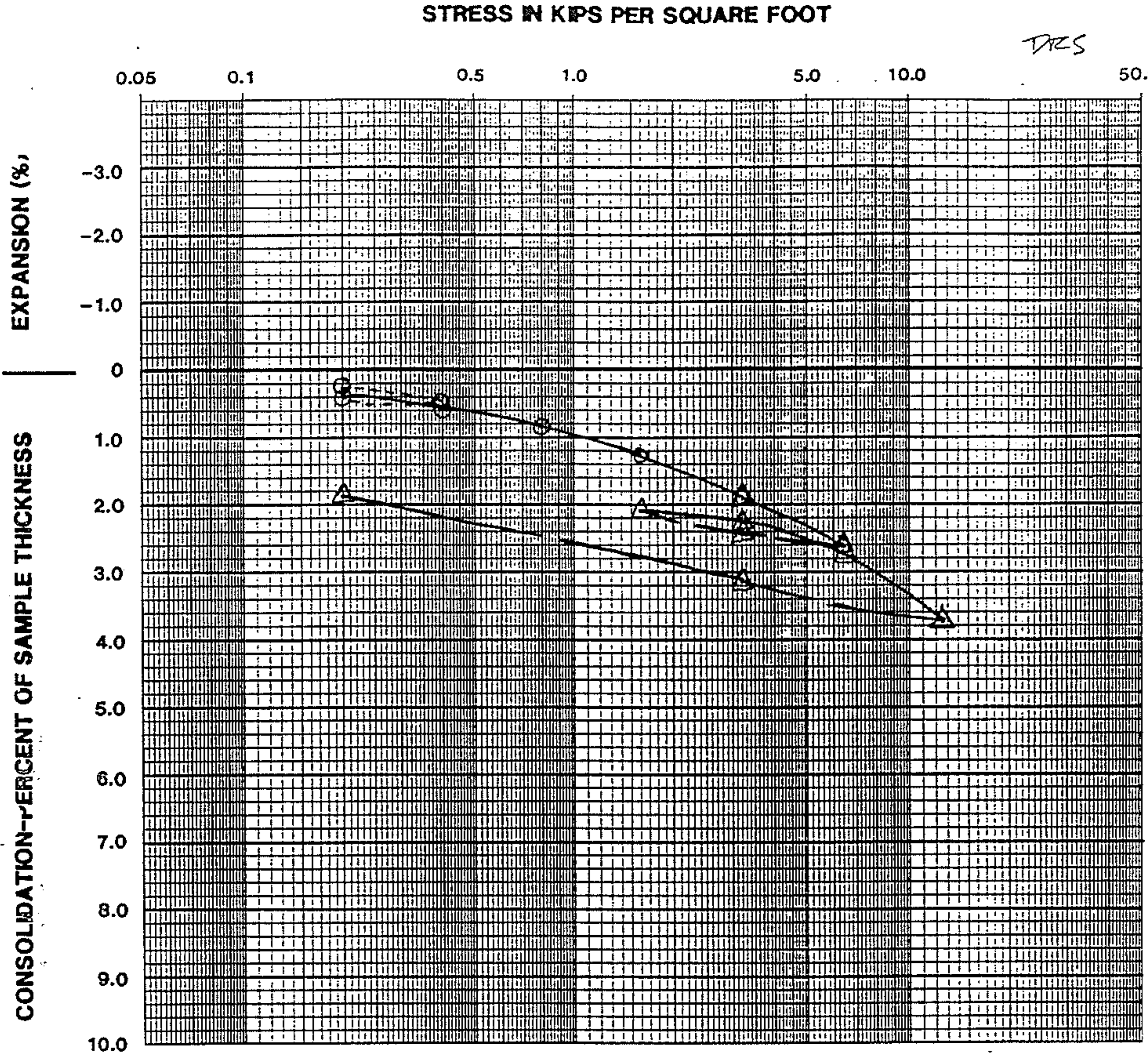
▲ **Inundated** ——— ——— **Rebound** **Depth (FT.)** 15

- - - - - - - - - **Seating Cycle** **Soil Type** SC

Ninyo & Moore

CONSOLIDATION TEST RESULTS		
CH2M Hill		
PROJECT NO.	DATE	FIGURE
102208-01	12-31-91	

DRS



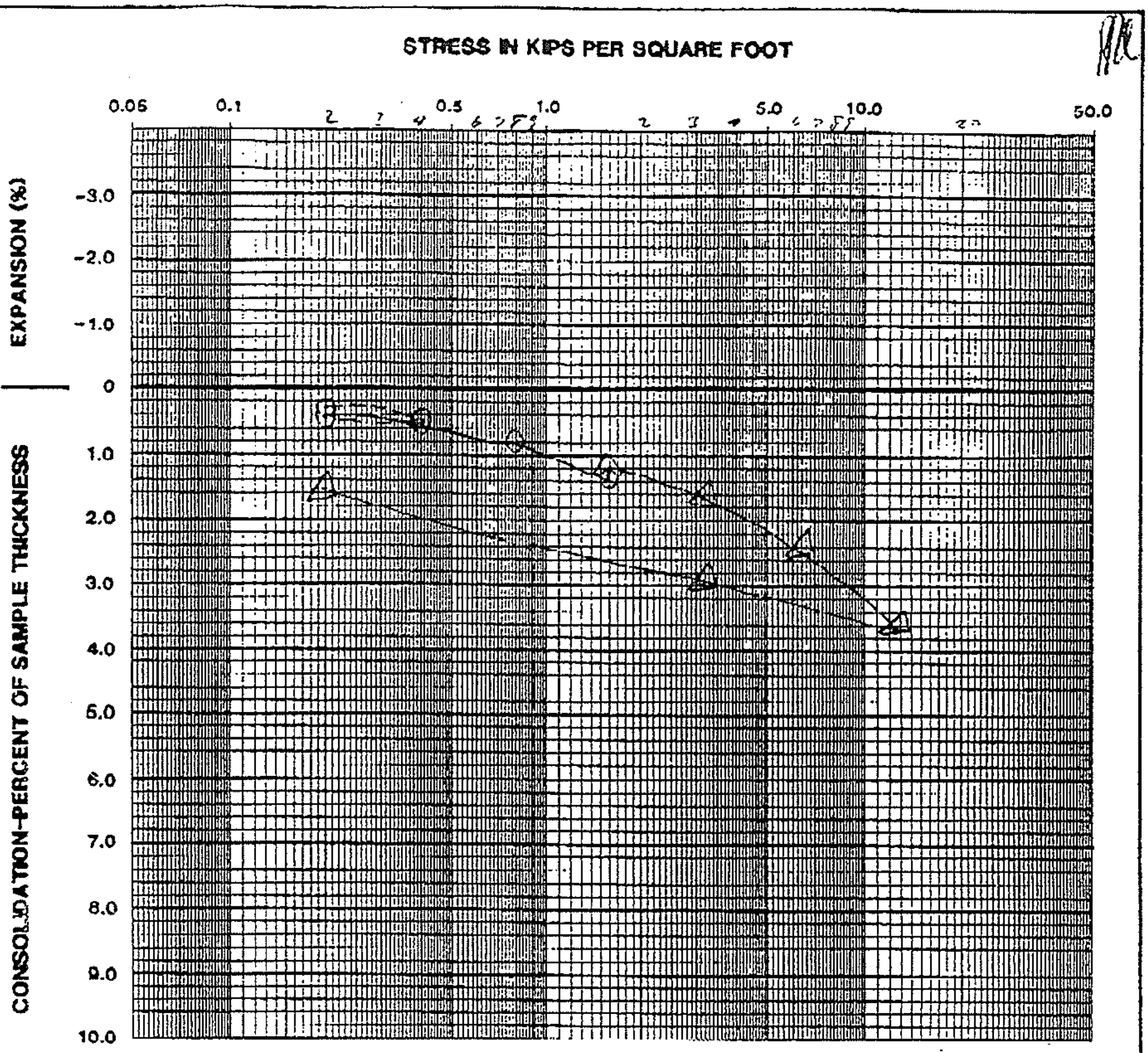
● Field Moisture	———————— Loading	Boring No.	B 13
▲ Inundated	———— ———— Rebound	Depth (FT.)	25'
	- - - - - - - - - Seating Cycle	Soil Type	SM + CL

Ninyo & Moore

CONSOLIDATION TEST RESULTS

CH2M Hill

PROJECT NO.	DATE	FIGURE
102208-01	12-31-91	



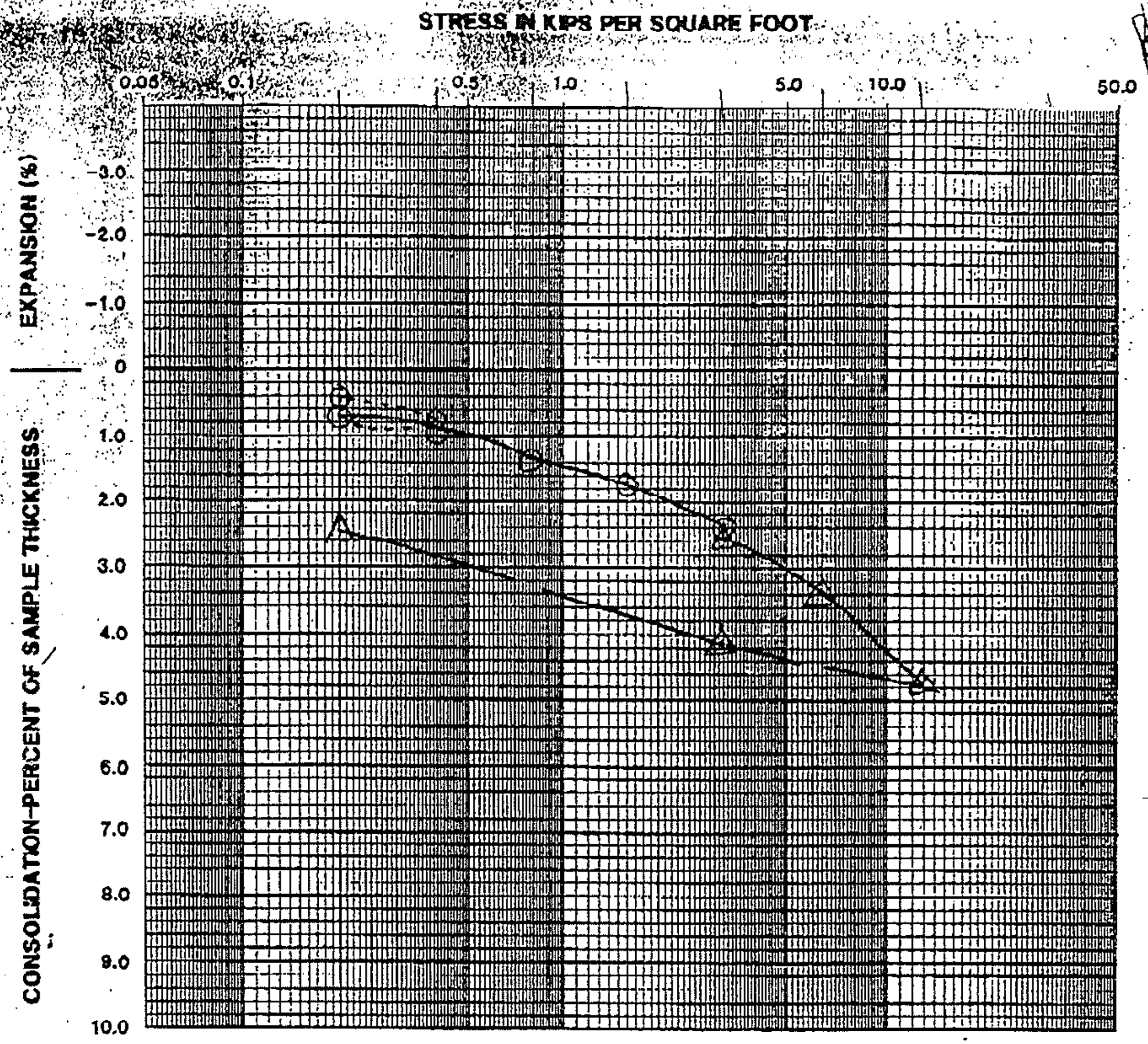
● **Field Moisture** ———————— **Loading** **Boring No.** B 15

▲ **Inundated** ——— ——— **Rebound** **Depth (FT.)** 10

- - - - - - - - - **Seating Cycle** **Soil Type** ML

Ninyo & Moore

CONSOLIDATION TEST RESULTS		
CH2M Hill		
PROJECT NO.	DATE	FIGURE
102208-01	1-24-92	



● Field Moisture

———— Loading

Boring No. B-16

▲ Inundated

—— —— Rebound

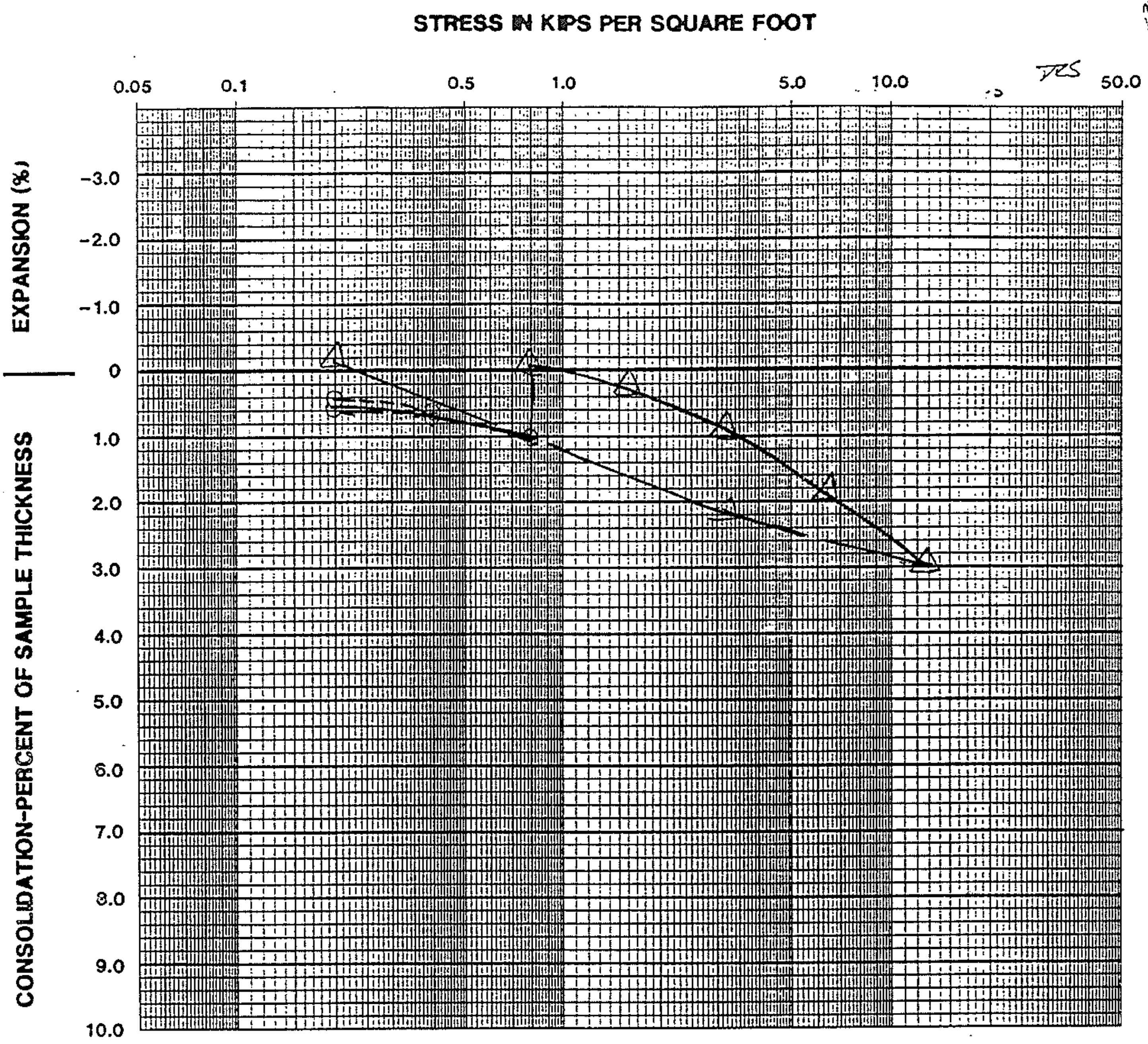
Depth (FT.) 25'

- - - - - - - - - Seating Cycle

Soil Type ML-CL

Ninyo & Moore

CONSOLIDATION TEST RESULTS		
CH2M Hill / NCTP		
PROJECT NO.	DATE	FIGURE
102208-01	1-27-92	

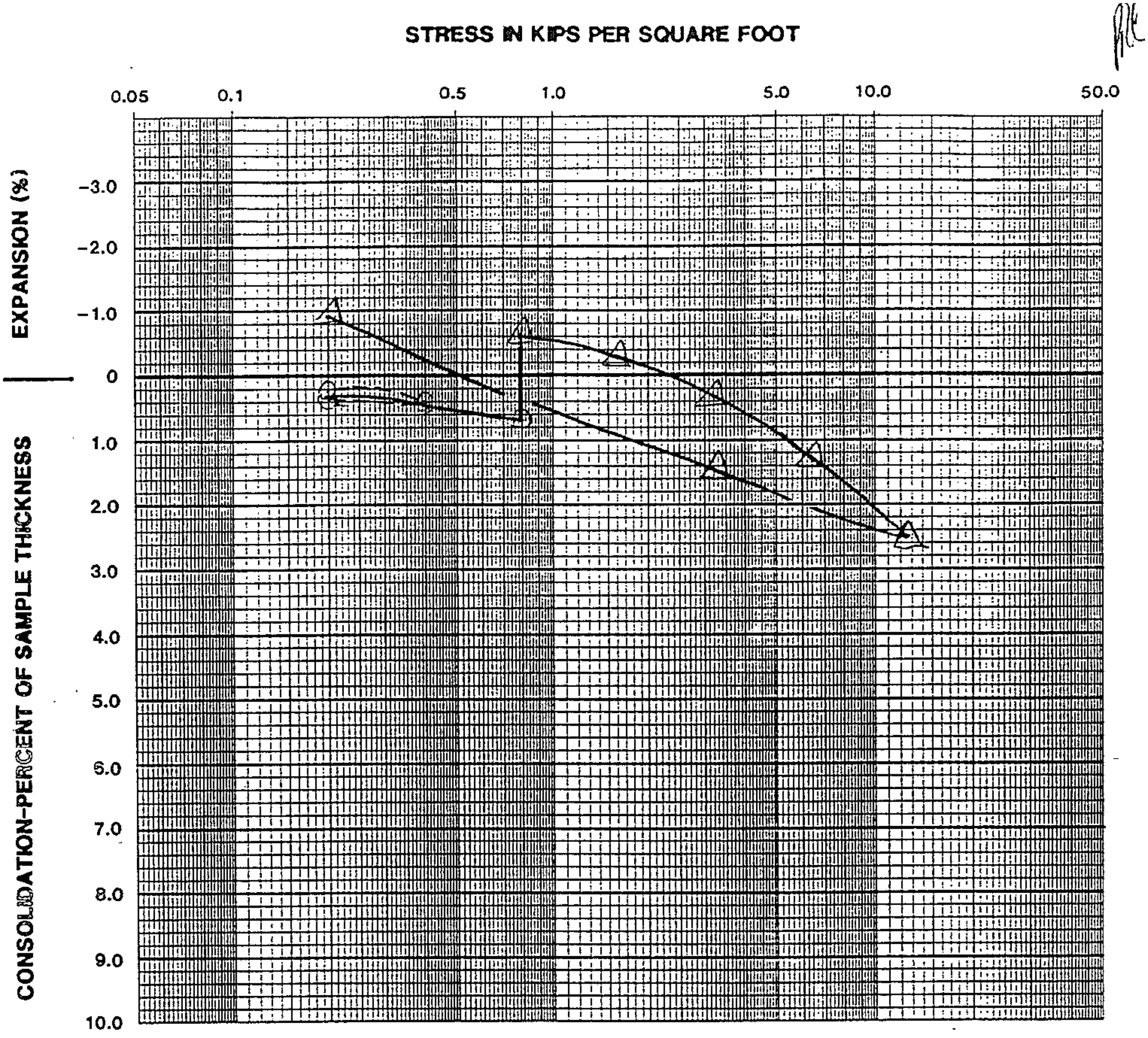


REMOLDED

●	Field Moisture	————————	Loading	Boring No.	TP1
▲	Inundated	———— ————	Rebound	Depth (FT.)	2 B
		- - - - - - - - -	Seating Cycle	Soil Type	ML

Ninyo & Moore

CONSOLIDATION TEST RESULTS		
CH2M Hill		
PROJECT NO.	DATE	FIGURE
102208-01	1-8-92	



REMOLDED

● Field Moisture ———— Loading

▲ Inundated ——— ——— Rebound

- - - - - - - - - Seating Cycle

Boring No. TP6

Depth (FT.) 2 B

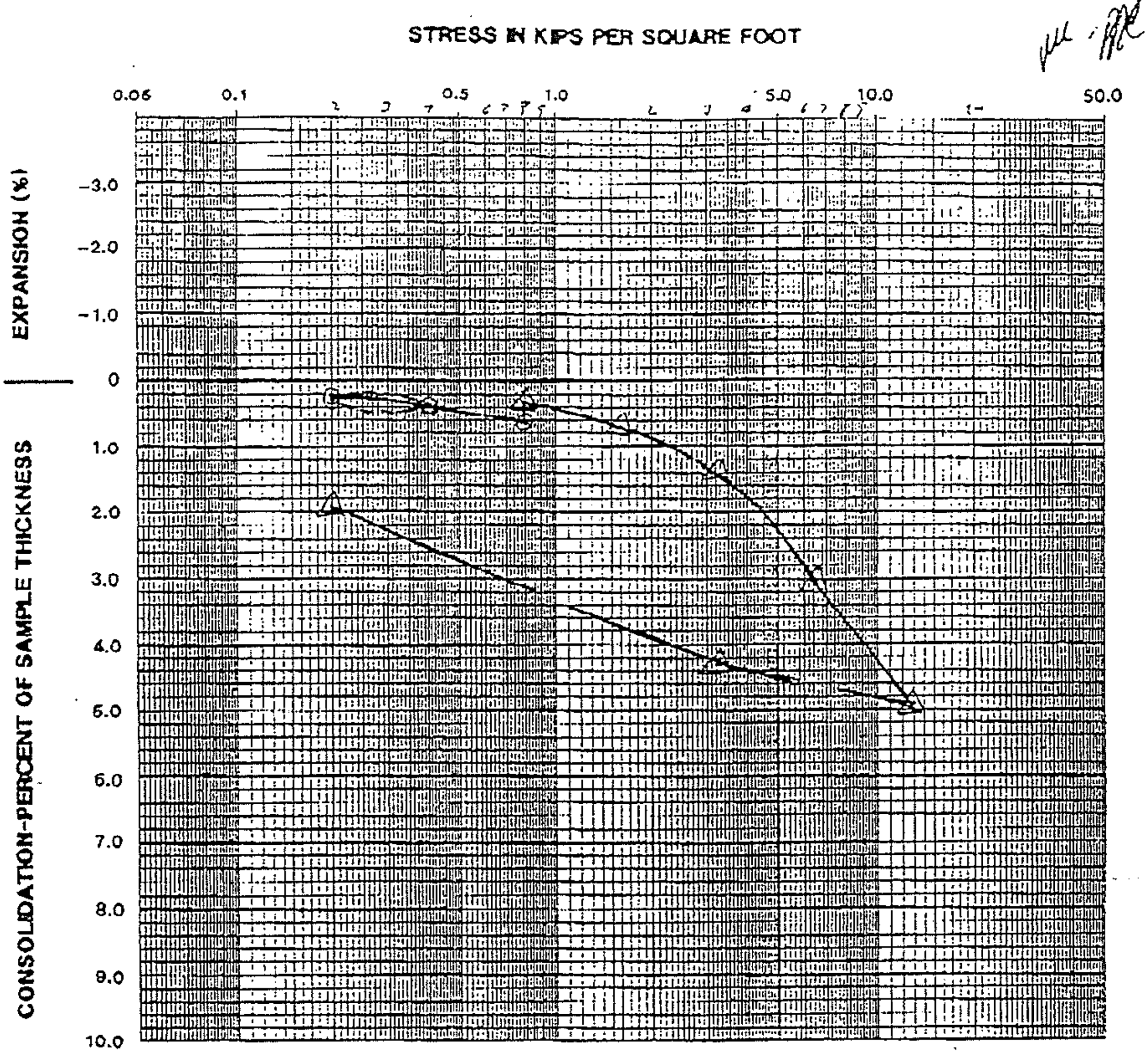
Soil Type ML

Ninyo & Moore

CONSOLIDATION TEST RESULTS

CH2M Hill

PROJECT NO.	DATE	FIGURE
102208-01	1-8-92	



REMOLDED

● Field Moisture	———————— Loading	**Boring No.**	TP1-2B
▲ Inundated	———— ———— Rebound	**Depth (FT.)**	5
	- - - - - - - - - Seating Cycle	**Soil Type**	ML

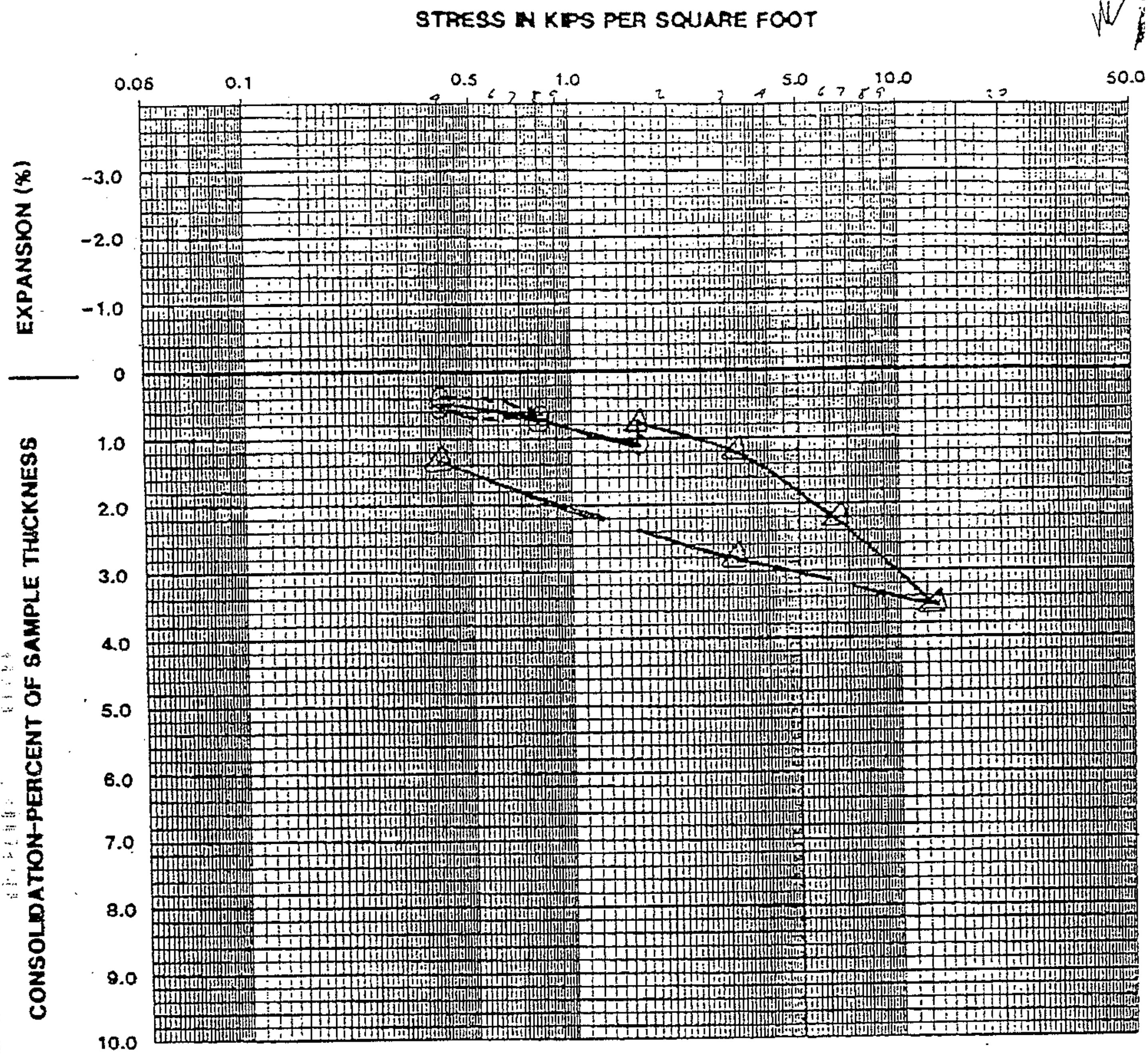
INUNDATED AT 0.8 KSF

Ninyo & Moore

CONSOLIDATION TEST RESULTS

CH2M Hill/NCTP

PROJECT NO.	DATE	FIGURE
102207-01	2-27-92	



● Field Moisture ———— Loading

▲ Inundated —— —— Rebound

- - - - - - - - - Seating Cycle

REMOLDED

Boring No. TP1

Depth (FT.) 2 B

Soil Type ML

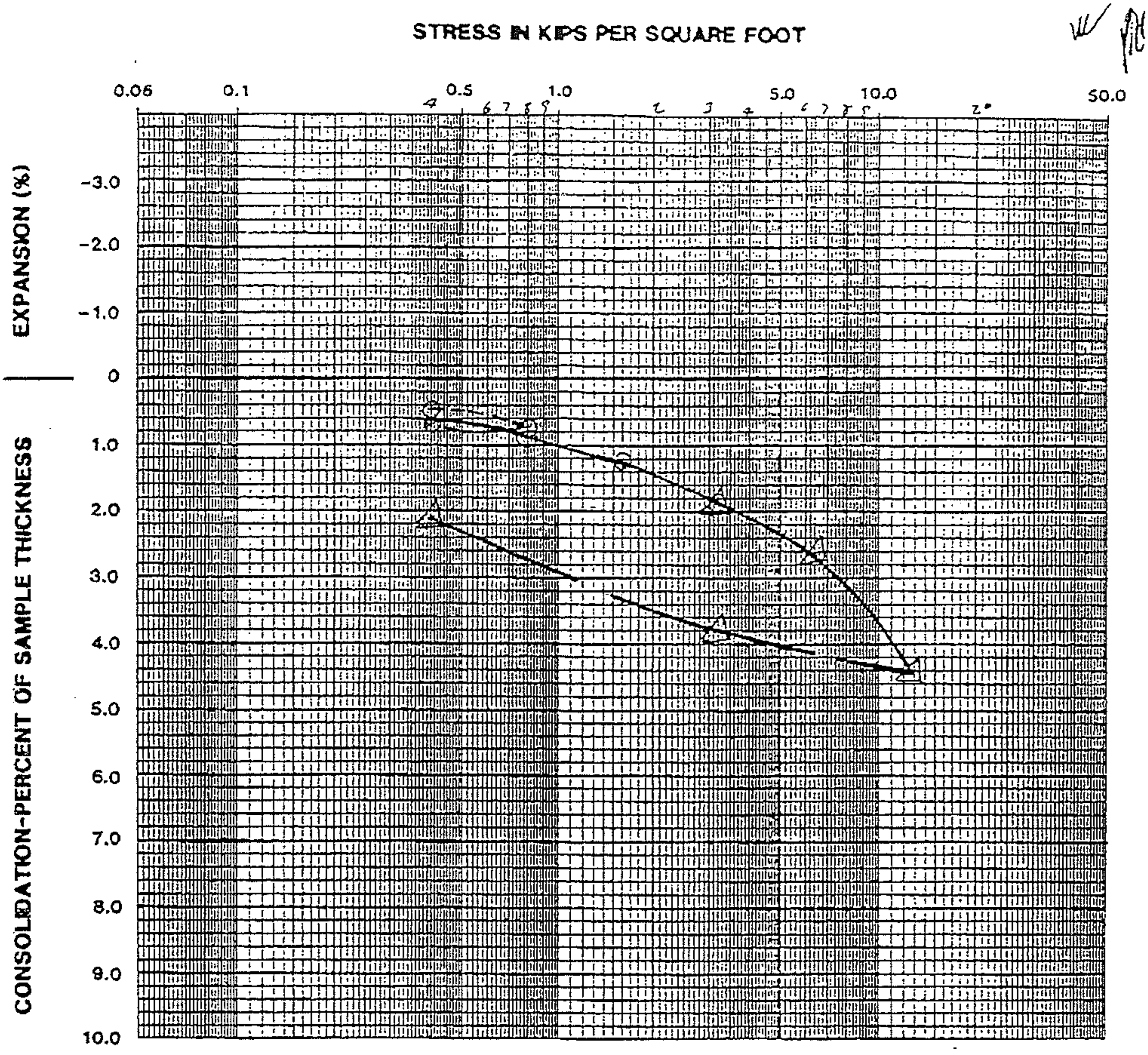
INUNDATED AT 1.6 KSF

CONSOLIDATION TEST RESULTS

Ninyo & Moore

CH2 M Hill / NCTP

PROJECT NO.	DATE



● Field Moisture

▲ Inundated

——— Loading

—— —— Rebound

- - - - - - Seating Cycle

REMOLDED
Boring No. TP1

Depth (FT.) 2 B

Soil Type ML

INUNDATED AT 3.2 KSF

Ninyo & Moore

CONSOLIDATION TEST RESULTS

CH2M Hill / NCTP

PROJECT NO.	DATE	FIGURE

Ninyo & Moore

EXPANSION PRESSURE TEST DATA

PROJECT NAME CH2m Hill /NCTP PROJECT NUMBER 102208 -
SAMPLE LOCATION TP-1 TP-5 DEPTH ______ SURCHARGE (PSF) .5
DATE TESTED 1-16-92 TECHNICIAN TS MACHINE NO. 7
SOIL DESCRIPTION ML

EXPANSION TEST DATA

EXPANSION DATA

DATE	TIME	DIAL READING	WEIGHT OF SAND ADDED (g)	DIAL READING
1 16-92	16:50	.1000		
	16:51	.1053		
1-20-92	07:02	.0955		
	0813	.0956		
	0815	.1000	H2O	.1000
	0821	.0994	300	.0916
	0832	.0995	200	.0998
	0900	.1000	—	.1000
1-21	0737	.0999	—	.0999
	15:10	.1003		.1003

TOTAL WEIGHT OF SAND ADDED (g) 500
TOTAL ELAPSED TIME (HRS) 32
EXPANSION PRESSURE (psf) 850 PSF

MOISTURE AND DENSITY DATA

MOISTURE	BEFORE EXPANSION	AFTER EXPANSION
CAN NUMBER	31	31
WEIGHT OF WET SOIL + RING + CAN	220.5	230.3
WEIGHT OF DRY SOIL + RING + CAN	201.7	201.7
WEIGHT OF WATER	18.8	28.6
WEIGHT OF RING	45.4	45.4
WEIGHT OF CAN	29.0	29.0
WEIGHT OF DRY SOIL	127.3	127.3
PERCENT MOISTURE	14.8	22.5
DENSITY		
WEIGHT OF WET SOIL + RING + CAN	220.5	230.3
WEIGHT OF RING	45.4	45.4
WEIGHT OF CAN	29.0	29.0
WEIGHT OF WET SOIL	146.1	155.9
WET DENSITY	121.3	129.4
DRY DENSITY	105.7	105.6

REMARKS EMC = 6.8 Rem 95% 111.7 @ 14.8
Batch 322.5
Soil Per Ring 146.8
192.2

Ninyo & Moore

EXPANSION PRESSURE TEST DATA

PROJECT NAME CH2m Hill / NCTP PROJECT NUMBER 102208-01

SAMPLE LOCATION TP-6 TP-21 DEPTH 2B SURCHARGE (PSF) .5

DATE TESTED 1-15-92 TECHNICIAN TS MACHINE NO. 8

SOIL DESCRIPTION ML

EXPANSION TEST DATA

EXPANSION DATA

DATE	TIME	DIAL READING	WEIGHT OF SAND ADDED (g)	DIAL READING
1-15-92	13:16	.1000		
	13:17	.1063		
1-16-92	09:00 11:08 13:08	.1081 .1083 .1086		
1-20-92	07:02	.1100		
	0813	.1101		
	0816	.1000	H20	.1000
	0820	.0991	1200	.0999
	0825	.0990	400	.0994
	0827	.0994	400	.1001
	0900	.0998	200	.1000
1-21	0737	.1000	—	.1000
	1510	.1004	—	.1004

TOTAL WEIGHT OF SAND ADDED (g) 2200 grams

TOTAL ELAPSED TIME (HRS) 32

EXPANSION PRESSURE (psf) 2050 PSF

MOISTURE AND DENSITY DATA

MOISTURE	BEFORE EXPANSION	AFTER EXPANSION
CAN NUMBER	16	16
WEIGHT OF WET SOIL + RING + CAN	221.9	231.2
WEIGHT OF DRY SOIL + RING + CAN	201.7	201.7
WEIGHT OF WATER	20.2	29.5
WEIGHT OF RING	45.0	45.0
WEIGHT OF CAN	29.0	29.0
WEIGHT OF DRY SOIL	127.7	127.7
PERCENT MOISTURE	15.8	23.1
DENSITY		
WEIGHT OF WET SOIL + RING + CAN	221.9	231.2
WEIGHT OF RING	45.0	45.0
WEIGHT OF CAN	29.0	29.0
WEIGHT OF WET SOIL	147.9	157.2
WET DENSITY	122.8	130.5
DRY DENSITY	106.0	106.0

REMARKS Cmc = 9.5 Rem 95* 111.9 @ 15.7

Batch = 317.0

Soil per Ring = 148.2 Ring = 45.0

Appendix D
Data from Previous Explorations

Preliminary Geotechnical Reconnaissance, Proposed North City Sludge Processing Sites

by

Geotechnical Consultants, Inc.

GEOTECHNICAL CONSULTANTS, INC.

PRELIMINARY GEOTECHNICAL RECONNAISSANCE

PROPOSED SLUDGE-PROCESSING SITE

NORTH CITY - NORTH

CITY OF SAN DIEGO, CALIFORNIA

FOR

METCALF AND EDDY

FEBRUARY 1990

S89012

1533 East 4th Street · Santa Ana · CA 92701 · Phone (714) 547-5413

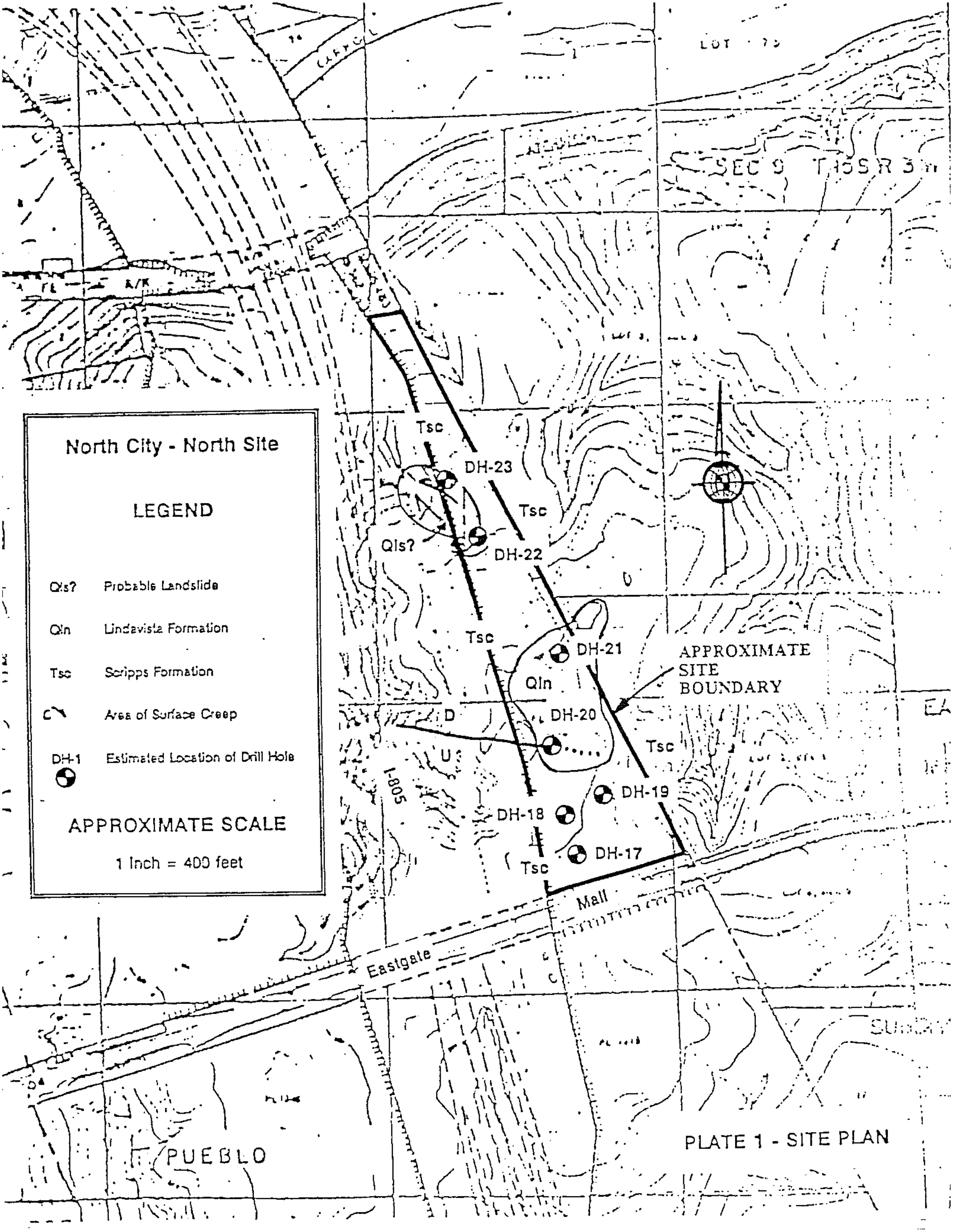


PLATE 1 - SITE PLAN

LOG OF DRILL HOLE

B NO.: S89012
ROJECT: Sludge Processing Sites
OCATION: North City-North
RILLING METHOD: Hollow Stem Auger, 7-inch

LOGGED BY: J. Thurber
CHECKED BY:

DRILL HOLE NO.: 17
DRILLING DATE: January 6, 1990
DATUM: City of San Diego
REFERENCE EL.: 380 Feet

LEVATION (FEET)	DEPTH	DRILLING RATE	REAL TIME/DEPTH	SAMPLE	SAMPLE NO.	BLOW COUNT (BLOWS PER FOOT)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT (%)	ATTERBERG LIMITS PLASTIC LIMIT (%)	TORVANE (PSF)	ADDITIONAL TESTS
80								"COLLUVIUM (Qc)" SANDY SILT (ML) brown, dry, soft.						
	5				1	72		""SCRIPPS FORMATION (Tsc)" SILTY SANDSTONE (R) light brown, damp, dense, sand is very fine to fine grained, locally oxidized, faintly laminated. Local volcanic gravel at 2 to 3 feet.						
70	10				2	86		Very finely laminated, 2-3 degree dip.						
	15				3	50/ 5.5"		"SCRIPPS FORMATION (Tsc)" CLAYEY SILTSTONE/SANDSTONE (R) light gray and light brown, damp, stiff-dense, sand is very fine grained, minor clay.						
								Firm, slow drilling.						
60	20				4	89		CLAYEY SILTSTONE (R) laminated gray and brown, laminations are subhorizontal.						
	25				5	50/ 6"		SILTSTONE/SANDSTONE (R) light brown, damp, dense, finely laminated.						
50	30				6	50/ 6"		SANDSTONE (R) very fine grained, moderate amount of silt, locally oxidized.						
								Bottom of drill hole at 30 feet. No groundwater encountered. Drill hole backfilled and tamped.						

LEGEND TO LOGS ON PLATE A-2

LOG OF DRILL HOLE

JOB NO.: S89012
PROJECT: Sludge Processing Sites
LOCATION: North City-North
DRILLING METHOD: Hollow Stem Auger, 7-inch

LOGGED BY: M. Hosseini
CHECKED BY: J. Thurber

DRILL HOLE NO.: 18
DRILLING DATE: January 8, 1990
DATUM: City of San Diego
REFERENCE EL.: 380 Feet

ELEVATION (FEET)	DEPTH	DRILLING RATE	REAL TIME/DEPTH	SAMPLE	SAMPLE.NO.	BLOW COUNT (BLOWS PER FOOT)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT (%)	ATTERBERG LIMITS PLASTIC LIMIT (%)	TORVANE (PSF)	ADDITIONAL TESTS
380								"COLLUVIUM (Qc)" SILTY CLAY (CL) brown, dry, soft to medium stiff, scattered cobbles.						
	5				1	63		"SCRIPPS FORMATION (Tsc)" SILTSTONE (R) light gray-brown, dry to damp, dense, thin claystone interlaminations. Interlaminated Siltstone/Claystone. Scattered hematite cementation. CLAYEY SILTSTONE (R) light gray-brown, damp, stiff.						
370	10				2	89		Minor, thin, fine grained sand lenses.						
	15				3	50/4"		Interlaminated CLAYEY SILTSTONE/SILTY CLAYSTONE (R) light gray/light brown, damp, stiff, laminations dip 3-4 degrees, locally oxidized, minor organics.						
360	20				4	50/6"								
	25				5	85/11"		CLAYEY SILTSTONE (R) light gray-brown, damp, stiff to medium hard, finely laminated-subhorizontal, minor iron oxide.						
350	30				6	50/6"		Locally stiff, slow drilling. 2-3 inch Silty Sandstone layers, oxidized orange-brown, sand is very fine grained.						
	35				7	88		CLAYEY SILTSTONE (R) light green-grey, damp, stiff, laminations subhorizontal, locally oxidized, minor organic matter, thin (less than 1/2 inch) medium grained sand layers.						
340	40				8	86/11"		Interbedded Sandy Siltstone (R) and Clayey Siltstone (R) light gray, damp, stiff, sand is fine grained, 4-6 inch beds.						

Bottom of drill hole at 40.5 feet.
No groundwater encountered.
Drill hole backfilled and tamped.

SHEET 1 OF 1

LEGEND TO LOGS ON PLATE A-2

PLATE A-1.2

LOG OF DRILL HOLE

JOB NO.: S89012
PROJECT: Sludge Processing Sites
LOCATION: North City-North
DRILLING METHOD: Hollow Stem Auger, 7-inch

LOGGED BY: M. Hosseini
CHECKED BY: J. Thurber

DRILL HOLE NO.: 19
DRILLING DATE: January 8, 1990
DATUM: City of San Diego
REFERENCE EL.: 380 Feet


GRAPHIC LOG

ELEVATION (FEET)	DEPTH	DRILLING RATE	REAL TIME/DEPTH	SAMPLE	SAMPLE NO.	BLOW COUNT (BLOWS PER FOOT)	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		TORVANE (PSF)	ADDITIONAL TESTS
										LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
380							"COLLUVIUM (Qc)" CLAYEY GRAVEL (Gc) brown, dry, dense, abundant cobbles.						
	5				1	51	"SCRIPPS FORMATION (Tsc)" SILTSTONE/CLAYSTONE (R) light gray-brown, dry to damp, laminated. Laminations are subhorizontal, locally oxidized, scattered organic-rich clay inclusions.						
370	10				2	52	SANDSTONE (R) very fine-grained, light gray, damp, dense (indurated), friable, uniform texture.						
	15				3	50/ 6"	Interlaminated SILTSTONE/CLAYSTONE (R) light gray/brown, damp, stiff (indurated), minor fine grained sand lenses.						
360	20				4	50/ 6"	SILTY SANDSTONE (R) light gray-brown, damp, dense, indurated, friable, locally oxidized. Sand is very fine grained. Streaks of tightly-cemented SILTSTONE (R) Very dense, well indurated SILTSTONE (R) bed, between 22 and 24 feet.						
	25				5	81	CLAYEY SILTSTONE (R) light gray-brown, damp, stiff (indurated), local oxidization, subhorizontal layers.						
350	30				6	89/ 11"	CLAYEY SILTSTONE (R) light gray-brown, damp, very stiff, locally hematite-stained along vertical micro-fractures. Scattered fine grained sand lenses. Very dense Siltstone layer at 32 feet.						
	35				7	89/ 11"	SILTSTONE (R) light grey/brown, damp, very firm, vertical and horizontal hematite stained fractures.						

Bottom of drill hole at 35.5 feet.
No groundwater encountered.
Drill hole backfilled and tamped.

LEGEND TO LOGS ON PLATE A-2

LOG OF DRILL HOLE

JOB NO.: S89012
PROJECT: Sludge Processing Sites
LOCATION: North City-North
DRILLING METHOD: Hollow Stem Auger, 7-inch

LOGGED BY: J. Thurber
CHECKED BY:

DRILL HOLE NO.: 20
DRILLING DATE: January 8, 1990
DATUM: City of San Diego
REFERENCE EL.: 380 Feet

ELEVATION (FEET)	DEPTH	DRILLING RATE	REAL TIME/DEPTH	SAMPLE	SAMPLE NO.	BLOW COUNT (BLOWS PER FOOT)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT (%)	ATTERBERG LIMITS PLASTIC LIMIT (%)	TORVANE (PSF)	ADDITIONAL TESTS
380								"COLLUVIUM (Qc)/LINDAVISTA FORMATION (Qln)" SANDY SILT (ML) brown, dry, soft, scattered cobbles at surface to 2 feet.						
	5				1	58		"SCRIPPS FORMATION (Tsc)" SILTSTONE (R) light brown, damp, stiff, locally medium hard, minor fine grained sand, thin (less than 1/4 inch) clay seams, damp, stiff, waxy.						
370	10				2	55		"SCRIPPS FORMATION (Tsc)" CLAYEY SILTSTONE (R) light gray and brown, damp, stiff, finely laminated subhorizontal sandy layers are oxidized orange-brown.						
	15				3	81		Laminations dip 2-3 degrees, minor to moderate amount of clay.						
360	20				4	72		Medium green-gray, damp, stiff to medium hard, laminated with numerous sand laminae, moderate amount of clay.						

Bottom of drill hole at 20.5 feet.
No groundwater encountered.
Drill hole backfilled and tamped.

SHEET 1 OF 1

LEGEND TO LOGS ON PLATE A-2

PLATE A-1.4

LOG OF DRILL HOLE

OB NO.: S89012
ROJECT: Sludge Processing Sites
OCATION: North City-North
RILLING METHOD: Hollow Stem Auger, 7-inch

LOGGED BY: J. Thurber
CHECKED BY:

DRILL HOLE NO.: 21
DRILLING DATE: January 8, 1990
DATUM: City of San Diego
REFERENCE EL.: 380 Feet

ELEVATION (FEET)	DEPTH	DRILLING RATE	REAL TIME/DEPTH	SAMPLE	SAMPLE NO.	BLOW COUNT (BLOWS PER FOOT)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		TORVANE (PSF)	ADDITIONAL TESTS
											LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
380								"COLLUVIUM (Qc)/LINDAVISTA FORMATION (Qln)" SANDY SILT (ML) brown, dry, soft, scattered gravel and cobble.						
	5				1	53		"SCRIPPS FORMATION (Tsc)" CLAYEY SILTSTONE (R) light gray-brown, damp, stiff, minor to moderate clay, brown clay layers with clay filling steep fractures, laminated, fissile.						
370	10				2	80		Moderate amount of clay, 1/4 inch Sand-Silt laminae. Laminations dip 2-4 degrees, minor organic matter locally along laminations.						
	15				3	50/ 5.5"		SANDY CLAYEY SILTSTONE (R) light gray, damp, stiff to medium hard, sand is very fine grained, near horizontal lamination, minor oxidization locally.						
360	20				4	75/ 11.5"		CLAYEY SILTSTONE (R) medium green gray, damp, stiff, laminations dip 3-4 degrees.						

Bottom of drill at 20.5 feet.
No groundwater encountered.
Drill hole backfilled and tamped.

SHEET 1 OF 1

LEGEND TO LOGS ON PLATE A-2

PLATE A-1.5

LOG OF DRILL HOLE

JOB NO.: S89012
PROJECT: Sludge Processing Sites
LOCATION: North City-North
DRILLING METHOD: Hollow Stem Auger, 7-inch

LOGGED BY: J. Thurber
CHECKED BY:

DRILL HOLE NO.: 22
DRILLING DATE: January 8, 1990
DATUM: City of San Diego
REFERENCE EL.: 350 Feet

ELEVATION (FEET)	DEPTH	DRILLING RATE	REAL TIME/DEPTH	SAMPLE	SAMPLE NO.	BLOW COUNT (BLOWS PER FOOT)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		TORVANE (PSF)	ADDITIONAL TESTS
											LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
350								"COLLUVIUM (Qc)" SANDY SILT (ML) brown, dry, soft.						
								"SCRIPPS FORMATION (Tsc)/POSSIBLE LANDSLIDE DEBRIS (Qls)"						
	5				1	46		CLAYEY SILTSTONE (R) medium gray, moderate amount of orange iron oxide, damp, stiff, moderate amount of clay, local steep micro-fractures, laminations dip 2-4 degrees.						
340	10				2	37		Light gray, minor iron oxide along laminations, fine grained sand laminae, sand fills pockets, burrows (less than 1/4 inch) laminations dip 5-6 degrees.						
	15				3	45		Carbonate cemented layer, hard. Gypsum fills laminae and open voids (up to 1/2 inch) below carbonate layer. Green-gray Clayey Siltstone (R), iron oxide locally.						
330	20				4	50/ 5.5"		Carbonate cemented layer over gypsum filled lamina (1/8 inch thick) over green-gray Siltstone (R).						
	25				5	55		Numerous gypsum filled laminations from less than 1/8 inch to 1 inch thick, in medium green-gray Clayey Siltstone (R), medium hard, fissile.						

Bottom of drill hole at 25.5 feet.
No groundwater encountered.
Drill hole backfilled and tamped.

SHEET 1 OF 1

LEGEND TO LOGS ON PLATE A-2

PLATE A-1.6

LOG OF DRILL HOLE

OB NO.: S89012
ROJECT: Sludge Processing Sites
OCATION: North City-North
RILLING METHOD: Hollow Stem Auger, 7-inch

LOGGED BY: J. Thurber
CHECKED BY:

DRILL HOLE NO.: 23
DRILLING DATE: January 8, 1990
DATUM: City of San Diego
REFERENCE EL.: 320 Feet

ELEVATION (FEET)	DEPTH	DRILLING RATE	REAL TIME/DEPTH	SAMPLE	SAMPLE NO.	BLOW COUNT (BLOWS PER FOOT)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT (%)	ATTERBERG LIMITS PLASTIC LIMIT (%)	TORVANE (PSF)	ADDITIONAL TESTS
20								"SCRIPPS FORMATION (Tsc)/POSSIBLE LANDSLIDE DEBRIS (Qls)" CLAYEY SILTSTONE (R) gray-brown, damp, stiff, minor clay, moderate pervasive iron oxide, faintly laminated.						
	5				1	46								
						30/2"								
10	10				2	51		Hard layer, calcium carbonate cement, 9 to 10 feet. Siltstone, faintly laminated.						
	15				3	61		CLAYEY SILTSTONE (R) gray green, damp, stiff, micro-fractures with brown iron oxide, gypsum fills steep fractures and pockets, less than 1/4 inch wide, locally calcareous.						
00	20				4	48		Locally moist, softer (medium stiff), green and brown (iron oxide), abundant thin (2-3 mm) gypsum laminae, laminations dip 2-4 degrees.						

Bottom of drill hole at 20.5 feet.
No groundwater encountered.
Drill hole backfilled and tamped.

HEET 1 OF 1

LEGEND TO LOGS ON PLATE A-2

PLATE A-1.7

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISION			GROUP SYMBOL	DESCRIPTION	GRAPHIC LOG
COARSE GRAINED SOILS Over 50% By Weight Coarser Than No. 200 Sieve Size	GRAVELLY SOILS OVER 50% OF COARSE FRACTION LARGER THAN NO. 4 SIEVE SIZE	CLEAN GRAVELLY SOILS LITTLE OR NO FINES	GW	WELL GRADED GRAVELS OR GRAVEL - SAND MIXTURES	░
			GP	POORLY GRADED GRAVELS OR POORLY GRADED GRAVEL -SAND SILT MIXTURES	░
		GRAVELLY SOILS WITH FINES OVER 12% FINES	GM	SILTY GRAVELS OR POORLY GRADED GRAVEL - SAND SILT MIXTURES	▥
			GC	CLAYEY GRAVELS OR POORLY GRADED GRAVEL - SAND - CLAY MIXTURES	▨
	SANDY SOILS OVER 50% OF COARSE FRACTION SMALLER THAN NO. 4 SIEVE SIZE	CLEAN SANDY SOILS LITTLE OR NO FINES	SW	WELL GRADED SANDS OR GRAVELLY SANDS	░
			SP	POORLY GRADED SANDS OR GRAVELLY SANDS	░
		SANDY SOILS WITH FINES OVER 12% FINES	SM	SILTY SANDS OR POORLY GRADED SAND - SILT MIXTURES	▥
			SC	CLAYEY SANDS OR POORLY GRADED SAND - CLAY MIXTURES	▨
FINE GRAINED SOILS Over 50% By Weight Finer Than No. 200 Sieve Size	SILTY AND CLAYEY SOILS LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS, VERY FINE SANDS SILTY/CLAYEY FINE SANDS, CLAYEY SILTS WITH SLIGHT PLASTICITY	▥
			CL	INORGANIC CLAYS-LOW TO MEDIUM PLASTICITY, GRAVELLY, SANDY, SILTY OR LEAN CLAYS	▩
			OL	ORGANIC CLAYS OR ORGANIC SILTY CLAYS OF LOW PLASTICITY	▥
	SILTY AND CLAYEY SOILS LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, OR ELASTIC SILTS	▥
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, OR FAT CLAYS	▨
			OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, OR ORGANIC SILTS	▤
HIGHLY ORGANIC SOILS			Pt	PEAT OR OTHER HIGHLY ORGANIC SOIL	▤

SAMPLE TYPES:

■ UNDISTURBED SLEEVE

☐ DISTURBED

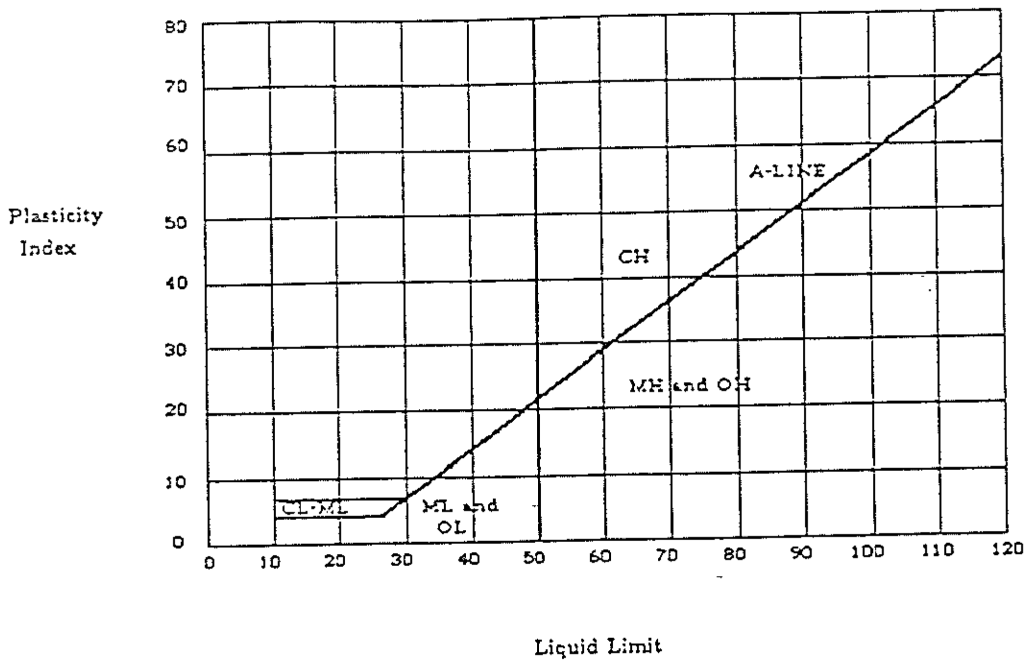
⊟ UNSUCCESSFUL ATTEMPT

◢ STANDARD PENETRATION

▼ WATER LEVEL

≡ WATER INFLOW

PLASTICITY CHART - Used for Classification of Fine Grained Soils



BLOW COUNT - The number of blows required to drive the indicated sampler the last 12 inches of an 18 inch drive. The notation 100/9 indicates only 9 inches of penetration were achieved in 100 blows. Hammer weights and drop heights are shown below:

Symbol	Driving Weight (pounds)	Drop Height (inches)
7		
(3)		
[6]		

Heavy Caving

Light Caving

ADDITIONAL TESTS -

UC : Unconfined Compression
TD : Triaxial Compression, Drained
TU : Triaxial Compression, Undrained
TDy: Triaxial Compression, Dynamic
PH : Hydrogen Ion Concentration
PA : Paleontologic, Analysis
GS : Grain Size Distribution
WP : Water Pressure
PMt: Pressuremeter
SE : Sand Equivalent
GJ : Goodman Jack
SP : Specific Gravity
CP : Compaction
C : Consolidation
DS : Direct Shear
PM : Permeability
EX : Expansion
RS : Resistivity
S : Swell
CL : Chloride
SU : Sulphate

GEOTECHNICAL CONSULTANTS, INC.

PRELIMINARY GEOTECHNICAL RECONNAISSANCE

PROPOSED SLUDGE PROCESSING SITE

NORTH CITY - CENTRAL

CITY OF SAN DIEGO, CALIFORNIA

FOR

METCALF AND EDDY

FEBRUARY 1990

S89012

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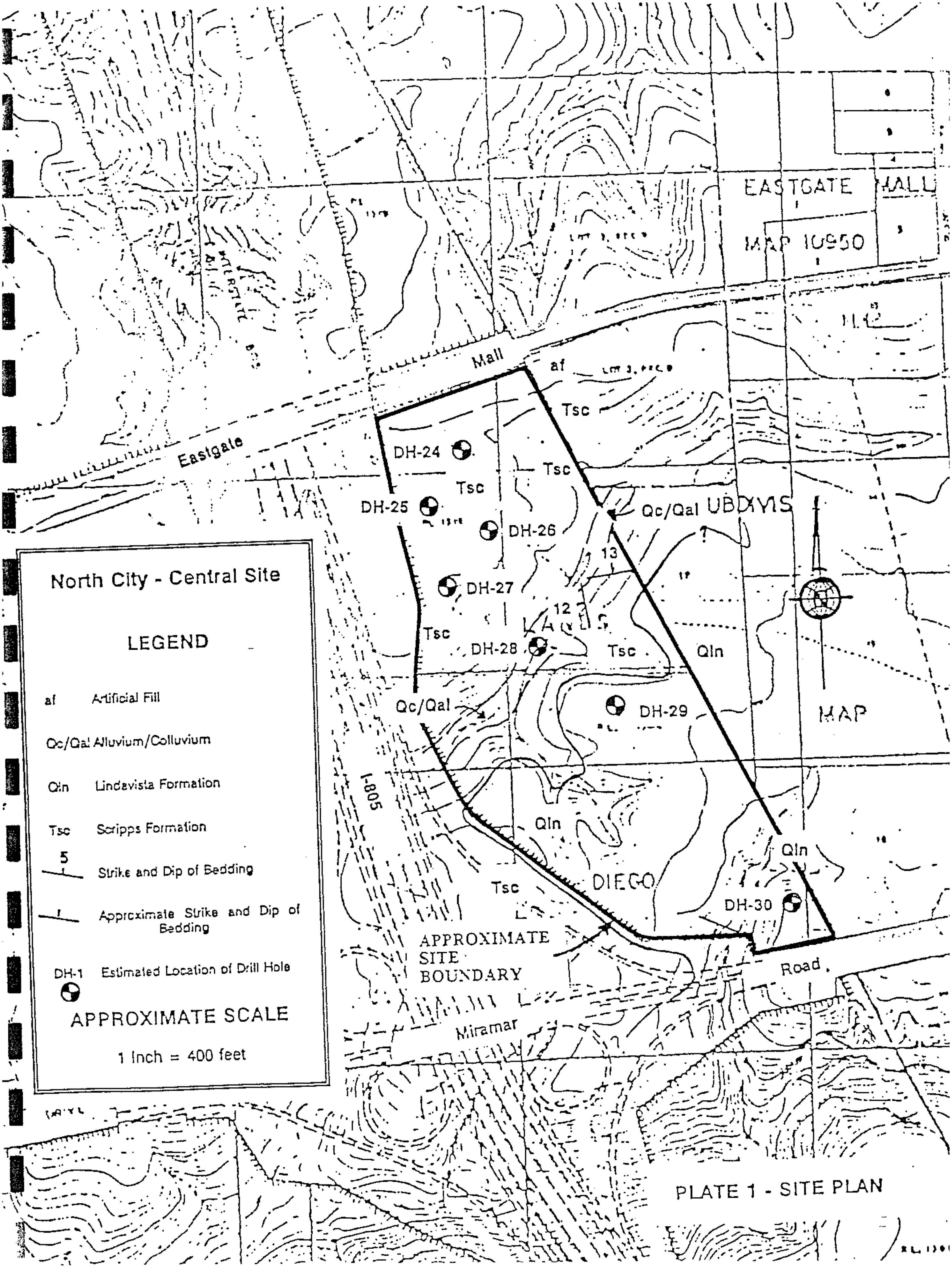


North City - Central Site

LEGEND

af	Artificial Fill
Qc/Qal	Alluvium/Colluvium
Qln	Lindavista Formation
Tsc	Scripps Formation
5	Strike and Dip of Bedding
	Approximate Strike and Dip of Bedding
DH-1	Estimated Location of Drill Hole

APPROXIMATE SCALE

1 Inch = 400 feet

PLATE 1 - SITE PLAN

LOG OF DRILL HOLE

B NO.: S89012
ROJECT: Sludge Processing Sites
CATION: North City-Central
RILLING METHOD: Hollow Stem Auger, 7-inch

LOGGED BY: M. Hosseini
CHECKED BY: J. Thurber

DRILL HOLE NO.: 24
DRILLING DATE: January 8, 1990
DATUM: City of San Diego
REFERENCE EL.: 375 Feet

ELEVATION (FEET)	DEPTH	DRILLING RATE	REAL TIME/DEPTH	SAMPLE	SAMPLE NO.	BLOW COUNT (BLOWS PER FOOT)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT (%)	ATTERBERG LIMITS PLASTIC LIMIT (%)	TORVANE (PSF)	ADDITIONAL TESTS
								"SCRIPPS FORMATION (Tsc)" CLAYEY SANDSTONE (R) damp, yellow-brown/gray, damp, dense (indurated), no laminations, sand is fine grained.						
70	5				1	95								
	10				2	53		CLAYEY SANDSTONE (R) medium grained, yellow-brown, damp, dense, highly oxidized and hematite-rich, scattered siltstone pebbles.						
60	15				3	40								
								"SCRIPPS FORMATION (Tsc)" SILTSTONE/CLAYSTONE (R) light gray-brown, damp, medium stiff, moderately indurated, thin interbeds of Sandstone 5-inch thick clay layer at 17 feet.						
	20				4	46		SANDSTONE (R) with Claystone interlamination, light gray/brown, damp, dense to very dense. Claystone is very plastic, between 2-5 inches thick and rich in organics. Local oxidization abundant.						
								SILTSTONE/CLAYSTONE (R) light gray/brown, damp, stiff to very stiff (well indurated), locally oxidized.						
50	25				5	91								
	30				6	88/ 10.5"		SILTSTONE/CLAYSTONE (R) thinly bedded with subhorizontal laminations. Light gray/brown, damp, very stiff (well indurated) oxidized.						
40	35				7	68		SILTY CLAYSTONE (R) light gray, damp, stiff to very stiff (well indurated), minor oxidization.						
	40				8	86/ 11"		Interlaminated SILTSTONE/CLAYSTONE (R) light gray/brown, damp, stiff to very stiff (well indurated). Siltstone shows abundance of local oxidization.						

Bottom of drill hole at 40.5 feet.
No groundwater encountered.
Drill hole backfilled and tamped.

LEGEND TO LOGS ON PLATE A-2

LOG OF DRILL HOLE

JOB NO.: S89012
PROJECT: Sludge Processing Sites
LOCATION: North City-Central
DRILLING METHOD: Hollow Stem Auger, 7-inch

LOGGED BY: M. Hosseini
CHECKED BY: J. Thurber

DRILL HOLE NO.: 25
DRILLING DATE: January 8, 1990
DATUM: City of San Diego
REFERENCE EL.: 375 Feet

ELEVATION (FEET)	DEPTH	DRILLING RATE	REAL TIME/DEPTH	SAMPLE	SAMPLE NO.	BLOW COUNT (BLOWS PER FOOT)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT (%)	ATTERBERG LIMITS PLASTIC LIMIT (%)	TORVANE (PSF)	ADDITIONAL TESTS
								"COLLUVIUM (Qc)" GRAVEL (GW) with clay, brown, dry, loose to medium dense.						
370	5				1	61		"SCRIPPS FORMATION (Tsc)" CLAYEY SANDSTONE (R) light gray, damp, dense (indurated), no laminations, locally oxidized, Sandstone is fine grained. Gravel at 5 feet.						
	10				2	79		CLAYEY SANDSTONE (R) light gray/yellow-brown, damp, dense (indurated), very uniform texture and composition, no laminations, very minor siltstone pebbles. Sandstone is fine grained.						
360	15				3	89		CLAYEY SANDSTONE (R) yellow-brown/light gray, damp, dense (well indurated), friable, very uniform, Sandstone is fine to medium grained, locally oxidized, minor siltstone pebbles.						
	20				4	79		Very uniform.						
350	25				5	89								
								"SCRIPPS FORMATION (Tsc)" Interlaminated SANDSTONE/CLAYSTONE(R)light gray and yellow-brown, damp, dense/stiff. Sandstone is medium grained, abundant oxidization. Claystone is slightly plastic.						
	30				6	86/11.5"								
340	35				7	29		Very thin (1-inch) highly plastic clay lamina. CLAYSTONE/SILTSTONE, light gray/brown, damp, medium stiff to stiff, locally oxidized.						
								Bottom of drill hole at 35.5 feet. No groundwater encountered. Drill hole backfilled and tamped.						

LEGEND TO LOGS ON PLATE A-2

LOG OF DRILL HOLE

OB NO.: S89012
PROJECT: Sludge Processing Sites
OCATION: North City-Central
RILLING METHOD: Hollow Stem Auger, 7-inch

LOGGED BY: M. Hosseini
CHECKED BY: J. Thurber

DRILL HOLE NO.: 26
DRILLING DATE: January 8, 1990
DATUM: City of San Diego
REFERENCE EL.: 365 Feet

ELEVATION (FEET)	DEPTH	DRILLING RATE	REAL TIME/DEPTH	SAMPLE	SAMPLE NO.	BLOW COUNT (BLOWS PER FOOT)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT (%)	ATTERBERG LIMITS PLASTIC LIMIT (%)	TORVANE (PSF)	ADDITIONAL TESTS
								"SCRIPPS FORMATION (Tsc)" CLAYEY SILTSTONE (R) light gray/yellow-brown, damp, stiff (indurated), minor organics and iron oxide.						
360	5			◭	1	93								
	10			◭	2	50/6"		CLAYSTONE/SILTSTONE (R), light gray, damp, very stiff.						
								Cemented thin (6-inch) bed of siltstone, minor organic inclusions, locally oxidized.						
350	15			◭	3	89		SILTSTONE (R) becoming more dominant, subhorizontal laminations.						
	20			◭	4	89/11"		Very thinly laminated SILTSTONE/CLAYSTONE (R) light gray/brown, damp, stiff.						

Bottom of drill hole at 20.5.
No groundwater encountered.
Drill hole backfilled and tamped.

SHEET 1 OF 1

LEGEND TO LOGS ON PLATE A-2

PLATE A-1.3

LOG OF DRILL HOLE

JOB NO.: S89012
PROJECT: Sludge Processing Sites
LOCATION: North City-Central
DRILLING METHOD: Hollow Stem Auger, 7-inch

LOGGED BY: M. Hosseini
CHECKED BY: J. Thurber

DRILL HOLE NO.: 27
DRILLING DATE: January 9, 1990
DATUM: City of San Diego
REFERENCE EL.: 360 Feet

ELEVATION (FEET)	DEPTH	DRILLING RATE	REAL TIME/DEPTH	SAMPLE	SAMPLE NO.	BLOW COUNT (BLOWS PER FOOT)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		TORVANE (PSF)	ADDITIONAL TESTS
											LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
360								"SCRIPPS FORMATION (Tsc)" CLAYSTONE (R) light gray/yellow-brown, dry to damp, stiff (indurated).						
	5				1	77		CLAYSTONE/SILTSTONE (R) (interlaminated), light gray/yellow-brown, damp, stiff (well indurated) subhorizontal laminations, locally oxidized.						
350	10				2	50/5"		SILTSTONE (R) yellow-brown, damp, stiff (well indurated), thin sandstone interlaminations.						
	15				3	73		CLAYEY SILTSTONE (R) light gray, damp, stiff (well indurated), thin claystone interlaminations, locally oxidized, scattered organic inclusions.						
340	20				4	69		CLAYSTONE (R) light gray/yellow-brown, damp, stiff (well-indurated). Very thin Siltstone interlaminations, locally oxidized, scattered siltstone pebbles.						

Bottom of drill hole at 20.5 feet.
No groundwater encountered.
Drill hole backfilled and tamped.

SHEET 1 OF 1

LEGEND TO LOGS ON PLATE A-2

LOG OF DRILL HOLE

OB NO.: S89012
ROJECT: Sludge Processing Sites
OCATION: North City-Central
RILLING METHOD: Hollow Stem Auger, 7-inch

LOGGED BY: M. Hosseini
CHECKED BY: J. Thurber

DRILL HOLE NO.: 28
DRILLING DATE: January 9, 1990
DATUM: City of San Diego
REFERENCE EL.: 305 Feet

ELEVATION (FEET) DEPTH	DRILLING RATE	REAL TIME/DEPTH	SAMPLE	SAMPLE NO.	BLOW COUNT (BLOWS PER FOOT)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT (%)	ATTERBERG LIMITS PLASTIC LIMIT (%)	TORVANE (PSF)	ADDITIONAL TESTS
							"ALLUVIUM/COLLUVIUM (Qal/Qc)" SANDY CLAY (CL) with gravel, dark brown, damp, medium stiff, slightly plastic, decreasing sand and gravel at 2.0 feet.						
00 5				1	45		Becoming more plastic.						
							Very plastic Clay (CH) with minor sand.						
10				2	50/ 6"		"SCRIPPS FORMATION (Tsc)" CLAYEY SILTSTONE (R) light gray, damp, stiff (indurated),						
							""SCRIPPS FORMATION (Tsc)" SANDSTONE (R) yellow-brown, damp, dense (indurated), minor silt, sand is medium grained.						
90 15				3	66		"SCRIPPS FORMATION (Tsc)" Interlaminated SILTSTONE/CLAYSTONE (R), light gray/yellow-brown, damp, stiff (well indurated), locally oxidized. Subhorizontal laminations, minor organics in claystone laminae.						
20				4	77		"SCRIPPS FORMATION (Tsc)" SANDY SILTSTONE (R) light gray/yellow-brown, damp, stiff (well indurated), interlaminated with Claystone.						

Bottom of drill hole at 20.5 feet.
No groundwater encountered.
Drill hole backfilled and tamped.

LEGEND TO LOGS ON PLATE A-2

LOG OF DRILL HOLE

JOB NO.: S89012
PROJECT: Sludge Processing Sites
LOCATION: North City-Central
DRILLING METHOD: Hollow Stem Auger, 7-inch

LOGGED BY: M. Hosseini
CHECKED BY: J. Thurber

DRILL HOLE NO.: 29
DRILLING DATE: January 9, 1990
DATUM: City of San Diego
REFERENCE EL.: 370 Feet

ELEVATION (FEET)	DEPTH	DRILLING RATE	REAL TIME/DEPTH	SAMPLE	SAMPLE NO.	BLOW COUNT (BLOWS PER FOOT)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT (%)	ATTERBERG LIMITS PLASTIC LIMIT (%)	TORVANE (PSF)	ADDITIONAL TESTS
370								"COLLUVIUM (Qc)" CLAYEY SAND (SC) red-brown, damp, medium dense, some gravel.						
	5				1	44/6"		"LINDAVISTA FORMATION (Qln)" CONGLOMERATE (R) light gray/brown, damp, very dense, drills with difficulty, abundant gravel and cobbles. Rig chattering.						
360	10				2	50/6"		CONGLOMERATE (R) light gray, damp, very dense, abundant rounded to subrounded pebbles and cobbles up to 4 inches in diameter.						
					3	50/3.5"		Abundant cobbles, boulders(?)						
								Refusal at 14.5 feet due to difficult drilling. No groundwater encountered. Drill hole backfilled and tamped.						

SHEET 1 OF 1

LEGEND TO LOGS ON PLATE A-2

PLATE A-1.6

LOG OF DRILL HOLE

OB NO.: S89012
ROJECT: Sludge Processing Sites
OCATION: North City-Central
RILLING METHOD: Hollow Stem Auger, 7-inch

LOGGED BY: M. Hosseini
CHECKED BY: J. Thurber

DRILL HOLE NO.: 30
DRILLING DATE: January 9, 1990
DATUM: City of San Diego
REFERENCE EL.: 380 Feet

ELEVATION (FEET)	DEPTH	DRILLING RATE	REAL TIME/DEPTH	SAMPLE	SAMPLE NO.	BLOW COUNT (BLOWS PER FOOT)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT (%)	ATTERBERG LIMITS PLASTIC LIMIT (%)	TORVANE (PSF)	ADDITIONAL TESTS
380							▨	"COLLUVIUM (Qc)" SANDY CLAY (CL) red-brown, damp, medium stiff, abundant pebbles and cobbles are present at surface.						
	3						▦	"LINDAVISTA FORMATION (Qln)" CONGLOMERATE (R) gray, damp, very dense, extremely slow drilling (difficult to drill) due to cobbles. Matrix is predominantly coarse sand, well cemented.						
				◩	1	50/ 3.5"	▦							
375							▦							
	6						▦	Very thin sandstone lamina at 5.5 feet, abundant cobbles.						
	9			◩	2	46/ 6"	▦							
								Refusal at 9.5 feet. No groundwater encountered. Drill hole backfilled and tamped.						

SHEET 1 OF 1

LEGEND TO LOGS ON PLATE A-2

PLATE A-1.7

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISION			GROUP SYMBOL	DESCRIPTION	GRAPHIC LOG
COARSE GRAINED SOILS Over 50% By Weight Coarser Than No. 200 Sieve Size	GRAVELLY SOILS OVER 50% OF COARSE FRACTION LARGER THAN NO. 4 SIEVE SIZE	CLEAN GRAVELLY SOILS LITTLE OR NO FINES	GW	WELL GRADED GRAVELS OR GRAVEL - SAND MIXTURES	⚊
			GP	POORLY GRADED GRAVELS OR POORLY GRADED GRAVEL -SAND SILT MIXTURES	⚊
		GRAVELLY SOILS WITH FINES OVER 12% FINES	GM	SILTY GRAVELS OR POORLY GRADED GRAVEL - SAND SILT MIXTURES	⚊
			GC	CLAYEY GRAVELS OR POORLY GRADED GRAVEL - SAND - CLAY MIXTURES	▩
	SANDY SOILS OVER 50% OF COARSE FRACTION SMALLER THAN NO. 4 SIEVE SIZE	CLEAN SANDY SOILS LITTLE OR NO FINES	SW	WELL GRADED SANDS OR GRAVELLY SANDS	⁘
			SP	POORLY GRADED SANDS OR GRAVELLY SANDS	⁘
		SANDY SOILS WITH FINES OVER 12% FINES	SM	SILTY SANDS OR POORLY GRADED SAND - SILT MIXTURES	┆
			SC	CLAYEY SANDS OR POORLY GRADED SAND - CLAY MIXTURES	▨
FINE GRAINED SOILS Over 50% By Weight Finer Than No. 200 Sieve Size	SILTY AND CLAYEY SOILS LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS, VERY FINE SANDS SILTY/CLAYEY FINE SANDS, CLAYEY SILTS WITH SLIGHT PLASTICITY	│
			CL	INORGANIC CLAYS-LOW TO MEDIUM PLASTICITY, GRAVELLY, SANDY, SILTY OR LEAN CLAYS	▩
			OL	ORGANIC CLAYS OR ORGANIC SILTY CLAYS OF LOW PLASTICITY	┆
	SILTY AND CLAYEY SOILS LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, OR ELASTIC SILTS	┃
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, OR FAT CLAYS	▨
			OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, OR ORGANIC SILTS	▤
HIGHLY ORGANIC SOILS			Pt	PEAT OR OTHER HIGHLY ORGANIC SOIL	⚌

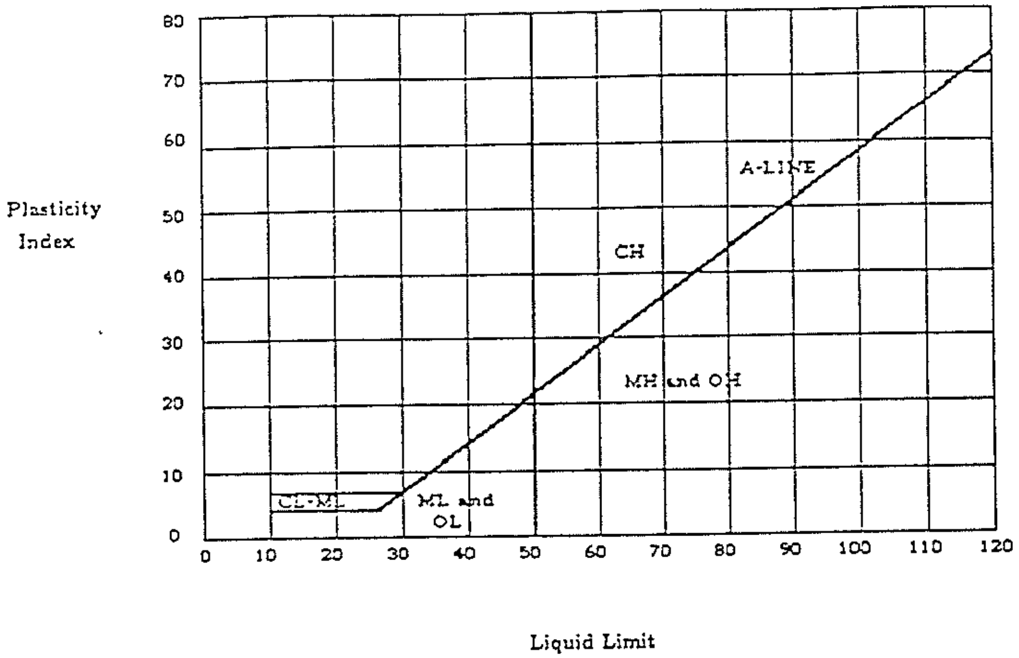
SAMPLE TYPES:

- ▤ UNDISTURBED SLEEVE
- ☒ DISTURBED
- ☐ UNSUCCESSFUL ATTEMPT
- ◢ STANDARD PENETRATION

▼ WATER LEVEL

≡ WATER INFLOW

PLASTICITY CHART - Used for Classification of Fine Grained Soils



BLOW COUNT - The number of blows required to drive the indicated sampler the last 12 inches of an 18 inch drive. The notation 100/9 indicates only 9 inches of penetration were achieved in 100 blows. Hammer weights and drop heights are shown below:

Symbol	Driving Weight (pounds)	Drop Height (inches)
7		
(3)		
[6]		

Heavy Caving

Light Caving

ADDITIONAL TESTS -

UC : Unconfined Compression
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TU : Triaxial Compression, Undrained
TDy: Triaxial Compression, Dynamic
PH : Hydrogen Ion Concentration
PA : Paleontologic, Analysis
GS : Grain Size Distribution

WP : Water Pressure
PMt: Pressuremeter
SE : Sand Equivalent
GJ : Goodman Jack
SP : Specific Gravity
CP : Compaction
C : Consolidation
DS : Direct Shear

PM : Permeability
EX : Expansion
RS : Resistivity
S : Swell
CL : Chloride
SU : Sulphate

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CITY OF SAN DIEGO, CALIFORNIA

FOR

METCALF AND EDDY

FEBRUARY 1990

S89012

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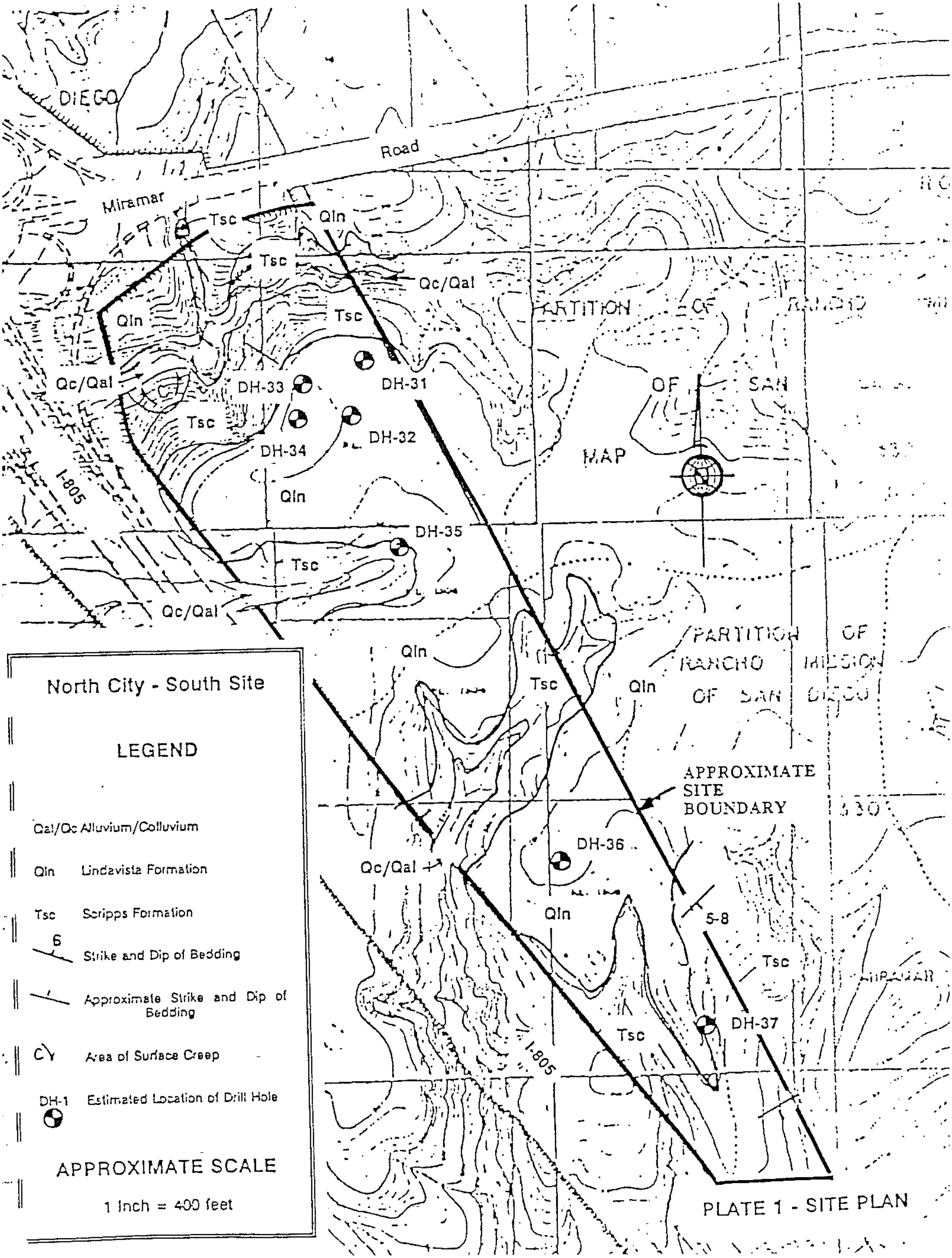


PLATE 1 - SITE PLAN

LOG OF DRILL HOLE

JOB NO.: S89012
PROJECT: Sludge Processing Sites
LOCATION: North City-South
DRILLING METHOD: Hollow Stem Auger, 7-inch

LOGGED BY: M. Hosseini
CHECKED BY: J. Thurber

DRILL HOLE NO.: S1
DRILLING DATE: January 9, 1990
DATUM: City of San Diego
REFERENCE EL.: 385 Feet

ELEVATION (FEET) DEPTH	DRILLING RATE	REAL TIME/DEPTH	SAMPLE	SAMPLE NO.	BLOW COUNT (BLOWS PER FOOT)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		TORVANE (PSF)	ADDITIONAL TESTS
										LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
385						▨	"COLLUVIUM (Qc)" SANDY CLAY (CL) dark brown, damp, medium stiff, scattered cobbles.						
3						▦	"LINDAVISTA FORMATION (Qln)" CONGLOMERATE (R) gray, damp, very dense, abundant cobbles. Drilled cobble at 3.0 feet (25 minutes).						
							Refusal at 4 feet. No groundwater encountered. Drill hole backfilled and tamped.						

SHEET 1 OF 1

LEGEND TO LOGS ON PLATE A-2

PLATE A-1.1

LOG OF DRILL HOLE

JOB NO.: S89012
PROJECT: Sludge Processing Sites
LOCATION: North City-South
DRILLING METHOD: Hollow Stem Auger, 7-inch

LOGGED BY: M. Hosseini
CHECKED BY: J. Thurber

DRILL HOLE NO.: 32
DRILLING DATE: January 9, 1990
DATUM: City of San Diego
REFERENCE EL.: 390 Feet

ELEVATION (FEET)	DEPTH	DRILLING RATE	REAL TIME/DEPTH	SAMPLE	SAMPLE NO.	BLOW COUNT (BLOWS PER FOOT)	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT (%)	ATTERBERG LIMITS PLASTIC LIMIT (%)	TORVANE (PSF)	ADDITIONAL TESTS
390							"COLLUVIUM (Qc)" SANDY CLAY (CL) red-brown, dry to damp, medium stiff, some pebbles and cobbles.						
	5				1	50/ 4"	"LINDAVISTA FORMATION (Qln)" CONGLOMERATE (R), gray, damp, very dense, cemented sandy matrix, abundant subrounded to well rounded cobbles.						
							"SCRIPPS FORMATION (Tsc)" CLAYEY SANDSTONE (R) greenish-gray, damp, medium dense to dense. Sandstone is medium-grained.						
380	10				2	46							
							2-3 inch thick cobble-rich layer at 12.5 feet.						
	15				3	68	SILTY SANDSTONE (R) with very thin claystone interlaminations, light gray, damp, dense (well-indurated) locally oxidized, sandstone is fine grained.						
370	20				4	59	SILTY SANDSTONE (R) light gray/yellow-brown, damp, dense (indurated), massive, uniform texture, friable, locally oxidized. Thin clay-rich bed at approximately 23 feet.						
	25						Scattered siltstone pebbles.						
360	30				5	73	SILTY SANDSTONE (R) light gray, damp, dense (well-indurated), friable, sandstone is fine grained, thinly interbedded with silty claystone, local oxidization.						
	35												
350	40				6	50/ 6"	SILTY SANDSTONE (R) light gray, damp, very dense, (well-indurated), friable, fine grained, scattered thin claystone interlaminations, locally oxidized.						

Bottom of drill hole at 40 feet.
No groundwater encountered.
Drill hole backfilled and tamped.

SHEET 1 OF 1

LEGEND TO LOGS ON PLATE A-2

PLATE A-1.2

LOG OF DRILL HOLE

OB NO.: S89012
ROJECT: Sludge Processing Sites
OCATION: North City-South
RILLING METHOD: Hollow Stem Auger, 7-inch

LOGGED BY: M. Hosseini
CHECKED BY: J. Thurber

DRILL HOLE NO.: 33
DRILLING DATE: January 9, 1990
DATUM: City of San Diego
REFERENCE EL.: 390 Feet

ELEVATION (FEET) DEPTH	DRILLING RATE	REAL TIME/DEPTH	SAMPLE	SAMPLE NO.	BLOW COUNT (BLOWS PER FOOT)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT (%)	ATTERBERG LIMITS PLASTIC LIMIT (%)	TORVANE (PSF)	ADDITIONAL TESTS
390 3						▨	"COLLUVIUM (Qc)" SANDY CLAY (CL) red-brown, dry to damp, medium stiff. Abundant pebbles and cobbles. Becoming stiff.						
385 6			◩	1	87	⁘	"LINDAVISTA FORMATION (Qln)" GRAVELLY SANDSTONE (R) gray, damp, dense (well-indurated), some clay matrix is also present. Increasing cobbles, difficult to drill.						
							Refusal at 8 feet. No groundwater encountered. Drill hole backfilled and tamped.						

SHEET 1 OF 1

LEGEND TO LOGS ON PLATE A-2

PLATE A-1.3

LOG OF DRILL HOLE

JOB NO.: S89012
PROJECT: Sludge Processing Sites
LOCATION: North City-South
DRILLING METHOD: Hollow Stem Auger, 7-inch

LOGGED BY: M. Hosseini
CHECKED BY: J. Thurber

DRILL HOLE NO.: 34
DRILLING DATE: January 9, 1990
DATUM: City of San Diego
REFERENCE EL.: 390 Feet

ELEVATION (FEET) DEPTH	DRILLING RATE	REAL TIME/DEPTH	SAMPLE	SAMPLE NO.	BLOW COUNT (BLOWS PER FOOT)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT (%)	ATTERBERG LIMITS PLASTIC LIMIT (%)	TORVANE (PSF)	ADDITIONAL TESTS
390							"COLLUVIUM (Qc)" SANDY CLAY (CL), red-brown, dry, medium stiff, abundant cobbles.						
							"LINDAVISTA FORMATION (Qln)" GRAVELLY SANDSTONE (R) gray, damp, very dense, abundant cobbles, very difficult to drill due to large cobbles.						
3													
385				1	50/ 3"								
6													

Refusal at 7 feet.
No groundwater encountered.
Drill hole backfilled and tamped.

SHEET 1 OF 1

LEGEND TO LOGS ON PLATE A-2

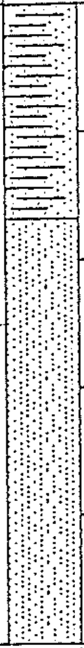
PLATE A-1.4

LOG OF DRILL HOLE

OB NO.: S89012
ROJECT: Sludge Processing Sites
OCATION: North City-South
RILLING METHOD: Hollow Stem Auger, 7-inch

LOGGED BY: M. Hosseini
CHECKED BY: J. Thurber

DRILL HOLE NO.: 35
DRILLING DATE: January 9, 1990
DATUM: City of San Diego
REFERENCE EL.: 375 Feet



ELEVATION (FEET) DEPTH	DRILLING RATE	REAL TIME/DEPTH	SAMPLE	SAMPLE NO.	BLOW COUNT (BLOWS PER FOOT)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT (%)	ATTERBERG LIMITS PLASTIC LIMIT (%)	TORVANE (PSF)	ADDITIONAL TESTS
							"SCRIPPS FORMATION (Tsc)" SILTY SANDSTONE (R) dark gray, damp, medium dense, scattered fine grained gravel, friable.						
370 5				1	43		SILTY SANDSTONE (R) light gray, damp, dense, friable, sandstone is fine grained, local oxidization, isolated clay inclusions.						
10				2	56		SANDSTONE (R) light gray, damp, dense, friable, medium-grained, very uniform grain size and texture, local oxidization, no clay.						
360 15				3	63		Very uniform, no clay.						
							Scattered siltstone pebbles.						
20				4	77		Sandstone is very uniform in texture and composition.						
350 25							Bottom of drill hole at 25 feet. No groundwater encountered. Drill hole backfilled and tamped.						

SHEET 1 OF 1

LEGEND TO LOGS ON PLATE A-2

PLATE A-1.5

LOG OF DRILL HOLE

JOB NO.: S89012
PROJECT: Sludge Processing Sites
LOCATION: North City-South
DRILLING METHOD: Hollow Stem Auger, 7-inch

LOGGED BY: M. Hosseini
CHECKED BY: J. Thurber

DRILL HOLE NO.: 36
DRILLING DATE: January 9, 1990
DATUM: City of San Diego
REFERENCE EL.: 380 Feet

ELEVATION (FEET)	DEPTH	DRILLING RATE	REAL TIME/DEPTH	SAMPLE	SAMPLE NO.	BLOW COUNT (BLOWS PER FOOT)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT (%)	ATTERBERG LIMITS: PLASTIC LIMIT (%)	TORVANE (PSF)	ADDITIONAL TESTS
380								"SCRIPPS FORMATION (Tsc)" SILTY SANDSTONE (R) light brown/gray, dry, medium dense, some clay and scattered cobbles.						
								SILTY SANDSTONE (R) light gray/yellow-brown, dry, dense, friable, sandstone is very fine-grained.						
	5			◢	1	78								
370	10			◢	2	56		SILTY SANDSTONE (R) light gray, damp, dense, friable, fine grained, locally oxidized, very uniform texture.						
								Scattered siltstone pebbles.						
	15			◢	3	81		SILTY SANDSTONE (R) light gray, damp, dense, friable, fine grained, very uniform texture.						
								Very thin clay-rich lamina at 16.5 feet.						
360	20			◢	4	71		SILTY SANDSTONE (R) light gray, damp, dense, friable, medium grained.						

Bottom of drill hole 20.5 feet.
No groundwater encountered.
Drill hole backfilled and tamped.

SHEET 1 OF 1

LEGEND TO LOGS ON PLATE A-2

LOG OF DRILL HOLE

OB NO.: S89012
ROJECT: Sludge Processing Sites
OCATION: North City-South
RILLING METHOD: Hollow Stem Auger, 7-inch

LOGGED BY: M. Hosseini
CHECKED BY: J. Thurber

DRILL HOLE NO.: 37
DRILLING DATE: January 9, 1990
DATUM: City of San Diego
REFERENCE EL.: 370 Feet

ELEVATION (FEET)	DEPTH	DRILLING RATE	REAL TIME/DEPTH	SAMPLE	SAMPLE NO.	BLOW COUNT (BLOWS PER FOOT)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT (%)	ATTERBERG LIMITS PLASTIC LIMIT (%)	TORVANE (PSF)	ADDITIONAL TESTS
	0							"SCRIPPS FORMATION (Tsc)" CLAYEY SILTSTONE/SILTY CLAYSTONE (R) light gray/yellow- brown, dry, firm.						
	5				1	45		SANDY SILTSTONE (R) light gray/yellow-brown, dry, firm to very firm, minor clay inclusions, thinly laminated with claystone, locally oxidized.						
60	10				2	53		SILTY CLAYSTONE/CLAYEY SILTSTONE (R) light gray, damp, firm (well-indurated). Local cemented siltstone layers.						
	15													
50	20				3	59		Interlaminated CLAYSTONE/SILTSTONE (R), light gray, damp, firm (well-indurated).						
								Bottom of drill hole at 20.5 feet. No groundwater encountered. Drill hole backfilled and tamped.						

HEET 1 OF 1

LEGEND TO LOGS ON PLATE A-2

PLATE A-1.7

UNIFIED SOIL CLASSIFICATION SYSTEM

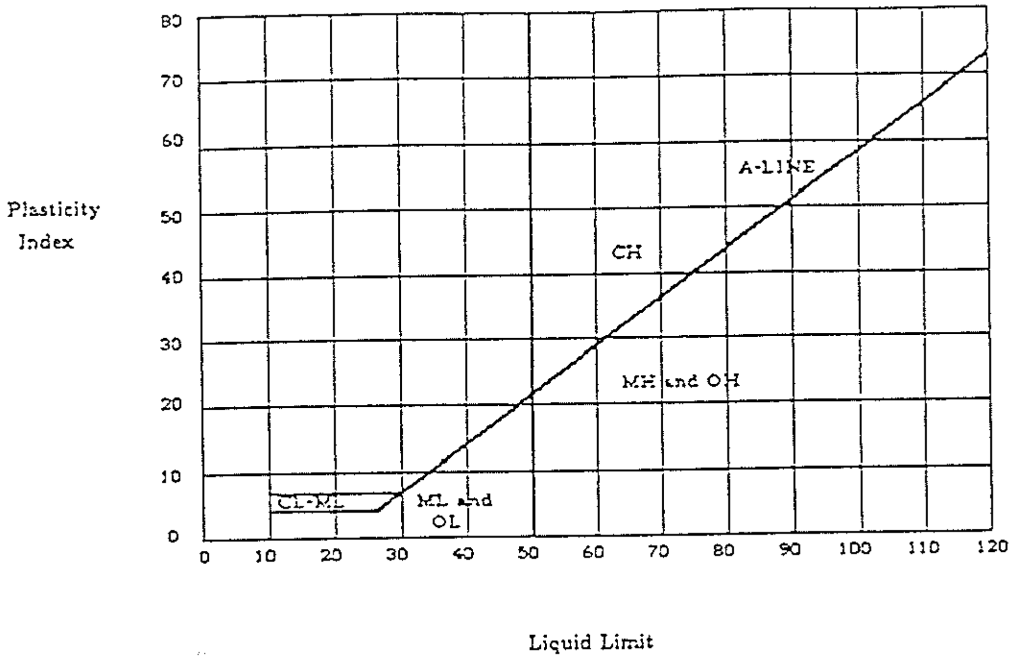
MAJOR DIVISION			GROUP SYMBOL	DESCRIPTION	GRAPHIC LOG
COARSE GRAINED SOILS Over 50% By Weight Coarser Than No. 200 Sieve Size	GRAVELLY SOILS OVER 50% OF COARSE FRACTION LARGER THAN NO. 4 SIEVE SIZE	CLEAN GRAVELLY SOILS LITTLE OR NO FINES	GW	WELL GRADED GRAVELS OR GRAVEL - SAND MIXTURES	▤
			GP	POORLY GRADED GRAVELS OR POORLY GRADED GRAVEL -SAND SILT MIXTURES	▤
		GRAVELLY SOILS WITH FINES OVER 12% FINES	GM	SILTY GRAVELS OR POORLY GRADED GRAVEL - SAND SILT MIXTURES	▤
			GC	CLAYEY GRAVELS OR POORLY GRADED GRAVEL - SAND - CLAY MIXTURES	▒
	SANDY SOILS OVER 50% OF COARSE FRACTION SMALLER THAN NO. 4 SIEVE SIZE	CLEAN SANDY SOILS LITTLE OR NO FINES	SW	WELL GRADED SANDS OR GRAVELLY SANDS	⁘
			SP	POORLY GRADED SANDS OR GRAVELLY SANDS	⁘
		SANDY SOILS WITH FINES OVER 12% FINES	SM	SILTY SANDS OR POORLY GRADED SAND - SILT MIXTURES	⁞
			SC	CLAYEY SANDS OR POORLY GRADED SAND - CLAY MIXTURES	▨
FINE GRAINED SOILS Over 50% By Weight Finer Than No. 200 Sieve Size	SILTY AND CLAYEY SOILS LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS, VERY FINE SANDS SILTY/CLAYEY FINE SANDS, CLAYEY SILTS WITH SLIGHT PLASTICITY	▥
			CL	INORGANIC CLAYS-LOW TO MEDIUM PLASTICITY, GRAVELLY, SANDY, SILTY OR LEAN CLAYS	▒
			OL	ORGANIC CLAYS OR ORGANIC SILTY CLAYS OF LOW PLASTICITY	┆
	SILTY AND CLAYEY SOILS LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, OR ELASTIC SILTS	▥
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, OR FAT CLAYS	▨
			OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, OR ORGANIC SILTS	☰
HIGHLY ORGANIC SOILS			Pt	PEAT OR OTHER HIGHLY ORGANIC SOIL	▤

SAMPLE TYPES:

■	UNDISTURBED SLEEVE
☐	DISTURBED
⊡	UNSUCCESSFUL ATTEMPT
◢	STANDARD PENETRATION

▼	WATER LEVEL
≡	WATER INFLOW

PLASTICITY CHART - Used for Classification of Fine Grained Soils



BLOW COUNT - The number of blows required to drive the indicated sampler the last 12 inches of an 18 inch drive. The notation 100/9 indicates only 9 inches of penetration were achieved in 100 blows. Hammer weights and drop heights are shown below:

Symbol	Driving Weight (pounds)	Drop Height (inches)
7		
(3)		
[6]		


Heavy Caving


Light Caving

ADDITIONAL TESTS -

UC : Unconfined Compression
TD : Triaxial Compression, Drained
TU : Triaxial Compression, Undrained
TDy: Triaxial Compression, Dynamic
PH : Hydrogen Ion Concentration
PA : Paleontologic, Analysis
GS : Grain Size Distribution

WP : Water Pressure
PMt: Pressuremeter
SE : Sand Equivalent
GJ : Goodman Jack
SP : Specific Gravity
CP : Compaction
C : Consolidation
DS : Direct Shear

PM : Permeability
EX : Expansion
RS : Resistivity
S : Swell
CL : Chloride
SU : Sulphate

GEOTECHNICAL CONSULTANTS, INC.

PRELIMINARY GEOTECHNICAL RECONNAISSANCE

PROPOSED SLUDGE PROCESSING SITE

EASTGATE TECHNOLOGY PARK

CITY OF SAN DIEGO, CALIFORNIA

FOR

METCALF AND EDDY

FEBRUARY 1990

S89012

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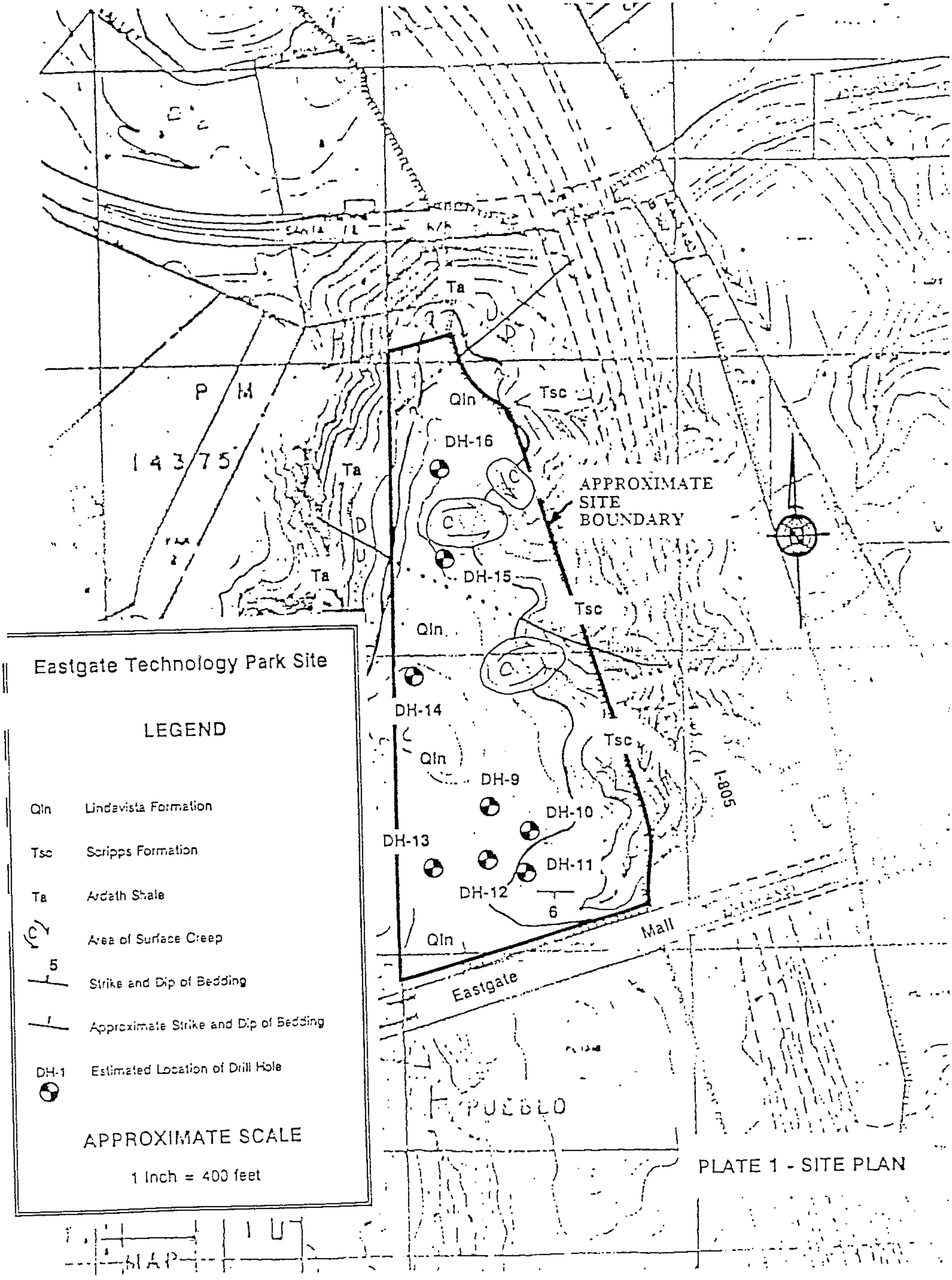


PLATE 1 - SITE PLAN

LOG OF DRILL HOLE

OB NO.: S89012
ROJECT: Sludge Processing Sites
OCATION: Eastgate Technology Park
RILLING METHOD: Hollow Stem Auger, 7-inch

LOGGED BY: J. Thurber
CHECKED BY:

DRILL HOLE NO.: 9
DRILLING DATE: January 6, 1990
DATUM: City of San Diego
REFERENCE EL.: 385 Feet

ELEVATION (FEET) DEPTH	DRILLING RATE	REAL TIME/DEPTH	SAMPLE	SAMPLE NO.	BLOW COUNT (BLOWS PER FOOT)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT (%)	ATTERBERG LIMITS PLASTIC LIMIT (%)	TORVANE (PSF)	ADDITIONAL TESTS
							"COLLUVIUM (Qc)" SANDY SILT (ML/SM) light brown, dry to damp, loose to medium stiff, sand is fine grained, scattered gravel.						
80 5				1	40		"LINDAVISTA FORMATION (Qln)" SILTY SANDSTONE (R) red-brown, damp, dense, finely bedded, layers of fine grained sand interbedded with fine to coarse grained sand with scattered gravel, minor silt and clay, local cobble. 8 feet: Becoming moist, increasing clay.						
10				2	50/ 5.5"		"SCRIPPS FORMATION (Tsc)" SILTSTONE (R) light gray, damp, medium hard, faintly laminated, scattered organics, gypsum(?) fills fractures, minor clay throughout. 11 feet: becoming hard, locally cemented. Minor fine grained sand layers.						
70 15				3	50/ 6"								
							locally oxidized.						
20				4	97/ 11"		CLAYEY SILTSTONE (R) medium hard, faintly laminated, thin partings, mottled light gray-buff.						
60 25				5	92/ 11"		Thinly bedded SILTY SANDSTONE (1/2 inch or less) and CLAYEY SILTSTONE (3 - 6 inch), waxy, laminated, 2 - 4 degree dip, locally oxidized.						
30				6	50/ 6"		Fine grained SILTY SANDSTONE (R) minor Clayey Siltstone, very light gray, locally oxidiaed brown.						
50 35				7	94/ 11"		SILTY SANDSTONE (R) very fine grained, minor clay, light gray - locally oxidized, damp, medium hard.						
				8	50/ 5"		37 feet: very hard, no drill penetration, carbonate cemented fine grained SANDSTONE (R).						

Bottom of drill hole at 37-1/2 feet.
No groundwater encountered.
Hole backfilled and tamped.

HEET 1 OF 1

LEGEND TO LOGS ON PLATE A-2

PLATE A-1.1

LOG OF DRILL HOLE

JOB NO.: S89012
PROJECT: Sludge Processing Sites
LOCATION: Eastgate Technology Park
DRILLING METHOD: Hollow Stem Auger, 7-inch

LOGGED BY: J. Thurber
CHECKED BY:

DRILL HOLE NO.: 10
DRILLING DATE: January 6, 1990
DATUM: City of San Diego
REFERENCE EL.: 380 Feet

ELEVATION (FEET)	DEPTH	DRILLING RATE	REAL TIME/DEPTH	SAMPLE	SAMPLE NO.	BLOW COUNT (BLOWS PER FOOT)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		TORVANE (PSF)	ADDITIONAL TESTS
											LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
380								"COLLUVIUM (Qc)" SANDY SILT (ML) light brown, dry, loose to medium stiff.						
								"LINDAVISTA FORMATION (Qln)" SANDY SILT (ML/SM) red-brown, damp, medium dense, sand is fine grained.						
	5			◢	1	96/ 11"								
								"SCRIPPS FORMATION (Tsc)" SILTSTONE (R) light gray, damp, medium hard, minor to moderate amount of clay, massive to faintly laminated, locally moist.						
370	10			◢	2	76		Becoming mottled gray and brown.						
								SILTY SANDSTONE (R) light brown, damp, dense, sand is fine to medium grained.						
	15			◢	3	95/ 10"								
								CLAYEY SILTSTONE (R) light gray, damp, medium hard, locally laminated, thin sand stringers (1/4 inch or less), locally oxidized brown.						
360	20			◢	4	67								
	25			◢	5	66		Faintly laminated, 2 - 3 degree dip.						
350	30			◢	6	77/ 11"		Finely laminated (near horizontal), thin sand stringers (oxidized) in CLAYEY SILTSTONE (R), minor very fine grained sand.						

Bottom of drill hole at 30.5 feet.
No groundwater encountered.
Hole backfilled and tamped.

SHEET 1 OF 1

LEGEND TO LOGS ON PLATE A-2

PLATE A-1.2

LOG OF DRILL HOLE

OB NO.: S89012
ROJECT: Sludge Processing Sites
OCATION: Eastgate Technology Park
RILLING METHOD: Hollow Stem Auger, 7-inch

LOGGED BY: J. Thurber
CHECKED BY:

DRILL HOLE NO.: 11
DRILLING DATE: January 6, 1990
DATUM: City of San Diego
REFERENCE EL.: 380 Feet

ELEVATION (FEET)	DEPTH	DRILLING RATE	REAL TIME/DEPTH	SAMPLE	SAMPLE NO.	BLOW COUNT (BLOWS PER FOOT)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT (%)	ATTERBERG LIMITS PLASTIC LIMIT (%)	TORVANE (PSF)	ADDITIONAL TESTS
80								"COLLUVIUM (Qc)/LINDAVISTA FORMATION (Qln)" SANDY SILT (ML) with gravel and cobbles, light brown, dry to damp, medium dense, cobbles are rounded, volcanic composition.						
								"SCRIPPS FORMATION (Tsc)"						
	5			◢	1	88		SILTSTONE (R) minor interbedded SANDSTONE (R) light gray, damp, stiff to medium hard, laminated, clayey. Sandstone is light gray-brown, damp, dense. Sand is fine to medium grained.						
70	10			◢	2	56		CLAYEY SILTSTONE (R) light gray, damp, stiff, organic material locally along laminations, laminations are near horizontal, locally oxidized.						
	15			◢	3	76		Local Sandy Siltstone interbeds, 1-2 inch thick.						
360	20			◢	4	81		Massive to laminated, 5 to 8 degree dip. Firm, consistent drilling, locally hard - Fe oxide(?) cement (non-calcareous).						
	25			◢	5	84/ 11.5"		CLAYEY SILTSTONE (R) light gray-brown, locally green-brown, damp, medium hard, locally oxidized, laminations - bedding dip 4-6 degrees. 26 feet: 8 to 12 inch hard layer, cemented?						
350	30			◢	6	50/ 6"		SANDY SILTSTONE (R) mottled light gray and orange-brown, damp, dense-medium hard, near horizontal laminations.						

Bottom of drill hole at 30 feet.
No groundwater encountered.
Hole backfilled and tamped.

HEET 1 OF 1

LEGEND TO LOGS ON PLATE A-2

PLATE A-1.3

LOG OF DRILL HOLE

JOB NO.: S89012
PROJECT: Sludge Processing Sites
LOCATION: Eastgate Technology Park
DRILLING METHOD: Hollow Stem Auger, 7-inch

LOGGED BY: J. Thurber
CHECKED BY:

DRILL HOLE NO.: 12
DRILLING DATE: January 6, 1990
DATUM: City of San Diego
REFERENCE EL.: 385 Feet

ELEVATION (FEET)	DEPTH	DRILLING RATE	REAL TIME/DEPTH	SAMPLE	SAMPLE NO.	BLOW COUNT (BLOWS PER FOOT)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT (%)	ATTERBERG LIMITS PLASTIC LIMIT (%)	TORVANE (PSF)	ADDITIONAL TESTS
								"COLLUVIUM (Qc)" SANDY SILT (ML/SM) light brown, dry to damp, medium stiff.						
380	5				1	50/3"		"LINDAVISTA FORMATION (Qln)" SILTY SANDSTONE (R) light gray, locally oxidized orange, damp, medium hard. Becoming orange.						
								8 feet: hard layer, hematite (?) cement, with layer of gravel-cobble, 3-6 inches thick.						
	10				2	90		"SCRIPPS FORMATION (Tsc)" SANDY SILTSTONE/SANDSTONE (R) very light gray, damp, stiff, sand is very fine grained, parallel laminations (subhorizontal).						
370	15				3	75		"SCRIPPS FORMATION (Tsc)" CLAYEY SILTSTONE (R) very light gray, damp, stiff to medium hard, laminated, locally oxidized. 17 to 18 feet: moist CLAYSTONE (R), medium stiff.						
	20				4	79		SANDY CLAYEY SILTSTONE (R) stiff, laminated, friable, locally Clayey Sandstone						
360	25				5	84/11.5"		CLAYEY SILTSTONE (R) light gray, locally oxidized orange, damp, stiff to medium hard, thin sand stringers (less than 1/4 inch). Becoming hard SILTY SANDSTONE (R) light gray-brown, damp, dense, slightly friable, sand is very fine to fine grained.						
	30				6	50/5"		Bottom of drill hole at 30 feet. No groundwater encountered. Drill hole backfilled and tamped.						

SHEET 1 OF 1

LEGEND TO LOGS ON PLATE A-2

PLATE A-1.4

LOG OF DRILL HOLE

B NO.: S89012
ROJECT: Sludge Processing Sites
CATION: Eastgate Technology Park
RILLING METHOD: Hollow Stem Auger, 7-inch

LOGGED BY: J. Thurber
CHECKED BY:

DRILL HOLE NO.: 13
DRILLING DATE: January 6, 1990
DATUM: City of San Diego
REFERENCE EL.: 385 Feet

ELEVATION (FEET)	DEPTH	DRILLING RATE	REAL TIME/DEPTH	SAMPLE	SAMPLE NO.	BLOW COUNT (BLOWS PER FOOT)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT (%)	ATTERBERG LIMITS PLASTIC LIMIT (%)	TORVANE (PSF)	ADDITIONAL TESTS
								"COLLUVIUM (Qc)" SANDY SILT (ML) red-brown, dry to damp, stiff, minor gravel.						
80	5			◢	1	50/ 5"		"LINDAVISTA FORMATION (Qln)" SANDSTONE (R) red-brown, damp, dense, sand is fine to coarse grained. Gravel-cobble layers (6-10 inch) from 6 to 9 feet.						
	10			◢	2	50/ 5"		"SCRIPPS FORMATION (Tsc)" SILTSTONE (R) light gray, locally oxidized orange, damp, stiff.						
70	15			◢	3	50/ 6"		SANDSTONE (R) light gray and gray-brown, damp, dense, sand is very fine to fine grained, moderate amount of silt, laminated. 17 feet: gravel layer, 6 inches thick. Becoming oxidized.						
	20			◢	4	75/ 11.5"		20 feet: becoming CLAYEY SILTSTONE (R) light gray and brown, damp, medium hard to hard, laminated.						

Bottom of drill hole at 20.5 feet.
No groundwater encountered.
Hole backfilled and tamped.

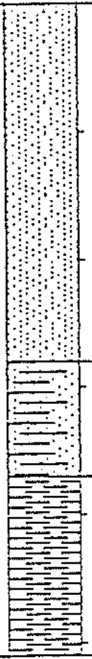
LEGEND TO LOGS ON PLATE A-2

LOG OF DRILL HOLE

JOB NO.: S89012
PROJECT: Sludge Processing Sites
LOCATION: Eastgate Technology Park
DRILLING METHOD: Hollow Stem Auger, 7-inch

LOGGED BY: J. Thurber
CHECKED BY:

DRILL HOLE NO.: 14
DRILLING DATE: January 6, 1990
DATUM: City of San Diego
REFERENCE EL.: 395 Feet



ELEVATION (FEET)	DEPTH	DRILLING RATE	REAL TIME/DEPTH	SAMPLE	SAMPLE NO.	BLOW COUNT (BLOWS PER FOOT)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT (%)	ATTERBERG LIMITS PLASTIC LIMIT (%)	TORVANE (PSF)	ADDITIONAL TESTS
								"LINDAVISTA FORMATION (Qln)" SANDSTONE (R) red-brown, damp, dense-hard, sand is fine to medium grained, hematite cement.						
390	5				1	50/3"								
	10				2	90/11"		Sandstone, locally coarse grained sand with rare pebble, hematite cement.						
								Gravel at 14 feet.						
380	15				3	90		"LINDAVISTA FORMATION (Qln)" SILTY SANDSTONE (R) light brown, damp, dense, sand is very fine to fine grained. 17 feet: gravel-cobble layer, approximately 12 inches thick, of hard siliceous volcanic clasts, subrounded.						
	20				4	92/9"		"SCRIPPS FORMATION (Tsc)" CLAYSTONE/SILTSTONE (R) light gray, damp, hard, faintly laminated, 2-3 inch fine grained sand layers, trace of organics, minor iron oxide.						
370	25					73/11"		Laminations dip 2 to 3 degrees.						
								Bottom of drill hole at 25.5 feet. No groundwater encountered. Drill hole backfilled and tamped.						

SHEET 1 OF 1

LEGEND TO LOGS ON PLATE A-2

PLATE A-1.6

LOG OF DRILL HOLE

B NO.: S89012
OJECT: Sludge Processing Sites
CATION: Eastgate Technology Park
ILLING METHOD: Hollow Stem Auger, 7-inch

LOGGED BY: J. Thurber
CHECKED BY:

DRILL HOLE NO.: 15
DRILLING DATE: January 6, 1990
DATUM: City of San Diego
REFERENCE EL.: 375 Feet

(FEET) DEPTH	DRILLING RATE	REAL TIME/DEPTH	SAMPLE	SAMPLE NO.	BLOW COUNT (BLOWS PER FOOT)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT (%)	ATTERBERG LIMITS PLASTIC LIMIT (%)	TORVANE (PSF)	ADDITIONAL TESTS
							"COLLUVIUM (Qc)" SANDY SILT (ML) brown, dry, medium stiff.						
70 5			◢	1	50/ 3"		"LINDAVISTA FORMATION (Qln)" SANDSTONE (R) red-brown, dry to damp, dense, sand is very fine to fine grained, minor hematite. 7.5 to 8.5 feet: gravel layer, volcanic clasts, subrounded.						
10			◢	2	77/ 11"		"SCRIPPS FORMATION (Tsc)" CLAYSTONE/SILTSTONE (R) light gray, oxidized brown, damp, stiff to medium hard, laminated, 3-5 degrees dip.						
50 15			◢	3	50/ 4.5"		"SCRIPPS FORMATION (Tsc)" SANDSTONE (R) light brown, damp, dense, sand is fine grained, moderate amount of silt. Becoming SANDY SILTSTONE (R) mottled gray and brown, damp, stiff, sand is fine grained.						
20			◢	4	50/ 4"		Bottom of drill hole at 20 feet. No groundwater encountered. Drill hole backfilled and tamped.						

HEET 1 OF 1

LEGEND TO LOGS ON PLATE A-2

PLATE A-1.7

LOG OF DRILL HOLE

JOB NO.: S89012
PROJECT: Sludge Processing Sites
LOCATION: Eastgate Technology Park
DRILLING METHOD: Hollow Stem Auger, 7-inch

LOGGED BY: J. Thurber
CHECKED BY:

DRILL HOLE NO.: 16
DRILLING DATE: January 6, 1990
DATUM: City of San Diego
REFERENCE EL.: 380 Feet

ELEVATION (FEET)	DEPTH	DRILLING RATE	REAL TIME/DEPTH	SAMPLE	SAMPLE NO.	BLOW COUNT (BLOWS PER FOOT)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT (%)	ATTERBERG LIMITS PLASTIC LIMIT (%)	TORVANE (PSF)	ADDITIONAL TESTS
380								"COLLUVIUM (Qc)" SANDY SILT (ML) brown, dry, soft, abundant roots.						
								"LINDAVISTA FORMATION (Qln)" SANDSTONE (R) light gray becoming light brown, damp, dense, sand is fine grained, scattered gravel (volcanic), hematite stain locally.						
	5			◢	1	50/ 5.5"								
								"SCRIPPS FORMATION (Tsc)" CLAYEY SILTSTONE (R) light gray, damp, stiff, faintly laminated, locally oxidized, thin Sandy Siltstone laminations (less than 1/4 inch).						
370	10			◢	2	61								
	15			◢	3	79/ 11.5"		Trace organic matter, laminations dip 2-3 degrees.						
								Faintly laminated.						
360	20			◢	4	90		Sand layer dips 4 to 6 degrees.						

Bottom of drill hole at 20.5 feet.
No groundwater encountered.
Drill hole backfilled and tamped.

SHEET 1 OF 1

LEGEND TO LOGS ON PLATE A-2

PLATE A-1.8

UNIFIED SOIL CLASSIFICATION SYSTEM

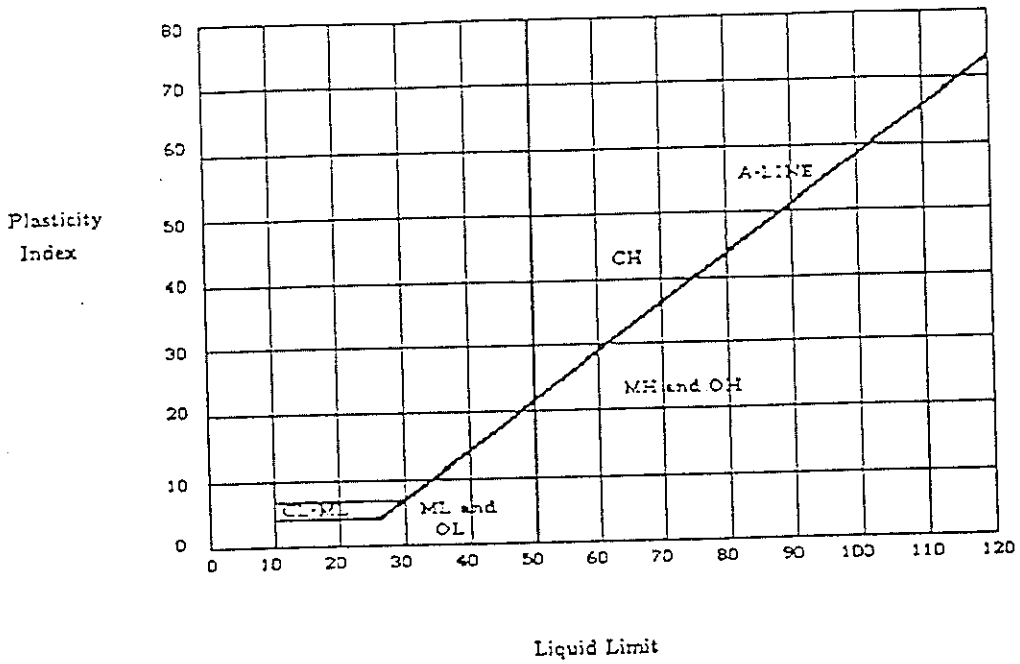
MAJOR DIVISION			GROUP SYMBOL	DESCRIPTION	GRAPHIC LOG
COARSE GRAINED SOILS Over 50% By Weight Coarser Than No. 200 Sieve Size	GRAVELLY SOILS OVER 50% OF COARSE FRACTION LARGER THAN NO. 4 SIEVE SIZE	CLEAN GRAVELLY SOILS LITTLE OR NO FINES	GW	WELL GRADED GRAVELS OR GRAVEL - SAND MIXTURES	▤
			GP	POORLY GRADED GRAVELS OR POORLY GRADED GRAVEL -SAND SILT MIXTURES	▤
		GRAVELLY SOILS WITH FINES OVER 12% FINES	GM	SILTY GRAVELS OR POORLY GRADED GRAVEL - SAND SILT MIXTURES	▦
			GC	CLAYEY GRAVELS OR POORLY GRADED GRAVEL - SAND - CLAY MIXTURES	▩
	SANDY SOILS OVER 50% OF COARSE FRACTION SMALLER THAN NO. 4 SIEVE SIZE	CLEAN SANDY SOILS LITTLE OR NO FINES	SW	WELL GRADED SANDS OR GRAVELLY SANDS	░
			SP	POORLY GRADED SANDS OR GRAVELLY SANDS	░
		SANDY SOILS WITH FINES OVER 12% FINES	SM	SILTY SANDS OR POORLY GRADED SAND - SILT MIXTURES	▥
			SC	CLAYEY SANDS OR POORLY GRADED SAND - CLAY MIXTURES	▨
FINE GRAINED SOILS Over 50% By Weight Finer Than No. 200 Sieve Size	SILTY AND CLAYEY SOILS LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS, VERY FINE SANDS - SILTY/CLAYEY FINE SANDS, CLAYEY SILTS WITH SLIGHT PLASTICITY	▥
			CL	INORGANIC CLAYS-LOW TO MEDIUM PLASTICITY, GRAVELLY, SANDY, SILTY OR LEAN CLAYS	▩
			OL	ORGANIC CLAYS OR ORGANIC SILTY CLAYS OF LOW PLASTICITY	▥
	SILTY AND CLAYEY SOILS LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, OR ELASTIC SILTS	▥
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, OR FAT CLAYS	▨
			OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, OR ORGANIC SILTS	▤
HIGHLY ORGANIC SOILS			Pt	PEAT OR OTHER HIGHLY ORGANIC SOIL	▤

MPLE TYPES:

■	UNDISTURBED SLEEVE
☐	DISTURBED
☐	UNSUCCESSFUL ATTEMPT
▨	STANDARD PENETRATION

▼	WATER LEVEL
≡	WATER INFLOW

PLASTICITY CHART - Used for Classification of Fine Grained Soils



BLOW COUNT - The number of blows required to drive the indicated sampler the last 12 inches of an 18 inch drive. The notation 100/9 indicates only 9 inches of penetration were achieved in 100 blows. Hammer weights and drop heights are shown below:

Symbol	Driving Weight (pounds)	Drop Height (inches)
7		
(3)		
[6]		


Heavy Caving


Light Caving

ADDITIONAL TESTS -

UC : Unconfined Compression
TD : Triaxial Compression, Drained
TU : Triaxial Compression, Undrained
TDy: Triaxial Compression, Dynamic
PH : Hydrogen Ion Concentration
PA : Paleontologic, Analysis
GS : Grain Size Distribution

WP : Water Pressure
PMt: Pressuremeter
SE : Sand Equivalent
GJ : Goodman Jack
SP : Specific Gravity
CP : Compaction
C : Consolidation
DS : Direct Shear

PM : Permeability
EX : Expansion
RS : Resistivity
S : Swell
CL : Chloride
SU : Sulphate

LEGEND TO LOGS

PLATE A-2

Pre-Design Geotechnical Investigation, North City Reclamation Plant Site (NTP-1)
and
Pre-Design Geotechnical Investigation, Long-Term Sludge Processing Plant-North (NSF-2)
by
Woodward-Clyde Consultants

1550 Hotel Circle North
San Diego, California 92108
(619) 294-9400
Fax (619) 293-7920

Woodward-Clyde Consultants

August 23, 1990
Revised September 27, 1990
Project No. 9053246M-NSF2

Clean Water Program for Greater San Diego
First Interstate Plaza
401 "B" Street, Suite 710
San Diego, California 92101-4230

Attention: Mr. John G. Moutes
Program Manager

PRE-DESIGN GEOTECHNICAL INVESTIGATION
LONG TERM SLUDGE
PROCESSING PLANT - NORTH (NSF-2)
SAN DIEGO, CALIFORNIA

Gentlemen:

Woodward-Clyde Consultants (WCC) is pleased to provide the accompanying pre-design report, which presents the results of our preliminary geotechnical investigation for the project. This study was performed in accordance with Tasks 1 through 6, 8, and 10 of Attachment 3 of your subcontract agreement dated July 26, 1990, and your Notice to Proceed letter dated July 30, 1990.

This report presents our preliminary conclusions and recommendations pertaining to the project, as well as the results of our field and laboratory investigations. The project site will also be occupied by the proposed North City Reclamation Plant (NTP-1). A separate report is issued for that project, including the same information as this report. In addition, the results of a Phase I environmental site assessment for the site, fulfilling the requirements of Task 7 of our contract, are provided in a separate report.

A draft version of this report was issued on August 23, 1990. Upon review by the CWP staff, a meeting was held on August 30, 1990 to discuss the CWP's comments. This final version of the report includes those comments and additional revisions.

Our engineer and geologist assigned to this project are Messrs. Moi Arzamendi and Jeff Brown, respectively. We have also been assisted by our subconsultants, Allied Geotechnical Engineers, Inc. and DeC Consultants, Inc. If you have any questions regarding this report or if we can be of further service, please give us a call.

Very truly yours,

WOODWARD-CLYDE CONSULTANTS

John Moossazadeh
G.E. 617

Registered Professional Engineer
John Moossazadeh
No. 617
Exp 12/31/92
Geotechnical
State of California

David L. Schug
C.E.G. 1212

Certified Engineering Geologist
David L. Schug
No. 1212
Exp. 6-30-92
State of California

JM/DLS/MA/kah (b/ma3)

(10)

Consulting Engineers, Geologists
and Environmental Scientists

Offices in Other Principal Cities

1550 Hotel Circle North
San Diego, California 92108
(619) 294-9400
Fax (619) 293-7920

Woodward-Clyde Consultants

August 23, 1990
Revised September 27, 1990
Project No. 9053245M-NTP1

Clean Water Program for Greater San Diego
First Interstate Plaza
401 "B" Street, Suite 710
San Diego, California 92101-4230

Attention: Mr. John G. Moutes
Program Manager

PRE-DESIGN GEOTECHNICAL INVESTIGATION
NORTH CITY RECLAMATION PLANT SITE (NTP-1)
SAN DIEGO, CALIFORNIA

Gentlemen:

Woodward-Clyde Consultants (WCC) is pleased to provide the accompanying pre-design report, which presents the results of our preliminary geotechnical investigation for the project. This study was performed in accordance with Tasks 1 through 6, 8, and 10 of Attachment 4 of your subcontract agreement dated July 26, 1990, and your Notice to Proceed letter dated July 30, 1990.

This report presents our preliminary conclusions and recommendations pertaining to the project, as well as the results of our field and laboratory investigations. The project site will also be occupied by the proposed Long Term Sludge Processing Plant - North (NSF-2). A separate report is issued for that project, including the same information as this report. In addition, the results of a Phase I environmental site assessment for the site, fulfilling the requirements of Task 7 of our contract, are provided in a separate report.

A draft version of this report was issued on August 23, 1990. Upon review by the CWP staff, a meeting was held on August 30, 1990 to discuss the CWP's comments. This final version of the report includes those comments and additional revisions.

Our engineer and geologist assigned to this project are Messrs. Moi Arzamendi and Jeff Brown, respectively. We have also been assisted by our subconsultants, Allied Geotechnical Engineers, Inc. and DeC Consultants, Inc. If you have any questions regarding this report or if we can be of further service, please give us a call.

Very truly yours,

WOODWARD-CLYDE CONSULTANTS

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G.E. 617

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No. 617
Exp. 12/31/92

David L. Schug
C.E.G. 1212

DAVID L. SCHUG
No. 1212
Exp. 6-30-92

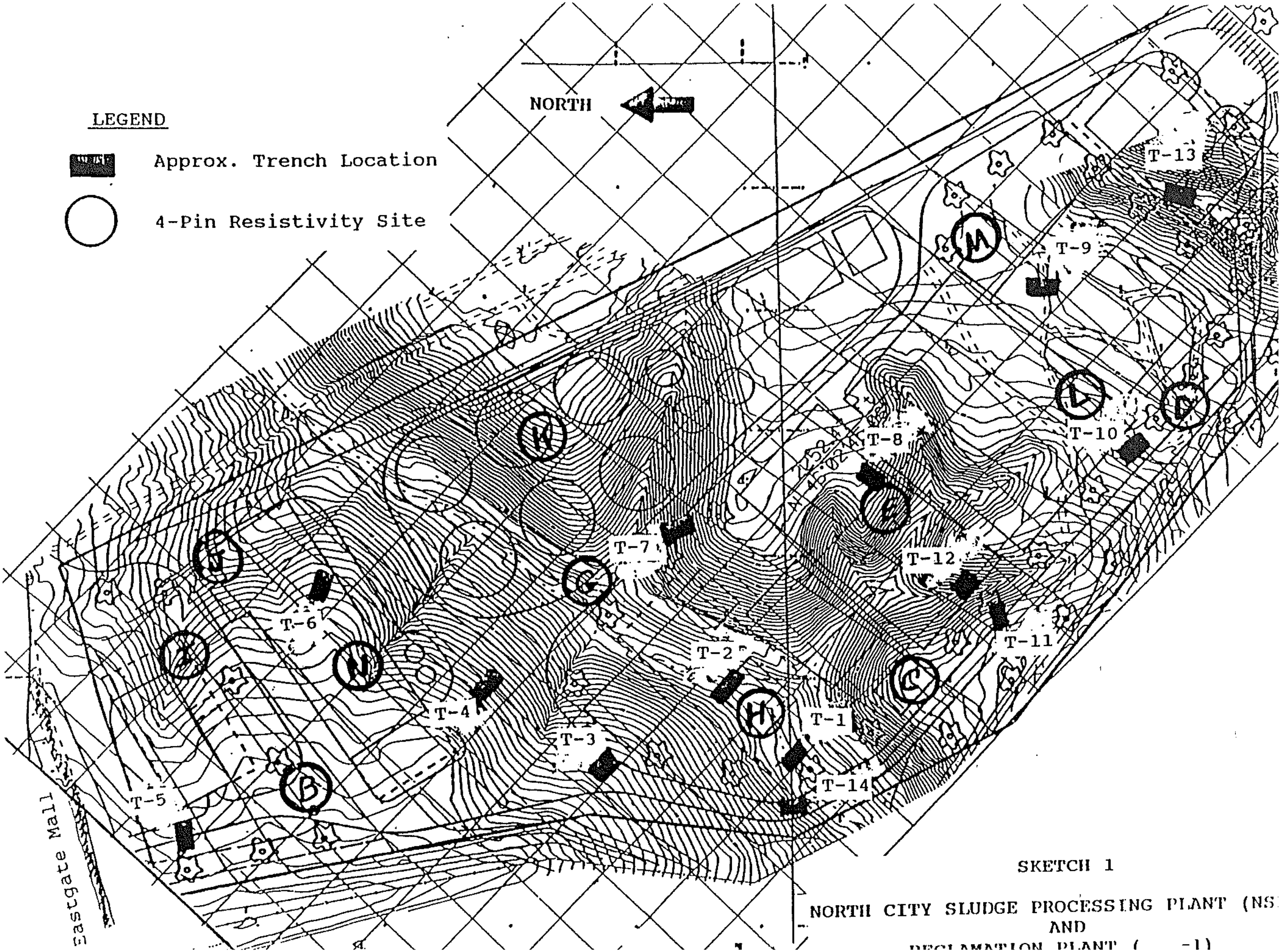
JM/DLS/MA/kah (a/ma3)

(10)

a/ma3

Consulting Engineers, Geologists
and Environmental Scientists

Offices in Other Principal Cities



SKETCH 1

NORTH CITY SLUDGE PROCESSING PLANT (NS
AND
RECLAMATION PLANT (-1)

Project: CWP - NORTH CITY SITE (NTP-1 & NSF-2)

Log of Test Pit No: T-1

Date Excavated: 8-7-90
Water Depth: Dry
Measured: At time of excavation
Type of Excavation: 24" Backhoe
Type of Rig:

* see Key to Logs, Fig. A-1

Surface Elevation: Approximately 298 feet

Depth, ft	Samples	Blows/ft	Material Description	Moisture Content, %	Dry Density, pcf	Other Tests*
0			**ALLUVIUM** Loose, moist, brown, silty sand (SM)			
1			Medium dense, moist, brown to dark brown, clayey sand (SC) with gravel (1" to 4" across)			
3	T-1 3'-4'					GS,PI
4			**SCRIPPS FORMATION** Interbedded dense, moist, pale gray brown, silty fine sand (SM), fine sandy silt (ML) with hard, moist, gray brown, sandy lean to fat clay (CL/CH)			
6	T-1 6'-7'					
8	T-1 8'-9'					PI
13			Bottom of hole at 13 feet			

Project No: 9053245M-NTP1

Woodward-Clyde Consultants

Figure: A-2

Project: CWP - NORTH CITY SITE (NTP-1 & NSF-2)	Log of Test Pit No: T-2

Date Excavated: 8-7-90
Water Depth: Dry
Measured: At time of excavation
Type of Excavation: 24" Backhoe
Type of Rig:

* see Key to Logs, Fig. A-1

Depth, ft	Samples	Blows/ft	Material Description	Moisture Content, %	Dry Density, pcf	Other Tests*
			Surface Elevation: Approximately 302 feet			
0			**ALLUVIUM** Loose, moist, brown, silty sand (SM)			
1			Medium dense, moist, brown to dark brown, silty sand (SM) with some clay and gravels (1" to 6" across)			
5			**SCRIPPS FORMATION** Dense, moist, reddish brown, silty to clayey sand (SM/SC) with some thin interbeds of pale gray, fine sandy silt (ML); locally cemented			
6	T-2 6'-7'					
8	T-2 8'-9'					GS
11			Very dense, moist, pale gray, fine sandy silt (ML)			
11.5	T-2 11.5'-12'					
12			Bottom of hole at 12 feet			

Project No: 9053245M-NTP1

Woodward-Clyde Consultants

Figure: A-3

Project: CWP - NORTH CITY SITE (NTP-1 & NSF-2)	Log of Test Pit No: T-3

Date Excavated: 8-7-90
Water Depth: Dry
Measured: At time of excavation

e of Excavation: 24" Backhoe
Type of Rig:

* see Key to Logs, Fig. A-1

Depth, ft	Samples	Blows/ft		Material Description	Moisture Content, %	Dry Density, pcf	Other Tests*
				Surface Elevation: Approximately 346 feet			
0				**TOPSOIL** Loose, moist, brown, clayey sand (SC)			
1			▨	**RESIDUAL CLAY** Hard, moist, dark brown, sandy lean clay (CL)			
2			▥	**SCRIPPS FORMATION** Very dense, moist, pale brown to pale gray with light reddish mottles, fine sandy silt (ML); locally cemented			
3							
4							
5							
6							
7							
8							
9							
10							
11	T-3 11.5' -12'		▨	---Grades to--- Hard, moist, light gray, fine sandy lean to fat clay (CL/CH)			GS,PI
12				Bottom of hole at 12 feet			
13							
14							
15							

Project No: 9053245M-NTP1	Woodward-Clyde Consultants	Figure: A-4

Project: CWP - NORTH CITY SITE (NTP-1 & NSF-2)	Log of Test Pit No: T-4

Date Excavated: 8-7-90

Water Depth: Dry

Measured: At time of excavation

Type of Excavation: 24" Backhoe

Type of Rig:

* see Key to Logs, Fig. A-1

Depth, ft	Samples	Blows/ft	Material Description	Moisture Content, %	Dry Density, pcf	Other Tests*
			Surface Elevation: Approximately 363 feet			
0			**TOPSOIL** Loose, moist, dark brown, clayey sand (SC)			
1			**RESIDUAL CLAY** Hard, moist, dark brown, sandy lean clay (CL)			
2			**SCRIPPS FORMATION** Dense, interbedded light brown and pale gray, sandy silt (ML) and silty fine sand (SM); locally cemented			
3						
4						
5						
6						
7						
8						
9						
10						
11						
12			Bottom of hole at 11.5 feet			
13						
14						
15						

Project No: 9053245M-NTP1

Woodward-Clyde Consultants

Figure: A-5

Project: CWP - NORTH CITY SITE (NTP-1 & NSF-2)	Log of Test Pit No: T-5

Date Excavated: 8-7-90
Water Depth: Dry
Measured: At time of excavation
pe of Excavation: 24" Backhoe
Type of Rig:

* see Key to Logs, Fig. A-1

Depth, ft	Samples	Blows/ft	Material Description	Moisture Content, %	Dry Density, pcf	Other Tests*
			Surface Elevation: Approximately 376 feet			
0			**TOPSOIL** Loose, moist, dark brown, silty sand sand (SM) with clay and gravels			
1			**RESIDUAL CLAY** Hard, moist, dark brown, sandy lean clay (CL)			
2			**SCRIPPS FORMATION** Dense, moist, light reddish brown, silty sand (SM) with thin interlayers of pale gray, sandy silt (ML)			
3						
4						
5						
6						
7						
8						
9						
10			Very dense, moist, pale gray to pale brown, fine sandy silt (ML) with lenses of light reddish brown, silty sand (SM)			
11						
12			Bottom of hole at 12 feet			
13						
14						
15						

Project No: 9053245M-NTP1 | Woodward-Clyde Consultants | Figure: A-6

Project: CWP - NORTH CITY SITE (NTP-1 & NSF-2)	Log of Test Pit No: T-6

Date Excavated: 8-7-90
Water Depth: Dry
Measured: At time of excavation
Type of Excavation: 24" Backhoe
Type of Rig:

* see Key to Logs, Fig. A-1

Depth, ft	Samples	Blows/ft	Material Description	Moisture Content, %	Dry Density, pcf	Other Tests*
			Surface Elevation: Approximately 352 feet			
0			**TOPSOIL** Loose to medium dense, moist, brown, silty sand (SM) with some clay and gravels			
1			**RESIDUAL CLAY** Hard, moist, dark brown, sandy lean clay (CL)			
2			**SCRIPPS FORMATION** Interbedded hard, moist, light brown to light gray, lean clay (CL) and dense, sandy silt (ML)			
3						
4						
5			At 5', bedding attitude estimated at N 90° E, 3°-5° N			
6						
7						
8						
9						
10						
11						
12			Bottom of hole at 12 feet			
13						
14						
15						

Project No: 9053245M-NTP1	Woodward-Clyde Consultants	Figure: A-7

Project: CWP - NORTH CITY SITE (NTP-1 & NSF-2)

Log of Test Pit No: T-7

Date Excavated: 8-7-90
Water Depth: Dry
Measured: At time of excavation
e of Excavation: 24" Backhoe
Type of Rig:

* see Key to Logs, Fig. A-1

Depth, ft	Samples	Blows/ft	Material Description	Moisture Content, %	Dry Density, pcf	Other Tests*
			Surface Elevation: Approximately 368 feet			
0			**TOPSOIL** Loose to medium dense, moist, brown, silty sand (SM) with some clay and gravels			
1			**LINDAVISTA FORMATION** Dense, moist, light reddish brown to light yellowish brown, silty sand (SM)			
2						
3	T-7 3'-3.5'					GS
4			**SCRIPPS FORMATION** Very dense, moist, light gray to light brown, silty sand (SM); locally cemented			
5						
7						
8	T-7 8'-9'					
9			Bottom of hole at 9 feet			
10						
11						
12						
13						
14						
5						

Project No: 9053245M-NTP1
Woodward-Clyde Consultants
Figure: A-8

Project: CWP - NORTH CITY SITE (NTP-1 & NSF-2)

Log of Test Pit No: T-8

Date Excavated: 8-8-90
Water Depth: Dry
Measured: At time of excavation
Type of Excavation: 24" Backhoe
Type of Rig:

* see Key to Logs, Fig. A-1

Depth, ft	Samples	Blows/ft	Material Description	Moisture Content, %	Dry Density, pcf	Other Tests*
			Surface Elevation: Approximately 362 feet			
0			**TOPSOIL** Loose, moist, brown, silty sand (SM) with gravels			
1			**RESIDUAL CLAY** Hard, moist, dark reddish brown, clayey gravel (GC) with some sand			
2			**LINDAVISTA FORMATION** Very dense, moist, reddish brown, sandy gravel (GM) with silt; well cemented; gravels (1" to 7" across)			
3						
4			Very dense, moist, mottled light reddish brown and light brown, silty sand (SM)			
5						
6						
7						
8						
9						
10			Bottom of hole at 10 feet			
11						
12						
13						
14						
15						

Project No: 9053245M-NTP1

Woodward-Clyde Consultants

Figure: A-9

Project: CWP - NORTH CITY SITE (NTP-1 & NSF-2)	Log of Test Pit No: T-9

Date Excavated: 8-8-90
Water Depth: Dry
Measured: At time of excavation
Type of Excavation: 24" Backhoe
Type of Rig:

* see Key to Logs, Fig. A-1

Depth, ft	Samples	Blows/ft	Material Description	Moisture Content, %	Dry Density, pcf	Other Tests*
			Surface Elevation: Approximately 380 feet			
0			**TOPSOIL** Loose, moist, brown, silty sand (SM)			
1			**RESIDUAL CLAY** Dense, moist, dark brown, clayey sand (SC)			
			LINDAVISTA FORMATION Very dense, moist, pale gray to pale brown, silty fine to coarse sand (SM); well cemented			
2	T-9 2.5' -3'					
3			Refusal at 3 feet on cemented sand			
4						
5						
7						
8						
9						
10						
11						
12						
13						
14						
5						

Project No: 9053245M-NTP1	Woodward-Clyde Consultants	Figure: A-10

Project: CWP - NORTH CITY SITE (NTP-1 & NSF-2)

Log of Test Pit No: T-10

Date Excavated: 8-8-90

Water Depth: Dry

Measured: At time of excavation

Type of Excavation: 24" Backhoe

Type of Rig:

* see Key to Logs, Fig. A-1

Depth, ft	Samples	Blows/ft	Material Description	Moisture Content, %	Dry Density, pcf	Other Tests*
			Surface Elevation: Approximately 380 feet			
0	T-10 0.5' -1'		**TOPSOIL** Loose, moist, light reddish brown, clayey sand (SC) with gravel			GS,PI
0.5			**RESIDUAL CLAY** Hard, moist, dark reddish brown, sandy lean clay (CL)			
1.3			**LINDAVISTA FORMATION** Very dense, moist, light brown to light reddish brown, silty fine to coarse sand (SM); well cemented			
5			Refusal at 5 feet on cemented sand			
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						

Project No: 9053245M-NTP1

Woodward-Clyde Consultants

Figure: A-11

Project: CWP - NORTH CITY SITE (NTP-1 & NSF-2)	Log of Test Pit No: T-11

Date Excavated: 8-8-90
Water Depth: Dry
Measured: At time of excavation
Type of Excavation: 24" Backhoe
Type of Rig:

* see Key to Logs, Fig. A-1

Surface Elevation: Approximately 354 feet

Depth, ft	Samples	Blows/ft	Material Description	Moisture Content, %	Dry Density, pcf	Other Tests*
0			**TOPSOIL** Loose, moist, brown, clayey sand (SC) with gravel			
			RESIDUAL CLAY Dense, moist, dark reddish brown, clayey gravel (GC) with sand			
1			**LINDAVISTA FORMATION** Very dense, moist, light reddish brown, sandy gravel (GM) with silt			
2						
3						
4						
5						
7						
8						
9	T-11 9.5' -10'					GS
10			Bottom of hole at 10 feet			
11						
12						
13						
14						

Project No: 9053245M-NTP1	Woodward-Clyde Consultants	Figure: A-12

Project: CWP - NORTH CITY SITE (NTP-1 & NSF-2)

Log of Test Pit No: T-12

Date Excavated: 8-8-90
Water Depth: Dry
Measured: At time of excavation
Type of Excavation: 24" Backhoe
Type of Rig:

* see Key to Logs, Fig. A-1

Depth, ft	Samples	Blows/ft	Material Description	Moisture Content, %	Dry Density, pcf	Other Tests*
			Surface Elevation: Approximately 333 feet			
0			**ALLUVIUM** Loose to medium dense, moist, dark brown, silty sand (SM) with gravel			
1						
2						
3						
4						
5			**SCRIPPS FORMATION** Very dense, moist, light reddish brown, silty sand (SM)			
6			Bottom of hole at 5.5 feet			
7						
8						
9						
10						
11						
12						
13						
14						
15						

Project: CWP - NORTH CITY SITE (NTP-1 & NSF-2)

Log of Test Pit No: T-13

Date Excavated: 8-8-90

Water Depth: Dry

Measured: At time of excavation

Type of Excavation: 24" Backhoe

Type of Rig:

* see Key to Logs, Fig. A-1

Depth, ft	Samples	Blows/ft	Material Description	Moisture Content, %	Dry Density, pcf	Other Tests*
			Surface Elevation: Approximately 342 feet			
0			**ALLUVIUM** Loose to medium dense, moist, brown to dark brown, silty to clayey sand (SM/SC) with some gravels (1" to 7" across)			
1						
2						
3						
4						
5			**SCRIPPS FORMATION** Dense, moist, pale yellowish brown, silty sand (SM) with interlayers of pale brown, fine sandy silt (ML)			
6						
7						
8						
9						
10			Bottom of hole at 9.5 feet			
11						
12						
13						
14						
15						

Project No: 9053245M-NTP1

Woodward-Clyde Consultants

Figure: A-14

Project: CWP - NORTH CITY SITE (NTP-1 & NSF-2)

Log of Test Pit No: T-14

Date Excavated: 8-8-90

Water Depth: Dry

Measured: At time of excavation

Type of Excavation: 24" Backhoe

Type of Rig:

* see Key to Logs, Fig. A-1

Depth, ft	Samples	Blows/ft	Material Description	Moisture Content, %	Dry Density, pcf	Other Tests*
			Surface Elevation: Approximately 298 feet			
0			ALLUVIUM Loose to medium dense, moist, brown to dark brown, clayey sand (SC) with silt and gravel (1" to 4" across)			
1						
2						
3						
4						
5						
6						
7			SCRIPPS FORMATION Dense, moist, light brown to light reddish brown, silty sand (SM) with interlayers of pale gray, fine sandy silt (ML)			
8			Bottom of hole at 8 feet			
9						
10						
11						
12						
13						
14						
15						

Project No: 9053245M-NTP1

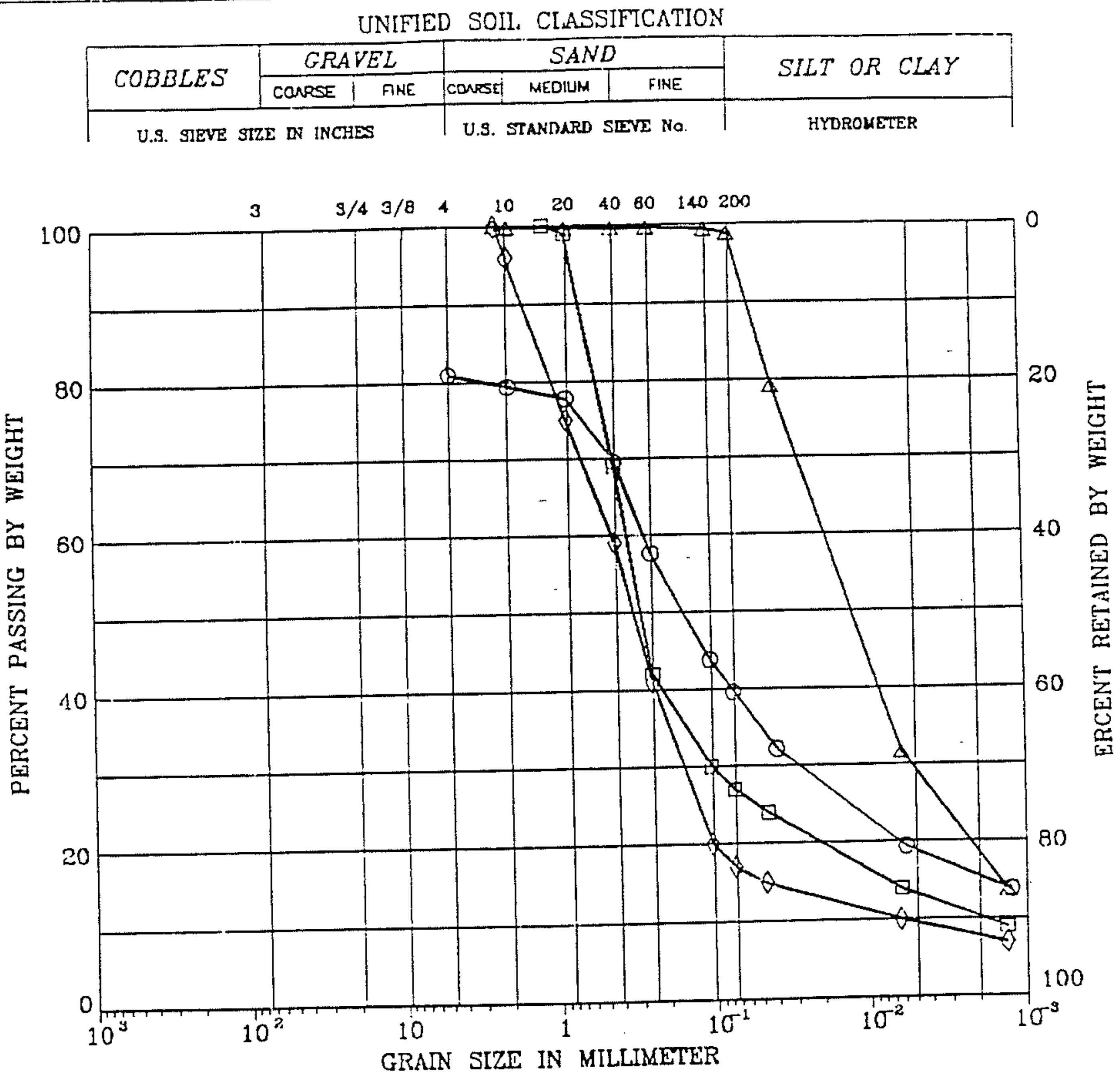
Woodward-Clyde Consultants

Figure: A-15

APPENDIX B

GEOTECHNICAL LABORATORY INVESTIGATION

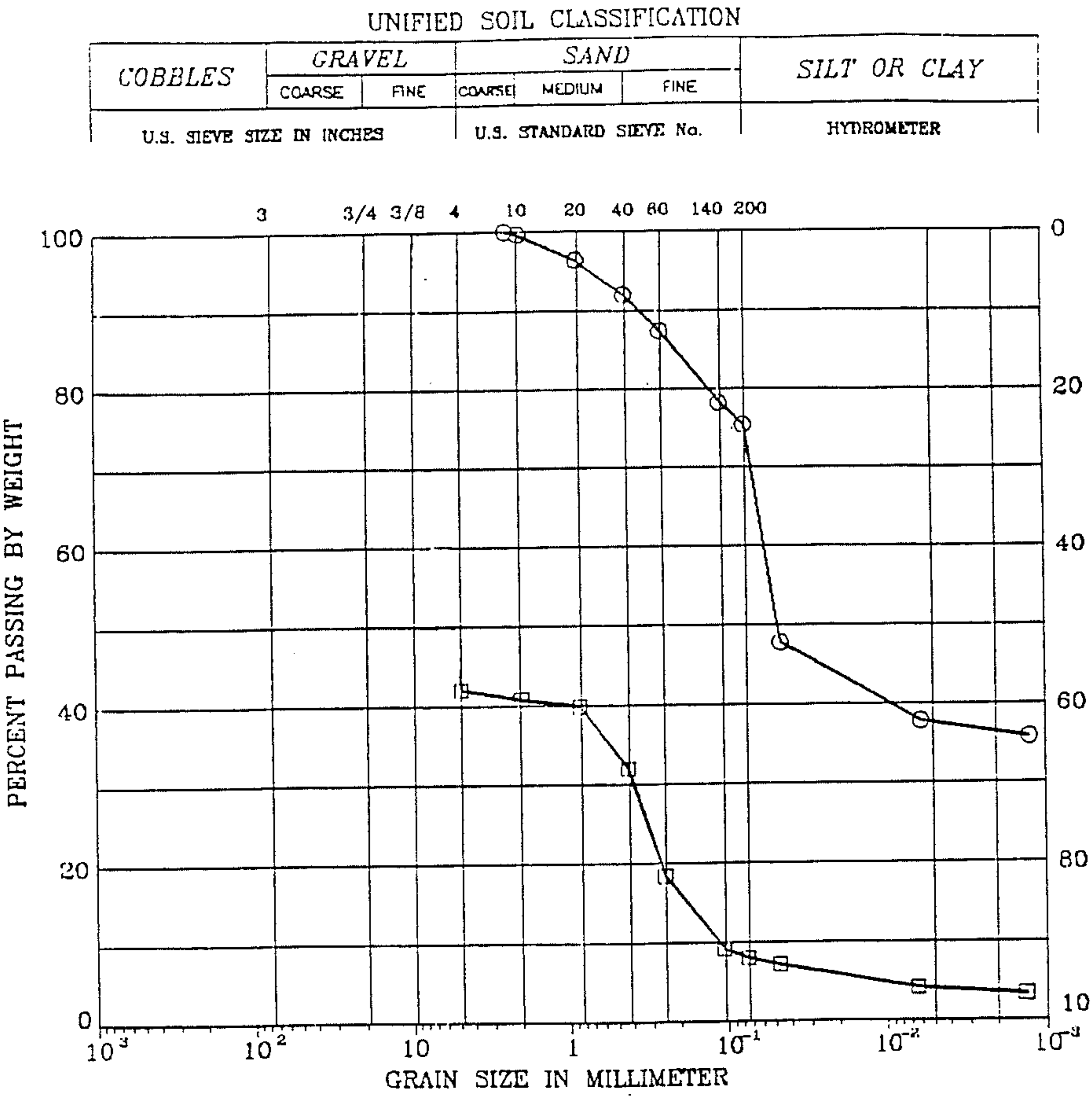
The materials observed in the test pit excavations were visually classified and evaluated with respect to strength, swelling and compressibility characteristics, dry density, and moisture content. The classifications were substantiated by performing grain size analyses and evaluating plasticity characteristics of representative samples of the soils. The results of grain size distribution tests and plasticity index tests are shown in Figures B-1 and B-2.



SYMBOL	BORING	DEPTH (ft)	LL (%)	PI (%)	DESCRIPTION
○	T-1	3-4	27	13	CLAYEY SAND WITH GRAVEL (SC)
□	T-2	8-9	—	—	CLAYEY SAND (SC)
△	T-3	12	56	29	FAT CLAY (CH)
◊	T-7	3			SILTY SAND (SM)

Remark : T-1 @ 8' to 9', LL=51, PI=26

9053245M NTP1	CWP - NORTH CITY SITE (NTP-1 & NSF-2)
Woodward Clyde Consultants San Diego, CA	GRAIN SIZE DISTRIBUTION Figure No. B-1



SYMBOL	BORING	DEPTH (ft)	LL (%)	PI (%)	DESCRIPTION
○	T-10	.5-1	45	28	LEAN CLAY WITH SAND (CL)
□	T-11	9.5-10			POORLY-GRADED GRAVEL WITH SILT AND SAND (GP-GM)

Remark :

9053245M NTP1	CWP - NORTH CITY SITE (NTP-1 & NSF-2)
Woodward Clyde Consultants San Diego, CA	GRAIN SIZE DISTRIBUTION Figure No. B-2

FIRP Sludge Dewatering and Drying Facilities, Eastgate Mall Site

by

Metcalf & Eddy, Inc.

GEOTECHNICAL CONSULTANTS, INC.

S89012B

GEOTECHNICAL INVESTIGATION
PROPOSED NORTH CITY SLUDGE PROCESSING FACILITIES AT I-805 AND EASTGATE MALL ROAD, CITY OF SAN DIEGO, CALIFORNIA

FOR

METCALF AND EDDY

NOVEMBER 1990

1533 East 4th Street · Santa Ana · CA 92701 · Phone (714) 547-5413

LOG OF DRILL HOLE

JOB NO.: S89012B
PROJECT: Sludge Dewatering Facility
LOCATION: North City, San Diego
DRILLING METHOD: Hollow Stem Auger, 7-inch

LOGGED BY: J. Thurber
CHECKED BY: T. Huber

DRILL HOLE NO.: 101
DRILLING DATE: September 5, 1990
DATUM: See Plate 1
REFERENCE EL.: 311 Feet

ELEVATION (FEET)	DEPTH (FEET)	DRILLING RATE REAL TIME/DEPTH	SAMPLE	SAMPLE NO.	BLOW COUNT (BLOWS PER FOOT)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT (%)	ATTERBERG LIMITS PLASTIC LIMIT (%)	POCKET PENETROMETER (TSF)	ADDITIONAL TESTS
310				1	50		"ALLUVIUM/COLLUVIUM (Qal/Qc)" CLAYEY SILT (ML) brown-mottled, slightly damp, stiff, scattered gravel & cobble of hard igneous/metamorphic rock.	95	10				RS,PH, CL,SU CP
				2									
				3	35		Becoming damp, decreasing cobble, scattered siltstone/sandstone fragments (1/2 inch).						
	5			4	23		Abundant siltstone fragments, 1 to 3 inch, mottled gray-red-brown, damp to moist.	91	20				
							"SCRIPPS FORMATION (Tsc)" Interbedded SANDSTONE (R) light brown, damp, hard, fine to medium grained, friable, and CLAYEY SILTSTONE (R) light gray, oxidized yellow-brown, damp, hard, fissile, finely laminated, both units non-calcareous.						
300	10			5	80			98	11				
	15			6	50/ 6"		SANDSTONE (R) light gray-yellow brown, damp, hard, minor silt, fine grained sand.						
							"SCRIPPS FORMATION (Tsc)" Interbedded CLAYEY SILTSTONE and SANDY SILTSTONE (R) light gray-brown, damp, hard, fissile, finely laminated, minor oxidation along fractures and laminae.						
290	20			7	50/ 3"			95	17				
	25			8	50/ 3"		Siltstone with 1 to 4 inch interbeds of Sandstone, fine grained.						
280	30			9	50/ 2"		gray-brown, moderate oxidation, laminations dip 8 to 12 degrees.						
	35				50/ 1"		Hard drilling at 33.5 feet. Calcareous cemented sandstone-siltstone, fine grained, very hard, approximately 12-15 inches thick.						
270	40			10	60/ 6"		Clayey siltstone with 1 to 2 inch sandstone interbeds, iron oxide deposits along fractures/bedding, slightly calcareous, 1/4 inch thick.	98	18				
	45			11	50/ 5"		"SCRIPPS FORMATION (Tsc)" CLAYEY SILTSTONE (R) light to medium gray, damp, hard, fissile, finely laminated, uniform, slightly to moderately calcareous.						
	50			12	50/ 5"		Becoming medium gray.						
							Bottom of drill hole at 50 feet. No groundwater encountered. Hole backfilled and tamped.						

SHEET 1 OF 1

LEGEND TO LOGS ON PLATE A-2

PLATE A-1.1

LOG OF DRILL HOLE

JOB NO.: S89012B
PROJECT: Sludge Dewatering Facility
LOCATION: North City, San Diego
DRILLING METHOD: Hollow Stem Auger, 7-inch

LOGGED BY: J. Thurber
CHECKED BY: T. Huber

DRILL HOLE NO.: 102
DRILLING DATE: September 5, 1990
DATUM: See Plate 1
REFERENCE EL.: 305 Feet

ELEVATION (FEET)	DEPTH (FEET)	DRILLING RATE REAL TIME/DEPTH	SAMPLE	SAMPLE NO.	BLOW COUNT (BLOWS PER FOOT)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT (%)	ATTERBERG LIMITS PLASTIC LIMIT (%)	POCKET PENETROMETER (TSF)	ADDITIONAL TESTS
			■	1	26		"ALLUVIUM/COLLUVIUM (Qal/Qc)" SILTY CLAY (CL) with sand, light brown, dry to damp, medium stiff, minor roots, many root borings - open vesicles, trace of gravel.	99	7	26	14		C, AL
			■	2	55		Becoming dark brown, open vesicles.	99	10				
300	5		◺	3	20		Medium gray-brown, moist, medium stiff, minor fine grained sand, scattered fine grained sandstone-siltstone fragments.						
	10		■	4	85		"SCRIPPS FORMATION (Tsc)" SANDY SILTSTONE (R) light gray-brown, damp, moderately hard, sand is fine grained, fissile. 12 feet: 6-inch thick hard-cemented layer.						
290	15		◺	5	50/5"		Finely laminated sandstone and clayey siltstone, fissile, light-gray, oxidized orange-brown along laminae, laminae dip 2 to 4 degrees. 16 feet: 8-10 inch thick hard layer.						
	20		◺	6	70/6"		"SCRIPPS FORMATION (Tsc)" CLAYEY SILTSTONE-SANDY SILTSTONE (R) light gray, oxidized orange-brown, damp, hard, finely laminated, fissile.						
280	25		■	7	70/6"		"SCRIPPS FORMATION (Tsc)" SANDSTONE (R) light brown, damp, hard, sand is very fine to fine grained, minor silt.	96	9				
	30		◺	8	50/3"		Sandstone, massive, hard, fine grained.						
							Cemented layer 32 to 33 feet, hard, slow drilling.						
270	35		◺	9	50/3"		"SCRIPPS FORMATION (Tsc)" SILTSTONE/CLAYSTONE (R) medium gray, damp, hard, laminated, fissile, uniform, laminae dip 0 to 2 degrees.						
	40		◺	10	50/5"		Claystone, medium gray, damp, hard, slightly plastic.						
260	45		■	11	61								
							Very hard drilling.						
							Refusal at 47 feet. No groundwater encountered. Hole backfilled and tamped.						

SHEET 1 OF 1

LEGEND TO LOGS ON PLATE A-2

PLATE A-1.2

LOG OF DRILL HOLE

JOB NO.: S89012B
PROJECT: Sludge Dewatering Facility
LOCATION: North City, San Diego
DRILLING METHOD: Hollow Stem Auger, 7-inch

LOGGED BY: J. Thurber
CHECKED BY: T. Huber

DRILL HOLE NO.: 103
DRILLING DATE: September 7, 1990
DATUM: See Plate 1
REFERENCE EL.: 352 Feet

ELEVATION (FEET)	DEPTH (FEET)	DRILLING RATE REAL TIME/DEPTH	SAMPLE	SAMPLE NO.	BLOW COUNT (BLOWS PER FOOT)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		POCKET PENETROMETER (TSF)	ADDITIONAL TESTS
										LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
350				1			"COLLUVIUM (Qc)" CLAYEY SILT (ML) light brown, dry, medium stiff, scattered gravel and cobble.						CP
				2	69		"SCRIPPS FORMATION (Tsc)" SILTSTONE (R) light brown, damp, hard, finely laminated, vertical fracture filled with brown clay-iron oxide (1/8 inch). Local silty sandstone, fine-grained, laminated, brittle, fissile.	76	44				
	5			3	64			99	14				DS,GS
	10			4	85/ 11"			99	15				
340							"SCRIPPS FORMATION (Tsc)" CLAYEY SILTSTONE (R) light gray, damp, moderately hard, with thin interbeds of SILTY SANDSTONE (R) orange-brown, damp, friable. Siltstone is finely laminated, fissile.						
	15			5	90/ 11"								
							Clayey Siltstone-Sandy Siltstone, light gray-brown, damp, moderately hard, interbedded, finely laminated, fissile, laminations dip 0-2 degrees.						
	20			6	75								
330													
	25			7	50/ 5"		Clayey Siltstone, light gray with iron oxide along lamination, fissile.	116	19				
	30			8	100/ 3"		Hard calcareous cemented sandstone-siltstone layer approximately 12 inches thick.						
320													
	35			9	100/ 5"		Slightly calcareous sandy siltstone hard layer, 8 inches thick.						
	40			10	58/ 6"		Sandy Siltstone with thin (2-3 inch) interbed of calcareous cemented Sandstone, hard.						
310													
	45			11	81		Clayey Siltstone with Sandy Siltstone laminae and 1/4-1/2 inch iron oxide cemented. Sandstone stringers.	99	22				
							"SCRIPPS FORMATION (Tsc)" CLAYEY SILTSTONE-SILTY CLAYSTONE (R) light gray, damp, hard, finely laminated, fissile, minor iron oxide stain along lamination.						
	50			12	80								
300													
				13	88/ 11"			100	16				

SHEET 1 OF 2

LEGEND TO LOGS ON PLATE A-2

LOG OF DRILL HOLE

JOB NO.: S89012B
PROJECT: Sludge Dewatering Facility
LOCATION: North City, San Diego
DRILLING METHOD: Hollow Stem Auger, 7-inch

LOGGED BY: J. Thurber
CHECKED BY: T. Huber

DRILL HOLE NO.: 103
DRILLING DATE: September 7, 1990
DATUM: See Plate 1
REFERENCE EL.: 352 Feet

ELEVATION (FEET)	DEPTH (FEET)	DRILLING RATE REAL TIME/DEPTH	SAMPLE	SAMPLE NO.	BLOW COUNT (BLOWS PER FOOT)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT (%)	ATTERBERG LIMITS PLASTIC LIMIT (%)	POCKET PENETROMETER (TSF)	ADDITIONAL TESTS
							"SCRIPPS FORMATION (Tsc)" CLAYEY SILTSTONE-SILTY CLAYSTONE (R) light gray-brown, damp, hard, finely laminated, fissile, iron oxide along laminae and fractures. 55 1/2 to 58 feet: hard calcareous cemented layer, slow drilling. (hammer disconnect/retrieve - no sample)						
	60												
290													
	65			14	70/ 6"		Silty claystone.	102	16				
							Clayey Siltstone, light gray, damp, hard, laminated, slightly calcareous, locally hard, calcareous cement, uniform lithology.						
	70			15	50/ 4"								
280													
	75			16	79/ 6"		light to medium gray, slightly calcareous, laminated, moderately fissile.						
				17	100/ 4"		Local hard cemented layers, finely laminated.						
							Bottom of drill hole at 79.5 feet. No groundwater encountered. Hole backfilled and tamped.						

SHEET 2 OF 2

LEGEND TO LOGS ON PLATE A-2

PLATE A-1.3

LOG OF DRILL HOLE

JOB NO.: S89012B
PROJECT: Sludge Dewatering Facility
LOCATION: North City, San Diego
DRILLING METHOD: Hollow Stem Auger, 7-inch

LOGGED BY: J. Thurber
CHECKED BY: T. Huber

DRILL HOLE NO.: 104
DRILLING DATE: September 7, 1990
DATUM: See Plate 1
REFERENCE EL.: 357 Feet

ELEVATION (FEET)	DEPTH (FEET)	DRILLING RATE REAL TIME/DEPTH	SAMPLE	SAMPLE NO.	BLOW COUNT (BLOWS PER FOOT)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT (%)	ATTERBERG LIMITS PLASTIC LIMIT (%)	POCKET PENETROMETER (TSF)	ADDITIONAL TESTS
							"COLLUVIUM (Qc)" SANDY SILT (ML) light brown, dry, medium stiff, minor gravel and cobble.						
	5		▨	1	61		"SCRIPPS FORMATION (Tsc)" CLAYEY SILTSTONE-SANDY SILTSTONE (R) light gray and light brown, damp, hard, sand is fine grained, minor iron oxide, finely laminated, laminae dip 4 to 6 degrees.						GS
350													
				2									R-Value
	10		■	3	70/9"		Local hard cemented layer 3 to 6 inches thick.	97	11				
			▨	4	100/11"		Sandy siltstone with thin interbeds of fine grained Silty Sandstone.						
	15		■	5	100/6"		14 to 15 feet: hard cemented concretion. Sandy siltstone, calcareous, laminated, fissile. 15.5 feet: hard cemented concretion, 18 to 20 inches thick, slow drilling.	100	13				
340													
	20		▨	6	50/5"		Sandy siltstone, light gray-brown, finely laminated, fissile, iron oxide along bedding, slightly calcareous locally.						
	25		■	7	92/10"		Finely laminated, fissile.	108	13				
330													
	30		▨	8	87/10"		Hard, finely laminated, fissile.						
							Bottom of drill hole at 30.5 feet. No groundwater encountered. Hole backfilled and tamped.						

SHEET 1 OF 1

LEGEND TO LOGS ON PLATE A-2

PLATE A-1.4

LOG OF DRILL HOLE

JOB NO.: S89012B
PROJECT: Sludge Dewatering Facility
LOCATION: North City, San Diego
DRILLING METHOD: Hollow Stem Auger, 7-inch

LOGGED BY: J. Thurber
CHECKED BY: T. Huber

DRILL HOLE NO.: 105
DRILLING DATE: September 7, 1990
DATUM: See Plate 1
REFERENCE EL.: 373 Feet

ELEVATION (FEET)	DEPTH (FEET)	DRILLING RATE REAL TIME/DEPTH	SAMPLE	SAMPLE NO.	BLOW COUNT (BLOWS PER FOOT)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT (%)	ATTERBERG LIMITS PLASTIC LIMIT (%)	POCKET PENETROMETER (TSF)	ADDITIONAL TESTS
370							"COLLUVIUM (Qc)" SANDY SILT (ML) light brown, dry, medium stiff, minor gravel and cobble.						
	5			1	51		"SCRIPPS FORMATION (Tsc)" CLAYEY SILTSTONE (R) with SILTY SANDSTONE (R) interbeds, light brown, damp, moderately hard, sandstone is fine grained, friable; siltstone is finely laminated, fissile.						
	10			2	80		Clayey siltstone with minor silty claystone, light brown-light green-gray, damp, hard, fissile.	102	20				
360													
	15			3	44		Silty claystone, green, damp, moderately hard, polished-molded fractures, locally moist, medium plastic, 2 to 4 feet thick layer. 15.5 feet: hard cemented layer, 6 inches thick.	99	18	57	27		AL
	20			4	82								
350				5			"SCRIPPS FORMATION (Tsc)" CLAYEY SILTSTONE-CLAYSTONE (R) light gray, damp, moderately hard, fissile, minor iron oxide.			57	25		AL,EI
	25			6	86			101	17				
				7	81/ 11"			97	18				
	30			8	87/ 11"		Light brown, damp, moderately hard.						
340													
	35			9	85			100	19				
							36 to 37 feet: hard cemented concretion.						
	40			10	50/5"		Local sandy siltstone, hard, minor iron oxide.						

Bottom of drill hole at 40 feet.
No groundwater encountered.
Hole backfilled and tamped.

SHEET 1 OF 1

LEGEND TO LOGS ON PLATE A-2

LOG OF DRILL HOLE

JOB NO.: S89012B
PROJECT: Sludge Dewatering Facility
LOCATION: North City, San Diego
DRILLING METHOD: Hollow Stem Auger, 7-inch

LOGGED BY: J. Thurber
CHECKED BY: T. Huber

DRILL HOLE NO.: 106
DRILLING DATE: September 7, 1990
DATUM: See Plate 1
REFERENCE EL.: 360 Feet

ELEVATION (FEET)	DEPTH (FEET)	DRILLING RATE REAL TIME/DEPTH	SAMPLE	SAMPLE NO.	BLOW COUNT (BLOWS PER FOOT)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT (%)	ATTERBERG LIMITS PLASTIC LIMIT (%)	POCKET PENETROMETER (TSF)	ADDITIONAL TESTS
360							"COLLUVIUM (Qc)" CLAYEY SILT (ML) light brown, dry, medium stiff, trace of gravel.						
							"SCRIPPS FORMATION (Tsc)" CLAYEY SILTSTONE (R) light gray, damp, moderately hard, finely laminated, fissile, moderate iron oxide.						
	5			1	40								GS
350	10							104	16				
				2	95/ 9"		Minor iron oxide along laminations, fissile, medium plastic. 1/4 to 1/2 inch sandy siltstone interbeds.						RS,PH CL,SU
				3	78					55	25		AL,EI
	15												
				4	86/ 11"			104	15				
340	20			5	81/ 11"		Local 1/4 inch Sandy Siltstone interbeds.						
							Bottom of drill hole at 20.5 feet. No groundwater encountered. Hole backfilled and tamped.						

SHEET 1 OF 1

LEGEND TO LOGS ON PLATE A-2

LOG OF DRILL HOLE

OB NO.: S89012B
ROJECT: Sludge Dewatering Facility
OCATION: North City, San Diego
RILLING METHOD: Hollow Stem Auger, 7-inch

LOGGED BY: J. Thurber
CHECKED BY: T. Huber

DRILL HOLE NO.: 107
DRILLING DATE: September 7, 1990
DATUM: See Plate 1
REFERENCE EL.: 361 Feet

ELEVATION (FEET)	DEPTH (FEET)	DRILLING RATE REAL TIME/DEPTH	SAMPLE	SAMPLE NO.	BLOW COUNT (BLOWS PER FOOT)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT (%)	ATTERBERG LIMITS PLASTIC LIMIT (%)	POCKET PENETROMETER (TSF)	ADDITIONAL TESTS
360							"COLLUVIUM (Qc)" CLAYEY SILT (ML) light brown, damp, medium stiff, trace of gravel.						
	5		▨	1	88		"SCRIPPS FORMATION (Tsc)" CLAYEY SILTSTONE (R) light grey, damp, moderately hard, minor Sandy Siltstone interbeds, sand is very fine grained, minor iron oxide.						
	10												
350			■	2	90/ 11"								
			■	3	77/9"		Clayey siltstone-claystone, slightly calcareous.						
	15		▨	4	99								
	20		■	5	53/ 6"		Silty sandstone, 8-10 inch, light brown, damp, hard, sand is fine grained.	97	7				
340													
	25		▨	6	90		Silty claystone, light gray, damp, hard.						
							27 feet: hard cemented layer/concretion, 6 inches thick.						
	30		■	7	79			105	16				
							Bottom of drill hole at 30 feet. No groundwater encountered. Hole backfilled and tamped.						

HEET 1 OF 1

LEGEND TO LOGS ON PLATE A-2

PLATE A-1.7

LOG OF DRILL HOLE

JOB NO.: S89012B
PROJECT: Sludge Dewatering Facility
LOCATION: North City, San Diego
DRILLING METHOD: Hollow Stem Auger, 7-inch

LOGGED BY: Y. Van
CHECKED BY: T. Huber

DRILL HOLE NO.: 108
DRILLING DATE: September 12, 1990
DATUM: See Plate 1
REFERENCE EL.: 366 Feet

ELEVATION (FEET)	DEPTH (FEET)	DRILLING RATE REAL TIME/DEPTH	SAMPLE	SAMPLE NO.	BLOW COUNT (BLOWS PER FOOT)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT (%)	ATTERBERG LIMITS PLASTIC LIMIT (%)	POCKET PENETROMETER (TSF)	ADDITIONAL TESTS
				1	37		"COLLUVIUM (Qc)" SANDY SILT (ML) red-brown, damp, hard and SILTY CLAY (CL) tan, damp, hard, slightly plastic.		12				
				2	82/ 10"		"SCRIPPS FORMATION (Tsc)" SILTSTONE (R) tan, damp, hard, moderate iron oxidation.		9				
360	5			3	76								
							7 feet: 1-1/2 feet concretion of well cemented Siltstone, very hard.						
	10			4	72/ 10"		Clayey siltstone, tan to light gray, damp, hard to very hard, fissile, moderate iron oxidation.		12				
350	15			5	100/ 10"								
	20			6	82		Laminated.						
340	25			7	83			99	20				
	30			8	86/ 11"								
							Bottom of drill hole at 30 feet. No groundwater encountered. Hole backfilled and tamped.						

SHEET 1 OF 1

LEGEND TO LOGS ON PLATE A-2

PLATE A-1.8

LOG OF DRILL HOLE

JOB NO.: S89012B
PROJECT: Sludge Dewatering Facility
LOCATION: North City, San Diego
DRILLING METHOD: Hollow Stem Auger, 7-inch

LOGGED BY: Y. Van
CHECKED BY: T. Huber

DRILL HOLE NO.: 109
DRILLING DATE: September 12, 1990
DATUM: See Plate 1
REFERENCE EL.: 373 Feet

ELEVATION (FEET)	DEPTH (FEET)	DRILLING RATE REAL TIME/DEPTH	SAMPLE	SAMPLE NO.	BLOW COUNT (BLOWS PER FOOT)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		POCKET PENETROMETER (TSF)	ADDITIONAL TESTS
										LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
370				1	41	▨	"FILL (af)" CLAYEY SILT (CL) tan, damp, hard, local roots, slightly weathered.		14	42	24		AL
				2	77	▤	"SCRIPPS FORMATION (Tsc)" CLAYEY SILTSTONE (R) tan, damp, hard, moderate iron oxidation, fissile.		12				
	5			3	65/6"	▤			7				

Bottom of drill hole at 5.5 feet.
No groundwater encountered.
Hole backfilled and tamped.

LEGEND TO LOGS ON PLATE A-2

LOG OF DRILL HOLE

JOB NO.: S89012B
PROJECT: Sludge Dewatering Facility
LOCATION: North City, San Diego
DRILLING METHOD: Hollow Stem Auger, 7-inch

LOGGED BY: Y. Van
CHECKED BY: T. Huber

DRILL HOLE NO.: 110
DRILLING DATE: September 12, 1990
DATUM: See Plate 1
REFERENCE EL.: 367 Feet

ELEVATION (FEET)	DEPTH (FEET)	DRILLING RATE REAL TIME/DEPTH	SAMPLE	SAMPLE NO.	BLOW COUNT (BLOWS PER FOOT)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT (%)	ATTERBERG LIMITS PLASTIC LIMIT (%)	POCKET PENETROMETER (TSF)	ADDITIONAL TESTS
				1	22		"FILL (af)" CLAY (CH) dark brown, moist, very stiff, plastic, local roots.		22	63	25		AL
	5			2	74		"SCRIPPS FORMATION (Tsc)" SILTSTONE (R) tan to light gray, damp, hard, fissile, moderate iron oxidation.						RS,PH CL,SU
360													
	10			3	33		Clayey siltstone, light brown, damp, moderately hard, fissile, 1 foot interbed of fine grained.	94	18				
	15			4	92		Becoming olive green, moist, plastic, laminated.						
350													
	20			5	69/6"				9				
							23 feet: 1 foot concretion of well cemented siltstone medium gray, damp, very hard.						
	25			6	92/11"		Sandy siltstone, brown, damp, hard, fine grained sands, local hematite.		7				
340													
	30			7	84/11"		Fissile, moderate iron oxidation.						
							1 foot concretion of well cemented siltstone.						
	35			8	75/3"		Refusal at 35 feet.						
							Bottom of drill hole at 35 feet. No groundwater encountered. Hole backfilled and tamped.						

SHEET 1 OF 1

LEGEND TO LOGS ON PLATE A-2

LOG OF DRILL HOLE

JOB NO.: S89012B
PROJECT: Sludge Dewatering Facility
LOCATION: North City, San Diego
DRILLING METHOD: Hollow Stem Auger, 7-inch

LOGGED BY: Y. Van
CHECKED BY: T. Huber

DRILL HOLE NO.: 111
DRILLING DATE: September 12, 1990
DATUM: See Plate 1
REFERENCE EL.: 347 Feet

ELEVATION (FEET)	DEPTH (FEET)	DRILLING RATE REAL TIME/DEPTH	SAMPLE	SAMPLE NO.	BLOW COUNT (BLOWS PER FOOT)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT (%)	ATTERBERG LIMITS PLASTIC LIMIT (%)	POCKET PENETROMETER (TSF)	ADDITIONAL TESTS
				1	42		"COLLUVIUM (Qc)" SANDY SILT (ML) dark brown, damp, hard.		11				
							2-1/2 feet: 1/2 foot concretion of well cemented siltstone, dark gray, very hard.						
	5			2	57/6"		"SCRIPPS FORMATION (Tsc)" SILTSTONE (R) tan, damp, hard, fissile, moderate iron oxidation, moderately weathered.		13				
340													
	10			3	84		Clayey siltstone, tan, damp, hard, fissile, moderate iron oxidation.	106	18				
	15			4	81		Becoming olive green.						
330													
	20			5	50/2"		19 feet: 1/2 foot concretion of well cemented siltstone. 21 feet: 1 foot concretion of well cemented siltstone.						
	25			6									
320													
							Refusal at 28.5 feet.						

Bottom of drill hole at 28.5 feet (refusal).
No groundwater encountered.
Hole backfilled and tamped.

LEGEND TO LOGS ON PLATE A-2

LOG OF DRILL HOLE

JOB NO.: S89012B
PROJECT: Sludge Dewatering Facility
LOCATION: North City, San Diego
DRILLING METHOD: Hollow Stem Auger, 7-inch

LOGGED BY: Y. Van
CHECKED BY: T. Huber

DRILL HOLE NO.: 112
DRILLING DATE: September 12, 1990
DATUM: See Plate 1
REFERENCE EL.: 373 Feet

ELEVATION (FEET)	DEPTH (FEET)	DRILLING RATE REAL TIME/DEPTH	SAMPLE	SAMPLE NO.	BLOW COUNT (BLOWS PER FOOT)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT (%)	ATTERBERG LIMITS PLASTIC LIMIT (%)	POCKET PENETROMETER (TSF)	ADDITIONAL TESTS
			▨	1	84/ 11"		"SCRIPPS FORMATION (Tsc)" SILTY SANDSTONE (R) red-brown, damp, hard, medium grained.						
370													
	5		■	2	79		Damp.	110	7				DS
	10		■	3	85		Patches of iron oxidation.						RS,PH, CL,SU
360													
	15		▨	4	65		Damp to moist, laminated locally.						GS
	20		■	5	87/ 11"		Abundant biotite locally.	104	11				
350													
	25		■	6	52/6"		Local small (1/4") well cemented concretions.		10				
	30		▨	7	92/ 11"								

Bottom of drill hole at 30.5 feet.
No groundwater encountered.
Hole backfilled and tamped.

SHEET 1 OF 1

LEGEND TO LOGS ON PLATE A-2

PLATE A-1.12

LOG OF DRILL HOLE

JOB NO.: S89012B
PROJECT: Sludge Dewatering Facility
LOCATION: North City, San Diego
DRILLING METHOD: Hollow Stem Auger, 7-inch

LOGGED BY: Y. Van
CHECKED BY: T. Huber

DRILL HOLE NO.: 113
DRILLING DATE: September 12, 1990
DATUM: See Plate 1
REFERENCE EL.: 380 Feet

ELEVATION (FEET)	DEPTH (FEET)	DRILLING RATE REAL TIME/DEPTH	SAMPLE	SAMPLE NO.	BLOW COUNT (BLOWS PER FOOT)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT (%)	ATTERBERG LIMITS PLASTIC LIMIT (%)	POCKET PENETROMETER (TSF)	ADDITIONAL TESTS
380			◭	1	57	▨	"FILL (af)" CLAY (CH) dark brown, moist, hard, local pebbles.		15				
	5		■	2	47		"LINDAVISTA FORMATION (Qln)" CONGLOMERATE (R) gray granitic and purple volcanic cobbles (1/2-3 inches), very hard, subrounded in clayey silt matrix, red-brown, damp, poorly indurated.	101	20				
						☰	"SCRIPPS FORMATION (Tsc)" CLAYEY SILTSTONE (R) tan to light gray, damp, medium hard, moderate iron oxidation, fissile.						
370	10		■	3	81/11"			107	16				
	15		◭	4	81/10"								
			▫	5									
360	20		■	6	98/10"								
	25		◭	7	98/11"								
350	30		■	8	82/11"		Uniform lithology.	101	19				
	35		■	9	93/11"								
340	40		◭	10	78/11"								
							Bottom of drill hole at 40.5 feet. No groundwater encountered. Hole backfilled and tamped.						

SHEET 1 OF 1

LEGEND TO LOGS ON PLATE A-2

LOG OF DRILL HOLE

JOB NO.: S89012B
PROJECT: Sludge Dewatering Facility
LOCATION: North City, San Diego
DRILLING METHOD: Hollow Stem Auger, 7-inch

LOGGED BY: Y. Van
CHECKED BY: T. Huber

DRILL HOLE NO.: 114
DRILLING DATE: September 12, 1990
DATUM: See Plate 1
REFERENCE EL.: 375 Feet

ELEVATION (FEET)	DEPTH (FEET)	DRILLING RATE REAL TIME/DEPTH	SAMPLE	SAMPLE NO.	BLOW COUNT (BLOWS PER FOOT)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		POCKET PENETROMETER (TSF)	ADDITIONAL TESTS
										LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
				1			"SCRIPPS FORMATION (Tsc)"						
				2	71		CLAYEY SILTSTONE (R) tan, damp, medium hard, moderate iron oxide, fissile.		11	40	22		AL
370	5			3	97								RS,PH, CL,SU
	10			4	70/6"		Sandy siltstone, tan, damp, hard, fine grained sand.		8				
				5									
360	15			6	70/6"		Clayey siltstone, tan, dry, hard, fissile.		11				
	20			7	50/6"		Refusal at 21 feet.						
							Bottom of drill hole at 21 feet. No groundwater encountered. Hole backfilled and tamped.						

