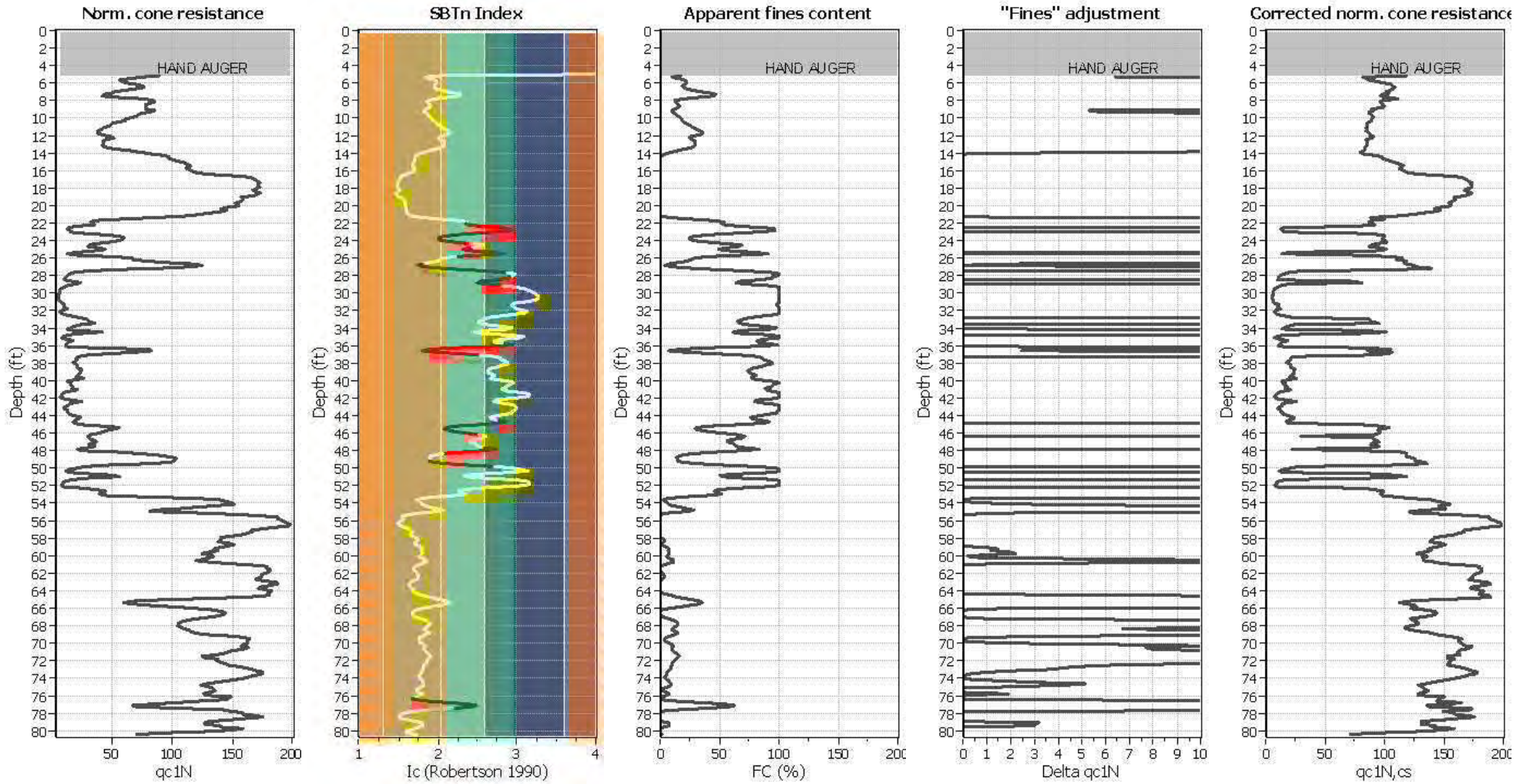


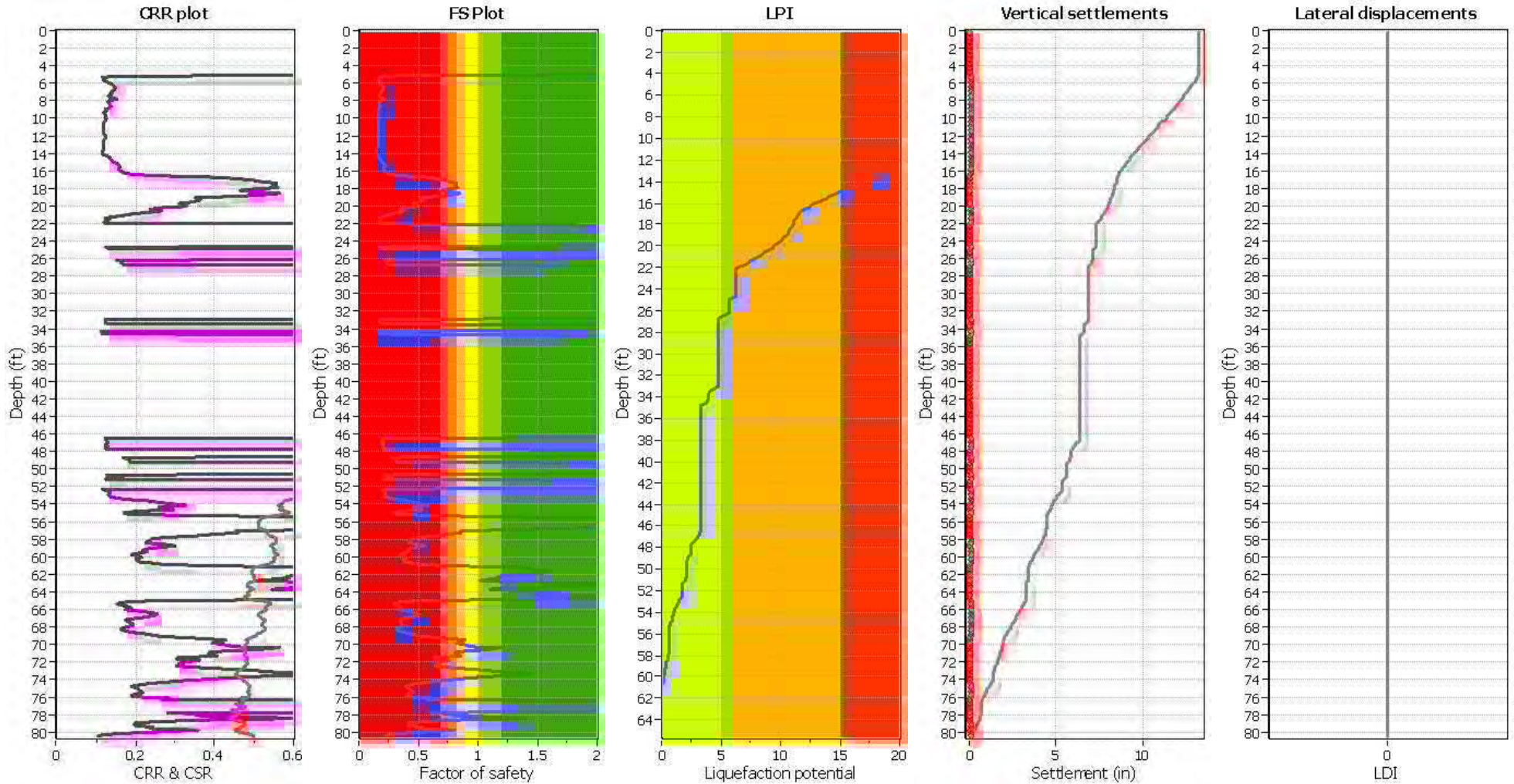
### Liquefaction analysis overall plots (intermediate res)



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>σ</sub> applied:	Yes
Earthquake magnitude M <sub>w</sub> :	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.59	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.00 ft	Fill height:	N/A	Limit depth:	N/A

### Liquefaction analysis overall plot



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on I <sub>c</sub> value	I <sub>c</sub> cut-off value:	2.60	K <sub>σ</sub> applied:	Yes
Earthquake magnitude M <sub>w</sub> :	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.59	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.00 ft	Fill height:	N/A	Limit depth:	N/A

**F.S. color scheme**

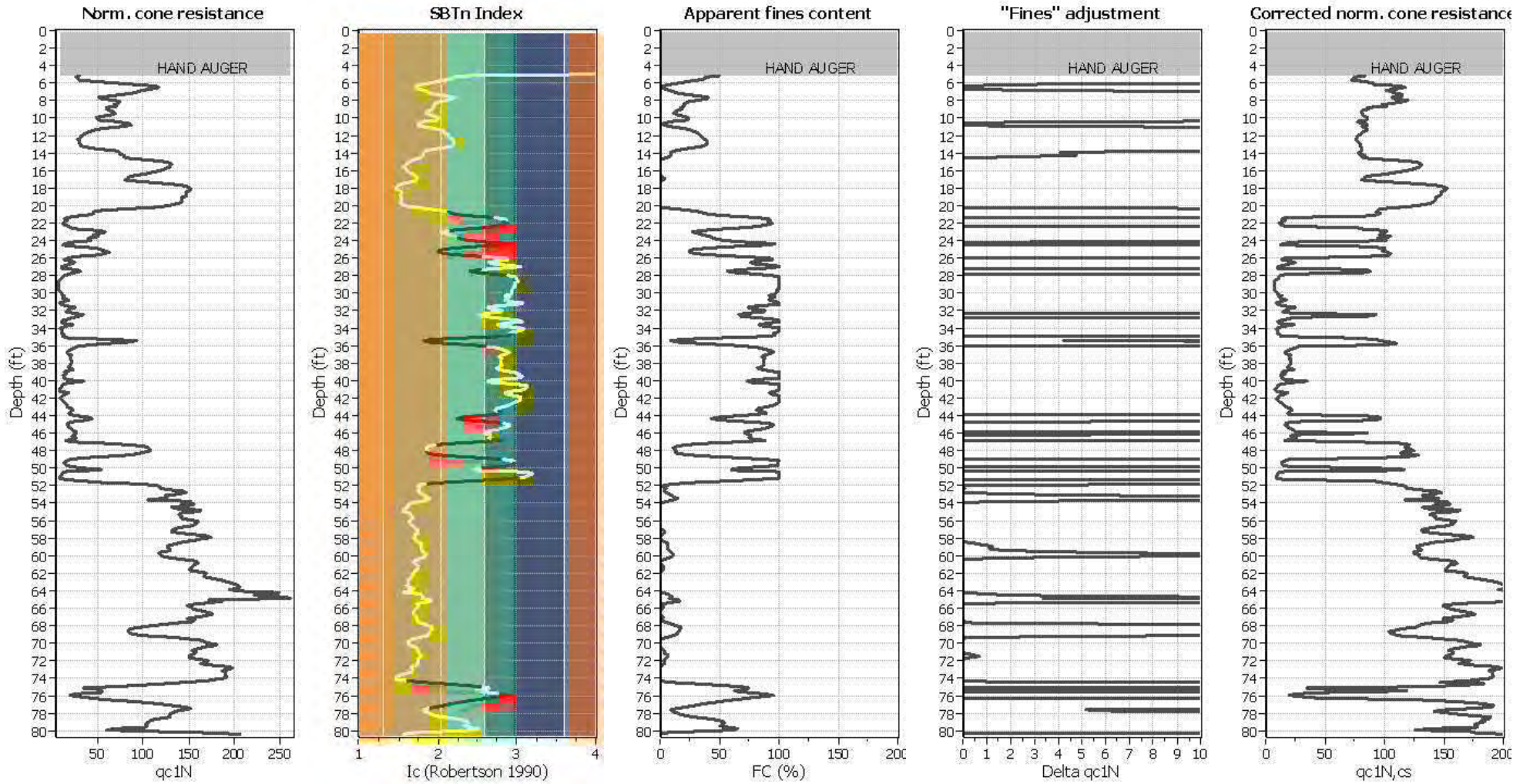
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

**LPI color scheme**

- Very high risk
- High risk
- Low risk



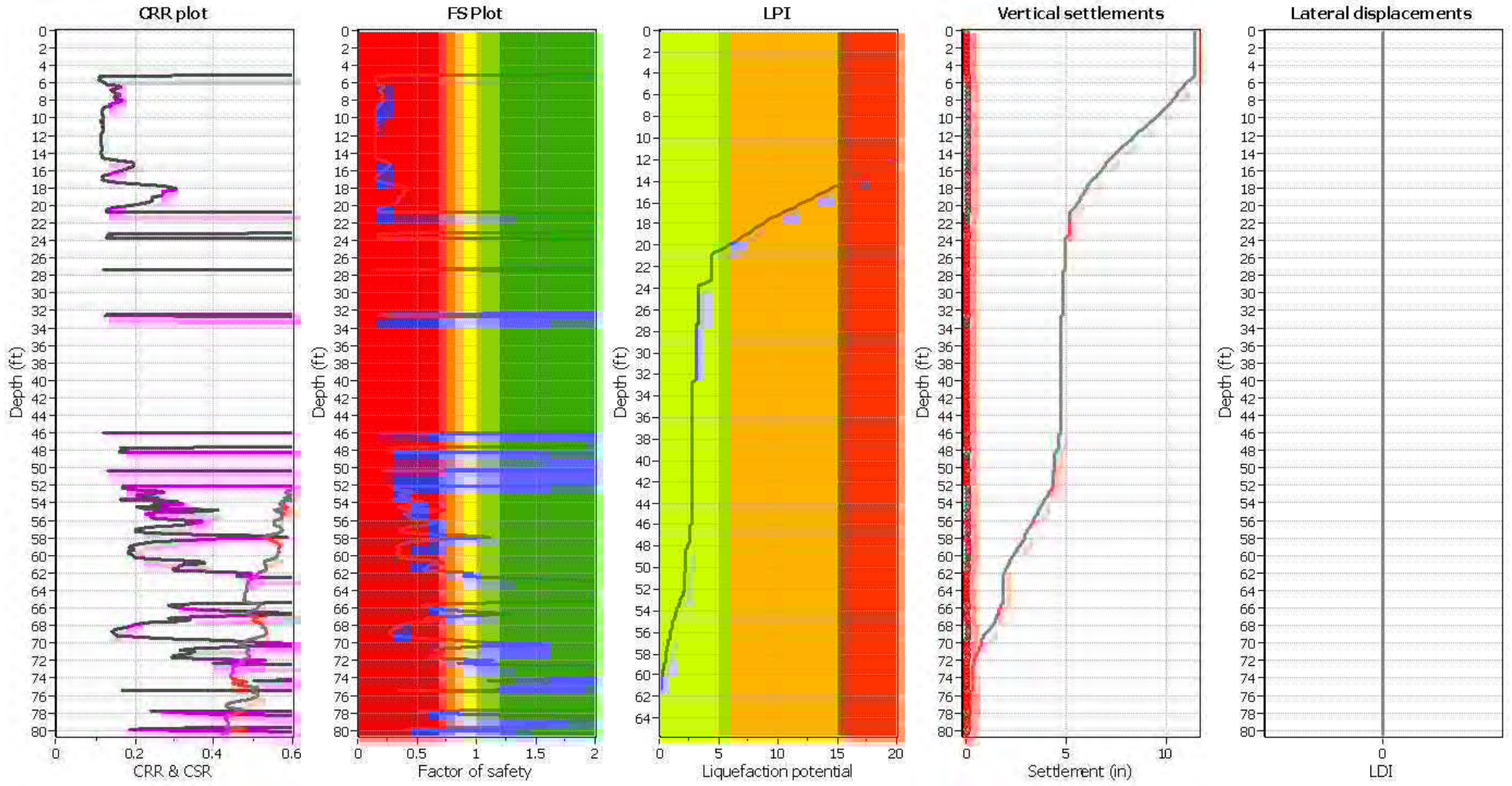
### Liquefaction analysis overall plots (intermediate res)



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>σ</sub> applied:	Yes
Earthquake magnitude M <sub>w</sub> :	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.59	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.00 ft	Fill height:	N/A	Limit depth:	N/A

### Liquefaction analysis overall plot



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on I <sub>c</sub> value	I <sub>c</sub> cut-off value:	2.60	K <sub>σ</sub> applied:	Yes
Earthquake magnitude M <sub>w</sub> :	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.59	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.00 ft	Fill height:	N/A	Limit depth:	N/A

**F.S. color scheme**

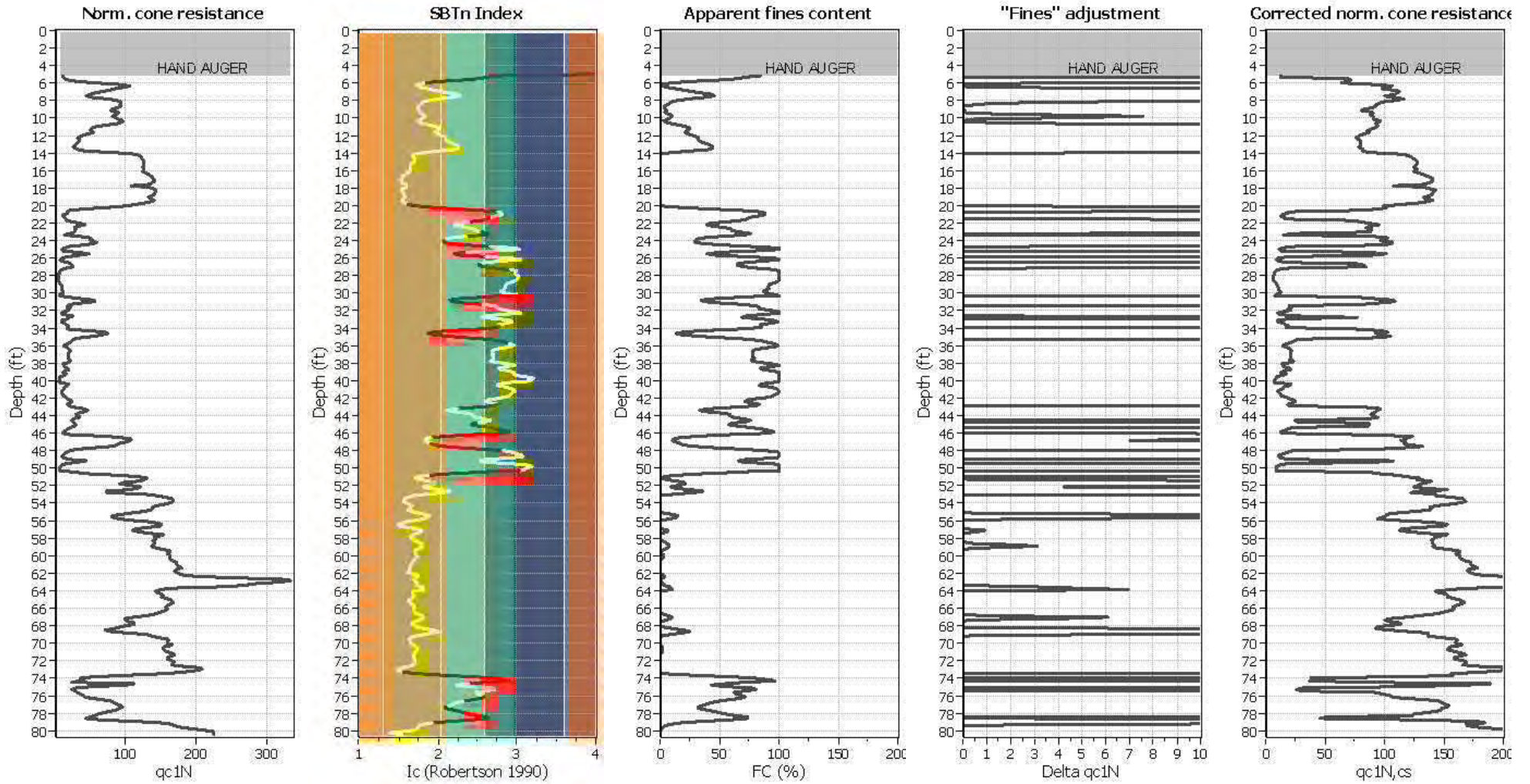
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

**LPI color scheme**

- Very high risk
- High risk
- Low risk



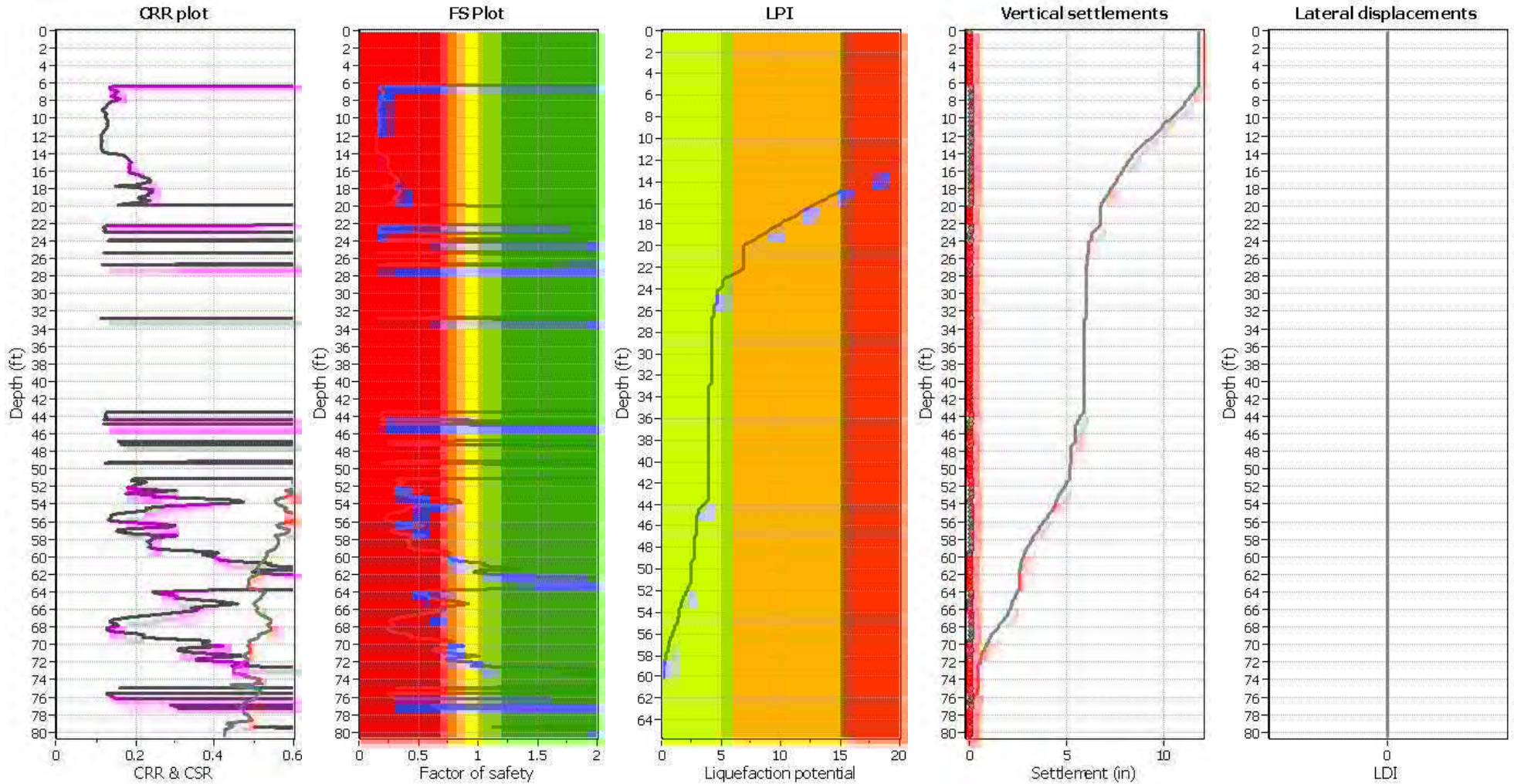
### Liquefaction analysis overall plots (intermediate res)



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>σ</sub> applied:	Yes
Earthquake magnitude M <sub>w</sub> :	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.59	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.00 ft	Fill height:	N/A	Limit depth:	N/A

### Liquefaction analysis overall plot



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on I <sub>c</sub> value	I <sub>c</sub> cut-off value:	2.60	K <sub>σ</sub> applied:	Yes
Earthquake magnitude M <sub>w</sub> :	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.59	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.00 ft	Fill height:	N/A	Limit depth:	N/A

**F.S. color scheme**

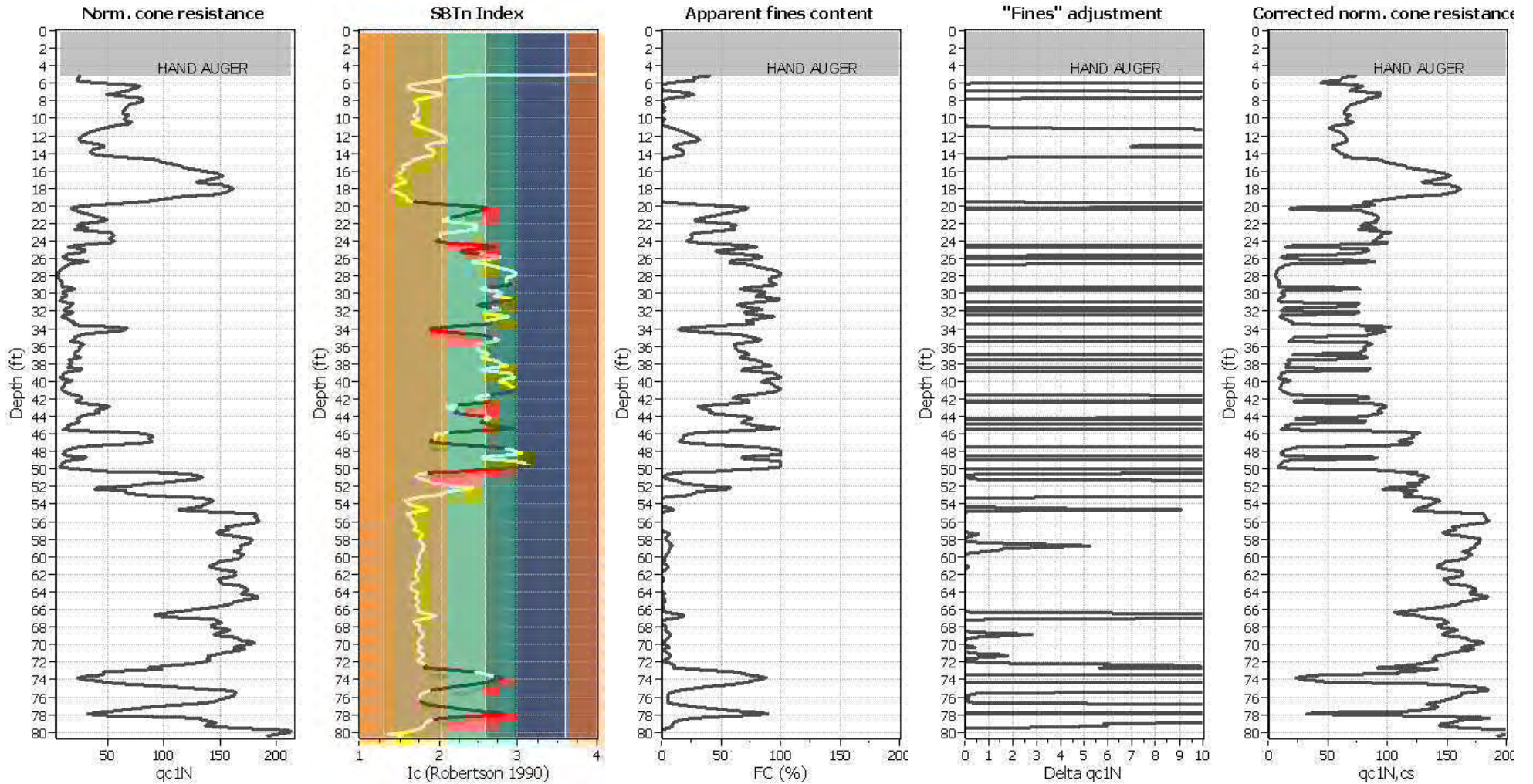
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

**LPI color scheme**

- Very high risk
- High risk
- Low risk



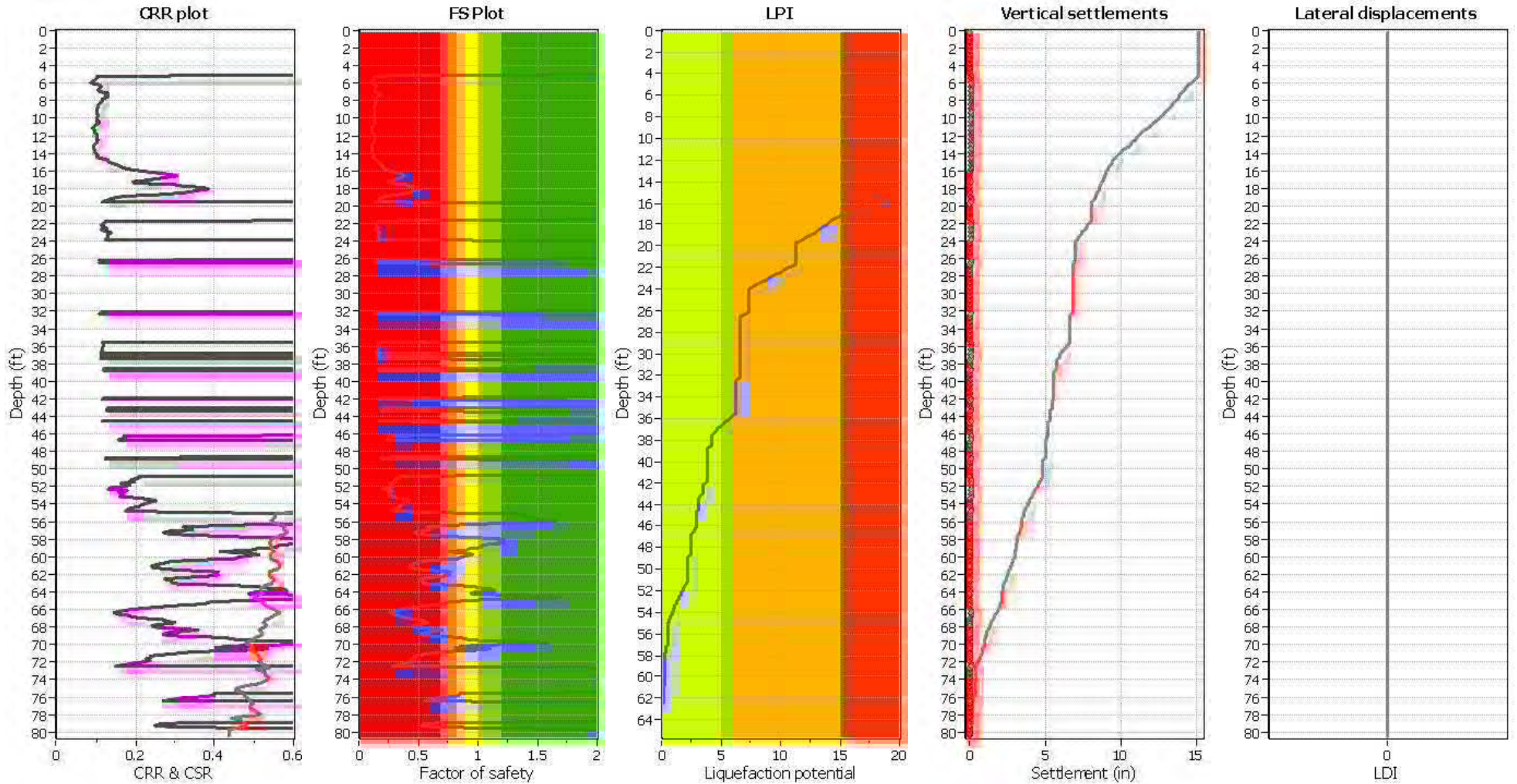
### Liquefaction analysis overall plots (intermediate res)



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>σ</sub> applied:	Yes
Earthquake magnitude M <sub>w</sub> :	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.59	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.00 ft	Fill height:	N/A	Limit depth:	N/A

### Liquefaction analysis overall plot



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on I <sub>c</sub> value	I <sub>c</sub> cut-off value:	2.60	K <sub>σ</sub> applied:	Yes
Earthquake magnitude M <sub>w</sub> :	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.59	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.00 ft	Fill height:	N/A	Limit depth:	N/A

**F.S. color scheme**

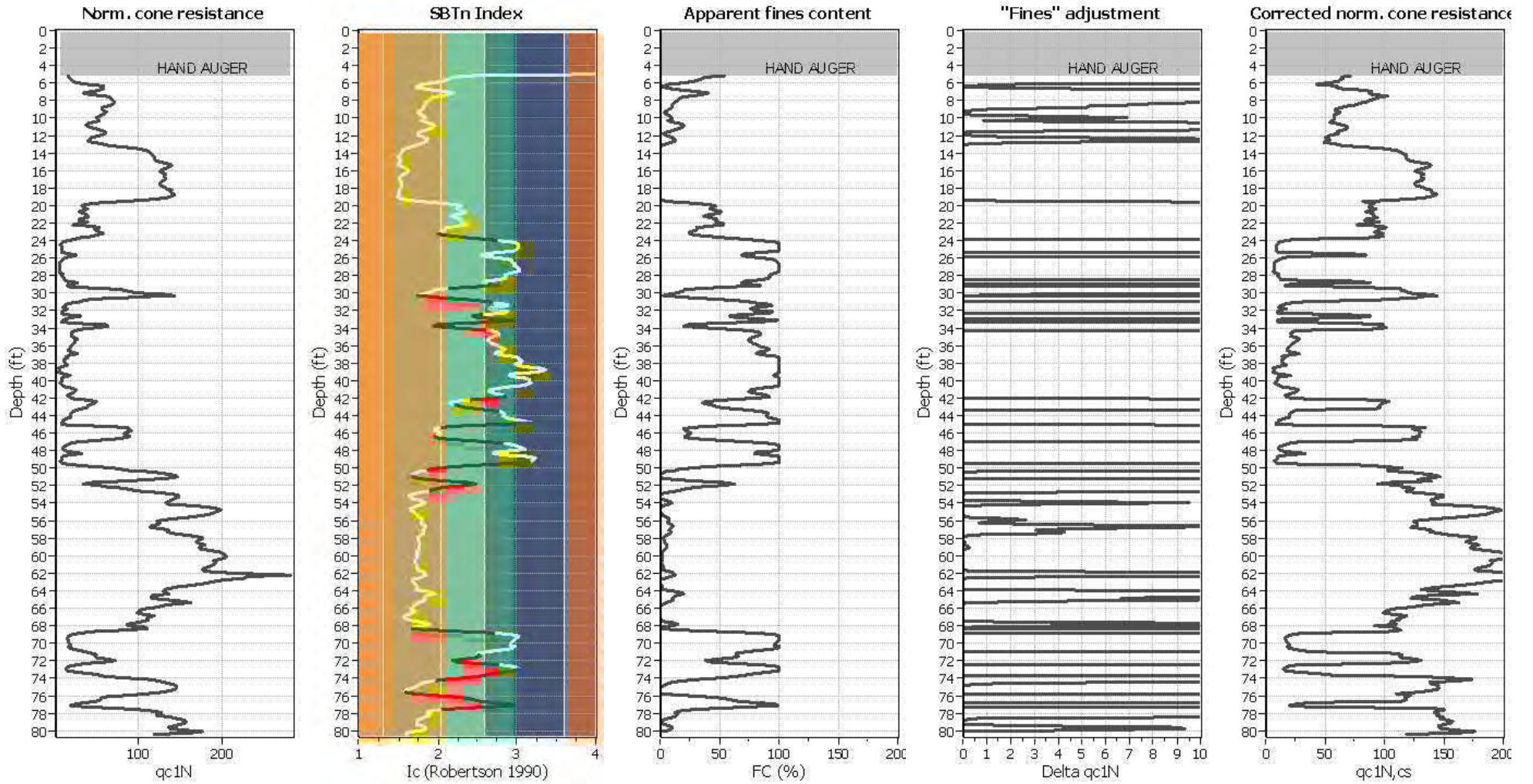
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

**LPI color scheme**

- Very high risk
- High risk
- Low risk



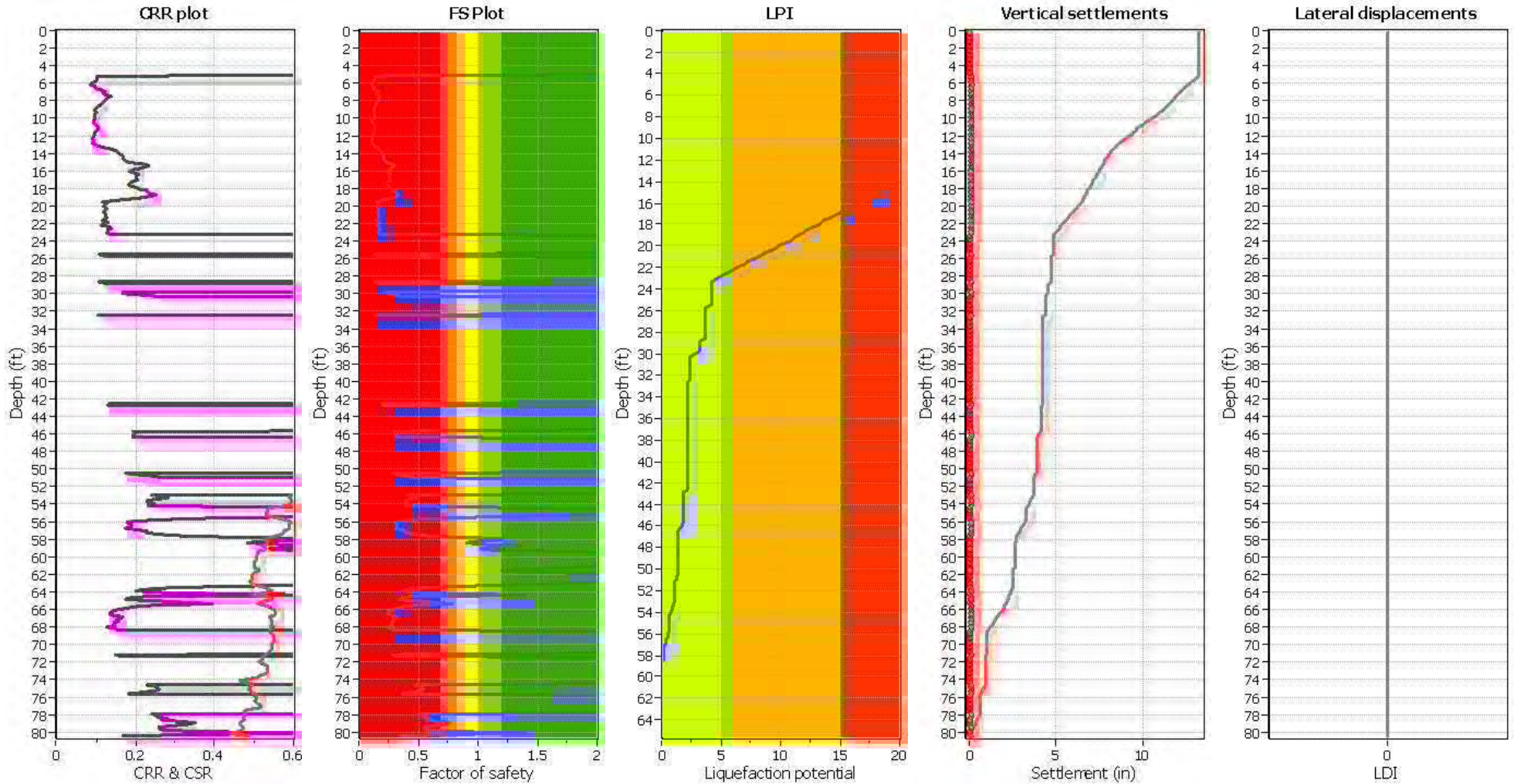
### Liquefaction analysis overall plots (intermediate res)



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>σ</sub> applied:	Yes
Earthquake magnitude M <sub>w</sub> :	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.59	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.00 ft	Fill height:	N/A	Limit depth:	N/A

### Liquefaction analysis overall plot



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on I <sub>c</sub> value	I <sub>c</sub> cut-off value:	2.60	K <sub>σ</sub> applied:	Yes
Earthquake magnitude M <sub>w</sub> :	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.59	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.00 ft	Fill height:	N/A	Limit depth:	N/A

**F.S. color scheme**

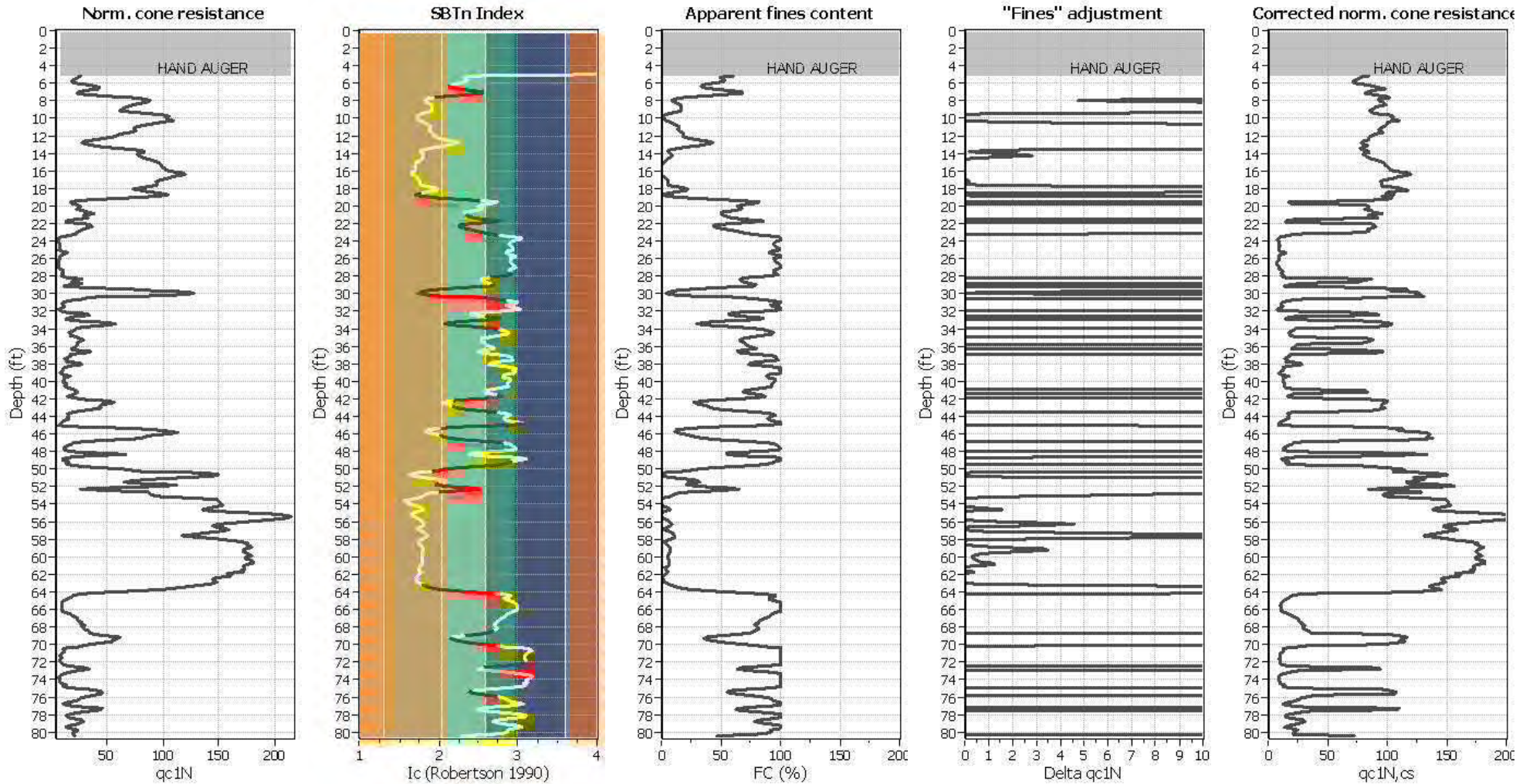
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

**LPI color scheme**

- Very high risk
- High risk
- Low risk



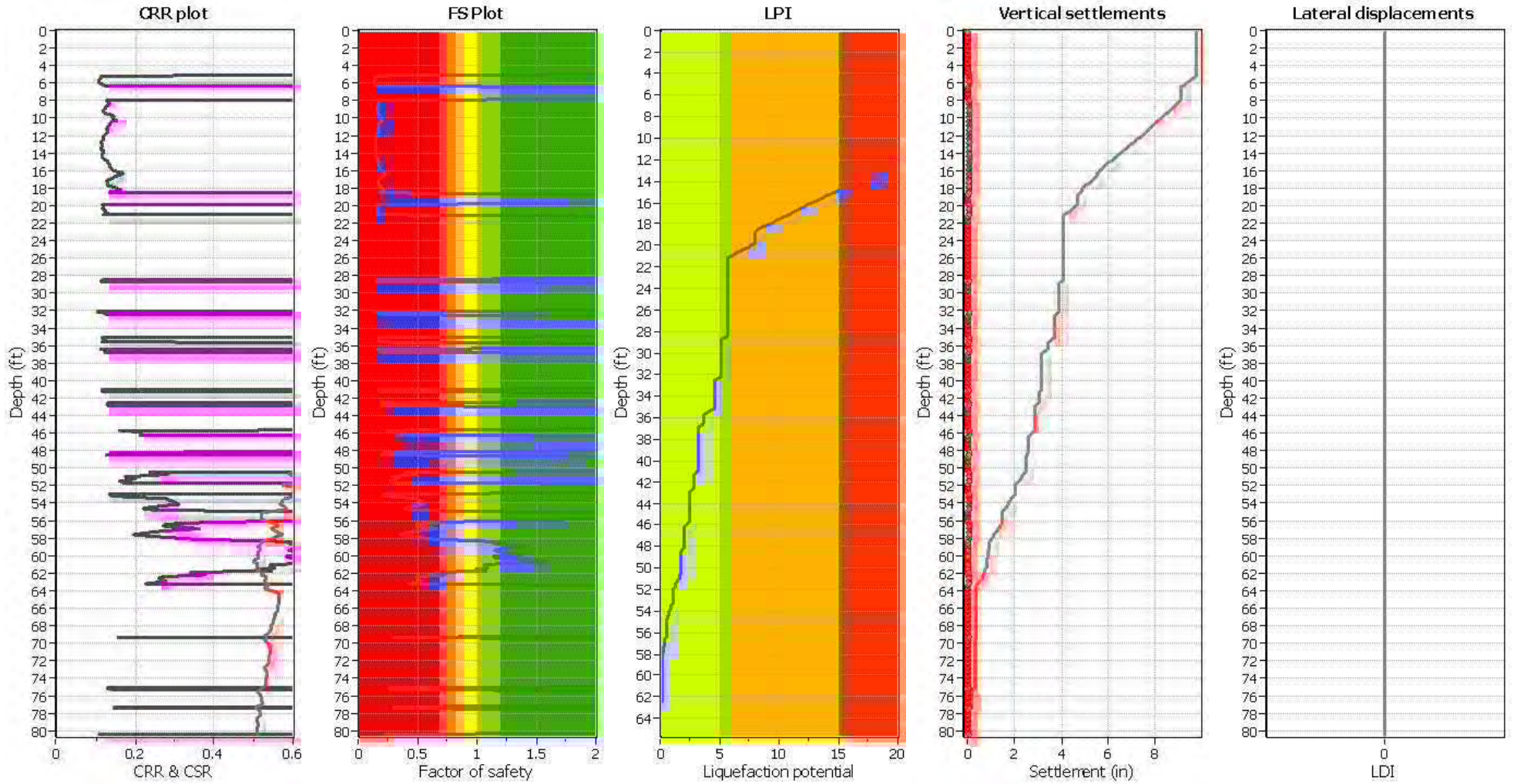
### Liquefaction analysis overall plots (intermediate res)



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>σ</sub> applied:	Yes
Earthquake magnitude M <sub>w</sub> :	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.59	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.00 ft	Fill height:	N/A	Limit depth:	N/A

### Liquefaction analysis overall plot



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on I <sub>c</sub> value	I <sub>c</sub> cut-off value:	2.60	K <sub>σ</sub> applied:	Yes
Earthquake magnitude M <sub>w</sub> :	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.59	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.00 ft	Fill height:	N/A	Limit depth:	N/A

**F.S. color scheme**

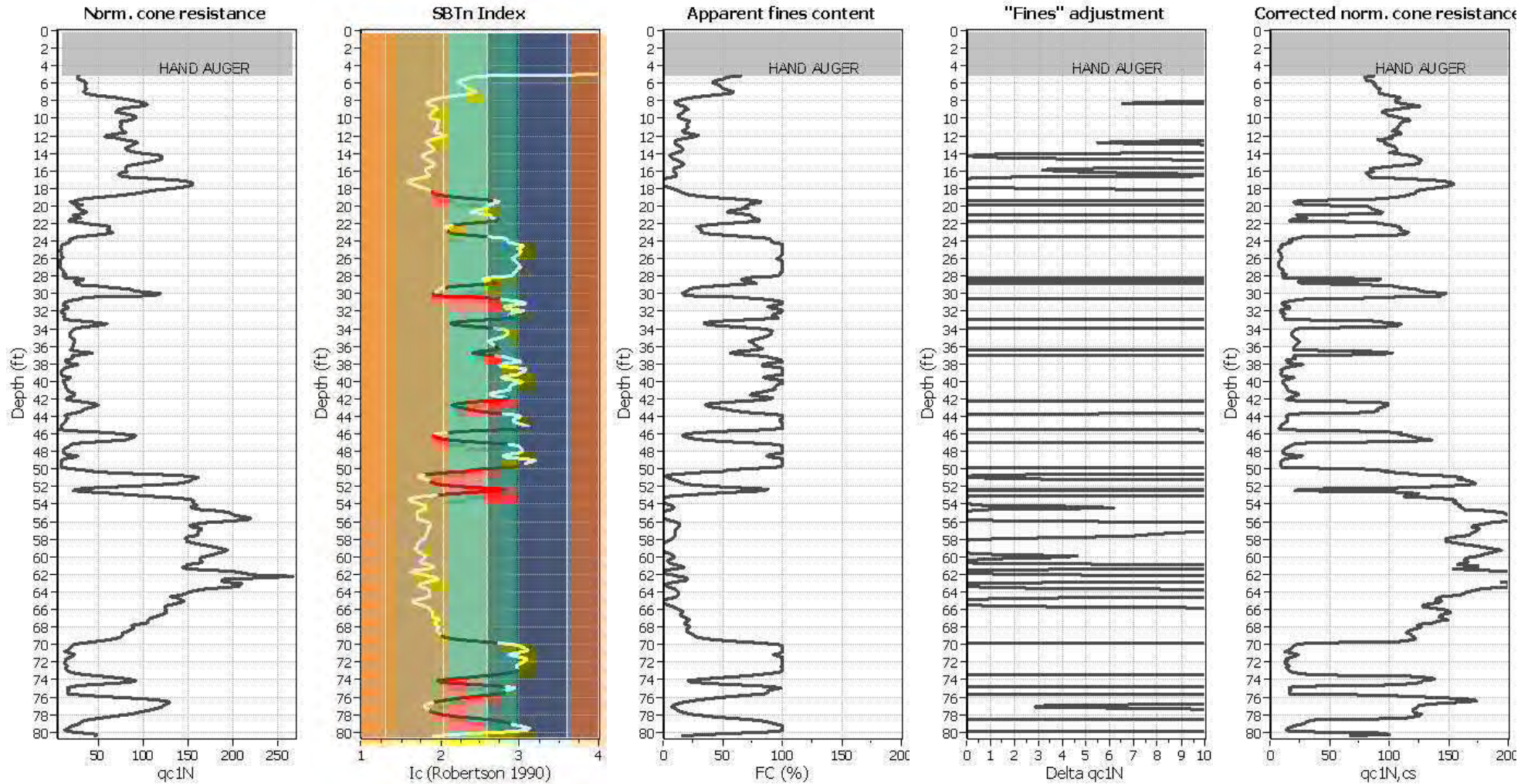
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

**LPI color scheme**

- Very high risk
- High risk
- Low risk



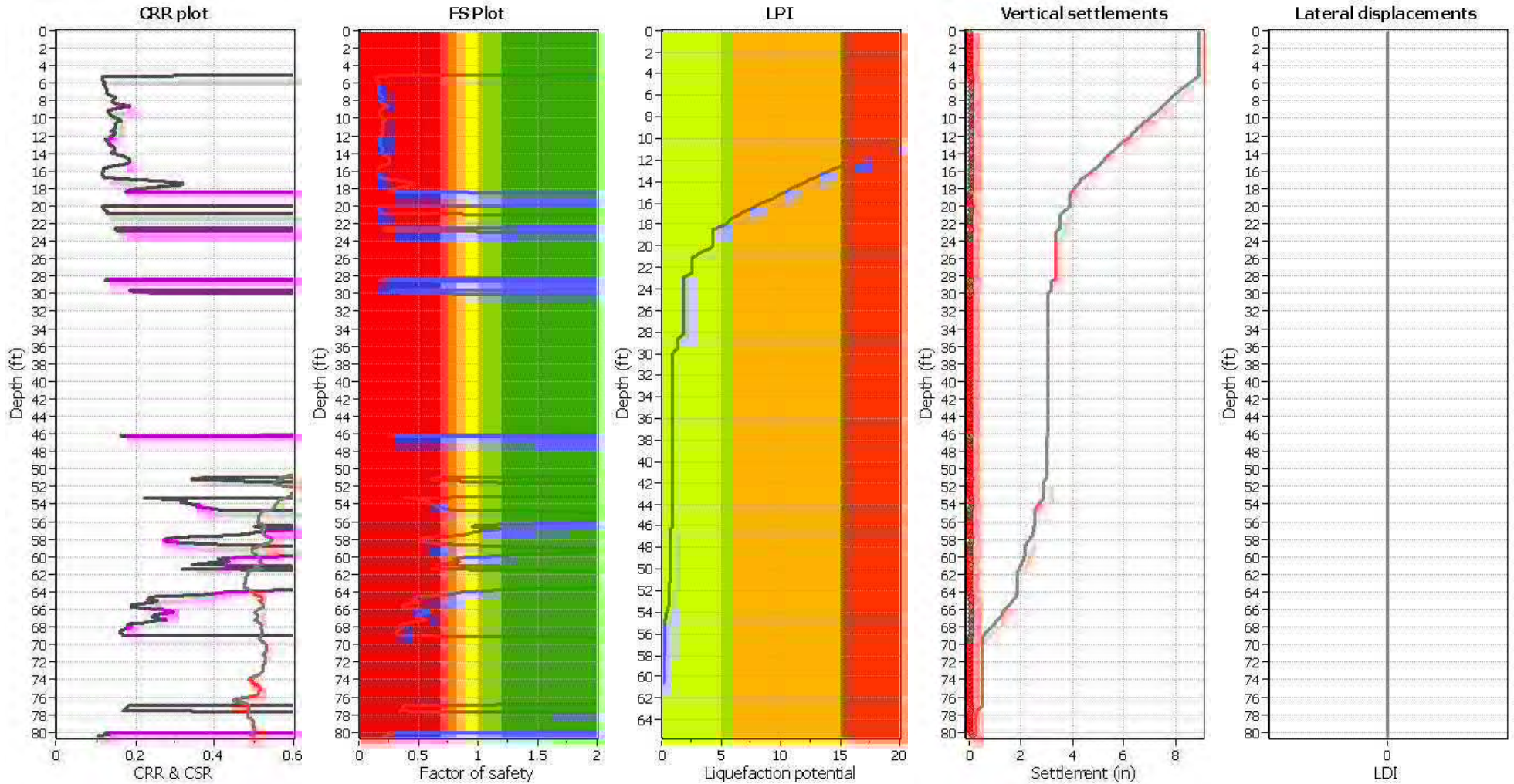
### Liquefaction analysis overall plots (intermediate res)



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>σ</sub> applied:	Yes
Earthquake magnitude M <sub>w</sub> :	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.59	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.00 ft	Fill height:	N/A	Limit depth:	N/A

### Liquefaction analysis overall plot



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on I <sub>c</sub> value	I <sub>c</sub> cut-off value:	2.60	K <sub>σ</sub> applied:	Yes
Earthquake magnitude M <sub>w</sub> :	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.59	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.00 ft	Fill height:	N/A	Limit depth:	N/A

**F.S. color scheme**

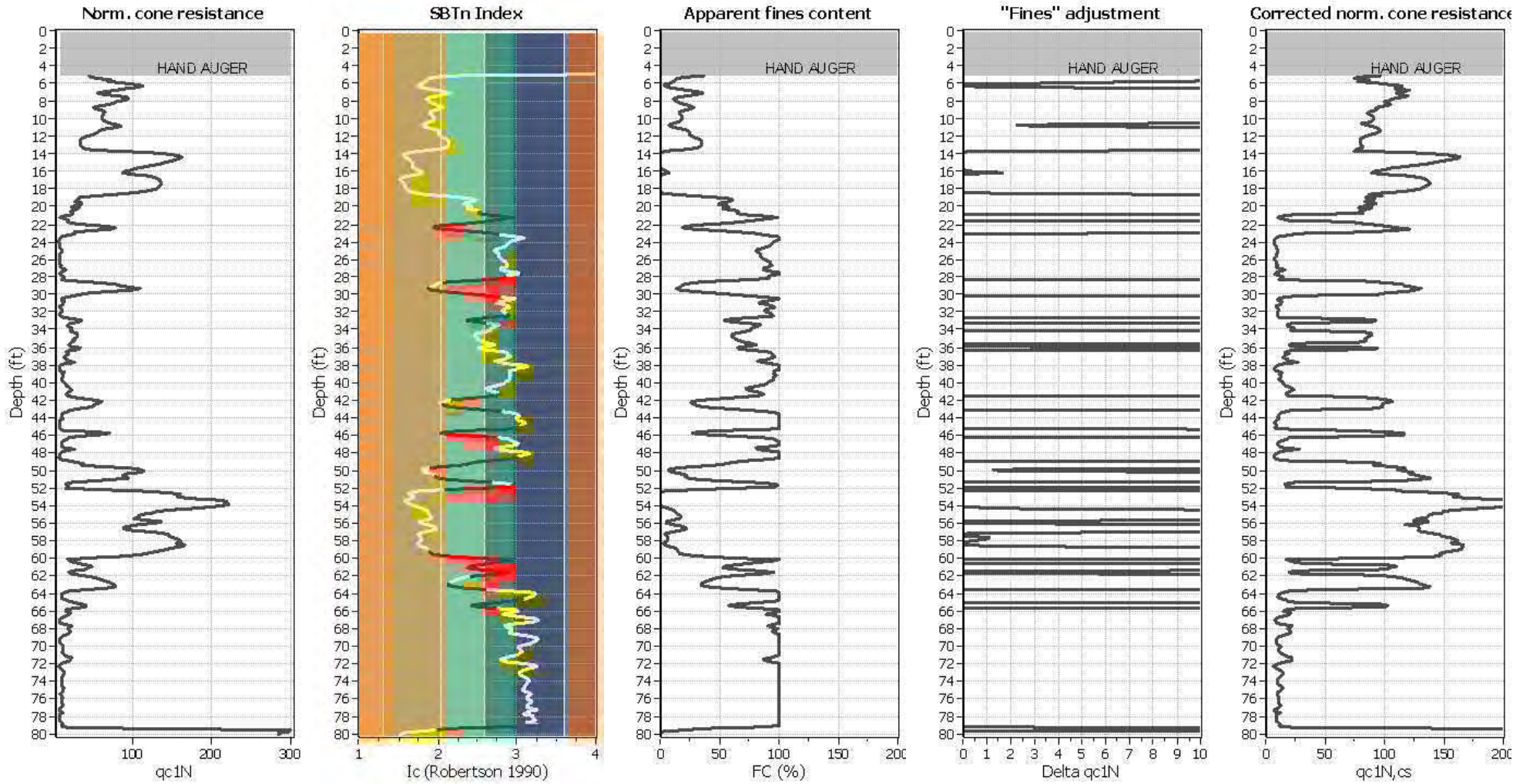
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

**LPI color scheme**

- Very high risk
- High risk
- Low risk



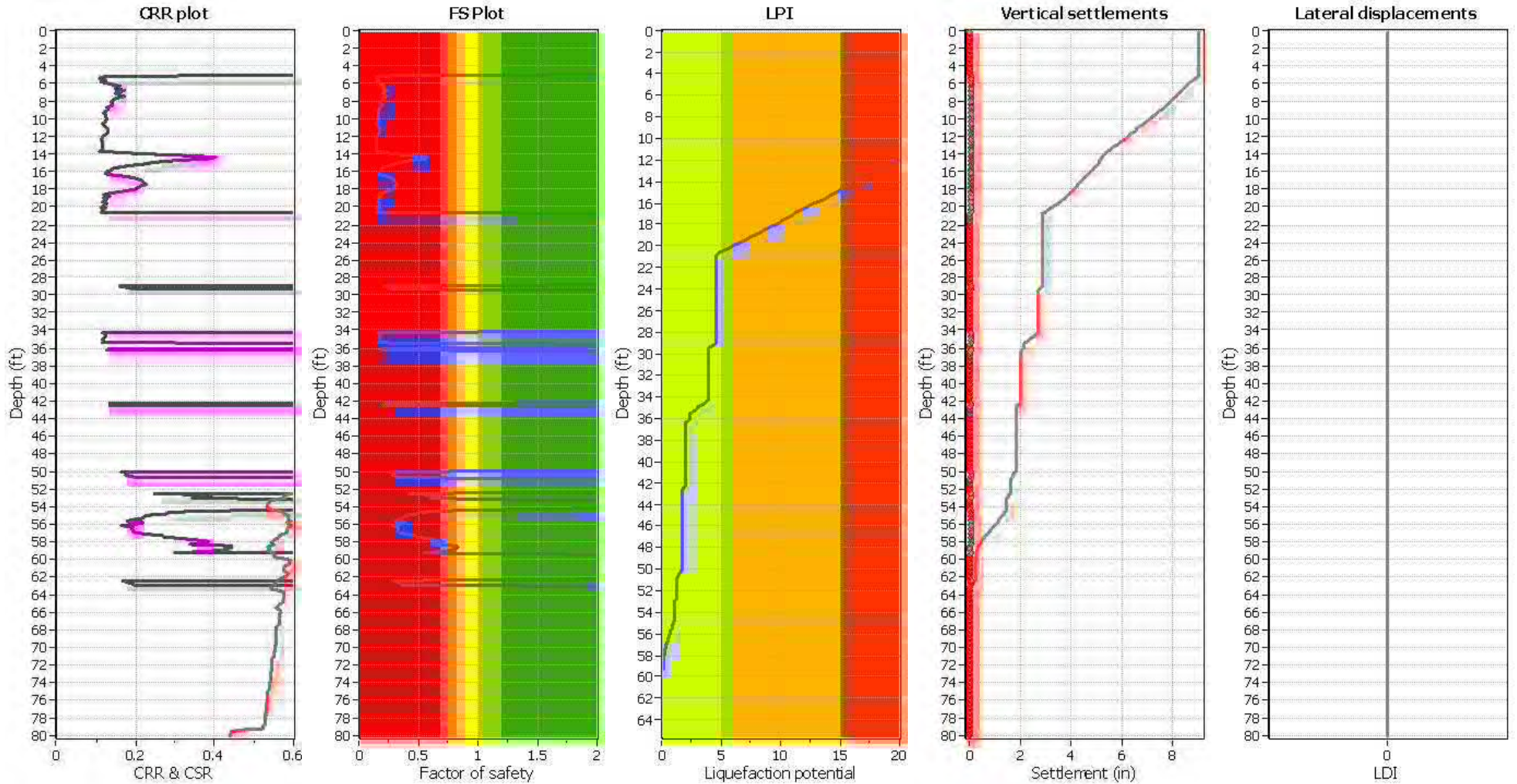
### Liquefaction analysis overall plots (intermediate res)



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>σ</sub> applied:	Yes
Earthquake magnitude M <sub>w</sub> :	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.59	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.00 ft	Fill height:	N/A	Limit depth:	N/A

### Liquefaction analysis overall plot



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on I <sub>c</sub> value	I <sub>c</sub> cut-off value:	2.60	K <sub>σ</sub> applied:	Yes
Earthquake magnitude M <sub>w</sub> :	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.59	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.00 ft	Fill height:	N/A	Limit depth:	N/A

**F.S. color scheme**

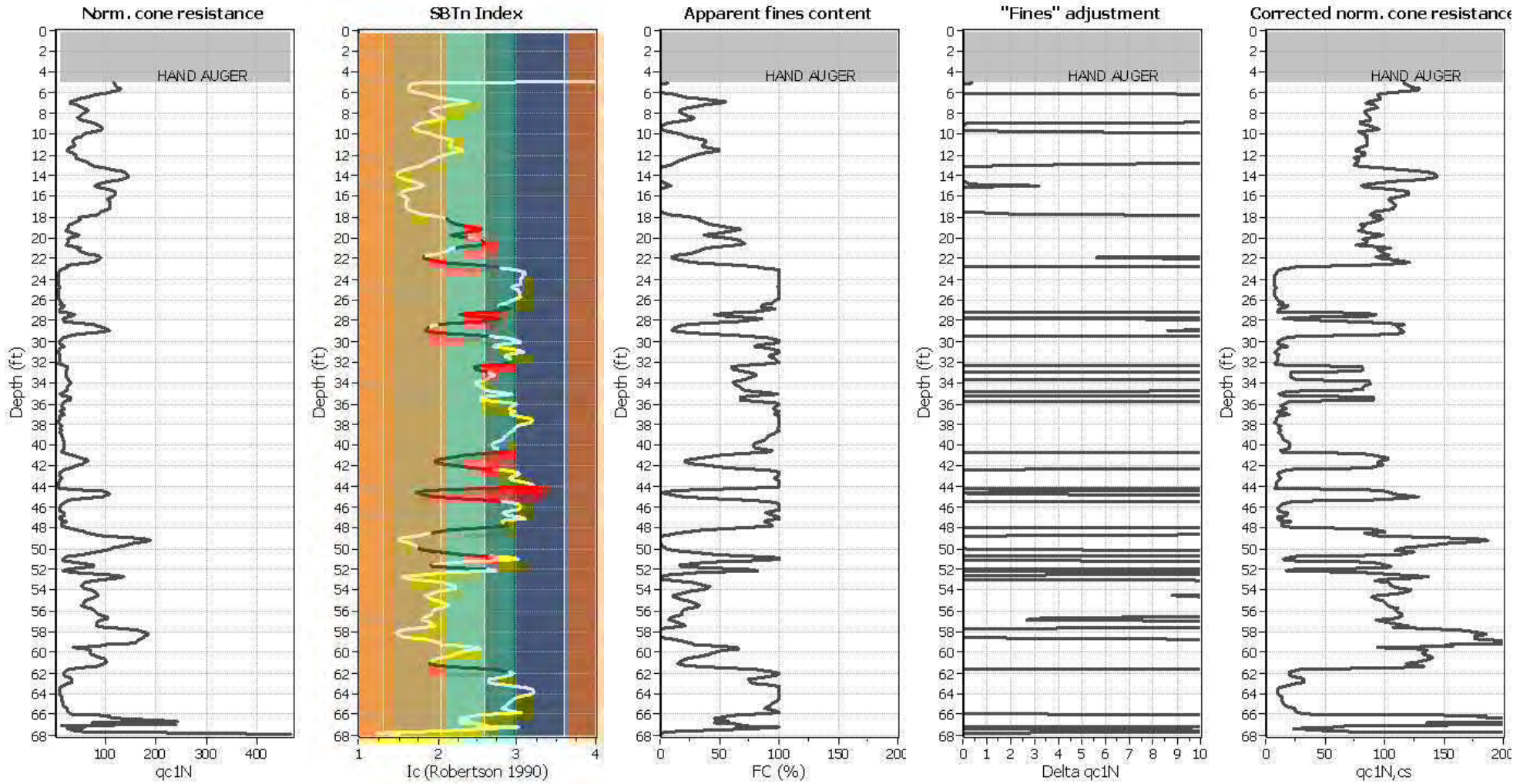
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

**LPI color scheme**

- Very high risk
- High risk
- Low risk



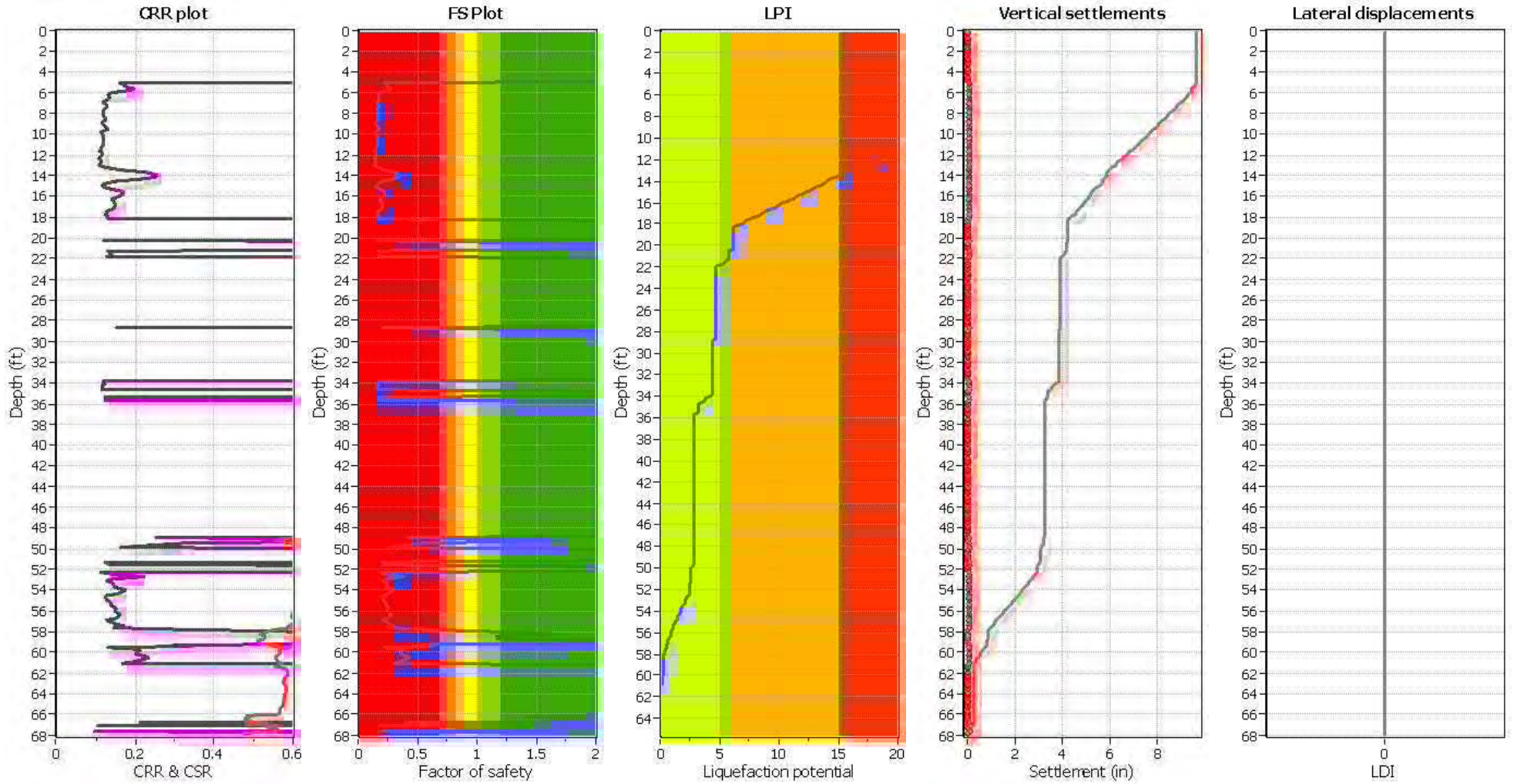
### Liquefaction analysis overall plots (intermediate res)



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>σ</sub> applied:	Yes
Earthquake magnitude M <sub>w</sub> :	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.59	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.00 ft	Fill height:	N/A	Limit depth:	N/A

### Liquefaction analysis overall plot



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on I <sub>c</sub> value	I <sub>c</sub> cut-off value:	2.60	K <sub>σ</sub> applied:	Yes
Earthquake magnitude M <sub>w</sub> :	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.59	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.00 ft	Fill height:	N/A	Limit depth:	N/A

**F.S. color scheme**

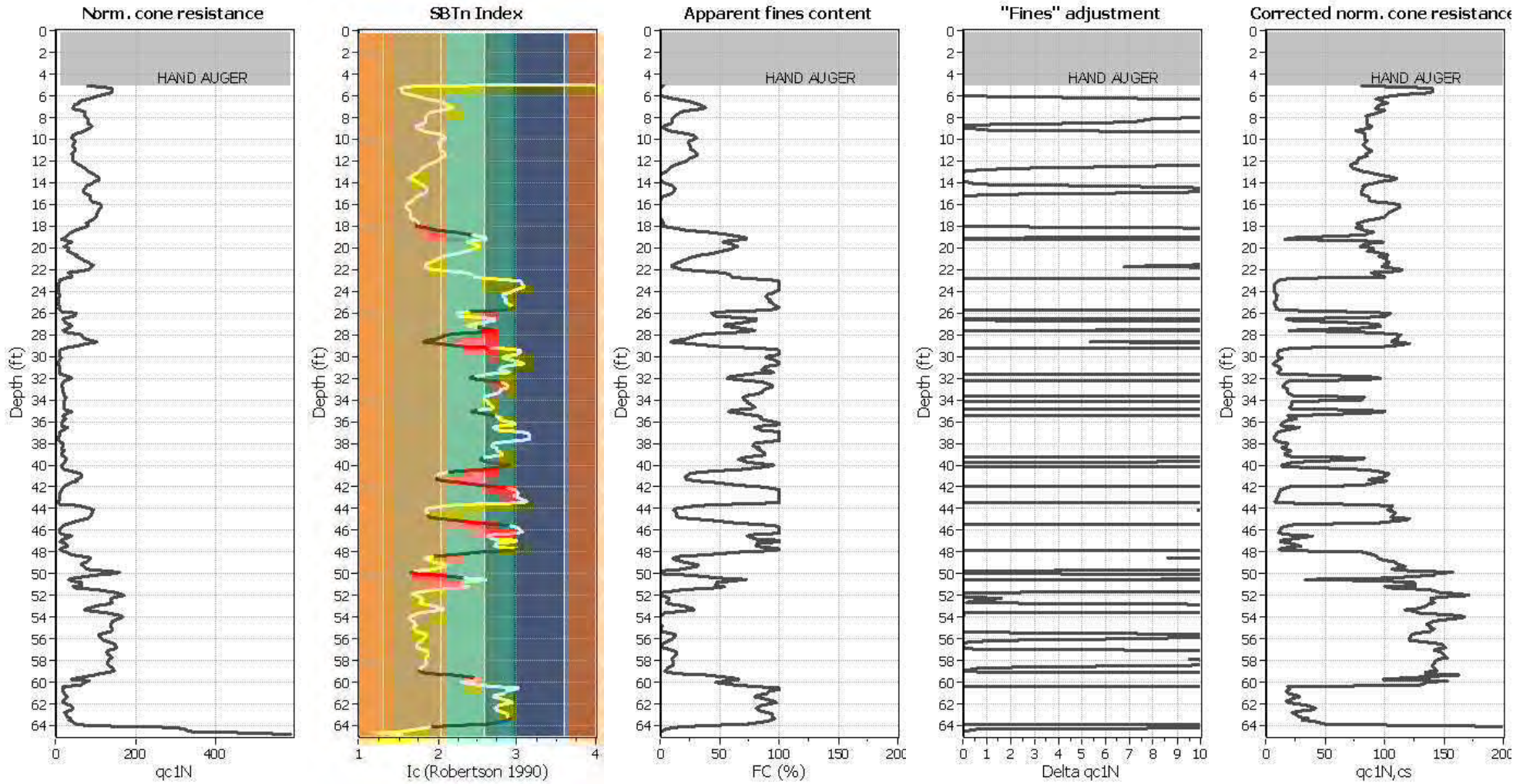
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

**LPI color scheme**

- Very high risk
- High risk
- Low risk



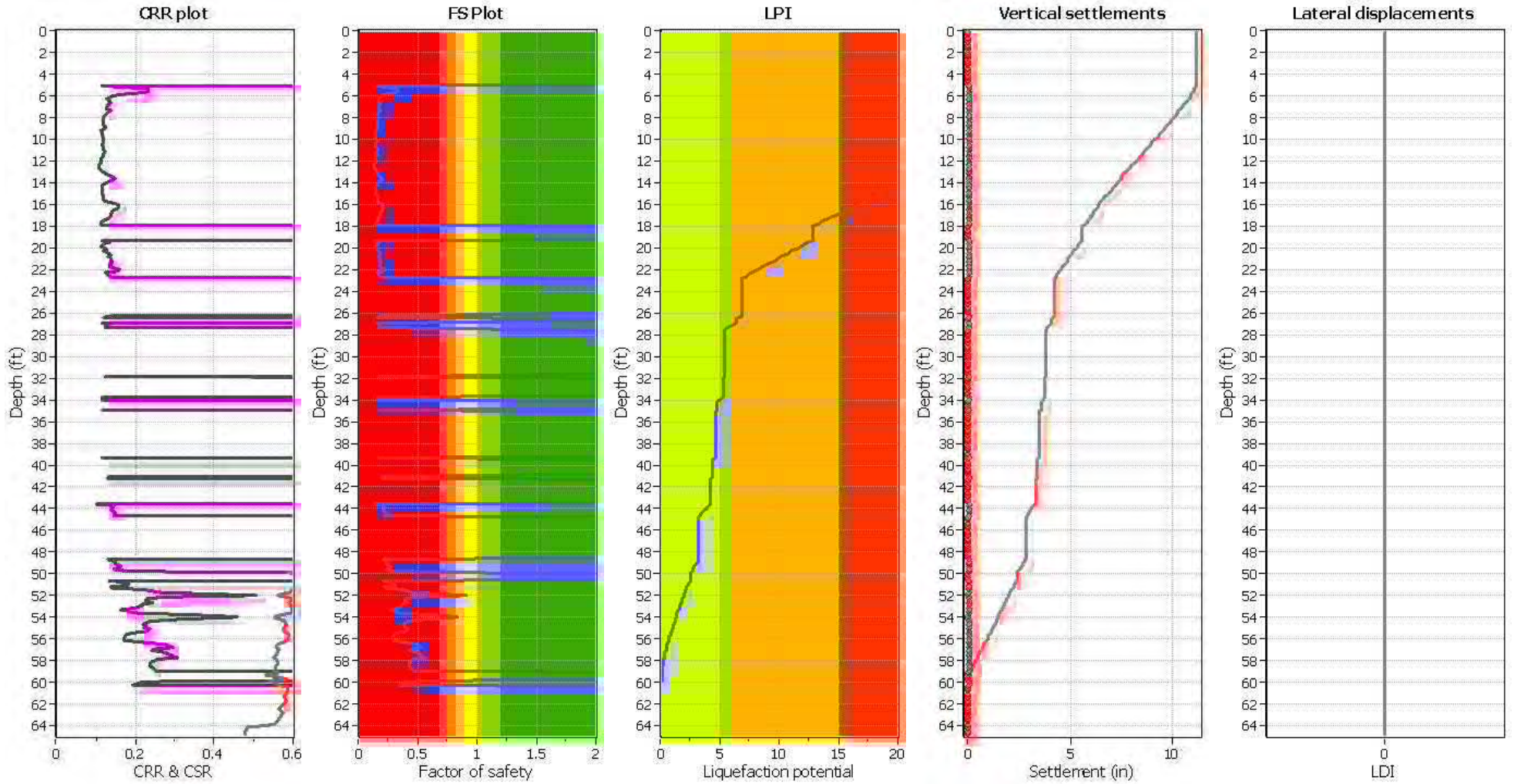
### Liquefaction analysis overall plots (intermediate res)



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>σ</sub> applied:	Yes
Earthquake magnitude M <sub>w</sub> :	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.59	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.00 ft	Fill height:	N/A	Limit depth:	N/A

### Liquefaction analysis overall plot



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>σ</sub> applied:	Yes
Earthquake magnitude M <sub>w</sub> :	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.59	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.00 ft	Fill height:	N/A	Limit depth:	N/A

**F.S. color scheme**

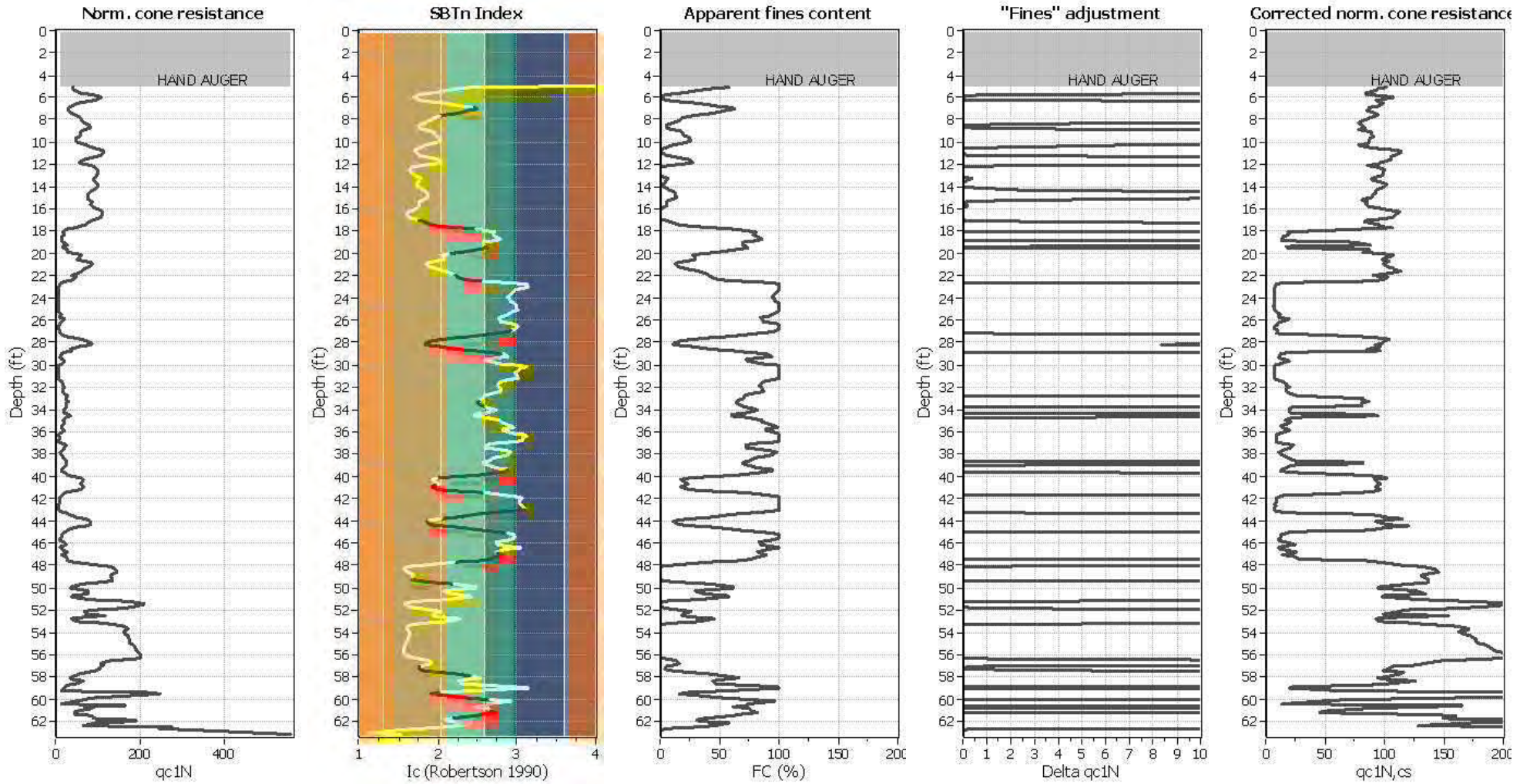
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

**LPI color scheme**

- Very high risk
- High risk
- Low risk



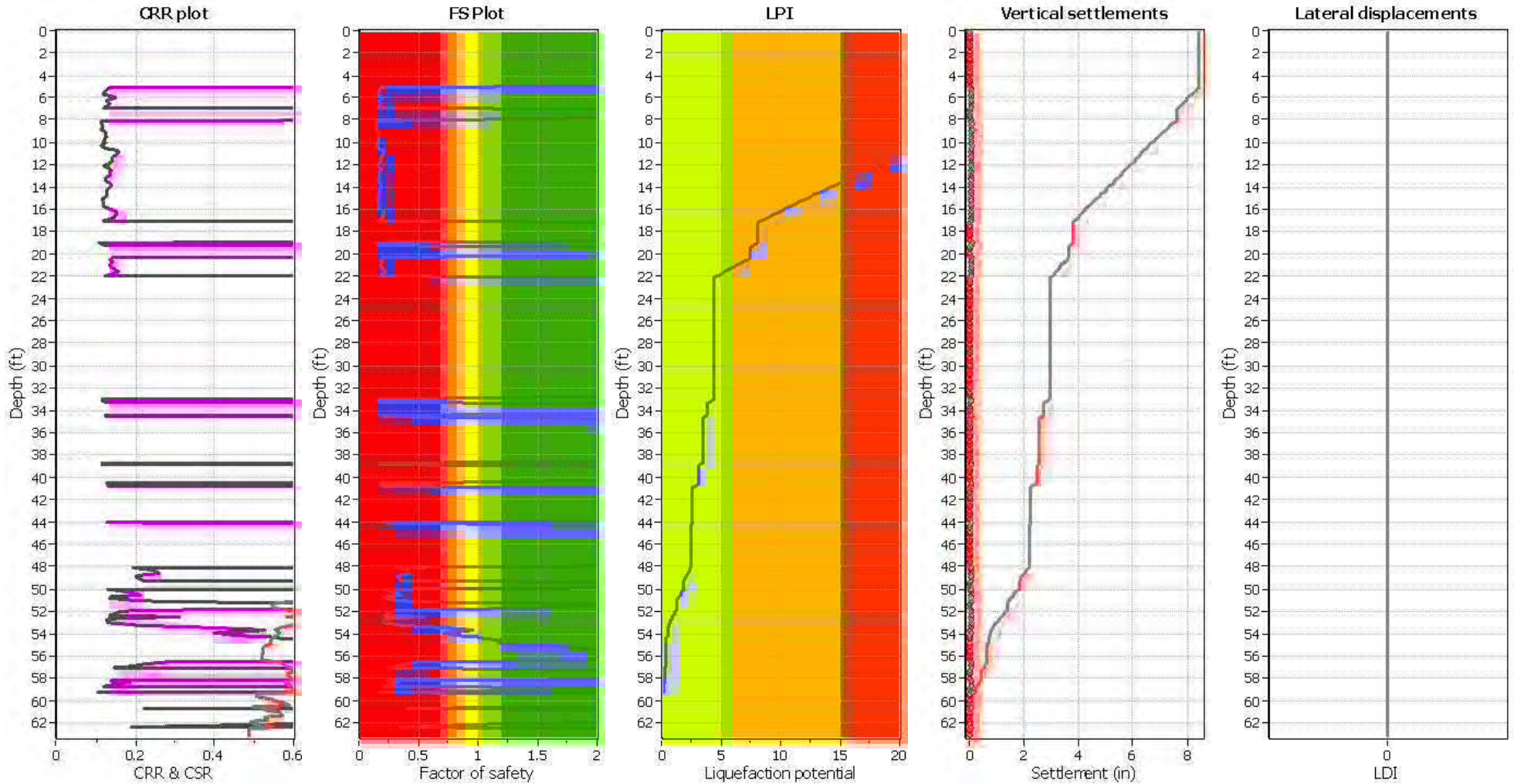
### Liquefaction analysis overall plots (intermediate res)



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>σ</sub> applied:	Yes
Earthquake magnitude M <sub>w</sub> :	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.59	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.00 ft	Fill height:	N/A	Limit depth:	N/A

### Liquefaction analysis overall plot



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on I <sub>c</sub> value	I <sub>c</sub> cut-off value:	2.60	K <sub>σ</sub> applied:	Yes
Earthquake magnitude M <sub>w</sub> :	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.59	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.00 ft	Fill height:	N/A	Limit depth:	N/A

**F.S. color scheme**

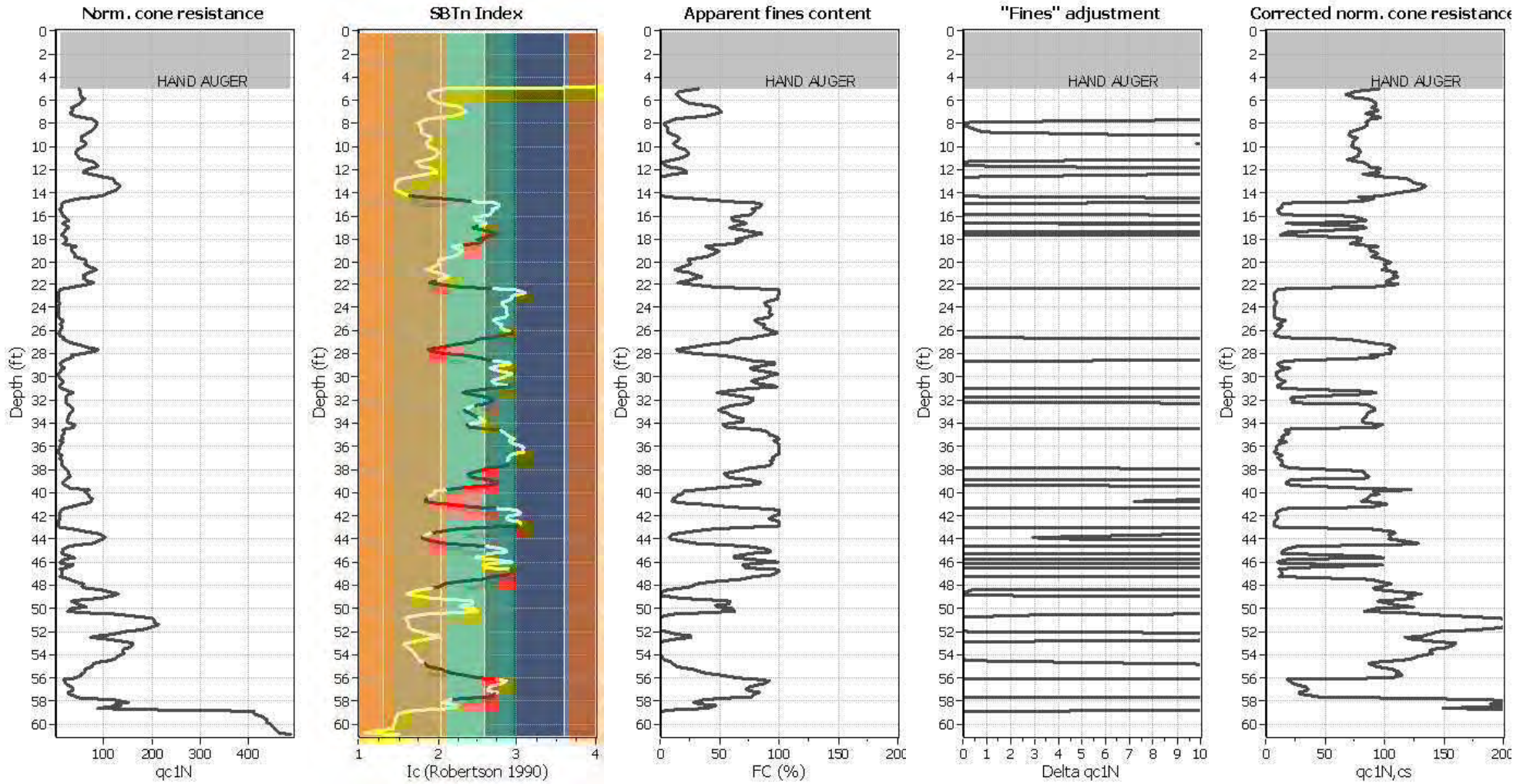
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

**LPI color scheme**

- Very high risk
- High risk
- Low risk



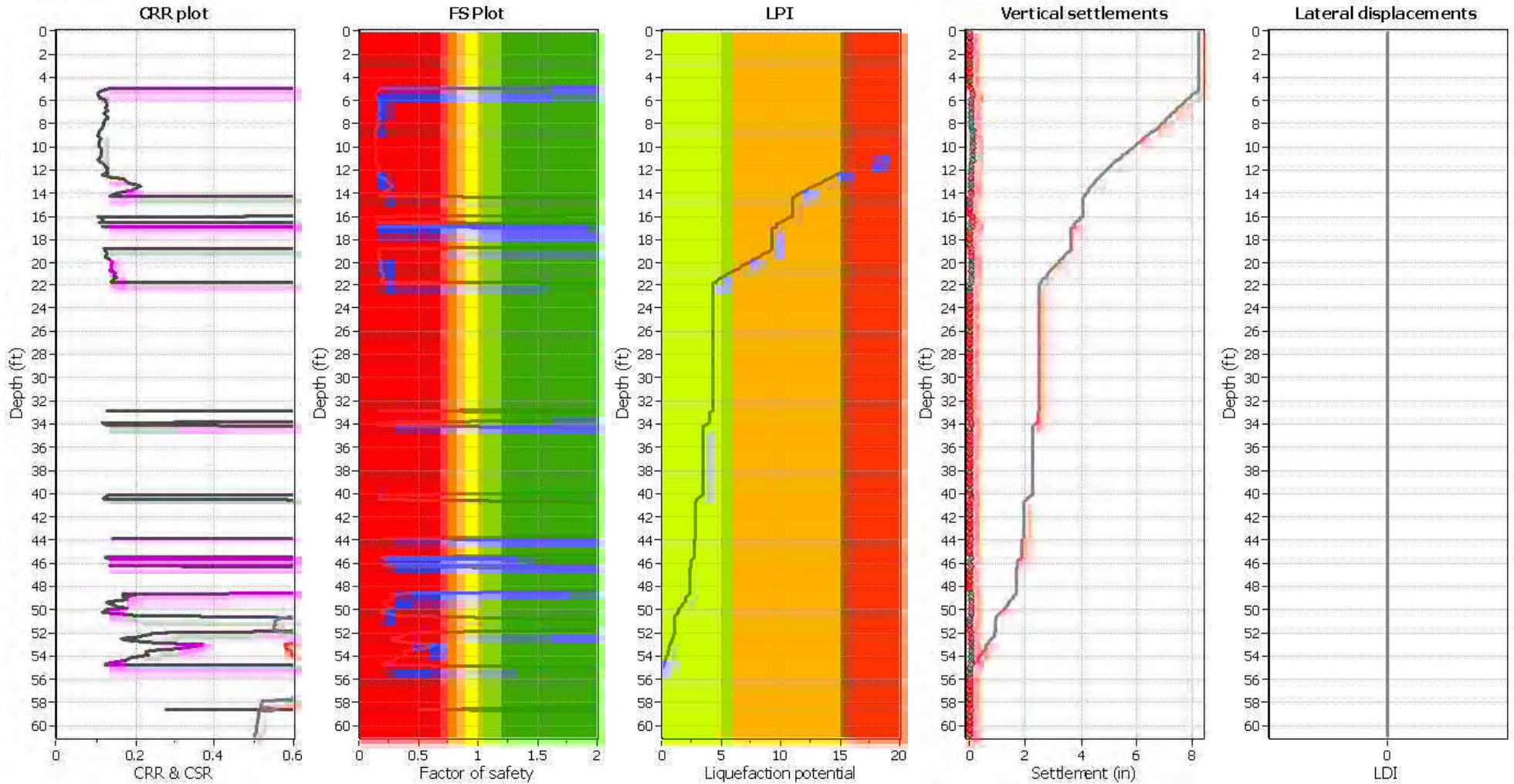
### Liquefaction analysis overall plots (intermediate res)



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>σ</sub> applied:	Yes
Earthquake magnitude M <sub>w</sub> :	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.59	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.00 ft	Fill height:	N/A	Limit depth:	N/A

### Liquefaction analysis overall plot



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_{\sigma}$ applied:	Yes
Earthquake magnitude $M_w$ :	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.59	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.00 ft	Fill height:	N/A	Limit depth:	N/A

**F.S. color scheme**

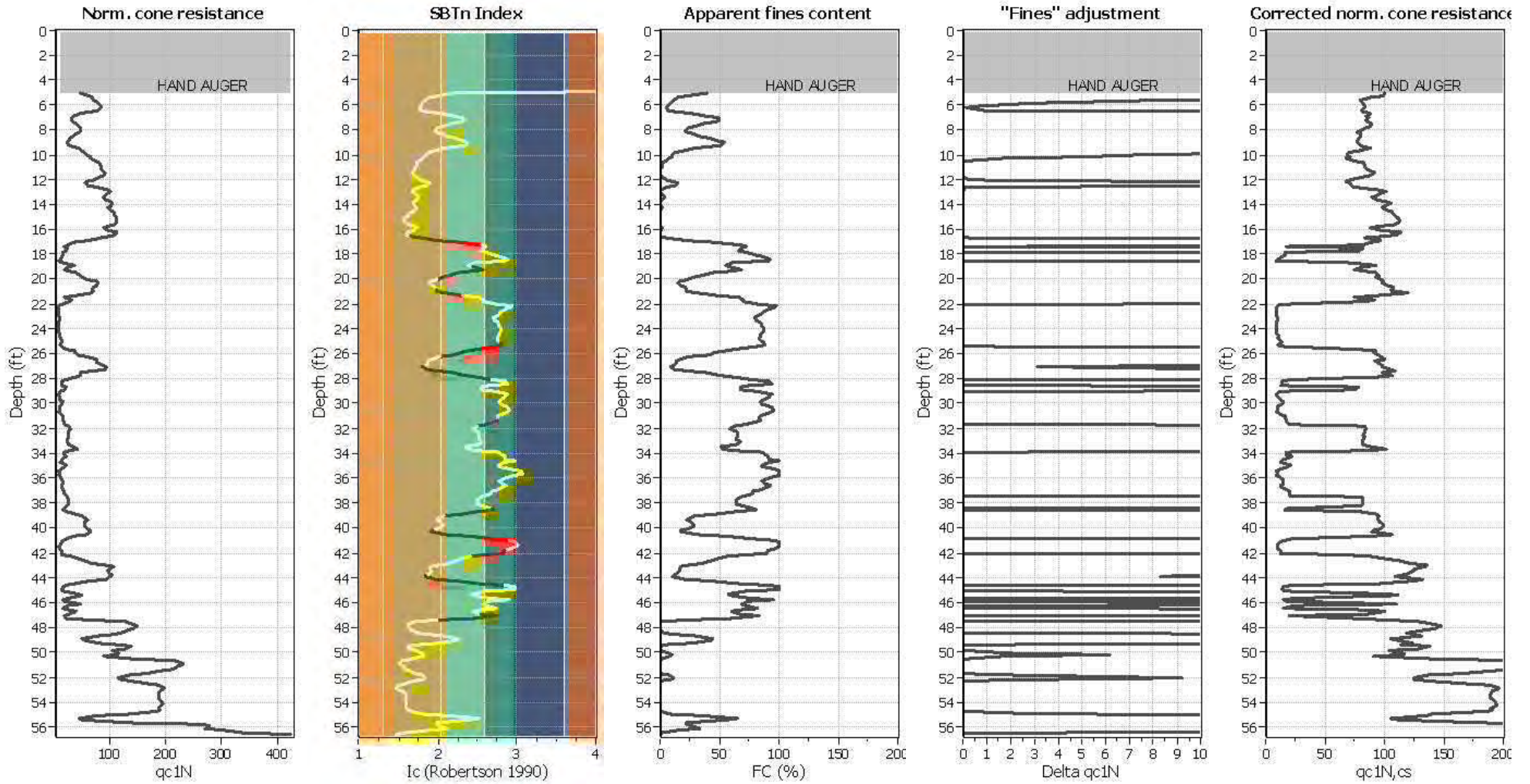
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

**LPI color scheme**

- Very high risk
- High risk
- Low risk



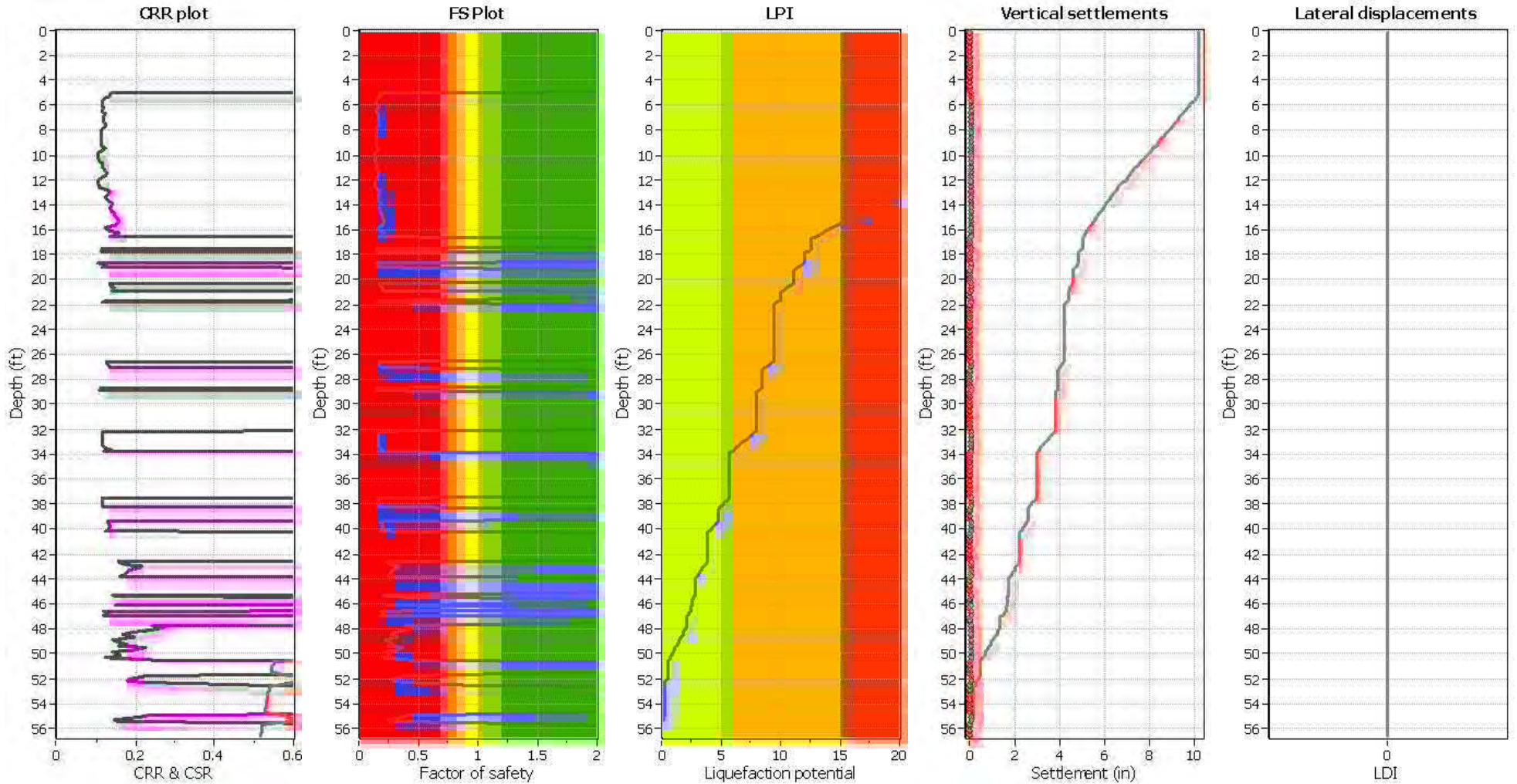
### Liquefaction analysis overall plots (intermediate res)



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>σ</sub> applied:	Yes
Earthquake magnitude M <sub>w</sub> :	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.59	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.00 ft	Fill height:	N/A	Limit depth:	N/A

### Liquefaction analysis overall plot



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on I <sub>c</sub> value	I <sub>c</sub> cut-off value:	2.60	K <sub>σ</sub> applied:	Yes
Earthquake magnitude M <sub>w</sub> :	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.59	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.00 ft	Fill height:	N/A	Limit depth:	N/A

**F.S. color scheme**

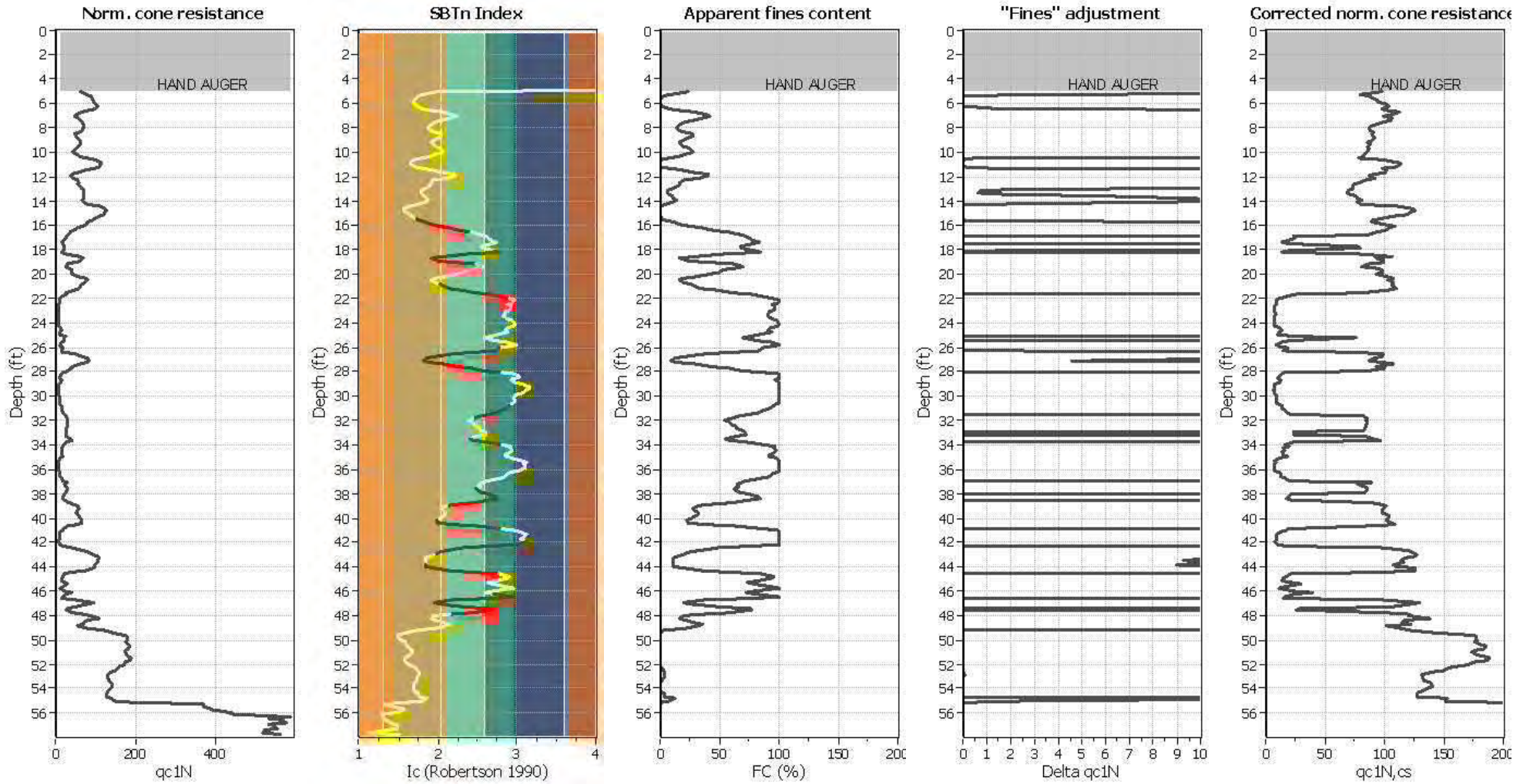
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

**LPI color scheme**

- Very high risk
- High risk
- Low risk



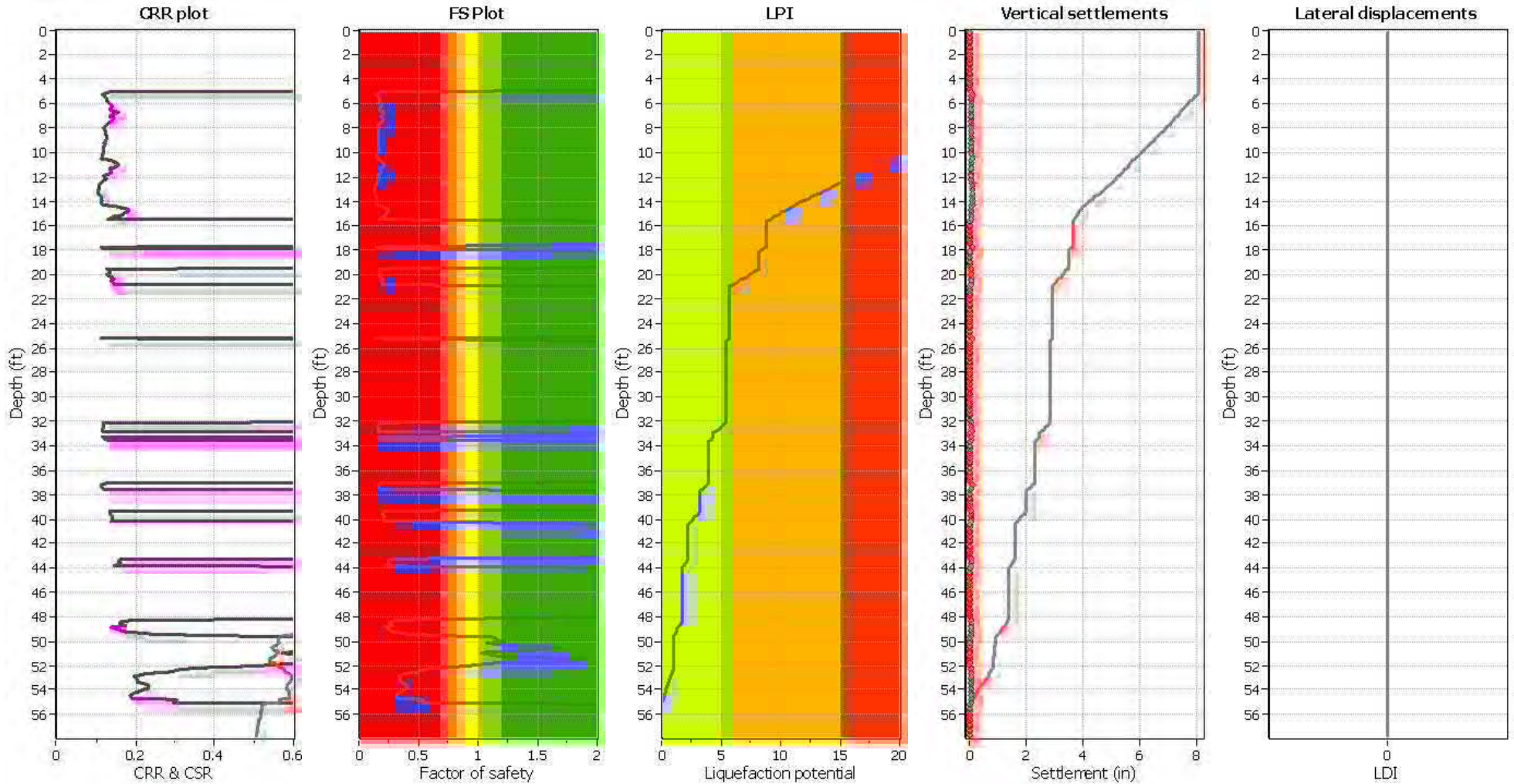
### Liquefaction analysis overall plots (intermediate res)



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>σ</sub> applied:	Yes
Earthquake magnitude M <sub>w</sub> :	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.59	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.00 ft	Fill height:	N/A	Limit depth:	N/A

### Liquefaction analysis overall plot



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on I <sub>c</sub> value	I <sub>c</sub> cut-off value:	2.60	K <sub>σ</sub> applied:	Yes
Earthquake magnitude M <sub>w</sub> :	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.59	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.00 ft	Fill height:	N/A	Limit depth:	N/A

**F.S. color scheme**

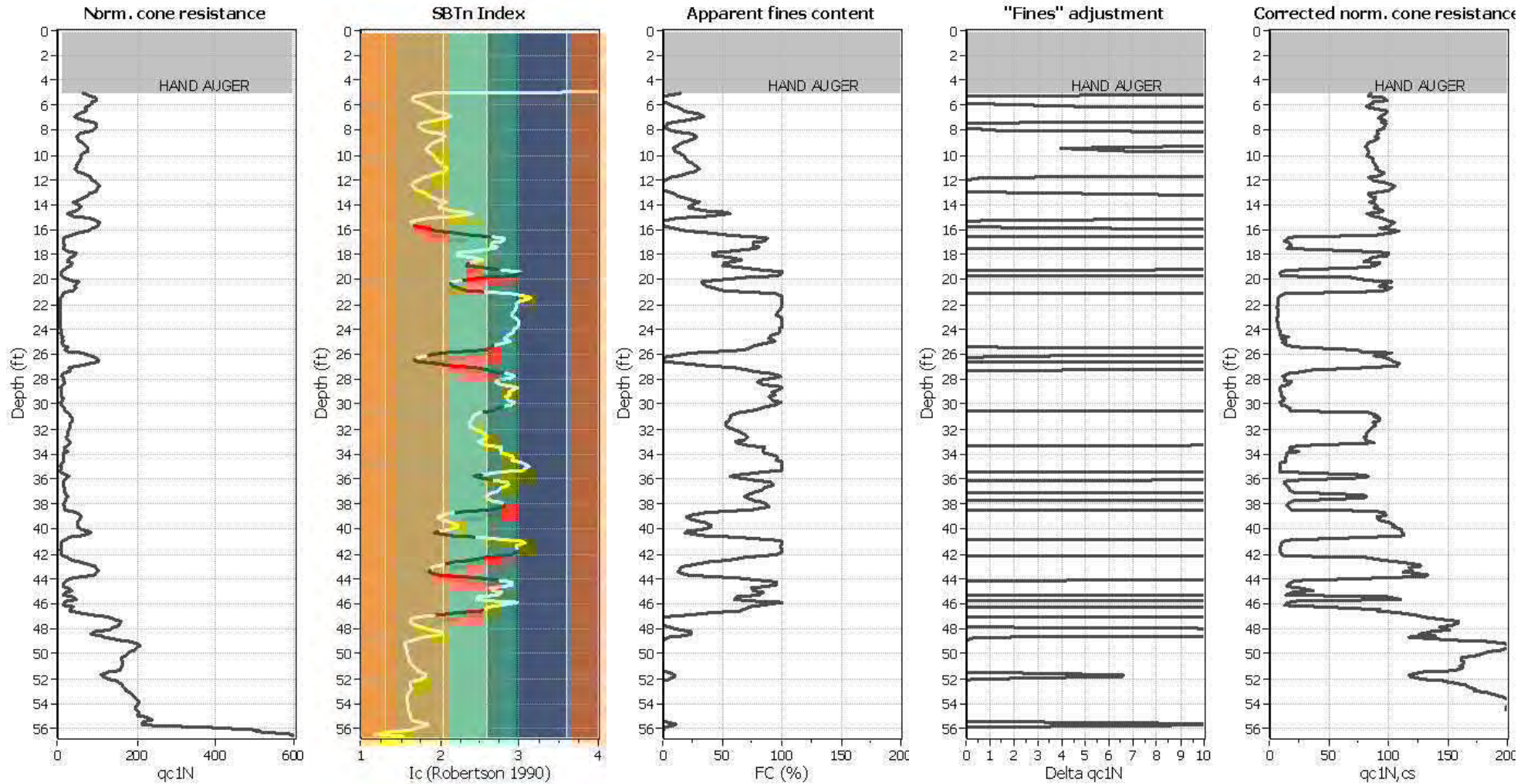
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

**LPI color scheme**

- Very high risk
- High risk
- Low risk



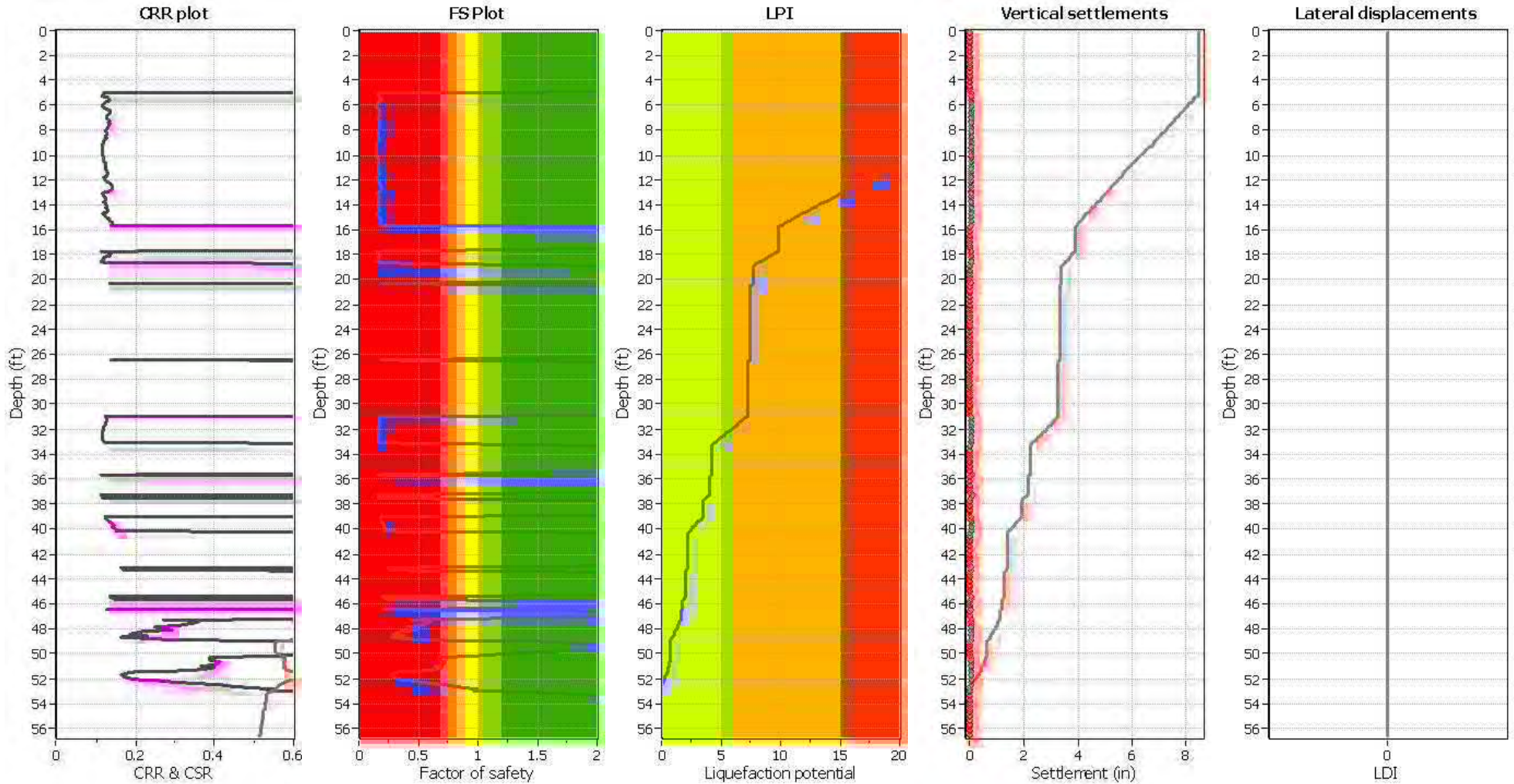
### Liquefaction analysis overall plots (intermediate res)



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>σ</sub> applied:	Yes
Earthquake magnitude M <sub>w</sub> :	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.59	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.00 ft	Fill height:	N/A	Limit depth:	N/A

### Liquefaction analysis overall plot



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on I <sub>c</sub> value	I <sub>c</sub> cut-off value:	2.60	K <sub>σ</sub> applied:	Yes
Earthquake magnitude M <sub>w</sub> :	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.59	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.00 ft	Fill height:	N/A	Limit depth:	N/A

**F.S. color scheme**

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

**LPI color scheme**

- Very high risk
- High risk
- Low risk

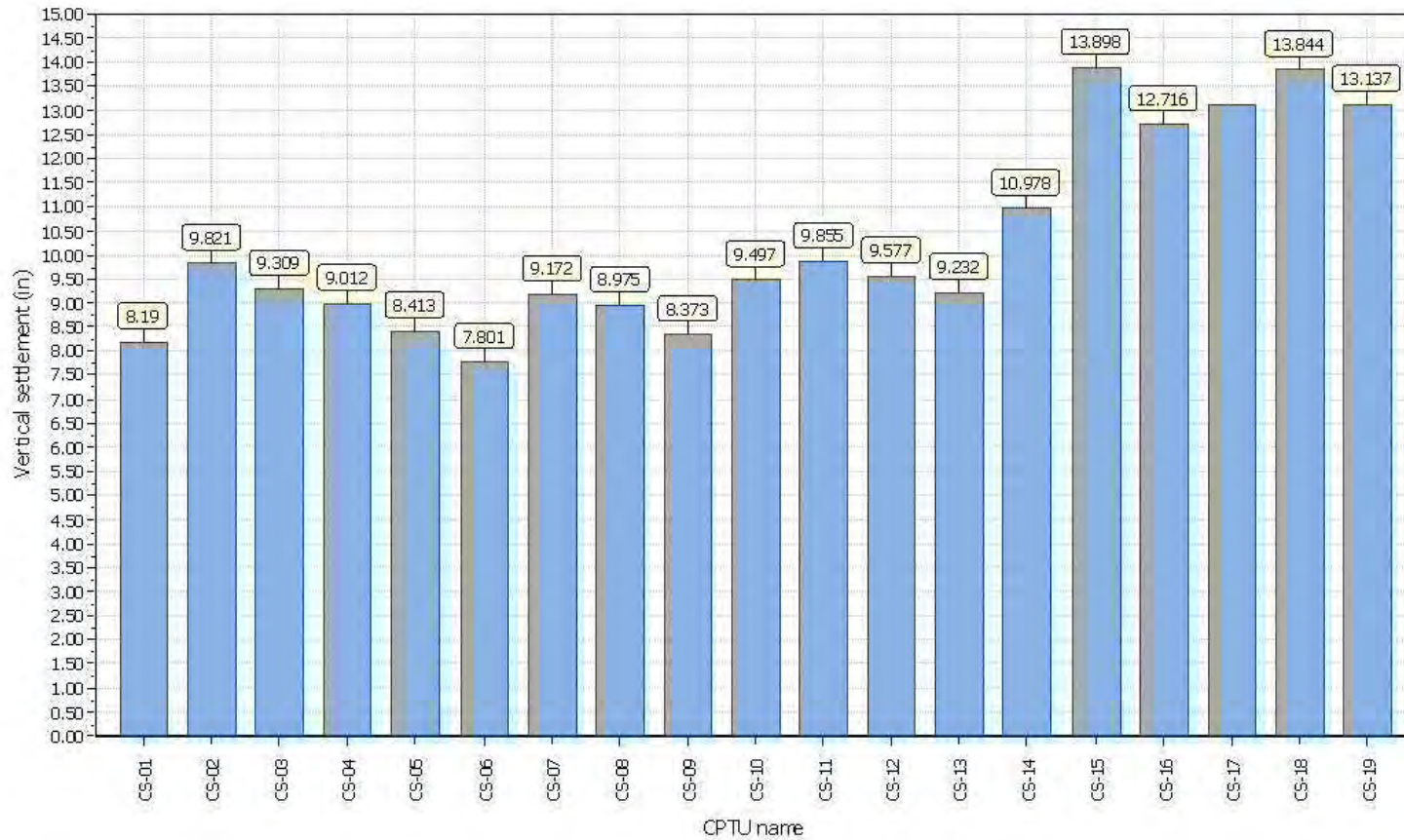


Liquefaction Analyses of CPTs Located  
on Custer Street

Project title :

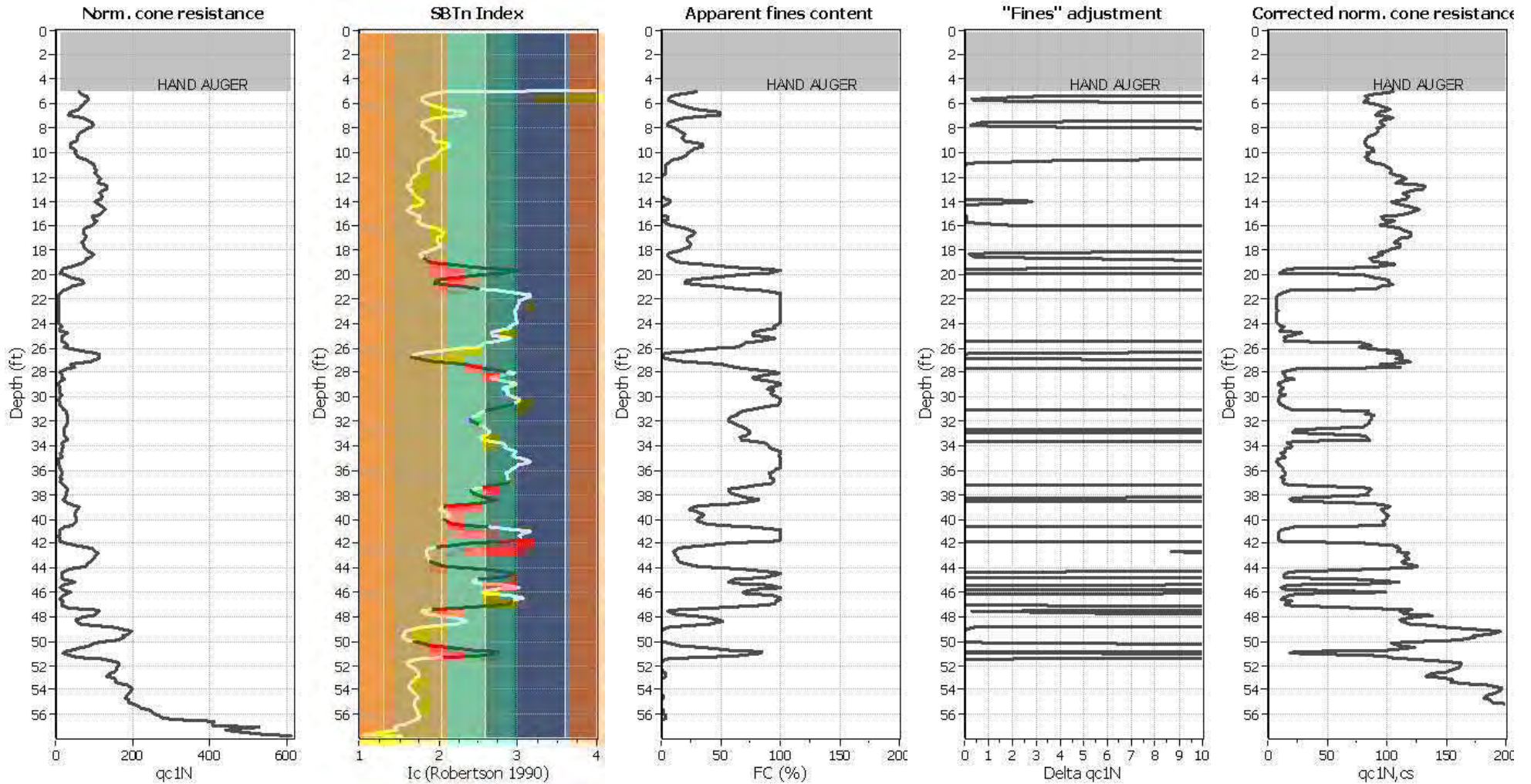
Location :

### Overall vertical settlements report





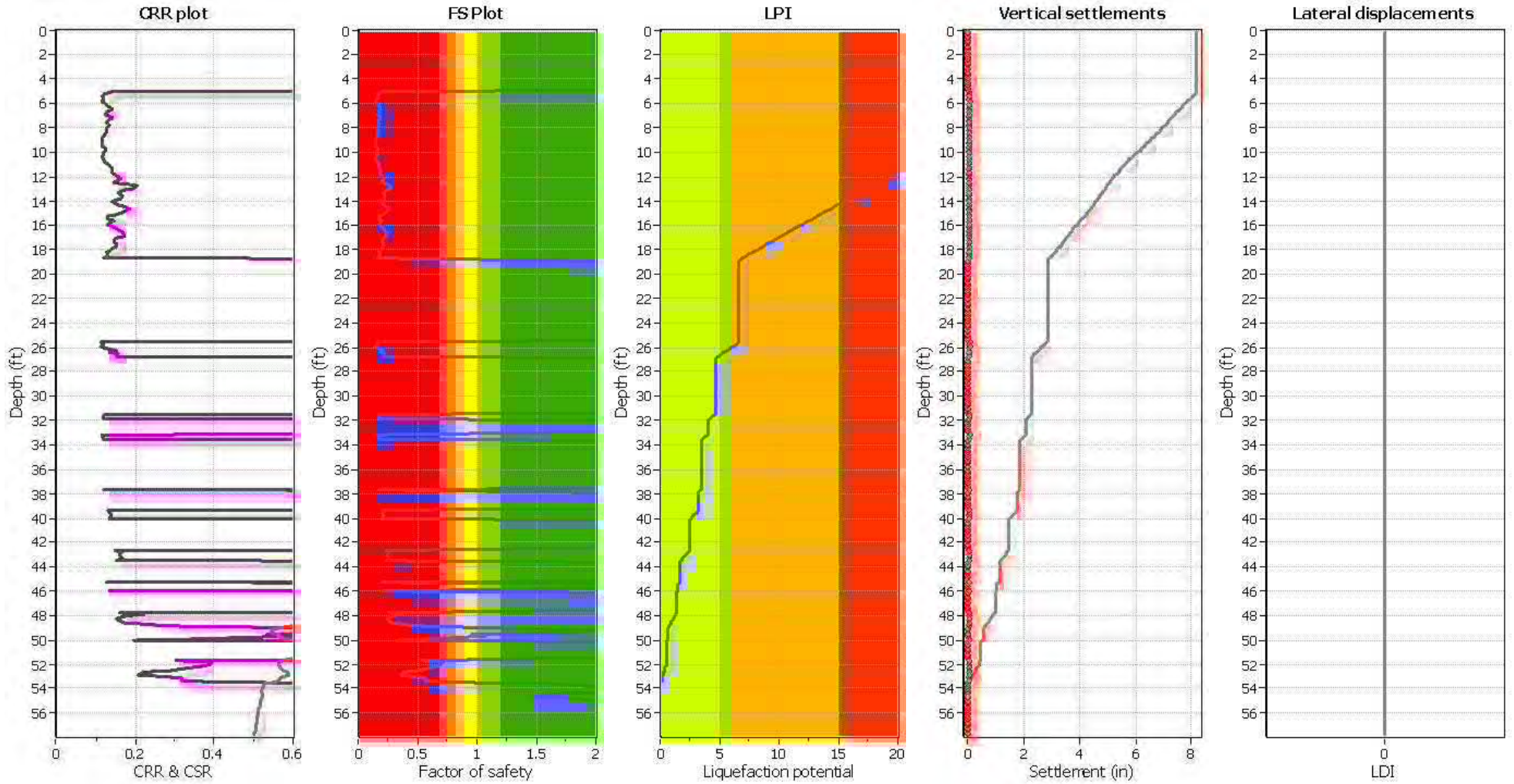
### Liquefaction analysis overall plots (intermediate res)



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>σ</sub> applied:	Yes
Earthquake magnitude M <sub>w</sub> :	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.59	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.00 ft	Fill height:	N/A	Limit depth:	N/A

### Liquefaction analysis overall plot



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on I <sub>c</sub> value	I <sub>c</sub> cut-off value:	2.60	K <sub>σ</sub> applied:	Yes
Earthquake magnitude M <sub>w</sub> :	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.59	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.00 ft	Fill height:	N/A	Limit depth:	N/A

**F.S. color scheme**

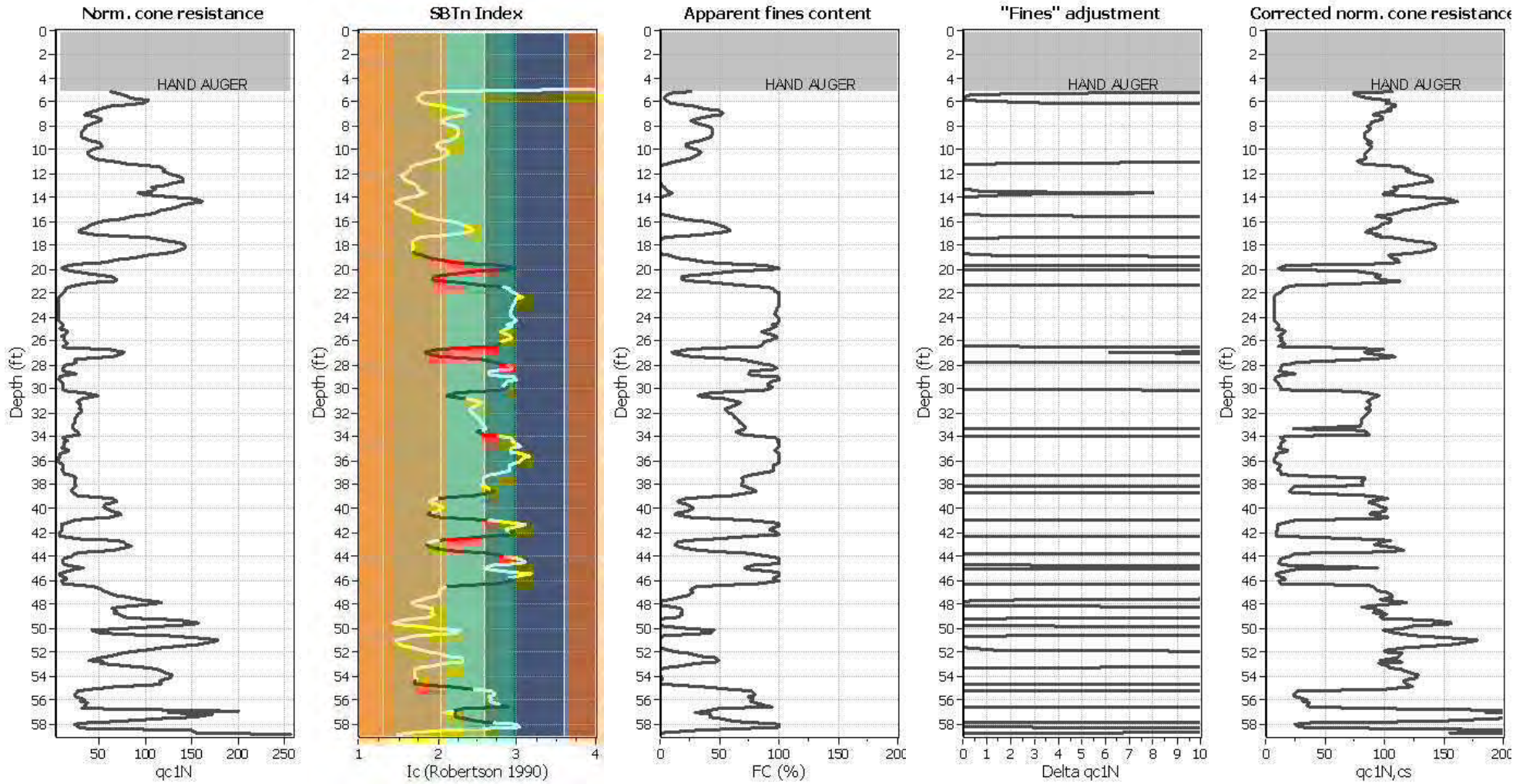
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

**LPI color scheme**

- Very high risk
- High risk
- Low risk



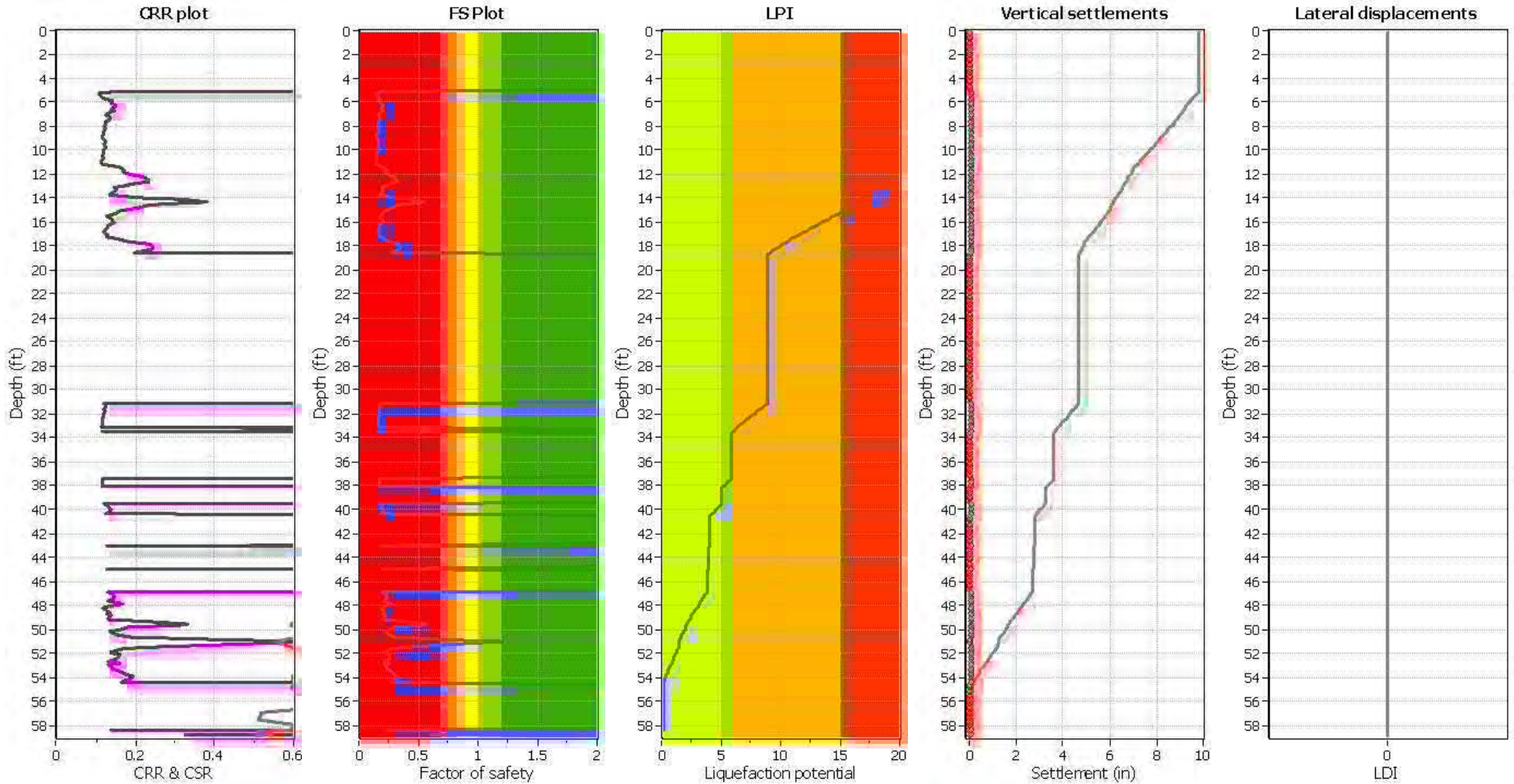
### Liquefaction analysis overall plots (intermediate res)



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>σ</sub> applied:	Yes
Earthquake magnitude M <sub>w</sub> :	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.59	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.00 ft	Fill height:	N/A	Limit depth:	N/A

### Liquefaction analysis overall plot



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on I <sub>c</sub> value	I <sub>c</sub> cut-off value:	2.60	K <sub>σ</sub> applied:	Yes
Earthquake magnitude M <sub>w</sub> :	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.59	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.00 ft	Fill height:	N/A	Limit depth:	N/A

**F.S. color scheme**

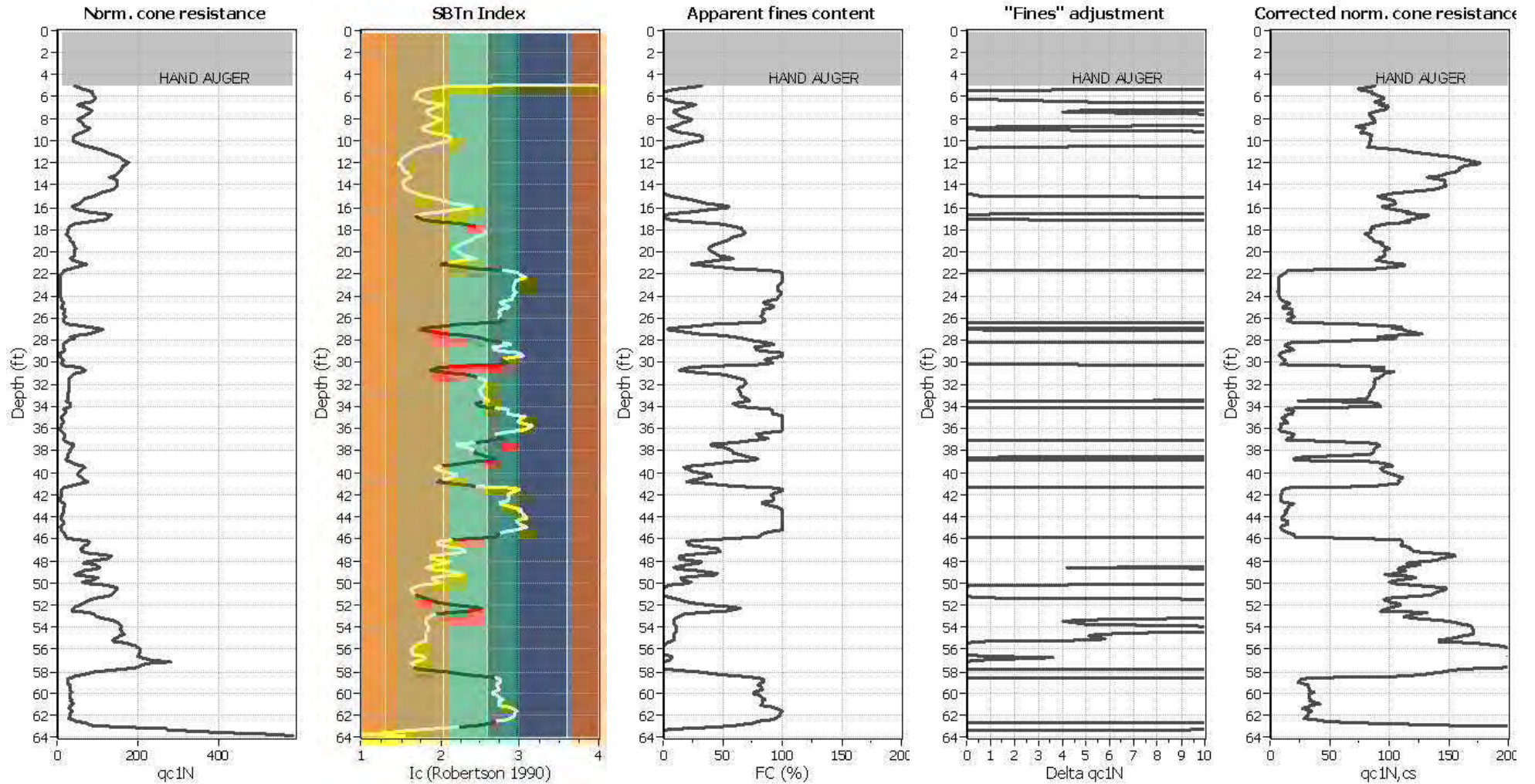
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

**LPI color scheme**

- Very high risk
- High risk
- Low risk



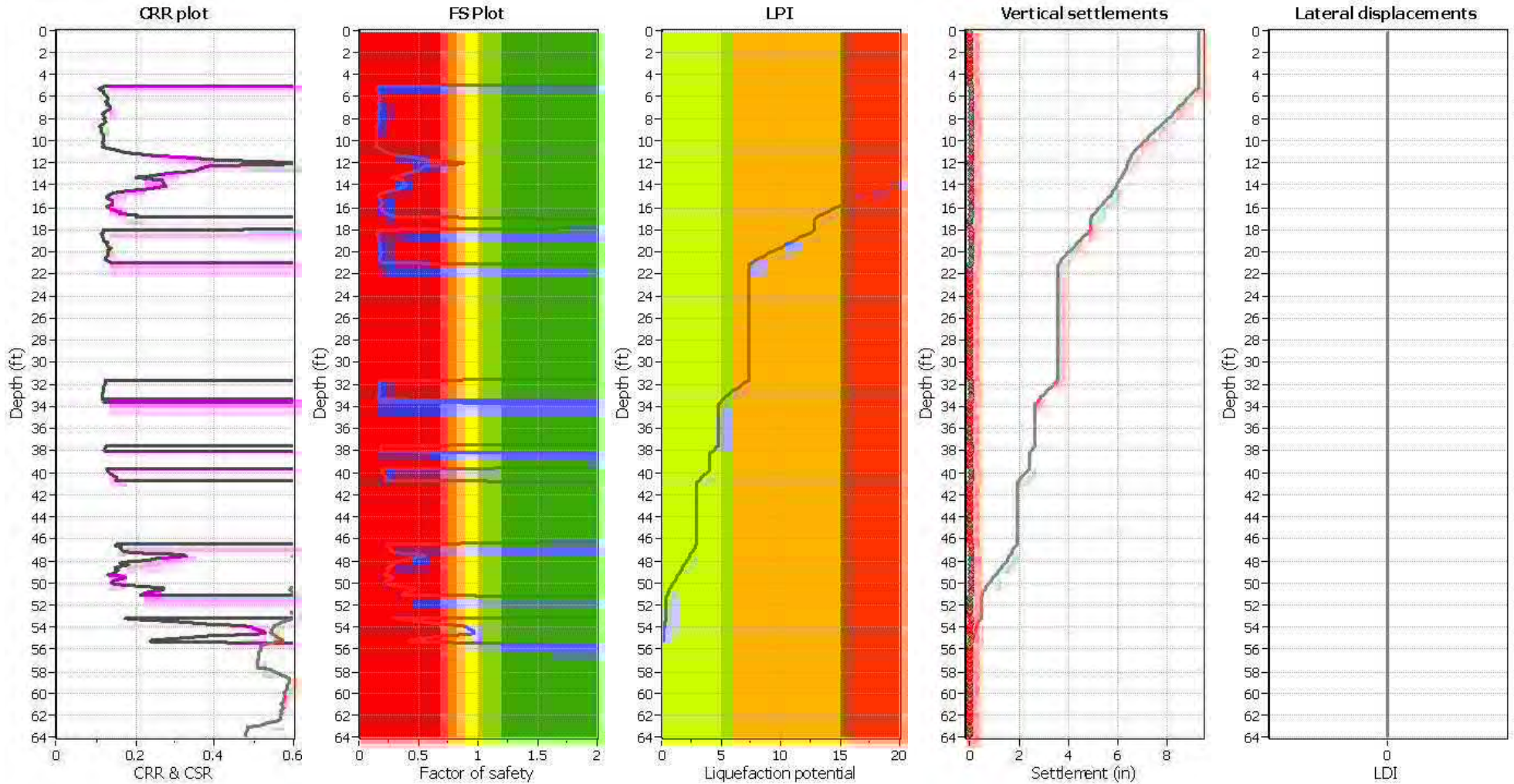
### Liquefaction analysis overall plots (intermediate res)



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>σ</sub> applied:	Yes
Earthquake magnitude M <sub>w</sub> :	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.59	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.00 ft	Fill height:	N/A	Limit depth:	N/A

### Liquefaction analysis overall plot



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on I <sub>c</sub> value	I <sub>c</sub> cut-off value:	2.60	K <sub>σ</sub> applied:	Yes
Earthquake magnitude M <sub>w</sub> :	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.59	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.00 ft	Fill height:	N/A	Limit depth:	N/A

**F.S. color scheme**

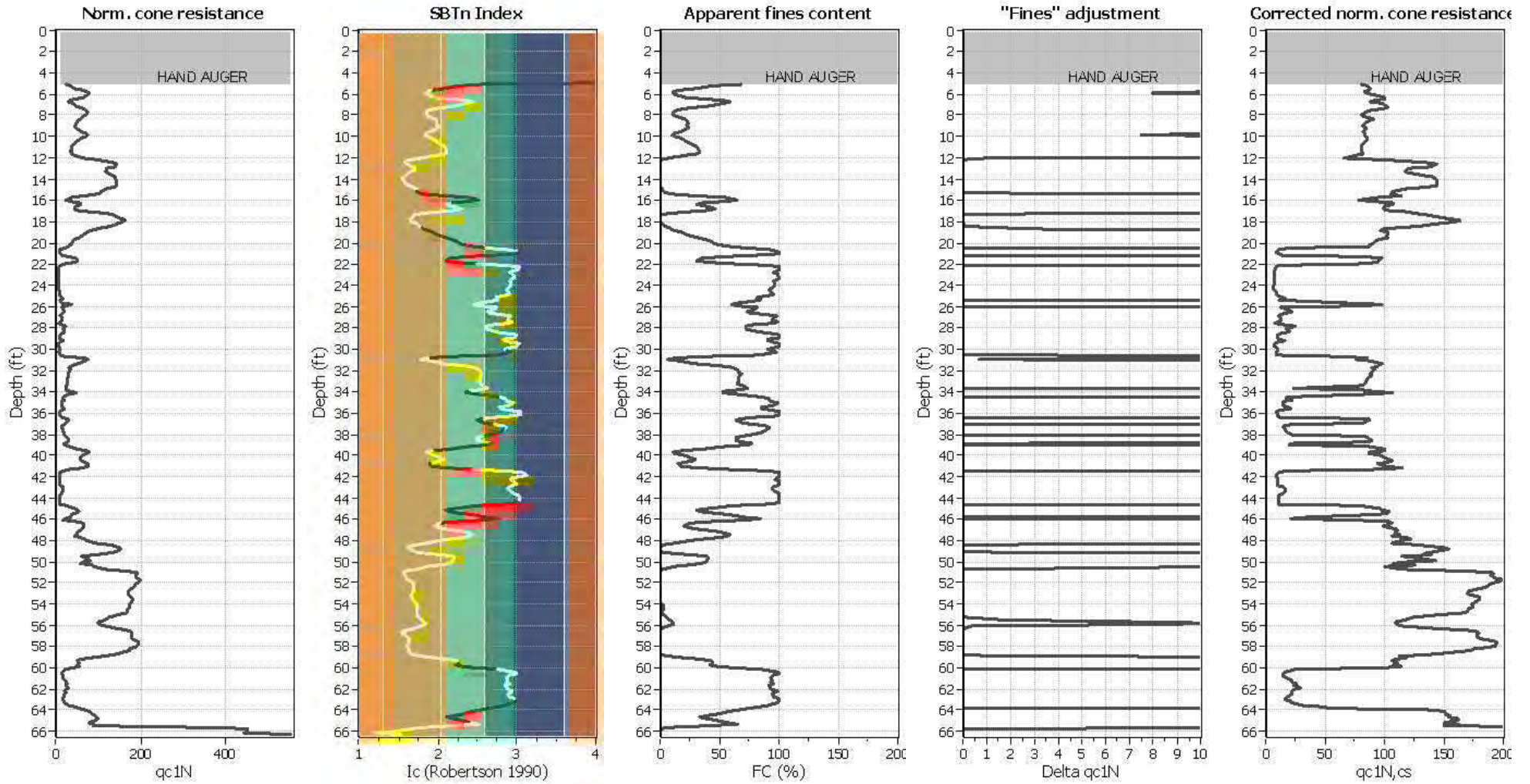
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

**LPI color scheme**

- Very high risk
- High risk
- Low risk



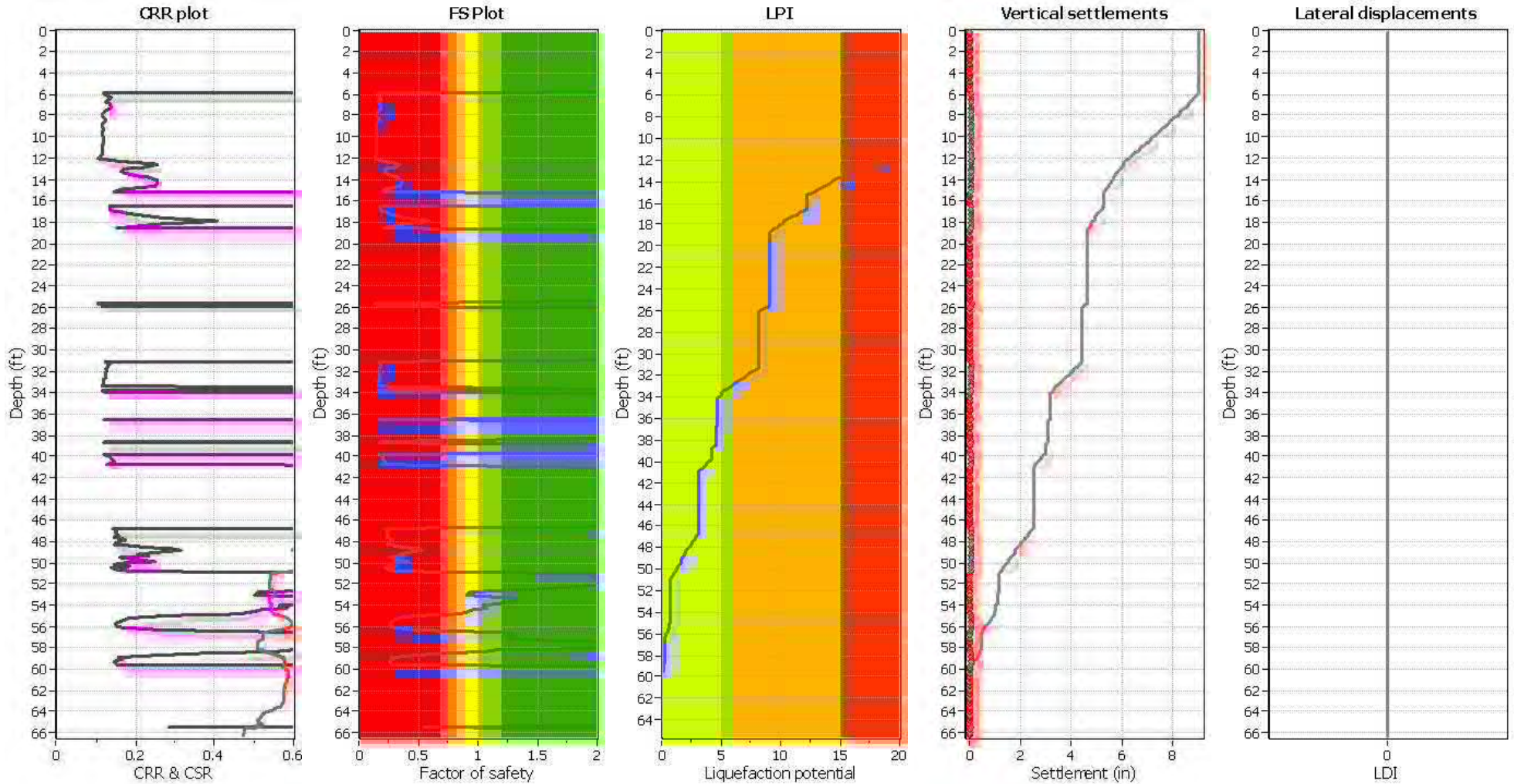
### Liquefaction analysis overall plots (intermediate res)



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>σ</sub> applied:	Yes
Earthquake magnitude M <sub>w</sub> :	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.59	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.00 ft	Fill height:	N/A	Limit depth:	N/A

### Liquefaction analysis overall plot



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on I <sub>c</sub> value	I <sub>c</sub> cut-off value:	2.60	K <sub>σ</sub> applied:	Yes
Earthquake magnitude M <sub>w</sub> :	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.59	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.00 ft	Fill height:	N/A	Limit depth:	N/A

**F.S. color scheme**

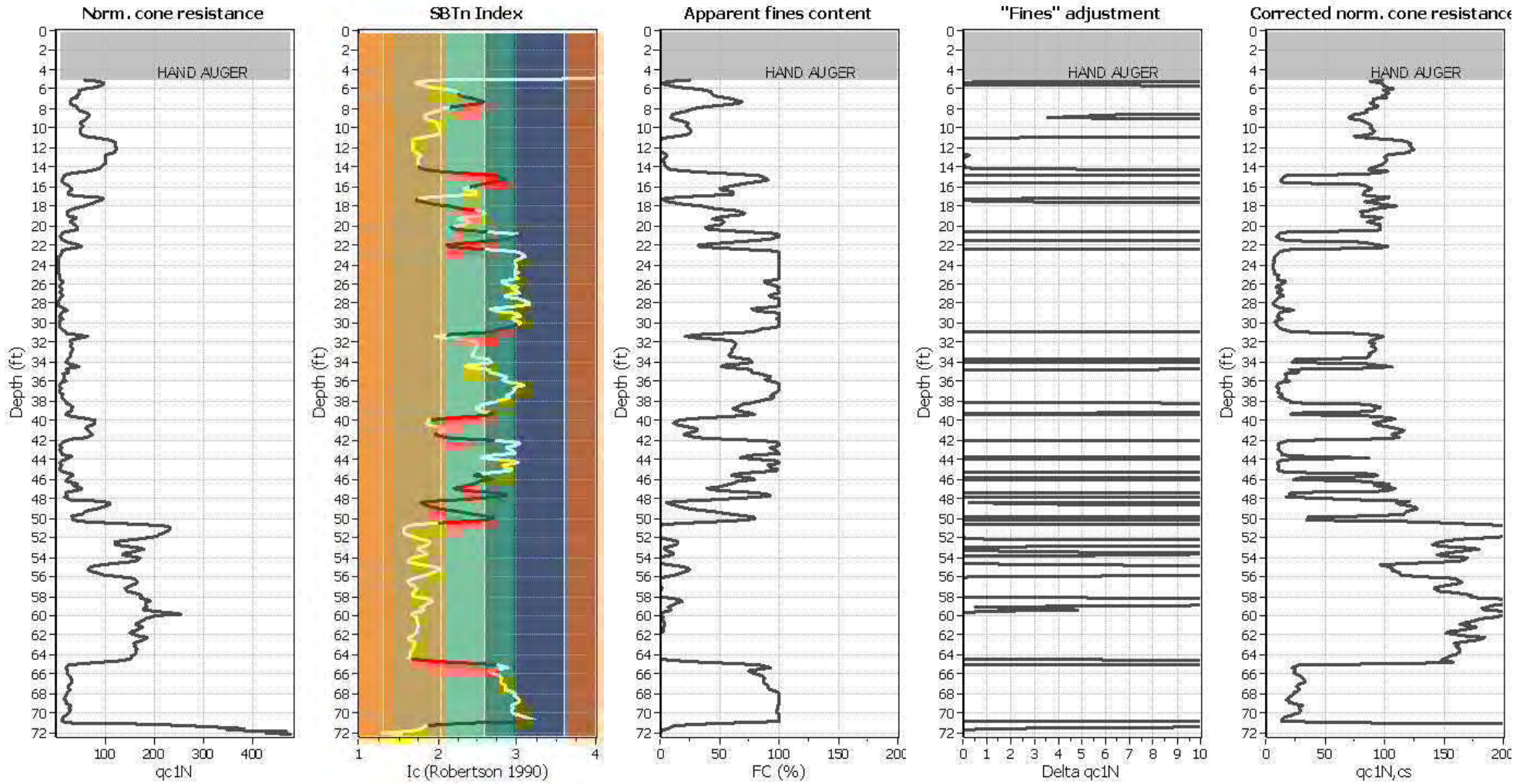
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

**LPI color scheme**

- Very high risk
- High risk
- Low risk



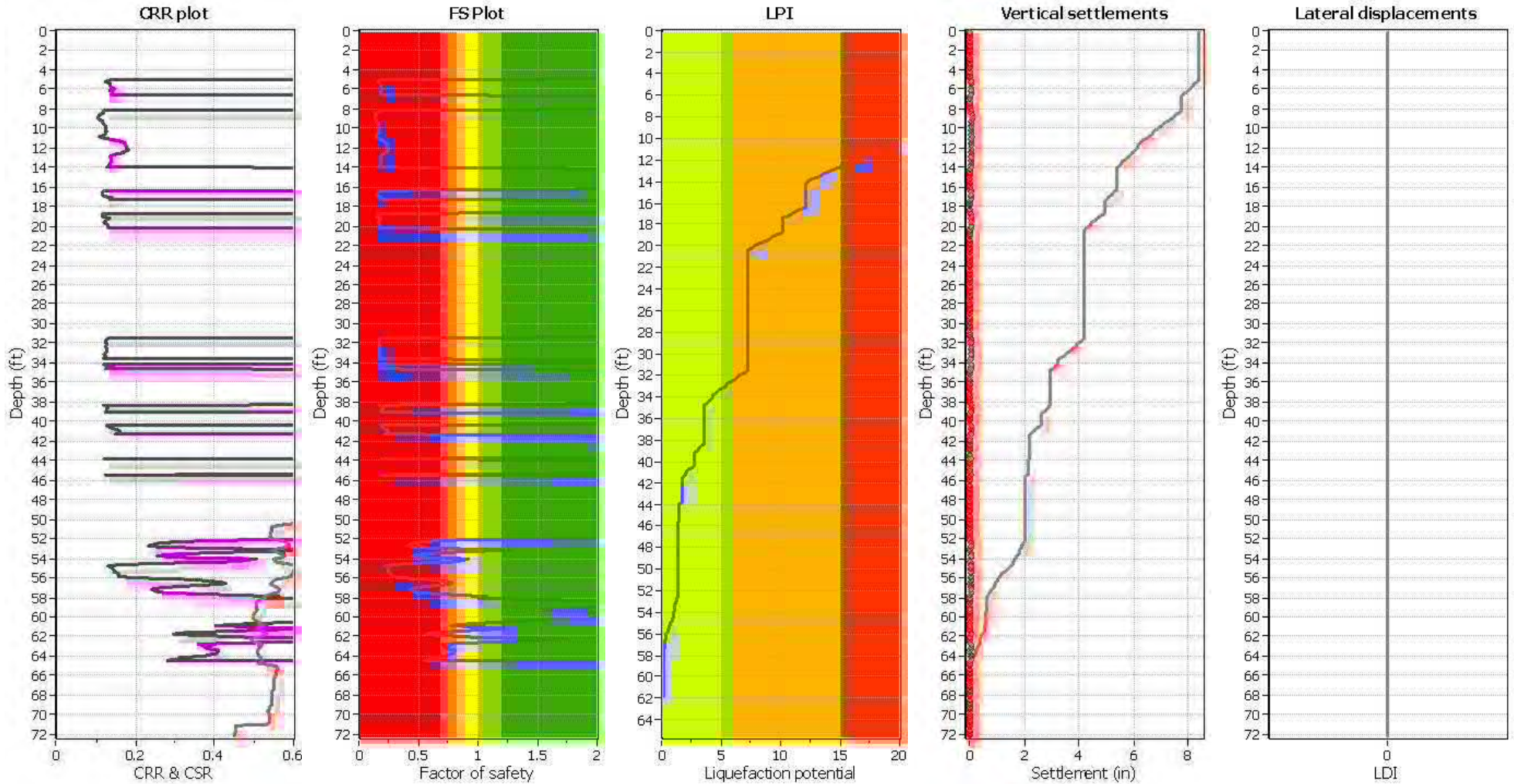
### Liquefaction analysis overall plots (intermediate res)



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>σ</sub> applied:	Yes
Earthquake magnitude M <sub>w</sub> :	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.59	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.00 ft	Fill height:	N/A	Limit depth:	N/A

### Liquefaction analysis overall plot



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on I <sub>c</sub> value	I <sub>c</sub> cut-off value:	2.60	K <sub>σ</sub> applied:	Yes
Earthquake magnitude M <sub>w</sub> :	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.59	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.00 ft	Fill height:	N/A	Limit depth:	N/A

**F.S. color scheme**

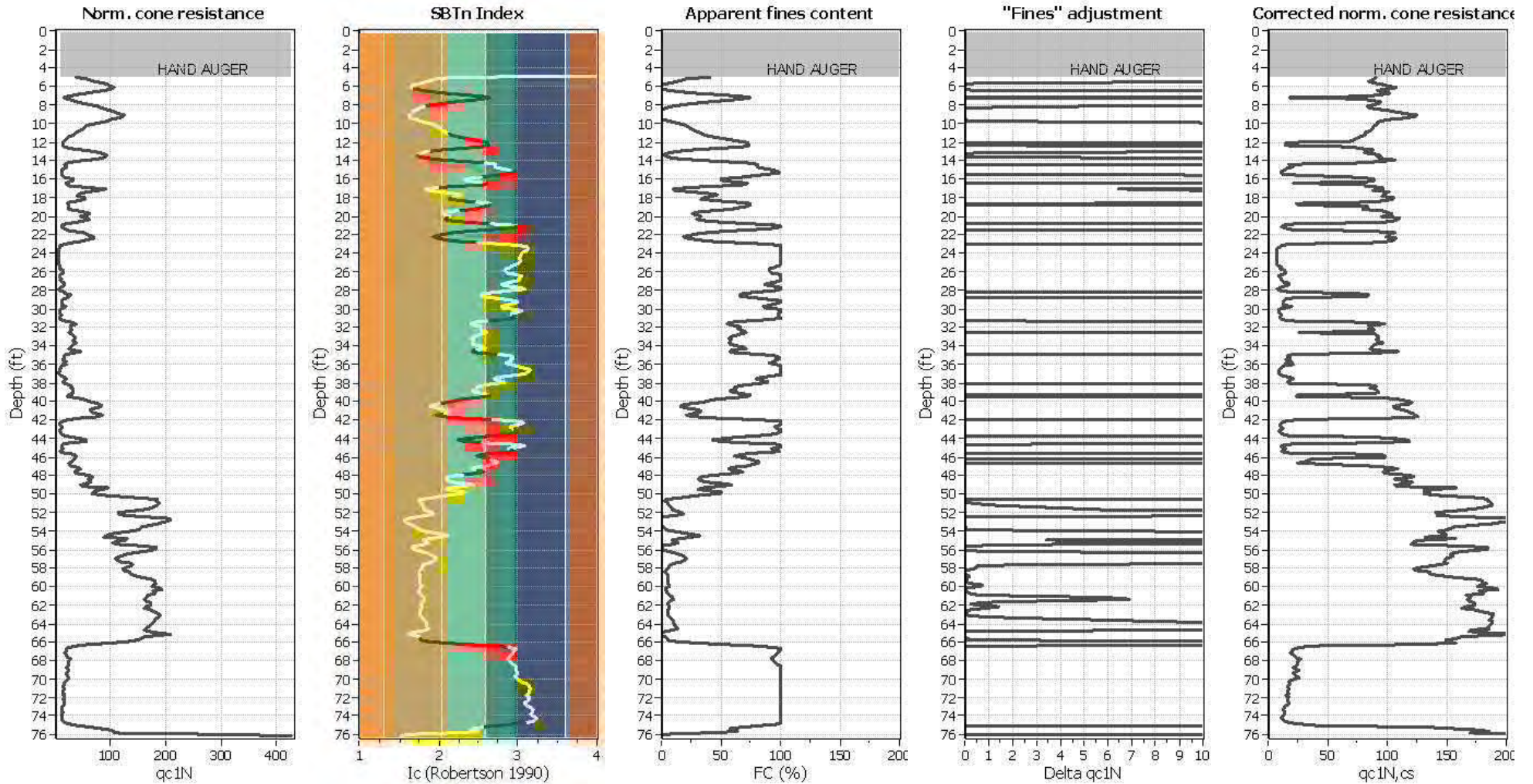
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

**LPI color scheme**

- Very high risk
- High risk
- Low risk



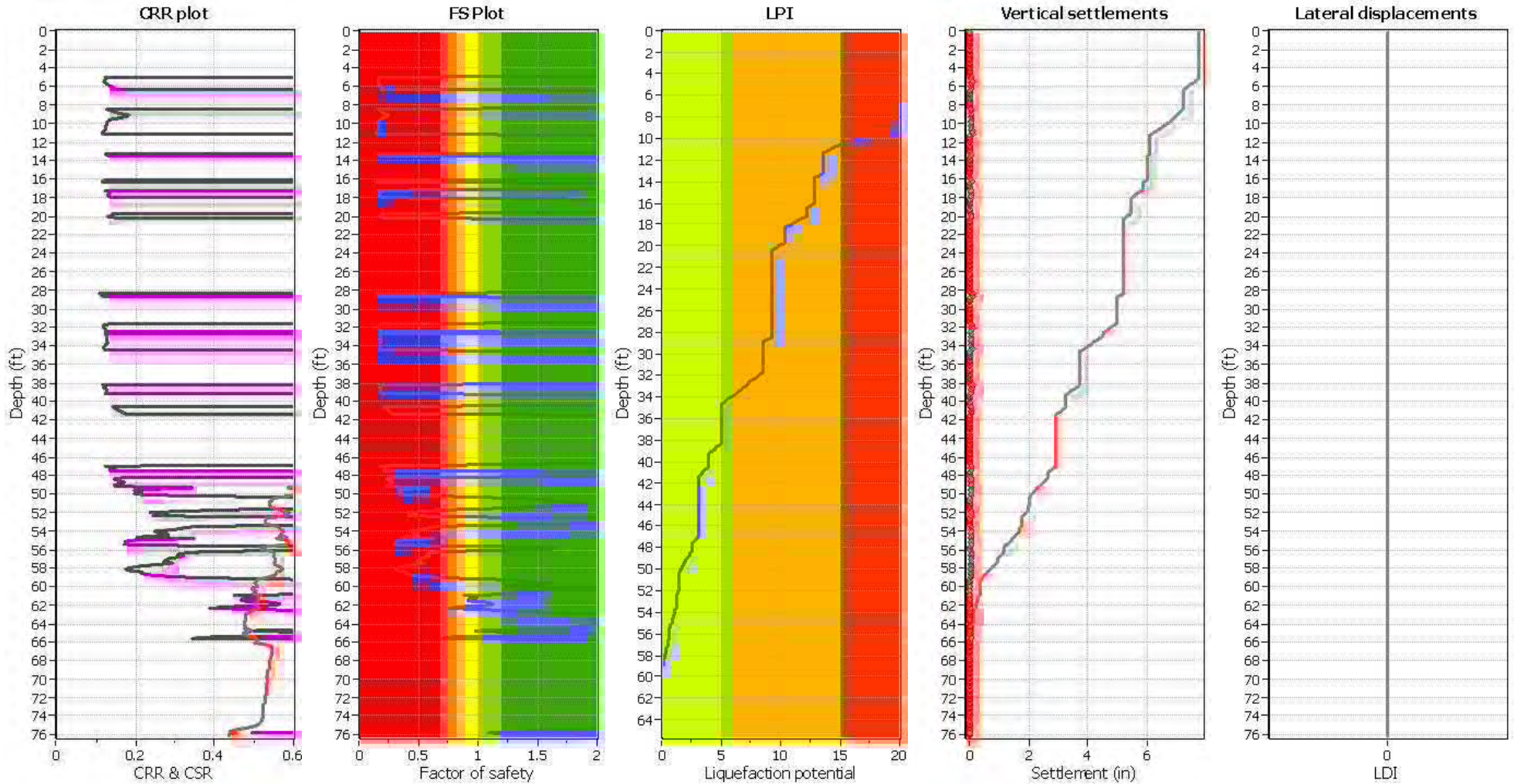
### Liquefaction analysis overall plots (intermediate res)



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>σ</sub> applied:	Yes
Earthquake magnitude M <sub>w</sub> :	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.59	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.00 ft	Fill height:	N/A	Limit depth:	N/A

### Liquefaction analysis overall plot



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_{\sigma}$ applied:	Yes
Earthquake magnitude $M_w$ :	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.59	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.00 ft	Fill height:	N/A	Limit depth:	N/A

**F.S. color scheme**

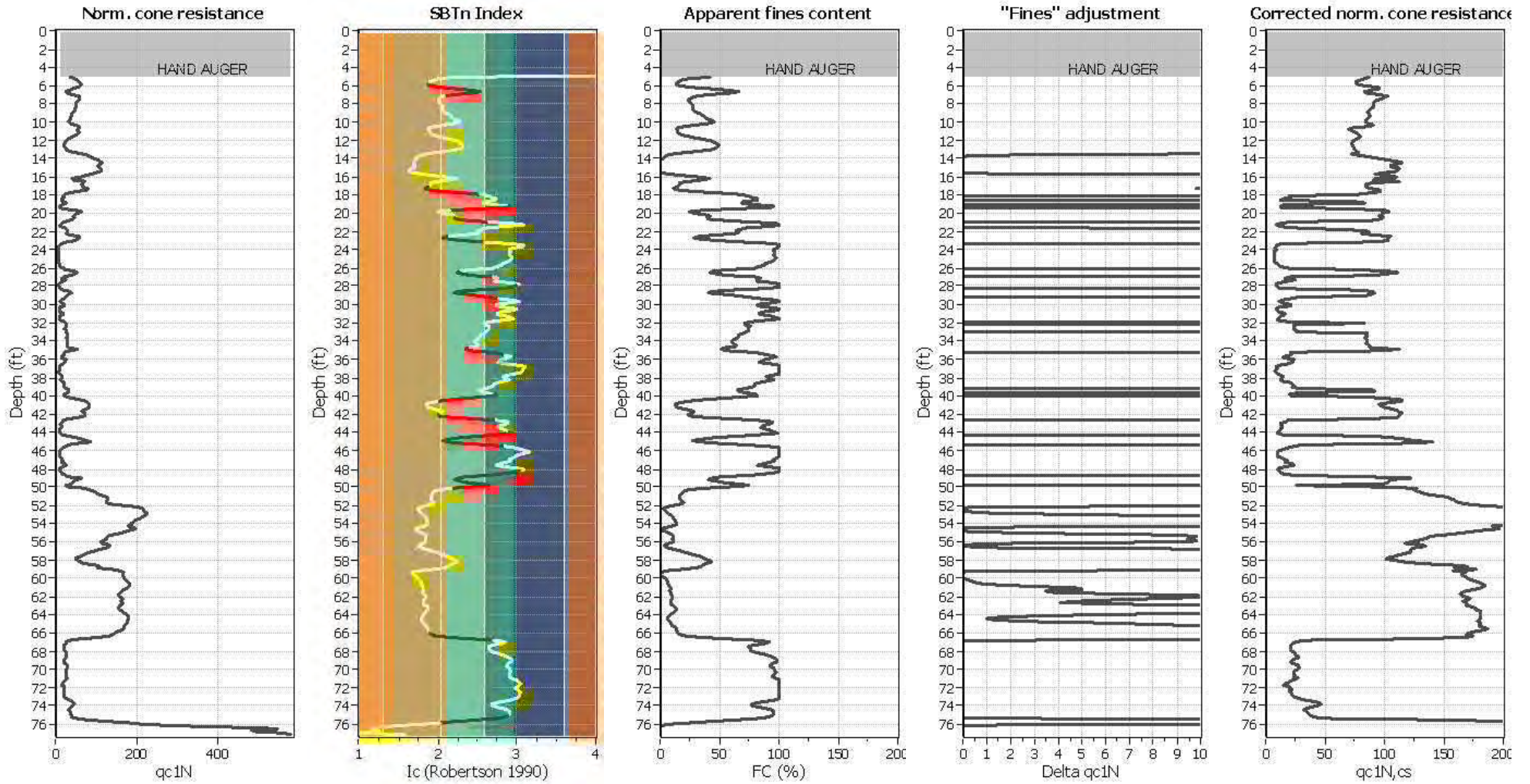
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

**LPI color scheme**

- Very high risk
- High risk
- Low risk



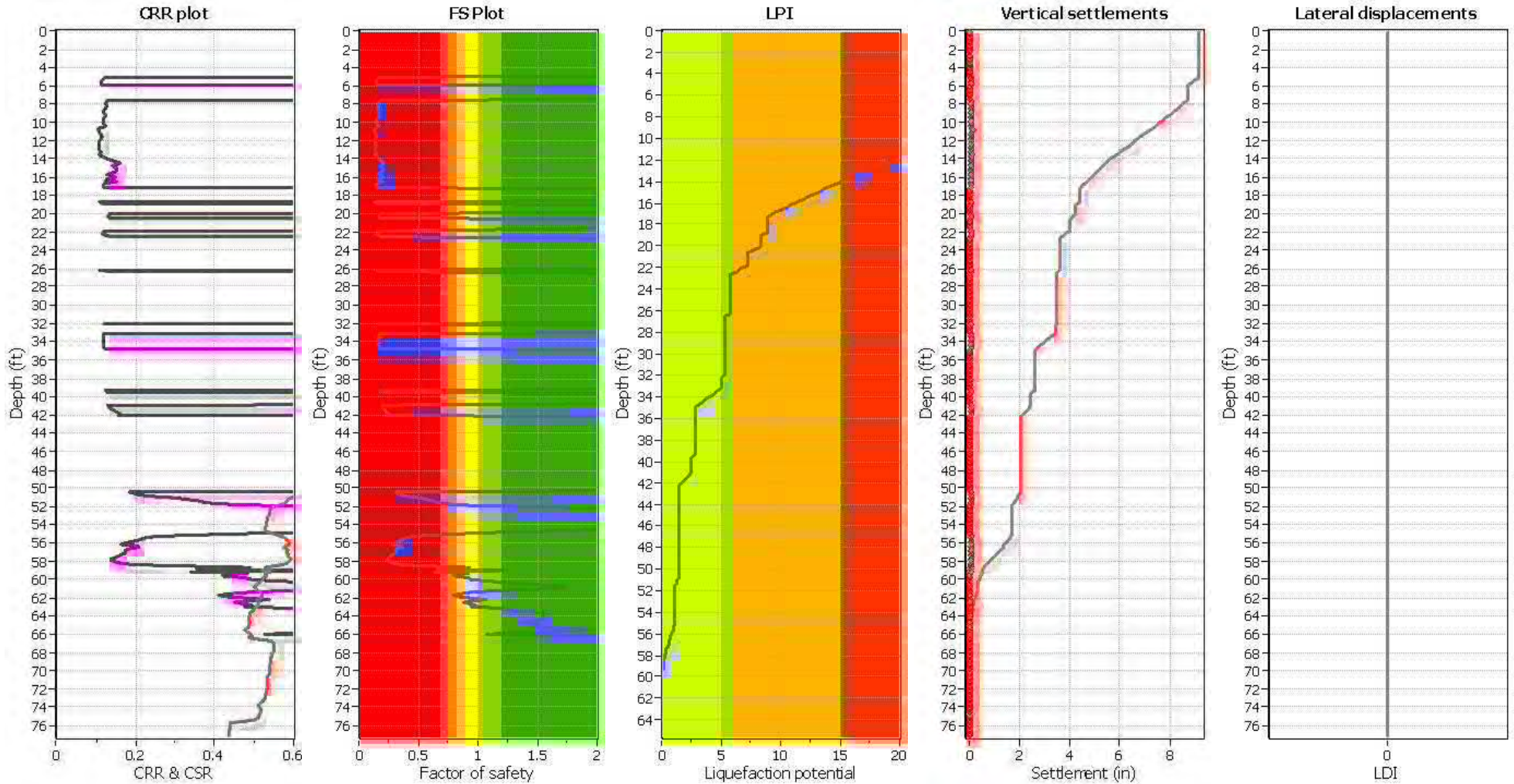
### Liquefaction analysis overall plots (intermediate res)



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>σ</sub> applied:	Yes
Earthquake magnitude M <sub>w</sub> :	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.59	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.00 ft	Fill height:	N/A	Limit depth:	N/A

### Liquefaction analysis overall plot



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>σ</sub> applied:	Yes
Earthquake magnitude M <sub>w</sub> :	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.59	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.00 ft	Fill height:	N/A	Limit depth:	N/A

**F.S. color scheme**

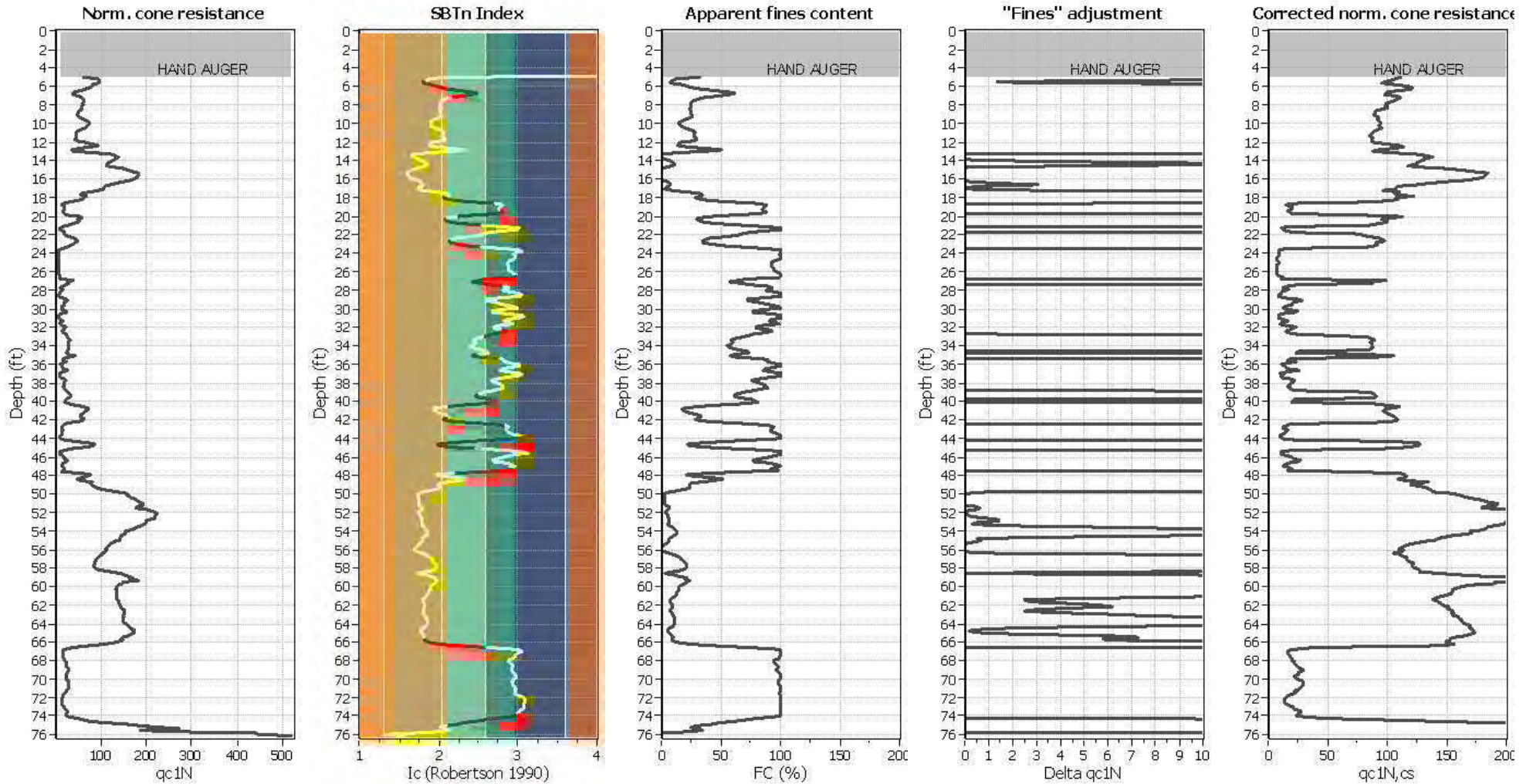
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

**LPI color scheme**

- Very high risk
- High risk
- Low risk



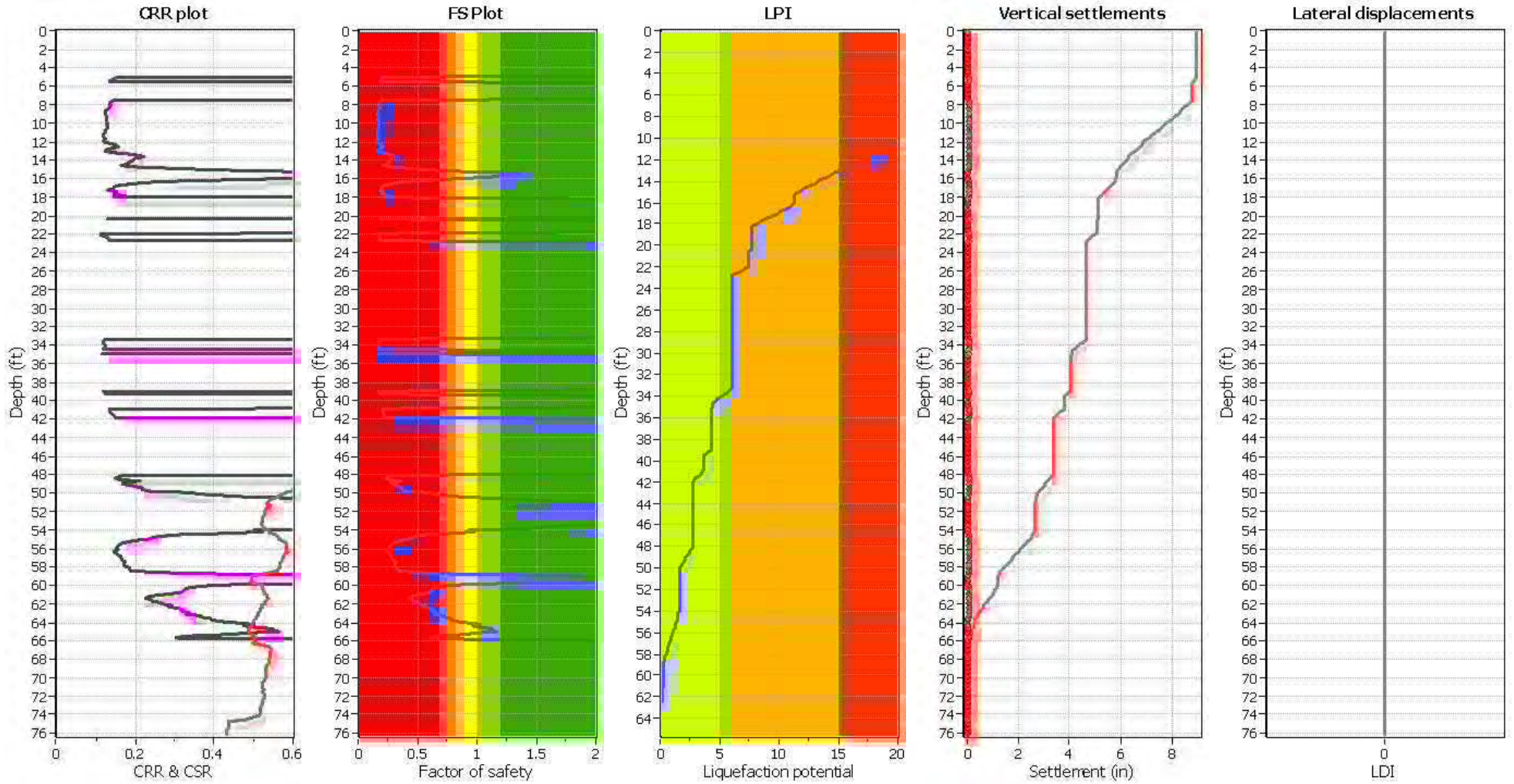
### Liquefaction analysis overall plots (intermediate res)



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>σ</sub> applied:	Yes
Earthquake magnitude M <sub>w</sub> :	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.59	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.00 ft	Fill height:	N/A	Limit depth:	N/A

### Liquefaction analysis overall plot



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on I <sub>c</sub> value	I <sub>c</sub> cut-off value:	2.60	K <sub>σ</sub> applied:	Yes
Earthquake magnitude M <sub>w</sub> :	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.59	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.00 ft	Fill height:	N/A	Limit depth:	N/A

**F.S. color scheme**

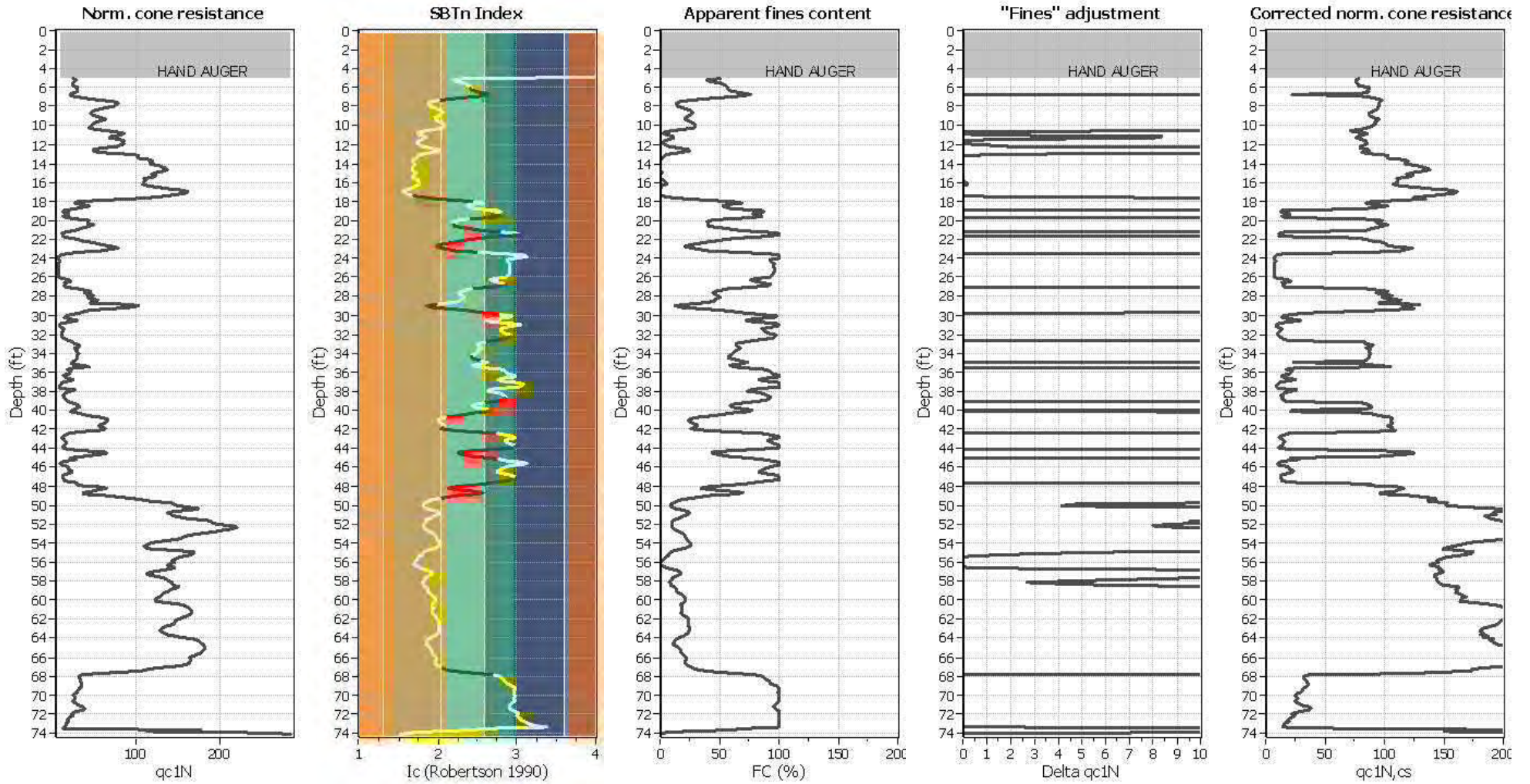
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

**LPI color scheme**

- Very high risk
- High risk
- Low risk



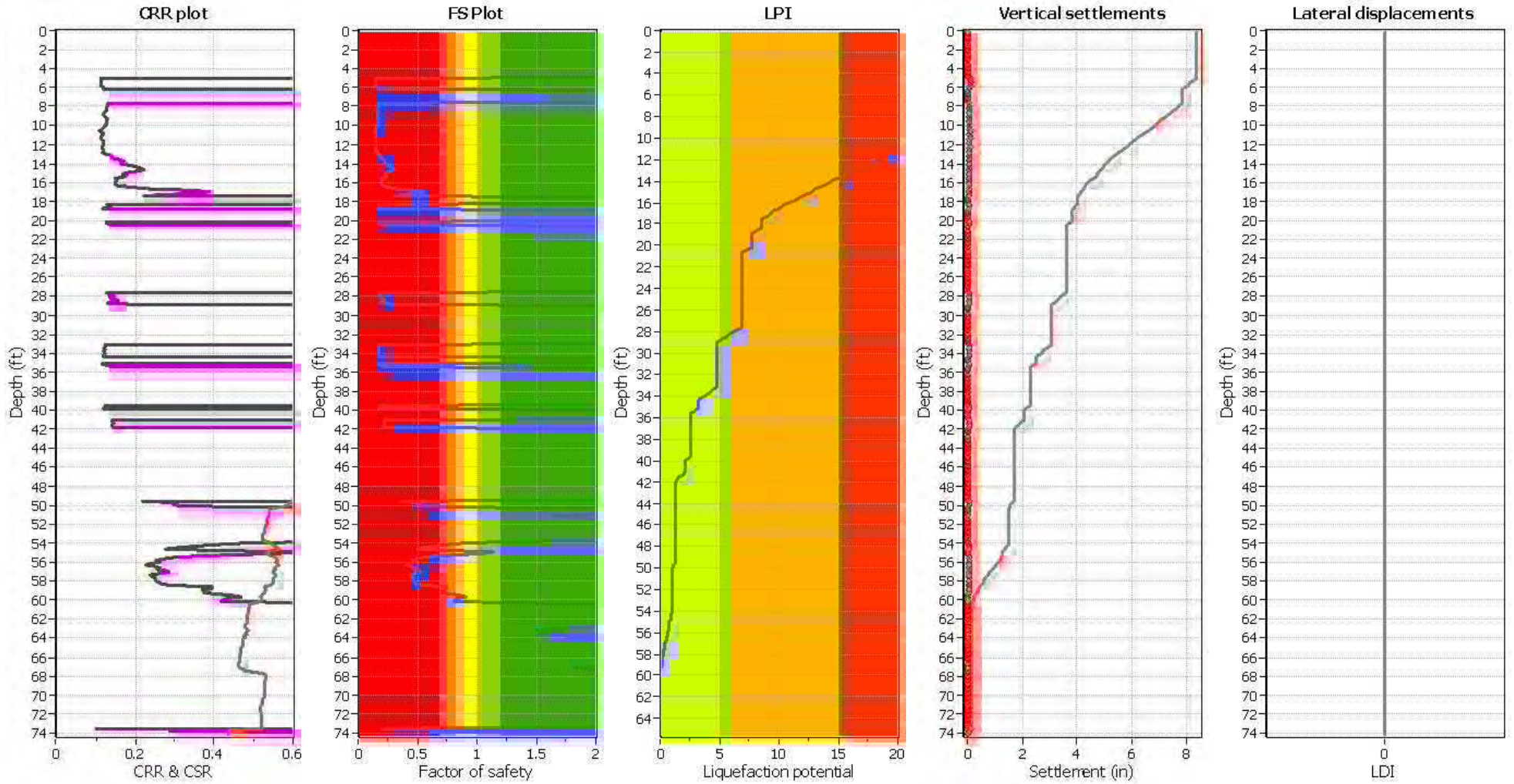
### Liquefaction analysis overall plots (intermediate res)



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>σ</sub> applied:	Yes
Earthquake magnitude M <sub>w</sub> :	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.59	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.00 ft	Fill height:	N/A	Limit depth:	N/A

### Liquefaction analysis overall plot



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on I <sub>c</sub> value	I <sub>c</sub> cut-off value:	2.60	K <sub>σ</sub> applied:	Yes
Earthquake magnitude M <sub>w</sub> :	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.59	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.00 ft	Fill height:	N/A	Limit depth:	N/A

**F.S. color scheme**

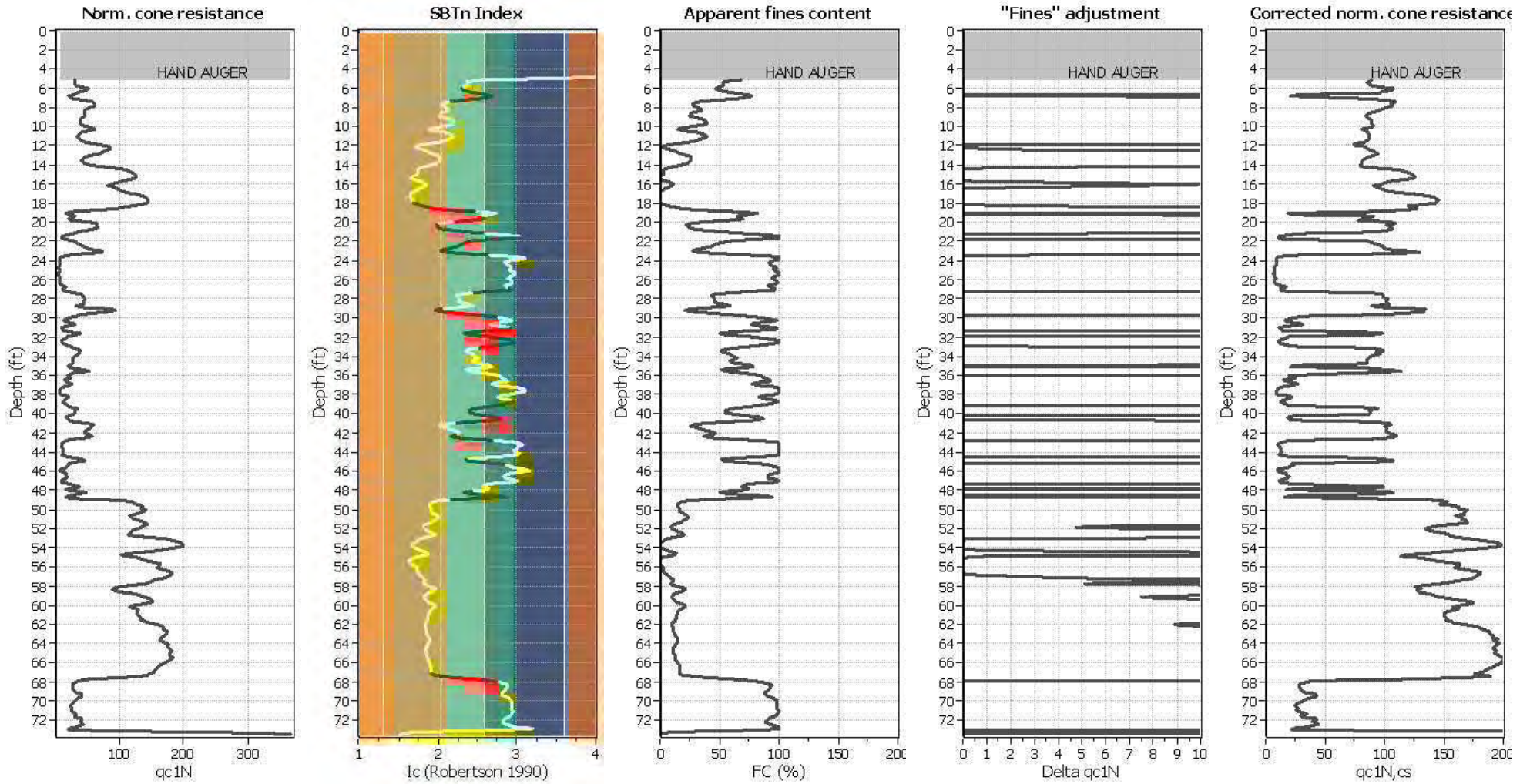
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

**LPI color scheme**

- Very high risk
- High risk
- Low risk



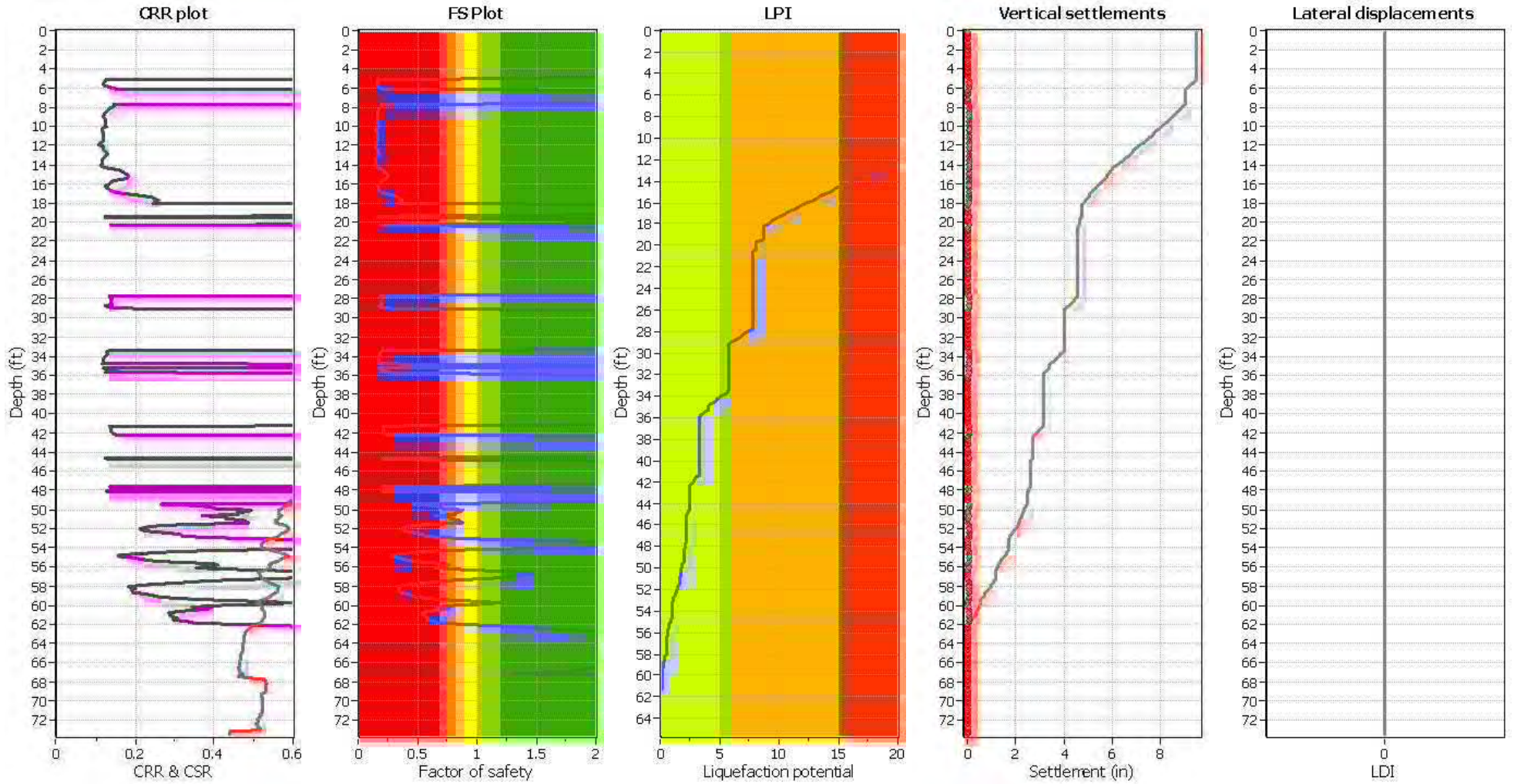
### Liquefaction analysis overall plots (intermediate res)



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>σ</sub> applied:	Yes
Earthquake magnitude M <sub>w</sub> :	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.59	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.00 ft	Fill height:	N/A	Limit depth:	N/A

### Liquefaction analysis overall plot



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>σ</sub> applied:	Yes
Earthquake magnitude M <sub>w</sub> :	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.59	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.00 ft	Fill height:	N/A	Limit depth:	N/A

**F.S. color scheme**

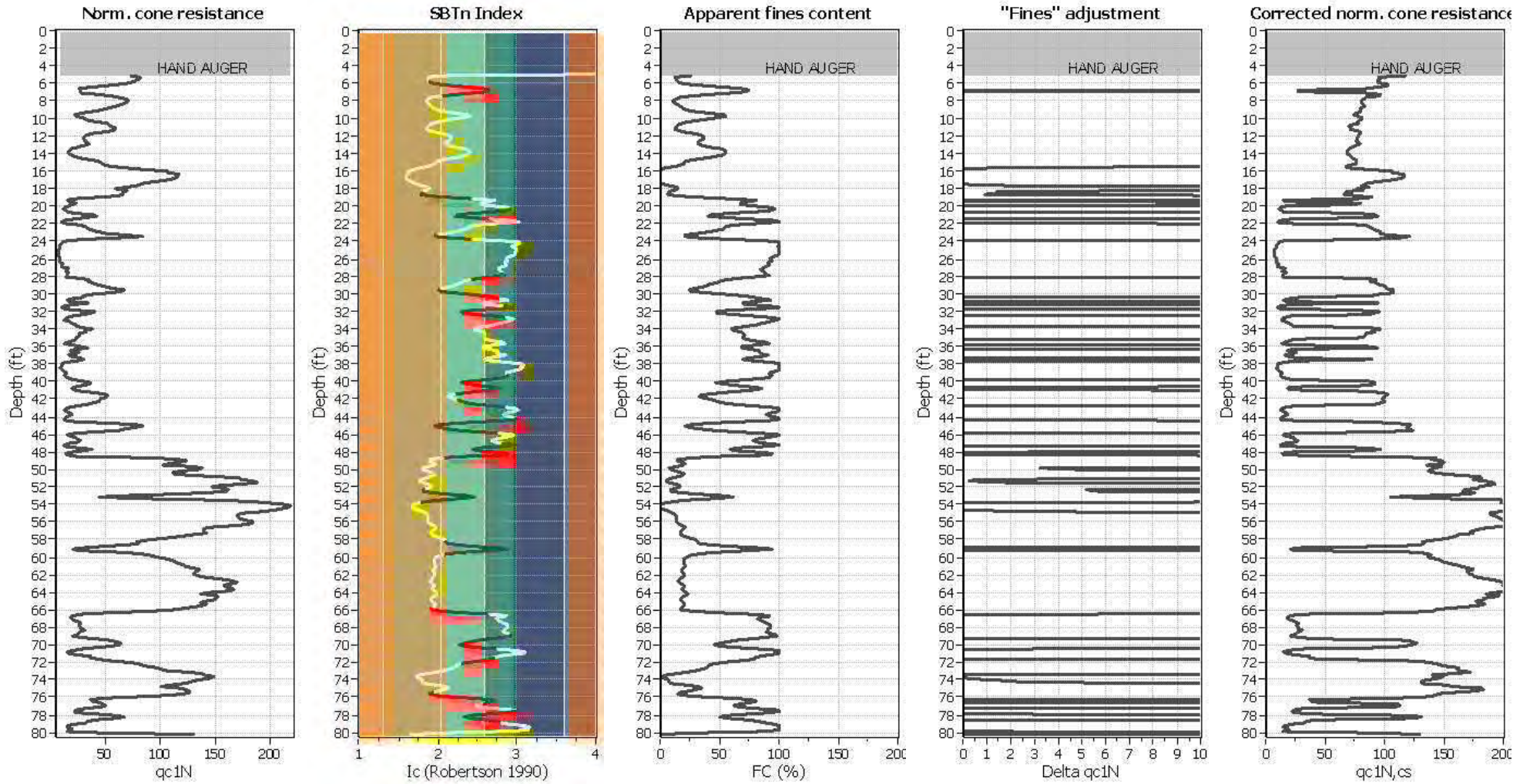
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

**LPI color scheme**

- Very high risk
- High risk
- Low risk



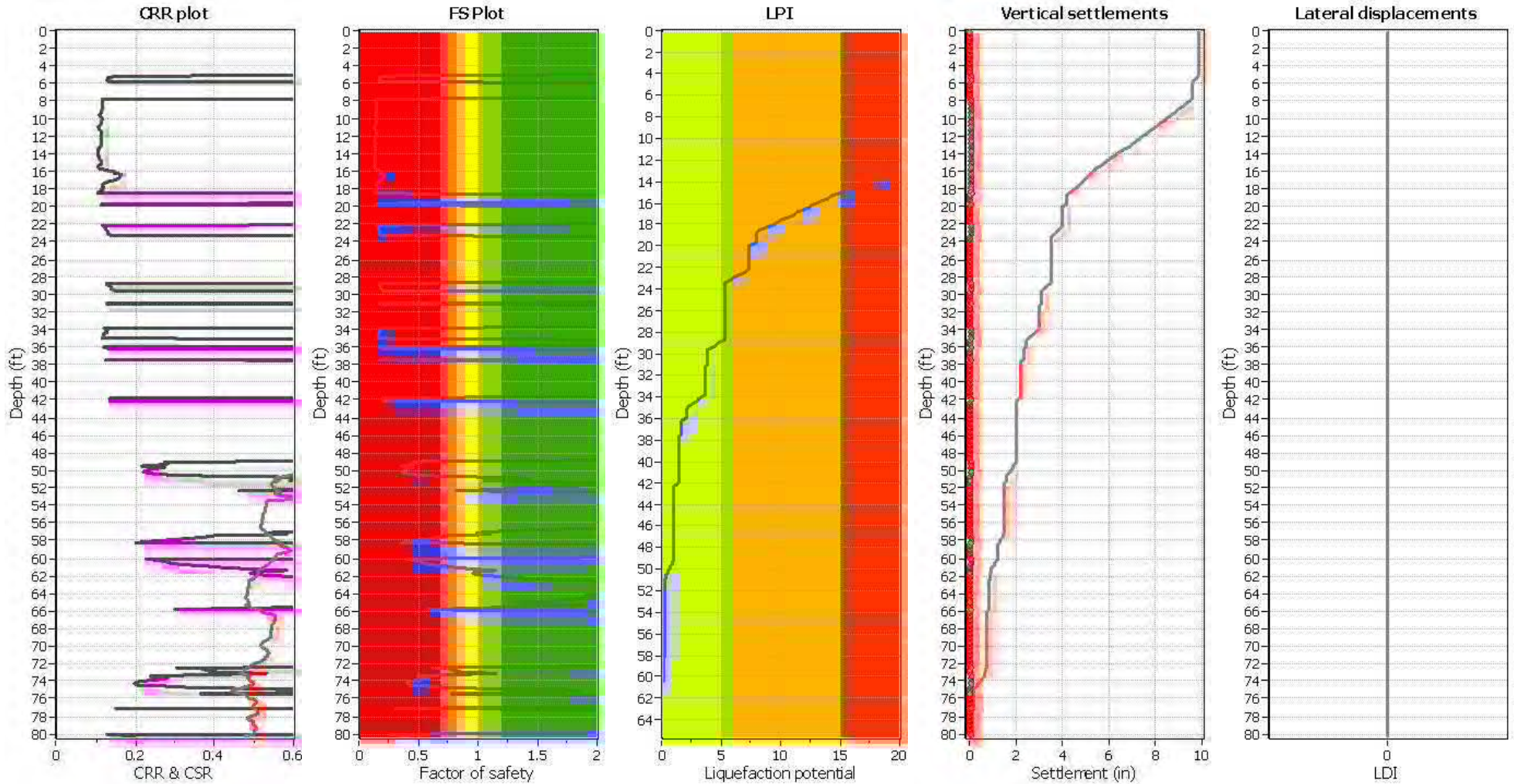
### Liquefaction analysis overall plots (intermediate res)



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>σ</sub> applied:	Yes
Earthquake magnitude M <sub>w</sub> :	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.59	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.00 ft	Fill height:	N/A	Limit depth:	N/A

### Liquefaction analysis overall plot



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on I <sub>c</sub> value	I <sub>c</sub> cut-off value:	2.60	K <sub>σ</sub> applied:	Yes
Earthquake magnitude M <sub>w</sub> :	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.59	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.00 ft	Fill height:	N/A	Limit depth:	N/A

**F.S. color scheme**

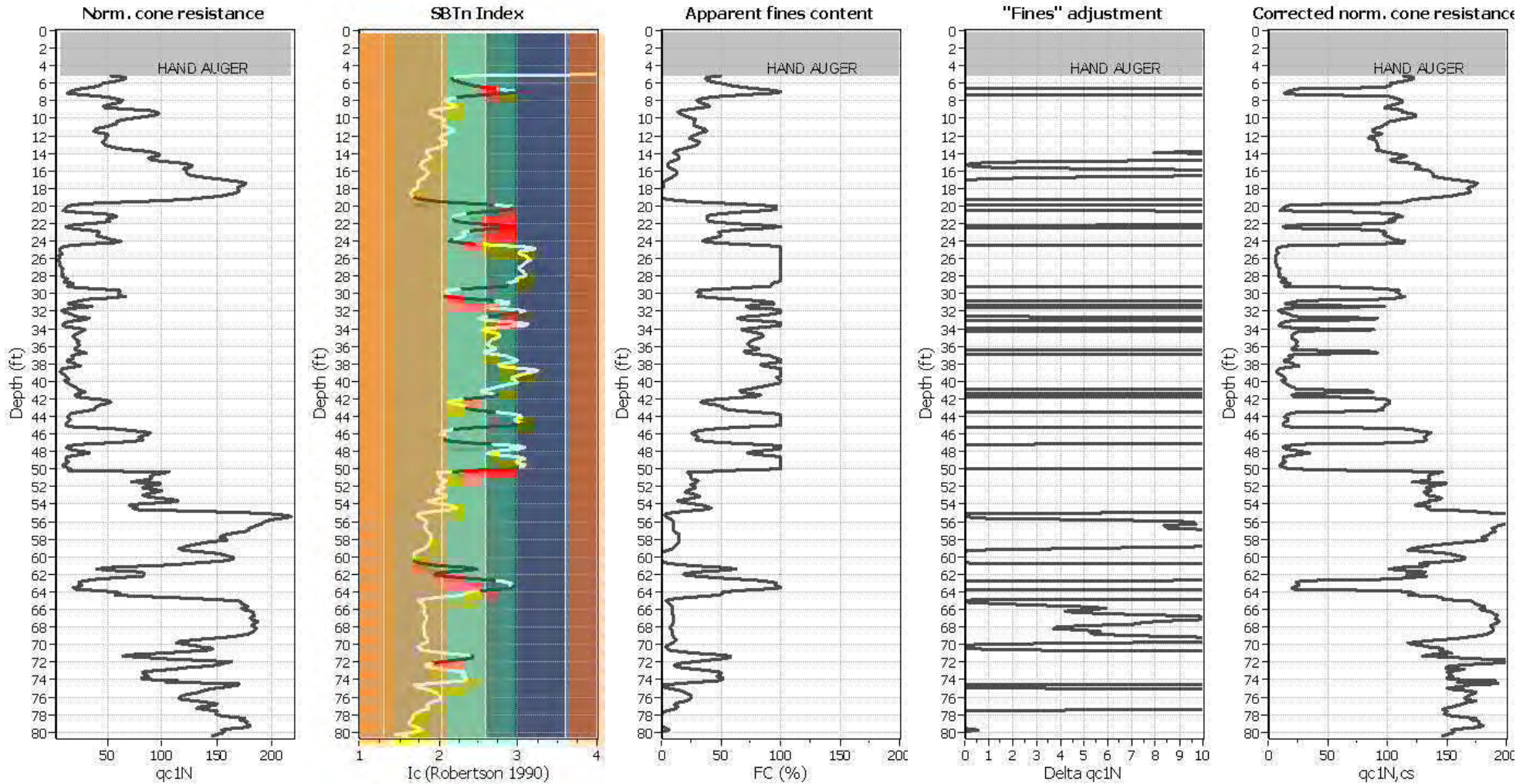
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

**LPI color scheme**

- Very high risk
- High risk
- Low risk



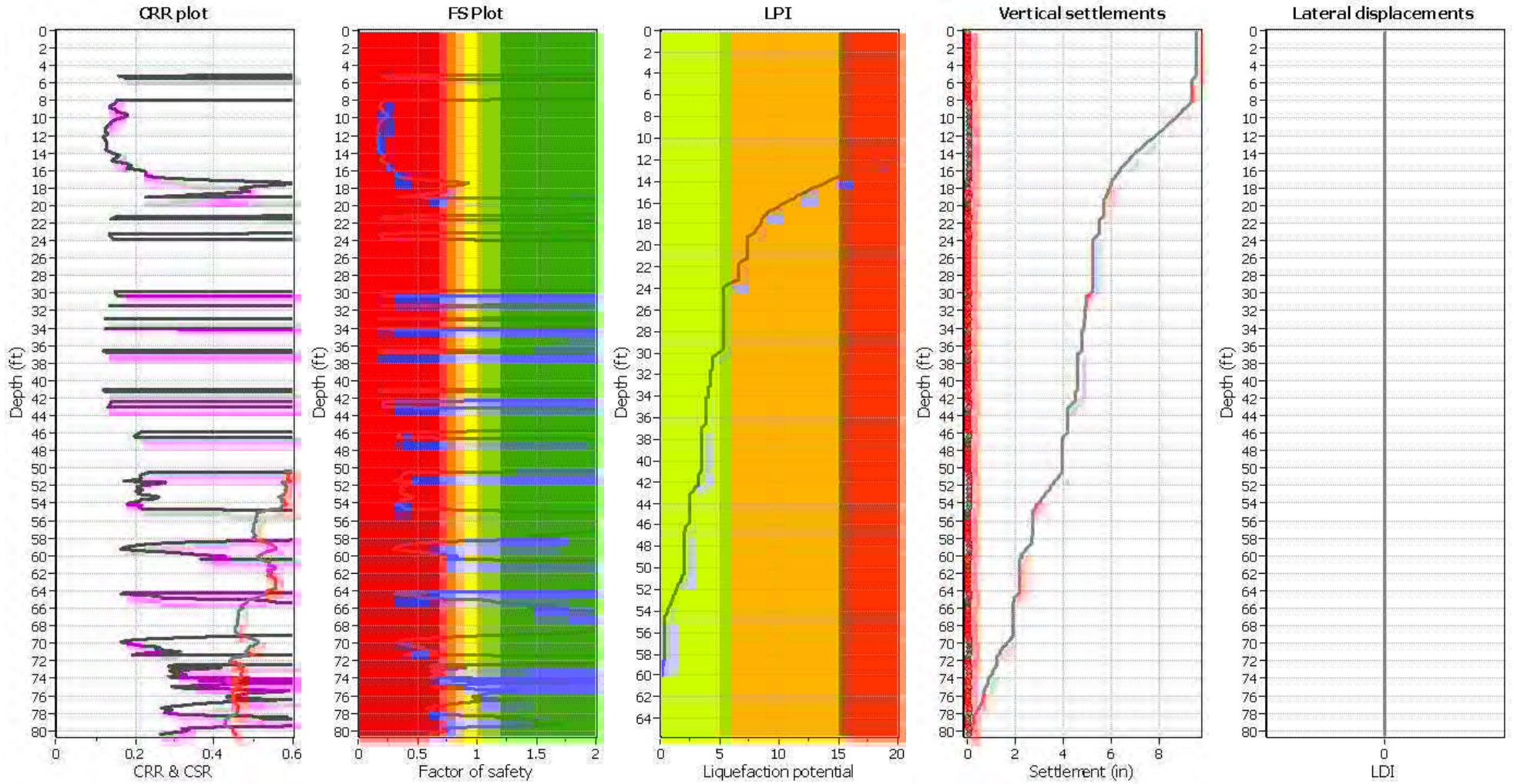
### Liquefaction analysis overall plots (intermediate res)



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>σ</sub> applied:	Yes
Earthquake magnitude M <sub>w</sub> :	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.59	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.00 ft	Fill height:	N/A	Limit depth:	N/A

### Liquefaction analysis overall plot



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on I <sub>c</sub> value	I <sub>c</sub> cut-off value:	2.60	K <sub>σ</sub> applied:	Yes
Earthquake magnitude M <sub>w</sub> :	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.59	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.00 ft	Fill height:	N/A	Limit depth:	N/A

**F.S. color scheme**

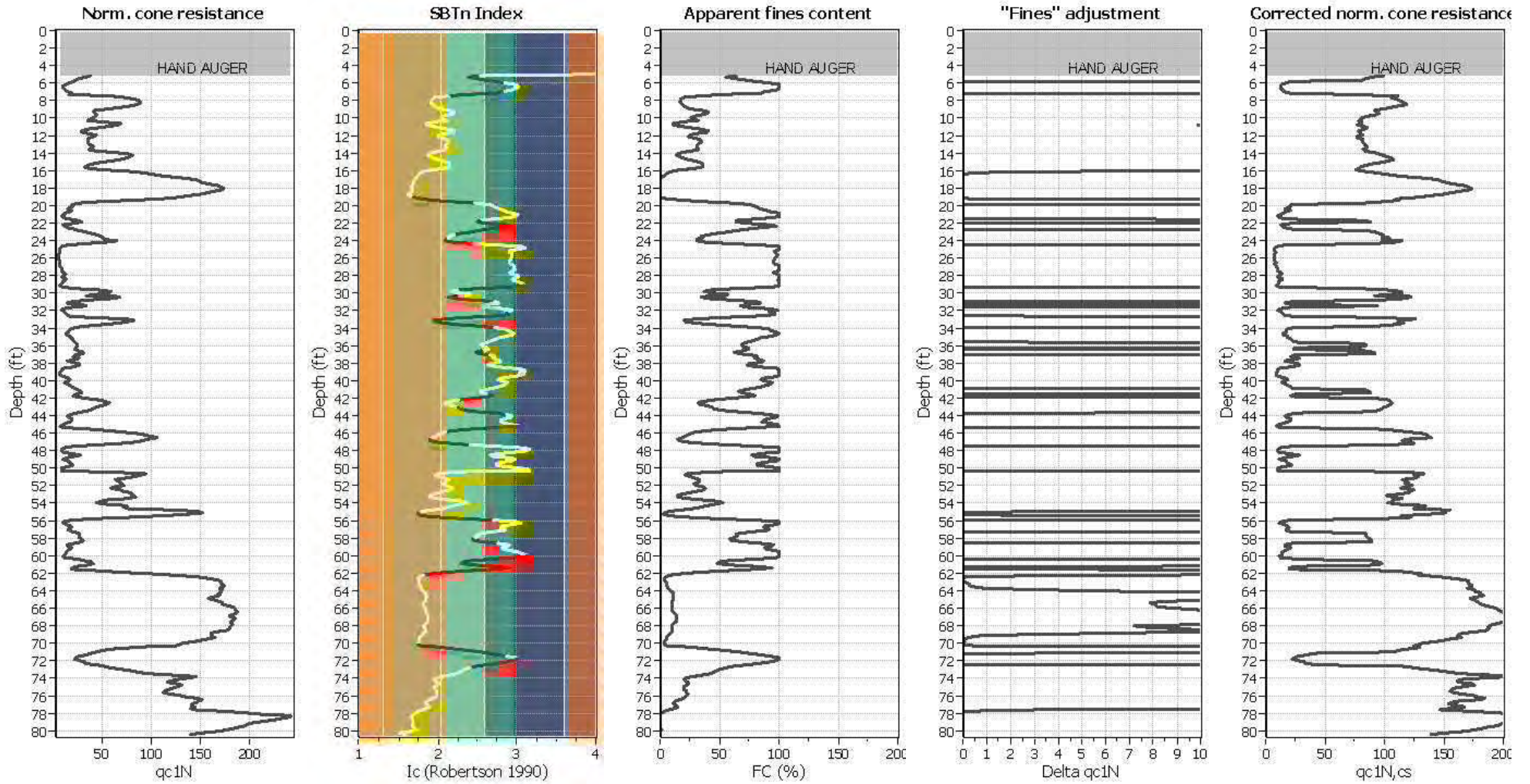
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

**LPI color scheme**

- Very high risk
- High risk
- Low risk



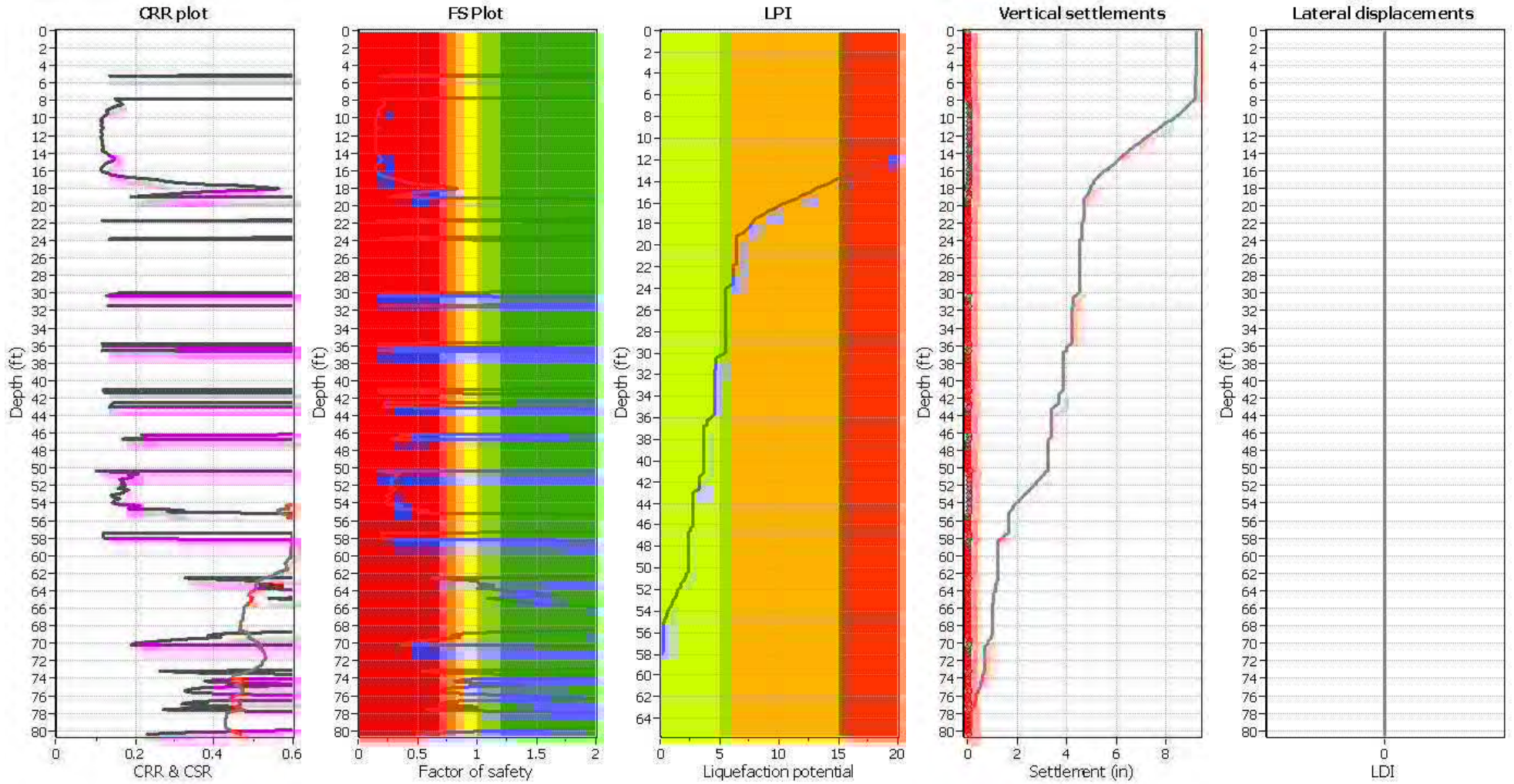
### Liquefaction analysis overall plots (intermediate res)



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>σ</sub> applied:	Yes
Earthquake magnitude M <sub>w</sub> :	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.59	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.00 ft	Fill height:	N/A	Limit depth:	N/A

### Liquefaction analysis overall plot



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on I <sub>c</sub> value	I <sub>c</sub> cut-off value:	2.60	K <sub>σ</sub> applied:	Yes
Earthquake magnitude M <sub>w</sub> :	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.59	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.00 ft	Fill height:	N/A	Limit depth:	N/A

**F.S. color scheme**

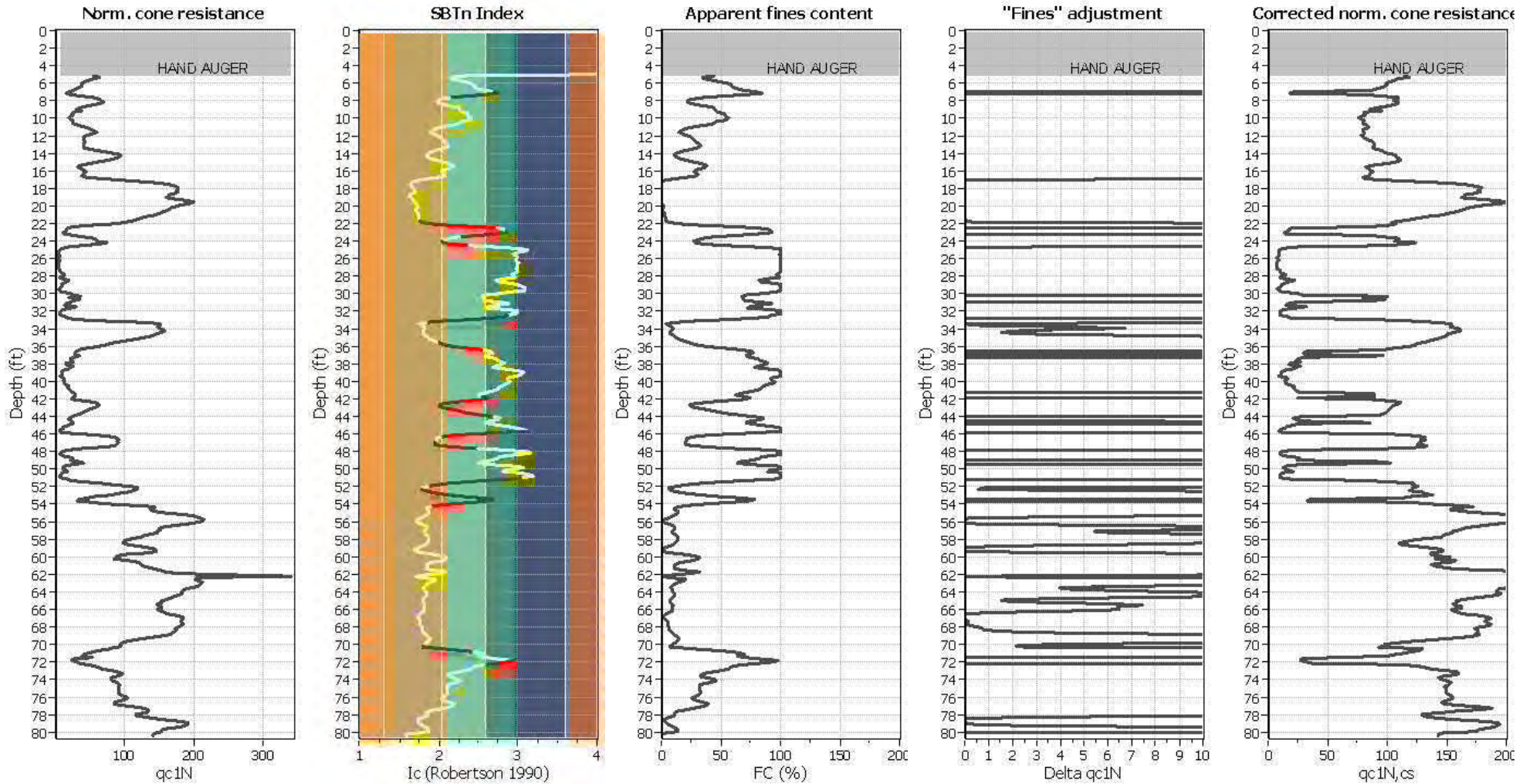
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

**LPI color scheme**

- Very high risk
- High risk
- Low risk



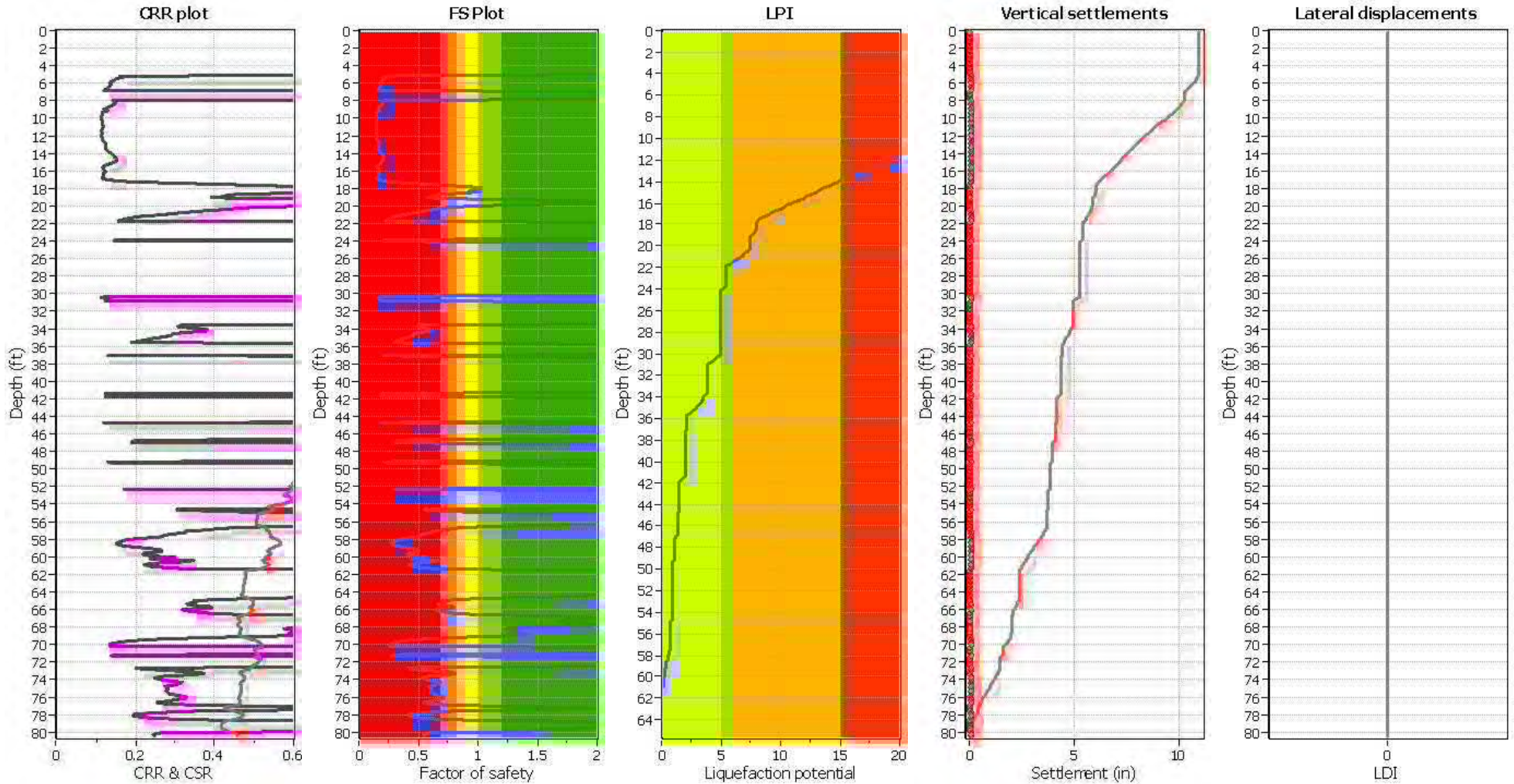
### Liquefaction analysis overall plots (intermediate res)



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>σ</sub> applied:	Yes
Earthquake magnitude M <sub>w</sub> :	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.59	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.00 ft	Fill height:	N/A	Limit depth:	N/A

### Liquefaction analysis overall plot



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	$K_{\sigma}$ applied:	Yes
Earthquake magnitude $M_w$ :	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.59	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.00 ft	Fill height:	N/A	Limit depth:	N/A

**F.S. color scheme**

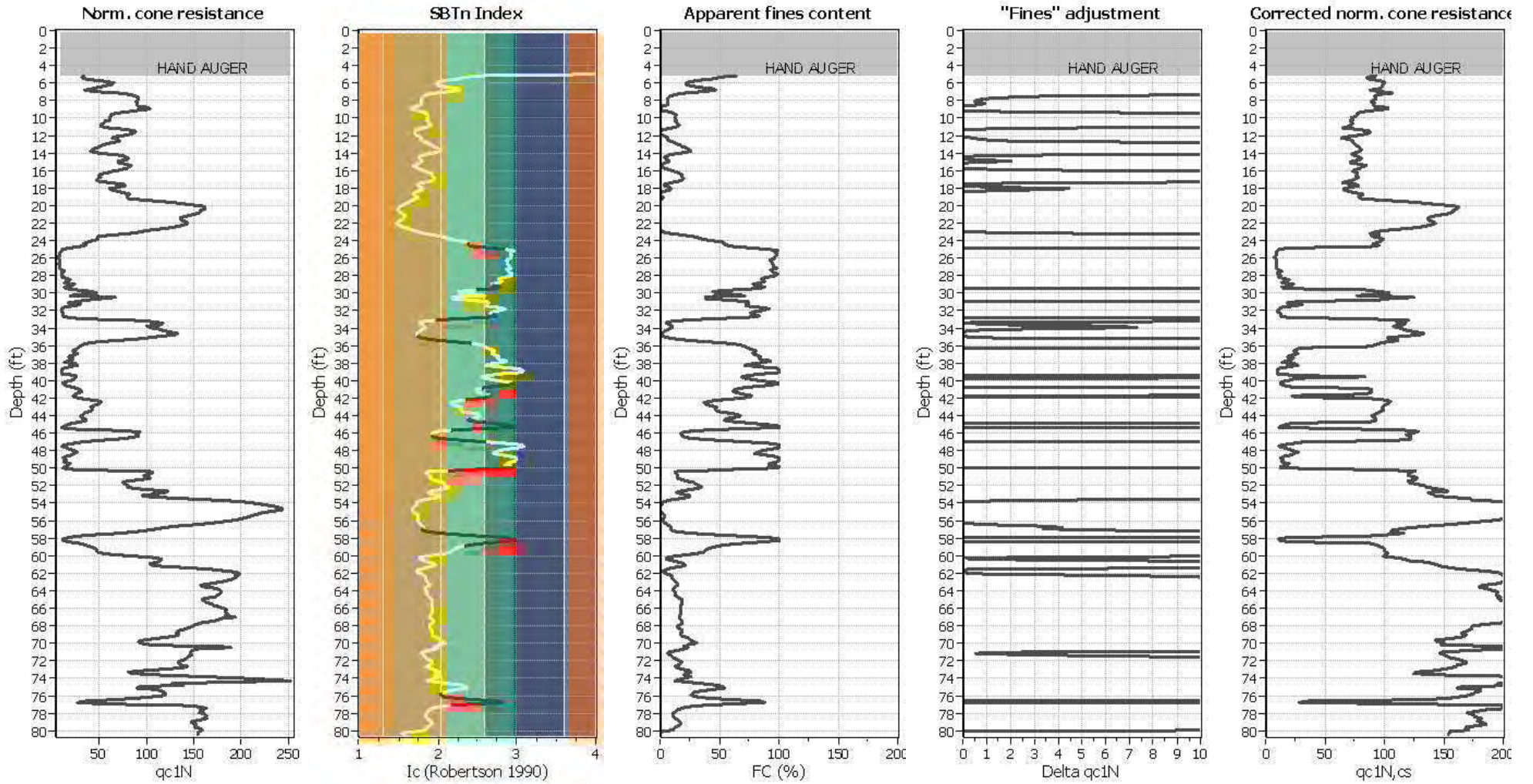
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

**LPI color scheme**

- Very high risk
- High risk
- Low risk



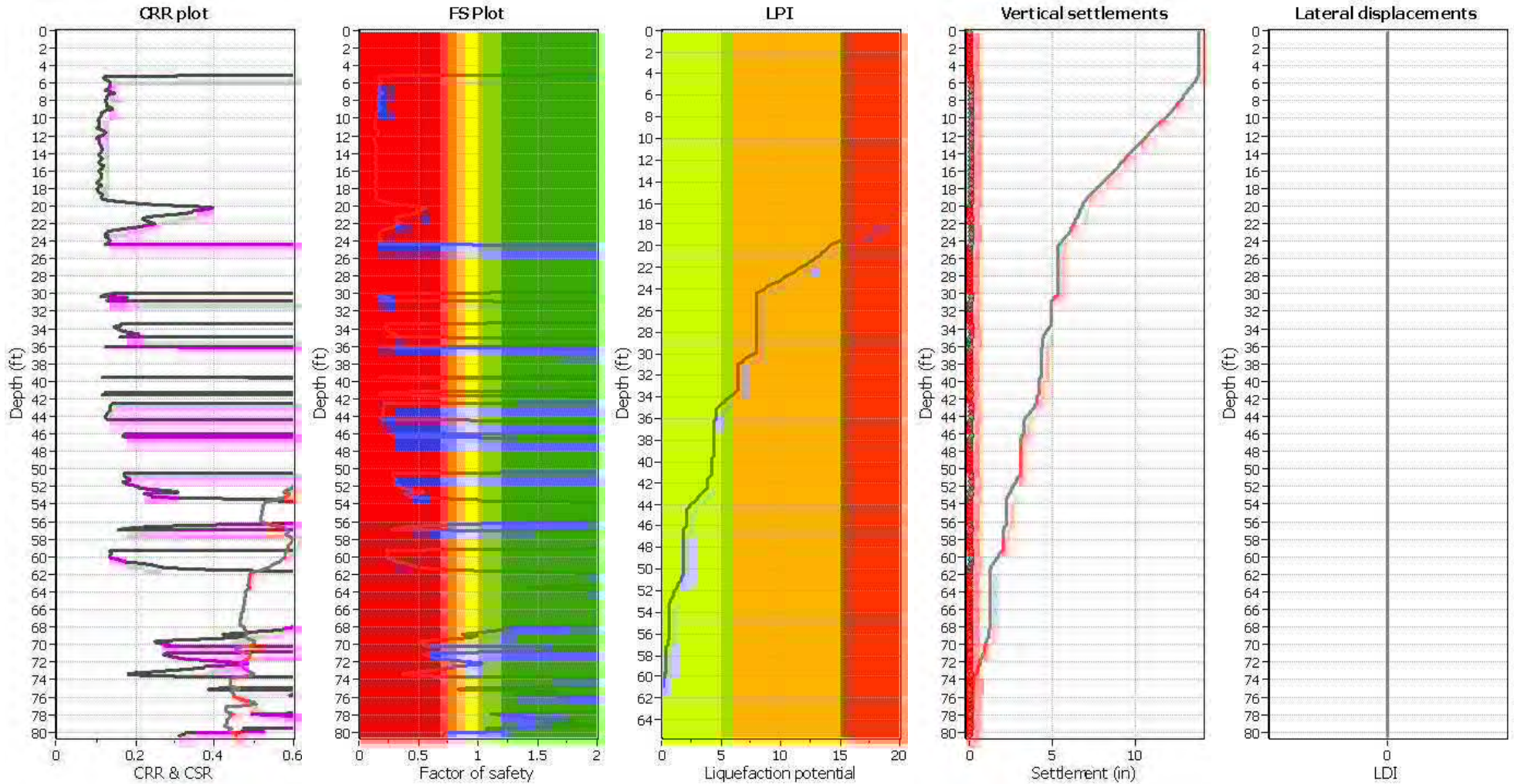
### Liquefaction analysis overall plots (intermediate res)



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>σ</sub> applied:	Yes
Earthquake magnitude M <sub>w</sub> :	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.59	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.00 ft	Fill height:	N/A	Limit depth:	N/A

### Liquefaction analysis overall plot



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>σ</sub> applied:	Yes
Earthquake magnitude M <sub>w</sub> :	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.59	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.00 ft	Fill height:	N/A	Limit depth:	N/A

**F.S. color scheme**

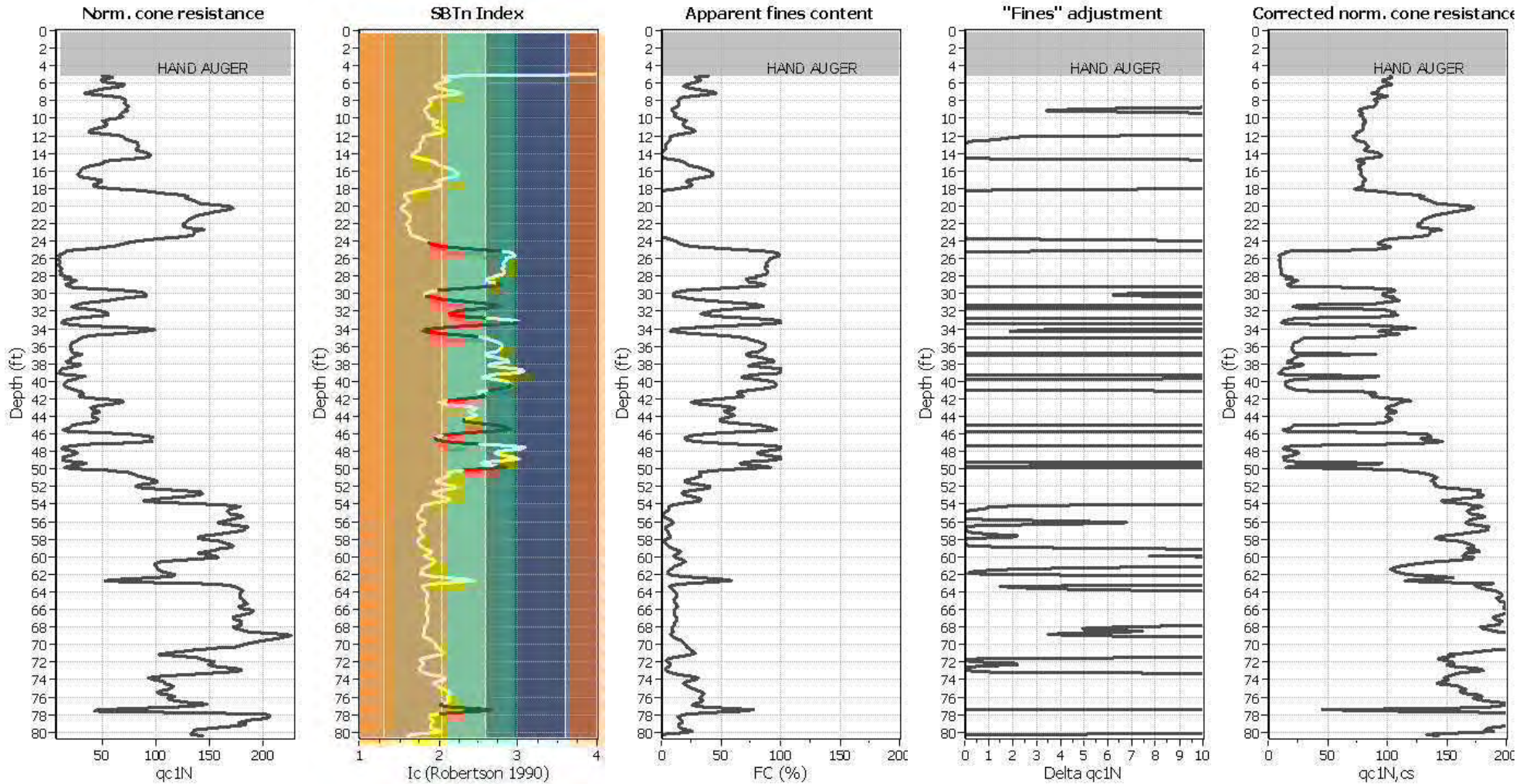
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

**LPI color scheme**

- Very high risk
- High risk
- Low risk



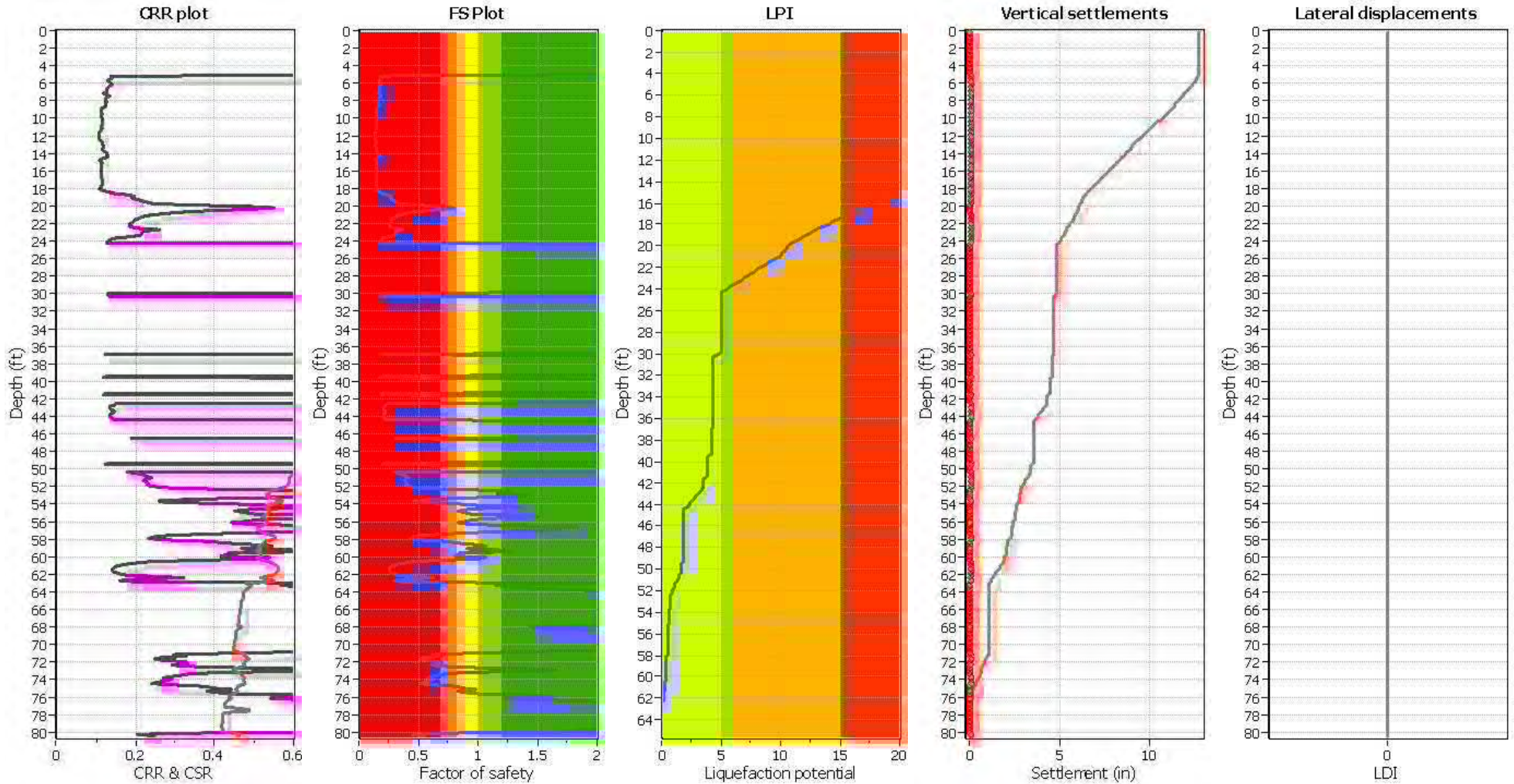
### Liquefaction analysis overall plots (intermediate res)



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>σ</sub> applied:	Yes
Earthquake magnitude M <sub>w</sub> :	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.59	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.00 ft	Fill height:	N/A	Limit depth:	N/A

### Liquefaction analysis overall plot



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on I <sub>c</sub> value	I <sub>c</sub> cut-off value:	2.60	K <sub>σ</sub> applied:	Yes
Earthquake magnitude M <sub>w</sub> :	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.59	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.00 ft	Fill height:	N/A	Limit depth:	N/A

**F.S. color scheme**

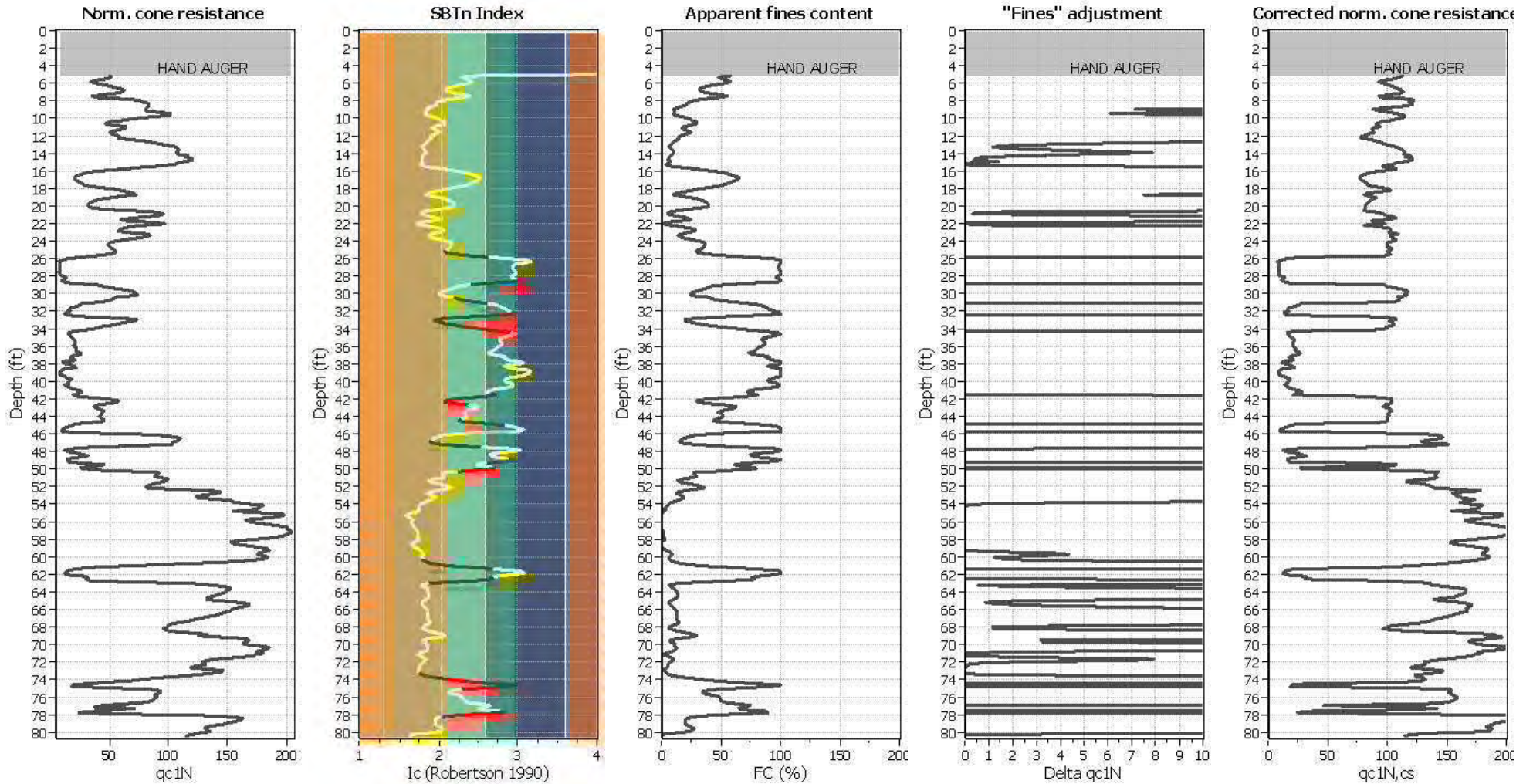
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

**LPI color scheme**

- Very high risk
- High risk
- Low risk



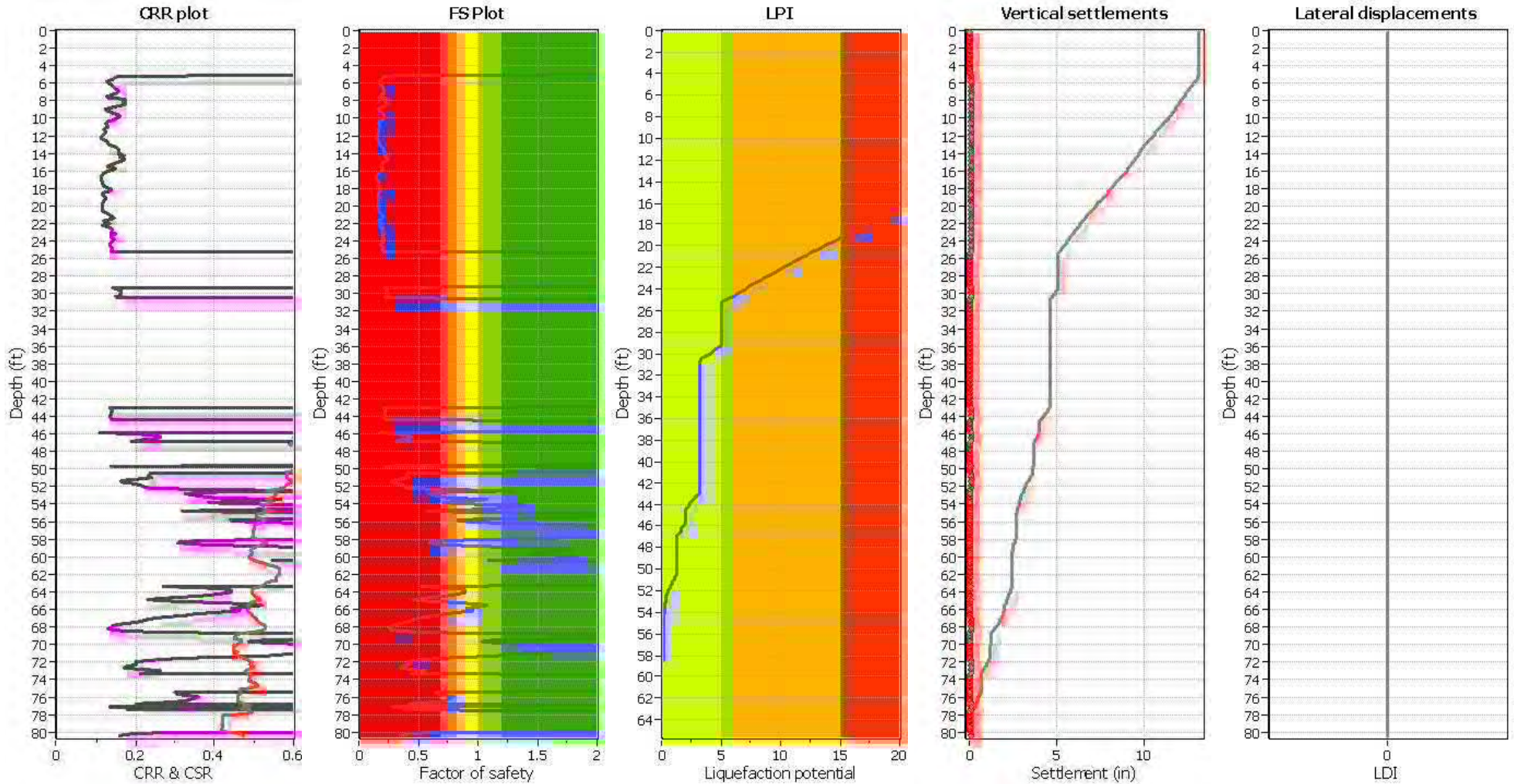
### Liquefaction analysis overall plots (intermediate res)



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>σ</sub> applied:	Yes
Earthquake magnitude M <sub>w</sub> :	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.59	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.00 ft	Fill height:	N/A	Limit depth:	N/A

### Liquefaction analysis overall plot



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>σ</sub> applied:	Yes
Earthquake magnitude M <sub>w</sub> :	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.59	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.00 ft	Fill height:	N/A	Limit depth:	N/A

**F.S. color scheme**

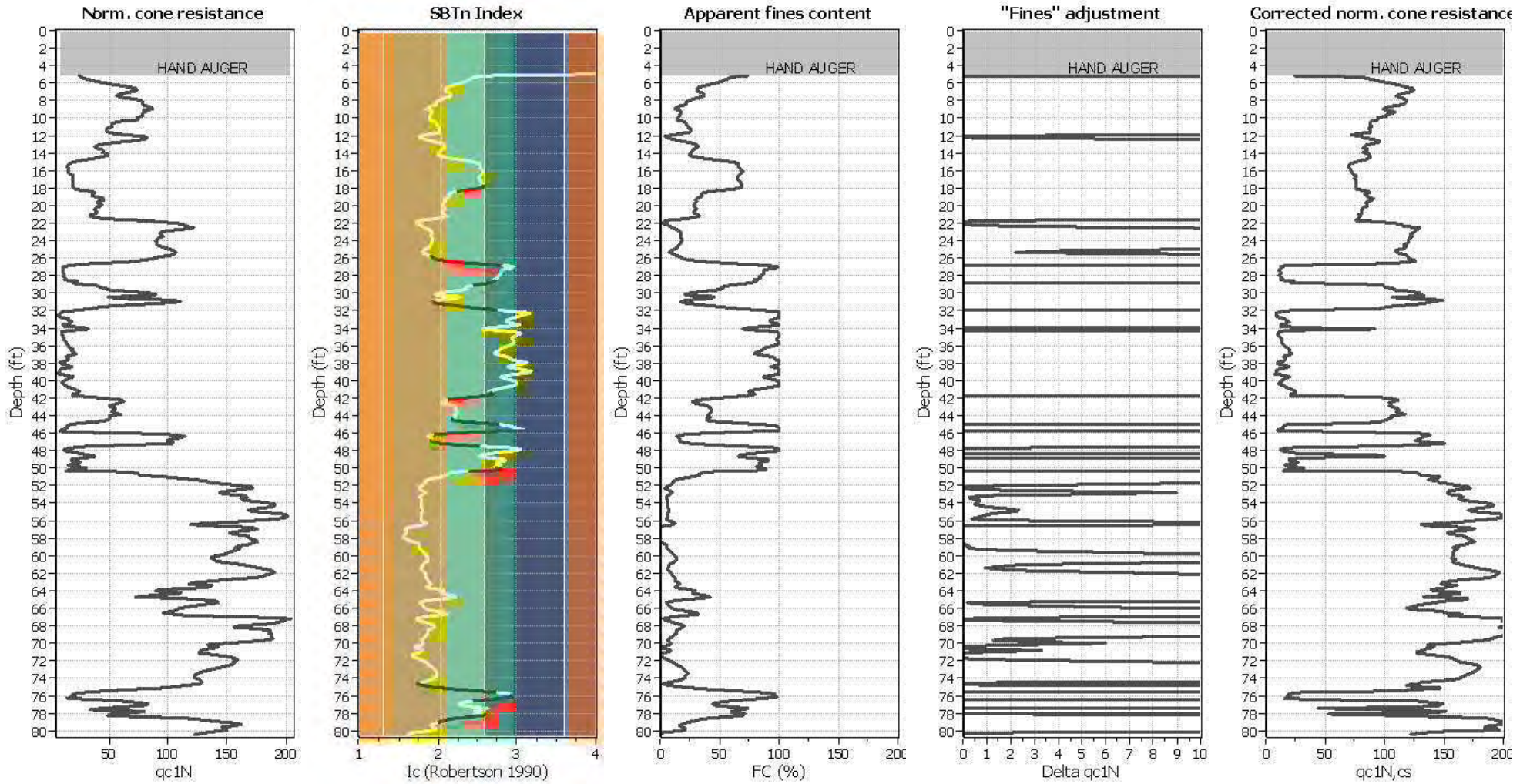
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

**LPI color scheme**

- Very high risk
- High risk
- Low risk



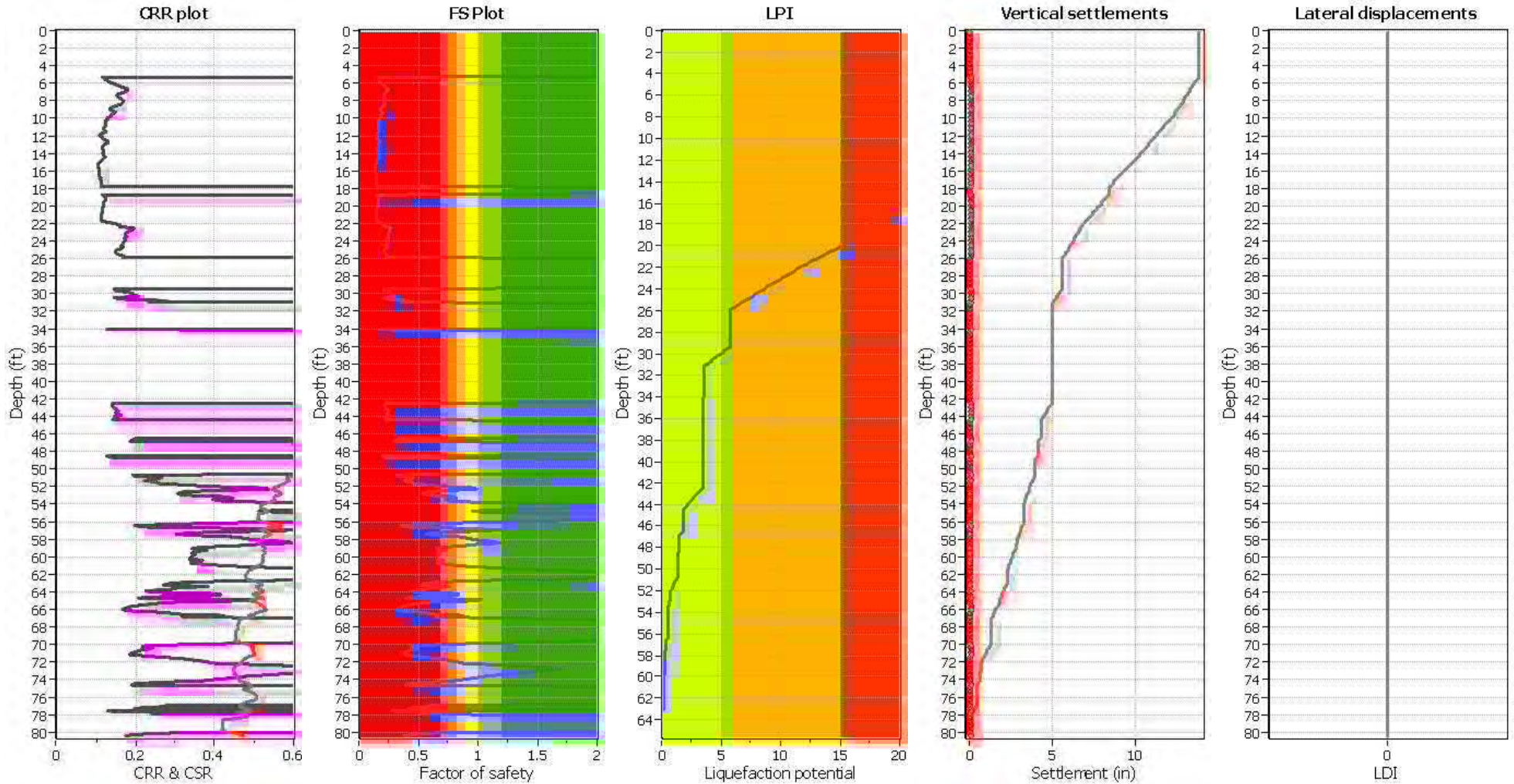
### Liquefaction analysis overall plots (intermediate res)



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>σ</sub> applied:	Yes
Earthquake magnitude M <sub>w</sub> :	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.59	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.00 ft	Fill height:	N/A	Limit depth:	N/A

### Liquefaction analysis overall plot



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on I <sub>c</sub> value	I <sub>c</sub> cut-off value:	2.60	K <sub>σ</sub> applied:	Yes
Earthquake magnitude M <sub>w</sub> :	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.59	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.00 ft	Fill height:	N/A	Limit depth:	N/A

**F.S. color scheme**

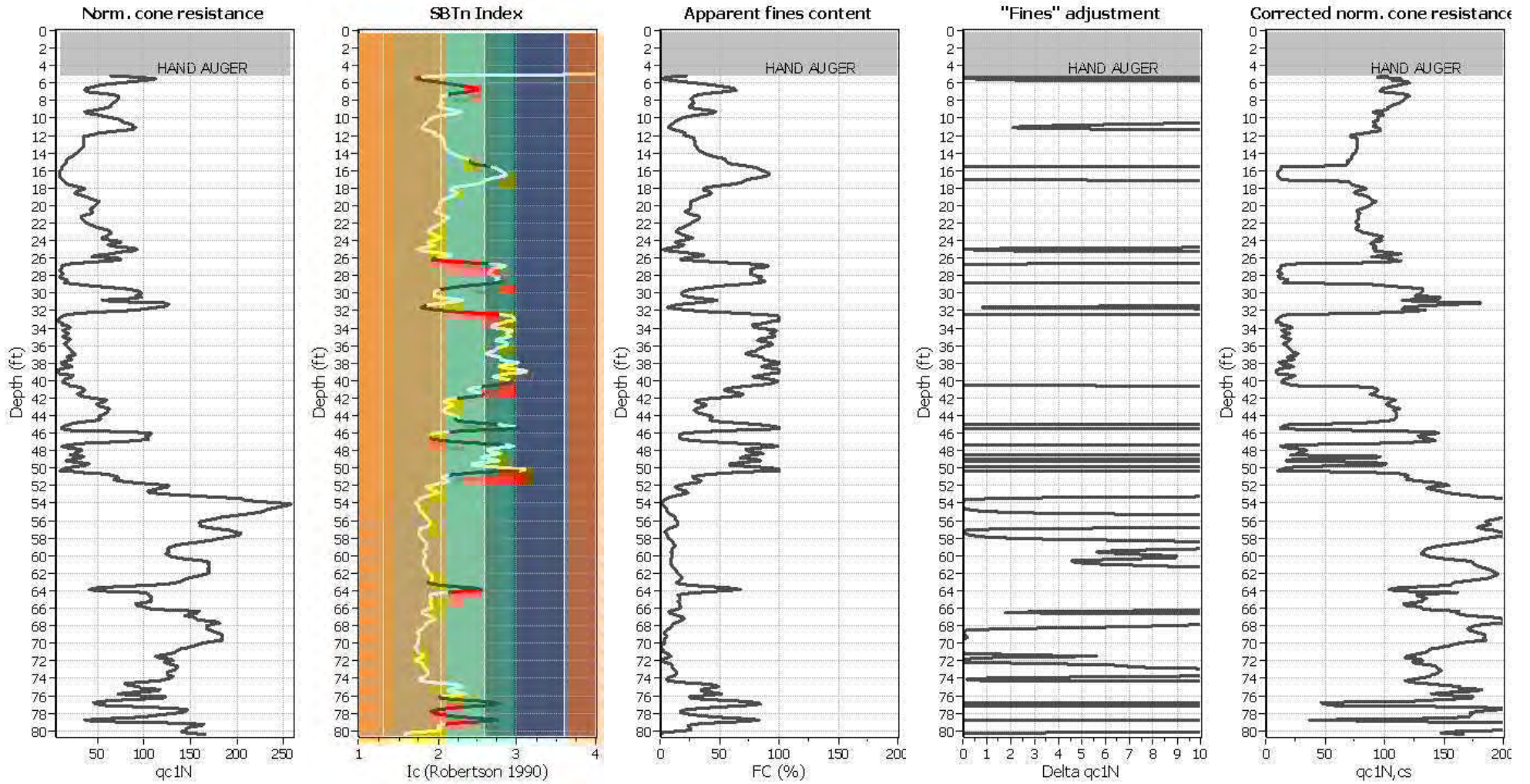
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