SHEET 1 OF 1

LEGEND TO LOGS ON PLATE A-2

LOG OF DRILL HOLE

JOB NO.: S89012B
PROJECT: Sludge Dewatering Facility
LOCATION: North City, San Diego
DRILLING METHOD: Hollow Stem Auger, 7-inch

LOGGED BY: Y. Van
CHECKED BY: T. Huber

DRILL HOLE NO.: 115
DRILLING DATE: September 12, 1990
DATUM: See Plate 1
REFERENCE EL.: 373 Feet

ELEVATION (FEET)	DEPTH (FEET)	DRILLING RATE REAL TIME/DEPTH	SAMPLE	SAMPLE NO.	BLOW COUNT (BLOWS PER FOOT)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT (%)	ATTERBERG LIMITS PLASTIC LIMIT (%)	POCKET PENETROMETER (TSF)	ADDITIONAL TESTS
							"SCRIPPS FORMATION (Tsc)" CLAYEY SILTSTONE (R) light tan, damp, hard, fissile, local iron oxidation.						
370			◺	1	56				14				
	5		■	2	79			98	16				
			⁘	3									R-Value
	10		■	4	64		Uniform lithology.	107	22				
			⁘	5									
360													
	15		◺	6	92		Abundant patches of manganese oxide.						
	20		■	7	93			104	18				
350							23 feet: 1 foot concretion of well cemented siltstone, very hard.						
	25		■	8	91		24 feet: 6-inch layer of sandy siltstone, red-brown, damp, hard, fine grained sand.						
	30		◺	9	98/11"								

Bottom of drill hole at 30.5 feet.
No groundwater encountered.
Hole backfilled and tamped.

SHEET 1 OF 1

LEGEND TO LOGS ON PLATE A-2

PLATE A-1.15

LOG OF DRILL HOLE

JOB NO.: S89012B
PROJECT: Sludge Dewatering Facility
LOCATION: North City, San Diego
DRILLING METHOD: Rotary Bucket, 24-inch

LOGGED BY: Y. Van
CHECKED BY: J. Thurber

DRILL HOLE NO.: 201
DRILLING DATE: September 7, 1990
DATUM: See Plate 1
REFERENCE EL.: 347 Feet

ELEVATION (FEET)	DEPTH (FEET)	DRILLING RATE REAL TIME/DEPTH	SAMPLE	SAMPLE NO.	BLOW COUNT (BLOWS PER FOOT)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT (%)	ATTERBERG LIMITS PLASTIC LIMIT (%)	POCKET PENETROMETER (TSF)	ADDITIONAL TESTS
							"COLLUVIUM (Qc)" CLAY (CL) dark brown, damp to moist, firm.						
340	5						"SCRIPPS FORMATION (Tsc)" SANDY SILTSTONE (R) tan, damp, moderately hard, thin laminae, minor iron oxidation, slightly weathered, fissile, poorly bedded. @ 3.5 feet: Bed N78W 12NE @ 5 feet: Bed N85W 17NE						
	10		■	1	(14)		@ 5.5 feet: 1 inch thick well cemented siltstone, concretion with discontinuous gypsum line fractures. @ 8 feet: siltstone, tan to light gray, damp, moderately hard, fissile, abundant iron oxidation. @ 8-9 feet: Concretion, well cemented siltstone. Interbeds of sandy siltstone and siltstone. @ 12 feet: Bed N73W 17NE, Iron oxide lined.	104	13				
330	15						@ 15 feet: Thin lens of well cemented siltstone, no visible fractures or joints.						
	20		■	2	(14)		Calcite lined laminae, patches of manganese oxides.	103	13				
320	25						"SCRIPPS FORMATION (Tsc)" CLAYSTONE-SILTSTONE (R) light gray, damp, medium hard, abundant iron oxides, slightly plastic, poorly bedded, laminated. @ 27.5 feet: Bed contact N77W 16NE.						
	30		■	3	[8]		@ 28 feet: Interbed of siltstone, gray, hard, well indurated, discontinuous fractures lined with manganese oxides. Concretion of well cemented siltstone. @ 29 feet: Bed N77W 17NE	106	18				
310	35						Concretion of well cemented siltstone gray, dry, very hard.						
	40		■	4	[20]		@ 37.5 feet: Contact between sandstone and siltstone, bed N77W 16NE, patches of manganese oxide. @ 38 feet: sandstone, light gray, moderately indurated, friable, abundant iron oxides, massive. @ 41 feet: siltstone, tan to gray, moderately indurated, moderately hard, abundant iron oxidation. @ 43 feet: Interbed of well cemented siltstone, gypsum lined bedding and discontinuous fractures.	105	16				
300	45						@ 45 feet: Claystone, medium gray, damp, slightly plastic, local discontinuous gypsum lined (1/4 - 1") fractures. Interbed of siltstone, fissile, laminated, local gypsum.						
	50		■	5	[17]		Interbed of well cemented siltstone. Claystone, tan to light brown, damp, medium hard, slightly plastic, local gypsum. @ 51 feet: Bed N80W 3NE.	102	18				

SHEET 1 OF 2

LEGEND TO LOGS ON PLATE A-2

LOG OF DRILL HOLE

JOB NO.: S89012B
PROJECT: Sludge Dewatering Facility
LOCATION: North City, San Diego
DRILLING METHOD: Rotary Bucket, 24-inch

LOGGED BY: Y. Van
CHECKED BY: J. Thurber

DRILL HOLE NO.: 201
DRILLING DATE: September 7, 1990
DATUM: See Plate 1
REFERENCE EL.: 347 Feet

ELEVATION (FEET)	DEPTH (FEET)	DRILLING RATE REAL TIME/DEPTH	SAMPLE	SAMPLE NO.	BLOW COUNT (BLOWS PER FOOT)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT (%)	ATTERBERG LIMITS PLASTIC LIMIT (%)	POCKET PENETROMETER (TSF)	ADDITIONAL TESTS
290							"SCRIPPS FORMATION (Tsc)" CLAYSTONE-SILTSTONE (R) light brown, damp, medium hard. Becoming medium gray, laminated, gypsum along bedding. Interbeds of silty sandstone.						
	60		■	6	<85/10">		Black manganese oxide along laminae.		12				
							@ 63.5 feet: Bed N79W 6NE						
	65												
280							1/4 inch thick gypsum lined fracture.						
							"SCRIPPS FORMATION (Tsc)" SILTSTONE (R) light brown, damp, moderately indurated, moderately hard, moderate iron oxidation, laminated, slightly fissile.						
	70		■	7	<60>		Well cemented sandstone concretion, gray, very hard, fine grained hematite and gypsum line fractures, abundant biotite, iron and manganese oxidation. Sandstone, tan to brown, hard, friable, abundant iron oxidation lined laminations.	94	14				
	75						Well cemented sandstone concretion 72-73 feet. @ 74 feet: Bed N47W 3NE.						
270							Becoming medium gray, moderately indurated, moderately hard, poorly bedded.						
	80		■	8	<54/11">			98	18				
							Bottom of drill hole at 81 feet. No groundwater encountered. Hole backfilled and tamped.						

SHEET 2 OF 2

LEGEND TO LOGS ON PLATE A-2

LOG OF DRILL HOLE

JOB NO.: S89012B
PROJECT: Sludge Dewatering Facility
LOCATION: North City, San Diego
DRILLING METHOD: Rotary Bucket, 24-inch

LOGGED BY: Y. Van
CHECKED BY: J. Thurber

DRILL HOLE NO.: 202
DRILLING DATE: September 8, 1990
DATUM: See Plate 1
REFERENCE EL.: 376 Feet

ELEVATION (FEET)	DEPTH (FEET)	DRILLING RATE REAL TIME/DEPTH	SAMPLE	SAMPLE NO.	BLOW COUNT (BLOWS PER FOOT)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT (%)	ATTERBERG LIMITS PLASTIC LIMIT (%)	POCKET PENETROMETER (TSF)	ADDITIONAL TESTS
							"COLLUVIUM (Qc)" SANDY SILT (ML) tan, dry, firm.						
							"SCRIPPS FORMATION (Tsc)" CLAYEY SILTSTONE (R) tan, dry to damp, medium hard.						
370	5			1	(2)		Moderately weathered, iron oxidation lined laminations.	100	15				GS,DS
	10			2	(6)		Fissile, abundant iron oxidation, local manganese oxide.	106	15				
							@ 12 feet: Bed N82W 5NE						
360	15			3	(14)		Interbed of sandy siltstone, tan, damp, moderately indurated, moderately hard. Siltstone, light brown, damp, moderately hard, fissile, moderate manganese oxides, no visible fractures, local small concretions. @ 17-20 feet: Interbed of sandstone, brown, fine grained, moderately dense.	102	16				
	20			4	(9)		Slightly weathered, local iron oxidation.	109	15				GS
				5			Concretion of well cemented sandstone, 6 inches thick. @ 20 feet: Bed N67W 6NE. Minor clay, laminated.						
350	25			6	(11)		"SCRIPPS FORMATION (Tsc)" CLAYSTONE (R) brown, damp, poorly indurated, plastic.	110	19				
							@ 26.2-27.5 feet: Concretion of well cemented sanstone, medium gray, dry, very hard, local hematite and manganese oxide, gypsum lined. @ 27.5-28.5 feet: Interbed sanstone, red-brown, damp, friable, moderately hard, medium grained, abundant iron oxide.						
	30			7	[14]		@ 29 feet: Contact N6W 2NE sanstone/claystone. I foot layer of claystone interbed. Olive green, damp, poorly indurated, weathered, abundant iron oxidation, slightly plastic.						
340	35			8	[21]		@ 30 feet: Contact N43E 3SE sanstone/claystone, interbed of claystone, brown, damp, poorly indurated, plastic. @ 35-46 feet: Massive clayey siltstone. Concretion of well cemented siltstone, 3 inches thick.	106	20				
	40												
330	45			9	[19]		"SCRIPPS FORMATION (Tsc)" CLAYEY SILTSTONE (R) brown, damp, moderately hard, moderately indurated, fissile, laminated, abundant iron oxidation. @ 46-47 feet: Concretion of well cemented siltstone.	106	19				
	50												
							@ 54 feet: Bed N80W 12NE.						

LEGEND TO LOGS ON PLATE A-2

LOG OF DRILL HOLE

JOB NO.: S89012B
PROJECT: Sludge Dewatering Facility
LOCATION: North City, San Diego
DRILLING METHOD: Rotary Bucket, 24-inch

LOGGED BY: Y. Van
CHECKED BY: J. Thurber

DRILL HOLE NO.: 202
DRILLING DATE: September 8, 1990
DATUM: See Plate 1
REFERENCE EL.: 376 Feet

ELEVATION (FEET)	DEPTH (FEET)	DRILLING RATE REAL TIME/DEPTH	SAMPLE	SAMPLE NO.	BLOW COUNT (BLOWS PER FOOT)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT (%)	ATTERBERG LIMITS PLASTIC LIMIT (%)	POCKET PENETROMETER (TSF)	ADDITIONAL TESTS
320	60		■	10	[13]	▤	"SCRIPPS FORMATION (Tsc)" CLAYEY SILTSTONE (R) brown, moderately hard, fissile, laminated.	104	20				
							Bottom of drill hole at 60 feet. No groundwater encountered. Hole backfilled and tamped.						

SHEET 2 OF 2

LEGEND TO LOGS ON PLATE A-2

LOG OF DRILL HOLE

JOB NO.: S89012B
PROJECT: Sludge Dewatering Facility
LOCATION: North City, San Diego
DRILLING METHOD: Rotary Bucket, 24-inch

LOGGED BY: Y. Van
CHECKED BY: J. Thurber

DRILL HOLE NO.: 203
DRILLING DATE: September 7, 1990
DATUM: See Plate 1
REFERENCE EL.: 365 Feet

ELEVATION (FEET)	DEPTH (FEET)	DRILLING RATE REAL TIME/DEPTH	SAMPLE	SAMPLE NO.	BLOW COUNT (BLOWS PER FOOT)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		POCKET PENETROMETER (TSF)	ADDITIONAL TESTS
										LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
							"COLLUVIUM (Qc)" SILTY SAND (SM) light brown, dry, grained, loose, local cobbles and pebbles.						
360	5						"SCRIPPS FORMATION (Tsc)" SILTY SANDSTONE (R) red-brown, damp, medium dense, fine to medium grained, friable, local pebbles and iron oxidation.						
	10												
							"SCRIPPS FORMATION (Tsc)" SILTSTONE (R) light gray, damp, moderately hard, moderately indurated, fissile, minor clay amounts. Local granitic and volcanic cobbles. @ 12.5 feet: Bed N65W 6NE.						
350	15												
			▪	1			"SCRIPPS FORMATION (Tsc)" CONGLOMERATE (R) granitic and volcanic cobbles (1/2 - 5 inch), subrounded in matrix of clayey sandstone, red-brown, damp to moist, moderately hard.						
	20						"SCRIPPS FORMATION (Tsc)" CLAYEY SILTSTONE (R) tan to brown, damp, moderately hard, moderately indurated, laminated, fissile, abundant iron oxidation. @ 20 feet: Contact clayey sandstone/clayey siltstone N85W 9NE. Interbed of claystone, massive, slightly to moderately plastic. Bed EW 4NE.						
340	25												
	30												
330	35												
	40												
320	45												
	50												
							Bottom of drill hole at 50 feet. No groundwater encountered. Hole backfilled and tamped.						

SHEET 1 OF 1

LEGEND TO LOGS ON PLATE A-2

LOG OF DRILL HOLE

JOB NO.: S89012B
PROJECT: Sludge Dewatering Facility
LOCATION: North City, San Diego
DRILLING METHOD: Rotary Bucket, 24-inch

LOGGED BY: Y. Van
CHECKED BY: J. Thurber

DRILL HOLE NO.: 204
DRILLING DATE: September 10, 1990
DATUM: See Plate 1
REFERENCE EL.: 379 Feet

ELEVATION (FEET)	DEPTH (FEET)	DRILLING RATE REAL TIME/DEPTH	SAMPLE	SAMPLE NO.	BLOW COUNT (BLOWS PER FOOT)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT (%)	ATTERBERG LIMITS PLASTIC LIMIT (%)	POCKET PENETROMETER (TSF)	ADDITIONAL TESTS
							"COLLUVIUM (Qc)" SANDY SILT (ML) tan, dry, soft.						
							"LINDAVISTA FORMATION (Qln)" CONGLOMERATE (R) granitic and volcanic cobbles in sandy siltstone matrix, brown, damp, moderately hard.						
	5		■	1	(3)		@ 3-4 feet: Clay (CL) dark brown to black, moist, hard, plastic, local pebbles and roots, weathered. Contact: N52W2SW	92	9				GS
370							"SCRIPPS FORMATION (Tsc)" SILTSTONE (R) tan to brown, damp, moderately hard, abundant iron oxides, laminated, moderately indurated, fissile.						
	10		■	2	(8)			110	15				
	15		■	3	(18)								RS,PH, CL,SU
360							Interbed of sandy siltstone, golden brown, dry to damp, moderately hard, fine grained sand, laminated.						
	20		■	4	(14)		19.5 - 20.5 feet: Well cemented sandstone concretion. Siltstone, massive, minor fine grained sand, local indurated beds. Minor to moderate amounts of clay.	98	13				
	25												
							Weakly laminated.						
350													
	30		■	5	[5]			108	16	54	33		AL
							Moderate amounts of clay. 33.5 - 34.5 feet: 1/2 foot concretion of well cemented sandstone.						
	35												
340													
	40		■	6	[39]		40-41 feet: 1 ft. concretion of well cemented sandstone.						
							Bottom of drill hole at 41 feet. No groundwater encountered. Hole backfilled and tamped.						

SHEET 1 OF 1

LEGEND TO LOGS ON PLATE A-2

UNIFIED SOIL CLASSIFICATION SYSTEM

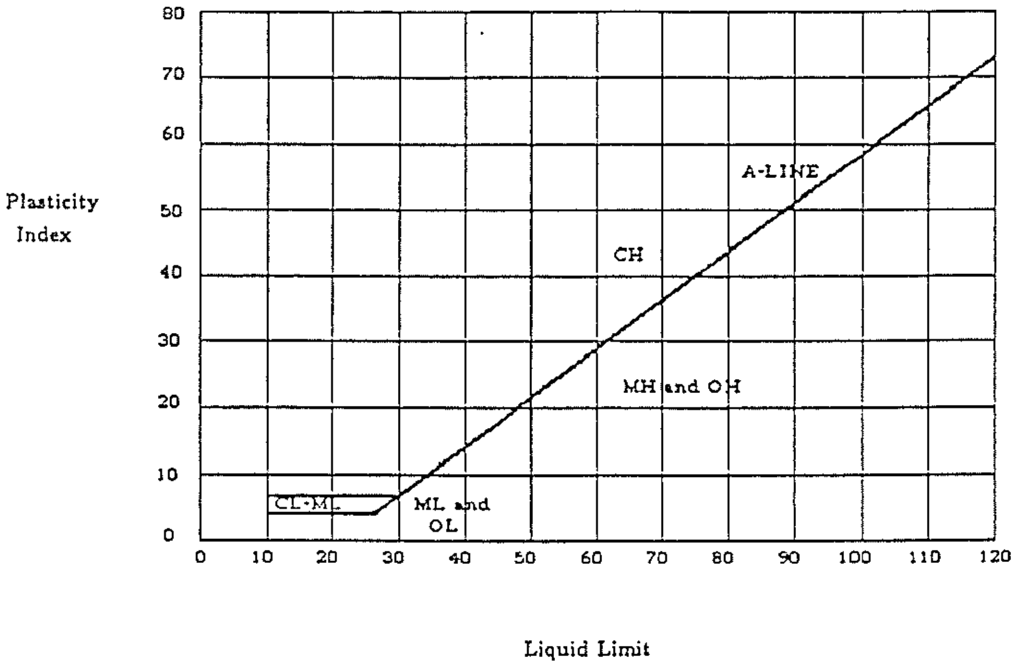
MAJOR DIVISION			GROUP SYMBOL	DESCRIPTION	GRAPHIC LOG
COARSE GRAINED SOILS Over 50% By Weight Coarser Than No. 200 Sieve Size	GRAVELLY SOILS OVER 50% OF COARSE FRACTION LARGER THAN NO. 4 SIEVE SIZE	CLEAN GRAVELLY SOILS LITTLE OR NO FINES	GW	WELL GRADED GRAVELS OR GRAVEL - SAND MIXTURES	░
			GP	POORLY GRADED GRAVELS OR GRAVEL - SAND MIXTURES	░
		GRAVELLY SOILS WITH FINES OVER 12% FINES	GM	SILTY GRAVELS OR POORLY GRADED GRAVEL - SAND - SILT MIXTURES	▥
			GC	CLAYEY GRAVELS OR POORLY GRADED GRAVEL - SAND - CLAY MIXTURES	▒
	SANDY SOILS OVER 50% OF COARSE FRACTION SMALLER THAN NO. 4 SIEVE SIZE	CLEAN SANDY SOILS LITTLE OR NO FINES	SW	WELL GRADED SANDS OR GRAVELLY SANDS	░
			SP	POORLY GRADED SANDS OR GRAVELLY SANDS	░
		SANDY SOILS WITH FINES OVER 12% FINES	SM	SILTY SANDS OR POORLY GRADED SAND - SILT MIXTURES	▥
			SC	CLAYEY SANDS OR POORLY GRADED SAND - CLAY MIXTURES	▨
FINE GRAINED SOILS Over 50% By Weight Finer Than No. 200 Sieve Size	SILTY AND CLAYEY SOILS LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS, VERY FINE SANDS SILTY OR CLAYEY FINE SANDS, CLAYEY SILTS WITH SLIGHT PLASTICITY	▥
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, OR LEAN CLAYS	▒
			OL	ORGANIC CLAYS OR ORGANIC SILTY CLAYS OF LOW PLASTICITY	▥
	SILTY AND CLAYEY SOILS LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, OR ELASTIC SILTS	▮
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, OR FAT CLAYS	▨
			OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, OR ORGANIC SILTS	▤
HIGHLY ORGANIC SOILS			Pt	PEAT OR OTHER HIGHLY ORGANIC SOIL	▤

SAMPLE TYPES:

■	UNDISTURBED SLEEVE
☐	DISTURBED
☐	UNSUCCESSFUL ATTEMPT
▨	STANDARD PENETRATION

▼	WATER LEVEL
☰	WATER INFLOW

PLASTICITY CHART - Used for Classification of Fine Grained Soils



BLOW COUNT - The number of blows required to drive the indicated sampler the last 12 inches of an 18 inch drive. The notation 100/9 indicates only 9 inches of penetration were achieved in 100 blows. Hammer weights and drop heights are shown below:

Symbol	Driving Weight (pounds)	Drop Height (inches)
7	140	30
(3)	3800	2-3
[6]	2300	2-3
<11>	800	2-3

Heavy Caving

Light Caving

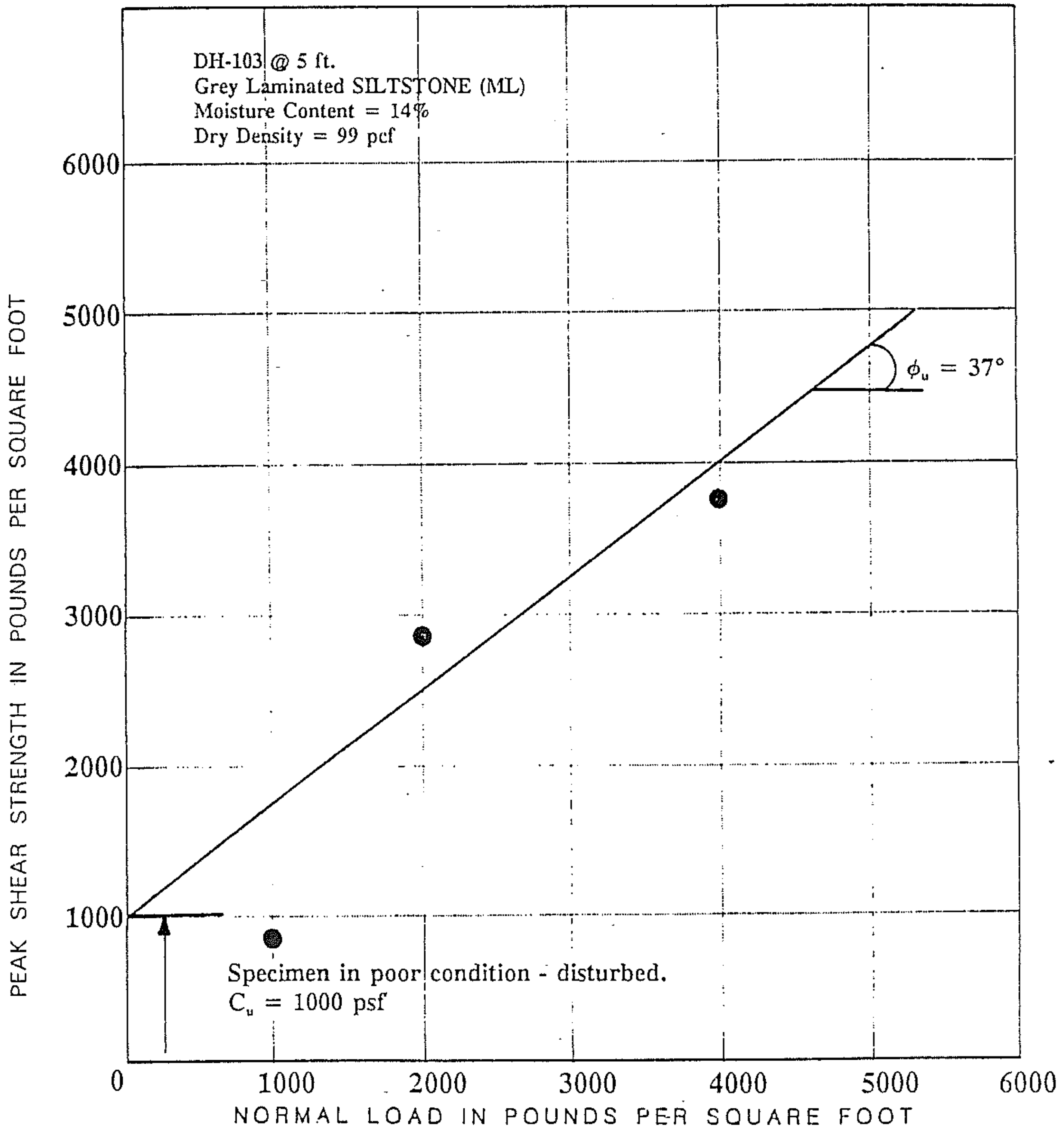
ADDITIONAL TESTS -

UC : Unconfined Compression
TD : Triaxial Compression, Drained
TU : Triaxial Compression, Undrained
TDy: Triaxial Compression, Dynamic
PH : Hydrogen Ion Concentration
PA : Paleontologic, Analysis
GS : Grain Size Distribution

WP : Water Pressure
PMt: Pressuremeter
SE : Sand Equivalent
GJ : Goodman Jack
SP : Specific Gravity
CP : Compaction
C : Consolidation
DS : Direct Shear

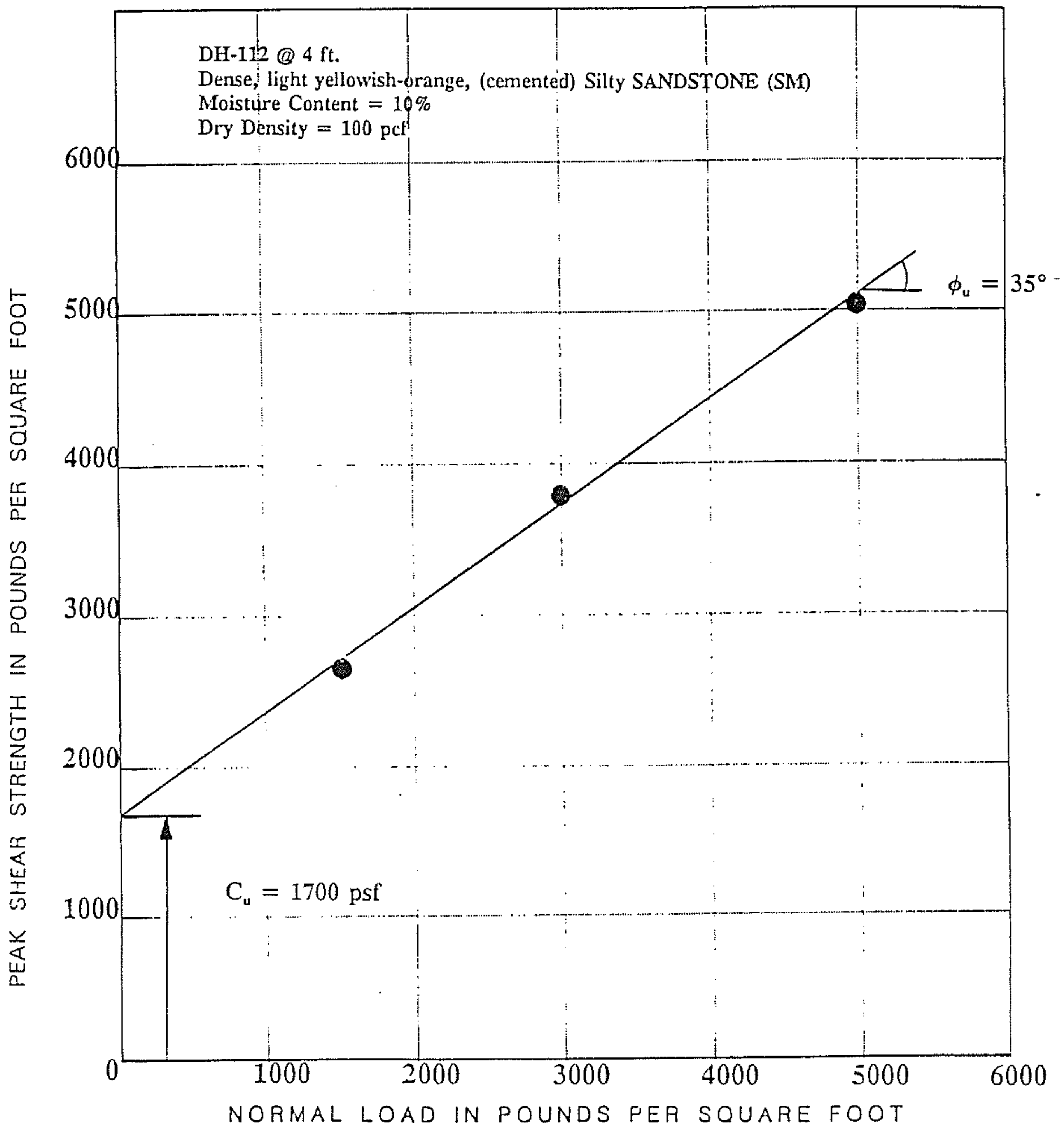
PM : Permeability
EX : Expansion
RS : Resistivity
S : Swell
CL : Chloride
SU : Sulphate

DIRECT SHEAR TEST DATA



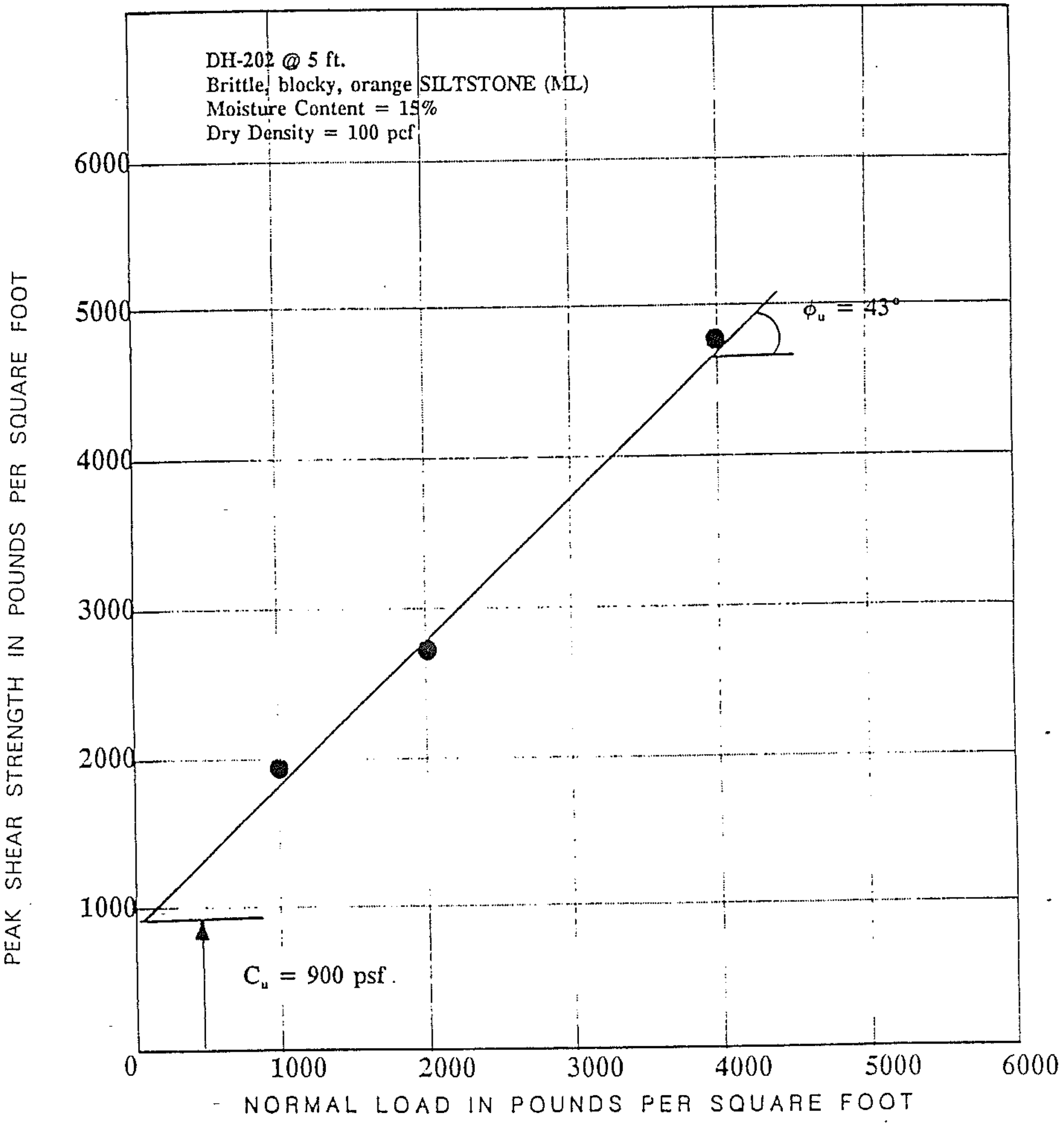
NOTE: All tests performed on specimens at approximately saturated moisture contents.

DIRECT SHEAR TEST DATA



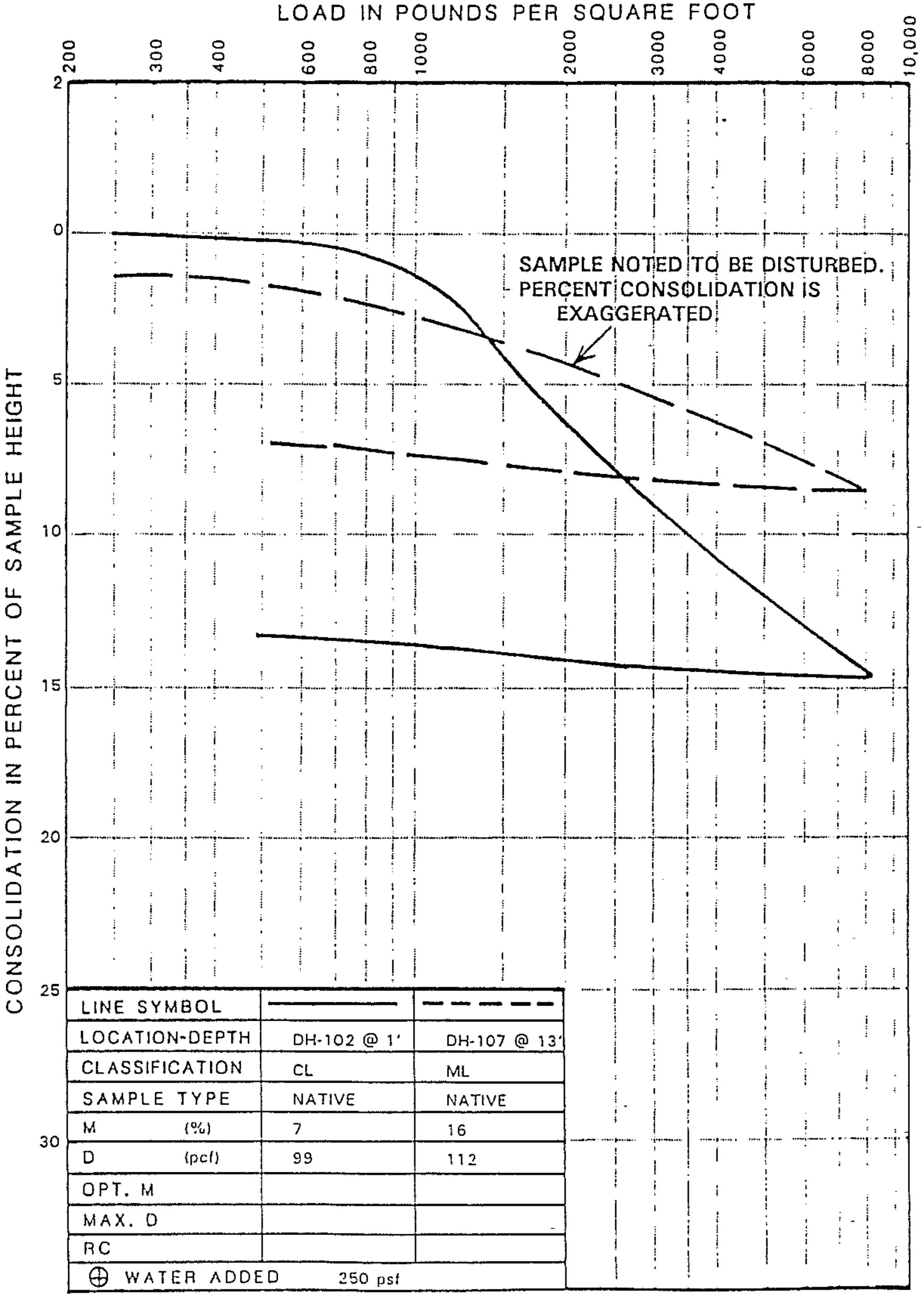
NOTE: All tests performed on specimens at approximately saturated moisture contents.

DIRECT SHEAR TEST DATA



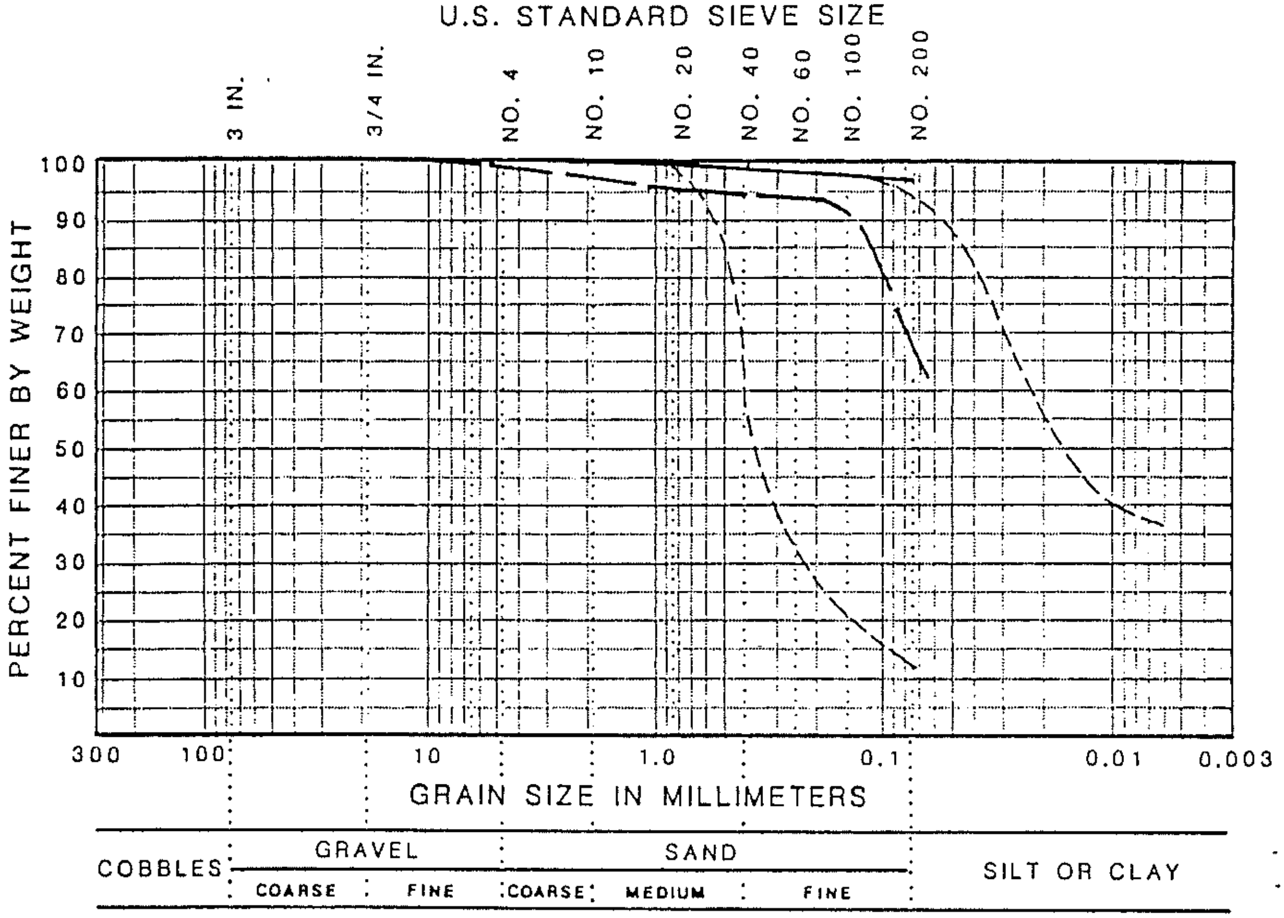
NOTE: All tests performed on specimens at approximately saturated moisture contents.

CONSOLIDATION TEST DATA



LINE SYMBOL	———————	— — — — —
LOCATION-DEPTH	DH-102 @ 1'	DH-107 @ 13'
CLASSIFICATION	CL	ML
SAMPLE TYPE	NATIVE	NATIVE
M (%)	7	16
D (pcf)	99	112
OPT. M		
MAX. D		
RC		
⊕ WATER ADDED	250 psf	

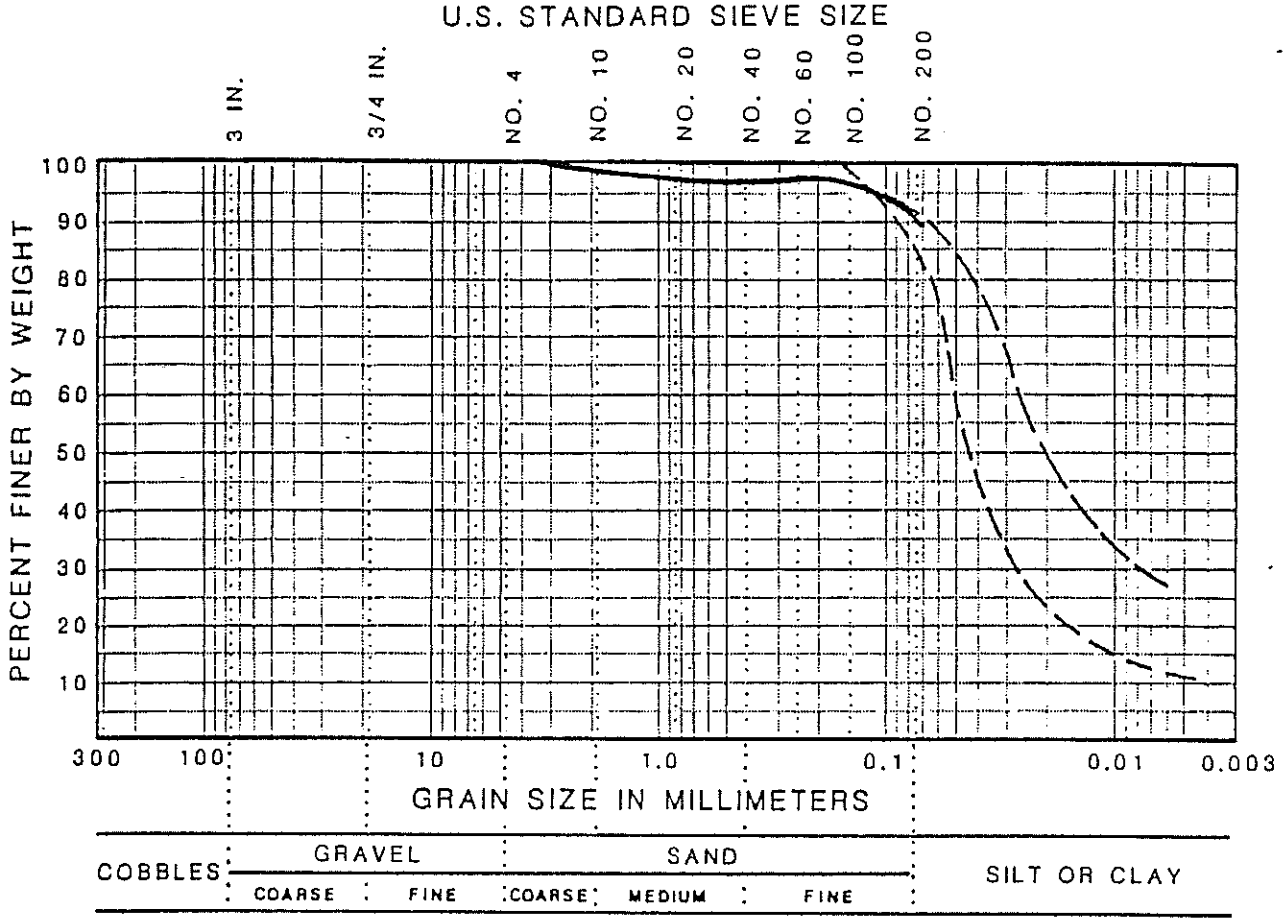
GRAIN-SIZE DISTRIBUTION DATA



PARTICLE SIZE DISTRIBUTION

LINE SYMBOL	SAMPLE LOCATION	REPRESENTATIVE FOR	LIQUID LIMIT	PLASTIC INDEX	CLASSIFICATION
———	DH-103 @ 5 ft.	SCRIPPS FORMATION (Tsc)			SILT (ML)
— — —	DH-104 @ 4 ft.	SCRIPPS FORMATION (Tsc)			CLAYEY SILT (ML)
- - - - -	DH-106 @ 4 ft.	SCRIPPS FORMATION (Tsc)			CLAYEY SILT (ML)
. . . . . .	DH-112 @ 14 ft.	SCRIPPS FORMATION (Tsc)			SILTY SAND (SM)

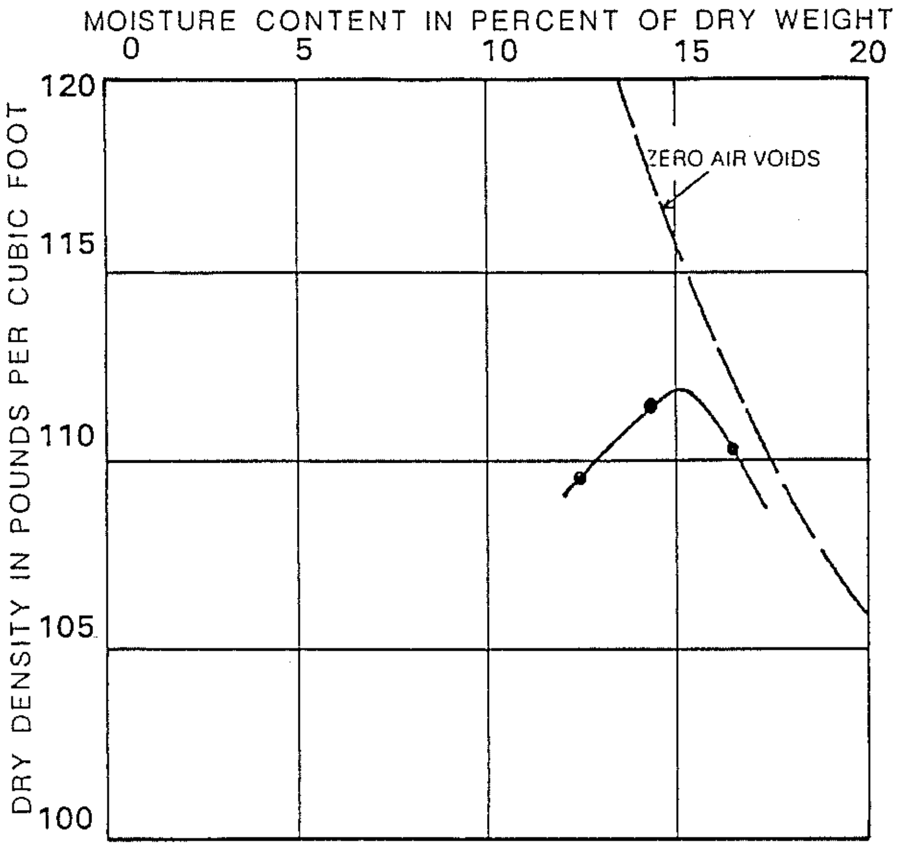
GRAIN-SIZE DISTRIBUTION DATA



PARTICLE SIZE DISTRIBUTION

LINE SYMBOL	SAMPLE LOCATION	REPRESENTATIVE FOR	LIQUID LIMIT	PLASTIC INDEX	CLASSIFICATION
———	DH-202 @ 5 ft.	SCRIPPS FORMATION (Tsc)			CLAYEY SILT (ML)
— — — —	DH-202 @ 20 ft.	SCRIPPS FORMATION (Tsc)			CLAYEY SILT (ML)
- - - - -	DH-204 @ 5 ft.	SCRIPPS FORMATION (Tsc)			SILT (ML)
• • • • • •					

COMPACTION TEST DATA



LOCATION

BORING OR TEST PIT DH-103
DEPTH, IN FEET 1-5
REPRESENTATIVE FOR SCRIPPS FORMATION (Tsc)

SOIL CLASSIFICATION

GRAIN SIZES IN PERCENT OF DRY WEIGHT
SAND (RETAINED ON No 200 SIEVE)
FINES (PASSING No. 200 SIEVE)
ATTERBERG LIMITS, IN PERCENT OF DRY WEIGHT
LIQUID LIMIT
PLASTICITY INDEX
SOIL TYPE AND DESCRIPTION SANDY SILTSTONE (ML)

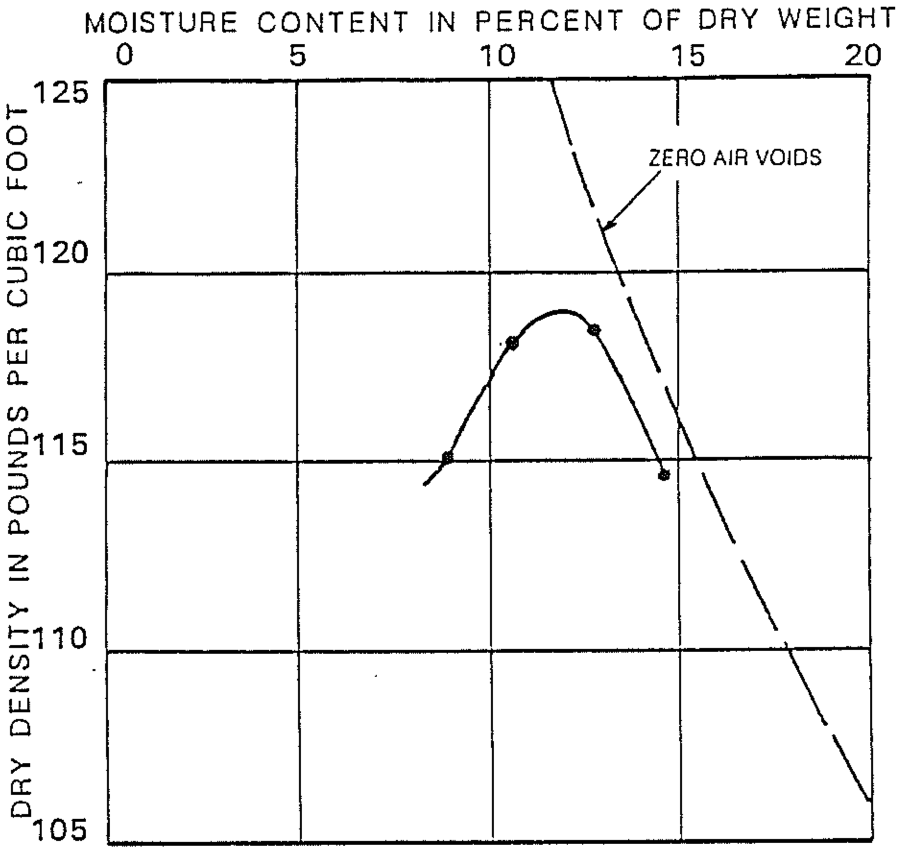
COMPACTION PROPERTIES

METHOD OF COMPACTION

ASTM STANDARD TEST METHOD D-1557-70 EQUIVALENT TO A.A.S.H.O. SOIL COMPACTION TEST T180-57 (1/30 CUBIC FOOT MOLD, 10 POUND HAMMER FALLING 18 INCHES, 25 BLOWS PER LAYER)

OPTIMUM MOISTURE CONTENT, IN PERCENT OF DRY WEIGHT 15
MAXIMUM DRY DENSITY, IN POUNDS PER CUBIC FOOT 112

COMPACTION TEST DATA



LOCATION

BORING OR TEST PIT DH-101
DEPTH. IN FEET 1-4
REPRESENTATIVE FOR ALLUVIUM/COLLUVIUM (Qal/Qc)

SOIL CLASSIFICATION

GRAIN SIZES IN PERCENT OF DRY WEIGHT
SAND (RETAINED ON No. 200 SIEVE)
FINES (PASSING No. 200 SIEVE)
ATTERBERG LIMITS. IN PERCENT OF DRY WEIGHT
LIQUID LIMIT
PLASTICITY INDEX
SOIL TYPE AND DESCRIPTION CLAYEY SILT (ML)

COMPACTION PROPERTIES

METHOD OF COMPACTION

ASTM STANDARD TEST METHOD D-1557-70 EQUIVALENT TO A.A.S.H.O. SOIL COMPACTION TEST T180-57 (1/30 CUBIC FOOT MOLD. 10 POUND HAMMER FALLING 18 INCHES. 25 BLOWS PER LAYER)

OPTIMUM MOISTURE CONTENT. IN PERCENT OF DRY WEIGHT 11.5
MAXIMUM DRY DENSITY. IN POUNDS PER CUBIC FOOT 119.0

LEGEND TO TEST DATA

SYMBOLS

△ ▲ ← GRANULAR SOIL

○ ● ← COHESIVE SOIL OR ROCK

● — TEST AT SATURATED MOISTURE CONTENT

○ — TEST AT MOISTURE CONTENT AS INDICATED

⊕ — WATER ADDED DURING TEST

ABBREVIATIONS

DH-16	—	DRILL HOLE NUMBER
TP - 12	—	TEST PIT NUMBER
@ 7'	—	DEPTH BELOW GRADE IN FEET
(SM)	—	SOIL TYPE EXPRESSED IN LETTER SYMBOL OF UNIFIED SOIL CLASSIFICATION SYSTEM

AL (45/10)	—	ATTERBERG LIMITS (LIQUID LIMIT / PLASTICITY INDEX)

M	—	MOISTURE CONTENT IN PERCENT OF DRY WEIGHT	AT WHICH TEST WAS INITIATED
D	—	DRY DENSITY IN POUNDS PER CUBIC FOOT	

OPT. M	—	OPTIMUM MOISTURE CONTENT IN PERCENT OF DRY WEIGHT
MAX. D	—	MAXIMUM DRY DENSITY IN POUNDS PER CUBIC FOOT
RC	—	RELATIVE COMPACTION IN PERCENT OF MAXIMUM DRY DENSITY

---

t_x	—	TIME IN MINUTES FOR x PERCENT CONSOLIDATION

TYPE OF SAMPLE TESTED

N	—	UNDISTURBED NATURAL SOIL
F	—	UNDISTURBED COMPACTED FILL SOIL
R	—	SOIL REMOLDED IN LABORATORY

R - VALUE DATA SHEET

W.O.# S89012B

PROJECT NUMBER 19281 BORING NUMBER: DH-104 @ 7'-12'

SAMPLE DESCRIPTION: Light Brown Silty Clay

Item	SPECIMEN		
	a	b	c
Mold Number	7	8	9
Water added, grams	30	55	18
Initial Test Water, %	17.1	19.5	16.0
Compact Gage Pressure,psi	200	125	250
Exudation Pressure, psi	307	187	704
Height Sample, Inches	2.47	2.53	2.49
Gross Weight Mold, grams	3076	3128	3100
Tare Weight Mold, grams	2085	2085	2074
Sample Wet Weight, grams	991	1043	1026
Expansion, Inches x 10exp-4	41	31	64
Stability 2,000 lbs (160psi)	28 / 68	42 / 105	26 / 65
Turns Displacement	4.35	4.39	4.02
R-Value Uncorrected	44	23	48
R-Value Corrected	44	23	48
Dry Density, pcf	103.8	104.5	107.6
	DESIGN CALCULATION DATA		
Traffic Index Assumed:	4.0	4.0	4.0
G.E. by Stability	0.57	0.79	0.53
G. E. by Expansion	1.37	1.03	2.13

Equilibrium R-Value	18 by EXPANSION	Examined & Checked: 9 /24/ 90

REMARKS: Gf = 1.25

STEVEN R. MARVIN
C 30659
Exp. 3/31/98

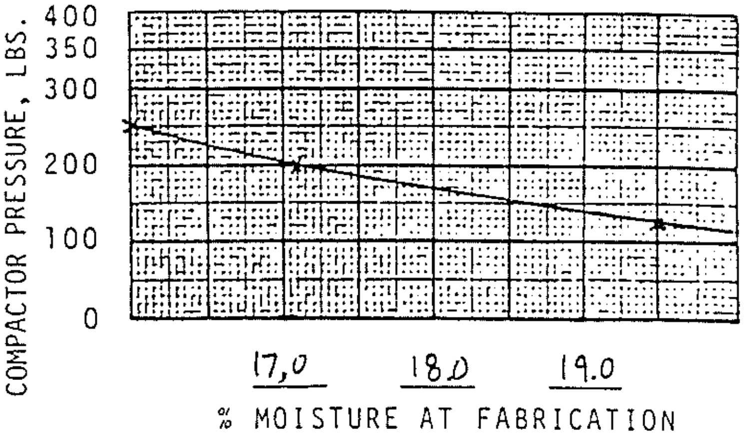
Steven R. Marvin, RCE 30659

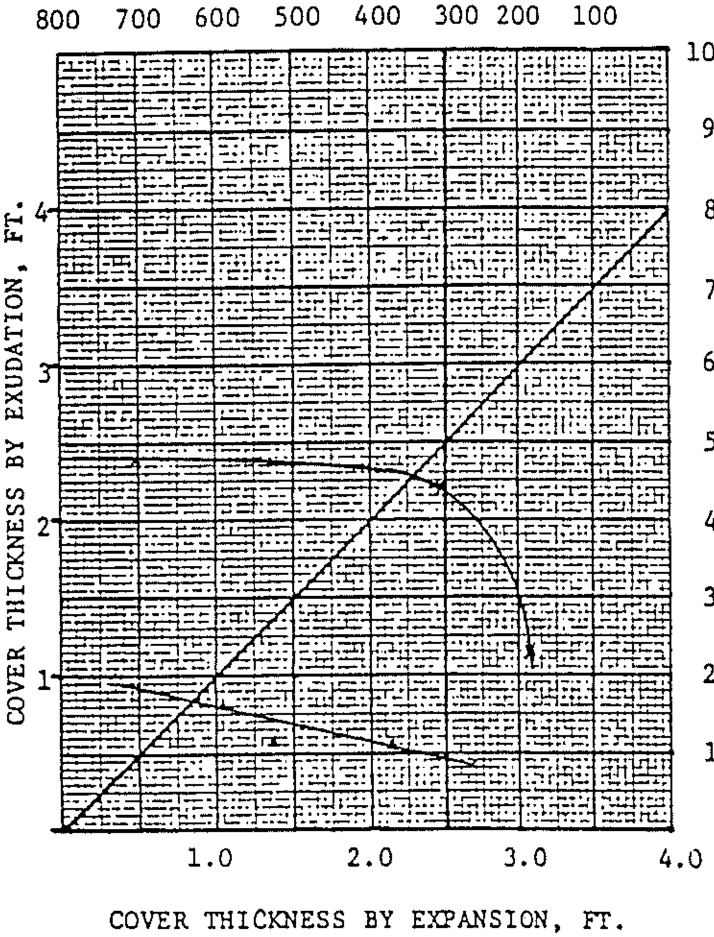
The data above is based upon processing and testing samples as received from the field. Test procedures in accordance with latest revisions to Department of Transportation, State of California, Materials & Research Test Method No. 301.

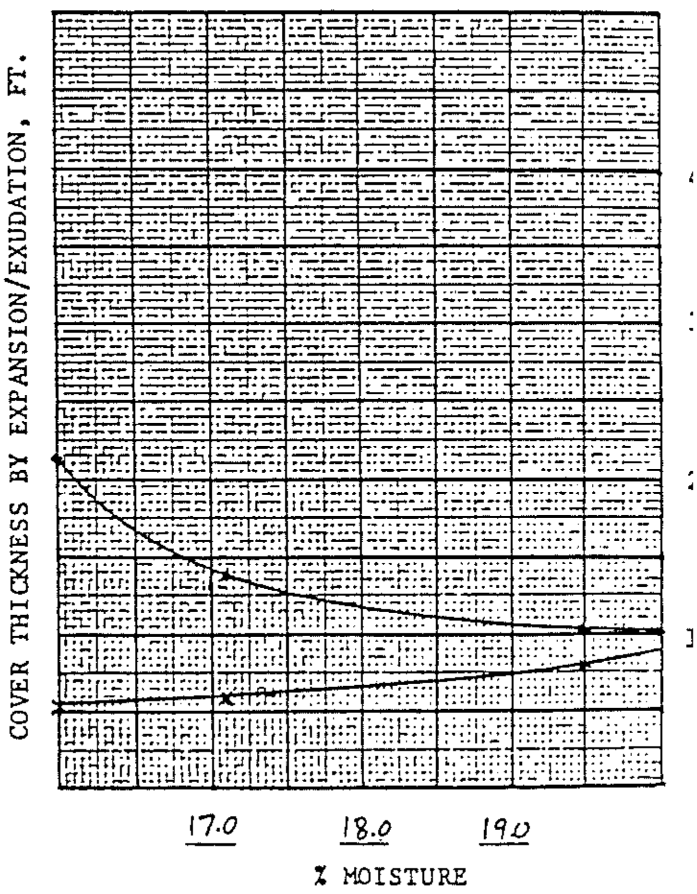
LaBelle • Marvin

R-VALUE GRAPHICAL PRESENTATION

PROJECT NO. 19281
W.O.# 5890128
BORING NO. DH 104@7-12'
DATE 9-24-90
TRAFFIC INDEX 4.0
R-VALUE BY EXUDATION 44
R-VALUE BY EXPANSION 18







■ ■ ■ R-VALUE vs. EXUD. PRES.

× × × T by EXUDATION

△ △ △ EXUD. T vs. EXPAN. T

△ △ △ T by EXPANSION

REMARKS Gf = 1.25

LaBelle • Marvin
PROFESSIONAL PAVEMENT ENGINEERING

R - VALUE DATA SHEET

PROJECT NUMBER 19292

J.N. S89012B

BORING NUMBER: DH 115 @ 6'-10'

SAMPLE DESCRIPTION: Light Brown Diatomaceous Silt

Item	SPECIMEN a	SPECIMEN b	SPECIMEN c
Mold Number	4	5	6
Water added, grams	225	130	170
Initial Test Water, %	25.4	17.1	20.6
Compact Gage Pressure,psi	25	150	70
Exudation Pressure, psi	129	406	260
Height Sample, Inches	2.64	2.45	2.38
Gross Weight Mold, grams	3110	3106	3025
Tare Weight Mold, grams	2085	2085	2083
Sample Wet Weight, grams	1025	1021	942
Expansion, Inches x 10exp-4	0	30	15
Stability 2,000 lbs (160psi)	68 / 145	45 / 113	55 / 133
urns Displacement	5.83	4.36	4.52
R-Value Uncorrected	4	19	10
R-Value Corrected	4	19	10
Dry Density, pcf	93.8	107.9	99.4
DESIGN CALCULATION DATA			
raffic Index Assumed:	4.0	4.0	4.0
G.E. by Stability	0.98	0.83	0.92
G. E. by Expansion	0.00	1.00	0.50

quilibrium R-Value: 12 by EXUDATION

Examined & Checked: 9 /28/ 90

Steven R. Marvin, RCE 30659

EMARKS: Gf = 1.25

he data above is based upon processing and testing samples as received from the ld. Test procedures in accordance with latest revisions to Department of ansportation, State of California, Materials & Research Test Method No. 301.

LaBelle • Marvin

R-VALUE GRAPHICAL PRESENTATION

PROJECT NO. 19292

J.N. S89012B

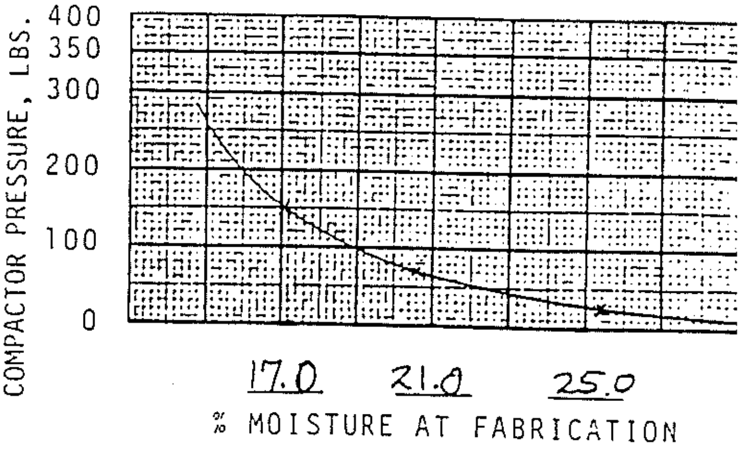
BORING NO. DH 115 @ 6-10'

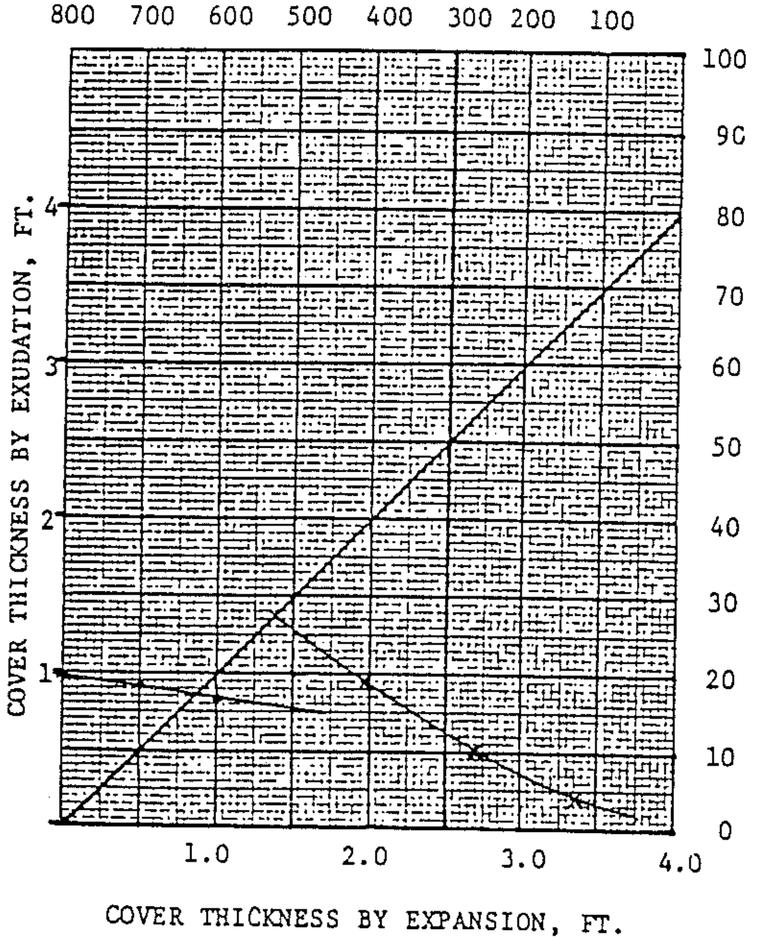
DATE 9-28-90

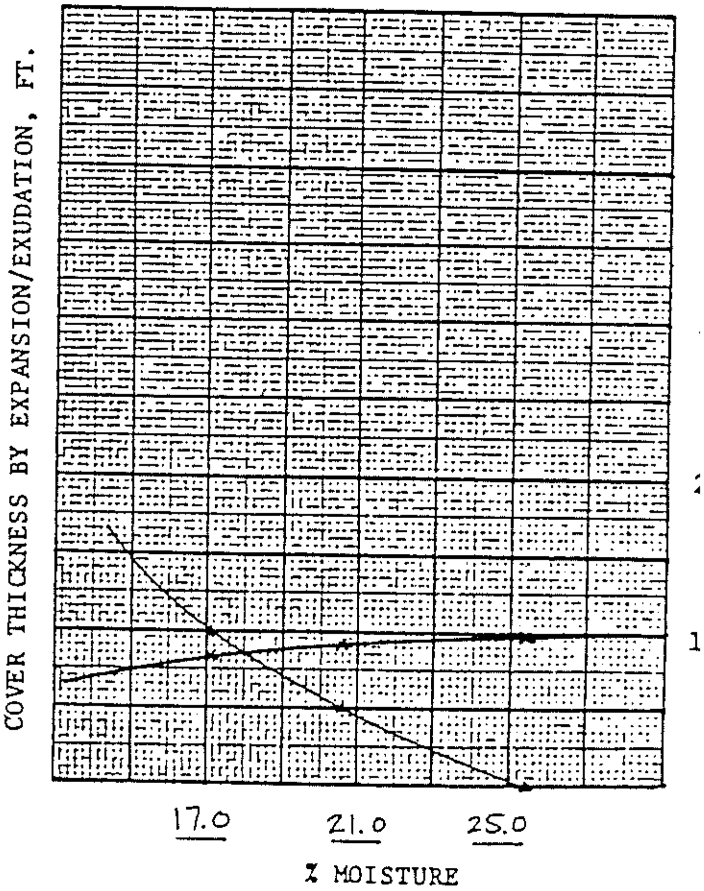
TRAFFIC INDEX 4.0

R-VALUE BY EXUDATION 12

R-VALUE BY EXPANSION —







—■—■—■— R-VALUE vs. EXUD. PRES.

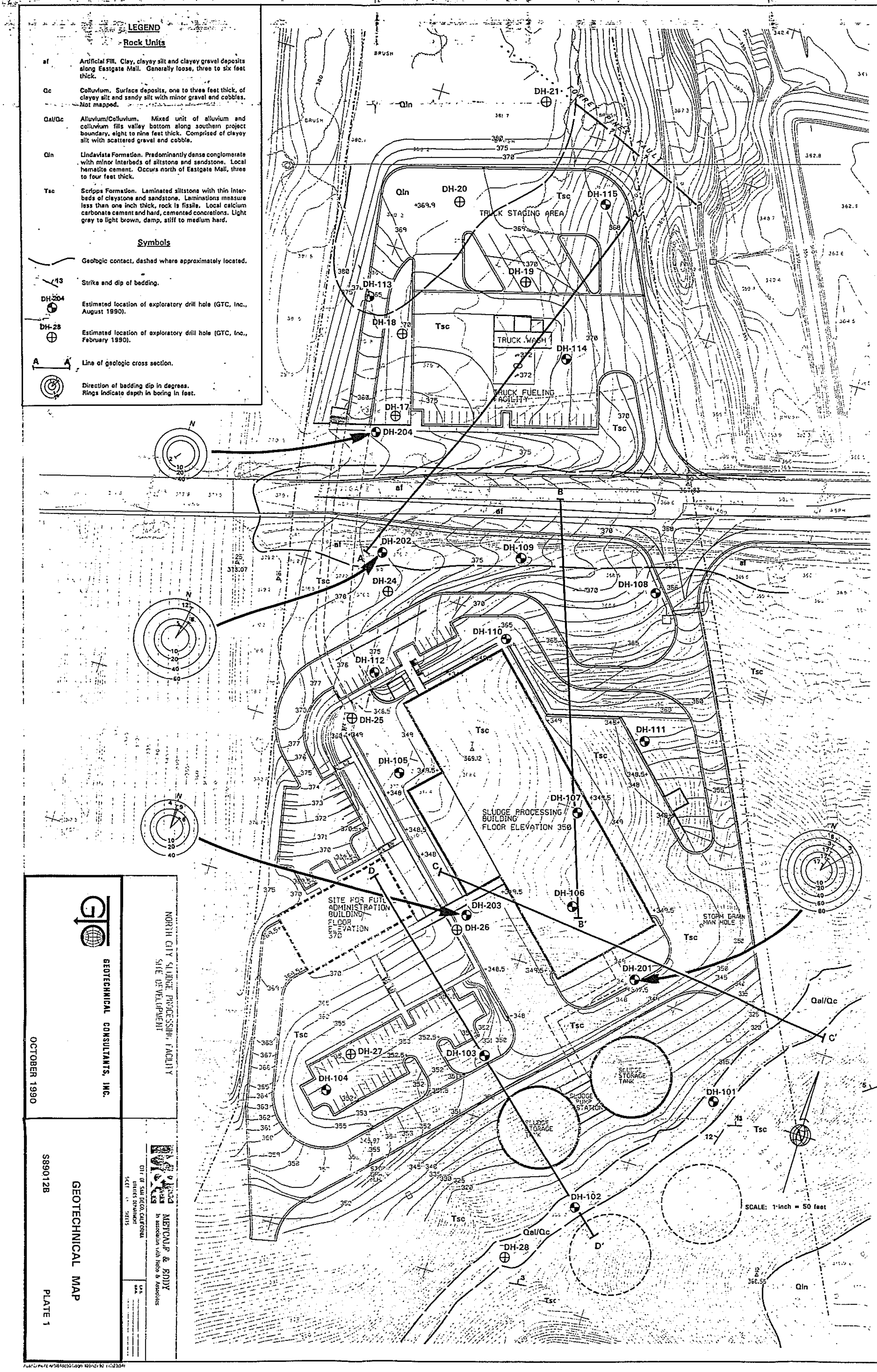
—×—×—×— T by EXUDATION

—△—△—△— EXUD. T vs. EXPAN. T

—△—△—△— T by EXPANSION

REMARKS Gf = 1.25

LaBelle • Marvin
PROFESSIONAL PAVEMENT ENGINEERING



LEGEND

Rock Units

af	Artificial Fill. Clay, clayey silt and clayey gravel deposits along Eastgate Mall. Generally loose, three to six feet thick.
Qc	Colluvium. Surface deposits, one to three feet thick, of clayey silt and sandy silt with minor gravel and cobbles. Not mapped.
Qal/Qc	Alluvium/Colluvium. Mixed unit of alluvium and colluvium fills valley bottom along southern project boundary, eight to nine feet thick. Comprised of clayey silt with scattered gravel and cobble.
Qln	Lindavista Formation. Predominantly dense conglomerate with minor interbeds of siltstone and sandstone. Local hematite cement. Occurs north of Eastgate Mall, three to four feet thick.
Tsc	Scripps Formation. Laminated siltstone with thin interbeds of claystone and sandstone. Laminations measure less than one inch thick, rock is fissile. Local calcium carbonate cement and hard, cemented concretions. Light gray to light brown, damp, stiff to medium hard.

Symbols

	Geologic contact, dashed where approximately located.
13	Strike and dip of bedding.
DH-204	Estimated location of exploratory drill hole (GTC, Inc., August 1990).
DH-28 ⊕	Estimated location of exploratory drill hole (GTC, Inc., February 1990).
A A'	Line of geologic cross section.
◎	Direction of bedding dip in degrees. Rings indicate depth in boring in feet.

NORTH CITY SLUDGE PROCESSING FACILITY
SITE DEVELOPMENT

METCALF & EDDY
In association with Nolo & Associates

CITY OF SAN DIEGO, CALIFORNIA
UTILITIES DEPARTMENT
SHEET OF SHEETS

GTC GEOTECHNICAL CONSULTANTS, INC.

OCTOBER 1990

GEOTECHNICAL MAP

S89012B

PLATE 1

Preliminary Geotechnical Investigation, Eastgate Mall Site Development Project

by

Metcalf & Eddy, Inc.

Ninyo & Moore
Geotechnical and Environmental Sciences Consultants

PRELIMINARY GEOTECHNICAL INVESTIGATION
EASTGATE MALL SITE
SITE DEVELOPMENT PROJECT
CITY OF SAN DIEGO, CALIFORNIA

PREPARED FOR:

METCALF & EDDY, INC.
600 B STREET, SUITE 2001
SAN DIEGO, CALIFORNIA 92101

MARCH 15, 1991
PROJECT NO. 101948-01

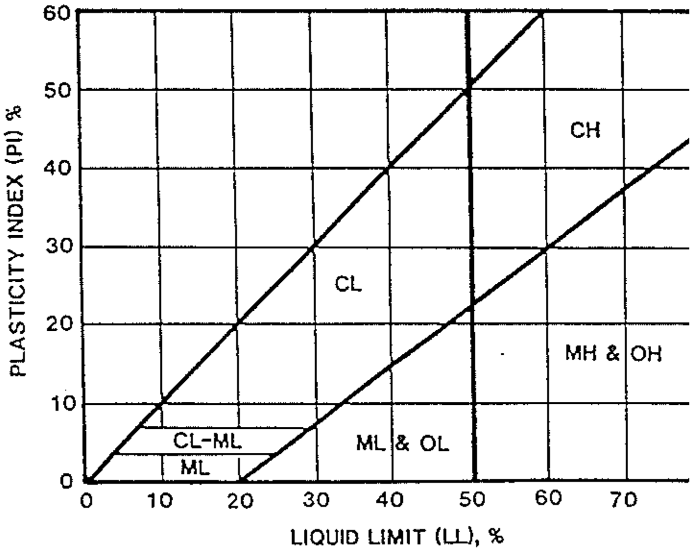
10225 Barnes Canyon Road • Suite A-112 • San Diego, California 92121 • Phone (619) 457-0400 • Fax (619) 558-1236

MAJOR DIVISIONS		SYMBOL	TYPICAL NAMES
COARSE GRAINED SOILS (More than 1/2 of soil > No. 200 sieve size)	GRAVELS (More than 1/2 of coarse fraction > No. 4 sieve size)	GW	Well graded gravels or gravel-sand mixtures, little or no fines
		GP	Poorly graded gravels or gravel-sand mixtures, little or no fines
		GM	Silty gravels, gravel-sand-silt mixtures
		GC	Clayey gravels, gravel-sand-clay mixtures
	SANDS (More than 1/2 of coarse fraction < No. 4 sieve size)	SW	Well graded sands or gravelly sands, little or no fines
		SP	Poorly graded sands or gravelly sands, little or no fines
		SM	Silty sands, sand-silt mixtures
		SC	Clayey sands, sand-clay mixtures
FINE GRAINED SOILS (More than 1/2 of soil < No. 200 sieve size)	SILTS & CLAYS Liquid Limit < 50	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
		OL	Organic silts and organic silty clays of low plasticity
	SILTS & CLAYS Liquid Limit > 50	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
		CH	Inorganic clays of high plasticity, fat clays
		OH	Organic clays of medium to high plasticity, organic silty clays, organic silts
HIGHLY ORGANIC SOILS		Pt	Peat and other highly organic soils

CLASSIFICATION CHART (Unified Soil Classification System)

CLASSIFICATION	RANGE OF GRAIN SIZES	
	U.S. Standard Sieve Size	Grain Size in Millimeters
BOULDERS	Above 12"	Above 305
COBBLES	12" to 3"	305 to 76.2
GRAVEL Coarse Fine	3" to No. 4 3" to 3/4" 3/4" to No. 4	76.2 to 4.76 76.2 to 19.1 19.1 to 4.76
SAND Coarse Medium Fine	No. 4 to No. 200 No. 4 to No. 10 No. 10 to No. 40 No. 40 to No. 200	4.76 to 0.074 4.76 to 2.00 2.00 to 0.420 0.420 to 0.074
SILT & CLAY	Below No. 200	Below 0.074

GRAIN SIZE CHART



PLASTICITY CHART

Ninyo & Moore U.S.C.S. METHOD OF SOIL CLASSIFICATION

DATE DRILLED ____________ **BORING NO.** ____________

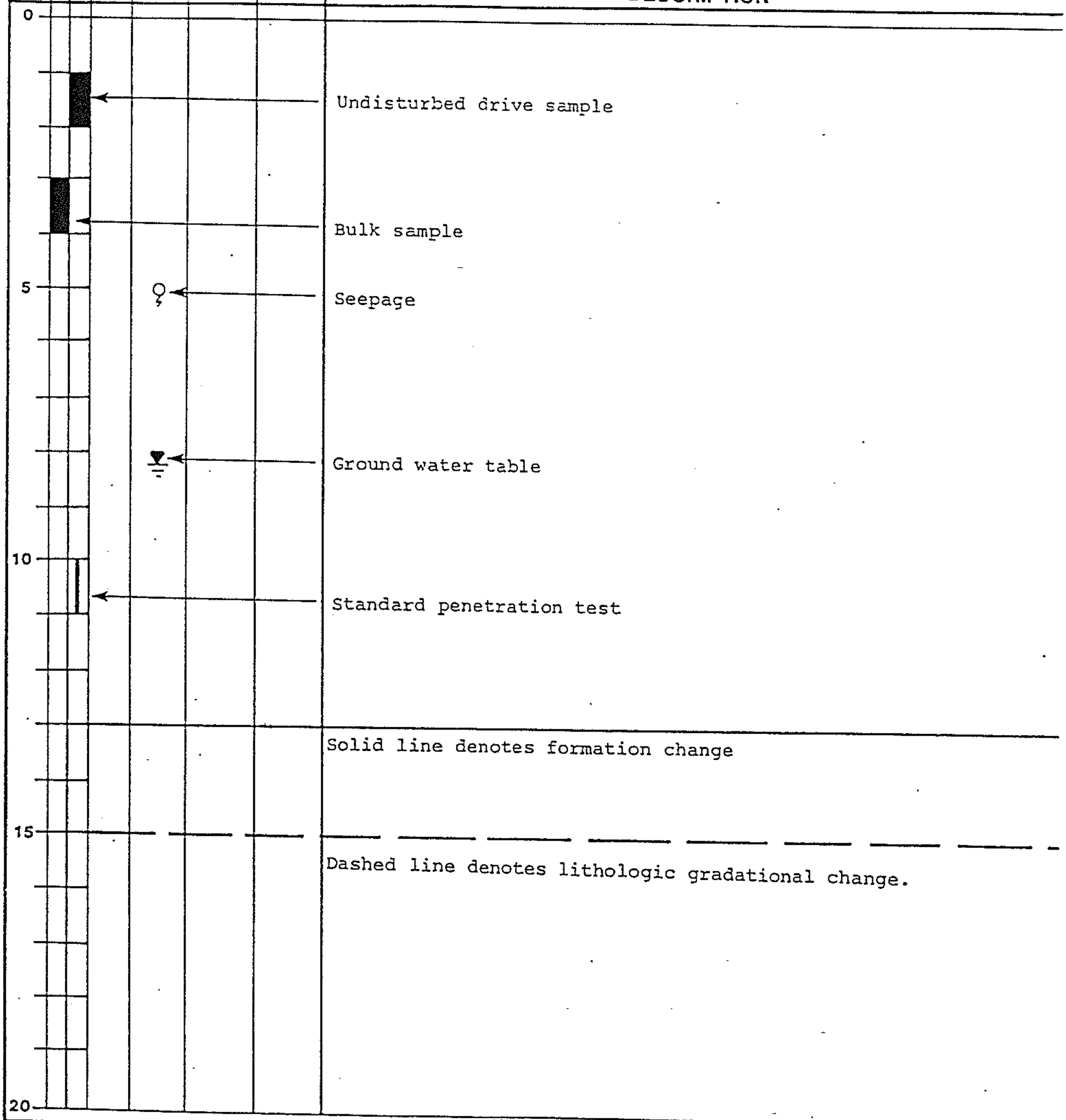
GROUND ELEVATION ____________ SHEET ____ OF ____

METHOD OF DRILLING ____________

DRIVE WEIGHT ____________ DROP ____________

SAMPLED BY ____________ LOGGED BY ____________

DEPTH (Feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DESCRIPTION



Undisturbed drive sample

Bulk sample

Seepage

Ground water table

Standard penetration test

Solid line denotes formation change

Dashed line denotes lithologic gradational change.

Ninyo & Moore

BORING LOG

Explanation of Boring Log

Ninyo & Moore

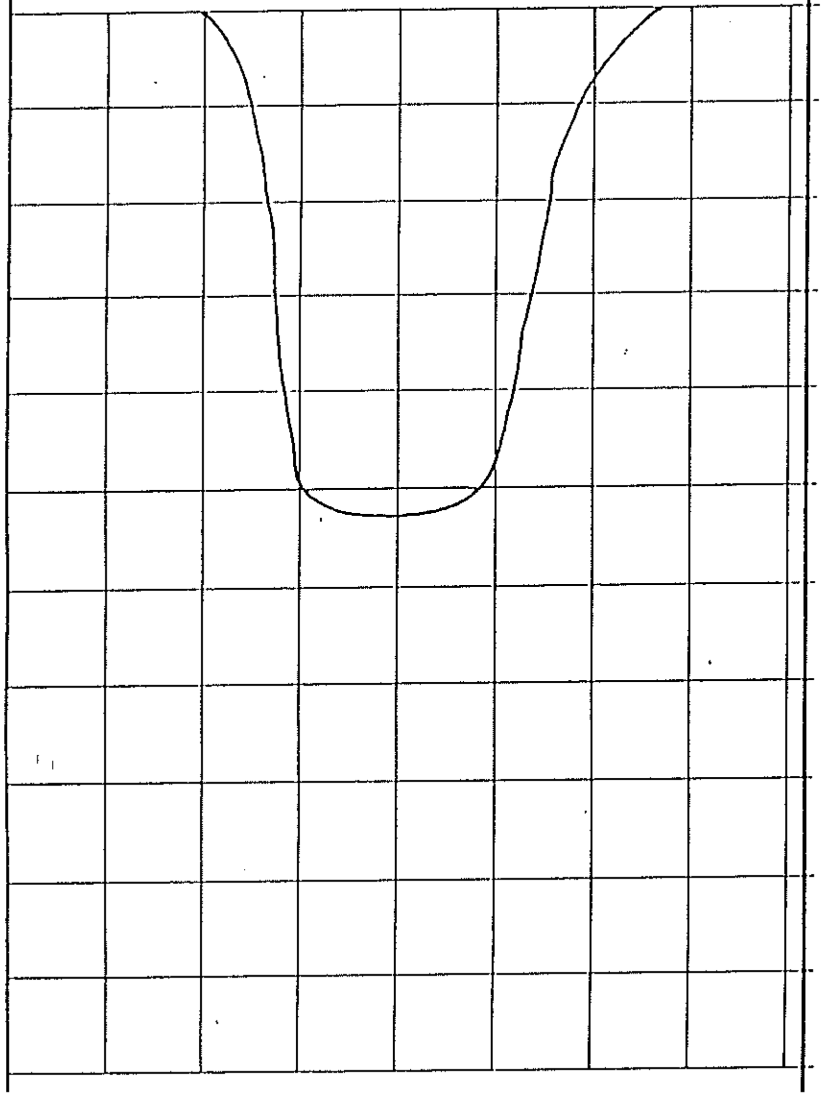
TEST PIT LOG

Explanation of Test Pit Log

PROJECT NO.
DATE

DATE EXCAVATED ____________ TEST PIT NO. ______
GROUND ELEVATION ____________ LOGGED BY ______
METHOD OF EXCAVATION ____________
LOCATION ____________

DEPTH (FEET)	SAMPLES: Bulk	SAMPLES: Driven	SAMPLES: Sand Cone	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DESCRIPTION
		■		←			Drive Tube density sample
			■	←			Sand Cone density sample
	■			←			Bulk sample
				♀	←		Seepage
				▼	←		Ground water table



FIGURE

DATE DRILLED 1/23/91 BORING NO. B-1
GROUND ELEVATION 345'+/- MSL SHEET 1 OF 1
METHOD OF DRILLING 8" Hollow Stem Auger
DRIVE WEIGHT 140 lbs. DROP 30"
SAMPLED BY GJS LOGGED BY GJS

SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DESCRIPTION
						ALLUVIUM:
▨		74			SM	Medium brown, damp, medium dense, slightly clayey, silty SAND with abundant gravel.
						SCRIPPS FORMATION:
	▨	86	8.8			Yellow-brown to red-brown, damp, dense to very dense, silty, fine-grained SANDSTONE.
						Total Depth = 12.0' No Caving No Ground Water Encountered Backfilled 1/28/91

Ninyo & Moore

BORING LOG

Eastgate Mall Site, North City Reclamation and Sludge Processing Facilities

PROJECT NO.	DATE	FIGURE

DATE DRILLED 1/29/91 BORING NO. B-2
GROUND ELEVATION 332'+/- MSL SHEET 1 OF 2
METHOD OF DRILLING 8" Hollow Stem Auger
DRIVE WEIGHT 140 lbs. DROP 30"
SAMPLED BY GJS LOGGED BY GJS

DEPTH (Feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DESCRIPTION
0							ALLUVIUM:
						SM	Brown, damp, medium dense, silty, fine SAND with gravel.
5	▨	☐	76				Harder drilling, abundant gravel and cobbles.
							SCRIPPS FORMATION: Yellow-brown, damp, dense to very dense, silty, fine-grained SANDSTONE to fine, sandy SILTSTONE.
		▨	58	8.2			
10	▨						Tan, damp, very dense, medium to fine-grained SANDSTONE.
15		▨	20/ 5"	9.5			Yellow-brown, damp, very dense, silty, fine-grained SANDSTONE.
20							

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BORING LOG

Eastgate Mall Site, North City Reclamation and Sludge Processing Facilities

PROJECT NO.	DATE	FIGURE
101949-01	3/91	B-2

DATE DRILLED 1/29/91 BORING NO. B-2
GROUND ELEVATION 332'+/- MSL SHEET 2 OF 2
METHOD OF DRILLING 8" Hollow Stem Auger
DRIVE WEIGHT 140 lbs. DROP 30"
SAMPLED BY GJS LOGGED BY GJS

SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DESCRIPTION
		89				<u>SCRIPPS FORMATION (Continued):</u>
						Total Depth = 20.8' No Caving No Ground Water Encountered Backfilled 1/29/91

Ninyo & Moore

BORING LOG

Eastgate Mall Site, North City Reclamation and Sludge Processing Facilities

DATE DRILLED 1/29/91 BORING NO. B-3

GROUND ELEVATION 312'+/- MSL SHEET 1 OF 2

METHOD OF DRILLING 8" Hollow Stem Auger

DRIVE WEIGHT 140 lbs. DROP 30"

SAMPLED BY GJS LOGGED BY GJS

DEPTH (Feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DESCRIPTION
0						SM-ML	ALLUVIUM: Brown, damp, medium dense, clayey, silty, fine SAND and fine, sandy SILT with abundant gravel.
		■	72/ 9"	9.6			
5							SCRIPPS FORMATION: Yellow-brown, damp, stiff to very stiff, fine, sandy SILTSTONE.
10		☐	63				Yellow-brown and gray, damp, very stiff to hard, fine, sandy SILTSTONE. Hard Drilling (Some Well Cemented Zones)
15		■	75/ 9"	12.9	108.3		
20							

Ninyo & Moore

BORING LOG

Eastgate Mall Site, North City Reclamation and Sludge Processing Facilities

PROJECT NO.	DATE	FIGURE

DATE DRILLED 1/29/91 BORING NO. B-3
GROUND ELEVATION 312'+/- MSL SHEET 2 OF 2
METHOD OF DRILLING 8" Hollow Stem Auger
DRIVE WEIGHT 140 lbs. DROP 30"
SAMPLED BY GJS LOGGED BY GJS

SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DESCRIPTION
		77				SCRIPPS FORMATION (Continued): Same as above
						Total Depth = 21.5' No Caving No Ground Water Encountered Backfilled 1/29/91

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BORING LOG

Eastgate Mall Site, North City Reclamation
and Sludge Processing Facilities

PROJECT NO.	DATE	FIGURE

DATE DRILLED 1/29/91 BORING NO. B-4
GROUND ELEVATION 302'+/- MSL SHEET 1 OF 2
METHOD OF DRILLING 8" Hollow Stem Auger
DRIVE WEIGHT 140 lbs. DROP 30"
SAMPLED BY GJS LOGGED BY GJS

DEPTH (Feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DESCRIPTION
0							<u>ALLUVIUM</u>:
						SL-CL	Brown, damp, medium dense, silty, clayey SAND and firm, sandy, CLAY.
5	■	■					
			31	11.3	114.8	SM	Brown, damp, medium dense, slightly clayey, silty SAND.
10		☐					
			48				<u>SCRIPPS FORMATION</u>: Yellow-brown and gray, damp, stiff to very stiff, fine, sandy SILTSTONE.
							Yellow-brown and gray, damp, very stiff to hard, fine, sandy SILTSTONE to silty, fine-grained SANDSTONE.
15	■	■	98	18.9			
20							

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BORING LOG

Eastgate Mall Site, North City Reclamation and Sludge Processing Facilities

PROJECT NO.	DATE	FIGURE

DATE DRILLED 1/29/91 BORING NO. B-4
GROUND ELEVATION 302'+/- MSL SHEET 2 OF 2
METHOD OF DRILLING 8" Hollow Stem Auger
DRIVE WEIGHT 140 lbs. DROP 30"
SAMPLED BY GJS LOGGED BY GJS

SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DESCRIPTION
		92				SCRIPPS FORMATION (Continued): Same as above.
	■	72/ 5"	17.1	101.3		Yellow-brown to reddish-brown, damp, very dense, medium-grained SANDSTONE.

Total Depth = 25.5'
No Caving
No Ground Water Encountered
Backfilled 1/29/90

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BORING LOG

Eastgate Mall Site, North City Reclamation and Sludge Processing Facilities

PROJECT NO.	DATE	FIGURE

DATE DRILLED 1/29/91 BORING NO. B-5
GROUND ELEVATION 310'+/- MSL SHEET 1 OF 2
METHOD OF DRILLING 8" Hollow Stem Auger
DRIVE WEIGHT 140 lbs. DROP 30"
SAMPLED BY GJS LOGGED BY GJS

DEPTH (Feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DESCRIPTION
0							ALLUVIUM:
						SM-ML	Brown, damp, medium dense, slightly clayey, silty, fine SAND and fine, sandy SILT.
5		■	76	17.7	106.6		
							SCRIPPS FORMATION: Yellow-brown to orange-brown and gray, damp, very stiff, fine, sandy SILTSTONE and silty, fine-grained SANDSTONE.
10		□	62				
15		■	60	15.2	102.1		Same as above.
20							

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BORING LOG

Eastgate Mall Site, North City Reclamation and Sludge Processing Facilities

PROJECT NO.	DATE	FIGURE
101948-01	3/91	B-5

DATE DRILLED 1/29/91 BORING NO. B-5
GROUND ELEVATION 310'+/- MSL SHEET 2 OF 2
METHOD OF DRILLING 8" Hollow Stem Auger
DRIVE WEIGHT 140 lbs. DROP 30"
SAMPLED BY GJS LOGGED BY GJS

SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DESCRIPTION
	|	75				SCRIPPS FORMATION (Continued): Same as above.
						Total Depth = 21.0' No Caving No Ground Water Encountered Backfilled 1/29/91

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BORING LOG

Eastgate Mall Site, North City Reclamation
and Sludge Processing Facilities

DATE DRILLED 1/29/91 BORING NO. B-6

GROUND ELEVATION 364'+/- MSL SHEET 1 OF 2

METHOD OF DRILLING 8" Hollow Stem Auger

DRIVE WEIGHT 140 lbs. DROP 30"

SAMPLED BY GJS LOGGED BY GJS

DEPTH (Feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DESCRIPTION
0							SCRIPPS FORMATION: Yellow-brown to orange-brown and gray, damp, dense to very dense, silty, fine-grained SANDSTONE and sandy SILTSTONE.
5		■	68	7.6	109.7		
10		▯	76				Same as above.
15		■	60/ 6"	7.6	109.7		Same as above.
20							

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BORING LOG

Eastgate Mall Site, North City Reclamation and Sludge Processing Facilities

PROJECT NO.	DATE	FIGURE
101948-01	3/91	B-6

DATE DRILLED 1/29/91 BORING NO. B-6
GROUND ELEVATION 364'+/- MSL SHEET 2 OF 2
METHOD OF DRILLING 8" Hollow Stem Auger
DRIVE WEIGHT 140 lbs. DROP 30"
SAMPLED BY GJS LOGGED BY GJS

SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DESCRIPTION
		92				Orange-brown and gray, damp, dense, sandy SILTSTONE.
	■	58/ 6"	20.5	105.9		
■						Orange-brown and gray, damp, dense, sandy SILTSTONE and interbedded, silty CLAYSTONE.
		50/ 6"				Orange-brown and gray, damp, dense, sandy, clayey SILTSTONE.
						Total Depth = 30.5' No Caving No Ground Water Encountered Backfilled 1/29/91

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BORING LOG

Eastgate Mall Site, North City Reclamation and Sludge Processing Facilities

PROJECT NO.	DATE	FIGURE

DATE DRILLED 1/29/91 BORING NO. B-7
GROUND ELEVATION 367'+/- MSL SHEET 1 OF 2
METHOD OF DRILLING 8" Hollow Stem Auger
DRIVE WEIGHT 140 lbs. DROP 30"
SAMPLED BY GJS LOGGED BY GJS

DEPTH (Feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DESCRIPTION
0							<u>SCRIPPS FORMATION</u>: Yellow-brown, damp, dense, silty, fine-grained SANDSTONE and sandy SILTSTONE.
5	▨	■	77	16.9	96.9		
10		│	83				Yellow-brown and gray, damp, dense, clayey SILTSTONE.
15		■	50/ 6"	14.0			Yellow-brown, damp, very dense, silty, fine-grained SANDSTONE and interbedded, sandy SILTSTONE.
20							

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BORING LOG

Eastgate Mall Site, North City Reclamation and Sludge Processing Facilities

PROJECT NO.	DATE	FIGURE
101948-01	3/91	B-7

DATE DRILLED 1/29/91 BORING NO. B-7
GROUND ELEVATION 367'+/- MSL SHEET 2 OF 2
METHOD OF DRILLING 8" Hollow Stem Auger
DRIVE WEIGHT 140 lbs. DROP 30"
SAMPLED BY GJS LOGGED BY GJS

SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DESCRIPTION
						SCRIPPS FORMATION (Continued):
		85				Yellow-brown and gray, damp, dense, sandy SILTSTONE.
	■	86	19.9	107.3		Same as above.
		55/ 6"				Gray, dry to damp, very dense, fine-grained SANDSTONE.

Total Depth = 30.5'
No Caving
No Ground Water Encountered
Backfilled 1/29/91

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BORING LOG

Eastgate Mall Site, North City Reclamation and Sludge Processing Facilities

PROJECT NO.	DATE	FIGURE

DATE DRILLED 1/29/91 BORING NO. B-8
GROUND ELEVATION 358'+/- MSL SHEET 1 OF 2
METHOD OF DRILLING 8" Hollow Stem Auger
DRIVE WEIGHT 140 lbs. DROP 30"
SAMPLED BY GJS LOGGED BY GJS

DEPTH (Feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DESCRIPTION
0							SCRIPPS FORMATION: Yellow-brown, damp, medium dense, silty, fine-grained SANDSTONE.
							Tan, damp, dense, silty, fine-grained SANDSTONE with black staining.
5		▨	76	10.2	100.3		
							(Hard Drilling) Well Cemented Zone
							Yellow-brown, damp, very stiff, fine, sandy, clayey SILTSTONE.
10	▨	▯	92				
							Yellow-brown to orange-brown and gray, damp, very stiff, fine, sandy SILTSTONE and silty, fine-grained SANDSTONE.
15		▨	60/ 6"	15.9	108.1		
20							

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BORING LOG

Eastgate Mall Site, North City Reclamation and Sludge Processing Facilities

PROJECT NO.	DATE	FIGURE
101948-01	3/91	B-8

DATE DRILLED 1/29/91 BORING NO. B-8
GROUND ELEVATION 358'+/- MSL SHEET 1 OF 1
METHOD OF DRILLING 8" Hollow Stem Aucer
DRIVE WEIGHT 140 lbs. DROP 30"
SAMPLED BY GJS LOGGED BY GJS

SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DESCRIPTION
		78				<u>SCRIPPS FORMATION (Continued)</u>: Same as above.

Total Depth = 21.0'
No Caving
No Ground Water Encountered
Backfilled 1/29/91

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BORING LOG

Eastgate Mall Site, North City Reclamation
and Sludge Processing Facilities

DATE DRILLED 2/1/91 BORING NO. B-9
GROUND ELEVATION 375'+/- MSL SHEET 1 OF 2
METHOD OF DRILLING 30" Bucket Auger
DRIVE WEIGHT 0'-25': 3,087 lbs. 25'-45': 1,999 lbs. DROP 12"
SAMPLED BY GJS LOGGED BY GJS/PSR/RI

DEPTH (Feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DESCRIPTION
0							TOPSOIL:
						SC	Reddish-brown, damp, loose to medium dense, clayey SAND with scattered cobbles; some desiccation cracks.
							SCRIPPS FORMATION:
							Light reddish-brown, damp, dense to very dense, silty, fine to medium-grained SANDSTONE; moderately to well indurated.
5	▨	▨	6	8.8	112.4		Becomes micaceous.
							Gray mottling and iron-oxide staining, massive, bedding not distinct.
0		▨	10	8.7	111.0		
	▨						Boulder size rip-up clast, light gray, hard SILTSTONE.
15		▨	9	8.4	108.0		
							Yellow-brown and gray, damp, hard SILTSTONE; rip-up clast above contact.
20							

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BORING LOG

Eastgate Mall Site, North City Reclamation and Sludge Processing Facilities

PROJECT NO.	DATE	FIGURE

DATE DRILLED 2/1/91 BORING NO. B-9
GROUND ELEVATION 375'+/- MSL SHEET 2 OF 2
METHOD OF DRILLING 30" Bucket Auger
DRIVE WEIGHT 0'-25': 3,087 lbs. 25'-45': 1,999 lbs. DROP 12"
SAMPLED BY GJS LOGGED BY GJS/PSR/RI

SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DESCRIPTION
		8	18.8	108.5		SCRIPPS FORMATION (Continued): @ 21.0': A thick laminate, bedding attitude N65° W4° N.
						@ 22.6': An irregular 9-inch thick layer of orange-brown SAND. Black mineral staining and iron-oxide staining in SILTSTONE.
		9	19.3	107.5		A 3-inch thick lense, moist to wet, discontinuous, spalls easier.
		15/ 10"	18.5	105.1		
						Total Depth = 30.8' Downhole Logged to 28.0' No Caving No Ground Water Encountered Backfilled 2/1/91

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BORING LOG

Eastgate Mall Site, North City Reclamation and Sludge Processing Facilities

PROJECT NO. DATE FIGURE

DATE DRILLED 2/1/91 BORING NO. B-10
GROUND ELEVATION 354'+/- MSL SHEET 1 OF 3
METHOD OF DRILLING 30" Bucket Auger
DRIVE WEIGHT 0'-25': 3,087 lbs. 25'-45': 1,999 lbs. DROP 12"
SAMPLED BY GJS LOGGED BY GJS/PSR/RI

DEPTH (Feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DESCRIPTION
0						SM-ML	<u>TOPSOIL</u>: Medium brown, dry to damp, loose to medium dense, clayey, silty SAND and sandy SILT with scattered rootlets.
							<u>LINDAVISTA FORMATION</u>: Reddish-brown, damp, dense, silty, fine to medium, sandy GRAVEL with abundant cobbles.
5	■						
							<u>SCRIPPS FORMATION</u>: Orange-brown, damp, very stiff, sandy, SILTSTONE; moderately to well indurated. @ 8.3': An irregular, 10-inch thick layer of orange-brown, silty, fine to medium SAND; micaceous, moderately to well cemented.
.0		■	9	16.2	106.2		
							@ 11.3': An irregular, 4-inch thick layer of orange-brown SAND.
							Gray and brown, damp, hard, sandy SILTSTONE with traces of silty sandstone.
15		■	12	12.5	111.6		A pocket to 1-inch in diameter of orange-brown, friable SAND with red-brown to black staining.
							Gray and orange-brown, damp, dense, silty, fine to medium-grained SANDSTONE, with strings of gray siltstone.
20							

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BORING LOG

Eastgate Mall Site, North City Reclamation and Sludge Processing Facilities

PROJECT NO.	DATE	FIGURE
101948-01	3/91	B-10

DATE DRILLED 2/1/91 BORING NO. B-10
GROUND ELEVATION 354'+/- MSL SHEET 2 OF 3
METHOD OF DRILLING 30" Bucket Auger
DRIVE WEIGHT 0'-25': 3,087 lbs. 25'-45': 1,999 lbs. DROP 12"
SAMPLED BY GJS LOGGED BY GJS/PSR/RI

SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DESCRIPTION
		12				SCRIPPS FORMATION (Continued):
						Orange-brown and gray, damp, dense, silty, fine to medium-grained SANDSTONE with abundant subrounded gravel and cobbles.
						Orange-brown, damp, very dense to dense, silty, fine-grained SANDSTONE; moderately to well cemented. @ 37.3': A 2-inch thick, approximately horizontal bed of gray, sandy SILTSTONE.
						Orange-brown and gray, damp, very stiff to hard, sandy SILTSTONE; moderately to well indurated, with zones of silty SANDSTONE.

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BORING LOG

Eastgate Mall Site, North City Reclamation and Sludge Processing Facilities

PROJECT NO.	DATE	FIGURE

DATE DRILLED 2/1/91 BORING NO. B-10

GROUND ELEVATION 354'+/- MSL SHEET 3 OF 3

METHOD OF DRILLING 30" Bucket Auger

DRIVE WEIGHT 0'-25': 3,087 lbs. 25'-45': 1,999 lbs. DROP 12"

SAMPLED BY GJS LOGGED BY GJS/PSR/RI

DEPTH (Feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DESCRIPTION
0		■	15/ 8"	9.4			SCRIPPS FORMATION (Continued): Same as above.
45		■	15/ 9"	16.9	102.9		
							Total Depth = 45.8' Downhole Logged to 43.0' No Caving No Ground Water Encountered Backfilled 2/1/91
50							
55							
60							

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BORING LOG

Eastgate Mall Site, North City Reclamation and Sludge Processing Facilities

PROJECT NO.	DATE	FIGURE
101840-01	[illegible]	B-10

DATE DRILLED 2/4/91 BORING NO. B-11
GROUND ELEVATION 376'+/- MSL SHEET 1 OF 2
METHOD OF DRILLING 30" Bucket Auger
DRIVE WEIGHT 0'-25': 3,087 lbs. 25'-45': 1,999 lbs. DROP 12"
SAMPLED BY GJS LOGGED BY GJS/PSR

SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DESCRIPTION
					SC	TOPSOIL: Brown, damp, loose to medium dense, silty, clayey SAND.
						LINDAVISTA FORMATION: Orange-brown, damp, very dense, silty, clayey SAND with angular gravel.
	■	13	9.9			
						Yellow-brown, damp, very dense, silty, sandy GRAVEL, with abundant cobbles to 6 inches in diameter.
						(Hard Drilling)
■						Becomes less silty.
						Same as above.

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BORING LOG

Eastgate Mall Site, North City Reclamation and Sludge Processing Facilities

PROJECT NO.	DATE	FIGURE

DATE DRILLED 2/4/91 BORING NO. B-11
GROUND ELEVATION 376'+/- MSL SHEET 2 OF 2
METHOD OF DRILLING 30" Bucket Auger
DRIVE WEIGHT 0'-25': 3,087 lbs. 25'-45': 1,999 lbs. DROP 12"
SAMPLED BY GJS LOGGED BY GJS/PSR

	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DESCRIPTION
)							<u>LINDAVISTA FORMATION (Continued)</u>: Same as above.
25							Total Depth = 25.0' No Caving No Ground Water Encountered Backfilled 2/4/91
0							
5							
40							

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BORING LOG

Eastgate Mall Site, North City Reclamation and Sludge Processing Facilities

PROJECT NO.	DATE	FIGURE
101948-01	3/91	B-11

DATE DRILLED 2/4/91 BORING NO. B-12

GROUND ELEVATION 382'+/- MSL SHEET 1 OF 1

METHOD OF DRILLING 30" Bucket Auger

DRIVE WEIGHT 3,087 lbs. DROP 12"

SAMPLED BY GJS LOGGED BY GJS/PSR

SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DESCRIPTION
					SM	<u>TOPSOIL</u>: Brown, dry to damp, loose to medium dense, silty SAND with gravel.
						<u>LINDAVISTA FORMATION</u>: Red-brown, dry to damp, loose to medium dense, silty SAND with gravel.
						Yellow-brown to orange-brown, dry, very dense, silty, fine-grained SANDSTONE with abundant gravel and cobbles. (Refusal)
						Total Depth = 8.0' No Caving No Ground Water Encountered Backfilled 2/4/91

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BORING LOG

Eastgate Mall Site, North City Reclamation and Sludge Processing Facilities

PROJECT NO.	DATE	FIGURE

DATE DRILLED 2/4/91 BORING NO. B-13
GROUND ELEVATION 377'+/- MSL SHEET 1 OF 2
METHOD OF DRILLING 30" Bucket Auger
DRIVE WEIGHT 0'-25': 3,087 lbs. 25'-45': 1,999 lbs. DROP 12"
SAMPLED BY GJS LOGGED BY GJS/PSR

	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DESCRIPTION
0						SC	<u>TOPSOIL</u>: Medium brown, dry to damp, medium dense, clayey SAND with abundant roots and rootlets.
						SC	<u>LINDAVISTA FORMATION</u>: Medium brown, damp, dense, silty, clayey SAND with abundant gravel and cobbles.
5							
						GM	Yellow-brown, damp, very dense, slightly clayey, sandy GRAVEL, with cobbles to 8 inches in diameter. @ 9.5': Occasional clasts of claystone.
10	■						
						GL	Medium brown, damp, very dense, clayey, sandy GRAVEL, with abundant cobbles.
15							
							<u>SCRIPPS FORMATION</u>: Yellow-brown, damp, dense, fine, sandy SILTSTONE.
							Medium brown, damp, dense, clayey SILTSTONE; appears massive, no apparent bedding.
20							

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BORING LOG

Eastgate Mall Site, North City Reclamation and Sludge Processing Facilities

PROJECT NO.	DATE	FIGURE
101948-01	3/91	B-13

DATE DRILLED	2/4/91	BORING NO.	B-13
GROUND ELEVATION	377'+/- MSL	SHEET	2 OF 2
METHOD OF DRILLING	30" Bucket Auger		
DRIVE WEIGHT	0'-25': 3,087 lbs. 25'-45': 1,999 lbs.	DROP	12"
SAMPLED BY	GJS	LOGGED BY	GJS/PSR

SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DESCRIPTION
						SCRIPPS FORMATION (Continued): @ 20.3': Some iron-oxide staining.
■	■	11	15.0	109.9		Gray, damp, dense, sandy CLAYSTONE.
	■	15/ 9"	13.4	100.3		Yellow-brown and gray, damp, dense, fine, sandy SILTSTONE.

Total Depth = 29.5'
Downhole Logged to 26.0'
No Ground Water Encountered
Backfilled 2/4/91

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BORING LOG

Eastgate Mall Site, North City Reclamation and Sludge Processing Facilities

PROJECT NO.	DATE	FIGURE

TEST PIT LOG

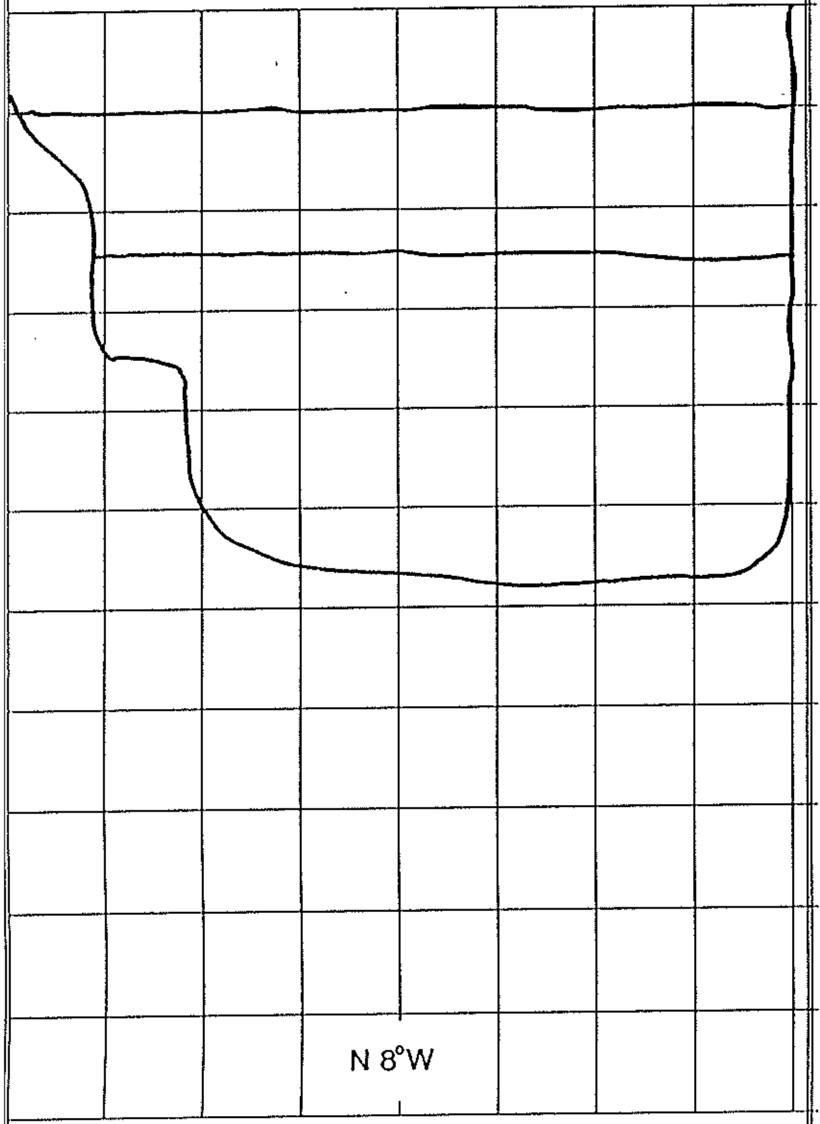
Eastgate Mall Site
North City Reclamation Plant and
Sludge Processing Facilities

PROJECT NO.	DATE
101948-01	3/91

GROUND ELEVATION 380'+/- MSL LOGGED BY GJS

METHOD OF EXCAVATION JD-510 Backhoe

LOCATION See Plate One



SCALE 1" = 4'

DEPTH (FEET)	SAMPl Bulk	SAMPl Driven	SAMPl Sand Cone	MOISTURE (%)	DRY DENSITY (PC	CLASSIFICATION U.S.(	DESCRIPTION
0						SM	TOPSOIL/COLLUVIUM: Dark brown, damp, medium dense, clayey, silty SAND.
2 4							LINDAVISTA FORMATION: Yellow-brown, damp, dense to very dense, silty SAND with abundant rounded gravel and cobbles to 10 inches in diameter.
6 8 10	▮						SCRIPPS FORMATION: Yellow-brown to light brown, damp, hard, SILTSTONE, with interbeds of gray, silty and yellow-brown, fine sand and light brown clay.
12 14 16 18 20 22							Total Depth 11.5' No Caving No Ground Water Encountered Backfilled 2/8/91

Ninyo & Moore

TEST PIT LOG

Eastgate Mall Site
North City Reclamation Plant and
Sludge Processing Facilities

PROJECT NO.	DATE
101948-01	3/91

DATE EXCAVATED 2/8/91 TEST PIT NO. TP-2

GROUND ELEVATION 380'+/- MSL LOGGED BY GJS

METHOD OF EXCAVATION JD-510 Backhoe

LOCATION See Plate One

SCALE 1" = 4'

DEPTH (FEET)	SAMPLES Bulk	SAMPLES Driven	SAMPLES Sand Cone	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DESCRIPTION
0–3						SM-CL	TOPSOIL/COLLUVIUM: Dark brown, damp, medium dense, clayey, silty SAND and firm, sandy CLAY with occasional rounded gravel.
3–11	■ (6–7)						SCRIPPS FORMATION: Yellow-brown to light brown, damp, stiff to hard, SILTSTONE with interbeds of yellow-brown, silty, fine sand and gray silt.
11							Total Depth 11.0' No Caving No Ground Water Encountered Backfilled 2/8/91

FIGURE B-15

TEST PIT LOG

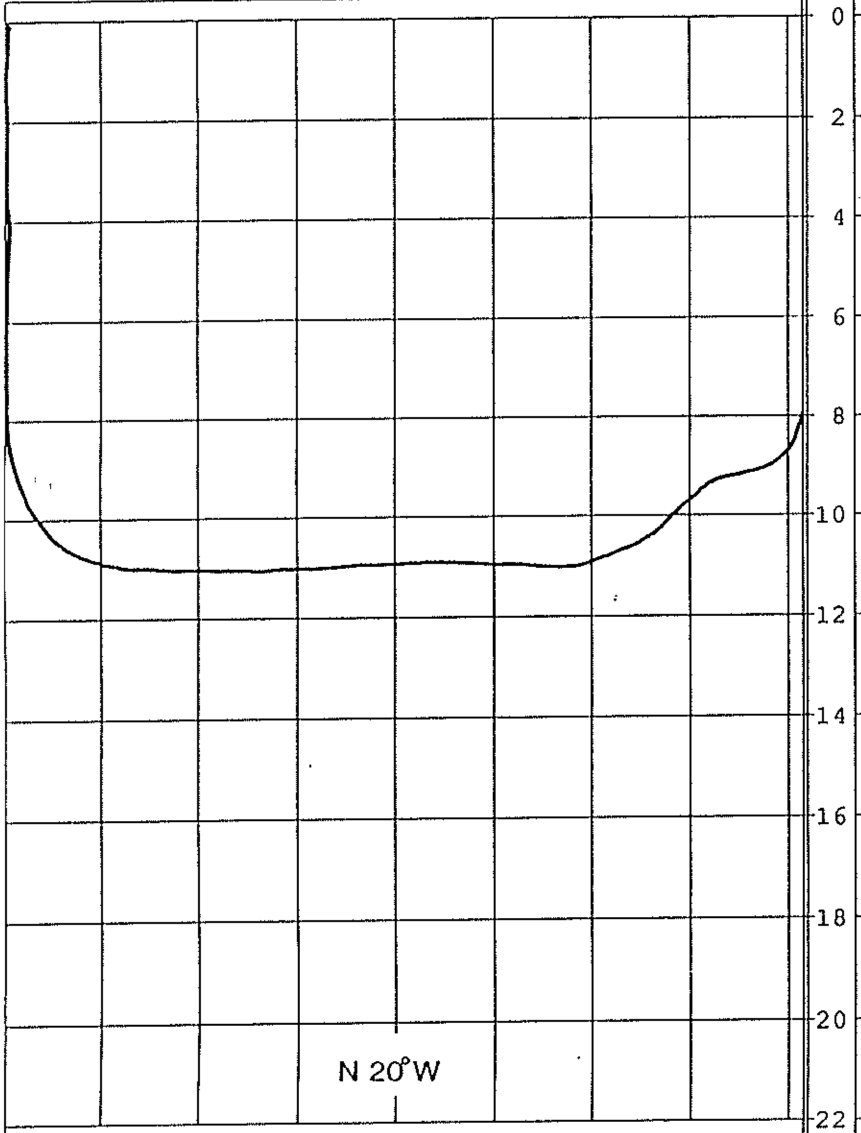
Eastgate Mall Site
North City Reclamation Plant and
Sludge Processing Facilities

PROJECT NO.	DATE
101948-01	3/91

GROUND ELEVATION 380'+/- MSL LOGGED BY GJS

METHOD OF EXCAVATION JD-510 Backhoe

LOCATION See Plate One



SCALE 1" = 4'

DEPTH (FEET)	SAMPL Bulk	SAMPL Driven	SAMPL Sand Cone	MOISTURE (%)	DRY DENSITY (PCI	CLASSIFICATION U.S.C	DESCRIPTION
						CL-SM	TOPSOIL/COLLUVIUM: Dark brown, damp, firm to stiff, sandy CLAY and clayey, silty SAND.
							LINDAVISTA FORMATION: Yellow-brown, damp, dense, silty, medium to fine SAND with rounded gravel and small cobbles. Not observed on south side of test pit.
							SCRIPPS FORMATION: Yellow-brown to light brown, damp, stiff to hard SILTSTONE with interbeds of gray siltstone and yellow-brown, silty, fine sand and brown clay.
							Total Depth 10.5' No Caving No Ground Water Encountered Backfilled 2/8/91

Ninyo & Moore

TEST PIT LOG

Eastgate Mall Site
North City Reclamation Plant and
Sludge Processing Facilities

PROJECT NO.	DATE
101948-01	3/91

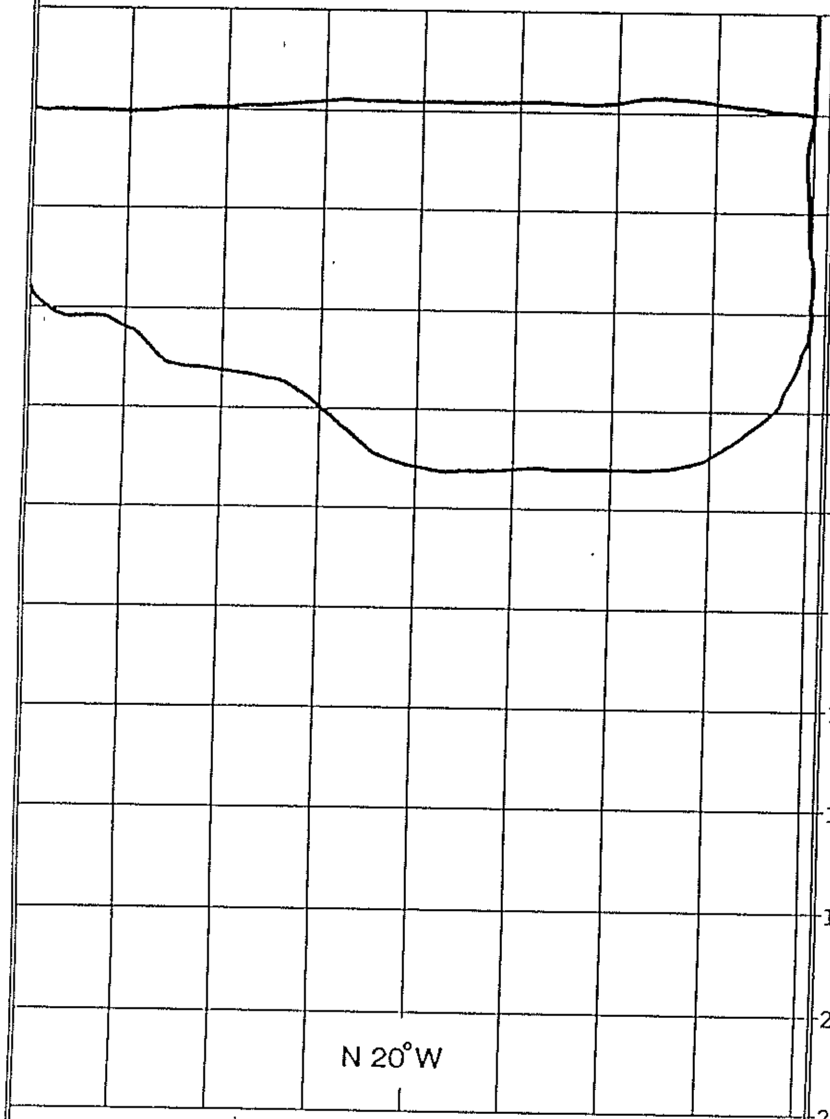
DATE EXCAVATED 2/8/91 TEST PIT NO. TP-4

GROUND ELEVATION 323'+/- MSL LOGGED BY GJS

METHOD OF EXCAVATION JD-510 Backhoe

LOCATION See Plate One

DEPTH (FEET)	SAMPLES: Bulk	SAMPLES: Driven	SAMPLES: Sand Cone	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DESCRIPTION
0							TOPSOIL/COLLUVIUM:
						SM-CL	Dark brown, damp, medium dense to dense, clayey, silty SAND and firm to stiff, sandy CLAY.
2							SCRIPPS FORMATION:
							Yellow-brown, damp, very stiff, fine, sandy SILTSTONE.
4							
6							Yellow-brown to light brown, damp, hard SILTSTONE with interbeds of gray silt and yellow-brown, silty, fine sand.
8							
10							Total Depth 9.0' No Caving No Ground Water Encountered Backfilled 2/8/91
12							
14							
16							
18							
20							
22							



SCALE 1" = 4'

TEST PIT LOG

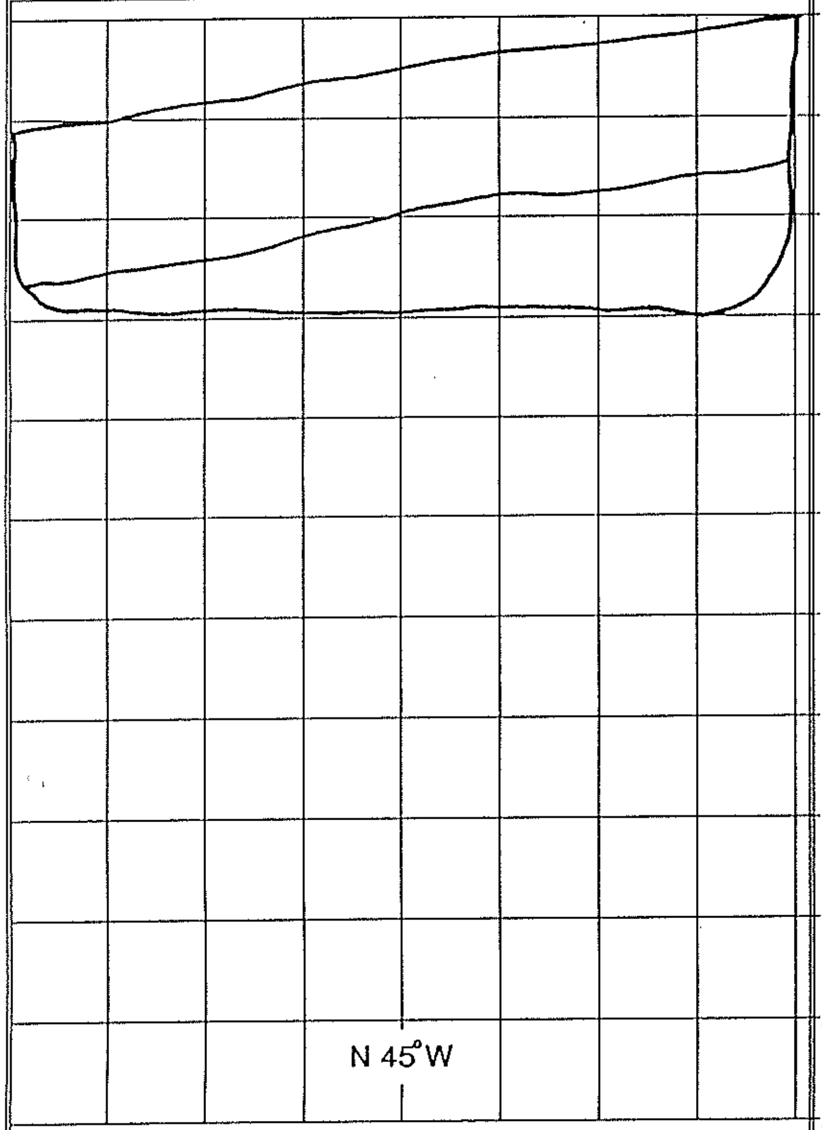
Eastgate Mall Site
North City Reclamation Plant and
Sludge Processing Facilities

PROJECT NO.	DATE
101948-01	3/91

GROUND ELEVATION 321'+/- MSL LOGGED BY GJS

METHOD OF EXCAVATION JD-510 Backhoe

LOCATION See Plate One



SCALE 1" = 4'

DEPTH (FEET)	SAMPL Bulk	SAMPL Driven	SAMPL Sand Cone	MOISTURE (%)	DRY DENSITY (PCF	CLASSIFICATION U.S.C	DESCRIPTION
0							COLLUVIUM:
						CL	Dark brown, dry to damp, stiff, silty, fine, sandy CLAY.
2							
							SCRIPPS FORMATION:
4							Yellow-brown and gray, damp, hard, fine, sandy SILTSTONE. (Refusal)
6							Total Depth 6.0' No Caving No Ground Water Encountered Backfilled 2/8/91
8							
10							
12							
14							
16							
18							
20							
22							

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TEST PIT LOG

Eastgate Mall Site
North City Reclamation Plant and
Sludge Processing Facilities

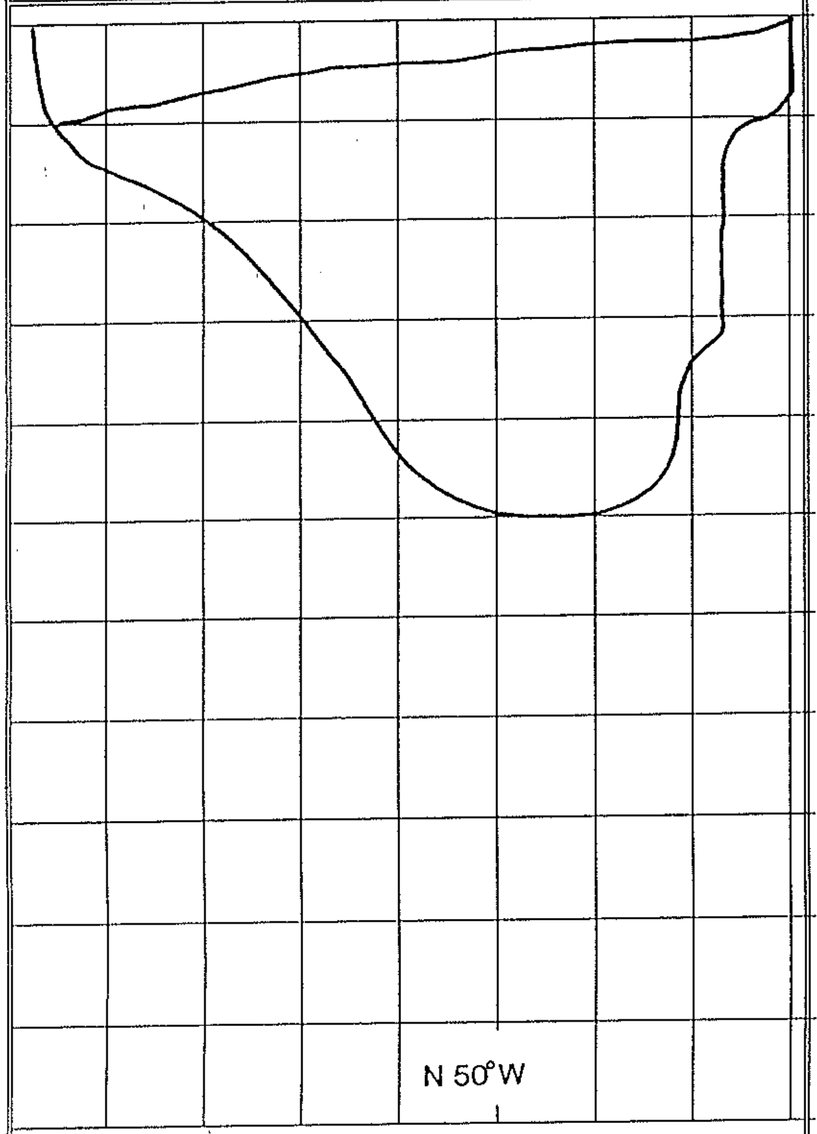
PROJECT NO.	DATE
101948-01	3/91

DATE EXCAVATED 2/8/91 TEST PIT NO. TP-6

GROUND ELEVATION 315'+/- MSL LOGGED BY GJS/PSR

METHOD OF EXCAVATION JD-510 Backhoe

LOCATION See Plate One



SCALE 1" = 4'

DEPTH (FEET)	SAMPLES Bulk	SAMPLES Driven	SAMPLES Sand Cone	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DESCRIPTION
0						ML	ALLUVIUM/COLLUVIUM: Brown, damp, firm, clayey, fine, sandy SILT.
2							
4							SCRIPPS FORMATION: Yellow-brown and gray, damp, hard SILTSTONE with yellow-brown, silty, fine SAND. Bedding Attitude: W 21° E 8° NW
6							
8							
10							Total Depth 10.0' No Caving No Ground Water Encountered Backfilled 2/8/91
12							
14							
16							
18							
20							
22							

FIGURE B-19

TEST PIT LOG

Eastgate Mall Site
North City Reclamation Plant and
Sludge Processing Facilities

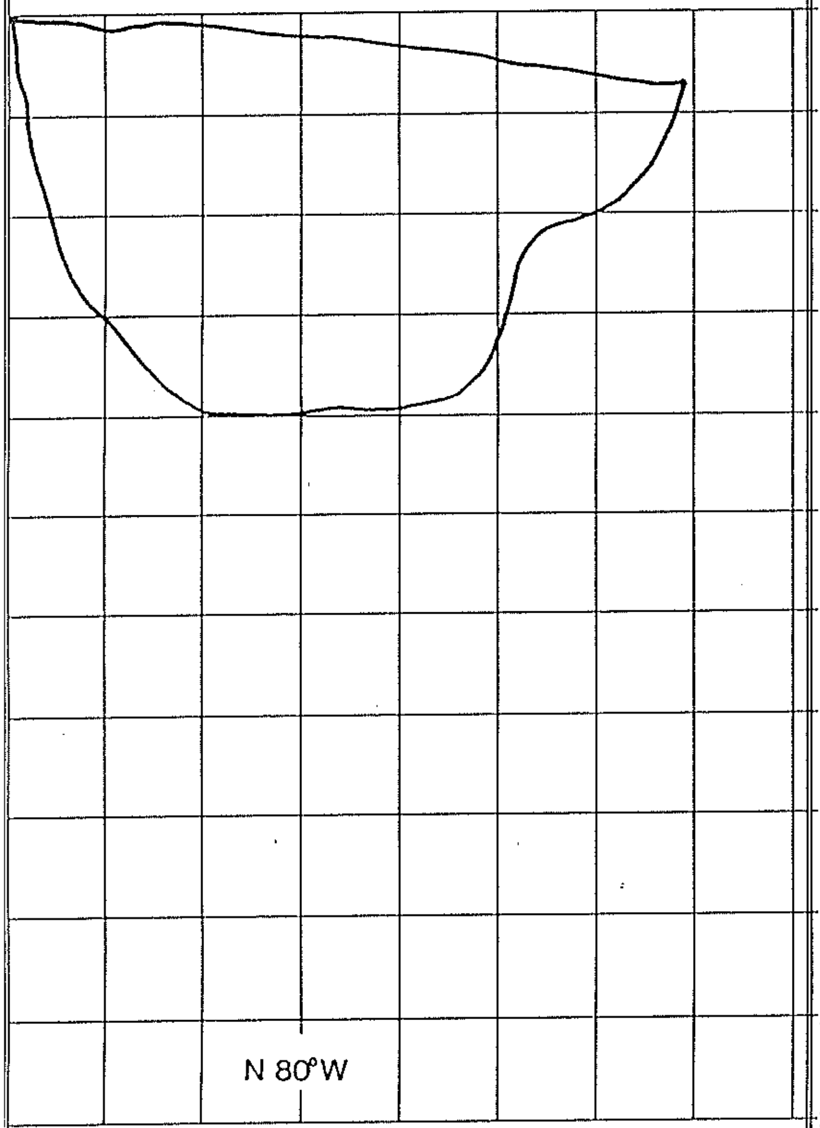
PROJECT NO.	DATE
101948-01	3/91

GROUND ELEVATION 328′+/- MSL LOGGED BY GJS/PSR

METHOD OF EXCAVATION JD-510 Backhoe

LOCATION See Plate One

DEPTH (FEET)	SAMPL Bulk	SAMPL Driven	SAMPL Sand Cone	MOISTURE (%)	DRY DENSITY (PCF	CLASSIFICATION U.S.C	DESCRIPTION
0						ML	ALLUVIUM/COLLUVIUM: Dark brown, damp, firm to stiff, fine, sandy, clayey SILT with scattered rounded gravel.
6							SCRIPPS FORMATION: Yellow-brown to light brown and gray, damp, hard SILTSTONE with yellow-brown, silty, fine sand interbedded.
8							Total Depth 8.0′ No Caving No Ground Water Encountered Backfilled 2/8/91
10							
12							
14							
16							
18							
20							
22							



SCALE 1″ = 4′

Ninyo & Moore

TEST PIT LOG

Eastgate Mall Site
North City Reclamation Plant and
Sludge Processing Facilities

PROJECT NO.	DATE
101948-01	3/91

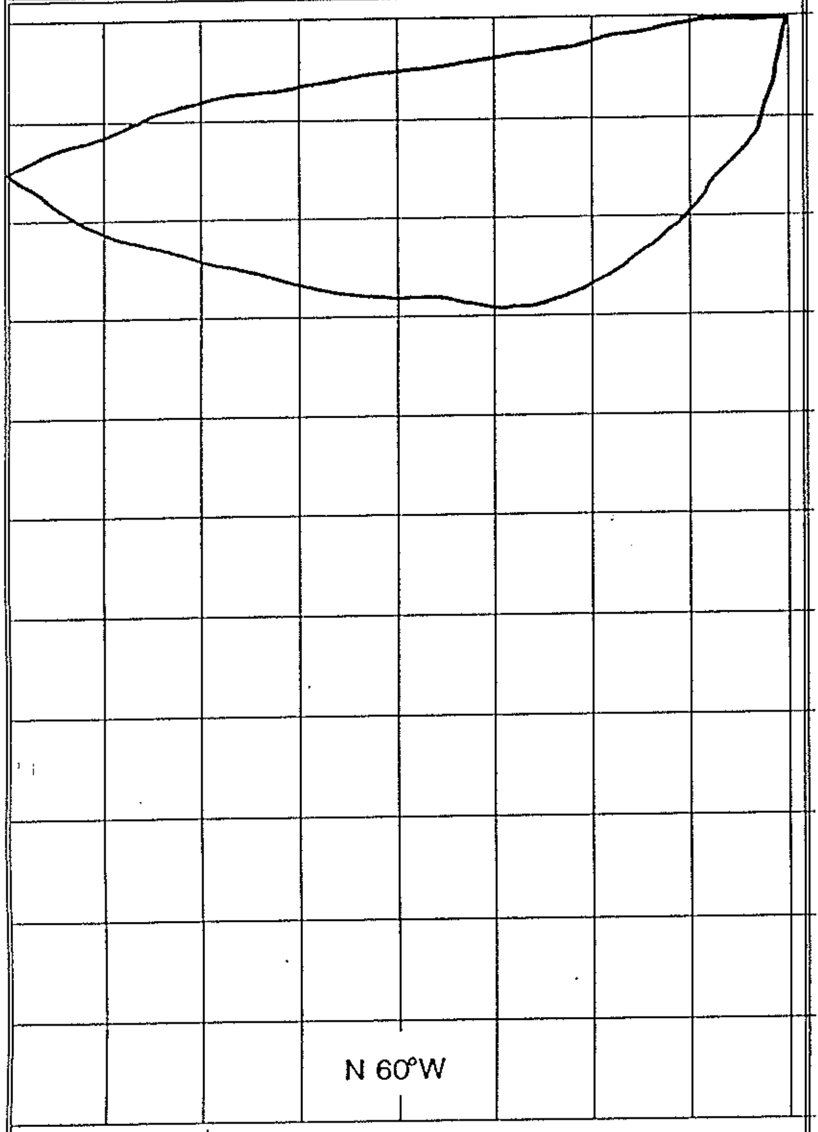
DATE EXCAVATED 2/8/91 TEST PIT NO. TP-8

GROUND ELEVATION 360'+/- MSL LOGGED BY GJS/PSR

METHOD OF EXCAVATION JD-510 Backhoe

LOCATION See Plate One

DEPTH (FEET)	SAMPLES Bulk	SAMPLES Driven	SAMPLES Sand Cone	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DESCRIPTION
0							LINDAVISTA FORMATION: Red-brown, dry to damp, dense to very dense, silty, medium to fine, sandy GRAVEL with abundant cobbles.
2							
4							@ 4.0': On east wall, red-brown, to yellow-brown, damp, dense to very dense, silty, medium to fine SANDSTONE. @ 5.0': On west wall, same as above.
6							Total Depth 5.5' No Caving No Ground Water Encountered Backfilled 2/8/91
8							
10							
12							
14							
16							
18							
20							
22							



SCALE 1" = 4'

FIGURE B-21

TEST PIT LOG

Eastgate Mall Site
North City Reclamation Plant and
Sludge Processing Facilities

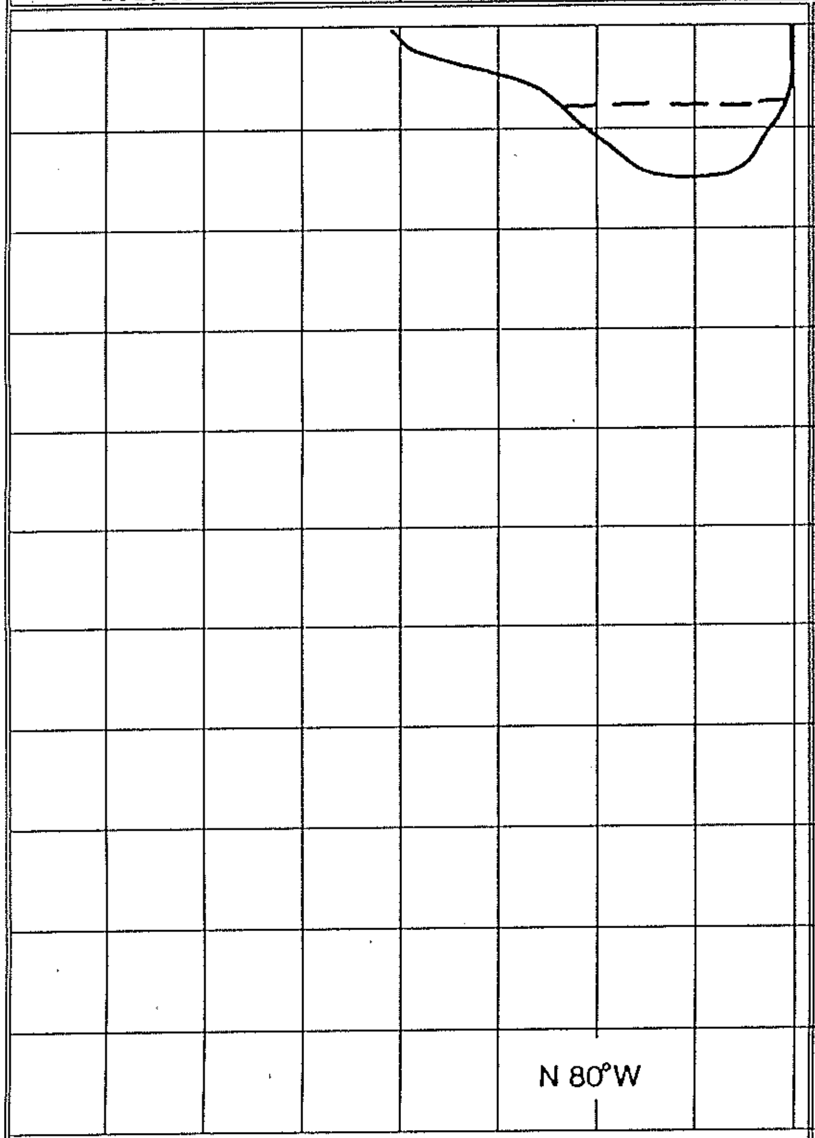
PROJECT NO. 101948-01

DATE 3/91

GROUND ELEVATION 377'+/- MSL LOGGED BY GJS

METHOD OF EXCAVATION JD-510 Backhoe

LOCATION See Plate One



SCALE 1" = 4'

DEPTH (FEET	SAMP Bulk	SAMP Driven	SAMP Sand Cone	MOISTURE (%)	DRY DENSITY (PC	CLASSIFICATION U.S.	DESCRIPTION
0							LINDAVISTA FORMATION: Red-brown, dry to damp, dense, silty SAND with rounded gravel.
2							Red-brown to yellow-brown, dry to damp, very dense, silty, medium to fine SAND (well-cemented). (Refusal)
4							Total Depth 2.5' No Caving No Ground Water Encountered Backfilled 2/8/91
6							
8							
10							
12							
14							
16							
18							
20							
22							

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TEST PIT LOG

Eastgate Mall Site
North City Reclamation Plant and
Sludge Processing Facilities

PROJECT NO.	DATE
101948-01	3/91

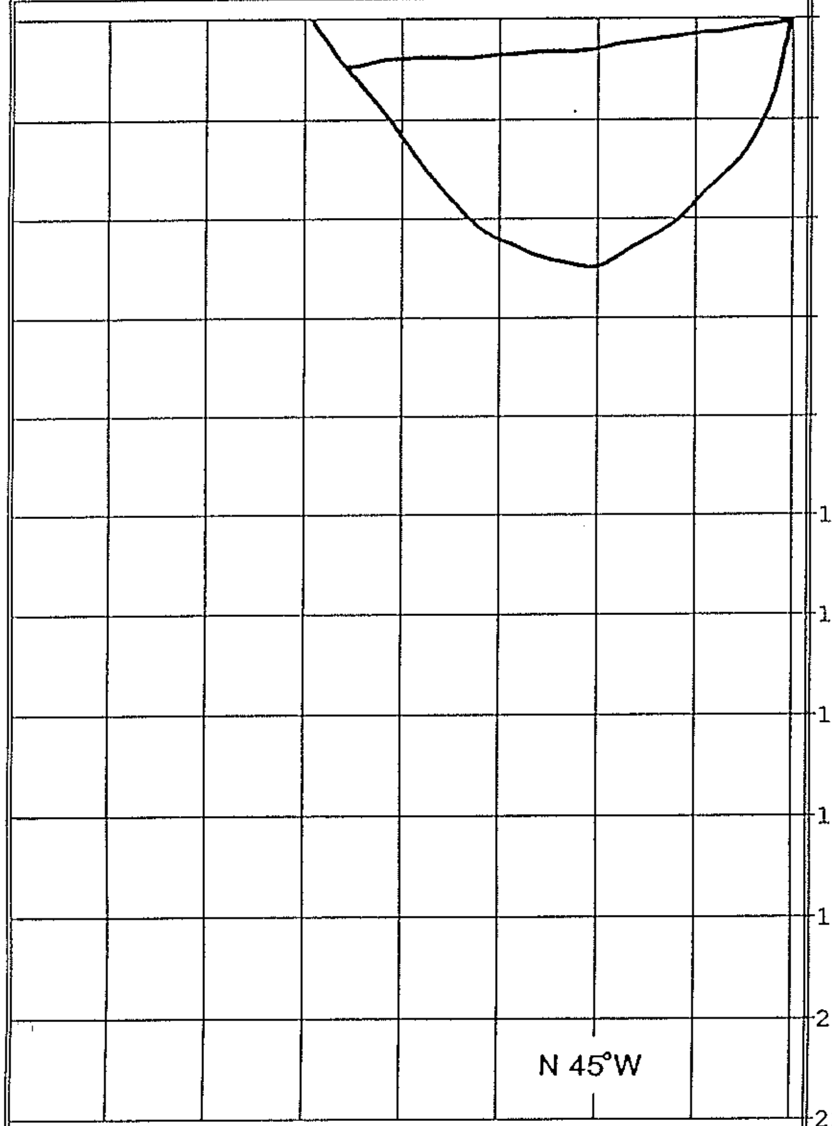
DATE EXCAVATED 2/8/91 TEST PIT NO. TP-10

GROUND ELEVATION 346' +/- MSL LOGGED BY GJS

METHOD OF EXCAVATION JD-510 Backhoe

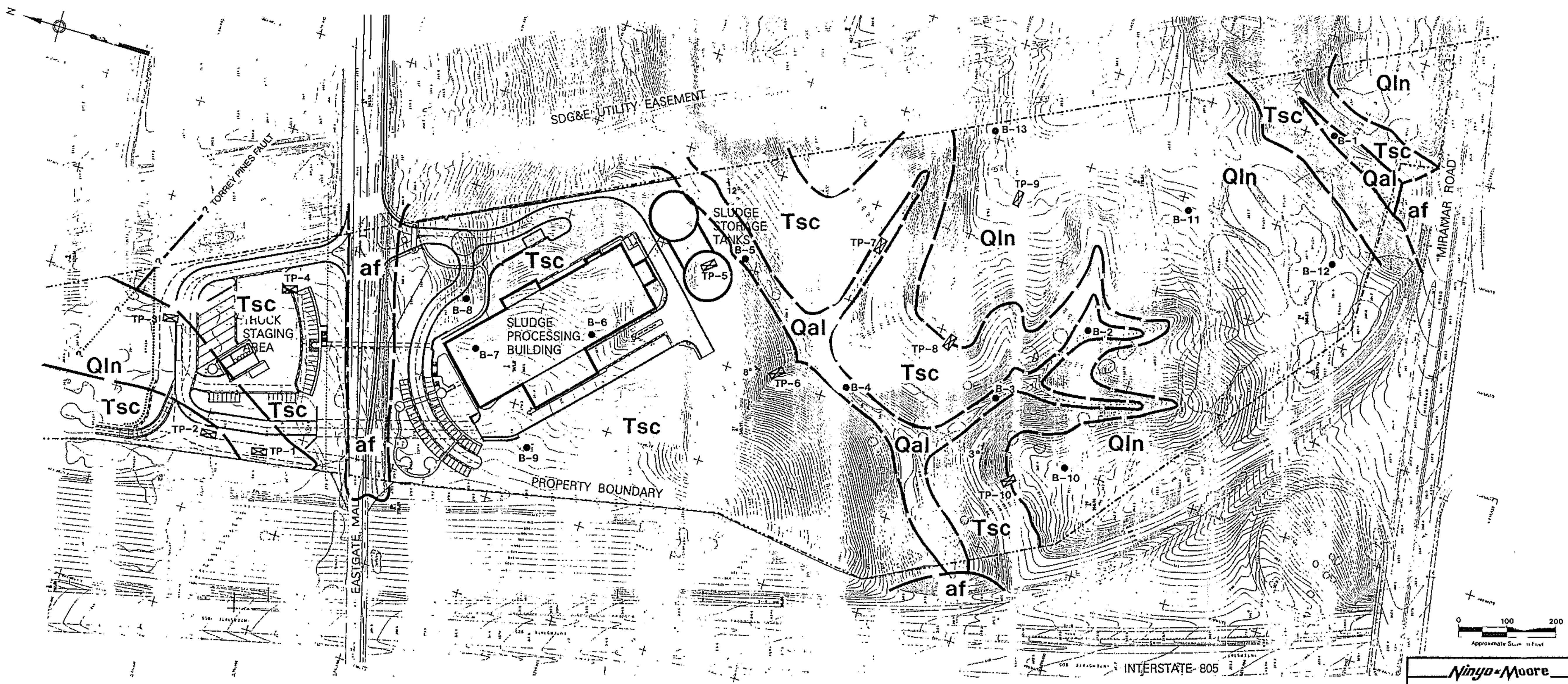
LOCATION See Plate One

DEPTH (FEET)	SAMPLES Bulk	SAMPLES Driven	SAMPLES Sand Cone	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DESCRIPTION
0						GM-SM	<u>TOPSOIL</u>: Brown, damp, dense, silty, sandy, GRAVEL and gravely, silty SAND.
2							<u>LINDAVISTA FORMATION</u>: Reddish-brown, damp, very dense, silty, sandy GRAVEL with clasts of gray siltstone.
4							Total Depth 4.5' No Caving No Ground Water Encountered Backfilled 2/8/91
6							
8							
10							
12							
14							
16							
18							
20							
22							



SCALE 1" = 4'

FIGURE B-23



LEGEND

GEOLOGIC UNITS	
af	Fill
Qal	Alluvium
Qln	Lindavista Formation
Tsc	Scripps Formation

SYMBOLS	
▬ ▬	Approximate location of geologic contact
12°	Bedding attitude, dip in degrees
TP-10 ☒	Approximate location of exploratory test pit
B-13 ●	Approximate location of exploratory boring
?……? ▬ ?	Approximate location of fault (inferred) dotted where buried, queried where uncertain as mapped by Kennedy, 1975

OVERALL SITE PLAN SCALE 1" = 100'

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GEOTECHNICAL MAP

EASTGATE MALL SITE
NORTH CITY RECLAMATION PLANT
AND SLUDGE PROCESSING FACILITIES
CITY OF SAN DIEGO, CALIFORNIA

PROJECT NO.	DATE	PLATE 1
101948-01	3/91	

FIESTA ISLAND REPLACEMENT PROJECT
SITE DEVELOPMENT
OVERALL SITE PLAN

METCALF & EDDY
In association with Nolte & Associates

CITY OF SAN DIEGO, CALIFORNIA
UTILITIES DEPARTMENT
SHEET OF SHEETS

REG. PROF. ENGR. DATE REG. PROF. ENGR. DATE
UTILITIES DIRECTOR DATE
ENGINEERING SUPERINTENDENT

	NO.	DATE	BY	DESCRIPTION	DESCRIPTION	BY	APPROVED	FILMED
PROJECT NUMBER								
FILE NO.								
CADD BY								
CHECK BY								
PROJECT CHECK								

CONSTRUCTION RECORD
CONTRACTOR DATE STARTED
INSPECTOR DATE COMPLETED
CORRECTIONS BY

DESIGN ENGINEER
CONTROL CERTIFICATION
LAMBERT COORDINATES

C-2-D

APPENDIX C

Ninyo & Moore

APPENDIX C

Laboratory Testing

Classification

Soils were visually and texturally classified in accordance with the Unified Soil Classification System. Soil classifications are indicated on the logs of the exploratory excavations in Appendix B.

In-Place Moisture and Density Tests

The moisture content and dry density of relatively undisturbed samples obtained from the exploratory excavations were evaluated in general accordance with ASTM D2216-80. The test results are presented in the logs of the exploratory excavations (Appendix B).

Particle-Size Analysis

An evaluation was performed on selected representative soil samples in general accordance with ASTM D422-63. Hydrometer analyses were performed on selected samples where appreciable quantities of fines were encountered. The grain-size distribution curves are shown on Figures C-1 and C-2. These test results were utilized in evaluating the soil classifications in accordance with the Unified Soil Classification System.

Atterberg Limits

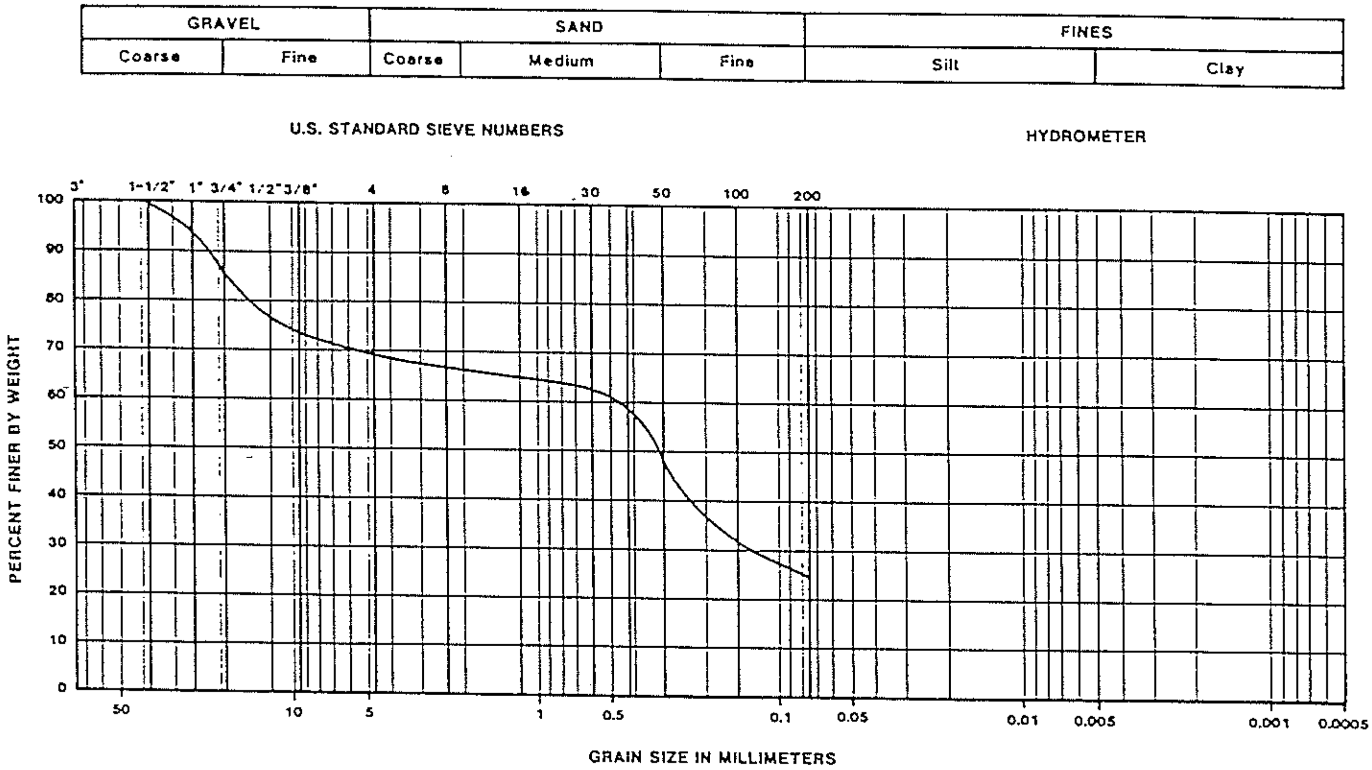
Tests were performed on selected representative fine grained soil samples to evaluate the liquid limit, plastic limit and plasticity index in general accordance with ASTM D4318-84. These test results were utilized to evaluate the soil classification in accordance with the Unified Soil Classification System. The test results and classification are shown on Figure C-3.

Direct Shear Tests

Direct shear tests were performed on both undisturbed and remolded samples in general accordance with ASTM D3080-72 to evaluate the shear strength characteristics of selected materials. The samples were inundated during shearing to represent adverse field conditions. Results are shown on Figures C-4 and C-5.

aximum Dry Density and Optimum Moisture Content Tests

e maximum dry density and optimum moisture content of selected representative soil samples were aluated in general accordance with ASTM D1557-78. The results of the tests are summarized on Figure 6.



Symbol	Hole Number	Depth (Feet)	Liquid Limit	Plastic Limit	Plasticity Index	Soil Type
	B-2	5.0-7.0	-	-	-	SM

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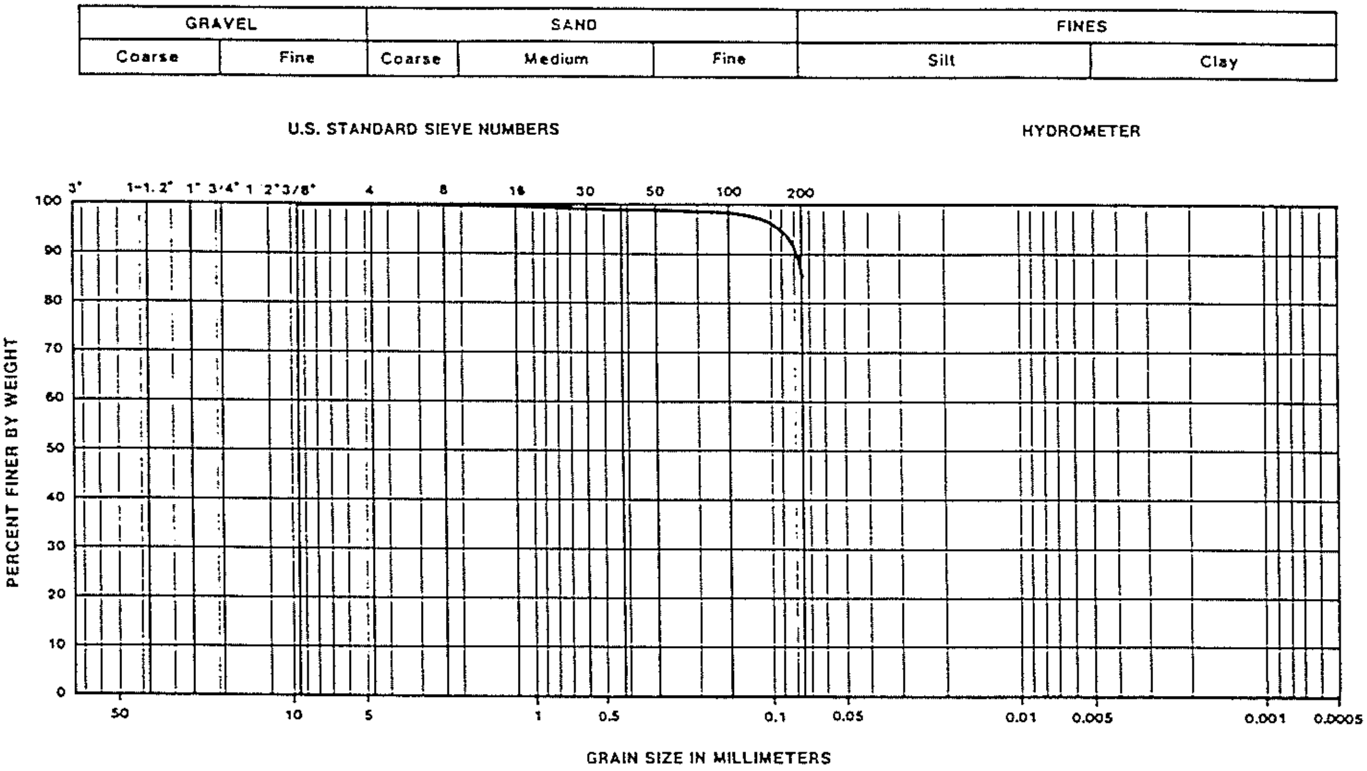
GRADATION TEST RESULTS

Eastgate Mall Site
North City Reclamation Plant and
Sludge Processing Facilities
City of San Diego, California

PROJECT NO.	DATE	FIGURE C-1
101948-01	3/91	



Symbol	Hole Number	Depth (Feet)	Liquid Limit	Plastic Limit	Plasticity Index	Soil Type
	B-7	15.0-15.5	-	-	-	ML

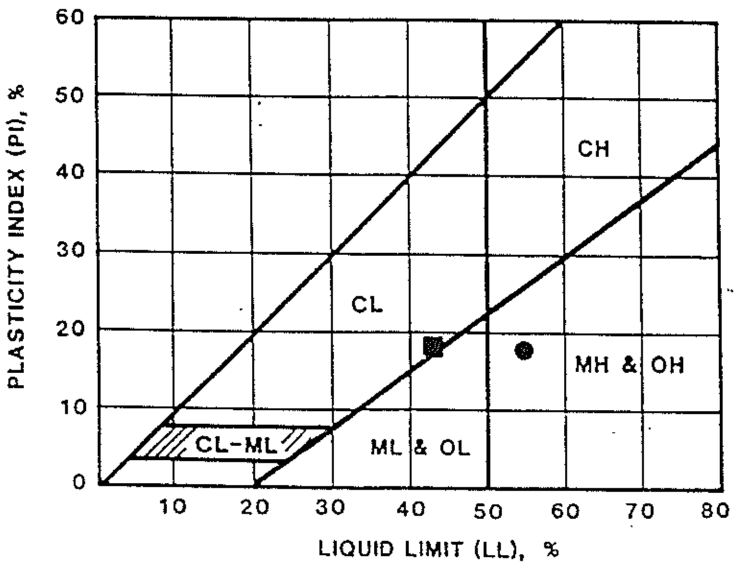
Ninyo & Moore

GRADATION TEST RESULTS

Eastgate Mall Site
North City Reclamation Plant and
Sludge Processing Facilities
City of San Diego, California

PROJECT NO.	DATE	FIGURE C-2
101948-01	3/91	

SYMBOL	LOCATION	DEPTH	LL (%)	PL (%)	PI (%)	U.S.C.S. (Entire Sample)
■	B-6	26.0'-28.0'	42	25	17	CL
●	B-9	14.0'-15.0'	55	37	18	MH



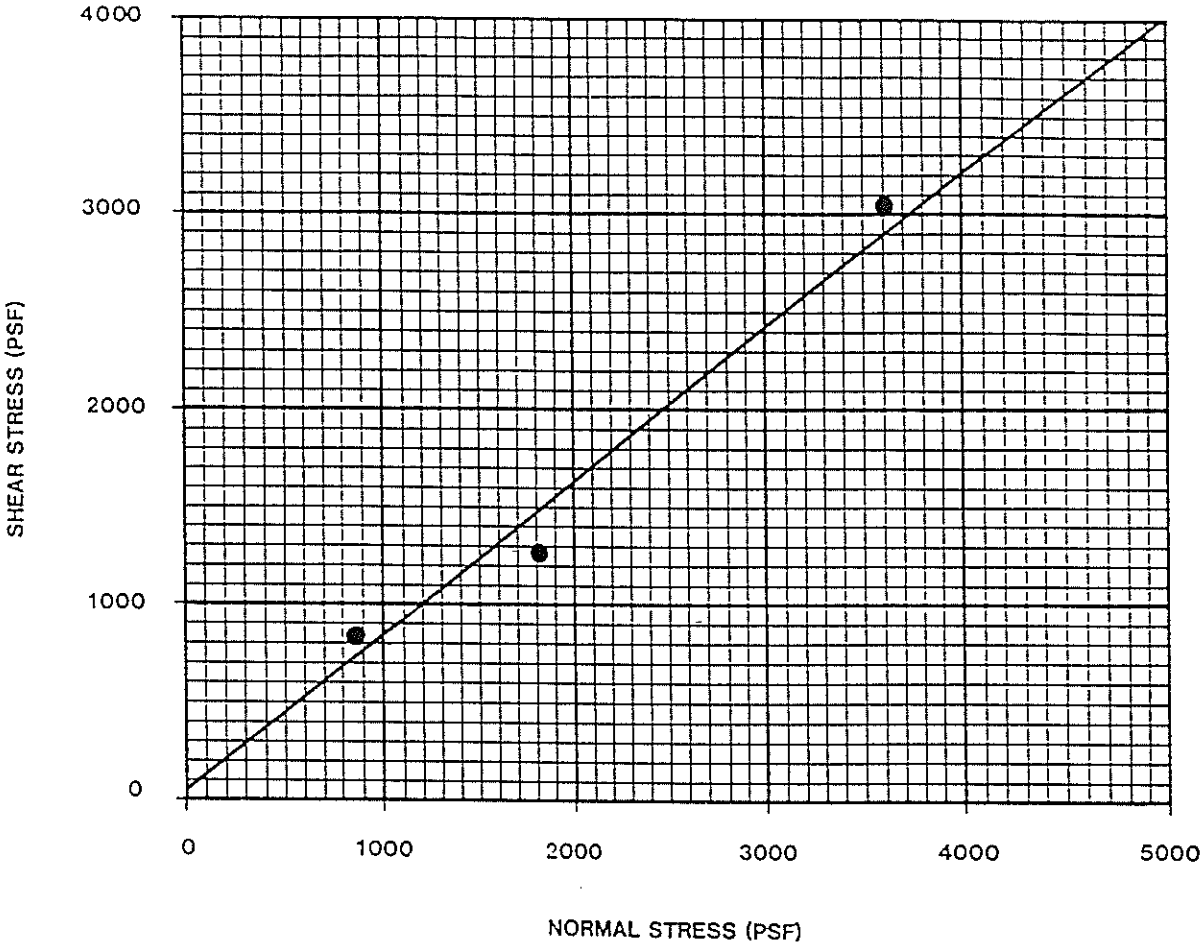
PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 4318-84

Ninyo & Moore

ATTERBERG LIMITS TEST RESULTS

Eastgate Mall Site
North City Reclamation Plant and
Sludge Processing Facilities
City of San Diego, California

PROJECT NO.	DATE	FIGURE C-3
101948-01	3/91	



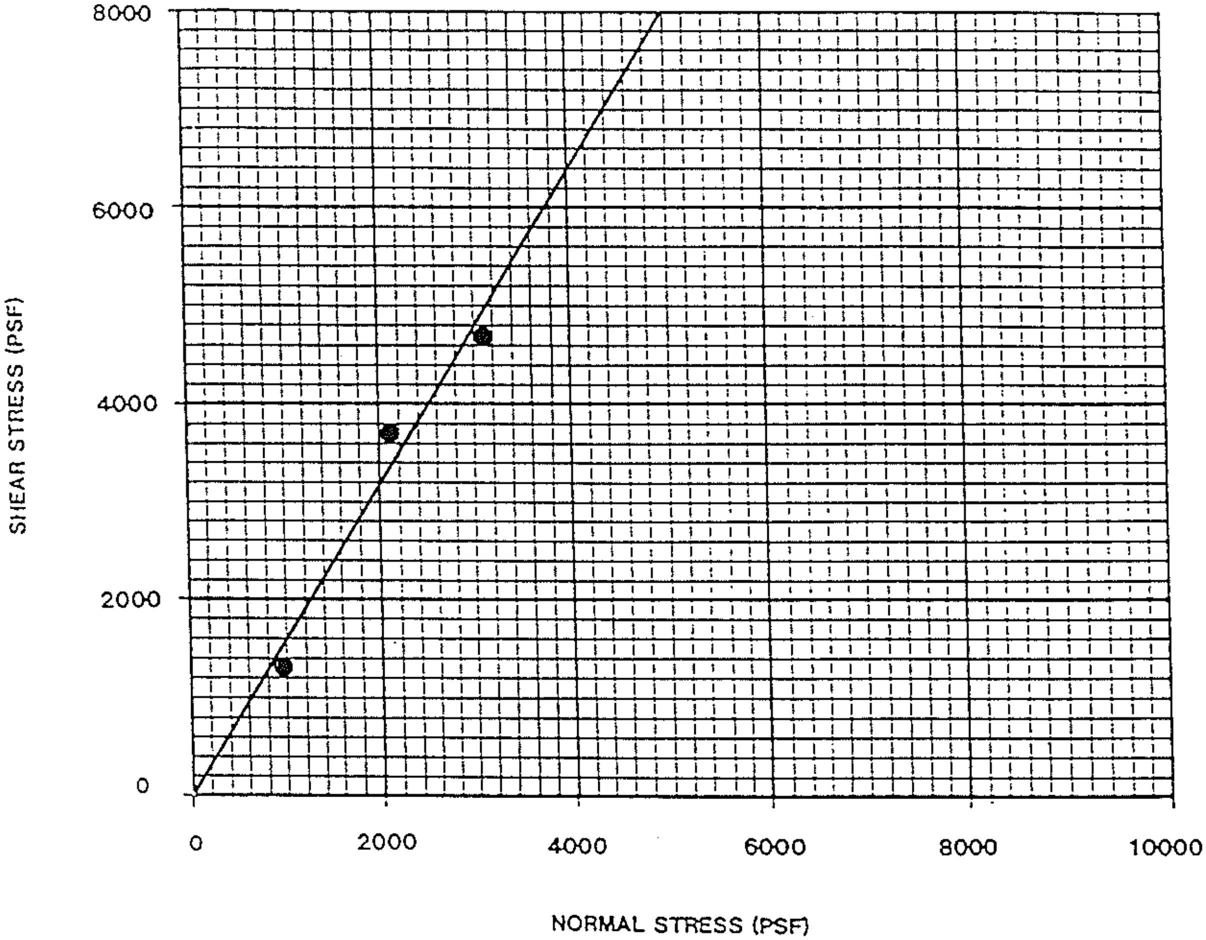
Description	Symbol	Boring Number	Sample Number	Depth (Feet)	Cohesion (PSF)	Friction Angle	Soil Type
Scripps Formation	●	B-8		15.0-15.5	40	38°	SM-ML

Ninyo & Moore

DIRECT SHEAR TEST RESULTS

Eastgate Mall Site
North City Reclamation Plant and
Sludge Processing Facilities
City of San Diego, California

PROJECT NO.	DATE	FIGURE C-4



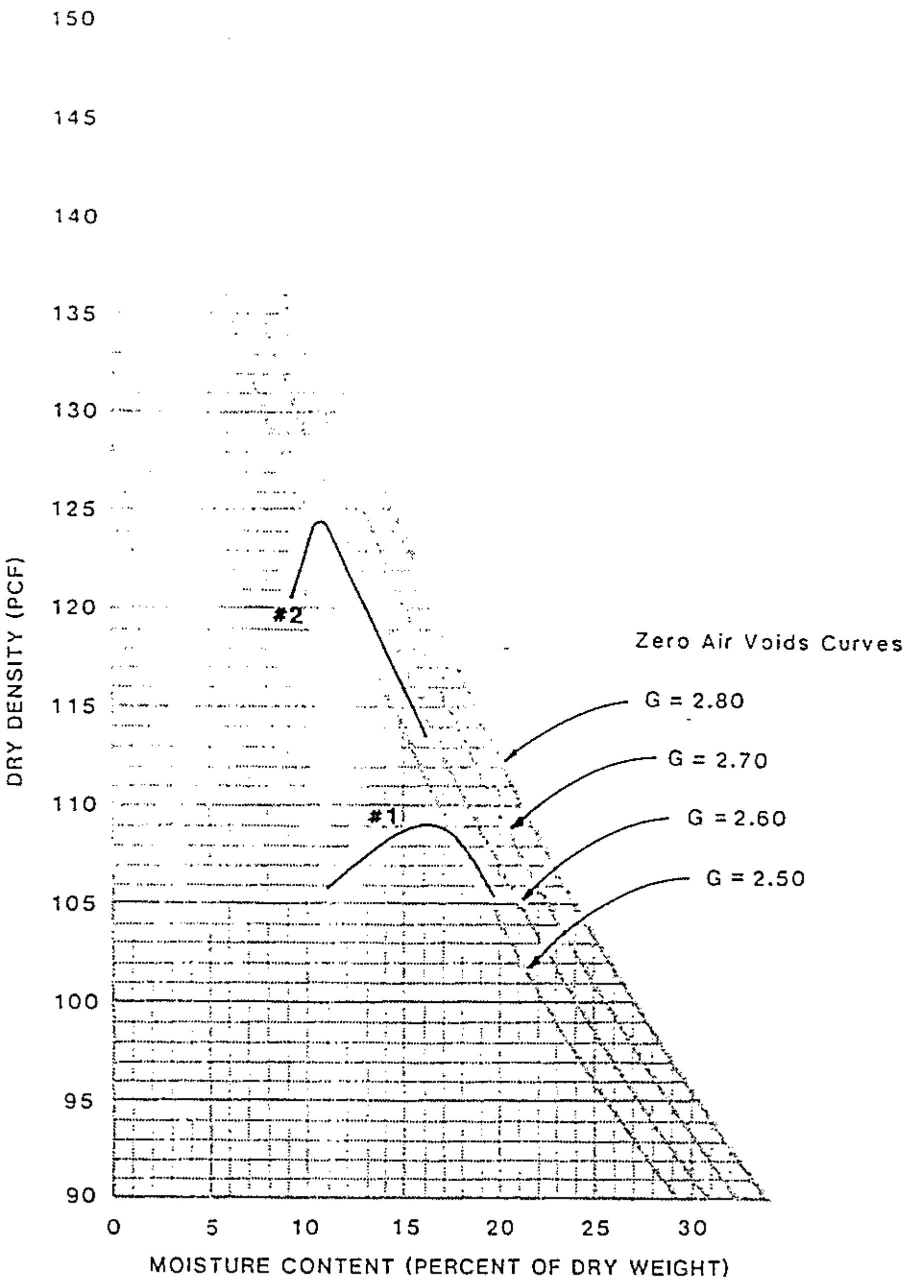
Description	Symbol	Boring Number	Sample Number	Depth (Feet)	Cohesion (PSF)	Friction Angle	Soil Type
Scripps Formation	●	B-13		25.0-26.0	10	58°	ML

Ninyo & Moore

DIRECT SHEAR TEST RESULTS

Eastgate Mall Site
North City Reclamation Plant and
Sludge Processing Facilities
City of San Diego, California

PROJECT NO.	DATE	FIGURE
101948-01	3/91	C-



CURVE NUMBER	SOIL TYPE NUMBER	SOIL DESCRIPTION	MAXIMUM DRY DENSITY (PCF)	OPTIMUM MOISTURE CONTENT (%)
#1	B-9 @ 20.0-22.0'	Olive-tan sandy SILT (ML)	109.1	16.1
#2	B-10 @ 5.0-7.0'	Red-brown silty GRAVEL with sand (GM)	124.5	10.5

THE AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) HAS EVALUATED THE PRECISION OF THE MAXIMUM DENSITY TEST METHOD (ASTM D1557-78), AND HAS INDICATED THAT VARIATIONS IN THE TEST RESULTS CAN OCCUR. ASTM DEFINES THE ACCEPTABLE RANGE OF TWO RESULTS IN TABLE 3 IN THE TEXT OF ASTM D1557-78. THE RANGE IS CONSIDERED ACCEPTABLE IF THE DIFFERENCE BETWEEN ANY TWO RESULTS EXPRESSED AS A PERCENTAGE OF THE AVERAGE VALUE OF THE TWO RESULTS DOES NOT EXCEED 4.0 PERCENT. AS YET, ASTM HAS NOT REPORTED PRECISION VALUES FOR FIELD DENSITY TEST METHODS, BUT WE EXPECT THAT VARIATIONS IN THE FIELD DENSITY TEST RESULTS COULD ALSO OCCUR. ACCORDINGLY, THE ACCURACY OF THE RELATIVE COMPACTION VALUES PRESENTED IN THIS REPORT IS DEPENDENT ON THE PRECISION OF THE ASTM TEST METHOD, AND THEREFORE, THE TEST RESULTS MAY BE SUBJECT TO VARIATION.

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D1557-78.

Ninyo & Moore

MAXIMUM DENSITY TEST RESULTS

Eastgate Mall Site
North City Reclamation Plant and
Sludge Processing Facilities
City of San Diego, California

PROJECT NO.	DATE	FIGURE C-6

Appendix E
Geologic Site Reconnaissance

Ninyo & Moore
Geotechnical and Environmental Sciences Consultants

GEOLOGIC SITE RECONNAISSANCE, PROPOSED NORTH CITY WATER RECLAMATION PLANT (NTP-1), CITY OF SAN DIEGO, CALIFORNIA

PREPARED FOR:

CH2M HILL
FIRST INTERSTATE BANK BUILDING
401 B STREET, SUITE 900
SAN DIEGO, CALIFORNIA 92101

DECEMBER 31, 1991
PROJECT NO. 102208-01

10225 Barnes Canyon Road · Suite A-112 · San Diego, California 92121 · Phone (619) 457-0400 · Fax (619) 558-1236

Ninyo & Moore
Geotechnical & Environmental Sciences Consultants

December 31, 1991
Project No. 102208-01

CH2M HILL
First Interstate Bank Building
401 B Street, Suite 900
San Diego, California 92101

Attention: Mr. Don Seward

Subject: Geologic Site Reconnaissance,
Proposed North City Water Reclamation Plant (NTP-1),
San Diego, California

In accordance with your request and written authorization dated October 29, 1991, we are providing this report of our geologic site reconnaissance for the North City Water Reclamation Plant (NTP-1), San Diego, California. The purpose of the study was to evaluate the existing geologic conditions and potential geologic hazards relative to the construction of the proposed water reclamation plant at the site. This study was performed in conjunction with a seismic study by Ninyo & Moore for the project which is provided under separate cover. Both studies are in support of additional geotechnical evaluations currently being performed by CH2M HILL for the project.

If you should have any questions regarding this report, please do not hesitate to contact our office. We sincerely appreciate this opportunity to be of service on this project.

Respectfully submitted,
NINYO & MOORE

Randy
Randy Irwin, CEG 1521
Senior Project Geologist

Clifford A. Craft
Clifford A. Craft, RCE 28832/GE 243
Chief Geotechnical Engineer

Gregory T. Farrand, CEG 1087
Principal Geologist

Clifford Alen Craft
No. 28832
Exp. 12-31-94
Civil

Gregory T. Farrand
6/30/92

RI/CAC/GTF/rlm

Distribution: (6) Addressee

10225 Barnes Canyon Road Suite A-112 San Diego, California 92121 Phone (619) 457-0400 • Fax (619) 558-1236
San Diego • Irvine

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Appendix

Appendix A - References

GEOLOGIC SITE RECONNAISSANCE,
PROPOSED NORTH CITY WATER RECLAMATIONPLANT (NTP-1)
CITY OF SAN DIEGO, CALIFORNIA

1.0 INTRODUCTION

This report presents the results of our geologic site reconnaissance of the subject property which is located immediately northeast of the intersection of Miramar Road and Interstate 805 in San Diego, California (Figure 1). The purpose of our geologic site reconnaissance was to evaluate the existing geologic conditions and potential geologic hazards relative to the proposed reclamation plant. This report is submitted pursuant to our subcontract services agreement dated October 29, 1991, and, as appropriate, was prepared in accordance with Part III of the City of San Diego Technical Guidelines for Geotechnical Reports, dated October 1988. This report is in support of additional geotechnical evaluation currently being performed for the project by CH2M HILL.

2.0 SCOPE OF SERVICES

Our scope of services has included background research and a geologic site reconnaissance. Specifically, we have performed the following tasks:

- Review of available maps, geologic literature, project documents and stereoscopic aerial photographs pertinent to the site (Appendix A).
- Geologic reconnaissance and mapping of the site.
- Analysis of data obtained.
- Preparation of this report presenting the findings and conclusions of our geologic site reconnaissance. Whereas, a subsurface evaluation is currently being conducted for the site by CH2M HILL, no subsurface investigation was performed specifically for the preparation of this report.

3.0 SITE DESCRIPTION

The subject site is an irregular parcel located immediately northeast of the intersection of Interstate 805 and Miramar Road. The site covers approximately 38 acres and is bounded on the north by Eastgate Mall Road, on the south by Miramar Road, on the east by an S.D.G.& E. easement, and on the west by the Interstate 805 right-of-way.

Topographically, the parcel is characterized by two gently sloping mesas separated by a central canyon. This canyon drains to the southwest and outlets into a storm drain which underlies Interstate 805. Several tributary canyons feed the main drainage course. Elevations at the site range from approximately 295 feet (MSL) at the downstream (west) end of the central canyon to approximately 385 feet (MSL) along the mesa tops. Existing westerly-descending cut slopes extending down to Interstate 805 are present adjacent to much of the westerly site boundary. These slopes range up to approximately 60 feet in height and are, in general, at an inclination of 2:1 (horizontal to vertical) or flatter. Vegetation at the site includes stands of native grasses, scattered scrub brush, and cacti.

The site is largely undeveloped. However, some improvements exist, including several overhead and underground utilities. A 36-inch diameter City of San Diego water main is located beneath Eastgate Mall Road. Underground telecommunication cables and electric lines are present along the west property boundary. A City of San Diego sewer main trends along the south side of the central canyon. An S.D.G.& E. easement with overhead lines and underground petroleum and natural gas pipelines parallel the east side of the site. A fill berm is present along the south side of Eastgate Mall Road.

4.0 PROJECT DESCRIPTION

The proposed North City Water Reclamation Plant is part of the Clean Water Program for Greater San Diego and will include various structural improvements including pump stations, clarifiers, aeration basins, administration facilities, and other components. Conventional cut and fill grading will be performed to construct level building pads for the proposed structures. It is our understanding that excavations of up to approximately 80 feet in depth may be required to facilitate some of the planned construction.

5.0 BACKGROUND INFORMATION

To assist our study, we have discussed the project with Mr. Jerry Tracy of CH2M HILL and reviewed documents listed in Appendix A. Previous studies performed at the site include a preliminary geotechnical reconnaissance for proposed sludge processing facilities (Geotechnical Consultants, Inc., 1990), a pre-design geotechnical investigation for sludge processing facilities (Woodward-Clyde, 1990), and a preliminary geotechnical investigation for a proposed water reclamation plant and sludge processing facilities (Ninyo & Moore, 1991). Draft logs of borings and trenches recently performed by CH2M HILL were also reviewed. In conjunction with the subject geologic site reconnaissance, Ninyo & Moore has recently conducted a seismic study for the site, the results of which have been provided under separate cover.

6.0 REGIONAL GEOLOGIC SETTING

The site is located in the Peninsular Range Province, a geomorphic province with a long and active history in southern California. The Peninsular Range Province is characterized by northwest-trending mountain ranges separated by subparallel fault zones. The mountain ranges are underlain by basement rocks consisting of Jurassic age metasedimentary rocks and metavolcanic rocks, and Cretaceous age igneous rocks of the southern California batholith. Late Cretaceous, Tertiary, and Quaternary age sediments flank the mountain ranges to the northeast and southwest (Norris and Webb, 1990).

Intrusion of the basement rocks occurred during the Cretaceous Period. The batholithic rocks intruded pre-existing metasedimentary and Jurassic age metavolcanic rocks. Uplift and erosion since the Cretaceous Period have resulted in discontinuous removal of large volumes of the metasedimentary, metavolcanic, and sedimentary rocks. In western San Diego County an area known as the San Diego Embayment has undergone several episodes of marine inundation and subsequent marine regression, during the last 54 million years. This has resulted in a thick sequence of marine and nonmarine sediment deposited on the basement rocks with relatively minor tectonism uplifting the area.

The upper Cretaceous, Tertiary, and Quaternary age rocks flanking the southwestern margin of the mountains are generally comprised of detrital marine, lagoonal, and nonmarine sediments consisting of claystones, siltstones, sandstones, and conglomerates. These sedimentary formations are generally flat-lying or gently dipping, except for locally deformed areas such as Mount Soledad in La Jolla.

7.0 SITE GEOLOGIC UNITS

The subject property is underlain by sedimentary rocks comprised of the Eocene age Scripps Formation and the Pleistocene age Lindavista Formation and by surficial deposits of fill soils, topsoil/colluvium, and alluvium. The approximate distribution of these geologic units is shown on the Geologic Map (Plate 1). The following provides a description of these units:

7.1 Fill (Map Symbol-af)

Fill soils were mapped along the northern property boundary in the form of a low berm parallelling Eastgate Mall Road. Minor fills were also observed on-site along the southern property boundary adjacent to Miramar Road. The fill soils appear to be generally less than 5 feet in depth and should be further evaluated where grading or structures are planned. Two fill areas occur immediately off-site in the canyon near Miramar Road and Interstate 805.

7.2 Topsoil/Colluvium (Not a Mapped Unit)

Topsoil and colluvium mantle the formational materials over much of the site. These soils consist of dark brown and reddish brown, clayey and silty sand with scattered to numerous cobbles. Based on previous geotechnical studies, this material is generally less than 5 feet in depth, potentially compressible, and not suitable for support of additional fill soils or structures in its present state.

7.3 Alluvium (Map Symbol-Qal)

Stream deposited alluvium occupies the central northeast-southwest trending canyon and associated tributary canyons. Based on previous geotechnical studies, the alluvium consists of porous, thinly to thickly layered and interlayered sand, silt and clay, with scattered to numerous gravels. This material is generally less than 10 feet in depth. The alluvial soils are potentially compressible and not suitable for support of additional fill soils or structures in their present state.

7.4 Lindavista Formation (Map Symbol-Qln)

The Pleistocene age Lindavista Formation is present as a relatively resistant formational cap overlying southern portions of the site. This unit is comprised of moderate to well-cemented reddish brown, interbedded sandstone and gravel to cobble conglomerate. Bedding in the Lindavista Formation is horizontal to gently dipping. This unit unconformably overlies the Scripps Formation.

7.5 Scripps Formation (Map Symbol-Tsc)

The Eocene age Scripps Formation represents the principal geologic unit underlying the site and consists of pale yellowish brown, thinly to thickly interbedded siltstone and sandstone with local cobble-conglomerate beds. In the cut slope along the western property boundary where the Scripps Formation is well exposed, bedding was observed having inclinations ranging from nearly horizontal up to approximately 12 degrees. Direction of inclination was observed to be variable, but primarily to the southeast and southwest. In addition, widely spaced joints and fractures, as well as cemented layers and concretions, were exposed in the cut slope.

8.0 LANDSLIDES AND SLOPE STABILITY

Our review of geologic literature (Appendix A) and our geologic site reconnaissance did not reveal any evidence of deep-seated or surficial landslides on or adjacent to the subject property. Evidence of deep-seated slope instability or obvious geologic planes of weakness were not observed in the existing cut slopes along the westerly site boundary nor reported in previous reports.

Specific information has not been provided regarding the heights and inclinations of future cut and fill slopes at the project site. We anticipate that in formational materials, cut slopes constructed at inclinations of 2:1 (horizontal to vertical) or flatter should be stable. Steeper inclinations for cut slopes, such as 1.5:1 (horizontal to vertical) may be practical depending on height and location and provided that no adverse geologic conditions are encountered.

When preliminary grading plans are produced, further studies should be performed by the geotechnical consultant to evaluate the surficial and deep-seated stability of proposed cut and fill slopes. Such studies would include a static and pseudo-static slope stability analysis utilizing pertinent data derived from subsurface geotechnical exploration.

9.0 GROUND WATER

A static, near-surface ground water table is not anticipated to be encountered during site development. No seeps or springs were observed during our geologic site reconnaissance nor were any reported in previous investigations. Localized seasonal fluctuations in surface water and ground water conditions may occur, particularly in drainage courses. Fluctuations in the ground water level may also occur due to variations in the ground surface topography, subsurface geologic conditions (i.e., perched ground water conditions), rainfall, irrigation, and other factors not evident at the time of our reconnaissance.

10.0 FAULTING AND SEISMICITY

Seismic considerations for structures in southern California are mainly surface fault rupture and damage caused by ground shaking or seismically induced ground settlement. No active or potentially active faults are known to directly underlie the site. An inferred extension of the Torrey Pines fault has been mapped approximately 300 feet northeast of the northeast corner of the site (Kennedy, 1975). The Torrey Pines fault has not been mapped offsetting the Pleistocene age Lindavista Formation in the subject area and is therefore not considered to be potentially active.

The seismic hazard most likely affecting the site is ground shaking due to large earthquakes on major active regional faults. The Coronado Bank fault, Elsinore fault, San Jacinto fault and Rose Canyon fault are considered major active faults in the region and are the most likely to affect the site with ground shaking, should an earthquake occur on one of these faults. The Rose Canyon fault, located approximately 3.5 miles west of the site, had generally been considered a "potentially active" fault by the California Division of Mines and Geology (CDMG) since there is evidence of offset of Pleistocene geologic materials (i.e., materials older than 11,000 years but younger than 2 million years). Recent geologic research by others indicates that a strand (Mount Soledad strand) of the Rose Canyon fault zone offsets Holocene materials (i.e., materials 11,000 years in age or younger) suggesting that this strand of the Rose Canyon fault zone is "active" as defined by the CDMG. In addition, the California Division of Mines and Geology has recently designated an Alquist-Priolo Special Studies Zone for the Mount Soledad strand of the Rose Canyon fault zone.

Based on published maximum credible earthquake magnitudes for major regional active faults (Appendix A), as well as the distance of the site from these faults, it is our opinion that the most significant seismic event affecting proposed development would be an earthquake of magnitude (M) 7.0 on the Rose Canyon fault, which is located approximately 3.5 miles west of the site. The estimated peak horizontal bedrock acceleration produced at the site by such an event would be 0.55g (Seed and Idriss 1982). Based on Ploessel and Slosson (1974), a repeatable high ground acceleration of 0.36g is calculated for the maximum credible earthquake. A more detailed discussion of seismic conditions at the site is presented in our seismic study for the project which has been provided under separate cover.

11.0 LIQUEFACTION AND SEISMICALLY INDUCED SETTLEMENT

Liquefaction of cohesionless soils can be caused by strong vibratory motion due to earthquakes. Research and historical data indicate that loose granular soils with a silt and clay content less than 20 percent, and saturated by a relatively shallow ground water table are most susceptible to liquefaction. Due to the dense nature of the underlying bedrock and expected absence of a static near-surface ground water table, the potential for liquefaction or seismically induced settlement of formational materials at the subject property is considered low.

12.0 RIPPABILITY

The site is primarily underlain by Tertiary and Pleistocene age sedimentary rocks and by surficial soils. Based on the observations during our field reconnaissance and our experience with these materials in the subject area, it is anticipated that the on-site earth materials should generally be rippable utilizing conventional heavy-duty grading equipment in good working order. Oversize materials consisting of cemented concretions and cemented cobble conglomerates may be encountered which may require special processing or disposal methods, or export from the site.