**LPI color scheme**

- Very high risk
- High risk
- Low risk



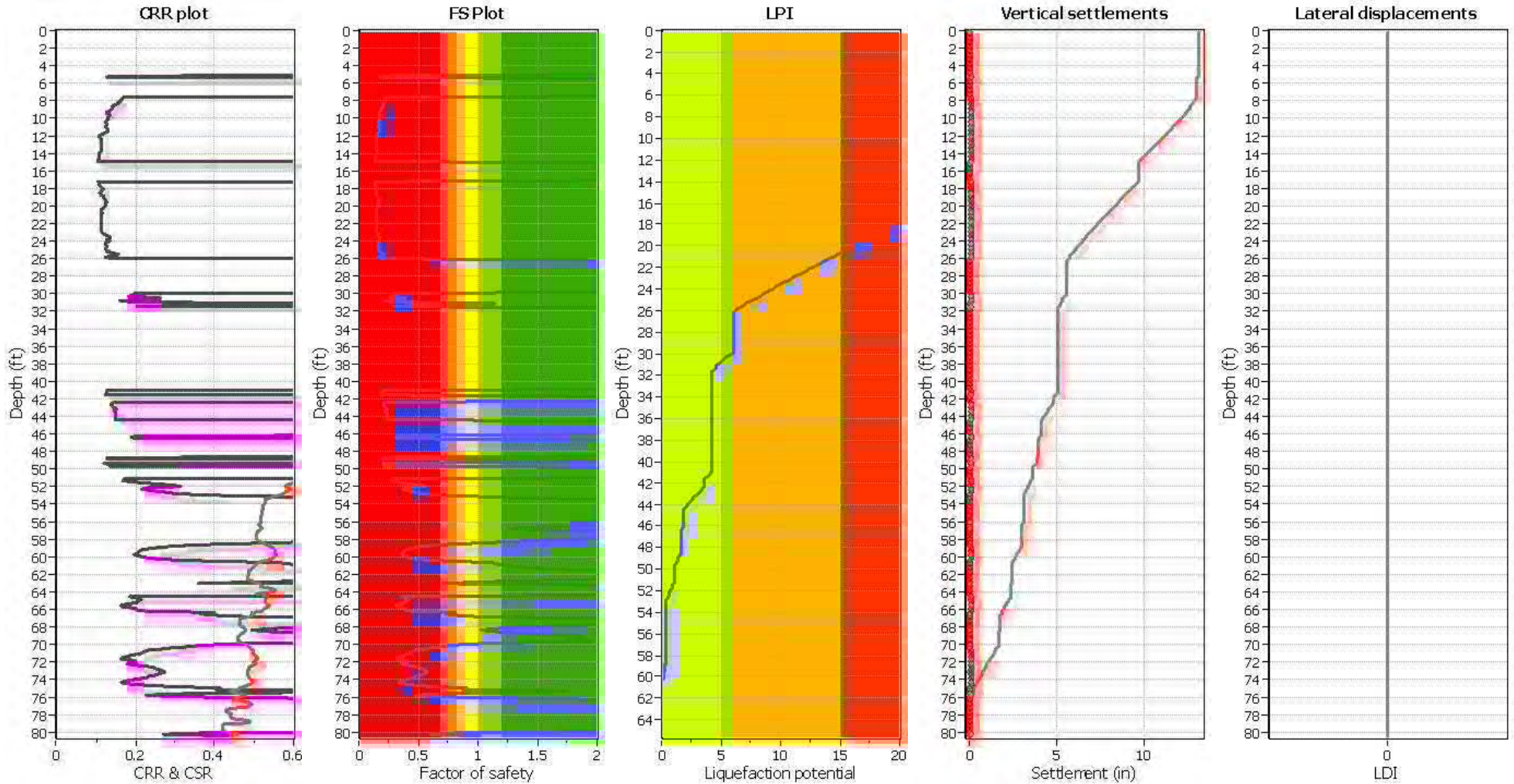
### Liquefaction analysis overall plots (intermediate res)



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K <sub>σ</sub> applied:	Yes
Earthquake magnitude M <sub>w</sub> :	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.59	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.00 ft	Fill height:	N/A	Limit depth:	N/A

### Liquefaction analysis overall plot



**Input parameters and analysis data**

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 ft	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on I <sub>c</sub> value	I <sub>c</sub> cut-off value:	2.60	K <sub>σ</sub> applied:	Yes
Earthquake magnitude M <sub>w</sub> :	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.59	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.00 ft	Fill height:	N/A	Limit depth:	N/A

**F.S. color scheme**

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

**LPI color scheme**

- Very high risk
- High risk
- Low risk



**APPENDIX F**

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**APPENDIX F – Dewatering Analyses Results**

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CALCULATION COVER PAGE				
<b>BASIC INFORMATION</b>				
Project Morena Pump Station	Job No. 60530732- 1.01.05.20.00	TTP No. (if req'd)	Total pages includes attachments Page 1 of <u>1</u>	
Client	Department/Discipline Geotechnical		Calculation No. 1	
Subject / Title				
Calculation Rev. No.	Originator	Discipline Reviewer	Technical Peer Reviewer (if req'd)	Confirmation Req'd Y/N
0	T. Kanax	Ben Choy <i>BXC</i>	<i>7/26/17</i>	
Calculation Objective: Dewatering Wells and flow calculations				
Calculation Methodology and data to be confirmed: Flow rates				
References / Inputs/ Field Data: L:\Projects\Legacy\IE_Xdrive\geo\Kanax\Others\Morena Pump Station\				
Conclusions including confirmations to be obtained: Estimated flow rates				
This calculation is complete and ready for Discipline Review:				
Originator <u><i>Honeyalgon</i></u> <span style="margin-left: 150px;">Signature / Date</span>				

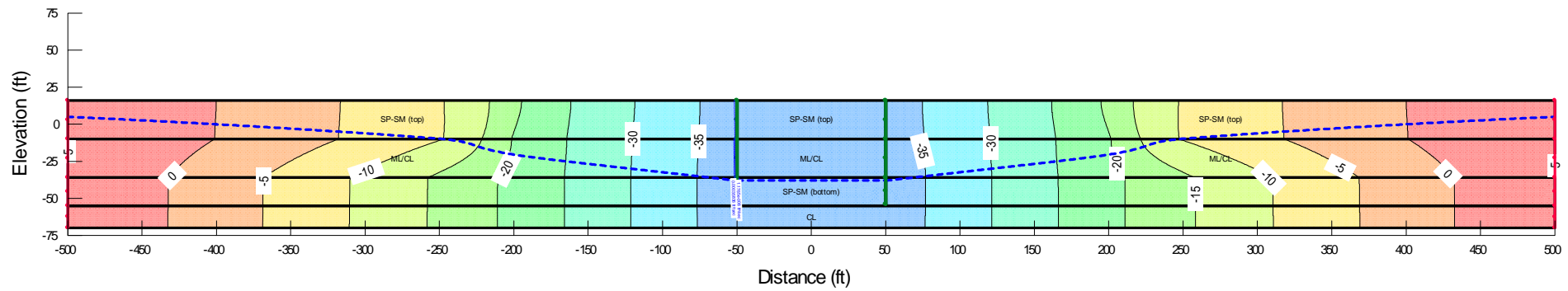
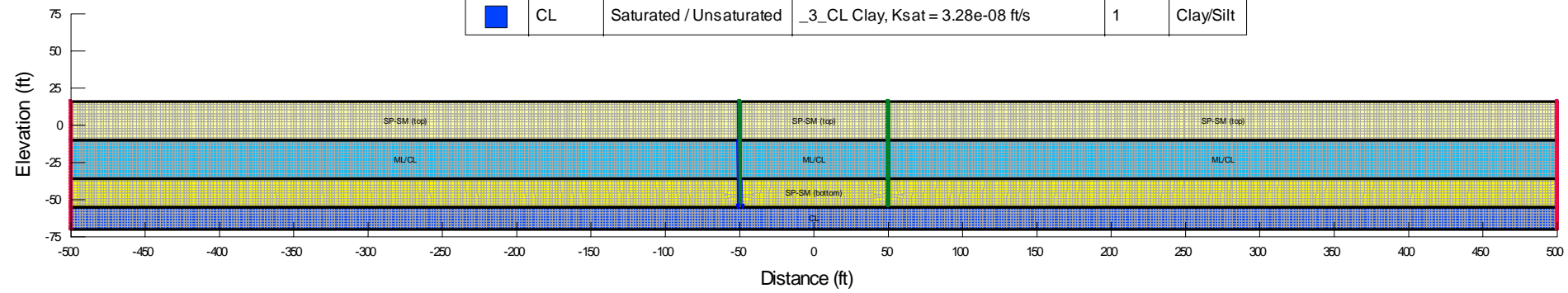
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**Preliminary SEEP/W Analysis Results –2D Model for Steady State Condition**

**(1) Model 1: Model width 1000 ft**

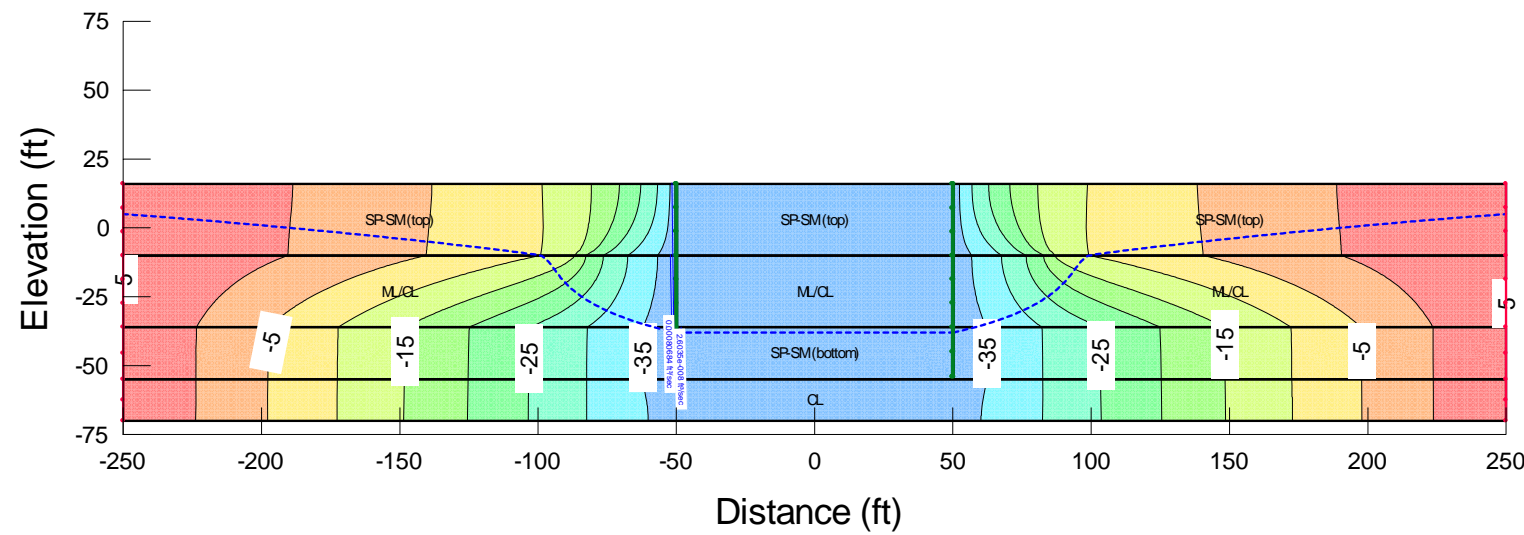
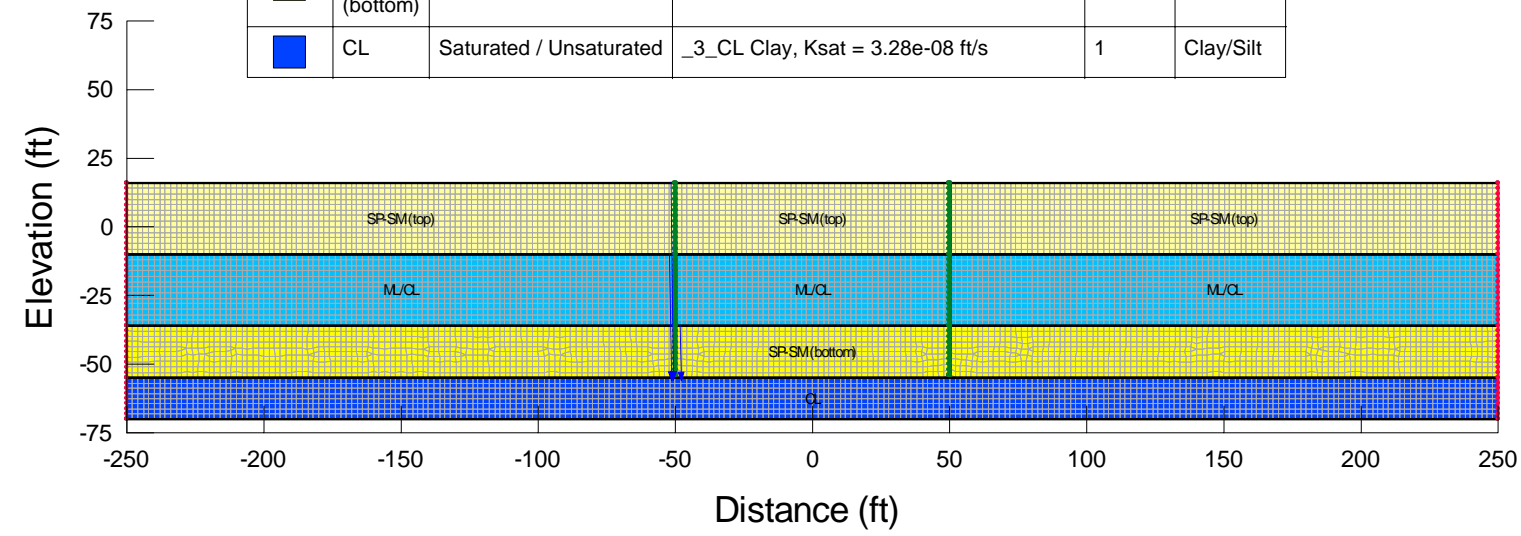
Color	Name	Model	K-Function	Ky/Kx Ratio	Vol. WC. Function
Light Yellow	SP-SM (top)	Saturated / Unsaturated	_1_SP-SM sand, Ksat = 1.64e-4 ft/s	1	Sand
Light Blue	ML/CL	Saturated / Unsaturated	_2_CL/ML, Silty Clay, Ksat = 3.28e-06 ft/s	1	Clay/Silt
Yellow	SP-SM (bottom)	Saturated / Unsaturated	_1_SP-SM sand, Ksat = 1.64e-4 ft/s	1	Sand
Dark Blue	CL	Saturated / Unsaturated	_3_CL Clay, Ksat = 3.28e-08 ft/s	1	Clay/Silt



<b>Results for Model 1: 20170725 Morena_2D_Model_R500ft_W1000ft.gsz</b>				
Flow per foot per line of wells	=	0.00036 ft <sup>3</sup> /s/ft =	31.1 ft <sup>3</sup> /day/ft :	0.16 gpm/ft = 233 gpd/ft
Flow per foot for 2-lines of wells	=	0.00072 ft <sup>3</sup> /s/ft =	62.2 ft <sup>3</sup> /day/ft :	0.32 gpm/ft = 465 gpd/ft

(2) Model 2: Model width 500 ft

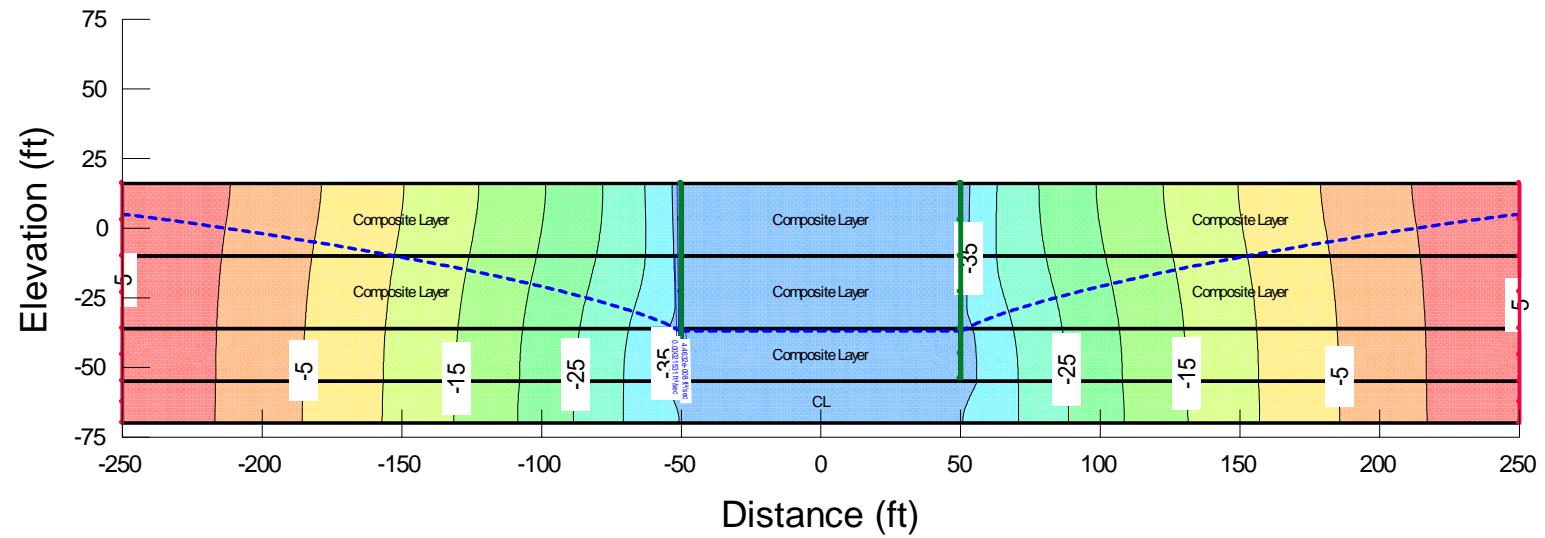
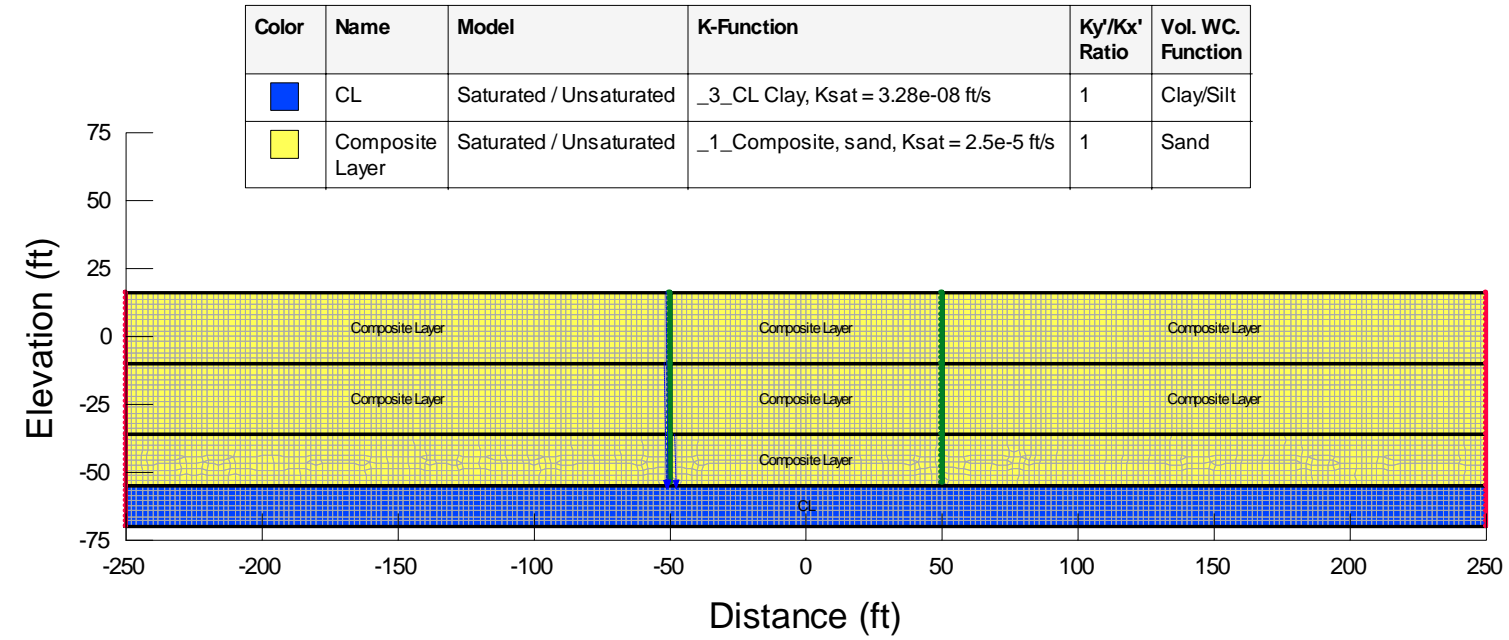
Color	Name	Model	K-Function	Ky'/Kx' Ratio	Vol. WC. Function
Light Yellow	SP-SM (top)	Saturated / Unsaturated	_1_SP-SM sand, Ksat = 1.64e-4 ft/s	1	Sand
Light Blue	ML/CL	Saturated / Unsaturated	_2_CL/ML, Silty Clay, Ksat = 3.28e-06 ft/s	1	Clay/Silt
Yellow	SP-SM (bottom)	Saturated / Unsaturated	_1_SP-SM sand, Ksat = 1.64e-4 ft/s	1	Sand
Dark Blue	CL	Saturated / Unsaturated	_3_CL Clay, Ksat = 3.28e-08 ft/s	1	Clay/Silt



Results for Model 2: 20170725 Morena 2D Model R250ft W500ft.gsz					
Flow per foot per line of wells	=	0.00081 ft <sup>3</sup> /s/ft =	69.7 ft <sup>3</sup> /day/ft :	0.36 gpm/ft =	522 gpd/ft
Flow per foot for 2-lines of wells	=	0.00161 ft <sup>3</sup> /s/ft =	139.4 ft <sup>3</sup> /day/ft :	0.72 gpm/ft =	1043 gpd/ft



(3) Model 3: Model width 500 ft and Composite Permeability

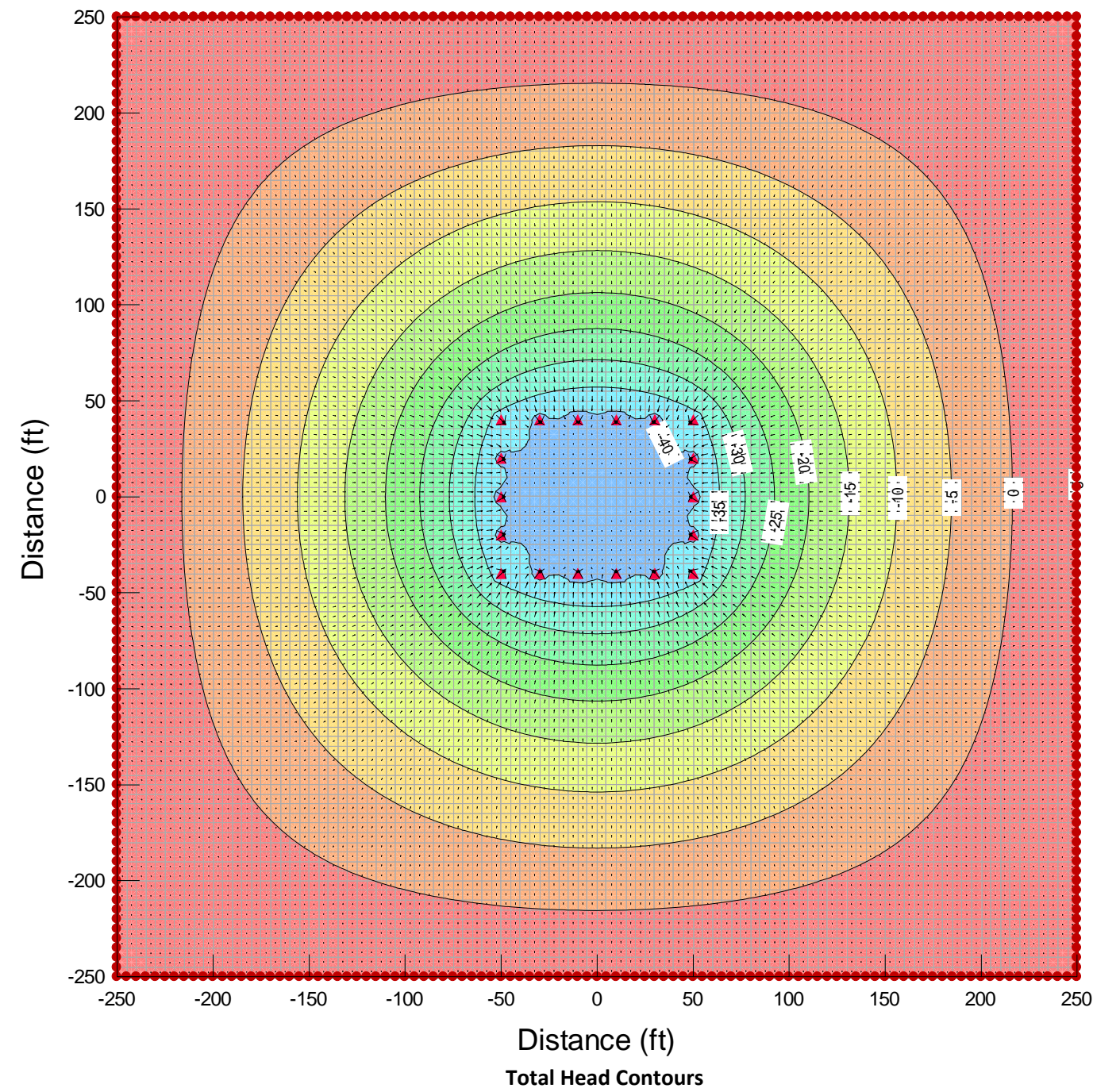
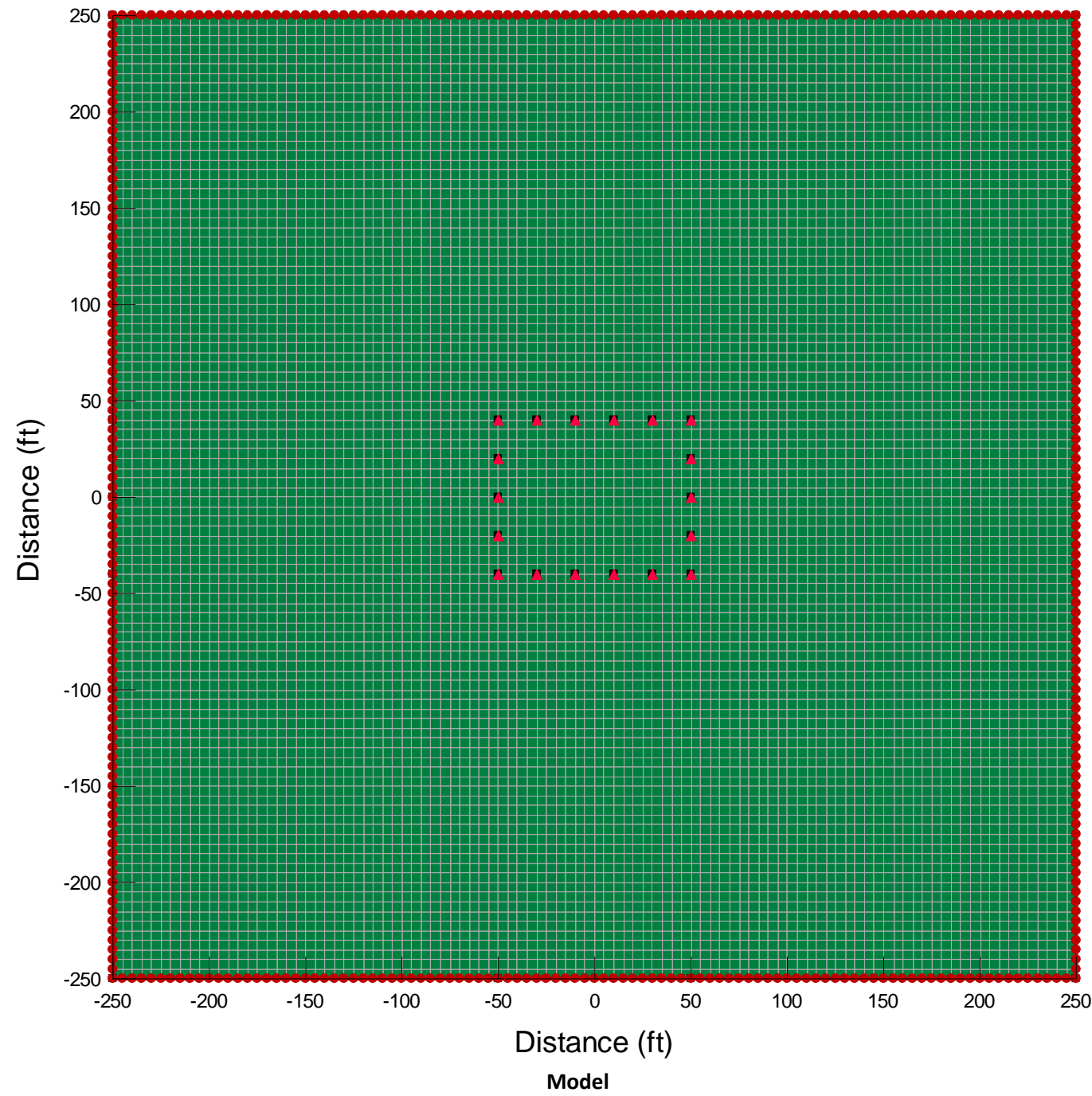


Results for Model 3: 20170727_Morena_2D_Model_R250ft_W500ft_k2.5e-5ftpersec.gsz						
Flow per foot per line of wells	=	0.00022	ft <sup>3</sup> /s/ft =	19.0	ft <sup>3</sup> /day/ft =	0.10 gpm/ft = 142 gpd/ft
Flow per foot for 2-lines of wells	=	0.00044	ft <sup>3</sup> /s/ft =	38.0	ft <sup>3</sup> /day/ft =	0.20 gpm/ft = 284 gpd/ft

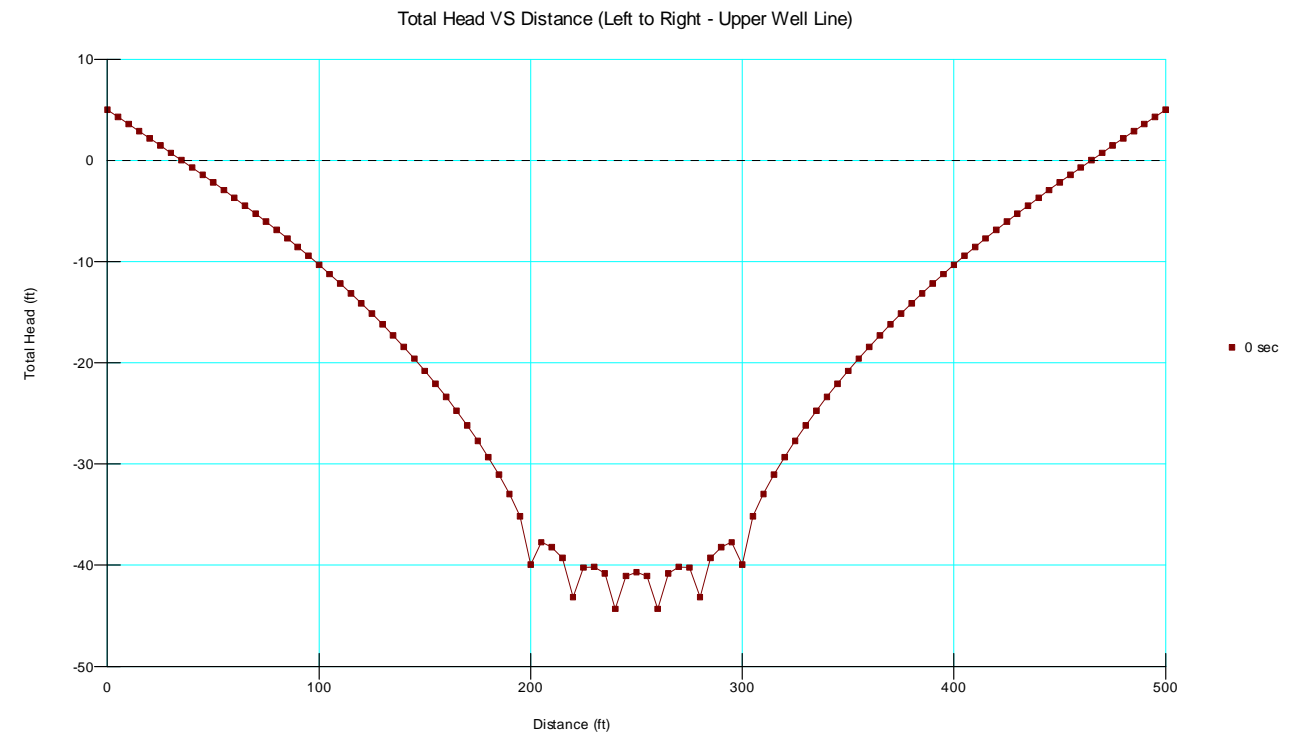
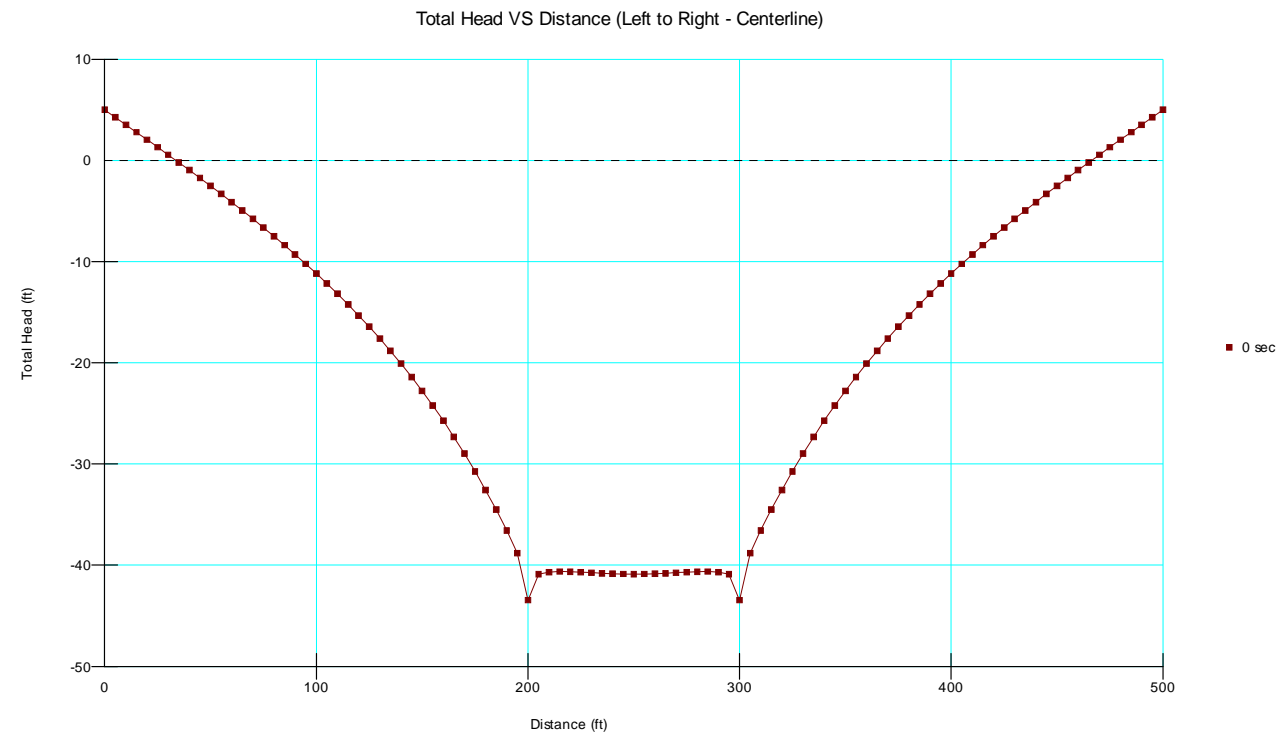
**Preliminary SEEP/W Analysis Results –Plan View Model for Steady State Condition**

**(4) Model 4: Plan View Model with Model width of 500 ft and Composite Permeability (kh/kv= 1)**

Wells spaced at 20 ft along 80 ft x100 ft rectangle; pumps operate at same pumping rate; thickness of the composite saturated aquifer 60 ft; Composite permeability =  $2.5e-5$  ft/s; kh/kv = 1



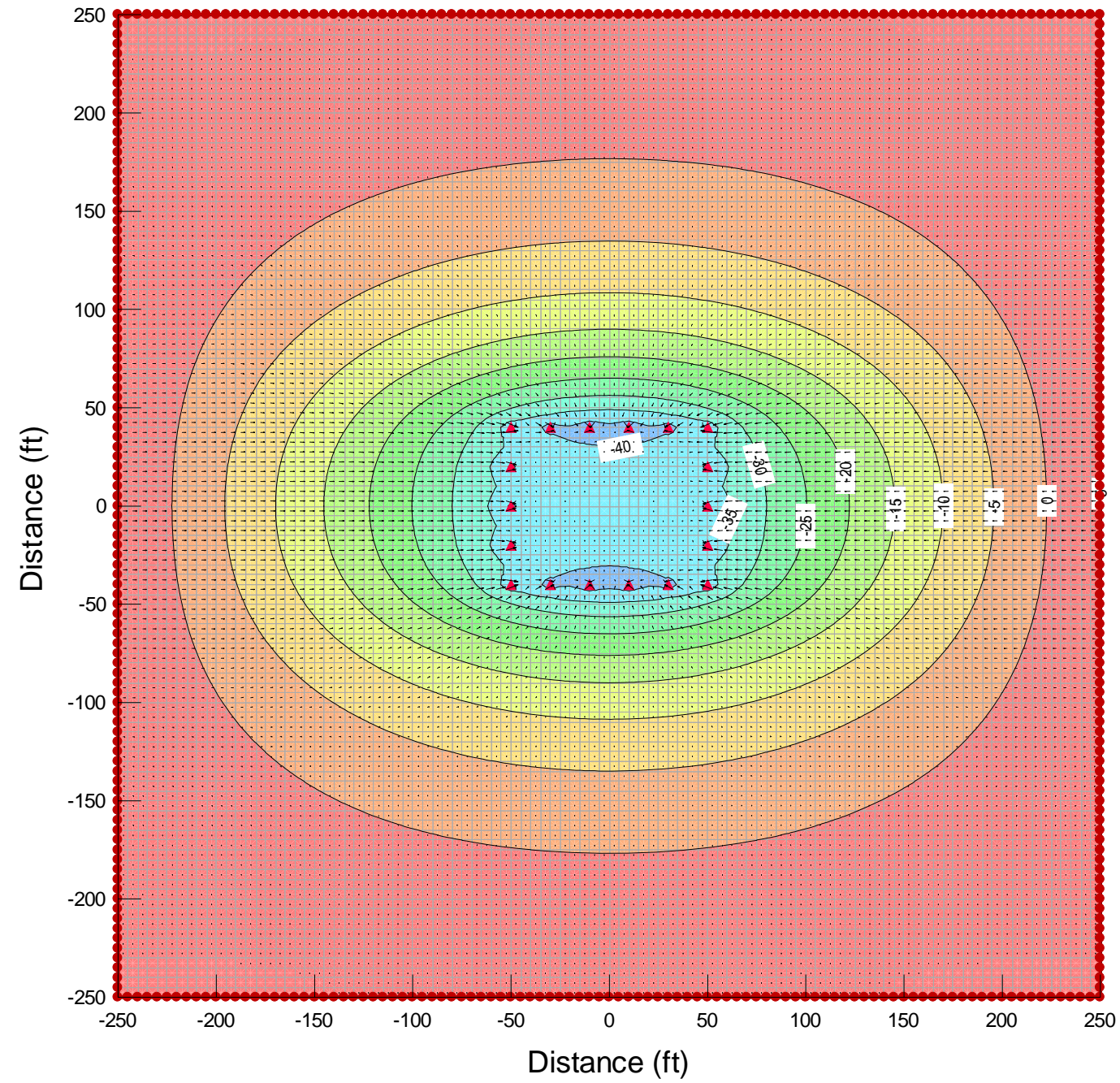




<b>Results for Model 4:</b>						
Pumping Rate	=	0.0145	ft <sup>3</sup> /s per pump			
Total number of pumps	=	18				
Total flow extracted	=	0.261	ft <sup>3</sup> /s =	22550	ft <sup>3</sup> /day =	117 gpm = 168689 gpd

**(5) Model 5: Plan View Model with Model width of 500 ft and Composite Permeability (kh/kv= 5)**

Wells spaced at 20 ft along 80 ft x100 ft rectangle; pumps operate at same pumping rate; thickness of the comosite saturated aquifer 60 ft; Horizontal composite permeability (kh) =  $1.25e-4$  ft/s; kh/kv=5



Results for Model 5:						
Pumping Rate	=	0.037	ft <sup>3</sup> /s per pump			
Total number of pumps	=	18				
Total flow extracted	=	0.666	ft <sup>3</sup> /s =	57542	ft <sup>3</sup> /day =	299 gpm = 430447 gpd



## **APPENDIX G**

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**APPENDIX G – Worksheet C.4-1**

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## Appendix C: Geotechnical and Groundwater Investigation Requirements

### Worksheet C.4-1: Categorization of Infiltration Feasibility Condition

Categorization of Infiltration Feasibility Condition		Worksheet C.4-1	
<p><b><u>Part 1 - Full Infiltration Feasibility Screening Criteria</u></b></p> <p><b>Would infiltration of the full design volume be feasible from a physical perspective without any undesirable consequences that cannot be reasonably mitigated?</b></p> <p>Note that it is not necessary to investigate each and every criterion in the worksheet if infiltration is precluded. Instead a letter of justification from a geotechnical professional familiar with the local conditions substantiating any geotechnical issues will be required.</p>			
Criteria	Screening Question	Yes	No
1	<p><b>Is the estimated reliable infiltration rate below proposed facility locations greater than 0.5 inches per hour?</b> The response to this Screening Question must be based on a comprehensive evaluation of the factors presented in Appendix C.2 and Appendix D.</p>		X
<p>Provide basis:</p> <p>The site is mapped in Hydraulic Soil Group D near the border of that zone. The explorations performed to date indicate that the site is underlain by interbedded sands, silts and clays. The soil is considered to have a potential infiltration rate below 0.5 inches per hour, but in the partial infiltration range. In addition groundwater has been measured at 9 feet below ground surface.</p> <p>Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.</p>			
2	<p><b>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?</b> The response to this Screening Question must be based on a comprehensive evaluation of the factors presented in Appendix C.2.</p>		X
<p>Provide basis:</p> <p>The alluvial soils underlying the site and the adjacent sites is potentially liquefiable. Full infiltration could cause mounding of the groundwater increasing the loose soils below the groundwater level that are potentially liquefiable in the area.</p> <p>Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.</p>			

## Appendix C: Geotechnical and Groundwater Investigation Requirements

Worksheet C.4-1 Page 2 of 4			
Criteria	Screening Question	Yes	No
3	<p><b>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?</b> The response to this Screening Question must be based on a comprehensive evaluation of the factors presented in Appendix C.3.</p>		X
<p>Provide basis:</p> <p style="margin-left: 40px;">An environmental release occurred at the Lloyd's Pest control about 200 feet upgradient of the project site has been reported and closed. Groundwater was sampled in the monitoring well performed for this project. The analytical laboratory testing indicated TPH and VOCs in the groundwater. Full infiltration could cause contaminants to migrate downgradient towards the San Diego River.</p> <p>Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.</p>			
4	<p><b>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?</b> The response to this Screening Question must be based on a comprehensive evaluation of the factors presented in Appendix C.3.</p>	X	
<p>Provide basis:</p> <p style="margin-left: 40px;">Downstream water rights should not be affected.</p> <p>Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.</p>			
<b>Part 1 Result*</b>	<p>If all answers to rows 1 - 4 are “<b>Yes</b>” a full infiltration design is potentially feasible. The feasibility screening category is <b>Full Infiltration</b></p> <p>If any answer from row 1-4 is “<b>No</b>”, infiltration may be possible to some extent but would not generally be feasible or desirable to achieve a “full infiltration” design. Proceed to Part 2</p>		

\*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 County staff to substantiate findings.



## Appendix C: Geotechnical and Groundwater Investigation Requirements

### Worksheet C.4-1 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	<p><b>Do soil and geologic conditions allow for infiltration in any appreciable rate or volume?</b> The response to this Screening Question must be based on a comprehensive evaluation of the factors presented in Appendix C.2 and Appendix D.</p>	X	

Provide basis:

Infiltration testing will be performed if infiltration is required. Partial infiltration is suspected feasible from a soils conditions based on the subsurface soils encountered as part of the field investigation performed for this project. However, groundwater has been measured at 9 feet below the ground surface at the site.

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	<p><b>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?</b> The response to this Screening Question must be based on a comprehensive evaluation of the factors presented in Appendix C.2.</p>	X	
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Provide basis:

Partial infiltration would be possible without much risk of mounding of the groundwater.

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.

## Appendix C: Geotechnical and Groundwater Investigation Requirements

Worksheet C.4-1 Page 4 of 4			
Criteria	Screening Question	Yes	No
7	<p><b>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)?</b> The response to this Screening Question must be based on a comprehensive evaluation of the factors presented in Appendix C.3.</p>		X
<p>Provide basis:</p> <p style="margin-left: 40px;">The groundwater contamination in the area would preclude infiltration of stormwater at the site.</p> <p>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.</p>			
8	<p><b>Can infiltration be allowed without violating downstream water rights?</b> The response to this Screening Question must be based on a comprehensive evaluation of the factors presented in Appendix C.3.</p>	X	
<p>Provide basis:</p> <p style="margin-left: 40px;">Downstream water rights should not be affected.</p> <p>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.</p>			
<b>Part 2 Result*</b>	<p>If all answers from row 5-8 are yes then partial infiltration design is potentially feasible. The feasibility screening category is <b>Partial Infiltration.</b></p> <p>If any answer from row 5-8 is no, then infiltration of any volume is considered to be <b>infeasible</b> within the drainage area. The feasibility screening category is <b>No Infiltration.</b></p>		

\*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 Agency/Jurisdictions to substantiate findings



# R E P O R T

## **FAULT INVESTIGATION MORENA PUMP STATION, 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

Prepared by

AECOM  
401 West A Street  
Suite 1200  
San Diego, California 92101





September 19, 2017

Ms. Laila Nasrawi  
City of San Diego  
Public Utilities Department  
9192 Topaz Way  
San Diego, California


Subject: Fault Hazard Investigation Report  
Morena Pump Station, WW Force Main, and  
Brine/Centrates Conveyance Predesign (NC01)  
San Diego, California  
AECOM Project No. 60530732


Dear Ms. Nasrawi:


AECOM Technical Services, Inc. has prepared the attached Fault Hazard Investigation Report for the Morena Pump Station, Wastewater Force Main and Brine/Centrates Conveyance Pipeline for Pure Water San Diego. The purpose of this investigation is to evaluate potential fault hazards for design. Close-spaced subsurface explorations (Cone Penetration Test [CPT]) soundings were performed to investigate possible faults at the Morena Pump Station. The assessment of potential fault hazards for the pipelines was based on review of published geologic maps, previous investigations and interpreting historical air photos, as discussed in the report. Separate geotechnical investigation reports were prepared for the Morena Pump Station and cut-and-cover pipelines and for the proposed tunnels.

Sincerely,

AECOM Technical Services, Inc.

  
Michael E. Hatch C.E.G. 1925  
Principal Engineering Geologist

  
David L. Schug, C.E.G. 1212  
Principal Engineering Geologist

  
Steven M. Fitzwilliam, G.E. 2501  
Principal Geotechnical Engineer





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**APPENDICES**

Appendix A. Previous Studies

Appendix B. Cone Penetrometer Testing



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## List of Acronyms and Abbreviations

AECOM	AECOM Technical Services, Inc.
ASCE	American Society of Civil Engineers
ASTM	ASTM International, formerly American Society for Testing and Materials
bgs	below ground surface
CBC	California Building Code
CGS	California Geological Survey
CPT	Cone Penetrometer Test
EQFZ	Earthquake Fault Zone
ft	feet
g	Gravitational Acceleration
ka	Thousand years (Kilo annum)
IBC	International Building Code
MCE	Maximum Considered Earthquake
MPS	Morena Pump Station
NGVD 29	National Geodetic Mean Datum of 1929
pcf	pounds per cubic foot
pci	pounds per cubic inch
Project	Morena Pump Station, WW Force Main, and Brine/Centrates Conveyance Predesign (NC01) Project
psf	pounds per square foot
RCFZ	Rose Canyon Fault Zone
SPT	Standard Penetration Test
URS	URS Corporation
USA	Underground Service Alert
USGS	United States Geological Survey

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## 1.0 INTRODUCTION

This fault investigation report was prepared for the Morena Pump Station, WW Force Main, and Brine/Centrates Conveyance Predesign (NC01) Project (“Project”) for Pure Water San Diego. Specifically, the report provides a summary of the fault hazard investigation performed for the Morena Pump Station. Fault hazard evaluations are also provided for the pipeline portions of the project based on available data and interpretations of historic aerial photography. The planned locations of the pump station and waste water and brine/centrates pipelines are shown on Figure 1.

### 1.1 PROJECT DESCRIPTION

The layout of the primary components of the Morena Pump Station is shown on Figure 2. The proposed finished grade for the Morena Pump Station (MPS) is approximately elevation 16 feet National Geodetic Mean Datum of 1929 (NGVD 29). The Intake Screening Building has a proposed bottom of foundation elevation of -18.25 feet NGVD 29, which will require an approximate excavation depth of 34 feet. The Pump Station Building will require an excavation depth of about 51 feet to accommodate the foundation (bottom elevation of -32.5 feet NGVD 29) and underlying base layer. The Energy Dissipator Structure has a proposed bottom of foundation elevation of -7.33 feet NGVD 29, which will require an excavation of about 25 feet deep. Other supporting facilities, including the Electrical/Maintenance Building, electrical transformers, Odor Control System and a High Purity Oxygen Injection Facility will be constructed at or near finished grade. Based on the planned operations of the MPS, it is expected that there will not be continuous human occupancy needed for general operations of the facility. Routine maintenance will be accomplished on a periodic basis with maintenance personnel being dispatched to the site. Maintenance activities will include the removal of screening debris containers from the Screenings Building along with general maintenance of the odor control systems, pumping facilities and inspections of said facilities.

The wastewater and brine/centrates pipelines will continue from the Morena Pump Station in a north and east direction to the North City Water Reclamation Plant, located in the northeast corner of Miramar Road and I-805. The general alignment is shown on Figure 1; minor deviations from this alignment are also being considered to address specific construction constraints such as utility conflicts and addressing constructability issues at Tecolote Creek, San Clemente Canyon and Rose Canyon/NCTD crossings. The majority of the proposed pipeline will be installed through traditional open cut/cover construction methods with the exception proposed tunnels at San Clemente Canyon, Rose Canyon at Rose Creek/NCTD Railroad, and Executive Drive at I-805. Additional tunnel crossings are proposed for the diversion structure pipelines south of the MPS. The proposed pipe invert depths for the cut-and-cover portions of the pipelines generally range from 10 to 30 feet below grade dependent on specific locations and existing infrastructure conflicts.



## 1.2 PREVIOUS STUDIES

Our understanding of the site geologic conditions and fault hazards is based on a review of available information and investigations performed by AECOM as part of this project. Selected portions of significant previous projects are included in Appendix A. Projects that provided important background for the fault hazard portion of this project included:

- Mid-Coast Corridor Transit Project – Geotechnical, Geologic and Seismic Impacts Technical Report. Kleinfelder Report dated August 2014.
- Mid-Coast Corridor Transit Project – Earthquake Fault Rupture Field Investigation. Kleinfelder Report dated April 9, 2014.
- Fault Hazard Investigation, Proposed Hilton Garden Inn, 4200 Taylor Street, San Diego. CTE report dated May 22, 2012 (revised).
- Paleoseismic Assessment of the Late Holocene Rupture History of the Rose Canyon Fault Zone in San Diego. Report to Southern California Edison, prepared by team led by Dr. T. K. Rockwell, dated December, 2012.

Appendix A includes selected portions of previous and current subsurface investigation.



Figure 1  
Alignment Map  
Morena Pipeline Project  
San Diego, CA

**Alignments**

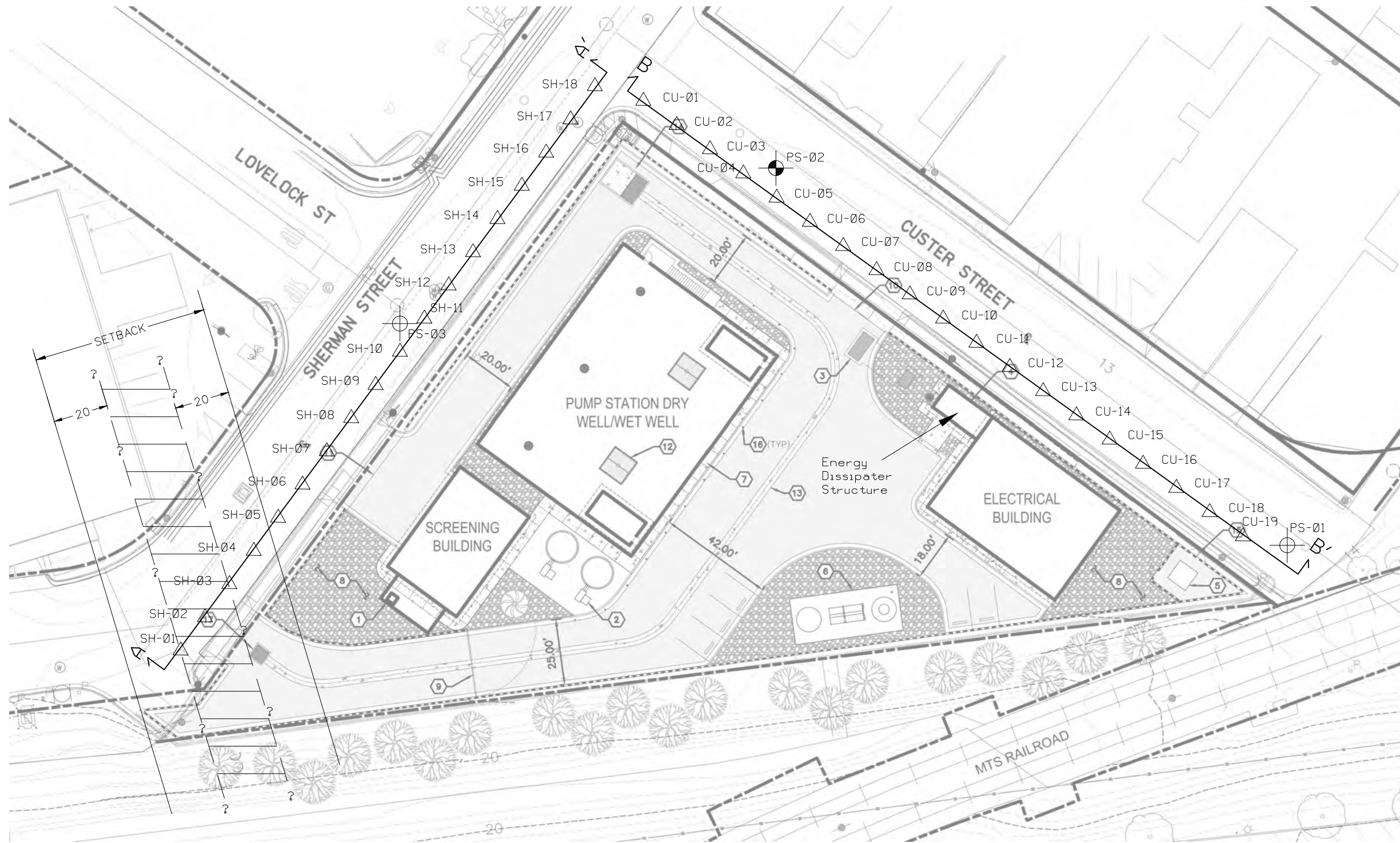
- City Alternative No. 1a (20151123)
- City Alternative No. 2 (20151123)
- Alvarado Morena Distribution and Transmission Water Pipelines
- Tunnel Crossing
- MTS Tunnel Crossings



0 1,750 3,500 ft  
1:42,000 1 inch = 3,500 feet

**AECOM**

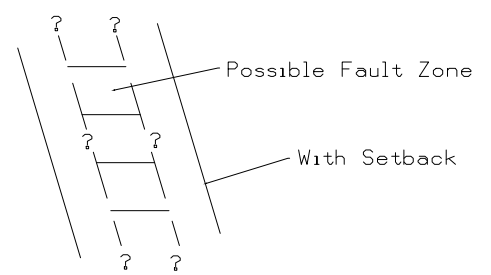




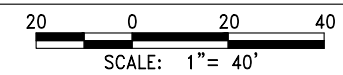
Reference: KEH 60% Design 7-25-17

**LEGEND**

- △ SH-01 Cone Penetration Test (CPT), 2017
- ⊕ PS-01 Exploratory Boring, 2017
- PS-02 Exploratory Boring with Monitoring Well, 2017
- A—A' Location of Geologic Cross Section



**MORENA PUMP STATION SITE PLAN  
MORENA PIPELINE PROJECT  
SAN DIEGO, CALIFORNIA**



CHECKED BY: MEH	DATE: 7-25-17	FIG. NO:
PM: JL	PROJ. NO: 60530732	<b>2</b>



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## 2.0 FAULT HAZARD INVESTIGATION

This section of the report summarizes the fault hazard investigation at the Morena Pump Station (MPS). Site specific explorations were performed adjacent to MPS along Sherman Street and Custer Street within 50 feet of the property line of said parcel. Currently, the City of San Diego is in the process of acquiring the property for the MPS which is occupied by the San Diego Humane Society. Until the City has obtained ownership rights to the property, on-site investigations cannot be conducted. Literature review and air photos interpretations were performed for the force main and brine/centrate pipeline alignments, including the proposed Alvarado Morena Transmission and Distribution Water Pipelines, as described below.

### 2.1 REVIEW, COMPILATION AND AERIAL PHOTOGRAPHY REVIEW

The investigation included review and evaluation of published and unpublished geotechnical, geologic, and geologic hazard information in the project area. The primary sources of published fault hazard information include California Geologic Survey (CGS) Earthquake Fault Zone (EFZ) information, the CGS publication on the Rose Canyon Fault Zone (Treiman 1993), and the City of San Diego Seismic Safety Study. Other significant studies include the published geologic mapping of the area by Kennedy (1975) and by Kennedy and Tan (2008). The City of San Diego Seismic Safety Study represents a compilation of data that draws from the mapping by Kennedy augmented by consulting studies aimed at updating hazard input into the City map.

Faults on Figure 3a and 3b are compiled from reviewed sources and rely primarily on the City Seismic Safety Study, CGS EFZ, and recent detailed studies along the Rose Canyon fault performed for the Mid Coast Corridor Project. The faults compiled include active and potentially active faults without differentiation, except for the CGS EFZ faults which are interpreted to be active.

Fault lines as shown on maps are represented as dotted, dashed and solid line segments denoting concealed, inferred or approximately located. This is the typical convention for faults as shown on geologic and geologic hazard maps and is presented for the various mapped faults, depending on the map source.

Faults located based on terrain analysis performed on historic aerial photography are similarly depicted using solid and dashed lines to show continuity of geomorphic features and confidence level based on geomorphic expression of faulting. These mapped features are suspected active faults, but their presence and level of activity have not been confirmed by field investigations.

The historic aerial photographs reviewed include vertical stereographic photographs from 1928, 1937, 1941 and 1953.

### 2.2 MORENA PUMP STATION FIELD INVESTIGATION

#### 2.2.1 Cone Penetrometer Tests

Thirty seven (37) Cone Penetrometer Test (CPT) soundings were performed by Gregg Drilling along Sherman and Custer Streets as shown of Figure 2. CPT soundings were spaced

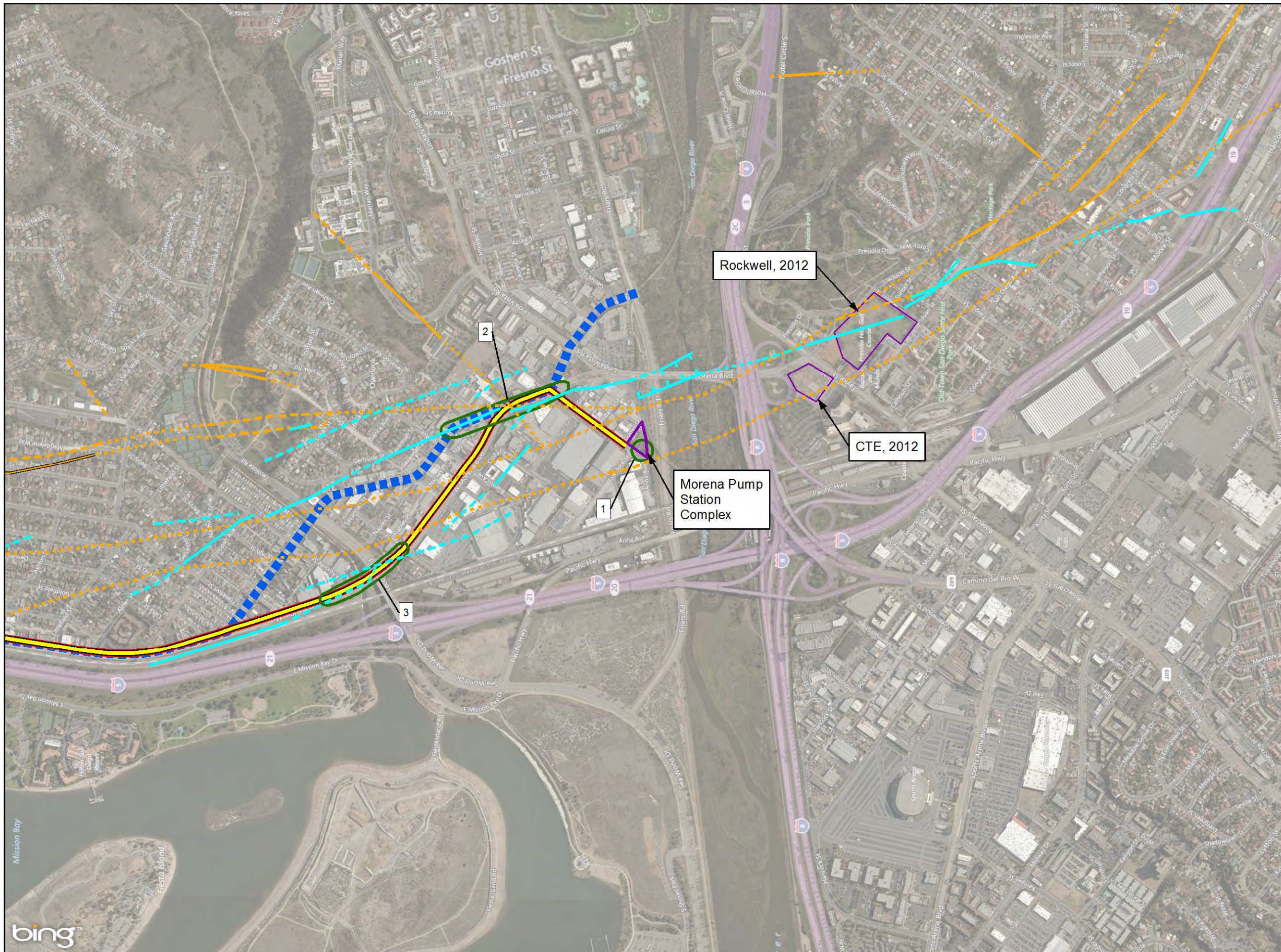
approximately 15 feet apart and extended to depths of 80 feet or refusal. Eighteen CPT soundings were performed along Sherman Street and 19 along Custer Street and are designated SH-1 through SH-18 and CU-1 through CU-19, respectively. Logs of these CPTs are presented in Appendix B along with a summary of the field activity and a description of the CPT methodology.

### 2.2.2 Geotechnical Borings

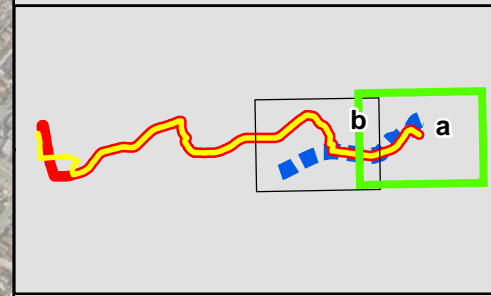
Three geotechnical borings were performed in the City streets adjacent to the MPS as shown on Figure 2 and designated PS-1, -2, and -3. These borings were drilled using hollow stem auger methods and extended to depths of 62 to 81 feet. The logs of borings for the pump station are presented in AECOM's Geotechnical Report for the project.



Figure 3a  
Project Fault Hazard Map  
Morena Pipeline Project  
San Diego, CA



- Alignments**
- City Alternative No. 1a (20151123)
  - City Alternative No. 2 (20151123)
  - Alvarado Morena Distribution and Transmission Water Pipelines
- Alquist Priolo (EFZ) Faults**
- Accurately Located Fault Trace
  - Approximately Located Fault Trace
  - Inferred Fault Trace
  - Concealed Fault Trace
  - Alquist-Priolo Earthquake Fault Zone
- Faults (SanGIS)**
- FAULT
  - INFERRED FAULT
  - CONCEALED ZONE
  - SHEAR ZONE
- Faults (Compiled interpretations)**
- Distinct geomorphic features in historic aerial photos
  - Moderately expressed geomorphic features in historic aerial photos
  - Concealed
  - Graben
  - Fault Hazard Location



Sources: SanGIS; CGS; Kleinfelder.

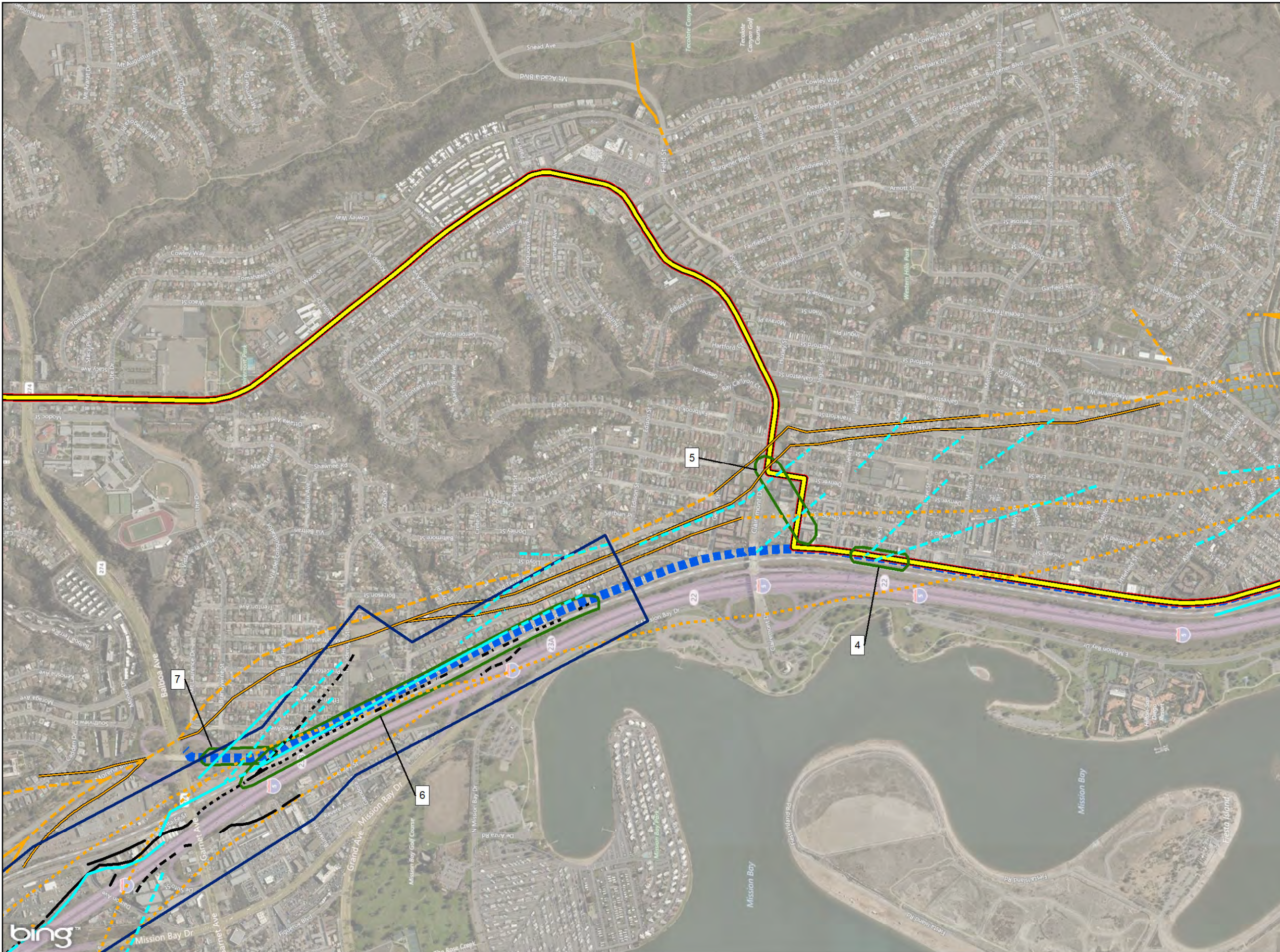
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1:12,000 1 inch = 1,000 feet

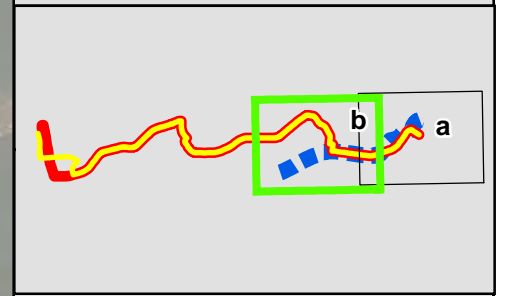
**AECOM**



Figure 3b  
Project Fault Hazard Map  
Morena Pipeline Project  
San Diego, CA



- Alignments**
- City Alternative No. 1a (20151123)
  - City Alternative No. 2 (20151123)
  - Alvarado Morena Distribution and Transmission Water Pipelines
- Alquist Priolo (EFZ) Faults**
- Accurately Located Fault Trace
  - Approximately Located Fault Trace
  - Inferred Fault Trace
  - Concealed Fault Trace
  - Alquist-Priolo Earthquake Fault Zone
- Faults (SanGIS)**
- FAULT
  - INFERRED FAULT
  - CONCEALED ZONE
  - SHEAR ZONE
- Faults (Compiled interpretations)**
- Distinct geomorphic features in historic aerial photos
  - Moderately expressed geomorphic features in historic aerial photos
  - Concealed
  - Graben
  - Fault Hazard Location



Sources: SanGIS; CGS; Kleinfelder.

0 1,000 Feet

1:12,000 1 inch = 1,000 feet



## 3.0 GEOLOGIC AND SEISMIC SETTING

### 3.1 GEOLOGIC SETTING

Coastal San Diego lies within the Peninsular Ranges physiographic province that is characterized by northwesterly trending mountains and intervening valleys. The western portion of the province, which includes the site area, is generally characterized as a coastal plain subprovince that includes broad mesas and terraces that have been cut into Tertiary age sedimentary deposits. These terraces are capped by thin Quaternary age sedimentary deposits that reflect former high stands of sea level during Pleistocene glacial epochs. These coastal terraces are incised by westerly trending drainages. The project alignments cross a series of secondary drainages including; Tecolote Canyon, Rose Canyon, and San Clemente Canyon.

The San Diego River is the main drainage course which has shaped and modified the central-western San Diego metropolitan area. The southern portion of the Project is located adjacent to the northern margin of San Diego River and lies within the ancient confines of this river system.

### 3.2 SITE GEOLOGY

#### 3.2.1 Pump Station

Subsurface conditions at the Morena Pump Station were interpreted based on the results of subsurface borings PS-1 through PS-3 and CPTs SH-01 through SH-18 and CU-01 through CU19, performed by AECOM in March and April 2017. CPT logs are included in the Appendix B. Approximate locations of the borings and CPTs are shown on Figure 2. Due to access limitations at the proposed Morena Pump Station site, all explorations were performed in the city streets around the perimeter of the site.

The preliminary available data indicates that within the depth of the explorations (maximum depth about 80 feet below ground surface [bgs]), the site is underlain by a thin fill layer over a thick sequence of young alluvium. The fill ranges from about 3 to 5 feet in depth and consists primarily of silty sand. The underlying alluvium varies significantly, and is highly interlayered in some zones. Three generally distinct units have been identified within the alluvial deposits and are described below. These units are very similar in thickness, depth and CPT signature to units identified in a study to the south of the Project area in the Old Town area for a Hilton Garden Hotel (CTE, 2012). This site occupies a very similar geologic and geomorphic setting as that of the pump station.

Unit 1. Sandy fluvial deposits. Unit 1 is present across the site as a continuous unit comprised primarily of silty sands and poorly graded sands with lesser amounts of sandy silt and fine grained layers. The layer extends to a depth of approximately 21 to 30 feet along Sherman Street and 22 to 26 feet along Custer Street.

Unit 2. Thinly bedded silts, clays, and sands. Unit 2 is a shallow estuarine and lagoonal deposit. Shell fragments are present and a sandy lower subunit is interpreted as shown on the site cross sections. The units are laterally continuous and extend to a depth of approximately 48 to 55 feet along the Sherman Street section and 48 to 51 feet along Custer Street.

Unit 3. Sandy fluvial deposits. Unit 3 represents a distinct geologic change with denser, sandy deposits underlying the thin bedded and generally fine-grained estuarine and lagoonal deposits of Unit 2. Unit 3 contains gravels and refusal to CPT advancement was encountered in approximately half of the CPT locations (see Appendix B).

Preliminary Age Assessment. Based on correlation to the dated lithologic and stratigraphic units to the south of the San Diego River channel in the Old Town area (CTE, 2012), AECOM interprets the sequence of deposits at the pump station to range in age from late Pleistocene to mid- Holocene. Pump Station Unit 2 correlates to the Hilton Unit 3 that dates to approximately 7 to 7.5 thousand years (ka). Pump Station unit three correlates to Hilton Unit 4 dated at 9.2 ka at a depth of 61 feet. The pump station CPTs encountered refusal in gravelly or cobbly materials that likely correlate to Hilton Unit 4 and Hilton Unit 5 in the deeper refusals. Hilton Unit 5 was estimated to range from 10.5 to 20 ka (CTE, 2012).

### 3.2.2 Pipeline

The project can be divided into three reaches with regard to geologic setting and subsurface conditions. Along most of the southerly pipeline reach (between Clairemont Drive and Friars Road) the combined thickness of fill and alluvium is greater than the anticipated pipeline trench depths, except for short reaches within the Older Paralic Deposits (formerly Bay Point Formation), a semi consolidated sedimentary formation.

A second reach for the project can be defined where the pipeline route ascends up along Clairemont Drive from the coastal plain to the mesa top. This reach traverses primarily Pleistocene age terrace deposits (Very Old Paralic Deposits – formerly Lindavista Formation).

A third reach can be described extending along the mesa tops and ending at the North City Water Reclamation Plant. This portion of the route is mostly within dense Tertiary sedimentary formations including the Scripps Formation and Quaternary sedimentary deposits including various units of the Very Old Paralic Deposits.

More description of the geologic units and a geologic strip map of the project are provided in the 30% Design Geotechnical Report.

## 3.3 TECTONIC 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 striking, predominantly right slip faults that span the width of the Peninsular Ranges and extend offshore into the California Continental Borderland Province. At the latitude of San Diego, this zone extends from the San Clemente fault zone, located approximately 60 miles offshore of the San Diego coastline to the San Andreas Fault, located about 70 miles east of San Diego, (CGS, 2010, <http://maps.conservation.ca.gov/cgs/fam/>).

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, including their associated branches, are currently the most active and appear dominant in accommodating the majority of the motion between the two adjacent plates. A smaller portion of the relative plate motion is being accommodated by northwest-striking faults to the west, including the Elsinore, Rose



Canyon, and offshore faults. Many of these faults have experienced historic seismic activity, as shown on Figure 4. The following is a general description of the Rose Canyon Fault Zone and its interaction with the proposed project improvements associated with the Morena Pump Station and Conveyance System.

### 3.3.1 Rose Canyon Fault Zone

The Morena Pump Station and the southern portion of the pipeline alignment along Morena Boulevard are considered to lie within the active Rose Canyon Fault Zone (RCFZ). The on-shore portion of the RCFZ extends along the northeast flank of Mount Soledad at La Jolla and continues southward along the eastern margins of Mission Bay (just west of Interstate 5) towards downtown San Diego. Between Mission Bay and San Diego Bay, the zone appears to widen and diverge. Active faults (i.e. Holocene-age fault rupture) and potentially active faults (i.e. Quaternary-age fault rupture) are present in the Project area.

The pump station lies within the RCFZ and concealed fault strands have been mapped on the City maps as lying to east and west of the pump station site as shown on Figure 3a. Mapped faults in the project area trend (strike) predominantly north-northwest; these trends are consistent with the overall trend of the RCFZ along the eastern margin of Mission Bay.

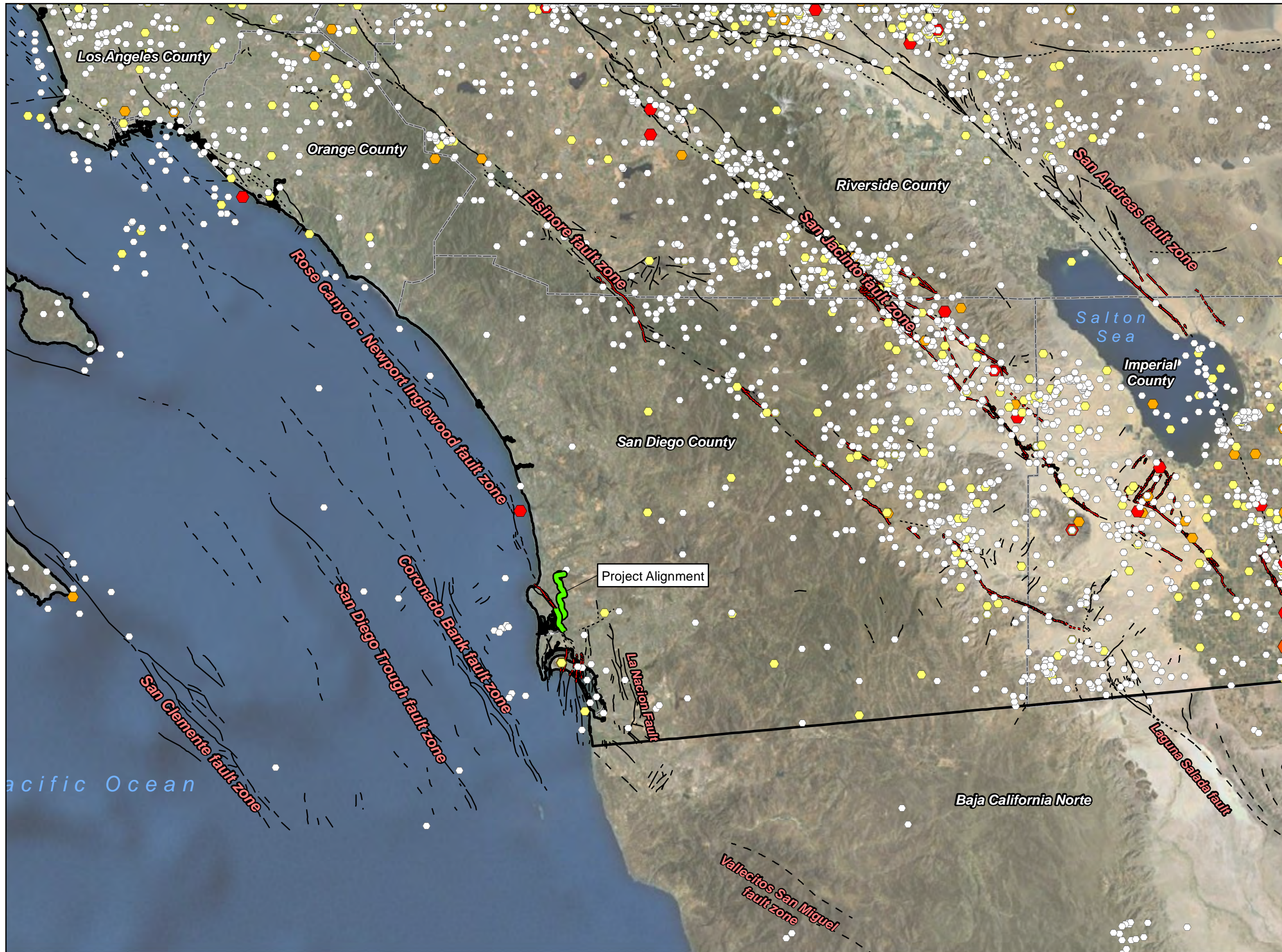
### 3.3.2 Other Faults

Other faults in the area include inactive and potentially active faults mapped in the project vicinity east of the RCFZ (City of San Diego, 2008). None of these faults cross the Project alignment and therefore are not considered potential fault hazards to the project limits.

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Figure 4  
Regional Fault and Epicenter Map  
Morena Pipeline Project  
San Diego, CA



**Project Alignment**  
 Project Alignment

**County Boundary**  
 County Boundary

**State Boundary**  
 State Boundary

**Earthquake Epicenter Magnitude**

- 2.91 - 4.0
- 4.01 - 5.0
- 5.01 - 6.0
- 6.01 - 7.0
- 7.01 - 8.0

**Alquist Priolo (EFZ) Faults**

- Accurately Located Fault Trace
- Approximately Located Fault Trace
- Concealed Fault Trace
- Inferred Fault Trace

**Quaternary & Pre-quaternary Faults**

- Accurately Located Fault Trace
- Approximately Located Fault Trace
- Concealed Fault Trace

Sources: ESRI; CGS.

0 6.5 13 Miles

1:823,680 1 inch = 13 miles



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## 4.0 CONCLUSIONS AND RECOMMENDATIONS

### 4.1 FAULT CONSIDERATIONS

Earthquake fault rupture is a hazard associated with active faults during sizable seismic events. The CGS and the City of San Diego consider a fault active if it displays evidence of activity within the Holocene epoch, i.e., in the last approximately 11,000 years (Hart and Bryant, 2008). Potentially active faults are classified as having exhibited activity prior to 11,000 years but within the past 1.6 million years (City of San Diego, 1999).

Significant ground rupture generally does not occur until earthquake magnitudes reach M6 or greater. Faulting events which do rupture the ground surface can have a significant effect on existing infrastructure and development improvements that crosses the ruptured area.

The RCFZ is considered capable of maximum earthquake magnitudes on the order of M6.8 to 7.2. Slip rate estimates based on paleoseismic studies (fault trenching, geomorphic analysis) in the Rose Creek area estimate a minimum slip rate of 1.5 mm/year (Lindvall and Rockwell, 1995). Subsequent studies by Rockwell (2010) provides a best estimate of slip rate for the Rose Canyon at 2 mm/yr.

The paleoseismic studies in Rose Creek noted evidence for at least 3 displacement events in the past 8,000 years. More recent studies in Old Town suggest that there have been more than three events. Current estimates of recurrence suggest an interval on the order of 500 to 1,000 years for displacement events. Displacement per event for the Rose Canyon fault is estimated at 3 to 6 feet of lateral (strike-slip) movement.

### 4.2 FAULT HAZARD ASSESSMENT

#### 4.2.1 Morena Pump Station

Two lines of closely spaced (15 feet on center) CPTs were performed to provide an evaluation of possible faulting within the site. Figures 5 and 6 present cross sections along Sherman and Custer Streets, respectively. The layered stratigraphy across the site provides for a basis to evaluate the presence or absence of possible faulting. Based on our interpretation of subsurface layering, there is an anomaly at the western end of the Sherman section. The interpreted layers correlated from CPT to CPT along the section show relationships varying from relatively flat lying to very shallowly dipping for a series of six or seven contacts between CPTs SH-03 and SH-18. Between SH-02 and SH-03 all of these contacts drop in elevation. This pattern is inferred to represent a fault with west-side-down vertical separation. The apparent vertical separation of the subsurface units also appears to increase slightly with depth, which would be consistent with a fault that has had repeated movement resulting in greater displacement of the older, deeper units.

Based on the CPT data (Figure 5), Units 1 and 2 appear to be offset by a fault between SH-02 and SH-03. Unit 2 correlates with sediments that date to approximately 7 to 7.5 ka, i.e., the sediments were deposited during the early Holocene. In our opinion, the offset layers represent Holocene age deposits that appear to have been displaced by a fault. Therefore the fault is considered active (City of San Diego, 1999).

An active fault poses a surface rupture hazard. The City requires setbacks from active faults (City of San Diego, 1999). A 20-foot setback from the fault zone is recommended at Morena Pump Station to reduce the risk of surface rupture during the design life of the structure.

The recommended 20-foot structural setback considers the approximate distance between adjacent CPTs (about 15 feet) and CPT location accuracy (up to about 5 feet). The north-northwest location trend of the fault (about N15W) mapped on Figure 2 reflects the general trend of the RCFZ and faults mapped in the pump station site vicinity as shown on Figure 3a. The 20-foot setback also provides a structural setback if the fault were to trend more northwesterly within the site limits.

The remainder of the site, as evidenced by the relatively flatlying and continuous stratigraphy shown along the Sherman Street section east of CPT SH-03 (Figure 5), and all of the Custer Street section (Figure 6), does not appear to be crossed by active faults.

The Morena Pump Station building and associated facilities are not considered habitable structures and therefore seismic danger exposure to humans is limited. In addition, the Morena Pump Station does not have public access and is an electronic controlled security site. Based on review of the anticipated operational procedures by City Operations staff, pump station operations are anticipated to require less than 2,000 man hours per year. Therefore the proposed project structures are not for human occupancy as defined in Section 3601(e) of the California Code of Regulations, Title 14, Division 2.

#### 4.2.2 Pipeline Alignments

The pipeline routes along Morena and West Morena Boulevard generally parallel the active RCFZ along east Mission Bay. Locations of active strands of the RCFZ are known near Balboa Avenue, at Buenos Avenue, and at Old Town; otherwise active faults in the Morena pipeline reach are generally mapped as suspected or “concealed” (i.e., not well located) on geologic and fault maps by the City of San Diego and the CGS. Fault locations are shown on Figures 3a and 3b.

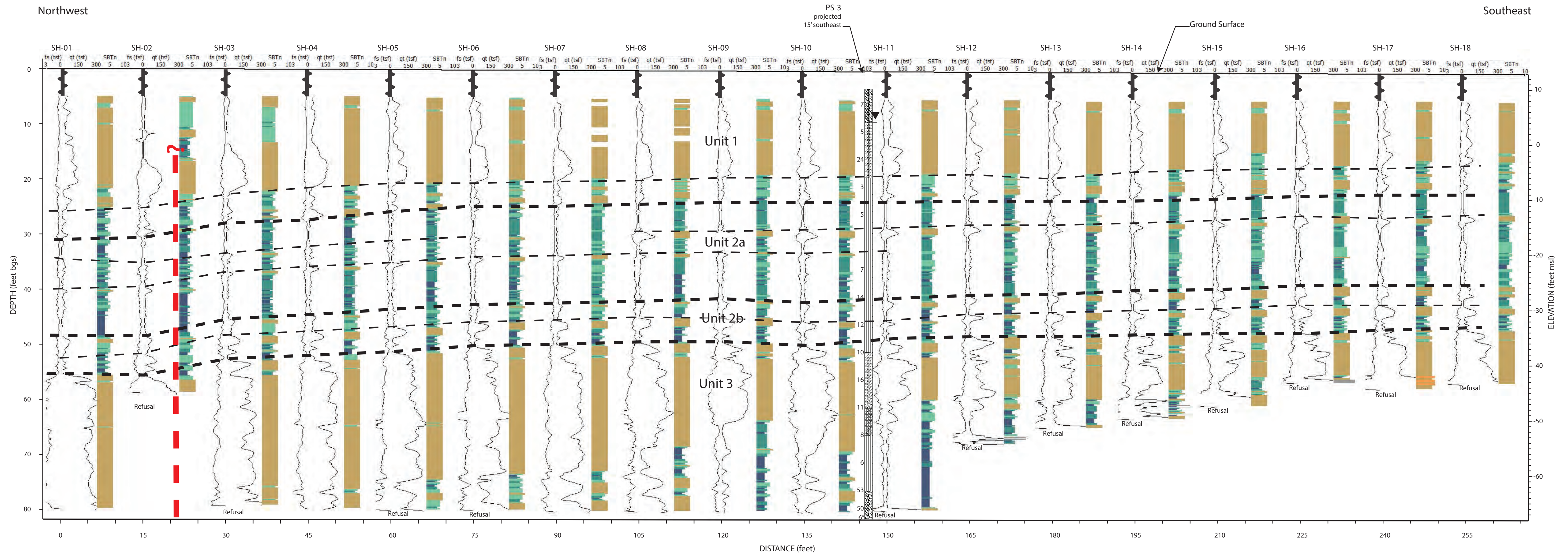
Geomorphic features evident on historical air photos are suggestive of faults that may cross the pipeline route. If active faults are present, as suggested by the air photo interpretations, fault rupture may pose a potential hazard at pipeline-fault crossings. Faults at locations shown as concealed, inferred or approximately located were judged to have a low potential to intersect the pipeline, especially if geomorphic features were not present. Locations of possible active faults that appear to cross the proposed pipeline are shown on Figures 3a and 3b.

Table 1 is a summary of suspected active faults that are mapped as crossing the alignment, and/or mapped very near the alignment. These faults appear to be active and may be a potential source of fault rupture.



A  
Northwest

A'  
Southeast



LEGEND

TYPICAL SOIL GRAPHIC SYMBOLS

- Silty SAND (SM)
- Poorly graded SAND with silt (SP-SM)
- FILL
- SILT (ML)
- Gravel (GP)
- Fat CLAY (CH)

TYPICAL SAMPLER GRAPHIC SYMBOLS

- Sampler Blowcounts for 12" interval

CPT GRAPHIC SYMBOL

- CPT data (fs, tsf, SBTn, qt)

HAND AUGER

- Hand Auger

OTHER GRAPHIC SYMBOLS

- Geologic Unit Contact
- Geologic Subunit Contact
- Inferred Fault
- First Groundwater encounter at time of drilling and sampling (ATD)
- Stabilized Groundwater

SBTn Legend

- Sensitive fine grained
- Clayey silt to silty clay
- Gravely sand to sand
- Organic soil
- Silty sand to sandy silt
- Very stiff sand to clayey sand
- Clay to silty clay
- Clean sand to silty sand
- Very stiff fine grained

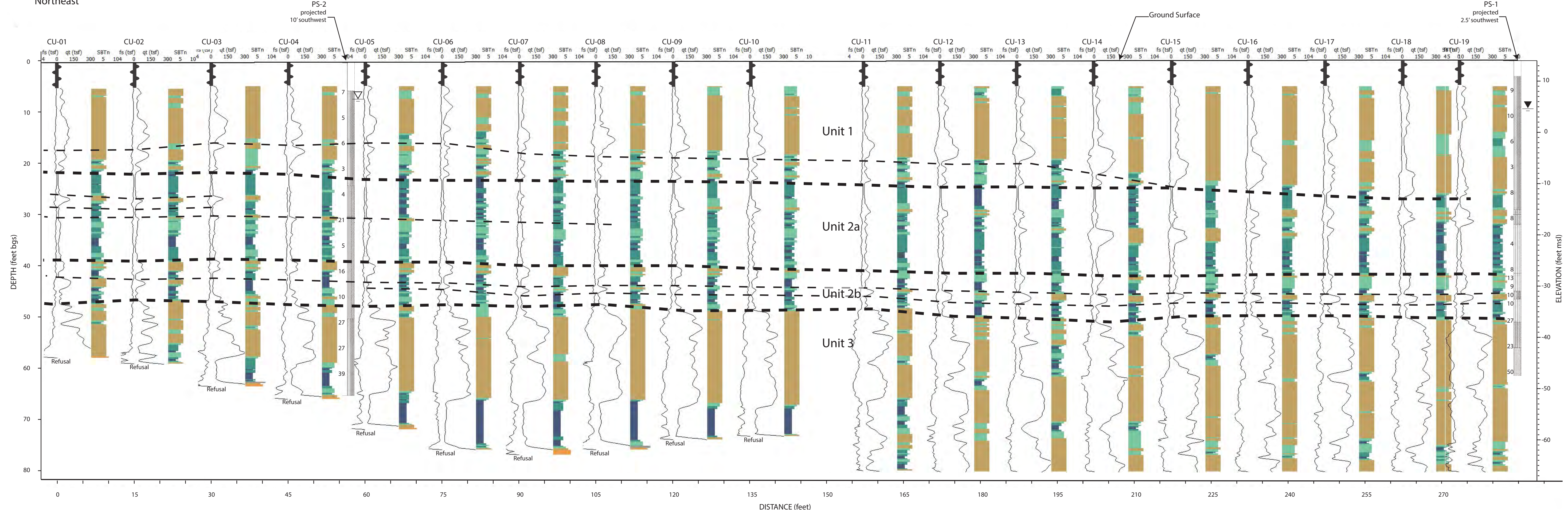
Notes:  
Scale 1:10

GENERALIZED GEOLOGIC CROSS SECTION A-A' (SHERMAN ST.) MORENA PIPELINE PROJECT SAN DIEGO, CALIFORNIA			
<b>AECOM</b>	CHECKED BY: MEH	DATE: 7-31-17	FIG. NO.
	PM: JL	NO: 60530732	5



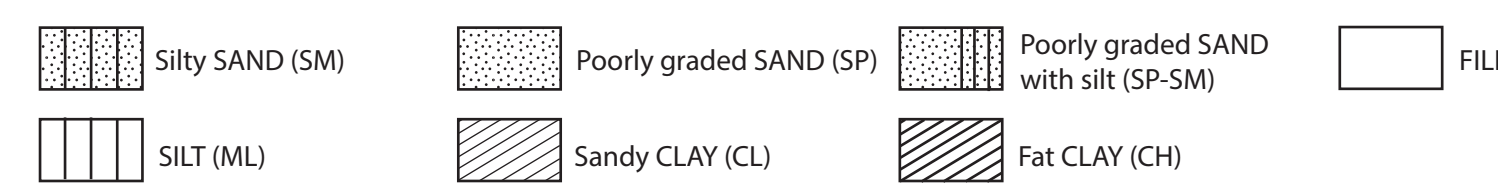
B  
Northeast

B'  
Southwest

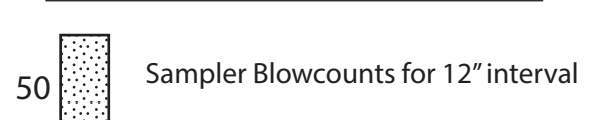


LEGEND

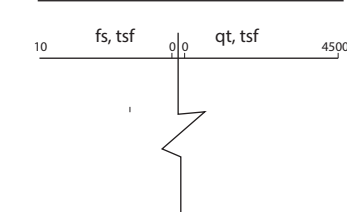
TYPICAL SOIL GRAPHIC SYMBOLS



TYPICAL SAMPLER GRAPHIC SYMBOLS



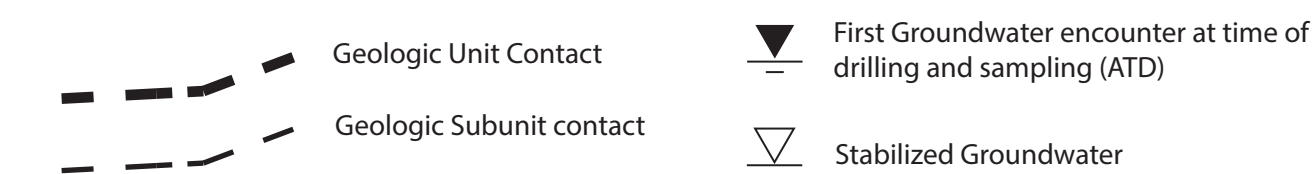
CPT GRAPHIC SYMBOL



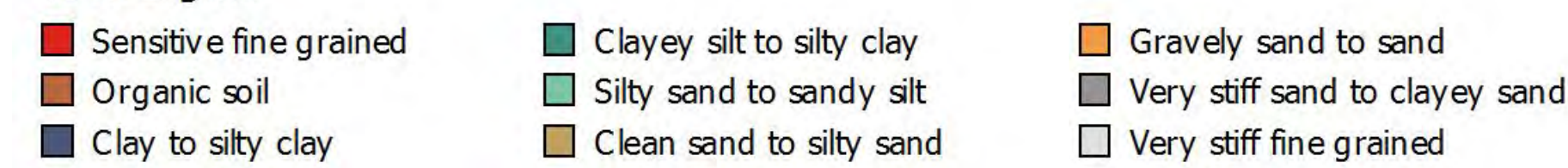
HAND AUGER



OTHER GRAPHIC SYMBOLS



SBTn Legend



Notes:  
Scale 1:10



**Table 1. Summary of Pipeline Fault Hazards**

Fault Hazard Location	Proposed Structure	Fault Data Source	Anticipated Displacement Style	Comments
1	Morena Pump Station	Cone Penetration Tests	Strike-slip with east-side-down apparent vertical separation.	Fault appears to underlie westernmost portion of site.
2	All pipelines	Historical air photos	Strike-slip; possible shear and/or compression.	Relatively continuous fault appears to align very near and along proposed alignments for over 1,000 lineal ft.
3	All pipelines including proposed tunnels below Tecolote Creek	Historical air photos	Strike-slip; possible shear and/or extension.	Pipeline-fault crossing appears to be within step-over features.
4	All pipelines	Historical air photos	Strike-slip; possible extension component	Possible minor faults within step-over
5	Force main and brine/centrate pipelines	Published geologic maps, historical air photos	Strike-slip, possible shear and/or compression.	Alignment crosses possible major fault strand
6	Alvarado Morena pipeline	Published geologic maps, including EQFZ, historical air photos	Strike-slip, possible shear and/or compression.	Relatively continuous fault appears to align very near and along proposed alignment for approx 3,000 lineal ft.
7	Alvarado Morena pipeline	Historical air photos	Strike-slip, possible shear and/or compression.	Pipeline alignment becomes northerly, possible relatively narrow pipeline-fault crossing.

The project seismic setting presents a risk of pipeline damage and resulting interruption of the project. Options for mitigating and/or reducing the vulnerability of pipelines to fault rupture hazards generally include: 1) operational options that would implement changes to system monitoring and responses to seismic events; 2) upgrades such as modifying soil conditions and pipeline physical characteristics to reduce the level of earthquake hazard and increase the pipeline resistance to the impact of earthquake hazards; 3) avoidance such as altering the pipeline alignment to reduce seismic hazards.

The project design will incorporate operational measures including system monitoring and responses to seismic events. The generalized operational measure being incorporated into the design of the Morena Pump Station and Conveyance System are as follows:

- Forcemain Pipe Break – Triggers a Low-Head Pump Signal, triggers a pump station shutdown.
- Forcemain Pipe Blockage – Triggers a High-Head Pump Signal, triggers a pump station shutdown.
- Brine/Centrate Return Pipe Break – Triggers a low pressure condition, triggers a Advance Water Purification Facility shutdown.

These design features will mitigate seismic risk by stopping flow and allowing investigations of pipeline integrity following a seismic event. The proposed operational measures would mitigate

fault rupture hazards without the need for site specific fault characterizations. Therefore site specific fault investigations were not performed for design.

### **4.3 ADDITIONAL INVESTIGATIONS**

The primary pump station components are located more than double the recommended structural setback zone, which further mitigates potential northwesterly fault trends within the site. In our opinion, additional geologic investigation is not necessary at this time to define the location of active faulting across the site or to delineate an appropriate structural setback zone for the purposes of environmental review.

An as-graded or as-built geologic/geotechnical report will be required according to City of San Diego Guidelines for Geotechnical reports (2011) to document geologic and geotechnical conditions encountered during construction of the pump station. Logs of additional subsurface explorations (especially CPTs, if performed during construction) with geologic cross sections will be provided in the as-built report to confirm the location of the inferred fault along the western portion of the site.



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## 5.0 REFERENCES

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**APPENDIX A**





## APPENDIX A— PREVIOUS STUDIES

Previous studies that provided specific information relied upon in this study include the compiled fault hazard information presented by Kleinfelder for the Mid-Coast Corridor Transit Project. Attached here are the figures from the technical report that present the compiled fault data including the geomorphic assessment based on historical aerial photographs from 1928 and 1953. Two figures from the 2014 Technical Report are attached here as A-1 and A-2.

Subsurface information and interpretations presented by CTE (2012) for a proposed Hilton Garden Hotel include age-dated deposits in a geologic and geomorphic setting that is very similar to the Morena Pump Station. Attached here is an interpreted section from the CTE report as A-3.

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Figure 4-10. Detail Fault Map (Approximate Stations 185–295)



**Mid-Coast Corridor Transit Project**

- Trolley - Future Blue Line Service on Existing Tracks
- Trolley Station
- Transit Center
- Future Trolley Station
- Transit Center with a Future Trolley Station
- Existing Substation
- Fault Hazard 1
- Fault Location

**City of San Diego**

- Fault
- Shear Zone
- Inferred Fault
- Concealed Zone

**Faults (Kleinfelder, 2011)**

- Fault - Identified by distinct geomorphic features in vintage aerial photos
- - - Fault - Identified by moderately expressed geomorphic features in vintage aerial photos
- ..... Fault, concealed
- Graben

**Alquist-Priolo Earthquake Fault Zones**

- Accurately located fault trace
- - - Approximately located fault trace
- ..... Inferred fault trace
- ..... Concealed fault trace
- Earthquake Fault Zone Boundary
- Interpretive Area

Projection: State Plane Coordinate System California Zone VI, NAD 1983  
 Common Aerial photo base provided by Parsons Brinckerhoff  
 Background Aerial photo base - (c) 2010 Microsoft Corporation and its data suppliers

The information included on this graphic representation has been compiled from a variety of sources and is subject to change without notice. Kleinfelder makes no representations or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information. This document is not intended for use as a land survey product nor is it designed or intended as a construction or design document. The use or misuse of the information contained on this graphic representation is at the sole risk of the party using or misusing the information.

0 500 1,000 2,000 Feet

Sources: City of San Diego Faults- from the SanGIS Database (www.sangis.org) Alquist-Priolo Earthquake Fault Zones- Modified from California Geological Survey CD-ROM 2001-05 (2002), Official Map of Alquist-Priolo Earthquake Fault Zones, La Jolla Quadrangle (1991)  
Alignment/stationing drawing is based on electronic drawing files provided by Parsons Brinckerhoff dated 4-18-11 and consistent with the 2012 Draft SEIS/SEIR Plan Set



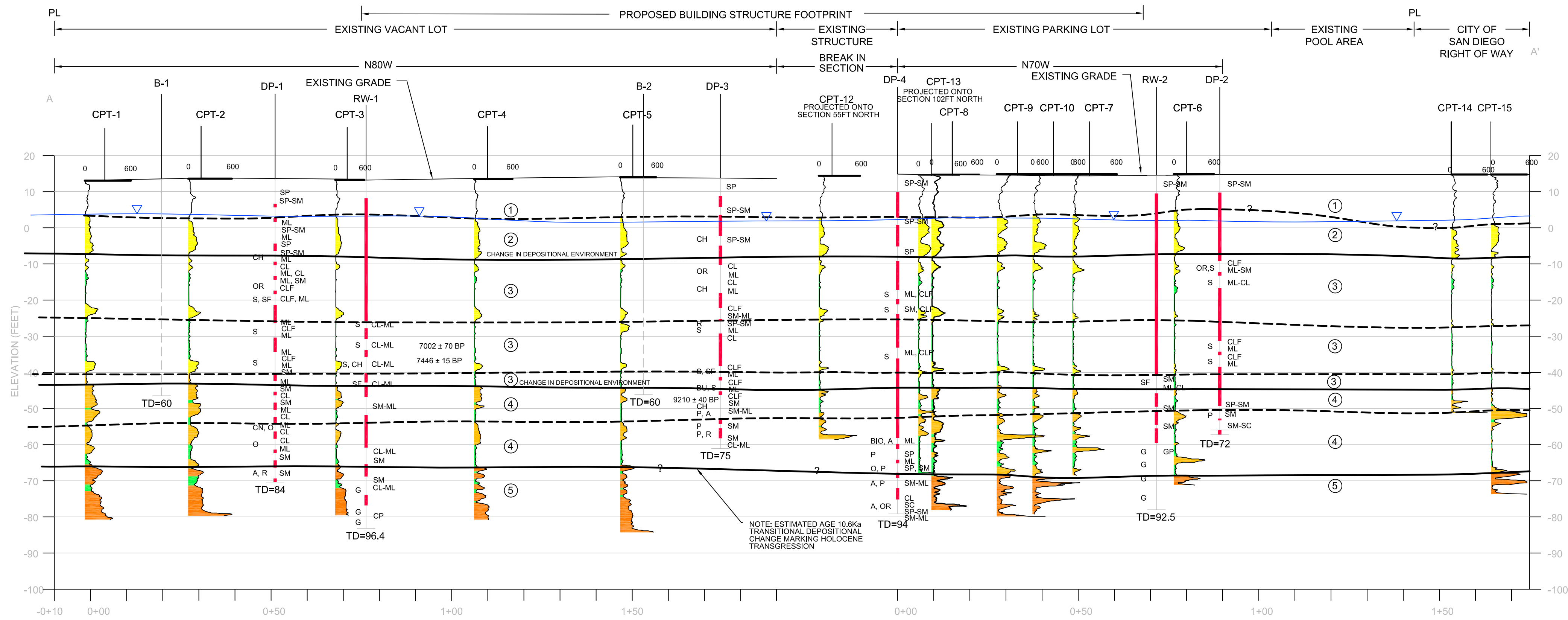


Figure 4-11. Detail Fault Map (Approximate Stations 260–418)



Sources: City of San Diego Faults - from the SanGIS Database (www.sangis.org); Alquist-Priolo Earthquake Fault Zones - Modified from California Geological Survey CD-ROM 2001-05 (2002); Official Map of Alquist-Priolo Earthquake Fault Zones, La Jolla Quadrangle (1991)  
Alignment/stationing drawing is based on electronic drawing files provided by Parsons Brinckerhoff dated 4-18-11 and consistent with the 2012 Draft SEIS/SEIR Plan Set





**LEGEND**

- CL CLAY
- CLF FISSILE CLAY
- ML SILT
- SM SILTY SAND
- SP-SM POORLY GRADED SAND W/ SILT
- SP POORLY GRADED SAND
- GP POORLY GRADED GRAVELS
- CH CHARCOAL
- OR ORGANICS
- S SHELLS
- SF SHELL FRAGMENTS
- P PEBBLES
- G GRAVEL
- A POSSIBLE A-HORIZON
- CN CARBONATE NODULES
- R ROOTS
- BU BURROWS

- CPT-1 CONE PENETRATION TEST
- DP-1 DIRECT PUSH BORING
- RW-1 ROTARY WASH BORING
- B-1 DIRECT PUSH BORING

- 0 600 TIP RESISTANCE (TONS PER SQUARE FOOT)
- POSSIBLE TIME-STRATIGRAPHIC BOUNDARY
- - - LITHOSTRATIGRAPHIC CONTACT
- APPROXIMATE GROUNDWATER ELEVATION
- 7002 ± 70 BP CONVENTIONAL RADIOCARBON AGE

**QUATERNARY HOLOCENE DEPOSITS**

UNIT 1: The recent mechanical fill material consisted of an approximately ten to twelve foot thick section of loose, dry, yellow gray poorly graded sand to poorly graded sand with silt. This unit extended down to and slightly below the observed groundwater elevations continuously across the site at approximate elevations 2-to 4-feet msl.

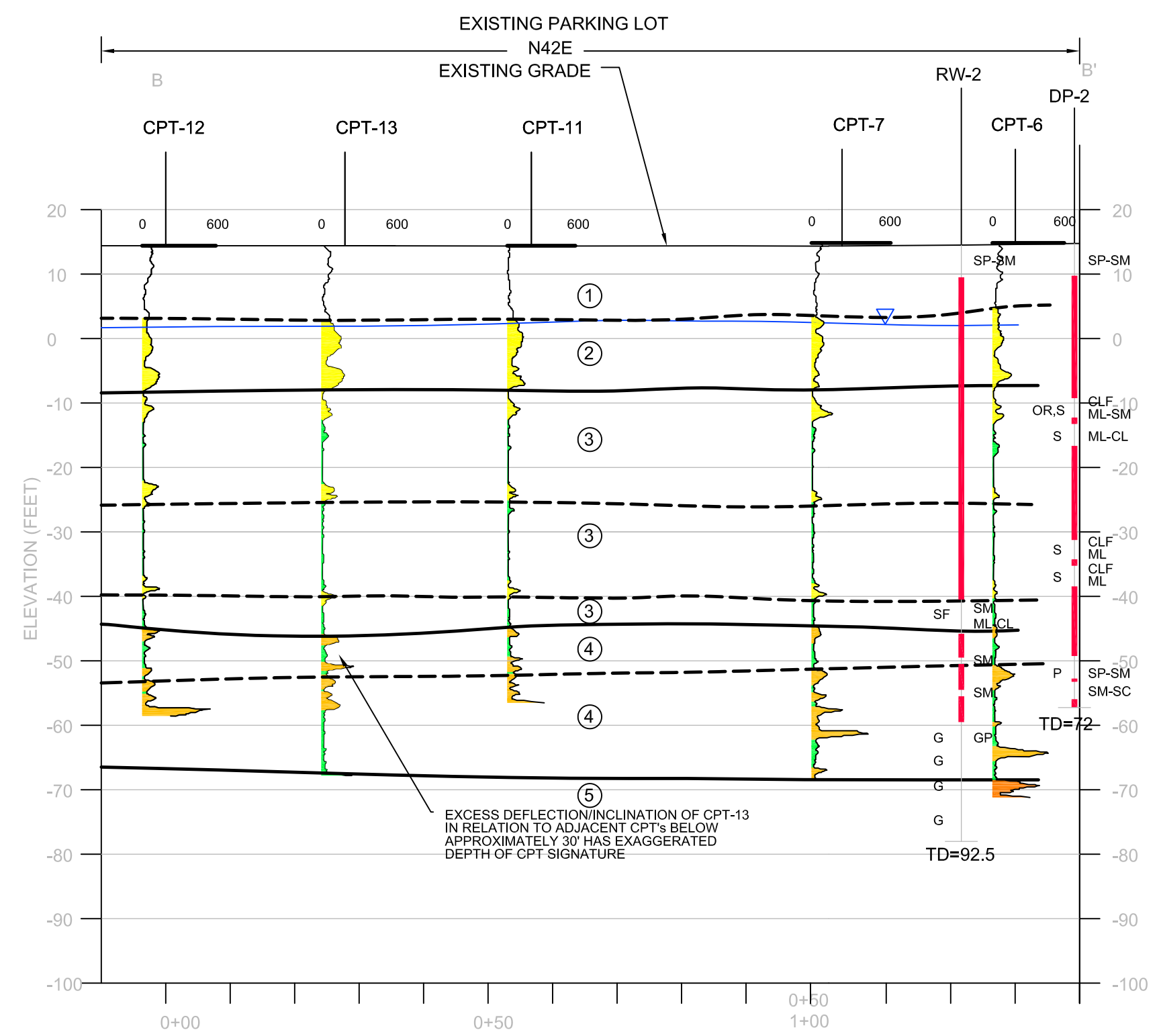
UNIT 2: Deposits of Unit 2 consisted of a sequence of loose to medium dense, planar laminated light and dark gray poorly graded sands, to weakly laminated, massive poorly graded sands and silty sands. Sands were generally micaceous, with occasional pebbles, and contained charcoal, and organic fragments of wood. This unit extended to depths of approximately 21 to 22 feet bgs and could be correlated continuously across the entire site.

UNIT 3: A marked change in depositional environment was observed between the overlying predominately sandy Unit 2 and the underlying Unit 3. Unit 3 consists of a series of alternating silt and clay layers to laminations, with occasional silty sands that contained a high percentage of silt. Sandy intervals occur on approximate 10-foot intervals separated by alternating clays and silts. Based on the CPT logs it appears there are a series of stacked fining upwards sequences within this map unit. An absence of shells was apparent in the upper portion of the unit above approximately 30 to 35 feet in depth and wood and charcoal was more abundant. Below this depth shells were readily observed and consisted of mollusks including gastropods and bivalvia, such as snails, turritella, varieties of clams, and oysters. Clays were highly organic, fissile with crude cross-laminations to planar wavy laminations. Our sample frequency was not frequent enough over this change to define a map contact, but there appears to be a change in environment from the upper and lower portions of Unit 3, possibly a change from predominately salt water to fresh water up section.

UNIT 4: Another change in depositional environment was recognized between Unit 3 and Unit 4, possibly representing a hiatus or unconformity. This change was marked by the disappearance of the shells, marked increase of silty sands and decrease in the dark, fissile, organic-rich clays. Also, an increase of pebbles was noticed, increasing both vertically downward and laterally to the east. Sands were coarser grained, with slight oxidation or gleying, and possible local development of A-soil horizons. This surface could also represent a depositional hiatus representing an environment with local areas exposed to the surface for a substantial time. The unit consists of interlayered clays, silts and sands, with pebble floaters to stringers.

**QUATERNARY PLEISTOCENE DEPOSITS**

UNIT 5: Unit 5 is similar to unit 4 with an increase in the amount of gravel that increases in abundance and size to the east and south across the site. The gravels consist of fine gravel to cobble sized clasts and interbedded sand layers. Clasts are almost exclusively volcanic in origin, with rhyolitic, andesitic, "Poway type" clasts. The clasts were well-rounded within a sand matrix that typically washed-out during the drilling process. These clasts are interpreted to be Pleistocene fluvial gravels and not part of Eocene deposits with similar gravel populations.



**LEGEND**

- CPT-1 CONE PENETRATION TEST
- TIP RESISTANCE (TONS PER SQUARE FOOT)
- APPROXIMATE GROUNDWATER ELEVATION
- POSSIBLE TIME-STRATIGRAPHIC BOUNDARY
- - - LITHOSTRATIGRAPHIC CONTACT
- DP-1 DIRECT PUSH BORING
- RW-1 ROTARY WASH BORING
- B-1 HOLLOW STEM BORING
- NOT SAMPLED OR NO RECOVERY
- SAMPLED/RECOVERY INTERVAL





**APPENDIX B**





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**APPENDIX B — CONE PENETROMETER TESTING**

The field program for this project took place along Sherman and Custer Streets near the proposed Morena Pump Station in San Diego, California. A number of permits were required including boring permits, encroachment permits and a traffic control plan. Underground Service Alert (USA or DigAlert) was also notified prior to beginning work.

*CPTs and Direct Push Borings*

Gregg Drilling of Signal Hill, California advanced 37 CPT soundings and 3 direct push holes between March 14 and March 24, 2017. The CPT program was cleared to 5 feet below ground surface (bgs) using a hand auger. Prior to beginning the field program, all the CPTs were permitted through the County of San Diego Department of Environmental Health. Upon completion, the holes were backfilled with bentonite grout and resurfaced with concrete or asphalt to match the existing ground.

The CPTs were performed in two lines, along the south side of Sherman Street and along the west side of Custer Street, approximately 5 feet off the curb. CPTs were generally spaced at 15 feet on center.

The first phase of work included CPT soundings along Sherman Street. Many of the soundings reached the target depth of 80 feet bgs, but a number of attempts reached refusal on a gravel/cobble layer at approximately 55 feet to 70 feet bgs. The second phase included a line of CPTs along Custer Street. Many of these soundings towards the south side of Custer Street reached the target depth of 80 feet bgs, but a number of attempts reached refusal on a gravel/cobble layer between approximately 55 feet to 75 feet bgs. The gravel layer was the shallowest at the intersection of Sherman and Custer Streets.

During the second phase of work three direct push borings were advanced at new locations in order to obtain a visual classification at selected depth intervals. The sampler was pushed 12 inches into the subsurface and samples were obtained at various intervals as determined by the Project Geologist. An AECOM geotechnical engineer observed and sampled the direct push borings. The direct push borings were advanced to depths ranging from 53 to 71 feet bgs. Copies of the field notes are retained in our files. Direct push borings CU-11a, CU-1a, and SH-09a were located 3 feet south of CU-11, 3 feet north of CU-01, and 3 feet east of SH-09, respectively.

The CPT soundings and direct push borings were conducted using a full-sized 30-ton rig. The cone on each rig has a 30-ton capacity with a tip area of 15 cm<sup>2</sup> and a friction sleeve area of 225 cm<sup>2</sup>. The cone is designed with an equal end area friction sleeve and a tip end area ratio of 0.85. The cone takes measurements of cone bearing, sleeve friction, and dynamic pore water pressure at 5-cm intervals during penetration to provide a nearly continuous geologic log. The CPT soundings were performed generally in accordance with ASTM D5778. Further details on methods and data interpretation are presented in a report by Gregg Drilling in this appendix.

The CPT sounding data were reviewed for changes in inclination (tilt). The only appreciable tilt (greater than 10 degrees) was noted on CPT SH-02 and so the sounding for that CPT was corrected for depth.

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**GREGG DRILLING & TESTING, INC.**  
 GEOTECHNICAL AND ENVIRONMENTAL INVESTIGATION SERVICES

March 21, 2017

AECOM  
 Attn: Kelsey Martin

Subject: CPT Site Investigation  
 Morena Pump Station  
 San Diego, California  
 GREGG Project Number: 17-035MA

Dear Ms. Martin:

The following report presents the results of GREGG Drilling & Testing's Cone Penetration Test investigation for the above referenced site. The following testing services were performed:

1	Cone Penetration Tests	(CPTU)	<input checked="" type="checkbox"/>
2	Pore Pressure Dissipation Tests	(PPD)	<input checked="" type="checkbox"/>
3	Seismic Cone Penetration Tests	(SCPTU)	<input type="checkbox"/>
4	UVOST Laser Induced Fluorescence	(UVOST)	<input type="checkbox"/>
5	Groundwater Sampling	(GWS)	<input type="checkbox"/>
6	Soil Sampling	(SS)	<input type="checkbox"/>
7	Vapor Sampling	(VS)	<input type="checkbox"/>
8	Membrane Interface Probe	(MIP)	<input type="checkbox"/>
9	Vane Shear Testing	(VST)	<input type="checkbox"/>
10	Dilatometer Testing	(DMT)	<input type="checkbox"/>

A list of reference papers providing additional background on the specific tests conducted is provided in the bibliography following the text of the report. If you would like a copy of any of these publications or should you have any questions or comments regarding the contents of this report, please do not hesitate to contact our office at (925) 313-5800.

Sincerely,  
 GREGG Drilling & Testing, Inc.

Mary Walden  
 Operations Manager



Cone Penetration Test Sounding Summary

-Table 1-

CPT Sounding Identification	Date	Termination Depth (feet)	Depth of Groundwater Samples (feet)	Depth of Soil Samples (feet)	Depth of Pore Pressure Dissipation Tests (feet)
SH-01	3/16/17	80	-	-	-
SH-02	3/14/17	62	-	-	-
SH-03	3/14/17	80	-	-	-
SH-04	3/14/17	80	-	-	-
SH-05	3/15/17	80	-	-	-
SH-06	3/14/17	80	-	-	55.1
SH-07	3/15/17	80	-	-	-
SH-08	3/15/17	80	-	-	-
SH-09	3/16/17	80	-	-	-
SH-10	3/16/17	80	-	-	-
SH-11	3/16/17	80	-	-	-
SH-12	3/17/17	67	-	-	-
SH-13	3/15/17	64	-	-	-
SH-14	3/17/17	63	-	-	-
SH-15	3/15/17	60	-	-	-
SH-16	3/17/17	56	-	-	-
SH-17	3/17/17	57	-	-	-
SH-18	3/17/17	56	-	-	-





GREGG DRILLING & TESTING, INC.  
GEOTECHNICAL AND ENVIRONMENTAL INVESTIGATION SERVICES

Cone Penetration Test Sounding Summary

-Table 1-

CPT Sounding Identification	Date	Termination Depth (feet)	Depth of Groundwater Samples (feet)	Depth of Soil Samples (feet)	Depth of Pore Pressure Dissipation Tests (feet)
CU-01	3/20/17	57	-	15.5, 21.5, 30.5, 32.5, 39.5, 40.5, 43.5, 52.5	-
CU-02	3/20/17	58	-	-	-
CU-03	3/20/17	63	-	19.5, 24.5, 32.5, 42.5, 43.5, 50.5, 53.5, 62.5	-
CU-04	3/20/17	66	-	-	-
CU-05	3/20/17	72	-	-	-
CU-06	3/21/17	76	-	-	-
CU-07	3/21/17	77	-	-	-
CU-08	3/21/17	76	-	-	-
CU-09	3/21/17	74	-	-	-
CU-10	3/21/17	73	-	-	-
CU-11	3/22/17	80	-	15.5, 22.5, 33.5, 41, 49.5, 52.5, 69.5NR, 71	-
CU-12	3/22/17	80	-	-	-
CU-13	3/22/17	80	-	-	-
CU-14	3/22/17	80	-	-	-
CU-15	3/22/17	80	-	-	-
CU-16	3/23/17	80	-	-	-
CU-17	3/23/17	80	-	-	-
CU-18	3/23/17	80	-	-	-
CU-19	3/23/17	80	-	-	-



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Copies of ASTM Standards are available through [www.astm.org](http://www.astm.org)



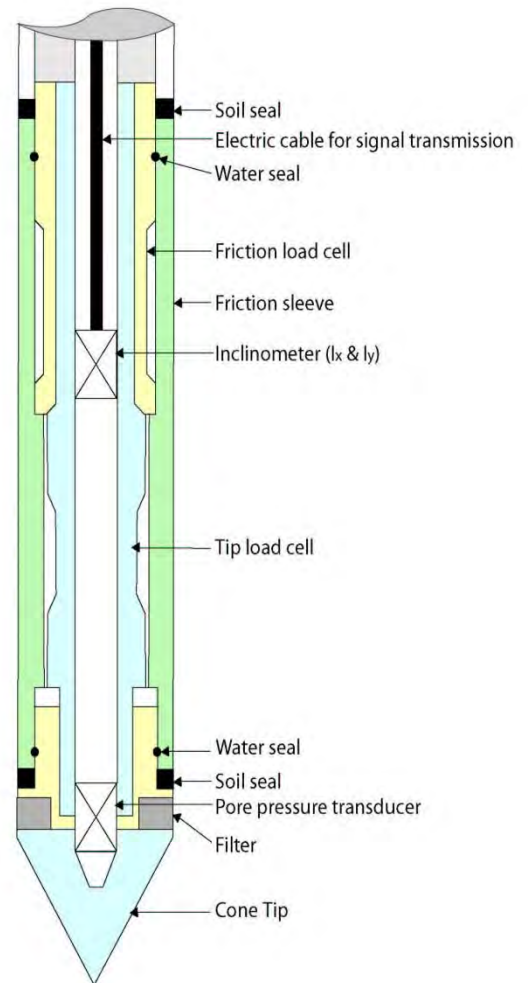
# Cone Penetration Testing Procedure (CPT)

Gregg Drilling carries out all Cone Penetration Tests (CPT) using an integrated electronic cone system, *Figure CPT*.

The cone takes measurements of tip resistance ( $q_c$ ), sleeve resistance ( $f_s$ ), and penetration pore water pressure ( $u_2$ ). Measurements are taken at either 2.5 or 5 cm intervals during penetration to provide a nearly continuous profile. CPT data reduction and basic interpretation is performed in real time facilitating on-site decision making. The above mentioned parameters are stored electronically for further analysis and reference. All CPT soundings are performed in accordance with revised ASTM standards (D 5778-12).

The 5mm thick porous plastic filter element is located directly behind the cone tip in the  $u_2$  location. A new saturated filter element is used on each sounding to measure both penetration pore pressures as well as measurements during a dissipation test (*PPDT*). Prior to each test, the filter element is fully saturated with oil under vacuum pressure to improve accuracy.

When the sounding is completed, the test hole is backfilled according to client specifications. If grouting is used, the procedure generally consists of pushing a hollow tremie pipe with a “knock out” plug to the termination depth of the CPT hole. Grout is then pumped under pressure as the tremie pipe is pulled from the hole. Disruption or further contamination to the site is therefore minimized.



*Figure CPT*

## Gregg 15cm<sup>2</sup> Standard Cone Specifications

<b>Dimensions</b>	
Cone base area	15 cm <sup>2</sup>
Sleeve surface area	225 cm <sup>2</sup>
Cone net area ratio	0.80
<b>Specifications</b>	
<b>Cone load cell</b>	
Full scale range	180 kN (20 tons)
Overload capacity	150%
Full scale tip stress	120 MPa (1,200 tsf)
Repeatability	120 kPa (1.2 tsf)
<b>Sleeve load cell</b>	
Full scale range	31 kN (3.5 tons)
Overload capacity	150%
Full scale sleeve stress	1,400 kPa (15 tsf)
Repeatability	1.4 kPa (0.015 tsf)
<b>Pore pressure transducer</b>	
Full scale range	7,000 kPa (1,000 psi)
Overload capacity	150%
Repeatability	7 kPa (1 psi)

*Note: The repeatability during field use will depend somewhat on ground conditions, abrasion, maintenance and zero load stability.*



# Cone Penetration Test Data & Interpretation

The Cone Penetration Test (CPT) data collected are presented in graphical and electronic form in the report. The plots include interpreted Soil Behavior Type (SBT) based on the charts described by Robertson (1990). Typical plots display SBT based on the non-normalized charts of Robertson et al (1986). For CPT soundings deeper than 30m, we recommend the use of the normalized charts of Robertson (1990) which can be displayed as SBT<sub>n</sub>, upon request. The report also includes spreadsheet output of computer calculations of basic interpretation in terms of SBT and SBT<sub>n</sub> and various geotechnical parameters using current published correlations based on the comprehensive review by Lunne, Robertson and Powell (1997), as well as recent updates by Professor Robertson (Guide to Cone Penetration Testing, 2015). The interpretations are presented only as a guide for geotechnical use and should be carefully reviewed. Gregg Drilling & Testing Inc. does not warranty the correctness or the applicability of any of the geotechnical parameters interpreted by the software and does not assume any liability for use of the results in any design or review. The user should be fully aware of the techniques and limitations of any method used in the software. Some interpretation methods require input of the groundwater level to calculate vertical effective stress. An estimate of the in-situ groundwater level has been made based on field observations and/or CPT results, but should be verified by the user.

A summary of locations and depths is available in Table 1. Note that all penetration depths referenced in the data are with respect to the existing ground surface.

Note that it is not always possible to clearly identify a soil type based solely on  $q_t$ ,  $f_s$ , and  $u_2$ . In these situations, experience, judgment, and an assessment of the pore pressure dissipation data should be used to infer the correct soil behavior type.

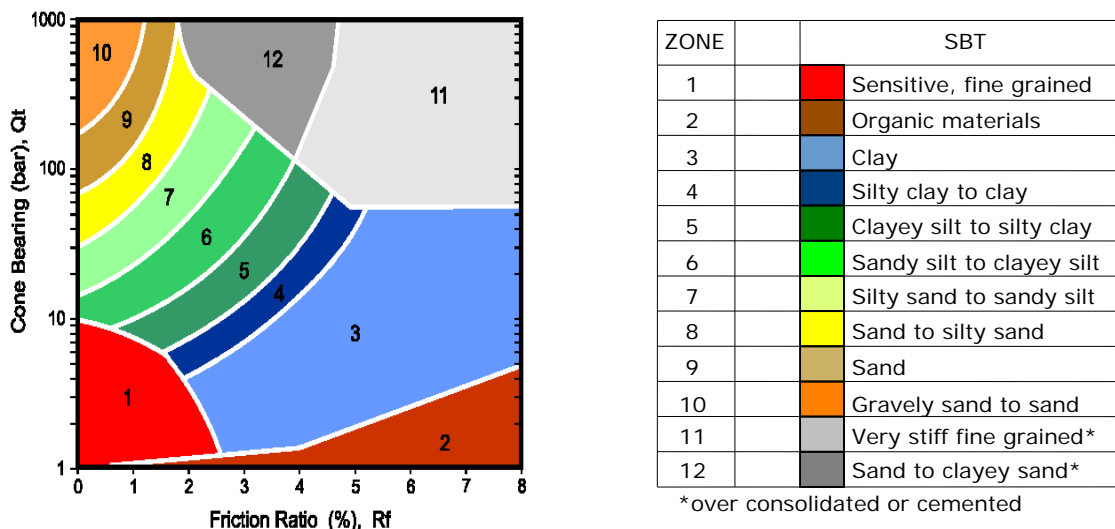


Figure SBT (After Robertson et al., 1986) – Note: Colors may vary slightly compared to plots

# Cone Penetration Test (CPT) Interpretation

Gregg uses a proprietary CPT interpretation and plotting software. The software takes the CPT data and performs basic interpretation in terms of soil behavior type (SBT) and various geotechnical parameters using current published empirical correlations based on the comprehensive review by Lunne, Robertson and Powell (1997). The interpretation is presented in tabular format using MS Excel. The interpretations are presented only as a guide for geotechnical use and should be carefully reviewed. Gregg does not warranty the correctness or the applicability of any of the geotechnical parameters interpreted by the software and does not assume any liability for any use of the results in any design or review. The user should be fully aware of the techniques and limitations of any method used in the software.

The following provides a summary of the methods used for the interpretation. Many of the empirical correlations to estimate geotechnical parameters have constants that have a range of values depending on soil type, geologic origin and other factors. The software uses 'default' values that have been selected to provide, in general, conservatively low estimates of the various geotechnical parameters.

## Input:

- 1 Units for display (Imperial or metric) (atm. pressure,  $p_a = 0.96$  tsf or 0.1 MPa)
- 2 Depth interval to average results (ft or m). Data are collected at either 0.02 or 0.05m and can be averaged every 1, 3 or 5 intervals.
- 3 Elevation of ground surface (ft or m)
- 4 Depth to water table,  $z_w$  (ft or m) – input required
- 5 Net area ratio for cone,  $a$  (default to 0.80)
- 6 Relative Density constant,  $C_{Dr}$  (default to 350)
- 7 Young's modulus number for sands,  $\alpha$  (default to 5)
- 8 Small strain shear modulus number
  - a. for sands,  $S_G$  (default to 180 for SBT<sub>n</sub> 5, 6, 7)
  - b. for clays,  $C_G$  (default to 50 for SBT<sub>n</sub> 1, 2, 3 & 4)
- 9 Undrained shear strength cone factor for clays,  $N_{kt}$  (default to 15)
- 10 Over Consolidation ratio number,  $k_{ocr}$  (default to 0.3)
- 11 Unit weight of water, (default to  $\gamma_w = 62.4$  lb/ft<sup>3</sup> or 9.81 kN/m<sup>3</sup>)

## Column

- 1 Depth,  $z$ , (m) – CPT data is collected in meters
- 2 Depth (ft)
- 3 Cone resistance,  $q_c$  (tsf or MPa)
- 4 Sleeve resistance,  $f_s$  (tsf or MPa)
- 5 Penetration pore pressure,  $u$  (psi or MPa), measured behind the cone (i.e.  $u_2$ )
- 6 Other – any additional data
- 7 Total cone resistance,  $q_t$  (tsf or MPa)  $q_t = q_c + u(1-a)$



8	Friction Ratio, $R_f$ (%)	$R_f = (f_s/q_t) \times 100\%$
9	Soil Behavior Type (non-normalized), SBT	see note
10	Unit weight, $\gamma$ (pcf or $\text{kN/m}^3$ )	based on SBT, see note
11	Total overburden stress, $\sigma_v$ (tsf)	$\sigma_{vo} = \sigma z$
12	In-situ pore pressure, $u_o$ (tsf)	$u_o = \gamma_w (z - z_w)$
13	Effective overburden stress, $\sigma'_{vo}$ (tsf)	$\sigma'_{vo} = \sigma_{vo} - u_o$
14	Normalized cone resistance, $Q_{tn}$	$Q_{tn} = (q_t - \sigma_{vo}) / \sigma'_{vo}$
15	Normalized friction ratio, $F_r$ (%)	$F_r = f_s / (q_t - \sigma_{vo}) \times 100\%$
16	Normalized Pore Pressure ratio, $B_q$	$B_q = u - u_o / (q_t - \sigma_{vo})$
17	Soil Behavior Type (normalized), $SBT_n$	see note
18	$SBT_n$ Index, $I_c$	see note
19	Normalized Cone resistance, $Q_{tn}$ (n varies with $I_c$ )	see note
20	Estimated permeability, $k_{SBT}$ (cm/sec or ft/sec)	see note
21	Equivalent SPT $N_{60}$ , blows/ft	see note
22	Equivalent SPT $(N_1)_{60}$ blows/ft	see note
23	Estimated Relative Density, $D_r$ , (%)	see note
24	Estimated Friction Angle, $\phi'$ , (degrees)	see note
25	Estimated Young's modulus, $E_s$ (tsf)	see note
26	Estimated small strain Shear modulus, $G_o$ (tsf)	see note
27	Estimated Undrained shear strength, $s_u$ (tsf)	see note
28	Estimated Undrained strength ratio	$s_u/\sigma'_v$
29	Estimated Over Consolidation ratio, OCR	see note

**Notes:**

- 1 Soil Behavior Type (non-normalized), SBT (Lunne et al., 1997 and table below)
- 2 Unit weight,  $\gamma$  either constant at 119 pcf or based on Non-normalized SBT (Lunne et al., 1997 and table below)
- 3 Soil Behavior Type (Normalized),  $SBT_n$  Lunne et al. (1997)
- 4  $SBT_n$  Index,  $I_c$   $I_c = ((3.47 - \log Q_{tn})^2 + (\log F_r + 1.22)^2)^{0.5}$
- 5 Normalized Cone resistance,  $Q_{tn}$  (n varies with  $I_c$ )

$Q_{tn} = ((q_t - \sigma_{vo})/pa) (pa/(\sigma'_{vo})^n)$  and recalculate  $I_c$ , then iterate:

When  $I_c < 1.64$ ,  $n = 0.5$  (clean sand)  
 When  $I_c > 3.30$ ,  $n = 1.0$  (clays)  
 When  $1.64 < I_c < 3.30$ ,  $n = (I_c - 1.64)0.3 + 0.5$   
 Iterate until the change in  $n$ ,  $\Delta n < 0.01$

6 Estimated permeability,  $k_{\text{SBT}}$  based on Normalized  $\text{SBT}_n$  (Lunne et al., 1997 and table below)

7 Equivalent SPT  $N_{60}$ , blows/ft Lunne et al. (1997)

$$\frac{(q_t/p_a)}{N_{60}} = 8.5 \left( 1 - \frac{I_c}{4.6} \right)$$

8 Equivalent SPT  $(N_1)_{60}$  blows/ft  $(N_1)_{60} = N_{60} C_N$   
 where  $C_N = (p_a/\sigma'_{vo})^{0.5}$

9 Relative Density,  $D_r$ , (%)  $D_r^2 = Q_{tn} / C_{Dr}$   
 Only  $\text{SBT}_n$  5, 6, 7 & 8 Show 'N/A' in zones 1, 2, 3, 4 & 9

10 Friction Angle,  $\phi'$ , (degrees)  $\tan \phi' = \frac{1}{2.68} \left[ \log \left( \frac{q_c}{\sigma'_{vo}} \right) + 0.29 \right]$   
 Only  $\text{SBT}_n$  5, 6, 7 & 8 Show 'N/A' in zones 1, 2, 3, 4 & 9

11 Young's modulus,  $E_s$   $E_s = \alpha q_t$   
 Only  $\text{SBT}_n$  5, 6, 7 & 8 Show 'N/A' in zones 1, 2, 3, 4 & 9

12 Small strain shear modulus,  $G_o$   
 a.  $G_o = S_G (q_t \sigma'_{vo} p_a)^{1/3}$  For  $\text{SBT}_n$  5, 6, 7  
 b.  $G_o = C_G q_t$  For  $\text{SBT}_n$  1, 2, 3 & 4  
 Show 'N/A' in zones 8 & 9

13 Undrained shear strength,  $s_u$   $s_u = (q_t - \sigma_{vo}) / N_{kt}$   
 Only  $\text{SBT}_n$  1, 2, 3, 4 & 9 Show 'N/A' in zones 5, 6, 7 & 8

14 Over Consolidation ratio, OCR  $\text{OCR} = k_{ocr} Q_{t1}$   
 Only  $\text{SBT}_n$  1, 2, 3, 4 & 9 Show 'N/A' in zones 5, 6, 7 & 8

The following updated and simplified SBT descriptions have been used in the software:

**SBT Zones**

- 1 sensitive fine grained
- 2 organic soil
- 3 clay
- 4 clay & silty clay
- 5 clay & silty clay
- 6 sandy silt & clayey silt

**$\text{SBT}_n$  Zones**

- 1 sensitive fine grained
- 2 organic soil
- 3 clay
- 4 clay & silty clay





7	silty sand & sandy silt	5	silty sand & sandy silt
8	sand & silty sand	6	sand & silty sand
9	sand		
10	sand	7	sand
11	very dense/stiff soil*	8	very dense/stiff soil*
12	very dense/stiff soil*	9	very dense/stiff soil*

\*heavily overconsolidated and/or cemented

Track when soils fall with zones of same description and print that description (i.e. if soils fall only within SBT zones 4 & 5, print 'clays & silty clays')

**Estimated Permeability** (see Lunne et al., 1997)

SBT <sub>n</sub>	Permeability (ft/sec)	(m/sec)
1	$3 \times 10^{-8}$	$1 \times 10^{-8}$
2	$3 \times 10^{-7}$	$1 \times 10^{-7}$
3	$1 \times 10^{-9}$	$3 \times 10^{-10}$
4	$3 \times 10^{-8}$	$1 \times 10^{-8}$
5	$3 \times 10^{-6}$	$1 \times 10^{-6}$
6	$3 \times 10^{-4}$	$1 \times 10^{-4}$
7	$3 \times 10^{-2}$	$1 \times 10^{-2}$
8	$3 \times 10^{-6}$	$1 \times 10^{-6}$
9	$1 \times 10^{-8}$	$3 \times 10^{-9}$

**Estimated Unit Weight** (see Lunne et al., 1997)

SBT	Approximate Unit Weight (lb/ft <sup>3</sup> )	(kN/m <sup>3</sup> )
1	111.4	17.5
2	79.6	12.5
3	111.4	17.5
4	114.6	18.0
5	114.6	18.0
6	114.6	18.0
7	117.8	18.5
8	120.9	19.0
9	124.1	19.5
10	127.3	20.0
11	130.5	20.5
12	120.9	19.0



# Pore Pressure Dissipation Tests (PPDT)

Pore Pressure Dissipation Tests (PPDT's) conducted at various intervals can be used to measure equilibrium water pressure (at the time of the CPT). If conditions are hydrostatic, the equilibrium water pressure can be used to determine the approximate depth of the ground water table. A PPDT is conducted when penetration is halted at specific intervals determined by the field representative. The variation of the penetration pore pressure ( $u$ ) with time is measured behind the tip of the cone and recorded.

Pore pressure dissipation data can be interpreted to provide estimates of:

- Equilibrium piezometric pressure
- Phreatic Surface
- In situ horizontal coefficient of consolidation ( $c_h$ )
- In situ horizontal coefficient of permeability ( $k_h$ )

In order to correctly interpret the equilibrium piezometric pressure and/or the phreatic surface, the pore pressure must be monitored until it reaches equilibrium, *Figure PPDT*. This time is commonly referred to as  $t_{100}$ , the point at which 100% of the excess pore pressure has dissipated.

A complete reference on pore pressure dissipation tests is presented by Robertson et al. 1992 and Lunne et al. 1997.

A summary of the pore pressure dissipation tests are summarized in Table 1.

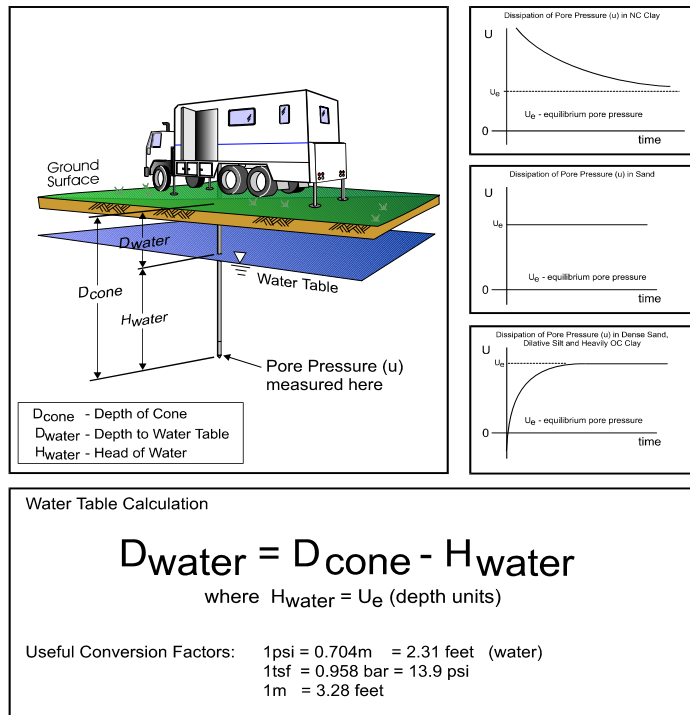


Figure PPDT

# Seismic Cone Penetration Testing (SCPT)

Seismic Cone Penetration Testing (SCPT) can be conducted at various intervals during the Cone Penetration Test. Shear wave velocity ( $V_s$ ) can then be calculated over a specified interval with depth. A small interval for seismic testing, such as 1-1.5m (3-5ft) allows for a detailed look at the shear wave profile with depth. Conversely, a larger interval such as 3-6m (10-20ft) allows for a more average shear wave velocity to be calculated. Gregg's cones have a horizontally active geophone located 0.2m (0.66ft) behind the tip.

To conduct the seismic shear wave test, the penetration of the cone is stopped and the rods are decoupled from the rig. An automatic hammer is triggered to send a shear wave into the soil. The distance from the source to the cone is calculated knowing the total depth of the cone and the horizontal offset distance between the source and the cone. To calculate an interval velocity, a minimum of two tests must be performed at two different depths. The arrival times between the two wave traces are compared to obtain the difference in time ( $\Delta t$ ). The difference in depth is calculated ( $\Delta d$ ) and velocity can be determined using the simple equation:  $v = \Delta d / \Delta t$

Multiple wave traces can be recorded at the same depth to improve quality of the data.

A complete reference on seismic cone penetration tests is presented by Robertson et al. 1986 and Lunne et al. 1997.

A summary the shear wave velocities, arrival times and wave traces are provided with the report.

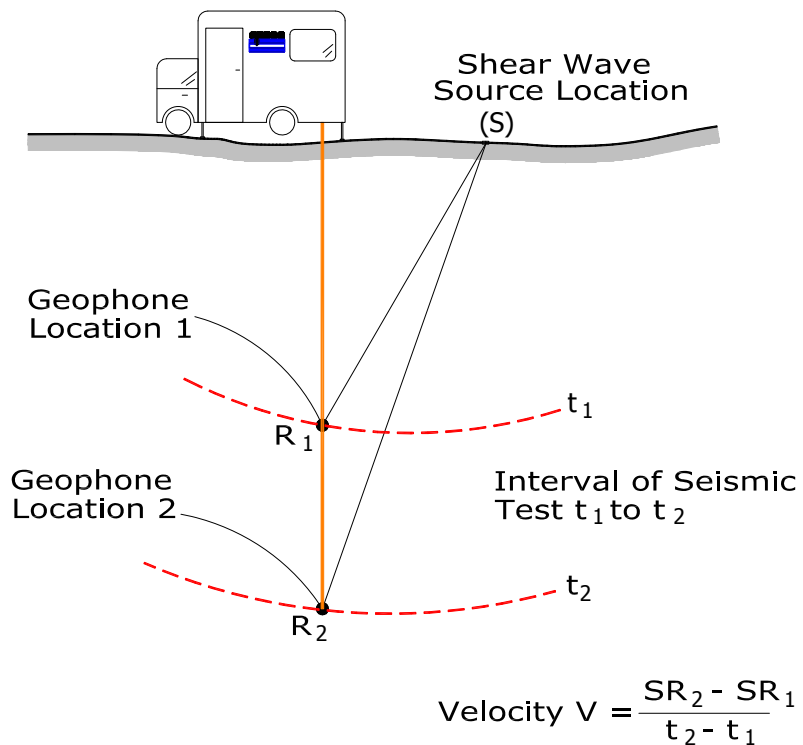


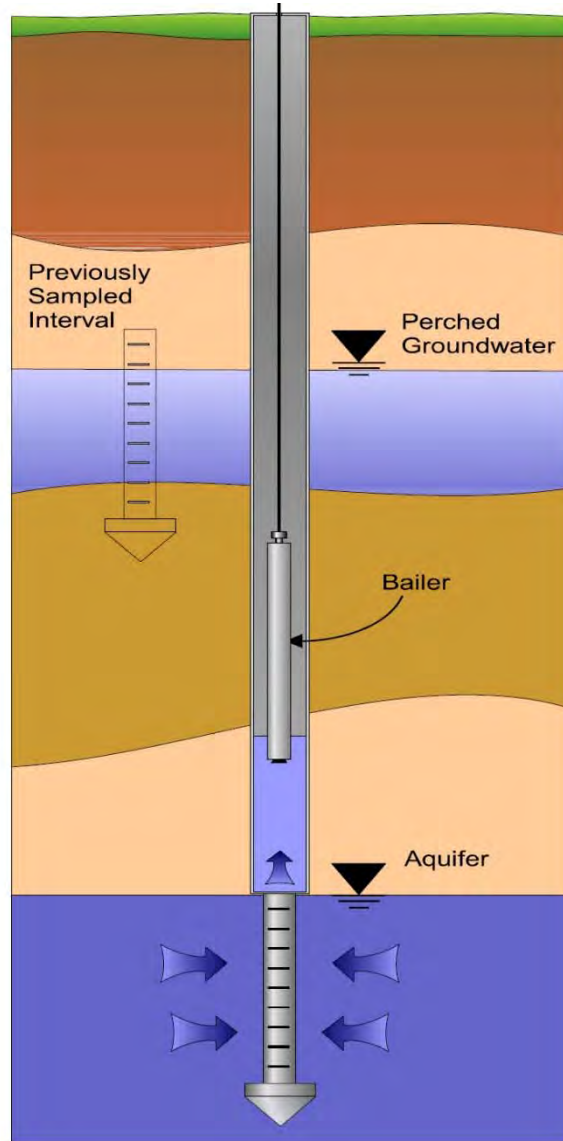
Figure SCPT



# Groundwater Sampling

Gregg Drilling & Testing, Inc. conducts groundwater sampling using a sampler as shown in *Figure GWS*. The groundwater sampler has a retrievable stainless steel or disposable PVC screen with steel drop off tip. This allows for samples to be taken at multiple depth intervals within the same sounding location. In areas of slower water recharge, provisions may be made to set temporary PVC well screens during sampling to allow the pushing equipment to advance to the next sample location while the groundwater is allowed to infiltrate.

The groundwater sampler operates by advancing 44.5mm (1¾ inch) hollow push rods with the filter tip in a closed configuration to the base of the desired sampling interval. Once at the desired sample depth, the push rods are retracted; exposing the encased filter screen and allowing groundwater to infiltrate hydrostatically from the formation into the inlet screen. A small diameter bailer (approximately ½ or ¾ inch) is lowered through the push rods into the screen section for sample collection. The number of downhole trips with the bailer and time necessary to complete the sample collection at each depth interval is a function of sampling protocols, volume requirements, and the yield characteristics and storage capacity of the formation. Upon completion of sample collection, the push rods and sampler, with the exception of the PVC screen and steel drop off tip are retrieved to the ground surface, decontaminated and prepared for the next sampling event.



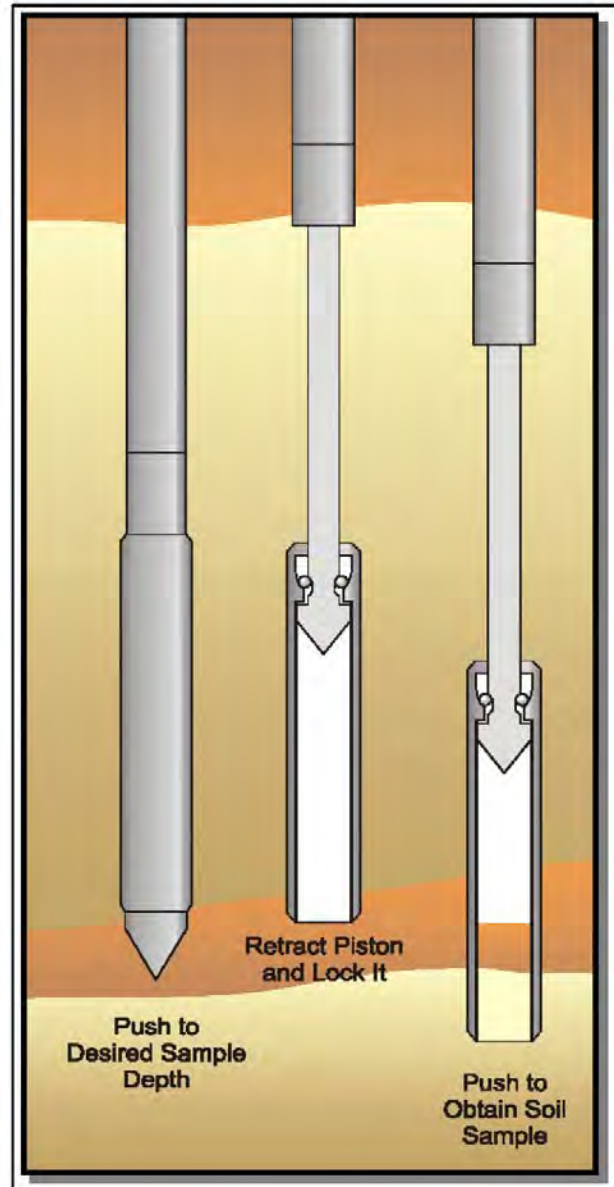
*Figure GWS*

*For a detailed reference on direct push groundwater sampling, refer to Zemo et. al., 1992.*

## Soil Sampling

Gregg Drilling & Testing, Inc. uses a piston-type push-in sampler to obtain small soil samples without generating any soil cuttings, *Figure SS*. Two different types of samplers (12 and 18 inch) are used depending on the soil type and density. The soil sampler is initially pushed in a "closed" position to the desired sampling interval using the CPT pushing equipment. Keeping the sampler closed minimizes the potential of cross contamination. The inner tip of the sampler is then retracted leaving a hollow soil sampler with inner 1¼" diameter sample tubes. The hollow sampler is then pushed in a locked "open" position to collect a soil sample. The filled sampler and push rods are then retrieved to the ground surface. Because the soil enters the sampler at a constant rate, the opportunity for 100% recovery is increased. For environmental analysis, the soil sample tube ends are sealed with Teflon and plastic caps. Often, a longer "split tube" can be used for geotechnical sampling.

*For a detailed reference on direct push soil sampling, refer to Robertson et al, 1998.*



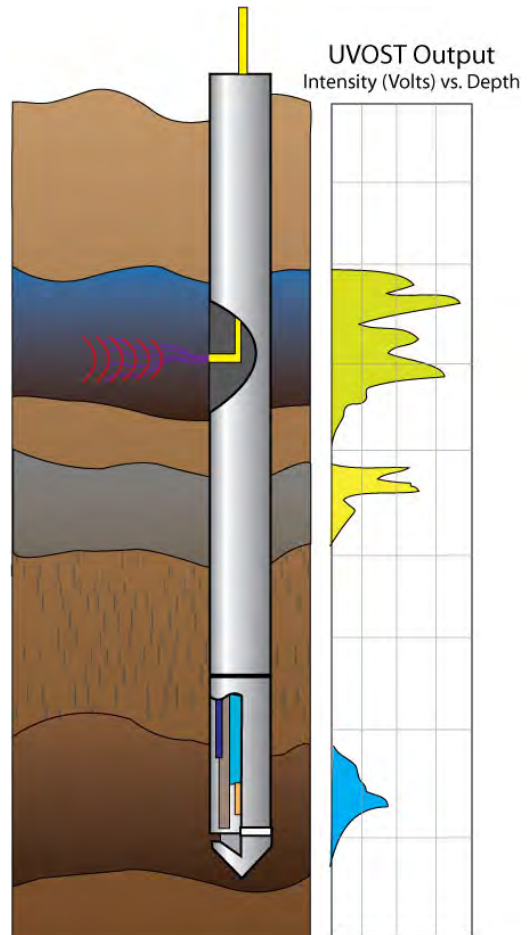
*Figure SS*



# Ultra-Violet Induced Fluorescence (UVOST)

Gregg Drilling conducts Laser Induced Fluorescence (LIF) Cone Penetration Tests using a UVOST module that is located behind the standard piezocone, *Figure UVOST*. The laser induced fluorescence cone works on the principle that polycyclic aromatic hydrocarbons (PAH's), mixed with soil and/or groundwater, fluoresce when irradiated by ultra violet light. Therefore, by measuring the intensity of fluorescence, the lateral and vertical extent of hydrocarbon contamination in the ground can be estimated.

The UVOST module uses principles of fluorescence spectrometry by irradiating the soil with ultra violet light produced by a laser and transmitted to the cone through fiber optic cables. The UV light passes through a small window in the side of the cone into the soil. Any hydrocarbon molecules present in the soil absorb the light energy during radiation and immediately re-emit the light at a longer wavelength. This re-emission is termed fluorescence. The UVOST system also measures the emission decay with time at four different wavelengths (350nm, 400nm, 450nm, and 500nm). This allows the software to determine a product "signature" at each data point. This process provides a method to evaluate the type of contaminant. A sample output from the UVOST system is shown in *Figure Output*. In general, the typical detection limit for the UVOST system is <100 ppm and it will operate effectively above and below the saturated zone.



*Figure UVOST*

With the capability to push up to 200m (600ft) per day, laser induced fluorescence offers a fast and efficient means for delineating PAH contaminant plumes. Color coded logs offer qualitative information in a quick glance and can be produced in the field for real-time decision making. Coupled with the data provided by the CPT, a complete site assessment can be completed with no samples or cuttings, saving laboratory costs as well as site and environmental impact.

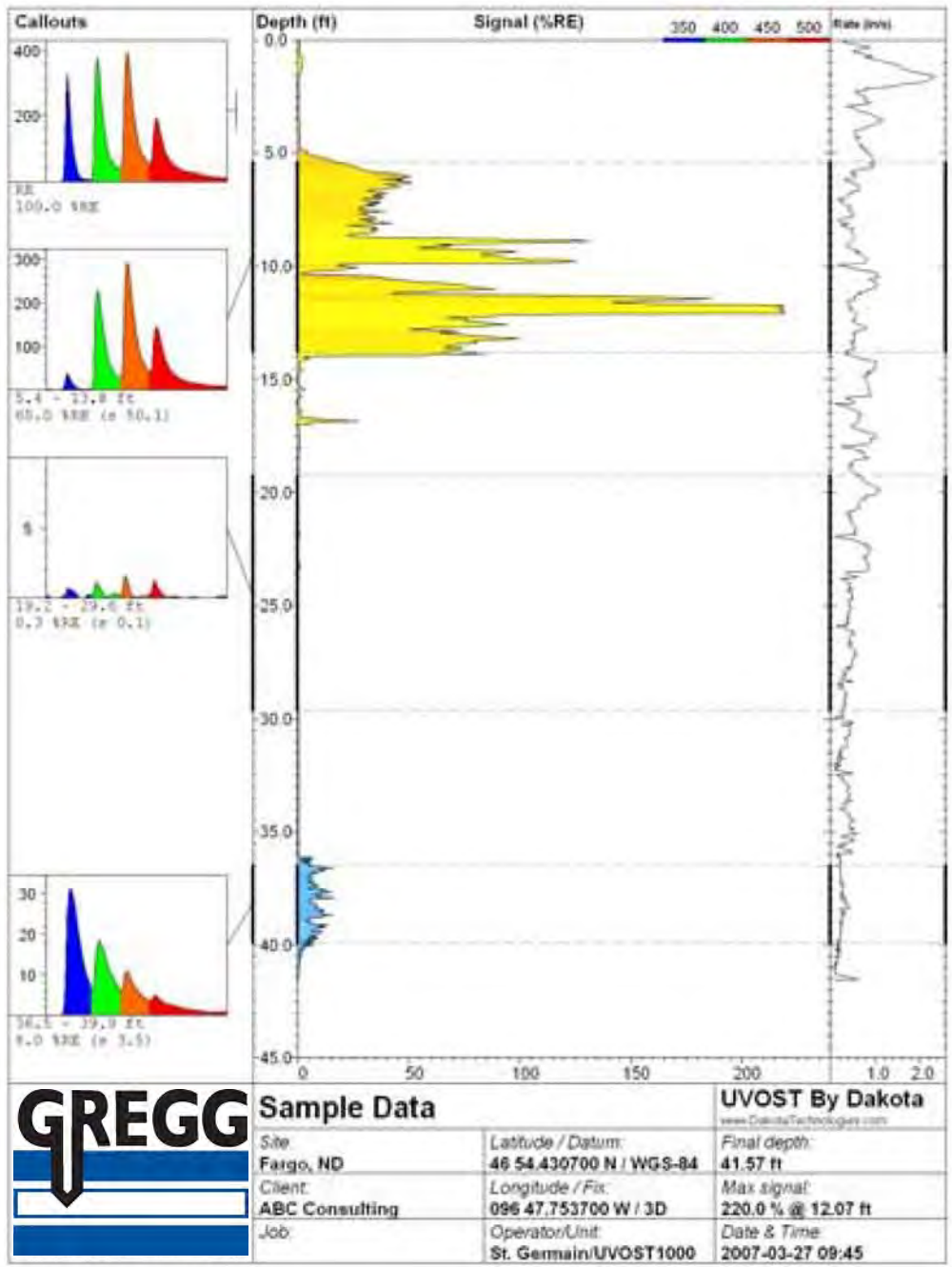


Figure Output



### **Hydrocarbons detected with UVOST**

- Gasoline
- Diesel
- Jet (Kerosene)
- 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, xylenes (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.

## Conductivity Plot :

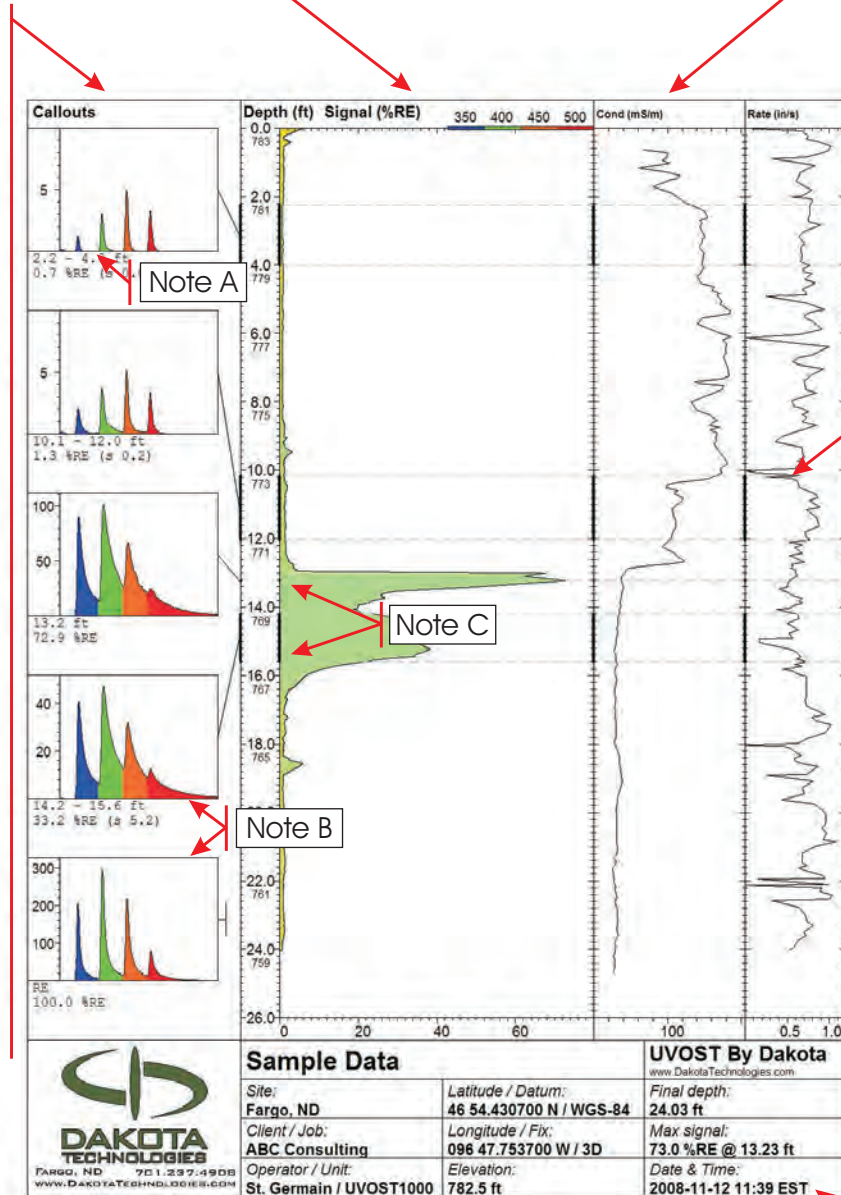
The Electrical Conductivity (EC) of the soil can be logged simultaneously with the UVOST data. EC often provides insight into the stratigraphy. Note the drop in EC from 10 - 13 ft, indicating a shift from consolidated to unconsolidated stratigraphy. This correlates with the observed NAPL distribution.

## 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.



## 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 :

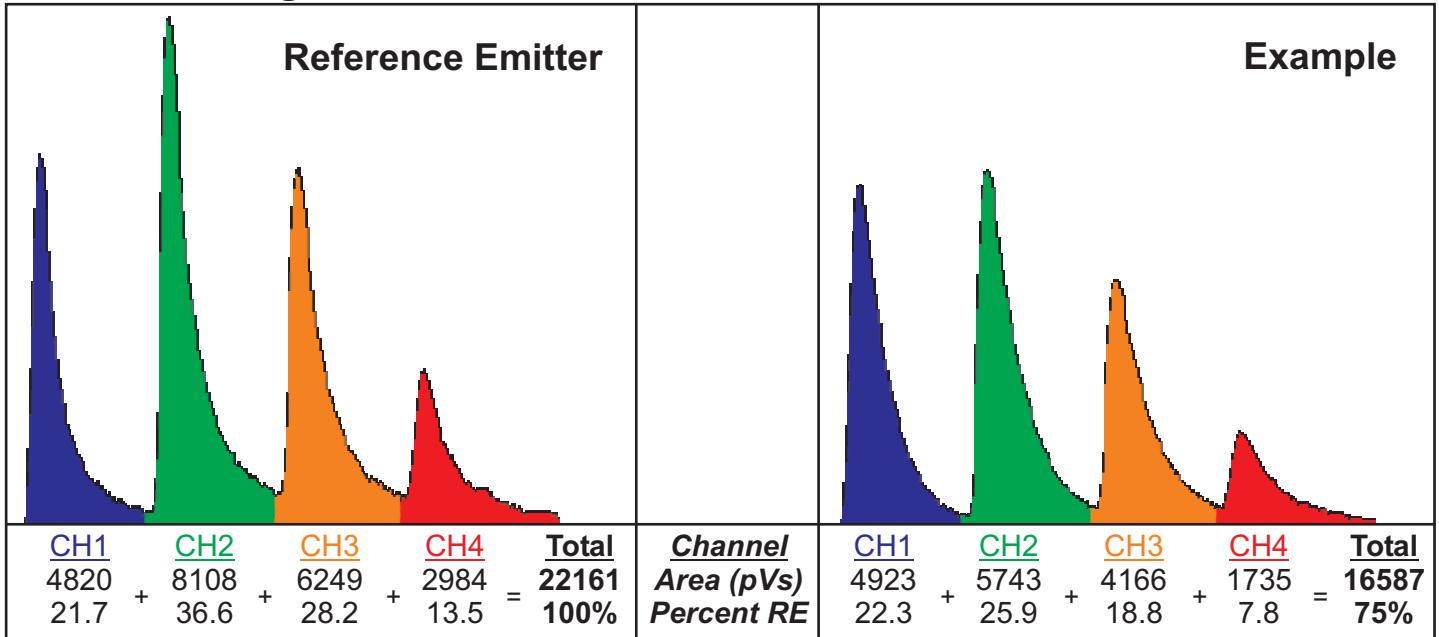
These two waveforms are clearly different. The first is weathered diesel from the log itself while the second is the Reference Emitter (a blend of NAPLs) always taken before each log for calibration.

## 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.



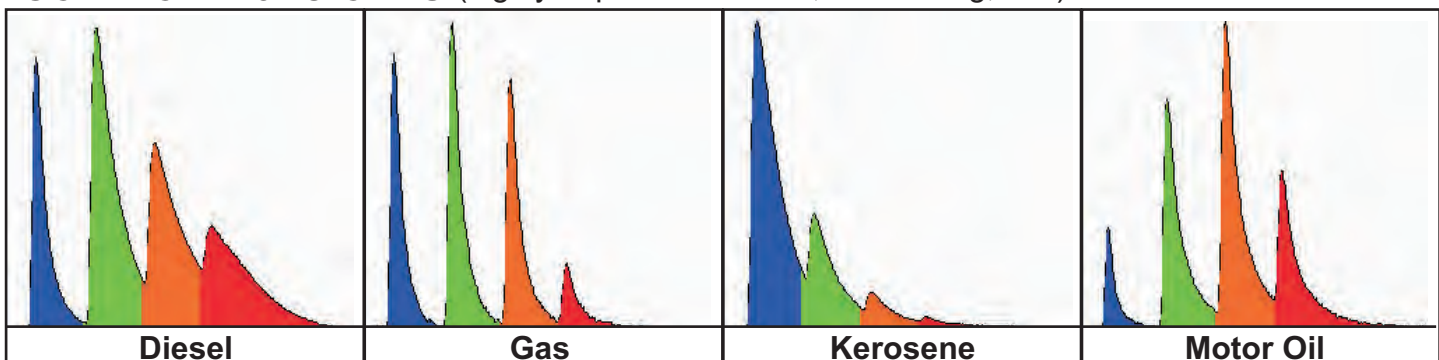
# Waveform Signal Calculation

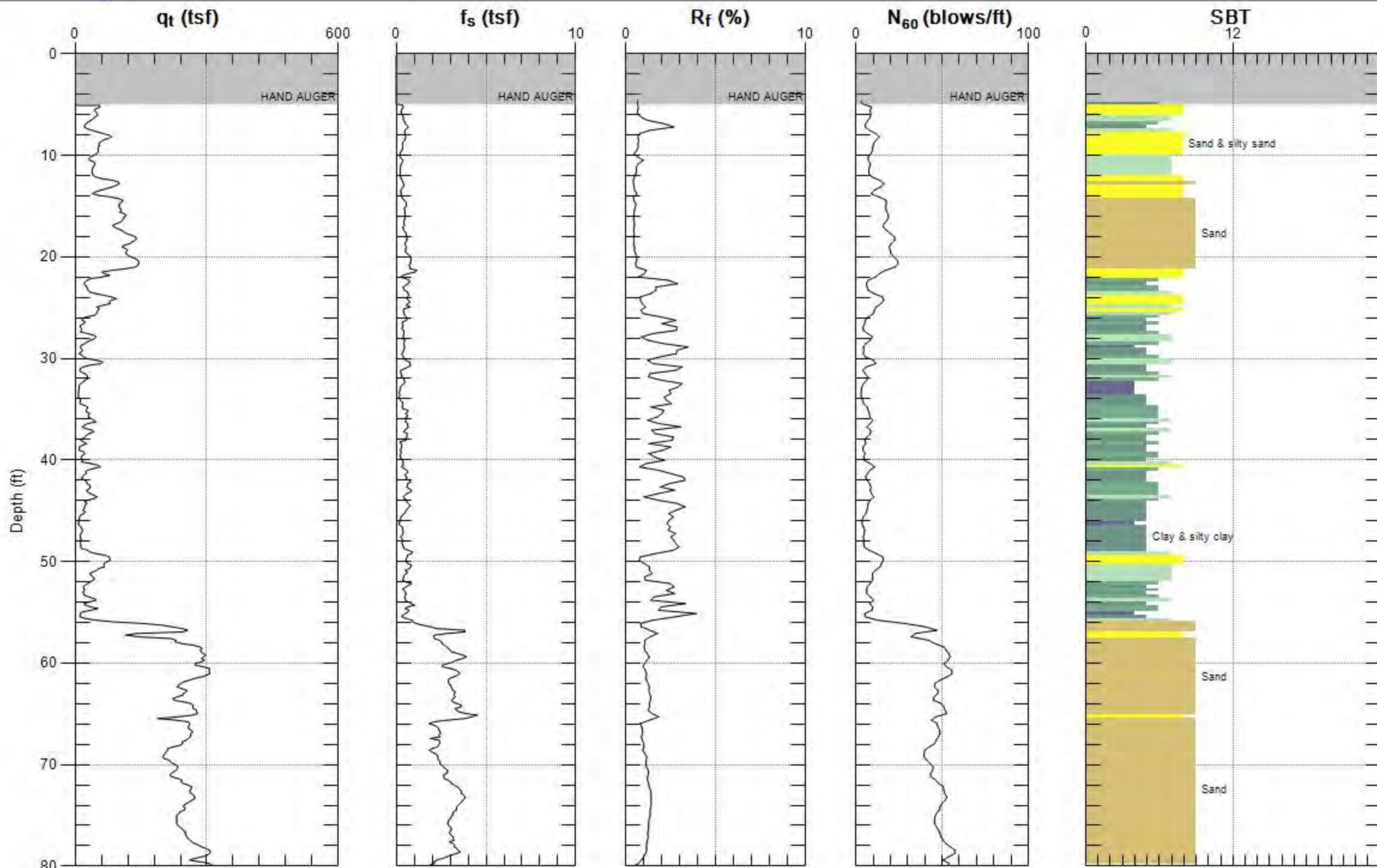


## Data Files

*.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 occurred.
*.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.

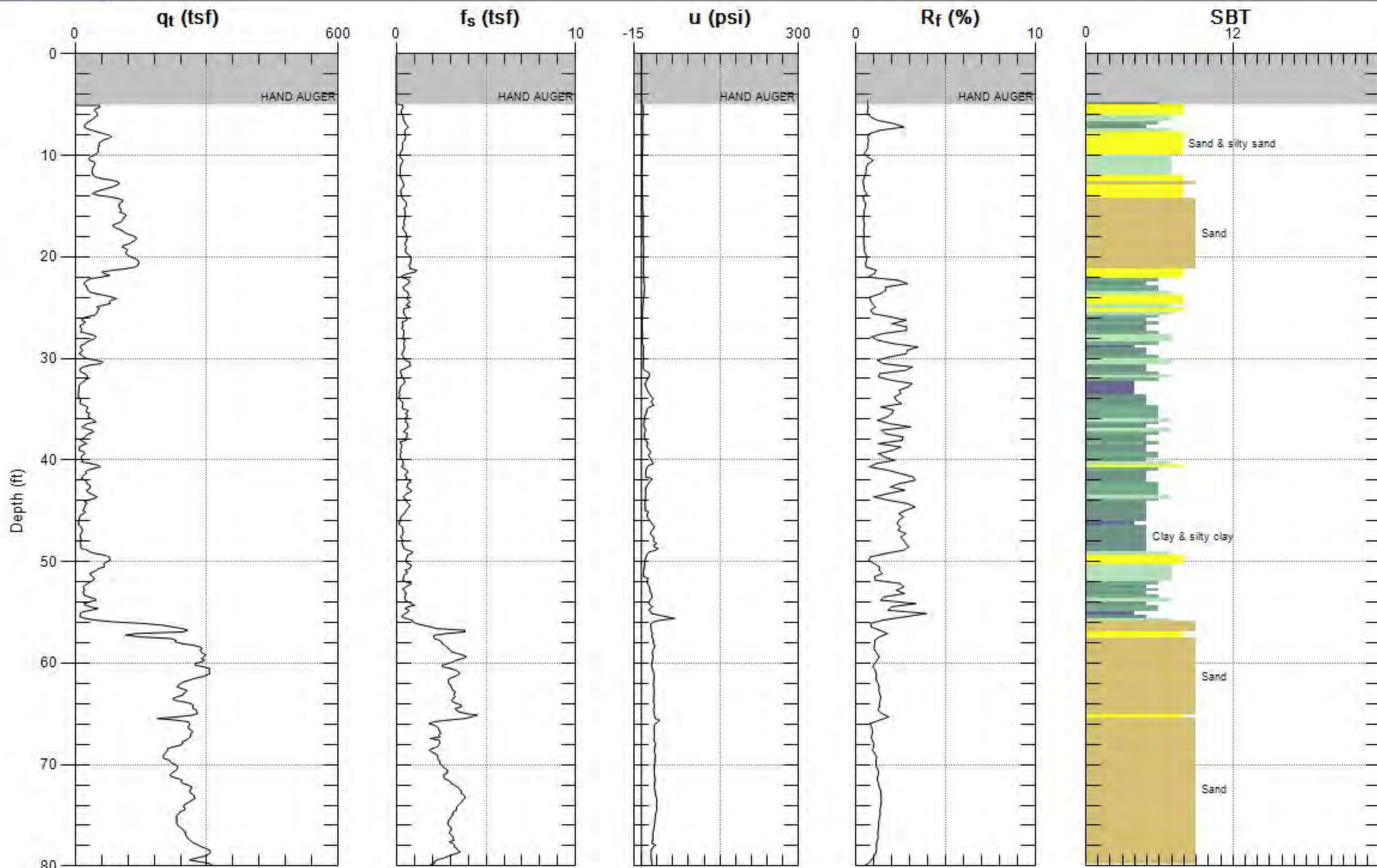
## Common Waveforms (highly dependent on soil, weathering, etc.)





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

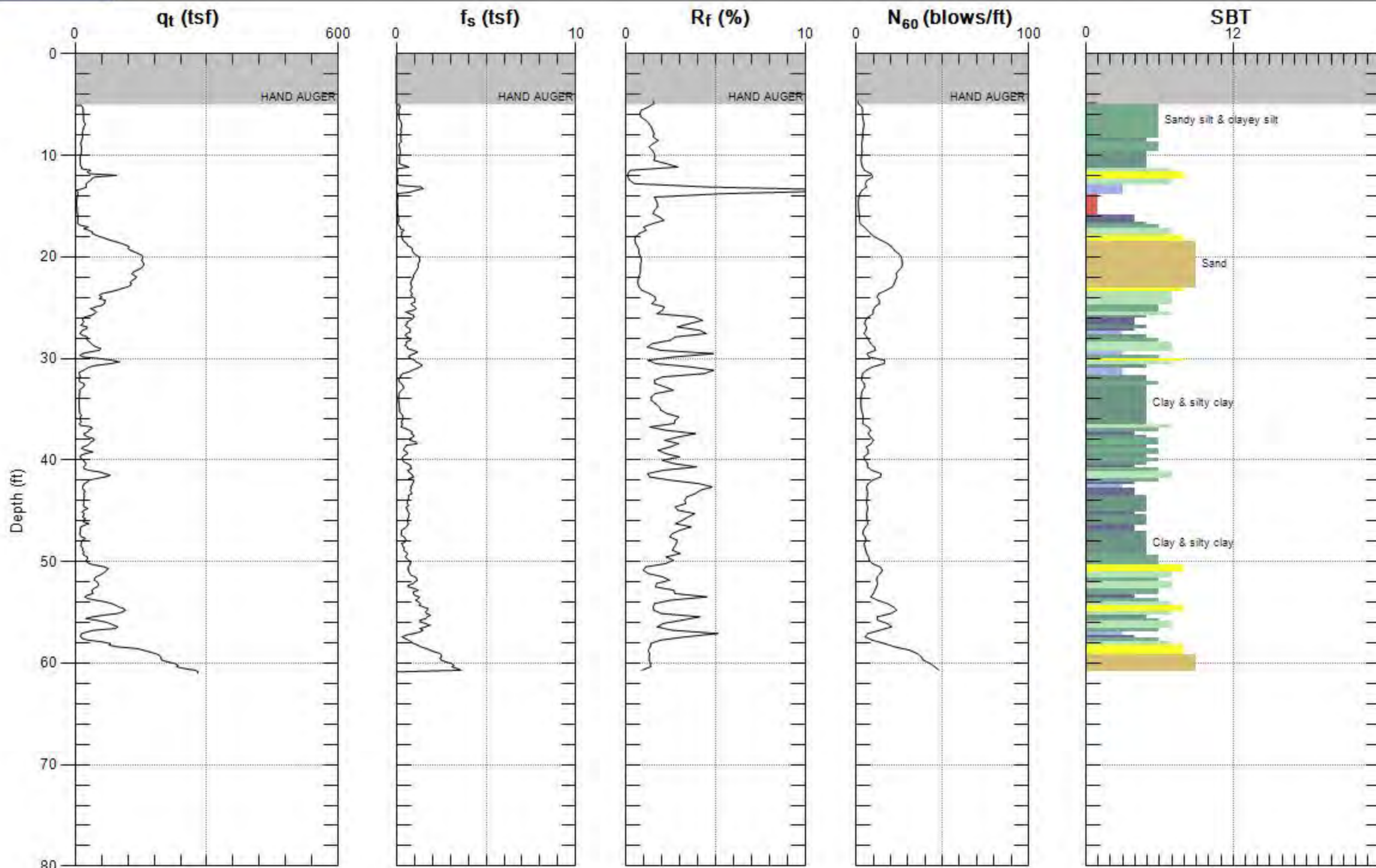
SBT: Soil Behavior Type (Robertson 1990)



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

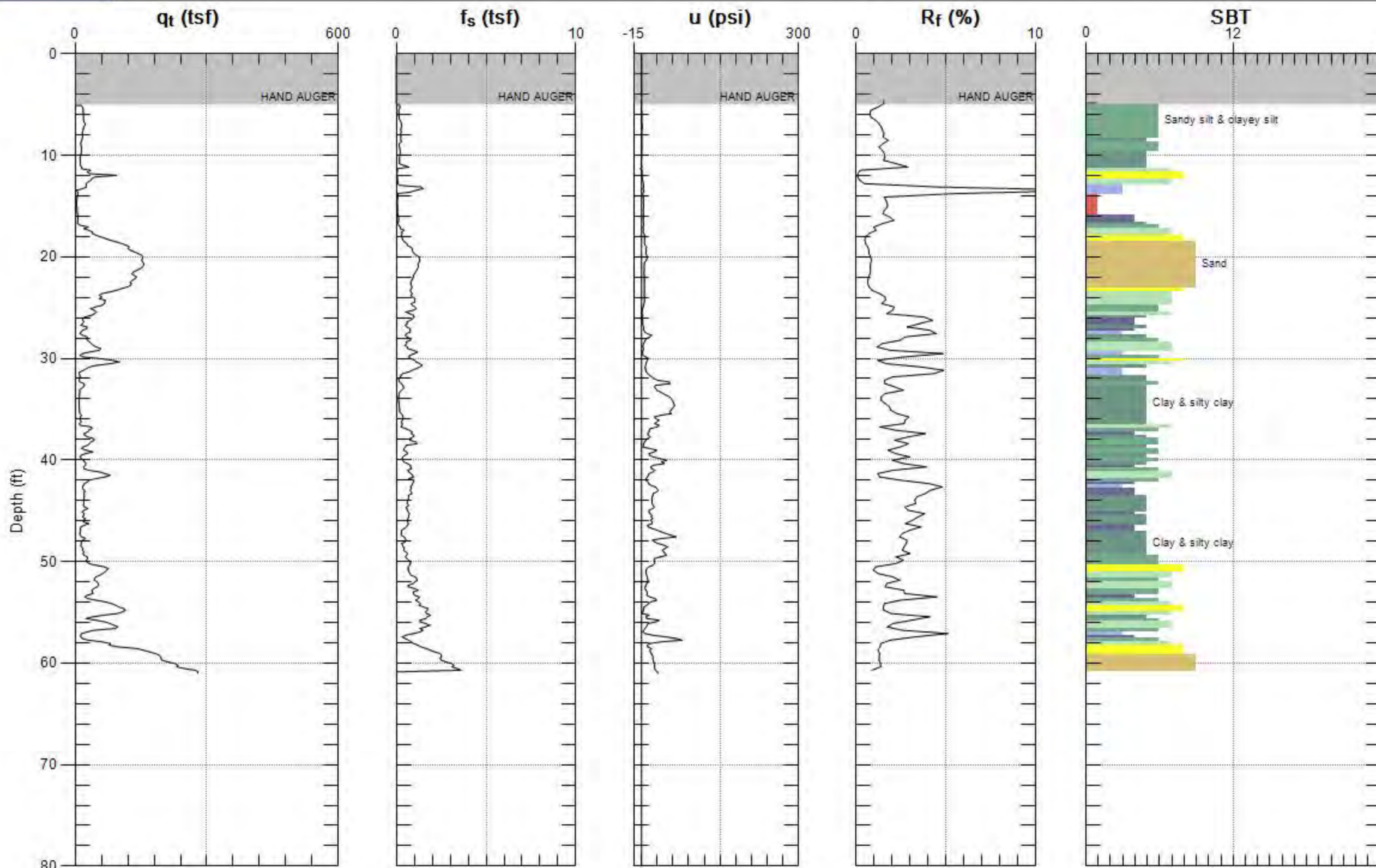
SBT: Soil Behavior Type (Robertson 1990)





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

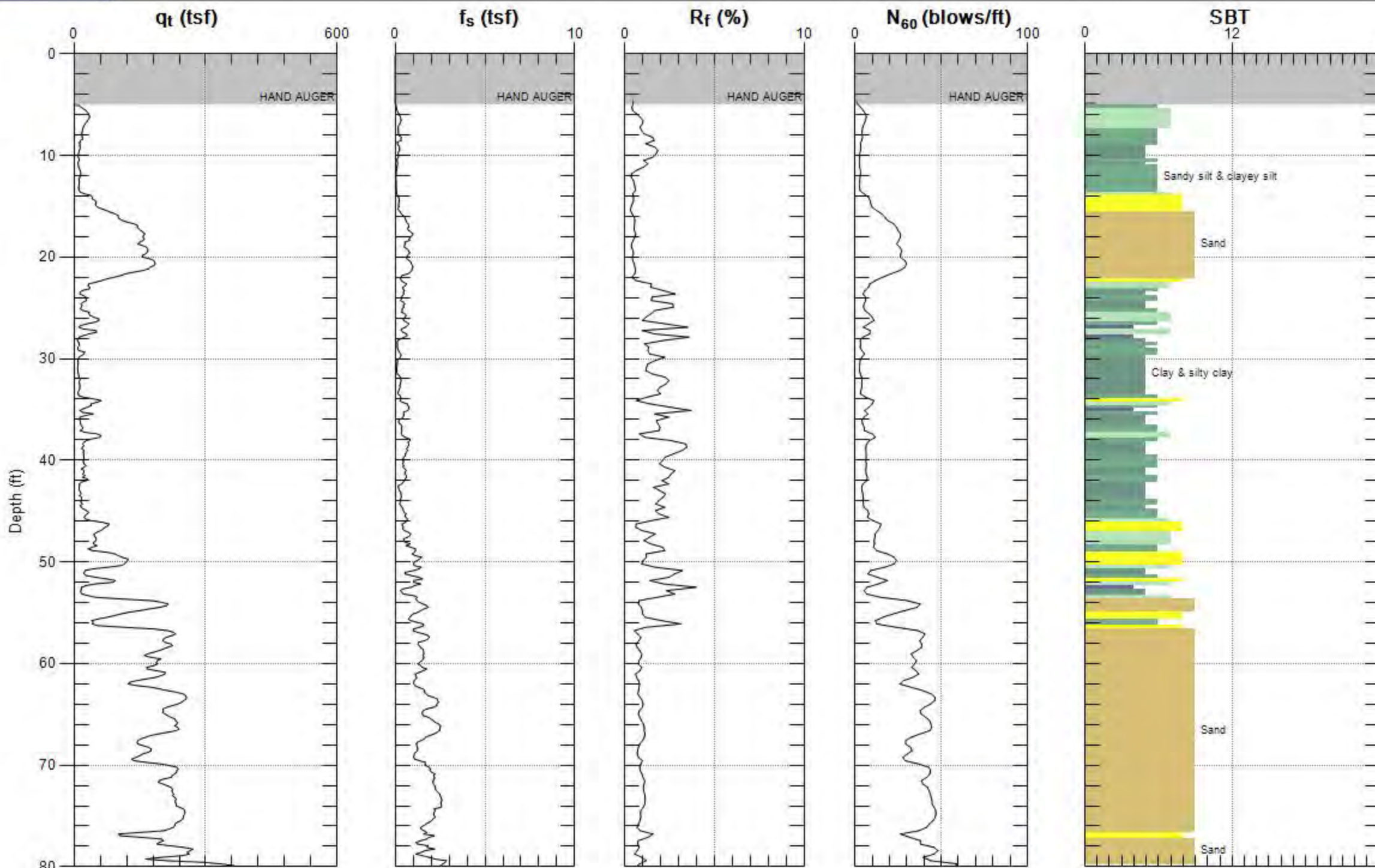
SBT: Soil Behavior Type (Robertson 1990)



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

SBT: Soil Behavior Type (Robertson 1990)

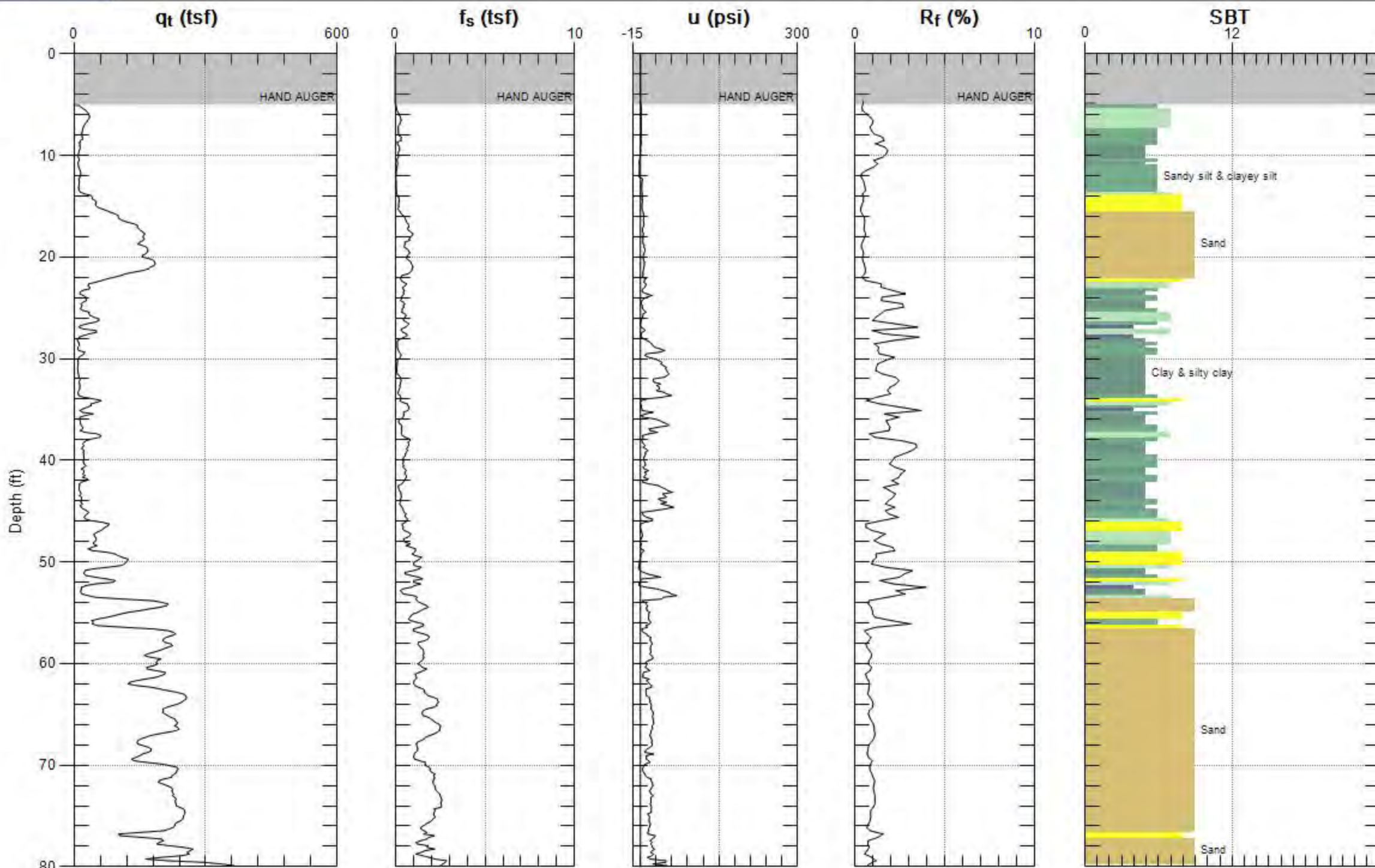




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Avg. Interval: 0.328 (ft)

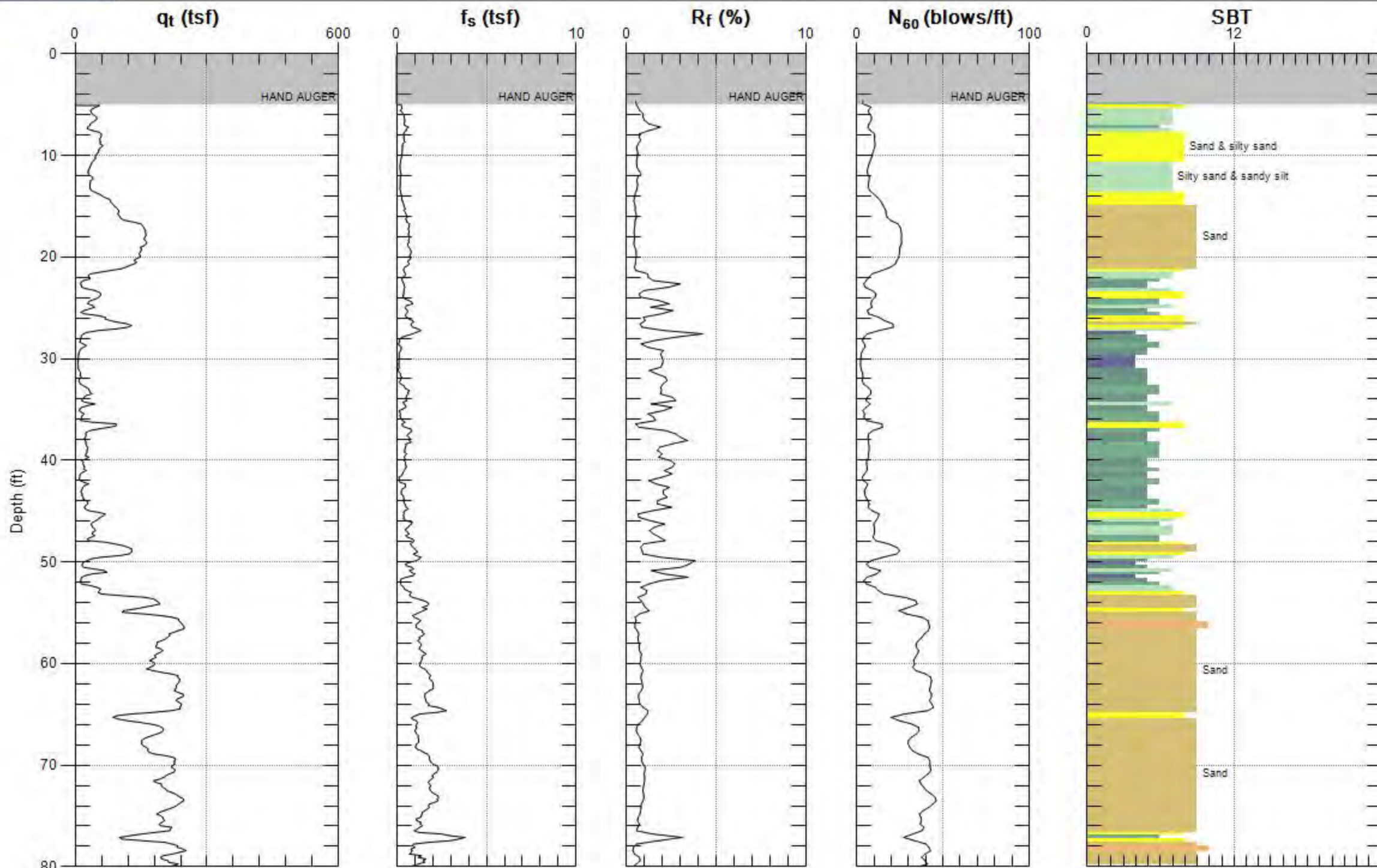
SBT: Soil Behavior Type (Robertson 1990)





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

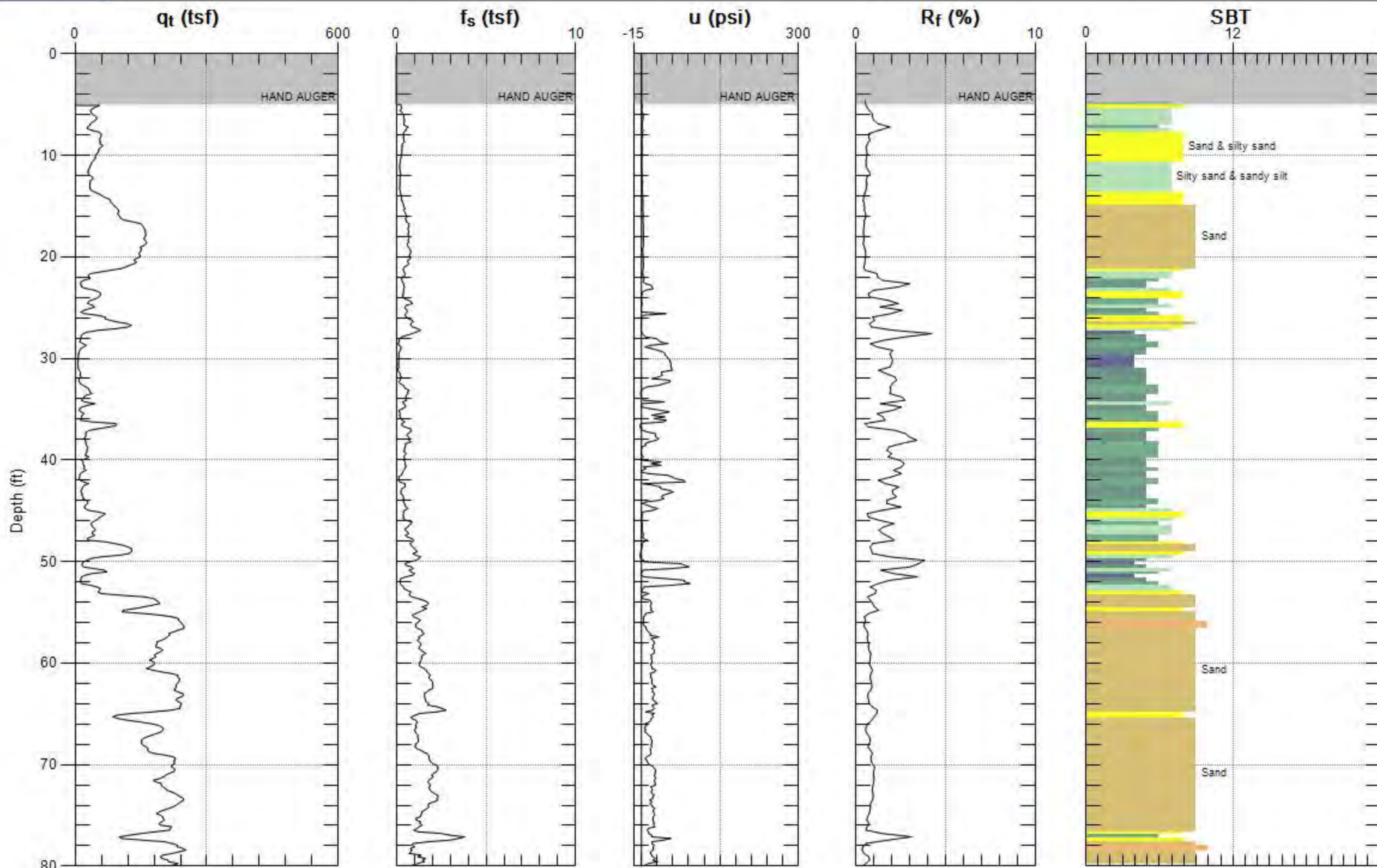
SBT: Soil Behavior Type (Robertson 1990)



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

SBT: Soil Behavior Type (Robertson 1990)

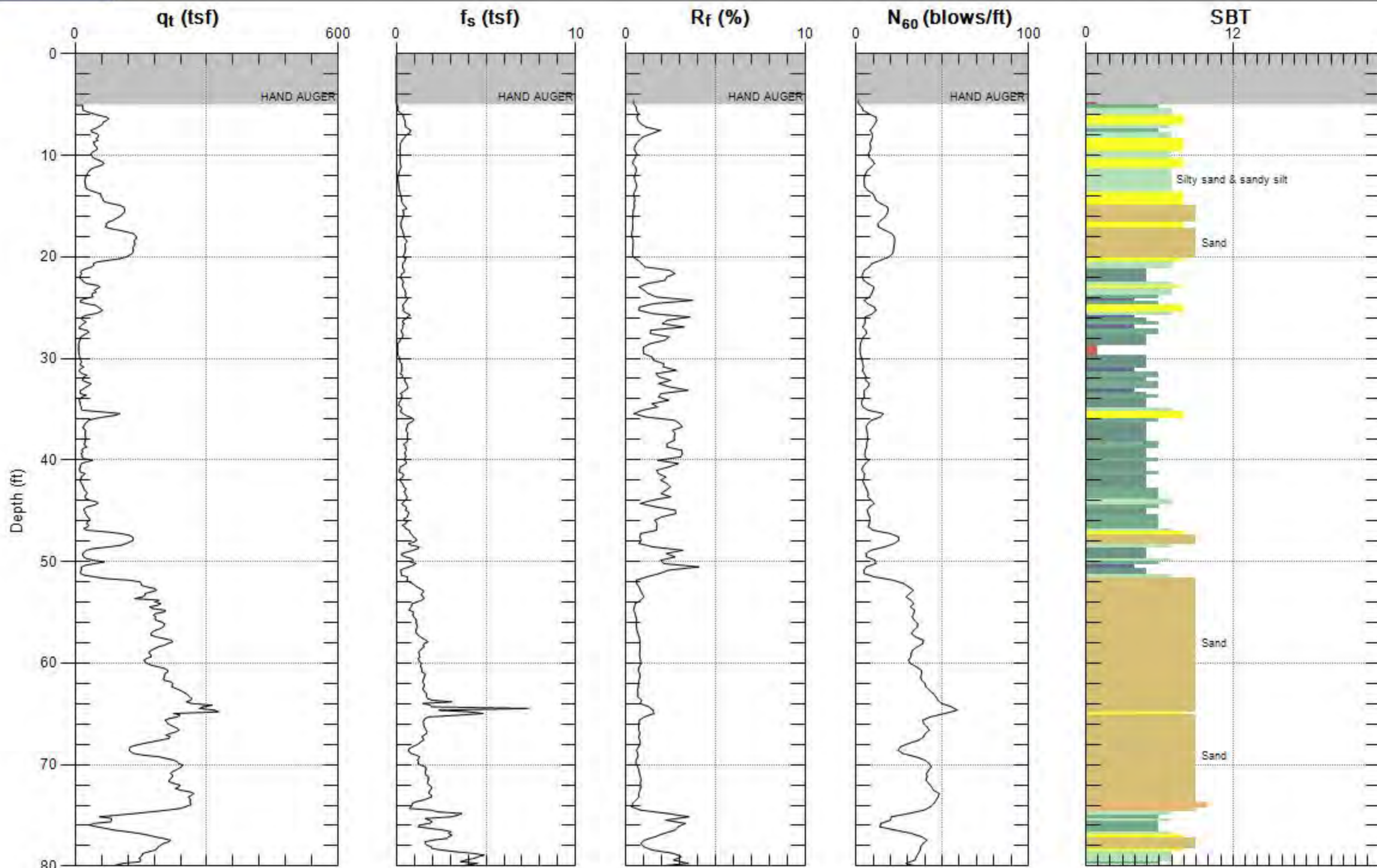




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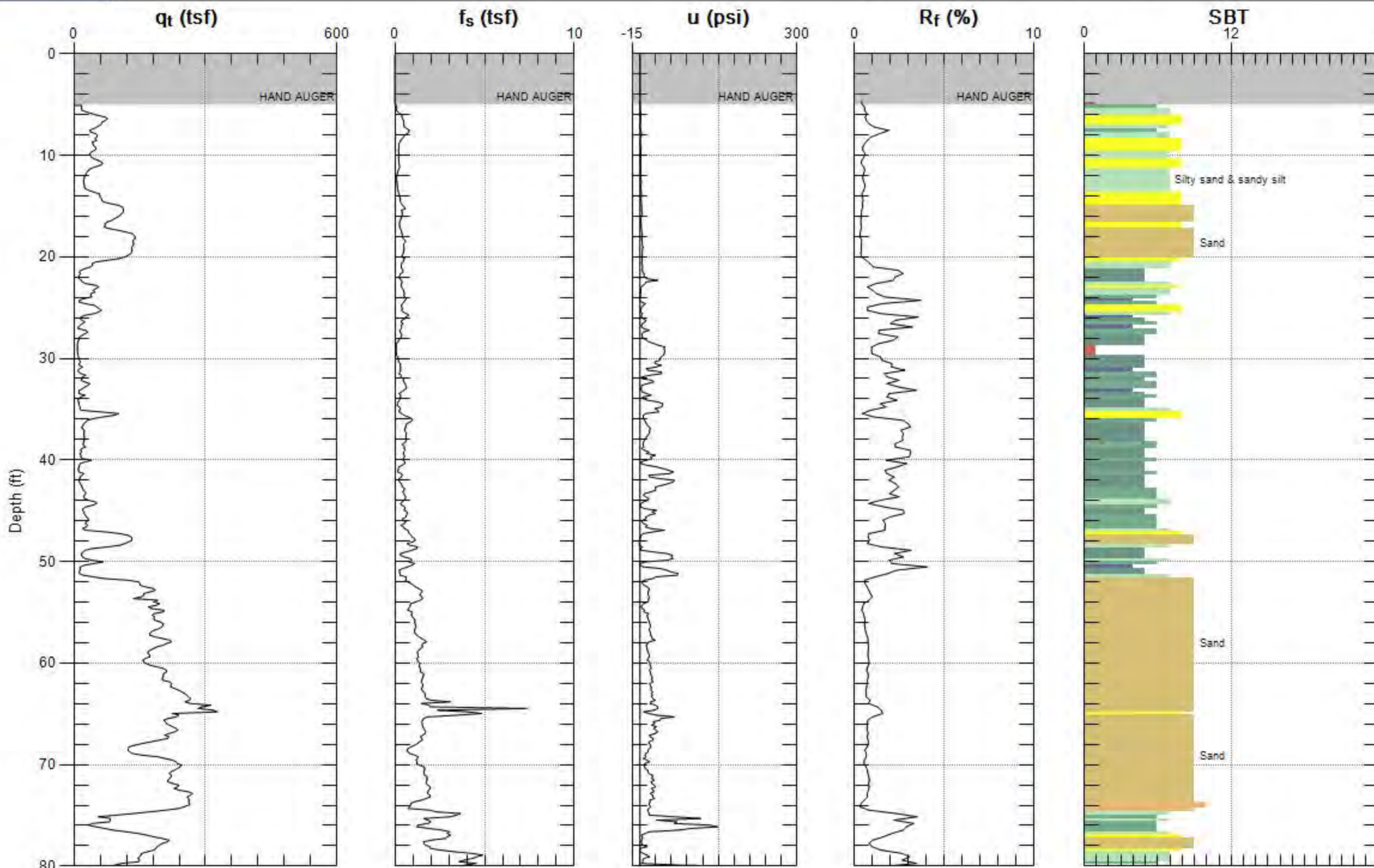
SBT: Soil Behavior Type (Robertson 1990)





Max. Depth: 80.381 (ft)  
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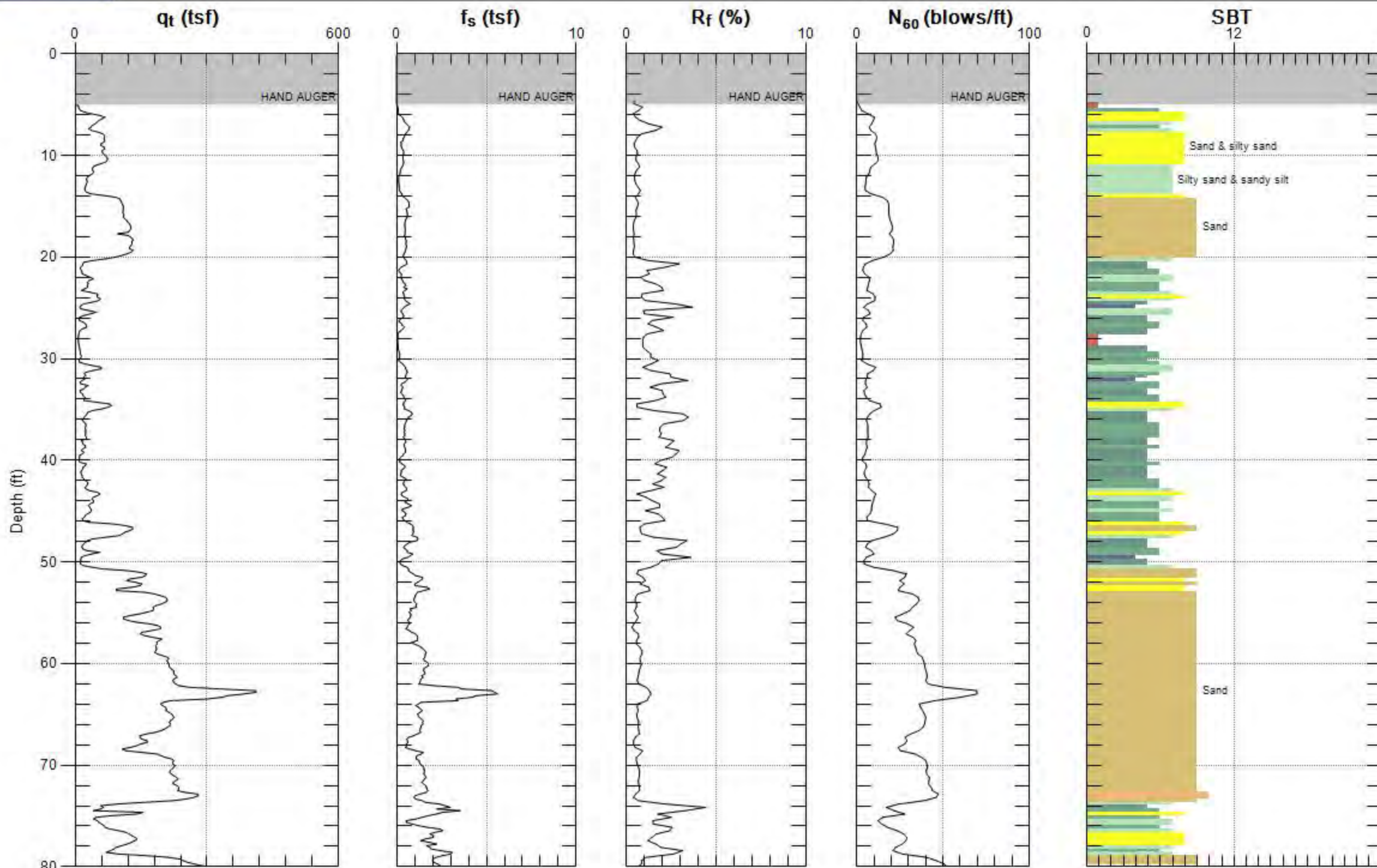
SBT: Soil Behavior Type (Robertson 1990)



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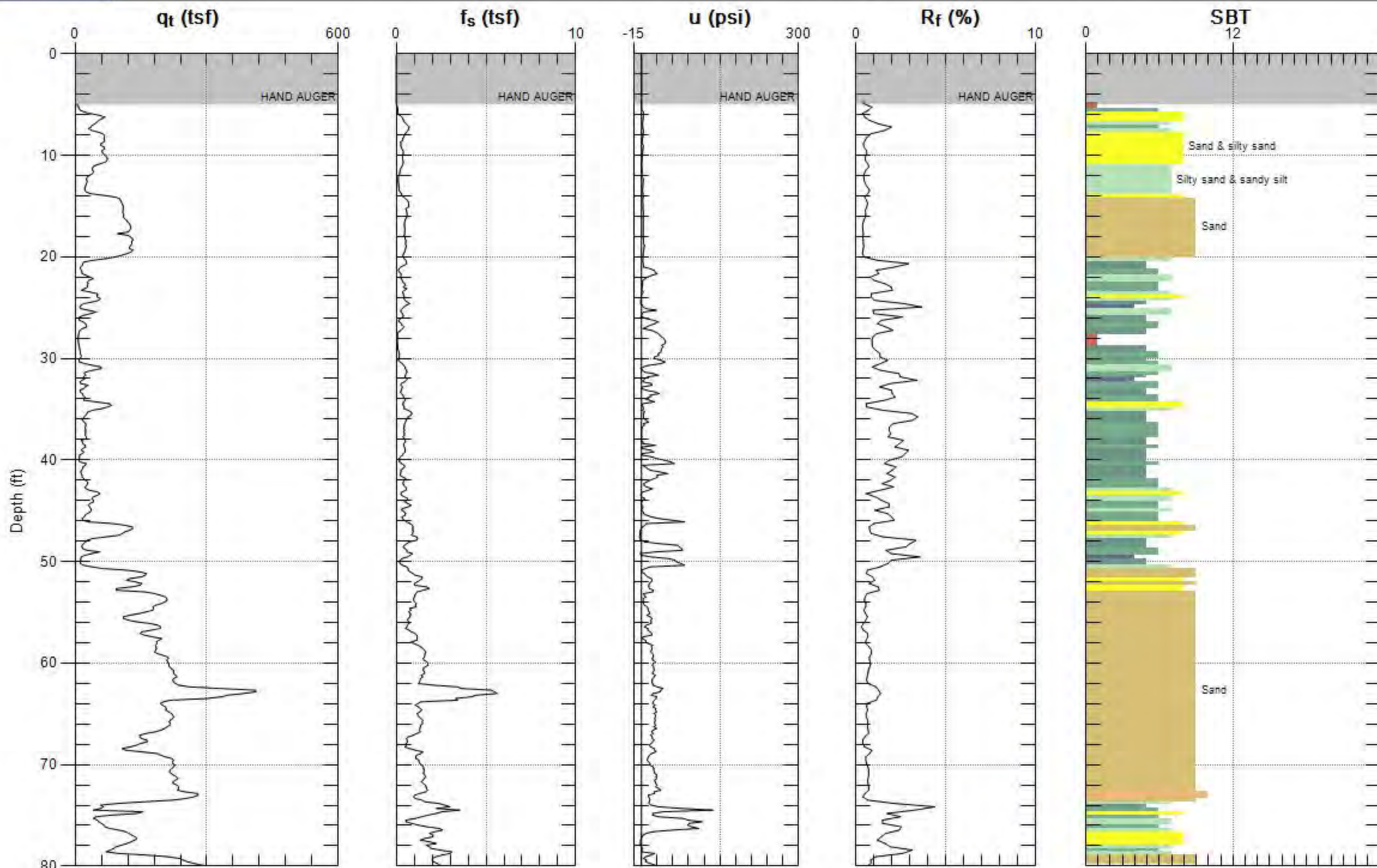
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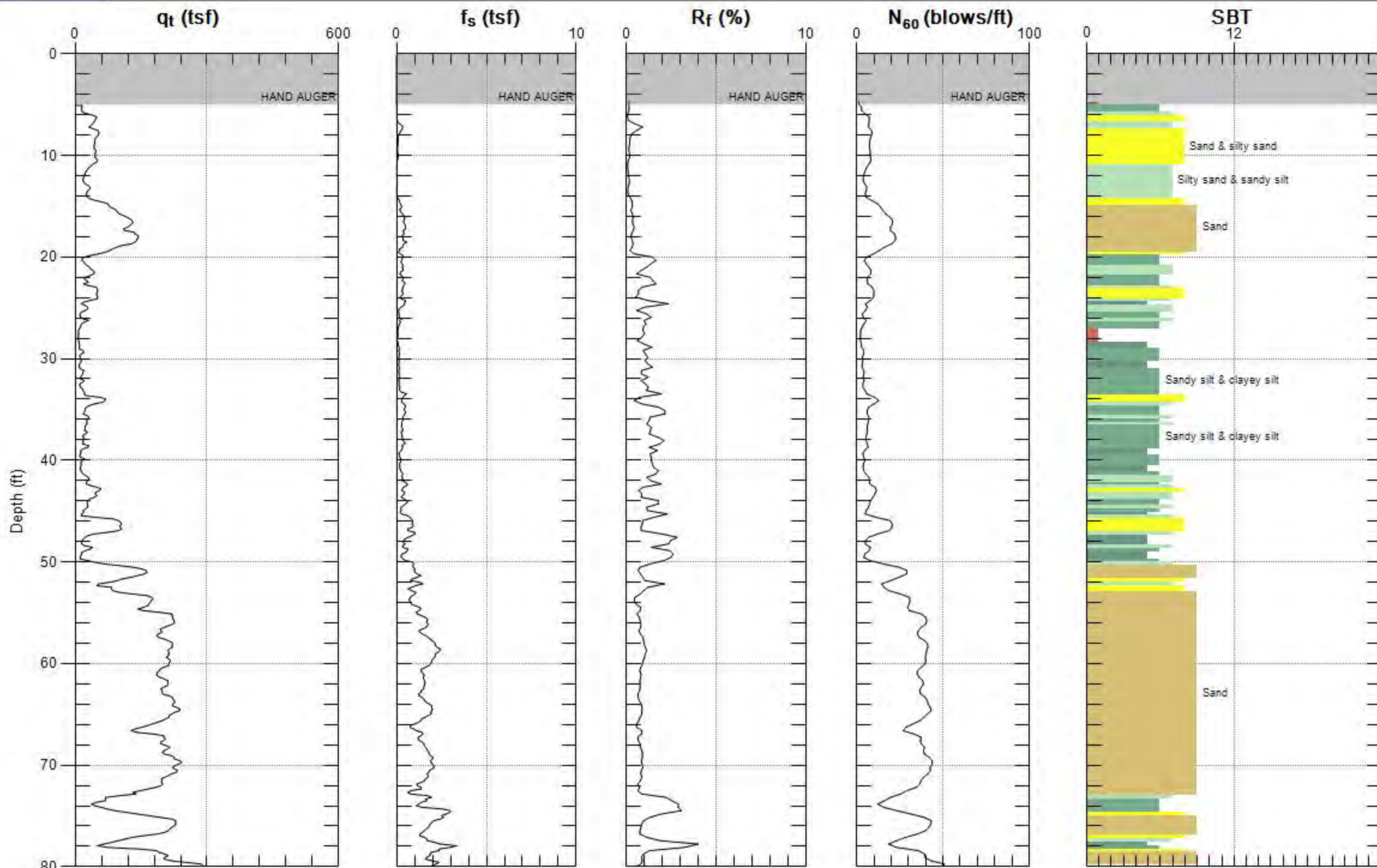
SBT: Soil Behavior Type (Robertson 1990)



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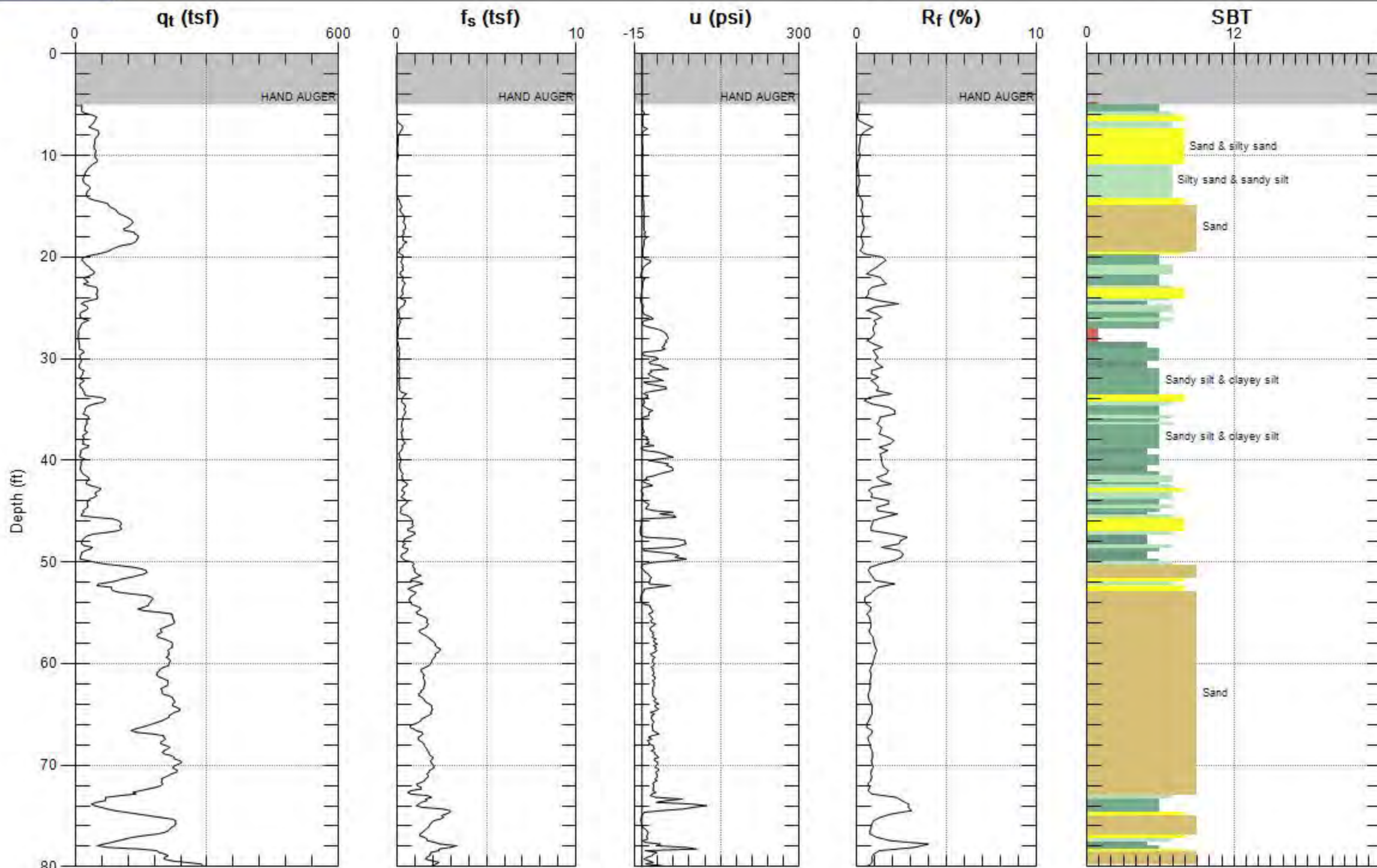
SBT: Soil Behavior Type (Robertson 1990)





Max. Depth: 80.381 (ft)  
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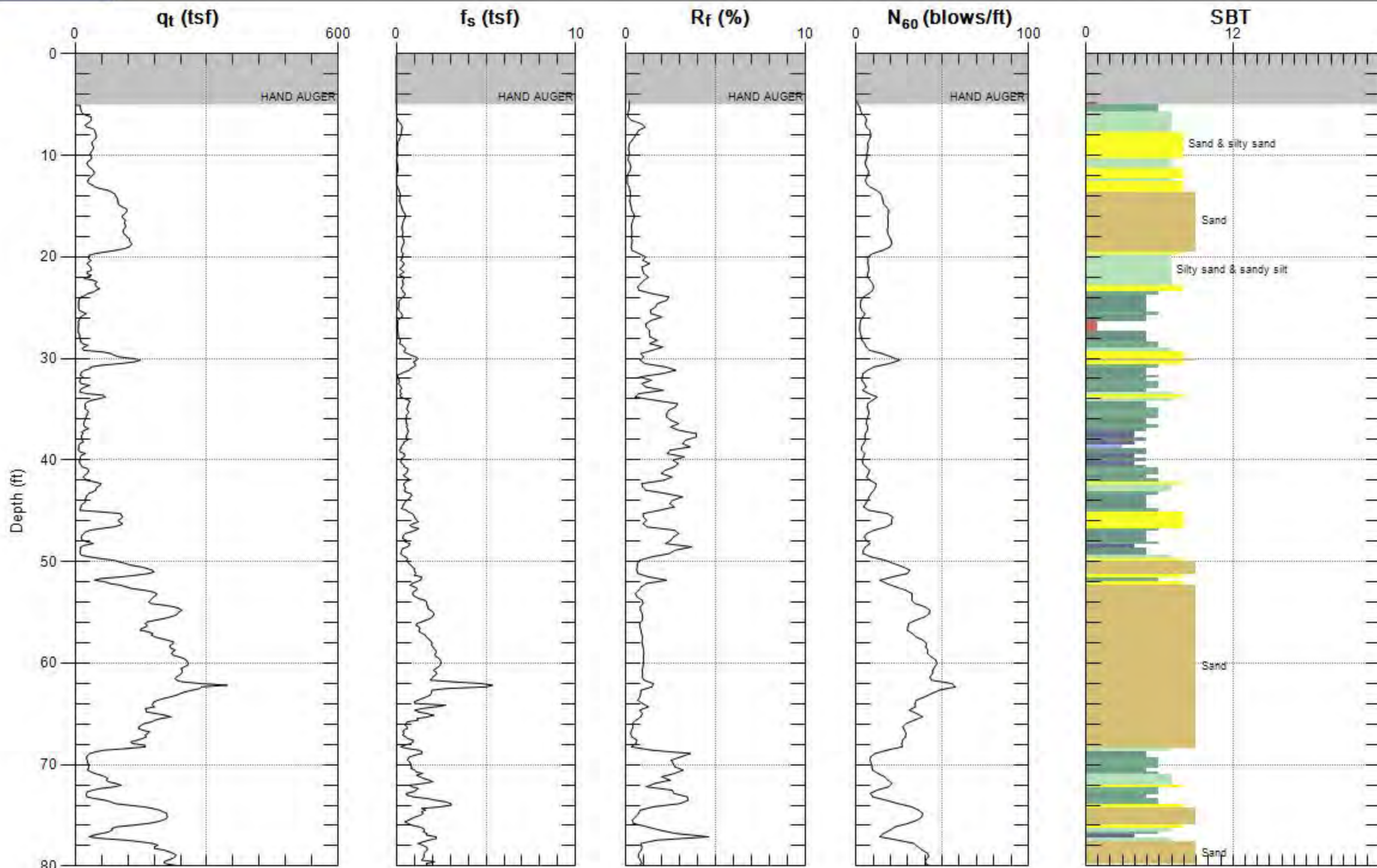
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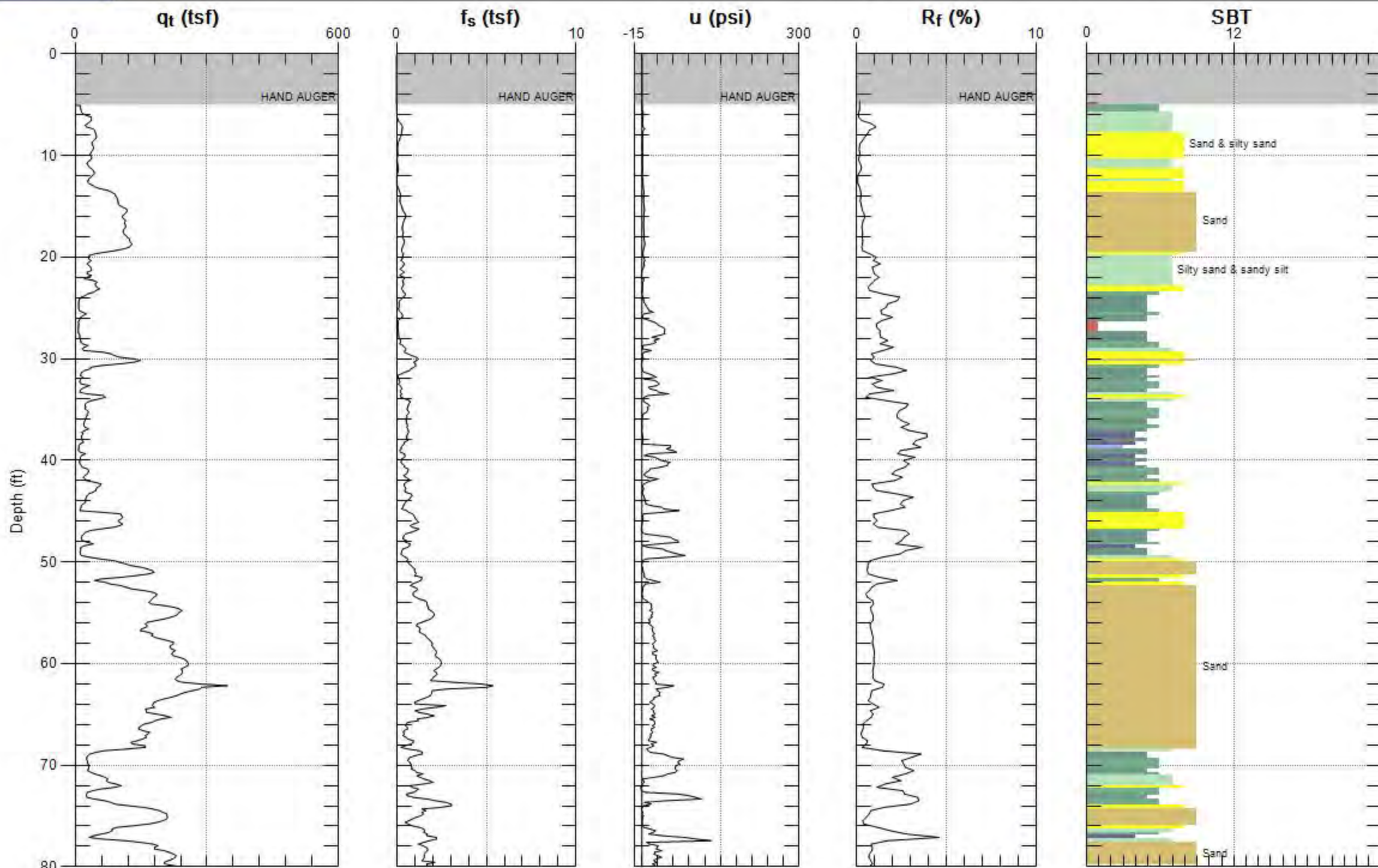
SBT: Soil Behavior Type (Robertson 1990)





Max. Depth: 80.381 (ft)  
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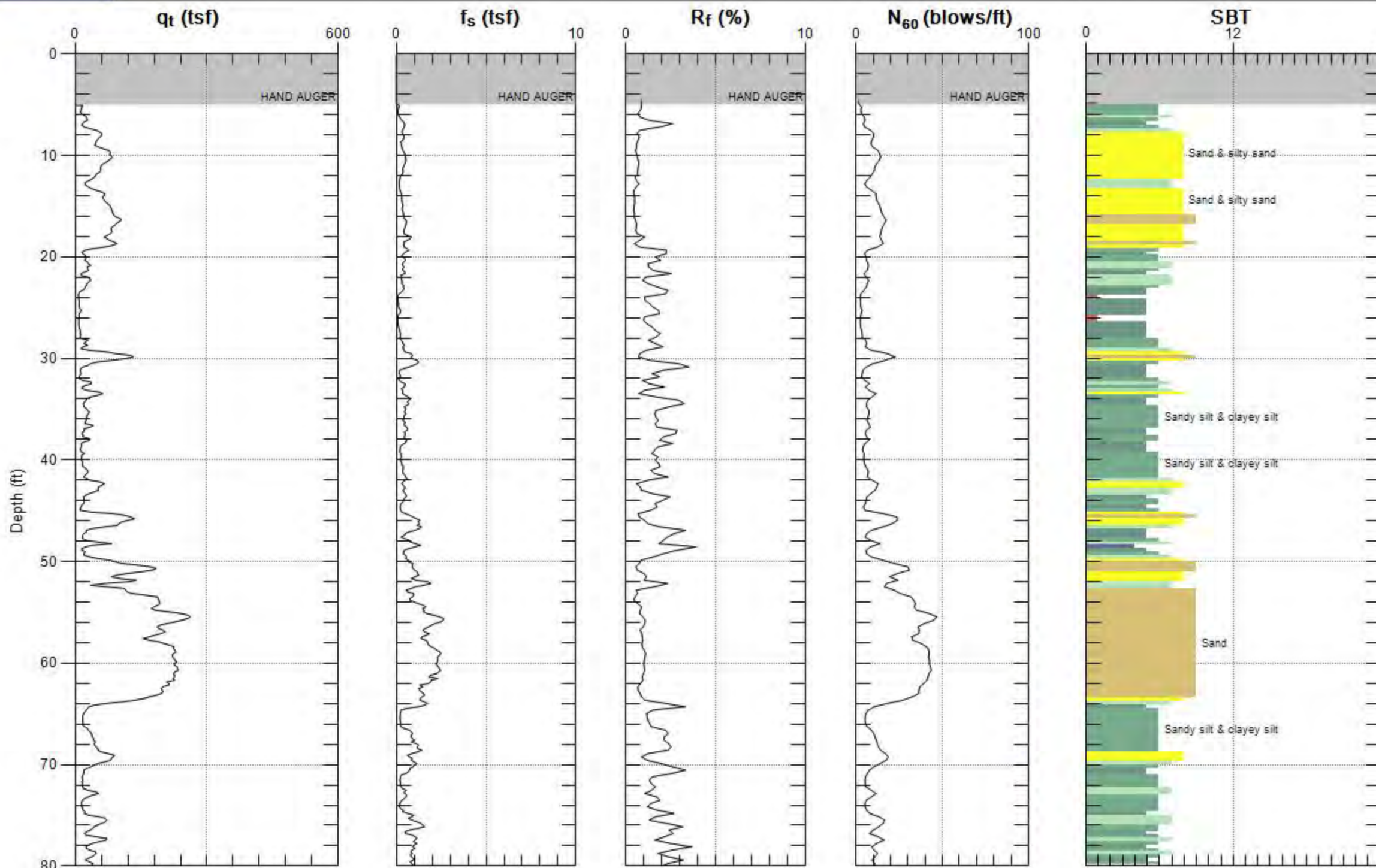
SBT: Soil Behavior Type (Robertson 1990)



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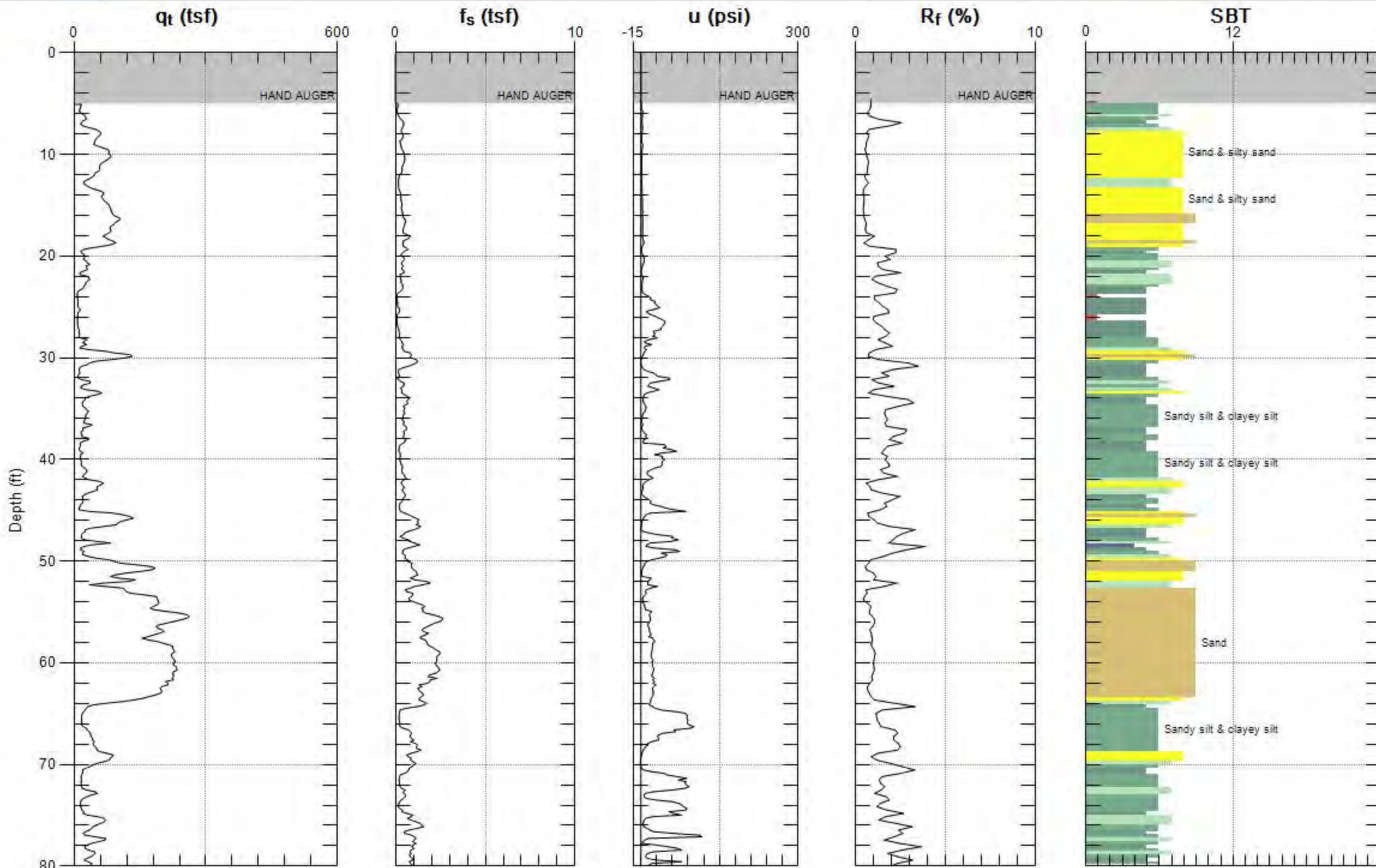
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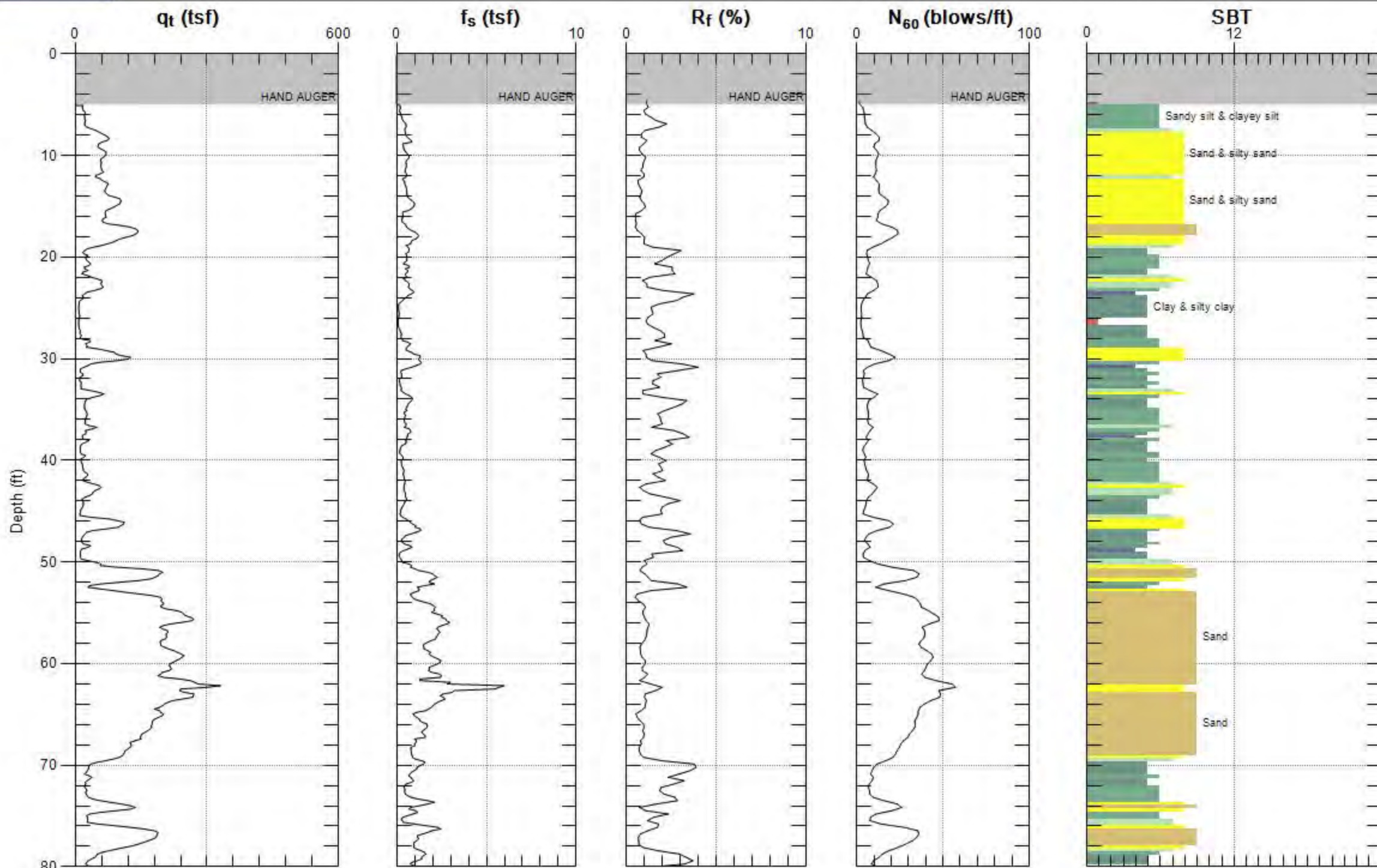
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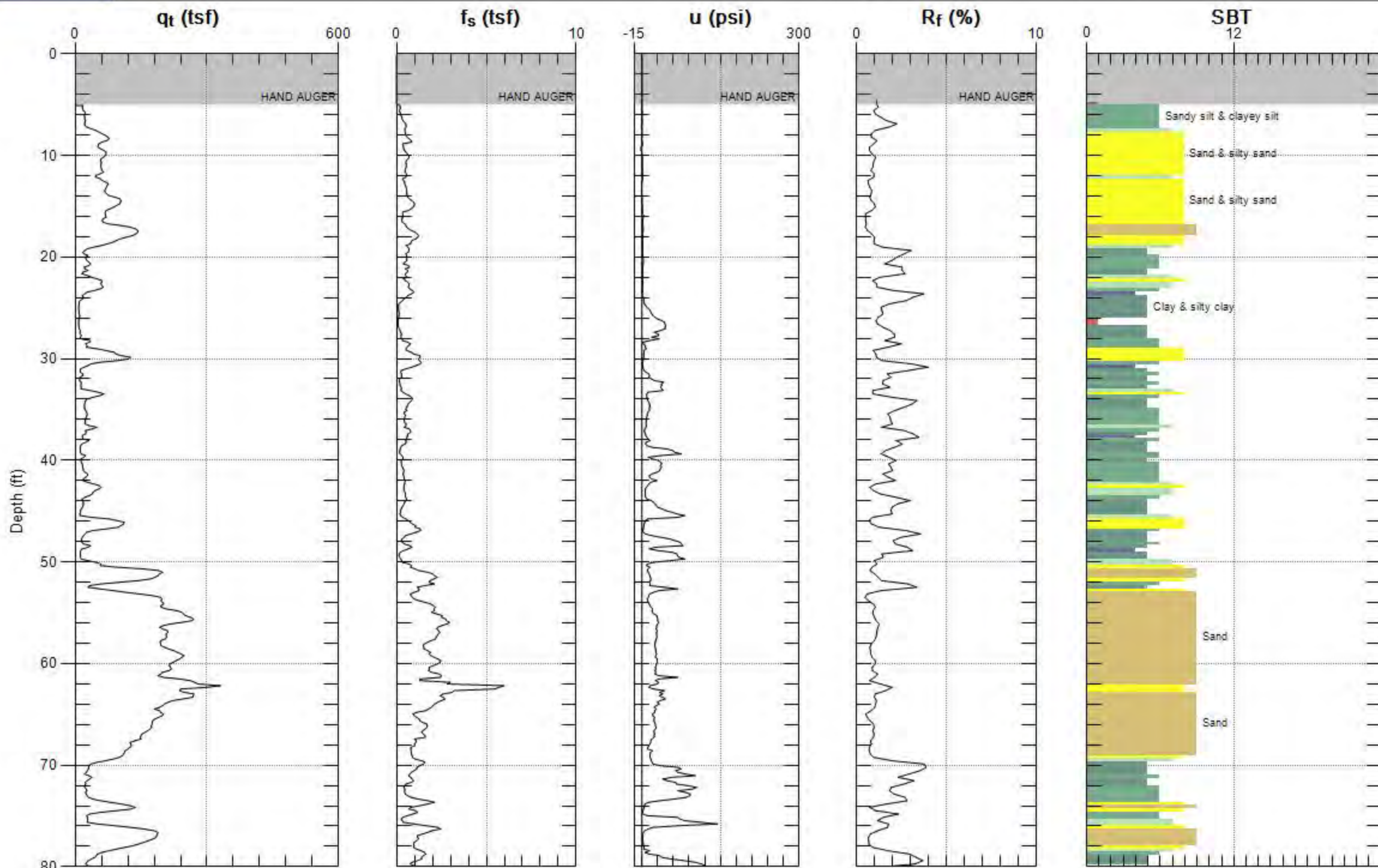
SBT: Soil Behavior Type (Robertson 1990)





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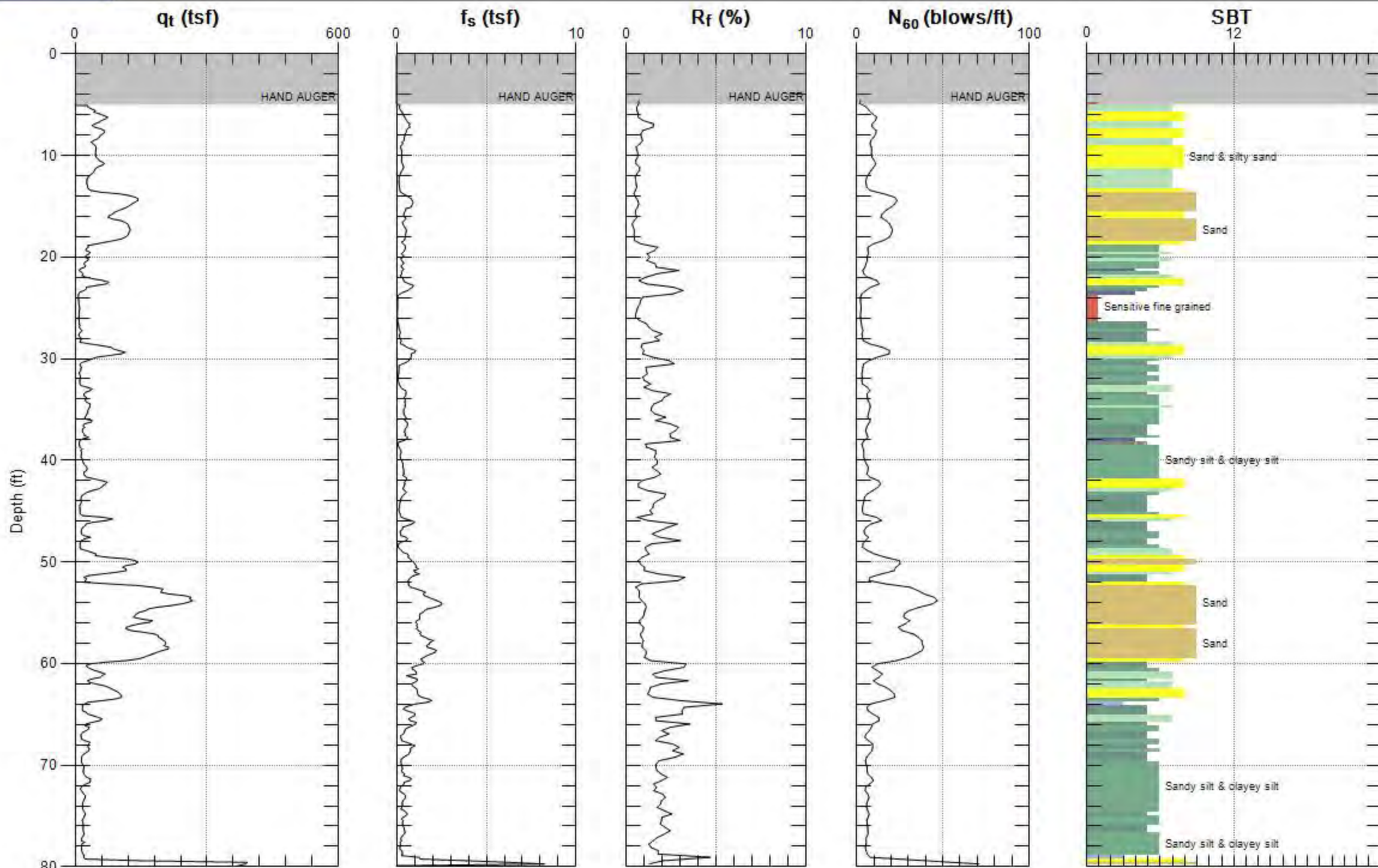
SBT: Soil Behavior Type (Robertson 1990)



Max. Depth: 80.381 (ft)  
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SBT: Soil Behavior Type (Robertson 1990)

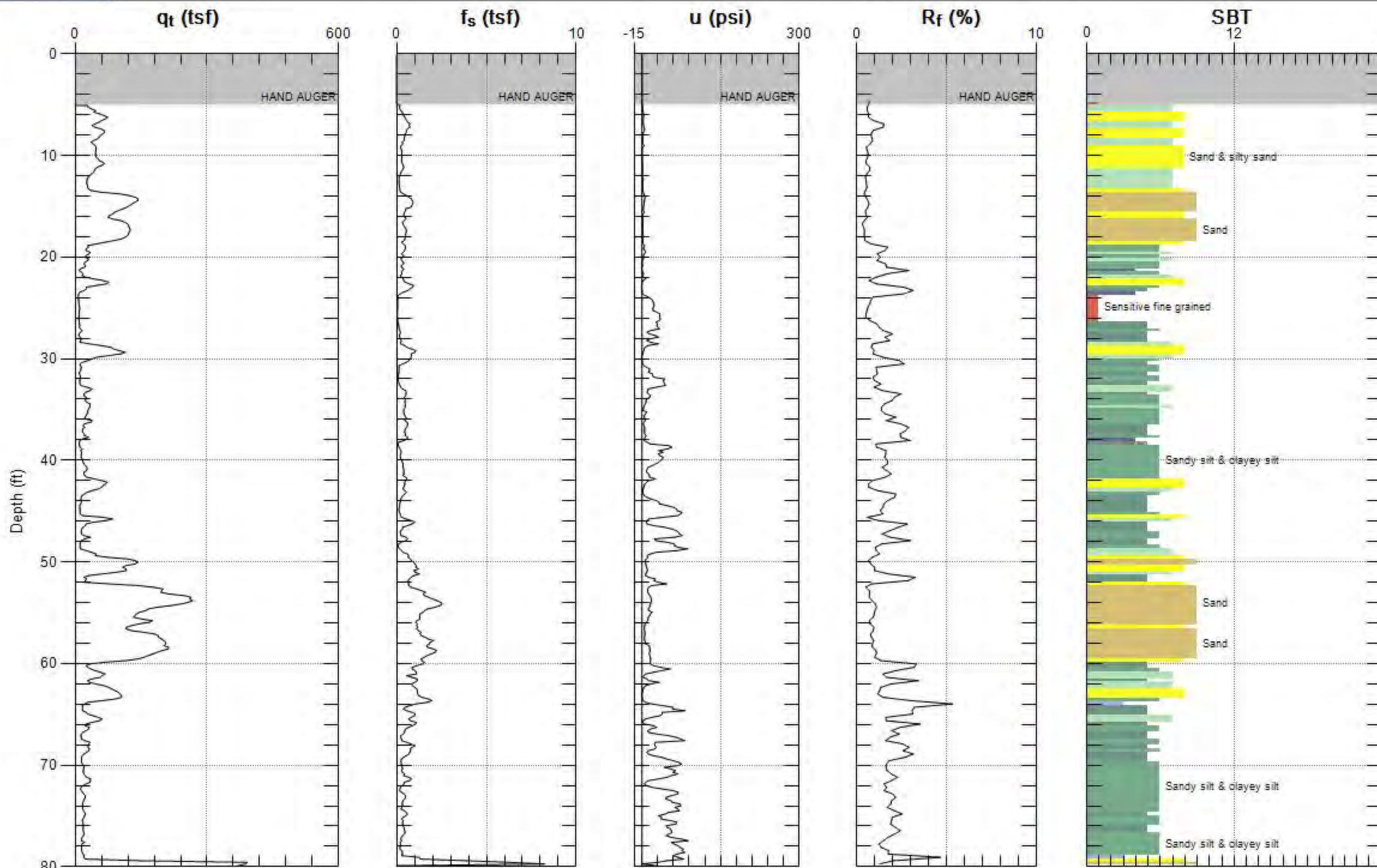




Max. Depth: 80.052 (ft)

Avg. Interval: 0.328 (ft)

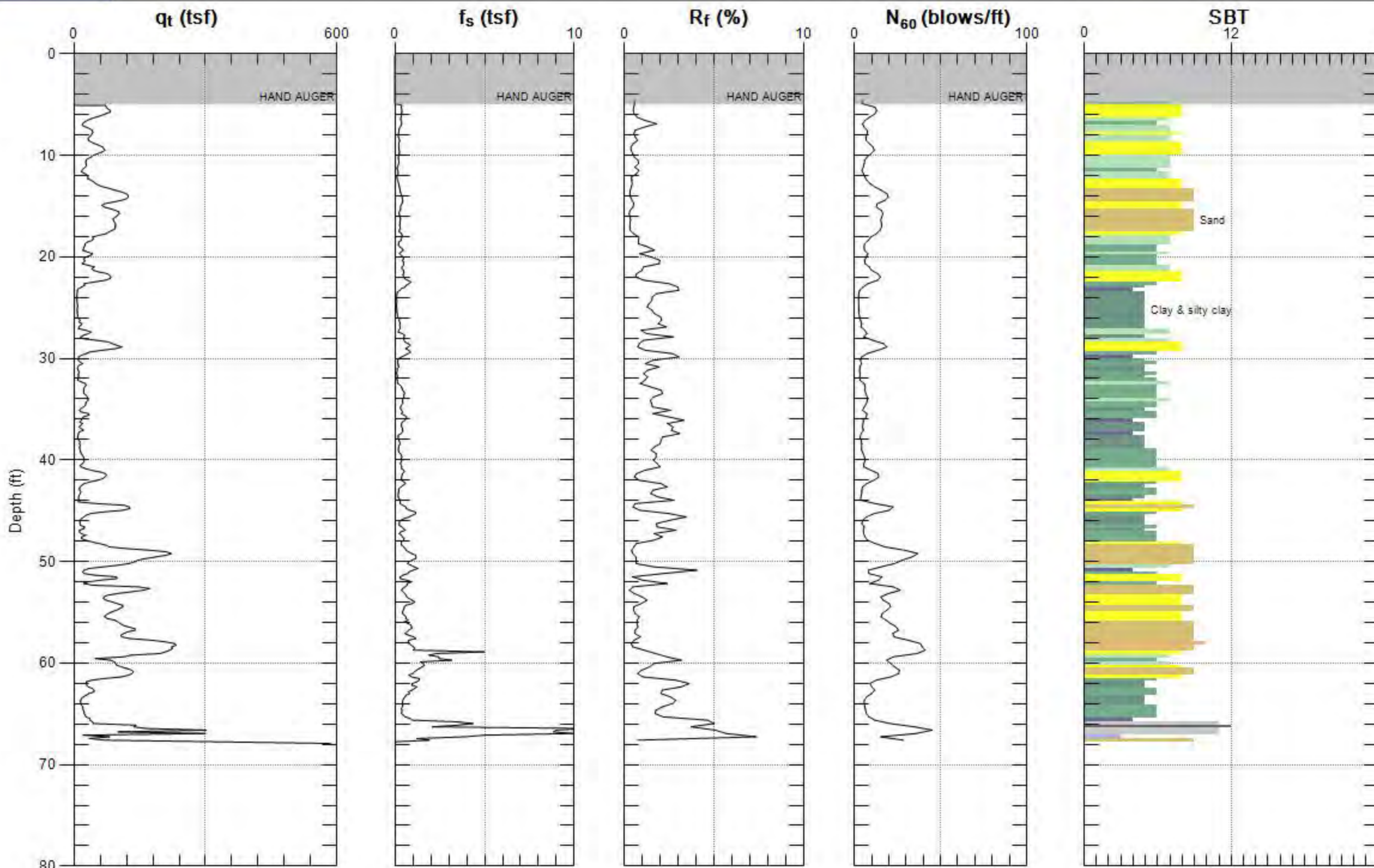
SBT: Soil Behavior Type (Robertson 1990)



Max. Depth: 80.052 (ft)  
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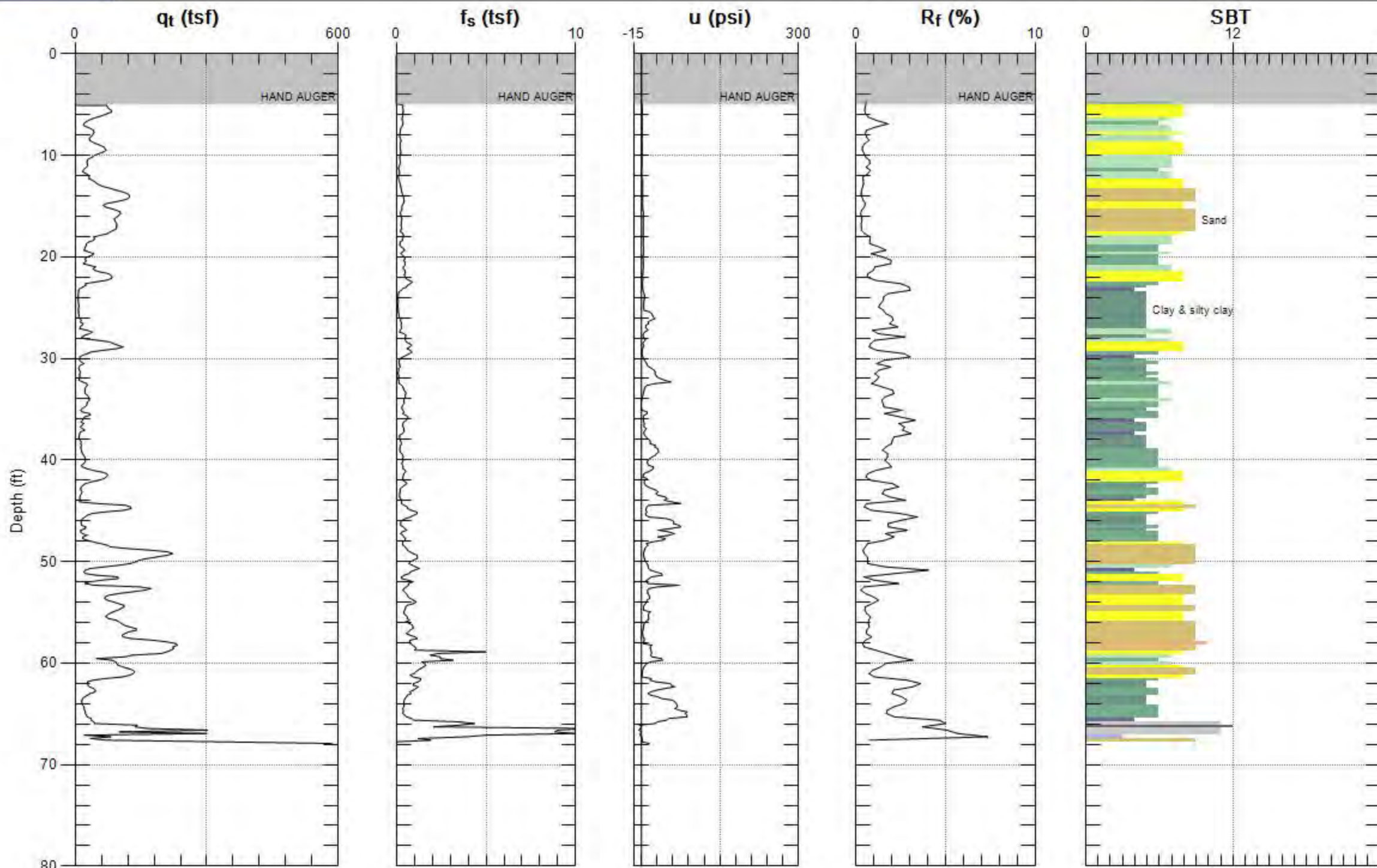
SBT: Soil Behavior Type (Robertson 1990)





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

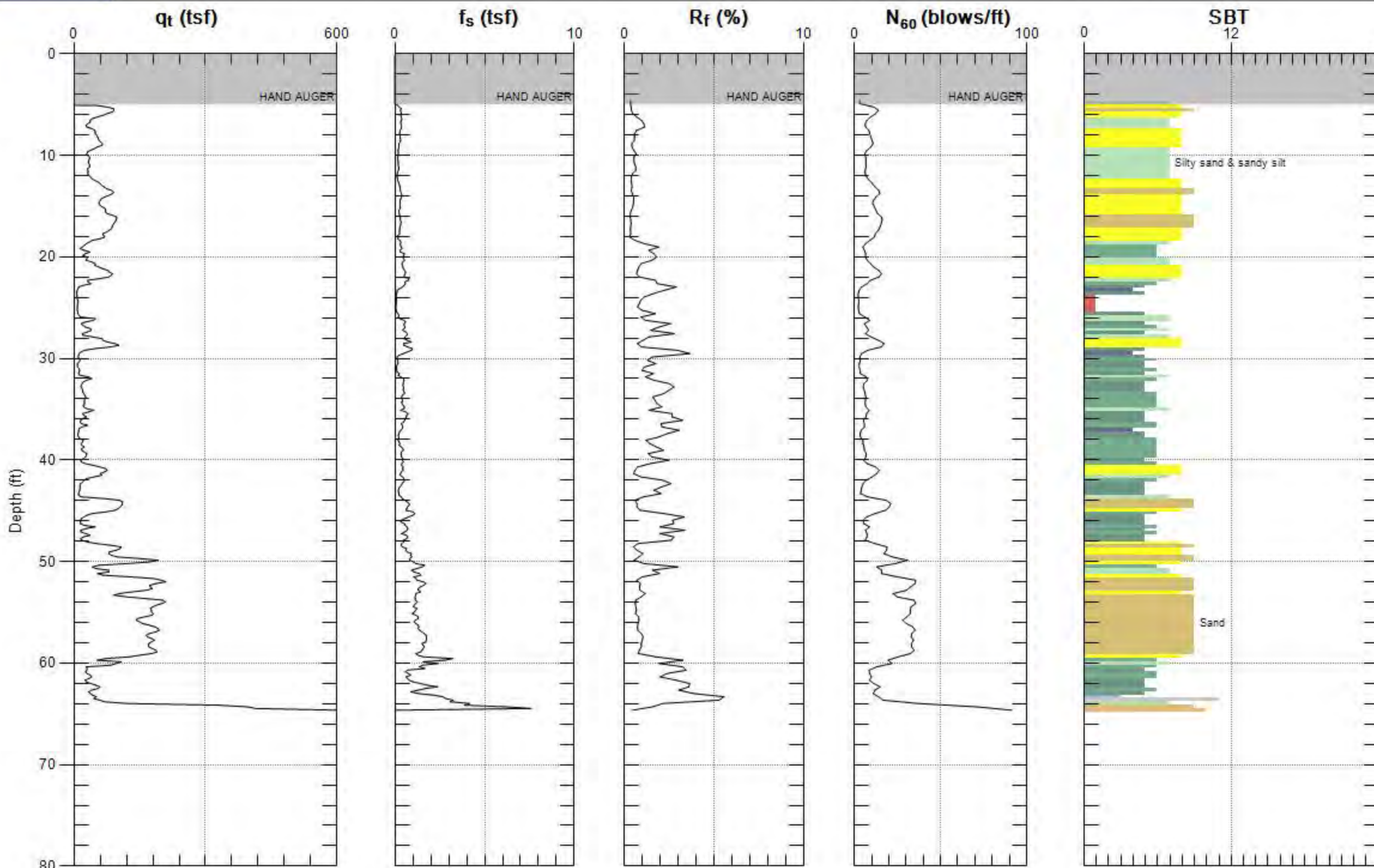
SBT: Soil Behavior Type (Robertson 1990)



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

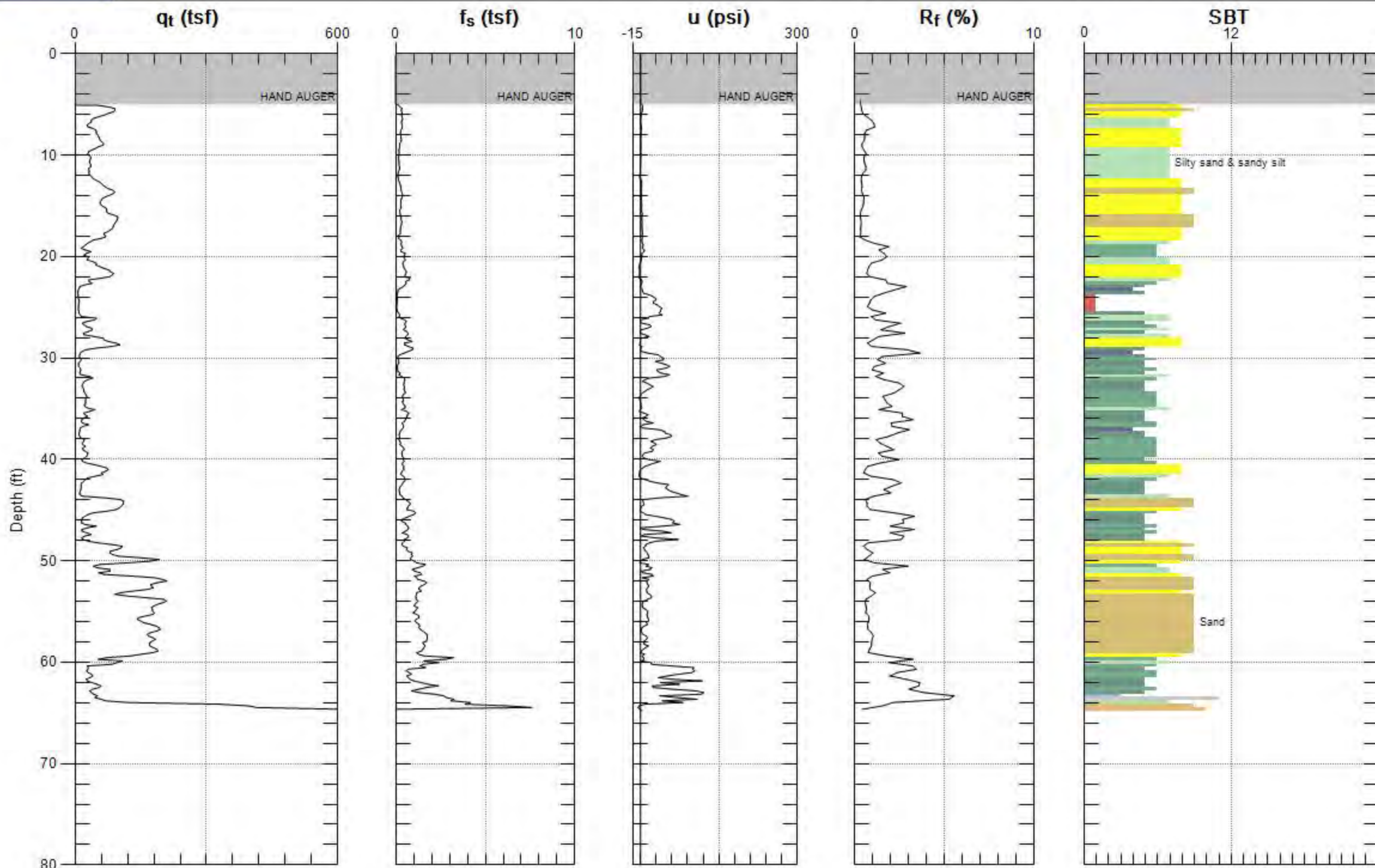
SBT: Soil Behavior Type (Robertson 1990)





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

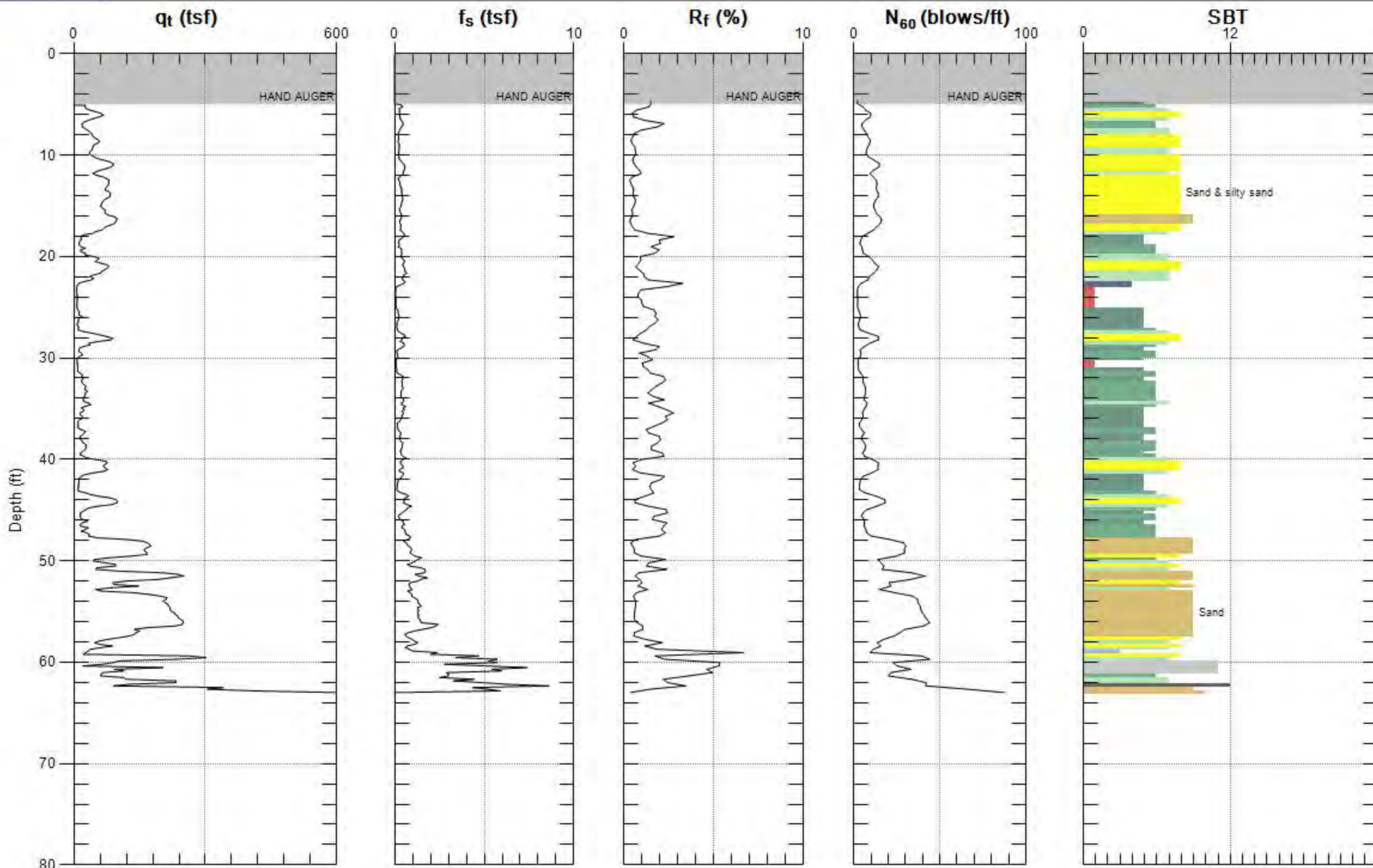
SBT: Soil Behavior Type (Robertson 1990)



Max. Depth: 64.797 (ft)  
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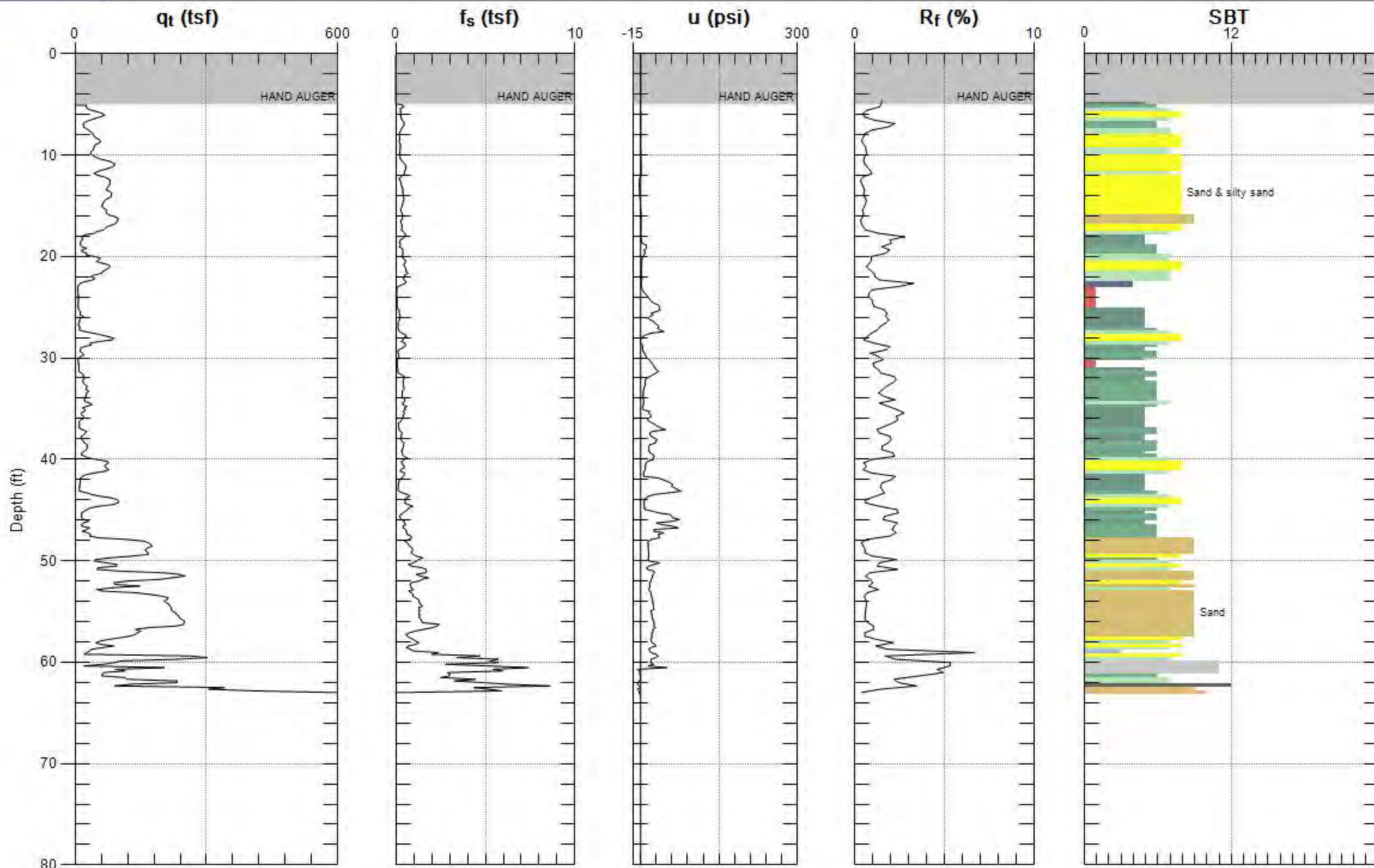
SBT: Soil Behavior Type (Robertson 1990)





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

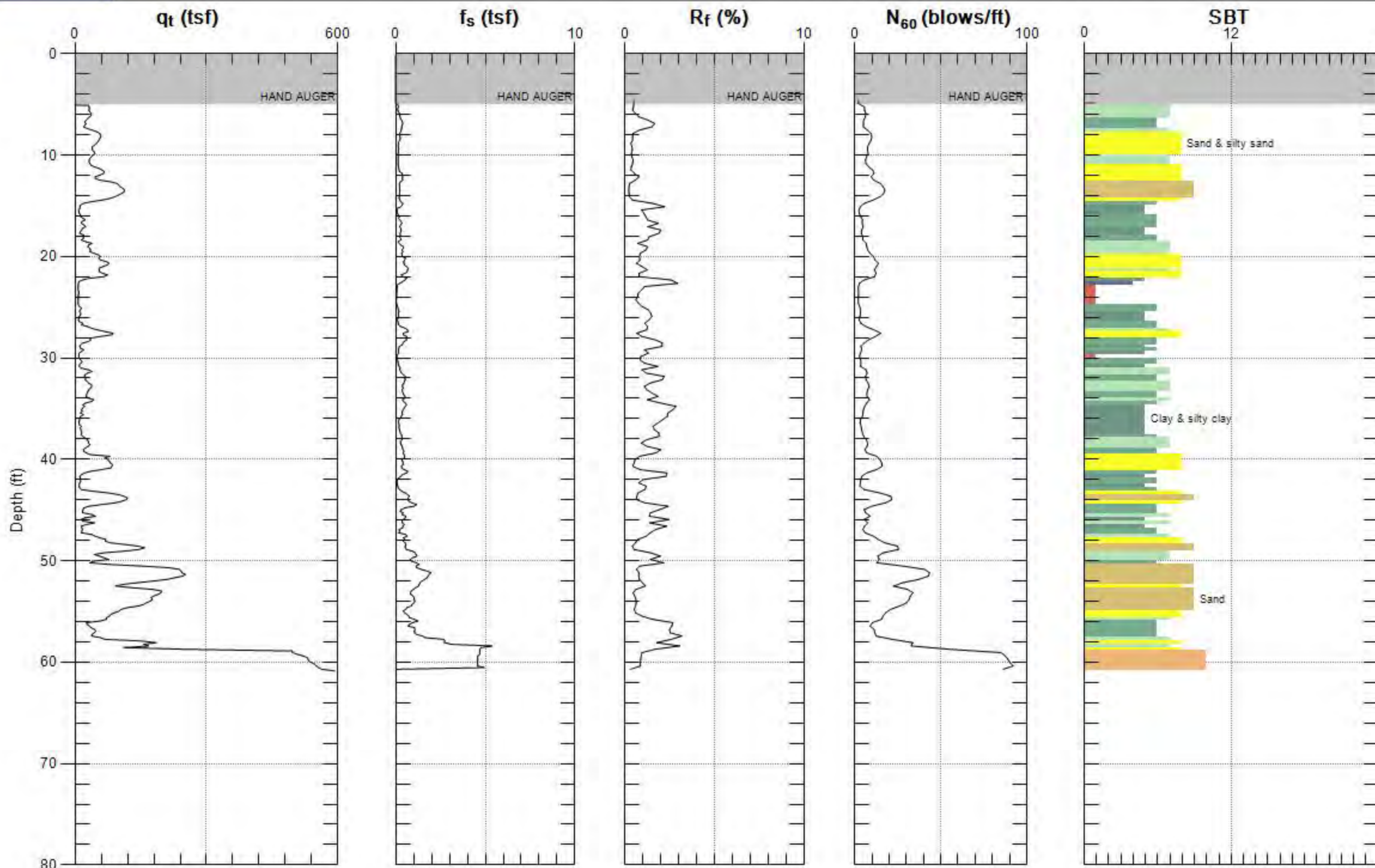
SBT: Soil Behavior Type (Robertson 1990)



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

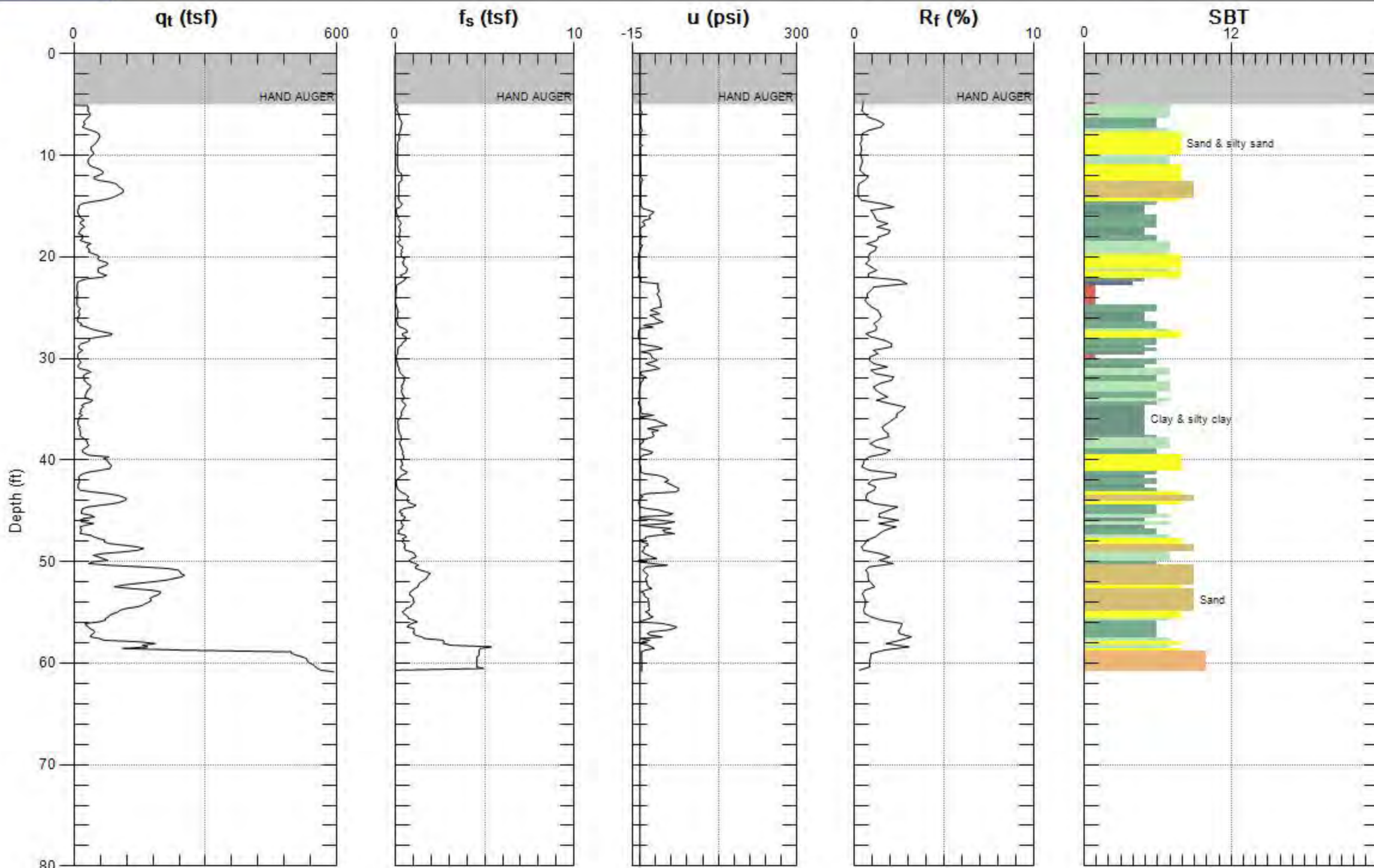
SBT: Soil Behavior Type (Robertson 1990)





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

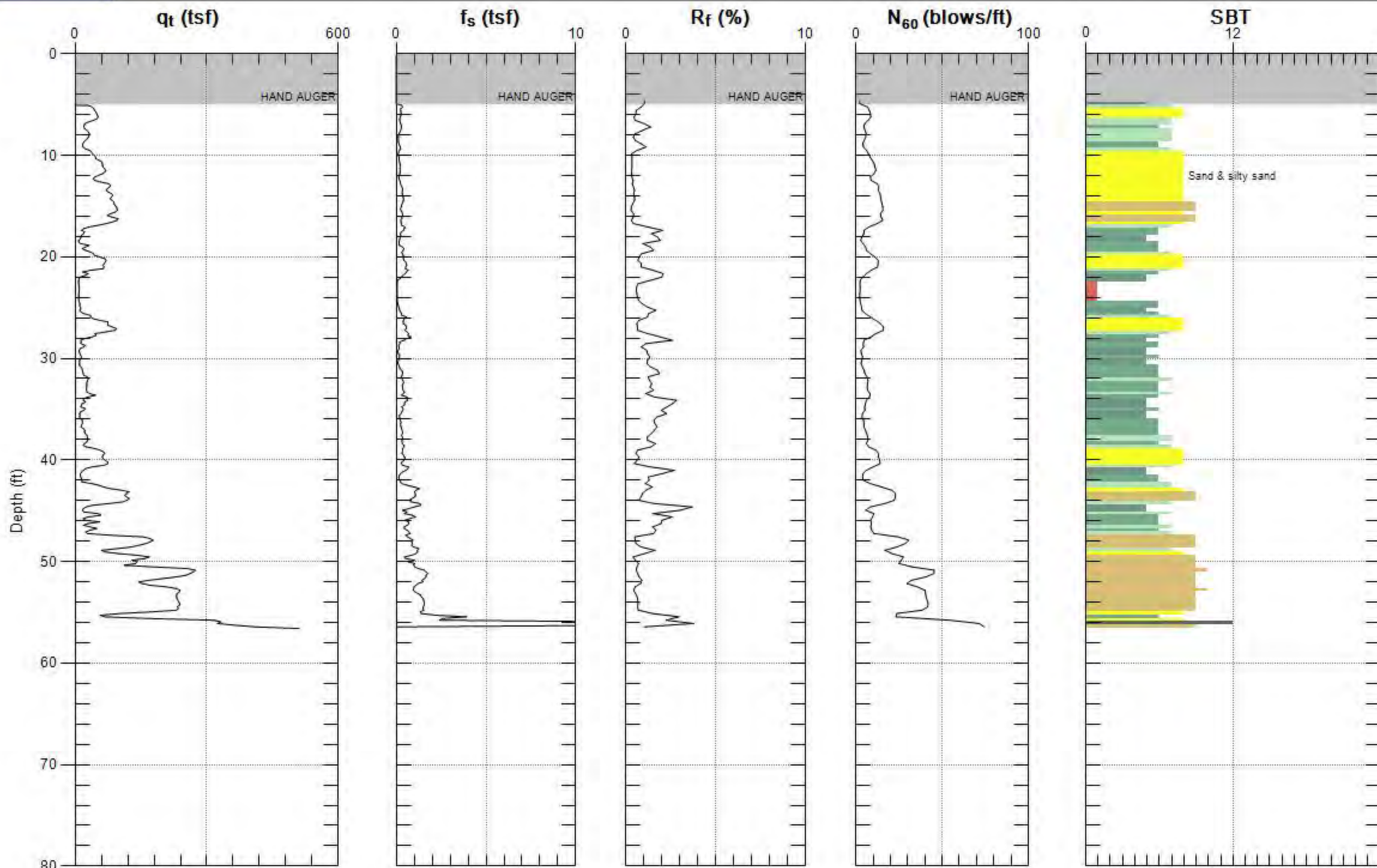
SBT: Soil Behavior Type (Robertson 1990)



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

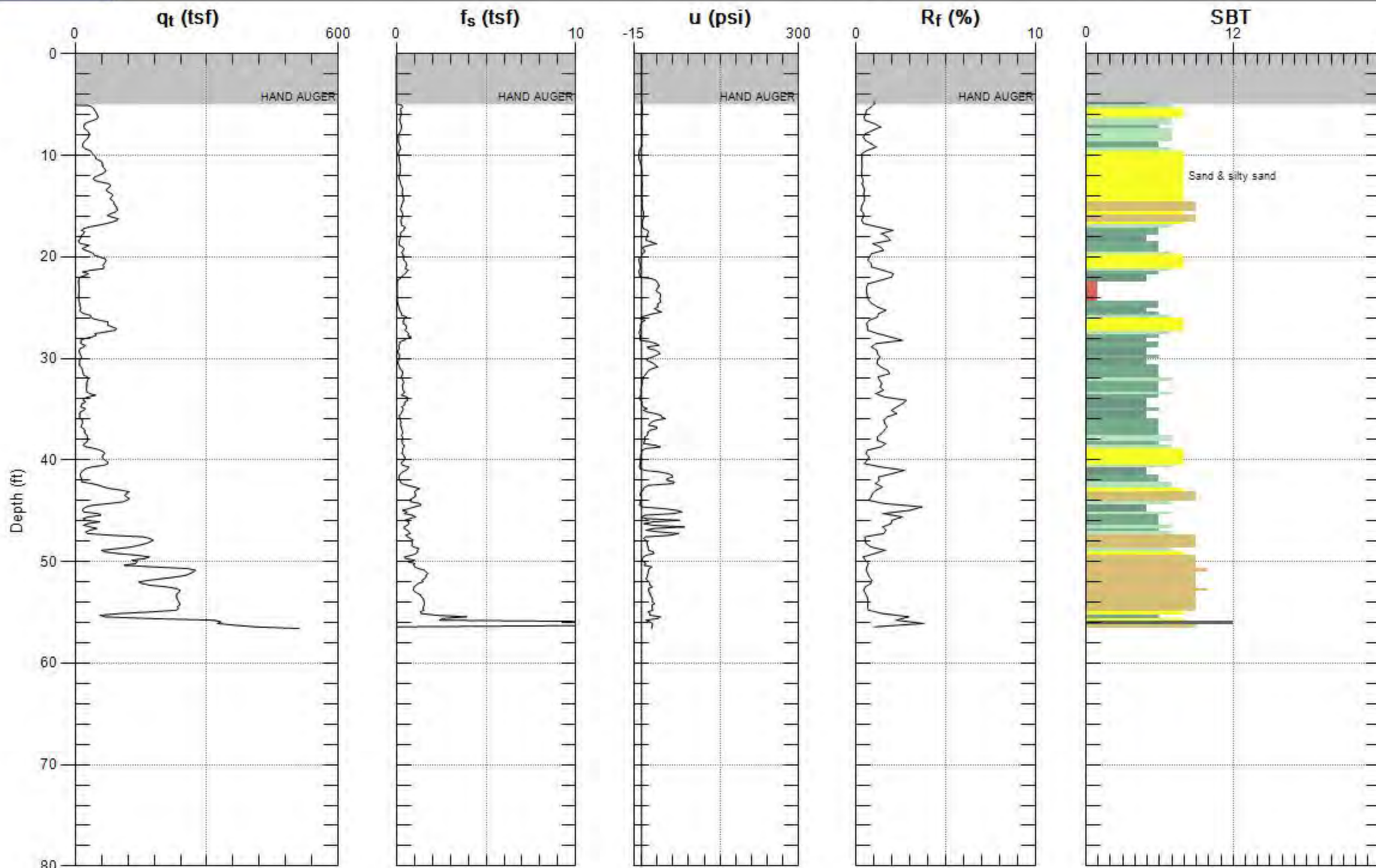
SBT: Soil Behavior Type (Robertson 1990)





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

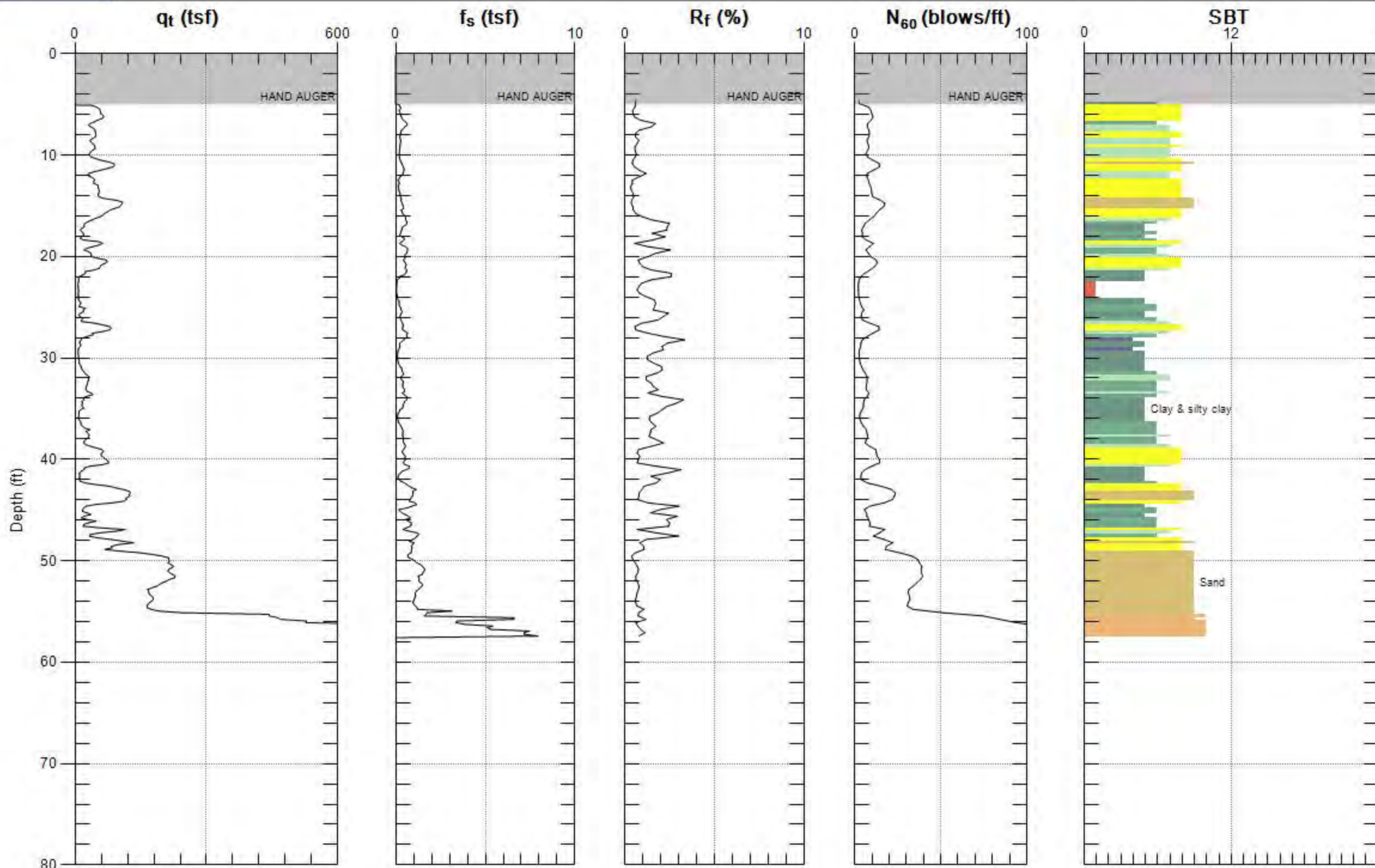
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Max. Depth: 56.594 (ft)  
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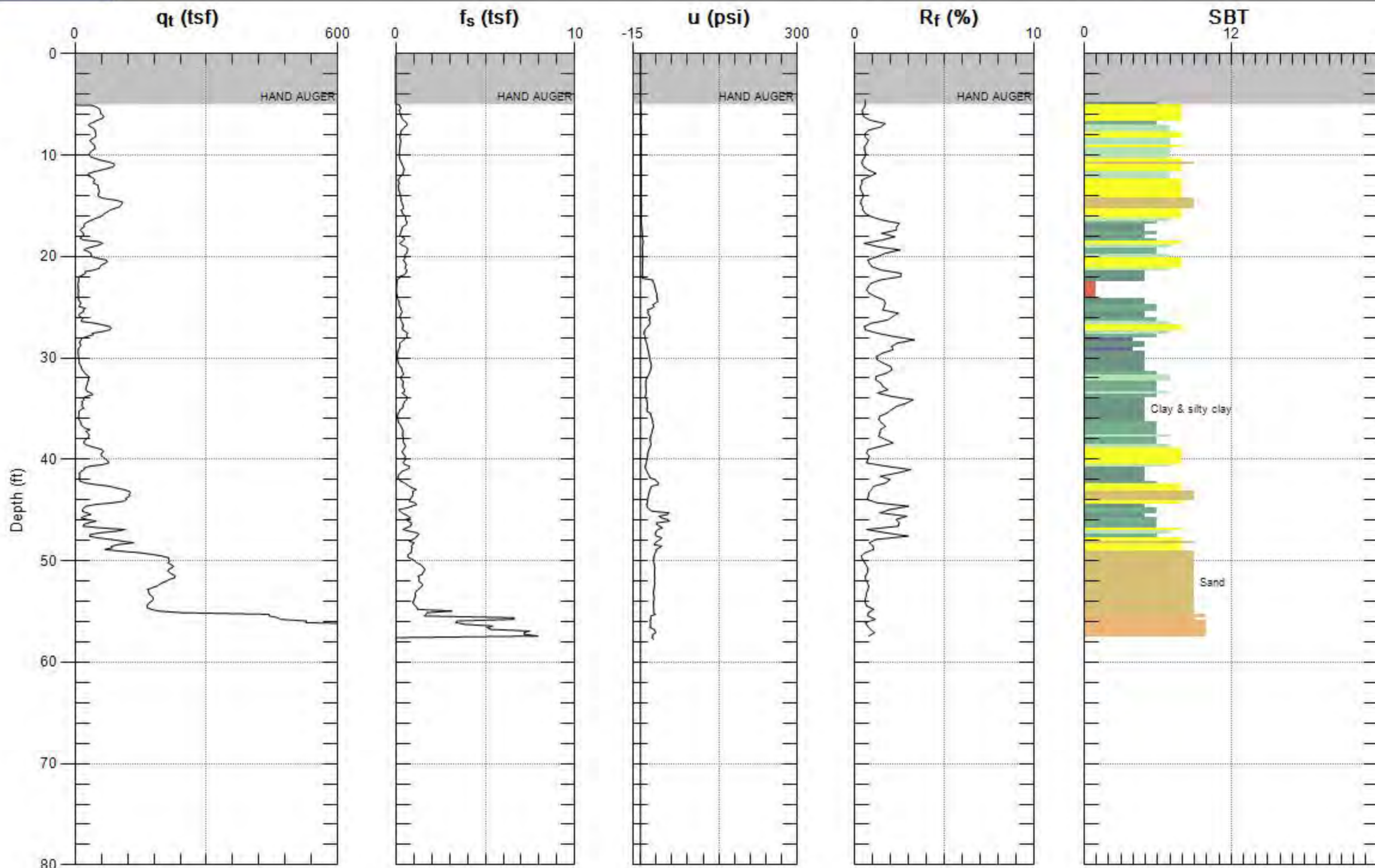
SBT: Soil Behavior Type (Robertson 1990)





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

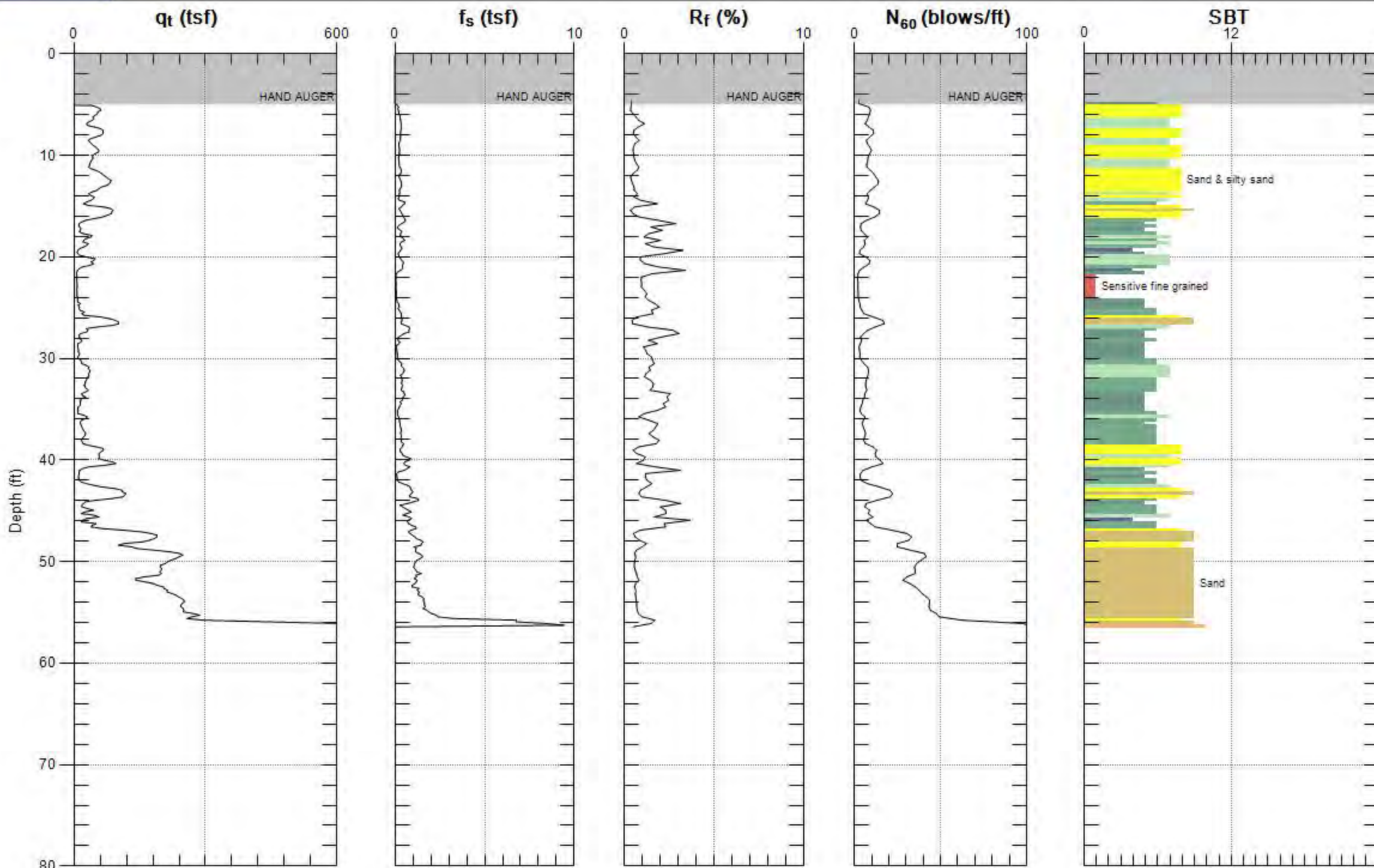
SBT: Soil Behavior Type (Robertson 1990)



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

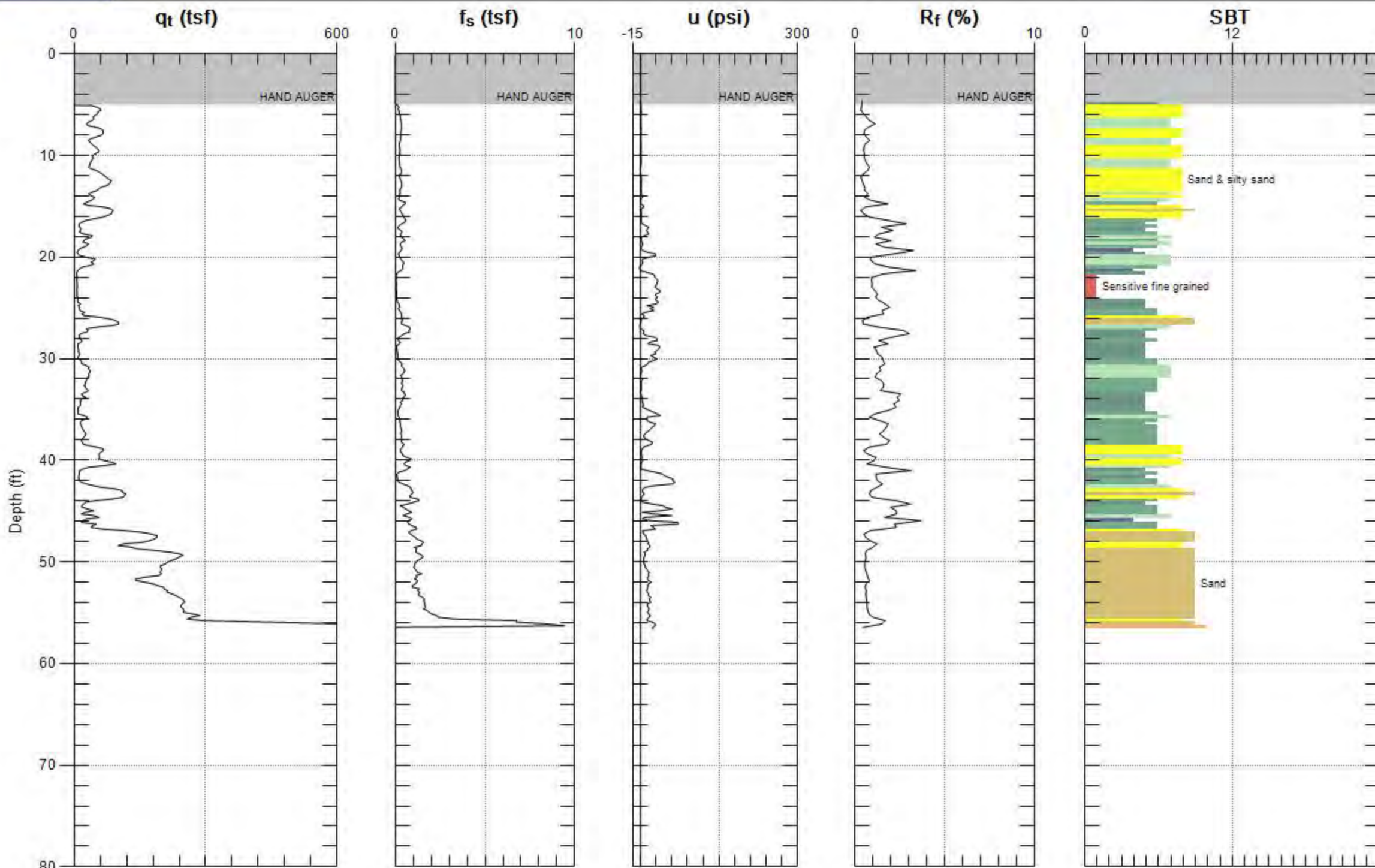
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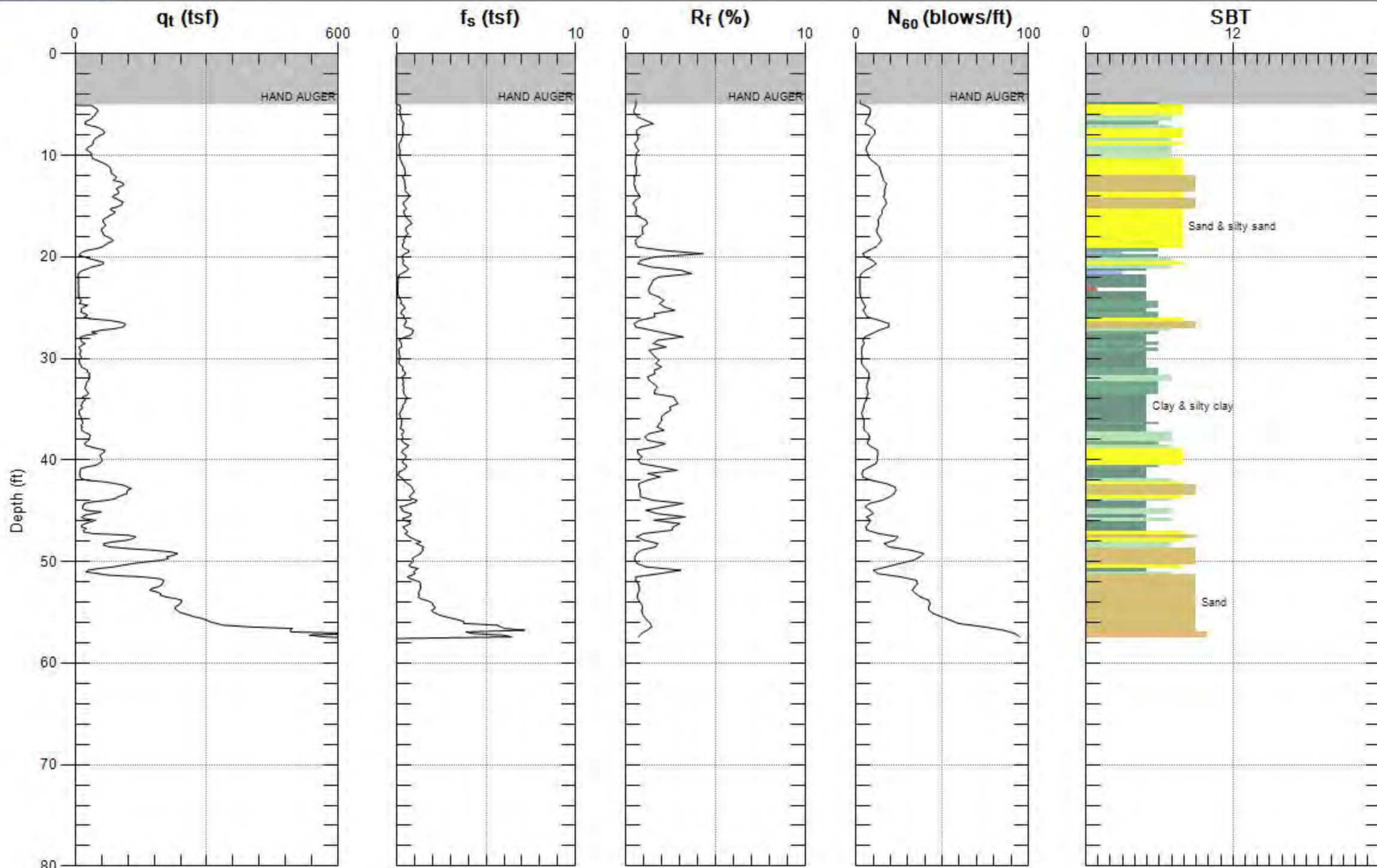
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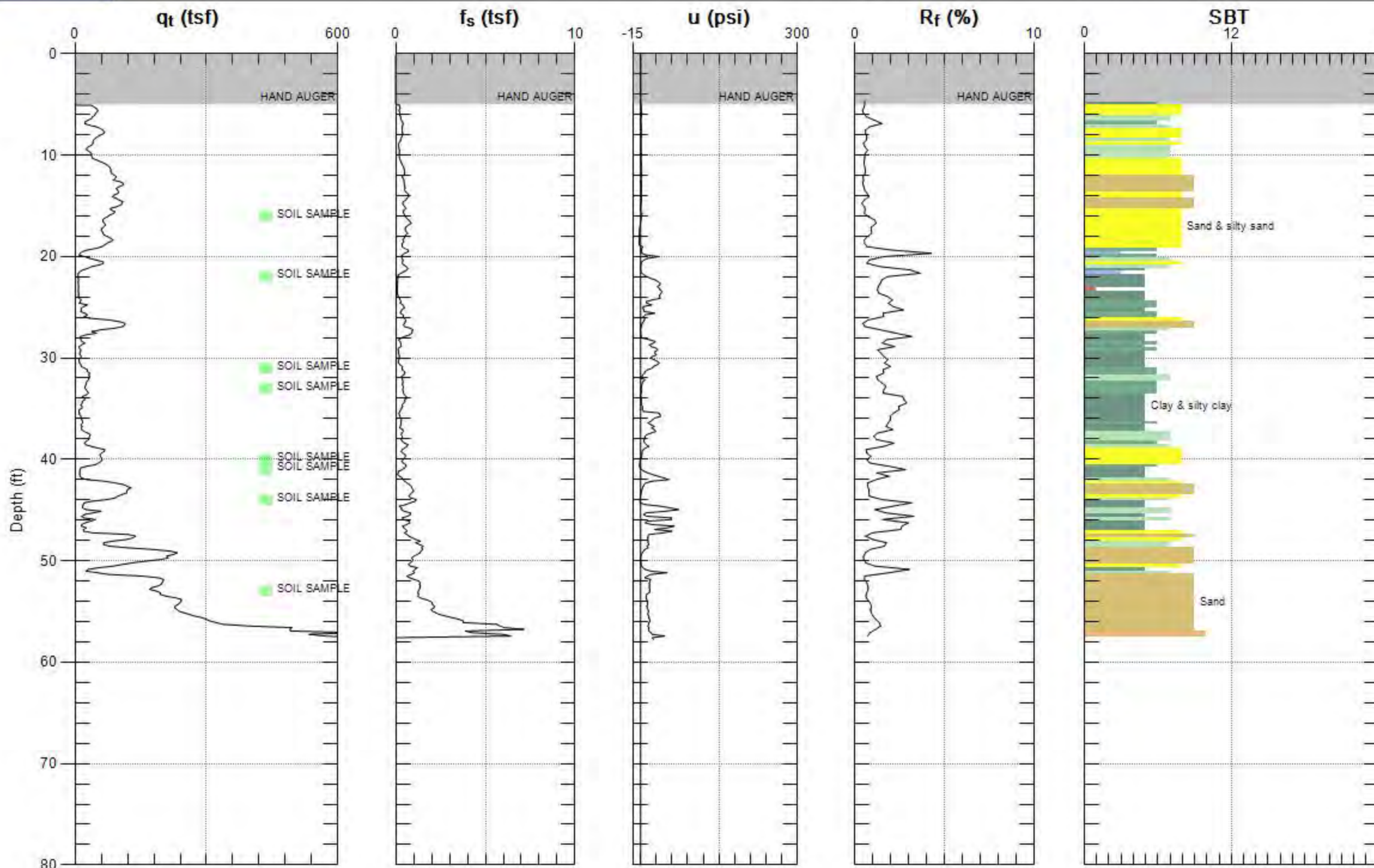
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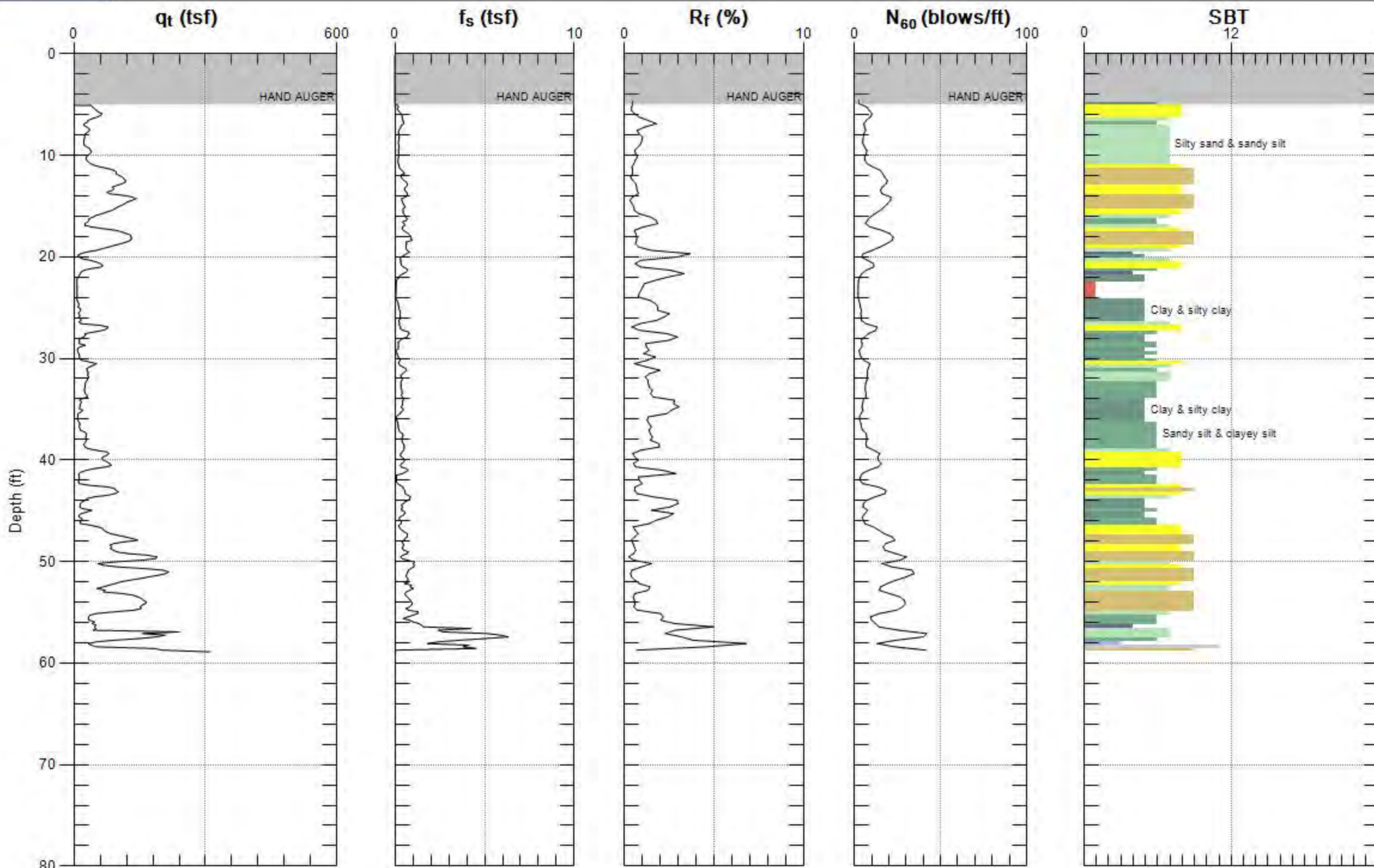
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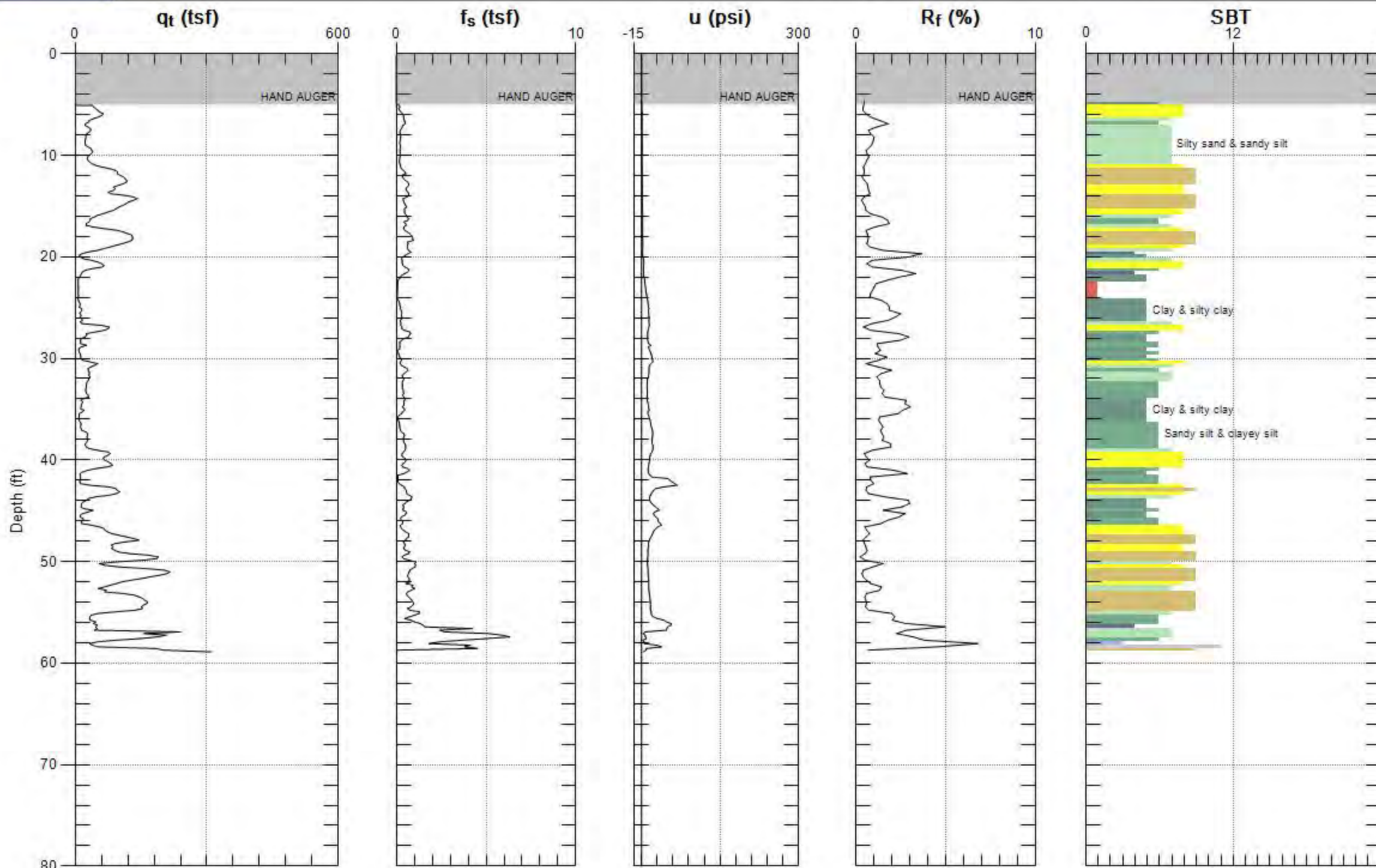
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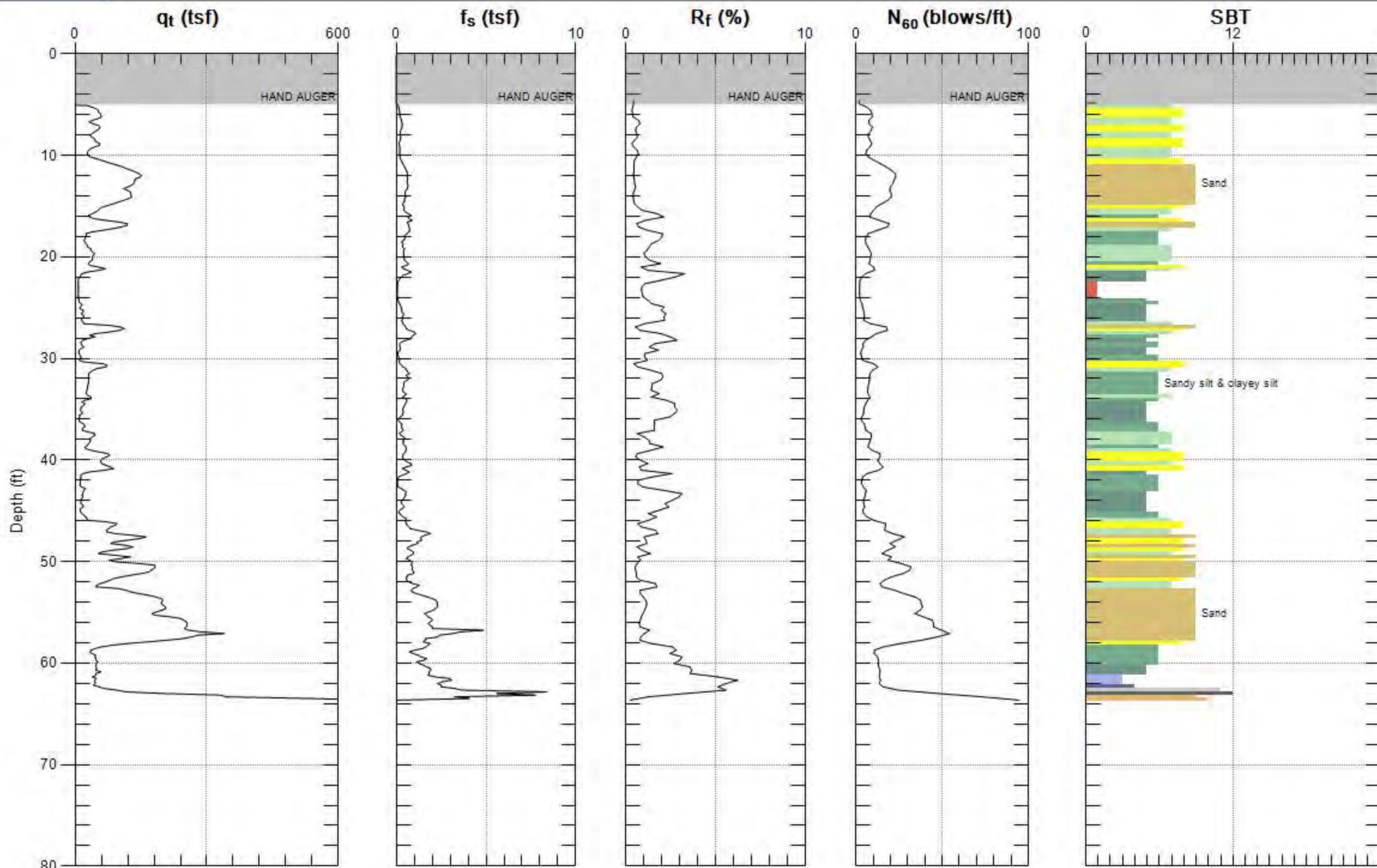
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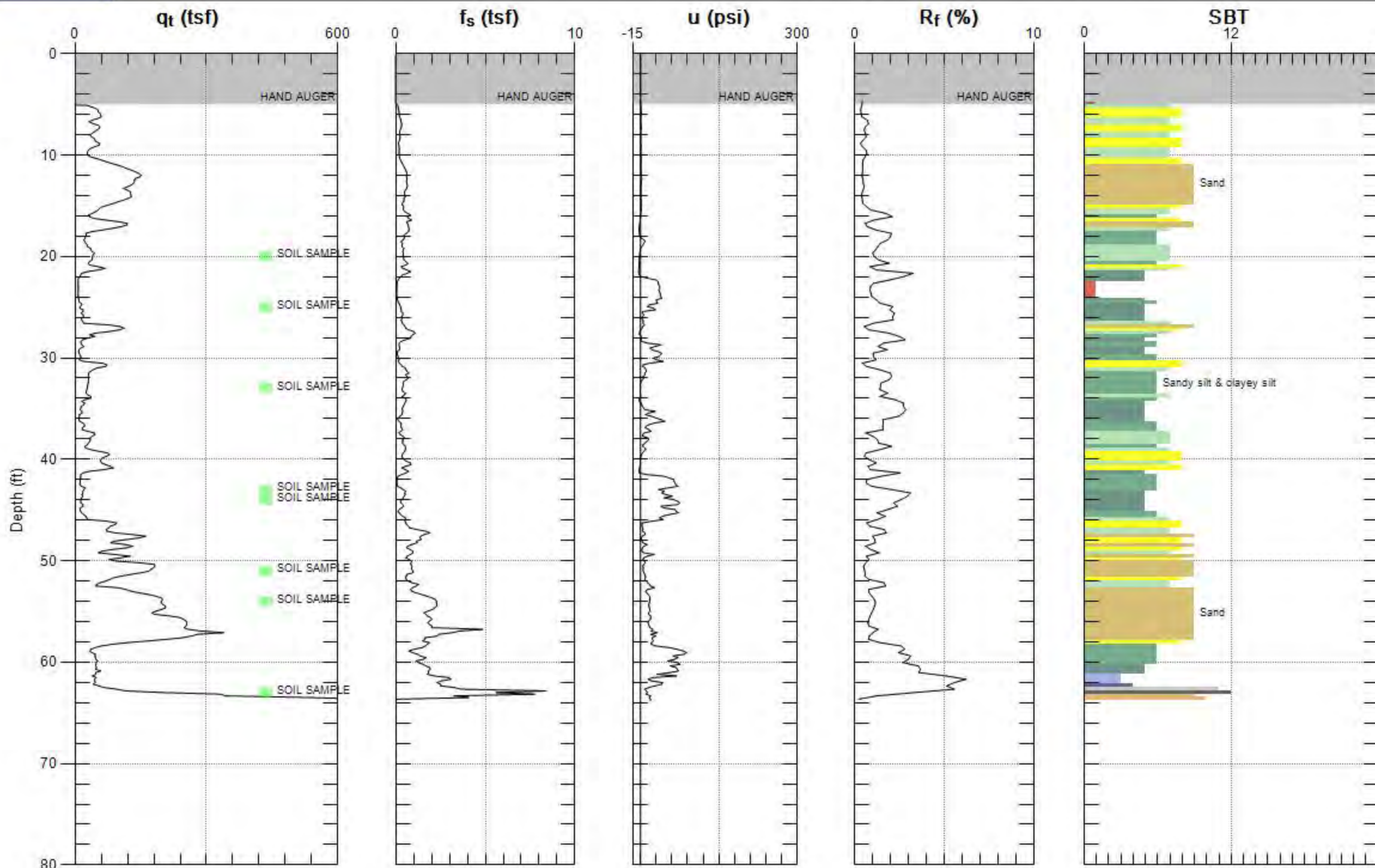
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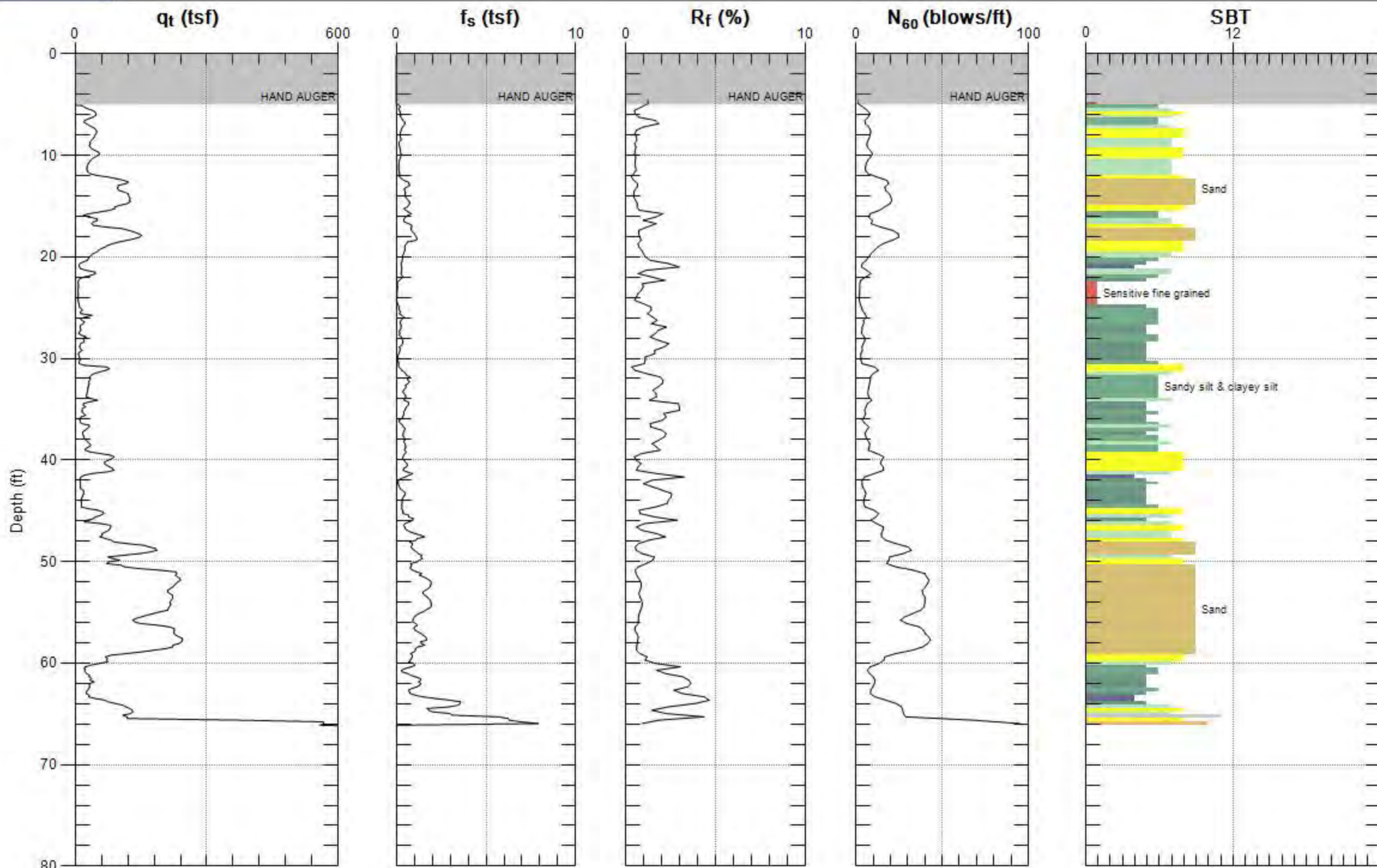
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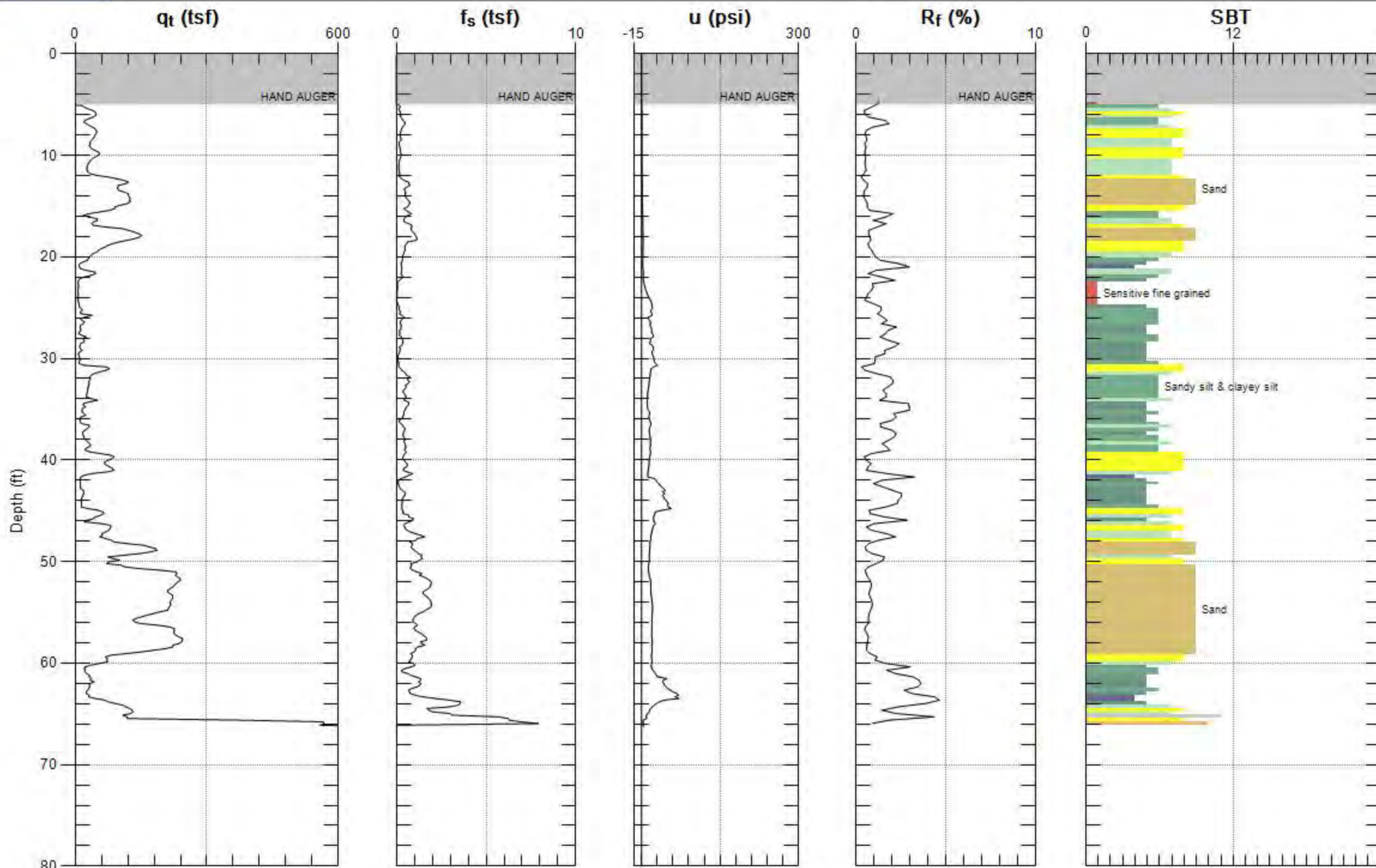
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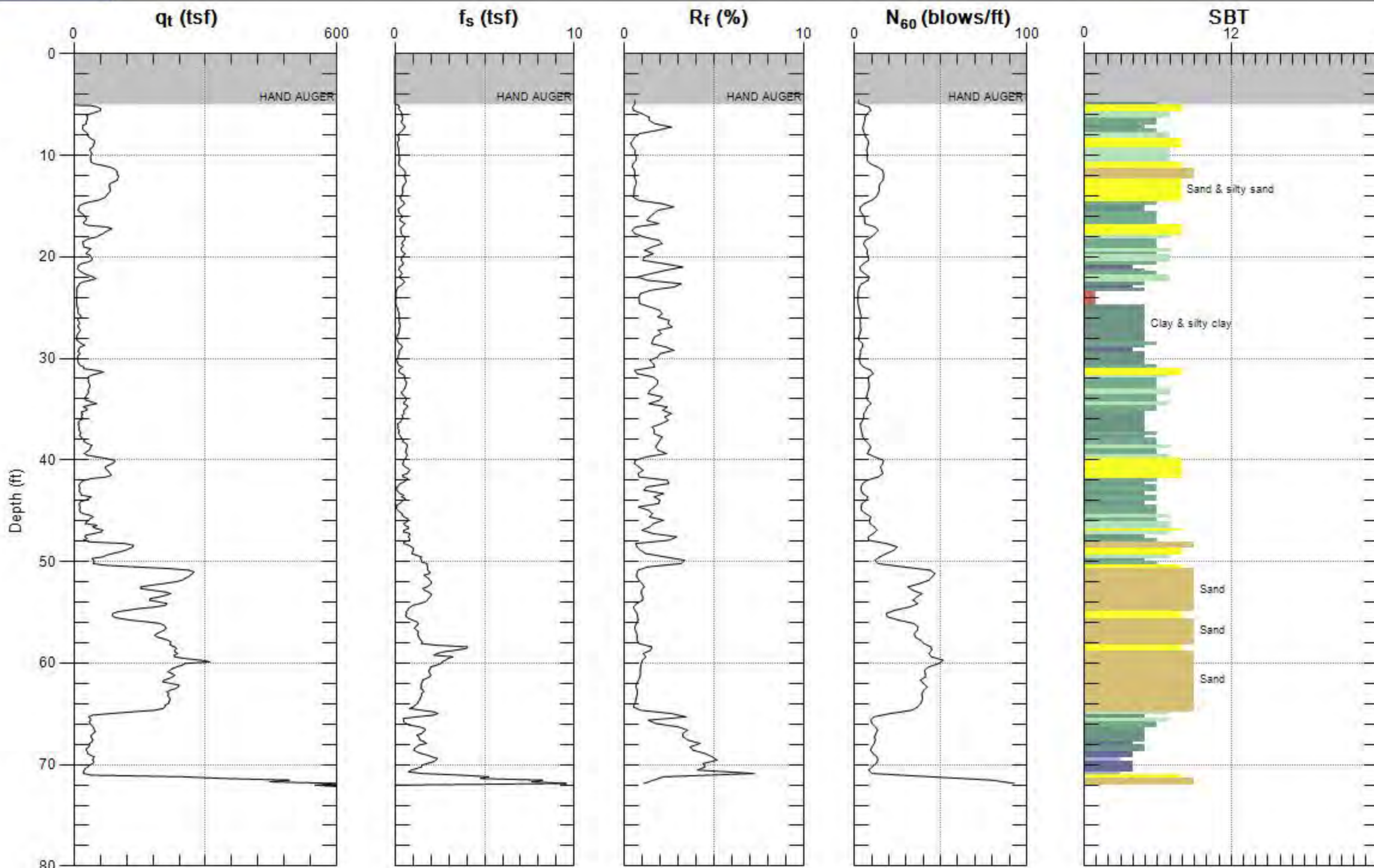
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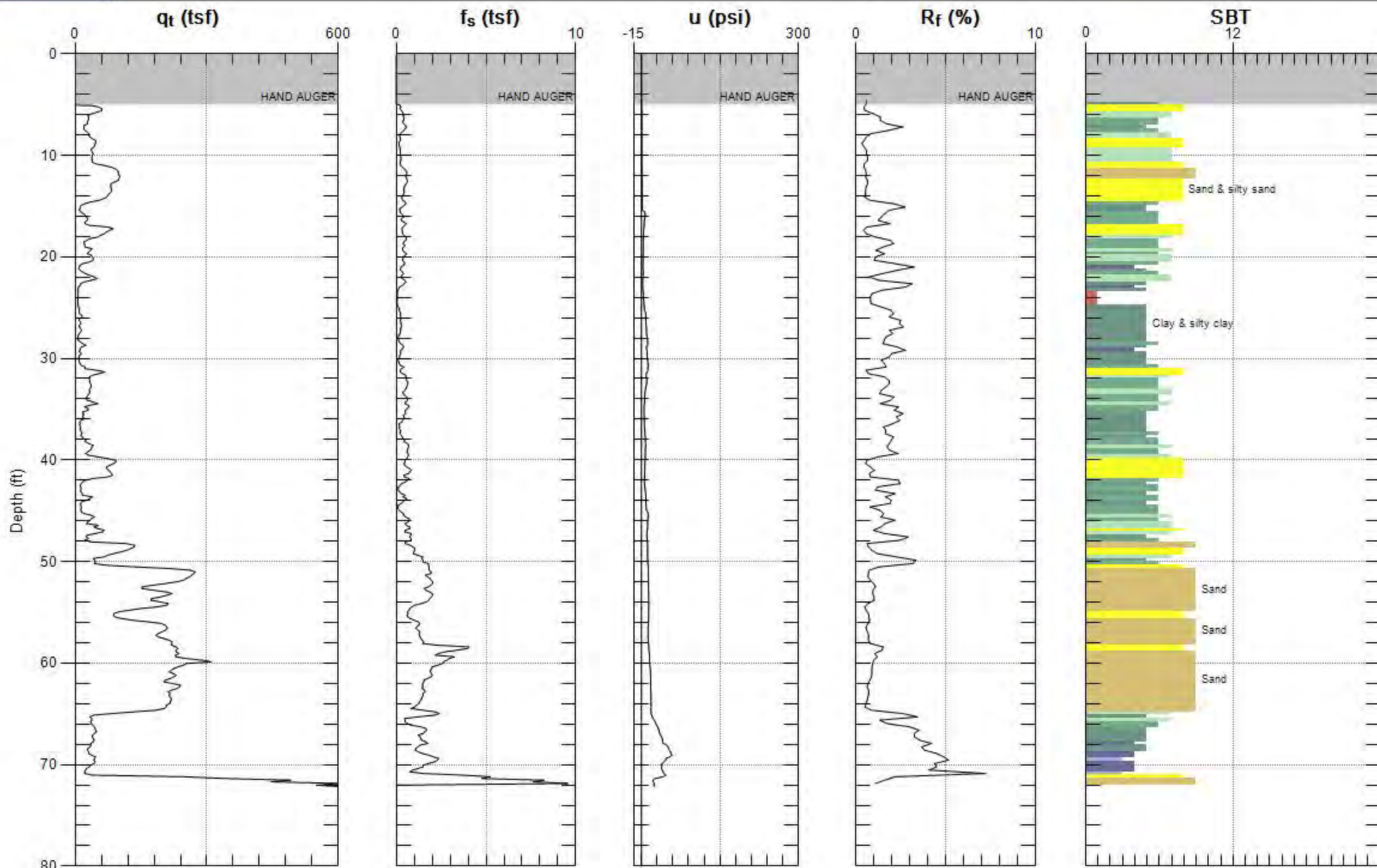
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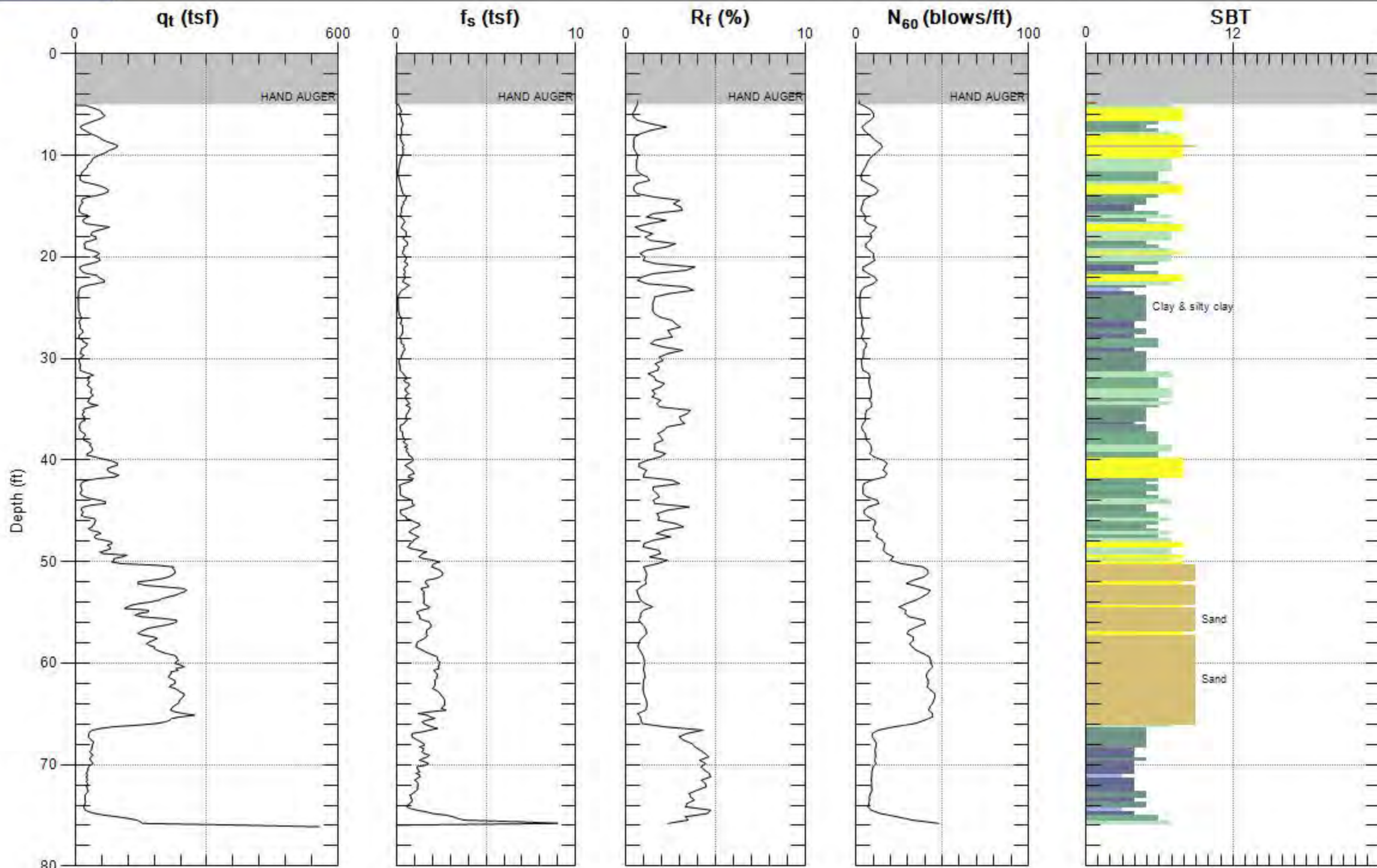
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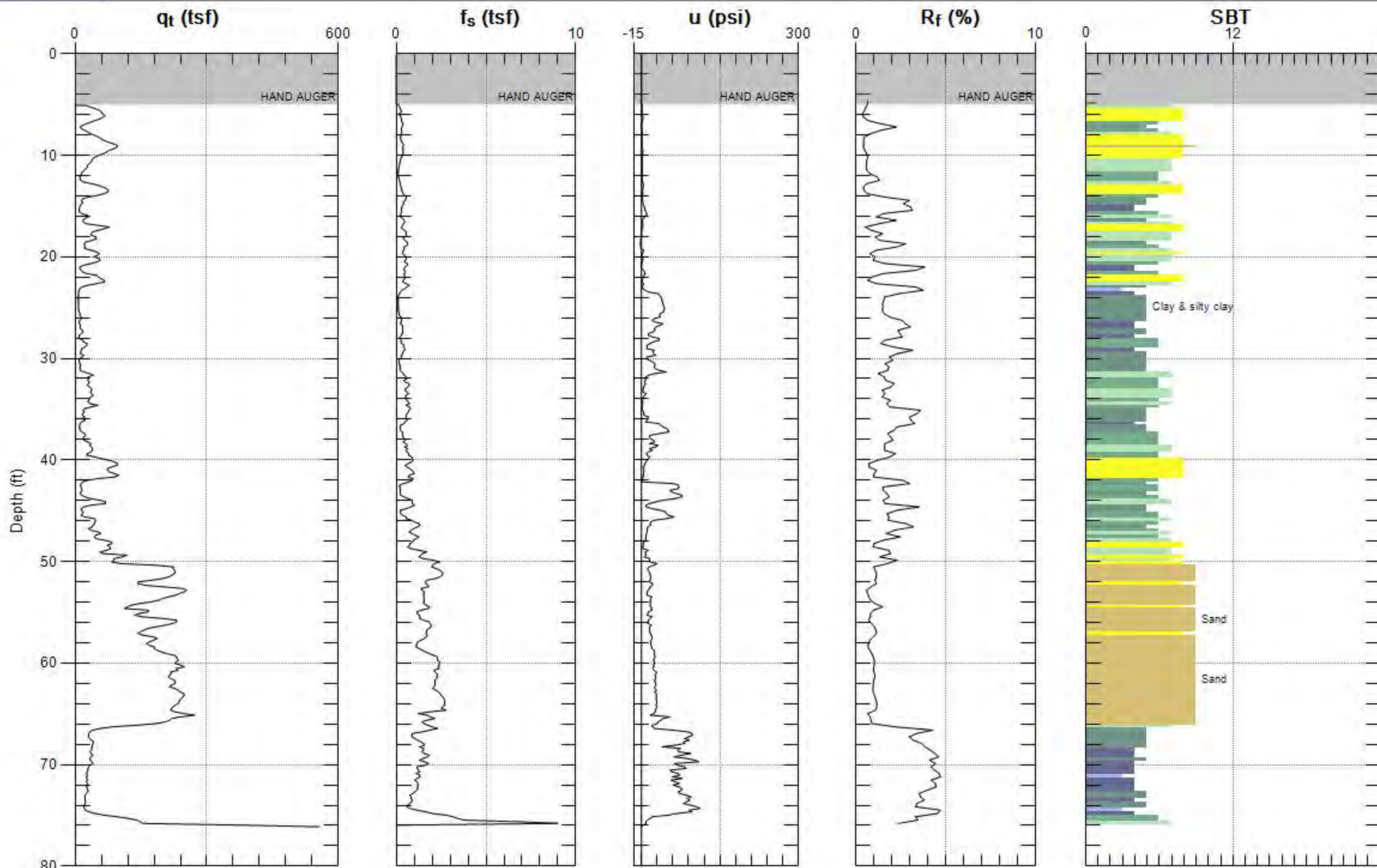
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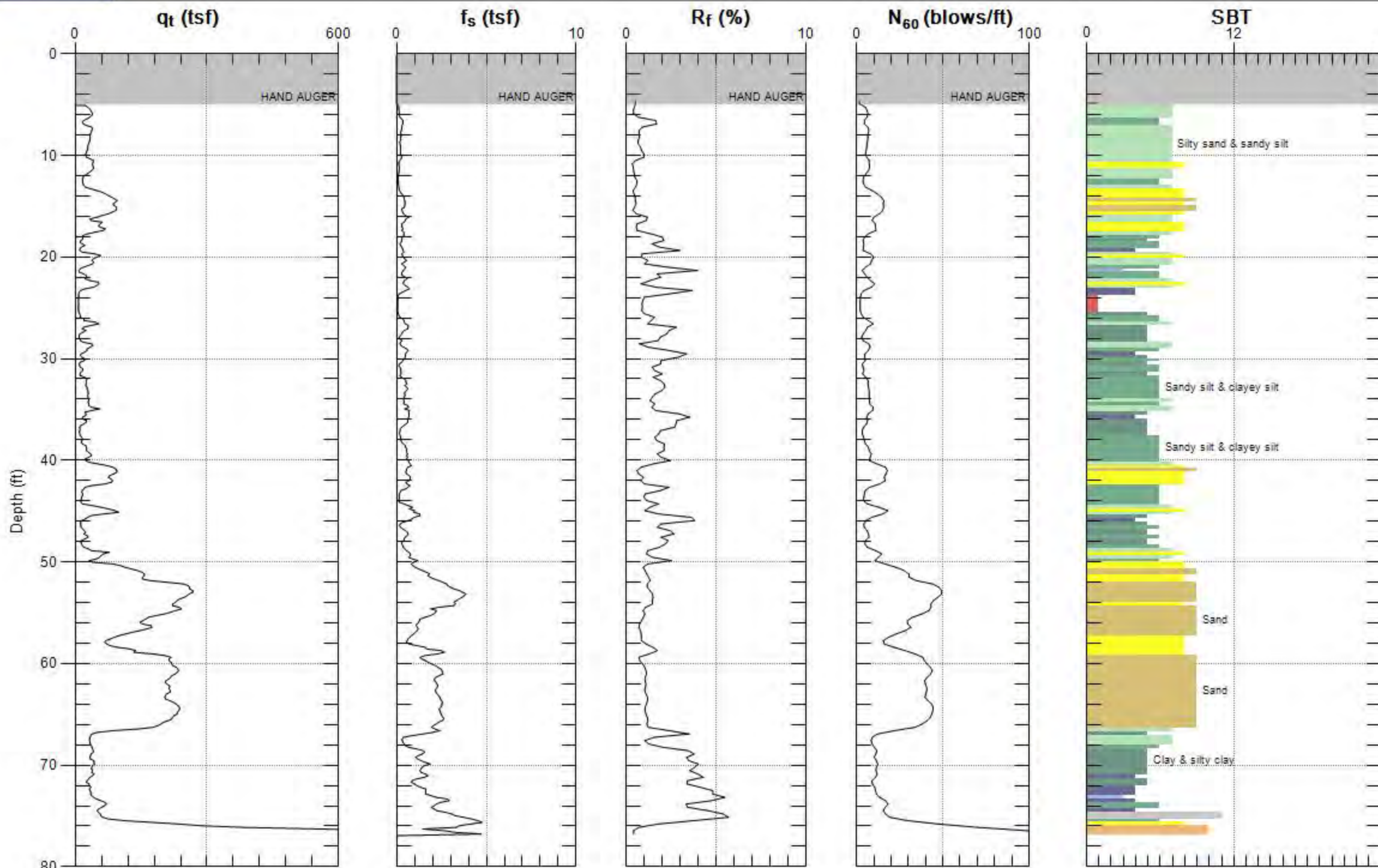
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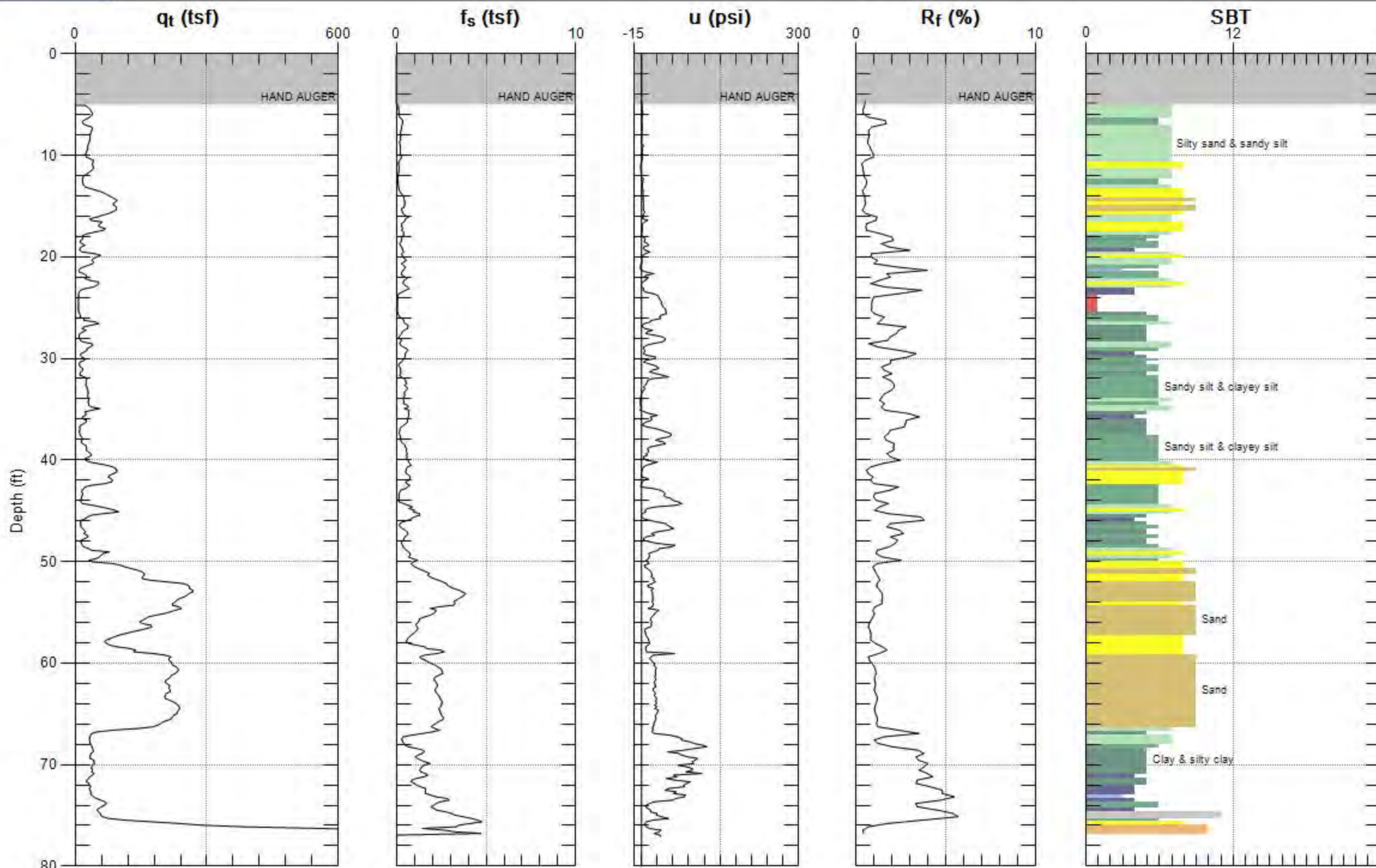
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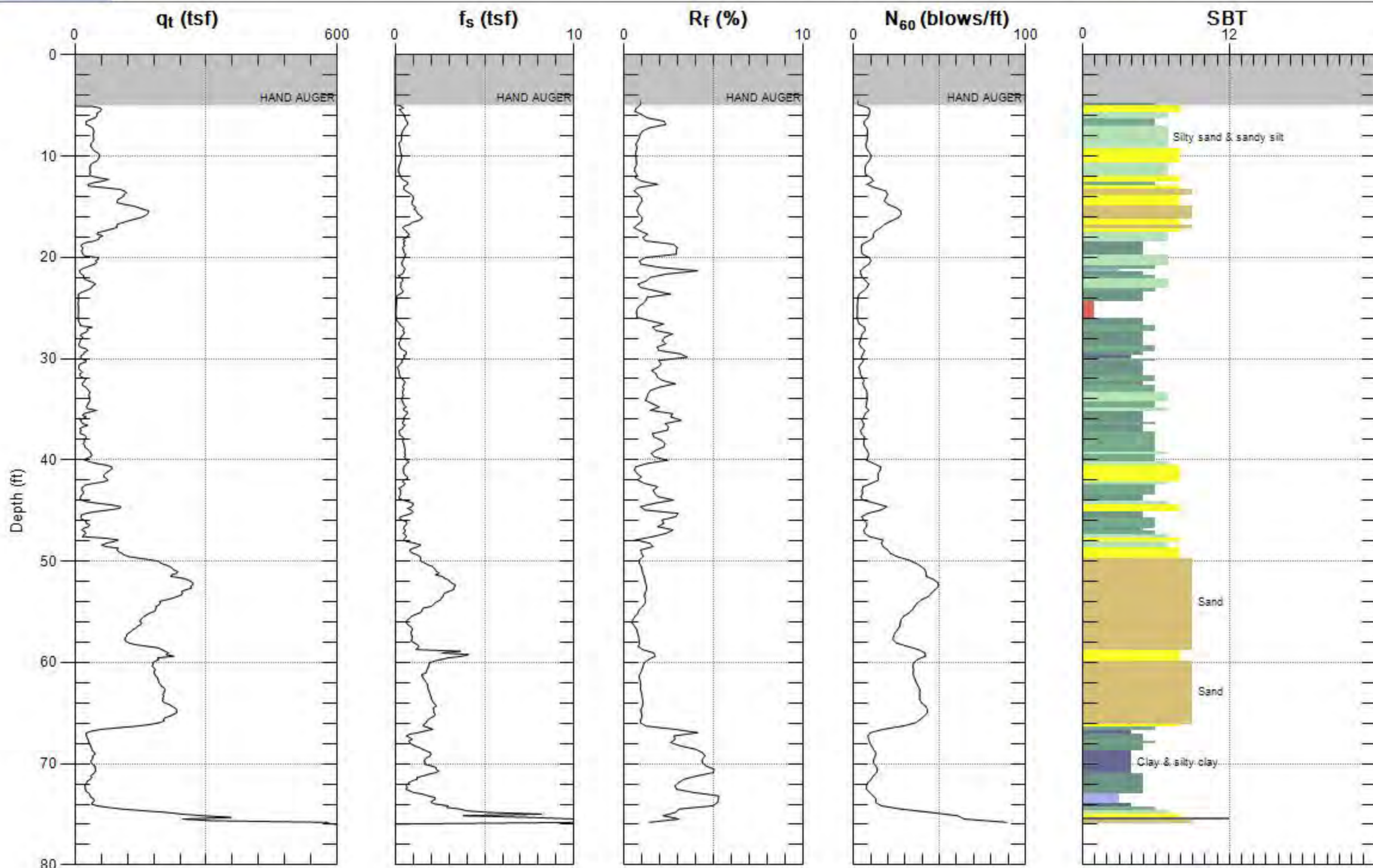
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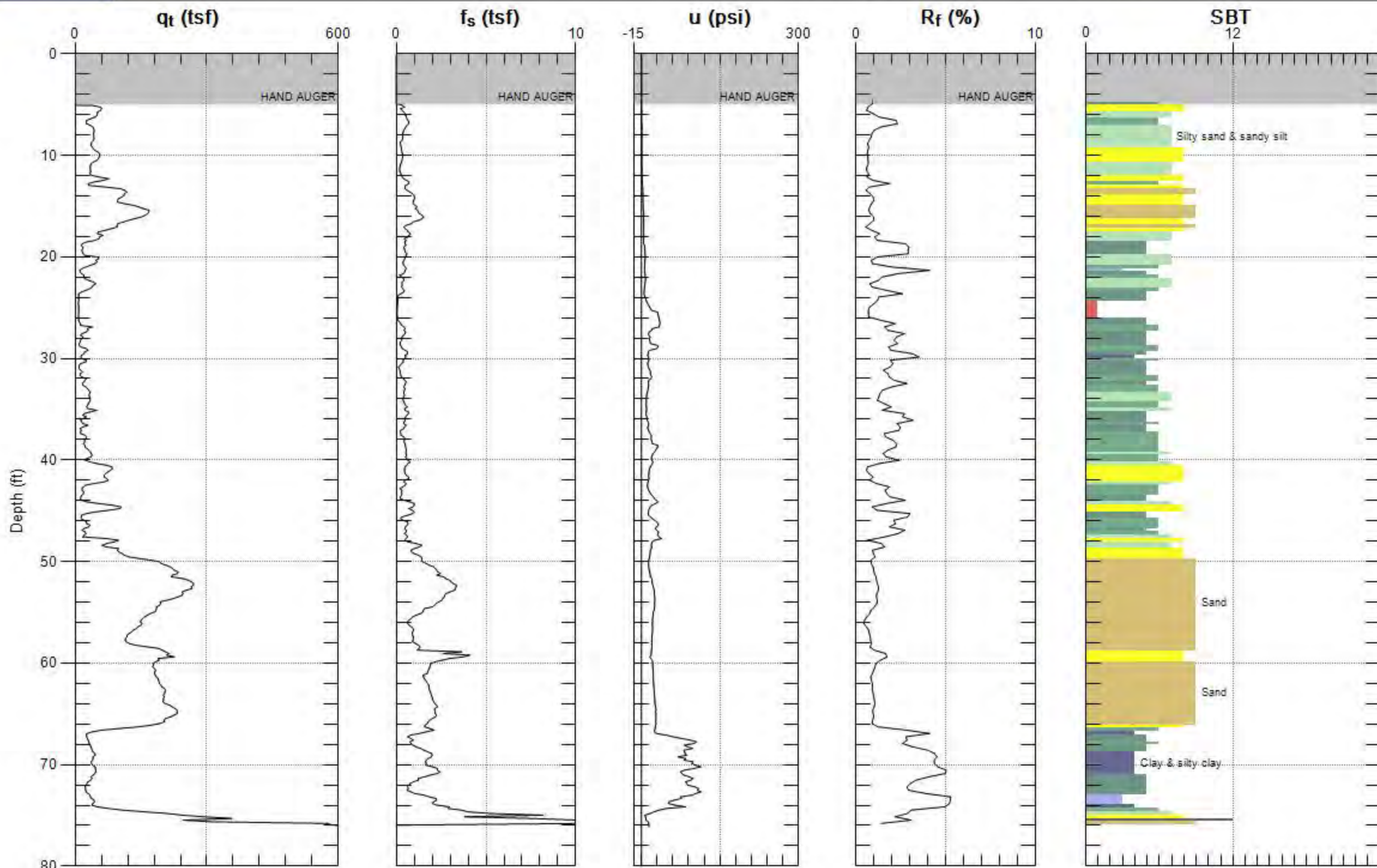
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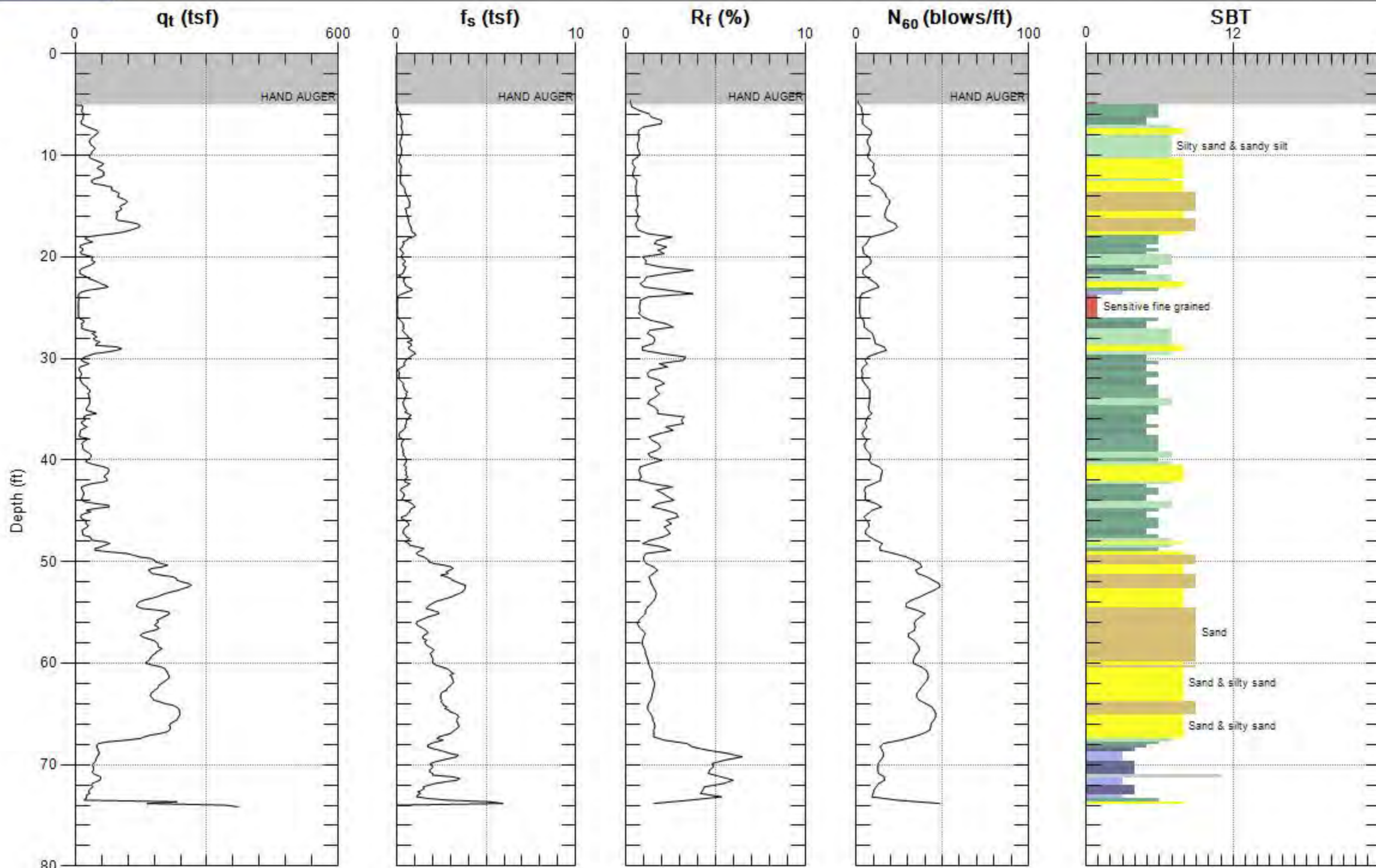
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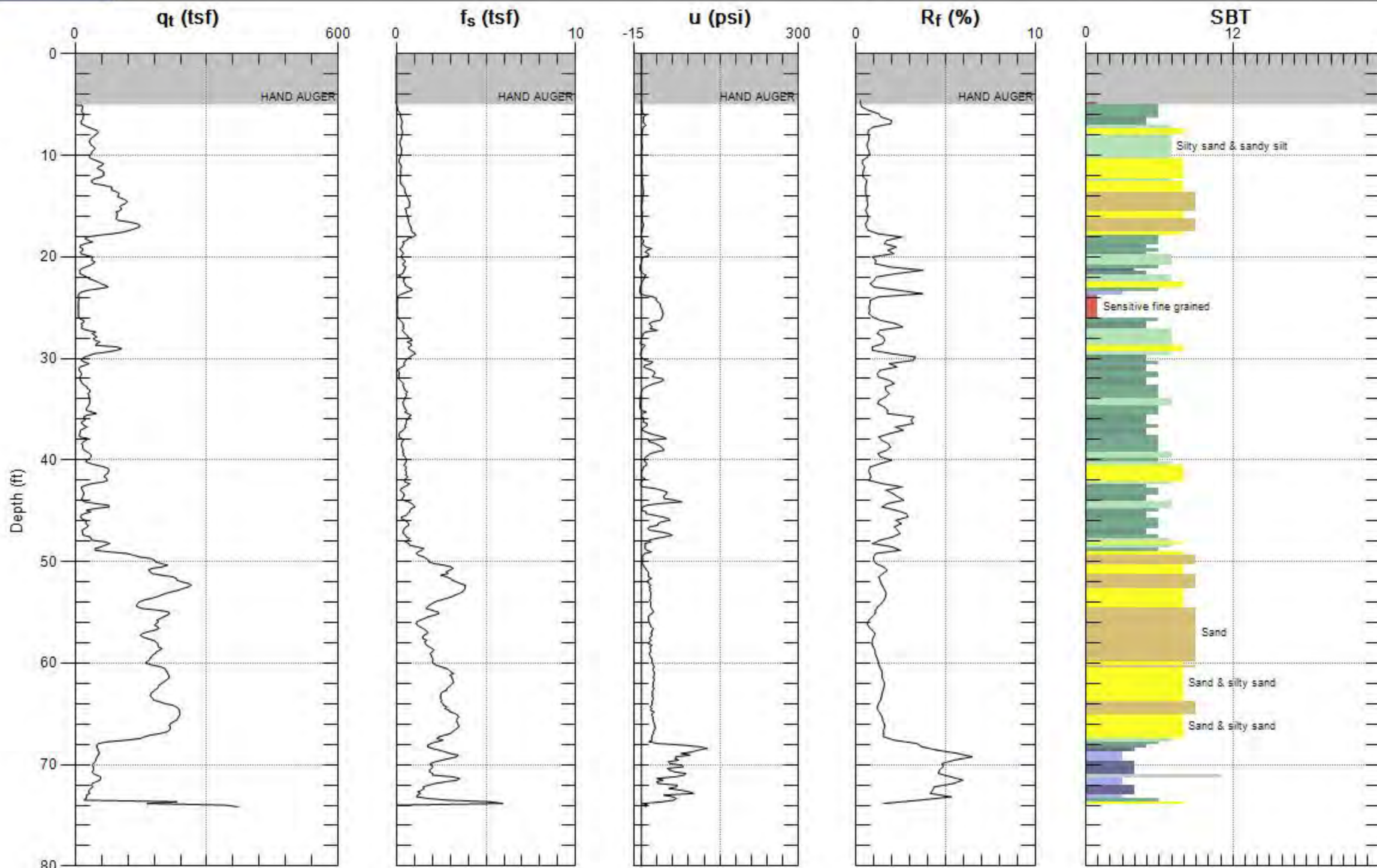
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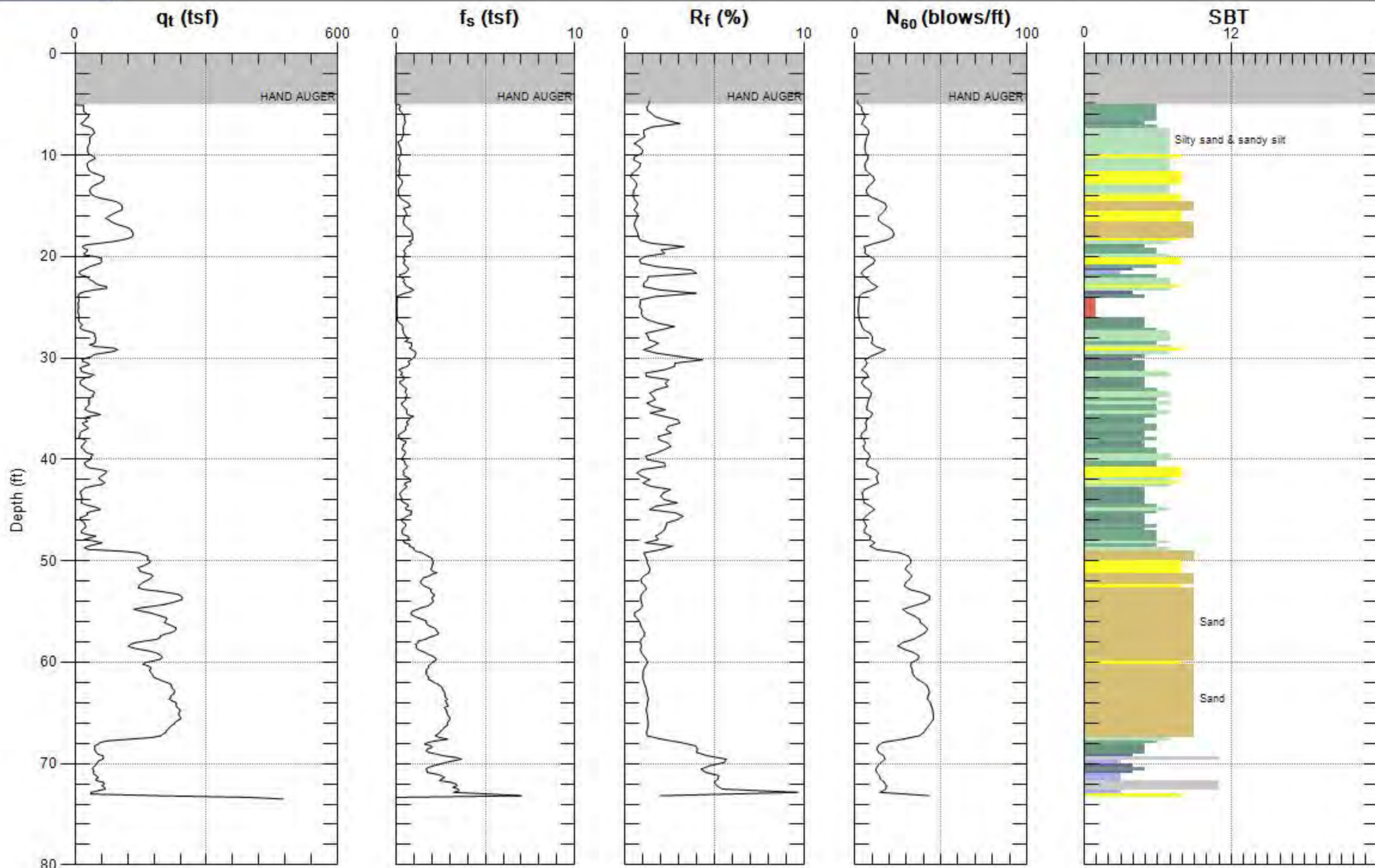
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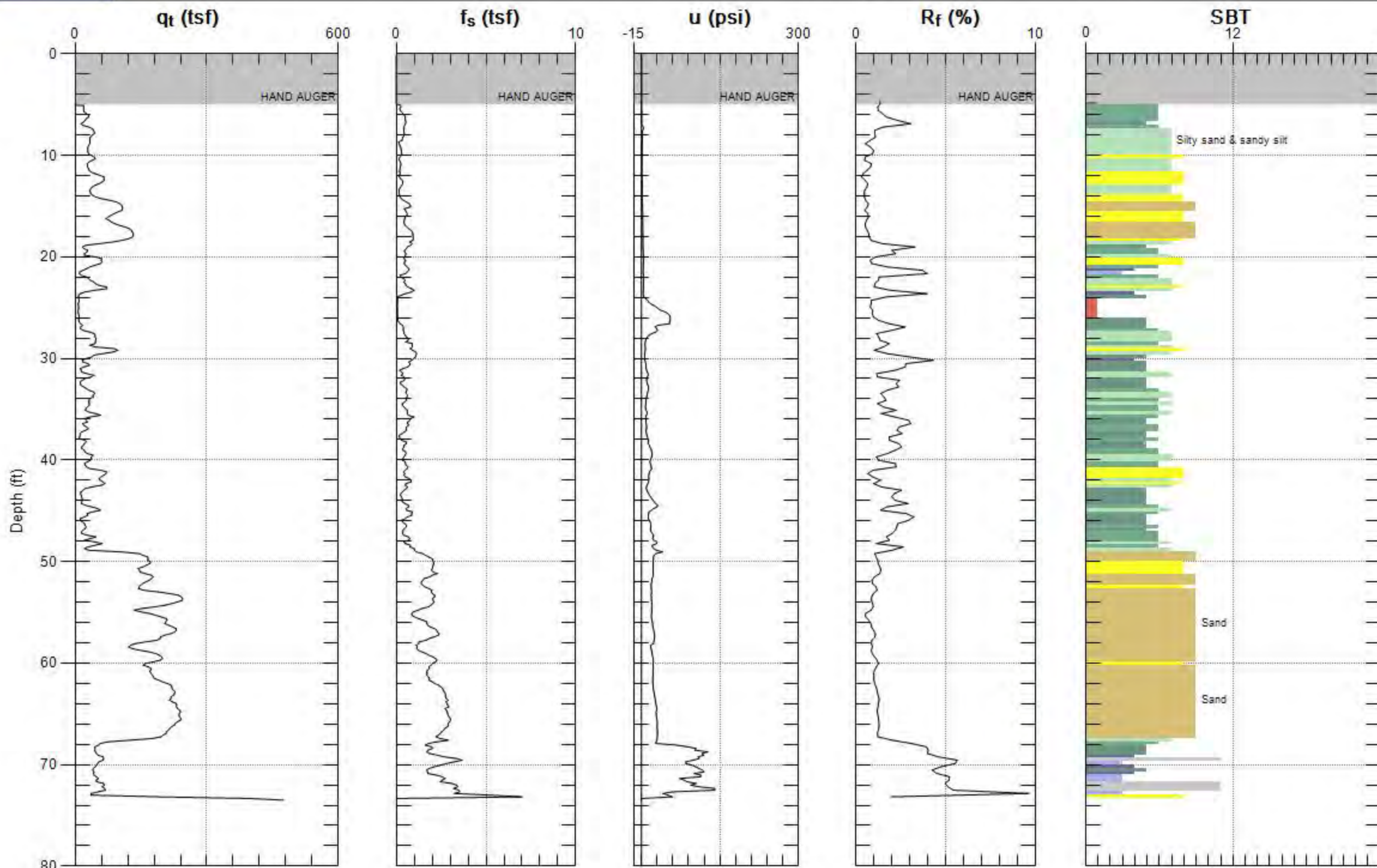
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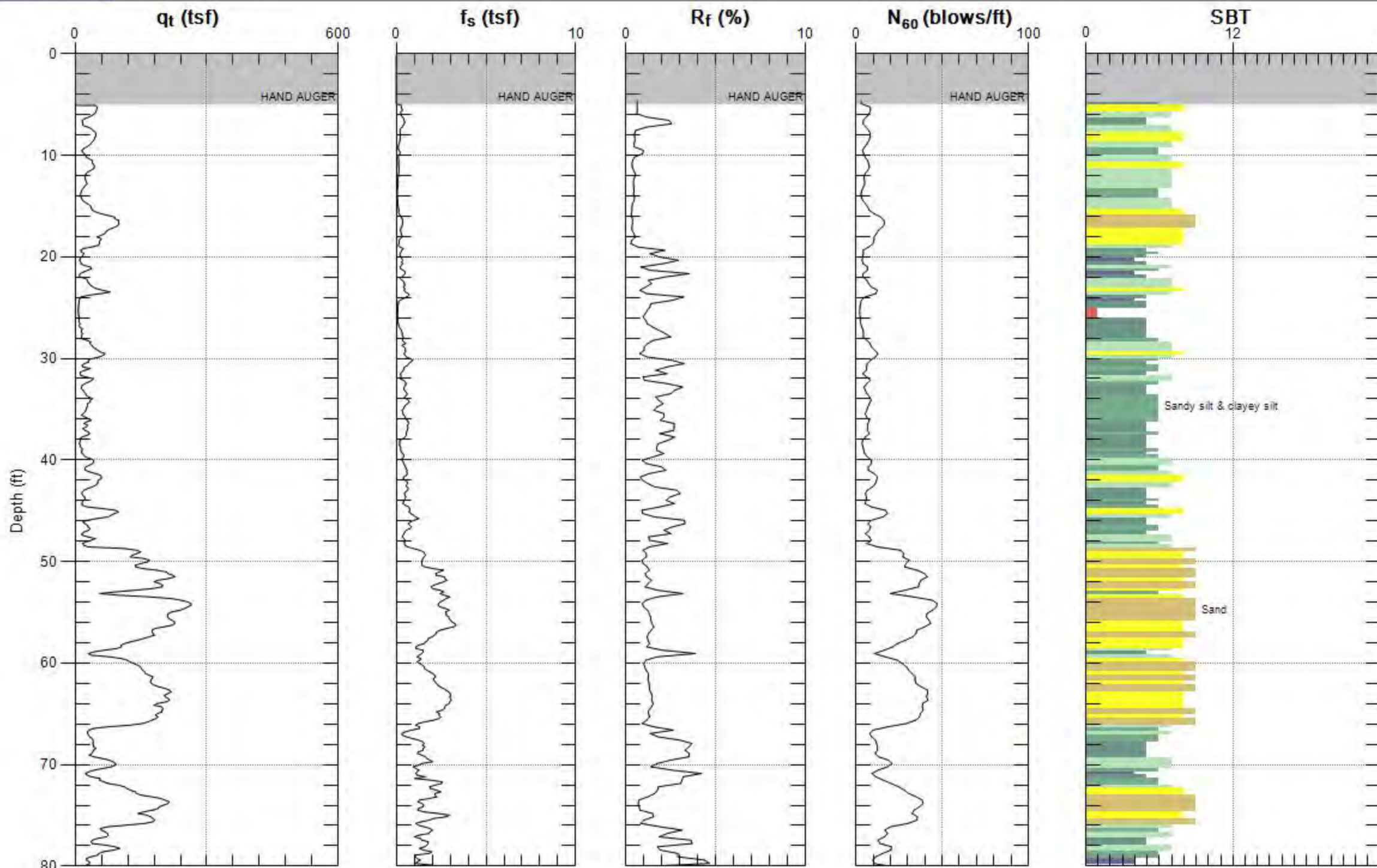
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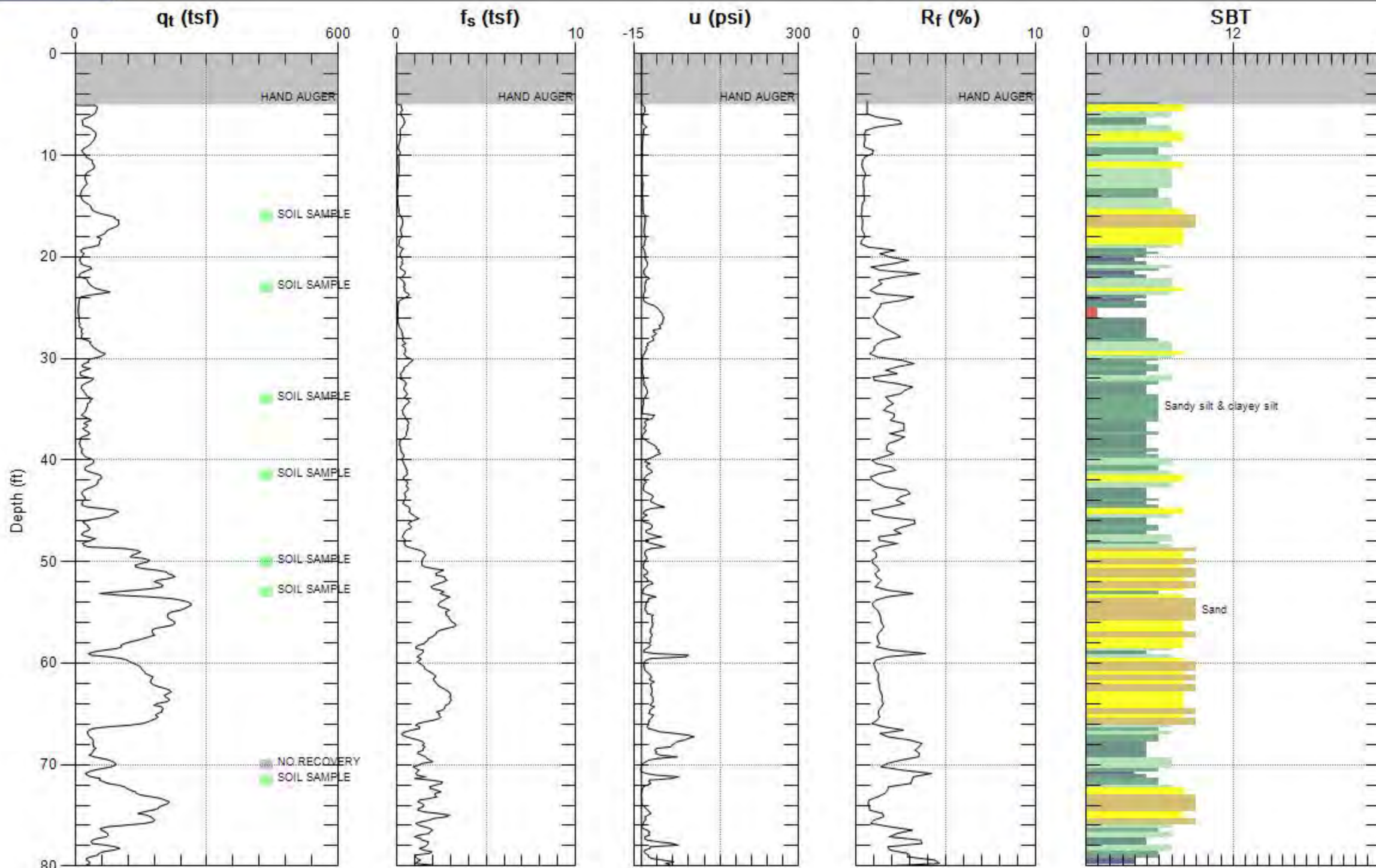
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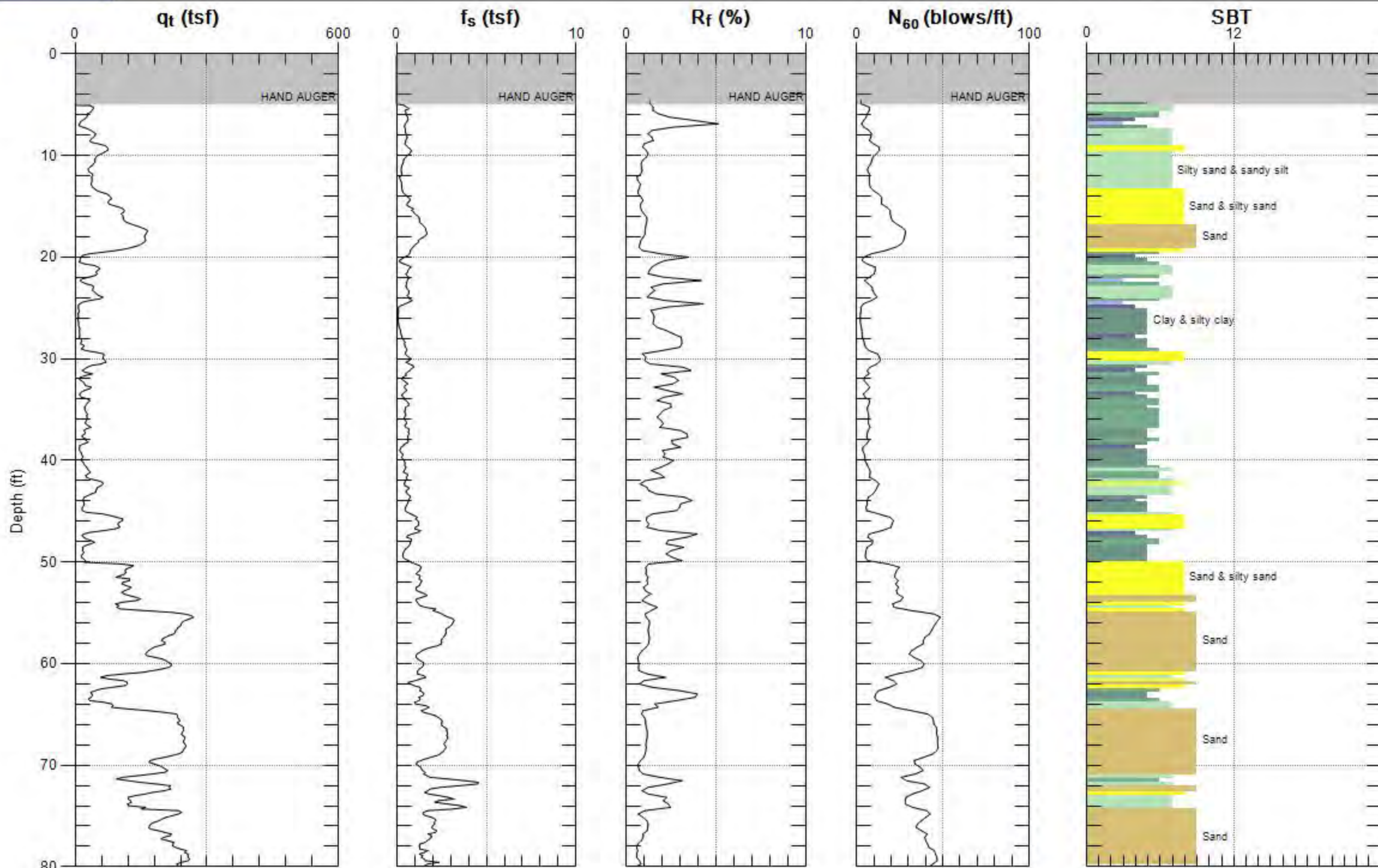
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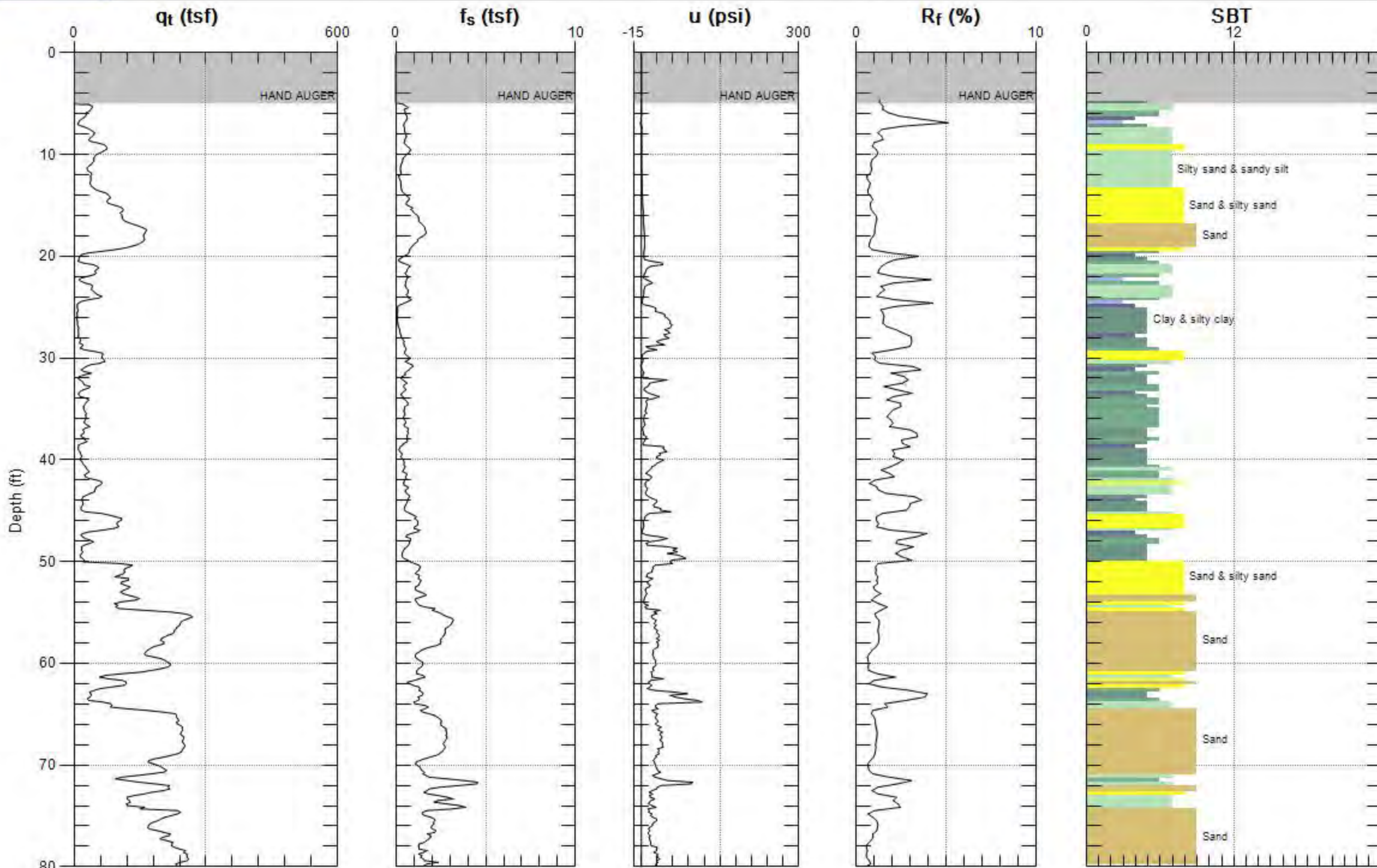
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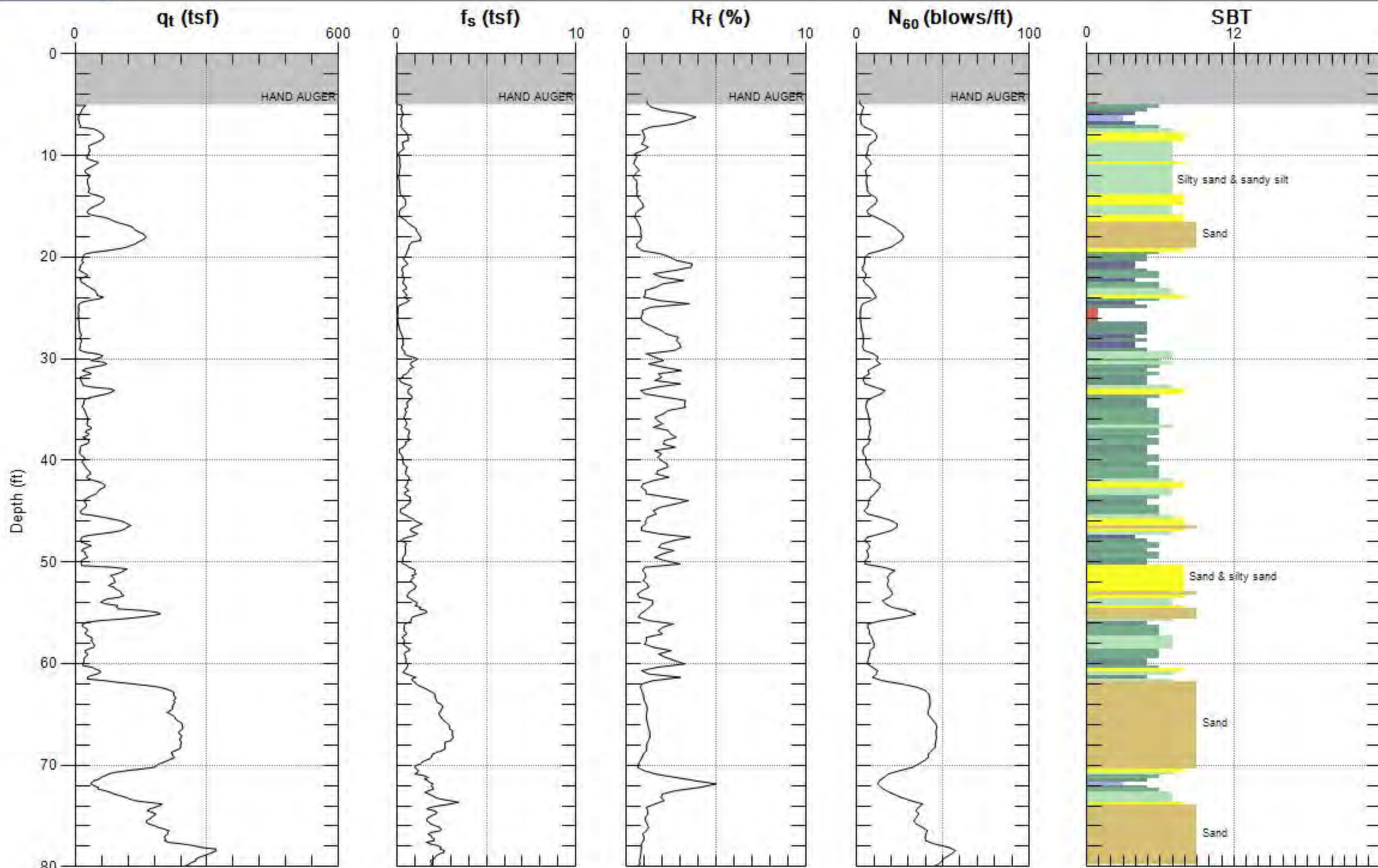
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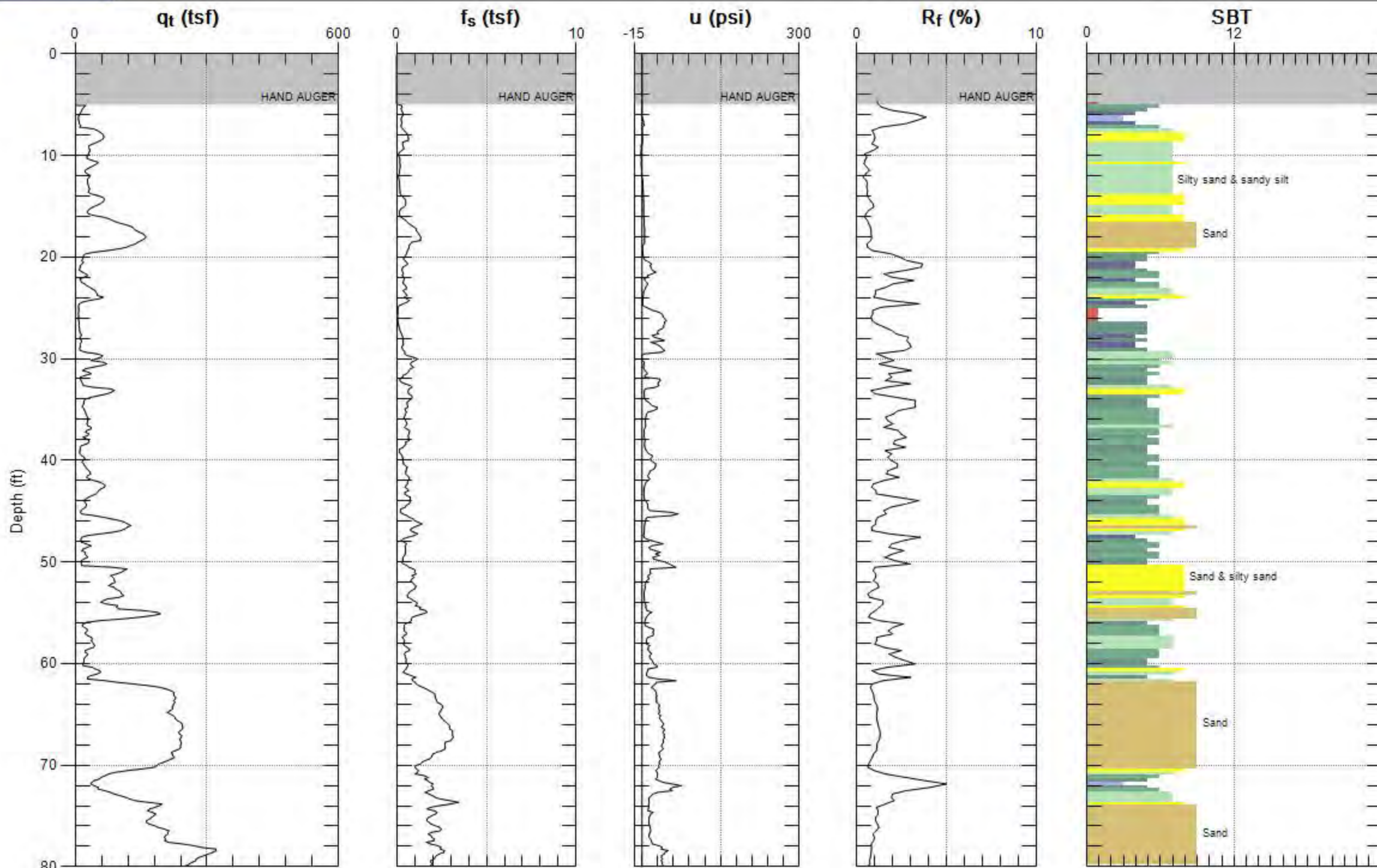
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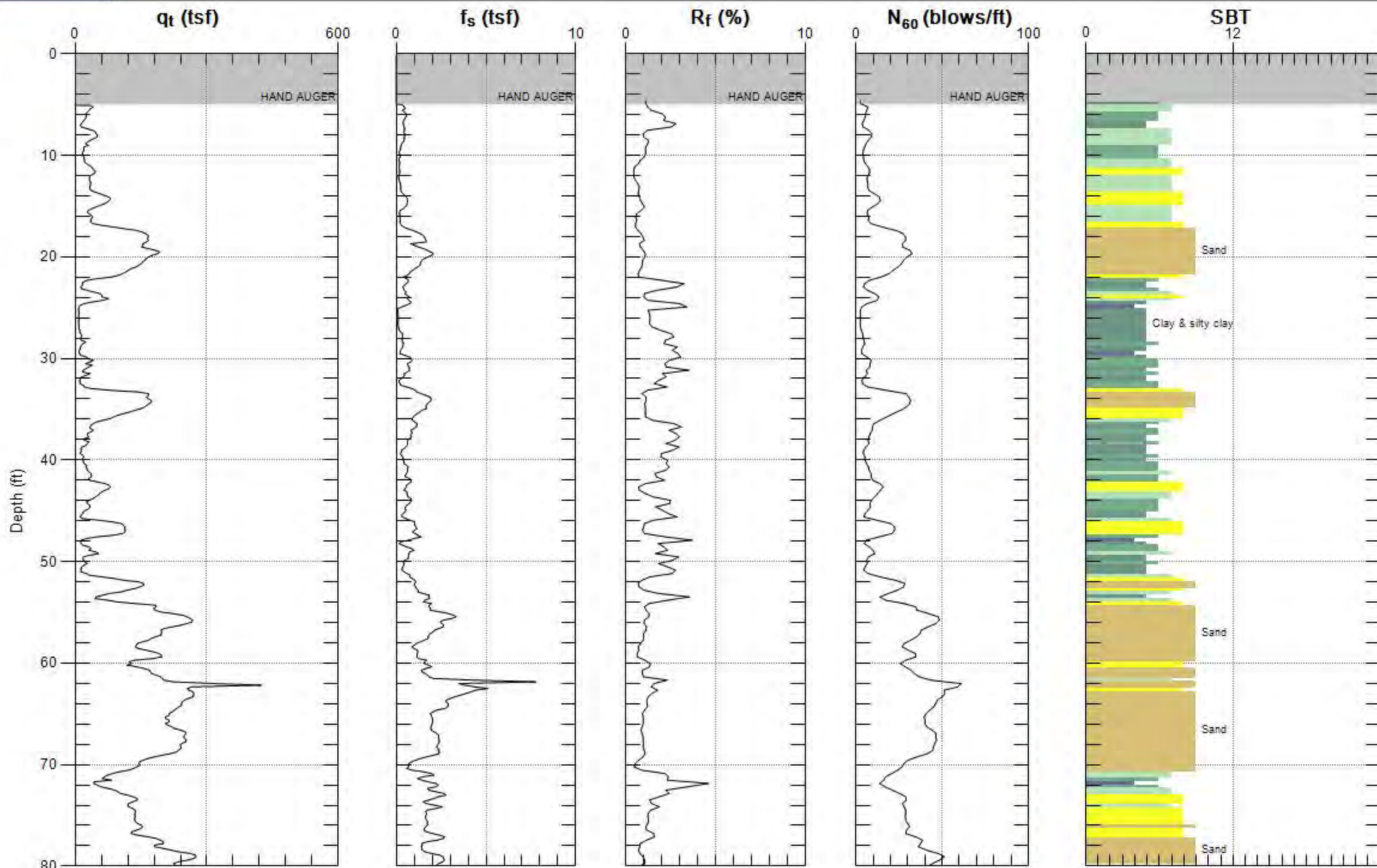
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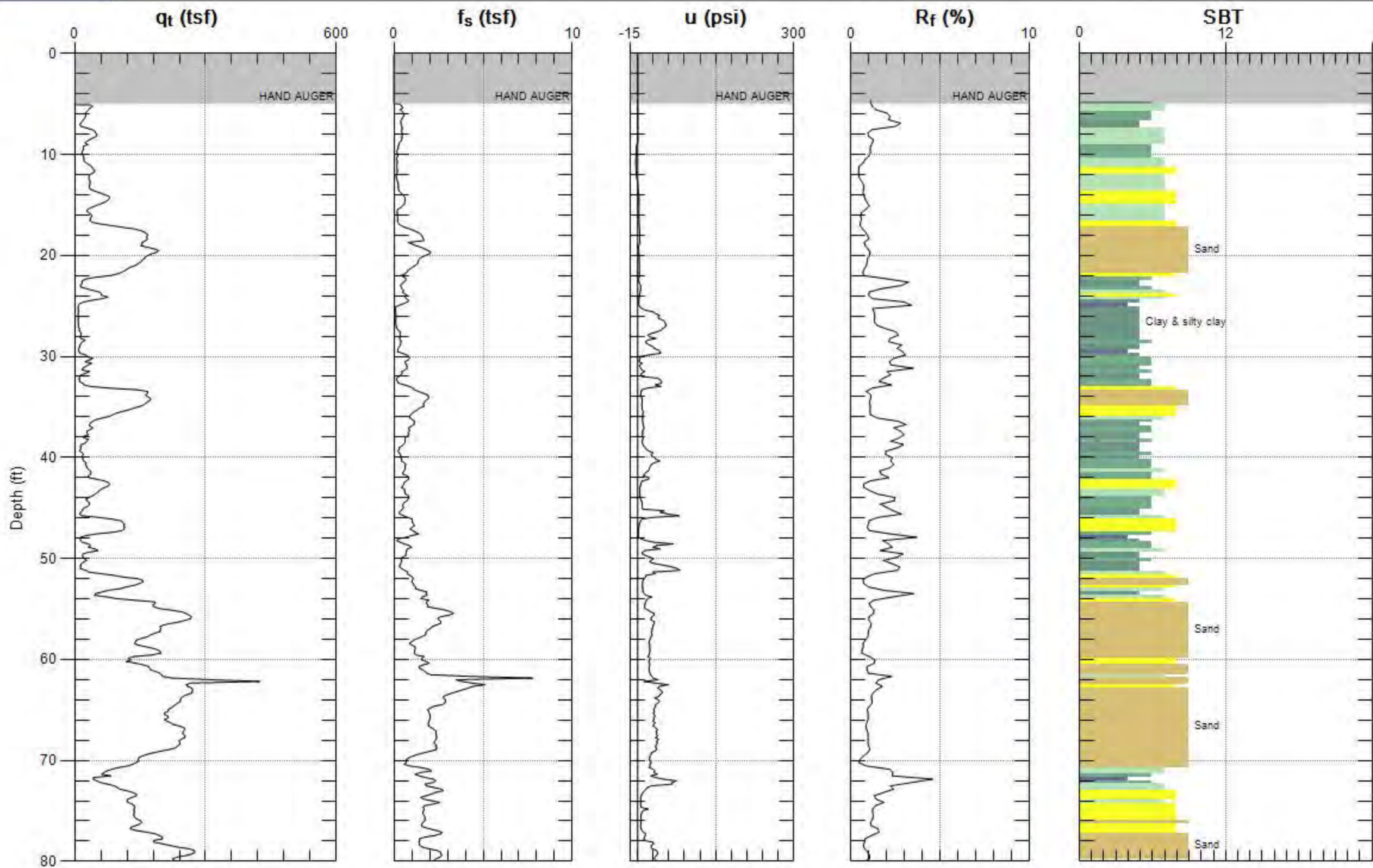
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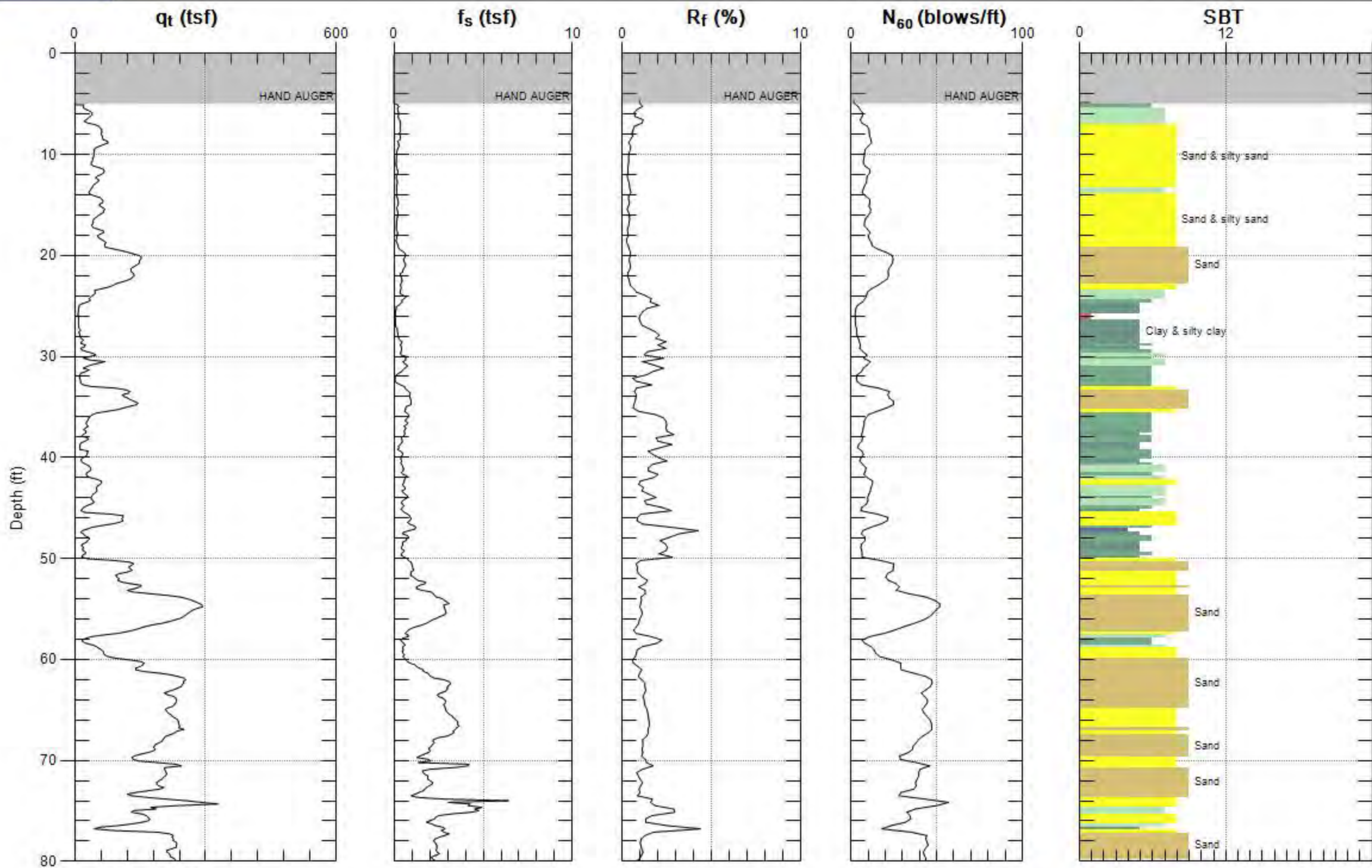
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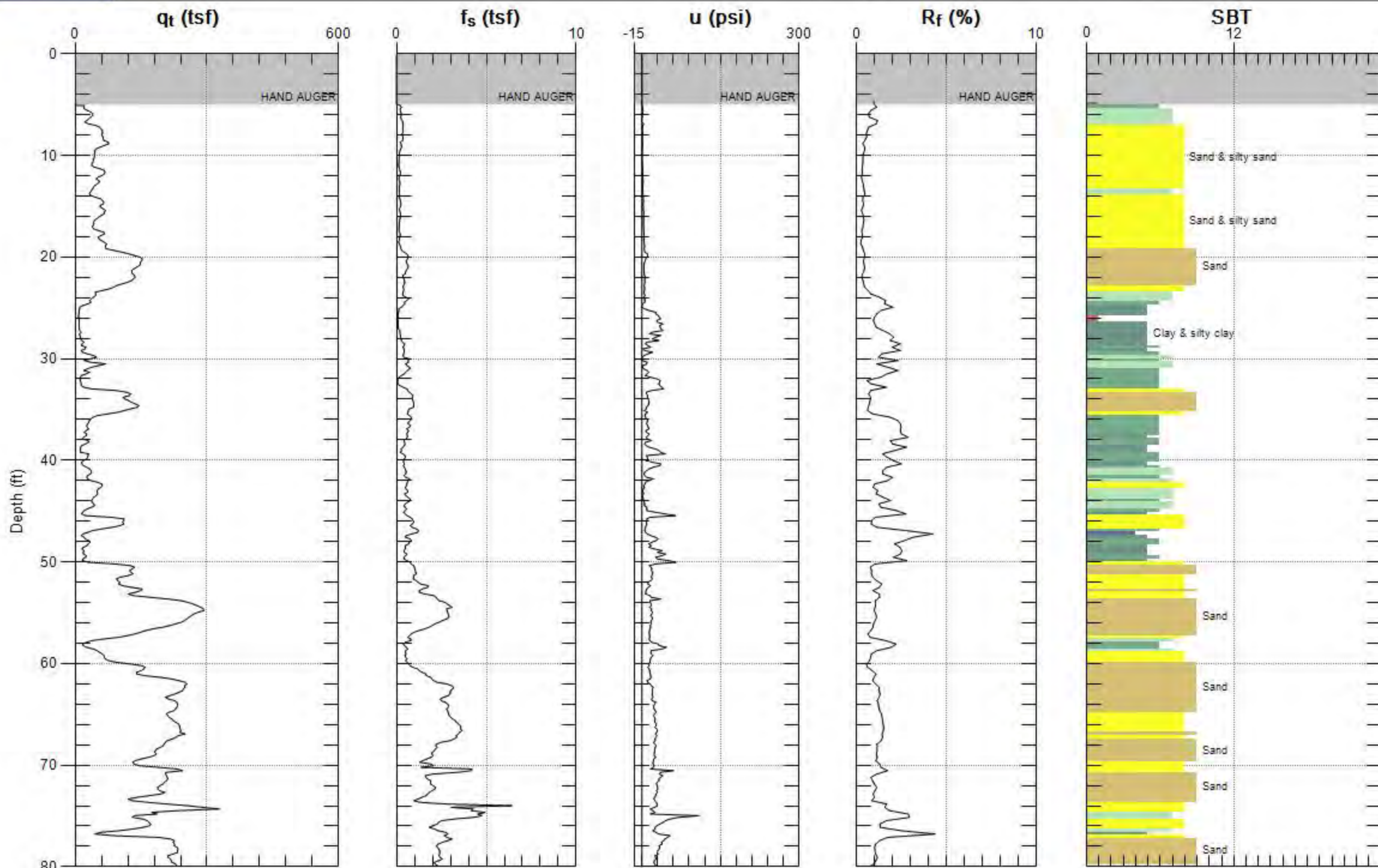
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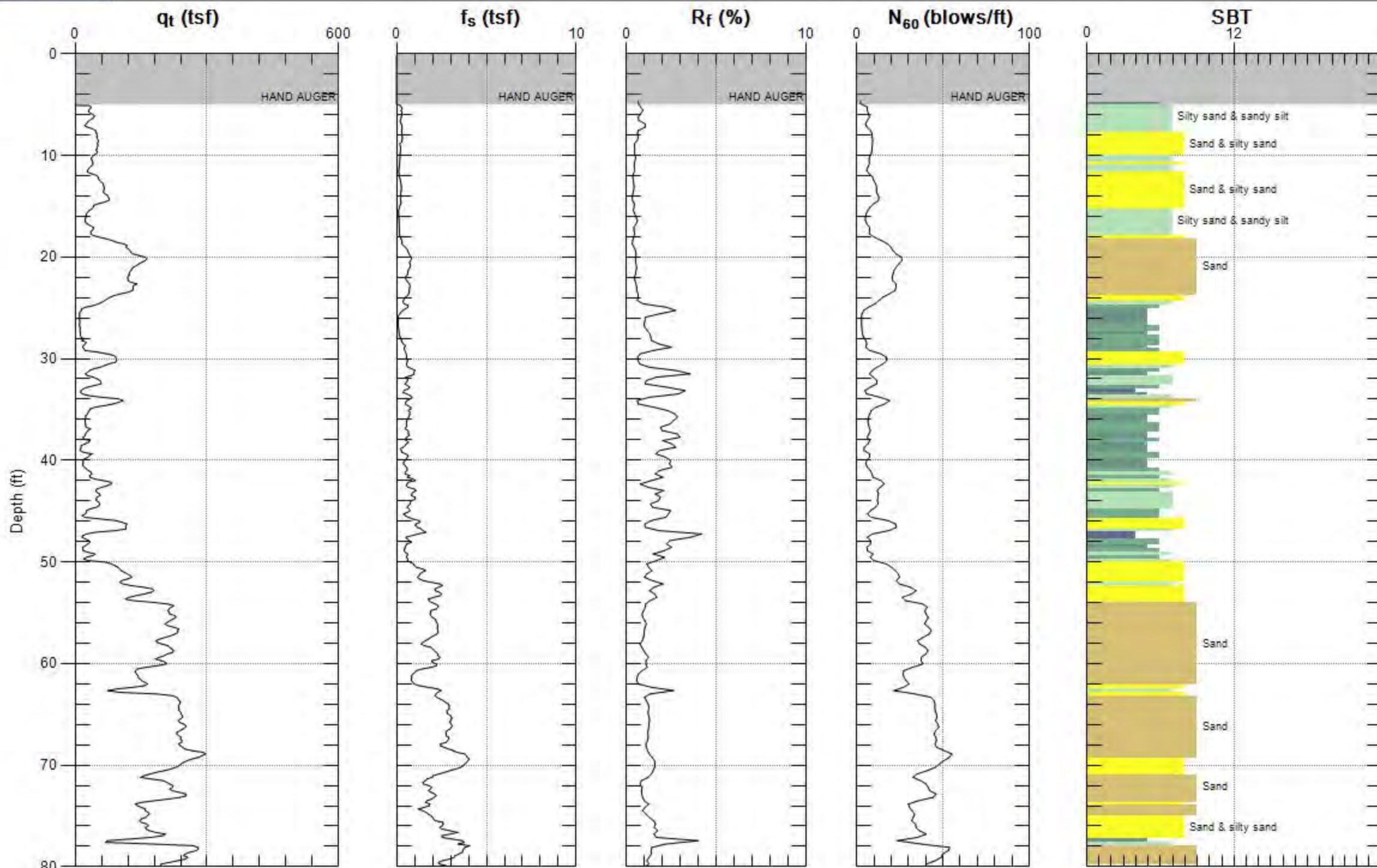
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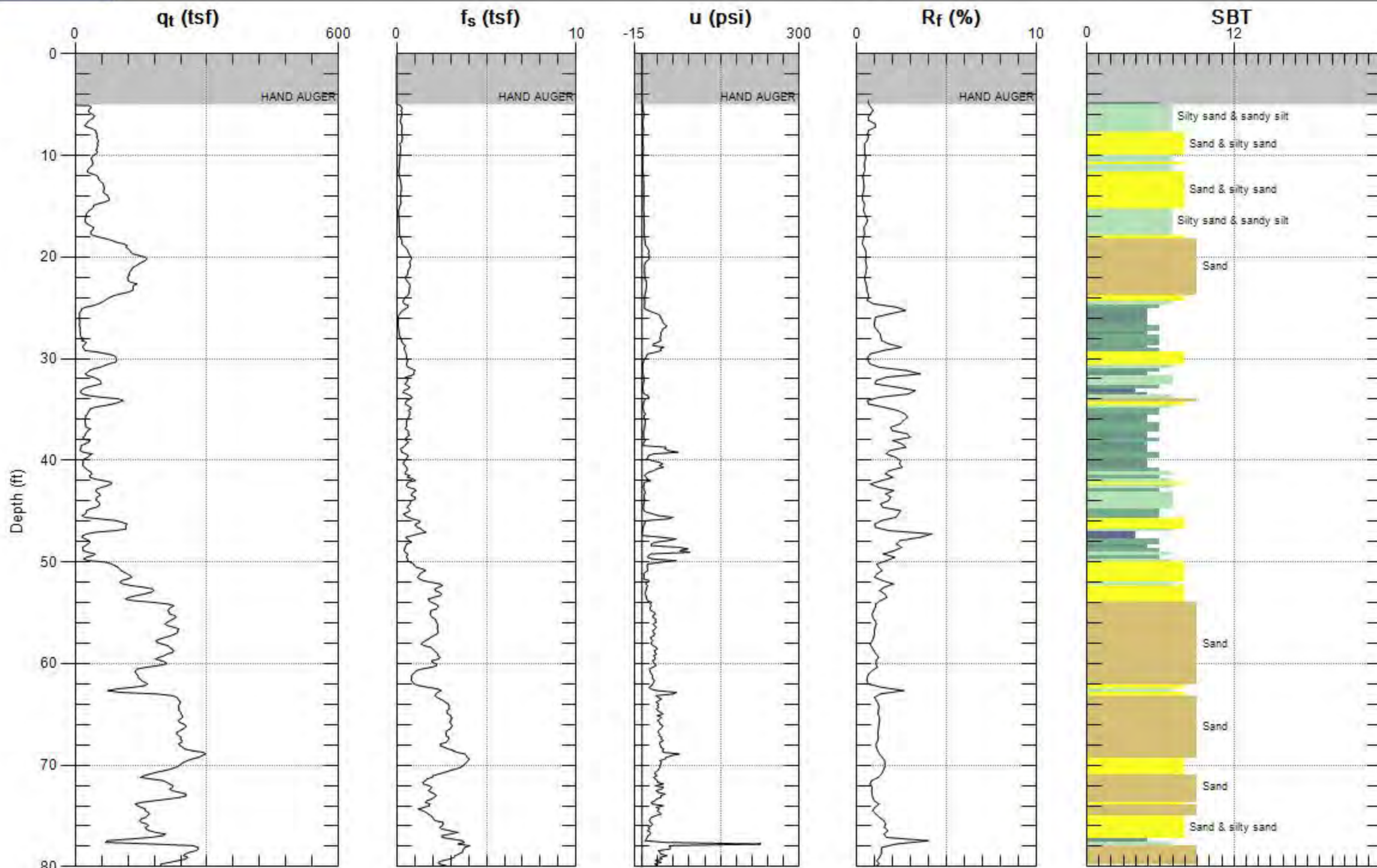
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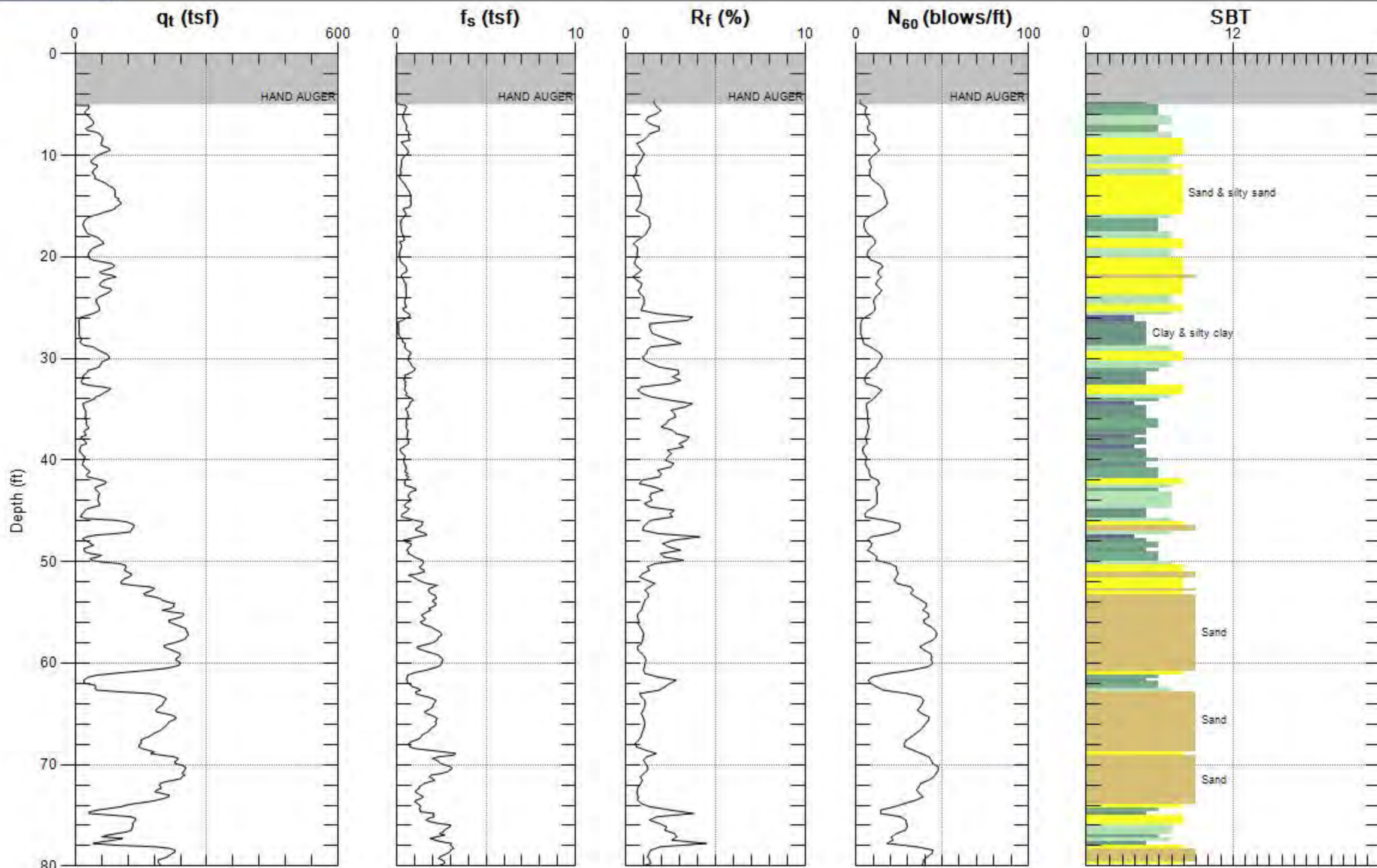
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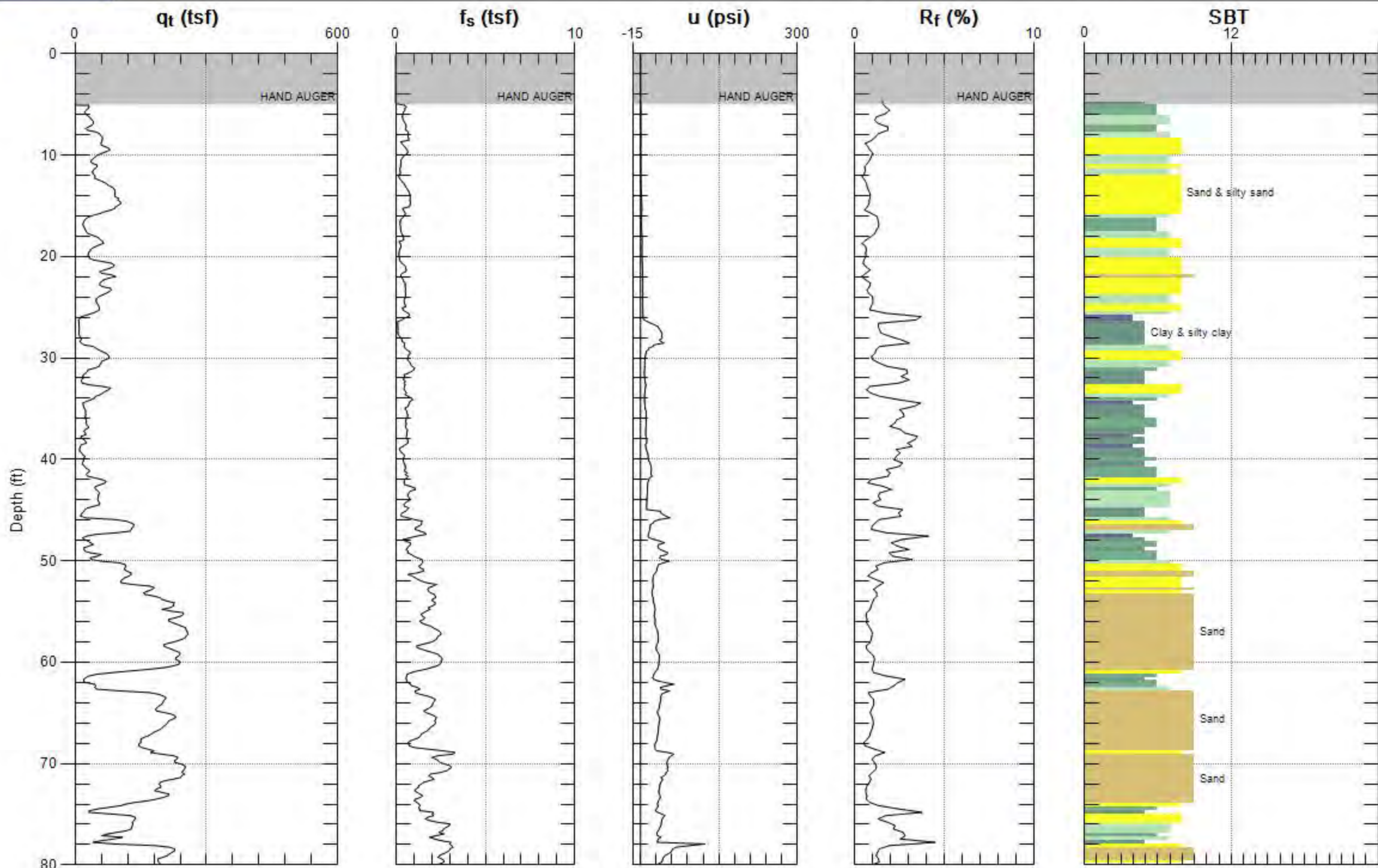
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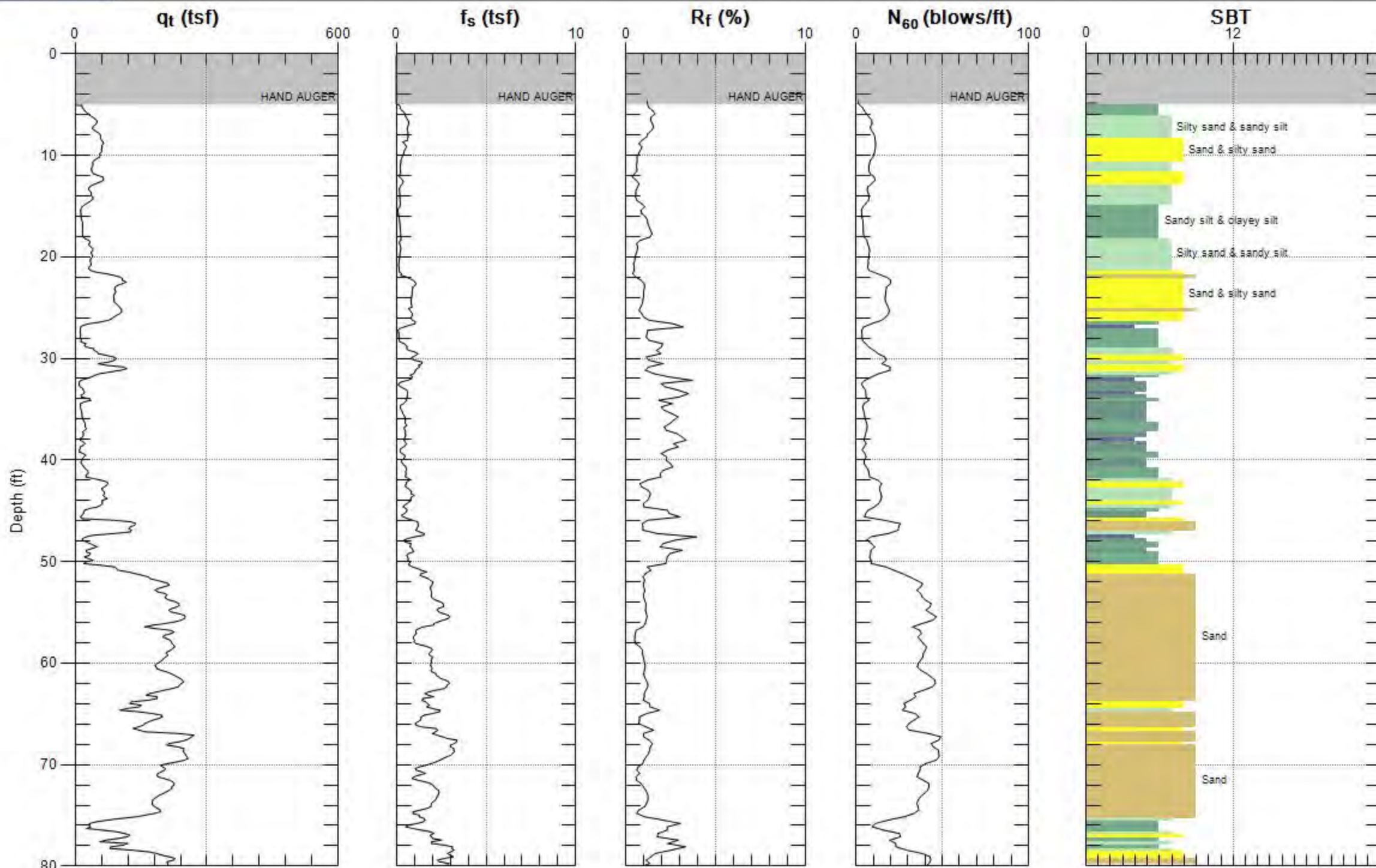
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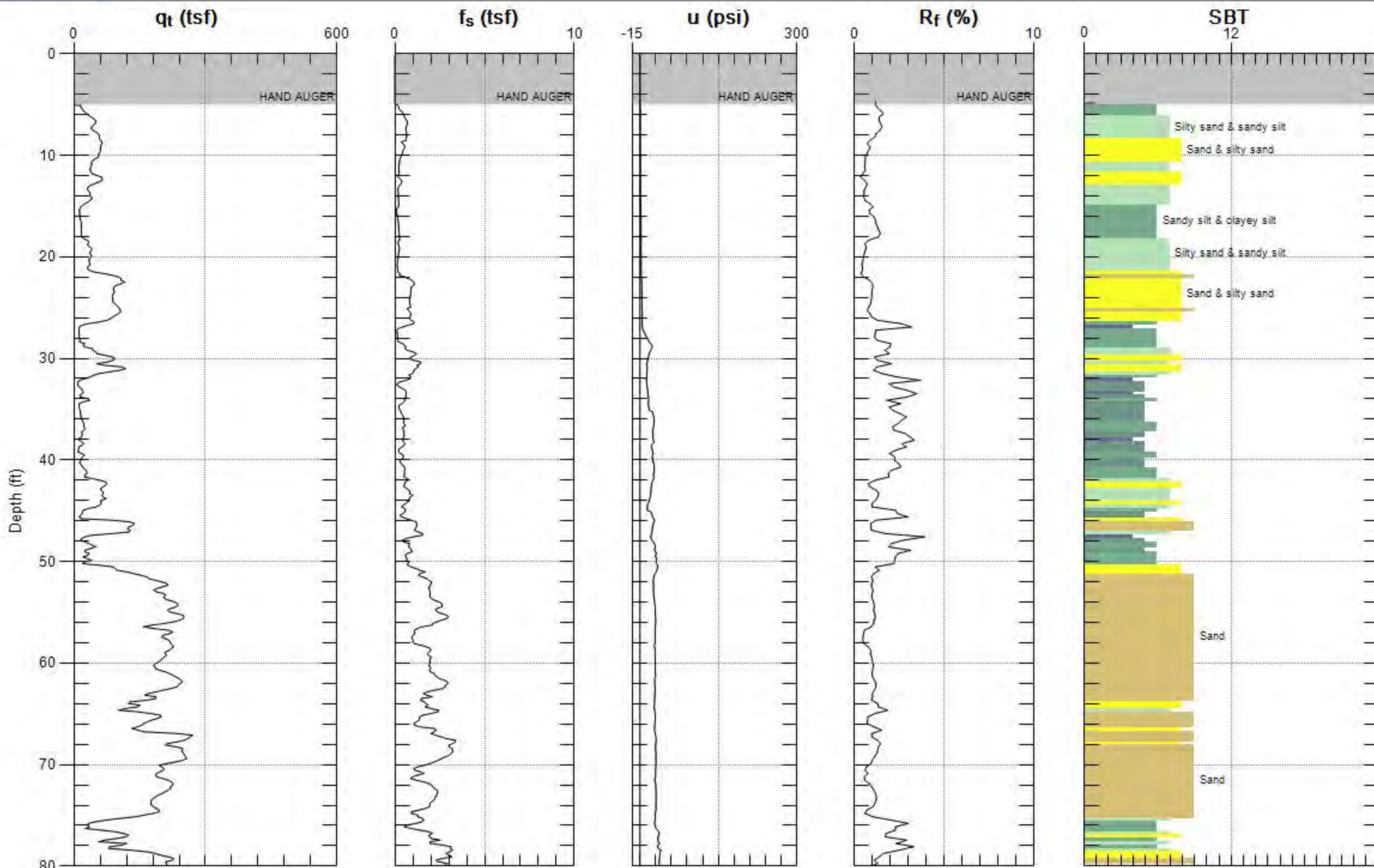
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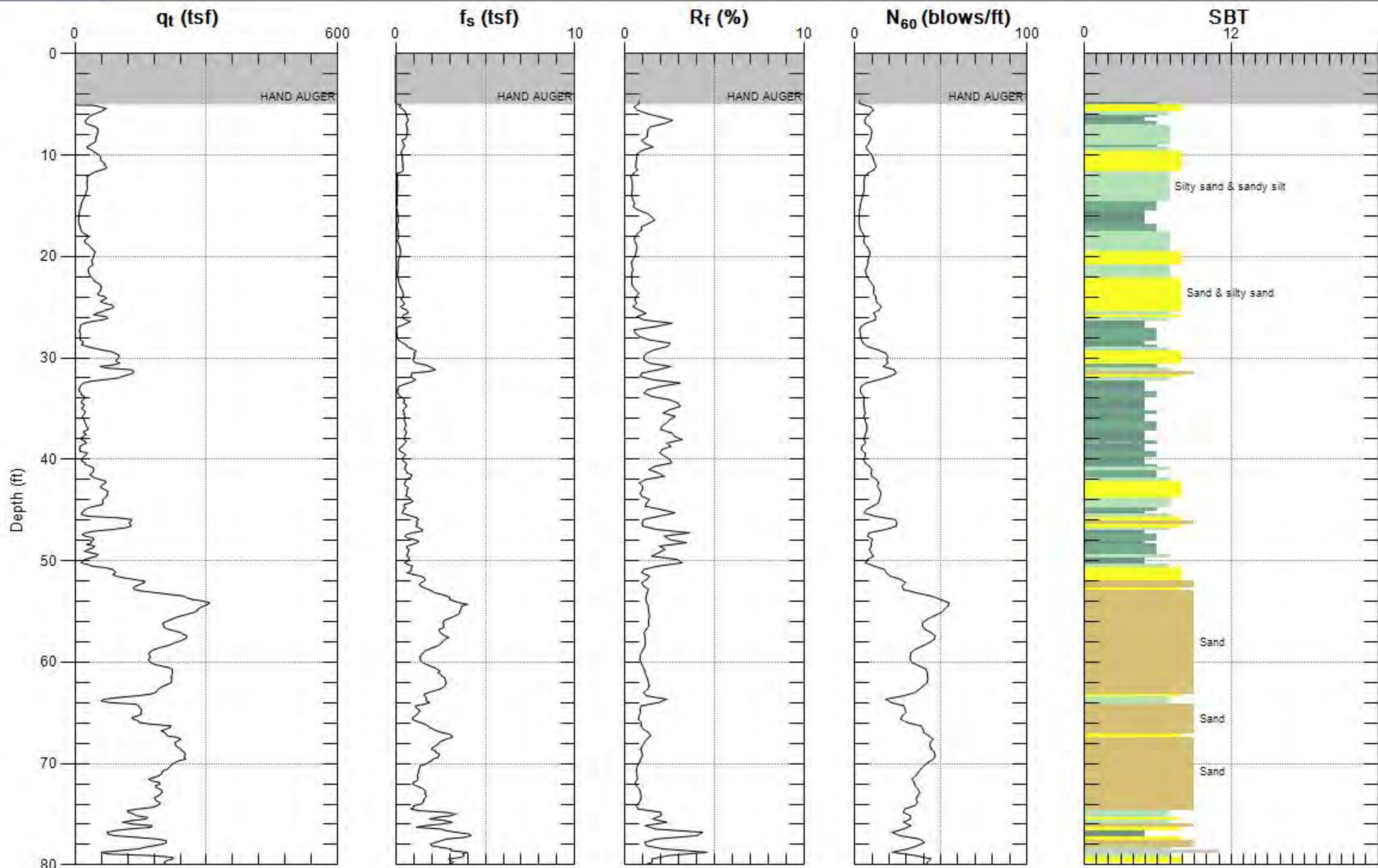
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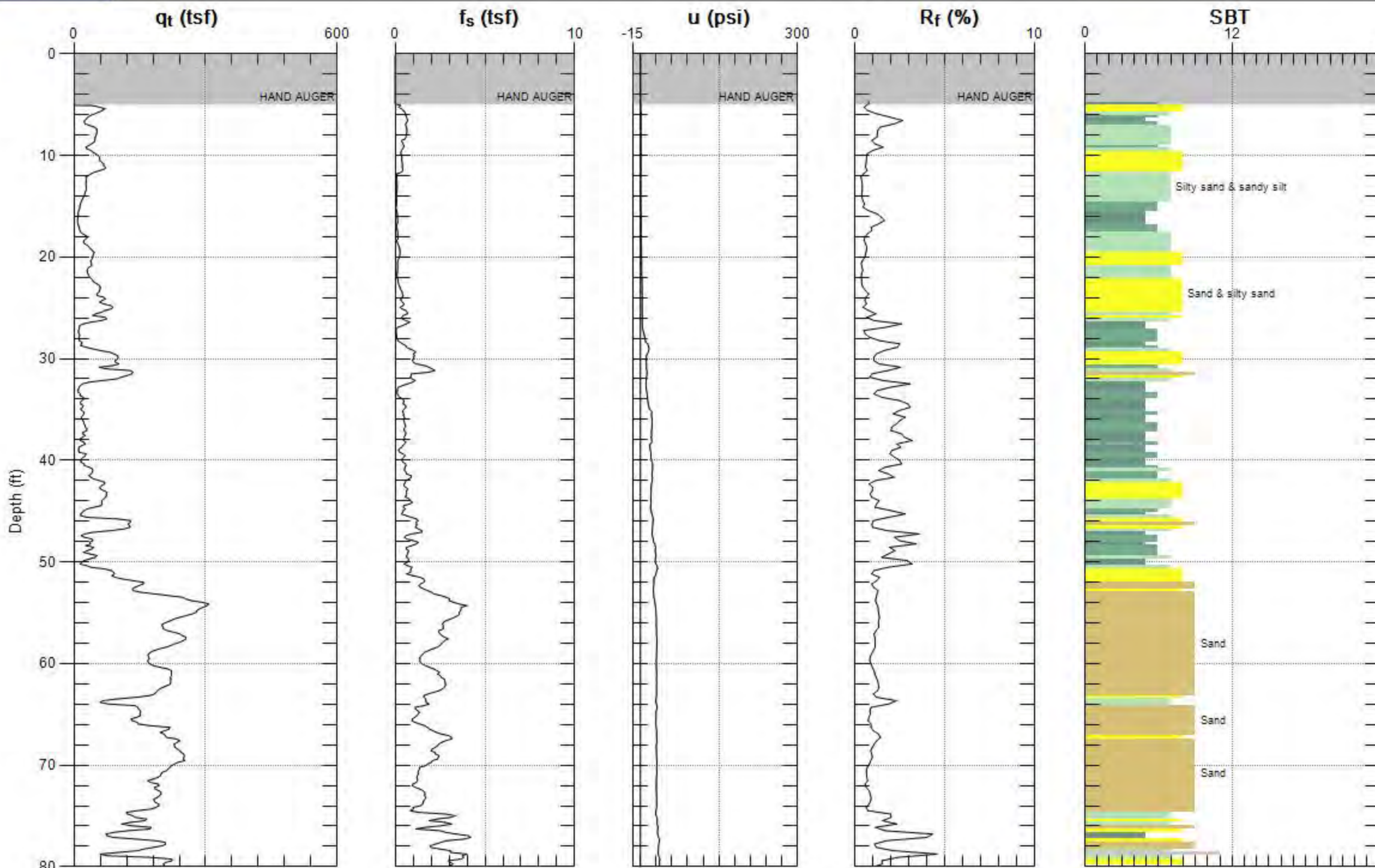
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Avg. Interval: 0.328 (ft)

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

Prepared by

AECOM  
401 West A Street, Suite 1200  
San Diego, California 92101





September 19, 2017

Ms. Laila Nasrawi  
City of San Diego  
Public Utilities Department  
9192 Topaz Way  
San Diego, California 92123-1119

Subject: 60% Design Development Report  
Geotechnical Investigation  
Morena Pipeline Tunnels  
WW Force Main and Brine/Centrated 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/Centrated 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.



David L. Schug, C.E.G. 1212  
Principal Engineering Geologist



Steven M. Fitzwilliam, G.E. 2501  
Principal Geotechnical Engineer





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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/Centrates 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/Centrates 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<sub>6</sub>, Qvop<sub>9</sub>, Qvop<sub>10</sub>)

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

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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 Genesee 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 that 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.

#### 4.4.12 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.

#### 4.4.32 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 properly 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

- Allied Geotechnical Engineers, Inc. "Geotechnical Desktop Study Report, Pure Water Program Task 7, Morena Pump Station, WW Force Main and Brine Conveyance Pre-Design (NC05), City of San Diego," dated December 14, 2015.
- Allied Geotechnical Services, Inc., 2017, Report of Geotechnical Investigation, North City Water Reclamation Plant Expansion, City of San Diego, prepared for CH2M, AGE Project No. 44F1, dated July 25, 2017.
- Bouwer H., Rice R.C. (1976) A slug test for determining hydraulic conductivity of unconfined aquifers with completely or partially penetrating wells. *Water Resources Research*, 12 (3): 423-428.
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## FIGURES









### Legend

**Qvop9** 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:

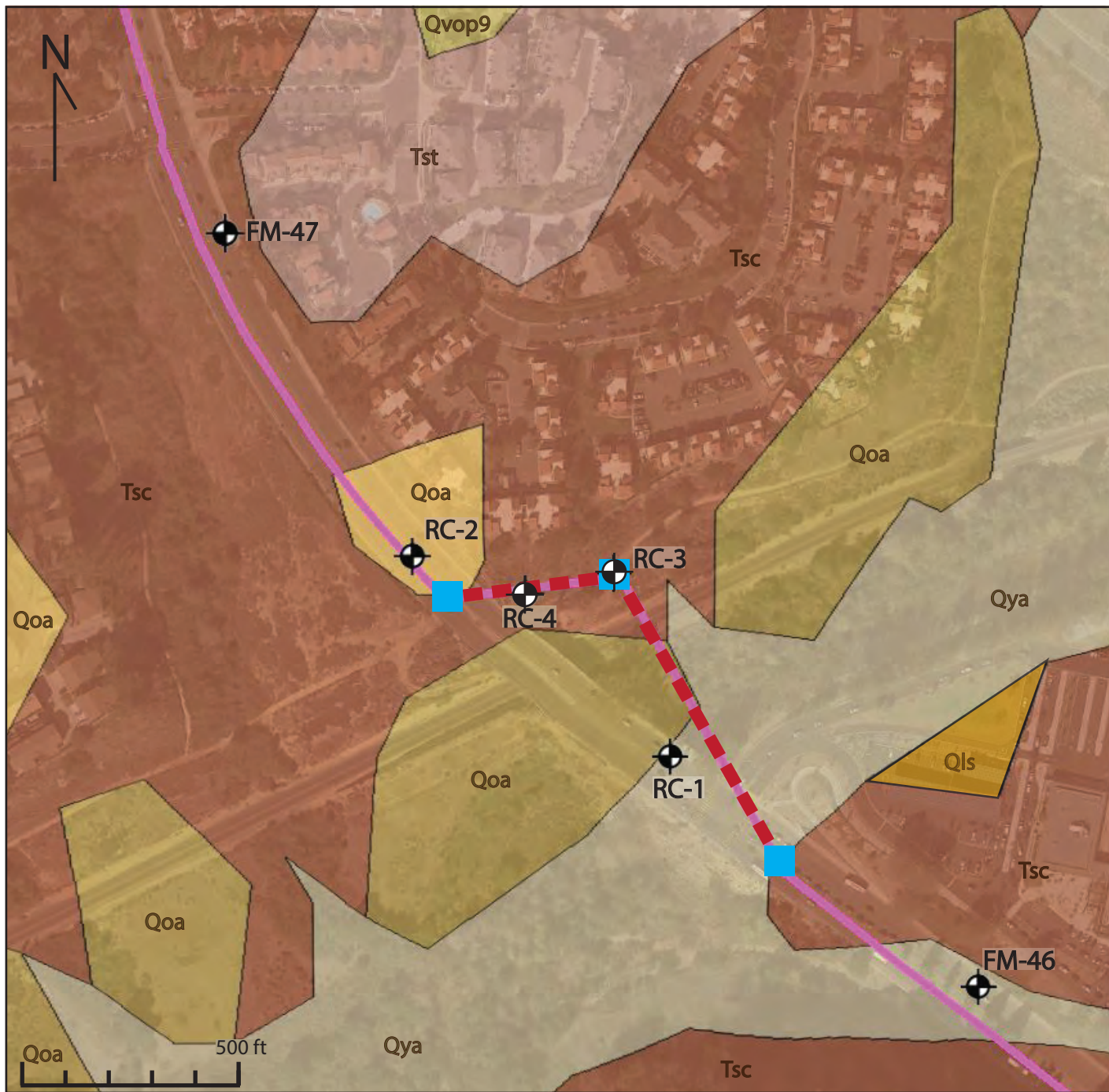
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FIG. NO.

PM:

NO: 60530732

9

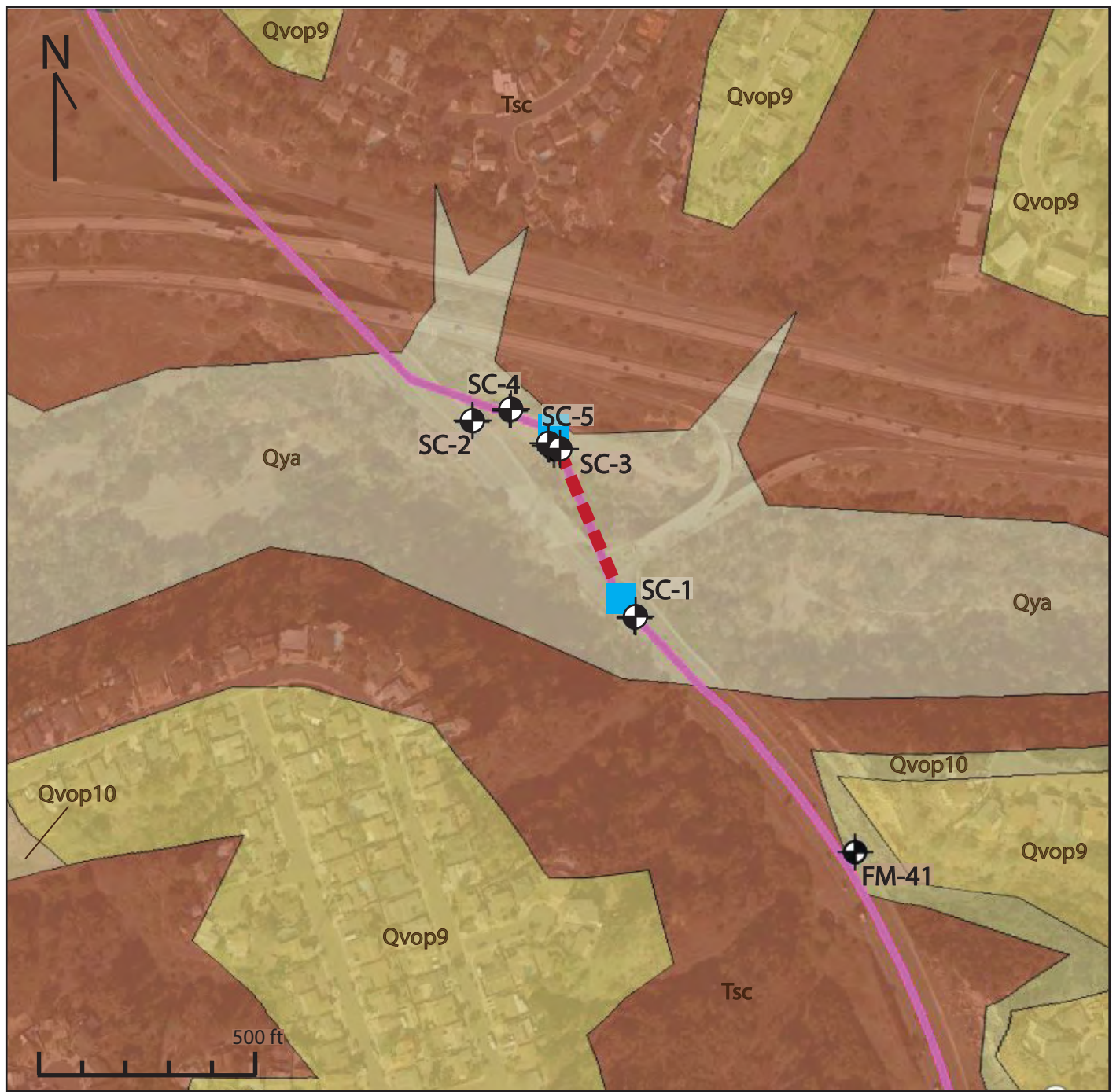


**Legend**

- Qls Landslide deposits
- Qya Young alluvial flood-plain deposits
- Qoa Old alluvial flood-plain deposits
- Qvop<sub>9</sub> Very old surficial deposits (Linda Vista Fm.)
- Tst Stadium Conglomerate
- Tsc Scripps Formation
- Boring
- Shaft
- Force Main Alignment
- Tunnel

<b>TUNNEL CROSSINGS</b>		
PROPOSED ROSE CANYON ALIGNMENT		
PURE WATER		
SAN DIEGO, CALIFORNIA		
<b>AECOM</b>	CHECKED BY:	DATE: 08-16-17
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		FIG. NO. 10

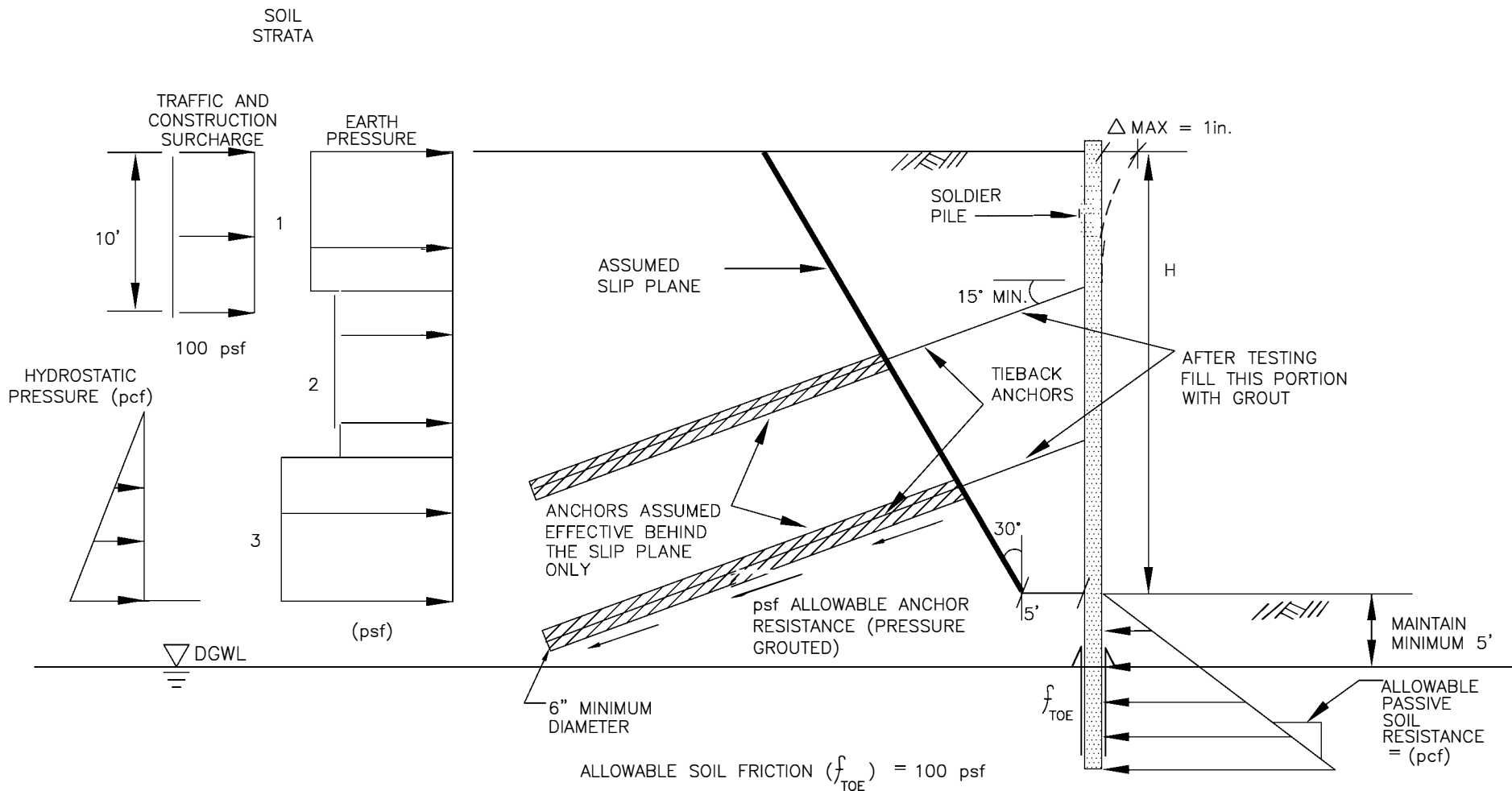




**Legend**

- Qya Young alluvial flood-plain deposits
- Qvop10 Very old surficial deposits (Linda Vista Fm.)
- Qvop9 Very old surficial deposits (Linda Vista Fm.)
- Tsc Scripps Formation
- Boring
- Shaft
- Force Main Alignment
- Tunnel

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

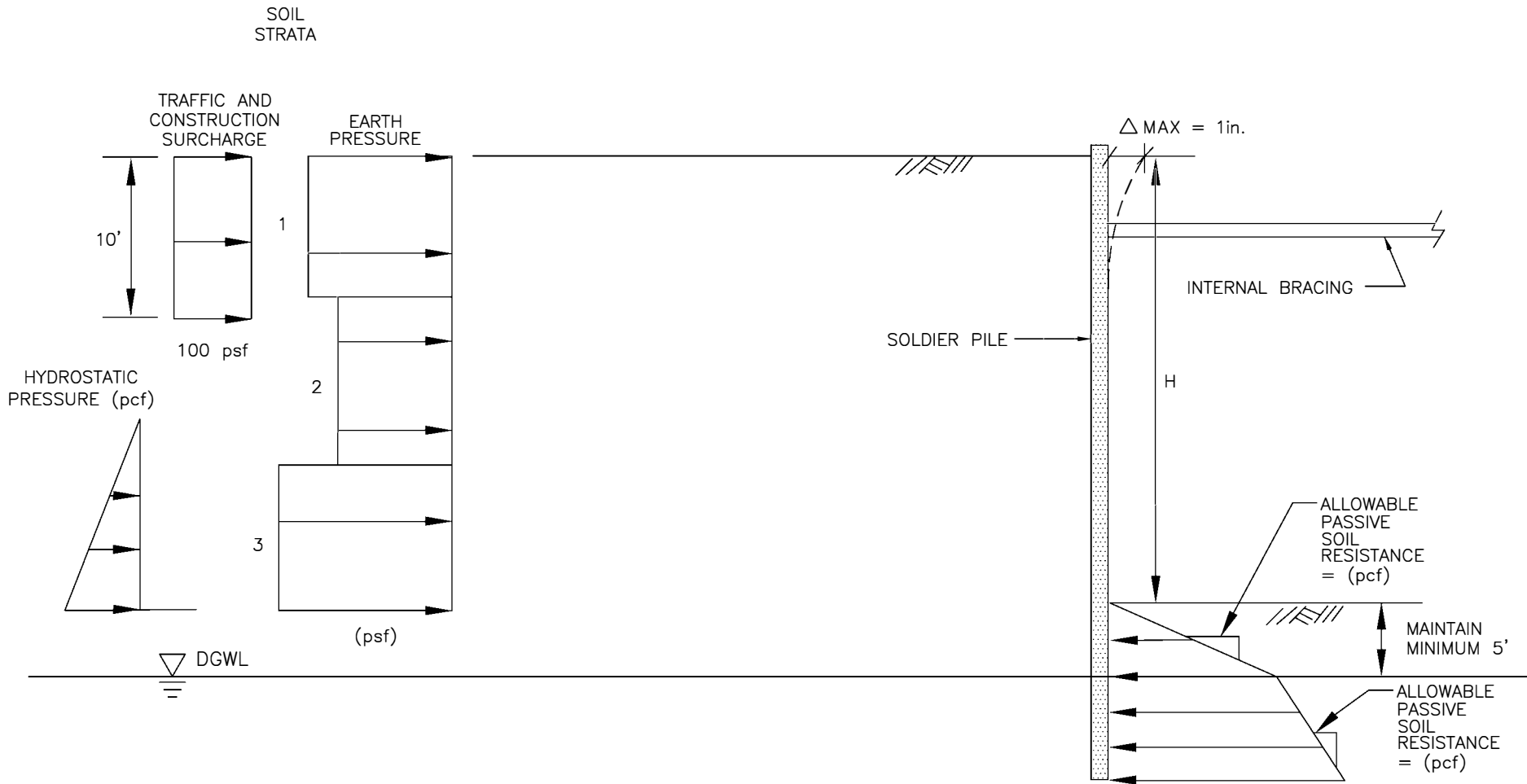


- NOTES:
- A. ASSUMES LEVEL BACKFILL
  - B. FOR PRELIMINARY DESIGN.
  - C. GWL - DESIGN GROUNDWATER LEVEL DURING CONSTRUCTION PER GEOTECHNICAL REPORT (5' BELOW BOTTOM OF EXCAVATION).

TOTAL ALLOWABLE PASSIVE RESISTANCE PER SOLDIER PILE =  
 UNIT ALLOWABLE PASSIVE RESISTANCE  
 TWICE THE CONCRETED SOLDIER PILE WIDTH

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

<b>AECOM</b>	NOT TO SCALE	CHECKED BY:	DATE: 8-22-2017	FIG. NO:
		PM: SF	PROJ. NO: 60530732	12



**NOTES:**

- A. ASSUMES LEVEL BACKFILL
- B. FOR PRELIMINARY DESIGN.
- C. GWL — DESIGN GROUNDWATER LEVEL DURING CONSTRUCTION PER GEOTECHNICAL REPORT (5' BELOW BOTTOM OF EXCAVATION).

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

TWICE THE CONCRETED  
SOLDIER PILE WIDTH

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

**AECOM**

NOT TO SCALE

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DATE: 8-22-2017

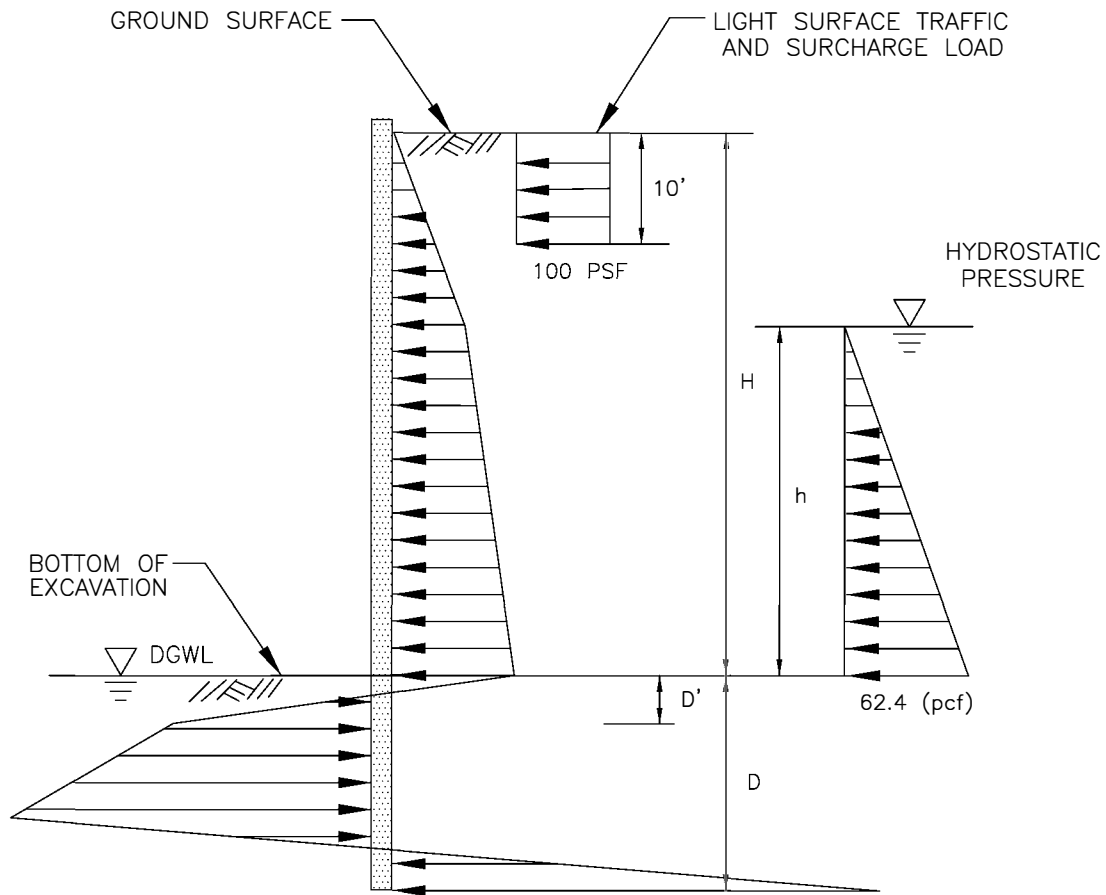
FIG. NO:

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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:

PM: SF

PROJ. NO: 60530732

**14**

## **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<sup>1</sup>**

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 table, 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.

<sup>1</sup> Modified by Heuer (1974) from Terzaghi (1950)

**Table 4**  
**Soil Profile – I-805 Freeway Crossing**

Soil Strata	Soil Strata	Western Shaft	Eastern Shaft
		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**

Soil Strata	Soil Strata	Southern Shaft	Northeastern Shaft	Northwestern Shaft
		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**

Soil Strata	Soil Strata	Southern Shaft	Northern Shaft
		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**

Soil Strata	Design Lateral Pressure (psf)		Design Passive Pressure (psf) <sup>2</sup>	
	Above Water Table	Below Water Table <sup>1</sup>	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)		Design Passive Pressure (psf) <sup>2</sup>	
	Above Water Table	Below Water Table <sup>1</sup>	Above Water Table	Below Water Table
Fill	26	12	240	115
Alluvium	26	12	240	115
Very Old Paralac 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)		Design Passive Pressure (psf) <sup>2</sup>	
	Above Water Table	Below Water Table <sup>1</sup>	Above Water Table	Below Water Table
Fill	39	19	240	115
Alluvium	39	19	240	115
Very Old Paralac 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)		Design Passive Pressure (psf) <sup>2</sup>	
	Above Water Table	Below Water Table <sup>1</sup>	Above Water Table	Below Water Table
Fill	60	29	240	115
Alluvium	60	29	240	115
Very Old Paralac 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**





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## 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 <sup>1</sup>	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



Elevation, feet	Depth, feet	ROCK CORE								Lithology	MATERIAL DESCRIPTION	Monitoring Well Detail	SOIL SAMPLES				FIELD NOTES AND TEST RESULTS
		Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Type	Number				Blows /12 in	Drill Time [Rate, ft/hr]			
1	2	3	4	5	6	7	8	9	10		11	12	13	14	15	16	17

**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 (Munsell), 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 sampler
	Core Sample		

**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

**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		

**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.

**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

**e** **Amount of Infilling:**

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

**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)

**f** **Surface Shape of Joint:**

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

**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

**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**

<u>Description</u>	<u>Recognition</u>
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**

<u>Description</u>	<u>Recognition</u>
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

Sheet 1 of 8

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	Cement/Bentonite Grout			Hammer Data	140 lbs / 30-inch

Elevation, feet	Depth, feet	ROCK CORE					Lithology	MATERIAL DESCRIPTION	Monitoring Well Detail	SOIL SAMPLES			FIELD NOTES AND TEST RESULTS
		Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %				Fracture Drawing Number	Type	Number	
366	0							5" AC over 10" AB over... <b>Fill</b> 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							<b>Scripps Formation (Tsc)</b> 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)					
	13										3	50 3"	

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Elevation, feet	Depth, feet	ROCK CORE					Lithology	MATERIAL DESCRIPTION	Monitoring Well Detail	SOIL SAMPLES			FIELD NOTES AND TEST RESULTS
		Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %				Fracture Drawing Number	Type	Number	
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												
	21								5		50 5"		
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			FIELD NOTES AND TEST RESULTS
		Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %				Fracture Drawing Number	Type	Number	
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	ROCK CORE					Lithology	MATERIAL DESCRIPTION	Monitoring Well Detail	SOIL SAMPLES			FIELD NOTES AND TEST RESULTS
		Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %				Fracture Drawing Number	Type	Number	
45					NA								Begin HQ coring
320	46	1		33	NA	33	NR					6	
	47				0			Dark blueish grey (GLE Y2, 4/1), CLAYSTONE (CH), fine grained, moderately to slightly weathered, very weak to extremely weak					
318	48				0								
	49				0					10			LL(66), PI(36), SA(100), UC=637, WC(20), DD(110)
316	50	2	1	100	0	100		Dark blueish grey to yellow (GLE Y2, 4/1 to 10YR, 7/6), sandy SILTSTONE (ML), fine grained, moderately to highly weathered, extremely weak, with noticeable oxidation				12	
	51				0								
314	52				0								
	53				0			Yellow (10YR, 7/6) with dark blueish grey (GLE Y2, 4/1), silty SANDSTONE (SM), medium grained, highly weathered, extremely weak					
312	54				0			Dark blueish grey (GLE Y2, 4/1), silty SANDSTONE (SM), fine to medium grained, moderately to slightly weathered, moderately strong to weak					
	55				0								
310	56	3		100	0	100		Concretion - very strong				12	UC=2741, WC(3), DD(152)
	57				0								
308	58	2			0								
	59												
306	60	4						Concretion - very strong					
	60							Concretion - very strong					
	61			100		100						11	

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Elevation, feet	Depth, feet	ROCK CORE					Lithology	MATERIAL DESCRIPTION	Monitoring Well Detail	SOIL SAMPLES			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														
	304	4			0		NR							
	62				0			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				0									
	65				0									
	300	5		100	0	100						11		
	66				0									
	67				0									
	298				0									
	68		3		0									
	69				0									
	296				0			extremely weak zone - laminated sand						
	70				0			Concretion - very strong						
	71	6		100	0	100						10		
	72				0			Dark grey to grey (10YR 4/1-5/1), CLAYSTONE with sand (CH), moderately weathered, weak to very weak, few fine sand					LL(56), PI(28), SA(91), UC=587, WC(17), DD(113)	
	294				0						12			
	73				0									
	292				0									
	74				0									
	75	4			0		1	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, PI, SR						
	290	7		100	1	100						12		
	76				0								UC=374, WC(14), DD(116)	
	77				0									

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

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

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Elevation, feet	Depth, feet	ROCK CORE					Lithology	MATERIAL DESCRIPTION	Monitoring Well Detail	SOIL SAMPLES			FIELD NOTES AND TEST RESULTS
		Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %				Fracture Drawing Number	Type	Number	
109					0								
256	110	14		100	0	100						14	
	111				0								
254	112				0								
	113				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												

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## Log of Boring EX-2

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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					Lithology	MATERIAL DESCRIPTION	Monitoring Well Detail	SOIL SAMPLES			FIELD NOTES AND TEST RESULTS
		Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %				Fracture Drawing Number	Type	Number	
320	0							<b>FILL (Qf)</b> 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												
	9							} few gravel / cobble					
310	10										2	23	
	11												
308	12												
	13												

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Elevation, feet	Depth, feet	ROCK CORE					Lithology	MATERIAL DESCRIPTION	Monitoring Well Detail	SOIL SAMPLES			FIELD NOTES AND TEST RESULTS
		Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %				Fracture Drawing Number	Type	Number	
13													
306	14												
	15												
	16						← 4" chunk of brown CLAY			3	15		
304	17												
	18												
302	19												
	20												
300	21												
	22						← few gravel / cobble						
298	23						▼ becomes very dark gray						
	24												
296	25												
	26						▼ increase moisture content						
294	27												
	28												
292	29												

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Elevation, feet	Depth, feet	ROCK CORE					Lithology	MATERIAL DESCRIPTION	Monitoring Well Detail	SOIL SAMPLES			FIELD NOTES AND TEST RESULTS
		Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %				Fracture Drawing Number	Type	Number	
29													
	29						<b>ALLUVIUM (Qal)</b> 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						<b>SCRIPPS FORMATION (Tsc)</b> 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	ROCK CORE					Lithology	MATERIAL DESCRIPTION	Monitoring Well Detail	SOIL SAMPLES			FIELD NOTES AND TEST RESULTS
		Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %				Fracture Drawing Number	Type	Number	
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 fbs
	51												Auger refusal. Begin wireline coring
268	52			N/A									
	53			N/A									
	54	1		50		40*		concretion; strong, moderately hard		11		(10)	*rock strength does not meet requirements for RQD
266	55			1			1) 30°/J/Vn/Fe/Su/Pl/Sr			12			
	56		1		0			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					partial circulation loss during drilling
264	57			N/A				few thin to moderate interbeds of Silty SANDSTONE (SM); extremely weak, very soft, sub-horizontal dip					
	58			1			1) 10°/J/Vn/No/N/Pl/Sr-R						
262	59	2		90	0	90*						(12)	
	60			0						13			
260	61			0				concretion; strong, moderately hard		14			

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Elevation, feet	Depth, feet	ROCK CORE					Lithology	MATERIAL DESCRIPTION	Monitoring Well Detail	SOIL SAMPLES				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													

Report: GEO\_CORE+SOIL\_17W; File: 60530732.GPJ; 9/14/2017 EX-2



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					Lithology	MATERIAL DESCRIPTION	Monitoring Well Detail	SOIL SAMPLES			FIELD NOTES AND TEST RESULTS
		Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %				Fracture Drawing Number	Type	Number	
0							4" asphalt over... <b>Fill</b> 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												

Report: GEO\_CORE+SOIL\_17W; File: 60530732.GPJ; 8/14/2017 RC-1



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

# Log of Boring RC-1

Sheet 2 of 5

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

Report: GEO\_CORE+SOIL\_17W; File: 60530732.GPJ; 8/14/2017 RC-1

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

# Log of Boring RC-1

Sheet 3 of 5

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

Report: GEO\_CORE-SOIL\_17W; File: 60530732.GPJ; 8/14/2017 RC-1



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

# Log of Boring RC-1

Sheet 4 of 5

Elevation, feet	Depth, feet	ROCK CORE					Lithology	MATERIAL DESCRIPTION	Monitoring Well Detail	SOIL SAMPLES			FIELD NOTES AND TEST RESULTS	
		Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %				Fracture Drawing Number	Type	Number		Blows per foot
188	45													
	46										9	9		
186	47						<b>Scripps Formation (Tsc)</b> 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												Begin HQ coring	
	56	1		20	NA	20					11	50 3"	8	
176	57				NA									
	58		1				Light blueish grey (GLEY2, 8/1), SILTSTONE (ML), fine grained, moderately weathered, weak rock							
174	59				0									
	60				0									
	61	2		100	0	100							12	

Report: GEO\_CORE-SOIL\_17W; File: 60530732.GPJ; 8/14/2017 RC-1

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

# Log of Boring RC-1

Sheet 5 of 5

Elevation, feet	Depth, feet	ROCK CORE					Lithology	MATERIAL DESCRIPTION	Monitoring Well Detail	SOIL SAMPLES			FIELD NOTES AND TEST RESULTS
		Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %				Fracture Drawing Number	Type	Number	
172	61				0					12			SA(94), UC=531, WC(16), DD(114)
	62		1		0								
170	63				0		Dark grey (10YR, 4/1), SANDSTONE (SP), medium grained, moderately to highly weathered, very weak						SA(92), UC=763, WC(16), DD(115)
	64				0		Light blueish grey (GLE Y2, 7/1), SILTSTONE (ML), fine grained, moderately weathered, weak to very weak						
168	65	3		96	0	96				13	12		SA(44), UC=625, WC(16), DD(115)
	66				0								
166	67				0								Bottom of boring at 73.0 feet below ground surface
	68				0		NR						
164	69		2		0								Bottom of boring at 73.0 feet below ground surface
	70				0								
162	71	4		100	0	100		Light blueish grey (GLE Y2, 7/1), silty SANDSTONE (SM), moderately weathered, weak to very weak		14	9		Bottom of boring at 73.0 feet below ground surface
	72				0								
160	73												Bottom of boring at 73.0 feet below ground surface
	74												
158	75												Bottom of boring at 73.0 feet below ground surface
	76												
156	77												Bottom of boring at 73.0 feet below ground surface

Report: GEO\_CORE+SOIL\_17W; File: 60530732.GPJ; 8/14/2017 RC-1

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

## Log of Boring RC-2

Sheet 1 of 7

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

Report: GEO\_CORE+SOIL\_17W; File: 60530732.GPJ; 8/14/2017 RC-2



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

## Log of Boring RC-2

Sheet 2 of 7

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

Report: GEO\_CORE-SOIL\_17W; File: 60530732.GPJ; 8/14/2017 RC-2

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

## Log of Boring RC-2

Sheet 3 of 7

Elevation, feet	Depth, feet	ROCK CORE					Lithology	MATERIAL DESCRIPTION	Monitoring Well Detail	SOIL SAMPLES			FIELD NOTES AND TEST RESULTS
		Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %				Fracture Drawing Number	Type	Number	
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												

Report: GEO\_CORE-SOIL\_17W; File: 60530732.GPJ; 8/14/2017 RC-2

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

## Log of Boring RC-2

Sheet 4 of 7

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

Report: GEO\_CORE-SOIL\_17W; File: 60530732.GPJ; 8/14/2017 RC-2



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

## Log of Boring RC-2

Sheet 5 of 7

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

Report: GEO\_CORE-SOIL\_17W; File: 60530732.GPJ; 8/14/2017 RC-2

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

## Log of Boring RC-2

Sheet 6 of 7

Elevation, feet	Depth, feet	ROCK CORE					Lithology	MATERIAL DESCRIPTION	Monitoring Well Detail	SOIL SAMPLES			FIELD NOTES AND TEST RESULTS
		Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %				Fracture Drawing Number	Type	Number	
186	77				0								
	78				0		NR	↙ Increase in strength					
184	79				0					15			LL(49), PI(21), SA(90), UC=671, WC(17), DD(113)
	80	4		92	0	92		Blueish grey (GLE Y2, 5/1), silty SANDSTONE (SM), medium grained, moderately weathered, very weak to extremely weak				5	
182	81		2		0								
	82				0								
180	83				0		NR						
	84				0					16			SA(15), UC=69, WC(20), DD(105)
178	85	5		84	0	84						2	
	86				0								
176	87				0			Dark blueish grey (GLE Y2, 4/1), sandy SILTSTONE (ML), fine grained, moderately weathered, very weak					
	88				0			↙ Increase in sand content					
174	89		3		0			Blueish grey (GLE Y2, 6/1), SANDSTONE with silt (SP-SM), fine to medium grained, moderately weathered, very weak to extremely weak					
	90	6		100	0	100						4	
172	91				0								
	92				0								
170	93				0								

Report: GEO\_CORE-SOIL\_17W; File: 60530732.GPJ; 8/14/2017 RC-2

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

## Log of Boring RC-2

Sheet 7 of 7

Elevation, feet	Depth, feet	ROCK CORE					Lithology	MATERIAL DESCRIPTION	Monitoring Well Detail	SOIL SAMPLES			FIELD NOTES AND TEST RESULTS
		Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %				Fracture Drawing Number	Type	Number	
170	93				0								
	94		3		0					17			SA(10), UC=51, WC(19), DD(108)
168	95	7		100	0	100						3	
	96				0			With few small siltstone xenoliths					
	97				0								
	98				0								
164	99		4		0			Dark blueish grey (GLE Y2, 4/1) brecciated SANDSTONE (SP), fine to medium grained, highly to moderately weathered, extremely weak					
	100	8		80	0	80						8	
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												

Report: GEO\_CORE-SOIL\_17W; File: 60530732.GPJ; 8/14/2017 RC-2



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

**Log of Boring RC-3**

Sheet 1 of 6

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						Lithology	MATERIAL DESCRIPTION	SOIL SAMPLES			REMARKS AND LAB TESTS	
		Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number			Type	Number	Blows/foot		Drill Time and Rate (ft/hr)
0	0								<b>Fill</b> Moist, yellowish brown, silty SAND, mostly fine sand, some fines					
-236	1													
	2								<b>Fluvial Terrace Deposits (Qt)</b> 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								<b>Scripps Fm. (Tsc)</b> 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													
-228	9										2	36		
	10													
-226	11										3	72 11"		
	12								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					
-224	13													

Report: GEO\_CORE+SOIL-17; File: 60530732.GPJ; 9/14/2017 RC-3



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

Log of Boring RC-3

Sheet 2 of 6

Elevation, feet	Depth, feet	ROCK CORE					Lithology	MATERIAL DESCRIPTION	SOIL SAMPLES			REMARKS AND LAB TESTS	
		Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %			Fracture Drawing Number	Type	Number		Blows/foot
224	13												
	14												
222	15												
	16								4	64			
220	17												
	18												
218	19												
	20												
216	21								5	85 9"			
	22							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					
214	23												
	24												
212	25												
	26								6	50 5"			
210	27												
	28												
208	29												

Report: GEO\_CORE+SOIL\_17; File: 60530732.GPJ; 9/14/2017 RC-3



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

Report: GEO\_CORE+SOIL\_17; File: 60530732.GPJ; 9/14/2017 RC-3





Elevation, feet	Depth, feet	ROCK CORE					Lithology	MATERIAL DESCRIPTION	SOIL SAMPLES			REMARKS AND LAB TESTS	
		Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %			Fracture Drawing Number	Type	Number		Blows/foot
192	45				0								
	46	3		100	0	100	3	3: <5°, B, T, No, N, Pl, St Becomes extremely weak, very soft				(38)	
190	47				0								
	48				N/A								
188	49				N/A		NR						
	50				N/A			Becomes very weak, very soft to soft					
	51	4	1	66	0	30	1	Material becomes thinly bedded with some laminations and cross bedding, becomes finer grained				(33)	
186	51				0			1: <5°, B, T, No, N, Pl, St 2: <5°, B, T, No, N, Pl, St					
	52				0		2	<b>Ardath Shale (Ta)</b> Slightly weathered sedimentary rock, sandy SILTSTONE (ML), dark blueish gray (GLE Y2 5PB 4/1), fine grained, slightly weathered, very weak to weak, soft to moderately soft, few sub-horizontal laminations, little fine sand					
184	53				N/A								
	54				1		NR						
182	55	5		70	0	62	1	1: 10°, J, Vn, Cl, Pa, Pl, St		9		(38)	
	56				0								
180	57				3		2	2: 10°, J, T, No, N, Pl, St					
	58				0		3	3: 5°, J, T, No, N, Pl, R					
	59		2		0			Shell fragments					
178	59	6		100	2	40	1					(19)	
	60				2		2						
	61				2		3	1: 65°, J, Vn, No, N, Pl, St to R					
							4	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					

Report: GEO\_CORE+SOIL\_17; File: 60530732.GPJ; 9/14/2017 RC-3

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

Log of Boring RC-3

Sheet 5 of 6

Elevation, feet	Depth, feet	ROCK CORE					Lithology	MATERIAL DESCRIPTION	SOIL SAMPLES			REMARKS AND LAB TESTS	
		Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %			Fracture Drawing Number	Type	Number		Blows/foot
-176	61				1		5	5: 70°, J, Vn, No, N, Pl, St					
	62	6		100	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				(19)	
-174	63				1		1	1: 85°, J, Vn, No, N, Pl, St to R					
	64				2		1	1: 85°, J, T, No, N, Pl, SR					
	65		2		0		2			10			UC=900
-172	66	7		100	0	77	1	2: 25°, B, T, No, N, Pl, St		11		(25)	
	67				0								
-170	68				>5		2	Silty SANDSTONE (SM) interbed Material is intensely fractured Becomes moderately soft					
-168	69				0		1	1: <5°, B, T, No, N, Pl, St 2: 10°, J, Vn, No, N, Pl, R		12			
	70				0		2	Concretion (strongly cemented)				(25)	
-166	71	8		100	1	100	1	Concretion (strongly cemented)					
	72				0								
-164	73		3		0					13			UC=705
	74				0								
-162	75	9		96	88		1	Silty SANDSTONE (SM) interbed				(23)	
	76				0		2	1: 15°, J, Vn, No, N, Pl, R 2: 15°, J, Vn, No, N, Pl, R					
-160	77				2								

Report: GEO\_CORE+SOIL\_17; File: 60530732.GPJ; 9/14/2017 RC-3



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

Log of Boring RC-3

Sheet 6 of 6

Elevation, feet	Depth, feet	ROCK CORE					Lithology	MATERIAL DESCRIPTION	SOIL SAMPLES			REMARKS AND LAB TESTS		
		Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %			Fracture Drawing Number	Type	Number		Blows/foot	Drill Time and Rate (ft/hr)
-160	77	9	3	96	0	88		Silty SANDSTONE (SM) interbed 3: <5°, B, Vn, No, N, PI, St						
	78												(23)	
-158	79				0									
	80	10		104	0	104								
-156	81				0			Slightly weathered sedimentary rock, silty SANDSTONE (SM), dark blueish gray (GLE Y2 5PB 4/1), fine grained, slightly weathered, very weak, moderately soft						(25)
	82				0		1	1: 5°, B, Vn, No, N, PI, R		14			UC=5132	
	83						1	Concretion, strong, moderately hard						
-154	84		4		1					15				
	85				0									
-152	86	11		92	0	92								(25)
	87				0			Bottom of well						
-150	87						2	Slightly weathered sedimentary rock, SILTSTONE (ML), dark blueish gray (GLE Y2 5PB 4/1), fine grained, slightly weathered, very weak to weak, moderately soft, some sub-horizontal bedding laminations, few fine sand						
	88							1: 10°, J, Vn, No, N, PI, St 2: <5°, B, T, No, N, PI, St						
	89	12		56	N/A	56		1: <5°, B, T, No, N, PI, St						(25)
	90				N/A									
-146	91							Bottom of boring at 90.5 feet below ground surface						
	92													
-144	93													

Report: GEO\_CORE+SOIL\_17; File: 60530732.GPJ; 9/14/2017 RC-3





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

# 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	Cement/Bentonite Grout			Hammer Data	140 lbs / 30-inch

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

Report: GEO\_CORE-SOIL\_17W; File: 60530732.GPJ; 8/14/2017 SC-1

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

# Log of Boring SC-1

Sheet 2 of 5

Elevation, feet	Depth, feet	ROCK CORE					Lithology	MATERIAL DESCRIPTION	Monitoring Well Detail	SOIL SAMPLES			FIELD NOTES AND TEST RESULTS
		Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %				Fracture Drawing Number	Type	Number	
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						<b>Alluvium (Qal)</b> 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

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

# Log of Boring SC-1

Sheet 3 of 5

Elevation, feet	Depth, feet	ROCK CORE					Lithology	MATERIAL DESCRIPTION	Monitoring Well Detail	SOIL SAMPLES			FIELD NOTES AND TEST RESULTS
		Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %				Fracture Drawing Number	Type	Number	
29													
168	30												
	31									6	20		
166	32												
	33						← becomes dense						
164	34												
	35												
162	36									7	33		
	37												
160	38						<b>Scripps Formation (Tsc)</b> 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												

Report: GEO\_CORE-SOIL\_17W; File: 60530732.GPJ; 8/14/2017 SC-1



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

# Log of Boring SC-1

Sheet 4 of 5

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

Report: GEO\_CORE+SOIL\_17W; File: 60530732.GPJ; 8/14/2017 SC-1



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

# Log of Boring SC-1

Sheet 5 of 5

Elevation, feet	Depth, feet	ROCK CORE					Lithology	MATERIAL DESCRIPTION	Monitoring Well Detail	SOIL SAMPLES			FIELD NOTES AND TEST RESULTS
		Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %				Fracture Drawing Number	Type	Number	
61					0								
136	62		2		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								SA(73), UC=433, WC(13), DD(118)
69			3		0		1			13			
128	70				0			← becomes extremely weak					
71		6		100	0	98		1: 30°, B, Vn, No, No, Pl, Sr					
126	72				2								
73					0								
124	74							Bottom of boring at 73.0 feet below ground surface					
75													
122	76												
77													

Report: GEO\_CORE+SOIL\_17W; File: 60530732.GPJ; 8/14/2017 SC-1

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					Lithology	MATERIAL DESCRIPTION	Monitoring Well Detail	SOIL SAMPLES			FIELD NOTES AND TEST RESULTS
		Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %				Fracture Drawing Number	Type	Number	
0							4" of asphalt over... <b>Fill</b> 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												
	9						Moist, brown, clayey SAND						
-176	10												
	11									2	8		
-174	12												
	13												
-172													

Report: GEO\_CORE+SOIL\_17W; File: 60530732.GPJ; 8/14/2017 SC-2



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

## Log of Boring SC-2

Sheet 2 of 4

Elevation, feet	Depth, feet	ROCK CORE					Lithology	MATERIAL DESCRIPTION	Monitoring Well Detail	SOIL SAMPLES			FIELD NOTES AND TEST RESULTS
		Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %				Fracture Drawing Number	Type	Number	
172	13							<b>Alluvium</b> Medium dense, moist, yellowish brown (10YR 5/4), clayey SAND (SC), fine to medium grained					
	14												
170	15												
	16							Medium dense, moist, light yellowish brown (10YR 5/3), silty SAND (SM), fine to medium grained		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							<b>Scripps Formation (Tsc)</b> Blueish gray (GLE Y2 6/1), silty SANDSTONE (SM), medium grained, highly weathered, very weak					
	24												
160	25												
	26							4-inch zone of brown (10YR 5/3) coloration		5	92 4"		
158	27												
	28												
156	29												

Report: GEO\_CORE-SOIL\_17W; File: 60530732.GPJ; 8/14/2017 SC-2

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

## Log of Boring SC-2

Sheet 3 of 4

Elevation, feet	Depth, feet	ROCK CORE					Lithology	MATERIAL DESCRIPTION	Monitoring Well Detail	SOIL SAMPLES			FIELD NOTES AND TEST RESULTS
		Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %				Fracture Drawing Number	Type	Number	
156	29												
	30						Dark grey (10YR 4/1), sandy SILTSTONE (ML), moderately weathered, very weak to weak, fine grained						
154	31									6	58		
	32	1		100	0	100						(58)	Begin HQ coring
	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)
152	34				0								
150	35	2		94	1	94						(38)	
	36		1		0								
148	37				1								
	38						NR						
146	39				0								
	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								
	42				0			Gray (10YR 6/1), SANDSTONE (SP), moderately weathered, moderately strong to strong, some shell fragments, few rounded gravels and small cobbles					
142	43		2				NR						PLT=13,078, WC(1)
	44				0								PLT=9,549, WC(1)
140	45				0			↙ decrease in shell fragments and gravel					PLT=1, WC(2)

Report: GEO\_CORE-SOIL\_17W; File: 60530732.GPJ; 8/14/2017 SC-2

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

## Log of Boring SC-2

Sheet 4 of 4

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

Report: GEO\_CORE-SOIL\_17W; File: 60530732.GPJ; 8/14/2017 SC-2

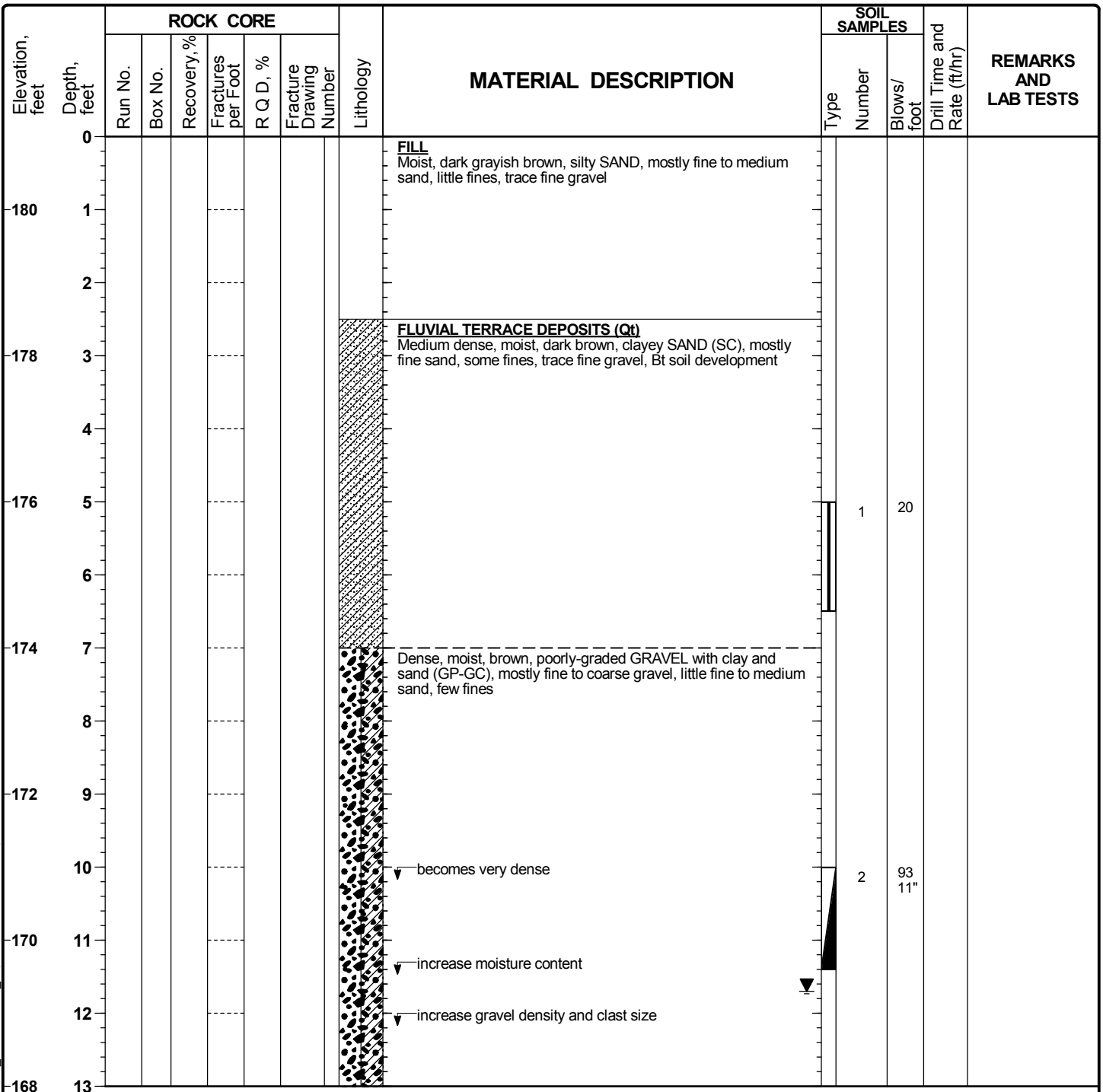


Project: Pure Water, City of San Diego  
 Project Location: San Diego, California  
 Project Number: 60530732

Log of Boring SC-3

Sheet 1 of 4

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



Report: GEO\_CORE+SOIL\_17; File: 60530732.GPJ; 9/14/2017 SC-3

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

Log of Boring SC-3

Sheet 2 of 4

Elevation, feet	Depth, feet	ROCK CORE					Lithology	MATERIAL DESCRIPTION	SOIL SAMPLES			REMARKS AND LAB TESTS	
		Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %			Fracture Drawing Number	Type	Number		Blows/foot
-168	13												
	14												
	15												
-166	15												
	16												
-164	17												
	18												
	19												
-162	19												
	20												
	21												
-160	21												
	22	1		0	N/A	0	NR						Begin HQ Coring
	23				N/A								(30)
-158	23				N/A								
	24				N/A								
-156	25	2	1	0	N/A	0	NR						(33)
	26				N/A								
	27				N/A								
-154	27				N/A								
	28				N/A		NR						
-152	29												

Report: GEO\_CORE+SOIL\_17; File: 60530732.GPJ; 9/14/2017 SC-3



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

Report: GEO\_CORE+SOIL\_17; File: 60530732.GPJ; 9/14/2017 SC-3



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					Lithology	MATERIAL DESCRIPTION	SOIL SAMPLES			REMARKS AND LAB TESTS	
		Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %			Fracture Drawing Number	Type	Number		Blows/foot
-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)	
-134	47				0		3	concretion; strongly cemented, slightly weathered, strong, moderately hard to hard					
-132	48				1								
-130	49				0		1	1: <5°, B, T, No, N, Pl, S					
-128	50	8	2	92	0	57							
-126	51				0			concretion; strongly cemented, slightly weathered, strong, moderately hard to hard					
-124	52				0								
-122	53						NR						
-120	53							Bottom of boring at 53.0 feet below ground surface					
	54												
	55												
	56												
	57												
	58												
	59												
	60												
	61												

Report: GEO\_CORE+SOIL\_17; File: 60530732.GPJ; 9/14/2017 SC-3





## **Core Box Photos**



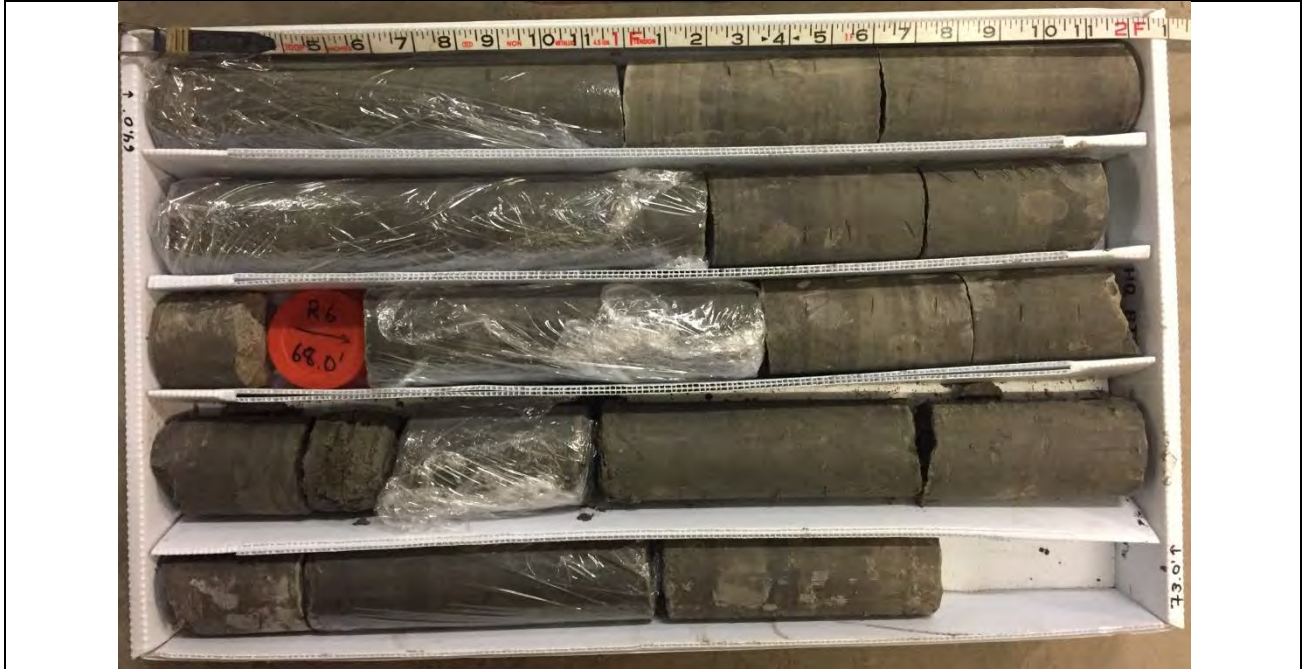




Pure Water, EX-01, Box 1, 45.0-55.0'



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'

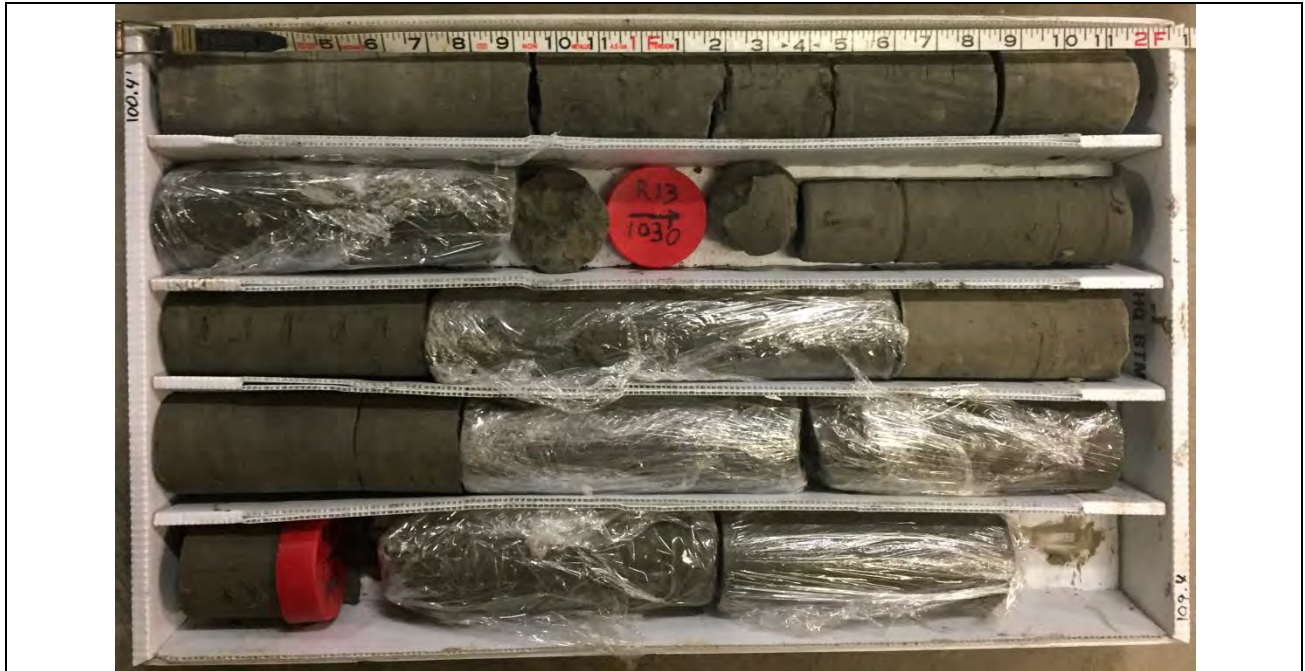




Pure Water, EX-01, Box 5, 82.0-91.5'



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'

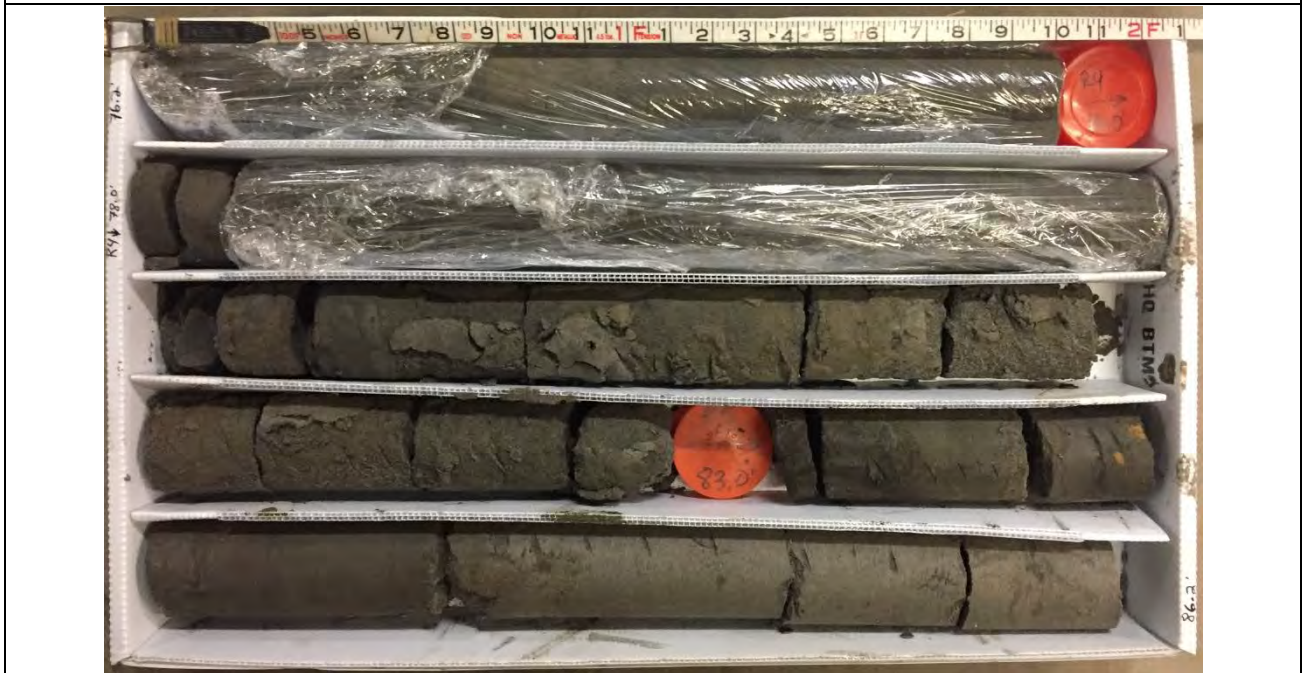


Pure Water, RC-01, Box 2, 66.2-78.0'

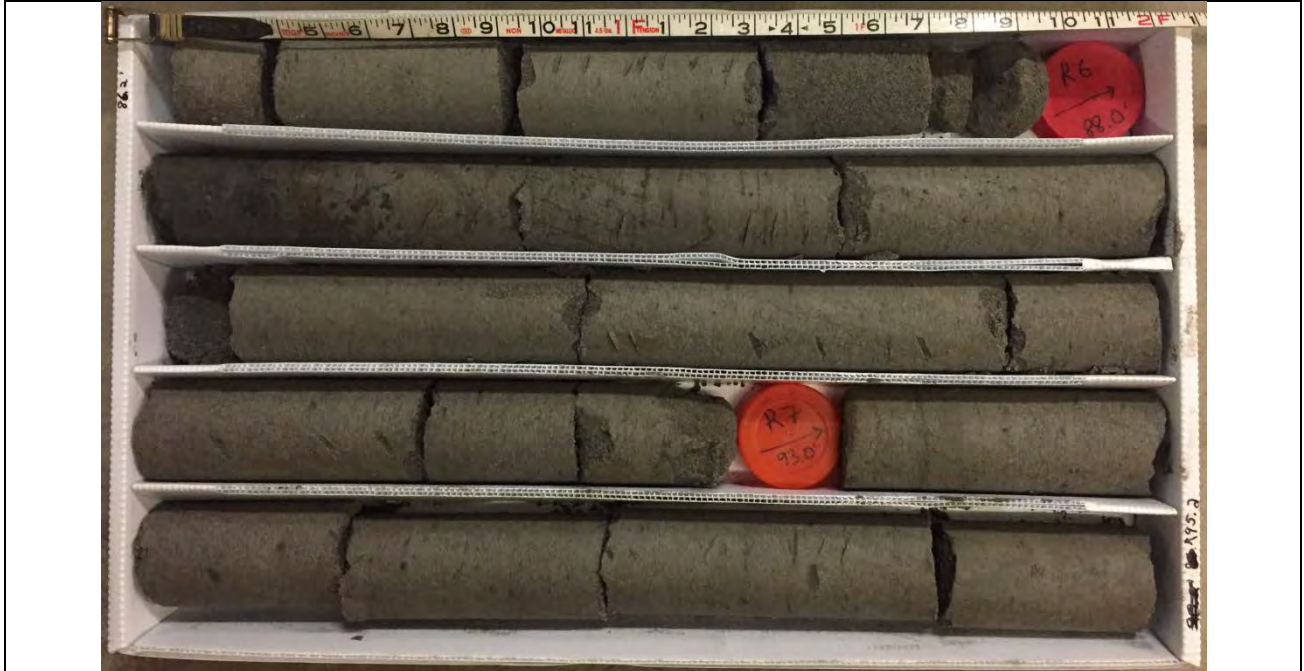




Pure Water, RC-02, Box 1, 65.0-76.2'



Pure Water, RC-02, Box 2, 76.2-86.2'

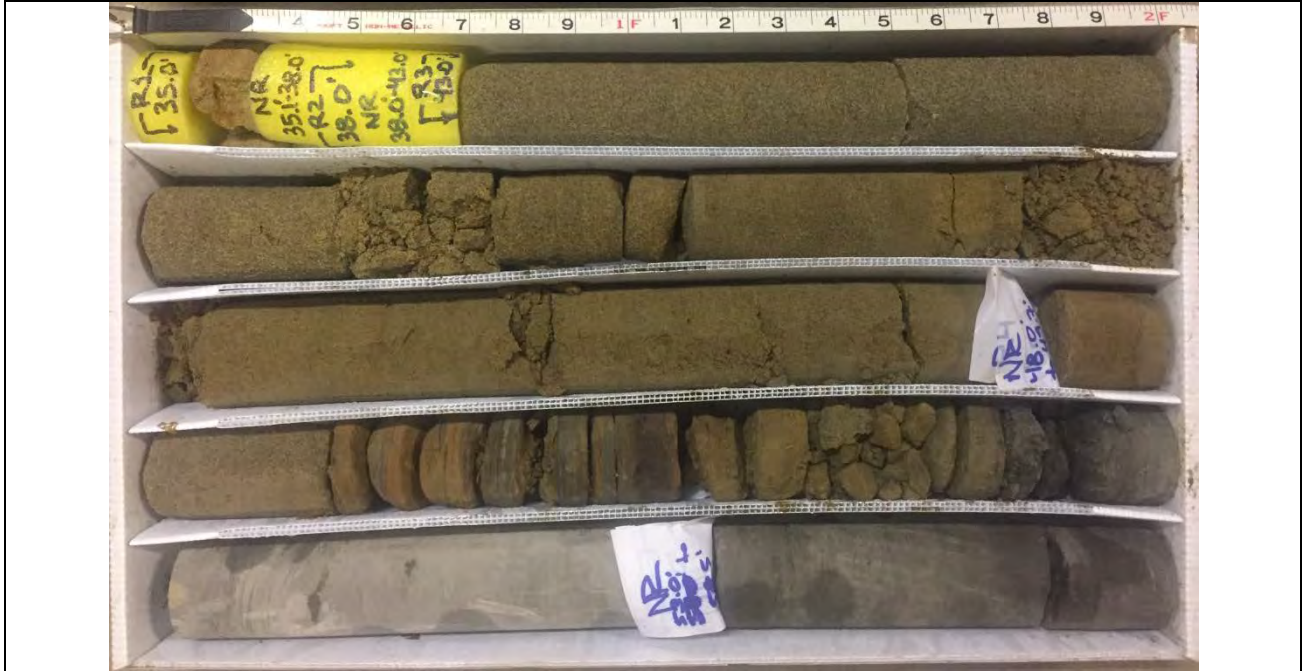


Pure Water, RC-02, Box 3, 86.2-95.2'



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



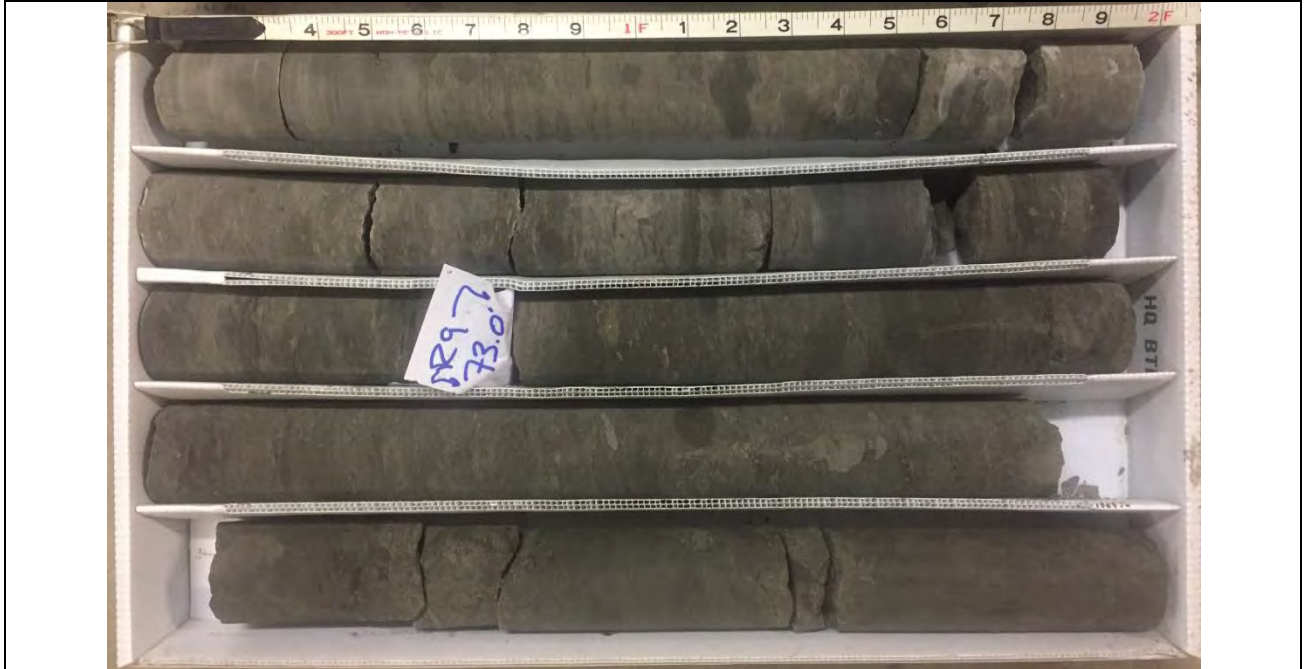


Pure Water, RC-03, Box 1, 35.0-55.4'



Pure Water, RC-03, Box 2, 55.4-68.7'





Pure Water, RC-03, Box 3, 68.7-78.0'

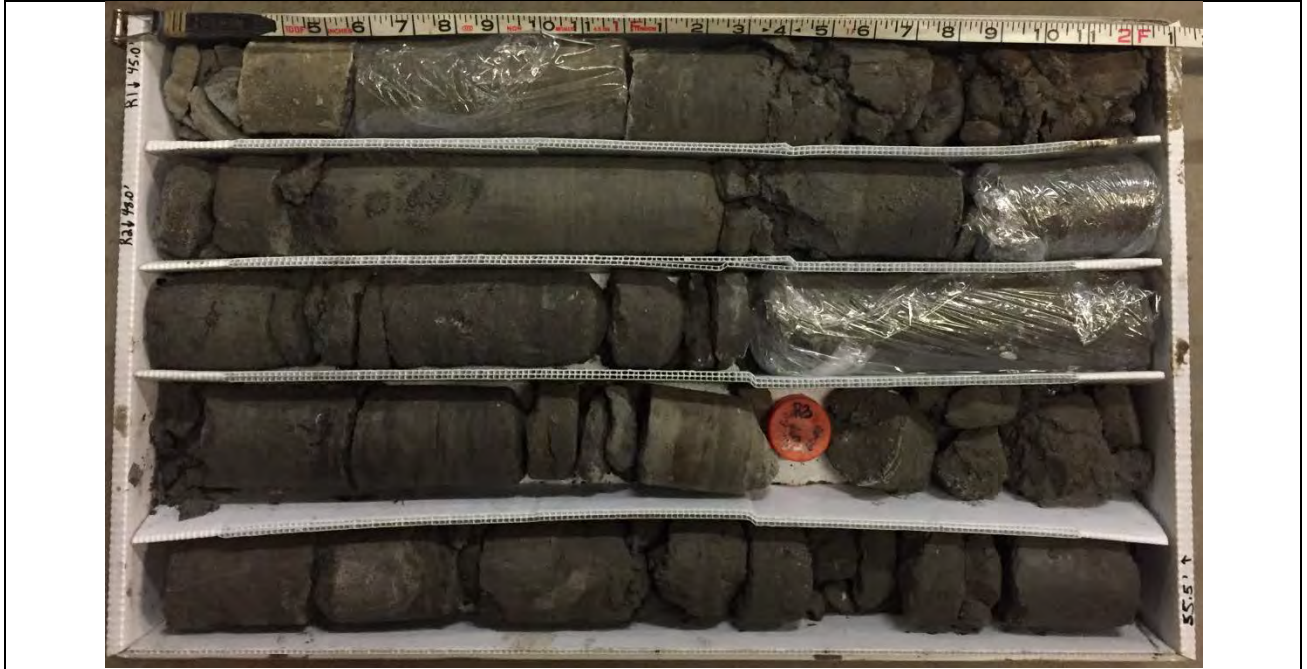


Pure Water, RC-03, Box 4, 78.0-87.4'



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'

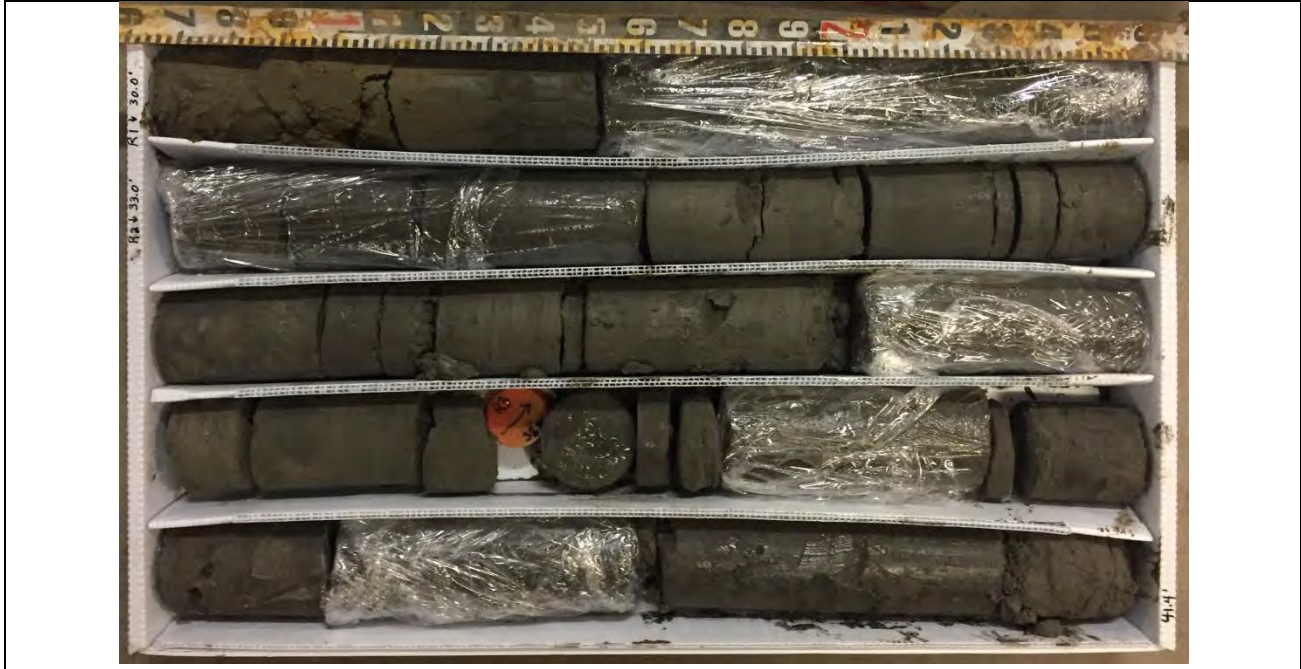


Pure Water, SC-01, Box 2, 55.5-65.0'





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'

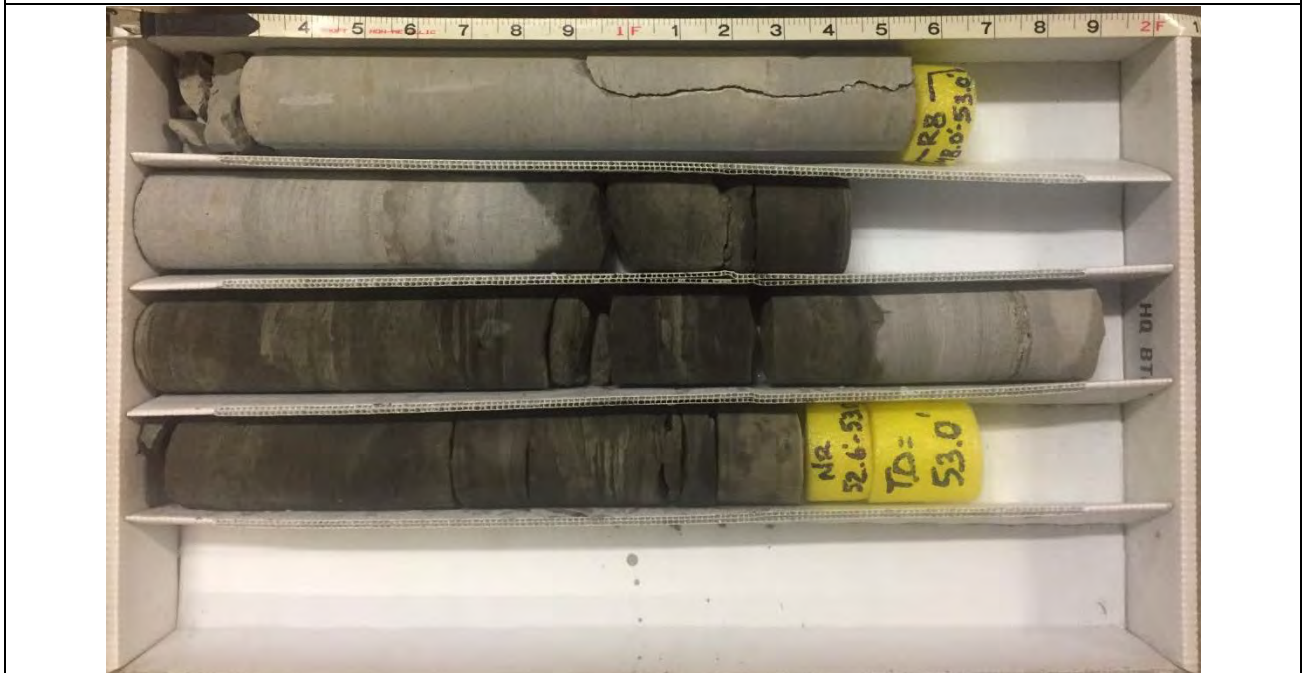


Pure Water, SC-02, Box 3, 50.7-58.0'





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**

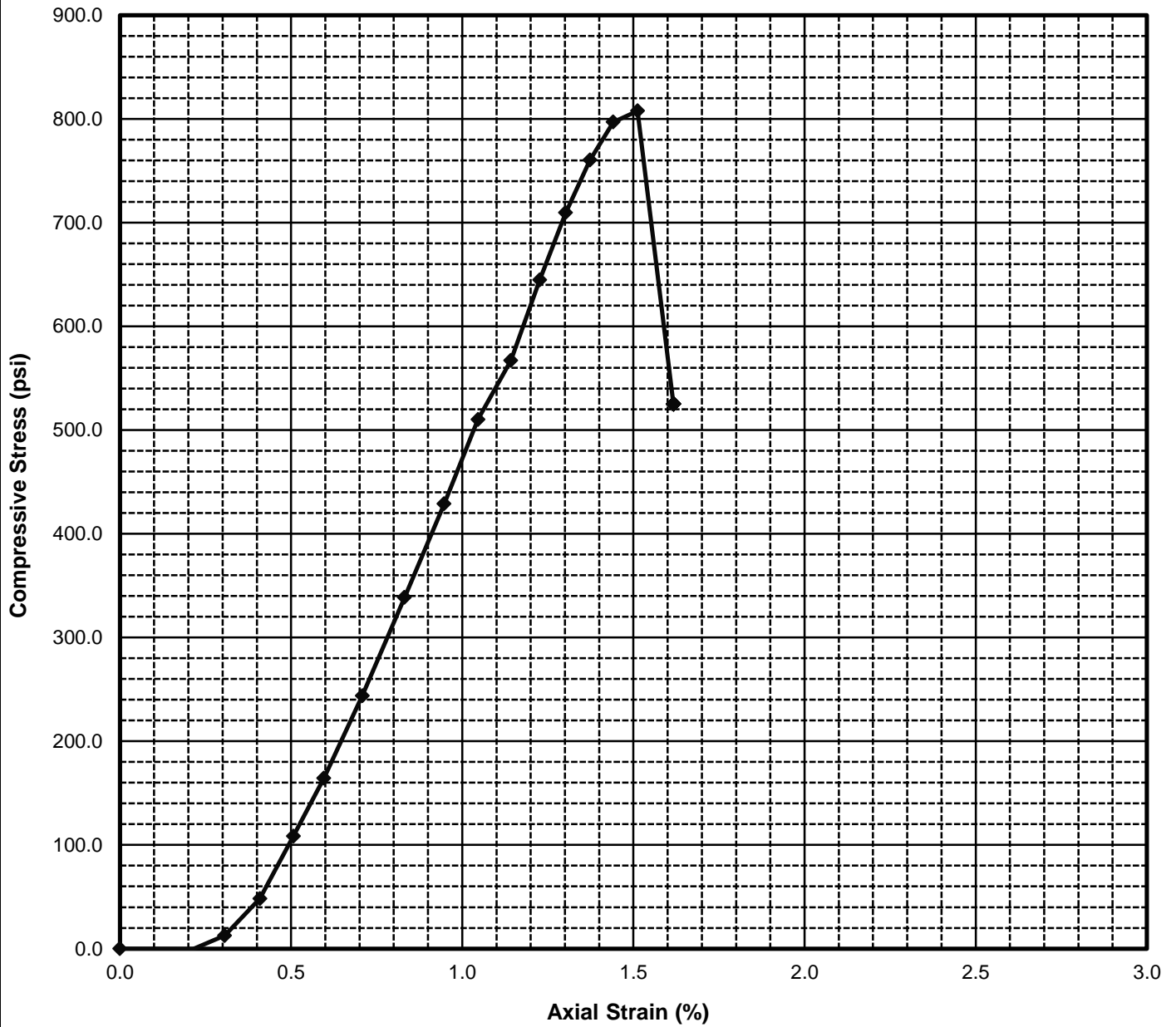
Laboratory testing was performed following more detailed review of the core samples and field logs of the borings. Geotechnical laboratory tests were performed on selected samples to aid in estimating soil properties and verify visual classifications of the materials. The tests included grain size, plasticity 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**

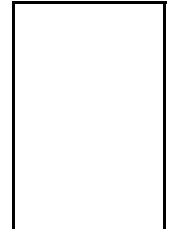
Exploration Number	Sample Number	Depth (ft)	Geologic Formation	Peak Compressive Strength (psi)
RC-01	1	61.2	Scripps Formation	531
RC-01	2	65.7	Scripps Formation	763
RC-01	3	71.7	Scripps Formation	625
RC-02	4	73.0	Scripps Formation	661
RC-02	5	79.0	Scripps Formation	671
RC-02	6	84.3	Scripps Formation	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 <sup>a</sup>	13	43.0	Scripps Formation	13078
SC-02 <sup>a</sup>	14	43.8	Scripps Formation	9549
SC-02 <sup>a</sup>	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 – <sup>a</sup> Point Load Test results



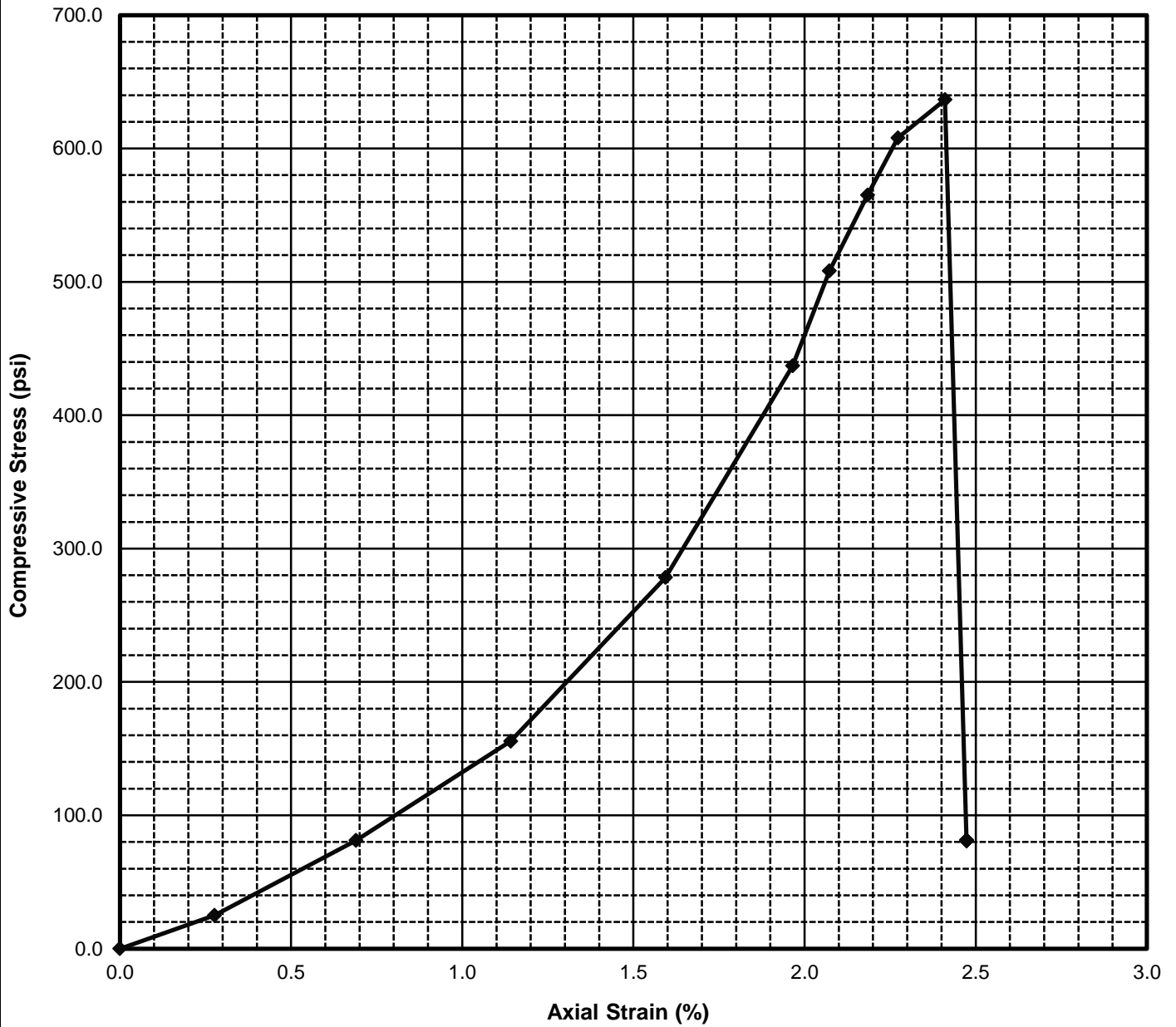


Failure Sketch

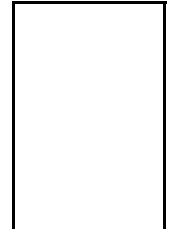


Water Content (%)	Length (in)	Diameter (in)	Wet Unit Weight (pcf)	Peak Stress (psi)
15.3	4.999	2.417	134.0	808

<b>Project Name: Pure Water</b>		<b>UNCONFINED COMPRESSION TEST ASTM D7012</b>
<b>Project Number: 60530732</b>		
<b>Boring Number: EX-01</b>	<b>Depth (ft): 106.5</b>	
<b>Description and/or Classification: Dark gray Siltstone</b>		

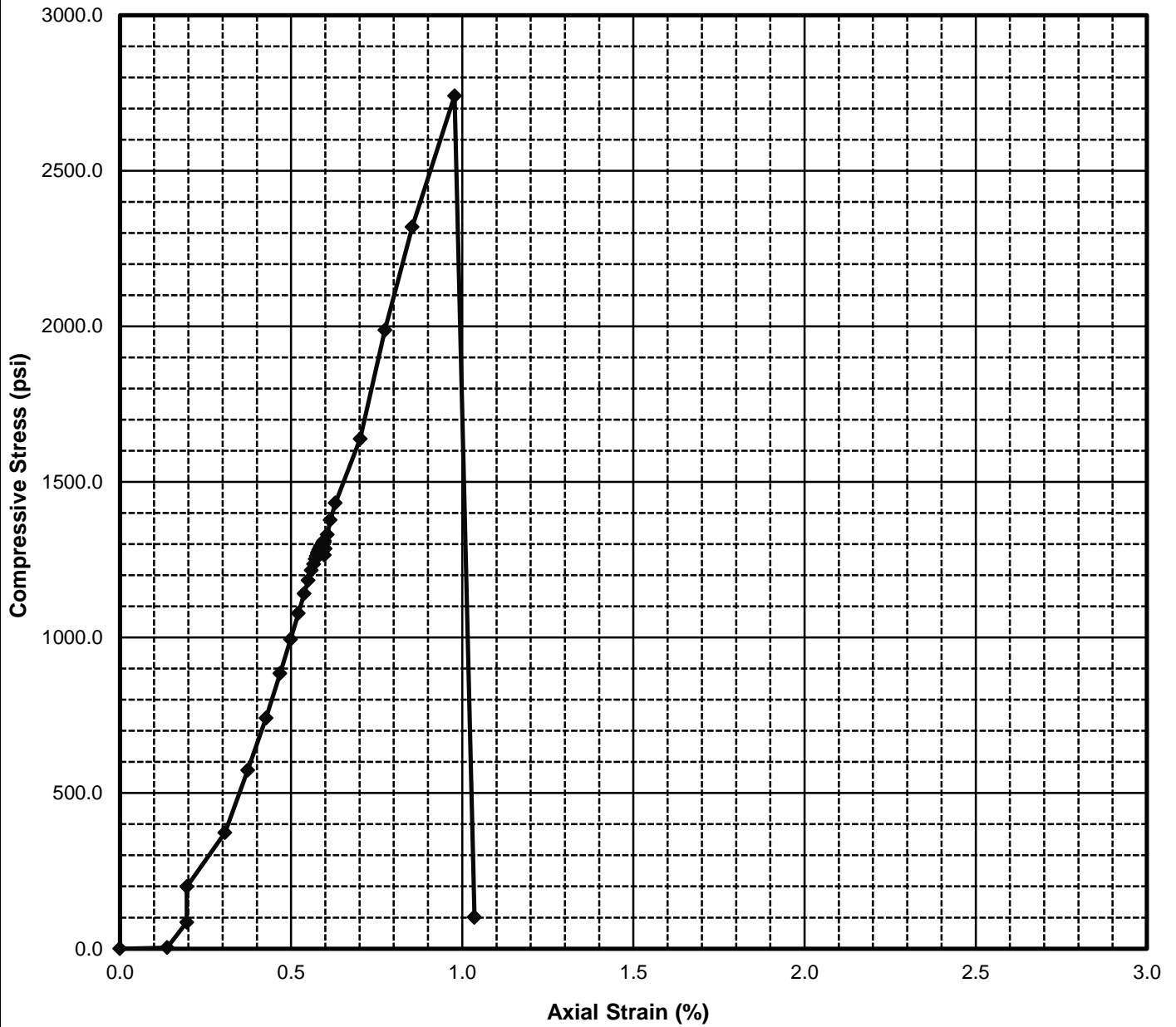


Failure Sketch

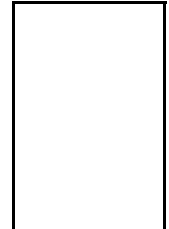


Water Content (%)	Length (in)	Diameter (in)	Wet Unit Weight (pcf)	Peak Stress (psi)
19.6	4.844	2.414	131.2	637

<b>Project Name: Pure Water</b>		<b>UNCONFINED COMPRESSION TEST ASTM D7012</b>
<b>Project Number: 60530732</b>		
<b>Boring Number: EX-01</b>	<b>Depth (ft): 48.5</b>	
<b>Description and/or Classification: Dark gray Claystone</b>		



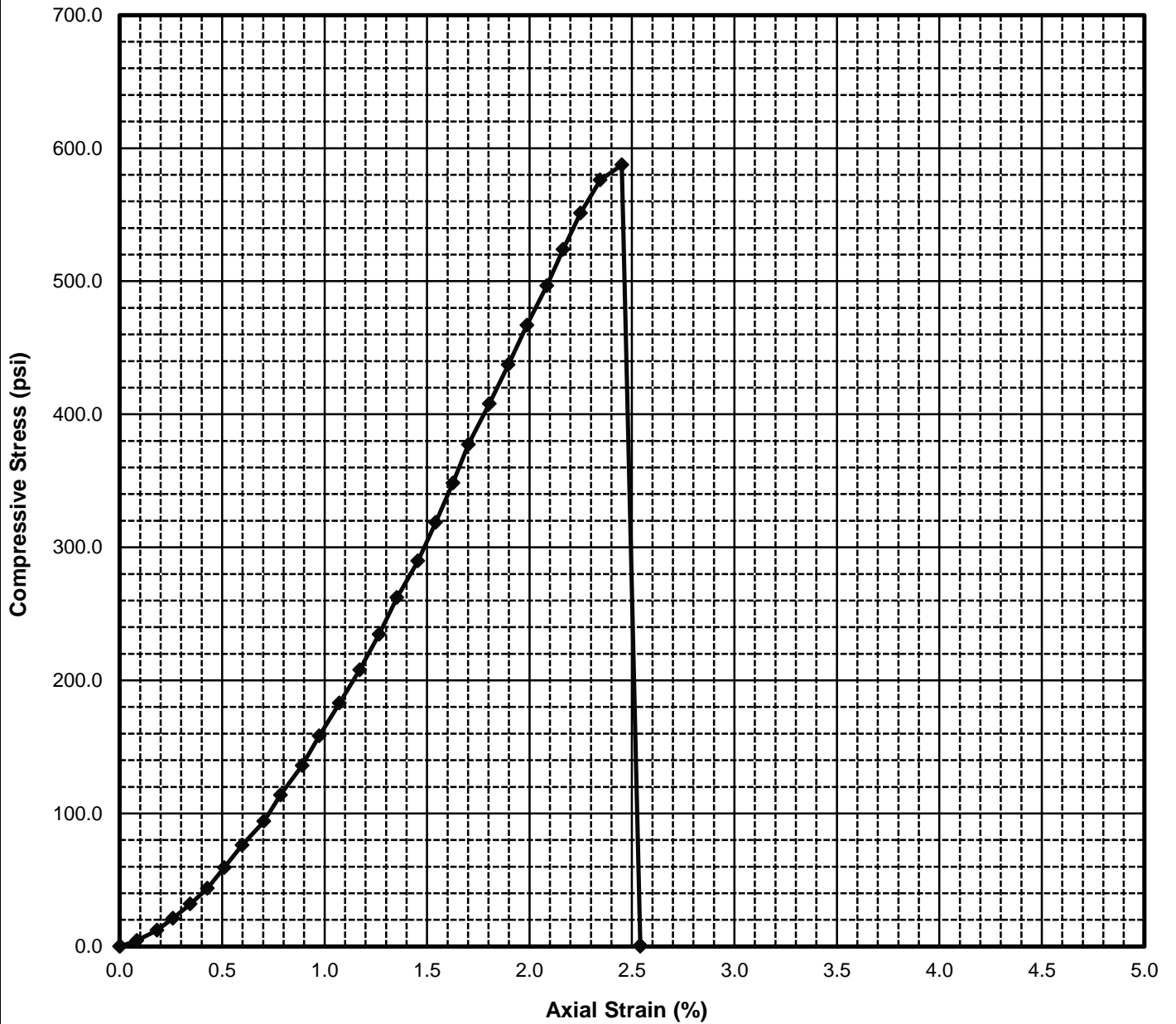
Failure Sketch



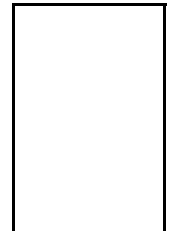
Water Content (%)	Length (in)	Diameter (in)	Wet Unit Weight (pcf)	Peak Stress (psi)
3.1	5.036	2.421	156.8	2741

<b>Project Name: Pure Water</b>		<b>UNCONFINED COMPRESSION TEST ASTM D7012</b>
<b>Project Number: 60530732</b>		
<b>Boring Number: EX-01</b>	<b>Depth (ft): 55.5</b>	
<b>Description and/or Classification: Dark gray Siltstone</b>		