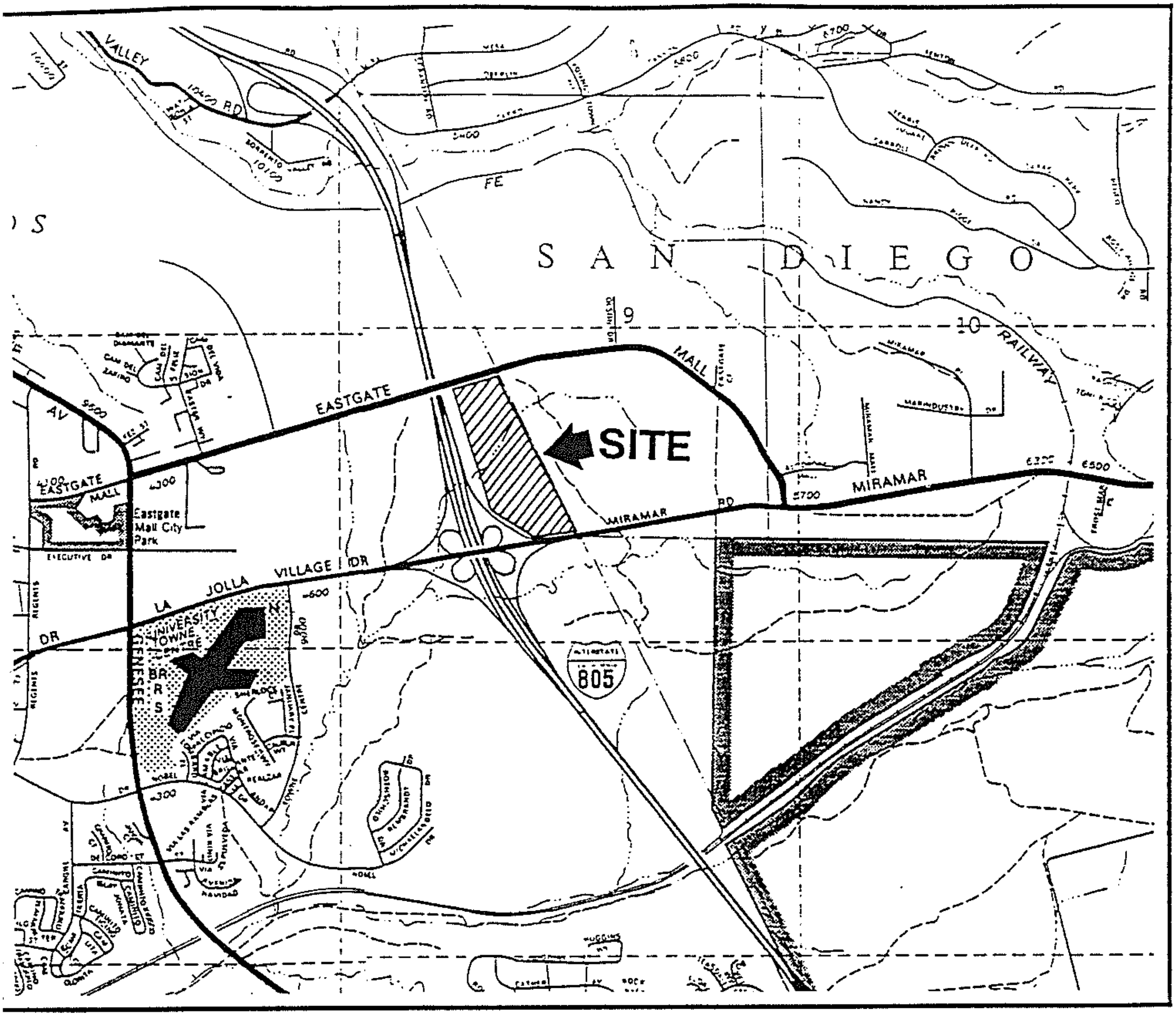
13.0 CONCLUSIONS

Our background review of data pertinent to the site and our geologic site reconnaissance did not reveal the presence of geologic hazards that will adversely impact the proposed construction or require special design and mitigative measures. Our conclusions, based on our limited geotechnical site reconnaissance are as follows:

- It is anticipated that rippability of the on-site earth materials can generally be achieved utilizing conventional heavy-duty grading equipment in good working order.
- Active faults or landslides are not known to directly underlie the subject property.
- Seeps, springs, or other indications of a shallow ground water table were not observed during our site reconnaissance.
- Portions of the subject property are underlain by potentially compressible topsoil, colluvium, and alluvium and by relatively minor amounts of undocumented fill soils.
- We understand that final design geotechnical recommendations will be provided by CH2M HILL incorporating the results of the subject geologic reconnaissance.

14.0 LIMITATIONS

The geotechnical analyses presented in this report for the North City Water Reclamation Plant were performed in accordance with current practice and standard of care exercised by reputable geotechnical consultants performing similar tasks in this area. No other warranty, expressed or implied, is made regarding findings, conclusions or professional opinions expressed in this report. Variations in actual site conditions from those conditions observed, evaluated and described in this report may be encountered during site grading.



REFERENCE: 1986 Aerial Foto-Map Book

Ninyo & Moore

SITE LOCATION MAP

NORTH CITY
WATER RECLAMATION PLANT (NTP-1)
SAN DIEGO, CALIFORNIA

PROJECT NO.	DATE	FIGURE 1

APPENDIX A

References

1. *CH2M HILL, 1991, Geotechnical Investigation of the North City Water Reclamation Plant (NTP-1) Site (in progress).*
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12. *Ploessel, M. R., and Slosson, J.E., 1974, Repeatable High Ground Accelerations from Earthquakes, California Geology, September.*
13. *Seed, H.B., and Idriss, I.M., 1982, Ground Motions and Soil Liquefaction During Earthquakes, Earthquake Engineering Research Institute, Monograph Series.*
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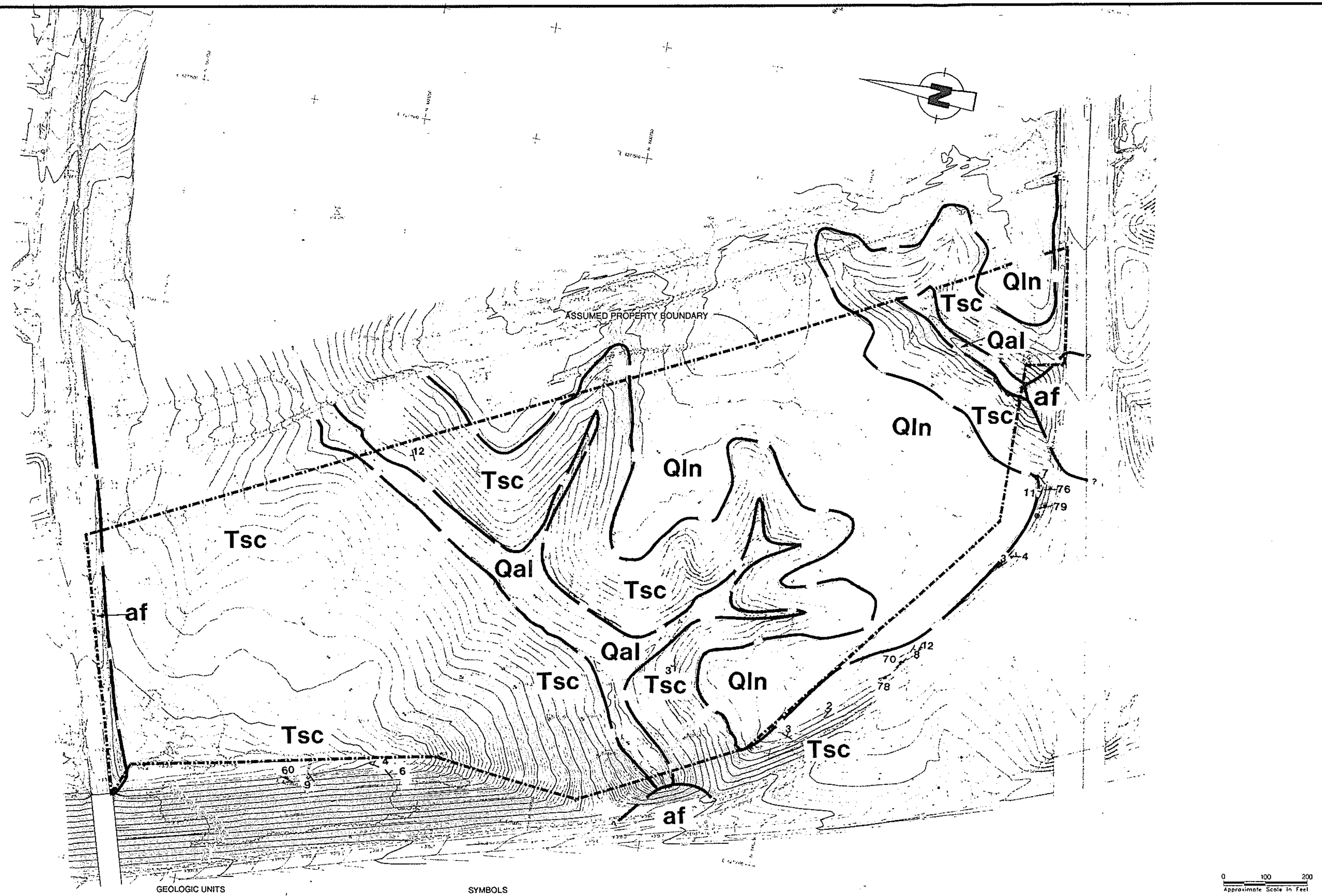
APPENDIX A

(continued)

Aerial Photographs

Source	*Date*	*Scale*	*Flight*	*Numbers*
USDA	*3-31-53*	*1:20,000*	*AXN-4M*	*7 and 8*
San Diego County	*1928*	*1:12,000*	*52E*	*6, 7, and 8*



GEOLOGIC UNITS

af	Fill
Qal	Alluvium
Qln	Lindavista Formation
Tsc	Scripps Formation

SYMBOLS

— —	Approximate location of geologic contact, queried where uncertain
12	Bedding attitude, dip shown in degrees. (⊕ horizontal)
79	Fracture or joint attitude, dip shown in degrees

SOURCE: BASE MAP PROVIDED BY CH2M HILL, NO DATE.

Ninyo & Moore

GEOLOGIC MAP

NORTH CITY
WATER RECLAMATION
PLANT (NTP-1)
SAN DIEGO, CALIFORNIA

PROJECT NO.	DATE	PLATE 1
102208-01	12/91	

Appendix F
Seismic Study

Ninyo & Moore
Geotechnical and Environmental Sciences Consultants

SEISMIC STUDY FOR THE, PROPOSED NORTH CITY WATER RECLAMATION PLANT (NTP-1), CITY OF SAN DIEGO, CALIFORNIA

PREPARED FOR:

CH2M HILL
FIRST INTERSTATE BANK BUILDING
401 B STREET, SUITE 900
SAN DIEGO, CALIFORNIA 92101

DECEMBER 30, 1991
PROJECT NO. 102208-01

10225 Barnes Canyon Road • Suite A-112 • San Diego, California 92121 • Phone (619) 457-0400 • Fax (619) 558-1236
• San Diego • Irvine

Ninyo & Moore
Geotechnical and Environmental Sciences Consultants

December 30, 1991
Project No. 102208-01

CH2M HILL
First Interstate Bank Building
401 B Street, Suite 900
San Diego, California 92101

Attention: Mr. Don Seward

Subject: Seismic Study for the Proposed North City Water Reclamation Plant (NTP-1), City of San Diego, California

Dear Mr. Seward:

In accordance with your request and written authorization dated October 29, 1991, we are providing this report of our seismic study for the proposed North City Water Reclamation Plant (NTP-1), San Diego, California. The purposes of the study were to evaluate seismic conditions for the site and to provide seismic data to assist in the design of the proposed water reclamation plant. This report presents the results of our field observations, background review, and analysis of seismic conditions relative to the site. This study was performed in conjunction with a geologic reconnaissance study by Ninyo and Moore for the project which is provided under separate cover. Both studies are in support of additional geotechnical evaluations currently being performed by CH2M HILL for the project.

10225 Barnes Canyon Road • Suite A-112 • San Diego, California 92121 • Phone (619) 457-0400 • Fax (619) 558-1236
• San Diego • Irvine

If you should have any questions regarding this report, please do not hesitate to contact our office. We sincerely appreciate this opportunity to be of service on this project.

Respectfully submitted,
NINYO & MOORE

Randy Irwin
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Distribution: (6) Addressee

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Appendix A - References

SEISMIC STUDY FOR THE PROPOSED,
NORTH CITY WATER RECLAMATION PLANT (NTP-1),
CITY OF SAN DIEGO, CALIFORNIA

1.0 INTRODUCTION

This report presents the results of our seismic study for the proposed North City Water Reclamation Plant, NTP-1. The proposed water reclamation plant will be located on a currently undeveloped site located north of Miramar Road and east of Interstate 805 in San Diego, California (see Figure 1). It is our understanding that some grading of the site, including excavations of up to approximately 80 feet, will be required to facilitate construction of the plant. The purposes of this study were to evaluate seismic conditions relative to the site and to provide seismic data to assist in the design of proposed improvements. This report is submitted pursuant to our Subcontract Services Agreement dated October 29, 1991, and was prepared, as appropriate, in accordance with Part V of the City of San Diego Technical Guidelines for Geotechnical Reports, dated October 1988. This report is in support of additional geotechnical evaluation currently being performed for the project by CH2M HILL.

2.0 SCOPE OF SERVICES

The scope of our geotechnical services performed during this evaluation included the following:

- Background review of previous geotechnical evaluations performed for the site (see Section 5.0 Background Information).
- Review of the referenced geologic and geotechnical literature, geologic/fault maps, and seismic data including recorded earthquake magnitudes and epicenter locations within an approximately 100 kilometer (63 mile) radius of the site (Appendix A).
- Review of stereoscopic aerial photographs (Appendix A).
- Geologic reconnaissance of the site. This work was performed in conjunction with a geologic reconnaissance study by Ninyo & Moore for the project which is provided under separate cover.
- Analysis of the data obtained, including a probabilistic evaluation of seismic ground accelerations at the site, and seismic response spectra.
- Preparation of this report presenting the results of our seismic study.

3.0 SITE DESCRIPTION

The subject site is an irregular parcel located immediately northeast of the intersection of Interstate 805 and Miramar Road. The site covers approximately 38 acres and is bounded on the north by Eastgate Mall Road, on the south by Miramar Road, on the east by an S.D.G & E. easement, and on the west by the Interstate 805 right-of-way.

Topographically, the parcel is characterized by two gently sloping mesas separated by a central canyon. This canyon drains to the southwest, and outlets into a storm drain which underlies Interstate 805. Several tributary canyons feed the main drainage course. Elevations at the site range from approximately 295 feet (MSL) at the downstream (west) end of the central canyon to approximately 385 feet (MSL) along the mesa tops. Existing westerly-descending cut slopes extending down to the Interstate 805 right-of-way are present adjacent to much of the westerly site boundary. These slopes range up to approximately 60 feet in height and are, in general, at an inclination of 2:1 (horizontal to vertical) or flatter. Vegetation at the site includes stands of native grasses, scattered scrub brush, and cacti.

The site is presently undeveloped. However, some improvements exist, including several overhead and underground utilities. A 36-inch diameter City of San Diego water main is located beneath Eastgate Mall Road. Underground telecommunication cables and electric lines are present along the west property boundary. A City of San Diego sewer main runs along the south side of the central canyon. An S.D.G.& E. easement with overhead lines and underground petroleum and natural gas pipelines bounds the east side of the site. A fill berm is present along the south side of Eastgate Mall Road.

4.0 PROJECT DESCRIPTION

The proposed North City Water Reclamation Plant is part of the Clean Water Program for Greater San Diego and will include various structural improvements including pump stations, clarifiers, aeration basins, administration facilities, and other components. Conventional cut and fill grading will be performed to construct level building pads for the proposed structures. It is our understanding that excavations of up to approximately 80 feet in depth may be required to facilitate some of the planned construction.

5.0 BACKGROUND INFORMATION

To assist our study, we have discussed the project with Mr. Jerry Tracy of CH2M HILL and reviewed available documents listed in Appendix A. Previous studies performed at the site include a preliminary geotechnical reconnaissance for proposed sludge processing facilities (Geotechnical Consultants, Inc., 1990), a pre-design geotechnical investigation for sludge processing facilities (Woodward-Clyde, 1990), and a preliminary geotechnical investigation for a proposed water reclamation plant and sludge processing facilities (Ninyo & Moore, 1991). Draft logs of borings and trenches recently performed by CH2M HILL were also reviewed. In conjunction with the subject seismic study, Ninyo & Moore is also currently conducting a geologic reconnaissance study of the site relative to proposed construction, the results of which will be provided under separate cover.

6.0 REGIONAL GEOLOGIC SETTING

The site is located in the Peninsular Range Province, a geomorphic province with a long and active history in southern California. The Peninsula Range Province is characterized by northwest-trending mountain ranges separated by subparallel fault zones. The mountain ranges are underlain by basement rocks consisting of metasedimentary rocks, Jurassic age metavolcanic rocks, and Cretaceous age igneous rocks of the southern California batholith. Late Cretaceous, Tertiary, and Quaternary age sediments flank the mountain ranges to the northeast and southwest (Norris and Webb, 1990).

Intrusion of the basement rocks occurred during the Cretaceous period. The batholithic rocks intruded pre-existing metasedimentary and Jurassic age metavolcanic rocks. Uplift and erosion since the Cretaceous period have resulted in discontinuous removal of large volumes of the metasedimentary, metavolcanic, and sedimentary rocks. In western San Diego County, through the last 54 million years, the area known as the San Diego

Embayment has undergone several episodes of marine inundation and subsequent marine regression resulting in a thick sequence of marine and nonmarine sediment deposited on the basement with relatively minor tectonism uplifting the area.

The upper Cretaceous, Tertiary, and Quaternary age rocks flanking the southwestern margin of the mountains are generally comprised of detrital marine, lagoonal, and nonmarine sediments consisting of claystones, siltstones, sandstones, and conglomerates. These sedimentary formations are generally flat-lying or gently dipping except for locally deformed areas such as Mount Soledad in La Jolla.

7.0 SITE GEOLOGY

Based on our literature review and our observations of subsurface conditions, the entire site is underlain at depth by weakly to moderately indurated detrital sedimentary rocks of the Eocene age Scripps Formation. The Scripps Formation is unconformably overlain in areas by moderately to well cemented sandstones and conglomerates of the Pleistocene age Lindavista Formation. The Scripps Formation and the Lindavista Formation typically consist of relatively competent materials. Surficial deposits of topsoil and colluvium mantle the formational materials on much of the site and alluvial deposits are present within the canyon crossing the site and tributary drainages.

Based on the City of San Diego Seismic Safety Study (1983), for seismic considerations the Lindavista Formation can be expected to have shear wave velocities ranging from 500 feet/second to 1500 feet/second. The Scripps Formation can be expected to have shear wave velocities ranging from 1500 feet/second to 2500 feet/second.

The City of San Diego Seismic Safety Study has assigned Hazard Category Numbers for the site of 51 and 52 which correspond to generally stable terrain with assigned Risk Zone Ratings of A (nominal) and B (low). There are no known deep-seated landslides on the site and there are no known active or potentially active faults crossing the site. The closest mapped fault is an inferred extension of the Torrey Pines fault, indicated to cross within approximately 300 feet northeast of the northeast corner of the site. The Torrey Pines fault is not considered active or potentially active. The closest known active fault is the Rose Canyon fault, located approximately 5.6 km (3.5 mi) west of the site. These and other faults are discussed further in subsequent sections of this report.

Based on our field observations and our literature review, including the cited previous geotechnical studies, a near-surface static ground water table is not present at the site. Further discussion of the site-specific geology is included in our geologic reconnaissance study which is provided under separate cover.

8.0 REGIONAL SEISMOTECTONIC SETTING

The tectonic setting of the San Diego area is influenced by plate boundary interaction between the Pacific and North American lithospheric plates. This crustal interaction occurs along a broad zone of northwest-trending predominantly strike slip-right lateral faults that span the width of the Peninsular Range Province and extend offshore into the California Continental Borderland Province.

Geologic, geodetic and seismic data indicate that the faults along the eastern margin of the plate boundary, including the San Andreas, San Jacinto and Imperial faults along with their associated branches, are currently the most active and appear to be dominant in accommodating the motion between the two adjacent plates. A smaller portion of the relative plate motion is being accommodated by northwest-trending faults to the west including the Elsinore fault, Newport-Inglewood fault zone, Rose Canyon fault zone, and offshore faults including the Coronado Bank and San Clemente fault zones. Major regional faults of tectonic significance are shown on Figure 2. Many of these faults have experienced historic seismic activity. The following provides a brief description of some of the major fault zones in southern California.

- San Andreas Fault Zone

  The San Andreas fault zone is the dominant active fault in California. A major characteristic of the boundary between the Pacific and the North American tectonic plates is that it extends as a continuous surface feature from Cape Mendocino in northern California for more than 1,000 km (625 mi) to east of San Bernardino in southern California. Within the southern California region, the San Andreas fault zone trends southeastward along the margin of the Antelope Valley and extends through Cajon Canyon to form part of the southern boundary of the San Bernardino Mountains and the east side of the Salton Sea. Two great historical earthquakes marked by extensive surface faulting have occurred along this fault--the renowned 1906 San Francisco earthquake and the lesser known but possibly more severe 1857 Fort Tejon earthquake.

- San Jacinto Fault Zone

  En echelon segments of the San Jacinto fault zone extend from near San Bernardino southeastward more than 300 km (190 mi) through the Imperial Valley and into northern Baja California, Mexico. The zone at its northern end appears to merge with the San Andreas fault. For the past century, the San Jacinto fault zone has been the most active earthquake-generating feature in southern California. It has produced at least 10 earthquakes of about magnitude (M) 6.0 or greater since 1890.

- Elsinore Fault Zone

  The Elsinore fault zone is composed of a system of predominantly strike slip-right lateral faults extending about 230 km (145 mi). The fault zone as considered here includes the Laguna Saluda fault at its southern end. The Elsinore fault may be associated with the Whittier and Chino faults to the north, but the relationship is not clear. The Elsinore fault is associated with a low level of microseismicity primarily along the southern section of the Mexican-U.S. Border and apparently generated a Magnitude 6, Temescal Valley earthquake in 1910 (Richter, 1958). The cumulative displacement on the Elsinore fault is only 3 to 4 km (1.9 to 2.5 mi) which is considerably less than the San Jacinto or San Andreas faults (Sharp, 1967). The longest relatively continuous segments on the Elsinore fault zone are about 65 to 80 km (40 to 50 mi).

- Newport-Inglewood Fault Zone

  The Newport-Inglewood fault zone is a broad zone of discontinuous faults and folds striking southeastward from near Santa Monica across the Los Angeles basin to Newport Beach. Faults having similar trends and projections occur offshore of San Clemente and in San Diego (the Rose Canyon and La Nacion faults). Altogether, these various faults constitute a system more than 240 km (150 mi) long that extends into Baja California, Mexico. A near-shore segment of the Newport-Inglewood fault zone was the source of the destructive 1933 Long Beach earthquake.

- Rose Canyon Fault Zone

  The Rose Canyon fault zone is a complex zone of en echelon fault strands that trends north-northwest through coastal San Diego. The onshore reach of the Rose Canyon fault zone extends from Point La Jolla in the north, through Old Town, to the downtown area adjacent to San Diego Bay. The fault zone is comprised of the Rose Canyon, Mount Soledad, Country Club, Mission Bay, Old Town, Spanish Bight, Coronado, and Silver Strand faults in addition to many other minor breaks (SCEPP, 1989).

Although the Rose Canyon fault zone is generally considered a right-lateral strike-slip fault zone (Kennedy, 1975), faults within the zone display various combinations of dip-slip and strike-slip motion. The variable sense of dip-slip motion expressed along this fault zone is characteristic of most strike-slip faults that change in orientation or dip along strike.

The complexity in geometry of the Rose Canyon fault zone has produced some of coastal San Diego's most prominent topographic and physiographic features including Mount Soledad and San Diego Bay. The Rose Canyon fault, located approximately 5.6 km (3.5 mi) west of the site, had generally been considered a "potentially active" fault by the California Division of Mines and Geology (CDMG) since there was evidence of offset of Pleistocene geologic materials (i.e., materials older than 11,000 years but younger than 2 million years). Recent geologic research indicates that the Mount Soledad strand of the Rose Canyon fault zone offsets Holocene materials (i.e., materials 11,000 years in age or younger). A slip rate of 1.2 mm/year has been estimated for the Rose Canyon fault zone (Anderson et al., 1989). It is estimated that this fault zone could generate earthquake magnitudes on the order of M6.5 to M7.0. However, historically the local San Diego area has experienced relatively low seismic activity with the exception of some recent events which include earthquake swarms (less than M 4.0) in San Diego Bay in 1985 and 1986 and an earthquake of M 5.3 in 1986 off the coast of Oceanside (SCEPP, 1989).

Based on the results of recent geologic research, the Mount Soledad strand has been designated as "active" by the CDMG. An Alquist-Priolo special studies zone has recently been designated by the CDMG on this strand of the Rose Canyon fault zone.

- <u>Coronado Bank Fault Zone</u>

The Coronado Bank fault zone has been identified on the basis of seismic reflection data to be a 122 km (76 mi) zone of subparallel faults. Strike-slip displacement is suggested by possible right lateral offsets of submarine canyons (Legg and Kennedy, 1979). Individual segments of the fault zone are difficult to assess because the fault traces have not been mapped as continuous along their length as is possible on the on-shore region. Instead, rather widely separated reflection profiles have been interpreted and extrapolations made between them. Because of this approach the tendency is for offshore faults to be mapped as more continuous than on-shore faults. In light of these uncertainties, two rupture segments are estimated based on available data; these have lengths of 34 and 83 km (21 to 52 mi).

The slip rate of the Coronado Bank fault zone and of the other offshore fault zones that are believed to be primarily strike-slip is not directly measurable in cross-strike reflection profiles. Therefore, slip rates are estimated based on general knowledge of the regional tectonic and seismologic environment and the evaluation of the relative activity of these fault zones. The tectonic association of the Coronado Bank fault zone with the Palos Verde fault suggests that the 0.7 mm per year assigned to Palos Verde is an upper bound (U.S.G.S., 1985).

- San Clemente Fault System

The San Clemente fault system defines the western edge of the inner California continental borderland. The San Clemente-San Isidro fault zone is a long (>300 km/190 mi), continuous, zone of dextral shear that marks the axis of the San Clemente fault system. The fault zone is generally narrow (<2 km/1.3 mi), although locally, major branch faults broaden its width (5-10 km/3-6 mi). To the northwest, the San Clemente fault zone has been mapped past San Clemente Island (Vedder et al., 1974; Ford and Normark, 1980); and it may continue as far north as Santa Cruz Island. Contrary to previous hypotheses (Moore, 1969), the San Clemente fault zone does not connect with the Agua Blanca fault zone to the south. Instead, through a major left-bend along the western edge of the Descanso Plain, it is linked to the San Isidro fault zone (SCEPP, 1989).

9.0 PROBABILISTIC EVALUATION OF REGIONAL SEISMICITY

9.1 General

As requested, an evaluation was performed of the seismic risk for the project site for a 50 and 100 year design life. For this study, probabilistic regional seismicity is considered as the evaluation of the seismicity of a region based on past earthquake records. References used in our evaluation are listed in Appendix A.

9.2 Historical Seismicity and Study Area

The seismic risk was evaluated based on a randomly occurring event anywhere within an approximately 100-kilometer (63 mile) radius of the site. The past records of the seismicity in this study area were obtained from California Institute of Technology (1932-1991) and Real, et al. (1978). These references provided records for events M5.0 to M7.0 during the time period of 1910 -1991, and events less than M5.0 during the period of 1932-1991. The study area was selected to provide frequency data for relatively larger magnitude earthquakes. Figure 3 is a plot of M4.0 to M7.0 events within an area around the site of 31,400 square kilometers (12,125 square mi) which occurred during the time period of 1910-1991. From Figure 3, the average number of earthquakes of a given magnitude per year per 1,000 square kilometers can be estimated. The following comments are provided pertinent to Figure 3:

- Earthquakes with a magnitude of less than 4 are not considered capable of causing structural damage and therefore are not included on this figure.

- The curve presented on this figure reflects the amount and quality of seismic history data. History only affords a very brief period of recorded ground motions. Since larger earthquakes are less frequent, a longer study period is necessary to provide data for such events.
- Events equal to and greater than M4 are included; differentiation between main shocks and aftershocks was not made.

9.3 Evaluation of Seismic Risk

The closest known active fault to the site is the Rose Canyon fault. A maximum credible magnitude earthquake on this fault (M7.0) is estimated to result in a peak ground acceleration of about 0.55g (Table 1). Based on Ploessel and Slosson (1974) an average design value (repeatable high ground acceleration) of 0.36g is calculated for the maximum credible earthquake. The duration of strong phase shaking for an earthquake of magnitude M7.0 is predicted to be approximately 24 seconds (Housner, 1970). A maximum credible earthquake has been estimated to occur on Rose Canyon approximately once every 500 to 1,000 years or longer.

We understand that two levels of peak ground acceleration associated with 10 and 50 percent probability of being exceeded during a selected life of the project will be used in seismic design of the subject facility. For these probabilities, Figure 4 indicates that in a 50-year period the subject site has a probability of 10 and 50 percent that it will experience an acceleration of 0.36g and 0.16g, respectively. Further, Figure 4 indicates that in a 100 year period the subject site has a probability of 10 and 50 percent that it will experience an acceleration of 0.42g and 0.23g, respectively. If the project life is selected to be 100 years, even though the probability distribution of the peak ground acceleration indicates that the site has probability of 10 percent that it will experience an acceleration of 0.42g, the maximum predicted repeatable high ground acceleration to be used in the design may be limited to 0.36g based on the maximum credible earthquake assigned to the Rose Canyon fault.

These estimates of earthquake recurrence probability do not mean that it is certain that any of those bedrock accelerations will occur or that more than one occurrence or a greater bedrock acceleration will not occur in those time period. It should be emphasized that these estimates are based on limited amount of seismic records.

However, since every structure can not be economically designed for the maximum credible seismic event, some probalistic estimates of the potential for earthquake ground shaking become a valuable tool if their limitations are kept in mind.

10.0 SEISMIC RESPONSE SPECTRA

We understand that two levels of peak ground acceleration associated with 10 and 50 percent probability of being exceeded during a selected life of the project will be used in seismic design of the subject facility. Seismic response spectra were constructed using the general empirical approach and amplification factors recommended by Newmark and Hall (1982). Horizontal peak ground accelerations of 0.16g and 0.36g, having 50 and 10 percent probability of being exceeded in 50 years, respectively, were selected as characteristic events for the construction of response spectra. Horizontal peak ground accelerations of 0.23g and 0.36g, having 50 and 10 percent probability of being exceeded in 100 years, respectively, were also used as characteristic events for the construction of response spectra. The following site and magnitude dependent peak ground motion parameter relationships were used in the construction of spectra:

$$v/a = 48 \text{ in/sec/g}$$
$$ad/v^2 = 6$$

Where **a** is acceleration; **v** is velocity and **d** is displacement.

Median structural amplification factors were used together with the peak ground motion parameters to evaluate spectral values of acceleration, velocity and displacement. Seismic response spectra for 0.5, 1, 2 and 5 percent of structural damping are shown on Figures 5 through 7.

11.0 GEOLOGIC HAZARD CONSIDERATIONS

- Faults

As previously discussed, evidence of faulting or fault related features were not observed and no active or potentially active faults are known to exist on the site.

- Landslides

  No landslides or landslide related features were observed during our geologic reconnaissance nor have any landslides been mapped on the site.

- Seiches and Tsunamis

  Due to the proximity of the site with respect to large bodies of water, the potential of seiches and tsunamis, as well as inundation caused by failure of existing large water storage facilities, is considered low.

- Liquefaction and Seismically Induced Settlement

  Liquefaction and seismically induced settlement of saturated cohesionless soils can be caused by strong vibratory motion due to earthquakes. Research and historical data indicates that loose granular soils saturated by a near-surface ground water table are most susceptible to liquefaction. Due to the dense nature of the underlying formational materials and the expected absence of a static near-surface ground water table, the potential for liquefaction and seismically induced settlement of formational materials at this site is considered low.

- Ground Surface Rupture

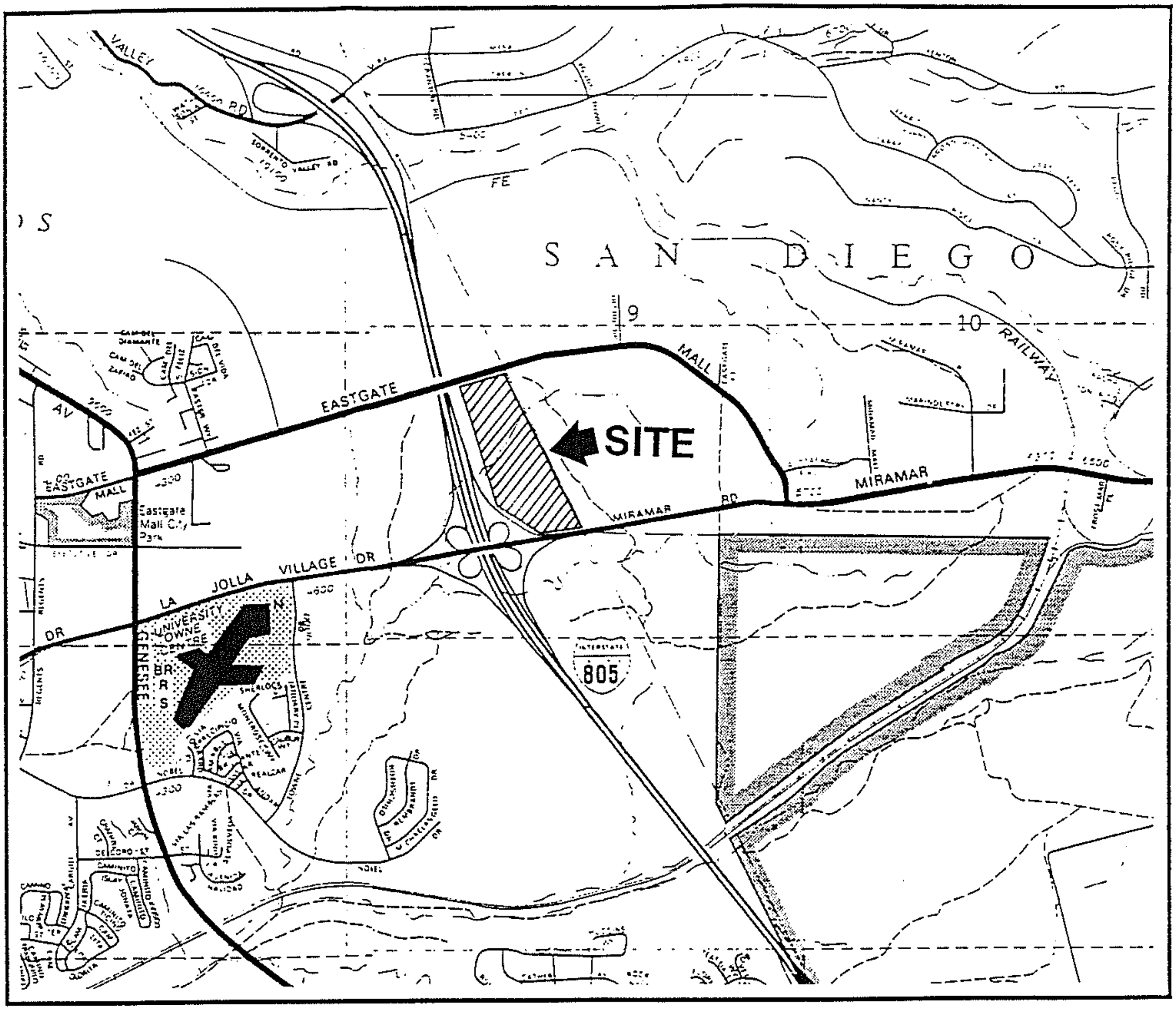
  Ground surface rupture commonly occurs along pre-existing faults triggered during a seismic event. Since no active or potentially active faults are known to directly underlie the site, the potential for damage due to ground surface rupture is considered low.

- Ground Lurching

  Ground lurching refers to the rolling motion produced on the surface by the passage of seismic surface waves. The vertical and longitudinal differential dynamic displacements of these waves can cause serious distortion in structures. Effects of this nature are likely to be especially significant near the edge of alluvial valleys or shores, and at the crests of ridges where the thickness of soft sediments vary appreciably. Underground utilities are especially subject to rupture in soft soils due to lurching. Due to the dense nature of the underlying formational materials and the relatively shallow depth of on-site alluvium, it is our opinion that the potential for damage due to ground lurching is considered low.

12.0 LIMITATIONS

Geotechnical engineering and the geologic sciences are characterized by uncertainty. Professional judgements presented herein are based partly on our understanding of the proposed construction, and partly on our general experience. The geotechnical services outlined in this report have been conducted in accordance with current practice and the standard of care exercised by geotechnical consultants performing similar tasks in this area. No other warranty, expressed or implied, is made regarding the conclusions, recommendations, and professional opinions presented in this report.



REFERENCE: 1986 Aerial Foto–Map Book

NORTH

0 2000 4000

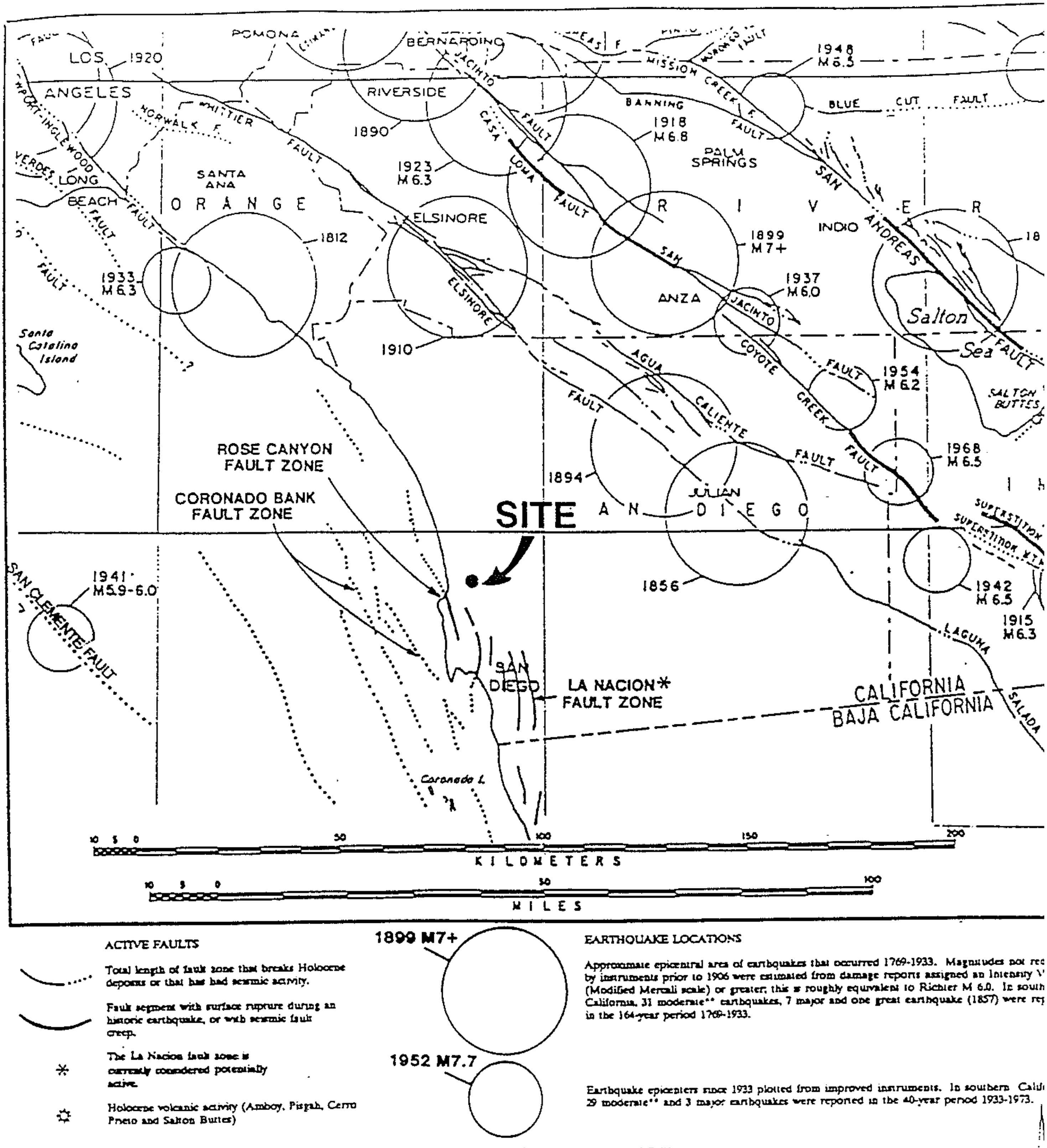
Approximate Scale in Feet

Ninyo & Moore

SITE LOCATION MAP

NORTH CITY
WATER RECLAMATION PLANT (NTP–1)
SAN DIEGO, CALIFORNIA

PROJECT NO.	DATE	FIGURE 1
102208–01	12/91	



ACTIVE FAULTS

Total length of fault zone that breaks Holocene deposits or that has had seismic activity.

Fault segment with surface rupture during an historic earthquake, or with seismic fault creep.

* The La Nacion fault zone is currently considered potentially active.

☼ Holocene volcanic activity (Amboy, Pisgah, Cerro Prieto and Salton Buttes)

EARTHQUAKE LOCATIONS

Approximate epicentral area of earthquakes that occurred 1769-1933. Magnitudes not rec by instruments prior to 1906 were estimated from damage reports assigned an Intensity V (Modified Mercalli scale) or greater; this is roughly equivalent to Richter M 6.0. In south California, 31 moderate** earthquakes, 7 major and one great earthquake (1857) were rep in the 164-year period 1769-1933.

Earthquake epicenters since 1933 plotted from improved instruments. In southern Calif 29 moderate** and 3 major earthquakes were reported in the 40-year period 1933-1973.

** Code recommendations by the Structural Engineers Association of California define a great earthquake as one that has a Richter Magnitude of 7-3/4 or greater; a major earthquake 7 to 7-3/4; a moderate earth earthquake 6 to 7.

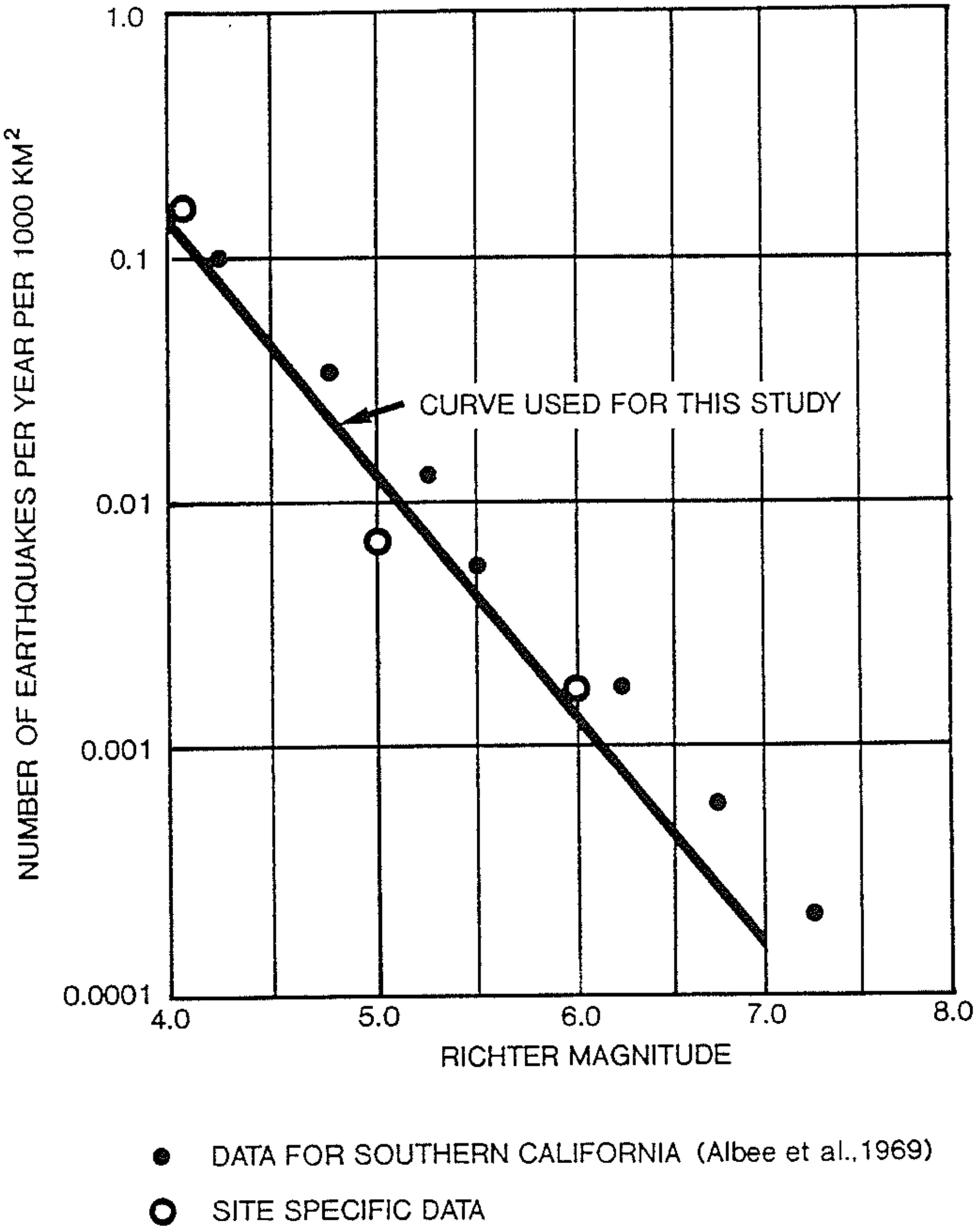
Modified from map compiled by R.J. Proctor in "Geology, Seismicity and Environmental Impact", special publication of the Association of Engineering Geologist, 1973.

Ninyo & Moore

FAULT LOCATION MAP

NORTH CITY
WATER RECLAMATION PLANT (NTP-1)
SAN DIEGO, CALIFORNIA

PROJECT NO.	DATE	FIGURE 2
102208-01	12/91	

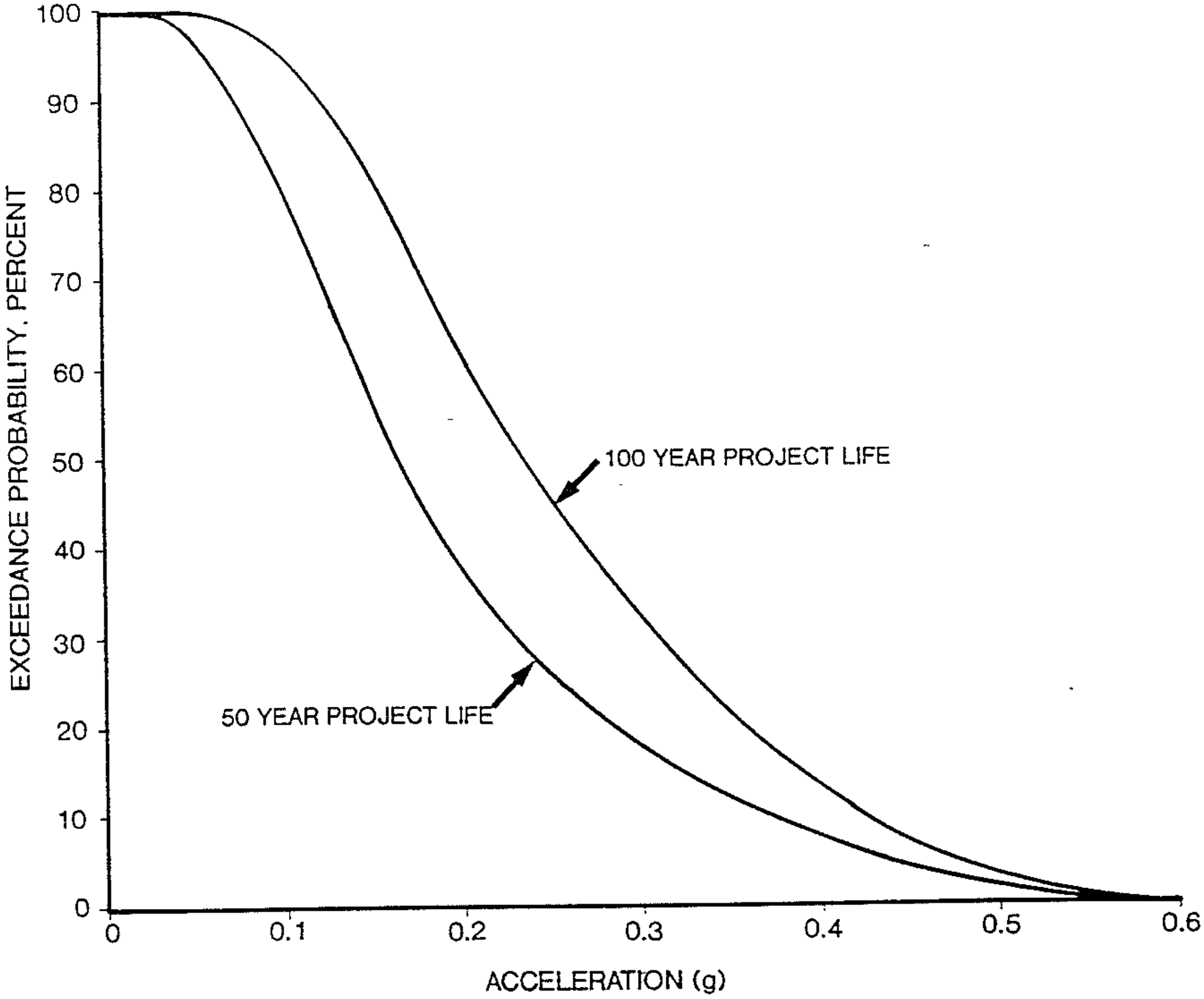


Ninyo & Moore

NUMBER OF EARTHQUAKES PER YEAR PER 1,000 KM ^{2}

NORTH CITY
WATER RECLAMATION PLANT (NTP-1)
SAN DIEGO, CALIFORNIA

PROJECT NO.	DATE	FIGURE 3
102208-01	12/91	

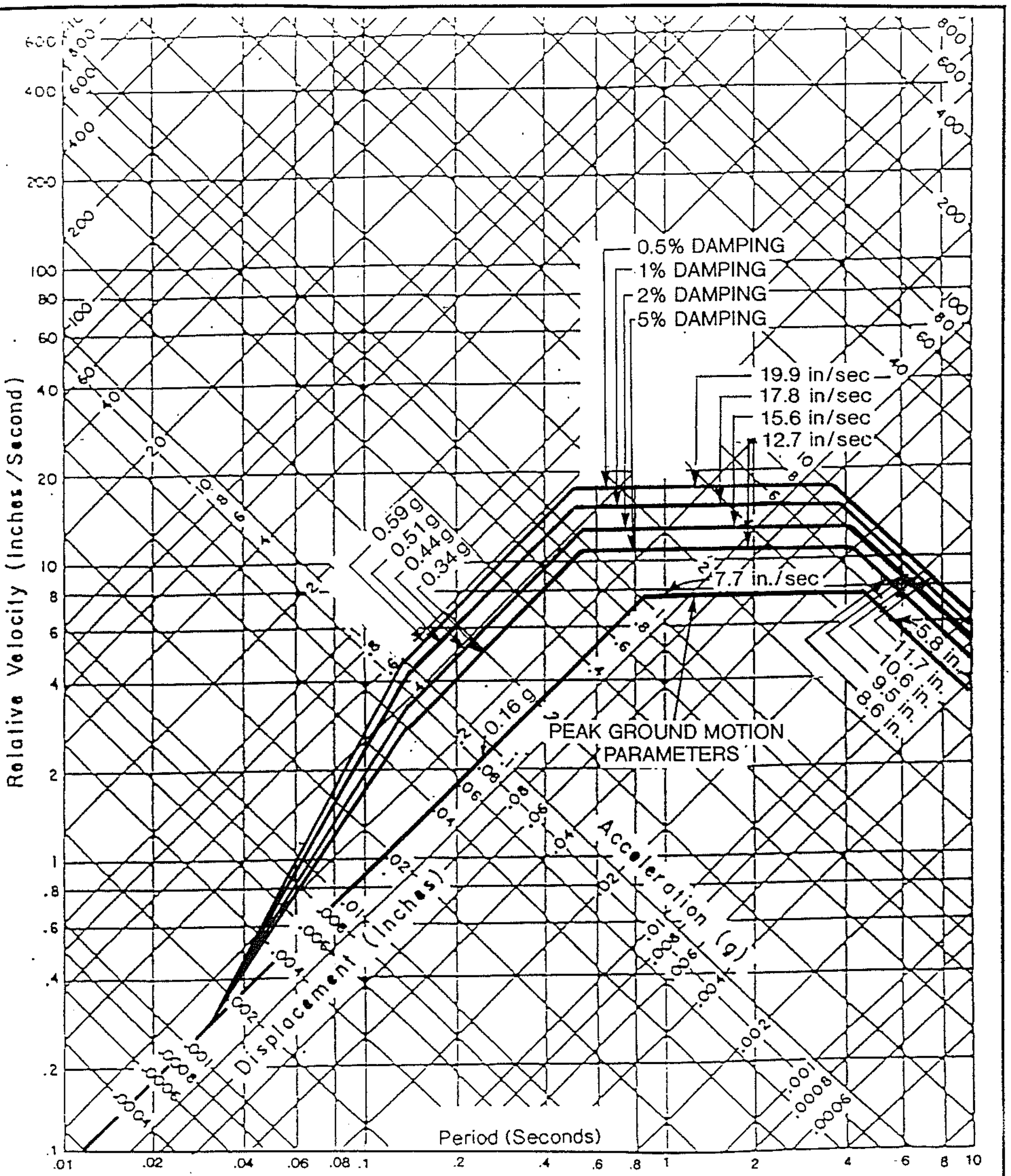


Ninyo & Moore

EXCEEDANCE PROBABILITY
VERSUS ACCELERATION

NORTH CITY
WATER RECLAMATION PLANT (NTP-1)
SAN DIEGO, CALIFORNIA

PROJECT NO.	DATE	FIGURE 4
102208-01	12/91	



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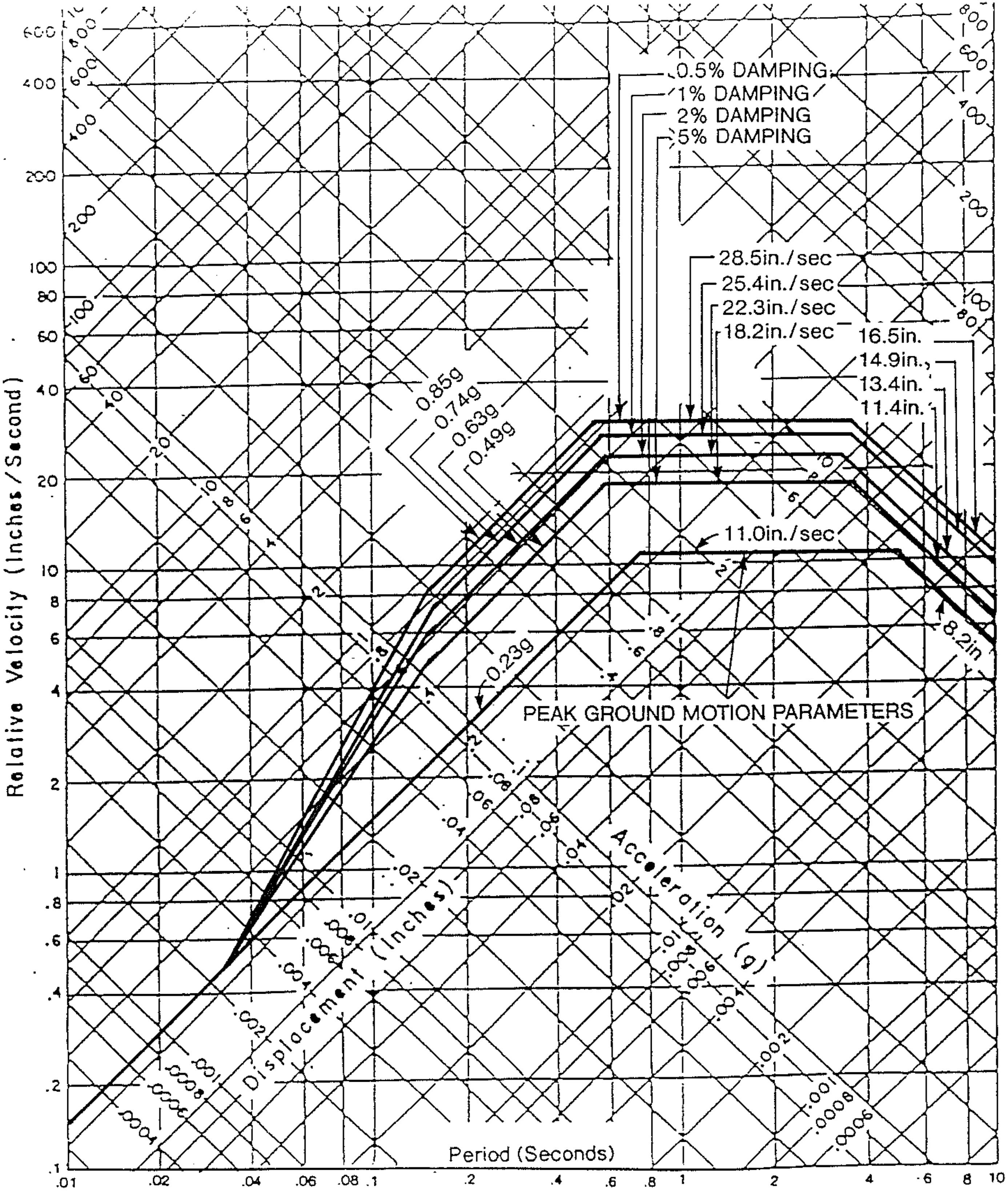
SEISMIC RESPONSE SPECTRA
(0.16g PEAK GROUND ACCELERATION)

NORTH CITY
WATER RECLAMATION PLANT (NTP-1)
SAN DIEGO, CALIFORNIA

PROJECT NO.	DATE	FIGURE 5
[illegible]	[illegible]	

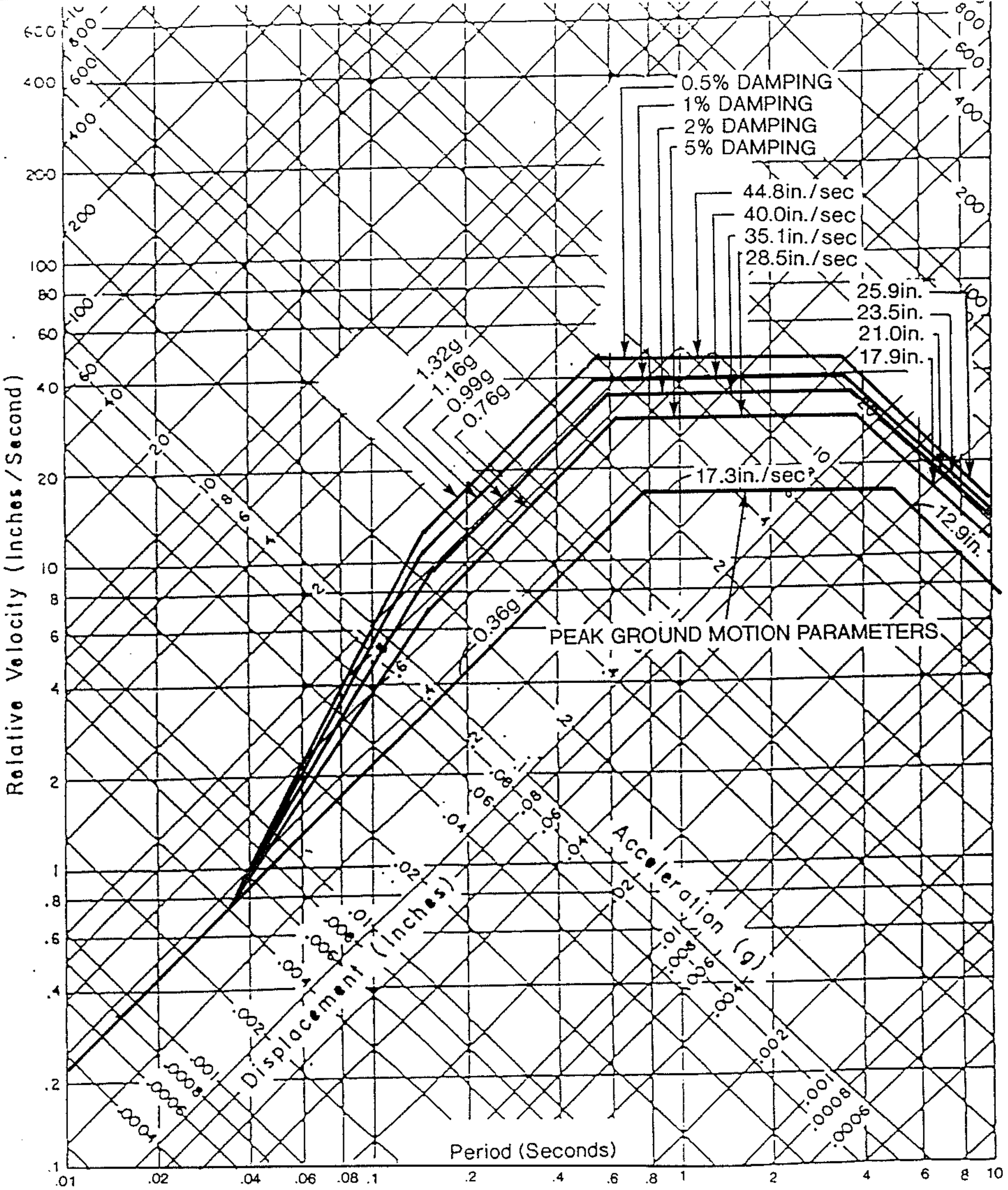


SEISMIC RESPONSE SPECTRA
(0.23 g PEAK GROUND ACCELERATION)

Ninyo & Moore

NORTH CITY
WATER RECLAMATION PLANT (NTP-1)
SAN DIEGO, CALIFORNIA

PROJECT NO.	DATE	FIGURE 6
102208-01	12/91	



Ninyo & Moore

SEISMIC RESPONSE SPECTRA
(0.36 g PEAK GROUND ACCELERATION)

NORTH CITY
WATER RECLAMATION PLANT (NTP-1)
SAN DIEGO, CALIFORNIA

PROJECT NO.	DATE	FIGURE 7
102208-01	12/91	

TABLE 1

SEISMIC PARAMETERS FOR MAJOR FAULTS

Fault	Fault to Site Distance (km/mi)	Maximum Credible Earthquake Magnitude[1] (M)	Estimated Acceleration (g)	
			Peak Horizontal[2] Bedrock	Repeatable[3] High Ground
Coronado Bank	24/15	6.7	0.24	0.16
Elsinore	56/35	7.5	0.15	0.15
Newport-Inglewood	106/66	7.0	0.04	0.04
La Nacion	15/9	6.8	0.38	0.25
Rose Canyon	5.6/3.5	7.0	0.55	0.36
San Andreas	137/85	7.8	0.04	0.04
San Clemente	79/49	7.5	0.09	0.09
San Jacinto	92/57	7.5	0.08	0.08

1. After Greensfelder 1974. 2. Seed and Idriss 1982. 3. Ploessel and Slosson 1974.

All faults shown are considered active except the La Nacion fault which is considered potentially active.

APPENDIX A

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AERIAL PHOTOGRAPHS

Source	*Scale*	*Date*	*Flight*	*Numbers*
USDA	*1:20,000*	*3-31-53*	*AXN-4M*	*7 and 8*
San Diego County	*1:12,000*	*1928*	*52E*	*6, 7, and 8*

Attachment No. 3

Geotechnical Report

(Allied Geotechnical Engineers, August 9, 2017)

REPORT OF GEOTECHNICAL INVESTIGATION
NORTH CITY WATER RECLAMATION PLANT EXPANSION
CITY OF SAN DIEGO

Submitted to:
CH2M
402 West Broadway, Suite 1450
San Diego, CA 92101

Prepared By:

ALLIED GEOTECHNICAL ENGINEERS, INC.
9500 Cuyamaca Street, Suite 102
Santee, California 92071-2685

July 25, 2017
(Revised August 9, 2017)

AGE

Allied Geotechnical Engineers, Inc.

July 25, 2017
(Revised August 9, 2017)

Mr. Julian Hoyle, P.E.
CH2M
402 West Broadway, Suite 1450
San Diego, CA 92101

Subject: **REPORT OF GEOTECHNICAL INVESTIGATION**
NORTH CITY WATER RECLAMATION PLANT EXPANSION
CITY OF SAN DIEGO
AGE Project No. 44F1

Dear Mr. Hoyle:

Allied Geotechnical Engineers, Inc. (AGE) is pleased to submit the accompanying "Report" to present the findings, opinions, and recommendations of a geotechnical investigation that was performed to assist CH2M with their design of the subject project. Upon our receipt of review comments from CH2M and the City of San Diego, we will prepare and submit a "Final Report" that will incorporate our response to the review comments that we received.

If you have any questions regarding the contents of this report or if we may be of further assistance, please feel free to give us a call. We greatly appreciate the opportunity to be of service on this important project for the City of San Diego.

Respectfully submitted,

ALLIED GEOTECHNICAL ENGINEERS, INC.

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NEB/SS/TJL:cal
Distr. (1 electronic) Addressee

REPORT OF GEOTECHNICAL INVESTIGATION
NORTH CITY WATER RECLAMATION PLANT EXPANSION
CITY OF SAN DIEGO

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1.0 INTRODUCTION

Allied Geotechnical Engineers, Inc. (AGE) is pleased to submit this report to present the findings, opinions, and recommendations of a geotechnical investigation conducted to assist CH2M with their design of the North City Water Reclamation Plant (NCWRP) Expansion for the City of San Diego (City). The investigation was performed in conformance with the subconsultant agreement entered into by and between CH2M and AGE on February 6, 2017.

This report has been prepared for the exclusive use of CH2M and its design team subconsultants and the City in their design of the project as described herein. The information presented in this report is not sufficient for any other uses or the purposes of other parties.

2.0 SITE AND PROJECT DESCRIPTION

The existing NCWRP is located at 4949 Eastgate Mall in the Miramar area of San Diego, California (See Figure 1 - Location Map). The site is bounded by Eastgate Mall to the north, Miramar Road to the south, an SDG&E easement to the northeast and the I-805 freeway to the southwest.

The site occupies a mesa top that was dissected by two southwest trending canyons prior to site grading. The larger of these canyons traversed the central portion of the site, and was 50 to 60 feet in depth with two main tributaries entering from the south. A pre-existing 60-inch diameter storm drain was reportedly present in the bottom of the canyon. A second smaller canyon was located in the southern portion of the site, and was on the order of 40 feet in depth. This smaller canyon had previously been infilled where Miramar Road crosses the canyon. During site earthwork for the construction of NCWRP an 18-inch diameter storm drain was installed in the bottom of the smaller canyon. Original site elevations at the project site range between +315 feet to +385 feet above the mean sea level (msl). Following completion of the construction of the NCWRP, the site elevations range between + 325 feet and +390 feet msl.

Existing site improvements include an operations building, flow equalization tanks, primary, secondary and tertiary filtration basins, aeration tanks, various pump stations and electrical rooms, an advanced water treatment demonstration plant, a chemical building, various outbuildings, a cogeneration facility, asphaltic concrete (a.c.) paved roadways and parking, and landscaping. The site is fenced, with a guard shack at the entrance gate. As-built record drawings prepared by CH2M (1997) indicate that original construction of the facility was completed by 1997. A site plan showing the existing improvements is shown in Figure 2.

Prior geotechnical investigations for the design and construction of the NCWRP include studies performed by Woodward-Clyde Consultants (WCC, 1990a and b), Geotechnical Consultants (GC, 1990), and Ninyo & Moore (1991a and b).

CH2M Hill (1992) performed a geotechnical investigation for the NCWRP. The investigation included the excavation of nineteen (19) soil borings and twenty one (21) test pits. CH2M reported that the project site was underlain at depth by the Eocene age Scripps Formation, and that the Scripps Formation was overlain in areas by terrace deposits belonging to the Lindavista Formation. Topsoil and colluvial deposits reportedly mantled much of the site, with alluvial deposits present in the canyon bottoms.

The CH2M Hill report (1992) included earthwork and foundation recommendations for the design and construction of the NCWRP. The report concluded that the site was favorable for the proposed construction, but that significant grading would be required. The report further indicated that the site grading would include the placement of up to 40 feet of compacted fill materials, with the majority of the fill to be placed in the existing canyons. The report also stated that the alluvial/colluvial materials were to be removed prior to fill placement, and that these materials were considered unsuitable for use as compacted fill. The report indicated that fill materials were to be derived from on-site sources, and further stated that some processing of the fill was required to remove oversize material. The report specified that the fill was to be compacted to a minimum of 95 percent of the laboratory maximum dry density in accordance with American Society of Testing and Materials (ASTM) test method D1557. CH2M Hill also determined that on-site soils are highly corrosive to buried metals and concrete.

Earthwork specifications prepared by CH2M Hill for the construction of the NCWRP required that backfill placed within 5 feet of structural walls was to consist of clean well-graded granular material with a maximum particle size of 4-inches and no more than 5 percent passing the No. 200 sieve. Structural fill located within the zone of influence of structures and pipelines was required to have a maximum particle size of 6-inches and no more than 20 percent passing the No. 200 sieve. In addition, a 6-inch thick layer of crushed rock was required beneath foundations for the various structures. The crushed rock was to be well-graded from course to fine and contain no more than 8 percent passing the No. 200 sieve, with a maximum particle size of 1 ½ inches and compacted to at least to 95 percent of the laboratory maximum dry density in accordance with ASTM test method D1557. Documentation regarding placement of the fill materials at the project site is not available for review.

The currently proposed project consists of an expansion of the existing NCWRP and adding a pump station and pipeline conveyance for the proposed North City Pure Water Facility (NCPWF). A review of the 30% submittal project plans prepared by CH2M (May, 2017) indicates that the scope of the proposed project will include the facilities described on the next page. The proposed improvements are shown on Figure 2.

Prior geotechnical investigations for the proposed project include a 10% Draft Report of Desktop Geotechnical Investigation for the North City Plant Upgrades and AWPF Influent Pump Station (K2 Engineering, 2016) and a Preliminary Desktop Geotechnical Investigation for the Proposed Secondary Clarifiers, Equalization Basin and Chemical Storage Farm (Brown & Caldwell, 2016).

Primary Sedimentation Tanks

New primary sedimentation tanks are planned on the southeast side of the existing primary sedimentation tanks. The primary sedimentation tanks are located in the southerly portion of the NCWRP facility adjacent to the Equalization basins. The new sedimentation tanks are designated as Tank Nos. 7, 8, and 9, and are planned to be of reinforced concrete construction. The reinforced floor slabs are to be 2 feet thick, with the slab elevations varying from +355.00 to +357.00 feet msl. The top of the roof parapet is at an elevation of +396.00 feet msl. The proposed construction will require partial demolition and conversion of the existing sedimentation tanks.

Equalization Basin

A new equalization basin is to be constructed southeast of the existing equalization tanks and adjacent to Miramar Road. The proposed tank is a circular reinforced concrete structure with an outside core wall diameter of 120 feet and wall height of 30 feet - 10 inches, with a wall thickness of 12 inches. The concrete roof is to be supported by 32 interior columns, and will slope toward a central drain from an elevation of +403.83 feet msl at the perimeter parapet to the drain elevation of +403.00 feet msl. The perimeter footing and interior column footings are to be underlain with 24-inch thick crushed rock over undisturbed earth or prepared subgrade.

The high point elevation of the perimeter footing will be 372.17 feet msl with the low point elevation at the center of the tank at 368.0 feet msl. The maximum water elevation is to be 399.3 feet msl. The equalization tank will be partially subterranean.

First Stage Bioreactor Basins

New first stage bioreactor basins will be constructed along the northwest side of the existing aeration basins in the south-central portion of the site. The existing aeration basins will be modified to become part of the first stage bioreactor basins. The basins will be mostly subterranean reinforced concrete structures, with concrete footings up to 4 feet - 6 inches thick and a sloping floor slab that typically varies between elevations of +341.00 and +341.50 feet msl. The roof height is at elevation of +365.00 feet msl. A wedge-shaped area of controlled low strength material (CLSM) will be placed below a gallery attached to the northeast side of the structure.

Second Stage Bioreaction Basins

The existing secondary clarifier basins located in the central portion of the site are to be converted into new second stage bioreaction basins. The work will include adding onto the southeast side of the existing basin and extending the basin further southwest into an undeveloped portion of the site. The work will require partial demolition and conversion of the existing clarifiers, including adding concrete fill to re-level the floor slab and achieve the design elevation of the new basins.

The plans indicate that the new second stage bioreaction basins are reinforced concrete structures with an interior floor slab that is 1 foot - 10 inches thick at an elevation of 344.17 feet msl. The basins are mostly subterranean, with a roof elevation of 361.50 feet msl. A wedge-shaped area of CLSM will be placed below a gallery attached to the southwest side of the structure. A new 96-inch diameter pipeline will extend from the second stage bioreaction basins to the inlet structure for the new secondary clarifiers.

Secondary Clarifiers

A total of four (4) new secondary clarifiers are to be added in the east-central portion of the site. The clarifiers will be circular reinforced concrete structures with inside diameters of 150 feet and wall heights of approximately 21 feet. The clarifiers will be provided with premanufactured aluminum geodesic dome roofs supported by the perimeter walls. The plans indicate that the perimeter concrete walls will be 2 feet-3 inches thick, and the mat slabs will be 36 inches thick.

The plans indicate a high point elevation of the slabs at +337.75 feet msl around the perimeter walls, with a low point elevation in the central portions of the slabs of +337.25 feet msl. The leak test maximum water elevation is anticipated at elevation +357.75 feet msl. The clarifiers will be partially subterranean.

The proposed structures are located above the larger canyon. It is anticipated that the proposed structures will be partially supported on filled ground and partially on undisturbed formation.

The existing 60-inch diameter storm drain pipe is located beneath Clarifier Nos. 2 and 4 with invert elevations ranging from +305 feet to +314 feet msl. Construction of the proposed structures will also include the installation of several pipelines ranging in diameter from 48- to 96-inch in diameter, and a central influent distribution structure located between the four clarifiers. The distribution structure is approximately 29-foot square in dimension, and will be supported on a 24-inch thick mat foundation with top of slab at elevation of +340 feet msl. The plan indicate that the distribution structure will be underlain with CLSM.

Tertiary Filters Building

A new tertiary filters building will abut the southwest side of the existing tertiary filters building. The lower gullet of the new building will have a 2-foot thick floor slab at elevation of +326.00 feet msl. The upper gullet will have an 18-inch thick floor slab at elevation of +334.50 feet msl. The scope of work will require some modification of the existing tertiary filter building.

NCPWF Influent Pump Station and Pipeline

A new NCPWF influent pump station will be constructed in a lawn area located north of the existing effluent pump station. The pump station building will be supported on mat foundation with finish grade elevation of +342.5 feet msl. To minimize the potential for additional foundation surcharge loading on the existing adjacent Chlorine Contact Tanks No. 3, a 24-inch thick subterranean concrete wall will be constructed between the proposed building and existing tanks. Furthermore, the proposed pump station building will be supported on CLSM.

The 42-inch diameter influent pipeline will extend northwesterly from the new pump station, and then continue in a northerly direction along the northwest boundary of the project site. The pipeline will then turn northeast and extends through the proposed construction Primary Staging Area and Eastgate Mall, and terminate on the north side of Eastgate Mall for a future connection to the NCPWF. The pipeline will be above-grade where it exits the pump station, with the remainder of the pipeline below-grade with a minimum cover of at least 5-feet above the crown of the pipe.

Retaining Wall

The design and construction of a retaining wall along the fill slope on the east side of the proposed Secondary Clarifiers Tanks. Based on the review of the preliminary project plans, it is our understanding that the wall will have a maximum height on the order of 15 feet and support 2 : 1 (horizontal : vertical) sloping filled ground. The bottom of retaining wall foundation is estimated to be located at approximate elevation of +321 feet above the mean sea level (msl).

Chemical Building

The proposed structure will be located in the central portion of the eastern boundary of the project site, and is anticipated to consist of a light canopy supported on 12- to 16-inch thick reinforced mat slab foundation.

Other Work

The project plans indicate that the scope of the project will also include the following:

- Re-alignment of the entrance road and guard shack to match the future NCPWF;
- Re-alignment of various roadways and the addition of a new parking area located east of the operations building;
- Localized grading at the locations of new and/or upgraded facilities;
- Various renovation and upgrading of existing facilities;

- New above-grade and below-grade pipelines;
- Re-location of the power generation facility;
- Installation of various retaining structures;
- Re-location and upgrading of various underground utilities;
- Installation of BMP biofiltration basins at ten (10) separate locations in the facility. The BMP areas will comply with City of San Diego 2016 stormwater standards; and
- Various restoration work and upgrading of sidewalk ramps to meet current ADA standards.

3.0 OBJECTIVE AND SCOPE OF INVESTIGATION

The objectives of this investigation were to characterize the subsurface conditions in the project study area and to develop geotechnical recommendations for use in the design of the currently proposed project. The scope of our investigation included several tasks which are described in more detail in the following sections.

3.1 Information Review

This task involved a review of readily available information pertaining to the proposed project, including the preliminary project plans, as-built utility maps, topographic maps, published geologic literature and maps, and AGE's in-house references. A listing of references that were reviewed is presented in Section 8.0.

3.2 Geotechnical Field Exploration

The field exploration program for this project was performed during the period between May 1 and May 26, 2017. A total of twenty two (22) soil borings were performed at the approximate locations shown on Figure 3. The borings were advanced using conventional hollow-stem auger, air percussion and mud rotary drilling methods to depths ranging from 19.5 feet to 101 feet below the existing ground surface (bgs). A brief description of the location and depth, and the subsurface conditions encountered in each boring is presented in Table 1. A more detailed description of the drilling and sampling activities, and logs of the borings are presented in Appendix A.

Prior to commencement of the drilling operations, several site visits were performed to observe existing site conditions and to select suitable locations for the borings. Subsequently, clearance of the proposed boring locations with respect to existing buried utilities was coordinated through Underground Service Alert (USA) and City's personnel. In addition, Cable Pipe & Leak Detection (CPL) was retained to perform independent utility clearance services. Existing buried utilities in the project study area include: potable water and sanitary sewer pipelines; effluent and sludge lines; storm drains; natural gas and electrical transmission lines; and cable, telephone, and fiber optic lines.

Table 1

Summary of Borings

Boring ID	Proposed Facility	Boring Depth (feet)	Existing Pavement Section	Subsurface Conditions	Estimated G.W. Depth (feet bgs)
H-1	New EQ Basin	81	N/A	Qaf to 8 feet, Qvop to 13 feet and Tsc to the maximum depth of exploration	N/A*
H-2	New EQ Basin	51	N/A	Qaf to 15 feet and Tsc to the maximum depth of exploration	N/A*
H-3	New Primary Clarifier	80.5	N/A	Qaf to 7 feet, Qvop to 13 feet and Tsc to the maximum depth of exploration	N/A*

Table 1

Summary of Borings

(continued)

Boring ID	Proposed Facility	Boring Depth (feet)	Existing Pavement Section	Subsurface Conditions	Estimated G.W. Depth (feet bgs)
H-4	New Primary Clarifier	51	N/A	Qaf to 3 feet, Qvop to 14 feet and Tsc to the maximum depth of exploration	N/A*
H-5	New Aeration Basins	51.5	7.5" A.C., no base	Qaf to 22 feet and Tsc to the maximum depth of exploration	N/A*
H-6	New Aeration Basins	50.5	8" A.C., no base	Qaf to 25 feet and Tsc to the maximum depth of exploration	N/A*
H-7	New Aeration Basins	100.5	N/A	Qaf to 7 feet, Qvop to 12 feet and Tsc to the maximum depth of exploration	N/A*
H-8	New Tertiary Filters	56.5	N/A	Qaf to 49 feet and Tsc to the maximum depth of exploration	N/A*
H-9	New NCPWF IPS	80.5	N/A	Qaf to 34 feet and Tsc to the maximum depth of exploration	N/A*
H-10	New NCPWF IPS	80.5	N/A	Qaf to 32 feet and Tsc to the maximum depth of exploration	N/A*

Table 1

Summary of Borings

(continued)

Boring ID	Proposed Facility	Boring Depth (feet)	Existing Pavement Section	Subsurface Conditions	Estimated G.W. Depth (feet bgs)
H-11	New Secondary Clarifier	81.5	N/A	Qaf to 15 feet and Tsc to the maximum depth of exploration	N/A*
H-12	New Secondary Clarifier	100.5	N/A	Qaf to 28 feet and Tsc to the maximum depth of exploration	N/A*
H-13	New Secondary Clarifier	101	N/A	Qaf to 29 feet and Tsc to the maximum depth of exploration	N/A*
H-14	New Secondary Clarifier	100.5	N/A	Qaf to 28 feet and Tsc to the maximum depth of exploration	N/A*
H-15	Western Pipeline Corridor	21.5	4.5" A.C. over 4" miscellaneous base	Qaf to 3 feet and Tsc to the maximum depth of exploration	Not encountered during drilling
H-16	Western Pipeline Corridor	21.5	7" A.C., no base	Qaf to 1.5 feet and Tsc to the maximum depth of exploration	Not encountered during drilling
H-17	Western Pipeline Corridor	19.5	N/A	Qyc to 3.5 feet and Tsc to the maximum depth of exploration	Not encountered during drilling
H-18	Eastern Pipeline Corridor	21	N/A	Qaf to 2.5 feet and Tsc to the maximum depth of exploration	Not encountered during drilling
H-19	Eastern Pipeline Corridor	21.5	N/A	Qaf to 3 feet and Tsc to the maximum depth of exploration	Not encountered during drilling

Table 1

Summary of Borings

(continued)

Boring ID	Proposed Facility	Boring Depth (feet)	Existing Pavement Section	Subsurface Conditions	Estimated G.W. Depth (feet bgs)
H-20	New Renewable Energy Facility	80.5	4" A.C. over 12" miscellaneous base	Tsc to the maximum depth of exploration	N/A*
H-21	Chemical Storage Facility	21.5	N/A	Qaf to 3 feet, Qvop to 8 feet and Tsc to the maximum depth of exploration	Not encountered during drilling
H-22	New Renewable Energy Facility	80.5	3" gravel	Qaf to 6 feet and Tsc to the maximum depth of exploration	N/A*

Explanation of Abbreviations and Symbols

A.C.	Asphalt Concrete
Qaf	Artificial Fill Materials
Qyc	Young Colluvial Deposits
Qvop	Very Old Paralic Deposits
Tsc	Scripps Formation
*	Unable to determine if groundwater present (Method of drilling required introduction of water into borehole)

3.3 Laboratory Testing

Selected soil samples obtained from the borings were tested in the laboratory to verify field classifications and evaluate certain engineering characteristics. The geotechnical laboratory tests were performed in general conformance with the American Society for Testing and Materials (ASTM) or other generally accepted testing procedures.

The laboratory tests included: in-place density and moisture content, maximum density and optimum moisture content, sieve (wash) analysis, Atterberg Limits, expansion index, shear strength, and consolidation. In addition, representative samples of the onsite soil materials were collected and delivered to Clarkson Laboratories and Supply, Inc. for chemical (analytical) testing to determine soil pH and resistivity, soluble sulfate and chloride concentrations, and bicarbonate content. A brief description of the tests that were performed and the final test results are presented in Appendix B.

4.0 GEOLOGIC CONDITIONS

4.1 Geologic Setting and Site Physiography

The project study area is located in the western portion of the San Diego Embayment, a deep sedimentary-filled basin which is underlain at depth by a basement rock complex of Cretaceous age batholithic and metavolcanic and metasedimentary rocks of Jurassic age. The sedimentary formations consist of nearly flat-lying to gently southwest dipping, marine and non-marine sediments which range from Cretaceous to Holocene in age.

The project site is situated on the Linda Vista marine terrace, a relatively level wave-cut platform. The terrace is deeply eroded, and two tributaries of Rose Creek traverse the site. Grading operations performed during development of the NCWRP site included the partial in-filling of these canyons. Nearby land uses include residential and commercial developments, USMC Air Station Miramar, the Miramar Landfill, and open spaces.

4.2 Tectonic Setting

Tectonically, the San Diego region is situated in a broad zone of northwest-trending, predominantly right-slip faults that span the width of the Peninsular Ranges and extend offshore into the California Continental Borderland Province west of California and northern Baja California. At the latitude of San Diego, this zone extends from the San Clemente fault zone, located approximately 60 miles to the west, and the San Andreas fault located about 95 miles to the east.

Major active regional faults of tectonic significance include the Coronado Bank, San Diego Trough, San Clemente, and Newport Inglewood/Rose Canyon fault zones which are located offshore; the faults in Baja California, including the San Miguel-Vallecitos and Agua Blanca fault zones; and the faults located further to the east in Imperial Valley which include the Elsinore, San Jacinto and San Andreas fault zones.

4.3 Geologic Units

Based on their origin and compositional characteristics, the soil types encountered in the exploratory borings can be categorized into four geologic units which include (in order of increasing age) fill materials; young colluvial deposits; very old paralic deposits; and Scripps Formation. A brief description of each unit (in order of increasing age) is presented below. A generalized geologic map of the project study area is shown on Figure 4. A site specific geologic map is shown on Figure 5, and the geologic cross-sections are shown on Figures 6, 7 and 8 for Cross-Sections A-A’, B-B’ and C-C’, respectively.

4.3.1 Fill Materials

Fill materials, ranging in thickness from 1.5 feet to 49 feet, were encountered in all of the exploratory borings, with the exception of borings H-17 and H-20. The fill materials generally consist of silty sands, sandy silts, clayey sands, and sandy clays with scattered to locally abundant gravel and cobbles. The fill was also found to contain intermixed sandstone and siltstone chunks.

It is our understanding that the fill was placed during development for the NCWRP facility, and that the fill materials were derived from on-site excavations. Although documentation pertaining to the original placement of the fill materials is unavailable, the blow counts and in-situ soil density obtained during the field exploration phase indicate that fill materials may be classified as medium dense to dense.

4.3.2 Young Colluvial Deposits

Young colluvial deposits of Holocene age (Kennedy and Tan, 2008), were encountered in boring H-17 to a depth of 3.5 feet bgs. The deposits consist of dark yellow brown highly plastic and expansive clay containing scattered sub-rounded and fractured gravel and cobbles.

4.3.3 Very Old Paralic Deposits

Portions of the study area are underlain by very old paralic deposits of middle to early Pleistocene age (Kennedy and Tan, 2008). These deposits are also referred to as the Lindavista Formation (Kennedy, 1975) of early Pleistocene age. The formation consists of interfingered strandline, beach, estuarine and colluvial deposits composed of siltstone, sandstone and conglomerate with a distinct reddish-brown color due to ferruginous cement. The combination of strong cementation and locally abundant gravels and cobbles pose difficult excavation conditions even for heavy duty construction equipment.

Very old paralic deposits were encountered below the fill materials in borings H-1, H-3, H-4, H-7 and H-21. The deposits extended to a maximum depth of 14 feet bgs. The deposits generally consist of yellowish red to reddish yellow silty sand with locally abundant sub-rounded gravel and cobbles. The formation is generally damp and very dense.

4.3.4 Scripps Formation

The Scripps Formation is a middle Eocene age sandstone with occasional cobble-conglomerate interbeds (Kennedy, 1975). The combination of local cobble-conglomerate zones and strong cementation pose difficult excavation conditions even for heavy-duty construction equipment. The Scripps Formation is in disconformable contact with the very old paralic deposits in the study area, and in conformable contact with the underlying Ardath Shale. However, the Ardath Shale was not encountered in any of our borings.

The Scripps Formation encountered in our borings generally consists of interbedded fine to medium grained sandstone and siltstone, with claystone and cobble-conglomerate interbeds. The Scripps Formation was found to be dense to very dense/very stiff to hard, and damp to wet. The formation was generally massive, with no bedding planes evident in samples obtained from our soil borings. Observation of the Scripps Formation in a cut slope along the east side of the co-generation plant indicates that the formation is nearly flat-lying, with a southerly dip of 5 degrees or less.

4.4 Groundwater

No groundwater or seepage was encountered in the shallow borings H-15 through H-19, and in H-21. These borings were extended to depths ranging from 19.5 feet bgs to 21.5 feet bgs. Drilling methods utilized for the remainder of soil borings required the introduction of water into the boreholes, which precluded our ability to measure if groundwater was present.

The depth of the regional groundwater table beneath the project site is unknown but may be assumed to be in excess of 100 feet bgs. However, localized shallow perched water conditions may occur, particularly during the wet (rainy) season. Perching would most likely be encountered in fill materials above the contact with the relatively impermeable formational materials. Pipe leaks, overflows, and landscape irrigation at the NCWRP facility could potentially contribute to groundwater perching.

The Geotracker website (www.Geotracker.com) contains a groundwater monitoring report by Geo-Logic Associates (2014) for the West Miramar Landfill. The landfill is located approximately 2 miles southeast of the NCWRP site, and is situated on the Linda Vista Terrace. The report states that both a perched (alluvial) and regional (bedrock) aquifer exist at the landfill site. Monitoring of eight deep wells during the period from 2002 through 2014 determined that the regional water table varied from approximately 70 to 253 feet bgs (elevations of 161 to 203 feet msl). The perched water table reportedly varied from approximately 10 to 50 feet bgs (elevations of 222 to 305 feet msl) during the period between 1996 to 2014.

5.0 DISCUSSIONS, OPINIONS, AND RECOMMENDATIONS

5.1 Potential Geologic Hazards

5.1.1 Faulting

A concealed northwesterly trending fault is mapped approximately 300 feet east of the NCWRP entrance on Eastgate Mall (Kennedy, 1975; City of San Diego, 2008). This fault is a strand of the Torrey Pines fault, a high-angle fault with mostly vertical displacement trending in a general eastwest orientation between the coastline and the USMC Air Station Miramar. The fault is classified as "potentially active, inactive, presumed inactive, or activity unknown" by the City of San Diego (2008).

The fault traverses the NCPWF site north of Eastgate Mall. K2 Engineering , Inc. (2016) observed sheared sediments of the Scripps Formation in a west-facing slope above the I-805 freeway west of the NCPWF site, and tentatively identified the shear zone as the Torrey Pines fault. Review of aerial photos did not reveal evidence of this fault where it traverses beneath very old paralic deposits on the mesa top. This fault strand is part of a system of roughly east-west trending faults which include the Salk and the Torrey Pines faults. None of these faults are known to offset geologic units that are younger than Eocene in age and are, therefore, not considered to pose a significant seismic risk to the proposed project.

The nearest mapped major active fault to the project site is the RCFZ, located approximately 3.7 miles southwest of the NCWRP. The RCFZ is a complex set of anastomosing and en-echelon, predominantly strike slip faults that extend from off the coast near Carlsbad to offshore south of downtown San Diego. Investigations of the RCFZ in the Rose Creek area (Rockwell et al, 1991) and in downtown San Diego (Patterson et al, 1986 and Woodward Clyde Con) found evidence of multiple Holocene earthquakes. Based on these studies, several fault strands within the RCFZ have been classified as active faults, and are included in Alquist-Priolo Special Studies Zones. Within San Diego Bay, this fault zone is believed to splay into multiple, subparallel strands; the most pronounced of which are the Silver Strand, Coronado, and Spanish Bight faults. The project site is not located within any Special Studies Zone.

The location of the project site in relation to the active faults in the region is shown on the Regional Fault Map (Figure 9). California Department of Transportation ARS Online (V2.3.09) was used to approximate the distance of the closest ten (10) known faults to the project site. A summary of seismic source characteristics for faults that present the most significant seismic hazard potential to the site is presented in Table 2 on the next page.

Table 2

Summary of Seismic Source Characteristics

Fault	Maximum Magnitude (MMax)	Deterministic Peak Site Acceleration (g)	Closest Distance to Site (mile)
Rose Canyon fault zone (San Diego section)	6.8	0.353	3.7
Rose Canyon fault zone (Del Mar section)	6.8	0.340	4.1
Rose Canyon fault zone (Silver Strand section-Spanish Bight fault)	6.8	0.201	8.82
Rose Canyon fault zone (Silver Strand section-Downtown Graben fault)	6.8	0.166	11.06
Point Loma Fault Zone	6.3	0.211	6.82
Rose Canyon fault zone (Silver Strand section-Silver Strand fault)	6.8	0.165	11.12
Coronado Bank (alt2)	7.4	0.142	17.38
Rose Canyon fault zone (Silver Strand section-Coronado fault)	6.8	0.158	11.65
Rose Canyon fault zone (Oceanside section)	6.8	0.151	12.32
Elsinore (Julian)	7.7	0.094	33.56

5.1.2 Fault Ground Rupture & Ground Lurching

There are no known (mapped) active or potentially active faults crossing the project site (Kennedy, 1975; City of San Diego, 2008). Therefore, the potential for fault ground rupture and ground lurching is considered insignificant.

5.1.3 Liquefaction Potential

Seismically induced soil liquefaction is a phenomenon in which loose to medium dense, saturated granular materials undergo matrix rearrangement, develop high pore water pressure, and lose shear strength due to cyclic ground vibrations. Manifestations of soil liquefaction can include loss of bearing capacity below foundations, surface settlements and tilting in level ground, and instabilities in sloping ground. Soil liquefaction can also result in an increase in lateral and uplift pressures on buried structures.

The findings of our investigation determined that the project site is underlain with medium dense to dense/stiff compacted fill and formational soils and deep groundwater conditions that are considered to have a very low to negligible liquefaction potential.

5.1.4 Landslides

A review of the published geologic maps indicates that the project site is not located on or near any known (mapped) ancient landslides. The geologic units underlying the project area are generally considered competent and not prone to landslide hazards, and review of the State of California Seismic Hazard Zones (2009) and City of San Diego Seismic Safety Study Geologic Hazards and Faults map (2008) indicates that the site is not located in an area that is susceptible to landslide hazards. Therefore, it is our opinion that the potential for landslides at the project site is considered very low.

5.1.5 Lateral Spreading

The project site is underlain by competent geologic units which are not considered susceptible to seismic-induced lateral spreading.

5.1.6 Differential Seismic-Induced Settlement

Differential seismic settlement occurs when seismic shaking causes one type of soil to settle more than another type. It may also occur within a soil deposit with largely homogeneous properties if the seismic shaking is uneven due to variable geometry or thickness of the soil deposit. Based on the results of our investigation, it is our opinion that there is a slight potential of differential settlement in areas underlain by deep mechanically placed man-made fills.

5.1.7 Compressible Soil

The project study area is underlain by competent formational materials that are considered noncompressible. There is a low compressible potential in fill materials and in surficial soils.

5.1.8 Secondary Hazards

The elevation of the project site and distance from any large open water bodies precludes the potential of property damage from seismic-induced tsunamis and/or seiches. The project site is not located within the 100- and/or 500-year flood zone (FEMA Flood Insurance Rate Map, 2012).

5.2 Soil Corrosivity

In accordance with the City of San Diego Water Facility Design Guidelines, Book 2, Chapter 7, soil is generally considered aggressive to concrete if its chloride concentration is greater than 300 parts per million (ppm) or sulfate concentration is greater than 1,000 ppm, or if the pH is 5.5 or less.

Analytical testing was performed on representative samples of the onsite soil materials to determine pH, resistivity, soluble sulfate, chlorides and bicarbonates content. The tests were performed in accordance with California Test Method Nos. 643, 417 and 422. A summary of the test results is presented in Table 3 on the next page. Copies of the analytical laboratory test reports are included in Appendix B.

Table 3

Summary of Corrosivity Test Results

Sample ID	pH	Resistivity (ohm-cm)	Sulfate Conc. (ppm)	Chloride Conc. (ppm)	Bicarbonates Conc. (ppm)
H-1 #2 @4'-5'	6.5	680	480	170	N/A
H-2 #6 @22'-23'	4.8	930	130	190	4
H-3 #2 @4'-5'	5.7	650	210	160	6
H-4 #1 @3'-6'	6.8	550	340	300	32
H-4 #5 @17'-18'	10.5	780	270	260	12
H-5 #3@8'-9'	7.1	450	440	310	30
H-5 #8@25'-28'	7.3	440	210	440	14
H-6 #4@12'-13'	7.9	410	1,080	430	27
H-7 #2@5'-8'	8.9	1,100	140	64	N/A
H-7 #4@13'-14'	8.9	950	140	110	N/A
H-8 #3@8'-9'	7.9	290	500	1,170	24
H-9 #4@14'-15'	7.9	840	150	130	28
H-9 #15@55'-59'	8.3	680	160	190	52
H-10 #3@7'-8'	7.9	840	180	90	50
H-10 #11@40'-43'	8.2	750	340	140	48
H-11 #3@12'-13'	8.2	580	200	230	54
H-11 #10@37'-38'	7.9	440	280	560	48
H-12 #4@12'-13'	8.2	420	340	430	54
H-13 #4@12'-13'	8.9	400	450	470	22
H-13 #9@33'-34'	8.3	300	240	800	30
H-14 #3@9'-10'	7.8	320	320	680	46

Table 3

Summary of Corrosivity Test Results

(Continued)

Sample ID	pH	Resistivity (ohm-cm)	Sulfate Conc. (ppm)	Chloride Conc. (ppm)	Bicarbonates Conc. (ppm)
H-14 #8@25'-26'	7.8	350	230	420	44
H-14 #17@56'-59'	7.7	290	3,420	850	26
H-15 #4@12'-13'	8.3	520	190	300	57
H-16 #3 @12'-13'	8.3	370	270	500	26
H-17 #1@1'-2'	7.7	500	140	43	N/A
H-18 #2@7'-8'	8.1	300	950	620	70
H-19 #2@7'-8'	8.2	480	540	310	18
H-20 #3@8'-9'	6.4	280	220	1,070	8
H-21 #4@13'-14'	7.3	430	290	450	8
H-22 #2@9'-10'	6.9	220	430	1,440	11
H-22 #10@35'-40'	7.4	280	200	960	6

NOTE:

N/A = Unable to extract due to high clay content.

The test results indicate that the on-site materials can be highly aggressive against concrete. Therefore, we recommend that Type V Portland Cement Concrete (high sulfate resistance) be used for the proposed facilities at the project site. It should be noted here that the most effective way to prevent sulfate attack is to keep the sulfate ions from entering the concrete in the first place. This can be done by using mix designs that give a low permeability (mainly by keeping the water/cement ratio low) and, if practical, by placing moisture barriers between the concrete and the soil.

AGE does not practice in the field of corrosion engineering. In the event that corrosion sensitive facilities are planned, we recommend that a corrosion engineer be retained to perform the necessary corrosion protection evaluation and design.

5.3 Expansive Soil

The majority of the onsite soil materials are considered non-expansive. Based on visual observations and laboratory test results, the Scripps Formation was found to contain lenses and/or zones of soil materials which are considered moderately expansive.

5.4 Seismic Design Parameters

The shear wave velocity for the upper 100 feet (V_S) at the project site was estimated based on the corrected blow counts in AGE's borings, and using the correlation method developed by Ohta and Gotto (1978) for cohesive soil and David Boore (2004) extrapolation equation.

$$V_S = 86.9\ (N_{60})^{0.333} \qquad \text{(Ohta \& Goto, 1978)}$$

$$V_S = [1.45 - (0.015 \text{ x } d)] \text{ x } V_{s(d)} \qquad \text{(David Boore, 2004)}$$

A summary of the results of the shear wave analysis based on the normalized blow counts, site classification and remarks are shown in Table 4 on the next page. The calculations are shown in Appendix C.1.

Table 4

Summary of Shear Wave Velocity Analysis

Boring ID	V_S (fps)	Site Classification	Remarks
H-1	1304	C	8' of fill over Very Old Paralic Deposits and Scripps Formation.
H-2	1344	C	15' of fill over Very Old Paralic Deposits and Scripps Formation.
H-3	1318	C	7' of fill over Very Old Paralic Deposits and Scripps Formation.
H-4	1390	C	3' of fill over Very Old Paralic Deposits and Scripps Formation.
H-5	1347	D	22' of fill over Very Old Paralic Deposits and Scripps Formation. Due to the presence of gravels in the fill, actual blow counts are likely lower than recorded blow counts. Despite the calculated shear wave velocity, we recommend that Site Class D be used in the design of structures located in this area.
H-6	1300	D	25' of fill over Very Old Paralic Deposits and Scripps Formation. Due to the presence of gravels in the fill, actual blow counts are likely lower than recorded blow counts. Despite the calculated shear wave velocity, we recommend that Site Class D be used in the design of structures located in this area.
H-7	1234	D	7' of fill over Very Old Paralic Deposits and Scripps Formation.
H-8	1196	D	49' of fill over Scripps Formation.
H-9	1179	D	34' of fill over Scripps Formation.
H-10	1172	D	32' of fill over Scripps Formation.
H-11	1204	D	15' of fill over Scripps Formation.
H-12	1227	D	28' of fill over Scripps Formation.
H-13	1203	D	29' of fill over Scripps Formation.
H-14	1202	D	28' of fill over Scripps Formation.
H-15	1318	C	3' of fill over Scripps Formation.
H-16	1318	C	1.5' of fill over Scripps Formation.
H-17	1318	C	3' of fill over Scripps Formation.
H-18	1318	C	2.5' of fill over Scripps Formation.
H-19	1318	C	3' of fill over Scripps Formation.
H-20	1318	C	1' of fill over Scripps Formation.
H-21	1318	C	3' of fill over Scripps Formation.
H-22	1318	C	6' of fill over Scripps Formation.

Both CBC 2016 and ASCE 7-10 classify sites with V_S of higher than 1,200 feet per second (fps) but lower than 2,500 fps as Site Class C. However, due to uncertainties of the fill thickness and consistency, and that the calculated V_S values for the areas underlain by deep fill are borderline Site Class C and D, we recommend that Site Class D classification be used for areas underlain by soil/bedrock materials with V_S of less than 1,250 fps. Site Class C may be used for areas underlain by soil/bedrock materials with V_S of 1,250 fps or higher. With the exception of the area in the vicinity of borings H-5 and H-6 which is underlain by filled ground in excess of 20 feet thick and should be classified as Site Class D.

The approximate boundaries of Site Class C and Site Class D within the project site is shown on Figure 10. Structures located within Site Class D area with foundation extended into the bedrock may be designed using Site Class C classification. Site Class D parameters, which are more conservative, may be used for design of structures located in Site Class C area. A summary of the recommended site classification for use in seismic design for the individual structures is shown on Table 5 on the next page.

Table 5

Summary of Site Classification for Seismic Design

Proposed Facility	Recommended Site Classification
Primary Sedimentation Tanks	Site Class C
Equalization Basins	Site Class C
First Stage Bioreactor Basins	Site Class C (Although the area is underlain by 22' to 25' of fill, the bottom of the structure is located at approximate elevation +338' msl on the Scripps Formation)
Second Stage Bioreactor Basins	Site Class C (Foundation for proposed structure is supported on either Very Old Paralic Deposits or Scripps Formation)
Secondary Clarifiers	Site Class D (Foundation for proposed structures will be supported on mixed filled ground and Scripps Formation)
Tertiary Filter Building	Site Class D
NCPWF Influent Pump Station	Site Class D
Chemical Building	Site Class C

For structural design in accordance with the ASCE 7-10 procedures (ASCE 7-10), the United States Geological Survey Design Maps (USGS, 2016) were used to calculate ground motion parameters for the project site. The Risk-Targeted Maximum Considered Earthquake (MCE_R) ground motion response acceleration is calculated based on the most severe earthquake effects considered by ASCE 7-10 determined for the orientation that resulted in the largest maximum response to the horizontal ground motions and with adjustment to the targeted risk. The Maximum Considered Earthquake Geometric Mean (MCE_G) is determined for the geometric peak ground acceleration and without adjustment for the targeted risk. The MCE_G Peak Ground Acceleration (PGA) adjusted for site effects (PGA_M) should be used for design and evaluation of liquefaction, lateral spreading, seismic settlements, and other soil related issues.

The calculated seismic design parameters are presented in Tables 6 and 7 on the next page for Site Class C and Site Class D, respectively. The design criteria are based on the soil profile type as determined by existing subsurface geologic conditions, on the proximity of the site to a nearby fault and on the maximum moment magnitude and slip rate of the nearby fault.

Table 6

Summary of Seismic Design Parameters (Site Class C)

REFERENCE	PARAMETER
Table 20.3-1 Site Classification	Site Class = C
Figure 22-1	$S_s = 1.065$ g
Table 11.4-1 Site Coefficient Fa	$F_a = 1.000$
Figure 22-2	$S_1 = 0.408$ g
Table 11.4-2 Site Coefficient Fv	$F_v = 1.392$
Equation 11.4-1	$S_{MS} = 1.065$ g
Equation 11.4-2	$S_{M1} = 0.568$ g
Equation 11.4-3	$S_{DS} = 0.710$ g
Equation 11.4-5	$S_{D1} = 0.379$ g
Figure 22-12	$T_L = 8$ seconds
Figure 22-7	PGA = 0.444 g
Equation 11.8-1	$PGA_M = 0.444$ g
Figure 22-17	$C_{RS} = 0.904$
Figure 22-18	$C_{R1} = 0.961$

Table 7

Summary of Seismic Design Parameters (Site Class D)

REFERENCE	PARAMETER
Table 20.3-1 Site Classification	Site Class = D
Figure 22-1	$S_s = 1.065$ g
Table 11.4-1 Site Coefficient Fa	$F_a = 1.074$
Figure 22-2	$S_1 = 0.408$ g
Table 11.4-2 Site Coefficient Fv	$F_v = 1.592$
Equation 11.4-1	$S_{MS} = 1.144$ g
Equation 11.4-2	$S_{M1} = 0.650$ g
Equation 11.4-3	$S_{DS} = 0.763$ g
Equation 11.4-5	$S_{D1} = 0.433$ g
Figure 22-12	$T_L = 8$ seconds
Figure 22-7	PGA = 0.444 g
Equation 11.8-1	$PGA_M = 0.469$ g
Figure 22-17	$C_{RS} = 0.904$
Figure 22-18	$C_{R1} = 0.961$

Figure 22-1	Ss Risk-Targeted Maximum Considered Earthquake (MCER) Ground Motion Parameter for the Conterminous United States for 0.2 s Spectral Response Acceleration (5% of Critical Damping), Site Class B.
Figure 22-2	S1Risk-Targeted Maximum Considered Earthquake (MCER) Ground Motion Parameter for the Conterminous United States for 1.0 s Spectral Response Acceleration (5% of Critical Damping), Site Class B.
Figure 22-12	Mapped Long-Period Transition Period, TL (s), for the Conterminous United States.
Figure 22-7	Maximum Considered Earthquake Geometric Mean (MCEG) PGA, %g, Site Class B for the Conterminous United States.
Figure 22-17	Mapped Risk Coefficient at 0.2 s Spectral Response Period, CRS.
Figure 22-18	Mapped Risk Coefficient at 1.0 s Spectral Response Period, CR1.

5.5 Earthwork

5.5.1 General Requirements

The earthwork operations for the project should be performed in accordance with the approved plans and specifications for the project, the applicable provisions of the City of San Diego Grading Ordinance, and Section 300 of the latest edition of Standard Specifications for Public Works Construction (SSPWC, known as the "Green Book").

5.5.2 Soil Excavation Characteristics

Based on our experience with similar geologic units, we anticipate that excavations in the majority of the on-site soil materials can be easily accomplished using conventional heavy-duty excavation equipment. Difficult excavation conditions may be encountered within the highly cemented and/or highly conglomeratic zones of the very old paralic deposits and Scripps Formation, and may require the use of rock breaker and/or jackhammer.

5.5.3 Fill Materials

Soil materials generated from excavation in the young colluvial deposits may be highly plastic and expansive, and may not considered suitable for use as compacted fill. Soil materials generated from the very old paralic deposits and the conglomerate facies of the Scripps Formation are likely to contain abundant gravel and cobbles, and may require selective screening of oversize materials if they are utilized as compacted fill. In lieu of screening, it may be more practical and economical for the Contractor to use select import fill materials.

The remainder of soil materials generated from excavations at the project site are considered suitable for use and placement as structural fill in the proposed building areas. Fill materials should be free of biodegradable materials, hazardous substance contamination, other deleterious debris, and shall have no rock and/or cobbles larger than 6 inches in any dimensions. If the fill materials contain rocks or hard lumps, at least 70 percent (by weight) of its particles shall pass a U.S. Standard 3/4-inch sieve. Fill materials should consist of predominantly granular soil (less than 40 percent passing the U.S. Standard #200 sieve) with Expansion Index of less than 50.

5.5.4 Fill Placement and Compaction

Prior to placement of fill materials, the firm competent ground which is determined to be satisfactory for the support of filled ground shall be plowed or scarified to a depth of at least 6 inches until the surface is free from ruts, hummocks, or other uneven features which would tend to prevent uniform compaction by the equipment to be used. Fill placed on slope steeper than 5 : 1 (horizontal : vertical) should be keyed and benched into properly compacted fill materials or competent formational materials. The key should consists of a minimum 10 feet wide by 2-foot deep bench which should be excavated into the slope with a minimum inclination of 2 percent.

Additional horizontal benches shall be cut into the existing slope in order to provide both lateral and vertical stability for the new fill materials. The purpose of the benches is to provide a horizontal base so that each layer is placed and compacted on a horizontal plane. The width and frequency of all benches should be determined in the field during the earthwork operation based on the actual soil conditions and the gradient of the existing slope.

The fill materials should be moisture-conditioned, placed and uniformly compacted in layers until final elevations are reached. Each layer should be no thicker than that will allow for adequate bonding and compaction, but shall not exceed 8 inches in loose (uncompacted) thickness. Unless otherwise specified, all fills shall be compacted to at least 90 percent of maximum dry density as determined in the laboratory by the ASTM D1557-00 test method. Field density testing shall be performed in accordance with either the Sand Cone Method (ASTM D1556) or the Nuclear Gauge Method (ASTM D2922 and D3017).

5.6 Controlled Low Strength Material

CLSM refers to a cementitious slurry consisting of a mixture of fine aggregate or filler, water, and cementitious material(s), which is used as a fill or backfill in lieu of compacted earth. The mixture is capable of filling all voids in irregular excavations and hard to reach places, self-leveling, and hardens in a matter of a few hours without the need for compaction.

CLSM for the subject project should be designed with a compressive strength that will allow excavation with heavy machinery at maximum compressive strengths of 50 psi at 4 days, 150 psi at 28 days, and 200 psi at 1 year and maximum unit weight not to exceed 115 pounds per cubic foot (pcf). The coefficient of permeability of the CLSM should be equal or greater than that of the surrounding soil.

CLSM should have minimal subsidence and bleed water shrinkage. Evaporation of bleed water should not result in shrinkage of more than 1/8 inch per foot of CLSM depth (for mixes containing high fly ash content) when measured in accordance with ASTM C 940 test method "Standard Test Method for Expansion and Bleeding of Freshly Mixed Grouts for Preplaced-Aggregate Concrete in the Laboratory".

CLSM should be sampled and tested in the field in conformance with either ASTM C 94 or C 685. Samples for tests should be taken for every 150 cubic yards of material, or fraction thereof, for each day's placement. Tests should include temperature reading and four compressive strength cylinders. Compressive strength sampling and testing should conform to ASTM D 4832 with one specimen tested at 7 days, two at 28 days, and one held for each batch of four specimens.

Installation of CLSM should only be performed when existing and forecasted weather conditions are within the limits established by the manufacturer of the materials and products used. The mix design should produce a consistency that will result in a flowable product at the time of placement which does not require manual means to move it into place. Placement of the CLSM should be performed in accordance with the manufacturer’s mix design specifications. CLSM is also considered suitable for use as trenched excavation backfill.

5.7 General Foundation Recommendations

An allowable soil bearing capacity of 4,000 psf and 2,500 psf may be use for design of foundations which are founded on undisturbed formational soil (Very Old Paralic Deposits and Scripps Formation) and properly compacted filled ground, respectively. An allowable soil bearing capacity of 4,000 psf may be used for design of foundations which are supported on CLSM.

For design of mat foundations, a modulus subgrade reaction (k) value of 275 pounds per cubic inch (pci) and 225 pci may be used for mats placed directly on firm native soils and properly compacted filled ground, respectively. Modulus subgrade reaction (k) values of 300 pci and 350 pci may be used for mat foundations placed on Class II Aggregate Base (or equivalent) and crushed rock materials wrapped in geofabric, respectively. A modulus subgrade reaction (k) value of 275 pci may be used for design of mats which are supported on CLSM.

Under static condition, total settlement of the foundation designed as recommended herein is estimated to be less than 0.25 inch. Differential settlement between the center and the edge of the mat foundation is expected not to exceed 0.25 inch over a horizontal distance of 50 feet. No permanent deformation and/or post-construction settlement is anticipated, provided that backfill around the structures is properly compacted in accordance with the project specifications.

Resistance to lateral loads may be developed by a combination of friction acting at the base of the foundation and passive earth pressure developed against the sides of the foundations below grade. Passive pressure and friction may be used in combination, without reduction, in determining the total resistance to lateral loads.

An allowable passive earth resistance of 350 psf per foot of foundation embedment below grade may be used for the sides of foundations placed against competent native soils and CLSM. The maximum recommended allowable passive pressure is 3,500 psf. An allowable passive earth pressure of 350 psf per foot of foundation embedment below grade may be used for the sides of foundations placed against properly compacted filled ground. The maximum recommended allowable passive pressure is 2,500 psf. A coefficient of friction of 0.40 , 0.35 and 0.30 may be used for foundations cast directly on competent native soils, properly compacted fill and visqueen moisture barrier, respectively. Based on Portland Cement Association Concrete Masonry Handbook for Architects, Engineers, Builders (2008), a friction coefficient of 0.4 may be used for design of concrete against CLSM. A coefficient of friction of 0.4 may be used for foundations cast directly on Class II Aggregate Base (or equivalent) and crushed aggregate rock materials wrapped in geofabric.

A summary of the general foundation recommendations are presented in Table 8 on the next page.

Table 8

Summary of General Foundation Recommendations

Recommended Design Parameters	**Properly Compacted Fill**	**Undisturbed Formation**	**CLSM**	**Class II Aggregate Base**	**Crushed Rock Wrapped in Geofabric**	**Visqueen Moisture Barrier**
Allowable Bearing (psf)	2,500	4,000	4,000	N/A	N/A	N/A
Modulus of Subgrade Reaction (pci)	225	275	275	300	350	N/A
Passive Resistance	350 pcf equivalent fluid weight not to exceed 2,500 psf	350 pcf equivalent fluid weight not to exceed 3,500 psf	350 pcf equivalent fluid weight not to exceed 3,500 psf	N/A	N/A	N/A
Coefficient of Friction	0.35	0.40	0.40	0.40	0.40	0.30

5.8 Subterranean and Retaining Walls

We recommend that all subterranean and retaining walls be backfilled with soil materials which have less than 40 percent passing the standard #200 sieve and not less than 70 percent passing the U.S. standard 3/4-inch sieve, expansion index of less than 30 and minimum internal friction angle of 35°. In addition, the backfill materials should not contain any organic debris, rocks or hard lumps greater than 6 inches, or other deleterious materials. All backfill soils should be compacted to at least 90 percent of maximum dry density as determined in the laboratory by the ASTM D1557 testing procedure. In lieu of soil materials, walls may also be backfilled with CLSM.

For design of properly backfilled subterranean and retaining walls, an active soil pressure equivalent to that generated by a fluid weighing 35 and 61 pounds per cubic foot, for level and 2:1 (horizontal : vertical) sloped backfill, respectively, may be used for design of the wall assuming that they are free to rotate at the top at least 0.001H (where H is the height of the wall). An at-rest soil pressure equivalent to that generated by a fluid weighing 60 pounds per cubic foot may be used for design of wall restrained at the top. Traffic surcharge occurring within a horizontal distance equal to the wall height should be added as lateral pressure equal to a uniformly distributed load of 75 psf along the entire face of the wall.

Subterranean and retaining walls should be designed to resist the lateral earth pressures presented in Figures 11 and 12 provided that the wall backfill materials are properly placed and compacted in conformance with the recommendations presented in this report. The at-rest soil pressure on Figure 12 is shown as a combination of the earth pressure and restrained additive term. Surcharge and foundation loads occurring within a horizontal distance equal to the wall height should be added to the lateral pressures presented in Figures 13 and 14.

Calculation for the Seismic Active Earth Pressure was performed in accordance with the procedure outlined in Section 11.6.5.3 of the AASHTO LRFD Bridge Design Specifications 6th Edition (2012) using the Mononobe-Okabe (M-O) Method. The Horizontal Acceleration Coefficient (K_h) is estimated to be 1/2 of PGA_M and equal to 0.234 (Site Class D) and 0.222 (Site Class C), Vertical Acceleration Coefficient (K_v) is assumed to be zero. The backfill material is assumed to have a unit weight of 120 pcf, friction angle of 35° and cohesion value of 500 psf. The calculated Seismic Active Earth Pressure Coefficient (K_{AE}) is equal to 0.15 for retaining structures up to 25 feet in height.

Based on the conditions described above, a triangular pressure distribution of 12 pcf (equivalent fluid pressure) may be used for the Seismic Active Earth Pressure for both Site Class C and Site Class D. This seismic earth pressures may be assumed to act at 0.4H from the bottom of the wall and are applicable for both cantilever and braced conditions. Forces resulting from wall inertia effects are expected to be relatively minor for non-gravity walls and/or walls retaining less than 5 feet of backfill materials, and may be ignored in estimating the seismic lateral earth pressure.

An active soil pressure equivalent to that generated by a fluid weighing 20 pounds per cubic foot may be used for walls backfilled with CLSM, assuming that they are free to rotate at the top at least 0.001H (where H is the height of the wall). An at-rest soil pressure equivalent to that generated by a fluid weighing 40 pounds per cubic foot may be used for the design of walls backfilled with CLSM. Forces resulting from the CLSM inertia effects are expected to be relatively minor, and may be ignored in estimating the seismic lateral earth pressure.

Based on the subsurface conditions observed within the borings, it is anticipated that foundations for the proposed retaining wall along the fill slope on the east side of the proposed Secondary Clarifiers Tanks will be underlain partially by the existing canyon fill and partially by the the Scripps Formation. In order to reduce the potential for differential soil settlement, we recommend that foundations for the proposed retaining wall be embedded in uniformly compacted filled ground. The filled ground should extend a minimum depth of 24 inches below the elevation of the bottom of the wall foundations and a minimum lateral distance of 12 inches beyond the face of the wall foundation. The over-excavated area should then be backfilled with uniformly compacted fill materials to the proposed finish grade elevations. The fill materials should be moisture-conditioned, and recompacted to at least 95 percent of maximum dry density as determined in the laboratory by the ASTM D1557 testing method.

The safe allowable bearing capacities, passive earth pressures and coefficient of frictions presented in Section 5.7 of this report may be used for design of walls as described herein. Where practical, it is recommended that a foundation setback of at least 6 feet be observed from the wall foundations to the face of any slope. Where the wall foundations are located closer than 6 feet from the face of the slope, it is recommended that the foundations in those areas be deepened such that the exterior face of the footing at its bottom level is at least 6 feet away from the face/surface of the slope at the same level. No reduction in friction and passive pressure is required for walls designed as above.

5.9 Secondary Clarifiers

Based on the subsurface conditions observed in borings H-11 through H-14, both the filled ground and Scripps Formation are considered capable of providing competent support for the proposed secondary clarifiers. Therefore, it is our opinion that reinforced mat foundation may be used to provide support for the proposed secondary clarifiers. To reduce the potential for differential settlement due to variable fill thickness and mixed condition (between the fill and Scripps Formation), we recommend that a 12-inch thick Class II Aggregagte Base material compacted to 95% relative compaction or 12-inch thick 3/4-inch crushed rock materials wrapped in geofabric be placed beneath the bottom of the secondary clarifiers. A geologic cross-section (D-D’) of the Secondary Clarifiers area is shown on Figure 15 and the location of the cross-section is shown on Figure 5.

We further understand that the proposed southern secondary clarifiers will be underlain by an existing 60-inch diameter storm drain pipeline. To reduce the potential for excessive settlement and damage to the existing pipeline, we recommend that the design load for the mat foundation be limited to 2,000 psf or less. The same modulus of subgrade reaction, passive resistance, coefficient of friction, active pressure and seismic active earth pressure values presented in Sections 5.7 and 5.8 of this report may be used in the design of the Secondary Clarifiers.

AGE has performed an analysis of the loading impact from the secondary clarifiers and proposed grading on the existing storm drain pipeline in general accordance with Holl’s and Newmark’s modifications to Boussinesq’s equation (Spangler, 1946) as described in Section 9.3.1.2 - Distributed Loads of the ASCE Manuals and Reports on Engineering Practice No. 60 - Gravity Sanitary Sewer Design and Construction, Second Edition -MOP 60, 2007. The design assumptions, procedures and results are shown in Appendix C.2. The results of the analysis indicate that the two southern secondary clarifiers will generate additional loading on the storm drain pipeline ranging between 65 psf to 680 psf. The analysis further indicates that no additional loading is imposed on the storm drain pipeline by the two northern secondary clarifiers.

It is our understanding that to protect the existing storm drain pipeline from the additional loading impact, a system which consists of a protective slab over the pipeline is proposed. The protective slab will be supported on 36-inch diameter Cast-In-Drilled-Hole (CIDH) piles on both sides of the existing storm drain pipeline. We further understand that the protective slab will extend beneath the proposed retaining wall located on the east side of the secondary clarifiers. The conceptual drawings of the proposed system prepared by Kleinfelder, the structural engineer for the Secondary Clarifiers, is shown on Figures 16 and 17. The pile design recommendations are presented in Section 5.10 below.

5.10 36-Inch CIDH Pile Design Recommendations

AGE has performed an analysis of the proposed CIDH piles using the following assumptions.

Pile Type = 36-inch CIDH

Approximate Pile Cut-off Elevation (ft. msl) = +319

Approximate Bottom of Fill (ft. msl) = +311
Note: Assumed to be 2' below the invert elevation of the 60-inch stormdrain pipe. Actual elevation during construction may vary.

Approximate Top of Scripps Formation (ft. msl) = +311
Note: Actual elevation during construction may vary.

Approximate Tip Elevation(ft. msl) = +294
Note: Required verification during construction that minimum embedment in Scripps Formation requirement specified below is met.

Minimum Pile Length (ft.) = 25

Minimum Embedment into Scripps Formation (ft.) = 10

Fill Soil Parameters
- Density (pcf) = 100
- Shear Angle (degree) = 30
- Cohesion (psf) = 0

Scripps Formation Parameters
- Density (pcf) = 100
- Shear Angle (degree) = 35
- Cohesion (psf) = 500

Resistance to lateral loads may be developed by the passive earth pressures developed against the sides of the pile caps or spread footings. For design purposes, an allowable passive earth resistance of 350 psf per foot of depth, up to a maximum of 2,500 psf, may be used for pile caps and footings placed against properly compacted fill material. The upper 12 inches of soil materials in areas not protected by slabs or pavements should be excluded in the calculation for passive resistance to lateral loads.

As an alternate, for piles, resistance to lateral loads may be developed by the bending strength of the pile. The lateral capacity of the piles depends on the amount of deflection and the condition of fixity at the top of the pile. A fixed-head condition denotes that the pile cap is free to translate but fixed against rotation. Whereas a free-head condition denotes that the pile cap is free both to translate and rotate. The response of the pile is assumed to be linearly elastic, whereas the soil behavior is modeled as an elasto-plastic material using soil resistance-deflection (P-Y) curves.

We recommend that the values in Table 9 below be used for preliminary structural design purposes. Pile calculations are shown on Appendix C.3.

Table 9

36-Inch CIDH Pile Design Parameters

	36-inch Diameter CIDH Pile
Factor of Safety	End Bearing = Skin friction = 2.0
Working Axial Resistance (kips)	375
Free-Head Working Lateral Resistance (kips)	28
Fixed-Head Working Lateral Resistance (kips)	47

The lateral pile capacities are applicable for the case where the lateral loads are applied at the pile cap and maximum allowable pile cap deflection of 0.25 inch. If greater deflection can be tolerated, pile lateral loads can be increased directly in proportion to the deflection, up to a maximum deflection of 1 inch. If the actual pile conditions are substantially different, AGE should be contacted to provide additional analyses.

To evaluate the installation procedure and actual pile capacity, we recommend the installation of at least 4 indicator piles prior to production pile construction. We further recommend that at least two static pile load test be performed to confirm the axial load capacity of the piles. The load tests should be performed in general accordance with ASTM D1143, "Standard Test Method for Deep Foundations under Static Axial Compressive Load." The static pile load test should be loaded to the ultimate load demand of twice the design service load (750 kips). As an alternative to the static pile load tests, force pulse testing (rapid load tests) may be performed. If force pulse testing is selected, we recommend that all 4 indicator piles be tested. Force pulse load test should be performed in general accordance with ASTM D7383, "Standard Test Methods for Axial Compressive Force Pulse (Rapid) Testing of Deep Foundations". Provided that the test piles were not tested to failure (more than 1 inch total deflection at the top of pile), the test piles may be used as production piles.

5.11 Concrete Slab-on-Grade

Conventional concrete slabs-on-grade may be used at the project site. New concrete slabs-on-grade should be 6 inches thick underlain by 6 inches of Class II Aggregate Base. Where moisture-sensitive floor coverings are planned, the slabs should also be underlain by a 10 Mil visqueen moisture barrier. Steel reinforcement for concrete slabs-on-grade shall be determined by the project structural engineer based on the actual thickness of the slabs, anticipated loading conditions and possible concrete shrinkage.

For slabs underlain by compacted fill, and mixed ground condition (partially on fill and partially on formational material), it is recommended that at least the upper 24 inches of the subgrade beneath all concrete slabs-on-grade and the base layer be uniformly compacted to a minimum of 95 percent of maximum dry density as determined in the laboratory by the ASTM D1557 testing procedure. For design of concrete slabs-on-grade, modulus subgrade reaction (k) values presented in Section 5.7 of the report may be used.

5.12 Drainage Control

Proper control and maintenance of site drainage is critical to the future performance of the project. Infiltration of irrigation and/or storm water into the subsurface soils could adversely affect the performance of the soils.

It is recommended that positive drainage be provided around the perimeter of all proposed buildings. Positive drainage is generally defined as a minimum 2 percent slope over a horizontal distance of at least 5 feet away from the perimeter foundations of a structure. No surface water should be allowed to collect or pond anywhere in the building areas, especially adjacent to or near foundations and slabs. Roof runoff should be controlled by using eave gutters and downdrains, and the discharge from the downdrains should be collected in a system of subdrain pipes which carry the water directly into a suitable on-site drainage facility.

Landscape irrigation should be monitored and controlled to determine the appropriate amount of irrigation necessary to maintain the landscaping without overwatering.

5.13 Cut-and-Cover Pipeline Construction

It is our understanding that construction of underground utilities for the proposed project will be performed using conventional open cut excavation methods. Since no changes are planned to the existing ground surface along the pipeline alignment, the net stress change in the underlying soils is considered negligible.

Furthermore, the fill materials are expected to provide a stable trench bottom under static conditions. In the event that loose or disturbed soils are encountered at the trench bottom, it is recommended that they be over-excavated and replaced with pipe bedding or other approved materials. The actual limits/extent of over-excavation of loose or soft materials at the bottom of the trench excavations should be evaluated by City's Resident Engineer during construction.

5.13.1 Soil and Excavation Characteristics

Based on our experience with similar geologic units, we anticipate that excavations in the majority of the on-site soil materials can be easily accomplished using conventional heavy-duty excavation equipment. Difficult excavation conditions may be encountered within the highly cemented and/or conglemeratic zones of the very old paralic deposits and Scripps Formation, and may require the use of rock breaker and/or jackhammer.

5.13.2 Fill Materials

Soil materials generated from excavation in the young colluvial deposits may be highly plastic and expansive, and may not considered suitable for use as compacted fill. Soil materials generated from the very old paralic deposits and the conglomerate facies of the Scripps Formation are likely to contain abundant gravel and cobbles, and may require selective screening of oversize materials if they are utilized as compacted fill. In lieu of screening, it may be more practical and economical for the Contractor to use select import fill materials.

The remainder of soil materials generated from excavations at the project site are considered suitable for use and placement as structural fill in the proposed building areas. Fill materials should be free of biodegradable materials, hazardous substance contamination, other deleterious debris, and shall have no rock and/or cobbles larger than 6 inches in any dimensions. If the fill materials contain rocks or hard lumps, at least 70 percent (by weight) of its particles shall pass a U.S. Standard 3/4-inch sieve. Fill materials should consist of predominantly granular soil (less than 40 percent passing the U.S. Standard #200 sieve) with Expansion Index of less than 50.

5.13.3 Pipe Loads and Settlement

Pipes should be designed for all loads applied by surrounding soils including dead load from soils, loads applied at the ground surface, uplift loads, and earthquake loads. Soil loading may be estimated assuming a density of 125 pcf for the backfill materials. Where a pipe changes direction abruptly, resistance to thrust forces can be provided by means of thrust blocks. For design purposes, the passive resistance against thrust blocks embedded in properly compacted fill and undisturbed formational soil may be estimated using an equivalent fluid density of 200 pcf and 300 pcf, respectively. Thrust blocks should be embedded a minimum of 3 feet beneath the ground surface.

As an alternate method, restrained joints may be used to provide resistance to thrust forces. Our analysis is based on the assumption that the pipe backfill materials are considered cohesionless. A restrained joint system is subjected to the same thrust forces as in a thrust block system, however the forces are distributed over the restrained pipe length. A friction angle between the pipe and soil (M) of 20°, Coefficient of Friction against sides of trench (μ) of 0.3 and Rankine's Ratio (K) of 0.37 may be used to design the necessary length of the restrained pipe.

Simplified (non finite element analysis) analysis methods for estimation of the additional soil pressure that will act on pipes during earthquake loading are not available. In general, unless the pipeline is located in a zone with potential for high differential movement such as a fault zone crossing, liquefiable zone, shear plane, or transition zone where the pipe enters a structure, flexible pipelines will conform to the ground movement during a seismic event without failure. To further reduce the risk of pipe damage that could occur as a result of earthquake loading, we recommend that design vertical and horizontal loads on pipes that result from soil dead loads be increased by 50 percent.

Buried flexible pipes are generally designed to limit deflections caused by applied loads. The deflections can be estimated using the Modified Spangler equation. A modulus of soil reaction, E', equal to 1,000 psi may be used to represent backfill soils of medium to low plasticity (LL < 50) with less than 50 percent fines passing the #200 standard sieve.

5.13.4 Trench Backfill

It is recommended that installation of sewer, water and storm drain pipelines be performed in accordance with Drawing No. SDS-110, SDW-110 and SDD-110, respectively, of the City of San Diego Regional Standard Drawings.

5.13.5 Placement and Compaction of Backfill

Prior to placement, all backfill materials should be moisture- conditioned, spread and placed in lifts (layers) not-to-exceed 6 inches in loose (uncompacted) thickness, and uniformly compacted to at least 90 percent relative compaction. During backfilling, the soil moisture content should be maintained at or within 2 percent above the optimum moisture content of the backfill materials. It is recommended that the upper 24 inches directly beneath proposed paved areas be compacted to at least 95 percent relative compaction. The maximum dry density and optimum moisture content of the backfill materials should be determined in the laboratory in accordance with the ASTM D1557 testing procedure.

Small hand-operated compacting equipment should be used for compaction of the backfill materials to an elevation of at least 3 feet above the top (crown) of the pipes. Flooding or jetting should not be used to densify the backfill.

5.14 Pavement Design for Driveways and Parking Lot

For the design of new pavement sections we have utilized the design procedures outlined in Asphalt Institute MS-1 and MS-23, and Portland Cement Association EB068. For preliminary design purposes, we have used a subgrade design R-value of 30. The actual R-value should be verified at the time of construction by sampling the final elevation subgrade material and performing R-value testing in the laboratory for verification. A summary of the recommended pavement sections is presented in Table 10 on the next page. These pavement sections assume a pavement life of approximately 20 years with normal maintenance.

Table 10

Recommended Pavement Sections

TRAFFIC TYPE	DESIGN LOAD	REINFORCED P.C.C. PAVEMENT	A.C. PAVEMENT	
			A.C.	CLASS II AGGREGATE BASE (min R-value of 78)
Parking Aisles & Driveway	TI = 6.5	7"	4.0"	6.0"

NOTES:

(1) Mix design for Portland Cement Concrete and asphalt concrete be prepared by an engineering company specializing in this type of work, and that the paving operations be inspected by a qualified testing laboratory.

(2) Aggregate base course should conform to the requirements of the Caltrans Standard Specifications.

(3) Prior to the construction of the pavement sections, R-value tests should be performed on representative samples of the subgrade soil materials to verify the R-value assumed for the design of the pavement sections.

For delivery truck areas subjected to stopping and impact loading, we recommend a minimum section of 8 inches of P.C.C. over 4 inches of Class II Aggregate Base. The P.C.C. pavement sections should be provided with steel reinforcement and crack-control joints designed by the structural engineer. Crack-control joints should extend a minimum depth of 1/3 of the thickness of the pavement section. A concrete mix with minimum 28-day modules of rupture (MOR) of 620 psi should be used in the design of the pavement section.

P.C.C. pavement should be constructed with thickened edges. Thickened edges should be at least 1.2 times the pavement thickness, and taper back to the recommended slab thickness three feet behind the edge of the slab. To control the location and spread of concrete shrinkage cracks, it is recommended that crack control joints (weakened plane joints) be included in the design of the concrete pavement. Crack control joints should be constructed at a spacing distance, in feet, of not less than three times the recommended slab thickness in inches, and should be sealed with an appropriate sealant to prevent migration of water through the control joint to the subgrade materials.

It is recommended that all structural pavement sections be constructed in accordance with the guidelines and procedures set forth in Section 302 of the “Green Book”. Both concrete and asphalt pavement sections should be placed on a prepared subgrade. We recommend that the upper 24 inches of the subgrade and aggregate base be uniformly compacted to a minimum of 95 percent of maximum dry density as determined in the laboratory by the ASTM D1557 testing procedure.

We recommend that adequate surface drainage be provided to reduce ponding and infiltration of water in the subgrade materials. All paved areas should have a minimum gradient of 1 percent. As much as possible, irrigated areas next to pavement should be avoided; otherwise subdrains should be used to drain the areas to appropriate outlets. It is important to provide adequate drainage to reduce ponding and possible future distress of the pavement sections.

5.15 Stormwater Infiltration

AGE did not perform a percolation testing program at the project site. However, based on our experience with other projects in the general area and similar soil types, and analysis based of particle size distribution (Appendix C.4), it is anticipated that infiltration rates of less than 0.2 inches per hour for Very Old Paralic Deposits and less than 0.1 inch per hour in the silt and clay facies to a high of 0.5 inches per hour in the sandstone unit of the Scripps Formation may be used for design of Best Management Practice (BMP) storm water facilities at the project site. Infiltration rates within the fill materials at the project site are expected to vary widely for preliminary evaluation. Infiltration rates of 0.1 to 0.5 inches per hour may be used for the fill materials for preliminary design purposes. We recommend that field infiltration testing be performed for the final design of proposed BMP storm water facilities.

Infiltrated water is anticipated to flow in the direction of the infilled canyons at the project site. The City should verify the presence of trenches in close proximity to any proposed BMP storm water facilities and/or deep trenches which may intercept the flow of the infiltrated water from BMP facilities.

The proposed storm water infiltration is not anticipated to adversely impact the groundwater quality in the general area of the project site. Vertical distance to the regional groundwater table is anticipated to be 100 feet or greater. A search of the Geotracker data base does not reveal the presence of any water supply wells within 100 feet of the project site.

6.0 CONSTRUCTION-RELATED CONSIDERATIONS

6.1 Temporary Excavations

Excavation and safety during construction are the sole responsibility of the contractor. Excavations should be performed in accordance with applicable Local, State, and prevailing Federal and Cal OSHA safety regulations to prevent excessive ground movement and failure. Unsupported temporary excavations in the fill materials similar to those encountered in the exploratory borings may be constructed at an inclination no steeper than 1.5 : 1 (horizontal to vertical), or flatter, up to a maximum height of 15 feet. Unsupported temporary excavations in the formational materials similar to those encountered in the exploratory borings may be constructed at an inclination no steeper than 3/4 : 1 (horizontal to vertical), or flatter, up to a maximum height of 15 feet. Temporary construction slopes are considered to have a factor of safety against deep-seated failure in excess of 1.2 under static conditions.

Observations will need to be performed during site grading to check that no adverse conditions, geologic features or discontinuities are exposed in the excavation which may necessitate shoring or tie-backs. The contractor should exercise caution and provide adequate safety measures during excavations to protect equipment and/or personnel working directly below any excavation. Adequate safety measures include, but are not limited to, providing proper drainage control above and below the excavation, and elimination of any surcharge within a lateral distance equal to the height of the excavations.

6.2 Temporary Shoring

The contractor shall be responsible for the design and installation of temporary shoring for all vertical excavations in excess of 4 feet in height. Design and installation of shoring should be in accordance with the requirements specified by the State of California, Division of Occupational Safety and Health, Department of Industrial Relations (CAL OSHA). Furthermore, it should be the contractor's responsibility to provide adequate and safe support for all excavations and nearby located improvements which could be damaged by earth movement.

Settlement of existing street improvements and/or utilties adjacent to the shoring may occur in proportion to both the distance between shoring system and adjacent structures or utilities and the amount of horizontal deflection of the shoring system. Vertical settlement will be maximum directly adjacent to the shoring system, and decreases as the distance from the shoring increases. At a distance equal to the height of the shoring, settlement is expected to be negligible. Maximum vertical settlement is estimated to be on the order of 75 percent of the horizontal deflection of the shoring system. It is recommended that shoring be designed to limit the maximum horizontal deflection to 1/2-inch or less where existing structures or utilities are to be protected.

Temporary shoring should be designed to resist the pressure exerted by the retained soils and any additional lateral forces due to loads placed near the top of the excavation. For design of braced shorings supporting fill materials, the recommended lateral earth pressure should be 32H psf, where H is equal to the height of the retained earth in feet. For braced shoring supporting formational materials, the recommended lateral earth pressures may be reduced to 20H psf. Any surcharge loads would impose uniform lateral pressure of 0.3q, where "q" equals the uniform surcharge pressure. The surcharge pressure should be applied starting at a depth equal to the distance of the surcharge load from the top of the excavation.

Resistance to lateral loads will be provided by passive soil resistance. The allowable passive pressure for the fill materials and colluvial deposits may be assumed to be equivalent to a fluid weighing 250 pcf. Allowable lateral bearing pressure in fill material should not exceed 2,500 psf. Allowable passive pressure for undisturbed formational materials may be assumed to be equivalent to a fluid weighing 350 pcf, with maximum allowable lateral bearing pressure of 3,500 psf.

6.3 Construction Dewatering

The depth of the local groundwater table is expected to be well below the anticipated depth of the proposed excavations for this project. No groundwater or seepage was encountered in any of our exploratory borings.

We therefore do not anticipate the need for dewatering of excavations made during construction. The contractor should, however, anticipate the possible need for sump pumps in the event that localized perched water conditions are encountered during construction. Localized perched water conditions would most likely occur at the interface between fill materials and formational materials. The design, installation, and operation of any construction dewatering measures necessary for the project shall be the sole responsibility of the contractor.

6.4 CIDH Piles Construction Considerations

It is anticipated that standard continuous flight rotary augers may be used for construction of the proposed CIDH piles. The need for the use of drilling fluids and or slurry displacement method for the installation of the proposed CIDH piles are not anticipated.

Zones with abundance gravels and cobbles were encountered during the subsurface investigation. The contractor should be prepared to use drilling buckets in the event that the augers are unable to extract the cuttings from the drilled shafts. No boulders and/or hard rocks were encountered during the subsurface investigation. Therefore, the need for rock coring is not anticipated on this project. The use of temporary steel casings may be required within portions of the drilled shafts which are located in fill and/or zones with abundant gravels and cobbles. In the event that steel casings are required, the casings may be extracted from the shafts as the concrete is placed.

It is recommended that prior to placement of reinforcing steel, all footing shafts be downhole inspected to confirm and verify the soil type at the bottom of the shafts and minimum depth embedment into the Scripps Formation. Furthermore, prior to placement of concrete, it is recommended that the shafts be cleaned of all loose materials with a cleanout bucket. Concrete should be placed by using a tremie or pump pipe which can be adjusted to permit free discharge of concrete and lowered rapidly, if needed, without excessive contact with the sides of the shaft.

6.5 Environmental Considerations

The scope of AGE's investigation did not include the performance of a Phase I Environmental Site Assessment (Phase I ESA) to evaluate the possible presence of soil and/or groundwater contamination beneath the project site. During our subsurface investigation soil samples were field screened for the presence of volatile organics using a RAE Systems MiniRAE 3000 organic vapor meter (OVM). The field screening did not reveal elevated levels of volatile organics in the samples. In the event that hazardous or toxic materials are encountered during the construction phase, the contractor should immediately notify the City and be prepared to handle and dispose of such materials in accordance with current industry practices and applicable Local, State and Federal regulations.

7.0 GENERAL CONDITIONS

7.1 Post-Investigation Services

Post-investigation geotechnical services are an important continuation of this investigation, and we recommend that the City's Construction Inspection Division performs the necessary geotechnical observation and testing services during construction. In the event that the City is unable to perform said services, it is recommended that our firm be retained to provide the services.

Sufficient and timely observation and testing should be performed during excavation, subgrade preparation, pipeline installation, backfilling and other related earthwork operations. The purpose of the geotechnical observation and testing is to correlate findings of this investigation with the actual subsurface conditions encountered during construction and/or to provide supplemental recommendations, if necessary. The geotechnical observation and testing are also intended to confirm that the structures and pipelines are placed on competent soil materials, and that suitable bedding and backfill materials have been properly placed and compacted to meet the project specifications.

7.2 Uncertainties and Limitations

The information presented in this report is intended to for the sole use of the CH2M Design Team, and the City of San Diego for project design purposes only and may not provide sufficient data to prepare an accurate bid.

Our firm has observed and investigated only a very limited portion of the subsurface conditions at the project site. The findings and recommendations presented in this report are based on the assumption that the subsurface conditions beneath the entire project site do not deviate substantially from those encountered in the exploratory soil borings. Consequently, modifications or changes to the recommendations presented herein may be necessary based on the actual subsurface conditions encountered during the project construction phase.

California, including San Diego County, is in an area of high seismic risk. It is generally considered economically unfeasible to build a totally earthquake-resistant project and it is, therefore, possible that a nearby large magnitude earthquake could cause damage at the project site.

Geotechnical engineering and geologic sciences are characterized by uncertainty. Professional judgments and opinions presented in this report are based partly on our evaluation and analysis of the technical data gathered during our present study, partly on our understanding of the scope of the proposed project, and partly on our general experience in geotechnical engineering.

In the performance of our professional services, we have complied with that level of care and skill ordinarily exercised by other members of the geotechnical engineering profession currently practicing under similar circumstances in southern California. Our services consist of professional consultation only, and no warranty of any kind whatsoever, expressed or implied, is made or intended in connection with the work performed. Furthermore, our firm does not guarantee the performance of the project in any respect.

Our firm does not practice or consult in the field of safety engineering. The contractor will be responsible for the health and safety of his/her personnel and all Subcontractors at the construction site. The contractor should notify the City if he or she considers any of the recommendations presented in this report to be unsafe.

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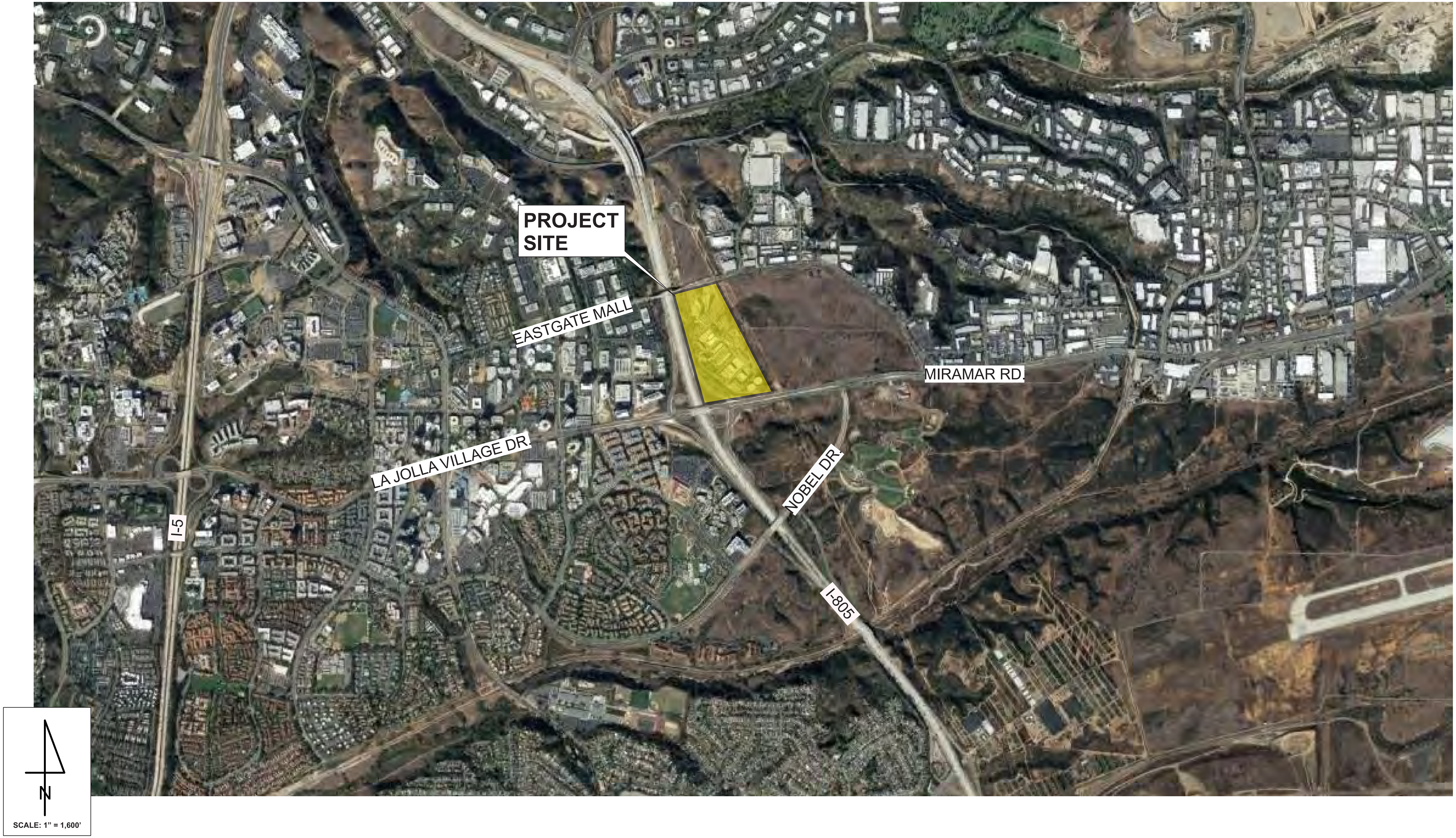
FIGURES



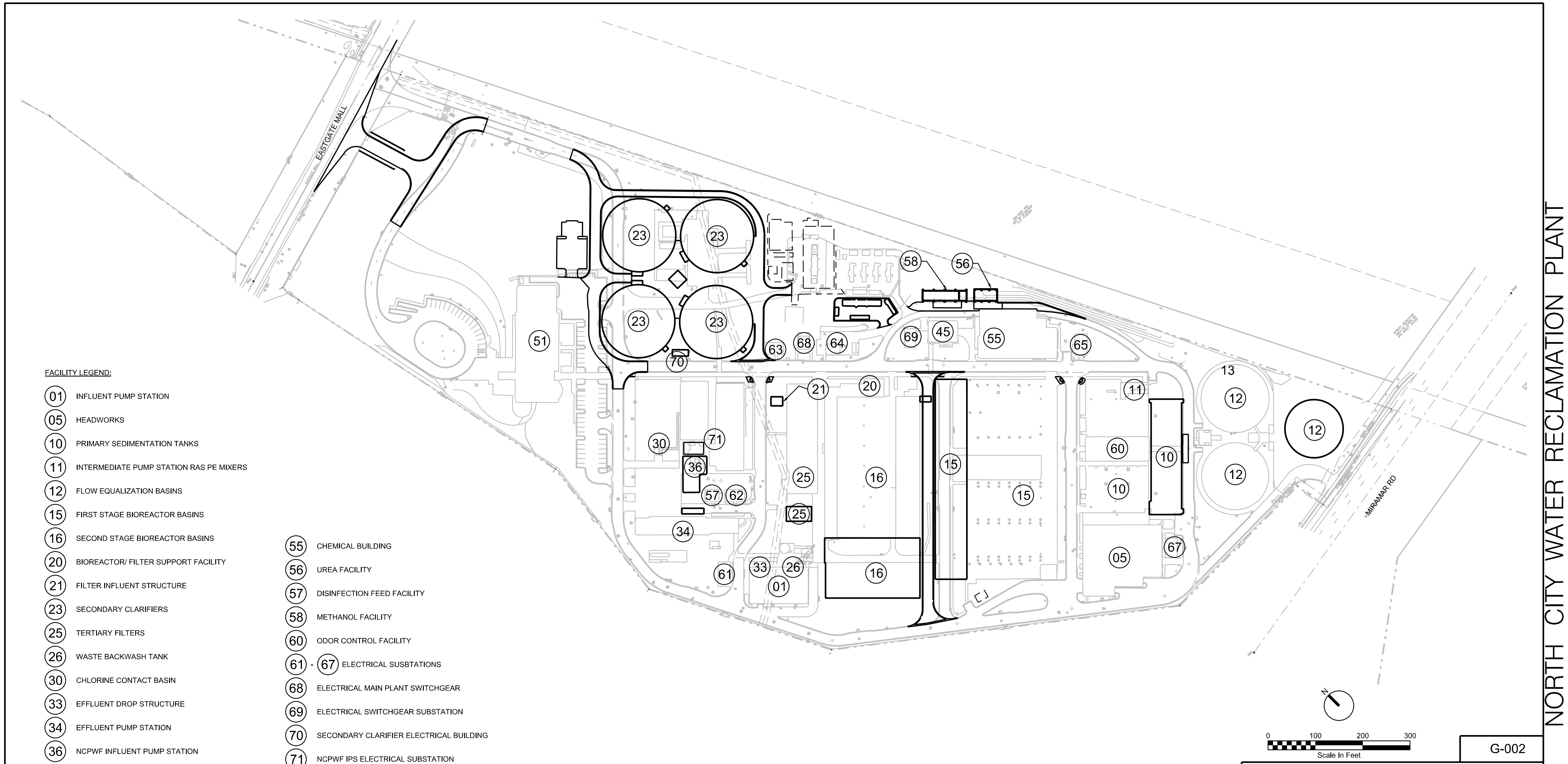
NORTH CITY WATER RECLAMATION PLANT EXPANSION

LOCATION MAP

PROJECT NO. 44F1

ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE 1



FACILITY LEGEND:

01	INFLUENT PUMP STATION
05	HEADWORKS
10	PRIMARY SEDIMENTATION TANKS
11	INTERMEDIATE PUMP STATION RAS PE MIXERS
12	FLOW EQUALIZATION BASINS
15	FIRST STAGE BIOREACTOR BASINS
16	SECOND STAGE BIOREACTOR BASINS
20	BIOREACTOR/ FILTER SUPPORT FACILITY
21	FILTER INFLUENT STRUCTURE
23	SECONDARY CLARIFIERS
25	TERTIARY FILTERS
26	WASTE BACKWASH TANK
30	CHLORINE CONTACT BASIN
33	EFFLUENT DROP STRUCTURE
34	EFFLUENT PUMP STATION
36	NCPWF INFLUENT PUMP STATION
45	BLENDED SLUDGE PUMP STATION
51	OPERATIONS BUILDING
55	CHEMICAL BUILDING
56	UREA FACILITY
57	DISINFECTION FEED FACILITY
58	METHANOL FACILITY
60	ODOR CONTROL FACILITY
61 - 67	ELECTRICAL SUSBTATIONS
68	ELECTRICAL MAIN PLANT SWITCHGEAR
69	ELECTRICAL SWITCHGEAR SUBSTATION
70	SECONDARY CLARIFIER ELECTRICAL BUILDING
71	NCPWF IPS ELECTRICAL SUBSTATION

G-002

SAN DIEGO NCWRP EXPANSION AND
NCPWF INFLUENT CONVEYANCE

GENERAL
PROJECT KEY PLAN

CITY OF SAN DIEGO, CALIFORNIA
PUBLIC UTILITIES DEPARTMENT
SHEET XXXX OF XXX SHEETS

WBS ______

APPROVED:
______ FOR CITY ENGINEER ______ DATE
______ PRINT DCE NAME ______ RCE#

SUBMITTED BY:
J HOYLE
PROJECT MANAGER

CHECKED BY:
M BALDWIN
PROJECT ENGINEER

______ CCS27 COORDINATE
______ CCS83 COORDINATE

DESCRIPTION	BY	APPROVED	DATE	FILM

CONSTRUCTION CHANGE / ADDENDUM

CHANGE	DATE	AFFECTED OR ADDED SHEET NUMBERS	APPROVAL NO.

WARNING
0 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE

The City of SAN DIEGO Public Utilities

CONSULTANT

ch2m SM

MATTHEW JOHN
BALDWIN
CA C71817

NOT FOR
CONSTRUCTION

CONTRACTOR ______ DATE STARTED ______
INSPECTOR ______ DATE COMPLETED ______

FILENAME: G-002_684476.dgn PLOT DATE: 2017\05\15 PLOT TIME: 4:00:22 PM

30% DESIGN

NORTH CITY WATER RECLAMATION PLANT EXPANSION | **SITE PLAN**

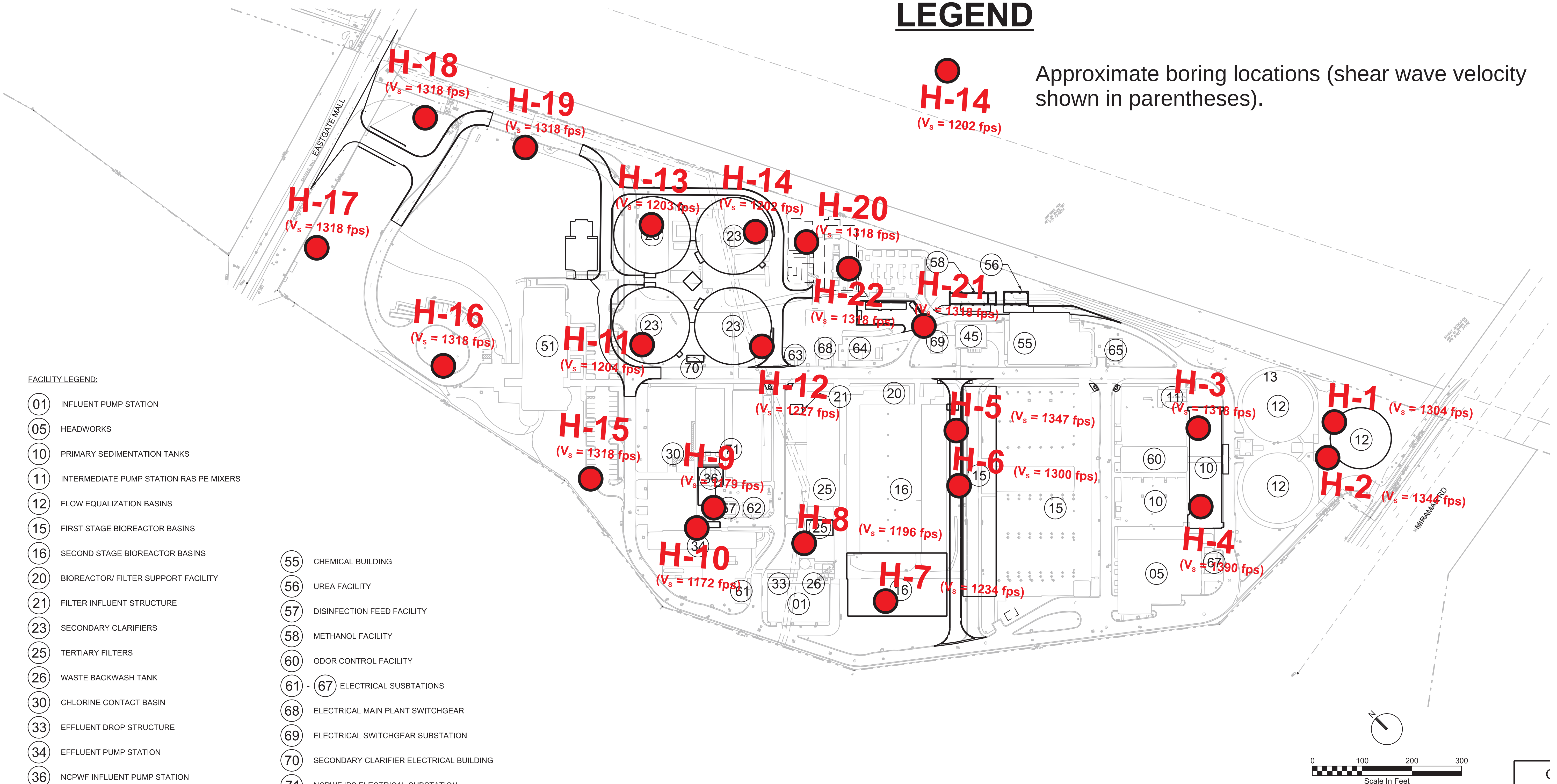
PROJECT NO. 44F1

ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE 2

LEGEND

● H-14 (V_s = 1202 fps) Approximate boring locations (shear wave velocity shown in parentheses).



FACILITY LEGEND:

01	INFLUENT PUMP STATION
05	HEADWORKS
10	PRIMARY SEDIMENTATION TANKS
11	INTERMEDIATE PUMP STATION RAS PE MIXERS
12	FLOW EQUALIZATION BASINS
15	FIRST STAGE BIOREACTOR BASINS
16	SECOND STAGE BIOREACTOR BASINS
20	BIOREACTOR/ FILTER SUPPORT FACILITY
21	FILTER INFLUENT STRUCTURE
23	SECONDARY CLARIFIERS
25	TERTIARY FILTERS
26	WASTE BACKWASH TANK
30	CHLORINE CONTACT BASIN
33	EFFLUENT DROP STRUCTURE
34	EFFLUENT PUMP STATION
36	NCPWF INFLUENT PUMP STATION
45	BLENDED SLUDGE PUMP STATION
51	OPERATIONS BUILDING
55	CHEMICAL BUILDING
56	UREA FACILITY
57	DISINFECTION FEED FACILITY
58	METHANOL FACILITY
60	ODOR CONTROL FACILITY
61 - 67	ELECTRICAL SUSBTATIONS
68	ELECTRICAL MAIN PLANT SWITCHGEAR
69	ELECTRICAL SWITCHGEAR SUBSTATION
70	SECONDARY CLARIFIER ELECTRICAL BUILDING
71	NCPWF IPS ELECTRICAL SUBSTATION

SAN DIEGO NCWRP EXPANSION AND
NCPWF INFLUENT CONVEYANCE

GENERAL
PROJECT KEY PLAN

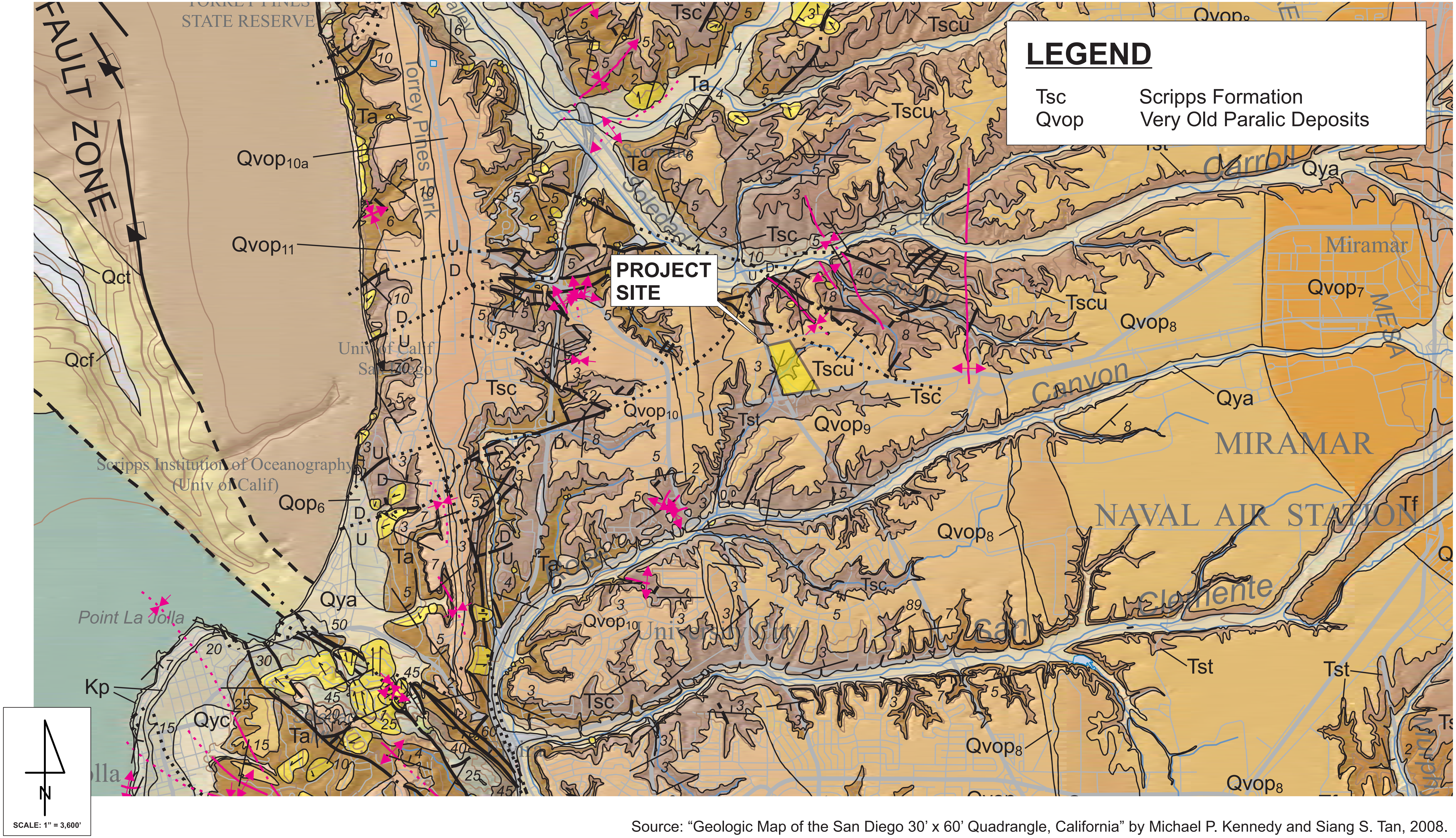
NORTH CITY WATER RECLAMATION PLANT EXPANSION

SITE PLAN SHOWING APPROXIMATE BORING LOCATIONS

PROJECT NO.
44F1

ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE 3



LEGEND

Tsc	Scripps Formation
Qvop	Very Old Paralic Deposits

Source: "Geologic Map of the San Diego 30' x 60' Quadrangle, California" by Michael P. Kennedy and Siang S. Tan, 2008.

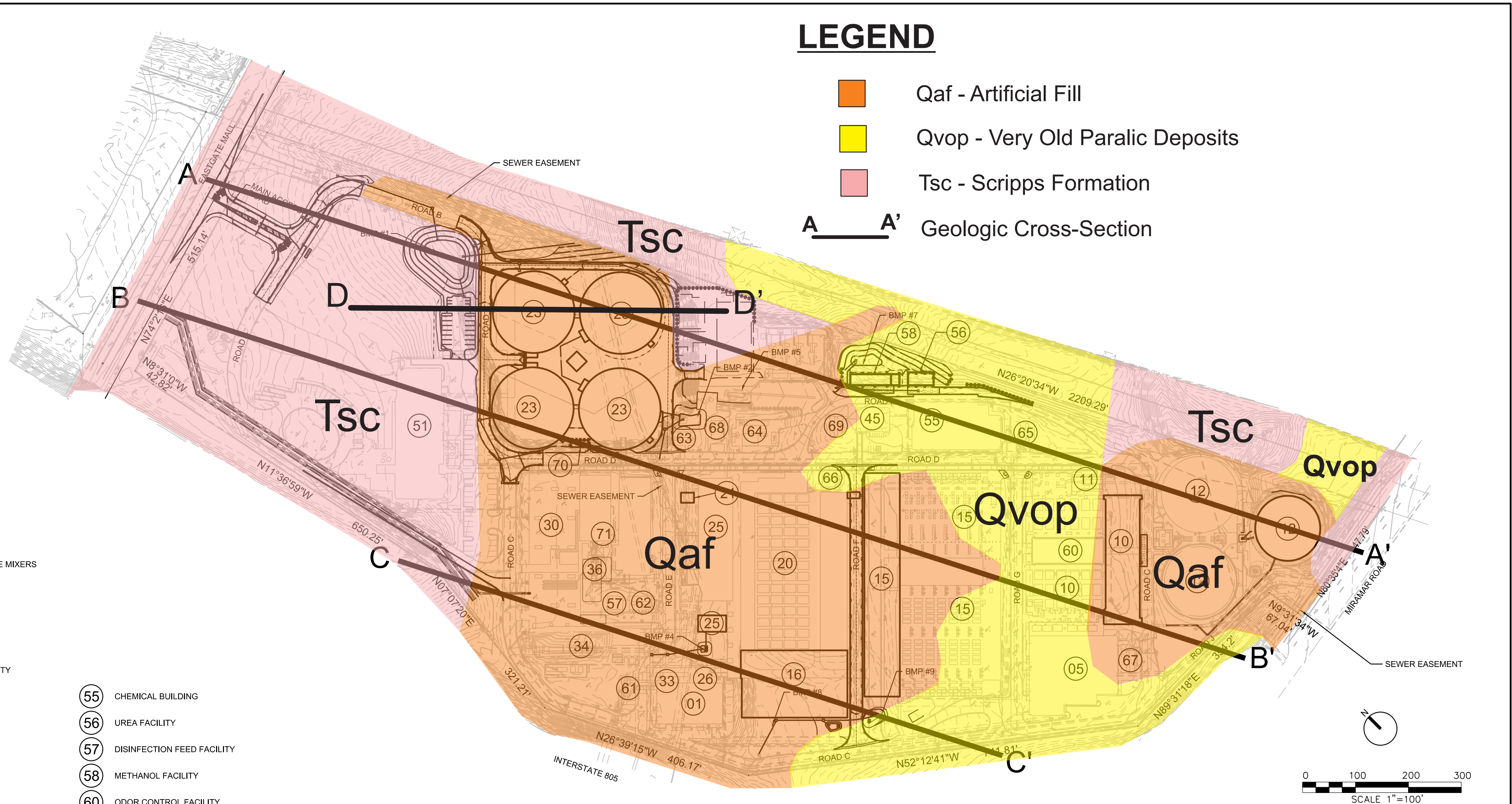
NORTH CITY WATER RECLAMATION PLANT EXPANSION

GENERALIZED GEOLOGIC MAP

PROJECT NO.
44F1

ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE 4



LEGEND

🟧	Qaf - Artificial Fill
🟨	Qvop - Very Old Paralic Deposits
🟥	Tsc - Scripps Formation
A_____A'	Geologic Cross-Section

0 100 200 300
SCALE 1"=100'

FACILITY LEGEND:

01	INFLUENT PUMP STATION
05	HEADWORKS
10	PRIMARY SEDIMENTATION TANKS
11	INTERMEDIATE PUMP STATION RAS PE MIXERS
12	FLOW EQUALIZATION BASINS
15	FIRST STAGE BIOREACTOR BASINS
16	SECOND STAGE BIOREACTOR BASINS
20	BIOREACTOR/FILTER SUPPORT FACILITY
21	FILTER EFFLUENT BOX
23	SECONDARY CLARIFIERS
25	TERTIARY FILTERS
26	WASTE BACKWASH TANK
30	CHLORINE CONTACT BASIN
33	EFFLUENT DROP STRUCTURE
34	EFFLUENT PUMP STATION
36	NCPWF INFLUENT PUMP STATION
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51	OPERATIONS BUILDING
55	CHEMICAL BUILDING
56	UREA FACILITY
57	DISINFECTION FEED FACILITY
58	METHANOL FACILITY
60	ODOR CONTROL FACILITY
61 - 67	ELECTRICAL SUBSTATIONS
68	ELECTRICAL MAIN PLANT SWITCHGEAR
69	ELECTRICAL SWITCHGEAR SUBSTATION
70	SECONDARY CLARIFIER ELECTRICAL BUILDING
71	NCPWF IPS ELECTRICAL SUBSTATION

Note: Shallow fill (3' or less) and backfill around structures are not shown.

NORTH CITY WATER RECLAMATION PLANT

PK2-CG-100

SAN DIEGO NCWRP EXPANSION
PACKAGE 2 – NCPWF INFLUENT CONVEYANCE
CIVIL
SITE CIVIL
GRADING PLAN
OVERALL

CITY OF SAN DIEGO, CALIFORNIA
PUBLIC UTILITIES DEPARTMENT
SHEET XXXX OF XXXX SHEETS

WBS ______

APPROVED:
______ FOR CITY ENGINEER
______ DATE
______ PRINT DCE NAME
______ RCE#

SUBMITTED BY:
______ PROJECT MANAGER
CHECKED BY:
______ PROJECT ENGINEER
______ CCS27 COORDINATE
______ CCS83 COORDINATE

DESCRIPTION	BY	APPROVED	DATE	FILM

CONSTRUCTION CHANGE / ADDENDUM

CHANGE	DATE	AFFECTED OR ADDED SHEET NUMBERS	APPROVAL NO.

WARNING
0 1
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The City of
SAN DIEGO Public Utilities

CONSULTANT

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CONSULTANTS
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Suite 100
Carlsbad, California 92010
760–931–7700
Fax: 760–931–8680
ODayConsultants.com

Civil Engineering
Planning
Processing
Surveying

KEITH W. HANSEN
CA 60223

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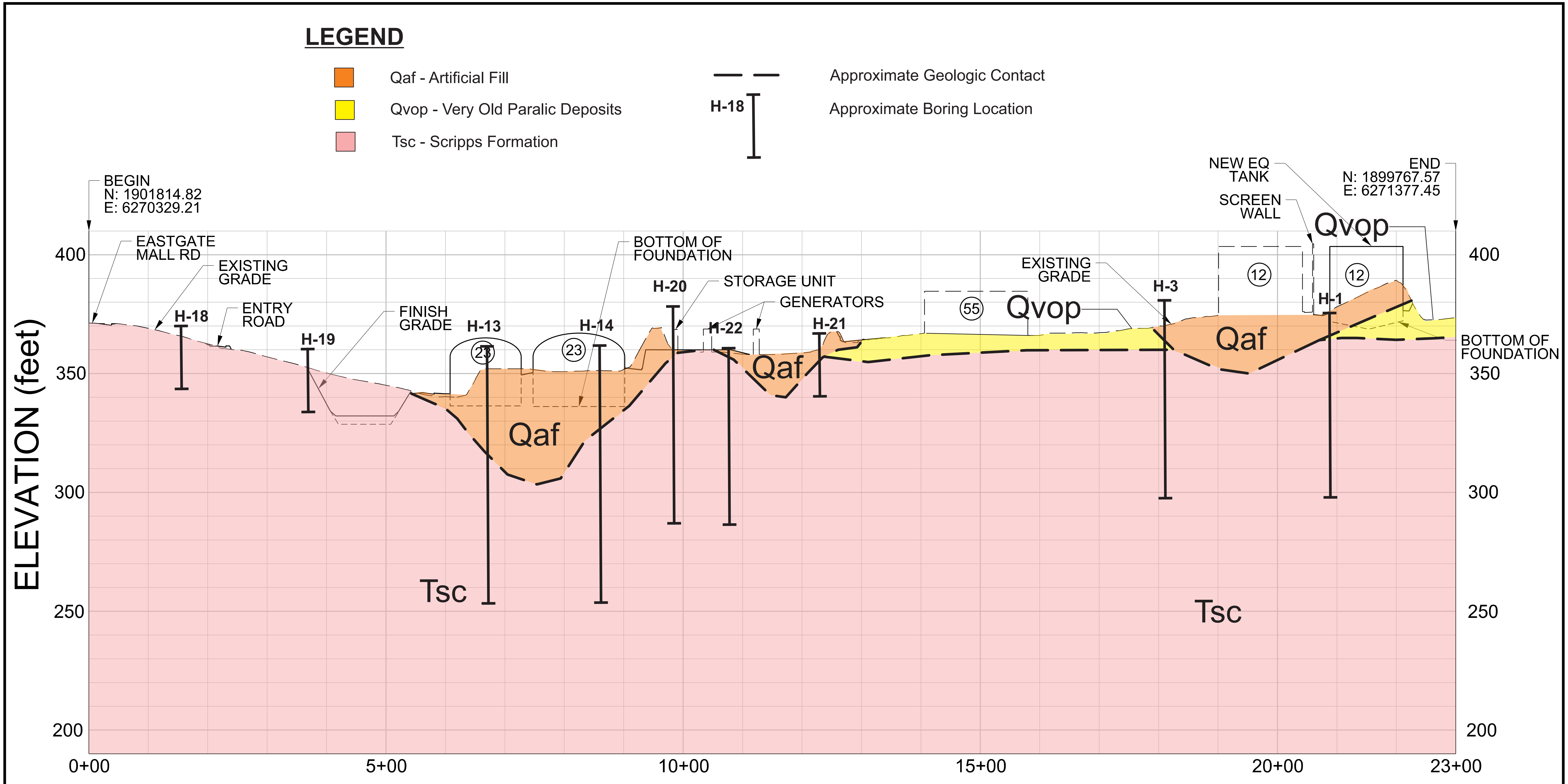
CONTRACTOR ______ DATE STARTED ______
INSPECTOR ______ DATE COMPLETED ______

FILENAME: PK2-CG-100_684476.dgn PLOT DATE: 2017\08\03 PLOT TIME: 11:00:03 AM

PK2-60% DESIGN

NORTH CITY WATER RECLAMATION PLANT EXPANSION	SITE SPECIFIC GEOLOGIC MAP
PROJECT NO. 44F1	ALLIED GEOTECHNICAL ENGINEERS, INC.
	FIGURE 5



SECTION A-A'

SCALE: H: 1" = 160'
V: 1" = 40'

NORTH CITY WATER RECLAMATION PLANT EXPANSION

CROSS-SECTION A-A'

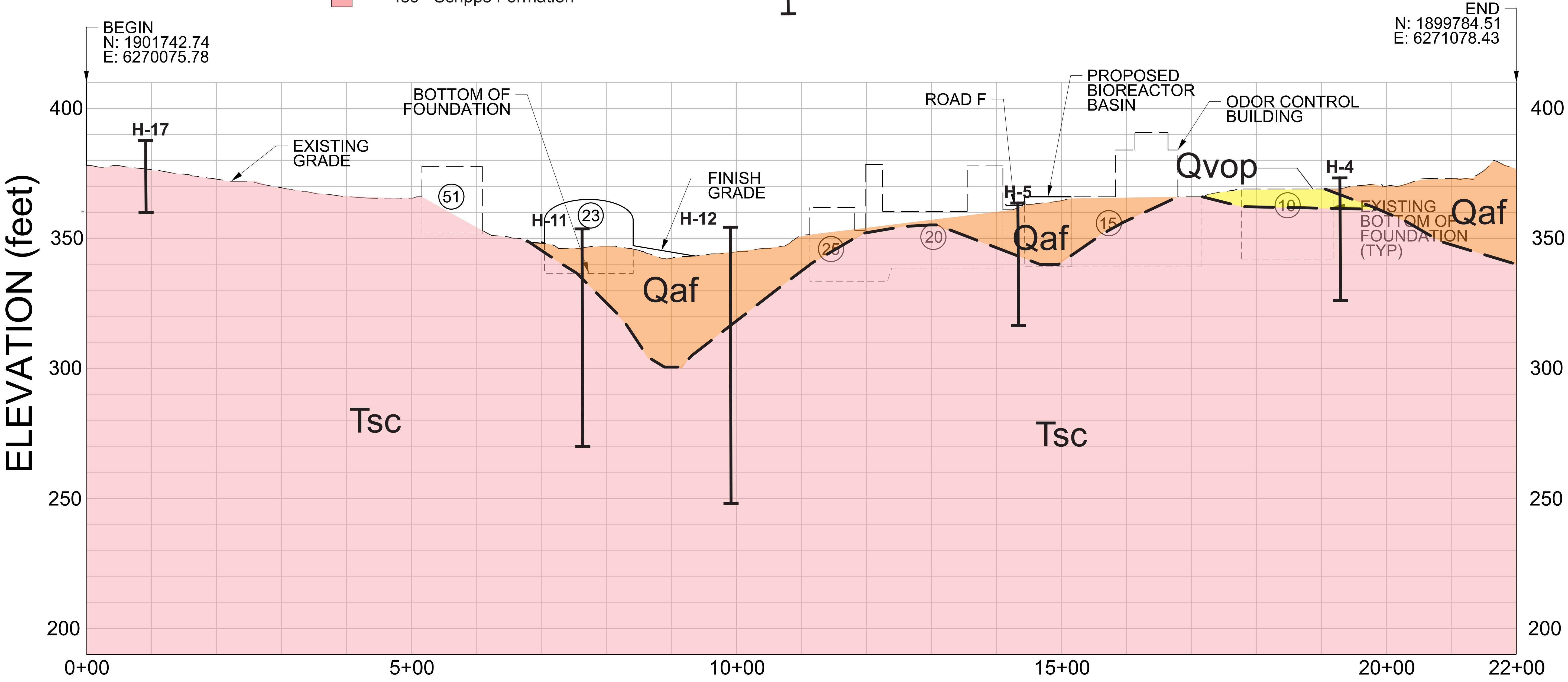
PROJECT NO.
44F1

ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE 6

LEGEND

🟧	Qaf - Artificial Fill
🟨	Qvop - Very Old Paralic Deposits
🟥	Tsc - Scripps Formation
— —	Approximate Geologic Contact
H-18 I	Approximate Boring Location

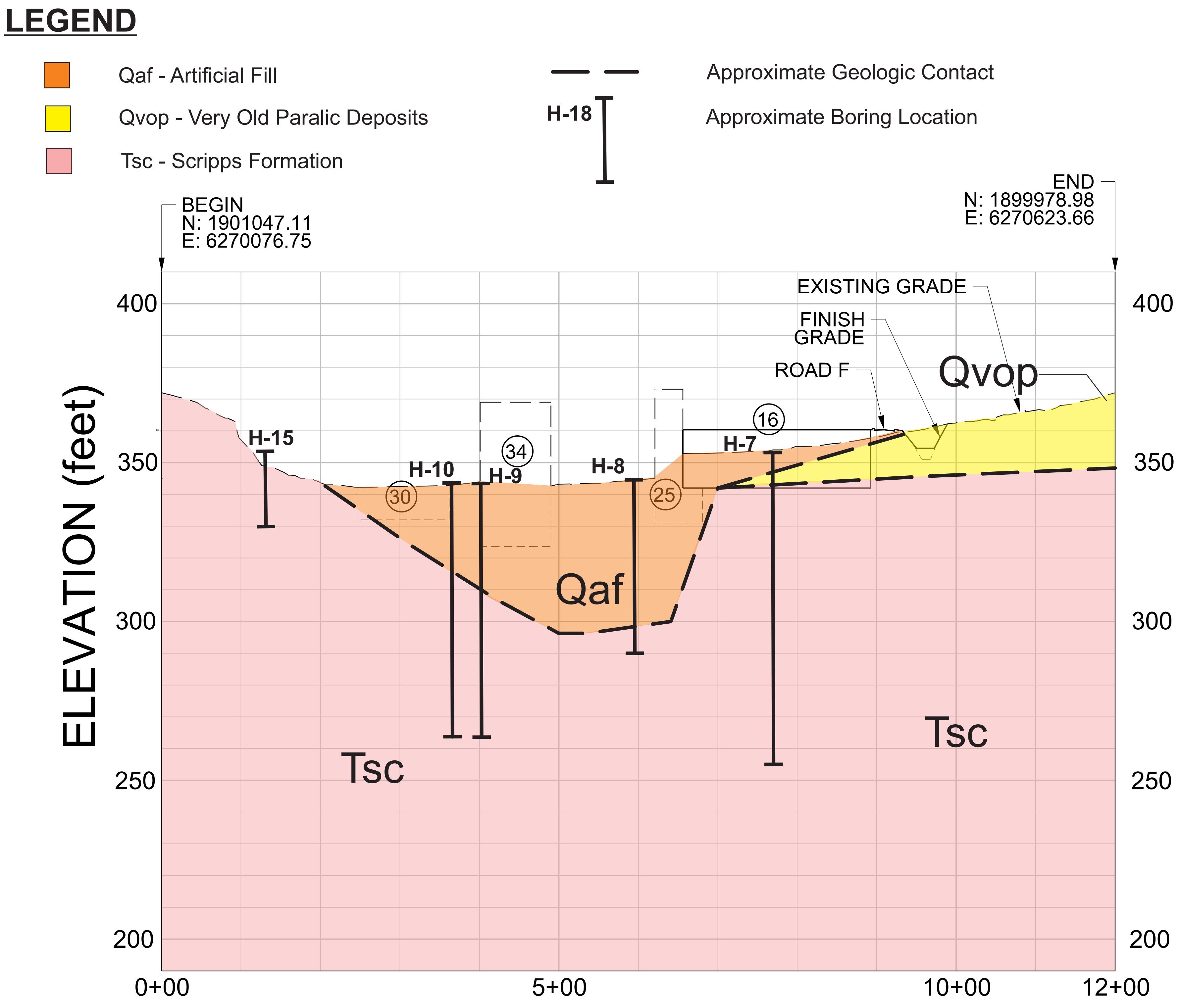


SECTION B-B'

SCALE: H: 1" = 160'
V: 1" = 40'

NORTH CITY WATER RECLAMATION PLANT EXPANSION	**CROSS-SECTION B-B’**

PROJECT NO. 44F1	**ALLIED GEOTECHNICAL ENGINEERS, INC.**	**FIGURE 7**



SECTION C-C'

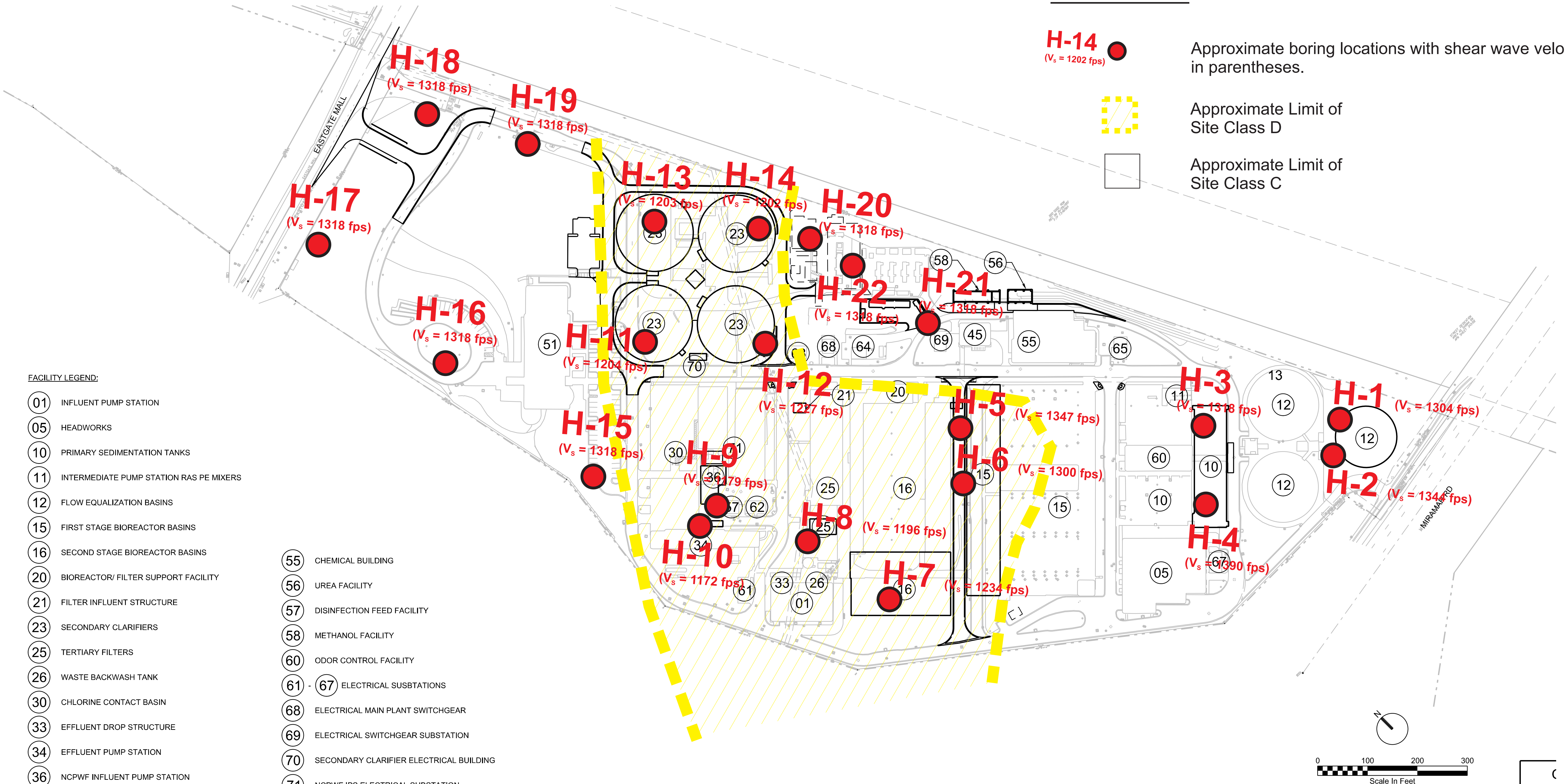
SCALE: H: 1" = 160'
V: 1" = 40'

NORTH CITY WATER RECLAMATION PLANT EXPANSION	CROSS-SECTION C-C’
PROJECT NO. 44F1	ALLIED GEOTECHNICAL ENGINEERS, INC.
	FIGURE 8

NORTH CITY WATER RECLAMATION PLANT EXPANSION		REGIONAL FAULT MAP
PROJECT NO. 44F1	ALLIED GEOTECHNICAL ENGINEERS, INC.	FIGURE 9

LEGEND

H-14 (V_s = 1202 fps) ●	Approximate boring locations with shear wave velocity in parentheses.
▨	Approximate Limit of Site Class D
☐	Approximate Limit of Site Class C



FACILITY LEGEND:

01	INFLUENT PUMP STATION
05	HEADWORKS
10	PRIMARY SEDIMENTATION TANKS
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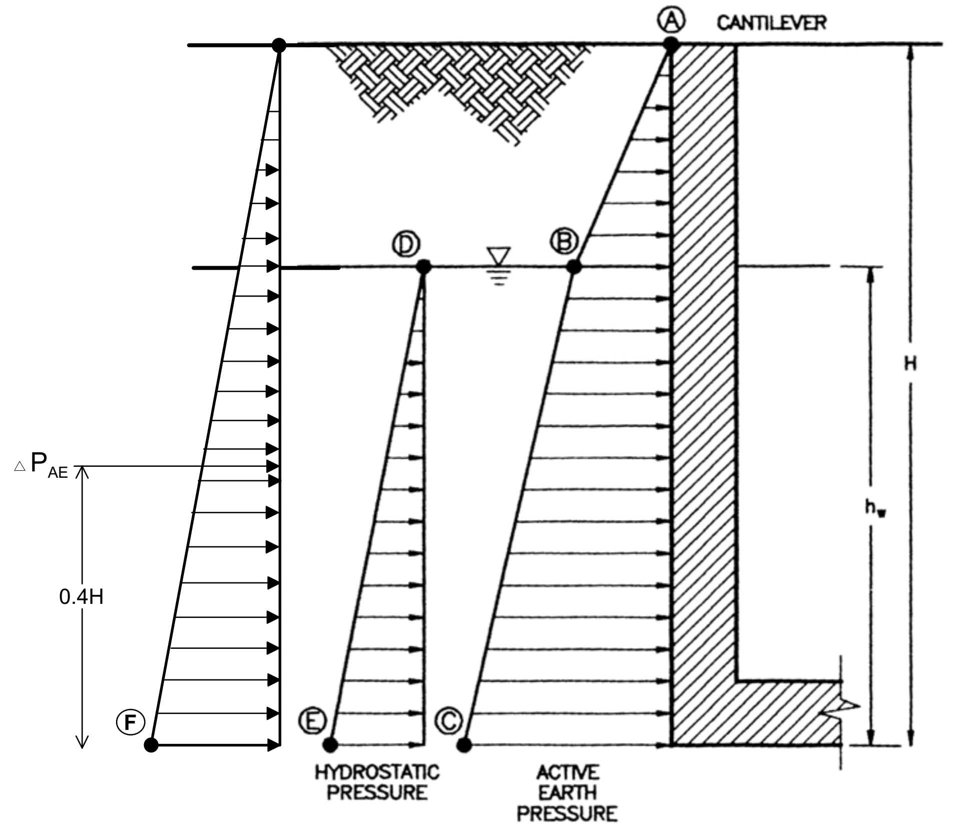
NORTH CITY WATER RECLAMATION PLANT EXPANSION	**SITE PLAN SHOWING SITE CLASSIFICATIONS**

PROJECT NO. 44F1	**ALLIED GEOTECHNICAL ENGINEERS, INC.**	**FIGURE 10**



NOTES

H = wall height in feet

h_w = water height above bottom of structure in feet

Lateral pressure values presented herein are based on the assumption that non-expansive backfill materials will be used to backfill behind walls

LATERAL PRESSURES

Earth Pressure

Ⓐ = 0
Ⓑ = 35 (H-h_w), psf for level backfill &
61 (H-h_w), psf for 2 : 1 (H : V) sloping backfill
Ⓒ = 35 (H-h_w) + 20h_w, psf

Hydrostatic Pressure

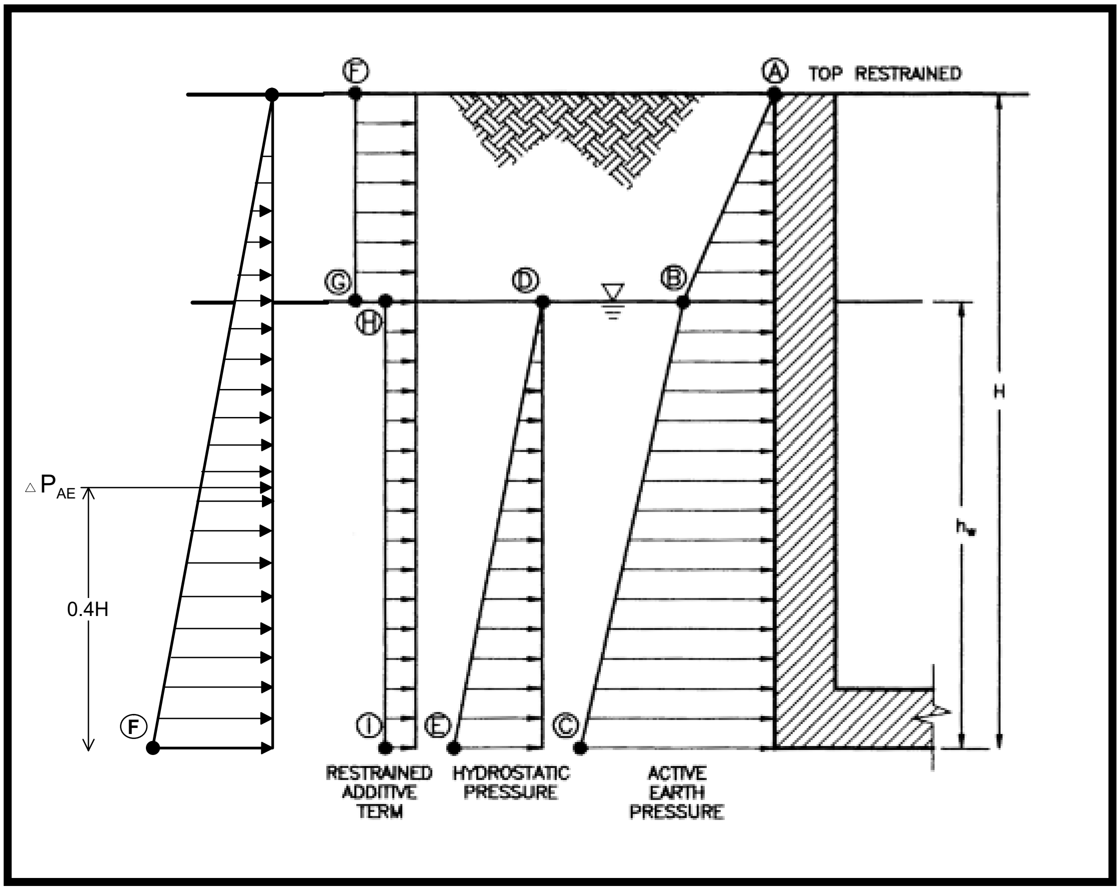
Ⓓ = 0
Ⓔ = 62.4h_w

Dynamic Resultant Force

Ⓕ = 12H
$\triangle P_{AE}$ = 6H^2, lb/ft @ 0.4H

LATERAL PRESSURES FOR CANTILEVER WALLS
NORTH CITY WATER RECLAMATION PLANT EXPANSION

PROJECT NO. 44F1	**ALLIED GEOTECHNICAL ENGINEERS, INC.**	**FIGURE 11**



NOTES

H = wall height in feet

h_w = water height above bottom of structure in feet

Lateral pressure values presented herein are based on the assumption that non-expansive backfill materials will be used to backfill behind walls

LATERAL PRESSURES

Earth Pressure
Ⓐ = 0
Ⓑ = 35 $(H-h_w)$, psf
Ⓒ = 35 $(H-h_w) + 20h_w$, psf

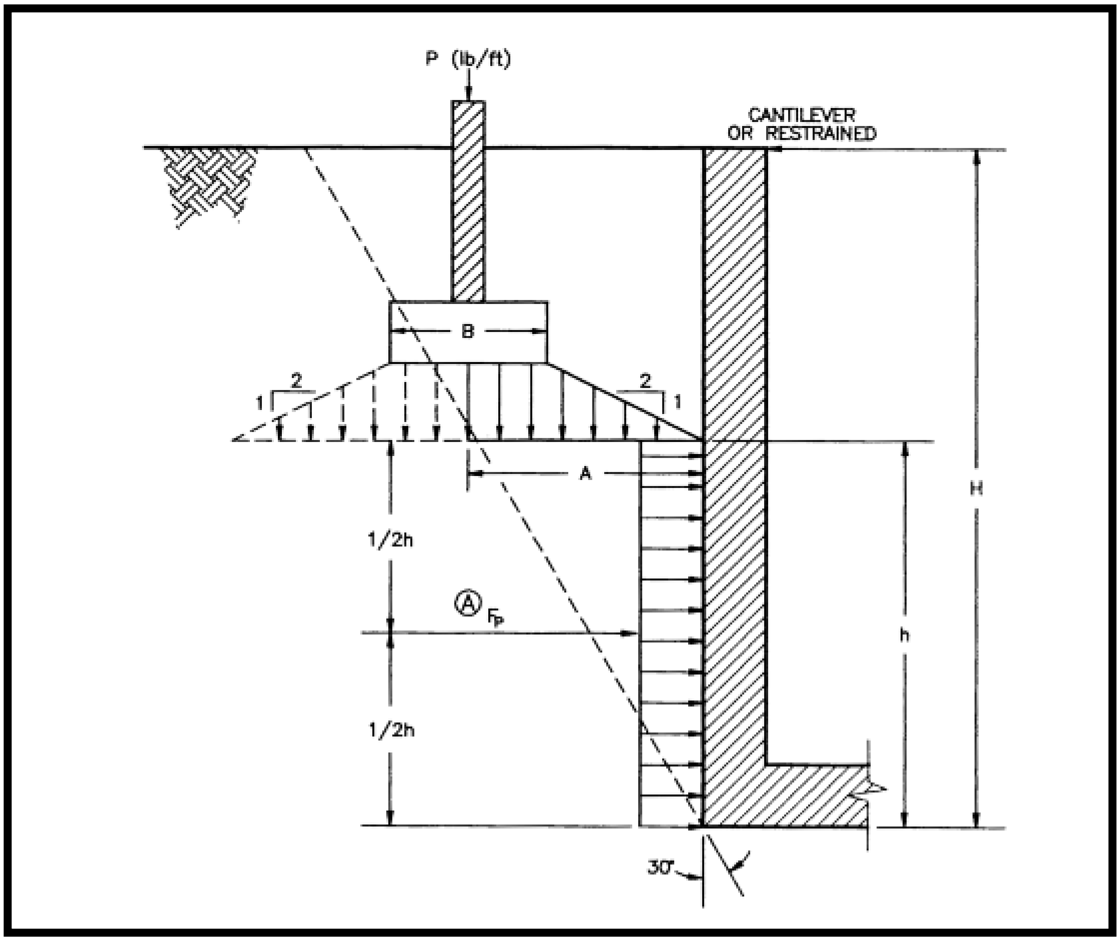
Hydrostatic Pressure
Ⓓ = 0
Ⓔ = $62.4h_w$

Restrained Additive Term
Ⓕ =Ⓖ= 25H, psf
Ⓗ=Ⓘ= 10H, psf

Dynamic Resultant Force
Ⓕ= 12H
$\triangle P_{AE} = 6H^2$, lb/ft @ 0.4H

LATERAL PRESSURES FOR RESTRAINED WALLS
NORTH CITY WATER RECLAMATION PLANT EXPANSION

PROJECT NO. 44F1	ALLIED GEOTECHNICAL ENGINEERS, INC.	FIGURE 12



NON-EXPANSIVE BACKFILL

$F_p = M\ (A/B)\ P$, lb/ft

A = h tan 30°, ft
M = 0.3 for cantilever wall
M = 0.4 for restrained wall

Angle of Internal Friction (φ) = 35°
Zone of Influence (γ) = 30°

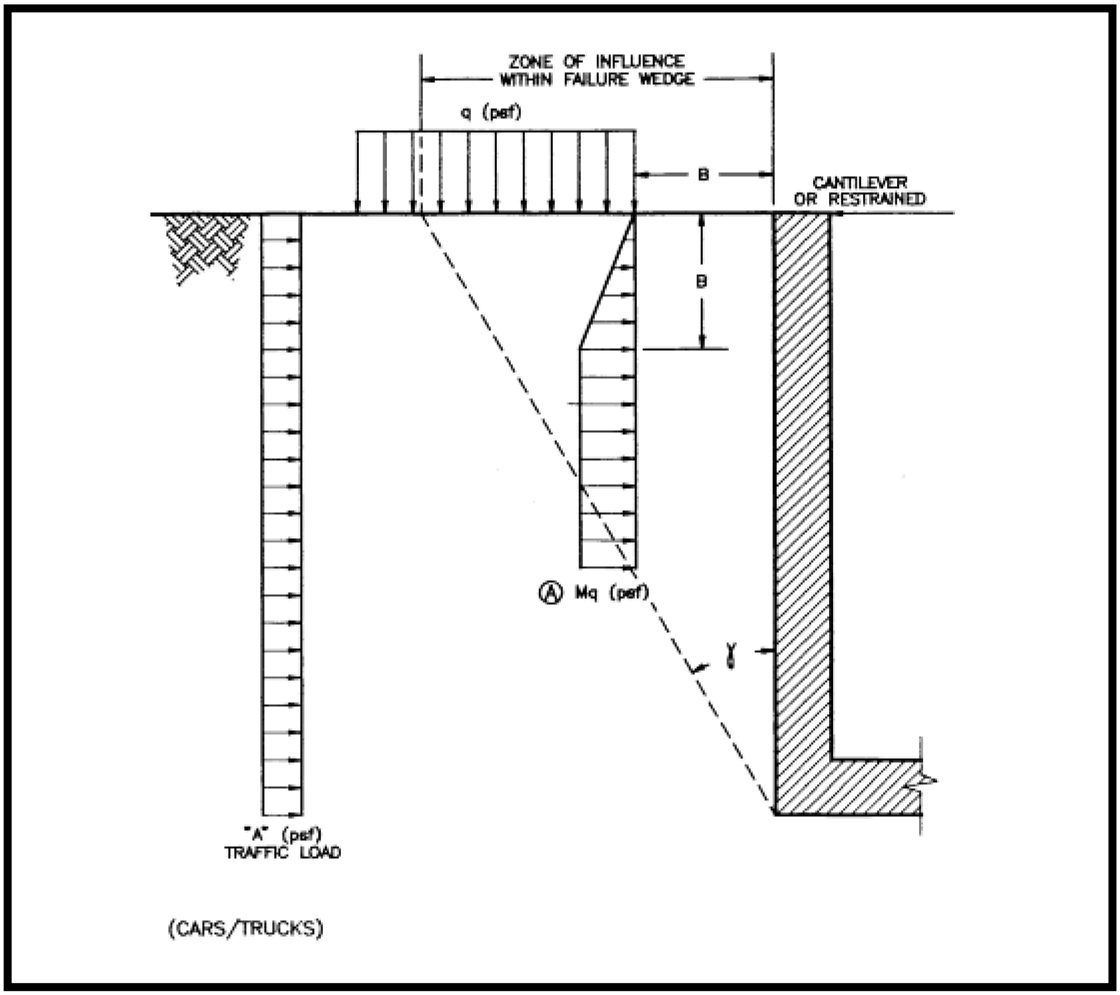
NOTES:

1. Surcharge pressure acting on wall is not affected by groundwater elevation.

2. Surcharge pressures shown are applicable for continuous footing only. Spread footings need to be evaluated individually.