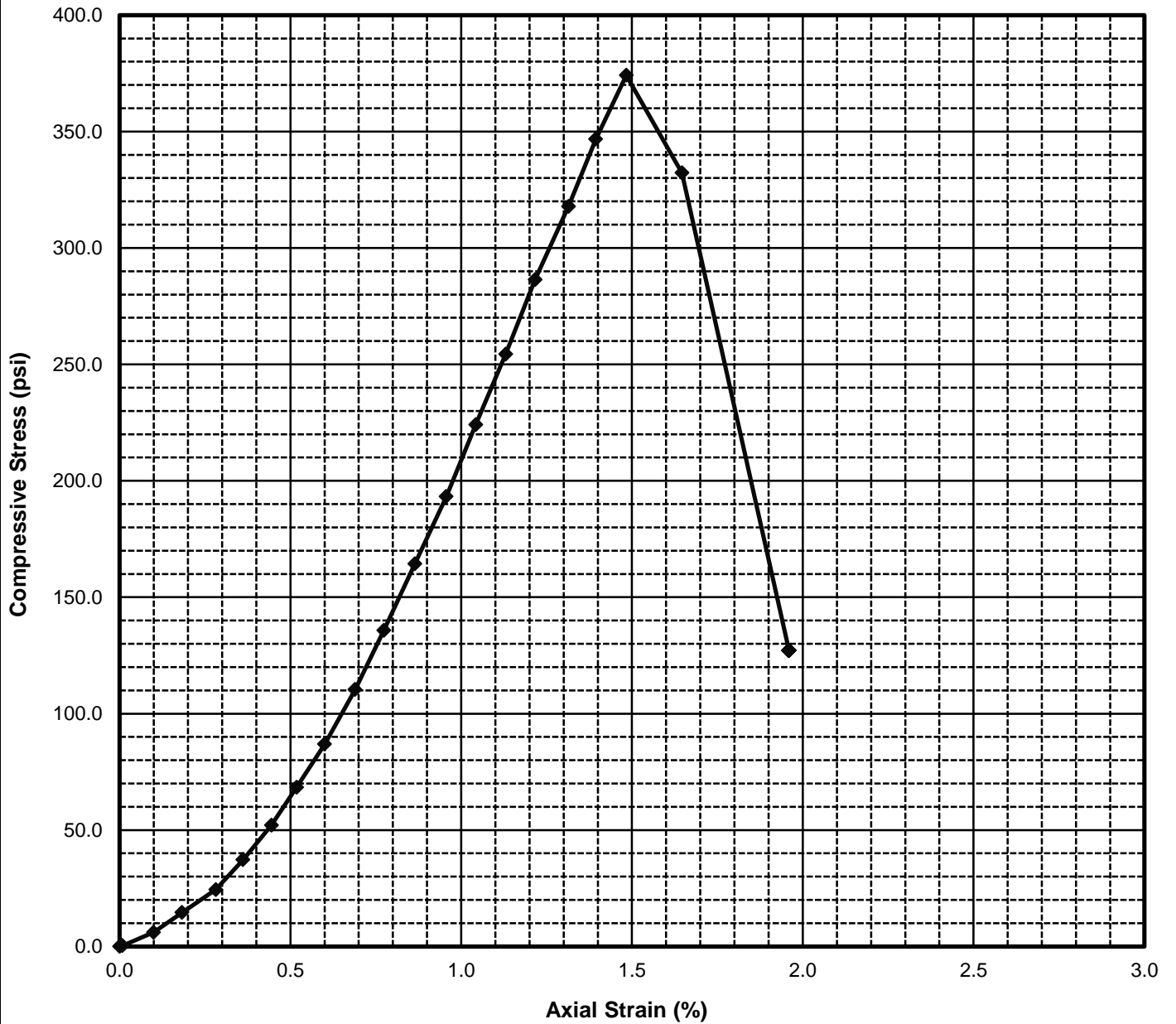


Failure Sketch

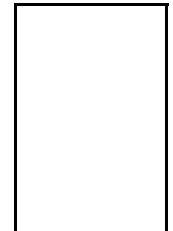


Water Content (%)	Length (in)	Diameter (in)	Wet Unit Weight (pcf)	Peak Stress (psi)
16.8	4.925	2.428	132.4	587

<b>Project Name: Pure Water</b>		<b>UNCONFINED COMPRESSION TEST ASTM D7012</b>
<b>Project Number: 60530732</b>		
<b>Boring Number: EX-01</b>	<b>Depth (ft): 71.8</b>	
<b>Description and/or Classification: Greenish gray Claystone</b>		

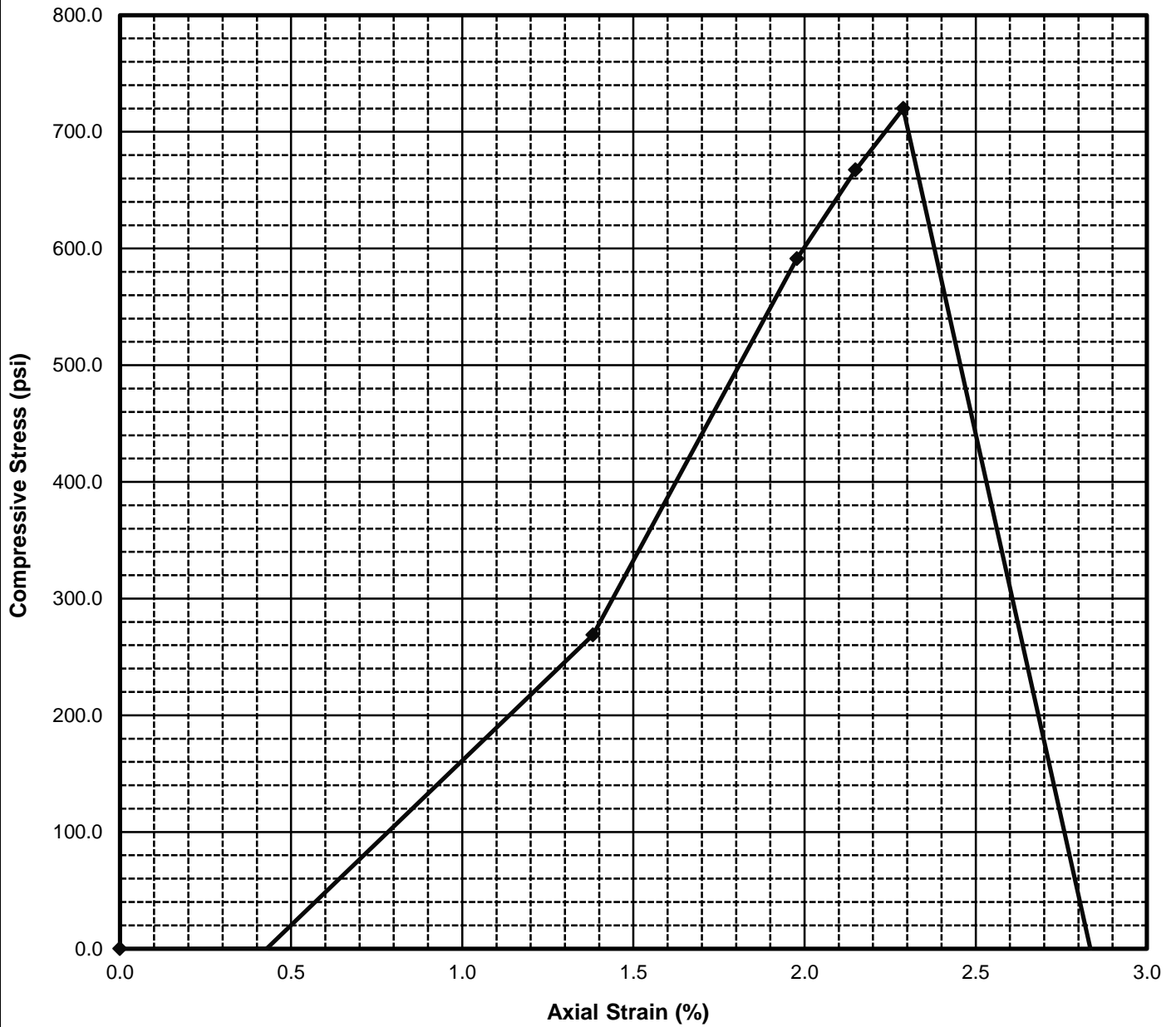


Failure Sketch

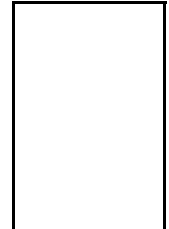


Water Content (%)	Length (in)	Diameter (in)	Wet Unit Weight (pcf)	Peak Stress (psi)
14.2	5.016	2.428	132.7	374

<b>Project Name: Pure Water</b>		<b>UNCONFINED COMPRESSION TEST ASTM D7012</b>
<b>Project Number: 60530732</b>		
<b>Boring Number: EX-01</b>	<b>Depth (ft): 76.0</b>	
<b>Description and/or Classification: Brownish yellow Sandstone</b>		



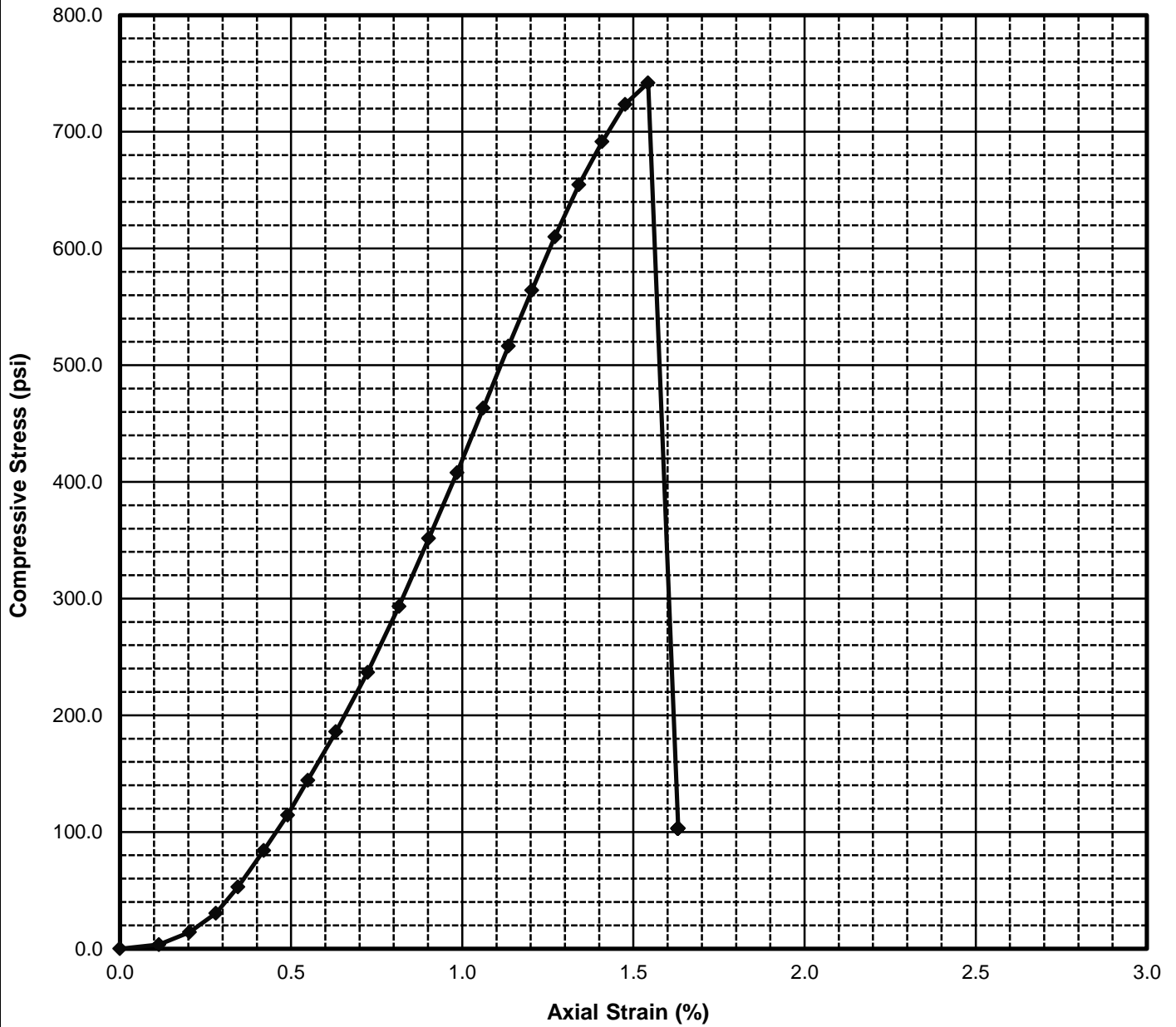
Failure Sketch



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

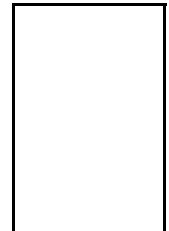
<b>Project Name: Pure Water</b>		<b>UNCONFINED COMPRESSION TEST ASTM D7012</b>
<b>Project Number: 60530732</b>		
<b>Boring Number: EX-01</b>	<b>Depth (ft): 80.9</b>	
<b>Description and/or Classification: Dark gray Siltstone</b>		



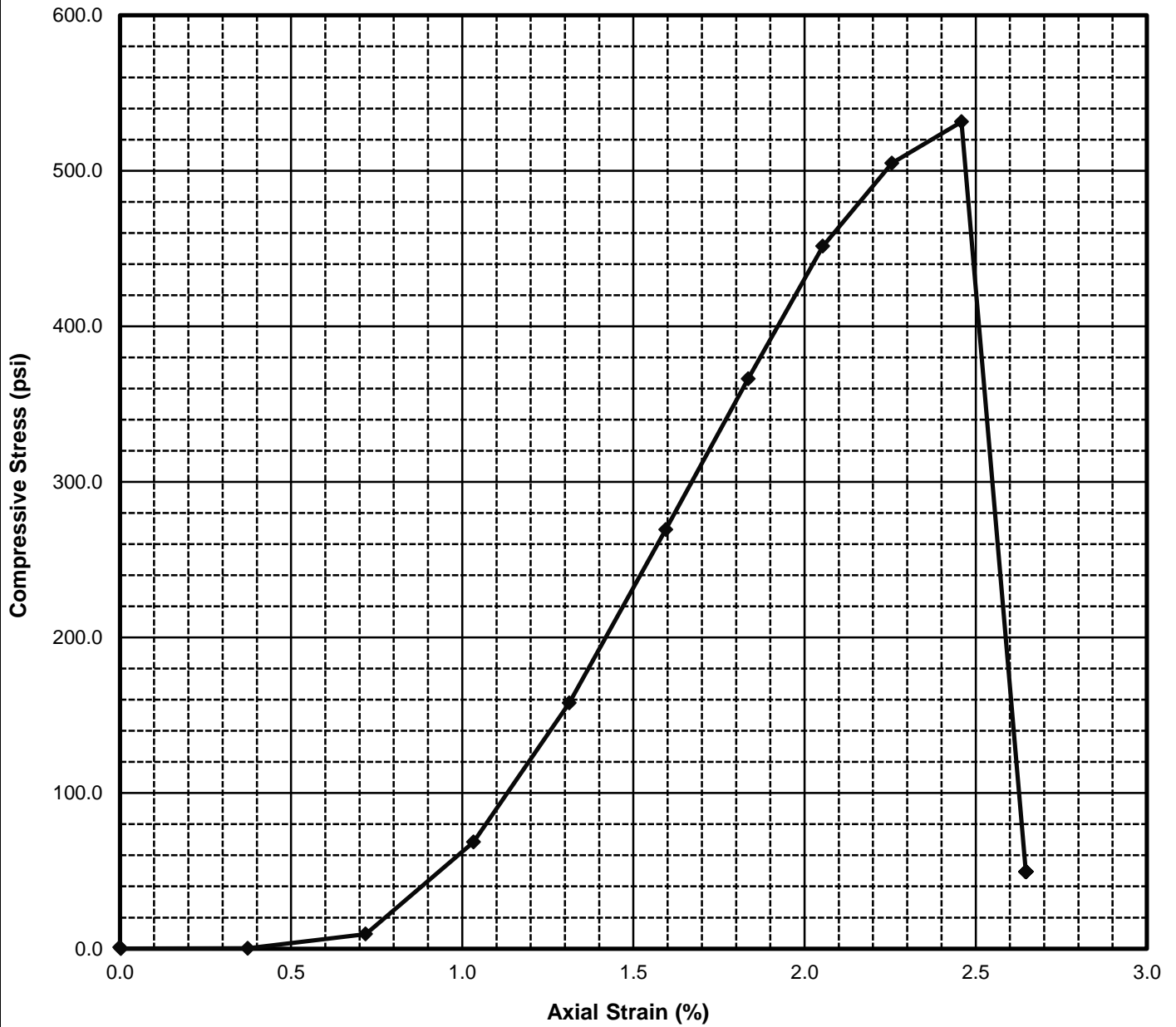


Water Content (%)	Length (in)	Diameter (in)	Wet Unit Weight (pcf)	Peak Stress (psi)
15.9	4.899	2.423	133.4	742

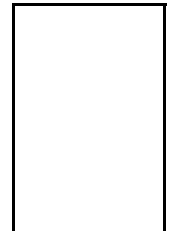
Failure Sketch



<b>Project Name: Pure Water</b>		<b>UNCONFINED COMPRESSION TEST ASTM D7012</b>
<b>Project Number: 60530732</b>		
<b>Boring Number: EX-01</b>	<b>Depth (ft): 95.6</b>	
<b>Description and/or Classification: Dark gray Siltstone</b>		

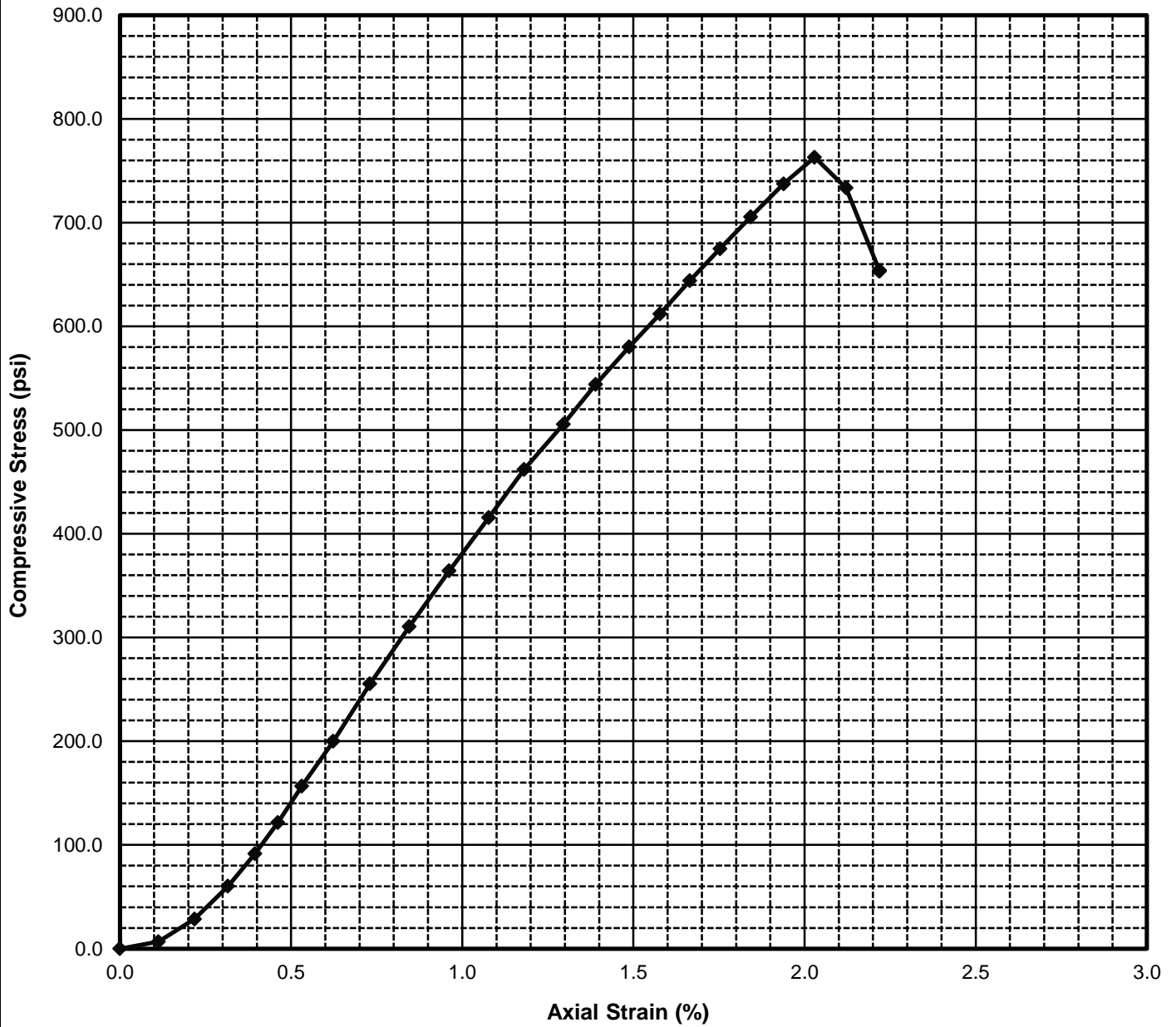


Failure Sketch

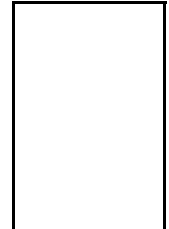


Water Content (%)	Length (in)	Diameter (in)	Wet Unit Weight (pcf)	Peak Stress (psi)
15.8	5.001	2.423	132.3	531

<b>Project Name: Pure Water</b>		<b>UNCONFINED COMPRESSION TEST ASTM D7012</b>
<b>Project Number: 60530732</b>		
<b>Boring Number: RC-01</b>	<b>Depth (ft): 61.2</b>	
<b>Description and/or Classification: Dark gray Siltstone</b>		



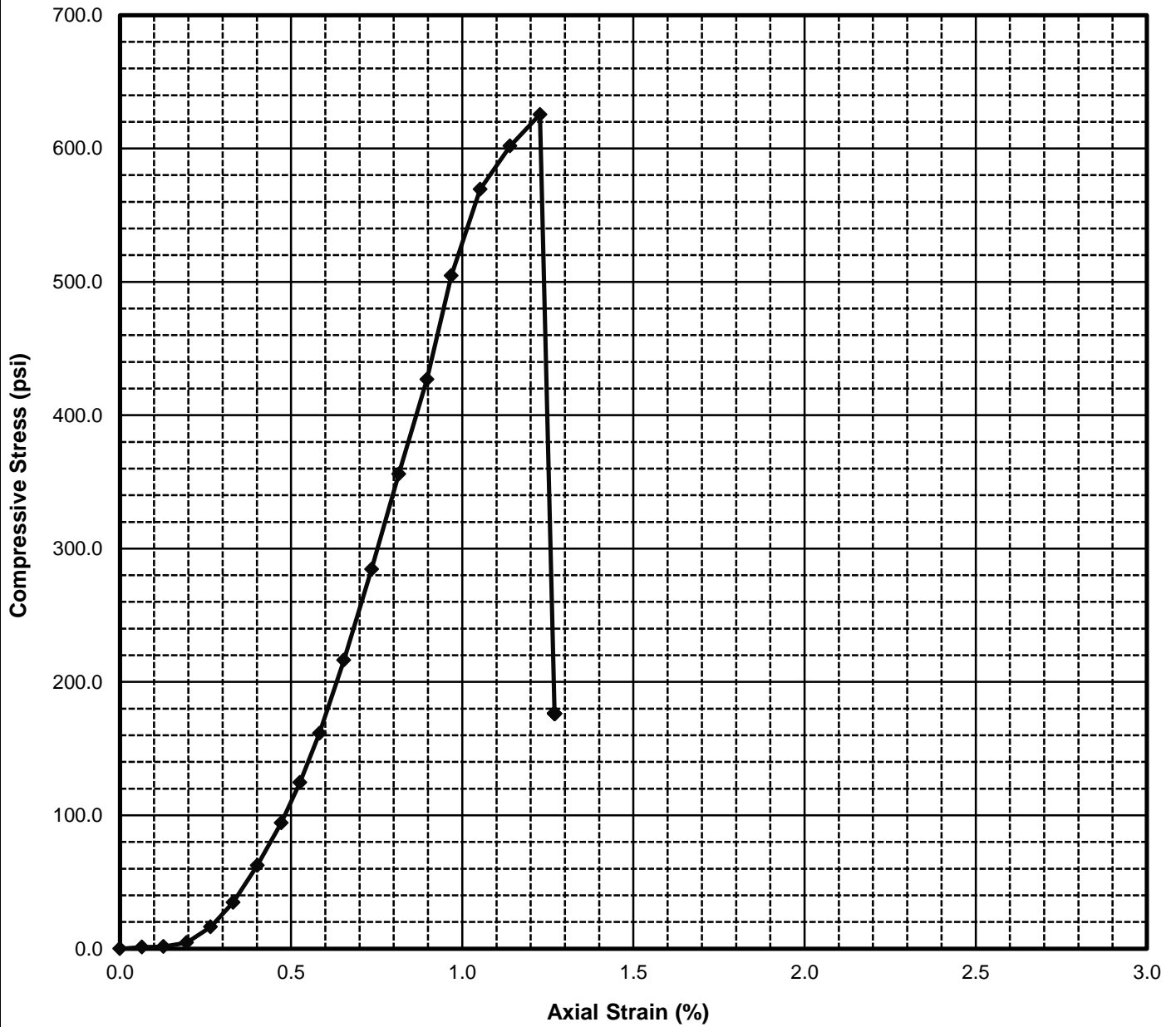
Failure Sketch



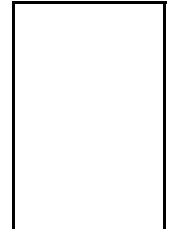
Water Content (%)	Length (in)	Diameter (in)	Wet Unit Weight (pcf)	Peak Stress (psi)
15.8	4.928	2.419	133.0	763

<b>Project Name: Pure Water</b>		<b>UNCONFINED COMPRESSION TEST ASTM D7012</b>
<b>Project Number: 60530732</b>		
<b>Boring Number: RC-01</b>	<b>Depth (ft): 65.7</b>	
<b>Description and/or Classification: Gray Siltstone</b>		



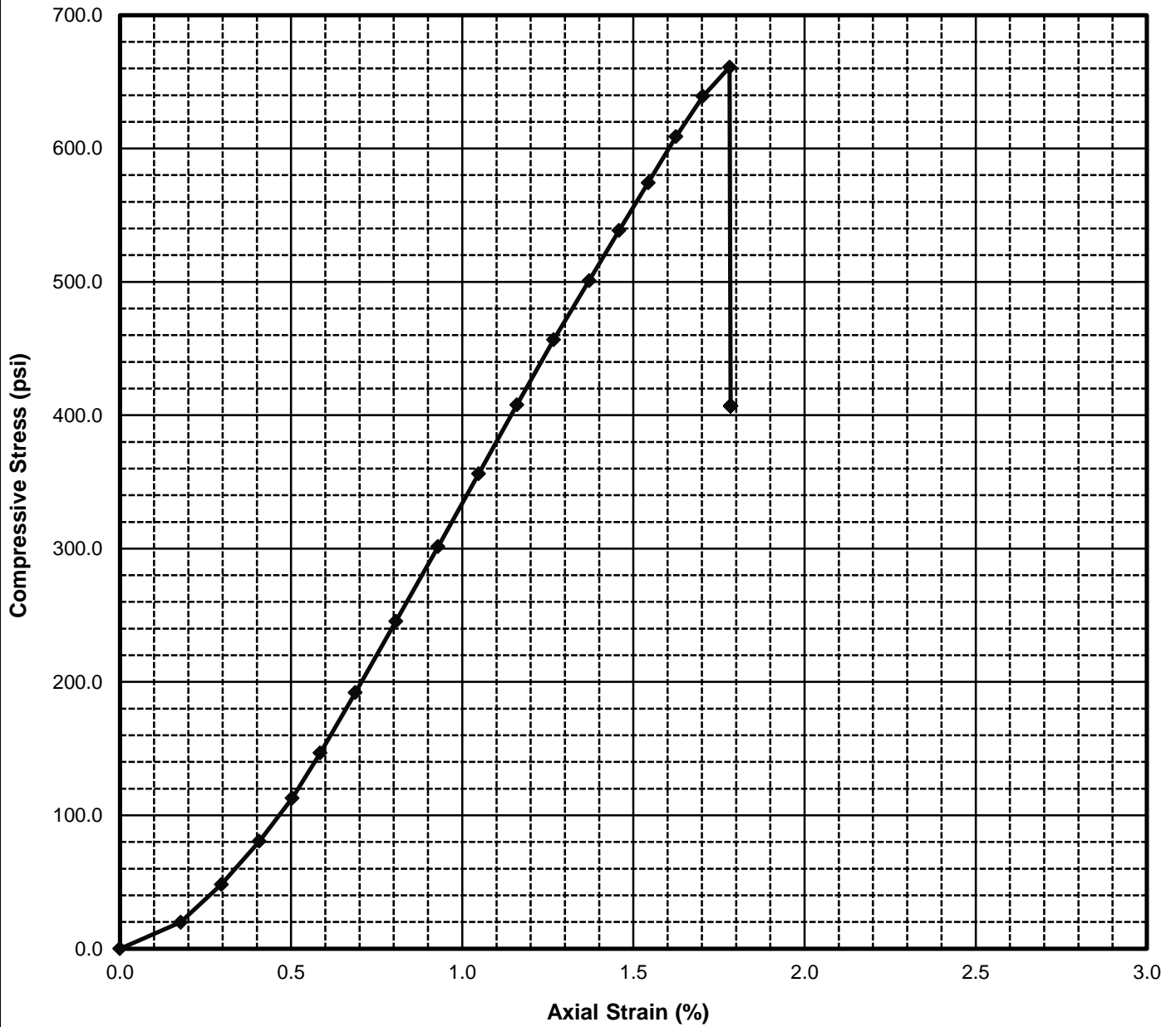


Failure Sketch

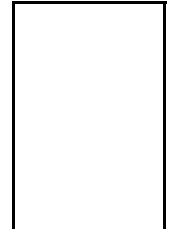


Water Content (%)	Length (in)	Diameter (in)	Wet Unit Weight (pcf)	Peak Stress (psi)
16.3	4.922	2.421	133.2	625

<b>Project Name: Pure Water</b>		<b>UNCONFINED COMPRESSION TEST ASTM D7012</b>
<b>Project Number: 60530732</b>		
<b>Boring Number: RC-01</b>	<b>Depth (ft): 71.7</b>	
<b>Description and/or Classification: Dark greenish gray Sandstone</b>		

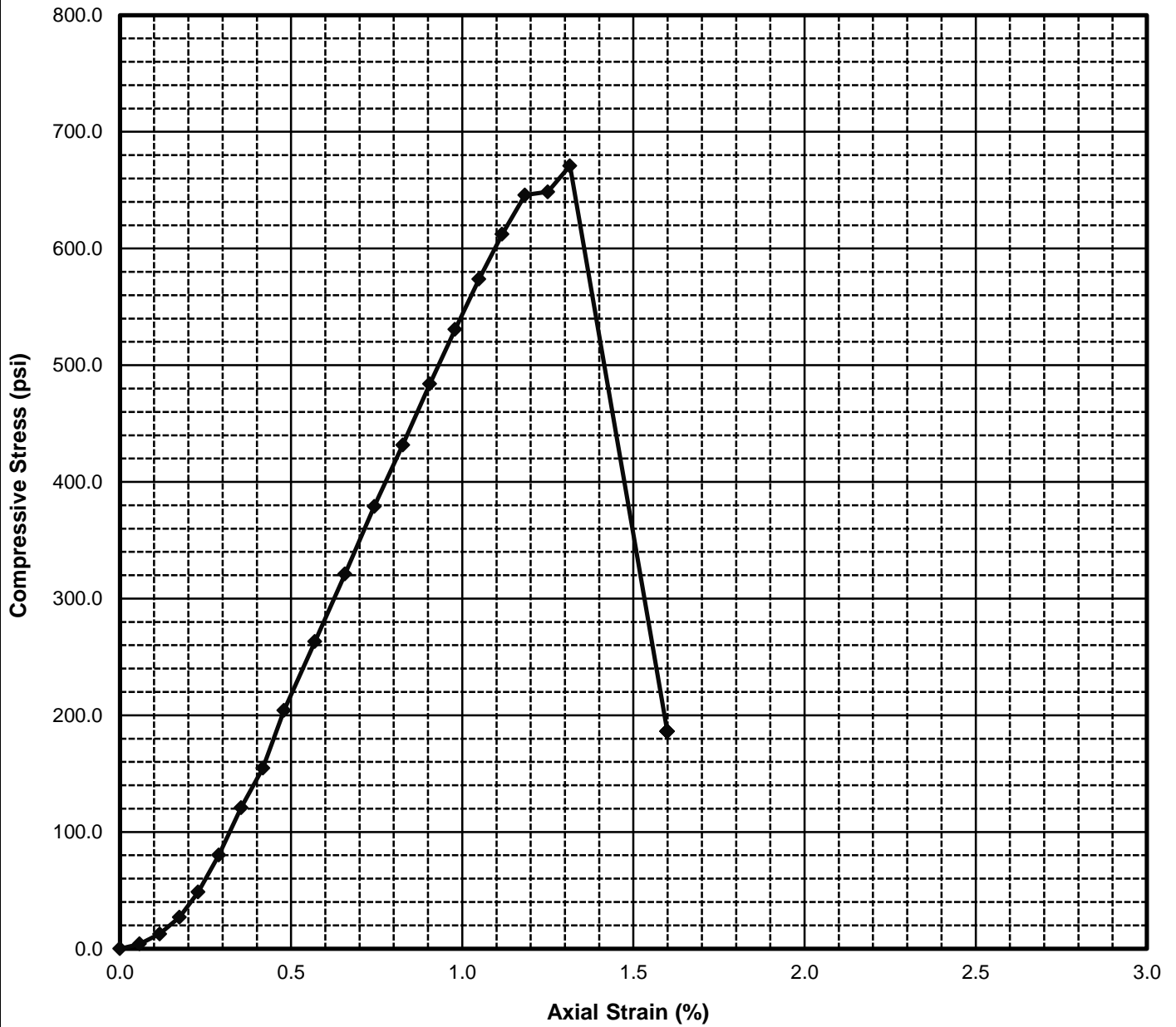


Failure Sketch

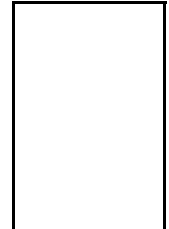


Water Content (%)	Length (in)	Diameter (in)	Wet Unit Weight (pcf)	Peak Stress (psi)
16.0	4.924	2.421	131.7	661

<b>Project Name: Pure Water</b>		<b>UNCONFINED COMPRESSION TEST ASTM D7012</b>
<b>Project Number: 60530732</b>		
<b>Boring Number: RC-02</b>	<b>Depth (ft): 73.0</b>	
<b>Description and/or Classification: Dark gray Siltstone</b>		



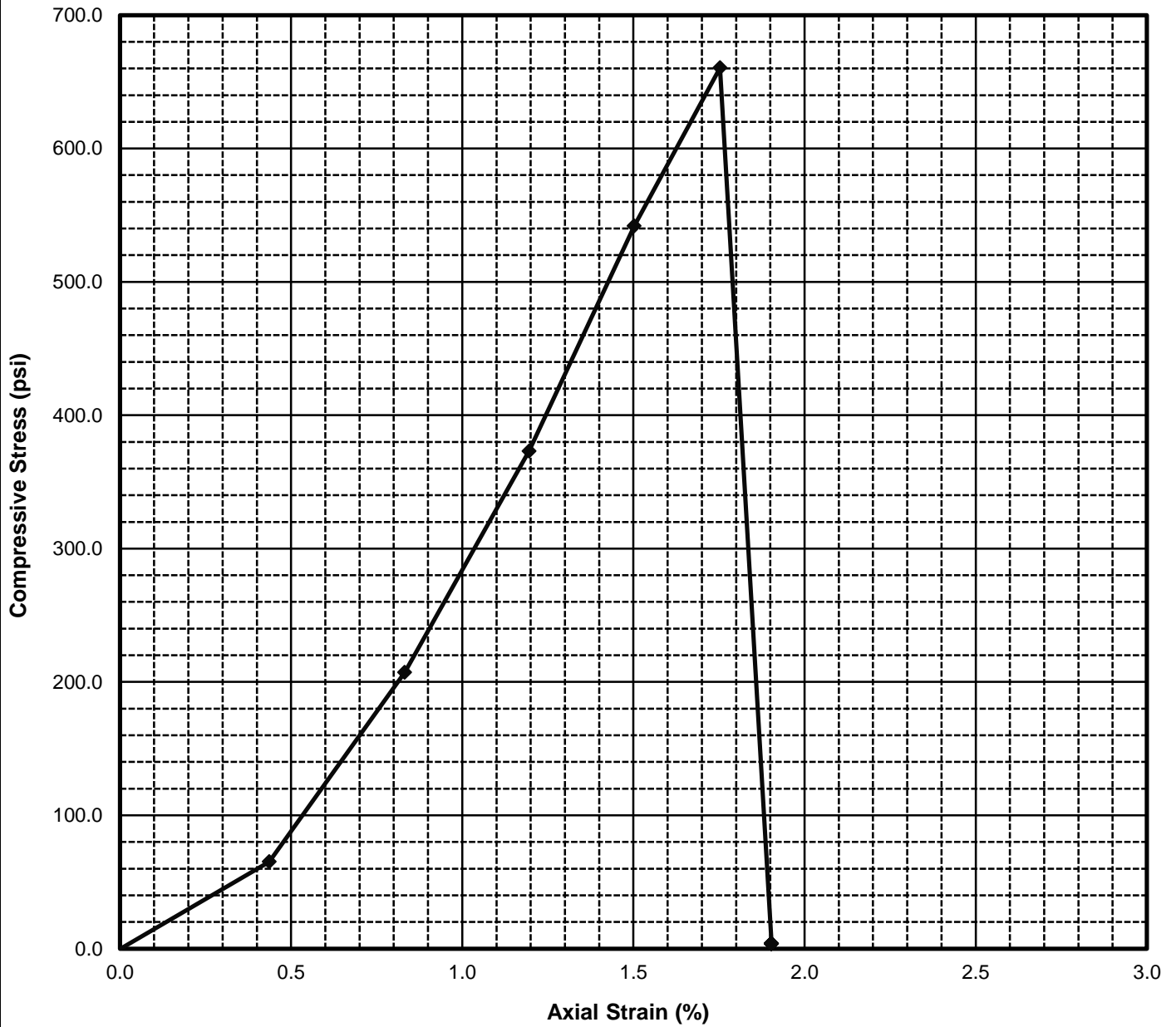
Failure Sketch



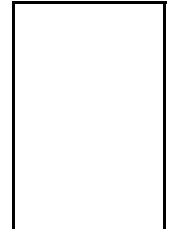
Water Content (%)	Length (in)	Diameter (in)	Wet Unit Weight (pcf)	Peak Stress (psi)
16.6	4.944	2.426	132.0	671

<b>Project Name: Pure Water</b>		<b>UNCONFINED COMPRESSION TEST ASTM D7012</b>
<b>Project Number: 60530732</b>		
<b>Boring Number: RC-02</b>	<b>Depth (ft): 79.0</b>	
<b>Description and/or Classification: Dark gray Siltstone</b>		



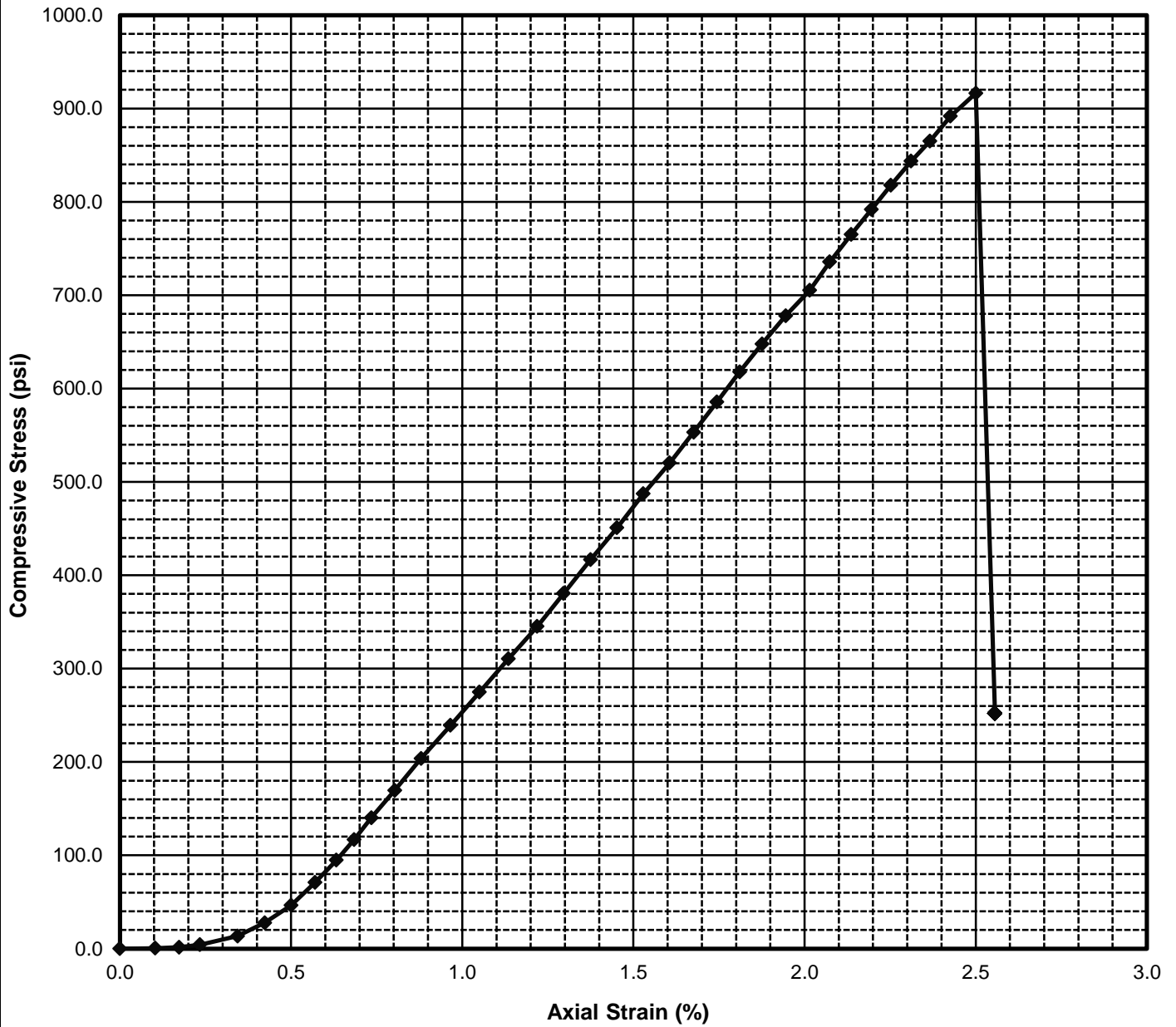


Failure Sketch

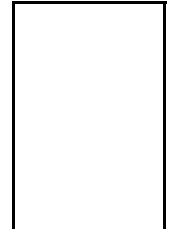


Water Content (%)	Length (in)	Diameter (in)	Wet Unit Weight (pcf)	Peak Stress (psi)
13.9	4.928	2.395	132.3	661

<b>Project Name: Pure Water</b>		<b>UNCONFINED COMPRESSION TEST ASTM D7012</b>
<b>Project Number: 60530732</b>		
<b>Boring Number: SC-01</b>	<b>Depth (ft): 45.9</b>	
<b>Description and/or Classification: Dark gray Siltstone</b>		

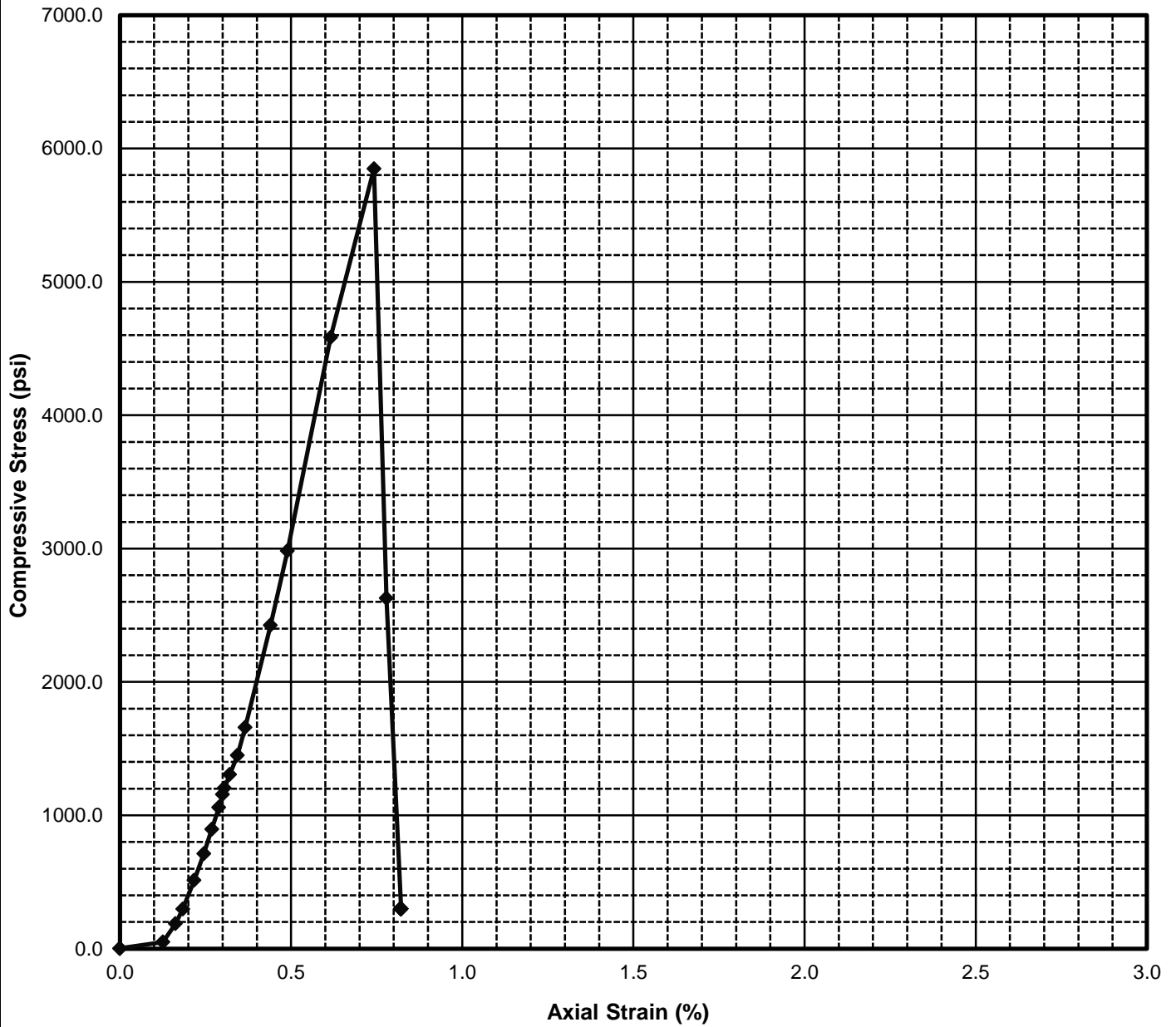


Failure Sketch



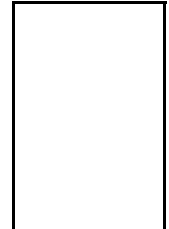
Water Content (%)	Length (in)	Diameter (in)	Wet Unit Weight (pcf)	Peak Stress (psi)
14.3	5.131	2.405	135.5	916

<b>Project Name: Pure Water</b>		<b>UNCONFINED COMPRESSION TEST ASTM D7012</b>
<b>Project Number: 60530732</b>		
<b>Boring Number: SC-01</b>	<b>Depth (ft): 51.5</b>	
<b>Description and/or Classification: Dark greenish gray Sandstone</b>		



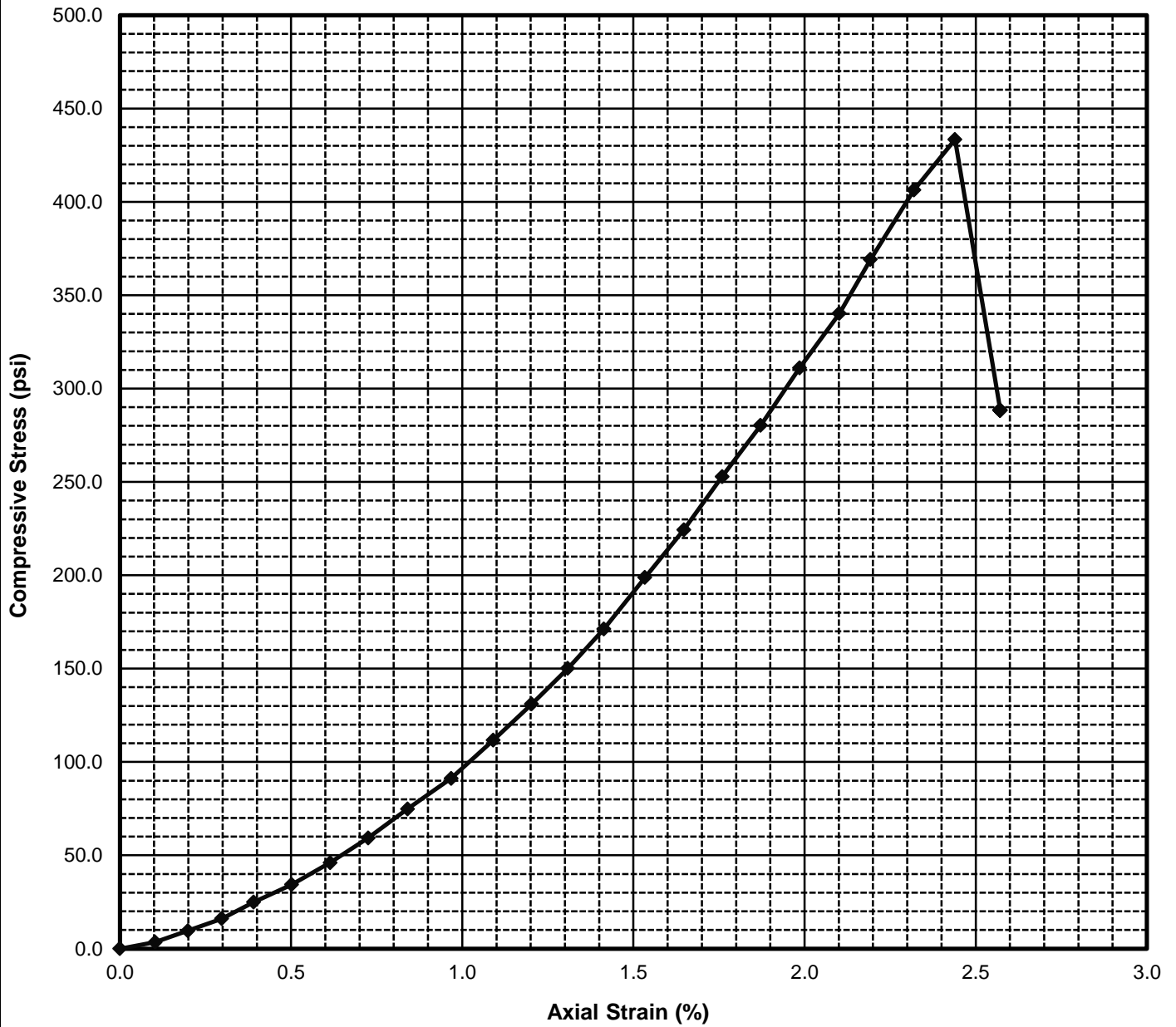
Water Content (%)	Length (in)	Diameter (in)	Wet Unit Weight (pcf)	Peak Stress (psi)
0.7	5.139	2.414	165.1	5849

Failure Sketch

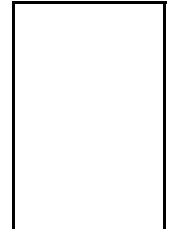


<b>Project Name: Pure Water</b>		<b>UNCONFINED COMPRESSION TEST ASTM D7012</b>
<b>Project Number: 60530732</b>		
<b>Boring Number: SC-01</b>	<b>Depth (ft): 56.2</b>	
<b>Description and/or Classification: Gray Sandstone</b>		



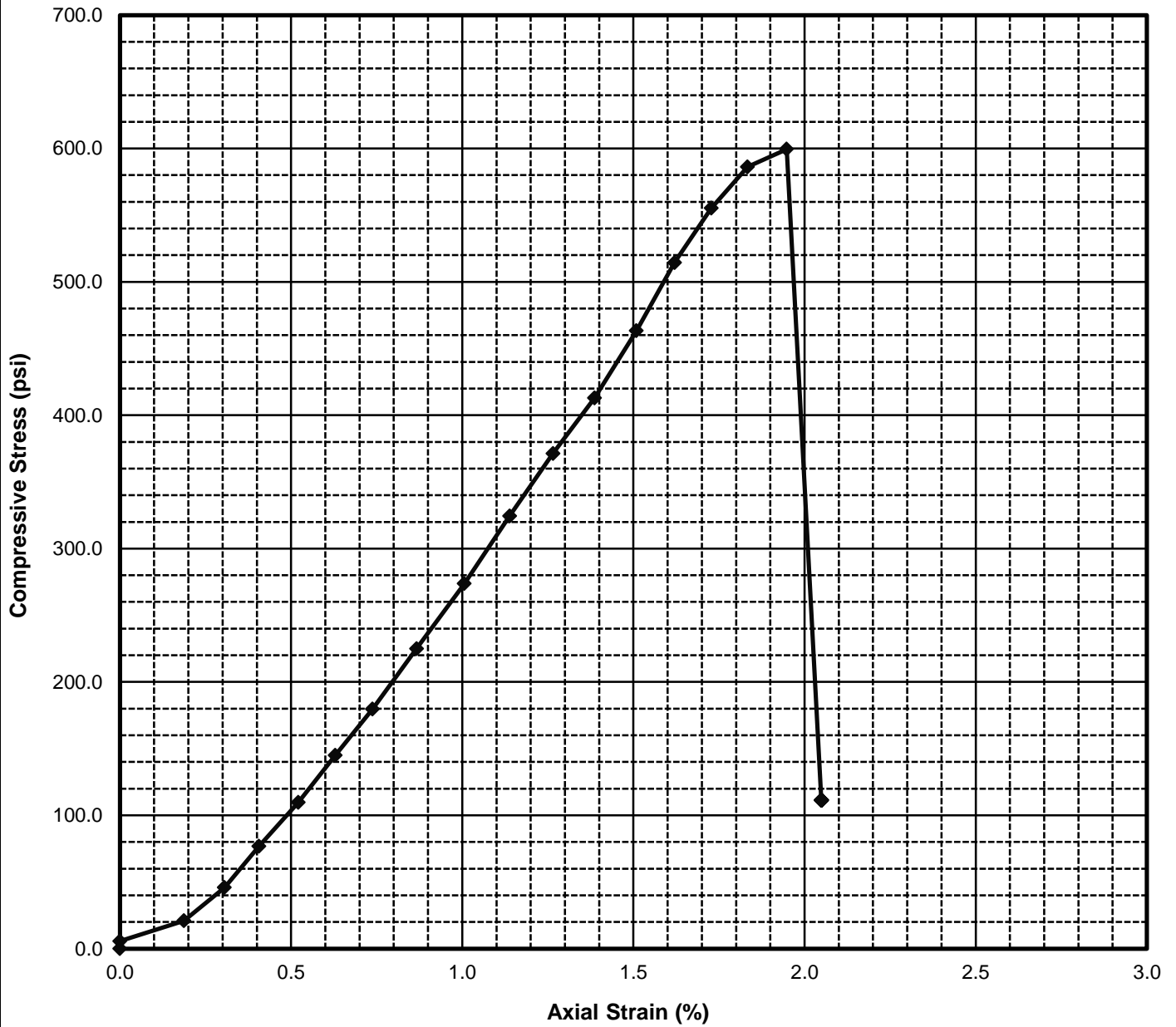


Failure Sketch

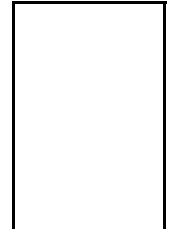


Water Content (%)	Length (in)	Diameter (in)	Wet Unit Weight (pcf)	Peak Stress (psi)
12.9	4.956	2.400	133.6	433

<b>Project Name: Pure Water</b>		<b>UNCONFINED COMPRESSION TEST ASTM D7012</b>
<b>Project Number: 60530732</b>		
<b>Boring Number: SC-01</b>	<b>Depth (ft): 68.1</b>	
<b>Description and/or Classification: Dark gray Siltstone</b>		

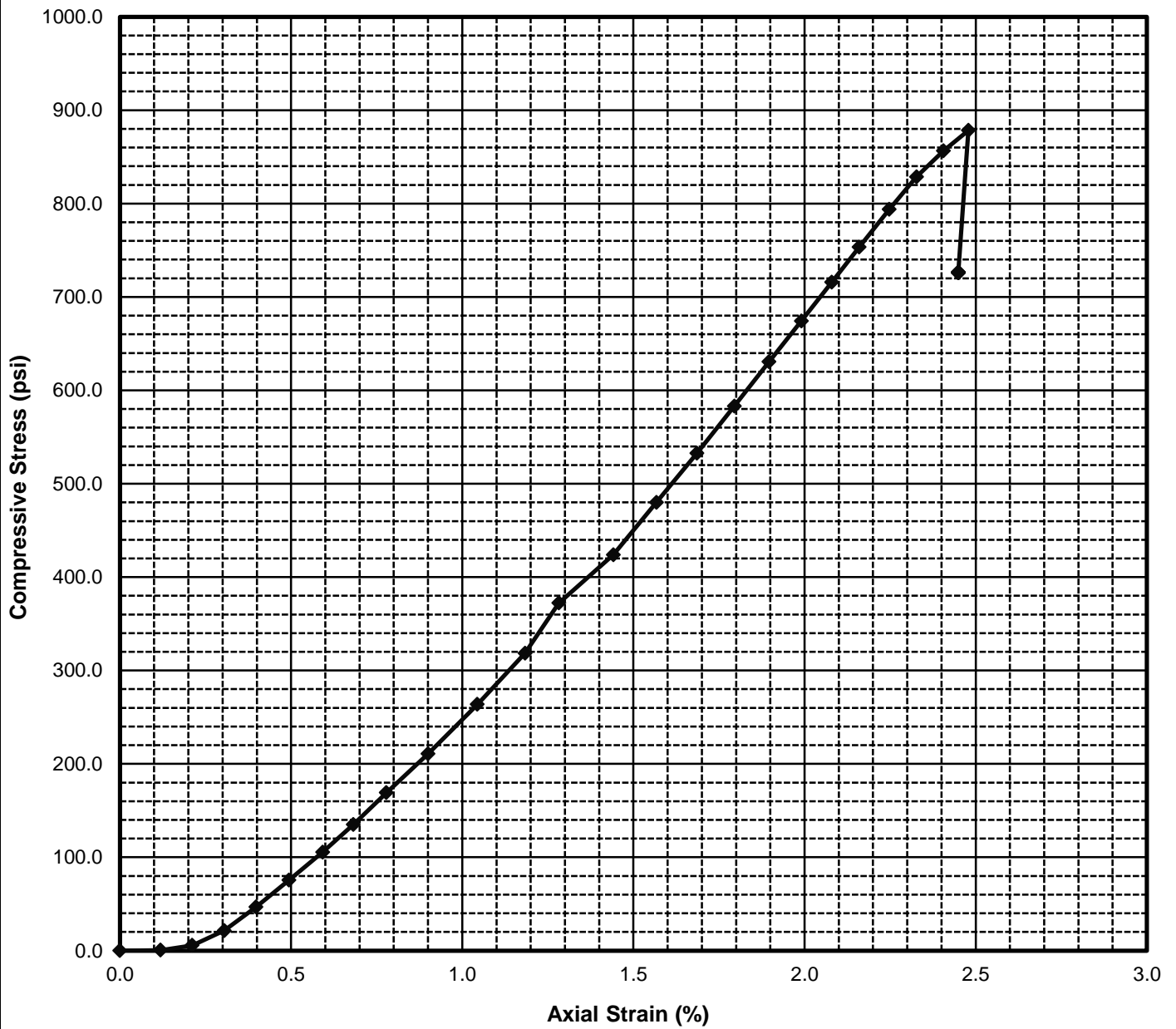


Failure Sketch

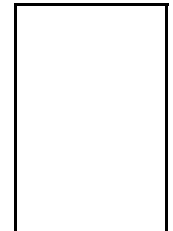


Water Content (%)	Length (in)	Diameter (in)	Wet Unit Weight (pcf)	Peak Stress (psi)
14.9	4.944	2.400	132.6	599

<b>Project Name: Pure Water</b>		<b>UNCONFINED COMPRESSION TEST ASTM D7012</b>
<b>Project Number: 60530732</b>		
<b>Boring Number: SC-02</b>	<b>Depth (ft): 33.0</b>	
<b>Description and/or Classification: Dark gray Siltstone</b>		



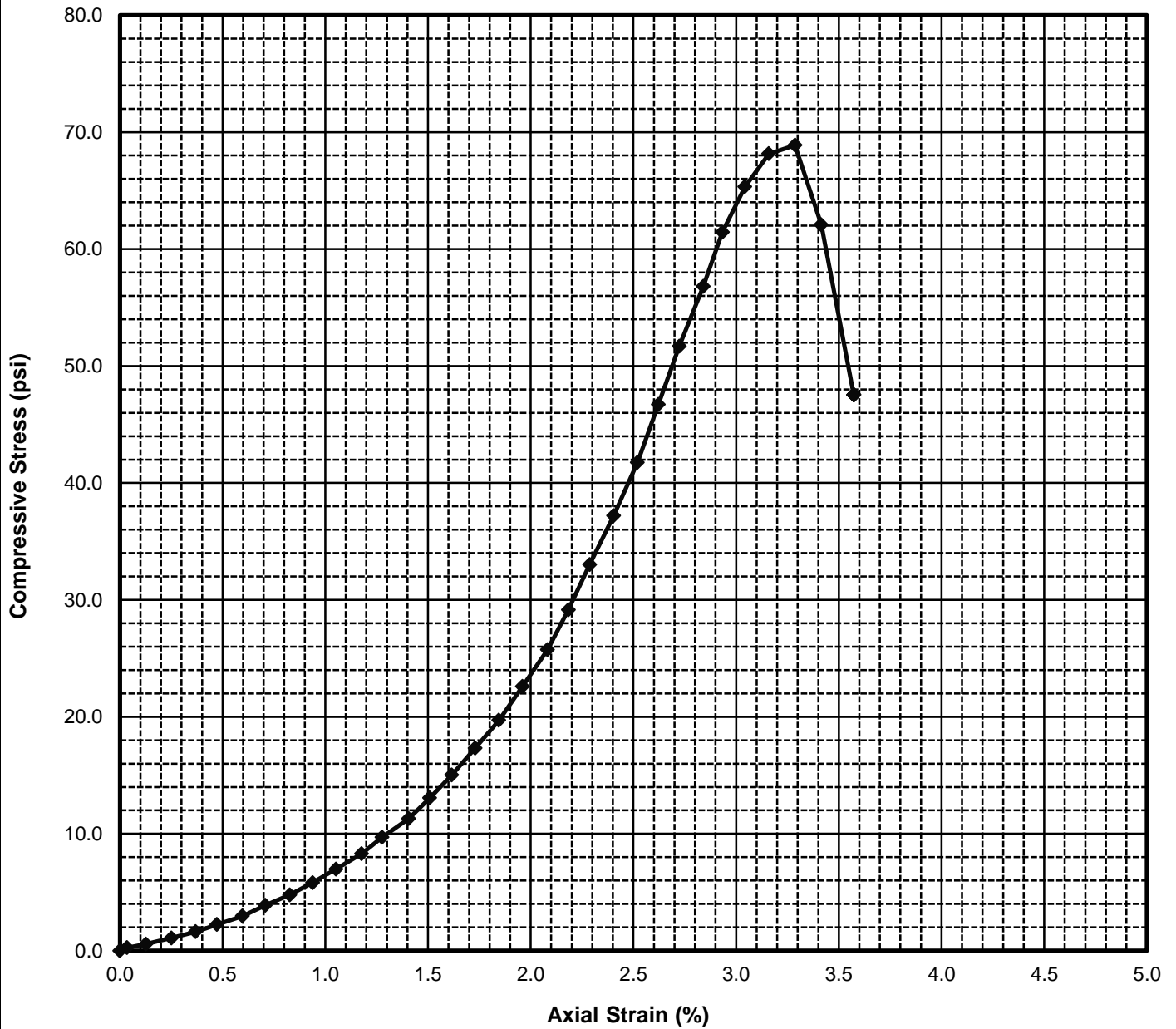
Failure Sketch



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

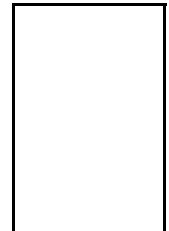
<b>Project Name: Pure Water</b>		<b>UNCONFINED COMPRESSION TEST ASTM D7012</b>
<b>Project Number: 60530732</b>		
<b>Boring Number: SC-02</b>	<b>Depth (ft): 56.2</b>	
<b>Description and/or Classification: Dark greenish gray Siltstone</b>		



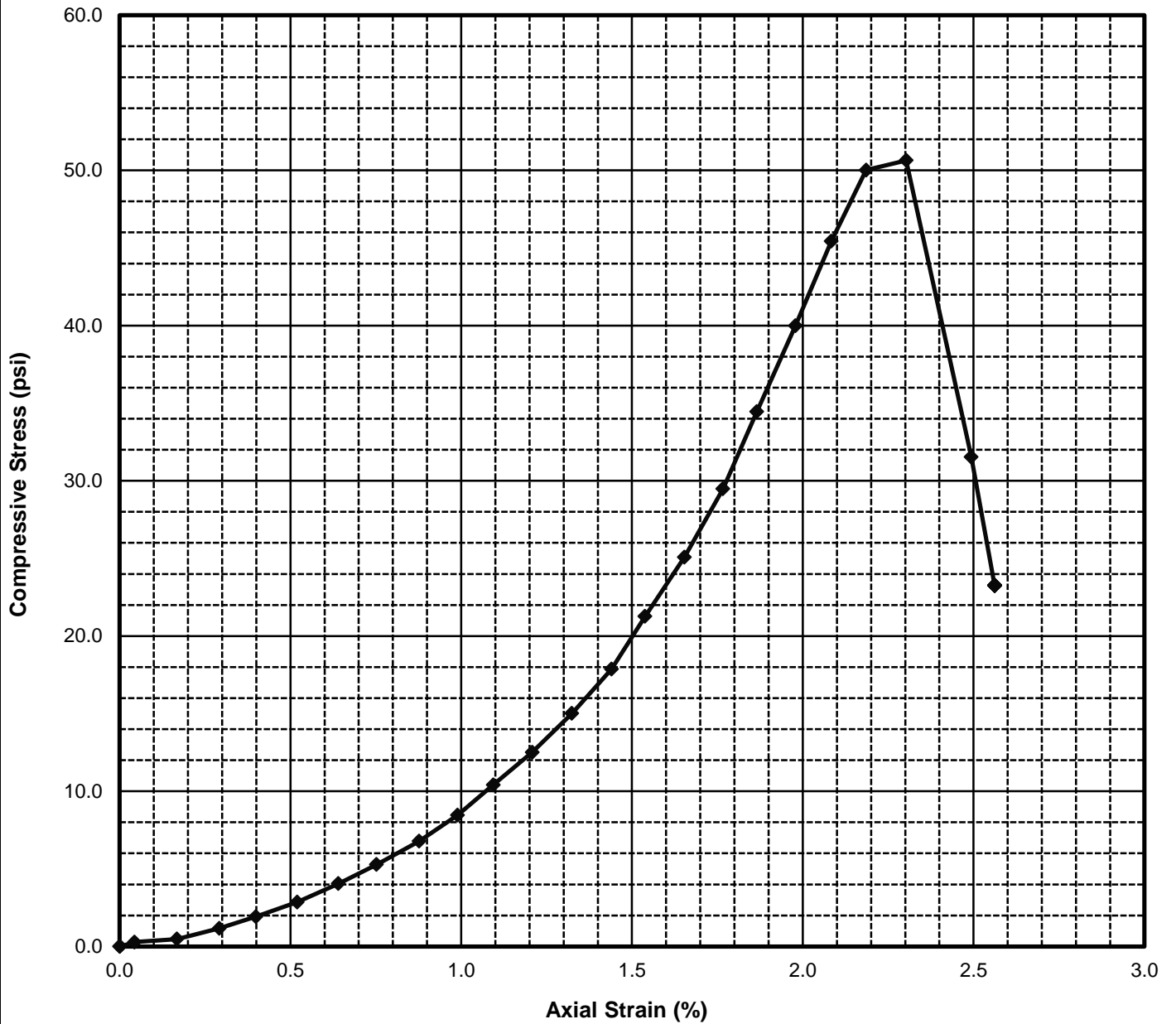


Water Content (%)	Length (in)	Diameter (in)	Wet Unit Weight (pcf)	Peak Stress (psi)
20.1	4.927	2.452	126.4	69

Failure Sketch

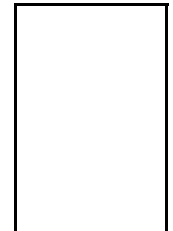


<b>Project Name: Pure Water</b>		<b>UNCONFINED COMPRESSION TEST ASTM D7012</b>
<b>Project Number: 60530732</b>		
<b>Boring Number: RC-02</b>	<b>Depth (ft): 84.3</b>	
<b>Description and/or Classification: Dark gray Sandstone</b>		

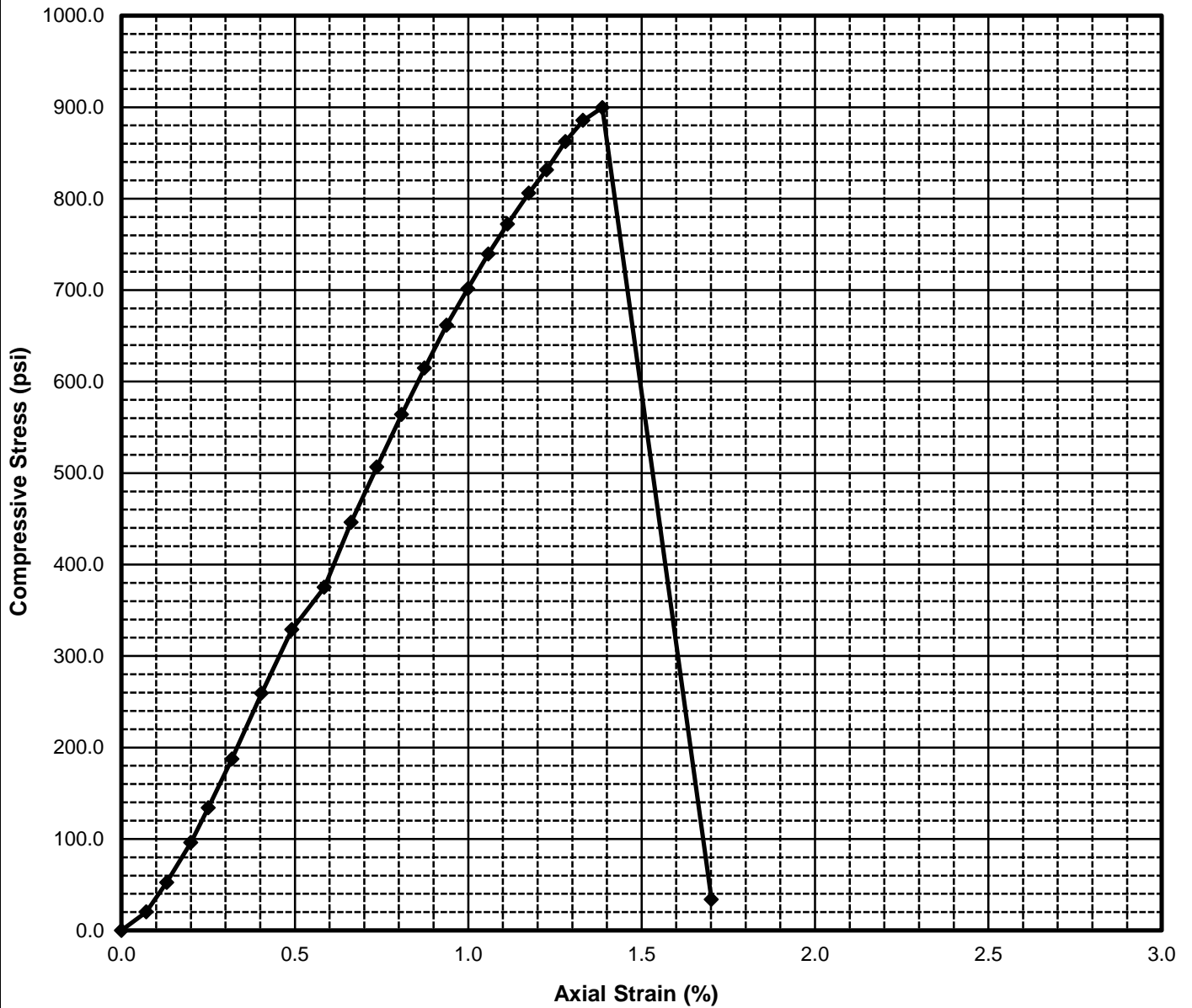


Water Content (%)	Length (in)	Diameter (in)	Wet Unit Weight (pcf)	Peak Stress (psi)
18.7	4.932	2.447	128.6	51

Failure Sketch

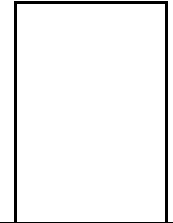


<b>Project Name: Pure Water</b>		<b>UNCONFINED COMPRESSION TEST ASTM D7012</b>
<b>Project Number: 60530732</b>		
<b>Boring Number: RC-02</b>	<b>Depth (ft): 94.0</b>	
<b>Description and/or Classification: Gray Sandstone</b>		



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

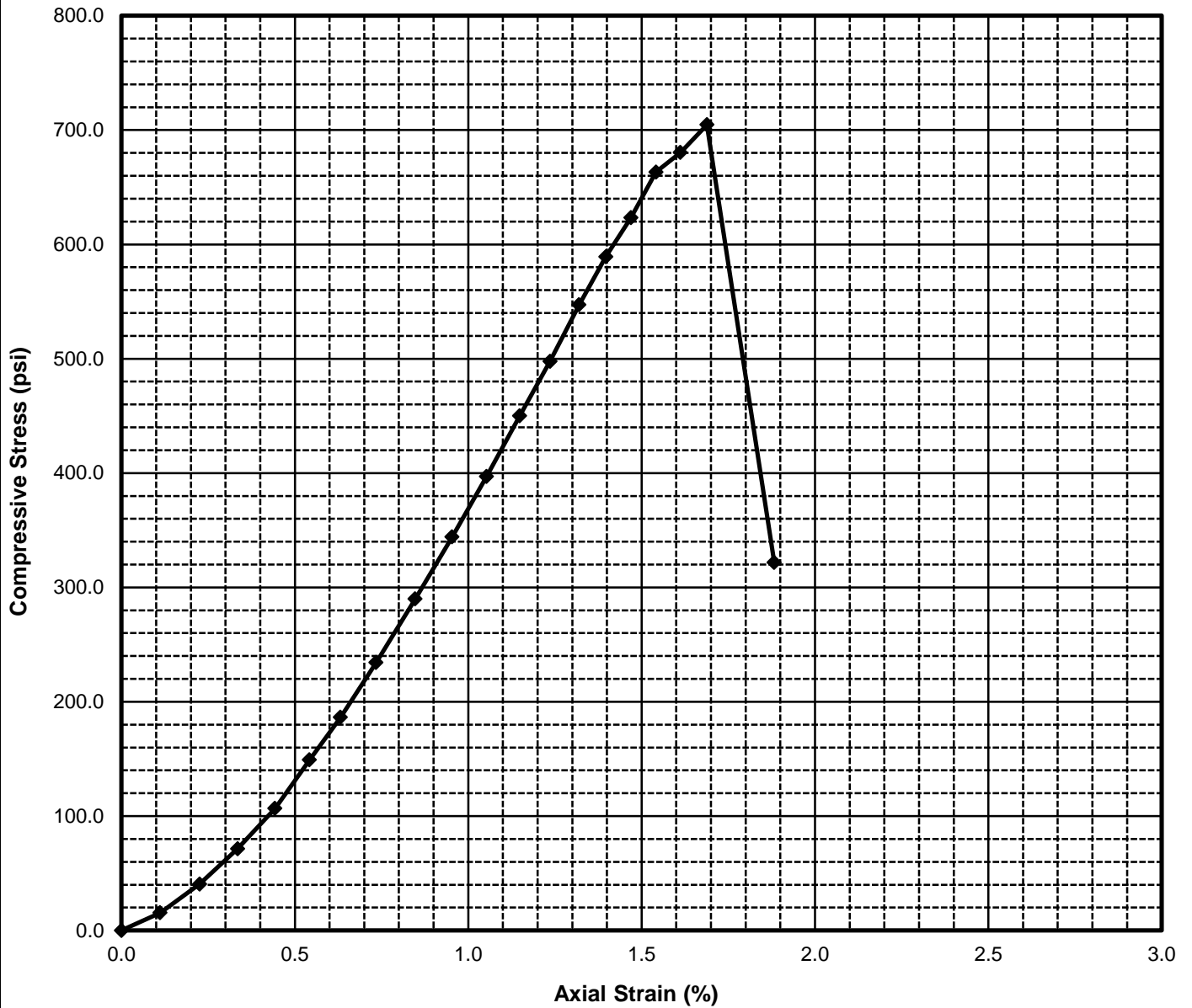
Failure Sketch



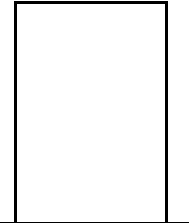
<b>Project Name:</b> Pure Water	
<b>Project Number:</b> 60530732	
<b>Boring Number:</b> RC-03	<b>Depth (ft):</b> 64.0
<b>Description and/or Classification:</b> Gray Silstone	

**UNCONFINED COMPRESSION TEST  
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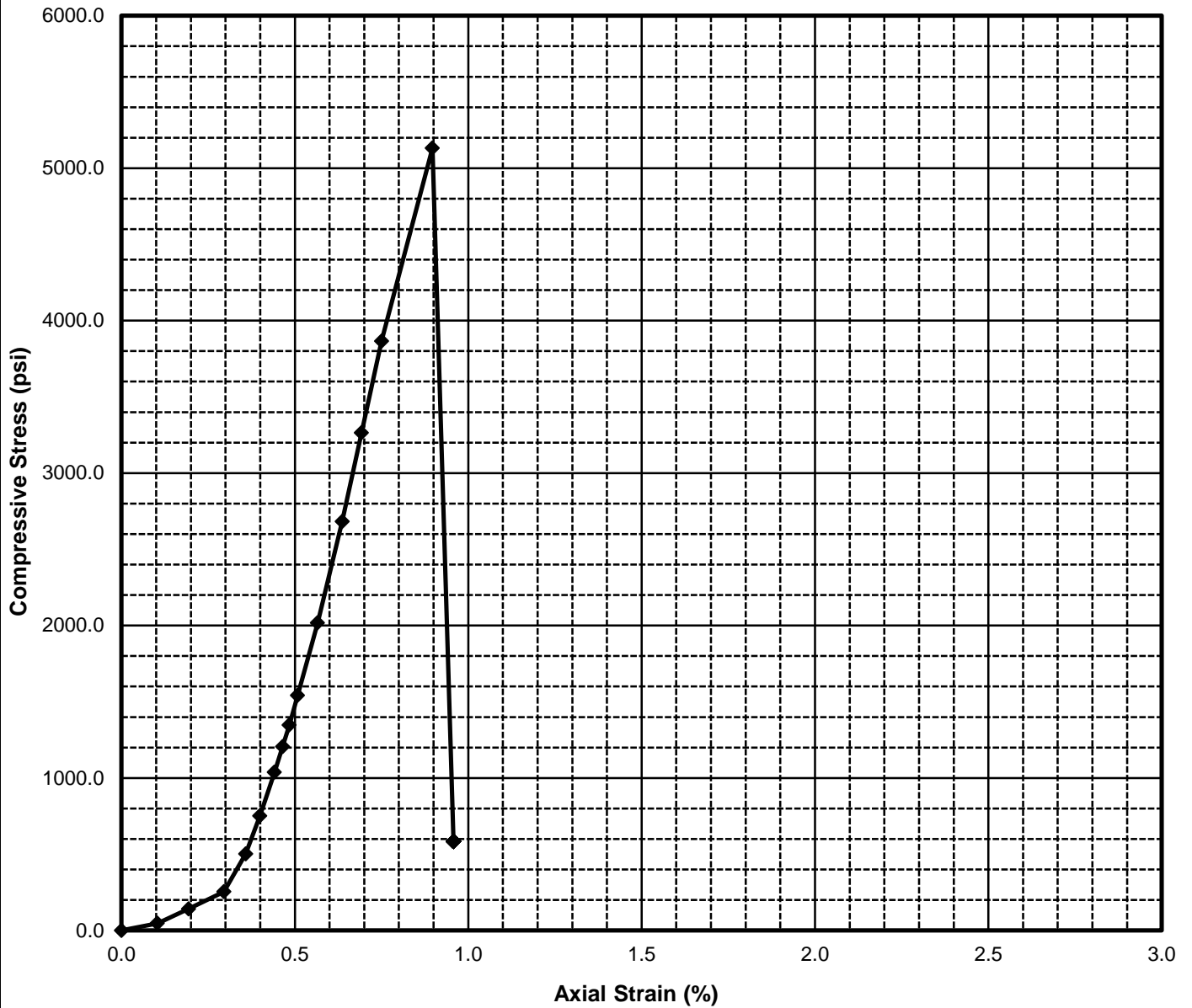
Failure Sketch



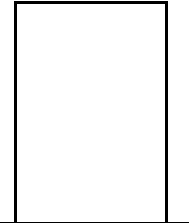
Water Content (%)	Length (in)	Diameter (in)	Wet Unit Weight (pcf)	Peak Stress (psi)
15.7	4.972	2.382	130.0	705

<b>Project Name:</b> Pure Water	
<b>Project Number:</b> 60530732	
<b>Boring Number:</b> RC-03	<b>Depth (ft):</b> 72.5
<b>Description and/or Classification:</b> Gray Siltstone	

**UNCONFINED COMPRESSION TEST  
ASTM D7012**



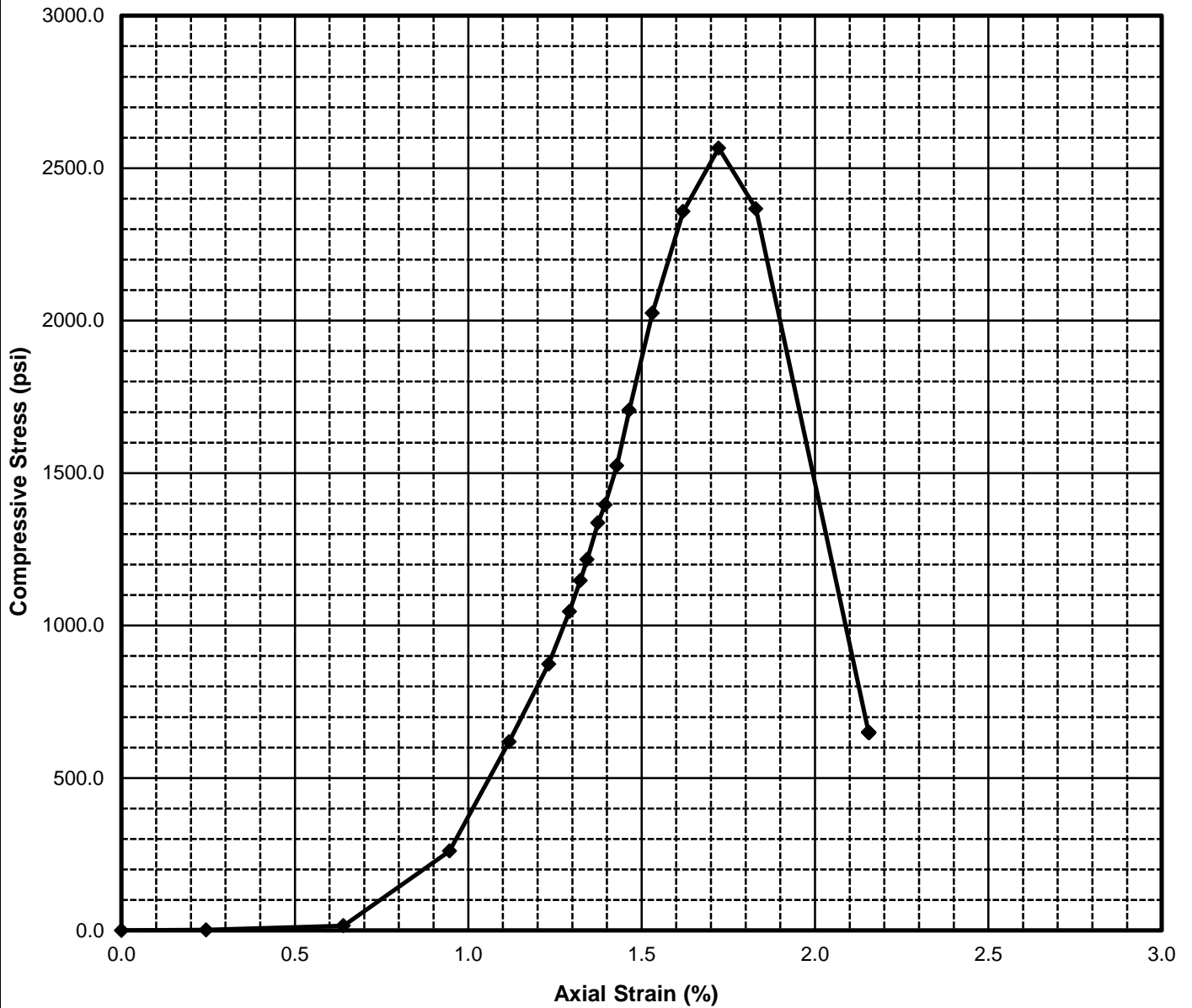
Failure Sketch



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

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

**UNCONFINED COMPRESSION TEST  
ASTM D7012**



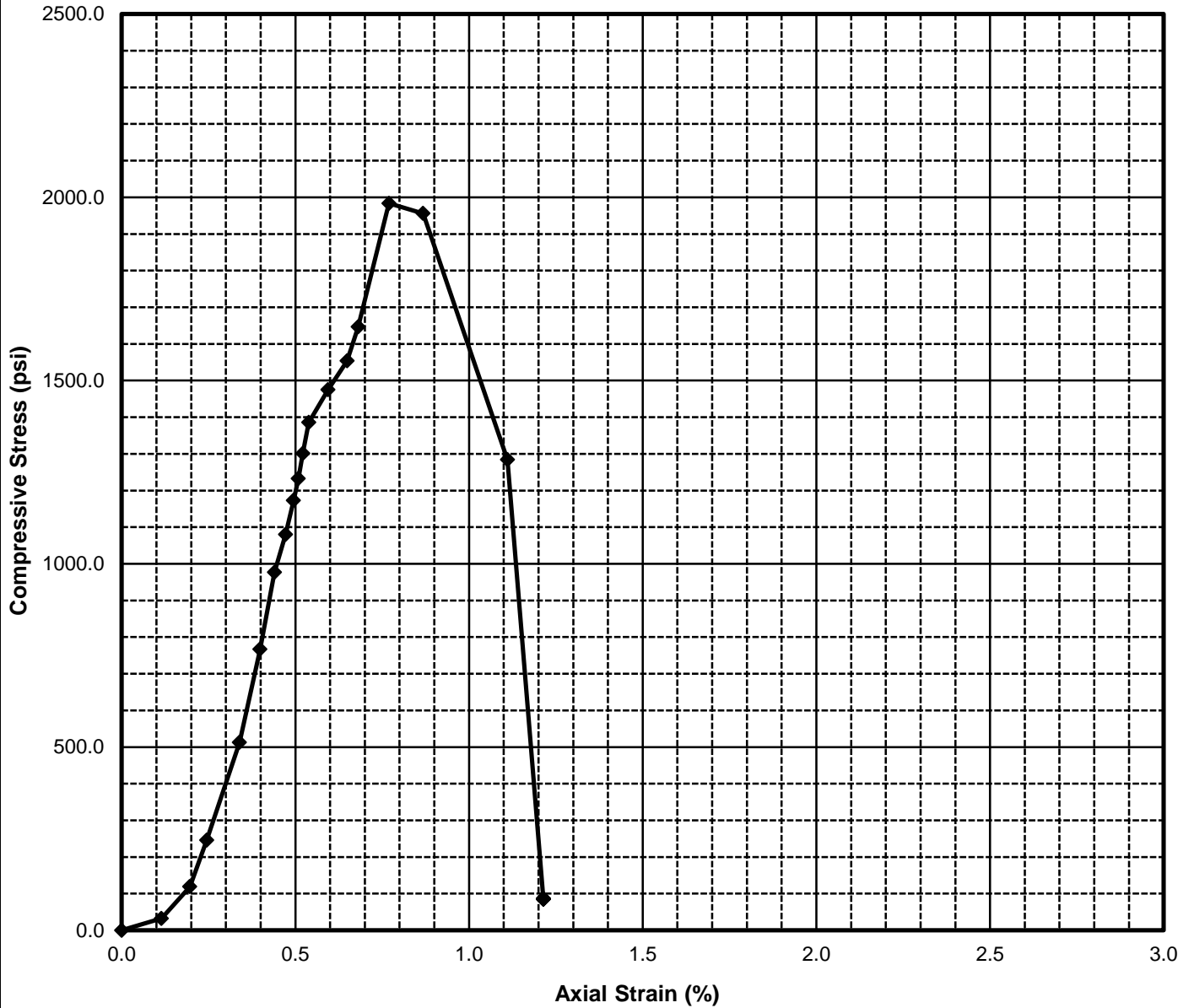
Water Content (%)	Length (in)	Diameter (in)	Wet Unit Weight (pcf)	Peak Stress (psi)
1.5	4.334	2.375	159.4	2566

Failure Sketch

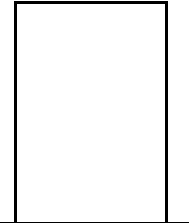
<b>Project Name:</b> Pure Water	
<b>Project Number:</b> 60530732	
<b>Boring Number:</b> SC-03	<b>Depth (ft):</b> 39.2
<b>Description and/or Classification:</b> Gray Sandstone	

**UNCONFINED COMPRESSION TEST**  
**ASTM D7012**





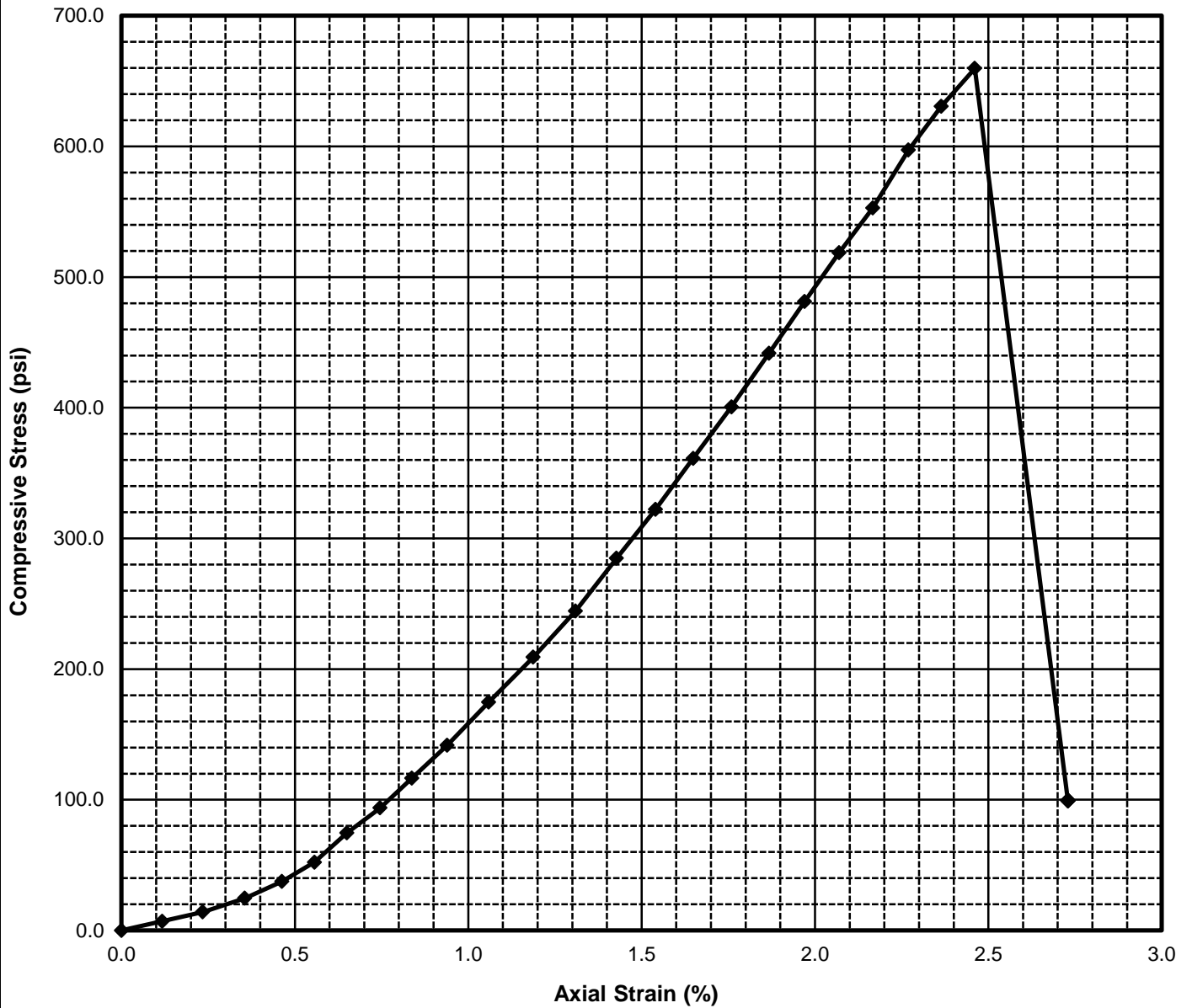
Failure Sketch



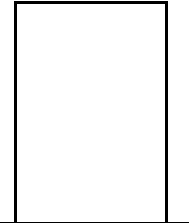
Water Content (%)	Length (in)	Diameter (in)	Wet Unit Weight (pcf)	Peak Stress (psi)
0.6	5.023	2.377	162.8	1983

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

**UNCONFINED COMPRESSION TEST**  
ASTM D7012



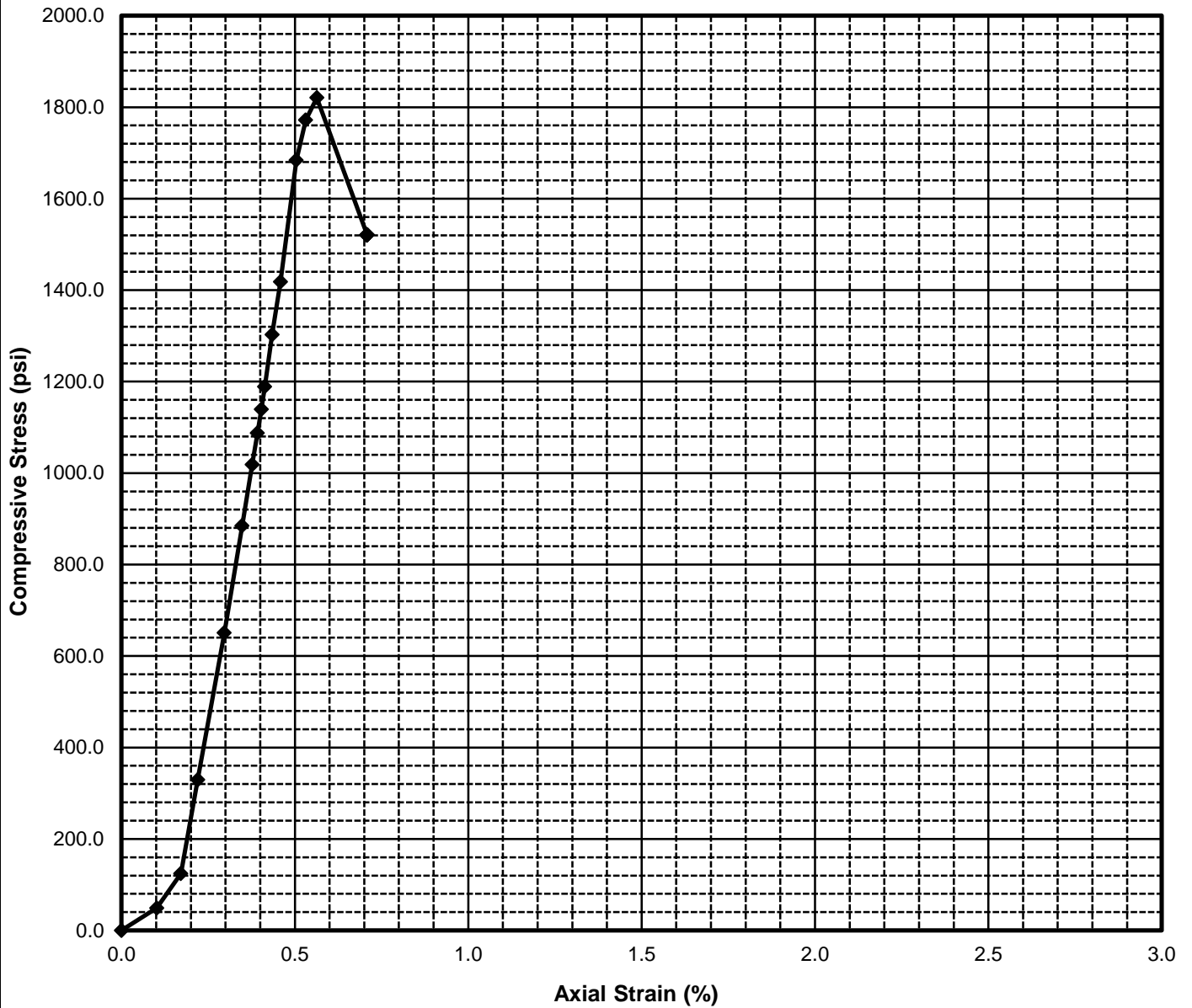
Failure Sketch



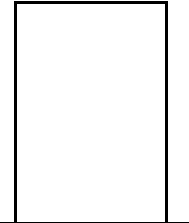
Water Content (%)	Length (in)	Diameter (in)	Wet Unit Weight (pcf)	Peak Stress (psi)
15.4	4.994	2.379	128.3	660

<b>Project Name:</b> Pure Water	
<b>Project Number:</b> 60530732	
<b>Boring Number:</b> SC-03	<b>Depth (ft):</b> 49.5
<b>Description and/or Classification:</b> 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

<b>Project Name:</b> Pure Water	
<b>Project Number:</b> 60530732	
<b>Boring Number:</b> SC-03	<b>Depth (ft):</b> 50.8
<b>Description and/or Classification:</b> 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**

$De^2 = D^2 \text{ or } 4A / (\pi)$  ; 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 <sup>2</sup> (mm) <sup>2</sup>	Strength Index Is (MPa)	Corr. Strength Is <sub>(50)</sub> (MPa)	Corr. Strength Is <sub>(50)</sub> (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	OVN 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					<b>FILL</b>			
3					Yellow brown to reddish yellow, damp, silty sand (SM) with scattered sub-rounded gravel up to 3" in maximum dimension.			
4								
5	1	7	0.0			10.6		
6	2							
7					-?-?-?			
8					<b>VERY OLD PARALIC DEPOSITS</b>			
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				<b>SCRIPPS FORMATION</b>			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								
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	
22								
23								
24								
25					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	QVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS	
31	8				<b>SCRIPPS FORMATION</b>			Did not attempt sampling between depth of 30' and 35' due to abundant gravel	
32					Gravel conglomerate with an olive brown to yellow brown silty sand (SM) matrix.				
33									
34									
35	9	100+			End of conglomerate zone at 37'.			No sample recovery	
36									
37									
38									
39	10	100+	0.0		Olive/gray to pale reddish yellow, damp, hard, sandy lean clay (CL).	23.2			
40									
41									
42									
43	11	100+	0.0		Pale greenish gray to medium gray, hard, lean clay (CL).	20.8	112.7		
44									
45									
46									
47	12	100+	0.0		Pale yellow brown to pale reddish yellow, damp, very dense, fine to medium grained, silty sand (SM).	21.5			
48									
49									
50									
51	13	100+	0.0		Olive color.	21.3	107.6		
52									
53									
54									

**PROJECT NO.  
44F1**

**ALLIED GEOTECHNICAL ENGINEERS, INC.**

**FIGURE A-18**

**BORING NO. H-7 (Continued)**

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	QVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
63					<b>SCRIPPS FORMATION</b>			
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					74' - 76', gravel zone.			Did not attempt 75' sample due to abundant gravel.
75								
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					<b>SCRIPPS FORMATION</b>			
96					Dark gray, hard claystone (CL/CH).			
97								
98								
99								
100	18	100+	0.1		Medium gray, damp, very dense, fine-grained silty sand (SM).	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**



# **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)



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**

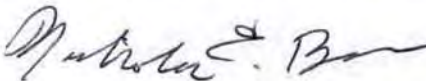
Dear Mr. Hoyle:

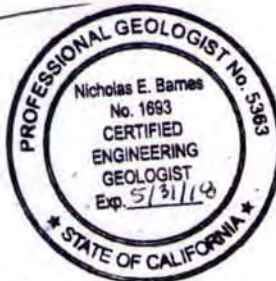
Allied Geotechnical Engineers, Inc. (AGE) is pleased to submit the accompanying "Report" to present the findings, opinions, and recommendations of a geotechnical investigation that was performed to assist CH2M with their design of the subject project. Upon our receipt of review comments from CH2M and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

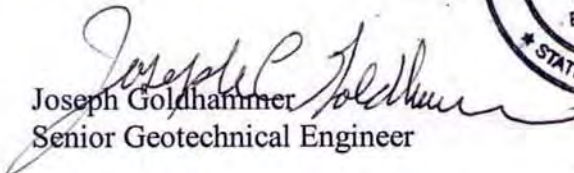
**ALLIED GEOTECHNICAL ENGINEERS, INC.**

  
Nicholas E. Barnes, P.G./C.E.G.  
Senior Geologist



  
Sani Sutanto P.E.  
Project Manager



  
Joseph Goldhammer  
Senior Geotechnical Engineer



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**

<b>Boring ID</b>	<b>Proposed Facility</b>	<b>Boring Depth (feet)</b>	<b>Existing Pavement Section</b>	<b>Subsurface Conditions</b>	<b>Estimated G.W. Depth (feet bgs)</b>
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)

<b>Boring ID</b>	<b>Proposed Facility</b>	<b>Boring Depth (feet)</b>	<b>Existing Pavement Section</b>	<b>Subsurface Conditions</b>	<b>Estimated G.W. Depth (feet bgs)</b>
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)

<b>Boring ID</b>	<b>Proposed Facility</b>	<b>Boring Depth (feet)</b>	<b>Existing Pavement Section</b>	<b>Subsurface Conditions</b>	<b>Estimated G.W. Depth (feet bgs)</b>
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)

<b>Boring ID</b>	<b>Proposed Facility</b>	<b>Boring Depth (feet)</b>	<b>Existing Pavement Section</b>	<b>Subsurface Conditions</b>	<b>Estimated G.W. Depth (feet bgs)</b>
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 interfingering 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](http://www.Geotracker.com)) contains a groundwater monitoring report by Geologic 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**

<b>Sample ID</b>	<b>pH</b>	<b>Resistivity (ohm-cm)</b>	<b>Sulfate Conc. (ppm)</b>	<b>Chloride Conc. (ppm)</b>	<b>Bicarbonates Conc. (ppm)</b>
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.

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

$$V_s = [1.45 - (0.015 \times d)] \times V_{s(d)} \quad (\text{David Boore, 2004})$$

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 <sub>s</sub> (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)**

<u>REFERENCE</u>	<u>PARAMETER</u>
Table 20.3-1 Site Classification	Site Class = C
Figure 22-1	$S_s = 1.065 \text{ g}$
Table 11.4-1 Site Coefficient $F_a$	$F_a = 1.000$
Figure 22-2	$S_1 = 0.408 \text{ g}$
Table 11.4-2 Site Coefficient $F_v$	$F_v = 1.392$
Equation 11.4-1	$S_{MS} = 1.065 \text{ g}$
Equation 11.4-2	$S_{M1} = 0.568 \text{ g}$
Equation 11.4-3	$S_{DS} = 0.710 \text{ g}$
Equation 11.4-5	$S_{D1} = 0.379 \text{ g}$
Figure 22-12	$T_L = 8 \text{ seconds}$
Figure 22-7	$PGA = 0.444 \text{ g}$
Equation 11.8-1	$PGA_M = 0.444 \text{ g}$
Figure 22-17	$C_{RS} = 0.904$
Figure 22-18	$C_{R1} = 0.961$

**Table 7**  
**Summary of Seismic Design Parameters (Site Class D)**

<u>REFERENCE</u>	<u>PARAMETER</u>
Table 20.3-1 Site Classification	Site Class = D
Figure 22-1	$S_s = 1.065 \text{ g}$
Table 11.4-1 Site Coefficient $F_a$	$F_a = 1.074$
Figure 22-2	$S_1 = 0.408 \text{ g}$
Table 11.4-2 Site Coefficient $F_v$	$F_v = 1.592$
Equation 11.4-1	$S_{MS} = 1.144 \text{ g}$
Equation 11.4-2	$S_{M1} = 0.650 \text{ g}$
Equation 11.4-3	$S_{DS} = 0.763 \text{ g}$
Equation 11.4-5	$S_{D1} = 0.433 \text{ g}$
Figure 22-12	$T_L = 8 \text{ seconds}$
Figure 22-7	$PGA = 0.444 \text{ g}$
Equation 11.8-1	$PGA_M = 0.469 \text{ g}$
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 S1 Risk-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 be 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 consist 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**

<b>Recommended Design Parameters</b>	<b>Properly Compacted Fill</b>	<b>Undisturbed Formation</b>	<b>CLSM</b>	<b>Class II Aggregate Base</b>	<b>Crushed Rock Wrapped in Geofabric</b>	<b>Visqueen Moisture Barrier</b>
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 6<sup>th</sup> 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  $35^\circ$  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 Aggregate 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**

	<i>36-inch Diameter CIDH Pile</i>
<i>Factor of Safety</i>	End Bearing = Skin friction = 2.0
<i>Working Axial Resistance (kips)</i>	375
<i>Free-Head Working Lateral Resistance (kips)</i>	28
<i>Fixed-Head Working Lateral Resistance (kips)</i>	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 conglomeratic 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 be 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  $20^\circ$ , Coefficient of Friction against sides of trench ( $\mu$ ) 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 utilities 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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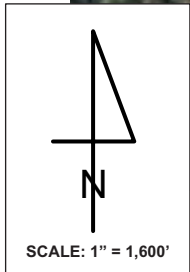
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## **FIGURES**





**NORTH CITY WATER RECLAMATION PLANT EXPANSION**

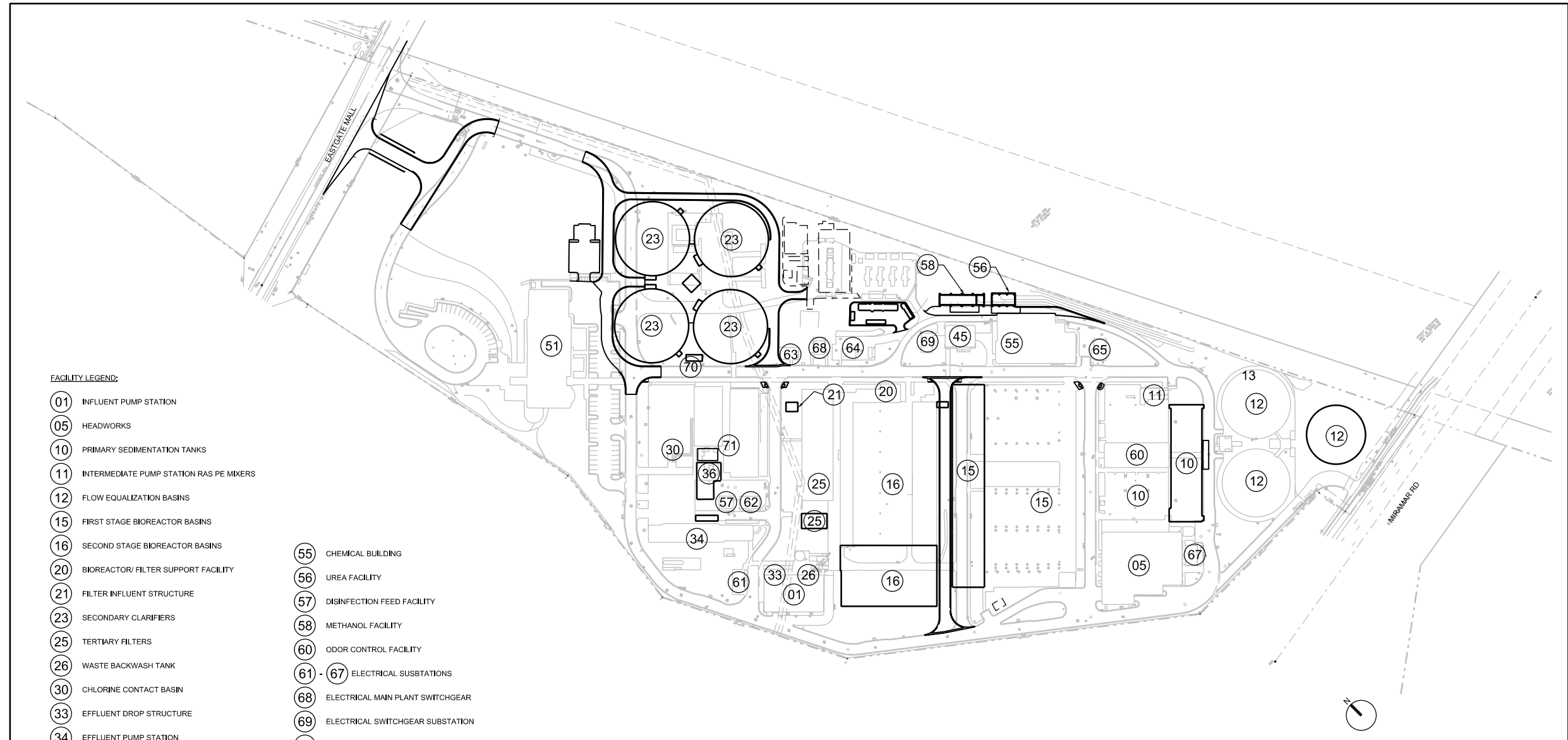
**LOCATION MAP**

**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 SUBSTATIONS
- (68) ELECTRICAL MAIN PLANT SWITCHGEAR
- (69) ELECTRICAL SWITCHGEAR SUBSTATION
- (70) SECONDARY CLARIFIER ELECTRICAL BUILDING
- (71) NCPWF IPS ELECTRICAL SUBSTATION



CONSTRUCTION CHANGE / ADDENDUM			
CHANGE	DATE	AFFECTED OR ADDED SHEET NUMBERS	APPROVAL NO.

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



MATTHEW JOHN BALDWIN  
 CA C71817  
 NOT FOR CONSTRUCTION

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 _____	
FOR CITY ENGINEER	DATE	DESIGNED BY: J HOYLE PROJECT MANAGER	
PRINT JOB NAME	DATE	CHECKED BY: M BALDWIN PROJECT ENGINEER	
DESCRIPTION	BY	APPROVED	DATE/FILM
CONTRACTOR INSPECTOR	DATE STARTED	DATE COMPLETED	

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

30% DESIGN



# LEGEND

Approximate boring locations (shear wave velocity shown in parentheses).

**H-14**  
( $V_s = 1202$  fps)

**H-18**  
( $V_s = 1318$  fps)

**H-19**  
( $V_s = 1318$  fps)

**H-13**  
( $V_s = 1203$  fps)

**H-14**  
( $V_s = 1202$  fps)

**H-20**  
( $V_s = 1318$  fps)

**H-17**  
( $V_s = 1318$  fps)

**H-16**  
( $V_s = 1318$  fps)

**H-11**  
( $V_s = 1204$  fps)

**H-22**  
( $V_s = 1318$  fps)

**H-21**  
( $V_s = 1318$  fps)

**H-12**  
( $V_s = 1227$  fps)

**H-3**  
( $V_s = 1318$  fps)

**H-1**  
( $V_s = 1304$  fps)

**H-15**  
( $V_s = 1318$  fps)

**H-9**  
( $V_s = 1179$  fps)

**H-5**  
( $V_s = 1347$  fps)

**H-6**  
( $V_s = 1300$  fps)

**H-2**  
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**H-8**  
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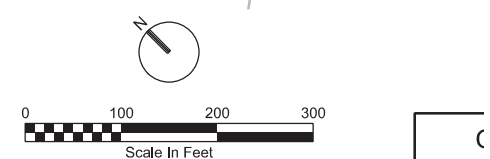
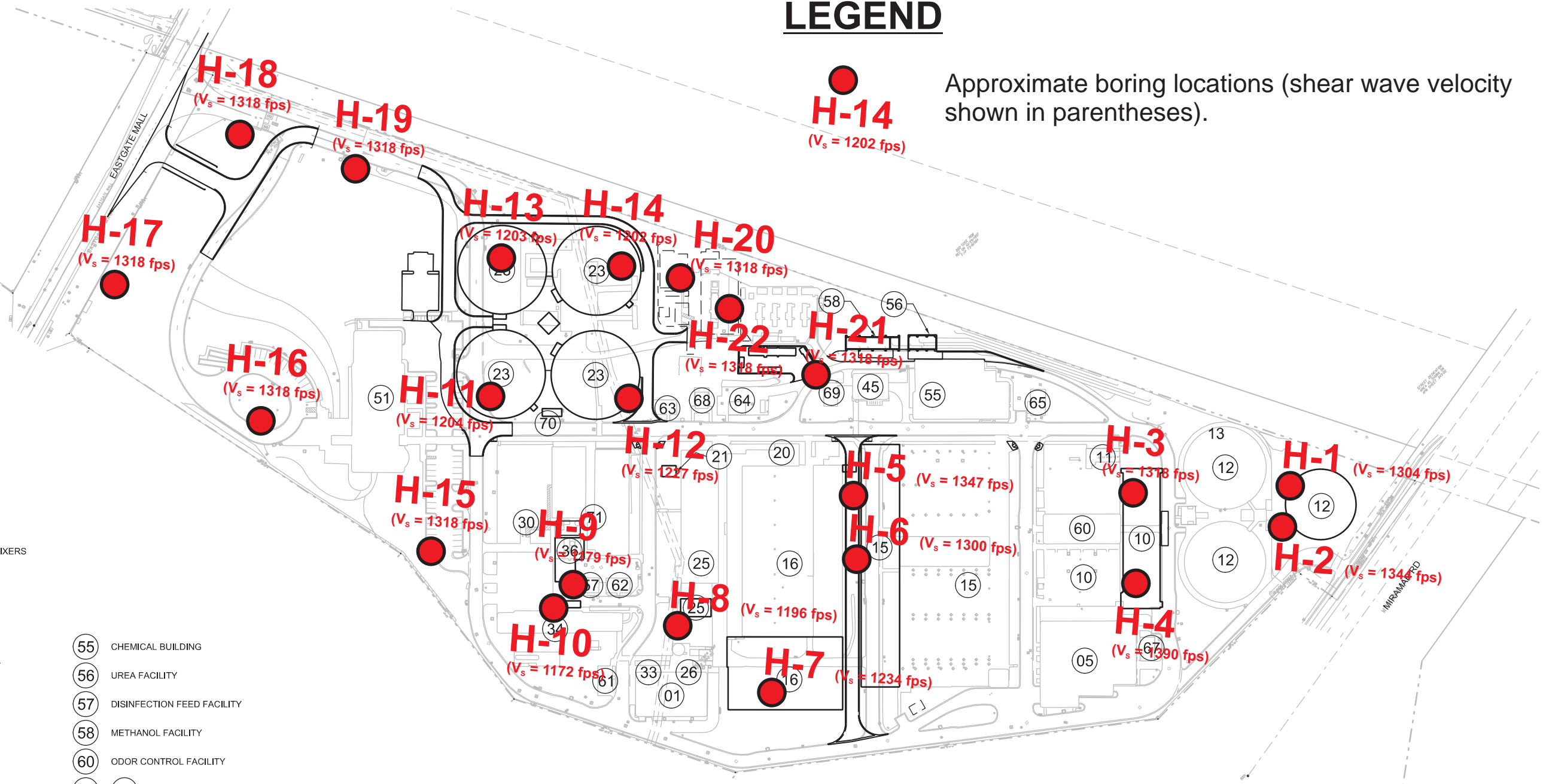
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**H-7**  
( $V_s = 1234$  fps)

**H-4**  
( $V_s = 1330$  fps)

FACILITY LEGEND:

- (01) INFLUENT PUMP STATION
- (05) HEADWORKS
- (10) PRIMARY SEDIMENTATION TANKS
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SAN DIEGO NCWRP EXPANSION AND NCPWF INFLUENT CONVEYANCE

GENERAL PROJECT KEY PLAN

**NORTH CITY WATER RECLAMATION PLANT EXPANSION**

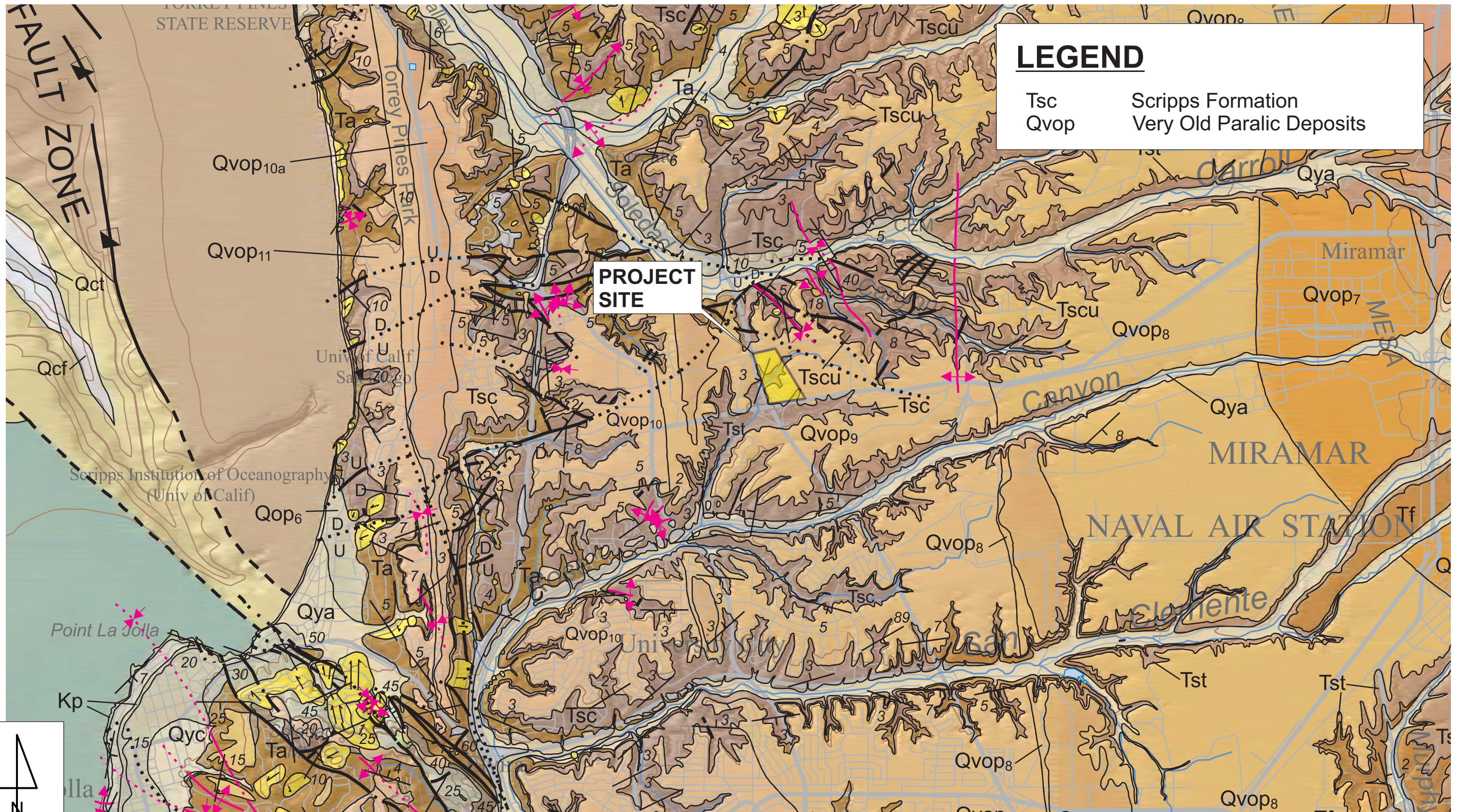
**SITE PLAN SHOWING APPROXIMATE BORING LOCATIONS**

PROJECT NO.  
44F1

ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE 3





SCALE: 1" = 3,600'

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**

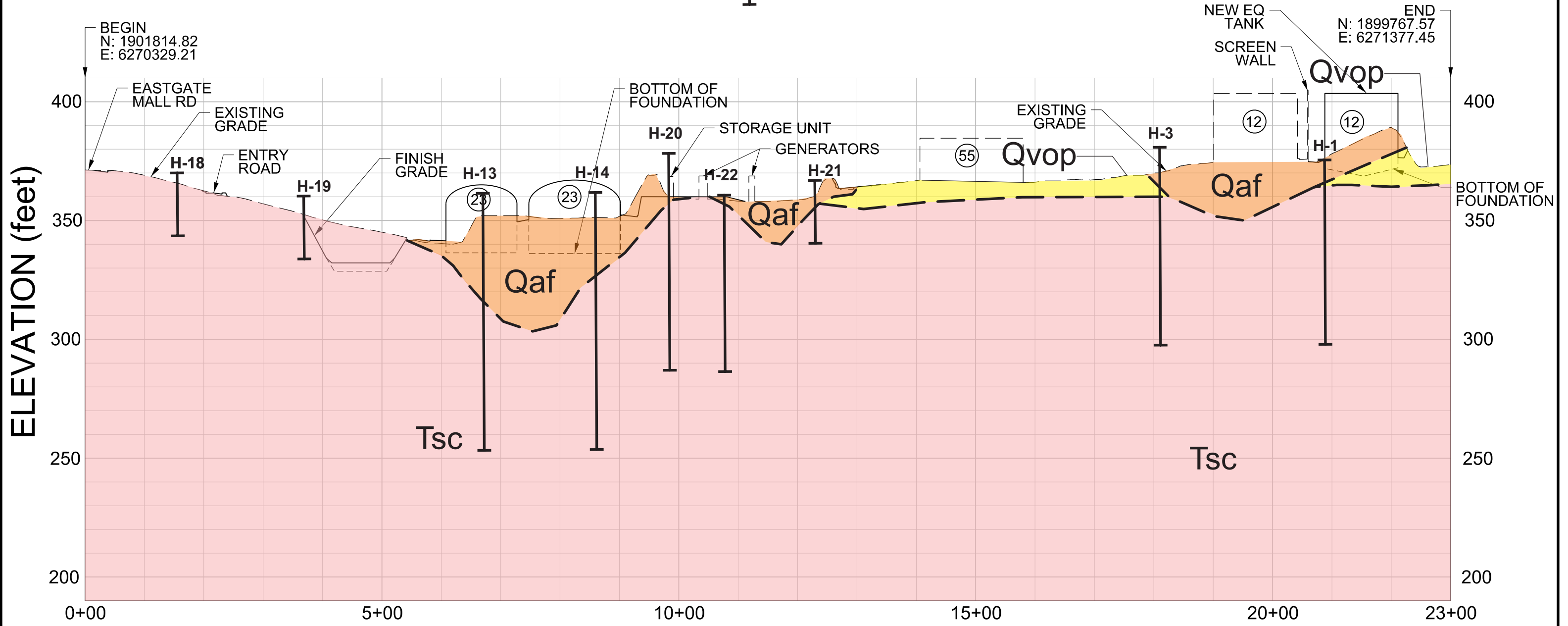




**LEGEND**

- Qaf - Artificial Fill
- Qvop - Very Old Paralic Deposits
- Tsc - Scripps Formation

- Approximate Geologic Contact
- H-18  
Approximate Boring Location



**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.**

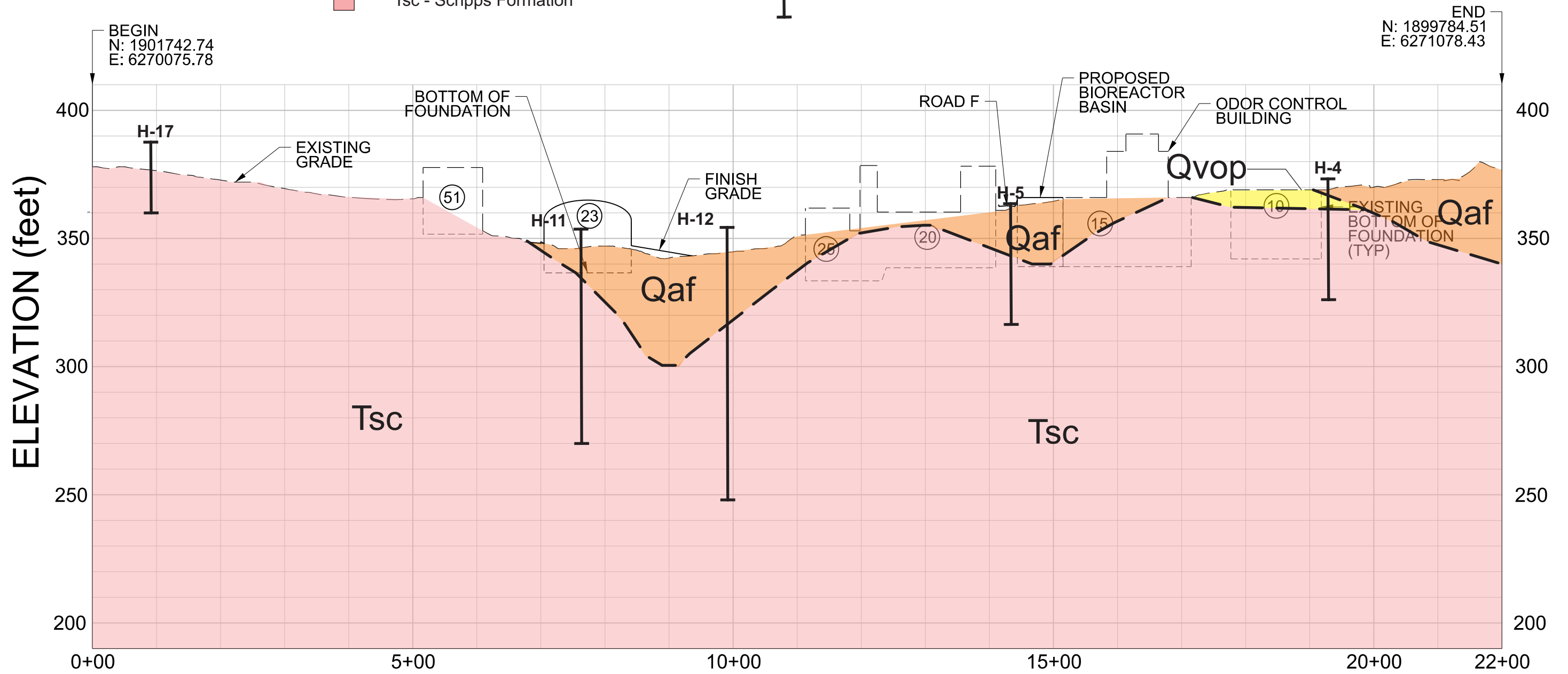
**FIGURE 6**



**LEGEND**

- Qaf - Artificial Fill
- Qvop - Very Old Paralic Deposits
- Tsc - Scripps Formation

- Approximate Geologic Contact
- H-18  
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

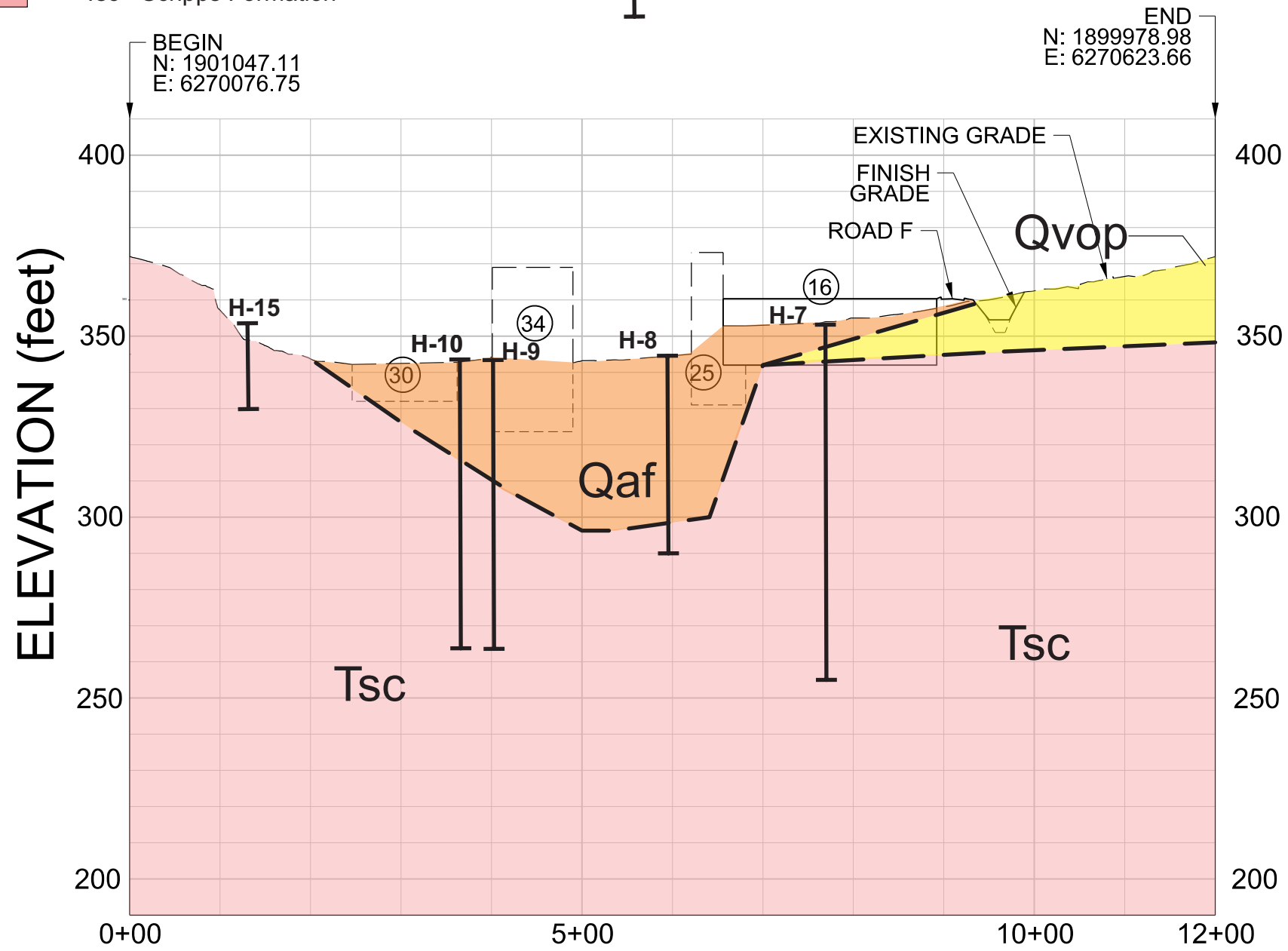
**ALLIED GEOTECHNICAL ENGINEERS, INC.**

**FIGURE 7**

**LEGEND**

- Qaf - Artificial Fill
- Qvop - Very Old Paralic Deposits
- Tsc - Scripps Formation

- Approximate Geologic Contact
- H-18
- Approximate Boring Location



**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**



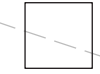
# LEGEND

**H-14**  
( $V_s = 1202$  fps)



Approximate boring locations with shear wave velocity in parentheses.

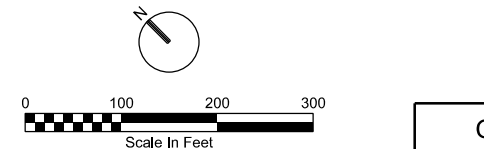
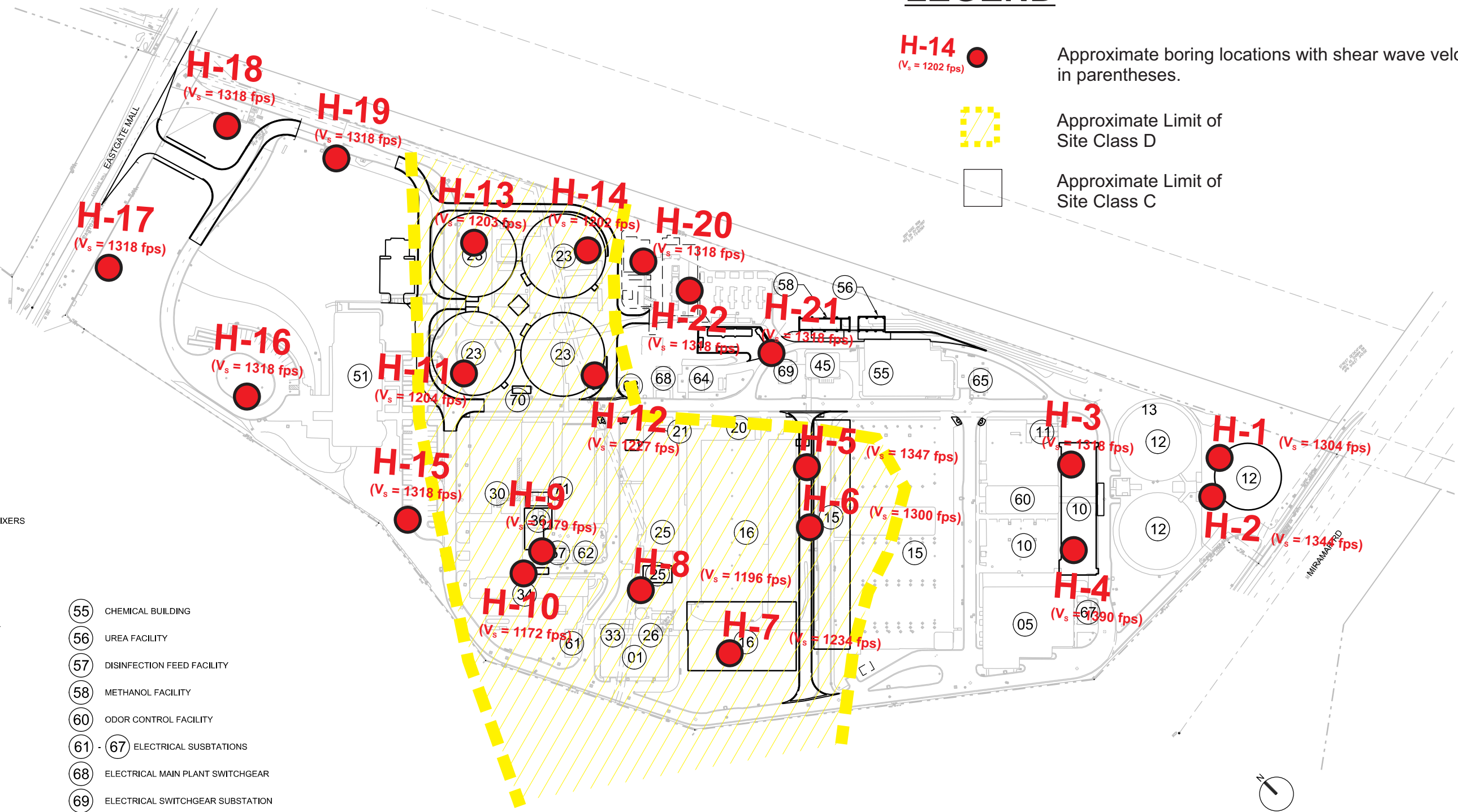
Approximate Limit of Site Class D



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 SUBSTATIONS
- (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**

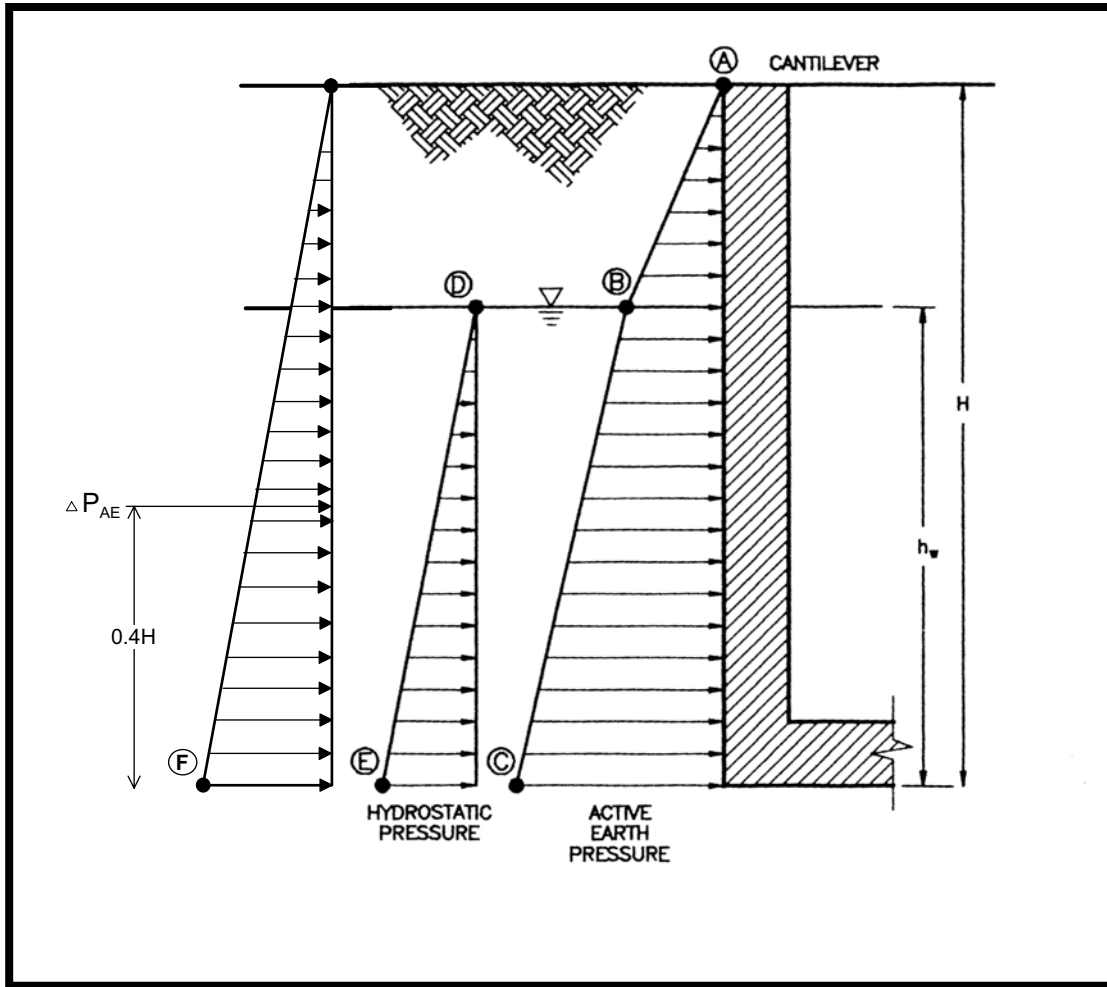
**SITE PLAN SHOWING SITE CLASSIFICATIONS**

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- $h_w$ ) + 20 $h_w$ , psf

#### Hydrostatic Pressure

Ⓓ = 0

Ⓔ = 62.4 $h_w$

#### Dynamic Resultant Force

Ⓕ = 12H

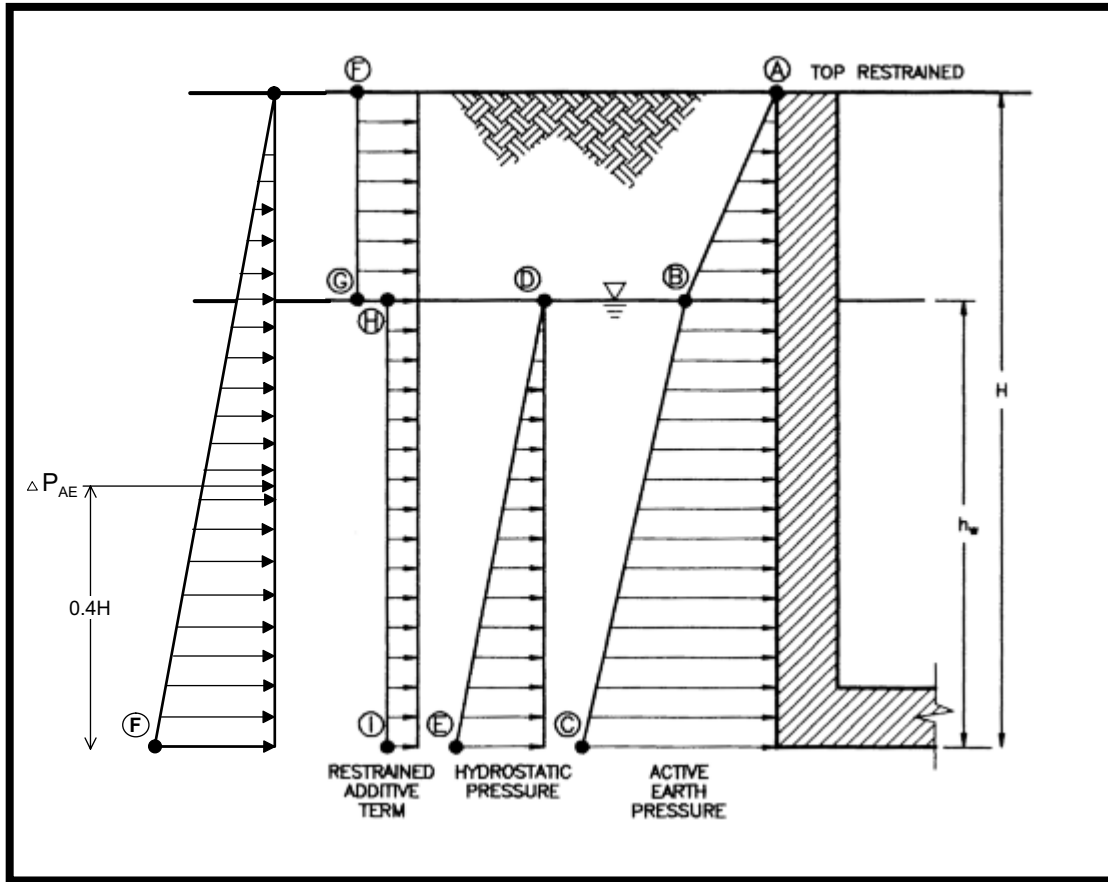
$\Delta P_{AE}$  = 6H<sup>2</sup>, lb/ft @ 0.4H

## 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

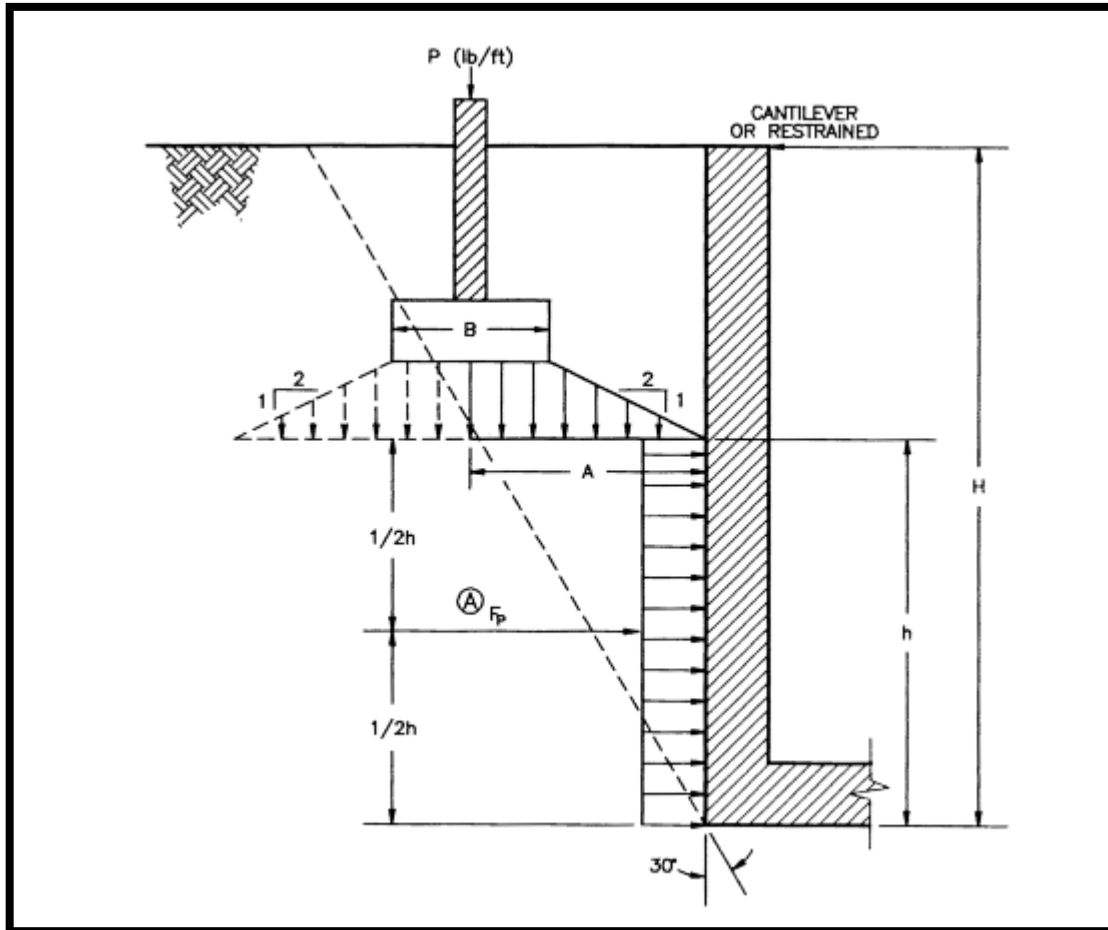
- Ⓕ =  $12H$
- $\Delta P_{AE} = 6H^2$ , lb/ft @  $0.4H$

**LATERAL PRESSURES FOR RESTRAINED WALLS  
NORTH CITY WATER RECLAMATION PLANT EXPANSION**

PROJECT NO.  
44F1

ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE 12



**NON-EXPANSIVE BACKFILL**

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

$$A = h \tan 30^\circ, \text{ ft}$$

$$M = 0.3 \text{ for cantilever wall}$$

$$M = 0.4 \text{ for restrained wall}$$

$$\text{Angle of Internal Friction } (\phi) = 35^\circ$$

$$\text{Zone of Influence } (\gamma) = 30^\circ$$

**NOTES:**

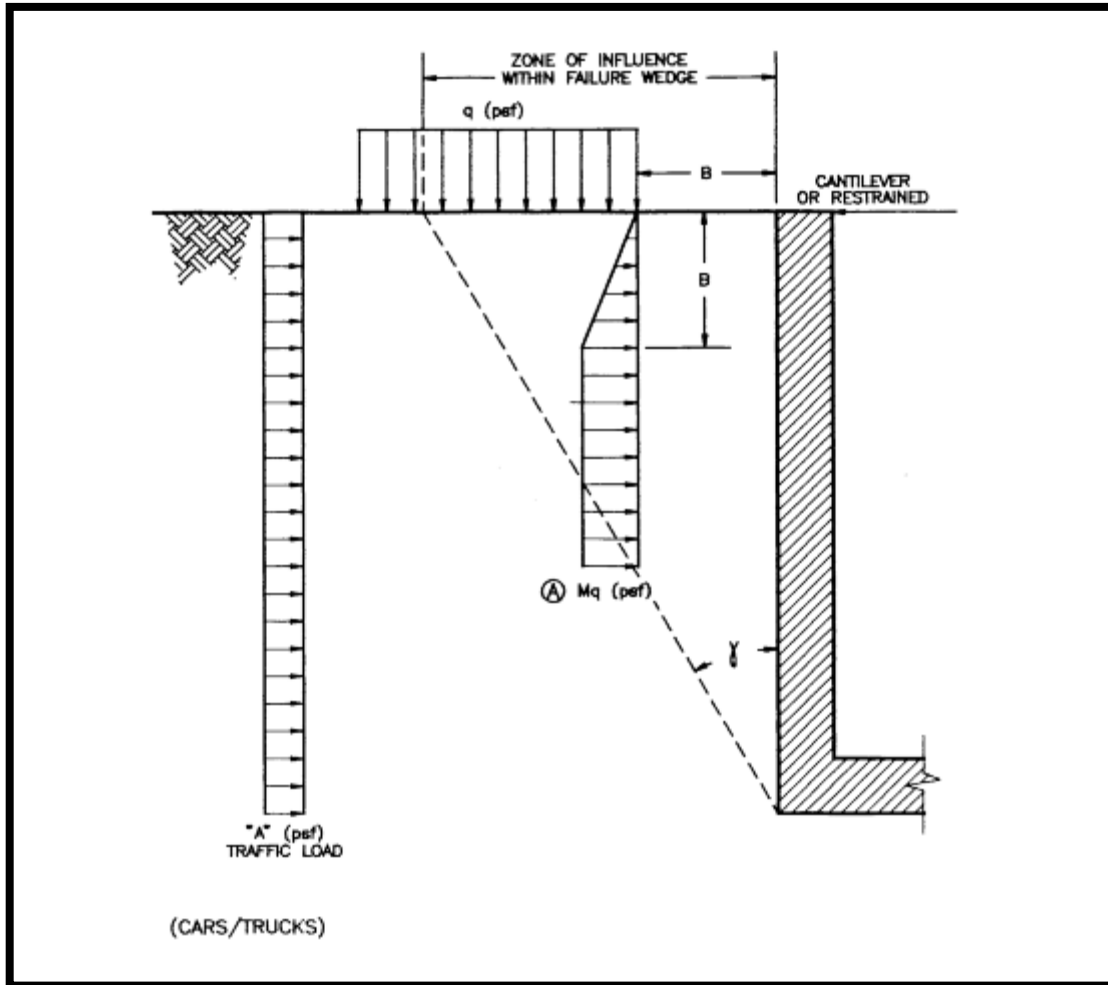
1. Surcharge pressure acting on wall is not affected by groundwater elevation.
2. Surcharge pressures shown are applicable for continuous footing only. Spread footings need to be evaluated individually.

**FOUNDATION INDUCED WALL PRESSURES  
NORTH CITY WATER RECLAMATION PLANT EXPANSION**

**PROJECT NO.  
44F1**

**ALLIED GEOTECHNICAL ENGINEERS, INC.**

**FIGURE13**



**NON-EXPANSIVE BACKFILL**

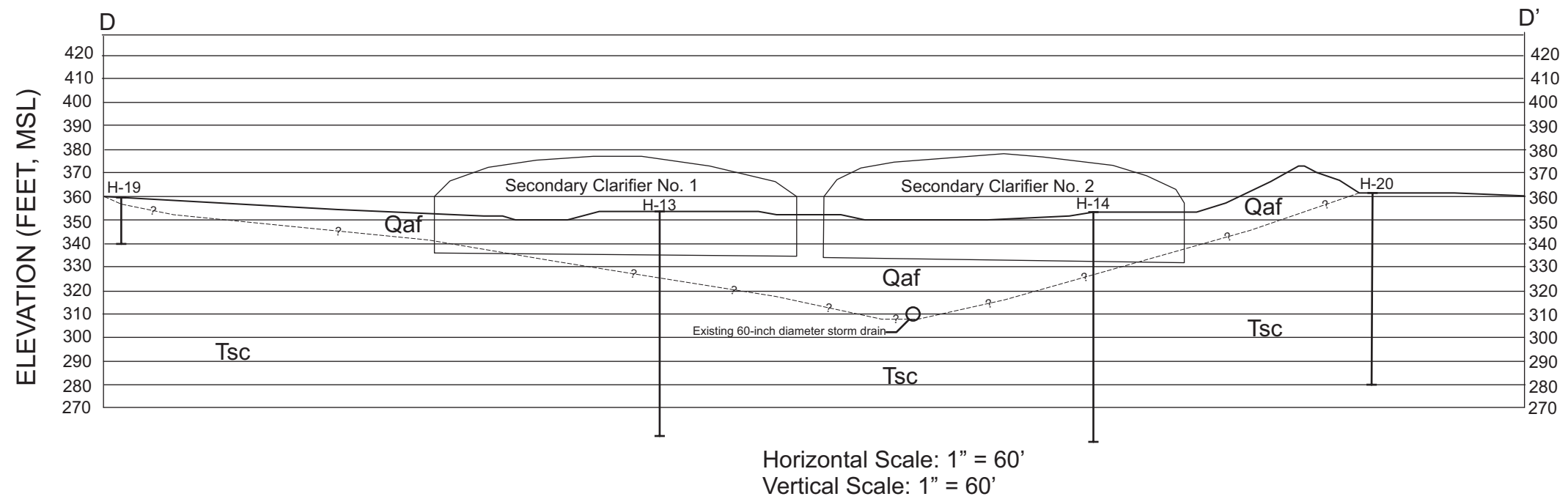
- q = surcharge load (psf)
- B = distance between wall and surcharge load, ft
- M = 0.3 for cantilever wall
- M = 0.4 for restrained wall
- Ⓐ = Mq, psf
- "A" = 75 psf
- Angle of Internal Friction ( $\phi$ ) = 35°
- Zone of Influence ( $\gamma$ ) = 30°

**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
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## LEGEND

┆ Approximate boring location

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

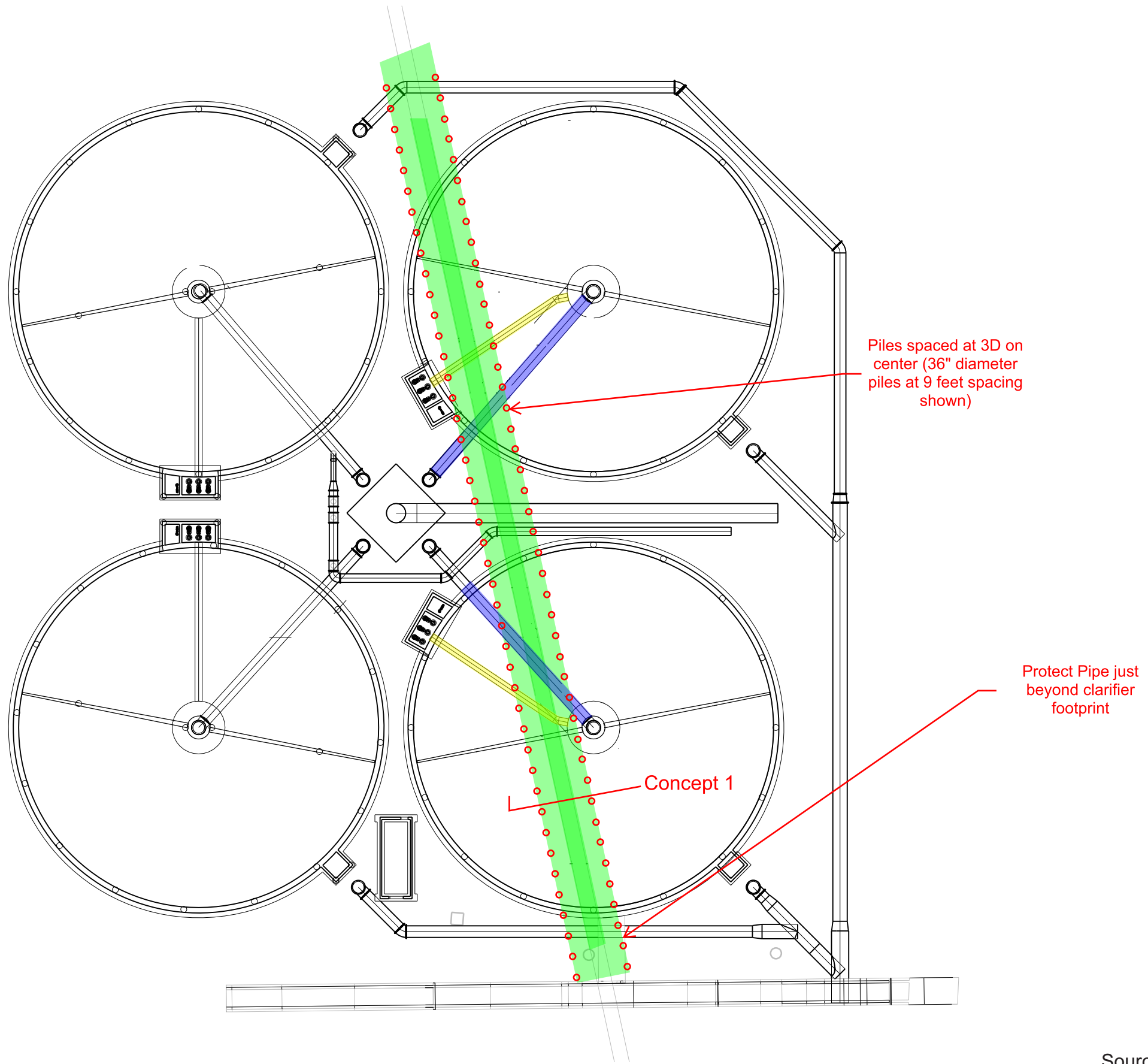
**NORTH CITY WATER RECLAMATION PLANT EXPANSION**

**CROSS-SECTION D-D'**

PROJECT NO.  
44F1

**ALLIED GEOTECHNICAL ENGINEERS, INC.**

**FIGURE 15**



Piles spaced at 3D on center (36" diameter piles at 9 feet spacing shown)

Concept 1

Protect Pipe just beyond clarifier footprint

Source: Sketch prepared by Kleinfelder, undated.

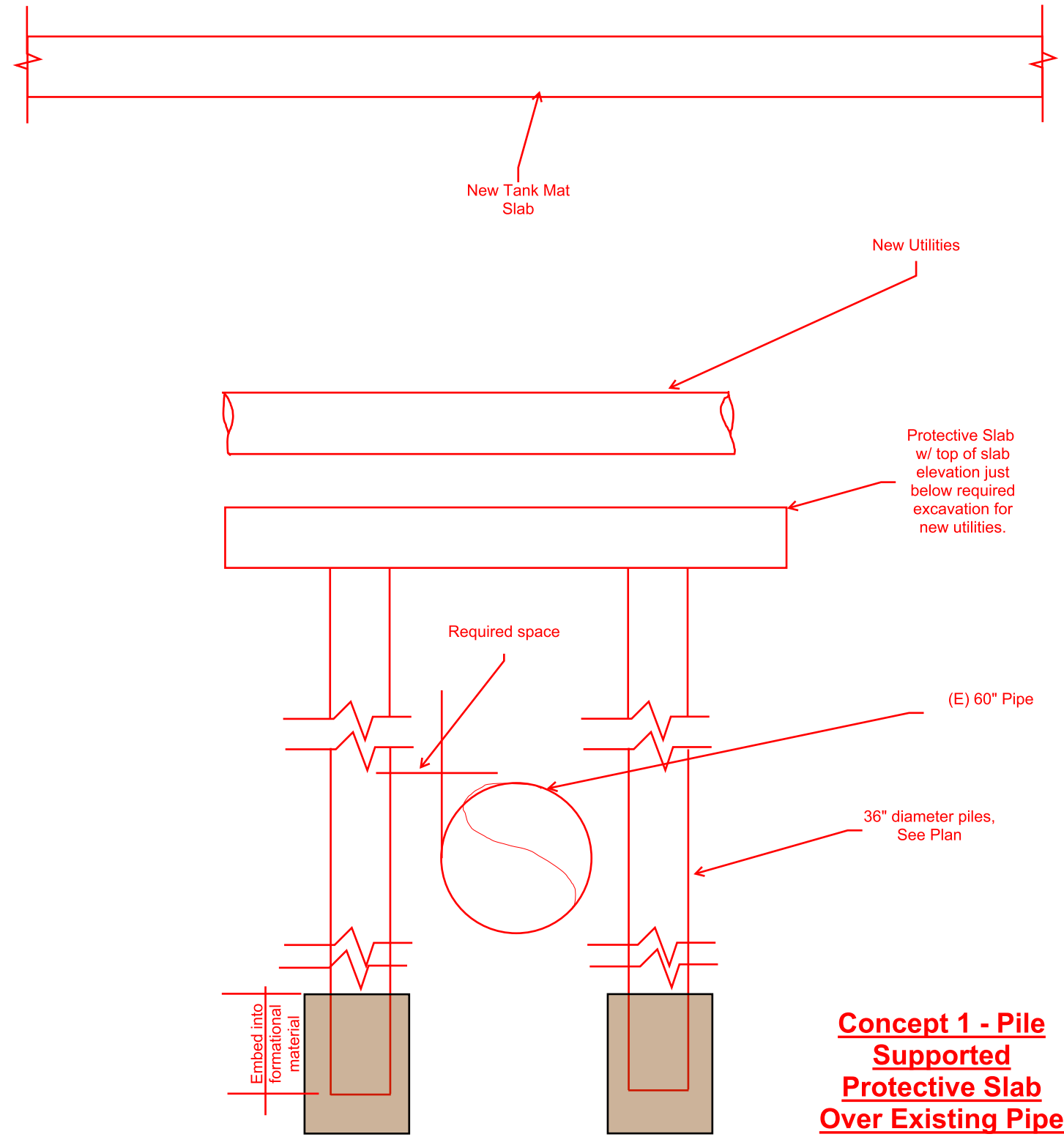
**NORTH CITY WATER RECLAMATION PLANT EXPANSION**

**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.

<p><b>NORTH CITY WATER RECLAMATION PLANT EXPANSION</b></p>		<p><b>60-INCH STORM DRAIN PROTECTION - PROFILE</b></p>	
<p>PROJECT NO. 44F1</p>	<p><b>ALLIED GEOTECHNICAL ENGINEERS, INC.</b></p>		<p><b>FIGURE 17</b></p>

**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
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19	<div style="position: relative; height: 100%; border-left: 1px solid black; border-right: 1px solid black;"> <div style="position: absolute; top: 20%; left: 5%; width: 10px; height: 10px; background-color: black;"></div> <div style="position: absolute; top: 45%; left: 5%; width: 10px; height: 10px; background-color: black;"></div> <div style="position: absolute; top: 70%; left: 5%; width: 10px; height: 10px; border: 1px solid black; transform: rotate(45deg);"></div> <div style="position: absolute; top: 80%; left: 5%; width: 10px; height: 10px; border: 1px solid black; transform: rotate(45deg);"></div> <div style="position: absolute; top: 105%; left: 5%; width: 10px; height: 10px; border: 1px solid black; transform: rotate(45deg);"></div> </div>				<p>Sample identification number</p> <p>Approximate interval of bulk sample</p> <p>Approximate interval of Standard California Sampler (SCS).</p> <p>Number of blows required to advance sampler for the last foot, or distance indicated.</p> <p>Approximate interval of Standard Penetration Test (SPT).</p>			
	1							
	2	16						
	3	18						

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

## 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					<b><u>GENERAL NOTES</u></b>			
11					1. Approximate elevations and locations of borings are based on GoogleEarth, 2017.			
12					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.			
13					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.			
14								
15								
16								
17								
18								
19								
<b>PROJECT NO. 44F1</b>					<b>ALLIED GEOTECHNICAL ENGINEERS, INC.</b>			<b>FIGURE A-2</b>



**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	OVIM 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	1				<b>FILL</b>			Drilled to 5-feet using 8-inch HSA, then switched to 4-inch air percussion.
3					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	2							
5								
6	3	54	0.0			8.2	112.7	
7								
8					- ? -			- ? -
9					<b>VERY OLD PARALIC DEPOSITS</b>			
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					<b>SCRIPPS FORMATION</b>			
15					Greenish gray to reddish yellow, wet, fine-grained, hard, sandy lean clay (CL).			
16	5	75	0.0			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.			
21								Did not attempt sampling at 20 feet and 25 feet due to abundant gravels and cobbles.
22	6							
23								
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	QVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS								
31	7	100+			<b>SCRIPPS FORMATION</b> 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																
38																
39																
40																
41																
42																
43																
44																
45																
46																
47																
48									8	100+			Sharp transition out of conglomerate at 48'.			Did not attempt sampling at 35 feet and 45 feet due to abundant gravels and cobbles.
49																
50																
51																
52																
53																
54																
55																
56																
57																
58																
59																
60																
61																
55	9	100+	0.1		Light gray to pale yellowish brown, damp, hard, sandy lean clay (CL).	18.2		Sample contains only slough and fractured gravel								
56																
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	QVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
63					<b>SCRIPPS FORMATION</b>			
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	OVN 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					<b>FILL</b>			Drilled to 5-feet using 8-inch HSA, then switched to 4-inch air percussion.
3								
4								
5	1	63	0.2		Brown to yellow brown, damp, silty sand (SM) and clayey sand (SC) with abundant gravel and scattered cobbles.	10.9		
6								
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		<b>SCRIPPS FORMATION</b>	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								

<b>PROJECT NO. 44F1</b>	<b>ALLIED GEOTECHNICAL ENGINEERS, INC.</b>	<b>FIGURE A-6</b>
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**BORING NO. H-2 (Continued)**

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	QVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS	
31	8	100+	0.1		<b>SCRIPPS FORMATION</b>	4.7			
32	9				Gravel - cobble conglomerate with a yellowish brown, fine to medium-grained, silty sand (SM) matrix.			Did not attempt to sample at 35 feet due to abundant gravel and cobbles.	
33									
34									
35									
36									
37									
38									
39									
40	10	100+				Sharp transition out of the conglomerate facies at 42'.			Slough only in sampler
41									
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	12	100+	0.0			18.2			
51									

**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	OVN READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
1					<b>FILL</b> Yellow brown to reddish yellow, damp, silty sand (SM) containing locally abundant sub-rounded and locally fractured gravel up to 3" in maximum dimension.	5.2		Drilled to 5-feet using 8-inch HSA, then switched to 4-inch air percussion.
2	1							
3	2							
4								
5	3	100+	0.1					
6								
7					- ? -	- ? -		- ? -
8					<b>VERY OLD PARALIC DEPOSITS</b> Reddish yellow, damp, very dense, medium-grained, silty sand (SM) with abundant sub-rounded gravel up to 3" in maximum dimension.			No sample recovery, sampler bouncing on rock
9								
10	4	100+						
11								
12								
13					- ? -	- ? -		- ? -
14					<b>SCRIPPS FORMATION</b> 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		
15								
16	5	100+	0.0					
17								
18								
19								
20								
21	6	100+	0.1			1.4		
22								
23								
24								
25								
26	7	100+	0.1			3.6		
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	QVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
31	8	100+			<b>SCRIPPS FORMATION</b> Gravel - cobble conglomerate with a yellowish brown to reddish brown, fine to medium-grained silty sand (SM) matrix.  Sharp transition out of conglomerate at 38'.			Did not attempt sampling at 30 feet and 35 feet due to abundant gravels and cobbles.
32								
33								
34								
35								
36								
37								
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					
47								
48								
49								
50								
51	11	100+	0.1					
52								
53								
54								
55								
56	12	100+	0.0					
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	QVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
63					<b>SCRIPPS FORMATION</b>			
64								
65	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		
66								
67								
68								
69								
70	15	100+	0.1		Light gray to pale yellow brown, silty sandstone (SM).	12.5	99.0	
71								
72								
73								
74								
75	16	100+	0.1		Reddish yellow, damp, hard, sandy lean clay (CL).	21.1		
76								
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	OVN READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
1					<b>FILL</b> Yellow brown, damp, silty sand (SM) with scattered to locally abundant sub-rounded gravel up to 3" in maximum dimension.			Drilled to 12-feet using 8-inch HSA, then switched to 4-inch air percussion.
2								
3					-----?-----?			-----?-----
4	1				<b>VERY OLD PARALIC DEPOSITS</b>			
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					<b>SCRIPPS FORMATION</b>			
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								
18	5							
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		<b>SCRIPPS FORMATION</b> Gravel conglomerate with yellow brown, medium-grained, silty sand (SM) matrix.			No sample recovery	
32									
33	9								
34									
35						End of conglomerate zone at 36'.			Did not attempt to sample at 35 feet due to abundant gravels.
40	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		
45	11	100+	0.0		Olive brown color, and fine to medium grain size.	16.2			
50	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	OVN READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
1					EXISTING PAVEMENT: 7.5" A.C. and no base.			
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	1	44	0.0			20.6	102.7	
5	2							
6	3							
7								
8								
9								
10	4	23	0.3		Olive brown to gray brown, damp to wet, clayey sand (SC) with scattered gravel.	9.9		
11								
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								
21	6	100+						No sample recovery, sampler bouncing on gravel
22					-----?-----?-----?			-----?-----
23					SCRIPPS FORMATION			
24								
25	7	100+	0.0		Olive yellow, damp, very dense, fine-grained, silty sand (SM). Sand is uncemented.	10.4		
26	8							
27								
28								
29								

**PROJECT NO.  
44F1**

**ALLIED GEOTECHNICAL ENGINEERS, INC.**

**FIGURE A-13**

**BORING NO. H-5 (Continued)**

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	QVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
31	9	100+	0.0		<b>SCRIPPS FORMATION</b>	19.6		Driller adding water inside of auger to assist in bringing soil cuttings to ground surface
32								
33	10							
34								
35								
36	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	
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								
51	14	100+	0.1		Similar to above, with a 2" wide interlayer of pale gray to olive yellow siltstone (ML).	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.

**PROJECT NO.**  
44F1

**ALLIED GEOTECHNICAL ENGINEERS, INC.**

**FIGURE A-14**



**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	OVN READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
1					<b>EXISTING PAVEMENT: 8" A.C. and no base.</b>			
2					<b>FILL</b>			
3								
4								
5	1				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.			
6	2	18	0.4			15.8		
7								
8								
9								
10								
11	3	50	0.1		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.	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	7							
23								
24								
25								
26	8	54	0.1		<b>SCRIPPS FORMATION</b>	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		<b>SCRIPPS FORMATION</b>  Pale olive yellow to pale olive brown, damp, hard, sandy lean clay (CL).	18.0	102.0	Driller adding water inside of auger to assist in bringing soil cuttings to ground surface
32								
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		

**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




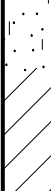


DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVN READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
1								Lawn sod in the upper 2 inches
2					<b>FILL</b>			
3					Yellow brown to reddish yellow, damp, silty sand (SM) with scattered sub-rounded gravel up to 3" in maximum dimension.			
4								
5	1	7	0.0			10.6		
6	2							
7					-?-?-?			
8					<b>VERY OLD PARALIC DEPOSITS</b>			
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					<b>SCRIPPS FORMATION</b>			Driller added water inside of auger to assist in bringing soil cuttings to ground surface
14	4							
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								
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	
22								
23								
24								
25					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	8				<b>SCRIPPS FORMATION</b>			Did not attempt sampling between depth of 30' and 35' due to abundant gravel
32					Gravel conglomerate with an olive brown to yellow brown silty sand (SM) matrix.			
33					End of conglomerate zone at 37'.			
34	9	100+						No sample recovery
35								
36	10	100+	0.0		Olive/gray to pale reddish yellow, damp, hard, sandy lean clay (CL).	23.2		
37								
38								
39	11	100+	0.0		Pale greenish gray to medium gray, hard, lean clay (CL).	20.8	112.7	
40								
41	12	100+	0.0		Pale yellow brown to pale reddish yellow, damp, very dense, fine to medium grained, silty sand (SM).	21.5		
42								
43	13	100+	0.0		Olive color.	21.3	107.6	
44								







**PROJECT NO.  
44F1**

**ALLIED GEOTECHNICAL ENGINEERS, INC.**

**FIGURE A-18**



**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					<b>SCRIPPS FORMATION</b>			
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					<b>SCRIPPS FORMATION</b> Dark gray, hard claystone (CL/CH).			
96					Medium gray, damp, very dense, fine-grained silty sand (SM).			
97								
98								
99								
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	OVN READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
1					<p><b>FILL</b></p> <p>Yellow brown to yellowish red, damp, gravelly silty sand (SM). Gravel is sub-rounded and locally fractured, up to 3" in maximum dimension.</p> <p>Similar to above, fill also contains chunks of cemented siltstone up to 1/2" in maximum dimension.</p> <p>Abundant gravel from 17' to 22'.</p> <p>Reddish brown to reddish yellow, damp, fine to medium-grained silty sand (SM) and sandy silt (ML) with scattered gravel.</p>			
2	1	23	0.0			9.7		
3								
4	2					21.3	102.0	
5								
6	3					15.7		
7								
8								
9	4	38	0.0					
10								
11								
12								
13								
14								
15	5	32	0.1					
16								
17								
18								
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		11.2			
27								
28								
29								

**PROJECT NO.  
44F1**

**ALLIED GEOTECHNICAL ENGINEERS, INC.**

**FIGURE A-21**





**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	OVN READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
1					<b>FILL</b> 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.			Lawn sod in the upper 2 inches
2								
3					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.			High blow counts in 20' and 25' samples due to abundant gravel in fill.
4								
5	1	25	0.0			20.3	99.0	
6					Between 17'-28', encountered scattered to locally abundant gravel in fill. Gravel sub-rounded and locally fractured, up to 3" in maximum dimension.			
7								
8	2				Olive yellow to medium brown, damp, silty sand (SM) and clayey sand (SC) with abundant gravel.			
9								
10	3	15	0.0			23.3		
11					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.			
12								
13					Between 17'-28', encountered scattered to locally abundant gravel in fill. Gravel sub-rounded and locally fractured, up to 3" in maximum dimension.			
14								
15	4					26.4	91.6	
16					Olive yellow to medium brown, damp, silty sand (SM) and clayey sand (SC) with abundant gravel.			
17								
18	5	20	0.0		9.6			
19					Between 17'-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			15.5	113.7	
22					Olive yellow to medium brown, damp, silty sand (SM) and clayey sand (SC) with abundant gravel.			
23								
24	7				100+	0.1		
25					Between 17'-28', encountered scattered to locally abundant gravel in fill. Gravel sub-rounded and locally fractured, up to 3" in maximum dimension.			
26	8	100+	0.1					
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	QVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
31	9	100+	0.1		<b>FILL</b> Yellowish brown, damp, fine to medium-grained, silty sand (SM).	21.9		
32								
33								
34				- ? -	- ? -			- ? -
35	10	100+	0.0		<b>SCRIPPS FORMATION</b> Gravel conglomerate with medium gray to pale reddish yellow, silty sand (SM) and sandy silt (ML) matrix.	18.3		Sampler bouncing on gravel.
36								
37								
38					Sharp transition out of conglomerate at 38'.			
39								Driller added water inside of auger to assist in bringing soil cuttings to ground surface.
40	11	100+	0.2		Medium gray to pale reddish yellow, damp, hard, sandy lean clay (CL).	23.1		
41								
42								
43								
44								
45	12	56	0.0			21.7	107.6	
46								
47								
48								
49								
50	13	100+	0.1		Medium gray to greenish gray, hard, lean clay (CL).	25.2		
51								
52								
53								
54								
55	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		
56								
57	15							
58								
59								
60	16	100+	0.1			20.5	112.4	
61								

**BORING NO. H-9 (Continued)**

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	QVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
63					<b>SCRIPPS FORMATION</b>			
64								
65	17	100+	0.2		Dark gray, damp, hard, sandy claystone (CL/CH).	19.3		
66								
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	19	100+	0.1		Dark gray claystone (CL/CH), similar to above.	23.4		
76								
77								
78								
79								
80	20	100+	0.0		Dark gray, very dense, silty sandstone (SM). Sandstone is strongly cemented.	5.2		
81								
<p><b>NOTES:</b></p> <p>Bottom of borehole at 80.5 feet.</p> <p>Unable to determine if groundwater is present. Method of drilling required introduction of water into borehole.</p>								

**PROJECT NO.  
44F1**

**ALLIED GEOTECHNICAL ENGINEERS, INC.**

**FIGURE A-25**

**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	OVN 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					<b>FILL</b>			
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	QVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
31	8	100+	0.1		<b>FILL</b> Olive, damp, silty sand (SM) and sandy silt (ML) with abundant gravel/cobble.	15.2		Sampler bouncing on gravel/cobble.
32				?	?	?		?
33					<b>SCRIPPS FORMATION</b>			
34								
35	9	100+	0.1		Reddish yellow to olive brown, damp, very dense, fine-grained silty sandstone (SM).	21.7		Driller added water inside of auger to assist in bringing soil cuttings to ground surface.
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	13	100+	0.0			20.8	106.7	
51								
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	QVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
63					<b>SCRIPPS FORMATION</b>			
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								
<p><b>NOTES:</b></p> <p>Bottom of borehole at 80.5 feet.</p> <p>Unable to determine if groundwater is present. Method of drilling required introduction of water into borehole.</p>								

**PROJECT NO.**  
44F1

**ALLIED GEOTECHNICAL ENGINEERS, INC.**

**FIGURE A-28**

**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








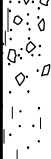

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	OVN READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS																																																																																																																																																																																											
1					FILL Yellow brown to olive yellow, damp, silty sand (SM).	23.5	98.0	Lawn sod in the upper 2 inches																																																																																																																																																																																											
2									3					FILL 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.	25.8		Poor recovery, sampler hit large gravel clasts in fill.	4	1	30	0.0		5					6					SCRIPPS FORMATION Olive yellow to pale greenish gray, wet, very stiff, slightly micaceous, sandy lean clay (CL).	24.0	97.5	-	7	2	14	0.1		8					9	3				10					SCRIPPS FORMATION Olive yellow to pale greenish gray, wet, very stiff, slightly micaceous, sandy lean clay (CL).	22.6			11					12					13					14					15	4	39	0.0		16					17					SCRIPPS FORMATION Olive yellow to pale greenish gray, wet, very stiff, slightly micaceous, sandy lean clay (CL).	21.5	103.4		18					19					20	5	40	0.2						21									22	6								23									24									25	7	100+	0.0						26									27									28									29				
3					FILL 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.	25.8		Poor recovery, sampler hit large gravel clasts in fill.																																																																																																																																																																																											
4	1	30	0.0																																																																																																																																																																																																
5																																																																																																																																																																																																			
6					SCRIPPS FORMATION Olive yellow to pale greenish gray, wet, very stiff, slightly micaceous, sandy lean clay (CL).	24.0	97.5	-																																																																																																																																																																																											
7	2	14	0.1																																																																																																																																																																																																
8																																																																																																																																																																																																			
9	3																																																																																																																																																																																																		
10					SCRIPPS FORMATION Olive yellow to pale greenish gray, wet, very stiff, slightly micaceous, sandy lean clay (CL).	22.6																																																																																																																																																																																													
11																																																																																																																																																																																																			
12																																																																																																																																																																																																			
13																																																																																																																																																																																																			
14																																																																																																																																																																																																			
15	4	39	0.0																																																																																																																																																																																																
16																																																																																																																																																																																																			
17					SCRIPPS FORMATION Olive yellow to pale greenish gray, wet, very stiff, slightly micaceous, sandy lean clay (CL).	21.5	103.4																																																																																																																																																																																												
18																																																																																																																																																																																																			
19																																																																																																																																																																																																			
20	5	40	0.2																																																																																																																																																																																																
21																																																																																																																																																																																																			
22	6																																																																																																																																																																																																		
23																																																																																																																																																																																																			
24																																																																																																																																																																																																			
25	7	100+	0.0																																																																																																																																																																																																
26																																																																																																																																																																																																			
27																																																																																																																																																																																																			
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**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		<b>SCRIPPS FORMATION</b>	24.5		Driller added water inside of auger to assist in bringing soil cuttings to ground surface.
32								
33								
34								
35	9	100+	0.6		Olive yellow to pale greenish gray, very dense, fine-grained, silty sandstone (SM).	19.0	104.0	
36								
37	10							
38								
39								
40	11	60	0.6		Olive to olive yellow, damp, hard, sandy lean clay (CL).	22.4		
41								
42								
43								
44								
45	12	100+	0.1		Olive to pale gray, silty sandstone (SM).	20.1	108.2	
46								
47								
48								
49								
50	13	88	0.4			11.8		
51								
52								
53								
54					53' - 55', gravel zone.			
55	14	100+	0.0			17.5	106.9	
56								
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
63					<b>SCRIPPS FORMATION</b>			
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	OVN 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					<b>FILL</b>			
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								
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					<b>SCRIPPS FORMATION</b>			
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		<b>SCRIPPS FORMATION</b>	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	11	100+	0.1				12.0		
41									
42									
43									
44									
45	12	100+							No sample recovery
46									
47									
48									
49									
50	13	100+	0.0		Reddish yellow, fine to medium grained silty sand (SM), interlayered with olive yellow to olive gray lean clay (CL).	22.1			
51									
52					Gravel zone between 51' and 52.5'.				
53									
54									
55	14	100+	0.0		Light gray to pale yellow brown, fine to medium grained, silty sand (SM).	7.3	107.8		
56									
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	QVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
63					<b>SCRIPPS FORMATION</b>			
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								
85	20	100+	0.2		Yellowish red, damp, very dense, fine to medium grained, poorly graded sand with silt (SP-SM).	22.1		
86								
87								
88								
89								
90	21	100+	0.3			22.0		
91								
92								
93								


**PROJECT NO.  
44F1**

**ALLIED GEOTECHNICAL ENGINEERS, INC.**

**FIGURE A-34**



**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 96 97 98 99 100	22	100+	0.4		<p><b>SCRIPPS FORMATION</b></p> <p>Abundant gravels and cobbles from 94' to 97'.</p> <p>Medium gray to dark gray claystone (CL/CH), interlayered with yellow brown silty sand (SM).</p>	25.8		<p>Did not attempt sampling at 95' due to abundant gravel and cobble.</p>

**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	OVN READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
1					<p><b>FILL</b></p> <p>Yellow brown, damp, sand lean clay (CL) with scattered sub-rounded and locally fractured gravel up to 3" in maximum dimension.</p> <p>Similar to above, soil is intermixed with angular chunks of cemented sandstone and claystone up to 2" in size.</p> <p>Mottled olive to pale gray color.</p>			
2	1	40	0.2			13.7	111.5	
3	2							
4	3	21	0.4			20.5		
5	4							
6	5	45	0.2			22.6	98.2	
7	6	19	0.3			20.4		
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26	7	33	0.2		22.5	102.2		
27								
28				?	?			?
29				/	<p><b>SCRIPPS FORMATION</b> - Olive gray to pale yellowish red, damp, hard, sandy lean clay (CL).</p>			

**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		<b>SCRIPPS FORMATION</b>	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	9								
34									
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									
61	16	74	0.0		Pale reddish yellow silty sandstone (SM).	20.8			

**PROJECT NO.  
44F1**

**ALLIED GEOTECHNICAL ENGINEERS, INC.**

**FIGURE A-37**

**BORING NO. H-13 (Continued)**

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	QVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
63					<b>SCRIPPS FORMATION</b>			
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								



**PROJECT NO.  
44F1**

**ALLIED GEOTECHNICAL ENGINEERS, INC.**

**FIGURE A-38**



**BORING NO. H-13 (Continued)**

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	QVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
95	23	100+	0.0		<b>SCRIPPS FORMATION</b> Medium gray to dark gray, hard claystone (CL/CH).	22.6		
96								
97	24	100+	0.0			23.6		
98								
99								
100								
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 (Continued)**

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	QVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
31	10	100+	0.1		<b>SCRIPPS FORMATION</b>  Olive yellow to pale olive sandy lean clay (CL).	20.6	102.5	
32								
33								
34								
35								
36	11	96	0.3					
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								
51	15	100+	0.1			21.4	98.2	
52								
53								
54								
55								
56	16	100+	0.0			17.1		
57	17							
58								
59								
60	18	100+	0.1					
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)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
63					<b>SCRIPPS FORMATION</b>			
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								
75	21	100+			72' - 78', gravel zone.			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 96 97 98 99 100	25	100+	0.2		<p align="center"><b>SCRIPPS FORMATION</b></p> <p>Gray, damp, hard sandy lean clay (CL).</p>	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.

**PROJECT NO.**  
44F1

**ALLIED GEOTECHNICAL ENGINEERS, INC.**

**FIGURE A-43**

**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	OVN READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
1					<b>EXISTING PAVEMENT:</b> 4.5" A.C. over 4" misc. base			
2					<b>FILL:</b> Medium brown to yellow brown, damp, silty sand (SM) with scattered sub-rounded gravel up to 3" in maximum dimension.			
3				?				? - - - - ?
4					<b>SCRIPPS FORMATION</b>			
5	1	100+	0.0		Olive yellow to olive gray to pale reddish yellow, damp, hard, highly plastic clay (CH).	21.7	102.8	
6	2							
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		

**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	OVN 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					<b>SCRIPPS FORMATION</b>			
4					Olive to olive yellow, damp, hard, sandy siltstone (ML).			
5	1	75	0.0			21.0	103.5	
6								
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	OVN READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
1	1				Bark & wood chips in the upper 6"			
2					<b>COLLUVIAL DEPOSITS</b> - Dark yellow brown, wet, stiff, highly plastic clay (CH) with scattered sub-rounded and fractured gravel and cobbles up to 4" in max. dimension.			
3								
4					<b>SCRIPPS FORMATION</b> Olive yellow to pale reddish yellow, damp, hard, lean clay (CL).	22.3	102.1	
5	2	80	0.0					
6					Pale reddish yellow to reddish brown, damp, very dense, fine to medium-grained, silty sandstone (SM).	20.7		
7	3							
8					Abundant gravel/cobbles from 17' to 19.5'	20.5	83.2	
9	4	100+	0.0					
10								
11								
12								
13								
14								
15	5	100+	0.0					
16								
17								
18								
19	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	OWN READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
1					<b>FILL</b> - 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					<b>SCRIPPS FORMATION</b> Olive to pale olive yellow to pale reddish yellow, damp, very dense, fine-grained, silty sandstone (SM).			
5	1	73	0.0			21.4		
6	2							
7								
8								
9								
10	3	100+			Abundant gravel between 10' and 11.5'.			Sampler bouncing on rock, no recovery
11								
12								
13	4							
14								
15	5	57	0.0			21.4		
16								
17								
18								
19								
20	6	100+	0.0		Very dense, fine-grained, silty sandstone (SM).	20.6	105.4	
21								
22								

**NOTES:**

Bottom of borehole at 21'

No groundwater or seepage encountered during drilling operations

**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	OVN READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
1					Bark & wood chips in the upper 6"			
2					<b>FILL:</b> Yellow/olive brown, damp, fine-grained silty sand (SM) with scattered sub-angular gravel up to 2" in maximum dimension.			
3								
4					<b>SCRIPPS FORMATION</b> Pale olive to pale reddish yellow, damp, dense to very dense, fine-grained, silty sandstone (SM).  Abundant gravels and cobbles between 8' and 10'.  Gray to pale reddish yellow, damp, hard, sandy lean clay (CL).  Olive brown to olive gray, hard, claystone (CL/CH).  Medium gray to pale reddish yellow, sandy lean clay (CL).			
5	1	52	0.1			20.2		
6								
7	2							
8								
9								5/11/17, refusal on gravel/cobbles. Relocate boring 5' east and resume drilling on 5/25/17 using 4" air rotary.
10	3	54	0.1		24.7			
11								
12								
13								
14								
15	4	82	0.0		21.9	109.4		
16								
17								
18								
19								
20								
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	QVM 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					<b>SCRIPPS FORMATION</b> Light gray to pale yellowish red, damp, hard, lean clay (CL).			Drill to 10' using 8-inch HSA, then switch to 4" mud rotary.
3	1							
4	2	55	0.1			19.3		
5								
6	3							
7	4	100+	0.0			13.4	106.8	
8								
9					Gravel bed between 12' and 13'.			
10					Olive gray, damp, hard, lean clay (CL).			
11	5	100+	0.1			22.0		
12					Olive gray to pale reddish yellow.			
13	6	100+	0.2			18.2	113.5	
14								
15								
16	7	100+	0.0			21.6		
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
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		
31	8	100+	0.0		<b>SCRIPPS FORMATION</b>  Olive gray to reddish yellow, damp, hard, sandy lean clay (CL).	18.7	108.0			
32										
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										
51	12	100+	0.0			19.6	112.8			
52										
53										
54										
55										
56	13	99	0.3			18.8				
57										
58										
59										
60										
61	14	100+	0.0		Olive brown, hard, medium to highly plastic claystone (CL/CH).	21.4	114.4			



**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					<b>SCRIPPS FORMATION</b>			
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	<p><b>NOTES:</b></p> <p>Bottom of borehole at 80.5 feet.</p> <p>Unable to determine if groundwater is present. Method of drilling required introduction of water into borehole.</p>							

**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	OVN READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
1					<b>FILL:</b> 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	1				<b>VERY OLD PARALIC DEPOSITS</b>			
5	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		
6								
7								
8								
9					<b>SCRIPPS FORMATION</b>			
10								
11	3	100+	0.1		Olive yellow to olive brown, damp, hard, sandy lean clay (CL).	19.7	105.5	
12								
13	4							
14								
15	5	75	0.1			17.5		
16								
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

**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	OVN READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
1					<b>FILL</b> 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.			Gravels in the upper 3"
2								
3					(transition in sample)			
4								
5	1	46	0.1	?		12.5	113.1	?
6					<b>SCRIPPS FORMATION</b>  Pale olive yellow to reddish yellow, damp, very dense, fine-grained silty sandstone (SM).  Olive gray to pale gray, damp, hard, sandy lean clay (CL).  Claystone contains 1/8" to 1/4" wide laminations of reddish yellow silty sandstone (SM).			
7								
8	2							
9								
10	3	70	0.5					
11								
12								
13								
14								
15	4	100+	0.0					
16								
17	5							
18								
19								
20	6	51	0.1					
21								
22								
23								
24								
25	7	100+	0.0					
26								
27								
28								
29								

**PROJECT NO.  
44F1**

**ALLIED GEOTECHNICAL ENGINEERS, INC.**



**FIGURE A-53**

**BORING NO. H-22 (Continued)**

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	QVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS	
31	8	87	0.3		<b>SCRIPPS FORMATION</b>  Olive gray, reddish yellow and olive brown, damp, very dense/hard, laminated silty sandstone (SM) and sandy lean clay (CL).	22.5			
32									
33									
34									
35	9	100+	0.0				14.8	110.9	
36									
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
63					<b>SCRIPPS FORMATION</b>			
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	<p><b>NOTES:</b></p> <p>Bottom of borehole at 80.5 feet.</p> <p>Unable to determine if groundwater is present. Method of drilling required introduction of water into borehole.</p>							

**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**

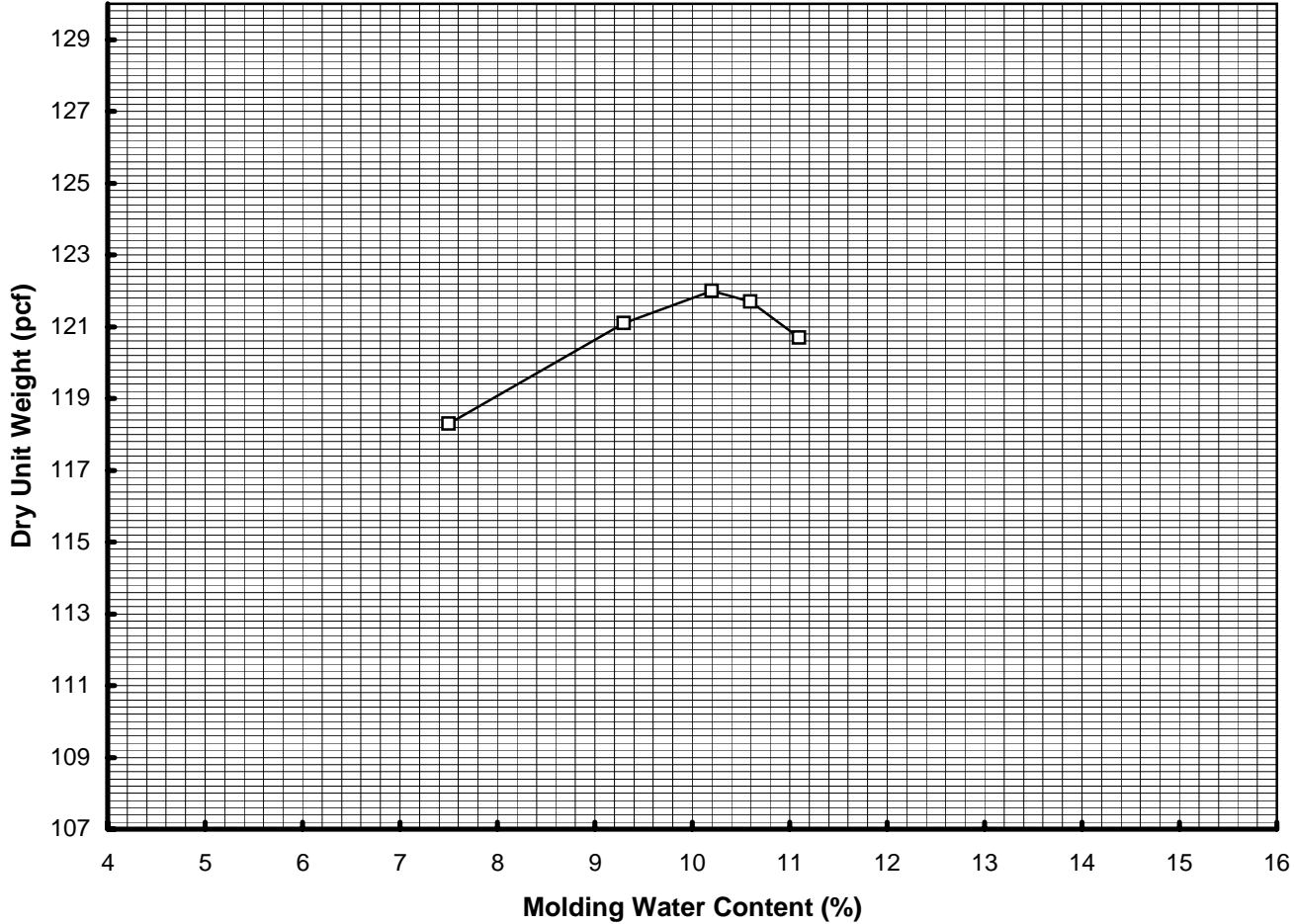
<b>Sample ID</b>	<b>Soil Classification</b>	<b>Expansion Index (%)</b>
H-9 #2 @9'-12'	Silty sand (SM)/sandy silt (ML)	43
H-11 #6 @21'-24'	Sandy lean clay (CL)	71
H-13 #25 @90'-100'	Claystone (CL/CH)	78
H-14 #7 @20'-24'	Sandy clay (CL)	55
H-15 #2 @4'-7'	Fat clay (CH)	75
H-16 #1 @6'-6.5'	Sandy siltstone (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**

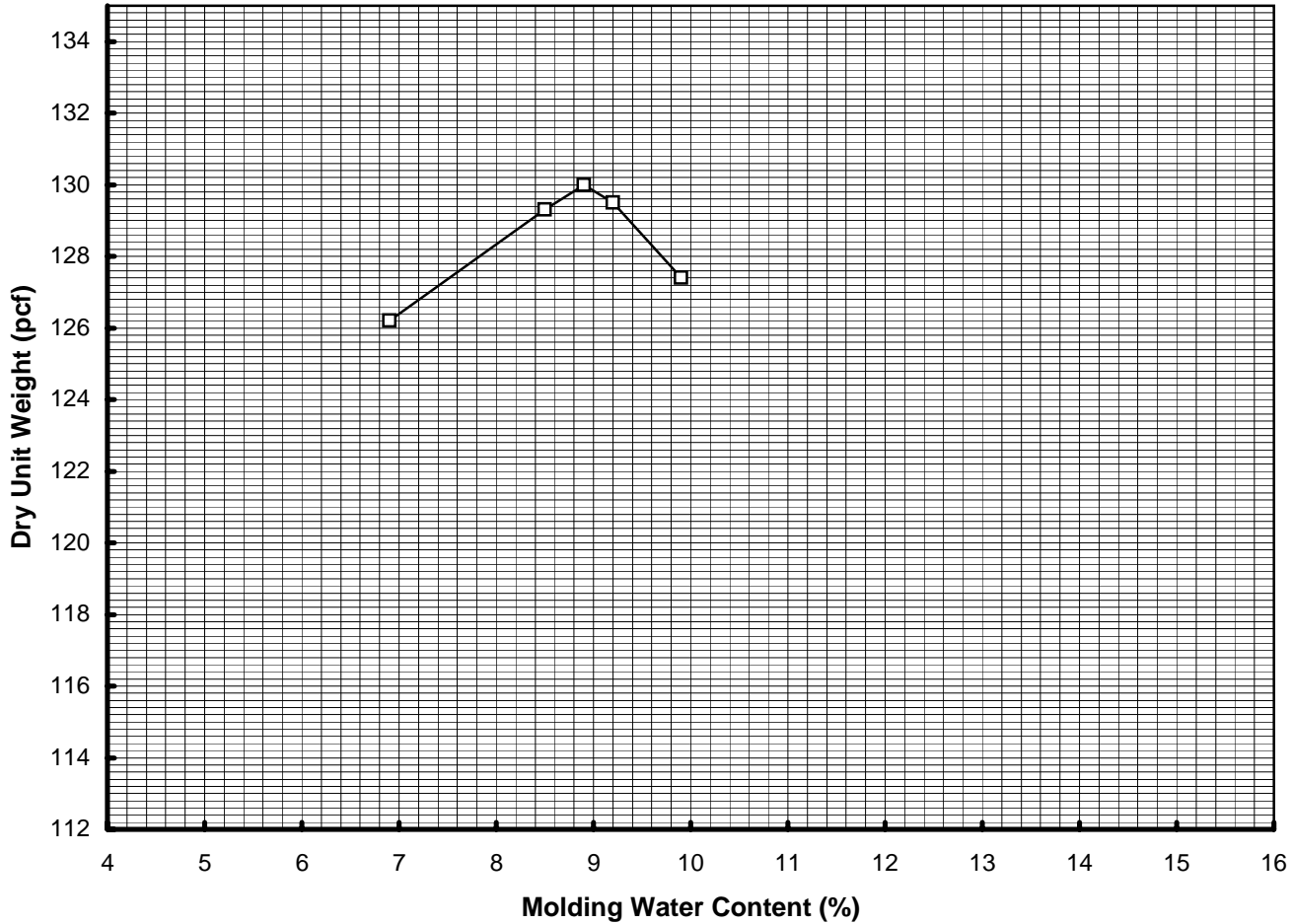
**ALLIED GEOTECHNICAL ENGINEERS, INC.**

**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**

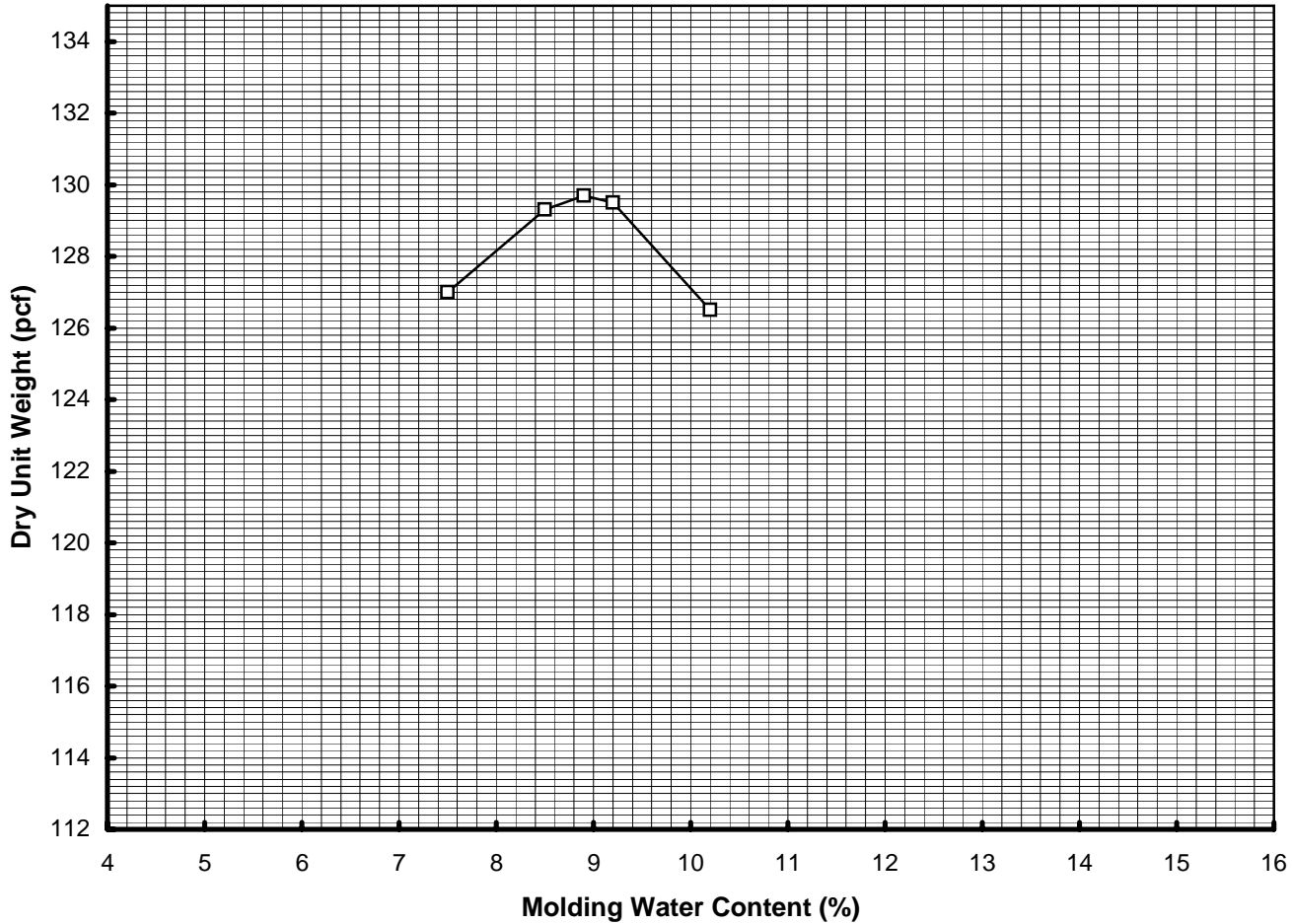
**ALLIED GEOTECHNICAL ENGINEERS, INC.**

**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**

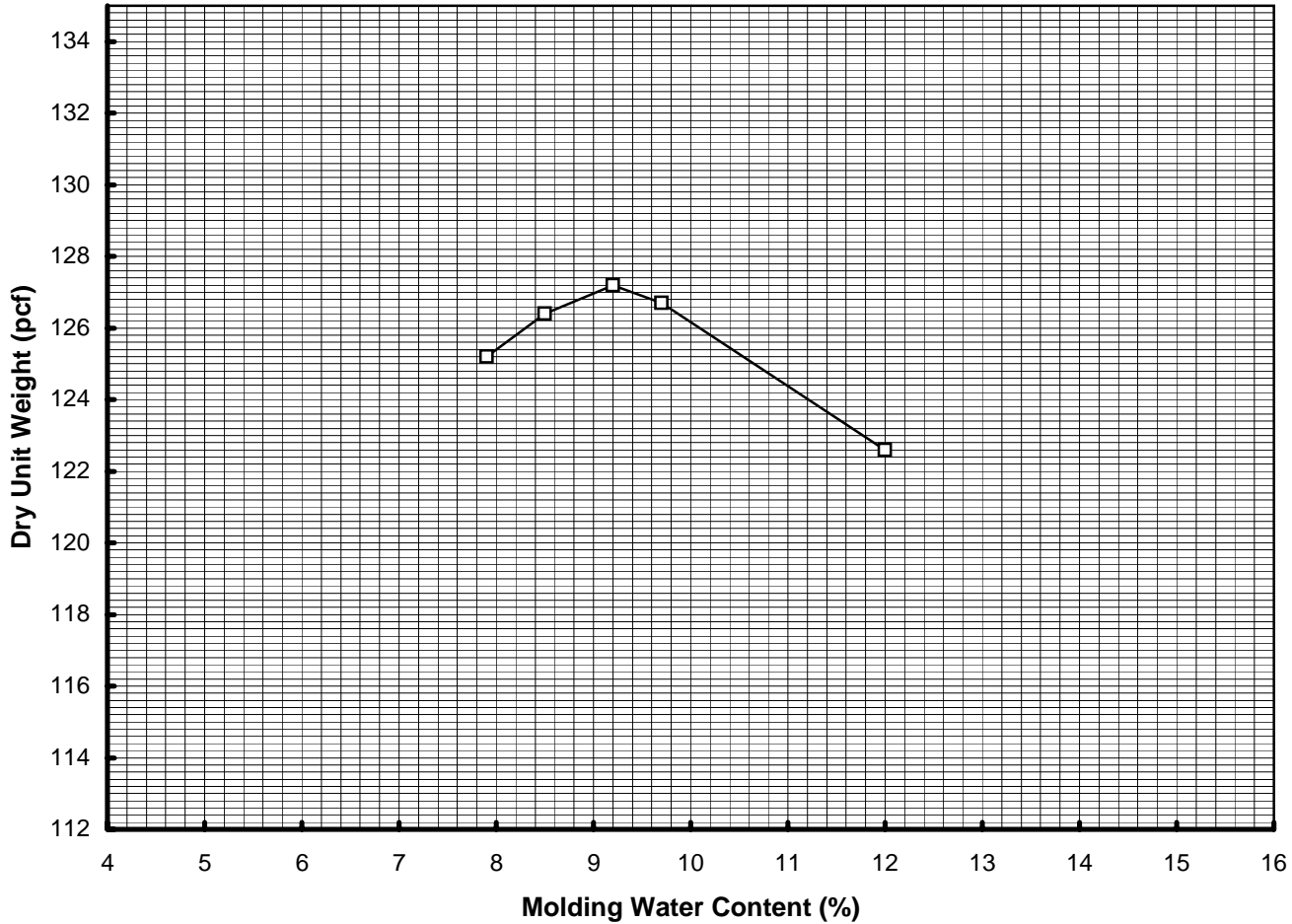
**ALLIED GEOTECHNICAL ENGINEERS, INC.**

**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.**

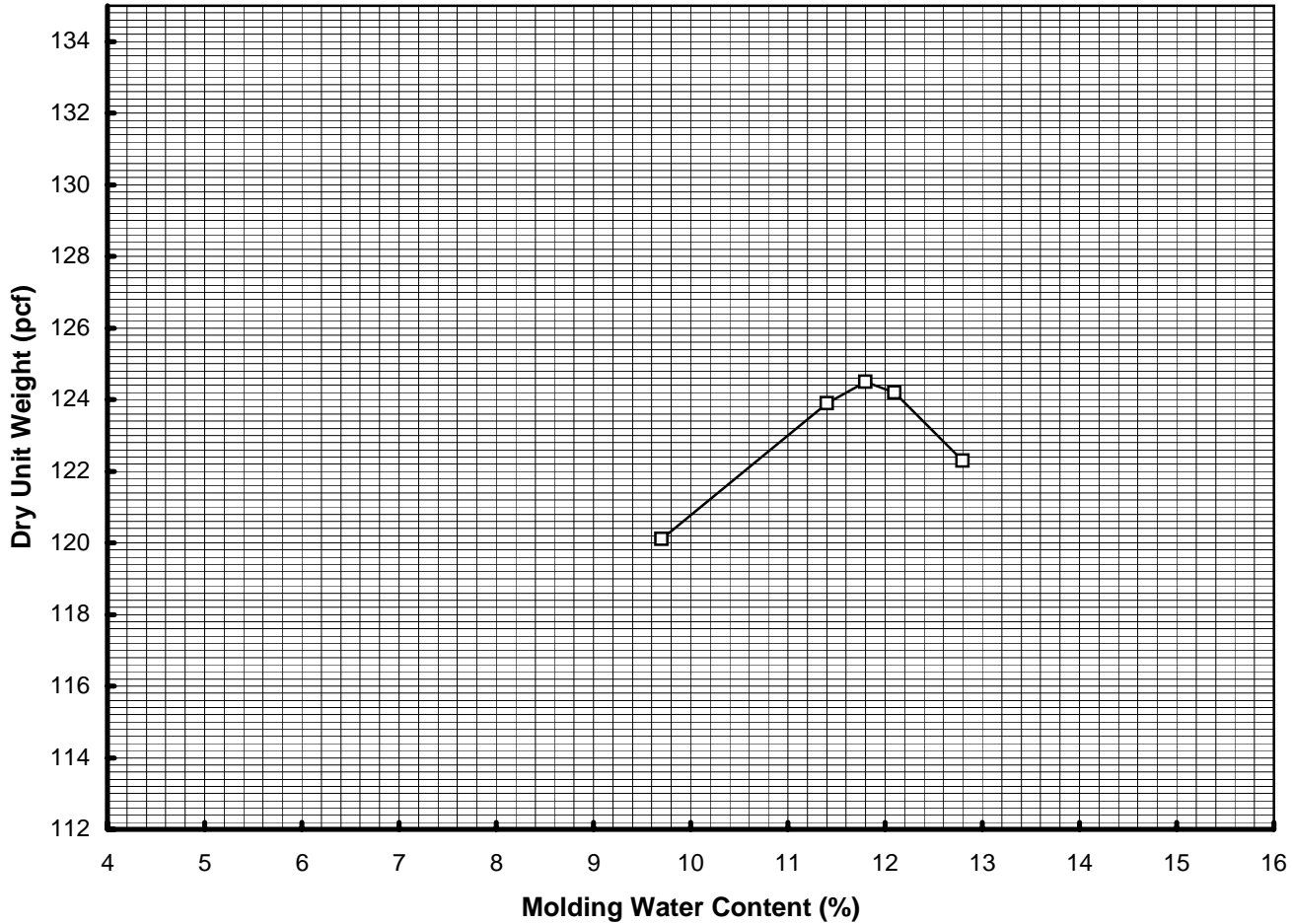
**FIGURE B-4**



### 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**

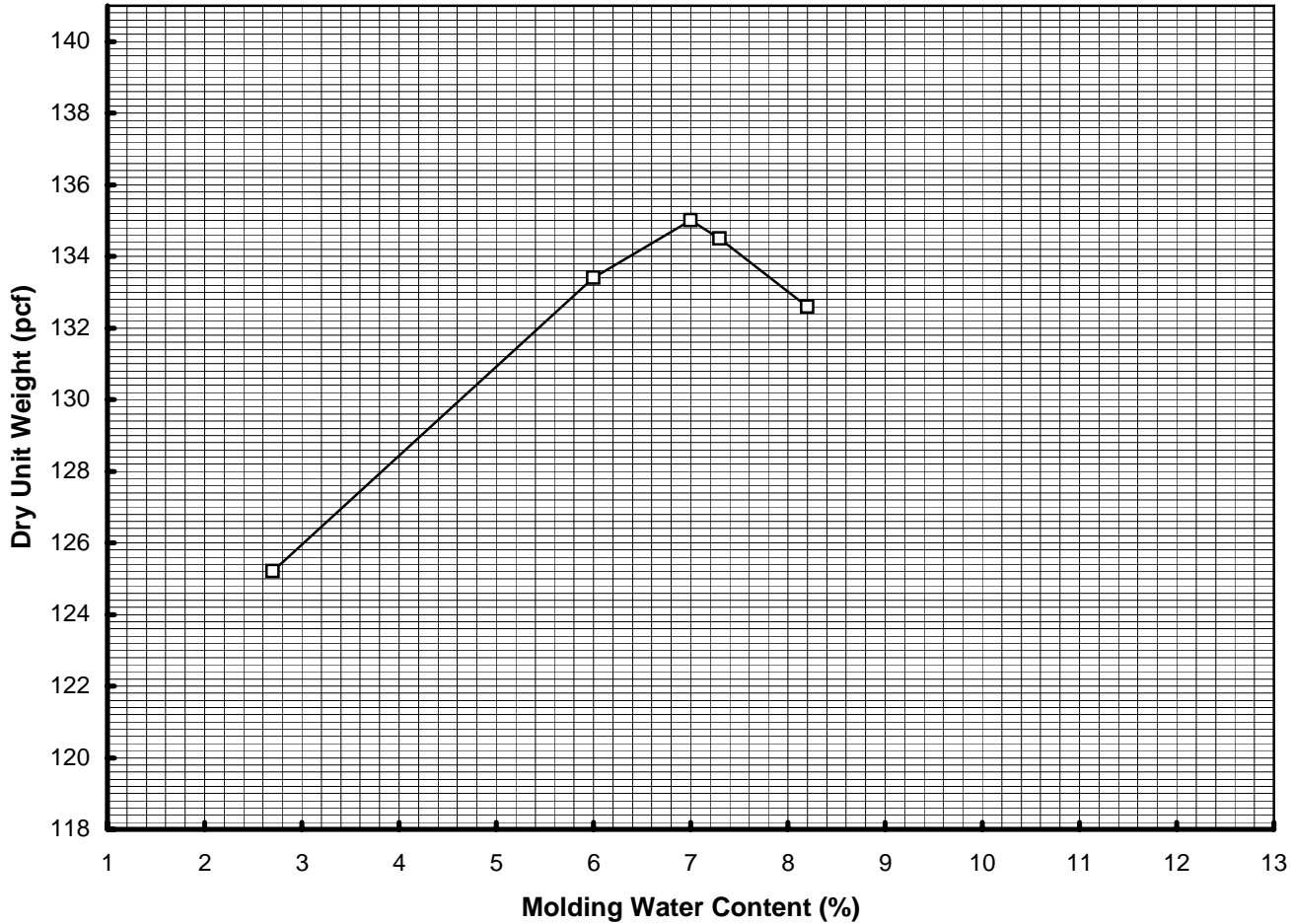
**ALLIED GEOTECHNICAL ENGINEERS, INC.**

**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**

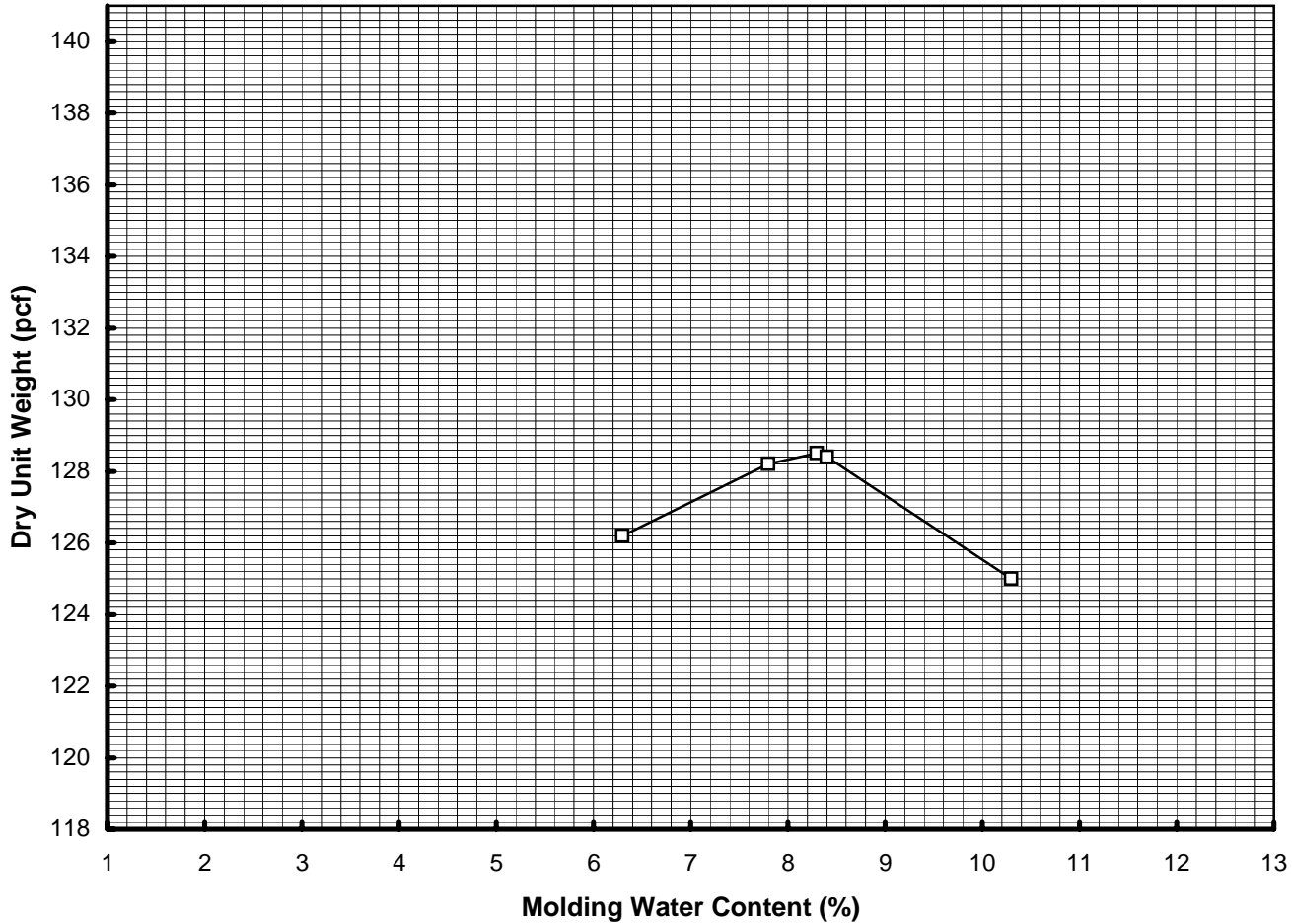
**ALLIED GEOTECHNICAL ENGINEERS, INC.**

**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**

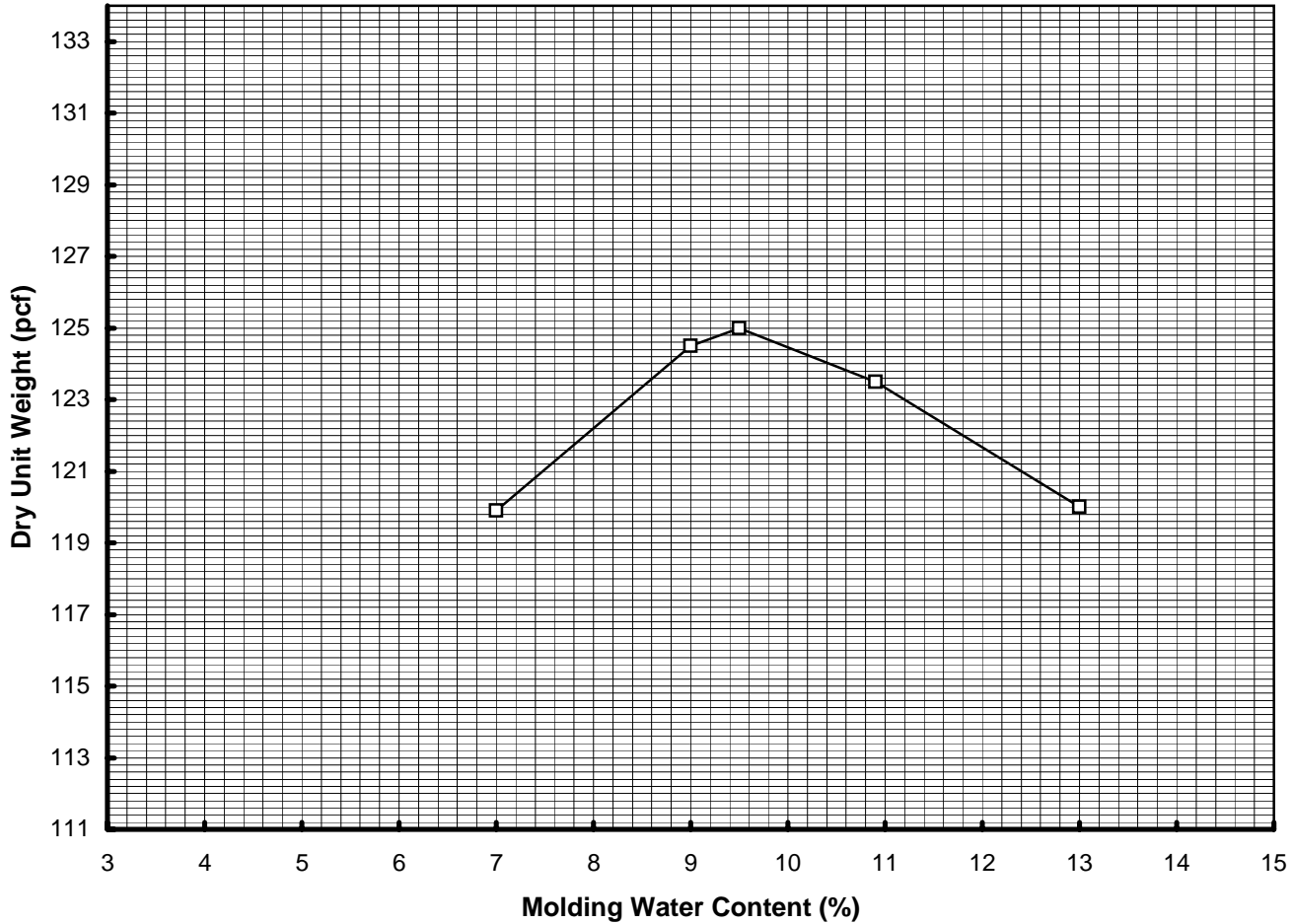
**ALLIED GEOTECHNICAL ENGINEERS, INC.**

**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**

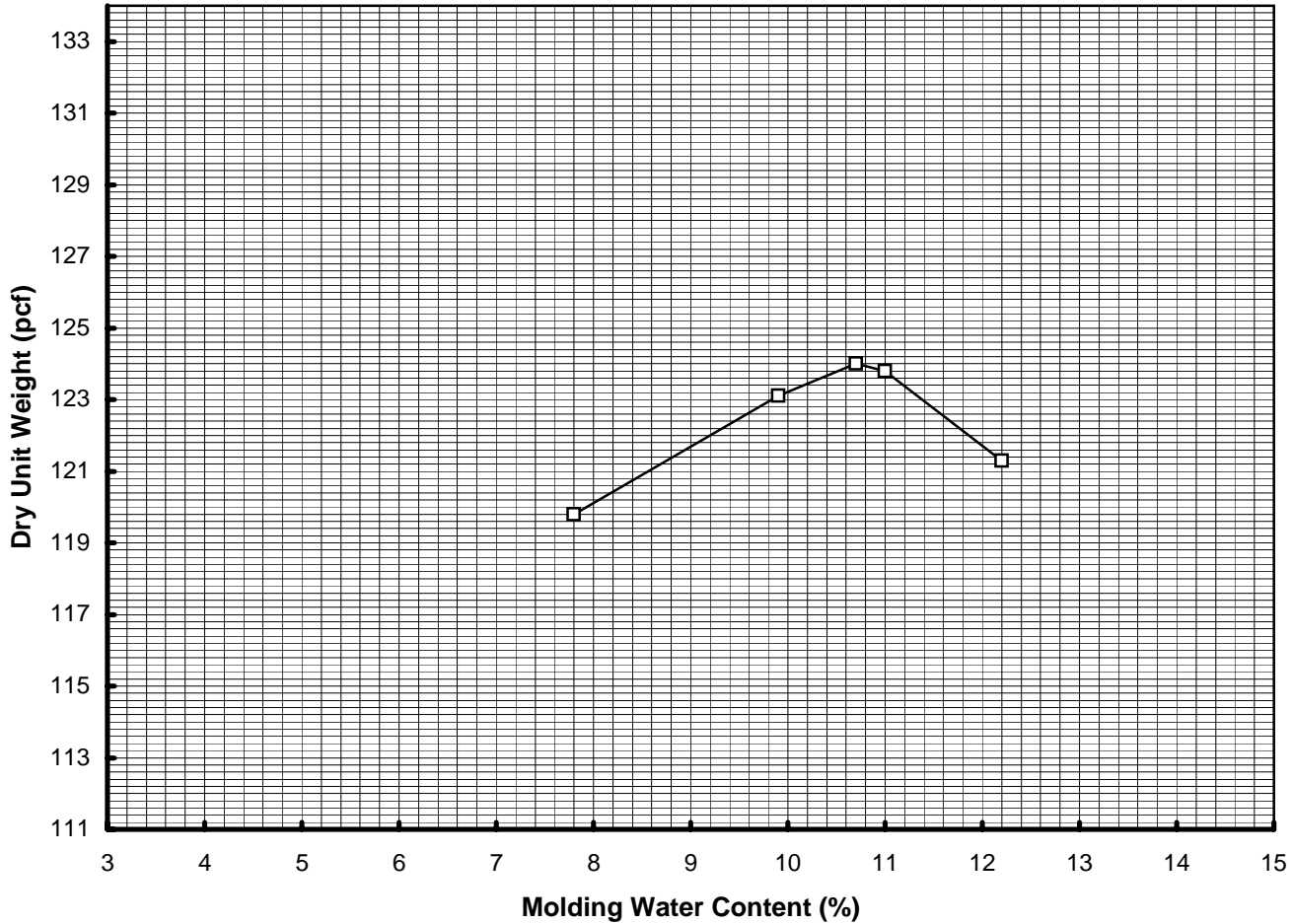
**ALLIED GEOTECHNICAL ENGINEERS, INC.**

**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.**

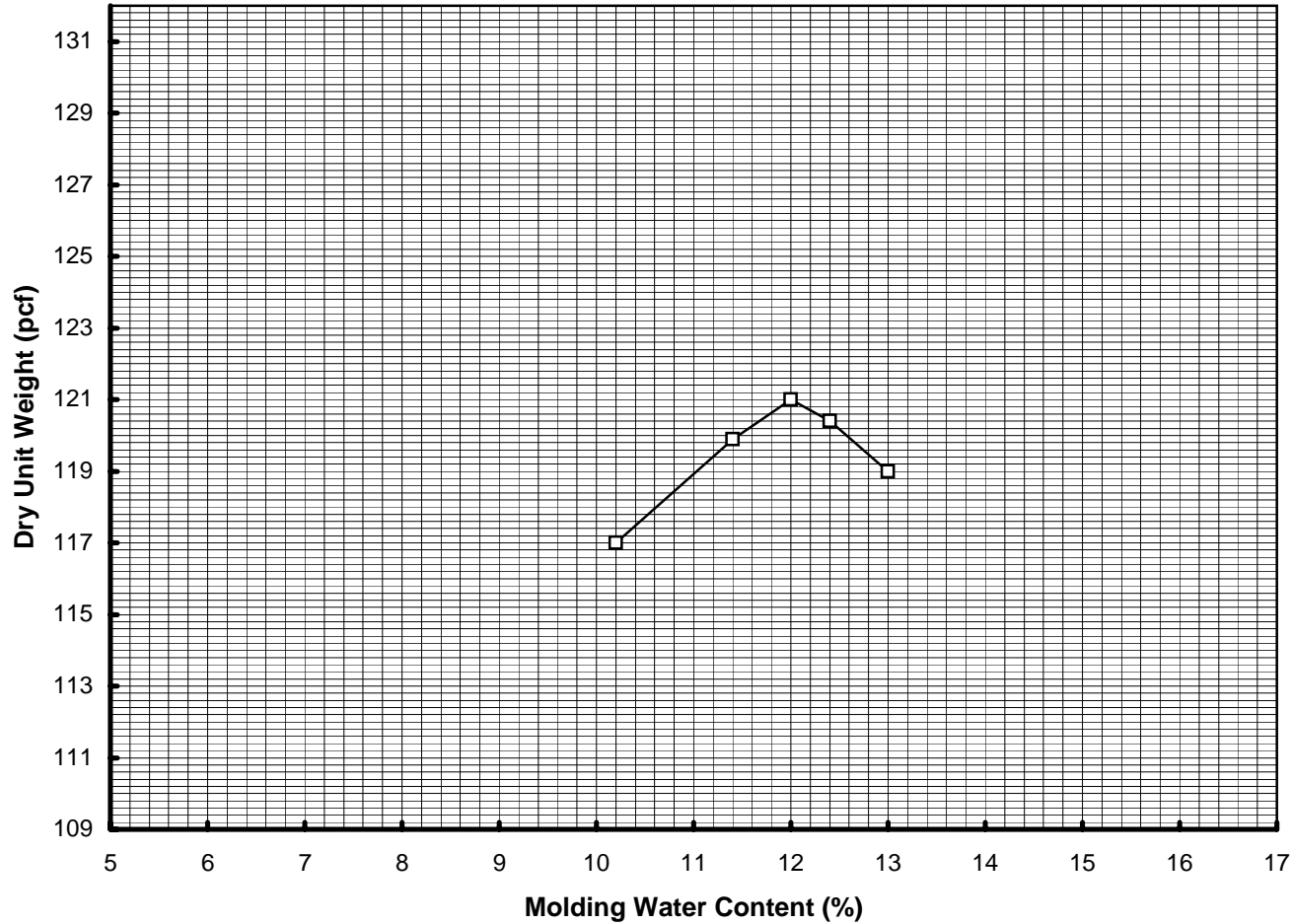
**FIGURE B-9**



### 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**

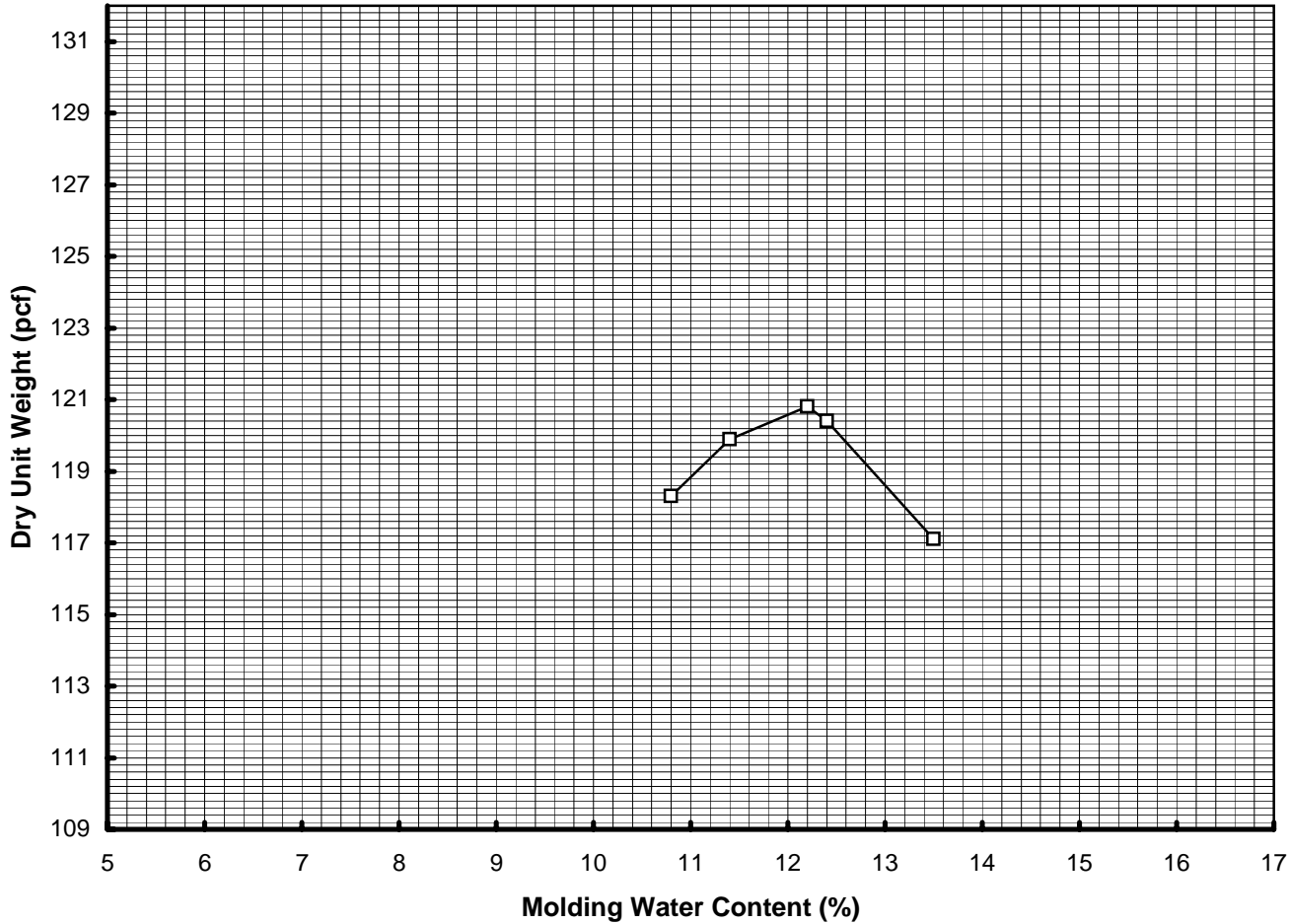
**ALLIED GEOTECHNICAL ENGINEERS, INC.**

**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**

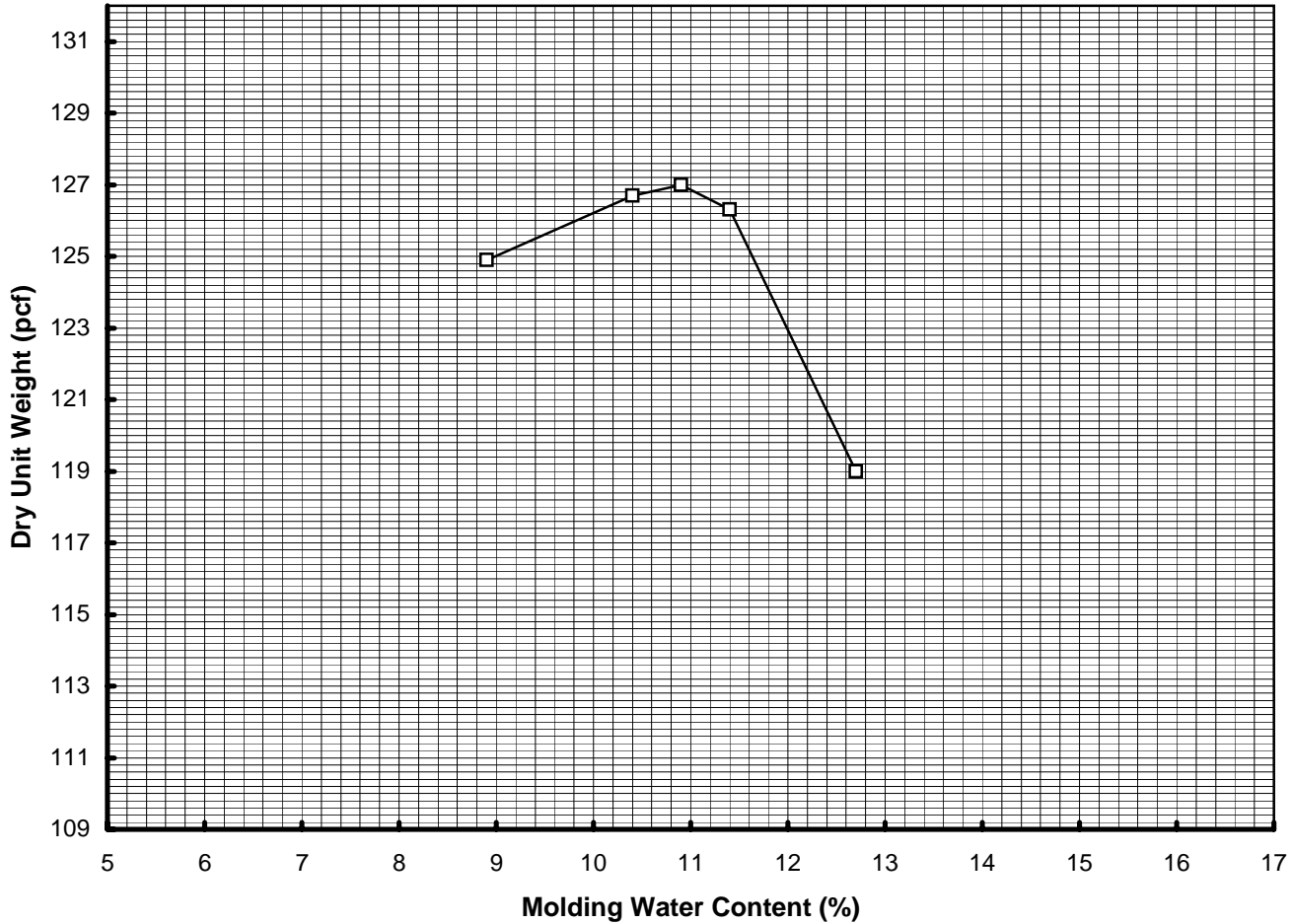
**ALLIED GEOTECHNICAL ENGINEERS, INC.**

**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**

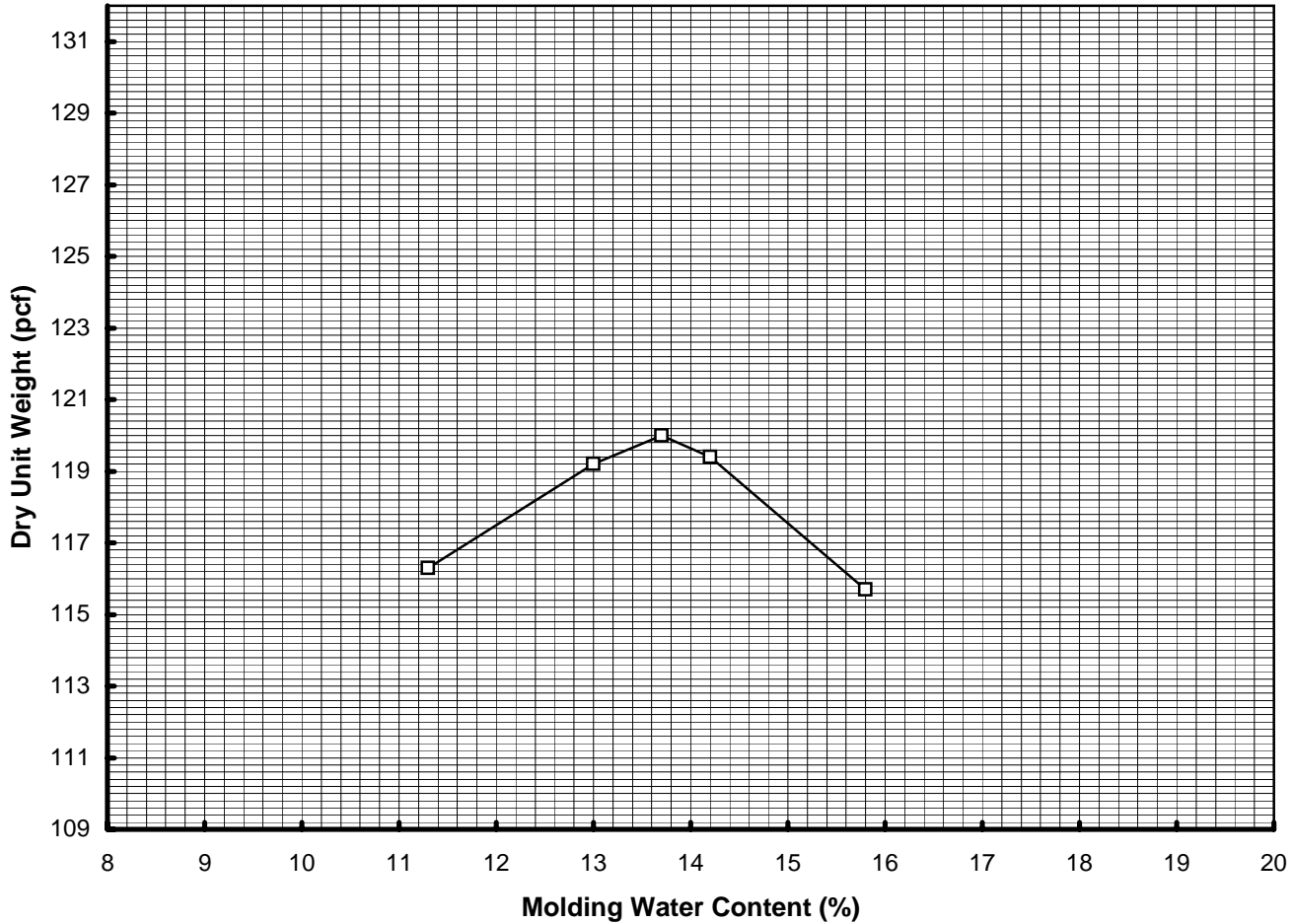
**ALLIED GEOTECHNICAL ENGINEERS, INC.**

**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**

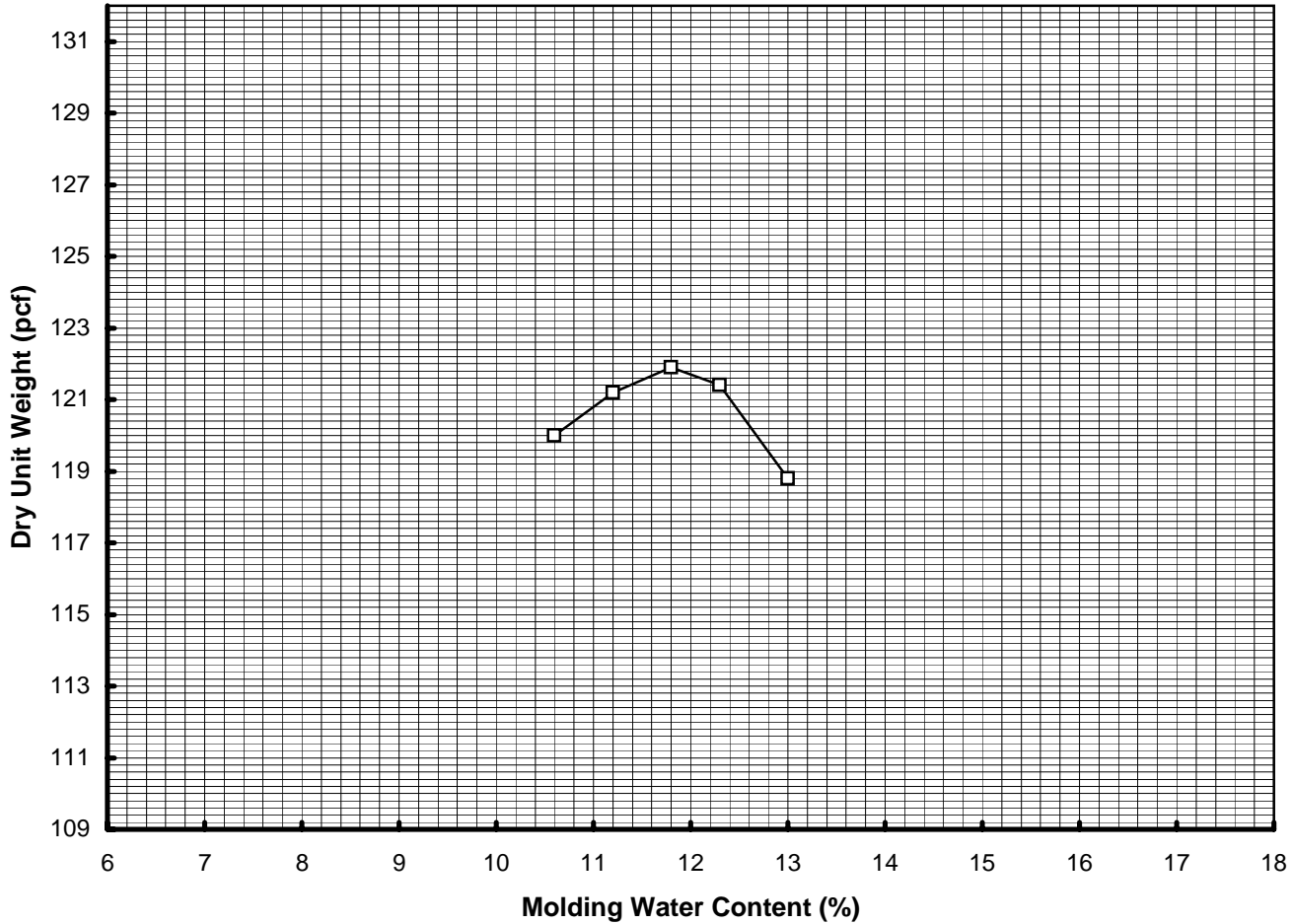
**ALLIED GEOTECHNICAL ENGINEERS, INC.**

**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.**

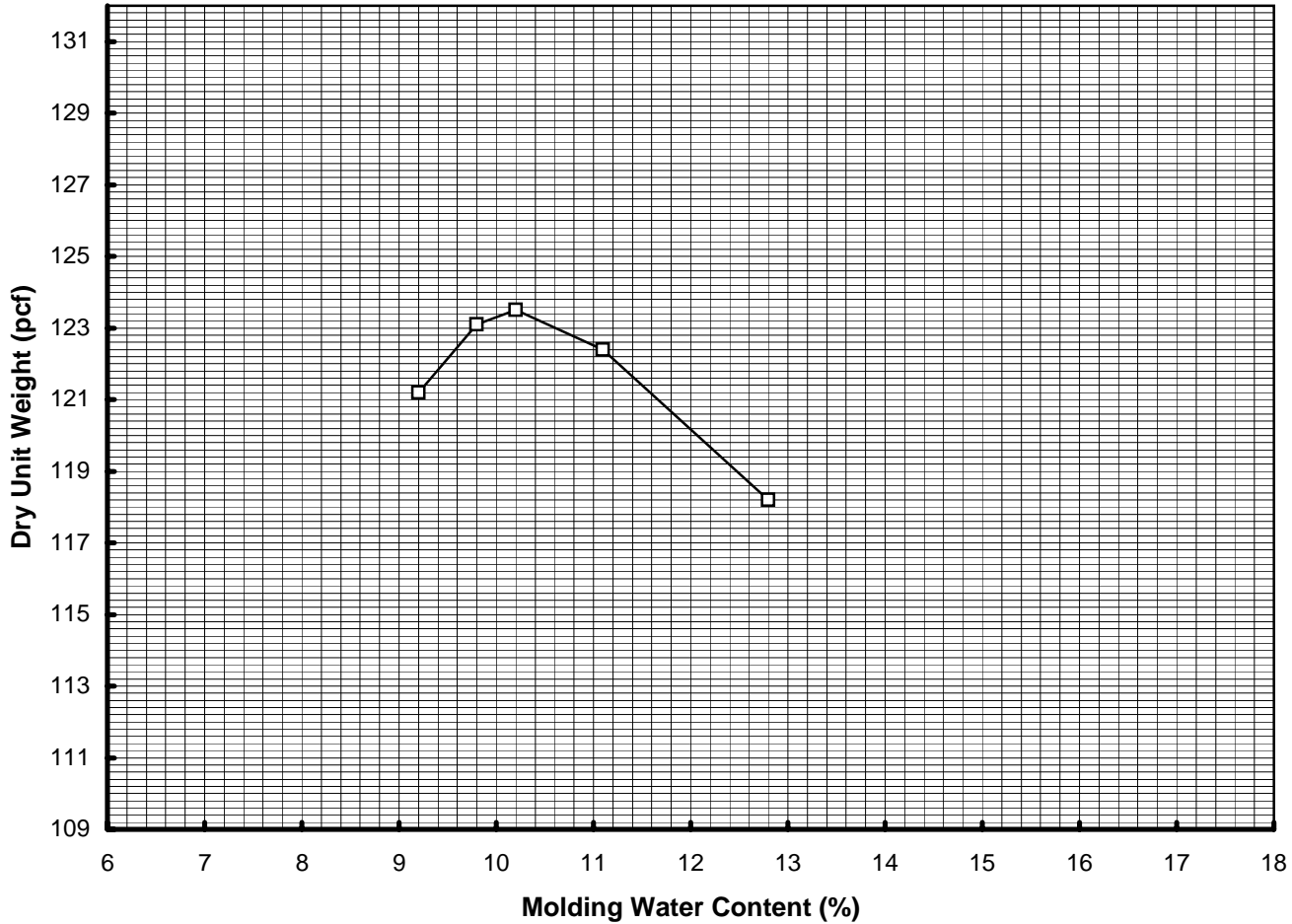
**FIGURE B-14**



### 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**

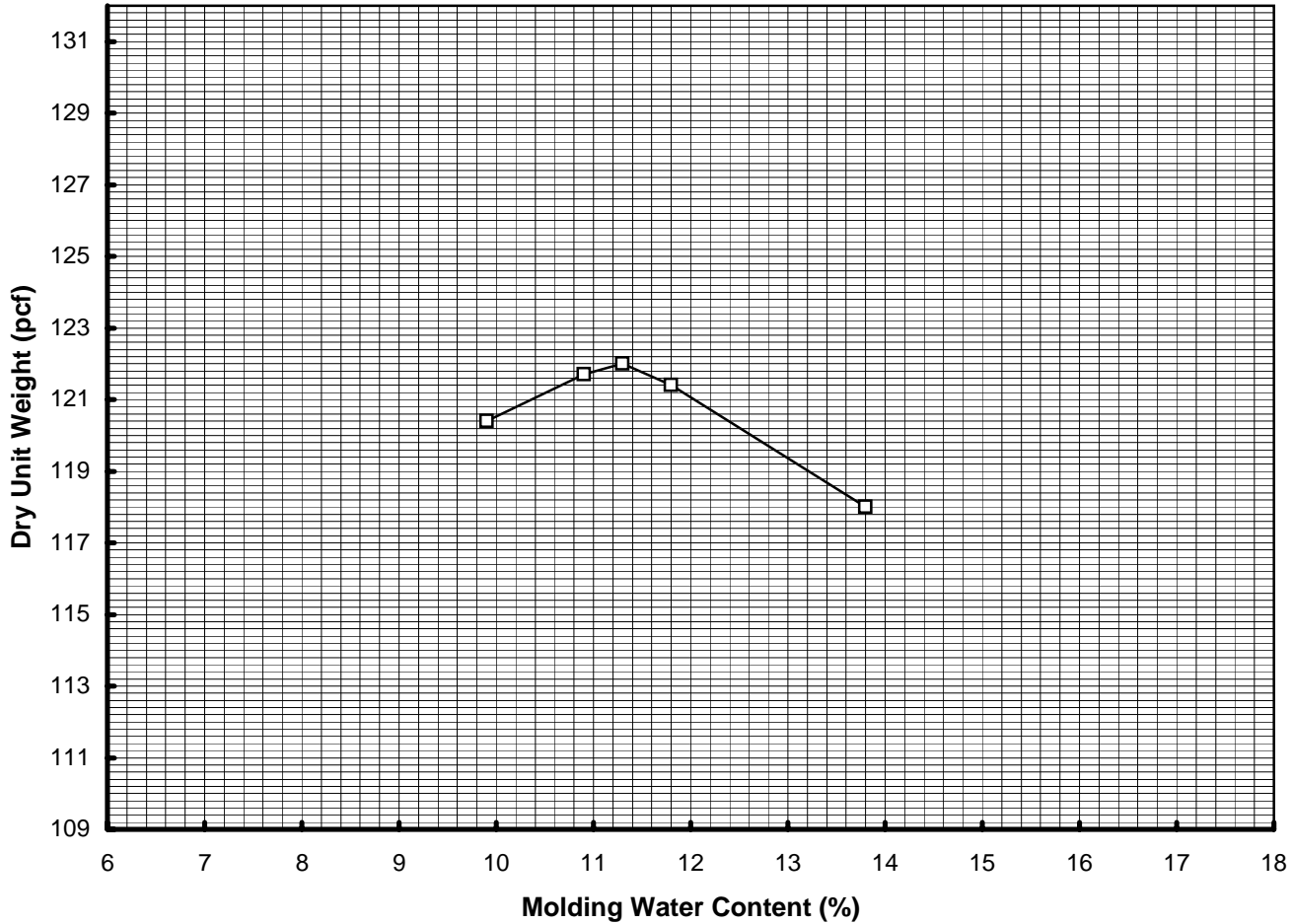
**ALLIED GEOTECHNICAL ENGINEERS, INC.**

**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**

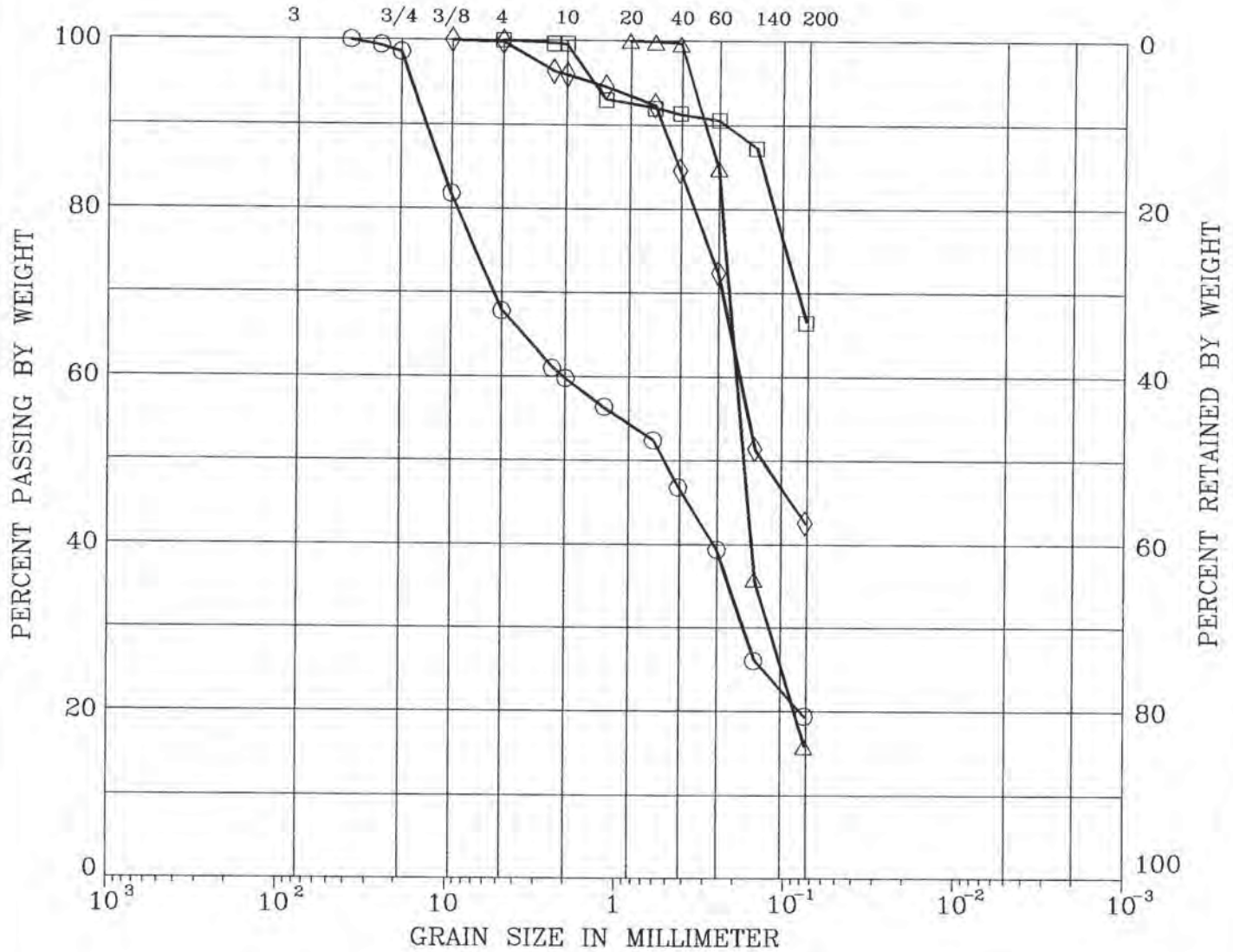
**PROJECT NO. 44 F1**

**ALLIED GEOTECHNICAL ENGINEERS, INC.**

**FIGURE B-16**

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	
U.S. SIEVE SIZE IN INCHES			U.S. STANDARD SIEVE No.			HYDROMETER



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

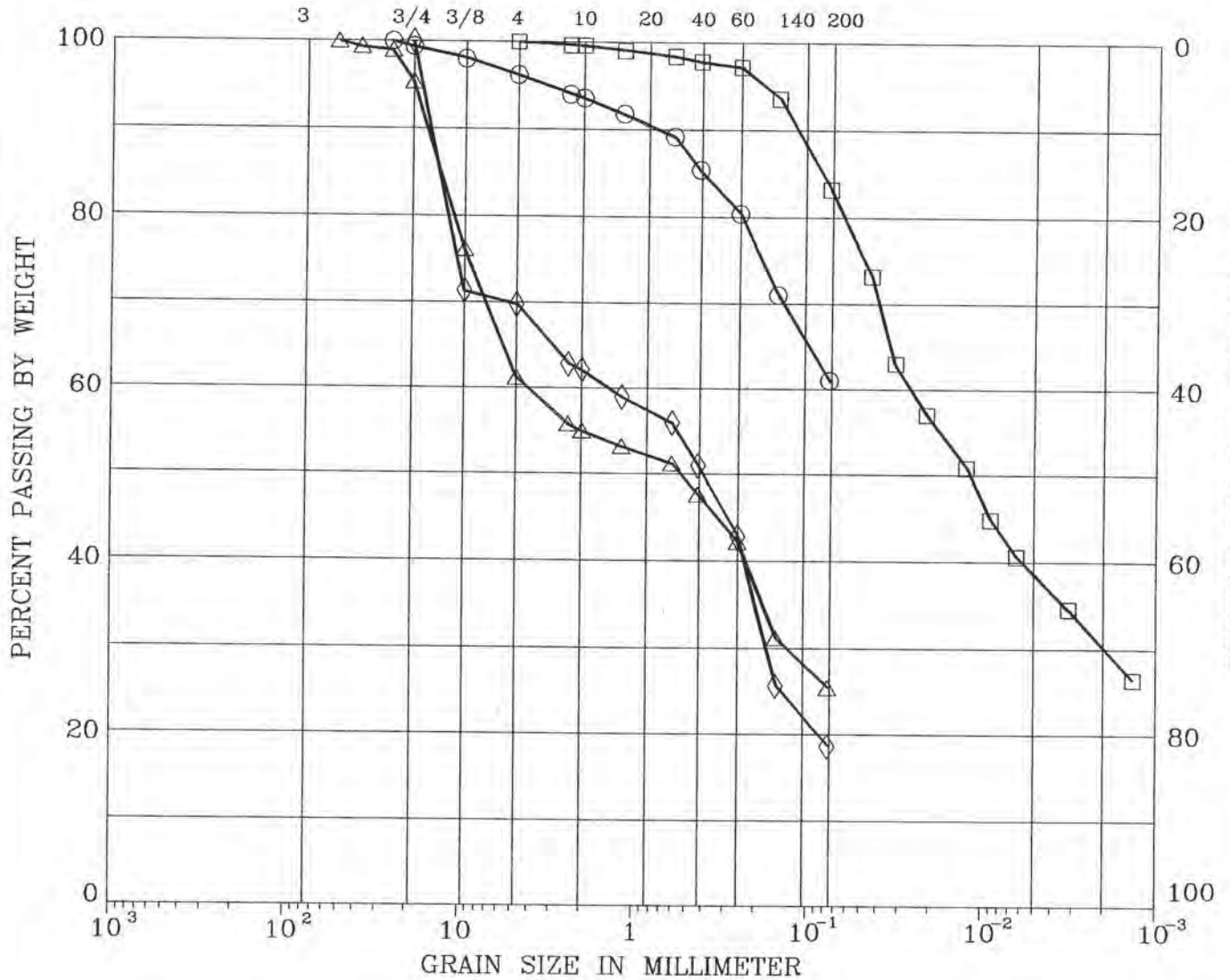
NORTH CITY WATER RECLAMATION PLANT EXPANSION

ALLIED GEOTECHNICAL ENGINEERS, INC.

GRAIN SIZE DISTRIBUTION Figure B-17

**UNIFIED SOIL CLASSIFICATION**

<i>COBBLES</i>	<i>GRAVEL</i>		<i>SAND</i>			<i>SILT OR CLAY</i>
	COARSE	FINE	COARSE	MEDIUM	FINE	
U.S. SIEVE SIZE IN INCHES			U.S. STANDARD SIEVE No.			HYDROMETER



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

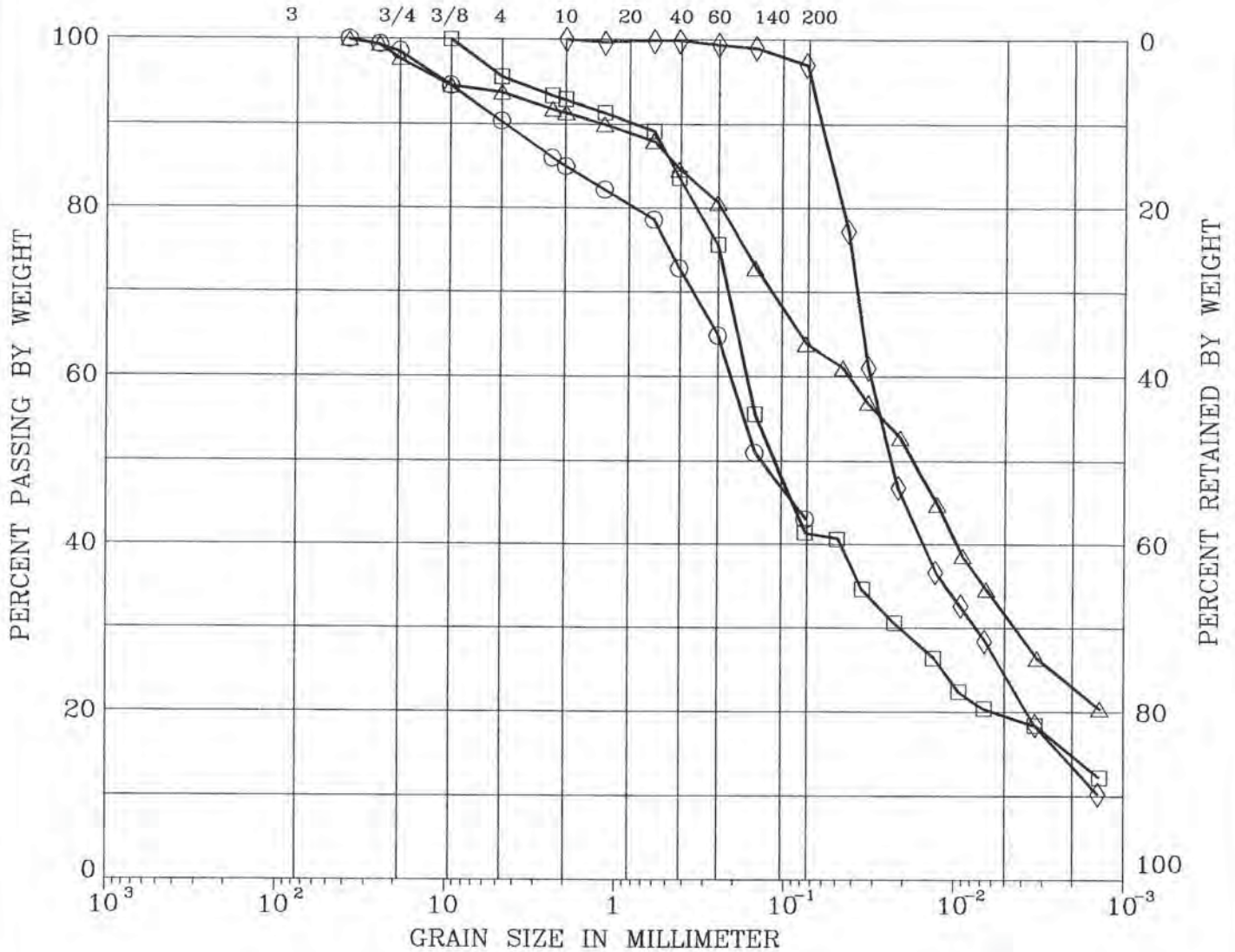
ALLIED GEOTECHNICAL ENGINEERS, INC.

GRAIN SIZE DISTRIBUTION Figure B-18



UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	
U.S. SIEVE SIZE IN INCHES			U.S. STANDARD SIEVE No.			HYDROMETER



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

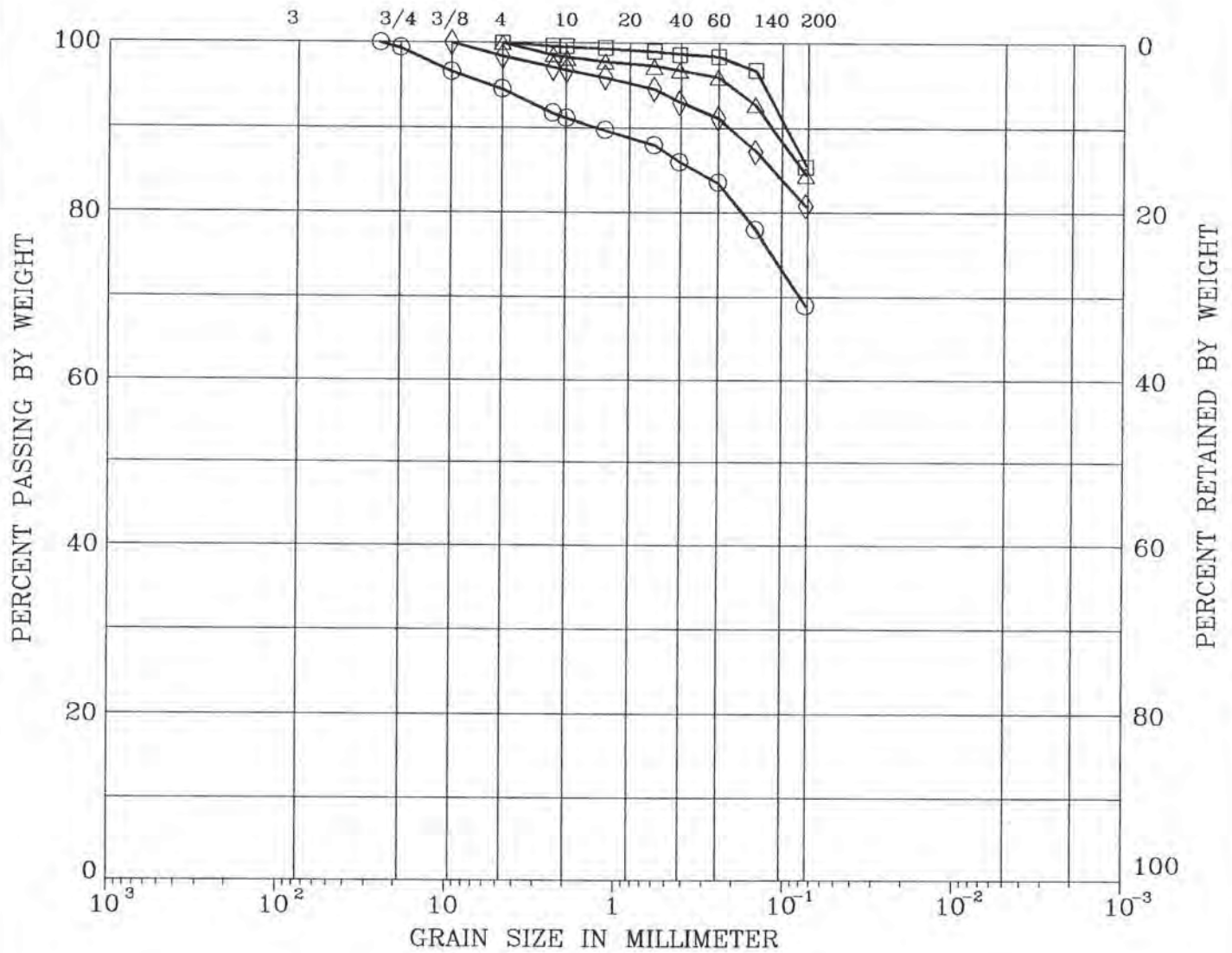
ALLIED GEOTECHNICAL ENGINEERS, INC.