FOUNDATION INDUCED WALL PRESSURES
NORTH CITY WATER RECLAMATION PLANT EXPANSION

PROJECT NO. **44F1**	**ALLIED GEOTECHNICAL ENGINEERS, INC.**	**FIGURE13**



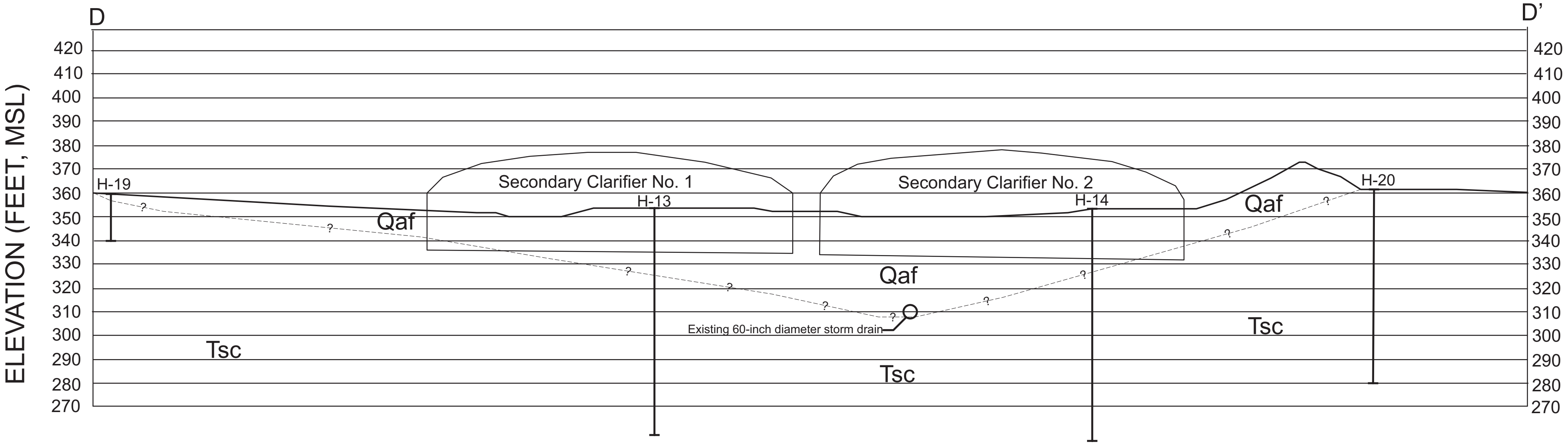
NON-EXPANSIVE BACKFILL

q = surcharge load (psf)
B = distance between wall and surcharge load, ft
M = 0.3 for cantilever wall
M = 0.4 for restrained wall
Ⓐ = Mq, psf
"A" = 75 psf
Angle of Internal Friction (φ) = 35°
Zone of Influence (γ) = 30°

NOTE: Surcharge pressure acting on wall is not affected by groundwater elevation.

TRAFFIC AND SURCHARGE PRESSURES
NORTH CITY WATER RECLAMATION PLANT EXPANSION

PROJECT NO. **44F1**	**ALLIED GEOTECHNICAL ENGINEERS, INC.**	**FIGURE 14**



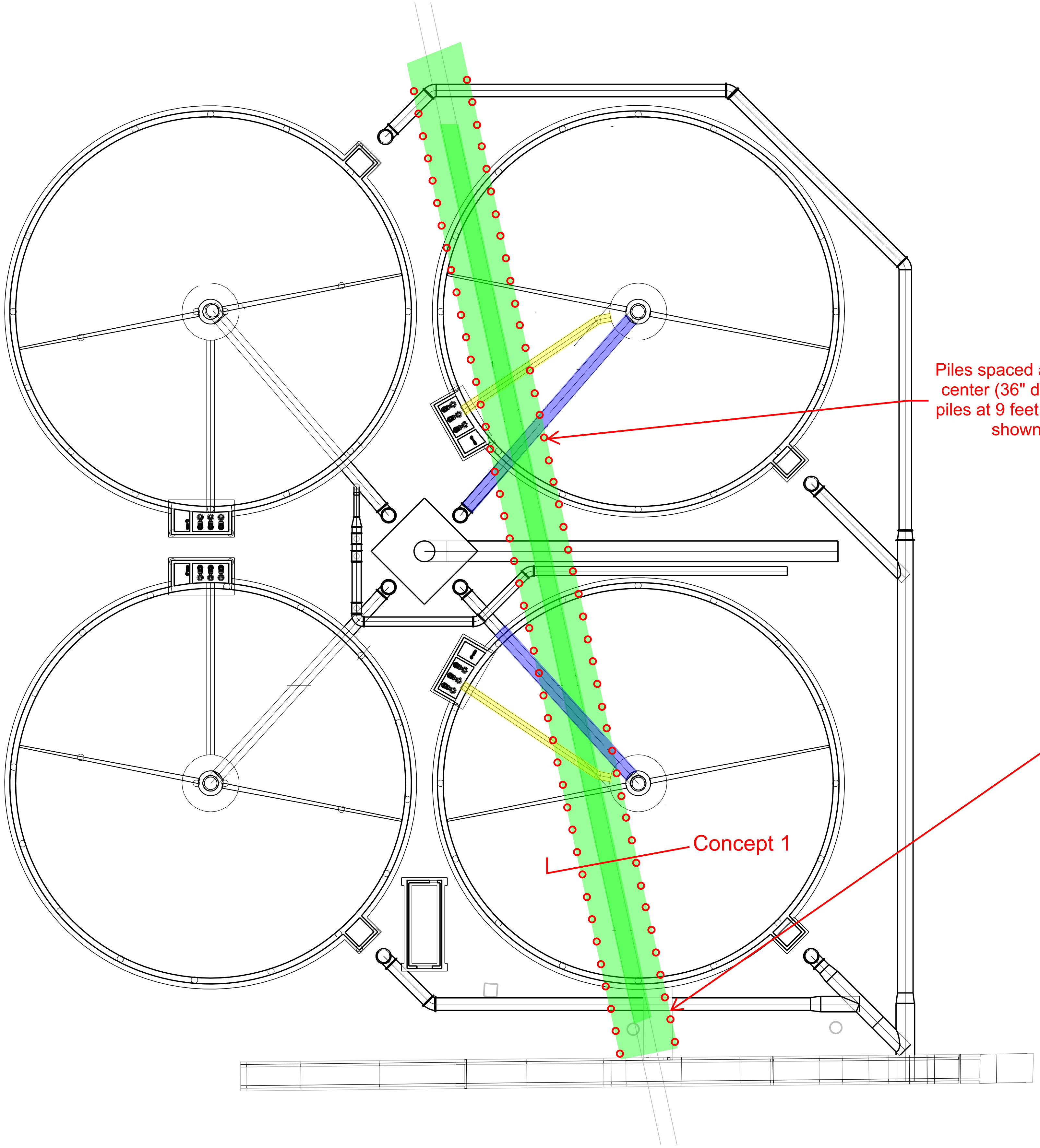
Horizontal Scale: 1” = 60’
Vertical Scale: 1” = 60’

LEGEND

Approximate boring location

Approximate geologic interface (queried where inferred)

NORTH CITY WATER RECLAMATION PLANT EXPANSION	CROSS-SECTION D-D’	
PROJECT NO. 44F1	ALLIED GEOTECHNICAL ENGINEERS, INC.	FIGURE 15



Source: Sketch prepared by Kleinfelder, undated.

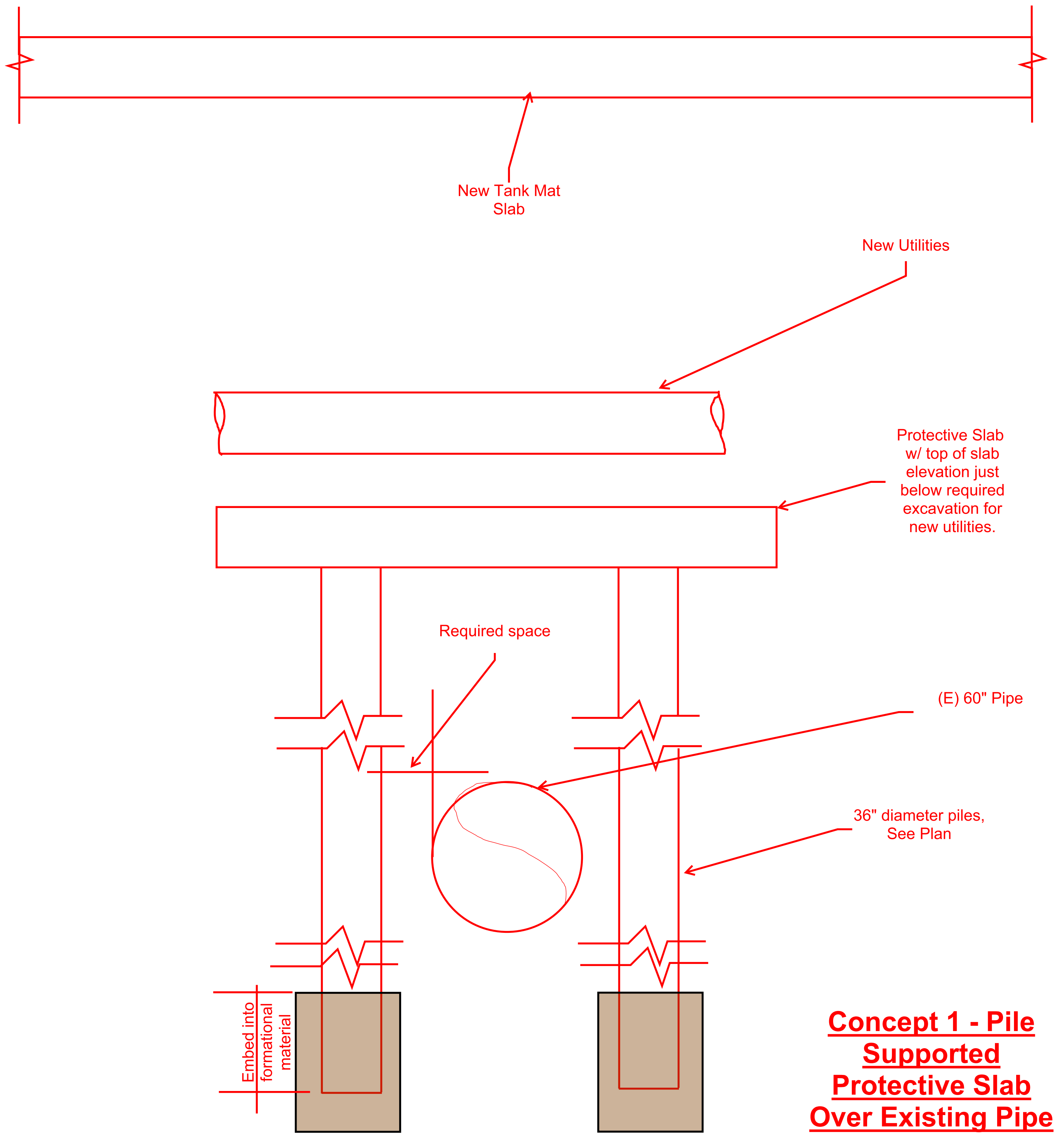
NORTH CITY WATER RECLAMATION PLANT EXPANSION

60-INCH STORM DRAIN PROTECTION - PLAN VIEW

PROJECT NO.
44F1

ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE 16



Concept 1 - Pile Supported Protective Slab Over Existing Pipe

Source: Sketch prepared by Kleinfelder, undated.

NORTH CITY WATER RECLAMATION PLANT EXPANSION

60-INCH STORM DRAIN PROTECTION - PROFILE

PROJECT NO.
44F1

ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE 17

APPENDIX A

FIELD EXPLORATION PROGRAM

APPENDIX A

FIELD EXPLORATION PROGRAM

The field exploration program for this project was performed during the period between May 1 and May 26, 2017. A total of twenty two (22) soil borings were performed at the approximate locations shown on Figure 3. The borings were advanced using conventional hollow-stem auger, air percussion and mud rotary drilling methods to depths ranging from 19.5 feet to 101 feet below the existing ground surface (bgs).

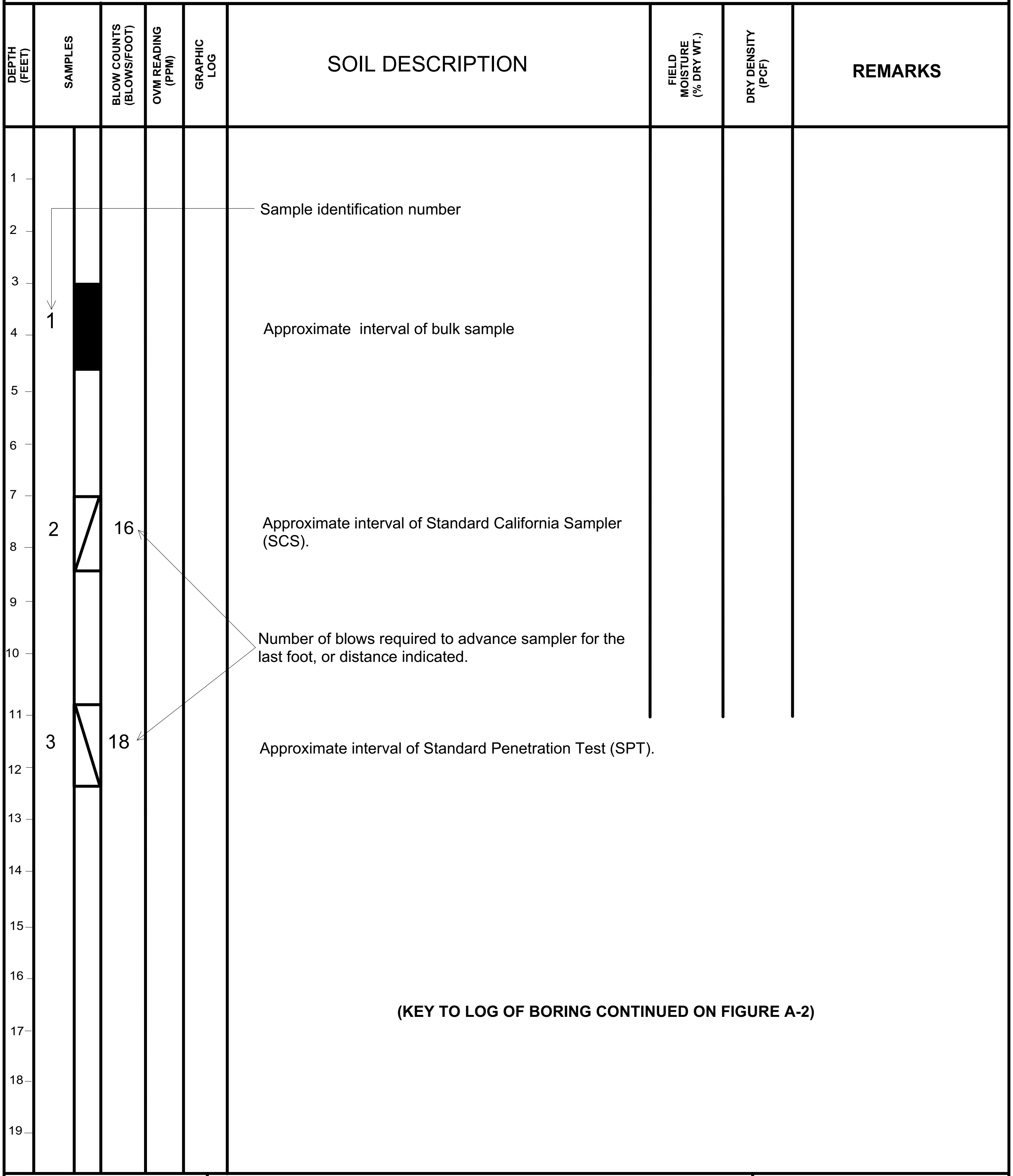
Prior to commencement of the drilling operations, several site visits were performed to observe existing site conditions and to select suitable locations for the borings. Subsequently, clearance of the proposed boring locations with respect to existing buried utilities was coordinated through Underground Service Alert (USA) and City's personnel. In addition, Cable Pipe & Leak Detection (CPL) was retained to perform independent utility clearance services. A more detailed description of the drilling, sampling and testing activities, and logs of the borings are presented in Appendix A. The soils encountered in the borings were visually classified and logged by an experienced field geologist from AGE. Representative samples of the various soil types encountered in the borings were collected for laboratory testing and analysis. A Key to Logs is presented on Figures A-1 and A-2, and the boring logs are presented in Figures A-3 through A-55.

During drilling, Standard Penetration Tests (SPT) were performed at selected depth intervals. The SPT tests involve the use of a specially manufactured "split spoon" sampler which is driven into the soils at the bottom of the borehole by dropping a 140-pound weight from a height of 30 inches. The number of blows required to drive the sampler 18 inches into the soil was recorded. As the first 6-inch increment of penetration is considered to be a "seating interval" in disturbed soils at the bottom of the borehole, the corresponding blow count is not taken into consideration. The total number of blows for the last 12 inches of penetration are shown on the boring logs, and have been used to evaluate the relative density and consistency of the materials.

Relatively undisturbed samples were obtained by driving a 3-inch (OD) diameter modified California
split-spoon sampler with a special cutting tip and inside lining of thin brass rings into the soils at the bottom of the borehole. The sampler is driven a distance of 12 inches into the soils at the bottom of the borehole by dropping a 140-pound weight from a height of 30 inches. A 6-inch long section of the soil samples that were retained in the brass rings were extracted from the sampling tube and transported to our laboratory in close-fitting, waterproof containers. In addition, loose bulk samples were also collected and stored in plastic sacks for transport to AGE's laboratory. Soil cuttings obtained from the samplers were field screened for the presence of volatile organics using a RAE Systems MiniRAE 3000 organic vapor meter (OVM). The OVM readings are also indicated on the boring logs.

Following completion of the drilling and sampling activities, the borings were backfilled using bentonite grout and bentonite chips to approximately 12 inches below the ground surface. Borings performed in paved areas were capped with rapid-set concrete to match the adjacent pavement surface, and borings performed in landscape areas were capped with soil cuttings.

KEY TO LOG OF BORING



Sample identification number

Approximate interval of bulk sample

Approximate interval of Standard California Sampler (SCS).

Number of blows required to advance sampler for the last foot, or distance indicated.

Approximate interval of Standard Penetration Test (SPT).

(KEY TO LOG OF BORING CONTINUED ON FIGURE A-2)

PROJECT NO.
44F1

ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE A-1

KEY TO LOG OF BORING
(CONTINUED)

DEPTH (FEET)	SAMPLES	BLOW COUNTS (BLOWS/FOOT)	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE (% DRY WT.)	DRY DENSITY (PCF)	REMARKS
1					—?— —?— APPROXIMATE GEOLOGIC CONTACT			
2					FILL			
3				∴	SAND			
4				‖	SILT			
5				▨	CLAY			
6				◇	GRAVELS & COBBLES			
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								

GENERAL NOTES

1. Approximate elevations and locations of borings are based on GoogleEarth, 2017.
2. Soil descriptions are based on visual classification made during the field exploration and, where deemed appropriate, have been modified based on the results of laboratory tests.
3. Descriptions on the boring logs apply only at the specific boring locations and at the time the borings were performed. They are not warranted to be representative of subsurface conditions at other locations or times.

PROJECT NO.
44F1

ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE A-2

BORING NO. H-1

DATE OF DRILLING: MAY 26, 2017

TOTAL BORING DEPTH: 81 FEET

GENERAL LOCATION: EQUALIZATION BASINS

APPROXIMATE SURFACE ELEV.: +380 FEET MSL

DRILLING CONTRACTOR: TRI-COUNTY DRILLING. INC..

DRILLING METHOD: 4 - INCH AIR PERCUSSION

LOGGED BY: NICK BARNES

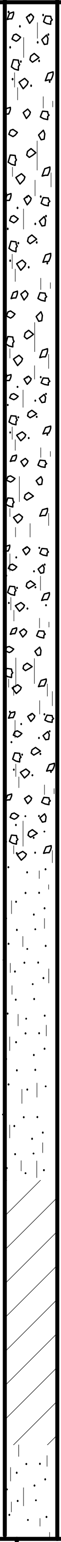
DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
1								Grasses and weeds in the upper 2 inches
2					**FILL**			Drilled to 5-feet using 8-inch HSA, then switched to 4-inch air percussion.
3	1				Reddish yellow to yellowish red, damp, silty sand (SM) and clayey sand (SC) with scattered sub-rounded gravel up to 2" in maximum dimension.			
4								
5	2							
6	3	54	0.0			8.2	112.7	
7								
8				?	? ?			?
9					**VERY OLD PARALIC DEPOSITS**			
10					Yellow to pale reddish yellow, damp, very dense, silty sand (SM) with abundant sub-rounded gravel up to 2" in maximum dimension.			
11	4	100+	0.1			5.1		
12								
13				?	? ?			?
14					**SCRIPPS FORMATION**			
15								
16	5	75	0.0		Greenish gray to reddish yellow, wet, fine-grained, hard, sandy lean clay(CL).	20.1	101.1	
17								
18								
19								
20					At 19', sharp transition into a gravel - cobble conglomerate with a yellowish brown to reddish brown, fine to medium-grained, silty sand (SM) matrix.			Did not attempt sampling at 20 feet and 25 feet due to abundant gravels and cobbles.
21								
22								
23	6							
24								
25								
26								
27								
28								
29								

PROJECT NO.
44F1

ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE A-3

BORING NO. H-1 (Continued)

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
31	7	100+			**SCRIPPS FORMATION**			No sample recovery
32					Gravel - cobble conglomerate with a yellowish brown to Reddish brown, fine to medium-grained silty sand (SM) matrix.			
33								
34								
35								
36								
37								Did not attempt sampling at 35 feet and 45 feet due to abundant gravels and cobbles.
38								
39								
40								
41								
42								
43								
44								
45								
46								
47								
48					Sharp transition out of conglomerate at 48'.			
49								
50	8	100+						Sample contains only slough and fractured gravel
51								
52								
53								
54								
55					Light gray to pale yellowish brown, damp, hard, sandy lean clay (CL).	18.2		
56	9	100+	0.1					
57								
58								
59								
60	10	100+	0.0		Olive brown, damp, very dense, medium grained, silty sand (SM).	19.3		
61								

PROJECT NO.
44F1

ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE A-4

BORING NO. H-1 (Continued)

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
					SCRIPPS FORMATION			
63								
64								
65	11	100+	0.3		Olive brown, fine-grained silty sand (SM).	23.1		
66								
67								
68								
69								
70	12	100+	0.0		Yellow brown to reddish yellow, and fine to medium grain size.	18.1	114.3	
71								
72								
73								
74								
75	13	100+	0.2			21.0		
76								
77								
78								
79								
80	14	100+	0.0		Light gray to pale reddish yellow, damp, hard, sandy lean clay (CL).	20.1		
81								

NOTES:

Bottom of borehole at 81 feet.

Unable to determine if groundwater is present. Method of drilling required introduction of water into borehole.

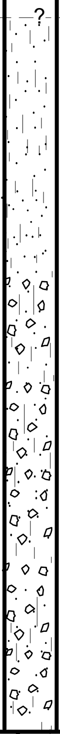
PROJECT NO. 44F1

ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE A-5

BORING NO. H-2

DATE OF DRILLING: MAY 10 AND 11, 2017
TOTAL BORING DEPTH: 51 FEET
GENERAL LOCATION: EQUALIZATION BASINS
APPROXIMATE SURFACE ELEV.: +380 FEET MSL
DRILLING CONTRACTOR: TRI-COUNTY DRILLING. INC..
DRILLING METHOD: 4- INCH AIR PERCUSSION
LOGGED BY: NICK BARNES

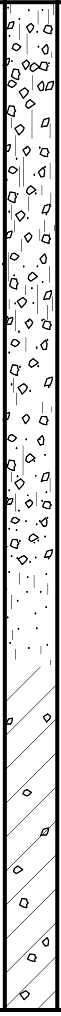
DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
1								Grasses and weeds in the upper 2 inches
2					**FILL**			Drilled to 5-feet using 8-inch HSA, then switched to 4-inch air percussion.
3								
4								
5					Brown to yellow brown, damp, silty sand (SM) and clayey sand (SC) with abundant gravel and scattered cobbles.			
6	1	63	0.2			10.9		
7								
8								
9								
10					Mottled reddish brown, reddish yellow and olive yellow, and wet.			
11	2	21	0.0					
12								
13	3							
14								
15				? 	? ?			?
16	4	51	0.1		**SCRIPPS FORMATION**	20.1		
17					Pale olive yellow to pale reddish yellow, damp, very dense, fine-grained, silty sand (SM).			
18								
19								
20								
21	5	100+	0.2		At 20', sharp transition to a gravel - cobble conglomerate with a greenish gray to pale reddish yellow, fine to medium-grained silty sand (SM) matrix.	9.8	106.1	
22	6							
23								
24								
25	7	100+						No sample recovery
26								
27								
28								
29								

PROJECT NO. 44F1

ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE A-6

BORING NO. H-2 (Continued)



DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
31	8	100+	0.1	**SCRIPPS FORMATION**	4.7		
32	9						
33							
34				Gravel - cobble conglomerate with a yellowish brown, fine to medium-grained, silty sand (SM) matrix.			
35							Did not attempt to sample at 35 feet due to abundant gravel and cobbles.
36							
37							
38							
39							
40							
41	10	100+					Slough only in sampler
42				Sharp transition out of the conglomerate facies at 42'.			
43							
44							
45	11	100+	0.0	Olive yellow to pale reddish yellow, damp, hard, sandy lean clay (CL) with traces of sub-rounded gravel up to 1/2" in maximum dimension.	19.9	104.8	
46							
47							
48							
49							
50							
51	12	100+	0.0		18.2		

NOTES:

Bottom of borehole at 51 feet.

Unable to determine if groundwater is present. Method of drilling required introduction of water into borehole.

BORING NO. H-3

DATE OF DRILLING: MAY 24 AND 25, 2017
TOTAL BORING DEPTH: 80.5 FEET
GENERAL LOCATION: PRIMARY CLARIFIER
APPROXIMATE SURFACE ELEV.: +377 FEET MSL
DRILLING CONTRACTOR: TRI-COUNTY DRILLING. INC..
DRILLING METHOD: 4- INCH AIR PERCUSSION
LOGGED BY: NICK BARNES

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
1								Drilled to 5-feet using 8-inch HSA, then switched to 4-inch air percussion.
2					**FILL**			
3	1				Yellow brown to reddish yellow, damp, silty sand (SM) containing locally abundant sub-rounded and locally fractured gravel up to 3" in maximum dimension.			
4	2							
5								
6	3	100+	0.1			5.2		
7				?	? ?			?
8					**VERY OLD PARALIC DEPOSITS**			
9					Reddish yellow, damp, very dense, medium-grained, silty sand (SM) with abundant sub-rounded gravel up to 3" in maximum dimension.			
10	4	100+						No sample recovery, sampler bouncing on rock
11								
12								
13				?	? ?			?
14								
15					**SCRIPPS FORMATION**			
16	5	100+	0.0		Gravel conglomerate with pale yellow to yellowish red, dense, silty sand (SM) matrix. Gravel is sub-rounded, up to 2" in maximum dimension.	13.8		
17								
18								
19								
20								
21	6	100+	0.1			1.4		
22								
23								
24								
25	7	100+	0.1			3.6		
26								
27								
28								
29								

PROJECT NO. 44F1

ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE A-8

BORING NO. H-3 (Continued)

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
31	8	100+			**SCRIPPS FORMATION** Gravel - cobble conglomerate with a yellowish brown to reddish brown, fine to medium-grained silty sand (SM) matrix.			Did not attempt sampling at 30 feet and 35 feet due to abundant gravels and cobbles.
38					Sharp transition out of conglomerate at 38'.			
41	9	100+	0.1		Reddish yellow to pale gray, damp, hard, sandy lean clay (CL).	20.6	113.9	
46	10	56	0.2			18.8		
51	11	100+	0.1			18.8	110.9	
56	12	100+	0.0			22.9		
60	13	100+	0.0		Medium gray, damp, very dense, fine to medium-grained, silty sandstone (SM).	14.2	90.1	

PROJECT NO.
44F1

ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE A-9

BORING NO. H-3 (Continued)

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
					SCRIPPS FORMATION			
63								
64								
65					Pale yellow brown to pale reddish yellow, damp, very dense, fine to medium grained, poorly graded sand with silt (SP-SM).			
66	14	100+	0.0			20.1		
67								
68								
69								
70					Light gray to pale yellow brown, silty sandstone (SM).			
71	15	100+	0.1			12.5	99.0	
72								
73								
74								
75					Reddish yellow, damp, hard, sandy lean clay (CL).			
76	16	100+	0.1			21.1		
77								
78								
79								
80	17	100+	0.2		Reddish yellow to medium gray color.	22.3	104.9	
81								

NOTES:

Bottom of borehole at 80.5 feet.

Unable to determine if groundwater is present.
Method of drilling required introduction of water
into borehole.

BORING NO. H-4

DATE OF DRILLING: MAY 9 AND 10, 2017
TOTAL BORING DEPTH: 51 FEET
GENERAL LOCATION: PRIMARY CLARIFIER
APPROXIMATE SURFACE ELEV.: +374 FEET MSL
DRILLING CONTRACTOR: TRI-COUNTY DRILLING. INC..
DRILLING METHOD: 4- INCH AIR PERCUSSION
LOGGED BY: NICK BARNES

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
1					**FILL**			Drilled to 12-feet using 8-inch HSA, then switched to 4-inch air percussion.
2					Yellow brown, damp, silty sand (SM) with scattered to locally abundant sub-rounded gravel up to 3" in maximum dimension.			
3				?	? ?			?
4	1				**VERY OLD PARALIC DEPOSITS**			
5								
6	2	100+	0.2		Yellowish red, damp, dense to very dense, medium-grained, silty sand (SM) with abundant sub-rounded gravel up to 3" in maximum dimension.	13.5	105.9	
7								
8								
9								
10	3	100+	0.0			6.2		Poor sample recovery, mostly fractured gravel
11								
12								
13								
14				?	? ?			?
15					**SCRIPPS FORMATION**			Driller added water inside of auger to assist in bringing soil cuttings to ground surface
16	4	100+	0.2		Gravel conglomerate with yellow brown to olive brown silty sand (SM) matrix.	11.0	100.8	
17	5							
18								
19								
20								
21	6	100+	0.0			2.5		Poor sample recovery, mostly fractured gravel
22								
23								
24								
25	7	100+						No sample recovery
26								
27								
28								
29								

PROJECT NO. 44F1

ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE A-11

BORING NO. H-4 (Continued)

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
31	8	100+	0.2		**SCRIPPS FORMATION** Gravel conglomerate with yellow brown, medium-grained, silty sand (SM) matrix.			No sample recovery
32								
33	9							
34								
35								
36					End of conglomerate zone at 36'.			Did not attempt to sample at 35 feet due to abundant gravels.
37								
38								
39								
40								
41	10	100+	0.2		Olive yellow to pale reddish yellow, damp, very dense, fine-grained, silty sand (SM) with traces of sub-rounded gravel up to 1/2" in maximum dimension.	21.5	104.9	
42								
43								
44								
45								
46	11	100+	0.0		Olive brown color, and fine to medium grain size.	16.2		
47								
48								
49								
50								
51	12	100+	0.0		Olive gray to pale reddish yellow, fine-grained silty sand (SM).	17.0	111.8	

NOTES:

Bottom of borehole at 51 feet.

Unable to determine if groundwater is present. Method of drilling required introduction of water into borehole.

BORING NO. H-5

DATE OF DRILLING: MAY 16, 2017	TOTAL BORING DEPTH: 51.5 FEET
GENERAL LOCATION: AERATION BASINS	
APPROXIMATE SURFACE ELEV.: +367 FEET MSL	DRILLING CONTRACTOR: TRI-COUNTY DRILLING. INC..
DRILLING METHOD: 8- INCH HSA	LOGGED BY: NICK BARNES

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
					EXISTING PAVEMENT: 7.5" A.C. and no base.			
1								
2					**FILL**			
3					Yellow brown to olive/grayish brown, damp to wet, sandy clay (CL) with scattered sub-rounded and locally fractured gravel up to 3" in maximum dimension. Fill also contains scattered chunks of olive yellow sandstone and greenish gray siltstone up to 1/2" in maximum dimension.			
4								
5								
6	1	44	0.0			20.6	102.7	
7	2							
8								
9	3							
10					Olive brown to gray brown, damp to wet, clayey sand (SC) with scattered gravel.			
11	4	23	0.3			9.9		
12								
13								
14					Abundant gravel between 14' and 15'.			
15								
16	5	68	0.0			11.2	113.2	
17								
18					Abundant gravel between 18' and 22'.			
19								
20								No sample recovery, sampler bouncing on gravel
21	6	100+						
22				?	?	?		?
23					**SCRIPPS FORMATION**			
24								
25					Olive yellow, damp, very dense, fine-grained, silty sand (SM). Sand is uncemented.			
26	7	100+	0.0			10.4		
27	8							
28								
29								

PROJECT NO. 44F1

ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE A-13

BORING NO. H-5 (Continued)

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
31	9	100+	0.0		**SCRIPPS FORMATION**	19.6		Driller adding water inside of auger to assist in bringing soil cuttings to ground surface
32								
33	10							
34								
35	11	100+	0.0		Olive yellow to olive gray, damp, hard, lean clay (CL), grading into reddish yellow, very dense, fine-grained silty sand (SM) at 36'.	20.2	113.3	
36								
37								
38								
39								
40	12	100+	0.0		Pale yellow brown to reddish yellow color.	21.1		
41								
42								
43								
44								
45	13	100+	0.0		Pale yellow brown, damp, very dense, medium grained, poorly graded sand with silt (SP-SM).	15.9	96.7	
46								
47								
48								
49								
50					Similar to above, with a 2" wide interlayer of pale gray tp olive yellow siltstone (ML).			
51	14	100+	0.1			17.4		

NOTES:

Bottom of borehole at 51.5 feet.

Unable to determine if groundwater is present. Method of drilling required introduction of water into borehole.

BORING NO. H-6

DATE OF DRILLING: MAY 9, 2017
TOTAL BORING DEPTH: 50.5 FEET
GENERAL LOCATION: AERATION BASINS
APPROXIMATE SURFACE ELEV.: +365 FEET MSL
DRILLING CONTRACTOR: TRI-COUNTY DRILLING. INC..
DRILLING METHOD: 8- INCH HSA
LOGGED BY: NICK BARNES

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
					EXISTING PAVEMENT: 8" A.C. and no base.			
1								
2					**FILL**			
3								
4					Olive, olive yellow to greenish gray, damp to wet, clayey sand (SC) with scattered sub-rounded and fractured gravel up to 3" in maximum dimension.			
5	1							
6	2	18	0.4			15.8		
7								
8								
9								
10					Olive to grayish brown clayey sand (SC), with scattered gravel up to 1" in maximum dimension. Fill also contains chunks of cemented siltstone up to 1.5" in maximum dimension.			
11	3	50	0.1			18.6	109.8	
12	4							
13								
14								
15								
16	5	33						No sample recovery, large gravel clast wedged in sampler shoe
17								
18								
19								
20								
21	6	100+	0.0		Olive yellow to olive, damp, fine-grained silty sand (SM) with scattered sub-rounded and locally fractured gravel up to 1" in maximum dimension, and scattered chunks of cemented siltstone and sandstone.	20.1	106.4	
22								
23	7							
24								
25				?	? ?			?
26	8	54	0.1		**SCRIPPS FORMATION**	18.6		
27					Reddish yellow, damp, very dense, fine to medium-grained silty sand (SM).			
28								
29								

PROJECT NO. 44F1

ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE A-15

BORING NO. H-6 (Continued)

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
31	9	100+	0.0	▨	**SCRIPPS FORMATION**	18.0	102.0	Driller adding water inside of auger to assist in bringing soil cuttings to ground surface
32					Pale olive yellow to pale olive brown, damp, hard, sandy lean clay (CL).			
33								
34								
35	10	100+	0.3			19.1		
36								
37								
38								
39								
40	11	100+	0.0	⁙	Reddish yellow, damp, medium grained silty sand (SM).	10.5	99.2	
41								
42								
43								
44								
45	12	100+			Pale yellow brown, fine grained, silty sand (SM).	10.9		
46								
47								
48								
49								
50	13	100+	0.0		Pale yellow brown to reddish yellow.	13.8		
51								

NOTES:

Bottom of borehole at 50.5 feet.

Unable to determine if groundwater is present. Method of drilling required introduction of water into borehole.

PROJECT NO.
44F1

ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE A-16

BORING NO. H-7

DATE OF DRILLING: MAY 12, 2017
TOTAL BORING DEPTH: 100.5 FEET
GENERAL LOCATION: AERATION BASINS
APPROXIMATE SURFACE ELEV.: +356 FEET MSL
DRILLING CONTRACTOR: TRI-COUNTY DRILLING. INC..
DRILLING METHOD: 8 INCH HSA
LOGGED BY: NICK BARNES

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
1								Lawn sod in the upper 2 inches
2					**FILL**			
3					Yellow brown to reddish yellow, damp, silty sand (SM) with scattered sub-rounded gravel up to 3" in maximum dimension.			
4								
5								
6	1 2	7	0.0			10.6		
7				?	? ?			?
8					**VERY OLD PARALIC DEPOSITS**			
9								
10					Yellow brown to reddish yellow, damp, very dense, fine to medium-grained silty sand (SM) with abundant sub-rounded gravel up to 3" in maximum dimension.			
11	3	100+	0.0			8.1		
12				?	? ?			?
13	4				**SCRIPPS FORMATION**			Driller added water inside of auger to assist in bringing soil cuttings to ground surface
14								
15								
16	5	100+	0.0		Olive yellow to pale yellowish red, damp, very dense, fine to medium-grained silty sand (SM).	13.0		Sampler bouncing on rock last 1"
17					16.5' - 19', gravelly zone			
18								
19								
20					Medium gray, fine-grained silty sand, grading into a light yellow brown, medium-grained, poorly graded sand with silt (SP-SM).			
21	6	100+	0.1			17.4	104.5	
22								
23								
24					At 23', abrupt transition into a gravel conglomerate with an olive brown to yellow brown silty sand (SM) matrix.			
25								
26	7	100+	0.0			8.4		
27								
28								
29								

PROJECT NO. 44F1

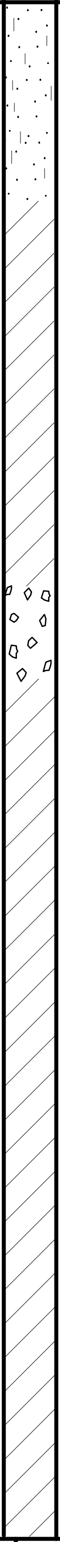
ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE A-17

BORING NO. H-7 (Continued)

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
31				**SCRIPPS FORMATION**			Did not attempt sampling between depth of 30' and 35' due to abundant gravel
32	8						
33				Gravel conglomerate with an olive brown to yellow brown silty sand (SM) matrix.			
34							
35							
36				End of conglomerate zone at 37'.			
37							
38							
39							
40	9	100+					
41							No sample recovery
42							
43							
44							
45				Olive/gray to pale reddish yellow, damp, hard, sandy lean clay (CL).			
46	10	100+	0.0		23.2		
47							
48							
49							
50							
51	11	100+	0.0	Pale greenish gray to medium gray, hard, lean clay (CL).	20.8	112.7	
52							
53							
54							
55	12	100+	0.0	Pale yellow brown to pale reddish yellow, damp, very dense, fine to medium grained, silty sand (SM).	21.5		
56							
57							
58							
59							
60	13	100+	0.0	Olive color.	21.3	107.6	
61							

BORING NO. H-7 (Continued)



DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
					SCRIPPS FORMATION			
63								
64								
65	14	100+	0.0		Gray to pale reddish yellow, damp, hard, lean clay (CL).	24.0		
66								
67								
68								
69								
70	15	100+	0.0			20.5	117.7	
71								
72								
73								
74								
75					74' - 76', gravel zone.			Did not attempt 75' sample due to abundant gravel.
76								
77								
78								
79								
80	16	100+	0.0		Dark gray, damp, hard, claystone (CL/CH).	22.3		
81								
82								
83								
84								
85								
86								
87								
88								
89								
90	17	100+	0.2		Similar to above.	20.6		
91								
92								
93								

BORING NO. H-7 (Continued)

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
95					**SCRIPPS FORMATION** Dark gray, hard claystone (CL/CH).			
96								
97								
98								
99					Medium gray, damp, very dense, fine-grained silty sand (SM).			
100	18	100+	0.1			8.2		

NOTES:

Bottom of borehole at 100.5 feet.

Unable to determine if groundwater is present.
Method of drilling required introduction of water
into borehole.

PROJECT NO.
44F1

ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE A-20

BORING NO. H-8

DATE OF DRILLING: MAY 19, 2017
TOTAL BORING DEPTH: 56.5 FEET
GENERAL LOCATION: TERTIARY FILTERS
APPROXIMATE SURFACE ELEV.: +348 FEET MSL
DRILLING CONTRACTOR: TRI-COUNTY DRILLING. INC..
DRILLING METHOD: 8- INCH HSA
LOGGED BY: NICK BARNES

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
1								
2					**FILL**			
3								
4					Yellow brown to yellowish red, damp, gravelly silty sand (SM). Gravel is sub-rounded and locally fractured, up to 3" in maximum dimension.			
5	1							
6	2	23	0.0			9.7		
7								
8								
9	3							
10								
11	4	38	0.0		Similar to above, fill also contains chunks of cemented siltstone up to 1/2" in maximum dimension.	21.3	102.0	
12								
13								
14								
15								
16	5	32	0.1			15.7		
17								
18					Abundant gravel from 17' to 22'.			
19								
20								
21	6	100+	0.0			9.3	93.0	Disturbed sample due to abundant gravels contained in fill.
22								
23								
24								
25								
26	7	30	0.2		Reddish brown to reddish yellow, damp, fine to medium-grained silty sand (SM) and sandy silt (ML) with scattered gravel.	11.2		
27								
28								
29								

BORING NO. H-8 (Continued)

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
31	8	100+	0.0		**FILL** Olive to olive yellow, damp, fine-grained, silty sand (SM), with scattered sub-rounded gravel up to 2" in maximum dimension.	15.5	111.2	Driller added water inside of auger to assist in bringing soil cuttings to ground surface
35	9	41	0.1			13.5		
41	10	52	0.1		Olive yellow, pale yellow and yellow brown silty sand (SM), intermixed with chunks of olive yellow siltystone (ML) and dark gray clayey sand (SC). Fill also contains scattered sub-rounded gravel up to 1 1/2" in maximum dimension.	19.2	111.8	
46	11	23	1.3		Dark gray, damp to wet, silty sand (SM) and clayey sand (SC) with scattered sub-rounded gravel up to 1" in maximum dimension.	12.4		Detected decomposing vegetation odors.
47	12							
49				?	?	?		?
50	13	100+	0.0		**SCRIPPS FORMATION** Olive gray to pale olive yellow, damp, hard, sandy lean clay (CL).	21.3	109.1	
56	14	51	0.2			24.9		

NOTES:

Bottom of borehole at 56.5 feet.

Unable to determine if groundwater is present. Method of drilling required introduction of water into borehole.

BORING NO. H-9

DATE OF DRILLING: MAY 22, 2017
TOTAL BORING DEPTH: 80.5 FEET
GENERAL LOCATION: NEW AWPF IPS
APPROXIMATE SURFACE ELEV.: +345 FEET MSL
DRILLING CONTRACTOR: TRI-COUNTY DRILLING. INC..
DRILLING METHOD: 8- INCH HSA
LOGGED BY: NICK BARNES

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
1								Lawn sod in the upper 2 inches
2					**FILL**			
3					Olive yellow to yellowish brown, damp, fine-grained silty sand (SM) and sandy silt (ML) with scattered sub-rounded and locally fractured gravel up to 3" in maximum dimension.			
4								
5								
6	1	25	0.0			20.3	99.0	
7								
8								
9								
10	2							
11	3	15	0.0			23.3		
12								
13								
14								
15	4							
16	5	20	0.0		Olive brown to pale gray, damp, fine-grained silty sand (SM) and sandy silt (ML) with intermixed chunks of siltstone and sandstone that appear to be derived from excavation into the Scripps Formation.	26.4	91.6	
17								
18					Between17'-28', encountered scattered to locally abundant gravel in fill. Gravel sub-rounded and locally fractured, up to 3" in maximum dimension.			
19								
20								
21	6	74	0.0		Olive yellow to medium brown, damp, silty sand (SM) and clayey sand (SC) with abundant gravel.	9.6		High blow counts in 20' and 25' samples due to abundant gravel in fill.
22								
23	7							
24								
25	8	100+	0.1			15.5	113.7	
26								
27								
28								
29								

**PROJECT NO.
44F1**

ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE A-23

BORING NO. H-9 (Continued)

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
31	9	100+	0.1		**FILL**	21.9		
32					Yellowish brown, damp, fine to medium-grained, silty sand (SM).			
33								
34				?	? ?			?
35	10	100+	0.0			18.3		Sampler bouncing on gravel.
36					**SCRIPPS FORMATION**			
37					Gravel conglomerate with medium gray to pale reddish yellow, silty sand (SM) and sandy silt (ML) matrix.			
38								Driller added water inside of auger to assist in bringing soil cuttings to ground surface.
39					Sharp transition out of conglomerate at 38'.			
40								
41	11	100+	0.2		Medium gray to pale reddish yellow, damp, hard, sandy lean clay (CL).	23.1		
42								
43								
44								
45								
46	12	56	0.0			21.7	107.6	
47								
48								
49								
50								
51	13	100+	0.1		Medium gray to greenish gray, hard, lean clay (CL).	25.2		
52								
53								
54								
55								
56	14	100+	0.2		Alternating laminations consisting of reddish yellow silty sandstone (SM) and medium gray clay (CL). Laminations on the order of 1/8" in thickness.	25.5		
57	15							
58								
59								
60								
61	16	100+	0.1			20.5	112.4	

BORING NO. H-9 (Continued)

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
					SCRIPPS FORMATION			
63								
64								
65								
66	17	100+	0.2		Dark gray, damp, hard, sandy claystone (CL/CH).	19.3		
67								
68								
69								
70	18	100+	0.2		Reddish yellow silty sandstone (SM) and sandy siltstone (ML), transitioning into a dark gray claystone (CL/CH).	18.4		
71								
72								
73								
74								
75								
76	19	100+	0.1		Dark gray claystone (CL/CH), similar to above.	23.4		
77								
78								
79					Dark gray, very dense, silty sandstone (SM). Sandstone is strongly cemented.			
80	20	100+	0.0			5.2		
81								

NOTES:

Bottom of borehole at 80.5 feet.

Unable to determine if groundwater is present. Method of drilling required introduction of water into borehole.

BORING NO. H-10

DATE OF DRILLING: MAY 23, 2017

TOTAL BORING DEPTH: 80.5 FEET

GENERAL LOCATION: NEW AWPF IPS

APPROXIMATE SURFACE ELEV.: +345 FEET MSL

DRILLING CONTRACTOR: TRI-COUNTY DRILLING. INC..

DRILLING METHOD: 8- INCH HSA

LOGGED BY: NICK BARNES

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
1								Lawn sod in the upper 2 inches
2					**FILL**			
3					Yellow brown to olive yellow, damp, fine-grained silty sand (SM) and sandy lean clay (CL) with scattered sub-rounded and locally fractured gravel up to 3" in maximum dimension.			
4	1							
5								
6	2	10	0.2			18.1		
7								
8	3							
9								
10					Similar to above, with traces of gravel up to 1" in maximum dimension. Fill also contains intermixed chunks of gray claystone (CL) and reddish yellow sandstone (SM) up to 1/2" in maximum dimension.			
11	4	29	0.0			15.8	103.9	
12								
13								
14								
15								
16	5	15	0.1			18.9		
17								
18								
19								
20								
21	6	26	0.0			26.3	97.5	High blow counts in the 20' and 25' drive samples due to abundant gravel in fill.
22								
23								
24								
25					Similar to above, sample also contains a 3" wide zone of dark gray, wet silty sand (SM) containing organic matter including grass and rootlets, and traces of sub-rounded gravel up to 3/4" in maximum dimension.			
26	7	21	0.4			13.9		
27								
28								
29								

PROJECT NO. 44F1

ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE A-26

BORING NO. H-10 (Continued)

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
31	8	100+	0.1		**FILL** Olive, damp, silty sand (SM) and sandy silt (ML) with abundant gravel/cobble.	15.2		Sampler bouncing on gravel/cobble.
32				?	? ?			?
33					**SCRIPPS FORMATION**			
34								Driller added water inside of auger to assist in bringing soil cuttings to ground surface.
35	9	100+	0.1		Reddish yellow to olive brown, damp, very dense, fine-grained silty sandstone (SM).	21.7		
36								
37								
38								
39								
40	10	100+	0.1			20.6	103.2	
41								
42	11							
43								
44								
45								
46	12	100+	0.3		Grayish brown to reddish yellow, damp, hard, sandy lean clay (CL).	23.6		
47								
48								
49								
50								
51	13	100+	0.0			20.8	106.7	
52					Gravel zone between 52' and 54'.			
53								
54								
55	14	100+	0.0			25.5	90.5	
56								
57								
58								
59								
60	15	100+	0.3			24.6		
61								

PROJECT NO.
44F1

ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE A-27

BORING NO. H-10 (Continued)

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
63				▨	**SCRIPPS FORMATION**			
64				▨	Grayish brown to reddish yellow, sandy lean clay (CL).			
65	16	100+		▨				No sample recovery
66				▨				
67				▨				
68				▨				
69				▨				
70	17	100+	0.2	▨	Similar to above, transitions into a dark gray, hard claystone (CL/CH) at 70.5'.	19.7		
71				▨				
72				▨				
73				▨				
74				▨				
75	18	100+		▨	Olive brown to reddish yellow, damp, sandy siltstone (ML), transitioning into dark gray claystone (CL/CH) at 75.5'.	18.1	115.4	
76				▨				
77				▨				
78				▨				
79				▨				
80	19	100+	0.3	▨	Dark gray, hard, claystone (CL/CH).	24.4		
81								

NOTES:

Bottom of borehole at 80.5 feet.

Unable to determine if groundwater is present. Method of drilling required introduction of water into borehole.

BORING NO. H-11

DATE OF DRILLING: MAY 2 AND 3, 2017	TOTAL BORING DEPTH: 81.5 FEET
GENERAL LOCATION: SECONDARY CLARIFIERS	
APPROXIMATE SURFACE ELEV.: +349 FEET MSL	DRILLING CONTRACTOR: TRI-COUNTY DRILLING. INC..
DRILLING METHOD: 8- INCH HSA	LOGGED BY: NICK BARNES

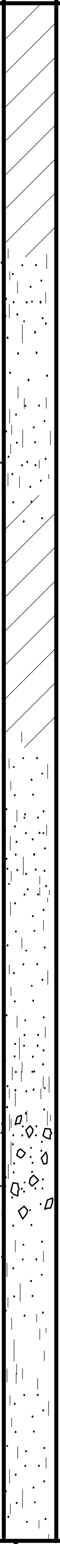
DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
1								Lawn sod in the upper 2 inches
2					**FILL**			
3					Yellow brown to olive yellow, damp,silty sand (SM).			
4								
5								
6	1	30	0.0			23.5	98.0	
7								
8								
9								
10					Yellow brown to olive yellow, damp to wet, sandy clay (CL). Fill contains intermixed chunks of claystone (CL) and siltstone (ML) up to 2" in maximum dimension.			
11	2	14	0.1			25.8		Poor recovery, sampler hit large gravel clasts in fill.
12								
13	3							
14								
15				?	? ?			?
16	4	39	0.0		**SCRIPPS FORMATION**	24.0	97.5	
17					Olive yellow to pale greenish gray, wet, very stiff, slightly micaceous, sandy lean clay (CL).			
18								
19								
20								
21	5	40	0.2			22.6		
22								
23	6							
24								
25								
26	7	100+	0.0			21.5	103.4	
27								
28								
29								

PROJECT NO.
44F1

ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE A-29

BORING NO. H-11 (Continued)



DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
31	8	100+	0.5	**SCRIPPS FORMATION**	24.5		Driller added water inside of auger to assist in bringing soil cuttings to ground surface.
32							
33							
34							
35							
36	9	100+	0.6	Olive yellow to pale greenish gray, very dense, fine-grained, silty sandstone (SM).	19.0	104.0	
37							
38	10						
39							
40							
41	11	60	0.6	Olive to olive yellow, damp, hard, sandy lean clay (CL).	22.4		
42							
43							
44							
45							
46	12	100+	0.1	Olive to pale gray, silty sandstone (SM).	20.1	108.2	
47							
48							
49							
50							
51	13	88	0.4		11.8		
52							
53							
54				53' - 55', gravel zone.			
55							
56	14	100+	0.0		17.5	106.9	
57							
58							
59							
60							
61	15	100+	0.7		26.7		

PROJECT NO.
44F1

ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE A-30

BORING NO. H-11 (Continued)

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
				▨	**SCRIPPS FORMATION**			
63								
64					Grayish brown to reddish yellow sandy lean clay (CL).			
65	16	100+	0.0			21.4		
66								
67								
68								
69								
70	17	100+						No sample recovery
71								
72								
73								
74								
75	18	100+	0.2		Medium gray, damp, hard, claystone (CL/CH).	26.1		
76								
77								
78								
79								
80	19	100+	0.3			21.3		
81								

NOTES:

Bottom of borehole at 81.5 feet.

Unable to determine if groundwater is present.
Method of drilling required introduction of water
into borehole.

BORING NO. H-12

DATE OF DRILLING: MAY 3 AND 4, 2017 | TOTAL BORING DEPTH: 100.5 FEET

GENERAL LOCATION: SECONDARY CLARIFIER

APPROXIMATE SURFACE ELEV.: +348 FEET MSL | DRILLING CONTRACTOR: TRI-COUNTY DRILLING. INC..

DRILLING METHOD: 8 INCH HSA | LOGGED BY: NICK BARNES

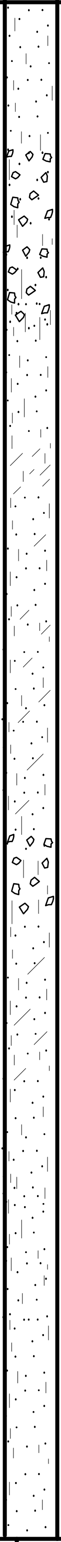
DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
1								Lawn sod in the upper 2 inches
2					**FILL**			
3					Yellow brown, olive to reddish brown, damp to wet, gravelly silty sand (SM) containing chunks of olive yellow claystone. Gravel is sub-rounded to sub-angular and locally fractured, up to 3" in maximum dimension.			
4	1							
5								
6	2	53	0.2			14.3	102.3	
7								
8								
9								
10								
11	3	14	0.0		Olive yellow to olive gray, wet, fine-grained, micaceous. Little to no gravel.	22.0		
12								
13	4							
14								
15								
16	5	30	0.1		Similar to above, soil is intermixed with 1" to 2" chunks of fine-grained, cemented sandstone.	23.9	100.3	
17								
18								
19								
20								
21	6	20	0.0			21.4		
22								
23	7							
24								
25								
26	8	44	0.1			23.2	107.3	
27				?	? ?			?
28					**SCRIPPS FORMATION**			
29					Reddish yellow, damp, very dense, fine-grained, silty sand (SM), grading into olive gray, hard, sandy lean clay (CL).			

PROJECT NO. 44F1 | **ALLIED GEOTECHNICAL ENGINEERS, INC.** | **FIGURE A-32**

BORING NO. H-12 (Continued)

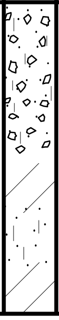
DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
31	9	100+	0.2		**SCRIPPS FORMATION**	19.7		Driller added water inside of auger to assist in bringing soil cuttings to ground surface
32								
33								
34								
35	10	100+	0.7		Reddish yellow, damp, very dense, medium-grained, poorly graded sand with silt (SP-SM). Soil is uncemented.	9.5	94.3	
36								
37								
38								
39								
40								
41	11	100+	0.1			12.0		
42								
43								
44								
45	12	100+						No sample recovery
46								
47								
48								
49								
50	13	100+	0.0					
51					Reddish yellow, fine to medium grained silty sand (SM), interlayered with olive yellow to olive gray lean clay (CL).	22.1		
52								
53					Gravel zone between 51' and 52.5'.			
54								
55	14	100+	0.0			7.3	107.8	
56					Light gray to pale yellow brown, fine to medium grained, silty sand (SM).			
57								
58								
59					Reddish yellow, fine to medium grained, poorly graded sand with silt (SP-SM).			
60	15	100+	0.1			15.1		
61								

BORING NO. H-12 (Continued)



DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
				SCRIPPS FORMATION			
63							
64							
65	16	100+	0.2	Abundant gravels and cobbles from 65' to 69'.	19.7		
66							
67							
68							
69							
70	17	100+	0.2	Reddish yellow, fine to medium grained, poorly graded sand with silt (SP-SM), interlayered with olive to olive gray claystone (CL). Interlayers up to 2" in thickness.	29.2		
71							
72							
73							
74							
75	18	100+	0.2		21.3		
76							
77							
78							
79				Gravel zone from 79' to 81'.			
80	19	100+					No sample recovery, sampler bouncing on rock.
81							
82							
83							
84				Yellowish red, damp, very dense, fine to medium grained, poorly graded sand with silt (SP-SM).			
85	20	100+	0.2		22.1		
86							
87							
88							
89							
90	21	100+	0.3		22.0		
91							
92							
93							

BORING NO. H-12 (Continued)

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
95					**SCRIPPS FORMATION** Abundant gravels and cobbles from 94' to 97'.			Did not attempt sampling at 95' due to abundant gravel and cobble.
96								
97								
98								
99					Medium gray to dark gray claystone (CL/CH), interlayered with yellow brown silty sand (SM).			
100	22 ◪	100+	0.4			25.8		

NOTES:

Bottom of borehole at 100.5 feet.

Unable to determine if groundwater is present. Method of drilling required introduction of water into borehole.

PROJECT NO. 44F1

ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE A-35

BORING NO. H-13

DATE OF DRILLING: MAY 4 AND 5, 2017
TOTAL BORING DEPTH: 101 FEET
GENERAL LOCATION: SECONDARY CLARIFIER
APPROXIMATE SURFACE ELEV.: +354 FEET MSL
DRILLING CONTRACTOR: TRI-COUNTY DRILLING. INC..
DRILLING METHOD: 8 INCH HSA
LOGGED BY: NICK BARNES

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
1								
2					**FILL**			
3					Yellow brown, damp, sand lean clay (CL) with scattered sub-rounded and locally fractured gravel up to 3" in maximum dimension.			
4	1							
5								
6	2	40	0.2			13.7	111.5	
7								
8								
9								
10								
11	3	21	0.4		Similar to above, soil is intermixed with angular chunks of cemented sandstone and claystone up to 2" in size.	20.5		
12								
13	4							
14								
15					Mottled olive to pale gray color.			
16	5	45	0.2			22.6	98.2	
17								
18								
19								
20								
21	6	19	0.3			20.4		
22								
23								
24								
25								
26	7	33	0.2			22.5	102.2	
27								
28				?	? ?			?
29					**SCRIPPS FORMATION -** Olive gray to pale yellowish red, damp, hard, sandy lean clay (CL).			

PROJECT NO. 44F1

ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE A-36

BORING NO. H-13 (Continued)

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
31	8	49	0.4	**SCRIPPS FORMATION**	21.2		Driller added water inside of auger to assist in bringing soil cuttings to ground surface
32				Olive gray to pale yellowish red sandy lean clay (CL).			
33							
34	9						
35							
36	10	100+	0.7		21.5	108.5	
37							
38							
39							
40							
41	11	61	0.2	Similar to above, pale olive brown to pale reddish yellow in color.	21.4		
42	12						
43							
44							
45							
46	13	100+	0.0		22.3	106.3	
47							
48							
49							
50							
51	14	100+	0.1	Similar to above, pale olive gray and brown to pale reddish yellow in color.	24.3		
52							
53							
54							
55							
56	15	100+	0.1	Medium gray to olive gray, damp, hard, claystone (CL/CH) with narrow laminations of pale reddish yellow silty sandstone (SM).	22.4		
57							
58				Abundant gravels and cobbles from 58' to 59.5'.			
59							
60				Pale reddish yellow silty sandstone (SM).			
61	16	74	0.0		20.8		

PROJECT NO.
44F1

ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE A-37

BORING NO. H-13 (Continued)

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
					SCRIPPS FORMATION			
63								
64								
65								
66	17	100+	0.1		Olive to olive gray sandy lean clay (CL).	20.4	110.5	
67								
68								
69								
70								
71	18	88	0.2			22.0		
72								
73								
74								
75								
76	19	100+	0.1		Similar to above, grading into medium to dark gray, hard claystone (CL/CH).	21.3	98.3	
77								
78								
79								
80								
81	20	100+	0.1			20.7		
82								
83								
84								
85	21	100+	0.3			17.4	112.7	
86								
87								
88								
89	25							
90	22	100+	0.1			17.7		
91								
92								
93								

BORING NO. H-13 (Continued)

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
					SCRIPPS FORMATION			
95								
	23	100+	0.0		Medium gray to dark gray, hard claystone (CL/CH).	22.6		
96								
97								
98								
99								
100								
	24	100+	0.0			23.6		
101								

NOTES:

Bottom of borehole at 101 feet.

Unable to determine if groundwater is present. Method of drilling required introduction of water into borehole.

BORING NO. H-14

DATE OF DRILLING: MAY 1 AND 2, 2017	TOTAL BORING DEPTH: 100.5 FEET
GENERAL LOCATION: SECONDARY CLARIFIER	
APPROXIMATE SURFACE ELEV.: +353 FEET MSL	DRILLING CONTRACTOR: TRI-COUNTY DRILLING. INC..
DRILLING METHOD: 8 INCH HSA	LOGGED BY: NICK BARNES

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
1								
2					**FILL**			
3					Olive yellow, olive green and yellow brown, damp to wet, sandy clay (CL).			
4	1							
5								
6	2	14	2.1			22.0		
7								
8								
9								
10	3				Very dark gray, wet, sandy clay (CL) with scattered sub-angular and locally fractured gravel up to 2" in maximum dimension.			
11	4	30	2.4			20.4	107.4	
12								
13								
14								
15								
16	5	14	2.6		Yellow brown to olive yellow to olive, wet, clayey sand (SC) and fine-grained silty sand (SM).	17.3		
17								
18								
19								
20								
21	6	58	0.2		Dark gray to very dark grayish brown, wet, sandy clay (CL) with scattered gravel and intermixed chunks of olive green cemented sandstone. Gravel and sandstone chunks up to 2" in maximum dimension.	17.3	113.5	
22								
23	7							
24								
25	8					15.2		
26	9	21	2.1					
27								
28				?	? ?			?
29					**SCRIPPS FORMATION -** Olive yellow to pale olive, damp, hard, sandy lean clay (CL).			

PROJECT NO. 44F1	**ALLIED GEOTECHNICAL ENGINEERS, INC.**	**FIGURE A-40**

BORING NO. H-14 (Continued)

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
31	10	100+	0.1		**SCRIPPS FORMATION**	20.6	102.5	
32					Olive yellow to pale olive sandy lean clay (CL).			
33								
34								
35								Driller added water inside of auger to assist in bringing soil cuttings to ground surface
36	11	96	0.3			23.6		
37								
38								
39								
40								
41	12	100+	0.1			19.7	110.7	
42								
43	13							
44								
45								
46	14	86	0.0			20.6		
47								
48								
49								
50	15	100+	0.1			21.4	98.2	
51								
52								
53								
54								
55	16	100+	0.0			17.1		
56					Reddish yellow to olive, damp, very dense, fine-grained silty sandstone (SM).			
57	17							
58								
59								
60	18	100+	0.1		Olive to olive yellow with local reddish yellow oxide staining, damp, very dense, silty sandstone (SM).	13.1	84.2	
61								

BORING NO. H-14 (Continued)

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
63					**SCRIPPS FORMATION**			
64								
65	19	100+	0.3		Olive yellow, very dense, silty sandstone (SM).	17.4		
66								
67								
68								
69								
70	20	100+	0.2		Olive yellow to gray, hard, sandy lean clay (CL).	20.5	100.1	
71								
72								
73								
74					72' - 78', gravel zone.			
75	21	100+						No sample recovery
76								
77								
78								
79								
80	22	100+	0.2		Yellow brown, wet, very dense, medium-grained, poorly graded sand with silt (SP-SM).	18.1	113.6	
81								
82								
83								
84								
85	23	100+	0.0			23.9		
86								
87								
88								
89								
90	24	100+	0.1		Olive to reddish yellow, damp, very dense, fine-grained, silty sandstone (SM).	24.9		
91								
92								
93					Abundant gravels and cobbles from 92' to 98'.			

PROJECT NO. 44F1	ALLIED GEOTECHNICAL ENGINEERS, INC.	FIGURE A-42

BORING NO. H-14 (Continued)

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
95					**SCRIPPS FORMATION**			
96								
97								
98								
99								
100	25	100+	0.2		Gray, damp, hard sandy lean clay (CL).	18.9		

NOTES:

Bottom of borehole at 100.5 feet.

Unable to determine if groundwater is present. Method of drilling required introduction of water into borehole.

BORING NO. H-15

DATE OF DRILLING: MAY 8, 2017
TOTAL BORING DEPTH: 21.5 FEET
GENERAL LOCATION: WESTERN PIPELINE CORRIDOR
APPROXIMATE SURFACE ELEV.: +349 FEET MSL
DRILLING CONTRACTOR: TRI-COUNTY DRILLING. INC..
DRILLING METHOD: 8 INCH HSA
LOGGED BY: NICK BARNES

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
1					**EXISTING PAVEMENT:** 4.5" A.C. over 4" misc. base			
2					**FILL:** Medium brown to yellow brown, damp, silty sand (SM) with scattered sub-rounded gravel up to 3" in maximum dimension.			
3				?				? ?
4					**SCRIPPS FORMATION**			
6	1 2	100+	0.0		Olive yellow to olive gray to pale reddish yellow, damp, hard, highly plastic clay (CH).	21.7	102.8	
10					Very dense, silty sandstone (SM).			
11	3	79	0.2			19.8		
13	4							
16	5	100+	0.0			18.6	102.9	
21	6	88	0.2			17.8		
22								

NOTES:

Bottom of borehole at 21.5'

No groundwater or seepage encountered during drilling operations

PROJECT NO.
44F1

ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE A-44

BORING NO. H-16

DATE OF DRILLING: MAY 8, 2017
TOTAL BORING DEPTH: 21.5 FEET
GENERAL LOCATION: WESTERN PIPELINE CORRIDOR
APPROXIMATE SURFACE ELEV.: +370 FEET MSL
DRILLING CONTRACTOR: TRI-COUNTY DRILLING. INC..
DRILLING METHOD: 8 INCH HSA
LOGGED BY: NICK BARNES

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
1					**EXISTING PAVEMENT: 7"** A.C., no base			
2				?	**FILL -** Yellow brown, damp, silty sand (SM). ? ?			? ?
3					**SCRIPPS FORMATION**			
4					Olive to olive yellow, damp, hard, sandy siltstone (ML).			
5								
6	1	75	0.0			21.0	103.5	
7								
8								
9								
10								
11	2	53	0.0			19.9		
12								
13	3							
14								
15								
16	4	98	0.0		Very dense, fine-grained, silty sandstone (SM).	21.0	106.2	
17								
18								
19								
20								
21	5	100+	0.0			21.1		
22								

NOTES:

Bottom of borehole at 21.5'

No groundwater or seepage encountered during drilling operations

BORING NO. H-17

DATE OF DRILLING: MAY 11, 2017
TOTAL BORING DEPTH: 19.5 FEET
GENERAL LOCATION: WESTERN PIPELINE CORRIDOR
APPROXIMATE SURFACE ELEV.: +381 FEET MSL
DRILLING CONTRACTOR: TRI-COUNTY DRILLING. INC..
DRILLING METHOD: 8 INCH HSA
LOGGED BY: NICK BARNES

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
					Bark & wood chips in the upper 6"			
1 – 2	1				**COLLUVIAL DEPOSITS -** Dark yellow brown, wet, stiff, highly plastic clay (CH) with scattered sub-rounded and fractured gravel and cobbles up to 4" in max. dimension.			
				?	? ?			? ?
4 – 5					**SCRIPPS FORMATION**			
5 – 6	2	80	0.0		Olive yellow to pale reddish yellow, damp, hard, lean clay (CL).	22.3	102.1	
7 – 10	3							
10 – 11	4	100+	0.0			20.7		
15 – 16	5	100+	0.0		Pale reddish yellow to reddish brown, damp, very dense, fine to medium-grained, silty sandstone (SM).	20.5	83.2	
17 – 19					Abundant gravel/cobbles from 17' to 19.5'.			
19 – 19.5	6	100+						No sample recovery

NOTES:

Bottom of borehole at 19.5'

No groundwater or seepage encountered during drilling operations

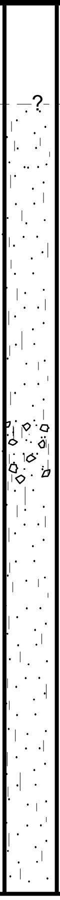
PROJECT NO. 44F1

ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE A-46

BORING NO. H-18

DATE OF DRILLING: MAY 8, 2017
TOTAL BORING DEPTH: 21 FEET
GENERAL LOCATION: EASTERN PIPELINE CORRIDOR
APPROXIMATE SURFACE ELEV.: +368 FEET MSL
DRILLING CONTRACTOR: TRI-COUNTY DRILLING. INC..
DRILLING METHOD: 8 INCH HSA
LOGGED BY: NICK BARNES



DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
1				**FILL -** Pale yellow to yellow brown, damp, silty sand (SM) with scattered sub-rounded and locally fractured gravel up to 3" in maximum dimension.			
2							
3				? ?			? ?
4				**SCRIPPS FORMATION**			
5				Olive to pale olive yellow to pale reddish yellow, damp, very dense, fine-grained, silty sandstone (SM).			
6	1	73	0.0		21.4		
7	2						
8							
9							
10	3	100+		Abundant gravel between 10' and 11.5'.			Sampler bouncing on rock, no recovery
11							
12							
13	4						
14							
15							
16	5	57	0.0		21.4		
17							
18							
19							
20				Very dense, fine-grained, silty sandstone (SM).			
21	6	100+	0.0		20.6	105.4	
22							

NOTES:

Bottom of borehole at 21'

No groundwater or seepage encountered during drilling operations

PROJECT NO. 44F1

ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE A-47

BORING NO. H-19

DATE OF DRILLING: MAY 11 AND 25, 2017
TOTAL BORING DEPTH: 21.5 FEET
GENERAL LOCATION: EASTERN PIPELINE CORRIDOR
APPROXIMATE SURFACE ELEV.: +353 FEET MSL
DRILLING CONTRACTOR: TRI-COUNTY DRILLING. INC..
DRILLING METHOD: 8 INCH HSA/4" AIR PERCUSSION
LOGGED BY: NICK BARNES

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
0					Bark & wood chips in the upper 6"			
1–3					**FILL:** Yellow/olive brown, damp, fine-grained silty sand (SM) with scattered sub-angular gravel up to 2" in maximum dimension.			
3				?	? ?			? ?
5					**SCRIPPS FORMATION**			
6	1	52	0.1		Pale olive to pale reddish yellow, damp, dense to very dense, fine-grained, silty sandstone (SM).	20.2		
7–8	2							
8					Abundant gravels and cobbles between 8' and 10'.			5/11/17, refusal on gravel/cobbles. Relocate boring 5' east and resume drilling on 5/25/17 using 4" air rotary.
10–11	3	54	0.1		Gray to pale reddish yellow, damp, hard, sandy lean clay (CL).	24.7		
15–16	4	82	0.0		Olive brown to olive gray, hard, claystone (CL/CH).	21.9	109.4	
20–21	5	66	0.0		Medium gray to pale reddish yellow, sandy lean clay (CL).	20.8		

NOTES:

Bottom of borehole at 21.5'

No groundwater or seepage encountered during drilling operations

PROJECT NO. 44F1

ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE A-48

BORING NO. H-20

DATE OF DRILLING: MAY 18, 2017
TOTAL BORING DEPTH: 80.5 FEET
GENERAL LOCATION: NEW RENEWABLE ENERGY FACILITY
APPROXIMATE SURFACE ELEV.: +367 FEET MSL
DRILLING CONTRACTOR: TRI-COUNTY DRILLING. INC..
DRILLING METHOD: 4- INCH MUD ROTARY
LOGGED BY: NICK BARNES

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
1				**EXISTING PAVEMENT:** 4" A.C. over 12" misc. base			
2							Drill to 10' using 8-inch HSA, then switch to 4" mud rotary.
3				**SCRIPPS FORMATION**			
4	1			Light gray to pale yellowish red, damp, hard, lean clay (CL).			
5							
6	2	55	0.1		19.3		
7							
8							
9	3						
10							
11	4	100+	0.0		13.4	106.8	
12				Gravel bed between 12' and 13'.			
13							
14							
15							
16	5	100+	0.1	Olive gray, damp, hard, lean clay (CL).	22.0		
17							
18							
19							
20	6	100+	0.2		18.2	113.5	
21							
22							
23							
24							
25							
26	7	100+	0.0	Olive gray to pale reddish yellow.	21.6		
27							
28							
29							

PROJECT NO. 44F1

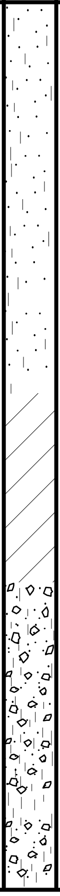
ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE A-49

BORING NO. H-20 (Continued)

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
	8	100+	0.0		**SCRIPPS FORMATION**	18.7	108.0	
31								
32					Olive gray to reddish yellow, damp, hard, sandy lean clay (CL).			
33								
34								
35								
36	9	80	0.2			21.6		
37								
38								
39								
40								
41	10	100+	0.3			16.4	112.0	
42								
43								
44								
45								
46	11	100+	0.4			23.7		
47								
48								
49								
50	12	100+	0.0			19.6	112.8	
51								
52								
53								
54								
55								
56	13	99	0.3			18.8		
57								
58								
59								
60	14	100+	0.0		Olive brown, hard, medium to highly plastic claystone (CL/CH).	21.4	114.4	
61								

BORING NO. H-20 (Continued)



DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
				SCRIPPS FORMATION			
63							
64							
65							
66	15	100+	0.0	Olive gray to pale yellowish red, damp, hard, sandy lean clay (CL). Grades into reddish yellow, medium-grained silty sandstone (SM) at 66.5'.	21.1		
67							
68							
69							
70	16	100+	0.1	Olive gray to pale reddish yellow, silty sandstone (SM) and sandy siltstone (ML), grading into olive brown claystone (CL/CH) at 70.5'.	18.3	114.4	
71							
72							
73							
74							
75				Scattered to locally abundant gravels from 74' to 80.5'.			
76							
77							
78							
79							
80	17	100+	0.3		24.2		
81							

NOTES:

Bottom of borehole at 80.5 feet.

Unable to determine if groundwater is present.
Method of drilling required introduction of water
into borehole.

PROJECT NO.
44F1

ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE A-51

BORING NO. H-21

DATE OF DRILLING: MAY 16, 2017
TOTAL BORING DEPTH: 21.5 FEET
GENERAL LOCATION: CHEMICAL STORAGE FACILITY
APPROXIMATE SURFACE ELEV.: +366 FEET MSL
DRILLING CONTRACTOR: TRI-COUNTY DRILLING. INC..
DRILLING METHOD: 8 INCH HSA
LOGGED BY: NICK BARNES

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
1					**FILL:** Medium brown to yellow brown, damp to wet, clayey sand (SC) and silty sand (SM) with scattered sub-rounded and locally fractured gravel/cobbles up to 4" in maximum dimension.			
2								
3				?	? ?			? ?
4					**VERY OLD PARALIC DEPOSITS**			
5	1							
6	2	79	0.0		Reddish brown, damp, very dense, gravelly silty sand (SM). Gravel is sub-rounded, up to 2" in maximum dimension.	6.0		
7								
8				?	? ?			? ?
9					**SCRIPPS FORMATION**			
10								
11	3	100+	0.1		Olive yellow to olive brown, damp, hard, sandy lean clay (CL).	19.7	105.5	
12								
13								
14	4							
15								
16	5	75	0.1			17.5		
17								
18								
19								
20								
21	6	53	0.0		Olive yellow to light olive gray, damp, very stiff to hard, sandy lean clay (CL).	19.4	112.1	
22								

NOTES:

Bottom of borehole at 21.5'

No groundwater or seepage encountered during drilling operations

PROJECT NO.
44F1

ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE A-52

BORING NO. H-22

DATE OF DRILLING: MAY 17, 2017
TOTAL BORING DEPTH: 80.5 FEET
GENERAL LOCATION: NEW RENEWABLE ENERGY FACILITY
APPROXIMATE SURFACE ELEV.: +371 FEET MSL
DRILLING CONTRACTOR: TRI-COUNTY DRILLING. INC..
DRILLING METHOD: 8 - INCH HSA
LOGGED BY: NICK BARNES

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
1								Gravels in the upper 3"
2					**FILL**			
3					Yellow brown to dark brown, damp, gravelly silty sand (SM) and clayey sand (SC). Fill is intermixed with chunks of pale yellow sandstone and olive gray siltstone.			
5					(transition in sample)			
6	1	46	0.1	?	? ?	12.5	113.1	? ?
8	2				**SCRIPPS FORMATION**			
10	3	70	0.5		Pale olive yellow to reddish yellow, damp, very dense, fine-grained silty sandstone (SM).	19.2		
15	4	100+	0.0		Olive gray to pale gray, damp, hard, sandy lean clay (CL).	20.5	106.6	Driller added water to assist in bringing soil cuttings to ground surface.
17	5							
20	6	51	0.1		Claystone contains 1/8" to 1/4" wide laminations of reddish yellow silty sandstone (SM).	20.9		
25	7	100+	0.0			17.6	106.9	

PROJECT NO. 44F1

ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE A-53

BORING NO. H-22 (Continued)

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
31	8	87	0.3		**SCRIPPS FORMATION**	22.5		
32					Olive gray, reddish yellow and olive brown, damp, very dense/hard,laminated silty sandstone (SM) and sandy lean clay (CL).			
33								
34								
35								
36	9	100+	0.0			14.8	110.9	
37								
38	10							
39								
40					Yellowish red, damp, very dense, fine to medium-grained, silty sandstone (SM).			
41	11	100+	0.4			17.0		
42								
43								
44								
45	12	100+	0.0		Pale yellow brown, damp, medium-grained, poorly graded sand with silt (SP-SM).	6.1	112.4	
46								
47								
48								
49								
50					Pale gray to reddish yellow, very stiff to hard, sandy lean clay (CL).			
51	13	65	0.3			19.0		
52								
53								
54								
55					Pale gray, hard, lean clay (CL).			
56	14	100+	0.2			20.2	109.5	
57								
58								
59								
60	15	100+	0.0			13.3		
61								

BORING NO. H-22 (Continued)

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
					SCRIPPS FORMATION			
63								
64								
65								
66					Pale gray to pale reddish yellow, damp, hard, sandy lean clay (CL).			
67								
68								
69								
70	16	100+	0.0		Reddish yellow, silty sandstone (SM).	5.6		
71								
72								
73								
74								
75								
76								
77								
78								
79								
80	17	100+	0.1		Interbedded pale gray sandy claystone (CL) and reddish yellow silty sandstone (SM).	24.9		
81								

NOTES:

Bottom of borehole at 80.5 feet.

Unable to determine if groundwater is present. Method of drilling required introduction of water into borehole.

PROJECT NO.
44F1

ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE A-55

APPENDIX B

LABORATORY TESTING

APPENDIX B

LABORATORY TESTING

Selected soil samples were tested in the laboratory to verify visual field classifications and to evaluate certain engineering characteristics. The testing was performed in accordance with the American Society for Testing and Materials (ASTM) or other generally accepted test methods, and included the following:

- Determination of in-place moisture content (ASTM D2216). The final test results are presented on the boring logs;
- Determination of in-place dry density and moisture content (ASTM D2937) based on relatively undisturbed drive samples. The final test results are presented on the boring logs;
- Compaction test (ASTM D1557) on representative bulk samples. The test results are presented on Figures B-1 through B-16;
- Mechanical and hydrometer analyses (ASTM D422). The final test results are plotted as gradation curves on Figure B-17 through B-22;
- Direct shear tests (ASTM D3080). The final test results are presented on Figures B-23 through B-45;
- Atterberg limits (ASTM D4318). The final test results are presented on Figures 17 through B-22.
- Consolidation tests (ASTM D2435). The final test results are presented on Figures B-46 through B-53; and
- Expansion Index (ASTM D4829). The final test results are presented in Table B-1 on the next page.

In addition, representative samples of the soil materials encountered in the soil borings were delivered to Clarkson Laboratory & Supply, Inc. for chemical (analytical) testing to determine soil pH, resistivity, soluble sulfate and chloride concentrations. Copies of Clarkson’s laboratory test data reports are included in this appendix.

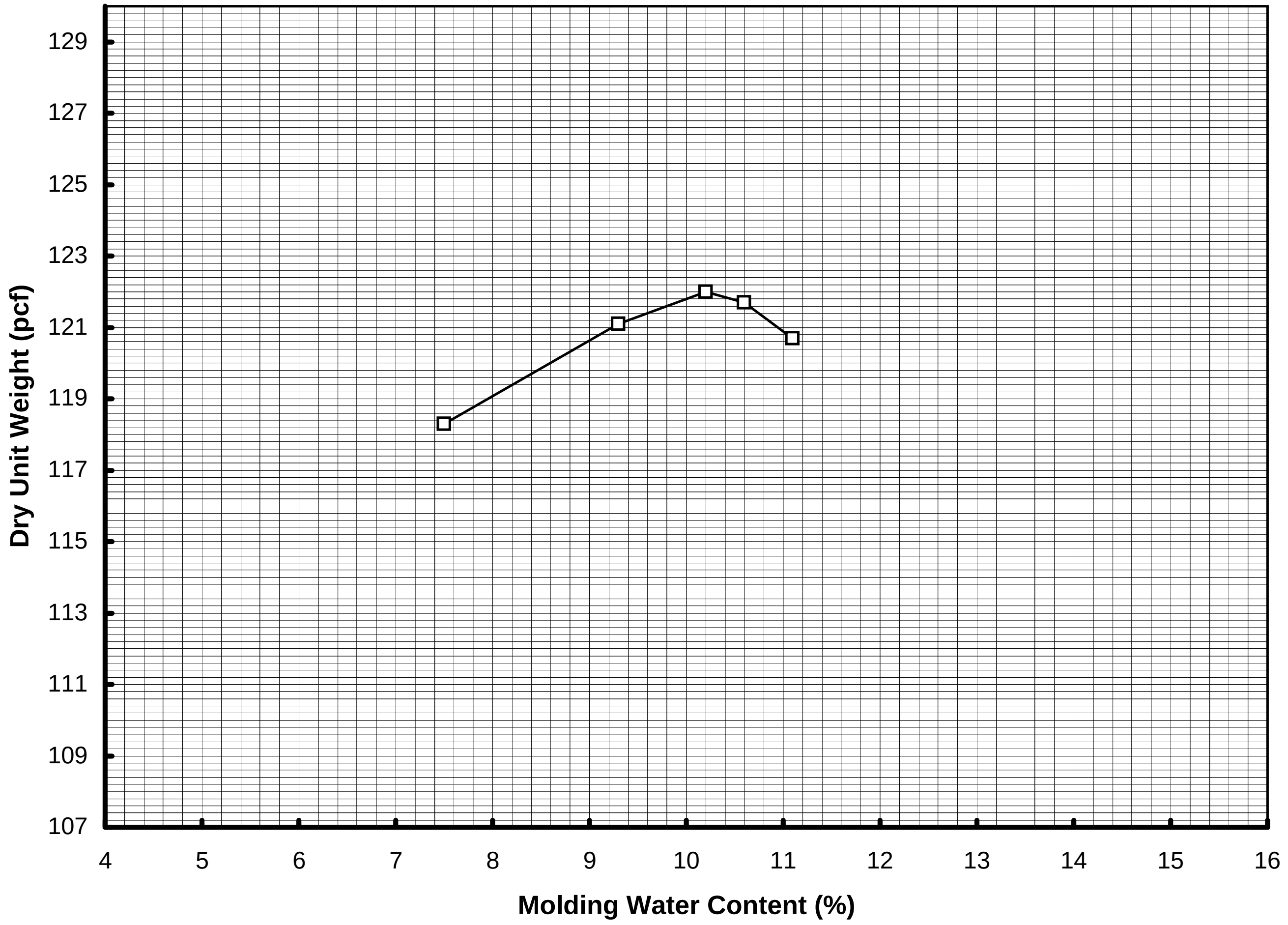
Table B-1
Summary of Expansion Index Test Results

Sample ID	Soil Classification	Expansion Index (%)
H-9 #2 @9'-12'	Silty sand (SM)/sandy silt (ML)	43
H-11 #6 @21'-24'	Sandy lean clay (CL)	71
H-13 #25 @90'-100'	Claystone (CL/CH)	78
H-14 #7 @20'-24'	Sandy clay (CL)	55
H-15 #2 @4'-7'	Fat clay (CH)	75
H-16 #1 @6'-6.5'	Sandy siltstone (ML)	67
H-19 #4 @16'-16.5'	Claystone (CL/CH)	82
H-20 #1 @3'-5'	Lean clay (CL)	40

COMPACTION CURVE

Test Method: ASTM D 1557

Compaction Procedure: A Specimen Preparation Method: ☒ Moist or ☐ Dry



Sample No.	Sample Type	Depth (ft)	OPT. WC (%)	MAX. DUW (pcf)	%ROCK %	ROCK CORR. (pcf)	Description and/or Classification
H-1 #1	Bulk	1-4	10.2	122.0	7.5	131.0	Silty sand (SM) and clayey sand (SC) with gravels.

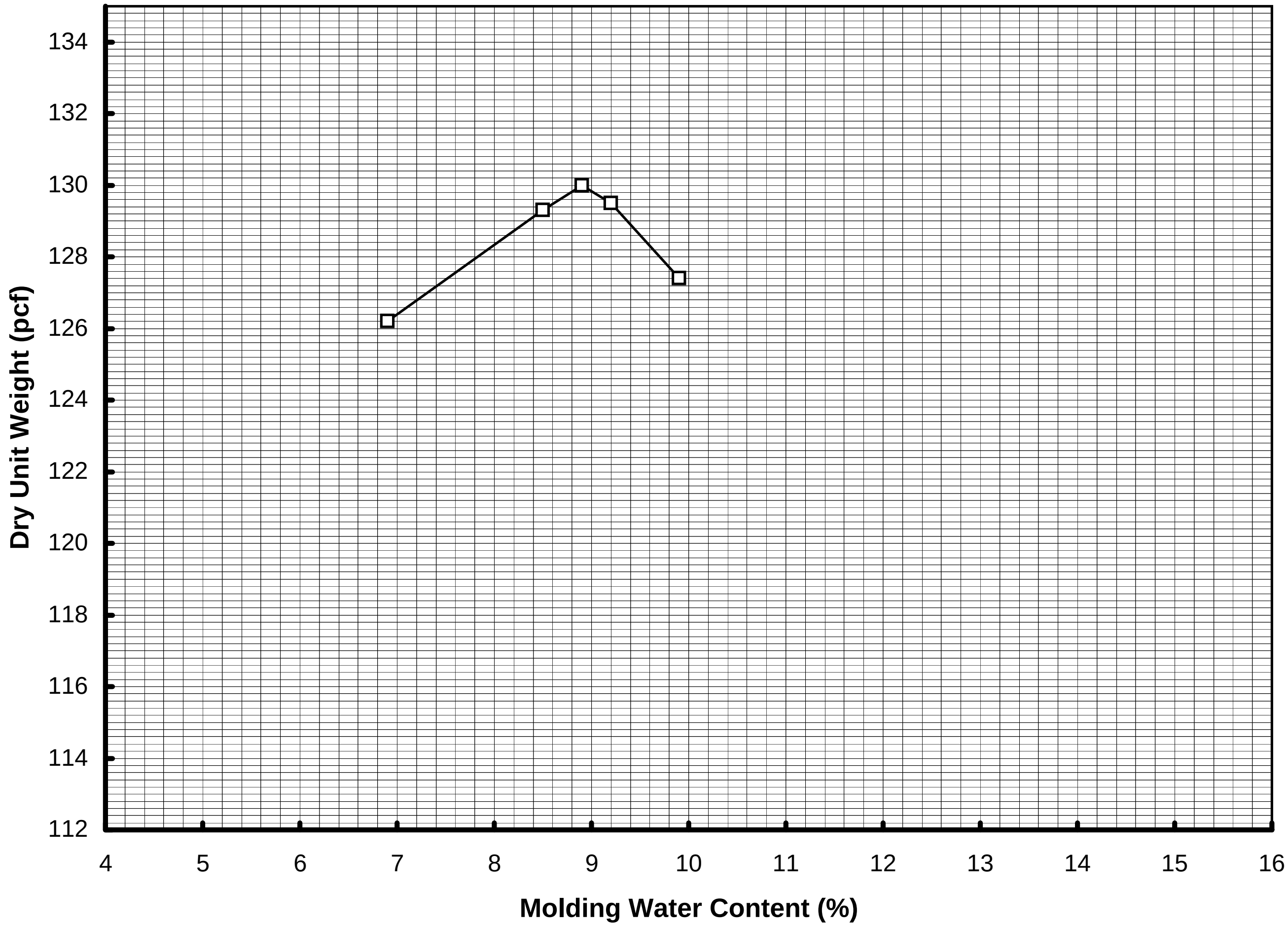
NORTH CITY WATER RECLAMATION PLANT EXPANSION
SAN DIEGO, CALIFORNIA

PROJECT NO. 44 F1	**ALLIED GEOTECHNICAL ENGINEERS, INC.**	**FIGURE B-1**

COMPACTION CURVE

Test Method: ASTM D 1557

Compaction Procedure: C Specimen Preparation Method: ☒ Moist or ☐ Dry



Sample No.	Sample Type	Depth (ft)	OPT. WC (%)	MAX. DUW (pcf)	%ROCK %	ROCK CORR. (pcf)	Description and/or Classification
H-2 #3	Bulk	11-15	8.9	130.0			Silty sand and clayey sand (SM/SC)

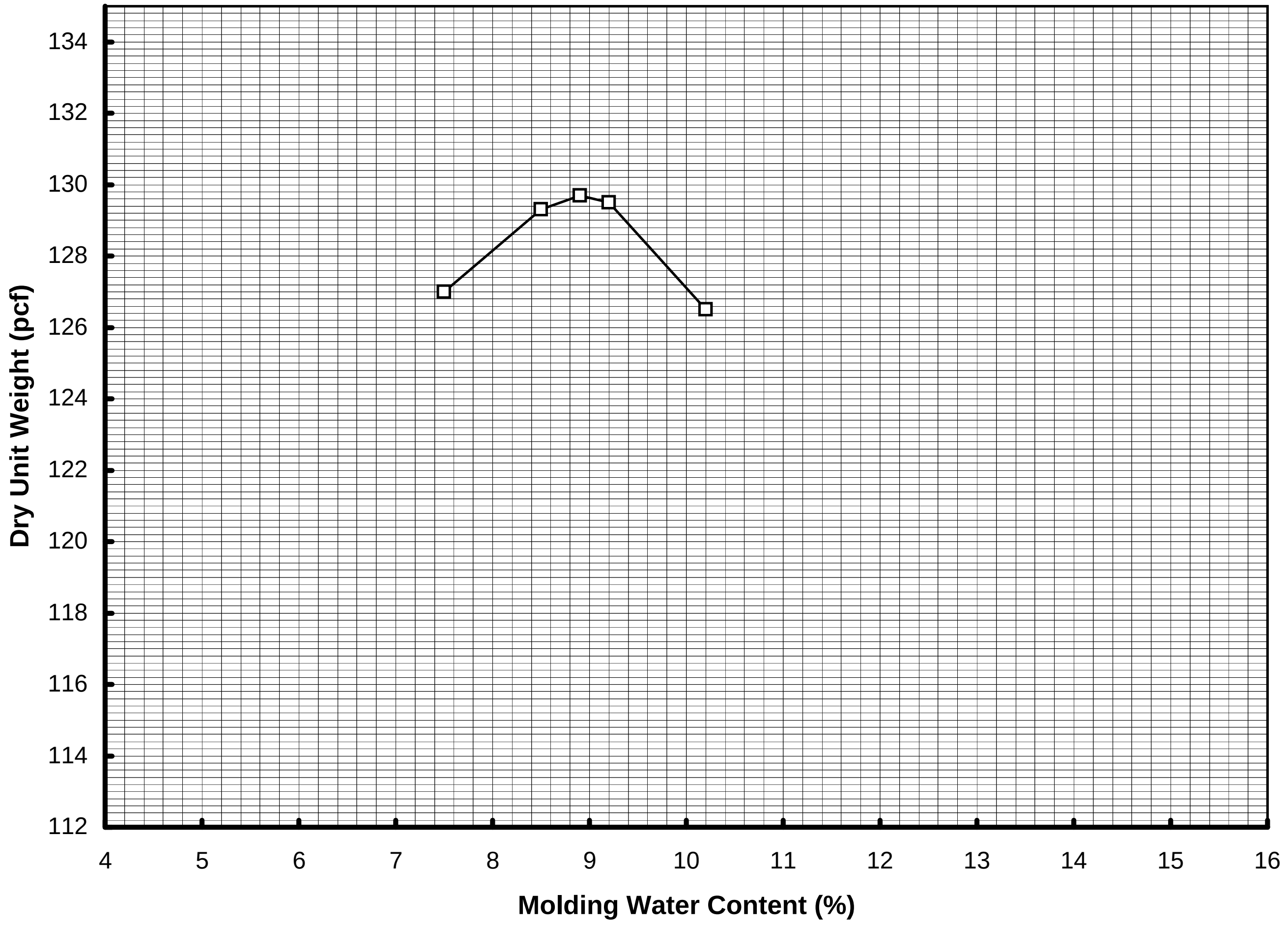
NORTH CITY WATER RECLAMATION PLANT EXPANSION
SAN DIEGO, CALIFORNIA

PROJECT NO. 44 F1	**ALLIED GEOTECHNICAL ENGINEERS, INC.**	**FIGURE B-2**

COMPACTION CURVE

Test Method: ASTM D 1557

Compaction Procedure: A Specimen Preparation Method: ☒ Moist or ☐ Dry



Sample No.	Sample Type	Depth (ft)	OPT. WC (%)	MAX. DUW (pcf)	%ROCK %	ROCK CORR. (pcf)	Description and/or Classification
H-4 #1	Bulk	3-6	8.9	129.7			Silty sand (SM) with scattered gravels

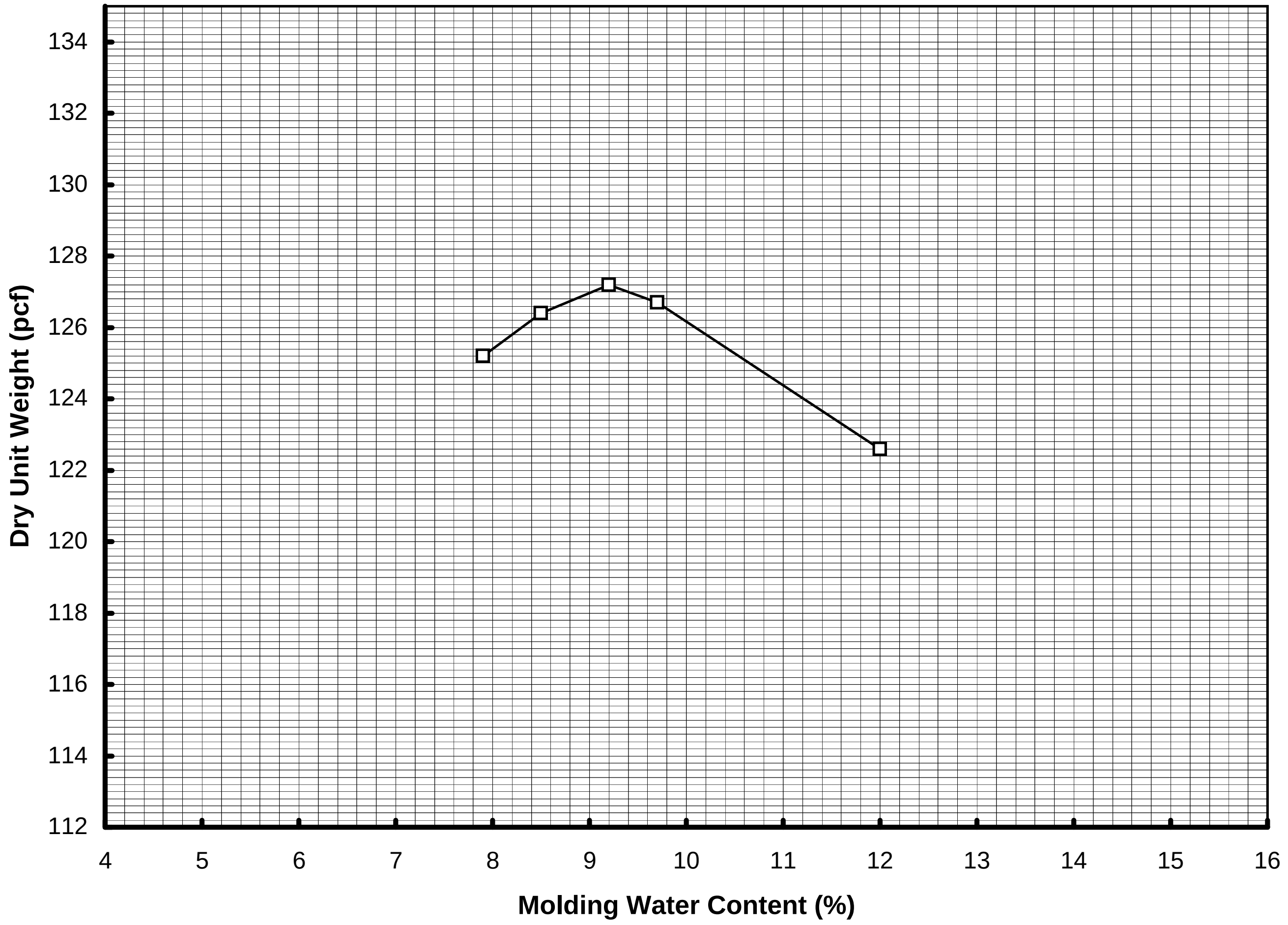
NORTH CITY WATER RECLAMATION PLANT EXPANSION
SAN DIEGO, CALIFORNIA

PROJECT NO. 44 F1	**ALLIED GEOTECHNICAL ENGINEERS, INC.**	**FIGURE B-3**

COMPACTION CURVE

Test Method: ASTM D 1557

Compaction Procedure: A Specimen Preparation Method: ☒ Moist or ☐ Dry



Sample No.	Sample Type	Depth (ft)	OPT. WC (%)	MAX. DUW (pcf)	%ROCK %	ROCK CORR. (pcf)	Description and/or Classification
H-5 #2	Bulk	4-7	9.2	127.2	1.9	129.3	Clayey sand (SC) with scattered gravels

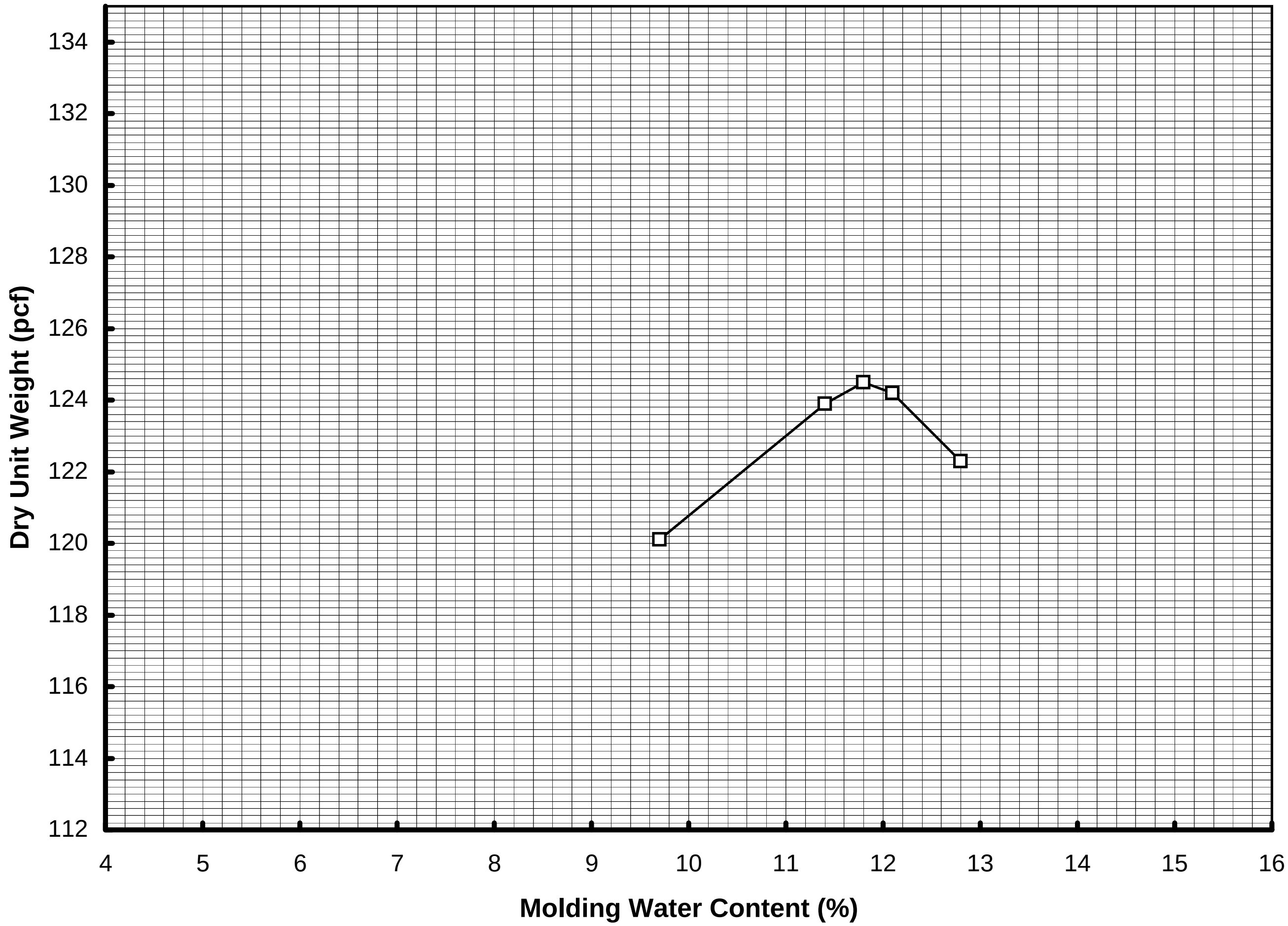
NORTH CITY WATER RECLAMATION PLANT EXPANSION
SAN DIEGO, CALIFORNIA

PROJECT NO. 44 F1	**ALLIED GEOTECHNICAL ENGINEERS, INC.**	**FIGURE B-4**

COMPACTION CURVE

Test Method: ASTM D 1557

Compaction Procedure: A Specimen Preparation Method: ☒ Moist or ☐ Dry



Sample No.	Sample Type	Depth (ft)	OPT. WC (%)	MAX. DUW (pcf)	%ROCK %	ROCK CORR. (pcf)	Description and/or Classification
H-6 #1	Bulk	4-7	11.8	124.5			Clayey sand (SC) with scattered gravels

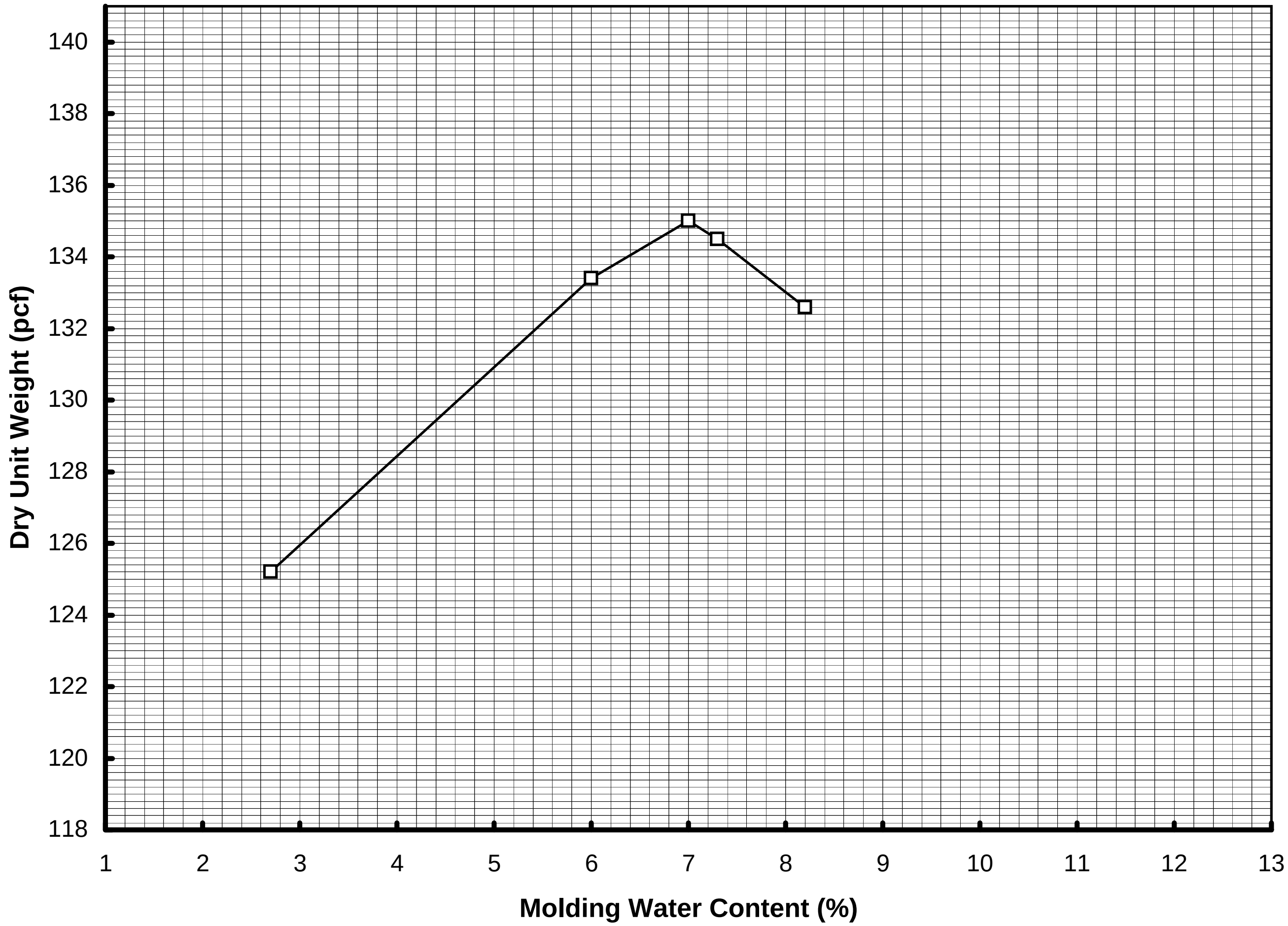
NORTH CITY WATER RECLAMATION PLANT EXPANSION
SAN DIEGO, CALIFORNIA

PROJECT NO. 44 F1	**ALLIED GEOTECHNICAL ENGINEERS, INC.**	**FIGURE B-5**

COMPACTION CURVE

Test Method: ASTM D 1557

Compaction Procedure: C Specimen Preparation Method: ☒ Moist or ☐ Dry



Sample No.	Sample Type	Depth (ft)	OPT. WC (%)	MAX. DUW (pcf)	%ROCK %	ROCK CORR. (pcf)	Description and/or Classification
H-7 #2	Bulk	5-8	7.0	135.0			Silty sand (SM) with some gravels

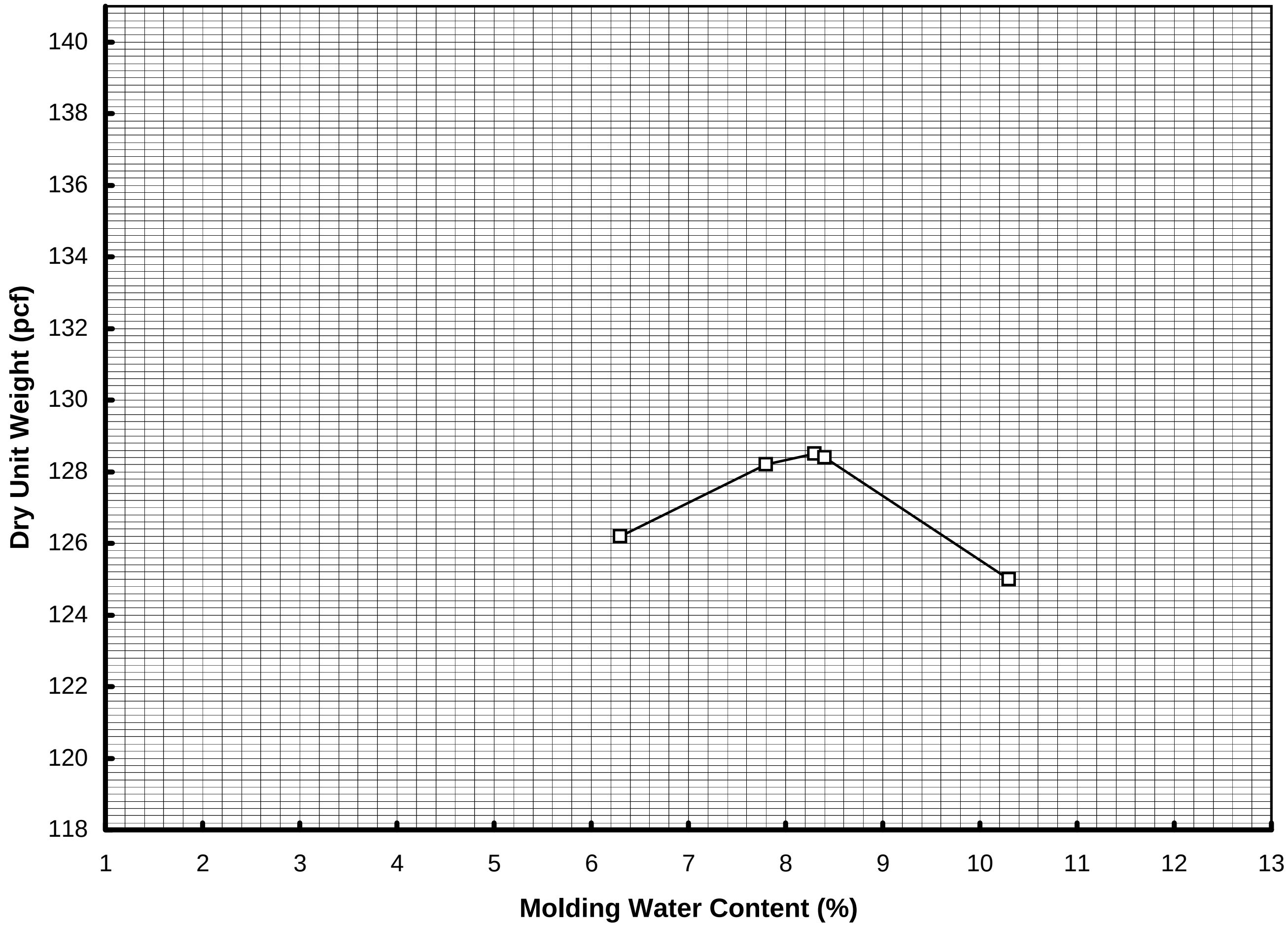
NORTH CITY WATER RECLAMATION PLANT EXPANSION
SAN DIEGO, CALIFORNIA

PROJECT NO. 44 F1	**ALLIED GEOTECHNICAL ENGINEERS, INC.**	**FIGURE B-6**

COMPACTION CURVE

Test Method: ASTM D 1557

Compaction Procedure: C Specimen Preparation Method: ☒ Moist or ☐ Dry



Sample No.	Sample Type	Depth (ft)	OPT. WC (%)	MAX. DUW (pcf)	%ROCK %	ROCK CORR. (pcf)	Description and/or Classification
H-8 #1	Bulk	4-7	8.3	128.5			Silty sand (SM) with some gravels

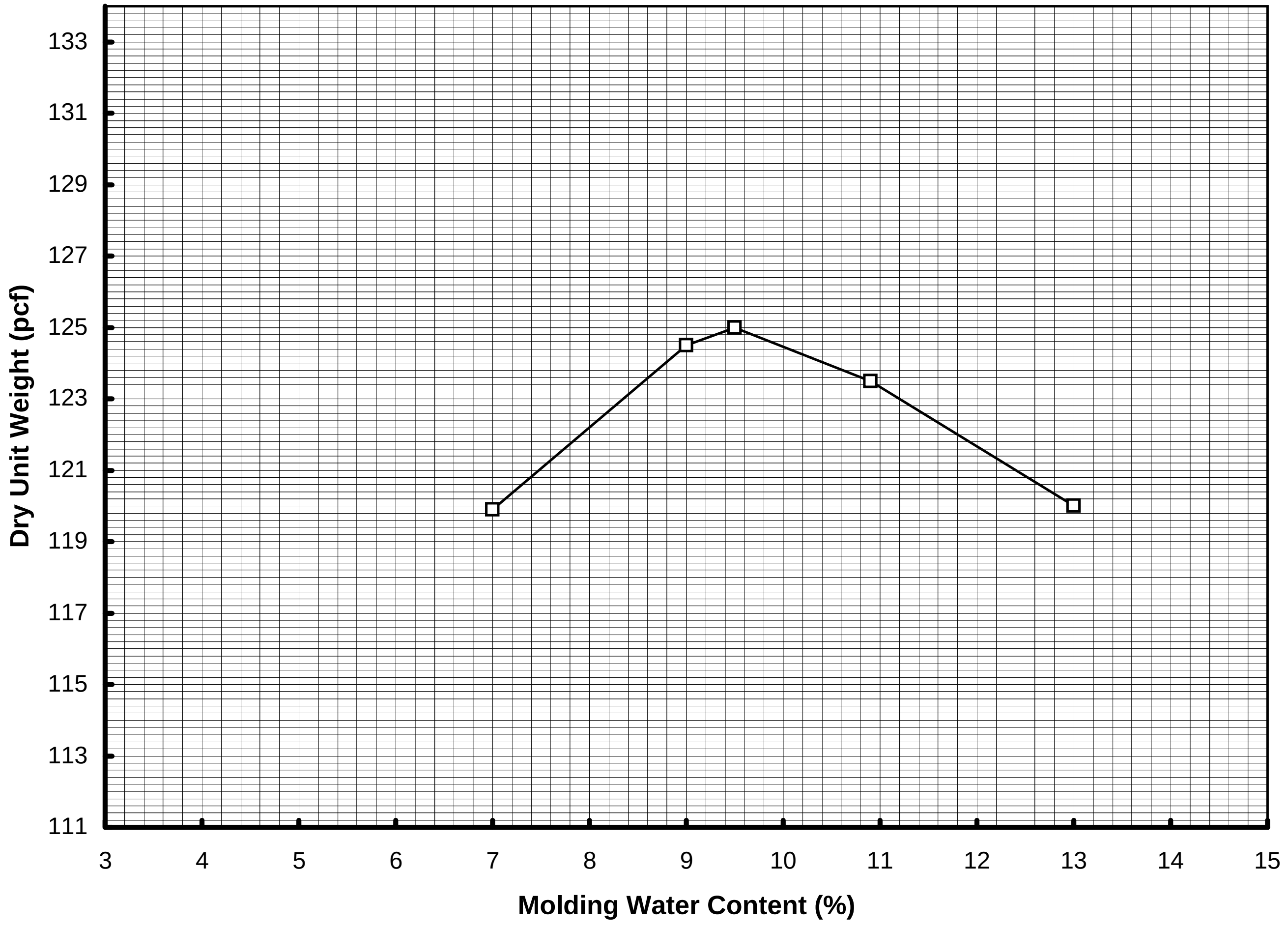
NORTH CITY WATER RECLAMATION PLANT EXPANSION
SAN DIEGO, CALIFORNIA

PROJECT NO. 44 F1	**ALLIED GEOTECHNICAL ENGINEERS, INC.**	**FIGURE B-7**

COMPACTION CURVE

Test Method: ASTM D 1557

Compaction Procedure: A Specimen Preparation Method: ☒ Moist or ☐ Dry



Sample No.	Sample Type	Depth (ft)	OPT. WC (%)	MAX. DUW (pcf)	%ROCK %	ROCK CORR. (pcf)	Description and/or Classification
H-9 #2	Bulk	9-12	9.5	125.0			Silty sand and sandy silt (SM/ML) with some gravels

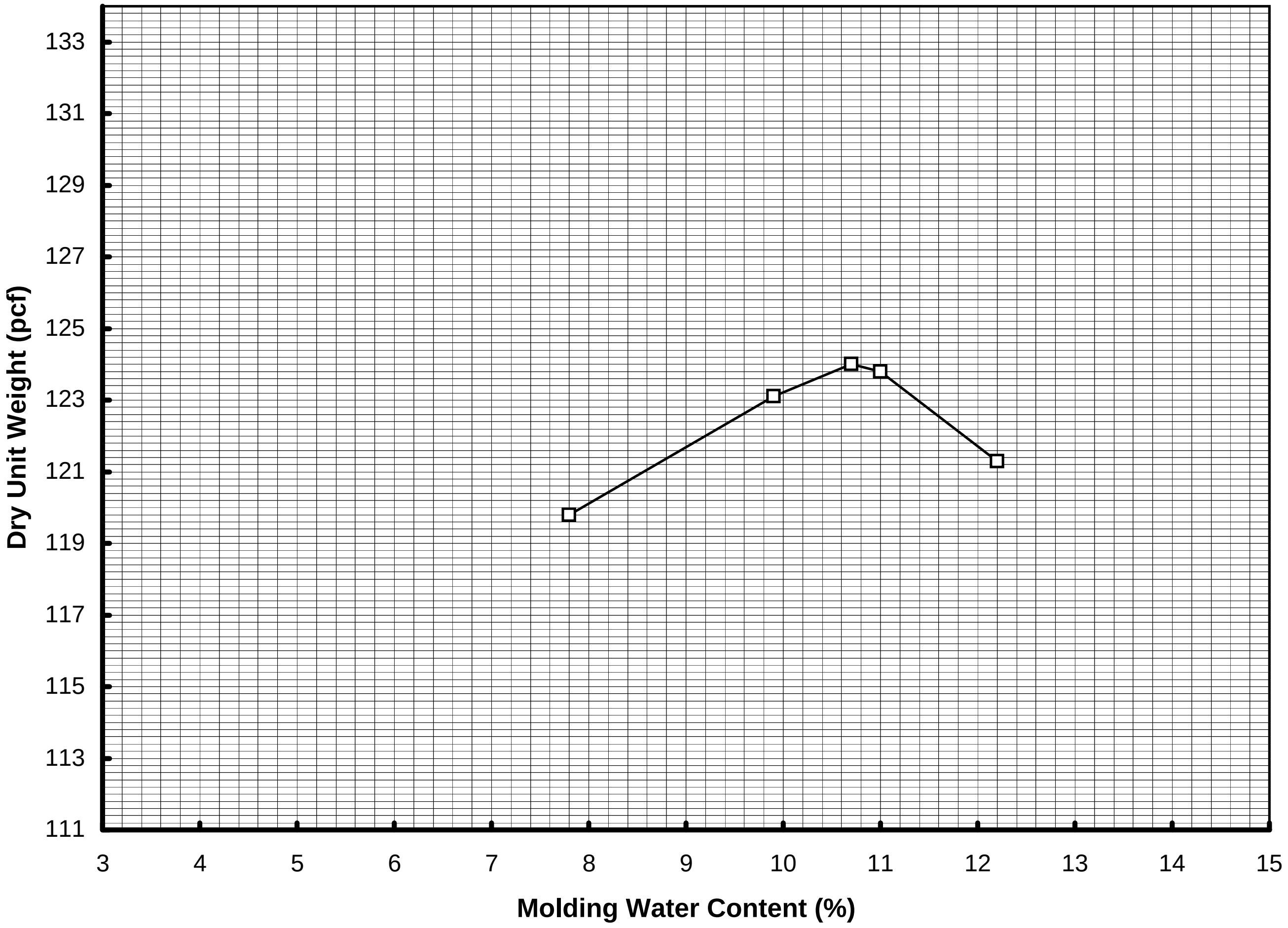
NORTH CITY WATER RECLAMATION PLANT EXPANSION
SAN DIEGO, CALIFORNIA

PROJECT NO. 44 F1	**ALLIED GEOTECHNICAL ENGINEERS, INC.**	**FIGURE B-8**

COMPACTION CURVE

Test Method: ASTM D 1557

Compaction Procedure: C Specimen Preparation Method: ☒ Moist or ☐ Dry



Sample No.	Sample Type	Depth (ft)	OPT. WC (%)	MAX. DUW (pcf)	%ROCK %	ROCK CORR. (pcf)	Description and/or Classification
H-10 #1	Bulk	3-7	10.7	124.0			Silty sand and clayey sand (SM/SC) with gravels

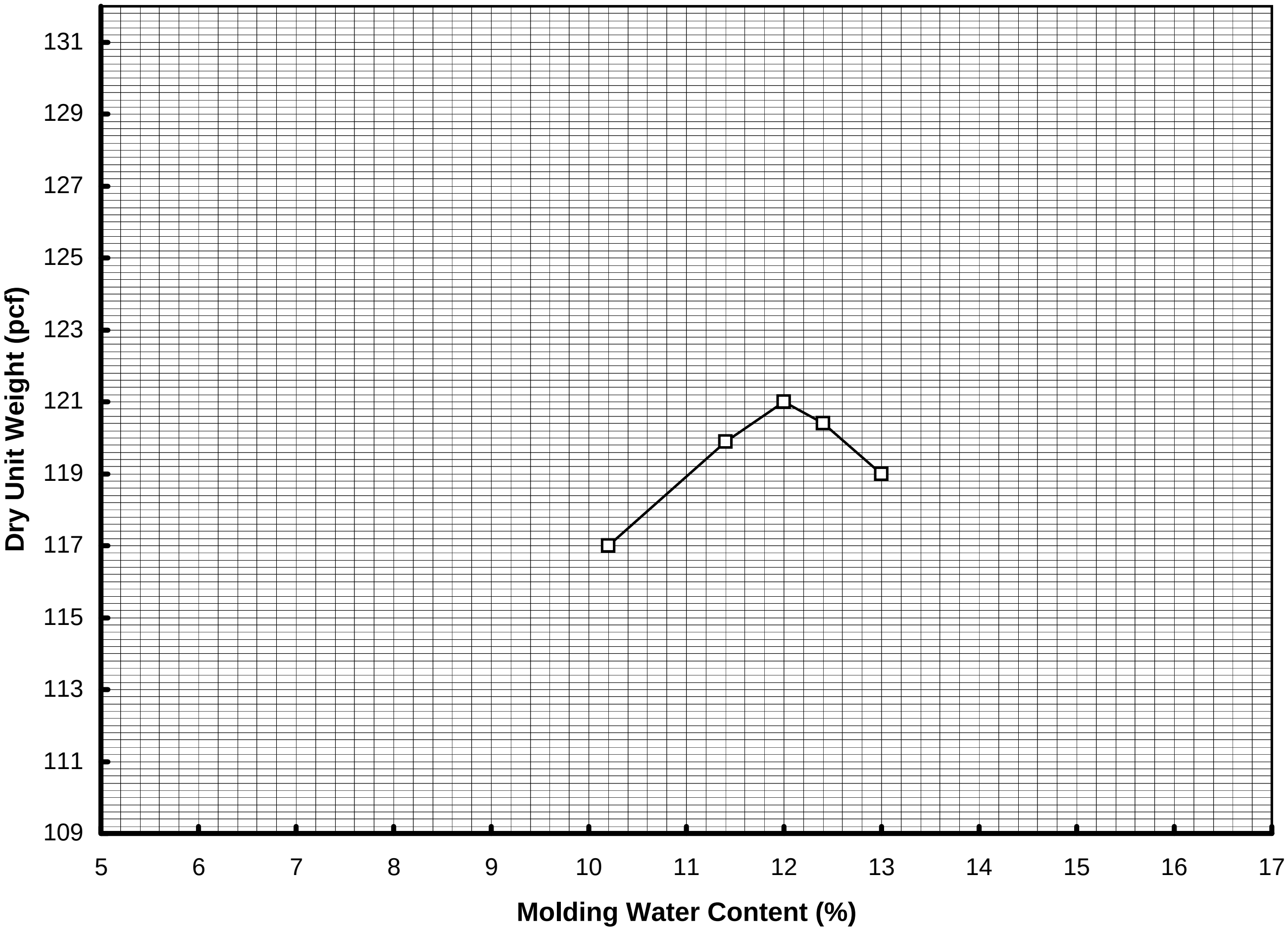
NORTH CITY WATER RECLAMATION PLANT EXPANSION
SAN DIEGO, CALIFORNIA

PROJECT NO. 44 F1	**ALLIED GEOTECHNICAL ENGINEERS, INC.**	**FIGURE B-9**

COMPACTION CURVE

Test Method: ASTM D 1557

Compaction Procedure: A Specimen Preparation Method: ☒ Moist or ☐ Dry



Sample No.	Sample Type	Depth (ft)	OPT. WC (%)	MAX. DUW (pcf)	%ROCK %	ROCK CORR. (pcf)	Description and/or Classification
H-11 #6	Bulk	21-24	12.0	121.0			Lean clay (CL)

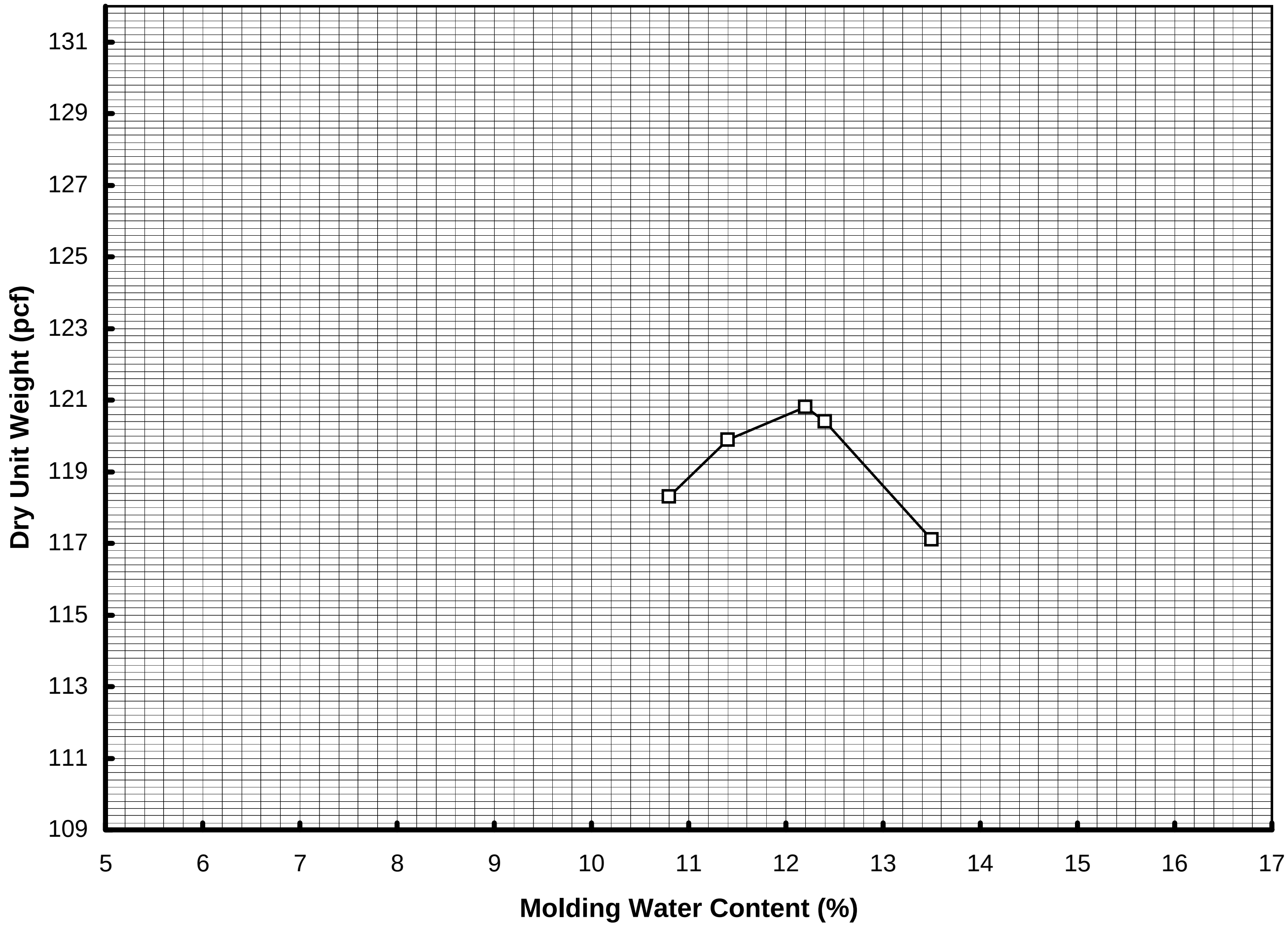
NORTH CITY WATER RECLAMATION PLANT EXPANSION
SAN DIEGO, CALIFORNIA

PROJECT NO. 44 F1 **ALLIED GEOTECHNICAL ENGINEERS, INC.** **FIGURE B-10**

COMPACTION CURVE

Test Method: ASTM D 1557

Compaction Procedure: A Specimen Preparation Method: ☒ Moist or ☐ Dry



Sample No.	Sample Type	Depth (ft)	OPT. WC (%)	MAX. DUW (pcf)	%ROCK %	ROCK CORR. (pcf)	Description and/or Classification
H-12 #7	Bulk	21-24	12.2	120.8			Sandy clay (CL)

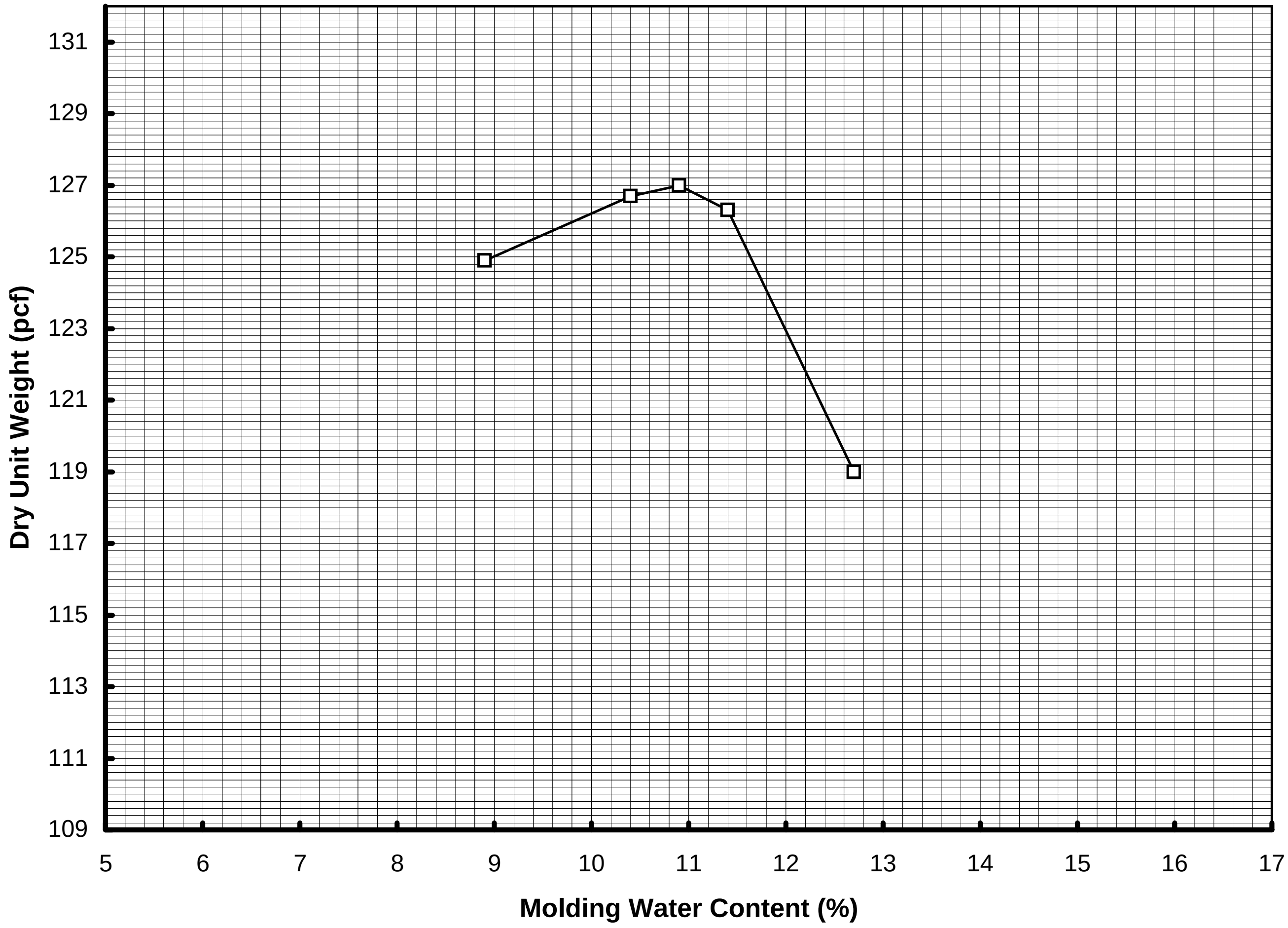
NORTH CITY WATER RECLAMATION PLANT EXPANSION
SAN DIEGO, CALIFORNIA

PROJECT NO. 44 F1	**ALLIED GEOTECHNICAL ENGINEERS, INC.**	**FIGURE B-11**

COMPACTION CURVE

Test Method: ASTM D 1557

Compaction Procedure: A Specimen Preparation Method: ☒ Moist or ☐ Dry



Sample No.	Sample Type	Depth (ft)	OPT. WC (%)	MAX. DUW (pcf)	%ROCK %	ROCK CORR. (pcf)	Description and/or Classification
H-13 #1	Bulk	3-7	10.0	127.0			Lean clay with gravels

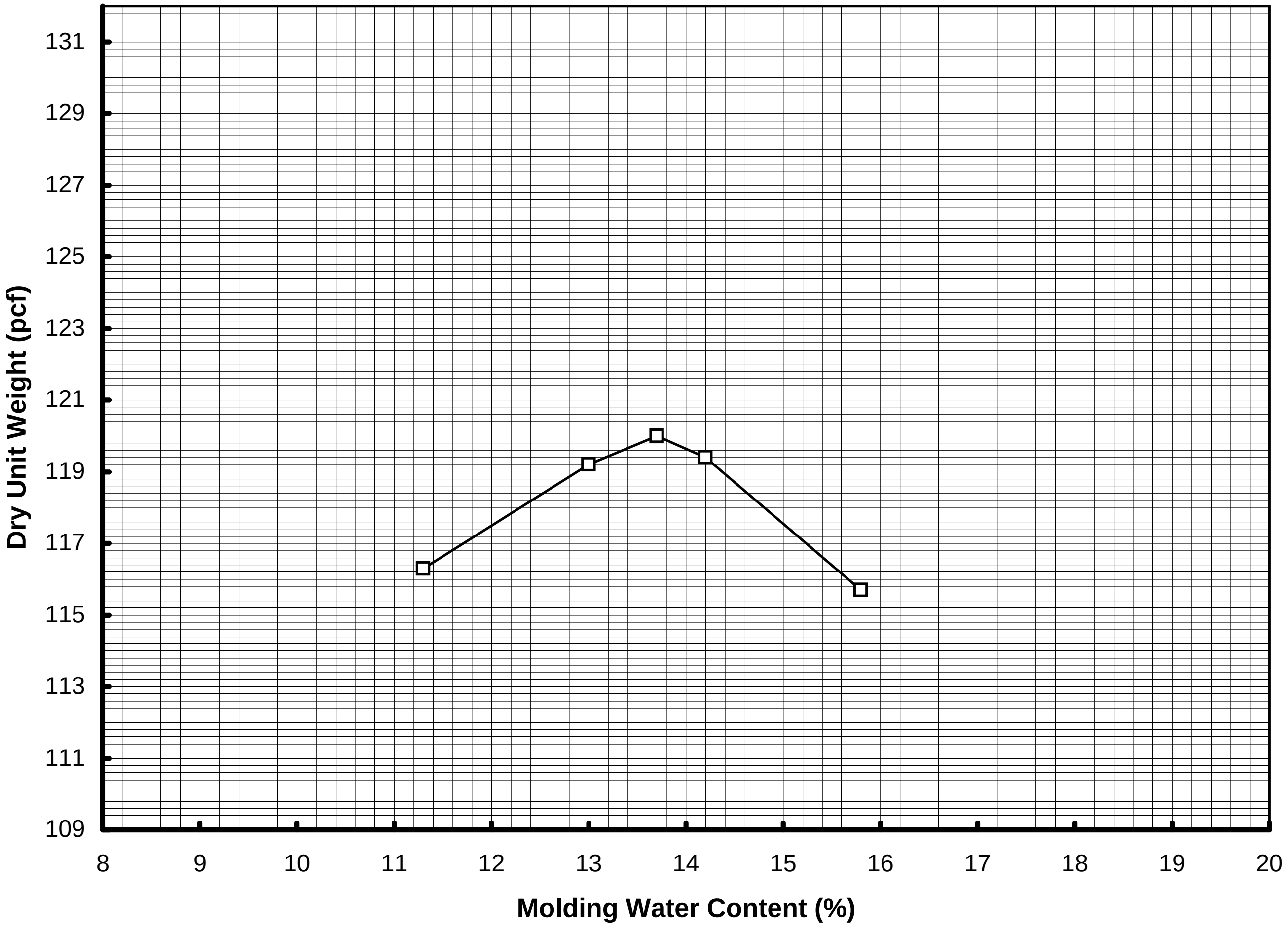
NORTH CITY WATER RECLAMATION PLANT EXPANSION
SAN DIEGO, CALIFORNIA

PROJECT NO. 44 F1	ALLIED GEOTECHNICAL ENGINEERS, INC.	FIGURE B-12

COMPACTION CURVE

Test Method: ASTM D 1557

Compaction Procedure: A Specimen Preparation Method: ☒ Moist or ☐ Dry



Sample No.	Sample Type	Depth (ft)	OPT. WC (%)	MAX. DUW (pcf)	%ROCK %	ROCK CORR. (pcf)	Description and/or Classification
H-14 #2	Bulk	4-7	13.7	120.0			Sandy clay (CL)

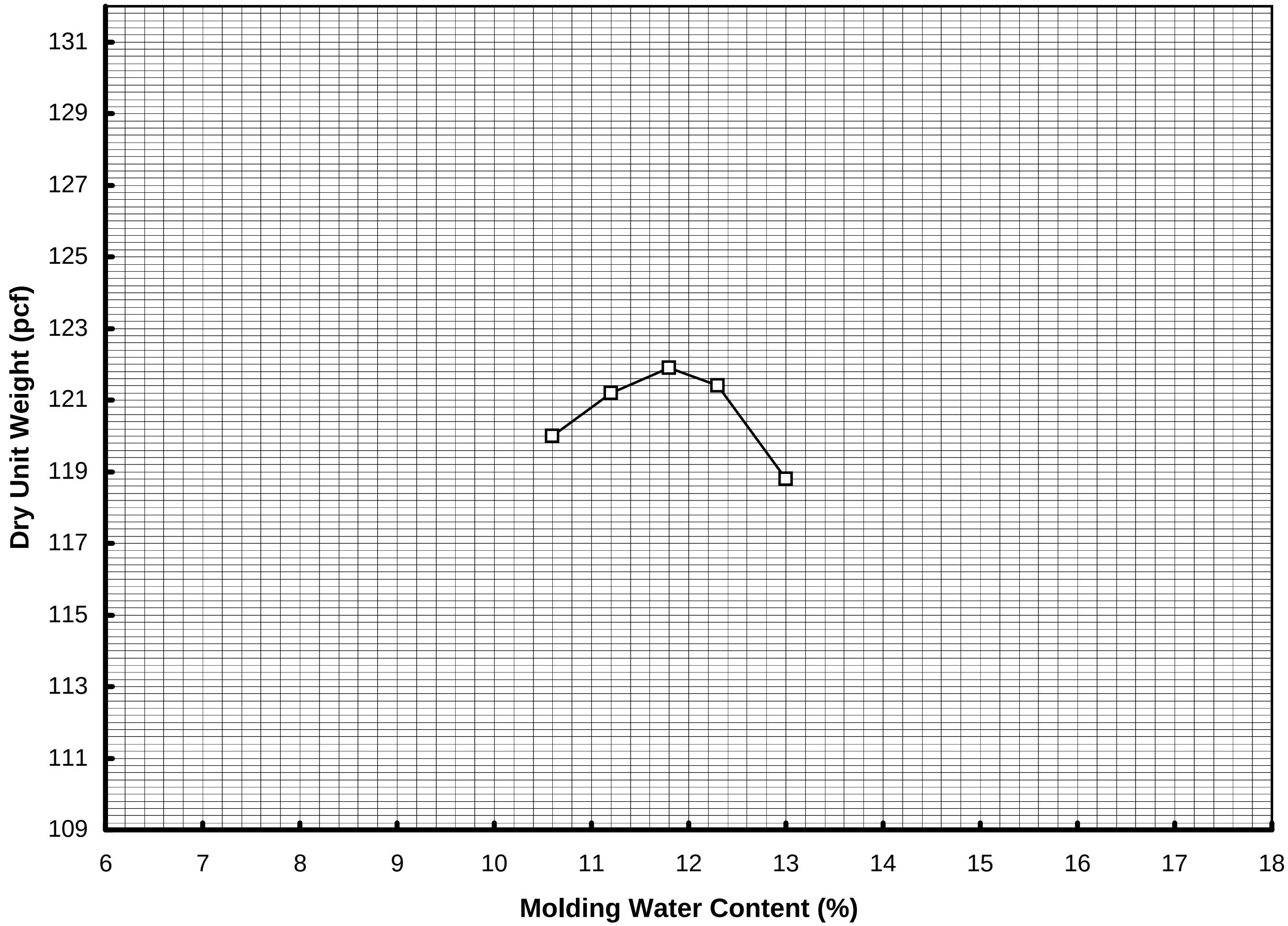
NORTH CITY WATER RECLAMATION PLANT EXPANSION
SAN DIEGO, CALIFORNIA

PROJECT NO. 44 F1	**ALLIED GEOTECHNICAL ENGINEERS, INC.**	**FIGURE B-13**

COMPACTION CURVE

Test Method: ASTM D 1557

Compaction Procedure: A Specimen Preparation Method: ☒ Moist or ☐ Dry



Sample No.	Sample Type	Depth (ft)	OPT. WC (%)	MAX. DUW (pcf)	%ROCK %	ROCK CORR. (pcf)	Description and/or Classification
H-14 #7	Bulk	20-24	11.8	121.9			Sandy clay (CL)

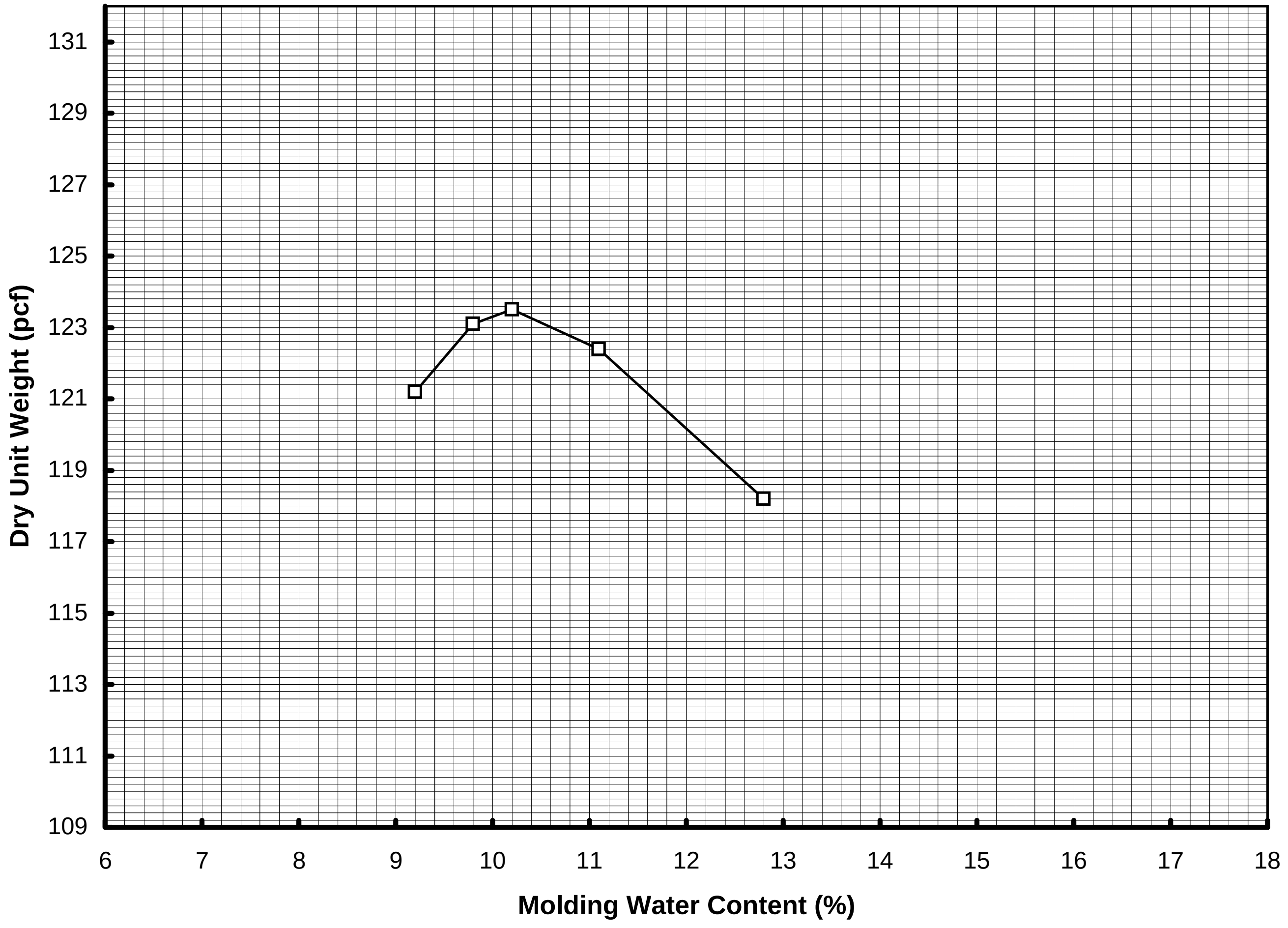
NORTH CITY WATER RECLAMATION PLANT EXPANSION
SAN DIEGO, CALIFORNIA

PROJECT NO. 44 F1	**ALLIED GEOTECHNICAL ENGINEERS, INC.**	**FIGURE B-14**

COMPACTION CURVE

Test Method: ASTM D 1557

Compaction Procedure: A Specimen Preparation Method: ☒ Moist or ☐ Dry



Sample No.	Sample Type	Depth (ft)	OPT. WC (%)	MAX. DUW (pcf)	%ROCK %	ROCK CORR. (pcf)	Description and/or Classification
H-17 #3	Bulk	7-10	10.3	123.5			Lean clay (CL)

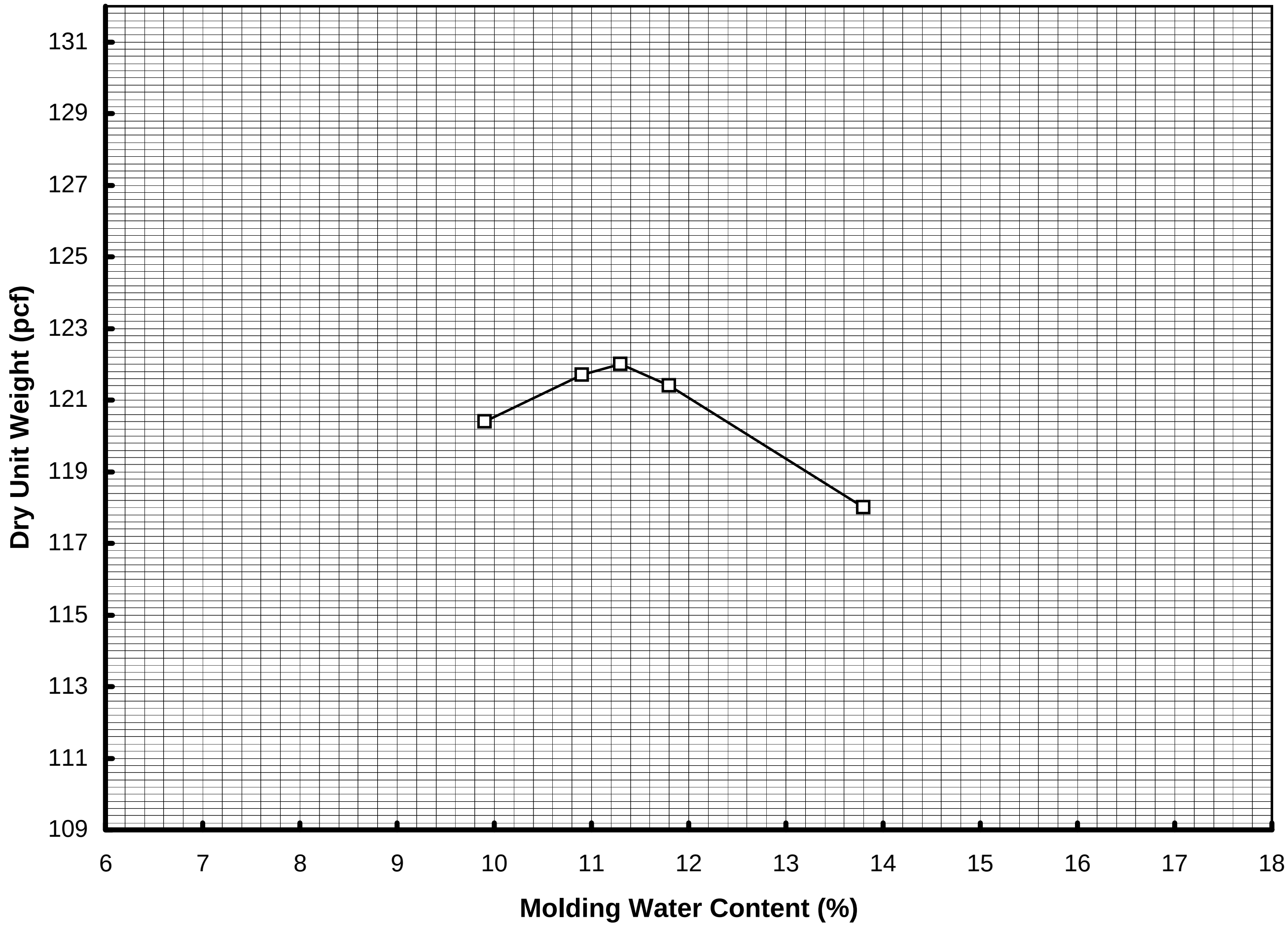
NORTH CITY WATER RECLAMATION PLANT EXPANSION
SAN DIEGO, CALIFORNIA

PROJECT NO. 44 F1	**ALLIED GEOTECHNICAL ENGINEERS, INC.**	**FIGURE B-15**

COMPACTION CURVE

Test Method: ASTM D 1557

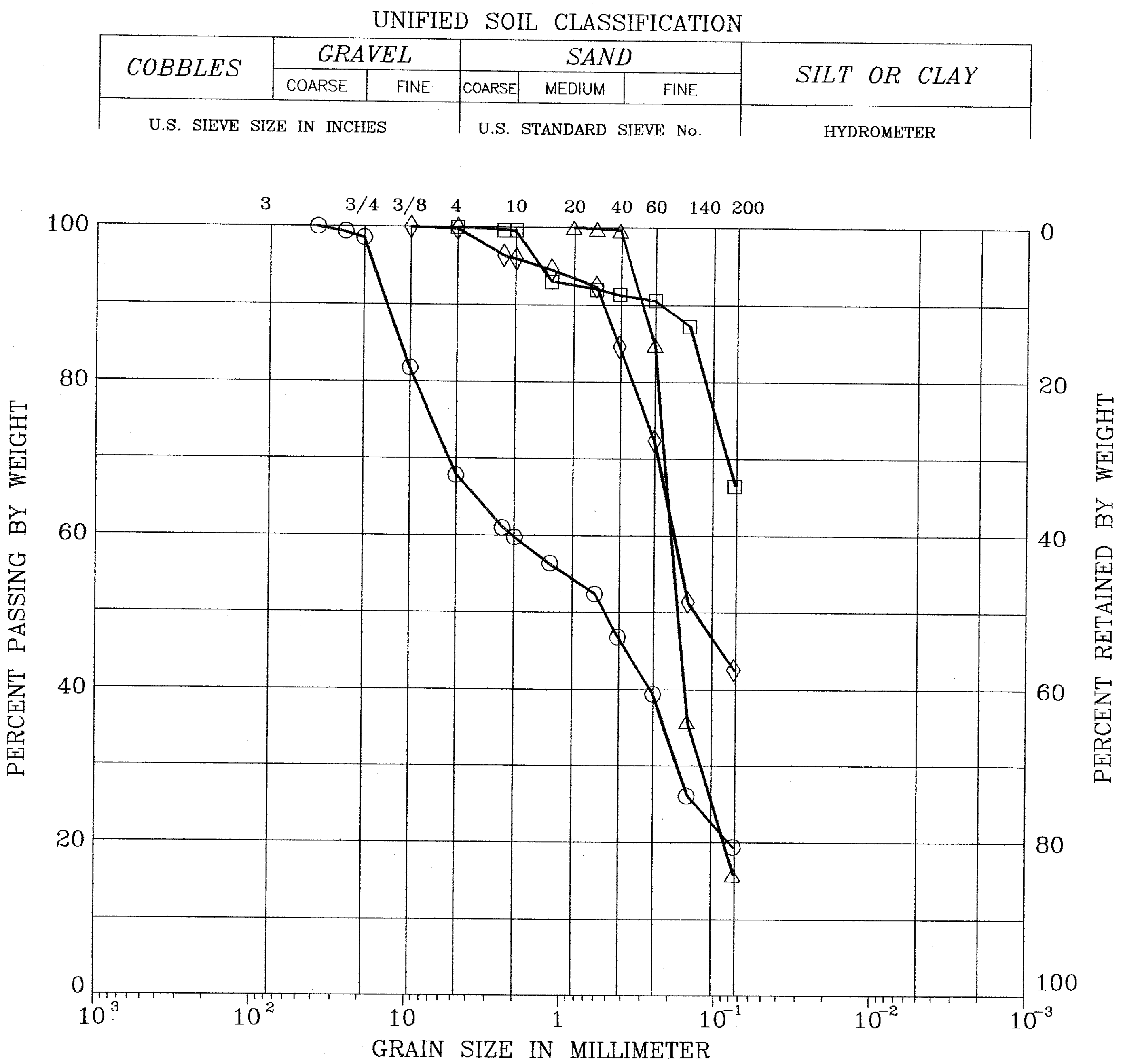
Compaction Procedure: A Specimen Preparation Method: ☒ Moist or ☐ Dry



Sample No.	Sample Type	Depth (ft)	OPT. WC (%)	MAX. DUW (pcf)	%ROCK %	ROCK CORR. (pcf)	Description and/or Classification
H-20 #1	Bulk	3-5	11.3	122.0			Lean clay (CL)

NORTH CITY WATER RECLAMATION PLANT EXPANSION
SAN DIEGO, CALIFORNIA

PROJECT NO. 44 F1	**ALLIED GEOTECHNICAL ENGINEERS, INC.**	**FIGURE B-16**



SYMBOL	BORING	DEPTH (ft)	LL (%)	PI (%)	DESCRIPTION
○	H-2 #3	11-15			SILTY SAND (SM)
□	H-3 #8	41-41.5			CLAYS (CH)
△	H-3 #13	65.5-66			SILTY SAND (SM)
◇	H-4 #1	3-6			SILTY SAND (SM)

Remark :

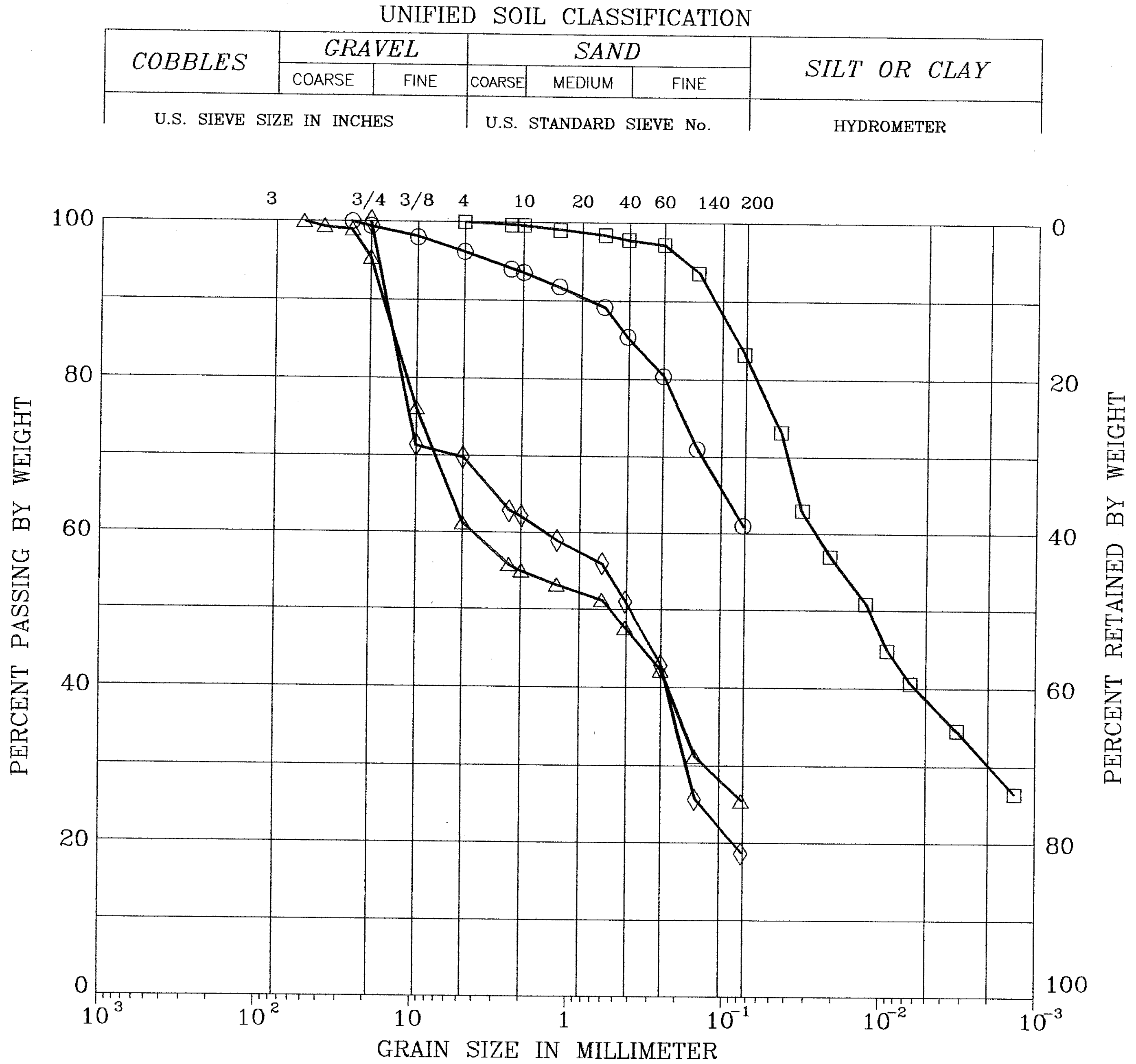
Project No. 44F1

NORTH CITY WATER RECLAMATION PLANT EXPANSION

ALLIED GEOTECHNICAL ENGINEERS, INC.

GRAIN SIZE DISTRIBUTION

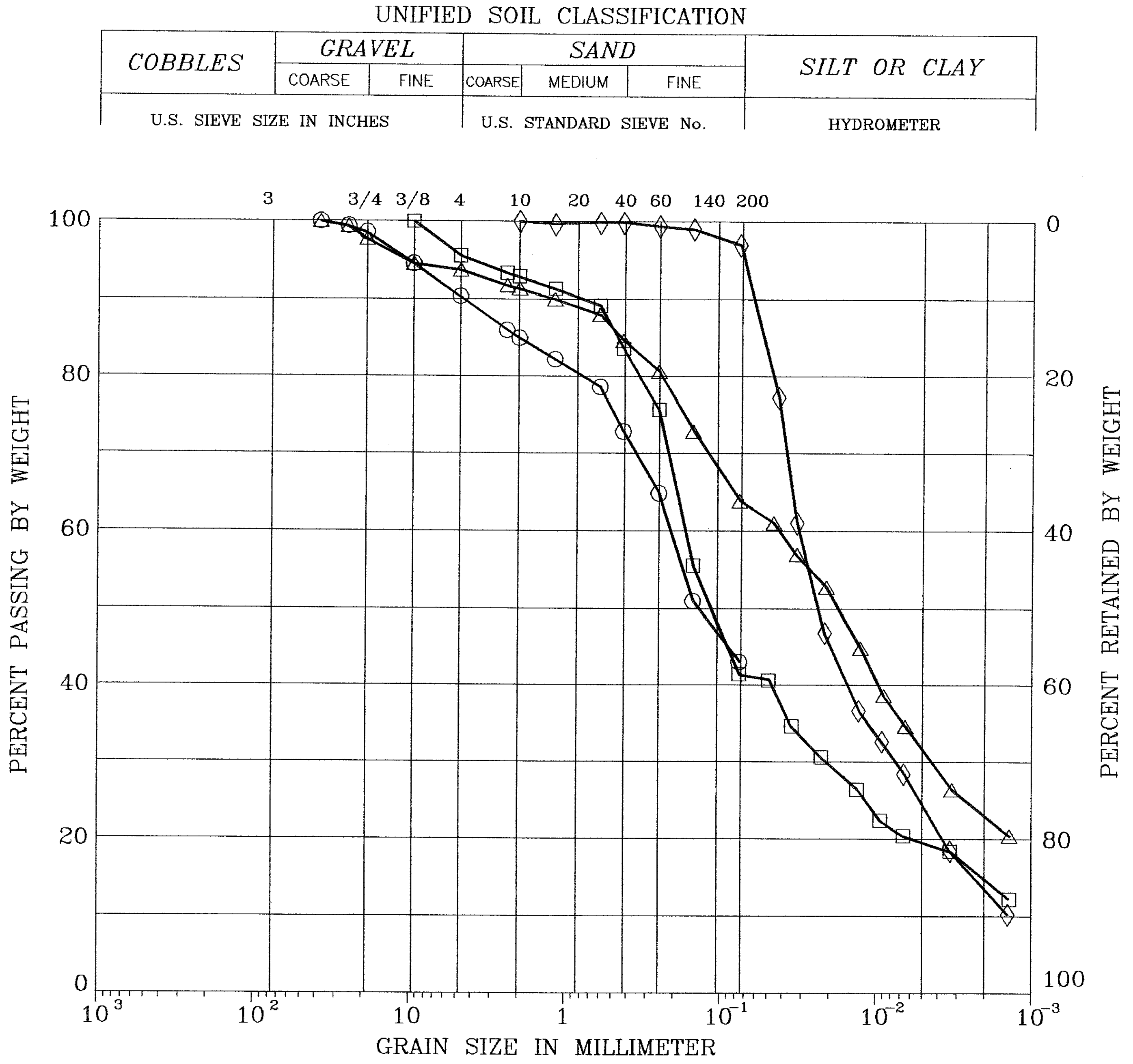
Figure B-17



SYMBOL	BORING	DEPTH (ft)	LL (%)	PI (%)	DESCRIPTION
○	H-5 #2	4-7			CLAYS (CH)
□	H-5 #10	30-35	35	20	CLAYS (CL)
△	H-7 #2	5-8			SILTY GRAVEL (GM)
◊	H-7 #3	10-10.5			SILTY SAND (SM)

Remark :

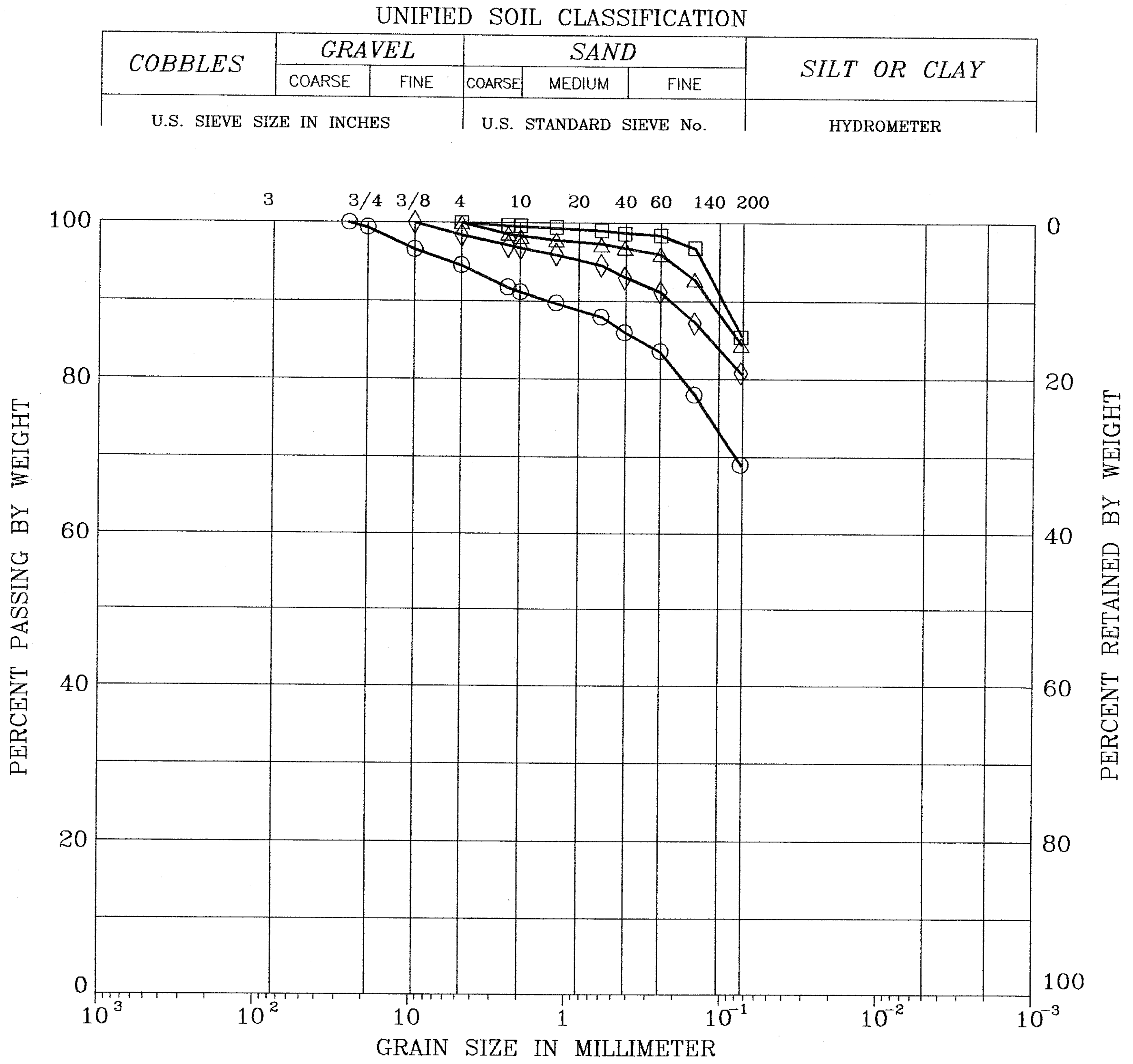
Project No. 44F1	NORTH CITY WATER RECLAMATION PLANT EXPANSION
ALLIED GEOTECHNICAL ENGINEERS, INC.	GRAIN SIZE DISTRIBUTION Figure B-18



SYMBOL	BORING	DEPTH (ft)	LL (%)	PI (%)	DESCRIPTION
○	H-8 #1	4-7			SILTY SAND (SM)
□	H-8 #8	31-31.5			SILTY SAND (SM)
△	H-9 #2	9-12			CLAYS (CL)
◇	H-9 #19	75-76			CLAYS (CL)

Remark :

Project No. 44F1	NORTH CITY WATER RECLAMATION PLANT EXPANSION
ALLIED GEOTECHNICAL ENGINEERS, INC.	GRAIN SIZE DISTRIBUTION Figure B-19



SYMBOL	BORING	DEPTH (ft)	LL (%)	PI (%)	DESCRIPTION
○	H-10 #1	3-7			CLAYS (CL)
□	H-11 #6	21-24	43	27	CLAYS (CL)
△	H-11 #2	11-11.5			CLAYS (CL)
◇	H-12 #7	21-24			CLAYS (CL)

Remark :

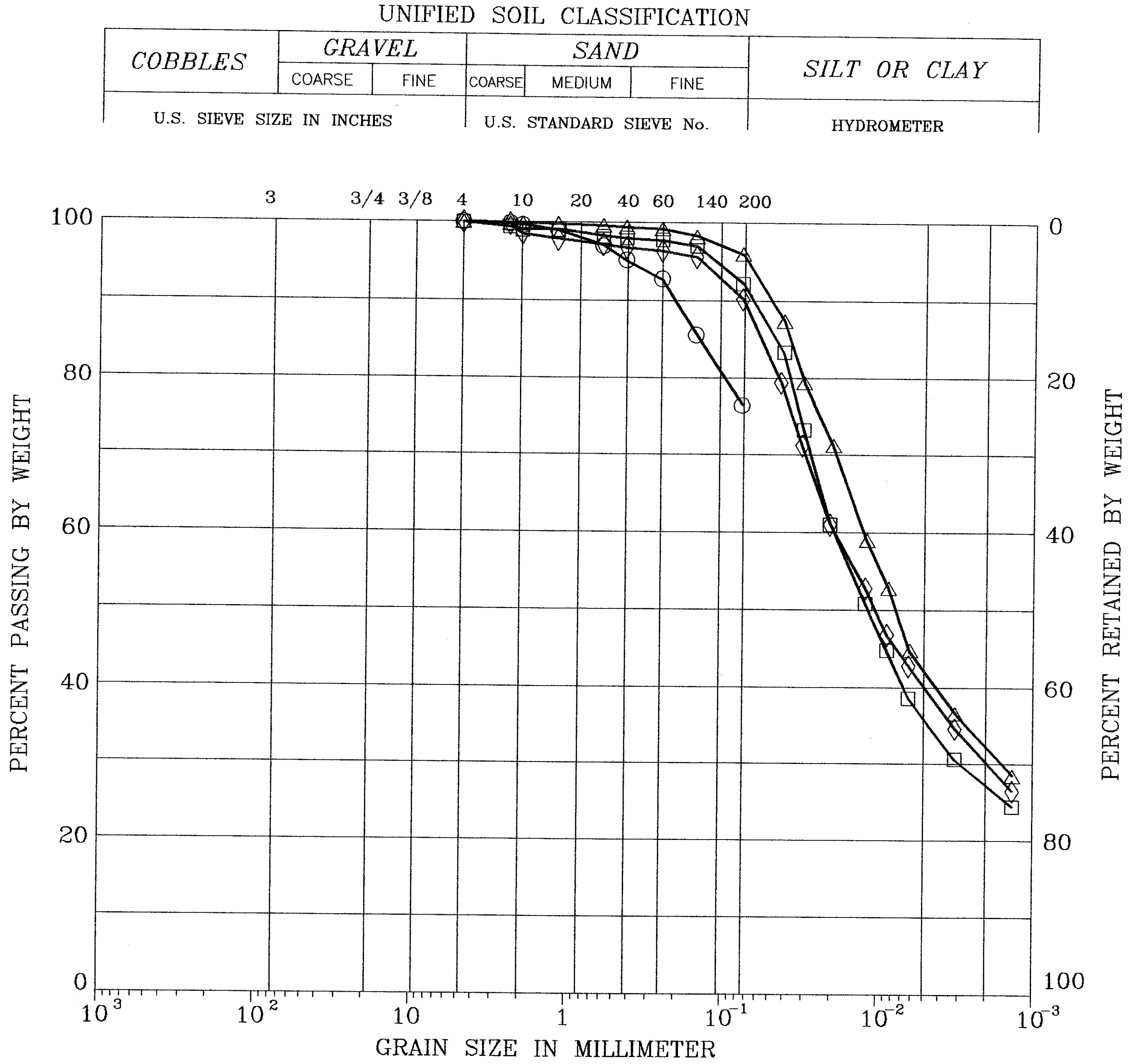
Project No. 44F1

NORTH CITY WATER RECLAMATION PLANT EXPANSION

ALLIED GEOTECHNICAL ENGINEERS, INC.

GRAIN SIZE DISTRIBUTION

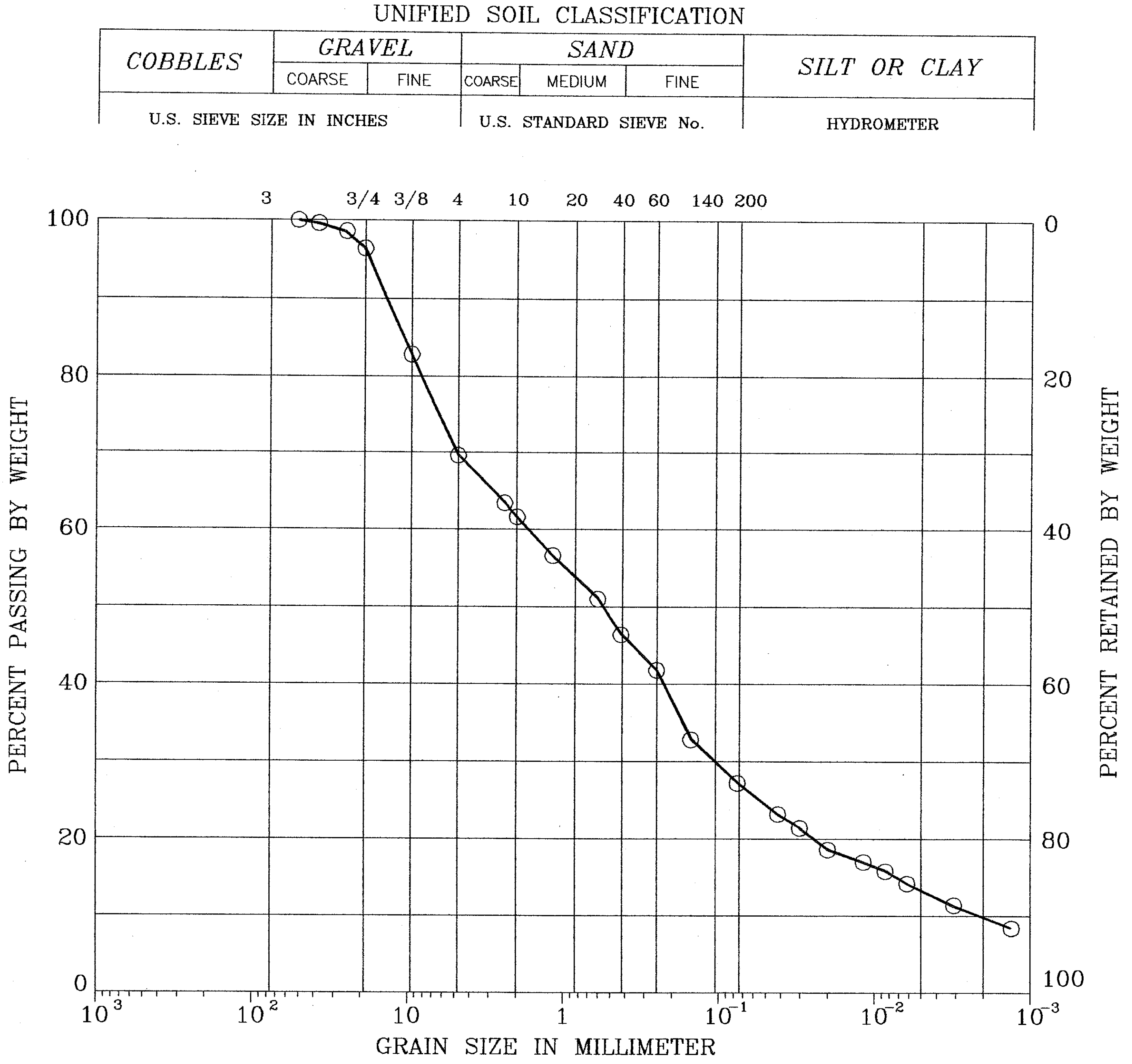
Figure B-20



SYMBOL	BORING	DEPTH (ft)	LL (%)	PI (%)	DESCRIPTION
○	H-16 #1	6-6.5	50	18	SILTS (ML)
□	H-15 #2	4-7	57	32	CLAYS (CH)
△	H-17 #3	7-10	42	25	CLAYS (CL)
◇	H-20 #1	3-5	41	23	CLAYS (CL)

Remark :

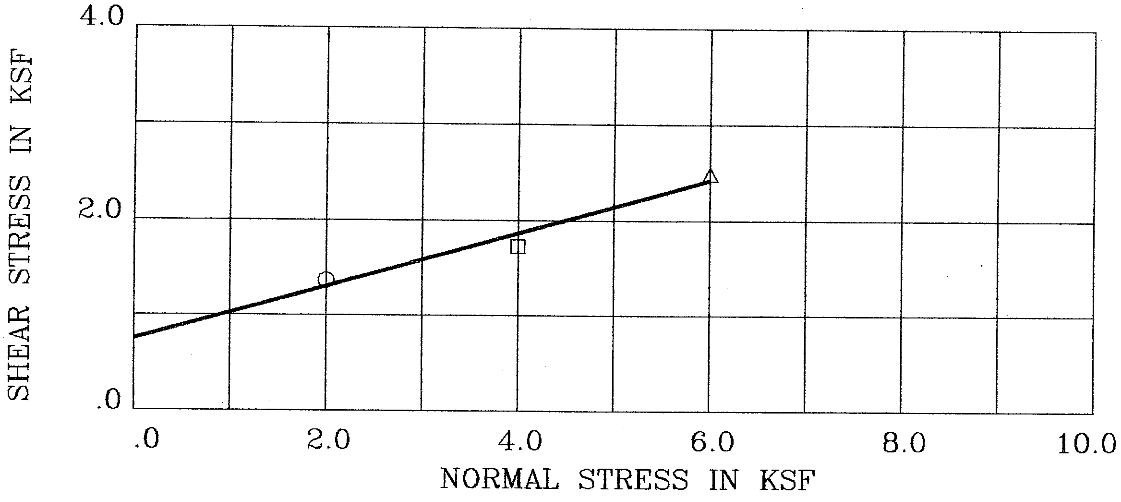
Project No. 44F1	NORTH CITY WATER RECLAMATION PLANT EXPANSION
ALLIED GEOTECHNICAL ENGINEERS, INC.	GRAIN SIZE DISTRIBUTION Figure B-21

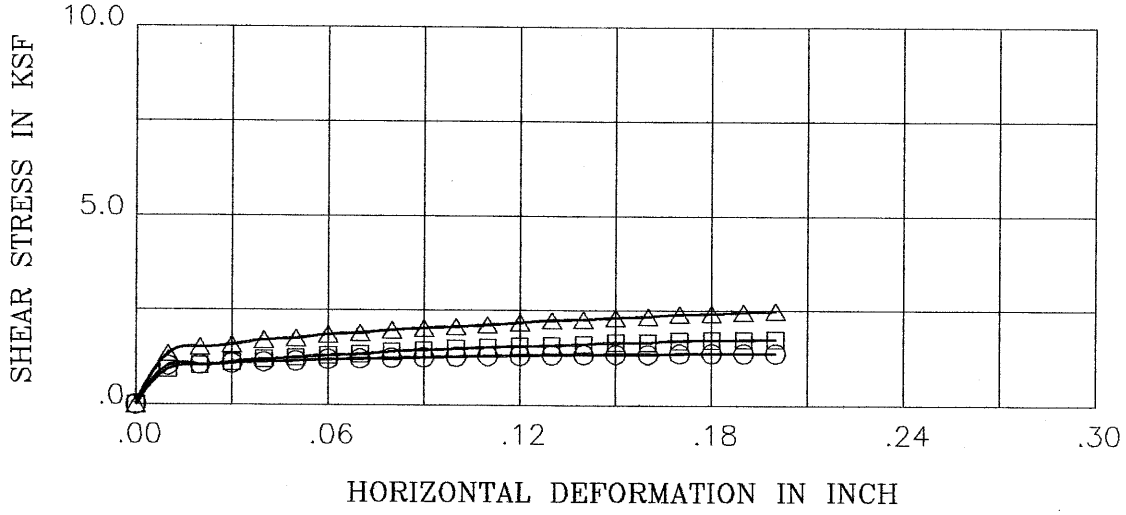


SYMBOL	BORING	DEPTH (ft)	LL (%)	PI (%)	DESCRIPTION
○	H-21 #1	4-7			SILTY SAND (SM)

Remark :

Project 44F1	NORTH CITY WATER RECLAMATION PLANT EXPANSION
ALLIED GEOTECHNICAL ENGINEERS, INC.	GRAIN SIZE DISTRIBUTION Figure B-22





BORING/SAMPLE : H-1 #1 DEPTH (ft) : 1-4

DESCRIPTION : Silty/clayey sand (SM/SC)

STRENGTH INTERCEPT (C) : .750 KSF

FRICTION ANGLE (PHI) : 15.6 DEG

(PEAK STRENGTH)

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	VOID RATIO	NORMAL STRESS (ksf)	PEAK SHEAR (ksf)	RESIDUAL SHEAR (ksf)
○	9.7	110.8	.465	2.00	1.37	1.37
□	9.7	110.8	.464	4.00	1.73	1.73
△	9.1	110.4	.469	6.00	2.48	2.48

Remark :

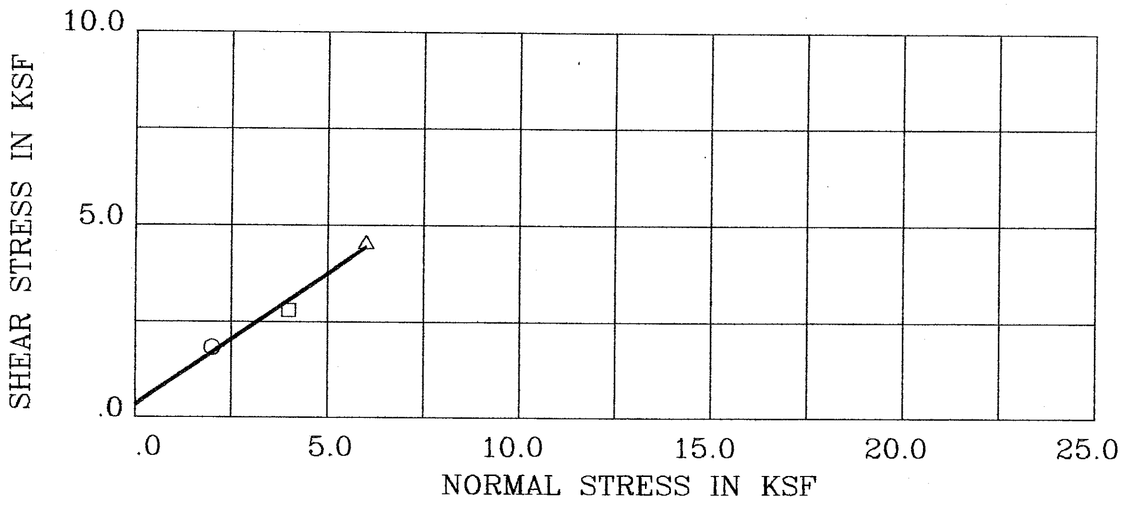
Project No. 44F1

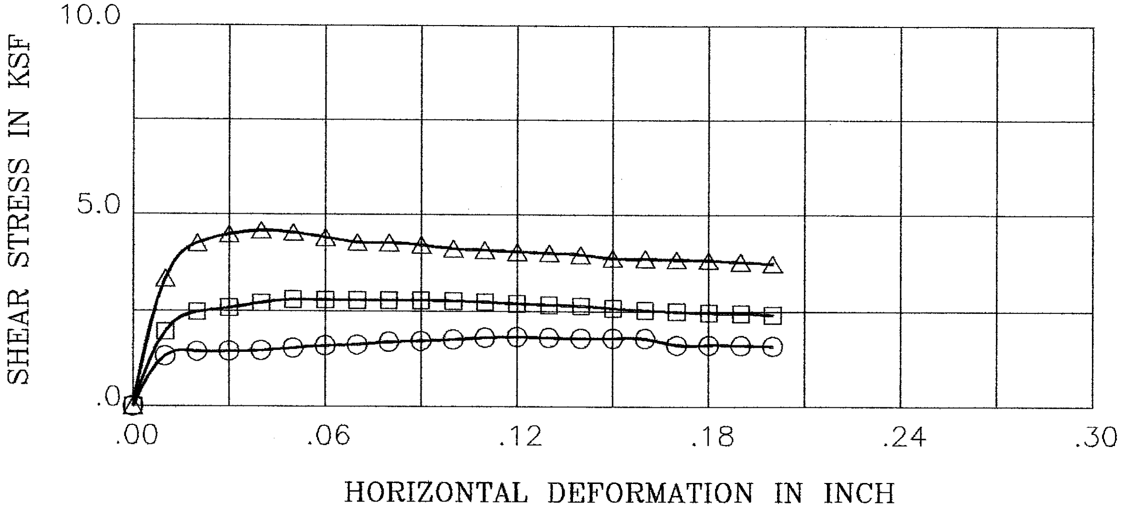
NORTH CITY WATER RECLAMATION PLANT EXPANSION

ALLIED GEOTECHNICAL ENGINEERS, INC.

DIRECT SHEAR TEST

Figure B-23





BORING/SAMPLE : H-1 #5 DEPTH (ft) : 16-16.5

DESCRIPTION : Lean clay (CL)

STRENGTH INTERCEPT (C) : .330 KSF

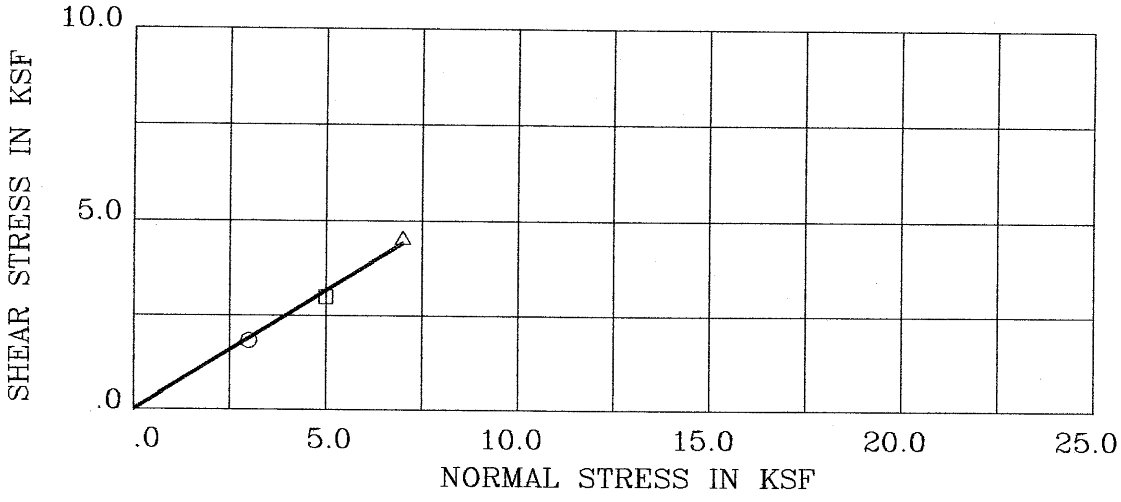
FRICTION ANGLE (PHI) : 34.4 DEG

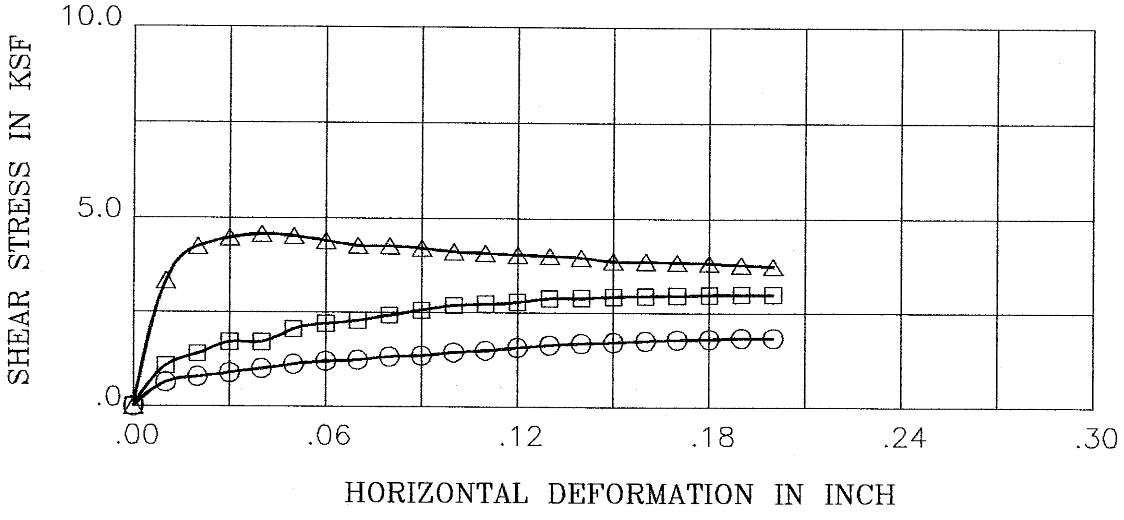
(PEAK STRENGTH)

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	VOID RATIO	NORMAL STRESS (ksf)	PEAK SHEAR (ksf)	RESIDUAL SHEAR (ksf)
○	19.8	100.4	.617	2.00	1.83	1.60
□	20.9	98.5	.646	4.00	2.80	2.41
△	19.5	105.2	.543	6.00	4.57	3.75

Remark :

Project No. 44F1	NORTH CITY WATER RECLAMATION PLANT EXPANSION
ALLIED GEOTECHNICAL ENGINEERS, INC.	DIRECT SHEAR TEST Figure B-24





BORING/SAMPLE : H-2 #2 DEPTH (ft) : 11-11.5

DESCRIPTION : Silty/clayey sand (SM/SC)

STRENGTH INTERCEPT (C) : .000 KSF

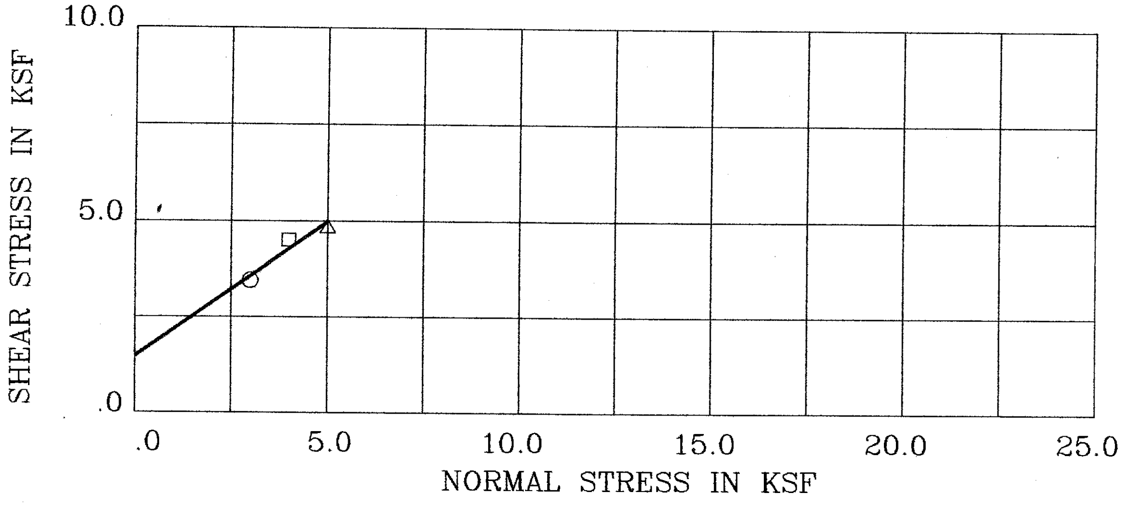
FRICTION ANGLE (PHI) : 32.3 DEG

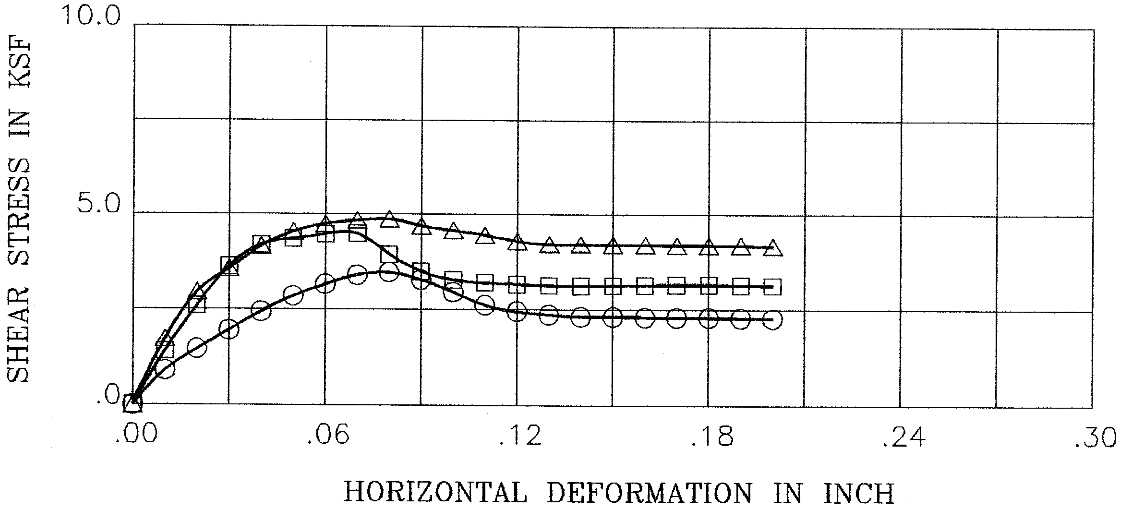
(PEAK STRENGTH)

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	VOID RATIO	NORMAL STRESS (ksf)	PEAK SHEAR (ksf)	RESIDUAL SHEAR (ksf)
○	21.0	98.0	.655	3.00	1.84	1.83
□	23.1	99.4	.632	5.00	3.00	3.00
△	18.9	104.3	.555	7.00	4.57	3.75

Remark :

Project No. 44F1	NORTH CITY WATER RECLAMATION PLANT EXPANSION
ALLIED GEOTECHNICAL ENGINEERS, INC.	DIRECT SHEAR TEST Figure B-25





BORING/SAMPLE : H-4 #2 DEPTH (ft) : 5-6

DESCRIPTION : Silty sand (SM) w/ gravel

STRENGTH INTERCEPT (C) : 1.468 KSF

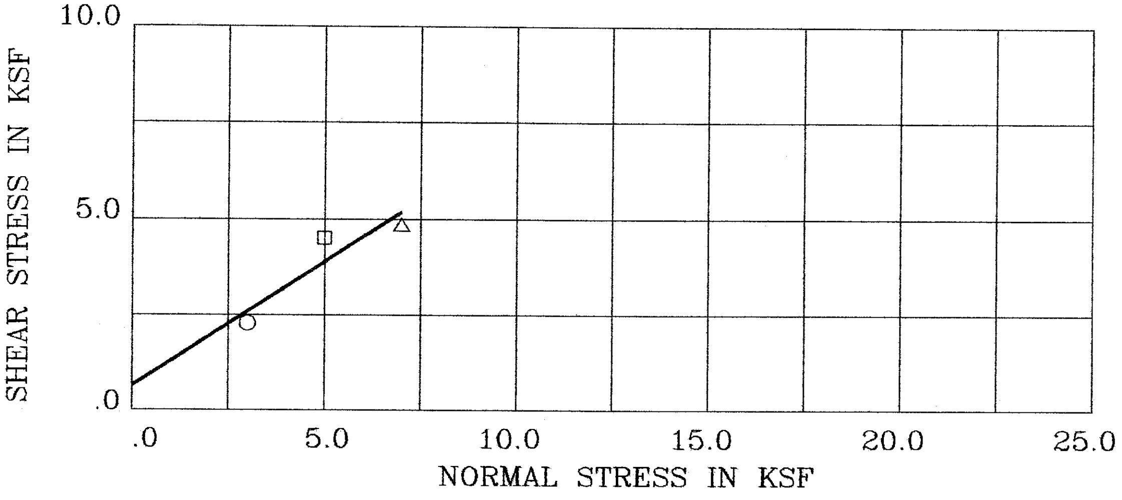
FRICTION ANGLE (PHI) : 35.2 DEG

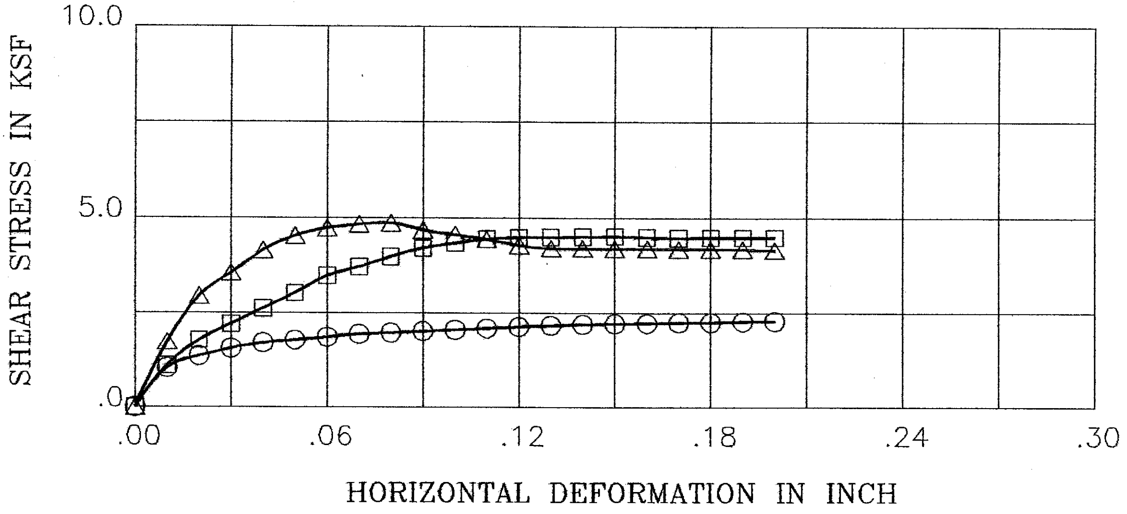
(PEAK STRENGTH)

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	VOID RATIO	NORMAL STRESS (ksf)	PEAK SHEAR (ksf)	RESIDUAL SHEAR (ksf)
○	13.3	104.7	.549	3.00	3.47	2.28
□	12.8	106.4	.525	4.00	4.53	3.11
△	14.1	107.8	.505	5.00	4.88	4.16

Remark :

Project No. 44F1	NORTH CITY WATER RECLAMATION PLANT EXPANSION
ALLIED GEOTECHNICAL ENGINEERS, INC.	DIRECT SHEAR TEST Figure B-26



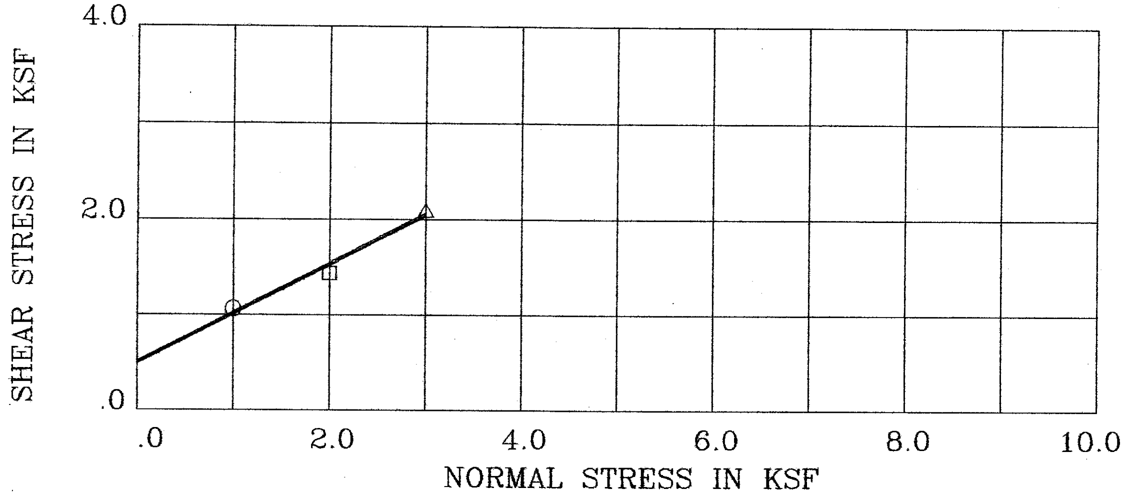


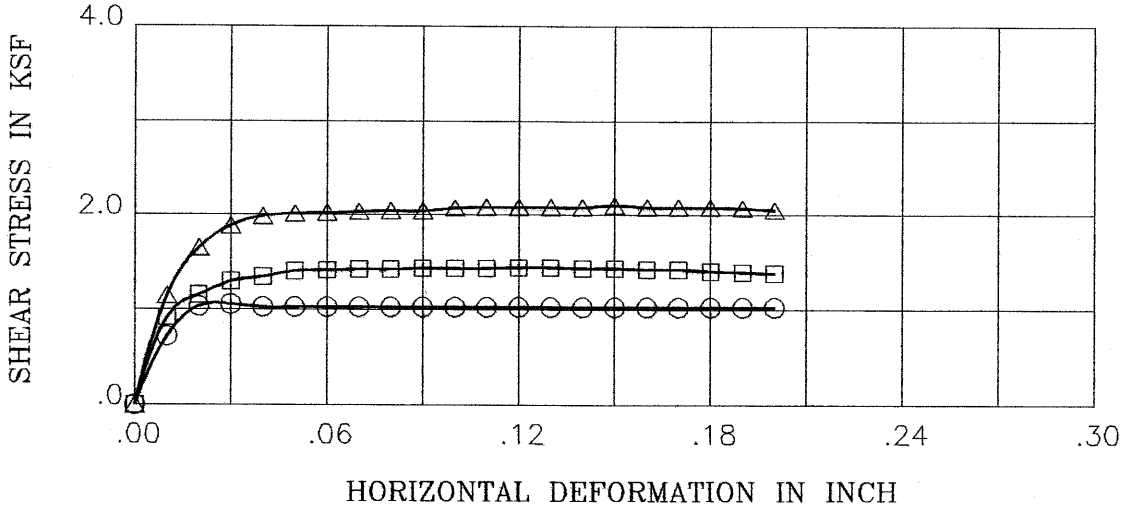
BORING/SAMPLE : H-5 #1 DEPTH (ft) : 6-6.5
DESCRIPTION : Sandy clay (CL)
STRENGTH INTERCEPT (C) : .657 KSF
FRICTION ANGLE (PHI) : 32.9 DEG
(PEAK STRENGTH)

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	VOID RATIO	NORMAL STRESS (ksf)	PEAK SHEAR (ksf)	RESIDUAL SHEAR (ksf)
○	20.2	102.8	.578	3.00	2.29	2.29
□	20.9	103.3	.571	5.00	4.52	4.48
△	17.5	98.5	.648	7.00	4.88	4.16

Remark :

Project No. 44F1	NORTH CITY WATER RECLAMATION PLANT EXPANSION
ALLIED GEOTECHNICAL ENGINEERS, INC.	DIRECT SHEAR TEST Figure B-27





BORING/SAMPLE : H-6 #1 DEPTH (ft) : 4-7

DESCRIPTION : Clayey sand (SC)

STRENGTH INTERCEPT (C) : .502 KSF

FRICTION ANGLE (PHI) : 27.3 DEG

(PEAK STRENGTH)

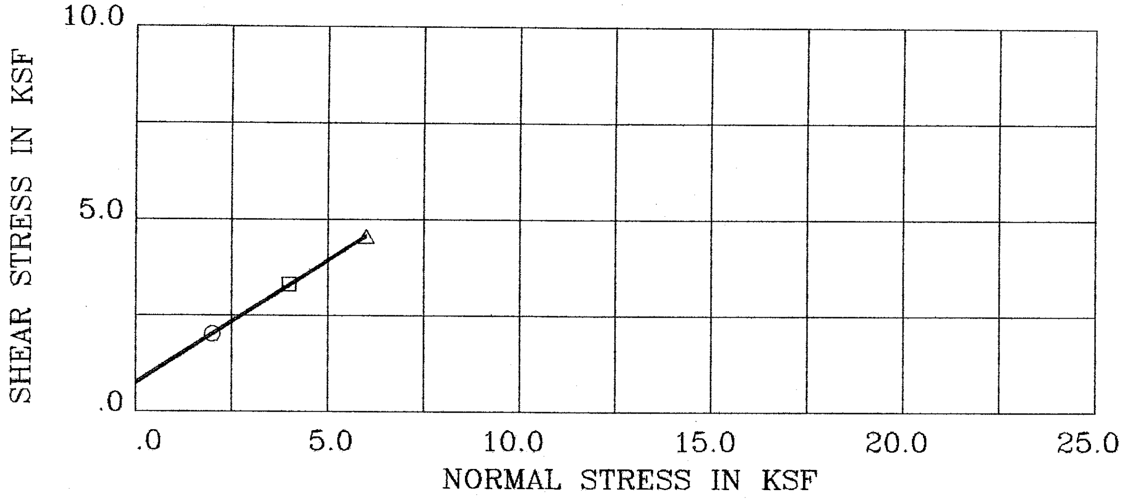
SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	VOID RATIO	NORMAL STRESS (ksf)	PEAK SHEAR (ksf)	RESIDUAL SHEAR (ksf)
○	14.8	108.6	.494	1.00	1.07	1.02
□	15.3	108.9	.490	2.00	1.44	1.38
△	15.3	109.5	.482	3.00	2.10	2.05

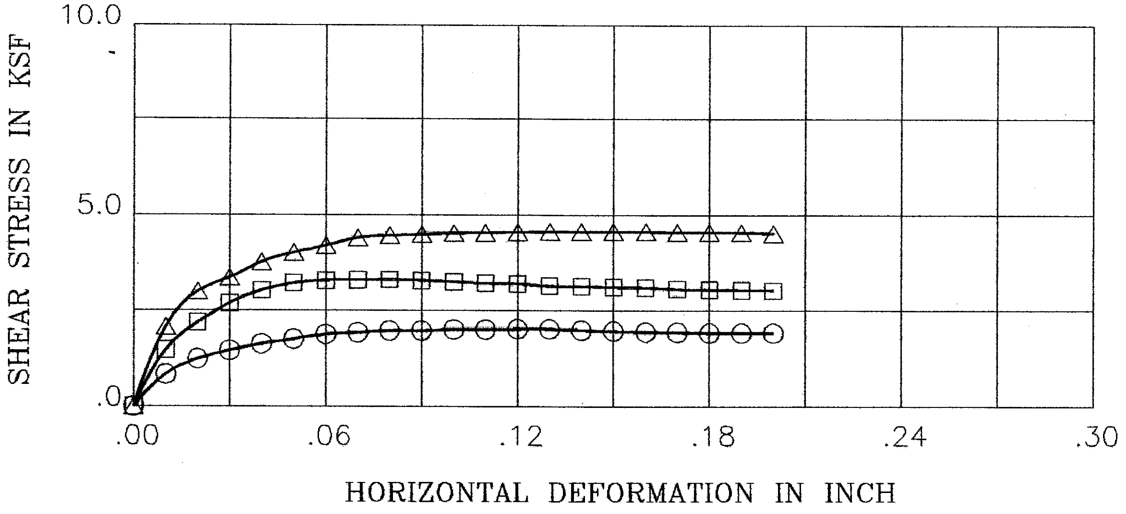
Remark :

Project No. 44F1
NORTH CITY WATER RECLAMATION PLANT EXPANSION

ALLIED GEOTECHNICAL ENGINEERS, INC.

DIRECT SHEAR TEST Figure B-28



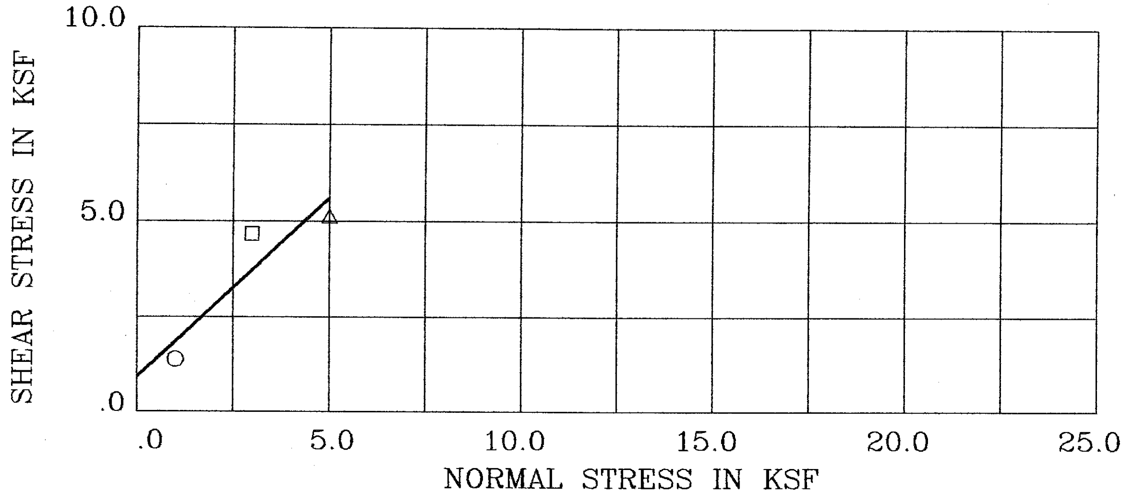


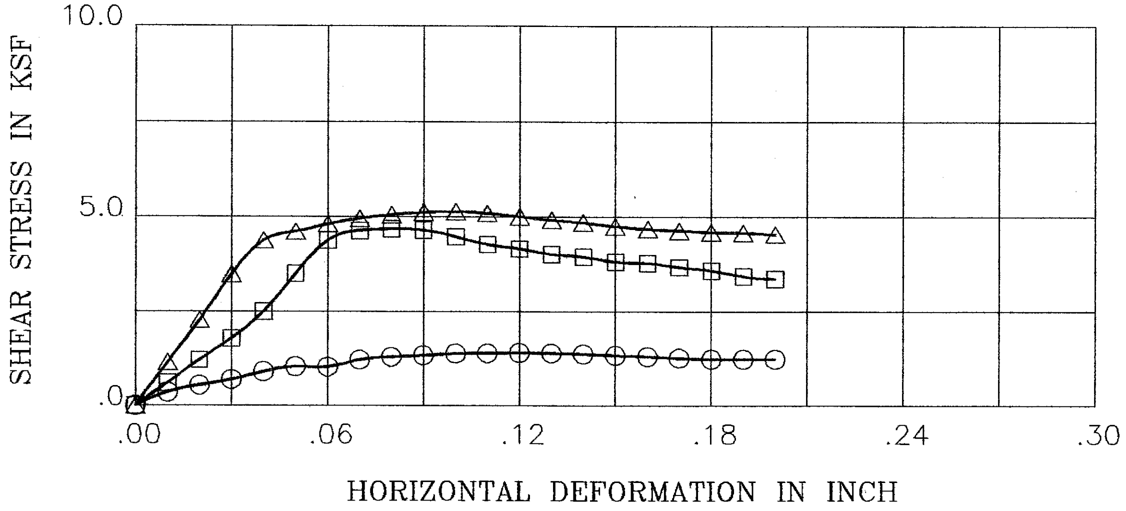
BORING/SAMPLE : H-8 #4 DEPTH (ft) : 11-11.5
DESCRIPTION : Silty sand (SM)
STRENGTH INTERCEPT (C) : .747 KSF
FRICTION ANGLE (PHI) : 32.5 DEG
(PEAK STRENGTH)

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	VOID RATIO	NORMAL STRESS (ksf)	PEAK SHEAR (ksf)	RESIDUAL SHEAR (ksf)
○	21.1	100.9	.608	2.00	2.01	1.91
□	21.9	100.5	.614	4.00	3.31	3.03
△	20.9	105.5	.538	6.00	4.56	4.51

Remark :

Project No. 44F1	NORTH CITY WATER RECLAMATION PLANT EXPANSION
ALLIED GEOTECHNICAL ENGINEERS, INC.	DIRECT SHEAR TEST Figure B-29





BORING/SAMPLE : H-9 #1 DEPTH (ft) : 6-6.5

DESCRIPTION : Silty sand (SM)

STRENGTH INTERCEPT (C) : .938 KSF

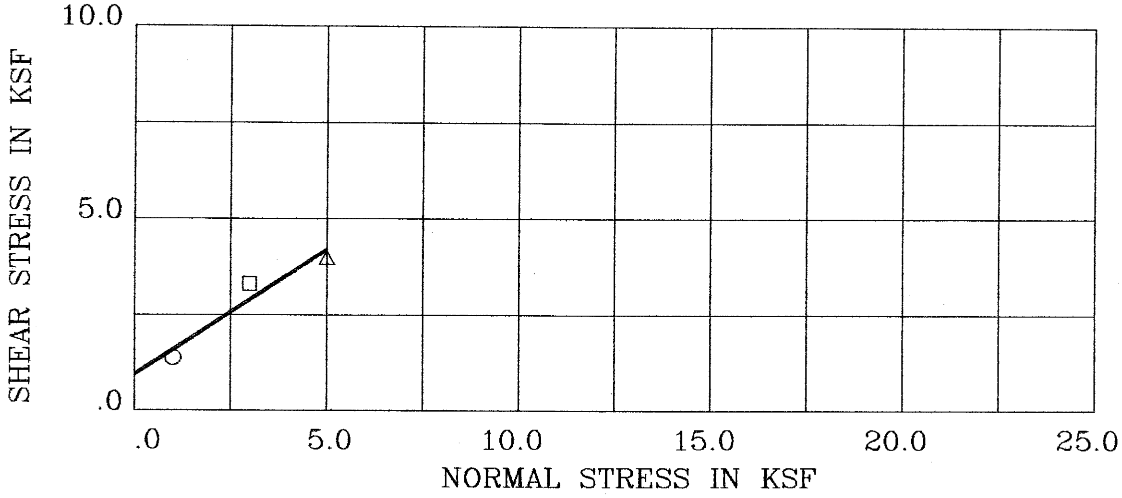
FRICTION ANGLE (PHI) : 43.0 DEG

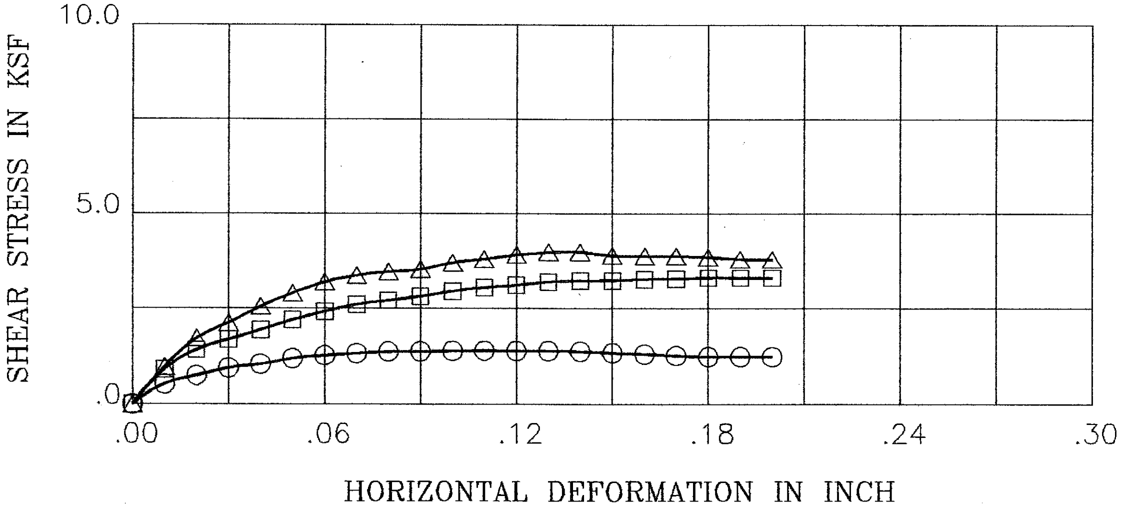
(PEAK STRENGTH)

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	VOID RATIO	NORMAL STRESS (ksf)	PEAK SHEAR (ksf)	RESIDUAL SHEAR (ksf)
○	24.6	93.6	.734	1.00	1.40	1.23
□	20.5	99.3	.634	3.00	4.68	3.37
△	15.9	105.3	.541	5.00	5.13	4.54

Remark :

Project No. 44F1	NORTH CITY WATER RECLAMATION PLANT EXPANSION
ALLIED GEOTECHNICAL ENGINEERS, INC.	DIRECT SHEAR TEST Figure B-30





BORING/SAMPLE : H-9 #5 DEPTH (ft) : 16-16.5

DESCRIPTION : Silty sand (SM)

STRENGTH INTERCEPT (C) : .943 KSF

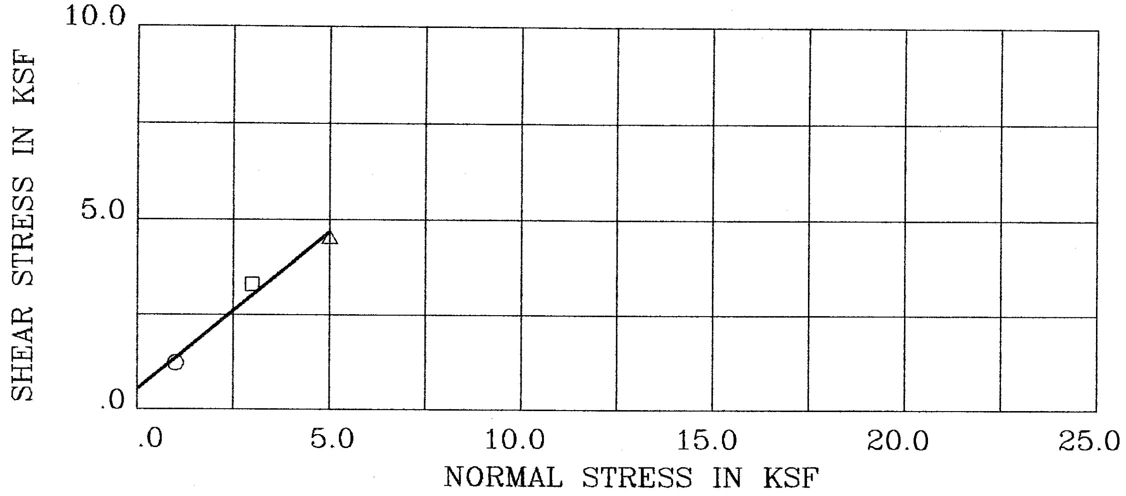
FRICTION ANGLE (PHI) : 33.1 DEG

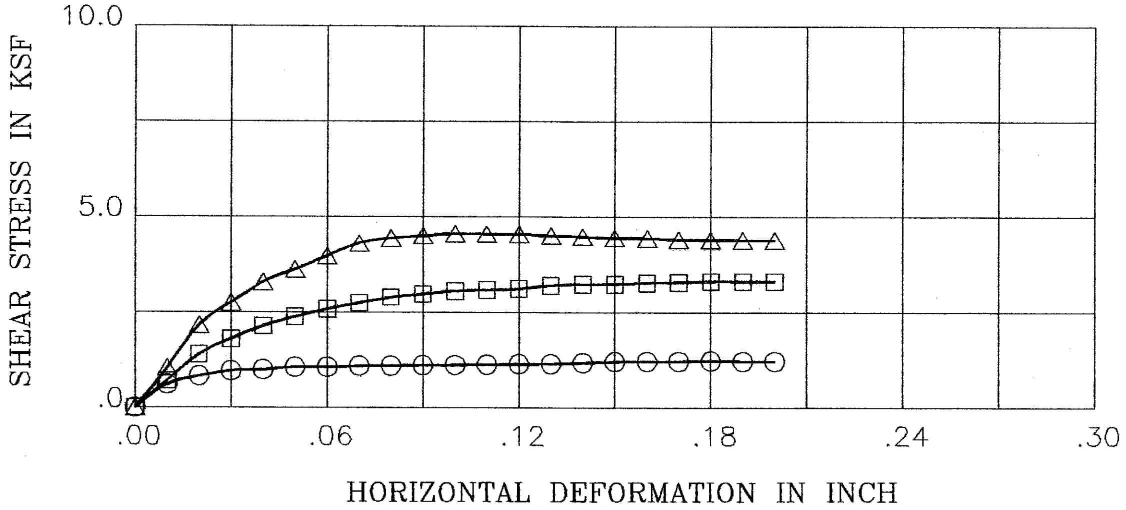
(PEAK STRENGTH)

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	VOID RATIO	NORMAL STRESS (ksf)	PEAK SHEAR (ksf)	RESIDUAL SHEAR (ksf)
○	25.6	90.5	.792	1.00	1.39	1.23
□	27.5	91.9	.765	3.00	3.31	3.31
△	26.1	93.5	.736	5.00	4.00	3.79

Remark :

Project No. 44F1	NORTH CITY WATER RECLAMATION PLANT EXPANSION
ALLIED GEOTECHNICAL ENGINEERS, INC.	DIRECT SHEAR TEST Figure B-31



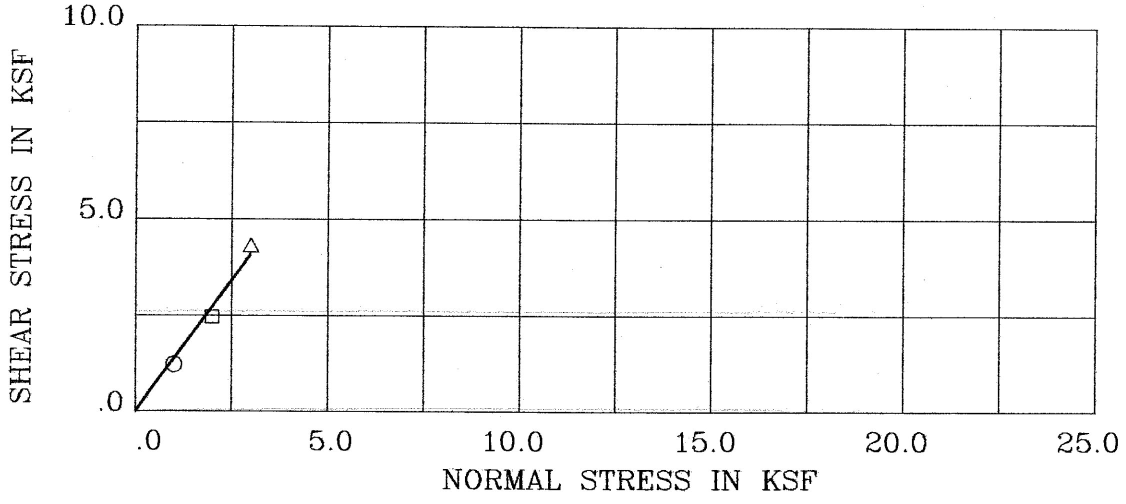


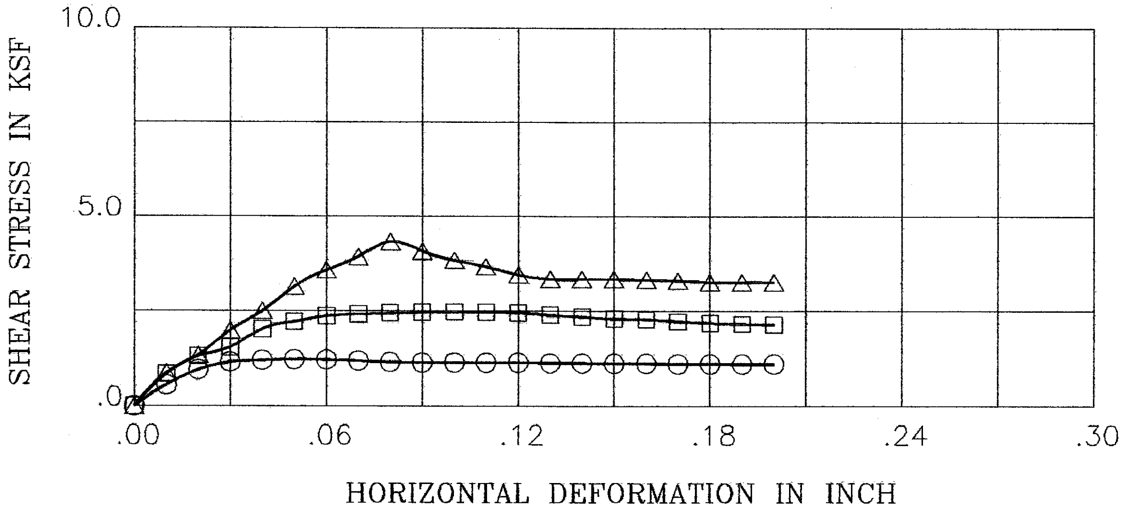
BORING/SAMPLE : H-10 #6 DEPTH (ft) : 21-21.5
DESCRIPTION : Claystone (CL)
STRENGTH INTERCEPT (C) : .541 KSF
FRICTION ANGLE (PHI) : 39.7 DEG
(PEAK STRENGTH)

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	VOID RATIO	NORMAL STRESS (ksf)	PEAK SHEAR (ksf)	RESIDUAL SHEAR (ksf)
○	27.0	96.2	.686	1.00	1.23	1.22
□	27.0	95.9	.692	3.00	3.31	3.31
△	25.0	101.3	.602	5.00	4.56	4.38

Remark :

Project No. 44F1	NORTH CITY WATER RECLAMATION PLANT EXPANSION
ALLIED GEOTECHNICAL ENGINEERS, INC.	DIRECT SHEAR TEST Figure B-32





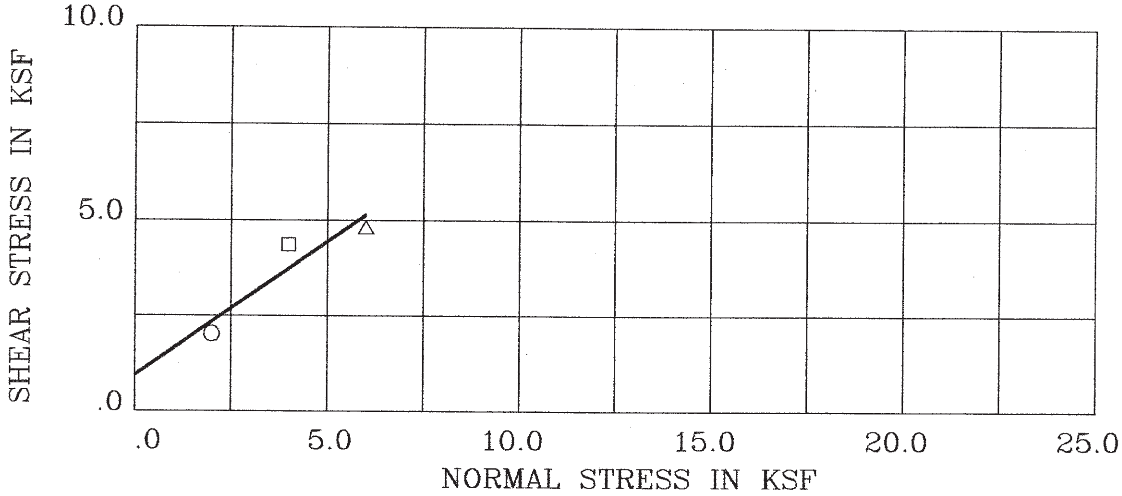
BORING/SAMPLE	: H-11 #1	DEPTH (ft)	: 6-6.5
DESCRIPTION	: Silty sand (SM)		

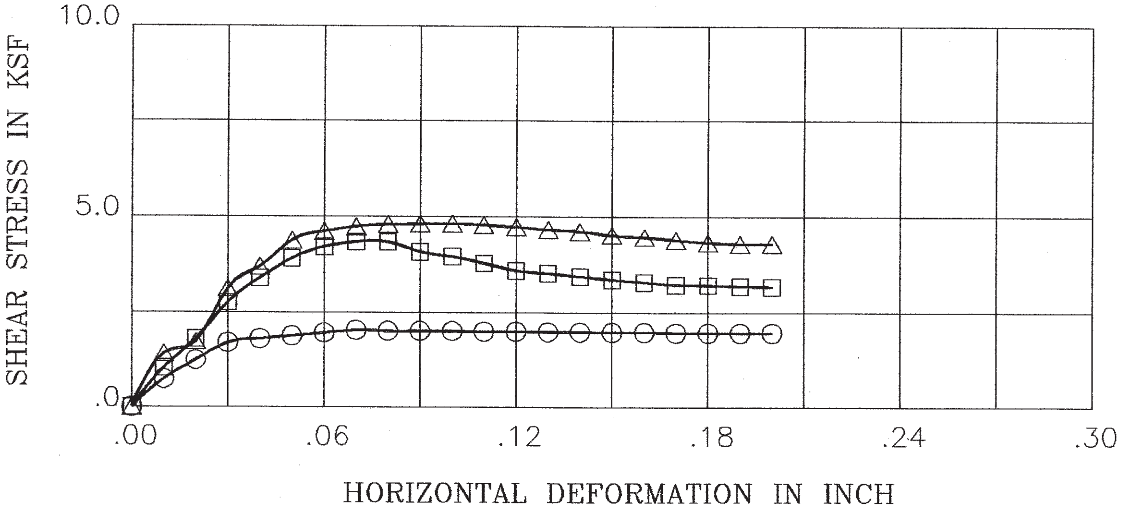
STRENGTH INTERCEPT (C) : .000 KSF
FRICTION ANGLE (PHI) : 53.9 DEG
(PEAK STRENGTH)

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	VOID RATIO	NORMAL STRESS (ksf)	PEAK SHEAR (ksf)	RESIDUAL SHEAR (ksf)
○	23.5	96.4	.683	1.00	1.22	1.09
□	23.4	96.7	.677	2.00	2.47	2.14
△	23.4	100.4	.615	3.00	4.34	3.27

Remark :

Project No. 44F1	NORTH CITY WATER RECLAMATION PLANT EXPANSION
ALLIED GEOTECHNICAL ENGINEERS, INC.	**DIRECT SHEAR TEST** Figure B-33





BORING/SAMPLE : H–11 #4 DEPTH (ft) : 16–16.5

DESCRIPTION : Sandy Lean Clay (CL)

STRENGTH INTERCEPT (C) : .954 KSF

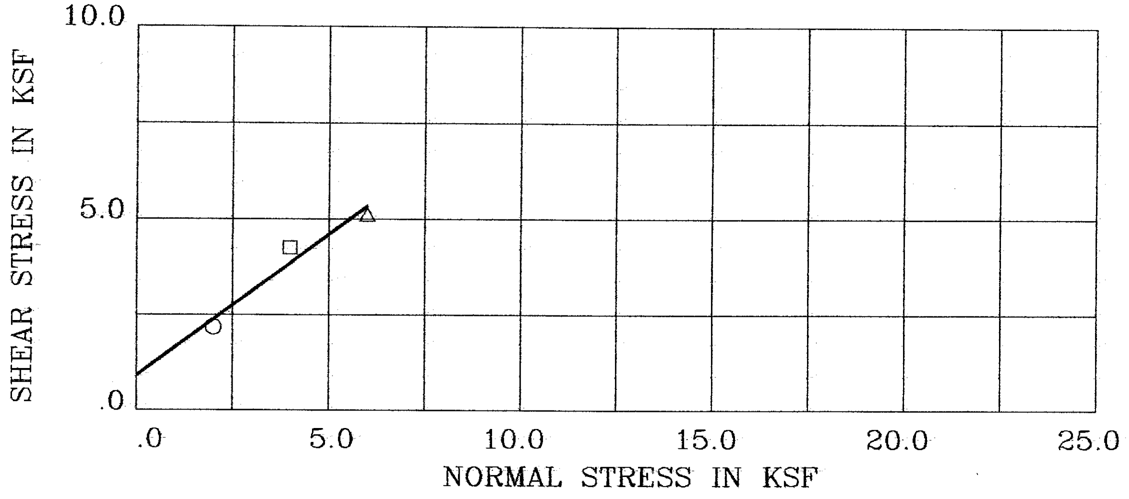
FRICTION ANGLE (PHI) : 34.9 DEG

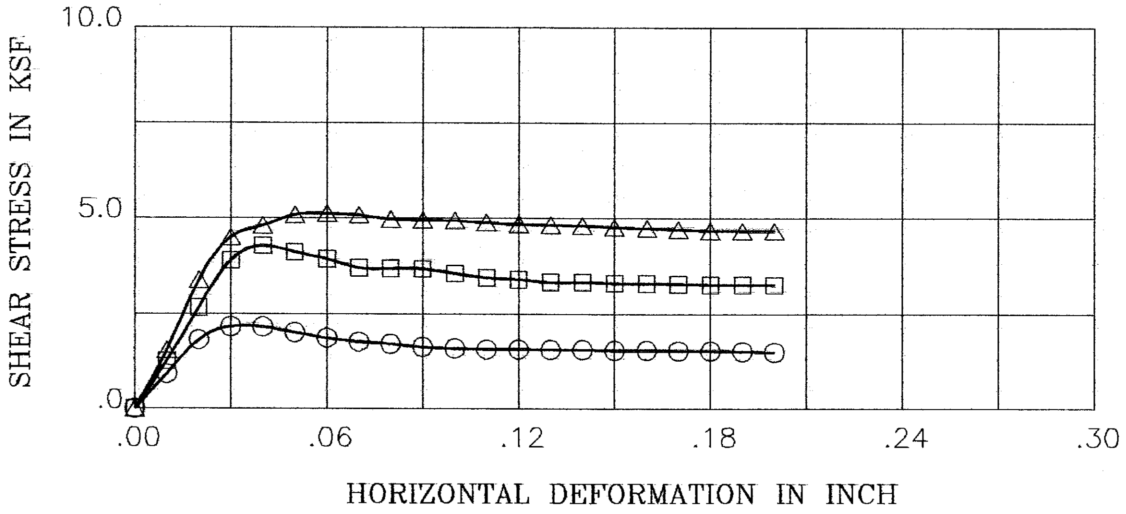
(PEAK STRENGTH)

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	VOID RATIO	NORMAL STRESS (ksf)	PEAK SHEAR (ksf)	RESIDUAL SHEAR (ksf)
○	23.2	99.8	.625	2.00	2.03	1.97
□	25.0	96.1	.688	4.00	4.38	3.18
△	25.3	97.9	.656	6.00	4.82	4.30

Remark :

Project No. 44F1	NORTH CITY WATER RECLAMATION PLANT EXPANSION
ALLIED GEOTECHNICAL ENGINEERS, INC.	DIRECT SHEAR TEST Figure B-34





BORING/SAMPLE : H-11 #9 DEPTH (ft) : 35.5-36
DESCRIPTION : Silty sandstone (SM)
STRENGTH INTERCEPT (C) : .927 KSF
FRICTION ANGLE (PHI) : 36.3 DEG
(PEAK STRENGTH)

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	VOID RATIO	NORMAL STRESS (ksf)	PEAK SHEAR (ksf)	RESIDUAL SHEAR (ksf)
○	19.5	103.9	.562	2.00	2.19	1.50
□	18.9	101.0	.606	4.00	4.28	3.26
△	19.1	109.1	.487	6.00	5.13	4.66

Remark :

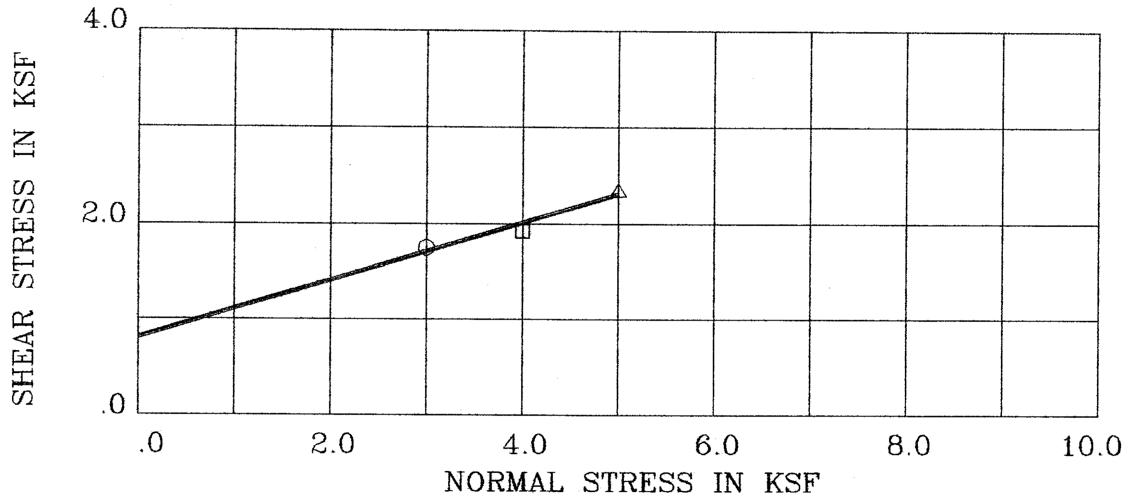
Project No. 44F1

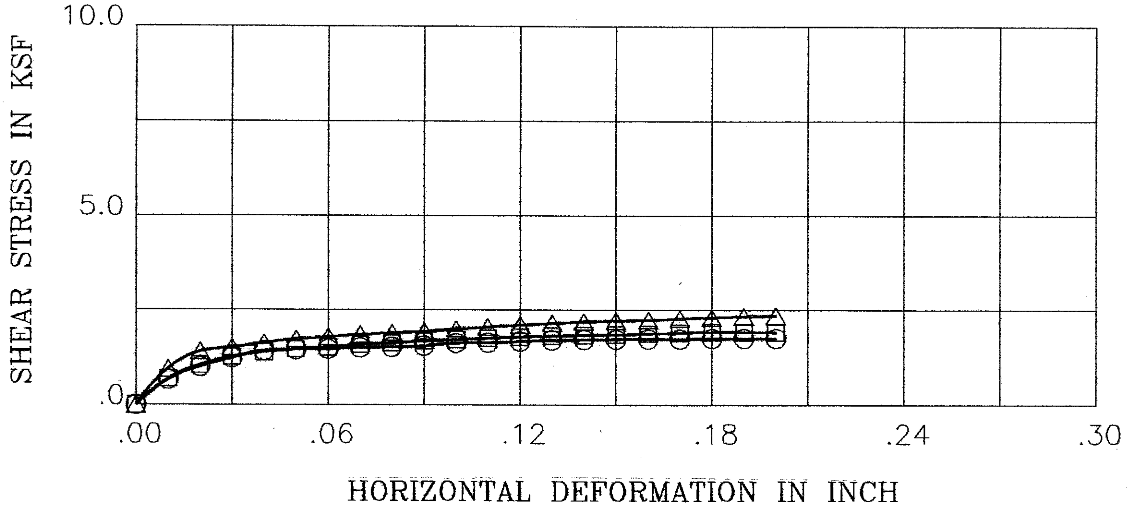
NORTH CITY WATER RECLAMATION PLANT EXPANSION

ALLIED GEOTECHNICAL ENGINEERS, INC.

DIRECT SHEAR TEST

Figure B-35





BORING/SAMPLE : H-12 #7 DEPTH (ft) : 21-24

DESCRIPTION : Silty sandstone (SM)

STRENGTH INTERCEPT (C) : .812 KSF

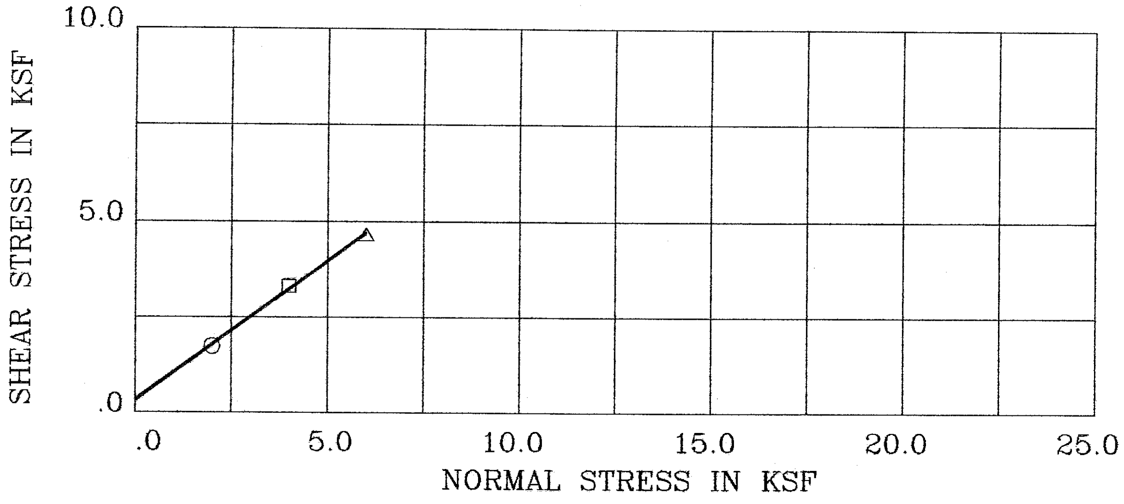
FRICTION ANGLE (PHI) : 16.7 DEG

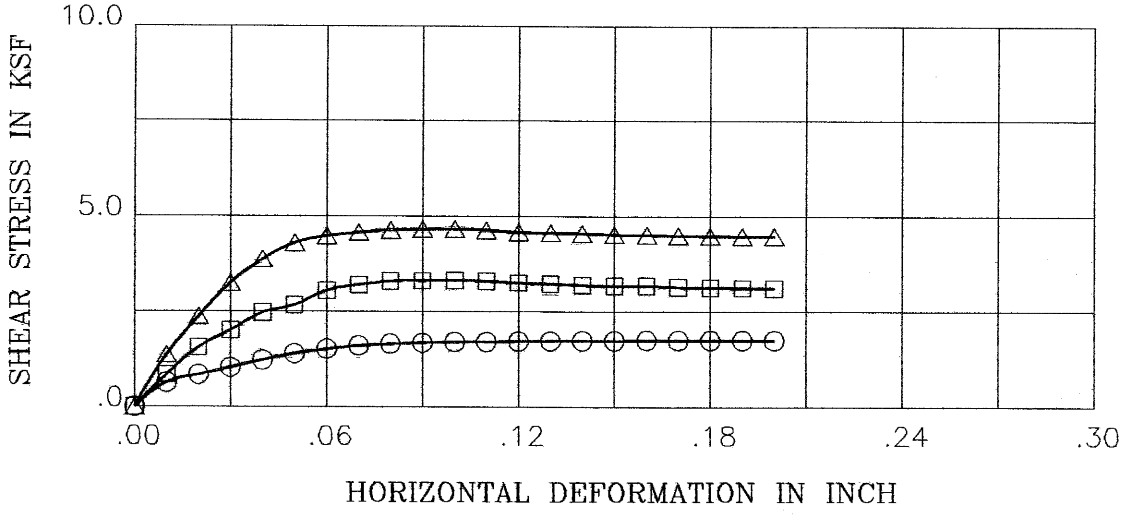
(PEAK STRENGTH)

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	VOID RATIO	NORMAL STRESS (ksf)	PEAK SHEAR (ksf)	RESIDUAL SHEAR (ksf)
○	13.3	107.7	.506	3.00	1.76	1.75
□	13.8	108.1	.501	4.00	1.92	1.91
△	12.9	107.5	.509	5.00	2.36	2.36

Remark :

Project No. 44F1	NORTH CITY WATER RECLAMATION PLANT EXPANSION
ALLIED GEOTECHNICAL ENGINEERS, INC.	DIRECT SHEAR TEST Figure B-36



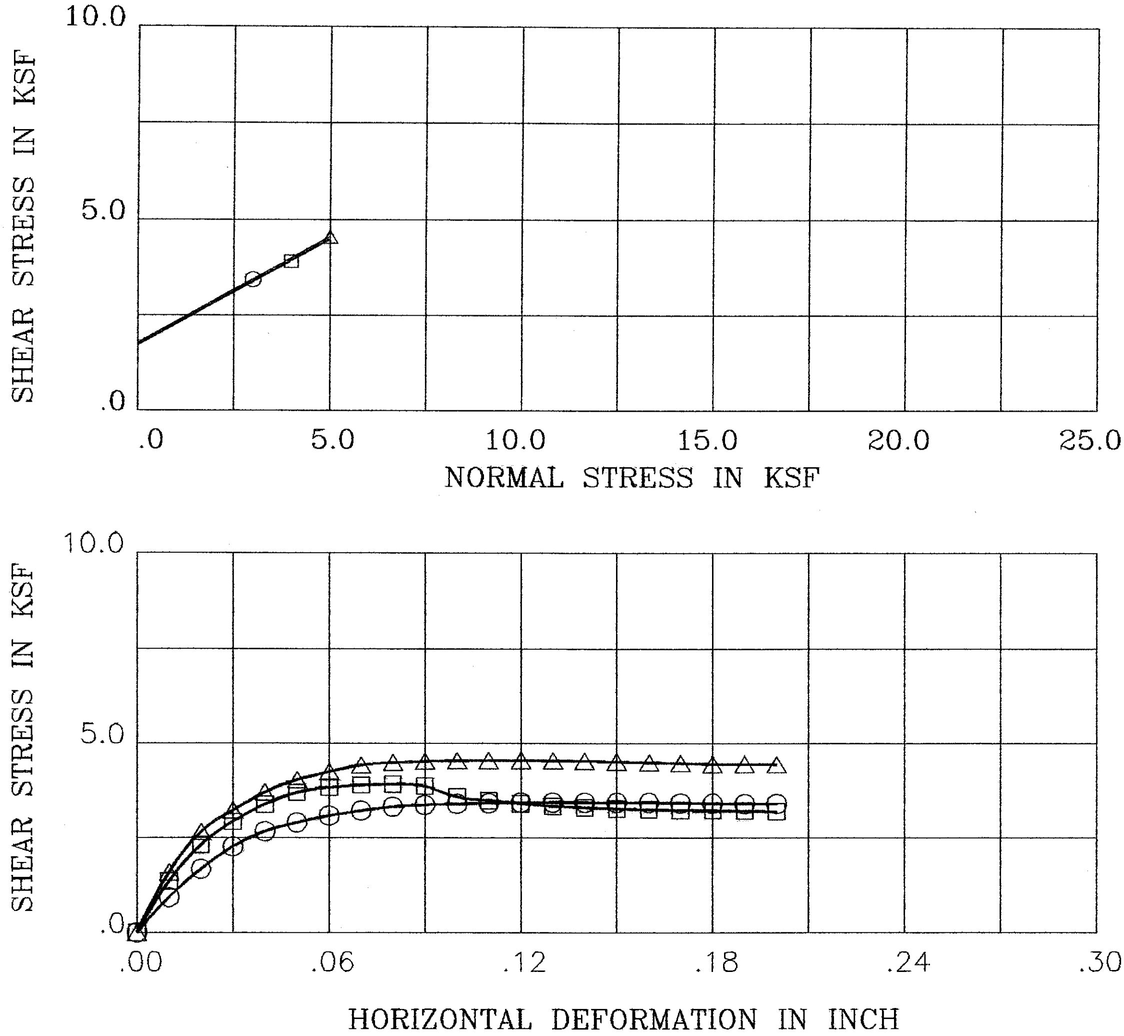


BORING/SAMPLE : H-12 #10 DEPTH (ft) : 35-35.5
DESCRIPTION : Poorly graded sand (SP)
STRENGTH INTERCEPT (C) : .320 KSF
FRICTION ANGLE (PHI) : 36.2 DEG
(PEAK STRENGTH)

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	VOID RATIO	NORMAL STRESS (ksf)	PEAK SHEAR (ksf)	RESIDUAL SHEAR (ksf)
○	9.5	94.5	.717	2.00	1.75	1.74
□	9.8	96.1	.689	4.00	3.32	3.11
△	10.1	97.5	.664	6.00	4.67	4.48

Remark :

Project No. 44F1	NORTH CITY WATER RECLAMATION PLANT EXPANSION
ALLIED GEOTECHNICAL ENGINEERS, INC.	DIRECT SHEAR TEST Figure B-37



BORING/SAMPLE : H–13 #5 DEPTH (ft) : 16–16.5

DESCRIPTION : Lean clay (CL)

STRENGTH INTERCEPT (C) : 1.748 KSF

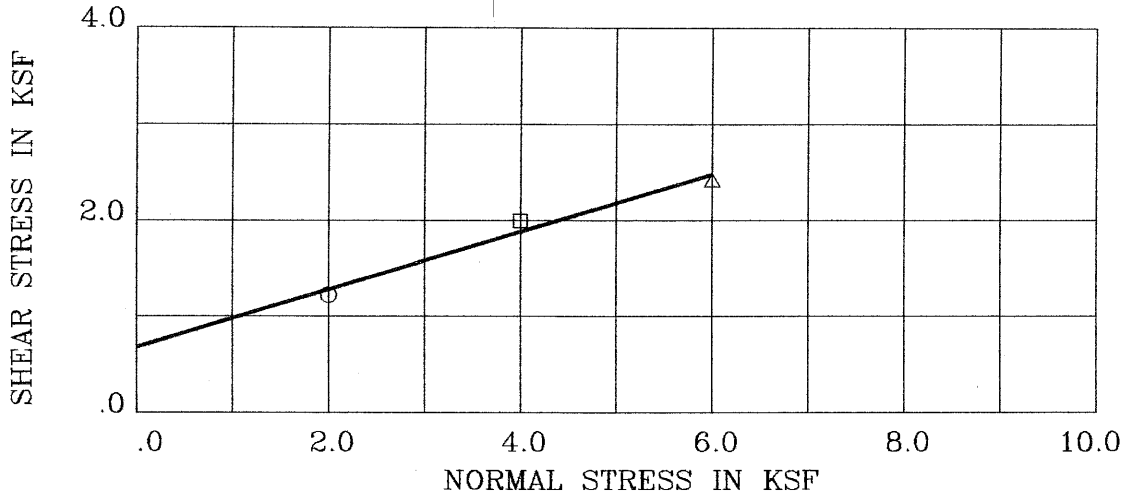
FRICTION ANGLE (PHI) : 29.1 DEG

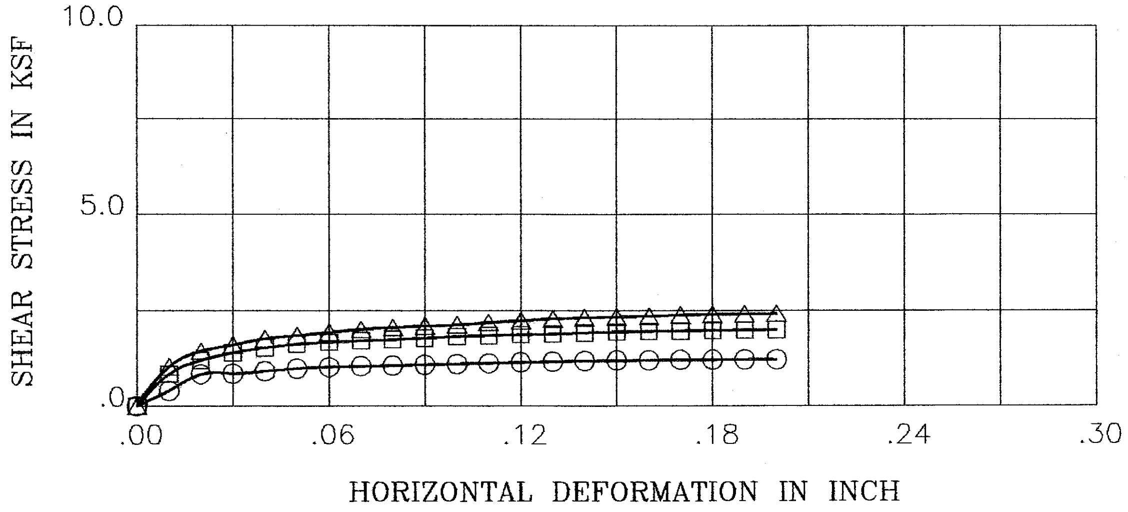
(PEAK STRENGTH)

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	VOID RATIO	NORMAL STRESS (ksf)	PEAK SHEAR (ksf)	RESIDUAL SHEAR (ksf)
○	23.2	96.8	.676	3.00	3.44	3.40
□	22.1	99.1	.636	4.00	3.93	3.20
△	22.4	99.7	.628	5.00	4.55	4.44

Remark :

Project No. 44F1	NORTH CITY WATER RECLAMATION PLANT EXPANSION
ALLIED GEOTECHNICAL ENGINEERS, INC.	DIRECT SHEAR TEST Figure B–38





BORING/SAMPLE : H–14 #2 DEPTH (ft) : 4–7

DESCRIPTION : Sandy clay (CL)

STRENGTH INTERCEPT (C) : .682 KSF

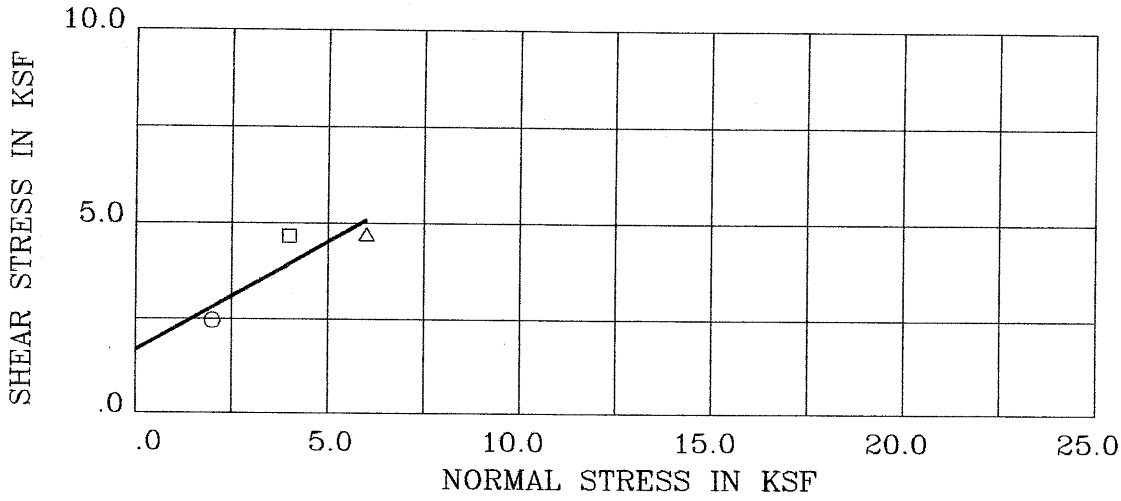
FRICTION ANGLE (PHI) : 16.7 DEG

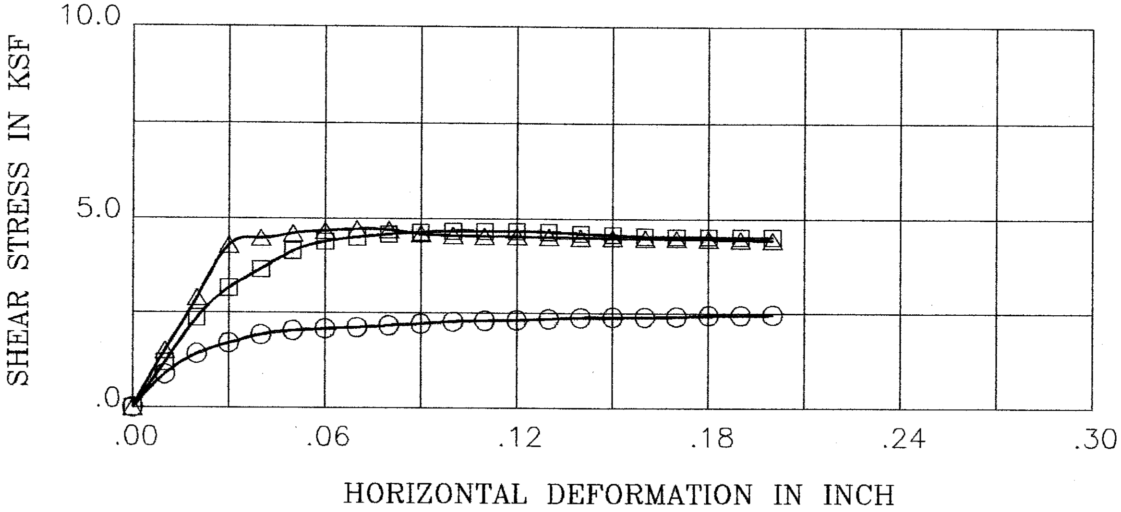
(PEAK STRENGTH)

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	VOID RATIO	NORMAL STRESS (ksf)	PEAK SHEAR (ksf)	RESIDUAL SHEAR (ksf)
○	15.3	103.1	.574	2.00	1.22	1.22
□	15.5	105.8	.534	4.00	2.00	2.00
△	15.4	106.9	.518	6.00	2.42	2.42

Remark :

Project No. 44F1	NORTH CITY WATER RECLAMATION PLANT EXPANSION
ALLIED GEOTECHNICAL ENGINEERS, INC.	DIRECT SHEAR TEST Figure B–39



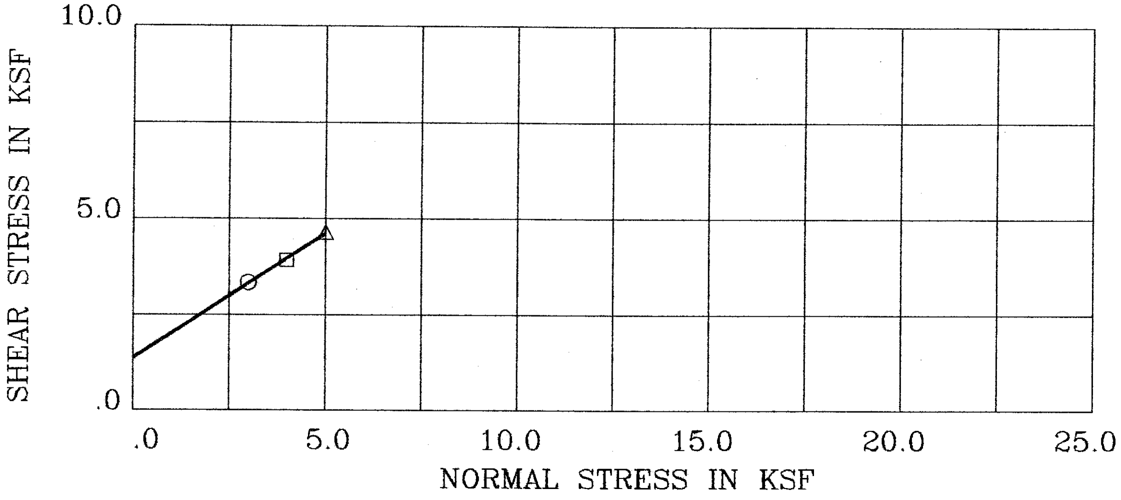


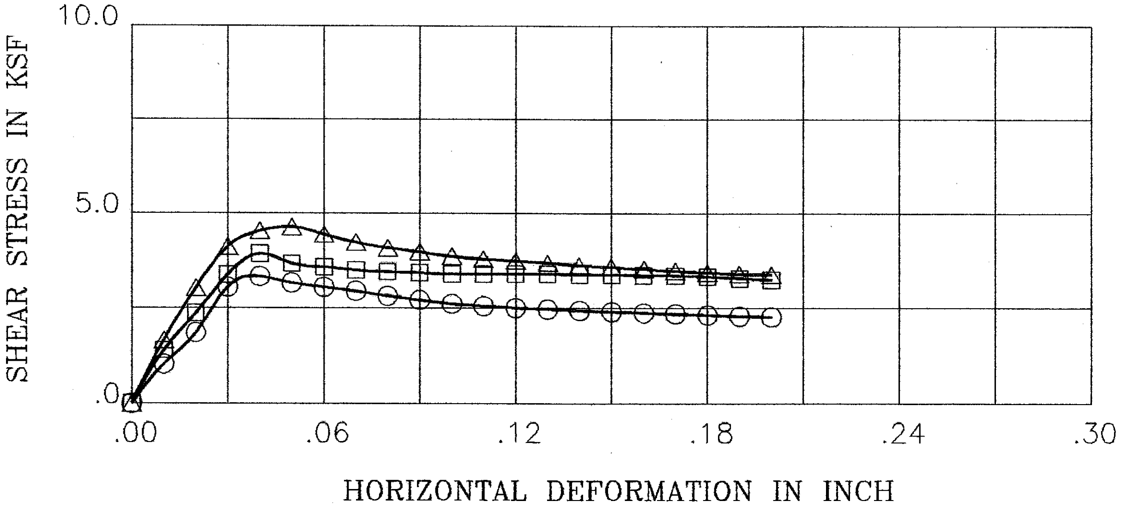
BORING/SAMPLE : H–14 #15 DEPTH (ft) : 50–50.5
DESCRIPTION : Lean clay (CL)
STRENGTH INTERCEPT (C) : 1.692 KSF
FRICTION ANGLE (PHI) : 29.5 DEG
(PEAK STRENGTH)

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	VOID RATIO	NORMAL STRESS (ksf)	PEAK SHEAR (ksf)	RESIDUAL SHEAR (ksf)
○	21.3	95.9	.692	2.00	2.46	2.46
□	19.9	99.3	.634	4.00	4.67	4.51
△	21.8	101.1	.604	6.00	4.73	4.43

Remark :

Project No. 44F1	NORTH CITY WATER RECLAMATION PLANT EXPANSION
ALLIED GEOTECHNICAL ENGINEERS, INC.	DIRECT SHEAR TEST Figure B–40





BORING/SAMPLE : H-15 #1 DEPTH (ft) : 6-6.5

DESCRIPTION : Plastic clay (CH)

STRENGTH INTERCEPT (C) : 1.369 KSF

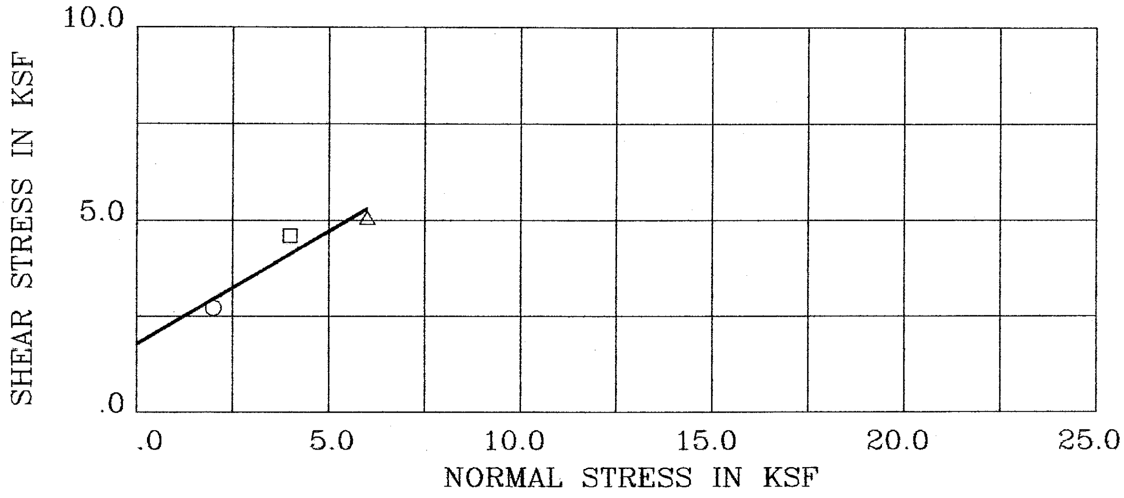
FRICTION ANGLE (PHI) : 33.1 DEG

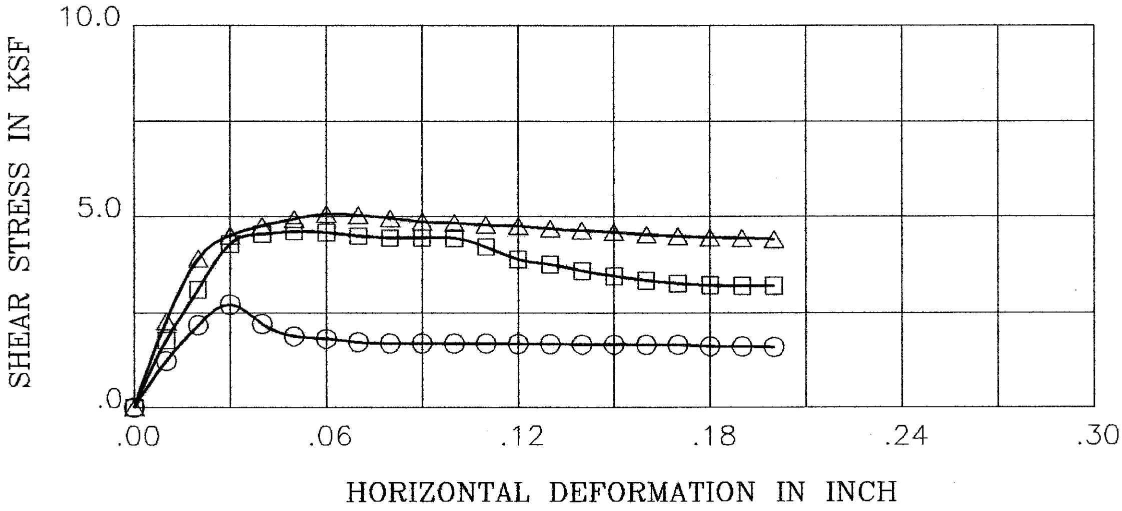
(PEAK STRENGTH)

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	VOID RATIO	NORMAL STRESS (ksf)	PEAK SHEAR (ksf)	RESIDUAL SHEAR (ksf)
○	21.9	103.1	.574	3.00	3.34	2.27
□	21.5	102.1	.589	4.00	3.93	3.25
△	22.0	104.1	.558	5.00	4.64	3.39

Remark :

Project No. 44F1	NORTH CITY WATER RECLAMATION PLANT EXPANSION
ALLIED GEOTECHNICAL ENGINEERS, INC.	DIRECT SHEAR TEST Figure B-41



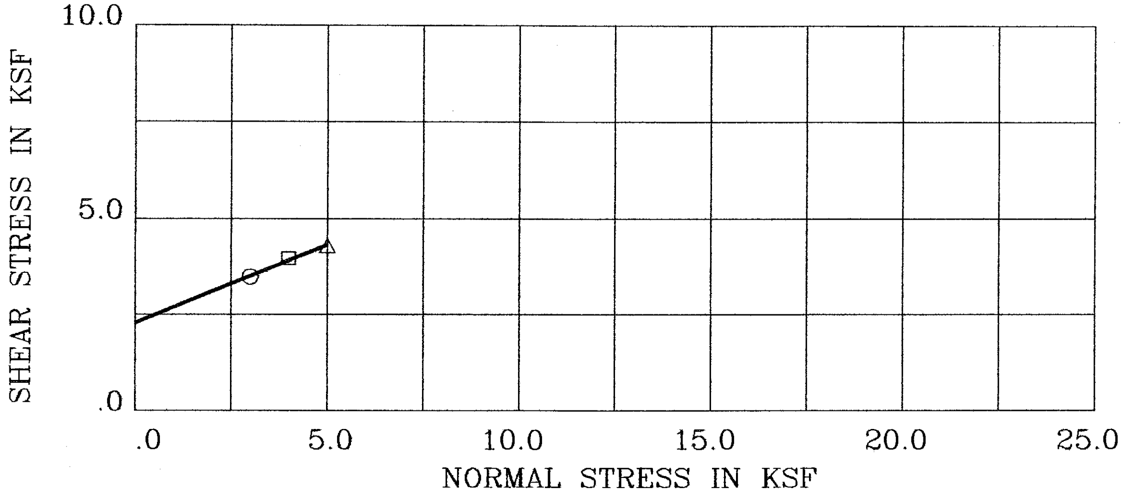


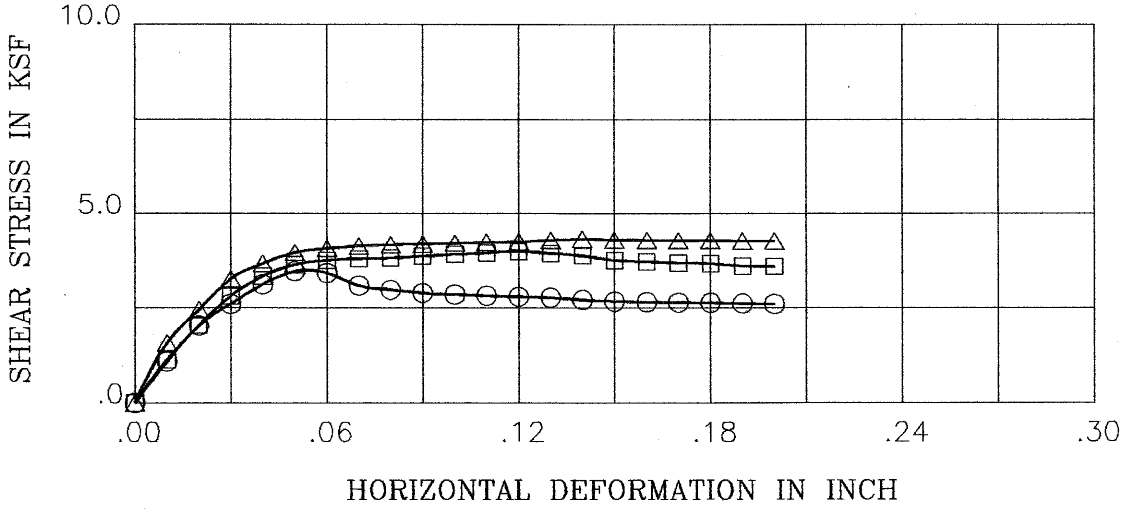
BORING/SAMPLE : H–16 #1 DEPTH (ft) : 6–6.5
DESCRIPTION : Siltstone (ML)
STRENGTH INTERCEPT (C) : 1.785 KSF
FRICTION ANGLE (PHI) : 30.4 DEG
(PEAK STRENGTH)

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	VOID RATIO	NORMAL STRESS (ksf)	PEAK SHEAR (ksf)	RESIDUAL SHEAR (ksf)
○	22.4	102.2	.587	2.00	2.72	1.61
□	20.4	105.6	.536	4.00	4.62	3.20
△	22.0	104.5	.553	6.00	5.07	4.41

Remark :

Project No. 44F1	NORTH CITY WATER RECLAMATION PLANT EXPANSION
ALLIED GEOTECHNICAL ENGINEERS, INC.	DIRECT SHEAR TEST Figure B–42





BORING/SAMPLE : H–17 #2 DEPTH (ft) : 6–6.5

DESCRIPTION : Lean clay (CL)

STRENGTH INTERCEPT (C) : 2.290 KSF

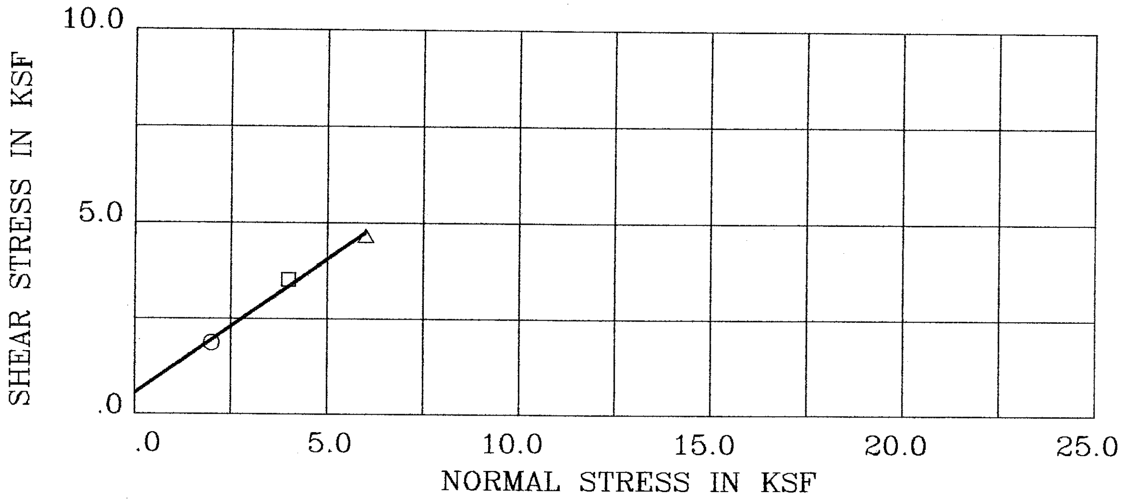
FRICTION ANGLE (PHI) : 22.3 DEG

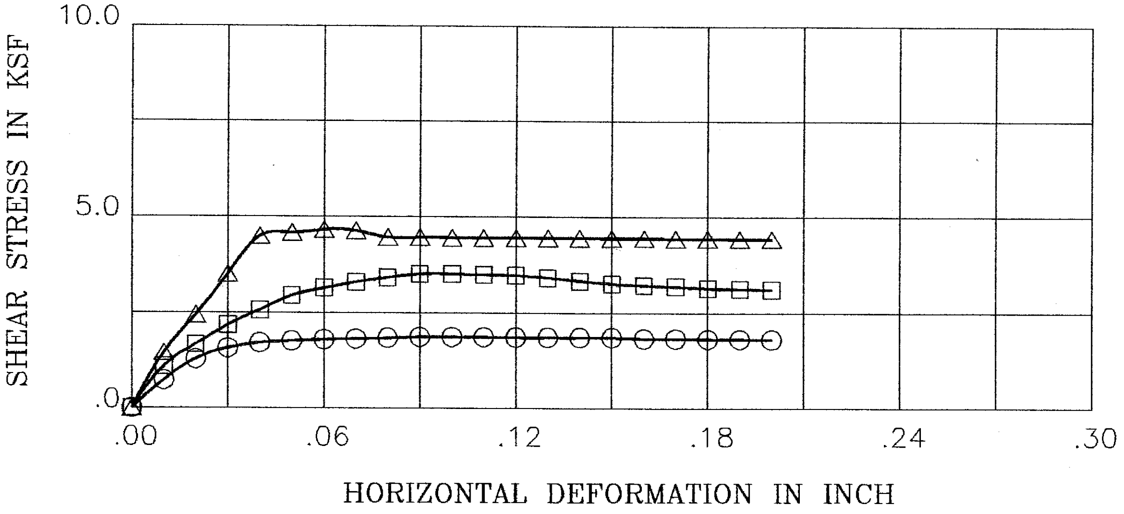
(PEAK STRENGTH)

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	VOID RATIO	NORMAL STRESS (ksf)	PEAK SHEAR (ksf)	RESIDUAL SHEAR (ksf)
○	20.6	102.7	.580	3.00	3.49	2.60
□	24.0	101.1	.604	4.00	3.99	3.59
△	22.2	103.5	.567	5.00	4.32	4.27

Remark :

Project No. 44F1	NORTH CITY WATER RECLAMATION PLANT EXPANSION
ALLIED GEOTECHNICAL ENGINEERS, INC.	**DIRECT SHEAR TEST** Figure B–43





BORING/SAMPLE : H-20 #4 DEPTH (ft) : 10.5-11

DESCRIPTION : Lean clay (CL)

STRENGTH INTERCEPT (C) : .559 KSF

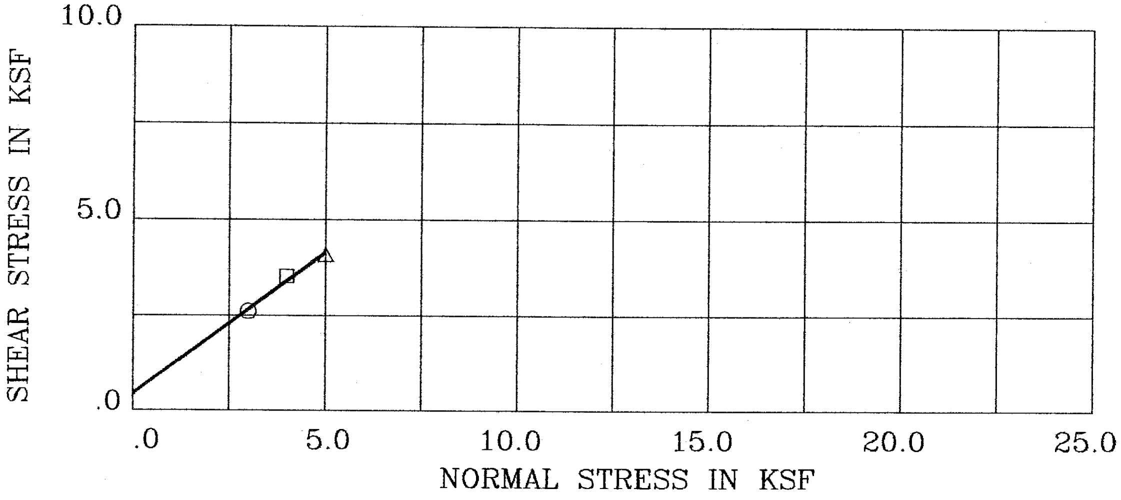
FRICTION ANGLE (PHI) : 35.0 DEG

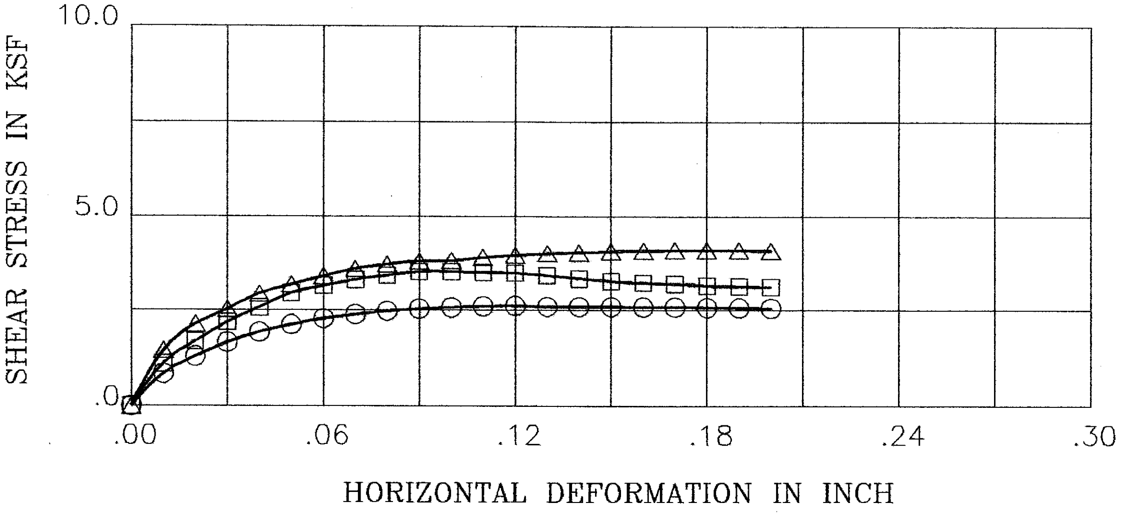
(PEAK STRENGTH)

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	VOID RATIO	NORMAL STRESS (ksf)	PEAK SHEAR (ksf)	RESIDUAL SHEAR (ksf)
○	11.7	106.0	.530	2.00	1.87	1.81
□	12.1	106.0	.530	4.00	3.53	3.11
△	16.3	109.5	.482	6.00	4.67	4.42

Remark :

Project No. 44F1	NORTH CITY WATER RECLAMATION PLANT EXPANSION
ALLIED GEOTECHNICAL ENGINEERS, INC.	DIRECT SHEAR TEST Figure B-44



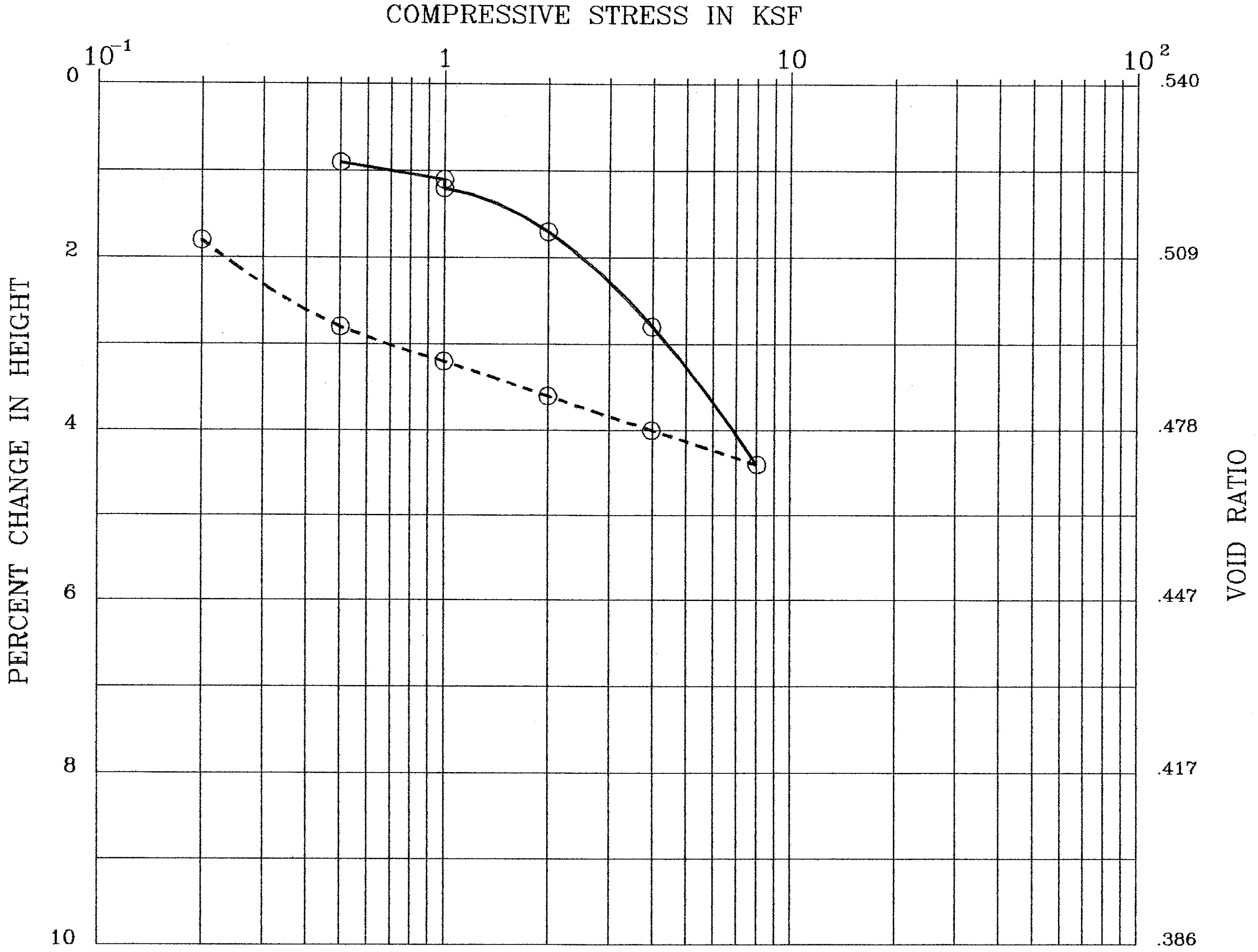


BORING/SAMPLE : H-22 #1 DEPTH (ft) : 6-6.5
DESCRIPTION : Silty/clayey sand (SM/SC)
STRENGTH INTERCEPT (C) : .438 KSF
FRICTION ANGLE (PHI) : 36.6 DEG
(PEAK STRENGTH)

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	VOID RATIO	NORMAL STRESS (ksf)	PEAK SHEAR (ksf)	RESIDUAL SHEAR (ksf)
○	12.9	113.4	.430	3.00	2.61	2.55
□	12.1	106.0	.530	4.00	3.53	3.11
△	12.2	113.5	.429	5.00	4.10	4.09

Remark :

Project No. 44F1	NORTH CITY WATER RECLAMATION PLANT EXPANSION
ALLIED GEOTECHNICAL ENGINEERS, INC.	DIRECT SHEAR TEST Figure B-45



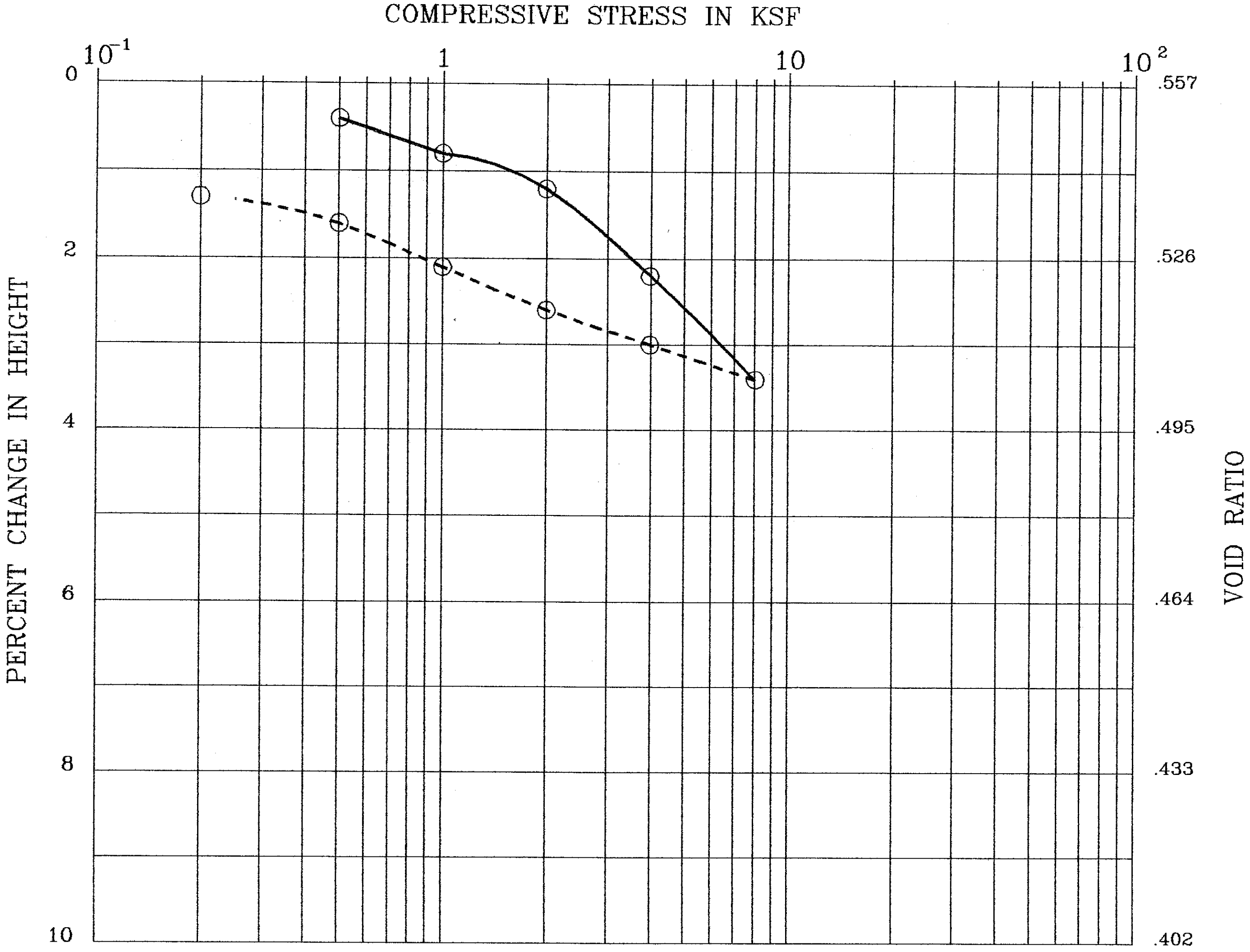
BORING : H-6 #3
DEPTH (ft) : 11-11.5
SPEC. GRAVITY : 2.71

DESCRIPTION : Clayey Sand (SC)
LIQUID LIMIT :
PLASTIC LIMIT :

	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	PERCENT SATURATION	VOID RATIO
INITIAL	16.7	110.2	84	.540
FINAL	18.6	112.6	100	.506

Remark :

Project 44F1	NCWRP EXPANSION
ALLIED GEOTECHNICAL ENGINEERS, INC.	CONSOLIDATION TEST Figure B-46



BORING : H-6 #6

DEPTH (ft) : 21-21.5

SPEC. GRAVITY : 2.66

DESCRIPTION : Silty sand (SM)

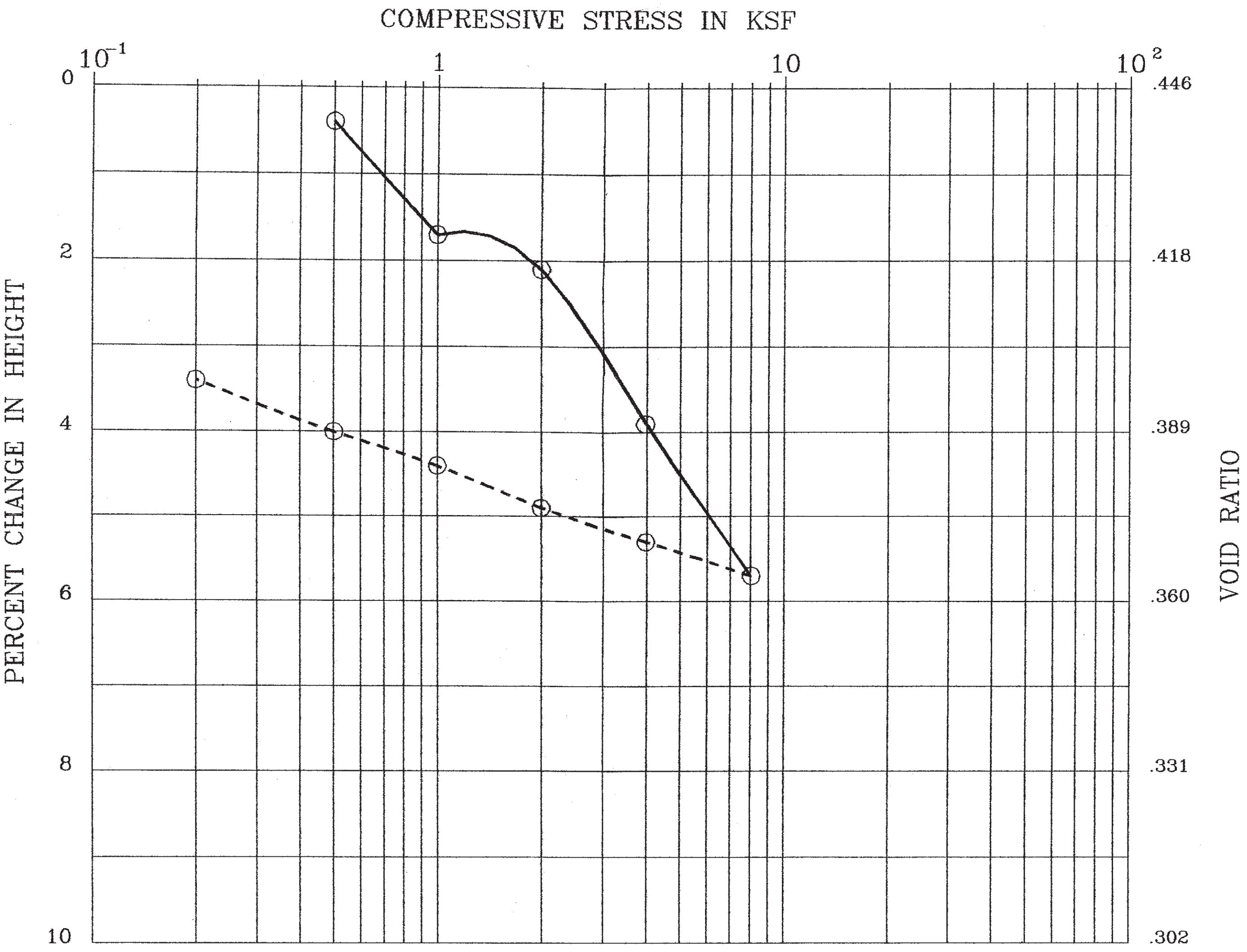
LIQUID LIMIT :

PLASTIC LIMIT :

	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	PERCENT SATURATION	VOID RATIO
INITIAL	17.6	106.7	85	.557
FINAL	20.1	108.2	100	.535

Remark :

Project 44F1	NCWRP EXPANSION
ALLIED GEOTECHNICAL ENGINEERS, INC.	CONSOLIDATION TEST Figure B-47



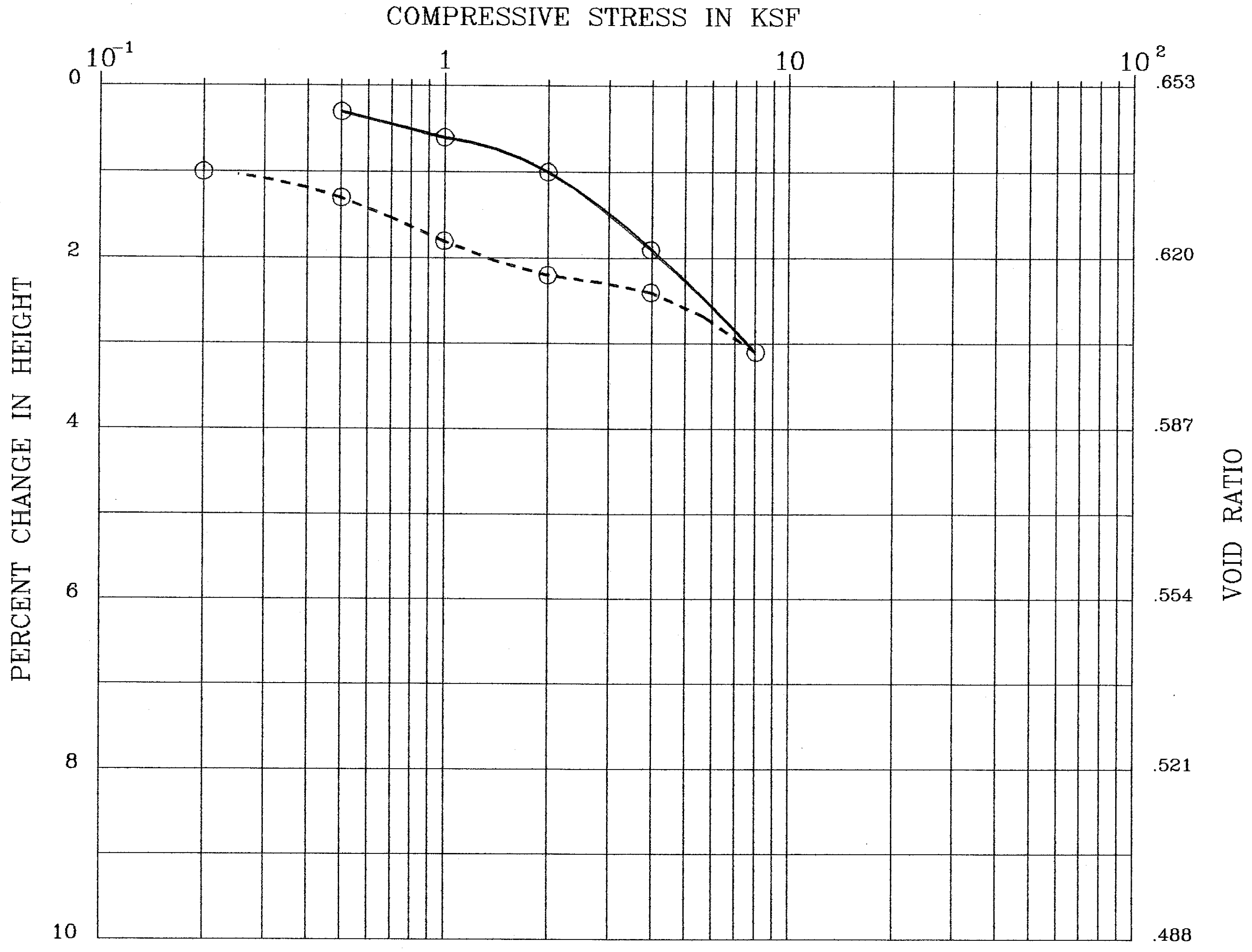
BORING : H–10 #4
DEPTH (ft) : 11–11.5
SPEC. GRAVITY : 2.41

DESCRIPTION : Silty sand/lean clay (SM/CL)
LIQUID LIMIT :
PLASTIC LIMIT :

	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	PERCENT SATURATION	VOID RATIO
INITIAL	15.8	104.2	86	.446
FINAL	16.3	108.0	100	.396

Remark :

Project 44F1	NCWRP EXPANSION
ALLIED GEOTECHNICAL ENGINEERS, INC.	CONSOLIDATION TEST Figure B-48



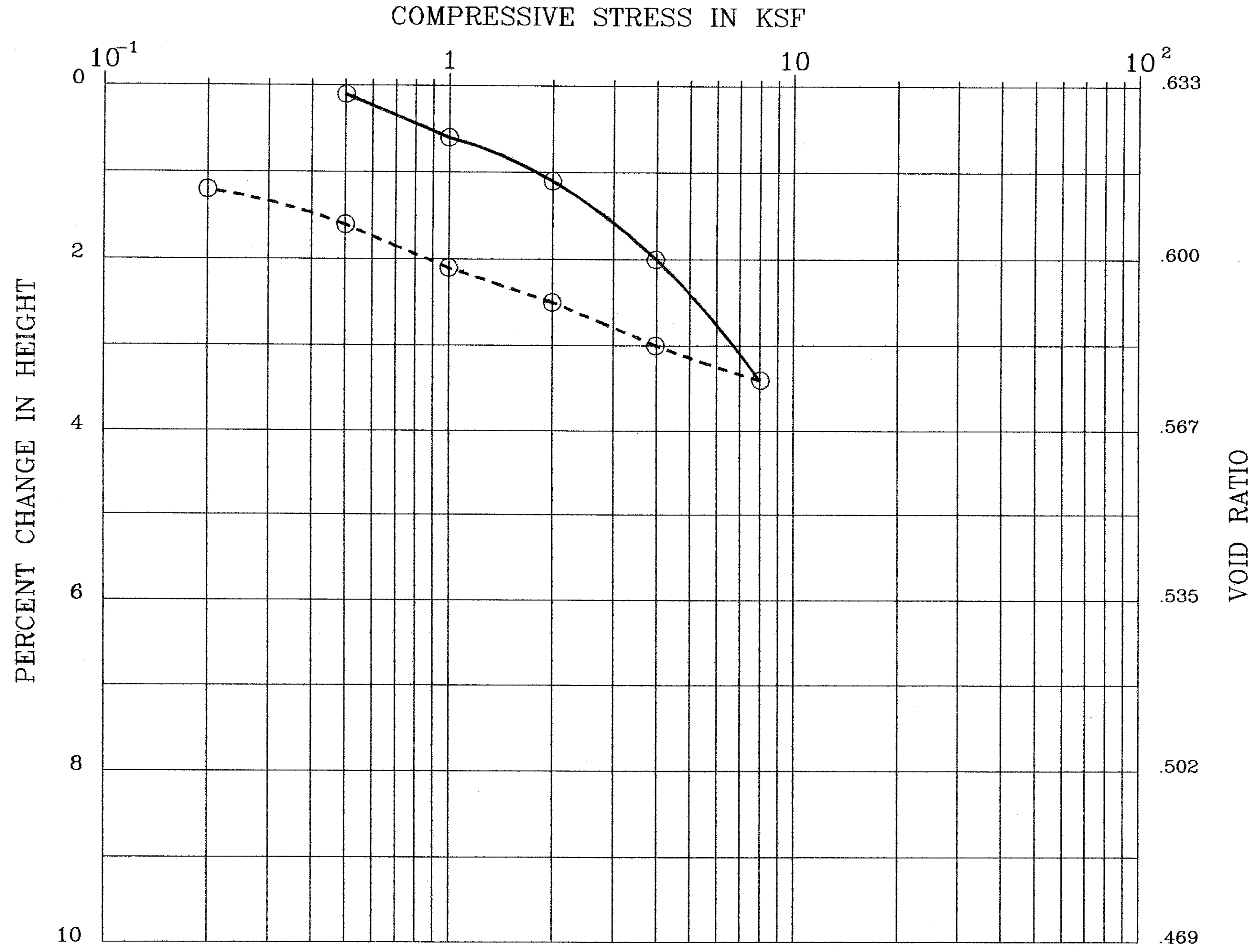
BORING : H-11 #1
DEPTH (ft) : 6-6.5
SPEC. GRAVITY : 2.59

DESCRIPTION : Silty sand (SM)
LIQUID LIMIT :
PLASTIC LIMIT :

	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	PERCENT SATURATION	VOID RATIO
INITIAL	24.6	98.0	98	.653
FINAL	24.5	99.0	100	.637

Remark :

Project 44F1	NCWRP EXPANSION
ALLIED GEOTECHNICAL ENGINEERS, INC.	CONSOLIDATION TEST Figure B-49



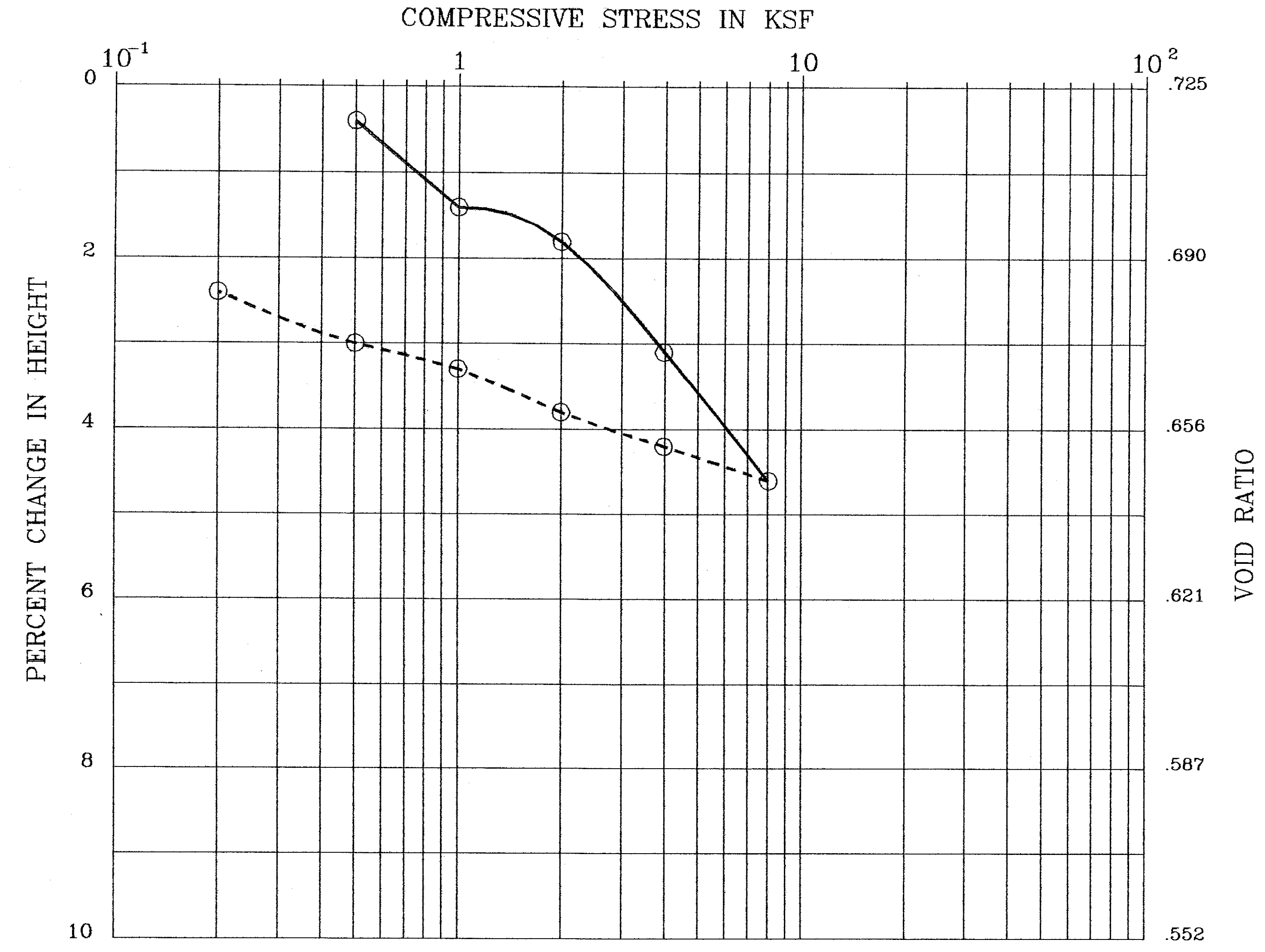
BORING : H-11 #7
DEPTH (ft) : 25.5-26
SPEC. GRAVITY : 2.71

DESCRIPTION : Sandy lean clay (CL)
LIQUID LIMIT :
PLASTIC LIMIT :

	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	PERCENT SATURATION	VOID RATIO
INITIAL	21.5	103.7	92	.633
FINAL	22.6	105.0	100	.613

Remark :

Project 44F1	NCWRP EXPANSION
ALLIED GEOTECHNICAL ENGINEERS, INC.	CONSOLIDATION TEST Figure B-50



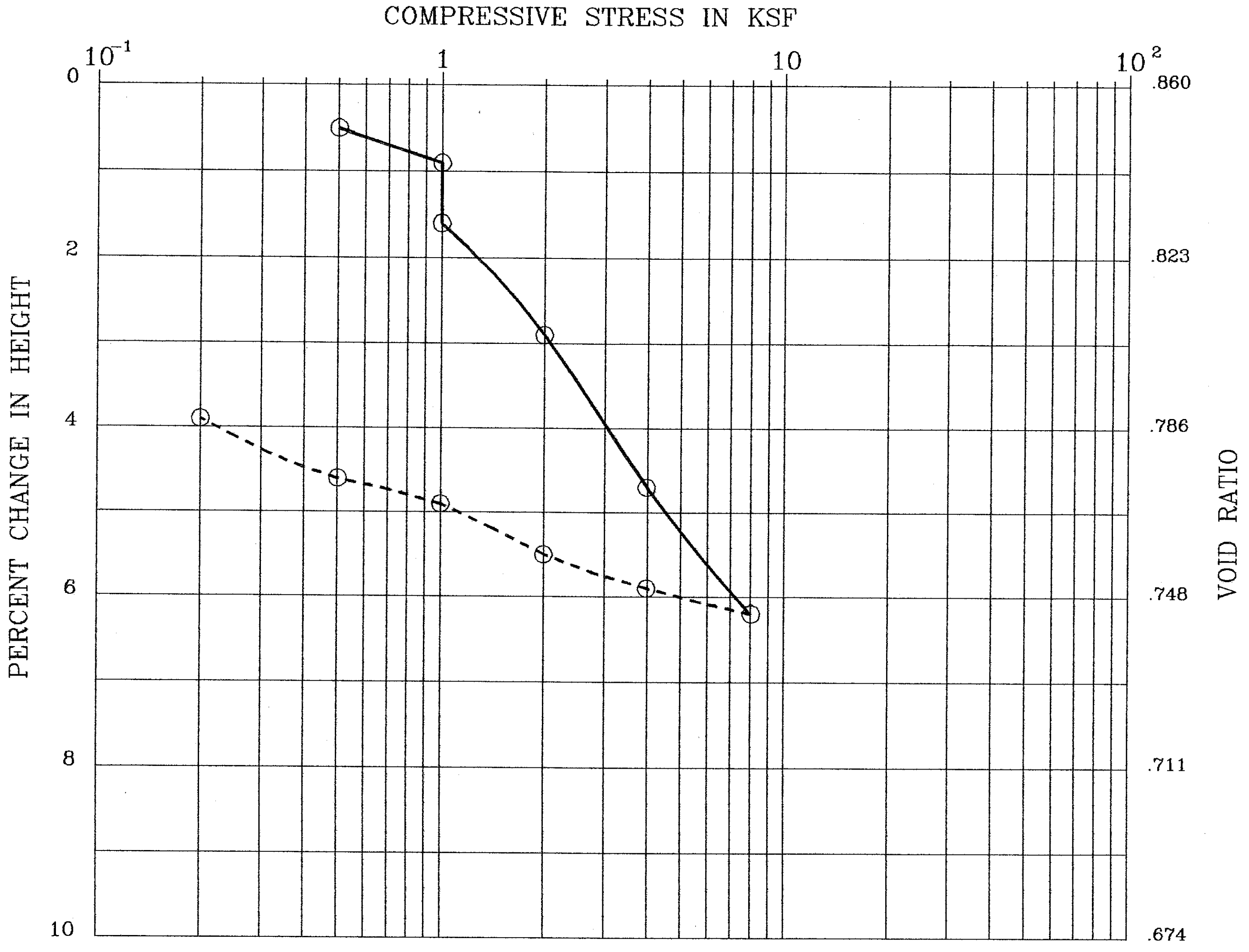
BORING : H-12 #5
DEPTH (ft) : 16-16.5
SPEC. GRAVITY : 2.78

DESCRIPTION : Silty sand (SM)
LIQUID LIMIT :
PLASTIC LIMIT :

	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	PERCENT SATURATION	VOID RATIO
INITIAL	23.9	100.5	92	.725
FINAL	24.6	103.0	100	.683

Remark :

Project 44F1	NCWRP EXPANSION
ALLIED GEOTECHNICAL ENGINEERS, INC.	CONSOLIDATION TEST — Figure B-51



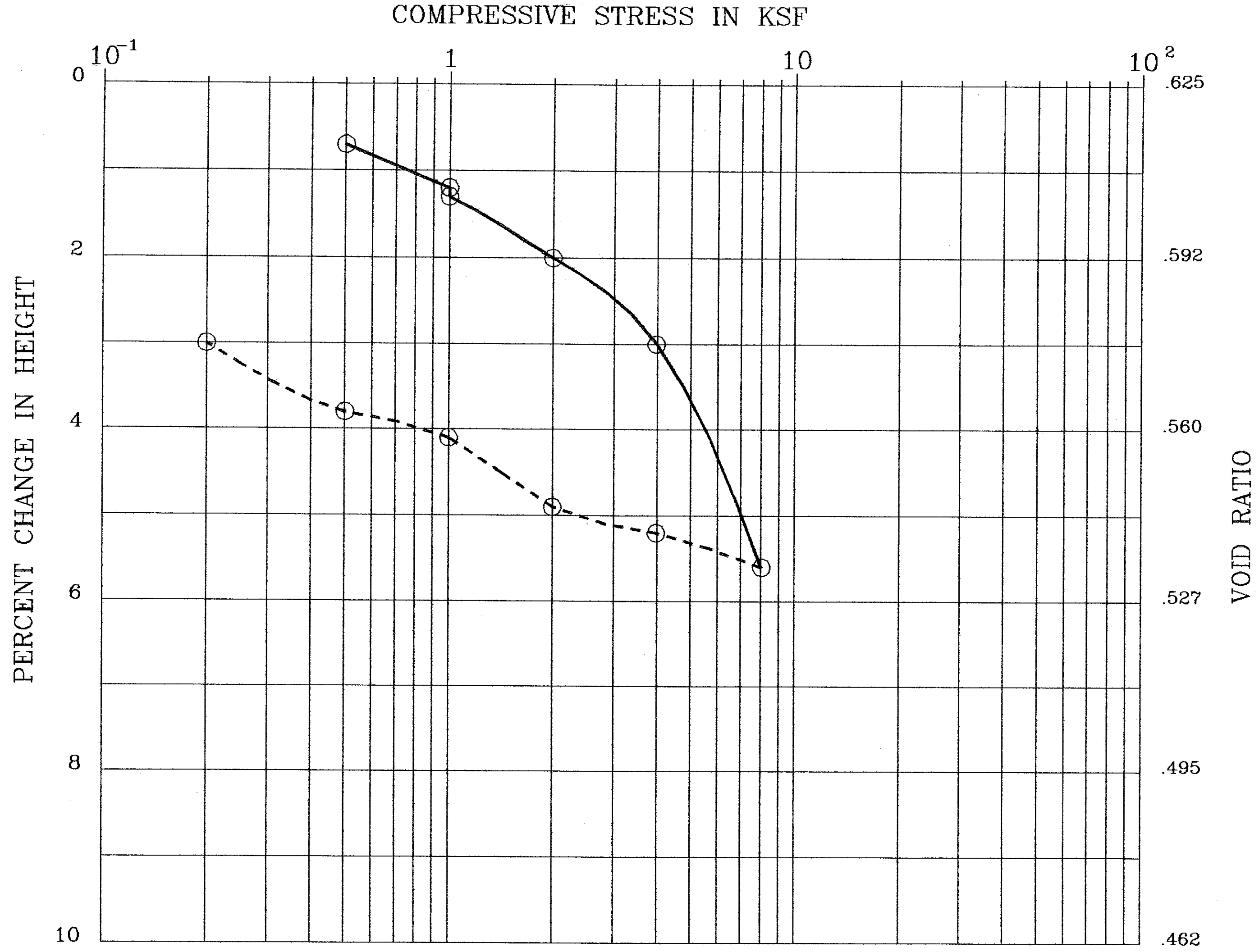
BORING : H–13 #7
DEPTH (ft) : 26–26.5
SPEC. GRAVITY : 3.05

DESCRIPTION : Lean clay (CL)
LIQUID LIMIT :
PLASTIC LIMIT :

	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	PERCENT SATURATION	VOID RATIO
INITIAL	22.5	102.6	80	.860
FINAL	25.6	106.9	100	.786

Remark :

Project 44F1	NCWRP EXPANSION
ALLIED GEOTECHNICAL ENGINEERS, INC.	CONSOLIDATION TEST Figure B–52



BORING : H-14 #4
DEPTH (ft) : 11-11.5
SPEC. GRAVITY : 2.80

DESCRIPTION : Sandy clay (CL)
LIQUID LIMIT :
PLASTIC LIMIT :

	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	PERCENT SATURATION	VOID RATIO
INITIAL	19.2	107.7	86	.625
FINAL	20.4	111.2	100	.574

Remark :

Project 44F1	NCWRP EXPANSION
ALLIED GEOTECHNICAL ENGINEERS, INC.	CONSOLIDATION TEST Figure B-53

LABORATORY REPORT

Telephone (619) 425-1993 Fax 425-7917 Established 1928

CLARKSON LABORATORY AND SUPPLY INC.
350 Trousdale Dr. Chula Vista, Ca. 91910 www.clarksonlab.com
ANALYTICAL AND CONSULTING CHEMISTS

Date: June 14, 2017
Purchase Order Number: 44F1
Sales Order Number: 36150
Account Number: ALLG

To:

Allied Geotechnical Engineers
1810 Gillespie Way Ste 104
El Cajon, CA 92020
Attention: Sani Sutanto

Laboratory Number: SO6422-1 Customers Phone: 449-5900
Fax: 449-5902

Sample Designation:

One soil sample received on 06/09/17 at 9:20am, taken on 06/05/17 from North City Wastewater Treatment Plan Expansion Project#44F1 marked as H-1 #2@4'-5'.

Analysis By California Test 643, 1999, Department of Transportation Division of Construction, Method for Estimating the Service Life of Steel Culverts.

pH 6.5

Water Added (ml)	Resistivity (ohm-cm)
10	3300
5	1500
5	830
5	680
5	680
5	720
5	740

12 years to perforation for a 16 gauge metal culvert.
15 years to perforation for a 14 gauge metal culvert.
21 years to perforation for a 12 gauge metal culvert.
27 years to perforation for a 10 gauge metal culvert.
33 years to perforation for a 8 gauge metal culvert.

Water Soluble Sulfate Calif. Test 417	0.048% (480ppm)
Water Soluble Chloride Calif. Test 422	0.017% (170ppm)
Bicarbonate (as $CaCO_3$) (In a saturated soil paste extract)	N/A

Note: N/A = Unable to determine due to the texture of the soil (Clay).

Laura Torres

Laura Torres
LT/ilv

LABORATORY REPORT

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CLARKSON LABORATORY AND SUPPLY INC.
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ANALYTICAL AND CONSULTING CHEMISTS

Date: May 25, 2017
Purchase Order Number: 44F1
Sales Order Number: 35882
Account Number: ALLG
To:

Allied Geotechnical Engineers
1810 Gillespie Way Ste 104
El Cajon, CA 92020
Attention: Sani Sutanto

Laboratory Number: SO6396-9 Customers Phone: 449-5900
Fax: 449-5902
Sample Designation:

One soil sample received on 05/18/17 at 11:30am, from North City Wastewater Treatment Plant Expansion marked as H-2#6@22-23'.

Analysis By California Test 643, 1999, Department of Transportation Division of Construction, Method for Estimating the Service Life of Steel Culverts.

pH 4.8

Water Added (ml)	Resistivity (ohm-cm)
10	5300
5	2500
5	1400
5	1000
5	930
5	1000
5	1200

5 years to perforation for a 16 gauge metal culvert.
7 years to perforation for a 14 gauge metal culvert.
10 years to perforation for a 12 gauge metal culvert.
12 years to perforation for a 10 gauge metal culvert.
15 years to perforation for a 8 gauge metal culvert.

Water Soluble Sulfate Calif. Test 417	0.013% (130ppm)
Water Soluble Chloride Calif. Test 422	0.019% (190ppm)
Bicarbonate (as $CaCO_3$) (In a 1:3 water extraction)	4ppm

Laura Torres

Laura Torres
LT/ram

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ANALYTICAL AND CONSULTING CHEMISTS

Date: June 14, 2017
Purchase Order Number: 44F1
Sales Order Number: 36150
Account Number: ALLG
To:

Allied Geotechnical Engineers
1810 Gillespie Way Ste 104
El Cajon, CA 92020
Attention: Sani Sutanto

Laboratory Number: SO6422-2 Customers Phone: 449-5900
Fax: 449-5902

Sample Designation:

One soil sample received on 06/09/17 at 9:20am, taken on 06/05/17 from North City Wastewater Treatment Plant Expansion Project#44F1 marked as H-3 #2@4'-5'.

Analysis By California Test 643, 1999, Department of Transportation Division of Construction, Method for Estimating the Service Life of Steel Culverts.

pH 5.7

Water Added (ml)	Resistivity (ohm-cm)
10	3200
5	1500
5	830
5	660
5	650
5	680
5	700

7 years to perforation for a 16 gauge metal culvert.
8 years to perforation for a 14 gauge metal culvert.
12 years to perforation for a 12 gauge metal culvert.
15 years to perforation for a 10 gauge metal culvert.
18 years to perforation for a 8 gauge metal culvert.

Water Soluble Sulfate Calif. Test 417	0.021% (210ppm)
Water Soluble Chloride Calif. Test 422	0.016% (160ppm)
Bicarbonate (as $CaCO_3$) (In a 1:3 water extraction)	6ppm

Laura Torres

Laura Torres
LT/ilv

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Date: May 25, 2017
Purchase Order Number: 44F1
Sales Order Number: 35882
Account Number: ALLG

To:
--
Allied Geotechnical Engineers
1810 Gillespie Way Ste 104
El Cajon, CA 92020
Attention: Sani Sutanto

Laboratory Number: SO6396-10 Customers Phone: 449-5900
Fax: 449-5902

Sample Designation:
--
One soil sample received on 05/18/17 at 11:30am, taken from North City Wastewater Treatment Plant Expansion marked as H-4#1@3-6'.

Analysis By California Test 643, 1999, Department of Transportation Division of Construction, Method for Estimating the Service Life of Steel Culverts.

pH 6.8

Water Added (ml)	Resistivity (ohm-cm)
10	2200
5	1100
5	620
5	560
5	550
5	570
5	590

14 years to perforation for a 16 gauge metal culvert.
18 years to perforation for a 14 gauge metal culvert.
25 years to perforation for a 12 gauge metal culvert.
32 years to perforation for a 10 gauge metal culvert.
39 years to perforation for a 8 gauge metal culvert.

Water Soluble Sulfate	Calif. Test 417	0.034% (340ppm)
Water Soluble Chloride	Calif. Test 422	0.030% (300ppm)
Bicarbonate (as $CaCO_3$) (In a 1:3 water extraction)		32ppm

Laura Torres

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Date: May 25, 2017
Purchase Order Number: 44F1
Sales Order Number: 35882
Account Number: ALLG

To:
--
Allied Geotechnical Engineers
1810 Gillespie Way Ste 104
El Cajon, CA 92020
Attention: Sani Sutanto

Laboratory Number: SO6396-11 Customers Phone: 449-5900
Fax: 449-5902

Sample Designation:
--
One soil sample received on 05/18/17 at 11:30am, taken from North City Wastewater Treatment Plant Expansion marked as H-4#5@17-18'.

Analysis By California Test 643, 1999, Department of Transportation Division of Construction, Method for Estimating the Service Life of Steel Culverts.

pH 10.5

Water Added (ml)	Resistivity (ohm-cm)
10	3700
5	1500
5	990
5	800
5	780
5	830
5	840

28 years to perforation for a 16 gauge metal culvert.
36 years to perforation for a 14 gauge metal culvert.
50 years to perforation for a 12 gauge metal culvert.
63 years to perforation for a 10 gauge metal culvert.
77 years to perforation for a 8 gauge metal culvert.

Water Soluble Sulfate Calif. Test 417	0.027% (270ppm)
Water Soluble Chloride Calif. Test 422	0.026% (260ppm)
Bicarbonate (as $CaCO_3$) (In a 1:3 water extraction)	12ppm

Laura Torres

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ANALYTICAL AND CONSULTING CHEMISTS

Date: June 14, 2017
Purchase Order Number: 44F1
Sales Order Number: 36150
Account Number: ALLG
To:

Allied Geotechnical Engineers
1810 Gillespie Way Ste 104
El Cajon, CA 92020
Attention: Sani Sutanto

Laboratory Number: SO6422-3 Customers Phone: 449-5900
Fax: 449-5902

Sample Designation:

One soil sample received on 06/09/17 at 9:20am, taken on 06/05/17 from North City Wastewater Treatment Plan Expansion Project#44F1 marked as H-5 #3@8'-9'.

Analysis By California Test 643, 1999, Department of Transportation Division of Construction, Method for Estimating the Service Life of Steel Culverts.

pH 7.1

Water Added (ml)	Resistivity (ohm-cm)
10	3400
5	1200
5	730
5	500
5	470
5	450
5	480
5	510

18 years to perforation for a 16 gauge metal culvert.
23 years to perforation for a 14 gauge metal culvert.
32 years to perforation for a 12 gauge metal culvert.
41 years to perforation for a 10 gauge metal culvert.
50 years to perforation for a 8 gauge metal culvert.

Water Soluble Sulfate Calif. Test 417	0.044% (440ppm)
Water Soluble Chloride Calif. Test 422	0.031% (310ppm)
Bicarbonate (as $CaCO_3$) (In a 1:3 water extraction)	30ppm

Laura Torres

Laura Torres
LT/ilv

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ANALYTICAL AND CONSULTING CHEMISTS

Date: June 14, 2017
Purchase Order Number: 44F1
Sales Order Number: 36150
Account Number: ALLG
To:

Allied Geotechnical Engineers
1810 Gillespie Way Ste 104
El Cajon, CA 92020
Attention: Sani Sutanto

Laboratory Number: SO6422-4 Customers Phone: 449-5900
Fax: 449-5902

Sample Designation:

One soil sample received on 06/09/17 at 9:20am, taken on 06/05/17 from North City Wastewater Treatment Plan Expansion Project#44F1 marked as H-5 #8@25'-28'.

Analysis By California Test 643, 1999, Department of Transportation Division of Construction, Method for Estimating the Service Life of Steel Culverts.

pH 7.3

Water Added (ml)	Resistivity (ohm-cm)
10	2900
5	1500
5	860
5	530
5	440
5	490
5	550

22 years to perforation for a 16 gauge metal culvert.
28 years to perforation for a 14 gauge metal culvert.
39 years to perforation for a 12 gauge metal culvert.
50 years to perforation for a 10 gauge metal culvert.
61 years to perforation for a 8 gauge metal culvert.

Water Soluble Sulfate	Calif. Test 417	0.021% (210ppm)
Water Soluble Chloride	Calif. Test 422	0.044% (440ppm)
Bicarbonate (as $CaCO_3$) (In a 1:3 water extraction)		14ppm

Laura Torres

Laura Torres
LT/ilv

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Date: June 16, 2017
Purchase Order Number: 44F1
Sales Order Number: 36150
Account Number: ALLG

To:
--
Allied Geotechnical Engineers
1810 Gillespie Way Ste 104
El Cajon, CA 92020
Attention: Sani Sutanto

Laboratory Number: SO6422-5 Customers Phone: 449-5900
Fax: 449-5902

Sample Designation:
--
One soil sample received on 06/09/17 at 9:20am, taken on 06/05/17 from North City Wastewater Treatment Plan Expansion Project#44F1 marked as H-6 #4@12'-13'.

Analysis By California Test 643, 1999, Department of Transportation Division of Construction, Method for Estimating the Service Life of Steel Culverts.

pH 7.9

Water Added (ml)	Resistivity (ohm-cm)
10	1500
5	730
5	530
5	500
5	450
5	410
5	440
5	470

21 years to perforation for a 16 gauge metal culvert.
28 years to perforation for a 14 gauge metal culvert.
38 years to perforation for a 12 gauge metal culvert.
49 years to perforation for a 10 gauge metal culvert.
59 years to perforation for a 8 gauge metal culvert.

Water Soluble Sulfate Calif. Test 417	0.108% (1080ppm)
Water Soluble Chloride Calif. Test 422	0.043% (430ppm)
Bicarbonate (as $CaCO_3$) (In a 1:3 water extraction)	27ppm

Rosa M. Bernal
RMB/ilv

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ANALYTICAL AND CONSULTING CHEMISTS

Date: May 25, 2017
Purchase Order Number: 44F1
Sales Order Number: 35882
Account Number: ALLG

To:

Allied Geotechnical Engineers
1810 Gillespie Way Ste 104
El Cajon, CA 92020
Attention: Sani Sutanto

Laboratory Number: SO6396-12 Customers Phone: 449-5900
Fax: 449-5902

Sample Designation:

One soil sample received on 05/18/17 at 11:30am, taken from North City Wastewater Treatment Plant Expansion marked as H-7#2@5-8'.

Analysis By California Test 643, 1999, Department of Transportation Division of Construction, Method for Estimating the Service Life of Steel Culverts.

pH 8.9

Water Added (ml)	Resistivity (ohm-cm)
10	5800
5	1800
5	1100
5	1100
5	1200
5	1500

32 years to perforation for a 16 gauge metal culvert.
41 years to perforation for a 14 gauge metal culvert.
57 years to perforation for a 12 gauge metal culvert.
73 years to perforation for a 10 gauge metal culvert.
89 years to perforation for a 8 gauge metal culvert.

Water Soluble Sulfate Calif. Test 417	0.014% (140ppm)
Water Soluble Chloride Calif. Test 422	0.006% (64ppm)
Bicarbonate (as $CaCO_3$) (In a 1:3 water extraction)	N/A

Note: N/A = Unable to determine due to the texture of the soil (Clay).

Laura Torres

Laura Torres
LT/ilv

LABORATORY REPORT

Telephone (619) 425-1993 Fax 425-7917 Established 1928

CLARKSON LABORATORY AND SUPPLY INC.
350 Trousdale Dr. Chula Vista, Ca. 91910 www.clarksonlab.com
ANALYTICAL AND CONSULTING CHEMISTS

Date: May 25, 2017
Purchase Order Number: 44F1
Sales Order Number: 35882
Account Number: ALLG

To:
--
Allied Geotechnical Engineers
1810 Gillespie Way Ste 104
El Cajon, CA 92020
Attention: Sani Sutanto

Laboratory Number: SO6396-13 Customers Phone: 449-5900
Fax: 449-5902

Sample Designation:
--
One soil sample received on 05/18/17 at 11:30am, taken from North City Wastewater Treatment Plant Expansion marked as H-7#4@13-14'.

Analysis By California Test 643, 1999, Department of Transportation Division of Construction, Method for Estimating the Service Life of Steel Culverts.

pH 8.9

Water Added (ml)	Resistivity (ohm-cm)
10	4500
5	2100
5	1100
5	950
5	970
5	1000
5	1100
5	1300

30 years to perforation for a 16 gauge metal culvert.
39 years to perforation for a 14 gauge metal culvert.
54 years to perforation for a 12 gauge metal culvert.
69 years to perforation for a 10 gauge metal culvert.
84 years to perforation for a 8 gauge metal culvert.

Water Soluble Sulfate Calif. Test 417	0.014% (140ppm)
Water Soluble Chloride Calif. Test 422	0.011% (110ppm)
Bicarbonate (as $CaCO_3$) (In a 1:3 water extraction)	N/A

Note: N/A = Unable to determine due to the texture of the soil (Clay).

Laura Torres

Laura Torres
LT/ilv

LABORATORY REPORT

Telephone (619) 425-1993 Fax 425-7917 Established 1928

CLARKSON LABORATORY AND SUPPLY INC.
350 Trousdale Dr. Chula Vista, Ca. 91910 www.clarksonlab.com
ANALYTICAL AND CONSULTING CHEMISTS

Date: June 16, 2017
Purchase Order Number: 44F1
Sales Order Number: 36150
Account Number: ALLG

To:
--
Allied Geotechnical Engineers
1810 Gillespie Way Ste 104
El Cajon, CA 92020
Attention: Sani Sutanto

Laboratory Number: SO6422-6 Customers Phone: 449-5900
Fax: 449-5902

Sample Designation:
--
One soil sample received on 06/09/17 at 9:20am, taken on 06/05/17 from North City Wastewater Treatment Plan Expansion Project#44F1 marked as H-8 #3@8'-9'.

Analysis By California Test 643, 1999, Department of Transportation Division of Construction, Method for Estimating the Service Life of Steel Culverts.

pH 7.9

Water Added (ml)	Resistivity (ohm-cm)
10	880
5	490
5	340
5	330
5	300
5	290
5	310
5	320

18 years to perforation for a 16 gauge metal culvert.
24 years to perforation for a 14 gauge metal culvert.
33 years to perforation for a 12 gauge metal culvert.
42 years to perforation for a 10 gauge metal culvert.
52 years to perforation for a 8 gauge metal culvert.

Water Soluble Sulfate Calif. Test 417	0.050% (500ppm)
Water Soluble Chloride Calif. Test 422	0.117% (1170ppm)
Bicarbonate (as $CaCO_3$) (In a 1:3 water extraction)	24ppm

Rosa M. Bernal
RMB/ilv

LABORATORY REPORT

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ANALYTICAL AND CONSULTING CHEMISTS

Date: June 15, 2017
Purchase Order Number: 44F1
Sales Order Number: 36150
Account Number: ALLG
To:

Allied Geotechnical Engineers
1810 Gillespie Way Ste 104
El Cajon, CA 92020
Attention: Sani Sutanto

Laboratory Number: SO6422-7 Customers Phone: 449-5900
Fax: 449-5902

Sample Designation:

One soil sample received on 06/09/17 at 9:20am, taken on 06/05/17 from North City Wastewater Treatment Plan Expansion Project#44F1 marked as H-9 #4@14'-15'

Analysis By California Test 643, 1999, Department of Transportation Division of Construction, Method for Estimating the Service Life of Steel Culverts.

pH 7.9

Water Added (ml)	Resistivity (ohm-cm)
10	4200
5	2400
5	1400
5	980
5	870
5	840
5	860
5	890

28 years to perforation for a 16 gauge metal culvert.
37 years to perforation for a 14 gauge metal culvert.
51 years to perforation for a 12 gauge metal culvert.
65 years to perforation for a 10 gauge metal culvert.
80 years to perforation for a 8 gauge metal culvert.

Water Soluble Sulfate Calif. Test 417	0.015% (150ppm)
Water Soluble Chloride Calif. Test 422	0.013% (130ppm)
Bicarbonate (as $CaCO_3$) (In a 1:3 water extraction)	28ppm

Laura Torres

Laura Torres
LT/dbb

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ANALYTICAL AND CONSULTING CHEMISTS

Date: June 15, 2017
Purchase Order Number: 44F1
Sales Order Number: 36150
Account Number: ALLG
To:

Allied Geotechnical Engineers
1810 Gillespie Way Ste 104
El Cajon, CA 92020
Attention: Sani Sutanto

Laboratory Number: SO6422-8 Customers Phone: 449-5900
Fax: 449-5902

Sample Designation:

One soil sample received on 06/09/17 at 9:20am, taken on 06/05/17 from North City Wastewater Treatment Plan Expansion Project#44F1 marked as H-9 #15@55'-59'

Analysis By California Test 643, 1999, Department of Transportation Division of Construction, Method for Estimating the Service Life of Steel Culverts.

pH 8.3

Water Added (ml)	Resistivity (ohm-cm)
10	3300
5	2000
5	1200
5	800
5	690
5	680
5	730
5	760

26 years to perforation for a 16 gauge metal culvert.
34 years to perforation for a 14 gauge metal culvert.
47 years to perforation for a 12 gauge metal culvert.
60 years to perforation for a 10 gauge metal culvert.
73 years to perforation for a 8 gauge metal culvert.

Water Soluble Sulfate Calif. Test 417	0.016% (160ppm)
Water Soluble Chloride Calif. Test 422	0.019% (190ppm)
Bicarbonate (as $CaCO_3$) (In a 1:3 water extraction)	52ppm

Laura Torres

Laura Torres
LT/dbb

LABORATORY REPORT

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ANALYTICAL AND CONSULTING CHEMISTS

Date: June 15, 2017
Purchase Order Number: 44F1
Sales Order Number: 36150
Account Number: ALLG
To:

Allied Geotechnical Engineers
1810 Gillespie Way Ste 104
El Cajon, CA 92020
Attention: Sani Sutanto

Laboratory Number: SO6422-9 Customers Phone: 449-5900
Fax: 449-5902

Sample Designation:

One soil sample received on 06/09/17 at 9:20am, taken on 06/05/17 from North City Wastewater Treatment Plan Expansion Project#44F1 marked as H-10 #3@7'-8'

Analysis By California Test 643, 1999, Department of Transportation Division of Construction, Method for Estimating the Service Life of Steel Culverts.

pH 7.9

Water Added (ml)	Resistivity (ohm-cm)
10	6700
5	2800
5	1000
5	840
5	880
5	920
5	970

28 years to perforation for a 16 gauge metal culvert.
37 years to perforation for a 14 gauge metal culvert.
51 years to perforation for a 12 gauge metal culvert.
65 years to perforation for a 10 gauge metal culvert.
80 years to perforation for a 8 gauge metal culvert.

Water Soluble Sulfate Calif. Test 417	0.018% (180ppm)
Water Soluble Chloride Calif. Test 422	0.009% (90ppm)
Bicarbonate (as $CaCO_3$) (In a 1:3 water extraction)	50ppm

Laura Torres

Laura Torres
LT/dbb

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ANALYTICAL AND CONSULTING CHEMISTS

Date: June 15, 2017
Purchase Order Number: 44F1
Sales Order Number: 36150
Account Number: ALLG
To:
--
Allied Geotechnical Engineers
1810 Gillespie Way Ste 104
El Cajon, CA 92020
Attention: Sani Sutanto

Laboratory Number: SO6422-10 Customers Phone: 449-5900
Fax: 449-5902

Sample Designation:
--
One soil sample received on 06/09/17 at 9:20am, taken on 06/05/17 from North City Wastewater Treatment Plan Expansion Project#44F1 marked as H-10 #11@40'-43'

Analysis By California Test 643, 1999, Department of Transportation Division of Construction, Method for Estimating the Service Life of Steel Culverts.

pH 8.2

Water Added (ml)	Resistivity (ohm-cm)
10	4000
5	2100
5	1100
5	920
5	770
5	750
5	790
5	810

27 years to perforation for a 16 gauge metal culvert.
35 years to perforation for a 14 gauge metal culvert.
49 years to perforation for a 12 gauge metal culvert.
62 years to perforation for a 10 gauge metal culvert.
76 years to perforation for a 8 gauge metal culvert.

Water Soluble Sulfate Calif. Test 417 0.034% (340ppm)

Water Soluble Chloride Calif. Test 422 0.014% (140ppm)

Bicarbonate (as $CaCO_3$) 48ppm
(In a 1:3 water extraction)

Laura Torres

Laura Torres
LT/dbb

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ANALYTICAL AND CONSULTING CHEMISTS

Date: May 24, 2017
Purchase Order Number: 44F1
Sales Order Number: 35882
Account Number: ALLG

To:
--
Allied Geotechnical Engineers
1810 Gillespie Way Ste 104
El Cajon, CA 92020
Attention: Sani Sutanto

Laboratory Number: SO6396-1 Customers Phone: 449-5900
Fax: 449-5902

Sample Designation:
--
One soil sample received on 05/18/17 at 11:30am, taken from North City Wastewater Treatment Plant Expansion marked as H-11#3@12-13'.

Analysis By California Test 643, 1999, Department of Transportation Division of Construction, Method for Estimating the Service Life of Steel Culverts.

pH 8.2

Water Added (ml)	Resistivity (ohm-cm)
20	1200
5	870
5	610
5	600
5	590
5	590
5	580
5	610
5	630

24 years to perforation for a 16 gauge metal culvert.
32 years to perforation for a 14 gauge metal culvert.
44 years to perforation for a 12 gauge metal culvert.
56 years to perforation for a 10 gauge metal culvert.
68 years to perforation for a 8 gauge metal culvert.

Water Soluble Sulfate Calif. Test 417 0.020% (200ppm)

Water Soluble Chloride Calif. Test 422 0.023% (230ppm)

Bicarbonate (as $CaCO_3$) 54ppm
(In a 1:3 water extraction)

Laura Torres

Laura Torres
LT/ilv

LABORATORY REPORT

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ANALYTICAL AND CONSULTING CHEMISTS

Date: May 24, 2017
Purchase Order Number: 44F1
Sales Order Number: 35882
Account Number: ALLG

To:

Allied Geotechnical Engineers
1810 Gillespie Way Ste 104
El Cajon, CA 92020
Attention: Sani Sutanto

Laboratory Number: SO6396-2 Customers Phone: 449-5900
Fax: 449-5902

Sample Designation:

One soil sample received on 05/18/17 at 11:30am, taken from North City Wastewater Treatment Plant Expansion marked as H-11#10@37-38'.

Analysis By California Test 643, 1999, Department of Transportation Division of Construction, Method for Estimating the Service Life of Steel Culverts.

pH 7.9

Water Added (ml)	Resistivity (ohm-cm)
10	3600
5	1800
5	900
5	640
5	470
5	450
5	440
5	450
5	480

22 years to perforation for a 16 gauge metal culvert.
28 years to perforation for a 14 gauge metal culvert.
39 years to perforation for a 12 gauge metal culvert.
50 years to perforation for a 10 gauge metal culvert.
61 years to perforation for a 8 gauge metal culvert.

Water Soluble Sulfate Calif. Test 417	0.028% (280ppm)
Water Soluble Chloride Calif. Test 422	0.056% (560ppm)
Bicarbonate (as $CaCO_3$) (In a 1:3 water extraction)	48ppm

Laura Torres
____
Laura Torres
LT/ilv

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Date: May 24, 2017
Purchase Order Number: 44F1
Sales Order Number: 35882
Account Number: ALLG

To:

Allied Geotechnical Engineers
1810 Gillespie Way Ste 104
El Cajon, CA 92020
Attention: Sani Sutanto

Laboratory Number: SO6396-3 Customers Phone: 449-5900
Fax: 449-5902

Sample Designation:

One soil sample received on 05/18/17 at 11:30am, taken from North City Wastewater Treatment Plant Expansion marked as H-12#4@12-13'.

Analysis By California Test 643, 1999, Department of Transportation Division of Construction, Method for Estimating the Service Life of Steel Culverts.

pH 8.2

Water Added (ml)	Resistivity (ohm-cm)
10	3500
5	1500
5	870
5	560
5	450
5	420
5	440
5	460

21 years to perforation for a 16 gauge metal culvert.
28 years to perforation for a 14 gauge metal culvert.
39 years to perforation for a 12 gauge metal culvert.
49 years to perforation for a 10 gauge metal culvert.
60 years to perforation for a 8 gauge metal culvert.

Water Soluble Sulfate Calif. Test 417 0.034% (340ppm)

Water Soluble Chloride Calif. Test 422 0.043% (430ppm)

Bicarbonate (as $CaCO_3$) 54ppm
(In a 1:3 water extraction)

Laura Torres

Laura Torres
LT/ilv

LABORATORY REPORT

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ANALYTICAL AND CONSULTING CHEMISTS

Date: June 15, 2017
Purchase Order Number: 44F1
Sales Order Number: 36150
Account Number: ALLG
To:

Allied Geotechnical Engineers
1810 Gillespie Way Ste 104
El Cajon, CA 92020
Attention: Sani Sutanto

Laboratory Number: SO6422-11 Customers Phone: 449-5900
Fax: 449-5902

Sample Designation:

One soil sample received on 06/09/17 at 9:20am, taken on 06/05/17 from North City Wastewater Treatment Plan Expansion Project#44F1 marked as H-13 #4@12'-13'

Analysis By California Test 643, 1999, Department of Transportation Division of Construction, Method for Estimating the Service Life of Steel Culverts.

pH 8.9

Water Added (ml)	Resistivity (ohm-cm)
10	2100
5	1100
5	720
5	490
5	410
5	400
5	420
5	440

21 years to perforation for a 16 gauge metal culvert.
27 years to perforation for a 14 gauge metal culvert.
38 years to perforation for a 12 gauge metal culvert.
48 years to perforation for a 10 gauge metal culvert.
59 years to perforation for a 8 gauge metal culvert.

Water Soluble Sulfate	Calif. Test 417	0.045% (450ppm)
Water Soluble Chloride	Calif. Test 422	0.047% (470ppm)
Bicarbonate (as $CaCO_3$) (In a 1:3 water extraction)		22ppm

Laura Torres

Laura Torres
LT/dbb

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350 Trousdale Dr. Chula Vista, Ca. 91910 www.clarksonlab.com
ANALYTICAL AND CONSULTING CHEMISTS

Date: June 16, 2017
Purchase Order Number: 44F1
Sales Order Number: 36150
Account Number: ALLG

To:

Allied Geotechnical Engineers
1810 Gillespie Way Ste 104
El Cajon, CA 92020
Attention: Sani Sutanto

Laboratory Number: SO6422-12 Customers Phone: 449-5900
Fax: 449-5902

Sample Designation:

One soil sample received on 06/09/17 at 9:20am, taken on 06/05/17 from North City Wastewater Treatment Plan Expansion Project#44F1 marked as H-13 #9@33'-34'.

Analysis By California Test 643, 1999, Department of Transportation Division of Construction, Method for Estimating the Service Life of Steel Culverts.

pH 8.3

Water Added (ml)	Resistivity (ohm-cm)
10	1600
5	900
5	570
5	300
5	330
5	350

19 years to perforation for a 16 gauge metal culvert.
24 years to perforation for a 14 gauge metal culvert.
34 years to perforation for a 12 gauge metal culvert.
43 years to perforation for a 10 gauge metal culvert.
52 years to perforation for a 8 gauge metal culvert.

Water Soluble Sulfate Calif. Test 417	0.024% (240ppm)
Water Soluble Chloride Calif. Test 422	0.080% (800ppm)
Bicarbonate (as $CaCO_3$) (In a 1:3 water extraction)	30ppm

Rosa M. Bernal
RMB/ilv

LABORATORY REPORT

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ANALYTICAL AND CONSULTING CHEMISTS

Date: May 24, 2017
Purchase Order Number: 44F1
Sales Order Number: 35882
Account Number: ALLG

To:
--
Allied Geotechnical Engineers
1810 Gillespie Way Ste 104
El Cajon, CA 92020
Attention: Sani Sutanto

Laboratory Number: SO6396-4 Customers Phone: 449-5900
Fax: 449-5902

Sample Designation:
--
One soil sample received on 05/18/17 at 11:30am, taken from North City Wastewater Treatment Plant Expansion marked as H-14#3@9-10'.

Analysis By California Test 643, 1999, Department of Transportation Division of Construction, Method for Estimating the Service Life of Steel Culverts.

pH 7.8

Water Added (ml)	Resistivity (ohm-cm)
10	2500
5	1100
5	580
5	390
5	320
5	350
5	370

19 years to perforation for a 16 gauge metal culvert.
25 years to perforation for a 14 gauge metal culvert.
34 years to perforation for a 12 gauge metal culvert.
44 years to perforation for a 10 gauge metal culvert.
54 years to perforation for a 8 gauge metal culvert.

Water Soluble Sulfate Calif. Test 417	0.032% (320ppm)
Water Soluble Chloride Calif. Test 422	0.068% (680ppm)
Bicarbonate (as $CaCO_3$) (In a 1:3 water extraction)	46ppm

Laura Torres

Laura Torres
LT/ilv

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ANALYTICAL AND CONSULTING CHEMISTS

Date: May 24, 2017
Purchase Order Number: 44F1
Sales Order Number: 35882
Account Number: ALLG

To:

Allied Geotechnical Engineers
1810 Gillespie Way Ste 104
El Cajon, CA 92020
Attention: Sani Sutanto

Laboratory Number: SO6396-5 Customers Phone: 449-5900
Fax: 449-5902

Sample Designation:

One soil sample received on 05/18/17 at 11:30am, taken from North City Wastewater Treatment Plant Expansion marked as H-14#8@25-26'.

Analysis By California Test 643, 1999, Department of Transportation Division of Construction, Method for Estimating the Service Life of Steel Culverts.

pH 7.8

Water Added (ml)	Resistivity (ohm-cm)
10	3000
5	1400
5	770
5	500
5	400
5	350
5	380
5	400

20 years to perforation for a 16 gauge metal culvert.
26 years to perforation for a 14 gauge metal culvert.
36 years to perforation for a 12 gauge metal culvert.
46 years to perforation for a 10 gauge metal culvert.
56 years to perforation for a 8 gauge metal culvert.

Water Soluble Sulfate Calif. Test 417	0.023% (230ppm)
Water Soluble Chloride Calif. Test 422	0.042% (420ppm)
Bicarbonate (as $CaCO_3$) (In a 1:3 water extraction)	44ppm

Laura Torres

Laura Torres
LT/ilv

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ANALYTICAL AND CONSULTING CHEMISTS

Date: May 24, 2017
Purchase Order Number: 44F1
Sales Order Number: 35882
Account Number: ALLG

To:

Allied Geotechnical Engineers
1810 Gillespie Way Ste 104
El Cajon, CA 92020
Attention: Sani Sutanto

Laboratory Number: SO6396-6 Customers Phone: 449-5900
Fax: 449-5902

Sample Designation:

One soil sample received on 05/18/17 at 11:30am, taken from North City Wastewater Treatment Plant Expansion marked as H-14#17@56-59'.

Analysis By California Test 643, 1999, Department of Transportation Division of Construction, Method for Estimating the Service Life of Steel Culverts.

pH 7.7

Water Added (ml)	Resistivity (ohm-cm)
10	3100
5	1400
5	670
5	410
5	320
5	290
5	330
5	370

18 years to perforation for a 16 gauge metal culvert.
24 years to perforation for a 14 gauge metal culvert.
33 years to perforation for a 12 gauge metal culvert.
42 years to perforation for a 10 gauge metal culvert.
52 years to perforation for a 8 gauge metal culvert.

Water Soluble Sulfate Calif. Test 417 0.342% (3420ppm)

Water Soluble Chloride Calif. Test 422 0.085% (850ppm)

Bicarbonate (as $CaCO_3$) 26ppm
(In a 1:3 water extraction)

Laura Torres

Laura Torres
LT/ilv

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ANALYTICAL AND CONSULTING CHEMISTS

Date: May 24, 2017
Purchase Order Number: 44F1
Sales Order Number: 35882
Account Number: ALLG

To:

Allied Geotechnical Engineers
1810 Gillespie Way Ste 104
El Cajon, CA 92020
Attention: Sani Sutanto

Laboratory Number: SO6396-7 Customers Phone: 449-5900
Fax: 449-5902

Sample Designation:

One soil sample received on 05/18/17 at 11:30am, taken from North City Wastewater Treatment Plant Expansion marked as H-15#4@12-13'.

Analysis By California Test 643, 1999, Department of Transportation Division of Construction, Method for Estimating the Service Life of Steel Culverts.

pH 8.3

Water Added (ml)	Resistivity (ohm-cm)
10	4600
5	3400
5	1300
5	780
5	590
5	530
5	520
5	590
5	640

23 years to perforation for a 16 gauge metal culvert.
30 years to perforation for a 14 gauge metal culvert.
42 years to perforation for a 12 gauge metal culvert.
54 years to perforation for a 10 gauge metal culvert.
65 years to perforation for a 8 gauge metal culvert.

Water Soluble Sulfate Calif. Test 417	0.019% (190ppm)
Water Soluble Chloride Calif. Test 422	0.030% (300ppm)
Bicarbonate (as $CaCO_3$) (In a 1:3 water extraction)	57ppm

Laura Torres

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LT/ilv

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ANALYTICAL AND CONSULTING CHEMISTS

Date: June 15, 2017
Purchase Order Number: 44F1
Sales Order Number: 36150
Account Number: ALLG
To:
--
Allied Geotechnical Engineers
1810 Gillespie Way Ste 104
El Cajon, CA 92020
Attention: Sani Sutanto

Laboratory Number: SO6422-13 Customers Phone: 449-5900
Fax: 449-5902
Sample Designation:
--
One soil sample received on 06/09/17 at 9:20am, taken on 06/05/17 from North City Wastewater Treatment Plan Expansion Project#44F1 marked as H-16 #3@12'-13'

Analysis By California Test 643, 1999, Department of Transportation Division of Construction, Method for Estimating the Service Life of Steel Culverts.

pH 8.3

Water Added (ml)	Resistivity (ohm-cm)
10	2800
5	1300
5	720
5	480
5	370
5	390
5	420

20 years to perforation for a 16 gauge metal culvert.
26 years to perforation for a 14 gauge metal culvert.
37 years to perforation for a 12 gauge metal culvert.
47 years to perforation for a 10 gauge metal culvert.
57 years to perforation for a 8 gauge metal culvert.

Water Soluble Sulfate	Calif. Test 417	0.027% (270ppm)
Water Soluble Chloride	Calif. Test 422	0.050% (500ppm)
Bicarbonate (as $CaCO_3$) (In a 1:3 water extraction)		26ppm

Laura Torres

Laura Torres
LT/dbb

LABORATORY REPORT

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350 Trousdale Dr. Chula Vista, Ca. 91910 www.clarksonlab.com
ANALYTICAL AND CONSULTING CHEMISTS

Date: May 25, 2017
Purchase Order Number: 44F1
Sales Order Number: 35882
Account Number: ALLG
To:

Allied Geotechnical Engineers
1810 Gillespie Way Ste 104
El Cajon, CA 92020
Attention: Sani Sutanto

Laboratory Number: SO6396-14 Customers Phone: 449-5900
Fax: 449-5902

Sample Designation:

One soil sample received on 05/18/17 at 11:30am, taken from North City Wastewater Treatment Plant Expansion marked as H-17#1@1-2'.

Analysis By California Test 643, 1999, Department of Transportation Division of Construction, Method for Estimating the Service Life of Steel Culverts.

pH 7.7

Water Added (ml)	Resistivity (ohm-cm)
10	5500
5	2500
5	1000
5	660
5	560
5	520
5	500
5	530
5	550

23 years to perforation for a 16 gauge metal culvert.
30 years to perforation for a 14 gauge metal culvert.
41 years to perforation for a 12 gauge metal culvert.
53 years to perforation for a 10 gauge metal culvert.
64 years to perforation for a 8 gauge metal culvert.

Water Soluble Sulfate Calif. Test 417	0.014% (140ppm)
Water Soluble Chloride Calif. Test 422	0.004% (43ppm)
Bicarbonate (as $CaCO_3$) (In a 1:3 water extraction)	N/A

Note: N/A = Unable to determine due to the texture of the soil (Clay).

Laura Torres

Laura Torres
LT/ilv

LABORATORY REPORT

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CLARKSON LABORATORY AND SUPPLY INC.
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ANALYTICAL AND CONSULTING CHEMISTS

Date: May 24, 2017
Purchase Order Number: 44F1
Sales Order Number: 35882
Account Number: ALLG

To:

Allied Geotechnical Engineers
1810 Gillespie Way Ste 104
El Cajon, CA 92020
Attention: Sani Sutanto

Laboratory Number: SO6396-8 Customers Phone: 449-5900
Fax: 449-5902

Sample Designation:

One soil sample received on 05/18/17 at 11:30am, taken from North City Wastewater Treatment Plant Expansion marked as H-18#2@7-8'.

Analysis By California Test 643, 1999, Department of Transportation Division of Construction, Method for Estimating the Service Life of Steel Culverts.

pH 8.1

Water Added (ml)	Resistivity (ohm-cm)
10	3100
5	1500
5	840
5	450
5	350
5	300
5	340
5	370

19 years to perforation for a 16 gauge metal culvert.
24 years to perforation for a 14 gauge metal culvert.
34 years to perforation for a 12 gauge metal culvert.
43 years to perforation for a 10 gauge metal culvert.
52 years to perforation for a 8 gauge metal culvert.

Water Soluble Sulfate Calif. Test 417	0.095% (950ppm)
Water Soluble Chloride Calif. Test 422	0.062% (620ppm)
Bicarbonate (as $CaCO_3$) (In a 1:3 water extraction)	70ppm

Laura Torres

Laura Torres
LT/ilv

LABORATORY REPORT

Telephone (619) 425-1993 Fax 425-7917 Established 1928

CLARKSON LABORATORY AND SUPPLY INC.
350 Trousdale Dr. Chula Vista, Ca. 91910 www.clarksonlab.com
ANALYTICAL AND CONSULTING CHEMISTS

Date: June 16, 2017
Purchase Order Number: 44F1
Sales Order Number: 36150
Account Number: ALLG

To:

Allied Geotechnical Engineers
1810 Gillespie Way Ste 104
El Cajon, CA 92020
Attention: Sani Sutanto

Laboratory Number: SO6422-14 Customers Phone: 449-5900
Fax: 449-5902

Sample Designation:

One soil sample received on 06/09/17 at 9:20am, taken on 06/05/17 from North City Wastewater Treatment Plan Expansion Project#44F1 marked as H-19 #2@7'-8'.

Analysis By California Test 643, 1999, Department of Transportation Division of Construction, Method for Estimating the Service Life of Steel Culverts.

pH 8.2

Water Added (ml)	Resistivity (ohm-cm)
10	1300
5	830
5	620
5	480
5	510
5	530

23 years to perforation for a 16 gauge metal culvert.
29 years to perforation for a 14 gauge metal culvert.
41 years to perforation for a 12 gauge metal culvert.
52 years to perforation for a 10 gauge metal culvert.
63 years to perforation for a 8 gauge metal culvert.

Water Soluble Sulfate Calif. Test 417	0.054% (540ppm)
Water Soluble Chloride Calif. Test 422	0.031% (310ppm)
Bicarbonate (as $CaCO_3$) (In a 1:3 water extraction)	18ppm

Rosa M. Bernal
RMB/ilv

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ANALYTICAL AND CONSULTING CHEMISTS

Date: June 16, 2017
Purchase Order Number: 44F1
Sales Order Number: 36150
Account Number: ALLG

To:

Allied Geotechnical Engineers
1810 Gillespie Way Ste 104
El Cajon, CA 92020
Attention: Sani Sutanto

Laboratory Number: SO6422-18 Customers Phone: 449-5900
Fax: 449-5902

Sample Designation:

One soil sample received on 06/09/17 at 9:20am, taken on 06/05/17 from North City Wastewater Treatment Plan Expansion Project#44F1 marked as H-20 #3@8'-9'.

Analysis By California Test 643, 1999, Department of Transportation Division of Construction, Method for Estimating the Service Life of Steel Culverts.

pH 6.4

Water Added (ml)	Resistivity (ohm-cm)
10	1100
5	640
5	430
5	320
5	300
5	280
5	340
5	390

Less than 5 years to perforation for a 16 gauge metal culvert.
6 years to perforation for a 14 gauge metal culvert.
9 years to perforation for a 12 gauge metal culvert.
11 years to perforation for a 10 gauge metal culvert.
14 years to perforation for a 8 gauge metal culvert.

Water Soluble Sulfate Calif. Test 417 0.022% (220ppm)

Water Soluble Chloride Calif. Test 422 0.107% (1070ppm)

Bicarbonate (as $CaCO_3$) 8ppm
(In a 1:3 water extraction)

Rosa M. Bernal
RMB/ilv

LABORATORY REPORT

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ANALYTICAL AND CONSULTING CHEMISTS

Date: June 16, 2017
Purchase Order Number: 44F1
Sales Order Number: 36150
Account Number: ALLG

To:

Allied Geotechnical Engineers
1810 Gillespie Way Ste 104
El Cajon, CA 92020
Attention: Sani Sutanto

Laboratory Number: SO6422-15 Customers Phone: 449-5900
Fax: 449-5902

Sample Designation:

One soil sample received on 06/09/17 at 9:20am, taken on 06/05/17 from North City Wastewater Treatment Plan Expansion Project#44F1 marked as H-21 #4@13'-14'.

Analysis By California Test 643, 1999, Department of Transportation Division of Construction, Method for Estimating the Service Life of Steel Culverts.

pH 7.3

Water Added (ml)	Resistivity (ohm-cm)
10	1500
5	920
5	580
5	460
5	430
5	480
5	560

28 years to perforation for a 16 gauge metal culvert.
36 years to perforation for a 14 gauge metal culvert.
50 years to perforation for a 12 gauge metal culvert.
64 years to perforation for a 10 gauge metal culvert.
78 years to perforation for a 8 gauge metal culvert.

Water Soluble Sulfate Calif. Test 417	0.029% (290ppm)
Water Soluble Chloride Calif. Test 422	0.045% (450ppm)
Bicarbonate (as $CaCO_3$) (In a 1:3 water extraction)	8ppm

Rosa M. Bernal
RMB/ilv

LABORATORY REPORT

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ANALYTICAL AND CONSULTING CHEMISTS

Date: June 16, 2017
Purchase Order Number: 44F1
Sales Order Number: 36150
Account Number: ALLG

To:

Allied Geotechnical Engineers
1810 Gillespie Way Ste 104
El Cajon, CA 92020
Attention: Sani Sutanto

Laboratory Number: SO6422-16 Customers Phone: 449-5900
Fax: 449-5902

Sample Designation:

One soil sample received on 06/09/17 at 9:20am, taken on 06/05/17 from North City Wastewater Treatment Plan Expansion Project#44F1 marked as H-22 #2@9'-10'.

Analysis By California Test 643, 1999, Department of Transportation Division of Construction, Method for Estimating the Service Life of Steel Culverts.

pH 6.9

Water Added (ml)	Resistivity (ohm-cm)
15	680
5	370
5	300
5	250
5	230
5	220
5	220
5	240
5	270

8 years to perforation for a 16 gauge metal culvert.
10 years to perforation for a 14 gauge metal culvert.
14 years to perforation for a 12 gauge metal culvert.
18 years to perforation for a 10 gauge metal culvert.
21 years to perforation for a 8 gauge metal culvert.

Water Soluble Sulfate Calif. Test 417	0.043% (430ppm)
Water Soluble Chloride Calif. Test 422	0.144% (1440ppm)
Bicarbonate (as $CaCO_3$) (In a 1:3 water extraction)	11ppm

Rosa M. Bernal
RMB/ilv

LABORATORY REPORT

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350 Trousdale Dr. Chula Vista, Ca. 91910 www.clarksonlab.com
ANALYTICAL AND CONSULTING CHEMISTS

Date: June 15, 2017
Purchase Order Number: 44F1
Sales Order Number: 36150
Account Number: ALLG
To:

Allied Geotechnical Engineers
1810 Gillespie Way Ste 104
El Cajon, CA 92020
Attention: Sani Sutanto

Laboratory Number: SO6422-17 Customers Phone: 449-5900
Fax: 449-5902
Sample Designation:

One soil sample received on 06/09/17 at 9:20am, taken on 06/05/17 from North City Wastewater Treatment Plan Expansion Project#44F1 marked as H-22 #10@35'-40'

Analysis By California Test 643, 1999, Department of Transportation Division of Construction, Method for Estimating the Service Life of Steel Culverts.

pH 7.4

Water Added (ml)	Resistivity (ohm-cm)
10	1700
5	1100
5	630
5	410
5	280
5	310
5	360

18 years to perforation for a 16 gauge metal culvert.
24 years to perforation for a 14 gauge metal culvert.
33 years to perforation for a 12 gauge metal culvert.
42 years to perforation for a 10 gauge metal culvert.
51 years to perforation for a 8 gauge metal culvert.