GRAIN SIZE DISTRIBUTION Figure B-19



### UNIFIED SOIL CLASSIFICATION

<i>COBBLES</i>	<i>GRAVEL</i>		<i>SAND</i>			<i>SILT OR CLAY</i>
	COARSE	FINE	COARSE	MEDIUM	FINE	
U.S. Sieve Size in Inches			U.S. Standard Sieve No.			Hydrometer



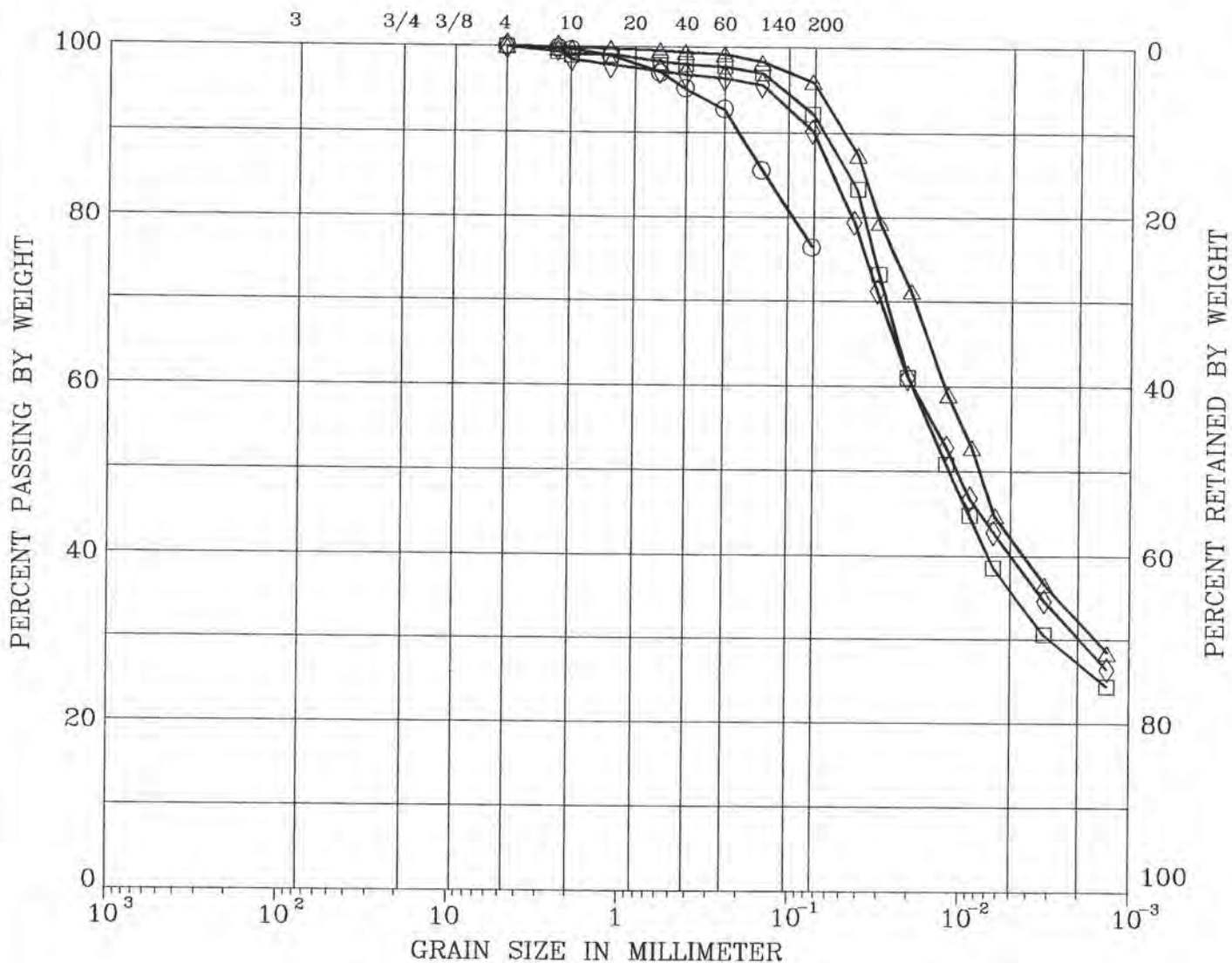
SYMBOL	BORING	DEPTH (ft)	LL (%)	PI (%)	DESCRIPTION
○	H-10 #1	3-7			CLAYS (CL)
□	H-11 #6	21-24	43	27	CLAYS (CL)
△	H-11 #2	11-11.5			CLAYS (CL)
◇	H-12 #7	21-24			CLAYS (CL)

Remark :

Project No. 44F1	NORTH CITY WATER RECLAMATION PLANT EXPANSION
ALLIED GEOTECHNICAL ENGINEERS, INC.	GRAIN SIZE DISTRIBUTION <span style="float: right;">Figure B-20</span>

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	
U.S. SIEVE SIZE IN INCHES			U.S. STANDARD SIEVE No.			HYDROMETER



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

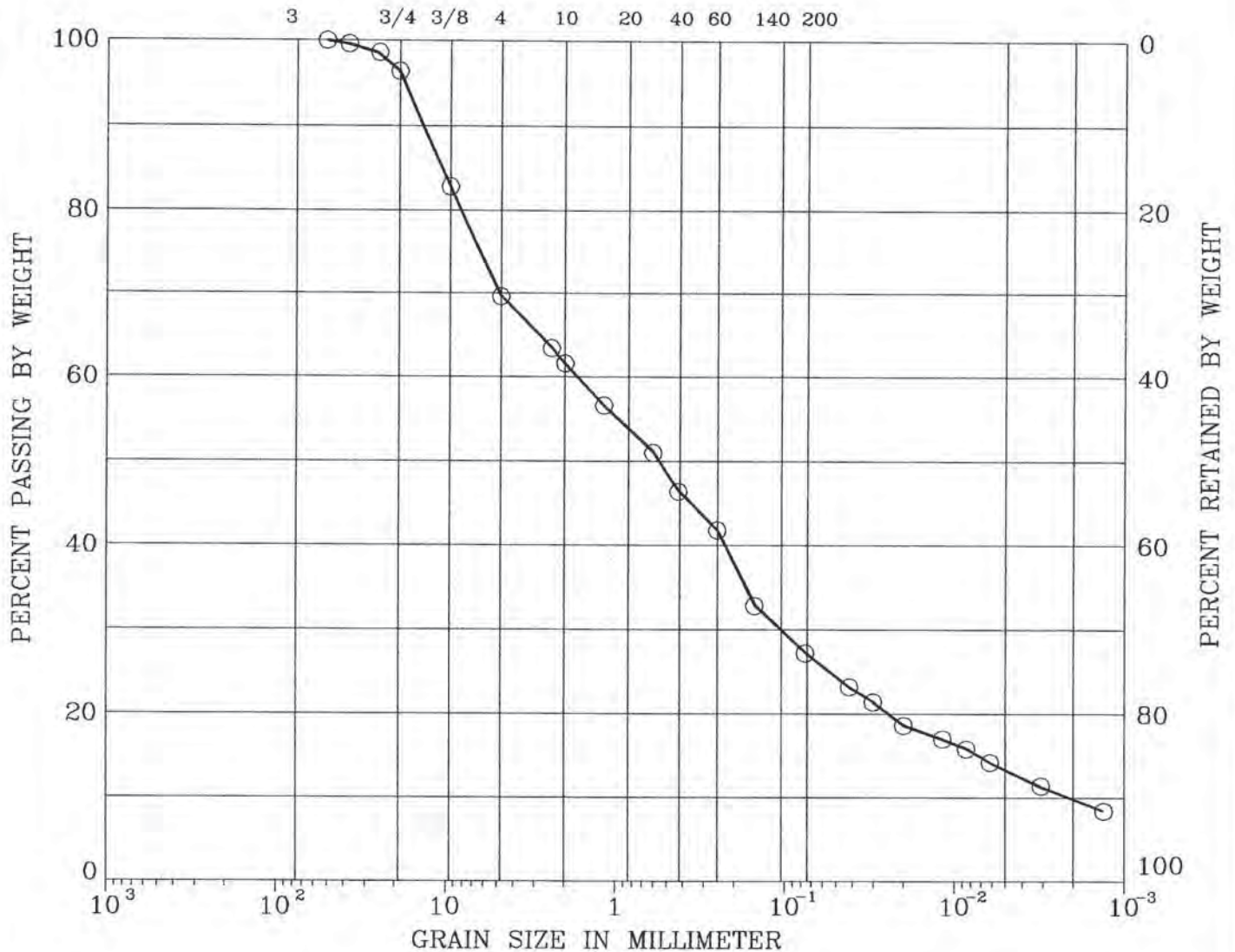
ALLIED GEOTECHNICAL ENGINEERS, INC.

GRAIN SIZE DISTRIBUTION Figure B-21



**UNIFIED SOIL CLASSIFICATION**

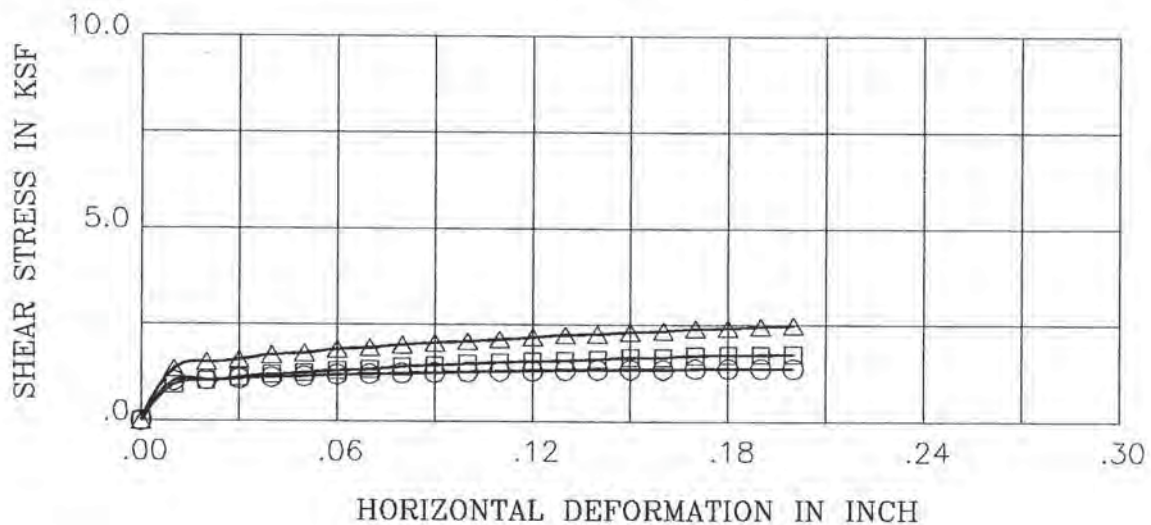
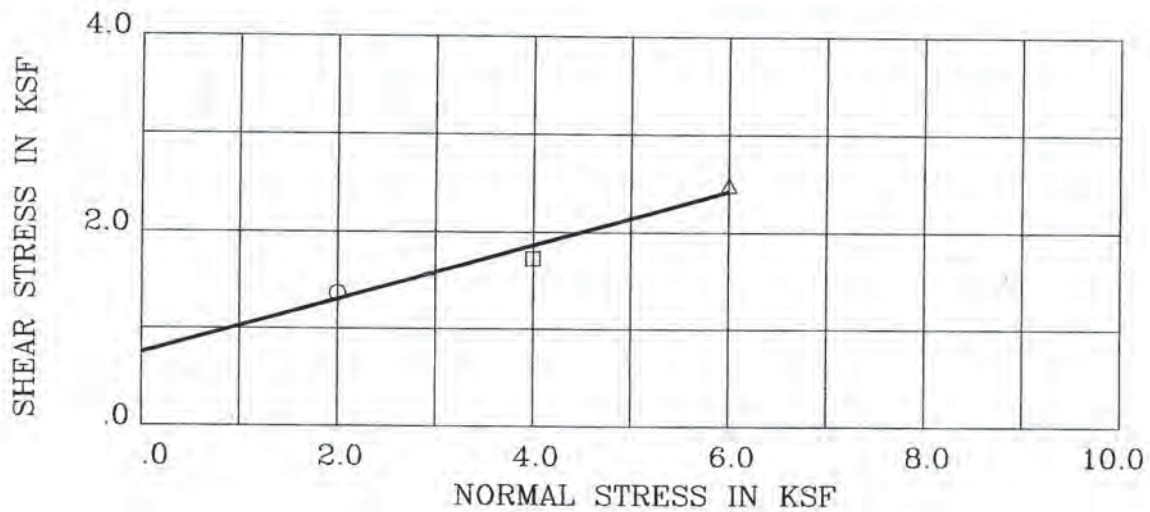
<i>COBBLES</i>	<i>GRAVEL</i>		<i>SAND</i>			<i>SILT OR CLAY</i>
	COARSE	FINE	COARSE	MEDIUM	FINE	
U.S. SIEVE SIZE IN INCHES			U.S. STANDARD SIEVE No.			HYDROMETER



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



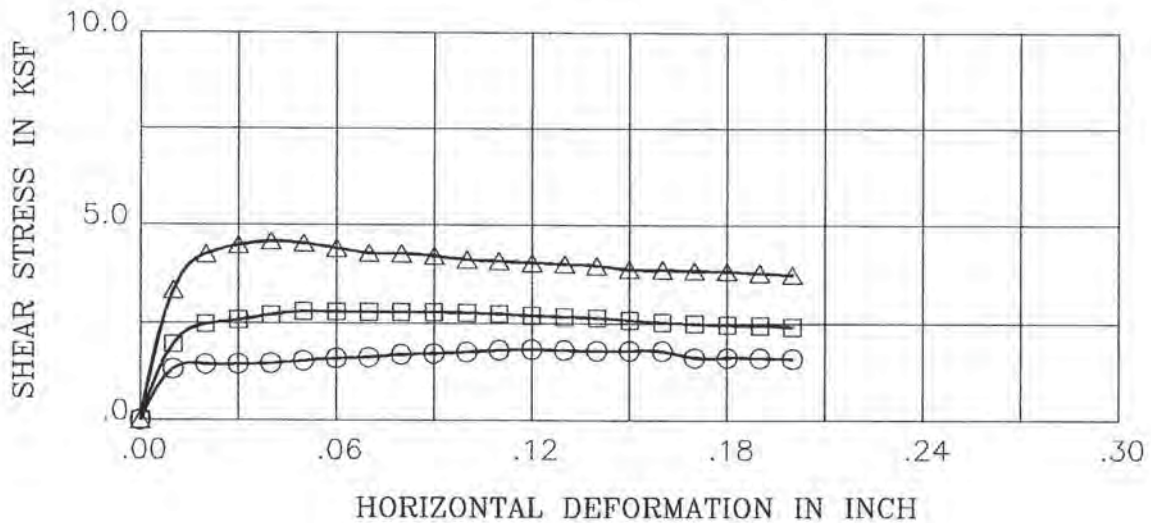
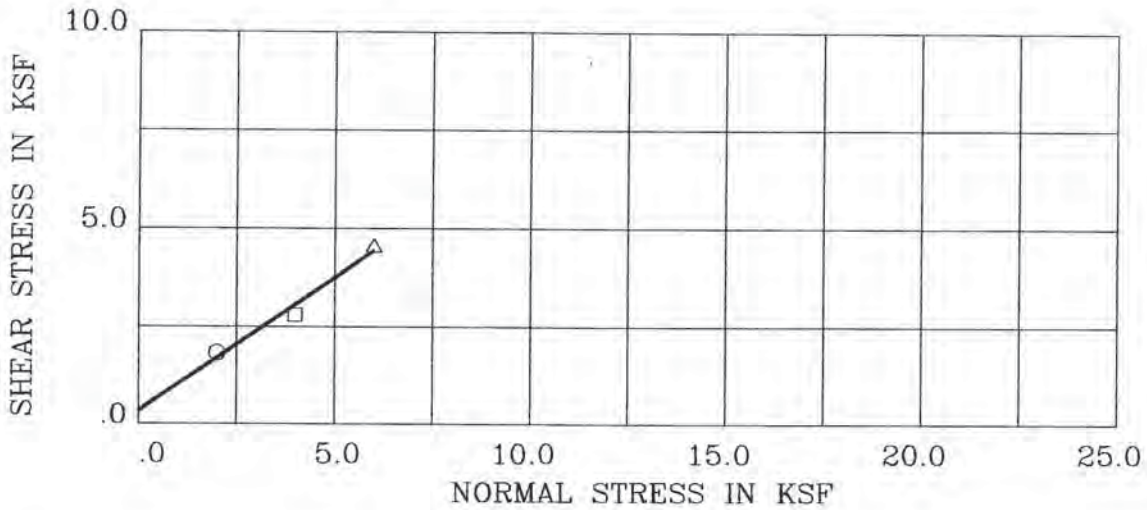
BORING/SAMPLE : H-1 #1                      DEPTH (ft) : 1-4  
 DESCRIPTION : Silty/clayey sand (SM/SC)  
 STRENGTH INTERCEPT (C) : .750 KSF  
 FRICTION ANGLE (PHI) : 15.6 DEG                      (PEAK STRENGTH)

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.	<b>DIRECT SHEAR TEST</b> Figure B-23





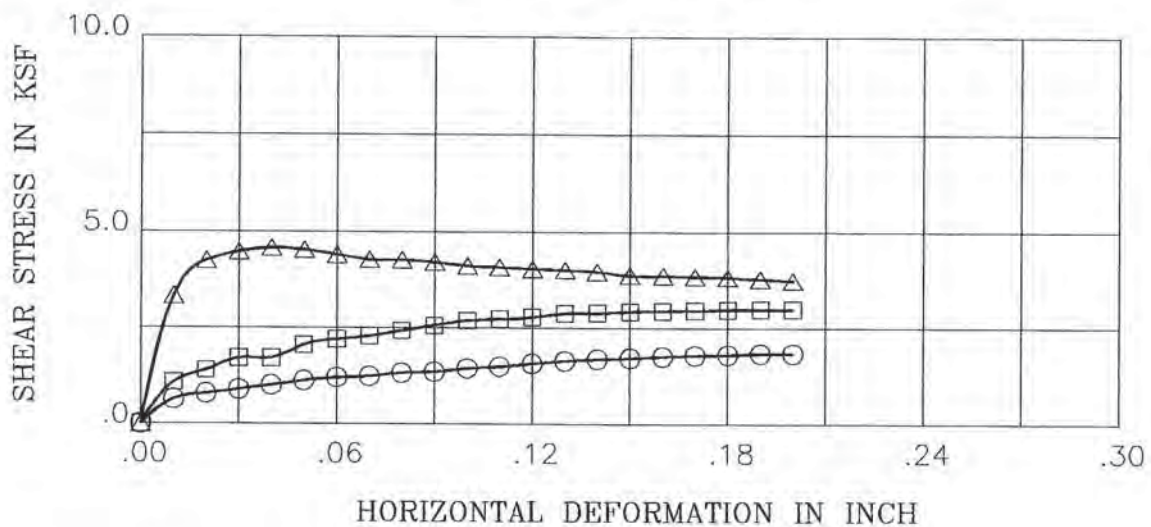
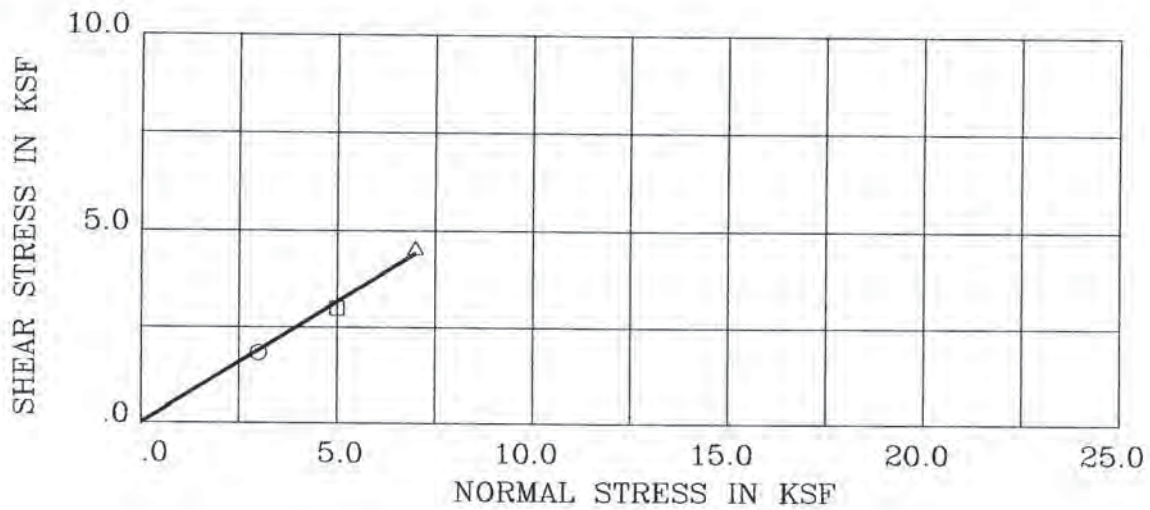
BORING/SAMPLE : H-1 #5                      DEPTH (ft) : 16-16.5  
 DESCRIPTION : Lean clay (CL)  
 STRENGTH INTERCEPT (C) : .330      KSF                      (PEAK STRENGTH)  
 FRICTION ANGLE (PHI) : 34.4      DEG

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



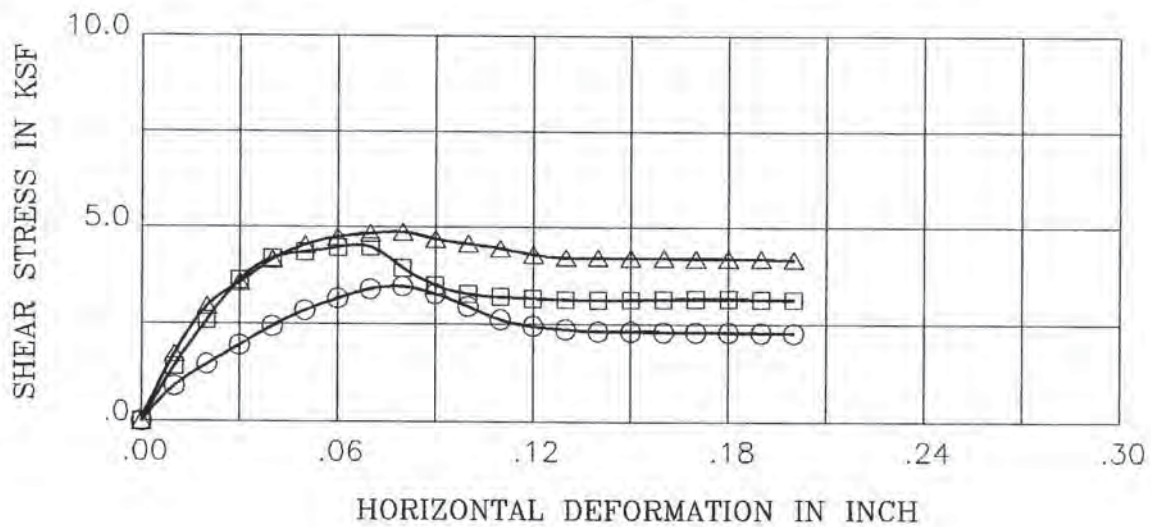
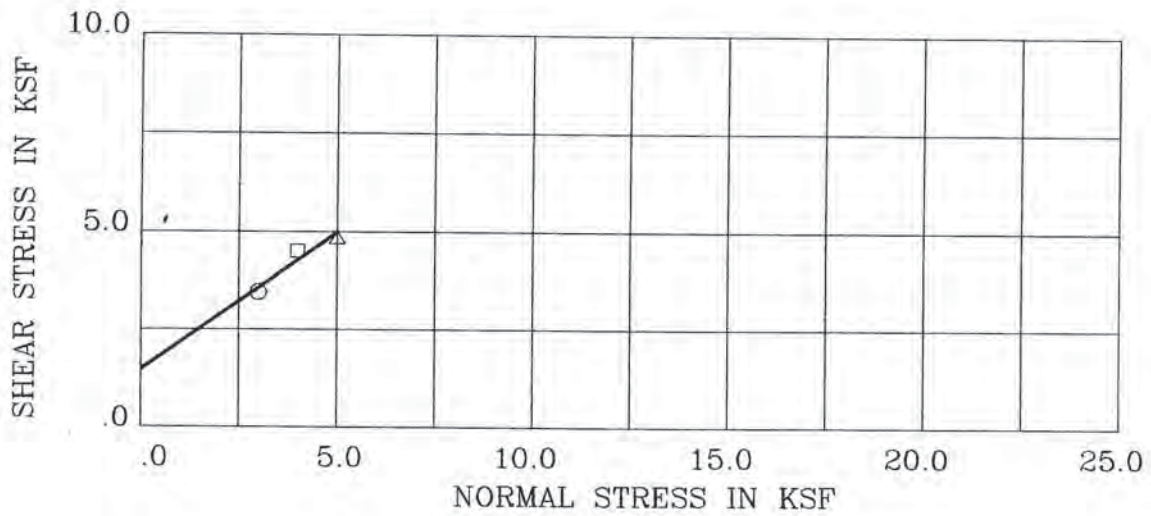


BORING/SAMPLE : H-2 #2                      DEPTH (ft) : 11-11.5  
 DESCRIPTION : Silty/clayey sand (SM/SC)  
 STRENGTH INTERCEPT (C) : .000 KSF  
 FRICTION ANGLE (PHI) : 32.3 DEG                      (PEAK STRENGTH)

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.	<b>DIRECT SHEAR TEST</b> Figure B-25



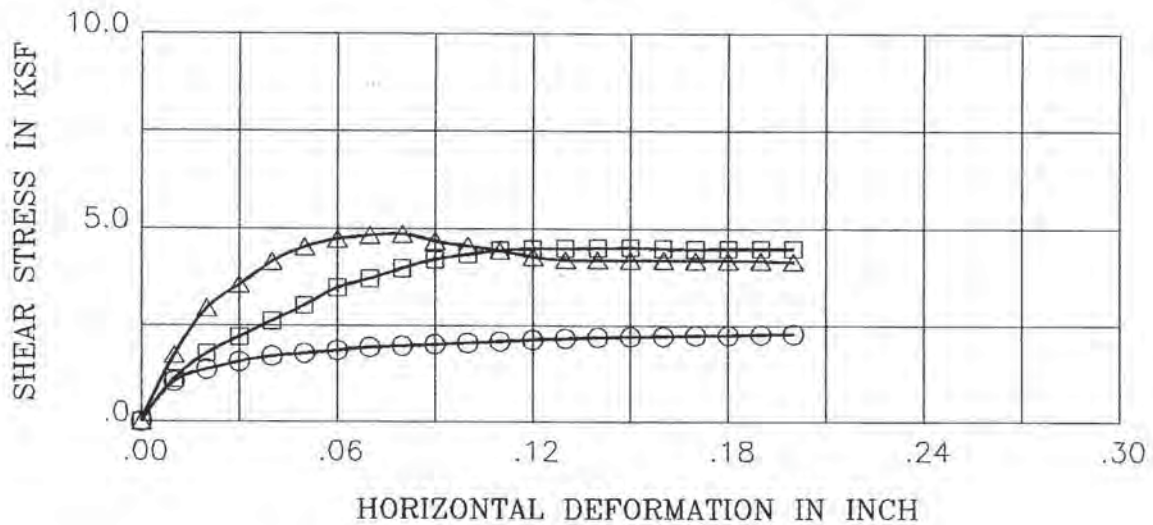
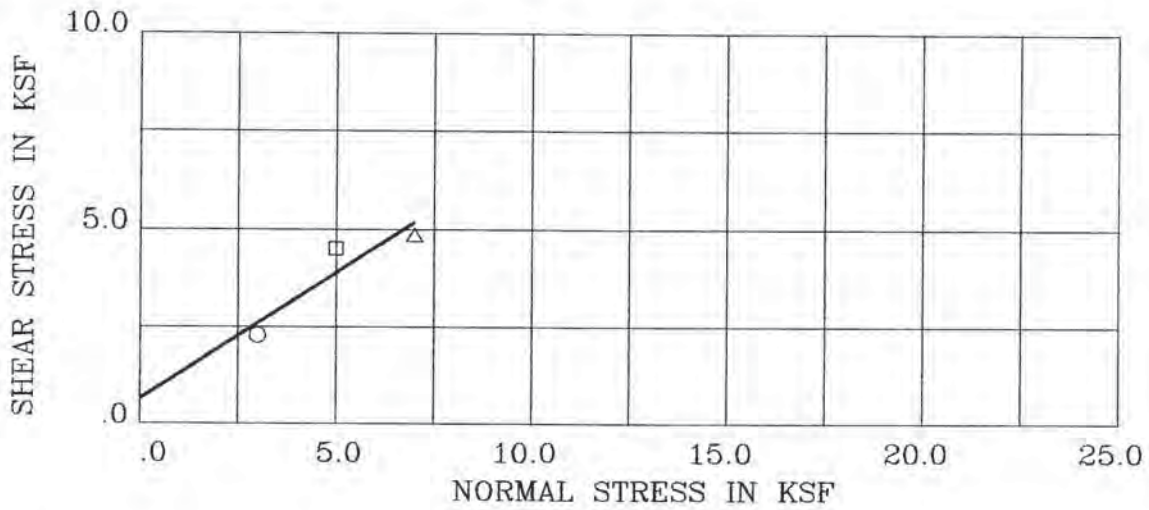
BORING/SAMPLE : H-4 #2                      DEPTH (ft) : 5-6  
 DESCRIPTION : Silty sand (SM) w/ gravel  
 STRENGTH INTERCEPT (C) : 1.468      KSF  
 FRICTION ANGLE (PHI) : 35.2      DEG                      (PEAK STRENGTH)

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.	<b>DIRECT SHEAR TEST</b> Figure B-26



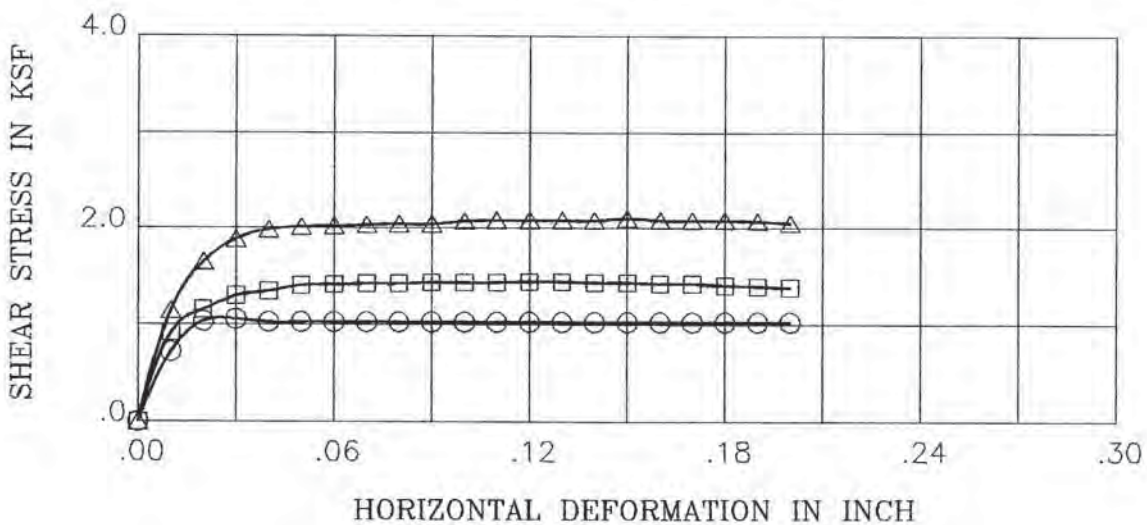
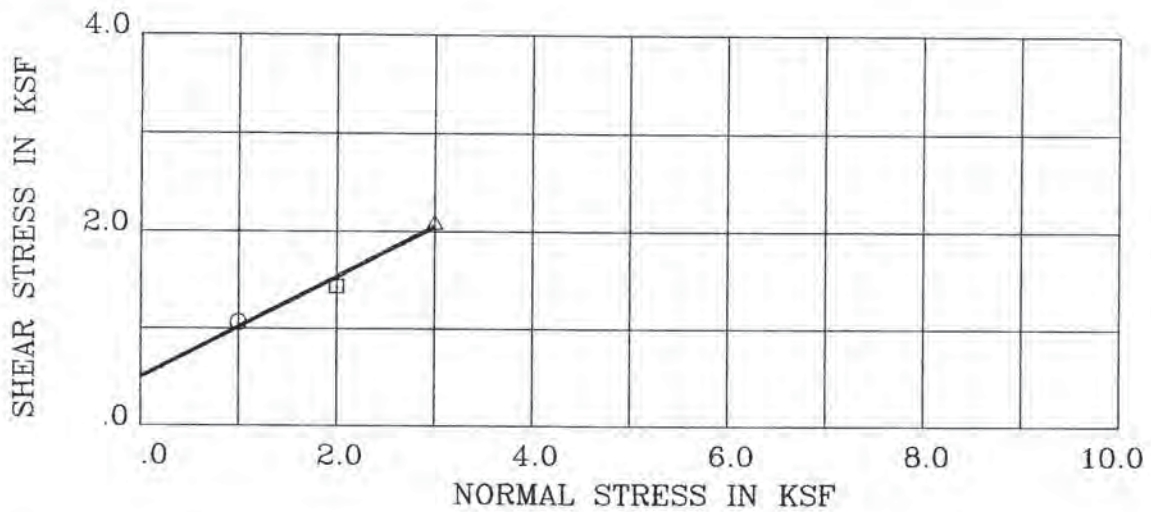


BORING/SAMPLE : H-5 #1                      DEPTH (ft) : 6-6.5  
 DESCRIPTION : Sandy clay (CL)  
 STRENGTH INTERCEPT (C) : .657      KSF                      (PEAK STRENGTH)  
 FRICTION ANGLE (PHI) : 32.9      DEG

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.	<b>DIRECT SHEAR TEST</b> Figure B-27



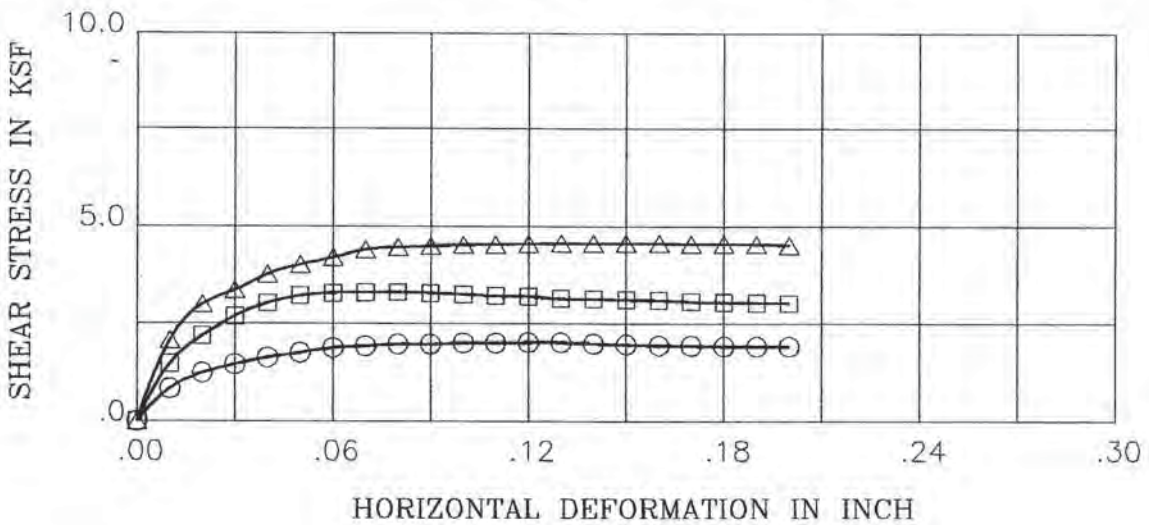
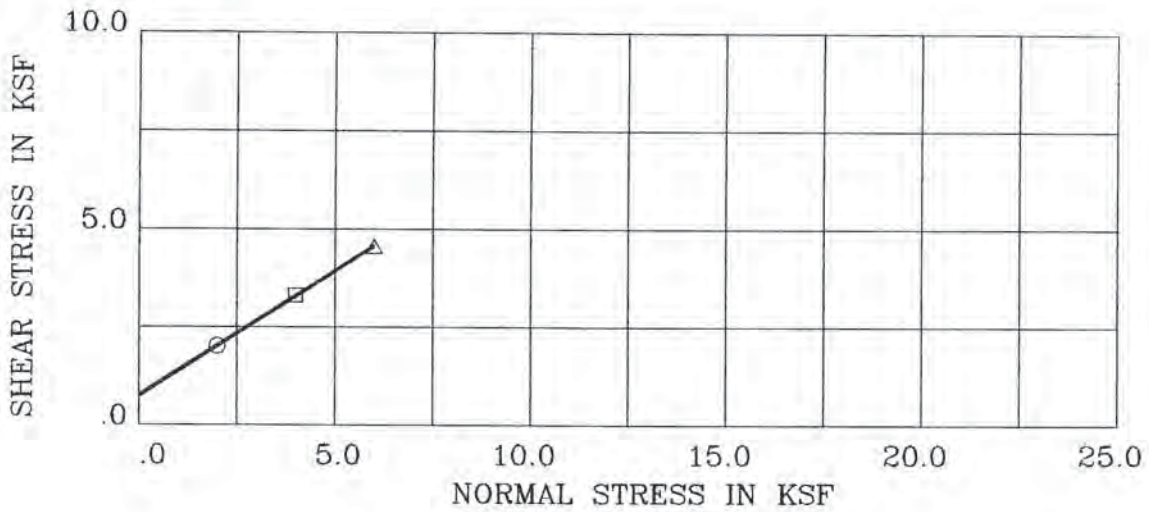
BORING/SAMPLE : H-6 #1                      DEPTH (ft) : 4-7  
 DESCRIPTION : Clayey sand (SC)  
 STRENGTH INTERCEPT (C) : .502 KSF  
 FRICTION ANGLE (PHI) : 27.3 DEG                      (PEAK STRENGTH)

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





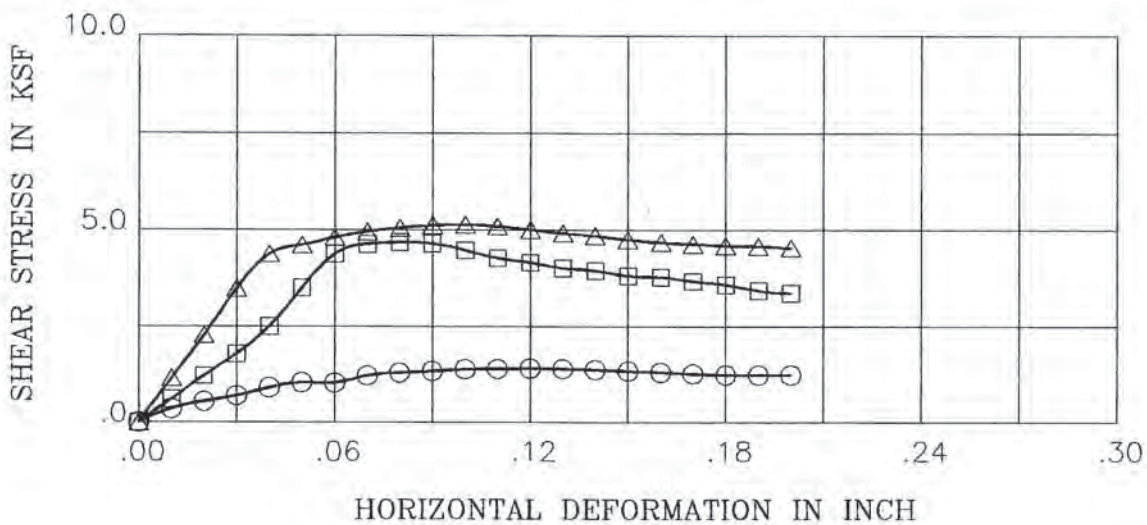
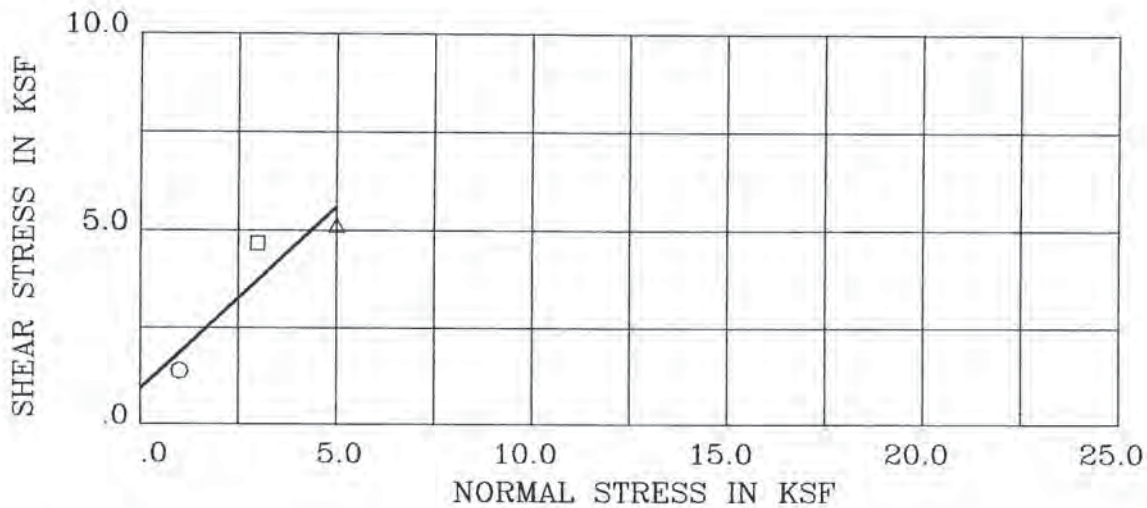
BORING/SAMPLE : H-8 #4                      DEPTH (ft) : 11-11.5  
 DESCRIPTION : Silty sand (SM)  
 STRENGTH INTERCEPT (C) : .747      KSF  
 FRICTION ANGLE (PHI) : 32.5      DEG                      (PEAK STRENGTH)

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.	<b>DIRECT SHEAR TEST</b> Figure B-29



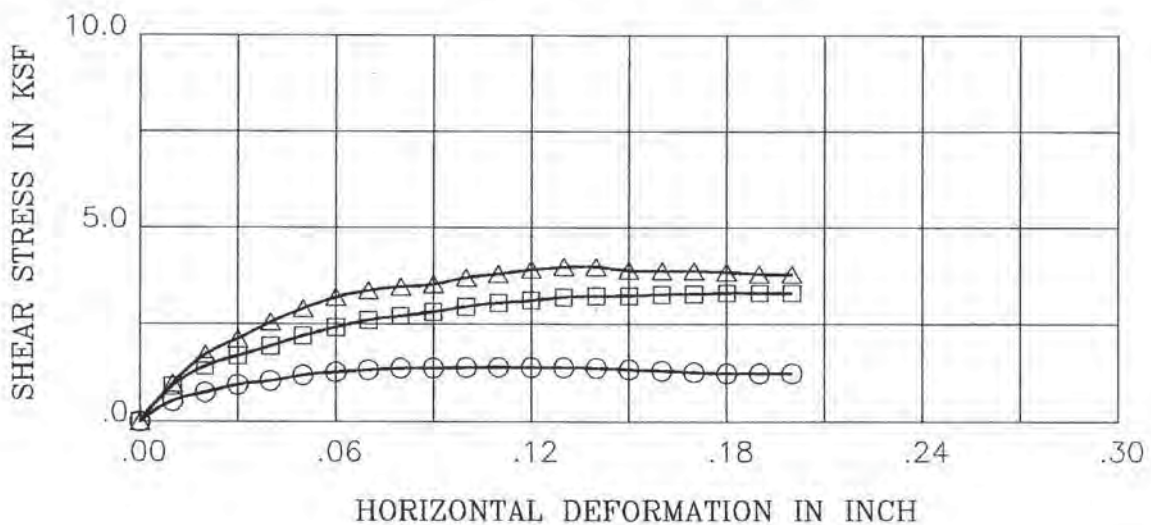
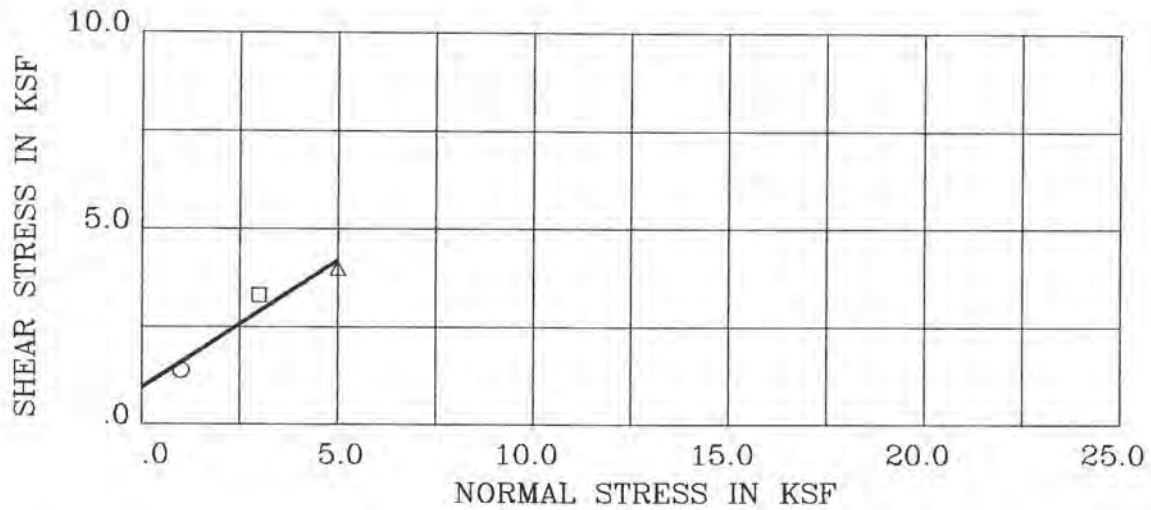


BORING/SAMPLE : H-9 #1                      DEPTH (ft) : 6-6.5  
 DESCRIPTION : Silty sand (SM)  
 STRENGTH INTERCEPT (C) : .938      KSF  
 FRICTION ANGLE (PHI) : 43.0      DEG                      (PEAK STRENGTH)

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



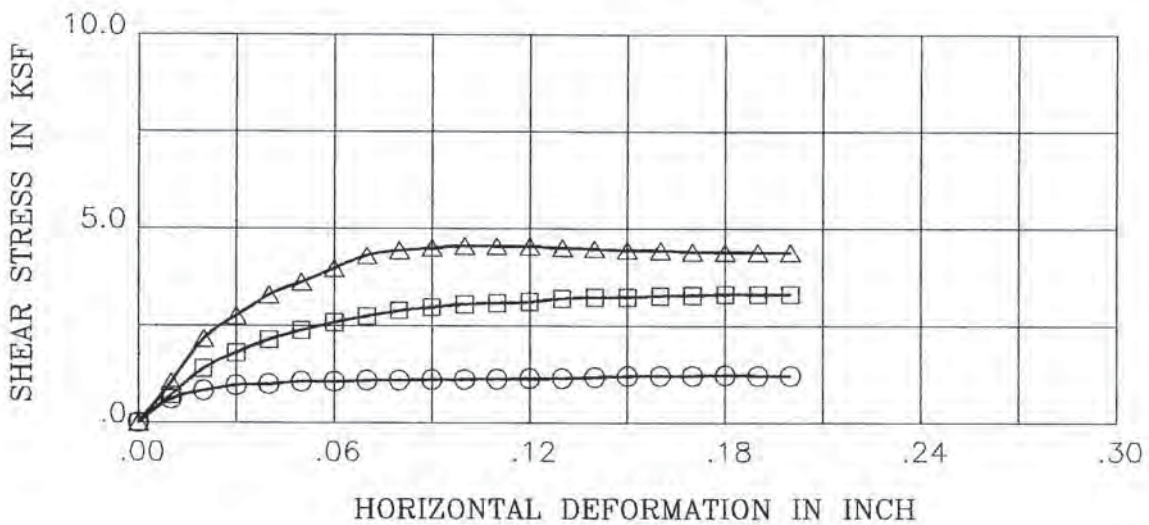
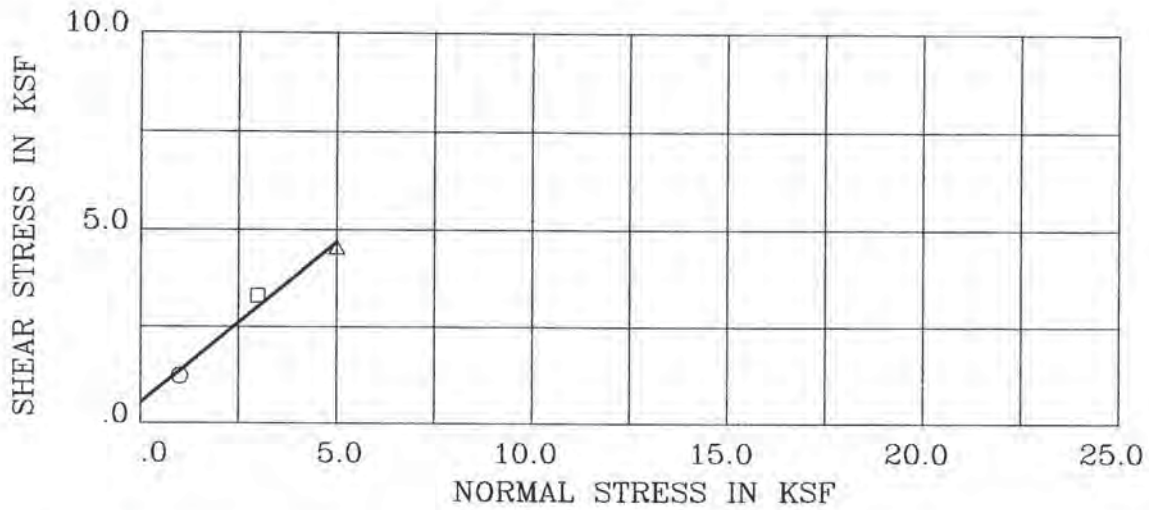
BORING/SAMPLE : H-9 #5                      DEPTH (ft) : 16-16.5  
 DESCRIPTION : Silty sand (SM)  
 STRENGTH INTERCEPT (C) : .943      KSF  
 FRICTION ANGLE (PHI) : 33.1      DEG                      (PEAK STRENGTH)

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



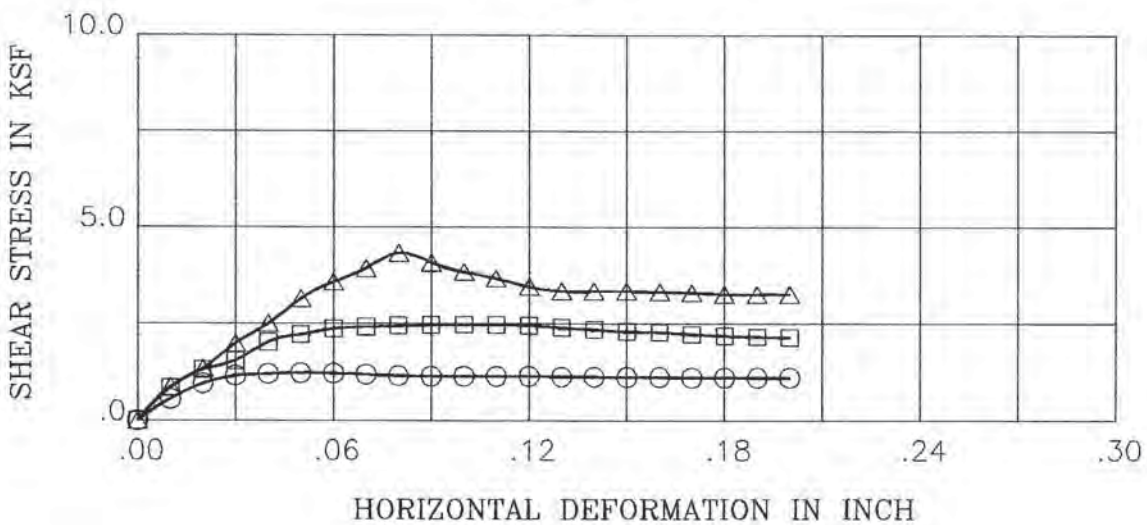
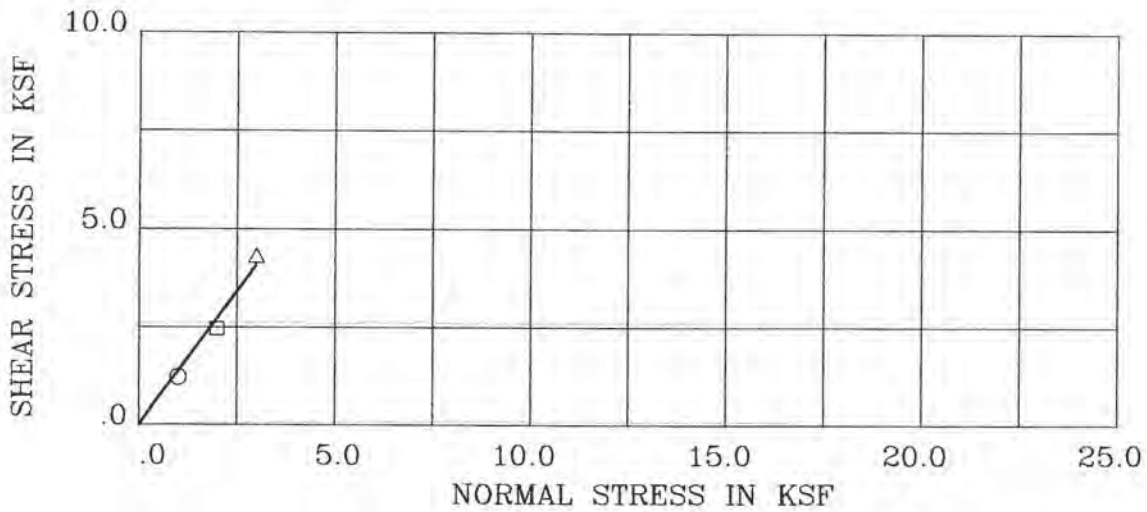


BORING/SAMPLE : H-10 #6                      DEPTH (ft) : 21-21.5  
 DESCRIPTION : Claystone (CL)  
 STRENGTH INTERCEPT (C) : .541      KSF  
 FRICTION ANGLE (PHI) : 39.7      DEG                      (PEAK STRENGTH)

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

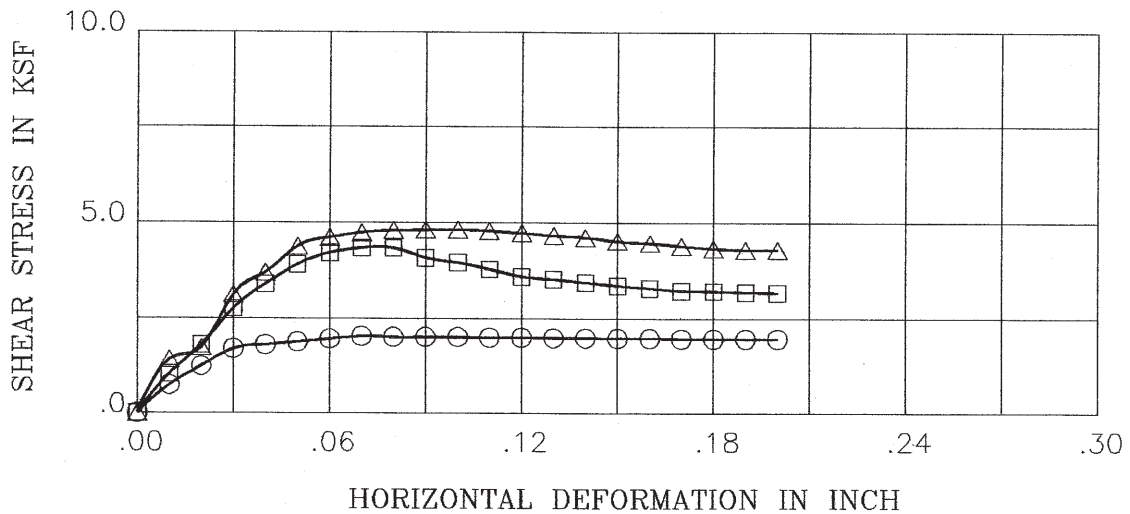
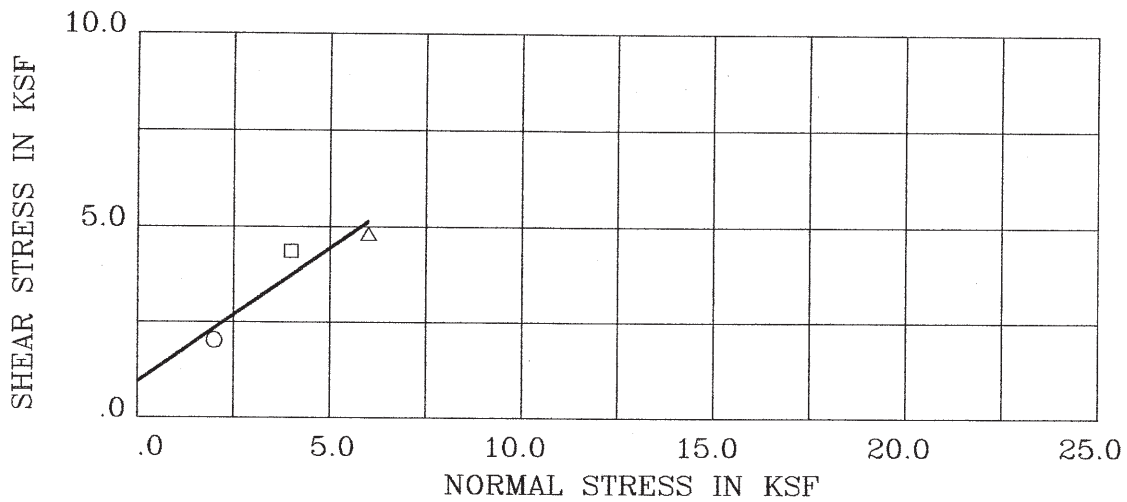


BORING/SAMPLE : H-11 #1                      DEPTH (ft) : 6-6.5  
 DESCRIPTION : Silty sand (SM)  
 STRENGTH INTERCEPT (C) : .000      KSF  
 FRICTION ANGLE (PHI) : 53.9      DEG                      (PEAK STRENGTH)

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.	<b>DIRECT SHEAR TEST</b> Figure B-33



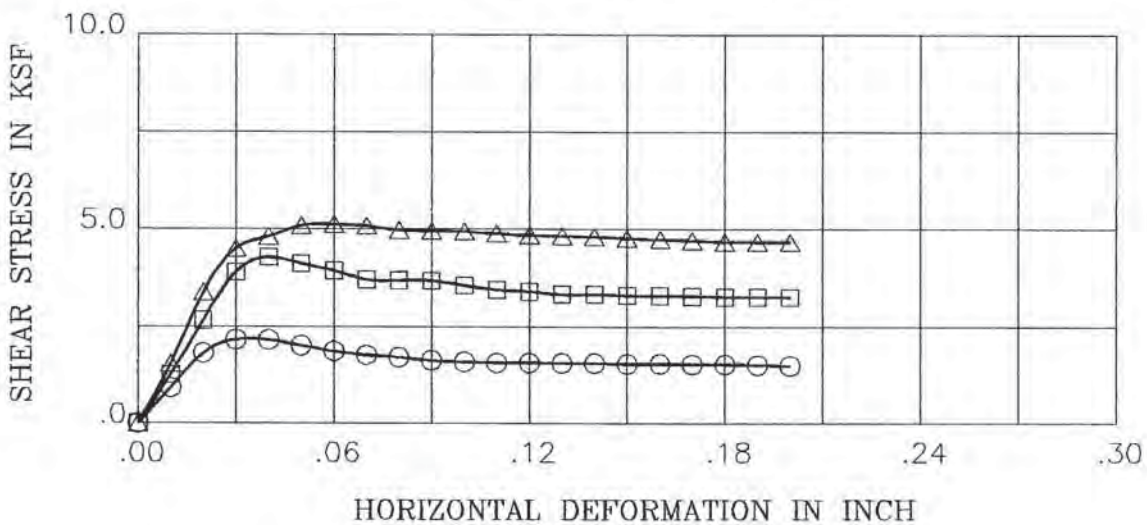
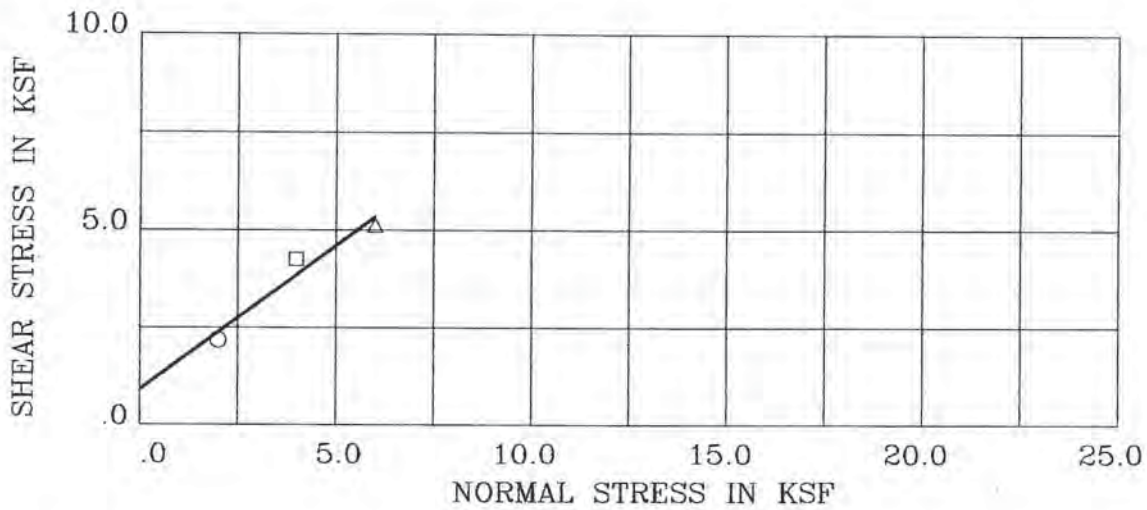
BORING/SAMPLE : H-11 #4                      DEPTH (ft) : 16-16.5  
 DESCRIPTION : Sandy Lean Clay (CL)  
 STRENGTH INTERCEPT (C) : .954 KSF  
 FRICTION ANGLE (PHI) : 34.9 DEG                      (PEAK STRENGTH)

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.	<b>DIRECT SHEAR TEST</b> Figure B-34



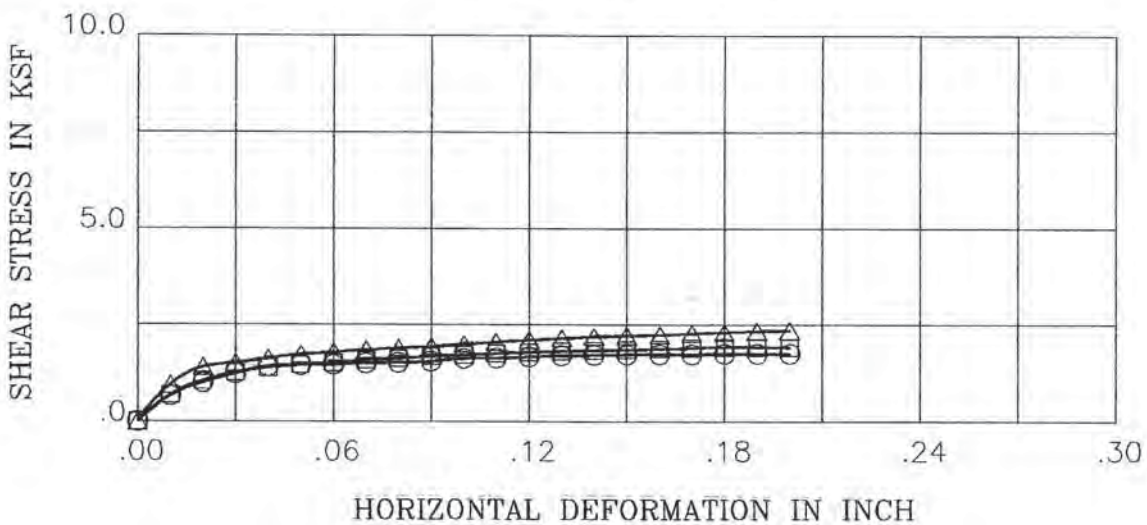
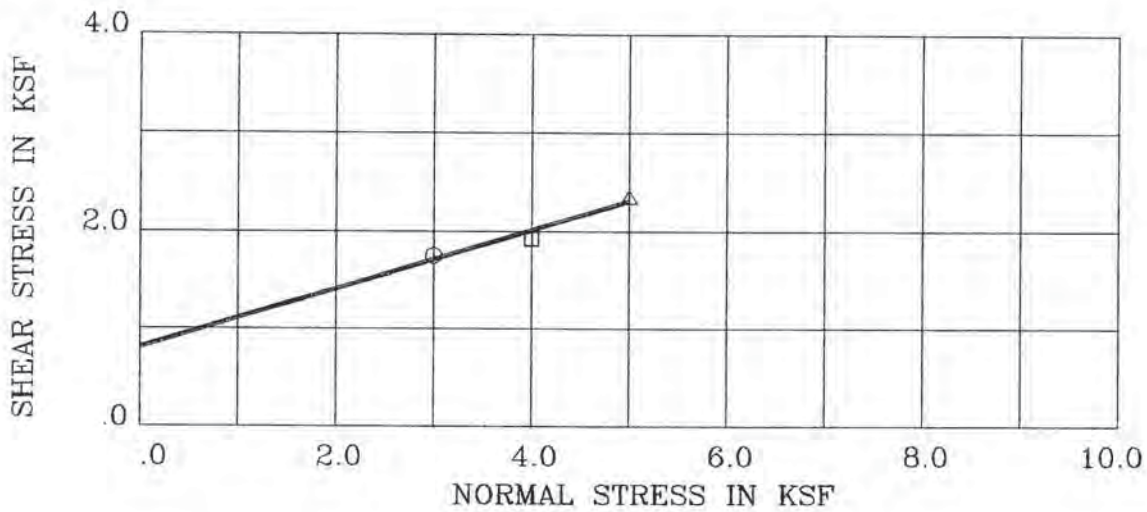


BORING/SAMPLE : H-11 #9                      DEPTH (ft) : 35.5-36  
 DESCRIPTION : Silty sandstone (SM)  
 STRENGTH INTERCEPT (C) : .927      KSF  
 FRICTION ANGLE (PHI) : 36.3      DEG                      (PEAK STRENGTH)

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.	<b>DIRECT SHEAR TEST</b> Figure B-35



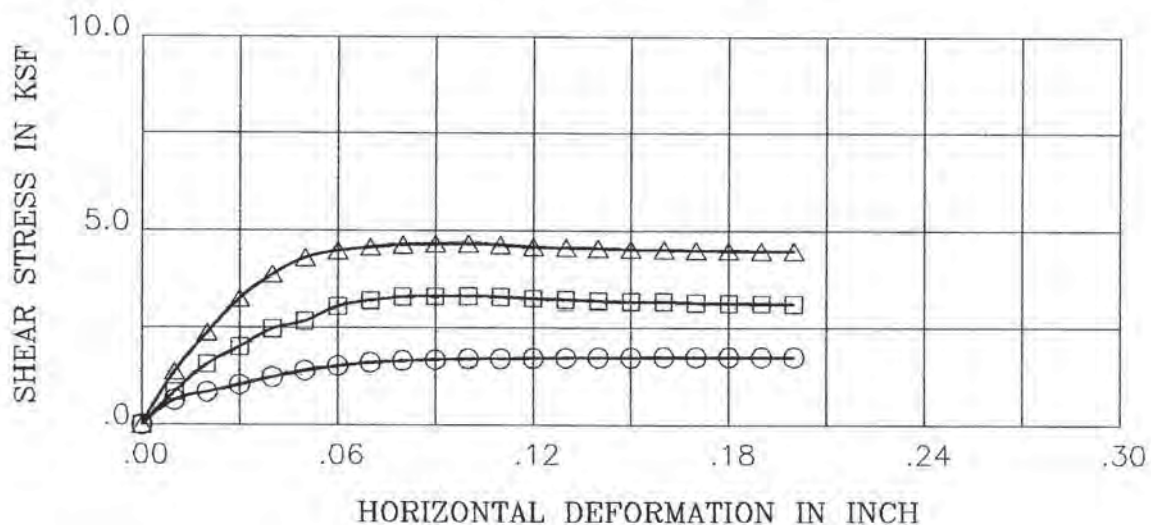
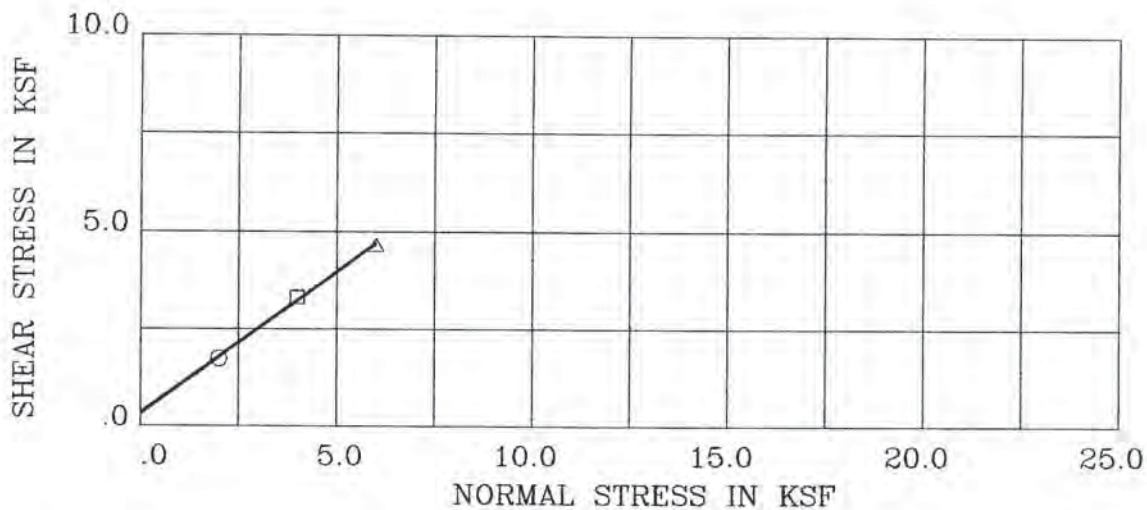
BORING/SAMPLE : H-12 #7                      DEPTH (ft) : 21-24  
 DESCRIPTION : Silty sandstone (SM)  
 STRENGTH INTERCEPT (C) : .812      KSF  
 FRICTION ANGLE (PHI) : 16.7      DEG                      (PEAK STRENGTH)

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.	<b>DIRECT SHEAR TEST</b> Figure B-36



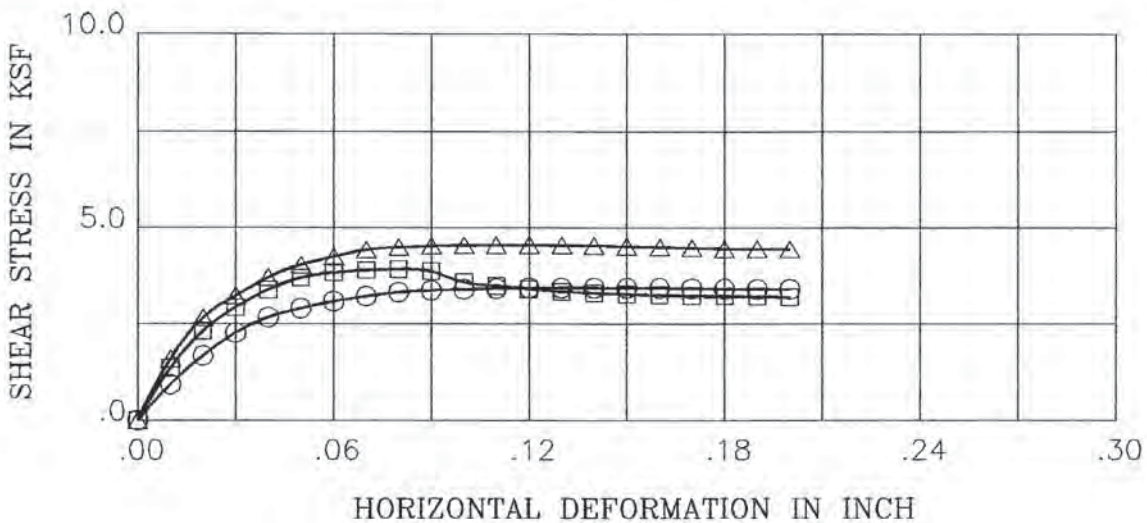
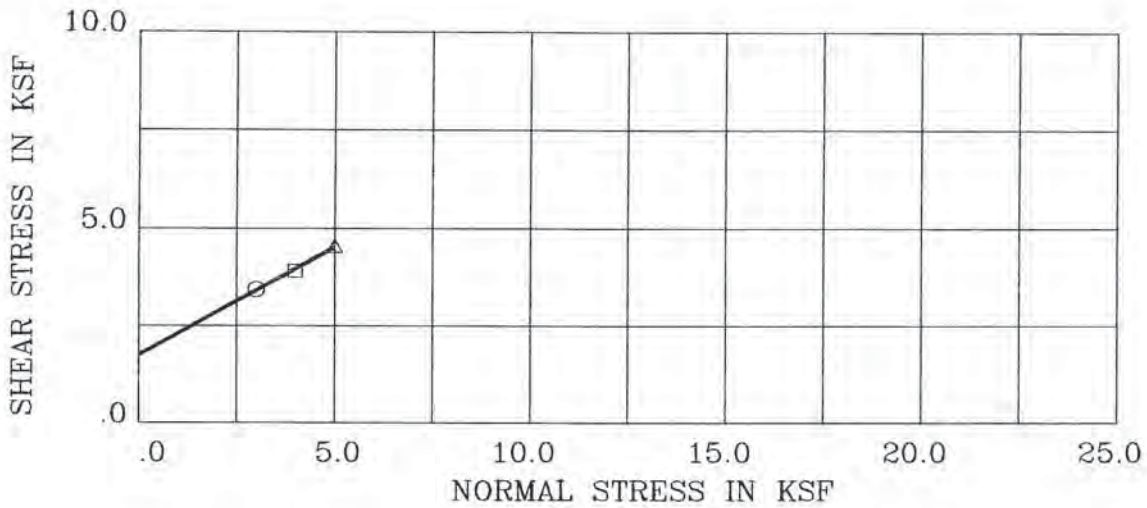


BORING/SAMPLE : H-12 #10      DEPTH (ft) : 35-35.5  
 DESCRIPTION : Poorly graded sand (SP)  
 STRENGTH INTERCEPT (C) : .320 KSF  
 FRICTION ANGLE (PHI) : 36.2 DEG      (PEAK STRENGTH)

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.	<b>DIRECT SHEAR TEST</b> Figure B-37



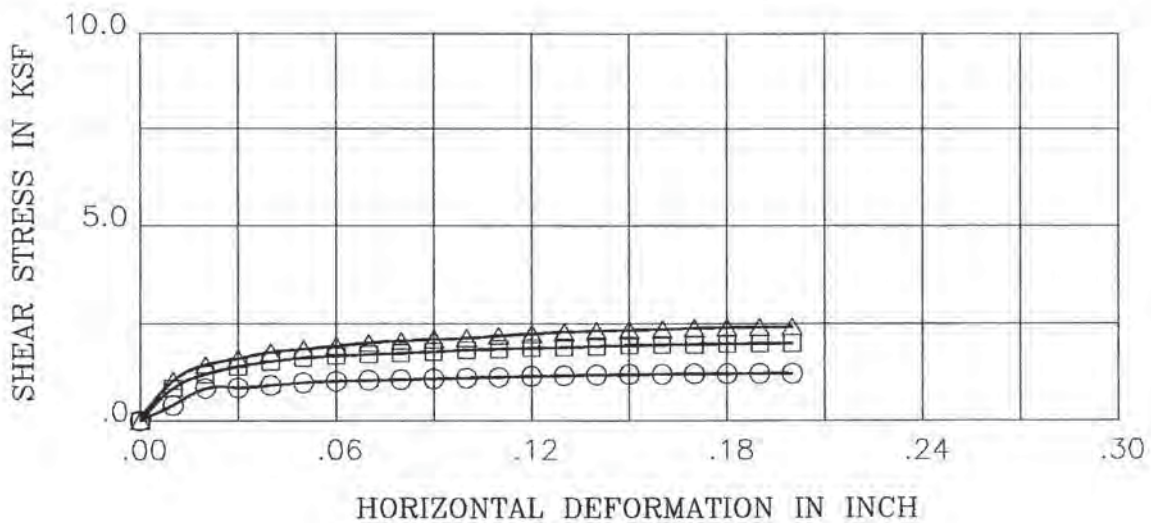
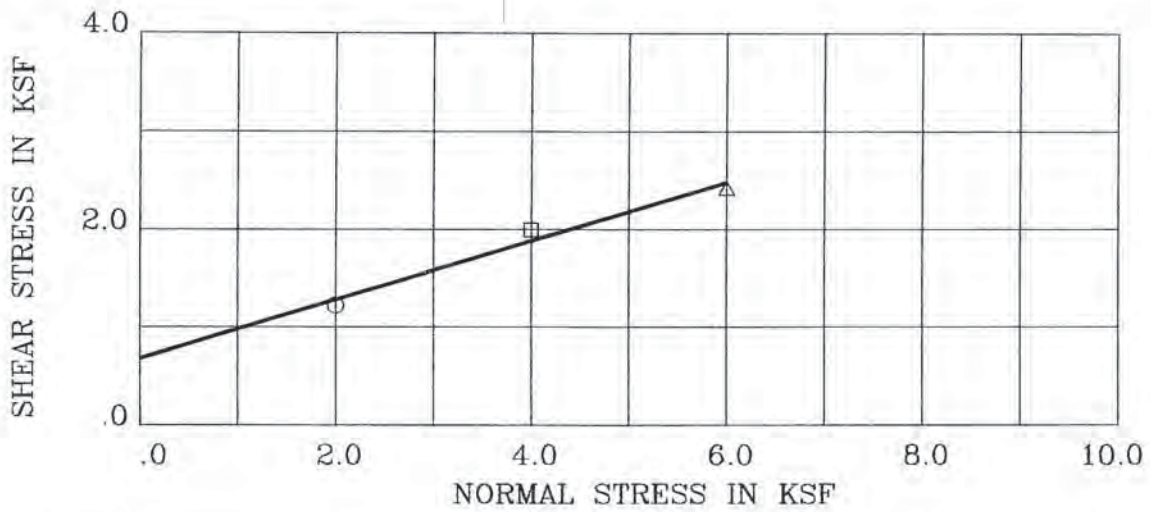
BORING/SAMPLE : H-13 #5                      DEPTH (ft) : 16-16.5  
 DESCRIPTION : Lean clay (CL)  
 STRENGTH INTERCEPT (C) : 1.748      KSF  
 FRICTION ANGLE (PHI) : 29.1      DEG                      (PEAK STRENGTH)

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.	<b>DIRECT SHEAR TEST</b> Figure B-38





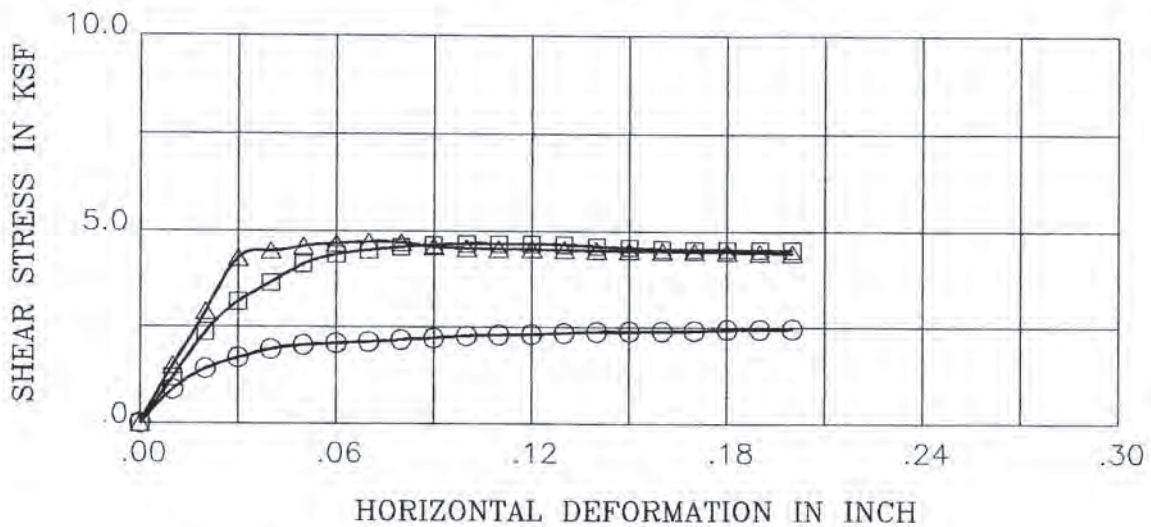
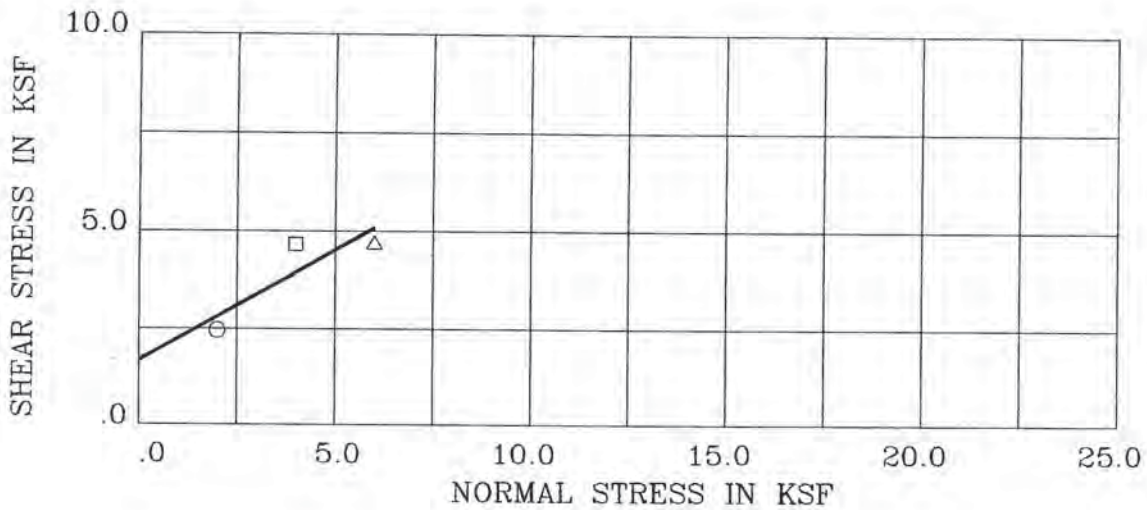
BORING/SAMPLE : H-14 #2                      DEPTH (ft) : 4-7  
 DESCRIPTION : Sandy clay (CL)  
 STRENGTH INTERCEPT (C) : .682      KSF  
 FRICTION ANGLE (PHI) : 16.7      DEG                      (PEAK STRENGTH)

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.	<b>DIRECT SHEAR TEST</b> Figure B-39



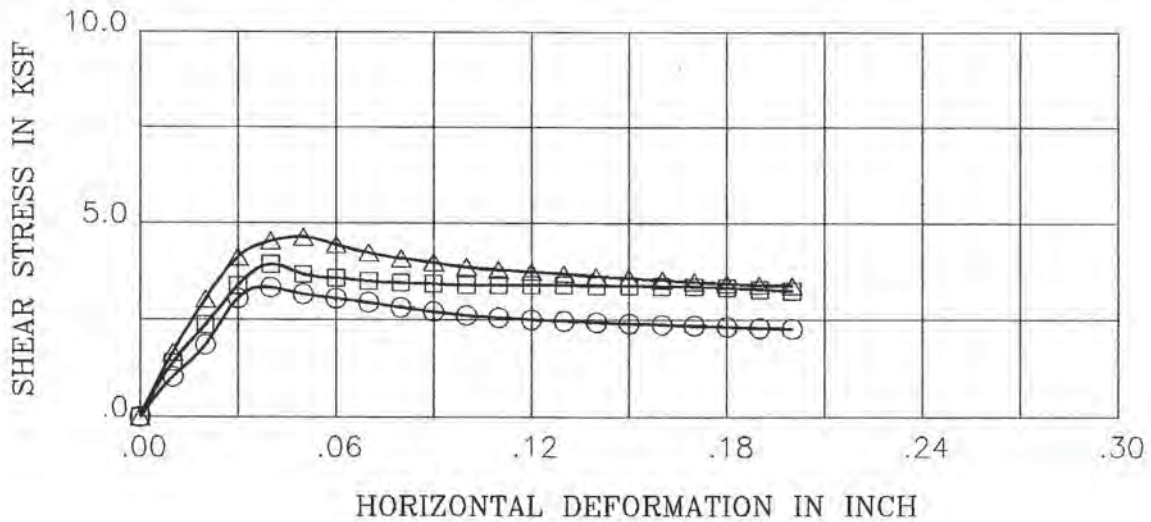
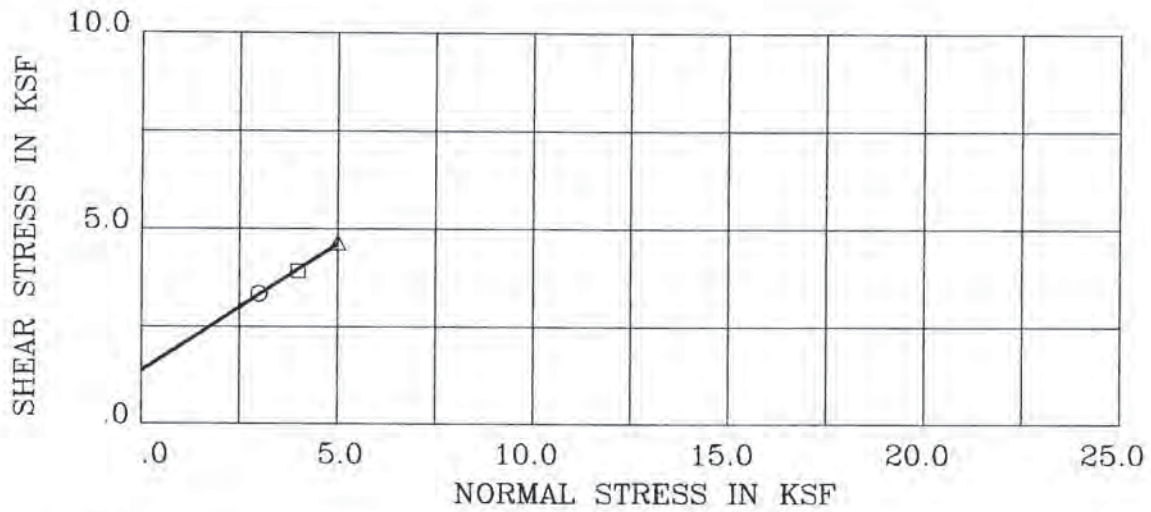


BORING/SAMPLE : H-14 #15      DEPTH (ft) : 50-50.5  
 DESCRIPTION : Lean clay (CL)  
 STRENGTH INTERCEPT (C) : 1.692 KSF  
 FRICTION ANGLE (PHI) : 29.5 DEG (PEAK STRENGTH)

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.	<b>DIRECT SHEAR TEST</b> Figure B-40



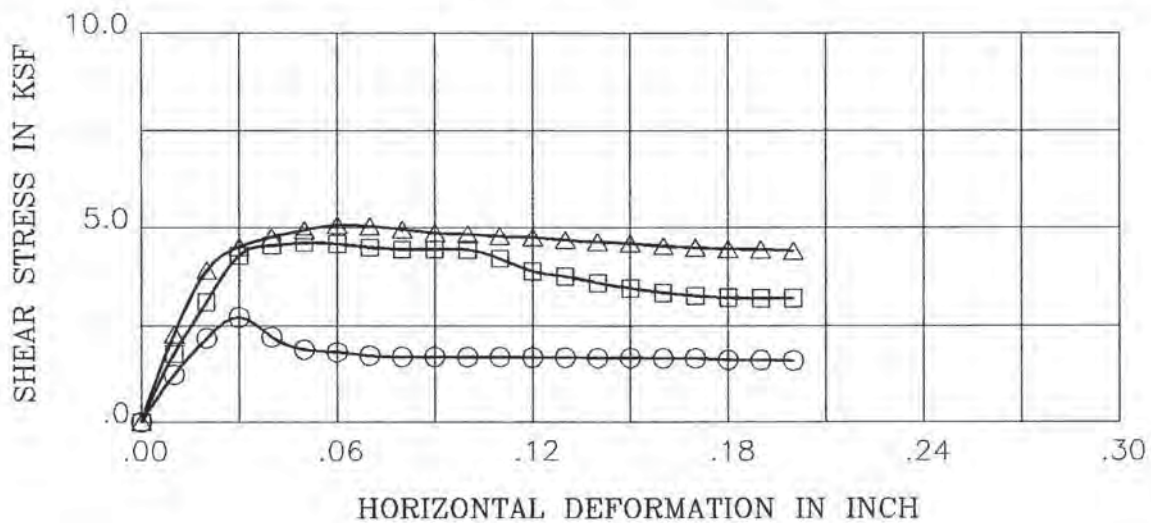
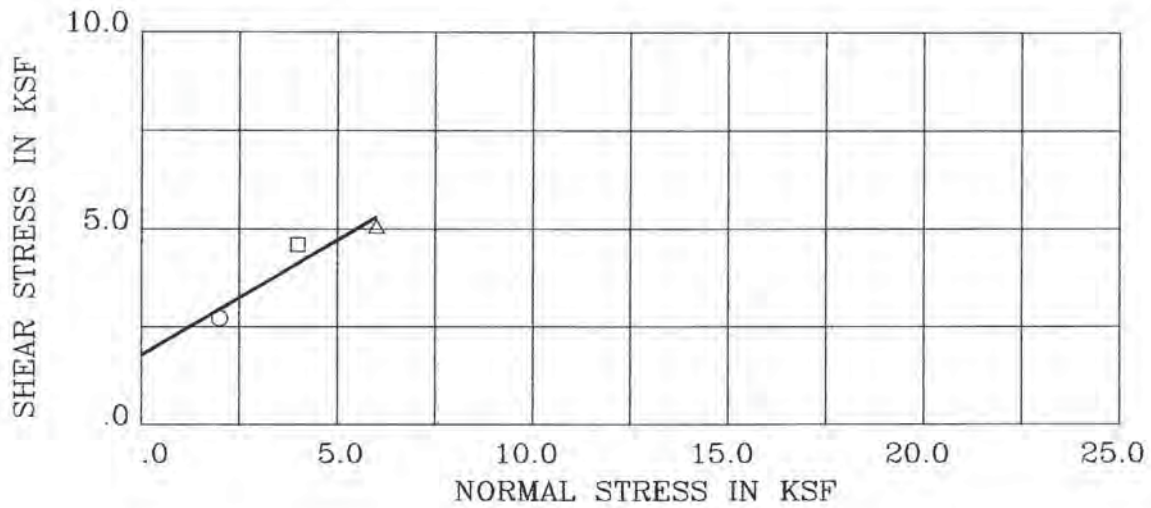
BORING/SAMPLE : H-15 #1                      DEPTH (ft) : 6-6.5  
 DESCRIPTION : Plastic clay (CH)  
 STRENGTH INTERCEPT (C) : 1.369      KSF  
 FRICTION ANGLE (PHI) : 33.1      DEG                      (PEAK STRENGTH)

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



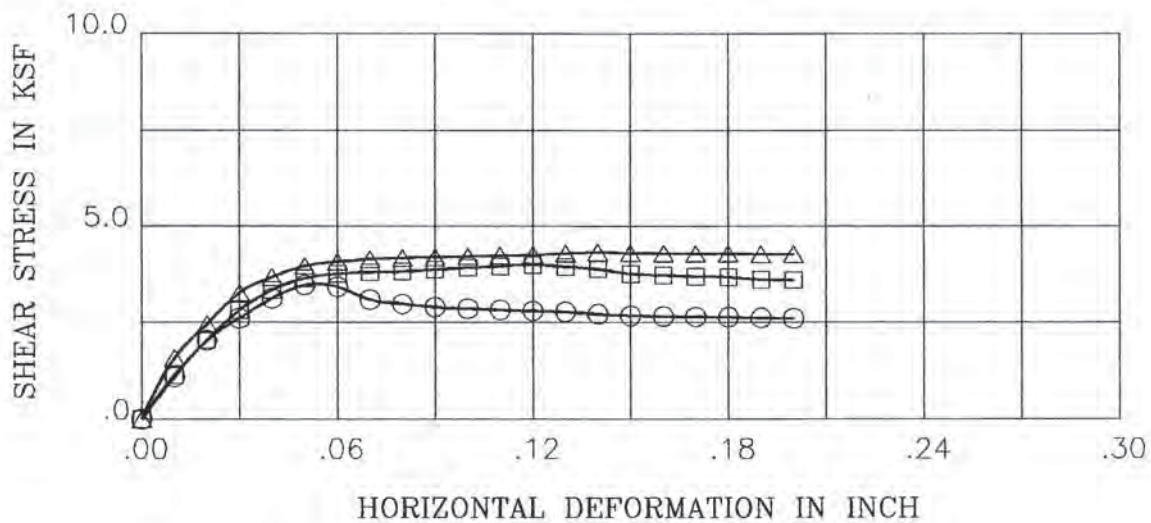
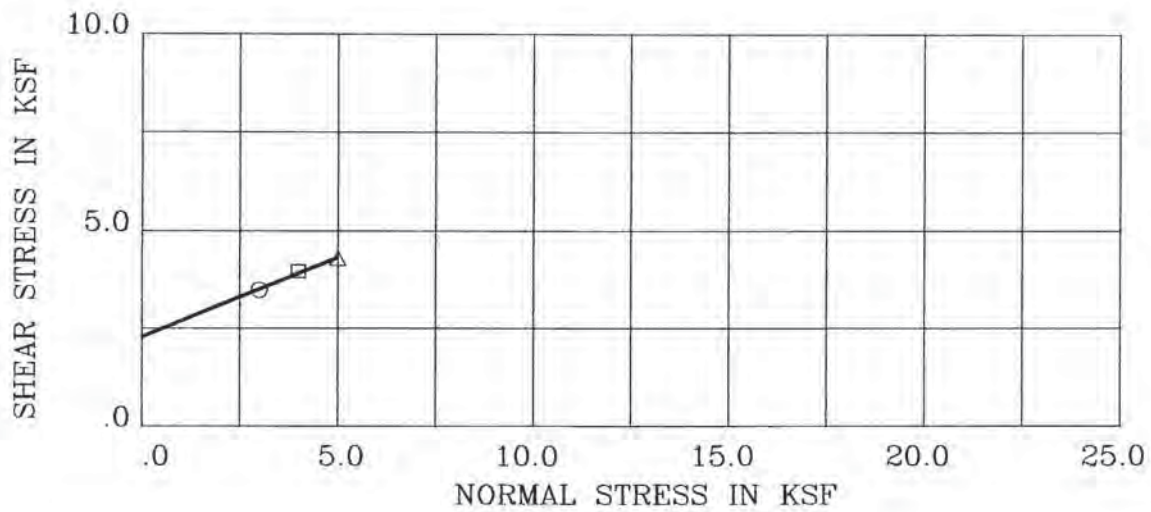


BORING/SAMPLE : H-16 #1                      DEPTH (ft) : 6-6.5  
 DESCRIPTION : Siltstone (ML)  
 STRENGTH INTERCEPT (C) : 1.785      KSF                      (PEAK STRENGTH)  
 FRICTION ANGLE (PHI) : 30.4      DEG

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



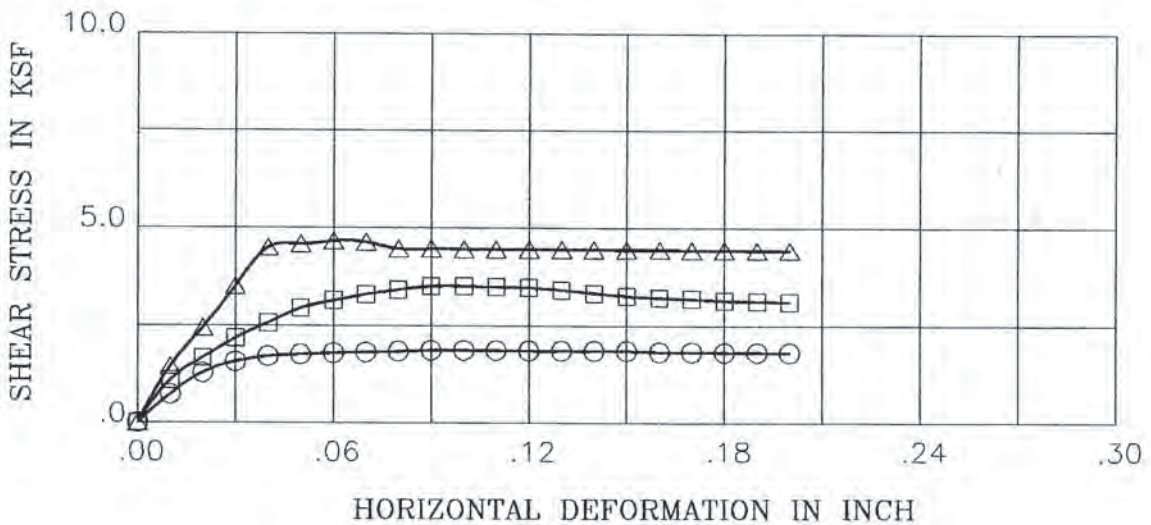
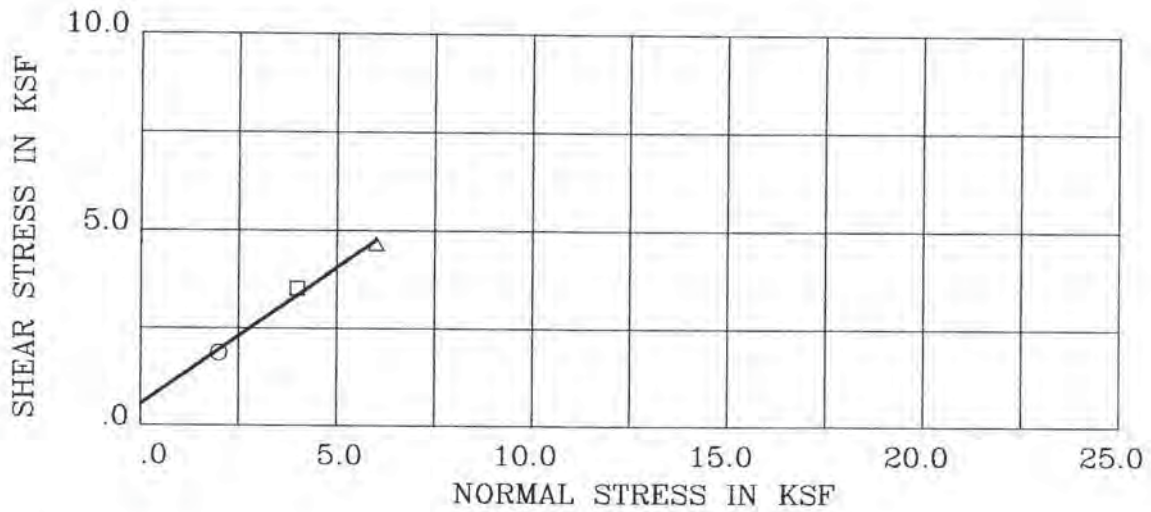
BORING/SAMPLE : H-17 #2                      DEPTH (ft) : 6-6.5  
 DESCRIPTION : Lean clay (CL)  
 STRENGTH INTERCEPT (C) : 2.290 KSF                      (PEAK STRENGTH)  
 FRICTION ANGLE (PHI) : 22.3 DEG

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



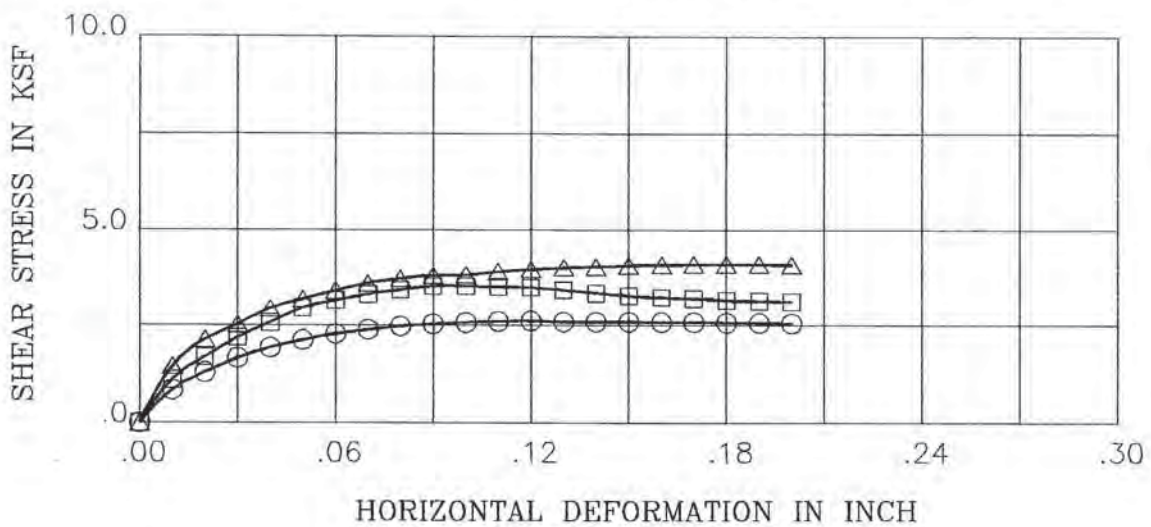
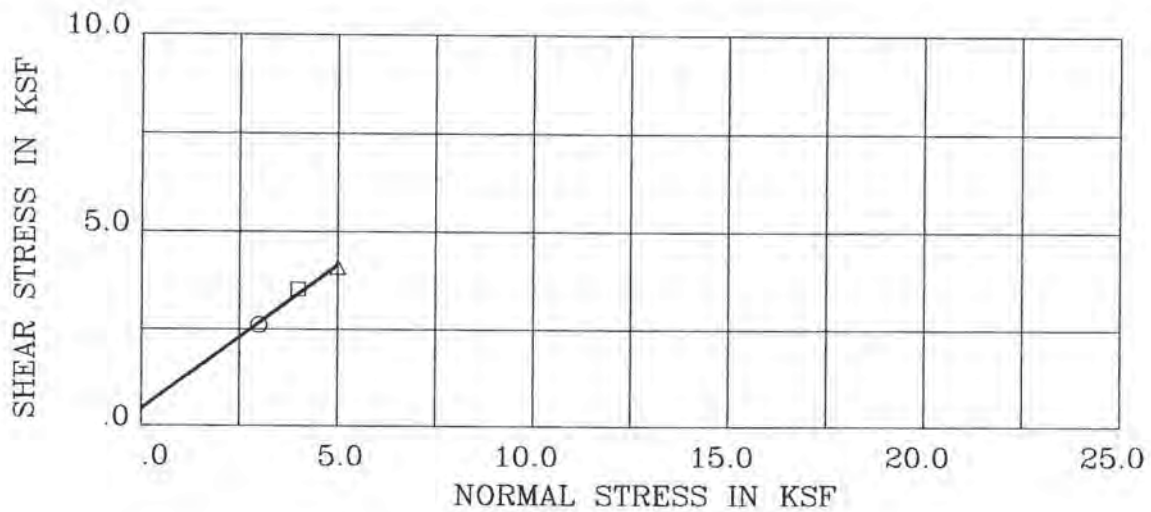


BORING/SAMPLE : H-20 #4                      DEPTH (ft) : 10.5-11  
 DESCRIPTION : Lean clay (CL)  
 STRENGTH INTERCEPT (C) : .559      KSF                      (PEAK STRENGTH)  
 FRICTION ANGLE (PHI) : 35.0      DEG

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



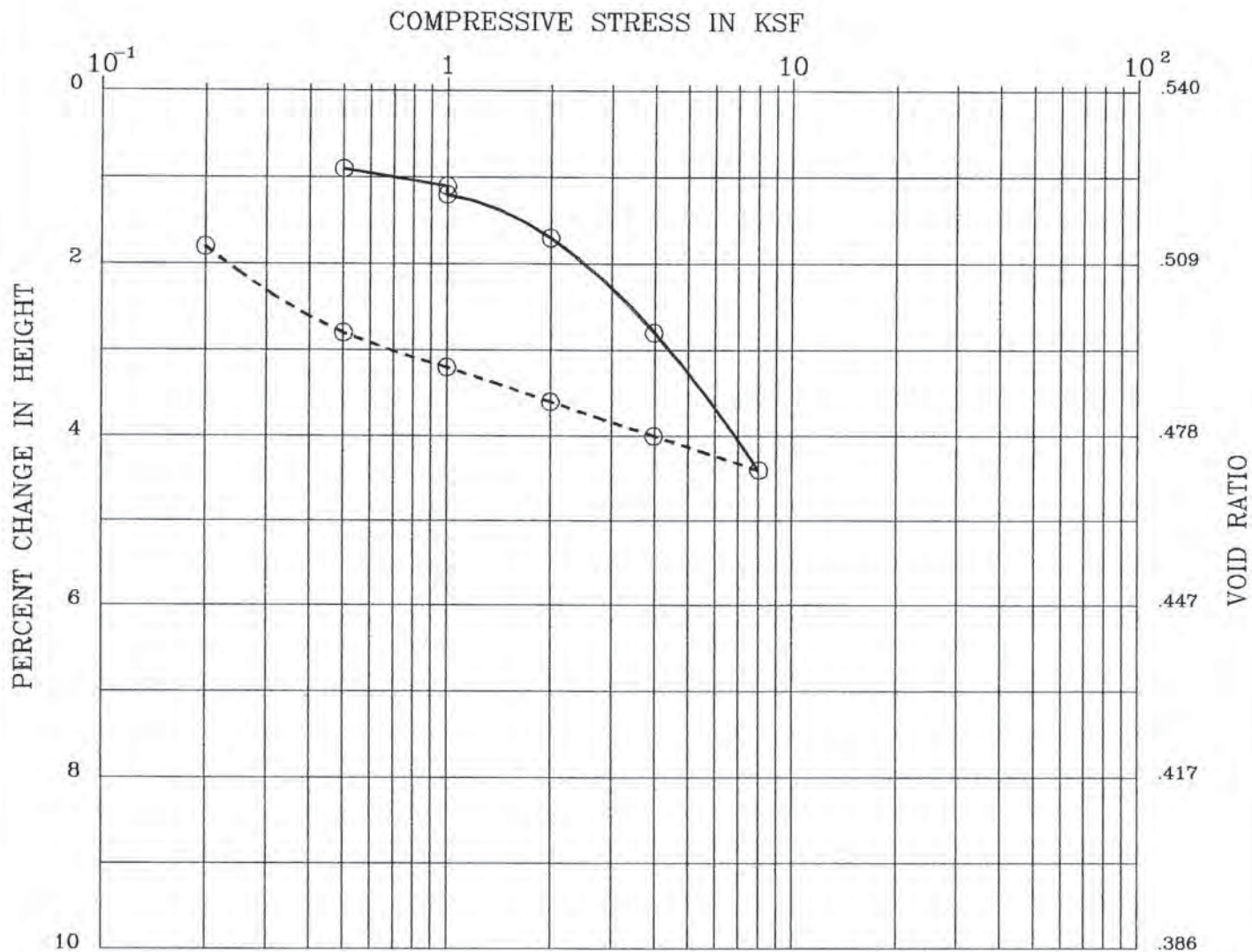
BORING/SAMPLE : H-22 #1                      DEPTH (ft) : 6-6.5  
 DESCRIPTION : Silty/clayey sand (SM/SC)  
 STRENGTH INTERCEPT (C) : .438 KSF  
 FRICTION ANGLE (PHI) : 36.6 DEG                      (PEAK STRENGTH)

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





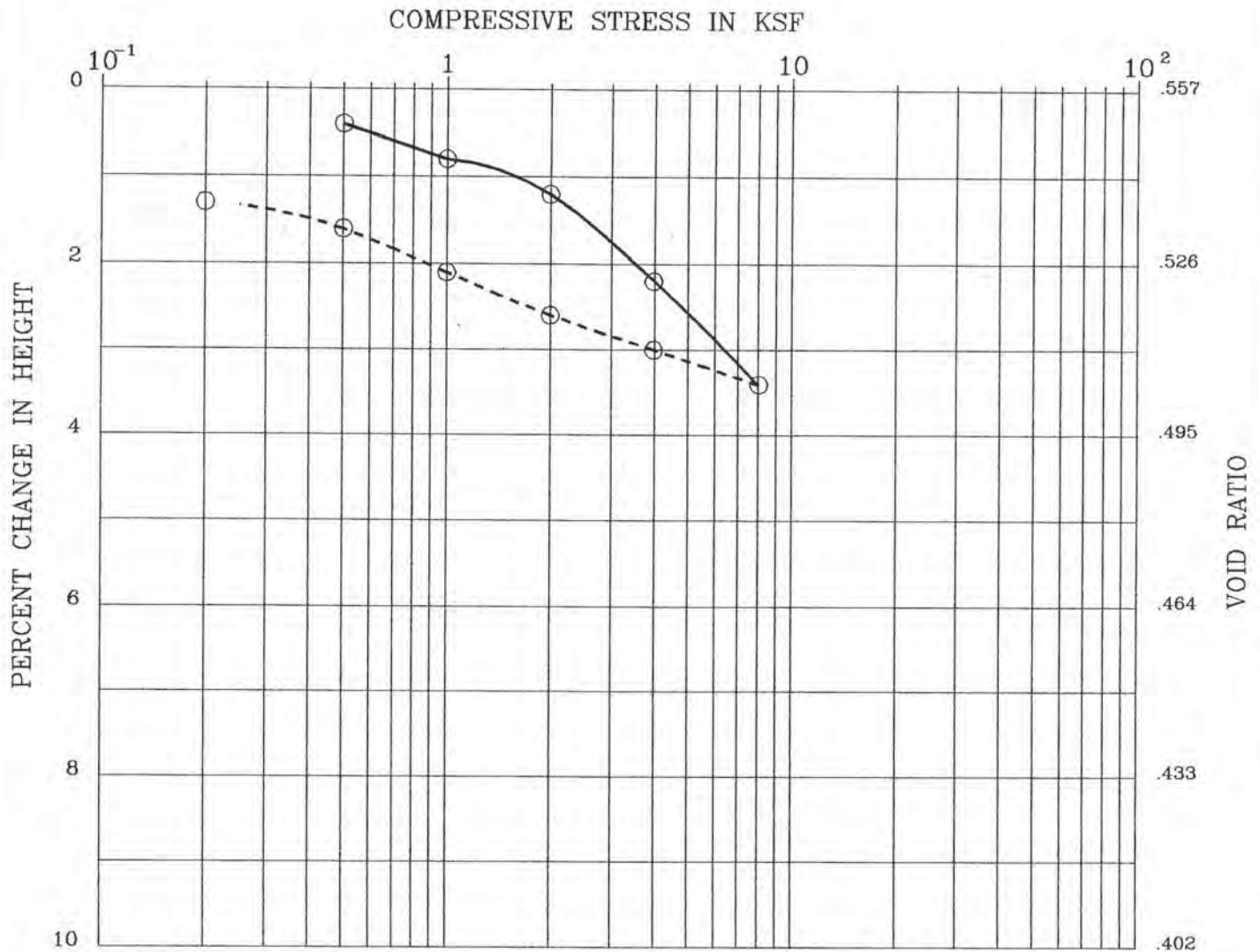
BORING : H-6 #3  
 DEPTH (ft) : 11-11.5  
 SPEC. GRAVITY : 2.71

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

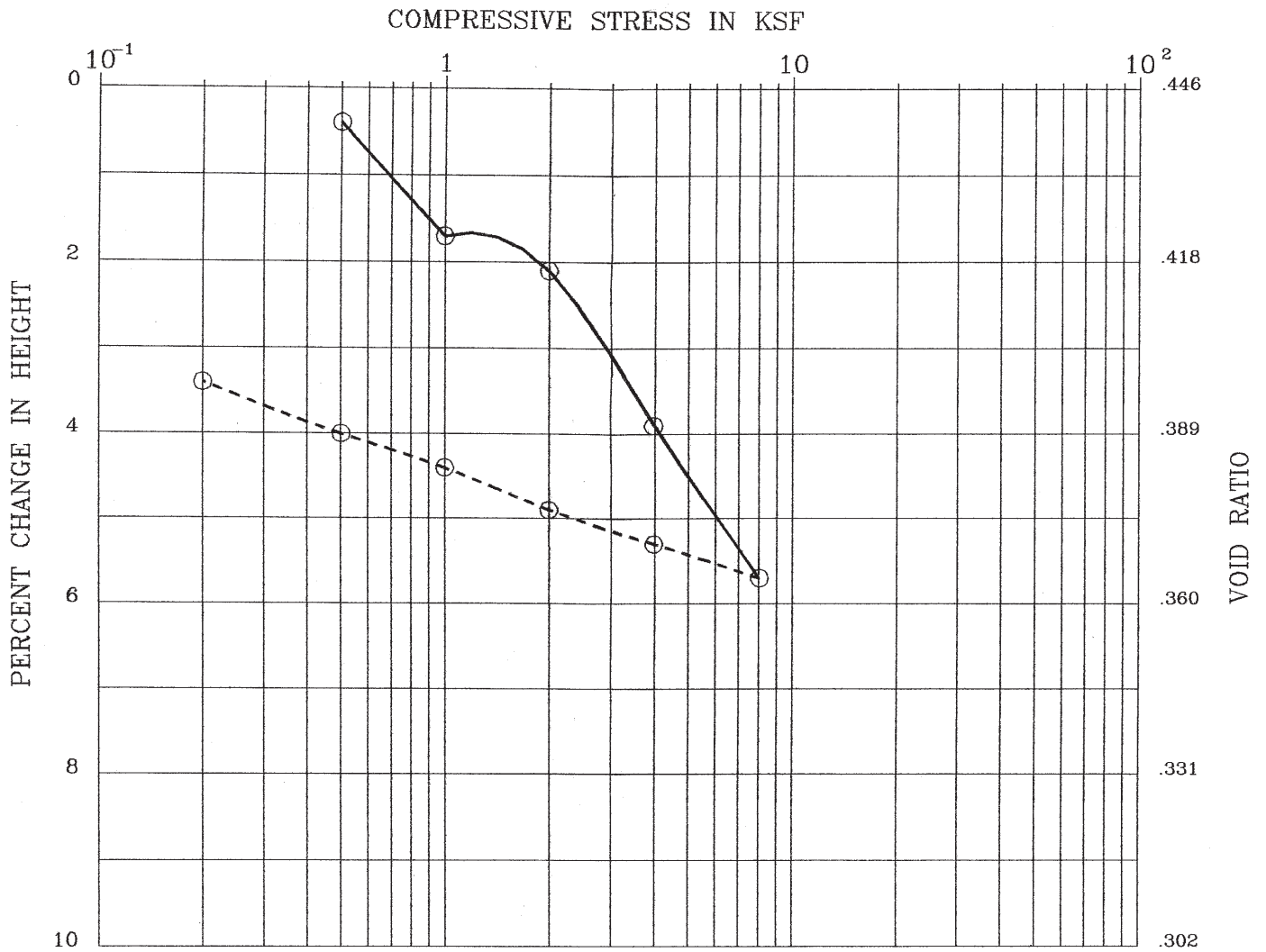
DESCRIPTION : Silty sand (SM)  
 LIQUID LIMIT :  
 PLASTIC LIMIT :

	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.	<p style="text-align: center;">CONSOLIDATION TEST</p> <p style="text-align: right;">Figure B-47</p>



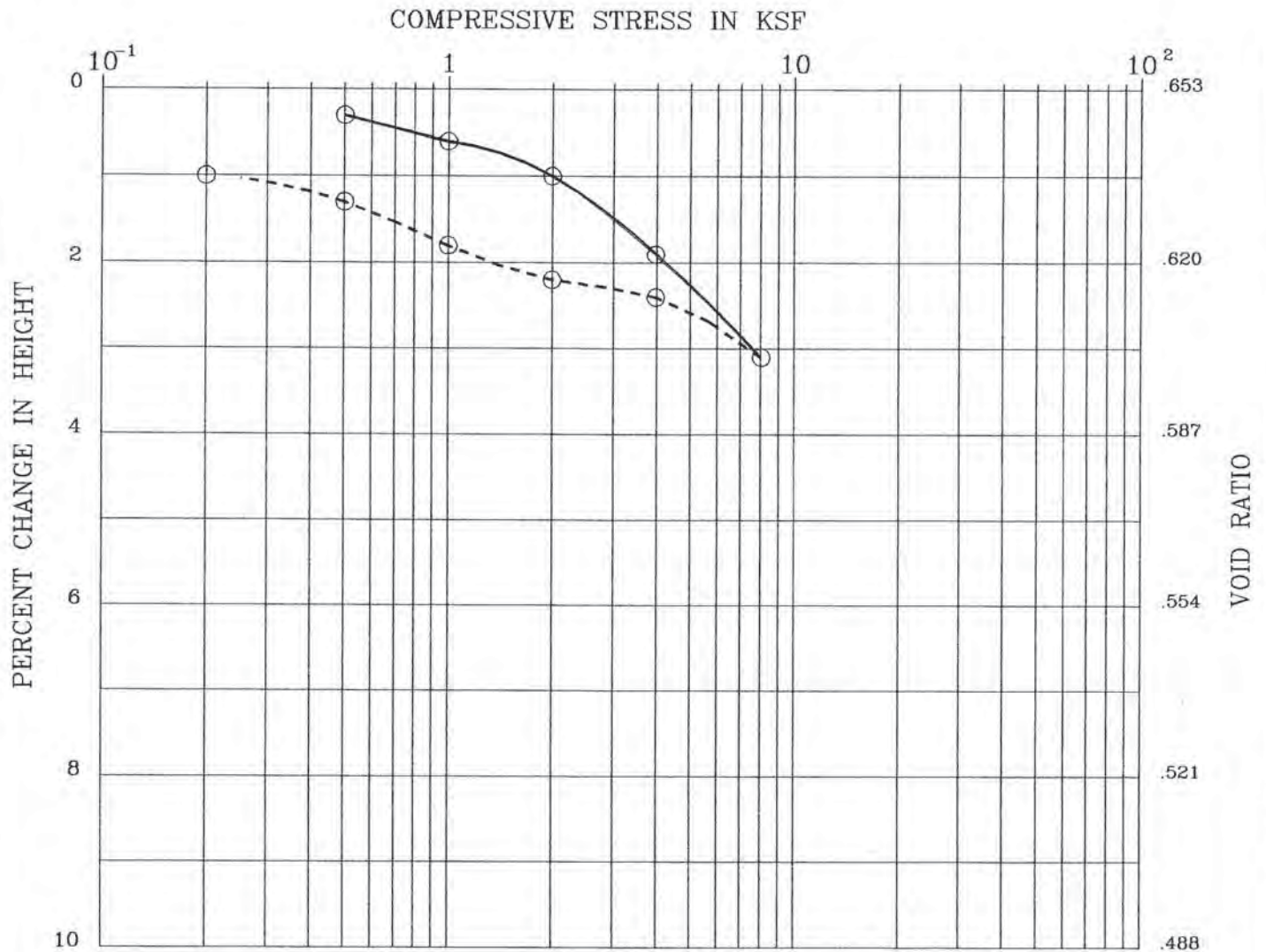


BORING : H-10 #4                      DESCRIPTION : Silty sand/lean clay (SM/CL)  
 DEPTH (ft) : 11-11.5                      LIQUID LIMIT :  
 SPEC. GRAVITY : 2.41                      PLASTIC LIMIT :

	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                      DESCRIPTION : Silty sand (SM)  
 DEPTH (ft) : 6-6.5                      LIQUID LIMIT :  
 SPEC. GRAVITY : 2.59                      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 :

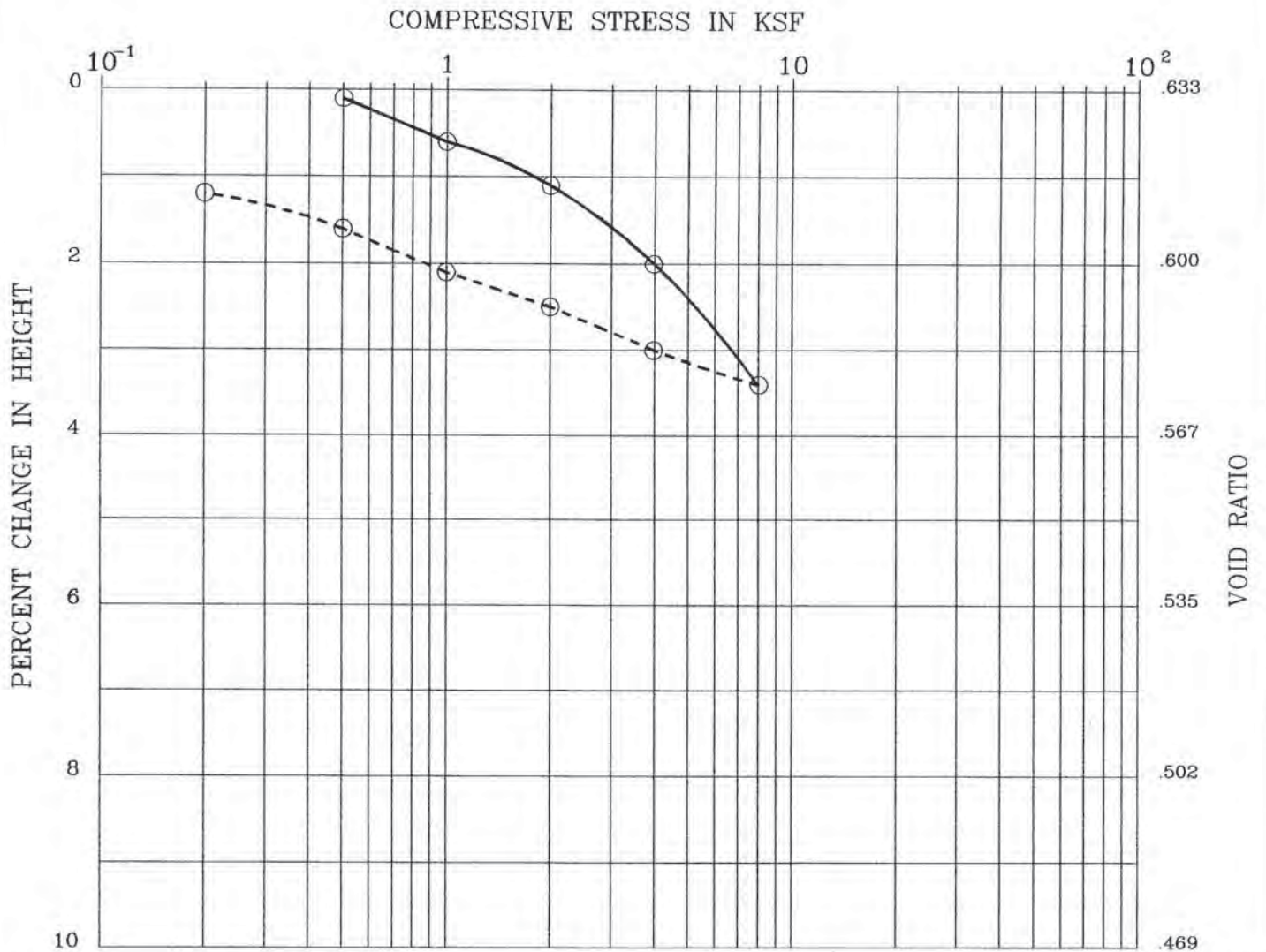
Project 44F1

NCWRP EXPANSION

ALLIED GEOTECHNICAL  
ENGINEERS, INC.

CONSOLIDATION TEST

Figure B-49



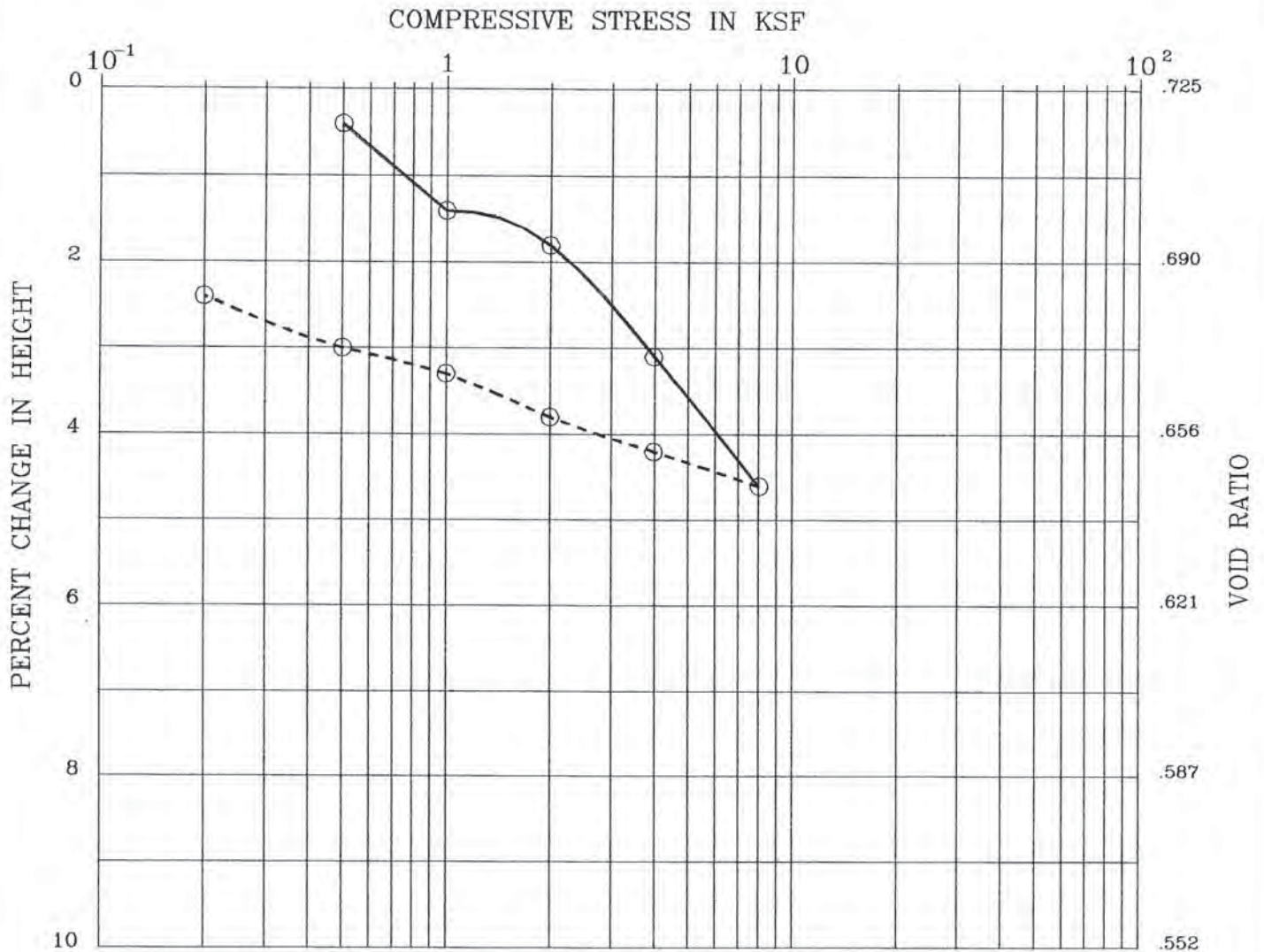
BORING : H-11 #7                      DESCRIPTION : Sandy lean clay (CL)  
 DEPTH (ft) : 25.5-26                      LIQUID LIMIT :  
 SPEC. GRAVITY : 2.71                      PLASTIC LIMIT :

	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.	<b>CONSOLIDATION TEST</b> Figure B-50





BORING : H-12 #5                      DESCRIPTION : Silty sand (SM)  
 DEPTH (ft) : 16-16.5                  LIQUID LIMIT :  
 SPEC. GRAVITY : 2.78                    PLASTIC LIMIT :

	<u>MOISTURE CONTENT (%)</u>	<u>DRY DENSITY (pcf)</u>	<u>PERCENT SATURATION</u>	<u>VOID RATIO</u>
INITIAL	23.9	100.5	92	.725
FINAL	24.6	103.0	100	.683

Remark :

Project 44F1

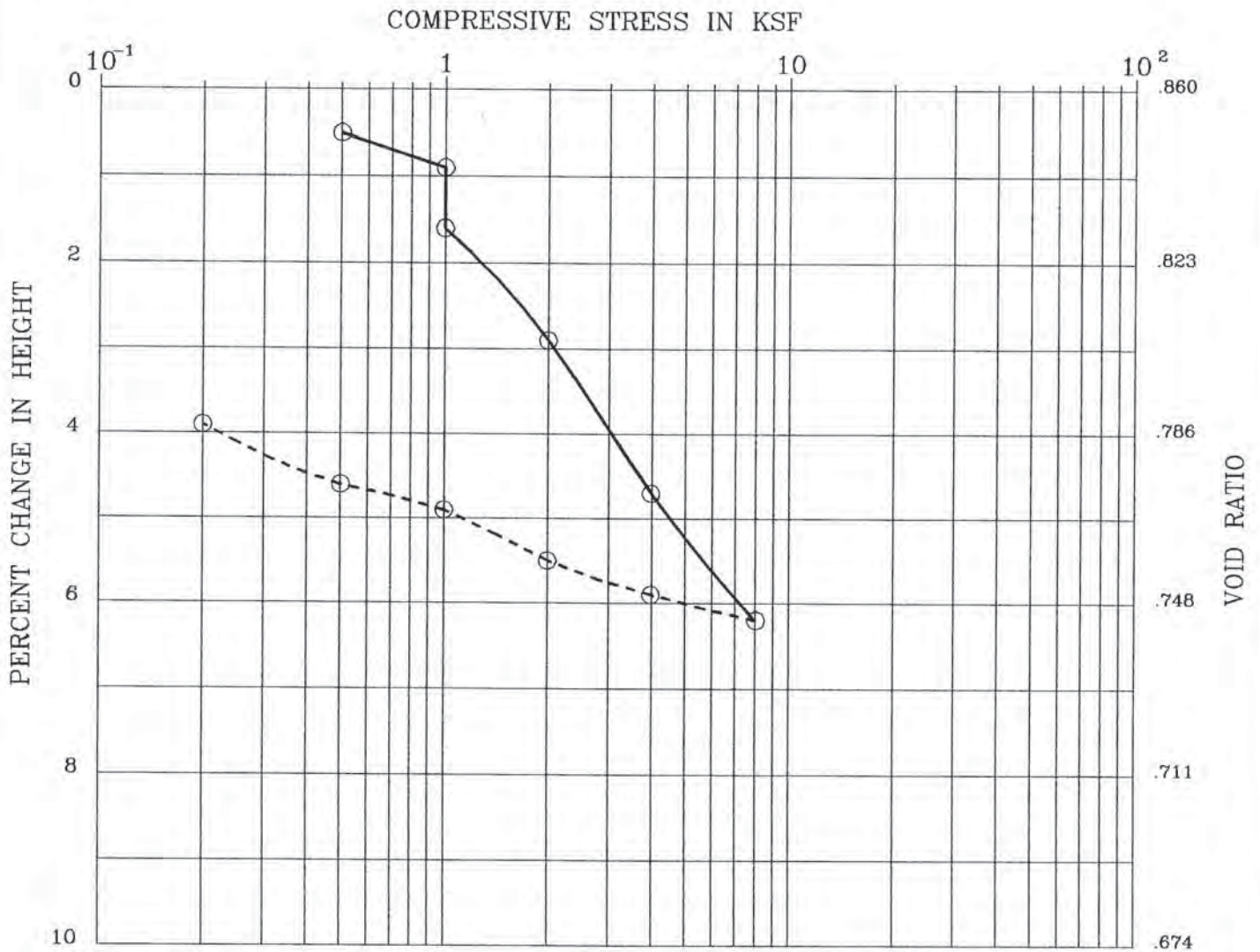
NCWRP EXPANSION

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 :

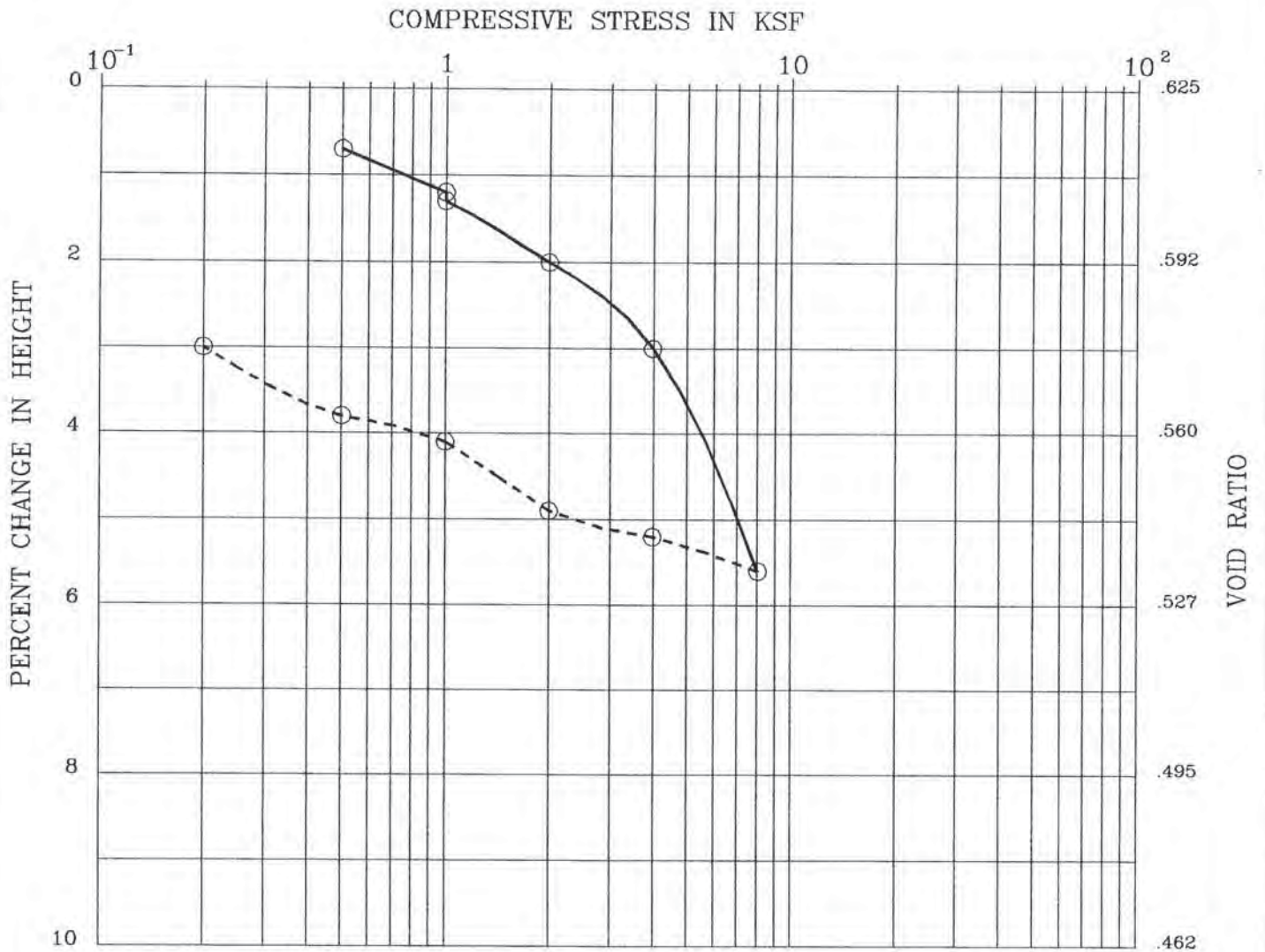
Project 44F1

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

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CONSOLIDATION TEST

Figure B-53









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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: SO6422-2      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 <sub>3</sub> ) (In a 1:3 water extraction)	6ppm

  
\_\_\_\_\_  
Laura Torres  
LT/ilv

L A B O R A T O R Y R E P O R T

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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<sub>3</sub>) 32ppm  
 (In a 1:3 water extraction)

  
 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: S06422-3      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<sub>3</sub>)      30ppm  
(In a 1:3 water extraction)

  
\_\_\_\_\_  
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Date: June 14, 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: SO6422-4 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 <sub>3</sub> ) (In a 1:3 water extraction)	14ppm

  
\_\_\_\_\_  
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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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 <sub>3</sub> ) (In a 1:3 water extraction)	27ppm

Rosa M. Bernal  
RMB/ilv





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Date: May 25, 2017  
Purchase Order Number: 44F1  
Sales Order Number: 35882  
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: S06396-13      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<sub>3</sub>)      N/A  
(In a 1:3 water extraction)

Note: N/A = Unable to determine due to the texture of the soil (Clay).

  
\_\_\_\_\_  
Laura Torres  
LT/ilv



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Purchase Order Number: 44F1  
Sales Order Number: 36150  
Account Number: ALLG

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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 <sub>3</sub> ) (In a 1:3 water extraction)	24ppm

Rosa M. Bernal  
RMB/ilv

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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: S06422-7 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<sub>3</sub>) 28ppm  
(In a 1:3 water extraction)

  
\_\_\_\_\_  
Laura Torres  
LT/dbb





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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<sub>3</sub>)  
(In a 1:3 water extraction)

50ppm

  
\_\_\_\_\_  
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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 <sub>3</sub> ) (In a 1:3 water extraction)	48ppm

  
\_\_\_\_\_  
Laura Torres  
LT/dbb

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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: SO6396-1

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<sub>3</sub>)  
(In a 1:3 water extraction)

54ppm

  
\_\_\_\_\_  
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: S06396-2 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<sub>3</sub>) 48ppm  
(In a 1:3 water extraction)

  
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 <sub>3</sub> ) (In a 1:3 water extraction)	54ppm

  
\_\_\_\_\_  
Laura Torres  
LT/ilv





L A B O R A T O R Y   R E P O R T

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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: S06422-12      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 <sub>3</sub> ) (In a 1:3 water extraction)	30ppm

Rosa M. Bernal  
RMB/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: S06396-7      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<sub>3</sub>)      57ppm  
(In a 1:3 water extraction)

  
\_\_\_\_\_  
Laura Torres  
LT/ilv



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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 <sub>3</sub> ) (In a 1:3 water extraction)	26ppm

*Laura Torres*

Laura Torres  
LT/dbb

L A B O R A T O R Y   R E P O R T

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A N A L Y T I C A L   A N D   C O N S U L T I N G   C H E M I S T S

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: S06396-14      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<sub>3</sub>)      N/A  
(In a 1:3 water extraction)

Note: N/A = Unable to determine due to the texture of the soil (Clay).

  
\_\_\_\_\_  
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: SO6396-8 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 <sub>3</sub> ) (In a 1:3 water extraction)	70ppm

  
\_\_\_\_\_  
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: S06422-15      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'.

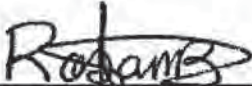
Analysis By California Test 643, 1999, Department of Transportation  
Division of Construction, Method for Estimating the Service Life of  
Steel Culverts.

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 <sub>3</sub> ) (In a 1:3 water extraction)	8ppm

  
 \_\_\_\_\_  
 Rosa M. Bernal  
 RMB/ilv







**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

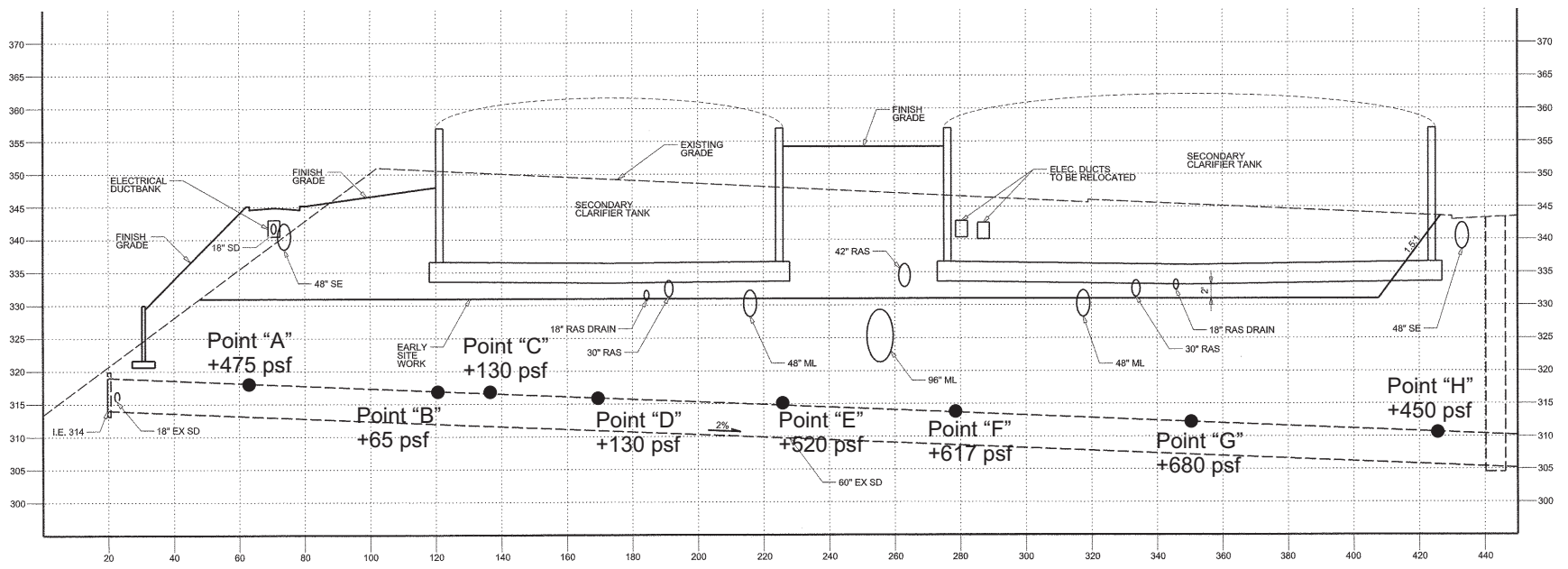
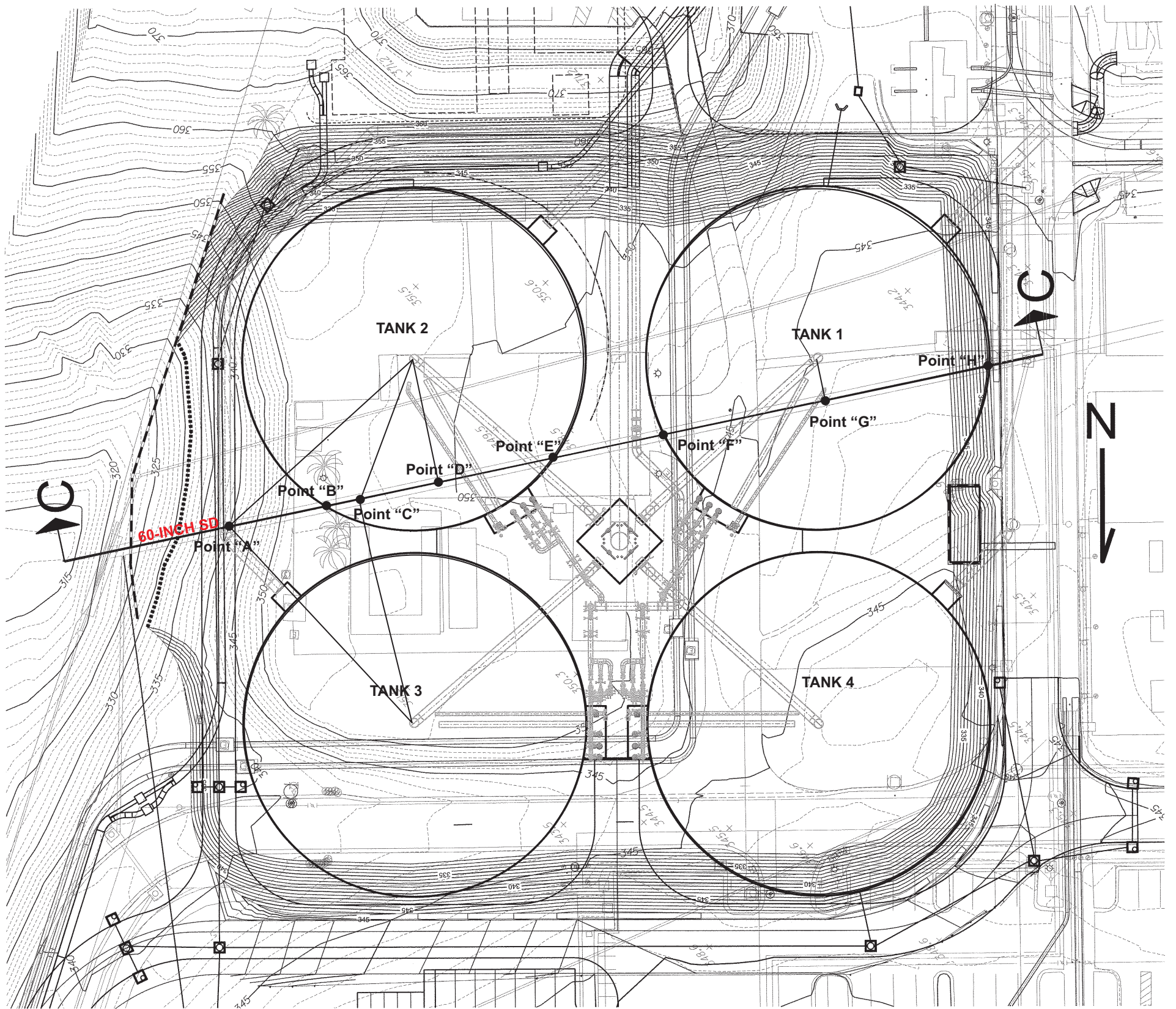
Boring H-22

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

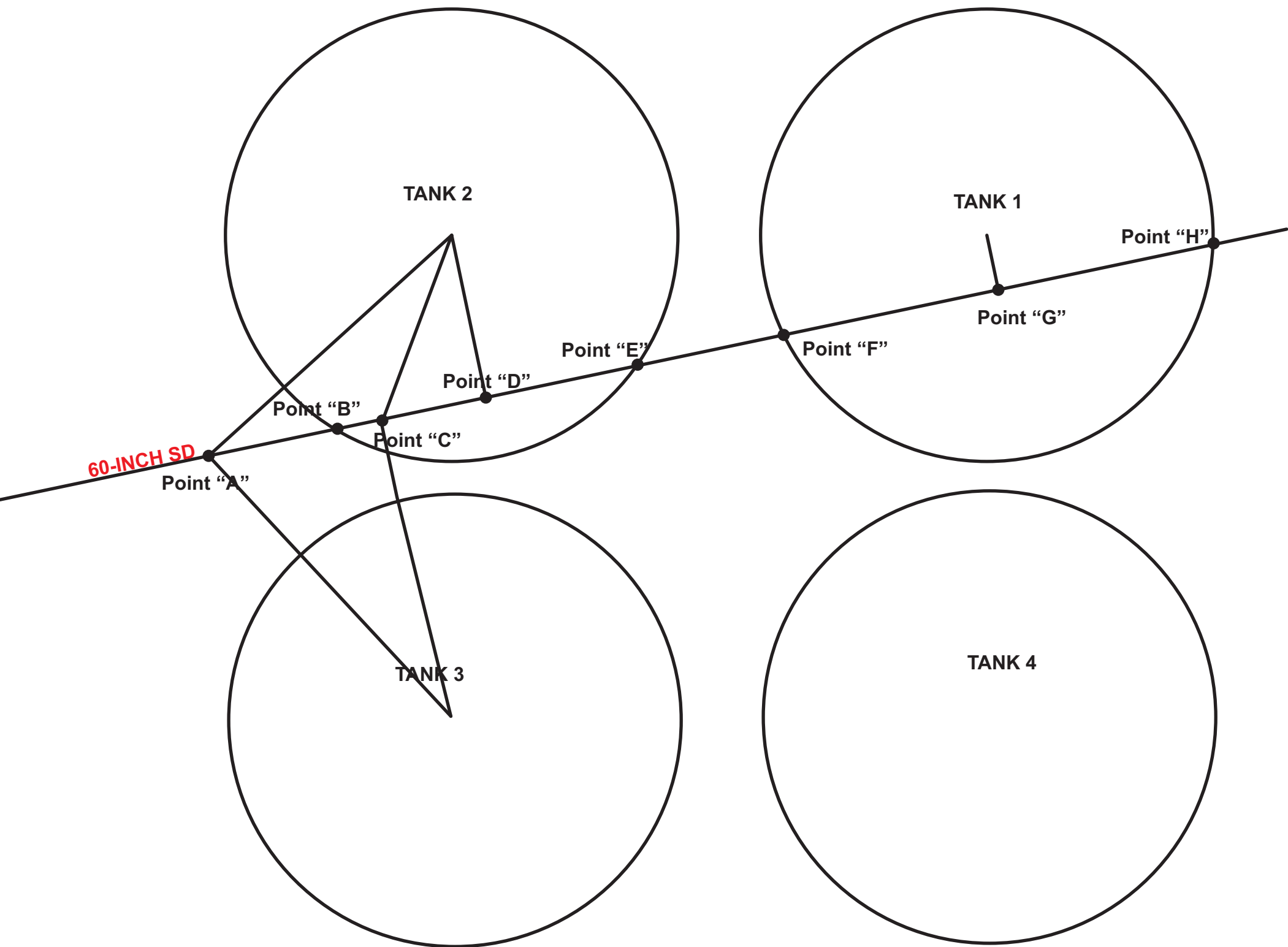


## **APPENDIX C.2**

### **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  
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## Point "A"

Load from additional fill treated as edge load of uniformly loaded rectangular area.

$$q = 10' \times 110 \text{ pcf} = 1,100 \text{ psf}$$

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)

$$\text{Load from additional fill} = 2 \times 0.21633 \times 1,100 \text{ psf} = 475 \text{ psf}$$

Contribution from Tank 2

$$\text{Radius } (r) = 80'$$

Depth from bottom of raft foundation to top of pipe ( $z$ ) =  $15'$

Distance from center to Point "A" ( $a$ ) =  $114'$

Additional foundation load =  $2,000 \text{ psf} - (16 \times 110 \text{ psf}) = 240 \text{ psf}$

$$m = z/r = 15/80 = 0.19$$

$$n = a/r = 114/80 = 1.425$$

$Nz = 0\%$  (Foster and Ahlvin, 1954)

$$\begin{aligned} Qz &= \text{pressure at Point "A" due to foundation load} = \\ &240 \text{ psf} \times 0\% = 0 \text{ psf.} \end{aligned}$$

Contribution from Tank 3

$$\text{Radius } (r) = 80'$$

Depth from bottom of raft foundation to top of pipe ( $z$ ) =  $15'$

Distance from center to Point "A" ( $a$ ) =  $110'$

Foundation Pressure =  $240 \text{ psf}$  (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)

$$\begin{aligned} Qz &= \text{pressure at Point "A" due to foundation load} = \\ &240 \text{ psf} \times 0\% = 0 \text{ psf.} \end{aligned}$$

## Conclusion:

Additional foundation load at Point "A" is estimated to be  $475 \text{ psf}$

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## 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

$m = z/r = 15/80 = 0.19$

$n = a/r = 80/80 = 1.0$

$N_z = 50\%$  (Foster and Ahlvin, 1954)

$Q_z =$  pressure at Point "B" due to foundation load =  
 $2,000 \text{ psf} \times 50\% = 1,000 \text{ psf.}$

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'

$m = z/r = 15/80 = 0.19$

$n = a/r = 106/80 = 1.325$

$N_z = 0\%$  (Foster and Ahlvin, 1954) - no contribution

Soil surcharge load removed =  $(17' \times 110 \text{ pcf})/2 = 935 \text{ psf}$

## Conclusion:

Additional foundation load at Point "B" is estimated to  
be  $1,000 \text{ psf} - 935 \text{ psf} = 65 \text{ psf}$

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## 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

$m = z/r = 15/80 = 0.19$

$n = a/r = 66/80 = 0.825$

$N_z = 100\%$  (Foster and Ahlvin, 1954)

$Q_z =$  pressure at Point "C" due to foundation load =  
 $2,000 \text{ psf} \times 100\% = 2,000 \text{ psf}.$

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'

$m = z/r = 15/80 = 0.19$

$n = a/r = 104/80 = 1.3$

$N_z = 0\%$  (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  $2,000 \text{ psf} - 1,870 \text{ psf} = 130 \text{ psf}$

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## 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

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## 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 =  
 $2,000 \text{ psf} \times 50\% = 1,000 \text{ psf.}$

Soil surcharge load removed =  $(14' \times 110 \text{ pcf})/2 = 770 \text{ psf}$

Load from additional fill treated as edge load of uniformly loaded rectangular area.

$q = 6' \times 110 \text{ pcf} = 660 \text{ psf}$

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 =  $2 \times 0.22025 \times 660 \text{ psf} = 290 \text{ psf}$

## Conclusion:

Additional load at Point "E" is estimated to be equal to:  
 $1,000 \text{ psf} + 290 \text{ psf} - 770 \text{ psf} = 520 \text{ psf.}$

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## 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.

$q = 8' \times 110 \text{ pcf} = 880 \text{ psf}$

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 =  $2 \times 0.22025 \times 880 \text{ psf} = 387 \text{ psf}$

## Conclusion:

Additional load at Point "F" is estimated to be equal to:  
 $1,000 \text{ psf} + 387 \text{ psf} - 770 \text{ psf} = 617 \text{ psf}.$

Calculation Performed By: Sani Sutanto

Calculation Performed On: May 19, 2017

Project Name: North City Wastewater Treatment Plant Expansion

Project No. 44F1

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### 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

Calculation Performed By: Sani Sutanto

Calculation Performed On: May 19, 2017

Project Name: North City Wastewater Treatment Plant Expansion

Project No. 44F1

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## 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

Calculation Performed By: Sani Sutanto

Calculation Performed On: May 19, 2017

Project Name: North City Wastewater Treatment Plant Expansion

Project No. 44F1

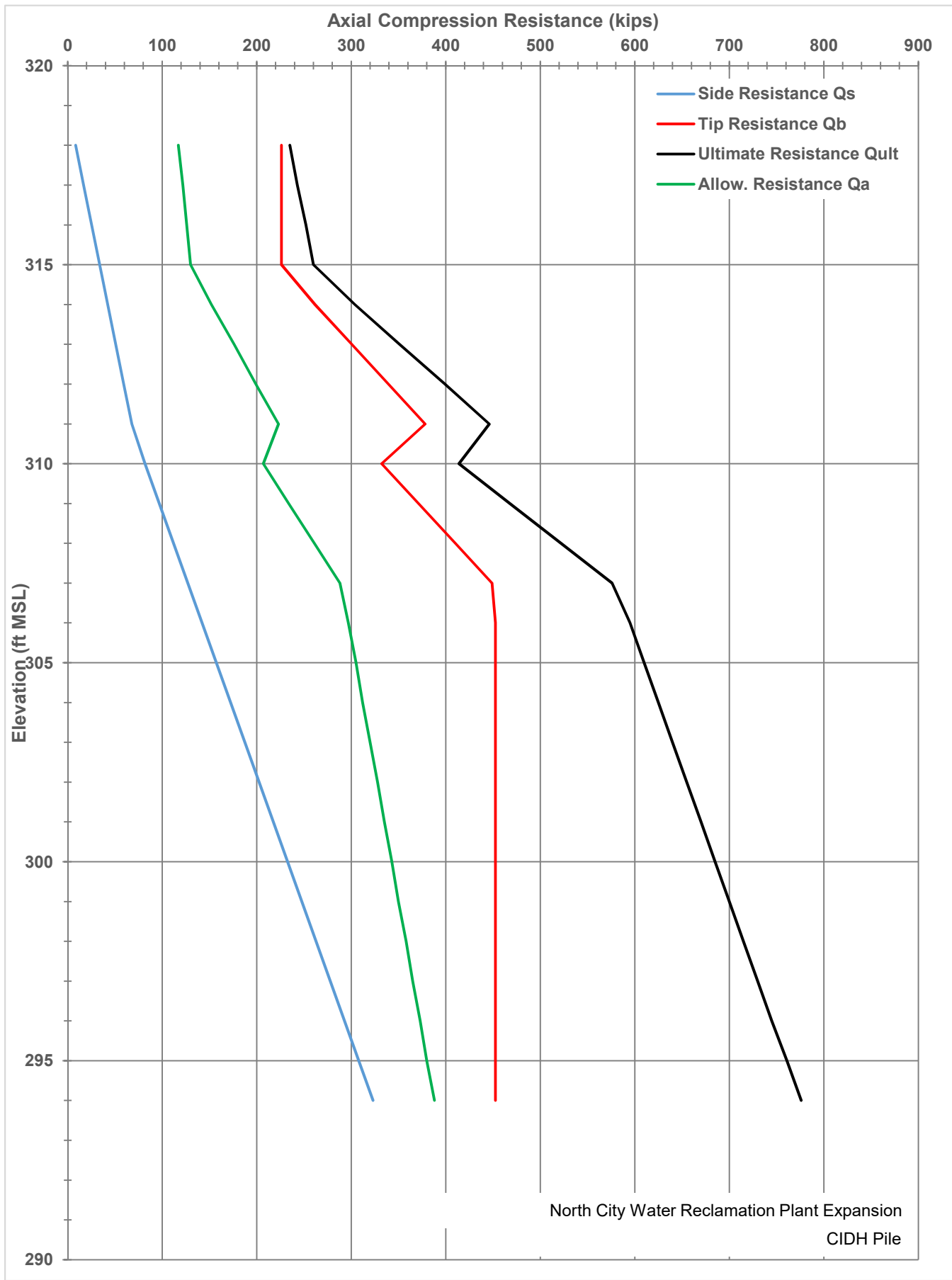
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## **APPENDIX C.3**

### **36-INCH DIAMETER CIDH PILE CALCULATIONS**

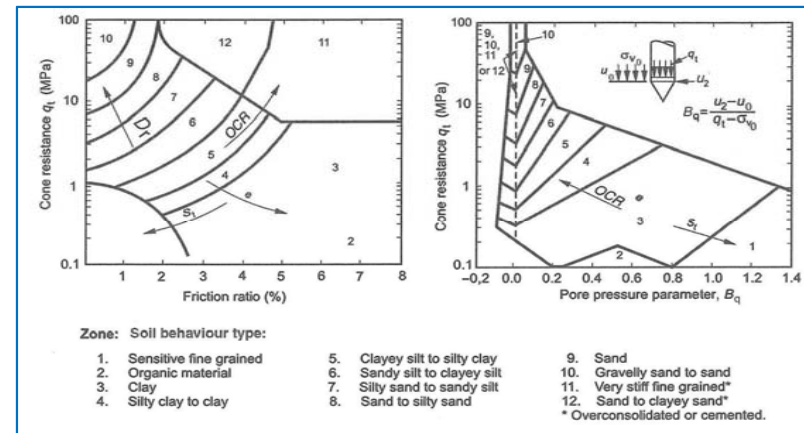




**CIDH PILE CALCULATION**

**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 <sub>t</sub> (tsf)/N <sub>60</sub>	W <sub>s</sub>	W <sub>t</sub>
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 <sub>pile</sub> (in.)	36
4D <sub>pile</sub> (ft)	12.0
A <sub>s</sub> (ft <sup>2</sup> )	9.42
A <sub>t</sub> (ft <sup>2</sup> )	7.07

FS (Side)	2
FS (Tip)	2
Target R <sub>a</sub>	375 kips

Depth (ft)	Elev. (ft)	1986 SBT	CPT q <sub>t</sub> (tsf)	Lim. q <sub>t</sub> (tsf)	f <sub>s1</sub> (ksf)	W <sub>s</sub> (tsf)	f <sub>s</sub> (ksf)	R <sub>si</sub> (kips)	ΣR <sub>si</sub> (kips)	Toe Ave. q <sub>t</sub> (tsf)	q <sub>b1</sub> (ksf)	W <sub>t</sub> (tsf)	q <sub>b</sub> (ksf)	R <sub>t</sub> (kips)	R <sub>ult</sub> (kips)	R <sub>a</sub> (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:**  $K_s = c (d_{10})^2$   
 $K_s =$  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

<b>Dia (mm)</b>	<b>% pass</b>
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**

<b>Dia (mm)</b>	<b>% pass</b>
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**

<b>Dia (mm)</b>	<b>% pass</b>
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

<b>Dia (mm)</b>	<b>% pass</b>
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

<b>Dia (mm)</b>	<b>% pass</b>
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

<b>Dia (mm)</b>	<b>% pass</b>
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**

<b>Dia (mm)</b>	<b>% pass</b>
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

<b>Dia (mm)</b>	<b>% pass</b>
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

<b>Dia (mm)</b>	<b>% pass</b>
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

<b>Dia (mm)</b>	<b>% pass</b>
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

<b>Dia (mm)</b>	<b>% pass</b>
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

<b>Dia (mm)</b>	<b>% pass</b>
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

<b>Dia (mm)</b>	<b>% pass</b>
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**

<b>Dia (mm)</b>	<b>% pass</b>
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

<b>Dia (mm)</b>	<b>% pass</b>
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

<b>Dia (mm)</b>	<b>% pass</b>
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

North City Water Reclamation Plant Expansion

AGE Project No. 44F1

July 12, 2017

Page 1

**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

<b>Dia (mm)</b>	<b>% pass</b>
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**

<b>Dia (mm)</b>	<b>% pass</b>
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**

<b>Dia (mm)</b>	<b>% pass</b>
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

<b>Dia (mm)</b>	<b>% pass</b>
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

<b>Dia (mm)</b>	<b>% pass</b>
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

<b>Dia (mm)</b>	<b>% pass</b>
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

<b>Dia (mm)</b>	<b>% pass</b>
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**

<b>Dia (mm)</b>	<b>% pass</b>
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

<b>Dia (mm)</b>	<b>% pass</b>
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

<b>Dia (mm)</b>	<b>% pass</b>
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

<b>Dia (mm)</b>	<b>% pass</b>
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

<b>Dia (mm)</b>	<b>% pass</b>
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

<b>Dia (mm)</b>	<b>% pass</b>
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**

<b>Dia (mm)</b>	<b>% pass</b>
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

<b>Dia (mm)</b>	<b>% pass</b>
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

<b>Dia (mm)</b>	<b>% pass</b>
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

<b>Dia (mm)</b>	<b>% pass</b>
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)

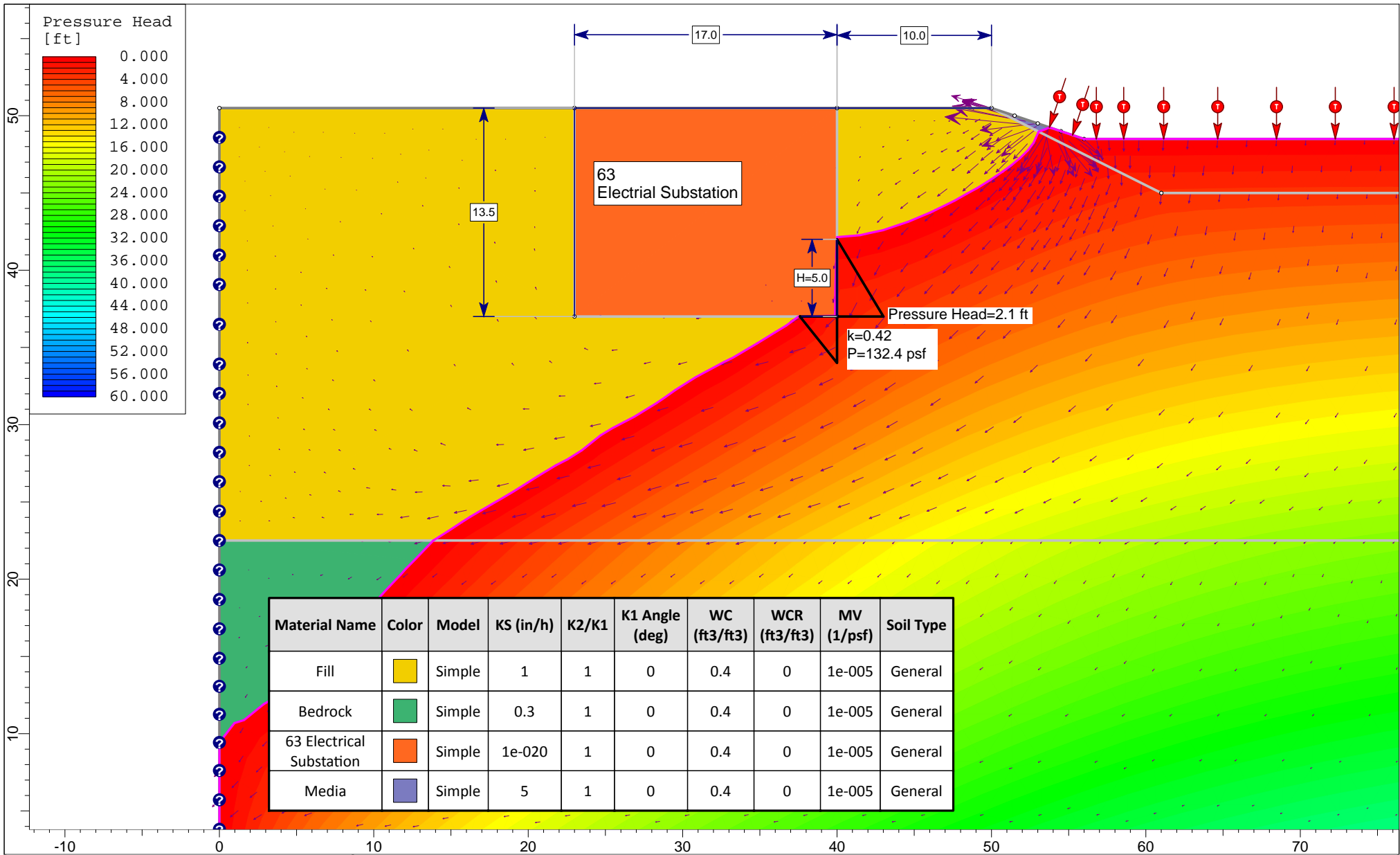
**Boring #** H-20  
**Sample #** 1  
**Depth** 3-5 ft.  
**Soil ID** Scripps


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)



	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  $m\alpha < 0.2$ : 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/ft<sup>3</sup>]: 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**

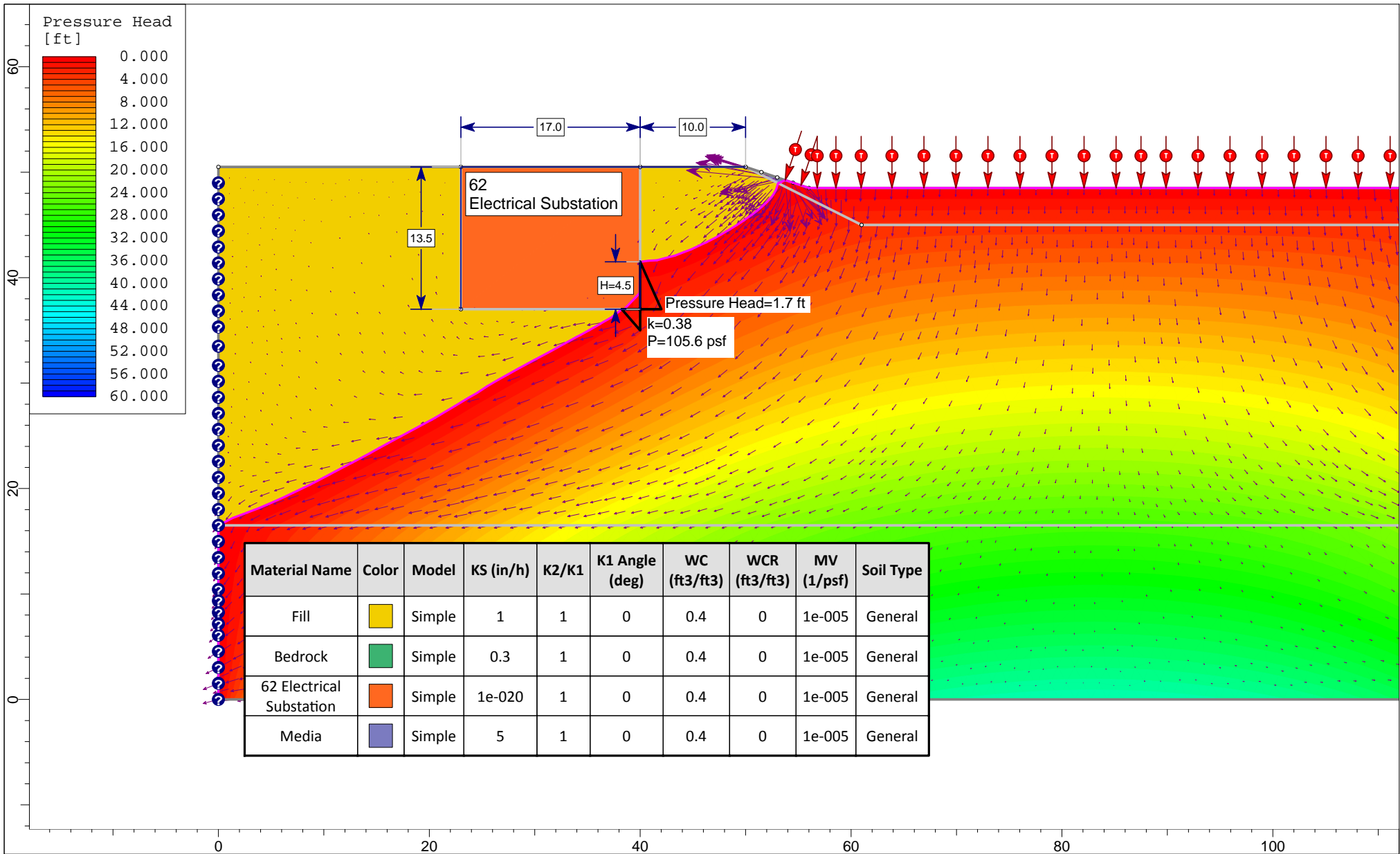
X	Y
40	37
40	50.5


**Material Boundary**

X	Y
199	45
210	50.5







	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  $m\alpha < 0.2$ : 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/ft<sup>3</sup>]: 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**

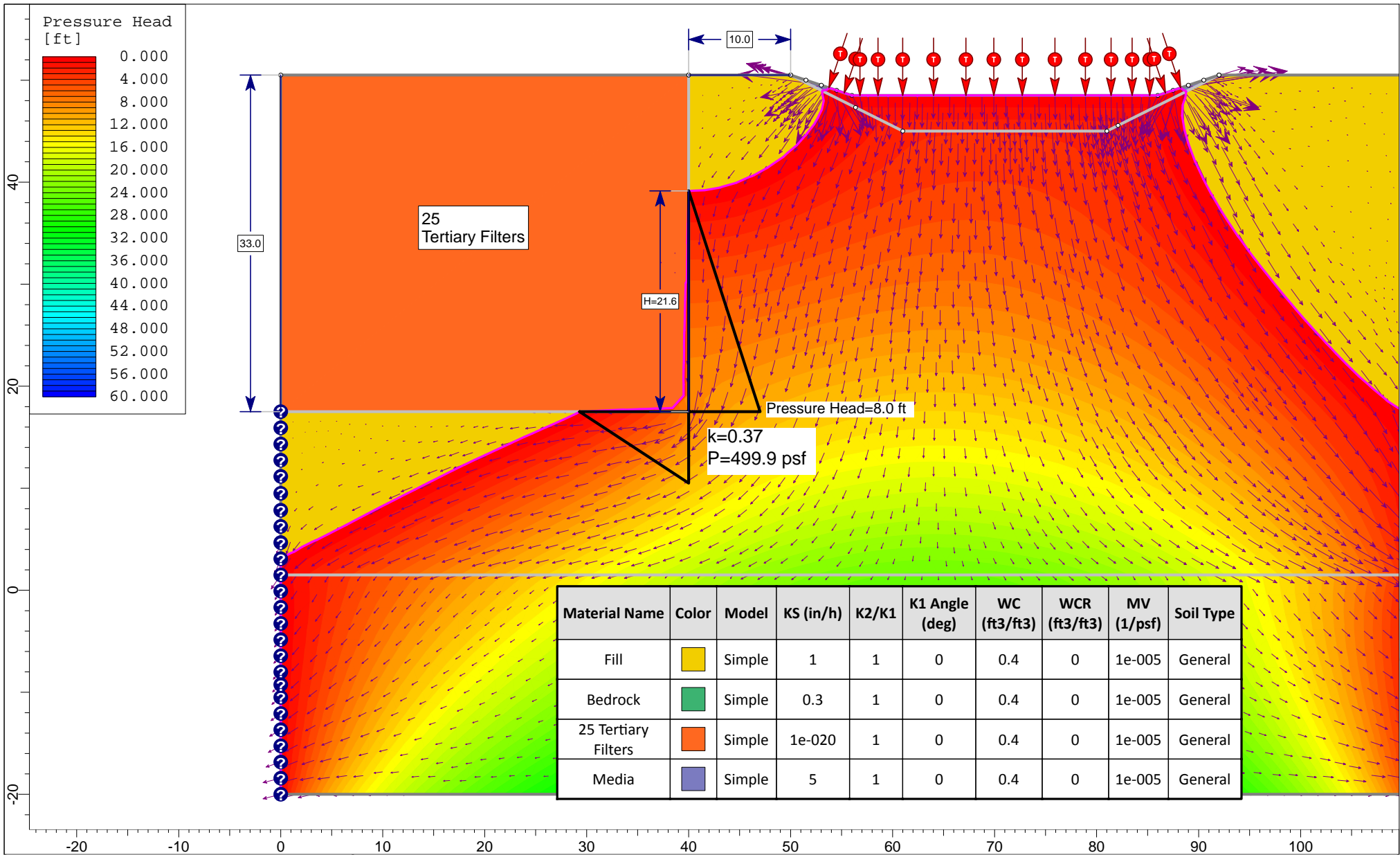
X	Y
0	16.5
145	16.5


**Material Boundary**

X	Y
23	50.5
23	37
40	37

**Material Boundary**

X	Y
40	50.5
40	37



	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  $m\alpha < 0.2$ : 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/ft<sup>3</sup>]: 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

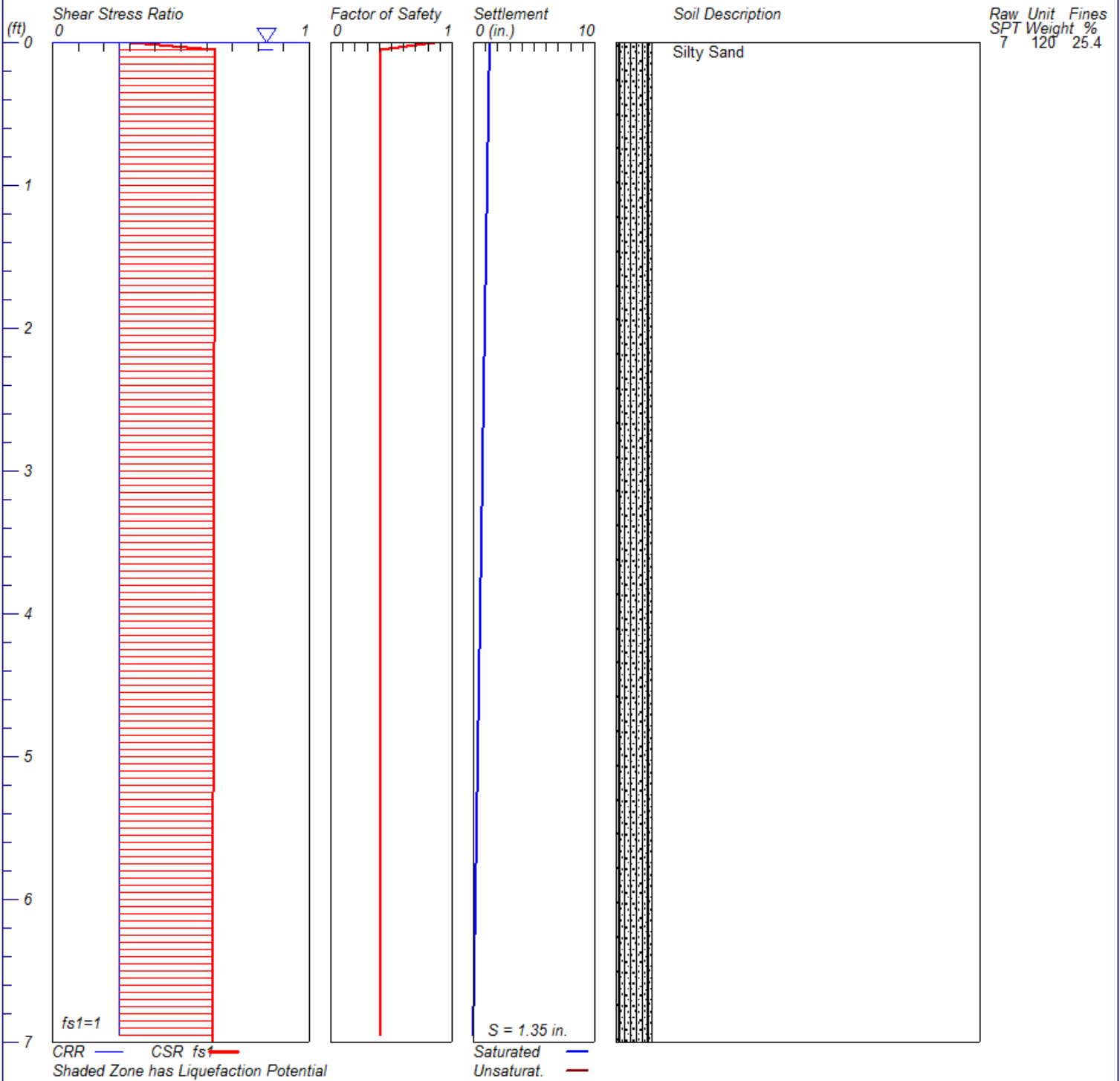
# Liquefaction and Seismic Settlement (Liquefy Pro)

# LIQUEFACTION ANALYSIS

## San Diego North City WWTP

Hole No.=H-7 Water Depth=0 ft

Magnitude=6.8  
Acceleration=0.469g



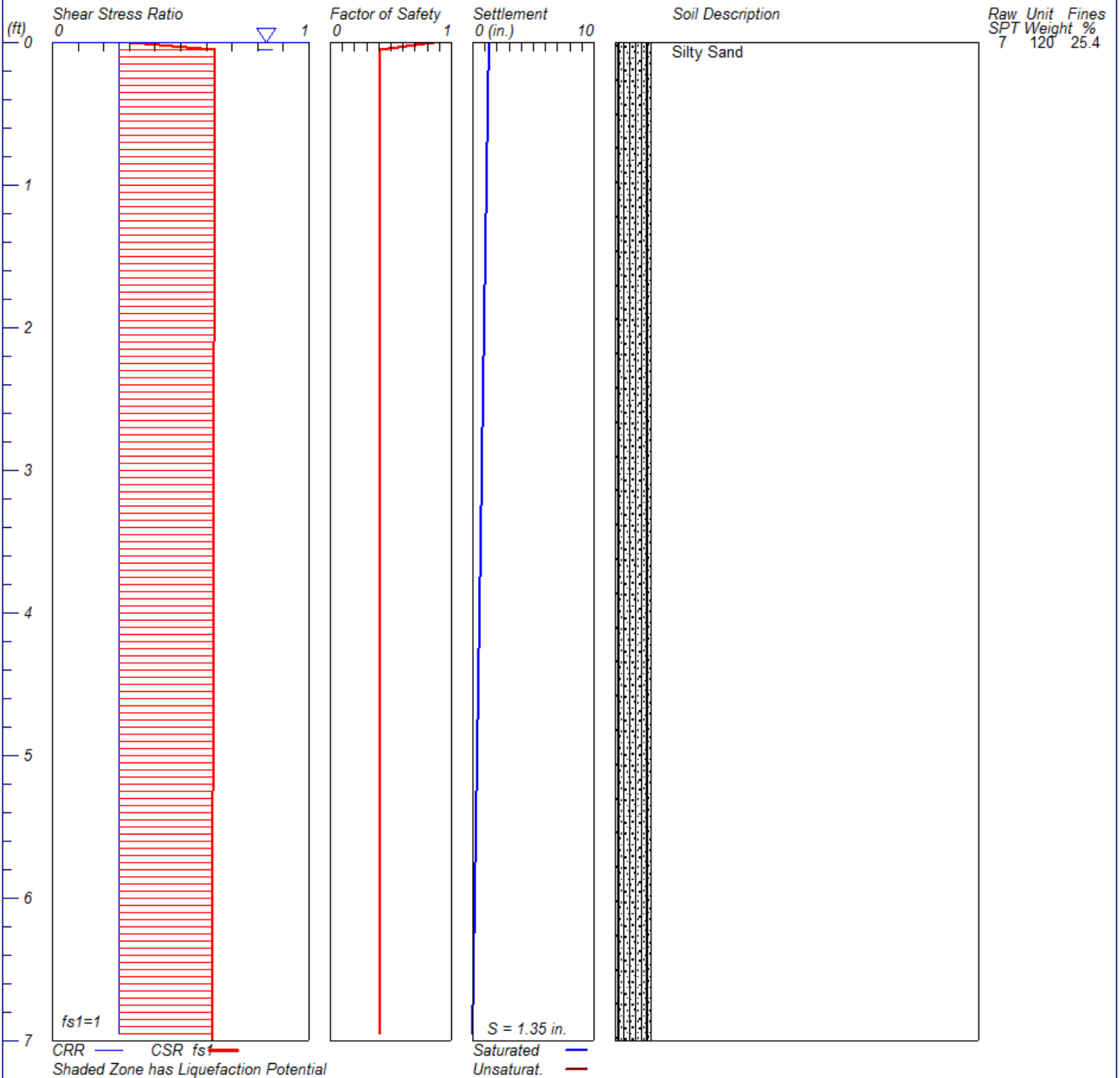


# LIQUEFACTION ANALYSIS

## San Diego North City WWTP

Hole No.=H-7 Water Depth=0 ft

Magnitude=6.8  
Acceleration=0.469g





CH2M  
402 W. Broadway, Suite 1450  
San Diego, CA 92101  
O +1 619-687-0120  
www.ch2m.com

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.

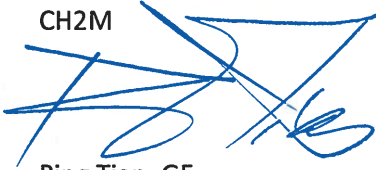
The City reviewed the revised memorandum (Revision 2) and provided comments via an email on August 14, 2017. The City's review comments indicated that the project's geotechnical consultant has adequately addressed the geologic site conditions for the purposes of environmental review of this component 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



# 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



## 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







**Attachment No. 2**  
Existing Geotechnical Report  
(CH2M HILL, November 1992)



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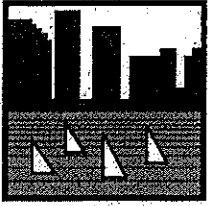
**Re: City of San Diego Public Utilities Department/ CH2M North City Water Reclamation Plant (NCWRP) Expansion Geotechnical Report**

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







**CLEAN WATER PROGRAM**  
for Greater San Diego



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# **NORTH CITY WATER RECLAMATION PLANT**

**CITY OF SAN DIEGO, CALIFORNIA**

FINAL  
GEOTECHNICAL REPORT  
REVISED NOVEMBER, 1992

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**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



Prepared by  
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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.

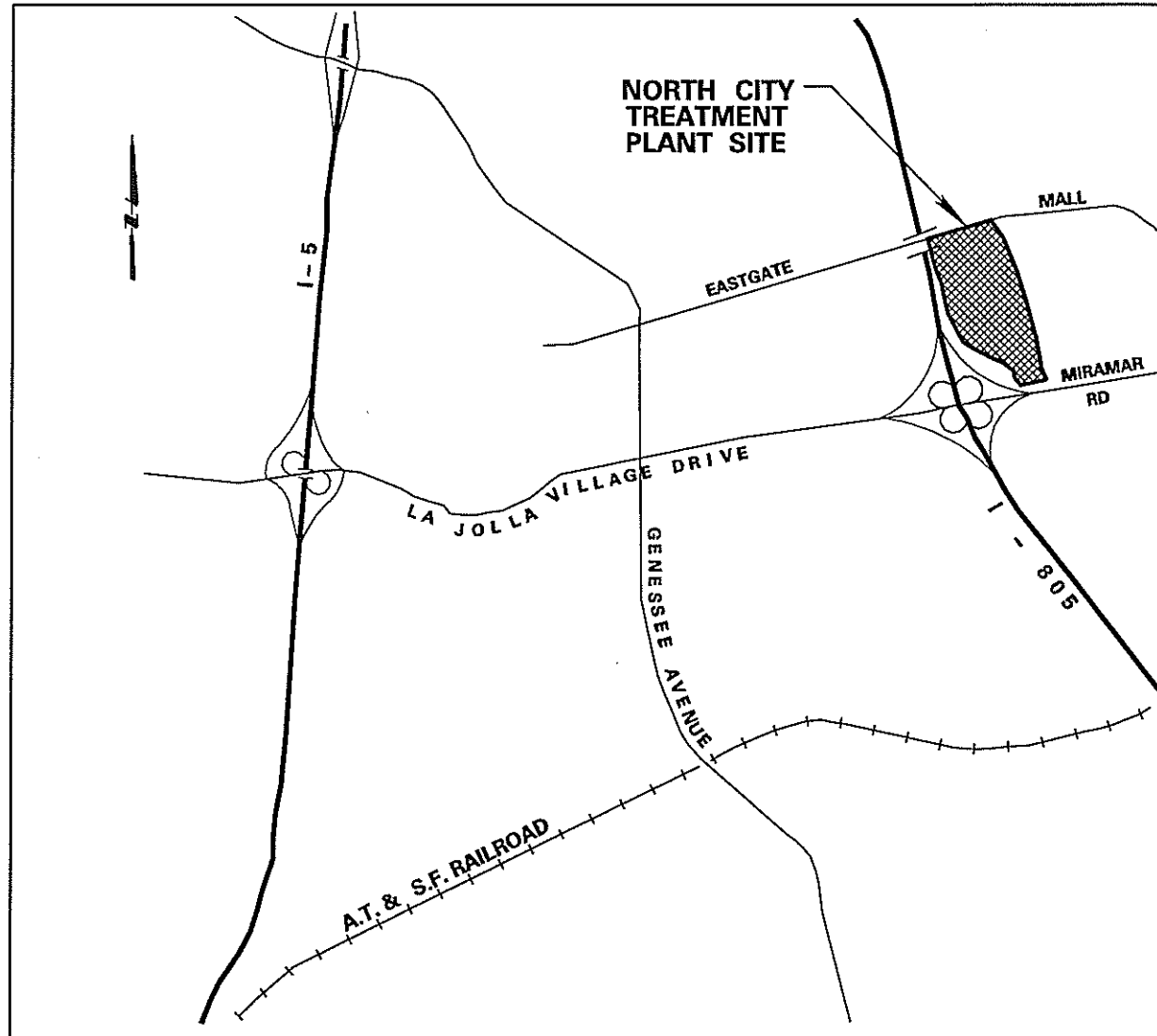
### 1.1.3 Background

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.

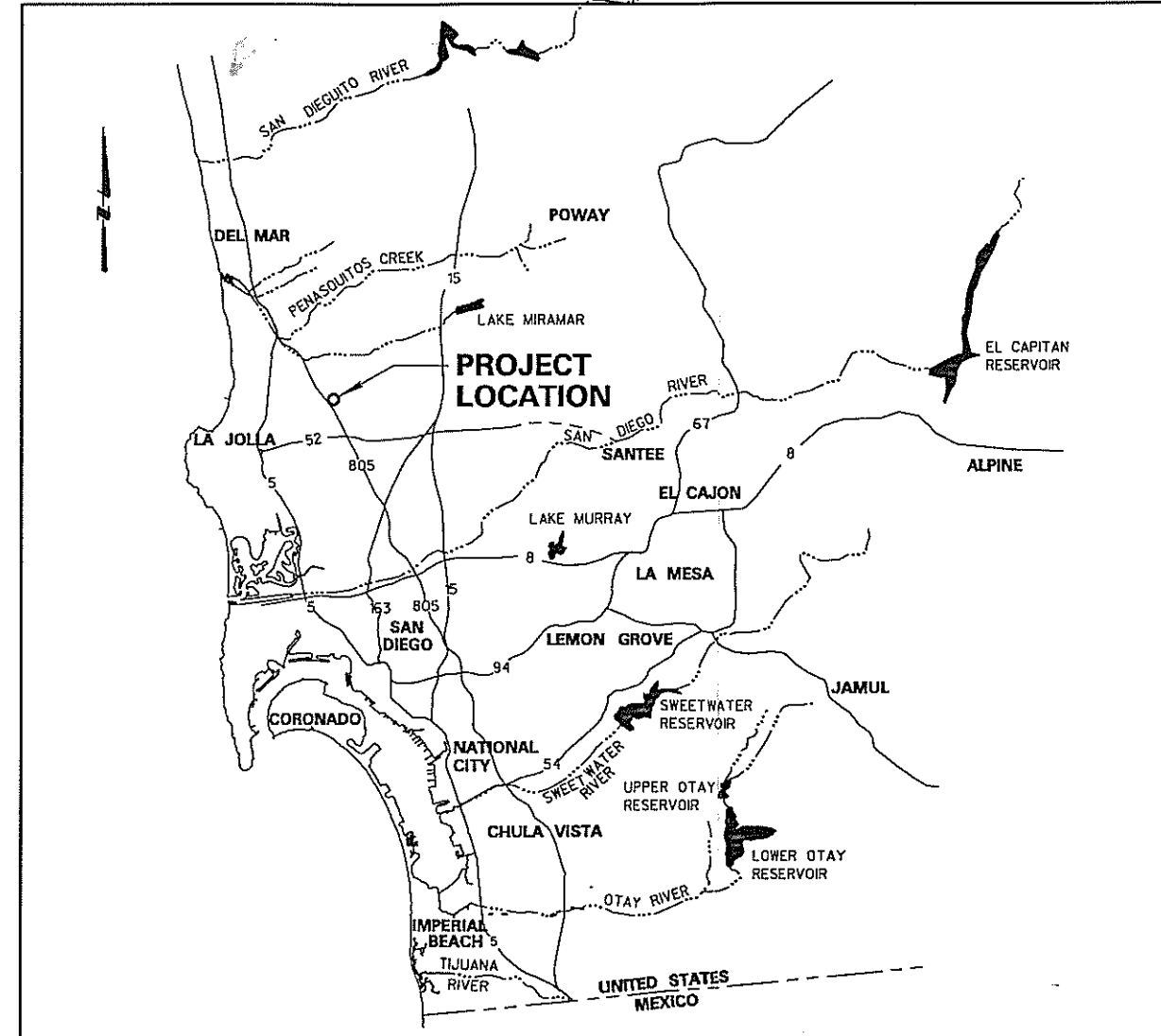
The project site consists of a mesa separated by a large westward trending canyon and its tributaries. A second, smaller box canyon is located at the southern end of the site adjacent to, and roughly paralleling, Miramar Road. Elevations at the site range from 387 feet mean sea level (msl) on the top 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 exploration

# 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.

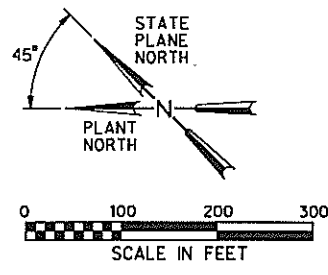
The flow equalization basins are located at the extreme southern end of the site. These reinforced concrete water holding basins measure approximately 145 feet in diameter. The maximum water depth will be approximately 25 feet. The basins are proposed to be supported by a combination of mats and spread 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.

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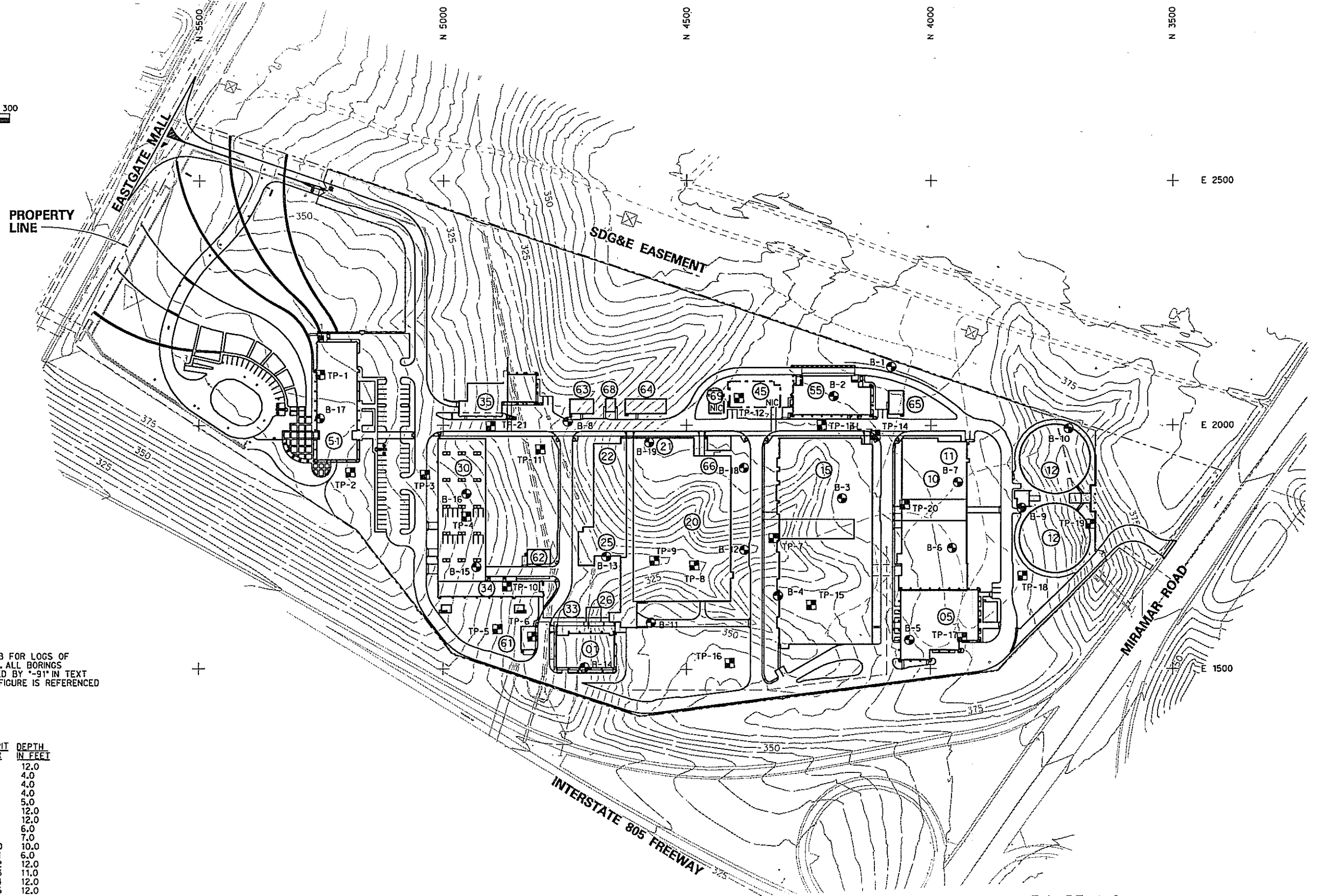


- FACILITIES LEGEND**
- 01 INFLUENT PUMP STATION
  - 05 HEADWORKS
  - 10 PRIMARY SEDIMENTATION TANKS
  - 11 INTERMEDIATE PUMP STATION
  - 12 FLOW EQUALIZATION
  - 15 AERATION BASINS
  - 20 SECONDARY CLARIFIERS
  - 21 SECONDARY EFFLUENT SPLITTER BOX
  - 22 COAGULATION AND METERING
  - 25 TERTIARY FILTERS
  - 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 PRECEDED 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	TEST PIT NUMBER	DEPTH IN FEET
B-1	66.5	TP-1	12.0
B-2	57.0	TP-2	4.0
B-3	51.5	TP-3	4.0
B-4	36.5	TP-4	4.0
B-5	36.5	TP-5	5.0
B-6	46.5	TP-6	12.0
B-7	71.5	TP-7	12.0
B-8	41.5	TP-8	6.0
B-9	36.5	TP-9	7.0
B-10	26.5	TP-10	10.0
B-11	26.5	TP-11	6.0
B-12	36.5	TP-12	12.0
B-13	31.5	TP-13	11.0
B-14	71.5	TP-14	12.0
B-15	23.0	TP-15	12.0
B-16	36.5	TP-16	12.0
B-17	41.5	TP-17	12.0
B-18	51.5	TP-18	12.0
B-19	51.5	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 Kobelco 909 LC II excavator with a 24-inch bucket and conventional wedge shaped teeth. Upon completion, the test pits were back-filled 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  $1,000 \times D$ , 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.

<p align="center"><b>Table 4-1</b> <b>Foundation Conditions</b></p>		
<p align="center"><b>Structures on Native Material</b> <b>Allowable Net Bearing Pressure = 6,000 psf</b></p>	<p align="center"><b>Structures on Fill Material</b> <b>Allowable Net Bearing Pressure = 4,000 psf</b></p>	<p align="center"><b>Structures on Both Fill and Native Material</b> <b>Allowable Net Bearing Pressure = 4,000 psf</b></p>
<p>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</p>	<p>Chlorination building Electrical substations on fill</p>	<p>Flow equalization basins Secondary clarifiers Tertiary filters Chlorine contact tanks —</p>



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  $\gamma$  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.

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  $\gamma$  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  $\gamma$  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.

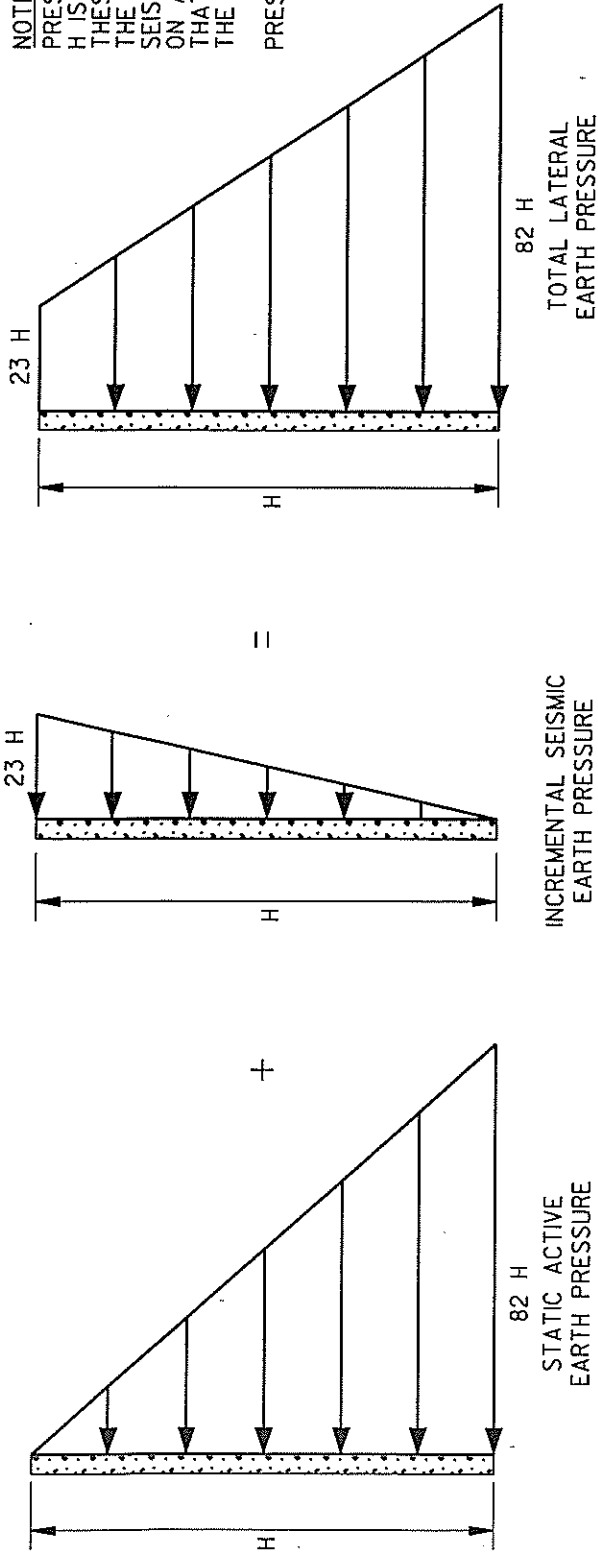
#### 4.2.2 Seismic Earth Pressures

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.

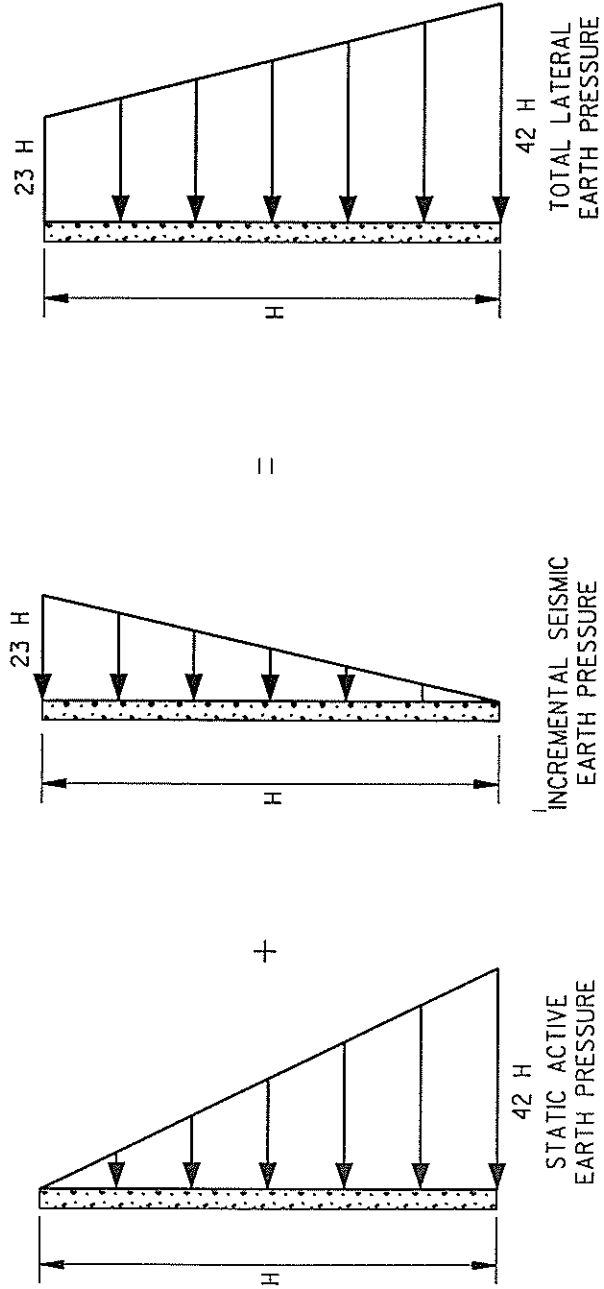
The effects of seismic loading on the structures were modeled using the Mononobe - Okabe Equation (Seed and Whitman, 1970). The pressures were calculated assuming a repeatable ground acceleration of 0.24 g and a level backfill. The repeatable ground acceleration is generally taken to be 65 percent of 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



UNDRAINED CASE



DRAINED CASE

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:  
 $\phi=28^\circ$   
 $C=0$  PSF  
 $\gamma=116$  PCF

FIGURE 4-1  
 SEISMIC LATERAL EARTH  
 PRESSURES FOR SCRIPPS  
 BACKFILL MATERIAL  
 NORTH CITY WATER RECLAMATION PLANT  
 SAN DIEGO, CALIFORNIA



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

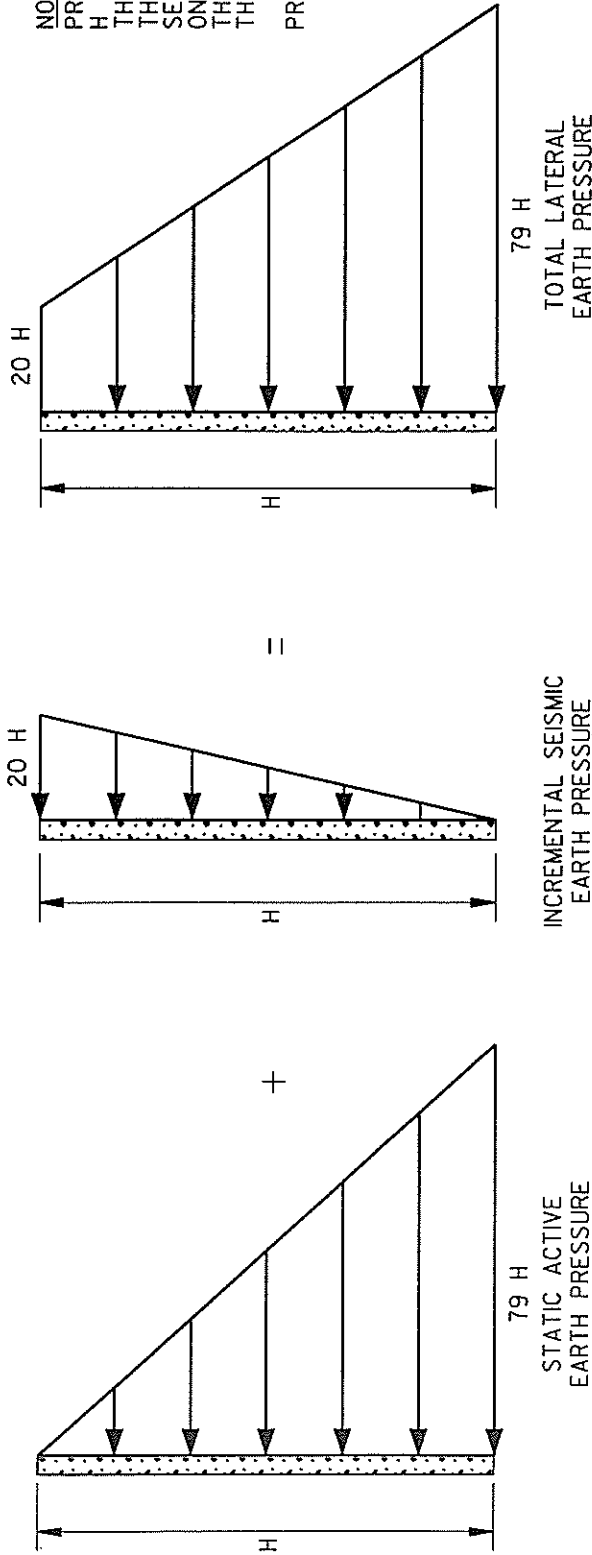
Surcharges due to traffic loads are often modeled as an additional depth of soil. It is understood that this is to be the case for the retaining wall and roadway along the east side of the site. The lateral earth pressures due to each additional foot of soil are 62 psf and 42 psf for at rest and active conditions, respectively, assuming a backfill of native material.

### 4.2.4 Coefficient of Sliding Friction

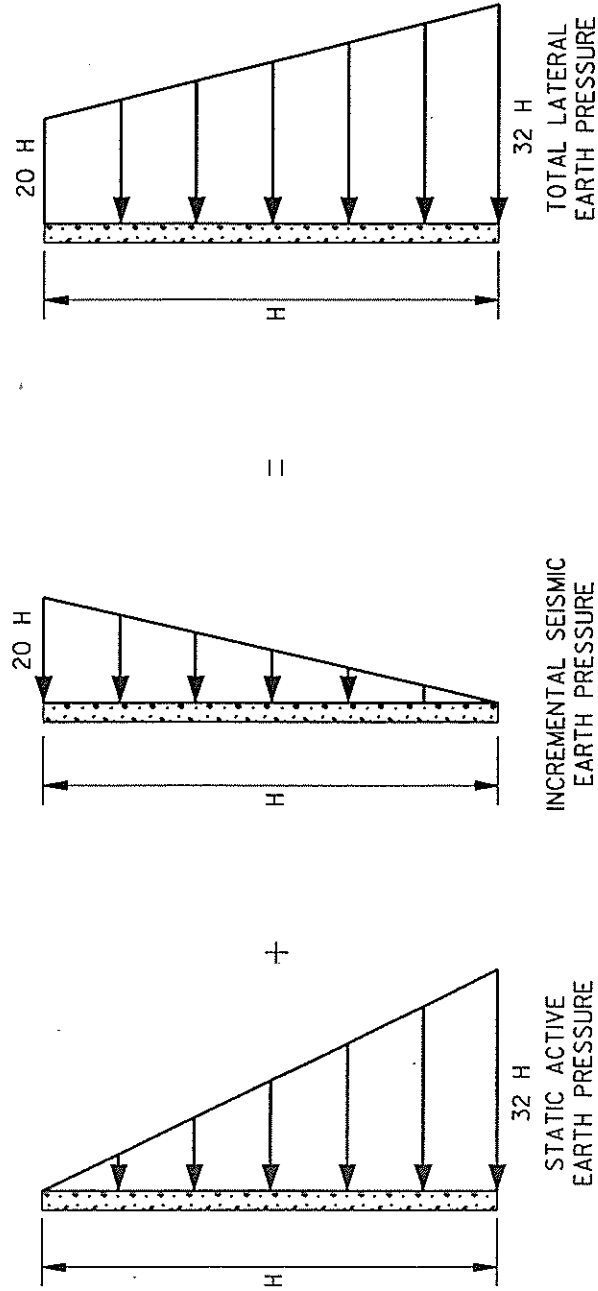
A coefficient of sliding friction equal to 0.35 should be used in the design of retaining walls and buried structures. This value is based upon an assumed sliding surface between the crushed rock layer below the wall or structure and the native soil.

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:  
 $\phi=38^\circ$   
 $C=0$  PSF  
 $\delta=130$  PCF



UNDRAINED CASE



DRAINED CASE

FIGURE 4-2  
 COMPONENTS OF  
 SEISMIC LATERAL EARTH  
 PRESSURES FOR  
 GRANULAR BACKFILL  
 NORTH CITY WATER RECLAMATION PLANT  
 SAN DIEGO, CALIFORNIA





## 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 sub-surface 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.

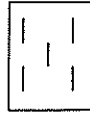
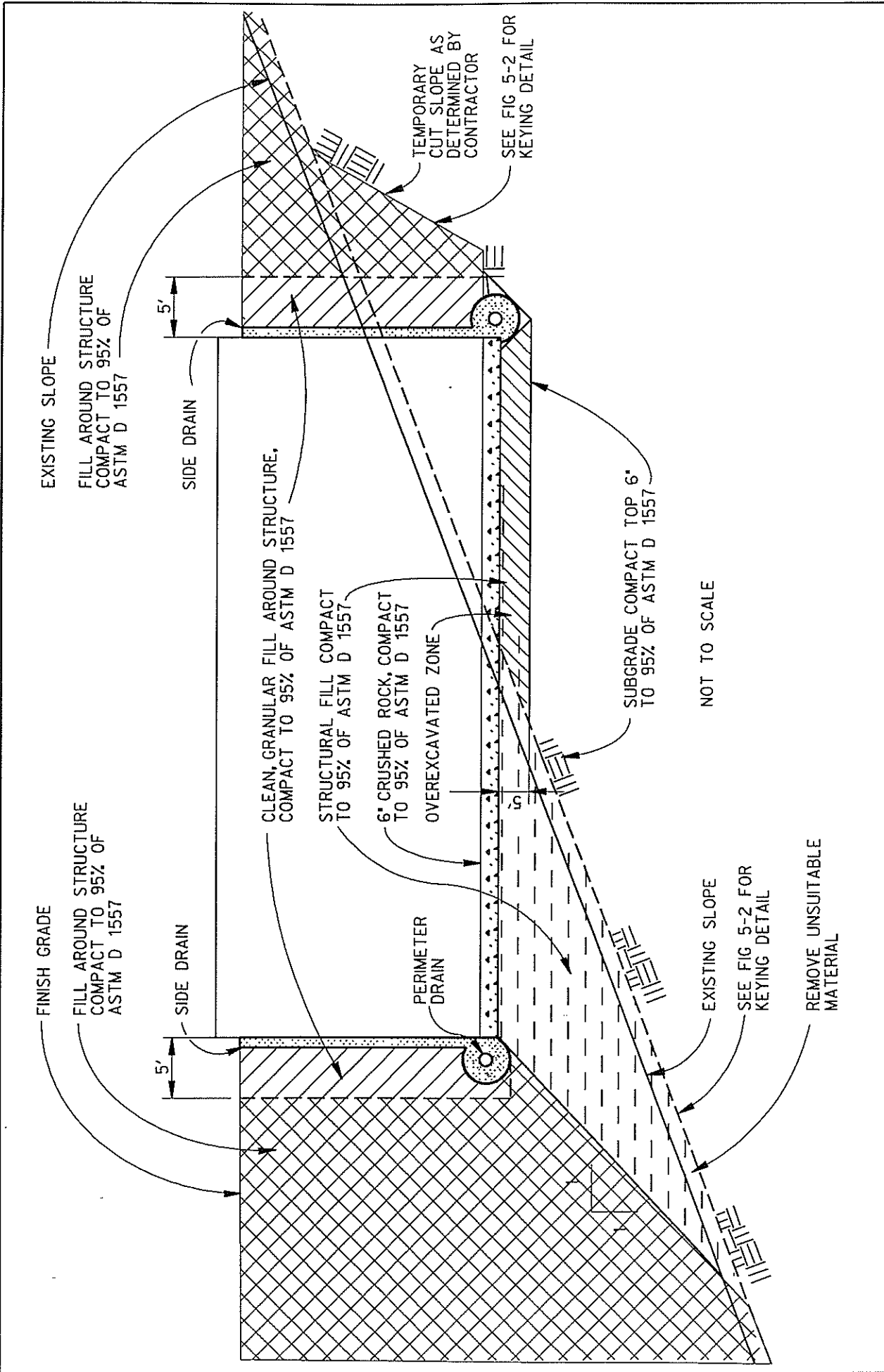
For structures such as the aeration basins and the operations building where only minimal fill will be required, consideration should be given to designing the slab in the fill area to accommodate additional differential settlement to avoid the necessity of overexcavating beneath the entire remaining 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 required for compaction of the fill material. The compaction should be field checked using ASTM D 4914.

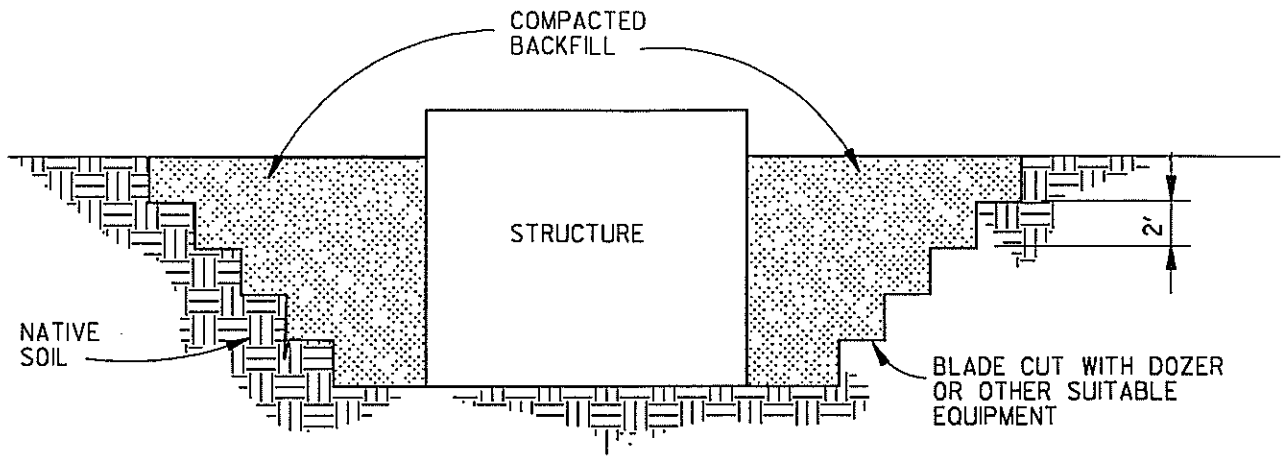
The fill should be keyed into the native soil by having a dozer or similar equipment cut small benches as shown in Figure 5-2. Fills placed against existing slopes steeper than 5:1 should be keyed into the existing slope as shown in Figure 5-2. The toe key should be cut at least 3 feet into competent 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.



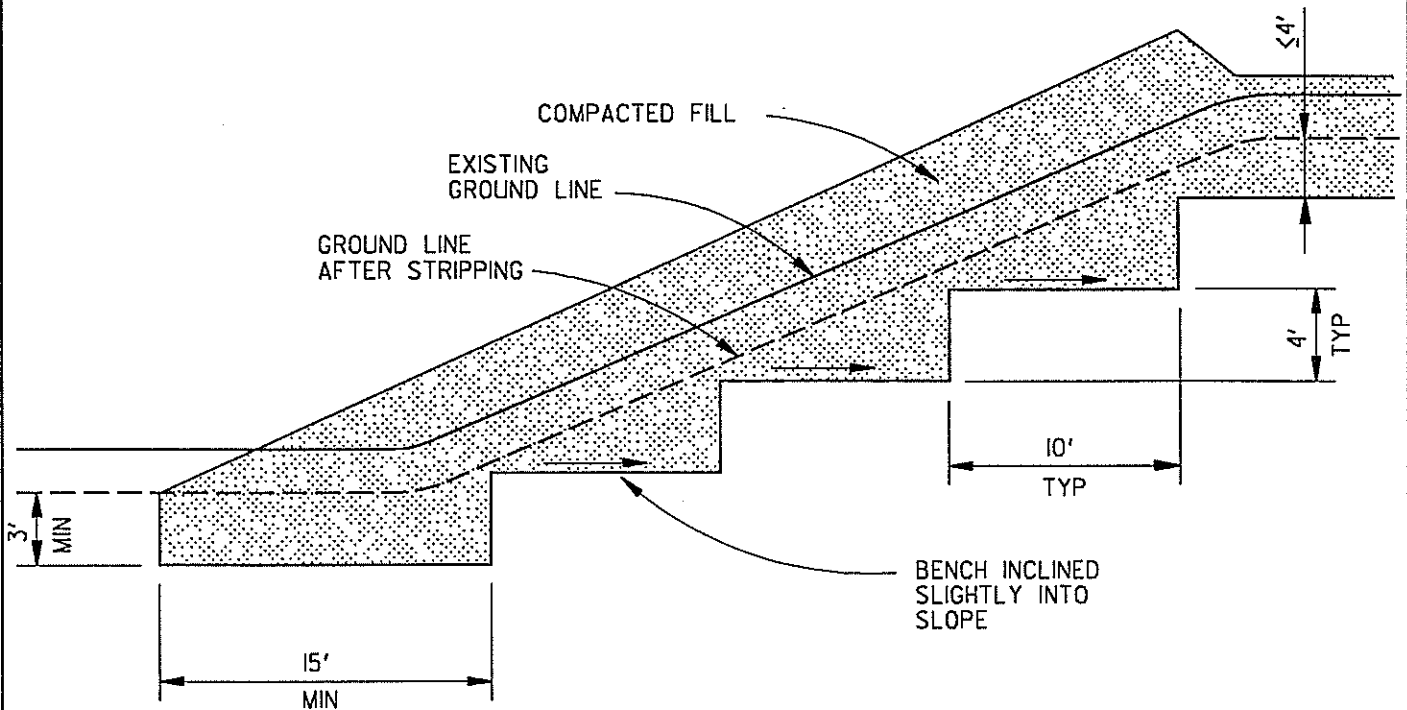
FILL WITHIN STRUCTURE'S ZONE OF INFLUENCE

FIGURE 5-1  
CROSS SECTION  
NORTH CITY WATER RECLAMATION PLANT  
SAN DIEGO, CALIFORNIA





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  
SAN DIEGO, CALIFORNIA



## **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.



## **Bibliography**

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**Appendix A**  
**Soil Boring Logs**



PROJECT NUMBER LAO 32316.A7	BORING NUMBER B-91-01
SHEET 1 OF 3	
<b>SOIL BORING LOG</b>	

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 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
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)			
		1-G			CLAYEY SAND (SC) reddish brown, dry, loose, trace mica	Start Drilling @ 0940
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					





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 ASR 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)			
30.0	30.0	7-C	1.5	26-35 -50/5"	SILTY SAND (SM) gray with orange streaks, moist, very dense, cemented, micaceous (SCRIPPS FORMATION)	
	31.4					
35.0	35.0	8-C	1.3	25-50/5"	SILTY SAND (SM) gray with orange streaks, moist, very dense, cemented, micaceous (SCRIPPS FORMATION)	
	35.9					
40.0	40.0	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)	
	40.9					
45.0	45.0	10-C	0.5	50/6"	SILT (ML) gray to brown, dry, hard, trace mica (SCRIPPS FORMATION)	
	45.5					
50.0	50.0	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
	50.9					
55.0	55.0	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)	
	55.9					
60.0						



PROJECT NUMBER LAO 32316.A7	BORING NUMBER B-91-01
SHEET 3 OF 3	
<b>SOIL BORING LOG</b>	

PROJECT North City Water Reclamation Plant LOCATION North City, San Diego  
 ELEVATION 387 MSL DRILLING CONTRACTOR ASR 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)			
	80.0 80.8	13-C	1.3	6" -6' -6"	48-50/4"	
	65.0				SAME AS ABOVE, except more even (4" to 8") layers (SCRIPPS FORMATION)	
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						



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			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
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)			
5.0	5.0	1-G			CLAYEY SAND (SC) reddish brown, dry, loose, trace mica	Start Drilling @ 1340
	6.0	2-C	1.0	9-50/6"		
10.0	10.0				CLAYEY SAND (SC) reddish brown, dry, very dense, cohesive	
	11.5	3-C	1.5	10-33-50 (83)		
15.0	15.0				POORLY GRADED SAND WITH SILT (SP-SM) yellow, dry, very dense, highly cemented, micaceous, some reddish brown mottling (LINDAVISTA FORMATION)	
	16.5	4-C	1.3	11-33-50 (83)		
20.0	20.0				No recovery	Sampler on rock
	20.3	5-C	0.0	50/3"		
25.0	25.0				SILT (ML) gray to yellow brown, dry, hard, micaceous (SCRIPPS FORMATION)	
	26.4	6-C	1.5	7-37-50/5"		
30.0						



PROJECT NUMBER LAO 32316.A7	BORING NUMBER B-91-02
SHEET 2 OF 2	
<b>SOIL BORING LOG</b>	

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. Poito

DEPTH BELOW SURFACE (FT)	SAMPLE			PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)			
	30.0	7-C	0.8	50/6"	Alternate layers @ 2" to 6" thick <b>POORLY GRADED SAND (SM)</b> reddish brown, dry, very dense, cemented, micaceous (SCRIPPS FORMATION)  <b>SILT (ML)</b> gray, dry, hard, as above (SCRIPPS FORMATION)	DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
35.0	35.0-35.5	8-C	0.8	50/5.5"		
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"	<b>SILT (ML)</b> 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"	<b>POORLY GRADED SAND (SP)</b> yellow to brown, dry, very dense, fine sand (SCRIPPS FORMATION) END OF BORING = 55.5 FEET @ 1600	Driller reports cobbles



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 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
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)			
5.0	5.0					Start Drilling @ 0745
	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					No lab sample taken
	15.4	3-C	0.3	50/4.5"	Same as 2C, except sand moderately cemented (LINDAVISTA FORMATION)	
20.0	20.0					No lab sample taken 2"x2"x1" rock jammed in shoe
	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)	
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	30.0					





PROJECT NUMBER LAO 32316.A7	BORING NUMBER B-91-03
SHEET 2 OF 2	
<b>SOIL BORING LOG</b>	

PROJECT North City Water Reclamation Plant LOCATION North City, San Diego  
 ELEVATION 372 MSL DRILLING CONTRACTOR ASR 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)			
	30.6	6-C	0.6	50/5.5"	Same as above, more yellow, less red sand (SCRIPPS FORMATION)	
35.0	35.0				No recovery	No lab sample taken
	35.3	7-C	0.0	50/4"		Driller indicates possible gravel layer
40.0	40.0				Alternate layers (2"-4") Lean silt as above	
	40.9	8-C	1.2	35-50/5"	<b>SILTY SAND (SM)</b> reddish brown, dry, very dense, highly cemented, fine sand (SCRIPPS FORMATION)	
45.0	45.0				Same as above, except silt and silty sand are swirled, not layered (SCRIPPS FORMATION)	
	45.9	9-C	1.2	28-50/5"		
50.0	50.0				Alternate @ 3" layers	
	50.9	10-C	1.0	29-50/5"	<b>SILT WITH SAND (ML)</b> gray, dry, hard, fine sand (SCRIPPS FORMATION) <b>SILT (ML)</b> and <b>Silty Sand (SM)</b> as in 9C (SCRIPPS FORMATION)	Gravel appears in cuttings as auger is removed
55.0					END OF BORING = 50.9 FEET @ 1000	



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 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
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)			
					Gravel and cobbles top 6'	Start Drilling @ 1035
5.0	5.0	1-G			CLAYEY SAND WITH GRAVEL (SC) reddish brown, dry, gravel up to 1"	No sample attempted, still in cobble layer
10.0	10.0 10.5	2-C	0.3	50/6"	CLAYEY SAND WITH GRAVEL (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"	POORLY GRADED SAND (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"	POORLY GRADED SAND WITH GRAVEL (SP) light brown, moist, dense, micaceous, gravel to 1" (LINDAVISTA FORMATION)	No lab sample taken  Driller still noting gravel
30.0						



PROJECT NUMBER LAO 32316.A7	BORING NUMBER B-91-04
SHEET 2 OF 2	
<b>SOIL BORING LOG</b>	

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)			
	30.0 31.2	6-C	1.0	22-36 -50/2"	Alternate layers (2"-4") <u>POORLY GRADED SAND WITH GRAVEL (SP)</u> reddish brown, moist, very dense, cemented and <u>SILTY SAND (SM)</u> brown to orange, moist, very dense, micaceous, lenses of lean clay @ 1/8" thick (LINDAVISTA FORMATION)	DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
35.0	35.0 35.9	7-C	1.2	35-50/5"		
40.0						
45.0						
50.0						
55.0						



PROJECT NUMBER LAO 32316.A7	BORING NUMBER B-91-05
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SHEET 1 OF 2

## SOIL BORING LOG

PROJECT <u>North City Water Reclamation Plant</u>	LOCATION <u>North City, San Diego</u>
ELEVATION <u>374 MSL</u>	DRILLING CONTRACTOR <u>A&amp;R Drilling</u>
DRILLING METHOD AND EQUIPMENT <u>8-inch Hollow Stem Augers, CME 75 rotary drill rig</u>	
WATER LEVELS <u>Not Encountered</u>	START <u>11/07/91</u> FINISH <u>11/07/91</u> LOGGER <u>C. Polito</u>

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 (SC) reddish brown, dry, fine sand, some gravel to 1/2"	Start Drilling @ 1215
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	30.0					



PROJECT NUMBER LAO 32316.A7	BORING NUMBER B-91-05
SHEET 2 OF 2	
<b>SOIL BORING LOG</b>	

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)			
	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						





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 ASR 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 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
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)			
	2.0				CLAYEY SAND WITH GRAVEL (SC) reddish brown, dry, loose, gravel to 3"	Start Drilling @ 1430
		1-G			CLAYEY SAND (SC) yellow, dry, loose, fine sand, micaceous	
5.0	5.0					No gravel in cuttings but can hear bit hitting rocks
	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					



PROJECT NUMBER LAO 32316.A7	BORING NUMBER B-91-06
SHEET 2 OF 2	
<b>SOIL BORING LOG</b>	

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)			
30.0	30.0 - 30.9	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
45.0	45.0 - 45.1	9-C	0.5	50/1"	POORLY GRADED SAND (SM) light brown, moist, very dense, cemented, fine sand, orange mottling (LINDAVISTA FORMATION) END OF BORING = 45.1 FEET @ 1630	No sample attempted, still in gravel and cobble layer
55.0						



PROJECT NUMBER  
LAO 32316.A7

BORING NUMBER  
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 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
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)			
5.0	5.0	1-G			CLAYEY SAND (SC) reddish brown, dry, loose, occasional gravel to 1/2"  SILTY SAND (SM) reddish brown, dry, very dense, cemented, fine sand, micaceous (LINDAVISTA FORMATION)	Start Drilling @ 0715
	6.0	2-C	1.0	18-50/6"		
10.0	10.0				POORLY GRADED SAND (SP) yellow, moist, very dense, cemented, some gravel, fine sand (LINDAVISTA FORMATION)	Begin entering gravel and cobble layer and 10'
	10.7	3-C	0.8	29-50/2"		
15.0	15.0				CLAYEY SAND WITH GRAVEL (SC) light brown, moist, very dense, light cementation, 30% gravel to 1" (LINDAVISTA FORMATION)	
	15.9	4-C	0.8	33-50/2.5"		
20.0	20.0				Same as 4C except smaller and less gravel (LINDAVISTA FORMATION)	No lab sample
	20.5	5-C	0.3	50/5.5"		
30.0						



PROJECT NUMBER LAO 32316.A7	BORING NUMBER B-91-07
SHEET 2 OF 3	
<b>SOIL BORING LOG</b>	

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)			
	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 ASR 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
<b>SOIL BORING LOG</b>		

PROJECT North City Water Reclamation Plant LOCATION North City, San Diego  
 ELEVATION 320 MSL DRILLING CONTRACTOR ASR 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 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
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)			
		1-G				Start Drilling @ 1340
5.0	5.0					
	6.5	2-C	1.5	19-37-50 (87)	SANDY SILT (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)	
30.0						Driller felt gravel layer 28-30'



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 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
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)			
35.0	30.0	7-C	0.3	50/5.5"	SILTY SAND (SM) light brown, moist, very dense, fine sand (SCRIPPS FORMATION)	No lab sample
	35.4	8-C	0.6	50/5"		
40.0	40.0	9-C	0.6	50/4.5"	Same as 8C (SCRIPPS FORMATION)	END OF BORING = 40.4 FEET @ 1530
	40.4					
45.0						
50.0						
55.0						



PROJECT NUMBER LAO 32316.A7	BORING NUMBER B-91-09	SHEET 1 OF 2
<b>SOIL BORING LOG</b>		

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
		1-G				Start Drilling @ 0920
5.0	5.0				CLAYEY SAND (SC) reddish brown, dry, loose, very fine sand	Large rock at 4'
	5.9	2-C	1.0	21-50/5"	CLAYEY SAND (SC) reddish brown, moist, very dense, fine sand, cohesive	
10.0	10.0					No lab sample
	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)	
15.0	15.0					No lab sample
	15.4	4-C	0.3	50/5"	Same as 3C (LINDAVISTA FORMATION)	
20.0	20.0					No lab sample
	20.6	5-C	0.8	42-50/1"	Same as 3C (LINDAVISTA FORMATION)	
25.0	25.0					No lab sample
	25.4	6-C	0.3	50/5"	Same as 3C Gravel to 2" (LINDAVISTA FORMATION)	
30.0						



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)			
	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	



PROJECT NUMBER LAO 32316.A7	BORING NUMBER B-91-10
SHEET 1 OF 1	
<b>SOIL BORING LOG</b>	

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
		1-G			<u>CLAYEY SAND (SC)</u> dark brown, moist, loose, fine sand, gravel to 1/2"	Start Drilling @ 1045
5.0	5.0				<u>SANDY LEAN CLAY WITH GRAVEL (CL)</u> reddish brown, moist, very dense, cohesive, fine sand, gravel to 1" @ 40%	
	6.5	2-C	1.0	14-55-46 (101)		
	10.0				<u>SANDY SILT (ML)</u> gray to light brown, moist, hard, micaceous, orange mottling of very fine sand (SCRIPPS FORMATION)	
10.0	11.5	3-C	1.5	10-35-50 (85)		
	15.0				<u>SILTY SAND (SM)</u> reddish brown to orangish brown, moist, very dense, micaceous, nonplastic fines, fine sand (SCRIPPS FORMATION)	
15.0	15.8	4-C	0.8	23-50/4"		
	20.0				Same as 4C (SCRIPPS FORMATION)	
20.0	20.9	5-C	1.0	9-50/5"		
	25.0				Same as 4C Sand is yellower (SCRIPPS FORMATION)	
25.0	25.9	6-C	1.0	11-50/5"		
					END OF BORING = 25.9 FEET @ 1135	





PROJECT NUMBER LAO 32316.A7	BORING NUMBER B-91-11	SHEET 1 OF 1
<b>SOIL BORING LOG</b>		

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 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
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)			
5.0	5.0	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
	5.8	2-C	0.9	33-50/4"		
10.0	10.0				POORLY GRADED SAND WITH SILT (SP-SM) orangish brown, moist, very dense, micaceous, fine uniform sand (LINDAVISTA FORMATION)	
	10.3	3-C	0.3	50/3"		
15.0	15.0				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
	15.4	4-C	0.0	50/4.5"		
20.0	20.0				No recovery	Driller pulled augers to replace teeth on bit
	20.5	5-C	0.3	50/5.5"		
25.0	25.0				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
	25.1	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



PROJECT NUMBER LAO 32316.A7	BORING NUMBER B-91-12	SHEET 1 OF 2
<b>SOIL BORING LOG</b>		

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 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
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)			
		1-G			<u>CLAYEY SAND (SC)</u> dark brown, dry, loose, fine sand	Start Drilling @ 1500
5.0	5.0					
	6.5	2-C	1.3	18-42 -50/4.5"	<u>SANDY LEAN CLAY (SC)</u> 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"	<u>POORLY GRADED SAND (SP)</u> 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"	<u>POORLY GRADED SAND (SP)</u> 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					



PROJECT NUMBER  
LAO 32316.A7

BORING NUMBER  
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 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
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)			
	30.0 30.9	7-C	0.8	22-50/4.5"	SILTY SAND (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) END OF BORING = 35.7 FEET @ 1135	No lab sample, no rings in sampler
40.0						
45.0						
50.0						
55.0						



PROJECT NUMBER LAO 32316.A7	BORING NUMBER B-91-13	SHEET 1 OF 2
<b>SOIL BORING LOG</b>		

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
		1-G				Start Drilling @ 0715
5.0	5.0				CLAYEY SAND (SC) brown, moist, loose, fine sand, some 1" gravel	
	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						



PROJECT NUMBER  
LAO 32316.A7

BORING NUMBER  
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 ASR 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)			
	30.0	7-C		6" -6" -6"	Same as 4C 4" seam of lean gray silt Silt - gray, moist, hard (SCRIPPS FORMATION)	DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	31.5					
35.0						
40.0						
45.0						
50.0						
55.0					END OF BORING = 31.5 FEET @ 0830	





PROJECT NUMBER LAO 32316.A7	BORING NUMBER B-91-14
SHEET 1 OF 3	
<b>SOIL BORING LOG</b>	

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
		1-G				Start Drilling @ 0915
5.0	5.0				CLAYEY SAND (SC) dark brown, dry, loose, occasional gravel to 1"	Gravel and cobbles
	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	30.0					



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 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
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)			
30.0	30.0	7-C			No sample attempted	Large rock, very hard @ 18" thick
	31.5					
35.0	35.0	8-C	0.7	50/5.5"	Same as 6-C (SCRIPPS FORMATION)	
	35.5					
40.0	40.0	9-C	1.0	30-50/4.5"	SANDY SILT (ML) gray, moist, hard, orange mottling of fine sand, 1/8" to 1/4" lenses of silt (SCRIPPS FORMATION)	
	40.9					
45.0	45.0	10-C	0.8	50/6"	Same as 6-C, except more sand, not quite as hard (SCRIPPS FORMATION)	
	45.5					
50.0	50.0	11-C		40-50/4"	Same as 10-C (SCRIPPS FORMATION)	
	50.8					
55.0	55.0	12-C		44-50/4"	Same as 6-C (SCRIPPS FORMATION)	
	55.8					
60.0						



PROJECT NUMBER LAO 32316.A7	BORING NUMBER B-91-14
SHEET 3 OF 3	
<b>SOIL BORING LOG</b>	

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)			
	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	
75.0						
80.0						Large rock, hole terminated Entire clay layer (20-70') has intermittent 1 to 2 foot thick gravel layers
85.0						



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 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
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)			
		1-G				Start Drilling @ 1315
5.0	5.0				CLAYEY SAND (SC) reddish brown, dry, loose, fine sand	
	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					
25.0					END OF BORING = 23.0 FEET @ 1420	Large rock, hole terminated



PROJECT NUMBER LAO 32316.A7	BORING NUMBER B-91-16
SHEET 1 OF 2	
<b>SOIL BORING LOG</b>	

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. Poito

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				Start Drilling @ 1455
5.0	5.0				<u>CLAYEY SAND</u> (SC) reddish brown, dry, loose, fine sand	Gravel layer
	6.4	2-C	1.4	17-39 -50/5"	<u>SANDY SILT</u> (ML) gray, moist, hard, orange mottling of fine sand, almost 50/50 sand and silt (SCRIPPS FORMATION)	
10.0	10.0				Same as 2C (SCRIPPS FORMATION)	
	11.5	3-C	1.3	8-25 -50/8"	Same as 2C (SCRIPPS FORMATION)	
15.0	15.0				Same as 2C (SCRIPPS FORMATION)	
	16.4	4-C	1.0	10-36 50/4.5"	Same as 2C (SCRIPPS FORMATION)	
20.0	20.0				Same as 2C (SCRIPPS FORMATION)	No lab sample
	20.9	5-C	0.5	24-50/5"	Same as 2C (SCRIPPS FORMATION)	
25.0	25.0				Same as 2C (SCRIPPS FORMATION)	
	25.9	6-C	0.9	46-50/5"	Same as 2C (SCRIPPS FORMATION)	
30.0	30.0					





PROJECT NUMBER  
LAO 32316.A7

BORING NUMBER  
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 ASR 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 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
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)			
35.0	30.0 30.8	7-C	1.0	28-50/3.5"	Same as 2C (SCRIPPS FORMATION)	
	35.0					
	35.8	8-C	1.0	45-50/3"	Same as 2C (SCRIPPS FORMATION)	
	36.5					
40.0					END OF BORING = 36.5 FEET @ 1555	
45.0						
50.0						
55.0						



PROJECT NUMBER LAO 32316.A7	BORING NUMBER B-91-17	SHEET 1 OF 2
<b>SOIL BORING LOG</b>		

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 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
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)			
		1-G			CLAYEY SAND (SC) dark brown, dry, loose, fine sand	Start Drilling @ 1630
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						



PROJECT NUMBER  
LAO 32316.A7

BORING NUMBER  
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			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
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)			
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
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	



PROJECT NUMBER LAO 32316.A7	BORING NUMBER B-91-18
SHEET 1 OF 2	
<b>SOIL BORING LOG</b>	

PROJECT North City Water Reclamation Plant LOCATION North City, San Diego  
 ELEVATION 388 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"		
5.0	5.0	1-G			<u>CLAYEY SAND WITH GRAVEL (SC)</u> reddish brown, dry, loose, fine sand, gravel to 1/2"  <u>SILTY SAND WITH GRAVEL (SM)</u> reddish brown, moist, very dense, fine sand, gravel to 1/2" (LINDAVISTA FORMATION)	Start Drilling @ 0800  Gravels and cobbles
	5.8	2-C	0.7	18-50/2.5"		
10.0	10.0				<u>POORLY GRADED SAND (SP)</u> yellow, moist, very dense, uniform fine sand (LINDAVISTA FORMATION)	
	11.4	3-C	1.2	20-38 -50/5"		
15.0	15.0				Same as 3-C (LINDAVISTA FORMATION)	
	16.3	4-C	1.0	8-40 -50/2.5"		
20.0	20.0				Same as 3-C, except with gravel to 1/2" (LINDAVISTA FORMATION)	No lab sample
	20.6	5-C	0.4	35-50/1"		
25.0	25.0				<u>POORLY GRADED SAND</u> , with some silt, orange mottling, moist, very dense (SCRIPPS FORMATION)	No lab sample
	25.5	6-C	0.4	50/6"		
30.0						



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 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
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)			
35.0	30.0 30.8	7-C	0.8	19-50/3.5"	Same as 6-C, very fine sand (SCRIPPS FORMATION)	
	35.0 35.4	8-C	0.6	50/5"		
40.0	40.0 40.8	9-C	1.0	46-50/6"	Same as 8-C (SCRIPPS FORMATION)	
	45.0 45.8	10-C	0.8	38-50/3"		
50.0	50.0 50.7	11-C		39-50/2"	Same as 8-C (SCRIPPS FORMATION)	
	51.5					
55.0					END OF BORING = 51.5 FEET @ 0940	





PROJECT NUMBER LAO 32316.A7	BORING NUMBER B-91-19	SHEET 1 OF 2
<b>SOIL BORING LOG</b>		

PROJECT North City Water Reclamation Plant LOCATION North City, San Diego  
 ELEVATION 371 MSL DRILLING CONTRACTOR ASR 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 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
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)			
5.0	5.0	1-G			CLAYEY SAND WITH GRAVEL (SC) reddish brown, dry, loose, fine sand, gravel to 1"	Start Drilling @ 1030  Gravels and cobbles
	5.8	2-C	0.0	38-50/1"		
10.0	10.0				No recovery	No lab sample
	10.4	3-C	0.0	50/5"		
15.0	15.0				SANDY SILT (ML) gray, moist, hard, orange mottling of fine sand (SCRIPPS FORMATION)	
	15.9	4-C	1.0	39-50/4.5"		
20.0	20.0				Same as 4-C, except some black mottling (SCRIPPS FORMATION)	
	21.4	5-C	1.4	13-34 50/5"		
25.0	25.0				Same as 4-C (SCRIPPS FORMATION)	
	25.8	6-C	0.8	20-50/4"		
30.0						



PROJECT NUMBER  
LAO 32316.A7

BORING NUMBER  
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			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
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)			
35.0	30.0 30.9	7-C	0.8	14-50/4.5"	Same as 4-C (SCRIPPS FORMATION)	
	35.0 35.5	8-C	0.7	50/5.5"		
40.0	40.0 40.5	9-C	0.8	50/5.5"	Same as 4-C (SCRIPPS FORMATION)	
	45.0 45.9	10-C	0.8	13-50/4.5"		
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**



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 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
	INTERVAL	NUMBER AND TYPE		
5	1.0		<u>CLAYEY SAND (SC)</u> brown, dry, dense, broke into 6" chunks (SCRIPPS FORMATION)  <u>SANDY LEAN CLAY (CL)</u> gray, moist, hard, orange mottling of fine sand, broke into plates @ 6"x4"x2", orange seams appear predominately horizontal in trench walls (SCRIPPS FORMATION)	No evidence of gravel or cobbles in top 12'
	2.0	1-B		
	5.0			
	6.0	2-B		
10				
	12.0		END TEST PIT @ 12 FEET	
15				
20				
25				



PROJECT NUMBER LA032316.A7	TEST PIT NUMBER 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)	
5			END TEST PIT @ 4 FEET	
10				
15				
20				
25				





PROJECT NUMBER LA032316.A7	TEST PIT NUMBER 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 Kobelco 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		
5	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 qu > 4.5 TSF (pocket penetrometer)
	4.0		SANDY SILT, (ML) gray, moist, hard, orange mottling of fine sand (SCRIPPS FORMATION)	
5			END TEST PIT @ 4 FEET	
10				
15				
20				
25				



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 Kobelco 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 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
	INTERVAL	NUMBER AND TYPE		
1.75			<u>CLAYEY SAND</u> , (SC) brown, dry, hard	No gravel
4.0			<u>SANDY SILT</u> , (ML) gray, moist, hard, orange mottling of fine sand (SCRIPPS FORMATION)	Contact varies from 1.5 to 2.0 feet
5			END TEST PIT @ 4 FEET	
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 Kobelco 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		
5	3.0	1-B	CLAYEY SAND (SC) brown, moist, loose, fine sand	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
	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)	
	12.0	2-B		
15			END TEST PIT @ 12 FEET	
20				
25				



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 Kobelco 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		
5	1.0		SANDY LEAN CLAY WITH GRAVEL (SC) dark brown, dry, loose, very fine sand, layers of clean medium sand, gravel to 3" 5 to 10%	DIFFICULTY IN EXCAVATION, RUNNING GRAVEL CONDITION, COLLAPSE OF WALLS, SAND HEAVE DEBRIS ENCOUNTERED, WATER SEEPAGE GRADATIONAL CONTACTS, TESTS, INSTRUMENTATION
	2.0	1-B		
	3.5			
	5.0		SANDY LEAN CLAY, (CL) gray, moist, hard, orange mottling of fine sand, no distinct layering, bedding or fracturing (SCRIPPS FORMATION)	
	6.0	2-B		
10			Strength increases with depth, breaks into larger chunks when excavated	Contact varies between 3 and 4 foot  Single 3'x 2'x 1' rock    Single 8"x 6"x 4" rock
	12.0		END TEST PIT @ 12 FEET	
15				
20				
25				



PROJECT NUMBER LA032316.A7	TEST PIT NUMBER 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		
5	3.0		<u>SANDY LEAN CLAY WITH GRAVEL (SC)</u> dark brown, dry, loose, very fine sand, 30% gravel to 3"	
	6.0		<u>POORLY GRADED SAND WITH GRAVEL (SP)</u> orange, moist, medium, fine uniform sand, 25% gravel and cobble to 6"	
	12.0		<u>SANDY SILT (ML)</u> gray, moist, hard, orange mottling of fine sand (SCRIPPS FORMATION)	
15		END TEST PIT @ 12 FEET		
20				
25				





PROJECT NUMBER LA032316.A7	TEST PIT NUMBER 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		
5	1.0	1-B	SANDY LEAN CLAY WITH GRAVEL (SC) dark brown, dry, loose, very fine sand, 30% gravel to 3"	
	2.0			
	3.0			
	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				



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 Kobelco 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"	
5.0			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	



PROJECT NUMBER LA032316.A7	TEST PIT NUMBER 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 Kobelco 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
5	2.5		<u>SANDY FAT CLAY</u> (CH) dark brown, moist, hard, very fine sand	Large shrinkage cracks in top 2'
	6.0		<u>SANDY LEAN CLAY</u> (CL) gray, moist, hard, orange mottling of fine sand, broke into cubes @ 6"x6"x6" (SCRIPPS FORMATION)	
	10.0		<u>SANDY LEAN CLAY</u> (CL) gray, moist, hard (SCRIPPS FORMATION)	
10			END TEST PIT @ 10 FEET	
15				
20				
25				



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 Kobelco 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		
2.0			SANDY LEAN CLAY (CL) dark brown, dry, very fine sand	
4.0			SANDY LEAN CLAY (CL) reddish brown, moist, medium, fine sand	
4.5			POORLY GRADED SAND (SP) orange, moist, loose, uniform fine sand (SCRIPPS FORMATION)	
6.0				
			SANDY LEAN CLAY (CL) gray, moist, hard, mottling of fine orange sand (SCRIPPS FORMATION)	
			END TEST PIT @ 6 FEET	



PROJECT NUMBER LAO32316.A7	TEST PIT NUMBER 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 Kobelco 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		
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			END TEST PIT @ 12 FEET	
20				
25				





PROJECT NUMBER LA032316.A7	TEST PIT NUMBER 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 Kobelco 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		
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			END TEST PIT @ 11 FEET	
20				
25				



PROJECT NUMBER LAO32316.A7	TEST PIT NUMBER 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		
1.0			CLAYEY SAND WITH GRAVEL (SC) reddish brown, dry, loose, fine sand, 10% gravel	DIFFICULTY IN EXCAVATION, RUNNING GRAVEL CONDITION, COLLAPSE OF WALLS, SAND HEAVE DEBRIS ENCOUNTERED, WATER SEEPAGE GRADATIONAL CONTACTS, TESTS, INSTRUMENTATION
3.0			CLAYEY SAND (SC) reddish brown, dry, dense, fine sand	
5.0			POORLY GRADED SAND (SP) orange to yellow, moist, dense, uniform fine sand, highly cemented zones, breaks into 1" thick plates (LINDAVISTA FORMATION)	
			POORLY GRADED SAND WITH GRAVEL (SP) orange and yellow, moist, fine sand, gravel to 4", occasional cobble to 1' (LINDAVISTA FORMATION)	
11.0			POORLY GRADED SAND WITH GRAVEL (SP) orange, moist, fine sand, 30% 1" gravel (LINDAVISTA FORMATION)	
12.0			END TEST PIT @ 12 FEET	



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		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	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)	
10	10.0			
	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)	
15		END TEST PIT @ 12 FEET		
20				
25				



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 Kobieco 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		
5	2.0	1-B	LEAN CLAY WITH SAND. (CL) dark brown, moist, hard, fine sand, 5% gravel to 1"	
	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		
12.0				
15			END TEST PIT @ 12 FEET	
20				
25				



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 Kobelco 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, COI OR. 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	2.0		<u>CLAYEY SAND (SC)</u> reddish brown, dry, loose, very fine sand	
	5.0	1-B	<u>WELL GRADED SAND (SW)</u> yellow, moist, dense, some highly cemented, occasional 1" gravel (LINDAVISTA FORMATION)	
	6.0	2-B	<u>POORLY GRADED SAND (SP)</u> orange to yellow, moist, dense, cemented, fine sand, trace mica, occasional gravel and cobbles to 8" (LINDAVISTA FORMATION)	
	8.0			
10	12.0		END TEST PIT @ 12 FEET	
15				
20				
25				





PROJECT NUMBER LA032316.A7	TEST PIT NUMBER 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		
5	2.0	1-B	WELL GRADED GRAVEL WITH SILT AND SAND (GW-GM) reddish brown, dry, very hard, fine sand, 10% gravel to 2"	DIFFICULTY IN EXCAVATION, RUNNING GRAVEL CONDITION, COLLAPSE OF WALLS, SAND HEAVE DEBRIS ENCOUNTERED, WATER SEEPAGE GRADATIONAL CONTACTS, TESTS, INSTRUMENTATION
	5.0		SANDY GRAVEL (GW-GM) gray, dry, very dense, highly cemented, sand well graded, gravel to 4" (LINDAVISTA FORMATION)	
	6.0	2-B		
	8.0			
10			POORLY GRADED SAND (SP) orange to yellow, moist, dense, fine sand, micaceous, occasional 1" gravel (LINDAVISTA FORMATION)	
	12.0		END TEST PIT @ 12 FEET	
15				
20				
25				



PROJECT NUMBER LA032316.A7	TEST PIT NUMBER 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 Kobelco 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
5	2.0	1-B	CLAYEY SAND WITH GRAVEL (SC) dark brown, dry, very loose, fine sand, micaceous, 25% gravel to 4", chiefly 1"	
	3.0			
10	8.0	2-B	CLAYEY SAND WITH GRAVEL (SC) dark brown, dry, loose, fine sand, micaceous, 25% gravel to 4", chiefly 1"	
	10.0			
15	12.0		POORLY GRADED SAND WITH GRAVEL (SP) orange to yellow, moist, dense, mostly fine, some medium sand, 30% gravel 4" to 1/2" (LINDAVISTA FORMATION)	
20			END TEST PIT @ 12 FEET	
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 LC11 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				



PROJECT NUMBER LA032316.A7	TEST PIT NUMBER 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 Kobelco 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		
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"	DIFFICULTY IN EXCAVATION, RUNNING GRAVEL CONDITION, COLLAPSE OF WALLS, SAND HEAVE DEBRIS ENCOUNTERED, WATER SEEPAGE GRADATIONAL CONTACTS, TESTS, INSTRUMENTATION
5.0	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	

**Appendix C**  
**Laboratory Test Data**



**Table C-1  
Atterberg Limits**

<b>Location</b>	<b>Depth (feet)</b>	<b>LL</b>	<b>PL</b>	<b>PI</b>	<b>Classification</b>
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

<b>Table C-2 Percent Passing the No. 200 Sieve</b>		
<b>Location</b>	<b>Depth (feet)</b>	<b>Percent Passing No. 200 Sieve</b>
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

<b>Table C-3 Expansion Index Test</b>			
<b>Location</b>	<b>Material</b>	<b>Expansion Index</b>	<b>Expansion Potential</b>
TP-1	Scripps Formation, ML	44	Low
TP-21	Alluvium, CL	60	Medium
TP-21	Scripps Formation, ML	28	Low

<b>Table C-4 Modified Proctor Test (ASTM D 1557)</b>			
<b>Location</b>	<b>Material</b>	<b>Maximum Dry Density (PCF)</b>	<b>Optimum Water Content (%)</b>
TP-1	ML	111.7	14.8
TP-6/TP-21	CL	111.9	15.7
TP-17	SM	119.6	12.2

<b>Table C-5 Direct Shear Test</b>					
<b>Description</b>	<b>Soil Type</b>	<b>Location</b>	<b>Depth (feet)</b>	<b>Cohesion</b>	<b>Friction Angle</b>
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

<b>Table C-6 Swell Pressure Test</b>		
<b>Location</b>	<b>Material</b>	<b>Swell Pressure (psf)</b>
TP-1/TP-5	CL	850
TP-6/TP-21	CL	2,050

PROJECT NAME: *CH 2 M Hill*

PROJECT NUMBER *102208-01*

SAMPLE LOCATION *B3*

DEPTH *25'*

TECHNICIAN *G.M.*

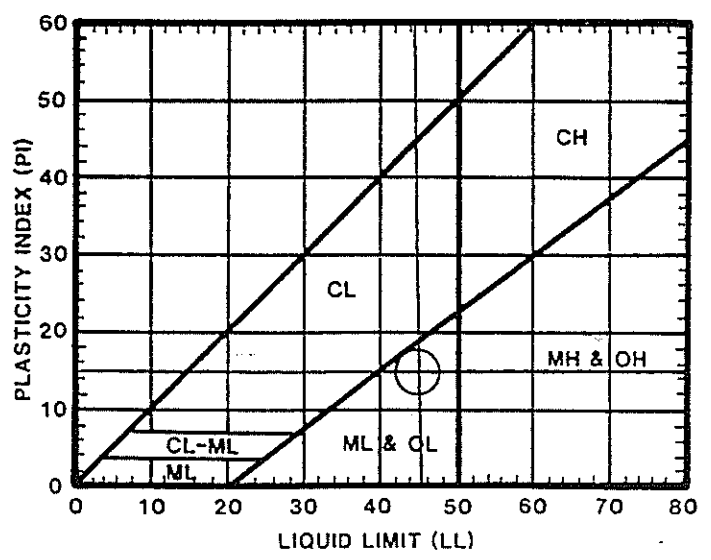
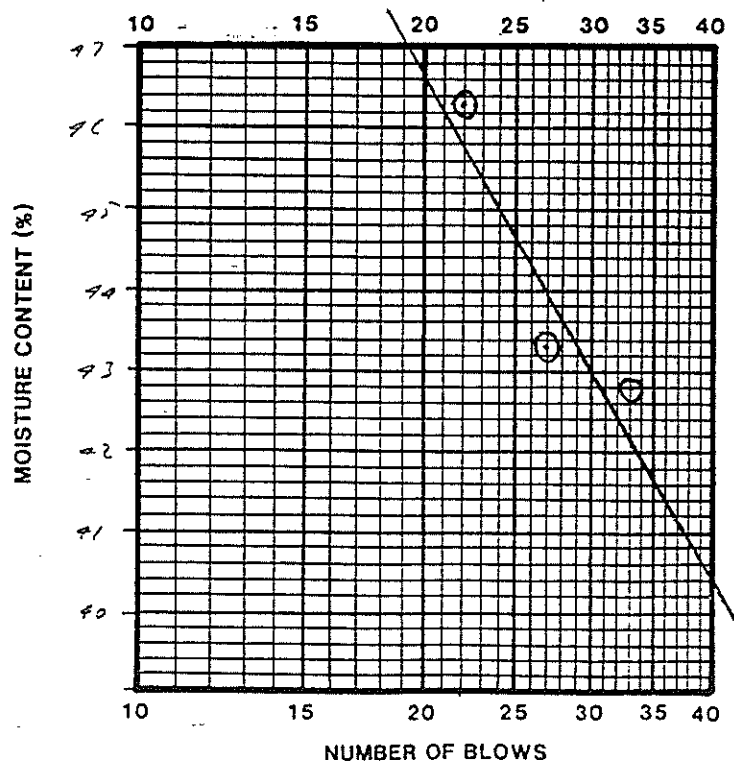
DATE *12-19-91*

SYMBOL	LIQUID LIMIT			PLASTIC LIMIT		SUMMARY
	21	22	41	23	29	
CAN NO.						
WEIGHT OF WET SOIL + TARE	<i>31.41</i>	<i>30.69</i>	<i>32.31</i>	<i>21.51</i>	<i>22.93</i>	LL = <i>45</i>
WEIGHT OF DRY SOIL + TARE	<i>26.57</i>	<i>26.06</i>	<i>26.92</i>	<i>20.07</i>	<i>20.91</i>	PL = <i>30</i>
WEIGHT OF WATER	<i>4.84</i>	<i>4.63</i>	<i>5.39</i>	<i>1.44</i>	<i>1.52</i>	PI = <i>15</i>
TARE	<i>15.38</i>	<i>15.25</i>	<i>15.28</i>	<i>15.22</i>	<i>15.80</i>	
WEIGHT OF DRY SOIL	<i>11.19</i>	<i>10.81</i>	<i>11.64</i>	<i>4.85</i>	<i>5.11</i>	
WATER CONTENT (%)	<i>43.3</i>	<i>42.8</i>	<i>46.3</i>	<i>29.7</i>	<i>29.7</i>	UNIFIED SOIL CLASSIFICATION: <i>ML</i>
NO. OF BLOWS	<i>27</i>	<i>33</i>	<i>22</i>	—	—	

SAMPLE LOCATION	DEPTH	TECHNICIAN	DATE

SYMBOL	LIQUID LIMIT			PLASTIC LIMIT		SUMMARY
CAN NO.						
WEIGHT OF WET SOIL + TARE						LL =
WEIGHT OF DRY SOIL + TARE						PL =
WEIGHT OF WATER						PI =
TARE						
WEIGHT OF DRY SOIL						
WATER CONTENT (%)						UNIFIED SOIL CLASSIFICATION:
NO. OF BLOWS				—	—	



TR5

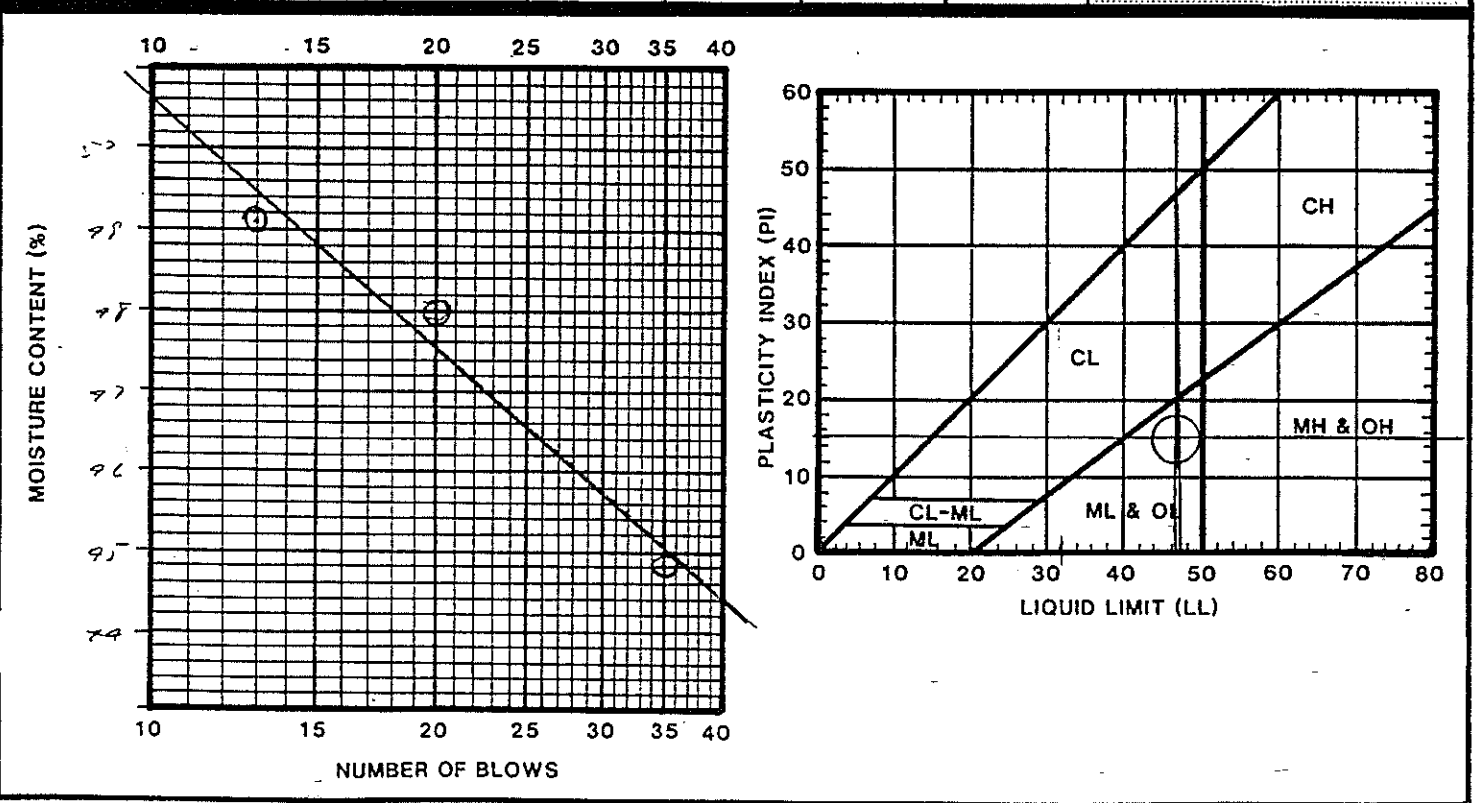
PROJECT NAME CA 2 M Hill PROJECT NUMBER 10 2208-01

SAMPLE LOCATION B 8 DEPTH 20' TECHNICIAN G.M. DATE 12-19-91

SYMBOL	⊕	LIQUID LIMIT			PLASTIC LIMIT		SUMMARY
		19	20	39	33	18	
CAN NO.							LL = 47
WEIGHT OF WET SOIL + TARE		30.38	30.83	33.30	22.92	22.37	
WEIGHT OF DRY SOIL + TARE		25.98	25.66	27.87	21.12	20.53	PL = 32
WEIGHT OF WATER		4.90	5.17	5.43	1.80	1.84	
TARE		15.51	14.89	15.79	15.57	14.85	PI = 15
WEIGHT OF DRY SOIL		9.97	10.77	12.13	5.55	5.68	
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.							LL =
WEIGHT OF WET SOIL + TARE							
WEIGHT OF DRY SOIL + TARE							PL =
WEIGHT OF WATER							
TARE							PI =
WEIGHT OF DRY SOIL							
WATER CONTENT (%)							UNIFIED SOIL CLASSIFICATION
NO. OF BLOWS					—	—	





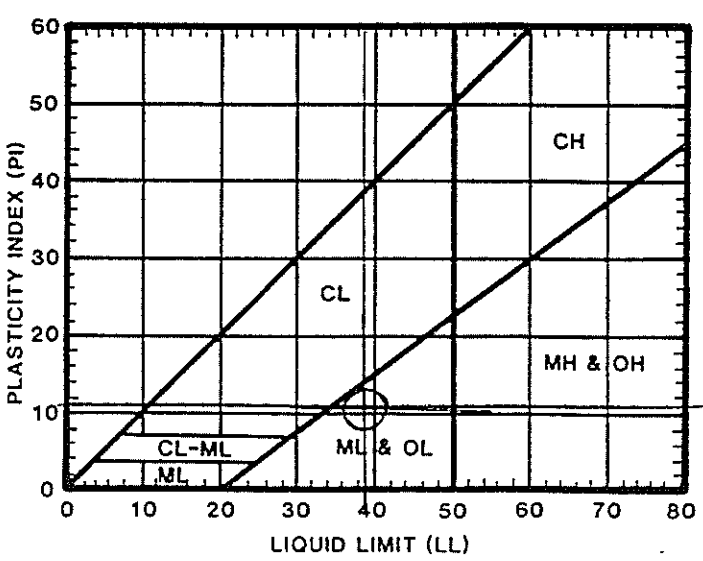
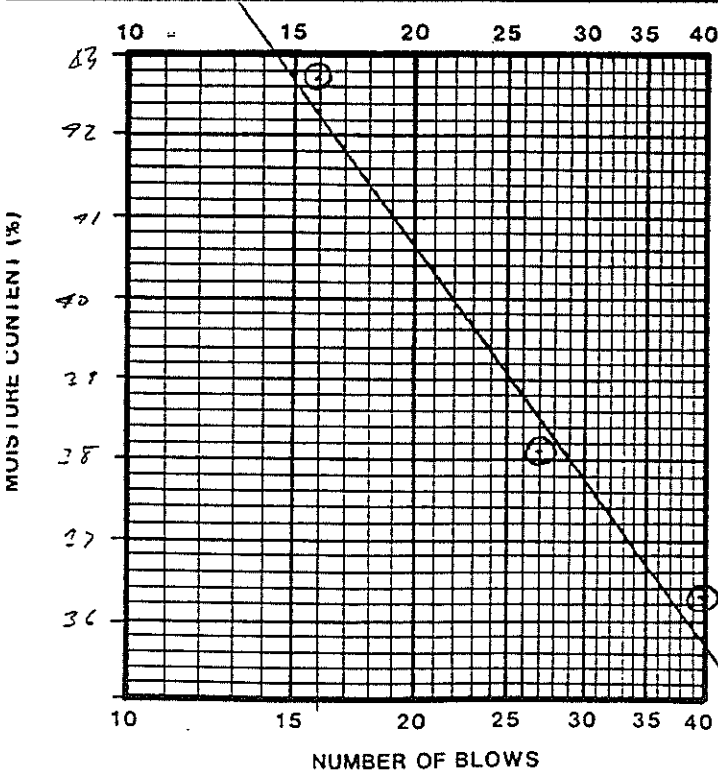
PROJECT NAME CH 24 Hill PROJECT NUMBER 102208-01

SAMPLE LOCATION B 13 DEPTH 15' TECHNICIAN G.M. DATE 12-22-91

SYMBOL	⊕	LIQUID LIMIT			PLASTIC LIMIT		SUMMARY
		15	16	17	4	5	
CAN NO.							
WEIGHT OF WET SOIL + TARE		32.69	33.47	33.57	25.51	27.39	LL = 39
WEIGHT OF DRY SOIL + TARE		27.98	28.73	28.08	22.74	29.66	
WEIGHT OF WATER		4.71	4.74	5.49	2.77	2.73	PL = 28
TARE		15.63	15.67	15.21	13.01	15.04	PI = 11
WEIGHT OF DRY SOIL		12.35	13.06	12.87	9.73	9.62	
WATER CONTENT (%)		38.1	36.3	42.7	28.5	28.4	UNIFIED SOIL CLASSIFICATION <u>ML</u>
NO. OF BLOWS		27	40	16	—	—	

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							PI =
WEIGHT OF DRY SOIL							
WATER CONTENT (%)							UNIFIED SOIL CLASSIFICATION
NO. OF BLOWS					—	—	



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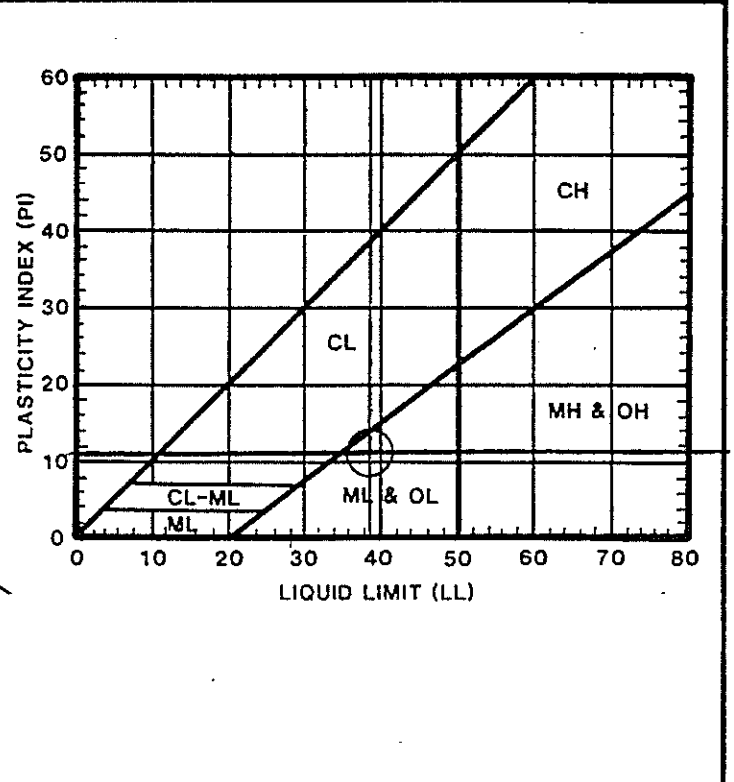
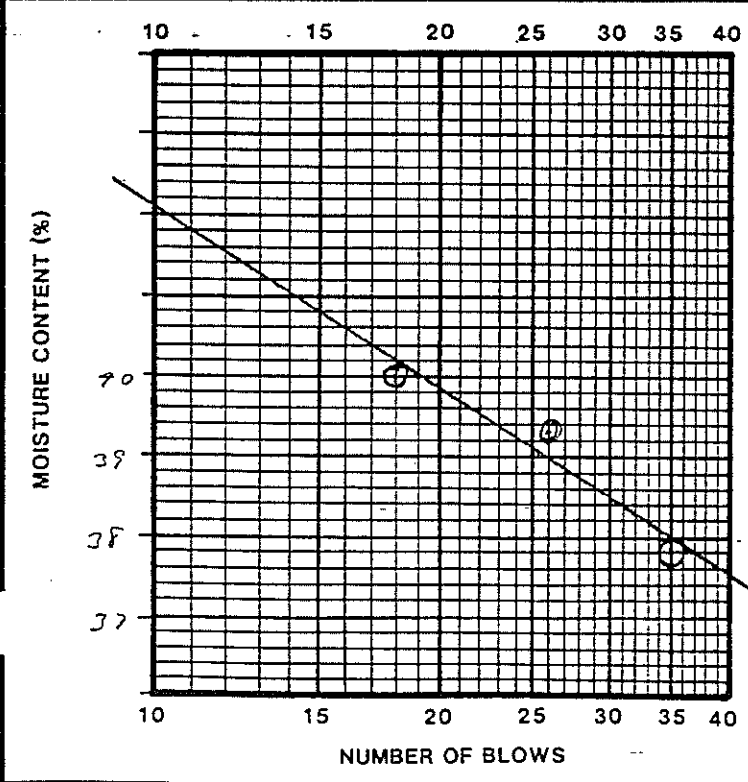
PROJECT NAME *CH 2 M Hill* PROJECT NUMBER *102208-01*

SAMPLE LOCATION *B 17* DEPTH *35'* TECHNICIAN *G.M.* DATE *12-19-91*

SYMBOL	LIQUID LIMIT			PLASTIC LIMIT		SUMMARY
	31	32	35	44	16	
CAN NO.						
WEIGHT OF WET SOIL + TARE	31.27	29.33	32.73	23.20	23.29	LL = 39
WEIGHT OF DRY SOIL + TARE	26.81	25.40	27.33	21.96	21.44	PL = 28
WEIGHT OF WATER	4.46	3.93	5.40	1.74	1.80	PI = 11
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	
WATER CONTENT (%)	40.0	39.3	37.8	27.9	29.0	UNIFIED SOIL CLASSIFICATION
NO. OF BLOWS	18	26	35	—	—	<i>ML</i>

SAMPLE LOCATION DEPTH TECHNICIAN DATE

SYMBOL	LIQUID LIMIT			PLASTIC LIMIT		SUMMARY
CAN NO.						
WEIGHT OF WET SOIL + TARE						LL =
WEIGHT OF DRY SOIL + TARE						PL =
WEIGHT OF WATER						PI =
TARE						
WEIGHT OF DRY SOIL						
WATER CONTENT (%)						UNIFIED SOIL CLASSIFICATION
NO. OF BLOWS				—	—	



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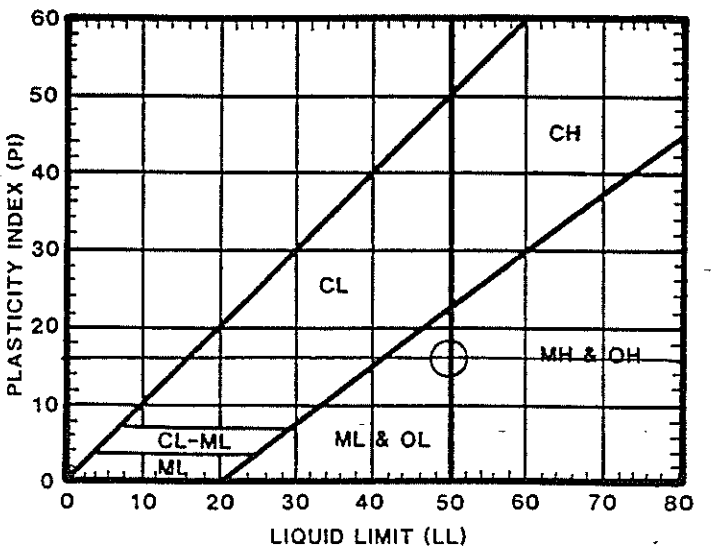
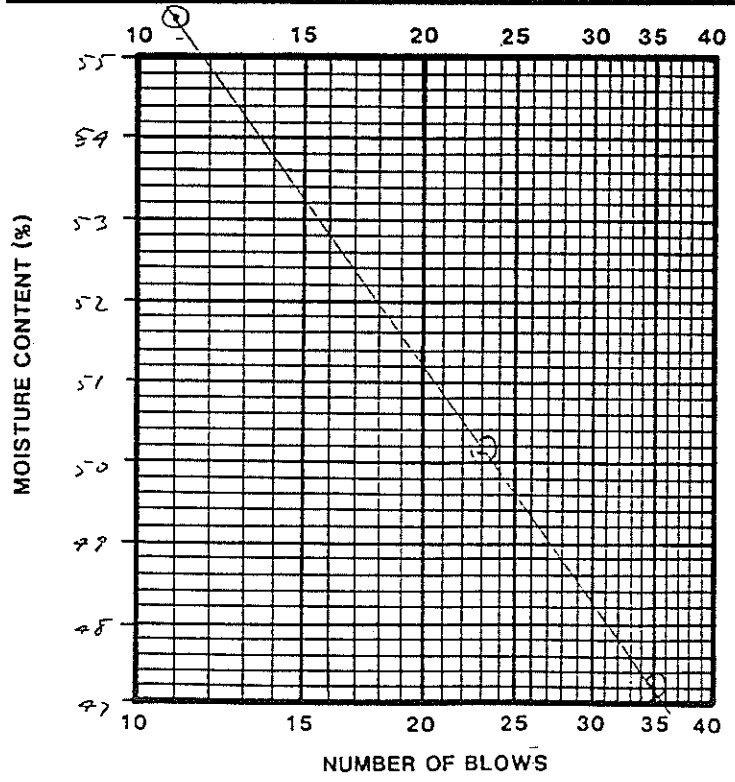
PROJECT NAME C42 M Hill PROJECT NUMBER 102208-01

SAMPLE LOCATION B16 DEPTH 15' TECHNICIAN G.M. DATE 12-20-91

SYMBOL	LIQUID LIMIT			PLASTIC LIMIT		SUMMARY
	1	2	3	49	50	
CAN NO.						
WEIGHT OF WET SOIL + TARE	71.00	33.63	29.28	23.57	29.04	LL = 50
WEIGHT OF DRY SOIL + TARE	25.25	26.71	23.75	21.50	21.66	PL = 34
WEIGHT OF WATER	5.75	6.92	5.83	2.07	2.38	
TARE	13.07	12.89	12.94	15.41	14.61	PI = 16
WEIGHT OF DRY SOIL	12.18	13.82	10.51	6.09	7.05	
WATER CONTENT (%)	47.2	50.1	55.5	34.0	33.8	UNIFIED SOIL CLASSIFICATION ML
NO. OF BLOWS	35	23	11	—	—	

SAMPLE LOCATION \_\_\_\_\_ DEPTH \_\_\_\_\_ TECHNICIAN \_\_\_\_\_ DATE \_\_\_\_\_

SYMBOL	LIQUID LIMIT			PLASTIC LIMIT		SUMMARY
CAN NO.						
WEIGHT OF WET SOIL + TARE						LL =
WEIGHT OF DRY SOIL + TARE						PL =
WEIGHT OF WATER						
TARE						PI =
WEIGHT OF DRY SOIL						
WATER CONTENT (%)						UNIFIED SOIL CLASSIFICATION
NO. OF BLOWS						



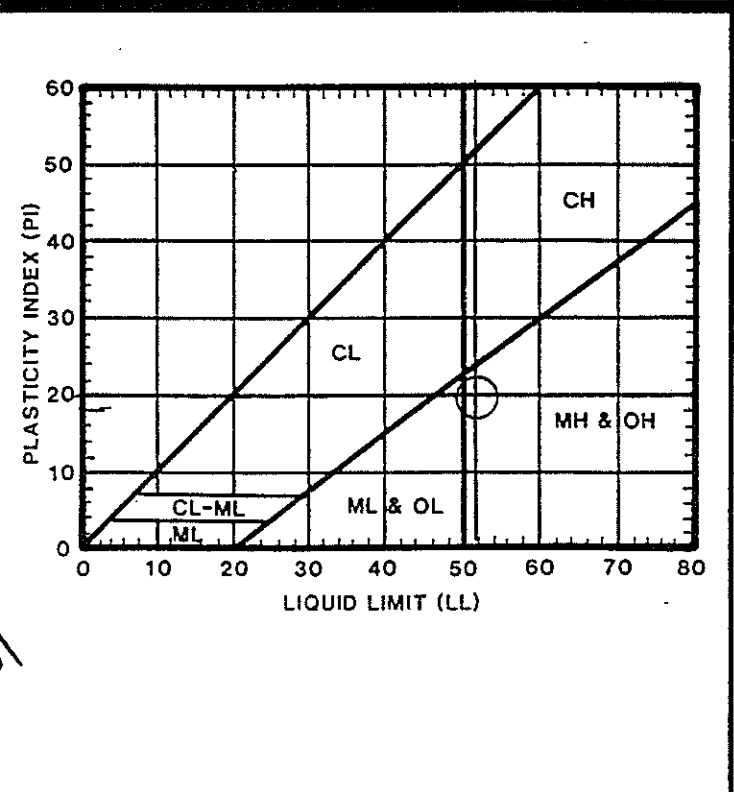
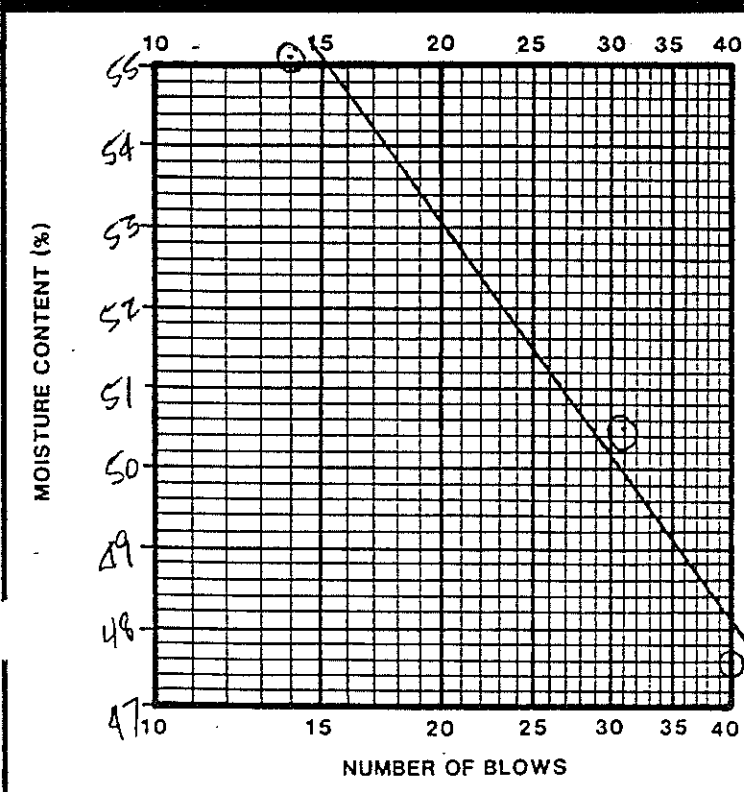
PROJECT NAME CH 2 M Hill PROJECT NUMBER 102208-01

SAMPLE LOCATION B 17 DEPTH 30 TECHNICIAN G.M. DATE 12-20-91

SYMBOL	LIQUID LIMIT			PLASTIC LIMIT		SUMMARY
	5	8	9	14	15	
CAN NO.						
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						



JCS

PROJECT NAME 42M HILL

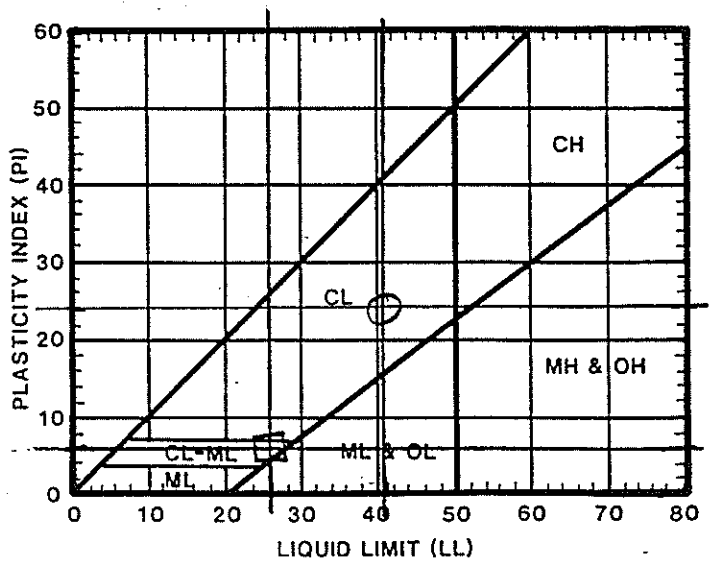
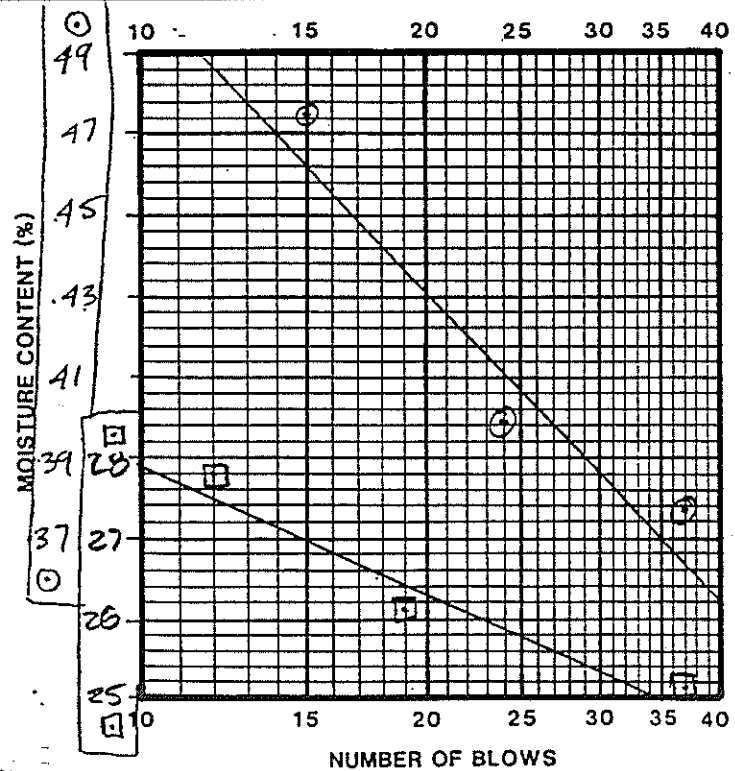
PROJECT NUMBER 2208-01

SAMPLE LOCATION TP-1 DEPTH 2B TECHNICIAN RLC DATE 11/21/91

SYMBOL	⊕	LIQUID LIMIT			PLASTIC LIMIT		SUMMARY
		1	2	3	4	5	
CAN NO.							
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	PI = 24
WEIGHT OF DRY SOIL		12.69	14.89	11.46	10.35	10.22	
WATER CONTENT (%)		47.5	39.9	37.7	17.3	16.2	UNIFIED SOIL CLASSIFICATION CL
NO. OF BLOWS		15	24	37	—	—	

SAMPLE LOCATION TP-19 DEPTH 1B TECHNICIAN RLC DATE 11/21/91

SYMBOL	⊕	LIQUID LIMIT			PLASTIC LIMIT		SUMMARY
		14	15	16	17	18	
CAN NO.							
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	PI = 6
WEIGHT OF DRY SOIL		20.00	23.53	21.70	7.54	8.21	
WATER CONTENT (%)		27.8	26.1	25.1	19.4	19.6	UNIFIED SOIL CLASSIFICATION CL-ML
NO. OF BLOWS		12	19	37	—	—	





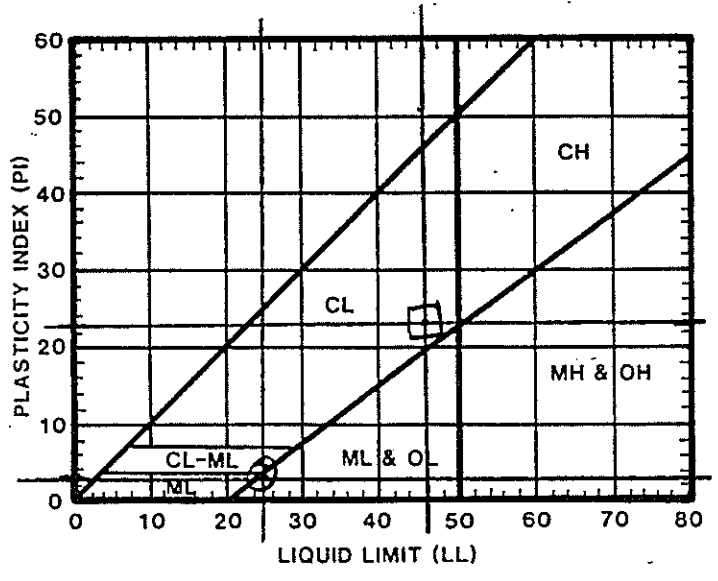
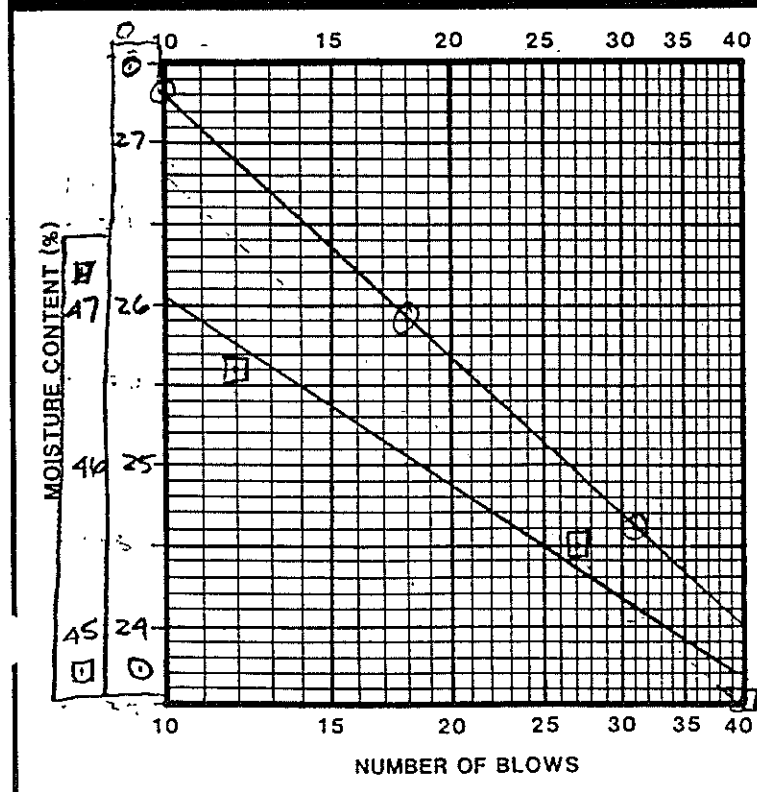
PROJECT NAME CHZM HILL PROJECT NUMBER 2208-01

SAMPLE LOCATION TP-12 DEPTH 1B TECHNICIAN RCC DATE 11/20/91

SYMBOL	LIQUID LIMIT			PLASTIC LIMIT		SUMMARY
	1	2	3	4	5	
CAN NO.						
WEIGHT OF WET SOIL + TARE	38.38	41.26	37.10	29.98	32.10	LL = 25
WEIGHT OF DRY SOIL + TARE	32.96	35.49	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 RCC DATE 11/20/91

SYMBOL	LIQUID LIMIT			PLASTIC LIMIT		SUMMARY
	6	7	8	9	10	
CAN NO.						
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	21.97	
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



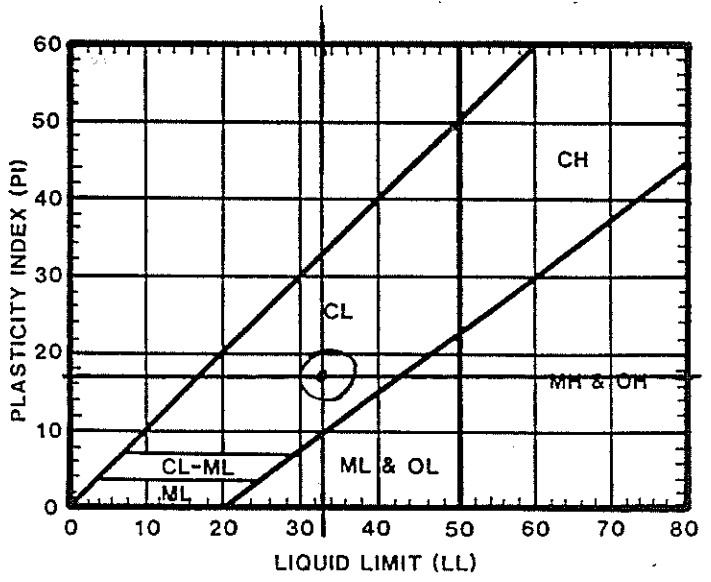
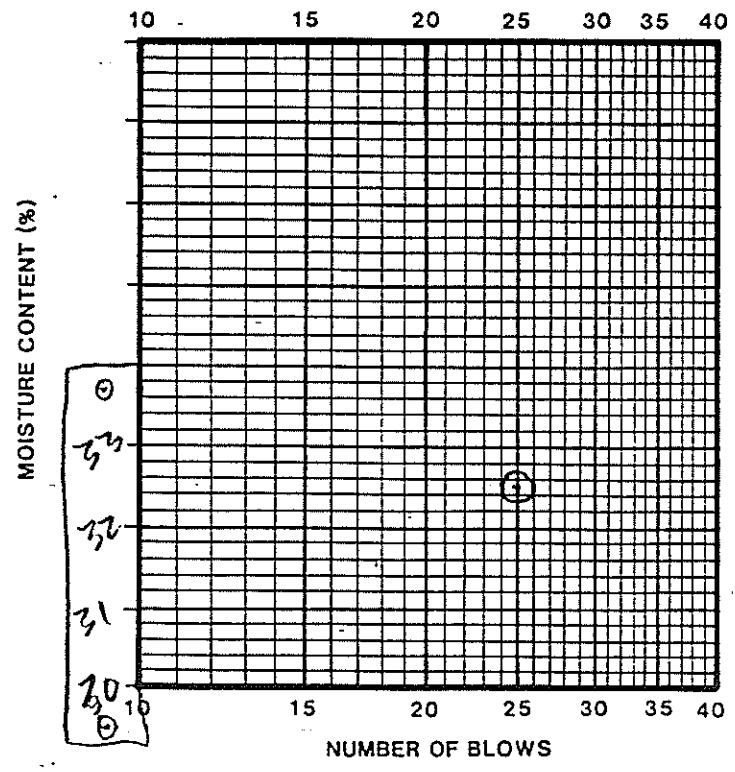
PROJECT NAME CH2M HILL PROJECT NUMBER 2208-01

SAMPLE LOCATION TP-21 DEPTH 1B TECHNICIAN RLC DATE 11/21/91

SYMBOL	⊕	LIQUID LIMIT			PLASTIC LIMIT		SUMMARY
		46	47	48	49	50	
CAN NO.							
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: <u>CL</u>
NO. OF BLOWS		25		—	—		

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							



TS file

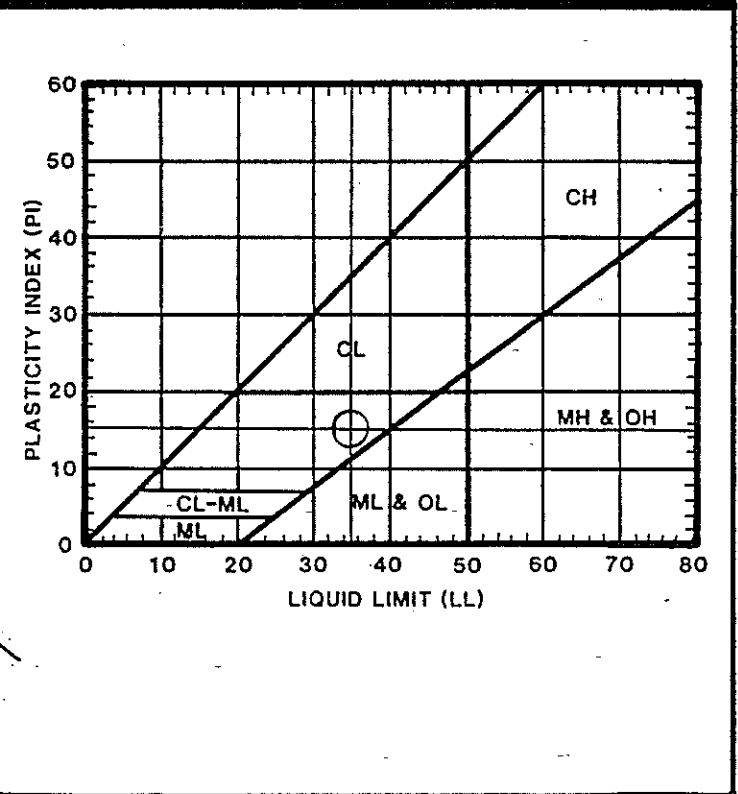
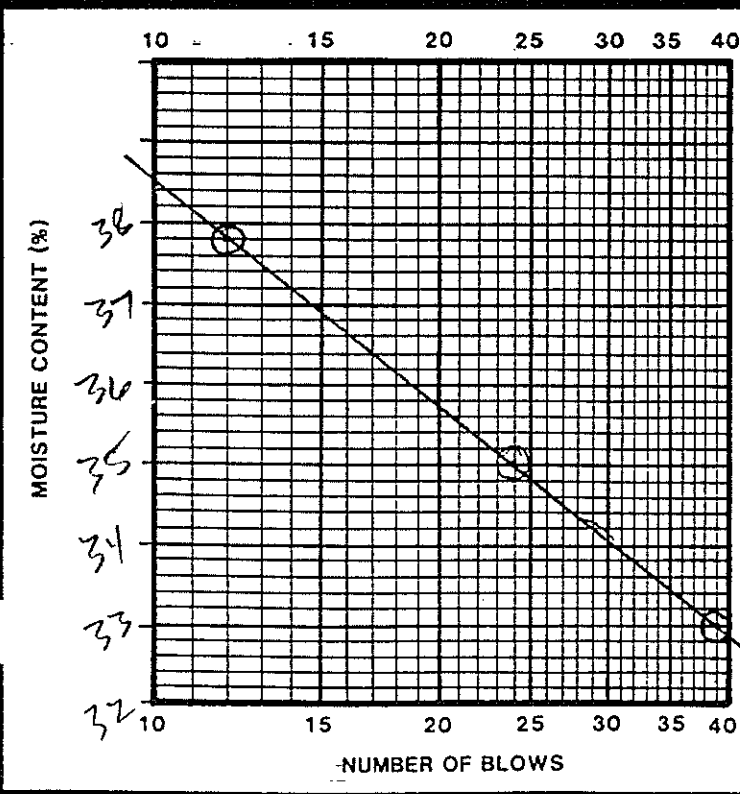
PROJECT NAME CH<sub>2</sub>m Hill / NCTP PROJECT NUMBER 102208-01

SAMPLE LOCATION TP-1 TP-5 DEPTH 2.8 TECHNICIAN TS DATE 12-26-91

SYMBOL	Φ	LIQUID LIMIT			PLASTIC LIMIT		SUMMARY
		1	2	3	16	17	
CAN NO.		1	2	3	16	17	LL = 35
WEIGHT OF WET SOIL + TARE		24.47	23.96	26.28	23.35	22.32	
WEIGHT OF DRY SOIL + TARE		21.34	21.09	22.97	22.06	21.14	PL = 20
WEIGHT OF WATER		3.13	2.87	3.31	1.29	1.18	
TARE		13.06	12.88	12.93	15.66	15.21	PI = 15
WEIGHT OF DRY SOIL		8.28	8.21	10.04	6.40	5.93	
WATER CONTENT (%)		37.8	35.0	33.0	20.2	19.9	UNIFIED SOIL CLASSIFICATION <u>CL</u>
NO. OF BLOWS		12	24	39	—	—	

SAMPLE LOCATION \_\_\_\_\_ DEPTH \_\_\_\_\_ TECHNICIAN \_\_\_\_\_ DATE \_\_\_\_\_

SYMBOL	Φ	LIQUID LIMIT			PLASTIC LIMIT		SUMMARY
		1	2	3	16	17	
CAN NO.							LL =
WEIGHT OF WET SOIL + TARE							
WEIGHT OF DRY SOIL + TARE							PL =
WEIGHT OF WATER							
TARE							PI =
WEIGHT OF DRY SOIL							
WATER CONTENT (%)							UNIFIED SOIL CLASSIFICATION
NO. OF BLOWS							



DRS *[Signature]*

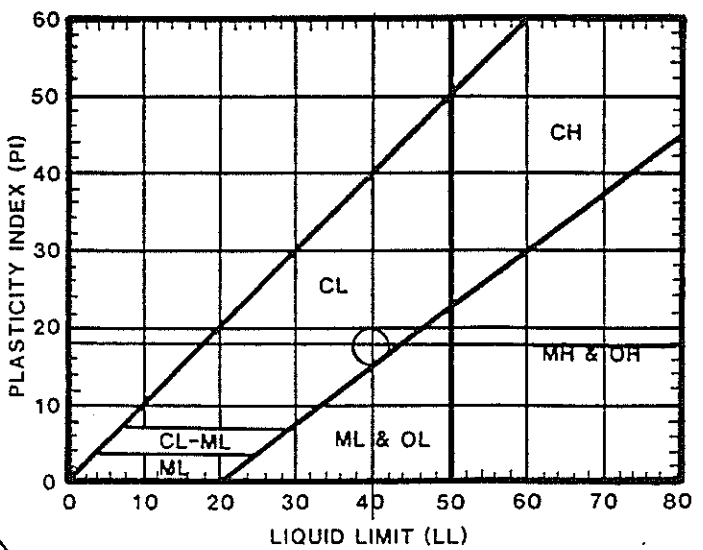
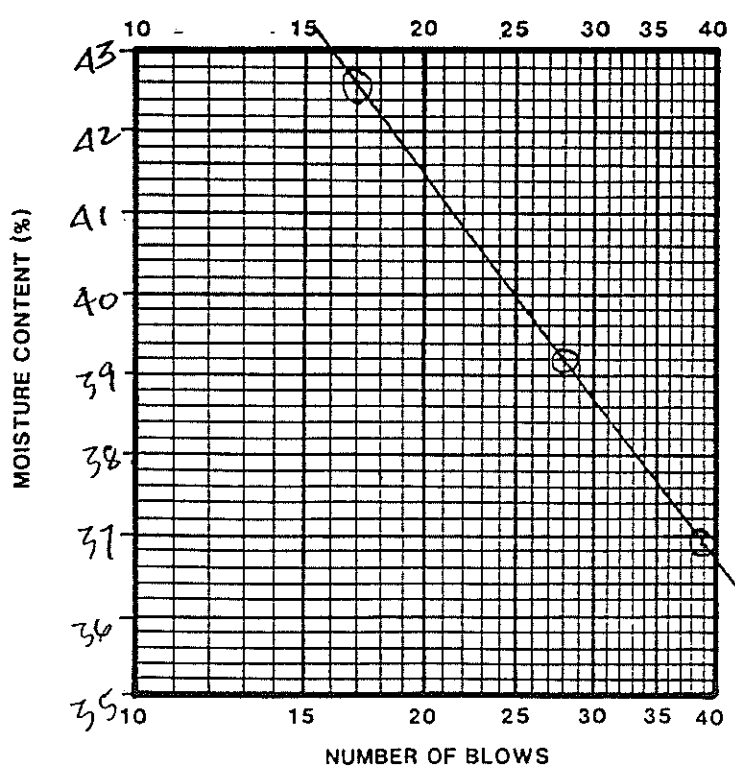
PROJECT NAME CH<sub>2</sub>M - Hill / NCTP PROJECT NUMBER 102208-01

SAMPLE LOCATION TP-6 + TP-2 DEPTH 2B TECHNICIAN TS DATE 12-26-91

SYMBOL	LIQUID LIMIT			PLASTIC LIMIT		SUMMARY	
	ϕ						
CAN NO.		9	8	14	4	5	LL = 40
WEIGHT OF WET SOIL + TARE		30.49	30.06	27.09	23.23	23.79	
WEIGHT OF DRY SOIL + TARE		26.30	26.10	22.87	21.40	21.75	PL = 22
WEIGHT OF WATER		4.19	3.96	4.22	1.83	2.04	
TARE		15.62	15.38	12.97	13.01	12.86	PI = 18
WEIGHT OF DRY SOIL		10.68	10.72	9.90	8.39	8.89	
WATER CONTENT (%)		39.2	36.9	42.6	21.8	22.9	UNIFIED SOIL CLASSIFICATION <u>CL</u>
NO. OF BLOWS		28	39	17	—	—	

SAMPLE LOCATION \_\_\_\_\_ DEPTH \_\_\_\_\_ TECHNICIAN \_\_\_\_\_ DATE \_\_\_\_\_

SYMBOL	LIQUID LIMIT			PLASTIC LIMIT		SUMMARY	
	ϕ						
CAN NO.							LL =
WEIGHT OF WET SOIL + TARE							
WEIGHT OF DRY SOIL + TARE							PL =
WEIGHT OF WATER							
TARE							PI =
WEIGHT OF DRY SOIL							
WATER CONTENT (%)							UNIFIED SOIL CLASSIFICATION
NO. OF BLOWS							



TR5

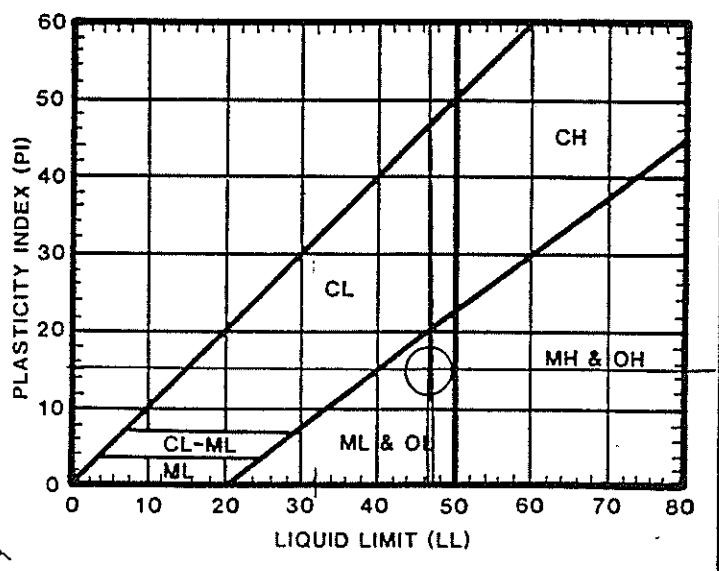
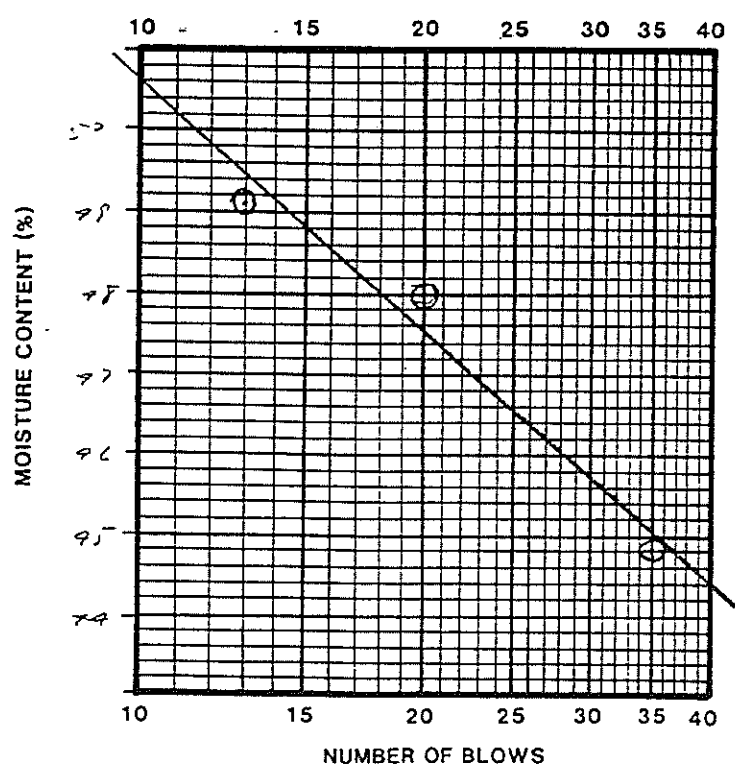
PROJECT NAME CH 2 M Hill PROJECT NUMBER 10 2208-01

SAMPLE LOCATION B 8 DEPTH 20' TECHNICIAN G.M. DATE 12-19-91

SYMBOL	LIQUID LIMIT			PLASTIC LIMIT		SUMMARY
	19	20	39	33	18	
CAN NO.	19	20	39	33	18	LL = 47
WEIGHT OF WET SOIL + TARE	30.38	30.83	33.30	22.92	22.37	
WEIGHT OF DRY SOIL + TARE	25.48	25.66	27.87	21.12	20.53	PL = 32
WEIGHT OF WATER	4.90	5.17	5.43	1.80	1.84	
TARE	15.51	14.89	15.79	15.57	14.85	PI = 15
WEIGHT OF DRY SOIL	9.97	10.77	12.13	5.55	5.68	
WATER CONTENT (%)	49.1	48.0	44.8	32.9	32.9	UNIFIED SOIL CLASSIFICATION: <u>ML</u>
NO. OF BLOWS	13	20	25	—	—	

SAMPLE LOCATION \_\_\_\_\_ DEPTH \_\_\_\_\_ TECHNICIAN \_\_\_\_\_ DATE \_\_\_\_\_

SYMBOL	LIQUID LIMIT			PLASTIC LIMIT		SUMMARY
CAN NO.						LL =
WEIGHT OF WET SOIL + TARE						
WEIGHT OF DRY SOIL + TARE						PL =
WEIGHT OF WATER						
TARE						PI =
WEIGHT OF DRY SOIL						
WATER CONTENT (%)						UNIFIED SOIL CLASSIFICATION:
NO. OF BLOWS						





**Ninyo & Moore****200 WASH**

DZS

PROJECT NAME CH 2 H.W. 11PROJECT NUMBER 102208-01DATE 11-18-91 SAMPLE LOCATION #4 DEPTH 35  
TECHNICIAN G.M. SAMPLE NUMBER \_\_\_\_\_

INITIAL WEIGHT OF DRY SOIL AND TARE	979.7
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 <u>11-18-91</u> SAMPLE LOCATION <u>#3</u> DEPTH <u>25</u>	
TECHNICIAN <u>G.M.</u> 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

PROJECT NAME CH 2 Mill PROJECT NUMBER 102208-01

DATE <u>11-18-91</u>	SAMPLE LOCATION <u># 16</u>	DEPTH <u>35</u>
TECHNICIAN <u>G.M.</u>	SAMPLE NUMBER _____	
INITIAL WEIGHT OF DRY SOIL AND TARE	390.3	
TARE WEIGHT	185.9	
INITIAL WEIGHT OF DRY SOIL (W <sub>i</sub> )	204.4	
WEIGHT OF DRY SOIL AND TARE AFTER 200 WASH	248.2	
WEIGHT OF DRY SOIL RETAINED ON NO. 4 SIEVE (W <sub>4</sub> )	6.0	
WEIGHT OF DRY SOIL RETAINED ON NO. 200 SIEVE (W <sub>200</sub> )	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 <u>11-18-91</u>	SAMPLE LOCATION <u>13</u>	DEPTH <u>2.0</u>
TECHNICIAN <u>G.M.</u>	SAMPLE NUMBER _____	
INITIAL WEIGHT OF DRY SOIL AND TARE	477.5	
TARE WEIGHT	211.9	
INITIAL WEIGHT OF DRY SOIL (W <sub>i</sub> )	265.6	
WEIGHT OF DRY SOIL AND TARE AFTER 200 WASH	372.0	
WEIGHT OF DRY SOIL RETAINED ON NO. 4 SIEVE (W <sub>4</sub> )	62.0	
WEIGHT OF DRY SOIL RETAINED ON NO. 200 SIEVE (W <sub>200</sub> )	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	

726  
725

PROJECT NAME CH 2 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 ( $W_1$ )	220.0
WEIGHT OF DRY SOIL AND TARE AFTER 200 WASH	227.7
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 ( $P_{R4} = \frac{W_4}{W_1} \times 100$ )	0.0
PERCENT PASSING A NO. 4 SIEVE ( $P_{P4} = 100 - P_{R4}$ )	100.0
PERCENT RETAINED ON NO. 200 SIEVE ( $P_{R200} = \frac{W_{200}}{W_1} \times 100$ )	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 \_\_\_\_\_

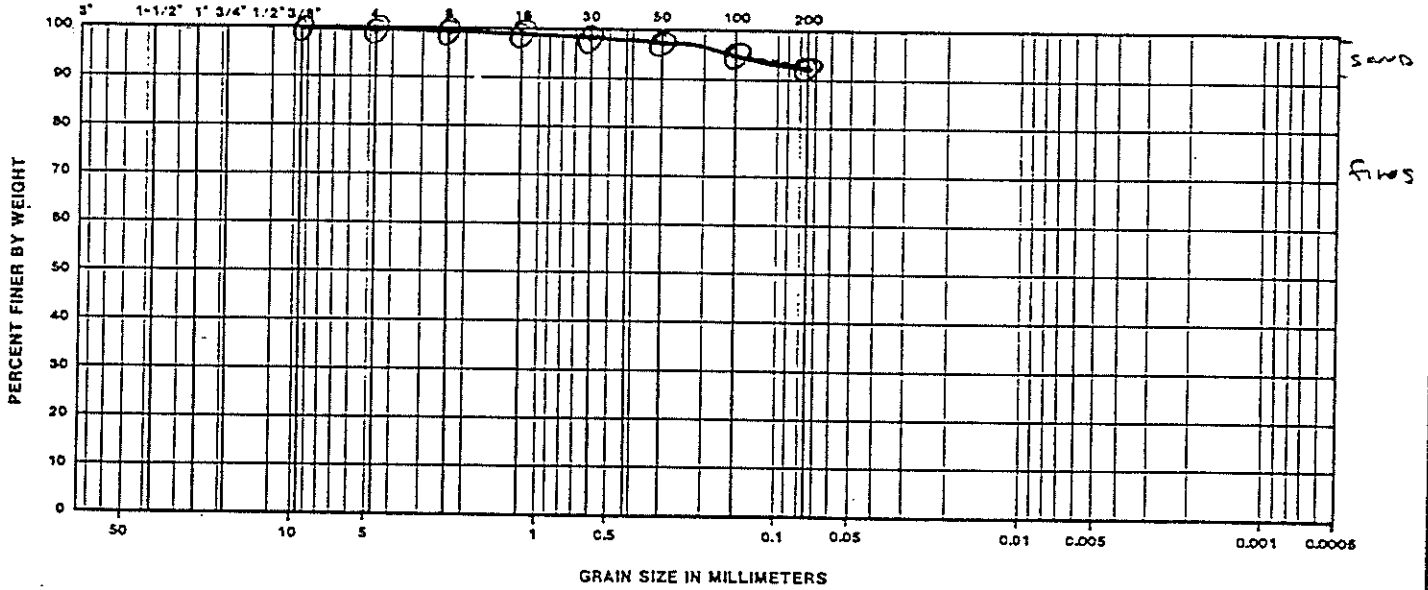
INITIAL WEIGHT OF DRY SOIL AND TARE	467.3
TARE WEIGHT	226.5
INITIAL WEIGHT OF DRY SOIL ( $W_1$ )	237.8
WEIGHT OF DRY SOIL AND TARE AFTER 200 WASH	242.0
WEIGHT OF DRY SOIL RETAINED ON NO. 4 SIEVE ( $W_4$ )	0.0
WEIGHT OF DRY SOIL RETAINED ON NO. 200 SIEVE ( $W_{200}$ )	11.3
PERCENT RETAINED ON NO. 4 SIEVE ( $P_{R4} = \frac{W_4}{W_1} \times 100$ )	0.0
PERCENT PASSING A NO. 4 SIEVE ( $P_{P4} = 100 - P_{R4}$ )	100.0
PERCENT RETAINED ON A NO. 200 SIEVE ( $P_{R200} = \frac{W_{200}}{W_1} \times 100$ )	4.8
PERCENT PASSING A NO. 200 SIEVE ( $P_{P200} = 100 - P_{R4} - P_{R200}$ )	95.2

JK  
DSS

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay

U.S. STANDARD SIEVE NUMBERS

HYDROMETER



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

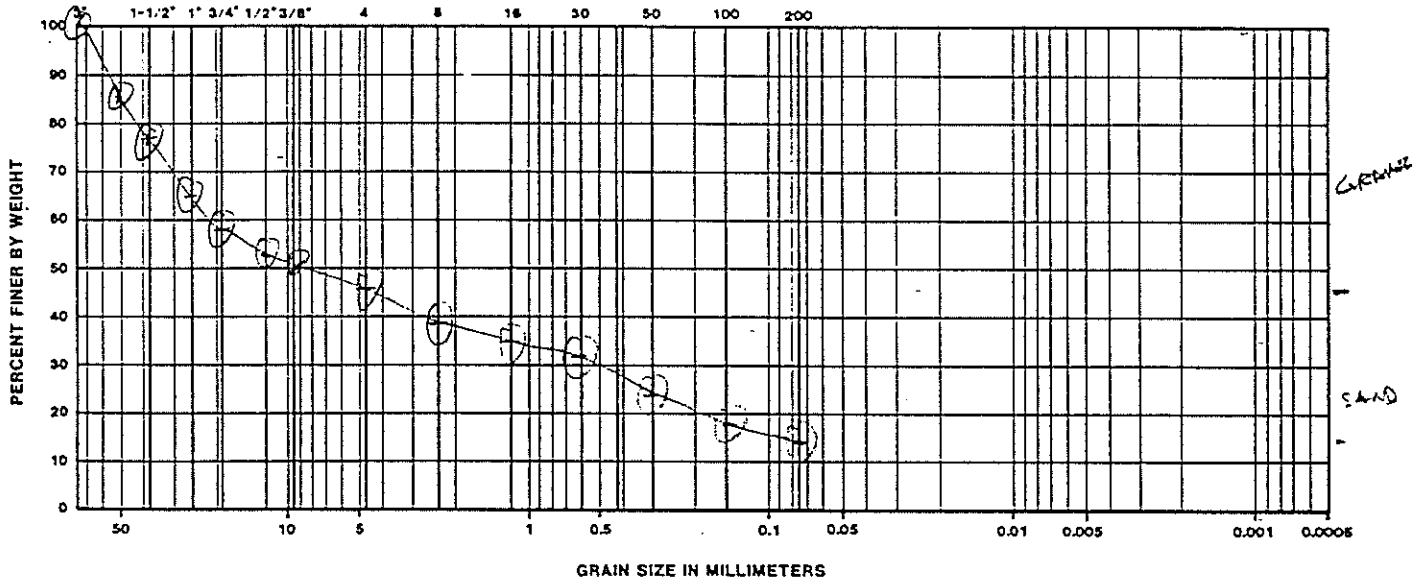
PROJECT NO.	DATE	FIGURE
2203-01	11/20/91	

DRS *[Signature]*

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay

U.S. STANDARD SIEVE NUMBERS

HYDROMETER



Symbol	Hole Number	Depth (Feet)	Liquid Limit	Plastic Limit	Plasticity Index	Soil Type
	TP 12	1 B	25	22	3	GM

## GRADATION TEST RESULTS

**Ninyo & Moore**

CH 2 M Hill

PROJECT NO.	DATE
102208-01	11-20-91

FIGURE



$$CA = D_{60} / D_{10} > 4$$

$$CC = 1 < D_{30}^2 / (D_{10} \cdot D_{60}) < 3$$

D<sub>10</sub> .073

D<sub>30</sub> .30

D<sub>60</sub> 30

All ✓

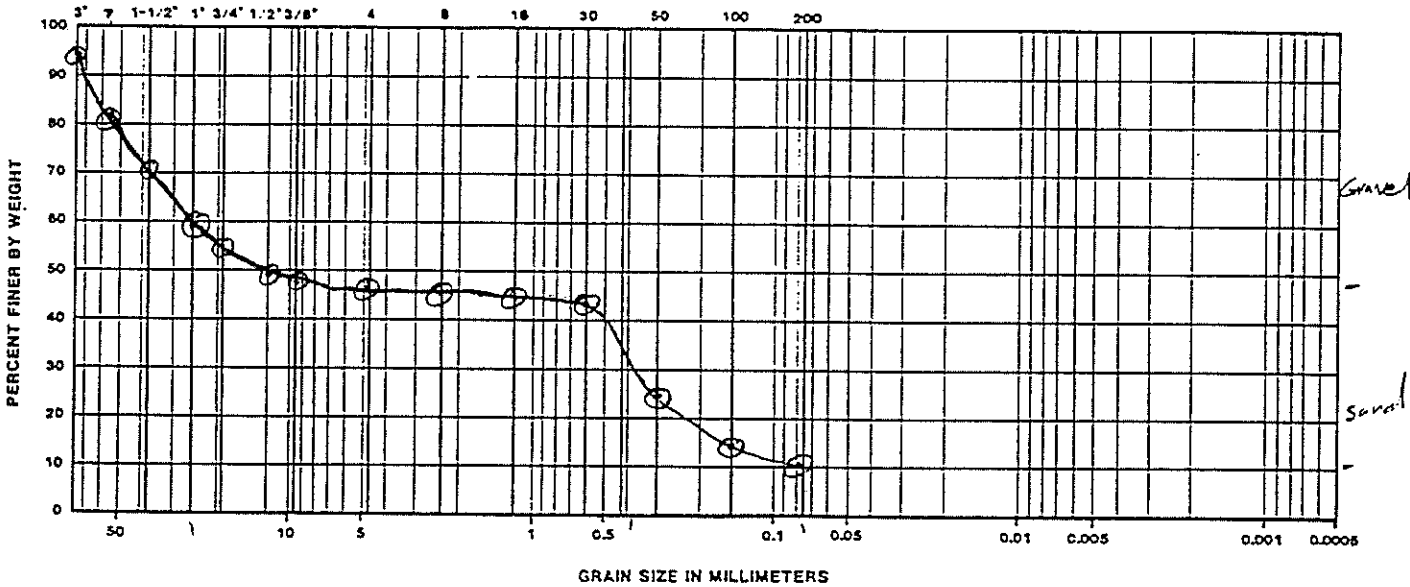
.06

PCS

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay

U.S. STANDARD SIEVE NUMBERS

HYDROMETER



Symbol	Hole Number	Depth (Feet)	Liquid Limit	Plastic Limit	Plasticity Index	Soil Type
	TP-12	2B	—	—	—	GP-GM

**Ninyo & Moore**

**GRADATION TEST RESULTS**

CHZM HILL

PROJECT NO.	DATE	FIGURE
2209-01	11/25/91	

D<sub>60</sub> - 39  
 D<sub>30</sub> - 15  
 D<sub>10</sub> - .27

$C_u = D_{60}/D_{10} > 4$

$C_c = \frac{(D_{30})^2}{(D_{10} \times D_{60})} < 3$

$C_u = 125.9 \checkmark$

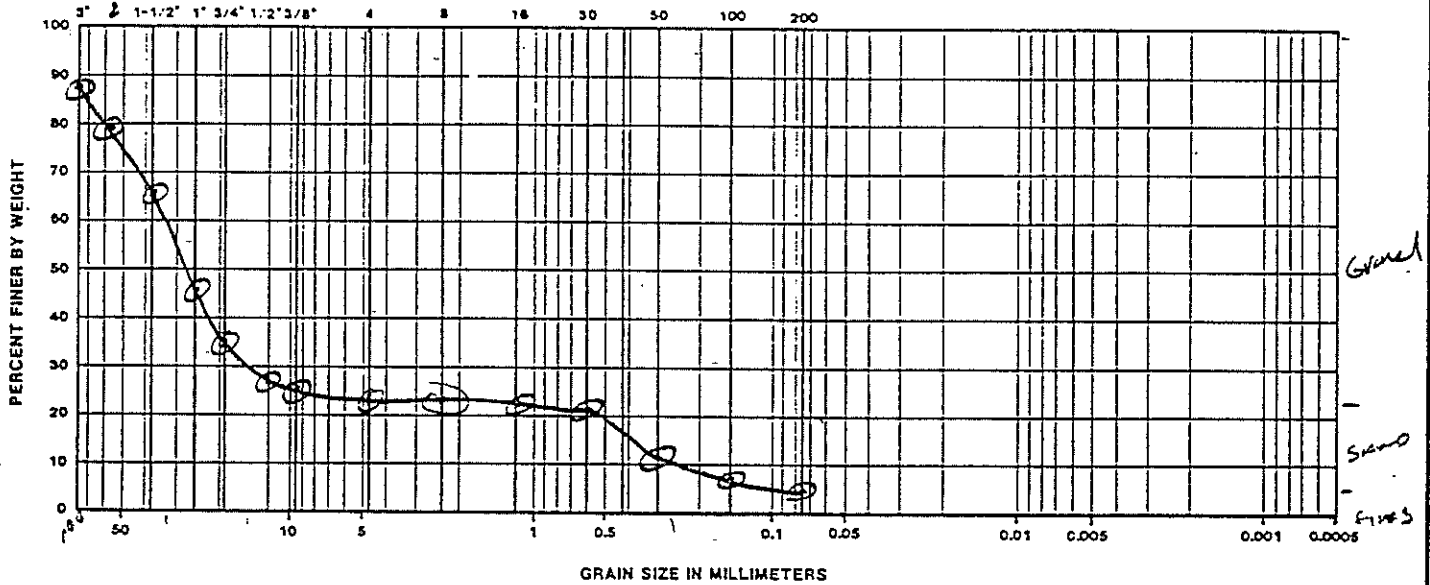
$C_c = 29.5$

YES

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay

U.S. STANDARD SIEVE NUMBERS

HYDROMETER



Symbol	Hole Number	Depth (Feet)	Liquid Limit	Plastic Limit	Plasticity Index	Soil Type
	TP-15	1B	—	—	—	GP

## GRADATION TEST RESULTS

**Ninyo & Moore**

EHAM HILL

PROJECT NO.

DATE

FIGURE

2208-01

11/20/91

D<sub>60</sub> 1.3  
 D<sub>30</sub> .25  
 D<sub>10</sub> .07

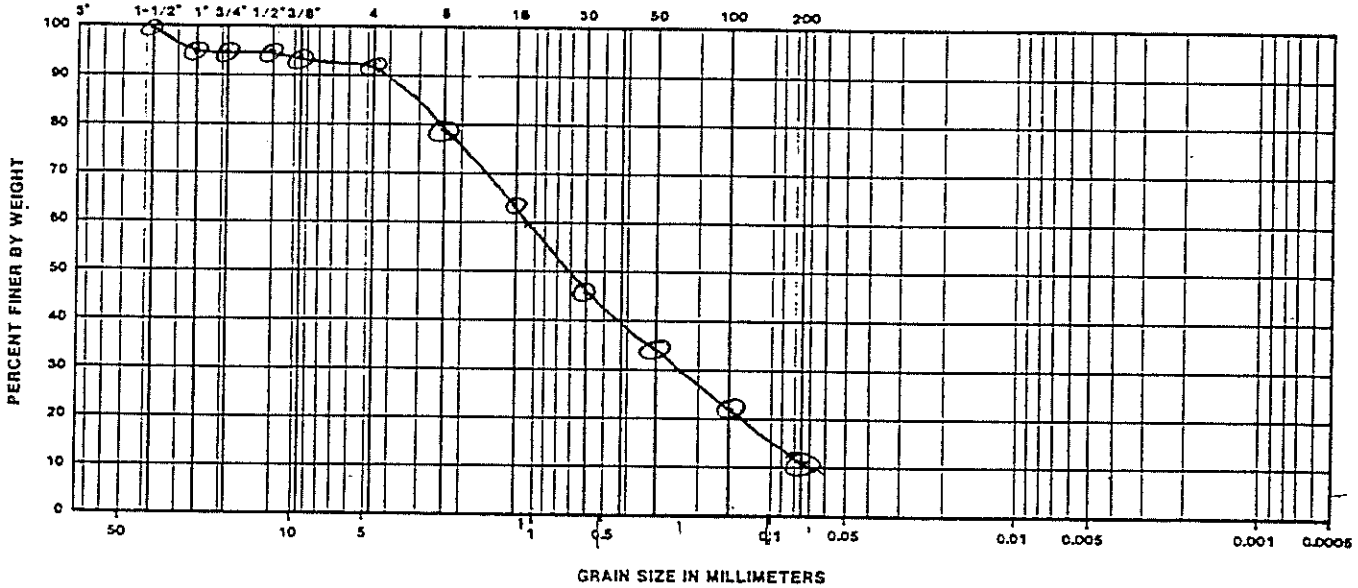
$cc =$   
 $cu = D_{60}/D_{10} > 4$   
 $1 < D_{30}^2 / (D_{10} \times D_{60}) < 3$   
 ~~$cc = .7$~~   
 $cu = 18.6$  ✓

CU 20  
 CC 7  
 PRES

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay

U.S. STANDARD SIEVE NUMBERS

HYDROMETER



Symbol	Hole Number	Depth (Feet)	Liquid Limit	Plastic Limit	Plasticity Index	Soil Type
	TP-17	1B	—	—	—	SP-SM

## GRADATION TEST RESULTS

**Ninyo & Moore**

CHEM HILL

PROJECT NO.

DATE

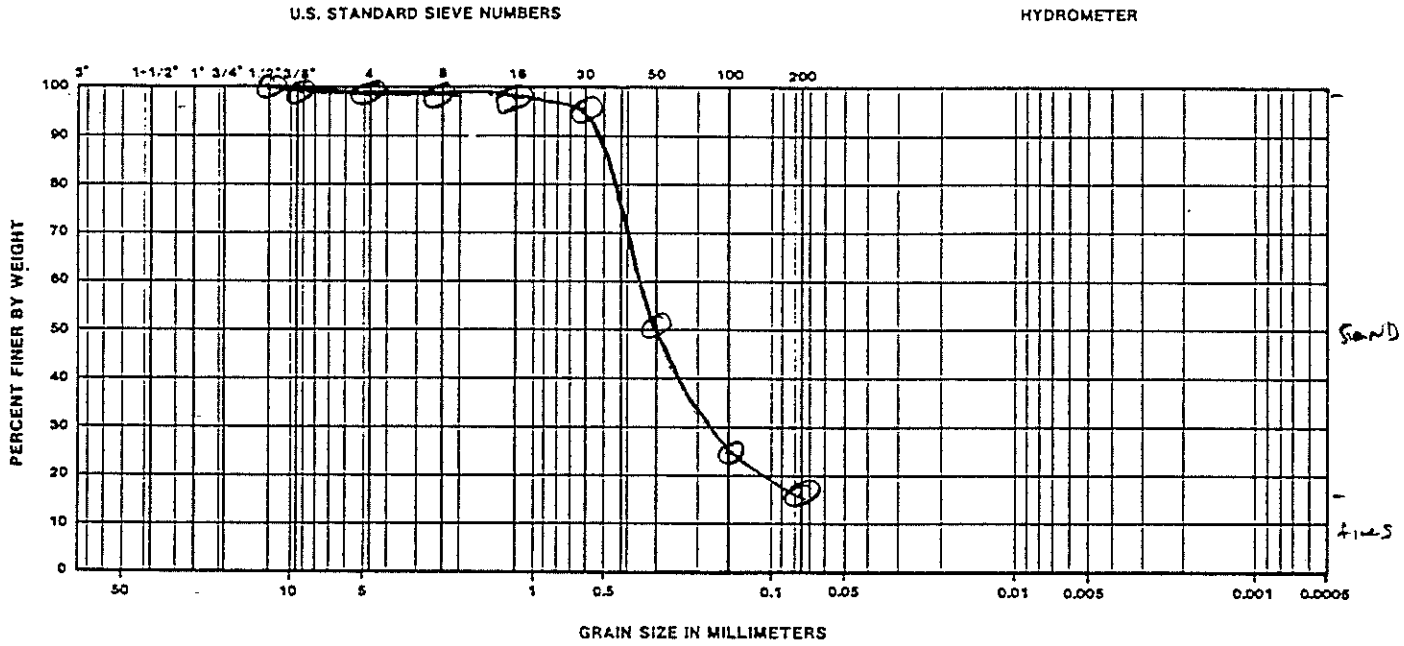
FIGURE

220801

11/21/91

me  
TCS

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay



Symbol	Hole Number	Depth (Feet)	Liquid Limit	Plastic Limit	Plasticity Index	Soil Type
	TP-17	2B	—	—	—	SM

## GRADATION TEST RESULTS

**Ninyo & Moore**

CH2M HILL

PROJECT NO.	DATE	FIGURE
2208-01	11/20/91	

D60 - 15  
 D30 - 2.7  
 D10 - .19

$C_u = D_{60} / D_{10} > 9$        $C_c = 1 < D_{30}^2 / (D_{10} \cdot D_{60}) < 3$

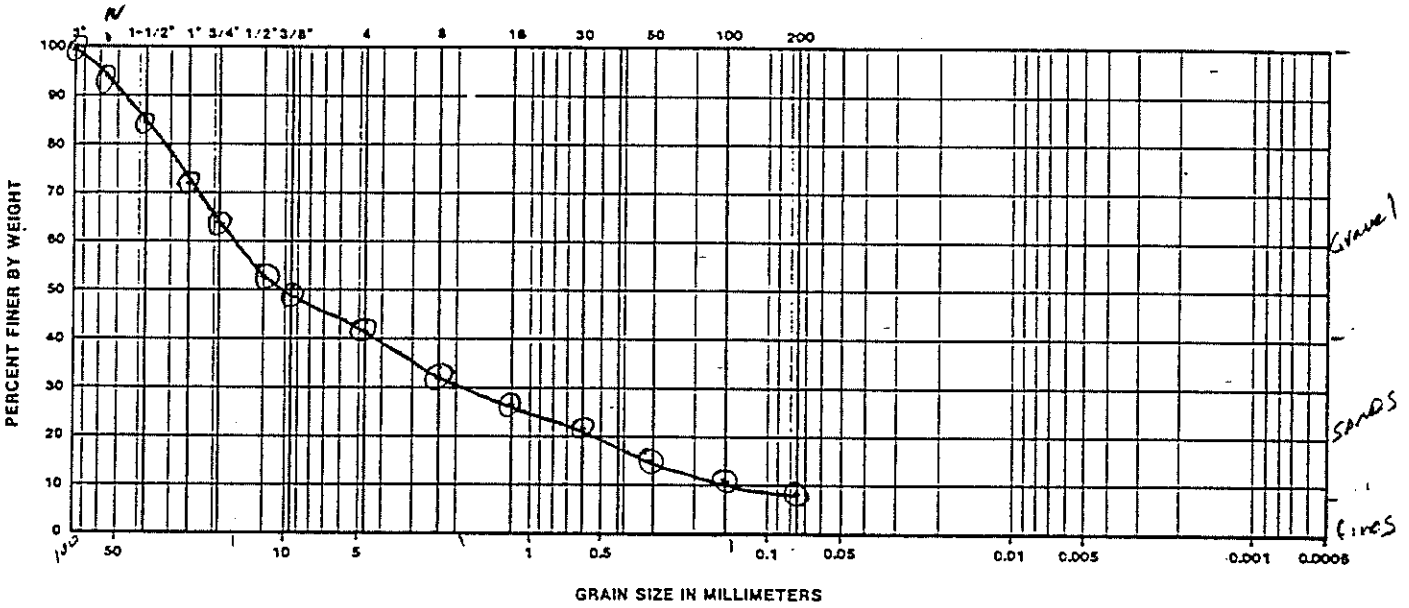
$C_h = 78.9$  ✓       $C_c = 2.6$  ✓

*PK*  
 TES

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay

U.S. STANDARD SIEVE NUMBERS

HYDROMETER



Symbol	Hole Number	Depth (Feet)	Liquid Limit	Plastic Limit	Plasticity Index	Soil Type
	TP-18	ZB	—	—	—	GW-GM

## GRADATION TEST RESULTS

**Ninyo & Moore**

CH2M HILL

PROJECT NO.

DATE

FIGURE

2208-01

11/20/91

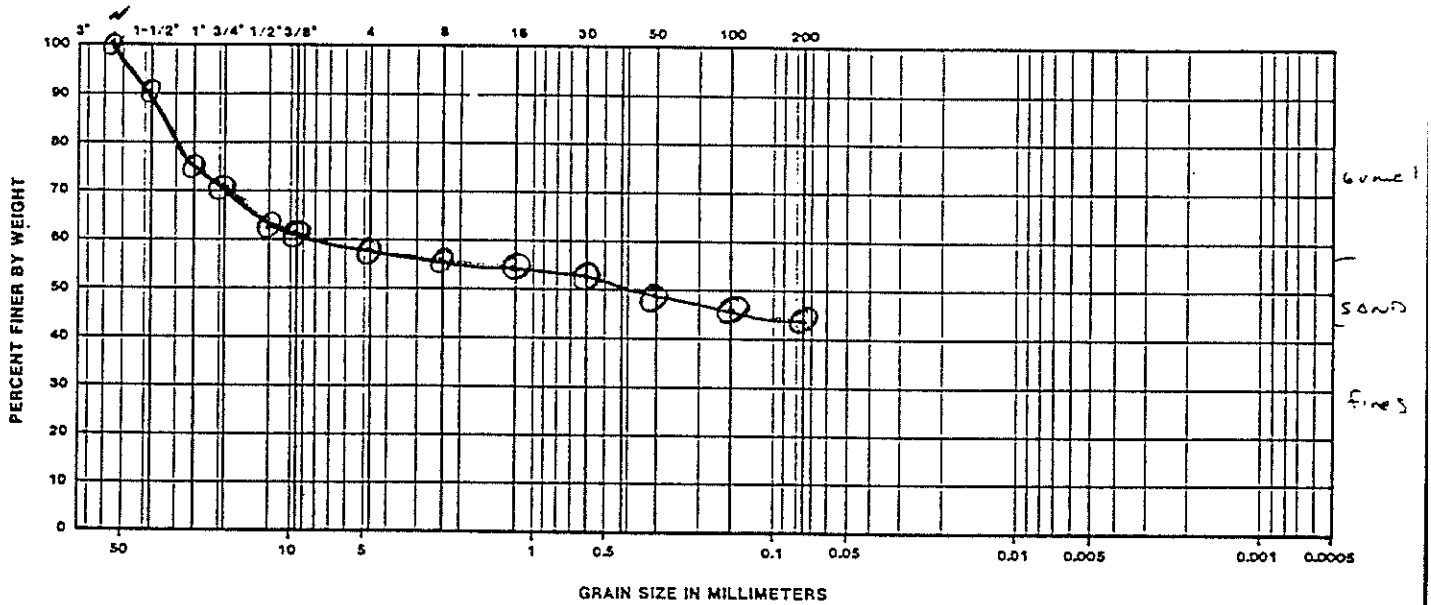


775  
MRE

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay

U.S. STANDARD SIEVE NUMBERS

HYDROMETER



Symbol	Hole Number	Depth (Feet)	Liquid Limit	Plastic Limit	Plasticity Index	Soil Type
	TP-18	18	46	23	23	GC

## GRADATION TEST RESULTS

**Ninyo & Moore**

CH2M HILL

PROJECT NO.

DATE

FIGURE

220001

11/20/01

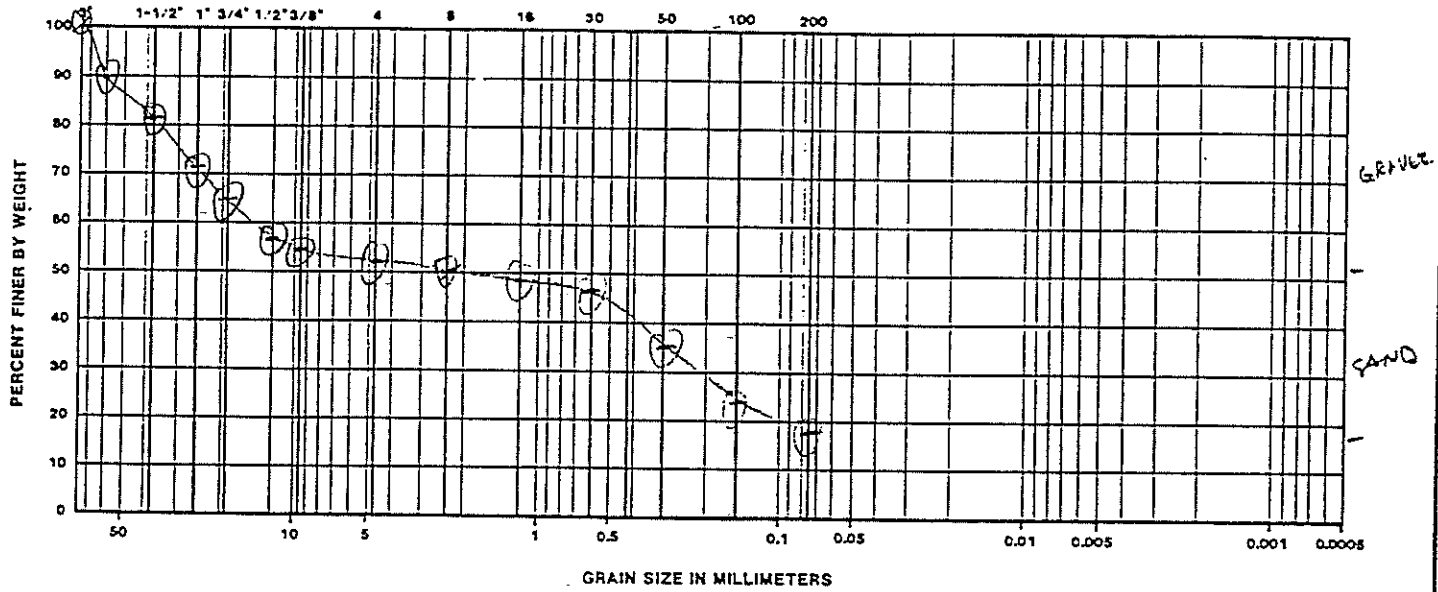
..

TRES PK

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay

U.S. STANDARD SIEVE NUMBERS

HYDROMETER



Symbol	Hole Number	Depth (Feet)	Liquid Limit	Plastic Limit	Plasticity Index	Soil Type
	TP-19	1 B	26	20	6	GL-GM

**Ninyo & Moore**

**GRADATION TEST RESULTS**

CH 2147/11

PROJECT NO.

DATE

FIGURE

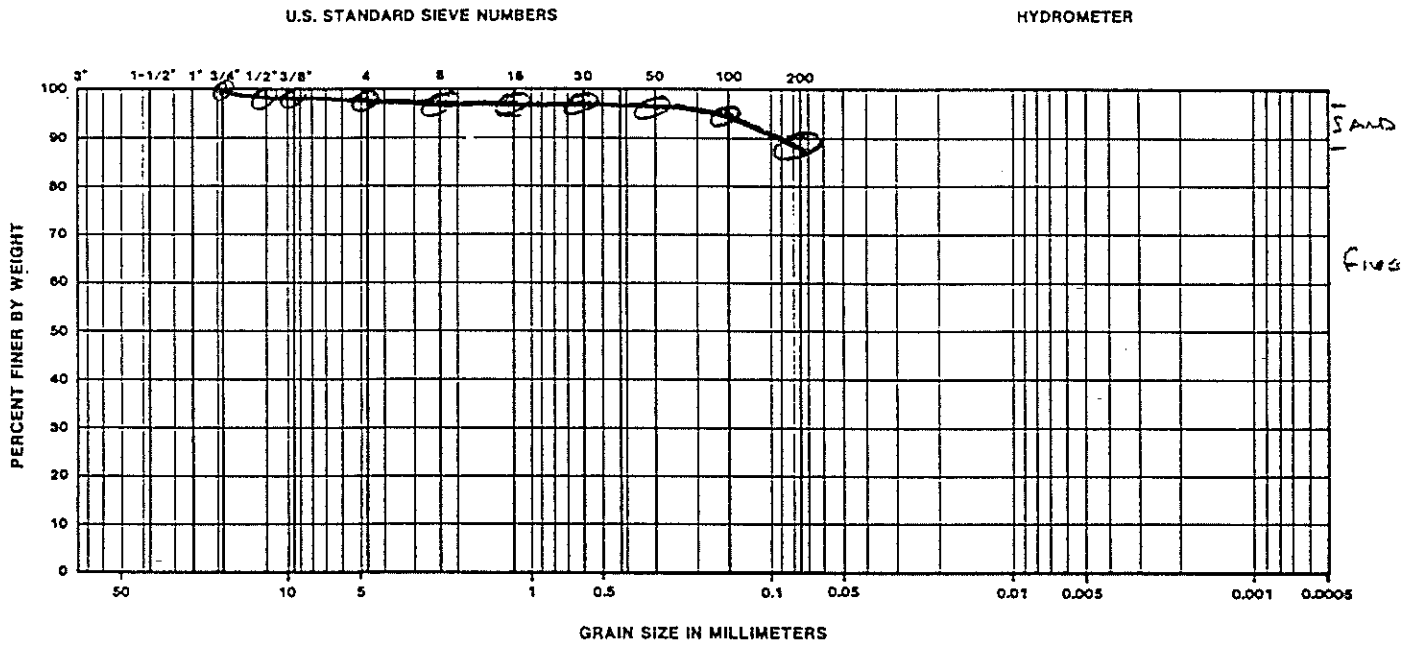
102208-01

11-21-91

16-12-11

TACS JR

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay



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
220001	11/20/90	

TES JMC

PROJECT CH2M HILL / NCTP PROJECT NO. 2208-01 LOT NO. \_\_\_\_\_

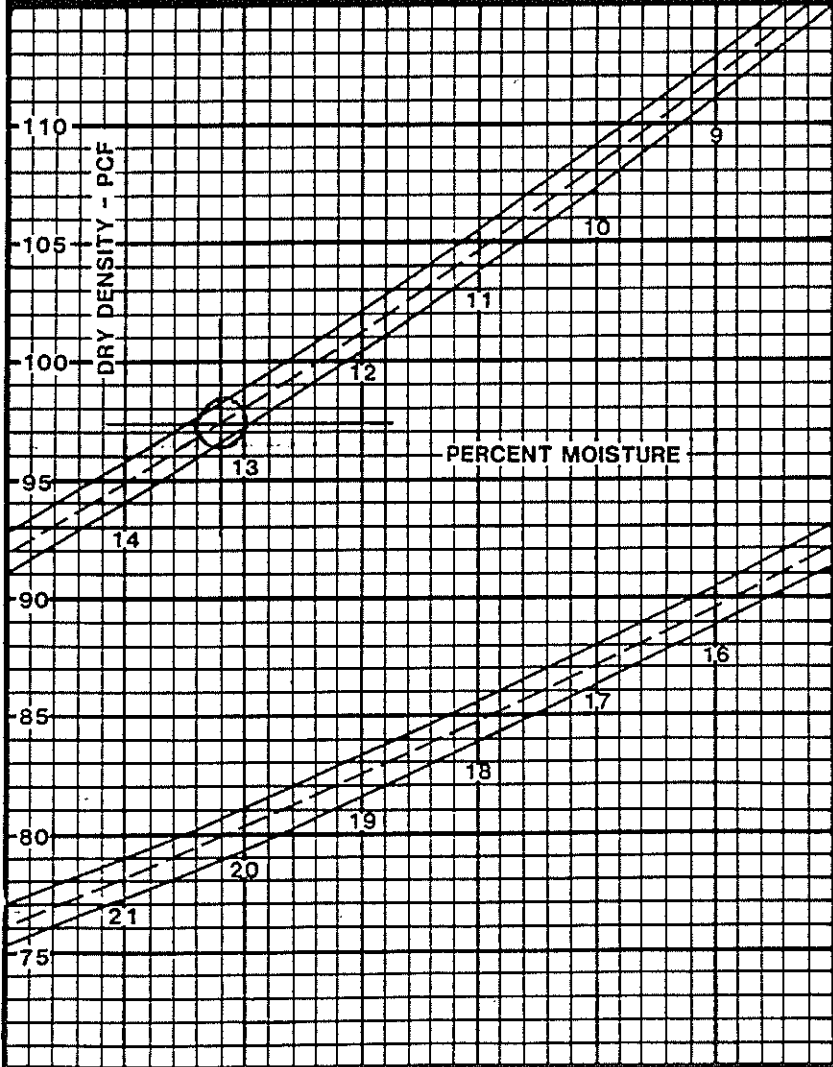
HOLE NO. TP-1 2B DEPTH 5' DATE SAMPLED 12-3-91

SOIL TYPE CL DATE TESTED 12-9-91

TECHNICIAN TD - G.M. MACHINE NO. 5

SWELL DATA		
DATE	TIME	DIAL (D)
12-4-91	10:43	100
	10:44	103
	12:05	140
12-5-91	12:00	143
	13:00	143
		VOL. SWELL (INCHES) <u>2.32</u>
		INDEX (D x 10 <sup>3</sup> ) <u>2.1</u>
		EXPANSION POTENTIAL <u>LOW</u>

A. PRIOR MOISTURE CONTENT	<u>10.2</u>			
B. INITIAL MOISTURE CONTENT	<u>13.2</u>			
C. COMPACTED WEIGHT, RING+SOIL	<u>571.3</u>			
D. WEIGHT OF RING	<u>206.2</u>			
E. SPECIMEN WEIGHT, (C - D)	<u>365.1</u>			
F. COMPACTED WET DENSITY, (E x 0.3014)	<u>110.0</u>			
G. COMPACTED DRY DENSITY, (F/(1+B))	<u>97.2</u>			
H. DEGREE OF SATURATION, (B / ( $\frac{62.4}{G} - 0.3774$ ))	<u>49.9</u>			



PRIOR MOISTURE CONTENT	
a. PAN NUMBER	<u>XXX</u>
b. WET WEIGHT+TARE	<u>246.6</u>
c. DRY WEIGHT+TARE	<u>227.0</u>
d. WATER LOSS, (b-c)	<u>19.6</u>
e. WEIGHT OF TARE	<u>34.8</u>
f. DRY WEIGHT, (c-e)	<u>192.2</u>
g. PRIOR MOISTURE, (d/f)	<u>10.2</u>
FINAL MOISTURE CONTENT	
h. PAN NUMBER	<u>XXXV</u>
i. WET WEIGHT+TARE	<u>258.2</u>
j. DRY WEIGHT+TARE	<u>210.9</u>
k. WATER LOSS, (i-j)	<u>47.3</u>
l. WEIGHT OF TARE	<u>34.6</u>
m. DRY WEIGHT, (j-l)	<u>176.3</u>
n. FINAL MOISTURE, (k/m)	<u>26.8</u>
REMARKS	

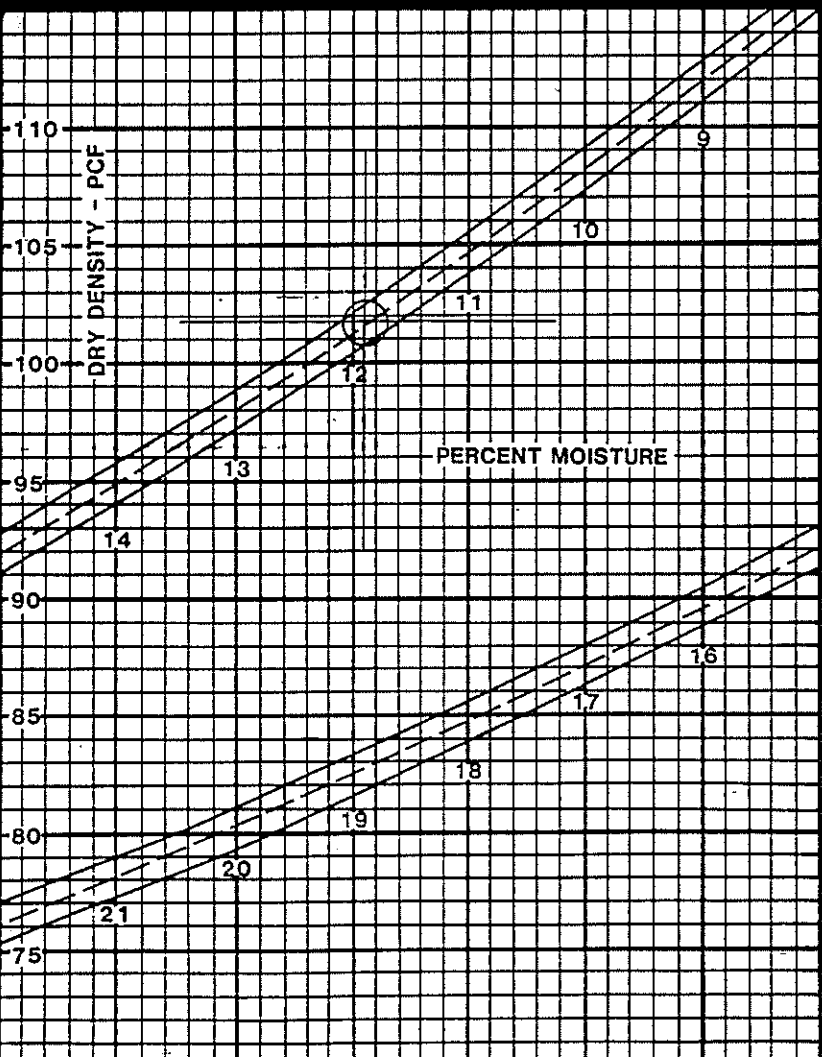
PKC  
TOS

PROJECT CH<sub>2</sub>M Hill PROJECT NO. 102208-01 LOT NO. \_\_\_\_\_  
 HOLE NO. 21-1B DEPTH \_\_\_\_\_ DATE SAMPLED \_\_\_\_\_  
 SOIL TYPE Expansive CL DATE TESTED 12-4-91  
 TECHNICIAN SPB - G.M. MACHINE NO. 6

SWELL DATA		
DATE	TIME	DIAL (D)
12-4-91	12:14	.100
	12:15	.103
	13:17	.131
	13:00	.159
	14:03	.159

A. PRIOR MOISTURE CONTENT	6.8				
B. INITIAL MOISTURE CONTENT	11.9				
C. COMPACTED WEIGHT, RING+SOIL	586.0				
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				

VOL. SWELL (INCHES)	57.6
INDEX (D x 10 <sup>3</sup> )	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	



*JCS* *1991*

PROJECT CH<sub>2</sub>M / H-11 PROJECT NO. 102208-01 LOT NO. \_\_\_\_\_

HOLE NO. 21 2B DEPTH \_\_\_\_\_ DATE SAMPLED \_\_\_\_\_

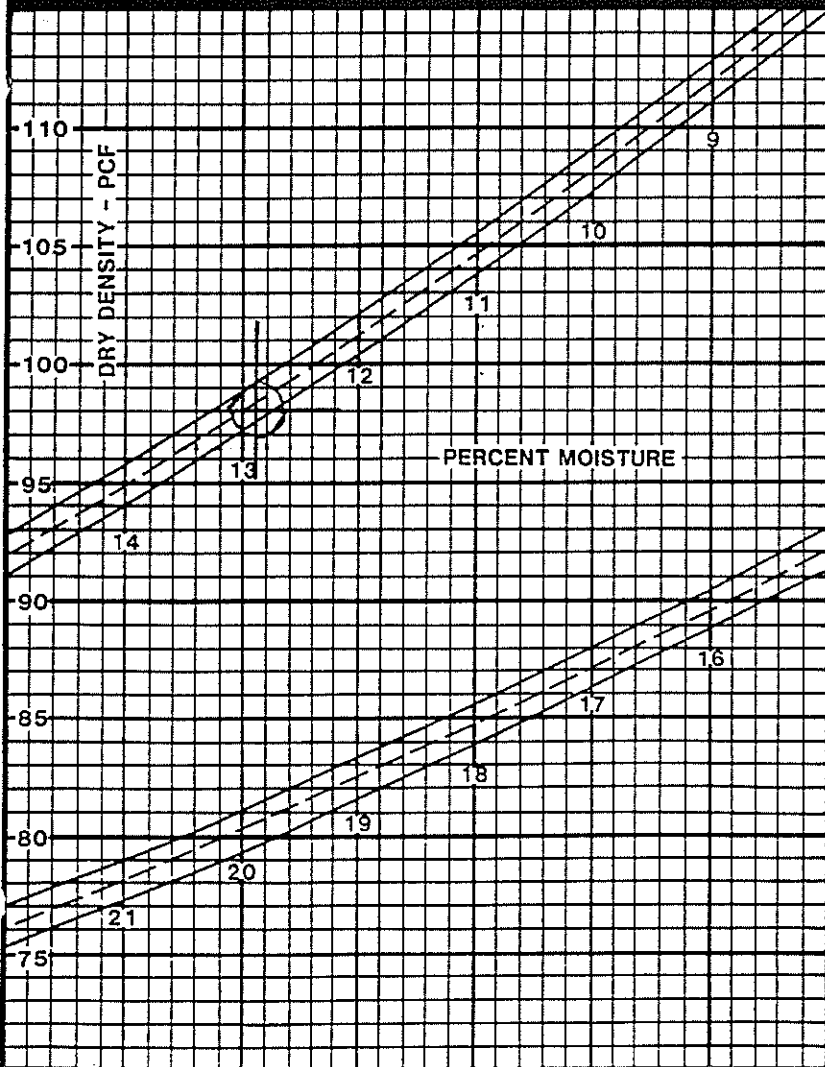
SOIL TYPE CL DATE TESTED 12-4-91

TECHNICIAN SPB - G.M. MACHINE NO. 8

### SWELL DATA

DATE	TIME	DIAL (D)
12-9-91	14:32	.100

A. PRIOR MOISTURE CONTENT	10.5							
B. INITIAL MOISTURE CONTENT	12.9					12-5-91	14:02	.126
C. COMPACTED WEIGHT, RING+SOIL	574.5					12-6-91	10:01	.127
D. WEIGHT OF RING	207.5						11:01	.127
E. SPECIMEN WEIGHT, (C - D)	367.0					VOL. SWELL (INCHES)		27
F. COMPACTED WET DENSITY, (E x 0.3014)	110.6					INDEX (D x 10 <sup>3</sup> )		28
G. COMPACTED DRY DENSITY, (F/(1+B))	98.0					EXPANSION POTENTIAL		
H. DEGREE OF SATURATION, (B / ( $\frac{62.4}{G} - 0.3774$ ))	49.7					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	39.1
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

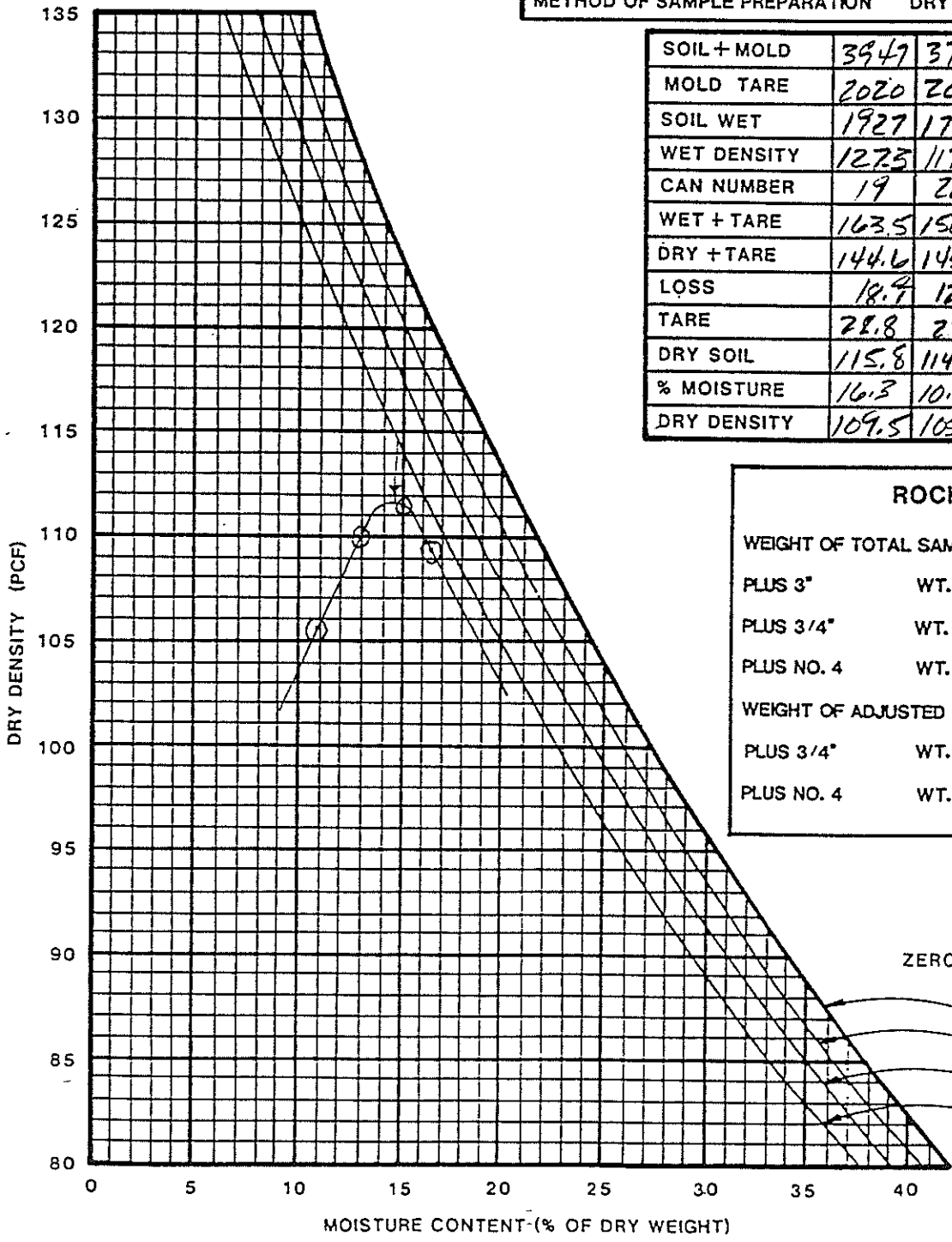
REMARKS

PROJECT NAME CH 2 M Hill / NCTP PROJECT NO. 102208-01  
 DATE 12/25/91 SAMPLE LOCATION TP-1, 2B DEPTH 5' TECHNICIAN RLC  
 SOIL DESCRIPTION ML - BRYN 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	127.3	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	29.2	28.9	29.1
DRY SOIL	115.8	114.9	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. \_\_\_\_\_ % \_\_\_\_\_

ZERO AIR VOIDS CURVES

G 2.80

G 2.70

G 2.60

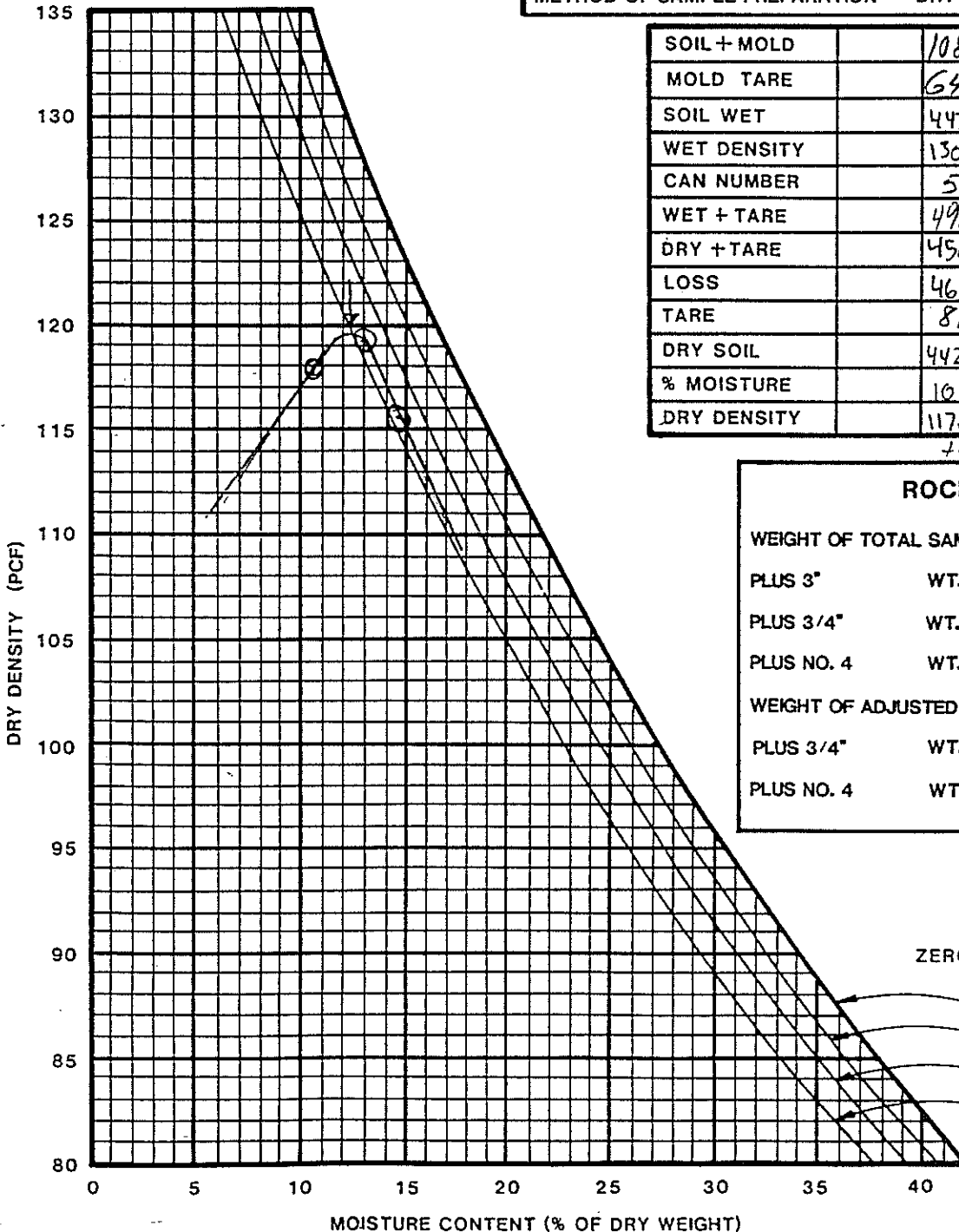
G 2.50

TRES

PROJECT NAME CH2M HILL PROJECT NO. 2208-01  
 DATE 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	<u>26748</u>	
PLUS 3"	WT. <u>0</u>	% <u>0</u>
PLUS 3/4"	WT. <u>8612</u>	% <u>32.2</u>
PLUS NO. 4	WT. <u>10431</u>	% <u>39.0</u>
WEIGHT OF ADJUSTED SAMPLE	<u>18136</u>	
PLUS 3/4"	WT. <u>0</u>	% <u>0</u>
PLUS NO. 4	WT. <u>1819</u>	% <u>10.0</u>

# Ninyo & Moore

## MAXIMUM DENSITY TEST DATA

TRES

PROJECT NAME Ch2m Hill PROJECT NO. 102208-01  
 DATE \_\_\_\_\_ SAMPLE LOCATION [P-6 + TP-2] DEPTH \_\_\_\_\_ TECHNICIAN TS  
 SOIL DESCRIPTION ML-CL - light brown silty clay

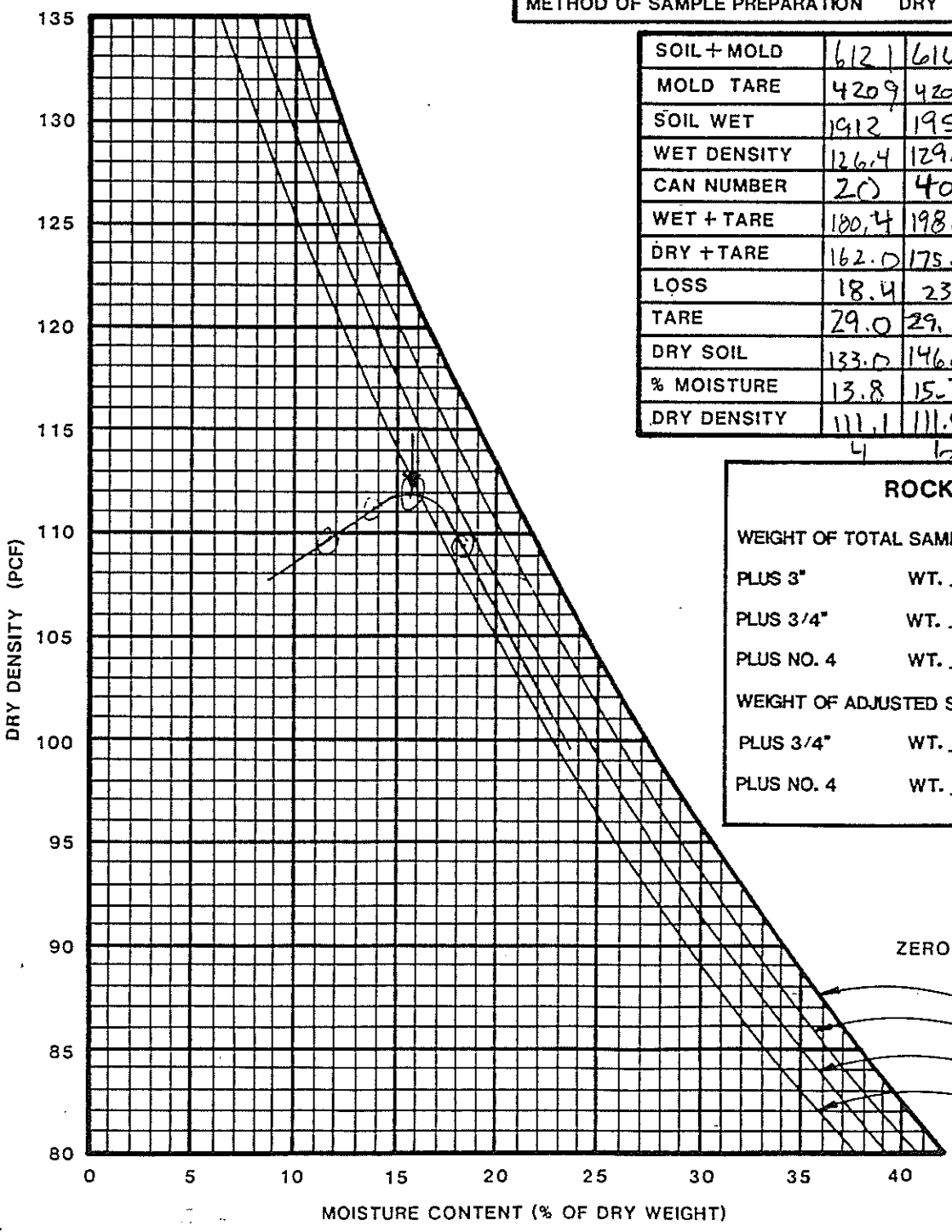
**TEST RESULTS**

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	612.1	616.8	616.5	606.6
MOLD TARE	420.9	420.9	420.9	420.9
SOIL WET	191.2	195.9	195.6	185.7
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



**ROCK CONTENT**

WEIGHT OF TOTAL SAMPLE \_\_\_\_\_

PLUS 3" WT. \_\_\_\_\_ % \_\_\_\_\_

PLUS 3/4" WT. \_\_\_\_\_ % \_\_\_\_\_

PLUS NO. 4 WT. \_\_\_\_\_ % \_\_\_\_\_

WEIGHT OF ADJUSTED SAMPLE \_\_\_\_\_

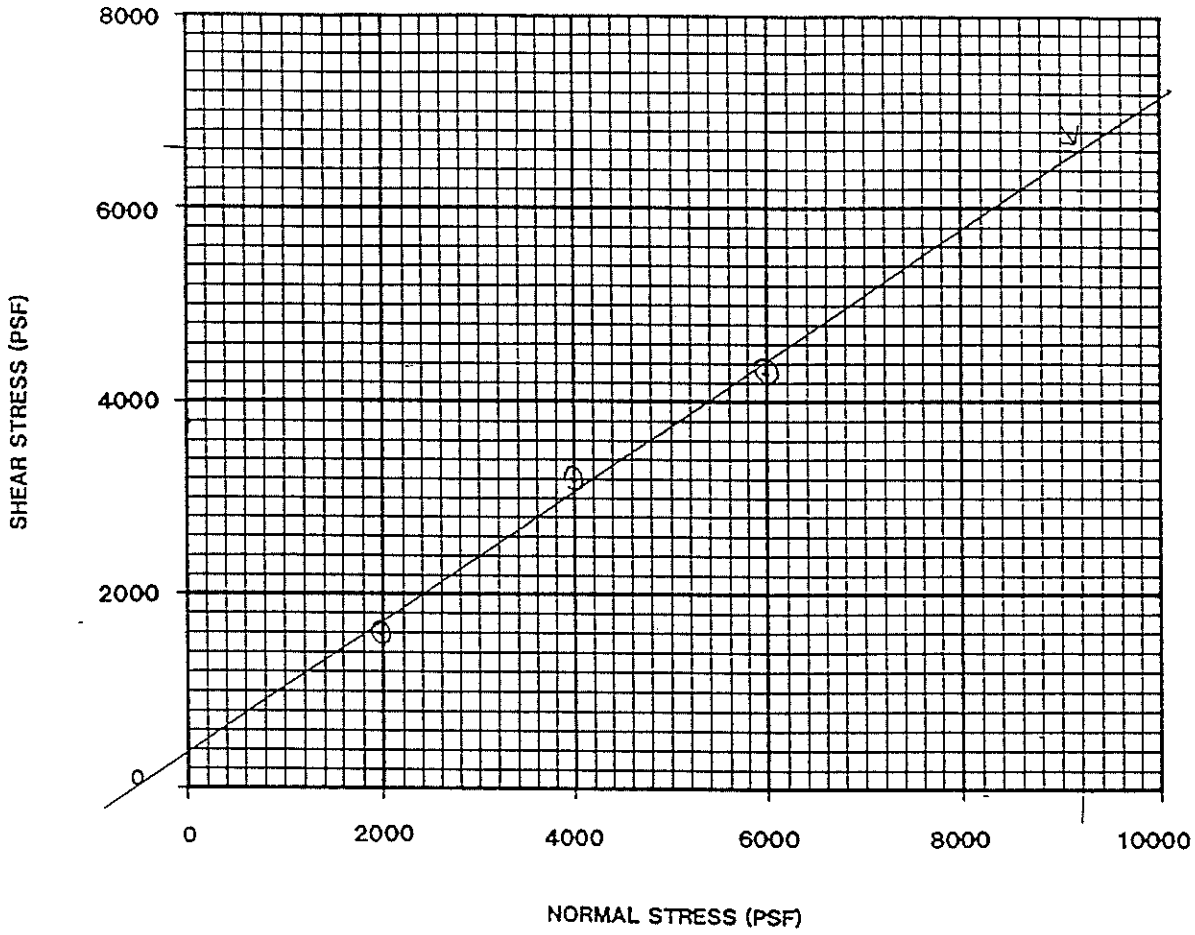
PLUS 3/4" WT. 0 % 0

PLUS NO. 4 WT. \_\_\_\_\_ % \_\_\_\_\_

ZERO AIR VOIDS CURVES

- G 2.80
- G 2.70
- G 2.60
- G 2.50

*PK*  
DES



Description	Symbol	Boring Number	Sample Number	Depth (Feet)	Cohesion (PSF)	Friction Angle	Soil Type
IN SITU		B8	6C	25'	390	39.0	SM

$$\begin{array}{r} 6600 \\ + 390 \\ \hline 6210 = 9200 \end{array}$$

**Ninyo & Moore**

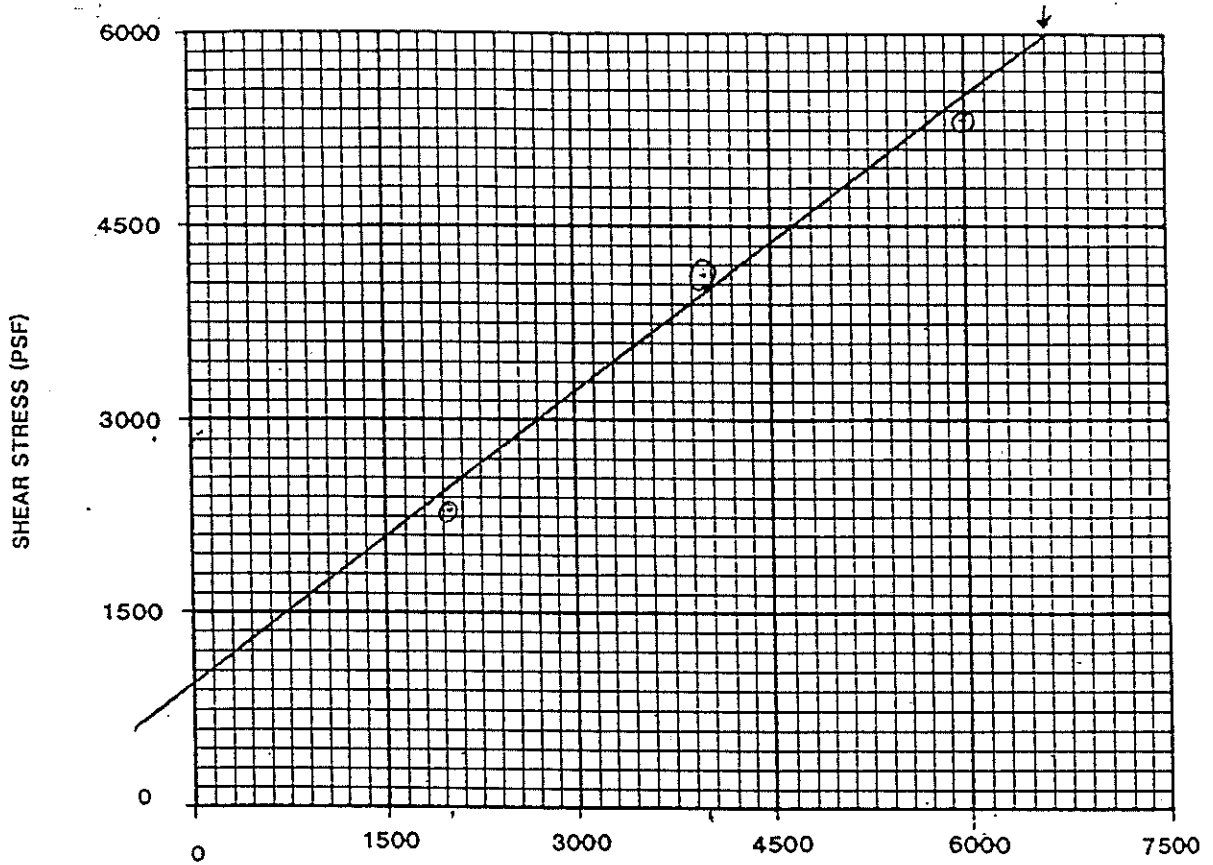
**DIRECT SHEAR TEST RESULTS**

*CH 2 M Hill*

PROJECT NO.	DATE
102208-01	1-8-92

FIGURE



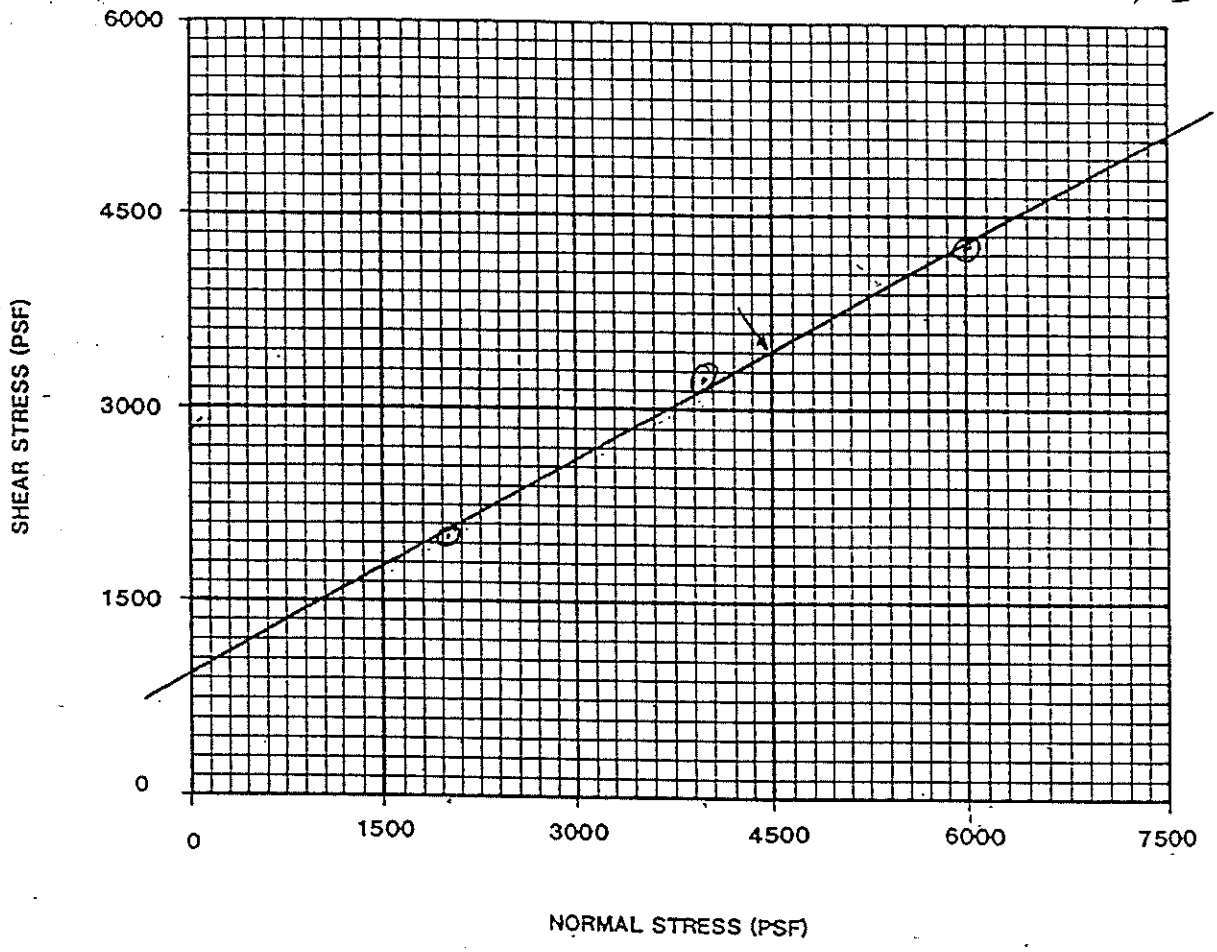


NORMAL STRESS (PSF)  $\frac{6000 - 945}{6600} =$   
IN TAN

Description	Symbol	Boring Number	Sample Number	Depth (Feet)	Cohesion (PSF)	Friction Angle	Soil Type
IN SITU		B-13		20'	945	37.4	ML-CL

	DIRECT SHEAR TEST RESULTS	
	CH2M HILL / NCTP	
	PROJECT NO. 2200-01	DATE 1/10/91
	FIGURE	

TRES *MR*

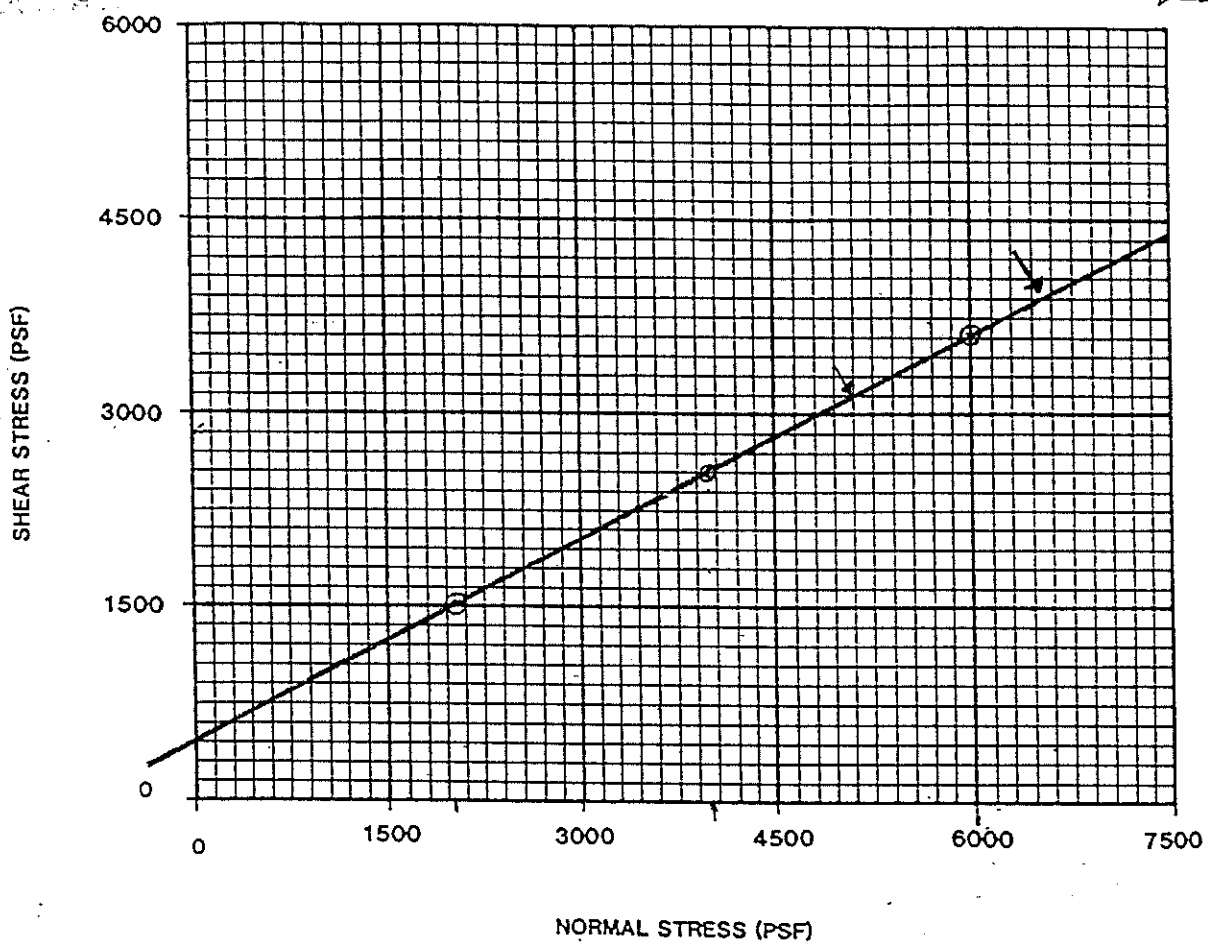


Description	Symbol	Boring Number	Sample Number	Depth (Feet)	Cohesion (PSF)	Friction Angle	Soil Type
REMOLDED		TP-6		2B	950	29.1°	ML

$$\frac{3450 - 950}{2500} = 1.1 \text{KV TAN}$$

	DIRECT SHEAR TEST RESULTS	
	CH2M HILL / NCTP	
	PROJECT NO. 102208-01	DATE 1/3/91
	FIGURE	

ZES  
RER



Description	Symbol	Boring Number	Sample Number	Depth (Feet)	Cohesion (PSF)	Friction Angle	Soil Type
REMOLDED		TP-1		ZB	450	27.9°	ML

3150  
450  
-----  
2700 = 5100  
INV TAN

**DIRECT SHEAR TEST RESULTS**

CH2M HILL / NCTP

**Ninyo & Moore**

PROJECT NO.

DATE

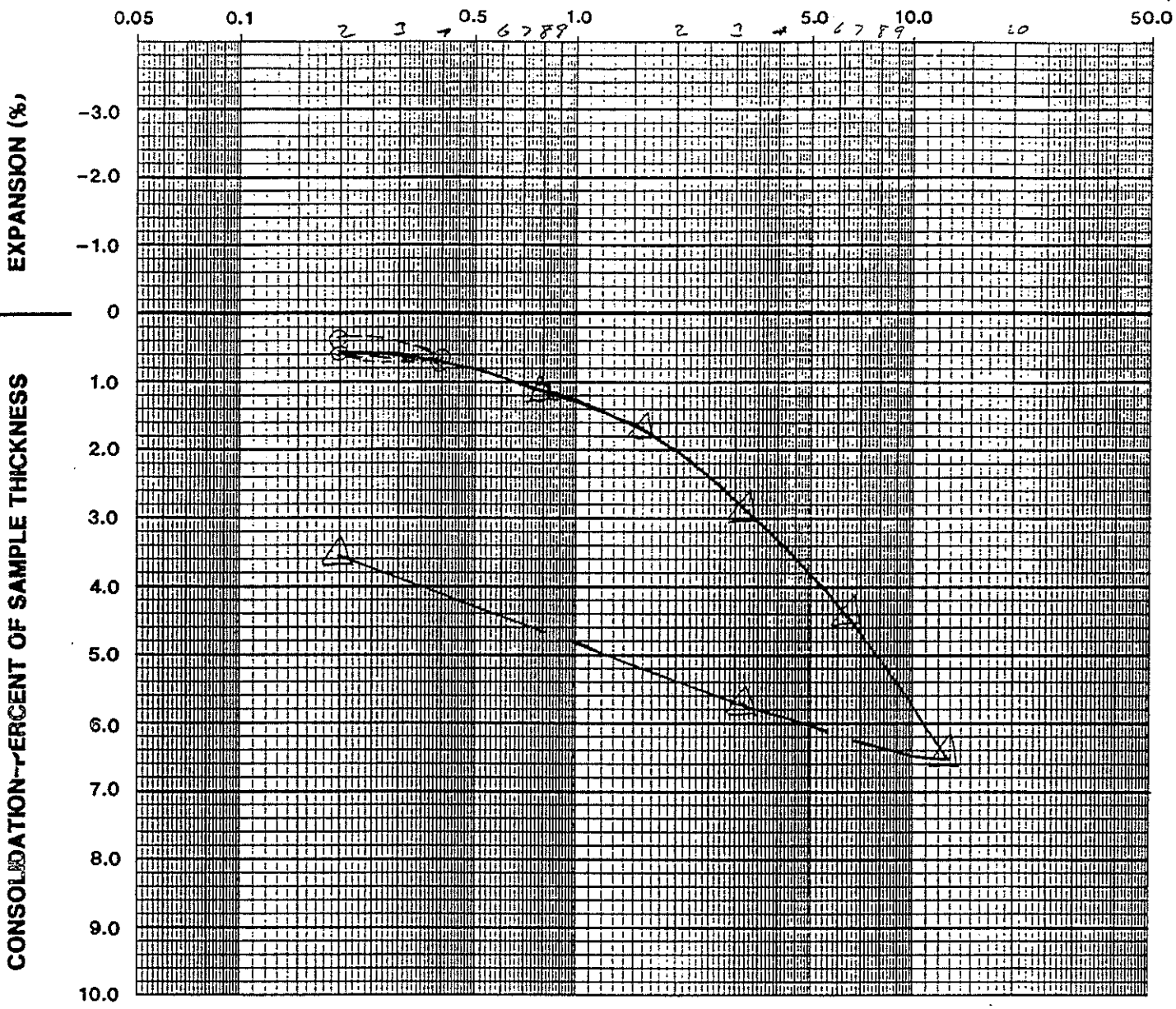
FIGURE

102200-01

1/7/91

STRESS IN KIPS PER SQUARE FOOT

RL



● Field Moisture      Loading      Boring No. 28  
 ▲ Inundated      Rebound      Depth (FT.) 15'  
 ----- Seating Cycle      Soil Type SC

**Ninyo & Moore**

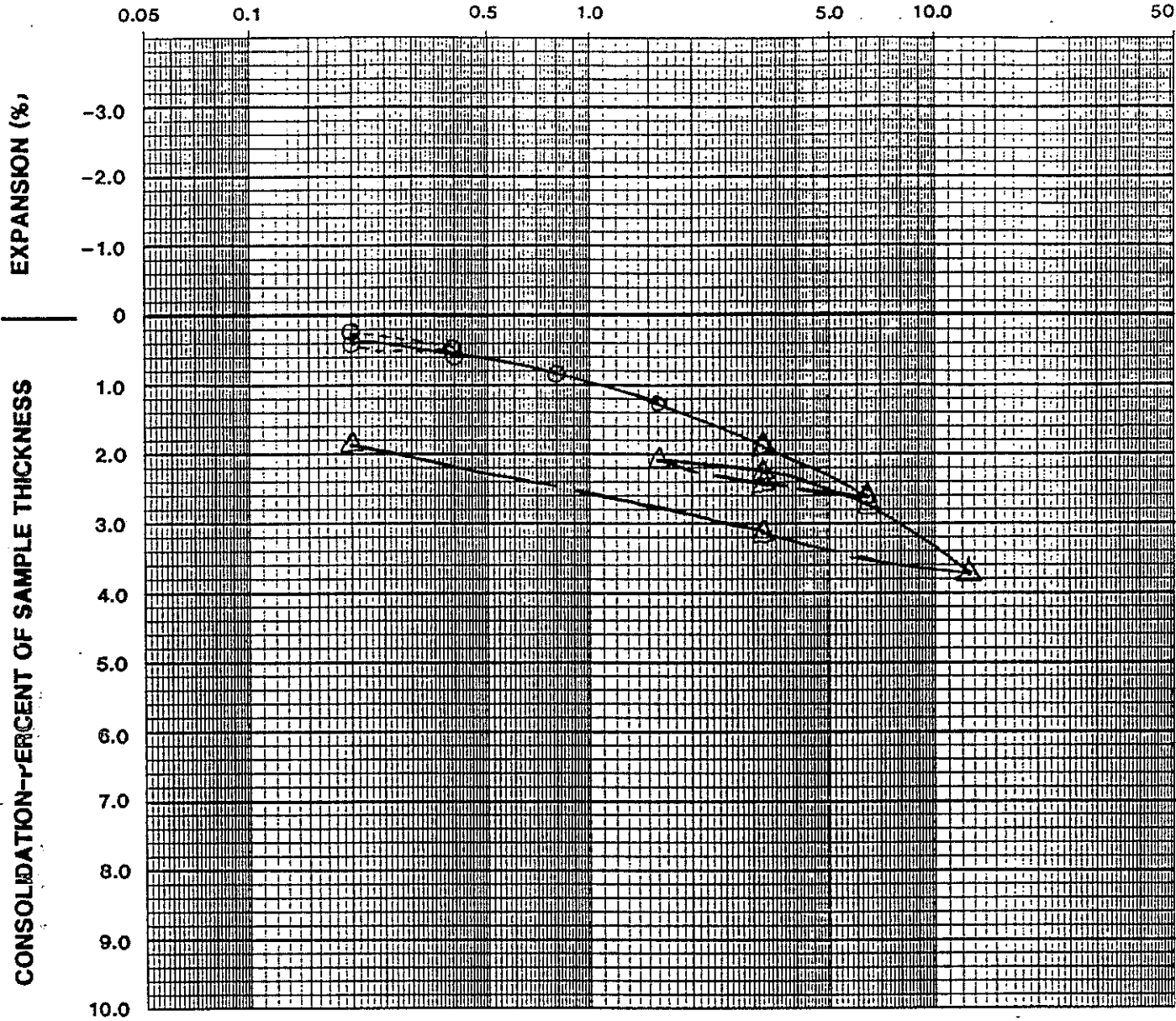
CONSOLIDATION TEST RESULTS

CH 2 M Hill

PROJECT NO.	DATE	FIGURE
102208-01	12-31-91	

STRESS IN KIPS PER SQUARE FOOT

DRES



● Field Moisture      Loading  
 ▲ Inundated          Rebound  
 ----- Seating Cycle

Boring No. B13  
 Depth (FT.) 25'  
 Soil Type SN + CL

**Ninyo & Moore**

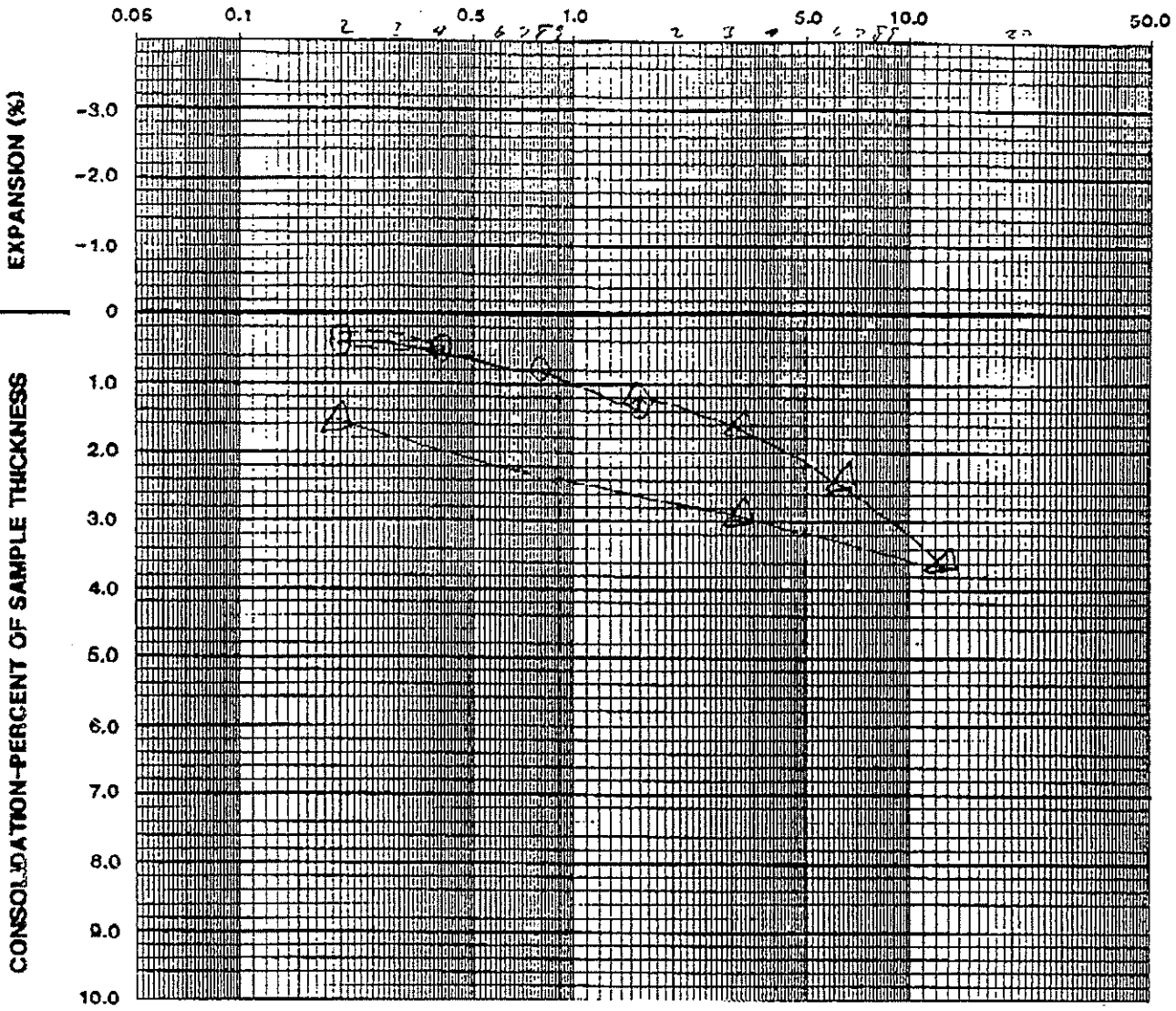
CONSOLIDATION TEST RESULTS

CH 2 M Hill		
PROJECT NO.	DATE	FIGURE
102208-01	12-21-91	



STRESS IN KIPS PER SQUARE FOOT

*ME*



● Field Moisture

———— Loading

Boring No. *B 15*

▲ Inundated

———— Rebound

Depth (FT.) *10*

----- Seating Cycle

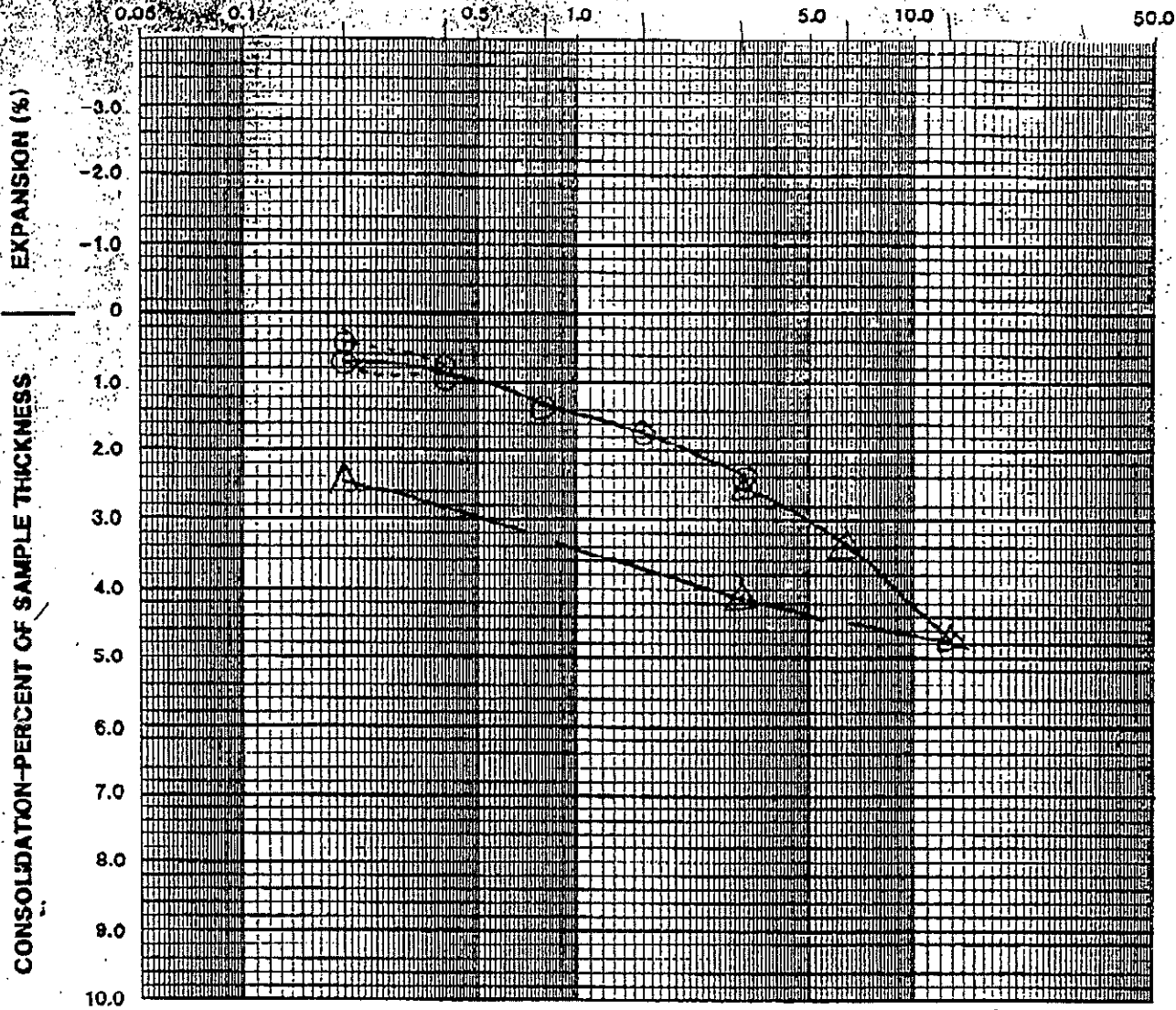
Soil Type *CL*

CONSOLIDATION TEST RESULTS

**Ninyo & Moore**

<i>CH 2 M Hill</i>		
PROJECT NO.	DATE	FIGURE
<i>102208-01</i>	<i>1-24-92</i>	

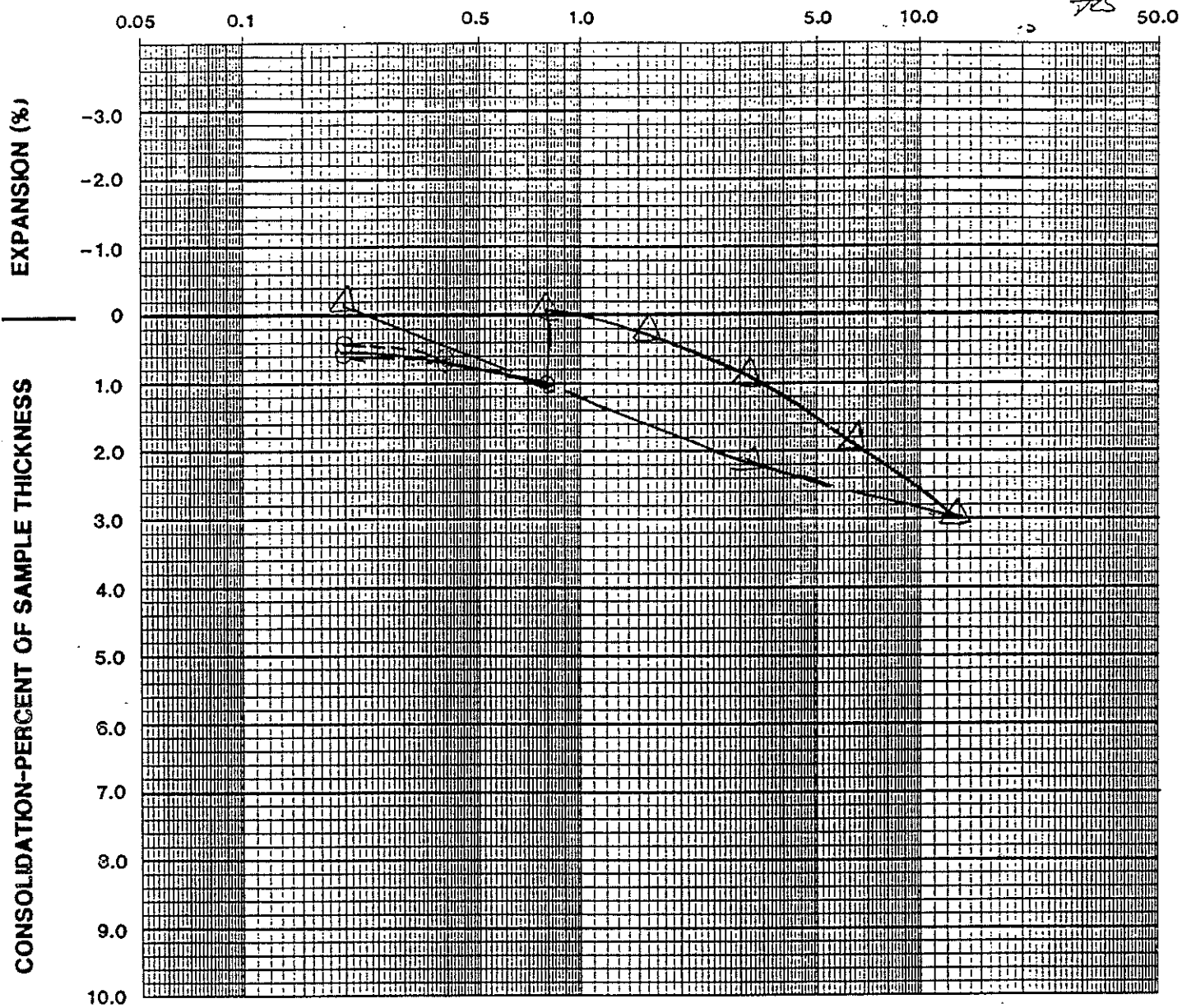
STRESS IN KIPS PER SQUARE FOOT



● Field Moisture      Loading      Boring No.      B-16  
 ▲ Inundated      Rebound      Depth (FT.)      25'  
 ----- Seating Cycle      Soil Type      ML-CL

	CONSOLIDATION TEST RESULTS		
	CH <sub>2</sub> M HILL / NCTP		
	PROJECT NO. 102208-01	DATE 1-27-92	FIGURE

STRESS IN KIPS PER SQUARE FOOT



● Field Moisture      Loading      REMOLDED      Boring No. TP1

▲ Inundated      Rebound      Depth (FT.) 2 B

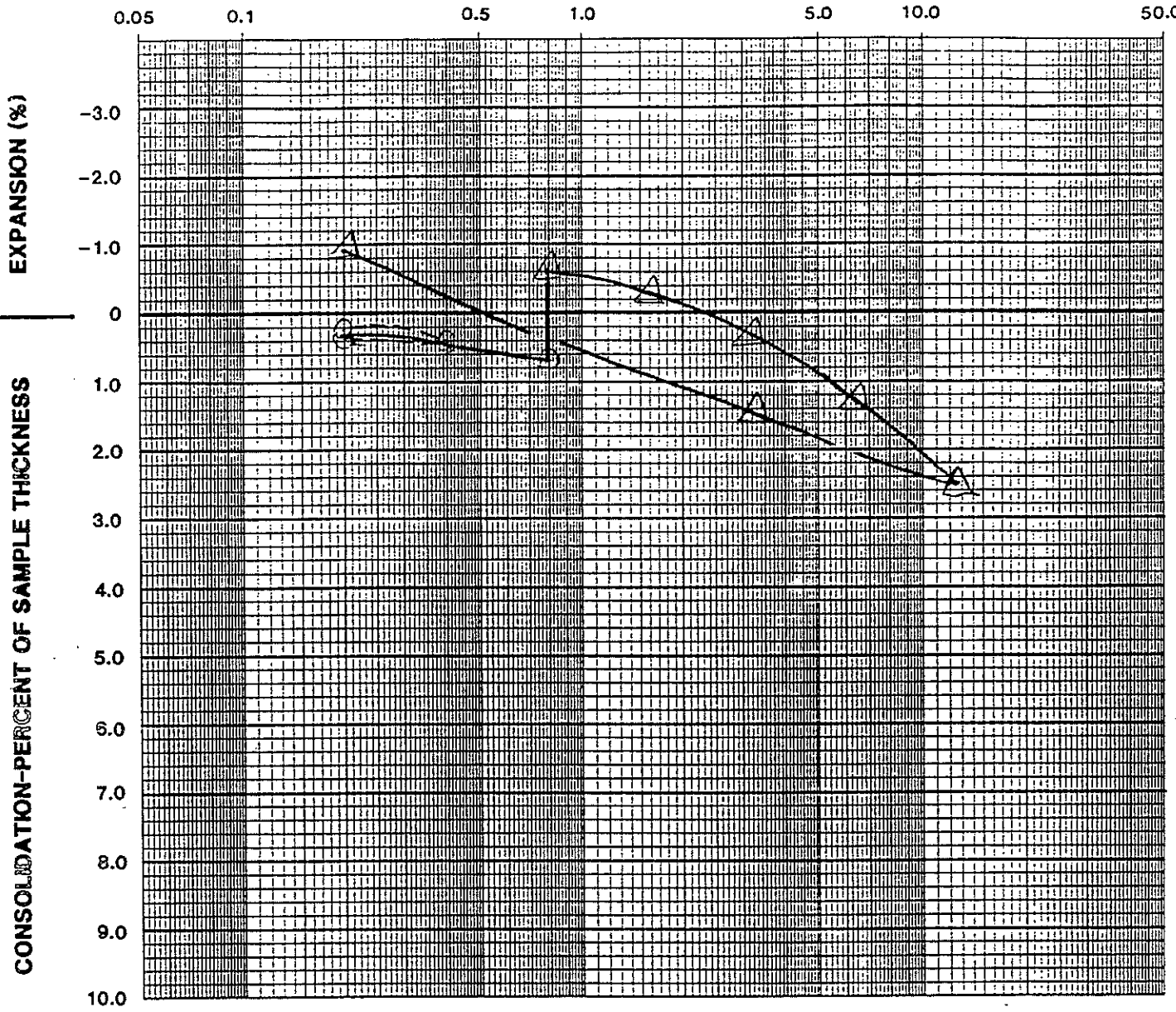
----- Seating Cycle      Soil Type ML

**Ninyo & Moore**

CONSOLIDATION TEST RESULTS		
CH2M Hill		
PROJECT NO.	DATE	FIGURE
102208-01	1-8-92	

STRESS IN KIPS PER SQUARE FOOT

RL



● Field Moisture      ———— Loading      REMOLDED  
 ▲ Inundated          ———— Rebound      Boring No. *TP6*  
 - - - - - Seating Cycle      Soil Type *ML*  
 Depth (FT.) *2 B*

CONSOLIDATION TEST RESULTS

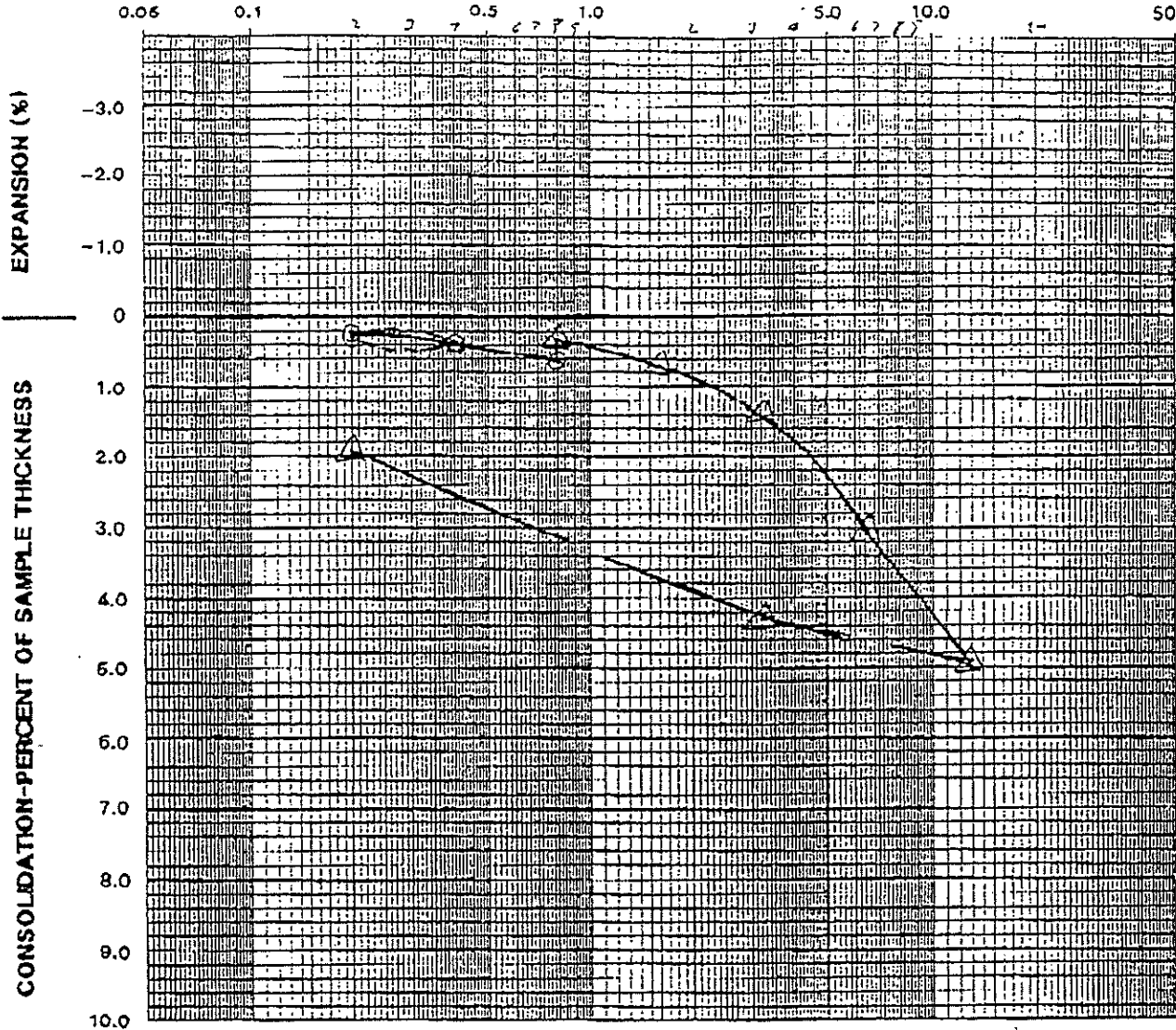
**Ningo & Moore**

*CH2M Hill*

PROJECT NO.	DATE	FIGURE
<i>102208-01</i>	<i>1-8-92</i>	

STRESS IN KIPS PER SQUARE FOOT

*ML - 1992*



● Field Moisture      Loading  
 ▲ Inundated      Rebound  
 ----- Seating Cycle

REMOLED  
 Boring No. TP 1-2B  
 Depth (FT.) 5'  
 Soil Type ML  
 INUNDATED AT 0.8 KSF

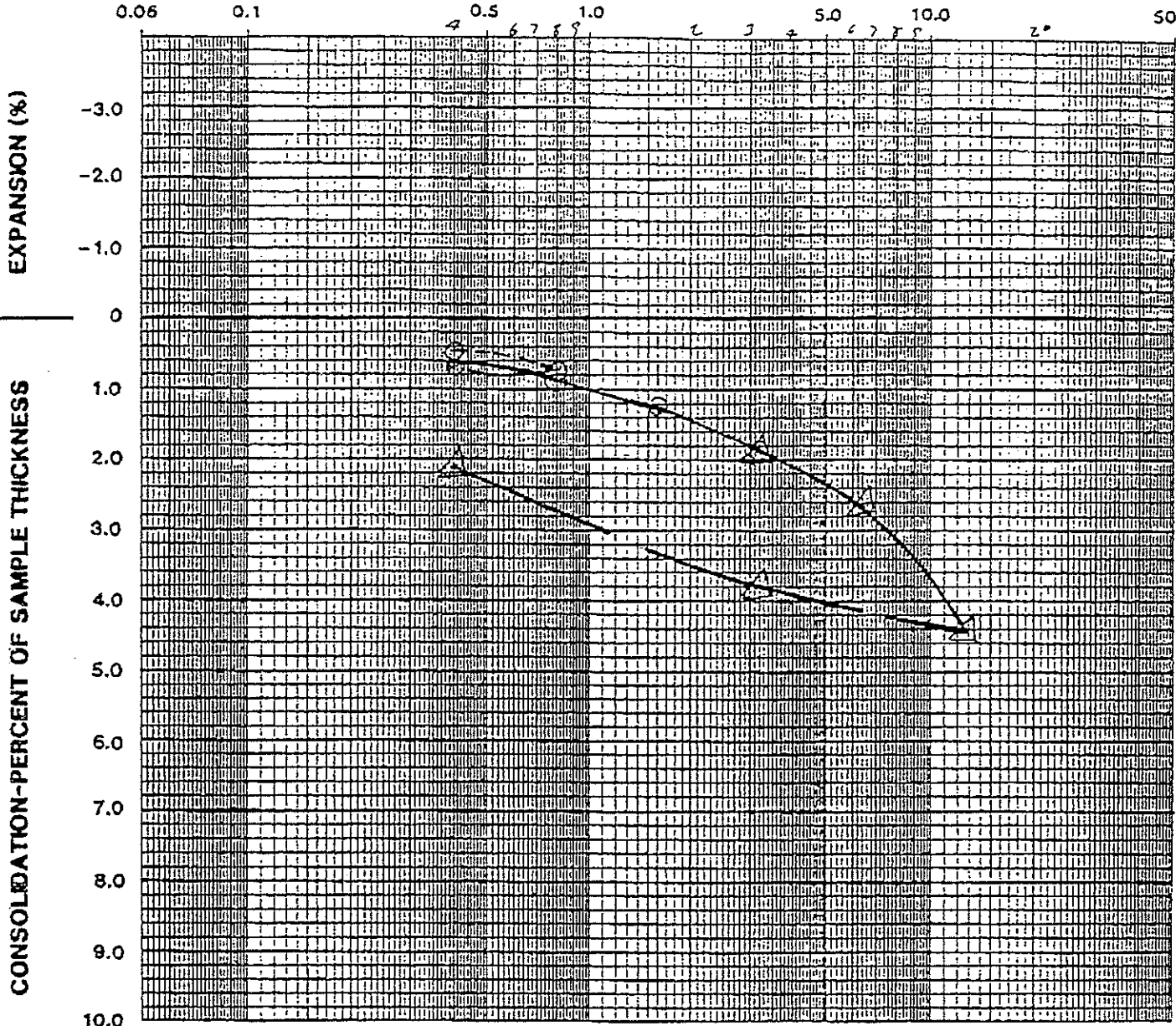
<b>Ninyo &amp; Moore</b>	CONSOLIDATION TEST RESULTS		
	CH 2M Hill / HCTP		
	PROJECT NO.	DATE	FIGURE
	102207-01	2-27-92	





STRESS IN KIPS PER SQUARE FOOT

*W*  
*PH*



- Field Moisture      ———— Loading
- ▲ Inundated          ———— Rebound
- - - - Seating Cycle

REMOLDED  
Boring No. *TP1*

Depth (FT.) *2.8*

Soil Type *ML*

INUNDATED AT 3.2 KSF

CONSOLIDATION TEST RESULTS

**Ninyo & Moore**

*CH2M Hill INC TP*

PROJECT NO.

DATE

FILE NO.

# Ninyo & Moore

## EXPANSION PRESSURE TEST DATA

PROJECT NAME Chm 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					MOISTURE AND DENSITY DATA		
DATE	TIME	DIAL READING	WEIGHT OF SAND ADDED (g)	DIAL READING	MOISTURE	BEFORE EXPANSION	AFTER EXPANSION
1-16-92	16:50	.1000			CAN NUMBER	31	31
	16:51	.1053			WEIGHT OF WET SOIL + RING + CAN	220.5	230.3
1-20-92	07:02	.0955			WEIGHT OF DRY SOIL + RING + CAN	201.7	201.7
	08:13	.0956			WEIGHT OF WATER	18.8	28.6
	08:15	.1000	14.0	.1000	WEIGHT OF RING	45.4	45.4
	08:21	.0994	300	.0996	WEIGHT OF CAN	29.0	29.0
	08:32	.0995	200	.0998	WEIGHT OF DRY SOIL	127.3	127.3
	09:00	.1000	-	.1000	PERCENT MOISTURE	14.8	22.5
1-21	07:37	.0999	-	.0999	DENSITY		
	15:10	.1003		.1003	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
TOTAL WEIGHT OF SAND ADDED (g) <u>500</u>							
TOTAL ELAPSED TIME (HRS) <u>32</u>							
EXPANSION PRESSURE (psf) <u>850 PSF</u>							

REMARKS cmc = 6.8 Rem -95% 11.7 @ 14.8  
Batch 322.5  
Soil Per Ring 146.0

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					MOISTURE AND DENSITY DATA		
DATE	TIME	DIAL READING	WEIGHT OF SAND ADDED (g)	DIAL READING	MOISTURE	BEFORE EXPANSION	AFTER EXPANSION
1-15-92	13:16	.1000			CAN NUMBER	16	16
	13:17	.1063			WEIGHT OF WET SOIL + RING + CAN	221.9	231.2
1-16-92	09:00	.1081			WEIGHT OF DRY SOIL + RING + CAN	201.7	201.7
	11:00	.1083					
	13:00	.1086					
1-20-92	07:02	.1100			WEIGHT OF WATER	20.2	29.5
	08:13	.1101			WEIGHT OF RING	45.0	45.0
	08:16	.1000	1120	.11013	WEIGHT OF CAN	29.0	29.0
	08:20	.0991	1200	.0999	WEIGHT OF DRY SOIL	127.7	127.7
	08:25	.0990	400	.0994	PERCENT MOISTURE	15.8	23.1
	08:27	.0994	400	.1001	DENSITY		
	09:00	.0998	200	.1000	WEIGHT OF WET SOIL + RING + CAN	221.9	231.2
1-21	07:37	.1000	-	.1000	WEIGHT OF RING	45.0	45.0
	15:10	.1004	-	.1004	WEIGHT OF CAN	29.0	29.0
TOTAL WEIGHT OF SAND ADDED (g) <u>2200 grams</u>					WEIGHT OF WET SOIL	147.9	157.2
TOTAL ELAPSED TIME (HRS) <u>32</u>					WET DENSITY	122.8	130.5
EXPANSION PRESSURE (psf) <u>2050 psf</u>					DRY DENSITY	106.0	106.0
REMARKS <u>Comp. = 9.5 Rem 95% 111.9 @ 15.7</u>							
<u>Batch = 317.0</u>							
<u>Soil per Ring = 148.2 Ring = 45.0</u>							

**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

LOT 75

SEC 9 T.15S R.3W

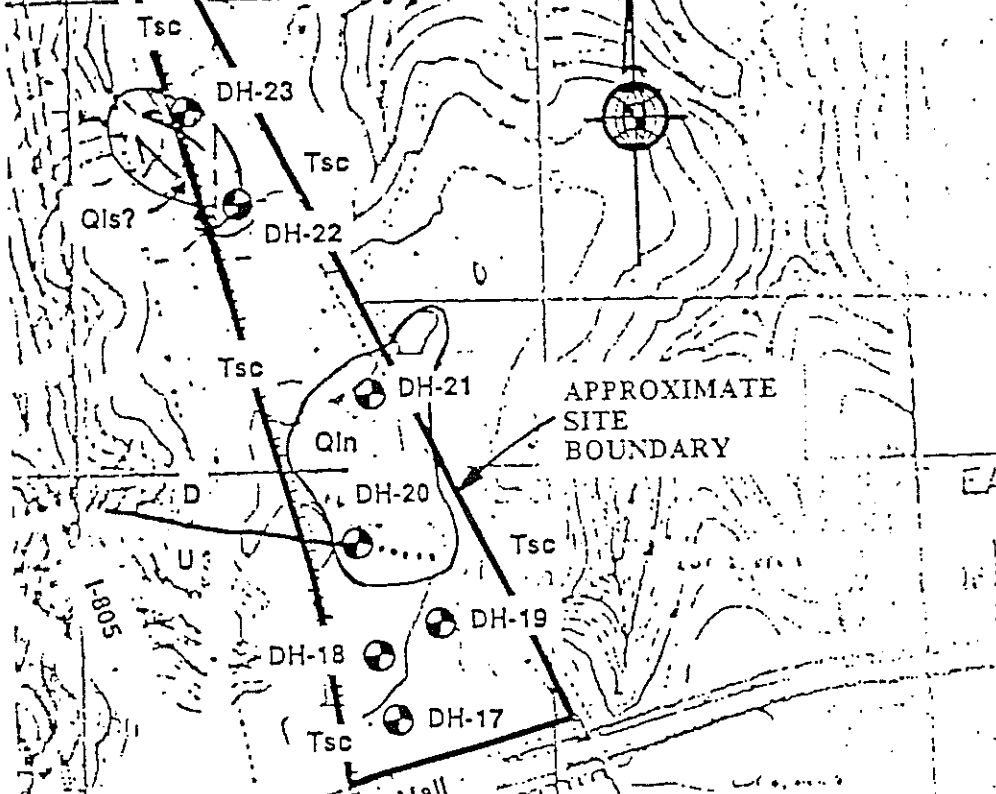
**North City - North Site**

**LEGEND**

- Qls? Probable Landslide
- Qln Lindavista Formation
- Tsc Scripps Formation
- Area of Surface Creep
- DH-1 Estimated Location of Drill Hole

**APPROXIMATE SCALE**

1 Inch = 400 feet



PUEBLO

PLATE 1 - SITE PLAN

# 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.: 17

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 (%)		
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			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.						
60			4	89		Firm, slow drilling. CLAYEY SILTSTONE (R) laminated gray and brown, laminations are subhorizontal.						
25			5	50/ 6"		SILTSTONE/SANDSTONE (R) light brown, damp, dense, finely laminated.						
50			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.						

# 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 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)" SILTY CLAY (CL) brown, dry, soft to medium stiff, scattered cobbles.						
375			1	63		"SCRIPPS FORMATION (Tsc)" SILTSTONE (R) light gray-brown, dry to damp, dense, thin claystone interlamination. Interlaminated Siltstone/Claystone. Scattered hematite cementation. CLAYEY SILTSTONE (R) light gray-brown, damp, stiff.						
370			2	89		Minor, thin, fine grained sand lenses.						
365			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			4	50/ 6"		CLAYEY SILTSTONE (R) light gray-brown, damp, stiff to medium hard, finely laminated-subhorizontal, minor iron oxide.						
355			5	85/ 11"		CLAYEY SILTSTONE (R) light gray-brown, damp, stiff to medium hard, finely laminated-subhorizontal, minor iron oxide.						
350			6	50/ 6"		Locally stiff, slow drilling. 2-3 inch Silty Sandstone layers, oxidized orange-brown, sand is very fine grained.						
345			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			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.						



# 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

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) 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				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				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)						
25				5	81		Very dense, well indurated SILTSTONE (R) bed, between 22 and 24 feet. CLAYEY SILTSTONE (R) light gray-brown, damp, stiff (indurated), local oxidization, subhorizontal layers.						
350				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 gray/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.						

# 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		TORVANE (PSF)	ADDITIONAL TESTS
								LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
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.						

# LOG OF DRILL HOLE

OB 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.: 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.						

# 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 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.						
5			1	46		*SCRIPPS FORMATION (Tsc)/POSSIBLE LANDSLIDE DEBRIS (Qls) 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			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			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.						

# LOG OF DRILL HOLE

DB 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.: 23

DRILLING DATE: January 8, 1990

DATUM: City of San Diego

REFERENCE EL.: 320 Feet

ELEVATION (FEET) DEPTH	DRILLING RATE	REAL TIME/DEPTH	SAMPLE NO.	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 (%)		
20							*SCRIPPS FORMATION (T <sub>sc</sub> )/POSSIBLE LANDSLIDE DEBRIS (Q <sub>ls</sub> )* CLAYEY SILTSTONE (R) gray-brown, damp, stiff, minor clay, moderate pervasive iron oxide, faintly laminated.						
5			1		46								
10				30/2			Hard layer, calcium carbonate cement, 9 to 10 feet. Siltstone, faintly laminated.						
15			2		51								
			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.						
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.						



# UNIFIED SOIL CLASSIFICATION SYSTEM

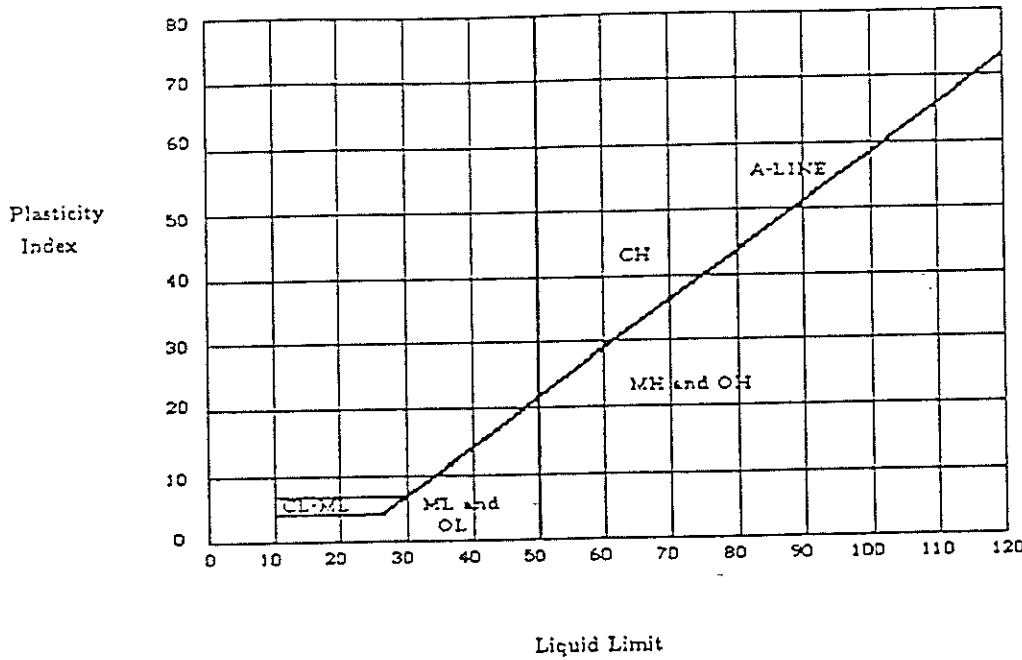
	MAJOR DIVISION	GROUP SYMBOL	DESCRIPTION	GRAPHIC LOG
<b>COARSE GRAINED SOILS</b> Over 50% By Weight Coarser Than No. 200 Sieve Size	GRAVELLY SOILS  OVER 50% OF COARSE FRACTION LARGER THAN NO. 4 SIEVE SIZE	CLEAN GRAVELLY SOILS  LITTLE OR NO FINES	GW  WELL GRADED GRAVELS OR GRAVEL - SAND MIXTURES	
		GP  POORLY GRADED GRAVELS OR POORLY GRADED GRAVEL - SAND SILT MIXTURES		
		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		
		SM  SILTY SANDS OR POORLY GRADED SAND - SILT MIXTURES		
		SC  CLAYEY SANDS OR POORLY GRADED SAND - CLAY MIXTURES		
<b>FINE GRAINED SOILS</b> 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



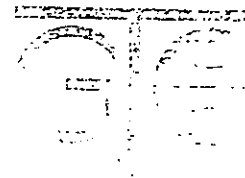
Light Caving

ADDITIONAL TESTS -

- |                                      |                       |                   |
|--------------------------------------|-----------------------|-------------------|
| UC : Unconfined Compression          | WP : Water Pressure   | PM : Permeability |
| TD : Triaxial Compression, Drained   | PMt: Pressuremeter    | EX : Expansion    |
| TU : Triaxial Compression, Undrained | SE : Sand Equivalent  | RS : Resistivity  |
| TDy: Triaxial Compression, Dynamic   | GJ : Goodman Jack     | S : Swell         |
| PH : Hydrogen Ion Concentration      | SP : Specific Gravity | CL : Chloride     |
| PA : Paleontologic, Analysis         | CP : Compaction       | SU : Sulphate     |
| GS : Grain Size Distribution         | C : Consolidation     |                   |
|                                      | DS : Direct Shear     |                   |

GEOTECHNICAL CONSULTANTS, INC.

3107 FIVE STAR DRIVE, SANTA ANA, CALIFORNIA 92705



PRELIMINARY GEOTECHNICAL RECONNAISSANCE

PROPOSED SLUDGE PROCESSING SITE

NORTH CITY - CENTRAL

CITY OF SAN DIEGO, CALIFORNIA

FOR




METCALF AND EDDY

FEBRUARY 1990

S89012

# North City - Central Site

## LEGEND

- af Artificial Fill
- Qc/Qal Alluvium/Colluvium
- Qln Lindavista Formation
- Tsc Scripps Formation
-  Strike and Dip of Bedding
-  Approximate Strike and Dip of Bedding
-  Estimated Location of Drill Hole

## APPROXIMATE SCALE

1 Inch = 400 feet

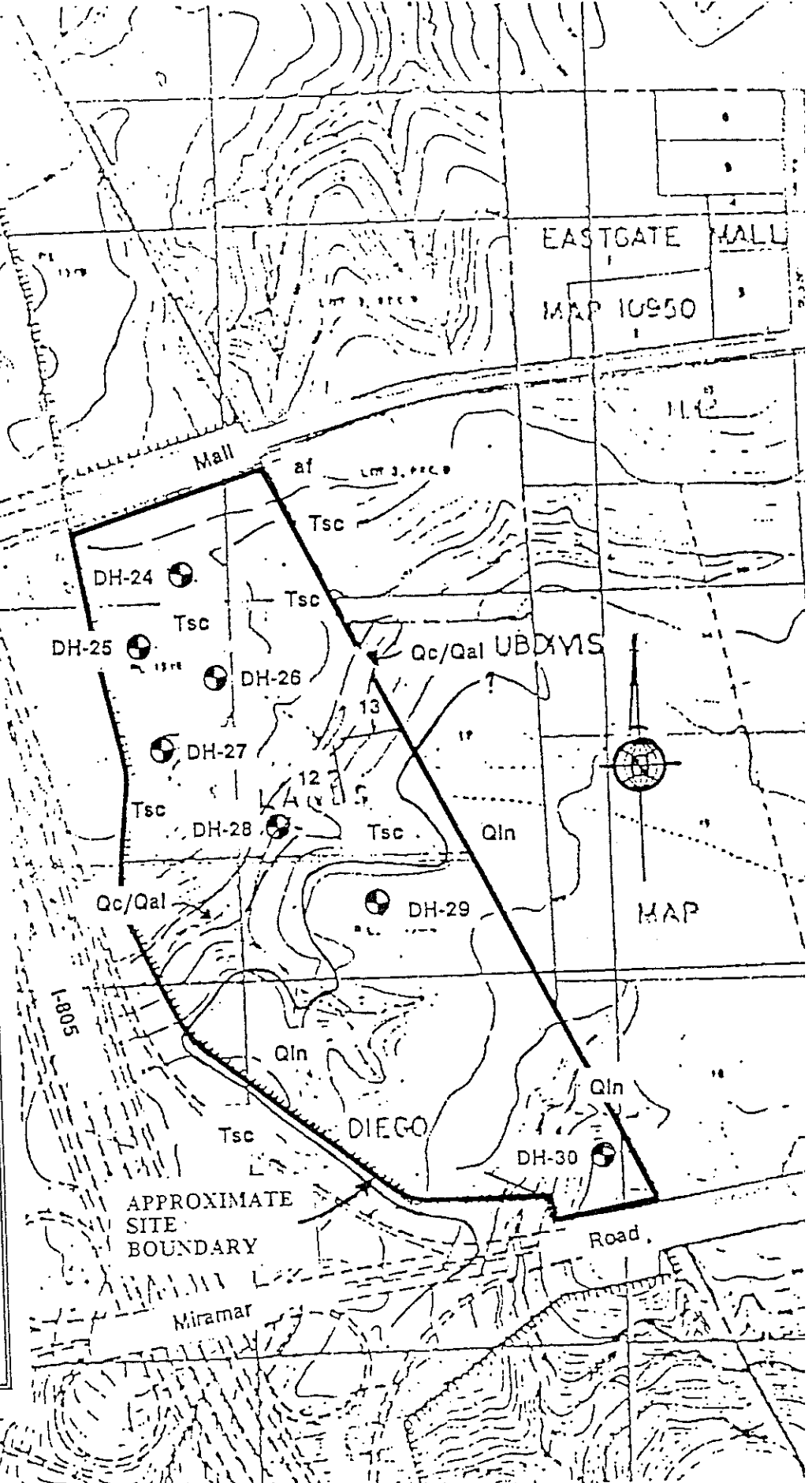


PLATE 1 - SITE PLAN

# LOG OF DRILL HOLE

DB 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.: 24

DRILLING DATE: January 8, 1990

DATUM: City of San Diego

REFERENCE EL.: 375 Feet

ELEVATION (FEET) DEPTH	DRILLING RATE	REAL TIME/DEPTH	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 (%)		
70	5		1	95		"SCRIPPS FORMATION (Tsc)" CLAYEY SANDSTONE (R) damp, yellow-brown/gray, damp, dense (indurated), no laminations, sand is fine grained.						
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						
20			4	46		5-inch thick clay layer at 17 feet. 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.						
50	25		5	91		SILTSTONE/CLAYSTONE (R) light gray/brown, damp, stiff to very stiff (well indurated), locally oxidized.						
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.						



# 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 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 (%)		
						*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.						
			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.						
			4	79		Very uniform.						
350	25		5	89								
			6	86/ 11.5		*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.						
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.						

# 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. Hoaseini  
 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		TORVANE (PSF)	ADDITIONAL TESTS
									LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
360 5			1	93		"SCRIPPS FORMATION (Tsc)" CLAYEY SILTSTONE (R) light gray/yellow-brown, damp, stiff (indurated), minor organics and iron oxide.						
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.						

# 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 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						"SCRIPPS FORMATION (T <sub>sc</sub> )" 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			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			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.												

# 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.: 28  
 DRILLING DATE: January 9, 1990  
 DATUM: City of San Diego  
 REFERENCE EL.: 305 Feet

ELEVATION (FEET) DEPTH	DRILLING RATE	REAL TIME/DEPTH	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 (%)		
00			1	45		*ALLUVIUM/COLLUVIUM (Qal/Qc)* SANDY CLAY (CL) with gravel, dark brown, damp, medium stiff, slightly plastic, decreasing sand and gravel at 2.0 feet.  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),						
90			3	66		**SCRIPPS FORMATION (Tsc)* SANDSTONE (R) yellow-brown, damp, dense (indurated), minor silt, sand is medium grained.						
20			4	77		*SCRIPPS FORMATION (Tsc)* Interlaminated SILTSTONE/CLAYSTONE (R), light gray/yellow-brown, damp, stiff (well indurated), locally oxidized. Subhorizontal laminations, minor organics in claystone laminae.						
						*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.						

# 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		TORVANE (PSF)	ADDITIONAL TESTS
								LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
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.						



# LOG OF DRILL HOLE

OB 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.: 30

DRILLING DATE: January 9, 1990

DATUM: City of San Diego

REFERENCE EL.: 380 Feet

ELEVATION (FEET) DEPTH	DRILLING RATE REAL TIME/DEPTH	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				[Hatched pattern]	<p>"COLLUVIUM (Qc)" SANDY CLAY (CL) red-brown, damp, medium stiff, abundant pebbles and cobbles are present at surface.</p>						
375		1	50/ 3.5"	[Dotted pattern]	<p>"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.</p> <p>Very thin sandstone lamina at 5.5 feet, abundant cobbles.</p>						
9		2	46/ 6"	[Dotted pattern]	<p>Refusal at 9.5 feet. No groundwater encountered. Drill hole backfilled and tamped.</p>						

# UNIFIED SOIL CLASSIFICATION SYSTEM

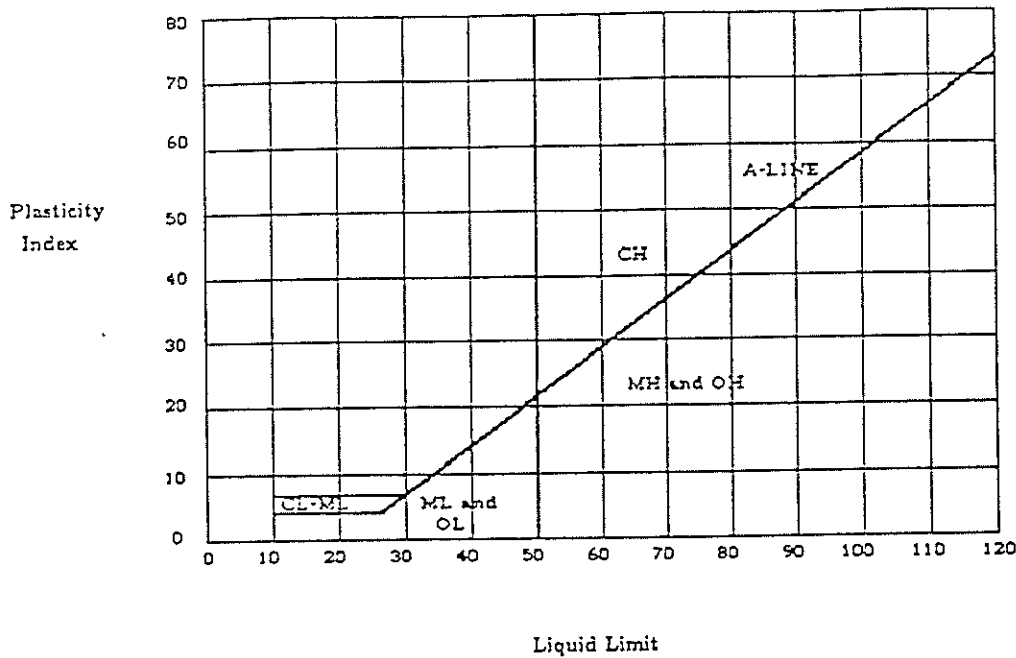
	MAJOR DIVISION	GROUP SYMBOL	DESCRIPTION	GRAPHIC LOG	
<b>COARSE GRAINED SOILS</b> Over 50% By Weight Coarser Than No. 200 Sieve Size	GRAVELLY SOILS  OVER 50% OF COARSE FRACTION LARGER THAN NO. 4 SIEVE SIZE	CLEAN GRAVELLY SOILS	GW	WELL GRADED GRAVELS OR GRAVEL - SAND MIXTURES	
		LITTLE OR NO FINES	GP	POORLY GRADED GRAVELS OR POORLY GRADED GRAVEL - SAND SILT MIXTURES	
		GRAVELLY SOILS WITH FINES	GM	SILTY GRAVELS OR POORLY GRADED GRAVEL - SAND SILT MIXTURES	
		OVER 12% FINES	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	SW	WELL GRADED SANDS OR GRAVELLY SANDS	
		LITTLE OR NO FINES	SP	POORLY GRADED SANDS OR GRAVELLY SANDS	
		SANDY SOILS WITH FINES	SM	SILTY SANDS OR POORLY GRADED SAND - SILT MIXTURES	
		OVER 12% FINES	SC	CLAYEY SANDS OR POORLY GRADED SAND - CLAY MIXTURES	
<b>FINE GRAINED SOILS</b> 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             | WP : Water Pressure   | PM : Permeability |
| TD : Triaxial Compression, Drained      | PMt: Pressuremeter    | EX : Expansion    |
| TU : Triaxial Compression,<br>Undrained | SE : Sand Equivalent  | RS : Resistivity  |
| TDy: Triaxial Compression, Dynamic      | GJ : Goodman Jack     | S : Swell         |
| PH : Hydrogen Ion Concentration         | SP : Specific Gravity | CL : Chloride     |
| PA : Paleontologic, Analysis            | CP : Compaction       | SU : Sulphate     |
| GS : Grain Size Distribution            | C : Consolidation     |                   |
|   | DS : Direct Shear     |                   |

GEOTECHNICAL CONSULTANTS, INC.

San Francisco, California

PRELIMINARY GEOTECHNICAL RECONNAISSANCE

PROPOSED SLUDGE PROCESSING SITE

NORTH CITY - SOUTH

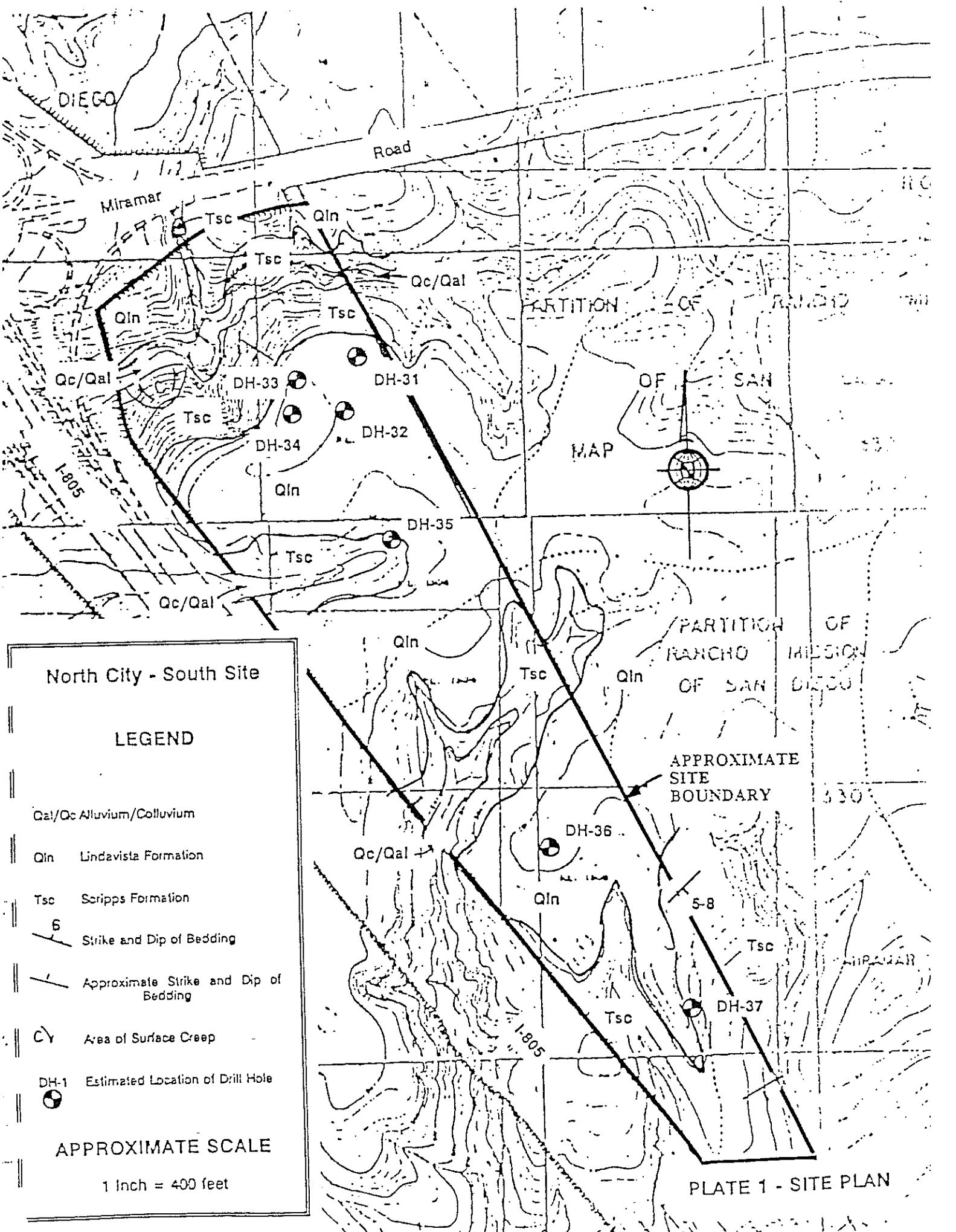
CITY OF SAN DIEGO, CALIFORNIA

FOR

METCALF AND EDDY

FEBRUARY 1990

S89012




North City - South Site


LEGEND


Qal/Qc Alluvium/Colluvium


Qln Lindavista Formation

Tsc Scripps Formation

 Strike and Dip of Bedding

 Approximate Strike and Dip of Bedding

 Area of Surface Creep

DH-1  Estimated Location of Drill Hole

APPROXIMATE SCALE

1 Inch = 400 feet

APPROXIMATE SITE BOUNDARY

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.: 31  
 DRILLING DATE: January 9, 1990  
 DATUM: City of San Diego  
 REFERENCE EL.: 385 Feet

ELEVATION (FEET) DEPTH	DRILLING RATE	REAL TIME/DEPTH	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.						

# 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)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		TORVANE (PSF)	ADDITIONAL TESTS
										LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
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.						
10				2	46		"SCRIPPS FORMATION (Tsc)" CLAYEY SANDSTONE (R) greenish-gray, damp, medium dense to dense. Sandstone is medium-grained.  2-3 inch thick cobble-rich layer at 12.5 feet.						
15				3	68		SILTY SANDSTONE (R) with very thin claystone interlamination, light gray, damp, dense (well-indurated) locally oxidized, sandstone is fine grained.						
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.						
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													
40				6	50/ 6"		SILTY SANDSTONE (R) light gray, damp, very dense, (well-indurated), friable, fine grained, scattered thin claystone interlamination, locally oxidized.  Bottom of drill hole at 40 feet. No groundwater encountered. Drill hole backfilled and tamped.						

# LOG OF DRILL HOLE

OB 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.: 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		TORVANE (PSF)	ADDITIONAL TESTS
									LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
390						"COLLUVIUM (Qc)" SANDY CLAY (CL) red-brown, dry to damp, medium stiff. Abundant pebbles and cobbles.  Becoming stiff.						
385			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.						

# 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 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 (%)		
390						<p>"COLLUVIUM (Qc)" SANDY CLAY (CL), red-brown, dry, medium stiff, abundant cobbles.</p> <p>"LINDAVISTA FORMATION (Qln)" GRAVELLY SANDSTONE (R) gray, damp, very dense, abundant cobbles, very difficult to drill due to large cobbles.</p>						
385			1	50/ 3"		<p>Refusal at 7 feet. No groundwater encountered. Drill hole backfilled and tamped.</p>						

# LOG OF DRILL HOLE

OB 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.: 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		TORVANE (PSF)	ADDITIONAL TESTS
										LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
370	5			1	43		*SCRIPPS FORMATION (T <sub>sc</sub> ) SILTY SANDSTONE (R) dark gray, damp, medium dense, scattered fine grained gravel, friable.						
				2	56		SILTY SANDSTONE (R) light gray, damp, dense, friable, sandstone is fine grained, local oxidization, isolated clay inclusions.						
360	10			3	63		SANDSTONE (R) light gray, damp, dense, friable, medium-grained, very uniform grain size and texture, local oxidization, no clay.						
				4	77		Very uniform, no clay.  Scattered siltstone pebbles.  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.						







# 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 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						"SCRIPPS FORMATION (T <sub>sc</sub> )" SILTY SANDSTONE (R) light brown/gray, dry, medium dense, some clay and scattered cobbles.						
5			1	78		SILTY SANDSTONE (R) light gray/yellow-brown, dry, dense, friable, sandstone is very fine-grained.						
370			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			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.						

# 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.: 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		TORVANE (PSF)	ADDITIONAL TESTS
										Liquid Limit (%)	Plastic Limit (%)		
350							*SCRIPPS FORMATION (T <sub>6c</sub> ) 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.						
10				2	53		SILTY CLAYSTONE/CLAYEY SILTSTONE (R) light gray, damp, firm (well-indurated).  Local cemented siltstone layers.						
15													
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.						

# UNIFIED SOIL CLASSIFICATION SYSTEM

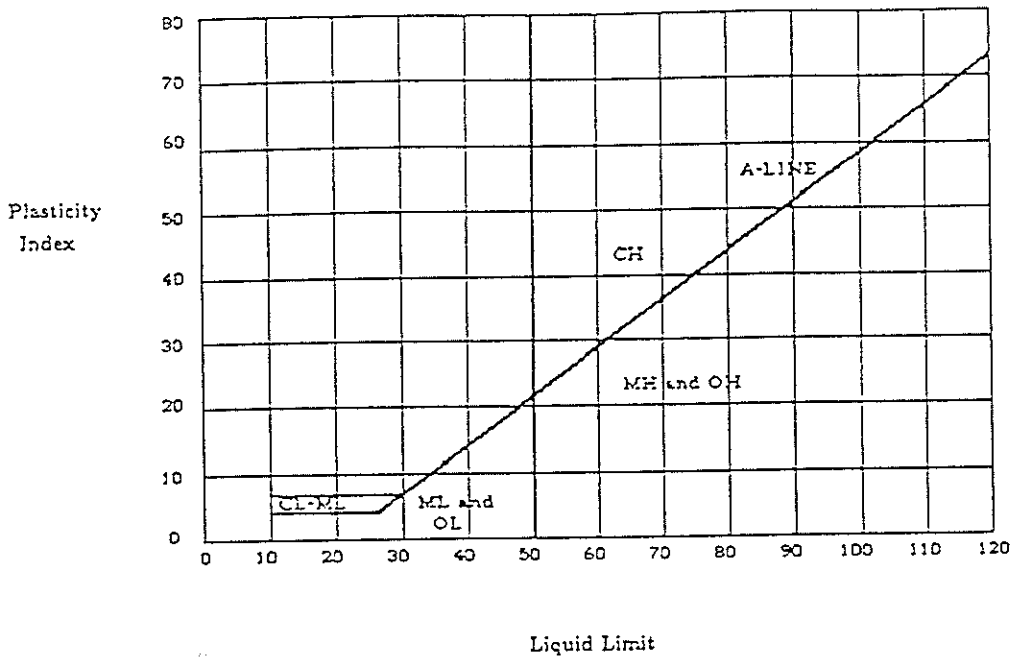
	MAJOR DIVISION	GROUP SYMBOL	DESCRIPTION	GRAPHIC LOG
<b>COARSE GRAINED SOILS</b> Over 50% By Weight Coarser Than No. 200 Sieve Size	GRAVELLY SOILS  OVER 50% OF COARSE FRACTION LARGER THAN NO. 4 SIEVE SIZE	CLEAN GRAVELLY SOILS LITTLE OR NO FINES	GW WELL GRADED GRAVELS OR GRAVEL - SAND MIXTURES	
		GRAVELLY SOILS WITH FINES	GP POORLY GRADED GRAVELS OR POORLY GRADED GRAVEL - SAND SILT MIXTURES	
		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	
		SANDY SOILS WITH FINES	SP POORLY GRADED SANDS OR GRAVELLY SANDS	
		OVER 12% FINES	SM SILTY SANDS OR POORLY GRADED SAND - SILT MIXTURES	
			SC CLAYEY SANDS OR POORLY GRADED SAND - CLAY MIXTURES	
<b>FINE GRAINED SOILS</b> 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          | WP : Water Pressure   | PM : Permeability |
| TD : Triaxial Compression, Drained   | PMT: Pressuremeter    | EX : Expansion    |
| TU : Triaxial Compression, Undrained | SE : Sand Equivalent  | RS : Resistivity  |
|                                      | GJ : Goodman Jack     | S : Swell         |
| TDy: Triaxial Compression, Dynamic   | SP : Specific Gravity | CL : Chloride     |
| PH : Hydrogen Ion Concentration      | CP : Compaction       | SU : Sulphate     |
| PA : Paleontologic, Analysis         | C : Consolidation     |                   |
| GS : Grain Size Distribution         | DS : Direct Shear     |                   |

GEOTECHNICAL CONSULTANTS, INC.

PRELIMINARY GEOTECHNICAL RECONNAISSANCE

PROPOSED SLUDGE PROCESSING SITE

EASTGATE TECHNOLOGY PARK

CITY OF SAN DIEGO, CALIFORNIA

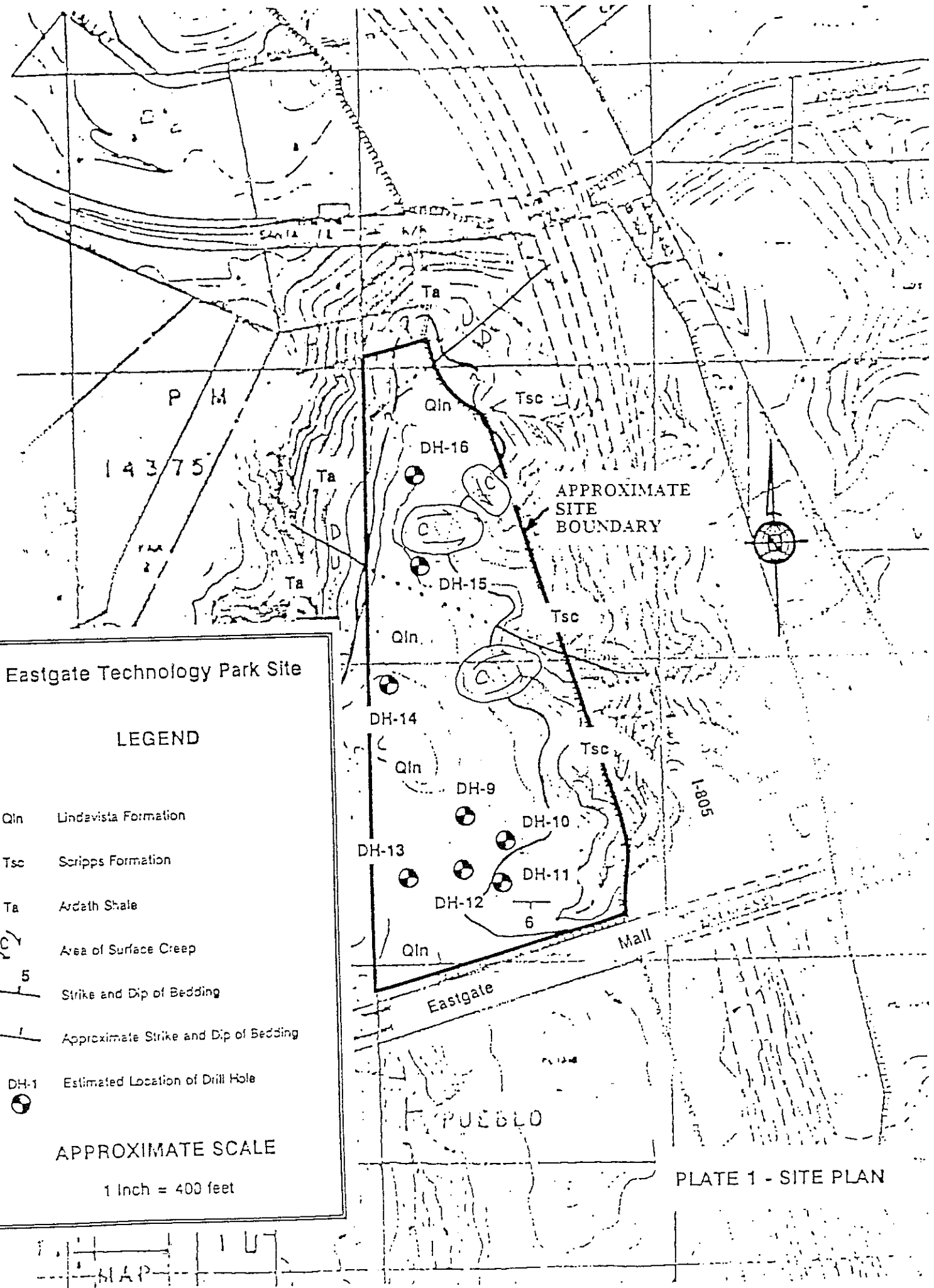
FOR

METCALF AND EDDY

FEBRUARY 1990

S89012





Eastgate Technology Park Site

LEGEND

- Qln Lindavista Formation
- Tsc Scripps Formation
- Ta Ardath Shale
- Area of Surface Creep
- 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

MAP

# 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.: 9  
 DRILLING DATE: January 6, 1990  
 DATUM: City of San Diego  
 REFERENCE EL.: 385 Feet

ELEVATION (FEET) DEPTH	DRILLING RATE REAL TIME/DEPTH	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 (%)		
					*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.						
170	15	3	50/ 6"		locally oxidized.						
20		4	97/ 11"		CLAYEY SILTSTONE (R) medium hard, faintly laminated, thin partings, mottled light gray-buff.						
360	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 oxidized brown.						
350	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.						

# 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.						
				1	96/ 11"		"LINDAVISTA FORMATION (Qln)" SANDY SILT (ML/SM) red-brown, damp, medium dense, sand is fine grained.						
				2	76		"SCRIPPS FORMATION (Tsc)" SILTSTONE (R) light gray, damp, medium hard, minor to moderate amount of clay, massive to faintly laminated, locally moist.  Becoming mottled gray and brown.						
370				3	95/ 10"		SILTY SANDSTONE (R) light brown, damp, dense, sand is fine to medium grained.						
				4	67		CLAYEY SILTSTONE (R) light gray, damp, medium hard, locally laminated, thin sand stringers (1/4 inch or less), locally oxidized brown.						
360				5	66		Faintly laminated, 2 - 3 degree dip.						
				6	77/ 11"		Finely laminated (near horizontal), thin sand stringers (oxidized) in CLAYEY SILTSTONE (R), minor very fine grained sand.						
350							Bottom of drill hole at 30.5 feet. No groundwater encountered. Hole backfilled and tamped.						

# LOG OF DRILL HOLE

OB NO.: S89012

PROJECT: Sludge Processing Sites

LOCATION: Eastgate Technology Park

DILLING 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		TORVANE (PSF)	ADDITIONAL TESTS
								LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
380					"COLLUVIUM (Qc)/LINDAVISTA FORMATION (Qln)" SANDY SILT (ML) with gravel and cobbles, light brown, dry to damp, medium dense, cobbles are rounded, volcanic composition.						
5		1	88		"SCRIPPS FORMATION (Tsc)" 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.						
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.						
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?						
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.						

# 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		TORVANE (PSF)	ADDITIONAL TESTS
									LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
380	5		1	50/3"		"COLLUVIUM (Qc)" SANDY SILT (ML/SM) light brown, dry to damp, medium stiff.						
			2	90		"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		3	75		"SCRIPPS FORMATION (Tsc)" SANDY SILTSTONE/SANDSTONE (R) very light gray, damp, stiff, sand is very fine grained, parallel laminations (subhorizontal).						
370	15		4	79		"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		5	84/11.5"		SANDY CLAYEY SILTSTONE (R) stiff, laminated, friable, locally Clayey Sandstone						
360	25		6	50/5"		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						Bottom of drill hole at 30 feet. No groundwater encountered. Drill hole backfilled and tamped.						

# 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.: 13  
 DRILLING DATE: January 6, 1990  
 DATUM: City of San Diego  
 REFERENCE EL.: 385 Feet

ELEVATION (FEET) DEPTH	DRILLING RATE	REAL TIME/DEPTH	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 (%)		
						*COLLUVIUM (Qc) SANDY SILT (ML) red-brown, dry to damp, stiff, minor gravel.						
80	5		1	50/5"		*LINDAVISTA FORMATION (Qin) SANDSTONE (R) red-brown, damp, dense, sand is fine to coarse grained. Gravel-cobble layers (6-10 inch) from 6 to 9 feet.						
			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	78/11.5"		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.						



# 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		TORVANE (PSF)	ADDITIONAL TESTS
										LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
390	5			1	50/ 3"		"LINDAVISTA FORMATION (Qln)" SANDSTONE (R) red-brown, damp, dense-hard, sand is fine to medium grained, hematite cement.						
10				2	90/ 11"		Sandstone, locally coarse grained sand with rare pebble, hematite cement.						
380	15			3	90		Gravel at 14 feet.						
20				4	92/ 9"		"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.						
370	25				73/ 11"		"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.  Laminations dip 2 to 3 degrees.						
							Bottom of drill hole at 25.5 feet. No groundwater encountered. Drill hole backfilled and tamped.						

# LOG OF DRILL HOLE

LOG 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.: 15  
 DRILLING DATE: January 6, 1990  
 DATUM: City of San Diego  
 REFERENCE EL.: 375 Feet





DEPTH (FEET)	DRILLING RATE REAL TIME/DEPTH	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 (%)		
					*COLLUVIUM (Qc) SANDY SILT (ML) brown, dry, medium stiff.						
70		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.						
30		3	50/ 4.5"		**SCRIPPS FORMATION (Tsc) SANDSTONE (R) light brown, damp, dense, sand is fine grained, moderate amount of silt.						
20		4	50/ 4"		Becoming SANDY SILTSTONE (R) mottled gray and brown, damp, stiff, sand is fine grained.						
					Bottom of drill hole at 20 feet. No groundwater encountered. Drill hole backfilled and tamped.						

# 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		TORVANE (PSF)	ADDITIONAL TESTS
									LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
380						"COLLUVIUM (Qc)" SANDY SILT (ML) brown, dry, soft, abundant roots.						
5			1	50/ 5.5"		"LINDAVISTA FORMATION (Qln)" SANDSTONE (R) light gray becoming light brown, damp, dense, sand is fine grained, scattered gravel (volcanic), hematite stain locally.						
370 10			2	61		"SCRIPPS FORMATION (Tsc)" CLAYEY SILTSTONE (R) light gray, damp, stiff, faintly laminated, locally oxidized, thin Sandy Siltstone laminations (less than 1/4 inch).						
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.						

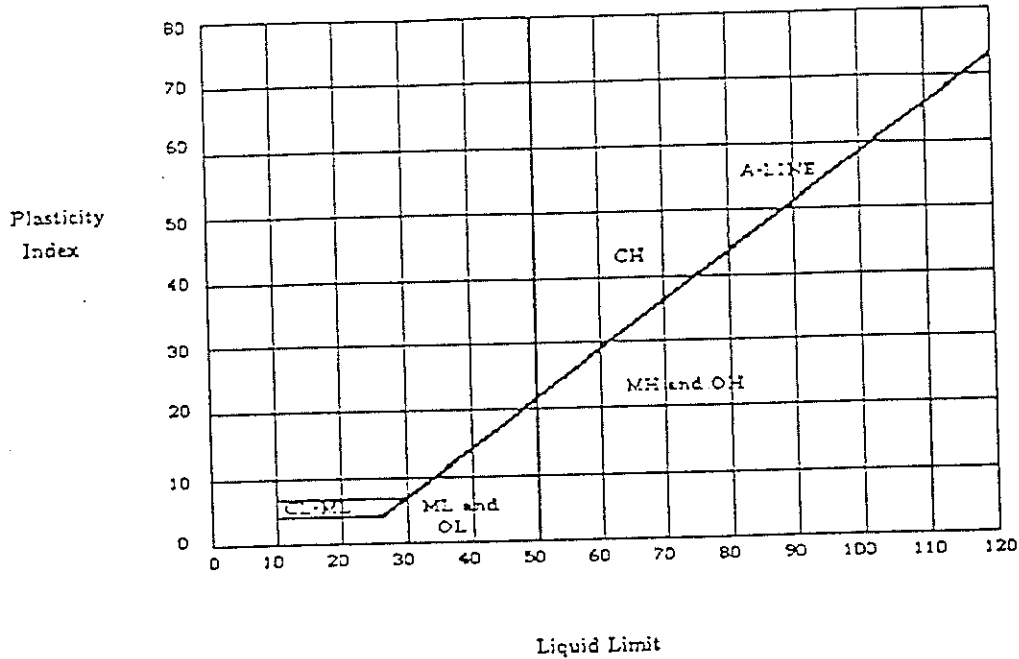
# UNIFIED SOIL CLASSIFICATION SYSTEM

	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	
		GRAVELLY SOILS WITH FINES OVER 12% FINES	GP POORLY GRADED GRAVELS OR POORLY GRADED GRAVEL - SAND SILT MIXTURES	
			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	
		SANDY SOILS WITH FINES OVER 12% FINES	SP POORLY GRADED SANDS OR GRAVELLY SANDS	
			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   |  |  | WATER LEVEL  |
|  | DISTURBED            |  |  | WATER INFLOW |
|  | UNSUCCESSFUL ATTEMPT |  |  |              |
|  | STANDARD PENETRATION |  |  |              |

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]	_____	_____



ADDITIONAL TESTS -

- |                                      |                       |                   |
|--------------------------------------|-----------------------|-------------------|
| UC : Unconfined Compression          | WP : Water Pressure   | PM : Permeability |
| TD : Triaxial Compression, Drained   | PMt: Pressuremeter    | EX : Expansion    |
| TU : Triaxial Compression, Undrained | SE : Sand Equivalent  | RS : Resistivity  |
| TDy: Triaxial Compression, Dynamic   | GJ : Goodman Jack     | S : Swell         |
| PH : Hydrogen Ion Concentration      | SP : Specific Gravity | CL : Chloride     |
| PA : Paleontologic, Analysis         | CP : Compaction       | SU : Sulphate     |
| GS : Grain Size Distribution         | C : Consolidation     |                   |
|                                      | DS : Direct Shear     |                   |

**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) 293-9400  
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.

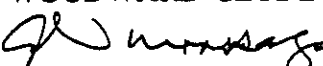
This report presents our preliminary conclusions and recommendations pertaining to the project, as well as the results of our field and laboratory investigations. The project site will also be occupied by the proposed North City Reclamation Plant (NTP-1). A separate report is issued for that project, 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.

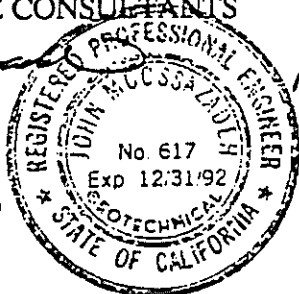
A draft version of this report was issued on August 23, 1990. Upon review by the CWP staff, a meeting was held on August 30, 1990 to discuss the CWP's comments. This final version of the report includes those comments and additional revisions.

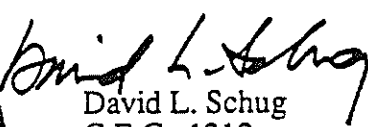
Our engineer and geologist assigned to this project are Messrs. Moi Arzamendi and Jeff Brown, respectively. We have also been assisted by our subconsultants, Allied Geotechnical Engineers, Inc. and DeC Consultants, Inc. If you have any questions regarding this report or if we can be of further service, please give us a call.

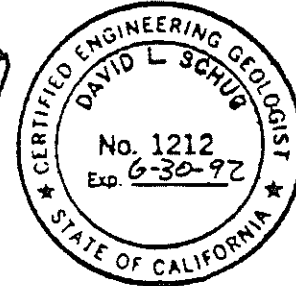
Very truly yours,

WOODWARD-CLYDE CONSULTANTS

  
John Moossazadeh  
G.E. 617



  
David L. Schug  
C.E.G. 1212



JM/DLS/MA/kah (b/ma3)

(10)

Consulting Engineers, Geologists  
and Environmental Scientists

Offices in Other Principal Cities



550 Hotel Circle North  
San Diego, California 92108  
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# 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.

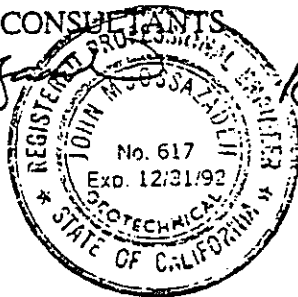
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Our engineer and geologist assigned to this project are Messrs. Moi Arzamendi and Jeff Brown, respectively. We have also been assisted by our subconsultants, Allied Geotechnical Engineers, Inc. and DeC Consultants, Inc. If you have any questions regarding this report or if we can be of further service, please give us a call.

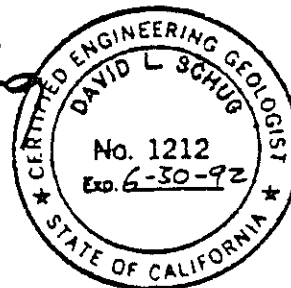
Very truly yours,

WOODWARD-CLYDE CONSULTANTS

*John Moossazadeh*  
John Moossazadeh  
G.E. 617



*David L. Schug*  
David L. Schug  
C.E.G. 1212

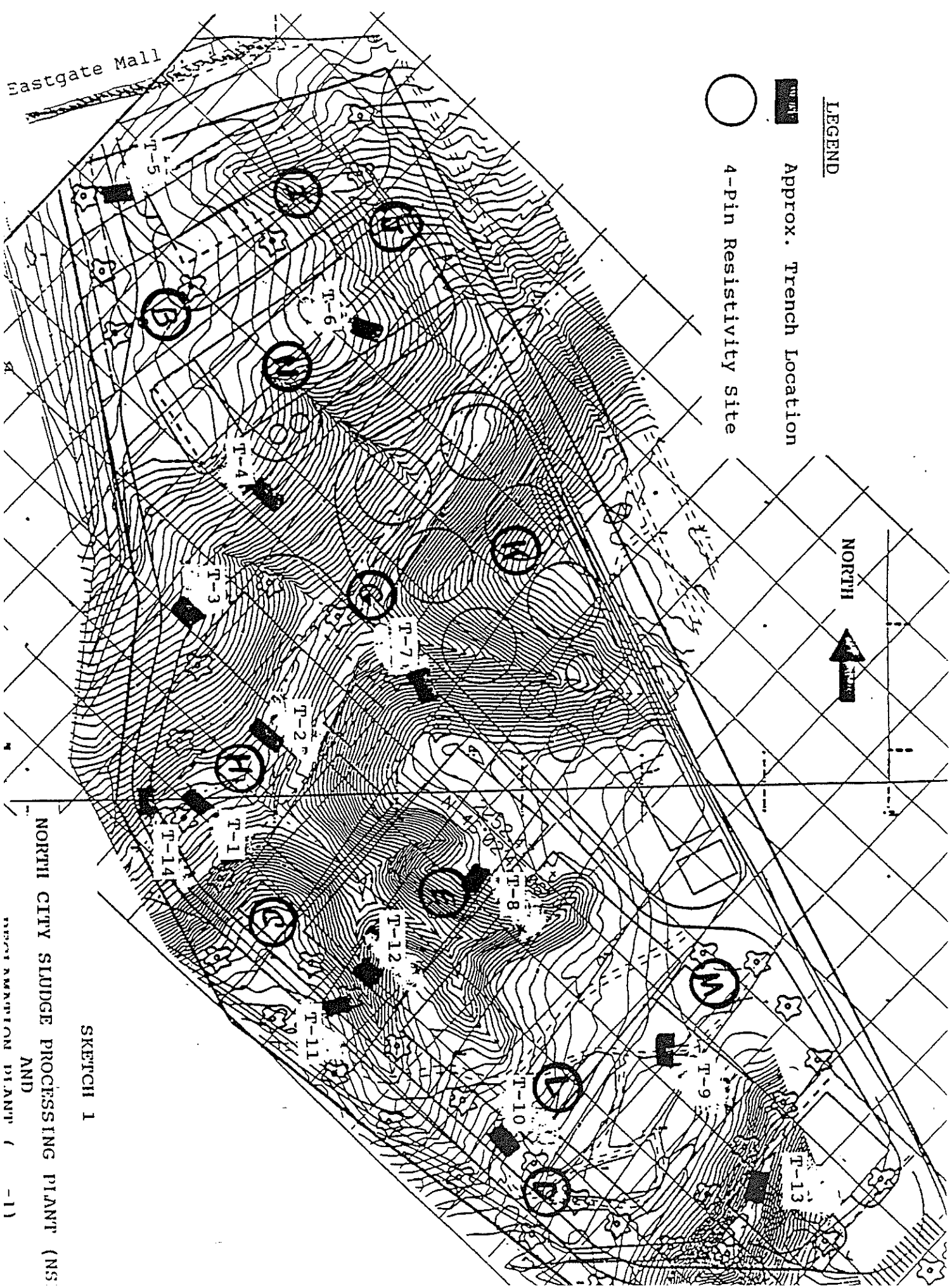


JM/DLS/MA/kah (a/ma3)

(10)



Eastgate Mall



LEGEND



Approx. Trench Location



4-Pin Resistivity Site

NORTH



SKETCH 1

NORTH CITY SLUDGE PROCESSING PLANT (NS  
AND  
WEST AMERICAN PLANT ( -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

Depth, ft	Samples	Blows/ft	Material Description	Moisture Content, %	Dry Density, pcf	Other Tests*
Surface Elevation: Approximately 298 feet						
0			<b>ALLUVIUM</b> Loose, moist, brown, silty sand (SM)			
1			Medium dense, moist, brown to dark brown, clayey sand (SC) with gravel (1" to 4" across)			
2						
3						
4	T-1 3'-4'		<b>SCRIPPS FORMATION</b> 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)			GS, PI
5						
6						
7	T-1 6'-7'					
8						
9	T-1 8'-9'					PI
10						
11						
12						
13			Bottom of hole at 13 feet			
14						
5						

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			<b>ALLUVIUM</b> 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)			
2						
3						
4						
5			<b>SCRIPPS FORMATION</b> Dense, moist, reddish brown, silty to clayey sand (SM/SC) with some thin interbeds of pale gray, fine sandy silt (ML); locally cemented			
6						
7	T-2 6'-7'					
8						
9	T-2 8'-9'					GS
10						
11			Very dense, moist, pale gray, fine sandy silt (ML)			
12	T-2 11.5'-12'		Bottom of hole at 12 feet			
13						
14						
15						

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

Method 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			<b>TOPSOIL</b> Loose, moist, brown, clayey sand (SC)			
1			<b>RESIDUAL CLAY</b> Hard, moist, dark brown, sandy lean clay (CL)			
2			<b>SCRIPPS FORMATION</b> 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			-----Grades to-----			
11.5'	T-3		Hard, moist, light gray, fine sandy lean to fat clay (CL/CH)			GS, PI
12'	-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			<b>TOPSOIL</b> Loose, moist, dark brown, clayey sand (SC)			
1			<b>RESIDUAL CLAY</b> Hard, moist, dark brown, sandy lean clay (CL)			
2			<b>SCRIPPS FORMATION</b> 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: 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

Depth 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			<b>TOPSOIL</b> Loose, moist, dark brown, silty sand (SM) with clay and gravels			
1			<b>RESIDUAL CLAY</b> Hard, moist, dark brown, sandy lean clay (CL)			
2			<b>SCRIPPS FORMATION</b> 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: 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			<b>TOPSOIL</b> Loose to medium dense, moist, brown, silty sand (SM) with some clay and gravels			
1			<b>RESIDUAL CLAY</b> Hard, moist, dark brown, sandy lean clay (CL)			
2			<b>SCRIPPS FORMATION</b> 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: 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

Method 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			<b>TOPSOIL</b> Loose to medium dense, moist, brown, silty sand (SM) with some clay and gravels			
1			<b>LINDAVISTA FORMATION</b> Dense, moist, light reddish brown to light yellowish brown, silty sand (SM)			GS
2						
3	T-7 3'-3.5'					
4			<b>SCRIPPS FORMATION</b> Very dense, moist, light gray to light brown, silty sand (SM); locally cemented			
5						
6						
7						
8	T-7 8'-9'					
9			Bottom of hole at 9 feet			
10						
11						
12						
13						
14						
15						

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			<b>TOPSOIL</b> Loose, moist, brown, silty sand (SM) with gravels			
1			<b>RESIDUAL CLAY</b> Hard, moist, dark reddish brown, clayey gravel (GC) with some sand			
2			<b>LINDAVISTA FORMATION</b> 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: 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			<b>TOPSOIL</b> Loose, moist, brown, silty sand (SM)			
1			<b>RESIDUAL CLAY</b> Dense, moist, dark brown, clayey sand (SC)			
2	T-9 2.5'		<b>LINDAVISTA FORMATION</b> Very dense, moist, pale gray to pale brown, silty fine to coarse sand (SM); well cemented			
3	-3'		Refusal at 3 feet on cemented sand			
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
5						



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		<b>TOPSOIL</b> Loose, moist, light reddish brown, clayey sand (SC) with gravel			GS, PI
0.5'			<b>RESIDUAL CLAY</b> Hard, moist, dark reddish brown, sandy lean clay (CL)			
1	-1'		<b>LINDAVISTA FORMATION</b> Very dense, moist, light brown to light reddish brown, silty fine to coarse sand (SM); well cemented			
2						
3						
4						
5			Refusal at 5 feet on cemented sand			
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						

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

Depth, ft	Samples	Blows/ft	Material Description	Moisture Content, %	Dry Density, pcf	Other Tests*
Surface Elevation: Approximately 354 feet						
0			<b>TOPSOIL</b> Loose, moist, brown, clayey sand (SC) with gravel			
1			<b>RESIDUAL CLAY</b> Dense, moist, dark reddish brown, clayey gravel (GC) with sand			
2			<b>LINDAVISTA FORMATION</b> Very dense, moist, light reddish brown, sandy gravel (GM) with silt			
3						
4						
5						
7						
8						
9						
9.5'	T-11					
10'	9.5' - 10'					GS
10			Bottom of hole at 10 feet			
11						
12						
13						
14						

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			<b>ALLUVIUM</b> Loose to medium dense, moist, dark brown, silty sand (SM) with gravel			
1						
2						
3						
4						
5			<b>SCRIPPS FORMATION</b> 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			<b>ALLUVIUM</b> 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			<b>SCRIPPS FORMATION</b> 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: 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 1 2 3 4 5 6			<b>ALLUVIUM</b> Loose to medium dense, moist, brown to dark brown, clayey sand (SC) with silt and gravel (1" to 4" across)			
7			<b>SCRIPPS FORMATION</b> Dense, moist, light brown to light reddish brown, silty sand (SM) with interlayers of pale gray, fine sandy silt (ML)			
8 9 10 11 12 13 14 15			Bottom of hole at 8 feet			

APPENDIX B

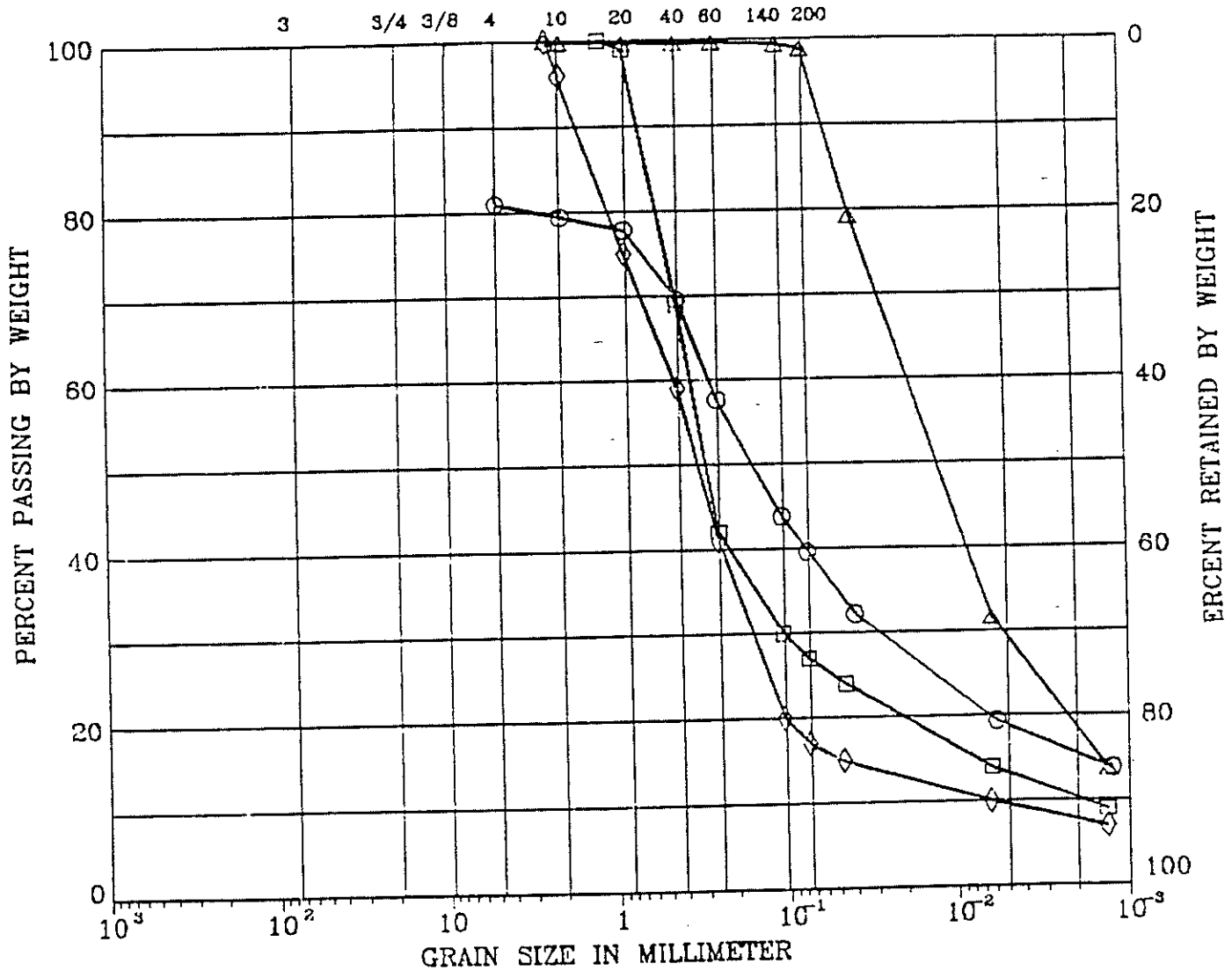
GEOTECHNICAL LABORATORY INVESTIGATION

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.



### UNIFIED SOIL CLASSIFICATION

<b>COBBLES</b>	<b>GRAVEL</b>		<b>SAND</b>			<b>SILT OR CLAY</b>
	COARSE	FINE	COARSE	MEDIUM	FINE	
U.S. SIEVE SIZE IN INCHES			U.S. STANDARD SIEVE No.			HYDROMETER



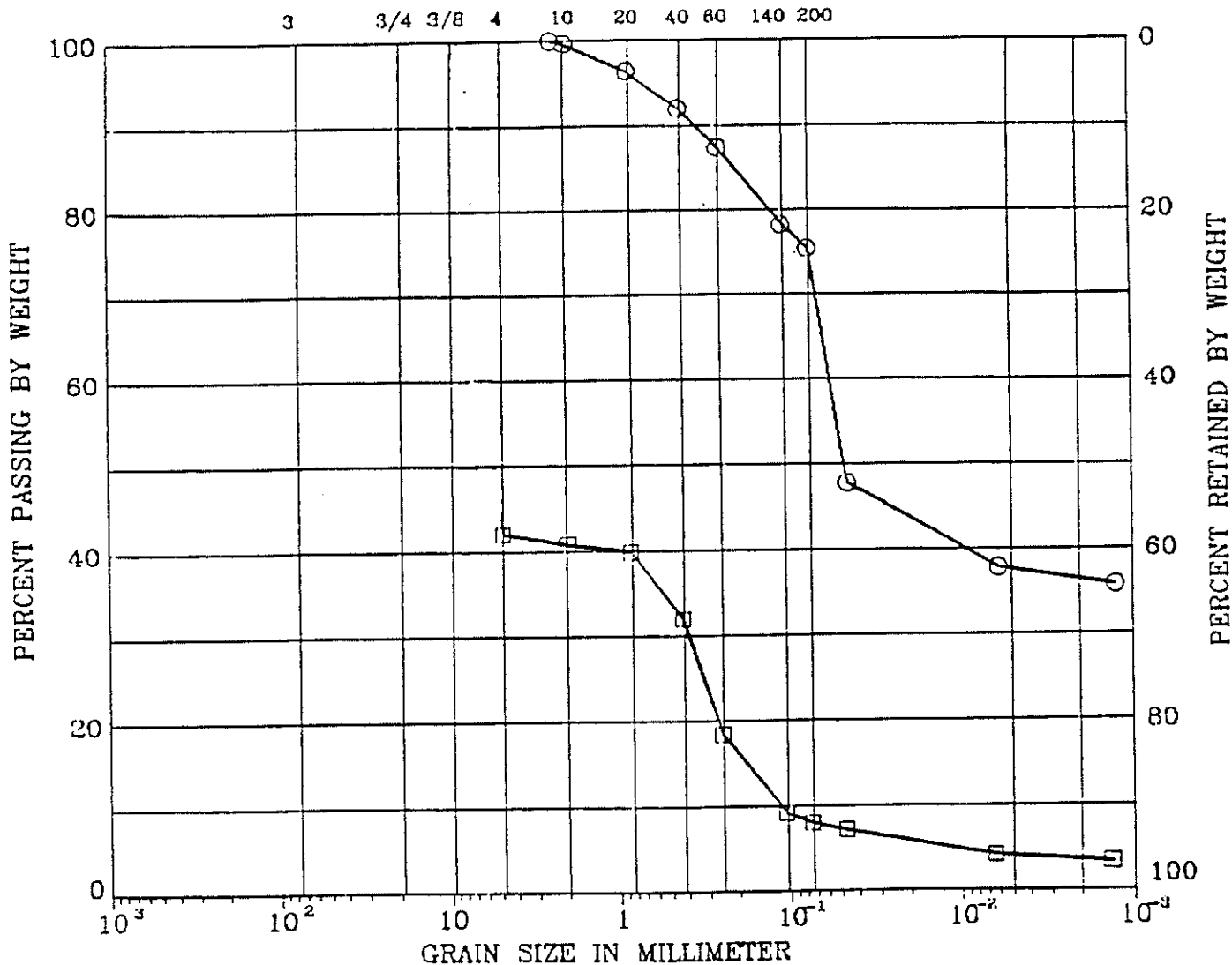
SYMBOL	BORING	DEPTH (ft)	LL (%)	PI (%)	DESCRIPTION
○	T-1	3-4	27	13	CLAYEY SAND WITH GRAVEL (SC)
□	T-2	8-9	—	—	CLAYEY SAND (SC)
△	T-3	12	56	29	FAT CLAY (CH)
◇	T-7	3			SILTY SAND (SM)

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 <span style="float: right;">Figure No. B-1</span>

**UNIFIED SOIL CLASSIFICATION**

<i>COBBLES</i>	<i>GRAVEL</i>		<i>SAND</i>			<i>SILT OR CLAY</i>
	COARSE	FINE	COARSE	MEDIUM	FINE	
U.S. SIEVE SIZE IN INCHES			U.S. STANDARD SIEVE No.			HYDROMETER



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**

# 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		POCKET PENETROMETER (TSF)	ADDITIONAL TESTS
										LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
310				1	50	[Diagonal Hatching]	"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
	5			2			Becoming damp, decreasing cobble, scattered siltstone/sandstone fragments (1/2 inch).						
				3	35	[Diagonal Hatching]	Abundant siltstone fragments, 1 to 3 inch, mottled gray-red-brown, damp to moist.	91	20				
	10			4	23	[Diagonal Hatching]							
300				5	80	[Horizontal Hatching]	"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.	98	11				
	15			6	50/ 6"	[Horizontal Hatching]	SANDSTONE (R) light gray-yellow brown, damp, hard, minor silt, fine grained sand.						
	20			7	50/ 3"	[Horizontal Hatching]	"SCRIPPS FORMATION (Tsc)" Interbedded CLAYEY SILTSTONE and SANDY SILTSTONE (R) light gray-brown, damp, hard, fissile, finely laminated, minor oxidation along fractures and laminae.	95	17				
290				8	50/ 3"	[Horizontal Hatching]	Siltstone with 1 to 4 inch interbeds of Sandstone, fine grained.						
	25			9	50/ 2"	[Horizontal Hatching]	gray-brown, moderate oxidation, laminations dip 8 to 12 degrees.						
280				10	50/ 1"	[Horizontal Hatching]	Hard drilling at 33.5 feet. Calcareous cemented sandstone-siltstone, fine grained, very hard, approximately 12-15 inches thick.						
	30			11	60/ 6"	[Horizontal Hatching]	Clayey siltstone with 1 to 2 inch sandstone interbeds, iron oxide deposits along fractures/bedding, slightly calcareous, 1/4 inch thick.	98	18				
	35			12	50/ 5"	[Horizontal Hatching]	"SCRIPPS FORMATION (Tsc)" CLAYEY SILTSTONE (R) light to medium gray, damp, hard, fissile, finely laminated, uniform, slightly to moderately calcareous.						
	40					[Horizontal Hatching]	Becoming medium gray.						
	45					[Horizontal Hatching]							
	50					[Horizontal Hatching]	Bottom of drill hole at 50 feet. No groundwater encountered. Hole backfilled and tamped.						

# LOG OF DRILL HOLE

JOB NO.: S80012B  
 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		POCKET PENETROMETER (TSF)	ADDITIONAL TESTS
										LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
300	5			1	26	[Diagonal Hatching]	"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	[Diagonal Hatching]	Becoming dark brown, open vesicles.	99	10				
				3	20	[Diagonal Hatching]	Medium gray-brown, moist, medium stiff, minor fine grained sand, scattered fine grained sandstone-siltstone fragments.						
290	15			4	85	[Horizontal Hatching]	"SCRIPPS FORMATION (T <sub>sc</sub> )" SANDY SILTSTONE (R) light gray-brown, damp, moderately hard, sand is fine grained, fissile. 12 feet: 6-inch thick hard-cemented layer.						
				5	50/5"	[Horizontal Hatching]	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.						
280	20			6	70/6"	[Horizontal Hatching]	"SCRIPPS FORMATION (T <sub>sc</sub> )" CLAYEY SILTSTONE-SANDY SILTSTONE (R) light gray, oxidized orange-brown, damp, hard, finely laminated, fissile.						
				7	70/6"	[Horizontal Hatching]	"SCRIPPS FORMATION (T <sub>sc</sub> )" SANDSTONE (R) light brown, damp, hard, sand is very fine to fine grained, minor silt.	96	9				
270	30			8	50/3"	[Horizontal Hatching]	Sandstone, massive, hard, fine grained.						
				9	50/3"	[Horizontal Hatching]	Cemented layer 32 to 33 feet, hard, slow drilling.						
260	40			10	50/5"	[Horizontal Hatching]	"SCRIPPS FORMATION (T <sub>sc</sub> )" SILTSTONE/CLAYSTONE (R) medium gray, damp, hard, laminated, fissile, uniform, laminae dip 0 to 2 degrees.						
				11	61	[Horizontal Hatching]	Claystone, medium gray, damp, hard, slightly plastic.						
						[Horizontal Hatching]	Very hard drilling.						
							Refusal at 47 feet. No groundwater encountered. Hole backfilled and tamped.						



# 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
	5			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				DS,GS
				3	64			99	14				
	10			4	85/ 11"		"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.	99	15				
340				5	90/ 11"		Clayey Siltstone-Sandy Siltstone, light gray-brown, damp, moderately hard, interbedded, finely laminated, fissile, laminations dip 0-2 degrees.						
	15			6	75								
	20			7	50/ 5"		Clayey Siltstone, light gray with iron oxide along lamination, fissile.	116	19				
330				8	100/ 3"		Hard calcareous cemented sandstone-siltstone layer approximately 12 inches thick.						
	25			9	100/ 5"		Slightly calcareous sandy siltstone hard layer, 8 inches thick.						
	30			10	58/ 6"		Sandy Siltstone with thin (2-3 inch) interbed of calcareous cemented Sandstone, hard.						
320				11	81		Clayey Siltstone with Sandy Siltstone laminae and 1/4-1/2 inch iron oxide cemented. Sandstone stringers.	99	22				
	35			12	80		"SCRIPPS FORMATION (Tsc)" CLAYEY SILTSTONE-SILTY CLAYSTONE (R) light gray, damp, hard, finely laminated, fissile, minor iron oxide stain along lamination.						
310				13	88/ 11"			100	16				
	40												
	45												
	50												

# 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 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 (%)		
290	60				[Hatched pattern]	"SCRIPPS FORMATION (T <sub>8c</sub> )" 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)						
	65		14	70/ 6"	[Hatched pattern]	Silty claystone.	102	16				
280	70		15	50/ 4"	[Hatched pattern]	Clayey Siltstone, light gray, damp, hard, laminated, slightly calcareous, locally hard, calcareous cement, uniform lithology.						
	75		16	79/ 6"	[Hatched pattern]	light to medium gray, slightly calcareous, laminated, moderately fissile.						
			17	100/ 4"	[Hatched pattern]	Local hard cemented layers, finely laminated.						
						Bottom of drill hole at 79.5 feet. No groundwater encountered. Hole backfilled and tamped.						

# 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 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       340       330	5		1	61		"COLLUVIUM (Qc)" SANDY SILT (ML) light brown, dry, medium stiff, minor gravel and cobble.							
			2			"SCRIPPS FORMATION (T <sub>sc</sub> )" 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	
	10		3	70/9"		Local hard cemented layer 3 to 6 inches thick.	97	11				R-Value	
			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					
	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					
	30		8	87/ 10"		Hard, finely laminated, fissile.							
						Bottom of drill hole at 30.5 feet. No groundwater encountered. Hole backfilled and tamped.							

# 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 J  
 REFERENCE EL.: 373 Feet

ELEVATION (FEET)	DEPTH (FEET)	DRILLING RATE REAL TIME/DEPTH	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						"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	25		5			"SCRIPPS FORMATION (Tsc)" CLAYEY SILTSTONE-CLAYSTONE (R) light gray, damp, moderately hard, fissile, minor iron oxide.	101	17	57	25		AL,EI
			6	86								
			7	81/ 11"		Light brown, damp, moderately hard.	97	18				
	30		8	87/ 11"								
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.						

# 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 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 (%)		
					[Hatched Pattern]	"COLLUVIUM (Qc)" CLAYEY SILT (ML) light brown, dry, medium stiff, trace of gravel.						
	5		1	40	[Hatched Pattern]	"SCRIPPS FORMATION (Tsc)" CLAYEY SILTSTONE (R) light gray, damp, moderately hard, finely laminated, fissile, moderate iron oxide.						GS
350	10		2	95/9"	[Hatched Pattern]	Minor iron oxide along laminations, fissile, medium plastic. 1/4 to 1/2 inch sandy siltstone interbeds.	104	16				RS,PH CL,SU
	15		3	78	[Hatched Pattern]				55	25		AL,EI
			4	86/11"	[Hatched Pattern]		104	15				
340	20		5	81/11"	[Hatched Pattern]	Local 1/4 inch Sandy Siltstone interbeds.						
						Bottom of drill hole at 20.5 feet. No groundwater encountered. Hole backfilled and tamped.						

# 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.: 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		POCKET PENETROMETER (TSF)	ADDITIONAL TESTS
										LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
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.						
350				2	90/11"		Clayey siltstone-claystone, slightly calcareous.						
	10			3	77/9"								
	15			4	99		Silty sandstone, 8-10 inch, light brown, damp, hard, sand is fine grained.	97	7				
340				5	53/6"								
	20			6	90		Silty claystone, light gray, damp, hard.						
	25			7	79		27 feet: hard cemented layer/concretion, 6 inches thick.						
	30						Bottom of drill hole at 30 feet. No groundwater encountered. Hole backfilled and tamped.	105	16				





# 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
	5			2	77		"SCRIPPS FORMATION (T <sub>bc</sub> )" CLAYEY SILTSTONE (R) tan, damp, hard, moderate iron oxidation, fissile.		12				
				3	55/6'		Bottom of drill hole at 5.5 feet. No groundwater encountered. Hole backfilled and tamped.		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





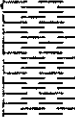



CHECKED BY: T. Huber

DRILL HOLE NO.: 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		POCKET PENETROMETER (TSF)	ADDITIONAL TESTS
										LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
				1	22		"FILL (af)" CLAY (CH) dark brown, moist, very stiff, plastic, local roots.		22	63	25		AL
360	5			2	74		"SCRIPPS FORMATION (T <sub>sc</sub> )" SILTSTONE (R) tan to light gray, damp, hard, fissile, moderate iron oxidation.						RS,PH CL,SU
	10			3	33		Clayey siltstone, light brown, damp, moderately hard, fissile, 1 foot interbed of fine grained.	94	18				
350	15			4	92		Becoming olive green, moist, plastic, laminated.						
	20			5	69/6"		23 feet: 1 foot concretion of well cemented siltstone medium gray, damp, very hard.		9				
340	25			6	92/ 11"		Sandy siltstone, brown, damp, hard, fine grained sands, local hematite.		7				
	30			7	84/ 11"		Fissile, moderate iron oxidation.						
	35			8	75/3"		1 foot concretion of well cemented siltstone. Refusal at 35 feet.						
							Bottom of drill hole at 35 feet. No groundwater encountered. Hole backfilled and tamped.						

# 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		POCKET PENETROMETER (TSF)	ADDITIONAL TESTS
										LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
				1	42		"COLLUVIUM (Qc)" SANDY SILT (ML) dark brown, damp, hard.		11				
	5			2	57/ 6"		2-1/2 feet: 1/2 foot concretion of well cemented siltstone, dark gray, very hard.		13				
340				3	84		"SCRIPPS FORMATION (T <sub>sc</sub> )" SILTSTONE (R) tan, damp, hard, fissile, moderate iron oxidation, moderately weathered.						
	10			3	84		Clayey siltstone, tan, damp, hard, fissile, moderate iron oxidation.	106	18				
	15			4	81		Becoming olive green.						
330				5	50/ 2"		19 feet: 1/2 foot concretion of well cemented siltstone. 21 feet: 1 foot concretion of well cemented siltstone.						
	20			5	50/ 2"								
	25			6									
320							Refusal at 28.5 feet.						
							Bottom of drill hole at 28.5 feet (refusal). No groundwater encountered. Hole backfilled and tamped.						

# 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		POCKET PENETROMETER (TSF)	ADDITIONAL TESTS
										LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
370				1	84/ 11"		"SCRIPPS FORMATION (Tsc)" SILTY SANDSTONE (R) red-brown, damp, hard, medium grained.						
	5			2	79		Damp.	110	7				DS
	10			3	85		Patches of iron oxidation.						RS,PH, CL,SU
360				4	65		Damp to moist, laminated locally.						GS
	20			5	87/ 11"		Abundant biotite locally.	104	11				
350				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.						

# 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		POCKET PENETROMETER (TSF)	ADDITIONAL TESTS
										LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
380	0			1	57		"FILL (af)" CLAY (CH) dark brown, moist, hard, local pebbles.		15				
375	5			2	47		"LINDAVISTA FORMATION (Qln)" CONGLOMERATE (R) gray granitic and purple volcanic cobble (1/2-3 inches), very hard, subrounded in clayey silt matrix, red-brown, damp, poorly indurated.	101	20				
370	10			3	81/ 11"		"SCRIPPS FORMATION (Tsc)" CLAYEY SILTSTONE (R) tan to light gray, damp, medium hard, moderate iron oxidation, fissile.	107	16				
	15			4	81/ 10"								
	20			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.						



# LOG OF DRILL HOLE

JOB NO.: S89012B

PROJECT: Sludge Dewatering Facility

LOCATION: North City, San Diego

DRILLING METHOD: Hollow Stem Auger, 7-inch

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 (%)		
370	5			1	71		"SCRIPPS FORMATION (T <sub>ac</sub> )" CLAYEY SILTSTONE (R) tan, damp, medium hard, moderate iron oxide, fissile.		11	40	22		AL
				2									
360	10			3	97		Sandy siltstone, tan, damp, hard, fine grained sand.		8			RS,PH, CL,SU	
				4									
360	15			5	70/6'		Clayey siltstone, tan, dry, hard, fissile.		11				
				6									
20				7	50/6'		Refusal at 21 feet.						
							Bottom of drill hole at 21 feet. No groundwater encountered. Hole backfilled and tamped.						

# 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		POCKET PENETROMETER (TSF)	ADDITIONAL TESTS
										LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
370	5			1	56	[Graphic Log]	"SCRIPPS FORMATION (T <sub>sc</sub> )" CLAYEY SILTSTONE (R) light tan, damp, hard, fissile, local iron oxidation.		14				
				2	79	[Graphic Log]		98	16				
				3			[Graphic Log]						
	10			4	64	[Graphic Log]	Uniform lithology.	107	22			R-Value	
360	15			5		[Graphic Log]							
	20			6	92	[Graphic Log]	Abundant patches of manganese oxide.						
				7	93	[Graphic Log]		104	18				
350	25			8	91	[Graphic Log]	23 feet: 1 foot concretion of well cemented siltstone, very hard. 24 feet: 6-inch layer of sandy siltstone, red-brown, damp, hard, fine grained sand.						
	30			9	98/ 11	[Graphic Log]							
							Bottom of drill hole at 30.5 feet. No groundwater encountered. Hole backfilled and tamped.						

# 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		POCKET PENETROMETER (TSF)	ADDITIONAL TESTS
											LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
						[Hatched pattern]	"COLLUVIUM (Qc)" CLAY (CL) dark brown, damp to moist, firm.							
340	5					[Horizontal lines]	"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 @ 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.  @ 15 feet: Thin lens of well cemented siltstone, no visible fractures or joints.	104	13					
330	10		1	(14)		[Horizontal lines]	Calcite lined laminae, patches of manganese oxides.	103	13					
320	20		2	(14)		[Horizontal lines]	"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. @ 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  Concretion of well cemented siltstone gray, dry, very hard.  @ 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.  @ 45 feet: Claystone, medium gray, damp, slightly plastic, local discontinuous gypsum lined (1/4 - 1") fractures. Interbed of siltstone, fissile, laminated, local gypsum.  Interbed of well cemented siltstone.	106	18					
310	30		3	(8)		[Horizontal lines]		105	16					
300	40		4	(20)		[Horizontal lines]		102	18					
	50		5	(17)		[Horizontal lines]	Claystone, tan to light brown, damp, medium hard, slightly plastic, local gypsum. @ 51 feet: Bed N80W 3NE.							

# 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		POCKET PENETROMETER (TSP)	ADDITIONAL TESTS
										LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
290	60			6	<85/ 10">	[Hatched Pattern]	"SCRIPPS FORMATION (Tsc)" CLAYSTONE-SILTSTONE (R) light brown, damp, medium hard. Becoming medium gray, laminated, gypsum along bedding. Interbeds of silty sandstone.  Black manganese oxide along laminae.  @ 63.5 feet: Bed N79W 6NE  1/4 inch thick gypsum lined fracture.		12				
280	70			7	<60>	[Hatched Pattern]	"SCRIPPS FORMATION (Tsc)" SILTSTONE (R) light brown, damp, moderately indurated, moderately hard, moderate iron oxidation, laminated, slightly fissile. 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. Well cemented sandstone concretion 72-73 feet. @ 74 feet: Bed N47W 3NE. Becoming medium gray, moderately indurated, moderately hard, poorly bedded.	94	14				
270	80			8	<54/ 11">	[Hatched Pattern]	Bottom of drill hole at 81 feet. No groundwater encountered. Hole backfilled and tamped.	98	18				

# 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		POCKET PENETROMETER (TSF)	ADDITIONAL TESTS
											LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
							"COLLUVIUM (Qc)" SANDY SILT (ML) tan, dry, firm.							
370	5			1	(2)		"SCRIPPS FORMATION (Tsc)" CLAYEY SILTSTONE (R) tan, dry to damp, medium hard. Moderately weathered, iron oxidation lined laminations.	100	15				GS, DS	
	10			2	(6)		Fissile, abundant iron oxidation, local manganese oxide. @ 12 feet: Bed N82W 5NE	106	15					
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. Concretion of well cemented sandstone, 6 inches thick. @ 20 feet: Bed N67W 6NE.	109	15				GS	
	25			5			Minor clay, laminated.							
350	25			6	(11)		"SCRIPPS FORMATION (Tsc)" CLAYSTONE (R) brown, damp, poorly indurated, plastic. @ 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. @ 29 feet: Contact N6W 2NE sanstone/claystone. 1 foot layer of claystone interbed. Olive green, damp, poorly indurated, weathered, abundant iron oxidation, slightly plastic.	110	19					
	30			7	(14)		@ 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					
340	35			8	(21)									
	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.							

# 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		POCKET PENETROMETER (TSF)	ADDITIONAL TESTS
										LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
320	60			10	[13]		"SCRIPPS FORMATION (T <sub>ec</sub> )" CLAYEY SILTSTONE (R) brown, moderately hard, fissile, laminated.	104	20				
							Bottom of drill hole at 60 feet. No groundwater encountered. Hole backfilled and tamped.						



# 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 (%)		
							<p>"COLLUVIUM (Qc)"                      SILTY SAND (SM) light brown, dry, grained, loose, local cobbles and pebbles.</p>							
360	5						<p>"SCRIPPS FORMATION (T<sub>sc</sub>)"                      SILTY SANDSTONE (R) red-brown, damp, medium dense, fine to medium grained, friable, local pebbles and iron oxidation.</p>							
	10						<p>"SCRIPPS FORMATION (T<sub>sc</sub>)"                      SILTSTONE (R) light gray, damp, moderately hard, moderately indurated, fissile, minor clay amounts. Local granitic and volcanic cobbles.                      @ 12.5 feet: Bed N65W 6NE.</p>							
350	15			1			<p>"SCRIPPS FORMATION (T<sub>sc</sub>)"                      CONGLOMERATE (R) granitic and volcanic cobbles (1/2 - 5 inch), subrounded in matrix of clayey sandstone, red-brown, damp to moist, moderately hard.</p>							
	20						<p>"SCRIPPS FORMATION (T<sub>sc</sub>)"                      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.</p>							
340	25													
	30													
330	35													
	40													
320	45													
	50													
							<p>Bottom of drill hole at 50 feet.                      No groundwater encountered.                      Hole backfilled and tamped.</p>							

# 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 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)" SANDY SILT (ML) tan, dry, soft.						
370	5		1	(3)		"LINDAVISTA FORMATION (Qln)" CONGLOMERATE (R) granitic and volcanic cobbles in sandy siltstone matrix, brown, damp, moderately hard. @ 3-4 feet: Clay (CL) dark brown to black, moist, hard, plastic, local pebbles and roots, weathered. Contact: N52W2SW	92	9				GS
	10		2	(8)		"SCRIPPS FORMATION (Tsc)" SILTSTONE (R) tan to brown, damp, moderately hard, abundant iron oxides, laminated, moderately indurated, fissile.	110	15				
	15		3	(18)								
360	20		4	(14)		Interbed of sandy siltstone, golden brown, dry to damp, moderately hard, fine grained sand, laminated. 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				RS,PH, CL,SU
	25					Weakly laminated.						
350	30		5	(5)		Moderate amounts of clay. 33.5 - 34.5 feet: 1/2 foot concretion of well cemented sandstone.	108	16	54	33		AL
	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.						

# UNIFIED SOIL CLASSIFICATION SYSTEM

	MAJOR DIVISION	GROUP SYMBOL	DESCRIPTION	GRAPHIC LOG	
<b>COARSE GRAINED SOILS</b> 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	
<b>FINE GRAINED SOILS</b> 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

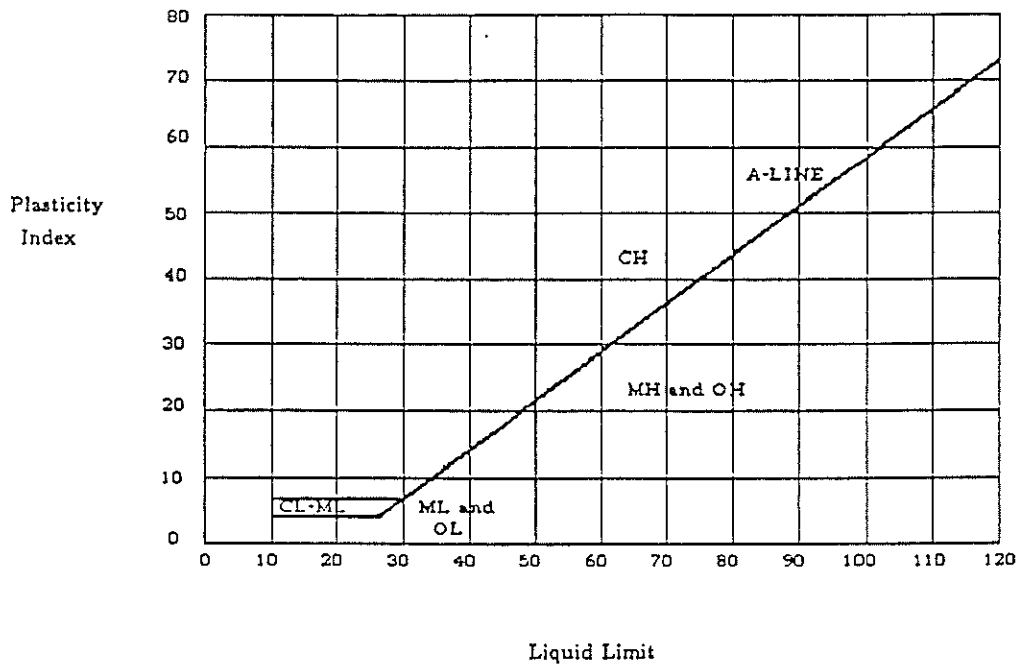


WATER LEVEL



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

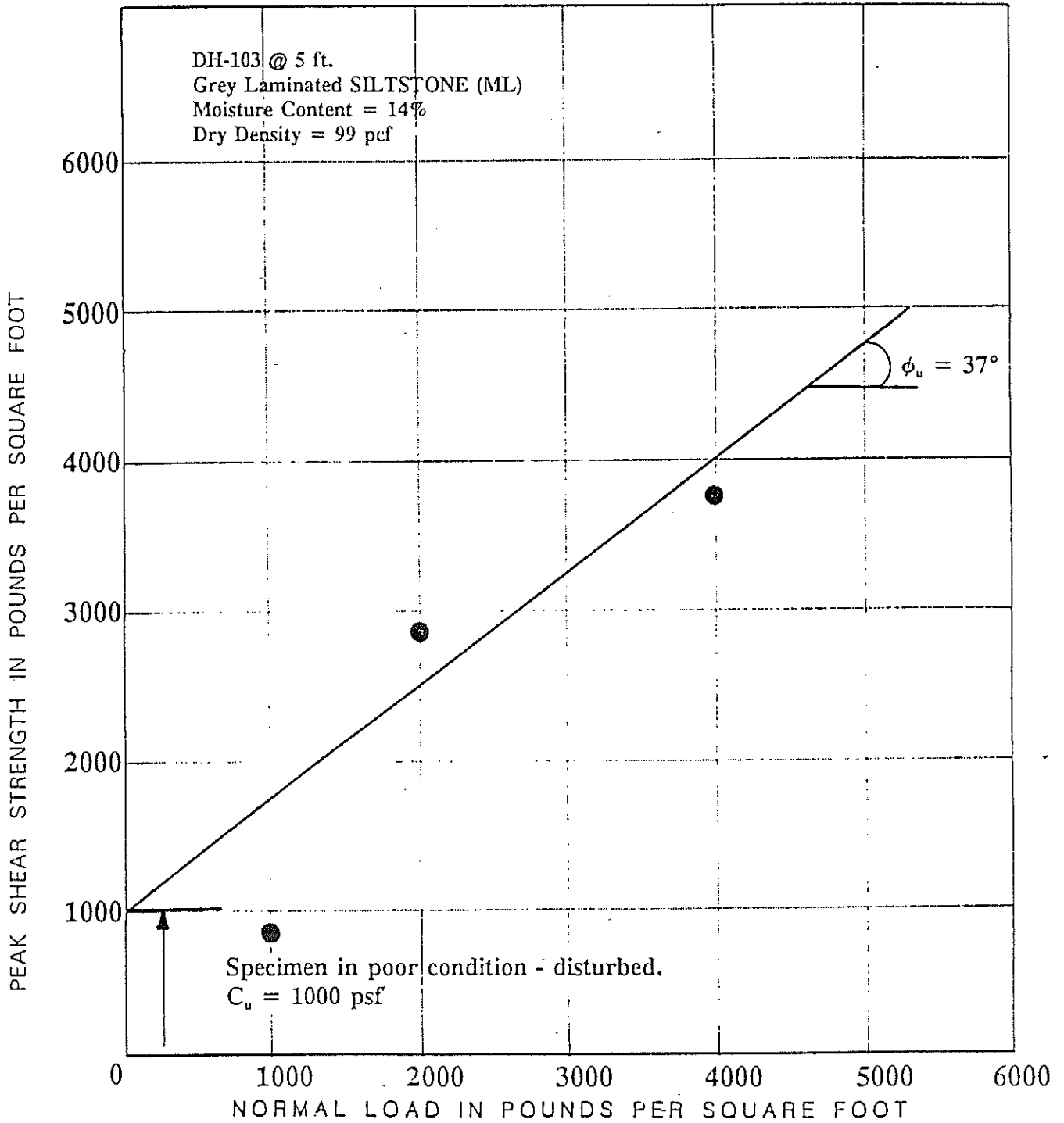


Light Caving

**ADDITIONAL TESTS -**

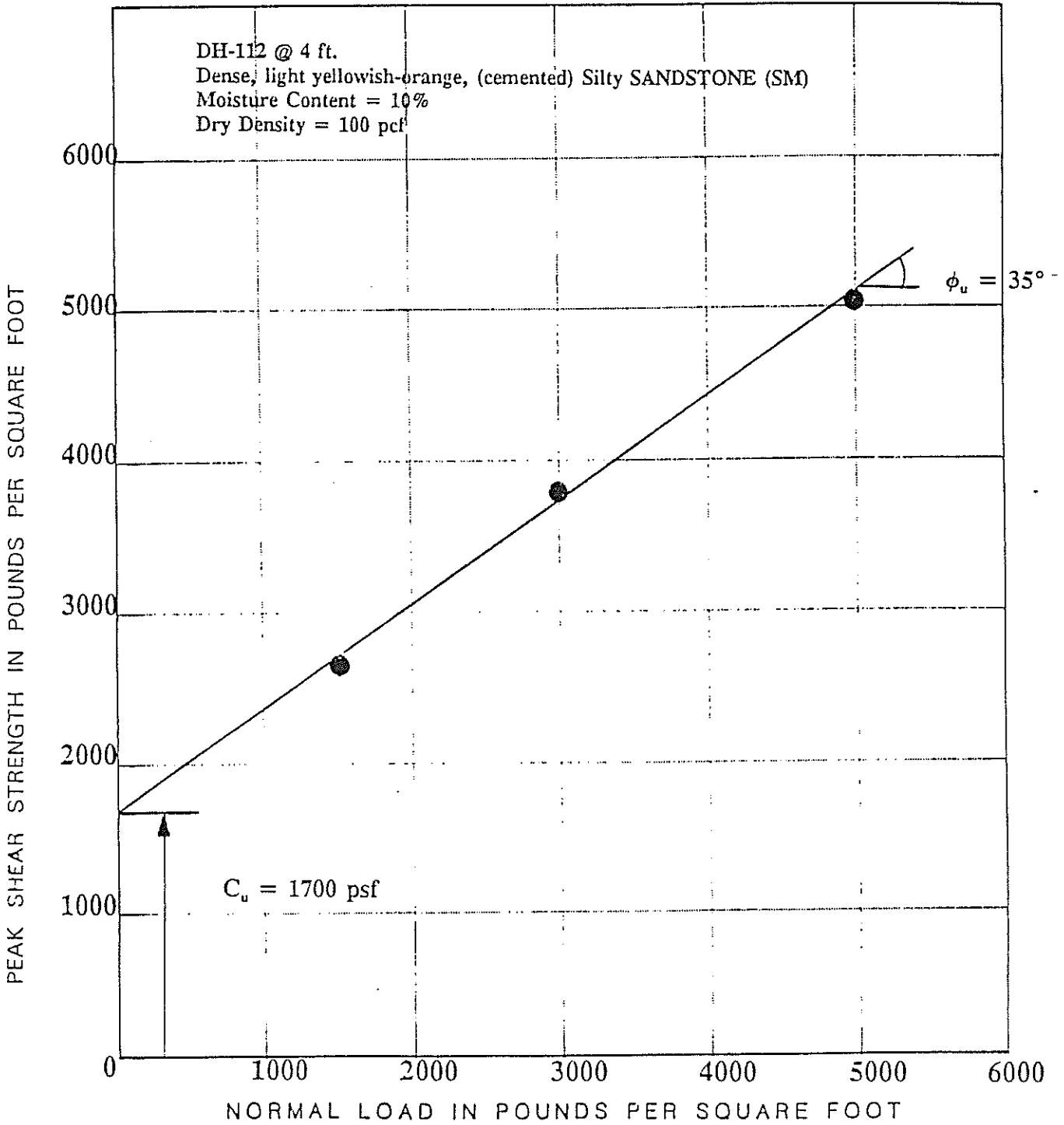
- |   |                       |                   |
|---|-----------------------|-------------------|
| UC : Unconfined Compression             | WP : Water Pressure   | PM : Permeability |
| TD : Triaxial Compression, Drained      | PmT: Pressuremeter    | EX : Expansion    |
| TU : Triaxial Compression,<br>Undrained | SE : Sand Equivalent  | RS : Resistivity  |
| TDy: Triaxial Compression, Dynamic      | GJ : Goodman Jack     | S : Swell         |
| PH : Hydrogen Ion Concentration         | SP : Specific Gravity | CL : Chloride     |
| PA : Paleontologic, Analysis            | CP : Compaction       | SU : Sulphate     |
| GS : Grain Size Distribution            | C : Consolidation     |                   |
|   | DS : Direct Shear     |                   |

DIRECT SHEAR TEST DATA



NOTE: All tests performed on specimens at approximately saturated moisture contents.

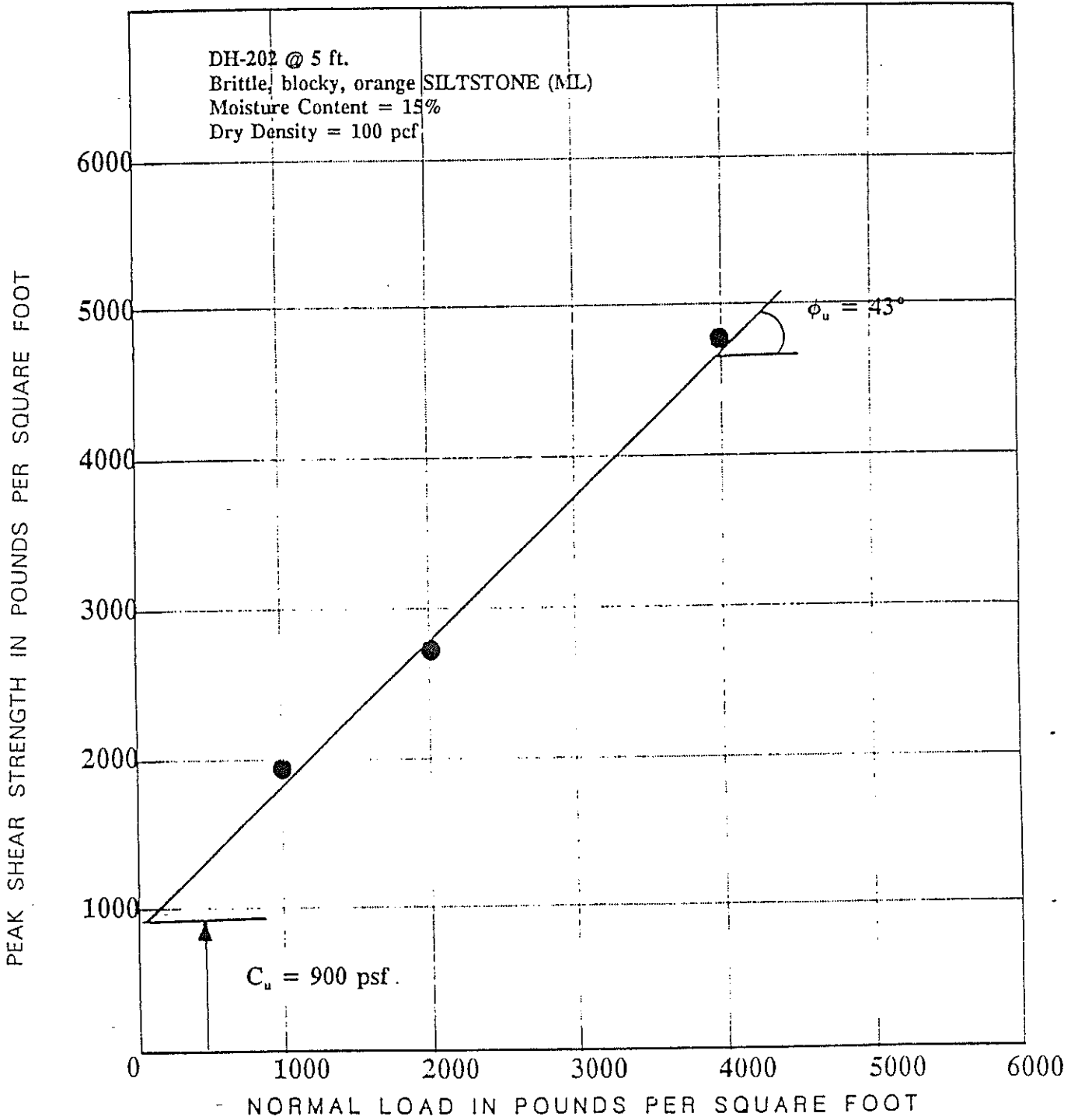
DIRECT SHEAR TEST DATA



NOTE: All tests performed on specimens at approximately saturated moisture contents.

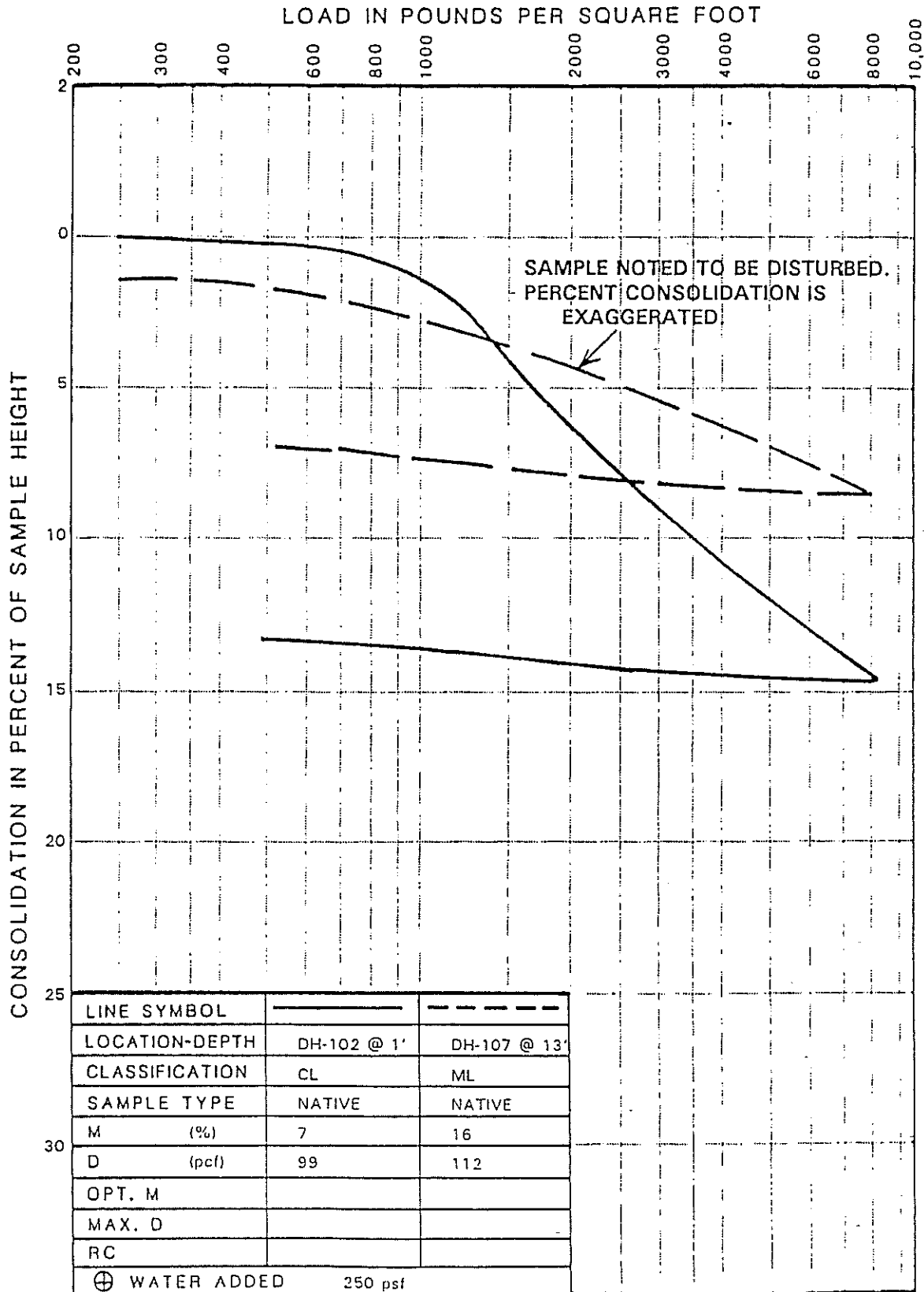


DIRECT SHEAR TEST DATA

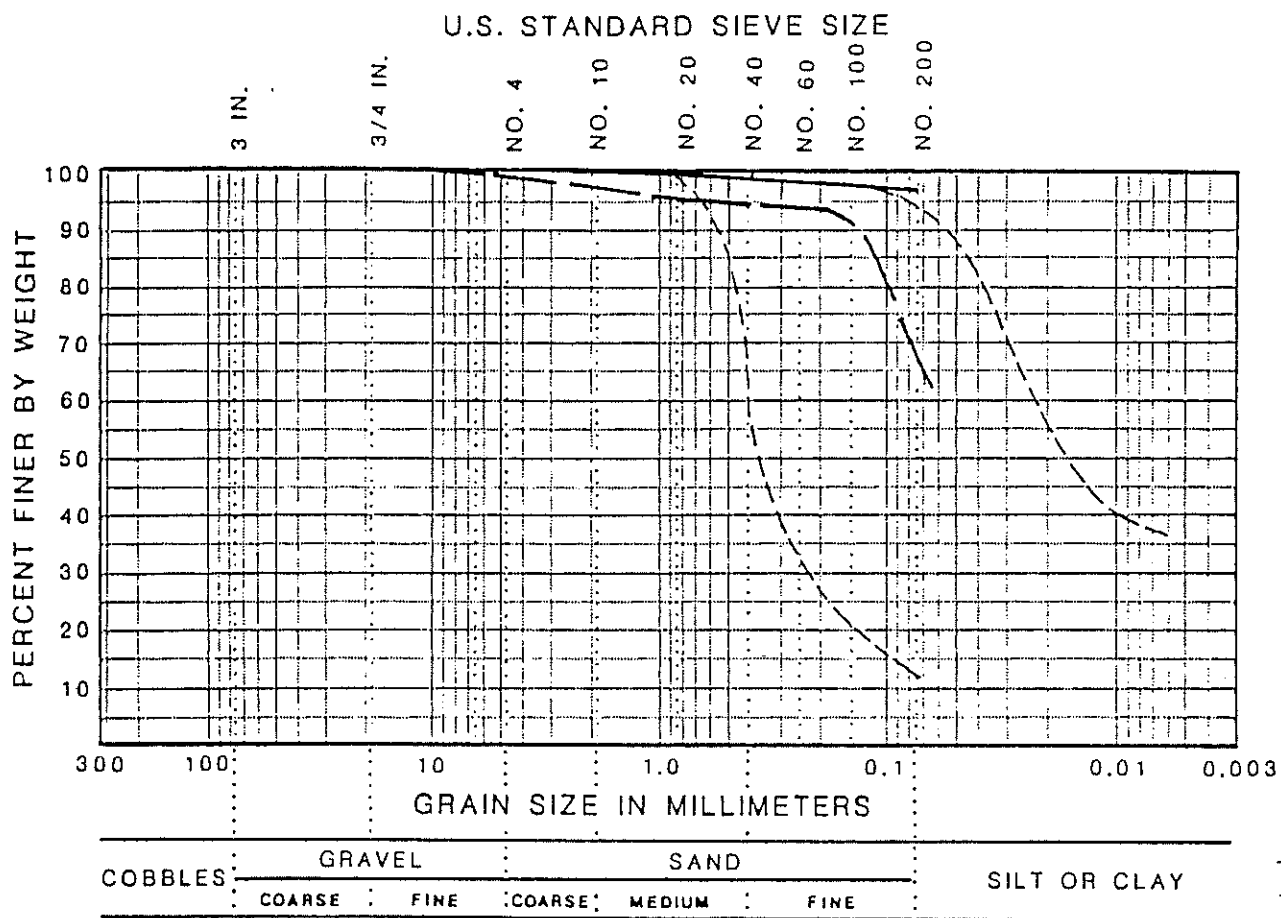


NOTE: All tests performed on specimens at approximately saturated moisture contents.

### CONSOLIDATION TEST DATA



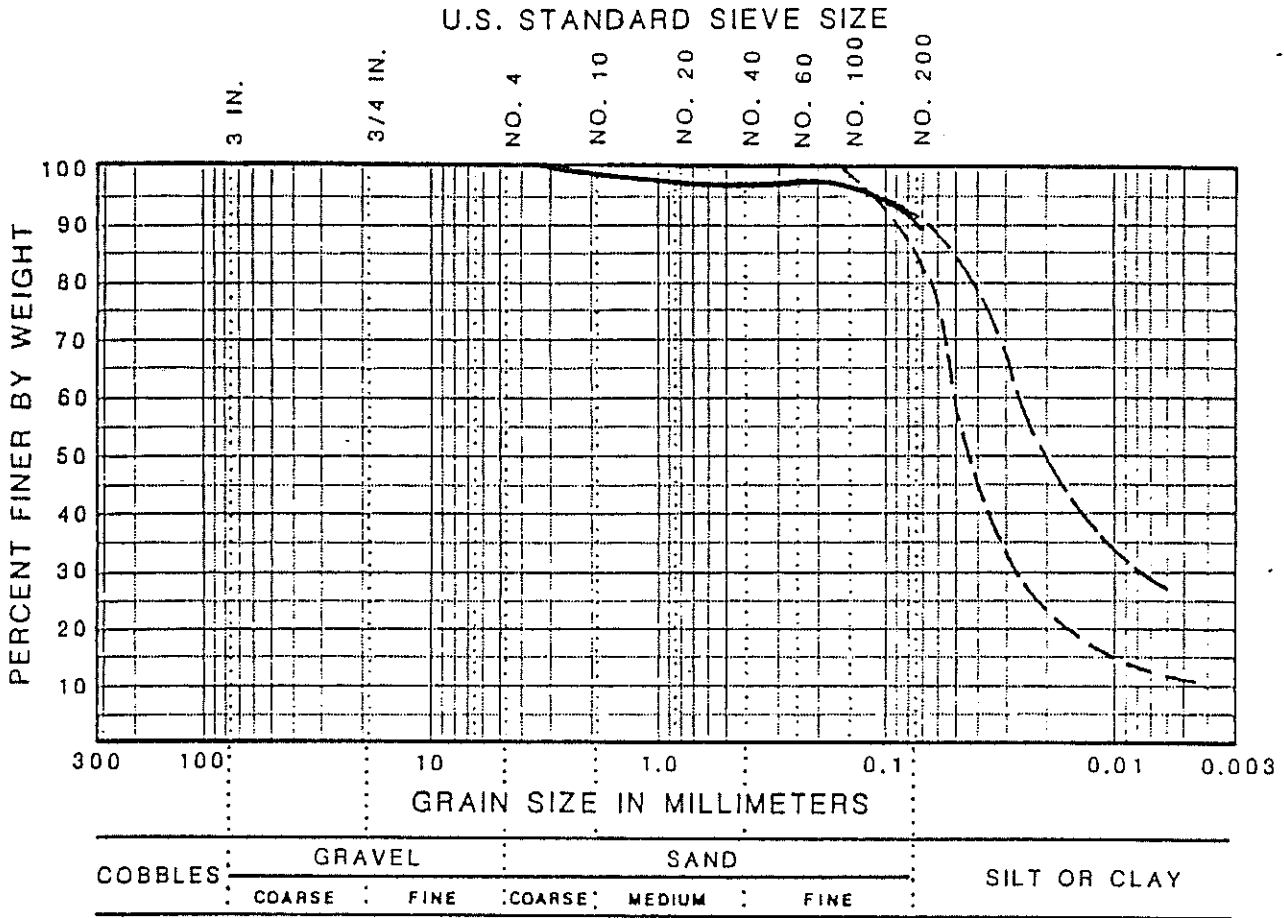
### GRAIN-SIZE DISTRIBUTION DATA



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)

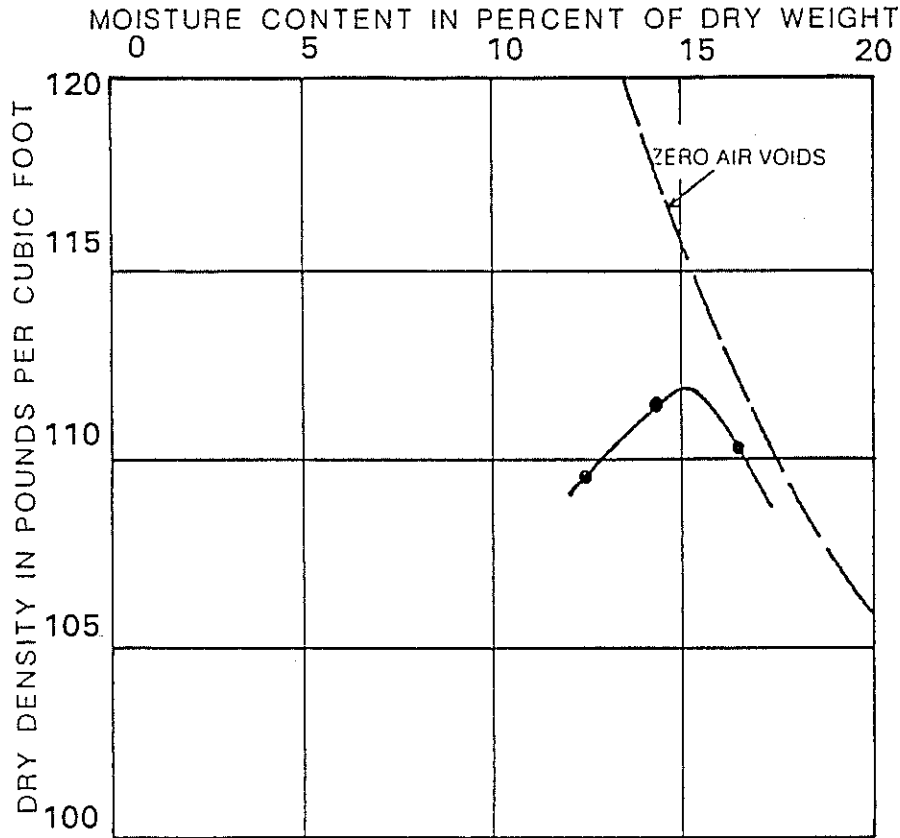
GRAIN-SIZE DISTRIBUTION DATA



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)
-----	DII-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

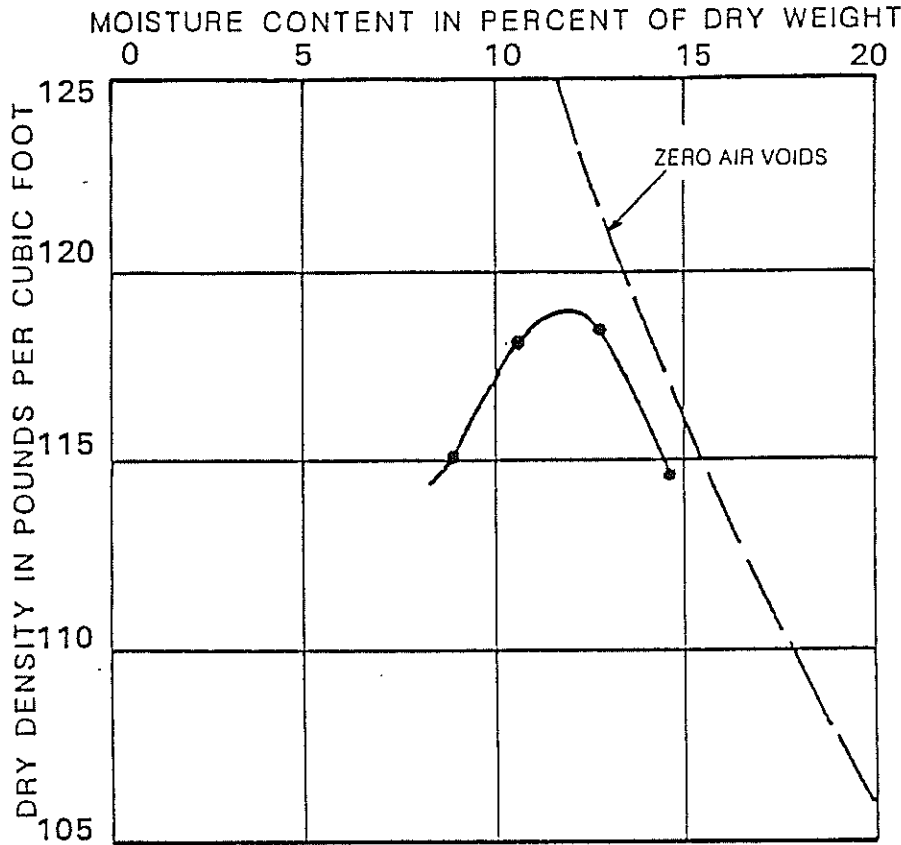
GRAIN SIZES IN PERCENT OF DRY WEIGHT  
 SAND (RETAINED ON No. 200 SIEVE)  
 FINES (PASSING No. 200 SIEVE)  
 ATTERBERG LIMITS, IN PERCENT OF DRY WEIGHT  
 LIQUID LIMIT  
 PLASTICITY INDEX  
 SOIL TYPE AND DESCRIPTION SANDY SILTSTONE (ML)

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 (Qa1/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
D	—	DRY DENSITY IN POUNDS PER CUBIC FOOT
		} AT WHICH TEST WAS INITIATED
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.	—	TIME IN MINUTES FOR * PERCENT CONSOLIDATION

## TYPE OF SAMPLE TESTED

N	—	UNDISTURBED NATURAL SOIL
F	—	UNDISTURBED COMPACTED FILL SOIL
R	—	SOIL REMOLDED IN LABORATORY

# R - VALUE DATA SHEET

PROJECT NUMBER 19281 W.O.# S89012B  
 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

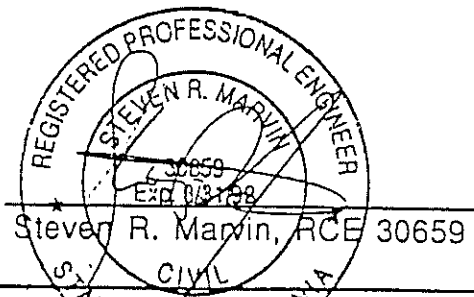
### DESIGN CALCULATION DATA

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



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.



# R - VALUE DATA SHEET

PROJECT NUMBER 19292

J.N. S89012B  
BORING NUMBER: DH 115 @ 6'-10'

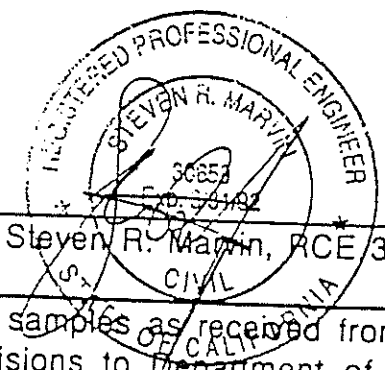
SAMPLE DESCRIPTION: Light Brown Diatomaceous Silt

Item	SPECIMEN		
	a	b	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
Turns 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			
Traffic Index	Assumed:	4.0	4.0
i. E. by Stability		0.98	0.83
i. E. by Expansion		0.00	1.00
			0.50

Equilibrium R-Value	12 by EXUDATION	
REMARKS:	Gf = 1.25	

Examined & Checked: 9 / 28 / 90



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.

# R-VALUE GRAPHICAL PRESENTATION

PROJECT NO. 19292

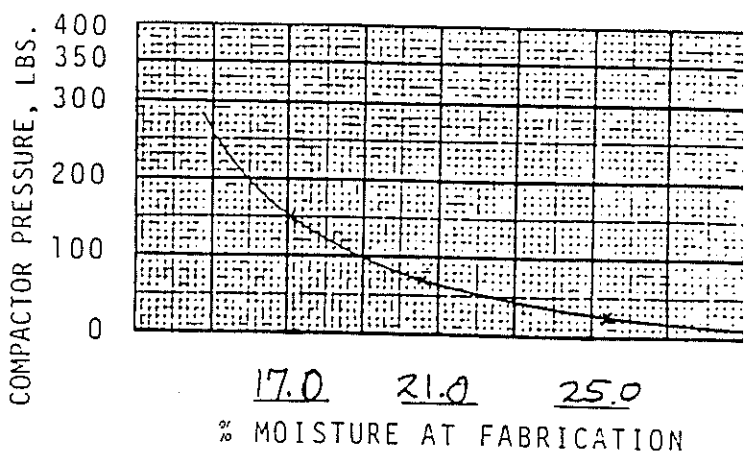
J.N. 589012B  
BORING NO. DH 115 @ 6'-10"

DATE 9-28-90

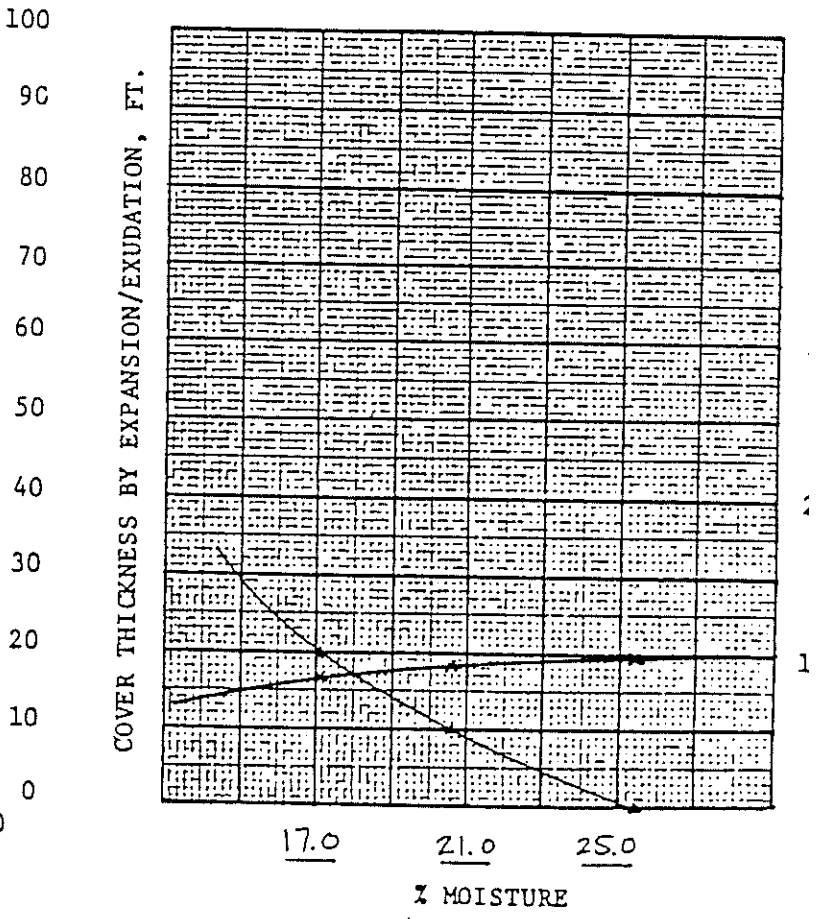
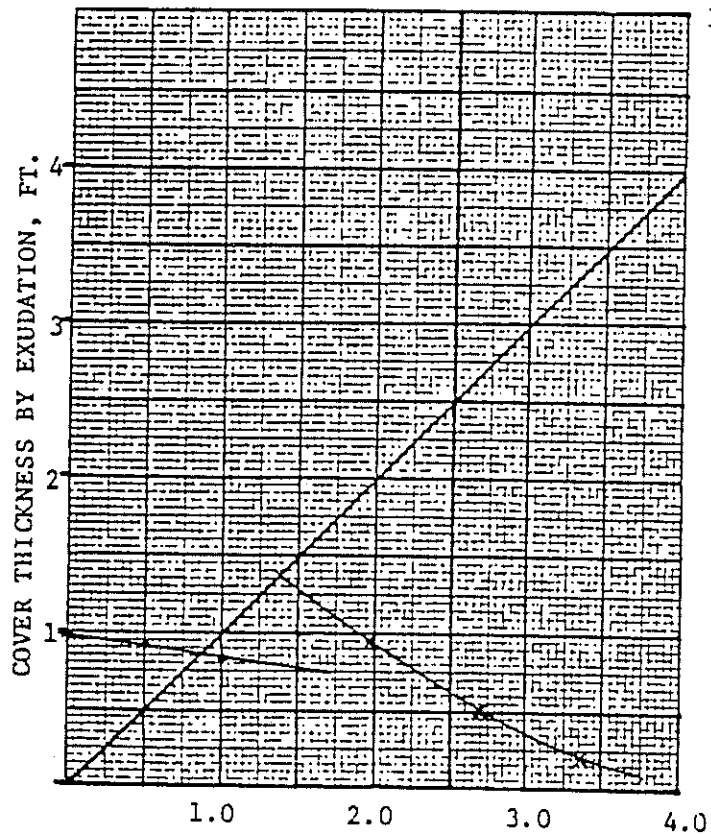
TRAFFIC INDEX 4.0

R-VALUE BY EXUDATION 12

R-VALUE BY EXPANSION —



800 700 600 500 400 300 200 100



COVER THICKNESS BY EXPANSION, FT.