Water Soluble Sulfate Calif. Test 417	0.020% (200ppm)
Water Soluble Chloride Calif. Test 422	0.096% (960ppm)
Bicarbonate (as $CaCO_3$) (In a 1:3 water extraction)	6ppm

Laura Torres

Laura Torres
LT/ram

APPENDIX C

ANALYSES AND CALCULATIONS

APPENDIX C.1

SHEAR WAVE ANALYSIS CALCULATIONS

Boring H-1

Depth (ft)	N60 (BPF)	VS(fps)	Vsint (fps)	Vsover (fps)
5	30	1264.14213	1264.142134	1264.142134
10	50	1474.77317	1369.45765	1369.45765
15	50	1450.76562	1462.769394	1396.560307
20	50	1426.75808	1438.761849	1404.10975
25	50	1402.75053	1414.754305	1403.837906
30	50	1378.74299	1390.74676	1399.65542
35	50	1354.73544	1366.739216	1393.23828
40	50	1330.7279	1342.731671	1385.424483
45	50	1306.72035	1318.724127	1376.679579
50	50	1282.71281	1294.716582	1367.282903
55	50	1258.70527	1270.709038	1357.412208
60	50	1234.69772	1246.701493	1347.186001
65	50	1210.69018	1222.693949	1336.686322
70	50	1186.68263	1198.686404	1325.971773
75	50	1162.67509	1174.67886	1315.085327
80	50	1138.66754	1150.671315	1304.059216

Boring H-2

Depth (ft)	N60 (BPF)	VS(fps)	Vsint (fps)	Vsover (fps)
5	50	1498.781	1498.78071	1498.78071
10	21	1104.471	1301.625726	1301.625726
15	41	1357.911	1231.191037	1320.387594
20	50	1426.758	1392.334704	1346.980215
25	50	1402.751	1414.754305	1358.134279
30	50	1378.743	1390.74676	1361.569063
35	50	1354.735	1366.739216	1360.592832
40	50	1330.728	1342.731671	1356.859715
45	50	1306.72	1318.724127	1351.288675
50	50	1282.713	1294.716582	1344.431089

Boring H-3

Depth (ft)	N60 (BPF)	VS(fps)	Vsint (fps)	Vsover (fps)
5	50	1498.781	1498.78071	1498.78071
10	50	1474.773	1486.776938	1486.776938
15	50	1450.766	1462.769394	1474.773166
20	50	1426.758	1438.761849	1462.769394
25	50	1402.751	1414.754305	1450.765621
30	50	1378.743	1390.74676	1438.761849
35	50	1354.735	1366.739216	1426.758077
40	50	1330.728	1342.731671	1414.754305
45	50	1306.72	1318.724127	1402.750532
50	50	1282.713	1294.716582	1390.74676
55	50	1258.705	1270.709038	1378.742988
60	50	1234.698	1246.701493	1366.739216
65	50	1210.69	1222.693949	1354.735443
70	50	1186.683	1198.686404	1342.731671
75	50	1162.675	1174.67886	1330.727899
80	50	1138.668	1150.671315	1318.724127

Boring H-4

Depth (ft)	N60 (BPF)	VS(fps)	Vsint (fps)	Vsover (fps)
5	50	1498.78071	1498.78071	1498.78071
10	50	1474.77317	1486.776938	1486.776938
15	50	1450.76562	1462.769394	1474.773166
20	50	1426.75808	1438.761849	1462.769394
25	50	1402.75053	1414.754305	1450.765621
30	50	1378.74299	1390.74676	1438.761849
35	50	1354.73544	1366.739216	1426.758077
40	50	1330.7279	1342.731671	1414.754305
45	50	1306.72035	1318.724127	1402.750532
50	50	1282.71281	1294.716582	1390.74676

Boring H-5

Depth (ft)	N60 (BPF)	VS(fps)	Vsint (fps)	Vsover (fps)
5	44	1436.264	1436.263651	1436.263651
10	23	1138.472	1287.367902	1287.367902
15	47	1421.153	1279.812467	1331.962862
20	50	1426.758	1423.955429	1355.661665
25	50	1402.751	1414.754305	1365.079439
30	50	1378.743	1390.74676	1367.356697
35	50	1354.735	1366.739216	1365.553661
40	50	1330.728	1342.731671	1361.200441
45	50	1306.72	1318.724127	1355.147098
50	50	1282.713	1294.716582	1347.903669

Boring H-6

Depth (ft)	N60 (BPF)	VS(fps)	Vsint (fps)	Vsover (fps)
5	18	1066.237	1066.236925	1066.236925
10	37	1333.952	1200.094396	1200.094396
15	33	1263.139	1298.545586	1221.109365
20	42	1346.209	1304.674364	1252.38438
25	44	1344.239	1345.22425	1270.755319
30	50	1378.743	1361.491033	1288.753264
35	50	1354.735	1366.739216	1298.17929
40	50	1330.728	1342.731671	1302.247866
45	50	1306.72	1318.724127	1302.744809
50	50	1282.713	1294.716582	1300.741609

Boring H-7

Depth (ft)	N60 (BPF)	VS(fps)	Vsint (fps)	Vsover (fps)
5	7	778.292005	778.2920052	778.2920052
10	50	1474.77317	1126.532585	1126.532585
15	50	1450.76562	1462.769394	1234.610264
20	50	1426.75808	1438.761849	1282.647217
25	50	1402.75053	1414.754305	1306.66788
30	50	1378.74299	1390.74676	1318.680398
35	50	1354.73544	1366.739216	1323.831119
40	50	1330.7279	1342.731671	1324.693216
45	50	1306.72035	1318.724127	1322.696232
50	50	1282.71281	1294.716582	1318.69789
55	50	1258.70527	1270.709038	1313.244015
60	50	1234.69772	1246.701493	1306.69849
65	50	1210.69018	1222.693949	1299.313235
70	50	1186.68263	1198.686404	1291.268192
75	50	1162.67509	1174.67886	1282.695319
80	50	1138.66754	1150.671315	1273.693583
85	50	1114.66	1126.663771	1264.338666
90	50	1090.65245	1102.656226	1254.689432
95	50	1066.64491	1078.648682	1244.792352
100	50	1042.63737	1054.641137	1234.684602

Boring H-8

Depth (ft)	N60 (BPF)	VS(fps)	Vsint (fps)	Vsover (fps)
5	23	1157.005	1157.005119	1157.005119
10	28	1215.616	1186.310403	1186.310403
15	32	1250.251	1232.9331	1207.623773
20	32	1229.561	1239.90582	1213.108112
25	30	1183.146	1206.353448	1207.115643
30	44	1321.233	1252.189351	1226.135192
35	32	1167.493	1244.362959	1217.757733
40	42	1255.601	1211.546839	1222.488104
45	23	1008.741	1132.171044	1198.738469
50	40	1190.774	1099.75767	1197.942017
55	41	1178.144	1184.458744	1196.142155

Boring H-9

Depth (ft)	N60 (BPF)	VS(fps)	Vsint (fps)	Vsover (fps)
5	25	1189.611	1189.610524	1189.610524
10	15	987.3014	1088.455948	1088.455948
15	20	1068.966	1028.133636	1081.959265
20	44	1367.245	1218.10556	1153.280754
25	50	1402.751	1384.997877	1203.17471
30	50	1378.743	1390.74676	1232.43609
35	50	1354.735	1366.739216	1249.907426
40	50	1330.728	1342.731671	1260.009985
45	50	1306.72	1318.724127	1265.200026
50	31	1093.789	1200.254716	1248.058931
55	50	1258.705	1176.247171	1249.02678
60	50	1234.698	1246.701493	1247.832691
65	50	1210.69	1222.693949	1244.975575
70	50	1186.683	1198.686404	1240.811793
75	50	1162.675	1174.67886	1235.60268
80	50	1138.668	1150.671315	1229.544234

Boring H-10

Depth (ft)	N60 (BPF)	VS(fps)	Vsint (fps)	Vsover (fps)
5	10	876.5393	876.5392998	876.5392998
10	29	1229.91692	1053.228111	1053.228111
15	15	971.229287	1100.573105	1025.89517
20	26	1147.3456	1059.287443	1056.257777
25	21	1050.53235	1098.938975	1055.112692
30	20	1015.89755	1033.214949	1048.576834
35	50	1354.73544	1185.316495	1092.313778
40	50	1330.7279	1342.731671	1122.115544
45	50	1306.72035	1318.724127	1142.627189
50	50	1282.71281	1294.716582	1156.635751
55	50	1258.70527	1270.709038	1165.914798
60	50	1234.69772	1246.701493	1171.646708
65	50	1210.69018	1222.693949	1174.650052
70	50	1186.68263	1198.686404	1175.509522
75	50	1162.67509	1174.67886	1174.653893
80	50	1138.66754	1150.671315	1172.404746

Boring H-11

Depth (ft)	N60 (BPF)	VS(fps)	Vsint (fps)	Vsover (fps)
5	30	1264.142	1264.142134	1264.142134
10	14	964.8571	1114.499619	1114.499619
15	31	1237.09	1100.973708	1155.363183
20	30	1203.395	1220.242585	1167.371102
25	30	1183.146	1193.270312	1170.526035
30	30	1162.897	1173.02122	1169.254475
35	30	1142.648	1152.772128	1165.45349
40	50	1330.728	1236.687741	1186.112791
45	50	1306.72	1318.724127	1199.513631
50	50	1282.713	1294.716582	1207.833549
55	50	1258.705	1270.709038	1212.458251
60	50	1234.698	1246.701493	1214.31154
65	50	1210.69	1222.693949	1214.032974
70	50	1186.683	1198.686404	1212.079378
75	50	1162.675	1174.67886	1208.785758
80	50	1138.668	1150.671315	1204.40337

Boring H-12

Depth (ft)	N60 (BPF)	VS(fps)	Vsint (fps)	Vsover (fps)
5	42	1414.166	1414.165966	1414.165966
10	14	964.8571	1189.511535	1189.511535
15	17	1012.603	988.7300156	1130.541999
20	20	1051.276	1031.939688	1110.725611
25	44	1344.239	1197.757763	1157.428305
30	50	1378.743	1361.491033	1194.314085
35	50	1354.735	1366.739216	1217.231422
40	50	1330.728	1342.731671	1231.418482
45	50	1306.72	1318.724127	1239.785357
50	50	1282.713	1294.716582	1244.078102
55	50	1258.705	1270.709038	1245.407844
60	50	1234.698	1246.701493	1244.515334
65	50	1210.69	1222.693949	1241.913399
70	50	1186.683	1198.686404	1237.968344
75	50	1162.675	1174.67886	1232.948793
80	50	1138.668	1150.671315	1227.056215

Boring H-13

Depth (ft)	N60 (BPF)	VS(fps)	Vsint (fps)	Vsover (fps)
5	20	1104.3448	1104.344799	1104.344799
10	21	1104.47074	1104.40777	1104.40777
15	30	1223.64395	1164.057346	1144.153163
20	19	1033.45653	1128.550239	1116.479004
25	33	1221.33397	1127.395247	1137.449997
30	39	1269.16605	1245.250011	1159.402673
35	34	1191.32351	1230.244784	1163.962793
40	50	1330.7279	1261.025706	1184.808432
45	50	1306.72035	1318.724127	1198.354201
50	50	1282.71281	1294.716582	1206.790062
55	50	1258.70527	1270.709038	1211.509626
60	50	1234.69772	1246.701493	1213.441967
65	50	1210.69018	1222.693949	1213.230291
70	50	1186.68263	1198.686404	1211.334029
75	50	1162.67509	1174.67886	1208.0901
80	50	1138.66754	1150.671315	1203.75119

Boring H-14

Depth (ft)	N60 (BPF)	VS(fps)	Vsint (fps)	Vsover (fps)
5	14	980.5638	980.5638242	980.5638242
10	15	987.3014	983.9325986	983.9325986
15	14	949.1504	968.2258782	972.3385268
20	50	1426.758	1187.95423	1085.943414
25	21	1050.532	1238.645214	1078.861202
30	50	1378.743	1214.637669	1128.841499
35	50	1354.735	1366.739216	1161.112063
40	50	1330.728	1342.731671	1182.314042
45	50	1306.72	1318.724127	1196.136966
50	50	1282.713	1294.716582	1204.79455
55	50	1258.705	1270.709038	1209.695524
60	50	1234.698	1246.701493	1211.779041
65	50	1210.69	1222.693949	1211.695282
70	50	1186.683	1198.686404	1209.908664
75	50	1162.675	1174.67886	1206.759759
80	50	1138.668	1150.671315	1202.503995

Boring H-15

Depth (ft)	N60 (BPF)	VS(fps)	Vsint (fps)	Vsover (fps)
5	50	1498.781	1498.78071	1498.78071
10	50	1474.773	1486.776938	1486.776938
15	50	1450.766	1462.769394	1474.773166
20	50	1426.758	1438.761849	1462.769394
25	50	1402.751	1414.754305	1450.765621
30	50	1378.743	1390.74676	1438.761849
35	50	1354.735	1366.739216	1426.758077
40	50	1330.728	1342.731671	1414.754305
45	50	1306.72	1318.724127	1402.750532
50	50	1282.713	1294.716582	1390.74676
55	50	1258.705	1270.709038	1378.742988
60	50	1234.698	1246.701493	1366.739216
65	50	1210.69	1222.693949	1354.735443
70	50	1186.683	1198.686404	1342.731671
75	50	1162.675	1174.67886	1330.727899
80	50	1138.668	1150.671315	1318.724127

Boring H-16

Depth (ft)	N60 (BPF)	VS(fps)	Vsint (fps)	Vsover (fps)
5	50	1498.78071	1498.78071	1498.78071
10	50	1474.77317	1486.776938	1486.776938
15	50	1450.76562	1462.769394	1474.773166
20	50	1426.75808	1438.761849	1462.769394
25	50	1402.75053	1414.754305	1450.765621
30	50	1378.74299	1390.74676	1438.761849
35	50	1354.73544	1366.739216	1426.758077
40	50	1330.7279	1342.731671	1414.754305
45	50	1306.72035	1318.724127	1402.750532
50	50	1282.71281	1294.716582	1390.74676
55	50	1258.70527	1270.709038	1378.742988
60	50	1234.69772	1246.701493	1366.739216
65	50	1210.69018	1222.693949	1354.735443
70	50	1186.68263	1198.686404	1342.731671
75	50	1162.67509	1174.67886	1330.727899
80	50	1138.66754	1150.671315	1318.724127

Boring H-17

Depth (ft)	N60 (BPF)	VS(fps)	Vsint (fps)	Vsover (fps)
5	50	1498.781	1498.78071	1498.78071
10	50	1474.773	1486.776938	1486.776938
15	50	1450.766	1462.769394	1474.773166
20	50	1426.758	1438.761849	1462.769394
25	50	1402.751	1414.754305	1450.765621
30	50	1378.743	1390.74676	1438.761849
35	50	1354.735	1366.739216	1426.758077
40	50	1330.728	1342.731671	1414.754305
45	50	1306.72	1318.724127	1402.750532
50	50	1282.713	1294.716582	1390.74676
55	50	1258.705	1270.709038	1378.742988
60	50	1234.698	1246.701493	1366.739216
65	50	1210.69	1222.693949	1354.735443
70	50	1186.683	1198.686404	1342.731671
75	50	1162.675	1174.67886	1330.727899
80	50	1138.668	1150.671315	1318.724127

Boring H-18

Depth (ft)	N60 (BPF)	VS(fps)	Vsint (fps)	Vsover (fps)
5	50	1498.781	1498.78071	1498.78071
10	50	1474.773	1486.776938	1486.776938
15	50	1450.766	1462.769394	1474.773166
20	50	1426.758	1438.761849	1462.769394
25	50	1402.751	1414.754305	1450.765621
30	50	1378.743	1390.74676	1438.761849
35	50	1354.735	1366.739216	1426.758077
40	50	1330.728	1342.731671	1414.754305
45	50	1306.72	1318.724127	1402.750532
50	50	1282.713	1294.716582	1390.74676
55	50	1258.705	1270.709038	1378.742988
60	50	1234.698	1246.701493	1366.739216
65	50	1210.69	1222.693949	1354.735443
70	50	1186.683	1198.686404	1342.731671
75	50	1162.675	1174.67886	1330.727899
80	50	1138.668	1150.671315	1318.724127

Boring H-19

Depth (ft)	N60 (BPF)	VS(fps)	Vsint (fps)	Vsover (fps)
5	50	1498.78071	1498.78071	1498.78071
10	50	1474.77317	1486.776938	1486.776938
15	50	1450.76562	1462.769394	1474.773166
20	50	1426.75808	1438.761849	1462.769394
25	50	1402.75053	1414.754305	1450.765621
30	50	1378.74299	1390.74676	1438.761849
35	50	1354.73544	1366.739216	1426.758077
40	50	1330.7279	1342.731671	1414.754305
45	50	1306.72035	1318.724127	1402.750532
50	50	1282.71281	1294.716582	1390.74676
55	50	1258.70527	1270.709038	1378.742988
60	50	1234.69772	1246.701493	1366.739216
65	50	1210.69018	1222.693949	1354.735443
70	50	1186.68263	1198.686404	1342.731671
75	50	1162.67509	1174.67886	1330.727899
80	50	1138.66754	1150.671315	1318.724127

Boring H-20

Depth (ft)	N60 (BPF)	VS(fps)	Vsint (fps)	Vsover (fps)
5	50	1498.781	1498.78071	1498.78071
10	50	1474.773	1486.776938	1486.776938
15	50	1450.766	1462.769394	1474.773166
20	50	1426.758	1438.761849	1462.769394
25	50	1402.751	1414.754305	1450.765621
30	50	1378.743	1390.74676	1438.761849
35	50	1354.735	1366.739216	1426.758077
40	50	1330.728	1342.731671	1414.754305
45	50	1306.72	1318.724127	1402.750532
50	50	1282.713	1294.716582	1390.74676
55	50	1258.705	1270.709038	1378.742988
60	50	1234.698	1246.701493	1366.739216
65	50	1210.69	1222.693949	1354.735443
70	50	1186.683	1198.686404	1342.731671
75	50	1162.675	1174.67886	1330.727899
80	50	1138.668	1150.671315	1318.724127

Boring H-21

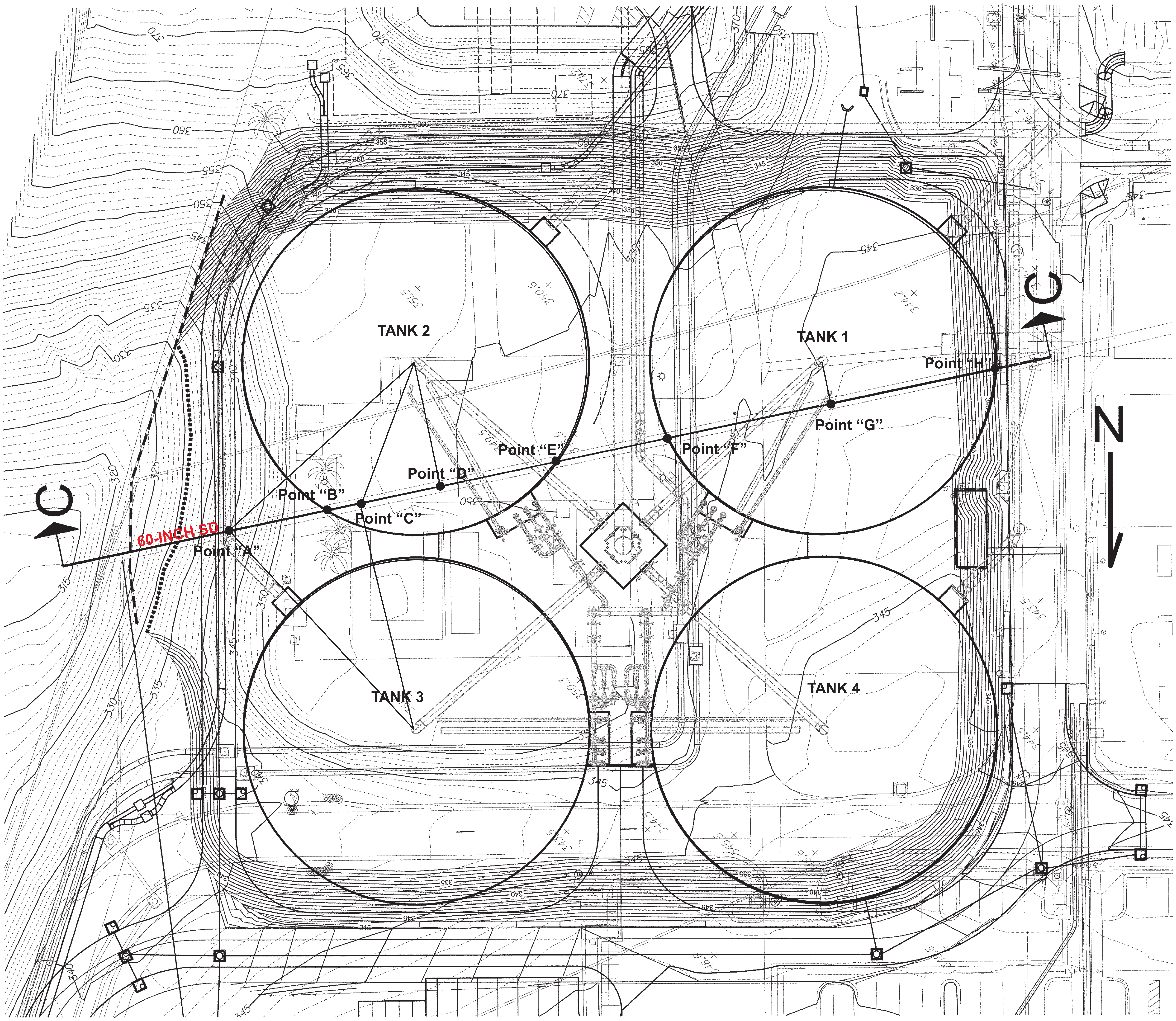
Depth (ft)	N60 (BPF)	VS(fps)	Vsint (fps)	Vsover (fps)
5	50	1498.781	1498.78071	1498.78071
10	50	1474.773	1486.776938	1486.776938
15	50	1450.766	1462.769394	1474.773166
20	50	1426.758	1438.761849	1462.769394
25	50	1402.751	1414.754305	1450.765621
30	50	1378.743	1390.74676	1438.761849
35	50	1354.735	1366.739216	1426.758077
40	50	1330.728	1342.731671	1414.754305
45	50	1306.72	1318.724127	1402.750532
50	50	1282.713	1294.716582	1390.74676
55	50	1258.705	1270.709038	1378.742988
60	50	1234.698	1246.701493	1366.739216
65	50	1210.69	1222.693949	1354.735443
70	50	1186.683	1198.686404	1342.731671
75	50	1162.675	1174.67886	1330.727899
80	50	1138.668	1150.671315	1318.724127

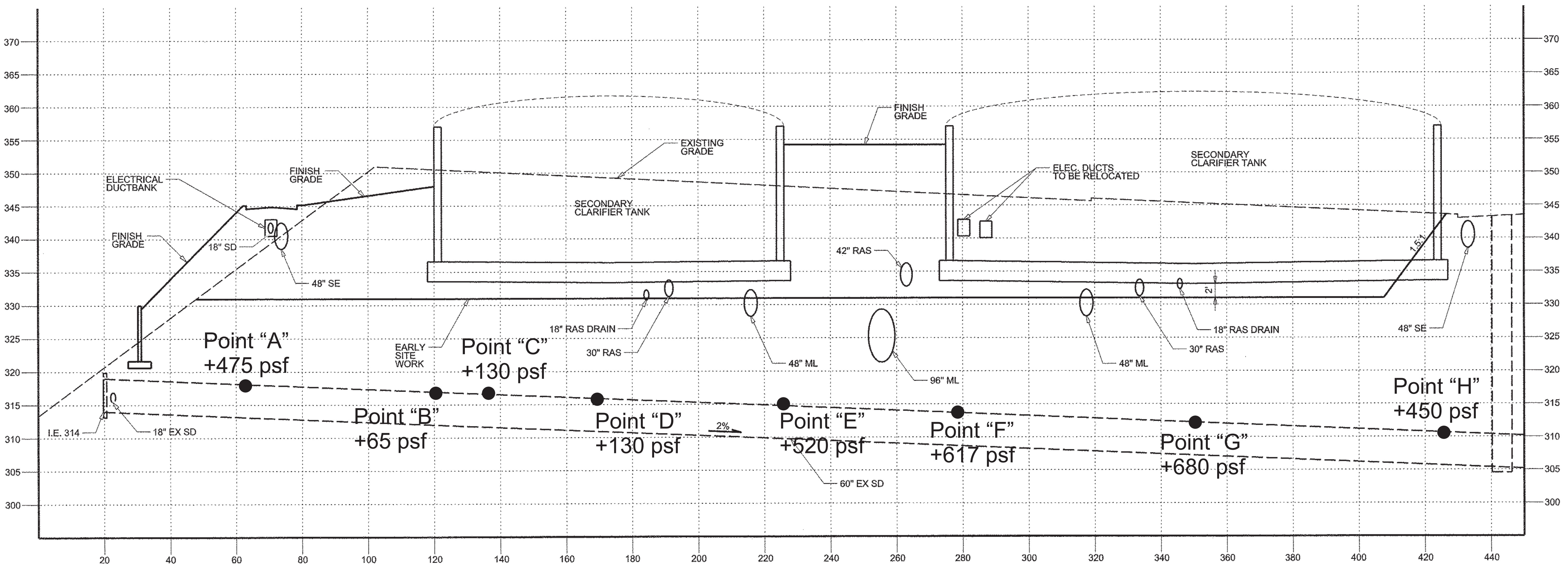
Boring H-22

Depth (ft)	N60 (BPF)	VS(fps)	Vsint (fps)	Vsover (fps)
5	50	1498.78071	1498.78071	1498.78071
10	50	1474.77317	1486.776938	1486.776938
15	50	1450.76562	1462.769394	1474.773166
20	50	1426.75808	1438.761849	1462.769394
25	50	1402.75053	1414.754305	1450.765621
30	50	1378.74299	1390.74676	1438.761849
35	50	1354.73544	1366.739216	1426.758077
40	50	1330.7279	1342.731671	1414.754305
45	50	1306.72035	1318.724127	1402.750532
50	50	1282.71281	1294.716582	1390.74676
55	50	1258.70527	1270.709038	1378.742988
60	50	1234.69772	1246.701493	1366.739216
65	50	1210.69018	1222.693949	1354.735443
70	50	1186.68263	1198.686404	1342.731671
75	50	1162.67509	1174.67886	1330.727899
80	50	1138.66754	1150.671315	1318.724127

APPENDIX C.2

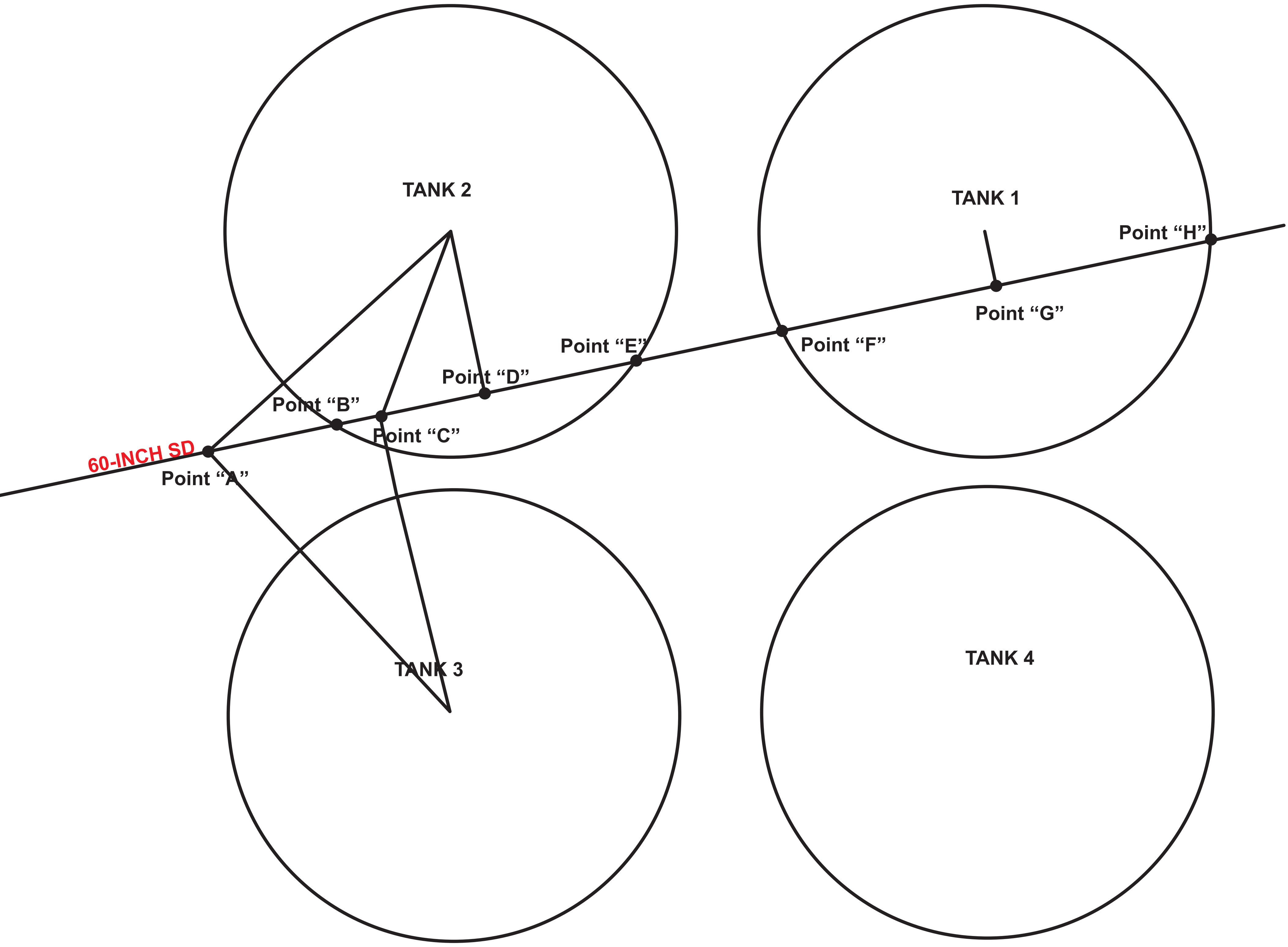
CALCULATIONS OF ADDITIONAL LOAD ON 60-INCH DIAMETER STORM DRAIN





SECTION C-C

SCALE H: 1" = 20' V: 1" = 10'



Calculation Performed By: Sani Sutanto
Calculation Performed On: May 19, 2017
Project Name: North City Wastewater Treatment Plant Expansion
Project No. 44F1
Page 1 of 9
ALLIED GEOTECHNICAL ENGINEERS, INC.

Point “A”

Load from additional fill treated as edge load of uniformly loaded rectangular area.
q = 10’ x 110 pcf = 1,100 psf
Horizontal dimensions: a = 20’ & b = 100’
Distance between bottom of new fill and top of pipe = 17’
m = a/z = 20/17 = 1.2
n = (b/2)/z = 50/17 = 3
Fz = 0.21633 (Boussinesq)
Load from additional fill = 2 x 0.21633 x 1,100 psf = 475 psf

Contribution from Tank 2
Radius (r) = 80’
Depth from bottom of raft foundation to top of pipe (z) = 15’
Distance from center to Point “A” (a) = 114’
Additional foundation load = 2,000 psf - (16 x 110 psf) = 240 psf
m = z/r = 15/80 = 0.19
n = a/r = 114/80 = 1.425
Nz = 0% (Foster and Ahlvin, 1954)
Qz = pressure at Point “A” due to foundation load =
240 psf x 0% = 0 psf.

Contribution from Tank 3
Radius (r) = 80’
Depth from bottom of raft foundation to top of pipe (z) = 15’
Distance from center to Point “A” (a) = 110’
Foundation Pressure = 240 psf (assume the same as Tank 2)
m = z/r = 15/80 = 0.19
n = a/r = 110/80 = 1.375
Nz = 0% (Foster and Ahlvin, 1954)
Qz = pressure at Point “A” due to foundation load =
240 psf x 0% = 0 psf.

Conclusion:
Additional foundation load at Point “A” is estimated to be 475 psf

Point “B”

Contribution from Tank 2
Radius (r) = 80’
Depth from bottom of raft foundation to top of pipe (z) = 15’
Distance from center to Point “B” (a) = 80’
Foundation Pressure = 2,000 psf
m = z/r = 15/80 = 0.19
n = a/r = 80/80 = 1.0
Nz = 50% (Foster and Ahlvin, 1954)
Qz = pressure at Point “B” due to foundation load =
2,000 psf x 50% = 1,000 psf.

Contribution from Tank 3
Radius (r) = 80’
Depth from bottom of raft foundation to top of pipe (z) = 15’
Distance from center to Point “B” (a) = 106’
m = z/r = 15/80 = 0.19
n = a/r = 106/80 = 1.325
Nz = 0% (Foster and Ahlvin, 1954) - no contribution

Soil surcharge load removed = (17’ x 110 pcf)/2 = 935 psf

Conclusion:
Additional foundation load at Point “B” is estimated to be 1,000 psf - 935 psf = 65 psf

Point “C”

Contribution from Tank 2
Radius (r) = 80’
Depth from bottom of raft foundation to top of pipe (z) = 15’
Distance from center to Point “C” (a) = 66’
Foundation Pressure = 2,000 psf
m = z/r = 15/80 = 0.19
n = a/r = 66/80 = 0.825
Nz = 100% (Foster and Ahlvin, 1954)
Qz = pressure at Point “C” due to foundation load =
2,000 psf x 100% = 2,000 psf.

Contribution from Tank 3
Radius (r) = 80’
Depth from bottom of raft foundation to top of pipe (z) = 15’
Distance from center to Point “C” (a) = 104’
m = z/r = 15/80 = 0.19
n = a/r = 104/80 = 1.3
Nz = 0% (Foster and Ahlvin, 1954) - no contribution

Soil surcharge load removed = 17’ x 110 pcf = 1,870 psf

Conclusion:

Additional foundation load at Point “C” is estimated to be 2,000 psf - 1,870 psf = 130 psf

Point “D”

Radius (r) = 80’
Depth from bottom of raft foundation to top of pipe (z) = 17’
Distance from center to Point “D” (a) = 54’
Foundation Pressure = 2,000 psf
m = z/r = 17/80 = 0.21
n = a/r = 54/80 = 0.675
Nz = 100% (Foster and Ahlvin, 1954)
Qz = pressure at Point “D” due to foundation load =
2,000 psf x 100% = 2,000 psf.
Soil surcharge load removed = 17’ x 110 pcf = 1,870 psf

Conclusion:
Additional foundation load at Point “D” is estimated to be 2,000 psf - 1,870 psf = 130 psf

Point “E”

Radius (r) = 80’
Depth from bottom of raft foundation to top of pipe (z) = 19’
Distance from center to Point “E” (a) = 80’
Foundation Pressure = 2,000 psf
m = z/r = 19/80 = 0.2375
n = a/r = 80/80 = 1
Nz = 50% (Foster and Ahlvin, 1954)
Qz = pressure at Point “E” due to foundation load =
2,000 psf x 50% = 1,000 psf.

Soil surcharge load removed = (14’ x 110 pcf)/2 = 770 psf

Load from additional fill treated as edge load of uniformly loaded rectangular area.
q = 6’ x 110 pcf = 660 psf
Depth from bottom of new fill to top of pipe (z) = 33’
Horizontal dimensions: a = 50 feet and b = 100 feet
m = a/z = 50/33 = 1.52
n = (b/2)/z = 50/33 = 1.52
Fz = 0.22025 (Boussinesq)
Load from additional fill = 2 x 0.22025 x 660 psf = 290 psf

Conclusion:

Additional load at Point “E” is estimated to be equal to:
1,000 psf + 290 psf - 770 psf = 520 psf.

Point “F”

Radius (r) = 80’
Depth from bottom of raft foundation to top of pipe (z) = 19’
Distance from center to Point “F” = 80’
Foundation Pressure = 2,000 psf
m = z/r = 19/80 = 0.2375
n = a/r = 80/80 = 1
Nz = 50% (Foster and Ahlvin, 1954)
Qz = pressure at Point “F” due to foundation load =
2,000 psf x 50% = 1,000 psf.

Soil surcharge load removed = (14’ x 110 pcf)/2 = 770 psf

Load from additional fill treated as edge load of uniformly loaded rectangular area.
q = 8’ x 110 pcf = 880 psf
Depth from bottom of new fill to top of pipe (z) = 32’
Horizontal dimensions: a = 50 feet and b = 100 feet
m = a/z = 50/32 = 1.56
n = (b/2)/z = 50/32 = 1.56
Fz = 0.22025 (Boussinesq)
Load from additional fill = 2 x 0.22025 x 880 psf = 387 psf

Conclusion:
Additional load at Point “F” is estimated to be equal to:
1,000 psf + 387 psf - 770 psf = 617 psf.

Point “G”

Radius (r) = 80’
Depth from bottom of raft foundation to top of pipe (z) = 20’
Distance from center to Point “G” (a) = 18’
Foundation Pressure = 2,000 psf
m = z/r = 20/80 = 0.25
n = a/r = 18/80 = 0.225
Nz = 100% (Foster and Ahlvin, 1954)
Qz = pressure at Point “G” due to foundation load = 2,000 psf x 100% = 2,000 psf.
Soil surcharge load removed = 12’ x 110 pcf = 1,320 psf

Conclusion:

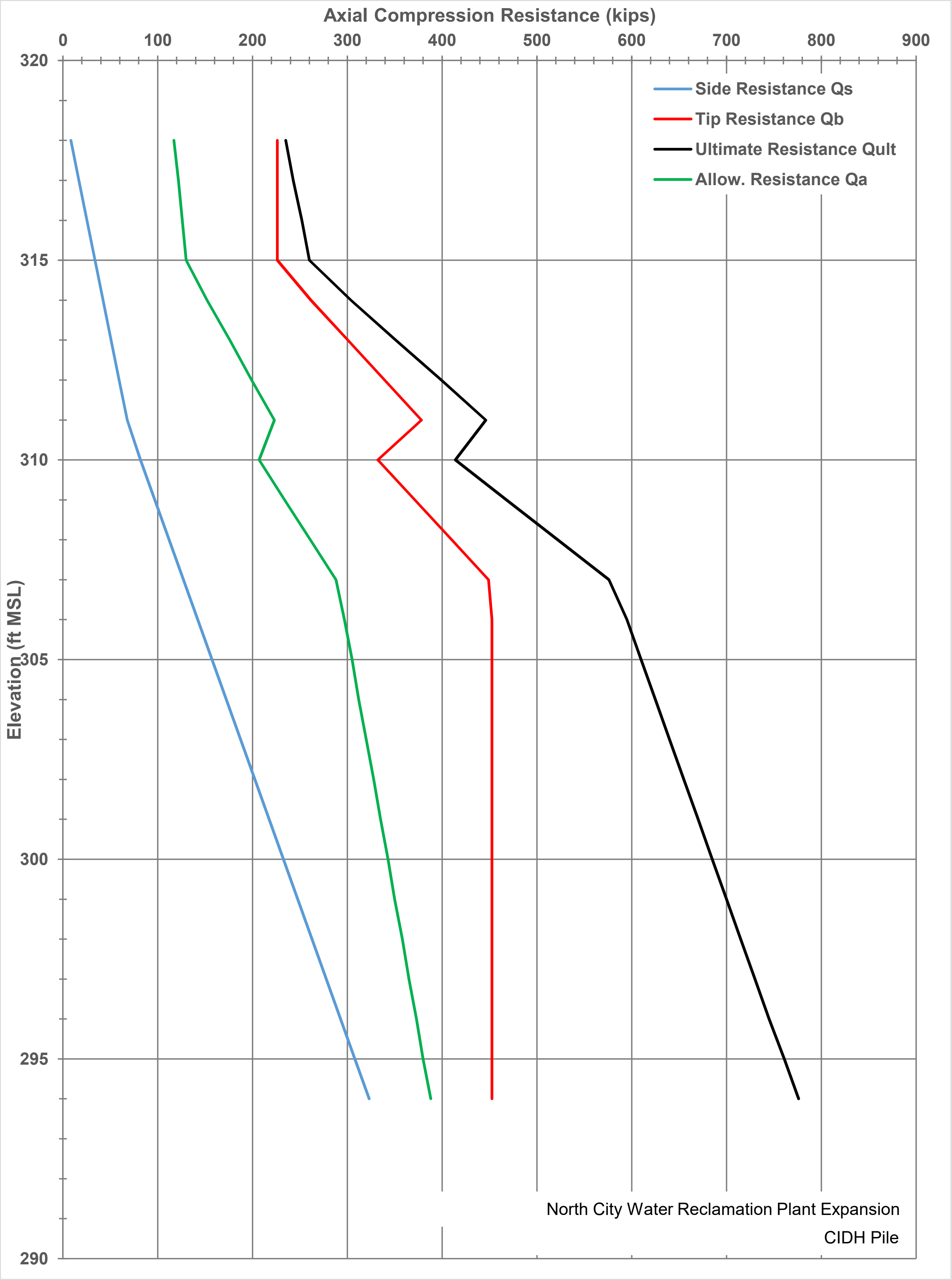
Additional foundation load at Point “G” is estimated to be 2,000 psf - 1,320 psf = 680 psf

Point “H”
Radius (r) = 80’
Depth from bottom of raft foundation to top of pipe (z) = 23’
Distance from center to Point “H” (a) = 80’
Foundation Pressure = 2,000 psf
m = z/r = 23/80 = 0.2875
n = a/r = 80/80 = 1
Nz = 50% (Foster and Ahlvin, 1954)
Qz = pressure at Point “H” due to foundation load =
2,000 psf x 50% = 1,000 psf.
Soil surcharge load removed = (10’ x 110 pcf)/2 = 550 psf

Conclusion:
Additional foundation load at Point “H” is estimated to be 1,000 psf - 550 psf = 450 psf

APPENDIX C.3

36-INCH DIAMETER CIDH PILE CALCULATIONS



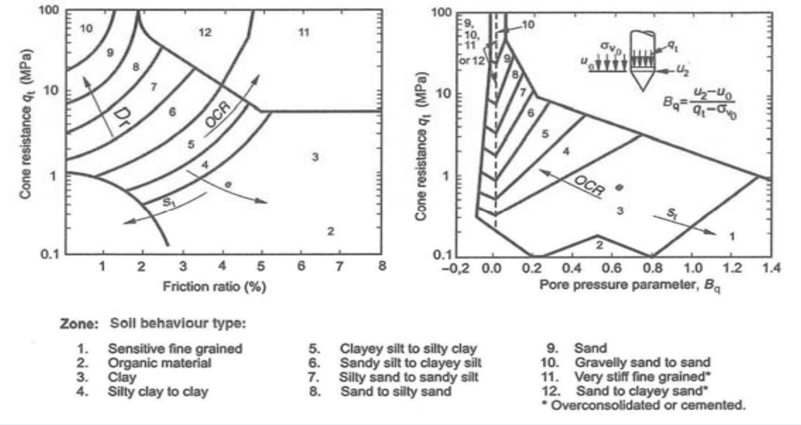
North City Water Reclamation Plant Expansion

CIDH Pile

CIDH PILE CALCULATION

Project No:	44F1	**Analysis Title:**	CIDH Pile			Rev. No:	0
Project:	North City Water Reclamation Plant Expansion	**By:**	SS	Date:	5/20/2017		
Location:	North City Water Reclamation Plant	**Checked By:**		Date:			

Soil Behavior Type	1986 SBT	q_t (tsf)/N_{60}	W_s	W_t
Sensitive Fine-Grained	1	2	0	0
Organic Material	2	1	0	0
Clay	3	1	0	0
Silty Clay to Clay	4	1.5	0	0
Clayey Silt to Silty Clay	5	2	0	0
Sandy Silt to Clayey Silt	6	2.3	0.1	3
Silty Sand to Sandy Silt	7	3	0.2	6
Sand to Silty Sand	8	4	0.3	9
Sand	9	5	0.4	12
Gravelly Sand to Sand	10	6	0.5	15
Very Stiff Fine Grained	11	1	0.2	6
Sand to Clayey Sand	12	2	0.15	4.5



D_{pile} (in.)	36
$4D_{pile}$ (ft)	12.0
A_s (ft^2)	9.42
A_t (ft^2)	7.07

FS (Side)	2
FS (Tip)	2
Target R_a	375 kips

Depth (ft)	Elev. (ft)	1986 SBT	CPT q_t (tsf)	Lim. q_t (tsf)	f_{s1} (ksf)	W_s (tsf)	f_s (ksf)	R_{si} (kips)	ΣR_{si} (kips)	Toe Ave. q_t (tsf)	q_{b1} (ksf)	W_t (tsf)	q_b (ksf)	R_t (kips)	R_{ult} (kips)	R_a (kips)
0	319		0	0												
1	318	7	25	25	0.50	0.2	0.90	8.48	8.48	25.00	20.00	6	32.00	226.24	235	117
2	317	7	25	25	0.50	0.2	0.90	8.48	16.96	25.00	20.00	6	32.00	226.24	243	122
3	316	7	25	25	0.50	0.2	0.90	8.48	25.43	25.00	20.00	6	32.00	226.24	252	126
4	315	7	25	25	0.50	0.2	0.90	8.48	33.91	25.00	20.00	6	32.00	226.24	260	130
5	314	7	25	25	0.50	0.2	0.90	8.48	42.39	31.25	25.00	6	37.00	261.59	304	152
6	313	7	25	25	0.50	0.2	0.90	8.48	50.87	38.13	30.50	6	42.50	300.48	351	176
7	312	7	25	25	0.50	0.2	0.90	8.48	59.35	45.00	36.00	6	48.00	339.36	399	199
8	311	7	25	25	0.50	0.2	0.90	8.48	67.82	51.88	41.50	6	53.50	378.25	446	223
9	310	5	75	75	1.50	0	1.50	14.13	81.95	58.75	47.00	0	47.00	332.29	414	207
10	309	5	80	80	1.60	0	1.60	15.07	97.03	65.63	52.50	0	52.50	371.18	468	234
11	308	5	80	80	1.60	0	1.60	15.07	112.10	72.50	58.00	0	58.00	410.06	522	261
12	307	5	80	80	1.60	0	1.60	15.07	127.17	79.38	63.50	0	63.50	448.95	576	288
13	306	5	80	80	1.60	0	1.60	15.07	142.24	80.00	64.00	0	64.00	452.48	595	297
14	305	5	80	80	1.60	0	1.60	15.07	157.31	80.00	64.00	0	64.00	452.48	610	305
15	304	5	80	80	1.60	0	1.60	15.07	172.39	80.00	64.00	0	64.00	452.48	625	312
16	303	5	80	80	1.60	0	1.60	15.07	187.46	80.00	64.00	0	64.00	452.48	640	320
17	302	5	80	80	1.60	0	1.60	15.07	202.53	80.00	64.00	0	64.00	452.48	655	328
18	301	5	80	80	1.60	0	1.60	15.07	217.60	80.00	64.00	0	64.00	452.48	670	335
19	300	5	80	80	1.60	0	1.60	15.07	232.67	80.00	64.00	0	64.00	452.48	685	343
20	299	5	80	80	1.60	0	1.60	15.07	247.75	80.00	64.00	0	64.00	452.48	700	350
21	298	5	80	80	1.60	0	1.60	15.07	262.82	80.00	64.00	0	64.00	452.48	715	358
22	297	5	80	80	1.60	0	1.60	15.07	277.89	80.00	64.00	0	64.00	452.48	730	365
23	296	5	80	80	1.60	0	1.60	15.07	292.96	80.00	64.00	0	64.00	452.48	745	373
24	295	5	80	80	1.60	0	1.60	15.07	308.03	80.00	64.00	0	64.00	452.48	761	**380**
25	294	5	80	80	1.60	0	1.60	15.07	323.11	80.00	64.00	0	64.00	452.48	776	**388**

APPENDIX C.4

INFILTRATION RATE BASED ON PARTICLE SIZE DISTRIBUTION

Project Name: **North City Water Reclamation Plant Expansion**
Project No. **44F1**

Subject: **Soil Infiltration Rate Estimate (Hazen 1892 & Cronican and Gribb 2004)**

Formula: Ks = c (d10^2)

Ks = Hydraulic Conductivity (cm/sec)
c = Constant which varies between 1.0 and 1.5. A value of 1.0 is selected for this project.
d10 = Particle size diameter for which 10% (by mass) of the particles in a soil sample are finer (mm)

	Min Inf Rate	**Max Inf. Rate**	**Median Inf. Rate**
Soil ID	**(inch/hour)**		
Fill	0.0024	1.45	0.0028
Qvop	0.0028	0.6073	*
Scripps	0.0017	1.45	0.0024

NOTE:
* Insufficient sample size

Boring # **H-2**
Sample # **3**
Depth **11-15 ft**
Soil ID **Fill**

Dia (mm)	**% pass**
152.4	
127	
101.6	
76.2	
50.8	100
38.1	99.3
19.05	98.6
12.7	89.7
9.525	81.7
4.75 (#4)	67.8
2.38 (#8)	61.1
2.0 (#10)	59.8
1.18 (#16)	56.3
0.6 (#30)	52.4
0.42 (#40)	46.8
0.3 (#50)	39.3
0.15 (#100)	26.1
.075 (#200)	19.3

Cu =	214.2	
Cc=	4.9	
D10=	0.032	
Ks=	0.001024	cm/sec
Ks=	1.4513	inch/hour

Boring # **H-3**
Sample # **8**
Depth **41-41.5 ft.**
Soil ID **Scripps**

Dia (mm)	**% pass**
152.4	
127	
101.6	
76.2	
50.8	
38.1	
19.05	
12.7	
9.525	
4.75 (#4)	100
2.38 (#8)	99.7
2.0 (#10)	99.5
1.18 (#16)	93.1
0.6 (#30)	92.1
0.42 (#40)	91.3
0.3 (#50)	90.6
0.15 (#100)	87.3
.075 (#200)	66.5

Cu =	25.7	
Cc=	0.5	
D10=	0.0014	
Ks=	1.96E-06	cm/sec
Ks=	0.0028	inch/hour

Boring #	**H-3**
Sample #	**13**
Depth	**65.5-66 ft.**
Soil ID	**Scripps**

Dia (mm)	**% pass**
152.4	
127	
101.6	
76.2	
50.8	
38.1	
19.05	
12.7	
9.525	
4.75 (#4)	
2.38 (#8)	
2.0 (#10)	
1.18 (#16)	100
0.6 (#30)	99.9
0.42 (#40)	99.7
0.3 (#50)	84.8
0.15 (#100)	35.8
.075 (#200)	15.8

Cu =	12.6	
Cc=	5.1	
D10=	0.032	
Ks=	0.001024	cm/sec
Ks=	1.4513	inch/hour

Boring # **H-4**
Sample # **1**
Depth **3-6 ft.**
Soil ID **Qvop**

Dia (mm)	**% pass**
152.4	
127	
101.6	
76.2	
50.8	
38.1	
19.05	
12.7	
9.525	100
4.75 (#4)	98.8
2.38 (#8)	96.4
2.0 (#10)	96
1.18 (#16)	94.6
0.6 (#30)	92.4
0.42 (#40)	84.6
0.3 (#50)	72.3
0.15 (#100)	51.3
.075 (#200)	42.5

Cu =	72.4	
Cc=	0.8	
D10=	0.0014	
Ks=	1.96E-06	cm/sec
Ks=	0.0028	inch/hour

Boring #	**H-5**
Sample #	**2**
Depth	**4-7 ft.**
Soil ID	**Fill**

Dia (mm)	**% pass**
152.4	
127	
101.6	
76.2	
50.8	
38.1	100
19.05	99.4
12.7	98.9
9.525	98.1
4.75 (#4)	96.2
2.38 (#8)	94.1
2.0 (#10)	93.6
1.18 (#16)	91.8
0.6 (#30)	89.2
0.42 (#40)	85.3
0.3 (#50)	80.5
0.15 (#100)	71
.075 (#200)	60.9

Cu = 34.6
Cc= 0.5
D10= 0.0014
Ks= 1.96E-06 cm/sec
Ks= 0.0028 inch/hour

Boring # **H-5**
Sample # **10**
Depth **30-35 ft.**
Soil ID **Scripps**

Dia (mm)	% pass
152.4	
127	
101.6	
76.2	
50.8	
38.1	
19.05	
12.7	
9.525	
4.75 (#4)	100
2.38 (#8)	99.7
2.0 (#10)	99.6
1.18 (#16)	99.1
0.6 (#30)	98.4
0.42 (#40)	97.8
0.3 (#50)	97.2
0.15 (#100)	93.7
.075 (#200)	83.2
0.0434	73.2
0.032	63.1
0.0207	57
0.0122	50.8
0.0088	44.7
0.0063	40.7
0.0032	34.6
0.0013	26.4

Cu = 23
Cc= 0.1
D10= 0.0013
Ks= 1.69E-06 cm/sec
Ks= 0.0024 inch/hour
LL= 35
PL= 15
PI = 20
Class: Sandy Clay (CL)

Boring #	**H-7**
Sample #	**2**
Depth	**5-8 ft.**
Soil ID	**Qvop**

Dia (mm)	**% pass**
152.4	
127	
101.6	
76.2	100
50.8	99.3
38.1	99
19.05	95.4
12.7	86
9.525	76.2
4.75 (#4)	61.2
2.38 (#8)	55.7
2.0 (#10)	55
1.18 (#16)	53.2
0.6 (#30)	51.2
0.42 (#40)	47.6
0.3 (#50)	42.2
0.15 (#100)	31.2
.075 (#200)	25.4

Cu =	23	
Cc=	0.1	
D10=	0.0207	
Ks=	0.000428	cm/sec
Ks=	0.6073	inch/hour

Boring # **H-8**
Sample # **1**
Depth **4-7 ft.**
Soil ID **Fill**

Dia (mm)	% pass
152.4	
127	
101.6	
76.2	
50.8	100
38.1	99.3
19.05	98.5
12.7	96.2
9.525	94.6
4.75 (#4)	90.3
2.38 (#8)	86
2.0 (#10)	85
1.18 (#16)	82.2
0.6 (#30)	78.6
0.42 (#40)	72.8
0.3 (#50)	64.9
0.15 (#100)	51
.075 (#200)	43

Cu =	23	
Cc=	0.1	
D10=	0.0125	
Ks=	0.000156	cm/sec
Ks=	0.2215	inch/hour

Boring #	**H-8**
Sample #	**8**
Depth	**31-31.5 ft.**
Soil ID	**Fill**

Dia (mm)	**% pass**
152.4	
127	
101.6	
76.2	
50.8	
38.1	
19.05	
12.7	
9.525	100
4.75 (#4)	95.6
2.38 (#8)	93.4
2.0 (#10)	92.9
1.18 (#16)	91.4
0.6 (#30)	89.2
0.42 (#40)	83.6
0.3 (#50)	75.5
0.15 (#100)	55.5
.075 (#200)	41.3
0.0486	40.7
0.0351	34.6
0.0225	30.5
0.0131	26.4
0.0094	22.4
0.0067	20.3
0.0033	18.3
0.0014	12.2

Cu =	133.4	
Cc=	1.9	
D10=	0.0014	
Ks=	1.96E-06	cm/sec
Ks=	0.0028	inch/hour

Boring # **H-9**
Sample # **2**
Depth **9-12 ft.**
Soil ID **Fill**

Dia (mm)	**% pass**
152.4	
127	
101.6	
76.2	
50.8	100
38.1	99.4
19.05	97.7
12.7	95.8
9.525	94.6
4.75 (#4)	93.8
2.38 (#8)	91.8
2.0 (#10)	91.4
1.18 (#16)	90
0.6 (#30)	88
0.42 (#40)	84.7
0.3 (#50)	80.6
0.15 (#100)	72.9
.075 (#200)	63.8
0.0456	61
0.0327	57
0.021	52.9
0.0125	44.7
0.009	38.6
0.0064	34.6
0.0032	26.4
0.0014	20.3

Cu = 35.9
Cc= 0.4
D10= 0.0013
Ks= 1.69E-06 cm/sec
Ks= 0.0024 inch/hour

Boring #	**H-9**
Sample #	**19**
Depth	**75-76.3 ft.**
Soil ID	**Scripps**

Dia (mm)	**% pass**
152.4	
127	
101.6	
76.2	
50.8	
38.1	
19.05	
12.7	
9.525	
4.75 (#4)	
2.38 (#8)	
2.0 (#10)	100
1.18 (#16)	99.7
0.6 (#30)	99.6
0.42 (#40)	99.5
0.3 (#50)	99.4
0.15 (#100)	99
.075 (#200)	97
0.0427	77.3
0.0322	61
0.0214	46.8
0.0128	86.6
0.0092	32.5
0.0066	28.5
0.0033	18.3
0.0014	10.2

Cu =	22.3	
Cc=	1.3	
D10=	0.0014	
Ks=	1.96E-06	cm/sec
Ks=	0.0028	inch/hour

Boring # **H-10**
Sample # **1**
Depth **3-7'**
Soil ID **Fill**

Dia (mm)	**% pass**
152.4	
127	
101.6	
76.2	
50.8	
38.1	100
19.05	99.3
12.7	97.6
9.525	96.6
4.75 (#4)	94.5
2.38 (#8)	91.7
2.0 (#10)	91.2
1.18 (#16)	89.7
0.6 (#30)	88
0.42 (#40)	86
0.3 (#50)	83.5
0.15 (#100)	78
.075 (#200)	68.9

Cu =	22.3	
Cc=	1.3	
D10=	0.0014	
Ks=	1.96E-06	cm/sec
Ks=	0.0028	inch/hour

Boring # **H-11**
Sample # **2**
Depth **10-11.5 ft.**
Soil ID **Fill**

Dia (mm)	**% pass**
152.4	
127	
101.6	
76.2	
50.8	
38.1	
19.05	
12.7	
9.525	
4.75 (#4)	100
2.38 (#8)	98.5
2.0 (#10)	98.3
1.18 (#16)	97.8
0.6 (#30)	97.3
0.42 (#40)	96.8
0.3 (#50)	96
0.15 (#100)	93.7
.075 (#200)	84.4

Cu =	22.3	
Cc=	1.3	
D10=	0.0013	
Ks=	1.69E-06	cm/sec
Ks=	0.0024	inch/hour

Boring # **H-11**
Sample # **6**
Depth **21-24 ft.**
Soil ID **Scripps**

Dia (mm)	**% pass**
152.4	
127	
101.6	
76.2	
50.8	
38.1	
19.05	
12.7	
9.525	
4.75 (#4)	100
2.38 (#8)	99.6
2.0 (#10)	99.5
1.18 (#16)	99.3
0.6 (#30)	99
0.42 (#40)	98.7
0.3 (#50)	98.4
0.15 (#100)	96.7
.075 (#200)	85.5

Cu =	22.3	
Cc=	1.3	
D10=	0.0013	
Ks=	1.69E-06	cm/sec
Ks=	0.0024	inch/hour
LL=	43	
PL=	16	
PI =	27	
Class:	Sandy Clay (CL)	

Boring # **H-12**
Sample # **7**
Depth **21-24 ft.**
Soil ID **Fill**

Dia (mm)	**% pass**
152.4	
127	
101.6	
76.2	
50.8	
38.1	
19.05	
12.7	
9.525	100
4.75 (#4)	98.4
2.38 (#8)	97.1
2.0 (#10)	96.8
1.18 (#16)	95.9
0.6 (#30)	94.6
0.42 (#40)	93.1
0.3 (#50)	91.2
0.15 (#100)	87.3
.075 (#200)	80.7

Cu =	22.3	
Cc=	1.3	
D10=	0.0013	
Ks=	1.69E-06	cm/sec
Ks=	0.0024	inch/hour

Boring # **H-13**
Sample # **1**
Depth **3-7 ft.**
Soil ID **Fill**

Dia (mm)	**% pass**
152.4	
127	
101.6	
76.2	
50.8	
38.1	
19.05	100
12.7	99.6
9.525	99
4.75 (#4)	97.3
2.38 (#8)	95.1
2.0 (#10)	94.7
1.18 (#16)	93.5
0.6 (#30)	92
0.42 (#40)	89.8
0.3 (#50)	86.9
0.15 (#100)	80.6
.075 (#200)	73.3

Cu =	22.3	
Cc=	1.3	
D10=	0.0013	
Ks=	1.69E-06	cm/sec
Ks=	0.0024	inch/hour

Boring # **H-13**
Sample # **25**
Depth **90-100 ft.**
Soil ID **Scripps**

Dia (mm)	% pass
152.4	
127	
101.6	
76.2	
50.8	
38.1	
19.05	
12.7	
9.525	
4.75 (#4)	100
2.38 (#8)	91.6
2.0 (#10)	91.4
1.18 (#16)	90.9
0.6 (#30)	90.4
0.42 (#40)	90
0.3 (#50)	89.7
0.15 (#100)	89
.075 (#200)	87.4
0.0416	81.4
0.0307	71.2
0.0201	63.1
0.012	52.9
0.0088	44.7
0.0063	40.7
0.0032	28.5
0.0014	20.3

Cu =	14.8	
Cc=	0.6	
D10=	0.0013	
Ks=	1.69E-06	cm/sec
Ks=	0.0024	inch/hour
LL=	42	
PL=	17	
PI =	25	
Class:	Sandy Clay (CL)	

Boring # **H-14**
Sample # **2**
Depth **4-7 ft.**
Soil ID **Fill**

Dia (mm)	% pass
152.4	
127	
101.6	
76.2	
50.8	
38.1	
19.05	
12.7	
9.525	100
4.75 (#4)	99.1
2.38 (#8)	98.2
2.0 (#10)	98
1.18 (#16)	97.3
0.6 (#30)	96.4
0.42 (#40)	95.2
0.3 (#50)	93.5
0.15 (#100)	89.4
.075 (#200)	83.1

Cu =	14.8	
Cc=	0.6	
D10=	0.0013	
Ks=	1.69E-06	cm/sec
Ks=	0.0024	inch/hour
LL=	42	
PL=	16	
PI =	26	
Class:	Sandy Clay (CL)	

Boring # **H-14**
Sample # **7**
Depth **20-24 ft.**
Soil ID **Fill**

Dia (mm)	**% pass**
152.4	
127	
101.6	
76.2	
50.8	
38.1	
19.05	
12.7	
9.525	100
4.75 (#4)	97.3
2.38 (#8)	95.7
2.0 (#10)	95.4
1.18 (#16)	94.5
0.6 (#30)	93
0.42 (#40)	90.5
0.3 (#50)	86.9
0.15 (#100)	76.3
.075 (#200)	65

Cu = 14.8
Cc= 0.6
D10= 0.0014
Ks= 1.96E-06 cm/sec
Ks= 0.0028 inch/hour
LL= 35
PL= 13
PI = 22
Class: Sandy Clay (CL)

Boring # **H-15**
Sample # **2**
Depth **4-7 ft.**
Soil ID **Scripps**

Dia (mm)	**% pass**
152.4	
127	
101.6	
76.2	
50.8	
38.1	
19.05	
12.7	
9.525	100
4.75 (#4)	99.4
2.38 (#8)	99.1
2.0 (#10)	99
1.18 (#16)	98.7
0.6 (#30)	98.3
0.42 (#40)	98
0.3 (#50)	97.7
0.15 (#100)	97
.075 (#200)	92.2
0.0412	83.4
0.0304	73.2
0.0202	61
0.0121	50.8
0.0088	44.7
0.0063	38.6
0.0032	30.5
0.0013	24.4

Cu =	17.7	
Cc=	0.4	
D10=	0.0012	
Ks=	1.44E-06	cm/sec
Ks=	0.0020	inch/hour
LL=	57	
PL=	25	
PI =	22	
Class:	Fat Clay (CH)	

Boring # **H-16**
Sample # **1**
Depth **5-6.5 ft.**
Soil ID **Scripps**

Dia (mm)	% pass
152.4	
127	
101.6	
76.2	
50.8	
38.1	
19.05	
12.7	
9.525	
4.75 (#4)	100
2.38 (#8)	99.8
2.0 (#10)	99.7
1.18 (#16)	99
0.6 (#30)	97.1
0.42 (#40)	95.1
0.3 (#50)	92.7
0.15 (#100)	85.7
.075 (#200)	76.4

Cu =	17	
Cc=	0.4	
D10=	0.0014	
Ks=	1.96E-06	cm/sec
Ks=	0.0028	inch/hour
LL=	50	
PL=	32	
PI =	18	
Class:	Sandy Silt (ML)	

Boring #	**H-17**
Sample #	**3**
Depth	**7-10 ft.**
Soil ID	**Scripps**

Dia (mm)	**% pass**
152.4	
127	
101.6	
76.2	
50.8	
38.1	
19.05	
12.7	
9.525	
4.75 (#4)	100
2.38 (#8)	99.9
2.0 (#10)	99.9
1.18 (#16)	99.8
0.6 (#30)	99.6
0.42 (#40)	99.4
0.3 (#50)	99.2
0.15 (#100)	98.3
.075 (#200)	95.9
0.0408	87.5
0.0299	79.3
0.0196	71.2
0.0119	59
0.0086	52.9
0.0062	44.7
0.0031	36.6
0.0013	28.5

Cu =	11.2	
Cc=	0.2	
D10=	0.0011	
Ks=	1.21E-06	cm/sec
Ks=	0.0017	inch/hour
LL=	42	
PL=	17	
PI =	25	
Class:	Sandy Clay (CL)	

Boring # **H-20**
Sample # **1**
Depth **3-5 ft.**
Soil ID **Scripps**

Dia (mm)	**% pass**
152.4	
127	
101.6	
76.2	
50.8	
38.1	
19.05	
12.7	
9.525	
4.75 (#4)	100
2.38 (#8)	98.8
2.0 (#10)	98.5
1.18 (#16)	97.9
0.6 (#30)	97.2
0.42 (#40)	96.8
0.3 (#50)	96.4
0.15 (#100)	95.6
.075 (#200)	90.2
0.0423	87.5
0.031	79.3
0.0204	71.2
0.0121	59
0.0088	52.9
0.0063	44.7
0.0032	36.6
0.0013	28.5

Cu =	11.2	
Cc=	0.2	
D10=	0.0011	
Ks=	1.21E-06	cm/sec
Ks=	0.0017	inch/hour
LL=	41	
PL=	18	
PI =	23	
Class:	Sandy Clay (CL)	

Attachment No. 4

Analysis and Calculation

Infiltration Rate

San Diego North City NCWRP Expansion
Project Number: 684476
Date: 7/14/2017
Note: Data based on CH2M HILL Final Geotechnical Report (November, 1992)
Method: Soil Infiltration Rate Estimate (Hazen 1892 & Cronican and Gribb 2004)

Project Name	Boring No.	Sample No.	Depth (feet)	D10	Ks (cm/sec)	Ks (inch/hour)	Material	Soil Type
CWP - North City Site (NTP-1 & NSF-2)	T-1		3-4	0.0008	0.00000064	0.0009	Fill	SC
Eastgate Mall Site, North City Reclamation Plan and Sludge Processing Facilities	B-2		5-7	0.02	0.0004	0.5669	Fill	SM
North City Water Reclamation Plan	TP-91-12	1-B	0-6	0.02	0.0004	0.5669	Fill	GM
North City Water Reclamation Plan	TP-91-19	1-B	0-2	0.03	0.0009	1.2756	Fill	GC-GM
CWP - North City Site (NTP-1 & NSF-2)	T-7		3	0.0065	0.00004225	0.0599	Lindavista	SM
CWP - North City Site (NTP-1 & NSF-2)	T-2		8-9	0.002	0.000004	0.0057	Scripps	SC
CWP - North City Site (NTP-1 & NSF-2)	T-3		12	0.001	0.000001	0.0014	Scripps	CH
Sludge Dewatering Facility	DH-204	1	5	0.004	0.000016	0.0227	Scripps	ML

Material	Infiltration Rate (inch/hour)		
	Min	Max	Median
Fill	0.0009	1.2756	0.5669
Lindavista	0.0599	-	-
Scripps	0.0014	0.0227	0.0057

Project Name: **North City Water Reclamation Plant Expansion**
Project No. **44F1**
Subject: **Soil Infiltration Rate Estimate (Hazen 1892 & Cronican and Gribb 2004)**

Formula: Ks = c (d10^2)
Ks = Hydraulic Conductivity (cm/sec)
c = Constant which varies between 1.0 and 1.5. A value of 1.0 is selected for this project.
d10 = Particle size diameter for which 10% (by mass) of the particles in a soil sample are finer (mm)

Soil ID	Min Inf. Rate	Max Inf. Rate	Median Inf. Rate
	(inch/hour)		
Fill	0.0024	1.45	0.0028
Qvop	0.0028	0.6073	*
Scripps	0.0017	1.45	0.0024

NOTE:
* Insufficient sample size

Boring #	**H-2**
Sample #	**3**
Depth	**11-15 ft**
Soil ID	**Fill**

Dia (mm)	**% pass**
152.4	
127	
101.6	
76.2	
50.8	100
38.1	99.3
19.05	98.6
12.7	89.7
9.525	81.7
4.75 (#4)	67.8
2.38 (#8)	61.1
2.0 (#10)	59.8
1.18 (#16)	56.3
0.6 (#30)	52.4
0.42 (#40)	46.8
0.3 (#50)	39.3
0.15 (#100)	26.1
.075 (#200)	19.3

Cu = 214.2
Cc= 4.9
D10= 0.032
Ks= 0.001024 cm/sec
Ks= 1.4513 inch/hour

Boring # **H-3**
Sample # **8**
Depth **41-41.5 ft.**
Soil ID **Scripps**

Dia (mm)	**% pass**
152.4	
127	
101.6	
76.2	
50.8	
38.1	
19.05	
12.7	
9.525	
4.75 (#4)	100
2.38 (#8)	99.7
2.0 (#10)	99.5
1.18 (#16)	93.1
0.6 (#30)	92.1
0.42 (#40)	91.3
0.3 (#50)	90.6
0.15 (#100)	87.3
.075 (#200)	66.5

Cu =	25.7	
Cc=	0.5	
D10=	0.0014	
Ks=	1.96E-06	cm/sec
Ks=	0.0028	inch/hour

Boring #	**H-3**
Sample #	**13**
Depth	**65.5-66 ft.**
Soil ID	**Scripps**

Dia (mm)	**% pass**
152.4	
127	
101.6	
76.2	
50.8	
38.1	
19.05	
12.7	
9.525	
4.75 (#4)	
2.38 (#8)	
2.0 (#10)	
1.18 (#16)	100
0.6 (#30)	99.9
0.42 (#40)	99.7
0.3 (#50)	84.8
0.15 (#100)	35.8
.075 (#200)	15.8

Cu =	12.6	
Cc=	5.1	
D10=	0.032	
Ks=	0.001024	cm/sec
Ks=	1.4513	inch/hour

Boring # **H-4**
Sample # **1**
Depth **3-6 ft.**
Soil ID **Qvop**

Dia (mm)	**% pass**
152.4	
127	
101.6	
76.2	
50.8	
38.1	
19.05	
12.7	
9.525	100
4.75 (#4)	98.8
2.38 (#8)	96.4
2.0 (#10)	96
1.18 (#16)	94.6
0.6 (#30)	92.4
0.42 (#40)	84.6
0.3 (#50)	72.3
0.15 (#100)	51.3
.075 (#200)	42.5

Cu =	72.4	
Cc=	0.8	
D10=	0.0014	
Ks=	1.96E-06	cm/sec
Ks=	0.0028	inch/hour

Boring # **H-5**
Sample # **2**
Depth **4-7 ft.**
Soil ID **Fill**

Dia (mm)	**% pass**
152.4	
127	
101.6	
76.2	
50.8	
38.1	100
19.05	99.4
12.7	98.9
9.525	98.1
4.75 (#4)	96.2
2.38 (#8)	94.1
2.0 (#10)	93.6
1.18 (#16)	91.8
0.6 (#30)	89.2
0.42 (#40)	85.3
0.3 (#50)	80.5
0.15 (#100)	71
.075 (#200)	60.9

Cu =	34.6	
Cc=	0.5	
D10=	0.0014	
Ks=	1.96E-06	cm/sec
Ks=	0.0028	inch/hour

Boring #	**H-5**
Sample #	**10**
Depth	**30-35 ft.**
Soil ID	**Scripps**

Dia (mm)	**% pass**
152.4	
127	
101.6	
76.2	
50.8	
38.1	
19.05	
12.7	
9.525	
4.75 (#4)	100
2.38 (#8)	99.7
2.0 (#10)	99.6
1.18 (#16)	99.1
0.6 (#30)	98.4
0.42 (#40)	97.8
0.3 (#50)	97.2
0.15 (#100)	93.7
.075 (#200)	83.2
0.0434	73.2
0.032	63.1
0.0207	57
0.0122	50.8
0.0088	44.7
0.0063	40.7
0.0032	34.6
0.0013	26.4

Cu =	23	
Cc=	0.1	
D10=	0.0013	
Ks=	1.69E-06	cm/sec
Ks=	0.0024	inch/hour
LL=	35	
PL=	15	
PI =	20	
Class:	Sandy Clay (CL)	

Boring # **H-7**
Sample # **2**
Depth **5-8 ft.**
Soil ID **Qvop**

Dia (mm)	% pass
152.4	
127	
101.6	
76.2	100
50.8	99.3
38.1	99
19.05	95.4
12.7	86
9.525	76.2
4.75 (#4)	61.2
2.38 (#8)	55.7
2.0 (#10)	55
1.18 (#16)	53.2
0.6 (#30)	51.2
0.42 (#40)	47.6
0.3 (#50)	42.2
0.15 (#100)	31.2
.075 (#200)	25.4

Cu = 23
Cc= 0.1
D10= 0.0207
Ks= 0.000428 cm/sec
Ks= 0.6073 inch/hour

Boring # **H-8**
Sample # **1**
Depth **4-7 ft.**
Soil ID **Fill**

Dia (mm)	**% pass**
152.4	
127	
101.6	
76.2	
50.8	100
38.1	99.3
19.05	98.5
12.7	96.2
9.525	94.6
4.75 (#4)	90.3
2.38 (#8)	86
2.0 (#10)	85
1.18 (#16)	82.2
0.6 (#30)	78.6
0.42 (#40)	72.8
0.3 (#50)	64.9
0.15 (#100)	51
.075 (#200)	43

Cu =	23	
Cc=	0.1	
D10=	0.0125	
Ks=	0.000156	cm/sec
Ks=	0.2215	inch/hour

Boring #	**H-8**
Sample #	**8**
Depth	**31-31.5 ft.**
Soil ID	**Fill**

Dia (mm)	**% pass**
152.4	
127	
101.6	
76.2	
50.8	
38.1	
19.05	
12.7	
9.525	100
4.75 (#4)	95.6
2.38 (#8)	93.4
2.0 (#10)	92.9
1.18 (#16)	91.4
0.6 (#30)	89.2
0.42 (#40)	83.6
0.3 (#50)	75.5
0.15 (#100)	55.5
.075 (#200)	41.3
0.0486	40.7
0.0351	34.6
0.0225	30.5
0.0131	26.4
0.0094	22.4
0.0067	20.3
0.0033	18.3
0.0014	12.2

Cu =	133.4	
Cc=	1.9	
D10=	0.0014	
Ks=	1.96E-06	cm/sec
Ks=	0.0028	inch/hour

Boring #	**H-9**
Sample #	**2**
Depth	**9-12 ft.**
Soil ID	**Fill**

Dia (mm)	**% pass**
152.4	
127	
101.6	
76.2	
50.8	100
38.1	99.4
19.05	97.7
12.7	95.8
9.525	94.6
4.75 (#4)	93.8
2.38 (#8)	91.8
2.0 (#10)	91.4
1.18 (#16)	90
0.6 (#30)	88
0.42 (#40)	84.7
0.3 (#50)	80.6
0.15 (#100)	72.9
.075 (#200)	63.8
0.0456	61
0.0327	57
0.021	52.9
0.0125	44.7
0.009	38.6
0.0064	34.6
0.0032	26.4
0.0014	20.3

Cu =	35.9	
Cc=	0.4	
D10=	0.0013	
Ks=	1.69E-06	cm/sec
Ks=	0.0024	inch/hour

Boring #	**H-9**
Sample #	**19**
Depth	**75-76.3 ft.**
Soil ID	**Scripps**

Dia (mm)	**% pass**
152.4	
127	
101.6	
76.2	
50.8	
38.1	
19.05	
12.7	
9.525	
4.75 (#4)	
2.38 (#8)	
2.0 (#10)	100
1.18 (#16)	99.7
0.6 (#30)	99.6
0.42 (#40)	99.5
0.3 (#50)	99.4
0.15 (#100)	99
.075 (#200)	97
0.0427	77.3
0.0322	61
0.0214	46.8
0.0128	86.6
0.0092	32.5
0.0066	28.5
0.0033	18.3
0.0014	10.2

Cu =	22.3	
Cc=	1.3	
D10=	0.0014	
Ks=	1.96E-06	cm/sec
Ks=	0.0028	inch/hour

Boring # **H-10**
Sample # **1**
Depth **3-7'**
Soil ID **Fill**

Dia (mm)	**% pass**
152.4	
127	
101.6	
76.2	
50.8	
38.1	100
19.05	99.3
12.7	97.6
9.525	96.6
4.75 (#4)	94.5
2.38 (#8)	91.7
2.0 (#10)	91.2
1.18 (#16)	89.7
0.6 (#30)	88
0.42 (#40)	86
0.3 (#50)	83.5
0.15 (#100)	78
.075 (#200)	68.9

Cu =	22.3	
Cc=	1.3	
D10=	0.0014	
Ks=	1.96E-06	cm/sec
Ks=	0.0028	inch/hour

Boring #	**H-11**
Sample #	**2**
Depth	**10-11.5 ft.**
Soil ID	**Fill**

Dia (mm)	**% pass**
152.4	
127	
101.6	
76.2	
50.8	
38.1	
19.05	
12.7	
9.525	
4.75 (#4)	100
2.38 (#8)	98.5
2.0 (#10)	98.3
1.18 (#16)	97.8
0.6 (#30)	97.3
0.42 (#40)	96.8
0.3 (#50)	96
0.15 (#100)	93.7
.075 (#200)	84.4

Cu =	22.3	
Cc=	1.3	
D10=	0.0013	
Ks=	1.69E-06	cm/sec
Ks=	0.0024	inch/hour

Boring # **H-11**
Sample # **6**
Depth **21-24 ft.**
Soil ID **Scripps**

Dia (mm)	**% pass**
152.4	
127	
101.6	
76.2	
50.8	
38.1	
19.05	
12.7	
9.525	
4.75 (#4)	100
2.38 (#8)	99.6
2.0 (#10)	99.5
1.18 (#16)	99.3
0.6 (#30)	99
0.42 (#40)	98.7
0.3 (#50)	98.4
0.15 (#100)	96.7
.075 (#200)	85.5

Cu =	22.3	
Cc=	1.3	
D10=	0.0013	
Ks=	1.69E-06	cm/sec
Ks=	0.0024	inch/hour
LL=	43	
PL=	16	
PI =	27	
Class:	Sandy Clay (CL)	

Boring #	**H-12**
Sample #	**7**
Depth	**21-24 ft.**
Soil ID	**Fill**

Dia (mm)	**% pass**
152.4	
127	
101.6	
76.2	
50.8	
38.1	
19.05	
12.7	
9.525	100
4.75 (#4)	98.4
2.38 (#8)	97.1
2.0 (#10)	96.8
1.18 (#16)	95.9
0.6 (#30)	94.6
0.42 (#40)	93.1
0.3 (#50)	91.2
0.15 (#100)	87.3
.075 (#200)	80.7

Cu =	22.3	
Cc=	1.3	
D10=	0.0013	
Ks=	1.69E-06	cm/sec
Ks=	0.0024	inch/hour

Boring # **H-13**
Sample # **1**
Depth **3-7 ft.**
Soil ID **Fill**

Dia (mm)	% pass
152.4	
127	
101.6	
76.2	
50.8	
38.1	
19.05	100
12.7	99.6
9.525	99
4.75 (#4)	97.3
2.38 (#8)	95.1
2.0 (#10)	94.7
1.18 (#16)	93.5
0.6 (#30)	92
0.42 (#40)	89.8
0.3 (#50)	86.9
0.15 (#100)	80.6
.075 (#200)	73.3

Cu =	22.3	
Cc=	1.3	
D10=	0.0013	
Ks=	1.69E-06	cm/sec
Ks=	0.0024	inch/hour

Boring # **H-13**
Sample # **25**
Depth **90-100 ft.**
Soil ID **Scripps**

Dia (mm)	**% pass**
152.4	
127	
101.6	
76.2	
50.8	
38.1	
19.05	
12.7	
9.525	
4.75 (#4)	100
2.38 (#8)	91.6
2.0 (#10)	91.4
1.18 (#16)	90.9
0.6 (#30)	90.4
0.42 (#40)	90
0.3 (#50)	89.7
0.15 (#100)	89
.075 (#200)	87.4
0.0416	81.4
0.0307	71.2
0.0201	63.1
0.012	52.9
0.0088	44.7
0.0063	40.7
0.0032	28.5
0.0014	20.3

Cu =	14.8	
Cc=	0.6	
D10=	0.0013	
Ks=	1.69E-06	cm/sec
Ks=	0.0024	inch/hour
LL=	42	
PL=	17	
PI =	25	
Class:	Sandy Clay (CL)	

Boring # **H-14**
Sample # **2**
Depth **4-7 ft.**
Soil ID **Fill**

Dia (mm)	**% pass**
152.4	
127	
101.6	
76.2	
50.8	
38.1	
19.05	
12.7	
9.525	100
4.75 (#4)	99.1
2.38 (#8)	98.2
2.0 (#10)	98
1.18 (#16)	97.3
0.6 (#30)	96.4
0.42 (#40)	95.2
0.3 (#50)	93.5
0.15 (#100)	89.4
.075 (#200)	83.1

Cu =	14.8	
Cc=	0.6	
D10=	0.0013	
Ks=	1.69E-06	cm/sec
Ks=	0.0024	inch/hour
LL=	42	
PL=	16	
PI =	26	
Class:	Sandy Clay (CL)	

Boring # **H-14**
Sample # **7**
Depth **20-24 ft.**
Soil ID **Fill**

Dia (mm)	**% pass**
152.4	
127	
101.6	
76.2	
50.8	
38.1	
19.05	
12.7	
9.525	100
4.75 (#4)	97.3
2.38 (#8)	95.7
2.0 (#10)	95.4
1.18 (#16)	94.5
0.6 (#30)	93
0.42 (#40)	90.5
0.3 (#50)	86.9
0.15 (#100)	76.3
.075 (#200)	65

Cu =	14.8	
Cc=	0.6	
D10=	0.0014	
Ks=	1.96E-06	cm/sec
Ks=	0.0028	inch/hour
LL=	35	
PL=	13	
PI =	22	
Class:	Sandy Clay (CL)	

Boring # **H-15**
Sample # **2**
Depth **4-7 ft.**
Soil ID **Scripps**

Dia (mm)	% pass
152.4	
127	
101.6	
76.2	
50.8	
38.1	
19.05	
12.7	
9.525	100
4.75 (#4)	99.4
2.38 (#8)	99.1
2.0 (#10)	99
1.18 (#16)	98.7
0.6 (#30)	98.3
0.42 (#40)	98
0.3 (#50)	97.7
0.15 (#100)	97
.075 (#200)	92.2
0.0412	83.4
0.0304	73.2
0.0202	61
0.0121	50.8
0.0088	44.7
0.0063	38.6
0.0032	30.5
0.0013	24.4

Cu = 17.7
Cc= 0.4
D10= 0.0012
Ks= 1.44E-06 cm/sec
Ks= 0.0020 inch/hour
LL= 57
PL= 25
PI = 22
Class: Fat Clay (CH)

Boring # **H-16**
Sample # **1**
Depth **5-6.5 ft.**
Soil ID **Scripps**

Dia (mm)	**% pass**
152.4	
127	
101.6	
76.2	
50.8	
38.1	
19.05	
12.7	
9.525	
4.75 (#4)	100
2.38 (#8)	99.8
2.0 (#10)	99.7
1.18 (#16)	99
0.6 (#30)	97.1
0.42 (#40)	95.1
0.3 (#50)	92.7
0.15 (#100)	85.7
.075 (#200)	76.4

Cu =	17	
Cc=	0.4	
D10=	0.0014	
Ks=	1.96E-06	cm/sec
Ks=	0.0028	inch/hour
LL=	50	
PL=	32	
PI =	18	
Class:	Sandy Silt (ML)	

Boring # **H-17**
Sample # **3**
Depth **7-10 ft.**
Soil ID **Scripps**

Dia (mm)	**% pass**
152.4	
127	
101.6	
76.2	
50.8	
38.1	
19.05	
12.7	
9.525	
4.75 (#4)	100
2.38 (#8)	99.9
2.0 (#10)	99.9
1.18 (#16)	99.8
0.6 (#30)	99.6
0.42 (#40)	99.4
0.3 (#50)	99.2
0.15 (#100)	98.3
.075 (#200)	95.9
0.0408	87.5
0.0299	79.3
0.0196	71.2
0.0119	59
0.0086	52.9
0.0062	44.7
0.0031	36.6
0.0013	28.5

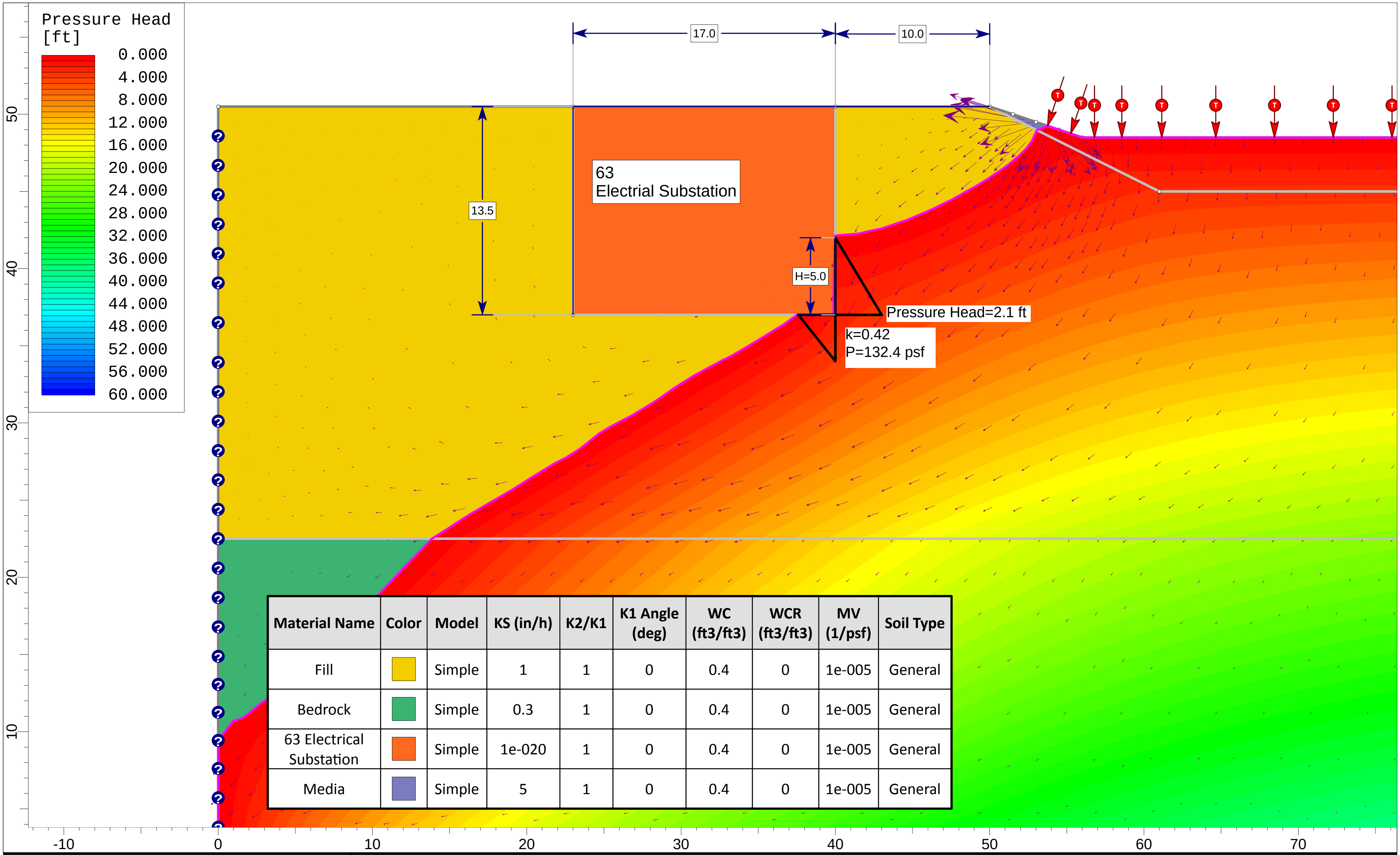
Cu = 11.2
Cc= 0.2
D10= 0.0011
Ks= 1.21E-06 cm/sec
Ks= 0.0017 inch/hour
LL= 42
PL= 17
PI = 25
Class: Sandy Clay (CL)

Boring # **H-20**
Sample # **1**
Depth **3-5 ft.**
Soil ID **Scripps**

Dia (mm)	**% pass**
152.4	
127	
101.6	
76.2	
50.8	
38.1	
19.05	
12.7	
9.525	
4.75 (#4)	100
2.38 (#8)	98.8
2.0 (#10)	98.5
1.18 (#16)	97.9
0.6 (#30)	97.2
0.42 (#40)	96.8
0.3 (#50)	96.4
0.15 (#100)	95.6
.075 (#200)	90.2
0.0423	87.5
0.031	79.3
0.0204	71.2
0.0121	59
0.0088	52.9
0.0063	44.7
0.0032	36.6
0.0013	28.5

Cu =	11.2	
Cc=	0.2	
D10=	0.0011	
Ks=	1.21E-06	cm/sec
Ks=	0.0017	inch/hour
LL=	41	
PL=	18	
PI =	23	
Class:	Sandy Clay (CL)	

Unsaturated Transient Seepage Analysis (Slide)



Material Name	Color	Model	KS (in/h)	K2/K1	K1 Angle (deg)	WC (ft3/ft3)	WCR (ft3/ft3)	MV (1/psf)	Soil Type
Fill	🟨	Simple	1	1	0	0.4	0	1e-005	General
Bedrock	🟩	Simple	0.3	1	0	0.4	0	1e-005	General
63 Electrical Substation	🟧	Simple	1e-020	1	0	0.4	0	1e-005	General
Media	🟪	Simple	5	1	0	0.4	0	1e-005	General

SLIDEINTERPRET 7.009

Project	San Diego NCWRP Expansion
Analysis Description	BMP2 - Transient Seepage Analysis (Boring H-12)
Drawn By	GB
Scale	1:103
Company	CH2M
Date	7/12/2017, 1:44:13 PM
File Name	BMP2 - Infiltration with Time.slim

Slide Analysis Information
San Diego NCWRP Expansion

Results at Initial Stage

Project Summary

File Name:	BMP2 - infiltration with time.slim
Slide Modeler Version:	7.009
Project Title:	San Diego NCWRP Expansion
Analysis:	BMP2 - Transient Seepage Analysis (Boring H-12)
Author:	GB
Company:	CH2M
Date Created:	7/12/2017, 1:44:13 PM

General Settings

Units of Measurement:	Imperial Units
Time Units:	hours
Permeability Units:	inches/hour
Failure Direction:	Right to Left
Data Output:	Standard
Maximum Material Properties:	20
Maximum Support Properties:	20

Analysis Options

Slices Type:	Vertical

Analysis Methods Used	
	Bishop simplified
	Janbu simplified

Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Advanced Groundwater Method:	Transient FEA

Transient Settings

Stage Name	Time [h]	Calculate Safety Factor
Stage 1	14	No
Stage 2	38	No
Stage 3	182	No

Tolerance (Transient):	1e-006
Maximum number of iterations (Transient):	500
Time Steps (Transient):	Automatic
Mesh Element Type:	6 noded triangles
Number of Elements:	1186
Number of Nodes:	2529

Transient Boundary Conditions

1

Time [h]	Pressure Head [ft]
0	1
14	1
38	0

Seepage Face Condition: Yes

0.75

Time [h]	Pressure Head [ft]
0	0.75
14	0.75
38	0

Seepage Face Condition: Yes

0.5

Time [h]	Pressure Head [ft]
0	0.5
14	0.5
38	0

Seepage Face Condition: Yes

0.25

Time [h]	Pressure Head [ft]
0	0.25
14	0.25
38	0

Seepage Face Condition: Yes

Infiltration 5 inch per hour

Time [h]	Normal Infiltration [ft/h]
0	0.416667
14	0.416667
38	0.416667
38.001	0

Seepage Face Condition: Yes

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Surface Type:	Circular
Search Method:	Grid Search
Radius Increment:	10
Composite Surfaces:	Disabled
Reverse Curvature:	Invalid Surfaces
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic

Advanced Seismic Analysis:	No
Staged pseudostatic analysis:	No

Material Properties

Property	Fill	Bedrock	63 Electrical Substation	Media
Color	🟨	🟩	🟧	🟪
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	120	120	120	120
Cohesion [psf]	0.02	0.02	1e+006	0.02
Friction Angle [deg]	35	35	42	35
Water Surface	None	None	None	None
Ru Value	0	0	0	0

List Of Coordinates

External Boundary

X	Y
230	0
230	22.5
230	50.5
210	50.5
208.5	50
207	49.5
205.5	49
204	48.5
56	48.5
54.5	49
53	49.5
51.5	50
50	50.5
40	50.5
23	50.5
0	50.5
0	22.5
0	0

Material Boundary

X	Y
50	50.5
61	45

Material Boundary

X	Y
61	45
199	45

Material Boundary

X	Y
0	22.5
230	22.5

Material Boundary

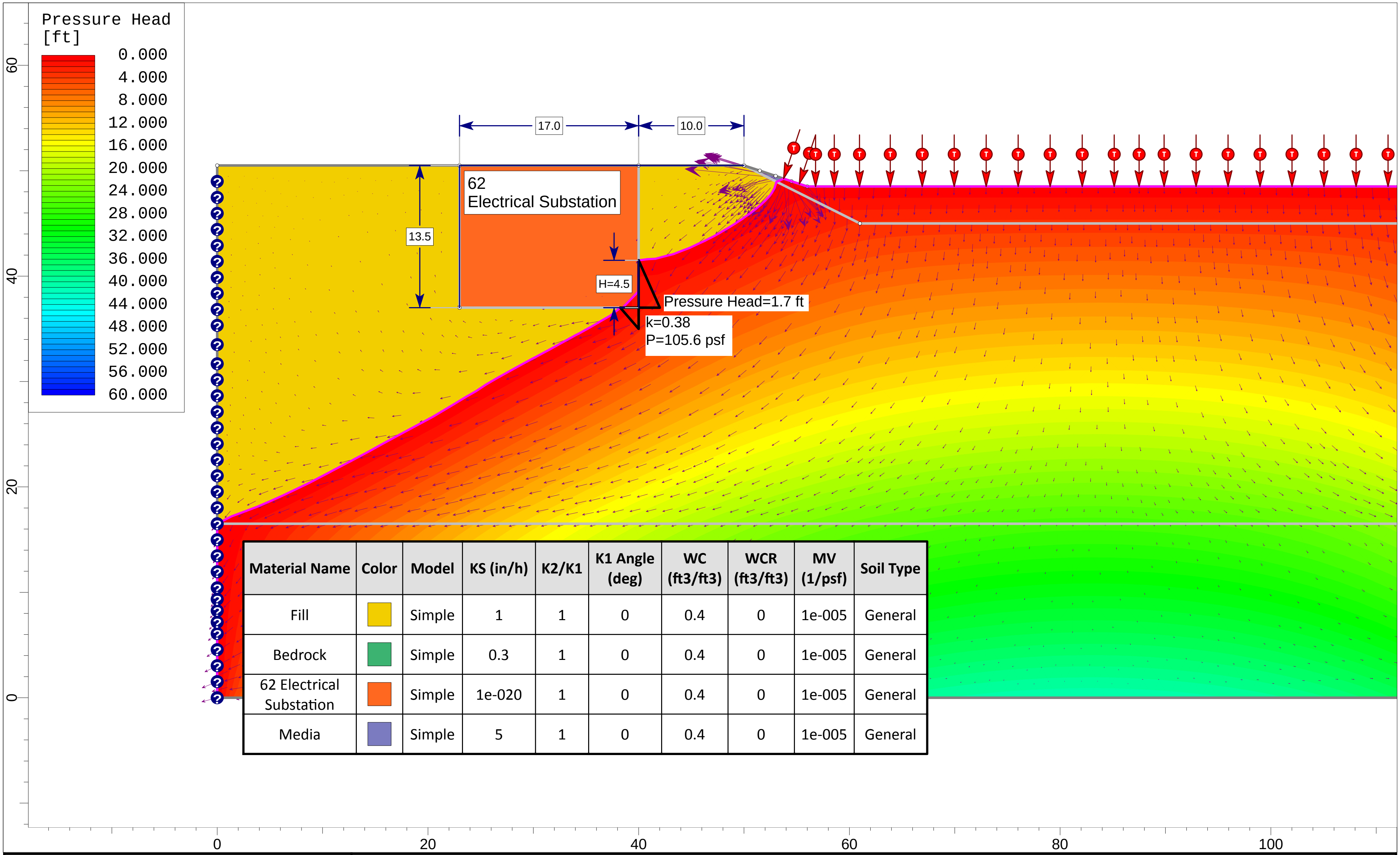
X	Y
23	50.5
23	37
40	37

Material Boundary

X	Y
40	37
40	50.5

Material Boundary

X	Y
199	45
210	50.5



Material Name	Color	Model	KS (in/h)	K2/K1	K1 Angle (deg)	WC (ft3/ft3)	WCR (ft3/ft3)	MV (1/psf)	Soil Type
Fill	🟨	Simple	1	1	0	0.4	0	1e-005	General
Bedrock	🟩	Simple	0.3	1	0	0.4	0	1e-005	General
62 Electrical Substation	🟧	Simple	1e-020	1	0	0.4	0	1e-005	General
Media	🟪	Simple	5	1	0	0.4	0	1e-005	General

SLIDEINTERPRET 7.009

Project	San Diego NCWRP Expansion
Analysis Description	BMP3 - Transient Seepage Analysis (Boring H-9)
Drawn By	GB
Scale	1:151
Company	CH2M
Date	7/12/2017, 1:44:13 PM
File Name	BMP3 - infiltration with time.slim

Slide Analysis Information

San Diego NCWRP Expansion

Results at Initial Stage

Project Summary

File Name:	BMP3 - infiltration with time.slim
Slide Modeler Version:	7.009
Project Title:	San Diego NCWRP Expansion
Analysis:	BMP3 - Transient Seepage Analysis (Boring H-9)
Author:	GB
Company:	CH2M
Date Created:	7/12/2017, 1:44:13 PM

General Settings

Units of Measurement:	Imperial Units
Time Units:	hours
Permeability Units:	inches/hour
Failure Direction:	Right to Left
Data Output:	Standard
Maximum Material Properties:	20
Maximum Support Properties:	20

Analysis Options

Slices Type:	Vertical

Analysis Methods Used	
	Bishop simplified
	Janbu simplified

Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Advanced Groundwater Method:	Transient FEA

Transient Settings

Stage Name	Time [h]	Calculate Safety Factor
Stage 1	14	No
Stage 2	38	No
Stage 3	182	No

Tolerance (Transient):	1e-006
Maximum number of iterations (Transient):	500
Time Steps (Transient):	Automatic
Mesh Element Type:	6 noded triangles
Number of Elements:	1292
Number of Nodes:	2723

Transient Boundary Conditions

1

Time [h]	Pressure Head [ft]
0	1
14	1
38	0

Seepage Face Condition: Yes

0.75

Time [h]	Pressure Head [ft]
0	0.75
14	0.75
38	0

Seepage Face Condition: Yes

0.5

Time [h]	Pressure Head [ft]
0	0.5
14	0.5
38	0

Seepage Face Condition: Yes

0.25

Time [h]	Pressure Head [ft]
0	0.25
14	0.25
38	0

Seepage Face Condition: Yes

Infiltration 5 inch per hour

Time [h]	Normal Infiltration [ft/h]
0	0.416667
14	0.416667
38	0.416667
38.001	0

Seepage Face Condition: Yes

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Surface Type:	Circular
Search Method:	Grid Search
Radius Increment:	10
Composite Surfaces:	Disabled
Reverse Curvature:	Invalid Surfaces
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic

Advanced Seismic Analysis:	No
Staged pseudostatic analysis:	No

Material Properties

Property	Fill	Bedrock	62 Electrical Substation	Media
Color	🟨	🟩	🟧	🟪
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	120	120	120	120
Cohesion [psf]	0.02	0.02	1e+006	0.02
Friction Angle [deg]	35	35	42	35
Water Surface	None	None	None	None
Ru Value	0	0	0	0

List Of Coordinates

External Boundary

X	Y
145	0
145	16.5
145	50.5
125	50.5
123.5	50
122	49.5
120.5	49
119	48.5
56	48.5
54.5	49
53	49.5
51.5	50
50	50.5
40	50.5
23	50.5
0	50.5
0	16.5
0	0

Material Boundary

X	Y
50	50.5
61	45

Material Boundary

X	Y
61	45
114	45
125	50.5

Material Boundary

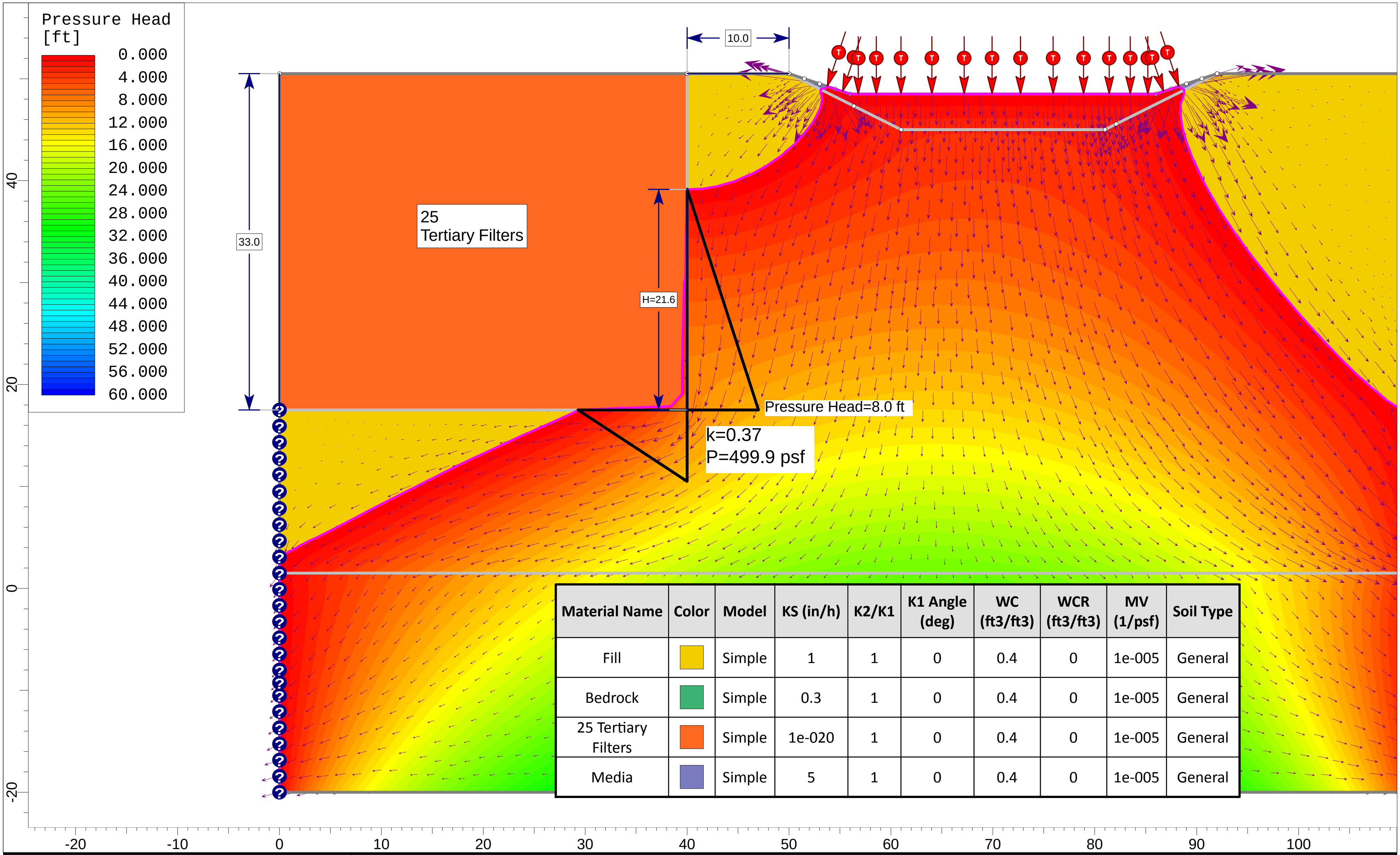
X	Y
0	16.5
145	16.5

Material Boundary

X	Y
23	50.5
23	37
40	37

Material Boundary

X	Y
40	50.5
40	37



Material Name	Color	Model	KS (in/h)	K2/K1	K1 Angle (deg)	WC (ft3/ft3)	WCR (ft3/ft3)	MV (1/psf)	Soil Type
Fill	🟨	Simple	1	1	0	0.4	0	1e-005	General
Bedrock	🟩	Simple	0.3	1	0	0.4	0	1e-005	General
25 Tertiary Filters	🟧	Simple	1e-020	1	0	0.4	0	1e-005	General
Media	🟪	Simple	5	1	0	0.4	0	1e-005	General

rocscience

SLIDEINTERPRET 7.009

Project	San Diego NCWRP Expansion
Analysis Description	BMP4 - Transient Seepage Analysis (Boring H-8)
Drawn By	GB
Scale	1:156
Company	CH2M
Date	7/12/2017, 1:44:13 PM
File Name	BMP4 - infiltration with time.slim

Slide Analysis Information
San Diego NCWRP Expansion

Results at Initial Stage

Project Summary

File Name:	BMP4 - infiltration with time.slim
Slide Modeler Version:	7.009
Project Title:	San Diego NCWRP Expansion
Analysis:	BMP4 - Transient Seepage Analysis (Boring H-8)
Author:	GB
Company:	CH2M
Date Created:	7/12/2017, 1:44:13 PM

General Settings

Units of Measurement:	Imperial Units
Time Units:	hours
Permeability Units:	inches/hour
Failure Direction:	Right to Left
Data Output:	Standard
Maximum Material Properties:	20
Maximum Support Properties:	20

Analysis Options

Slices Type:	Vertical

Analysis Methods Used	
	Bishop simplified
	Janbu simplified

Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Advanced Groundwater Method:	Transient FEA

Transient Settings

Stage Name	Time [h]	Calculate Safety Factor
Stage 1	14	No
Stage 2	38	No
Stage 3	182	No

Tolerance (Transient):	1e-006
Maximum number of iterations (Transient):	500
Time Steps (Transient):	Automatic
Mesh Element Type:	6 noded triangles
Number of Elements:	1428
Number of Nodes:	2981

Transient Boundary Conditions

1

Time [h]	Pressure Head [ft]
0	1
14	1
38	0

Seepage Face Condition: Yes

0.75

Time [h]	Pressure Head [ft]
0	0.75
14	0.75
38	0

Seepage Face Condition: Yes

0.5

Time [h]	Pressure Head [ft]
0	0.5
14	0.5
38	0

Seepage Face Condition: Yes

0.25

Time [h]	Pressure Head [ft]
0	0.25
14	0.25
38	0

Seepage Face Condition: Yes

Infiltration 5 inch per hour

Time [h]	Normal Infiltration [ft/h]
0	0.416667
14	0.416667
38	0.416667
38.001	0

Seepage Face Condition: Yes

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Surface Type:	Circular
Search Method:	Grid Search
Radius Increment:	10
Composite Surfaces:	Disabled
Reverse Curvature:	Invalid Surfaces
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic

Advanced Seismic Analysis:	No
Staged pseudostatic analysis:	No

Material Properties

Property	Fill	Bedrock	25 Tertiary Filters	Media
Color	🟨	🟩	🟧	🟪
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	120	120	120	120
Cohesion [psf]	0.02	0.02	1e+006	0.02
Friction Angle [deg]	35	35	42	35
Water Surface	None	None	None	None
Ru Value	0	0	0	0

List Of Coordinates

External Boundary

X	Y
112	-20
112	1.5
112	50.5
92	50.5
90.5	50
89	49.5
87.5	49
86	48.5
56	48.5
54.5	49
53	49.5
51.5	50
50	50.5
40	50.5
0	50.5
0	17.5
0	1.5
0	-20

Material Boundary

X	Y
0	17.5
40	17.5
40	50.5

Material Boundary

X	Y
50	50.5
56.3636	47.3182
61	45
81	45
82.1034	45.5517
92	50.5

Material Boundary

X	Y
0	1.5
112	1.5

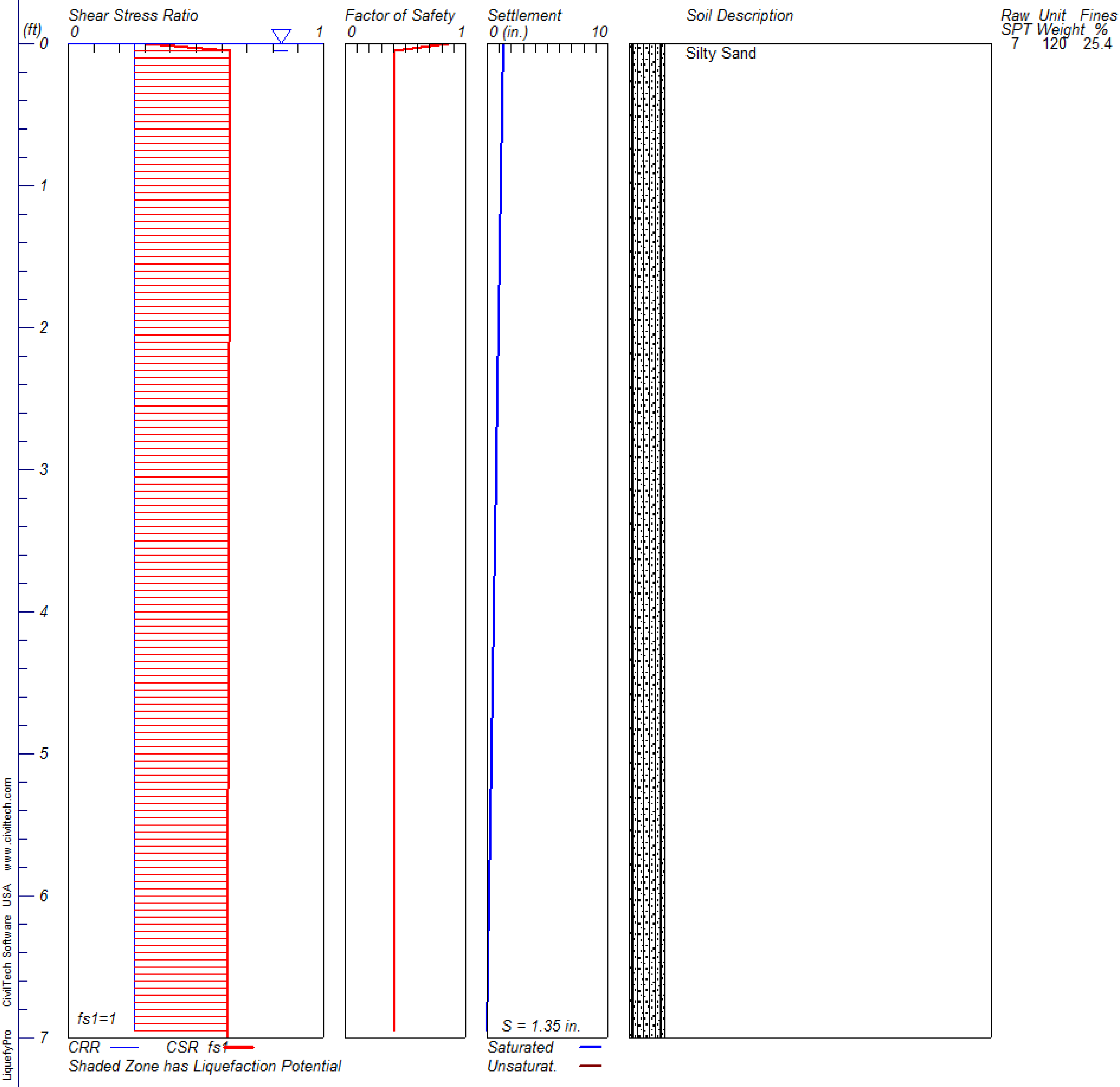
Liquefaction and Seismic Settlement (Liquefy Pro)

LIQUEFACTION ANALYSIS

San Diego North City WWTP

Hole No.=H-7 Water Depth=0 ft

Magnitude=6.8
Acceleration=0.469g

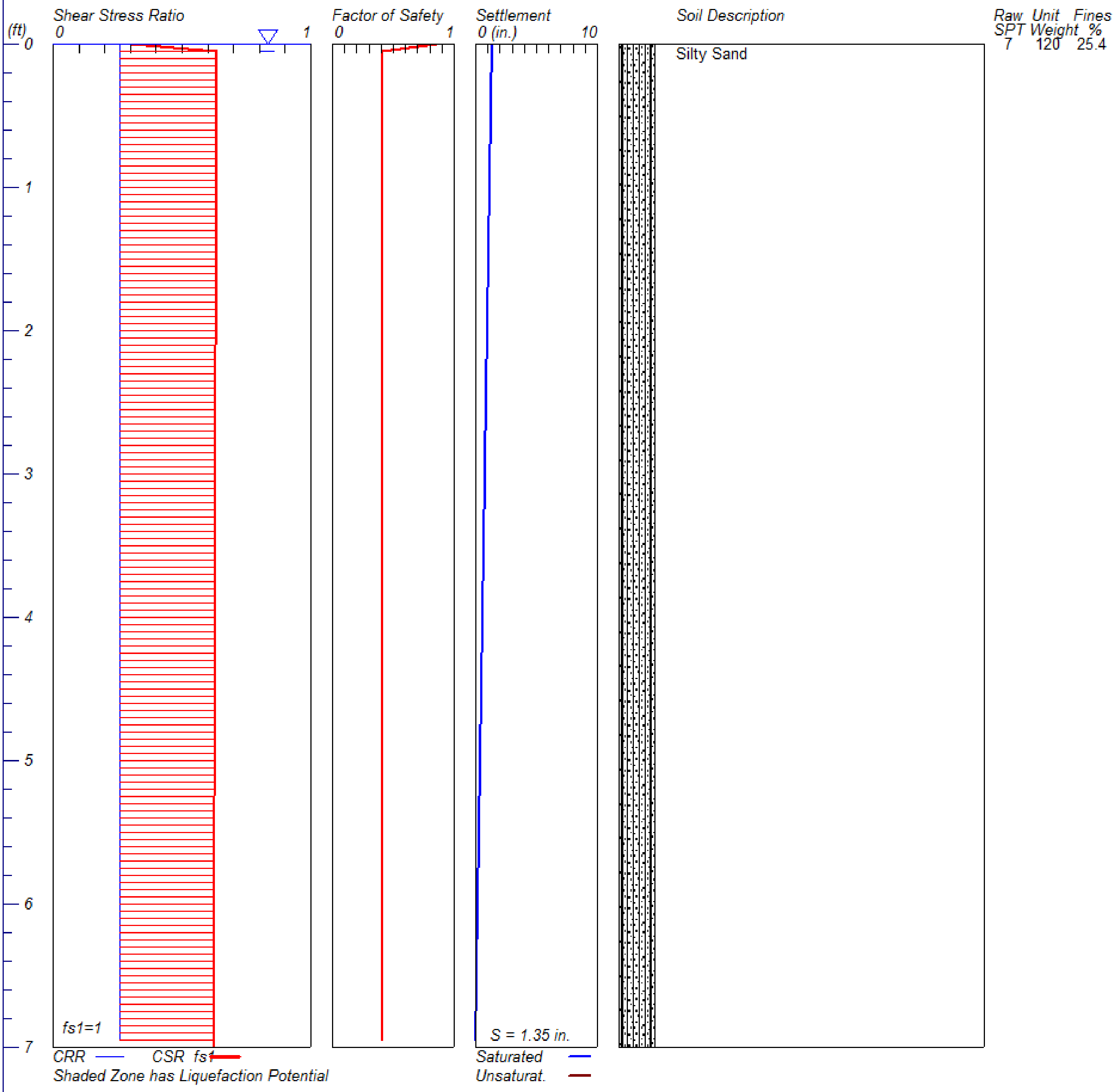


LIQUEFACTION ANALYSIS

San Diego North City WWTP

Hole No.=H-7 Water Depth=0 ft

Magnitude=6.8
Acceleration=0.469g



Attachment No. 5

Form I-8 for each BMP

BMP #1

<table>
<tr><td colspan="2">Categorization of Infiltration Feasibility Condition</td><td colspan="2">Form I-8</td></tr>
<tr><td colspan="4">Part 1 - Full Infiltration Feasibility Screening Criteria
Would infiltration of the full design volume be feasible from a physical perspective without any undesirable consequences that cannot be reasonably mitigated?</td></tr>
<tr><td>Criteria</td><td>Screening Question</td><td>Yes</td><td>No</td></tr>
<tr><td>1</td><td>Is the estimated reliable infiltration rate below proposed facility locations greater than 0.5 inches per hour? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.2 and Appendix D.</td><td></td><td>✓</td></tr>
<tr><td colspan="4">Provide basis: The site of BMP 1 consists of approximately 3 feet of engineered fill material underlain by native Scripps Formational materials, including dense to very dense fine-grained silty sandstone, hard sandy siltstone, sandy lean clay, and claystone. The expected infiltration rate for this BMP ranges between 0.1 inches per hour and 0.5 inches per hour, based on its location within the Scripps Formation. A sample from Boring H-13, which is the closest boring to the BMP taken during the 2017 geotechnical assessment, indicates a calculated potential infiltration rate of 0.0024 inches per hour. Therefore, the estimated infiltration rate below the proposed facility location is not greater than 0.5 inches per hour.
Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.</td></tr>
<tr><td>2</td><td>Can infiltration greater than 0.5 inches per hour be allowed without increasing risk of geotechnical hazards (slope stability, groundwater mounding, utilities, or other factors) that cannot be mitigated to an acceptable level? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.2.</td><td></td><td></td></tr>
<tr><td colspan="4">Provide basis:
Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.</td></tr>
</table>

<table>
<tr><th colspan="4">Form I-8 Page 2 of 4</th></tr>
<tr><td>Criteria</td><td>Screening Question</td><td>Yes</td><td>No</td></tr>
<tr><td>3</td><td>Can infiltration greater than 0.5 inches per hour be allowed without increasing risk of groundwater contamination (shallow water table, storm water pollutants or other factors) that cannot be mitigated to an acceptable level? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.3.</td><td></td><td></td></tr>
<tr><td colspan="4">Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.</td></tr>
<tr><td>4</td><td>Can infiltration greater than 0.5 inches per hour be allowed without causing potential water balance issues such as change of seasonality of ephemeral streams or increased discharge of contaminated groundwater to surface waters? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.3.</td><td></td><td></td></tr>
<tr><td colspan="4">Provide basis:
Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.</td></tr>
<tr><td>Part 1 Result*</td><td colspan="2">If all answers to rows 1 - 4 are “Yes” a full infiltration design is potentially feasible. The feasibility screening category is Full Infiltration
If any answer from row 1-4 is “No”, infiltration may be possible to some extent but would not generally be feasible or desirable to achieve a “full infiltration” design.</td><td></td></tr>
</table>

*To be completed using gathered site information and best professional judgment considering the definition of MEP in the MS4 Permit. Additional testing and/or studies may be required by the City Engineer to substantiate findings

Form I-8 Page 3 of 4			
Part 2 – Partial Infiltration vs. No Infiltration Feasibility Screening Criteria Would infiltration of water in any appreciable amount be physically feasible without any negative consequences that cannot be reasonably mitigated?			
Criteria	Screening Question	Yes	No
5	Do soil and geologic conditions allow for infiltration in any appreciable rate or volume? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.2 and Appendix D.	✓	
Provide basis: The site of BMP 1 consists of approximately 3 feet of engineered fill material underlain by native Scripps Formational materials, including dense to very dense fine-grained silty sandstone, hard sandy siltstone, sandy lean clay, and claystone. The expected infiltration rate for this BMP ranges between 0.1 inches per hour and 0.5 inches per hour, based on its location within the Scripps Formation. A sample from Boring H-13, which is the closest boring to the BMP taken during the 2017 geotechnical assessment, indicates a calculated potential infiltration rate of 0.0024 inches per hour. See the Evaluation of Geotechnical Impacts due to BMP Partial Infiltration for the NCWRP Expansion and NCPWF Influent Conveyance Project TM for the detailed evaluation. Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability and why it was not feasible to mitigate low infiltration rates.			
6	Can Infiltration in any appreciable quantity be allowed without increasing risk of geotechnical hazards (slope stability, groundwater mounding, utilities, or other factors) that cannot be mitigated to an acceptable level? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.2.	✓	
Provide basis: Due to the rather lengthy distance to the existing or the proposed facilities, geotechnical hazard impacts and risks to the adjacent facilities are considered low. However, it shall be noted that, the proposed asphalt parking lot on its west side and the access road on its east and south sides, respectively, may experience some early than expected surface cracking and roadway settlement due to potential subgrade pumping effect (pumping out of the fine subgrade particles when vehicles passing through), which may short their design service life. It may require early and more frequent regular maintenance to provide the intended services for these facilities with the design life. However, considering the relatively low infiltration rate of the Scripps Formation beneath the site, the risk and damage can be managed and remediated with relatively low cost, if the sides of the BMP are lined. The bottom of BMP 1 can be unlined and left open for infiltration. See the Evaluation of Geotechnical Impacts due to BMP Partial Infiltration for the NCWRP Expansion and NCPWF Influent Conveyance Project TM for the detailed evaluation. Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability and why it was not feasible to mitigate low infiltration rates.			

<table>
<tr><th colspan="4">Form I-8 Page 4 of 4</th></tr>
<tr><td>Criteria</td><td>Screening Question</td><td>Yes</td><td>No</td></tr>
<tr><td>7</td><td>Can Infiltration in any appreciable quantity be allowed without posing significant risk for groundwater related concerns (shallow water table, storm water pollutants or other factors)? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.3.</td><td>✓</td><td></td></tr>
<tr><td colspan="4">Provide basis: Based on the Final Geotechnical Report prepared by CH2M HILL (November, 1992), there was no evidence of groundwater in borings done when borings reached an elevation of 242 feet. Based on the Geotechnical Report prepared by Allied Geotechnical (August 9, 2017), there was no evidence of groundwater in borings done when borings reached an elevation of 328 feet.
Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability and why it was not feasible to mitigate low infiltration rates.</td></tr>
<tr><td>8</td><td>Can infiltration be allowed without violating downstream water rights? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.3.</td><td>✓</td><td></td></tr>
<tr><td colspan="4">Provide basis: Based on the Final Geotechnical Report prepared by CH2M HILL (November, 1992), there was no evidence of groundwater in borings done when borings reached an elevation of 242 feet. Based on the Geotechnical Report prepared by Allied Geotechnical (August 9, 2017), there was no evidence of groundwater in borings done when borings reached an elevation of 328 feet. There are no known downstream water rights issues.
Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability and why it was not feasible to mitigate low infiltration rates.</td></tr>
<tr><td>Part 2 Result*</td><td colspan="2">If all answers from row 1-4 are yes then partial infiltration design is potentially feasible. The feasibility screening category is Partial Infiltration.
If any answer from row 5-8 is no, then infiltration of any volume is considered to be infeasible within the drainage area. The feasibility screening category is No Infiltration.</td><td></td></tr>
</table>

*To be completed using gathered site information and best professional judgment considering the definition of MEP in the MS4 Permit. Additional testing and/or studies may be required by the City Engineer to substantiate findings

BMP #2

Categorization of Infiltration Feasibility Condition			**Form I-8**	
Part 1 - Full Infiltration Feasibility Screening Criteria Would infiltration of the full design volume be feasible from a physical perspective without any undesirable consequences that cannot be reasonably mitigated?				
Criteria	Screening Question		Yes	No
1	Is the estimated reliable infiltration rate below proposed facility locations greater than 0.5 inches per hour? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.2 and Appendix D.			✓
Provide basis: The site of BMP 2 consists of approximately 27 feet of engineered fill materials underlain by native Scripps Formational materials. The engineered fill materials consist of compacted medium dense to very dense gravelly silty sand, and fine-grained and cemented sandstone. The Scripps Formational materials consist of very dense fine to medium-grained silty sand and hard sandy silt, very dense fine to medium-grained poorly graded sand with silt, abundant gravels and cobbles at various depths, and interlayered claystone. The expected infiltration rate for this BMP ranges from less than 0.1 inches per hour to 0.5 inches per hour, based on its location within the fills. A sample from Boring H-12, which is the closest boring to the BMP taken during the 2017 geotechnical assessment, indicates a calculated potential infiltration rate of 0.0024 inches per hour. While this value would indicate a very low infiltration rate, CH2M expects fill materials to have relatively wide variability in infiltration rates from less than 0.1 inches per hour to 0.5 inches per hour. Therefore, the estimated infiltration rate below the proposed facility location is not greater than 0.5 inches per hour. Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.				
2	Can infiltration greater than 0.5 inches per hour be allowed without increasing risk of geotechnical hazards (slope stability, groundwater mounding, utilities, or other factors) that cannot be mitigated to an acceptable level? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.2.			
Provide basis: Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.				

<table>
<tr><th colspan="4">Form I-8 Page 2 of 4</th></tr>
<tr><td>Criteria</td><td>Screening Question</td><td>Yes</td><td>No</td></tr>
<tr><td>3</td><td>Can infiltration greater than 0.5 inches per hour be allowed without increasing risk of groundwater contamination (shallow water table, storm water pollutants or other factors) that cannot be mitigated to an acceptable level? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.3.</td><td></td><td></td></tr>
<tr><td colspan="4">Provide basis:

Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.</td></tr>
<tr><td>4</td><td>Can infiltration greater than 0.5 inches per hour be allowed without causing potential water balance issues such as change of seasonality of ephemeral streams or increased discharge of contaminated groundwater to surface waters? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.3.</td><td></td><td></td></tr>
<tr><td colspan="4">Provide basis:

Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.</td></tr>
<tr><td>Part 1 Result*</td><td colspan="2">If all answers to rows 1 - 4 are “Yes” a full infiltration design is potentially feasible. The feasibility screening category is Full Infiltration

If any answer from row 1-4 is “No”, infiltration may be possible to some extent but would not generally be feasible or desirable to achieve a “full infiltration” design.</td><td></td></tr>
</table>

*To be completed using gathered site information and best professional judgment considering the definition of MEP in the MS4 Permit. Additional testing and/or studies may be required by the City Engineer to substantiate findings

<table>
<tr><th colspan="4">Form I-8 Page 3 of 4</th></tr>
<tr><td colspan="4">Part 2 – Partial Infiltration vs. No Infiltration Feasibility Screening Criteria
Would infiltration of water in any appreciable amount be physically feasible without any negative consequences that cannot be reasonably mitigated?</td></tr>
<tr><td>Criteria</td><td>Screening Question</td><td>Yes</td><td>No</td></tr>
<tr><td>5</td><td>Do soil and geologic conditions allow for infiltration in any appreciable rate or volume? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.2 and Appendix D.</td><td>✓</td><td></td></tr>
<tr><td colspan="4">Provide basis: The site of BMP 2 consists of approximately 27 feet of engineered fill materials underlain by native Scripps Formational materials. The engineered fill materials consist of compacted medium dense to very dense gravelly silty sand, and fine-grained and cemented sandstone. The Scripps Formational materials consist of very dense fine to medium-grained silty sand and hard sandy silt, very dense fine to medium-grained poorly graded sand with silt, abundant gravels and cobbles at various depths, and interlayered claystone. The expected infiltration rate for this BMP ranges from less than 0.1 inches per hour to 0.5 inches per hour, based on its location within the fills. A sample from Boring H-12, which is the closest boring to the BMP taken during the 2017 geotechnical assessment, indicates a calculated potential infiltration rate of 0.0024 inches per hour. While this value would indicate a very low infiltration rate, CH2M expects fill materials to have relatively wide variability in infiltration rates from less than 0.1 inches per hour to 0.5 inches per hour. See the Evaluation of Geotechnical Impacts due to BMP Partial Infiltration for the NCWRP Expansion and NCPWF Influent Conveyance Project TM for the detailed evaluation.
Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability and why it was not feasible to mitigate low infiltration rates.</td></tr>
<tr><td>6</td><td>Can Infiltration in any appreciable quantity be allowed without increasing risk of geotechnical hazards (slope stability, groundwater mounding, utilities, or other factors) that cannot be mitigated to an acceptable level? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.2.</td><td></td><td>✓</td></tr>
<tr><td colspan="4">Provide basis: The adjacent structures and facilities include the new secondary clarifiers, an existing electrical substation, and an existing main plant switchgear. If the bottom of BMP 2 is unlined, unsaturated transient seepage may flow through the relatively deep engineered fills to the granular structural backfill beside the adjacent existing underground electrical substation wall. Also, the seepage may seep into the structural backfill beside the new secondary clarifiers which will increase the cost to construct the new clarifiers. Unsaturated transient seepage analysis was performed to model this seepage condition, and it is estimated that an additional hydro-pressure about 132 psf may potentially act against the wall of the existing electrical substation. To mitigate the potential impacts, a groundwater cut-off wall will need to be constructed around the BMP. The cost for the mitigation has been estimated at $2.8-$4.2 million. The impacts can be technically mitigated; however, in CH2M's opinion, the cost for the mitigation is prohibitive and disproportionate to the pollution control benefits to be achieved. Therefore, CH2M does not recommend mitigating these impacts and recommend lining the BMP basin. See the Evaluation of Geotechnical Impacts due to BMP Partial Infiltration for the NCWRP Expansion and NCPWF Influent Conveyance Project TM for the detailed evaluation.
Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability and why it was not feasible to mitigate low infiltration rates.</td></tr>
</table>

Form I-8 Page 4 of 4

Criteria	Screening Question	Yes	No
7	Can Infiltration in any appreciable quantity be allowed without posing significant risk for groundwater related concerns (shallow water table, storm water pollutants or other factors)? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.3.	✓	
Provide basis: Based on the Final Geotechnical Report prepared by CH2M HILL (November, 1992), there was no evidence of groundwater in borings done when borings reached an elevation of 242 feet. Based on the Geotechnical Report prepared by Allied Geotechnical (August 9, 2017), there was no evidence of groundwater in borings done when borings reached an elevation of 328 feet. Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability and why it was not feasible to mitigate low infiltration rates.			
8	Can infiltration be allowed without violating downstream water rights? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.3.	✓	
Provide basis: Based on the Final Geotechnical Report prepared by CH2M HILL (November, 1992), there was no evidence of groundwater in borings done when borings reached an elevation of 242 feet. Based on the Geotechnical Report prepared by Allied Geotechnical (August 9, 2017), there was no evidence of groundwater in borings done when borings reached an elevation of 328 feet. There are no known downstream water rights issues. Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability and why it was not feasible to mitigate low infiltration rates.			
Part 2 Result*	If all answers from row 1-4 are yes then partial infiltration design is potentially feasible. The feasibility screening category is Partial Infiltration. If any answer from row 5-8 is no, then infiltration of any volume is considered to be infeasible within the drainage area. The feasibility screening category is No Infiltration.		

*To be completed using gathered site information and best professional judgment considering the definition of MEP in the MS4 Permit. Additional testing and/or studies may be required by the City Engineer to substantiate findings

BMP #3

Categorization of Infiltration Feasibility Condition			**Form I-8**
Part 1 - Full Infiltration Feasibility Screening Criteria Would infiltration of the full design volume be feasible from a physical perspective without any undesirable consequences that cannot be reasonably mitigated?			
Criteria	Screening Question	Yes	No
1	Is the estimated reliable infiltration rate below proposed facility locations greater than 0.5 inches per hour? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.2 and Appendix D.		✓
Provide basis: The site of BMP 3 consists of approximately 34 feet of engineered fill material underlain by native Scripps Formational materials. The engineered fill consists of compacted medium dense to very dense fine to medium-grained silty sand and sandy silt with locally scattered, sub-rounded gravels up to 3 inches in maximum dimension, and clayey sand with locally abundant gravels. The Scripps Formational materials consist of very dense silty sand and sandy silt with gravel conglomerate matrix, very dense and hard silty sandstone and sandy siltstone, alternating laminations of silty sandstone and siltstone, and hard sandy lean clay, sandy claystone and strongly cemented siltstone. The expected infiltration rate for this BMP ranges from less than 0.1 inches per hour to 0.5 inches per hour, based on its location within the fills. A sample from Boring H-9, which is the closest boring to the BMP taken during the 2017 geotechnical assessment, indicates a calculated potential infiltration rate of 0.0024 inches per hour. While this value would indicate a very low infiltration rate, CH2M expects fill materials have relatively wide variability in infiltration rates from less than 0.1 inches per hour to 0.5 inches per hour. Therefore, the estimated infiltration rate below the proposed facility location is not greater than 0.5 inches per hour. Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			
2	Can infiltration greater than 0.5 inches per hour be allowed without increasing risk of geotechnical hazards (slope stability, groundwater mounding, utilities, or other factors) that cannot be mitigated to an acceptable level? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.2.		
Provide basis: Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			

Form I-8 Page 2 of 4

Criteria	Screening Question	Yes	No
3	Can infiltration greater than 0.5 inches per hour be allowed without increasing risk of groundwater contamination (shallow water table, storm water pollutants or other factors) that cannot be mitigated to an acceptable level? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.3.		
Provide basis: Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			
4	Can infiltration greater than 0.5 inches per hour be allowed without causing potential water balance issues such as change of seasonality of ephemeral streams or increased discharge of contaminated groundwater to surface waters? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.3.		
Provide basis: Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			
Part 1 Result*	If all answers to rows 1 - 4 are “Yes” a full infiltration design is potentially feasible. The feasibility screening category is Full Infiltration If any answer from row 1-4 is “No”, infiltration may be possible to some extent but would not generally be feasible or desirable to achieve a “full infiltration” design.		

*To be completed using gathered site information and best professional judgment considering the definition of MEP in the MS4 Permit. Additional testing and/or studies may be required by the City Engineer to substantiate findings

Form I-8 Page 3 of 4			
Part 2 – Partial Infiltration vs. No Infiltration Feasibility Screening Criteria Would infiltration of water in any appreciable amount be physically feasible without any negative consequences that cannot be reasonably mitigated?			
Criteria	Screening Question	Yes	No
5	Do soil and geologic conditions allow for infiltration in any appreciable rate or volume? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.2 and Appendix D.	✓	
Provide basis: The site of BMP 3 consists of approximately 34 feet of engineered fill material underlain by native Scripps Formational materials. The engineered fill consists of compacted medium dense to very dense fine to medium-grained silty sand and sandy silt with locally scattered, sub-rounded gravels up to 3 inches in maximum dimension, and clayey sand with locally abundant gravels. The Scripps Formational materials consist of very dense silty sand and sandy silt with gravel conglomerate matrix, very dense and hard silty sandstone and sandy siltstone, alternating laminations of silty sandstone and siltstone, and hard sandy lean clay, sandy claystone and strongly cemented siltstone. The expected infiltration rate for this BMP ranges from less than 0.1 inches per hour to 0.5 inches per hour, based on its location within the fills. A sample from Boring H-9, which is the closest boring to the BMP taken during the 2017 geotechnical assessment, indicates a calculated potential infiltration rate of 0.0024 inches per hour. While this value would indicate a very low infiltration rate, CH2M expects fill materials have relatively wide variability in infiltration rates from less than 0.1 inches per hour to 0.5 inches per hour. See the Evaluation of Geotechnical Impacts due to BMP Partial Infiltration for the NCWRP Expansion and NCPWF Influent Conveyance Project TM for the detailed evaluation.			
6	Can Infiltration in any appreciable quantity be allowed without increasing risk of geotechnical hazards (slope stability, groundwater mounding, utilities, or other factors) that cannot be mitigated to an acceptable level? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.2.		✓
Provide basis: The adjacent structures and facilities include the new NCPWF Influent Pump Station (IPS), an existing electrical substation, and the existing water purification demonstration facility. If the bottom of BMP 3 is unlined, unsaturated transient seepage can flow through the relatively deep engineered fills to the granular structural backfill beside the adjacent existing underground electrical substation wall. Also, the water has the potential to seep into the structural backfill beside the new NCPWF IPS, which will increase the construction cost of the new pump station. Unsaturated transient seepage analysis was performed to model this seepage condition, and it is estimated that an additional hydro-pressure of approximately 106 psf may act against the wall of the existing electrical substation. To mitigate the potential impacts, a groundwater cut-off wall will need to be constructed around the BMP. The cost for this mitigation is estimated at $1.3-$2.0 million. The impacts can be technically mitigated; however, in CH2M's opinion, the cost for the mitigation is prohibitive and disproportionate to the pollution control benefits to be achieved. Therefore, CH2M does not recommend mitigating these impacts and recommend lining the BMP basin. See the Evaluation of Geotechnical Impacts due to BMP Partial Infiltration for the NCWRP Expansion and NCPWF Influent Conveyance Project TM for the detailed evaluation.			

<table>
<tr><th colspan="4">Form I-8 Page 4 of 4</th></tr>
<tr><td>Criteria</td><td>Screening Question</td><td>Yes</td><td>No</td></tr>
<tr><td>7</td><td>Can Infiltration in any appreciable quantity be allowed without posing significant risk for groundwater related concerns (shallow water table, storm water pollutants or other factors)? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.3.</td><td>✓</td><td></td></tr>
<tr><td colspan="4">Provide basis: Based on the Final Geotechnical Report prepared by CH2M HILL (November, 1992), there was no evidence of groundwater in borings done when borings reached an elevation of 242 feet. Based on the Geotechnical Report prepared by Allied Geotechnical (August 9, 2017), there was no evidence of groundwater in borings done when borings reached an elevation of 328 feet.

Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability and why it was not feasible to mitigate low infiltration rates.</td></tr>
<tr><td>8</td><td>Can infiltration be allowed without violating downstream water rights? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.3.</td><td>✓</td><td></td></tr>
<tr><td colspan="4">Provide basis: Based on the Final Geotechnical Report prepared by CH2M HILL (November, 1992), there was no evidence of groundwater in borings done when borings reached an elevation of 242 feet. Based on the Geotechnical Report prepared by Allied Geotechnical (August 9, 2017), there was no evidence of groundwater in borings done when borings reached an elevation of 328 feet. There are no known downstream water rights issues.

Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability and why it was not feasible to mitigate low infiltration rates.</td></tr>
<tr><td>Part 2 Result*</td><td colspan="2">If all answers from row 1-4 are yes then partial infiltration design is potentially feasible. The feasibility screening category is Partial Infiltration.
If any answer from row 5-8 is no, then infiltration of any volume is considered to be infeasible within the drainage area. The feasibility screening category is No Infiltration.</td><td></td></tr>
</table>

*To be completed using gathered site information and best professional judgment considering the definition of MEP in the MS4 Permit. Additional testing and/or studies may be required by the City Engineer to substantiate findings

BMP #4

Categorization of Infiltration Feasibility Condition		**Form I-8**	
Part 1 - Full Infiltration Feasibility Screening Criteria Would infiltration of the full design volume be feasible from a physical perspective without any undesirable consequences that cannot be reasonably mitigated?			
Criteria	Screening Question	Yes	No
1	Is the estimated reliable infiltration rate below proposed facility locations greater than 0.5 inches per hour? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.2 and Appendix D.		✓
Provide basis: The site of BMP 4 consists of approximately 49 feet of engineered fill materials underlain by Scripps Formational materials. The engineered fill material consists of compacted medium dense to very dense fine to medium-grained silty sand and sandy silt with locally scattered sub-rounded gravels up to a maximum of 2 inches, and clayey sand with locally abundant gravels. The Scripps Formational materials consist of hard sandy lean clay. The expected infiltration rate for this BMP ranges from less than 0.1 inches per hour to 0.5 inches per hour, based on its location within the fills. Two samples from Boring H-8, which is the closest boring to the BMP taken during the 2017 geotechnical assessment, indicate the calculated potential infiltration rates of 0.0028 inches per hour and 0.2215 inches per hour. While these values would indicate a very low or low infiltration rate, CH2M expects fill materials have relatively wide variability in infiltration rates from less than 0.1 inches per hour to 0.5 inches per hour. Therefore, the estimated infiltration rate below the proposed facility location is not greater than 0.5 inches per hour. Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			
2	Can infiltration greater than 0.5 inches per hour be allowed without increasing risk of geotechnical hazards (slope stability, groundwater mounding, utilities, or other factors) that cannot be mitigated to an acceptable level? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.2.		
Provide basis: Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			

<table>
<tr><th colspan="4">Form I-8 Page 2 of 4</th></tr>
<tr><td>Criteria</td><td>Screening Question</td><td>Yes</td><td>No</td></tr>
<tr><td>3</td><td>Can infiltration greater than 0.5 inches per hour be allowed without increasing risk of groundwater contamination (shallow water table, storm water pollutants or other factors) that cannot be mitigated to an acceptable level? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.3.</td><td></td><td></td></tr>
<tr><td colspan="4">Provide basis:

Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.</td></tr>
<tr><td>4</td><td>Can infiltration greater than 0.5 inches per hour be allowed without causing potential water balance issues such as change of seasonality of ephemeral streams or increased discharge of contaminated groundwater to surface waters? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.3.</td><td></td><td></td></tr>
<tr><td colspan="4">Provide basis:

Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.</td></tr>
<tr><td>Part 1 Result*</td><td colspan="2">If all answers to rows 1 - 4 are “Yes” a full infiltration design is potentially feasible. The feasibility screening category is Full Infiltration

If any answer from row 1-4 is “No”, infiltration may be possible to some extent but would not generally be feasible or desirable to achieve a “full infiltration” design.</td><td></td></tr>
</table>

*To be completed using gathered site information and best professional judgment considering the definition of MEP in the MS4 Permit. Additional testing and/or studies may be required by the City Engineer to substantiate findings

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Part 2 – Partial Infiltration vs. No Infiltration Feasibility Screening Criteria
Would infiltration of water in any appreciable amount be physically feasible without any negative consequences that cannot be reasonably mitigated?

Criteria	Screening Question	Yes	No
5	Do soil and geologic conditions allow for infiltration in any appreciable rate or volume? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.2 and Appendix D.	✓	

Provide basis: The site of BMP 4 consists of approximately 49 feet of engineered fill materials underlain by Scripps Formational materials. The engineered fill material consists of compacted medium dense to very dense fine to medium-grained silty sand and sandy silt with locally scattered sub-rounded gravels up to a maximum of 2 inches, and clayey sand with locally abundant gravels. The Scripps Formational materials consist of hard sandy lean clay. The expected infiltration rate for this BMP ranges from less than 0.1 inches per hour to 0.5 inches per hour, based on its location within the fills. Two samples from Boring H-8, which is the closest boring to the BMP taken during the 2017 geotechnical assessment, indicate the calculated potential infiltration rates of 0.0028 inches per hour and 0.2215 inches per hour. While these values would indicate a very low or low infiltration rate, CH2M expects fill materials have relatively wide variability in infiltration rates from less than 0.1 inches per hour to 0.5 inches per hour. See the Evaluation of Geotechnical Impacts due to BMP Partial Infiltration for the NCWRP Expansion and NCPWF Influent Conveyance Project TM for the detailed evaluation.

Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability and why it was not feasible to mitigate low infiltration rates.

Criteria	Screening Question	Yes	No
6	Can Infiltration in any appreciable quantity be allowed without increasing risk of geotechnical hazards (slope stability, groundwater mounding, utilities, or other factors) that cannot be mitigated to an acceptable level? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.2.		✓

Provide basis: The adjacent structures and facilities include the existing and new tertiary filters and existing waste backwash tanks. If the bottom of BMP 4 is unlined, unsaturated transient seepage can flow through the relatively deep engineered fills to the granular structural backfill beside the adjacent underground wall of the tertiary filter facility. Also, the water has the potential to seep into the structural backfill beside the new tertiary filters, which will increase the construction cost for the new tertiary filters. Unsaturated transient seepage analysis was performed to model this seepage condition, and it is estimated that an additional hydro-pressure of approximately 500 psf may potentially act against the wall of the existing tertiary filters. To mitigate the potential impacts, a groundwater cut-off wall will need to be constructed around the BMP. The cost for this mitigation is estimated at $0.7-$1.1 million. The impact can be technically mitigated; however, in CH2M's opinion, the cost for the mitigation is prohibitive and disproportionate to the pollution control benefits to be achieved. Therefore, CH2M does not recommend mitigating these impacts and recommend lining the BMP basin. See the Evaluation of Geotechnical Impacts due to BMP Partial Infiltration for the NCWRP Expansion and NCPWF Influent Conveyance Project TM for the detailed evaluation.

Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability and why it was not feasible to mitigate low infiltration rates.

<table>
<tr><th colspan="4">Form I-8 Page 4 of 4</th></tr>
<tr><td>Criteria</td><td>Screening Question</td><td>Yes</td><td>No</td></tr>
<tr><td>7</td><td>Can Infiltration in any appreciable quantity be allowed without posing significant risk for groundwater related concerns (shallow water table, storm water pollutants or other factors)? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.3.</td><td>✓</td><td></td></tr>
<tr><td colspan="4">Provide basis: Based on the Final Geotechnical Report prepared by CH2M HILL (November, 1992), there was no evidence of groundwater in borings done when borings reached an elevation of 242 feet. Based on the Geotechnical Report prepared by Allied Geotechnical (August 9, 2017), there was no evidence of groundwater in borings done when borings reached an elevation of 328 feet.
Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability and why it was not feasible to mitigate low infiltration rates.</td></tr>
<tr><td>8</td><td>Can infiltration be allowed without violating downstream water rights? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.3.</td><td>✓</td><td></td></tr>
<tr><td colspan="4">Provide basis: Based on the Final Geotechnical Report prepared by CH2M HILL (November, 1992), there was no evidence of groundwater in borings done when borings reached an elevation of 242 feet. Based on the Geotechnical Report prepared by Allied Geotechnical (August 9, 2017), there was no evidence of groundwater in borings done when borings reached an elevation of 328 feet. There are no known downstream water rights issues.
Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability and why it was not feasible to mitigate low infiltration rates.</td></tr>
<tr><td>Part 2 Result*</td><td colspan="2">If all answers from row 1-4 are yes then partial infiltration design is potentially feasible. The feasibility screening category is Partial Infiltration.
If any answer from row 5-8 is no, then infiltration of any volume is considered to be infeasible within the drainage area. The feasibility screening category is No Infiltration.</td><td></td></tr>
</table>

*To be completed using gathered site information and best professional judgment considering the definition of MEP in the MS4 Permit. Additional testing and/or studies may be required by the City Engineer to substantiate findings

BMP #5

Categorization of Infiltration Feasibility Condition			**Form I-8**
Part 1 - Full Infiltration Feasibility Screening Criteria Would infiltration of the full design volume be feasible from a physical perspective without any undesirable consequences that cannot be reasonably mitigated?			
Criteria	Screening Question	Yes	No
1	Is the estimated reliable infiltration rate below proposed facility locations greater than 0.5 inches per hour? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.2 and Appendix D.		✓
Provide basis: The site of BMP 5 consists of approximately 6 feet of engineered fill material underlain by native Scripps Formational materials, including very dense fine-grained silty sandstone, hard sandy siltstone, siltstone with laminations of silty sandstone, and sandy lean clay. The expected infiltration rate for this BMP ranges between 0.1 inches per hour and 0.5 inches per hour, based on its location within the Scripps Formation. Therefore, the estimated infiltration rate below the proposed facility location is not greater than 0.5 inches per hour. Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			
2	Can infiltration greater than 0.5 inches per hour be allowed without increasing risk of geotechnical hazards (slope stability, groundwater mounding, utilities, or other factors) that cannot be mitigated to an acceptable level? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.2.		
Provide basis: Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			

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Criteria	Screening Question	Yes	No
3	Can infiltration greater than 0.5 inches per hour be allowed without increasing risk of groundwater contamination (shallow water table, storm water pollutants or other factors) that cannot be mitigated to an acceptable level? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.3.		
Provide basis: Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			
4	Can infiltration greater than 0.5 inches per hour be allowed without causing potential water balance issues such as change of seasonality of ephemeral streams or increased discharge of contaminated groundwater to surface waters? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.3.		
Provide basis: Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			
Part 1 Result*	If all answers to rows 1 - 4 are "Yes" a full infiltration design is potentially feasible. The feasibility screening category is Full Infiltration If any answer from row 1-4 is "No", infiltration may be possible to some extent but would not generally be feasible or desirable to achieve a "full infiltration" design.		

*To be completed using gathered site information and best professional judgment considering the definition of MEP in the MS4 Permit. Additional testing and/or studies may be required by the City Engineer to substantiate findings

Form I-8 Page 3 of 4			
Part 2 – Partial Infiltration vs. No Infiltration Feasibility Screening Criteria Would infiltration of water in any appreciable amount be physically feasible without any negative consequences that cannot be reasonably mitigated?			
Criteria	Screening Question	Yes	No
5	Do soil and geologic conditions allow for infiltration in any appreciable rate or volume? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.2 and Appendix D.	✓	
Provide basis: The site of BMP 5 consists of approximately 6 feet of engineered fill underlain by native Scripps Formational materials including very dense fine-grained silty sandstone, hard sandy siltstone, and siltstone with laminations of silty sandstone. Infiltration rate within the Scripps Formation is estimated to vary from less than 0.1-inch per hour in the silt and clay facies to a high of 0.5-inch per hour in the sandstone unit. See the Evaluation of Geotechnical Impacts due to BMP Partial Infiltration for the NCWRP Expansion and NCPWF Influent Conveyance Project TM for the detailed evaluation. Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability and why it was not feasible to mitigate low infiltration rates.			
6	Can Infiltration in any appreciable quantity be allowed without increasing risk of geotechnical hazards (slope stability, groundwater mounding, utilities, or other factors) that cannot be mitigated to an acceptable level? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.2.	✓	
Provide basis: The adjacent facilities include the new and existing generation facilities, an existing electrical substation, and an existing main plant switchgear. Considering the relatively low infiltration rate of the native Scripps Formation materials underlain the site, the foundation types of the adjacent existing and new facilities, along with the distance to these facilities, the geotechnical impacts and risk of hazards from BMP 5 to the adjacent facilities are considered low, if the sides of BMP 5 are lined. The bottom of BMP 5 can be unlined and left open for infiltration. See the Evaluation of Geotechnical Impacts due to BMP Partial Infiltration for the NCWRP Expansion and NCPWF Influent Conveyance Project TM for the detailed evaluation. Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability and why it was not feasible to mitigate low infiltration rates.			

<table>
<tr><th colspan="4">Form I-8 Page 4 of 4</th></tr>
<tr><td>Criteria</td><td>Screening Question</td><td>Yes</td><td>No</td></tr>
<tr><td>7</td><td>Can Infiltration in any appreciable quantity be allowed without posing significant risk for groundwater related concerns (shallow water table, storm water pollutants or other factors)? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.3.</td><td>✓</td><td></td></tr>
<tr><td colspan="4">Provide basis: Based on the Final Geotechnical Report prepared by CH2M HILL (November, 1992), there was no evidence of groundwater in borings done when borings reached an elevation of 242 feet. Based on the Geotechnical Report prepared by Allied Geotechnical (August 9, 2017), there was no evidence of groundwater in borings done when borings reached an elevation of 328 feet.
Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability and why it was not feasible to mitigate low infiltration rates.</td></tr>
<tr><td>8</td><td>Can infiltration be allowed without violating downstream water rights? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.3.</td><td>✓</td><td></td></tr>
<tr><td colspan="4">Provide basis: Based on the Final Geotechnical Report prepared by CH2M HILL (November, 1992), there was no evidence of groundwater in borings done when borings reached an elevation of 242 feet. Based on the Geotechnical Report prepared by Allied Geotechnical (August 9, 2017), there was no evidence of groundwater in borings done when borings reached an elevation of 328 feet. There are no known downstream water rights issues.
Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability and why it was not feasible to mitigate low infiltration rates.</td></tr>
<tr><td>Part 2 Result*</td><td colspan="2">If all answers from row 1-4 are yes then partial infiltration design is potentially feasible. The feasibility screening category is Partial Infiltration.
If any answer from row 5-8 is no, then infiltration of any volume is considered to be infeasible within the drainage area. The feasibility screening category is No Infiltration.</td><td></td></tr>
</table>

*To be completed using gathered site information and best professional judgment considering the definition of MEP in the MS4 Permit. Additional testing and/or studies may be required by the City Engineer to substantiate findings

BMP #7

<table>
<tr><th colspan="2">Categorization of Infiltration Feasibility Condition</th><th colspan="2">Form I-8</th></tr>
<tr><td colspan="4">Part 1 - Full Infiltration Feasibility Screening Criteria
Would infiltration of the full design volume be feasible from a physical perspective without any undesirable consequences that cannot be reasonably mitigated?</td></tr>
<tr><td>Criteria</td><td>Screening Question</td><td>Yes</td><td>No</td></tr>
<tr><td>1</td><td>Is the estimated reliable infiltration rate below proposed facility locations greater than 0.5 inches per hour? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.2 and Appendix D.</td><td></td><td>✓</td></tr>
<tr><td colspan="4">Provide basis: The site of BMP 7 consists of approximately 3 feet of engineered fill material and approximately 5 feet of native Lindavista Formational materials underlain by Scripps Formational materials. The Lindavista Formational material consists of very dense gravelly silty sand with sub-rounded gravel up to 2 inches in maximum dimension. The Scripps Formational materials consist of sandy lean clay. The expected infiltration rate for this BMP ranges between 0.1 inches per hour and 0.5 inches per hour, based on its location within the Scripps Formation. Therefore, the estimated infiltration rate below the proposed facility location is not greater than 0.5 inches per hour.
Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.</td></tr>
<tr><td>2</td><td>Can infiltration greater than 0.5 inches per hour be allowed without increasing risk of geotechnical hazards (slope stability, groundwater mounding, utilities, or other factors) that cannot be mitigated to an acceptable level? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.2.</td><td></td><td></td></tr>
<tr><td colspan="4">Provide basis:
Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.</td></tr>
</table>

Form I-8 Page 2 of 4			
Criteria	Screening Question	Yes	No
3	Can infiltration greater than 0.5 inches per hour be allowed without increasing risk of groundwater contamination (shallow water table, storm water pollutants or other factors) that cannot be mitigated to an acceptable level? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.3.		
Provide basis: Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			
4	Can infiltration greater than 0.5 inches per hour be allowed without causing potential water balance issues such as change of seasonality of ephemeral streams or increased discharge of contaminated groundwater to surface waters? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.3.		
Provide basis: Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			
Part 1 Result*	If all answers to rows 1 - 4 are "Yes" a full infiltration design is potentially feasible. The feasibility screening category is Full Infiltration If any answer from row 1-4 is "No", infiltration may be possible to some extent but would not generally be feasible or desirable to achieve a "full infiltration" design.		

*To be completed using gathered site information and best professional judgment considering the definition of MEP in the MS4 Permit. Additional testing and/or studies may be required by the City Engineer to substantiate findings

Form I-8 Page 3 of 4

Part 2 – Partial Infiltration vs. No Infiltration Feasibility Screening Criteria
Would infiltration of water in any appreciable amount be physically feasible without any negative consequences that cannot be reasonably mitigated?

Criteria	Screening Question	Yes	No
5	Do soil and geologic conditions allow for infiltration in any appreciable rate or volume? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.2 and Appendix D.	✓	

Provide basis: The site of BMP 7 consists of approximately 3 feet of engineered fill material and approximately 5 feet of native Lindavista Formational materials underlain by Scripps Formational materials. The Lindavista Formational material consists of very dense gravelly silty sand with sub-rounded gravel up to 2 inches in maximum dimension. The Scripps Formational materials consist of sandy lean clay. The expected infiltration rate for this BMP ranges between 0.1 inches per hour and 0.5 inches per hour, based on its location within the Scripps Formation. See the Evaluation of Geotechnical Impacts due to BMP Partial Infiltration for the NCWRP Expansion and NCPWF Influent Conveyance Project TM for the detailed evaluation.

Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability and why it was not feasible to mitigate low infiltration rates.

Criteria	Screening Question	Yes	No
6	Can Infiltration in any appreciable quantity be allowed without increasing risk of geotechnical hazards (slope stability, groundwater mounding, utilities, or other factors) that cannot be mitigated to an acceptable level? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.2.	✓	

Provide basis: The adjacent facilities include the existing power generation facilities and new chemical facilities. Considering the relatively low infiltration rates of the Lindavista and Scripps Formation materials beneath the site, the foundation types of the adjacent existing and new facilities, along with the distance between BMP 7 and the adjacent facilities, the geotechnical impacts and risk of hazards to the adjacent facilities are considered low if the sides of BMP 7 are lined. The bottom of BMP 7 can be unlined and left open for partial infiltration. See the Evaluation of Geotechnical Impacts due to BMP Partial Infiltration for the NCWRP Expansion and NCPWF Influent Conveyance Project TM for the detailed evaluation.

Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability and why it was not feasible to mitigate low infiltration rates.

<table>
<tr><th colspan="4">Form I-8 Page 4 of 4</th></tr>
<tr><td>Criteria</td><td>Screening Question</td><td>Yes</td><td>No</td></tr>
<tr><td>7</td><td>Can Infiltration in any appreciable quantity be allowed without posing significant risk for groundwater related concerns (shallow water table, storm water pollutants or other factors)? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.3.</td><td>✓</td><td></td></tr>
<tr><td colspan="4">Provide basis: Based on the Final Geotechnical Report prepared by CH2M HILL (November, 1992), there was no evidence of groundwater in borings done when borings reached an elevation of 242 feet. Based on the Geotechnical Report prepared by Allied Geotechnical (August 9, 2017), there was no evidence of groundwater in borings done when borings reached an elevation of 328 feet.
Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability and why it was not feasible to mitigate low infiltration rates.</td></tr>
<tr><td>8</td><td>Can infiltration be allowed without violating downstream water rights? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.3.</td><td>✓</td><td></td></tr>
<tr><td colspan="4">Provide basis: Based on the Final Geotechnical Report prepared by CH2M HILL (November, 1992), there was no evidence of groundwater in borings done when borings reached an elevation of 242 feet. Based on the Geotechnical Report prepared by Allied Geotechnical (August 9, 2017), there was no evidence of groundwater in borings done when borings reached an elevation of 328 feet. There are no known downstream water rights issues.
Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability and why it was not feasible to mitigate low infiltration rates.</td></tr>
<tr><td>Part 2 Result*</td><td colspan="2">If all answers from row 1-4 are yes then partial infiltration design is potentially feasible. The feasibility screening category is Partial Infiltration.
If any answer from row 5-8 is no, then infiltration of any volume is considered to be infeasible within the drainage area. The feasibility screening category is No Infiltration.</td><td></td></tr>
</table>

*To be completed using gathered site information and best professional judgment considering the definition of MEP in the MS4 Permit. Additional testing and/or studies may be required by the City Engineer to substantiate findings

BMP #8

Categorization of Infiltration Feasibility Condition		**Form I-8**	
Part 1 - Full Infiltration Feasibility Screening Criteria Would infiltration of the full design volume be feasible from a physical perspective without any undesirable consequences that cannot be reasonably mitigated?			
Criteria	Screening Question	Yes	No
1	Is the estimated reliable infiltration rate below proposed facility locations greater than 0.5 inches per hour? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.2 and Appendix D.		✓
Provide basis: The site of BMP 8 consists of approximately 7 feet of fill and 5 feet of native Lindavista Formational material underlain by native Scripps Formational materials. The fill consists of yellowish brown to reddish yellow, damp, loose silty sand with scattered sub-rounded gravels up to a maximum of 3 inches. The Lindavista Formational material consists of very dense fine to medium-grained silty sand with abundant sub-rounded gravel up to a maximum of 3 inches. The Scripps Formational materials consist of very dense fine to medium-grained silty sand, medium-grained poorly graded sand with silt, gravel conglomerate with silty sand matrix, hard and very dense fine-grained sandy siltstone and silty sandstone, and hard sandy lean clay, lean clay, and claystone. The expected infiltration rate for this BMP ranges from less than 0.1 inches per hour to 0.5 inches per hour, based on its location within the fills and the Lindavista Formational materials. Therefore, the estimated infiltration rate below the proposed facility location is not greater than 0.5 inches per hour. Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			
2	Can infiltration greater than 0.5 inches per hour be allowed without increasing risk of geotechnical hazards (slope stability, groundwater mounding, utilities, or other factors) that cannot be mitigated to an acceptable level? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.2.		
Provide basis: Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			

Form I-8 Page 2 of 4			
Criteria	Screening Question	Yes	No
3	Can infiltration greater than 0.5 inches per hour be allowed without increasing risk of groundwater contamination (shallow water table, storm water pollutants or other factors) that cannot be mitigated to an acceptable level? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.3.		
Provide basis: Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			
4	Can infiltration greater than 0.5 inches per hour be allowed without causing potential water balance issues such as change of seasonality of ephemeral streams or increased discharge of contaminated groundwater to surface waters? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.3.		
Provide basis: Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			
Part 1 Result*	If all answers to rows 1 - 4 are "Yes" a full infiltration design is potentially feasible. The feasibility screening category is Full Infiltration If any answer from row 1-4 is "No", infiltration may be possible to some extent but would not generally be feasible or desirable to achieve a "full infiltration" design.		

*To be completed using gathered site information and best professional judgment considering the definition of MEP in the MS4 Permit. Additional testing and/or studies may be required by the City Engineer to substantiate findings

Form I-8 Page 3 of 4

Part 2 – Partial Infiltration vs. No Infiltration Feasibility Screening Criteria
Would infiltration of water in any appreciable amount be physically feasible without any negative consequences that cannot be reasonably mitigated?

Criteria	Screening Question	Yes	No
5	Do soil and geologic conditions allow for infiltration in any appreciable rate or volume? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.2 and Appendix D.	✓	

Provide basis: The site of BMP 8 consists of approximately 7 feet of fill and 5 feet of native Lindavista Formational material underlain by native Scripps Formational materials. The fill consists of yellowish brown to reddish yellow, damp, loose silty sand with scattered sub-rounded gravels up to a maximum of 3 inches. The Lindavista Formational material consists of very dense fine to medium-grained silty sand with abundant sub-rounded gravel up to a maximum of 3 inches. The Scripps Formational materials consist of very dense fine to medium-grained silty sand, medium-grained poorly graded sand with silt, gravel conglomerate with silty sand matrix, hard and very dense fine-grained sandy siltstone and silty sandstone, and hard sandy lean clay, lean clay, and claystone. The expected infiltration rate for this BMP ranges from less than 0.1 inches per hour to 0.5 inches per hour, based on its location within the fills and the Lindavista Formational materials.

Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability and why it was not feasible to mitigate low infiltration rates.

Criteria	Screening Question	Yes	No
6	Can Infiltration in any appreciable quantity be allowed without increasing risk of geotechnical hazards (slope stability, groundwater mounding, utilities, or other factors) that cannot be mitigated to an acceptable level? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.2.		✓

Provide basis: The adjacent facilities include the new second stage bioreactor basins, an access road, and an existing 20-foot high slope, located to the west outside of the property boundary in Caltrans ROW. If the bottom of BMP 8 is unlined, seepage may flow through the top fill, and has the potential to saturate the fill in a short period of time. The loose fill could also be liquefied and result in an estimated liquefaction-induced settlement about 1.4 inches with dry sand seismic settlement about 1.0 inch. This shallow loose fill will be removed during excavation for newly constructed facilities and will not impact the proposed construction. However, there is a potential risk that this loose fill may impact the existing adjacent facilities, such as cracking of the access road, and negatively affect the stability of the existing slope. Because CH2M is not performing a detailed investigation for all existing facilities and offsite conditions, boring locations are limited to key impact areas; therefore, potential geotechnical uncertainties exist in areas that may contain shallow loose soils. CH2M's concerns with the BMP was the proximity to the slope that is actually offsite in the Caltrans ROW. If the shallow loose fills as shown in boring H-7 are actually extended to the slope areas, it is CH2M's opinion that there is a potential of shallow surficial failure along the face of the slope, as a result, a potential of destabilizing the slope, especially during an earthquake with the potential of soil liquefaction. With the BMP placed on top of the adjacent slope, it also puts the City (plant's owner) with a liability for potential claims of property damage and loss from the potential hazard. To mitigate the potential impacts, a groundwater cut-off wall will need to be constructed around the BMP. The cost for this mitigation is estimated at about $0.7-$1.1 million. The impacts could be technically mitigated; however, in CH2M's opinion, the cost for the mitigation is prohibitive and disproportionate to the pollution control benefits to be achieved. By recommending that BMP 8 be lined to prevent infiltration, CH2M is attempting to mitigate the potential of geotechnical hazards.

<table>
<tr><th colspan="4">Form I-8 Page 4 of 4</th></tr>
<tr><td>Criteria</td><td>Screening Question</td><td>Yes</td><td>No</td></tr>
<tr><td>7</td><td>Can Infiltration in any appreciable quantity be allowed without posing significant risk for groundwater related concerns (shallow water table, storm water pollutants or other factors)? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.3.</td><td>✓</td><td></td></tr>
<tr><td colspan="4">Provide basis: Based on the Final Geotechnical Report prepared by CH2M HILL (November, 1992), there was no evidence of groundwater in borings done when borings reached an elevation of 242 feet. Based on the Geotechnical Report prepared by Allied Geotechnical (August 9, 2017), there was no evidence of groundwater in borings done when borings reached an elevation of 328 feet.
Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability and why it was not feasible to mitigate low infiltration rates.</td></tr>
<tr><td>8</td><td>Can infiltration be allowed without violating downstream water rights? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.3.</td><td>✓</td><td></td></tr>
<tr><td colspan="4">Provide basis: Based on the Final Geotechnical Report prepared by CH2M HILL (November, 1992), there was no evidence of groundwater in borings done when borings reached an elevation of 242 feet. Based on the Geotechnical Report prepared by Allied Geotechnical (August 9, 2017), there was no evidence of groundwater in borings done when borings reached an elevation of 328 feet. There are no known downstream water rights issues.
Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability and why it was not feasible to mitigate low infiltration rates.</td></tr>
<tr><td>Part 2 Result*</td><td colspan="2">If all answers from row 1-4 are yes then partial infiltration design is potentially feasible. The feasibility screening category is Partial Infiltration.
If any answer from row 5-8 is no, then infiltration of any volume is considered to be infeasible within the drainage area. The feasibility screening category is No Infiltration.</td><td></td></tr>
</table>

*To be completed using gathered site information and best professional judgment considering the definition of MEP in the MS4 Permit. Additional testing and/or studies may be required by the City Engineer to substantiate findings

BMP #9

Categorization of Infiltration Feasibility Condition		**Form I-8**	
Part 1 - Full Infiltration Feasibility Screening Criteria Would infiltration of the full design volume be feasible from a physical perspective without any undesirable consequences that cannot be reasonably mitigated?			
Criteria	Screening Question	Yes	No
1	Is the estimated reliable infiltration rate below proposed facility locations greater than 0.5 inches per hour? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.2 and Appendix D.		✓
Provide basis: The site of BMP 9 consists of approximately 7 feet of fill and 5 feet of native Lindavista Formational material underlain by native Scripps Formational materials. The fill consists of yellowish brown to reddish yellow, damp, loose silty sand with scattered sub-rounded gravels up to a maximum of 3 inches. The Lindavista Formational material consists of very dense fine to medium-grained silty sand with abundant sub-rounded gravel up to a maximum of 3 inches. The Scripps Formational materials consist of very dense fine to medium-grained silty sand, medium-grained poorly graded sand with silt, gravel conglomerate with silty sand matrix, hard and very dense fine-grained sandy siltstone and silty sandstone, and hard sandy lean clay, lean clay, and claystone. The expected infiltration rate for this BMP ranges from less than 0.1 inches per hour to 0.5 inches per hour, based on its location within the fills and the Lindavista Formational materials. Therefore, the estimated infiltration rate below the proposed facility location is not greater than 0.5 inches per hour. Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			
2	Can infiltration greater than 0.5 inches per hour be allowed without increasing risk of geotechnical hazards (slope stability, groundwater mounding, utilities, or other factors) that cannot be mitigated to an acceptable level? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.2.		
Provide basis: Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			

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Criteria	Screening Question	Yes	No
3	Can infiltration greater than 0.5 inches per hour be allowed without increasing risk of groundwater contamination (shallow water table, storm water pollutants or other factors) that cannot be mitigated to an acceptable level? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.3.		
Provide basis: Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			
4	Can infiltration greater than 0.5 inches per hour be allowed without causing potential water balance issues such as change of seasonality of ephemeral streams or increased discharge of contaminated groundwater to surface waters? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.3.		
Provide basis: Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			
Part 1 Result*	If all answers to rows 1 - 4 are "Yes" a full infiltration design is potentially feasible. The feasibility screening category is Full Infiltration If any answer from row 1-4 is "No", infiltration may be possible to some extent but would not generally be feasible or desirable to achieve a "full infiltration" design.		

*To be completed using gathered site information and best professional judgment considering the definition of MEP in the MS4 Permit. Additional testing and/or studies may be required by the City Engineer to substantiate findings

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Part 2 – Partial Infiltration vs. No Infiltration Feasibility Screening Criteria
Would infiltration of water in any appreciable amount be physically feasible without any negative consequences that cannot be reasonably mitigated?

Criteria	Screening Question	Yes	No
5	Do soil and geologic conditions allow for infiltration in any appreciable rate or volume? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.2 and Appendix D.	✓	

Provide basis: The site of BMP 9 consists of approximately 7 feet of fill and 5 feet of native Lindavista Formational material underlain by native Scripps Formational materials. The fill consists of yellowish brown to reddish yellow, damp, loose silty sand with scattered sub-rounded gravels up to a maximum of 3 inches. The Lindavista Formational material consists of very dense fine to medium-grained silty sand with abundant sub-rounded gravel up to a maximum of 3 inches. The Scripps Formational materials consist of very dense fine to medium-grained silty sand, medium-grained poorly graded sand with silt, gravel conglomerate with silty sand matrix, hard and very dense fine-grained sandy siltstone and silty sandstone, and hard sandy lean clay, lean clay, and claystone. The expected infiltration rate for this BMP ranges from less than 0.1 inches per hour to 0.5 inches per hour, based on its location within the fills and the Lindavista Formational materials.

Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability and why it was not feasible to mitigate low infiltration rates.

6	Can Infiltration in any appreciable quantity be allowed without increasing risk of geotechnical hazards (slope stability, groundwater mounding, utilities, or other factors) that cannot be mitigated to an acceptable level? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.2.		✓

Provide basis: The adjacent facilities include the new second stage bioreactor basins, an access road, and an existing 20-foot high slope, located to the west outside of the property boundary in Caltrans ROW. If the bottom of BMP 9 is unlined, seepage may flow through the top fill, and has the potential to saturate the fill in a short period of time. The loose fill could also be liquefied and result in an estimated liquefaction-induced settlement about 1.4 inches with dry sand seismic settlement about 1.0 inch. This shallow loose fill will be removed during excavation for newly constructed facilities and will not impact the proposed construction. However, there is a potential risk that this loose fill may impact the existing adjacent facilities, such as cracking of the access road, and negatively affect the stability of the existing slope. Because CH2M is not performing a detailed investigation for all existing facilities and offsite conditions, boring locations are limited to key impact areas; therefore, potential geotechnical uncertainties exist in areas that may contain shallow loose soils. CH2M's concerns with the BMP was the proximity to the slope that is actually offsite in the Caltrans ROW. If the shallow loose fills as shown in boring H-7 are actually extended to the slope areas, it is CH2M's opinion that there is a potential of shallow surficial failure along the face of the slope, as a result, a potential of destabilizing the slope, especially during an earthquake with the potential of soil liquefaction. With the BMP placed on top of the adjacent slope, it also puts the City (plant's owner) with a liability for potential claims of property damage and loss from the potential hazard. To mitigate the potential impacts, a groundwater cut-off wall will need to be constructed around the BMP. The cost is estimated at about $0.7-$1.1 million. The impacts can be technically mitigated; however, in CH2M's opinion, the cost for the mitigation is prohibitive and disproportionate to the pollution control benefits to be achieved. By recommending that BMP 9 be lined to prevent infiltration, CH2M is attempting to mitigate the potential of geotechnical hazards.

<table>
<tr><th colspan="4">Form I-8 Page 4 of 4</th></tr>
<tr><td>Criteria</td><td>Screening Question</td><td>Yes</td><td>No</td></tr>
<tr><td>7</td><td>Can Infiltration in any appreciable quantity be allowed without posing significant risk for groundwater related concerns (shallow water table, storm water pollutants or other factors)? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.3.</td><td>✓</td><td></td></tr>
<tr><td colspan="4">Provide basis: Based on the Final Geotechnical Report prepared by CH2M HILL (November, 1992), there was no evidence of groundwater in borings done when borings reached an elevation of 242 feet. Based on the Geotechnical Report prepared by Allied Geotechnical (August 9, 2017), there was no evidence of groundwater in borings done when borings reached an elevation of 328 feet.

Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability and why it was not feasible to mitigate low infiltration rates.</td></tr>
<tr><td>8</td><td>Can infiltration be allowed without violating downstream water rights? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.3.</td><td>✓</td><td></td></tr>
<tr><td colspan="4">Provide basis: Based on the Final Geotechnical Report prepared by CH2M HILL (November, 1992), there was no evidence of groundwater in borings done when borings reached an elevation of 242 feet. Based on the Geotechnical Report prepared by Allied Geotechnical (August 9, 2017), there was no evidence of groundwater in borings done when borings reached an elevation of 328 feet. There are no known downstream water rights issues.

Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability and why it was not feasible to mitigate low infiltration rates.</td></tr>
<tr><td>Part 2 Result*</td><td colspan="2">If all answers from row 1-4 are yes then partial infiltration design is potentially feasible. The feasibility screening category is Partial Infiltration.
If any answer from row 5-8 is no, then infiltration of any volume is considered to be infeasible within the drainage area. The feasibility screening category is No Infiltration.</td><td></td></tr>
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BMP #10

Categorization of Infiltration Feasibility Condition			**Form I-8**
Part 1 - Full Infiltration Feasibility Screening Criteria Would infiltration of the full design volume be feasible from a physical perspective without any undesirable consequences that cannot be reasonably mitigated?			
Criteria	Screening Question	Yes	No
1	Is the estimated reliable infiltration rate below proposed facility locations greater than 0.5 inches per hour? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.2 and Appendix D.		✓
Provide basis: The site of BMP 10 consists of approximately 15 feet of engineered fill material underlain by Scripps Formational materials. The engineered fill material consists of medium dense to very dense silty sand and clayey sand with abundant gravel and scattered cobbles. The Scripps Formational material consists of very dense fine-grained silty sand with gravel and cobble conglomerate, very dense and hard silty sandstone and sandy siltstone with traces of sub-rounded gravels up to 0.5 inches in maximum dimension, and sandy lean clay. The expected infiltration rate for this BMP ranges between 0.1 inches per hour and 0.5 inches per hour, based on its location within the fills and the Scripps Formation. Therefore, the estimated infiltration rate below the proposed facility location is not greater than 0.5 inches per hour. Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			
2	Can infiltration greater than 0.5 inches per hour be allowed without increasing risk of geotechnical hazards (slope stability, groundwater mounding, utilities, or other factors) that cannot be mitigated to an acceptable level? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.2.		
Provide basis: Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			

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Criteria	Screening Question	Yes	No
3	Can infiltration greater than 0.5 inches per hour be allowed without increasing risk of groundwater contamination (shallow water table, storm water pollutants or other factors) that cannot be mitigated to an acceptable level? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.3.		
Provide basis: Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			
4	Can infiltration greater than 0.5 inches per hour be allowed without causing potential water balance issues such as change of seasonality of ephemeral streams or increased discharge of contaminated groundwater to surface waters? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.3.		
Provide basis: Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			
Part 1 Result*	If all answers to rows 1 - 4 are "Yes" a full infiltration design is potentially feasible. The feasibility screening category is Full Infiltration If any answer from row 1-4 is "No", infiltration may be possible to some extent but would not generally be feasible or desirable to achieve a "full infiltration" design.		

*To be completed using gathered site information and best professional judgment considering the definition of MEP in the MS4 Permit. Additional testing and/or studies may be required by the City Engineer to substantiate findings

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<tr><td colspan="4">Part 2 – Partial Infiltration vs. No Infiltration Feasibility Screening Criteria
Would infiltration of water in any appreciable amount be physically feasible without any negative consequences that cannot be reasonably mitigated?</td></tr>
<tr><td>Criteria</td><td>Screening Question</td><td>Yes</td><td>No</td></tr>
<tr><td>5</td><td>Do soil and geologic conditions allow for infiltration in any appreciable rate or volume? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.2 and Appendix D.</td><td>✓</td><td></td></tr>
<tr><td colspan="4">Provide basis: The site of BMP 10 consists of approximately 15 feet of engineered fill material underlain by Scripps Formational materials. The engineered fill material consists of medium dense to very dense silty sand and clayey sand with abundant gravel and scattered cobbles. The Scripps Formational material consists of very dense fine-grained silty sand with gravel and cobble conglomerate, very dense and hard silty sandstone and sandy siltstone with traces of sub-rounded gravels up to 0.5 inches in maximum dimension, and sandy lean clay. The expected infiltration rate for this BMP ranges between 0.1 inches per hour and 0.5 inches per hour, based on its location within the fills and the Scripps Formation. See the Evaluation of Geotechnical Impacts due to BMP Partial Infiltration for the NCWRP Expansion and NCPWF Influent Conveyance Project TM for the detailed evaluation.

Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability and why it was not feasible to mitigate low infiltration rates.</td></tr>
<tr><td>6</td><td>Can Infiltration in any appreciable quantity be allowed without increasing risk of geotechnical hazards (slope stability, groundwater mounding, utilities, or other factors) that cannot be mitigated to an acceptable level? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.2.</td><td>✓</td><td></td></tr>
<tr><td colspan="4">Provide basis: The adjacent facilities include the existing flow equalization basins and a new flow equalization basin. Considering the relatively low infiltration rates of the Scripps Formation materials beneath the site and the foundation types of the adjacent existing and new facilities, the geotechnical impacts and risk of hazards to the adjacent facilities are considered low if the sides of BMP 10 are lined. The bottom of BMP 10 can be unlined and left open for partial infiltration. See the Evaluation of Geotechnical Impacts due to BMP Partial Infiltration for the NCWRP Expansion and NCPWF Influent Conveyance Project TM for the detailed evaluation.

Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability and why it was not feasible to mitigate low infiltration rates.</td></tr>
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<tr><td>Criteria</td><td>Screening Question</td><td>Yes</td><td>No</td></tr>
<tr><td>7</td><td>Can Infiltration in any appreciable quantity be allowed without posing significant risk for groundwater related concerns (shallow water table, storm water pollutants or other factors)? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.3.</td><td>✓</td><td></td></tr>
<tr><td colspan="4">Provide basis: Based on the Final Geotechnical Report prepared by CH2M HILL (November, 1992), there was no evidence of groundwater in borings done when borings reached an elevation of 242 feet. Based on the Geotechnical Report prepared by Allied Geotechnical (August 9, 2017), there was no evidence of groundwater in borings done when borings reached an elevation of 328 feet.

Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability and why it was not feasible to mitigate low infiltration rates.</td></tr>
<tr><td>8</td><td>Can infiltration be allowed without violating downstream water rights? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.3.</td><td>✓</td><td></td></tr>
<tr><td colspan="4">Provide basis: Based on the Final Geotechnical Report prepared by CH2M HILL (November, 1992), there was no evidence of groundwater in borings done when borings reached an elevation of 242 feet. Based on the Geotechnical Report prepared by Allied Geotechnical (August 9, 2017), there was no evidence of groundwater in borings done when borings reached an elevation of 328 feet. There are no known downstream water rights issues.

Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability and why it was not feasible to mitigate low infiltration rates.</td></tr>
<tr><td>Part 2 Result*</td><td colspan="2">If all answers from row 1-4 are yes then partial infiltration design is potentially feasible. The feasibility screening category is Partial Infiltration.
If any answer from row 5-8 is no, then infiltration of any volume is considered to be infeasible within the drainage area. The feasibility screening category is No Infiltration.</td><td></td></tr>
</table>

*To be completed using gathered site information and best professional judgment considering the definition of MEP in the MS4 Permit. Additional testing and/or studies may be required by the City Engineer to substantiate findings

APPENDIX D3

GEOTECHNICAL INVESTIGATION
NCCS MIRAMAR PIPELINE PROJECT
SAN DIEGO, CALIFORNIA

Prepared for
HDR
San Diego, California

Prepared by
TERRACOSTA CONSULTING GROUP, INC.
San Diego, California

Project No. 2934
April 17, 2017
Revised: May 15, 2017

TerraCosta
Consulting Group
Geotechnical Engineering
Coastal Engineering
Maritime Engineering

Project No. 2934
April 17, 2017
Revised: May 15, 2017

Ms. Kathy Haynes
HDR
8690 Balboa Avenue, Suite 200
San Diego, California 92123

GEOTECHNICAL INVESTIGATION
NCCS MIRAMAR PIPELINE PROJECT
SAN DIEGO, CALIFORNIA

Dear Ms. Haynes:

In accordance with your request, TerraCosta Consulting Group, Inc. (TerraCosta) is pleased to present this report of our geotechnical investigation for the subject project alignment, which extends from the pump station at Eastgate Mall and Interstate 805, along portions of Eastgate Mall and Miramar Road, and up to the Miramar Lake Reservoir. This report provides a summary of our investigation, descriptions of the alignment site conditions, and our geotechnical recommendations for the design of the project.

We appreciate the opportunity to work with you on this project and trust this information meets your current needs. If you have any questions or require additional information, please give us a call.

Very truly yours,
TERRACOSTA CONSULTING GROUP, INC.

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GEOTECHNICAL INVESTIGATION
NCCS MIRAMAR PIPELINE PROJECT
SAN DIEGO, CALIFORNIA

1 INTRODUCTION AND PROJECT DESCRIPTION

This report presents the results of our geotechnical investigation which has included our review of previously completed work along the alignment, the results of our field investigation and laboratory testing, our description and discussion of geologic and geotechnical conditions along the pipeline alignment, and our geotechnical recommendations for the proposed NCCS Miramar Pipeline Project in San Diego, California.

The project is part of the City of San Diego Water Department North City Pure Water Project, and is designed to incorporate reclaimed purified water into the system to augment water demands within the growing San Diego area. The project consists of a new 48-inch pipeline dedicated to the transmission of reclaimed water from the North City Water Reclamation Plant located on Eastgate Mall, up to the Lake Miramar Reservoir. We understand that, as part of a separate follow-on project, the reclaimed water will be blended with imported water within the reservoir, and re-treated at the Miramar Plant before entering the City's water distribution system.

The project alignment consists of a single 48-inch-diameter pipeline having an overall length of approximately 39,500 feet from Station 1+00 to Station 395+45 (see Vicinity Map, Figure 1). As we understand, construction of the pipeline will primarily employ the cut and cover construction method, with five shorter segments requiring tunneling.

The current project pipeline will extend southeast and south along Eastgate Mall to Miramar Road, where it will turn east, following Miramar Road to Kearny Villa Road, where it turns north to Candida Street. The pipeline then turns east, following portions of Candida Street, Via Pasar, and Via Excelencia, crossing under the Interstate 15 (I-15) corridor, through a segment of private property, north along Businesspark Avenue to Carroll Canyon Road, east and then northerly along Carroll Canyon Road and Scripps Ranch Boulevard, north and east along Hoyt Drive, east to the end of Meanly Drive, and then north and east under Evans Pond and Scripps Lake Drive, and eventually up to Lake Miramar Reservoir, for a total distance of 39,500 , or approximately 7.48 miles.

We further understand that, as part of the next design project, an additional segment of the pipeline will be laid along the bottom of Miramar Lake Reservoir, extending approximately 4,500 feet to the northeasterly end of the reservoir.

2 PURPOSE

The purpose of our geotechnical investigation is to provide an assessment of the geologic and geotechnical conditions that are likely to be encountered in the construction of the project pipeline on the landward side of the total alignment, and to assist HDR engineers in their design for the project.

3 SCOPE OF WORK

Our scope of work included:

1. Reviewing available information along the project alignment, including: historic topographic maps, pertinent geologic and geotechnical maps; available geotechnical reports for existing pipelines and other improvements within the project area; and historic aerial photographs along the project alignment. A list of references is provided at the end of this report.

2. Drilling, logging, and sampling of 32 test borings, including:

    - Twenty-three borings drilled with a Marl M-5 rig using an 8-inch-diameter hollow-stem continuous-flight auger;
    - One boring drilled with a Fraste drill rig using an 8-inch-diameter hollow-stem continuous-flight auger;
    - Two borings with a Badger drill rig using a 24-inch-diameter highway auger;
    - One boring with a Badger drill rig using an 18-inch-diameter highway auger;
    - Two borings with an Earthdrill drill rig using a 24-inch-diameter bucket auger; and
    - Three borings with a Longyear Model LF-70 drill rig using an HQ triple-tube core barrel system and diamond core bit.

The test borings were conducted by Pacific Drilling Company and its subcontractors. Final logs of the test borings are provided in Appendix A of this report. The locations of the test borings used for our study are indicated on the Plan and Profile Sheets provided as Figures 2 and 3-1 through 3-29.

3. Performing 16 geophysical seismic traverses, including 12 seismic refraction traverses and four REMi shear wave surveys along the alignment. The geophysical work for this project was conducted by Southwest Geophysics, Inc. The geophysical survey results are presented in two reports in Appendix B of this report.

4. Performing laboratory testing on select samples. Laboratory testing was performed by HDR, Inc. and Amec Foster Wheeler. Laboratory test results are provided in Appendix C.

5. Other data used in our assessment of site conditions along the project limits included borings and laboratory testing conducted by Group Delta Consultants (GDC, 2000), Ninyo and Moore (N-M, 1994 and 1995), Southland Geotechnical (SGC, 1993), and Geobase (GEO, 1993 and 1994). The logs of test borings from these studies are presented in Appendix A of this report. The laboratory tests results from these studies are presented in Appendix C of this report.

6. Developing a generalized geologic site model of subsurface conditions along the alignment, including lithology, soil characteristics, groundwater conditions, and issues pertinent to trench and tunnel excavatability and pipeline construction, including:

    - Description and discussion of geologic hazards along the alignment including faults, seismicity, landslides, and liquefaction/settlement potential;
    - Assessment of trench excavation considerations, such as excavatability, construction-period trench-wall stability, and suitability of the excavated materials for use as backfill;
    - Development of recommended geotechnical parameters, such as bearing capacity and settlement characteristics, for ancillary structures, and earth pressures for retaining walls;

- Assessment of geotechnical considerations for trenchless construction methods; and
- Guidelines for grading and earthwork specifications.

7. We provided an Interim Geotechnical Data Report (February 13, 2017) presenting preliminary field and laboratory data. After the completion of field work, laboratory testing, geologic and engineering analyses, we have prepared this Geotechnical Investigation report presenting all available geotechnical data and our recommendations for grading and construction of the project.

4 SITE, SOIL, AND GEOLOGIC CONDITIONS

As discussed above, the pipeline alignment extends approximately 7.48 miles (39,500 feet) from the City of San Diego North City Water Reclamation Plant, easterly to Lake Miramar Reservoir. The general geologic and subsurface conditions anticipated to be encountered along the alignment are described in the following sections.

4.1 Geologic Setting

The NCCS pipeline extends across the dissected remnants of a series of gently rising marine terraces in the area collectively known as Kearny Mesa, to the hills south of Lake Miramar. The marine terraces consist of a relatively thin veneer of paralic deposits overlying older Tertiary sedimentary deposits, which in turn overlie Mesozoic-aged metasedimentary, metavolcanic, and granitic rocks.

The interpreted surface geology along the alignment of the project is illustrated in Figures 4 and 5A. Figure 4 shows the interpreted surface geology as it was understood and mapped in the 1970s. Figure 5A shows the recent interpretation of surface geology. The alignment of the pipeline is presented on both Figures 4 and 5A. Approximate spot elevations of the contacts at the boring locations between the Quaternary-age terrace deposits and the underlying Tertiary-age deposits are shown on Figures 4 and 5A. In addition, contact elevations between the Tertiary-age deposits and the underlying Mesozoic-aged deposits, where encountered, are also shown. Using these spot elevations, estimates of the regional trend of contacts between the Quaternary and Tertiary-age, and between the Tertiary and Mesozoic-age deposits, were made and are shown on Figures 4 and 5A.

4.2 Surface Conditions

The majority of the pipeline is generally within City easements and follows existing roadways. The alignment generally follows Eastgate Mall Road to Miramar Road, then easterly to Kearny Villa Road and then under I-15 to follow additional roadways where it ultimately enters Lake Miramar. The pipeline starts near an elevation of approximately 370 feet and rises to its highest elevation of approximately 640 feet (Boring TB-4c), then descends to elevation 615 feet within the Lake Miramar Reservoir.

Typical construction along the alignment is anticipated to be cut and cover, with localized segments of trenchless construction used to cross under utilities, pass beneath I-15, and for the last approximately 1,200 feet to Lake Miramar. The majority of the alignment is developed following public roadways, some of which are heavily traveled.

4.3 Subsurface Conditions

The pipeline alignment is underlain by a combination of man-placed fills, localized remnants of natural surficial soils, alluvial soils, Pleistocene-age paralic terrace deposits, Tertiary-age Stadium Conglomerate, and Mesozoic-age metasedimentary and metavolcanic rocks. These soil and rock units are described in the following paragraphs in the order of increasing age. The geologic symbol for each mappable unit is shown after the formal name of the unit. The estimated areal extent of the unit in the near surface, with the exception of surficial soils, pavement sections, and localized zones of shallow fills, is shown on Figures 4 and 5A.

Fill Soils (Qaf). A review of maps, photographs, and other documents indicates that the alignment and general road grades for Eastgate Mall and Miramar Roads were established by the mid-1950s. Grading for the original and expanded versions of the roadway included the filling of five canyon drainages along the alignment, with estimated fills ranging up to 32 feet in thickness along the pipeline alignment. Natural alluvial soils exist in some of the drainage bottoms beneath the fills, as indicated by some of the borings. Table 1 notes the approximate locations of the fills referenced to the current pipeline alignment station numbers, with an estimate of the location of drainage centerline and fill thickness along the alignment.

Natural Surficial Soils (not mapped). Localized areas along the pipeline alignment contain remnants of natural surficial soils. These remnant soils typically range from 1 to 3 feet in thickness, and consist of hard, sandy clays characteristic of a residual clay horizon.

Alluvium (Qal). Alluvial soils were encountered locally and underlie some of the fill soils placed within the drainages. Locations where fill soil was encountered and expected are summarized on Table 1. Generally, these soils consist of silty sands, clayey sands, and sandy clays.

Terrace Deposits. Surficial mapping by Kennedy in 1975 (Figure 4) identified much of the area as being underlain by the Lindavista Formation (Qln). More recent updated mapping by Kennedy and Tan (2005) has broken the Lindavista down into fourteen subunits, defining the units generally as middle to early Pleistocene age, very old paralic deposits. These units are identified on Kennedy and Tan's map (Figure 5A) as Qvop1 through Qvop13. In general, these deposits are described as consisting of mostly poorly sorted, moderately permeable, reddish-brown, interfingered strandline beach estuarine and colluvial deposits composed of siltstone, sandstone, and conglomerate. From an engineering standpoint, these soils are all similar in nature and consistency. Terrace deposits are also known to be moderately to strongly cemented, causing localized excavation difficulties that may require the use of specialized equipment for trench excavation. In addition, lenses of gravels, cobbles, and boulders are anticipated to be encountered.

Stadium Conglomerate (Tst). The Stadium Conglomerate underlies the terrace deposits throughout most of the alignment. Elevations where the Stadium Conglomerate was encountered in our borings are shown on Figures 4 and 5A. In addition, the regional trend of the Stadium Conglomerate is shown on Figures 4 and 5A.

The Stadium Conglomerate typically consists of yellow-brown to light brown, silty to clayey sands with gravel and cobble conglomerates. Test borings indicate that clast size is typically less than 8 inches. However, clasts up to 18 or 20 inches may be locally present. It has been reported that clast sizes within the Stadium Conglomerate have reached up to and greater than 24 inches in maximum dimension. However, clasts of this size were not observed during our investigation, with 12-inch clasts being the largest observed. The matrix for this unit is typically moderately to strongly cemented. The Stadium Conglomerate tends to be encountered at shallower depths east of I-15 and tends to be deeper west of I-15. As such, the Stadium Conglomerate may be encountered in deeper excavations on the west end of the alignment, and it will certainly be encountered east of the I-15 corridor.

Mesozoic-age Metasedimentary and Metavolcanic Rocks (Mzu): Mesozoic-age metasedimentary and metavolcanic rocks generally underlie the Tertiary-aged Stadium Conglomerate. These rocks, locally known as the Santiago Peak Volcanics, are described as consisting of low grade metamorphosed sedimentary rocks (conglomerate, siltstone, and sandstone) interlayered and mixed with metavolcanic rocks consisting of flows, tuffs, and volcaniclastic breccia. While not encountered or exposed along the alignment, undifferentiated sedimentary and granitic rock exist at depth.

Elevations where Mesozoic-age metasedimentary and metavolcanic rocks were encountered in our borings are shown on Figures 4 and 5A. In addition the regional trend of the Mesozoic-age metasedimentary and metavolcanic rocks is also shown on Figures 4 and 5A. In general the Mesozoic-age metasedimentary and metavolcanic rocks are not anticipated to be encountered to the west of Interstate I-15 except near the proposed tunnel location near the intersection of Candida Street and Via Pasar (Stations 290+00 to 294+00). However east of Interstate I-15, the Mesozoic-age metasedimentary and metavolcanic rocks is generally shallower up station of Station 315+00 and may be encountered where the invert of the pipeline is near the regional contact between the Stadium Conglomerate and the Mesozoic-age metasedimentary and metavolcanic rocks, see Figures 4 and 5A.

4.4 Geologic Structure

The primary geologic formation that will be encountered at the surface along the Miramar Road segment is the Quaternary-age terrace deposits. Previous studies (Southland Geotechnical, 1994) indicate that sedimentary deposits of this formation are typically flat-lying or dip a few degrees locally. Along the Miramar Road segment, massive bedding is expected to be characteristic of the structure within sediments of the Stadium Conglomerate. However, either formation mentioned may exhibit localized variability due to scouring, lensing, and cross-stratification. At the easterly end of the alignment, the younger deposits rest unconformably on the Mesozoic-aged basement rocks.

4.5 Possibility of Soil Contamination

Samples of the fill soils recovered from Group Delta Consultants' (GDC) Boring B-2 (Station 100+75) were described as having a musty hydrocarbon-type odor from a depth of approximately 6 feet to the bottom of the boring (25½ feet). In the absence of monitoring equipment, the suspected contamination could not be characterized at the time of exploration.

TerraCosta Boring B-6 (Station 99+00) encountered fill soils to a depth of approximately 12 feet. These soils had an organic odor typical of fills containing organic matter, but not a hydrocarbon-type odor as described in GDC Boring B-2.

This portion of the pipeline alignment traverses fill soils placed along the northern half of Miramar Road where it encroached into an adjacent drainage. The fill was probably placed during the original grading of Miramar Road and is evident in the City's 1950s-series topographic maps. Based on a review of historic topographic maps, this fill is estimated to underlie the proposed pipeline alignment from approximately Station 65+50 to Station 70+40. The fill is estimated to extend to a depth of less than 30 feet along the alignment in this area.

Assessment of the nature of any suspected contamination will require additional study beyond the scope of this investigation. If the suspected contamination is present in excess of allowable limits, environmental regulations will likely require remediation or disposal in specialized landfills. Due to the nature of nearby businesses, it is recommended that the contractor review the California State Water Resources Control Board Geotracker website (https://geotracker.waterboards.ca.gov) to determine what type of contamination may exist and what monitoring is appropriate for health and safety during construction operations.

4.6 Geologic Hazards

4.6.1 *On-Site Faults*

The conjectured location of a far-eastern extension of the west/northwest-trending Torrey Pines Fault crosses the Miramar Road Pipeline Segment twice at approximately 60 feet southeast of the intersection of Eastgate Mall and Autoport Mall, and approximately 300 feet east of the Miramar Road/ Eastgate Mall intersection. An unnamed fault is also shown by Kennedy as extending northeast from the Torrey Pines Fault to cross the pipeline alignment. No other faults are mapped as crossing either alignment segment, nor did our review of available subsurface information suggest that any unmapped faults are present along the pipeline route.

The Torrey Pines Fault and the perpendicularly-oriented unnamed fault are mapped as offsetting sediments of the Eocene-age Scripps Formation in areas off the mesa top. However, both faults are mapped as not breaking the surface of the overlying Pleistocene-age terrace deposits (estimated 1.2 million-year-old deposits) at any location along its length. Since there is no direct evidence that movement along this fault has not occurred within the Quaternary (last 1.6 million years), California Division of Mines and Geology guidelines (Hart, 1994) suggest that these faults be considered "potentially active."

The style of faulting exhibited by the these and other similar-trending fault traces in the area was prevalent within the Miocene epoch when tectonic stresses produced widespread north-south extensional faulting in southern California. Near the end of the Miocene epoch (estimated to be 5.3 million years ago), regional stress changed to north/south compression in association with the beginning of separation of Baja California from the rest of California and the opening of the Gulf of California. Considering that the tectonic stresses that produced these faults had ended long before the Quaternary, it is unlikely that the faults have experienced displacement within the Quaternary. No earthquake epicenters have been associated with any of these northeast/southwest-trending faults in this area. Thus, in our opinion, the potential for ground displacement along the on-site faults and other similar faults in this area is considered to be very low.

4.6.2 *Regional Faulting and Seismicity*

Our review of geologic maps and literature indicates that there are no known major or active faults near or projecting toward the pipeline alignment. The site is, however, located in a moderately-active seismic region of southern California that is subject to significant hazards from moderate to large earthquakes. Ground shaking could affect the site in the event of an earthquake on any of the several active fault zones located on or offshore of Southern California.

The nearest known active faults are within the Rose Canyon Fault Zone, located approximately 4 miles to the southwest at its nearest location. The maximum credible earthquake assigned to the Rose Canyon Fault is Magnitude 6.9. Other active fault zones within 60 miles of the site, which could generate ground shaking along the alignment, are the Coronado Banks, La Nacion, San Diego Trough, San Clemente, Elsinore, and San Jacinto Fault Zones.

4.6.3 *Groundwater*

Along the Miramar Road Pipeline Segment, groundwater was noted as existing within the buried alluvial soils that existed from 19½ to 26 feet in GDC Boring B-6. Localized wet zones were also encountered within the fill soils, from a depth of 18½ to 22 feet in GDC Boring B-2. Occurrences of groundwater seepage or moist conditions were noted in TerraCosta Borings B-10, B-14, TB-5a, TB-2b, TB-4b, TB-4c, and TB-4d. Depths where groundwater was encountered are noted on the boring logs.

Our study indicates that a static, near-surface water table is not anticipated to exist along the alignment. Some perched water zones exist locally within buried alluvial soils or within the lower portions of fills placed in drainages along the alignment. Such perched water conditions can develop in any area where permeable granular soils are underlain by less permeable, fine-grained sediments. As such, localized perched water conditions may be encountered during pipeline trenching, particularly within the filled canyons and drainages. Groundwater sources may include natural flow to the site through buried alluvial deposits, or localized leakage from existing underground utility lines. Based on our studies, it is not anticipated that zones of large volume seepage will be encountered at proposed trenching depths.

4.6.4 *Liquefaction*

Our review of subsurface explorations along the project alignment suggests that the underlying soils are primarily medium dense to very dense, silty to clayey sands and gravels. In addition, a shallow groundwater table was not indicated to be present in this area. Therefore, the potential for liquefaction or seismically-induced settlement for the vast majority of the subsurface soils along the project alignment is considered low. Alluvial soils that exist in a loose condition beneath fill, such as in shallow, filled drainages along the alignment, may have a potential for liquefaction if saturated and subjected to strong seismic shaking. Based on our study along the alignment, the potential for settlement associated with liquefaction of buried alluvial deposits is not expected to have a negative effect on the pipeline construction.

4.6.5 *Landslides*

Our site observations and review of geologic literature and aerial photographs provided no indications that areas along or adjacent to the proposed alignment are underlain by landslides. The geologic formations underlying the alignment area are generally not considered to be prone to landsliding.

4.6.6 *Tsunamis and Seiches*

Based on the geographic location of the project alignment, tsunamis are not considered to be likely hazards for this project. A seiche is a standing wave in an enclosed body of water, such as a lake or reservoir. While a seiche can occur in either Miramar Reservoir or Evans Pond, they would be limited in nature and would not be expected to be of concern to the project.

4.6.7 *Expansive Soils*

Portions of the project alignment are comprised of clayey soils. These soils are anticipated to have moderate expansion potential. However, as these soils are covered by pavements throughout much of the alignment, and soil moistures are expected to remain relatively constant, reducing changes in soil volumes. Thus, it is our opinion that impacts to the proposed project due to expansive soils is low along the pipeline alignment, except at the proposed pure water chlorination facility where the impacts to the proposed project due to expansive soils is considered moderate.

4.6.8 *Corrosive Soils*

Soil chemistry and wet clayey soils can be corrosive in nature. As we understand, testing of select soils has been completed by HDR for corrosion potential, and will be evaluated by a corrosion specialist during design.

5 DISCUSSION

5.1 General Soil Characteristics Along Pipeline Alignment

Based on our study and the shallow nature of the construction, we anticipate that excavations for the proposed pipeline will encounter fill soils, remnants of natural surficial soils, Quaternary-age terrace deposits, Tertiary–age Stadium Conglomerate, and Mesozoic-age metasedimentary and metavolcanic rocks. The soils generated from these excavations are anticipated to consist primarily of silty to clayey sands and sandy lean to fat clays, with varying amounts of gravels and cobbles. In addition, hard cemented zones are anticipated. We have prepared Tables 2 through 4 to better summarize the anticipated materials and their excavation characteristics along the pipeline alignment. Table 2 presents a summary of general material types encountered in the borings, whereas Table 3 presents a summary of our assessment of the materials likely to be encountered at the invert of the pipeline and what materials are likely to be encountered by the excavations. Table 4 summarizes our assessment of the general competence of the materials likely to be encountered during construction.

5.2 Pure Water Dechlorination Facility

A dechlorination facility is proposed along the alignment of the pipeline near Station 375+00. We understand that this facility consists of a lightly loaded structure with parking. The facility is to be constructed approximately east of the alignment, encroaching into an existing hillside. Grading for the facility is anticipated to result in a relatively flat pad near elevation 626 feet. A perimeter retaining wall is anticipated to be constructed along the northern, eastern, and southern limits of the property.

The facility appears to be located over and near the edge of a buried drainage. As such, subsurface conditions at the site consist of fill soils used to infill that buried drainage, with portions of the proposed pad located in Stadium Conglomerate, depending upon the exact limits of the buried drainage. We drilled two borings (Borings B-20 and B-20A) in this area, with Boring B-20A being drilled near the eastern limits of the proposed pad. Boring B-20A encountered fill soils to the depth explored, while Boring B-20 encountered approximately 3 feet of fill before encountering Stadium Conglomerate. The fill soils are comprised of sandy clays to clayey sands, with gravels upwards of 30 percent. The plastic index of the more clayey portions is on the order of 26 percent, which suggests a moderately expansive material having an Expansion Index (EI) of less than 80. The Stadium Conglomerate that was encountered in Boring B-20 is comprised of sandy clays with gravels and cobbles. We estimate the oversized fraction to be on the order of 30 percent.

We anticipate that grading of the site will likely result in a pad comprised of undocumented fill and Stadium Conglomerate. We estimate that Stadium Conglomerate will likely be encountered in the northeastern edge of the pad area for the proposed building. The site will likely need to be overexcavated and fill soils recompacted.

Materials generated by the grading operations will be clayey in nature and contain a fair amount of oversized materials. As such, the on-site materials in their as-is condition are generally unsuitable for use as retaining wall backfill, and more suitable backfill material should be used for the wall backfill.

Recommendations for site preparation and design recommendations are presented in Section 6.3.1 of this report.

5.3 **Tunnels**

There are six locations where the pipe is anticipated to be installed using micro-tunneling operations. These locations are summarized in Table 5. Included in Table 5 is a summary of the anticipated depths to the invert of the tunnel, the anticipated general conditions of materials likely to be encountered within the construction of the access shafts, the possible face conditions along the tunnel alignment, our estimate of groundwater conditions within the limits of the proposed tunnel, and a listing of nearby borings.

5.4 **Trench Stability**

The excavations for the pipeline will generally be into fill soils, residual soils, and the Lindavista Formation and Stadium Conglomerate. Descriptions of these materials are presented in Section 4.3 of this report.

Trenching operations for the proposed pipeline will need to comply with OSHA and Cal/OSHA requirements. As such, trench excavations for the pipeline will generally need to be either shored or sloped back. Trench shields may be used in lieu of shoring or sloping the excavations, provided Cal/OSHA and OSHA regulations are followed. For preliminary trench shoring design and cost estimating purposes, we anticipate that the majority of the excavations will be within OSHA Type B soils. Trench safety regulations indicate that for Type B soils, the maximum allowable slope for unsupported trench walls from 5 to 20 feet in height is 1:1 (horizontal to vertical).

5.5 Pavement Repair

Depending on the width of the existing pavement removed for the pipeline trench, City of San Diego standards may require construction of a replacement asphalt/concrete pavement section along Miramar Road. The effectiveness of the restored pavement section is a function of the components of the structural pavement section, as well as the underlying subgrade soils.

To assess the potential subgrade conditions of the backfilled pipeline trenches, we reviewed the nature of the material composition of the potential excavated soils. Our review of available data indicates that the potential subgrade soils may be comprised of mixtures of residual clays, formational clays, sands, and gravels. The support characteristics of the potential subgrade soils are directly related to the amount of the finer fraction (clays and silts) of soils in the mixture. The results of laboratory testing on near-surface residual clay soils, as reported for samples tested in GDC Borings B-4 and B-9, indicated an R-value of 8 and 4, respectively. Subgrade soils with lesser amounts of clay will have a higher R-value.

6 RECOMMENDATIONS

6.1 General Site Preparation and Earthwork Operations

All grading and site preparation should be performed under the observation of the geotechnical engineer and in accordance with the 2015 Edition of the Standard Specifications for Public Works Construction (“Whitebook”) and the 2012 City of San Diego Standard Drawings for Public Works Construction.

In general, all vegetation, debris, and other deleterious material should be removed from areas to receive fill prior to site regrading. All structural fill soils, including trench backfill, should be compacted to a minimum 90 percent of the maximum dry density, as determined by ASTM Test Method D1557. Moisture content in the fill should be maintained between the optimum moisture content and 3 percent over optimum.

In areas receiving pavement or foundations, we recommend that the upper 1 foot of subgrade soils be compacted to 95 percent of the maximum dry density, as determined by ASTM D1557.

As noted in the Whitebook, soft, spongy, or other unstable soils should be removed from the trench bottom before placement of the bedding material or pipe. It is expected that trench bottoms in formational materials will be firm and competent. Unsuitable soils are most likely to be encountered in those portions of the alignment underlain by canyon fills (see Table 1). When encountered at trench grade, the unsuitable material should be excavated and replaced as properly compacted fill.

The geotechnical engineer should review the project plans to evaluate whether the intent of the recommendations presented herein has been properly interpreted and incorporated into the contract documents.