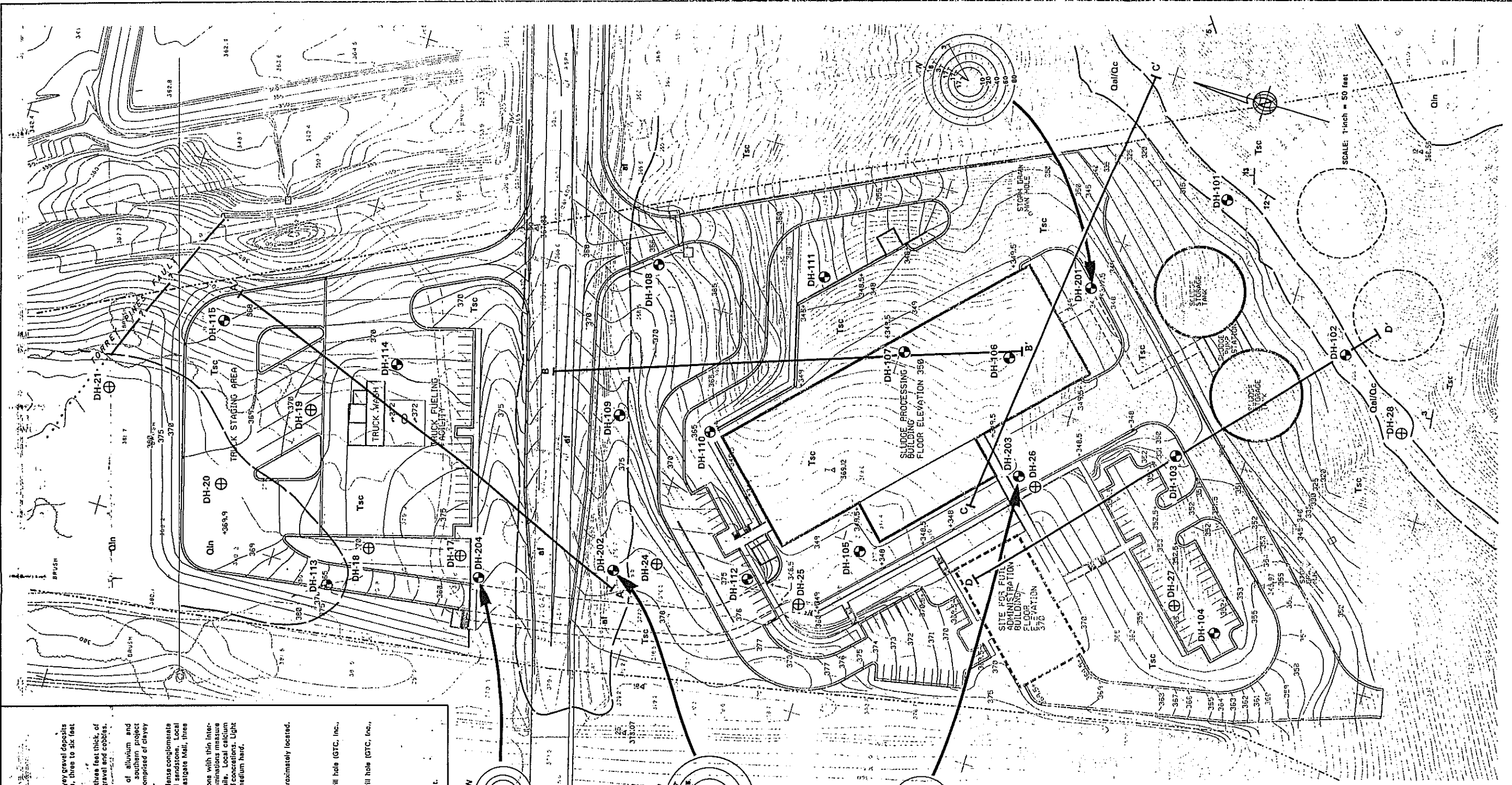
—■— R-VALUE vs. EXUD. PRES.

—x— T by EXUDATION

—△— EXUD. T vs. EXPAN. T

—△— T by EXPANSION

REMARKS Gf = 1.25



**LEGEND**

**Rock Units**

af Artificial Fill. Clay, clayey silt and clayey gravel deposits along Eastgate Mall. Generally loose, three to six feet thick.

Oc 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. Composed of clayey silt with scattered gravel and cobbles.

Qin Lindsaea 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 friable. Local calcium carbonate cement. Occurs north of Eastgate Mall, light gray to light brown, damp, stiff to medium hard.

**Symbols**

Geologic contact, dashed where approximately located.

Strike and dip of bedding.

Estimated location of exploratory drill hole (GTC, Inc., August 1990).

Estimated location of exploratory drill hole (GTC, Inc., February 1990).

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

**MEYCALP & EDDY**  
In association with Helbo & Associates

CITY OF SAN DIEGO, CALIFORNIA  
UTILITIES DEPARTMENT  
SHEET 12 OF 12

**GEOTECHNICAL CONSULTANTS, INC.**

**GEOTECHNICAL MAP**

S89012B

PLATE 1

OCTOBER 1990



**Preliminary Geotechnical Investigation,  
Eastgate Mall Site Development Project  
by  
Metcalf & Eddy, Inc.**



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

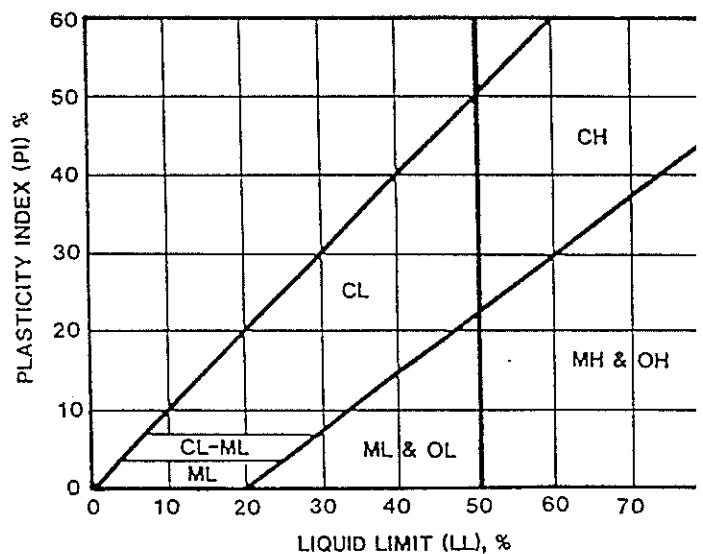
MARCH 15, 1991  
PROJECT NO. 101948-01

GROUP SYMBOLS		GROUP 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	3" to No. 4	76.2 to 4.76
	Coarse 3" to 3/4"	76.2 to 19.1
	Fine 3/4" to No. 4	19.1 to 4.76
SAND	No. 4 to No. 200	4.76 to 0.074
	Coarse No. 4 to No. 10	4.76 to 2.00
	Medium No. 10 to No. 40	2.00 to 0.420
	Fine No. 40 to No. 200	0.420 to 0.074
SILT & CLAY	Below No. 200	Below 0.074

GRAIN SIZE CHART



PLASTICITY CHART



DEPTH (Feet)	SAMPLES		BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DATE DRILLED _____ BORING NO. _____
	Bulk	Driven					GROUND ELEVATION _____ SHEET ____ OF ____
							METHOD OF DRILLING _____
							DRIVE WEIGHT _____ DROP _____
							SAMPLED BY _____ LOGGED BY _____
							<b>DESCRIPTION</b>
0							
							Undisturbed drive sample
							Bulk sample
5							Seepage
							Ground water table
10							Standard penetration test
							Solid line denotes formation change
15							Dashed line denotes lithologic gradational change.
20							

## TEST PIT LOG

Explanation of Test Pit Log

PROJECT NO. \_\_\_\_\_

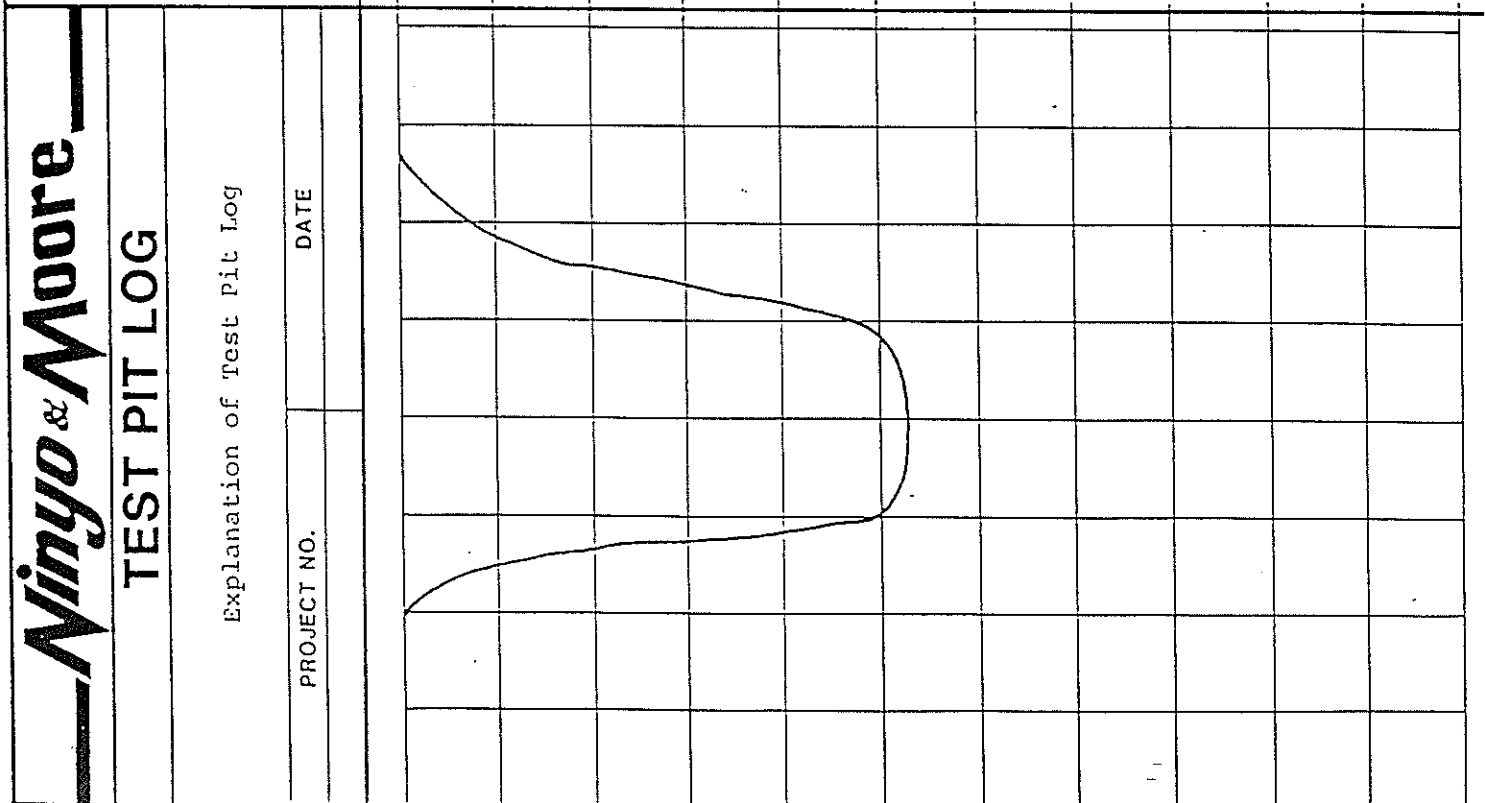
DATE \_\_\_\_\_

DATE EXCAVATED \_\_\_\_\_ TEST PIT NO. \_\_\_\_\_

GROUND ELEVATION \_\_\_\_\_ LOGGED BY \_\_\_\_\_

METHOD OF EXCAVATION \_\_\_\_\_

LOCATION \_\_\_\_\_ DESCRIPTION \_\_\_\_\_



DEPTH (FEET)	SAMPLES		
	Bulk	Driven	Sand Cone
0 - 1			
1 - 2			
2 - 3			
3 - 4			
4 - 5			
5 - 6			
6 - 7			
7 - 8			
8 - 9			
9 - 10			

MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.
↓		
↓		
↓		
↓		
↓		

DESCRIPTION
Drive Tube density sample
Sand Cone density sample
Bulk sample
Seepage
Ground water table

Bulk Driven	SAMPLES	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DATE DRILLED	BORING NO.
						1/23/91	B-1
						GROUND ELEVATION	SHEET
						345'+/- MSL	1 OF 1
						METHOD OF DRILLING	
						8" Hollow Stem Auger	
						DRIVE WEIGHT	DROP
						140 lbs.	30"
						SAMPLED BY	LOGGED BY
						GJS	GJS
DESCRIPTION							
					SM	<u>ALLUVIUM:</u> Medium brown, damp, medium dense, slightly clayey, silty SAND with abundant gravel.	
		74					
						<u>SCRIPPS FORMATION:</u> Yellow-brown to red-brown, damp, dense to very dense, silty, fine-grained SANDSTONE.	
		86	8.8				
						Total Depth = 12.0' No Caving No Ground Water Encountered Backfilled 1/28/91	



BORING LOG		
Eastgate Mall Site, North City Reclamation and Sludge Processing Facilities		
PROJECT NO.	DATE	FIGURE



DEPTH (Feet)	SAMPLES		BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DESCRIPTION
	Bulk	Driven					
0							DATE DRILLED <u>1/29/91</u> BORING NO. <u>B-2</u> GROUND ELEVATION <u>332' +/- MSL</u> SHEET <u>1</u> OF <u>2</u> METHOD OF DRILLING <u>8" Hollow Stem Auger</u> DRIVE WEIGHT <u>140 lbs.</u> DROP <u>30"</u> SAMPLED BY <u>GJS</u> LOGGED BY <u>GJS</u>
0 - 5			76			SM	<u>ALLUVIUM:</u> Brown, damp, medium dense, silty, fine SAND with gravel.  Harder drilling, abundant gravel and cobbles.
5 - 10			58	8.2			<u>SCRIPPS FORMATION:</u> Yellow-brown, damp, dense to very dense, silty, fine-grained SANDSTONE to fine, sandy SILTSTONE.  Tan, damp, very dense, medium to fine-grained SANDSTONE.
10 - 15			20/ 5"	9.5			Yellow-brown, damp, very dense, silty, fine-grained SANDSTONE.
15 - 20							



### BORING LOG

Eastgate Mall Site, North City Reclamation and Sludge Processing Facilities

PROJECT NO.  
101049-01

DATE  
2/01

FIGURE  
R-2

Bulk Driven	SAMPLES	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DATE DRILLED <u>1/29/91</u>	BORING NO. <u>B-2</u>
						GROUND ELEVATION <u>332' +/- MSL</u>	SHEET <u>2</u> OF <u>2</u>
						METHOD OF DRILLING <u>8" Hollow Stem Auger</u>	
						DRIVE WEIGHT <u>140 lbs.</u>	DROP <u>30"</u>
						SAMPLED BY <u>GJS</u>	LOGGED BY <u>GJS</u>

**DESCRIPTION**

89	<u>SCRIPPS FORMATION (Continued):</u>					
	<p>Total Depth = 20.8'          No Caving          No Ground Water Encountered          Backfilled 1/29/91</p>					



DEPTH (Feet)	SAMPLES		BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DESCRIPTION
	Bulk	Driven					
DATE DRILLED <u>1/29/91</u> BORING NO. <u>B-3</u> GROUND ELEVATION <u>312' +/- MSL</u> SHEET <u>1</u> OF <u>2</u> METHOD OF DRILLING <u>8" Hollow Stem Auger</u> DRIVE WEIGHT <u>140 lbs.</u> DROP <u>30"</u> SAMPLED BY <u>GJS</u> LOGGED BY <u>GJS</u>							
0						SM-ML	<u>ALLUVIUM:</u> Brown, damp, medium dense, clayey, silty, fine SAND and fine, sandy SILT with abundant gravel.
5			72/ 9"	9.6			
10							<u>SCRIPPS FORMATION:</u> Yellow-brown, damp, stiff to very stiff, fine, sandy SILTSTONE.  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							



BORING LOG		
Eastgate Mall Site, North City Reclamation and Sludge Processing Facilities		
PROJECT NO.	DATE	FIGURE

Bulk Driven	SAMPLES		BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DATE DRILLED <u>1/29/91</u> BORING NO. <u>B-3</u>	
							GROUND ELEVATION <u>312' +/- MSL</u>	SHEET <u>2</u> OF <u>2</u>
							METHOD OF DRILLING <u>8" Hollow Stem Auger</u>	
							DRIVE WEIGHT <u>140 lbs.</u>	DROP <u>30"</u>
							SAMPLED BY <u>GJS</u>	LOGGED BY <u>GJS</u>
<b>DESCRIPTION</b>								
							<u>SCRIPPS FORMATION (Continued):</u>	
			77				Same as above	
							Total Depth = 21.5' No Caving No Ground Water Encountered Backfilled 1/29/91	



<b>BORING LOG</b>		
Eastgate Mall Site, North City Reclamation and Sludge Processing Facilities		
PROJECT NO.	DATE	FIGURE

DEPTH (Feet)	Bulk	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DATE DRILLED <u>1/29/91</u>	BORING NO. <u>B-4</u>
	Driven					GROUND ELEVATION <u>302' +/- MSL</u>	SHEET <u>1</u> OF <u>2</u>
						METHOD OF DRILLING <u>8" Hollow Stem Auger</u>	
						DRIVE WEIGHT <u>140 lbs.</u>	DROP <u>30"</u>
						SAMPLED BY <u>GJS</u>	LOGGED BY <u>GJS</u>

**DESCRIPTION**

0					SL-CL	<u>ALLUVIUM:</u> 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.	
15							
		98	18.9			Yellow-brown and gray, damp, very stiff to hard, fine, sandy SILTSTONE to silty, fine-grained SANDSTONE.	
20							



**BORING LOG**

Eastgate Mall Site, North City Reclamation and Sludge Processing Facilities

PROJECT NO.	DATE	FIGURE
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Bulk Driven	SAMPLES	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DATE DRILLED	BORING NO.	
						1/29/91	B-4	
						GROUND ELEVATION	SHEET	OF
						302' +/- MSL	2	2
						METHOD OF DRILLING		
						8" Hollow Stem Auger		
						DRIVE WEIGHT	DROP	
						140 lbs.	30"	
						SAMPLED BY	LOGGED BY	
						GJS	GJS	
<b>DESCRIPTION</b>								
		92				<u>SCRIPPS FORMATION (Continued):</u> 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		



### BORING LOG

Eastgate Mall Site, North City Reclamation  
and Sludge Processing Facilities

PROJECT NO	DATE	FIGURE
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DEPTH (Feet)	SAMPLES		BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DATE DRILLED <u>1/29/91</u>	BORING NO. <u>B-5</u>
	Bulk	Driven					GROUND ELEVATION <u>310' +/- MSL</u>	SHEET <u>1</u> OF <u>2</u>
							METHOD OF DRILLING <u>8" Hollow Stem Auger</u>	
							DRIVE WEIGHT <u>140 lbs.</u>	DROP <u>30"</u>
							SAMPLED BY <u>GJS</u>	LOGGED BY <u>GJS</u>
<b>DESCRIPTION</b>								

0							<u>ALLUVIUM:</u> Brown, damp, medium dense, slightly clayey, silty, fine SAND and fine, sandy SILT.	
5							76	17.7 106.6
10								
15							60	15.2 102.1
20								

SCRIPPS FORMATION:  
Yellow-brown to orange-brown and gray, damp, very stiff, fine, sandy SILTSTONE and silty, fine-grained SANDSTONE.

Same as above.



<b>BORING LOG</b>		
Eastgate Mall Site, North City Reclamation and Sludge Processing Facilities		
PROJECT NO. 101948-01	DATE 3/91	FIGURE B-5

Bulk Driven	SAMPLES	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DATE DRILLED	BORING NO.	
						1/29/91	B-5	
						GROUND ELEVATION	SHEET	OF
						310'+/- MSL	2	2
						METHOD OF DRILLING		
						8" Hollow Stem Auger		
						DRIVE WEIGHT	DROP	
						140 lbs.	30"	
						SAMPLED BY	LOGGED BY	
						GJS	GJS	
						<b>DESCRIPTION</b>		
		75				<u>SCRIPPS FORMATION (Continued):</u>		
						Same as above.		
						Total Depth = 21.0' No Caving No Ground Water Encountered Backfilled 1/29/91		

DEPTH (Feet)	SAMPLES		BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DATE DRILLED <u>1/29/91</u>	BORING NO. <u>B-6</u>
	Bulk	Driven					GROUND ELEVATION <u>364'+/- MSL</u>	SHEET <u>1</u> OF <u>2</u>
							METHOD OF DRILLING <u>8" Hollow Stem Auger</u>	
							DRIVE WEIGHT <u>140 lbs.</u>	DROP <u>30"</u>
							SAMPLED BY <u>GJS</u>	LOGGED BY <u>GJS</u>
<b>DESCRIPTION</b>								

0							<u>SCRIPPS FORMATION:</u> 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								



<b>BORING LOG</b>		
Eastgate Mall Site, North City Reclamation and Sludge Processing Facilities		
PROJECT NO. 101948-01	DATE 2/01	FIGURE B-6

SAMPLES	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DATE DRILLED	BORING NO.
					1/29/91	B-6
					GROUND ELEVATION	SHEET
					364' +/- MSL	2 OF 2
					METHOD OF DRILLING	
					8" Hollow Stem Auger	
					DRIVE WEIGHT	DROP
					140 lbs.	30"
					SAMPLED BY	LOGGED BY
					GJS	GJS
<b>DESCRIPTION</b>						
	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.	
					Orange-brown and gray, damp, dense, sandy, clayey SILTSTONE.	
	50/ 6"				Total Depth = 30.5' No Caving No Ground Water Encountered Backfilled 1/29/91	



<b>BORING LOG</b>		
Eastgate Mall Site, North City Reclamation and Sludge Processing Facilities		
PROJECT NO.	DATE	FIGURE

DEPTH (Feet)	SAMPLES		BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DESCRIPTION
	Bulk	Driven					
DATE DRILLED <u>1/29/91</u> BORING NO. <u>B-7</u> GROUND ELEVATION <u>367'+/- MSL</u> SHEET <u>1</u> OF <u>2</u> METHOD OF DRILLING <u>8" Hollow Stem Auger</u> DRIVE WEIGHT <u>140 lbs.</u> DROP <u>30"</u> SAMPLED BY <u>GJS</u> LOGGED BY <u>GJS</u>							
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							



BORING LOG		
Eastgate Mall Site, North City Reclamation and Sludge Processing Facilities		
PROJECT NO. 101948-01	DATE 3/91	FIGURE B-7

BULK SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DATE DRILLED	BORING NO.
					DESCRIPTION	
					1/29/91	B-7
					367' +/- MSL	SHEET 2 OF 2
					8" Hollow Stem Auger	
					140 lbs.	DROP 30"
					GJS	LOGGED BY GJS
85					SCRIPPS FORMATION (Continued): 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	



### BORING LOG

Eastgate Mall Site, North City Reclamation and Sludge Processing Facilities

PROJECT NO | DATE | FIGURE



DEPTH (Feet)	SAMPLES		BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DATE DRILLED <u>1/29/91</u> BORING NO. <u>B-8</u>	GROUND ELEVATION <u>358'+/- MSL</u> SHEET <u>1</u> OF <u>2</u>	METHOD OF DRILLING <u>8" Hollow Stem Auger</u>	DRIVE WEIGHT <u>140 lbs.</u> DROP <u>30"</u>	SAMPLED BY <u>GJS</u> LOGGED BY <u>GJS</u>
	Bulk	Driven									
0							<b>DESCRIPTION</b>				
							<u>SCRIPPS FORMATION:</u> 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											

**Ningo & Moore**

**BORING LOG**

Eastgate Mall Site, North City Reclamation and Sludge Processing Facilities

PROJECT NO. 101948-01	DATE 3/91	FIGURE R-8
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BULK Samples Driven	SAMPLES	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DATE DRILLED <u>1/29/91</u>	BORING NO. <u>B-8</u>
						GROUND ELEVATION <u>358' +/- MSL</u>	SHEET <u>1</u> OF <u>1</u>
						METHOD OF DRILLING <u>8" Hollow Stem Auger</u>	
						DRIVE WEIGHT <u>140 lbs.</u>	DROP <u>30"</u>
						SAMPLED BY <u>GJS</u>	LOGGED BY <u>GJS</u>

**DESCRIPTION**

78	<u>SCRIPPS FORMATION (Continued):</u>					
	Same as above.					
<p align="right">           Total Depth = 21.0'            No Caving            No Ground Water Encountered            Backfilled 1/29/91         </p>						

DEPTH (Feet)	SAMPLES		BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DATE DRILLED <u>2/1/91</u>	BORING NO. <u>B-9</u>
	Bulk	Driven					GROUND ELEVATION <u>375' +/- MSL</u>	SHEET <u>1</u> OF <u>2</u>
							METHOD OF DRILLING <u>30" Bucket Auger</u>	
							DRIVE WEIGHT <u>0'-25': 3,087 lbs.</u>	DROP <u>12"</u>
							DRIVE WEIGHT <u>25'-45': 1,999 lbs.</u>	
							SAMPLED BY <u>GJS</u>	LOGGED BY <u>GJS/PSR/RI</u>

**DESCRIPTION**

TOPSOIL:

SC

Reddish-brown, damp, loose to medium dense, clayey SAND with scattered cobbles; some desiccation cracks.

SCRIPPS FORMATION:

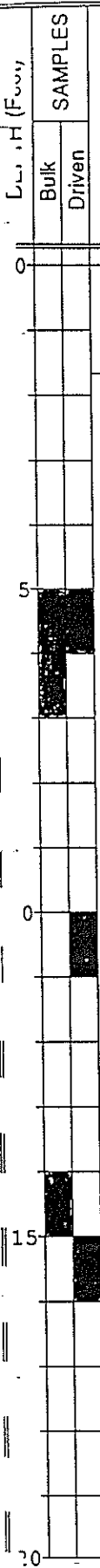
Light reddish-brown, damp, dense to very dense, silty, fine to medium-grained SANDSTONE; moderately to well indurated.

Becomes micaceous.

Gray mottling and iron-oxide staining, massive, bedding not distinct.

Boulder size rip-up clast, light gray, hard SILTSTONE.

Yellow-brown and gray, damp, hard SILTSTONE; rip-up clast above contact.



**BORING LOG**

Eastgate Mall Site, North City Reclamation and Sludge Processing Facilities

PROJECT NO.	DATE	FIGURE
100000-02	2/1/91	1

SAMPLES	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DATE DRILLED	BORING NO.	
					2/1/91	B-9	
					GROUND ELEVATION	SHEET	OF
					375' +/- MSL	2	2
					METHOD OF DRILLING		
					30" Bucket Auger		
					DRIVE WEIGHT	DROP	
					0'-25': 3,087 lbs. 25'-45': 1,999 lbs.	12"	
					SAMPLED BY	LOGGED BY	
					GJS	GJS/PSR/RI	
<b>DESCRIPTION</b>							
	8	18.8	108.5		<u>SCRIPPS FORMATION (Continued):</u> @ 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		



<b>BORING LOG</b>		
Eastgate Mall Site, North City Reclamation and Sludge Processing Facilities		
PROJECT NO	DATE	FIGURE

DEPTH (feet)	BULK SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DATE DRILLED	BORING NO.
						2/1/91	B-10
						GROUND ELEVATION	SHEET
						354' +/- MSL	1 OF 3
						METHOD OF DRILLING	
						30" Bucket Auger	
						DRIVE WEIGHT	DROP
						0'-25': 3,087 lbs.	12"
						25'-45': 1,999 lbs.	
						SAMPLED BY	LOGGED BY
						GJS	GJS/PSR/RI
<b>DESCRIPTION</b>							
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.	
9		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.	
12		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							

**Ninyo & Moore**

**BORING LOG**

Eastgate Mall Site, North City Reclamation and Sludge Processing Facilities

PROJECT NO.  
101948-01

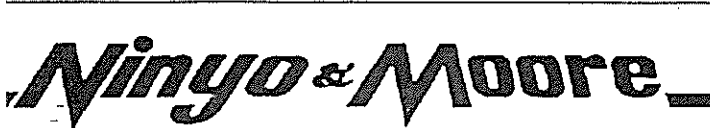
DATE  
3/91

FIGURE  
B-10

Bulk Driven	SAMPLES	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DATE DRILLED <u>2/1/91</u>	BORING NO. <u>B-10</u>
						GROUND ELEVATION <u>354' +/- MSL</u>	SHEET <u>2</u> OF <u>3</u>
						METHOD OF DRILLING <u>30" Bucket Auger</u>	
						DRIVE WEIGHT <u>0'-25': 3,087 lbs.</u>	DROP <u>12"</u>
						DRIVE WEIGHT <u>25'-45': 1,999 lbs.</u>	
						SAMPLED BY <u>GJS</u>	LOGGED BY <u>GJS/PSR/RI</u>

**DESCRIPTION**

12						<p><u>SCRIPPS FORMATION (Continued):</u></p>	
						<p>Orange-brown and gray, damp, dense, silty, fine to medium-grained SANDSTONE with abundant subrounded gravel and cobbles.</p>	
						<p>Orange-brown, damp, very dense to dense, silty, fine-grained SANDSTONE; moderately to well cemented.</p>	
						<p>@ 37.3': A 2-inch thick, approximately horizontal bed of gray, sandy SILTSTONE.</p>	
						<p>Orange-brown and gray, damp, very stiff to hard, sandy SILTSTONE; moderately to well indurated, with zones of silty SANDSTONE.</p>	



BORING LOG		
Eastgate Mall Site, North City Reclamation and Sludge Processing Facilities		
PROJECT NO.	DATE	FIGURE



DEPTH (Feet)	SAMPLES		BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DATE DRILLED <u>2/1/91</u>	BORING NO. <u>B-10</u>
	Bulk	Driven					GROUND ELEVATION <u>354' +/- MSL</u>	SHEET <u>3</u> OF <u>3</u>
							METHOD OF DRILLING <u>30" Bucket Auger</u>	
							DRIVE WEIGHT <u>0'-25': 3,087 lbs.</u>	DROP <u>12"</u>
							DRIVE WEIGHT <u>25'-45': 1,999 lbs.</u>	
							SAMPLED BY <u>GJS</u>	LOGGED BY <u>GJS/PSR/RI</u>

**DESCRIPTION**

0	15/8"	9.4					<u>SCRIPPS FORMATION (Continued):</u>  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								



BORING LOG		
Eastgate Mall Site, North City Reclamation and Sludge Processing Facilities		
PROJECT NO. 101010-01	DATE 2/01	FIGURE B-10

BULK SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DATE DRILLED	BORING NO.
					2/4/91	B-11
					GROUND ELEVATION	SHEET
					376' +/- MSL	1 OF 2
					METHOD OF DRILLING	
					30" Bucket Auger	
					DRIVE WEIGHT	DROP
					0' - 25' : 3,087 lbs.	12"
					25' - 45' : 1,999 lbs.	
					SAMPLED BY	LOGGED BY
					GJS	GJS/PSR
<b>DESCRIPTION</b>						
				SC	<u>TOPSOIL:</u> Brown, damp, loose to medium dense, silty, clayey SAND.	
					<u>LINDAVISTA FORMATION:</u> 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.	



<b>BORING LOG</b>		
Eastgate Mall Site, North City Reclamation and Sludge Processing Facilities		
PROJECT NO.	DATE	FIGURE

Bulk Driven	SAMPLES	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DATE DRILLED <u>2/4/91</u>	BORING NO. <u>B-11</u>
						GROUND ELEVATION <u>376'+/- MSL</u>	SHEET <u>2</u> OF <u>2</u>
						METHOD OF DRILLING <u>30" Bucket Auger</u>	
						DRIVE WEIGHT <u>0'-25': 3,087 lbs.</u>	DROP <u>12"</u>
						DRIVE WEIGHT <u>25'-45': 1,999 lbs.</u>	
						SAMPLED BY <u>GJS</u>	LOGGED BY <u>GJS/PSR</u>
<b>DESCRIPTION</b>							

LINDAVISTA FORMATION (Continued):  
Same as above.

Total Depth = 25.0'  
No Caving  
No Ground Water Encountered  
Backfilled 2/4/91



### BORING LOG

Eastgate Mall Site, North City Reclamation and Sludge Processing Facilities

PROJECT NO. 101948-01	DATE 3/91	FIGURE B-11
--------------------------	--------------	----------------

Bulk Driven	SAMPLES	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DATE DRILLED <u>2/4/91</u>	BORING NO. <u>B-12</u>
						GROUND ELEVATION <u>382' +/- MSL</u>	SHEET <u>1</u> OF <u>1</u>
						METHOD OF DRILLING <u>30" Bucket Auger</u>	
						DRIVE WEIGHT <u>3,087 lbs.</u>	DROP <u>12"</u>
						SAMPLED BY <u>GJS</u>	LOGGED BY <u>GJS/PSR</u>

**DESCRIPTION**

						<p><u>TOPSOIL:</u> Brown, dry to damp, loose to medium dense, silty SAND with gravel.</p>
					SM	<p><u>LINDAVISTA FORMATION:</u> Red-brown, dry to damp, loose to medium dense, silty SAND with gravel.</p>

						<p>Yellow-brown to orange-brown, dry, very dense, silty, fine-grained SANDSTONE with abundant gravel and cobbles.</p> <p>(Refusal)</p>
--	--	--	--	--	--	--

						<p>Total Depth = 8.0' No Caving No Ground Water Encountered Backfilled 2/4/91</p>
--	--	--	--	--	--	---



<b>BORING LOG</b>		
Eastgate Mall Site, North City Reclamation and Sludge Processing Facilities		
PROJECT NO.	DATE	FIGURE

DEPTH (ft.)	SAMPLES		BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DATE DRILLED <u>2/4/91</u>	BORING NO. <u>B-13</u>
	Bulk	Driven					GROUND ELEVATION <u>377' +/- MSL</u>	SHEET <u>1</u> OF <u>2</u>
							METHOD OF DRILLING <u>30" Bucket Auger</u>	
							DRIVE WEIGHT <u>0'-25': 3,087 lbs.</u>	DROP <u>12"</u>
							SAMPLED BY <u>GJS</u>	LOGGED BY <u>GJS/PSR</u>
<b>DESCRIPTION</b>								

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.
0						GL	Medium brown, damp, very dense, clayey, sandy GRAVEL, with abundant cobbles.
							<u>SCRIPPS FORMATION:</u> Yellow-brown, damp, dense, fine, sandy SILTSTONE.  Medium brown, damp, dense, clayey SILTSTONE; appears massive, no apparent bedding.
15							
20							



<b>BORING LOG</b>		
Eastgate Mall Site, North City Reclamation and Sludge Processing Facilities		
PROJECT NO.	DATE	FIGURE
101948-01	3/91	B-13

SAMPLES Bulk Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DATE DRILLED	BORING NO.
					DESCRIPTION	
					2/4/91	B-13
					GROUND ELEVATION	SHEET
					377' +/- MSL	2 OF 2
					METHOD OF DRILLING	
					30" Bucket Auger	
					DRIVE WEIGHT	DROP
					0'-25': 3,087 lbs.	12"
					25'-45': 1,999 lbs.	
					SAMPLED BY	LOGGED BY
					GJS	GJS/PSR
					DESCRIPTION	
					SCRIPPS FORMATION (Continued):	
					@ 20.3': Some iron-oxide staining.	
					Gray, damp, dense, sandy CLAYSTONE.	
11		15.0	109.9			
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	



BORING LOG		
Eastgate Mall Site, North City Reclamation and Sludge Processing Facilities		
PROJECT NO.	DATE	FIGURE
101048-01	2/01	B-13



**TEST PIT LOG**  
 Eastgate Mall Site  
 North City Reclamation Plant and  
 Sludge Processing Facilities

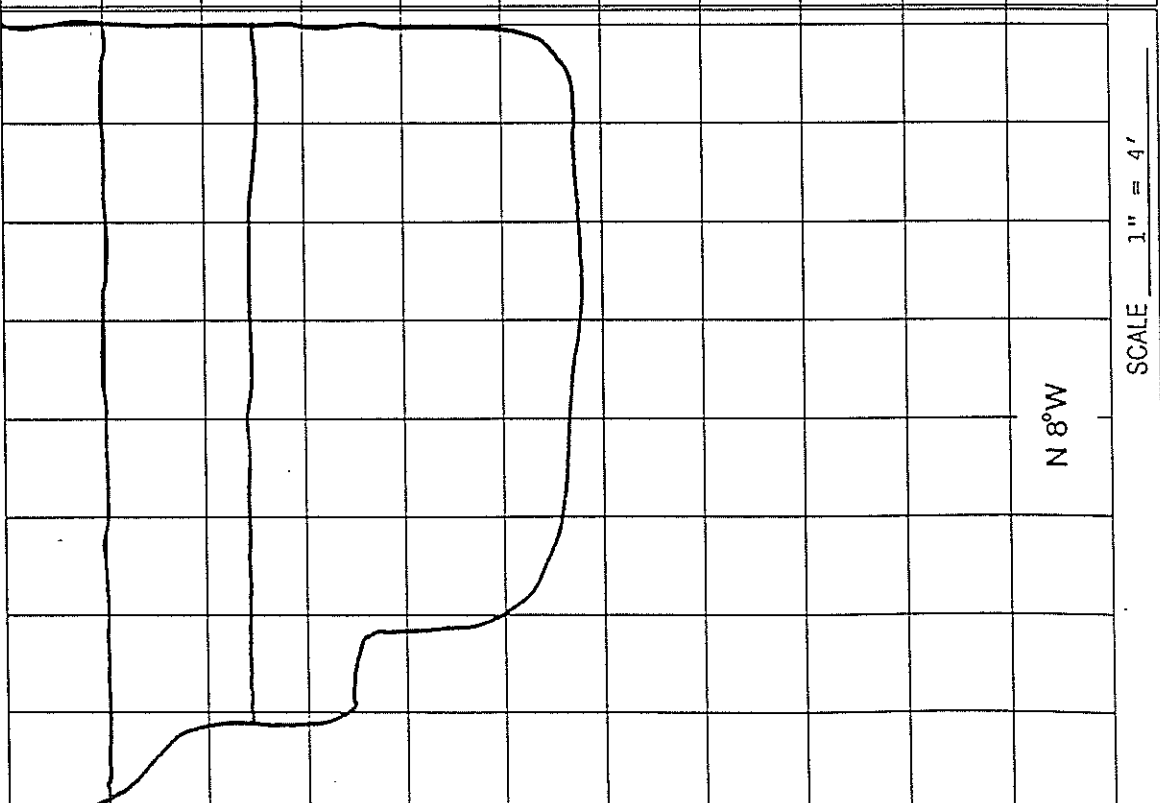
PROJECT NO. DATE  
 101948-01 3/91

DEPTH (FEET)	SAMPLE	
	Bulk	Sand Cone
0		
2		
4		
6		
8		
10		
12		
14		
16		
18		
20		
22		

MOISTURE (%)	DRY DENSITY (PC)	CLASSIFICATION U.S.
		SM

GROUND ELEVATION 380' +/- MSL LOGGED BY GJS  
 METHOD OF EXCAVATION JD-510 Backhoe  
 LOCATION See Plate One

DESCRIPTION
<p><u>TOPSOIL/COLLUVIUM:</u>            Dark brown, damp, medium dense, clayey, silty SAND.</p> <p><u>LINDAVISTA FORMATION:</u>            Yellow-brown, damp, dense to very dense, silty SAND with abundant rounded gravel and cobbles to 10 inches in diameter.</p> <p><u>SCRIPPS FORMATION:</u>            Yellow-brown to light brown, damp, hard, SILTSTONE, with interbeds of gray, silty and yellow-brown, fine sand and light brown clay.</p>
<p>Total Depth 11.5'            No Caving            No Ground Water Encountered            Backfilled 2/8/91</p>

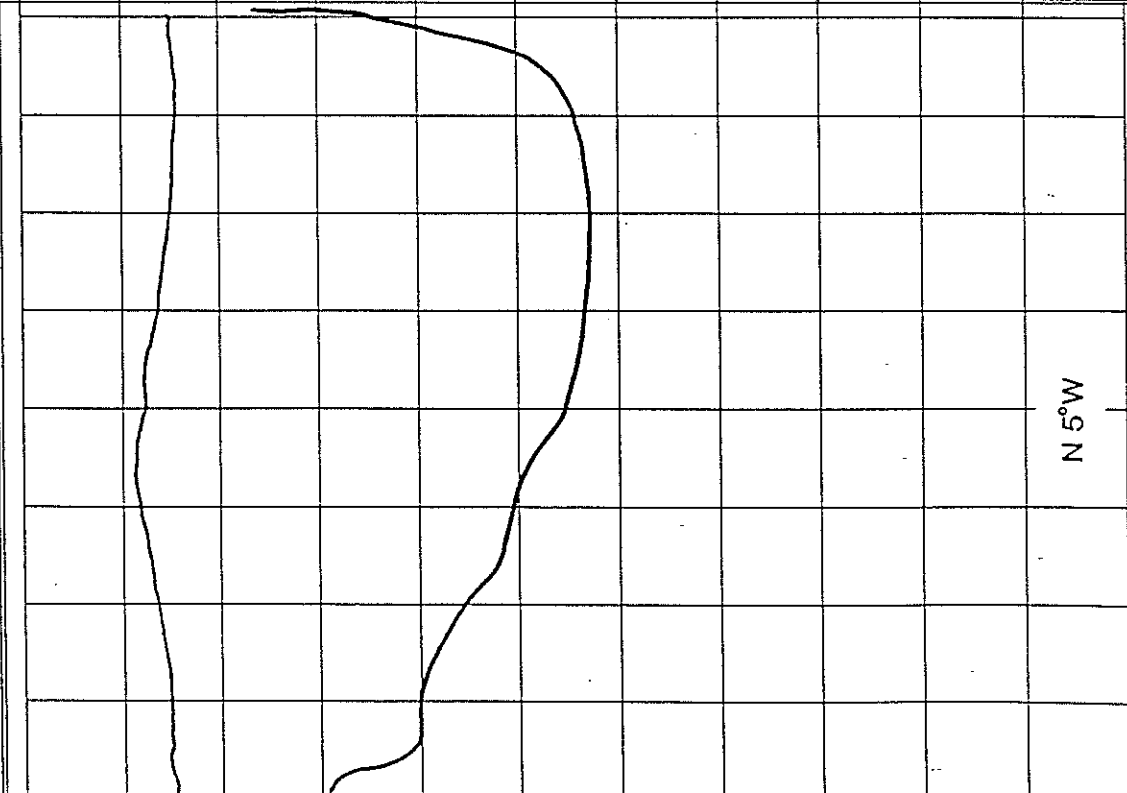


# Ningo & Moore

## TEST PIT LOG

Eastgate Mall Site  
North City Reclamation Plant and  
Sludge Processing Facilities

PROJECT NO. 101948-01  
DATE 3/91



N 5°W

SCALE 1" = 4'

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

### DESCRIPTION

TOPSOIL/COLLUVIUM:  
Dark brown, damp, medium dense, clayey, silty SAND and firm, sandy CLAY with occasional rounded gravel.

SCRIPPS FORMATION:  
Yellow-brown to light brown, damp, stiff to hard, SILTSTONE with interbeds of yellow-brown, silty, silty, fine sand and gray silt.

Total Depth 11.0'  
No Caving  
No Ground Water Encountered  
Backfilled 2/8/91

CLASSIFICATION U.S.C.S. SM-CL  
DRY DENSITY (PCF)  
MOISTURE (%)

DEPTH (FEET)	SAMPLES		Sand Cone
	Bulk	Driven	
0			
2			
4			
6			
8			
10			
12			
14			
16			
18			
20			
22			

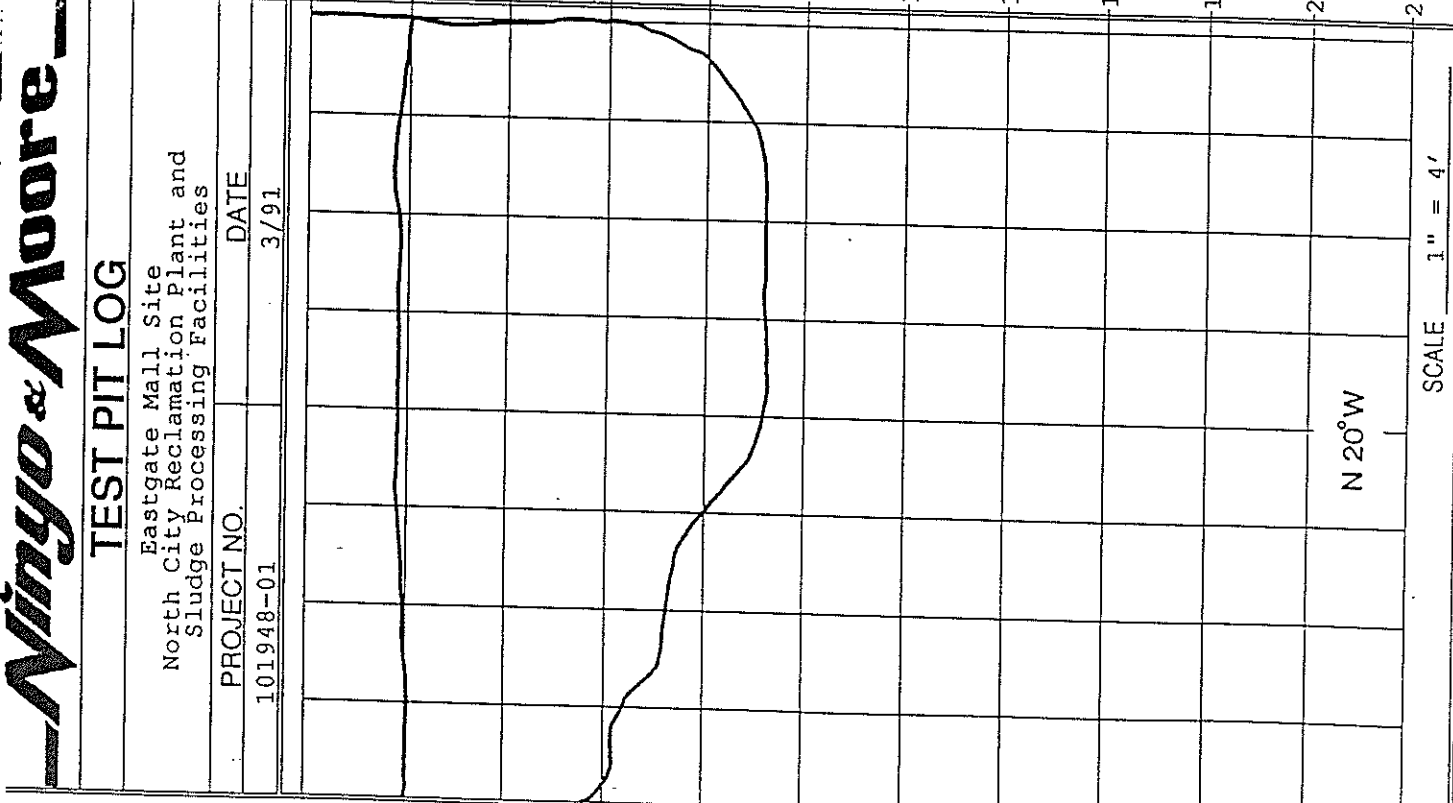
FIGURE B-15



## TEST PIT LOG

Eastgate Mall Site  
North City Reclamation Plant and  
Sludge Processing Facilities

PROJECT NO. 101948-01      DATE 3/91



DEPTH (FEET)	SAMPLES			MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DESCRIPTION
	Bulk	Driven	Sand Cone				
0						SM-CL	<u>TOPSOIL/COLLUVIUM:</u> Dark brown, damp, medium dense to dense, clayey, silty SAND and firm to stiff, sandy CLAY.
2							
4							<u>SCRIPPS FORMATION:</u> Yellow-brown, damp, very stiff, fine, sandy SILTSTONE.
6							Yellow-brown to light brown, damp, hard SILTSTONE with interbeds of gray silt and yellow-brown, silty, fine sand.
8							
10							
12							
14							
16							
18							
20							
22							

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

Total Depth 9.0'  
No Caving  
No Ground Water Encountered  
Backfilled 2/8/91

SCALE 1" = 4'

N 20°W



# TEST PIT LOG

Eastgate Mall Site  
North City Reclamation Plant and  
Sludge Processing Facilities

PROJECT NO. 101948-01  
DATE 3/91

GROUND ELEVATION 321'+/- MSL LOGGED BY GJS  
METHOD OF EXCAVATION JD-510 Backhoe  
LOCATION See Plate One

## DESCRIPTION

COLLUVIUM:  
Dark brown, dry to damp, stiff, silty, fine, sandy CLAY.

SCRIPPS FORMATION:  
Yellow-brown and gray, damp, hard, fine, sandy SILTSTONE.  
(Refusal)

Total Depth 6.0'  
No Caving  
No Ground Water Encountered  
Backfilled 2/8/91

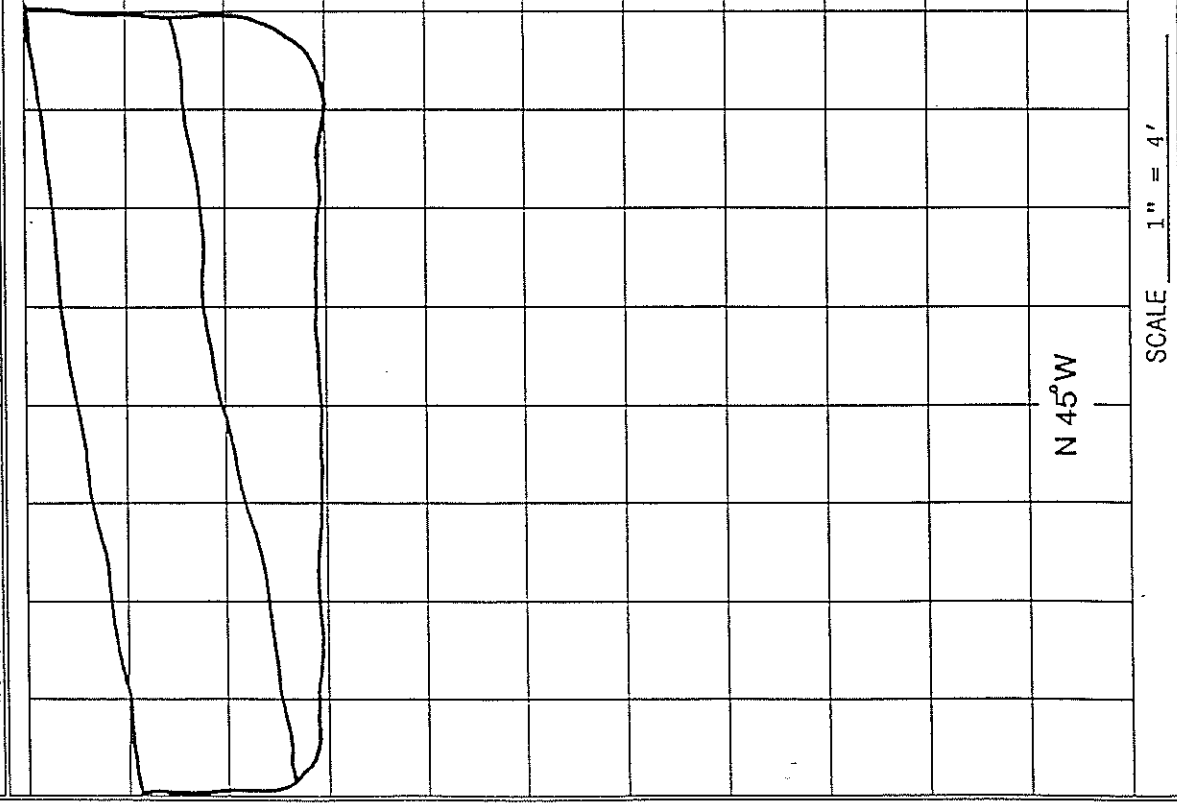
CLASSIFICATION U.S.C. CL

DRY DENSITY (PCF)

MOISTURE (%)

SAMPL. BULK Driven Sand Cone DEPTH (FEET)

DEPTH (FEET)	Bulk	Driven	Sand Cone
0			
2			
4			
6			
8			
10			
12			
14			
16			
18			
20			
22			



## TEST PIT LOG

Eastgate Mall Site  
North City Reclamation Plant and  
Sludge Processing Facilities

PROJECT NO. 101948-01  
DATE 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

### DESCRIPTION

ALLUVIUM/COLLUVIUM:  
Brown, damp, firm, clayey, fine, sandy SILT.

### SCRIPPS FORMATION:

Yellow-brown and gray, damp, hard SILTSTONE with yellow-brown, silty, fine SAND.  
Bedding Attitude: W 21° E 8° NW

Total Depth 10.0'  
No Caving  
No Ground Water Encountered  
Backfilled 2/8/91

DEPTH (FEET)	SAMPLES			MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.
	Bulk	Driven	Sand Cone			
0						ML
2						
4						
6						
8						
10						
12						
14						
16						
18						
20						
22						

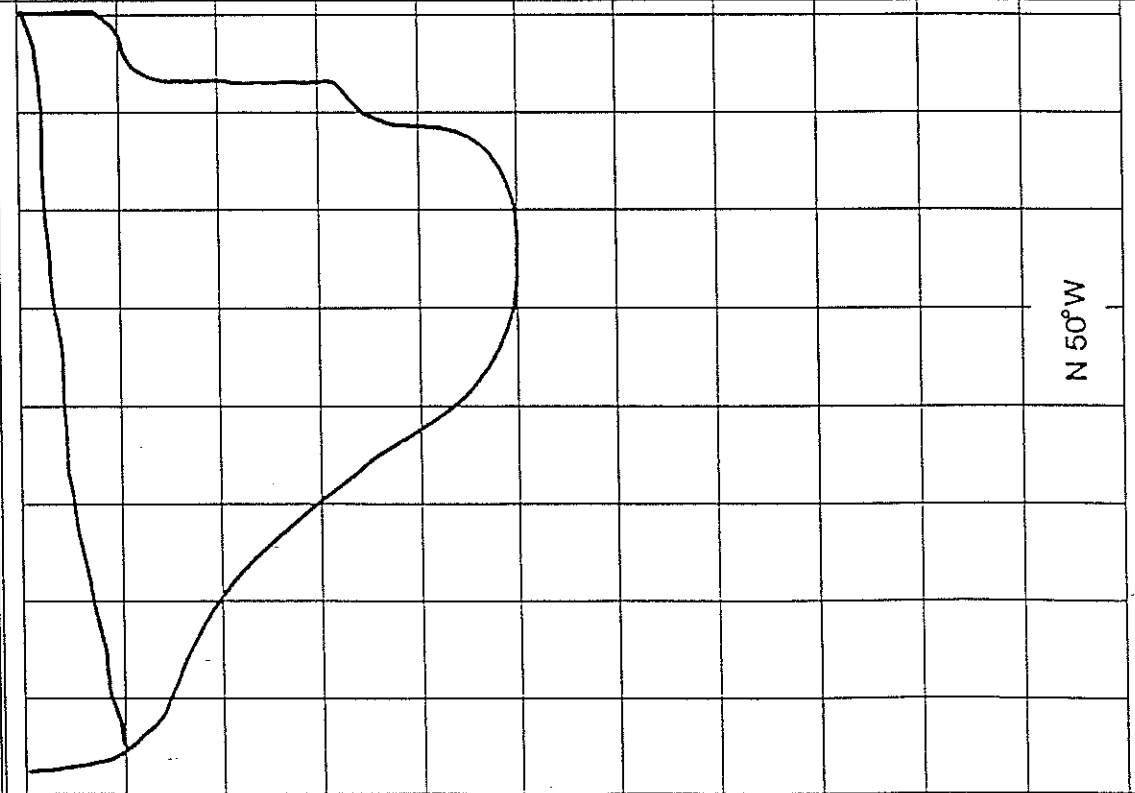


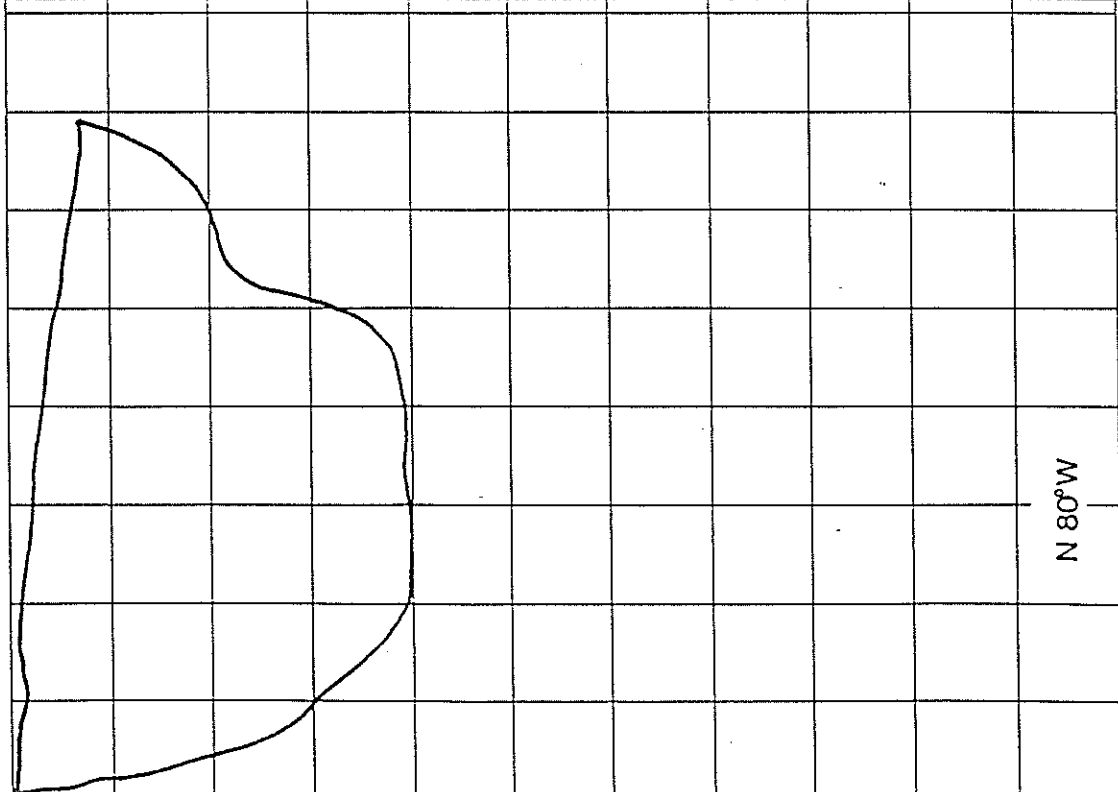
FIGURE B-19



**TEST PIT LOG**

Eastgate Mall Site  
 North City Reclamation Plant and  
 Sludge Processing Facilities

PROJECT NO. 101948-01  
 DATE 3/91



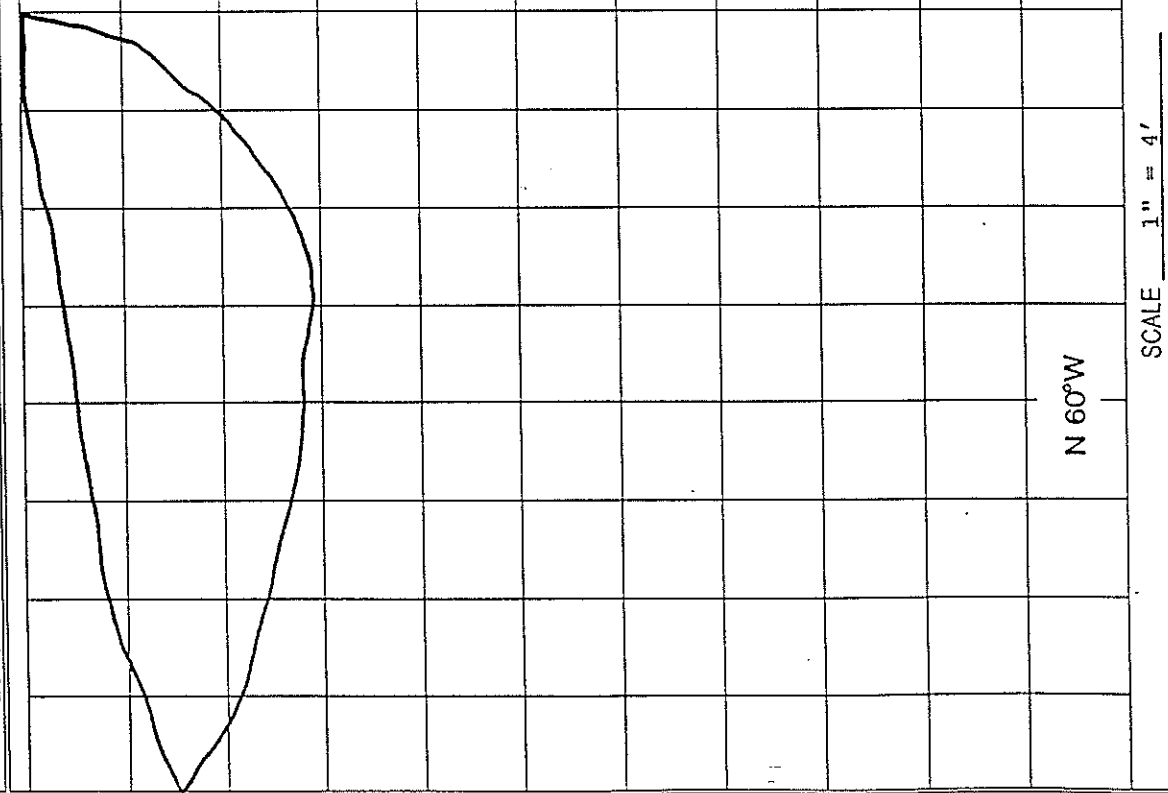
DEPTH (FEET)	SAMPL			MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.	DESCRIPTION
	Bulk	Driven	Sand Cone				
0						ML	<u>ALLUVIUM/COLLUVIUM:</u> Dark brown, damp, firm to stiff, fine, sandy, clayey SILT with scattered rounded gravel.
2							
4							
6							
8							<u>SCRIPPS FORMATION:</u> Yellow-brown to light brown and gray, damp, hard SILTSTONE with yellow-brown, silty, fine sand interbedded.
10							Total Depth 8.0' No Caving No Ground Water Encountered Backfilled 2/8/91
12							
14							
16							
18							
20							
22							

GROUND ELEVATION 328' +/- MSL LOGGED BY GJS/PSR  
 METHOD OF EXCAVATION JD-510 Backhoe  
 LOCATION See Plate One

## TEST PIT LOG

Eastgate Mall Site  
North City Reclamation Plant and  
Sludge Processing Facilities

PROJECT NO. 101948-01  
DATE 3/91



DATE EXCAVATED 2/8/91 TEST PIT NO. 1P-8  
GROUND ELEVATION 360'+/- MSL LOGGED BY GJS/PSR  
METHOD OF EXCAVATION JD-510 Backhoe  
LOCATION See Plate One

### DESCRIPTION

#### LINDAVISTA FORMATION:

Red-brown, dry to damp, dense to very dense, silty, medium to fine, sandy GRAVEL with abundant cobbles.  
@ 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.

Total Depth 5.5'  
No Caving  
No Ground Water Encountered  
Backfilled 2/8/91

CLASSIFICATION U.S.C.S.

DRY DENSITY (PCF)

MOISTURE (%)

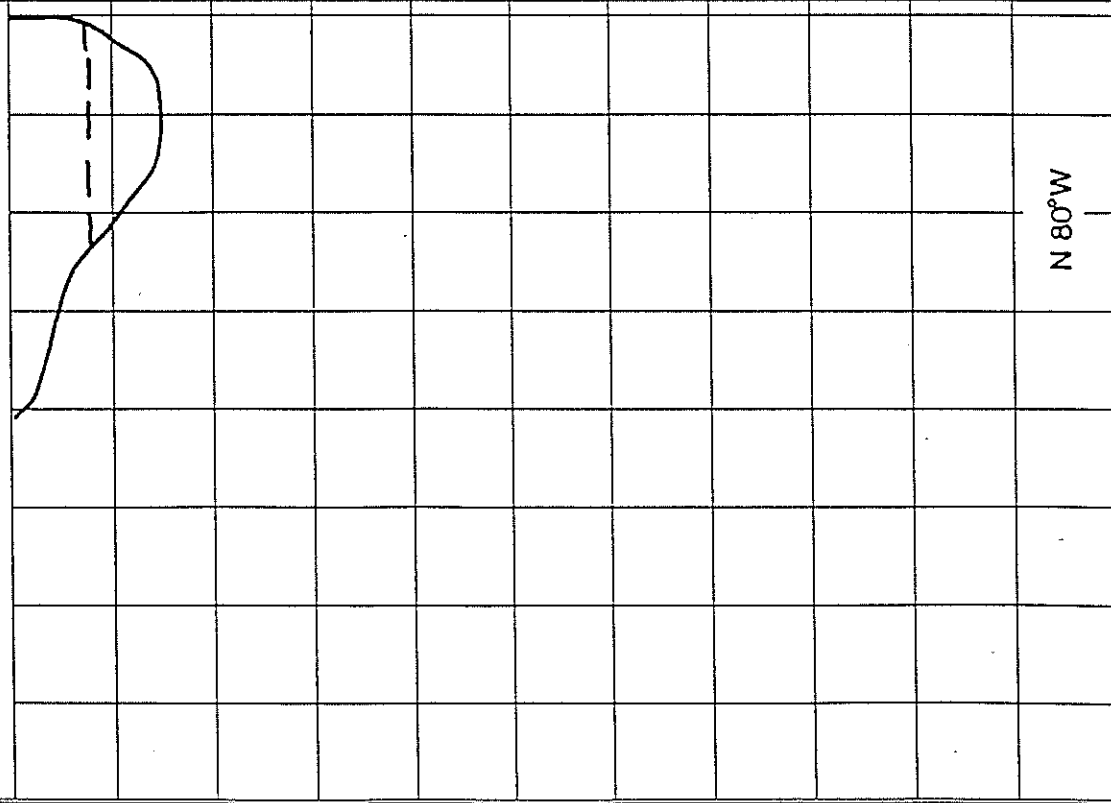
SAMPLES  
Bulk  
Driven  
Sand Cone

DEPTH (FEET)

# 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

**DESCRIPTION**

LINDAVISTA FORMATION:

Red-brown, dry to damp, dense, silty SAND with rounded gravel.

Red-brown to yellow-brown, dry to damp, very dense, silty, medium to fine SAND (well-cemented). (Refusal)

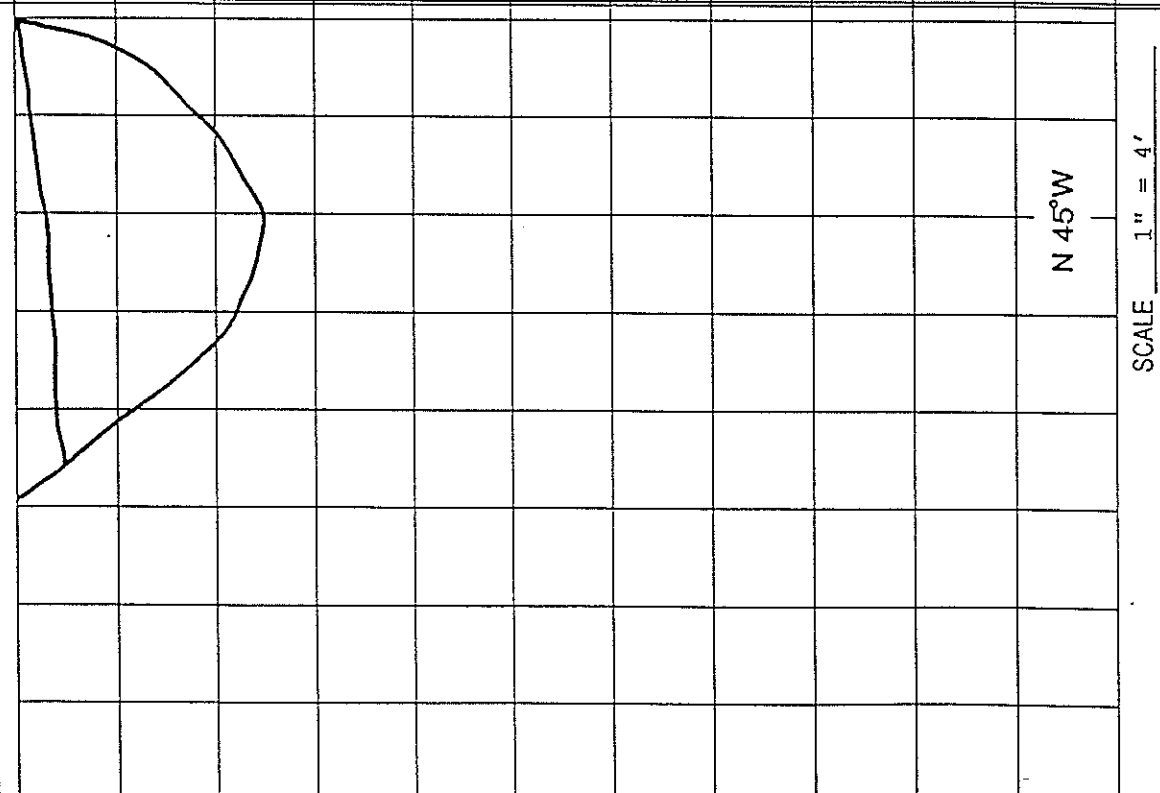
Total Depth 2.5'  
No Caving  
No Ground Water Encountered  
Backfilled 2/8/91

DEPTH (FEET)	SAMP			MOISTURE (%)	DRY DENSITY (PC)	CLASSIFICATION U.S.
	Bulk	Driven	Sand Cone			
0						
2						
4						
6						
8						
10						
12						
14						
16						
18						
20						
22						

## TEST PIT LOG

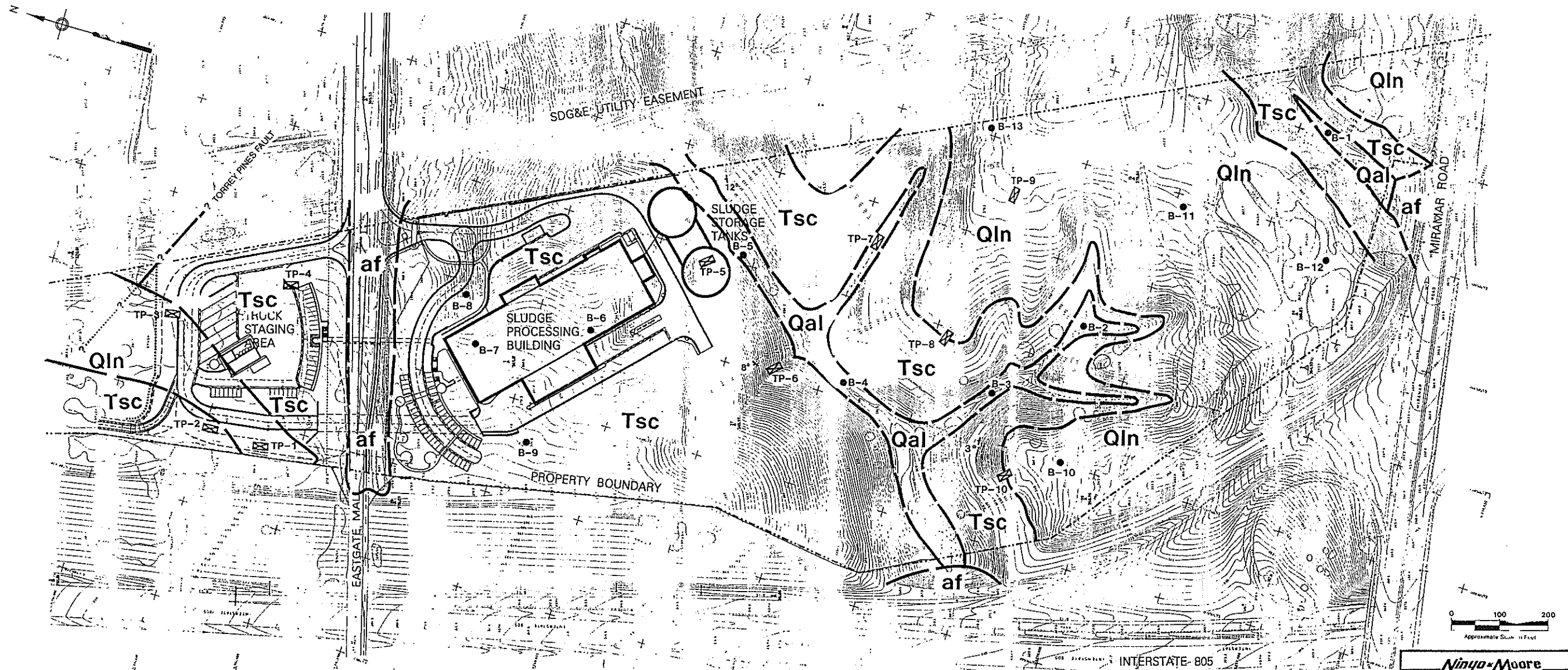
Eastgate Mall Site  
North City Reclamation Plant and  
Sludge Processing Facilities

PROJECT NO. 101948-01  
DATE 3/91



DEPTH (FEET)	SAMPLES			MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DESCRIPTION
	Bulk	Driven	Sand Cone				
0							<b>TOPSOIL:</b> Brown, damp, dense, silty, sandy, GRAVEL and gravely, silty SAND.  <u>LINDAVISTA FORMATION:</u> Reddish-brown, damp, very dense, silty, sandy GRAVEL with clasts of gray siltstone.  Total Depth 4.5' No Caving No Ground Water Encountered Backfilled 2/8/91
2							
4							
6							
8							
10							
12							
14							
16							
18							
20							
22							

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



**LEGEND**

GEOLOGIC UNITS		SYMBOLS	
af	Fill		Approximate location of geologic contact
Qal	Alluvium	$12^\circ$	Bedding attitude, dip in degrees
Qln	Lindavista Formation	TP-10	Approximate location of exploratory test pit
Tsc	Scripps Formation	B-13	Approximate location of exploratory boring
			Approximate location of fault (indicated) or fault where buried, queried where the fault as mapped by Kennedy, 1975

OVERALL SITE PLAN SCALE 1" = 100'

**Ninyo & Moore**  
**GEOTECHNICAL MAP**  
 EASTGATE MALL SITE  
 NORTH CITY RECLAMATION PLANT  
 AND SLUDGE PROCESSING FACILITIES  
 CITY OF SAN DIEGO, CALIFORNIA

PROJECT NO.	DATE	PLATE
101948-01	3/91	1

<b>FIESTA ISLAND REPLACEMENT PROJECT</b> SITE DEVELOPMENT OVERALL SITE PLAN				<b>METCALF &amp; EDDY</b> In association with Note & Associates			
CITY OF SAN DIEGO, CALIFORNIA UTILITIES DEPARTMENT				SHEET OF SHEETS			
REG. PROF. ENGR.		DATE		UTILITIES DIRECTOR		DATE	
PROJECT NUMBER	NO.	DATE	BY	DESCRIPTION	BY	APPROVED	FILED
FILE NO.							
CHGD BY							
CHECK BY							
PROJECT CHECK							
CONSTRUCTION RECORD				CONSTRUCTION RECORD			
CONTRACTOR				DATE STARTED			
INSPECTION				DATE COMPLETED			
ERECTOR				DATE COMPLETED			

# APPENDIX C

*Ninyo & Moore*



## APPENDIX C

Laboratory TestingClassification

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.

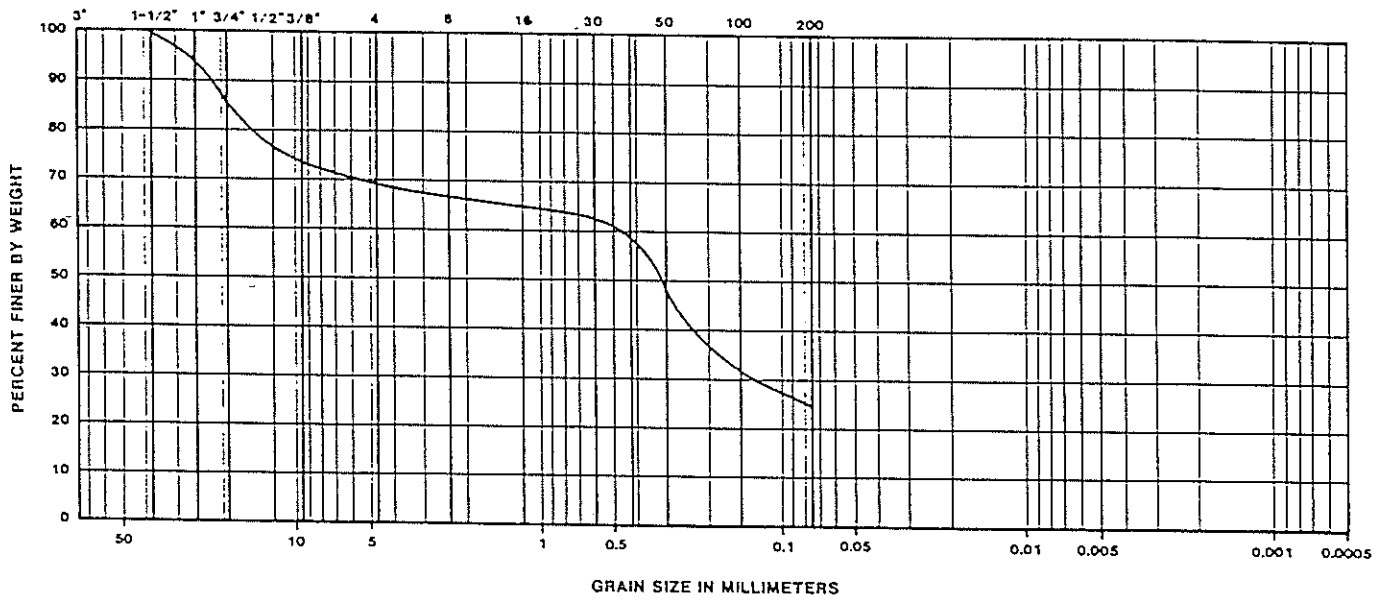
Maximum Dry Density and Optimum Moisture Content Tests

The maximum dry density and optimum moisture content of selected representative soil samples were evaluated in general accordance with ASTM D1557-78. The results of the tests are summarized on Figure 6.

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay

U.S. STANDARD SIEVE NUMBERS

HYDROMETER



Symbol	Hole Number	Depth (Feet)	Liquid Limit	Plastic Limit	Plasticity Index	Soil Type
	B-2	5.0-7.0	-	-	-	SM

## GRADATION TEST RESULTS

Eastgate Mall Site  
 North City Reclamation Plant and  
 Sludge Processing Facilities  
 City of San Diego, California

PROJECT NO.	DATE
101948-01	3/91

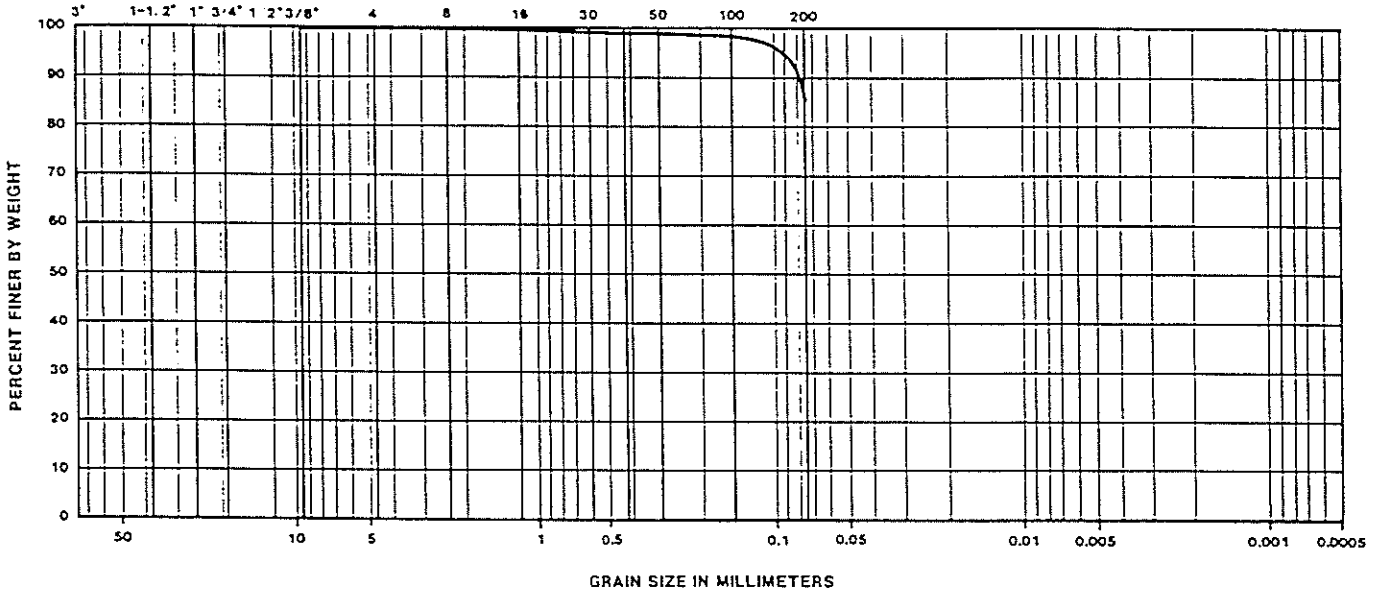
FIGURE C-1

**Ninyo & Moore**

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay

U.S. STANDARD SIEVE NUMBERS

HYDROMETER



Symbol	Hole Number	Depth (Feet)	Liquid Limit	Plastic Limit	Plasticity Index	Soil Type
	B-7	15.0-15.5	-	-	-	ML

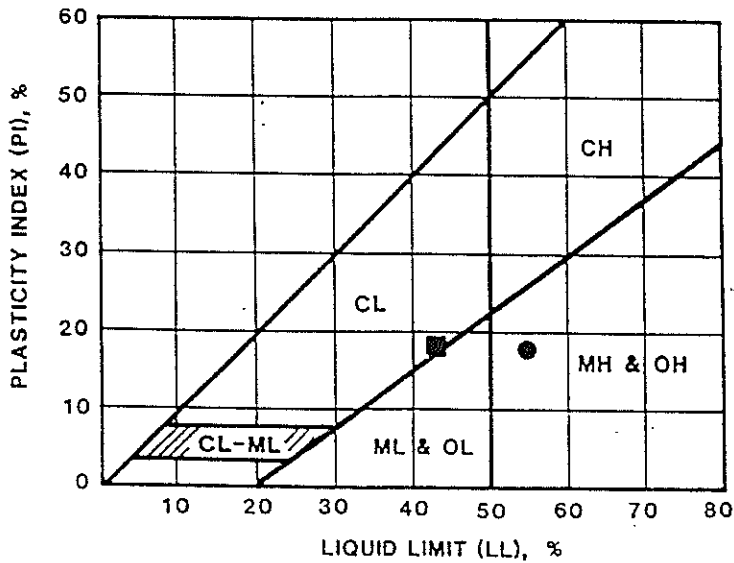


## GRADATION TEST RESULTS

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

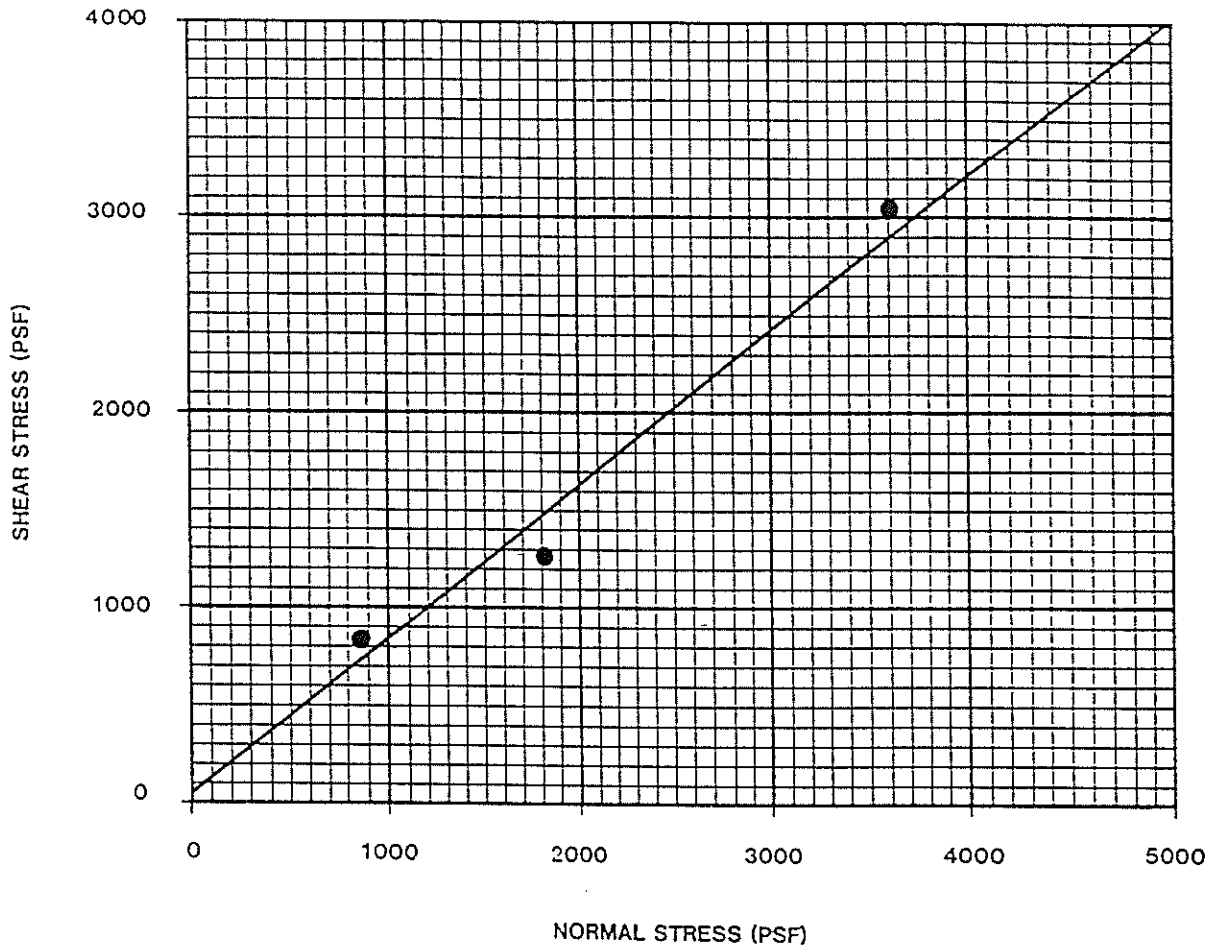
**Ninyo & Moore**

**ATTERBERG LIMITS TEST RESULTS**

Eastgate Mall Site  
 North City Reclamation Plant and  
 Sludge Processing Facilities  
 City of San Diego, California

PROJECT NO.	DATE
101948-01	3/91

FIGURE C-3



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

**DIRECT SHEAR TEST RESULTS.**

Eastgate Mall Site  
 North City Reclamation Plant and  
 Sludge Processing Facilities  
 City of San Diego, California

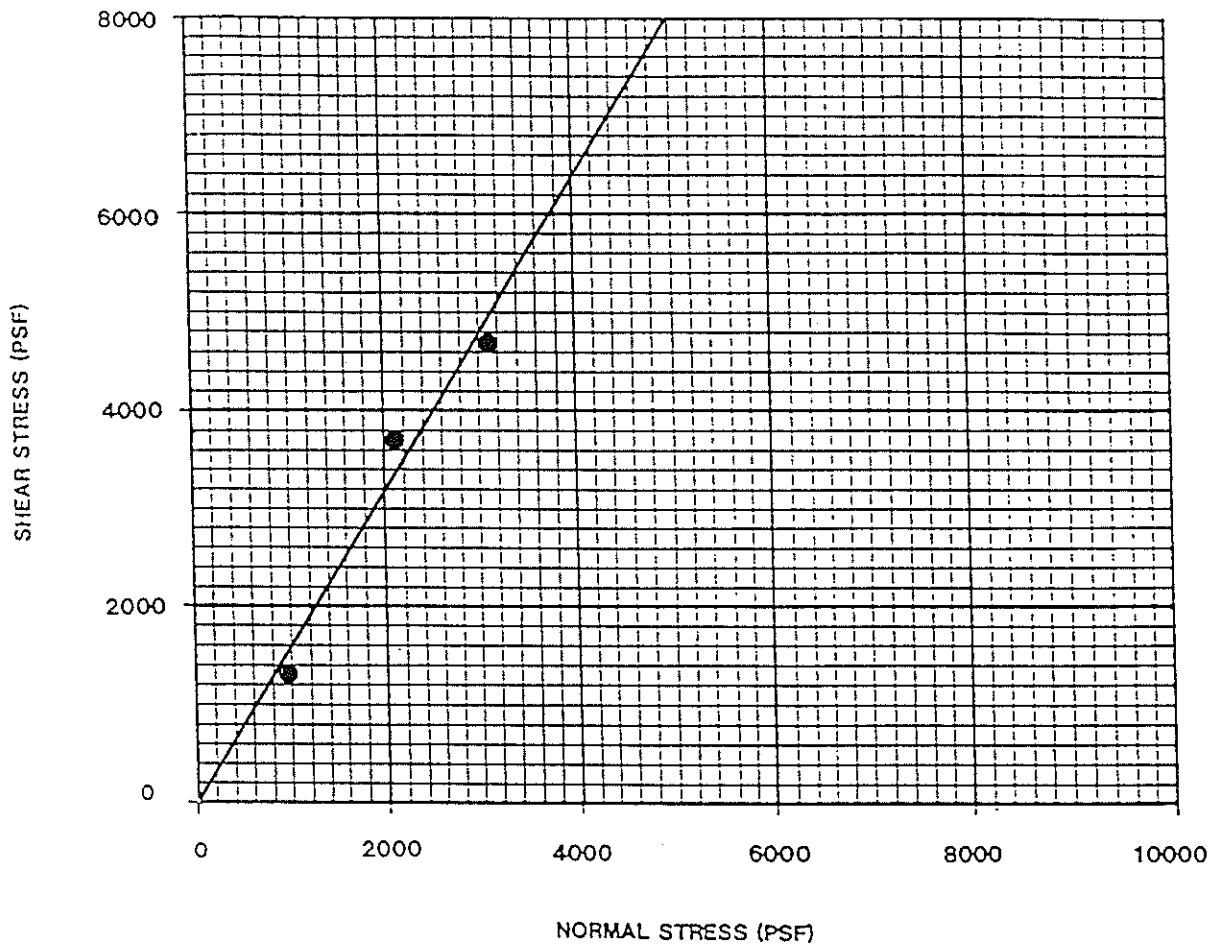
PROJECT NO.

DATE

FIGURE C-4

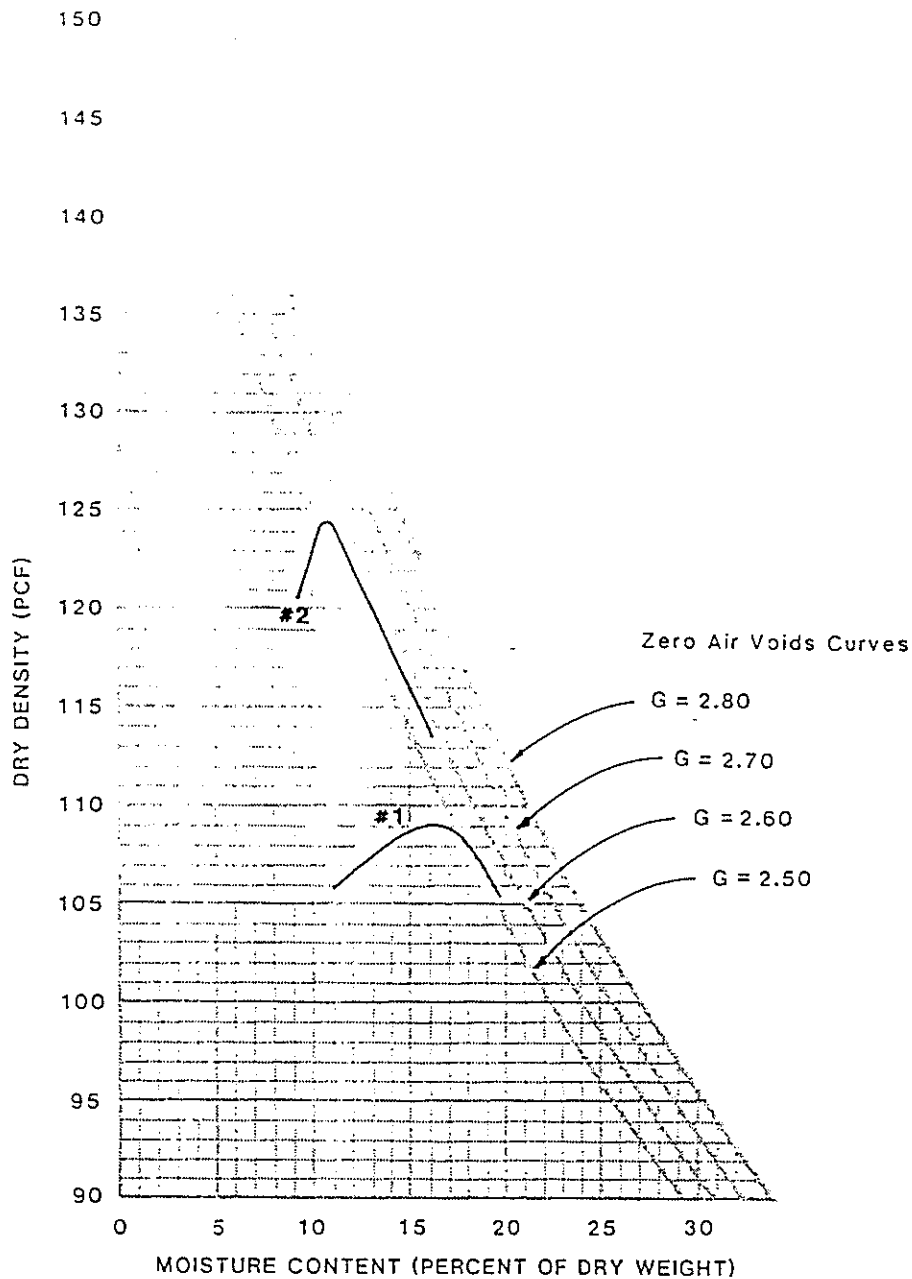






Description	Symbol	Boring Number	Sample Number	Depth (Feet)	Cohesion (PSF)	Friction Angle	Soil Type
Scripps Formation	●	B-13		25.0-26.0	10	58°	ML

	<b>DIRECT SHEAR TEST RESULTS</b>	
	Eastgate Mall Site North City Reclamation Plant and Sludge Processing Facilities City of San Diego, California	
	<b>PROJECT NO.</b>	<b>DATE</b>
	101948-01	3/91
		<b>FIGURE C-5</b>



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.

### 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
-------------	------	------------

**Ninyo & Moore**

**Appendix E**  
**Geologic Site Reconnaissance**

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

December 31, 1991  
Project No. 102208-01

CH2M HILL  
First Interstate Bank Building  
401 B Street, Suite 900  
San Diego, California 92101

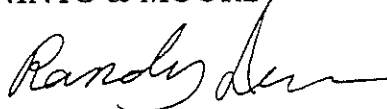
Attention: Mr. Don Seward

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 Irwin, CEG 1521  
Senior Project Geologist



Clifford A. Craft, RCE 28832/GE 243  
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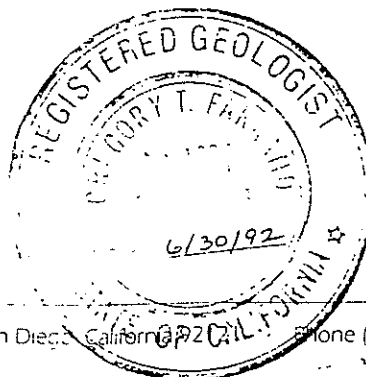
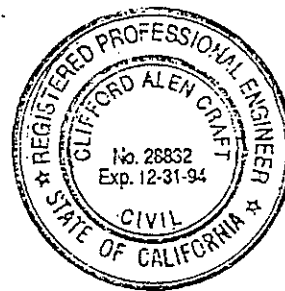


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GEOLOGIC SITE RECONNAISSANCE,  
PROPOSED NORTH CITY WATER RECLAMATION PLANT (NTP-1)  
CITY OF SAN DIEGO, CALIFORNIA

## 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 paralleling 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.

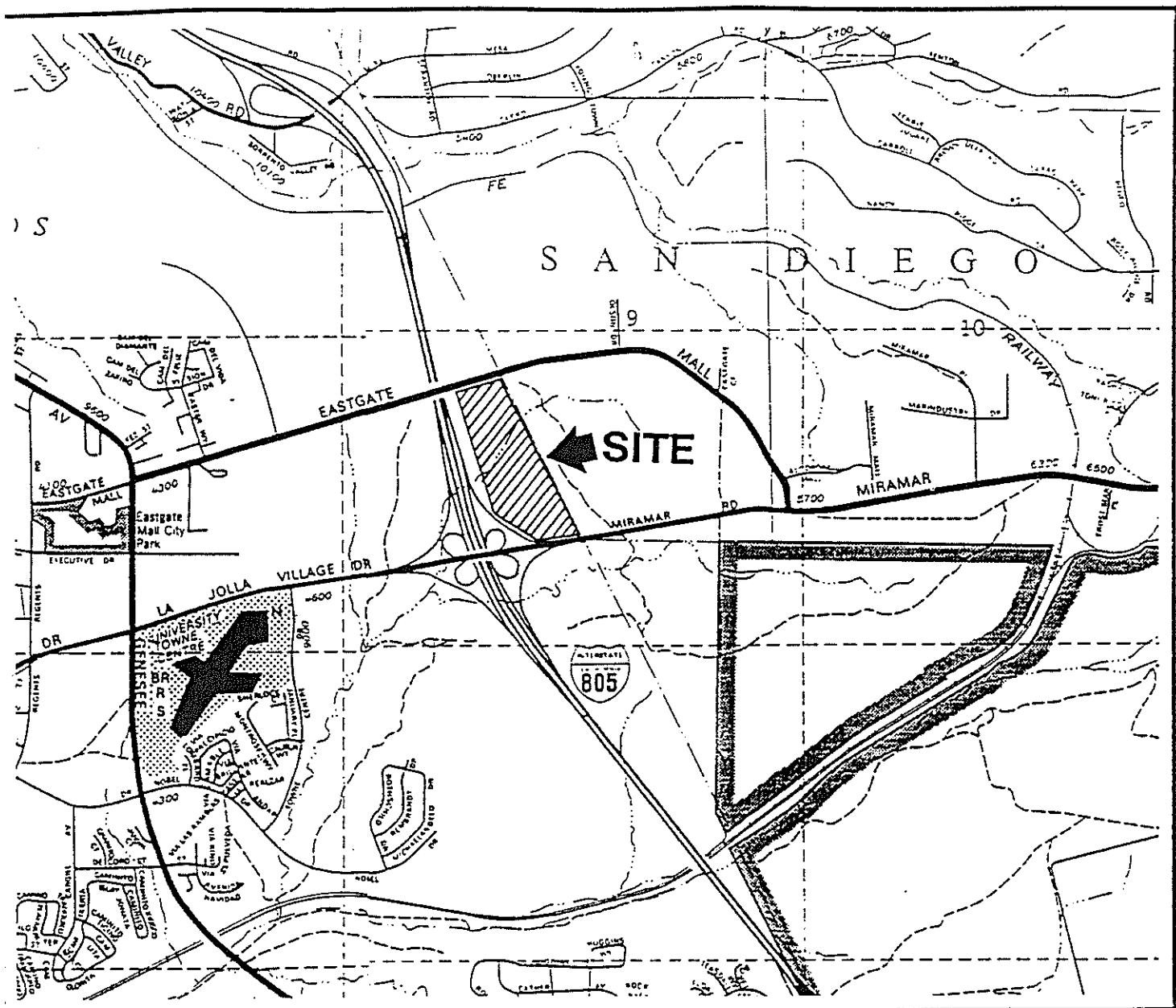
### 13.0 CONCLUSIONS

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:

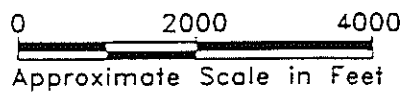
- It is anticipated that rippability of the on-site earth materials can generally be achieved utilizing conventional heavy-duty grading equipment in good working order.
- Active faults or landslides are not known to directly underlie the subject property.
- Seeps, springs, or other indications of a shallow 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***

<b>SITE LOCATION MAP</b>		
NORTH CITY WATER RECLAMATION PLANT (NTP-1) SAN DIEGO, CALIFORNIA		
PROJECT NO.	DATE	FIGURE 1

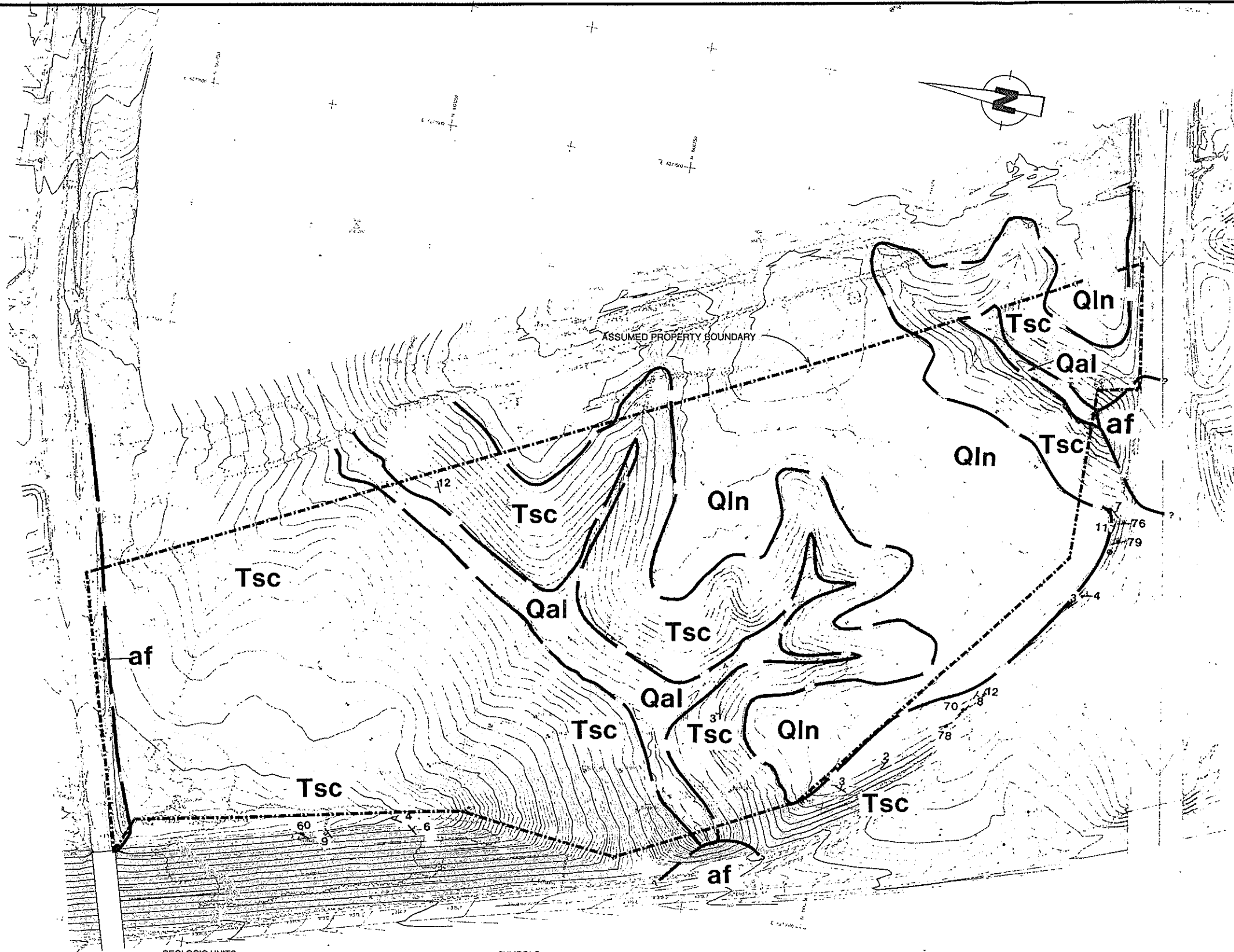
## APPENDIX A

References

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11. *Norris, R.M., and Webb, R.W.*, 1990, *Geology of California, Second Edition, John Wiley & Sons, Inc., pp. 541*.
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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)

<i>Aerial Photographs</i>				
<i>Source</i>	<i>Date</i>	<i>Scale</i>	<i>Flight</i>	<i>Numbers</i>
<i>USDA</i>	<i>3-31-53</i>	<i>1:20,000</i>	<i>AXN-4M</i>	<i>7 and 8</i>
<i>San Diego County</i>	<i>1928</i>	<i>1:12,000</i>	<i>52E</i>	<i>6, 7, and 8</i>



af  
Qal  
Qln  
Tsc

GEOLOGIC UNITS  
 Fill  
 Alluvium  
 Lindavista Formation  
 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

0 100 200  
 Approximate Scale in Feet

<i>Ninyo &amp; Moore</i>		
GEOLOGIC MAP		
NORTH CITY WATER RECLAMATION PLANT (NTP-1) SAN DIEGO, CALIFORNIA		
PROJECT NO. 102208-01	DATE 12/91	PLATE 1

SOURCE: BASE MAP PROVIDED BY CH2M HILL, NO DATE.



**Appendix F**  
**Seismic Study**



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**

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

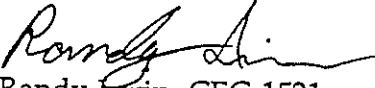
Subject: Seismic Study for the Proposed North City Water Reclamation Plant (NTP-1),  
City of San Diego, California

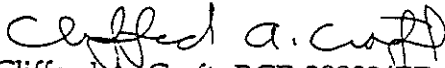
Dear Mr. Seward:

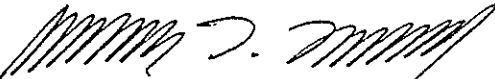
In accordance with your request and written authorization dated October 29, 1991, we are providing this report of our seismic study for the proposed North City Water Reclamation Plant (NTP-1), San Diego, California. The purposes of the study were to evaluate seismic conditions for the site and to provide 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.

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, CEG 1521  
Senior Project Geologist

  
Clifford A. Craft, RCE 28832/CE 243  
Chief Geotechnical Engineer

  
Gregory T. Farrand, CEG 1087  
Principal Geologist

RI/TSS/CAC/GTF/rlm

Distribution: (6) Addressee

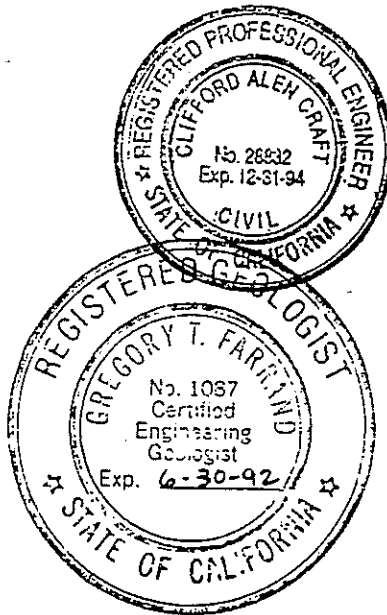


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Table 1 - Seismic Parameters for Major Faults

Appendices

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.

- Coronado Bank Fault Zone

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 probabilistic 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:

$$\begin{aligned} v/a &= 48 \text{ in/sec/g} \\ ad/v^2 &= 6 \end{aligned}$$

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.

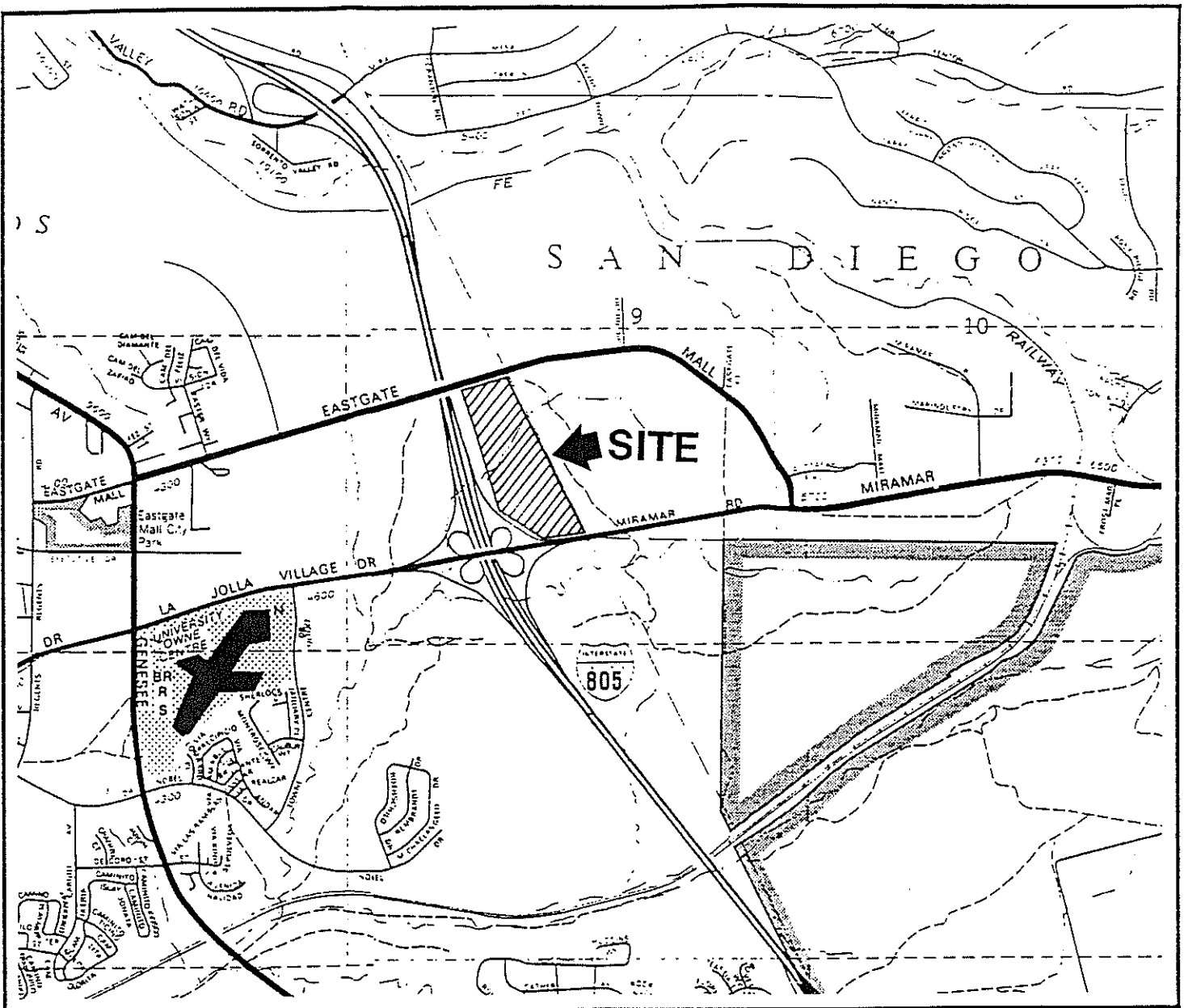
- Ground Lurching

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

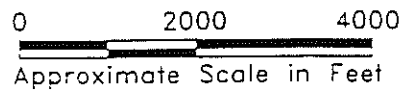
the relatively shallow depth of on-site alluvium, it is our opinion that the potential for damage due to ground lurching is considered low.

## 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



***Ninyo & Moore***

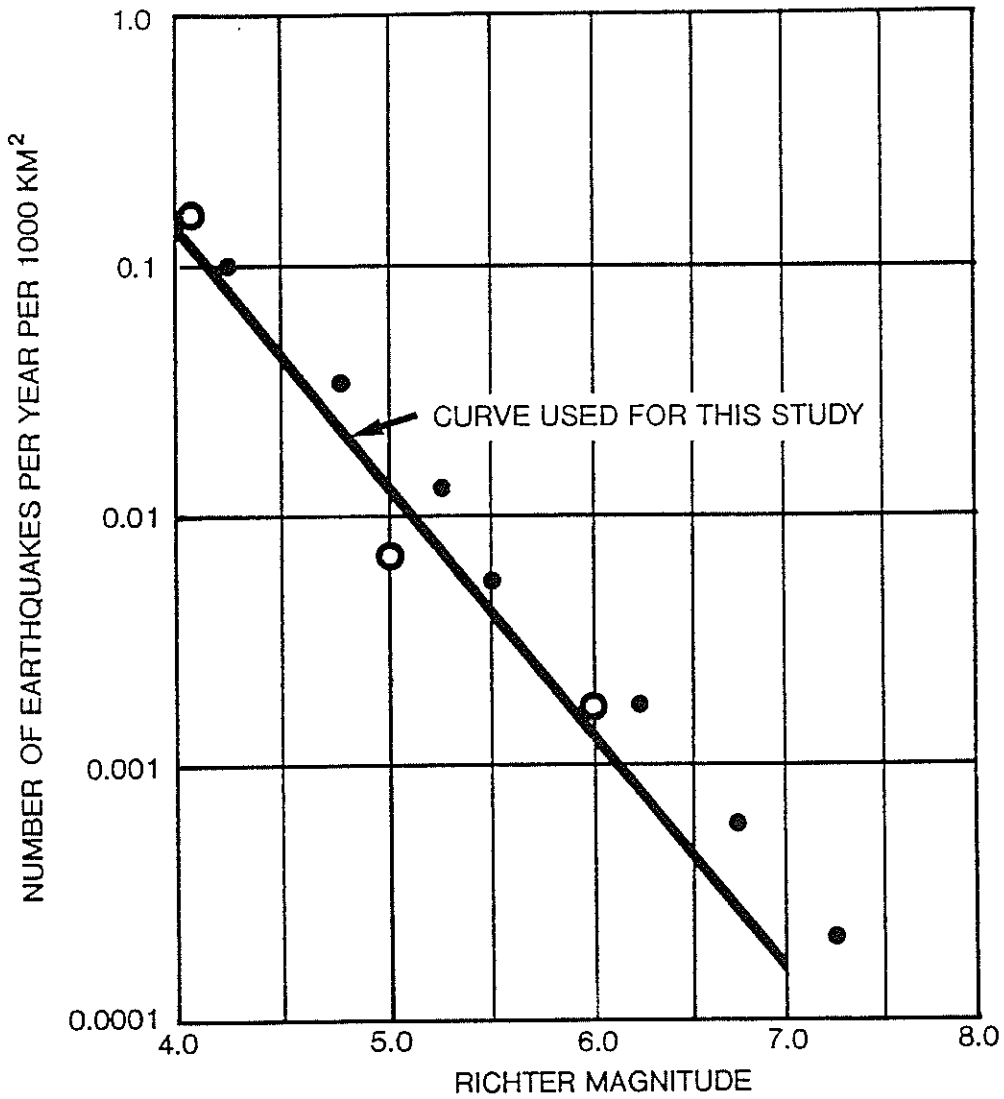
**SITE LOCATION MAP**

NORTH CITY  
 WATER RECLAMATION PLANT (NTP-1)  
 SAN DIEGO, CALIFORNIA

PROJECT NO.	DATE	FIGURE 1
102208-01	12/91	







- DATA FOR SOUTHERN CALIFORNIA (Albee et al., 1969)
- SITE SPECIFIC DATA

NUMBER OF EARTHQUAKES PER YEAR  
PER 1,000 KM<sup>2</sup>

NORTH CITY  
WATER RECLAMATION PLANT (NTP-1)  
SAN DIEGO, CALIFORNIA

PROJECT NO.

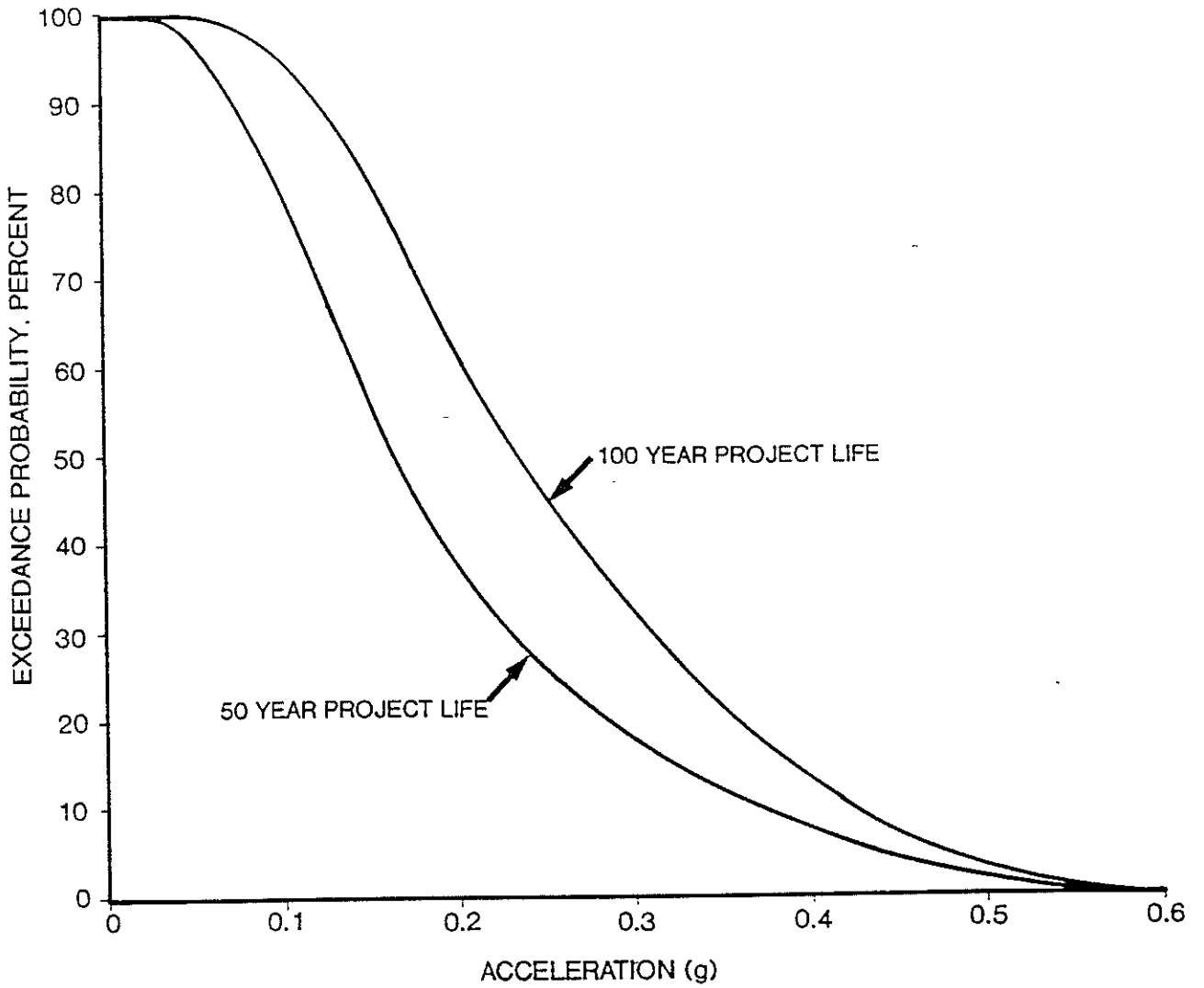
DATE

FIGURE 3

102208-01

12/91

**Ninyo & Moore**



EXCEEDANCE PROBABILITY  
VERSUS ACCELERATION

NORTH CITY  
WATER RECLAMATION PLANT (NTP-1)  
SAN DIEGO, CALIFORNIA

***Ninyo & Moore***

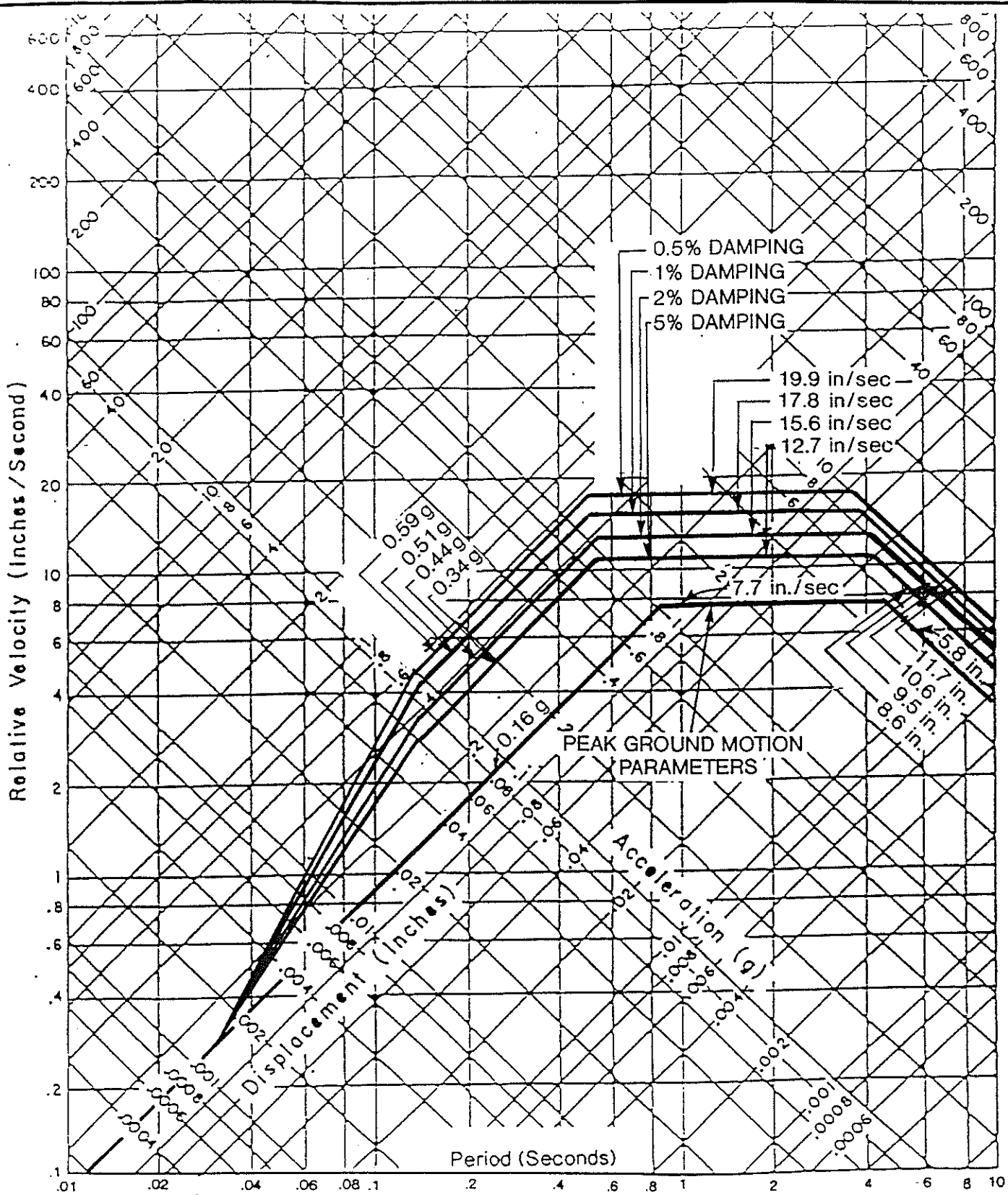
PROJECT NO.

DATE

FIGURE 4

102208-01

12/91



SEISMIC RESPONSE SPECTRA  
(0.16g PEAK GROUND ACCELERATION)

NORTH CITY  
WATER RECLAMATION PLANT (NTP-1)  
SAN DIEGO, CALIFORNIA

**Ninyo & Moore**

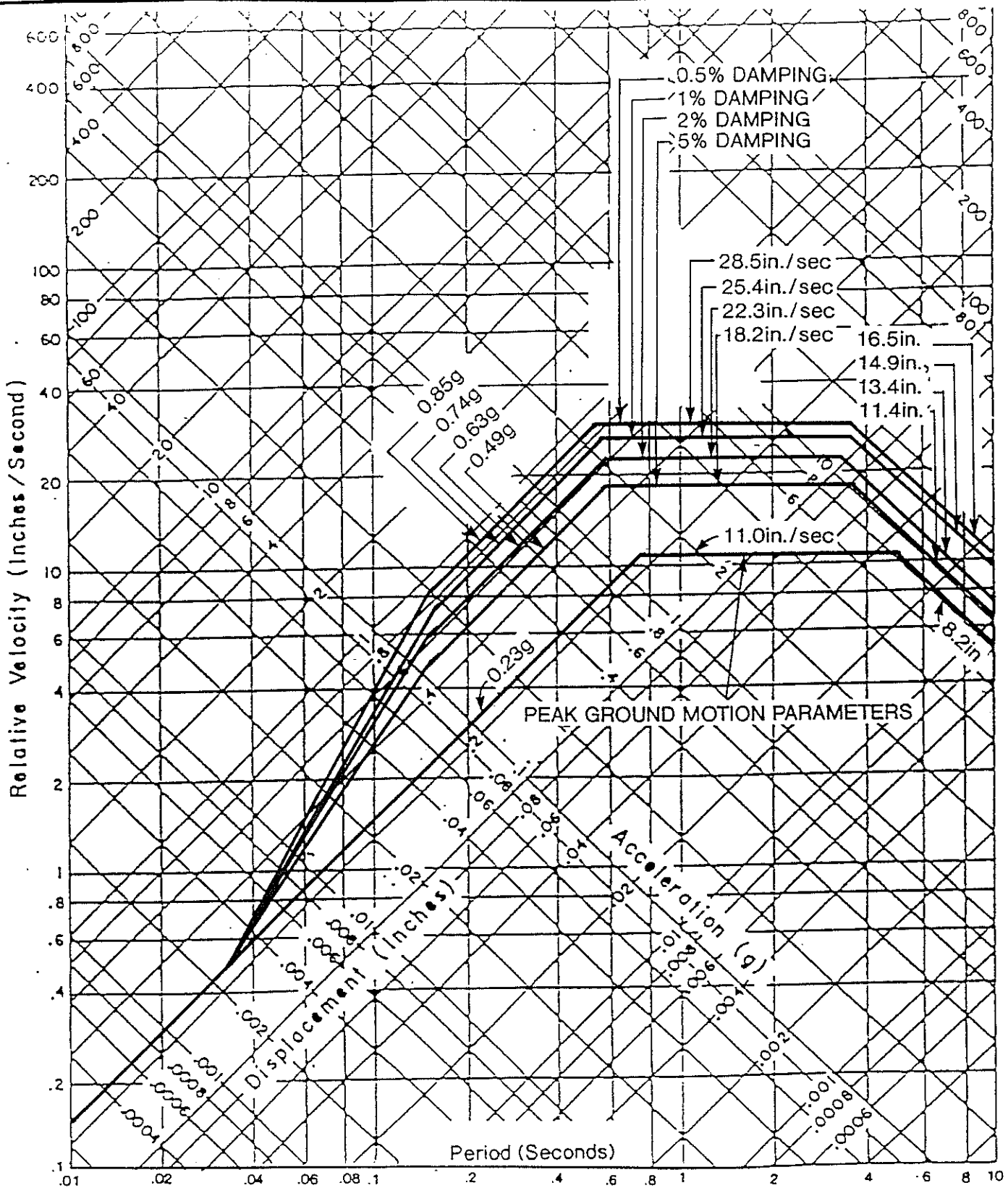
PROJECT NO.

DATE

FIGURE 5

100000-01

12/91



SEISMIC RESPONSE SPECTRA  
(0.23 g PEAK GROUND ACCELERATION)

NORTH CITY  
WATER RECLAMATION PLANT (NTP-1)  
SAN DIEGO, CALIFORNIA

**Ninyo & Moore**

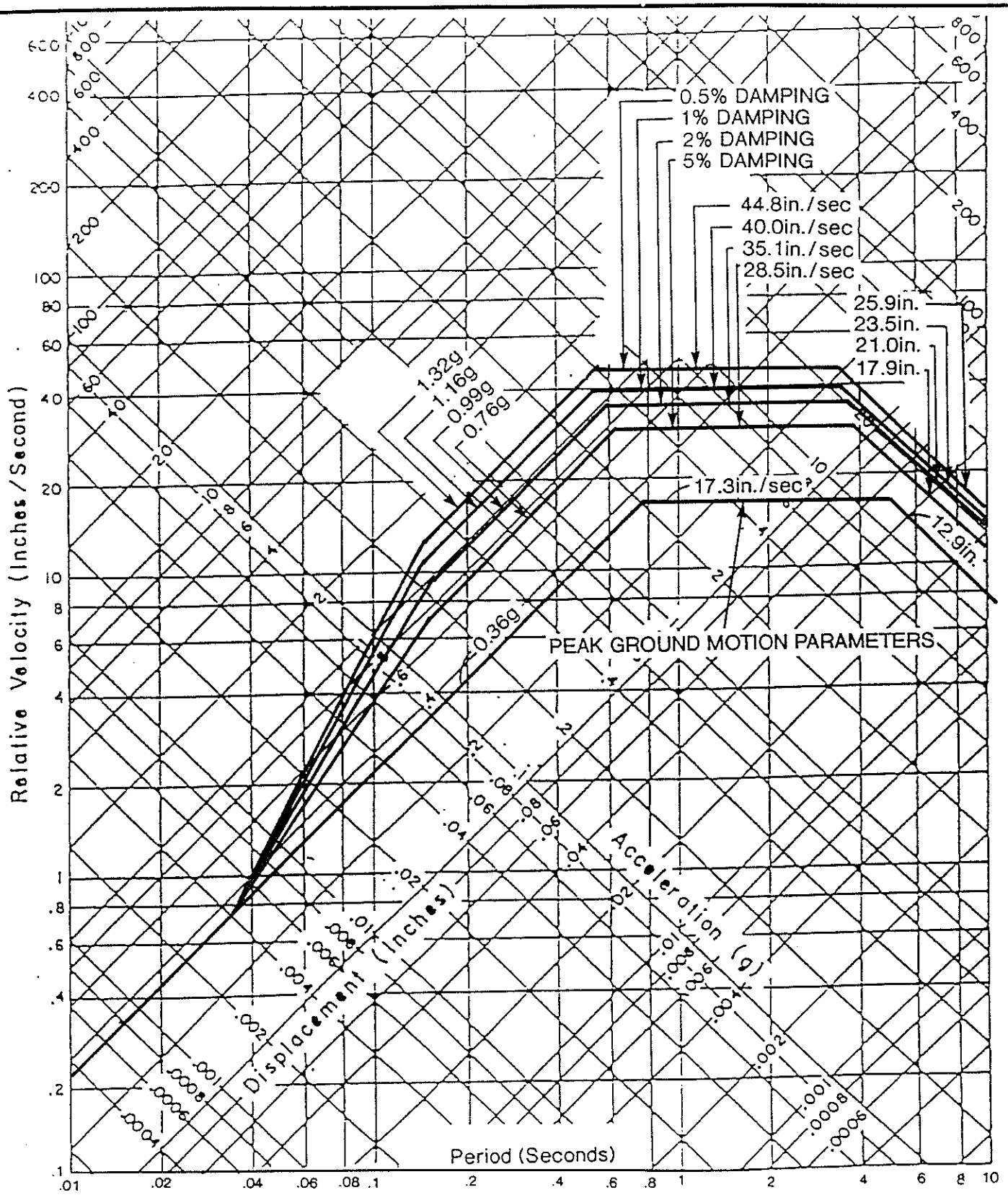
PROJECT NO.

DATE

FIGURE 6

102208-01

12/91



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

**Ninyo & Moore**



TABLE 1  
 SEISMIC PARAMETERS FOR MAJOR FAULTS

Fault	Fault to Site Distance (km/mi)	Maximum Credible Earthquake Magnitude <sup>1</sup> (M)	Estimated Acceleration (g)	
			Peak Horizontal <sup>2</sup> Bedrock	Repeatable <sup>3</sup> 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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## APPENDIX A

(continued)

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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)



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**

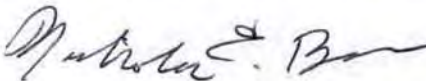
Dear Mr. Hoyle:

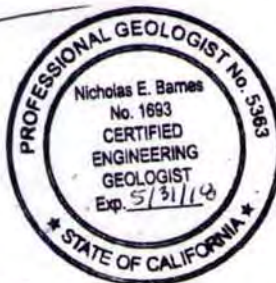
Allied Geotechnical Engineers, Inc. (AGE) is pleased to submit the accompanying "Report" to present the findings, opinions, and recommendations of a geotechnical investigation that was performed to assist CH2M with their design of the subject project. Upon our receipt of review comments from CH2M and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

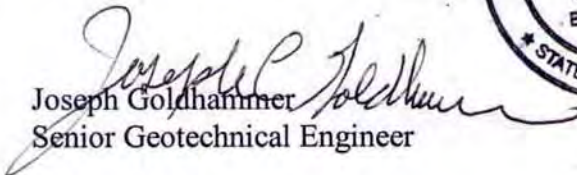
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**REPORT OF GEOTECHNICAL INVESTIGATION  
NORTH CITY WATER RECLAMATION PLANT EXPANSION  
CITY OF SAN DIEGO**

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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**

<b>Boring ID</b>	<b>Proposed Facility</b>	<b>Boring Depth (feet)</b>	<b>Existing Pavement Section</b>	<b>Subsurface Conditions</b>	<b>Estimated G.W. Depth (feet bgs)</b>
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)

<b>Boring ID</b>	<b>Proposed Facility</b>	<b>Boring Depth (feet)</b>	<b>Existing Pavement Section</b>	<b>Subsurface Conditions</b>	<b>Estimated G.W. Depth (feet bgs)</b>
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)

<b>Boring ID</b>	<b>Proposed Facility</b>	<b>Boring Depth (feet)</b>	<b>Existing Pavement Section</b>	<b>Subsurface Conditions</b>	<b>Estimated G.W. Depth (feet bgs)</b>
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)

<b>Boring ID</b>	<b>Proposed Facility</b>	<b>Boring Depth (feet)</b>	<b>Existing Pavement Section</b>	<b>Subsurface Conditions</b>	<b>Estimated G.W. Depth (feet bgs)</b>
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 interfingering 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](http://www.Geotracker.com)) contains a groundwater monitoring report by Geologic 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**

<b>Sample ID</b>	<b>pH</b>	<b>Resistivity (ohm-cm)</b>	<b>Sulfate Conc. (ppm)</b>	<b>Chloride Conc. (ppm)</b>	<b>Bicarbonates Conc. (ppm)</b>
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.

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

$$V_s = [1.45 - (0.015 \times d)] \times V_{s(d)} \quad (\text{David Boore, 2004})$$

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 <sub>s</sub> (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)**

<u>REFERENCE</u>	<u>PARAMETER</u>
Table 20.3-1 Site Classification	Site Class = C
Figure 22-1	$S_s = 1.065 \text{ g}$
Table 11.4-1 Site Coefficient $F_a$	$F_a = 1.000$
Figure 22-2	$S_1 = 0.408 \text{ g}$
Table 11.4-2 Site Coefficient $F_v$	$F_v = 1.392$
Equation 11.4-1	$S_{MS} = 1.065 \text{ g}$
Equation 11.4-2	$S_{M1} = 0.568 \text{ g}$
Equation 11.4-3	$S_{DS} = 0.710 \text{ g}$
Equation 11.4-5	$S_{D1} = 0.379 \text{ g}$
Figure 22-12	$T_L = 8 \text{ seconds}$
Figure 22-7	$PGA = 0.444 \text{ g}$
Equation 11.8-1	$PGA_M = 0.444 \text{ g}$
Figure 22-17	$C_{RS} = 0.904$
Figure 22-18	$C_{R1} = 0.961$



**Table 7**  
**Summary of Seismic Design Parameters (Site Class D)**

<u>REFERENCE</u>	<u>PARAMETER</u>
Table 20.3-1 Site Classification	Site Class = D
Figure 22-1	$S_s = 1.065 \text{ g}$
Table 11.4-1 Site Coefficient $F_a$	$F_a = 1.074$
Figure 22-2	$S_1 = 0.408 \text{ g}$
Table 11.4-2 Site Coefficient $F_v$	$F_v = 1.592$
Equation 11.4-1	$S_{MS} = 1.144 \text{ g}$
Equation 11.4-2	$S_{M1} = 0.650 \text{ g}$
Equation 11.4-3	$S_{DS} = 0.763 \text{ g}$
Equation 11.4-5	$S_{D1} = 0.433 \text{ g}$
Figure 22-12	$T_L = 8 \text{ seconds}$
Figure 22-7	$PGA = 0.444 \text{ g}$
Equation 11.8-1	$PGA_M = 0.469 \text{ g}$
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 S1 Risk-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 be 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 consist 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**

<b>Recommended Design Parameters</b>	<b>Properly Compacted Fill</b>	<b>Undisturbed Formation</b>	<b>CLSM</b>	<b>Class II Aggregate Base</b>	<b>Crushed Rock Wrapped in Geofabric</b>	<b>Visqueen Moisture Barrier</b>
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 6<sup>th</sup> 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  $35^\circ$  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 Aggregate 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**

	<i>36-inch Diameter CIDH Pile</i>
<i>Factor of Safety</i>	End Bearing = Skin friction = 2.0
<i>Working Axial Resistance (kips)</i>	375
<i>Free-Head Working Lateral Resistance (kips)</i>	28
<i>Fixed-Head Working Lateral Resistance (kips)</i>	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 conglomeratic 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 be 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  $20^\circ$ , Coefficient of Friction against sides of trench ( $\mu$ ) 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 utilities 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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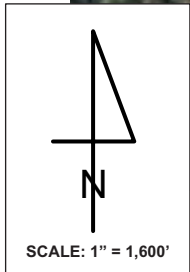
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U.S. Department of Agriculture black and white aerial photograph Nos. AXN-4M- 7 and8 (dated 1953)

## **FIGURES**





**NORTH CITY WATER RECLAMATION PLANT EXPANSION**

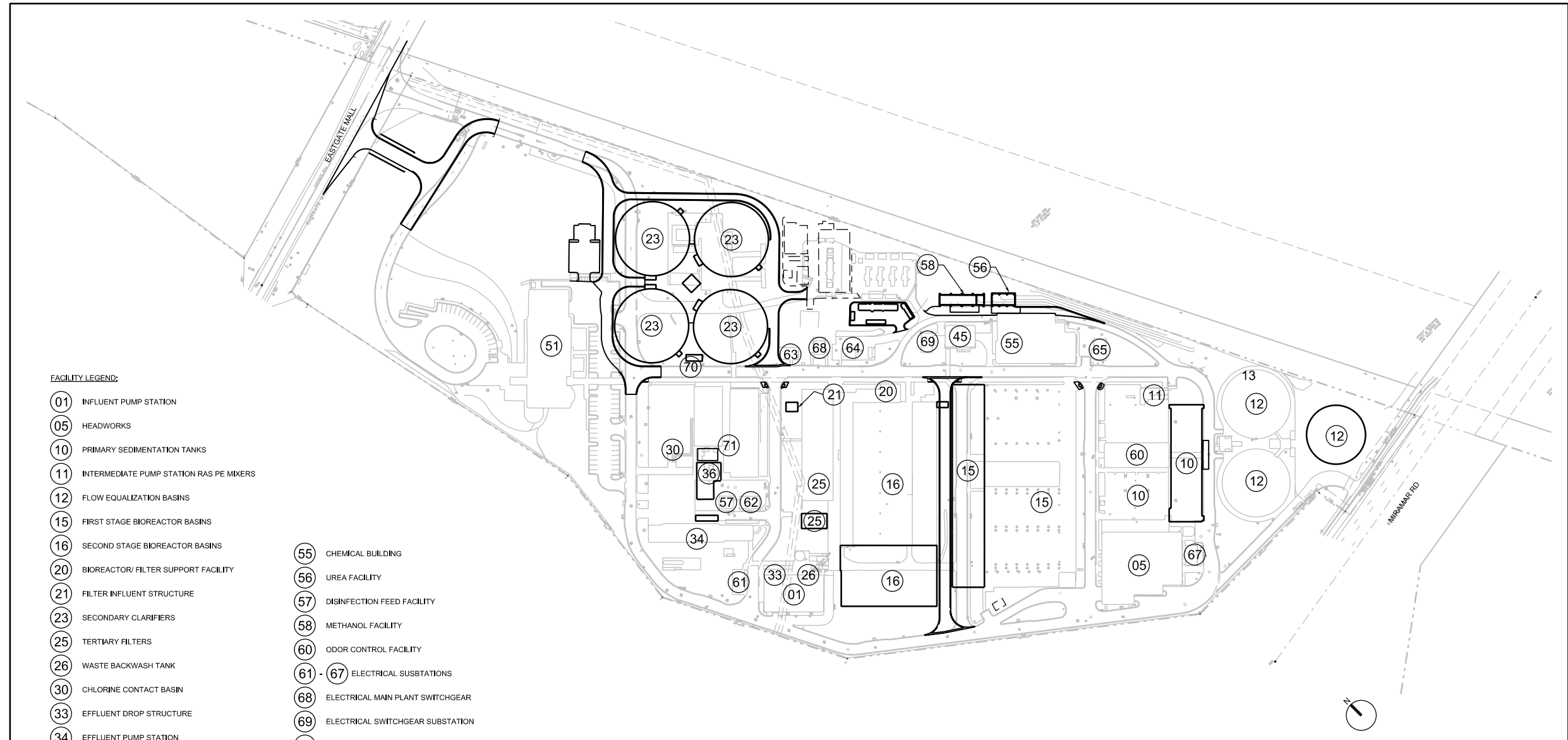
**LOCATION MAP**

**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 SUBSTATIONS
- (68) ELECTRICAL MAIN PLANT SWITCHGEAR
- (69) ELECTRICAL SWITCHGEAR SUBSTATION
- (70) SECONDARY CLARIFIER ELECTRICAL BUILDING
- (71) NCPWF IPS ELECTRICAL SUBSTATION



CONSTRUCTION CHANGE / ADDENDUM			
CHANGE	DATE	AFFECTED OR ADDED SHEET NUMBERS	APPROVAL NO.

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



MATTHEW JOHN BALDWIN  
 CA C71817  
 NOT FOR CONSTRUCTION

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

FOR CITY ENGINEER	DATE	WBS
PRINT JOB NAME	DATE	J. HOYLE PROJECT MANAGER
DESCRIPTION	BY	M. BALDWIN PROJECT ENGINEER
APPROVED	DATE	COSBY COORDINATE
FILM		COSBY COORDINATE

CONTRACTOR INSPECTOR \_\_\_\_\_ DATE STARTED \_\_\_\_\_ DATE COMPLETED \_\_\_\_\_

**30% DESIGN**

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

# LEGEND

Approximate boring locations (shear wave velocity shown in parentheses).

**H-14**  
( $V_s = 1202$  fps)

**H-18**  
( $V_s = 1318$  fps)

**H-19**  
( $V_s = 1318$  fps)

**H-17**  
( $V_s = 1318$  fps)

**H-13**  
( $V_s = 1203$  fps)

**H-14**  
( $V_s = 1202$  fps)

**H-20**  
( $V_s = 1318$  fps)

**H-16**  
( $V_s = 1318$  fps)

**H-11**  
( $V_s = 1204$  fps)

**H-22**  
( $V_s = 1318$  fps)

**H-21**  
( $V_s = 1318$  fps)

**H-12**  
( $V_s = 1227$  fps)

**H-3**  
( $V_s = 1318$  fps)

**H-1**  
( $V_s = 1304$  fps)

**H-15**  
( $V_s = 1318$  fps)

**H-9**  
( $V_s = 1179$  fps)

**H-5**  
( $V_s = 1347$  fps)

**H-6**  
( $V_s = 1300$  fps)

**H-2**  
( $V_s = 1344$  fps)

**H-10**  
( $V_s = 1172$  fps)

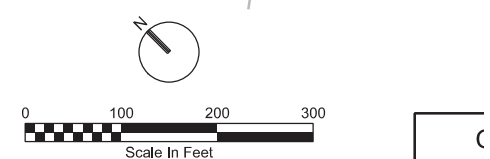
**H-8**  
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**H-4**  
( $V_s = 1330$  fps)

**H-7**  
( $V_s = 1234$  fps)

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 SUBSTATIONS
- (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**

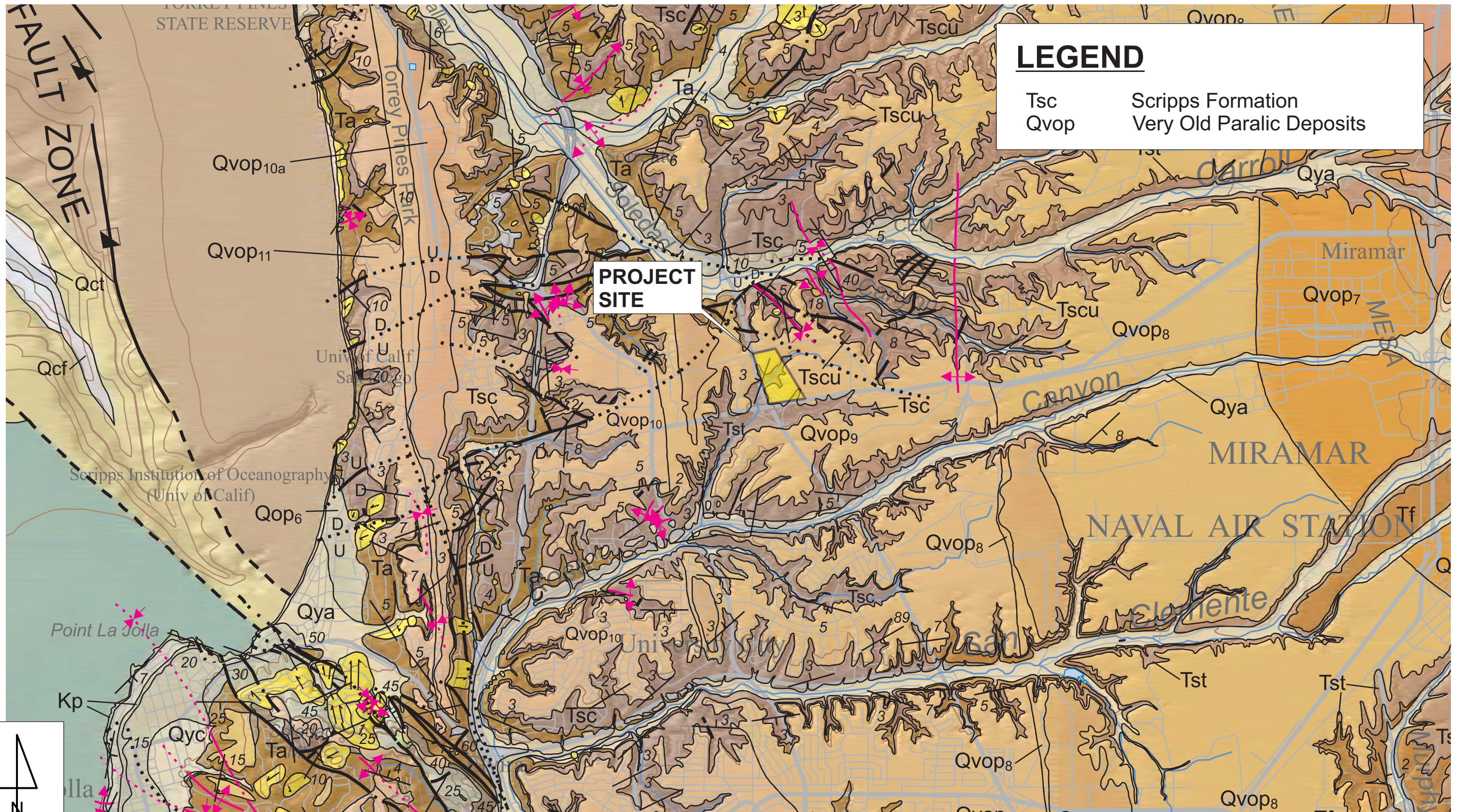
**SITE PLAN SHOWING APPROXIMATE BORING LOCATIONS**

PROJECT NO.  
44F1

ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE 3





**LEGEND**

Tsc      Scripps Formation  
 Qvop      Very Old Paralic Deposits

**PROJECT SITE**

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.

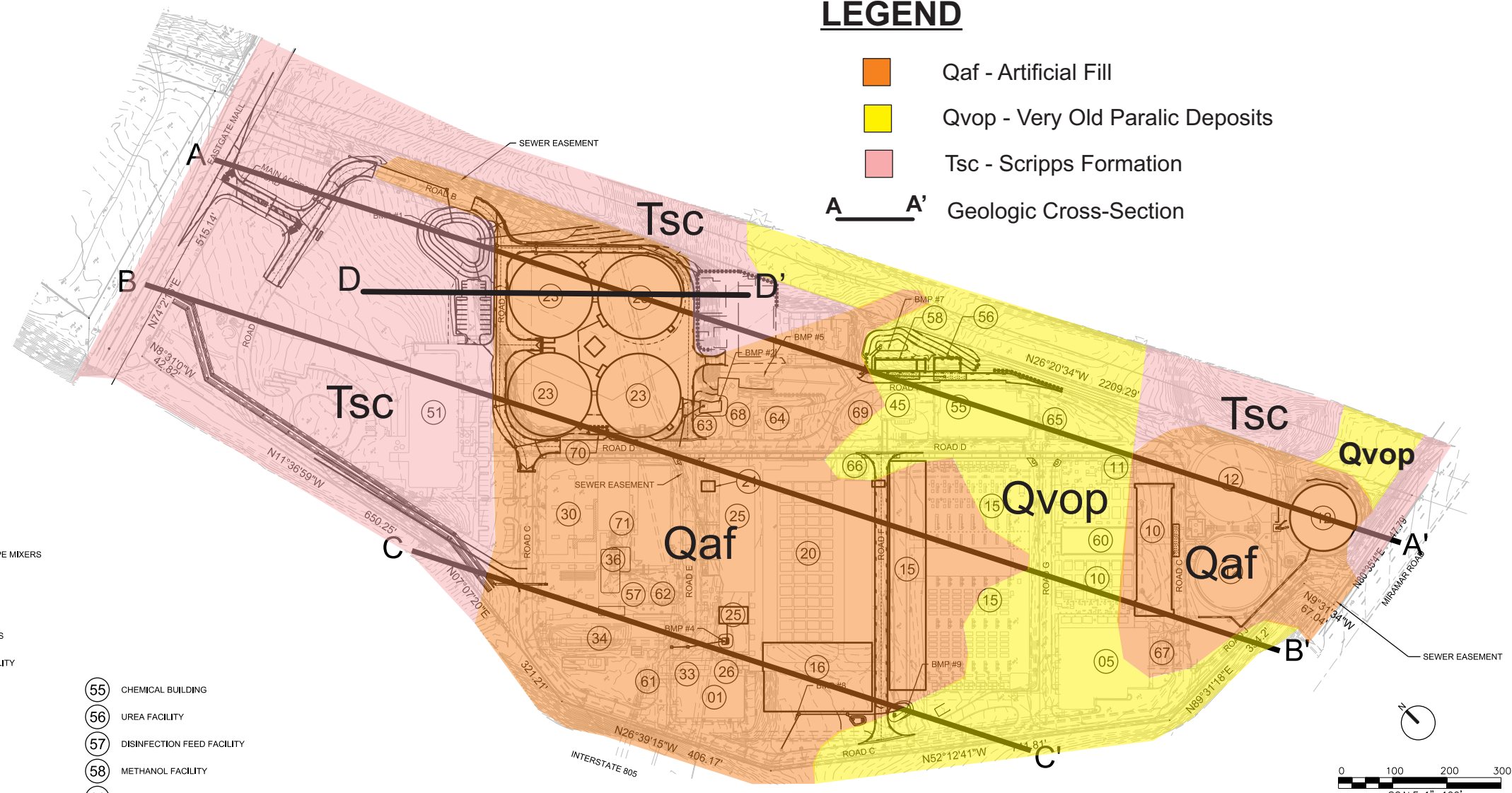
FIGURE 4



NORTH CITY WATER RECLAMATION PLANT

**LEGEND**

- Qaf - Artificial Fill
- Qvop - Very Old Paralitic Deposits
- Tsc - Scripps Formation
- A — A'** Geologic Cross-Section



**FACILITY LEGEND:**

- ⓪1 INFLUENT PUMP STATION
- ⓪5 HEADWORKS
- ⓪10 PRIMARY SEDIMENTATION TANKS
- ⓪11 INTERMEDIATE PUMP STATION RAS PE MIXERS
- ⓪12 FLOW EQUALIZATION BASINS
- ⓪15 FIRST STAGE BIOREACTOR BASINS
- ⓪16 SECOND STAGE BIOREACTOR BASINS
- ⓪20 BIOREACTOR/FILTER SUPPORT FACILITY
- ⓪21 FILTER EFFLUENT BOX
- ⓪23 SECONDARY CLARIFIERS
- ⓪25 TERTIARY FILTERS
- ⓪26 WASTE BACKWASH TANK
- ⓪30 CHLORINE CONTACT BASIN
- ⓪33 EFFLUENT DROP STRUCTURE
- ⓪34 EFFLUENT PUMP STATION
- ⓪36 NCPWF INFLUENT PUMP STATION
- ⓪45 BLENDED SLUDGE PUMP STATION
- ⓪51 OPERATIONS BUILDING
- ⓪55 CHEMICAL BUILDING
- ⓪56 UREA FACILITY
- ⓪57 DISINFECTION FEED FACILITY
- ⓪58 METHANOL FACILITY
- ⓪60 ODOR CONTROL FACILITY
- ⓪61 - ⓪67 ELECTRICAL SUBSTATIONS
- ⓪68 ELECTRICAL MAIN PLANT SWITCHGEAR
- ⓪69 ELECTRICAL SWITCHGEAR SUBSTATION
- ⓪70 SECONDARY CLARIFIER ELECTRICAL BUILDING
- ⓪71 NCPWF IPS ELECTRICAL SUBSTATION

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

CONSTRUCTION CHANGE / ADDENDUM			
CHANGE	DATE	AFFECTED OR ADDED SHEET NUMBERS	APPROVAL NO.

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

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 INSPECTOR

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

FOR CITY ENGINEER	DATE
PROJECT NAME	PROJECT NO.
DESCRIPTION	BY
APPROVED	DATE
FILM	

DATE STARTED \_\_\_\_\_  
 DATE COMPLETED \_\_\_\_\_

PK2-60% DESIGN

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

**NORTH CITY WATER RECLAMATION PLANT EXPANSION**

**SITE SPECIFIC GEOLOGIC MAP**

PROJECT NO.  
 44F1

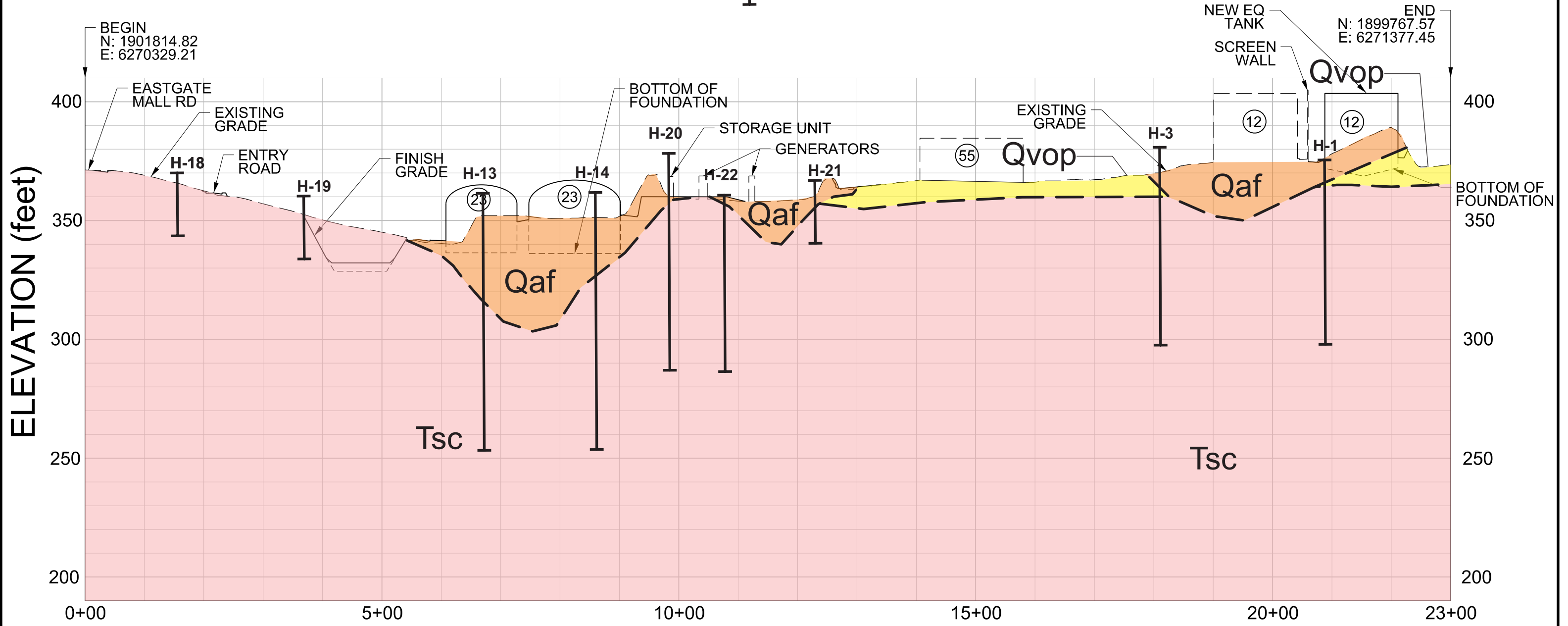
**ALLIED GEOTECHNICAL ENGINEERS, INC.**

**FIGURE 5**

**LEGEND**

- Qaf - Artificial Fill
- Qvop - Very Old Paralic Deposits
- Tsc - Scripps Formation

- Approximate Geologic Contact
- H-18  
Approximate Boring Location



**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.**

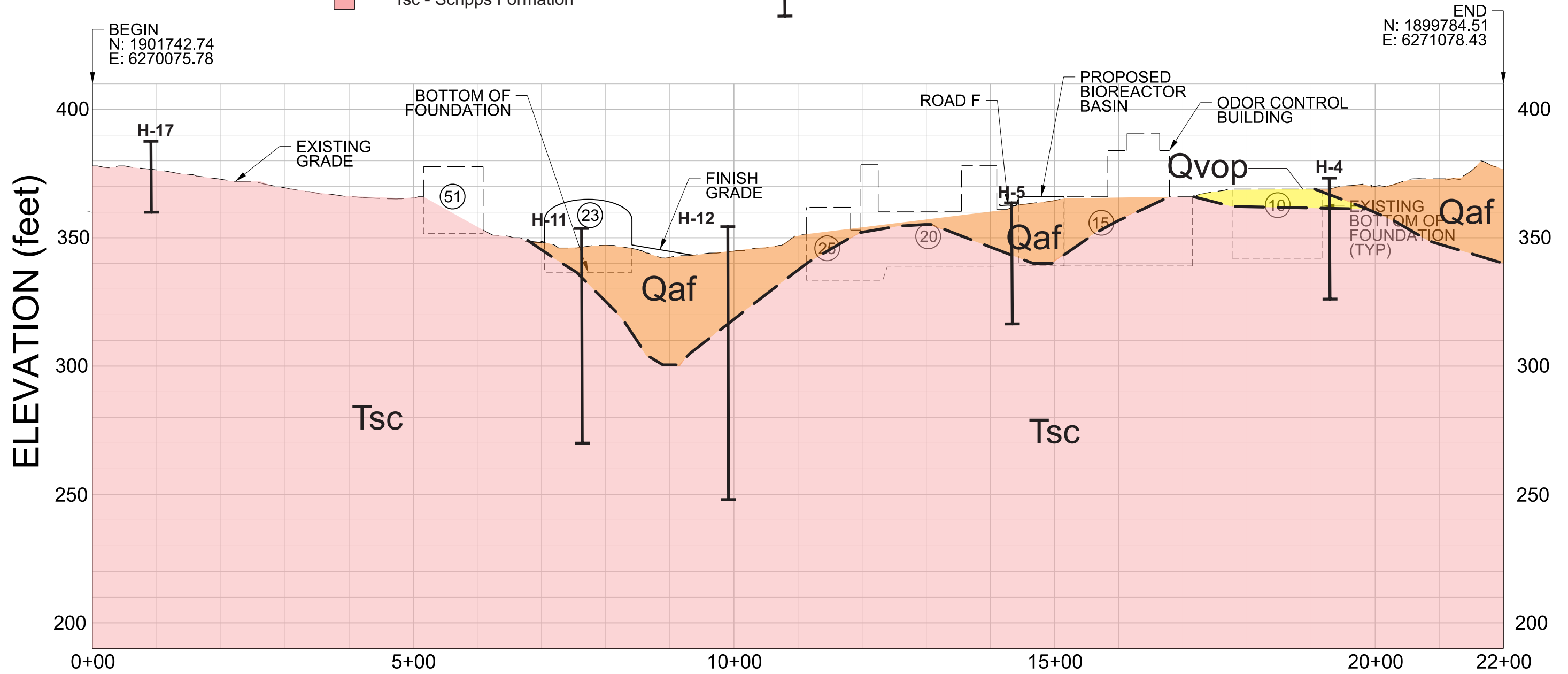
**FIGURE 6**



**LEGEND**

- Qaf - Artificial Fill
- Qvop - Very Old Paralic Deposits
- Tsc - Scripps Formation

- Approximate Geologic Contact
- H-18  
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**





**NORTH CITY WATER RECLAMATION PLANT EXPANSION**

**REGIONAL FAULT MAP**

PROJECT NO.  
 44F1

**ALLIED GEOTECHNICAL ENGINEERS, INC.**

**FIGURE 9**



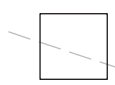
# LEGEND

**H-14**  
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Approximate boring locations with shear wave velocity in parentheses.

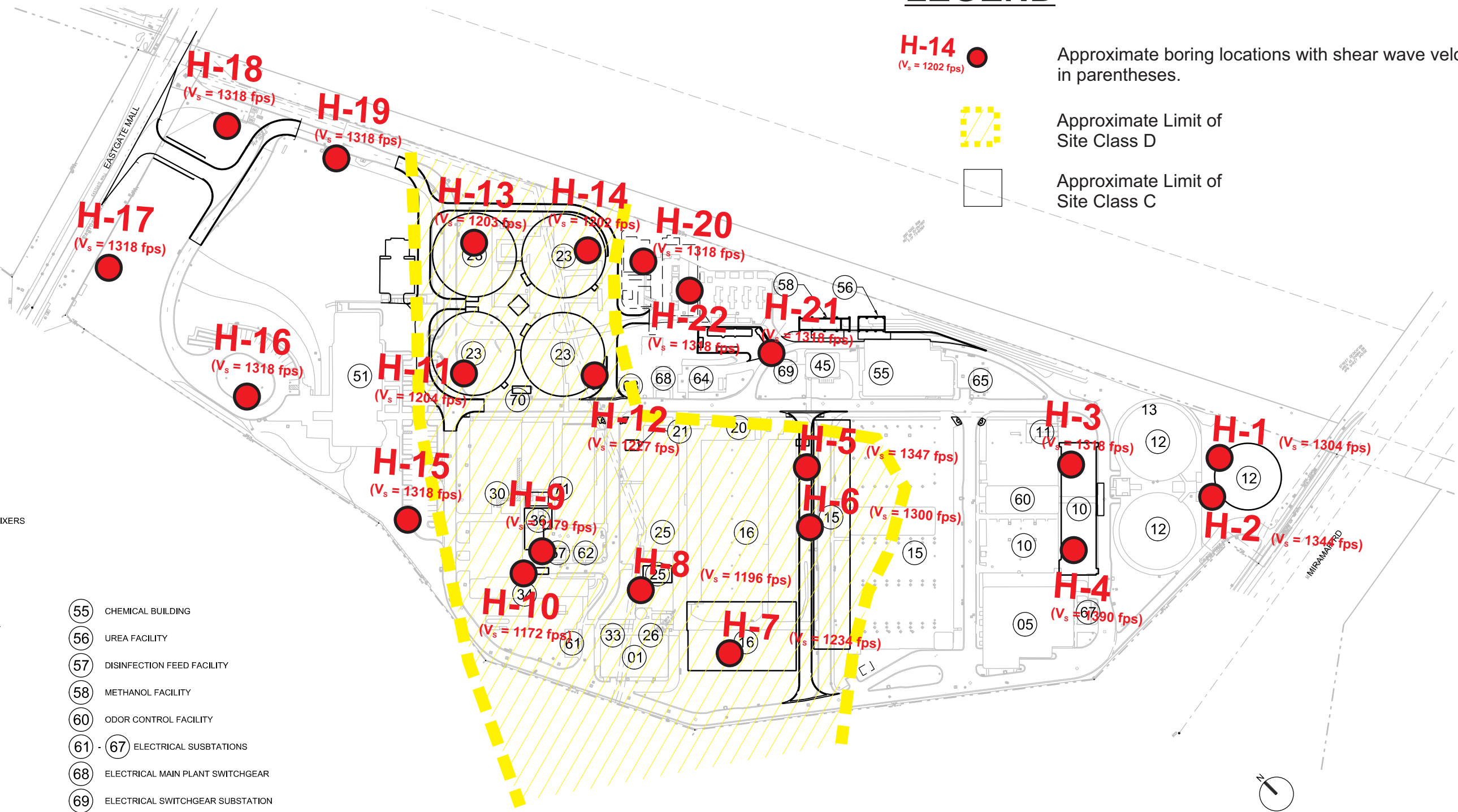
Approximate Limit of Site Class D



Approximate Limit of Site Class C

FACILITY LEGEND:

- (01) INFLUENT PUMP STATION
- (05) HEADWORKS
- (10) PRIMARY SEDIMENTATION TANKS
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- (70) SECONDARY CLARIFIER ELECTRICAL BUILDING
- (71) NCPWF IPS ELECTRICAL SUBSTATION



SAN DIEGO NCWRP EXPANSION AND NCPWF INFLUENT CONVEYANCE

GENERAL PROJECT KEY PLAN

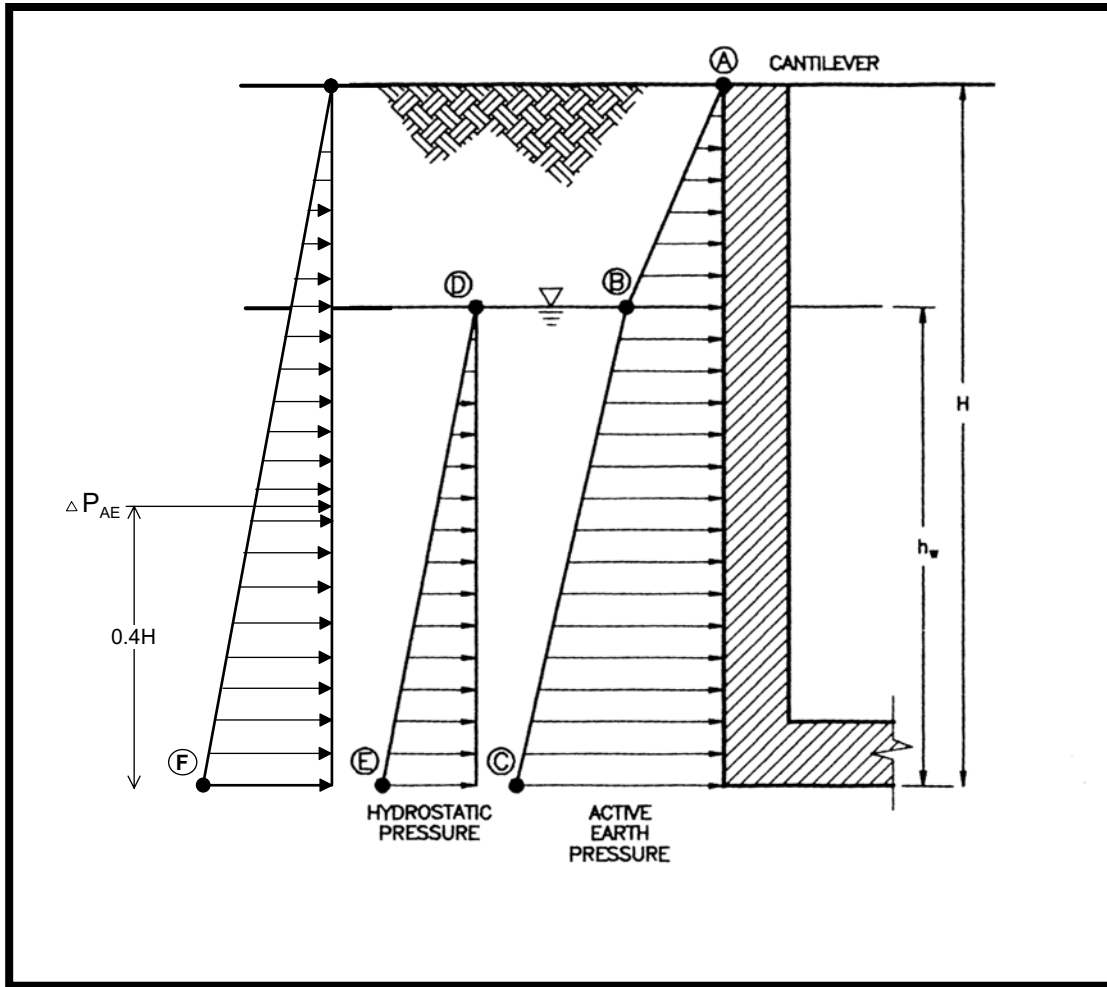
**NORTH CITY WATER RECLAMATION PLANT EXPANSION**

**SITE PLAN SHOWING 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- $h_w$ ) + 20 $h_w$ , psf

Hydrostatic Pressure

- Ⓓ = 0
- Ⓔ = 62.4 $h_w$

Dynamic Resultant Force

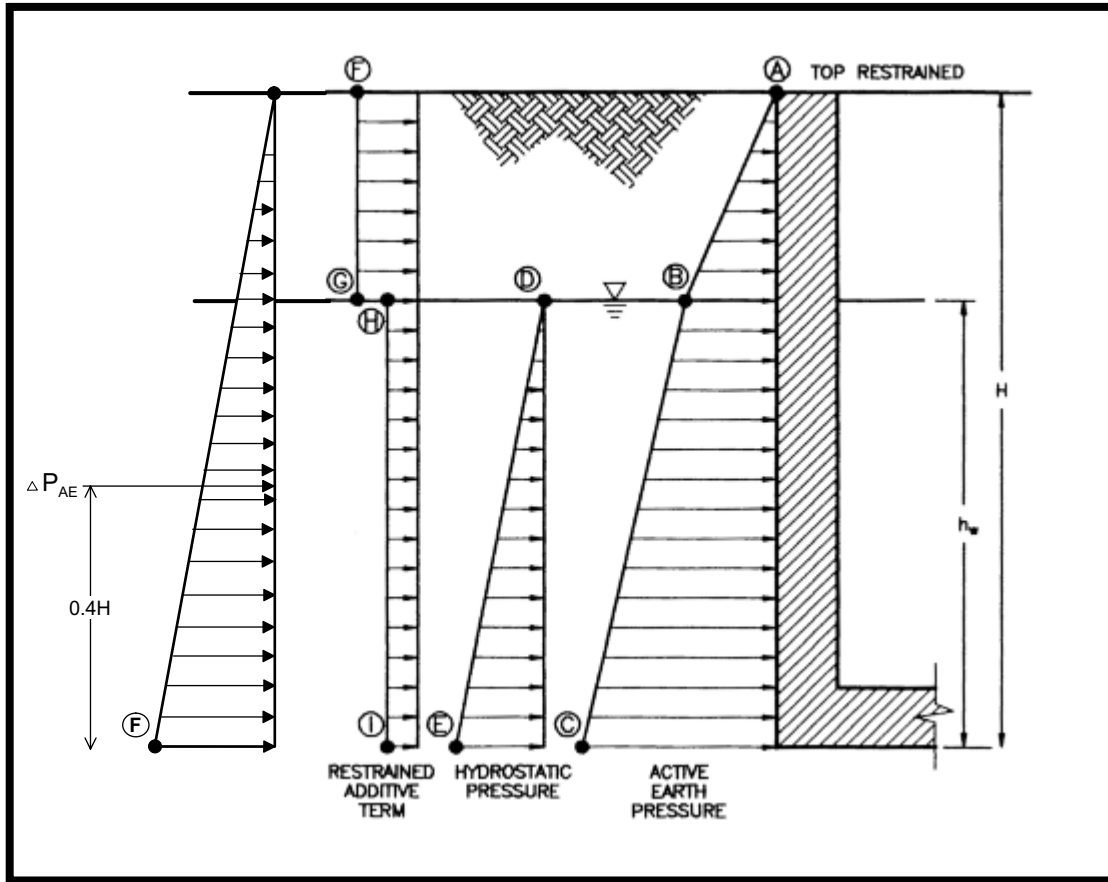
- Ⓕ = 12H
- $\Delta P_{AE} = 6H^2$ , lb/ft @ 0.4H

**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

- Ⓕ =  $12H$
- $\Delta P_{AE} = 6H^2$ , lb/ft @  $0.4H$

## LATERAL PRESSURES FOR RESTRAINED WALLS NORTH CITY WATER RECLAMATION PLANT EXPANSION

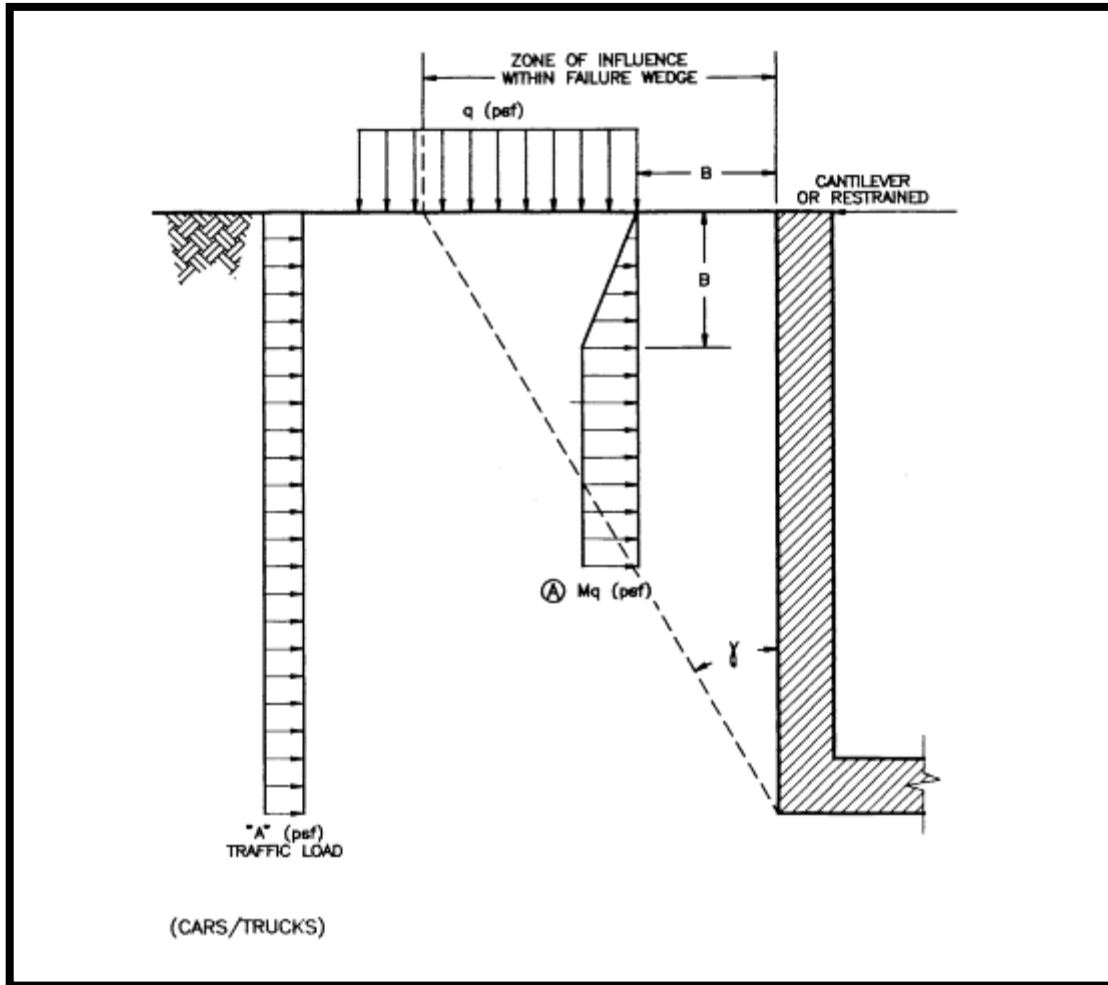
PROJECT NO.  
44F1

ALLIED GEOTECHNICAL ENGINEERS, INC.

FIGURE 12







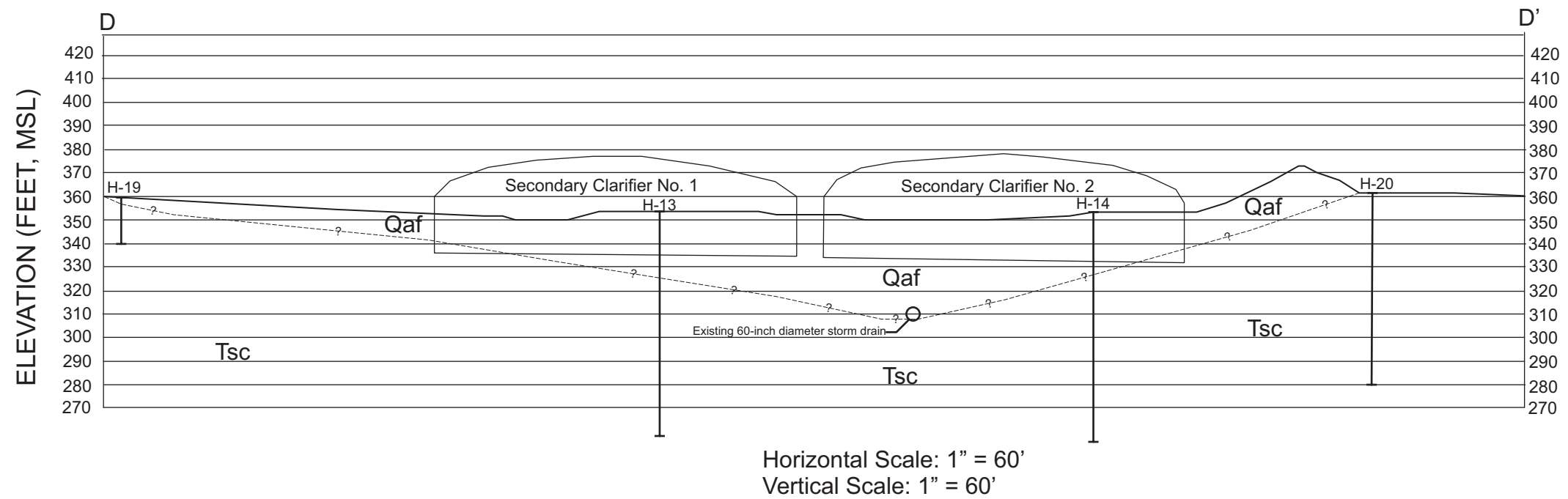
**NON-EXPANSIVE BACKFILL**

- $q$  = surcharge load (psf)
- $B$  = distance between wall and surcharge load, ft
- $M = 0.3$  for cantilever wall
- $M = 0.4$  for restrained wall
- $\textcircled{A} = Mq$ , psf
- "A" = 75 psf
- Angle of Internal Friction ( $\phi$ ) =  $35^\circ$
- Zone of Influence ( $\gamma$ ) =  $30^\circ$

**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

┆ Approximate boring location

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

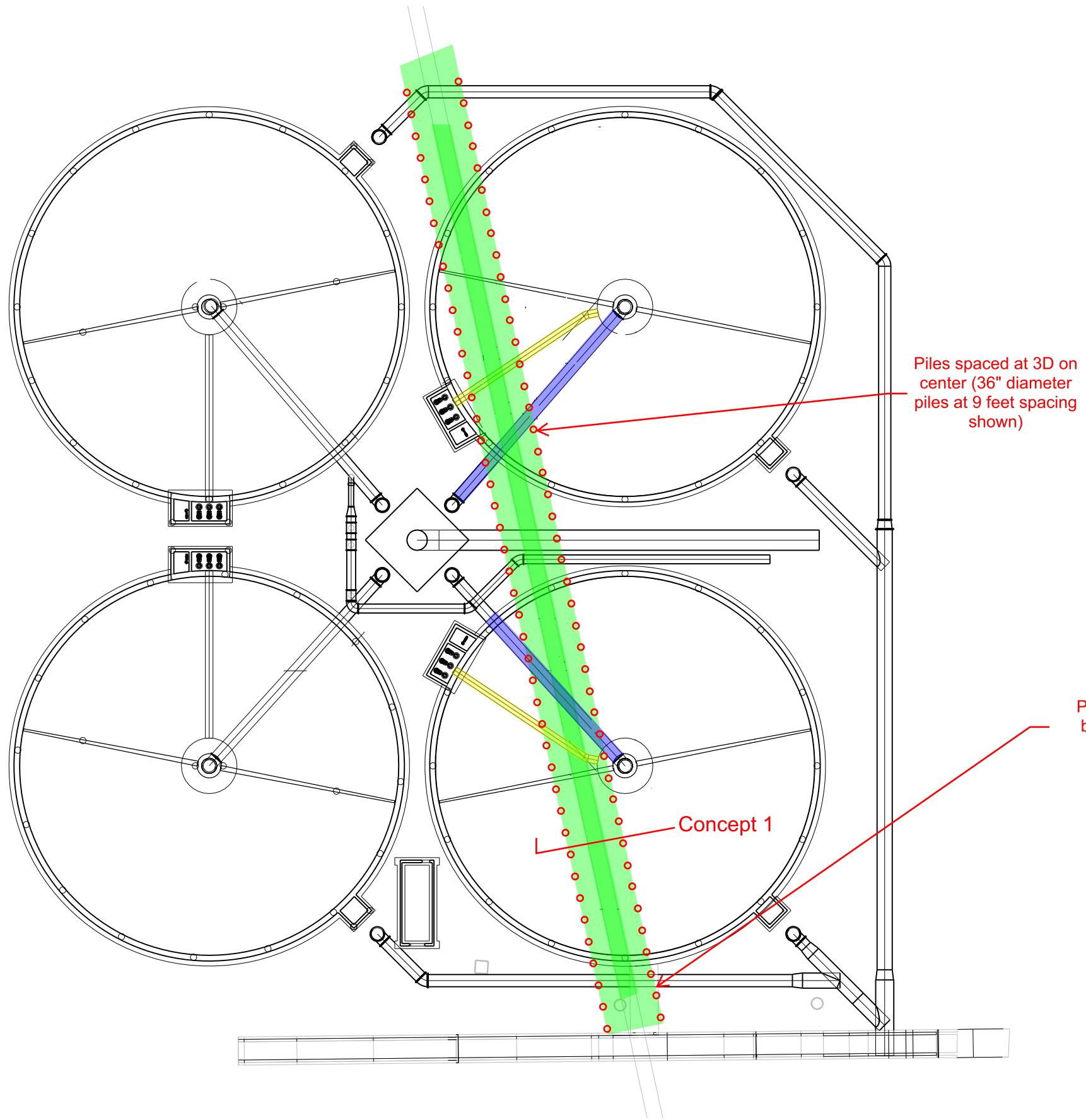
**NORTH CITY WATER RECLAMATION PLANT EXPANSION**

**CROSS-SECTION D-D'**

PROJECT NO.  
44F1

**ALLIED GEOTECHNICAL ENGINEERS, INC.**

**FIGURE 15**



Piles spaced at 3D on center (36" diameter piles at 9 feet spacing shown)

Concept 1

Protect Pipe just beyond clarifier footprint

Source: Sketch prepared by Kleinfelder, undated.

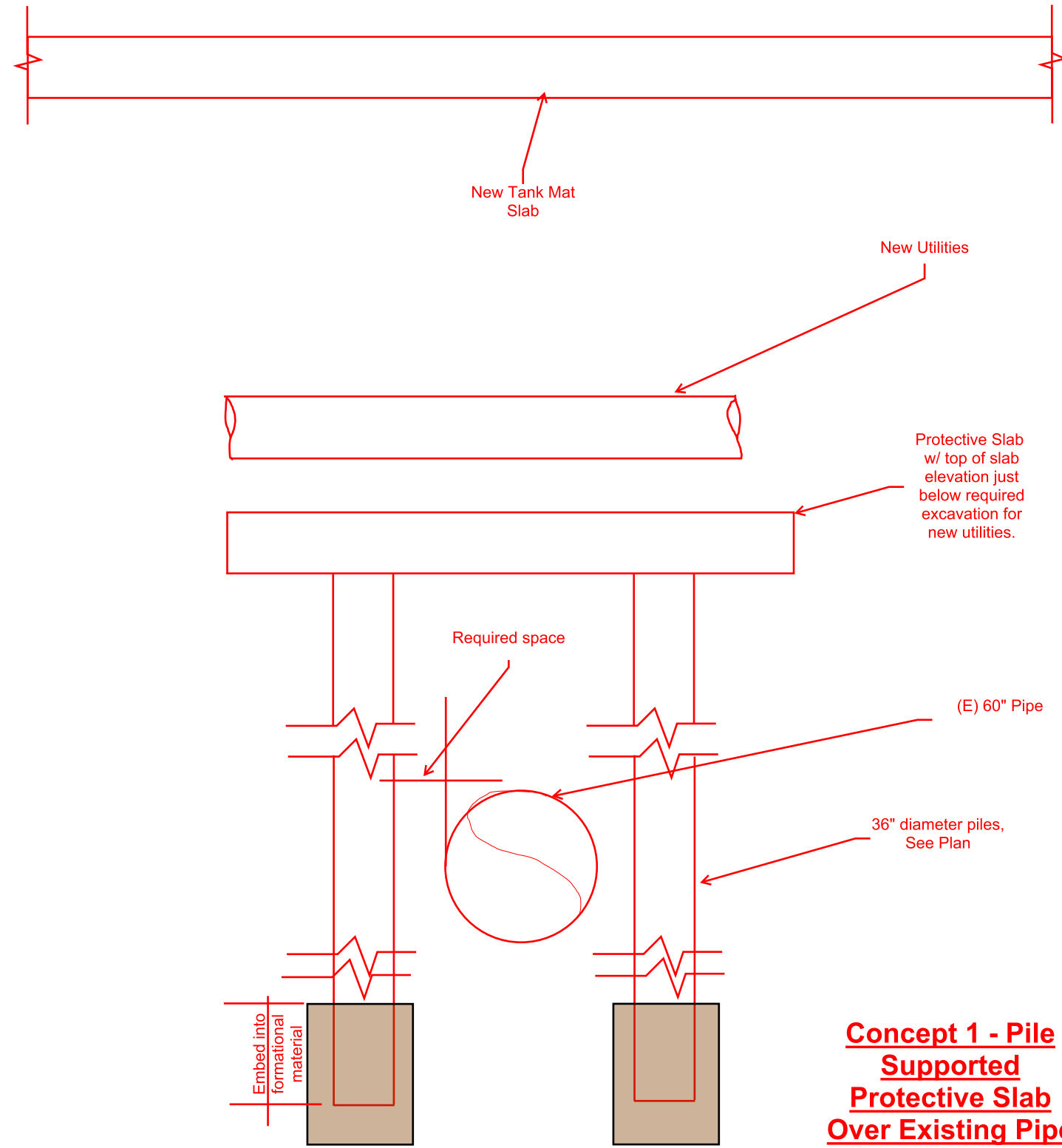
**NORTH CITY WATER RECLAMATION PLANT EXPANSION**

**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
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19	<div style="position: relative; height: 100%; border-left: 1px solid black; border-right: 1px solid black;"> <div style="position: absolute; top: 0; left: 50%; transform: translate(-50%, -50%);">Sample identification number</div> <div style="position: absolute; top: 20%; left: 5%; width: 10%; height: 10%; background-color: black; border: 1px solid black;">1</div> <div style="position: absolute; top: 20%; left: 15%; width: 10%; height: 10%; background-color: black; border: 1px solid black;">1</div> <div style="position: absolute; top: 20%; left: 25%; width: 10%; height: 10%; background-color: black; border: 1px solid black;">1</div> <div style="position: absolute; top: 20%; left: 35%; width: 10%; height: 10%; background-color: black; border: 1px solid black;">1</div> <div style="position: absolute; top: 20%; left: 45%; width: 10%; height: 10%; background-color: black; border: 1px solid black;">1</div> <div style="position: absolute; top: 20%; left: 55%; width: 10%; height: 10%; background-color: black; border: 1px solid black;">1</div> <div style="position: absolute; top: 20%; left: 65%; width: 10%; height: 10%; background-color: black; border: 1px solid black;">1</div> <div style="position: absolute; top: 20%; left: 75%; width: 10%; height: 10%; background-color: black; border: 1px solid black;">1</div> <div style="position: absolute; top: 20%; left: 85%; width: 10%; height: 10%; background-color: black; border: 1px solid black;">1</div> <div style="position: absolute; top: 20%; left: 95%; width: 10%; height: 10%; background-color: black; border: 1px solid black;">1</div> <div style="position: absolute; top: 40%; left: 5%; width: 10%; height: 10%; background-color: black; border: 1px solid black;">2</div> <div style="position: absolute; top: 40%; left: 15%; width: 10%; height: 10%; background-color: black; border: 1px solid black;">2</div> <div style="position: absolute; top: 40%; left: 25%; width: 10%; height: 10%; background-color: black; border: 1px solid black;">2</div> <div style="position: absolute; top: 40%; left: 35%; width: 10%; height: 10%; background-color: black; border: 1px solid black;">2</div> <div style="position: absolute; top: 40%; left: 45%; width: 10%; height: 10%; background-color: black; border: 1px solid black;">2</div> <div style="position: absolute; top: 40%; left: 55%; width: 10%; height: 10%; background-color: black; border: 1px solid black;">2</div> <div style="position: absolute; top: 40%; left: 65%; width: 10%; height: 10%; background-color: black; border: 1px solid black;">2</div> <div style="position: absolute; top: 40%; left: 75%; width: 10%; height: 10%; background-color: black; border: 1px solid black;">2</div> <div style="position: absolute; top: 40%; left: 85%; width: 10%; height: 10%; background-color: black; border: 1px solid black;">2</div> <div style="position: absolute; top: 40%; left: 95%; width: 10%; height: 10%; background-color: black; border: 1px solid black;">2</div> <div style="position: absolute; top: 60%; left: 5%; width: 10%; height: 10%; background-color: black; border: 1px solid black;">3</div> <div style="position: absolute; top: 60%; left: 15%; width: 10%; height: 10%; background-color: black; border: 1px solid black;">3</div> <div style="position: absolute; top: 60%; left: 25%; width: 10%; height: 10%; background-color: black; border: 1px solid black;">3</div> <div style="position: absolute; top: 60%; left: 35%; width: 10%; height: 10%; background-color: black; border: 1px solid black;">3</div> <div style="position: absolute; top: 60%; left: 45%; width: 10%; height: 10%; background-color: black; border: 1px solid black;">3</div> <div style="position: absolute; top: 60%; left: 55%; width: 10%; height: 10%; background-color: black; border: 1px solid black;">3</div> <div style="position: absolute; top: 60%; left: 65%; width: 10%; height: 10%; background-color: black; border: 1px solid black;">3</div> <div style="position: absolute; top: 60%; left: 75%; width: 10%; height: 10%; background-color: black; border: 1px solid black;">3</div> <div style="position: absolute; top: 60%; left: 85%; width: 10%; height: 10%; background-color: black; border: 1px solid black;">3</div> <div style="position: absolute; top: 60%; left: 95%; width: 10%; height: 10%; background-color: black; border: 1px solid black;">3</div> </div>	<div style="position: relative; height: 100%; border-left: 1px solid black; border-right: 1px solid black;"> <div style="position: absolute; top: 20%; left: 15%; width: 10%; height: 10%; border: 1px solid black;">16</div> <div style="position: absolute; top: 60%; left: 15%; width: 10%; height: 10%; border: 1px solid black;">18</div> </div>			<p>Approximate interval of bulk sample</p> <p>Approximate interval of Standard California Sampler (SCS).</p> <p>Number of blows required to advance sampler for the last foot, or distance indicated.</p> <p>Approximate interval of Standard Penetration Test (SPT).</p>			
<p>(KEY TO LOG OF BORING CONTINUED ON FIGURE A-2)</p>								

## 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					<b><u>GENERAL NOTES</u></b>			
11					1. Approximate elevations and locations of borings are based on GoogleEarth, 2017.			
12					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.			
13					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.			
14								
15								
16								
17								
18								
19								
<b>PROJECT NO. 44F1</b>					<b>ALLIED GEOTECHNICAL ENGINEERS, INC.</b>			<b>FIGURE A-2</b>

**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	OVIM 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	1				<b>FILL</b>			Drilled to 5-feet using 8-inch HSA, then switched to 4-inch air percussion.
3					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	2							
5								
6	3	54	0.0			8.2	112.7	
7								
8					-?-?-?-?-?-?-?-?-?			-?-?-?-?-?-?-?-?-?
9					<b>VERY OLD PARALIC DEPOSITS</b>			
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					<b>SCRIPPS FORMATION</b>			
15					Greenish gray to reddish yellow, wet, fine-grained, hard, sandy lean clay (CL).			
16	5	75	0.0			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.			
21								Did not attempt sampling at 20 feet and 25 feet due to abundant gravels and cobbles.
22	6							
23								
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	QVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
31	7	100+			<b>SCRIPPS FORMATION</b> 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								
38								
39								
40								
41								
42								
43								
44								
45								
46	8	100+			Sharp transition out of conglomerate at 48'.			Did not attempt sampling at 35 feet and 45 feet due to abundant gravels and cobbles.
47								
48								
49								
50								
51								
52								
53								
54								
55								
56								
57								
58								
59								
60								
61								
55	9	100+	0.1		Light gray to pale yellowish brown, damp, hard, sandy lean clay (CL).	18.2		Sample contains only slough and fractured gravel
56								
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	QVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
63					<b>SCRIPPS FORMATION</b>			
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	OVN 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					<b>FILL</b>			Drilled to 5-feet using 8-inch HSA, then switched to 4-inch air percussion.
3								
4								
5	1	63	0.2		Brown to yellow brown, damp, silty sand (SM) and clayey sand (SC) with abundant gravel and scattered cobbles.	10.9		
6								
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		<b>SCRIPPS FORMATION</b>	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	QVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS	
31	8	100+	0.1		<b>SCRIPPS FORMATION</b>	4.7			
32	9				Gravel - cobble conglomerate with a yellowish brown, fine to medium-grained, silty sand (SM) matrix.			Did not attempt to sample at 35 feet due to abundant gravel and cobbles.	
33									
34									
35									
36									
37									
38									
39									
40	10	100+				Sharp transition out of the conglomerate facies at 42'.			Slough only in sampler
41									
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	12	100+	0.0			18.2			
51									

**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	OVN READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
1					<b>FILL</b> Yellow brown to reddish yellow, damp, silty sand (SM) containing locally abundant sub-rounded and locally fractured gravel up to 3" in maximum dimension.	5.2		Drilled to 5-feet using 8-inch HSA, then switched to 4-inch air percussion.
2	1							
3	2							
4								
5	3	100+	0.1					
6								
7					- ? -	- ? -		- ? -
8					<b>VERY OLD PARALIC DEPOSITS</b> Reddish yellow, damp, very dense, medium-grained, silty sand (SM) with abundant sub-rounded gravel up to 3" in maximum dimension.			No sample recovery, sampler bouncing on rock
9								
10	4	100+						
11								
12								
13					- ? -	- ? -		- ? -
14					<b>SCRIPPS FORMATION</b> 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		
15								
16	5	100+	0.0					
17								
18								
19								
20								
21	6	100+	0.1			1.4		
22								
23								
24								
25								
26	7	100+	0.1			3.6		
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	QVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS	
31	8	100+			<b>SCRIPPS FORMATION</b> 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									

**PROJECT NO.  
44F1**

**ALLIED GEOTECHNICAL ENGINEERS, INC.**

**FIGURE A-9**

**BORING NO. H-3 (Continued)**

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	QVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
63					<b>SCRIPPS FORMATION</b>			
64								
65	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		
66								
67								
68								
69								
70	15	100+	0.1		Light gray to pale yellow brown, silty sandstone (SM).	12.5	99.0	
71								
72								
73								
74								
75	16	100+	0.1		Reddish yellow, damp, hard, sandy lean clay (CL).	21.1		
76								
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	OVN READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
1					<b>FILL</b> Yellow brown, damp, silty sand (SM) with scattered to locally abundant sub-rounded gravel up to 3" in maximum dimension.			Drilled to 12-feet using 8-inch HSA, then switched to 4-inch air percussion.
2								
3					-----?-----?			-----?-----
4	1				<b>VERY OLD PARALIC DEPOSITS</b>			
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					<b>SCRIPPS FORMATION</b>			
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								
18	5							
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		<b>SCRIPPS FORMATION</b> 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	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	
41									
42									
43									
44									
45	11	100+	0.0		Olive brown color, and fine to medium grain size.	16.2			
46									
47									
48									
49									
50	12	100+	0.0		Olive gray to pale reddish yellow, fine-grained silty sand (SM).	17.0	111.8		
51									

**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	OVN READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
1					<b>EXISTING PAVEMENT: 7.5" A.C. and no base.</b>			
2					<b>FILL</b>			
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	1	44	0.0			20.6	102.7	
5	2							
6	3							
7								
8								
9								
10	4	23	0.3		Olive brown to gray brown, damp to wet, clayey sand (SC) with scattered gravel.	9.9		
11								
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								
21	6	100+						No sample recovery, sampler bouncing on gravel
22					-----?-----?-----?-----			-----?-----
23					<b>SCRIPPS FORMATION</b>			
24								
25	7	100+	0.0		Olive yellow, damp, very dense, fine-grained, silty sand (SM). Sand is uncemented.	10.4		
26								
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	QVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS	
31	9	100+	0.0		<b>SCRIPPS FORMATION</b>	19.6	113.3	Driller adding water inside of auger to assist in bringing soil cuttings to ground surface	
32									
33	10								
34									
35									
36	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			
37									
38									
39									
40						Pale yellow brown to reddish yellow color.			
41	12	100+	0.0			21.1			
42									
43									
44									
45					Pale yellow brown, damp, very dense, medium grained, poorly graded sand with silt (SP-SM).				
46	13	100+	0.0		15.9	96.7			
47									
48									
49									
50					Similar to above, with a 2" wide interlayer of pale gray to 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	OVN READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
1					<b>EXISTING PAVEMENT: 8" A.C. and no base.</b>			
2					<b>FILL</b>			
3								
4								
5	1				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.			
6	2	18	0.4			15.8		
7								
8								
9								
10								
11	3	50	0.1		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.	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	7							
23								
24								
25								
26	8	54	0.1		<b>SCRIPPS FORMATION</b>	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		<b>SCRIPPS FORMATION</b>  Pale olive yellow to pale olive brown, damp, hard, sandy lean clay (CL).	18.0	102.0	Driller adding water inside of auger to assist in bringing soil cuttings to ground surface
32								
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		

**NOTES:**

Bottom of borehole at 50.5 feet.  
  
Unable to determine if groundwater is present.  
Method of drilling required introduction of water into borehole.




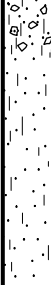




**BORING NO. H-7**

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	OVN 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					<b>FILL</b>			
3					Yellow brown to reddish yellow, damp, silty sand (SM) with scattered sub-rounded gravel up to 3" in maximum dimension.			
4								
5	1	7	0.0			10.6		
6	2							
7					-?-?-?			
8					<b>VERY OLD PARALIC DEPOSITS</b>			
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					<b>SCRIPPS FORMATION</b>			Driller added water inside of auger to assist in bringing soil cuttings to ground surface
14	4							
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								
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	
22								
23								
24								
25					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								

<b>PROJECT NO. 44F1</b>	<b>ALLIED GEOTECHNICAL ENGINEERS, INC.</b>	<b>FIGURE A-17</b>
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**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	8				<b>SCRIPPS FORMATION</b>			Did not attempt sampling between depth of 30' and 35' due to abundant gravel	
32					Gravel conglomerate with an olive brown to yellow brown silty sand (SM) matrix.				
33									
34									
35	9	100+			End of conglomerate zone at 37'.			No sample recovery	
36									
37									
38									
39	10	100+	0.0		Olive/gray to pale reddish yellow, damp, hard, sandy lean clay (CL).	23.2			
40									
41									
42									
43	11	100+	0.0		Pale greenish gray to medium gray, hard, lean clay (CL).	20.8	112.7		
44									
45									
46									
47	12	100+	0.0		Pale yellow brown to pale reddish yellow, damp, very dense, fine to medium grained, silty sand (SM).	21.5			
48									
49									
50									
51	13	100+	0.0		Olive color.	21.3	107.6		
52									
53									
54									

**PROJECT NO.  
44F1**

**ALLIED GEOTECHNICAL ENGINEERS, INC.**

**FIGURE A-18**

**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					<b>SCRIPPS FORMATION</b>			
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					74' - 76', gravel zone.			
75								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					<b>SCRIPPS FORMATION</b>			
96					Dark gray, hard claystone (CL/CH).			
97								
98								
99								
100	18	100+	0.1		Medium gray, damp, very dense, fine-grained silty sand (SM).	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	OVN READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
1					<p><b>FILL</b></p> <p>Yellow brown to yellowish red, damp, gravelly silty sand (SM). Gravel is sub-rounded and locally fractured, up to 3" in maximum dimension.</p> <p>Similar to above, fill also contains chunks of cemented siltstone up to 1/2" in maximum dimension.</p> <p>Abundant gravel from 17' to 22'.</p> <p>Reddish brown to reddish yellow, damp, fine to medium-grained silty sand (SM) and sandy silt (ML) with scattered gravel.</p>			
2	1	23	0.0			9.7		
3								
4	2					21.3	102.0	
5								
6	3					15.7		
7								
8								
9								
10	4	38	0.0					
11								
12								
13								
14								
15	5	32	0.1					
16								
17								
18								
19								
20								
21	6	100+	0.0					
22								
23								
24								
25								
26	7	30	0.2					
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	QVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
31	8	100+	0.0		<b>FILL</b>	15.5	111.2	Driller added water inside of auger to assist in bringing soil cuttings to ground surface
32					Olive to olive yellow, damp, fine-grained, silty sand (SM), with scattered sub-rounded gravel up to 2" in maximum dimension.			
35	9	41	0.1			13.5		
36								
37								
38								
39								
40	10	52	0.1		Olive yellow, pale yellow and yellow brown silty sand (SM), intermixed with chunks of olive yellow siltstone (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	
41								
42								
43								
44								
45	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.
46	12							
47								
48								
49				?	?			?
50	13	100+	0.0		<b>SCRIPPS FORMATION</b>	21.3	109.1	
51					Olive gray to pale olive yellow, damp, hard, sandy lean clay (CL).			
52								
53								
54								
55								
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	OVN READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
1					<b>FILL</b> 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.			Lawn sod in the upper 2 inches
2								
3					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.			High blow counts in 20' and 25' samples due to abundant gravel in fill.
4								
5	1	25	0.0			20.3	99.0	
6					Between 17'-28', encountered scattered to locally abundant gravel in fill. Gravel sub-rounded and locally fractured, up to 3" in maximum dimension.			
7								
8	2				Olive yellow to medium brown, damp, silty sand (SM) and clayey sand (SC) with abundant gravel.			
9								
10	3	15	0.0			23.3		
11					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.			
12								
13					Between 17'-28', encountered scattered to locally abundant gravel in fill. Gravel sub-rounded and locally fractured, up to 3" in maximum dimension.			
14								
15	4					26.4	91.6	
16					Olive yellow to medium brown, damp, silty sand (SM) and clayey sand (SC) with abundant gravel.			
17								
18	5	20	0.0		9.6			
19					Between 17'-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			15.5	113.7	
22					Olive yellow to medium brown, damp, silty sand (SM) and clayey sand (SC) with abundant gravel.			
23								
24	7				100+	0.1		
25					Between 17'-28', encountered scattered to locally abundant gravel in fill. Gravel sub-rounded and locally fractured, up to 3" in maximum dimension.			
26								
27	8	100+	0.1					
28					Olive yellow to medium brown, damp, silty sand (SM) and clayey sand (SC) with abundant gravel.			
29								

**PROJECT NO.  
44F1**

**ALLIED GEOTECHNICAL ENGINEERS, INC.**

**FIGURE A-23**

**BORING NO. H-9 (Continued)**

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

**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					<b>SCRIPPS FORMATION</b>			
64								
65	17	100+	0.2		Dark gray, damp, hard, sandy claystone (CL/CH).	19.3		
66								
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	19	100+	0.1		Dark gray claystone (CL/CH), similar to above.	23.4		
76								
77								
78								
79								
80	20	100+	0.0		Dark gray, very dense, silty sandstone (SM). Sandstone is strongly cemented.	5.2		
81								
<p><b>NOTES:</b></p> <p>Bottom of borehole at 80.5 feet.</p> <p>Unable to determine if groundwater is present. Method of drilling required introduction of water into borehole.</p>								

**PROJECT NO.  
44F1**

**ALLIED GEOTECHNICAL ENGINEERS, INC.**

**FIGURE A-25**

**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	OVN 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					<b>FILL</b>			
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	QVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
31	8	100+	0.1		<b>FILL</b> Olive, damp, silty sand (SM) and sandy silt (ML) with abundant gravel/cobble.	15.2		Sampler bouncing on gravel/cobble.
32				-?-	-?-			-?-
33					<b>SCRIPPS FORMATION</b>			
34								
35	9	100+	0.1		Reddish yellow to olive brown, damp, very dense, fine-grained silty sandstone (SM).	21.7		Driller added water inside of auger to assist in bringing soil cuttings to ground surface.
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	13	100+	0.0			20.8	106.7	
51								
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
63					<b>SCRIPPS FORMATION</b>			
64								
65	16	100+			Grayish brown to reddish yellow, sandy lean clay (CL).			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								
<p><b>NOTES:</b></p> <p>Bottom of borehole at 80.5 feet.</p> <p>Unable to determine if groundwater is present. Method of drilling required introduction of water into borehole.</p>								

**PROJECT NO.**  
44F1

**ALLIED GEOTECHNICAL ENGINEERS, INC.**

**FIGURE A-28**



**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	OVN 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					<b>FILL</b>			
3					Yellow brown to olive yellow, damp, silty sand (SM).			
4								
5	1	30	0.0			23.5	98.0	
6								
7								
8								
9								
10								
11	2	14	0.1		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.	25.8		Poor recovery, sampler hit large gravel clasts in fill.
12	3							
13								
14								
15				?	----- ? ----- ?			?
16	4	39	0.0		<b>SCRIPPS FORMATION</b>	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		<b>SCRIPPS FORMATION</b>	24.5		Driller added water inside of auger to assist in bringing soil cuttings to ground surface.
32								
33								
34								
35	9	100+	0.6		Olive yellow to pale greenish gray, very dense, fine-grained, silty sandstone (SM).	19.0	104.0	
36								
37	10							
38								
39								
40	11	60	0.6		Olive to olive yellow, damp, hard, sandy lean clay (CL).	22.4		
41								
42								
43								
44								
45	12	100+	0.1		Olive to pale gray, silty sandstone (SM).	20.1	108.2	
46								
47								
48								
49								
50	13	88	0.4			11.8		
51								
52								
53								
54					53' - 55', gravel zone.			
55	14	100+	0.0			17.5	106.9	
56								
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
63					<b>SCRIPPS FORMATION</b>			
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.

**PROJECT NO.  
44F1**

**ALLIED GEOTECHNICAL ENGINEERS, INC.**

**FIGURE A-31**

**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	OVN 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					<b>FILL</b>			
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								
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					<b>SCRIPPS FORMATION</b>			
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	QVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS	
31	9	100+	0.2		<b>SCRIPPS FORMATION</b>	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	11	100+	0.1				12.0		
41									
42									
43									
44									
45	12	100+							No sample recovery
46									
47									
48									
49									
50	13	100+	0.0		Reddish yellow, fine to medium grained silty sand (SM), interlayered with olive yellow to olive gray lean clay (CL).	22.1			
51									
52					Gravel zone between 51' and 52.5'.				
53									
54									
55	14	100+	0.0		Light gray to pale yellow brown, fine to medium grained, silty sand (SM).	7.3	107.8		
56									
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	QVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
63					<b>SCRIPPS FORMATION</b>			
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								
85	20	100+	0.2		Yellowish red, damp, very dense, fine to medium grained, poorly graded sand with silt (SP-SM).	22.1		
86								
87								
88								
89								
90	21	100+	0.3			22.0		
91								
92								
93								


**PROJECT NO.  
44F1**

**ALLIED GEOTECHNICAL ENGINEERS, INC.**

**FIGURE A-34**



**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 96 97 98 99 100	22	100+	0.4		<p><b>SCRIPPS FORMATION</b></p> <p>Abundant gravels and cobbles from 94' to 97'.</p> <p>Medium gray to dark gray claystone (CL/CH), interlayered with yellow brown silty sand (SM).</p>	25.8		<p>Did not attempt sampling at 95' due to abundant gravel and cobble.</p>

**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	QVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
1					<p><b>FILL</b></p> <p>Yellow brown, damp, sand lean clay (CL) with scattered sub-rounded and locally fractured gravel up to 3" in maximum dimension.</p> <p>Similar to above, soil is intermixed with angular chunks of cemented sandstone and claystone up to 2" in size.</p> <p>Mottled olive to pale gray color.</p>			
2	1	40	0.2			13.7	111.5	
3	2							
4	3	21	0.4			20.5		
5	4							
6	5	45	0.2			22.6	98.2	
7	6	19	0.3			20.4		
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26	7	33	0.2		22.5	102.2		
27								
28				?	?			?
29				/	<p><b>SCRIPPS FORMATION</b> - Olive gray to pale yellowish red, damp, hard, sandy lean clay (CL).</p>			

**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		<b>SCRIPPS FORMATION</b>	21.2	108.5	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	9							
34								
35								
36	10	100+	0.7			21.5		
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								
61	16	74	0.0		Pale reddish yellow silty sandstone (SM).	20.8		

**PROJECT NO.  
44F1**

**ALLIED GEOTECHNICAL ENGINEERS, INC.**

**FIGURE A-37**

**BORING NO. H-13 (Continued)**



DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	QVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
63					<b>SCRIPPS FORMATION</b>			
64								
65	17	100+	0.1		Olive to olive gray sandy lean clay (CL).	20.4	110.5	
66								
67								
68								
69								
70	18	88	0.2			22.0		
71								
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	20	100+	0.1			20.7		
81								
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								

**PROJECT NO.  
44F1**

**ALLIED GEOTECHNICAL ENGINEERS, INC.**

**FIGURE A-38**

**BORING NO. H-13 (Continued)**

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	QVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
95	23	100+	0.0		<b>SCRIPPS FORMATION</b> Medium gray to dark gray, hard claystone (CL/CH).	22.6		
96								
97	24	100+	0.0			23.6		
98								
99								
100								
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	OWM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
1					<p><b>FILL</b></p> <p>Olive yellow, olive green and yellow brown, damp to wet, sandy clay (CL).</p>			
2	1	14	2.1			22.0		
3	2							
4					<p>Very dark gray, wet, sandy clay (CL) with scattered sub-angular and locally fractured gravel up to 2" in maximum dimension.</p>			
5	3	30	2.4			20.4	107.4	
6					<p>Yellow brown to olive yellow to olive, wet, clayey sand (SC) and fine-grained silty sand (SM).</p>			
7	4							
8	5	14	2.6			17.3		
9					<p>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.</p>			
10	6	58	0.2			17.3	113.5	
11	7							
12					<p>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.</p>			
13	8							
14	9	21	2.1		15.2			
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
					<p>SCRIPPS FORMATION - Olive yellow to pale olive, damp, hard, sandy lean clay (CL).</p>			

**PROJECT NO. 44F1**

**ALLIED GEOTECHNICAL ENGINEERS, INC.**

**FIGURE A-40**



**BORING NO. H-14 (Continued)**

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	QVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
31	10	100+	0.1		<b>SCRIPPS FORMATION</b>  Olive yellow to pale olive sandy lean clay (CL).	20.6	102.5	
32								
33								
34								
35								
36	11	96	0.3					
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								
51	15	100+	0.1			21.4	98.2	
52								
53								
54								
55								
56	16	100+	0.0			17.1		
57	17							
58								
59								
60	18	100+	0.1					
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)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
63					<b>SCRIPPS FORMATION</b>			
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								
75	21	100+			72' - 78', gravel zone.			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 96 97 98 99 100	25	100+	0.2		<p align="center"><b>SCRIPPS FORMATION</b></p> <p>Gray, damp, hard sandy lean clay (CL).</p>	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.

**PROJECT NO.**  
44F1

**ALLIED GEOTECHNICAL ENGINEERS, INC.**

**FIGURE A-43**

**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	OVN READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
1					<b>EXISTING PAVEMENT:</b> 4.5" A.C. over 4" misc. base			
2					<b>FILL:</b> Medium brown to yellow brown, damp, silty sand (SM) with scattered sub-rounded gravel up to 3" in maximum dimension.			
3				?				? - - - - ?
4					<b>SCRIPPS FORMATION</b>			
5	1	100+	0.0		Olive yellow to olive gray to pale reddish yellow, damp, hard, highly plastic clay (CH).	21.7	102.8	
6	2							
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		

**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	OVN 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					<b>SCRIPPS FORMATION</b>			
4					Olive to olive yellow, damp, hard, sandy siltstone (ML).			
5	1	75	0.0			21.0	103.5	
6								
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	OVN READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
1	1				Bark & wood chips in the upper 6"			
2					<b>COLLUVIAL DEPOSITS</b> - Dark yellow brown, wet, stiff, highly plastic clay (CH) with scattered sub-rounded and fractured gravel and cobbles up to 4" in max. dimension.			
3								
4					<b>SCRIPPS FORMATION</b> Olive yellow to pale reddish yellow, damp, hard, lean clay (CL).	22.3	102.1	
5	2	80	0.0					
6					Pale reddish yellow to reddish brown, damp, very dense, fine to medium-grained, silty sandstone (SM).	20.7		
7	3							
8					Abundant gravel/cobbles from 17' to 19.5'	20.5	83.2	
9	4	100+	0.0					
10								
11								
12								
13								
14								
15	5	100+	0.0					
16								
17								
18								
19	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	OVN READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
1					<b>FILL</b> - 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					<b>SCRIPPS FORMATION</b> Olive to pale olive yellow to pale reddish yellow, damp, very dense, fine-grained, silty sandstone (SM).  Abundant gravel between 10' and 11.5'.  Very dense, fine-grained, silty sandstone (SM).			
5	1	73	0.0			21.4		
6	2							
7								
8								
9								
10	3	100+						Sampler bouncing on rock, no recovery
11								
12								
13	4							
14								
15								
16	5	57	0.0		21.4			
17								
18								
19								
20	6	100+	0.0		20.6	105.4		
21								
22								

**NOTES:**  
 Bottom of borehole at 21'  
 No groundwater or seepage encountered during drilling operations

**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	OVN READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
1					Bark & wood chips in the upper 6"			
2					<b>FILL:</b> Yellow/olive brown, damp, fine-grained silty sand (SM) with scattered sub-angular gravel up to 2" in maximum dimension.			
3								
4								
5	1	52	0.1		<b>SCRIPPS FORMATION</b>	20.2		
6					Pale olive to pale reddish yellow, damp, dense to very dense, fine-grained, silty sandstone (SM).			
7	2							
8					Abundant gravels and cobbles between 8' and 10'.			5/11/17, refusal on gravel/cobbles.
9								Relocate boring 5' east
10	3	54	0.1		Gray to pale reddish yellow, damp, hard, sandy lean clay (CL).	24.7		and resume drilling on 5/25/17 using 4" air rotary.
11								
12								
13								
14								
15	4	82	0.0		Olive brown to olive gray, hard, claystone (CL/CH).	21.9	109.4	
16								
17								
18								
19								
20								
21	5	66	0.0		Medium gray to pale reddish yellow, sandy lean clay (CL).	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	QVM 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					<b>SCRIPPS FORMATION</b> Light gray to pale yellowish red, damp, hard, lean clay (CL).			Drill to 10' using 8-inch HSA, then switch to 4" mud rotary.
3	1							
4	2	55	0.1			19.3		
5								
6	3							
7	4	100+	0.0			13.4	106.8	
8								
9					Gravel bed between 12' and 13'.			
10					Olive gray, damp, hard, lean clay (CL).			
11	5	100+	0.1			22.0		
12					Olive gray to pale reddish yellow.			
13								
14	6	100+	0.2			18.2	113.5	
15								
16								
17	7	100+	0.0			21.6		
18								
19								
20								
21								
22								
23								
24								
25								
26								
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		
31	8	100+	0.0		<b>SCRIPPS FORMATION</b>  Olive gray to reddish yellow, damp, hard, sandy lean clay (CL).	18.7	108.0			
32										
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										
51	12	100+	0.0			19.6	112.8			
52										
53										
54										
55										
56	13	99	0.3			18.8				
57										
58										
59										
60										
61	14	100+	0.0		Olive brown, hard, medium to highly plastic claystone (CL/CH).	21.4	114.4			

**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					<b>SCRIPPS FORMATION</b>			
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	<p><b>NOTES:</b></p> <p>Bottom of borehole at 80.5 feet.</p> <p>Unable to determine if groundwater is present. Method of drilling required introduction of water into borehole.</p>							

**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	OVN READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
1					<b>FILL:</b> 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	1				<b>VERY OLD PARALIC DEPOSITS</b>			
5	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		
6								
7								
8								
9					<b>SCRIPPS FORMATION</b>			
10								
11	3	100+	0.1		Olive yellow to olive brown, damp, hard, sandy lean clay (CL).	19.7	105.5	
12								
13	4							
14								
15	5	75	0.1			17.5		
16								
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



**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	OVN READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS	
1					<b>FILL</b> 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.			Gravels in the upper 3"	
2									
3					(transition in sample)				
4									
5	1	46	0.1	?		12.5	113.1	?	
6									
7					<b>SCRIPPS FORMATION</b>  Pale olive yellow to reddish yellow, damp, very dense, fine-grained silty sandstone (SM).  Olive gray to pale gray, damp, hard, sandy lean clay (CL).  Claystone contains 1/8" to 1/4" wide laminations of reddish yellow silty sandstone (SM).			Driller added water to assist in bringing soil cuttings to ground surface.	
8	2								
9									
10	3	70	0.5			19.2			
11									
12									
13									
14									
15	4	100+	0.0		20.5	106.6			
16									
17	5								
18									
19									
20	6	51	0.1		20.9				
21									
22									
23									
24									
25	7	100+	0.0		17.6	106.9			
26									
27									
28									
29									

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44F1**

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**FIGURE A-53**

**BORING NO. H-22 (Continued)**

DEPTH (FEET)	SAMPLES	BLOW COUNTS BLOWS/FOOT	QVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS	
31	8	87	0.3		<b>SCRIPPS FORMATION</b>	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	9	100+	0.0				14.8	110.9	
36									
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	QVM READING (PPM)	GRAPHIC LOG	SOIL DESCRIPTION	FIELD MOISTURE % DRY WT.	DRY DENSITY LBS./CU. FT.	REMARKS
63					<b>SCRIPPS FORMATION</b>			
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	<p><b>NOTES:</b></p> <p>Bottom of borehole at 80.5 feet.</p> <p>Unable to determine if groundwater is present. Method of drilling required introduction of water into borehole.</p>							

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44F1

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**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.

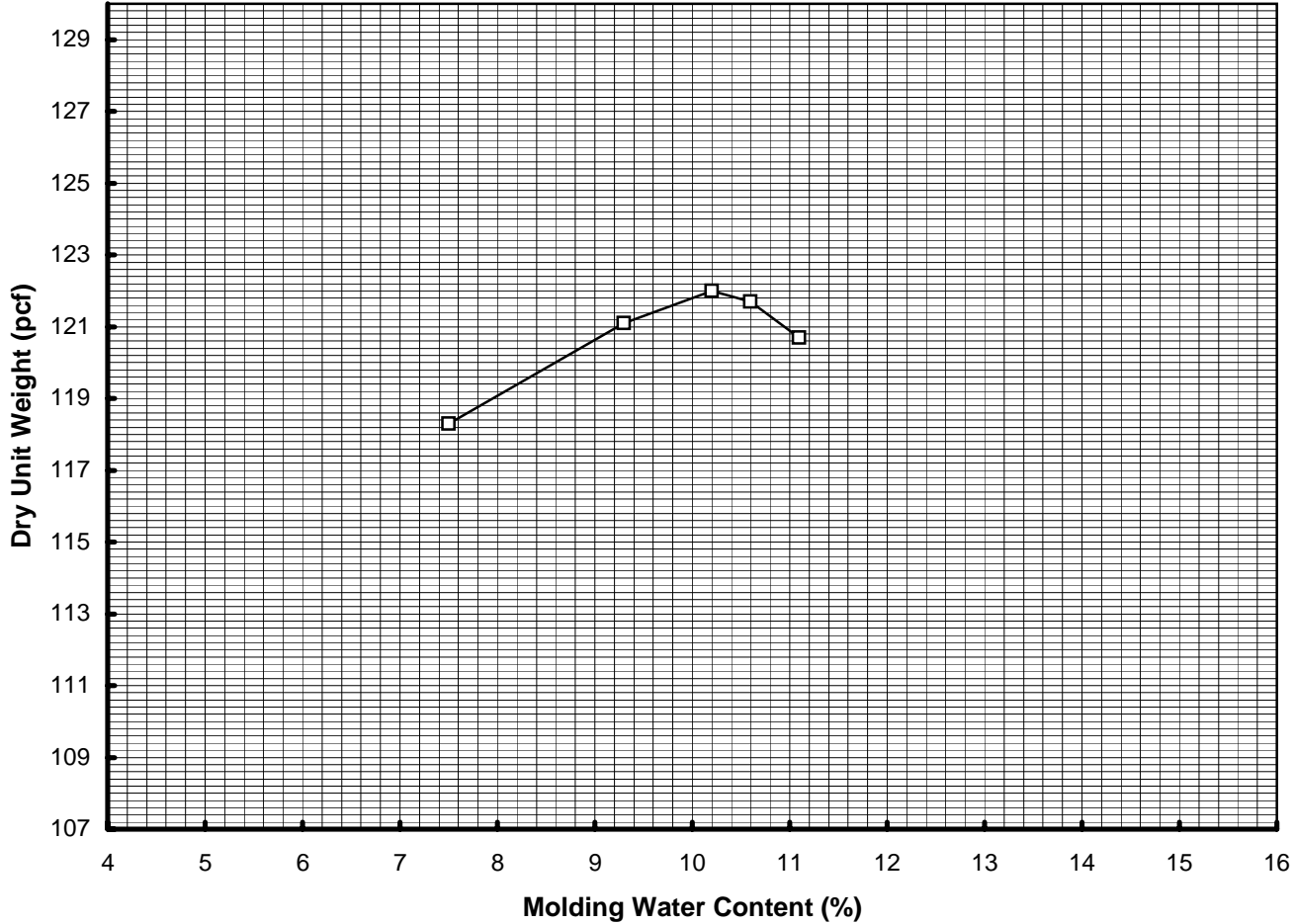
**Table B-1**  
**Summary of Expansion Index Test Results**

<b>Sample ID</b>	<b>Soil Classification</b>	<b>Expansion Index (%)</b>
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**

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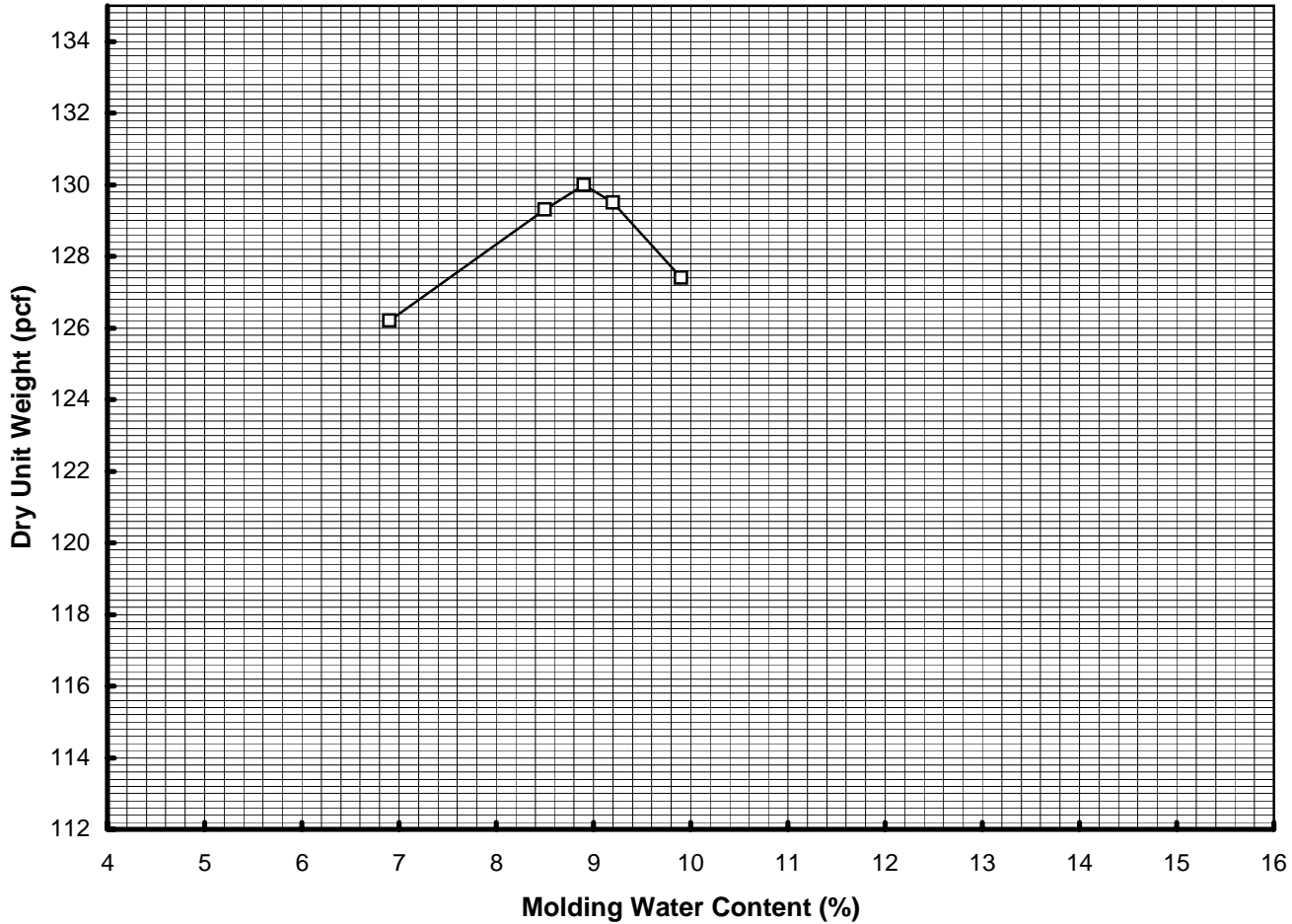
**FIGURE B-1**



### 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)

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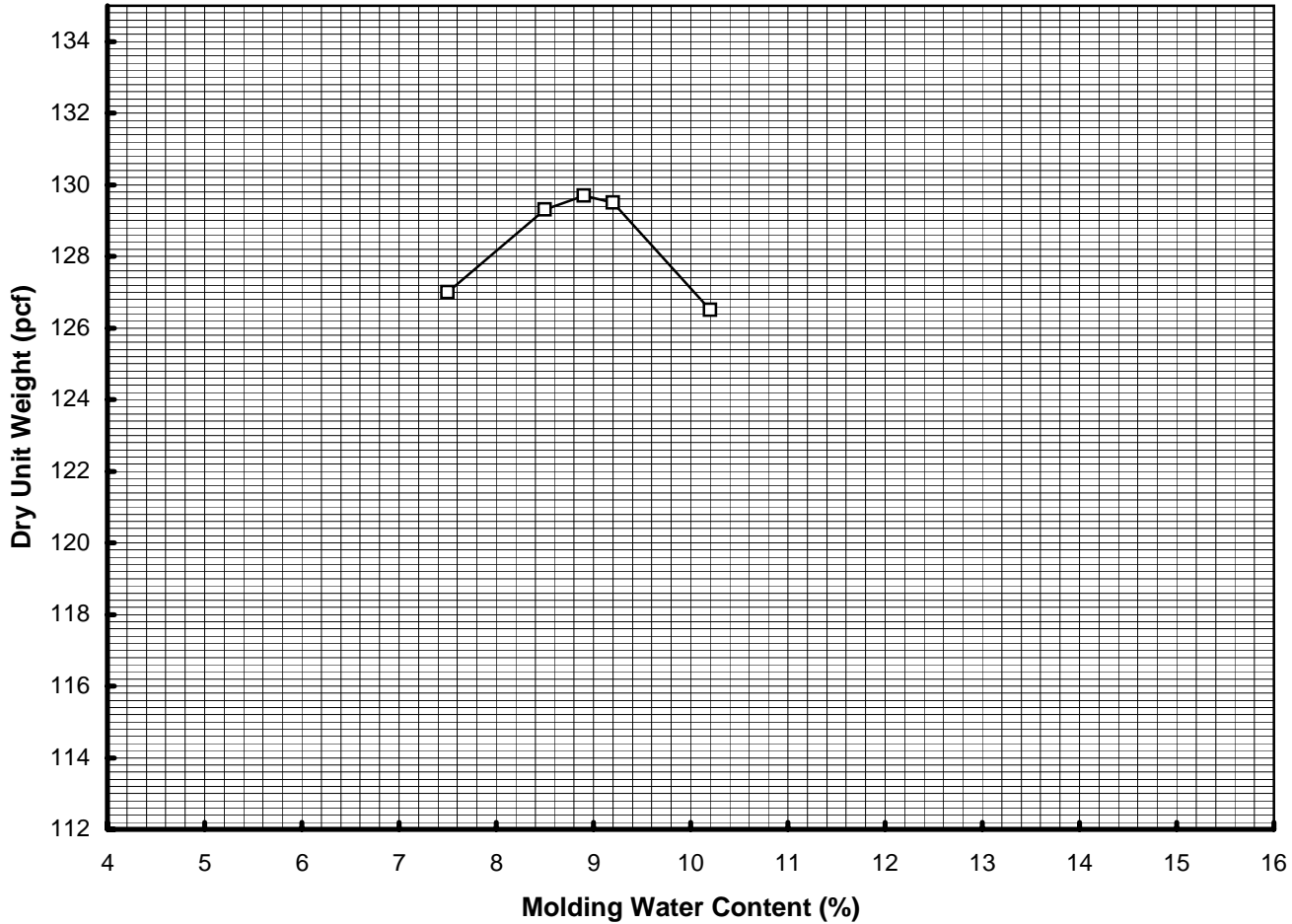
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**FIGURE B-2**

### 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

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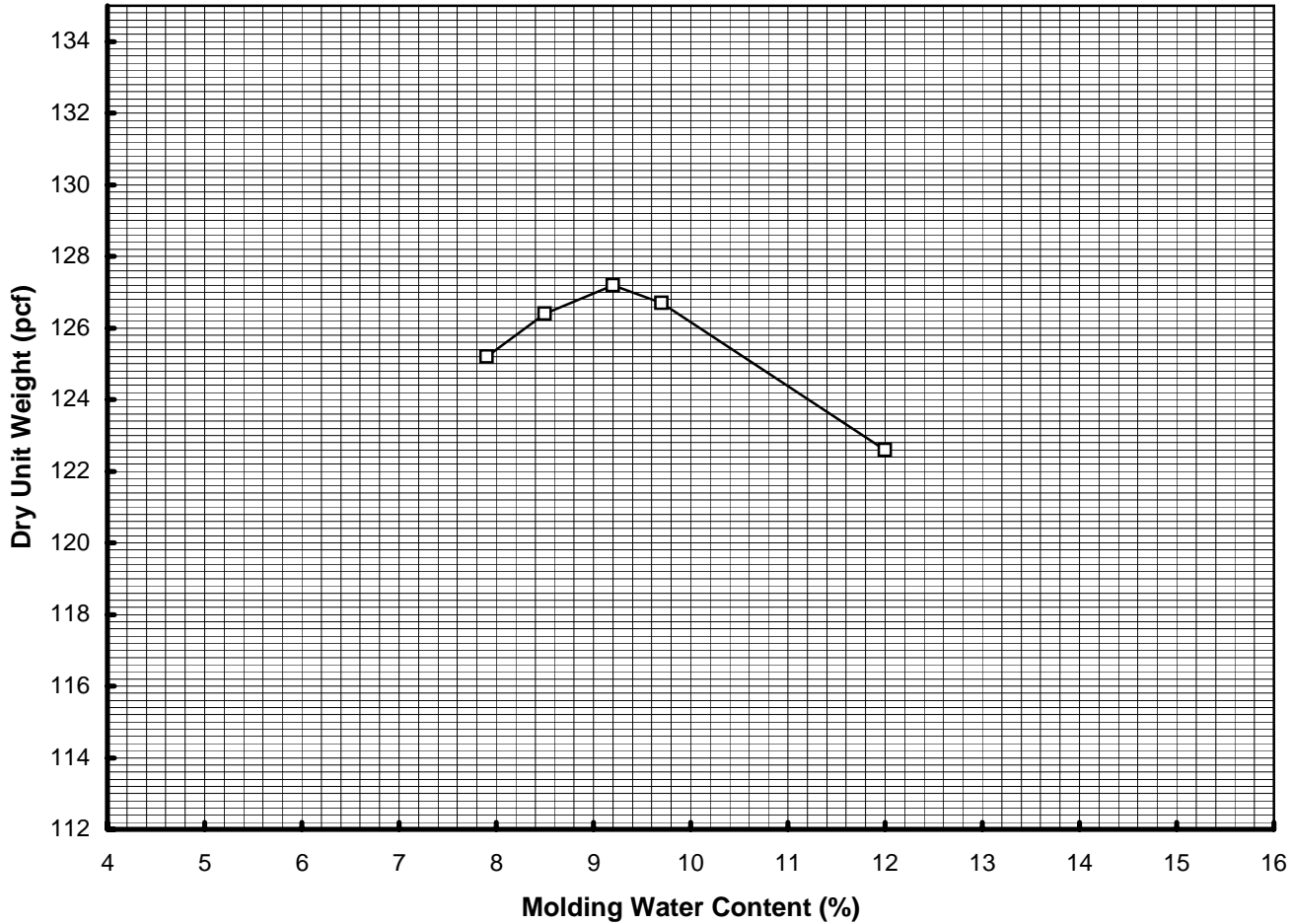
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**FIGURE B-3**

### 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

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**PROJECT NO. 44 F1**

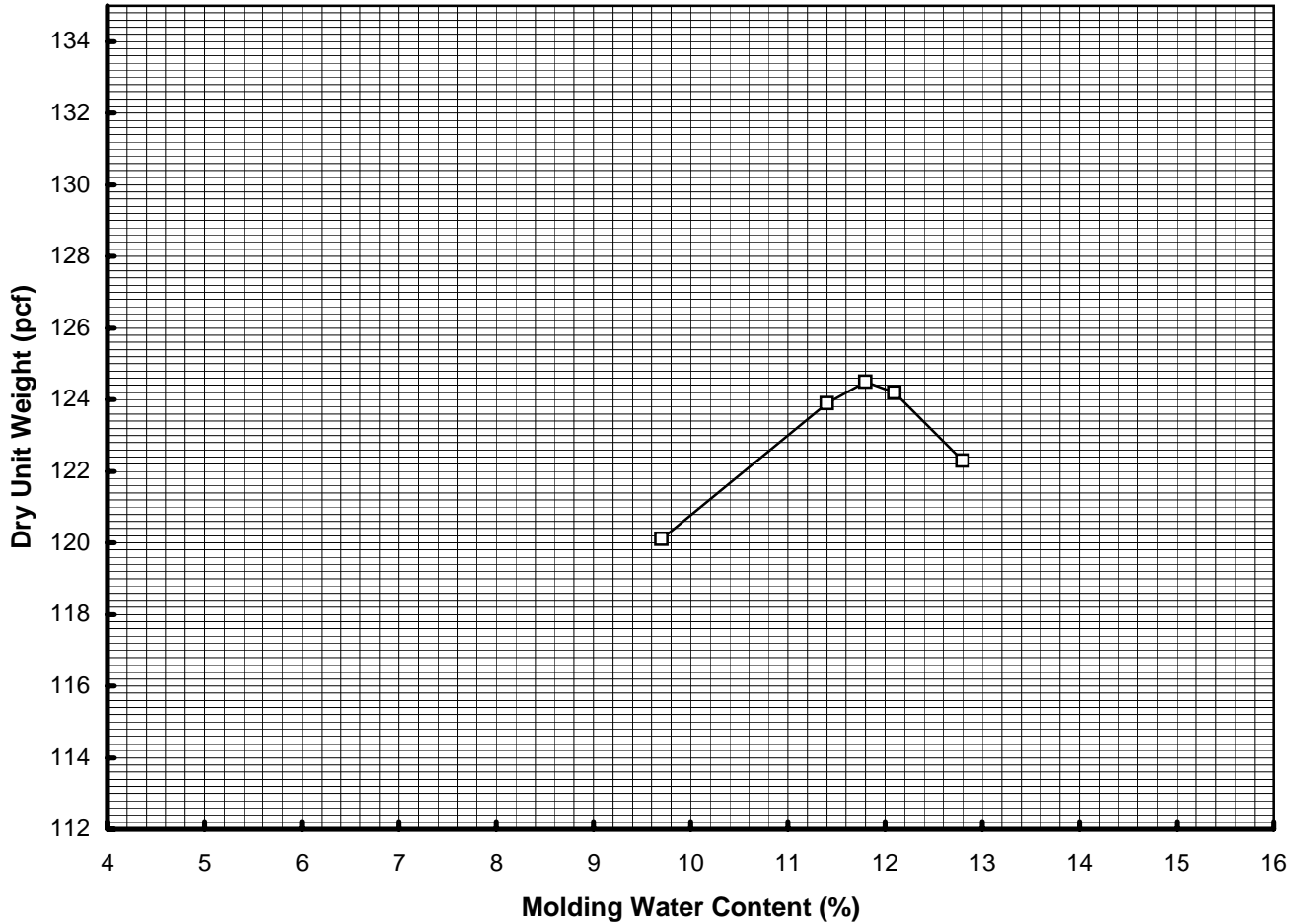
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**FIGURE B-4**

### 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

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**PROJECT NO. 44 F1**

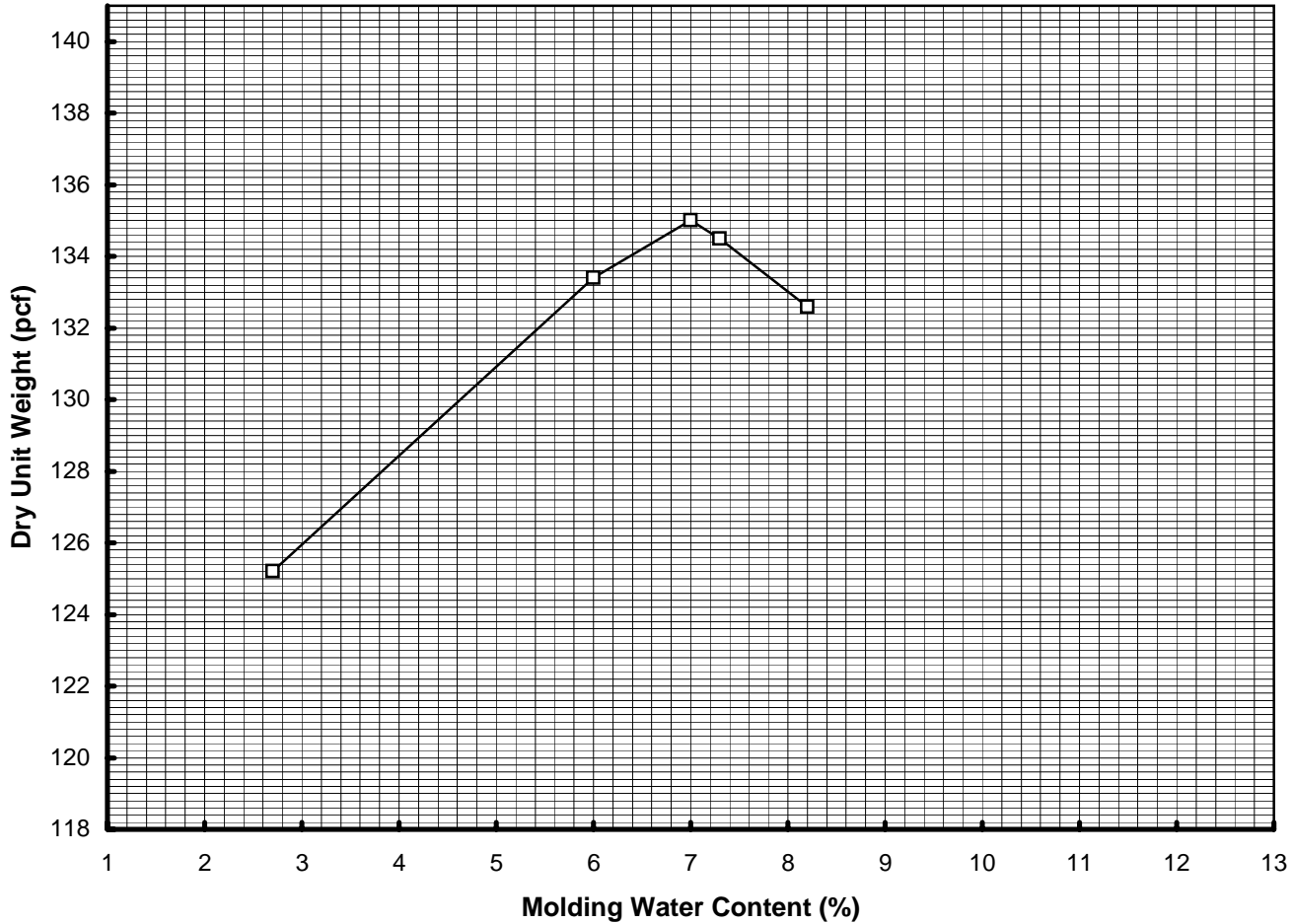
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**FIGURE B-5**

### 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

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**PROJECT NO. 44 F1**

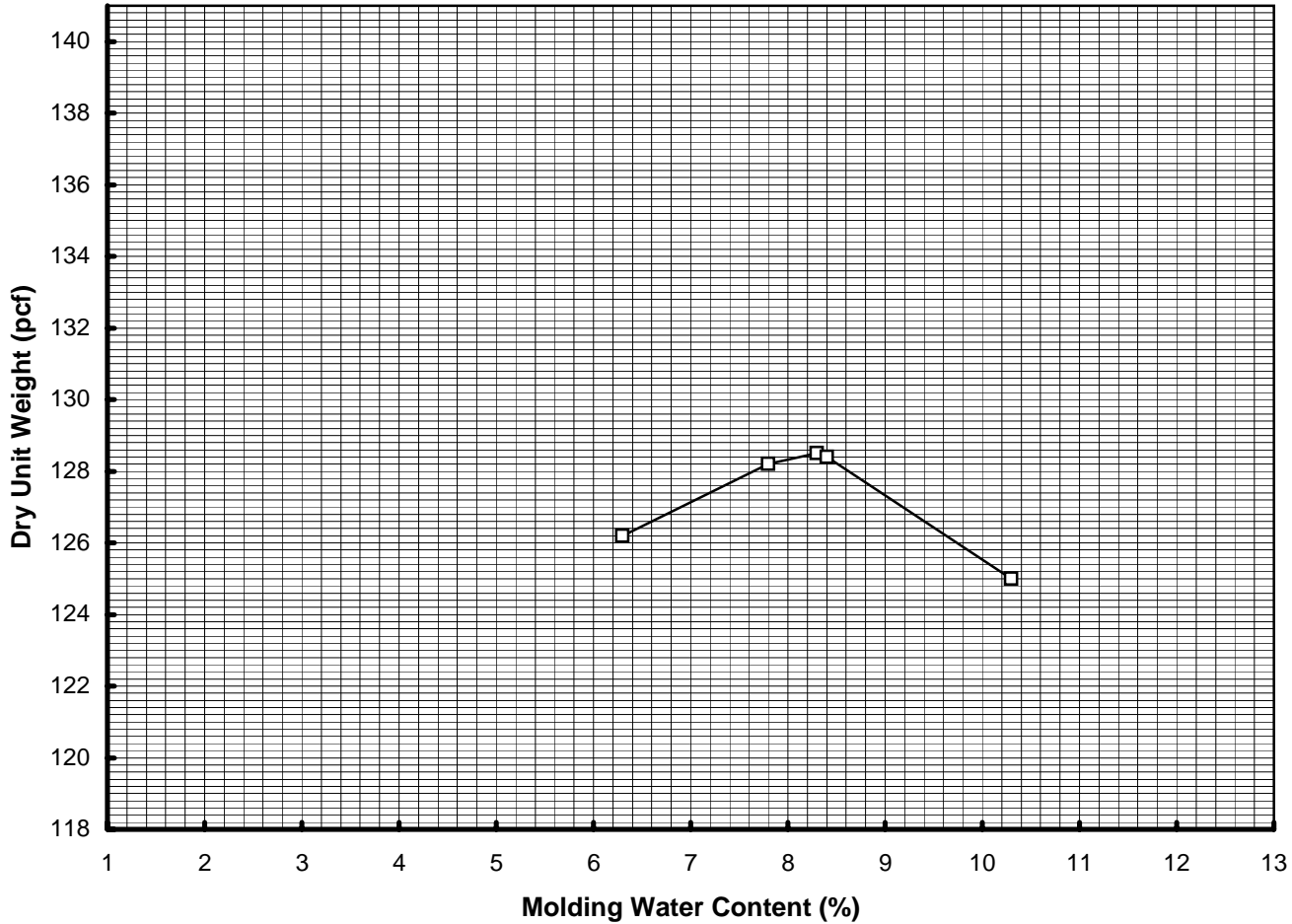
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**FIGURE B-6**

### 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  
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**PROJECT NO. 44 F1**

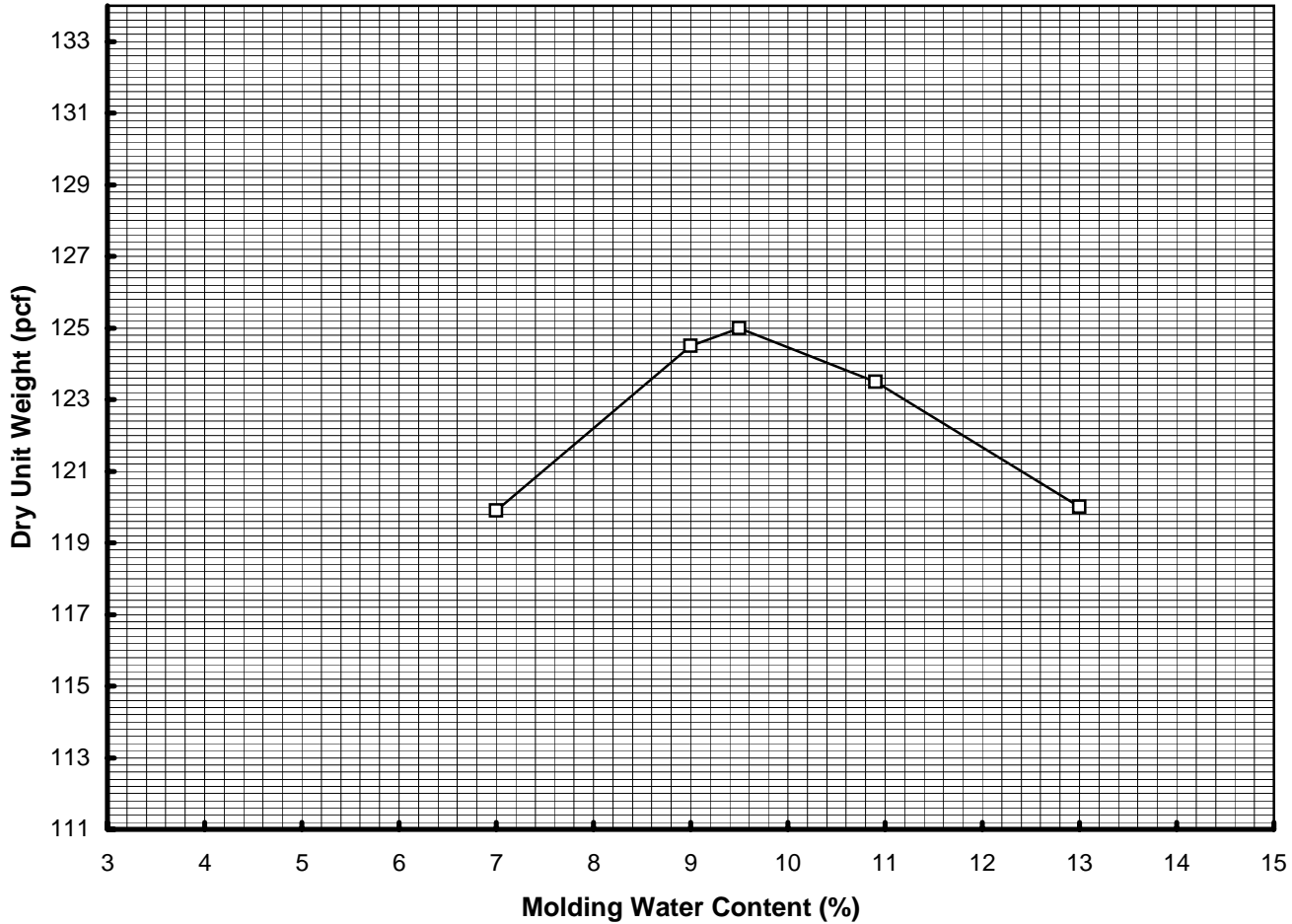
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**FIGURE B-7**

### 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  
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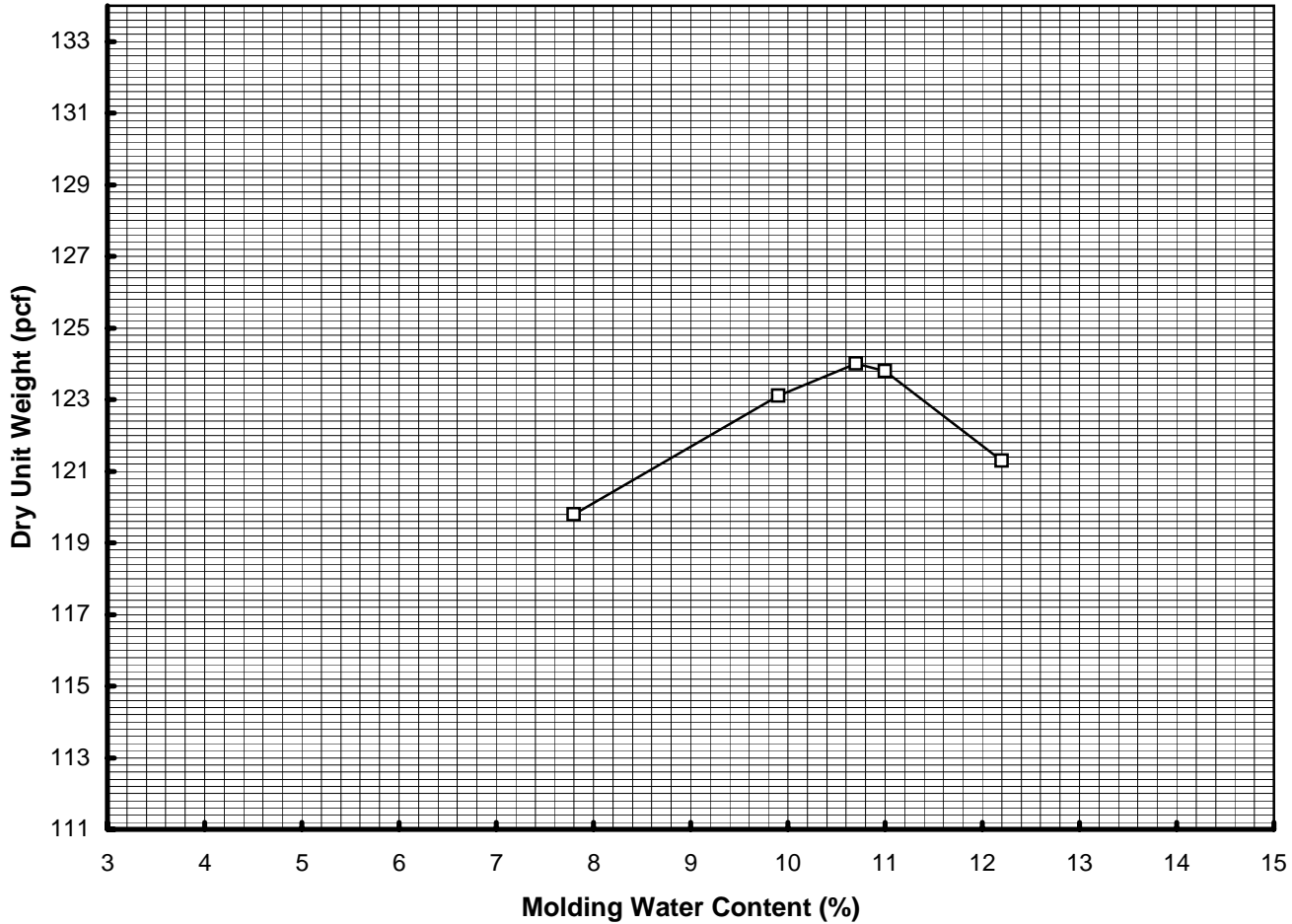
**FIGURE B-8**



### 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**

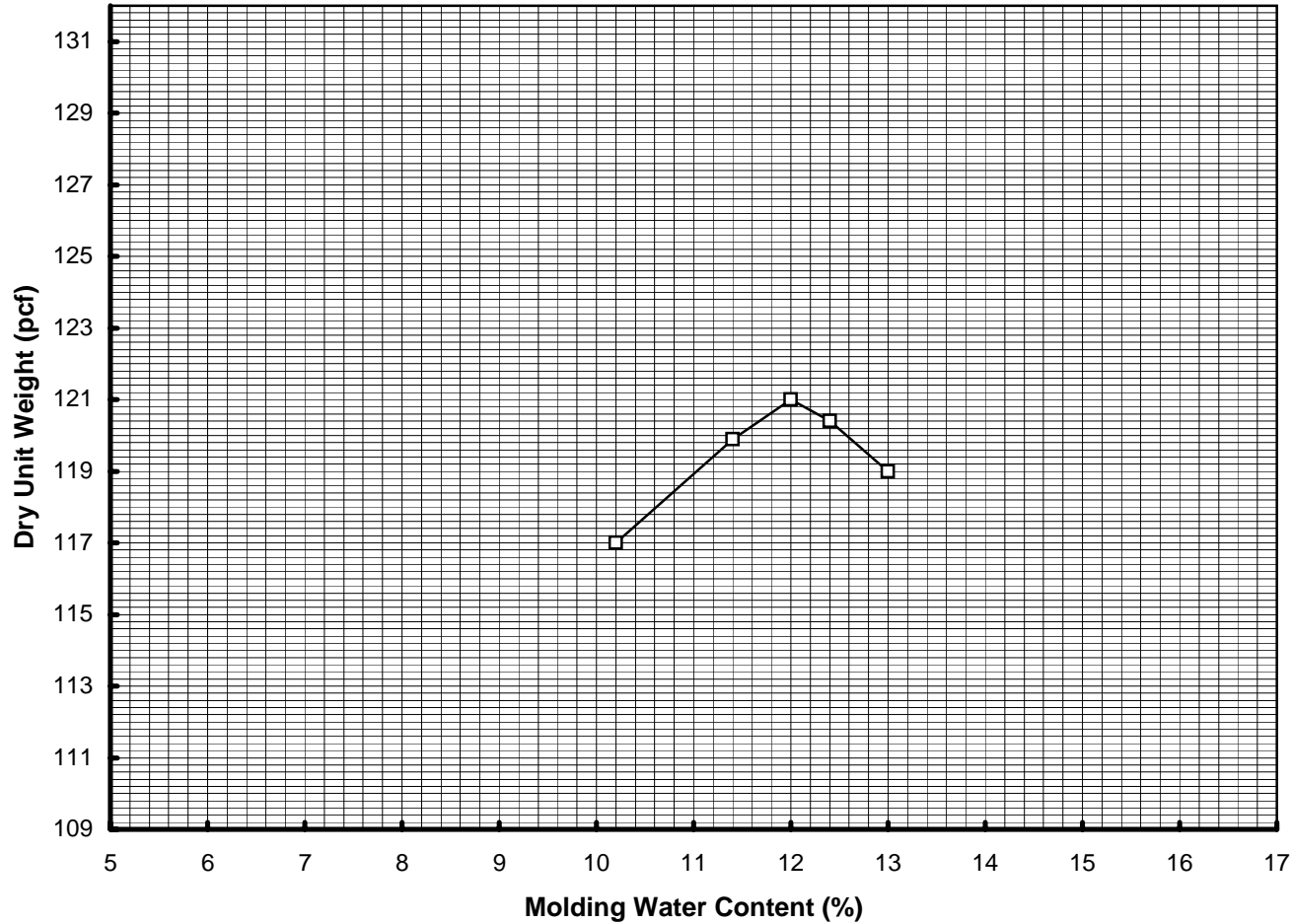
**ALLIED GEOTECHNICAL ENGINEERS, INC.**

**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)

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SAN DIEGO, CALIFORNIA**

**PROJECT NO. 44 F1**

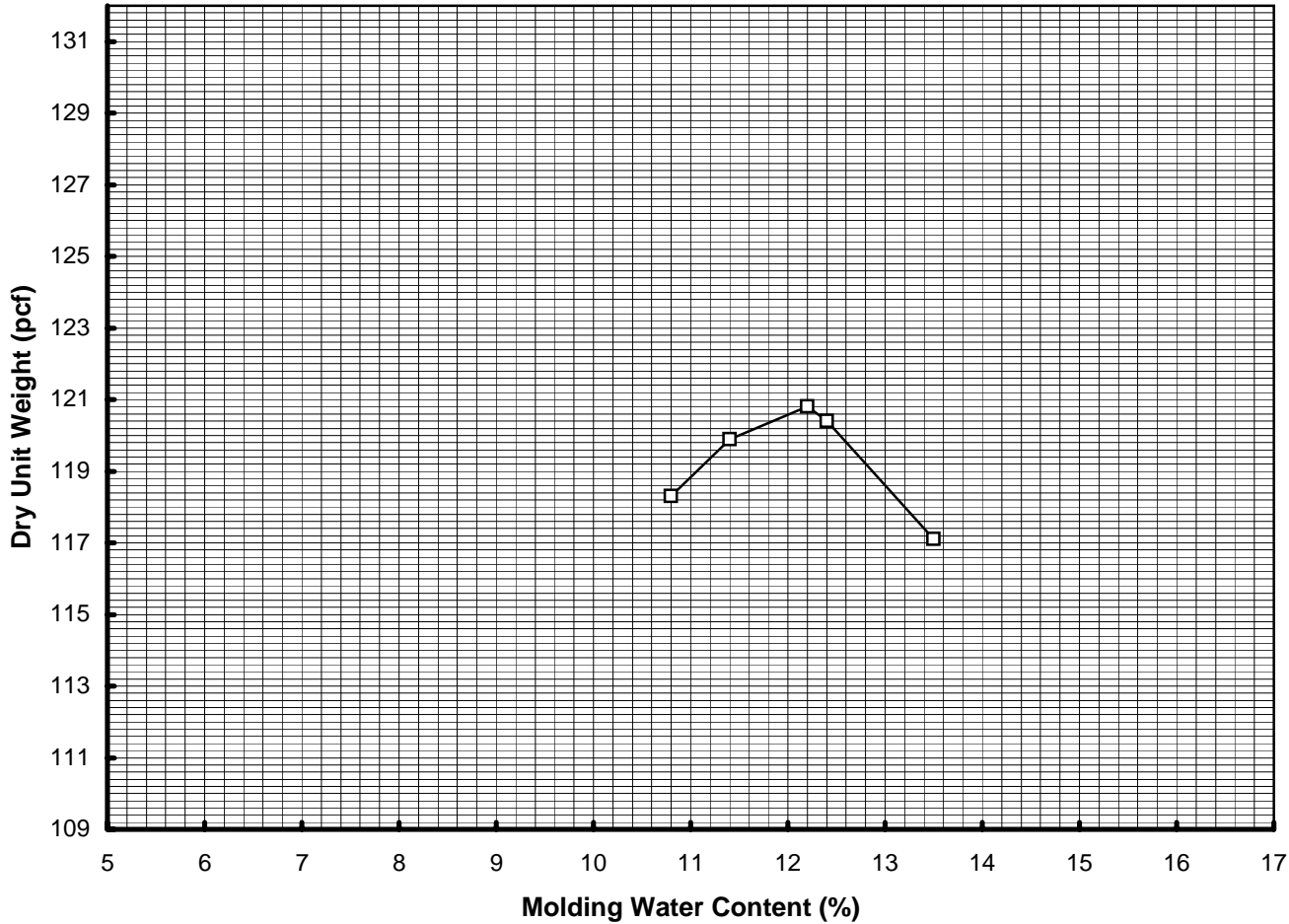
**ALLIED GEOTECHNICAL ENGINEERS, INC.**

**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**

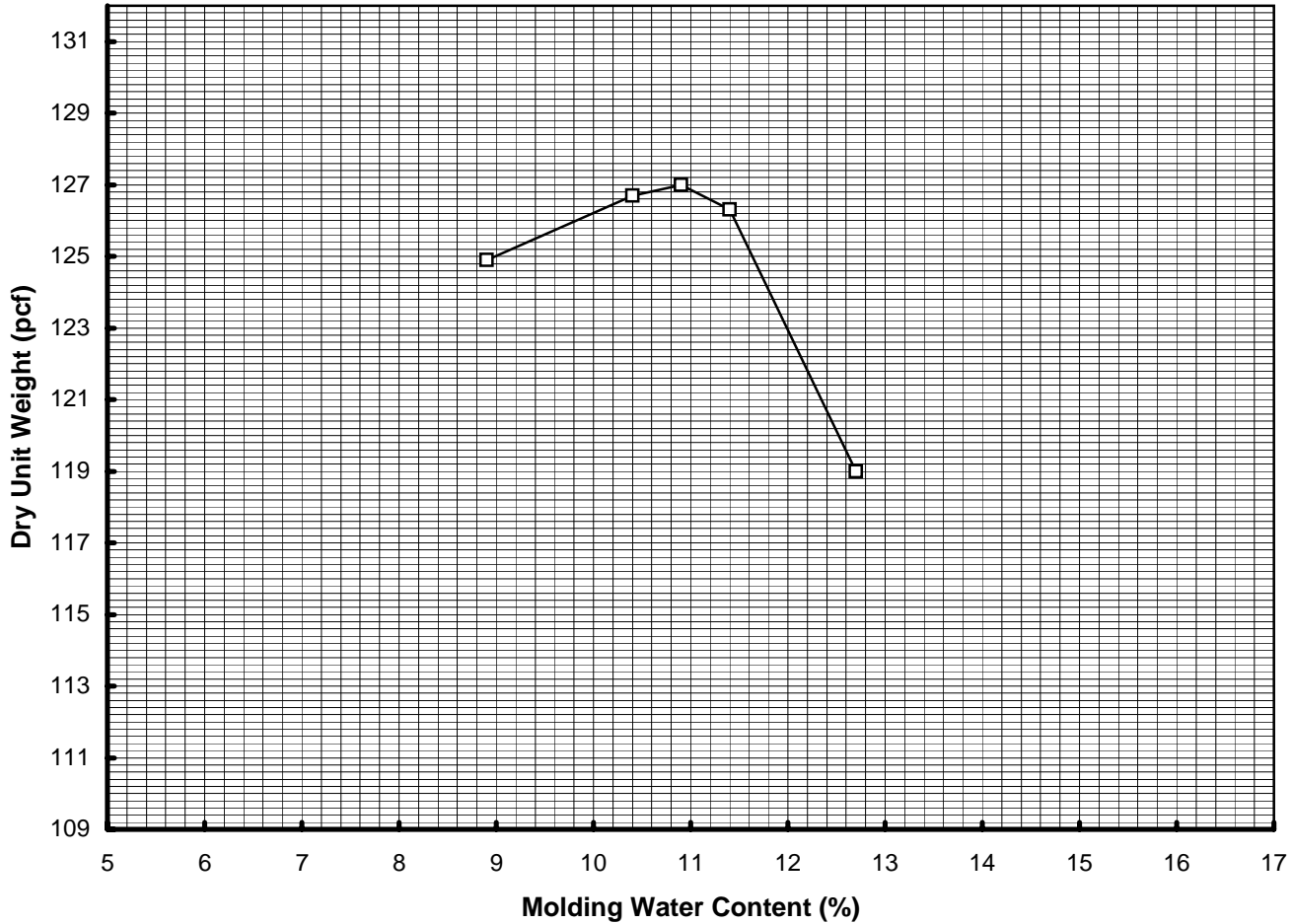
**ALLIED GEOTECHNICAL ENGINEERS, INC.**

**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**

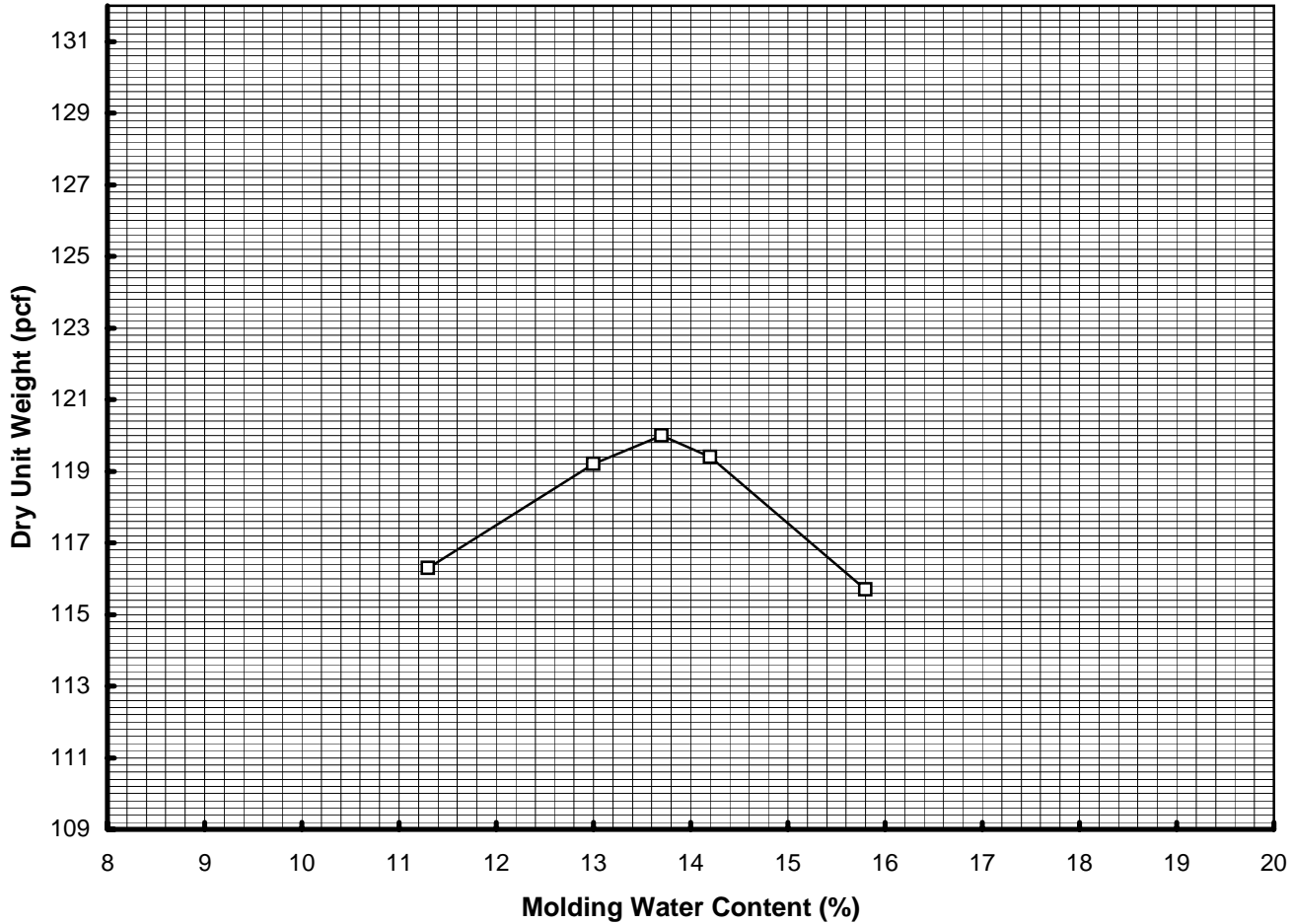
**ALLIED GEOTECHNICAL ENGINEERS, INC.**

**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**

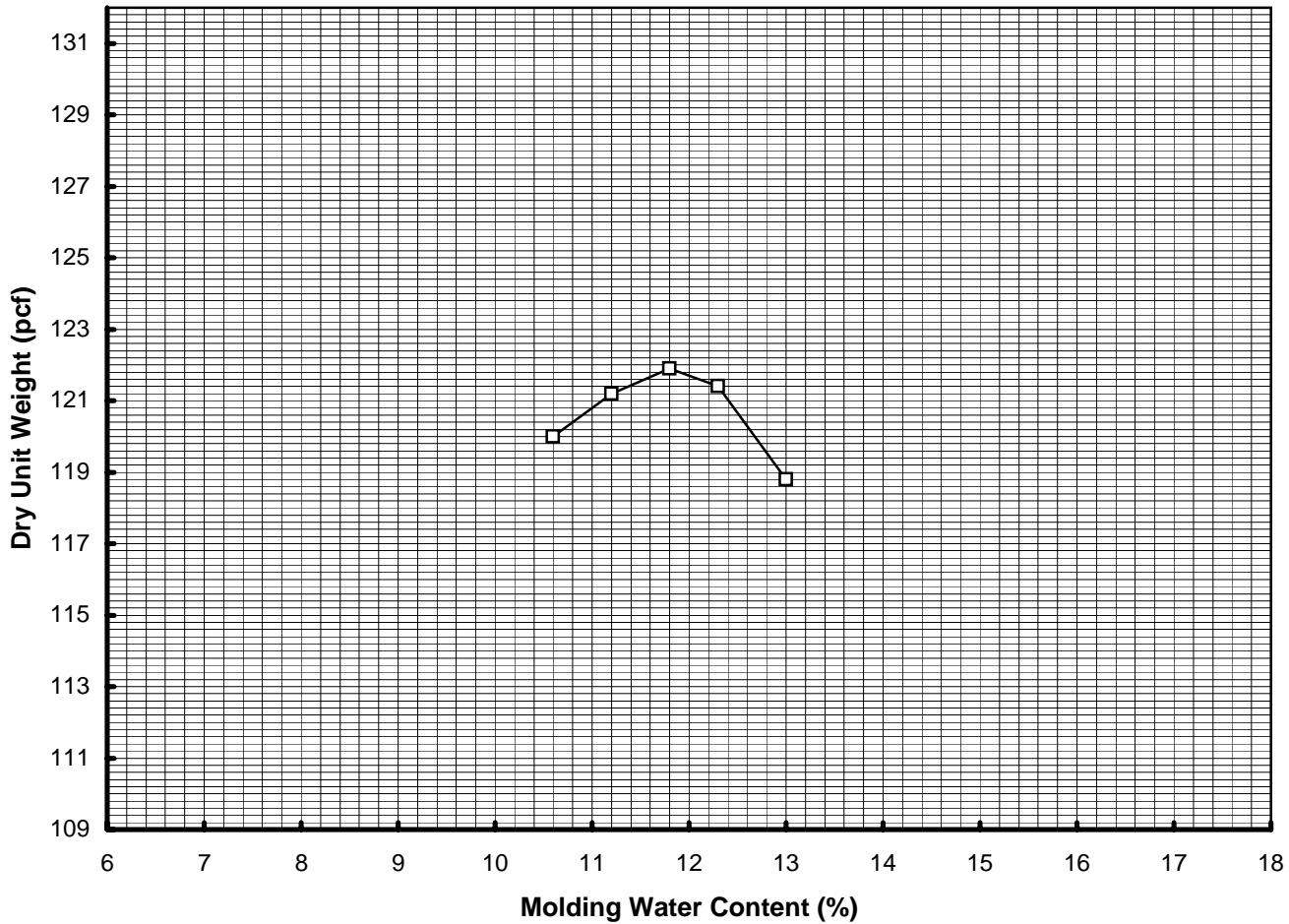
**ALLIED GEOTECHNICAL ENGINEERS, INC.**

**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**

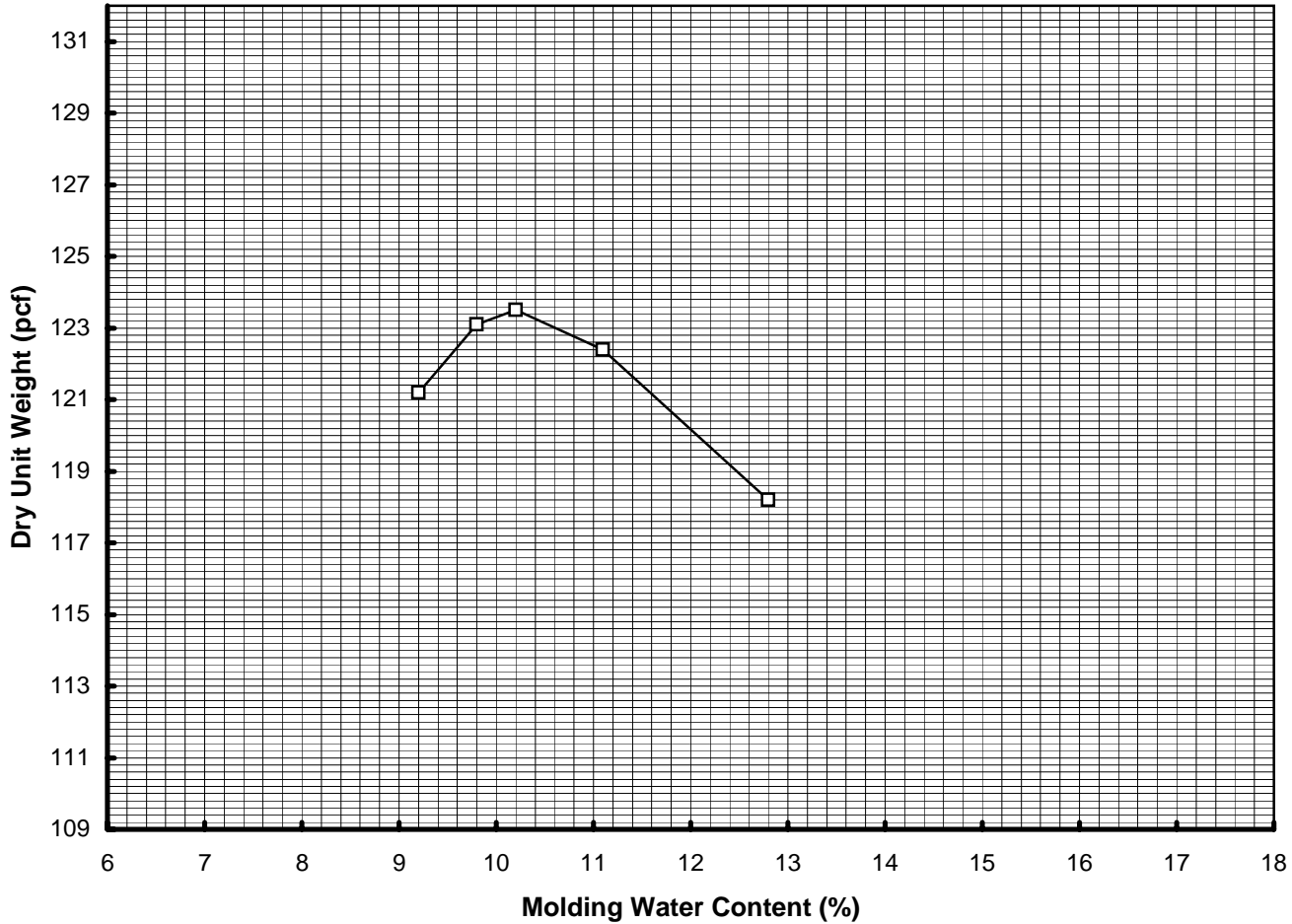
**ALLIED GEOTECHNICAL ENGINEERS, INC.**

**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.**

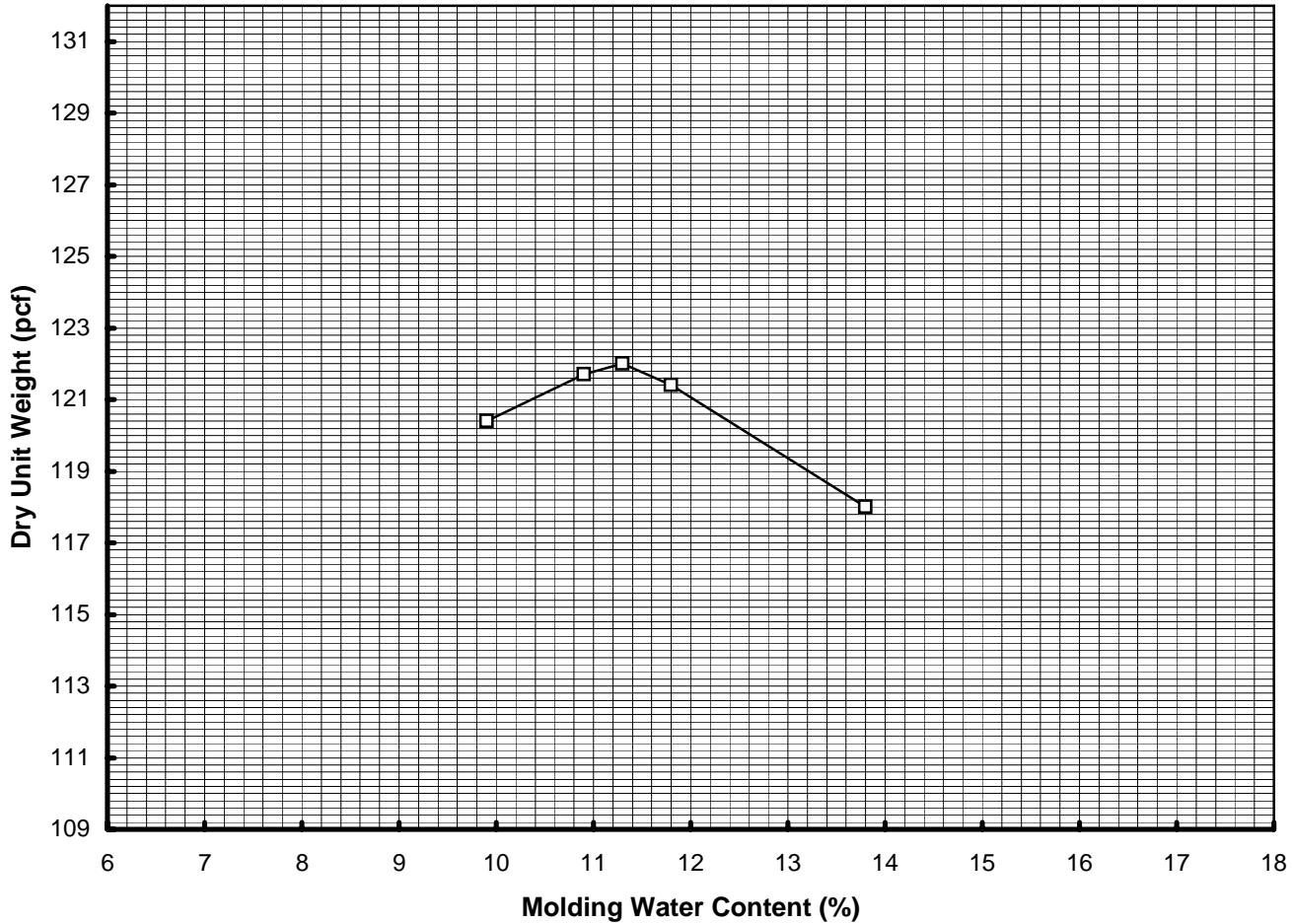
**FIGURE B-15**



### 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**

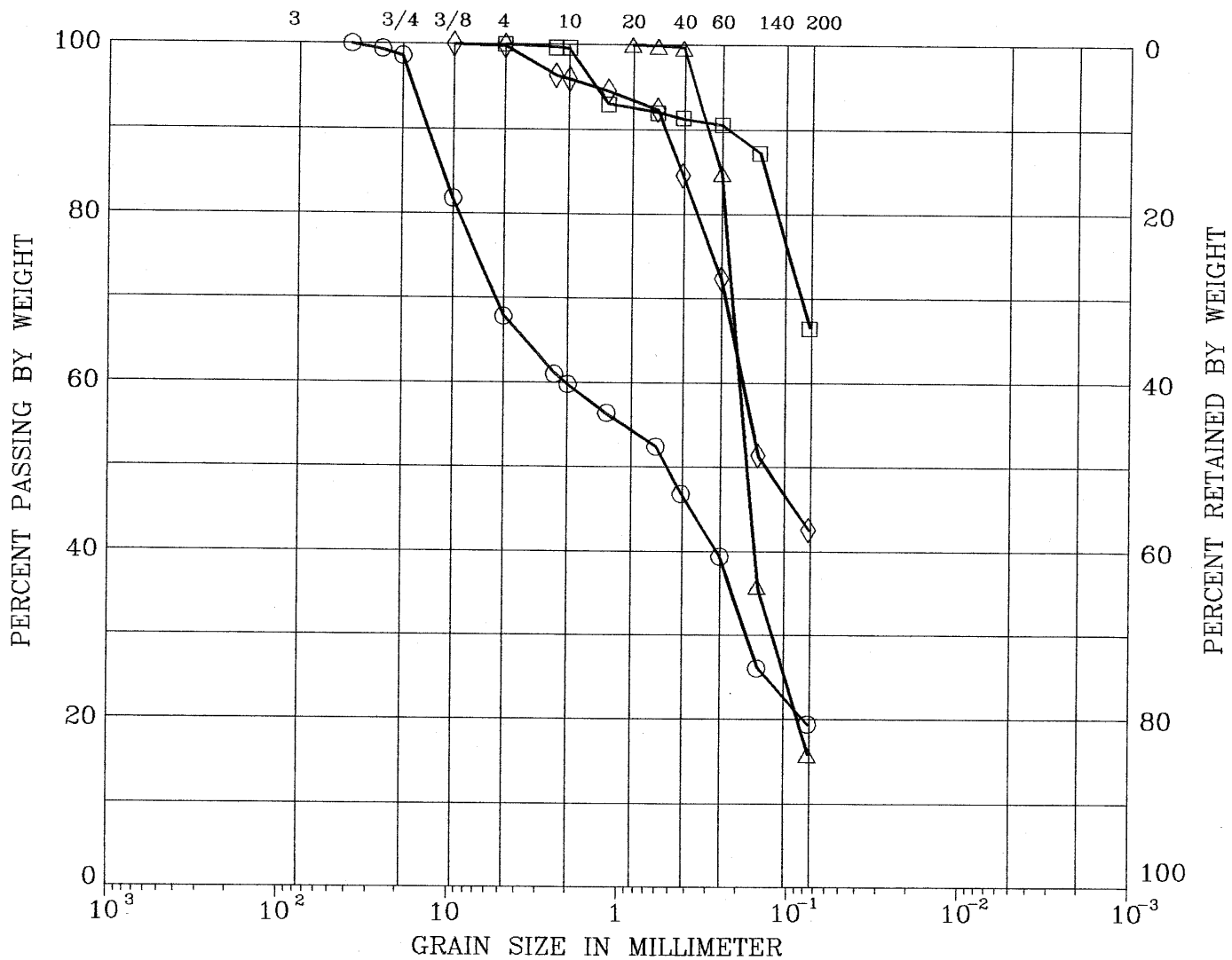
**PROJECT NO. 44 F1**

**ALLIED GEOTECHNICAL ENGINEERS, INC.**

**FIGURE B-16**

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	
U.S. SIEVE SIZE IN INCHES			U.S. STANDARD SIEVE No.			HYDROMETER



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

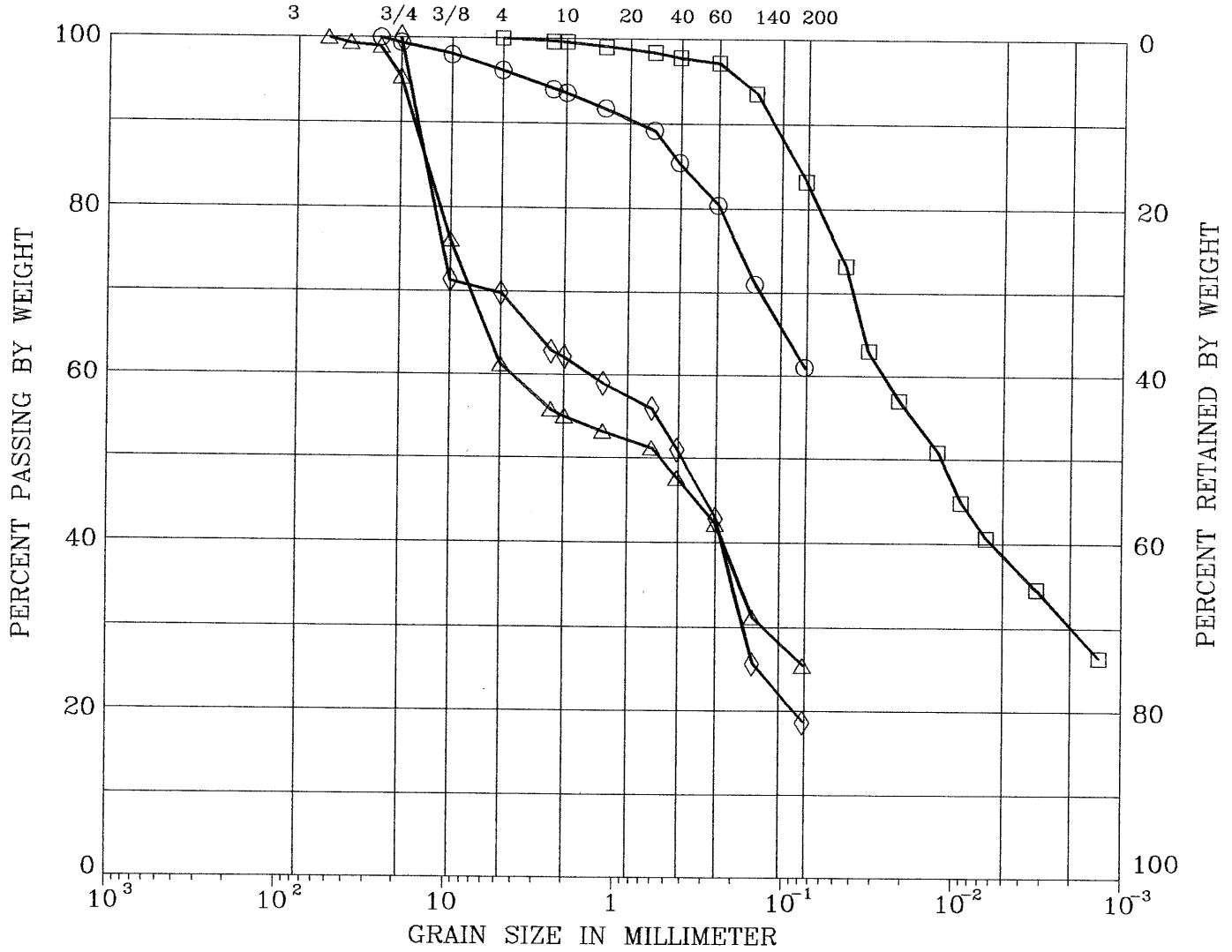
NORTH CITY WATER RECLAMATION PLANT EXPANSION

ALLIED GEOTECHNICAL ENGINEERS, INC.