We recommend that all trenching operations for the proposed pipeline comply with OSHA and Cal/OSHA requirements. As such, trench excavations for the pipeline will generally need to be either shored or sloped back. Trench shields may be used in lieu of shoring or sloping the excavations, provided Cal/OSHA and OSHA regulations are followed.

For preliminary design and cost estimating purposes, we anticipate that the majority of the excavations will be within OSHA Type B soils. We recommend that excavation conditions be verified in the field, and that modifications be made to any trench excavation support systems as needed based upon the actual exposed conditions in the field. We recommend that the designated "competent person" determine the need for, and method for, trench stabilization, as stated in the OSHA and Cal/OSHA requirements.

6.2 Pipeline Design

6.2.1 *Pipeline and Anchorage and Sliding*

We recommend an allowable passive earth pressure of 350 pcf for thrust block design. For test conditions, we recommend that this value be increased by one-third. The allowable passive earth pressure includes a factor of safety of 2.

We recommend an allowable bearing pressure of 1,200 psf for anchor blocks for no embedment of the anchor block, and an allowable bearing pressure of 2,800 psf for 1 foot of embedment. We recommend a minimum bearing area for the anchor block of 1 foot by 1 foot square.

For frictional resistance of anchor blocks and thrust blocks, we recommend an ultimate coefficient of friction of 0.70 and an allowable coefficient of friction of 0.35. For thrust block design, both the passive pressure and friction coefficient can be combined. However, if the passive pressure and friction coefficient are combined, we recommend reducing the passive pressure and friction coefficient by 25 percent.

For frictional resistance of buried pipes, where the pipeline anchorage is obtained by soil-pipe friction, we recommend an alternate coefficient of friction of 0.30. This value assumes a formed steel-soil or plastic interface. We recommend reducing this value by 75 percent if a bituminous coating is used around the pipe.

6.2.2 *Pipe Design*

For design of the loads acting on the buried conduit, we recommend using a total unit weight of soil of 130 pcf and a buoyant soil weight of 70 pounds pcf. The total unit weight of soil includes the effects of moisture, and reflects compactive efforts. It is intended to reflect the likely in-situ unit weight of the compacted backfill soil. Typically, silty sands have a laboratory maximum (ASTM D1557) dry density between 120 and 127 pcf, with an optimum moisture content ranging from 10 to 12 percent. Assuming a minimum relative compaction of 90 percent, and allowing for moisture contents between 10 and 14 percent, the likely range of total in-situ compaction unit weight is 123 to 130 pcf. The buoyant soil weight can be used for resisting uplift forces.

The conditions along the pipeline generally consist of two cases. Case One consists of a trench wall comprised of formational soils, with select compacted soils placed within and around the pipe in the trench. Case Two consists of compacted soils or less competent soils/materials within the trench walls and selected compacted soils placed within and around the pipe in the trench.

For Case One, our preliminary recommended E’ is 2,500 psi. For Case Two, our preliminary recommended E’ is 1,000 psi. These recommendations assume that the trench width (B) to pipe diameter (D) ratio (B/D) is 2 or less.

6.2.3 *Pipe Trench, Pipe Bedding, and Pipe Zone Backfill Criteria*

We recommend that the proposed pipe trench width, pipe bedding, and pipe zone backfill criteria comply with San Diego Regional Standard Drawing No. SDW-110, as adopted in the City of San Diego Standard Drawings. In addition, we recommend that modifications to minimum trench width requirements dictated by construction methods and requirements be approved by the Engineer-of-Record Additionally, we recommend that if a clean crushed rock is used for the pipe zone and pipe bedding areas, a layer of filter fabric be placed at the interface between the pipe backfill zone and pipe zone in order to mitigate migration of fines into the pipe zone rock.

We recommend that, where unsuitable soils are encountered at the pipe subgrade, the materials be overexcavated, and replaced as properly compacted fill where practical or replaced with 1/2-inch maximum size crushed rock.

In addition, we recommend that open trench operations, pipe installation, and backfill material be in conformance with the Whitebook requirements, except that jetting of backfill and bedding materials will not be permitted.

6.3 Design Recommendations for Pure Water Dechlorination Facility

6.3.1 *Site Preparation*

The proposed dechlorination facility is anticipated to be founded on a building pad consisting of both fill soils and formational materials comprised of Stadium Conglomerate. The fill soils are undocumented and are associated with past grading operations performed to infill a previous drainage. The fill soils and formational soils are clayey in nature, with a plastic index on the order of 25. As such, these soils are considered moderately expansive, with an estimated EI ranging from 40 to 80.

Given that the fill soils are undocumented, and that a fill/formation contact line is anticipated within the pad area, we recommend that the depth of soil removal and recompaction be extended to a minimum depth of 5 feet below the bottoms of footings. Given that the on-site materials contain oversized materials consisting of gravels and possible cobbles, the materials excavated and recompacted may require processing to remove the larger portions of the oversized materials. We recommend that oversized materials greater than 6 inches be removed from the materials that are overexcavated and recompacted.

We recommend that the materials be recompacted to a minimum 90 percent of the maximum dry density, as determined by ASTM Test Method D1557. Moisture content in the fill should be maintained between the optimum moisture content and 3 percent over optimum. In addition, we recommend that the upper 1 foot of the subgrade soil materials in areas to receive pavement be recompacted to a minimum relative compaction of 95 percent.

6.3.2 *Foundations*

As we understand, the proposed building for the dechlorination facility is a lightly loaded structure. In addition, the current subgrade soils are considered moderately expansive, having an estimated EI on the order of 40 to 80 and a plastic index of approximately 25. As such, the foundation subgrade soils are considered potentially sensitive to seasonal moisture variation and have the potential for shrinkage and swelling. Given that the proposed structure is lightly loaded, the foundation system for the proposed structure is potentially subject to ground movements associated with the expansive nature of the existing soils. In addition, portions of the site are underlain by undocumented fill, of which a limited thickness of the near-surface will be removed and recompacted. As such, some amount of undocumented fill is anticipated to remain beneath the structure. Given these conditions, we recommend that the proposed building be founded on a stiffened mat foundation. Such systems are typically designed using either the Wire Reinforcement Institute's (WRI) Method or the Post-Tensioning Institute's method. A copy of the WRI Method is presented in

Appendix D. Alternative foundation systems include supporting the building on a pier and grade-beam system, or replacement of the upper 5 feet of material (as measured from the bottom of the lowest point in the footings) with a low expansive material (EI less than 20), and then supporting the proposed building on a conventional shallow foundation system. Recommendations using the WMI method are presented below.

For a foundation system assuming non-expansive soils, we recommend an allowable bearing pressure of 2,000 psf. This would result in estimated settlements due to building loads of only 1 inch or less, and differential settlements of 1/2 inch or less.

In addition, we recommend that all footings be designed by a structural or civil engineer knowledgeable in the design of foundations. We recommend that all footings have a minimum width of 12 inches, and be founded a minimum of 18 inches below the lowest adjacent grade. Footings should be reinforced to minimize cracking due to shrinkage, and to accommodate structural loads. Reinforcement should be determined by the engineer responsible for the design of footings. All footing excavations should be free of loose soil prior to the placement of concrete. Footing excavations should be observed by the geotechnical engineer to confirm appropriate dimensions and bearing material.

For foundation systems designed using the WRI Method to accommodate the expansive soil conditions at the site, and designed as a stiffened slab-on-ground system, we recommend the following design parameters:

CW = 15
PI = 25

These parameters assume that the native soils underlying the building have been removed and recompacted to 90 percent relative compaction at a moisture condition equal to the optimum moisture content plus 2 percent moisture. We recommend that the depth of removal and recompaction extend a minimum of 3 feet below the bottom of the footing.

If the zone of removal and recompaction is replaced with a non-expansive structural fill having an EI of 20 or less and a Plastic Index of 4 or less, we recommend that the

5-foot non-expansive structure fill mat be compacted to 95 percent relative compaction at a moisture content between the optimum moisture content to 2 percent plus the optimum moisture content.

For this condition, using a non-expansive soil mat beneath the building, and for foundation systems designed using the WRI Method, we recommend the following design parameters:

CW = 15
PI = 14

6.3.3 *Settlement*

For foundations designed in accordance with the WRI Method, we anticipate settlements to be less than 1 inch, with post-construction differential settlements of less than 1/2 inch. This assumes footing subgrade is prepared in accordance with our recommendations and footing loads do not exceed the bearing pressures provided above. In addition, we anticipate angular distortions within the structures will be on the order of 1/240 to 1/500 or less.

6.3.4 *Lateral Resistance*

To provide resistance for lateral loads applied to footings and shear keys poured neat against vertical excavations, we recommend using an equivalent fluid pressure of 350 pcf for properly compacted granular fill or competent formational materials. These values assume a horizontal surface for the soil mass extending at least 10 feet from the face of the footing or three times the height of the surface generating the passive pressure, whichever is greater. The upper 12 inches of soil in areas not protected by floor slabs or pavements should not be included in design for passive resistance to lateral loads. If friction is to be used to resist lateral loads, we recommend a coefficient of friction of 0.35 between soil and concrete for either compacted fill or formational soil. If it is desired to combine friction and passive resistance in design, we recommend reducing the friction coefficient by 25 percent. The values of earth pressure and the coefficient of friction are allowable values, which include a factor of safety of 2.

6.3.5 *Retaining Wall Recommendations*

We understand that a site perimeter retaining wall is proposed for the boundary of the building pad for the dechlorination facility. This wall will be constructed by cutting into the upslope materials. Review of the preliminary project plans suggests that the retaining wall has a height ranging from 1 to 4 feet. The retained materials slope upward to an approximate elevation of 632 feet, which is approximately 6 feet above the anticipated finished building pad elevation.

The materials being retained by the retaining wall are anticipated to be comprised of fill soils and formational materials of the Stadium Conglomerate. The fill soils are undocumented and may require remediation by removal and recompaction within the footing area of the retaining wall. The Stadium Conglomerate materials are considered competent for the support of the proposed retaining wall. The retained soils are considered clayey in nature and contain oversized gravels and cobbles. In general, these soils are considered poorly draining and poor backfill materials. Lateral earth pressures are generally higher due to the clayey nature of the soils. As such, we have assumed that these materials will be removed within a 1:1 inclined prism beginning at the heel of the retaining wall, extending upward until it daylights with select materials.

When selecting lateral earth pressures, active lateral earth pressures should only be used for cantilevered walls where a horizontal movement of at least 0.002H can be accommodated at the top of the wall, where H is the height of the wall in feet. If this condition is not satisfied, design criteria for the restrained or partially-restrained condition should be used. We recommend providing all retaining walls with a backfill drainage system adequate to prevent the buildup of hydrostatic pressures.

Recommended earth pressures for walls with select granular backfill are presented below. Select granular backfill available from materials on site should conform to the structure backfill requirements outlined in the Whitebook and have a Sand Equivalent of 20 or more.

For cantilevered retaining walls with level granular backfill extending a minimum horizontal distance equal to the height of the wall, we recommend, for preliminary design, an active earth pressure equivalent to a fluid pressure of 40 pcf. This value assumes that no surcharge loads, such as adjacent footings or vehicle traffic, will act on the wall.

For cantilevered retaining walls with a 2:1 inclined sloping backfill, we recommend, for preliminary design, an active earth pressure equivalent to a fluid pressure of 60 pcf.

Cantilevered retaining walls subjected to vehicular loads should be designed to resist an equivalent fluid pressure for the active case described above, plus an additional uniform lateral pressure equal to 60 psf.

For walls that are to be subjected to adjacent uniform area-wide surface surcharges, we recommend including an additional uniform pressure in the design that is equal to 0.3 times the surcharge magnitude for cantilevered walls that are free to rotate and 0.5 times the surcharge magnitude for restrained walls.

For walls that are to be designed for seismic load conditions, we recommend that the walls be designed to accommodate an additional equivalent fluid pressure equal to 18 pcf. We recommend that this pressure be distributed as an inverted triangle.

For the design of the retaining wall foundations, we recommend that continuous footings founded in properly compacted fill soils or formational materials be designed for an allowable soil bearing pressure of 2,000 psf. These bearing capacities may be increased by no more than one-third for loads that include wind or seismic forces.

To provide resistance for lateral loads applied to footings and shear keys poured neat against vertical excavations, we recommend using an equivalent fluid pressure of 350 pcf for properly compacted granular fill or competent formational materials. These values assume a horizontal surface for the soil mass extending at least 10 feet from the face of the footing or three times the height of the surface generating the passive pressure, whichever is greater. The upper 12 inches of soil in areas not protected by floor slabs or pavements should not be included in design for passive resistance to lateral loads. If friction is to be used to resist lateral loads, we recommend a coefficient of friction of 0.35 between soil and concrete for either compacted fill or formational soil. If it is desired to combine friction and passive resistance in design, we recommend reducing the friction coefficient by 25 percent.

The values of earth pressure and the coefficient of friction are allowable values, which include a factor of safety of 2.

6.3.6 *Pavement Recommendations*

We have not been provided with any specific traffic requirements for the pavement for the dechlorination facility. As such, we have assumed a design Traffic Index of 4.5. Given the clayey nature of the on-site soils, we have used a design R-value of 10, which will need to be field-verified at the time of construction. For the design parameters stated above, we recommend a pavement section consisting of 3 inches of asphaltic concrete underlain by 8 inches of a crushed aggregate base having a minimum R-value of 79.

6.3.7 *Seismic Design Parameters*

Recommended seismic design parameters for the proposed dechlorination facility are presented below. We have treated the site as a non-liquefiable site having Site Class D.

The site is located at approximate location 32.7096 degrees latitude, -117.2272 degrees longitude. The corresponding CBC seismic design parameters are listed below.

CBC Seismic Design Parameters	
F_S	1.138
F_V	1.694
S_S	0.905g
S_1	0.353g
S_{MS}	1.030g
S_{M1}	0.598g
S_{DS}	0.687g
S_{D1}	0.399g

6.4 Pavement Repair

For design purposes, we recommend assuming potential subgrade soils in formational areas where the subgrade soils are not clayey to have an R-value on the order of 20, and an R-value of 5 for fill areas and areas underlain by clayey soils.

In addition, we recommend that all pavement repair areas comply with the resurfacing requirements presented in City of San Diego Standard Drawings Nos. SDG-107 and SDG-108.

6.5 Construction Material Compatibility and Corrosion Protection

We recommend that a corrosion and construction materials compatibility expert review the construction materials and corrosion systems selected for the project, and make recommendations as needed regarding the modification of materials or systems as deemed appropriate based on a review of the collected data. In addition, we recommend that all construction materials comply with the appropriate sections of the CBC, as it relates to the selection of materials and their environment of use.

7 LIMITATIONS

The data and conclusions provided in this report are based on the review of published reports and the results of our test explorations. The conclusions and information presented in this report are intended to assist HDR in the completion of their pipeline design studies. Use of this information for any other intended purpose is not recommended.

It should be understood that California, including San Diego County, is an area of high seismic risk. It is generally considered economically unfeasible to build totally earthquake-resistant structures. Therefore, it is possible that a large or nearby earthquake could cause damage at the site.

This firm does not practice or consult in the field of safety engineering. We do not direct the contractor's operations, and we cannot be responsible for the safety of other than our own personnel on the site; therefore, the safety of others is the responsibility of the contractor.

The contractor should notify the owner if he considers any of the recommended actions presented herein to be unsafe.

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TABLE 1

ESTIMATED FILL DEPTHS ASSOCIATED WITH BURIED DRAINAGES ALONG NCCS MIRAMAR PIPELINE PROJECT ALIGNMENT

Estimated Lateral Limits of Buried Drainage Fill*	Estimated Deepest Fill Area Along Alignment – Typically Thalweg of Drainage*	Estimated Fill Thickness Along Alignment
Sta. 96+80 to 101+80	Sta. 96+85	Up to 30± feet
Sta. 138+75 to 140+85	Sta. 139+85	Up to 20± feet
Sta. 186+55 to 188+25	Sta. 187+45	Up to 18± feet
Sta. 196+35 to 197+20	Sta. 196+85	Up to 8± feet
Sta. 198+40 to 201+50	Sta. 200+45	Up to 20± feet
Sta. 298+80 to 301+10	Sta. 301+04	Up to 12± feet
Sta. 284+00 to 293+00	Sta. 286+00	Up to 40± feet

*Locations are approximated; actual limits and depths may vary.

TABLE 2

SUMMARY OF TEST AND ROCK CORE BORINGS WITH ENCOUNTERED SUBSURFACE MATERIALS

Geotechnical Company	Boring Number	Station	Depth (feet)	Bottom Elevation (feet)	Qaf	Residual or Qal	Qt	Tst	Mzu
TerraCosta	B-1	1+20	19.5	351.5			X		
	B-2	20+38	19.5	361.5	X		X		
	TB-1a	32+62	31.0	355.0	X		X		
	TB-1b	34+32	31.0	353.0	X		X		
	B-3	44+03	31.5	357.5	X	X	X		
	B-4	65+05	25.5	372.5			X		
	B-5	74+18	21.5	380.5			X		
	B-6	98+28	31.5	371.5	X		X		
	B-21	113+21	25.0	394.0	X		X		
	B-7	128+89	30.5	392.5	X	X	X		
	B-8	138+18	26.5	389.5			X		
	B-9	156+90	21.5	409.5	X		X		
	B-10	201+66	25.5	406.5	X	X (Qal)		X	
	B-11	223+30	20.5	426.0			X		
	B-12	240+00	20.0	452.0			X		
	B-13	277+30	19.5	475.5			X		
	B-14	287+50	19.5	436.5	X				
	TB-5a	290+25	36.0	401.0	X			X	
	TB-5b	293+19	22.0	420.0				X	X
	TB-2a	300+72	33.0	440.0	X		X	X	
	TB-2b	306+30	59.0	450.0			X	X	
	B-15	314+76	24.5	477.5			X	X	
	B-16	327+64	23.0	477.0	X		X		
	B-17	334+16	20.0	478.0	X		X	X	
	B-18	353+60	21.3	499.7	X		X		X
	B-19	366+43	30.0	541.0	X			X	X
	B-20	374+62	18.0	607.0	X			X	
	B-20a	374+84	21.5	610.5	X				
	TB-4a	383+50	28.5	633.5				X	X
	TB-4b	388+96	110.0	615.0	X			X	
	TB-4c	390+34	131.5	592.5	X			X	
	TB-4d	392+78	123.0	599.0	X			X	
N-M	B-10*	256+75	16.5	471.5	X	X	X		
	B-11	231+30	15.9	442.1	X	X	X		
	B-12	219+07	15.9	430.1	X		X		

TABLE 2
(continued)

Geotechnical Company	Boring Number	Station	Depth (feet)	Bottom Elevation (feet)	Qaf	Residual or Qal	Qt	Tst	Mzu
GDC	B-1	51+56	15.0	377.5	X		X		
	B-2	99+93	25.5	377.7	X				
	B-3	111+96	20.0	397.6	X	X	X		
	B-4	113+50	20.5	397.0	X	X	X		
	B-5	123+11	20.5	398.5	X		X		
	B-6	140+12	30.5	387.3	X	X(Qal)	X		
	B-7	187+70	25.5	404.0	X		X		
	B-8	248+97	15.0	465.4	X	X	X		
	B-10	65+50	21.0	367.0	X	X	X		
	B-11	33+88	21.5	365.0	X		X		
SGC	B-1*	44+50	20.0	369.0					
	B-2	55+67	20.0	375.38	X		X		
	B-3	68+38	20.0	379.69	X		X		
	B-4	79+82	3.5	401.5		X	X		
	B-5	80+02	12.0	393.35		X	X		
	B-6	161+90	17.0	417.38		X	X		
	B-7	168+62	18.5	421.7			X		
	B-8*	169+00	20.0	423.2		X	X		
	B-9	191+69	12.0	425.0			X		
	B-10	191+72	4.5	432.5			X		
	B-11	191+93	5.0	432.0			X		
	B-12	200+46	20.0	410.95	X		X		
	B-13	215+82	19.5	426.17			X		
GEO	B-3	52+95	20.5	373.5			X		
	B-4	68+00	19.0	381.0	X		X		
	B-5	87+30	36.0	-36.0	X		X		
	B-6	87+89	7.0	362.0	X		X		
	B-7	88+25	8.5	360.5	X		X		
	B-8	108+89	25.5	390.5	X		X		
	B-9	132+90	26.5	398.5	X		X		
	B-10	135+38	25.5	395.5	X		X	X	
	B-11	152+90	30.5	398.5	X		X		
	B-12	173+88	35.0	405.0	X		X		
	B-13	192+92	27.2	409.8			X		
	B-14	212+38	20.3	422.7			X		
	B-15	240+35	20.0	452.0	X		X		
	B-16	260+80	11.0	480.0	X		X		
	B-40	92+48	5.5	401.5	X				
	B-41	93+24	16.5	-16.5			X		

*SGC Borings B-1 and B-8, and N-M Boring B-10, locations are not available. Station numbers are estimated from surface elevations on the boring logs.

TABLE 3

SUMMARY OF ANTICIPATED INVERT CONDITIONS

Stations	Anticipated Invert Conditions
1+00 to 4+00	Likely Qt
4+00 to 7+00	Likely Qt to possible Tscu
7+00 to 32+00	Likely Qt
32+00 to 35+00	Likely Qt to possible Tscu
35+00 to 97+00	Likely Qt
97+00 to 103+00	Likely Qaf
103+00 to 139+00	Likely Qt
139+00 to 142+00	Likely Qaf
142+00 to 187+00	Likely Qt
187+00 to 189+00	Likely Qt to possible Tst
189+00 to 198+00	Likely Qt
198+00 to 203+00	Likely Tst
203+00 to 225+00	Likely Qt to possible Tst
225+00 to 278+00	Likely Qt
278+00 to 285+00	Likely Tst
285+00 to 294+00	Likely Mzu
294+00 to 308+00	Likely Tst
308+00 to 313+00	Likely Qt
313+00 to 332+00	Likely Tst
332+00 to 338+00	Likely Tst to possible Mzu
338+00 to 352+00	Likely Tst
352+00 to 380+00	Likely Mzu
380+00 to 382+00	Likely Tst
382+00 to 388+00	Likely Mzu
388+00 to 394+50	Likely Tst

TABLE 4

ANTICIPATED EXCAVATION CHARACTERISTICS OF SITE MATERIAL

Material	**General Description**	**Sample Penetration Resistance (bpf)**	**Estimated Range of Likely p-wave velocity (fps)**	**Estimated Range of Likely s-wave velocity (fps)**
Fill	Silty and clayey sands and sandy and silty clays with gravels	From approximately 10 to 100 plus, with approximately 50 percent less than 30 and 13 percent greater than 100	400 to 2,000	200 to 800
Qt	Silty and clayey sands and sandy and silty clays with gravels, cobbles, and cemented zones	From approximately 10 to 100 plus, with approximately 30 percent less than 60, 47 percent less than 90, and 53 percent greater than 100	2,000 to 5,000	1,000 to 2,500
Tst	Silty and clayey sands and sandy and silty clays with gravels, cobbles and cemented zones	From approximately 10 to 100 plus, with approximately 27 percent less than 70, and 64 percent greater than 100	5,000 to 9,000	2,000 to 5,000
Mzu		Insufficient data	6,000 to 12,000	3,000 to 5,000

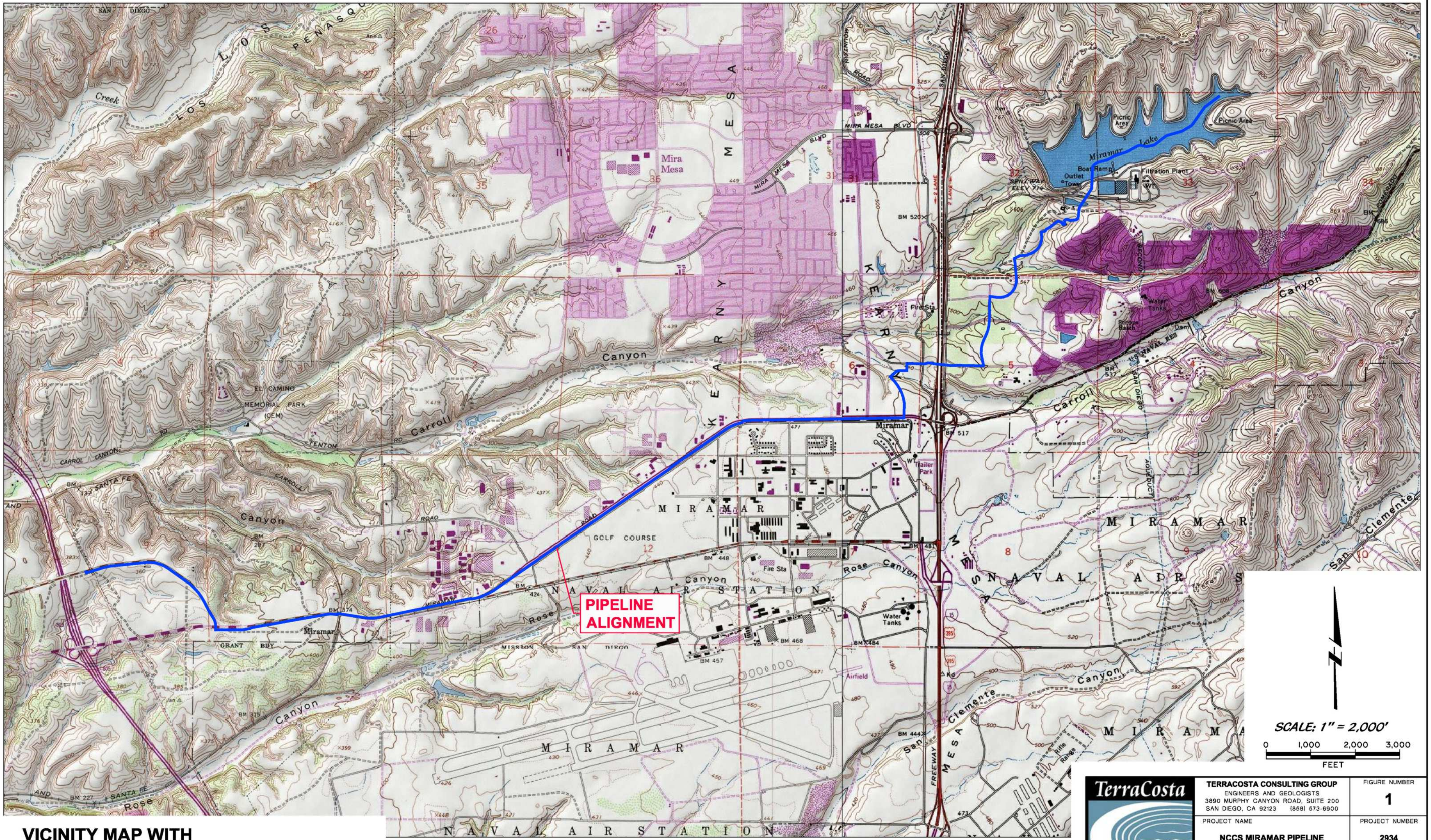
TABLE 5

SUMMARY OF TUNNELS

Stations	Estimated Depth to Invert (feet)	Conditions at Access Shafts	Anticipated Tunnel Face Conditions	Anticipated Groundwater Conditions	Nearby Borings
32+35 to 34+25	22 to 24	Qaf and Qt	Qt	Negligible to low	TB-1a, TB-1b, and GDC-B-11
111+20 to 112+95	17 to 18	Qaf, Residual, Qt	Qt	Negligible to low	GEO-B-8, GDC-B-3, B-21, GDC-B-4
198+15 to 210+60	25	Qaf, Qal, Qt and Tst	Mixed with Tst, Qt, Qal	Likely	SGC-B-12 and B-10
290+80 to 291+35	26 to 29	Qaf, Qal, Tst and Mzu	Mixed Tst and Mzu	Likely	TB-5a and TB-5b, along with seismic lines
300+40 to 305+70	29 to 34	Qaf, Qt, Tst	Mixed Qt and Tst	Negligible to low	TB-2a and TB-2b, with nearby seismic lines
383+40 to 390+50	38 to 92	Qaf, Tst, Mzu	Mixed Mzu and Tst	Likely	TB-4a, TB-4b, TB-4c, and TB-4d, along with seismic lines

Notes:

1. Stations are approximate and include the estimated limits of the access shafts.
2. The depths to the invert of the tunnel are estimated from project plans.
3. Borings by others are indicated by the initials of the company that performed the investigation. TerraCosta borings are indicated by boring number only.



VICINITY MAP WITH NCCS MIRAMAR PIPELINE ALIGNMENT

SCALE: 1"=2,000'

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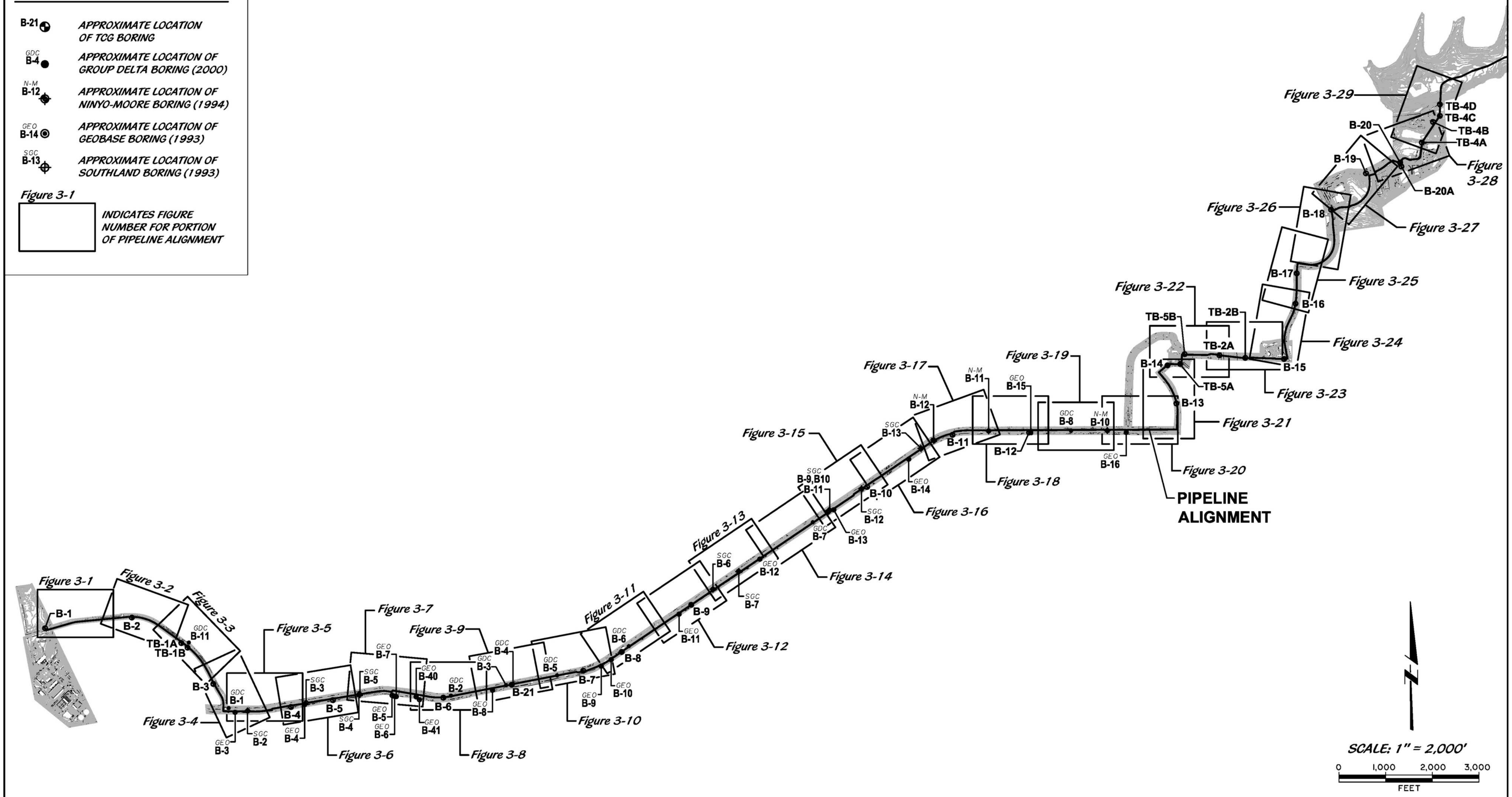
FIGURE NUMBER	PROJECT NAME	PROJECT NUMBER
1	NCCS MIRAMAR PIPELINE	2934

VICINITY MAP

LEGEND

B-21 ◕	*APPROXIMATE LOCATION OF TCG BORING*
GDC B-4 ●	*APPROXIMATE LOCATION OF GROUP DELTA BORING (2000)*
N-M B-12 ⊕	*APPROXIMATE LOCATION OF NINYO-MOORE BORING (1994)*
GEO B-14 ◉	*APPROXIMATE LOCATION OF GEOBASE BORING (1993)*
SGC B-13 ⊕	*APPROXIMATE LOCATION OF SOUTHLAND BORING (1993)*
Figure 3-1 ☐	*INDICATES FIGURE NUMBER FOR PORTION OF PIPELINE ALIGNMENT*



NCCS MIRAMAR PIPELINE ALIGNMENT

SCALE: 1"=2,000'

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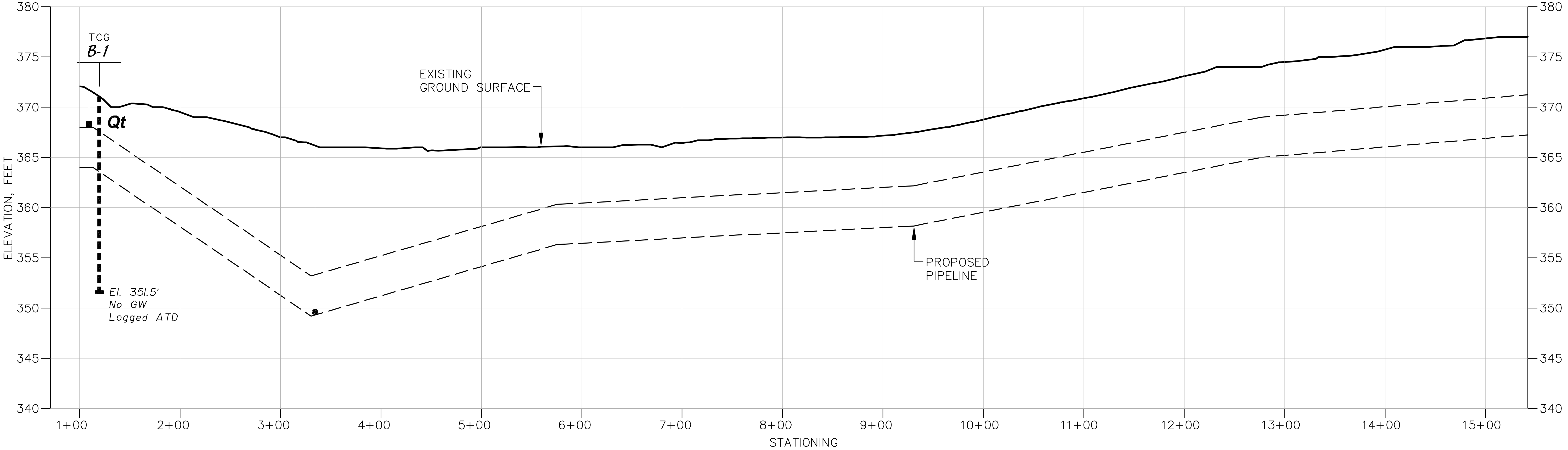
FIGURE NUMBER
2

PROJECT NAME
NCCS MIRAMAR PIPELINE

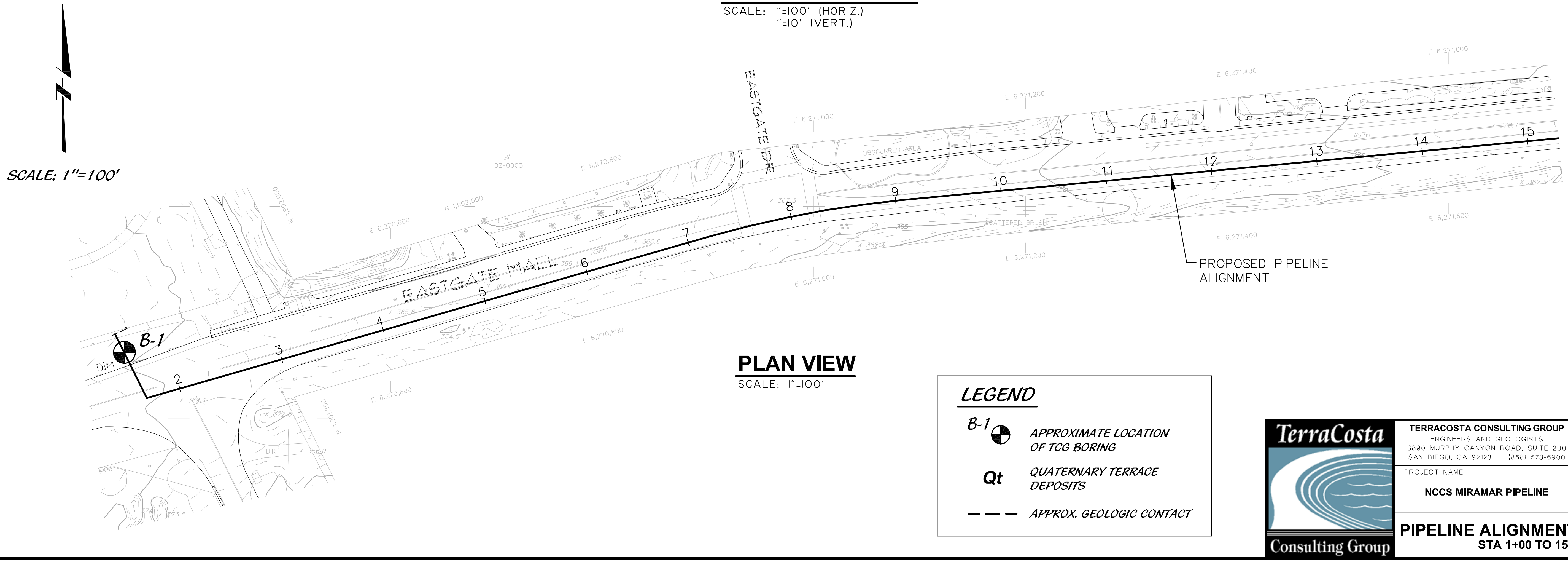
PROJECT NUMBER
2934

PIPELINE ALIGNMENT
KEY MAP WITH BORINGS



PIPELINE PROFILE

SCALE: 1"=100' (HORIZ.)
1"=10' (VERT.)



PLAN VIEW

SCALE: 1"=100'

LEGEND

B-1 ⊕	*APPROXIMATE LOCATION OF TCG BORING*
Qt	*QUATERNARY TERRACE DEPOSITS*
— — —	*APPROX. GEOLOGIC CONTACT*

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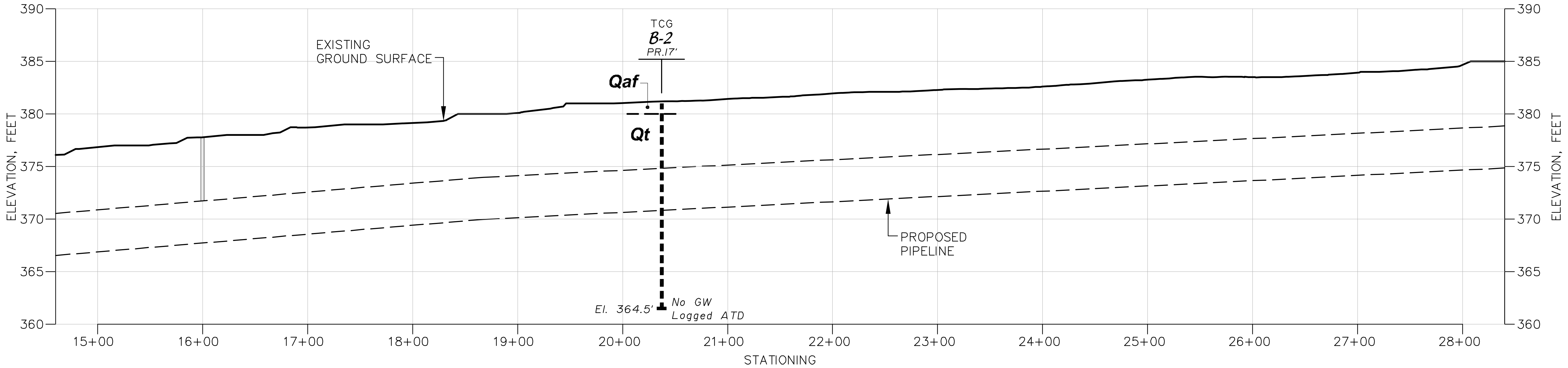
FIGURE NUMBER
3-1

PROJECT NAME
NCCS MIRAMAR PIPELINE

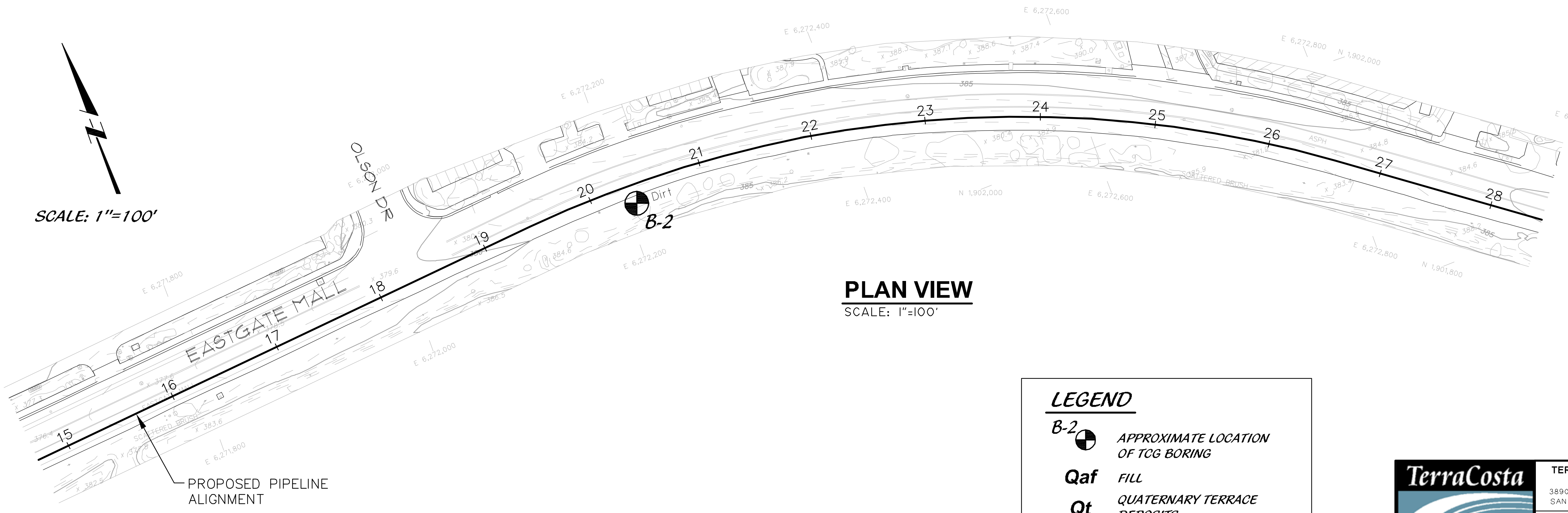
PROJECT NUMBER
2934

PIPELINE ALIGNMENT & PROFILE
STA 1+00 TO 15+00



PIPELINE PROFILE

SCALE: 1"=100' (HORIZ.)
1"=10' (VERT.)



PLAN VIEW

SCALE: 1"=100'

LEGEND

B-2 ◐	APPROXIMATE LOCATION OF TCG BORING
Qaf	FILL
Qt	QUATERNARY TERRACE DEPOSITS
— —	APPROX. GEOLOGIC CONTACT

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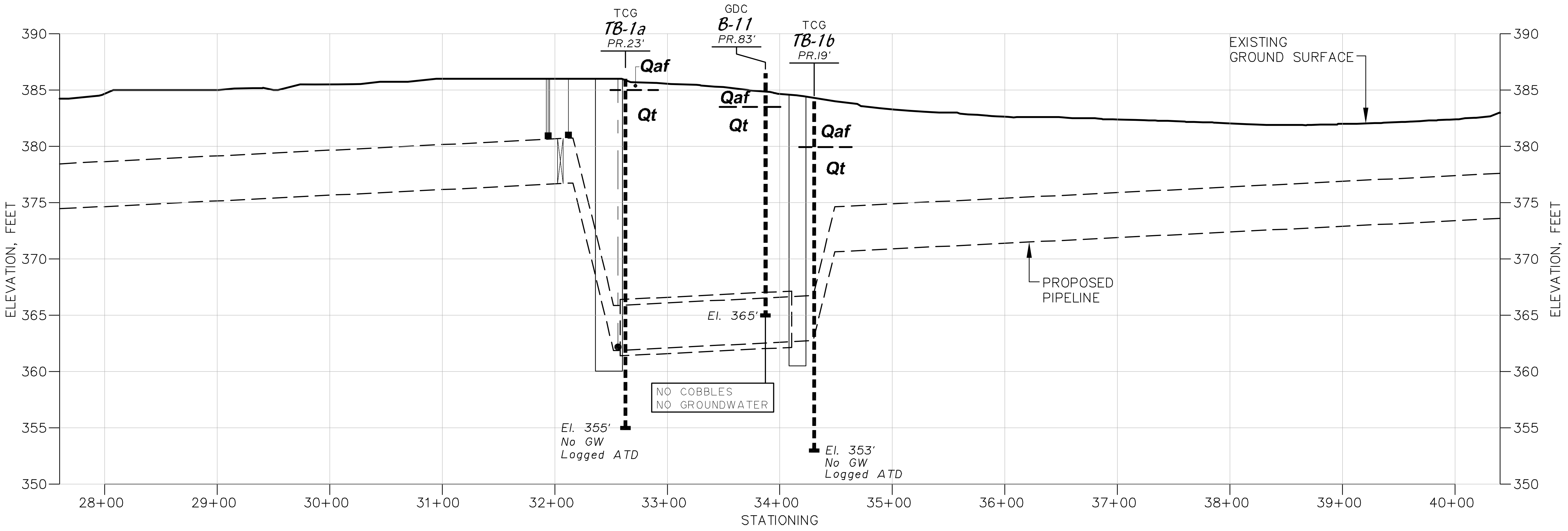
FIGURE NUMBER
3-2

PROJECT NAME
NCCS MIRAMAR PIPELINE

PROJECT NUMBER
2934

PIPELINE ALIGNMENT & PROFILE
STA 15+00 TO 28+00

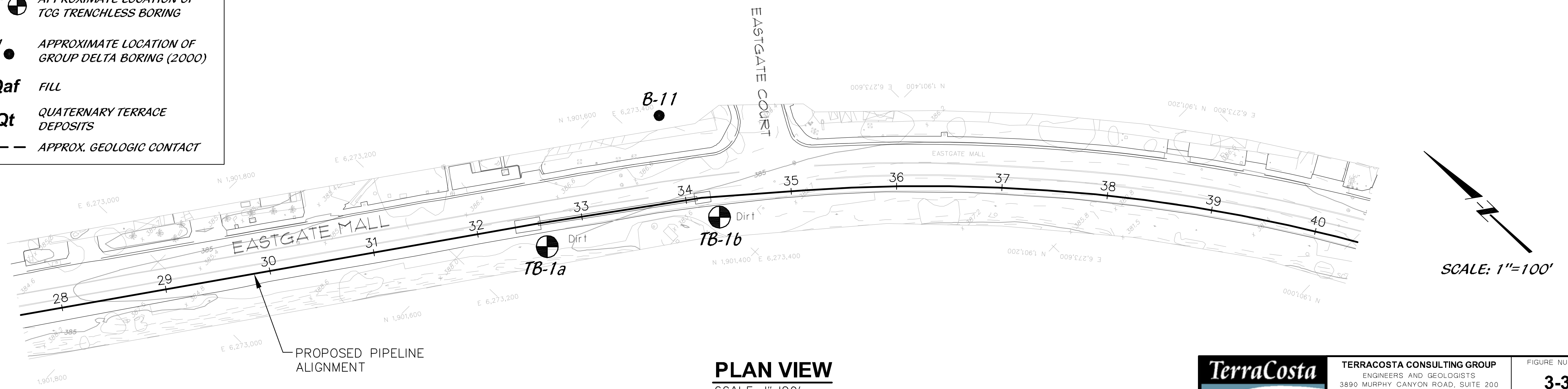


PIPELINE PROFILE

SCALE: 1"=100' (HORIZ.)
1"=10' (VERT.)

LEGEND

TB-1b ⊕	*APPROXIMATE LOCATION OF TCG TRENCHLESS BORING*
B-11 ●	*APPROXIMATE LOCATION OF GROUP DELTA BORING (2000)*
Qaf	*FILL*
Qt	*QUATERNARY TERRACE DEPOSITS*
— — —	*APPROX. GEOLOGIC CONTACT*



PLAN VIEW

SCALE: 1"=100'

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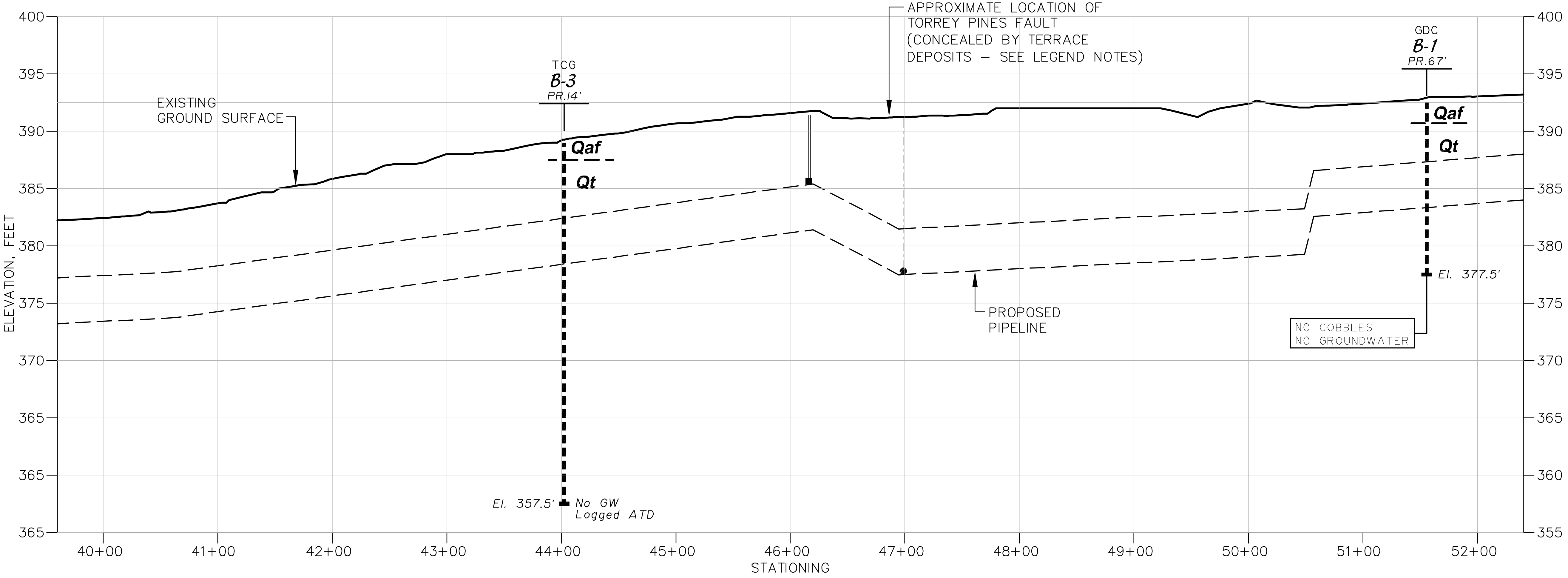
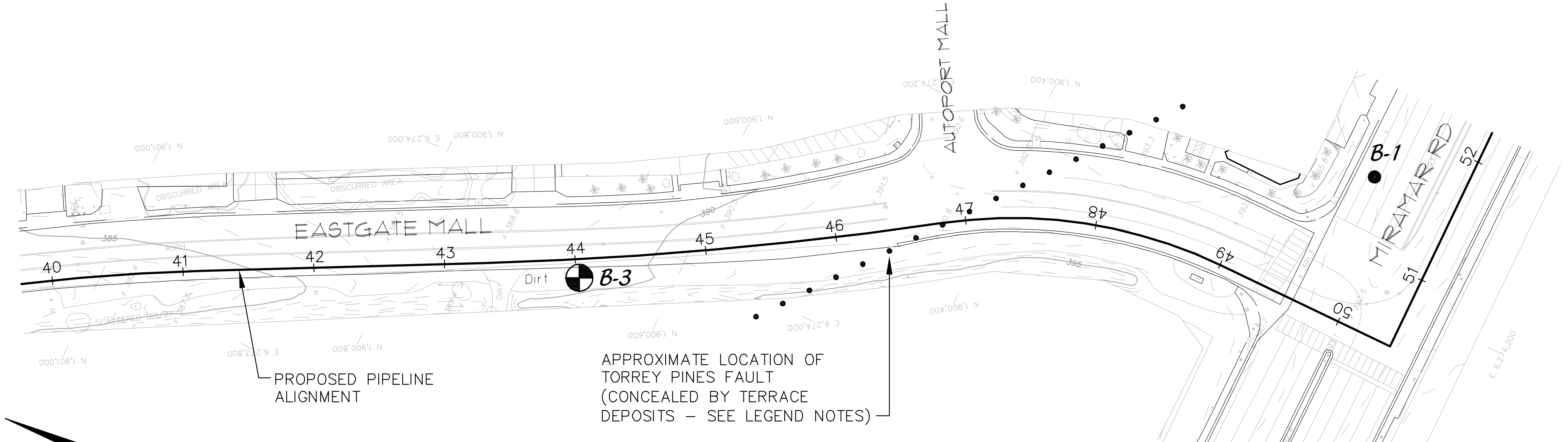
FIGURE NUMBER	3-3
PROJECT NAME	NCCS MIRAMAR PIPELINE
PROJECT NUMBER	2934

PIPELINE ALIGNMENT & PROFILE
STA 28+00 TO 40+00



PIPELINE PROFILE

SCALE: 1"=100' (HORIZ.)
1"=10' (VERT.)



SCALE: 1"=100'

PLAN VIEW

SCALE: 1"=100'

LEGEND

B-3 ⊕	APPROXIMATE LOCATION OF TCG BORING
B-1 ●	APPROXIMATE LOCATION OF GROUP DELTA BORING (2000)
Qaf	FILL
Qt	QUATERNARY TERRACE DEPOSITS
— — —	APPROX. GEOLOGIC CONTACT
• • •	APPROX. ALIGNMENT OF TORREY PINES FAULT

NOTE: TORREY PINES FAULT IS CLASSIFIED AS "POTENTIALLY ACTIVE" (NO MOVEMENT WITHIN PAST 1.6 MILLION YEARS).

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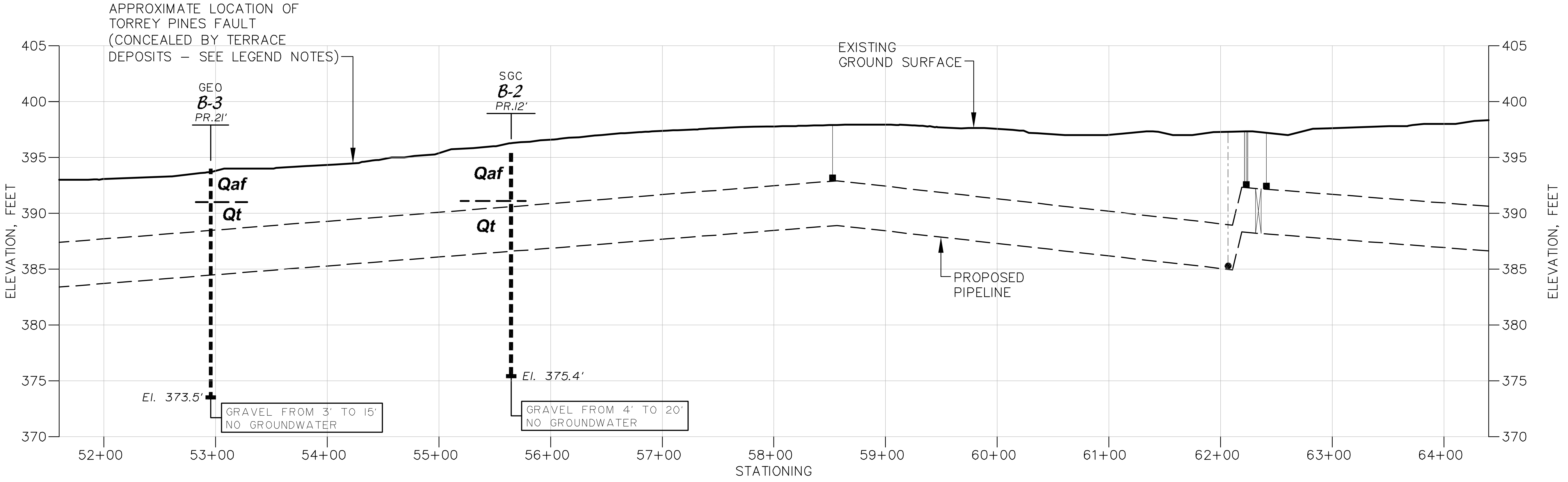
FIGURE NUMBER
3-4

PROJECT NAME
NCCS MIRAMAR PIPELINE

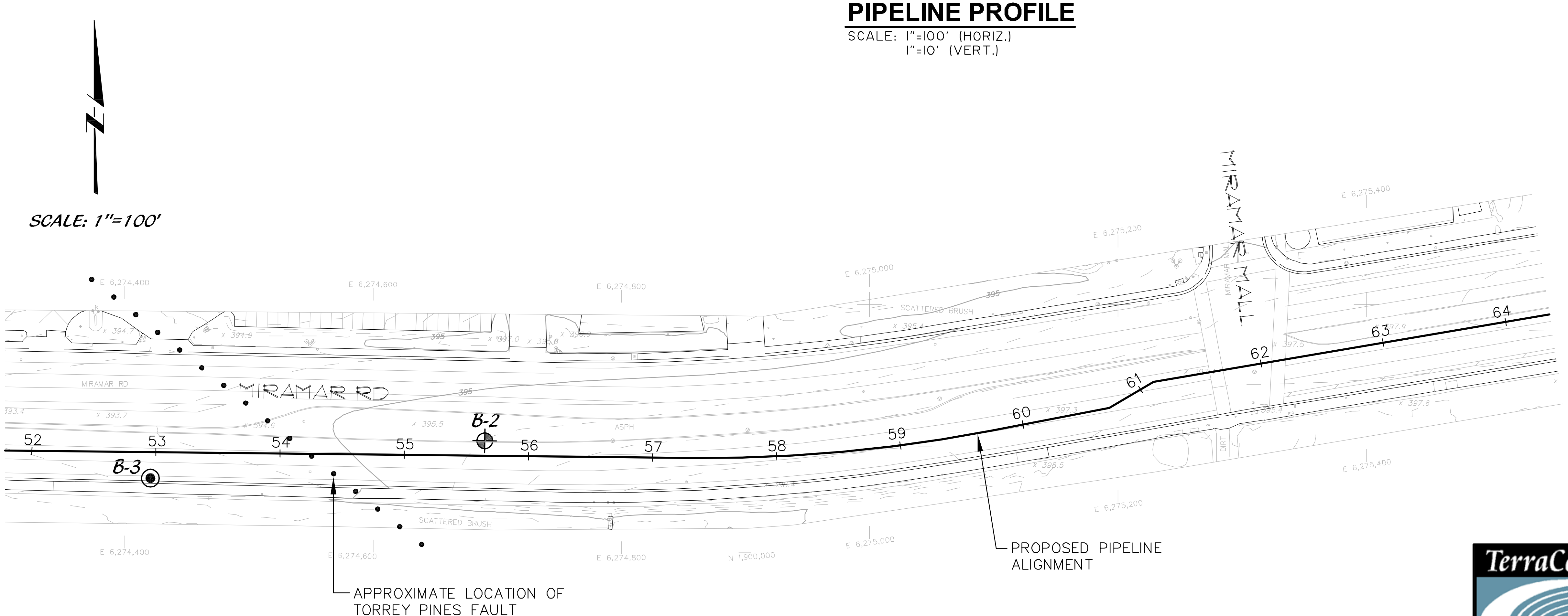
PROJECT NUMBER
2934

PIPELINE ALIGNMENT & PROFILE
STA 40+00 TO 52+00



PIPELINE PROFILE

SCALE: 1"=100' (HORIZ.)
1"=10' (VERT.)



PLAN VIEW

SCALE: 1"=100'

LEGEND

B-2 ⊕	*APPROXIMATE LOCATION OF SOUTHLAND BORING (1993)*
B-3 ◉	*APPROXIMATE LOCATION OF GEOBASE BORING (1993)*
Qaf	*FILL*
Qt	*QUATERNARY TERRACE DEPOSITS*
— — —	*APPROX. GEOLOGIC CONTACT*
• • •	*APPROX. ALIGNMENT OF TORREY PINES FAULT*

NOTE: TORREY PINES FAULT IS CLASSIFIED AS "POTENTIALLY ACTIVE" (NO MOVEMENT WITHIN PAST 1.6 MILLION YEARS).

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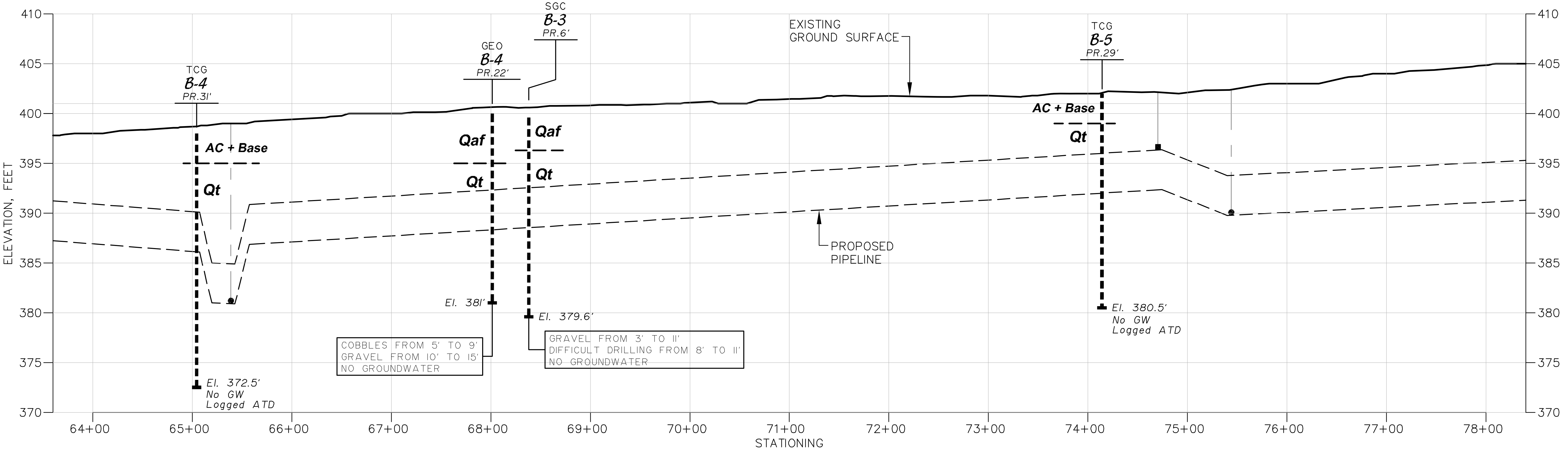
FIGURE NUMBER
3-5

PROJECT NAME
NCCS MIRAMAR PIPELINE

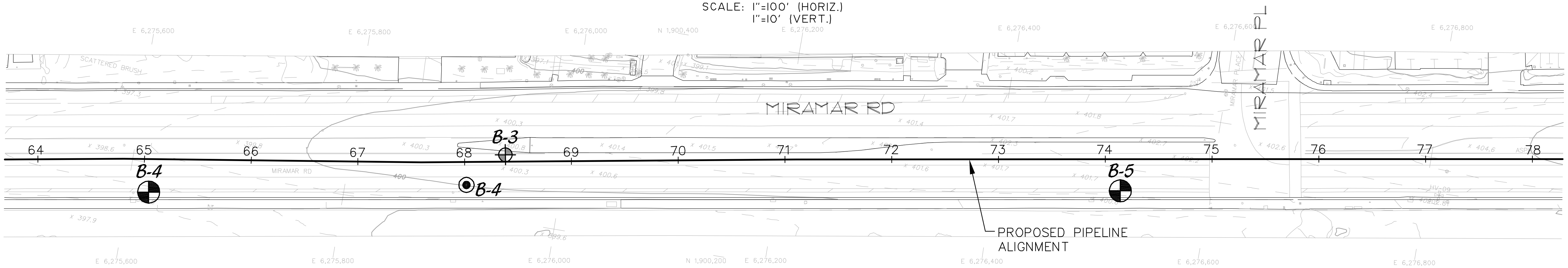
PROJECT NUMBER
2934

PIPELINE ALIGNMENT & PROFILE
STA 52+00 TO 64+00



PIPELINE PROFILE

SCALE: 1"=100' (HORIZ.)
1"=10' (VERT.)



PLAN VIEW

SCALE: 1"=100'

SCALE: 1"=100'

LEGEND

B-5	APPROXIMATE LOCATION OF TCG BORING
B-3 ⊕	APPROXIMATE LOCATION OF SOUTHLAND BORING (1993)
B-4 ⊙	APPROXIMATE LOCATION OF GEOBASE BORING (1993)
AC + Base	PAVEMENT SECTION
Qaf	FILL
Qt	QUATERNARY TERRACE DEPOSITS
— — —	APPROX. GEOLOGIC CONTACT

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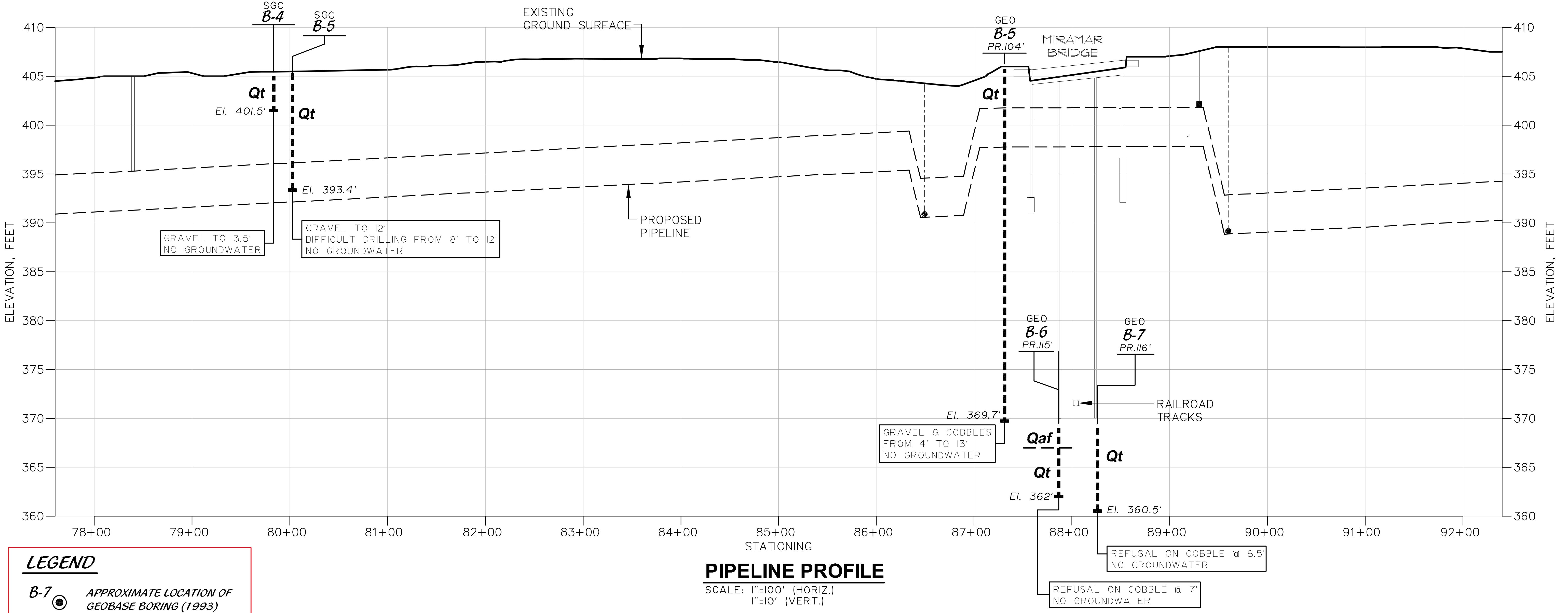
FIGURE NUMBER
3-6

PROJECT NAME
NCCS MIRAMAR PIPELINE

PROJECT NUMBER
2934

PIPELINE ALIGNMENT & PROFILE
STA 64+00 TO 78+00

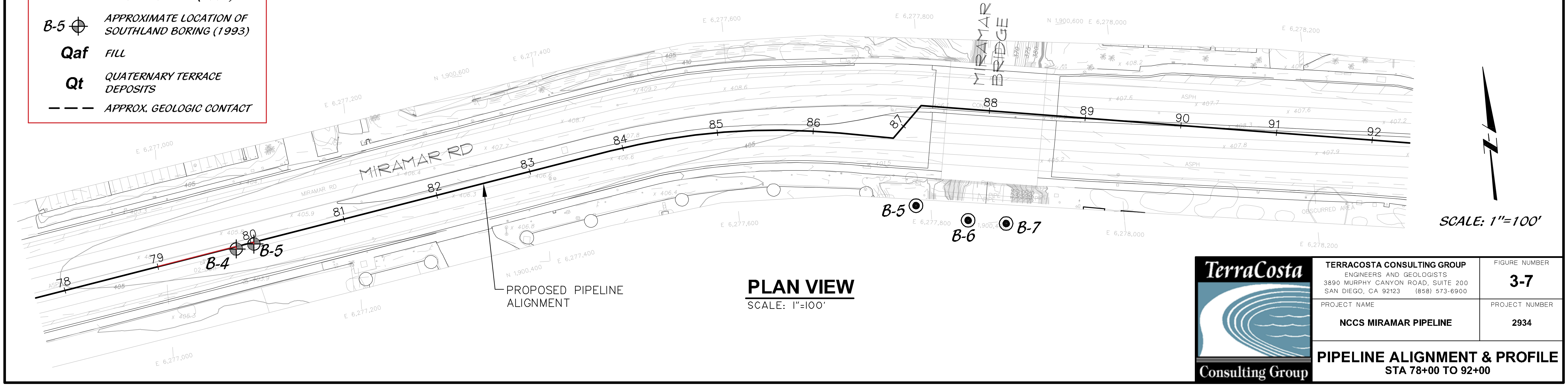


PIPELINE PROFILE

SCALE: 1"=100' (HORIZ.)
1"=10' (VERT.)

LEGEND

B-7 ●	*APPROXIMATE LOCATION OF GEOBASE BORING (1993)*
B-5 ⊕	*APPROXIMATE LOCATION OF SOUTHLAND BORING (1993)*
Qaf	*FILL*
Qt	*QUATERNARY TERRACE DEPOSITS*
— — —	*APPROX. GEOLOGIC CONTACT*



PLAN VIEW

SCALE: 1"=100'

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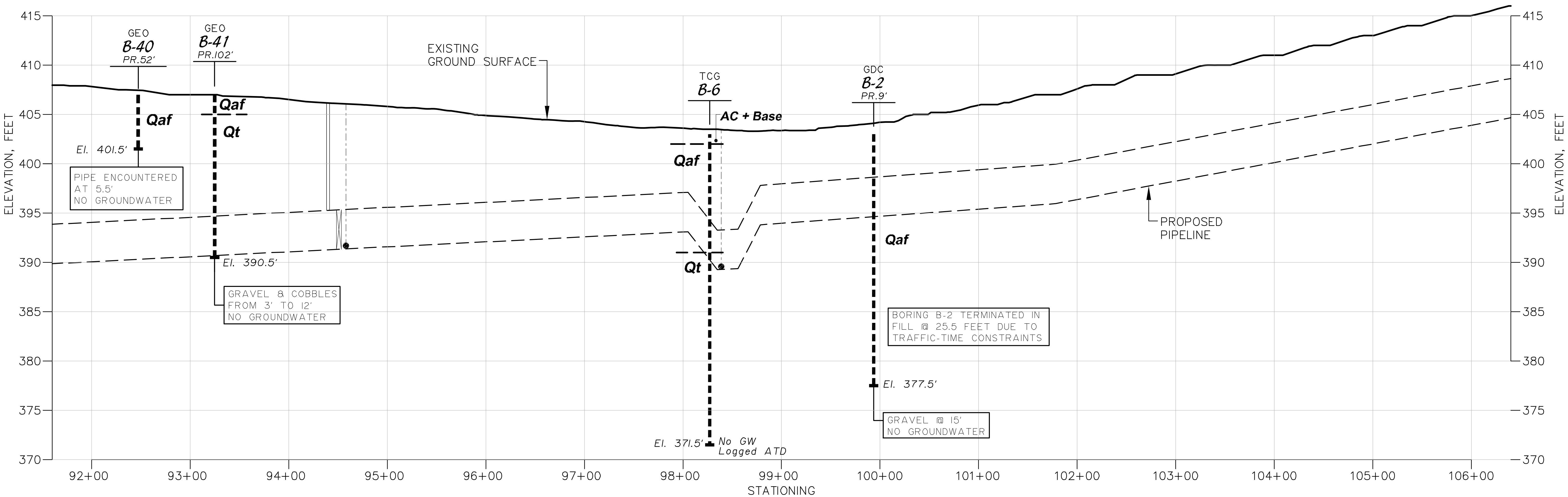
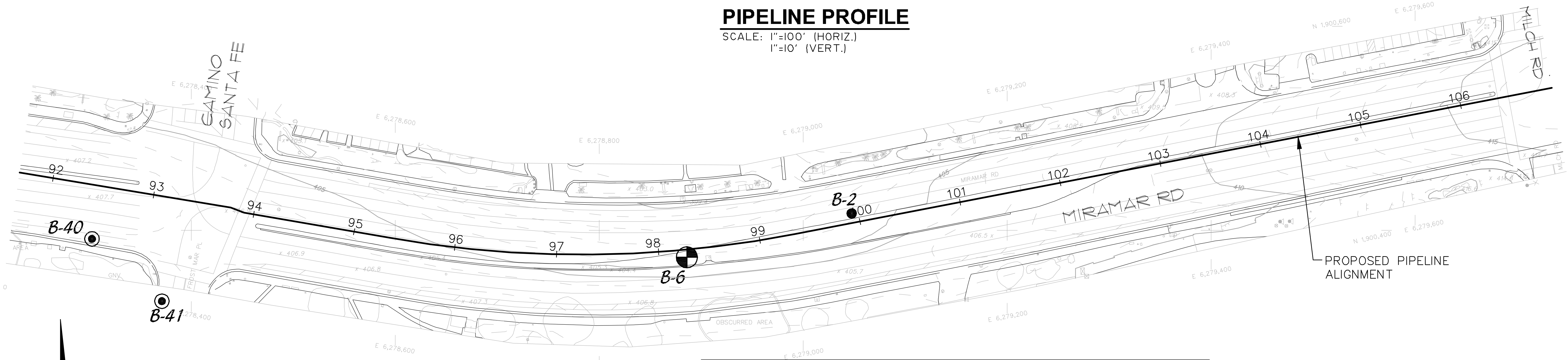
FIGURE NUMBER	PROJECT NAME	PROJECT NUMBER
3-7	NCCS MIRAMAR PIPELINE	2934

PIPELINE ALIGNMENT & PROFILE
STA 78+00 TO 92+00



PIPELINE PROFILE

SCALE: 1"=100' (HORIZ.)
1"=10' (VERT.)



PLAN VIEW

SCALE: 1"=100'

SCALE: 1"=100'

LEGEND

B-6 ◐	APPROXIMATE LOCATION OF TCG BORING	AC + Base	PAVEMENT SECTION
B-2 ●	APPROXIMATE LOCATION OF GROUP DELTA BORING (2000)	Qaf	FILL
B-41 ◉	APPROXIMATE LOCATION OF GEOBASE BORING (1993)	Qt	QUATERNARY TERRACE DEPOSITS
		— — —	APPROX. GEOLOGIC CONTACT

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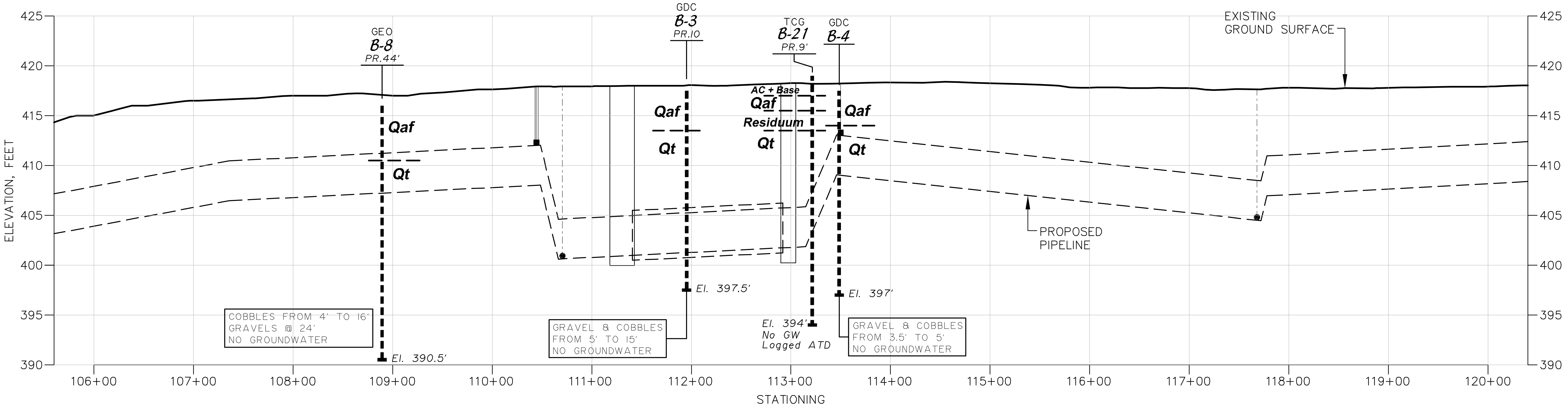
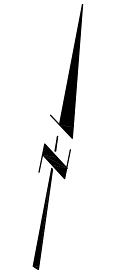
FIGURE NUMBER	3-8
PROJECT NAME	NCCS MIRAMAR PIPELINE
PROJECT NUMBER	2934

PIPELINE ALIGNMENT & PROFILE
STA 92+00 TO 106+00



PIPELINE PROFILE

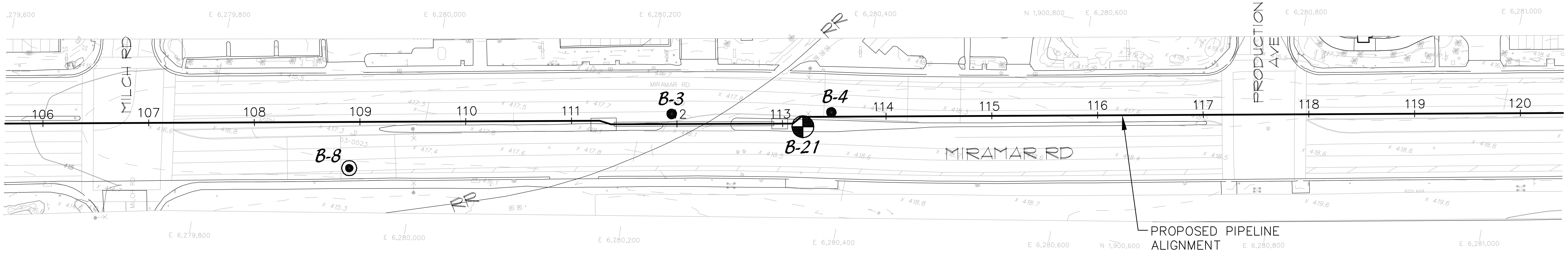
SCALE: 1"=100' (HORIZ.)
1"=10' (VERT.)



SCALE: 1"=100'

LEGEND

B-21	APPROXIMATE LOCATION OF TCG BORING	AC + Base	PAVEMENT SECTION
		Qaf	FILL
B-4	APPROXIMATE LOCATION OF GROUP DELTA BORING (2000)	Residuum	WEATHERED TERRACE DEPOSITS
B-8	APPROXIMATE LOCATION OF GEOBASE BORING (1993)	Qt	QUATERNARY TERRACE DEPOSITS
		— — —	APPROX. GEOLOGIC CONTACT



PLAN VIEW

SCALE: 1"=100'

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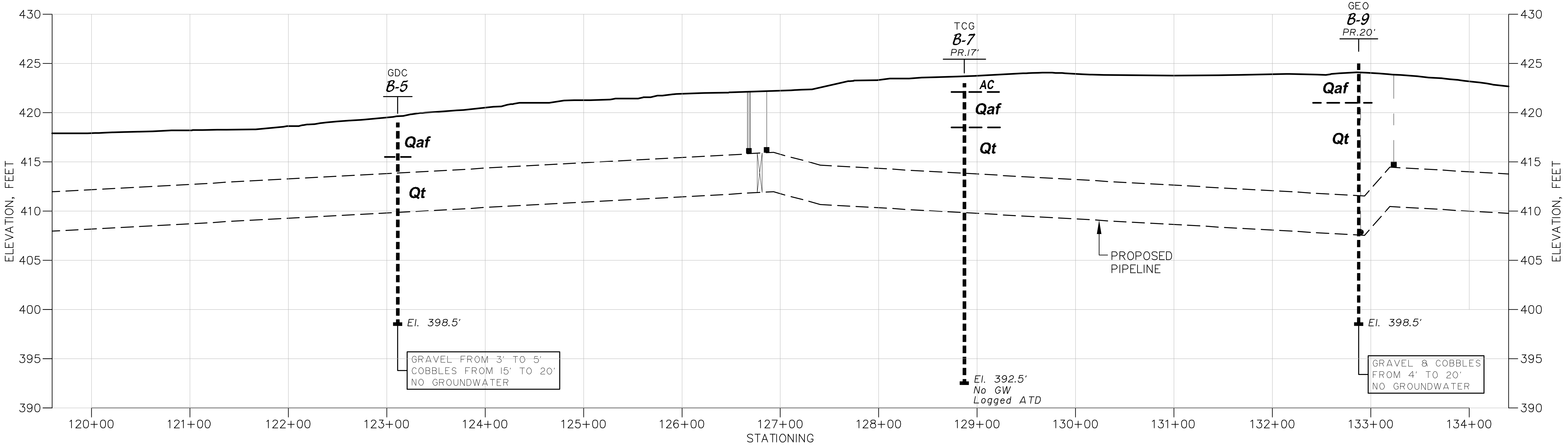
FIGURE NUMBER 3-9

PROJECT NAME: NCCS MIRAMAR PIPELINE

PROJECT NUMBER: 2934

PIPELINE ALIGNMENT & PROFILE
STA 106+00 TO 120+00

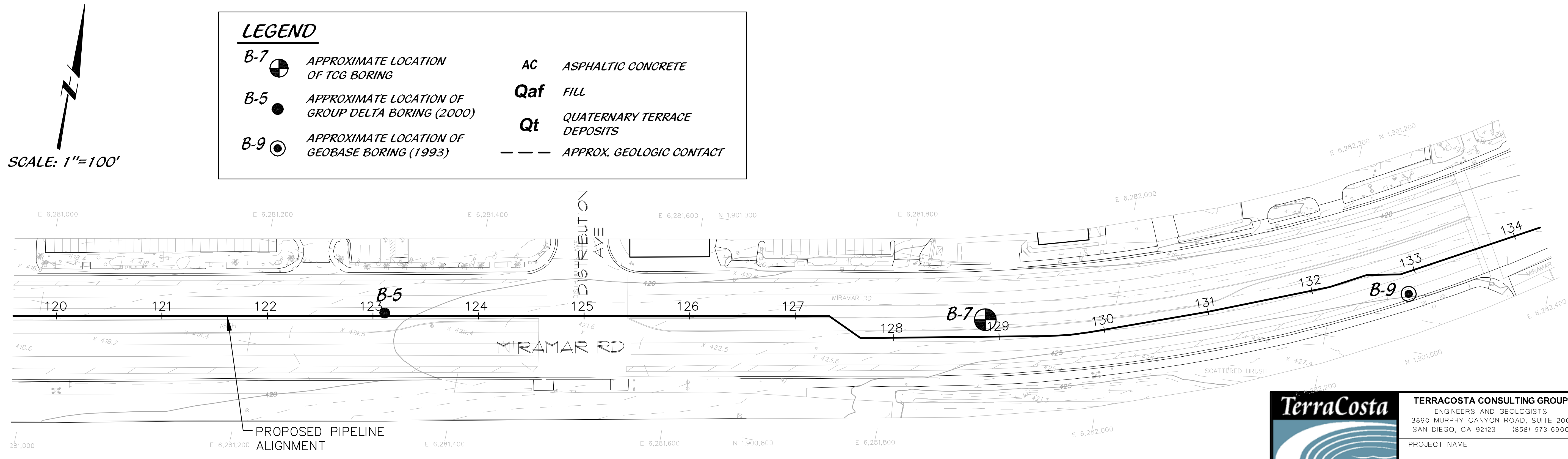


PIPELINE PROFILE

SCALE: 1"=100' (HORIZ.)
1"=10' (VERT.)

LEGEND

B-7 ◐	APPROXIMATE LOCATION OF TCG BORING	AC	ASPHALTIC CONCRETE
B-5 ●	APPROXIMATE LOCATION OF GROUP DELTA BORING (2000)	Qaf	FILL
B-9 ⊙	APPROXIMATE LOCATION OF GEOBASE BORING (1993)	Qt	QUATERNARY TERRACE DEPOSITS
		— — —	APPROX. GEOLOGIC CONTACT



PLAN VIEW

SCALE: 1"=100'

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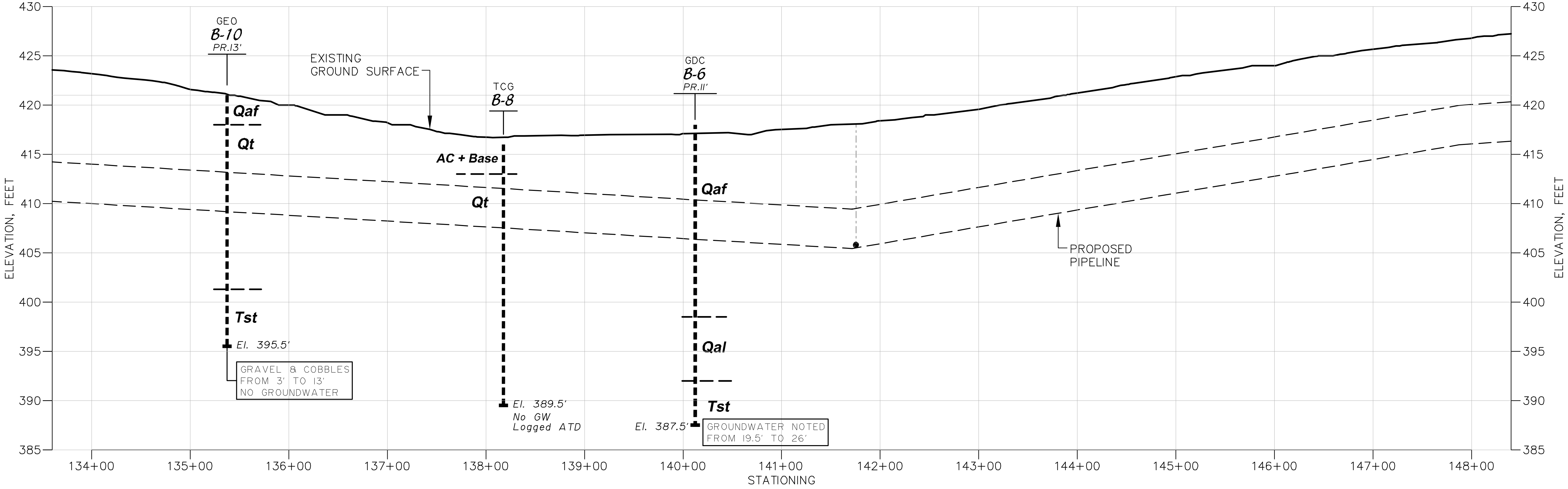
FIGURE NUMBER
3-10

PROJECT NAME
NCCS MIRAMAR PIPELINE

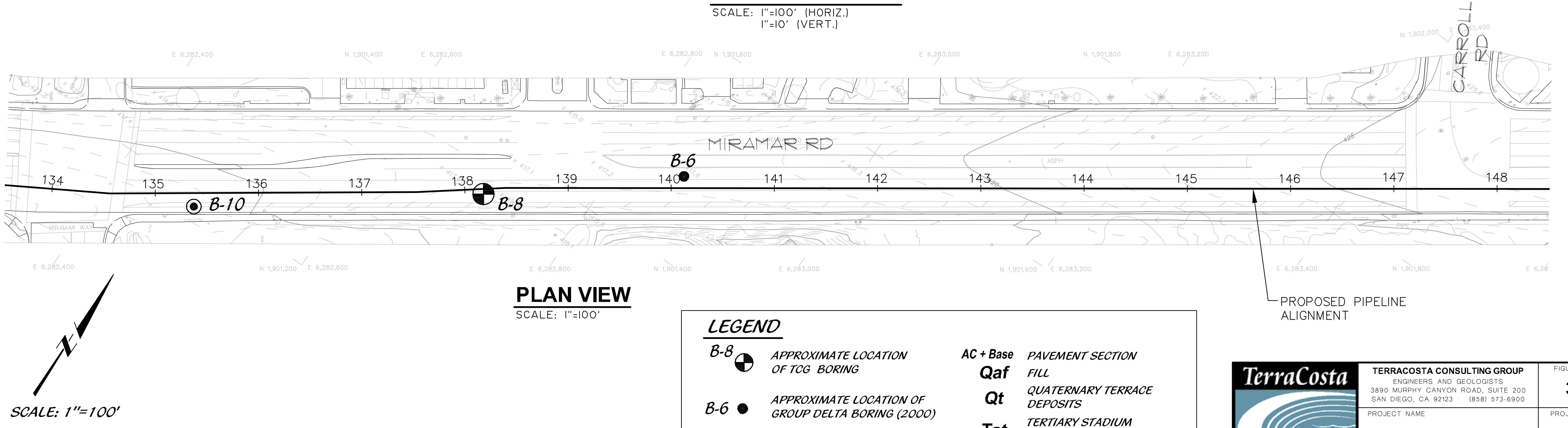
PROJECT NUMBER
2934

PIPELINE ALIGNMENT & PROFILE
STA 120+00 TO 134+00



PIPELINE PROFILE

SCALE: 1"=100' (HORIZ.)
1"=10' (VERT.)



PLAN VIEW

SCALE: 1"=100'

LEGEND

B-8	APPROXIMATE LOCATION OF TCG BORING	AC + Base	PAVEMENT SECTION
		Qaf	FILL
B-6 ●	APPROXIMATE LOCATION OF GROUP DELTA BORING (2000)	Qt	QUATERNARY TERRACE DEPOSITS
		Tst	TERTIARY STADIUM CONGLOMERATE
B-10 ◉	APPROXIMATE LOCATION OF GEOBASE BORING (1993)	— — —	APPROX. GEOLOGIC CONTACT

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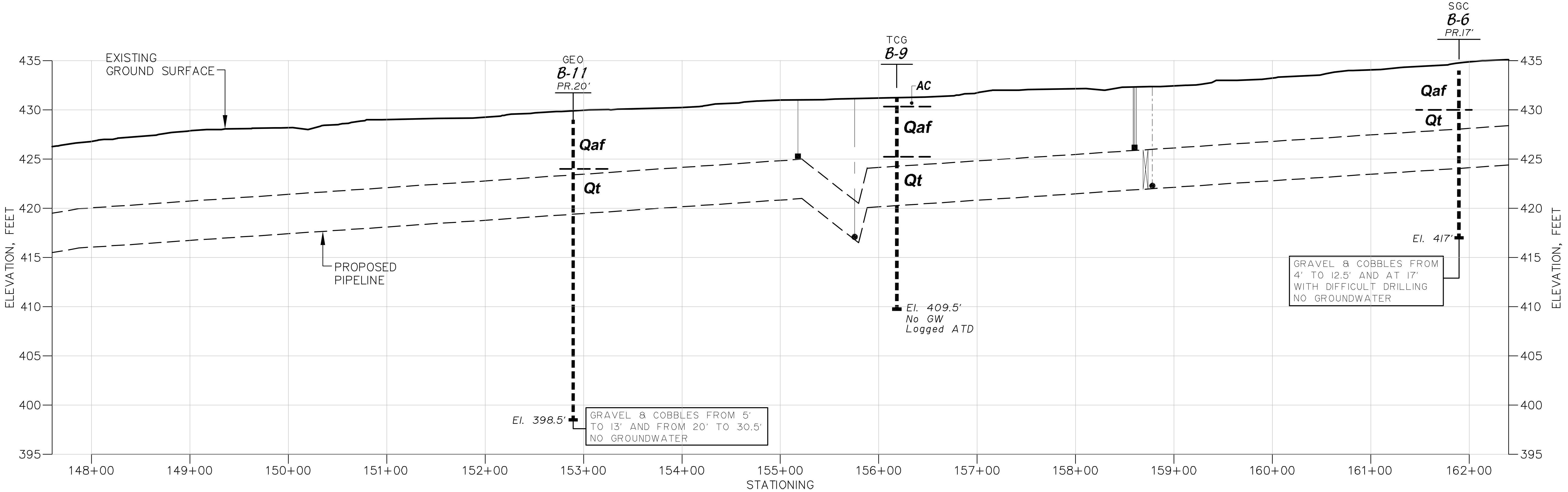
FIGURE NUMBER
3-11

PROJECT NAME
NCCS MIRAMAR PIPELINE

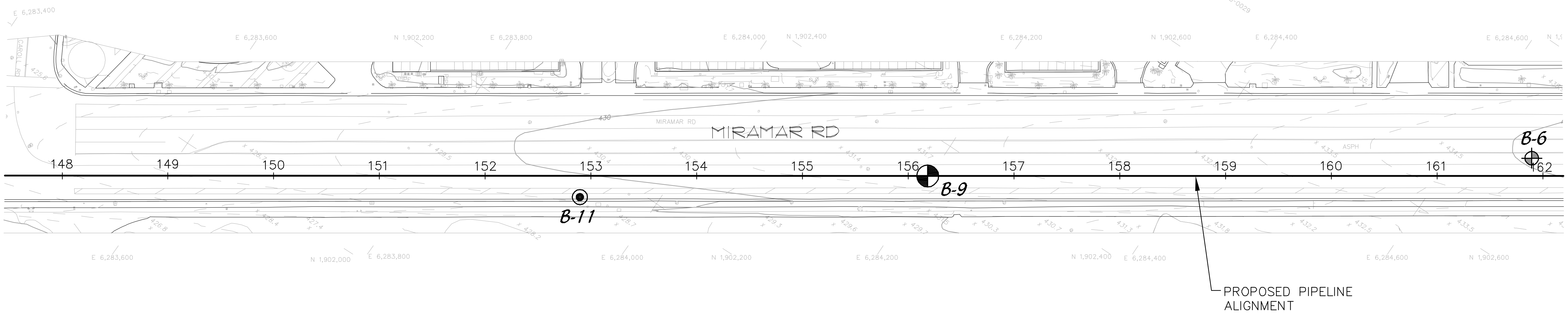
PROJECT NUMBER
2934

PIPELINE ALIGNMENT & PROFILE
STA 134+00 TO 148+00



PIPELINE PROFILE

SCALE: 1"=100' (HORIZ.)
1"=10' (VERT.)



PLAN VIEW

SCALE: 1"=100'

N

SCALE: 1"=100'

LEGEND

B-9 ⊕	APPROXIMATE LOCATION OF TCG BORING	AC	ASPHALTIC CONCRETE
B-11 ◉	APPROXIMATE LOCATION OF GEOBASE BORING (1993)	Qaf	FILL
B-6 ⌖	APPROXIMATE LOCATION OF SOUTHLAND BORING (1993)	Qt	QUATERNARY TERRACE DEPOSITS
		— —	APPROX. GEOLOGIC CONTACT

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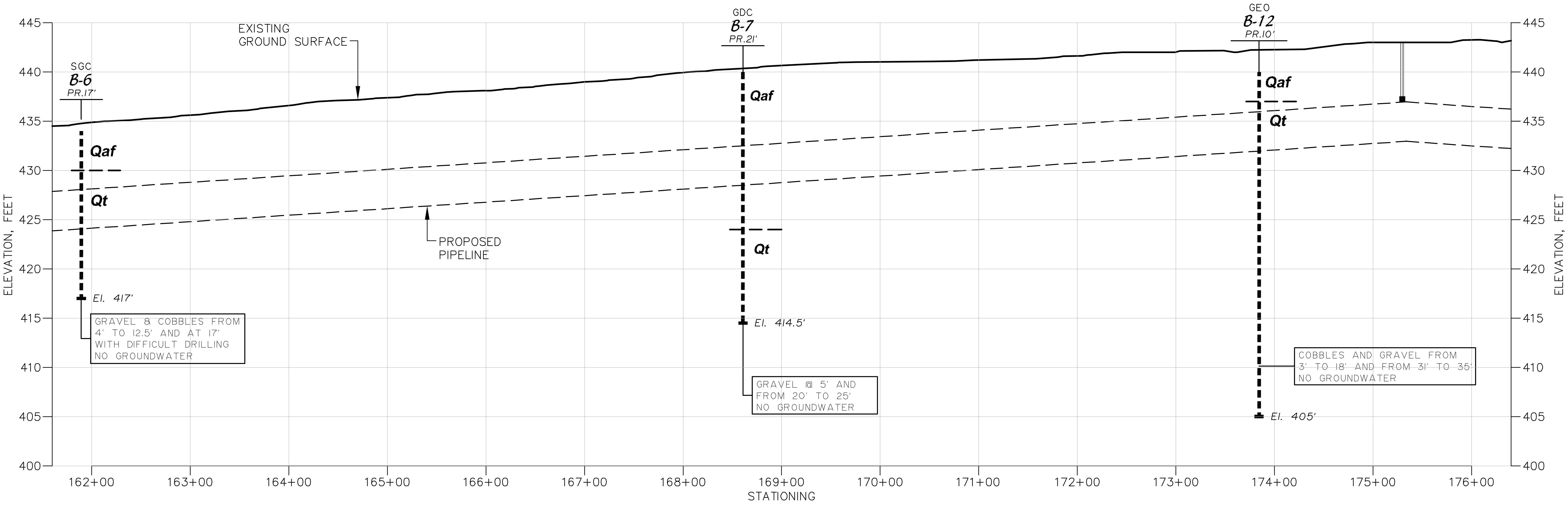
FIGURE NUMBER
3-12

PROJECT NAME
NCCS MIRAMAR PIPELINE

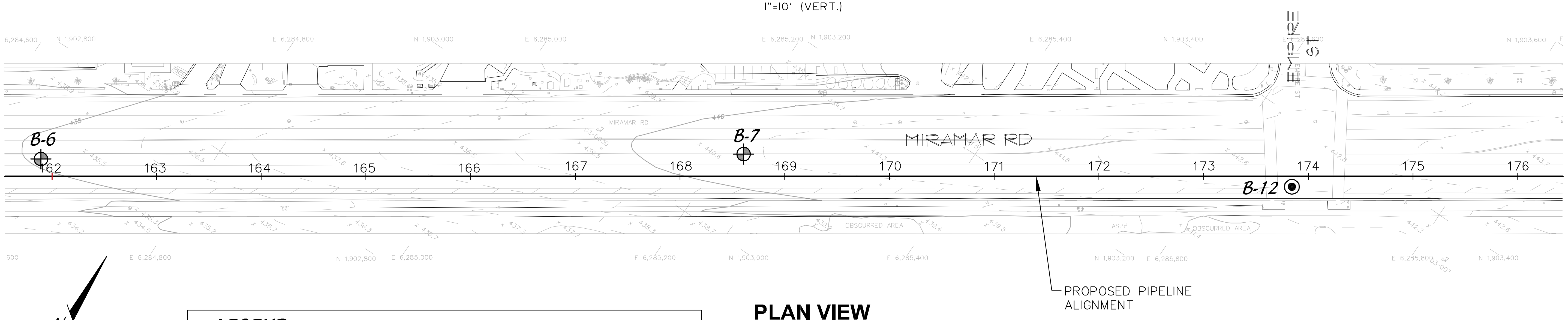
PROJECT NUMBER
2934

PIPELINE ALIGNMENT & PROFILE
STA 148+00 TO 162+00



PIPELINE PROFILE

SCALE: 1"=100' (HORIZ.)
1"=10' (VERT.)



PLAN VIEW

SCALE: 1"=100'

N

SCALE: 1"=100'

LEGEND

B-7 ●	*APPROXIMATE LOCATION OF GROUP DELTA BORING (2000)*	**Qaf**	*FILL*
B-6 ⊕	*APPROXIMATE LOCATION OF SOUTHLAND BORING (1993)*	**Qt**	*QUATERNARY TERRACE DEPOSITS*
B-12 ◉	*APPROXIMATE LOCATION OF GEOBASE BORING (1993)*	— — —	*APPROX. GEOLOGIC CONTACT*

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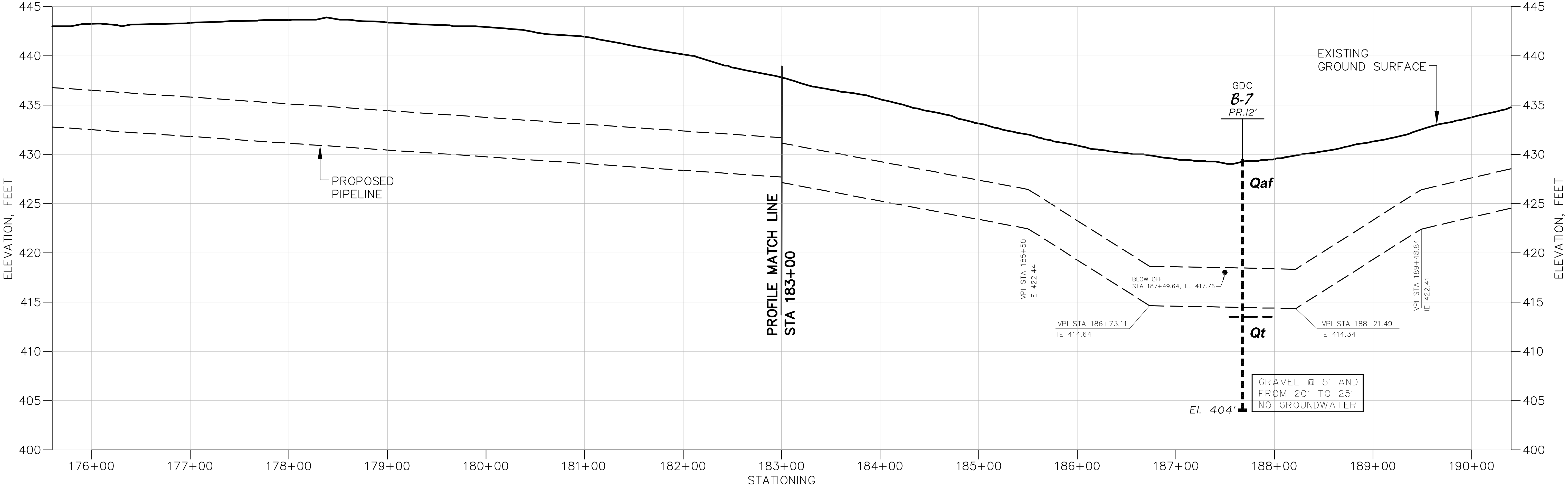
3890 MURPHY CANYON ROAD, SUITE 200
SAN DIEGO, CA 92123 (858) 573-6900

FIGURE NUMBER
3-13

PROJECT NAME
NCCS MIRAMAR PIPELINE

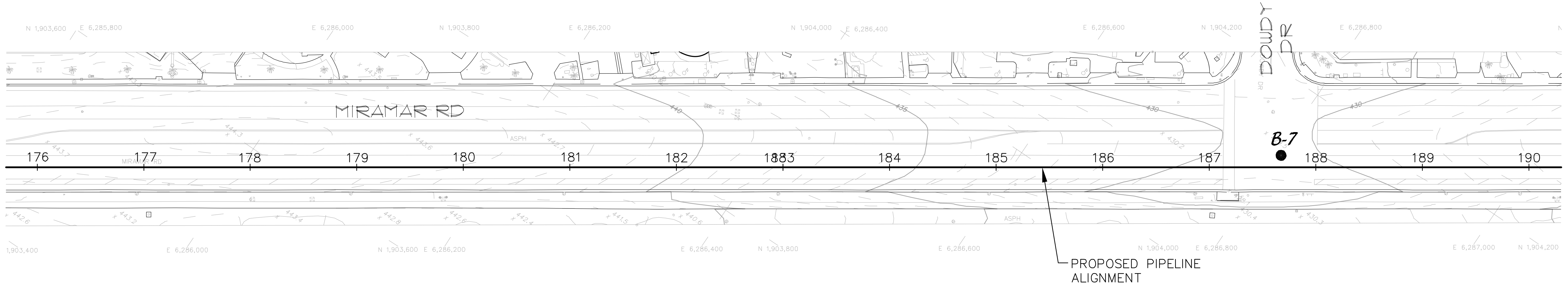
PROJECT NUMBER
2934

PIPELINE ALIGNMENT & PROFILE
STA 162+00 TO 176+00



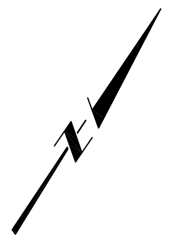
PIPELINE PROFILE

SCALE: 1"=100' (HORIZ.)
1"=10' (VERT.)



PLAN VIEW

SCALE: 1"=100'



SCALE: 1"=100'

LEGEND

B-7 ●	*APPROXIMATE LOCATION OF GROUP DELTA BORING (2000)*
Qaf	*FILL*
Qt	*QUATERNARY TERRACE DEPOSITS*
— —	*APPROX. GEOLOGIC CONTACT*

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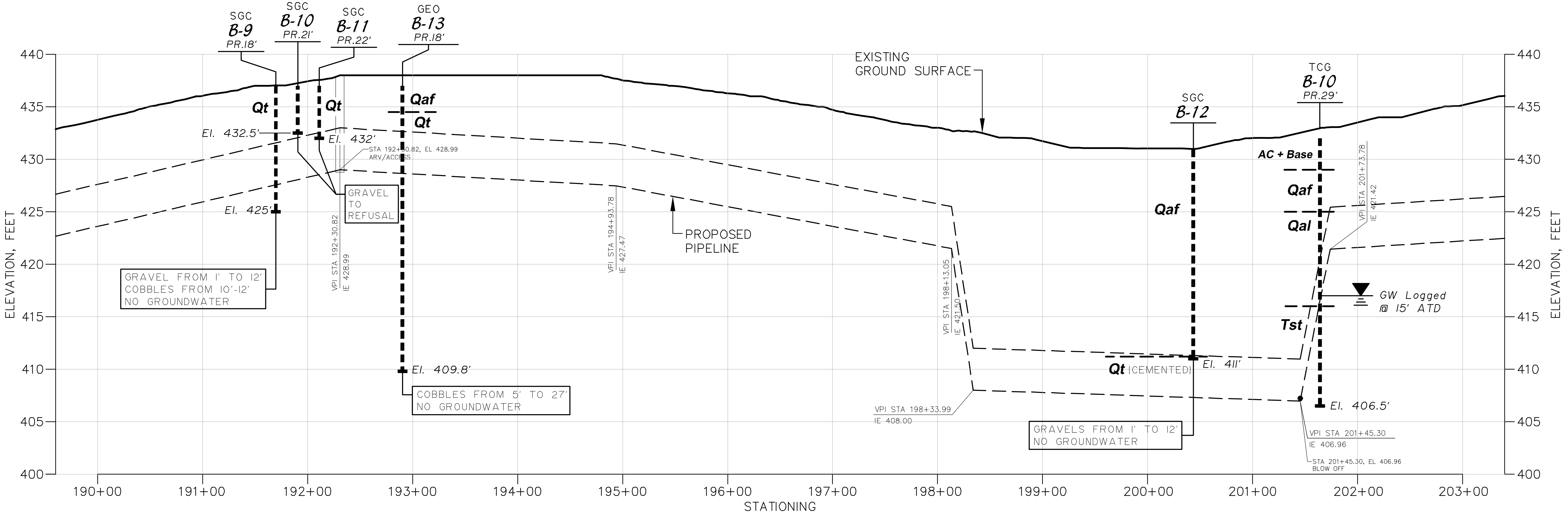
FIGURE NUMBER
3-14

PROJECT NAME
NCCS MIRAMAR PIPELINE

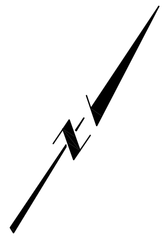
PROJECT NUMBER
2934

PIPELINE ALIGNMENT & PROFILE
STA 176+00 TO 190+00



PIPELINE PROFILE

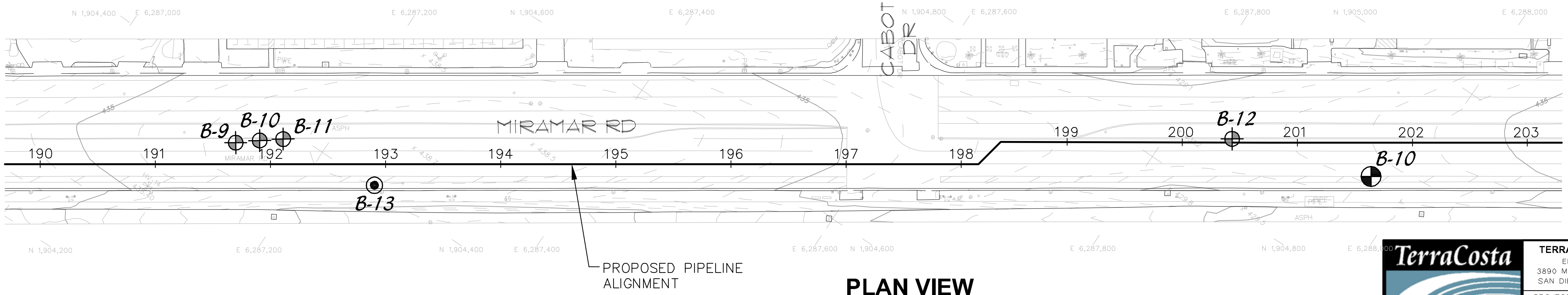
SCALE: 1"=100' (HORIZ.)
1"=10' (VERT.)



SCALE: 1"=100'

LEGEND

B-10	*APPROXIMATE LOCATION OF TCG BORING*	**Qaf**	*FILL*
B-13	*APPROXIMATE LOCATION OF GEOBASE BORING (1993)*	**Qal**	*ALLUVIUM*
B-11	*APPROXIMATE LOCATION OF SOUTHLAND BORING (1993)*	**Qt**	*QUATERNARY TERRACE DEPOSITS*
		Tst	*TERTIARY STADIUM CONGLOMERATE*
AC + Base	*PAVEMENT SECTION*	— — —	*APPROX. GEOLOGIC CONTACT*



PLAN VIEW

SCALE: 1"=100'

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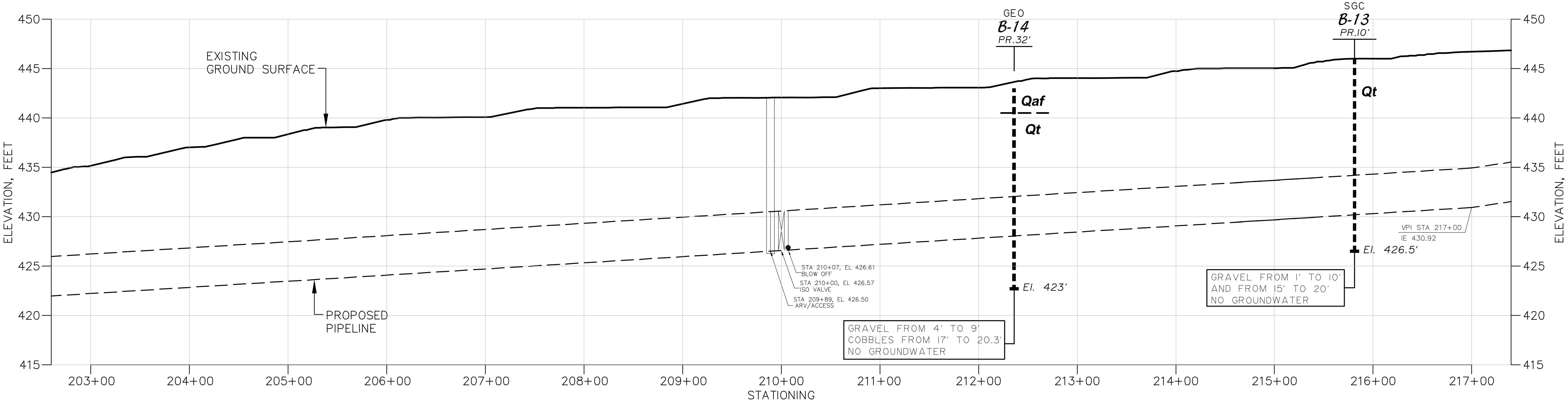
FIGURE NUMBER
3-15

PROJECT NAME
NCCS MIRAMAR PIPELINE

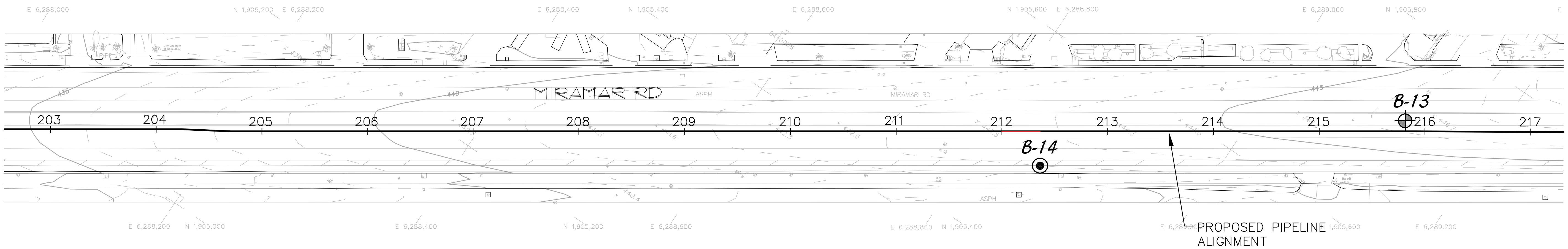
PROJECT NUMBER
2934

PIPELINE ALIGNMENT & PROFILE
STA 190+00 TO 203+00



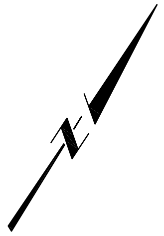
PIPELINE PROFILE

SCALE: 1"=100' (HORIZ.)
1"=10' (VERT.)



PLAN VIEW

SCALE: 1"=100'



SCALE: 1"=100'

LEGEND

B-14 ◉	*APPROXIMATE LOCATION OF GEOBASE BORING (1993)*
B-13 ⊕	*APPROXIMATE LOCATION OF SOUTHLAND BORING (1993)*
Qaf	*FILL*
Qt	*QUATERNARY TERRACE DEPOSITS*
— — —	*APPROX. GEOLOGIC CONTACT*

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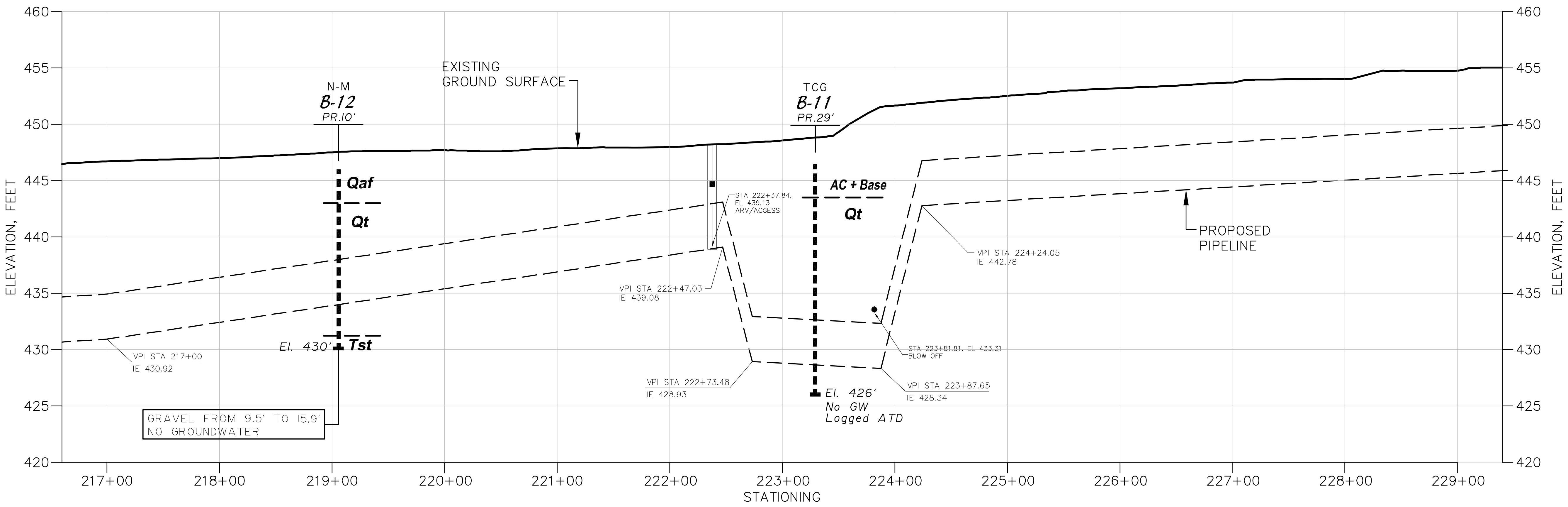
FIGURE NUMBER
3-16

PROJECT NAME
NCCS MIRAMAR PIPELINE

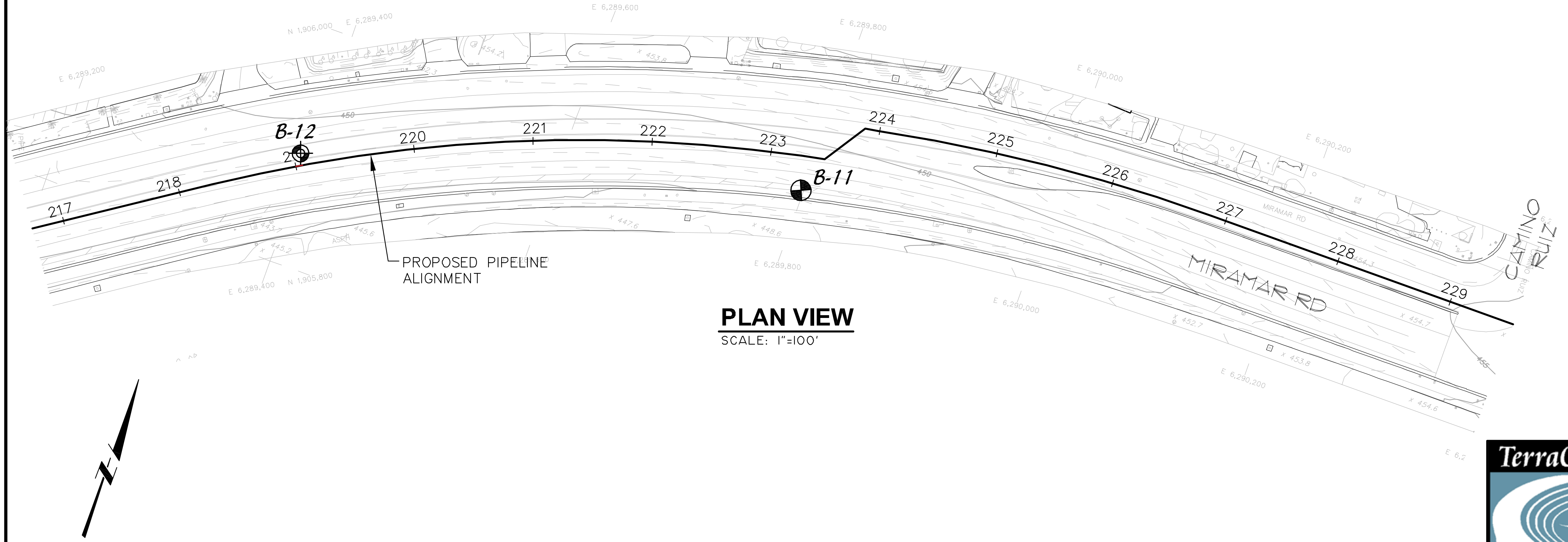
PROJECT NUMBER
2934

PIPELINE ALIGNMENT & PROFILE
STA 203+00 TO 217+00



PIPELINE PROFILE

SCALE: 1"=100' (HORIZ.)
1"=10' (VERT.)



PLAN VIEW

SCALE: 1"=100'

LEGEND

B-11 ◕	*APPROXIMATE LOCATION OF TCG BORING*
B-12 ⊕	*APPROXIMATE LOCATION OF NINYO-MOORE BORING (1994)*
AC + Base	*PAVEMENT SECTION*
Qaf	*FILL*
Qt	*QUATERNARY TERRACE DEPOSITS*
Tst	*TERTIARY STADIUM CONGLOMERAGE*
— —	*APPROX. GEOLOGIC CONTACT*

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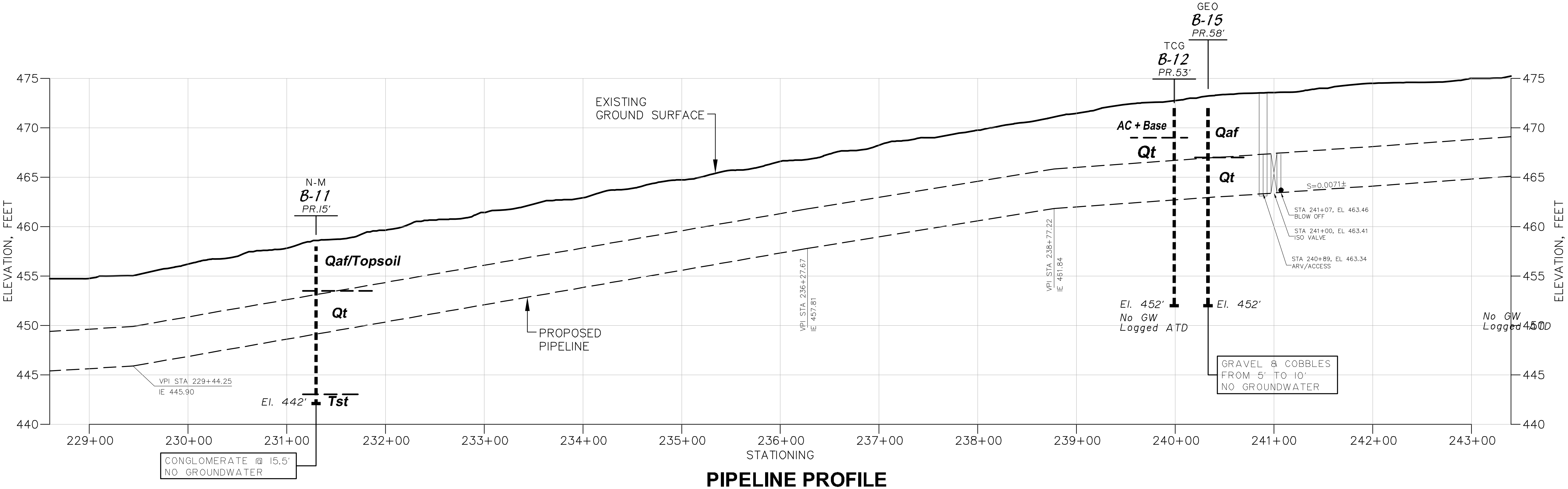
FIGURE NUMBER
3-17

PROJECT NAME
NCCS MIRAMAR PIPELINE

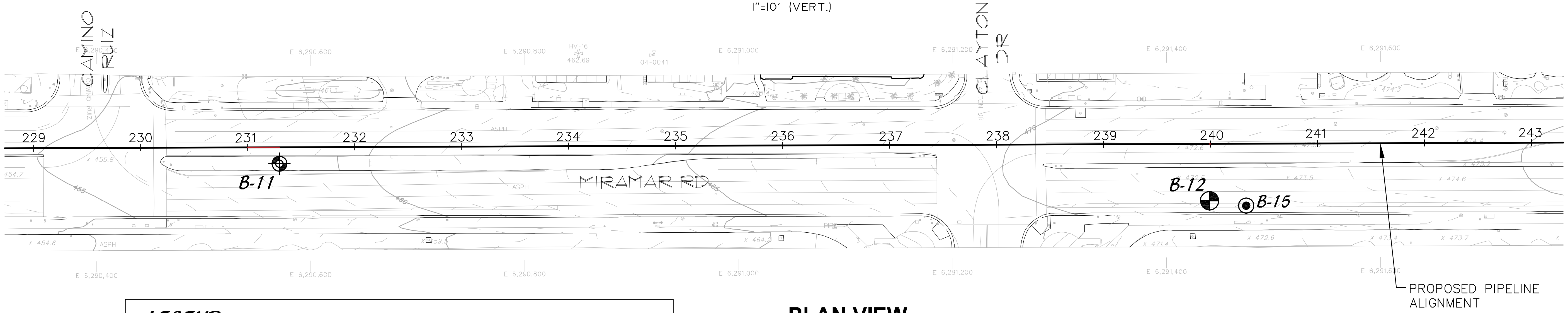
PROJECT NUMBER
2934

PIPELINE ALIGNMENT & PROFILE
STA 217+00 TO 229+00



PIPELINE PROFILE

SCALE: 1"=100' (HORIZ.)
1"=10' (VERT.)



PLAN VIEW

SCALE: 1"=100'

N

SCALE: 1"=100'

LEGEND

B-12 ◕	APPROXIMATE LOCATION OF TCG BORING	AC + Base	PAVEMENT SECTION
B-11 ⌖	APPROXIMATE LOCATION OF NINYO-MOORE BORING (1994)	Qaf/Topsoil	FILL/TOPSOIL
		Qt	QUATERNARY TERRACE DEPOSITS
B-15 ◉	APPROXIMATE LOCATION OF GEOBASE BORING (1993)	Tst	TERTIARY STADIUM CONGLOMERAGE
		— — —	APPROX. GEOLOGIC CONTACT

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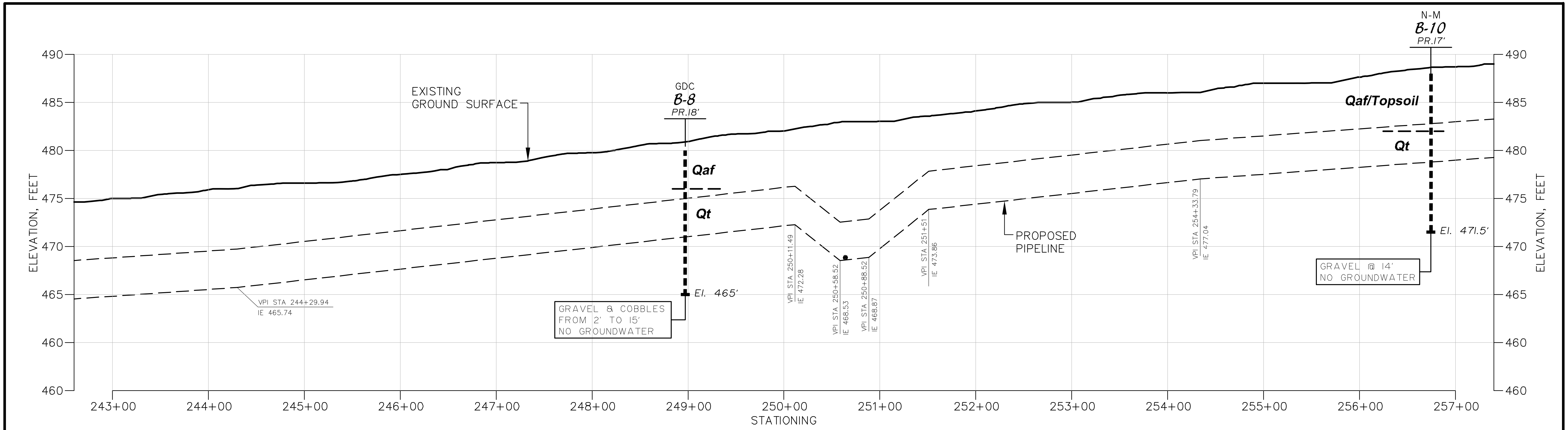
FIGURE NUMBER
3-18

PROJECT NAME
NCCS MIRAMAR PIPELINE

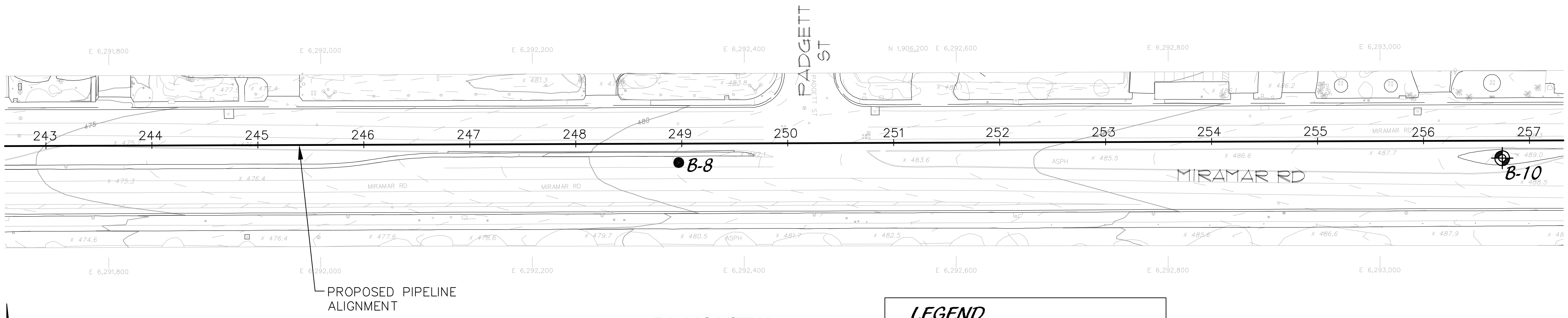
PROJECT NUMBER
2934

PIPELINE ALIGNMENT & PROFILE
STA 229+00 TO 243+00



PIPELINE PROFILE

SCALE: 1"=100' (HORIZ.)
1"=10' (VERT.)



PLAN VIEW

SCALE: 1"=100'

SCALE: 1"=100'

LEGEND

B-8 ●	APPROXIMATE LOCATION OF GROUP DELTA BORING (2000)
B-10 ⊕	APPROXIMATE LOCATION OF NINYO-MOORE BORING (1994)
Qaf/Topsoil	FILL/TOPSOIL
Qt	QUATERNARY TERRACE DEPOSITS
— — —	APPROX. GEOLOGIC CONTACT

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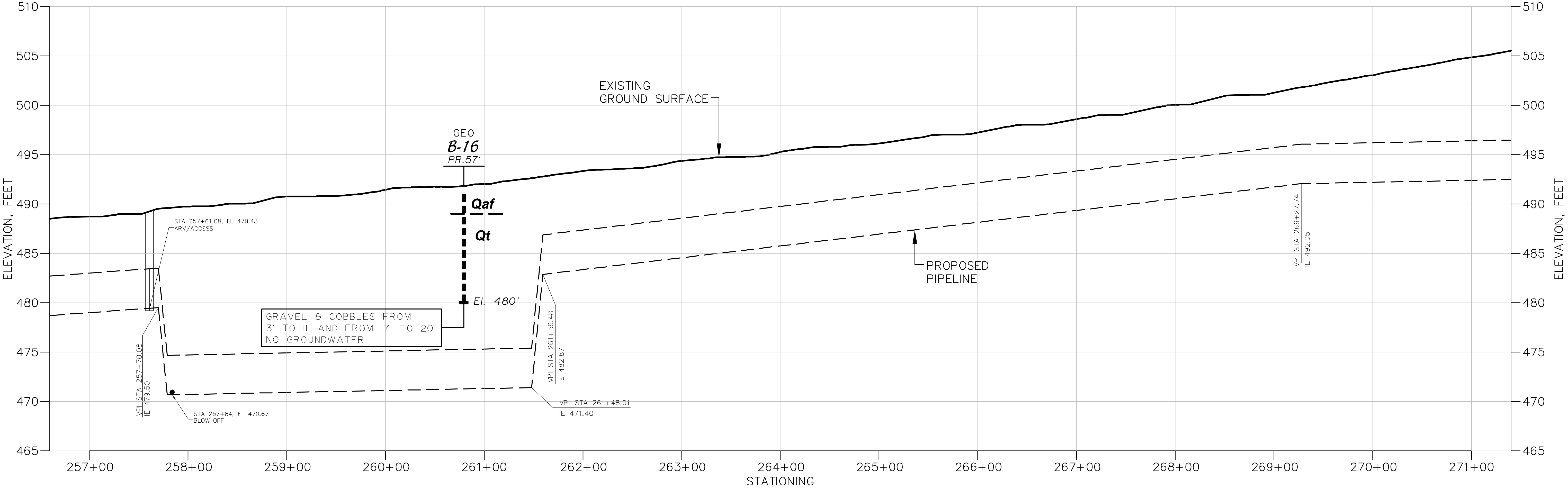
FIGURE NUMBER
3-19

PROJECT NAME
NCCS MIRAMAR PIPELINE

PROJECT NUMBER
2934

PIPELINE ALIGNMENT & PROFILE
STA 243+00 TO 257+00

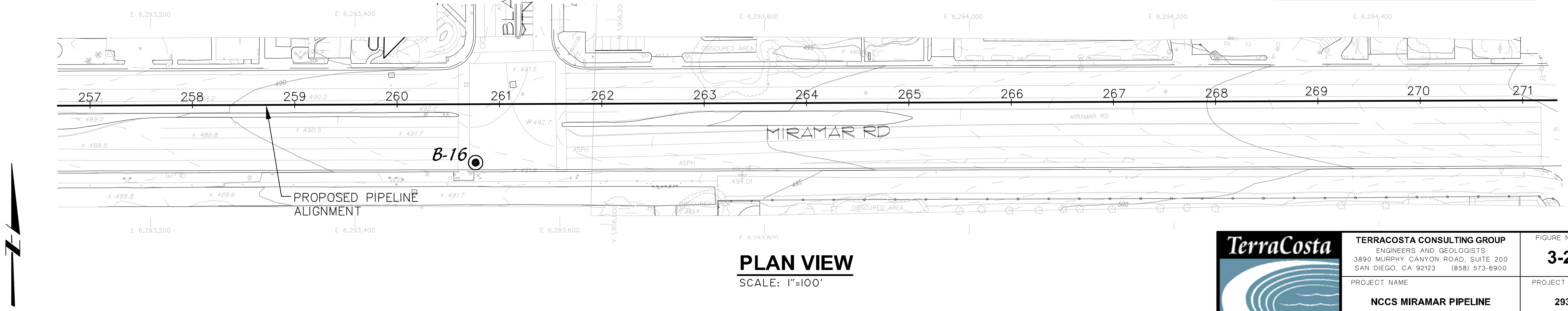


PIPELINE PROFILE

SCALE: 1"=100' (HORIZ.)
1"=10' (VERT.)

LEGEND

B-16 ◉	APPROXIMATE LOCATION OF GEOBASE BORING (1993)
Qaf	FILL/TOPSOIL
Qt	QUATERNARY TERRACE DEPOSITS
— —	APPROX. GEOLOGIC CONTACT



PLAN VIEW

SCALE: 1"=100'

SCALE: 1"=100'

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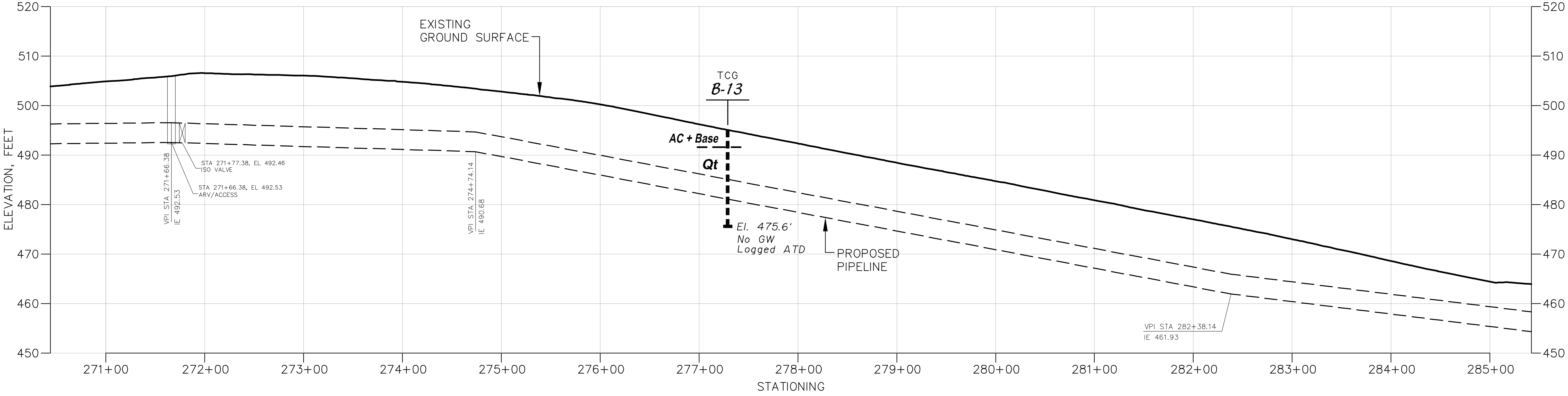
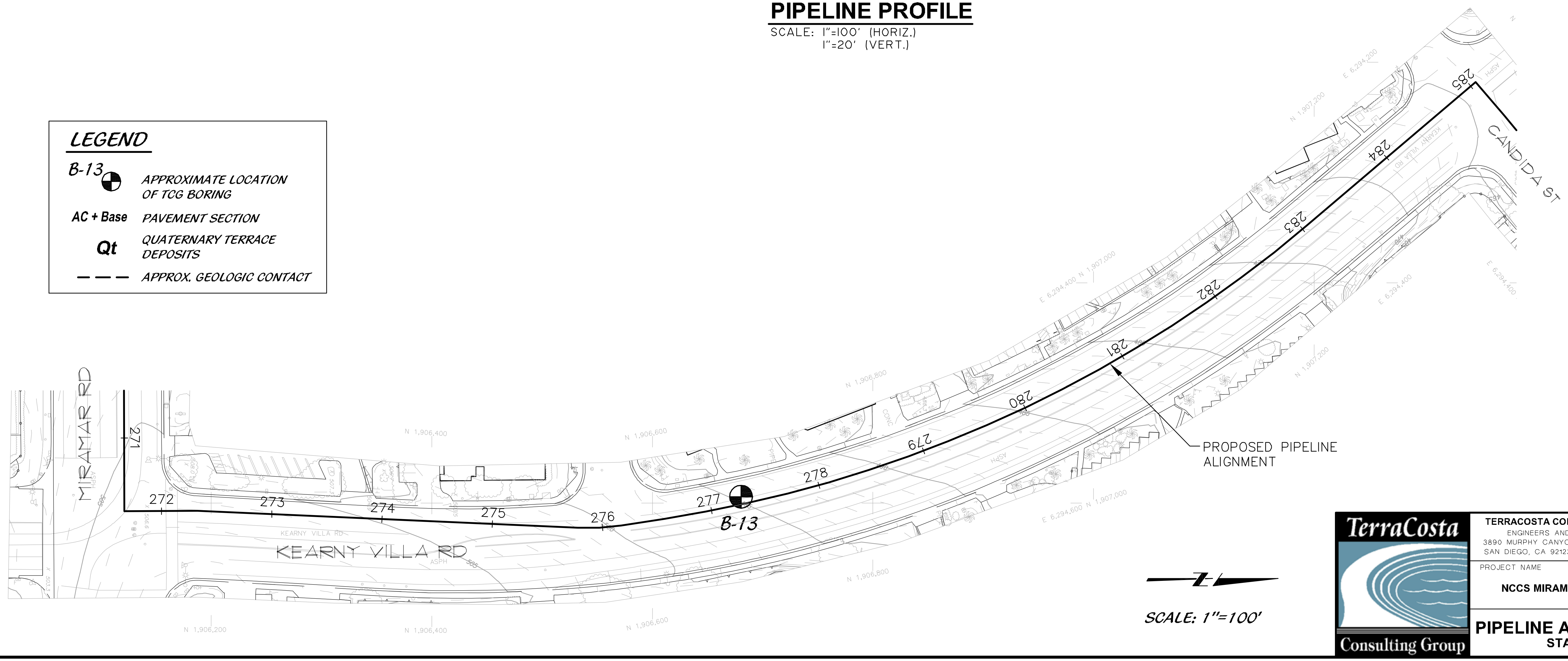
FIGURE NUMBER	3-20
PROJECT NAME	NCCS MIRAMAR PIPELINE
PROJECT NUMBER	2934

PIPELINE ALIGNMENT & PROFILE
STA 257+00 TO 271+00



PIPELINE PROFILE

SCALE: 1"=100' (HORIZ.)
1"=20' (VERT.)



LEGEND

B-13 ◐	*APPROXIMATE LOCATION OF TCG BORING*
AC + Base	*PAVEMENT SECTION*
Qt	*QUATERNARY TERRACE DEPOSITS*
— — —	*APPROX. GEOLOGIC CONTACT*

SCALE: 1"=100'

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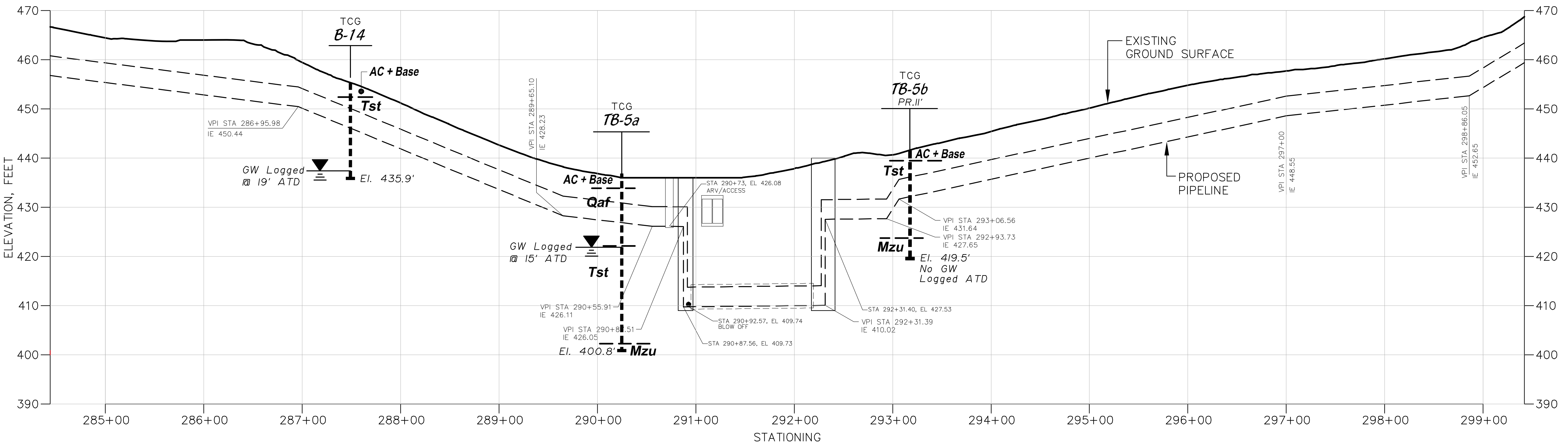
FIGURE NUMBER
3-21

PROJECT NAME
NCCS MIRAMAR PIPELINE

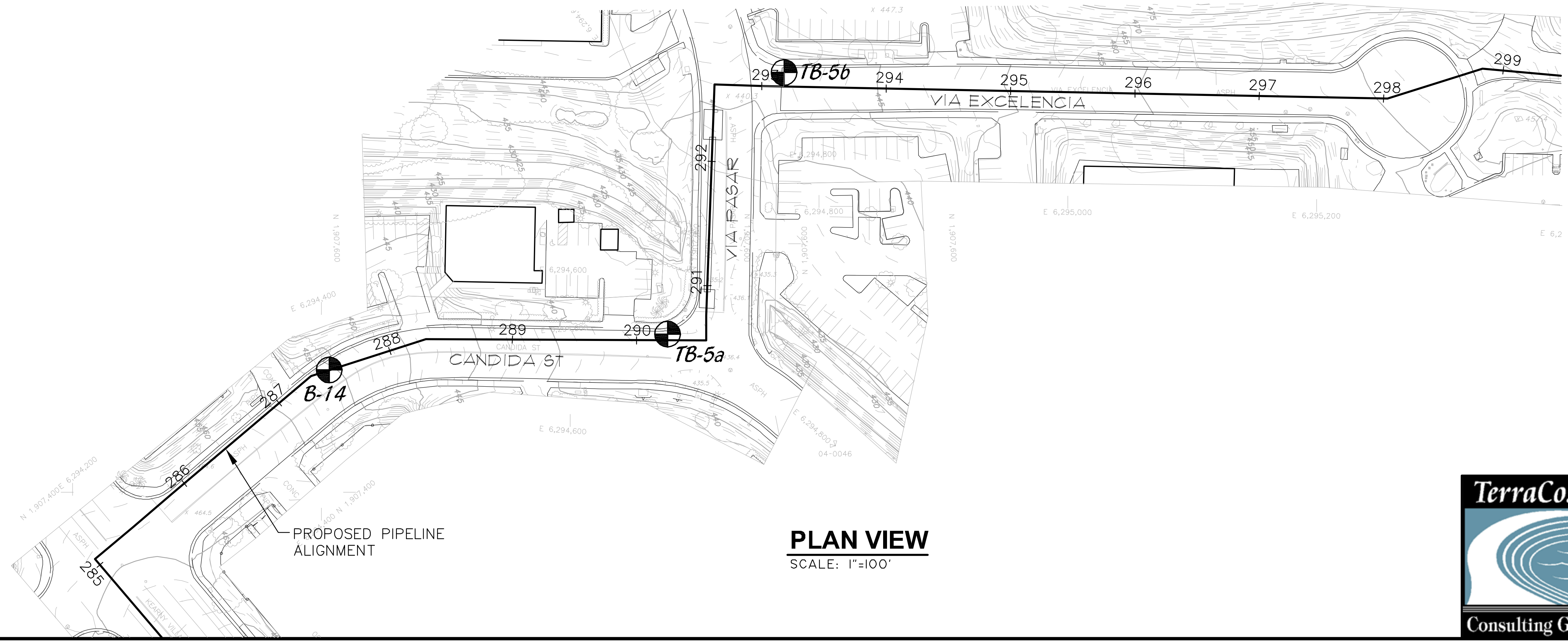
PROJECT NUMBER
2934

PIPELINE ALIGNMENT & PROFILE
STA 271+00 TO 285+00



PIPELINE PROFILE

SCALE: 1"=100' (HORIZ.)
1"=20' (VERT.)



PLAN VIEW

SCALE: 1"=100'

LEGEND

TB-5a ⊕	APPROXIMATE LOCATION OF TCG TRENCHLESS BORING
AC + Base	PAVEMENT SECTION
Qaf	FILL
Tst	TERTIARY STADIUM CONGLOMERATE
Mzu	MESOZOIC METAMORPHOSED VOLCANIC & SEDIMENTARY ROCKS (UNDIVIDED)
— — —	APPROX. GEOLOGIC CONTACT

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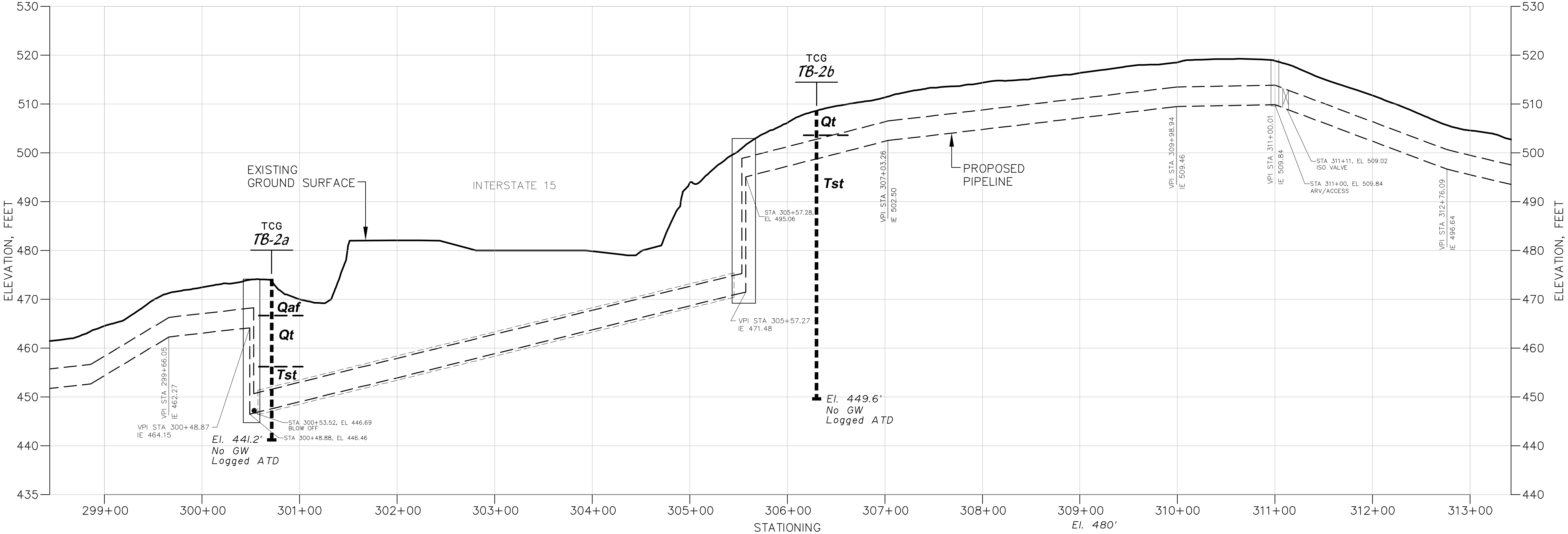
FIGURE NUMBER
3-22

PROJECT NAME
NCCS MIRAMAR PIPELINE

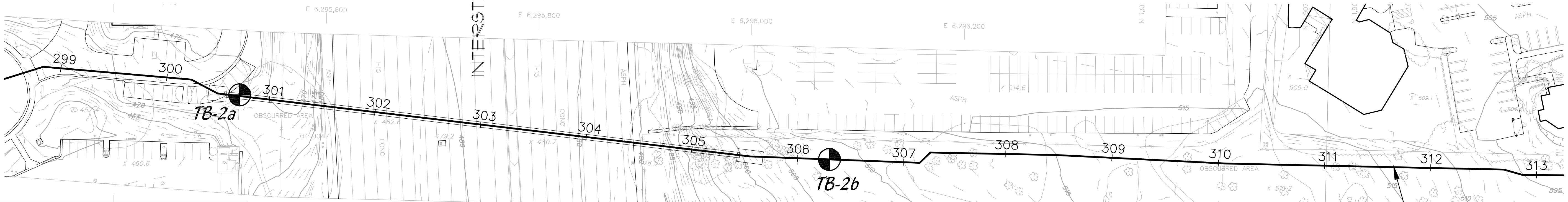
PROJECT NUMBER
2934

PIPELINE ALIGNMENT & PROFILE
STA 285+00 TO 299+00



PIPELINE PROFILE

SCALE: 1"=100' (HORIZ.)
1"=20' (VERT.)



PLAN VIEW

SCALE: 1"=100'

SCALE: 1"=100'

LEGEND

TB-2b ⊕	APPROXIMATE LOCATION OF TCG TRENCHLESS BORING
Qaf	FILL
Qt	QUATERNARY TERRACE DEPOSITS
Tst	TERTIARY STADIUM CONGLOMERAGE
— — —	APPROX. GEOLOGIC CONTACT

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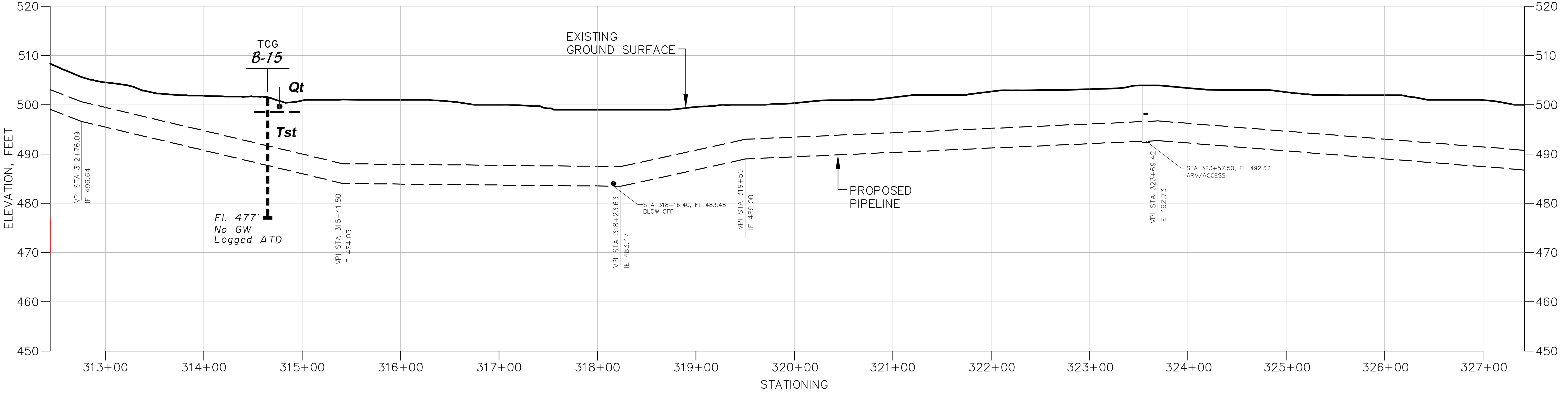
FIGURE NUMBER
3-23

PROJECT NAME
NCCS MIRAMAR PIPELINE

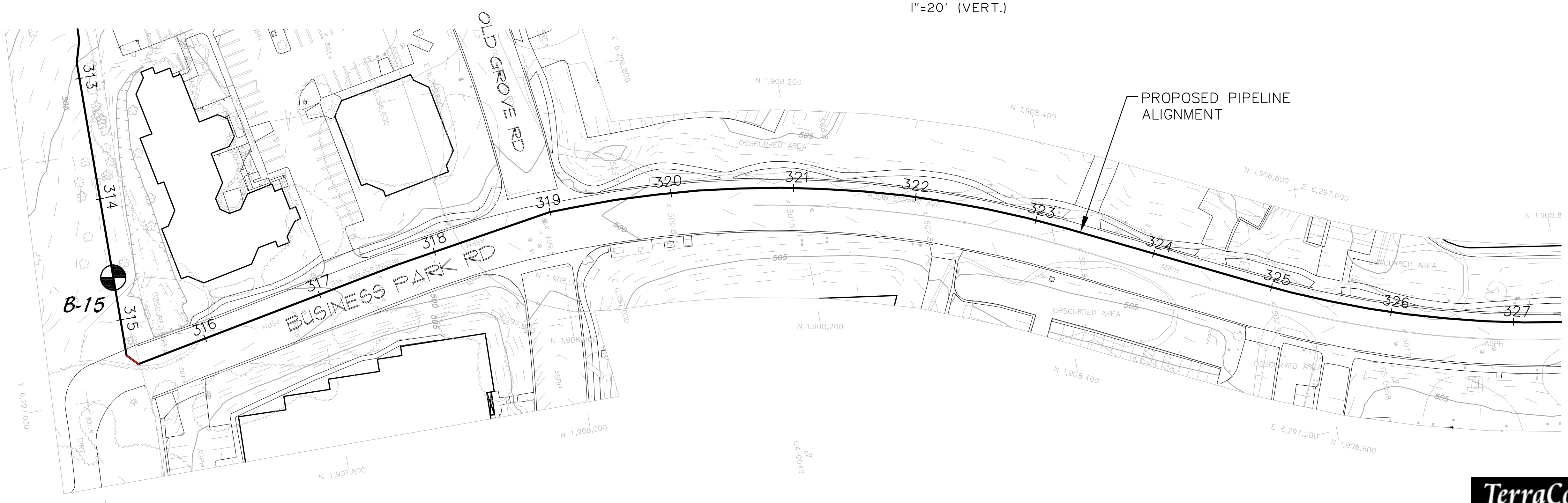
PROJECT NUMBER
2934

PIPELINE ALIGNMENT & PROFILE
STA 299+00 TO 313+00



PIPELINE PROFILE

SCALE: 1"=100' (HORIZ.)
1"=20' (VERT.)



SCALE: 1"=100'

PLAN VIEW

SCALE: 1"=100'

LEGEND

B-15 ●	APPROXIMATE LOCATION OF TCG BORING
Qt	QUATERNARY TERRACE DEPOSITS
Tst	TERTIARY STADIUM CONGLOMERAGE
— — —	APPROX. GEOLOGIC CONTACT

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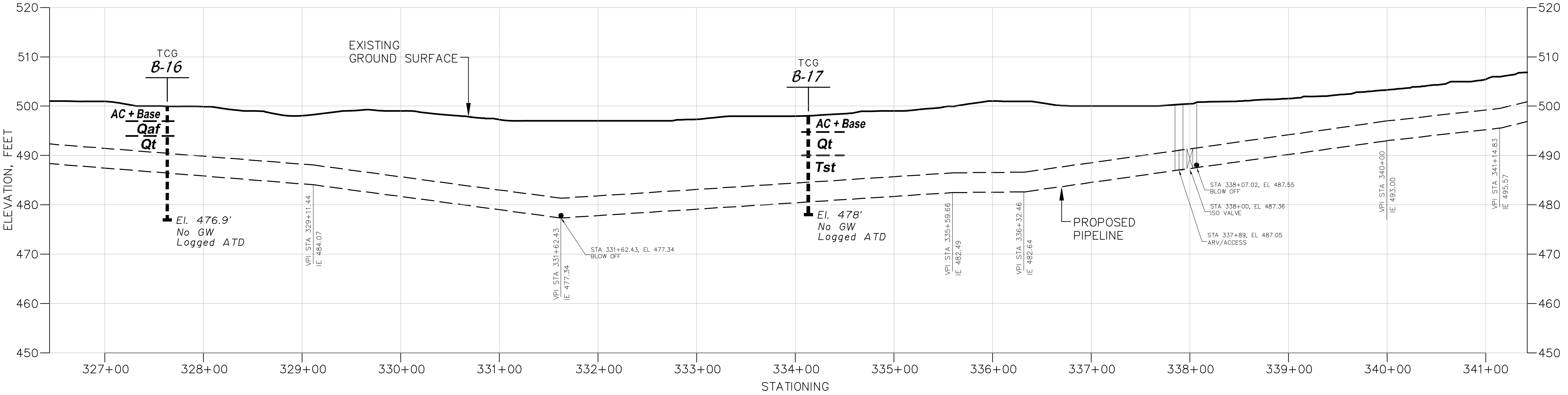
FIGURE NUMBER
3-24

PROJECT NAME
NCCS MIRAMAR PIPELINE

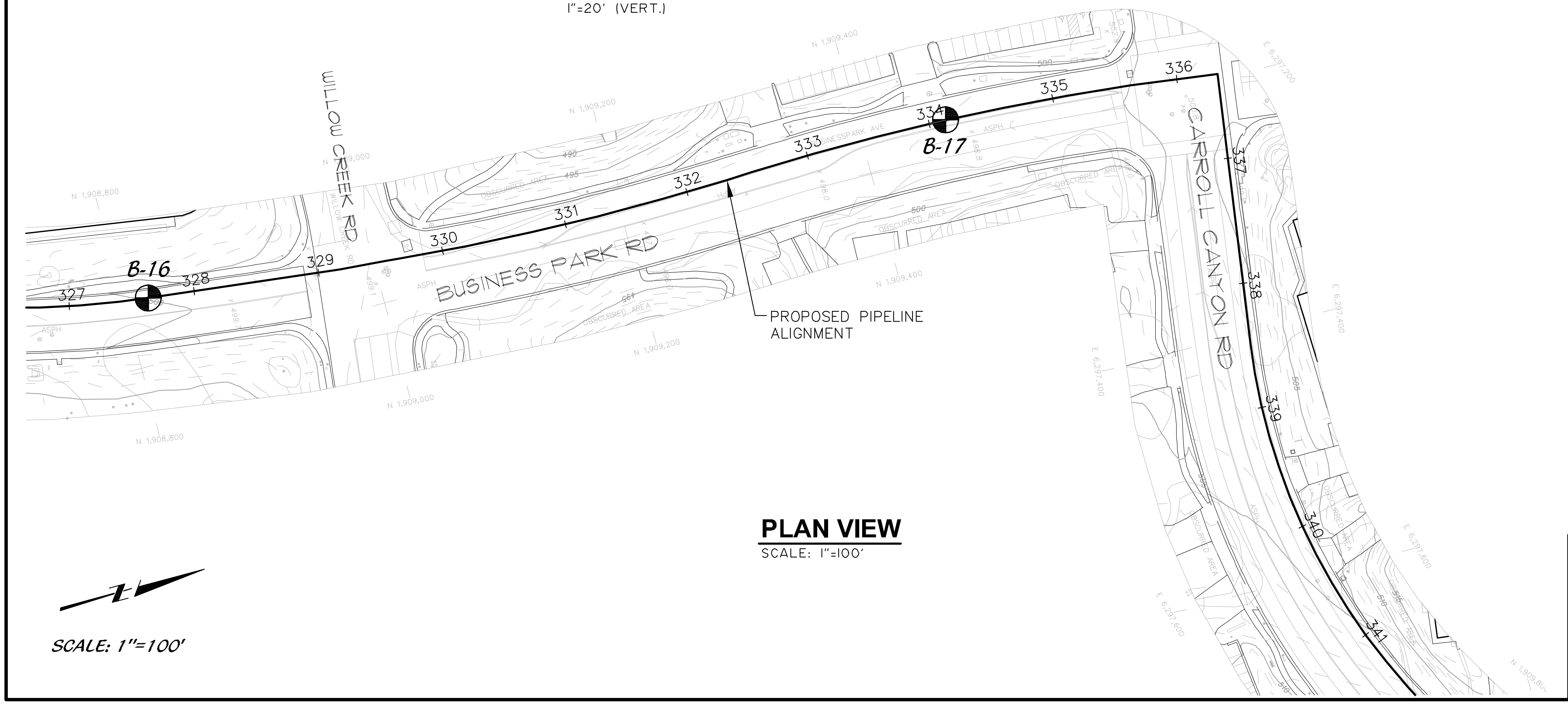
PROJECT NUMBER
2934

PIPELINE ALIGNMENT & PROFILE
STA 313+00 TO 327+00



PIPELINE PROFILE

SCALE: 1"=100' (HORIZ.)
1"=20' (VERT.)



PLAN VIEW

SCALE: 1"=100'

LEGEND

B-17 ⊕	APPROXIMATE LOCATION OF TCG BORING
AC + Base	PAVEMENT SECTION
Qaf	FILL
Qt	QUATERNARY TERRACE DEPOSITS
Tst	TERTIARY STADIUM CONGLOMERAGE
— — —	APPROX. GEOLOGIC CONTACT

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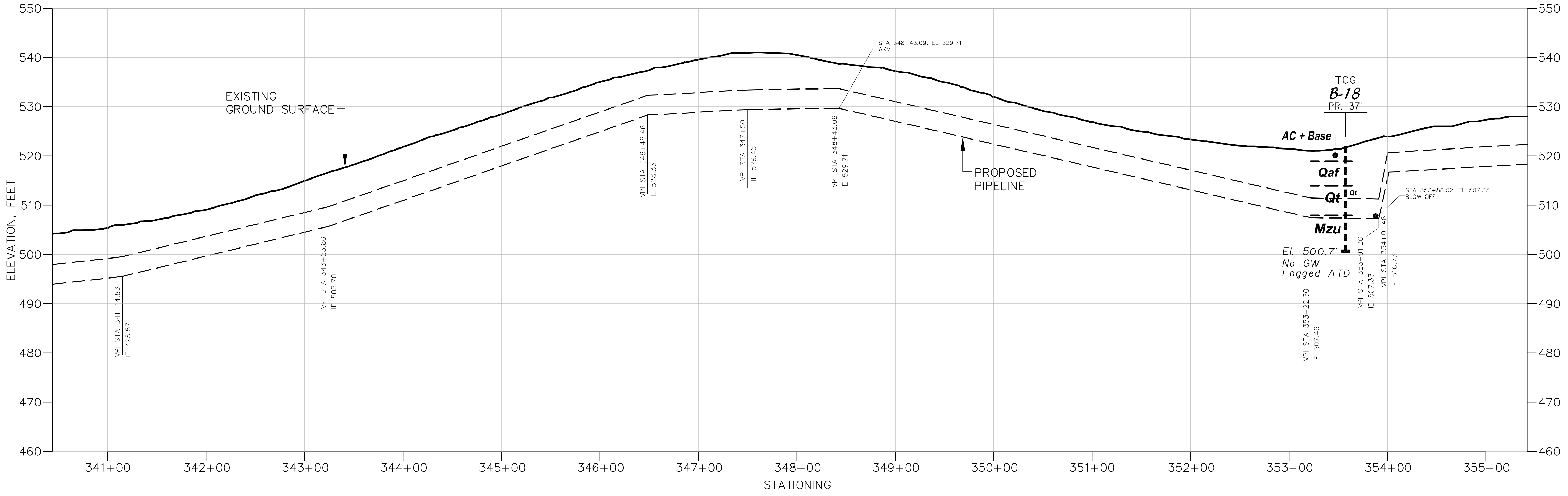
FIGURE NUMBER
3-25

PROJECT NAME
NCCS MIRAMAR PIPELINE

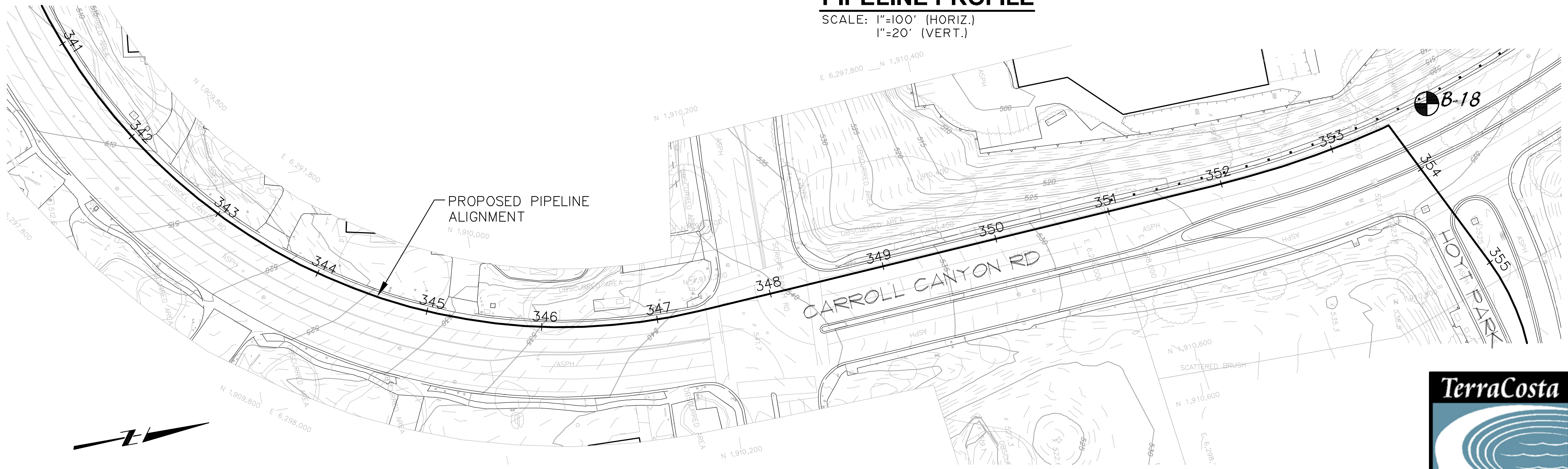
PROJECT NUMBER
2934

PIPELINE ALIGNMENT & PROFILE
STA 327+00 TO 341+00



PIPELINE PROFILE

SCALE: I"=I00' (HORIZ.)
I"=20' (VERT.)



SCALE: 1"=100'

PLAN VIEW

SCALE: I"=I00'

LEGEND

B-18 ⊕	APPROXIMATE LOCATION OF TCG BORING
AC + Base	PAVEMENT SECTION
Qaf	FILL
Qt	QUATERNARY TERRACE DEPOSITS
Mzu	MESOZOIC METAMORPHOSED VOLCANIC & SEDIMENTARY ROCKS (UNDIVIDED)
— — —	APPROX. GEOLOGIC CONTACT

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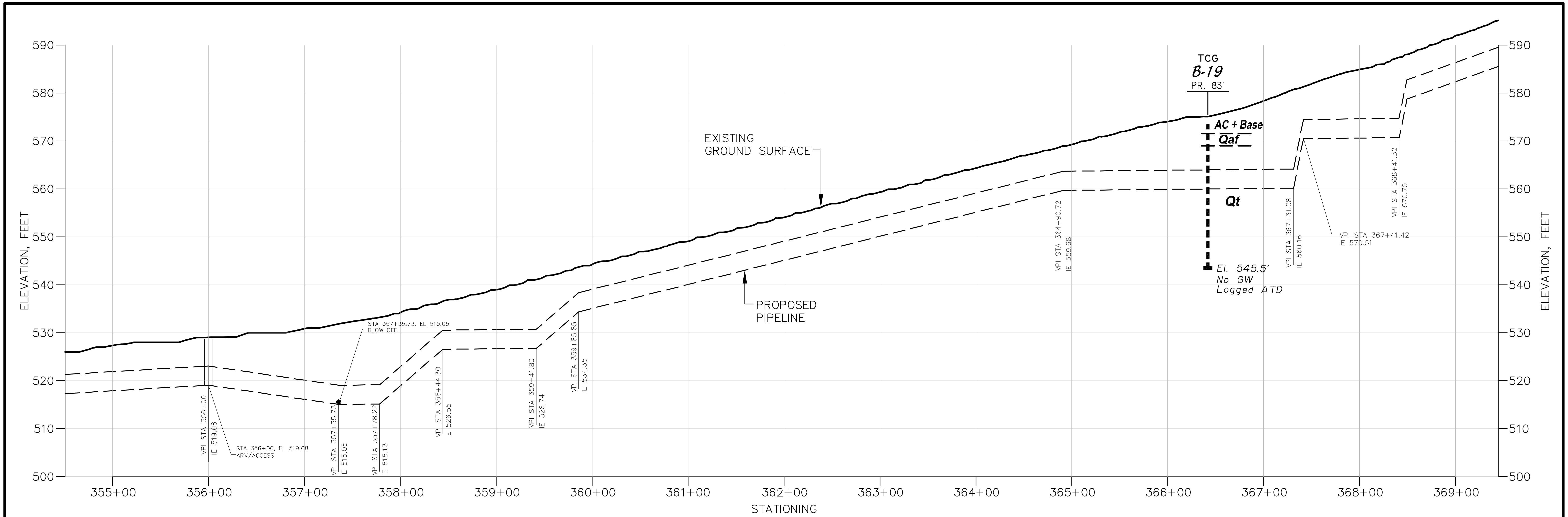
FIGURE NUMBER
3-26

PROJECT NAME
NCCS MIRAMAR PIPELINE

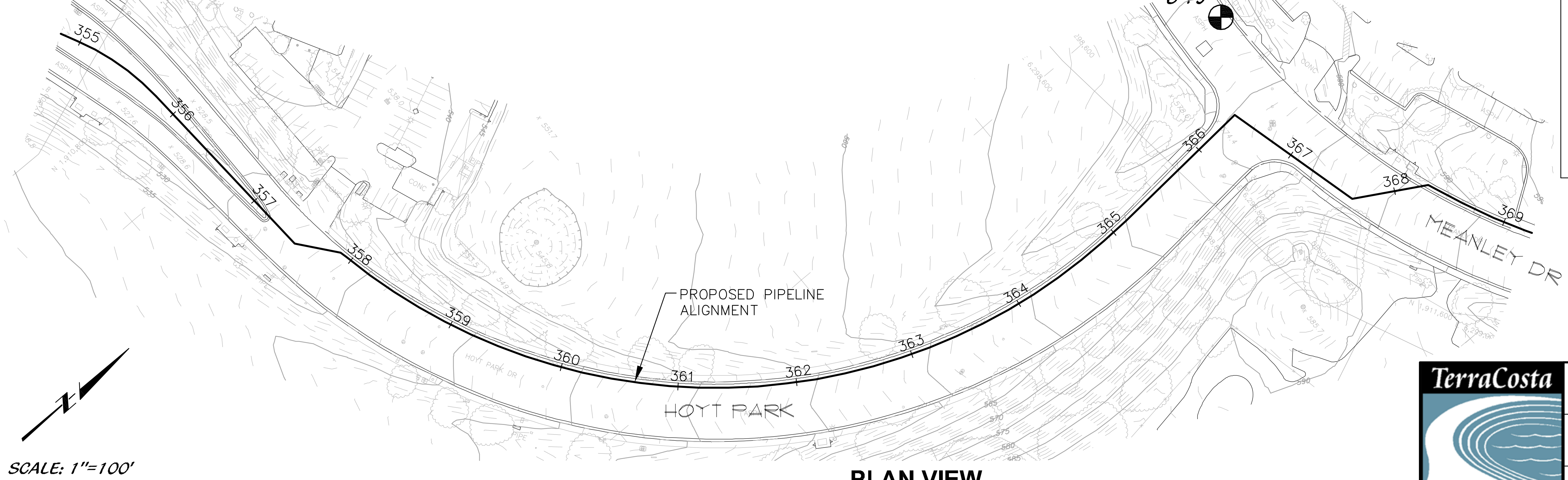
PROJECT NUMBER
2934

PIPELINE ALIGNMENT & PROFILE
STA 341+00 TO 355+00



PIPELINE PROFILE

SCALE: 1"=100' (HORIZ.)
1"=20' (VERT.)



PLAN VIEW

SCALE: 1"=100'

LEGEND

B-19 ⊕	APPROXIMATE LOCATION OF TCG BORING
AC + Base	PAVEMENT SECTION
Qaf	FILL
Qt	QUATERNARY TERRACE DEPOSITS
— — —	APPROX. GEOLOGIC CONTACT

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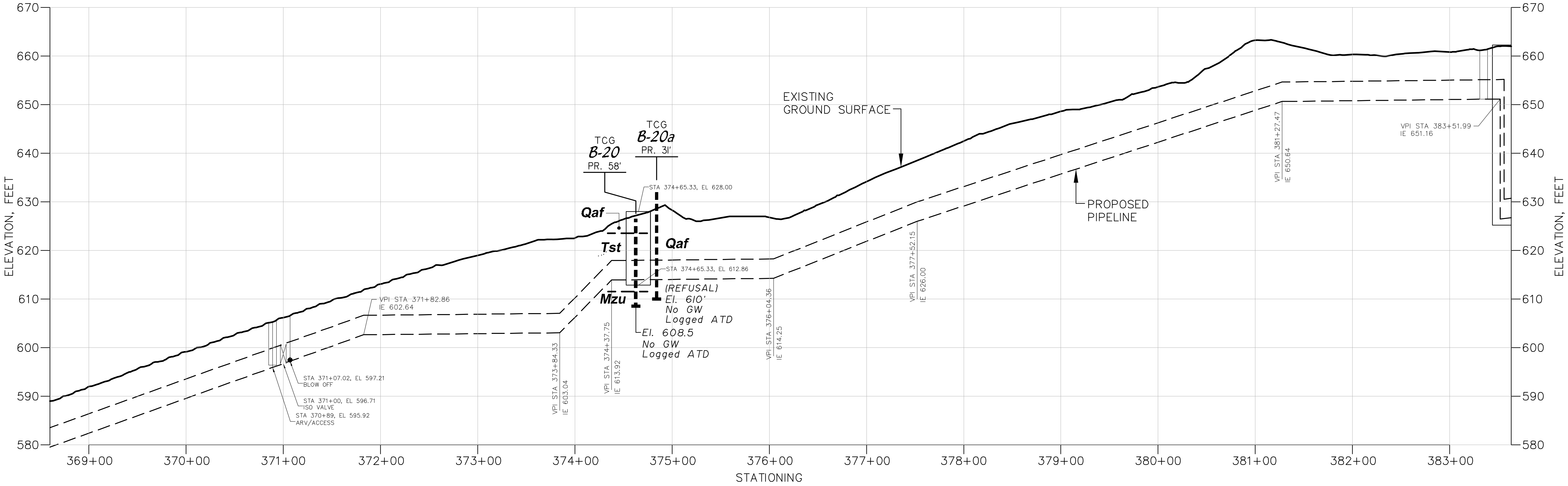
FIGURE NUMBER
3-27

PROJECT NAME
NCCS MIRAMAR PIPELINE

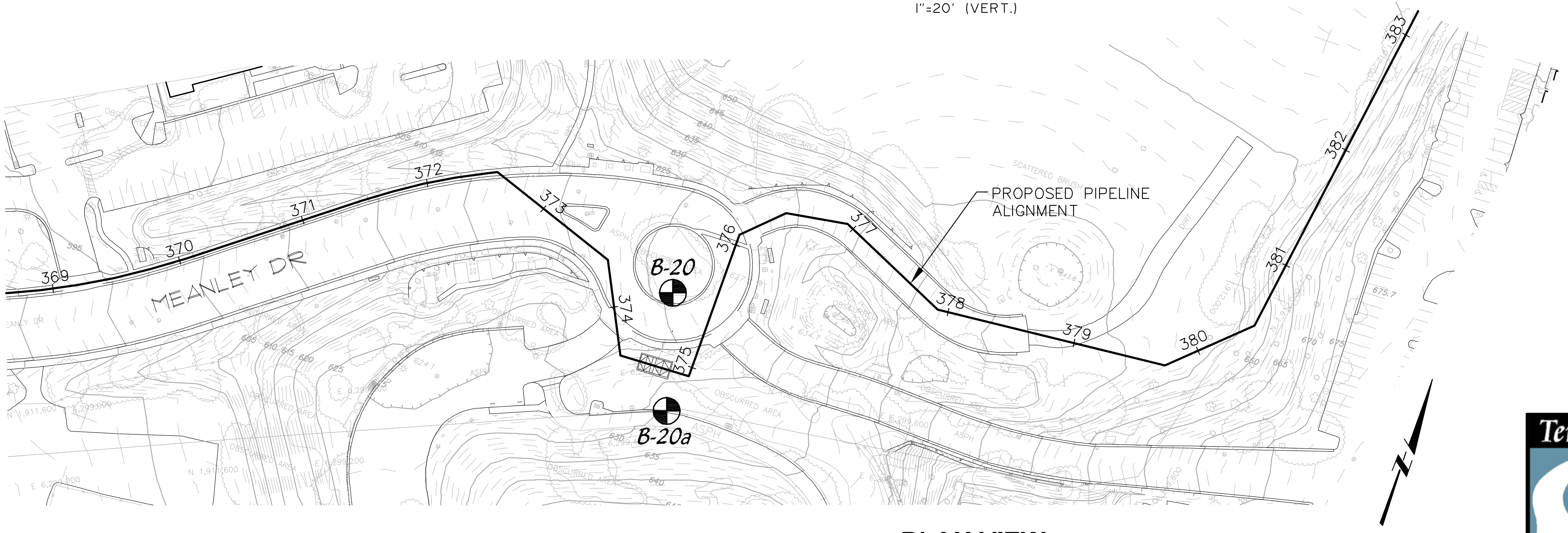
PROJECT NUMBER
2934

PIPELINE ALIGNMENT & PROFILE
STA 355+00 TO 369+00



PIPELINE PROFILE

SCALE: 1"=100' (HORIZ.)
1"=20' (VERT.)



PLAN VIEW

SCALE: 1"=100'

SCALE: 1"=100'

LEGEND

B-20 ⊕	*APPROXIMATE LOCATION OF TCG BORING*
Qaf	*FILL*
Tst	*TERTIARY STADIUM CONGLOMERAGE*
Mzu	*MESOZOIC METAMORPHOSED VOLCANIC & SEDIMENTARY ROCKS (UNDIVIDED)*
— — —	*APPROX. GEOLOGIC CONTACT*

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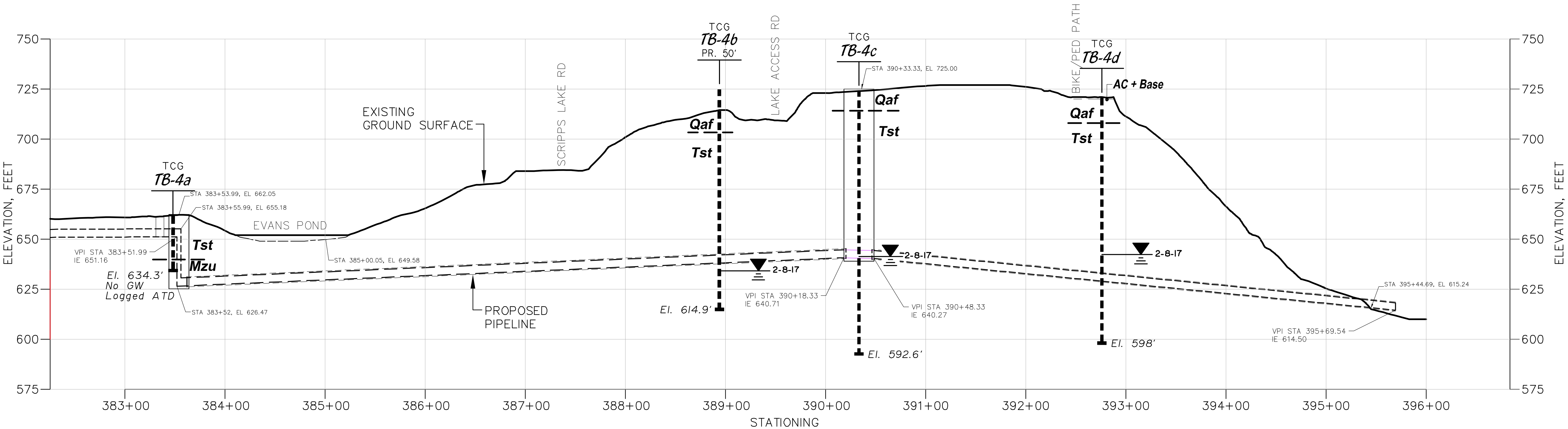
3890 MURPHY CANYON ROAD, SUITE 200
SAN DIEGO, CA 92123 (858) 573-6900

FIGURE NUMBER
3-28

PROJECT NAME
NCCS MIRAMAR PIPELINE

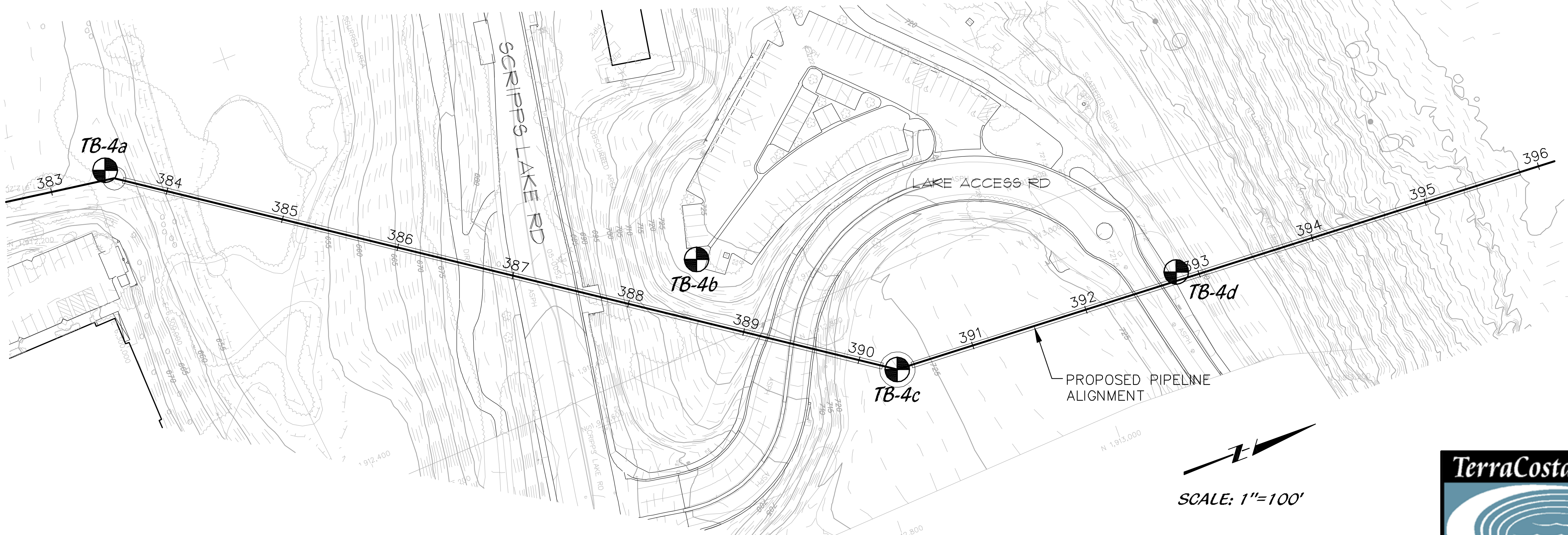
PROJECT NUMBER
2934

PIPELINE ALIGNMENT & PROFILE
STA 369+00 TO 383+00



PIPELINE PROFILE

SCALE: 1"=100' (HORIZ.)
1"=50' (VERT.)



PLAN VIEW

SCALE: 1"=100'

LEGEND

TB-4a ⊕	APPROXIMATE LOCATION OF TCG BORING
AC + Base	PAVEMENT SECTION
Qaf	FILL
Tst	TERTIARY STADIUM CONGLOMERATE
Mzu	MESOZOIC METAMORPHOSED VOLCANIC & SEDIMENTARY ROCKS (UNDIVIDED)
— — —	APPROX. GEOLOGIC CONTACT
▼ 2-8-17	DEPTH GROUNDWATER MEASURED IN PIEZOMETER & DATE OF MEASUREMENT

TerraCosta
Consulting Group

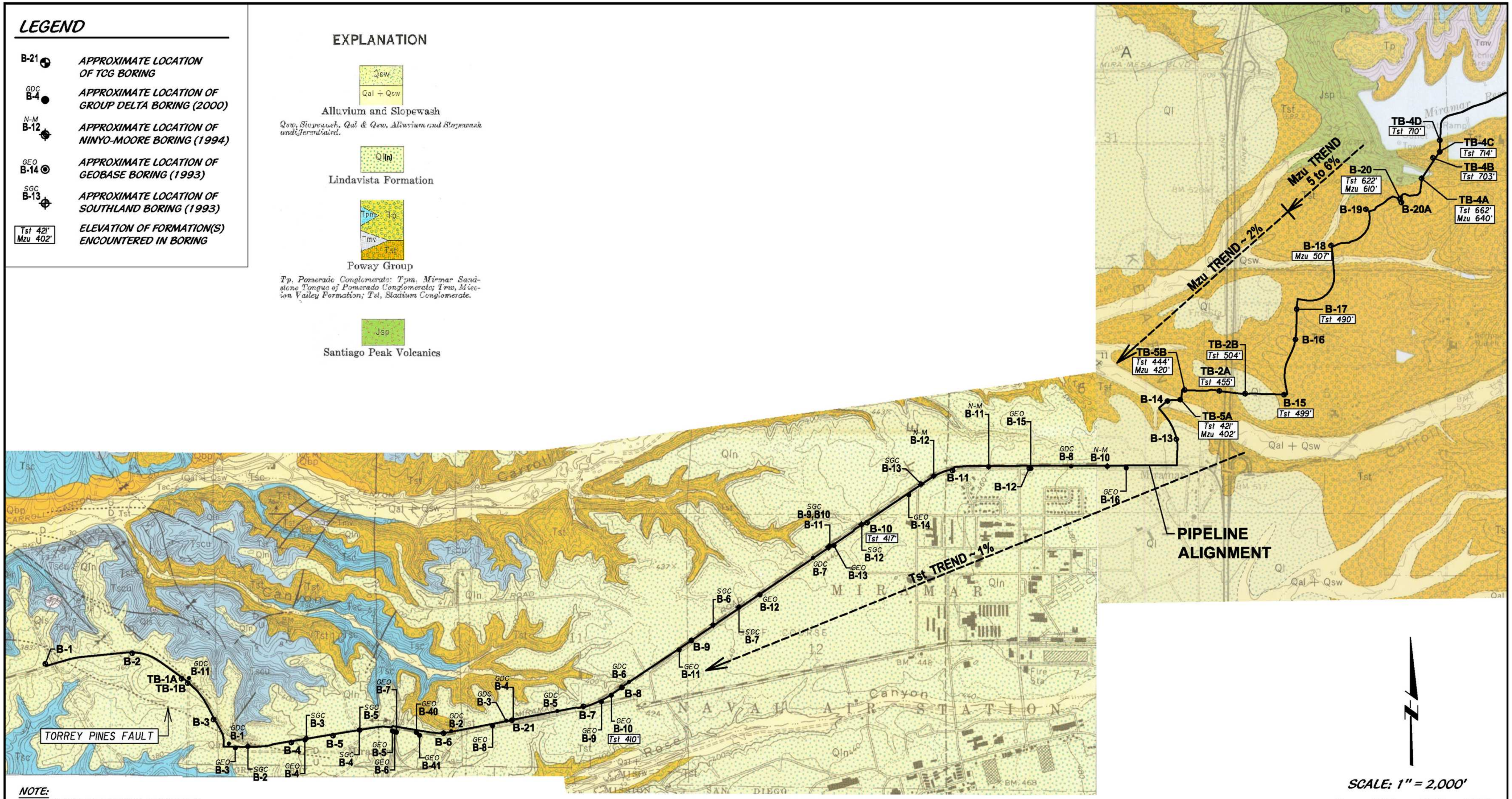
TERRACOSTA CONSULTING GROUP
ENGINEERS AND GEOLOGISTS
3890 MURPHY CANYON ROAD, SUITE 200
SAN DIEGO, CA 92123 (858) 573-6900

FIGURE NUMBER
3-29

PROJECT NAME
NCCS MIRAMAR PIPELINE

PROJECT NUMBER
2934

PIPELINE ALIGNMENT & PROFILE
STA 383+00 TO 396+00



LEGEND

B-21	*APPROXIMATE LOCATION OF TCG BORING*
GDC B-4 ●	*APPROXIMATE LOCATION OF GROUP DELTA BORING (2000)*
N-M B-12	*APPROXIMATE LOCATION OF NINYO-MOORE BORING (1994)*
GEO B-14 ◎	*APPROXIMATE LOCATION OF GEOBASE BORING (1993)*
SGC B-13	*APPROXIMATE LOCATION OF SOUTHLAND BORING (1993)*
Tst 421' Mzu 402'	*ELEVATION OF FORMATION(S) ENCOUNTERED IN BORING*

EXPLANATION

Qsw / Qal + Qsw

Alluvium and Slopewash

Qsw, Slopewash; Qal & Qsw, Alluvium and Slopewash undifferentiated.

Ql(n)

Lindavista Formation

Tpm / Tp / Tmv / Tst

Poway Group

Tp, Pomerado Conglomerate; Tpm, Miramar Sandstone Tongue of Pomerado Conglomerate; Tmv, Mission Valley Formation; Tst, Stadium Conglomerate.

Jsp

Santiago Peak Volcanics

NOTE:
SHOWN FOR HISTORICAL PURPOSES.

SCALE: 1" = 2,000'

0 1,000 2,000 3,000
FEET

KENNEDY MAP
NCCS MIRAMAR PIPELINE ALIGNMENT

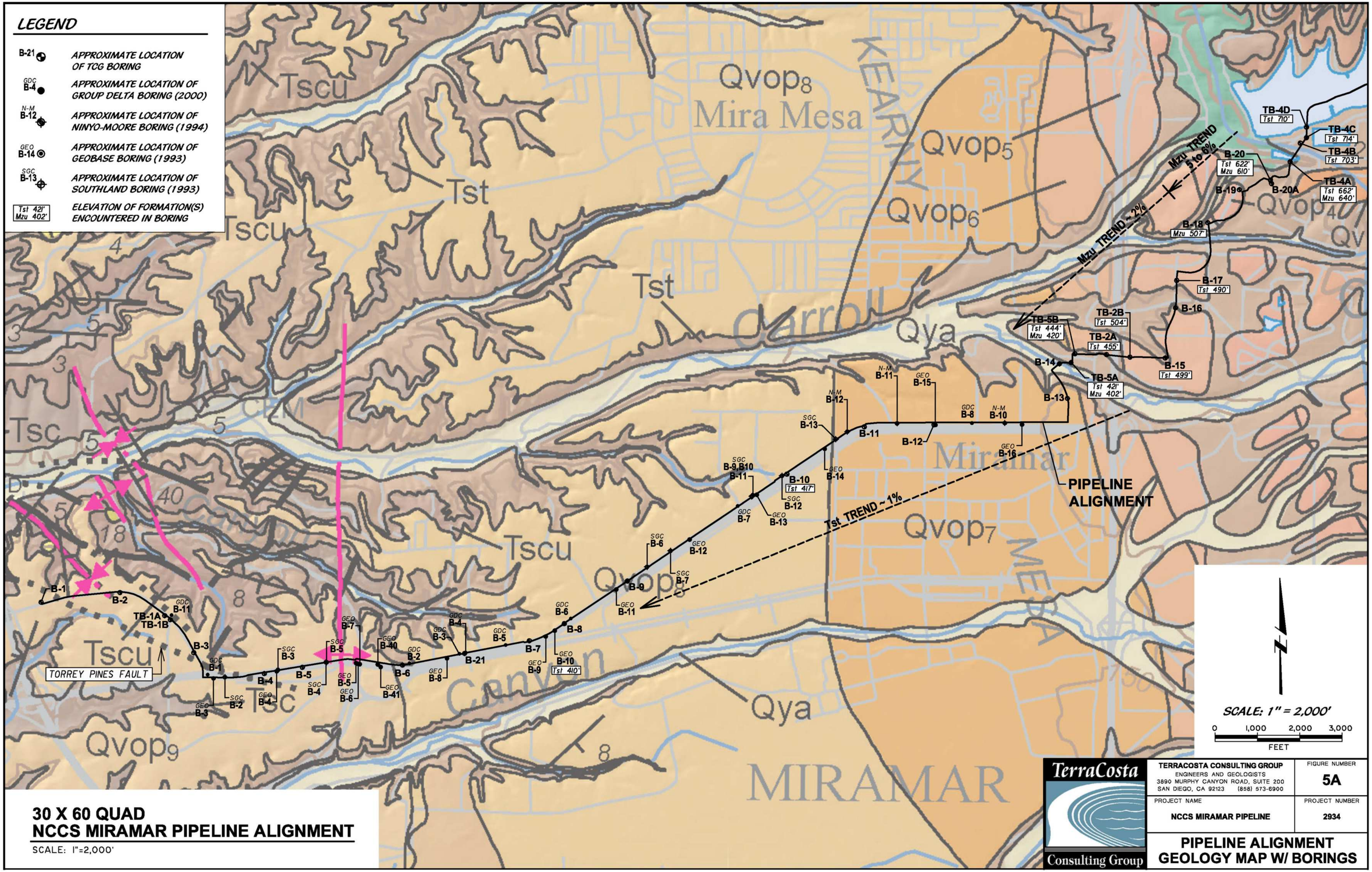
SCALE: 1"=2,000'

TerraCosta Consulting Group

TERRACOSTA CONSULTING GROUP ENGINEERS AND GEOLOGISTS 3890 MURPHY CANYON ROAD, SUITE 200 SAN DIEGO, CA 92123 (858) 573-6900	FIGURE NUMBER 4
PROJECT NAME NCCS MIRAMAR PIPELINE	PROJECT NUMBER 2934
PIPELINE ALIGNMENT GEOLOGY MAP W/ BORINGS	

LEGEND

B-21 ⊕	APPROXIMATE LOCATION OF TCG BORING
GDC B-4 ●	APPROXIMATE LOCATION OF GROUP DELTA BORING (2000)
N-M B-12 ⊕	APPROXIMATE LOCATION OF NINYO-MOORE BORING (1994)
GEO B-14 ◉	APPROXIMATE LOCATION OF GEOBASE BORING (1993)
SGC B-13 ⊕	APPROXIMATE LOCATION OF SOUTHLAND BORING (1993)
Tst 421' Mzu 402'	ELEVATION OF FORMATION(S) ENCOUNTERED IN BORING



30 X 60 QUAD
NCCS MIRAMAR PIPELINE ALIGNMENT

SCALE: 1"=2,000'

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FIGURE NUMBER	5A
PROJECT NAME	NCCS MIRAMAR PIPELINE
PROJECT NUMBER	2934

PIPELINE ALIGNMENT GEOLOGY MAP W/ BORINGS

DESCRIPTION OF MAP UNITS

Qya **YOUNG ALLUVIAL FLOOD-PLAIN DEPOSITS (Holocene and late Pleistocene) -** Poorly consolidated, poorly sorted, permeable flood-plain deposits of sandy, silty or clay-bearing alluvium.

Qvop **VERY OLD PARALIC DEPOSITS, UNDIVIDED (middle to early Pleistocene) -** Poorly sorted, moderately permeable, reddish-brown, interfingered strandline, beach, estuarine and colluvial deposits composed of siltstone, sandstone and conglomerate. These deposits rest on the now emergent wave cut abrasion platforms preserved by regional uplift. Includes:

Qvop$_9$ **VERY OLD PARALIC DEPOSITS, UNIT 9 (middle to early Pleistocene) -** Poorly sorted, moderately permeable, reddish-brown, interfingered strandline, beach, estuarine and colluvial deposits composed of siltstone, sandstone and conglomerate. These deposits rest on the 113-115 m Linda Vista terrace.

Qvop$_8$ **VERY OLD PARALIC DEPOSITS, UNIT 8 (middle to early Pleistocene) -** Poorly sorted, moderately permeable, reddish-brown, interfingered strandline, beach, estuarine and colluvial deposits composed of siltstone, sandstone and conglomerate. These deposits rest on the 123-125 m Tierra Santa terrace.

Qvop$_7$ **VERY OLD PARALIC DEPOSITS, UNIT 7 (middle to early Pleistocene) -** Poorly sorted, moderately permeable, reddish-brown, interfingered strandline, beach, estuarine and colluvial deposits composed of siltstone, sandstone and conglomerate. These deposits rest on the 129-131 m Mira Mesa terrace.

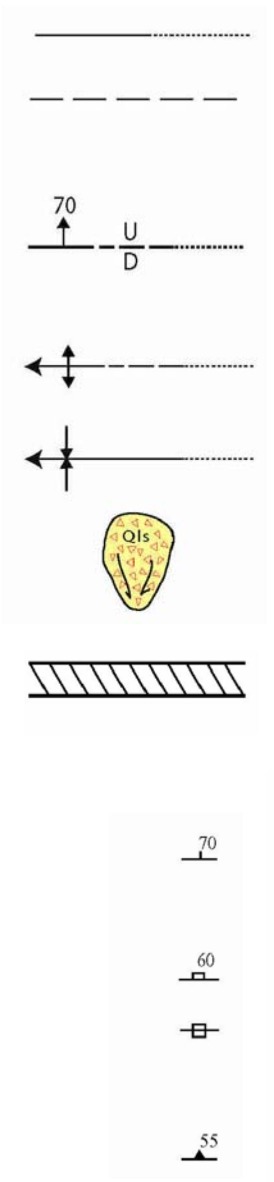
Qvop$_4$ **VERY OLD PARALIC DEPOSITS, UNIT 4 (middle to early Pleistocene) -** Poorly sorted, moderately permeable, reddish-brown, interfingered strandline, beach, estuarine and colluvial deposits composed of siltstone, sandstone and conglomerate. These deposits rest on the 170-174 m Aquaduct terrace.

Qvop$_2$ **VERY OLD PARALIC DEPOSITS, UNIT 2 (middle to early Pleistocene) -** Poorly sorted, moderately permeable, reddish-brown, interfingered strandline, beach, estuarine and colluvial deposits composed of siltstone, sandstone and conglomerate. These deposits rest on the 190-194 m Flores Hill terrace.

Tsc
Tscu **SCRIPPS FORMATION (middle Eocene) -** The Scripps Formation (Tsc) is mostly pale-yellowish -brown, medium grained sandstone containing occasional cobble-conglomerate interbeds. It contains a middle Eocene Molluscan fauna (Givens and Kennedy, 1979). The Scripps Formation is 56 m thick at its type section, which is 1 km north of Scripps Pier, on the north side of the mouth of Blacks Canyon (Kennedy and Moore, 1971). Both the basal contact with the Ardath Shale and the upper contact with the Friars Formation are conformable. In upper Carroll Canyon, a tongue of the Scripps Formation (Tscu) exists above an intervening part of the Stadium Conglomerate. The "upper" tongue is difficult to separate from the main body of the Scripps Formation where the Stadium Conglomerate is absent.

Mzu **METAMORPHOSED AND UNMETAMORPHOSED VOLCANIC AND SEDIMENTARY ROCKS, UNDIVIDED (Mesozoic) -** Massive cobble conglomerate with a dark-yellowish--brown, coarse-grained sandstone matrix. The conglomerate contains up to 85% of slighly metamorphosed rhyolitic to dacitic volcanic and volcaniclastic rocks and up to 20% quartzite. It yields early Uintan mammals (Walsh and others, 1996) and Tejon stage mollusks (Givens and Kennedy, 1979). The Stadium Conglomerate is 50 m thick at its type section, located between the La Jolla and La Mesa quadrangles along the northern wall of Mission Valley near the San Diego Stadium (Kennedy and Moore, 1971).

MAP SYMBOLS



Contacts - Contact between geologic units; dotted where concealed

Contacts - Contact between paralic deposits and their associated marine abrasion platorms. This contact is approximate and generally buried by 1-5 m of marine and/or nonmarine sediment

Fault - Solid where accurately located; dashed where approximately located; dotted where concealed. U - upthrown block. D - downthrown block. Arrow and number indicate direction and angle of dip of fault plane.

Anticline - Solid where accurately located; dashed where approximately located; dotted where concealed. Arrow indicates direction of axial plunge.

Syncline - Solid where accurately located; dotted where concealed. Arrow indicates direction of axial plunge.

Landslide - Arrows indicate principal direction of movement.

Fault Zone - Area of extensively sheared rock within a zone defined by multiple faults.

Strike and dip of beds

Inclined

Strike and dip of igneous joints

Inclined

Vertical

Strike and dip of metamorphic foliation

Inclined

SOURCE:

Reproduced from: Pamphlet from "Geologic Map of the San Diego 30'x60' Quadrangle, California." by Michael P. Kennedy and Siang S. Tan, 2008.

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FIGURE NUMBER
5B

PROJECT NAME
NCCS MIRAMAR PIPELINE

PROJECT NUMBER
2934

GEOLOGY MAP LEGEND

REFERENCE:

"FAULT ACTIVITY MAP OF CALIFORNIA AND ADJACENT AREAS," DIVISION OF MINES & GEOLOGY, COMPILED BY CHARLES W. JENNINGS, 1994.

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FIGURE NUMBER	6
PROJECT NAME	NCCS MIRAMAR PIPELINE
PROJECT NUMBER	2934

REGIONAL FAULT MAP

APPENDIX A

FINAL LOGS OF TEST BORING

LOGS OF EXCAVATIONS
FROM
TERRACOSTA CONSULTING GROUP
2015-16

LOG OF TEST BORING

PROJECT NAME NORTH CITY CONVEYANCE SYSTEM		**PROJECT NUMBER** 2934	**BORING** **LEGEND**
SITE LOCATION San Diego	**START** 11/7/2016	**FINISH**	**SHEET NO.** 1 of 3
DRILLING COMPANY Pacific Drilling / Ruen Drilling	**DRILLING METHOD** Auger / Core	**LOGGED BY** G. Spaulding	**CHECKED BY**
DRILLING EQUIPMENT Marl M5/ LF 70	**BORING DIA. (in)**	**TOTAL DEPTH (ft)** 60	**GROUND ELEV (ft)**
DEPTH/*ELEV.* GROUND WATER (ft) ⯵ n/a_			
SAMPLING METHOD SPT / CAL	**NOTES**		

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	WELL CONSTRUCTION	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
5										
10										
		C	1							
		S	2							
		B	3							
15		PB	4							

KEY TO EXCAVATION LOGS

WATER TABLE MEASURED AT TIME OF DRILLING

OTHER TESTS

CC	Confined Compression	PL	Acceptable Point Load Test
CL	Chloride Content	ppm	parts per million of VOCs*
CS	Consolidation	R	Resistivity
DS	Direct Shear	RV	R-Value
EI	Expansion Index	SA	Sieve Analysis
GS	Grain Size Analysis	SE	Sand Equivalent
LC	Laboratory Compaction	SF	Sulfate
pH	Hydrogen Ion	SG	Specific Gravity
PI	Plasticity Index	SW	Swell

PENETRATION RESISTANCE (BLOWS/ft)

Number of blows required to advance the sampler 1 foot.

California Sampler blow counts can be converted to equivalent SPT blow counts by using an end-area conversion factor of 0.67 when using a 140-pound hammer and a 30-inch drop.

SAMPLE TYPE

C ("California Sampler") - An 18-inch-long, 2-1/2-inch I.D., 3-inch O.D., thick-walled sampler. The sampler is lined with eighteen 2-3/8-inch I.D. brass rings. Relatively undisturbed, intact soil samples are retained in the brass rings.

S ("SPT") - a.k.a. Standard Penetration Test, an 18-inch-long, 2-inch O.D., 1-3/8-inch I.D. drive sampler.

B ("Bulk") - a.k.a. Bulk Sack Sample, a disturbed, but representative sample obtained from a specific depth interval placed in a large plastic bag.

PB ("Plastic Bag") - A disturbed, but representative sample obtained from a specific depth interval placed in a small sealable plastic bag.

ROCK CORE

Run No.: Number of the individual coring interval, starting at the top of bedrock.

Box No.: Number of the core box that contains core from the corresponding run.

Recovery, %: Amount (in percent) of core recovered from the coring interval; calculated as the length of core recovered divided by the length of the run.

THIS SUMMARY APPLIES ONLY AT THE LOCATION OF THIS BORING AND AT THE TIME OF DRILLING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF THE ACTUAL CONDITIONS ENCOUNTERED.

FIGURE A-1 a

LOG OF TEST BORING

PROJECT NAME NORTH CITY CONVEYANCE SYSTEM	**PROJECT NUMBER** 2934	**BORING** **LEGEND**	
SITE LOCATION San Diego	**START** 11/7/2016	**FINISH**	**SHEET NO.** 2 of 3
DRILLING COMPANY Pacific Drilling / Ruen Drilling	**DRILLING METHOD** Auger / Core	**LOGGED BY** G. Spaulding	**CHECKED BY**
DRILLING EQUIPMENT Marl M5/ LF 70	**BORING DIA. (in)**	**TOTAL DEPTH (ft)** 60	**GROUND ELEV (ft)**
DEPTH/*ELEV.* GROUND WATER (ft) ⯆ n/a_			
SAMPLING METHOD SPT / CAL	**NOTES**		

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	WELL CONSTRUCTION	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
25										
30										
35										

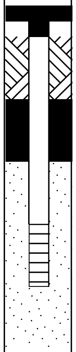
KEY TO EXCAVATION LOGS
(continued)

ROCK CORE, Continued

Frac. Freq.: (Fracture Frequency) The number of naturally occurring fractures in each foot of core; does not include mechanical breaks, which are considered to be induced by drilling.

R.Q.D., %: (Rock Quality Designation) Amount (in percent) of intact core (pieces of sound core greater than 4 inches in length) in each coring interval; calculated as the sum of the lengths of intact core divided by the length of the core run.

WELL CONSTRUCTION



Flush-mounted traffic-rated cover & locking cap

Concrete seal
Blank casing

Bentonite seal
Blank casing

Filter sand
Blank casing

Filter sand
Screened interval

filter sand

Notes on Well Construction

Wells consist of 2-inch PVC casing and screen. Surface completion is with a flush-mount traffic-rated cover and locking cap.

NOTES ON FIELD INVESTIGATION

Borings were advanced using a truck-mounted Marl M5 drill rig with an 8-inch hollow-stem auger, a limited-access track-mounted bucket rig, and an EZ Bore truck-mounted bucket rig. Core borings were advanced using a Boart-Longyear LF 70 coring rig with an HQ-size triple-barrel coring system.

Standard Penetration Tests (SPT), Californai Samplers, and Triple Tube HQ Continuous-Core samples were collected. The SPT and California Samplers were driven into the soil at the bottom of the borings with a 140-pound hammer falling 30 inches. When the samplers were withdrawn from the boring, the samples were removed, visually classified, sealed in plastic containers or core boxes, and taken to the laboratory for detailed inspection.

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San Diego, California 92123

LOG OF TEST BORING

PROJECT NAME NORTH CITY CONVEYANCE SYSTEM
PROJECT NUMBER 2934
BORING **LEGEND**
SITE LOCATION San Diego
START 11/7/2016
FINISH
SHEET NO. 3 of 3
DRILLING COMPANY Pacific Drilling / Ruen Drilling
DRILLING METHOD Auger / Core
LOGGED BY G. Spaulding
CHECKED BY
DRILLING EQUIPMENT Marl M5/ LF 70
BORING DIA. (in)
TOTAL DEPTH (ft) 60
GROUND ELEV (ft)
DEPTH/*ELEV.* GROUND WATER (ft) ⊻ n/a_
SAMPLING METHOD SPT / CAL
NOTES

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	WELL CONSTRUCTION	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
45										
50										
55										

KEY TO EXCAVATION LOGS
(continued)

NOTES ON FIELD INVESTIGATION, Continued

Free groundwater was encountered in the borings as shown on the logs.

Classifications are based upon the Unified Soil Classification System and include color, moisture, and consistency. Field descriptions have been modified to reflect results of laboratory inspection where deemed appropriate.

No evidence of contaminated soils were encountered at time of drilling.

Borings were sealed with bentonite per state and local well standards.

TCG_METRIC_LOG(2A)_W/WELL 2934LGND.GPJ GDCLOGMT.GDT 4/12/17

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THIS SUMMARY APPLIES ONLY AT THE LOCATION OF THIS BORING AND AT THE TIME OF DRILLING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF THE ACTUAL CONDITIONS ENCOUNTERED.

FIGURE A-1 c

LOG OF TEST BORING

PROJECT NAME NORTH CITY CONVEYANCE SYSTEM	**PROJECT NUMBER** 2934	**BORING** **B-1**	
SITE LOCATION San Diego	**START** 11/14/2016	**FINISH** 11/14/2016	**SHEET NO.** 1 of 1
DRILLING COMPANY Pacific Drilling	**DRILLING METHOD** Hollow Stem Auger	**LOGGED BY** G. Spaulding	**CHECKED BY**
DRILLING EQUIPMENT Marl M5	**BORING DIA. (in)** 8	**TOTAL DEPTH (ft)** 19.5	**GROUND ELEV (ft)** 371
SAMPLING METHOD SPT	**NOTES** LOCATION: EASTGATE MALL. HOLE BACKFILLED/SEALED W/BENTONITE PER COUNTY/STATE WELL STANDARDS.	**DEPTH/*ELEV.* GROUND WATER (ft)** ⊻ n/a_	

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
								▨	TERRACE DEPOSITS (Qvop9) **Silty to Fine Sandy CLAY (CL)**, stiff, light-brown, damp
	370							▨	
								▨	**Silty CLAY)**, hard, mottled gray / yellow-brown, damp
5								▨	
	365	S	1	55		20.7		▨	
		PB	2				pH R CL SF GS	▨	
10		S	3	72			PI	▨	
								░	**Silty SAND (SM)**, dense to very dense, mottled gray / red, damp
	360							░	
15								░	
								▒	**Fine Sandy SILT (ML) to Silty Fine SAND (SM)**, hard, mottled gray / red, damp
	355	S	4	72				▒	
		S	5	95/9"			pH R CL SF GS	▒	
									Boring terminated at depth of 19.5'. No free groundwater encountered.

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THIS SUMMARY APPLIES ONLY AT THE LOCATION OF THIS BORING AND AT THE TIME OF DRILLING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF THE ACTUAL CONDITIONS ENCOUNTERED.

FIGURE A-2

LOG OF TEST BORING

PROJECT NAME NORTH CITY CONVEYANCE SYSTEM		**PROJECT NUMBER** 2934	**BORING** **B-2**
SITE LOCATION San Diego	**START** 11/14/2016	**FINISH** 11/14/2016	**SHEET NO.** 1 of 1
DRILLING COMPANY Pacific Drilling	**DRILLING METHOD** Hollow Stem Auger	**LOGGED BY** G. Spaulding	**CHECKED BY**
DRILLING EQUIPMENT Marl M5	**BORING DIA. (in)** 8	**TOTAL DEPTH (ft)** 19.5	**GROUND ELEV (ft)** 381
DEPTH/*ELEV.* GROUND WATER (ft) ⊻ n/a_			
SAMPLING METHOD SPT	**NOTES** LOCATION: EASTGATE MALL. BORING SEALED PER COUNTY/STATE WELL STANDARDS.		

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	380							▨	FILL **Sandy CLAY (CL)**, soft, gray, dry
									TERRACE DEPOSITS (Qvop9) **Fine Sandy SILT (ML) to Silty Fine SAND (SM)**, very stiff, mottled gray / red / yellow, damp
5									
	375	S	1	25		24.0			
10									
	370	S	2	40					
									- Seepage at approx. 13 to 14.5 feet - Gray-brown color
15									
	365	S	3	40		22.0			
		S	4	67					
									Boring terminated at depth of 19.5'. No free groundwater encountered.

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THIS SUMMARY APPLIES ONLY AT THE LOCATION OF THIS BORING AND AT THE TIME OF DRILLING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF THE ACTUAL CONDITIONS ENCOUNTERED.

FIGURE A-3

LOG OF TEST BORING

PROJECT NAME NORTH CITY CONVEYANCE SYSTEM	**PROJECT NUMBER** 2934	**BORING** **TB-1a**	
SITE LOCATION San Diego	**START** 11/18/2016	**FINISH** 11/18/2016	**SHEET NO.** 1 of 2
DRILLING COMPANY Pacific Drilling	**DRILLING METHOD** Highway Auger	**LOGGED BY** G. Spaulding	**CHECKED BY**
DRILLING EQUIPMENT Badger	**BORING DIA. (in)** 24	**TOTAL DEPTH (ft)** 31	**GROUND ELEV (ft)** 386
DEPTH/*ELEV.* GROUND WATER (ft) ▽ n/a_			
SAMPLING METHOD	**NOTES** LOCATION: EASTGATE MALL. BORING SEALED PER COUNTY/STATE WELL STANDARDS.		

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	385								FILL **Clayey SAND to Sandy CLAY (SC-CL)**, loose to medium dense, gray to gray-brown, dry
									TERRACE DEPOSITS (Qovp9) **Silty SAND (SM)**, medium dense, brown, damp
									Silty to Clayey SAND (SM-SC), medium dense, light brown to yellow brown, damp
5	380	PB	1			8.1	-200 PI GS		
									Silty SAND (SC), dense, yellow-brown to red-brown, damp - Gravel and cobble layer approx 8" to 9" from 9.5 to 11 feet
10	375	PB	2			8.3			- Plastic bag sample recovered from 10 to 11 feet
									- Mottled gray-brown to red-brown in color
15	370	PB	3			12.2	-200		- Trace of gravel to approx 3/4"

FIGURE A-4 a

LOG OF TEST BORING

PROJECT NAME NORTH CITY CONVEYANCE SYSTEM	**PROJECT NUMBER** 2934	**BORING** **TB-1a**	
SITE LOCATION San Diego	**START** 11/18/2016	**FINISH** 11/18/2016	**SHEET NO.** 2 of 2
DRILLING COMPANY Pacific Drilling	**DRILLING METHOD** Highway Auger	**LOGGED BY** G. Spaulding	**CHECKED BY**
DRILLING EQUIPMENT Badger	**BORING DIA. (in)** 24	**TOTAL DEPTH (ft)** 31	**GROUND ELEV (ft)** 386
DEPTH/*ELEV.* GROUND WATER (ft) ⊻ n/a_			
SAMPLING METHOD	**NOTES** LOCATION: EASTGATE MALL. BORING SEALED PER COUNTY/STATE WELL STANDARDS.		

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	365	PB	4				pH R CL SF GS	▨	
25	360	PB	5			11.4	-200 PI GS	▨	- Plastic bag sample recovered from 25 to 26 feet - Becomes light brown in color
30	355	PB	6					▨	*Boring terminated at depth of 31 feet.* *No free groundwater encountered at time of excavation.*
35	350								

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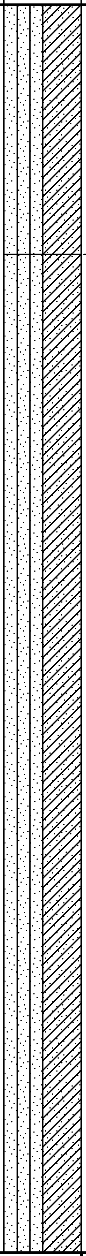
FIGURE A-4 b

LOG OF TEST BORING

PROJECT NAME NORTH CITY CONVEYANCE SYSTEM	**PROJECT NUMBER** 2934	**BORING** **TB-1b**	
SITE LOCATION San Diego	**START** 11/18/2016	**FINISH** 11/18/2016	**SHEET NO.** 1 of 2
DRILLING COMPANY Pacific Drilling	**DRILLING METHOD** Highway Auger	**LOGGED BY** G. Spaulding	**CHECKED BY**
DRILLING EQUIPMENT Badger	**BORING DIA. (in)** 24	**TOTAL DEPTH (ft)** 31	**GROUND ELEV (ft)** 384
DEPTH/*ELEV.* GROUND WATER (ft) ⊻ n/a_			
SAMPLING METHOD	**NOTES** LOCATION: EASTGATE MALL. BORING SEALED PER COUNTY/STATE WELL STANDARDS.		



DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
									FILL **Silty to Clayey SAND (SM-SC)**, loose to medium dense, gray to gray-brown, dry to damp, with gravel and cobble approx 10% to 9"
	380								TERRACE DEPOSITS (Qvop9) **Silty to Clayey SAND (SM-SC)**, medium dense, light brown, damp, with occasional gravel to approx 3/4"
5		PB	1			7.9	-200 PI GS		
	375								- Gravel and cobble to 9" from 9 to 10 feet
10		PB	2				-200		- Becomes mottled gray-brown / red-brown in color
	370								
15		PB	3			9.9	-200 PI		
	365								- Cemented zone

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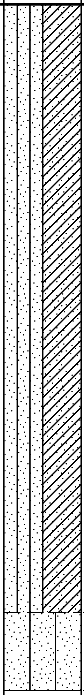
FIGURE A-5 a

LOG OF TEST BORING

PROJECT NAME NORTH CITY CONVEYANCE SYSTEM		**PROJECT NUMBER** 2934		**BORING** **TB-1b**
SITE LOCATION San Diego		**START** 11/18/2016	**FINISH** 11/18/2016	**SHEET NO.** 2 of 2
DRILLING COMPANY Pacific Drilling	**DRILLING METHOD** Highway Auger		**LOGGED BY** G. Spaulding	**CHECKED BY**
DRILLING EQUIPMENT Badger	**BORING DIA. (in)** 24	**TOTAL DEPTH (ft)** 31	**GROUND ELEV (ft)** 384	**DEPTH/*ELEV.* GROUND WATER (ft)** ⊻ n/a_
SAMPLING METHOD	**NOTES** LOCATION: EASTGATE MALL. BORING SEALED PER COUNTY/STATE WELL STANDARDS.			



DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
		PB	4						
	360								
25		PB	5						- Becomes moist, gray in color
									- Occasional cemented zones
									- Hard drilling; cemented zone from 27.75 to 29.75 feet
	355								
30		PB	6						**Silty SAND (SM)**, medium dense, gray, damp
									Boring terminated at depth of 31 feet. *No free groundwater encountered at time of excavation.*
	350								
35									
	345								

TCG_METRIC_LOG(3) 2934.GPJ GDCLOGMT.GDT 4/12/17

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THIS SUMMARY APPLIES ONLY AT THE LOCATION OF THIS BORING AND AT THE TIME OF DRILLING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF THE ACTUAL CONDITIONS ENCOUNTERED.

FIGURE A-5 b

LOG OF TEST BORING

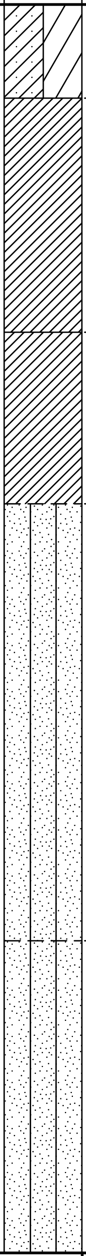
PROJECT NAME NORTH CITY CONVEYANCE SYSTEM	**PROJECT NUMBER** 2934	**BORING** **B-3**

SITE LOCATION San Diego	**START** 11/14/2016	**FINISH** 11/14/2016	**SHEET NO.** 1 of 2

DRILLING COMPANY Pacific Drilling	**DRILLING METHOD** Hollow Stem Auger	**LOGGED BY** G. Spaulding	**CHECKED BY**

DRILLING EQUIPMENT Marl M5	**BORING DIA. (in)** 8	**TOTAL DEPTH (ft)** 31.5	**GROUND ELEV (ft)** 389	**DEPTH/*ELEV.* GROUND WATER (ft)** ⊻ n/a_

SAMPLING METHOD SPT	**NOTES** LOCATION: EASTGATE MALL. BORING SEALED PER COUNTY/STATE WELL STANDARDS.



DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
									FILL **Sandy CLAY to Clayey SAND (SC-CL)**, loose, gray to gray-brown, dry, with gravel approx 15% to 3/4"
									RESIDUUM **Sandy CLAY (CL)**, very stiff, red-brown, dry to damp
	385								
5									- Becomes gray-brown with gravel
		S	1	50/6"		16.7	-200 PI GS		- Very hard drilling; cemented zone TERRACE DEPOSITS (Qvop9) **Silty CLAY (CL)**, hard, light brown, dry to damp, calcium carbonate cementation
									SAND (SM), dense, gray-brown to gray, damp
	380								
10									
		S	2	43		9.6	-200		
		PB	3			9.3	-200 PI GS		- Gravels to 1"
	375								
15									**Silty SAND (SM)**, very dense, mottled red-brown / gray, damp
		S	4	50					
	370								

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FIGURE A-6 a

LOG OF TEST BORING

PROJECT NAME NORTH CITY CONVEYANCE SYSTEM	**PROJECT NUMBER** 2934	**BORING** **B-3**	
SITE LOCATION San Diego	**START** 11/14/2016	**FINISH** 11/14/2016	**SHEET NO.** 2 of 2
DRILLING COMPANY Pacific Drilling	**DRILLING METHOD** Hollow Stem Auger	**LOGGED BY** G. Spaulding	**CHECKED BY**
DRILLING EQUIPMENT Marl M5	**BORING DIA. (in)** 8	**TOTAL DEPTH (ft)** 31.5	**GROUND ELEV (ft)** 389
DEPTH/*ELEV.* GROUND WATER (ft) ▼ n/a_			
SAMPLING METHOD SPT	**NOTES** LOCATION: EASTGATE MALL. BORING SEALED PER COUNTY/STATE WELL STANDARDS.		

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
		S	5	53					
		PB	6				pH R CL SF GS		
	365								
25									
		S	7	93/10"					- Cemented gravels to approx 2"
									- Gravels to approx 1"
	360								
30									
		S	8	70/9"					
									Boring terminated at depth of 31.5 feet. *No free groundwater encountered at time of excavation.*
	355								
35									
	350								

FIGURE A-6 b

LOG OF TEST BORING

PROJECT NAME NORTH CITY CONVEYANCE SYSTEM			**PROJECT NUMBER** 2934		**BORING** **B-4**
SITE LOCATION San Diego		**START** 11/7/2016	**FINISH** 11/7/2016		**SHEET NO.** 1 of 2
DRILLING COMPANY Pacific Drilling	**DRILLING METHOD** Hollow Stem Auger		**LOGGED BY** G. Spaulding		**CHECKED BY**
DRILLING EQUIPMENT Marl M5	**BORING DIA. (in)** 8	**TOTAL DEPTH (ft)** 25.5	**GROUND ELEV (ft)** 398	**DEPTH/*ELEV.* GROUND WATER (ft)** ▼ n/a_	
SAMPLING METHOD SPT/Cal	**NOTES** LOCATION: MIRAMAR ROAD. BORING SEALED PER COUNTY/STATE WELL STANDARDS.				

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
								■	11" Asphalt Concrete
								●	BASE **Sandy GRAVEL (GW)**, olive-gray, damp
	395							▧	TERRACE DEPOSITS (Qvop9) **Sandy CLAY (CL/CH)**, hard, olive-brown, damp, with gravel approx 10% to 1" - On rock, no recovery
5		S	1	35/5"				▨	**Clayey SAND (SC)**, hard, yellow-brown, dry, with gravel approx 10% to approx 1"
	390							▨	
								▧	**Sandy CLAY (CL-CH)**, hard, yellow-brown, damp
10								▧	
		S	2	41		12.0	-200 PI	▧	
	385							▧	
15								▧	
		C	3	82/11"			pH R CL SF GS	▧	
								▨	**Clayey SAND (SC)**, dense, yellow-brown, damp, with occasional gravel
	380							▨	

THIS SUMMARY APPLIES ONLY AT THE LOCATION OF THIS BORING AND AT THE TIME OF DRILLING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF THE ACTUAL CONDITIONS ENCOUNTERED.

FIGURE A-7 a

LOG OF TEST BORING

PROJECT NAME NORTH CITY CONVEYANCE SYSTEM	**PROJECT NUMBER** 2934	**BORING** **B-4**	
SITE LOCATION San Diego	**START** 11/7/2016	**FINISH** 11/7/2016	**SHEET NO.** 2 of 2
DRILLING COMPANY Pacific Drilling	**DRILLING METHOD** Hollow Stem Auger	**LOGGED BY** G. Spaulding	**CHECKED BY**
DRILLING EQUIPMENT Marl M5	**BORING DIA. (in)** 8	**TOTAL DEPTH (ft)** 25.5	**GROUND ELEV (ft)** 398
DEPTH/*ELEV.* GROUND WATER (ft) ⊻ n/a_			
SAMPLING METHOD SPT/Cal	**NOTES** LOCATION: MIRAMAR ROAD. BORING SEALED PER COUNTY/STATE WELL STANDARDS.		

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
		S	4	42				▨	
	375							▨	
25		C	5	50/6"				▨	
									Boring terminated at depth of 25.5 feet. *No free groundwater encountered at time of excavation.*
	370								
30									
	365								
35									
	360								

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FIGURE A-7 b

LOG OF TEST BORING

PROJECT NAME NORTH CITY CONVEYANCE SYSTEM	**PROJECT NUMBER** 2934	**BORING** **B-5**		
SITE LOCATION San Diego	**START** 11/7/2016	**FINISH** 11/7/2016	**SHEET NO.** 1 of 2	
DRILLING COMPANY Pacific Drilling	**DRILLING METHOD** Hollow Stem Auger	**LOGGED BY** G. Spaulding	**CHECKED BY**	
DRILLING EQUIPMENT Marl M5	**BORING DIA. (in)** 8	**TOTAL DEPTH (ft)** 21.5	**GROUND ELEV (ft)** 402	**DEPTH/*ELEV.* GROUND WATER (ft)** ▽ n/a_
SAMPLING METHOD SPT	**NOTES** LOCATION: MIRAMAR ROAD. BORING SEALED PER COUNTY/STATE WELL STANDARDS.			

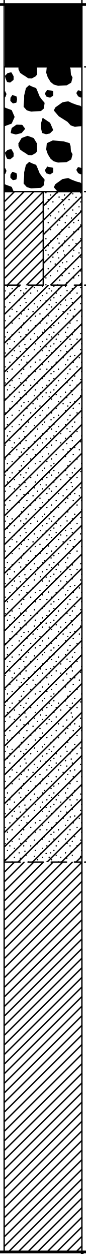
DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
									11" to 12" Asphalt Concrete
									<u>BASE</u> **Sandy GRAVEL (GW)**, olive-gray, damp
	400								
									<u>TERRACE DEPOSITS (Qvop9)</u> **Sandy CLAY (CL)**, very stiff to hard, gray-brown, damp, and **Clayey SAND (SC)**, dense, red-brown, damp, with gravels
									Clayey SAND (SC), very dense, yellow-brown, dry, with gravel approx 10% to 1"
5									
		S	1	77		6.4	-200 PI GS		
	395								
									- Increased gravel to approx 20% - Becomes gray-brown
10									
		S	2	62/8"					
									- Gravels approx 25-30% to 1"
	390								
		PB	3				pH R CL SF GS		
									Sandy CLAY (CL), hard, olive-brown to yellow-brown, damp to moist
15									
		S	4	74					- On rock; poor recovery
	385								
		PB	5						

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FIGURE A-8 a

LOG OF TEST BORING

PROJECT NAME NORTH CITY CONVEYANCE SYSTEM	**PROJECT NUMBER** 2934	**BORING** **B-5**		
SITE LOCATION San Diego	**START** 11/7/2016	**FINISH** 11/7/2016	**SHEET NO.** 2 of 2	
DRILLING COMPANY Pacific Drilling	**DRILLING METHOD** Hollow Stem Auger	**LOGGED BY** G. Spaulding	**CHECKED BY**	
DRILLING EQUIPMENT Marl M5	**BORING DIA. (in)** 8	**TOTAL DEPTH (ft)** 21.5	**GROUND ELEV (ft)** 402	**DEPTH/*ELEV.* GROUND WATER (ft)** ▼ n/a_
SAMPLING METHOD SPT	**NOTES** LOCATION: MIRAMAR ROAD. BORING SEALED PER COUNTY/STATE WELL STANDARDS.			

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
		S	6	52				▨	Becomes interbedded, orange-gray **Clayey SAND (SC)**
	380								*Boring terminated at depth of 21.5 feet.* *No free groundwater encountered at time of excavation.*
25									
	375								
30									
	370								
35									
	365								

FIGURE A-8 b

LOG OF TEST BORING

PROJECT NAME NORTH CITY CONVEYANCE SYSTEM		**PROJECT NUMBER** 2934		**BORING** **B-6**
SITE LOCATION San Diego	**START** 11/7/2016	**FINISH** 11/7/2016		**SHEET NO.** 1 of 2
DRILLING COMPANY Pacific Drilling	**DRILLING METHOD** Hollow Stem Auger	**LOGGED BY** G. Spaulding		**CHECKED BY**
DRILLING EQUIPMENT Marl M5	**BORING DIA. (in)** 8	**TOTAL DEPTH (ft)** 31.5	**GROUND ELEV (ft)** 403	**DEPTH/*ELEV.* GROUND WATER (ft)** ▼ n/a_
SAMPLING METHOD SPT	**NOTES** LOCATION: MIRAMAR ROAD. HOLE BACKFILLED/SEALED PER COUNTY/STATE WELL STANDARDS.			

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
									2" to 3" Asphalt Concrete
									BASE **Sandy GRAVEL (GW)**, olive-gray, damp
									FILL **Clayey SAND (SC)**,loose, yellow-brown to olive-brown, damp to moist, with gravel approx 15% to 1"
	400								
									Sandy CLAY (CL), stiff, dark gray, moist, with occasional gravel
5									
		S	1	8		12.2			- Organic smell
	395								
10									
		PB	2				pH R CL SF GS		- On rock, no drive sample - gravels approx 10%
									TERRACE DEPOSITS (Qvop8) **Silty SAND (SM)**, very dense, mottled gray / orange, dry, with gravel approx 25-30% to 1.5"
	390								
									- Becomes brown-gray
15									
		S	3	30/16"			-200		
	385								

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FIGURE A-9 a

LOG OF TEST BORING

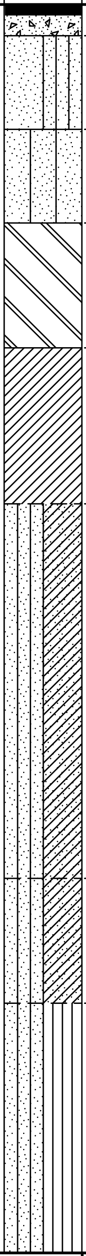
PROJECT NAME NORTH CITY CONVEYANCE SYSTEM	**PROJECT NUMBER** 2934	**BORING** **B-6**	
SITE LOCATION San Diego	**START** 11/7/2016	**FINISH** 11/7/2016	**SHEET NO.** 2 of 2
DRILLING COMPANY Pacific Drilling	**DRILLING METHOD** Hollow Stem Auger	**LOGGED BY** G. Spaulding	**CHECKED BY**
DRILLING EQUIPMENT Marl M5	**BORING DIA. (in)** 8	**TOTAL DEPTH (ft)** 31.5	**GROUND ELEV (ft)** 403
DEPTH/*ELEV.* GROUND WATER (ft) ⊻ n/a_			
SAMPLING METHOD SPT	**NOTES** LOCATION: MIRAMAR ROAD. HOLE BACKFILLED/SEALED PER COUNTY/STATE WELL STANDARDS.		

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
		S	4	49					- Poor recovery; rock in sampler
									Sandy CLAY (CL), stiff, mottled gray, yellow-brown, moist
	380	PB	5						
25									
		S	6	8					
	375								
									Silty SAND (SM), dense, gray / gray-brown, damp to moist
30									
		S	7	30					
									Boring terminated at depth of 31.5 feet. *No free groundwater encountered at time of excavation.*
	370								
35									
	365								

FIGURE A-9 b

LOG OF TEST BORING

PROJECT NAME NORTH CITY CONVEYANCE SYSTEM	**PROJECT NUMBER** 2934	**BORING** **B-21**	
SITE LOCATION San Diego	**START** 11/10/2016	**FINISH** 11/11/2016	**SHEET NO.** 1 of 2
DRILLING COMPANY Pacific Drilling	**DRILLING METHOD** Highway Auger	**LOGGED BY** G. Spaulding	**CHECKED BY**
DRILLING EQUIPMENT Badger	**BORING DIA. (in)** 18	**TOTAL DEPTH (ft)** 25	**GROUND ELEV (ft)** 419
DEPTH/*ELEV.* GROUND WATER (ft) ▼ n/a_			
SAMPLING METHOD Bulk Samples	**NOTES** LOCATION: MIRAMAR ROAD. BORING SEALED PER COUNTY/STATE WELL STANDARDS.		



DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	DESCRIPTION AND CLASSIFICATION
								2" Asphalt Concrete / Class II Base
								BASE **Gravelly SAND (SP-SM)**, medium dense, olive-gray, damp
								FILL **Silty SAND (SM???)**, medium dense, olive-gray to yellow-brown, damp, with gravel approx 10%
	415	B	1			24.7	-200 PI	RESIDUUM **Sandy CLAY (CL-CH)**, medium stiff, olive-gray, moist
5								- Gravel & cobble to 6"
		PB	2					TERRACE DEPOSITS (Qvop8) **Sandy CLAY (CL)**, hard, red-brown to light brown, dry
								- Cemented zone from 5.5 to 8 feet; harder drilling; cemented with calcium carbonate
								Silty to Clayey SAND (SM-SC), very dense, red-brown, dry, with gravel approx 30% to 1.5" and occasional cobble to 4"
	410							
10		B	3				pH R CL SF GS	- Becomes damp
								- Occasional cobble to 6"
	405							**Silty to Clayey SAND (SM-SC)**, dense, light red-brown, damp, with occasional gravel and cobble to 8"
15								
		B	4			23.3	-200 PI	**Fine Sandy SILT (SM-ML)**, dense, light brown, moist
	400							

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LOG OF TEST BORING

PROJECT NAME NORTH CITY CONVEYANCE SYSTEM	**PROJECT NUMBER** 2934	**BORING** **B-21**		
SITE LOCATION San Diego	**START** 11/10/2016	**FINISH** 11/11/2016	**SHEET NO.** 2 of 2	
DRILLING COMPANY Pacific Drilling	**DRILLING METHOD** Highway Auger	**LOGGED BY** G. Spaulding	**CHECKED BY**	
DRILLING EQUIPMENT Badger	**BORING DIA. (in)** 18	**TOTAL DEPTH (ft)** 25	**GROUND ELEV (ft)** 419	**DEPTH/*ELEV.* GROUND WATER (ft)** ⊻ n/a_
SAMPLING METHOD Bulk Samples	**NOTES** LOCATION: MIRAMAR ROAD. BORING SEALED PER COUNTY/STATE WELL STANDARDS.			

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
								▨	**Clayey SAND (SC)**, stiff, light brown, moist
	395	B	5					▨	
25									*Boring terminated at depth of 25 feet.* *No free groundwater encountered at time of excavation.*
	390								
30									
	385								
35									
	380								

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FIGURE A-10 b

LOG OF TEST BORING

PROJECT NAME NORTH CITY CONVEYANCE SYSTEM	**PROJECT NUMBER** 2934	**BORING** **B-7**	
SITE LOCATION San Diego	**START** 11/6/2016	**FINISH** 11/7/2016	**SHEET NO.** 1 of 2
DRILLING COMPANY Pacific Drilling	**DRILLING METHOD** Hollow Stem Auger	**LOGGED BY** G. Spaulding	**CHECKED BY**
DRILLING EQUIPMENT Marl M5	**BORING DIA. (in)** 8	**TOTAL DEPTH (ft)** 30.5	**GROUND ELEV (ft)** 423
DEPTH/*ELEV.* GROUND WATER (ft) ⊻ n/a_			
SAMPLING METHOD SPT/Cal	**NOTES** LOCATION: MIRAMAR ROAD. BORING SEALED PER COUNTY/STATE WELL STANDARDS.		

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	DESCRIPTION AND CLASSIFICATION
								9" Asphalt Concrete
								FILL **Sandy CLAY (CL-CH)**, stiff, mottled red-brown, damp
	420							
								TERRACE DEPOSITS (Qvop9) **Sandy CLAY (CL)**, very stiff to hard, red-brown, dry, with gravels approx 10%
5		S	1	60/10"		5.8	-200 PI GS	
		B	2			6.9	-200 GS	- Sampler on rock
								Sandy CLAY (CL), hard, gray to brown gray, dry, cemented calcium carbonate
	415							
10								
		C	3	72/7"				- On rock
	410							- Gravels 10% to 1"
15								
		S	4	30/4"				- On rock - Very hard drilling on gravel and cobble
		PB	5				pH R CL SF GS	
	405							

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THIS SUMMARY APPLIES ONLY AT THE LOCATION OF THIS BORING AND AT THE TIME OF DRILLING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF THE ACTUAL CONDITIONS ENCOUNTERED.

FIGURE A-11 a

LOG OF TEST BORING

PROJECT NAME NORTH CITY CONVEYANCE SYSTEM			**PROJECT NUMBER** 2934		**BORING** **B-7**
SITE LOCATION San Diego		**START** 11/6/2016	**FINISH** 11/7/2016		**SHEET NO.** 2 of 2
DRILLING COMPANY Pacific Drilling	**DRILLING METHOD** Hollow Stem Auger		**LOGGED BY** G. Spaulding		**CHECKED BY**
DRILLING EQUIPMENT Marl M5	**BORING DIA. (in)** 8	**TOTAL DEPTH (ft)** 30.5	**GROUND ELEV (ft)** 423	**DEPTH/*ELEV.* GROUND WATER (ft)** ▼ n/a_	
SAMPLING METHOD SPT/Cal	**NOTES** LOCATION: MIRAMAR ROAD. BORING SEALED PER COUNTY/STATE WELL STANDARDS.				

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
		S	6	37				▨	**Sandy CLAY (CL)**, hard, yellow-brown, damp
	400							▨	
25								▨	
		S	7	30/3"				▨	- On rock; no recovery
		PB	8					▨	**Sandy CLAY (CL)**, very stiff, olive-gray, damp
	395							▨	
								▨	- Very hard drilling in gravels
30								▨	
		S	9	50/4"				▨	
									Boring terminated at depth of 30.5 feet. *No free groundwater encountered at time of excavation.*
	390								
35									
	385								

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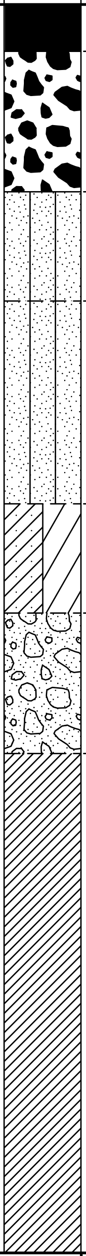
FIGURE A-11 b

LOG OF TEST BORING

PROJECT NAME NORTH CITY CONVEYANCE SYSTEM		**PROJECT NUMBER** 2934		**BORING** **B-8**
SITE LOCATION San Diego	**START** 11/7/2016	**FINISH** 11/8/2016		**SHEET NO.** 1 of 2
DRILLING COMPANY Pacific Drilling	**DRILLING METHOD** Hollow Stem Auger	**LOGGED BY** G. Spaulding		**CHECKED BY**
DRILLING EQUIPMENT Marl M5	**BORING DIA. (in)** 8	**TOTAL DEPTH (ft)** 26.5	**GROUND ELEV (ft)** 416	**DEPTH/*ELEV.* GROUND WATER (ft)** ▼ n/a_
SAMPLING METHOD SPT	**NOTES** LOCATION: MIRAMAR ROAD. BORING SEALED PER COUNTY/STATE WELL STANDARDS.			



DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	DESCRIPTION AND CLASSIFICATION
								9" Asphalt Concrete
	415							BASE **Sandy GRAVEL (GW)**, dense, olive-gray, damp
								TERRACE DEPOSITS (Qvop8) **Silty SAND (SM)**, very dense, light brown, dry, with gravel approx 30% to 1.5"
5								**Silty SAND (SM)**, medium dense, mottled gray / orange, damp
	410	S	1	28		11.9	-200	
								Becomes **Clayey SAND to Sandy CLAY (SC-CL)**, with gravel approx 15% to 1.5"
		PB	2				pH R CL SF GS -200	
10								**Sandy GRAVEL (GP-GW)**, very dense, gray, dry to damp
	405	S	3	52		5.7		
								Sandy CLAY (CL), hard, olive-gray to yellow-brown, damp to moist, with gravel approx 25% to 1.5"
15								
	400	S	4	52				
								- Gravels

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FIGURE A-12 a

LOG OF TEST BORING

PROJECT NAME NORTH CITY CONVEYANCE SYSTEM	**PROJECT NUMBER** 2934	**BORING** **B-8**		
SITE LOCATION San Diego	**START** 11/7/2016	**FINISH** 11/8/2016	**SHEET NO.** 2 of 2	
DRILLING COMPANY Pacific Drilling	**DRILLING METHOD** Hollow Stem Auger	**LOGGED BY** G. Spaulding	**CHECKED BY**	
DRILLING EQUIPMENT Marl M5	**BORING DIA. (in)** 8	**TOTAL DEPTH (ft)** 26.5	**GROUND ELEV (ft)** 416	**DEPTH/*ELEV.* GROUND WATER (ft)** ▼ n/a_
SAMPLING METHOD SPT	**NOTES** LOCATION: MIRAMAR ROAD. BORING SEALED PER COUNTY/STATE WELL STANDARDS.			

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
		S	5	86/10"					- Gravels; poor recovery
	395								
									Silty SAND (SM), very dense, mottled gray / yellow-brown, damp with occasional gravels
25									
	390	S	6	60					
									Boring terminated at depth of 26.5 feet. *No free groundwater encountered at time of excavation.*
30									
	385								
35									
	380								

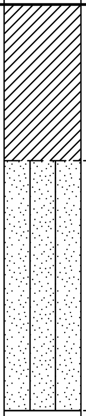

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FIGURE A-12 b

LOG OF TEST BORING

PROJECT NAME NORTH CITY CONVEYANCE SYSTEM	**PROJECT NUMBER** 2934		**BORING** **B-9**
SITE LOCATION San Diego	**START** 11/7/2016	**FINISH** 11/8/2016	**SHEET NO.** 1 of 2
DRILLING COMPANY Pacific Drilling	**DRILLING METHOD** Hollow Stem Auger	**LOGGED BY** G. Spaulding	**CHECKED BY**
DRILLING EQUIPMENT Marl M5	**BORING DIA. (in)** 8	**TOTAL DEPTH (ft)** 21.5	**GROUND ELEV (ft)** 431
DEPTH/*ELEV.* GROUND WATER (ft) ▼ n/a_			
SAMPLING METHOD SPT	**NOTES** LOCATION: MIRAMAR ROAD. BORING SEALED PER COUNTY/STATE WELL STANDARDS.		

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
									9" Asphalt Concrete
	430								FILL **Sandy GRAVEL (GP)**, dense, olive-gray, damp
									Sandy CLAY (CL), stiff, olive-brown, damp
5	425	S	1	57/11"		7.1			
									TERRACE DEPOSITS (Qvop8) **Sandy CLAY (CL)**, hard, light brown, dry, with occasional gravel
10	420	S	2	28		13.1			
		PB	3				pH R CL SF GS		
15	415	S	4	26		15.7			- Iron oxide staining

LOG OF TEST BORING

PROJECT NAME NORTH CITY CONVEYANCE SYSTEM			**PROJECT NUMBER** 2934		**BORING** **B-9**
SITE LOCATION San Diego		**START** 11/7/2016	**FINISH** 11/8/2016		**SHEET NO.** 2 of 2
DRILLING COMPANY Pacific Drilling	**DRILLING METHOD** Hollow Stem Auger		**LOGGED BY** G. Spaulding		**CHECKED BY**
DRILLING EQUIPMENT Marl M5	**BORING DIA. (in)** 8	**TOTAL DEPTH (ft)** 21.5	**GROUND ELEV (ft)** 431	**DEPTH/*ELEV.* GROUND WATER (ft)** ▼ n/a_	
SAMPLING METHOD SPT	**NOTES** LOCATION: MIRAMAR ROAD. BORING SEALED PER COUNTY/STATE WELL STANDARDS.				

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
								▨	- Gravel approx 10% to 3/4"
	410		5	47				▨	
									Boring terminated at depth of 21.5 feet. *No free groundwater encountered at time of excavation.*
25									
	405								
30									
	400								
35									
	395								

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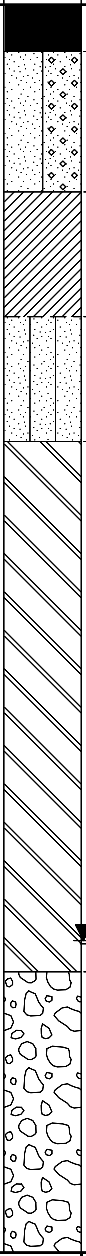
FIGURE A-13 b

LOG OF TEST BORING

PROJECT NAME NORTH CITY CONVEYANCE SYSTEM	**PROJECT NUMBER** 2934	**BORING** **B-10**	
SITE LOCATION San Diego	**START** 11/8/2016	**FINISH** 11/8/2016	**SHEET NO.** 1 of 2
DRILLING COMPANY Pacific Drilling	**DRILLING METHOD** Hollow Stem Auger	**LOGGED BY** G. Spaulding	**CHECKED BY**
DRILLING EQUIPMENT Marl M5	**BORING DIA. (in)** 8	**TOTAL DEPTH (ft)** 25.5	**GROUND ELEV (ft)** 432
DEPTH/*ELEV.* GROUND WATER (ft) ⊻ 15.0 / *417.0*			
SAMPLING METHOD SPT	**NOTES** LOCATION: MIRAMAR ROAD. BORING SEALED PER COUNTY/STATE WELL STANDARDS.		



DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	DESCRIPTION AND CLASSIFICATION
								9" Asphalt Concrete
								BASE **Gravelly SAND (SP-SW)**, dense, olive-gray, damp
	430							
								FILL **Sandy CLAY (CL)**, medium stiff, red to red-brown, moist
5		S	1	9		11.6	-200 PI	**Silty SAND (SM)**, loose to medium dense, mottled red / red-brown / brown, damp, with gravel approx 15% to 1/2"
	425							ALLUVIUM **Sandy CLAY (CL-CH)**, medium stiff, dark gray, moist, with gravel approx 10% to 1"
10								
		PB	2				pH R CL SF GS	
	420							
15								⊻ - Heavy seepage
		S	3	24				STADIUM CONGLOMERATE (Tst) **Sandy GRAVEL (GP)**, medium dense, gray, wet, gravel to approx 1½"
	415							- Very hard drilling with gravels

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LOG OF TEST BORING

PROJECT NAME NORTH CITY CONVEYANCE SYSTEM		**PROJECT NUMBER** 2934	**BORING** **B-10**
SITE LOCATION San Diego	**START** 11/8/2016	**FINISH** 11/8/2016	**SHEET NO.** 2 of 2
DRILLING COMPANY Pacific Drilling	**DRILLING METHOD** Hollow Stem Auger	**LOGGED BY** G. Spaulding	**CHECKED BY**
DRILLING EQUIPMENT Marl M5	**BORING DIA. (in)** 8	**TOTAL DEPTH (ft)** 25.5	**GROUND ELEV (ft)** 432
DEPTH/*ELEV.* GROUND WATER (ft) ⊻ 15.0 / *417.0*			
SAMPLING METHOD SPT	**NOTES** LOCATION: MIRAMAR ROAD. BORING SEALED PER COUNTY/STATE WELL STANDARDS.		

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			4	54/8"		15.7			Interbedded **Sandy GRAVEL (GP) and Gravelly SAND (SP)**, very dense, gray, moist, rocks to approx 1½"
	410								
25			5	24/5"					- On rock
									Boring terminated at depth of 25.5 feet. *Groundwater encountered at depth of 15 feet at time of excavation.*
	405								
30									
	400								
35									
	395								

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FIGURE A-14 b

LOG OF TEST BORING

PROJECT NAME NORTH CITY CONVEYANCE SYSTEM		**PROJECT NUMBER** 2934		**BORING** **B-11**	
SITE LOCATION San Diego		**START** 11/8/2016	**FINISH** 11/8/2016	**SHEET NO.** 1 of 2	
DRILLING COMPANY Pacific Drilling	**DRILLING METHOD** Hollow Stem Auger		**LOGGED BY** G. Spaulding	**CHECKED BY**	
DRILLING EQUIPMENT Marl M5	**BORING DIA. (in)** 8	**TOTAL DEPTH (ft)** 20.5	**GROUND ELEV (ft)** 446.5	**DEPTH/*ELEV.* GROUND WATER (ft)** ⊻ n/a_	
SAMPLING METHOD SPT	**NOTES** LOCATION: MIRAMAR ROAD. BORING SEALED PER COUNTY/STATE WELL STANDARDS.				

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
									11" to 12" Asphalt Concrete
	445								<u>BASE</u> **Gravelly SAND (SP-SW)**, dense, olive-gray, damp
									<u>TERRACE DEPOSITS (Qvop7)</u> **Sandy CLAY (CL)**, stiff, red-brown, damp to moist
5									**Sandy CLAY (CL)**, dense, mottled gray / red / red-brown, damp, with gravel approx 15% to 1½"
		S	1	38		10.9	-200 PI GS		
	440								
		PB	2				pH R CL SF GS		
10									
									- On rock; no sample - Hard drilling in gravels to approx 1"
	435								
									Sandy CLAY to Clayey SAND (SC-CL), hard, red-brown, damp, with gravel approx 10% to 1"
15									
		PB	3						
	430								

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FIGURE A-15 a

LOG OF TEST BORING

PROJECT NAME NORTH CITY CONVEYANCE SYSTEM		**PROJECT NUMBER** 2934		**BORING** **B-11**
SITE LOCATION San Diego	**START** 11/8/2016	**FINISH** 11/8/2016		**SHEET NO.** 2 of 2
DRILLING COMPANY Pacific Drilling	**DRILLING METHOD** Hollow Stem Auger	**LOGGED BY** G. Spaulding		**CHECKED BY**
DRILLING EQUIPMENT Marl M5	**BORING DIA. (in)** 8	**TOTAL DEPTH (ft)** 20.5	**GROUND ELEV (ft)** 446.5	**DEPTH/*ELEV.* GROUND WATER (ft)** ⊻ n/a_
SAMPLING METHOD SPT	**NOTES** LOCATION: MIRAMAR ROAD. BORING SEALED PER COUNTY/STATE WELL STANDARDS.			

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
		S	4	50/6"				▨	
									Boring terminated at depth of 20.5 feet. *No free groundwater encountered at time of excavation.*
	425								
25									
	420								
30									
	415								
35									
	410								

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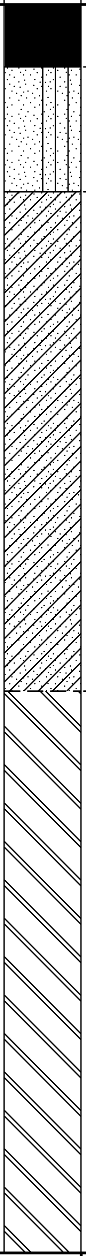
FIGURE A-15 b

LOG OF TEST BORING

PROJECT NAME NORTH CITY CONVEYANCE SYSTEM			**PROJECT NUMBER** 2934	**BORING** **B-12**
SITE LOCATION San Diego		**START** 11/9/2016	**FINISH** 11/9/2016	**SHEET NO.** 1 of 2
DRILLING COMPANY Pacific Drilling	**DRILLING METHOD** Hollow Stem Auger		**LOGGED BY** G. Spaulding	**CHECKED BY**
DRILLING EQUIPMENT Marl M5	**BORING DIA. (in)** 8	**TOTAL DEPTH (ft)** 20	**GROUND ELEV (ft)** 472	**DEPTH/*ELEV.* GROUND WATER (ft)** ⊻ n/a_
SAMPLING METHOD SPT	**NOTES** LOCATION: MIRAMAR ROAD. BORING SEALED PER COUNTY/STATE WELL STANDARDS.			

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	DESCRIPTION AND CLASSIFICATION
								12" Asphalt Concrete
								BASE **Gravelly SAND (SP-SM)**, dense, olive-gray, damp
	470							
								TERRACE DEPOSITS (Qvop7) **Clayey SAND (SC)**, very dense, light brown to yellow-brown, damp, with gravel approx 15% to 1"
5		S	1	50/6"		3.2		
	465							
		PB	2			14.8	-200 GS	
10		S	3	69/11"			pH R CL SF GS	- No recovery, collected grab sample
								Sandy CLAY (CL-CH), hard, olive-brown, damp
	460							
								- Becomes red-brown with gravel approx 10% to 1"
15		S	4	22/3"				- On rocks
		PB	5					
	455							
		S	6	50/5"				- No recovery

GRAPHIC LOG



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LOG OF TEST BORING

PROJECT NAME NORTH CITY CONVEYANCE SYSTEM		**PROJECT NUMBER** 2934	**BORING** **B-12**
SITE LOCATION San Diego	**START** 11/9/2016	**FINISH** 11/9/2016	**SHEET NO.** 2 of 2
DRILLING COMPANY Pacific Drilling	**DRILLING METHOD** Hollow Stem Auger	**LOGGED BY** G. Spaulding	**CHECKED BY**
DRILLING EQUIPMENT Marl M5	**BORING DIA. (in)** 8	**TOTAL DEPTH (ft)** 20	**GROUND ELEV (ft)** 472
DEPTH/*ELEV.* GROUND WATER (ft) ⊻ n/a_			
SAMPLING METHOD SPT	**NOTES** LOCATION: MIRAMAR ROAD. BORING SEALED PER COUNTY/STATE WELL STANDARDS.		

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
									Boring terminated at depth of 20 feet. *No free groundwater encountered at time of excavation.*
	450								
25									
	445								
30									
	440								
35									
	435								

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FIGURE A-16 b

LOG OF TEST BORING

PROJECT NAME NORTH CITY CONVEYANCE SYSTEM		**PROJECT NUMBER** 2934		**BORING** **B-13**
SITE LOCATION San Diego	**START** 11/9/2016	**FINISH** 11/9/2016		**SHEET NO.** 1 of 1
DRILLING COMPANY Pacific Drilling	**DRILLING METHOD** Hollow Stem Auger	**LOGGED BY** G. Spaulding		**CHECKED BY**
DRILLING EQUIPMENT Marl M5	**BORING DIA. (in)** 8	**TOTAL DEPTH (ft)** 19.5	**GROUND ELEV (ft)** 495	**DEPTH/*ELEV.* GROUND WATER (ft)** ⊻ n/a_
SAMPLING METHOD SPT/Cal	**NOTES** LOCATION: KEARNY VILLA ROAD. BORING SEALED PER COUNTY/STATE WELL STANDARDS.			

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
								■	9" to 10" Asphalt Concrete
								░	BASE **Gravelly SAND (SP-SM)**, dense, olive-gray, damp, gravels to 3/4"
								▨	TERRACE DEPOSITS (Qvop7) **Sandy CLAY (CL)**, stiff, yellow-brown, dry, with gravel approx 10% to 1"
5	490	S	1	20		15.1		▨	
								▨	- Becomes moist
		PB	2				pH R CL SF GS	▧	**Sandy CLAY (CL-CH)**, very stiff, red-brown, moist, with occasional gravel to approx 1"
10	485							○	- Gravel to 1.5"
		C	3	50/6"	122.9	4.8	PI	▧	**Sandy CLAY (CL-CH)**, very stiff to hard, red-brown, moist
		PB	4			14.0	-200 GS	▧	
15	480	S	5	30				▧	
		S	6	46				▧	
									Boring terminated at depth of 19.5'. No free groundwater encountered.

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FIGURE A-17

LOG OF TEST BORING

PROJECT NAME NORTH CITY CONVEYANCE SYSTEM		**PROJECT NUMBER** 2934		**BORING** **B-14**
SITE LOCATION San Diego	**START** 11/9/2016	**FINISH** 11/9/2016		**SHEET NO.** 1 of 1
DRILLING COMPANY Pacific Drilling	**DRILLING METHOD** Hollow Stem Auger	**LOGGED BY** G. Spaulding		**CHECKED BY**
DRILLING EQUIPMENT Marl M5	**BORING DIA. (in)** 8	**TOTAL DEPTH (ft)** 19.5	**GROUND ELEV (ft)** 456	**DEPTH/*ELEV.* GROUND WATER (ft)** ▼ 19.0 / *437.0*
SAMPLING METHOD SPT	**NOTES** LOCATION: CANDIDA STREET. BORING SEALED PER COUNTY/STATE WELL STANDARDS.			

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
									5" Asphalt Concrete
	455								BASE **Gravelly SAND (SP-SM)**, dense, olive-gray, damp
									FILL (derived from Stadium Conglomerate) **Sandy CLAY (CL-CH)**, very stiff to hard, yellow-brown, dry, with gravel approx 15% to 1"
5									
	450	S	1	48					
10									
	445	S	2	32					
									- Gravels
		PB	3				pH R CL SF GS		
									Sandy CLAY (CL-CH), very stiff, red-brown, damp, with gravel approx 10% to 1"
15									
	440	S	4	18					
									- No recovery; rock in sampler
		S	5	18				▼	
									Boring terminated at depth of 19.5'. Groundwater encountered at 19'.

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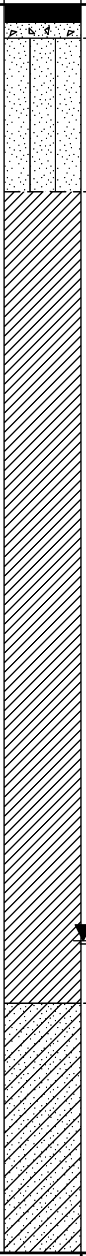
FIGURE A-18

LOG OF TEST BORING

PROJECT NAME NORTH CITY CONVEYANCE SYSTEM		**PROJECT NUMBER** 2934		**BORING** **TB-5a**
SITE LOCATION San Diego	**START** 1/10/2017	**FINISH** 1/10/2017		**SHEET NO.** 1 of 2
DRILLING COMPANY Pacific Drilling	**DRILLING METHOD** Hollow Stem Auger	**LOGGED BY** G. Spaulding		**CHECKED BY**
DRILLING EQUIPMENT Marl M5	**BORING DIA. (in)** 8	**TOTAL DEPTH (ft)** 36	**GROUND ELEV (ft)** 437	**DEPTH/*ELEV.* GROUND WATER (ft)** ▼ 15.0 / *422.0*
SAMPLING METHOD SPT	**NOTES** LOCATION: VIA PASAR. BORING SEALED PER COUNTY/STATE WELL STANDARDS.			



DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	DESCRIPTION AND CLASSIFICATION
								3.5" AC / 6.5" Class II Base
	435							FILL **Silty SAND (SM)**, medium dense, gray, damp, with approximately 20% gravel
								Sandy CLAY (CL), stiff to very stiff, mottled olive-gray / brown / dark gray, moist, with approximately 10-15% gravel
5								
		S	1	15				
	430							
10								
		S	2	10				
	425							- Becomes olive-brown in color
15								▼ - Seepage
		S	3	47				STADIUM CONGLOMERATE (Tst) **Clayey SAND (SC)**, dense, olive-gray, damp, with approximately 15% gravel up to 2"
	420							

TCG_METRIC_LOG(3) 2934.GPJ GDCLOGMT.GDT 4/12/17

LOG OF TEST BORING

PROJECT NAME NORTH CITY CONVEYANCE SYSTEM	**PROJECT NUMBER** 2934	**BORING** **TB-5a**	
SITE LOCATION San Diego	**START** 1/10/2017	**FINISH** 1/10/2017	**SHEET NO.** 2 of 2
DRILLING COMPANY Pacific Drilling	**DRILLING METHOD** Hollow Stem Auger	**LOGGED BY** G. Spaulding	**CHECKED BY**
DRILLING EQUIPMENT Marl M5	**BORING DIA. (in)** 8	**TOTAL DEPTH (ft)** 36	**GROUND ELEV (ft)** 437
DEPTH/*ELEV.* GROUND WATER (ft) ▽ 15.0 / *422.0*			
SAMPLING METHOD SPT	**NOTES** LOCATION: VIA PASAR. BORING SEALED PER COUNTY/STATE WELL STANDARDS.		

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
		S	4	50/6"				▨	**Clayey SAND (SC)**, very dense, mottled yellow-brown / yellow / light brown, damp, with approximately 30% gravel up to 2"
	415							▨	
								▨	- Gravels and cobbles up to +6"
25								▨	
		S	*					▨	* On rock; no sample
	410							▨	- Hard drilling on rock; gravel and cobbles
30								▨	
		S	*					▨	* Gravels and cobble; no sample
	405							▨	- Very hard drilling from 32 to 36 feet
35								▨	
	400								*Boring terminated at depth of 36 feet due to refusal. Groundwater seepage encountered at depth of 15 feet at time of excavation.*

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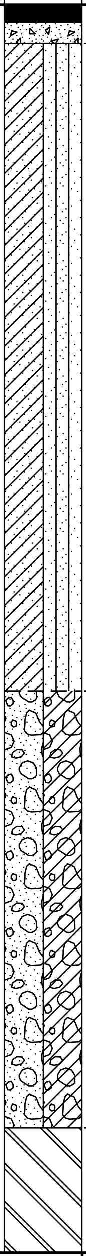
FIGURE A-19 b

LOG OF TEST BORING

PROJECT NAME NORTH CITY CONVEYANCE SYSTEM
PROJECT NUMBER 2934
BORING **TB-5b**
SITE LOCATION San Diego
START 1/10/2017
FINISH 1/10/2017
SHEET NO. 1 of 2
DRILLING COMPANY Pacific Drilling
DRILLING METHOD Hollow Stem Auger
LOGGED BY G. Spaulding
CHECKED BY
DRILLING EQUIPMENT Marl M5
BORING DIA. (in) 8
TOTAL DEPTH (ft) 22
GROUND ELEV (ft) 442
DEPTH/*ELEV.* GROUND WATER (ft) ▼ n/a_
SAMPLING METHOD SPT
NOTES LOCATION: VIA EXCELENCIA. BORING SEALED PER COUNTY/STATE WELL STANDARDS.



DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
									3½" AC / 4" Class II Base
									STADIUM CONGLOMERATE (Tst) **Silty to Clayey SAND (SC-SM)**, very dense, yellow-brown to light brown, damp, with approximately 30% gravel and cobbles
	440								
5									- Very hard drilling
		PB	1						- Sampler on rock
	435								
10		PB	2						
									Interbedded Silty SAND to Clayey SAND (SM-SC) and Sandy GRAVELS (GP-GW), very dense, yellow-brown to light olive-brown, dry to damp
	430								
15									
	425								
									WEATHERED SANTIAGO PEAK METAVOLCANICS (Mzu) **Sandy CLAY (CL-CH)**, very stiff to hard, olive-brown, damp to moist, with occasional metavolcanic rock chips

THIS SUMMARY APPLIES ONLY AT THE LOCATION OF THIS BORING AND AT THE TIME OF DRILLING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF THE ACTUAL CONDITIONS ENCOUNTERED.

FIGURE A-20 a

LOG OF TEST BORING

PROJECT NAME NORTH CITY CONVEYANCE SYSTEM

PROJECT NUMBER 2934

BORING **TB-5b**

SITE LOCATION San Diego

START 1/10/2017

FINISH 1/10/2017

SHEET NO. 2 of 2

DRILLING COMPANY Pacific Drilling

DRILLING METHOD Hollow Stem Auger

LOGGED BY G. Spaulding

CHECKED BY

DRILLING EQUIPMENT Marl M5

BORING DIA. (in) 8

TOTAL DEPTH (ft) 22

GROUND ELEV (ft) 442

DEPTH/*ELEV.* GROUND WATER (ft) ⊻ n/a_

SAMPLING METHOD SPT

NOTES
LOCATION: VIA EXCELENCIA. BORING SEALED PER COUNTY/STATE WELL STANDARDS.

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
		PB	3					▨	
		PB	4					▨	- Very hard drilling
	420								*Boring terminated at depth of 22 feet due to refusal.* *No free groundwater encountered at time of excavation.*
25									
	415								
30									
	410								
35									
	405								

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THIS SUMMARY APPLIES ONLY AT THE LOCATION OF THIS BORING AND AT THE TIME OF DRILLING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF THE ACTUAL CONDITIONS ENCOUNTERED.

FIGURE A-20 b

LOG OF TEST BORING

PROJECT NAME NORTH CITY CONVEYANCE SYSTEM	**PROJECT NUMBER** 2934	**BORING** **TB-2a**	
SITE LOCATION San Diego	**START** 11/14/2016	**FINISH** 11/14/2016	**SHEET NO.** 1 of 2
DRILLING COMPANY Pacific Drilling	**DRILLING METHOD** Hollow Stem Auger	**LOGGED BY** G. Spaulding	**CHECKED BY**
DRILLING EQUIPMENT Marl M5	**BORING DIA. (in)** 8	**TOTAL DEPTH (ft)** 33	**GROUND ELEV (ft)** 473
DEPTH/*ELEV.* GROUND WATER (ft) ⯹ n/a_			
SAMPLING METHOD SPT	**NOTES** LOCATION: VIA EXCELENCIA. BORING SEALED PER COUNTY/STATE WELL STANDARDS.		

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
									<u>FILL</u> **Sandy CLAY (CL)**, medium stiff to very stiff, brown to gray-brown, damp, with occasional gravel to 1"
	470								
5									
			1	18		11.4	PI		
									<u>TERRACE DEPOSITS (Qvop6)</u> **Silty SAND (SM)**, very dense, red-brown, dry to damp, with occasional gravel and cobble to 6"
	465								
10									
			2	80/11"			-200		
	460								
15									
			3	39		-6.0	PI		
	455								- Hard drilling on gravel and cobble <u>STADIUM CONGLOMERATE (Tst)</u> **Clayey SAND Matrix (SC)**, very dense, light gray-brown, dry

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THIS SUMMARY APPLIES ONLY AT THE LOCATION OF THIS BORING AND AT THE TIME OF DRILLING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF THE ACTUAL CONDITIONS ENCOUNTERED.

FIGURE A-21 a

# LOG OF TEST BORING	**PROJECT NAME** NORTH CITY CONVEYANCE SYSTEM		**PROJECT NUMBER** 2934	**BORING** **TB-2a**
SITE LOCATION San Diego		**START** 11/14/2016	**FINISH** 11/14/2016	**SHEET NO.** 2 of 2
DRILLING COMPANY Pacific Drilling	**DRILLING METHOD** Hollow Stem Auger		**LOGGED BY** G. Spaulding	**CHECKED BY**
DRILLING EQUIPMENT Marl M5	**BORING DIA. (in)** 8	**TOTAL DEPTH (ft)** 33	**GROUND ELEV (ft)** 473	**DEPTH/*ELEV.* GROUND WATER (ft)** ▼ n/a_
SAMPLING METHOD SPT	**NOTES** LOCATION: VIA EXCELENCIA. BORING SEALED PER COUNTY/STATE WELL STANDARDS.			

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
								▨	- Very hard drilling in gravel and cobble
		PB	4			4.2	-200	▨	
	450							▨	
25		S	5	50/4"				▨	
	445	PB	6					▨	
30								▨	
		PB	7				pH R CL SF GS	▨	
	440								*Boring terminated at depth of 33. feet due to refusal on rock.* *All teeth missing on drill bit.* *No free groundwater encountered at time of excavation.*
35									
	435								

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FIGURE A-21 b

LOG OF TEST BORING

PROJECT NAME NORTH CITY CONVEYANCE SYSTEM	**PROJECT NUMBER** 2934	**BORING** **TB-2b**	
SITE LOCATION San Diego	**START** 2/9/2017	**FINISH** 2/9/2017	**SHEET NO.** 1 of 3
DRILLING COMPANY Pacific Drilling	**DRILLING METHOD** Bucket Auger	**LOGGED BY** G. Spaulding	**CHECKED BY**
DRILLING EQUIPMENT Earth Drill	**BORING DIA. (in)** 24	**TOTAL DEPTH (ft)** 59	**GROUND ELEV (ft)** 509
DEPTH/*ELEV.* GROUND WATER (ft) ⊻ n/a_			
SAMPLING METHOD Grab	**NOTES** LOCATION: HORSE RANCH/BUSINESSPARK AVE. BORING SEALED PER COUNTY/STATE WELL STANDARDS.		

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
									TOPSOIL/TERRACE DEPOSITS **Clayey SAND (SC)**, loose to dense, brown to red-brown, moist to damp, with gravel and cobble ~20% to 6"
	505	PB	1						
5									STADIUM CONGLOMERATE **Silty to Clayey SAND (SM-SC)**, very dense, mottled light brown/gray, damp, trace of gravel
		PB	2						
	500								
10									
									- with 20% gravels to 2"
	495								
15									
									- ~30% gravel and cobble to 8"
	490								

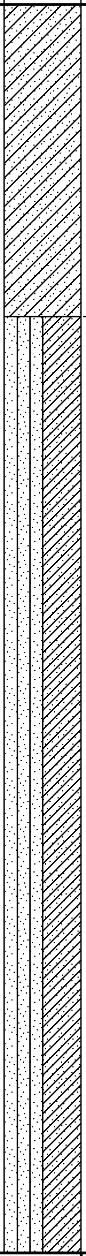

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FIGURE A-22 a

LOG OF TEST BORING

PROJECT NAME NORTH CITY CONVEYANCE SYSTEM	**PROJECT NUMBER** 2934	**BORING** **TB-2b**	
SITE LOCATION San Diego	**START** 2/9/2017	**FINISH** 2/9/2017	**SHEET NO.** 2 of 3
DRILLING COMPANY Pacific Drilling	**DRILLING METHOD** Bucket Auger	**LOGGED BY** G. Spaulding	**CHECKED BY**
DRILLING EQUIPMENT Earth Drill	**BORING DIA. (in)** 24	**TOTAL DEPTH (ft)** 59	**GROUND ELEV (ft)** 509
DEPTH/*ELEV.* GROUND WATER (ft) ⊻ n/a_			
SAMPLING METHOD Grab	**NOTES** LOCATION: HORSE RANCH/BUSINESSPARK AVE. BORING SEALED PER COUNTY/STATE WELL STANDARDS.		

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
		PB	3						
									Silty to clayey SAND (SM-SC), very dense, light brown, damp
	485	PB	4						
25									**Silty SAND (SC)**, very dense, light brown, damp, with gravel and cobble to ~6", 20%
	480								
30									
									- becomes moist
	475								
35									
		PB	5						
									Silty to Clayey SAND (SM-SC), very dense, light brown to red-brown, damp to moist, with trace of gravel
	470								

FIGURE A-22 b

LOG OF TEST BORING

PROJECT NAME NORTH CITY CONVEYANCE SYSTEM			**PROJECT NUMBER** 2934		**BORING** **TB-2b**
SITE LOCATION San Diego		**START** 2/9/2017	**FINISH** 2/9/2017		**SHEET NO.** 3 of 3
DRILLING COMPANY Pacific Drilling	**DRILLING METHOD** Bucket Auger		**LOGGED BY** G. Spaulding		**CHECKED BY**
DRILLING EQUIPMENT Earth Drill	**BORING DIA. (in)** 24	**TOTAL DEPTH (ft)** 59	**GROUND ELEV (ft)** 509	**DEPTH/*ELEV.* GROUND WATER (ft)** ▼ n/a_	
SAMPLING METHOD Grab	**NOTES** LOCATION: HORSE RANCH/BUSINESSPARK AVE. BORING SEALED PER COUNTY/STATE WELL STANDARDS.				

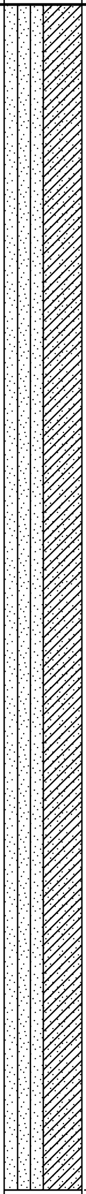
DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	465								
45									- trace of gravel
		B	6						- harder drilling - with gravel and cobble to 10" ~40 to 50% - switched to auger to drill - becomes light brown to olive-brown in color
	460								
50									
	455								
55									
		B	7						- very hard drilling in gravel and cobble ~40% to 8"±
	450								*Boring terminated at depth of 59 feet due to refusal.* *No free groundwater encountered at time of excavation.*

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FIGURE A-22 c

LOG OF TEST BORING

PROJECT NAME NORTH CITY CONVEYANCE SYSTEM			**PROJECT NUMBER** 2934	**BORING** **B-15**
SITE LOCATION San Diego		**START** 2/10/2017	**FINISH** 2/10/2017	**SHEET NO.** 1 of 2
DRILLING COMPANY Pacific Drilling	**DRILLING METHOD** Bucket Auger		**LOGGED BY** G. Spaulding	**CHECKED BY**
DRILLING EQUIPMENT Earth Drill	**BORING DIA. (in)** 24	**TOTAL DEPTH (ft)** 24.5	**GROUND ELEV (ft)** 502	**DEPTH/*ELEV.* GROUND WATER (ft)** ⊻ n/a_
SAMPLING METHOD Grab	**NOTES** LOCATION: HORSE RANCH/BUSINESSPARK AVE. BORING SEALED PER COUNTY/STATE WELL STANDARDS.			

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
								▒	TOPSOIL/TERRACE DEPOSITS **Silty SAND (SM)**, loose to medium dense, red-brown, damp
	500							▒	
								▒	STADIUM CONGLOMERATE **Silty SAND (SM)**, dense, light brown to yellow-brown, damp, wih gravel and cobble to 4" 20 - 40%
5								▒	
		PB	1					▒	
	495							▒	
								▒	- becomes dense, yellow-brown, damp, with trace of gravel
10								▒	- occasional cobbles to 8"
	490							▒	
								▒	- hard drilling; switched to auger
								▒	**Silty SAND (SM)**, very dense, yellow-brown to light brown, moist, with gravel and cobble to 10" ~10%
		PB	2					▒	
15								▒	
	485							▒	
								▒	- increased gravel and cobble to ~40%, with occasional boulder 12"+
		PB	3					▒	

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FIGURE A-23 a

LOG OF TEST BORING

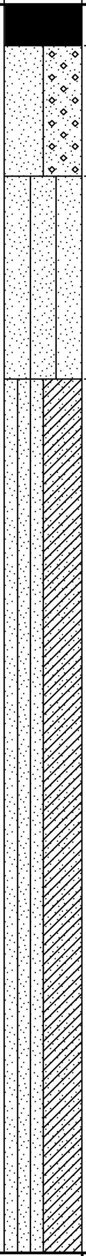
PROJECT NAME NORTH CITY CONVEYANCE SYSTEM	**PROJECT NUMBER** 2934	**BORING** **B-15**	
SITE LOCATION San Diego	**START** 2/10/2017	**FINISH** 2/10/2017	**SHEET NO.** 2 of 2
DRILLING COMPANY Pacific Drilling	**DRILLING METHOD** Bucket Auger	**LOGGED BY** G. Spaulding	**CHECKED BY**
DRILLING EQUIPMENT Earth Drill	**BORING DIA. (in)** 24	**TOTAL DEPTH (ft)** 24.5	**GROUND ELEV (ft)** 502
DEPTH/*ELEV.* GROUND WATER (ft) ⊻ n/a_	**SAMPLING METHOD** Grab	**NOTES** LOCATION: HORSE RANCH/BUSINESSPARK AVE. BORING SEALED PER COUNTY/STATE WELL STANDARDS.	

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
								▨	- hard drilling in gravel, cobble, and occasional boulders
	480							▨	
		B	4					▨	
25									*Boring terminated at depth of 24.5 feet.* *No free groundwater encountered at time of excavation.*
	475								
30									
	470								
35									
	465								

FIGURE A-23 b

LOG OF TEST BORING

PROJECT NAME NORTH CITY CONVEYANCE SYSTEM	**PROJECT NUMBER** 2934	**BORING** **B-16**	
SITE LOCATION San Diego	**START** 11/15/2016	**FINISH** 11/15/2016	**SHEET NO.** 1 of 2
DRILLING COMPANY Pacific Drilling	**DRILLING METHOD** Hollow Stem Auger	**LOGGED BY** G. Spaulding	**CHECKED BY**
DRILLING EQUIPMENT Marl M5	**BORING DIA. (in)** 8	**TOTAL DEPTH (ft)** 23	**GROUND ELEV (ft)** 500
DEPTH/*ELEV.* GROUND WATER (ft) ⊻ n/a_			
SAMPLING METHOD SPT	**NOTES** LOCATION: BUSINESSPARK AVE. BORING SEALED PER COUNTY/STATE WELL STANDARDS.		



DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
									8" Asphalt Concrete
									BASE **Gravelly SAND (SP-SW)**, dense, olive-gray, damp
									FILL **Silty SAND (SM)**, dense, light brown, damp to moist, with gravel approx 15% to 2"
		PB	1				-200 GS		
5	495								
		S	2	33		11.5	-200 GS		- Refusal on rock; hard drilling
									TERRACE DEPOSITS (Qvop5) **Silty to Clayey SAND (SM-SC)**, very dense, gray-brown to yellow-brown, dry to damp, with gravel and cobble approx 20% to approx 8"
10	490								
		S	3	35		9.2	-200		
									- Hard drilling in rock from 13 to 23 feet
15	485								
		PB	4				pH R CL SF GS		

FIGURE A-24 a

LOG OF TEST BORING

PROJECT NAME NORTH CITY CONVEYANCE SYSTEM			**PROJECT NUMBER** 2934		**BORING** **B-16**
SITE LOCATION San Diego			**START** 11/15/2016	**FINISH** 11/15/2016	**SHEET NO.** 2 of 2
DRILLING COMPANY Pacific Drilling	**DRILLING METHOD** Hollow Stem Auger		**LOGGED BY** G. Spaulding	**CHECKED BY**	
DRILLING EQUIPMENT Marl M5	**BORING DIA. (in)** 8	**TOTAL DEPTH (ft)** 23	**GROUND ELEV (ft)** 500	**DEPTH/*ELEV.* GROUND WATER (ft)** ⊻ n/a_	
SAMPLING METHOD SPT	**NOTES** LOCATION: BUSINESSPARK AVE. BORING SEALED PER COUNTY/STATE WELL STANDARDS.				

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
		PB	5					▨	- Becomes moist; brown in color
		PB	6					▨	
									Boring terminated at depth of 23 feet. *No free groundwater encountered at time of excavation.*
25	475								
30	470								
35	465								

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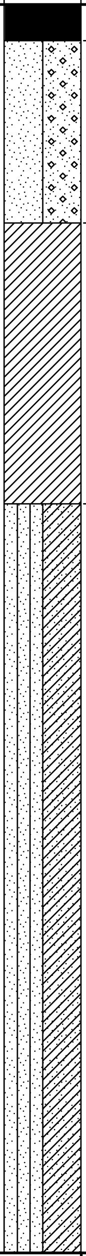
FIGURE A-24 b

LOG OF TEST BORING

PROJECT NAME NORTH CITY CONVEYANCE SYSTEM		**PROJECT NUMBER** 2934		**BORING** **B-17**
SITE LOCATION San Diego	**START** 11/16/2016	**FINISH** 11/16/2016		**SHEET NO.** 1 of 2
DRILLING COMPANY Pacific Drilling	**DRILLING METHOD** Hollow Stem Auger	**LOGGED BY** G. Spaulding		**CHECKED BY**
DRILLING EQUIPMENT Marl M5	**BORING DIA. (in)** 8	**TOTAL DEPTH (ft)** 20	**GROUND ELEV (ft)** 498	**DEPTH/*ELEV.* GROUND WATER (ft)** ⊻ n/a_
SAMPLING METHOD SPT	**NOTES** LOCATION: BUSINESSPARK AVE. BORING SEALED PER COUNTY/STATE WELL STANDARDS.			



DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	DESCRIPTION AND CLASSIFICATION
								7" Asphalt Concrete
								BASE **Silty SAND (SP-SW)**, medium dense, red-brown, damp, with gravel approx 40% to 3/4"
	495							
								TERRACE DEPOSITS (Qvop5) **Sandy CLAY (CL)**, stiff, brown to gray-brown, moist, with gravel approx 15% to 1.5"
5								
		S	1	10		13.0	-200 PI GS	
	490							- Hard drilling
								STADIUM CONGLOMERATE (Tst) **Silty to Clayey SAND matrix (SM-SC)**, very dense, gray to gray-brown, damp, gravel and cobble conglomerate
10								
		PB	2				pH R CL SF GS	
	485							
15								
	480							
		PB	3			3.5		

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FIGURE A-25 a

LOG OF TEST BORING

PROJECT NAME NORTH CITY CONVEYANCE SYSTEM	**PROJECT NUMBER** 2934	**BORING** **B-17**	
SITE LOCATION San Diego	**START** 11/16/2016	**FINISH** 11/16/2016	**SHEET NO.** 2 of 2
DRILLING COMPANY Pacific Drilling	**DRILLING METHOD** Hollow Stem Auger	**LOGGED BY** G. Spaulding	**CHECKED BY**
DRILLING EQUIPMENT Marl M5	**BORING DIA. (in)** 8	**TOTAL DEPTH (ft)** 20	**GROUND ELEV (ft)** 498
DEPTH/*ELEV.* GROUND WATER (ft) ▼ n/a_			
SAMPLING METHOD SPT	**NOTES** LOCATION: BUSINESSPARK AVE. BORING SEALED PER COUNTY/STATE WELL STANDARDS.		

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
									Boring terminated at depth of 20 feet due to practical refusal. *No free groundwater encountered at time of excavation.*
	475								
25									
	470								
30									
	465								
35									
	460								

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FIGURE A-25 b

LOG OF TEST BORING

PROJECT NAME NORTH CITY CONVEYANCE SYSTEM			**PROJECT NUMBER** 2934	**BORING** **B-18**
SITE LOCATION San Diego		**START** 11/16/2016	**FINISH** 11/16/2016	**SHEET NO.** 1 of 2
DRILLING COMPANY Pacific Drilling	**DRILLING METHOD** Hollow Stem Auger		**LOGGED BY** G. Spaulding	**CHECKED BY**
DRILLING EQUIPMENT Marl M5	**BORING DIA. (in)** 8	**TOTAL DEPTH (ft)** 21.33	**GROUND ELEV (ft)** 521	**DEPTH/*ELEV.* GROUND WATER (ft)** ▼ n/a_
SAMPLING METHOD SPT	**NOTES** LOCATION: SCRIPPS RANCH BLVD. BORING SEALED PER COUNTY/STATE WELL STANDARDS.			

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
								■	6" Asphalt Concrete
	520							⁙	BASE **Silty SAND (SP-SW)**, medium dense, red-brown, damp
								▨	FILL **Clayey SAND (SC)**, medium dense, mottled red-brown / gray-brown, damp, with occasional gravel to 1.5'
5									
	515	S	1	15					
								⁚	TERRACE DEPOSITS (Qvop4) **Silty to Clayey SAND (SM)**, dense, olive-gray to gray, damp, with gravel approx 20% to 2"
10									
	510	S	2	42			pH R CL SF GS		
								▨	WEATHERED METAVOLCANIC ROCK (Mzu) **Sandy CLAY (CL)**, hard, gray to blue-gray, damp, with gravel
15									
	505	S	3	40		9.1	-200		

TCG_METRIC_LOG(3) 2934.GPJ GDCLOGMT.GDT 4/12/17

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FIGURE A-26 a

LOG OF TEST BORING

PROJECT NAME NORTH CITY CONVEYANCE SYSTEM	**PROJECT NUMBER** 2934	**BORING** **B-18**	
SITE LOCATION San Diego	**START** 11/16/2016	**FINISH** 11/16/2016	**SHEET NO.** 2 of 2
DRILLING COMPANY Pacific Drilling	**DRILLING METHOD** Hollow Stem Auger	**LOGGED BY** G. Spaulding	**CHECKED BY**
DRILLING EQUIPMENT Marl M5	**BORING DIA. (in)** 8	**TOTAL DEPTH (ft)** 21.33	**GROUND ELEV (ft)** 521
DEPTH/*ELEV.* GROUND WATER (ft) ⊻ n/a_			
SAMPLING METHOD SPT	**NOTES** LOCATION: SCRIPPS RANCH BLVD. BORING SEALED PER COUNTY/STATE WELL STANDARDS.		

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	500							▨	- Sampler on rock
		S	4	25/4"		8.5			*Boring terminated at depth of 21.33 feet.* *No free groundwater encountered at time of excavation.*
25									
	495								
30									
	490								
35									
	485								

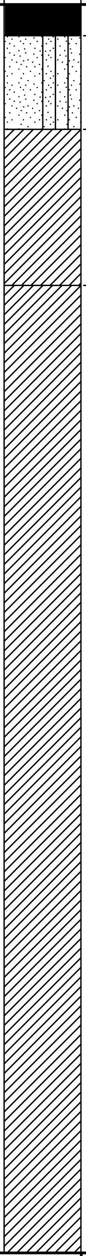
FIGURE A-26 b

LOG OF TEST BORING

PROJECT NAME NORTH CITY CONVEYANCE SYSTEM	**PROJECT NUMBER** 2934	**BORING** **B-19**	
SITE LOCATION San Diego	**START** 11/16/2016	**FINISH** 11/16/2016	**SHEET NO.** 1 of 2
DRILLING COMPANY Pacific Drilling	**DRILLING METHOD** Hollow Stem Auger	**LOGGED BY** G. Spaulding	**CHECKED BY**
DRILLING EQUIPMENT Marl M5	**BORING DIA. (in)** 8	**TOTAL DEPTH (ft)** 30	**GROUND ELEV (ft)** 571
DEPTH/*ELEV.* GROUND WATER (ft) ▼ n/a_			
SAMPLING METHOD SPT	**NOTES** LOCATION: MEANLEY DRIVE. BORING SEALED PER COUNTY/STATE WELL STANDARDS.		

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	DESCRIPTION AND CLASSIFICATION
								6" Asphalt Concrete
	570							BASE **Silty SAND (SP-SM)**, medium dense, olive-gray, damp, with gravel approx 50% to 3/4"
								FILL **Sandy CLAY (CL)**, very stiff, red-brown, moist
								TERRACE DEPOSITS (Qvop4) **Sandy CLAY (CL)**, very stiff, light brown to gray-brown, moist, with occasional gravel to 2"
5								
	565	S	1	30		10.9		
10								
	560	S	2	32				
		PB	3				GS	
15								
	555	S	4	31		11.8	-200 GS	

GRAPHIC LOG



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THIS SUMMARY APPLIES ONLY AT THE LOCATION OF THIS BORING AND AT THE TIME OF DRILLING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF THE ACTUAL CONDITIONS ENCOUNTERED.

FIGURE A-27 a

LOG OF TEST BORING

PROJECT NAME NORTH CITY CONVEYANCE SYSTEM		**PROJECT NUMBER** 2934		**BORING** **B-19**
SITE LOCATION San Diego	**START** 11/16/2016	**FINISH** 11/16/2016		**SHEET NO.** 2 of 2
DRILLING COMPANY Pacific Drilling	**DRILLING METHOD** Hollow Stem Auger	**LOGGED BY** G. Spaulding		**CHECKED BY**
DRILLING EQUIPMENT Marl M5	**BORING DIA. (in)** 8	**TOTAL DEPTH (ft)** 30	**GROUND ELEV (ft)** 571	**DEPTH/*ELEV.* GROUND WATER (ft)** ▼ n/a_
SAMPLING METHOD SPT	**NOTES** LOCATION: MEANLEY DRIVE. BORING SEALED PER COUNTY/STATE WELL STANDARDS.			

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	550	S	5	17				▨	
								▨	- Gravels to 1" from 23 to 23.5 feet
25								▨	
	545	PB	6					▨	
30									*Boring terminated at depth of 30 feet.* *No free groundwater encountered at time of excavation.*
	540								
35									
	535								

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FIGURE A-27 b

LOG OF TEST BORING

PROJECT NAME NORTH CITY CONVEYANCE SYSTEM	**PROJECT NUMBER** 2934	**BORING** **B-20**	
SITE LOCATION San Diego	**START** 11/16/2016	**FINISH** 11/16/2016	**SHEET NO.** 1 of 1
DRILLING COMPANY Pacific Drilling	**DRILLING METHOD** Hollow Stem Auger	**LOGGED BY** G. Spaulding	**CHECKED BY**
DRILLING EQUIPMENT Marl M5	**BORING DIA. (in)** 8	**TOTAL DEPTH (ft)** 18	**GROUND ELEV (ft)** 625
DEPTH/*ELEV.* GROUND WATER (ft) ⊻ n/a_			
SAMPLING METHOD SPT	**NOTES** LOCATION: MEANLEY DRIVE. BORING SEALED PER COUNTY/STATE WELL STANDARDS.		

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
									FILL **Clayey SAND (SC)**, loose, gray to gray-brown, dry to damp, with gravel and cobble approx 30% to 8"
									STADIUM CONGLOMERATE (Tst) **Sandy CLAY (CL)**, stiff, mottled gray-brown / yellow-brown, moist, with gravel and cobble approx 30% to 4"
5	620								
		S	1	19			GS		
									- Hard drilling on rocks
10	615								
		PB	2				GS PI		
									Sandy CLAY (CL), stiff, mottled yellow-brown / brown, moist, with gravel to approx 1.5"
									WEATHERED METAVOLCANIC ROCK (Mzu) **Sandy CLAY (CL)**, stiff, gray to blue-gray, moist, with gravel
15	610								
		S	3	63/10"		12.0			
		PB	4						
									- Very hard drilling
									Boring terminated at depth of 18 feet. *No free groundwater encountered at time of excavation.*

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FIGURE A-28

LOG OF TEST BORING

PROJECT NAME NORTH CITY CONVEYANCE SYSTEM	**PROJECT NUMBER** 2934	**BORING** **B-20a**	
SITE LOCATION San Diego	**START** 1/11/2017	**FINISH** 1/11/2017	**SHEET NO.** 1 of 2
DRILLING COMPANY Pacific Drilling	**DRILLING METHOD** Hollow Stem Auger	**LOGGED BY** G. Spaulding	**CHECKED BY**
DRILLING EQUIPMENT Fraste	**BORING DIA. (in)** 8	**TOTAL DEPTH (ft)** 21.5	**GROUND ELEV (ft)** 632
DEPTH/*ELEV.* GROUND WATER (ft) ⊻ n/a_			
SAMPLING METHOD SPT	**NOTES** LOCATION: MEANLEY DRIVE. BORING SEALED PER COUNTY/STATE WELL STANDARDS.		

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
								▨	FILL **Clayey Fine SAND to Sandy Clay (SC-CL)**, medium stiff to stiff, olive-brown, moist
	630							▨	**Sandy CLAY (CL) and Clayey SAND (SC)**, stiff to very stiff, mottled yellow-brown / brown / gray-brown, damp, with approximately 15% to 1½" gravel
		S	1	9		13.4	PI -200	▨	
5								▨	
		S	2	26				▨	
	625							▨	
								▨	- Hard drilling - gravel and cobbles
10								▨	
		S	3	32				▨	
	620							▨	
								▨	**Sandy CLAY (CL-CH)**, very stiff, dark gray, moist, organic smell
15								▨	**Sandy CLAY (CL) and Clayey SAND (SC)**, very stiff, mottled yellow-brown / brown, damp to moist, with gravel and cobbles
		S	4	28				▨	
	615							▨	- Harder drilling on rocks
		S	5	19				▨	

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FIGURE A-29 a

LOG OF TEST BORING

PROJECT NAME NORTH CITY CONVEYANCE SYSTEM			**PROJECT NUMBER** 2934		**BORING** **B-20a**
SITE LOCATION San Diego			**START** 1/11/2017	**FINISH** 1/11/2017	**SHEET NO.** 2 of 2
DRILLING COMPANY Pacific Drilling	**DRILLING METHOD** Hollow Stem Auger		**LOGGED BY** G. Spaulding		**CHECKED BY**
DRILLING EQUIPMENT Fraste	**BORING DIA. (in)** 8	**TOTAL DEPTH (ft)** 21.5	**GROUND ELEV (ft)** 632	**DEPTH/*ELEV.* GROUND WATER (ft)** ⊻ n/a_	
SAMPLING METHOD SPT	**NOTES** LOCATION: MEANLEY DRIVE. BORING SEALED PER COUNTY/STATE WELL STANDARDS.				

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
								▨	
	610								*Boring terminated at depth of 21.5 feet due to refusal.* *No groundwater encountered at time of excavation.*
25									
	605								
30									
	600								
35									
	595								

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FIGURE A-29 b

LOG OF TEST BORING

PROJECT NAME NORTH CITY CONVEYANCE SYSTEM		**PROJECT NUMBER** 2934		**BORING** **TB-4a**
SITE LOCATION San Diego	**START** 1/9/2017	**FINISH** 1/9/2017		**SHEET NO.** 1 of 2
DRILLING COMPANY Pacific Drilling	**DRILLING METHOD** Hollow Stem Auger	**LOGGED BY** G. Spaulding		**CHECKED BY**
DRILLING EQUIPMENT Marl M5	**BORING DIA. (in)** 8	**TOTAL DEPTH (ft)** 28.5	**GROUND ELEV (ft)** 662	**DEPTH/*ELEV.* GROUND WATER (ft)** ▼ n/a_
SAMPLING METHOD SPT	**NOTES** LOCATION: LOT @ END OF MEANLEY DR. BORING SEALED PER COUNTY/STATE WELL STANDARDS.			

DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
								▨	STADIUM CONGLOMERATE **Sandy CLAY (CL)**, very stiff to hard, yellow to yellow-brown, damp, with gravel approximately 10-20%
	660							▨	
		PB	1					▨	
								▨	- Occasional cobbles and boulder to 12"
5								▨	- Cobbles and gravel
	655							▨	becomes **Clayey SAND (SC)**, olive-gray
								▨	- Cobbles
10								▨	- Plastic bag sampled recovered from 10 to 12 feet
		S	2	3" on rock				▨	- Hard drilling on cobbles/boulder
	650	PB	3					▨	
15								▨	
		S	4	68/8"				▨	- On rock
	645							▨	
								▨	- Gravel and cobbles from 18 to 20 feet

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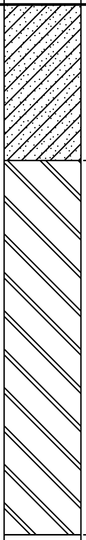
FIGURE A-30 a

LOG OF TEST BORING

PROJECT NAME NORTH CITY CONVEYANCE SYSTEM	**PROJECT NUMBER** 2934	**BORING** **TB-4a**	
SITE LOCATION San Diego	**START** 1/9/2017	**FINISH** 1/9/2017	**SHEET NO.** 2 of 2
DRILLING COMPANY Pacific Drilling	**DRILLING METHOD** Hollow Stem Auger	**LOGGED BY** G. Spaulding	**CHECKED BY**
DRILLING EQUIPMENT Marl M5	**BORING DIA. (in)** 8	**TOTAL DEPTH (ft)** 28.5	**GROUND ELEV (ft)** 662
DEPTH/*ELEV.* GROUND WATER (ft) ⊻ n/a_			
SAMPLING METHOD SPT	**NOTES** LOCATION: LOT @ END OF MEANLEY DR. BORING SEALED PER COUNTY/STATE WELL STANDARDS.		

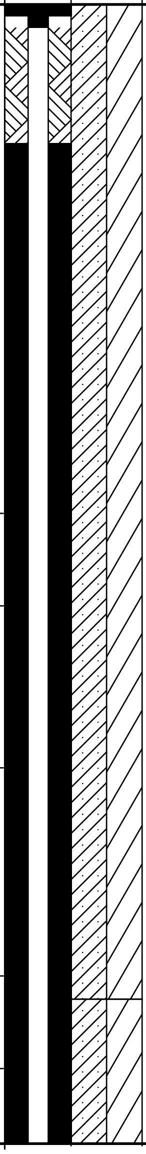


DEPTH (ft)	ELEVATION (ft)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
		PB	5						
	640								- Very hard drilling
									SANTIAGO PEAK METAVOLCANICS (Mzu) **Sandy CLAY (CL/CH)**, very dense, yellow-brown to olive, damp, with small volcanic rock chips
25									
		PB	6						
	635								
									Boring terminated at depth of 28.5 feet due to refusal. *No free groundwater encountered at time of excavation.*
30									
	630								
35									
	625								

FIGURE A-30 b

LOG OF CORE BORING

PROJECT NAME North City Conveyance System	**PROJECT NUMBER** 2934	**BORING** **TB-4b**	
SITE LOCATION San Diego, CA	**DATE(S) DRILLED** 12/1 to 12/1	**LOGGED BY** G. Spaulding	**SHEET NO.** 1 of 5
DRILLING METHOD Triple Tube Core	**DRILL BIT SIZE/TYPE** HQ	**CHECKED BY**	**TOTAL DEPTH DRILLED (feet)** 110
DRILL RIG TYPE LF 70	**DRILLED BY** Ruen Drilling	**INCLINATION FROM VERTICAL/BEARING** 0	
APPARENT GROUNDWATER DEPTH (feet) Groundwater measured at 90.0 feet below ground surface (2/8/2017)		**APPROXIMATE SURFACE ELEVATION (feet)** 725	
COMMENTS Location - Miramar Lake		**BOREHOLE BACKFILL** See well construction.	



DEPTH (ft)	ELEVATION (ft)	RUN NO.	BOX NO.	RECOVERY, %	FRAC. FREQ.	R.Q.D., %	WELL CONSTRUCTION	LITHOLOGY	MATERIAL DESCRIPTION	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS
									<u>FILL</u> **Sandy CLAY to Clayey SAND (SC-CL)**, medium dense, mottled olive-gray / brown, damp, with gravel and cobbles						
5	720														
10	715														
		1	1	100	N/A	N/A									
15	710	2	1	90	N/A	N/A									
		3	1	82	N/A	N/A									
20	705														
		4	1	100	N/A	N/A			<u>STADIUM CONGLOMERATE</u> **Clayey SAND to Sandy CLAY (SC-CL)**, dense, gray to olive-gray, damp, with gravel and cobbles up to 4" diameter - Moist to wet; soft zones; poor recovery						

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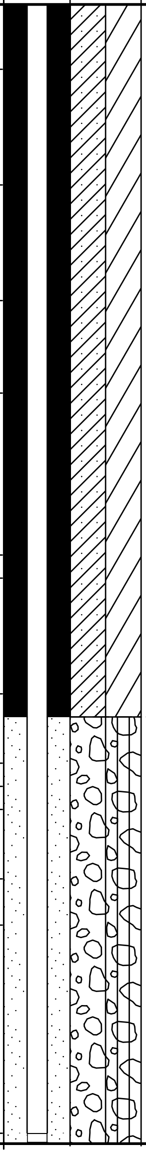
LOG OF CORE BORING

PROJECT NAME North City Conveyance System	**PROJECT NUMBER** 2934	**BORING** **TB-4b**	
SITE LOCATION San Diego, CA	**DATE(S) DRILLED** 12/1 to 12/1	**LOGGED BY** G. Spaulding	**SHEET NO.** 2 of 5
DRILLING METHOD Triple Tube Core	**DRILL BIT SIZE/TYPE** HQ	**CHECKED BY**	**TOTAL DEPTH DRILLED (feet)** 110
DRILL RIG TYPE LF 70	**DRILLED BY** Ruen Drilling	**INCLINATION FROM VERTICAL/BEARING** 0	
APPARENT GROUNDWATER DEPTH (feet) Groundwater measured at 90.0 feet below ground surface (2/8/2017)		**APPROXIMATE SURFACE ELEVATION (feet)** 725	
COMMENTS Location - Miramar Lake		**BOREHOLE BACKFILL** See well construction.	



DEPTH (ft)	ELEVATION (ft)	RUN NO.	BOX NO.	RECOVERY, %	FRAC. FREQ.	R.Q.D., %	MATERIAL DESCRIPTION	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS
25	700	5	1	25	N/A	N/A							
		6	1	23	N/A	N/A							
30	695	7	1	30	N/A	N/A							
		8	1	38	N/A	N/A							
35	690	9	1	22	N/A	N/A							
		10	2	100	N/A	N/A							
		11	2	86	N/A	N/A	- Cobbles up to 6" diameter						
40	685	12	2	100	N/A	N/A	**Sandy GRAVEL & COBBLE (GP-GM)**, dense, olive-brown to yellow-brown sand matrix, damp,moderately well cemented zones with calcium carbonate						
		13	2	100	N/A	N/A							
		14	2	100	N/A	N/A							
		15	2	100	N/A	N/A							
		16	2	70	N/A	N/A							
45	680	17	2	100	N/A	N/A							

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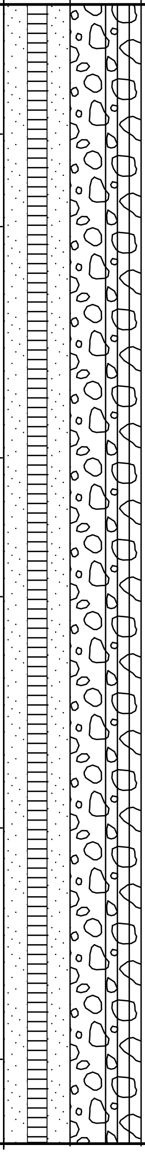
FIGURE A-31 b

LOG OF CORE BORING

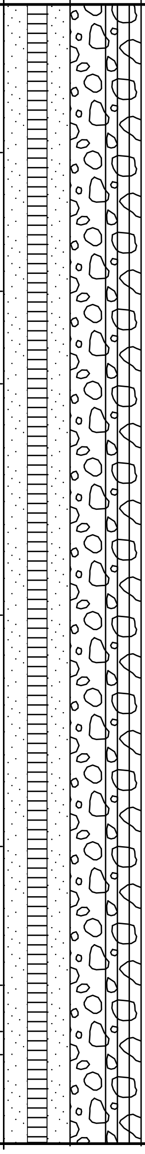
PROJECT NAME North City Conveyance System	**PROJECT NUMBER** 2934	**BORING** **TB-4b**	
SITE LOCATION San Diego, CA	**DATE(S) DRILLED** 12/1 to 12/1	**LOGGED BY** G. Spaulding	**SHEET NO.** 3 of 5
DRILLING METHOD Triple Tube Core	**DRILL BIT SIZE/TYPE** HQ	**CHECKED BY**	**TOTAL DEPTH DRILLED (feet)** 110
DRILL RIG TYPE LF 70	**DRILLED BY** Ruen Drilling	**INCLINATION FROM VERTICAL/BEARING** 0	
APPARENT GROUNDWATER DEPTH (feet) Groundwater measured at 90.0 feet below ground surface (2/8/2017)		**APPROXIMATE SURFACE ELEVATION (feet)** 725	
COMMENTS Location - Miramar Lake		**BOREHOLE BACKFILL** See well construction.	



DEPTH (ft)	ELEVATION (ft)	ROCK CORE RUN NO.	BOX NO.	RECOVERY, %	FRAC. FREQ.	R.Q.D., %	WELL CONSTRUCTION	LITHOLOGY	MATERIAL DESCRIPTION	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS
50	675	18	3	100	N/A	N/A									
		19	3	90	N/A	N/A									
55	670	20	3	100	N/A	N/A									
60	665	21	3	100	N/A	N/A									
65	660	22	4	100	N/A	N/A			- Cobbles up to ±10" diameter						
70	655	23	4	100	N/A	N/A									

LOG OF CORE BORING

PROJECT NAME North City Conveyance System	**PROJECT NUMBER** 2934	**BORING** **TB-4b**	
SITE LOCATION San Diego, CA	**DATE(S) DRILLED** 12/1 to 12/1	**LOGGED BY** G. Spaulding	**SHEET NO.** 4 of 5
DRILLING METHOD Triple Tube Core	**DRILL BIT SIZE/TYPE** HQ	**CHECKED BY**	**TOTAL DEPTH DRILLED (feet)** 110
DRILL RIG TYPE LF 70	**DRILLED BY** Ruen Drilling	**INCLINATION FROM VERTICAL/BEARING** 0	
APPARENT GROUNDWATER DEPTH (feet) Groundwater measured at 90.0 feet below ground surface (2/8/2017)		**APPROXIMATE SURFACE ELEVATION (feet)** 725	
COMMENTS Location - Miramar Lake		**BOREHOLE BACKFILL** See well construction.	



DEPTH (ft)	ELEVATION (ft)	ROCK CORE RUN NO.	ROCK CORE BOX NO.	ROCK CORE RECOVERY, %	ROCK CORE FRAC. FREQ.	ROCK CORE R.Q.D., %	MATERIAL DESCRIPTION	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS
75	650	24	4	100	N/A	N/A							
		25	5	100	N/A	N/A							GS PL
80	645	26	5	100	N/A	N/A	- Cobbles up to 8 to 9" diameter						
85	640	27	5	100	N/A	N/A							
90	635	28	5	100	N/A	N/A	▽ ▼Groundwater measured at 90.0 feet below ground surface (2/8/2017)						
		29	6	0	N/A	N/A							
95	630	30	6	100	N/A	N/A	Note: Material stuck in drill string						
		31	6	100	N/A	N/A							

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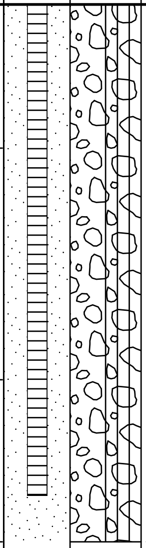
FIGURE A-31 d

LOG OF CORE BORING

PROJECT NAME North City Conveyance System	**PROJECT NUMBER** 2934	**BORING** **TB-4b**	
SITE LOCATION San Diego, CA	**DATE(S) DRILLED** 12/1 to 12/1	**LOGGED BY** G. Spaulding	**SHEET NO.** 5 of 5
DRILLING METHOD Triple Tube Core	**DRILL BIT SIZE/TYPE** HQ	**CHECKED BY**	**TOTAL DEPTH DRILLED (feet)** 110
DRILL RIG TYPE LF 70	**DRILLED BY** Ruen Drilling	**INCLINATION FROM VERTICAL/BEARING** 0	
APPARENT GROUNDWATER DEPTH (feet) Groundwater measured at 90.0 feet below ground surface (2/8/2017)		**APPROXIMATE SURFACE ELEVATION (feet)** 725	
COMMENTS Location - Miramar Lake		**BOREHOLE BACKFILL** See well construction.	



DEPTH (ft)	ELEVATION (ft)	ROCK CORE: RUN NO.	BOX NO.	RECOVERY, %	FRAC. FREQ.	R.Q.D., %	WELL CONSTRUCTION	LITHOLOGY	MATERIAL DESCRIPTION	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS
		32	6	92	N/A	N/A									
100	625														
		33	6	100	N/A	N/A									
105	620														
		34	6	98	N/A	N/A									
110	615														
115	610														
120	605														

Boring terminated at depth of 110 feet.
Groundwater measured at 90.0 feet below ground surface (2/8/2017)

Monitoring Well Construction:
PCC Grout: 3 to 40 feet
#3 Sand: 40 to 110 feet
2" Blank Casing: 0 to 49 feet
2" Slotted Casing: 49 to 109 feet

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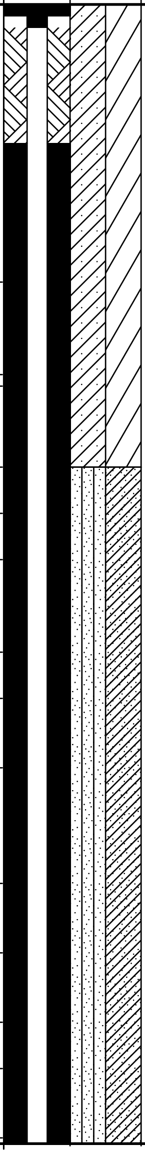
LOG OF CORE BORING

PROJECT NAME North City Conveyance System	**PROJECT NUMBER** 2934	**BORING** **TB-4c**		
SITE LOCATION San Diego, CA	**DATE(S) DRILLED** 11/28 to 11/30	**LOGGED BY** G. Spaulding	**SHEET NO.** 1 of 6	
DRILLING METHOD Triple Tube Core	**DRILL BIT SIZE/TYPE** HQ	**CHECKED BY**	**TOTAL DEPTH DRILLED (feet)** 131.5	
DRILL RIG TYPE LF 70	**DRILLED BY** Ruen Drilling	**INCLINATION FROM VERTICAL/BEARING** 0		
APPARENT GROUNDWATER DEPTH (feet) - Groundwater measured at 82.8 feet below ground surface (2/8/2017)		**APPROXIMATE SURFACE ELEVATION (feet)** 724		
COMMENTS Location - Miramar Lake		**BOREHOLE BACKFILL** See well construction.		

DEPTH (ft)	ELEVATION (ft)	ROCK CORE RUN NO.	BOX NO.	RECOVERY, %	FRAC. FREQ.	R.Q.D., %	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS
5	720			pipe	N/A	N/A						
		1	1	50	N/A	N/A						
		2	1	0	N/A	N/A						
10	715	3	1	60	N/A	N/A						
		4	1	66	N/A	N/A						
		5	1	60	N/A	N/A						
	710	6	1	60	N/A	N/A						
15		7	1	90	N/A	N/A						
		8	1	40	N/A	N/A						
	705	9	1	40	N/A	N/A						
20		10	1	66	N/A	N/A						
		11	1	66	N/A	N/A						
		12	1	40	N/A	N/A						
	700	13	1	85	N/A	N/A						

WELL CONSTRUCTION / LITHOLOGY



MATERIAL DESCRIPTION

FILL
Sandy CLAY to Clayey SAND (SC-CL), brown, moist, with gravel and cobbles approx 40% up to 4" diameter

STADIUM CONGLOMERATE
Silty to Clayey SAND (SM-SC), dense, gray / brown-gray, damp, with gravel and cobbles approx 30-80% up to 6" diameter, and **Sandy GRAVEL (GP-GM)** interbeds

Notes
1452: Pulled drill string to check bit
1520: Advanced conductor pipe to -11'

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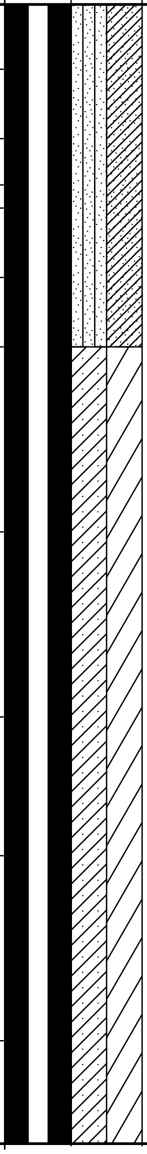
FIGURE A-32 a

LOG OF CORE BORING

PROJECT NAME North City Conveyance System	**PROJECT NUMBER** 2934	**BORING** **TB-4c**	
SITE LOCATION San Diego, CA	**DATE(S) DRILLED** 11/28 to 11/30	**LOGGED BY** G. Spaulding	**SHEET NO.** 2 of 6
DRILLING METHOD Triple Tube Core	**DRILL BIT SIZE/TYPE** HQ	**CHECKED BY**	**TOTAL DEPTH DRILLED (feet)** 131.5
DRILL RIG TYPE LF 70	**DRILLED BY** Ruen Drilling	**INCLINATION FROM VERTICAL/BEARING** 0	
APPARENT GROUNDWATER DEPTH (feet) - Groundwater measured at 82.8 feet below ground surface (2/8/2017)		**APPROXIMATE SURFACE ELEVATION (feet)** 724	
COMMENTS Location - Miramar Lake		**BOREHOLE BACKFILL** See well construction.	



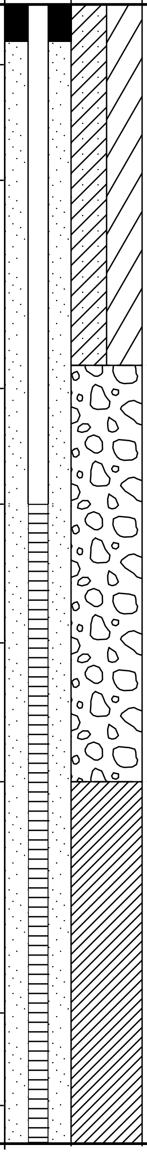
DEPTH (ft)	ELEVATION (ft)	ROCK CORE RUN NO.	BOX NO.	RECOVERY, %	FRAC. FREQ.	R.Q.D., %	MATERIAL DESCRIPTION	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS
25		14	1	75	N/A	N/A							
		15	1	30	N/A	N/A							
		16	1	30	N/A	N/A							
	695	17	1	0	N/A	N/A							
30		18	2	100	N/A	N/A	<u>Note</u>: Switched to polymer						
		19	2	100	N/A	N/A							
35	690	20	2	100	N/A	N/A	Interbedded **Clayey SAND/Sandy CLAY (SC/CL)**, hard, damp						
	685	21	2	100	N/A	N/A	- Gravel from 36 to 38 feet						
40		22	2	100	N/A	N/A							
45	680	23	3	100	N/A	N/A							
	675	24	3	100	N/A	N/A	- Gravel from 48 to 50 feet						

FIGURE A-32 b

LOG OF CORE BORING

PROJECT NAME North City Conveyance System	**PROJECT NUMBER** 2934	**BORING** **TB-4c**	
SITE LOCATION San Diego, CA	**DATE(S) DRILLED** 11/28 to 11/30	**LOGGED BY** G. Spaulding	**SHEET NO.** 3 of 6
DRILLING METHOD Triple Tube Core	**DRILL BIT SIZE/TYPE** HQ	**CHECKED BY**	**TOTAL DEPTH DRILLED (feet)** 131.5
DRILL RIG TYPE LF 70	**DRILLED BY** Ruen Drilling	**INCLINATION FROM VERTICAL/BEARING** 0	
APPARENT GROUNDWATER DEPTH (feet) - Groundwater measured at 82.8 feet below ground surface (2/8/2017)		**APPROXIMATE SURFACE ELEVATION (feet)** 724	
COMMENTS Location - Miramar Lake		**BOREHOLE BACKFILL** See well construction.	

WELL CONSTRUCTION | LITHOLOGY



DEPTH (ft)	ELEVATION (ft)	ROCK CORE: RUN NO.	BOX NO.	RECOVERY, %	FRAC. FREQ.	R.Q.D., %	MATERIAL DESCRIPTION	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS
50													
		25	3	100	N/A	N/A							
	670												
55		26	3	100	N/A	N/A	- Occasional gravel						
							Gravel and cobbles						
	665	27	4	100	N/A	N/A							
60													
		28	4	85	N/A	N/A							
	660												
65		29	4	100	N/A	N/A							
							Sandy CLAY (CL), hard mottled olive-gray / yellow / red, damp, with occasional gravel and cobbles						
	655	30	4	100	N/A	N/A							
70													
		31	5	60	N/A	N/A	Note: 1300-1415: Core stuck in casing. Pulled casing to clear blockage						

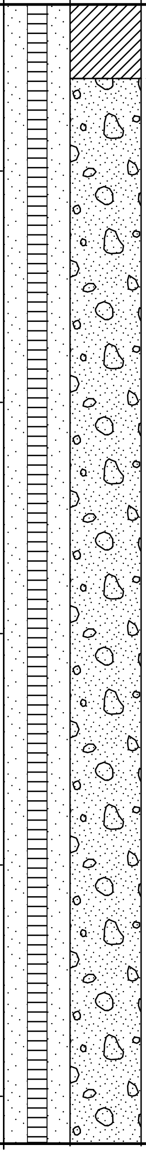
LOG OF CORE BORING

PROJECT NAME North City Conveyance System	**PROJECT NUMBER** 2934	**BORING** **TB-4c**	
SITE LOCATION San Diego, CA	**DATE(S) DRILLED** 11/28 to 11/30	**LOGGED BY** G. Spaulding	**SHEET NO.** 4 of 6
DRILLING METHOD Triple Tube Core	**DRILL BIT SIZE/TYPE** HQ	**CHECKED BY**	**TOTAL DEPTH DRILLED (feet)** 131.5
DRILL RIG TYPE LF 70	**DRILLED BY** Ruen Drilling	**INCLINATION FROM VERTICAL/BEARING** 0	
APPARENT GROUNDWATER DEPTH (feet) - Groundwater measured at 82.8 feet below ground surface (2/8/2017)		**APPROXIMATE SURFACE ELEVATION (feet)** 724	
COMMENTS Location - Miramar Lake		**BOREHOLE BACKFILL** See well construction.	

DEPTH (ft)	ELEVATION (ft)	ROCK CORE RUN NO.	ROCK CORE BOX NO.	ROCK CORE RECOVERY, %	ROCK CORE FRAC. FREQ.	ROCK CORE R.Q.D., %	WELL CONSTRUCTION	LITHOLOGY	MATERIAL DESCRIPTION	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS
	650	32	5	60	N/A	N/A									
75		33	5	100	N/A	N/A									
		34	5	98	N/A	N/A			- Gravel and cobbles up to 4" diameter						
80	645	35	5	100	N/A	N/A			- Gravel and cobbles up to 6" diameter						
	640	36	5	100	N/A	N/A			- Groundwater measured at 82.8 feet below ground surface (2/8/2017)						
85		37	5 6	100	N/A	N/A			- Interbedded sand and gravel						GS PL
	635	38	6	100	N/A	N/A									
90		39	6	85	N/A	N/A			- 10" diameter rock						
		40	6	88	N/A	N/A			- Gravel and cobbles from 92 to 93.5 feet						
95	630	41	6	100	N/A	N/A			- Sand - Gravel and cobbles up to 6" diameter from 96.5 to 100 feet						
			6												

LOG OF CORE BORING

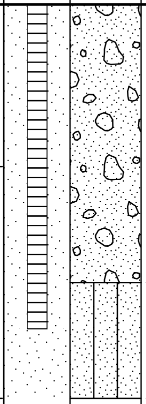
PROJECT NAME North City Conveyance System	**PROJECT NUMBER** 2934	**BORING** **TB-4c**	
SITE LOCATION San Diego, CA	**DATE(S) DRILLED** 11/28 to 11/30	**LOGGED BY** G. Spaulding	**SHEET NO.** 5 of 6
DRILLING METHOD Triple Tube Core	**DRILL BIT SIZE/TYPE** HQ	**CHECKED BY**	**TOTAL DEPTH DRILLED (feet)** 131.5
DRILL RIG TYPE LF 70	**DRILLED BY** Ruen Drilling	**INCLINATION FROM VERTICAL/BEARING** 0	
APPARENT GROUNDWATER DEPTH (feet) - Groundwater measured at 82.8 feet below ground surface (2/8/2017)		**APPROXIMATE SURFACE ELEVATION (feet)** 724	
COMMENTS Location - Miramar Lake		**BOREHOLE BACKFILL** See well construction.	



DEPTH (ft)	ELEVATION (ft)	ROCK CORE RUN NO.	BOX NO.	RECOVERY, %	FRAC. FREQ.	R.Q.D., %	MATERIAL DESCRIPTION	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS
100	625	42	7	100	N/A	N/A	**Gravelly SAND to Sandy Gravel (SP-GP)**, dense, red to red-brown, damp, well indurated, gravel and cobbles to 6", iron oxide staining						
105	620	43	7	100	N/A	N/A							
110	615	44	7	100	N/A	N/A							
115	610	45	8	100	N/A	N/A							
120	605	46	8	100	N/A	N/A							

LOG OF CORE BORING

PROJECT NAME North City Conveyance System	**PROJECT NUMBER** 2934	**BORING** **TB-4c**	
SITE LOCATION San Diego, CA	**DATE(S) DRILLED** 11/28 to 11/30	**LOGGED BY** G. Spaulding	**SHEET NO.** 6 of 6
DRILLING METHOD Triple Tube Core	**DRILL BIT SIZE/TYPE** HQ	**CHECKED BY**	**TOTAL DEPTH DRILLED (feet)** 131.5
DRILL RIG TYPE LF 70	**DRILLED BY** Ruen Drilling	**INCLINATION FROM VERTICAL/BEARING** 0	
APPARENT GROUNDWATER DEPTH (feet) - Groundwater measured at 82.8 feet below ground surface (2/8/2017)		**APPROXIMATE SURFACE ELEVATION (feet)** 724	
COMMENTS Location - Miramar Lake		**BOREHOLE BACKFILL** See well construction.	



DEPTH (ft)	ELEVATION (ft)	ROCK CORE					WELL CONSTRUCTION	LITHOLOGY	MATERIAL DESCRIPTION	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS
		RUN NO.	BOX NO.	RECOVERY, %	FRAC. FREQ.	R.Q.D., %									
	600	47	9	89	N/A	N/A									
125															
	595	48	9	100	N/A	N/A			**Silty SAND (SM)**, dense, red-brown, damp to moist						
130															
									Boring terminated at depth of 131.5 feet. *- Groundwater measured at 82.8 feet below ground surface (2/8/2017)* *Monitoring Well Construction:* *Hole opened to 6.5-inch diameter to 20 feet* *PCC Grout: -3 to -50 feet* *#3 Sand: -50 to -131.5 feet* *Blank Casing: 0 to -60 feet* *Slotted Casing: -60 to -130 feet*						
	590														
135															
	585														
140															
	580														
145															

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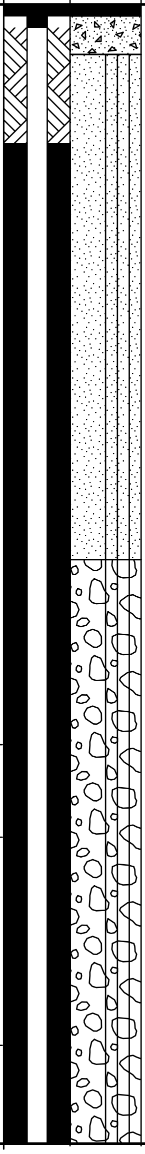
San Diego, California 92123

FIGURE A-32 f

LOG OF CORE BORING

PROJECT NAME North City Conveyance System	**PROJECT NUMBER** 2934	**BORING** **TB-4d**	
SITE LOCATION San Diego, CA	**DATE(S) DRILLED** 12/5 to 12/7	**LOGGED BY** G. Spaulding	**SHEET NO.** 1 of 6
DRILLING METHOD Triple Tube Core	**DRILL BIT SIZE/TYPE** HQ	**CHECKED BY**	**TOTAL DEPTH DRILLED (feet)** 123
DRILL RIG TYPE LF 70	**DRILLED BY** Ruen Drilling	**INCLINATION FROM VERTICAL/BEARING** 0	
APPARENT GROUNDWATER DEPTH (feet) Groundwater measured at 78.75 feet below ground surface (2/8/2017)		**APPROXIMATE SURFACE ELEVATION (feet)** 722	
COMMENTS Location - Miramar Lake		**BOREHOLE BACKFILL** See well construction.	



DEPTH (ft)	ELEVATION (ft)	ROCK CORE RUN NO.	BOX NO.	RECOVERY, %	FRAC. FREQ.	R.Q.D., %	WELL CONSTRUCTION	LITHOLOGY	MATERIAL DESCRIPTION	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS
									2 to 3 inches AC / 10 to 12" Class II Base						
	720								FILL **Clayey and Gravelly SAND (SP-SM)**, medium dense, gray-brown, damp to moist, with gravel and cobbles up to 8" diameter						
5															
	715														
		Pipe													
10															
	710								- Harder drilling STADIUM CONGLOMERATE **Sandy GRAVEL (GM-GP)**, dense, gray-brown to gray, damp to moist with cobbles up to 8" diameter						
15															
	705	1	1	100	N/A	N/A									
20		2	1	90	N/A	N/A									
	700														

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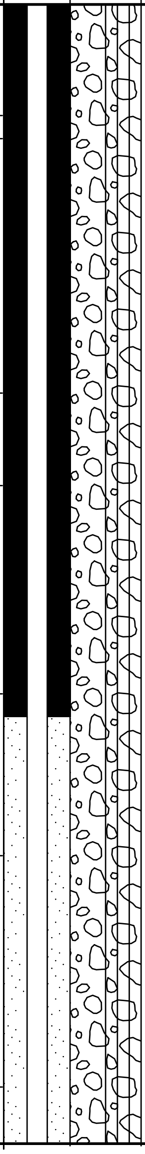
LOG OF CORE BORING

PROJECT NAME North City Conveyance System	**PROJECT NUMBER** 2934	**BORING** **TB-4d**	
SITE LOCATION San Diego, CA	**DATE(S) DRILLED** 12/5 to 12/7	**LOGGED BY** G. Spaulding	**SHEET NO.** 2 of 6
DRILLING METHOD Triple Tube Core	**DRILL BIT SIZE/TYPE** HQ	**CHECKED BY**	**TOTAL DEPTH DRILLED (feet)** 123
DRILL RIG TYPE LF 70	**DRILLED BY** Ruen Drilling	**INCLINATION FROM VERTICAL/BEARING** 0	
APPARENT GROUNDWATER DEPTH (feet) Groundwater measured at 78.75 feet below ground surface (2/8/2017)		**APPROXIMATE SURFACE ELEVATION (feet)** 722	
COMMENTS Location - Miramar Lake		**BOREHOLE BACKFILL** See well construction.	

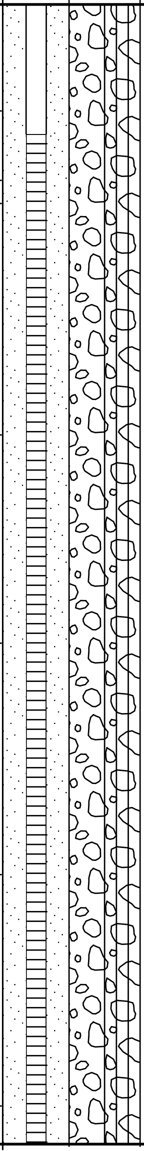


DEPTH (ft)	ELEVATION (ft)	ROCK CORE RUN NO.	ROCK CORE BOX NO.	ROCK CORE RECOVERY, %	ROCK CORE FRAC. FREQ.	ROCK CORE R.Q.D., %	WELL CONSTRUCTION	LITHOLOGY	MATERIAL DESCRIPTION	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS
25		3	1	98	N/A	N/A									
	695	4	1	100	N/A	N/A									
30		5	1	58	N/A	N/A									
	690								Soft zone Becomes clayier Interbedded clayey sands and gravels, gray to light olive-brown color matrix						
		6	2	100	N/A	N/A									
35															
	685	7	2	90	N/A	N/A									
40															
		8	2	95	N/A	N/A									
	680														
45		9	2	92	N/A	N/A									
	675														

LOG OF CORE BORING

PROJECT NAME North City Conveyance System	**PROJECT NUMBER** 2934	**BORING** **TB-4d**	
SITE LOCATION San Diego, CA	**DATE(S) DRILLED** 12/5 to 12/7	**LOGGED BY** G. Spaulding	**SHEET NO.** 3 of 6
DRILLING METHOD Triple Tube Core	**DRILL BIT SIZE/TYPE** HQ	**CHECKED BY**	**TOTAL DEPTH DRILLED (feet)** 123
DRILL RIG TYPE LF 70	**DRILLED BY** Ruen Drilling	**INCLINATION FROM VERTICAL/BEARING** 0	
APPARENT GROUNDWATER DEPTH (feet) Groundwater measured at 78.75 feet below ground surface (2/8/2017)		**APPROXIMATE SURFACE ELEVATION (feet)** 722	
COMMENTS Location - Miramar Lake		**BOREHOLE BACKFILL** See well construction.	

DEPTH (ft)	ELEVATION (ft)	ROCK CORE RUN NO.	BOX NO.	RECOVERY, %	FRAC. FREQ.	R.Q.D., %	WELL CONSTRUCTION	LITHOLOGY	MATERIAL DESCRIPTION	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS
50		10	3	98	N/A	N/A			**Sandy GRAVEL**, dense, gray, damp to moist, with gravel and cobbles up to 4 to 6" diameter						
	670	11	3	90	N/A	N/A									
		12	3	100	N/A	N/A									
55															
		13	3	100	N/A	N/A									
	665														
60															
		14	3	96	N/A	N/A									
	660														
65															
		15	4	99	N/A	N/A									
	655														
70															
		16	4	100	N/A	N/A									
	650														



TCG_CORE_LOG_FT-2 2934CORE.GPJ ROCK.GDT 4/12/17

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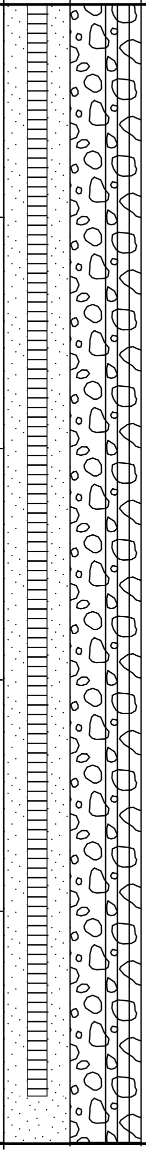
LOG OF CORE BORING

PROJECT NAME North City Conveyance System	**PROJECT NUMBER** 2934	**BORING** **TB-4d**	
SITE LOCATION San Diego, CA	**DATE(S) DRILLED** 12/5 to 12/7	**LOGGED BY** G. Spaulding	**SHEET NO.** 4 of 6
DRILLING METHOD Triple Tube Core	**DRILL BIT SIZE/TYPE** HQ	**CHECKED BY**	**TOTAL DEPTH DRILLED (feet)** 123
DRILL RIG TYPE LF 70	**DRILLED BY** Ruen Drilling	**INCLINATION FROM VERTICAL/BEARING** 0	
APPARENT GROUNDWATER DEPTH (feet) Groundwater measured at 78.75 feet below ground surface (2/8/2017)		**APPROXIMATE SURFACE ELEVATION (feet)** 722	
COMMENTS Location - Miramar Lake		**BOREHOLE BACKFILL** See well construction.	

DEPTH (ft)	ELEVATION (ft)	ROCK CORE RUN NO.	BOX NO.	RECOVERY, %	FRAC. FREQ.	R.Q.D., %	WELL CONSTRUCTION	LITHOLOGY	MATERIAL DESCRIPTION	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS
75	645	17	4	100	N/A	N/A									
80	640	18	5	100	N/A	N/A			- Groundwater measured at 78.75 feet below ground surface (2/8/2017)						
85	635	19	5	99	N/A	N/A									
90	630	20	5	100	N/A	N/A									
95	625	21	6	99	N/A	N/A									GS PL

LOG OF CORE BORING

PROJECT NAME North City Conveyance System
PROJECT NUMBER 2934
BORING TB-4d
SITE LOCATION San Diego, CA
DATE(S) DRILLED 12/5 to 12/7
LOGGED BY G. Spaulding
SHEET NO. 5 of 6
DRILLING METHOD Triple Tube Core
DRILL BIT SIZE/TYPE HQ
CHECKED BY
TOTAL DEPTH DRILLED (feet) 123
DRILL RIG TYPE LF 70
DRILLED BY Ruen Drilling
INCLINATION FROM VERTICAL/BEARING 0
APPARENT GROUNDWATER DEPTH (feet) Groundwater measured at 78.75 feet below ground surface (2/8/2017)
APPROXIMATE SURFACE ELEVATION (feet) 722
COMMENTS Location - Miramar Lake
BOREHOLE BACKFILL See well construction.



DEPTH (ft)	ELEVATION (ft)	ROCK CORE RUN NO.	BOX NO.	RECOVERY, %	FRAC. FREQ.	R.Q.D., %	WELL CONSTRUCTION	LITHOLOGY	MATERIAL DESCRIPTION	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS
100	620	22	6	100	N/A	N/A									
105	615	23	6	100	N/A	N/A			Silty sand lense, moist, yellow-brown, with occasional gravel from 106 to 112 feet						
110	610	24	7	100	N/A	N/A			**Silty-Sandy GRAVEL (GM-GP)**, dense, brown to yellow-brown, moist						
115	605	25	7	100	N/A	N/A									
120	600	26	7	100	N/A	N/A									

LOG OF CORE BORING

	PROJECT NAME North City Conveyance System	**PROJECT NUMBER** 2934	**BORING** **TB-4d**
SITE LOCATION San Diego, CA	**DATE(S) DRILLED** 12/5 to 12/7	**LOGGED BY** G. Spaulding	**SHEET NO.** 6 of 6
DRILLING METHOD Triple Tube Core	**DRILL BIT SIZE/TYPE** HQ	**CHECKED BY**	**TOTAL DEPTH DRILLED (feet)** 123
DRILL RIG TYPE LF 70	**DRILLED BY** Ruen Drilling	**INCLINATION FROM VERTICAL/BEARING** 0	
APPARENT GROUNDWATER DEPTH (feet) Groundwater measured at 78.75 feet below ground surface (2/8/2017)		**APPROXIMATE SURFACE ELEVATION (feet)** 722	
COMMENTS Location - Miramar Lake		**BOREHOLE BACKFILL** See well construction.	

DEPTH (ft)	ELEVATION (ft)	ROCK CORE RUN NO.	BOX NO.	RECOVERY, %	FRAC. FREQ.	R.Q.D., %	WELL CONSTRUCTION	LITHOLOGY	**MATERIAL DESCRIPTION**	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS/ft)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS
									Boring terminated at depth of 123 feet. *Groundwater measured at 78.75 feet below ground surface (2/8/2017)* *<u>Monitoring Well Construction:</u>* *PCC Grout: 3 to 40 feet* *#3 Sand: 40 to 123 feet* *2" Blank Casing: 0 to 52 feet* *2" Slotted Casing: 52 to 122 feet*						
125															
	595														
130															
	590														
135															
	585														
140															
	580														
145															
	575														

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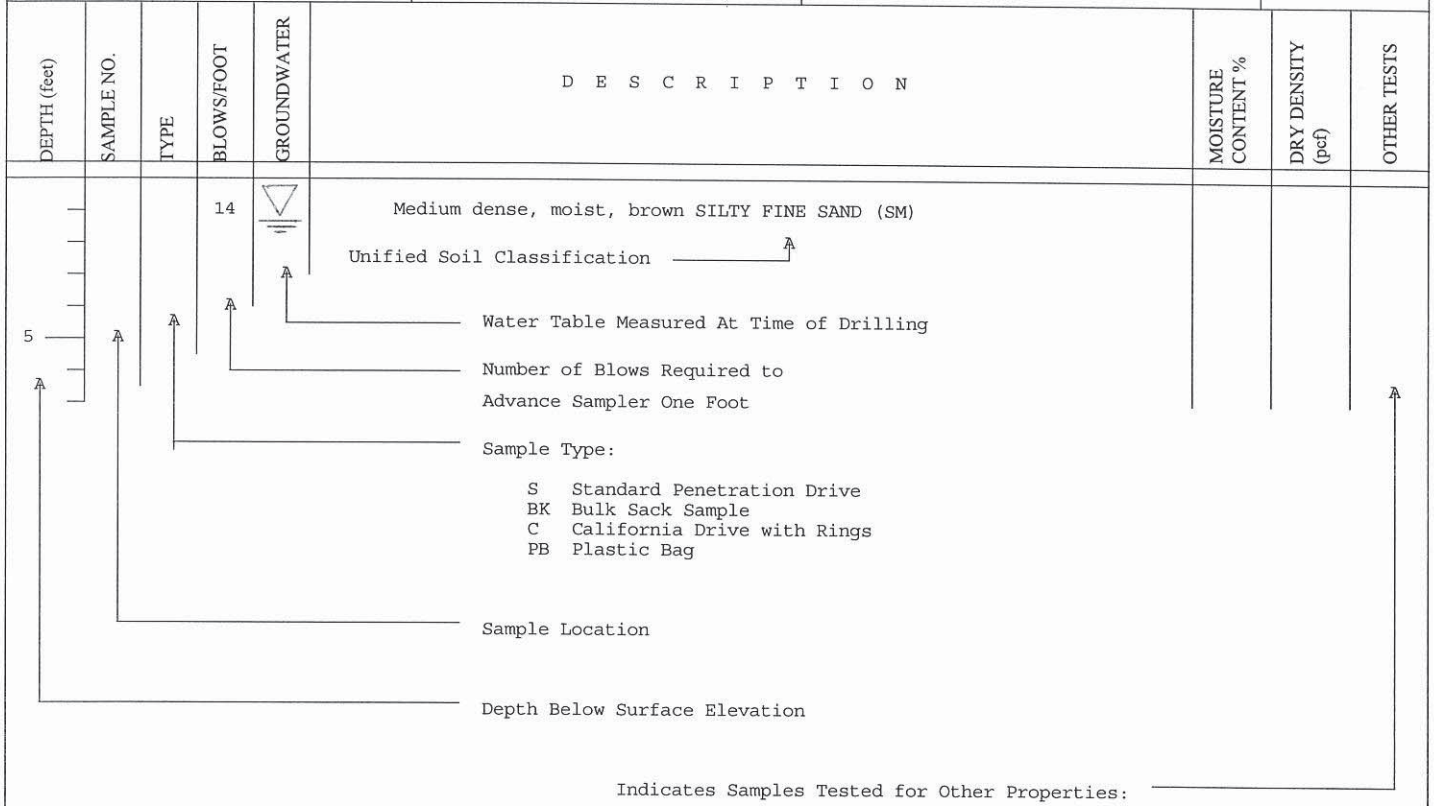
FIGURE A-33 f

LOGS OF EXCAVATIONS
FROM
GROUP DELTA CONSULTANTS
2000

KEY TO EXCAVATION LOGS

LOGGED BY:	DATE DRILLED:	BORING ELEVATION:	BORING NO.:
DRILL RIG:	BORING DIAMETER:	HAMMER WT.: DROP:	



Sample Type:

S	Standard Penetration Drive
BK	Bulk Sack Sample
C	California Drive with Rings
PB	Plastic Bag

Indicates Samples Tested for Other Properties:

CH	Chloride Content
LC	Laboratory Compaction
PH	pH
PI	Plasticity Index
RS	Resistivity
RV	R-Value
SA	Sieve Analysis
SL	Sulfate Content

NOTES ON FIELD INVESTIGATION

1. Borings were advanced using a truck-mounted CME 85 drill rig with an 8-inch hollow-stem auger.
2. Standard Penetration Tests (SPT) and California Samplers were used to obtain soil samples. The SPT and California Samplers were driven into the soil at the bottom of the borings with a 140-pound hammer falling 30 inches. When the samplers were withdrawn from the boring, the samples were removed, visually classified, sealed in plastic containers, and taken to the laboratory for detailed inspection.

   The Standard Penetration Test (SPT) is an 18-inch-long, 2-inch O.D., 1-3/8-inch I.D. drive sampler.

   The California Sampler is an 18-inch-long, 2-1/2-inch I.D., 3-inch O.D., thick-walled sampler. The sampler is lined with eighteen 2-3/8-inch I.D. brass rings. Relatively undisturbed, intact soil samples are retained in the brass rings.
3. Free groundwater was encountered in the borings as shown on the logs.
4. Classifications are based upon the Unified Soil Classification System and include color, moisture and consistency. Field descriptions have been modified to reflect results of laboratory inspection where deemed appropriate.

Descriptions on this boring log apply only at the specific boring location and at the time the boring was made. The descriptions on this log are not warranted to be representative of subsurface conditions at other locations or times.

PROJECT NO.: **1910**	**MIRAMAR ROAD PIPELINE**	FIGURE: **A - 1, Page 1 of 1**

GROUP DELTA CONSULTANTS, INC.
Engineers and Geologists

BORING LOG

LOGGED BY: **J. Brown**	DATE DRILLED: **4/13/00**	BORING ELEVATION: **392.5 feet**	BORING NO.:
DRILL RIG: **CME 85**	BORING DIAMETER: **8 inches**	HAMMER WT.: **140 lbs** DROP: **30 in**	**B - 1**

DEPTH (feet)	SAMPLE NO.	TYPE	BLOWS/FOOT	GROUNDWATER	DESCRIPTION	MOISTURE CONTENT %	DRY DENSITY (pcf)	OTHER TESTS
					11" Asphalt Concrete			
1					Moist, light yellowish-brown, SILTY MEDIUM TO FINE SAND (SM) with few small rock fragments FILL			
2	1	S	30		Dense, moist, gray-brown, CLAYEY MEDIUM TO FINE SAND (SC) LINDAVISTA FORMATION	23.4		
3	2	BK						PI SA
4					Very dense, moist, light yellowish-brown to light gray-brown, CLAYEY MEDIUM TO FINE SAND (SC), with few thin (<3") interbeds of clayey coarse to fine sand (SC)			
5	3	C	100/4"					
6					moderately cemented			
7								
8	4	BK				7.3		CL LC PH PI RS SA SL
9								
10								
11	5	S	90					
12					Very dense, moist, yellowish-gray, CLAYEY COARSE TO FINE SAND (SC)			
13	6	BK						
14								
15					drive sample attempt at 15 feet - no penetration - 50 blows			
16					BOTTOM OF BORING at 15 feet No free groundwater encountered at time of excavation Backfilled with cuttings; patched with concrete			
17								
18								
19								
20								

PROJECT NO.: **1910**	**MIRAMAR ROAD PIPELINE**	FIGURE: **A - 2, Page 1 of 1**

BORING LOG

LOGGED BY: **J. Brown**	DATE DRILLED: **4/13/00**	BORING ELEVATION: **403.2 feet**	BORING NO.: **B - 2**
DRILL RIG: **CME 85**	BORING DIAMETER: **8 inches**	HAMMER WT.: **140 lbs** DROP: **30 in**	

DEPTH (feet)	SAMPLE NO.	TYPE	BLOWS/FOOT	GROUNDWATER	DESCRIPTION	MOISTURE CONTENT %	DRY DENSITY (pcf)	OTHER TESTS
					8" Asphalt Concrete			
1	1	S	60 6"		Moist, light yellowish-brown, SILTY MEDIUM TO FINE SAND (SM), with some small rock fragments FILL			
2								
3								
4	2	PB			Moist, dark brown, FINE SANDY LEAN TO FAT CLAY (CL/CH), with reddish-brown and gray-brown mottles and trace gravel (<2" in size)			
5								
	3	C	80					
6					Moist, gray-brown with brown mottles, CLAYEY COARSE TO FINE SAND (SC), with few small gravels (up to 2" in size) and asphalt fragments (up to 1/2" in size) (est. <5% gravel) musty hydrocarbon-type odor			
7								
8	4	BK				14.2	CL LC PH PI RS SA SL	
9								
10								
	5	S	70					
11								
12					change to dark gray-brown color			
13								
	6	PB						
14								
15					drive sample attempt at 15 ft on gravel - no penetration/50 blows			
16								
	7	PB						
17								
18								
19					Moist, mottled gray-brown and gray, SANDY SILT (ML), with zones of yellowish-brown SILTY FINE SAND (SM) contains localized wet zones musty hydrocarbon-type odor			
20								
	8	S	40					

Descriptions on this boring log apply only at the specific boring location and at the time the boring was made. The descriptions on this log are not warranted to be representative of subsurface conditions at other locations or times.

PROJECT NO.: **1910**	**MIRAMAR ROAD PIPELINE**	FIGURE: **A - 3, Page 1 of 2**

BORING LOG

LOGGED BY: **J. Brown**	DATE DRILLED: **4/13/00**	BORING ELEVATION: **403.2 feet**	BORING NO.: **B - 2**
DRILL RIG: **CME 85**	BORING DIAMETER: **8 inches**	HAMMER WT.: **140 lbs** DROP: **30 in**	

DEPTH (feet)	SAMPLE NO.	TYPE	BLOWS/FOOT	GROUNDWATER	DESCRIPTION	MOISTURE CONTENT %	DRY DENSITY (pcf)	OTHER TESTS
21	8	S	40		Moist, mottled gray-brown and gray, SANDY SILT (ML) with zones of yellowish-brown SILTY FINE SAND (SM) contains localized wet zones FILL ↓			
22					Moist, dark gray-brown, VERY CLAYEY MEDIUM TO FINE SAND (SC), with small angular rock fragments musty hydrocarbon-type odor			
23								
24								
25	9	S	55/6"					
26					BOTTOM OF BORING at 25½ feet Unable to continue boring to native due to time constraints Localized wet zones encountered 18½ to 22 feet. However, no free groundwater table identified at time of excavation Backfilled with cuttings; patched with cuttings			
27								
28								
29								
30								
31								
32								
33								
34								
35								
36								
37								
38								
39								
40								

Descriptions on this boring log apply only at the specific boring location and at the time the boring was made. The descriptions on this log are not warranted to be representative of subsurface conditions at other locations or times.

PROJECT NO.: **1910**	**MIRAMAR ROAD PIPELINE**	FIGURE: **A - 3, Page 2 of 2**

BORING LOG

LOGGED BY: **J. Brown**	DATE DRILLED: **4/13/00**	BORING ELEVATION: **417.6 feet**	BORING NO.:
DRILL RIG: **CME 85**	BORING DIAMETER: **8 inches**	HAMMER WT.: **140 lbs** DROP: **30 in**	**B - 3**

DEPTH (feet)	SAMPLE NO.	TYPE	BLOWS/FOOT	GROUNDWATER	DESCRIPTION	MOISTURE CONTENT %	DRY DENSITY (pcf)	OTHER TESTS
					8" Asphalt Concrete			
1	1	S	65 6"		Moist, light yellowish-brown, SILTY MEDIUM TO FINE SAND (SM), with some small rock fragments FILL			
2								
3	2	BK			Hard, moist, reddish-brown, SANDY FAT CLAY (CH) RESIDUAL CLAY			
4								
5					Very dense, moist, light yellowish-brown, SILTY TO SLIGHTLY CLAYEY, COARSE TO FINE SAND (SM/SC), with some gravels (est. 15% to 20% gravel up to 4" in size) drive sample attempt at 5 ft on gravel; no penetration/50 blows LINDAVISTA FORMATION			
6								
7								
8	3	BK				6.2	CL PH RS SA SL	
9								
10					drive sample attempt at 10 ft on gravel; no penetration/50 blows			
11	4	BK						
12								
13								
14								
15	5	PB			Hard, moist, gray-brown, SANDY LEAN CLAY (CL), with some gravel (est. 10% to 15% gravel, up to 3" in size) drive sample attempt at 15 ft on gravel; no penetration/50 blows			
16								
17								
18	6	PB			Very dense, moist, light yellowish-brown, FINE SANDY SILT (ML), lightly cemented			
19					drive sample attempt at 20 ft; no penetration/50 blows			
20					BOTTOM OF BORING at 20 feet No free groundwater encountered at time of excavation Backfilled with cuttings; patched with concrete			

Descriptions on this boring log apply only at the specific boring location and at the time the boring was made. The descriptions on this log are not warranted to be representative of subsurface conditions at other locations or times.

PROJECT NO.: **1910**	**MIRAMAR ROAD PIPELINE**	FIGURE: **A - 4, Page 1 of 1**

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B O R I N G L O G

LOGGED BY: **J. Brown**	DATE DRILLED: **4/12/00**	BORING ELEVATION: **417.5 feet**	BORING NO.:
DRILL RIG: **CME 85**	BORING DIAMETER: **8 inches**	HAMMER WT.: **140 lbs** DROP: **30 in**	**B - 4**

DEPTH (feet)	SAMPLE NO.	TYPE	BLOWS/FOOT	GROUNDWATER	DESCRIPTION	MOISTURE CONTENT %	DRY DENSITY (pcf)	OTHER TESTS
0					8" Asphalt Concrete			
1					Moist, light yellowish-brown, SILTY MEDIUM TO FINE SAND (SM), with few rock fragments FILL			
3	1	BK			Hard, moist, dark reddish-brown, SANDY FAT CLAY (CH), with few small gravels RESIDUAL CLAY			RV
4					Very dense, moist, light brown, VERY CLAYEY, MEDIUM TO FINE SAND (SC), with some gravels (est. 15 - 20% gravel, up to 4" in size); drive sample attempt at 5 ft on gravel; no penetration/50 blows LINDAVISTA FORMATION			
6	2	PB						
8	3	BK						
10					Very dense, moist, gray CLAYEY COARSE TO FINE SAND (SC) with some small gravels (est. <5% gravel)			
10.5	4	S	100/4"					
12	5	BK				12.2	CL PH RS SA SL	
14					Very dense, moist, light brown, SILTY MEDIUM TO FINE SAND (SM)			
15.5	6	C	80/6"					
20.5	7	S	80/6"		BOTTOM OF BORING at 20½ feet No free groundwater encountered at time of excavation Backfilled with cuttings; patched with concrete			

Descriptions on this boring log apply only at the specific boring location and at the time the boring was made. The descriptions on this log are not warranted to be representative of subsurface conditions at other locations or times.

PROJECT NO.: **1910**	**MIRAMAR ROAD PIPELINE**	FIGURE: **A - 5, Page 1 of 1**

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BORING LOG

LOGGED BY: **J. Brown**	DATE DRILLED: **4/12/00**	BORING ELEVATION: **419.0 feet**	BORING NO.: **B - 5**
DRILL RIG: **CME 85**	BORING DIAMETER: **8 inches**	HAMMER WT.: **140 lbs** DROP: **30 in**	

DEPTH (feet)	SAMPLE NO.	TYPE	BLOWS/FOOT	GROUNDWATER	DESCRIPTION	MOISTURE CONTENT %	DRY DENSITY (pcf)	OTHER TESTS
					12" Asphalt Concrete			
1					Moist, light brown, poorly graded SAND (SP), with many small gravels BASE			
2					Moist, mottled gray-brown/reddish-brown and gray, LEAN TO FAT CLAY (CL/CH), with some small gravel FILL			
3	1	S	131*/10"		* sampler driven on gravel			
	2	BK						
4								
					Very dense, moist, light brown, VERY CLAYEY MEDIUM TO FINE SAND (SC), with few small gravels (<5% gravel, to 2" across), moderate cementation			
5	3	C	100/4"		no recovery from sampler LINDAVISTA FORMATION			
6								
7								
	4	BK						
8								
9								
10	5	C	100/3"		no recovery from sampler			
11								
	6	PB						
12								
13								
					Hard, moist, gray with reddish-brown mottles, SANDY LEAN CLAY (CL), with some gravels			
14								
15	7	S	100/3"					
					large gravel slow drilling below 15½ feet			
16								
17	8	BK						
18								
19					Very dense, moist, light brown to light gray, SILTY MEDIUM TO FINE SAND (SM)			
20	9	C	100/4"		BOTTOM OF BORING at 20½ feet No free groundwater encountered at time of excavation Backfilled with cuttings; patched with concrete			

Descriptions on this boring log apply only at the specific boring location and at the time the boring was made. The descriptions on this log are not warranted to be representative of subsurface conditions at other locations or times.

PROJECT NO.: **1910**	**MIRAMAR ROAD PIPELINE**	FIGURE: **A - 6, Page 1 of 1**

BORING LOG

LOGGED BY: **J. Brown**	DATE DRILLED: **4/13/00**	BORING ELEVATION: **417.8 feet**	BORING NO.:
DRILL RIG: **CME 85**	BORING DIAMETER: **8 inches**	HAMMER WT.: **140 lbs** DROP: **30 in**	**B - 6**

DEPTH (feet)	SAMPLE NO.	TYPE	BLOWS/FOOT	GROUNDWATER	DESCRIPTION	MOISTURE CONTENT %	DRY DENSITY (pcf)	OTHER TESTS
					10" Asphalt Concrete			
1					Moist, gray-brown, SILTY MEDIUM TO FINE SAND (SM), with some rock fragments FILL			
2								
	1	S	16					
3					Moist, dark gray-brown, FINE SANDY LEAN TO FAT CLAY (CL/CH)			
4	2	BK						
5								
	3	C	30		Moist, dark reddish-brown, FINE SANDY LEAN TO FAT CLAY (CL/CH), with trace small (<1" in size) gravel			
6								
7								
8								
9	4	BK						
10					moist, dark gray-brown, FINE SANDY LEAN TO FAT CLAY (CL/CH), with coarse sand-sized pieces of yellowish-brown sandstone			
	5	S	20					
11								
12								
13								
	6	PB						
14								
15								
	7	C	70					
16								
17								
	8	PB						
18								
19				▽	groundwater encountered at 19½ feet			
20					Dense, wet, dark gray-brown, VERY SILTY COARSE TO FINE SAND (SM) ALLUVIUM			
	9	S	70/6"					

Descriptions on this boring log apply only at the specific boring location and at the time the boring was made. The descriptions on this log are not warranted to be representative of subsurface conditions at other locations or times.

PROJECT NO.: **1910**	**MIRAMAR ROAD PIPELINE**	FIGURE: **A - 7, Page 1 of 2**

GROUP DELTA CONSULTANTS, INC.
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BORING LOG

LOGGED BY: **J. Brown**	DATE DRILLED: **4/13/00**	BORING ELEVATION: **417.8 feet**	BORING NO.:
DRILL RIG: **CME 85**	BORING DIAMETER: **8 inches**	HAMMER WT.: **140 lbs** DROP: **30 in**	**B - 6**

DEPTH (feet)	SAMPLE NO.	TYPE	BLOWS/FOOT	GROUNDWATER	DESCRIPTION	MOISTURE CONTENT %	DRY DENSITY (pcf)	OTHER TESTS
	9	S	70/6"		Dense, wet, dark gray-brown, VERY SILTY COARSE TO FINE SAND (SM) ALLUVIUM			
21								
22					— with some gravel			
23								
24								
25	10	S	60/5"		Very dense, wet, dark brown, CLAYEY COARSE TO FINE SAND (SC), with many clasts of yellowish sandstone			
26					Very dense, moist, interlayered pale gray and yellowish-brown, VERY CLAYEY FINE SAND (SC), with zones of FINE SANDY LEAN CLAY (CL) LINDAVISTA FORMATION			
27								
28								
29								
30	11	S	50/6"					
31					BOTTOM OF BORING at 30½ feet Groundwater in alluvium (19½ to 26 feet) Backfilled with cuttings; patched with concrete			
32								
33								
34								
35								
36								
37								
38								
39								
40								

Descriptions on this boring log apply only at the specific boring location and at the time the boring was made. The descriptions on this log are not warranted to be representative of subsurface conditions at other locations or times.

PROJECT NO.: **1910** | **MIRAMAR ROAD PIPELINE** | FIGURE: **A - 7, Page 2 of 2**

BORING LOG

LOGGED BY: **J. Brown**	DATE DRILLED: **4/13/00**	BORING ELEVATION: **429.5 feet**	BORING NO.:
DRILL RIG: **CME 85**	BORING DIAMETER: **8 inches**	HAMMER WT.: **140 lbs** DROP: **30 in**	**B - 7**

DEPTH (feet)	SAMPLE NO.	TYPE	BLOWS/FOOT	GROUNDWATER	DESCRIPTION	MOISTURE CONTENT %	DRY DENSITY (pcf)	OTHER TESTS
					8" Asphalt Concrete			
1					Moist, yellowish-brown, SILTY MEDIUM TO FINE SAND (SM) FILL			
2	1	S	47					
3					Moist, mottled dark brown, dark gray-brown, and reddish-brown, CLAYEY COARSE TO FINE SAND (SC), with few small (<2" in size) gravel			
4	2	PB						
5	3	C	55* 6"		* sampler driven on gravel; no recovery			
6								
7								
8	4	BK				14.1		CL PH PI RS SA SL
9								
10	5	S	30					
11								
12					primarily dark gray-brown to dark brown color			
13	6	BK						
14								
15	7	C	55					
16					Hard, moist, olive-gray with brown mottles, FAT CLAY (CH), with trace fine sand LINDAVISTA FORMATION			
17								
18								
19					Very dense, moist, yellowish-brown, CLAYEY FINE SAND (SC), with many small (<2" in size) gravels			
20					drive sample attempt at 20 feet; no penetration/50 blows; probably on gravel			

Descriptions on this boring log apply only at the specific boring location and at the time the boring was made. The descriptions on this log are not warranted to be representative of subsurface conditions at other locations or times.

PROJECT NO.: **1910**	**MIRAMAR ROAD PIPELINE**	FIGURE: **A - 8, Page 1 of 2**

BORING LOG

LOGGED BY: **J. Brown**	DATE DRILLED: **4/13/00**	BORING ELEVATION: **429.5 feet**	BORING NO.: **B - 7**
DRILL RIG: **CME 85**	BORING DIAMETER: **8 inches**	HAMMER WT.: **140 lbs** DROP: **30 in**	

DEPTH (feet)	SAMPLE NO.	TYPE	BLOWS/FOOT	GROUNDWATER	DESCRIPTION	MOISTURE CONTENT %	DRY DENSITY (pcf)	OTHER TESTS
					<u>LINDAVISTA FORMATION</u>			
21					Very dense, moist, yellowish-brown, CLAYEY FINE SAND (SC), with many small (<2" in size) gravels			
	8	PB						
22								
23								
24								
25	9	S	50/2"					
					BOTTOM OF BORING at 25¼ feet No free groundwater encountered at time of excavation Backfilled with cuttings; patched with concrete			
26								
27								
28								
29								
30								
31								
32								
33								
34								
35								
36								
37								
38								
39								
40								

Descriptions on this boring log apply only at the specific boring location and at the time the boring was made. The descriptions on this log are not warranted to be representative of subsurface conditions at other locations or times.

PROJECT NO.: **1910**	**MIRAMAR ROAD PIPELINE**	FIGURE: **A - 8, Page 2 of 2**

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B O R I N G L O G

LOGGED BY: **J. Brown**	DATE DRILLED: **4/14/00**	BORING ELEVATION: **480.4 feet**	BORING NO.: **B - 8**
DRILL RIG: **CME 85**	BORING DIAMETER: **8 inches**	HAMMER WT.: **140 lbs** DROP: **30 in**	

DEPTH (feet)	SAMPLE NO.	TYPE	BLOWS/FOOT	GROUNDWATER	DESCRIPTION	MOISTURE CONTENT %	DRY DENSITY (pcf)	OTHER TESTS
					8" Asphalt Concrete			
1					Moist, brown, CLAYEY MEDIUM TO FINE SAND (SC), with many small rock fragments FILL drive sample attempt at 1½ feet; no penetration/50 blows			
2	1	BK			Moist, brown, CLAYEY FINE SAND (SC) ↓			
3					Hard, moist, reddish-brown LEAN CLAY (CL) RESIDUAL CLAY			
4					Very dense, moist, yellowish-brown to gray, CLAYEY MEDIUM TO FINE SAND (SC), with some gravels (est. 20% gravel, up to 6" in size) well cemented; very difficult drilling no drive sample attempt at 5 feet due to dense, gravelly material			
5								
6					LINDAVISTA FORMATION			
7	2	BK				7.8		CL PH RS SL
8								
9								
10	3	S	90/6"					
11								
12								
13	4	PB						
14					drive sample attempt at 15 feet; no penetration/50 blows			
15					BOTTOM OF BORING at 15 feet No free groundwater encountered at time of excavation Backfilled with cuttings; patched with concrete			
16								
17								
18								
19								
20								

Descriptions on this boring log apply only at the specific boring location and at the time the boring was made. The descriptions on this log are not warranted to be representative of subsurface conditions at other locations or times.

PROJECT NO.: **1910**	**MIRAMAR ROAD PIPELINE**	FIGURE: **A - 9, Page 1 of 1**

GROUP DELTA CONSULTANTS, INC.
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B O R I N G   L O G

LOGGED BY: **J. Brown**	DATE DRILLED: **4/14/00**	BORING ELEVATION: **512.3 feet**	BORING NO.:
DRILL RIG: **CME 85**	BORING DIAMETER: **8 inches**	HAMMER WT.: **140 lbs** DROP: **30 in**	**B - 9**

DEPTH (feet)	SAMPLE NO.	TYPE	BLOWS/FOOT	GROUNDWATER	D E S C R I P T I O N	MOISTURE CONTENT %	DRY DENSITY (pcf)	OTHER TESTS
					6" Asphalt Concrete			
1	1	S	60 4"		Moist, brown, SILTY COARSE TO FINE SAND (SM), with some small (<1" in size) rock fragments FILL			
2	2	PB						
3								
4	3	BK			Hard, moist, reddish-brown, SANDY FAT CLAY (CH) RESIDUAL CLAY			RV
5								
6	4	C	80		no recovery from sampler			
7	5	BK			Very dense, moist, gray-brown, VERY CLAYEY MEDIUM TO FINE SAND (SC) LINDAVISTA FORMATION			
8					Very dense, moist, light brown, CLAYEY MEDIUM TO FINE SAND (SC), with some gravel (est. 20% gravel, up to 2" in size) moderately to well cemented			
9								
10	6	S	100 3"					
11	7	BK						
12								
13								
14								
15	8	S	80 6"					
16					BOTTOM OF BORING at 15½ feet No free groundwater encountered at time of excavation Backfilled with cuttings; patched with concrete			
17								
18								
19								
20								

Descriptions on this boring log apply only at the specific boring location and at the time the boring was made. The descriptions on this log are not warranted to be representative of subsurface conditions at other locations or times.

PROJECT NO.: **1910**	**MIRAMAR ROAD PIPELINE**	FIGURE: **A - 10, Page 1 of 1**

GROUP DELTA CONSULTANTS, INC.
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B O R I N G   L O G

LOGGED BY: **J. Brown**	DATE DRILLED: **6/7/00**	BORING ELEVATION: **388.0 feet**	BORING NO.:
DRILL RIG: **CME 85**	BORING DIAMETER: **8 inches**	HAMMER WT.: **140 lbs** DROP: **30 in**	**B - 1 0**

DEPTH (feet)	SAMPLE NO.	TYPE	BLOWS/FOOT	GROUNDWATER	DESCRIPTION	MOISTURE CONTENT %	DRY DENSITY (pcf)	OTHER TESTS
					4" Asphalt Concrete			
1	1	PB			Moist, yellowish-brown, SILTY MEDIUM TO FINE SAND (SM), with gravel (est. 20% gravel up to 3/4" in size) <u>BASE/FILL</u>			
2	2	BK			Hard, moist, dark reddish-brown, FAT CLAY (CH) <u>RESIDUAL CLAY</u>			
3	3	S	105		Very dense, moist, light brown, SILTY MEDIUM TO FINE SAND (SM) with zones of moderate cementation <u>LINDAVISTA FORMATION</u>			
4								
5	4	C	79/10"		Very dense, moist, light reddish-brown, CLAYEY COARSE TO FINE SAND (SC)	8.2	105.9	
6								
7								
8								
9	5	BK						SA
10								
11	6	S	41					
12					Dense, moist, light yellowish-brown, CLAYEY MEDIUM TO FINE SAND (SC)			
13								
14					– with trace gravel up to 3" in size			
15								
16	7	C	62		Very dense, moist, light reddish-brown, CLAYEY MEDIUM TO FINE SAND (SC)			
17								
18								
19								
20								
	8	S	90		BOTTOM OF BORING at 21 feet No free groundwater encountered at time of excavation Backfilled with cuttings; patched with asphalt			

Descriptions on this boring log apply only at the specific boring location and at the time the boring was made. The descriptions on this log are not warranted to be representative of subsurface conditions at other locations or times.

PROJECT NO.: **1910**	**MIRAMAR ROAD PIPELINE**	FIGURE: **A - 11, Page 1 of 1**

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BORING LOG

LOGGED BY: **J. Brown**	DATE DRILLED: **6/7/00**	BORING ELEVATION: **386.5 feet**	BORING NO.:
DRILL RIG: **CME 85**	BORING DIAMETER: **8 inches**	HAMMER WT.: **140 lbs** DROP: **30 in**	**B - 11**

DEPTH (feet)	SAMPLE NO.	TYPE	BLOWS/FOOT	GROUNDWATER	DESCRIPTION	MOISTURE CONTENT %	DRY DENSITY (pcf)	OTHER TESTS
					2½" Asphalt Concrete			
1	1	PB			Moist, light yellowish-brown, SILTY MEDIUM TO FINE SAND (SM), with gravel (est. 20% gravel up to 3/4" in size) BASE/FILL			
2					Moist, dark brown, SILTY MEDIUM TO FINE SAND (SM) FILL			
	2	S	64					
3					Moist, gray-brown, CLAYEY COARSE TO FINE SAND (SM)			
4	3	BK			Very dense, moist, pale reddish-brown, CLAYEY COARSE TO FINE SAND (SC) LINDAVISTA FORMATION			
5	4	C	82		Very dense, moist, reddish-gray to gray-brown, CLAYEY COARSE TO FINE SAND (SC)	10.4	109.8	
6								
7								
8								
9	5	BK						
10								
11	6	S	41		Dense, moist, light reddish-brown, SILTY FINE SAND (SM)			
12	7	BK			Dense, moist, light brown, SILTY MEDIUM TO FINE SAND (SM)			
13								
14								
15								
16	8	C	79 11"					
17					change to pale gray with reddish-brown mottles			
18								
19								
20								
	9	S	69		BOTTOM OF BORING at 21½ feet No free groundwater encountered at time of excavation Backfilled with cuttings; patched with asphalt			

Descriptions on this boring log apply only at the specific boring location and at the time the boring was made. The descriptions on this log are not warranted to be representative of subsurface conditions at other locations or times.

PROJECT NO.: **1910**	**MIRAMAR ROAD PIPELINE**	FIGURE: **A - 12, Page 1 of 1**

GROUP DELTA CONSULTANTS, INC.
Engineers and Geologists

BORING LOG

LOGGED BY: **J. Brown**	DATE DRILLED: **6/5/00**	BORING ELEVATION: **492.2 feet**	BORING NO.:
DRILL RIG: **CME 85**	BORING DIAMETER: **8 inches**	HAMMER WT.: **140 lbs** DROP: **30 in**	**B - 12**

DEPTH (feet)	SAMPLE NO.	TYPE	BLOWS/FOOT	GROUNDWATER	DESCRIPTION	MOISTURE CONTENT %	DRY DENSITY (pcf)	OTHER TESTS
1	1	S	24		Moist, gray-brown to dark gray-brown, CLAYEY COARSE TO FINE SAND (SC), with many gravels (est. 15 to 20% gravel up to 6" in size) FILL			
2								
3								
4	2	C	34			11.8	113.9	
5					Moist, brown, very CLAYEY COARSE TO FINE SAND (SC), with many gravels (est. 20 to 25% gravel, up to 8" in size)			
6	3	BK						SA
7								
8								
9	4	S	26					
10	5	BK						
11								
12					Very dense, moist, yellowish to reddish-brown, CLAYEY MEDIUM TO FINE SAND (SC), with many gravels (est. 30 to 40% gravel up to 8" across) STADIUM CONGLOMERATE			
13								
14	6	C	50/5"		— on rock - no recovery			
15	7	C	68/6"		— sampler driven through gravels (relatively disturbed)			
16								
17					Dense, moist, yellowish-brown, CLAYEY MEDIUM TO FINE SAND (SC), with reddish-brown mottles			
18								
19	8	S	42					
20								

Descriptions on this boring log apply only at the specific boring location and at the time the boring was made. The descriptions on this log are not warranted to be representative of subsurface conditions at other locations or times.

PROJECT NO.: **1910**	**MIRAMAR ROAD PIPELINE**	FIGURE: **A - 13, Page 1 of 2**

GROUP DELTA CONSULTANTS, INC.
Engineers and Geologists

BORING LOG

LOGGED BY: **J. Brown**	DATE DRILLED: **6/5/00**	BORING ELEVATION: **492.2 feet**	BORING NO.:
DRILL RIG: **CME 85**	BORING DIAMETER: **8 inches**	HAMMER WT.: **140 lbs** DROP: **30 in**	**B - 12**

DEPTH (feet)	SAMPLE NO.	TYPE	BLOWS/FOOT	GROUNDWATER	DESCRIPTION	MOISTURE CONTENT %	DRY DENSITY (pcf)	OTHER TESTS
21					STADIUM CONGLOMERATE Dense, moist, yellowish-brown, CLAYEY MEDIUM TO FINE SAND (SC) with reddish-brown mottles			
22					Very dense, moist, yellowish-brown, CLAYEY GRAVEL WITH SAND (GC) (est. 40 to 50% gravel up to 8" in size)			
23								
	8	C	50/5"					
24								
25					BOTTOM OF BORING at 24 feet No free groundwater encountered at time of excavation Backfilled with cuttings			
26								
27								
28								
29								
30								
31								
32								
33								
34								
35								
36								
37								
38								
39								
40								

Descriptions on this boring log apply only at the specific boring location and at the time the boring was made. The descriptions on this log are not warranted to be representative of subsurface conditions at other locations or times.

PROJECT NO.: **1910**	**MIRAMAR ROAD PIPELINE**	FIGURE: **A - 13, Page 2 of 2**

GROUP DELTA CONSULTANTS, INC.
Engineers and Geologists

BORING LOG

LOGGED BY: **J. Brown**	DATE DRILLED: **6/5/00**	BORING ELEVATION: **494.5 feet**	BORING NO.:
DRILL RIG: **CME 85**	BORING DIAMETER: **8 inches**	HAMMER WT.: **140 lbs** DROP: **30 in**	**B - 13**

DEPTH (feet)	SAMPLE NO.	TYPE	BLOWS/FOOT	GROUNDWATER	DESCRIPTION	MOISTURE CONTENT %	DRY DENSITY (pcf)	OTHER TESTS
1	1	S	23		Moist, light brown to yellowish-brown, CLAYEY MEDIUM TO FINE SAND (SC), with some gravels (est. 15 to 20% gravel up to 6" in size) FILL			
2								
3								
4								
5	2	C	15			10.3	106.0	
6	3	BK			Moist, mottled yellowish-brown, gray-brown, and reddish-brown, CLAYEY MEDIUM TO FINE SAND (SC), with some gravels (est. 5 to 10% gravel up to 4" in size)			SA
7								
8								
9								
10	4	S	9					
11					Moist, dark reddish-brown, SILTY TO CLAYEY MEDIUM TO FINE SAND (SC), with some gravel (est. 15 to 20% gravel up to 3" in size)			
12								
13					Very dense, moist, yellowish-brown, CLAYEY GRAVEL WITH SAND (GM), with reddish-brown mottles (est. 50 to 60% gravel up to 6" in size) STADIUM CONGLOMERATE			
14								
15	5	C	50 5"					
16								
17								
18								
19								
20	6	S	87		BOTTOM OF BORING at 21 feet No free groundwater encountered at time of excavation Backfilled with cuttings			

PROJECT NO.: **1910**	**MIRAMAR ROAD PIPELINE**	FIGURE: **A - 14, Page 1 of 1**

B O R I N G   L O G

LOGGED BY: **J. Brown**	DATE DRILLED: **6/5/00**	BORING ELEVATION: **495.9 feet**	BORING NO.:
DRILL RIG: **CME 85**	BORING DIAMETER: **8 inches**	HAMMER WT.: **140 lbs** DROP: **30 in**	**B - 1 4**

DEPTH (feet)	SAMPLE NO.	TYPE	BLOWS/FOOT	GROUND-WATER	DESCRIPTION	MOISTURE CONTENT %	DRY DENSITY pcf	OTHER TESTS
1	1	S	22		Loose to medium dense, moist, light reddish-brown, SILTY MEDIUM TO FINE SAND (SM), with trace clay and some gravel (est. 15 to 20% gravel up to 8" in size) TOPSOIL			
2								
3					Very dense, moist, light reddish-brown, SILTY TO CLAYEY MEDIUM TO FINE SAND (SM/SC), with many gravels (est. 20 to 25% gravel up to 6" in size) STADIUM CONGLOMERATE			
4	2	BK						
5					drive sample attempt at 5 feet on gravel; no advance/50 blows			
6								
7					Dense, moist, yellowish-brown, CLAYEY MEDIUM TO FINE SAND (SC)			
8								
9	3	BK						
10	4	C	65/8"		sampler driven on gravel			
11	5	BK			Very dense, moist, yellowish-brown with reddish-brown mottles, CLAYEY GRAVEL (GC) (est. 40 to 50% gravel up to 8" in size)			SA
12								
13								
14								
15	6	S	86/9"					
16								
17								
18								
19								
20	7	C	94/10"		BOTTOM OF BORING at 20¾ feet No free groundwater encountered at time of excavation Backfilled with cuttings			

Descriptions on this boring log apply only at the specific boring location and at the time the boring was made. The descriptions on this log are not warranted to be representative of subsurface conditions at other locations or times.

PROJECT NO.: **1910**	**MIRAMAR ROAD PIPELINE**	FIGURE: **A - 15, Page 1 of 1**

GROUP DELTA CONSULTANTS, INC.
Engineers and Geologists

BORING LOG

LOGGED BY: **J. Brown**	DATE DRILLED: **6/5/00**	BORING ELEVATION: **513.0 feet**	BORING NO.:
DRILL RIG: **CME 85**	BORING DIAMETER: **8 inches**	HAMMER WT.: **140 lbs** DROP: **30 in**	**B - 15**

DEPTH (feet)	SAMPLE NO.	TYPE	BLOWS/FOOT	GROUND-WATER	DESCRIPTION	MOISTURE CONTENT %	DRY DENSITY pcf	OTHER TESTS
					3¾" AC over 4" yellowish-brown SILTY GRAVEL WITH SAND (GM) PAVEMENT SECTION			
1					Moist, yellowish-brown, CLAYEY MEDIUM TO FINE SAND (SC), with few gravel (est. 5% gravel to 1" in size)			
2	1	S	33		5" AC over 4" black, SILTY GRAVEL WITH SAND (GM)			
3				▽	Moist, black, SILTY COARSE TO FINE SAND (SM), with few to some small gravel FILL			
4	2	C	21		— wet, perched water zone			
5					Moist, yellowish-brown to brown, CLAYEY MEDIUM TO FINE SAND (SC), with many gravels and local zones of SANDY LEAN CLAY (CL) with many gravel (est. 25 to 30% gravel up to 4" in size)			
6								
7								
8								
9	3	S	22					
10								
11								
12								
13					Moist, very dark, very CLAYEY COARSE TO FINE SAND (SC), with few gravels			
14	4	C	25					
15								
16								
17					Very dense, moist, yellowish-brown, CLAYEY MEDIUM TO FINE SAND (SC), with many gravels (est. 30 to 40% gravel up to 5" in size) STADIUM CONGLOMERATE			
18								
19	5	S	50/4"					
20								

Descriptions on this boring log apply only at the specific boring location and at the time the boring was made. The descriptions on this log are not warranted to be representative of subsurface conditions at other locations or times.

PROJECT NO.: **1910**	**MIRAMAR ROAD PIPELINE**	FIGURE: **A - 16, Page 1 of 2**

GROUP DELTA CONSULTANTS, INC.
Engineers and Geologists

BORING LOG

LOGGED BY: **J. Brown**	DATE DRILLED: **6/5/00**	BORING ELEVATION: **513.0 feet**	BORING NO.:
DRILL RIG: **CME 85**	BORING DIAMETER: **8 inches**	HAMMER WT.: **140 lbs** DROP: **30 in**	**B - 1 5**

DEPTH (feet)	SAMPLE NO.	TYPE	BLOWS/FOOT	GROUND-WATER	DESCRIPTION	MOISTURE CONTENT %	DRY DENSITY pcf	OTHER TESTS
					STADIUM CONGLOMERATE			
21					Very dense, moist, yellowish-brown, CLAYEY MEDIUM TO FINE SAND (SC), with many gravels (est. 30 to 40% gravel up to 5" in size)			
22								
23								
24	6	C	80/6"			13.5	104.1	
25								
26	7	BK						SA
27								
28	8	S	60/6"					
29								
30								
31								
32								
33								
34	9	C	75/4"		no recovery			
35					BOTTOM OF BORING at 34½ feet Perched water zone 4 - 4¾ feet Backfilled with cuttings; patched with asphalt			
36								
37								
38								
39								
40								

Descriptions on this boring log apply only at the specific boring location and at the time the boring was made. The descriptions on this log are not warranted to be representative of subsurface conditions at other locations or times.

PROJECT NO.: **1910**	**MIRAMAR ROAD PIPELINE**	FIGURE: **A - 16, Page 2 of 2**

GROUP DELTA CONSULTANTS, INC.
Engineers and Geologists

BORING LOG

LOGGED BY: **J. Brown**	DATE DRILLED: **6/7/00**	BORING ELEVATION: **499.0 feet**	BORING NO.:
DRILL RIG: **CME 85**	BORING DIAMETER: **8 inches**	HAMMER WT.: **140 lbs** DROP: **30 in**	**B - 16**

DEPTH (feet)	SAMPLE NO.	TYPE	BLOWS/FOOT	GROUNDWATER	DESCRIPTION	MOISTURE CONTENT %	DRY DENSITY (pcf)	OTHER TESTS
	1	S	32		Moist, dark brown, CLAYEY GRAVEL WITH SAND (GC) FILL			
1					(est. 40% gravel up to 6" in size)			
2								
3	2	PB						
4								
5								
	3	C	32		no recovery - possibly pushed rock during drive			
6								
7				▽	Loose, moist, dark brown, SILTY MEDIUM TO FINE SAND (SM) ALLUVIUM - wet zone (perched water)			
8	4	C	7		Firm, moist, brown, FAT CLAY (CH)	27.0	92.6	
9								
	5	BK			- change to dark olive-gray color			
10					Firm, moist, olive-gray, SANDY LEAN TO FAT CLAY (CL/CH)			
11	6	S	49		Dense to very dense, moist, gray-brown with reddish-brown mottles, CLAYEY MEDIUM TO FINE SAND (SC) LINDAVISTA FORMATION			
12								
13					- with some gravel (est. 20% gravel up to 3" in size)			
14								
15					with trace gravel (est. <5% gravel)			
16	7	C	75			17.8	105.9	
	8	BK						
17								
18					Interbedded dense, moist, brown and gray-brown, CLAYEY MEDIUM TO FINE SAND (SC)			
19								
20								
	9	S	37					

Descriptions on this boring log apply only at the specific boring location and at the time the boring was made. The descriptions on this log are not warranted to be representative of subsurface conditions at other locations or times.

PROJECT NO.: **1910**	**MIRAMAR ROAD PIPELINE**	FIGURE: **A - 17, Page 1 of 2**

GROUP DELTA CONSULTANTS, INC.
Engineers and Geologists

BORING LOG

LOGGED BY: **J. Brown**	DATE DRILLED: **6/7/00**	BORING ELEVATION: **499.0 feet**	BORING NO.:
DRILL RIG: **CME 85**	BORING DIAMETER: **8 inches**	HAMMER WT.: **140 lbs** DROP: **30 in**	**B - 16**

DEPTH (feet)	SAMPLE NO.	TYPE	BLOWS/FOOT	GROUNDWATER	DESCRIPTION	MOISTURE CONTENT %	DRY DENSITY (pcf)	OTHER TESTS
					LINDAVISTA FORMATION			
21	9	S	37		Interbedded dense, moist, brown and gray-brown, CLAYEY MEDIUM TO FINE SAND (SC)			
22					Very dense, moist, dark yellowish-brown to gray-brown, SILTY MEDIUM TO FINE SAND (SM)			
23								
24								
25	10	C	85/9"					
26								
27					BOTTOM OF BORING at 26¼ feet Perched water zone 7½ - 8 feet Backfilled with cuttings			
28								
29								
30								
31								
32								
33								
34								
35								
36								
37								
38								
39								
40								

Descriptions on this boring log apply only at the specific boring location and at the time the boring was made. The descriptions on this log are not warranted to be representative of subsurface conditions at other locations or times.

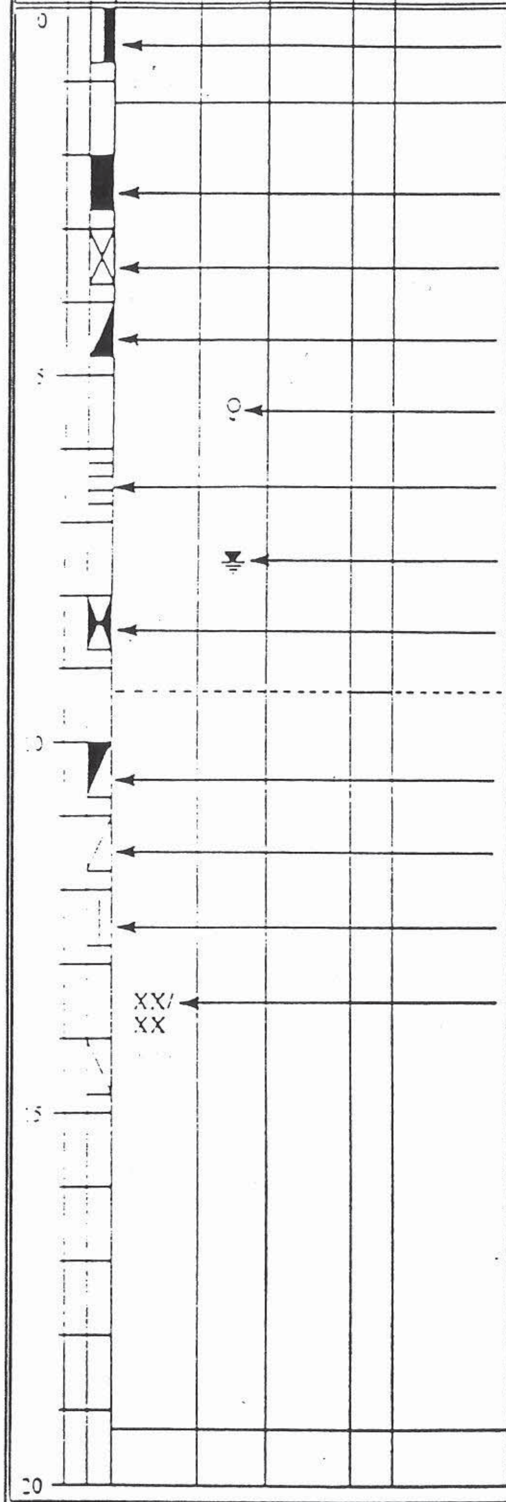
PROJECT NO.: **1910**	**MIRAMAR ROAD PIPELINE**	FIGURE: **A - 17, Page 2 of 2**

LOGS OF EXCAVATIONS
FROM
NINYO & MOORE
1994-95

TerraCosta
Consulting Group

DATE DRILLED ____________ BORING NO. SAMPLE
GROUND ELEVATION ____________ SHEET 1 OF 1
METHOD OF DRILLING ____________
DRIVE WEIGHT ____________ DROP ____________
SAMPLED BY ________ LOGGED BY ________ REVIEWED BY ________

DEPTH (feet)	SAMPLES Bulk Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION



Auger (A)

Solid line denotes formation change.

Modified split-barrel drive sampler (C)

No recovery with modified Split-Barrel Drive Sampler (B)

Dutch cone test (D)

Seepage

Rock Cores (E)

Groundwater

Piston (I)

Dashed line denotes lithologic change

Standard Penetration Test (P)

No recovery with a standard penetration test (T)

Shelby tube sample (R)

Distance pushed in inches/Length of sample recovered in inches.

No recovery with Shelby tube sampler (X)

Attitudes: Strike/Dip
b: Bedding
c: Contact
j: Joint
f: Fracture
F: Fault
cs: Clay Seam
s: Shear
bss: Basal Slide Surface
sf: Shear Fracture
sz: Shear Zone
sbs: Sheared Bedding Surface

The total depth line is a solid line that is drawn at the level of the last entry.

Ninyo & Moore

BORING LOG

EXPLANATION OF BORING LOG

PROJECT NO.	DATE	FIGURE
SAMPLE	Rev.9/94	