GRAIN SIZE DISTRIBUTION Figure B-17

**UNIFIED SOIL CLASSIFICATION**

<b>COBBLES</b>	<b>GRAVEL</b>		<b>SAND</b>			<b>SILT OR CLAY</b>
	COARSE	FINE	COARSE	MEDIUM	FINE	
U.S. SIEVE SIZE IN INCHES			U.S. STANDARD SIEVE No.			HYDROMETER



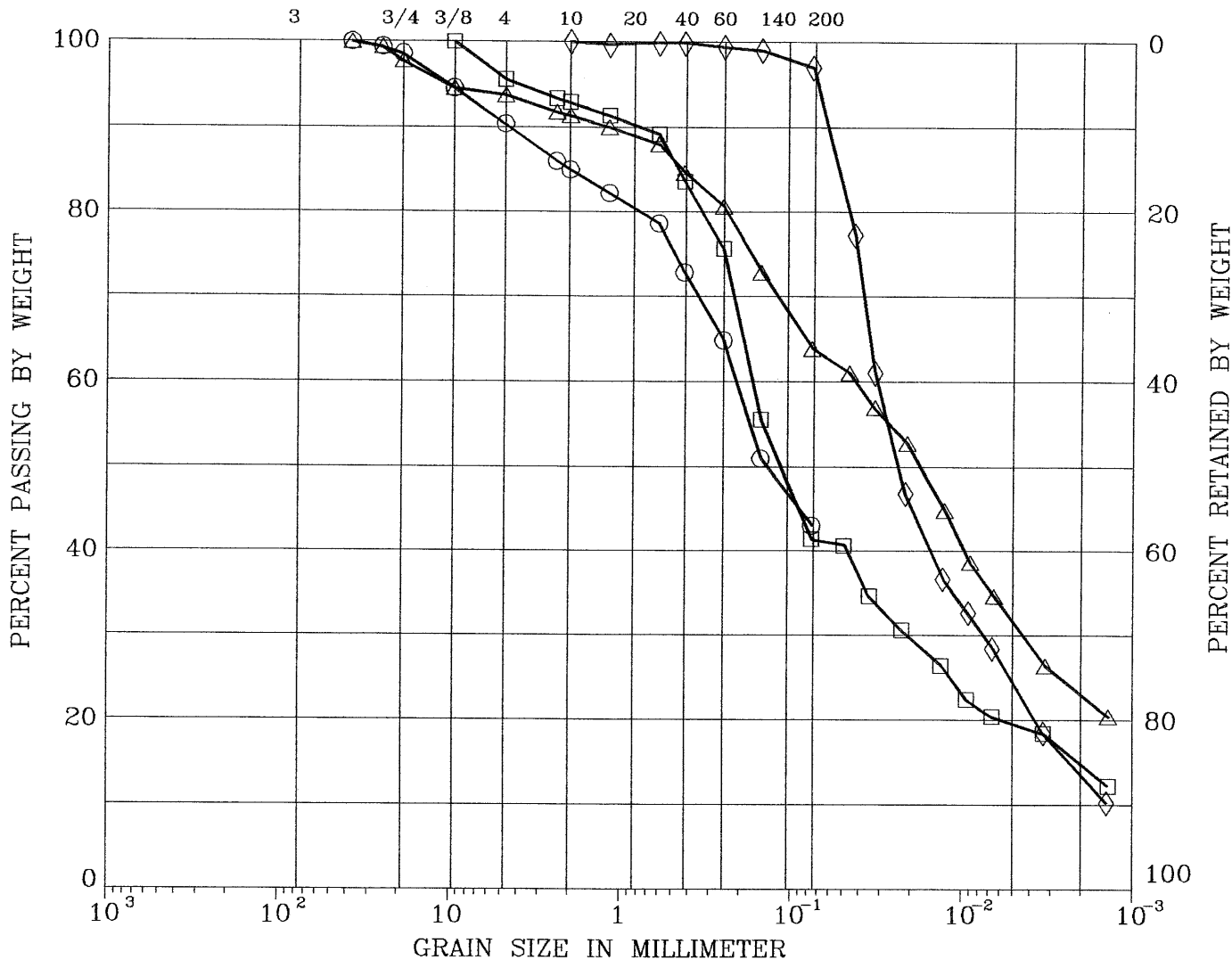
SYMBOL	BORING	DEPTH (ft)	LL (%)	PI (%)	DESCRIPTION
○	H-5 #2	4-7			CLAYS (CH)
□	H-5 #10	30-35	35	20	CLAYS (CL)
△	H-7 #2	5-8			SILTY GRAVEL (GM)
◇	H-7 #3	10-10.5			SILTY SAND (SM)

Remark :

Project No. 44F1	NORTH CITY WATER RECLAMATION PLANT EXPANSION
ALLIED GEOTECHNICAL ENGINEERS, INC.	GRAIN SIZE DISTRIBUTION Figure B-18

**UNIFIED SOIL CLASSIFICATION**

<i>COBBLES</i>	<i>GRAVEL</i>		<i>SAND</i>			<i>SILT OR CLAY</i>
	COARSE	FINE	COARSE	MEDIUM	FINE	
U.S. SIEVE SIZE IN INCHES			U.S. STANDARD SIEVE No.			HYDROMETER



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

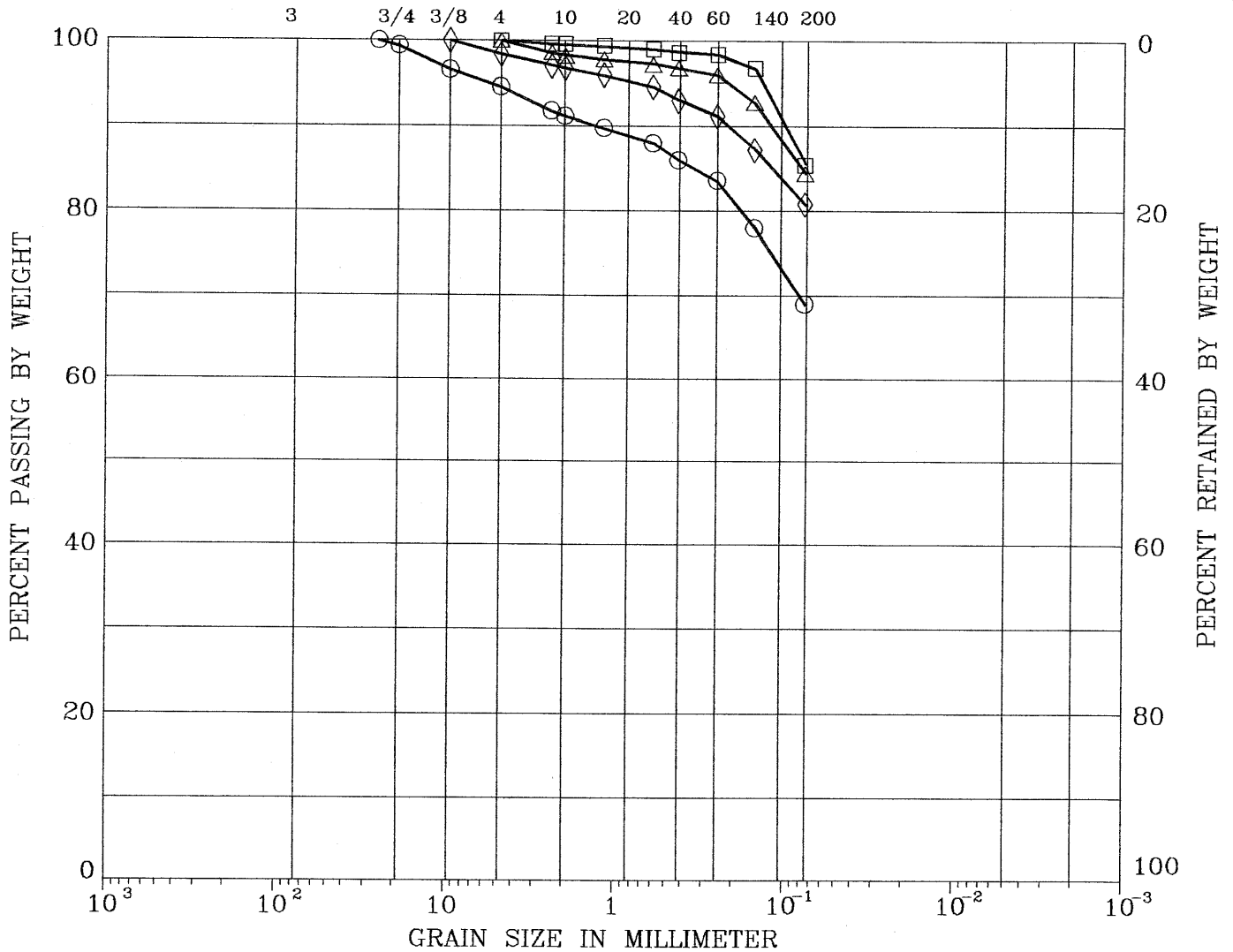
NORTH CITY WATER RECLAMATION PLANT EXPANSION

ALLIED GEOTECHNICAL ENGINEERS, INC.

GRAIN SIZE DISTRIBUTION Figure B-19

### UNIFIED SOIL CLASSIFICATION

<i>COBBLES</i>	<i>GRAVEL</i>		<i>SAND</i>			<i>SILT OR CLAY</i>
	COARSE	FINE	COARSE	MEDIUM	FINE	
U.S. SIEVE SIZE IN INCHES			U.S. STANDARD SIEVE No.			HYDROMETER



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

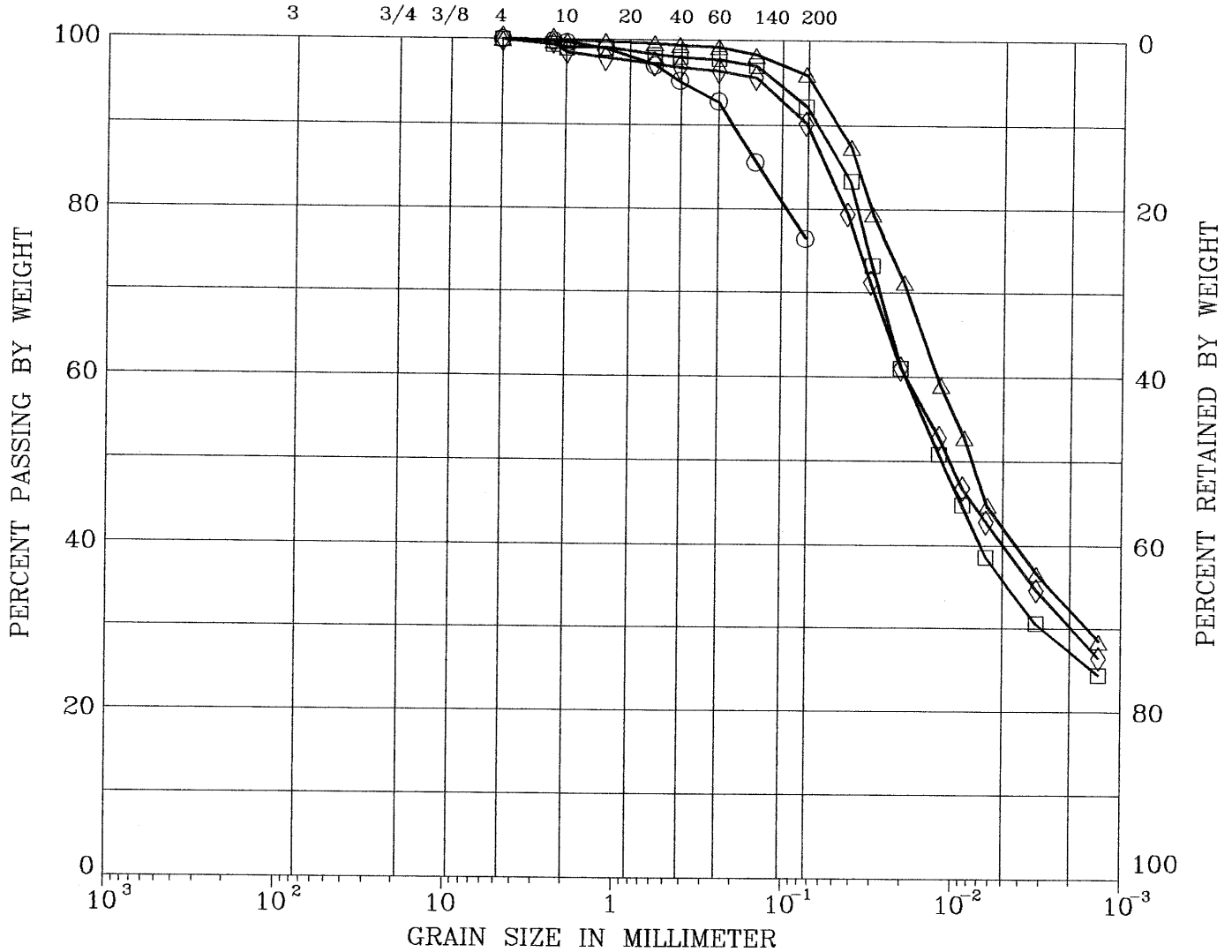
NORTH CITY WATER RECLAMATION PLANT EXPANSION

ALLIED GEOTECHNICAL ENGINEERS, INC.

GRAIN SIZE DISTRIBUTION Figure B-20

### UNIFIED SOIL CLASSIFICATION

<i>COBBLES</i>	<i>GRAVEL</i>		<i>SAND</i>			<i>SILT OR CLAY</i>
	COARSE	FINE	COARSE	MEDIUM	FINE	
U.S. SIEVE SIZE IN INCHES			U.S. STANDARD SIEVE No.			HYDROMETER



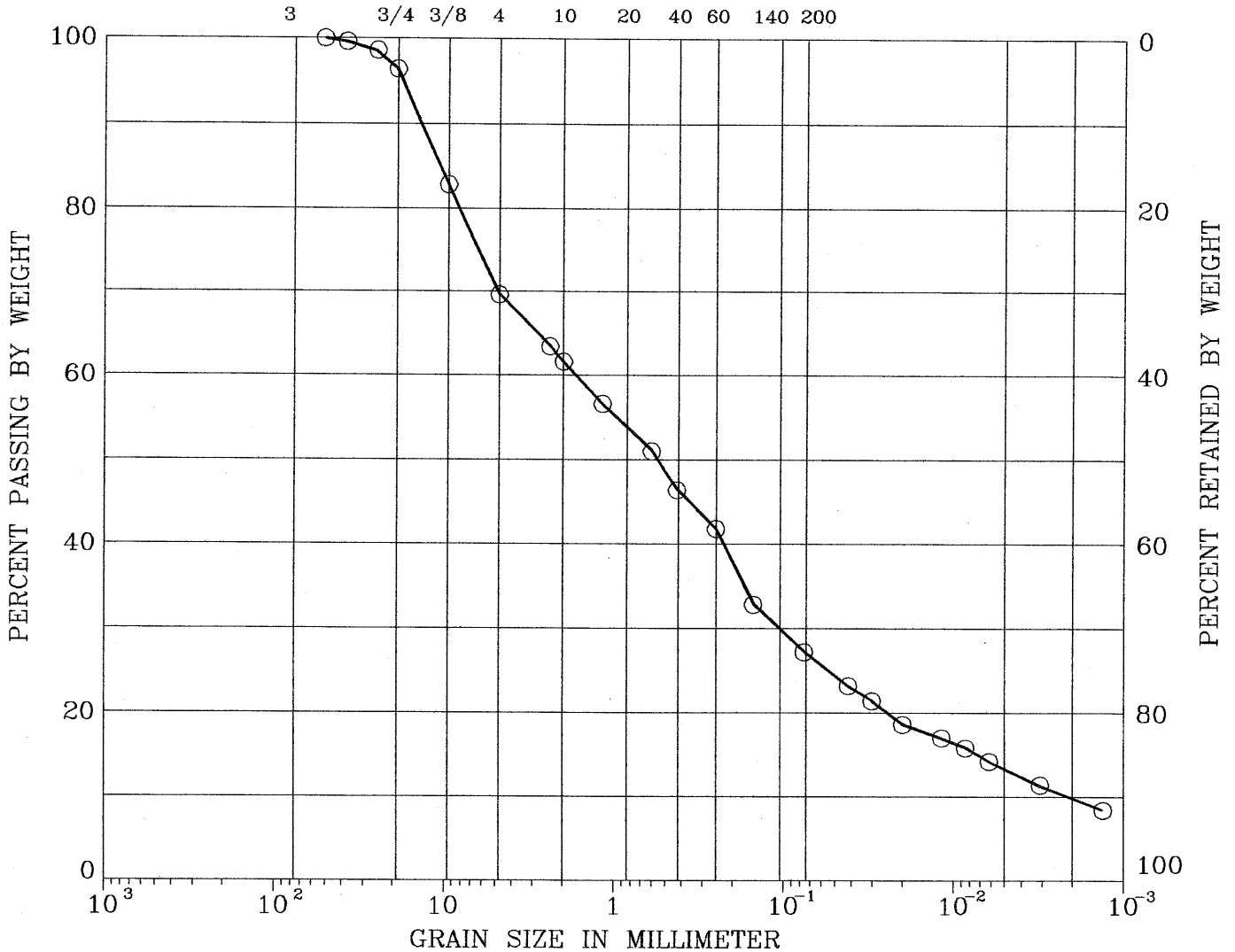
SYMBOL	BORING	DEPTH (ft)	LL (%)	PI (%)	DESCRIPTION
○	H-16 #1	6-6.5	50	18	SILTS (ML)
□	H-15 #2	4-7	57	32	CLAYS (CH)
△	H-17 #3	7-10	42	25	CLAYS (CL)
◇	H-20 #1	3-5	41	23	CLAYS (CL)

Remark :

Project No. 44F1	NORTH CITY WATER RECLAMATION PLANT EXPANSION
ALLIED GEOTECHNICAL ENGINEERS, INC.	GRAIN SIZE DISTRIBUTION <span style="float: right;">Figure B-21</span>

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	
U.S. SIEVE SIZE IN INCHES			U.S. STANDARD SIEVE No.			HYDROMETER

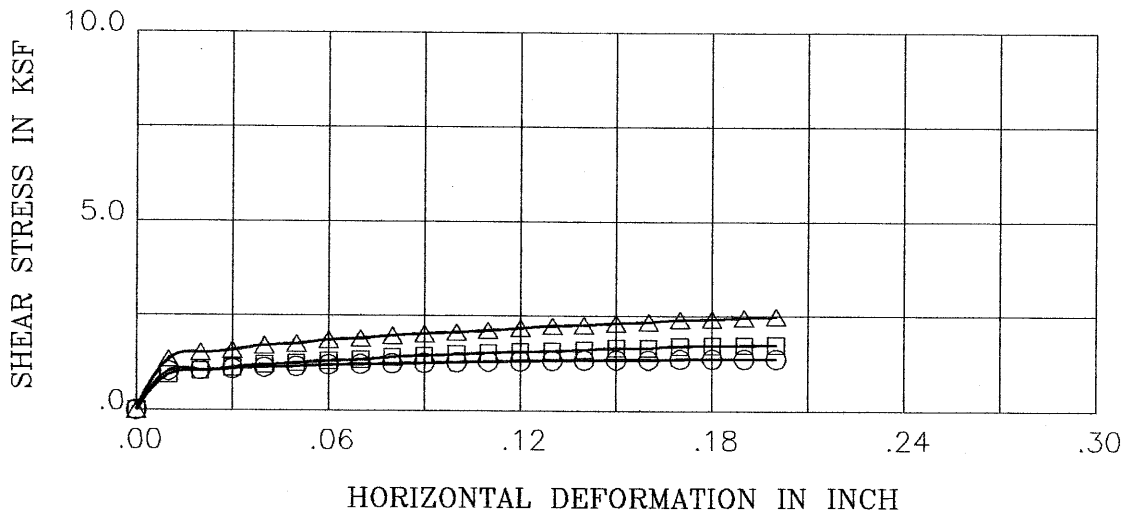
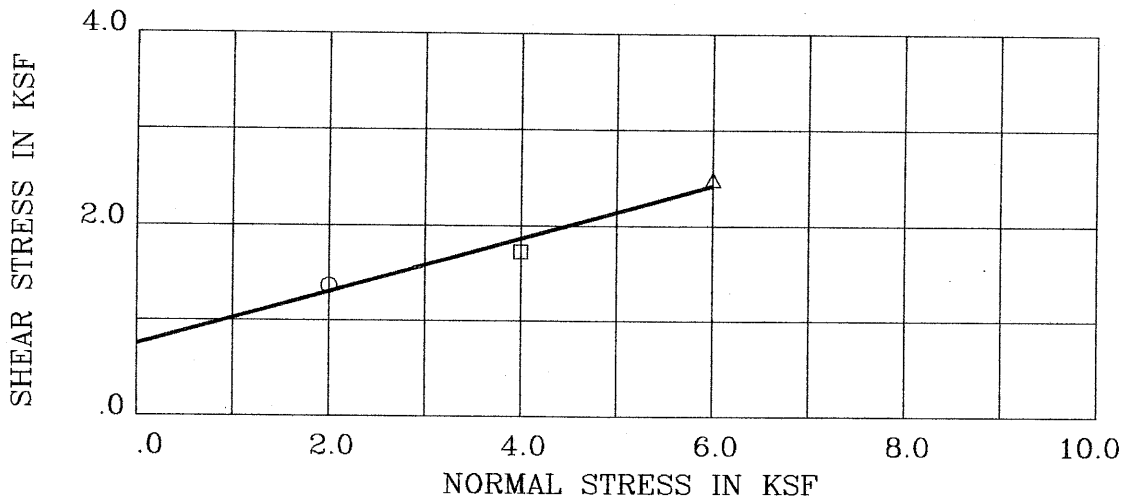


SYMBOL	BORING	DEPTH (ft)	LL (%)	PI (%)	DESCRIPTION
○	H-21 #1	4-7			SILTY SAND (SM)

Remark :

Project 44F1	NORTH CITY WATER RECLAMATION PLANT EXPANSION
ALLIED GEOTECHNICAL ENGINEERS, INC.	GRAIN SIZE DISTRIBUTION Figure B-22



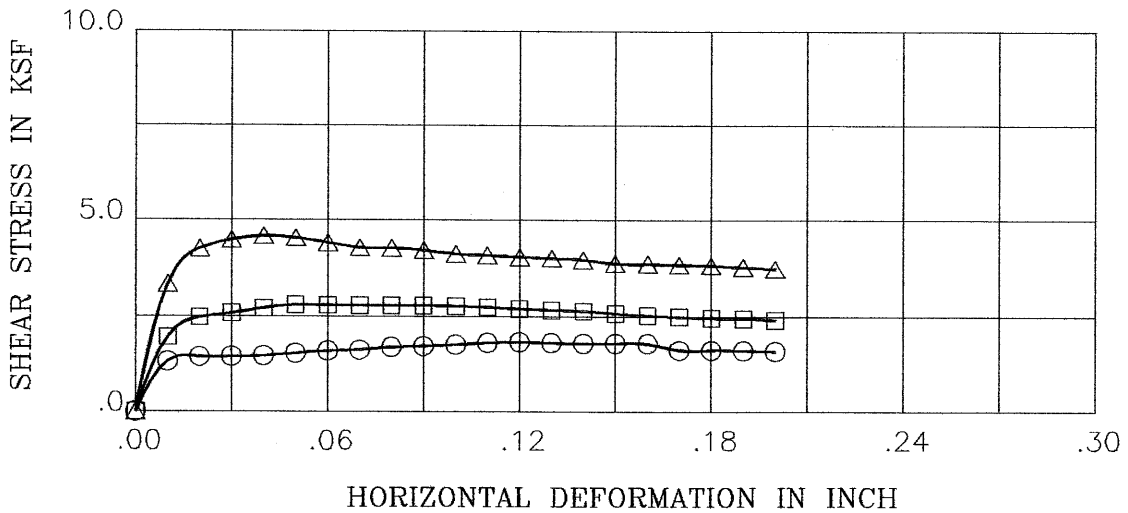
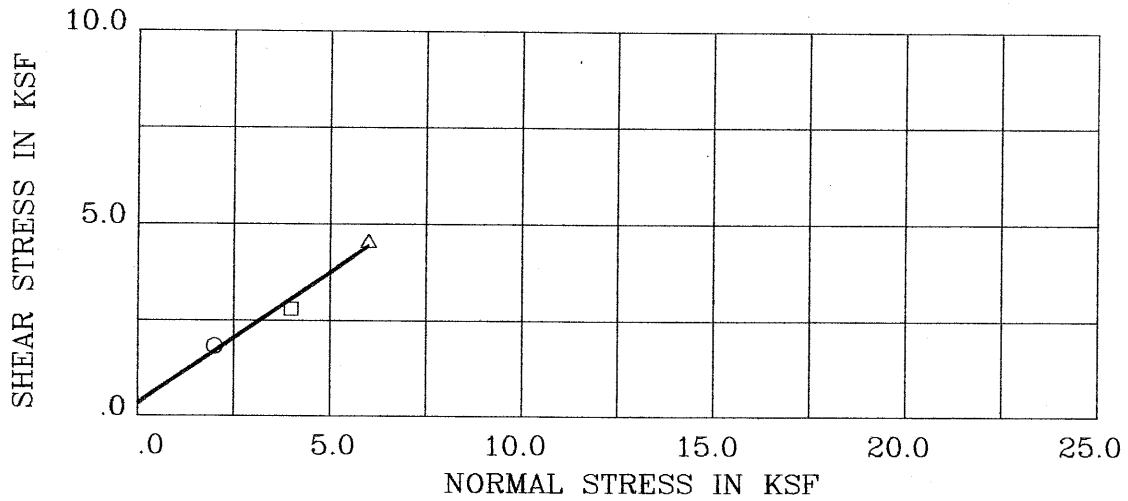


BORING/SAMPLE : H-1 #1                      DEPTH (ft) : 1-4  
 DESCRIPTION : Silty/clayey sand (SM/SC)  
 STRENGTH INTERCEPT (C) : .750 KSF  
 FRICTION ANGLE (PHI) : 15.6 DEG                      (PEAK STRENGTH)

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 (PEAK STRENGTH)  
 FRICTION ANGLE (PHI) : 34.4 DEG

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 :

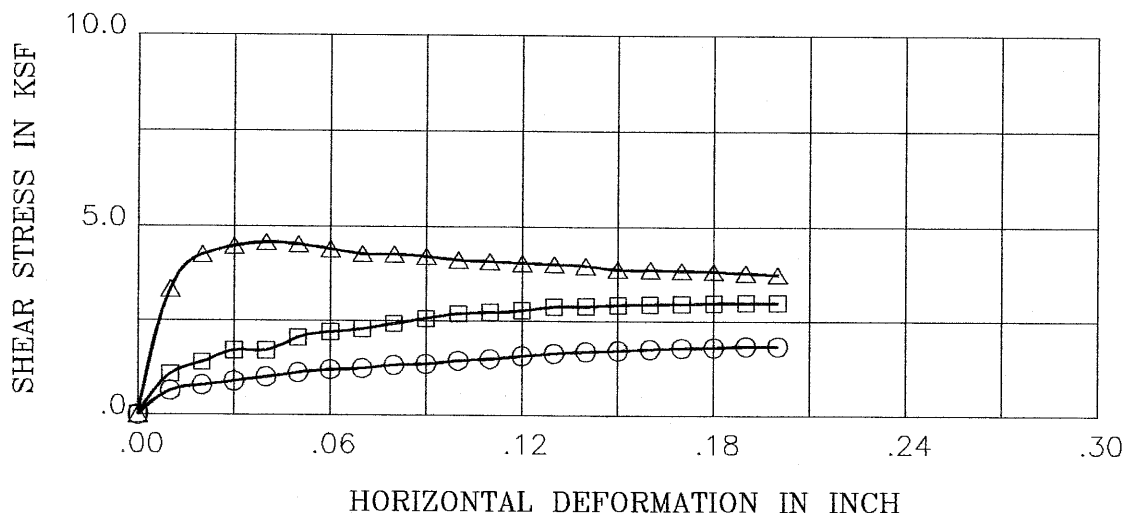
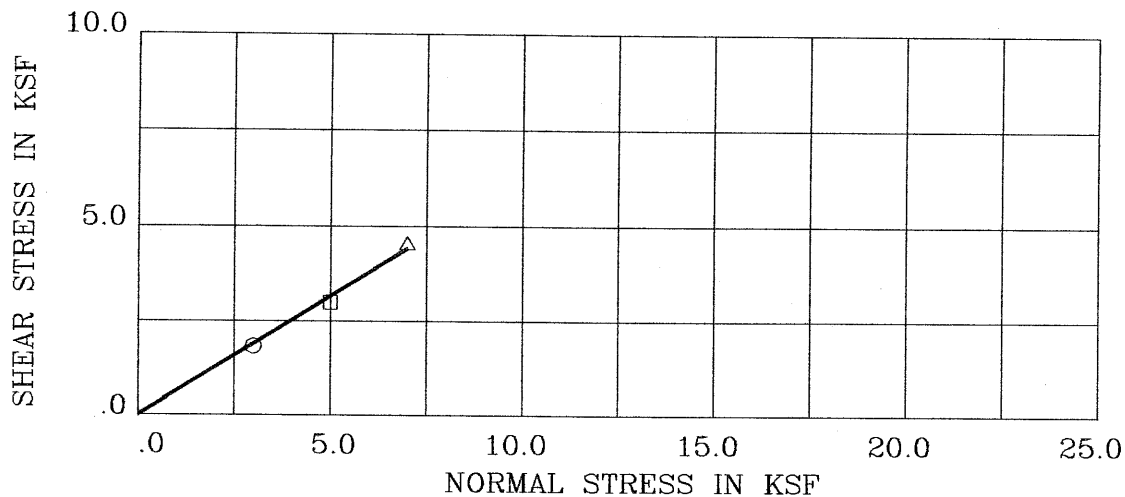
Project No. 44F1

NORTH CITY WATER RECLAMATION PLANT EXPANSION

ALLIED GEOTECHNICAL ENGINEERS, INC.

DIRECT SHEAR TEST

Figure B-24

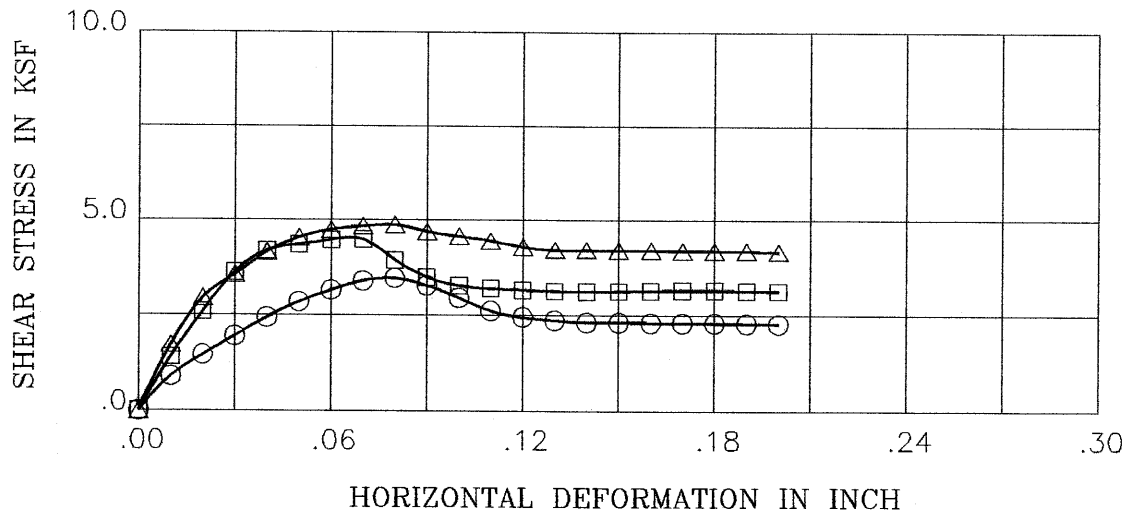
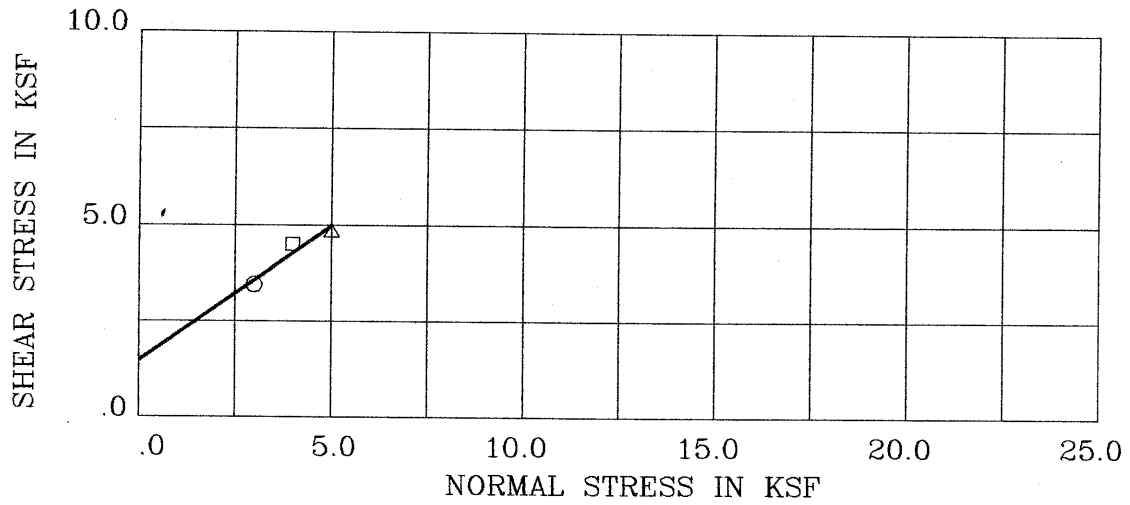


BORING/SAMPLE : H-2 #2                      DEPTH (ft) : 11-11.5  
 DESCRIPTION : Silty/clayey sand (SM/SC)  
 STRENGTH INTERCEPT (C) : .000 KSF  
 FRICTION ANGLE (PHI) : 32.3 DEG                      (PEAK STRENGTH)

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

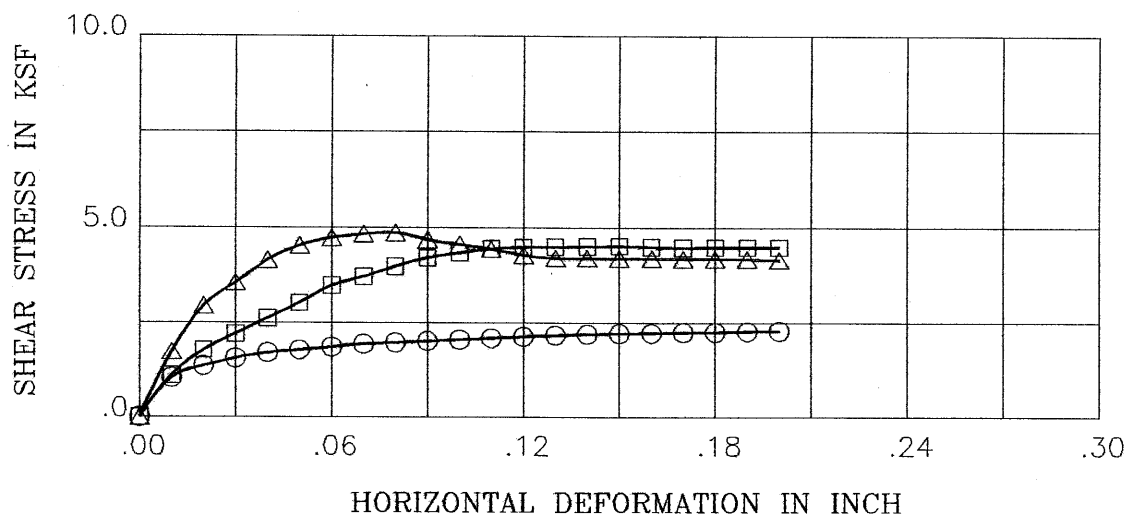
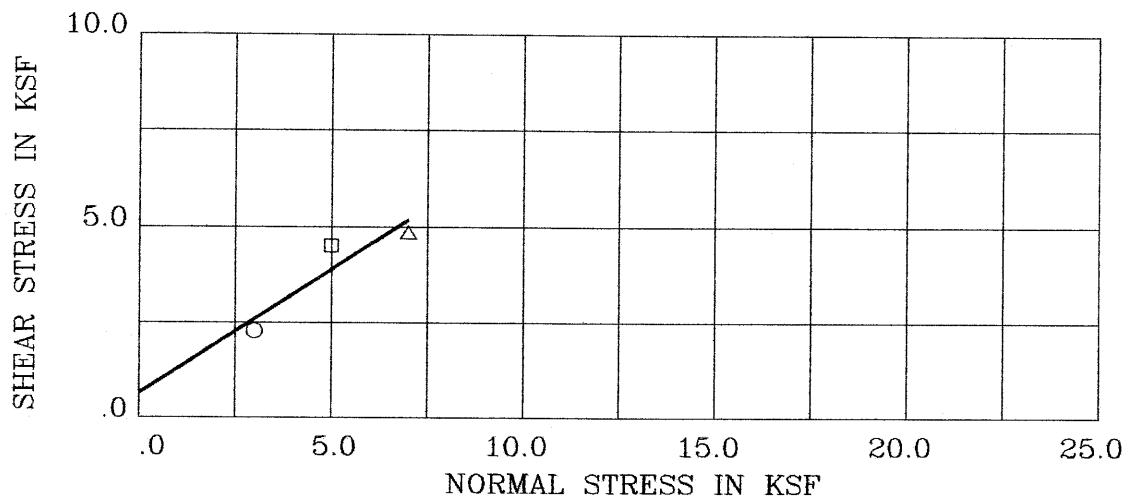


BORING/SAMPLE : H-4 #2                      DEPTH (ft) : 5-6  
 DESCRIPTION : Silty sand (SM) w/ gravel  
 STRENGTH INTERCEPT (C) : 1.468 KSF  
 FRICTION ANGLE (PHI) : 35.2 DEG                      (PEAK STRENGTH)

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

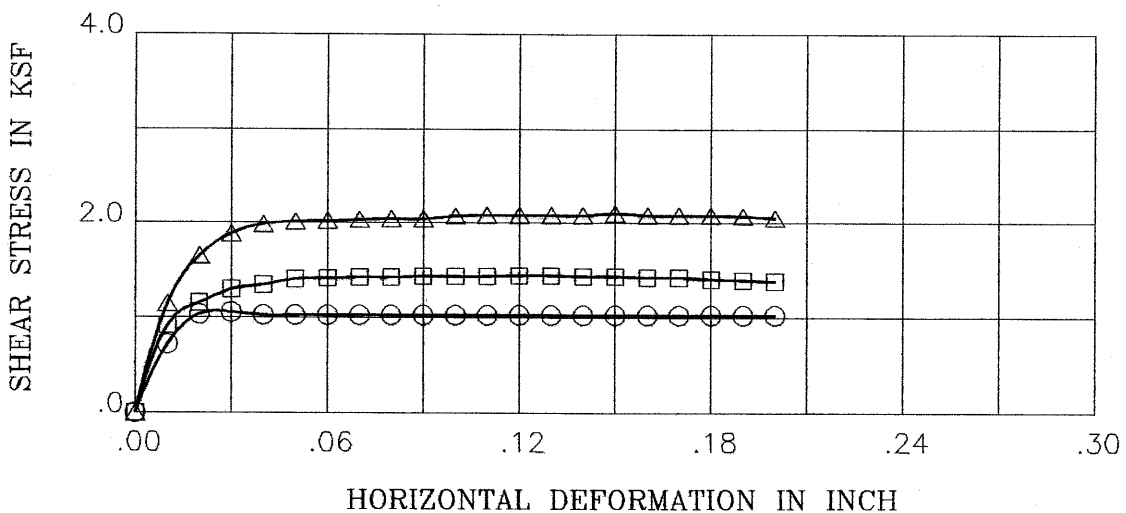
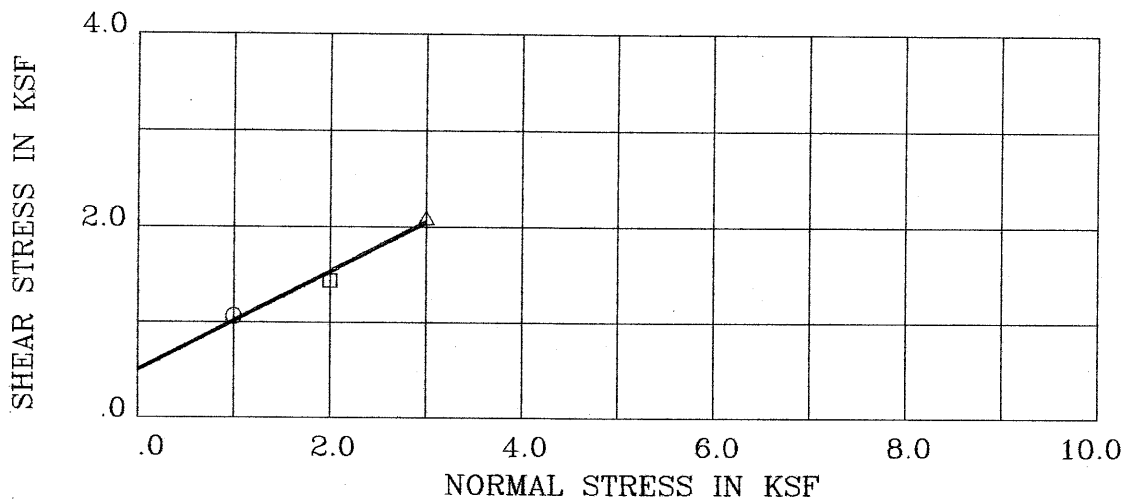


BORING/SAMPLE : H-5 #1                      DEPTH (ft) : 6-6.5  
 DESCRIPTION : Sandy clay (CL)  
 STRENGTH INTERCEPT (C) : .657      KSF  
 FRICTION ANGLE (PHI) : 32.9      DEG                      (PEAK STRENGTH)

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	VOID RATIO	NORMAL STRESS (ksf)	PEAK SHEAR (ksf)	RESIDUAL SHEAR (ksf)
O	20.2	102.8	.578	3.00	2.29	2.29
□	20.9	103.3	.571	5.00	4.52	4.48
Δ	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

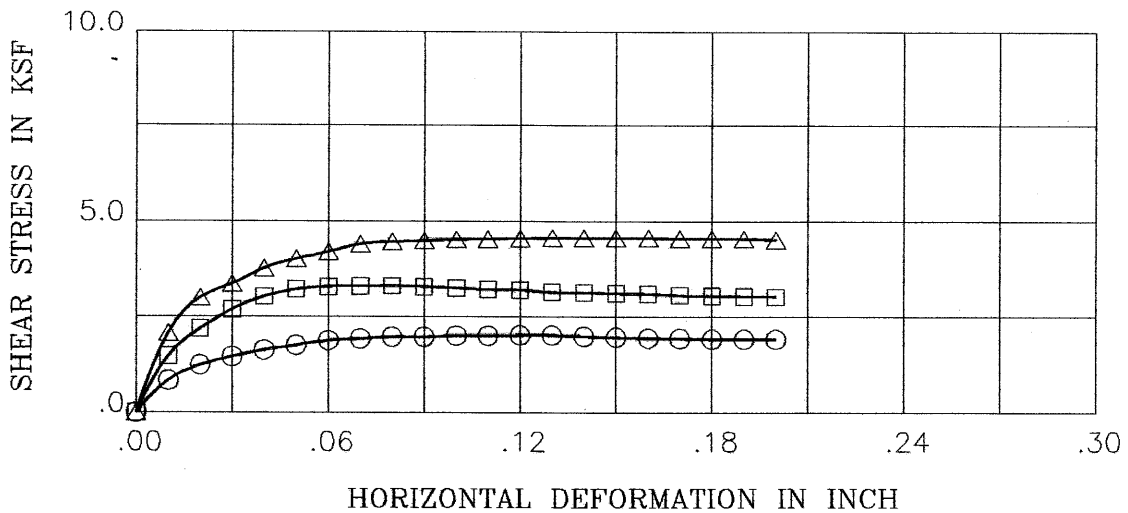
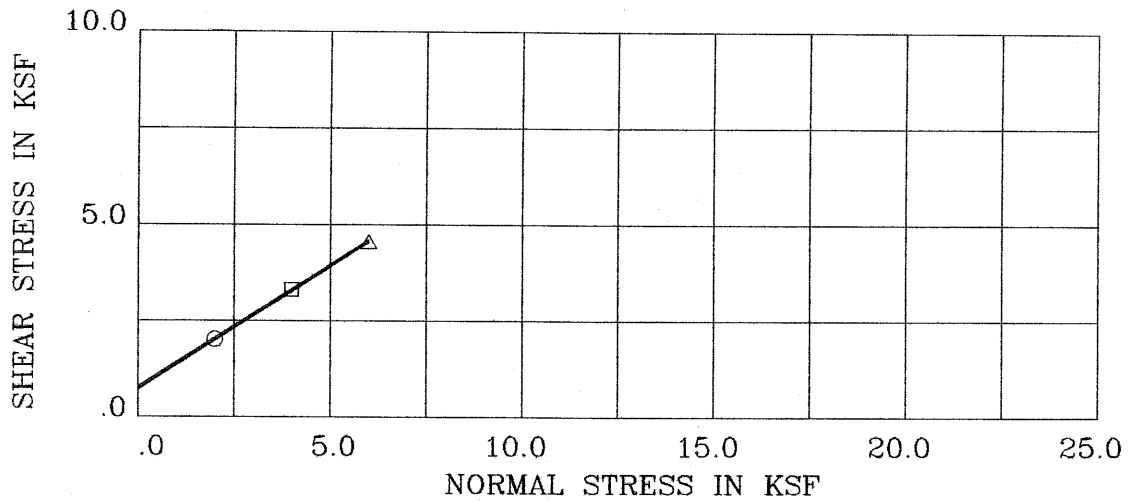


BORING/SAMPLE : H-6 #1                      DEPTH (ft) : 4-7  
 DESCRIPTION : Clayey sand (SC)  
 STRENGTH INTERCEPT (C) : .502      KSF  
 FRICTION ANGLE (PHI) : 27.3      DEG                      (PEAK STRENGTH)

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



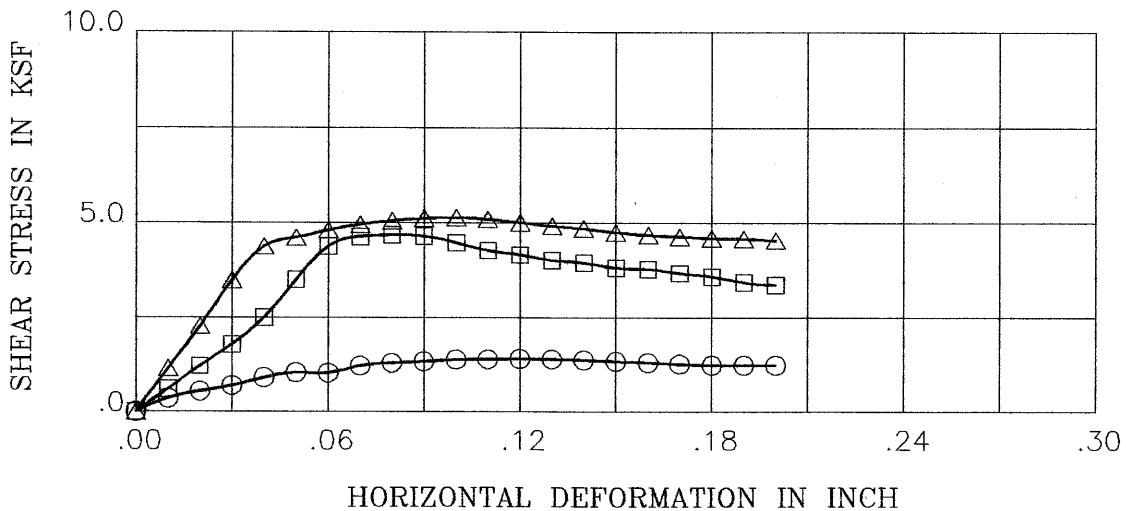
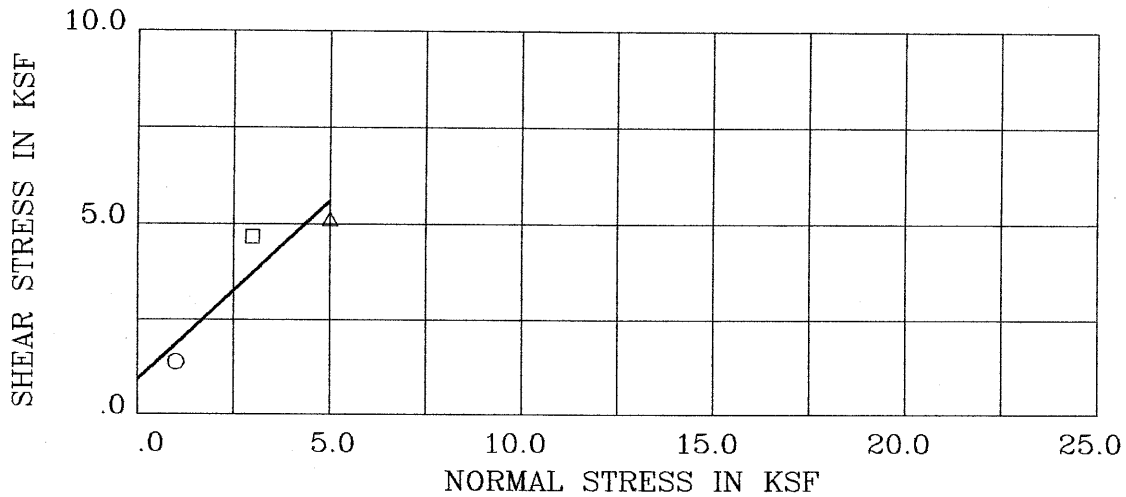
BORING/SAMPLE : H-8 #4                      DEPTH (ft) : 11-11.5  
 DESCRIPTION : Silty sand (SM)  
 STRENGTH INTERCEPT (C) : .747 KSF                      (PEAK STRENGTH)  
 FRICTION ANGLE (PHI) : 32.5 DEG

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



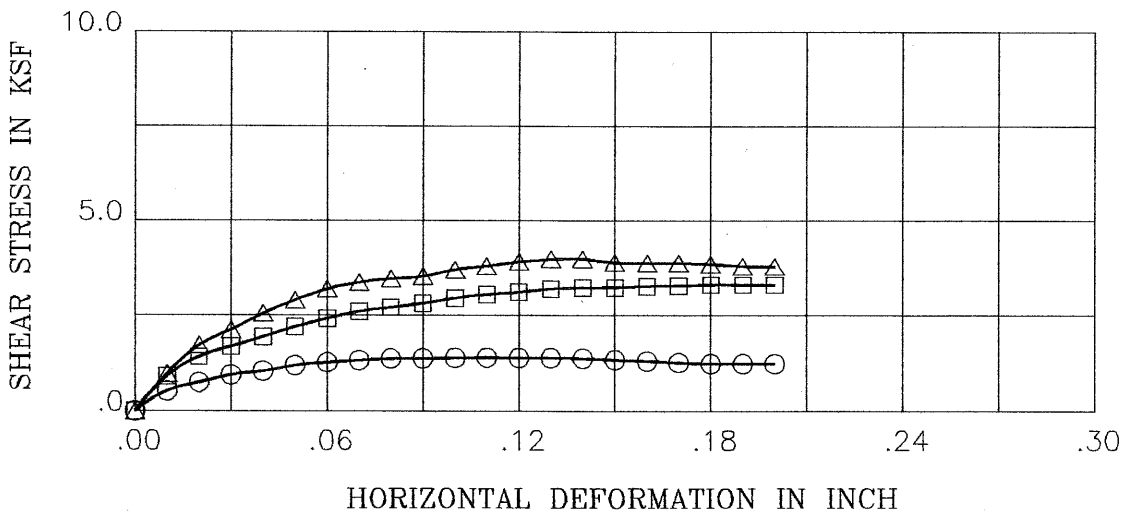
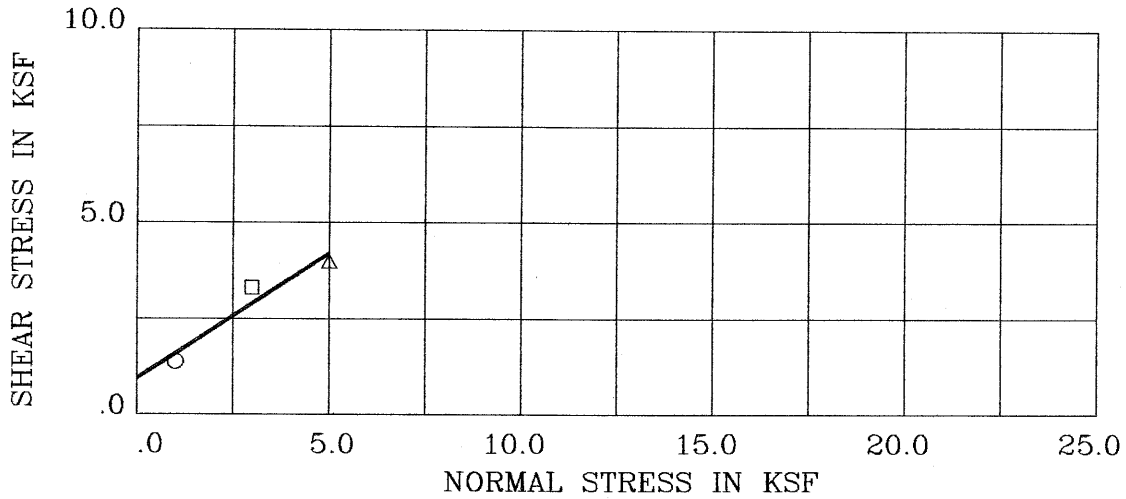


BORING/SAMPLE : H-9 #1                      DEPTH (ft) : 6-6.5  
 DESCRIPTION : Silty sand (SM)  
 STRENGTH INTERCEPT (C) : .938      KSF  
 FRICTION ANGLE (PHI) : 43.0      DEG                      (PEAK STRENGTH)

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

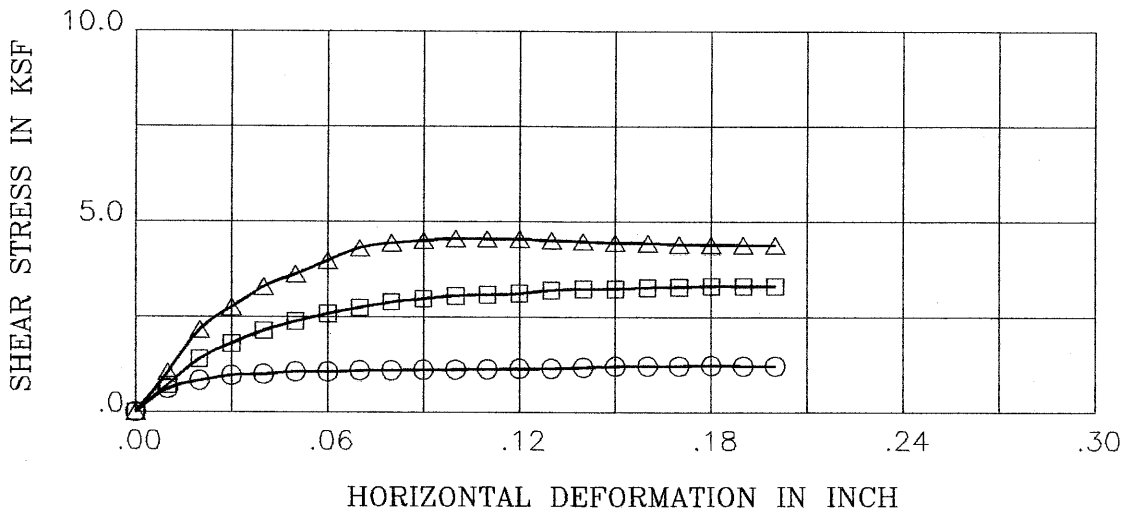
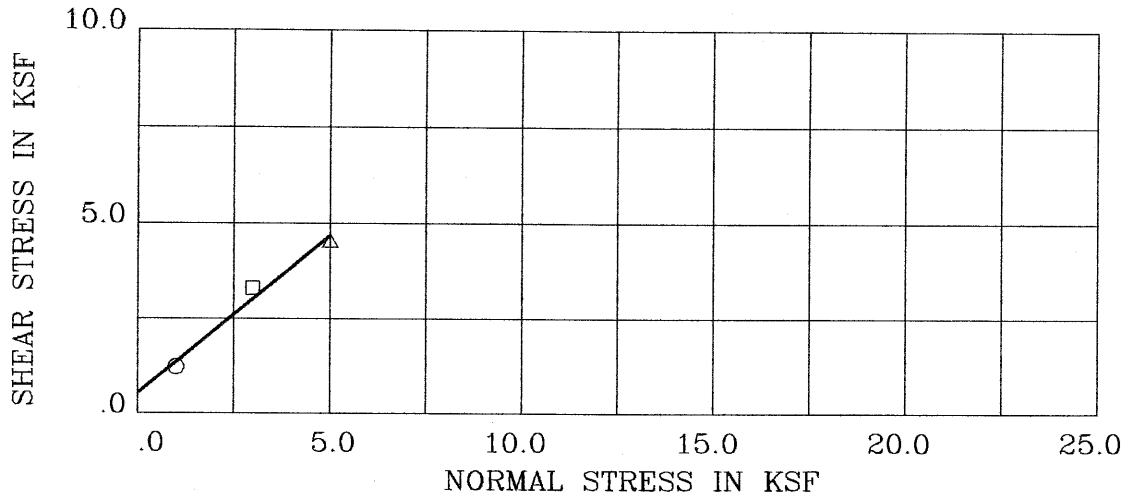


BORING/SAMPLE : H-9 #5                      DEPTH (ft) : 16-16.5  
 DESCRIPTION : Silty sand (SM)  
 STRENGTH INTERCEPT (C) : .943      KSF                      (PEAK STRENGTH)  
 FRICTION ANGLE (PHI) : 33.1      DEG

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.	<b>DIRECT SHEAR TEST</b> Figure B-31

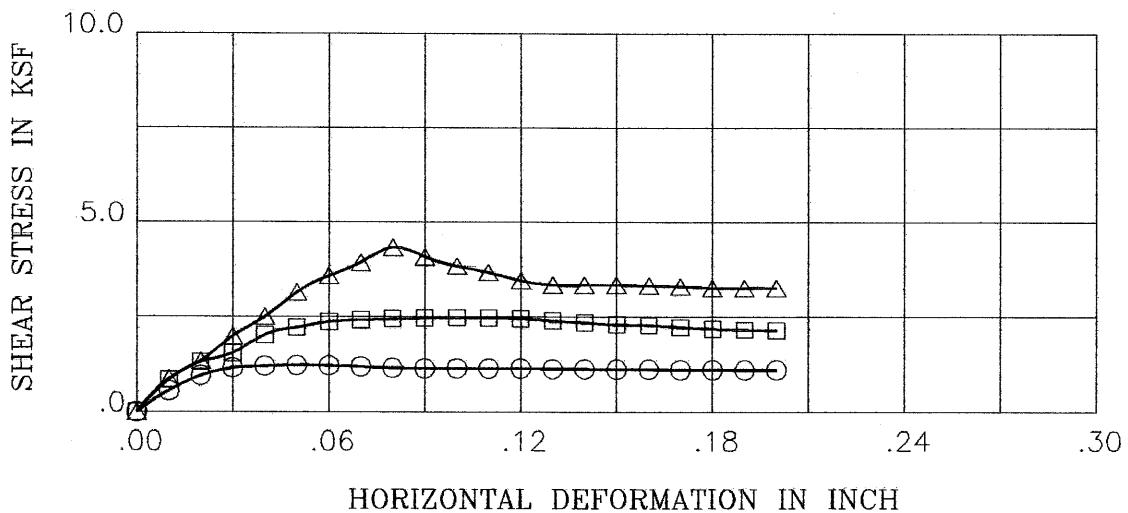
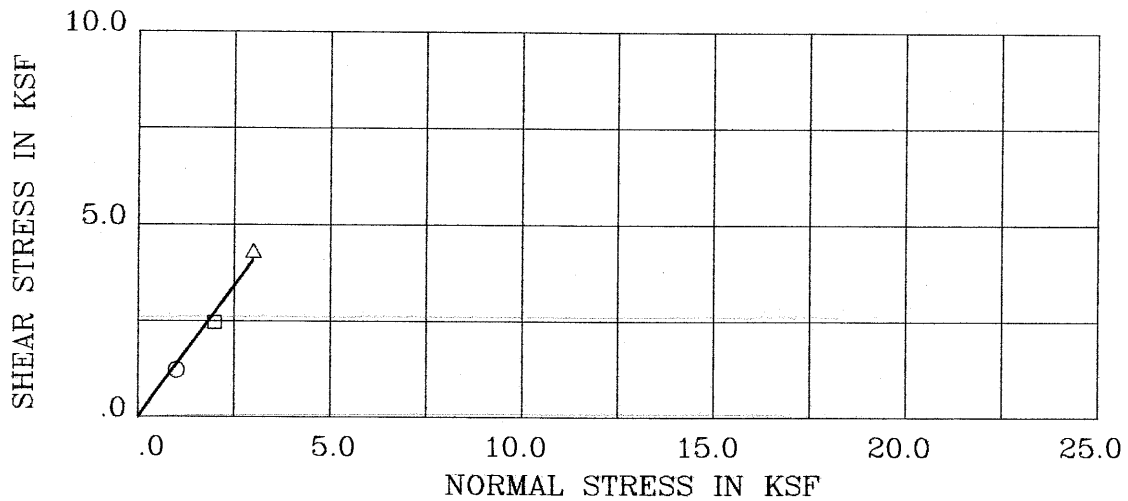


BORING/SAMPLE : H-10 #6                      DEPTH (ft) : 21-21.5  
 DESCRIPTION : Claystone (CL)  
 STRENGTH INTERCEPT (C) : .541      KSF  
 FRICTION ANGLE (PHI) : 39.7      DEG                      (PEAK STRENGTH)

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.	<b>DIRECT SHEAR TEST</b> Figure B-32

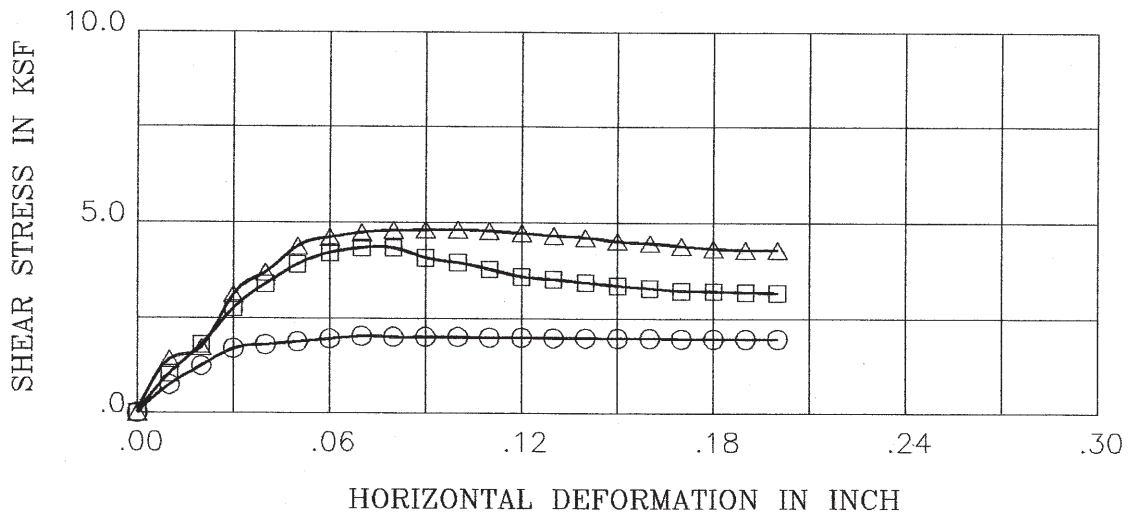
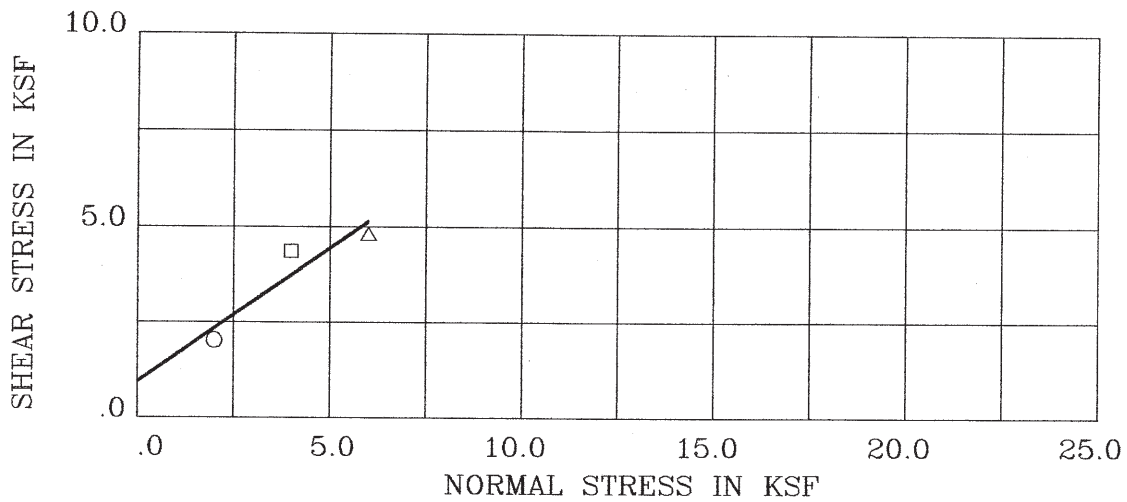


BORING/SAMPLE : H-11 #1                      DEPTH (ft) : 6-6.5  
 DESCRIPTION : Silty sand (SM)  
 STRENGTH INTERCEPT (C) : .000      KSF                      (PEAK STRENGTH)  
 FRICTION ANGLE (PHI) : 53.9      DEG

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

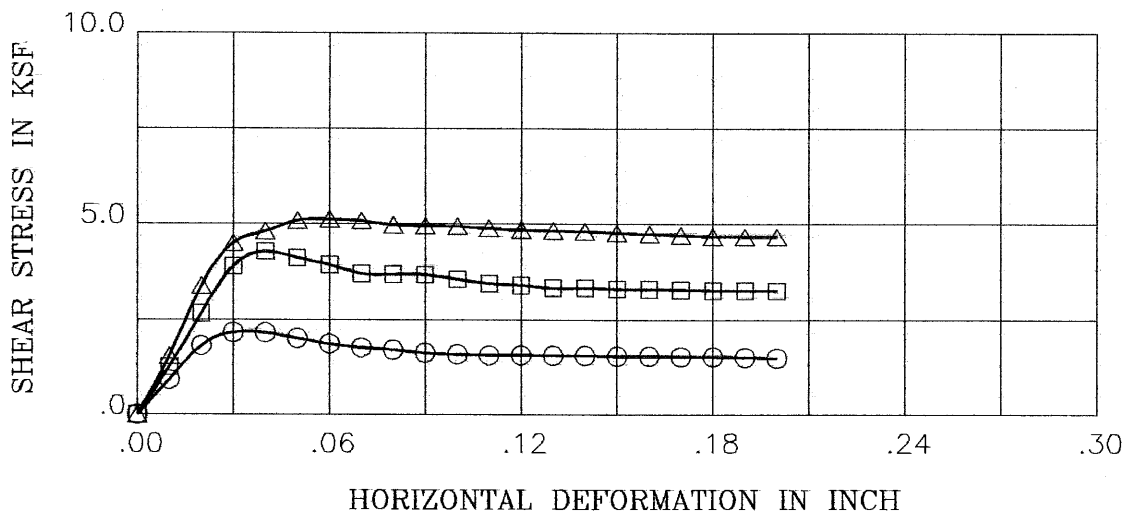
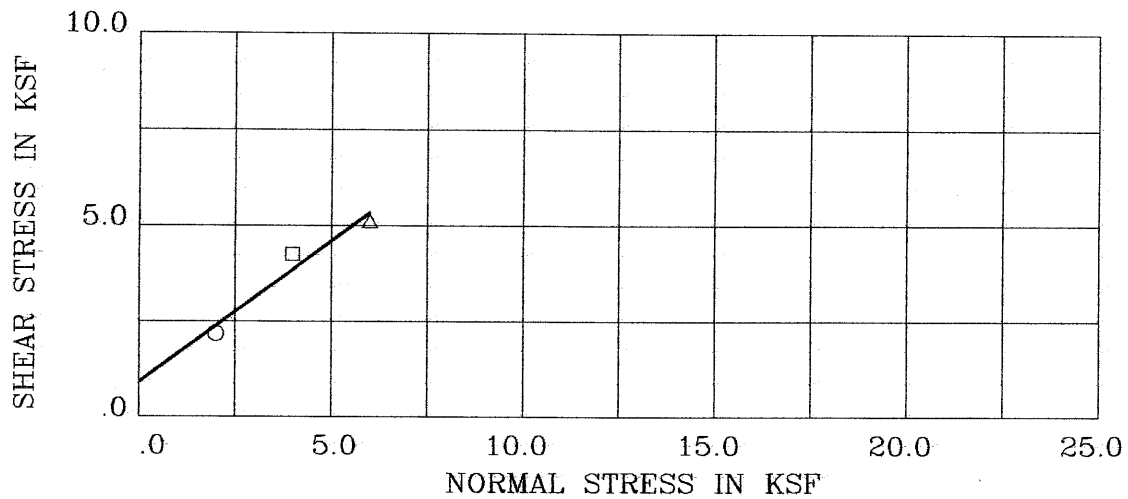


BORING/SAMPLE : H-11 #4                      DEPTH (ft) : 16-16.5  
 DESCRIPTION : Sandy Lean Clay (CL)  
 STRENGTH INTERCEPT (C) : .954 KSF  
 FRICTION ANGLE (PHI) : 34.9 DEG                      (PEAK STRENGTH)

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

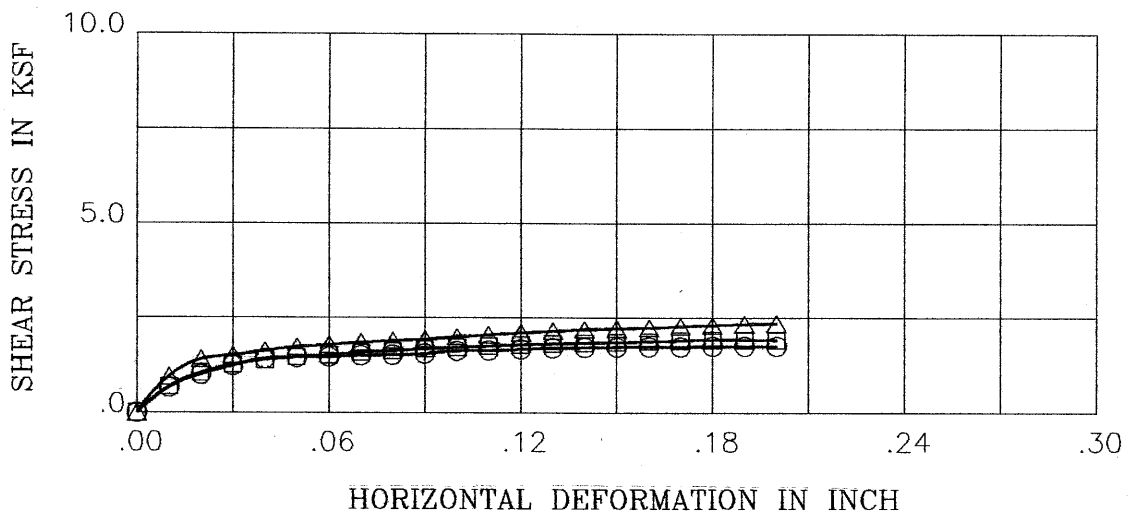
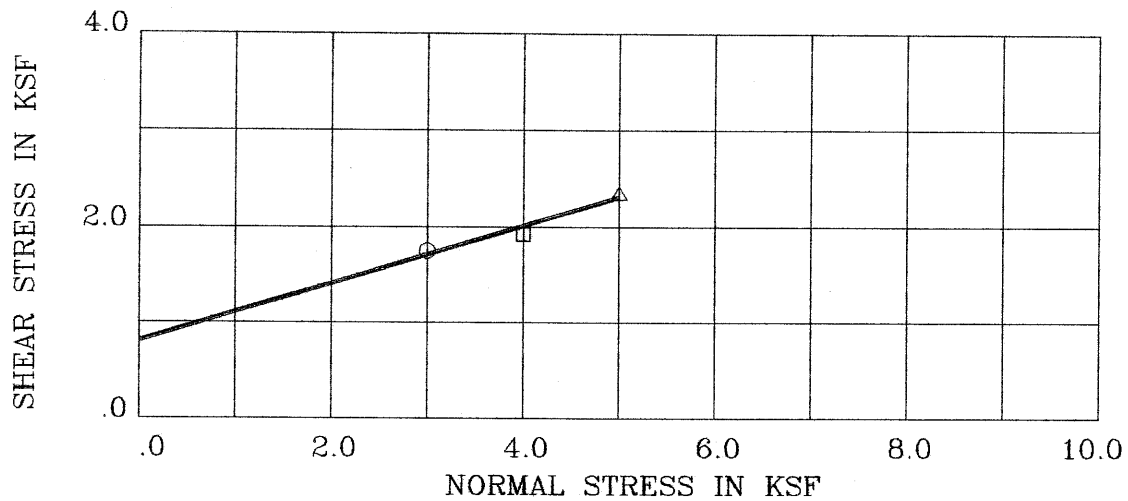


BORING/SAMPLE : H-11 #9                      DEPTH (ft) : 35.5-36  
 DESCRIPTION : Silty sandstone (SM)  
 STRENGTH INTERCEPT (C) : .927      KSF                      (PEAK STRENGTH)  
 FRICTION ANGLE (PHI) : 36.3      DEG

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



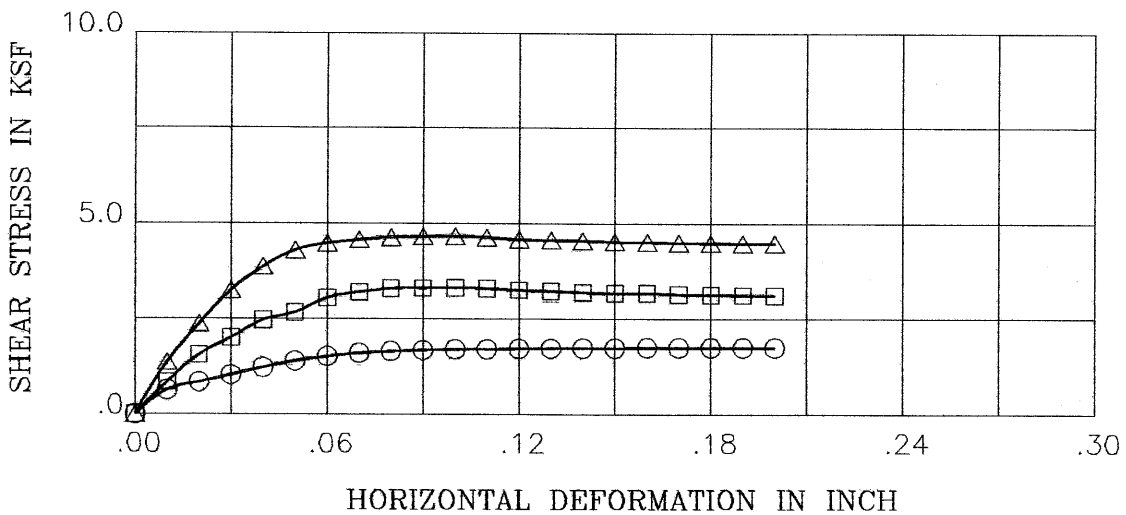
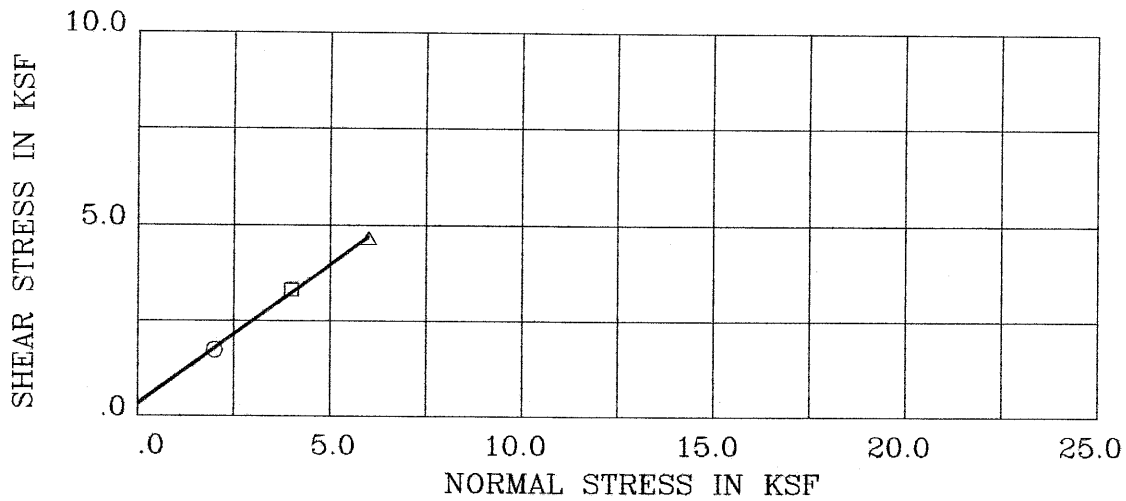
BORING/SAMPLE : H-12 #7                      DEPTH (ft) : 21-24  
 DESCRIPTION : Silty sandstone (SM)  
 STRENGTH INTERCEPT (C) : .812      KSF  
 FRICTION ANGLE (PHI) : 16.7      DEG                      (PEAK STRENGTH)

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



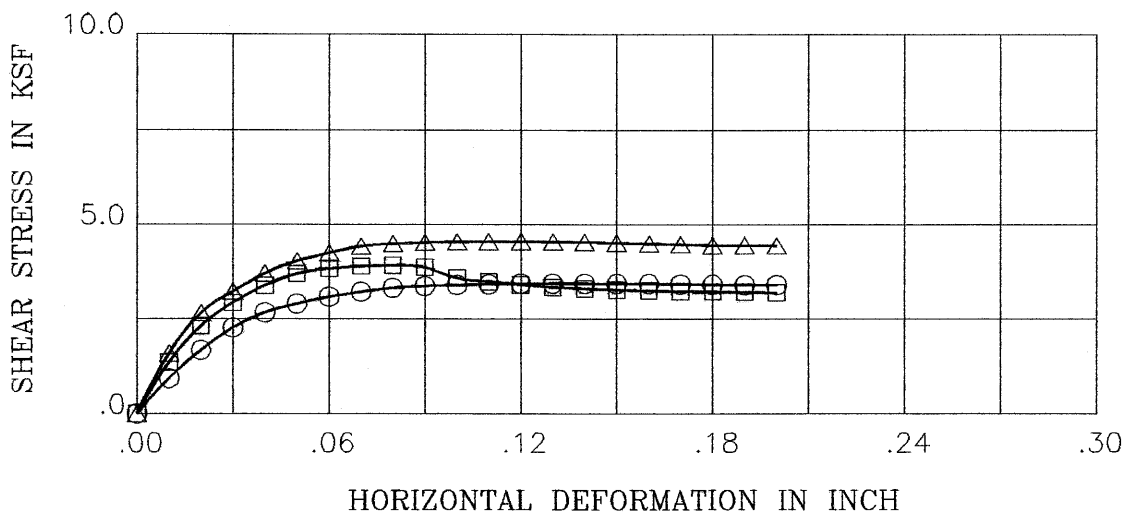
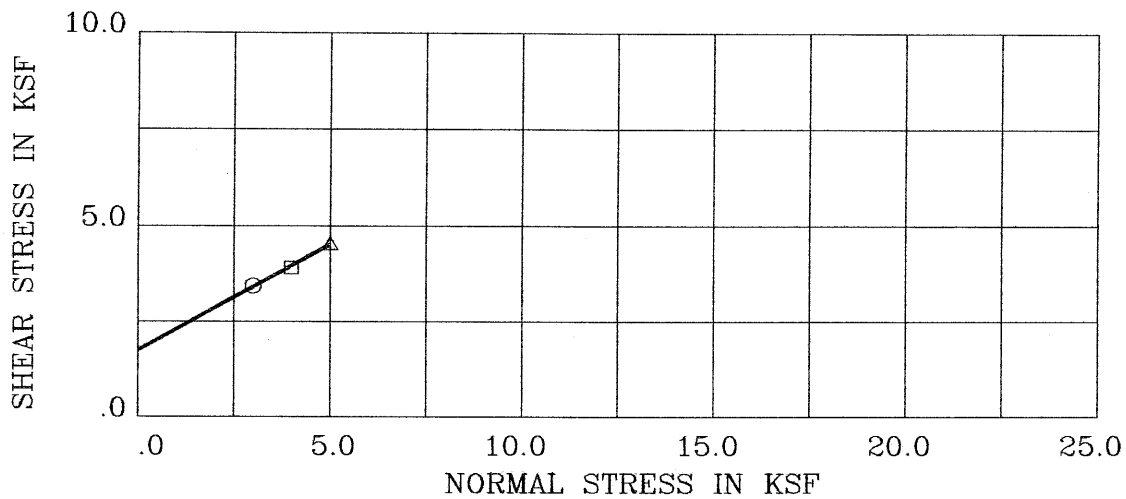


BORING/SAMPLE : H-12 #10      DEPTH (ft) : 35-35.5  
 DESCRIPTION : Poorly graded sand (SP)  
 STRENGTH INTERCEPT (C) : .320 KSF  
 FRICTION ANGLE (PHI) : 36.2 DEG      (PEAK STRENGTH)

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                      (PEAK STRENGTH)  
 FRICTION ANGLE (PHI) : 29.1 DEG

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 :

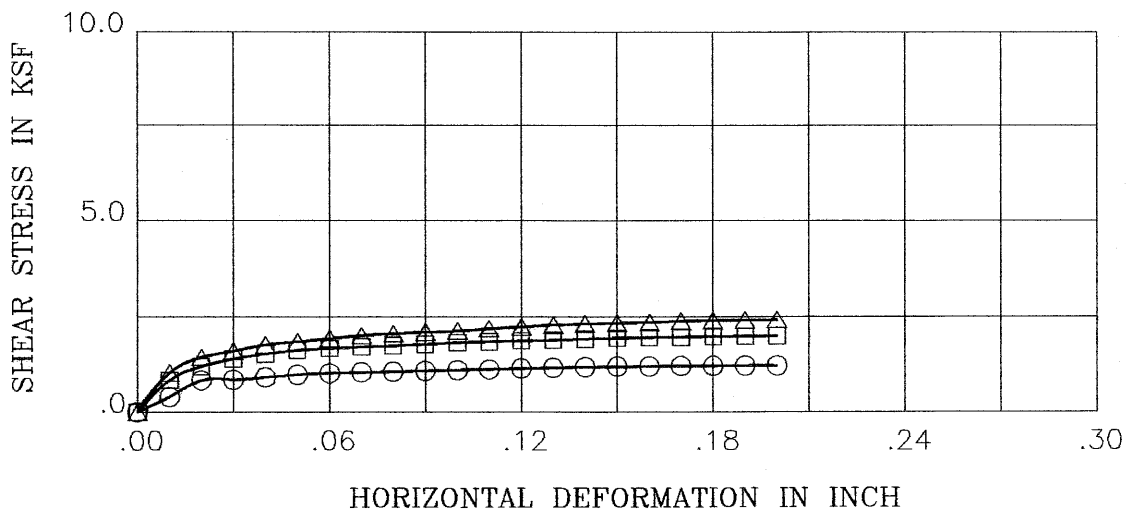
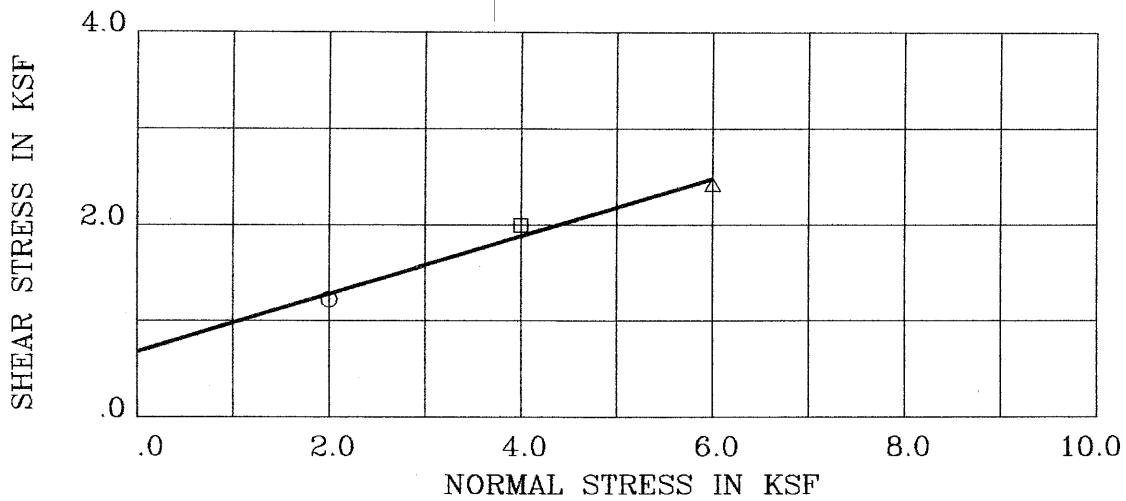
Project No. 44F1

NORTH CITY WATER RECLAMATION PLANT EXPANSION

ALLIED GEOTECHNICAL ENGINEERS, INC.

DIRECT SHEAR TEST

Figure B-38

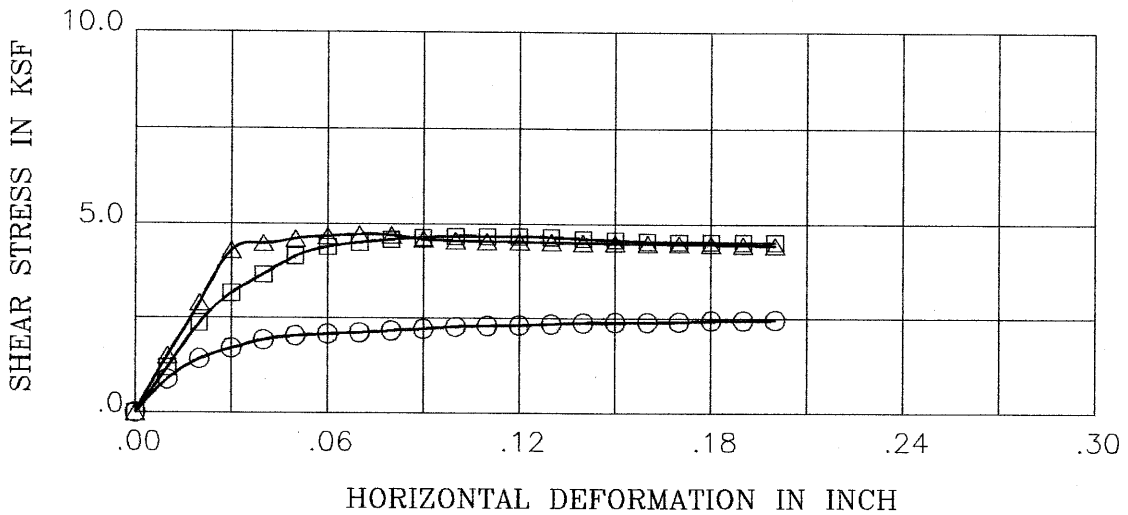
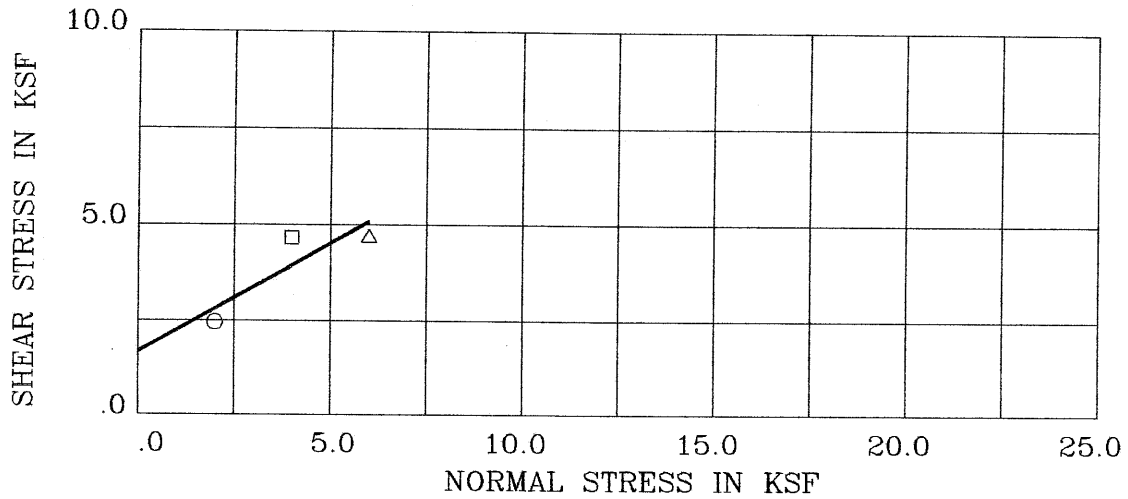


BORING/SAMPLE : H-14 #2                      DEPTH (ft) : 4-7  
 DESCRIPTION : Sandy clay (CL)  
 STRENGTH INTERCEPT (C) : .682      KSF                      (PEAK STRENGTH)  
 FRICTION ANGLE (PHI) : 16.7      DEG

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

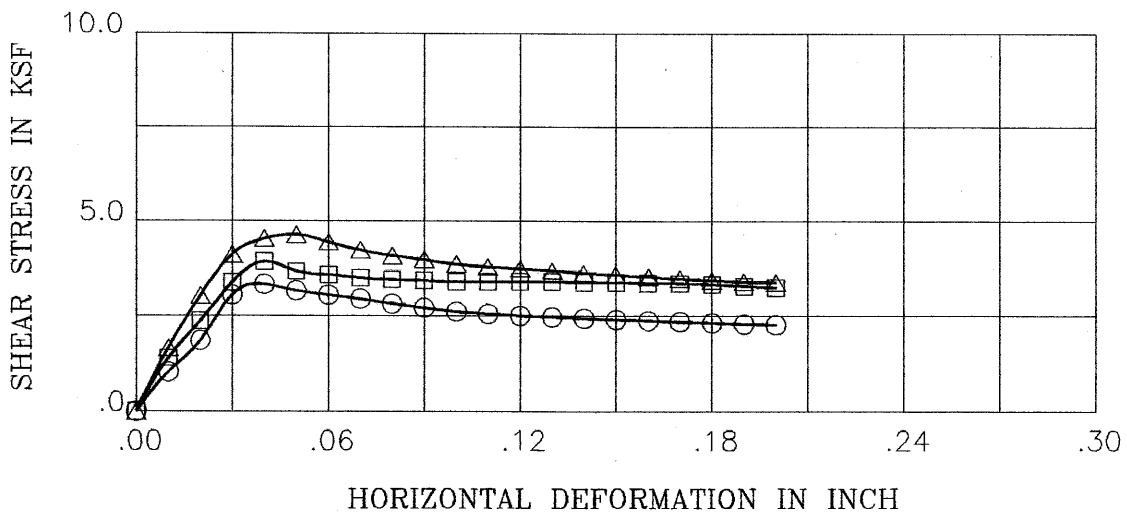
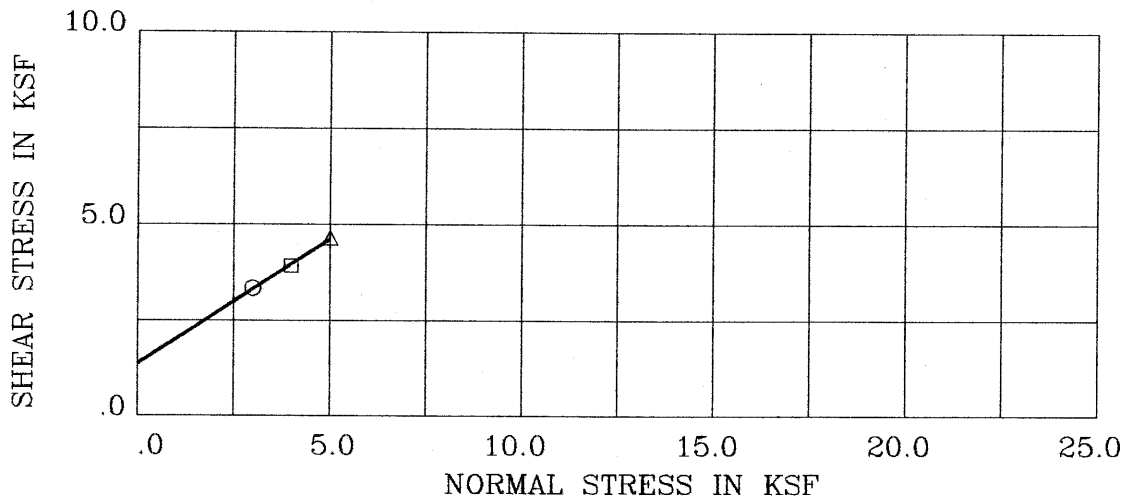


BORING/SAMPLE : H-14 #15      DEPTH (ft) : 50-50.5  
 DESCRIPTION : Lean clay (CL)  
 STRENGTH INTERCEPT (C) : 1.692 KSF  
 FRICTION ANGLE (PHI) : 29.5 DEG      (PEAK STRENGTH)

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

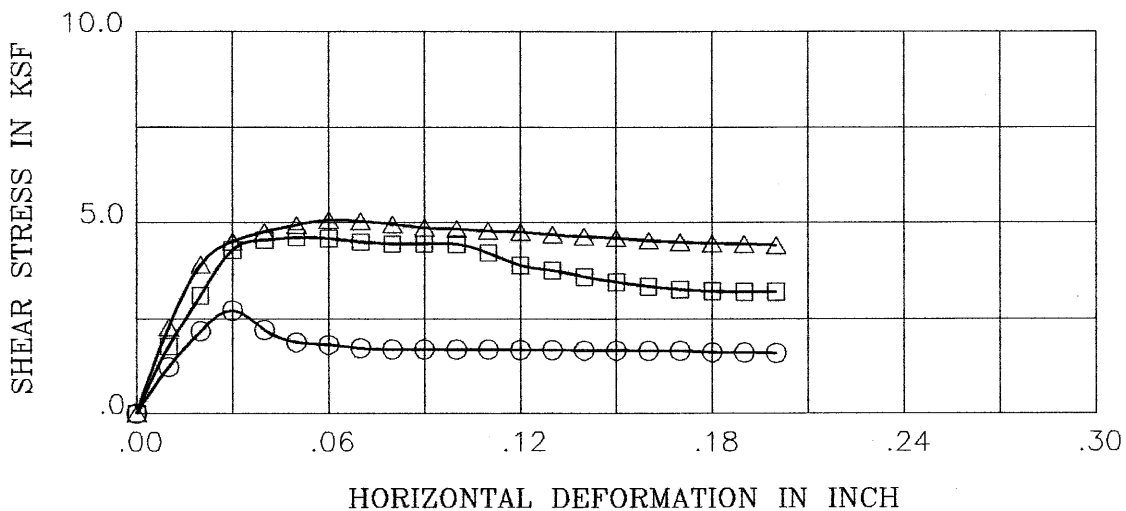
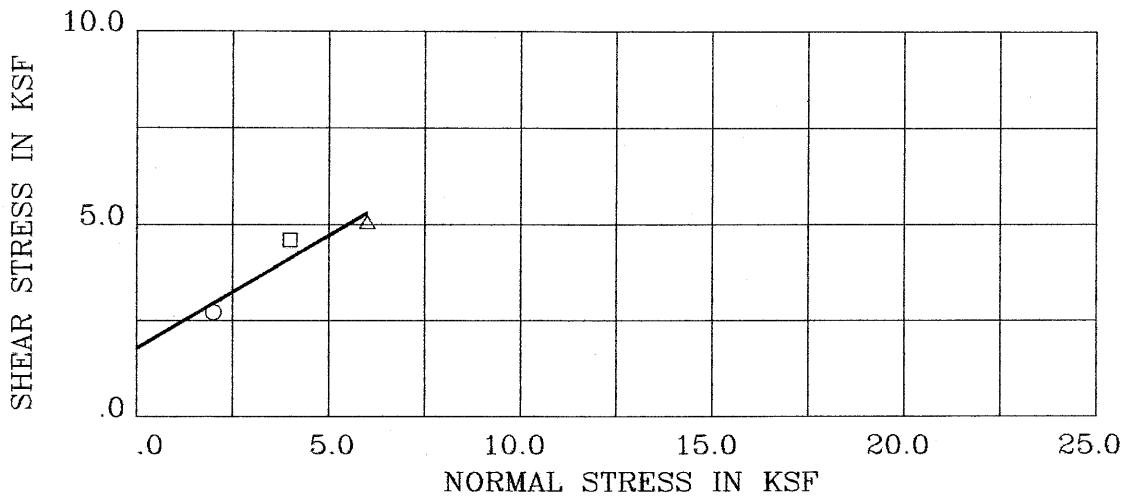


BORING/SAMPLE : H-15 #1                      DEPTH (ft) : 6-6.5  
 DESCRIPTION : Plastic clay (CH)  
 STRENGTH INTERCEPT (C) : 1.369      KSF  
 FRICTION ANGLE (PHI) : 33.1      DEG                      (PEAK STRENGTH)

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

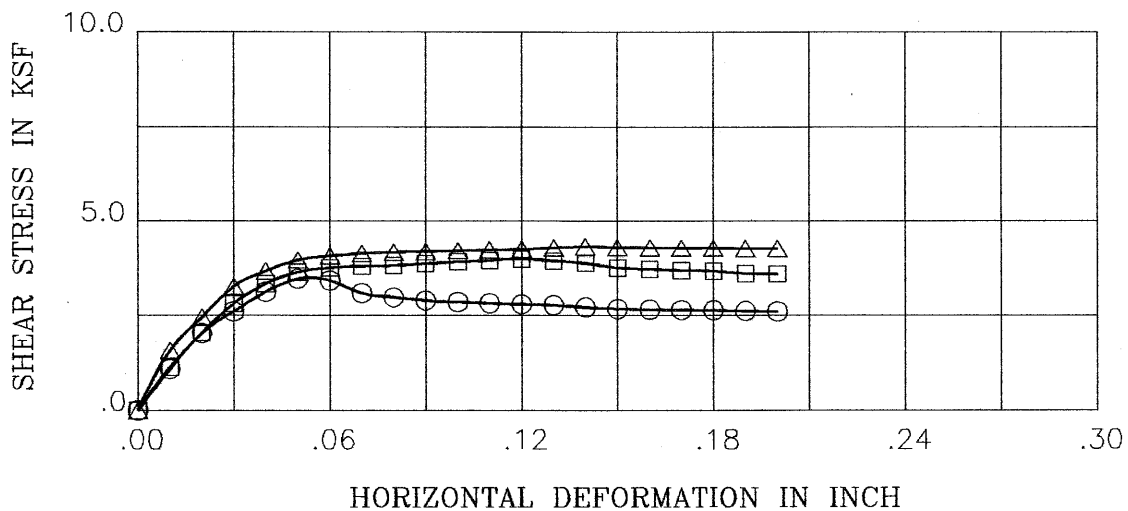
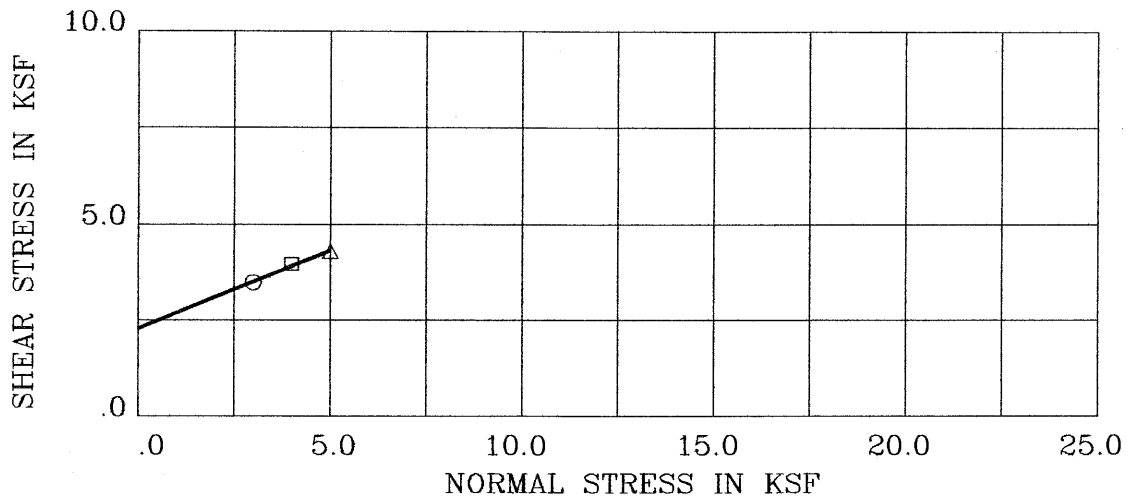


BORING/SAMPLE : H-16 #1                      DEPTH (ft) : 6-6.5  
 DESCRIPTION : Siltstone (ML)  
 STRENGTH INTERCEPT (C) : 1.785      KSF                      (PEAK STRENGTH)  
 FRICTION ANGLE (PHI) : 30.4      DEG

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	VOID RATIO	NORMAL STRESS (ksf)	PEAK SHEAR (ksf)	RESIDUAL SHEAR (ksf)
O	22.4	102.2	.587	2.00	2.72	1.61
□	20.4	105.6	.536	4.00	4.62	3.20
Δ	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.	<b>DIRECT SHEAR TEST</b> Figure B-42



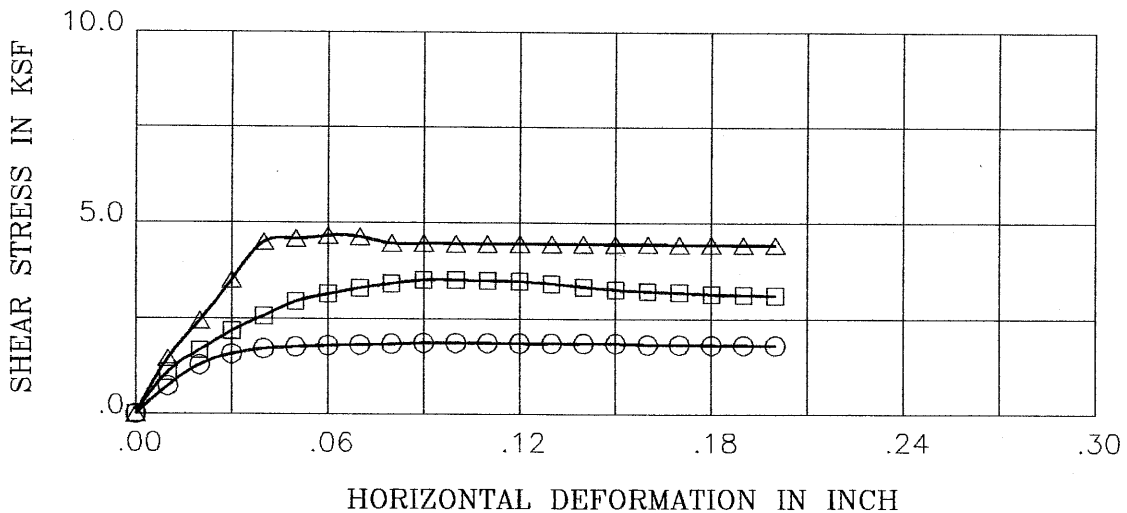
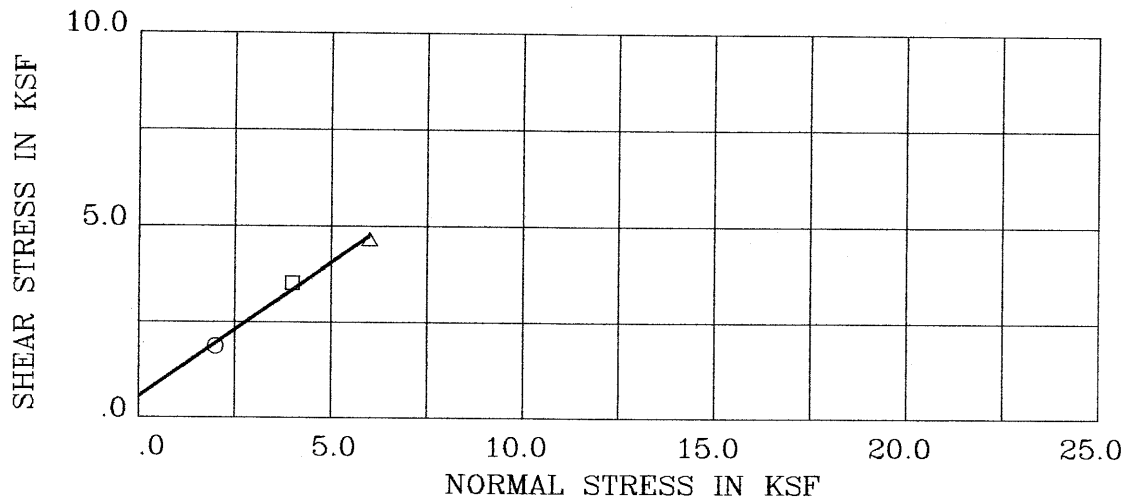
BORING/SAMPLE : H-17 #2                      DEPTH (ft) : 6-6.5  
 DESCRIPTION : Lean clay (CL)  
 STRENGTH INTERCEPT (C) : 2.290 KSF                      (PEAK STRENGTH)  
 FRICTION ANGLE (PHI) : 22.3 DEG

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



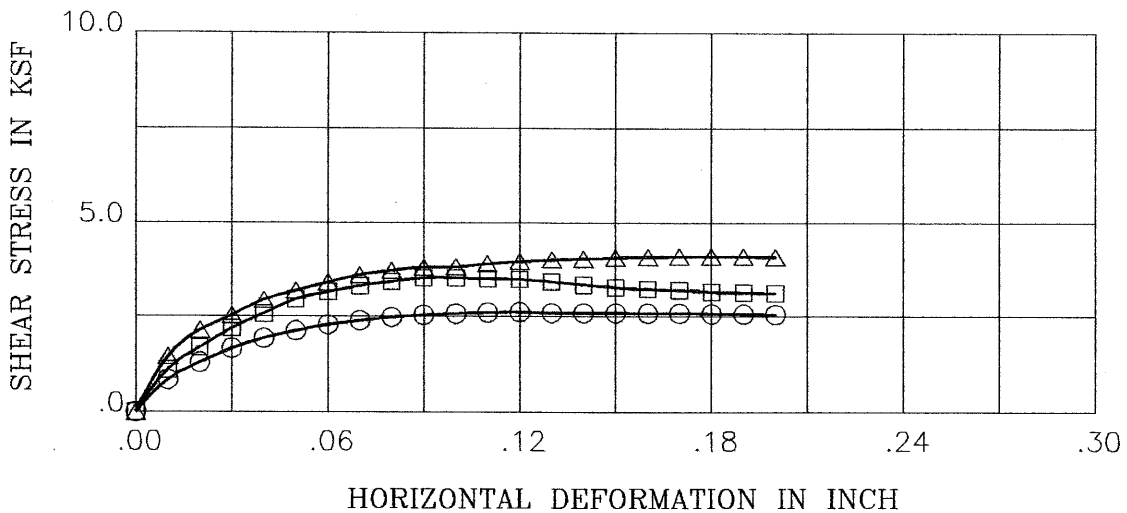
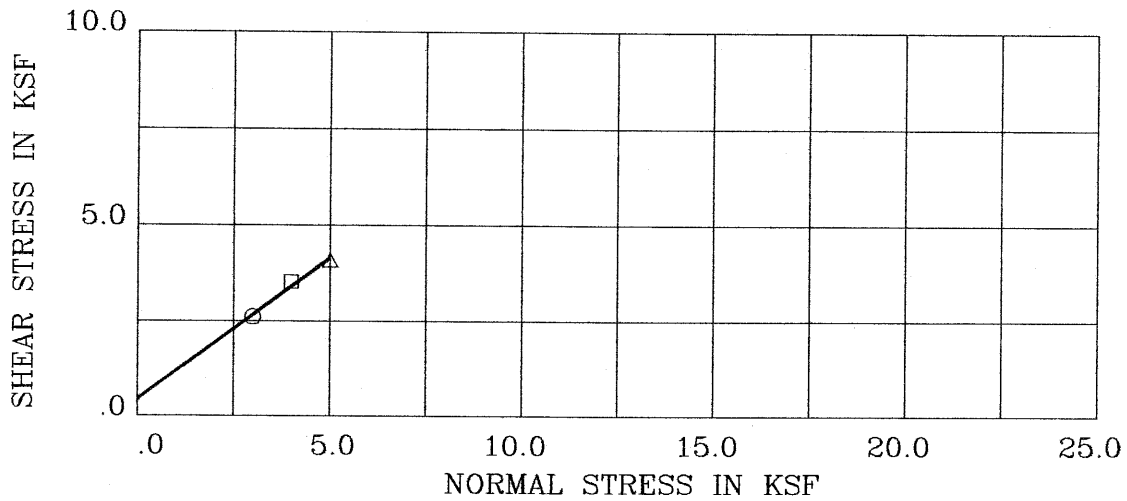


BORING/SAMPLE : H-20 #4                      DEPTH (ft) : 10.5-11  
 DESCRIPTION : Lean clay (CL)  
 STRENGTH INTERCEPT (C) : .559      KSF  
 FRICTION ANGLE (PHI) : 35.0      DEG                      (PEAK STRENGTH)

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

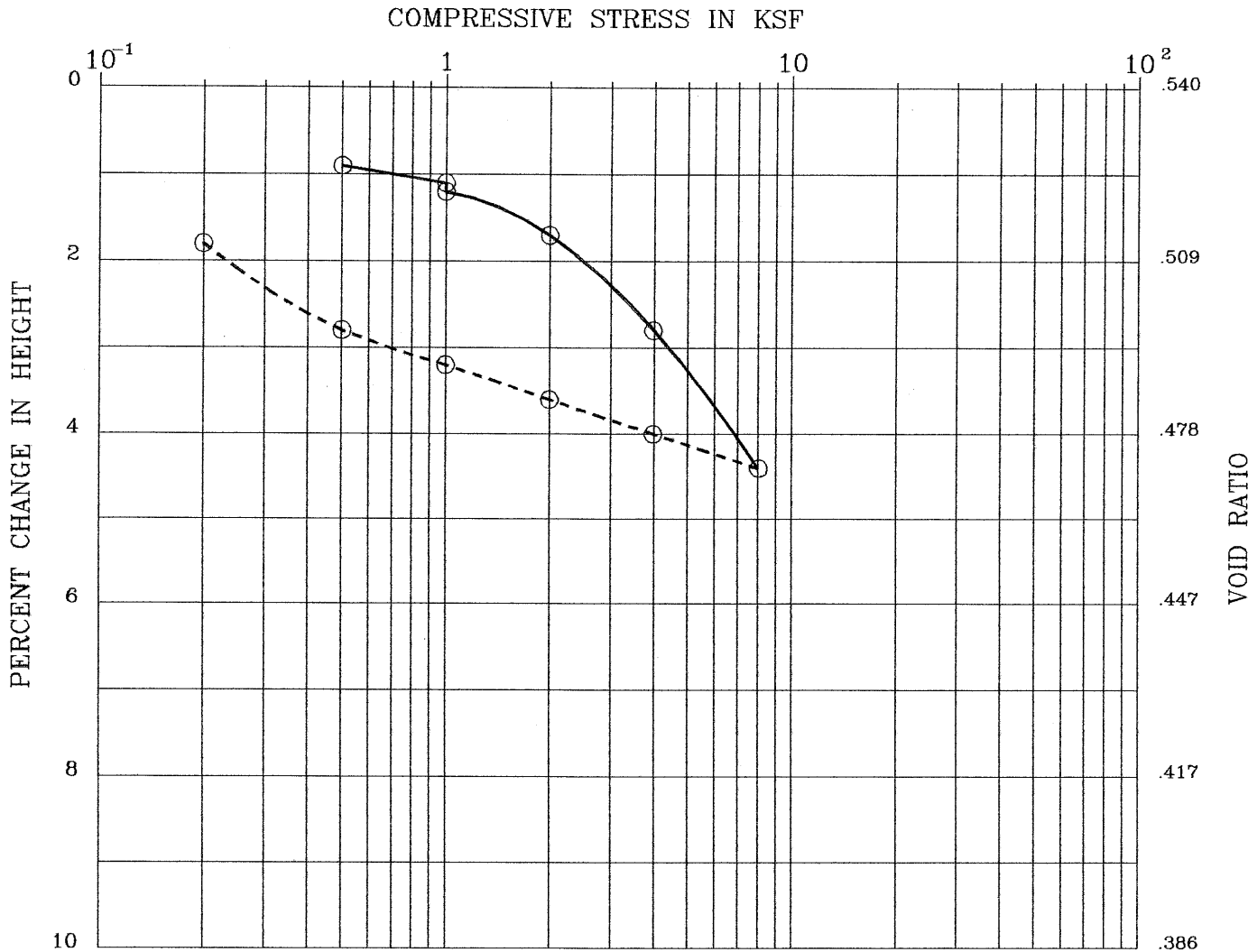


BORING/SAMPLE : H-22 #1                      DEPTH (ft) : 6-6.5  
 DESCRIPTION : Silty/clayey sand (SM/SC)  
 STRENGTH INTERCEPT (C) : .438 KSF                      (PEAK STRENGTH)  
 FRICTION ANGLE (PHI) : 36.6 DEG

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



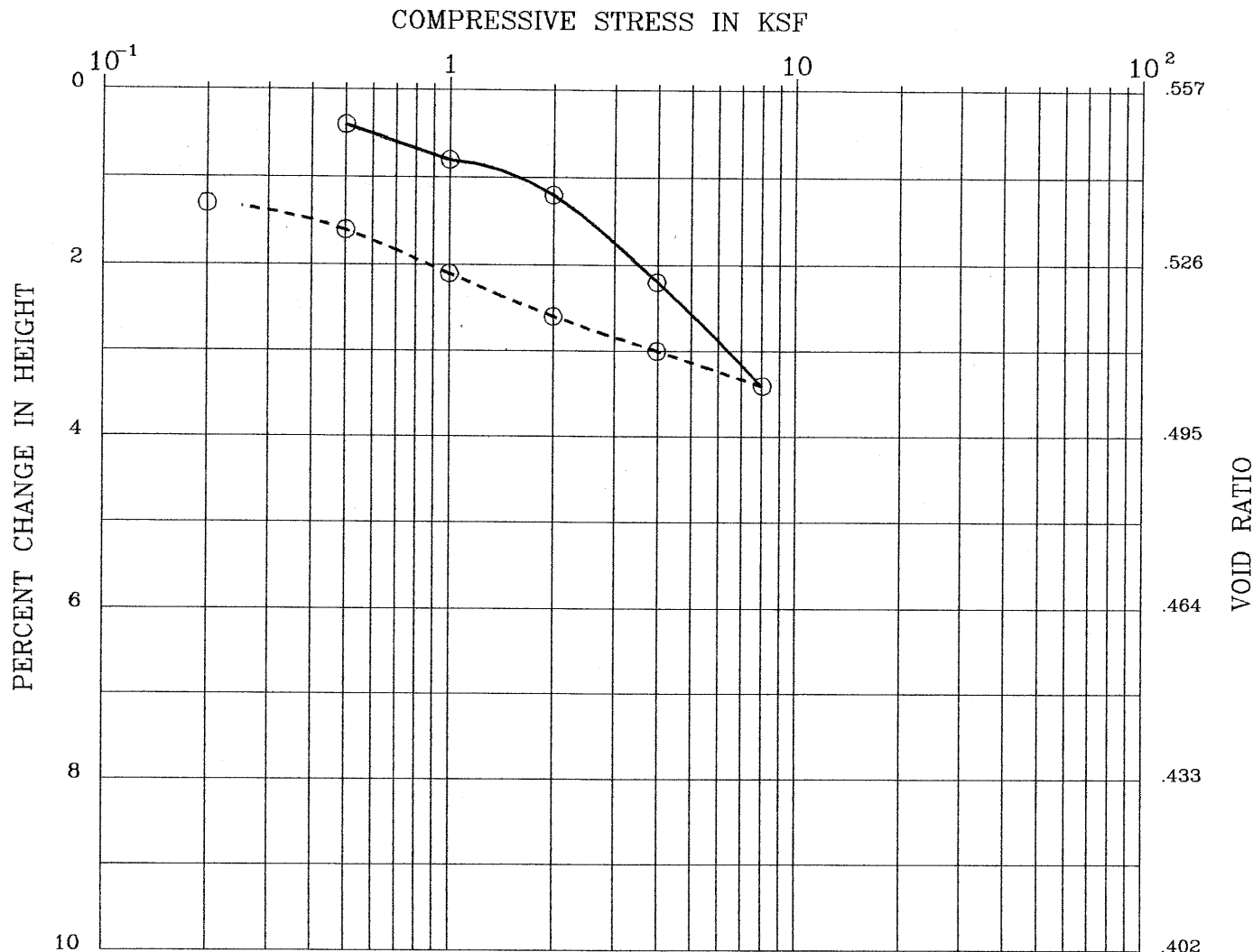
BORING : H-6 #3  
 DEPTH (ft) : 11-11.5  
 SPEC. GRAVITY : 2.71

DESCRIPTION : Clayey Sand (SC)  
 LIQUID LIMIT :  
 PLASTIC LIMIT :

	<u>MOISTURE CONTENT (%)</u>	<u>DRY DENSITY (pcf)</u>	<u>PERCENT SATURATION</u>	<u>VOID RATIO</u>
INITIAL	16.7	110.2	84	.540
FINAL	18.6	112.6	100	.506

Remark :

Project 44F1	NCWRP EXPANSION
ALLIED GEOTECHNICAL ENGINEERS, INC.	<b>CONSOLIDATION TEST</b> <span style="float: right;">Figure B-46</span>

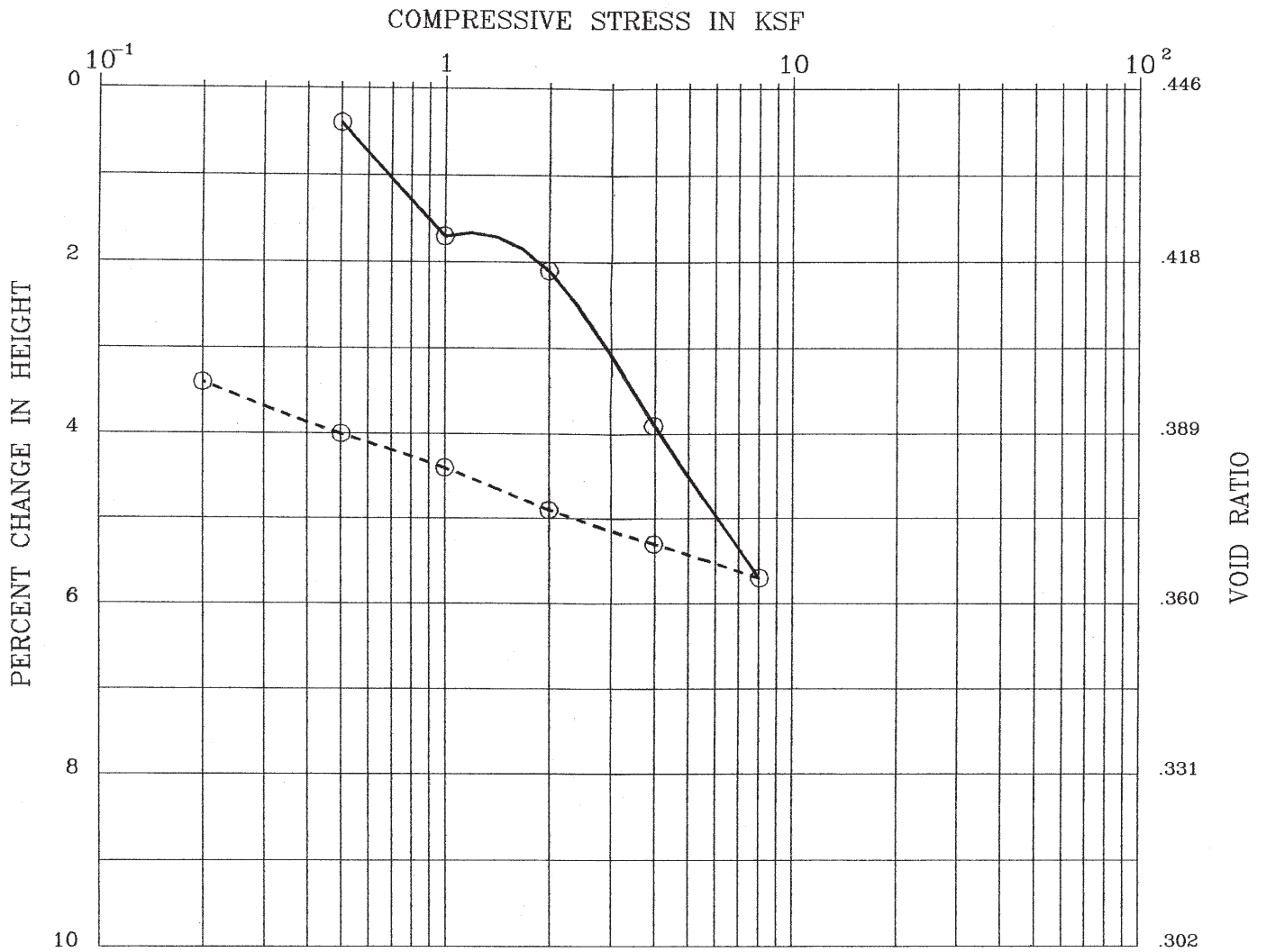


BORING	: H-6 #6	DESCRIPTION	: Silty sand (SM)
DEPTH (ft)	: 21-21.5	LIQUID LIMIT	:
SPEC. GRAVITY	: 2.66	PLASTIC LIMIT	:

	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.	<p style="text-align: center;">CONSOLIDATION TEST</p> <p style="text-align: right;">Figure B-47</p>

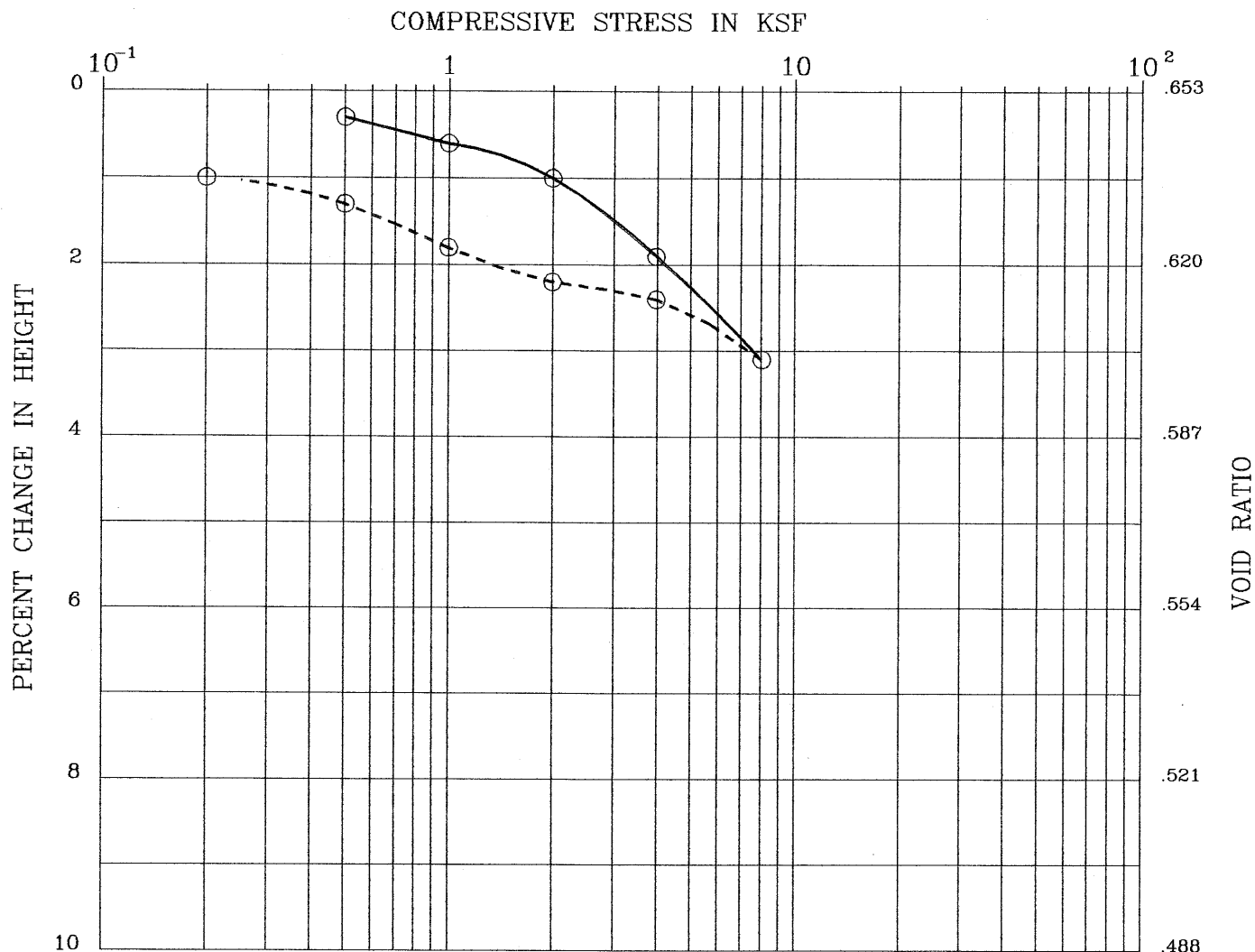


BORING	: H-10 #4	DESCRIPTION	: Silty sand/lean clay (SM/CL)
DEPTH (ft)	: 11-11.5	LIQUID LIMIT	:
SPEC. GRAVITY	: 2.41	PLASTIC LIMIT	:

	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

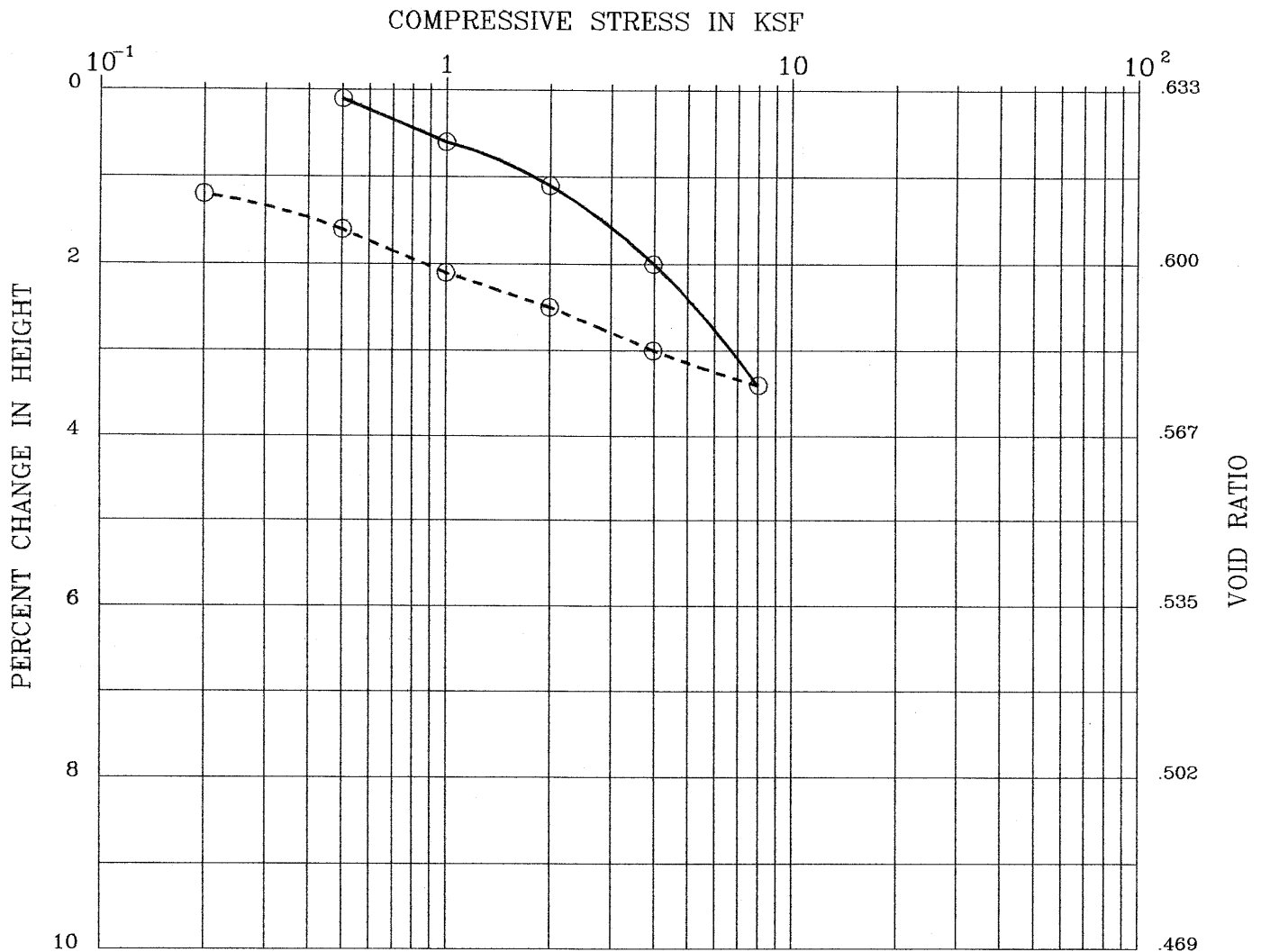


BORING : H-11 #1                      DESCRIPTION : Silty sand (SM)  
 DEPTH (ft) : 6-6.5                      LIQUID LIMIT :  
 SPEC. GRAVITY : 2.59                      PLASTIC LIMIT :

	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.	<p style="text-align: center;">CONSOLIDATION TEST</p> <p style="text-align: right;">Figure B-49</p>



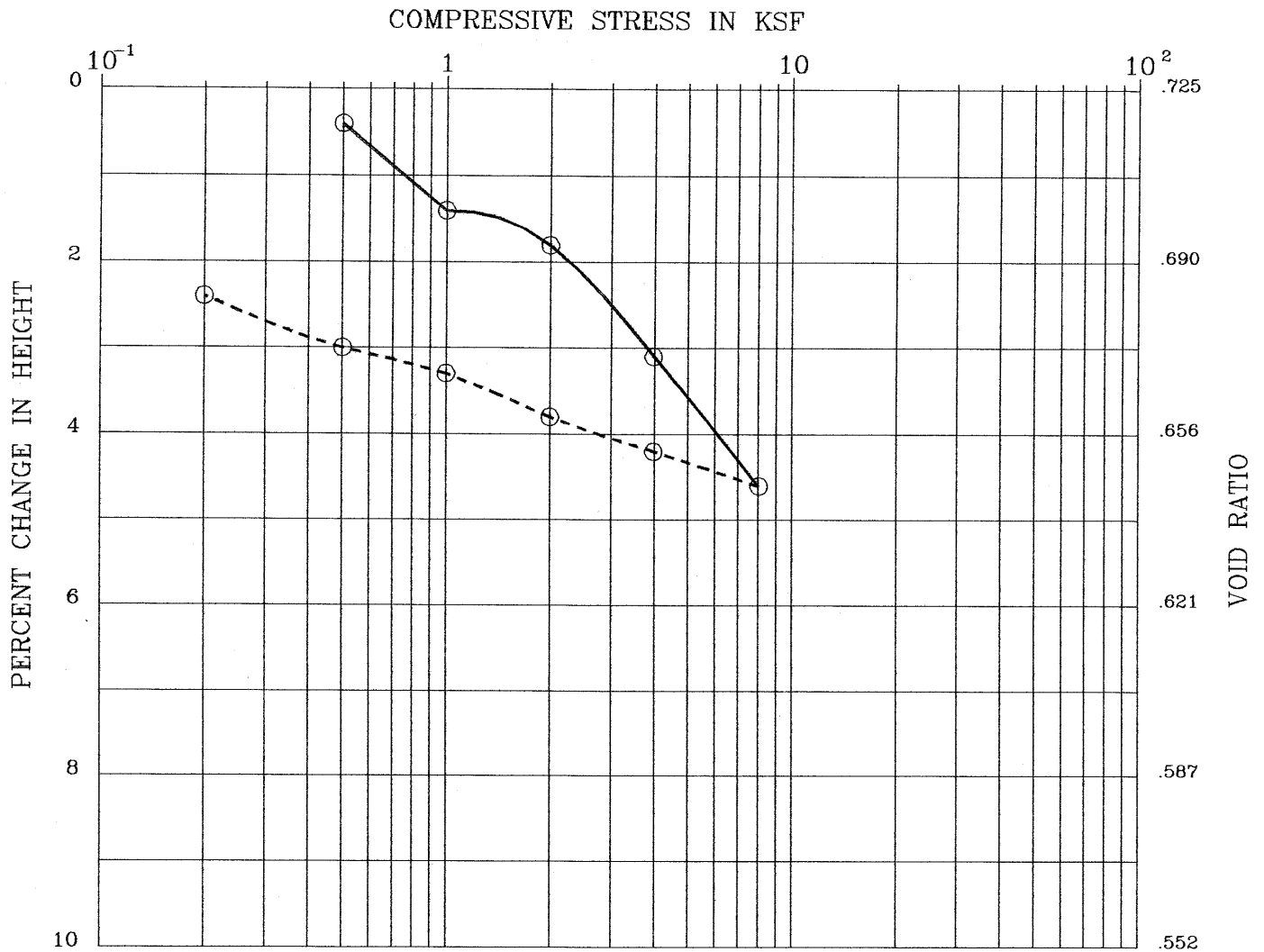
BORING	: H-11 #7	DESCRIPTION	: Sandy lean clay (CL)
DEPTH (ft)	: 25.5-26	LIQUID LIMIT	:
SPEC. GRAVITY	: 2.71	PLASTIC LIMIT	:

	<u>MOISTURE CONTENT (%)</u>	<u>DRY DENSITY (pcf)</u>	<u>PERCENT SATURATION</u>	<u>VOID RATIO</u>
INITIAL	21.5	103.7	92	.633
FINAL	22.6	105.0	100	.613

Remark :

Project 44F1	NCWRP EXPANSION
ALLIED GEOTECHNICAL ENGINEERS, INC.	<p style="text-align: center;"><b>CONSOLIDATION TEST</b></p> <p style="text-align: right;">Figure B-50</p>





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 :

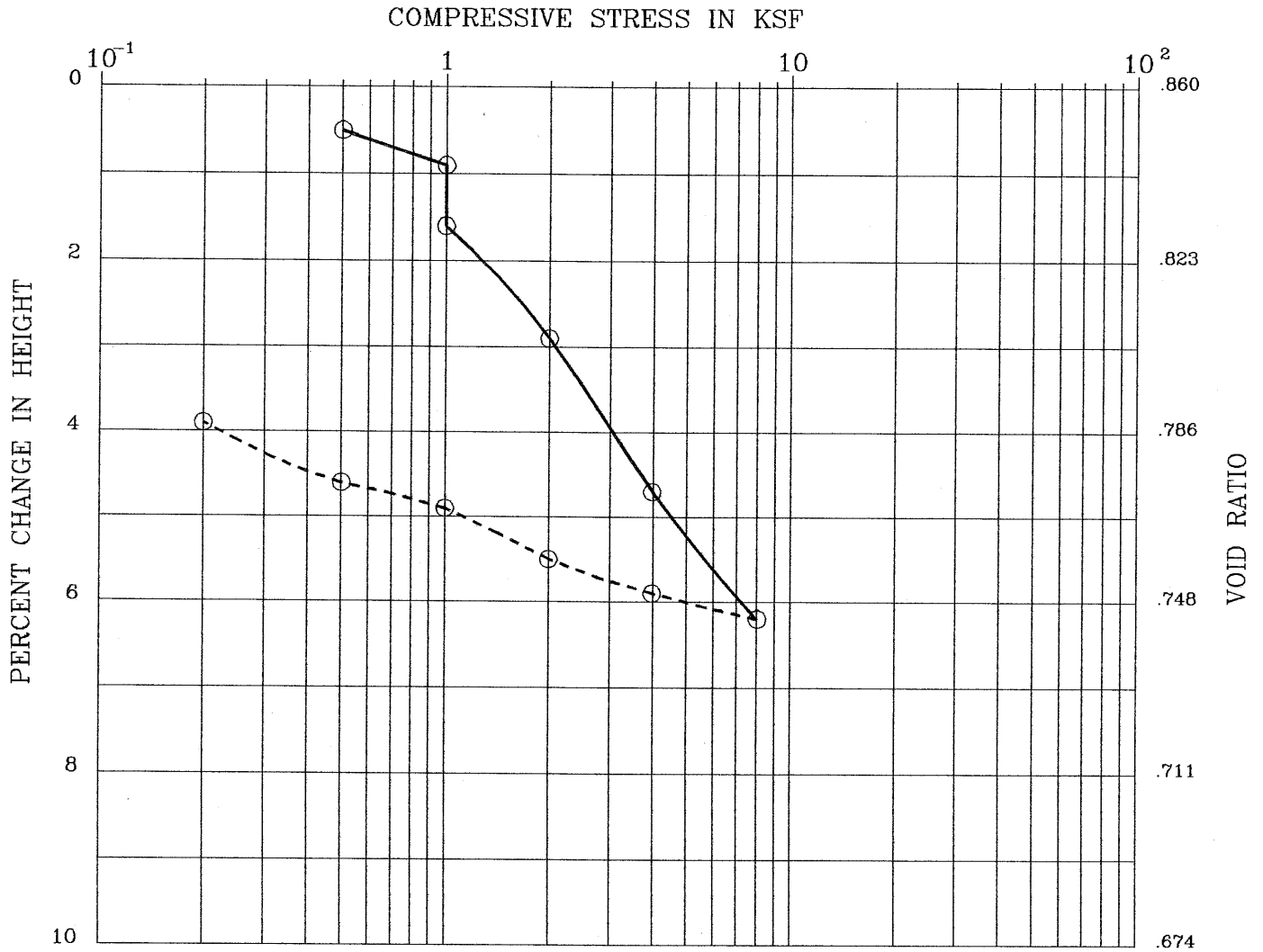
Project 44F1

NCWRP EXPANSION

ALLIED GEOTECHNICAL  
ENGINEERS, INC.

CONSOLIDATION TEST

Figure B-51

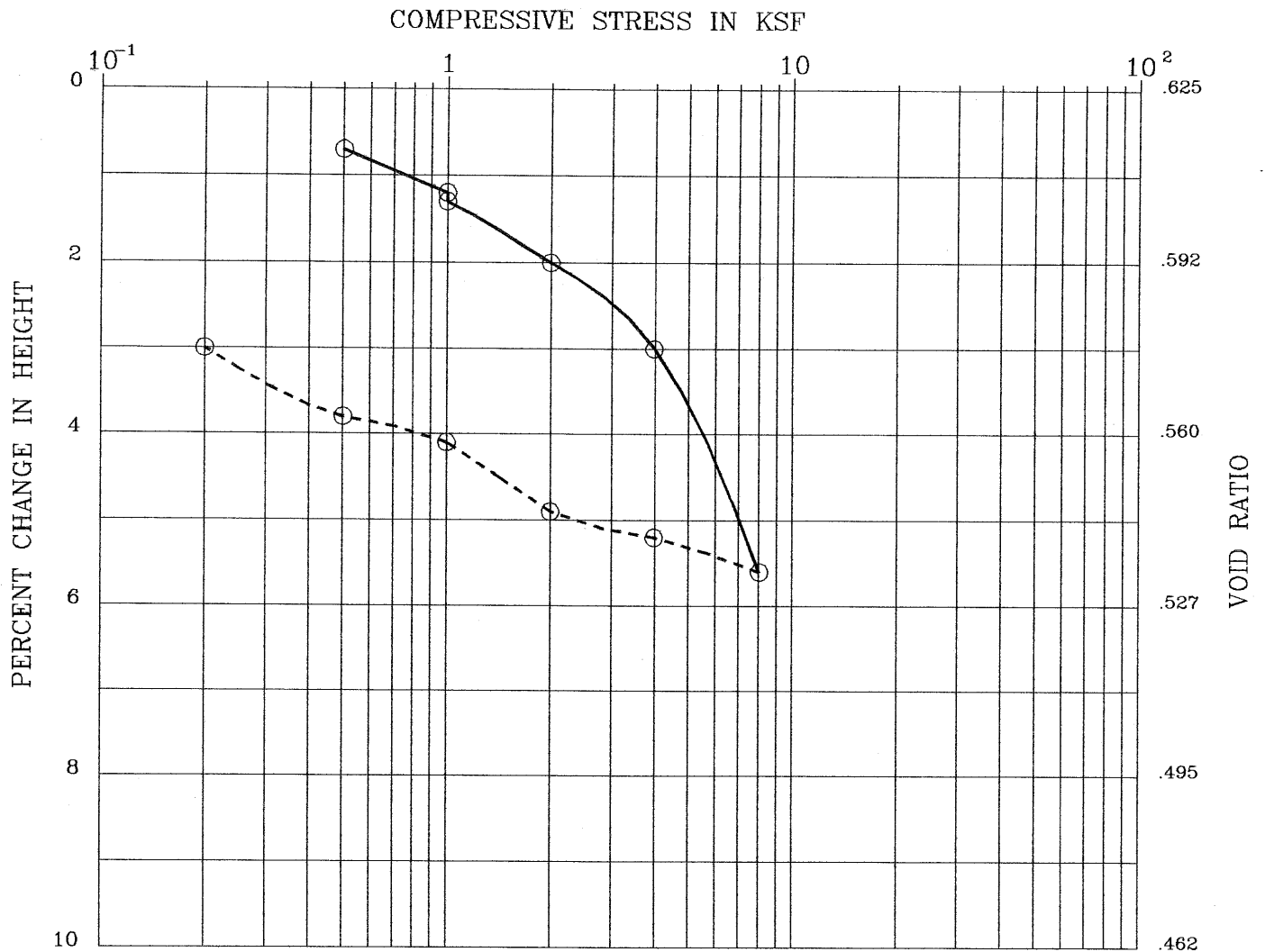


BORING : H-13 #7                      DESCRIPTION : Lean clay (CL)  
 DEPTH (ft) : 26-26.5                      LIQUID LIMIT :  
 SPEC. GRAVITY : 3.05                      PLASTIC LIMIT :

	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.	<p style="text-align: center;">CONSOLIDATION TEST</p> <p style="text-align: right;">Figure B-53</p>

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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: SO6422-1      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<sub>3</sub>)  
(In a saturated soil paste extract)      N/A

Note: N/A = Unable to determine due to the  
texture of the soil (Clay).

  
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: SO6396-9

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<sub>3</sub>)  
(In a 1:3 water extraction)

4ppm

  
\_\_\_\_\_  
Laura Torres  
LT/ram

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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: S06422-2      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<sub>3</sub>)      6ppm  
(In a 1:3 water extraction)

  
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Date: May 25, 2017

Purchase Order Number: 44F1

Sales Order Number: 35882

Account Number: ALLG

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Allied Geotechnical Engineers  
1810 Gillespie Way Ste 104  
El Cajon, CA 92020  
Attention: Sani Sutanto

Laboratory Number: S06396-10      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 <sub>3</sub> ) (In a 1:3 water extraction)	32ppm

  
 \_\_\_\_\_  
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Sales Order Number: 35882  
Account Number: ALLG

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Allied Geotechnical Engineers  
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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<sub>3</sub>)      12ppm  
(In a 1:3 water extraction)

  
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Date: June 14, 2017  
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Sales Order Number: 36150  
Account Number: ALLG  
To:

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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<sub>3</sub>)      30ppm  
(In a 1:3 water extraction)

  
\_\_\_\_\_  
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LT/ilv

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Date: June 14, 2017  
Purchase Order Number: 44F1  
Sales Order Number: 36150  
Account Number: ALLG

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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 <sub>3</sub> ) (In a 1:3 water extraction)	14ppm

  
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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: S06422-5      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 <sub>3</sub> ) (In a 1:3 water extraction)	27ppm

Rosa M. Bernal  
RMB/ilv

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Date: May 25, 2017

Purchase Order Number: 44F1

Sales Order Number: 35882

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: SO6396-12      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<sub>3</sub>)      N/A  
(In a 1:3 water extraction)

Note: N/A = Unable to determine due to the texture of the soil (Clay).

  
\_\_\_\_\_  
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: S06396-13 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<sub>3</sub>) N/A

(In a 1:3 water extraction)  
Note: N/A = Unable to determine due to the texture of the soil (Clay).

  
\_\_\_\_\_  
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: SO6422-6      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 <sub>3</sub> ) (In a 1:3 water extraction)	24ppm

Rosa M. Bernal  
RMB/ilv



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Date: June 15, 2017

Purchase Order Number: 44F1

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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: 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<sub>3</sub>)  
(In a 1:3 water extraction)

28ppm



Laura Torres  
LT/dbb

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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<sub>3</sub>)      52ppm  
(In a 1:3 water extraction)

  
\_\_\_\_\_  
Laura Torres  
LT/dbb

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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: S06422-9

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<sub>3</sub>)  
(In a 1:3 water extraction)

50ppm

  
\_\_\_\_\_  
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<sub>3</sub>) 48ppm  
(In a 1:3 water extraction)

  
\_\_\_\_\_  
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A N A L Y T I C A L A N D C O N S U L T I N G C H E M I S T S

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<sub>3</sub>)  
(In a 1:3 water extraction)

54ppm



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: S06396-2      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<sub>3</sub>)      48ppm  
(In a 1:3 water extraction)

  
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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: S06396-3 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<sub>3</sub>) 54ppm  
(In a 1:3 water extraction)

  
\_\_\_\_\_  
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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: S06422-11      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<sub>3</sub>)      22ppm  
(In a 1:3 water extraction)

  
\_\_\_\_\_  
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LT/dbb

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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: SO6422-12    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 <sub>3</sub> ) (In a 1:3 water extraction)	30ppm

Rosa M. Bernal  
RMB/ilv

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Date: May 24, 2017  
Purchase Order Number: 44F1  
Sales Order Number: 35882  
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: S06396-4      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 <sub>3</sub> ) (In a 1:3 water extraction)	46ppm

  
\_\_\_\_\_  
Laura Torres  
LT/ilv

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Date: May 24, 2017  
Purchase Order Number: 44F1  
Sales Order Number: 35882  
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: SO6396-5      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 <sub>3</sub> ) (In a 1:3 water extraction)	44ppm

  
\_\_\_\_\_  
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Date: May 24, 2017  
Purchase Order Number: 44F1  
Sales Order Number: 35882  
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: S06396-6 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<sub>3</sub>) 26ppm  
(In a 1:3 water extraction)

  
\_\_\_\_\_  
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Date: May 24, 2017  
Purchase Order Number: 44F1  
Sales Order Number: 35882  
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: SO6396-7      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<sub>3</sub>)      57ppm  
(In a 1:3 water extraction)

  
\_\_\_\_\_  
Laura Torres  
LT/ilv

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A N A L Y T I C A L   A N D   C O N S U L T I N G   C H E M I S T S

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<sub>3</sub>)  
(In a 1:3 water extraction)

26ppm



Laura Torres  
LT/dbb



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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: SO6396-14

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<sub>3</sub>)  
(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.  
350 Trousdale Dr. Chula Vista, Ca. 91910 www.clarksonlab.com  
ANALYTICAL AND CONSULTING CHEMISTS

Date: May 24, 2017

Purchase Order Number: 44F1

Sales Order Number: 35882

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: SO6396-8

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<sub>3</sub>)  
(In a 1:3 water extraction)

70ppm



Laura Torres  
LT/ilv

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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: S06422-14      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 <sub>3</sub> ) (In a 1:3 water extraction)	18ppm

Rosa M. Bernal  
RMB/ilv



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A N A L Y T I C A L   A N D   C O N S U L T I N G   C H E M I S T S

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: S06422-15    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 <sub>3</sub> ) (In a 1:3 water extraction)	8ppm

  
\_\_\_\_\_  
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

C L A R K S O N   L A B O R A T O R Y   A N D   S U P P L Y   I N C.  
350 Trousdale Dr. Chula Vista, Ca. 91910 www.clarksonlab.com  
A N A L Y T I C A L   A N D   C O N S U L T I N G   C H E M I S T S

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: S06422-16    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 <sub>3</sub> ) (In a 1:3 water extraction)	11ppm

Rosa M. Bernal  
RMB/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 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<sub>3</sub>)      6ppm  
(In a 1:3 water extraction)

  
\_\_\_\_\_  
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

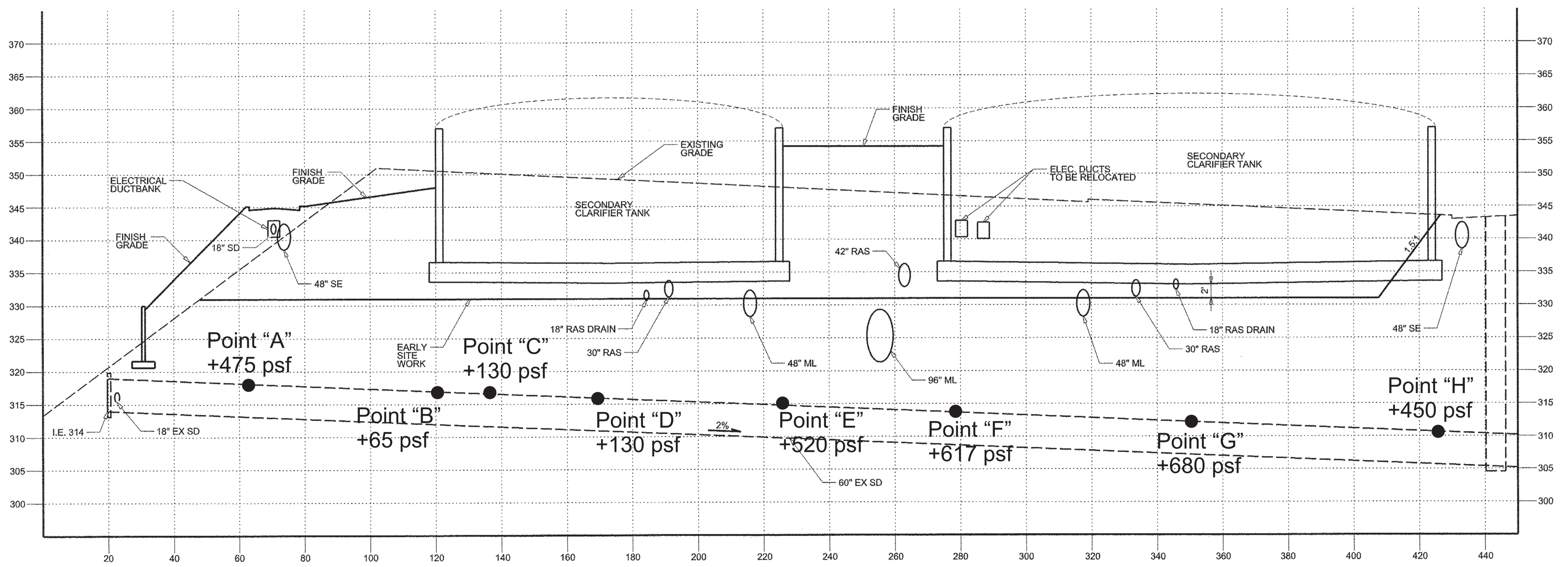
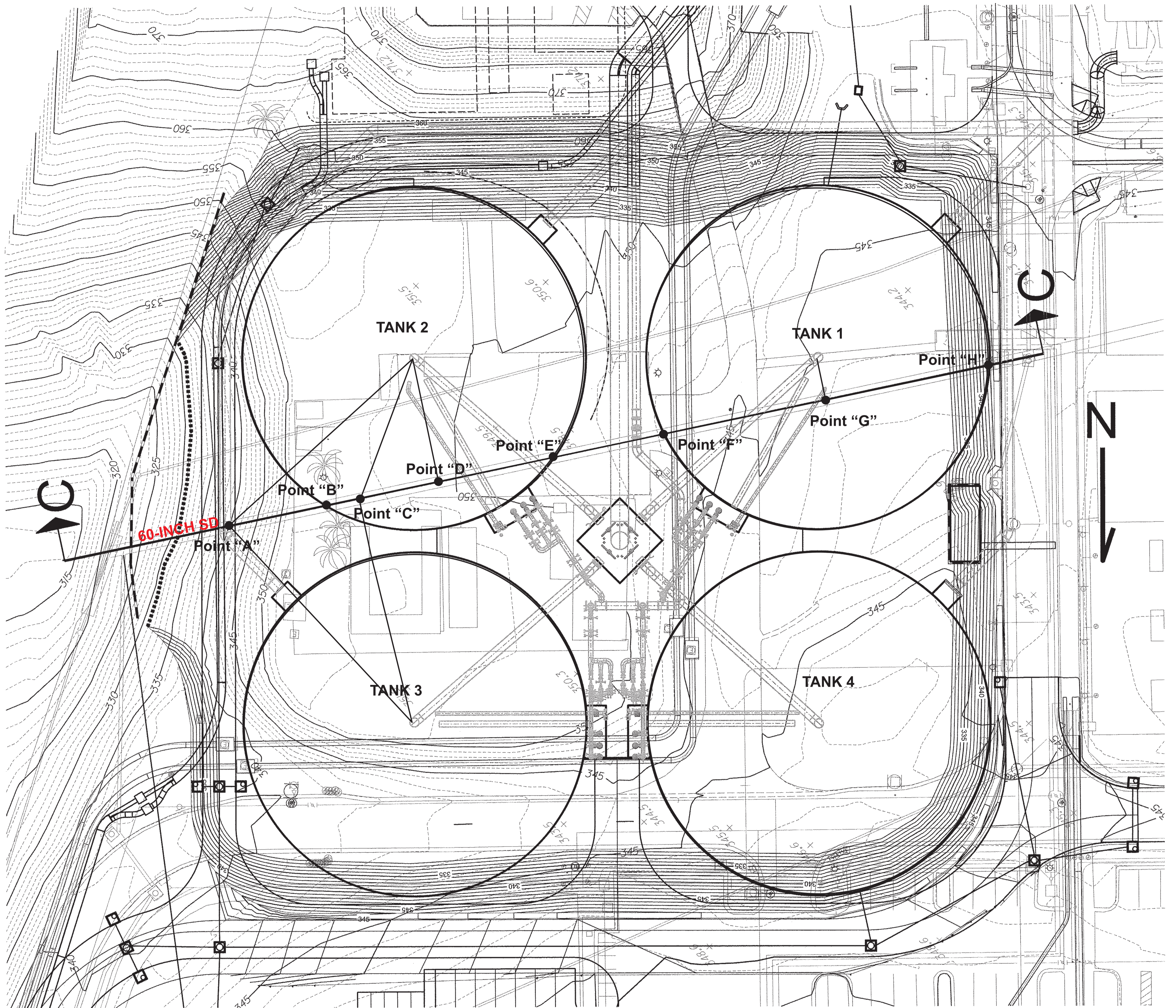
Boring H-22

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**

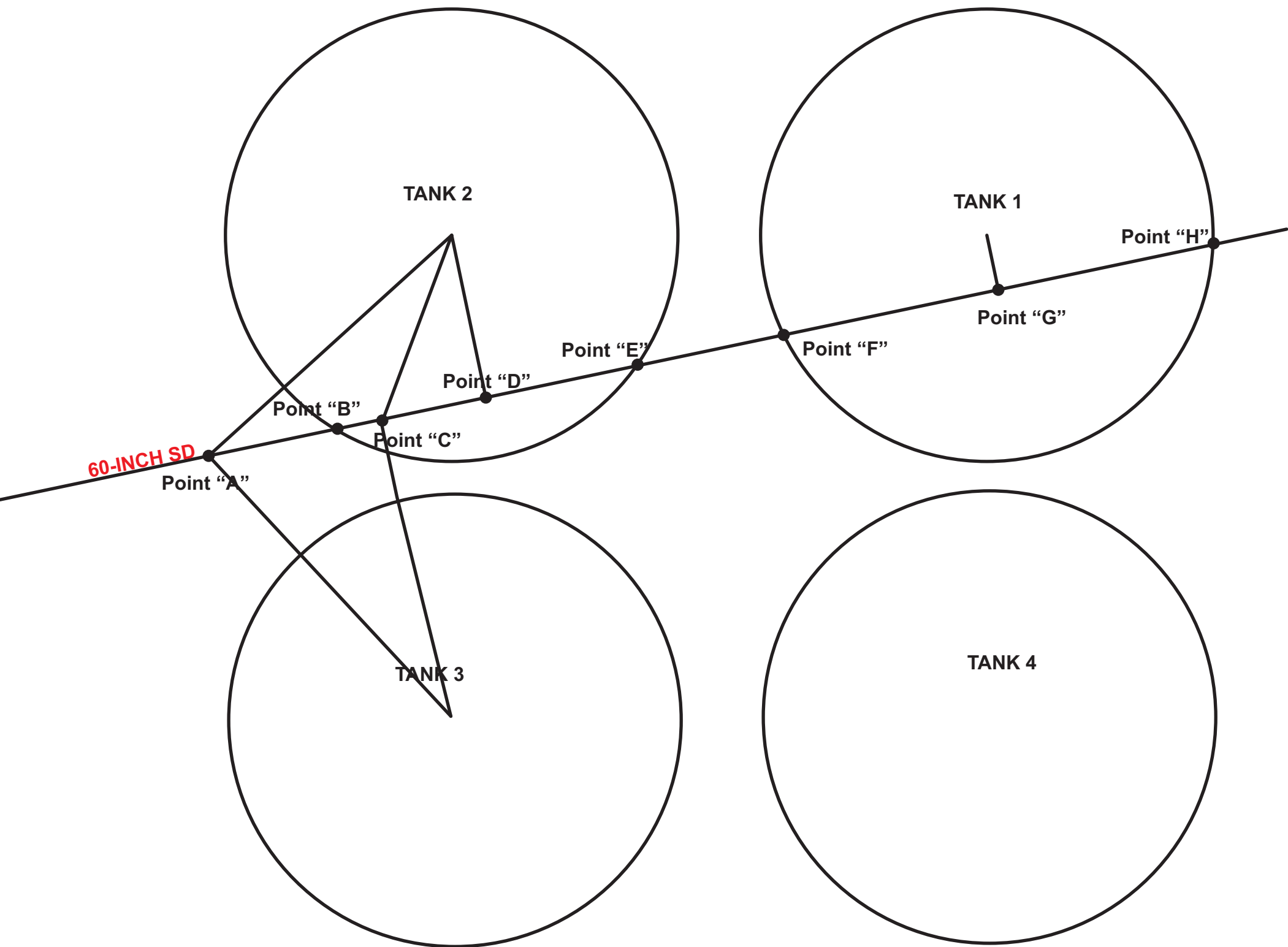
### **CALCULATIONS OF ADDITIONAL LOAD ON 60-INCH DIAMETER STORM DRAIN**





**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  
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## Point "A"

Load from additional fill treated as edge load of uniformly loaded rectangular area.

$$q = 10' \times 110 \text{ pcf} = 1,100 \text{ psf}$$

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)

$$\text{Load from additional fill} = 2 \times 0.21633 \times 1,100 \text{ psf} = 475 \text{ psf}$$

Contribution from Tank 2

$$\text{Radius ( } r \text{ )} = 80'$$

Depth from bottom of raft foundation to top of pipe ( $z$ ) =  $15'$

Distance from center to Point "A" ( $a$ ) =  $114'$

Additional foundation load =  $2,000 \text{ psf} - (16 \times 110 \text{ psf}) = 240 \text{ psf}$

$$m = z/r = 15/80 = 0.19$$

$$n = a/r = 114/80 = 1.425$$

$Nz = 0\%$  (Foster and Ahlvin, 1954)

$$\begin{aligned} Qz &= \text{pressure at Point "A" due to foundation load} = \\ &240 \text{ psf} \times 0\% = 0 \text{ psf.} \end{aligned}$$

Contribution from Tank 3

$$\text{Radius ( } r \text{ )} = 80'$$

Depth from bottom of raft foundation to top of pipe ( $z$ ) =  $15'$

Distance from center to Point "A" ( $a$ ) =  $110'$

Foundation Pressure =  $240 \text{ psf}$  (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)

$$\begin{aligned} Qz &= \text{pressure at Point "A" due to foundation load} = \\ &240 \text{ psf} \times 0\% = 0 \text{ psf.} \end{aligned}$$

## Conclusion:

Additional foundation load at Point "A" is estimated to be  $475 \text{ psf}$

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## 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

$m = z/r = 15/80 = 0.19$

$n = a/r = 80/80 = 1.0$

$N_z = 50\%$  (Foster and Ahlvin, 1954)

$Q_z =$  pressure at Point "B" due to foundation load =  
 $2,000 \text{ psf} \times 50\% = 1,000 \text{ psf.}$

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'

$m = z/r = 15/80 = 0.19$

$n = a/r = 106/80 = 1.325$

$N_z = 0\%$  (Foster and Ahlvin, 1954) - no contribution

Soil surcharge load removed =  $(17' \times 110 \text{ pcf})/2 = 935 \text{ psf}$

## Conclusion:

Additional foundation load at Point "B" is estimated to  
be  $1,000 \text{ psf} - 935 \text{ psf} = 65 \text{ psf}$

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## 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

$m = z/r = 15/80 = 0.19$

$n = a/r = 66/80 = 0.825$

$N_z = 100\%$  (Foster and Ahlvin, 1954)

$Q_z =$  pressure at Point "C" due to foundation load =  
 $2,000 \text{ psf} \times 100\% = 2,000 \text{ psf.}$

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'

$m = z/r = 15/80 = 0.19$

$n = a/r = 104/80 = 1.3$

$N_z = 0\%$  (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  $2,000 \text{ psf} - 1,870 \text{ psf} = 130 \text{ psf}$

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## 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

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Calculation Performed On: May 19, 2017

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## 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 =  
 $2,000 \text{ psf} \times 50\% = 1,000 \text{ psf.}$

Soil surcharge load removed =  $(14' \times 110 \text{ pcf})/2 = 770 \text{ psf}$

Load from additional fill treated as edge load of uniformly loaded rectangular area.

$q = 6' \times 110 \text{ pcf} = 660 \text{ psf}$

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 =  $2 \times 0.22025 \times 660 \text{ psf} = 290 \text{ psf}$

## Conclusion:

Additional load at Point "E" is estimated to be equal to:  
 $1,000 \text{ psf} + 290 \text{ psf} - 770 \text{ psf} = 520 \text{ psf.}$

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Calculation Performed On: May 19, 2017

Project Name: North City Wastewater Treatment Plant Expansion

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## 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 =  
 $2,000 \text{ psf} \times 50\% = 1,000 \text{ psf.}$

Soil surcharge load removed =  $(14' \times 110 \text{ pcf})/2 = 770 \text{ psf}$

Load from additional fill treated as edge load of uniformly loaded rectangular area.

$q = 8' \times 110 \text{ pcf} = 880 \text{ psf}$

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 =  $2 \times 0.22025 \times 880 \text{ psf} = 387 \text{ psf}$

## Conclusion:

Additional load at Point "F" is estimated to be equal to:  
 $1,000 \text{ psf} + 387 \text{ psf} - 770 \text{ psf} = 617 \text{ psf.}$

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Calculation Performed On: May 19, 2017

Project Name: North City Wastewater Treatment Plant Expansion

Project No. 44F1

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## 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

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Calculation Performed On: May 19, 2017

Project Name: North City Wastewater Treatment Plant Expansion

Project No. 44F1

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## 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

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Calculation Performed On: May 19, 2017

Project Name: North City Wastewater Treatment Plant Expansion

Project No. 44F1

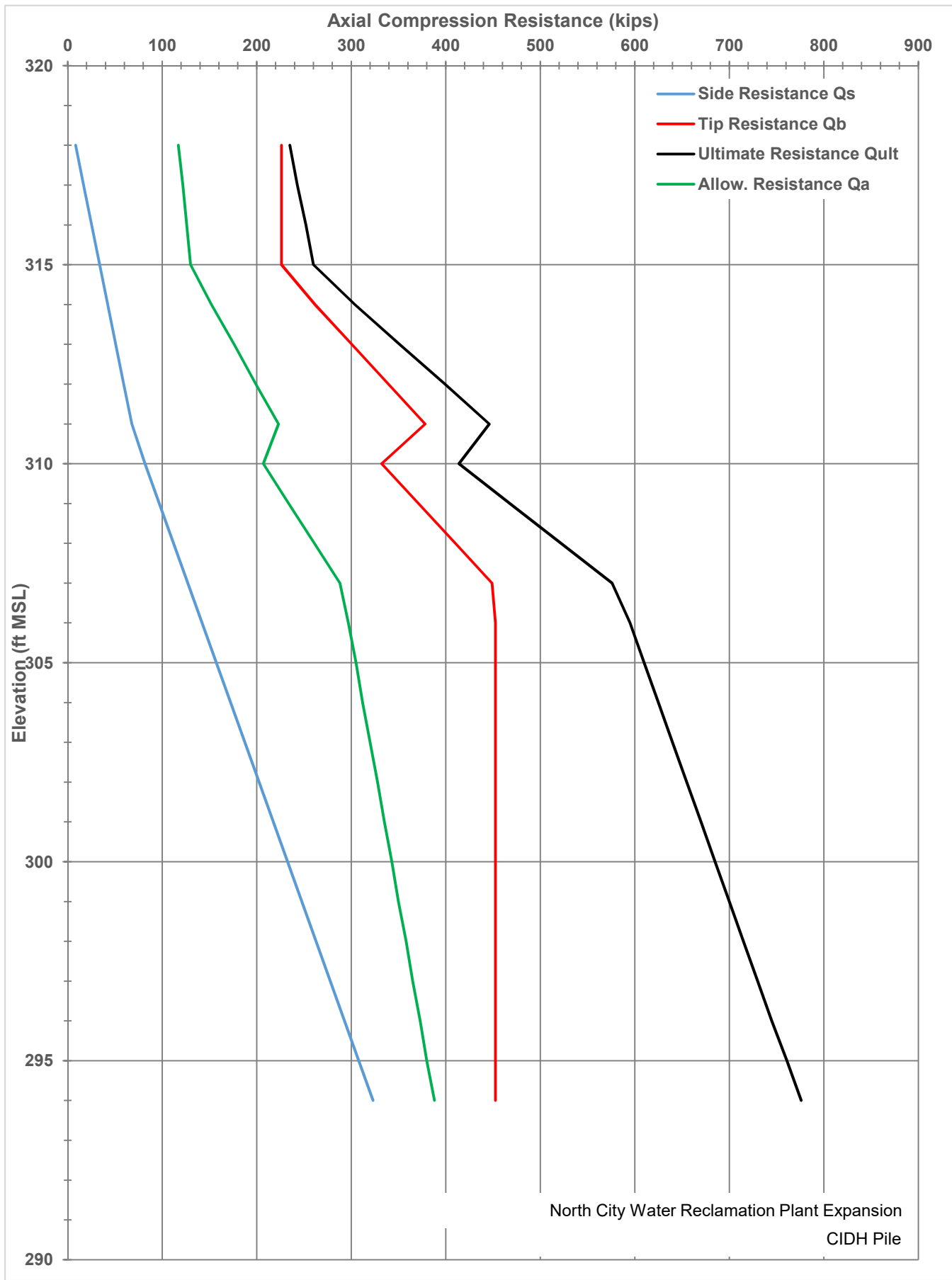
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## **APPENDIX C.3**

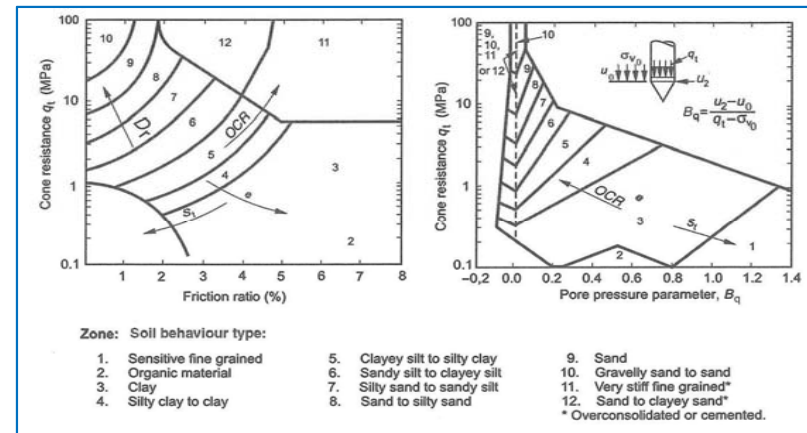
### **36-INCH DIAMETER CIDH PILE CALCULATIONS**



**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 <sub>t</sub> (tsf)/N <sub>60</sub>	W <sub>s</sub>	W <sub>t</sub>
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 <sub>pile</sub> (in.)	36
4D <sub>pile</sub> (ft)	12.0
A <sub>s</sub> (ft <sup>2</sup> )	9.42
A <sub>t</sub> (ft <sup>2</sup> )	7.07

FS (Side)	2
FS (Tip)	2
Target R <sub>a</sub>	375 kips

Depth (ft)	Elev. (ft)	1986 SBT	CPT q <sub>t</sub> (tsf)	Lim. q <sub>t</sub> (tsf)	f <sub>s1</sub> (ksf)	W <sub>s</sub> (tsf)	f <sub>s</sub> (ksf)	R <sub>si</sub> (kips)	ΣR <sub>si</sub> (kips)	Toe Ave. q <sub>t</sub> (tsf)	q <sub>b1</sub> (ksf)	W <sub>t</sub> (tsf)	q <sub>b</sub> (ksf)	R <sub>t</sub> (kips)	R <sub>ult</sub> (kips)	R <sub>a</sub> (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:**  $K_s = c (d_{10})^2$   
 $K_s =$  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	Max Inf.	Median
	Rate	Rate	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**

<b>Dia (mm)</b>	<b>% pass</b>
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**

<b>Dia (mm)</b>	<b>% pass</b>
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**

<b>Dia (mm)</b>	<b>% pass</b>
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

<b>Dia (mm)</b>	<b>% pass</b>
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

<b>Dia (mm)</b>	<b>% pass</b>
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

<b>Dia (mm)</b>	<b>% pass</b>
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**

<b>Dia (mm)</b>	<b>% pass</b>
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

<b>Dia (mm)</b>	<b>% pass</b>
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

<b>Dia (mm)</b>	<b>% pass</b>
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**

<b>Dia (mm)</b>	<b>% pass</b>
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

<b>Dia (mm)</b>	<b>% pass</b>
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

<b>Dia (mm)</b>	<b>% pass</b>
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

<b>Dia (mm)</b>	<b>% pass</b>
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

<b>Dia (mm)</b>	<b>% pass</b>
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

<b>Dia (mm)</b>	<b>% pass</b>
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

<b>Dia (mm)</b>	<b>% pass</b>
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**

<b>Dia (mm)</b>	<b>% pass</b>
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

North City Water Reclamation Plant Expansion

AGE Project No. 44F1

July 12, 2017

Page 1

**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**

<b>Dia (mm)</b>	<b>% pass</b>
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**

<b>Dia (mm)</b>	<b>% pass</b>
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**

<b>Dia (mm)</b>	<b>% pass</b>
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**

<b>Dia (mm)</b>	<b>% pass</b>
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

<b>Dia (mm)</b>	<b>% pass</b>
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

<b>Dia (mm)</b>	<b>% pass</b>
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

<b>Dia (mm)</b>	<b>% pass</b>
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**

<b>Dia (mm)</b>	<b>% pass</b>
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

<b>Dia (mm)</b>	<b>% pass</b>
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

<b>Dia (mm)</b>	<b>% pass</b>
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

<b>Dia (mm)</b>	<b>% pass</b>
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**

<b>Dia (mm)</b>	<b>% pass</b>
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

<b>Dia (mm)</b>	<b>% pass</b>
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

<b>Dia (mm)</b>	<b>% pass</b>
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

<b>Dia (mm)</b>	<b>% pass</b>
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

<b>Dia (mm)</b>	<b>% pass</b>
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

<b>Dia (mm)</b>	<b>% pass</b>
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

<b>Dia (mm)</b>	<b>% pass</b>
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)

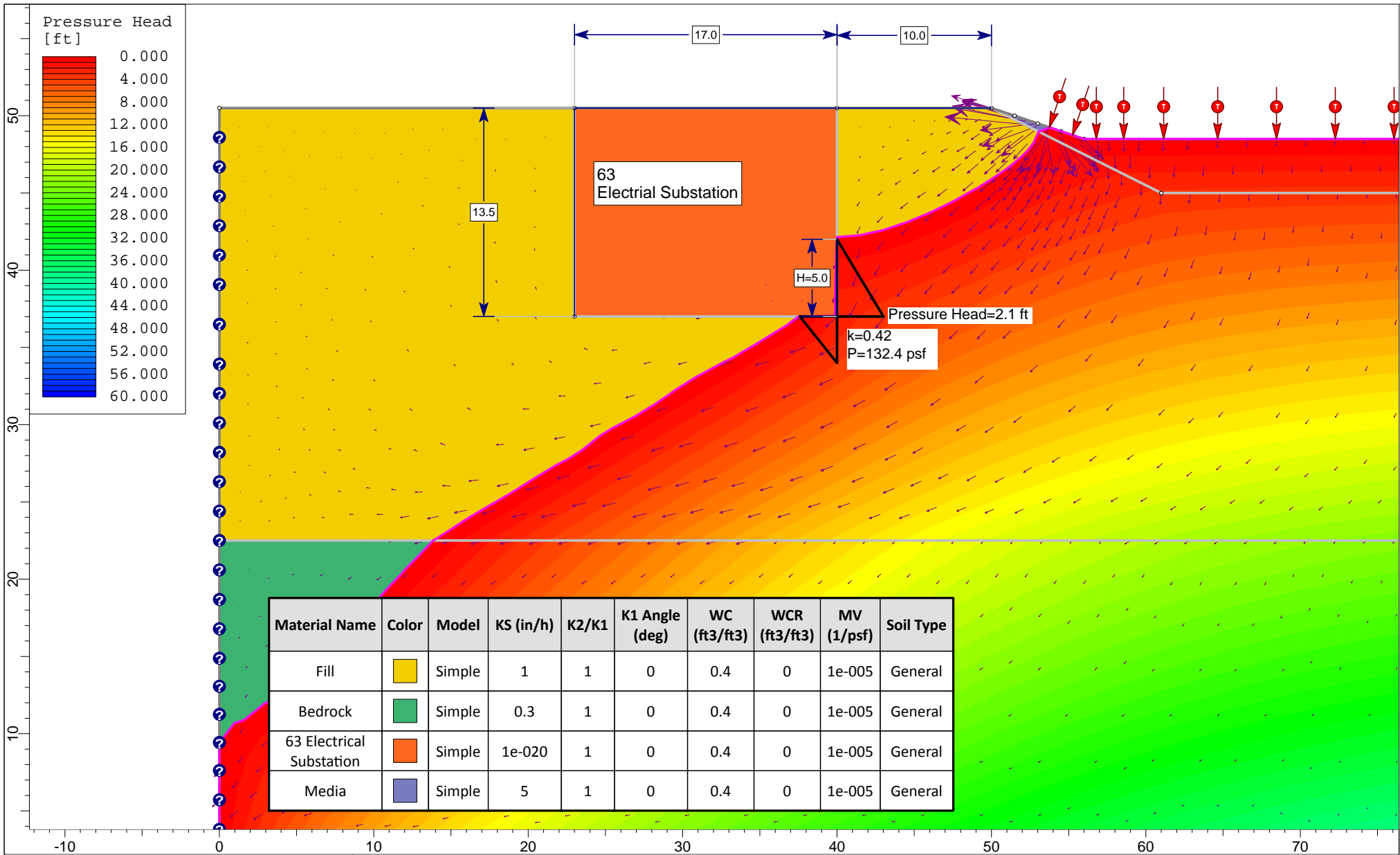
**Boring #** H-20  
**Sample #** 1  
**Depth** 3-5 ft.  
**Soil ID** Scripps


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)





	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  $m\alpha < 0.2$ : 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/ft<sup>3</sup>]: 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

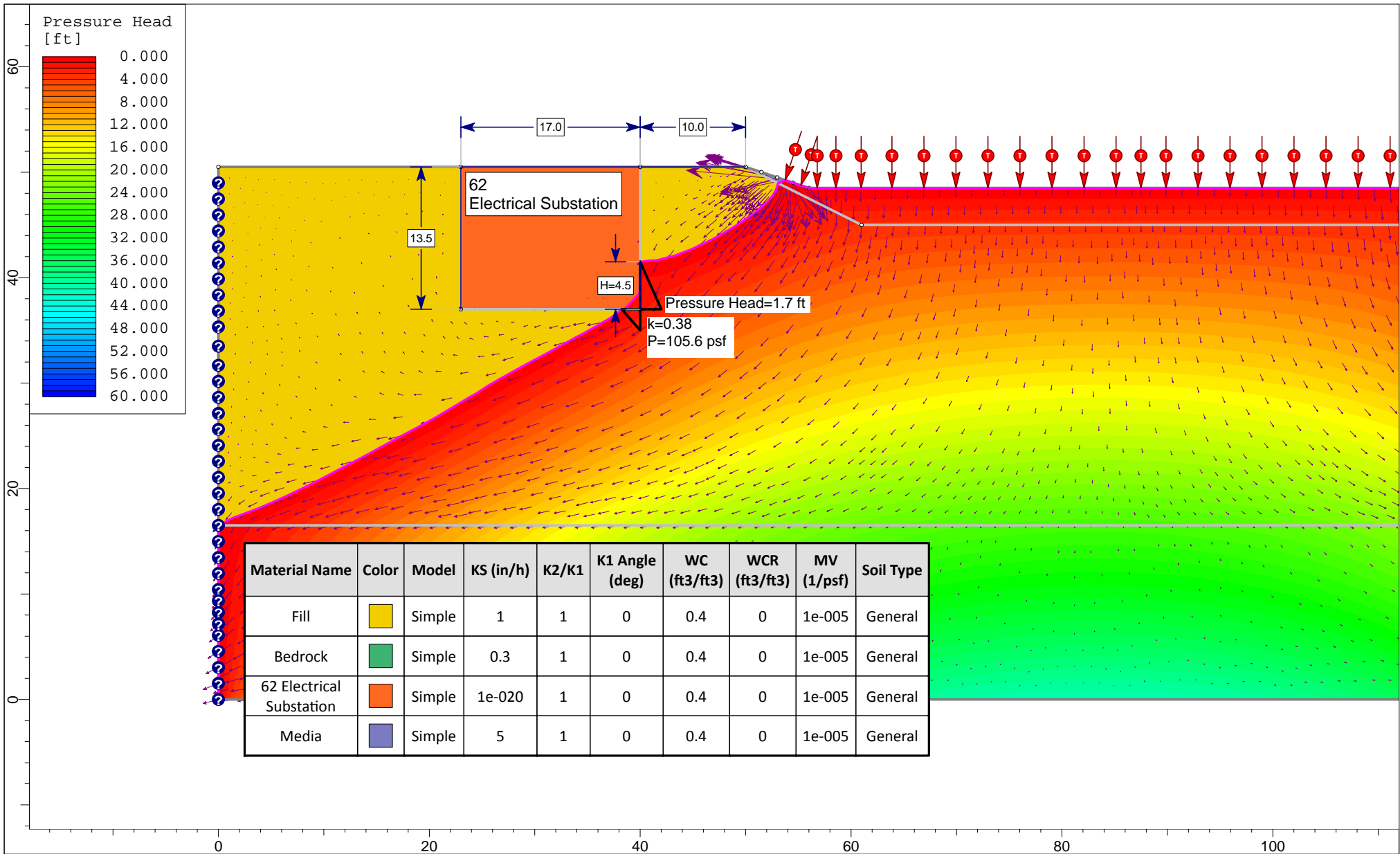
**Material Boundary**


X	Y
40	37
40	50.5

**Material Boundary**

X	Y
199	45
210	50.5





	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  $m\alpha < 0.2$ : 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/ft<sup>3</sup>]: 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

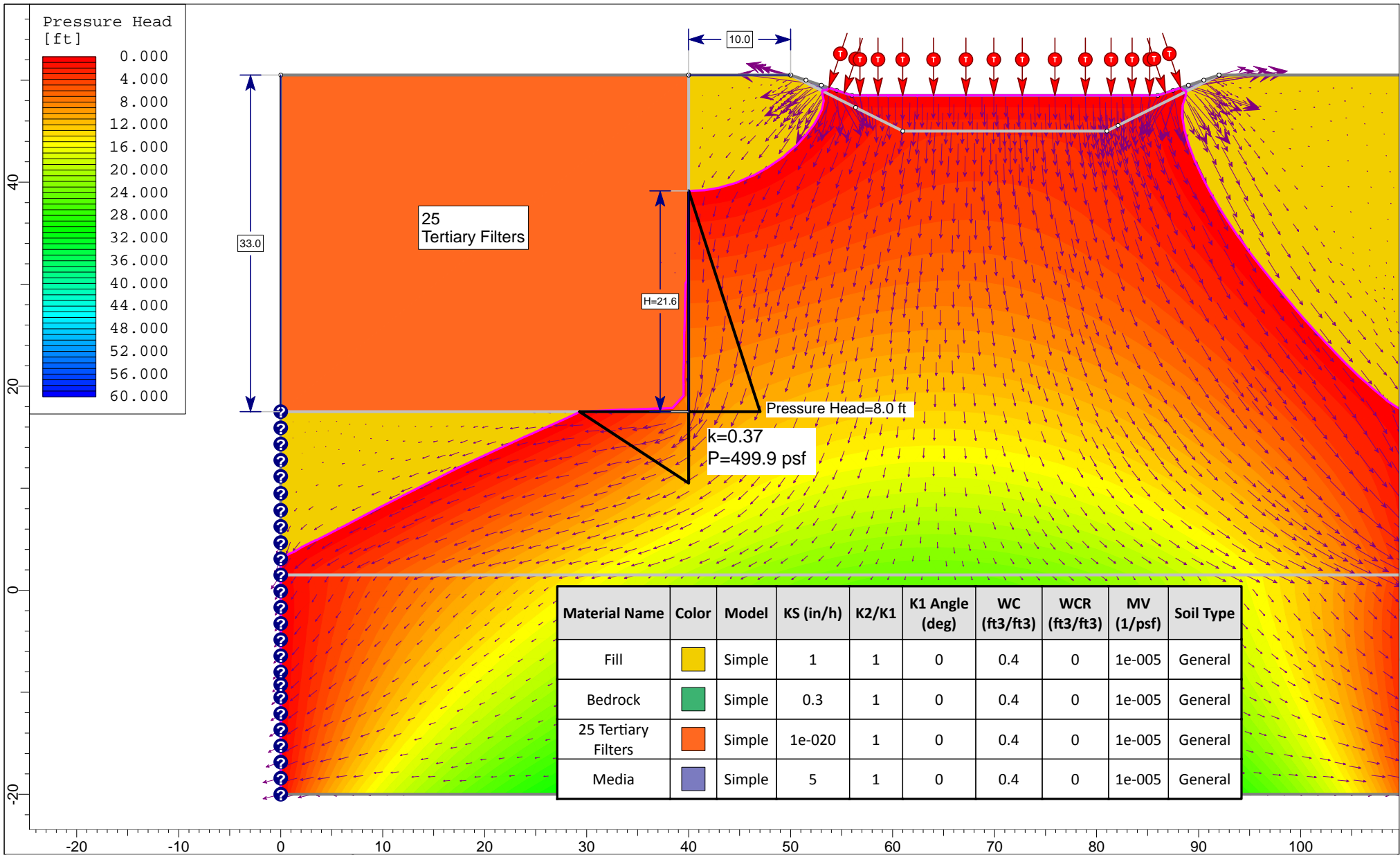
**Material Boundary**


X	Y
23	50.5
23	37
40	37

**Material Boundary**

X	Y
40	50.5
40	37





	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

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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

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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  $m\alpha < 0.2$ : Yes  
 Create Interslice boundaries at intersections with water tables and piezos: Yes  
 Initial trial value of FS: 1  
 Steffensen Iteration: Yes

#### Groundwater Analysis

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Groundwater Method: Water Surfaces  
 Pore Fluid Unit Weight [lbs/ft<sup>3</sup>]: 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





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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**

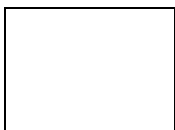
**External Boundary**

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

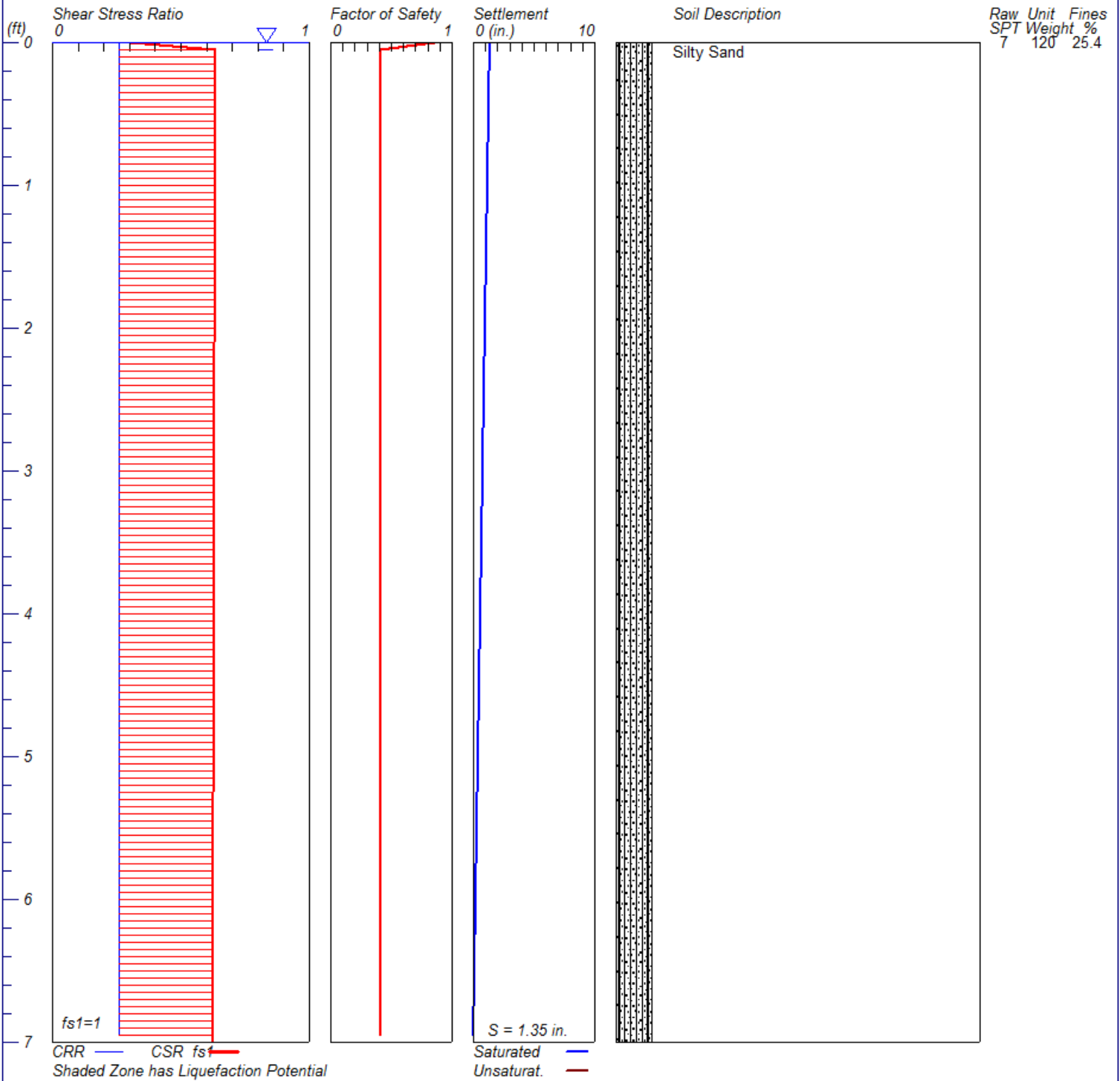
# Liquefaction and Seismic Settlement (Liquefy Pro)

# LIQUEFACTION ANALYSIS

## San Diego North City WWTP

Hole No.=H-7 Water Depth=0 ft

Magnitude=6.8  
Acceleration=0.469g



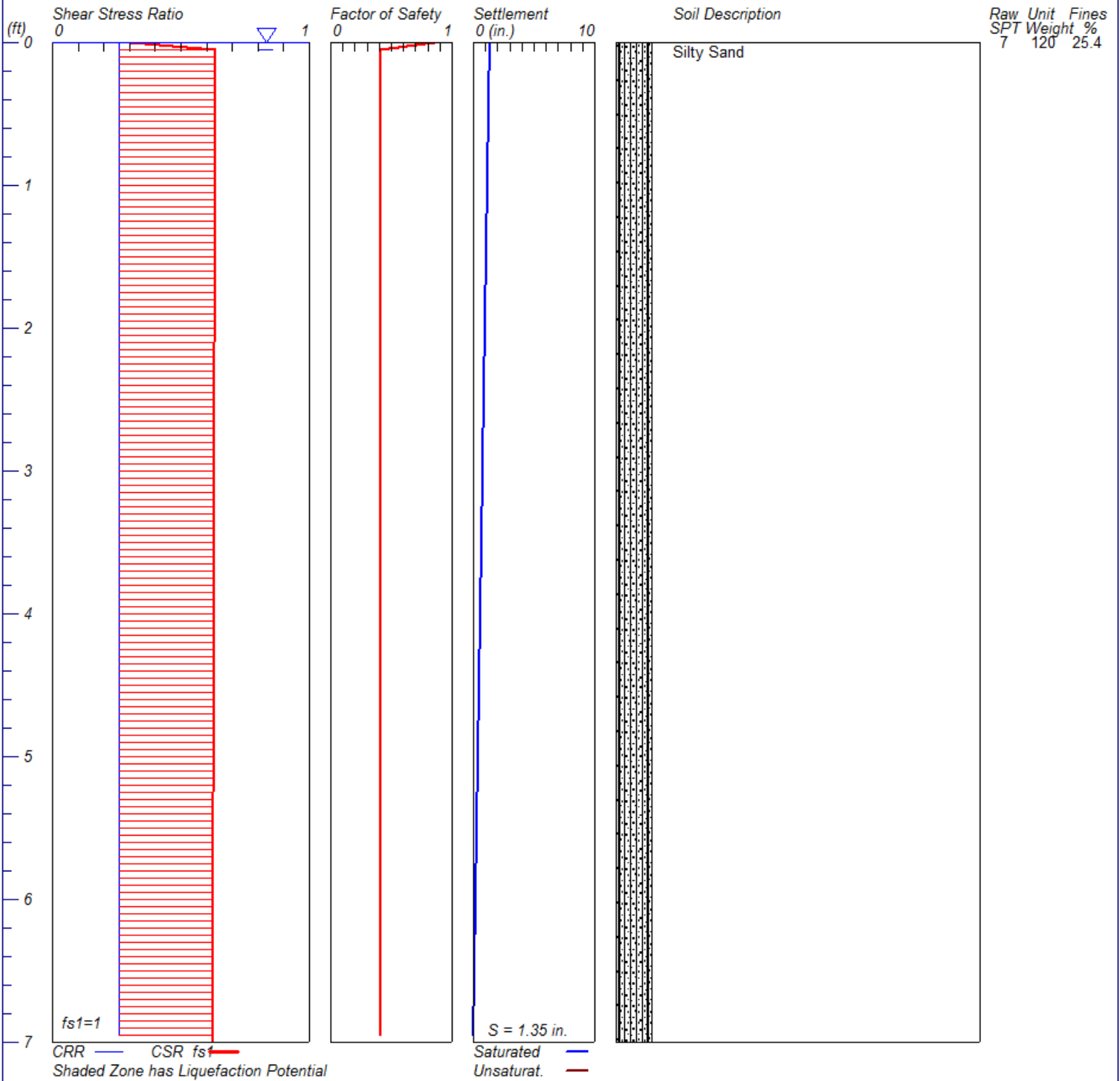


# LIQUEFACTION ANALYSIS

## San Diego North City WWTP

Hole No.=H-7 Water Depth=0 ft

Magnitude=6.8  
Acceleration=0.469g



LiquefyPro CivilTech Software USA www.civiltech.com

**Attachment No. 5**  
Form I-8 for each BMP

BMP #1

Categorization of Infiltration Feasibility Condition		Form I-8	
<p>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?</p>			
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.		✓
<p>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.</p> <p>Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.</p>			
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.		
<p>Provide basis:</p> <p>Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.</p>			

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.		
<p>Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.</p>			
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.		
<p>Provide basis:</p> <p>Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.</p>			
Part 1 Result*	<p>If all answers to rows 1 - 4 are “Yes” a full infiltration design is potentially feasible. The feasibility screening category is Full Infiltration</p> <p>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.</p>		

\*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

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.	✓	
<p>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.</p> <p>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.</p> <p>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.</p>			
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.	✓	
<p>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.</p> <p>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.</p>			

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.	✓	
<p>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.</p> <p>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.</p>			
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.	✓	
<p>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.</p> <p>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.</p>			
Part 2 Result*	<p>If all answers from row 1-4 are yes then partial infiltration design is potentially feasible. The feasibility screening category is Partial Infiltration.</p> <p>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.</p>		

\*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







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.	✓	
<p>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.</p> <p>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.</p>			
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.		✓
<p>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.</p> <p>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.</p>			

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.	✓	
<p>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.</p> <p>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.</p>			
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.	✓	
<p>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.</p> <p>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.</p>			
Part 2 Result*	<p>If all answers from row 1-4 are yes then partial infiltration design is potentially feasible. The feasibility screening category is Partial Infiltration.</p> <p>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.</p>		

\*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





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.	✓	
<p>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.</p>			
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.		✓
<p>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.</p>			

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.	✓	
<p>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.</p> <p>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.</p>			
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.	✓	
<p>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.</p> <p>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.</p>			
Part 2 Result*	<p>If all answers from row 1-4 are yes then partial infiltration design is potentially feasible. The feasibility screening category is Partial Infiltration.</p> <p>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.</p>		

\*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	
<p>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?</p>			
Criteria	Screening Question	Yes	No
1	<p>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.</p>		✓
<p>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.</p> <p>Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.</p>			
2	<p>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.</p>		
<p>Provide basis:</p> <p>Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.</p>			



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.	✓	
<p>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.</p> <p>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.</p>			
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.		✓
<p>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.</p> <p>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.</p>			

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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.	✓	
<p>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.</p> <p>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.</p>			
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.	✓	
<p>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.</p> <p>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.</p>			
Part 2 Result*	<p>If all answers from row 1-4 are yes then partial infiltration design is potentially feasible. The feasibility screening category is Partial Infiltration.</p> <p>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.</p>		

\*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	
<p>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?</p>			
Criteria	Screening Question	Yes	No
1	<p>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.</p>		✓
<p>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.</p> <p>Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.</p>			
2	<p>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.</p>		
<p>Provide basis:</p> <p>Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.</p>			



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.	✓	
<p>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.</p> <p>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.</p>			
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.	✓	
<p>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.</p> <p>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.</p>			



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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.	✓	
<p>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.</p> <p>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.</p>			
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.	✓	
<p>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.</p> <p>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.</p>			
Part 2 Result*	<p>If all answers from row 1-4 are yes then partial infiltration design is potentially feasible. The feasibility screening category is Partial Infiltration.</p> <p>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.</p>		

\*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

Categorization of Infiltration Feasibility Condition		Form I-8	
<p>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?</p>			
Criteria	Screening Question	Yes	No
1	<p>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.</p>		✓
<p>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.</p> <p>Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.</p>			
2	<p>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.</p>		
<p>Provide basis:</p> <p>Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.</p>			



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.	✓	
<p>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.</p> <p>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.</p>			
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.	✓	
<p>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.</p> <p>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.</p>			

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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.	✓	
<p>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.</p> <p>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.</p>			
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.	✓	
<p>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.</p> <p>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.</p>			
Part 2 Result*	<p>If all answers from row 1-4 are yes then partial infiltration design is potentially feasible. The feasibility screening category is Partial Infiltration.</p> <p>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.</p>		

\*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	
<p>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?</p>			
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.		✓
<p>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.</p> <p>Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.</p>			
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.		
<p>Provide basis:</p> <p>Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.</p>			

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



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.	✓	
<p>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.</p> <p>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.</p>			
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.		✓
<p>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.</p>			

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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.	✓	
<p>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.</p> <p>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.</p>			
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.	✓	
<p>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.</p> <p>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.</p>			
Part 2 Result*	<p>If all answers from row 1-4 are yes then partial infiltration design is potentially feasible. The feasibility screening category is Partial Infiltration.</p> <p>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.</p>		

\*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	
<p>Part 1 - Full Infiltration Feasibility Screening Criteria</p> <p>Would infiltration of the full design volume be feasible from a physical perspective without any undesirable consequences that cannot be reasonably mitigated?</p>			
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.		✓
<p>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.</p> <p>Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.</p>			
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.		
<p>Provide basis:</p> <p>Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.</p>			



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.	✓	
<p>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.</p> <p>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.</p>			
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.		✓
<p>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.</p>			

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.	✓	
<p>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.</p> <p>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.</p>			
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.	✓	
<p>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.</p> <p>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.</p>			
Part 2 Result*	<p>If all answers from row 1-4 are yes then partial infiltration design is potentially feasible. The feasibility screening category is Partial Infiltration.</p> <p>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.</p>		

\*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 #10

Categorization of Infiltration Feasibility Condition		Form I-8	
<p>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?</p>			
Criteria	Screening Question	Yes	No
1	<p>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.</p>		✓
<p>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.</p> <p>Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.</p>			
2	<p>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.</p>		
<p>Provide basis:</p> <p>Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.</p>			





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.	✓	
<p>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.</p> <p>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.</p>			
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.	✓	
<p>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.</p> <p>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.</p>			

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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.	✓	
<p>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.</p> <p>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.</p>			
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.	✓	
<p>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.</p> <p>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.</p>			
Part 2 Result*	<p>If all answers from row 1-4 are yes then partial infiltration design is potentially feasible. The feasibility screening category is Partial Infiltration.</p> <p>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.</p>		

\*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







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

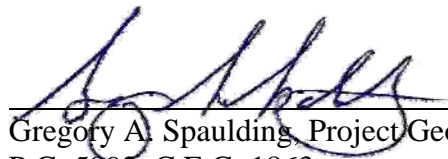
**GEOTECHNICAL INVESTIGATION  
NCCS MIRAMAR PIPELINE PROJECT  
SAN DIEGO, CALIFORNIA**


Dear Ms. Haynes:

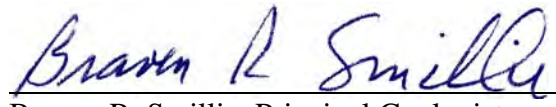
In accordance with your request, TerraCosta Consulting Group, Inc. (TerraCosta) is pleased to present this report of our geotechnical investigation for the subject project alignment, which extends from the pump station at Eastgate Mall and Interstate 805, along portions of Eastgate Mall and Miramar Road, 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.

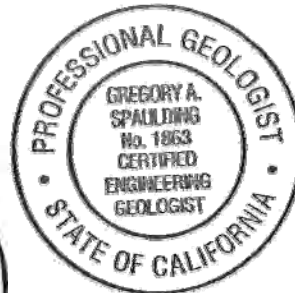
Very truly yours,  
TERRACOSTA CONSULTING GROUP, INC.

  
\_\_\_\_\_  
Gregory A. Spaulding, Project Geologist  
P.G. 5892, C.E.G. 1863

  
\_\_\_\_\_  
Matthew W. Eckert, Ph.D., Director of  
Engineering, R.C.E. 45171, R.G.E. 2316

  
\_\_\_\_\_  
Braven R. Smillie, Principal Geologist  
P.G. 402, C.E.G. 207

GAS/MWE/BRS/jg  
Attachments



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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, interfingering 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 volcanoclastic 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 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 daylight 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.

<b>CBC Seismic Design Parameters</b>	
$F_S$	1.138
$F_V$	1.694
$S_S$	0.905g
$S_I$	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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**(continued)**

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16. Thomson, James, 1993, Pipejacking and Microtunneling, Blackie Academic & Professional, an Imprint of Chapman and Hall.
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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
<b>TerraCosta</b>	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	
<b>N-M</b>	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
<b>GDC</b>	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		
	<b>SGC</b>	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		
<b>GEO</b>	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**

<b>Stations</b>	<b>Anticipated Invert Conditions</b>
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**

<b>Material</b>	<b>General Description</b>	<b>Sample Penetration Resistance (bpf)</b>	<b>Estimated Range of Likely p-wave velocity (fps)</b>	<b>Estimated Range of Likely s-wave velocity (fps)</b>
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



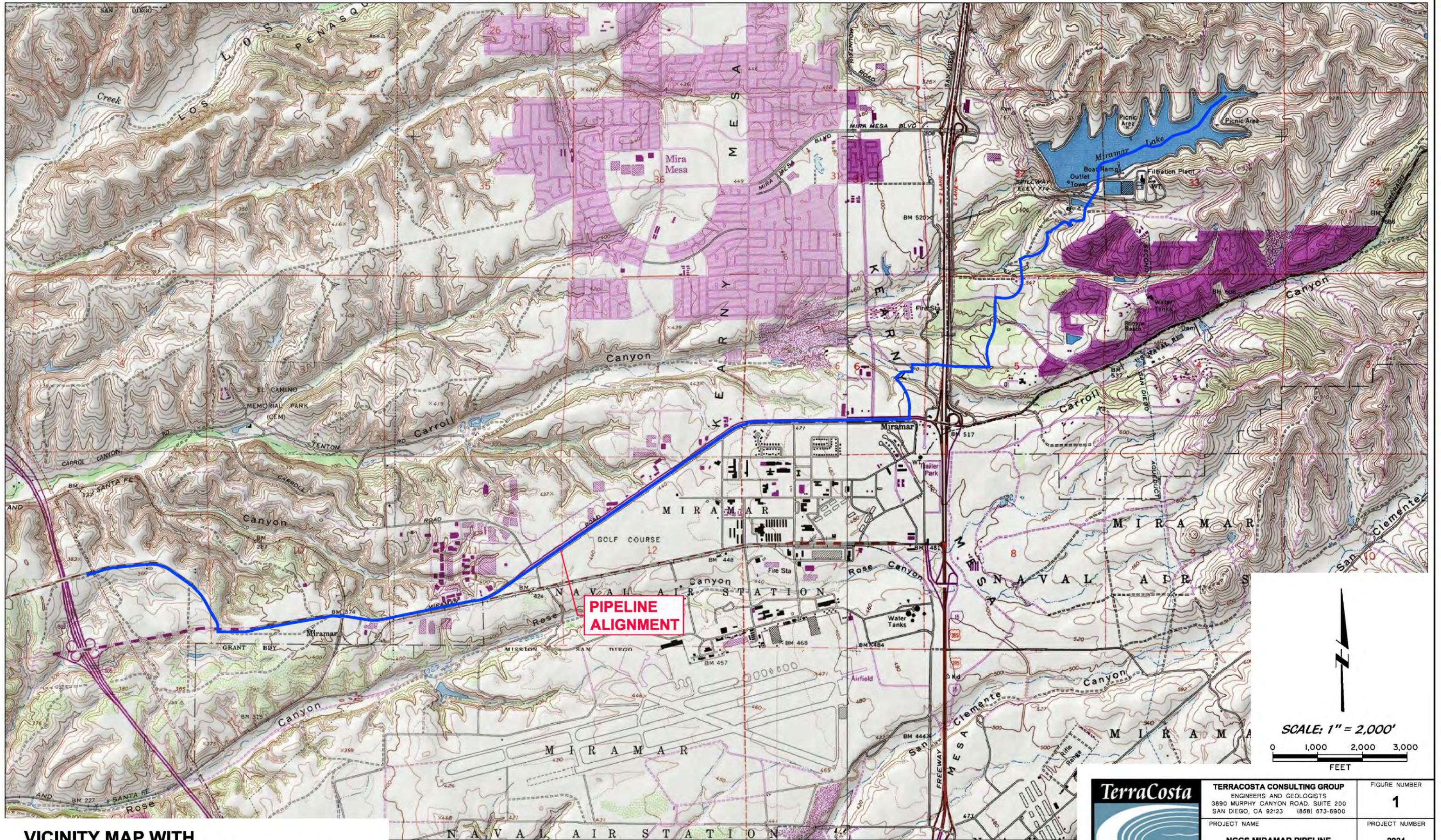
**TABLE 5**  
**SUMMARY OF TUNNELS**

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:

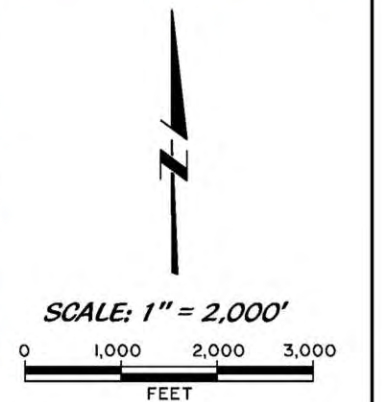
1. Stations are approximate and include the estimated limits of the access shafts.
2. The depths to the invert of the tunnel are estimated from project plans.
3. Borings by others are indicated by the initials of the company that performed the investigation. TerraCosta borings are indicated by boring number only.





**VICINITY MAP WITH  
NCCS MIRAMAR PIPELINE ALIGNMENT**

SCALE: 1"=2,000'



Reproduced from: "TOPO!", Version 2.6.1, Copyright 2000, National Geographic Holdings.



<b>TERRACOSTA CONSULTING GROUP</b> ENGINEERS AND GEOLOGISTS 3890 MURPHY CANYON ROAD, SUITE 200 SAN DIEGO, CA 92123 (858) 573-6900		FIGURE NUMBER <b>1</b>
PROJECT NAME <b>NCCS MIRAMAR PIPELINE</b>		PROJECT NUMBER <b>2934</b>

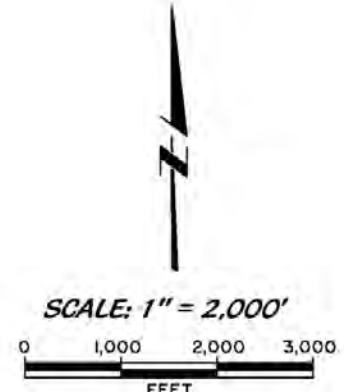
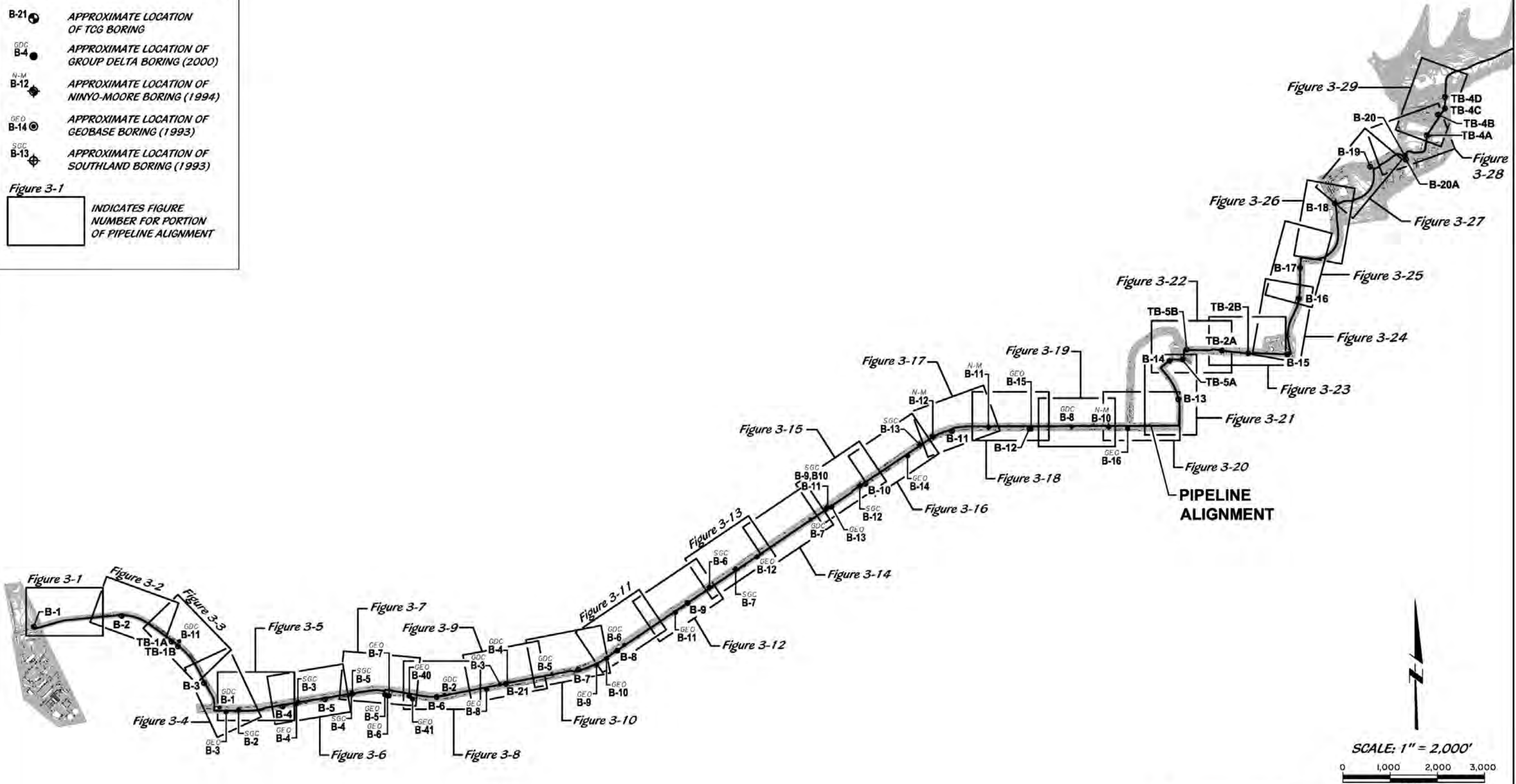
**VICINITY MAP**



**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 GEORISE BORING (1993)
- SGC B-13 APPROXIMATE LOCATION OF SOUTHLAND BORING (1993)

Figure 3-1 INDICATES FIGURE NUMBER FOR PORTION OF PIPELINE ALIGNMENT



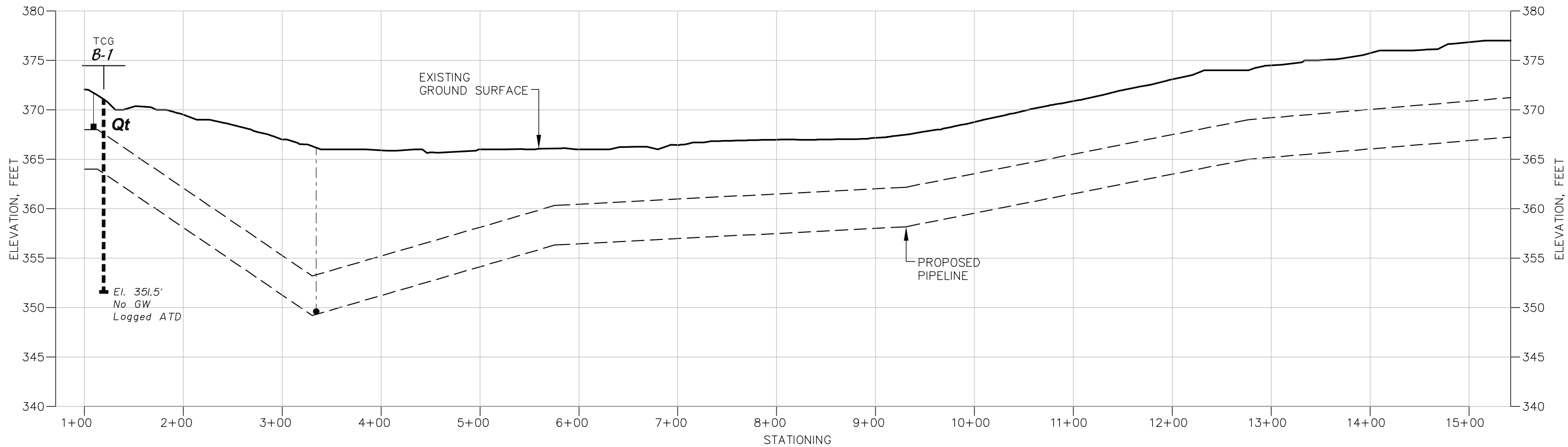
**NCCS MIRAMAR PIPELINE ALIGNMENT**

SCALE: 1"=2,000'



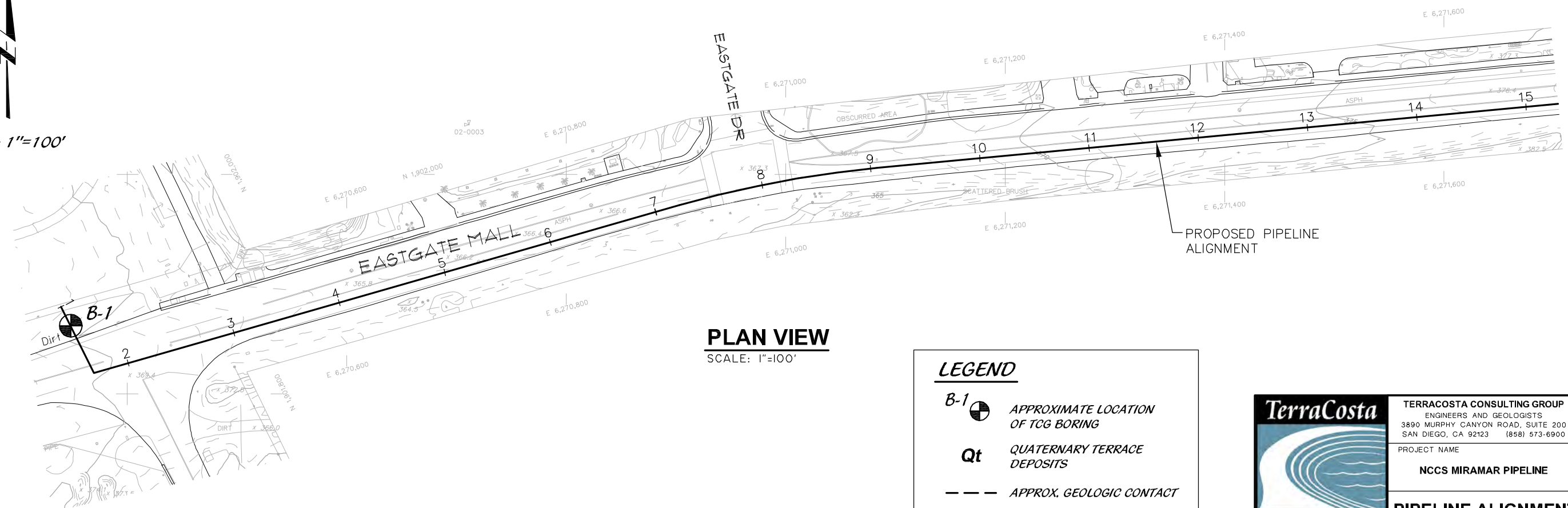
<b>TERRACOSTA CONSULTING GROUP</b> ENGINEERS AND GEOLOGISTS 3890 MURPHY CANYON ROAD, SUITE 200 SAN DIEGO, CA 92123 (858) 573-6900		FIGURE NUMBER <b>2</b>
PROJECT NAME <b>NCCS MIRAMAR PIPELINE</b>		PROJECT NUMBER <b>2934</b>

**PIPELINE ALIGNMENT  
KEY MAP WITH BORINGS**



**PIPELINE PROFILE**  
 SCALE: 1"=100' (HORIZ.)  
 1"=10' (VERT.)

SCALE: 1"=100'

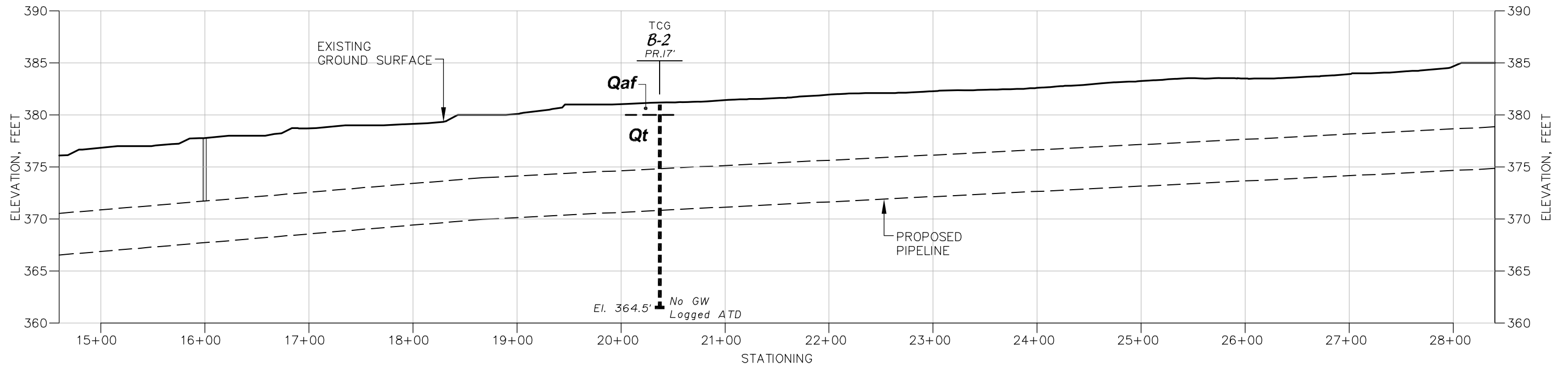


**PLAN VIEW**  
 SCALE: 1"=100'

**LEGEND**

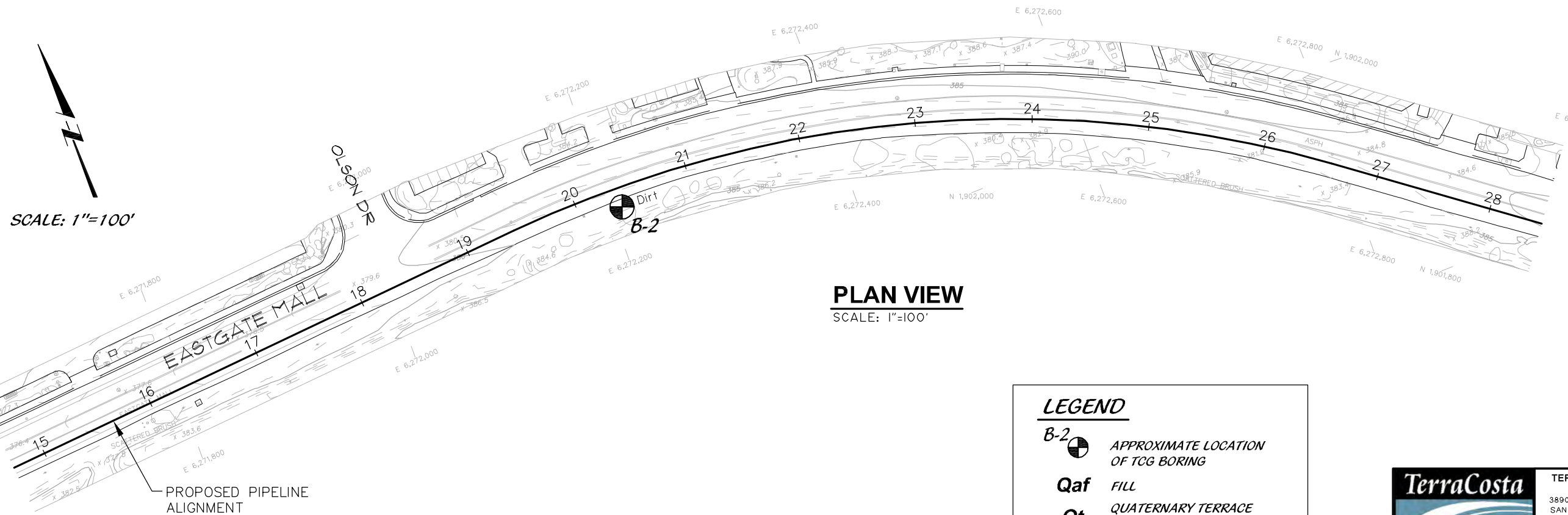
- B-1 APPROXIMATE LOCATION OF TCG BORING
- Qt QUATERNARY TERRACE DEPOSITS
- APPROX. GEOLOGIC CONTACT

	<b>TERRACOSTA CONSULTING GROUP</b> ENGINEERS AND GEOLOGISTS 3890 MURPHY CANYON ROAD, SUITE 200 SAN DIEGO, CA 92123 (858) 573-6900	FIGURE NUMBER <b>3-1</b>
	PROJECT NAME <b>NCCS MIRAMAR PIPELINE</b>	PROJECT NUMBER <b>2934</b>
	<b>PIPELINE ALIGNMENT &amp; PROFILE</b> STA 1+00 TO 15+00	



**PIPELINE PROFILE**

SCALE: 1"=100' (HORIZ.)  
1"=10' (VERT.)

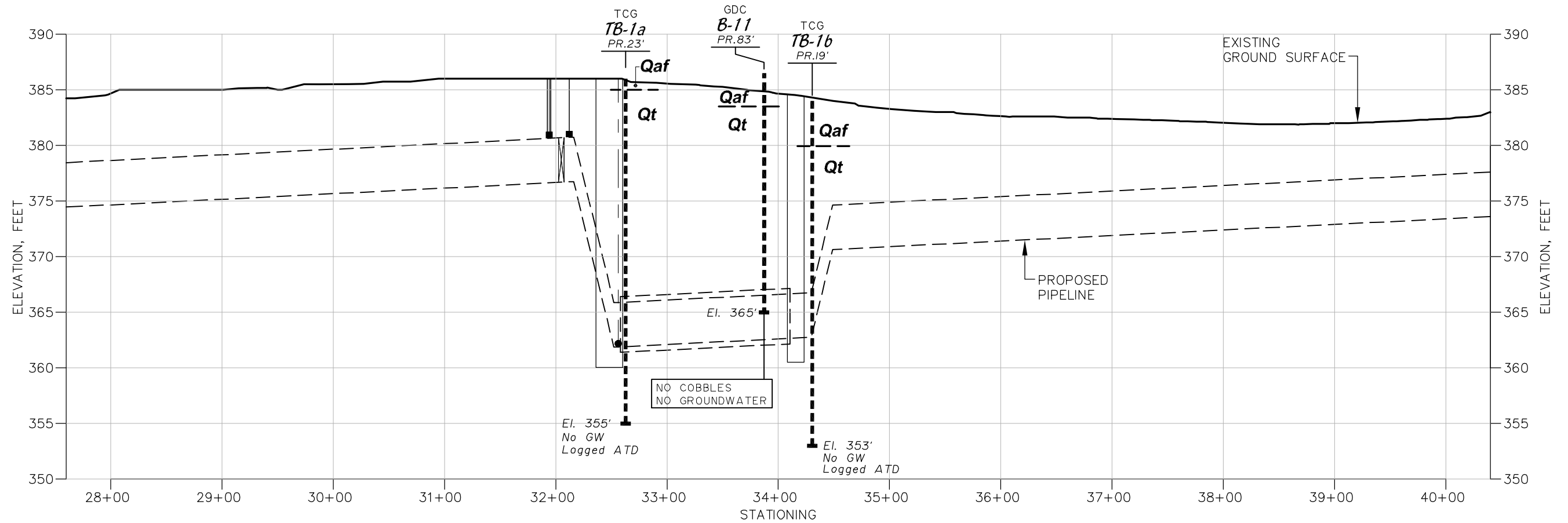


**LEGEND**

- B-2 APPROXIMATE LOCATION OF TCG BORING
- Qaf FILL
- Qt QUATERNARY TERRACE DEPOSITS
- APPROX. GEOLOGIC CONTACT



<b>TERRACOSTA CONSULTING GROUP</b> ENGINEERS AND GEOLOGISTS 3890 MURPHY CANYON ROAD, SUITE 200 SAN DIEGO, CA 92123 (858) 573-6900		FIGURE NUMBER <b>3-2</b>
PROJECT NAME <b>NCCS MIRAMAR PIPELINE</b>		PROJECT NUMBER <b>2934</b>
<b>PIPELINE ALIGNMENT &amp; PROFILE</b> STA 15+00 TO 28+00		

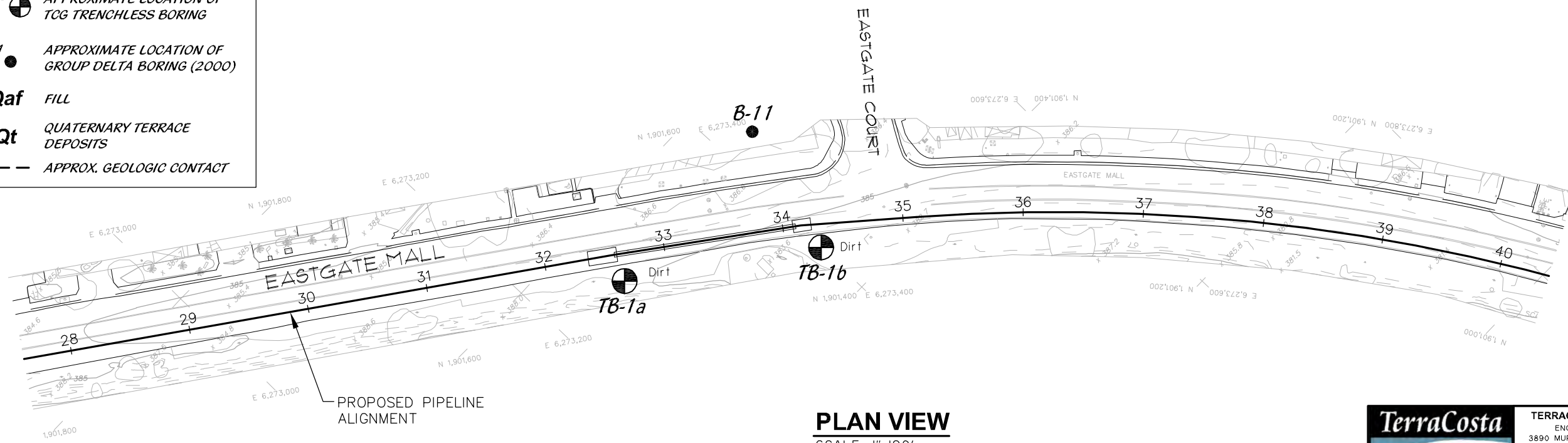


**PIPELINE PROFILE**

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'



TERRACOSTA CONSULTING GROUP  
ENGINEERS AND GEOLOGISTS  
3890 MURPHY CANYON ROAD, SUITE 200  
SAN DIEGO, CA 92123 (858) 573-6900

FIGURE NUMBER

**3-3**

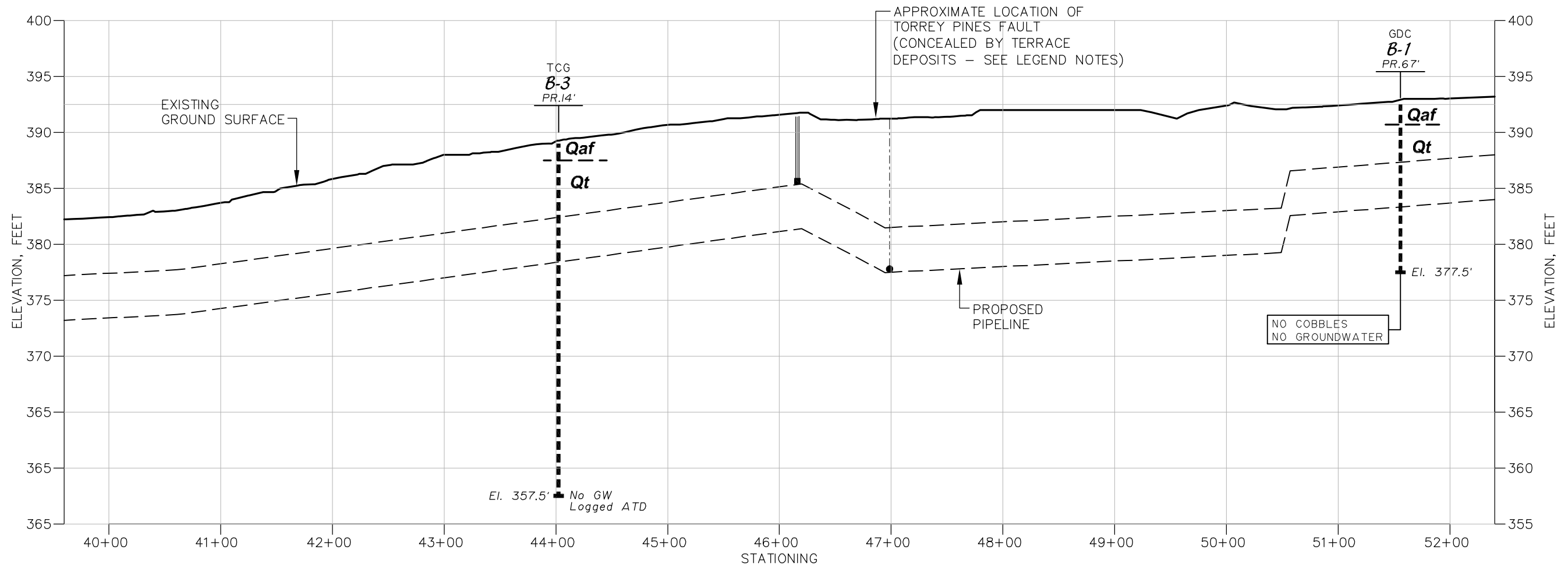
PROJECT NAME  
**NCCS MIRAMAR PIPELINE**

PROJECT NUMBER

**2934**

**PIPELINE ALIGNMENT & PROFILE**  
STA 28+00 TO 40+00





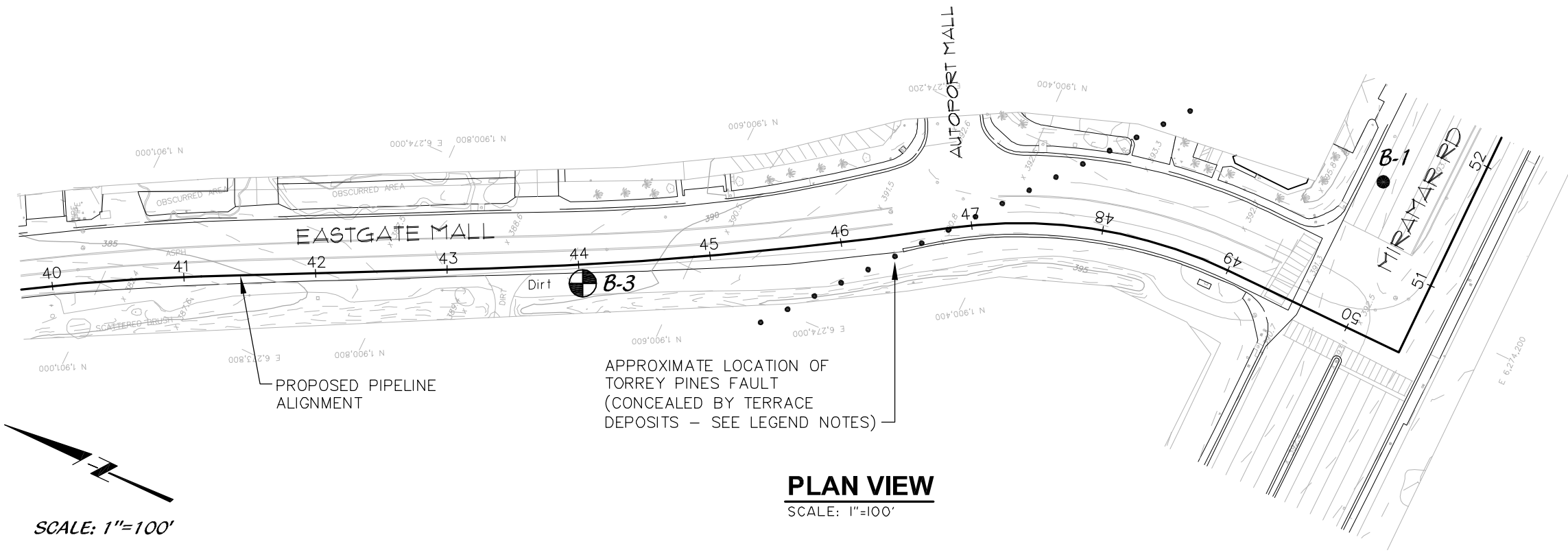
**PIPELINE PROFILE**

SCALE: 1"=100' (HORIZ.)  
1"=10' (VERT.)

**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).



**PLAN VIEW**

SCALE: 1"=100'

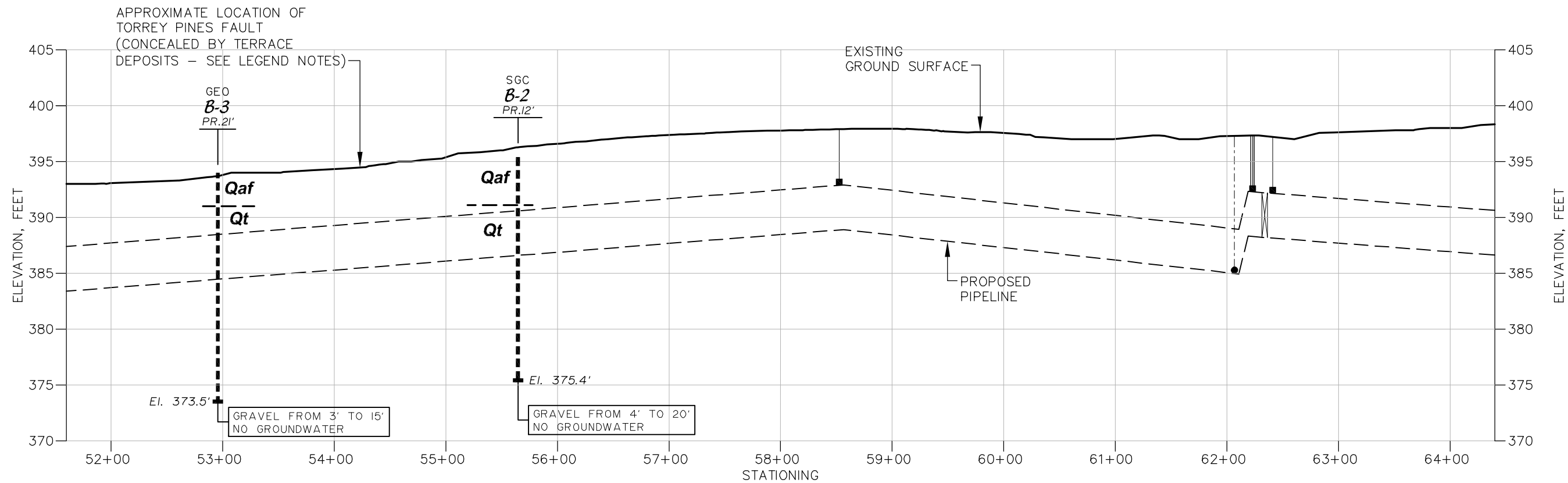
SCALE: 1"=100'



TERRACOSTA CONSULTING GROUP ENGINEERS AND GEOLOGISTS 3890 MURPHY CANYON ROAD, SUITE 200 SAN DIEGO, CA 92123 (858) 573-6900	FIGURE NUMBER <b>3-4</b>
PROJECT NAME <b>NCCS MIRAMAR PIPELINE</b>	PROJECT NUMBER <b>2934</b>

**PIPELINE ALIGNMENT & PROFILE**  
STA 40+00 TO 52+00



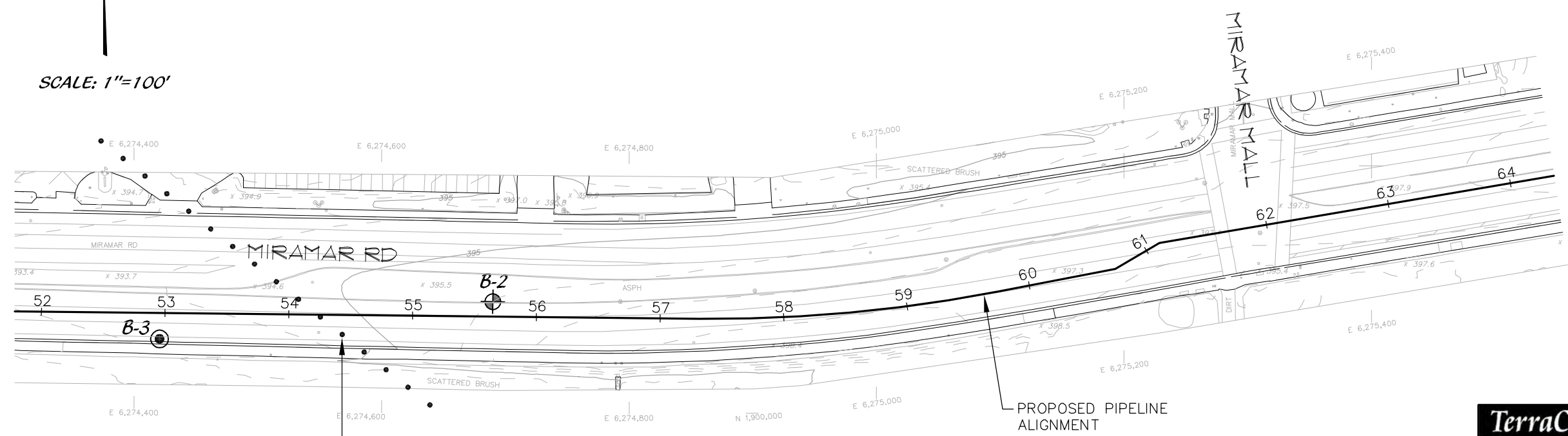


**PIPELINE PROFILE**  
 SCALE: 1"=100' (HORIZ.)  
 1"=10' (VERT.)

**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).



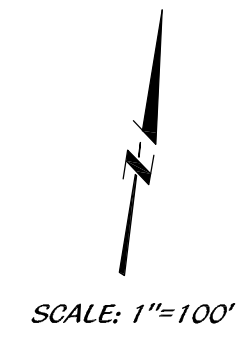
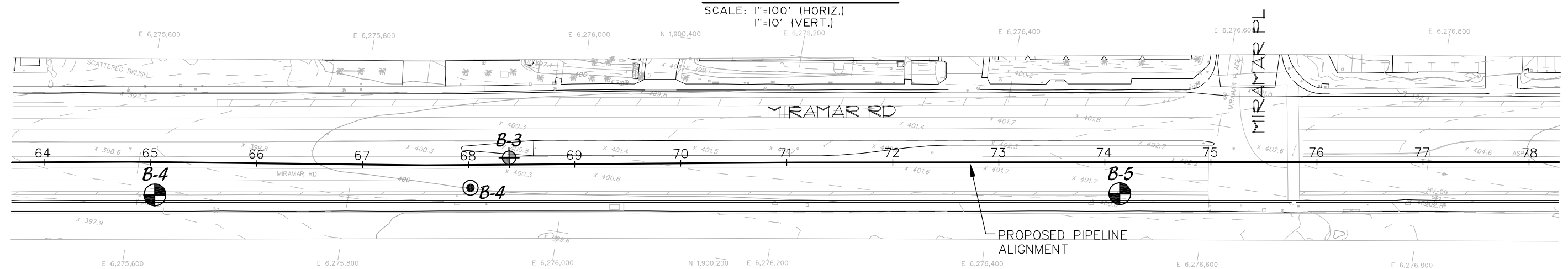
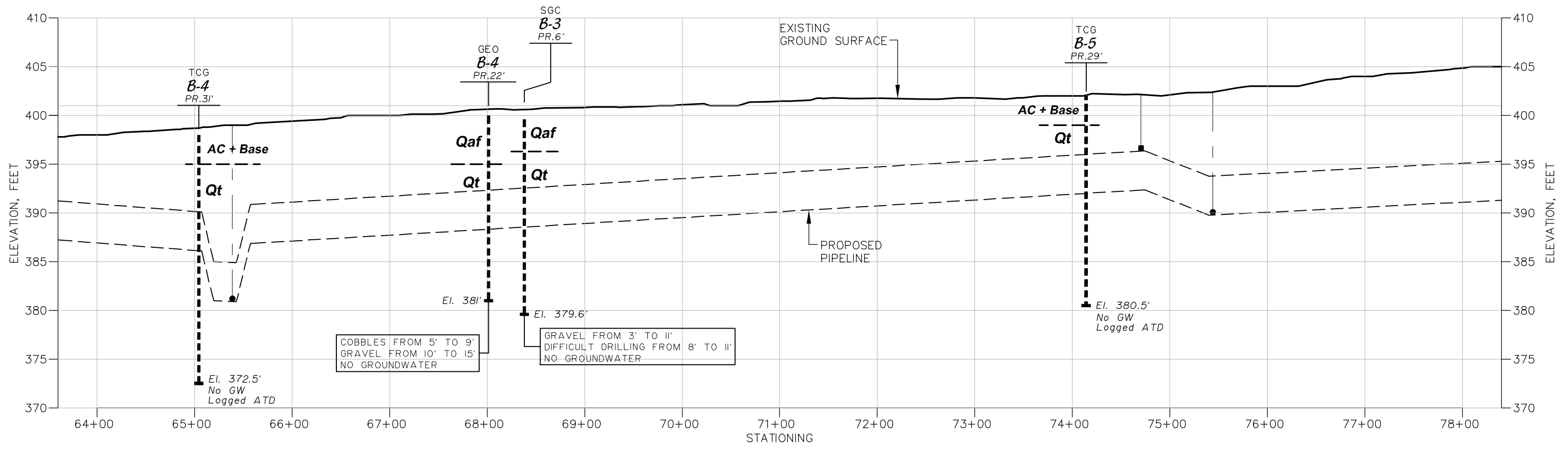
APPROXIMATE LOCATION OF TORREY PINES FAULT (CONCEALED BY TERRACE DEPOSITS - SEE LEGEND NOTES)

**PLAN VIEW**  
 SCALE: 1"=100'



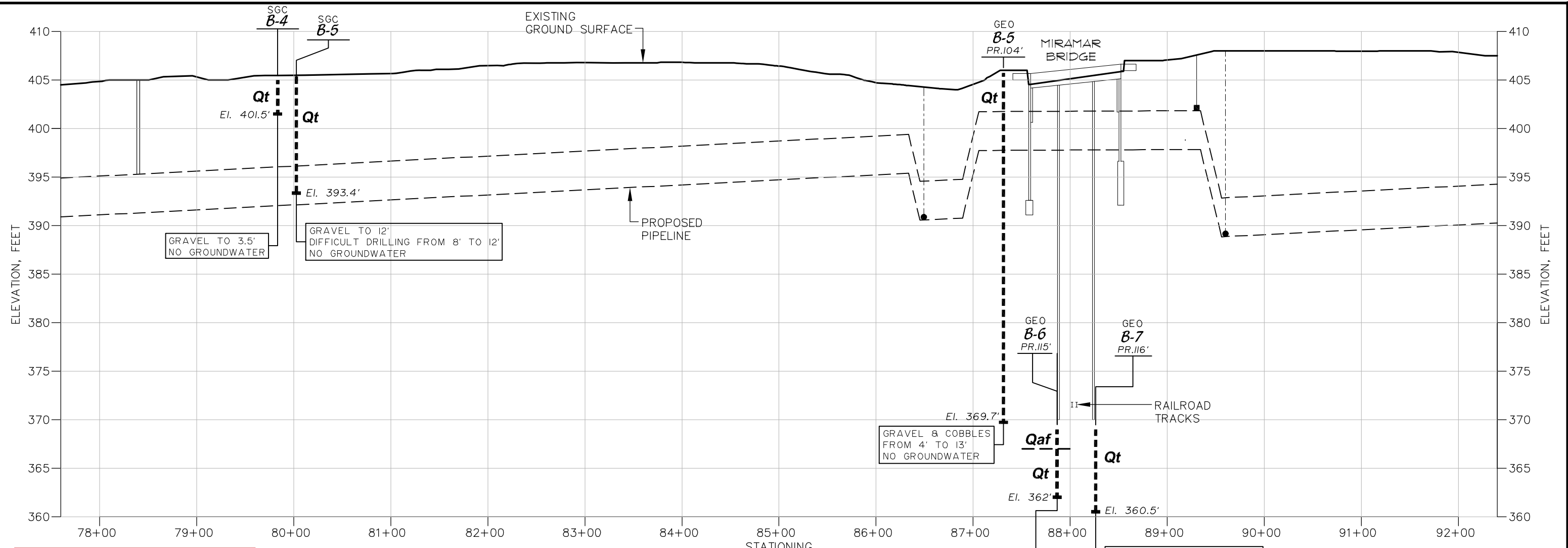
<b>TERRACOSTA CONSULTING GROUP</b> ENGINEERS AND GEOLOGISTS 3890 MURPHY CANYON ROAD, SUITE 200 SAN DIEGO, CA 92123 (858) 573-6900		FIGURE NUMBER <b>3-5</b>
PROJECT NAME <b>NCCS MIRAMAR PIPELINE</b>		PROJECT NUMBER <b>2934</b>

**PIPELINE ALIGNMENT & PROFILE**  
 STA 52+00 TO 64+00



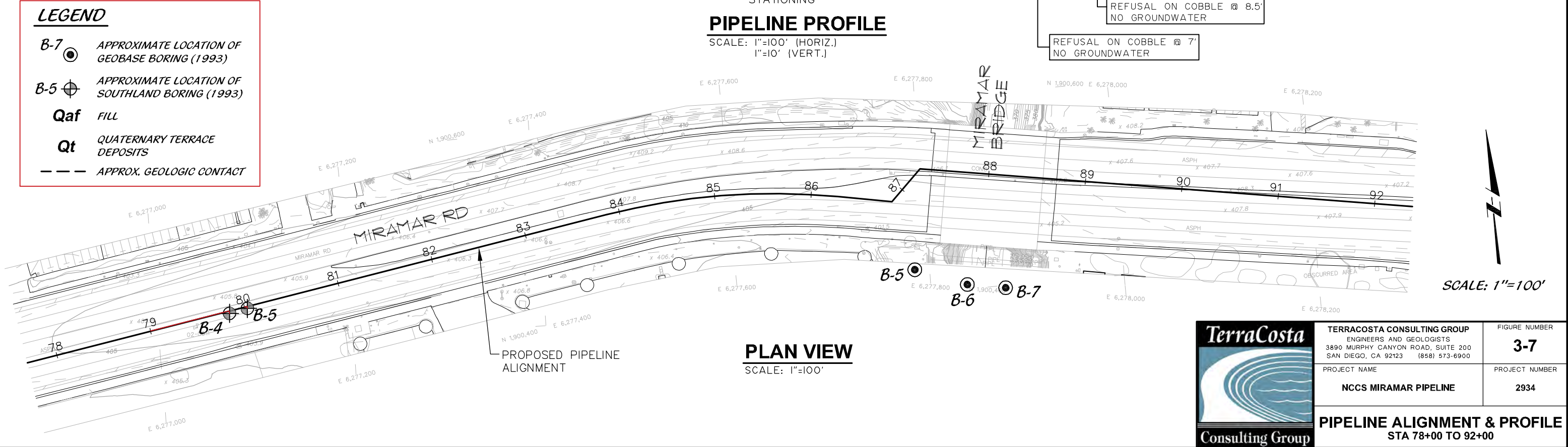
LEGEND	
B-5	APPROXIMATE LOCATION OF TCG BORING
B-3	APPROXIMATE LOCATION OF SOUTHLAND BORING (1993)
B-4	APPROXIMATE LOCATION OF GEOBASE BORING (1993)
AC + Base	PAVEMENT SECTION
Qaf	FILL
Qt	QUATERNARY TERRACE DEPOSITS
---	APPROX. GEOLOGIC CONTACT

	<b>TERRACOSTA CONSULTING GROUP</b> ENGINEERS AND GEOLOGISTS 3890 MURPHY CANYON ROAD, SUITE 200 SAN DIEGO, CA 92123 (858) 573-6900	FIGURE NUMBER <b>3-6</b>
	PROJECT NAME <b>NCCS MIRAMAR PIPELINE</b>	PROJECT NUMBER <b>2934</b>
<b>PIPELINE ALIGNMENT &amp; PROFILE</b> STA 64+00 TO 78+00		

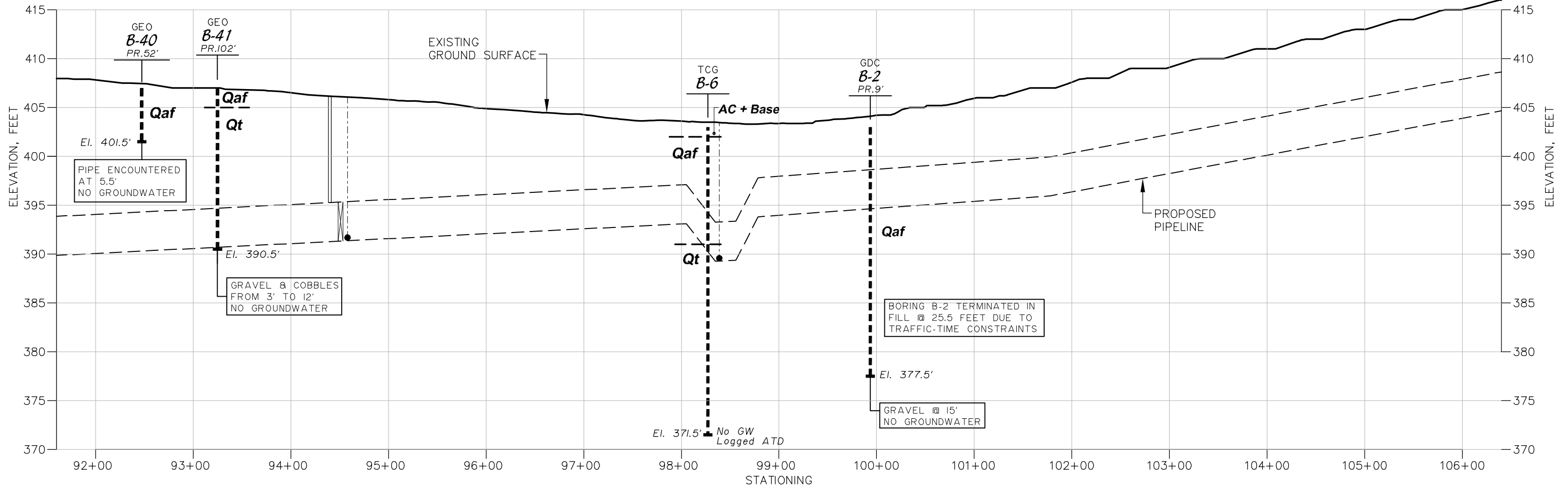


**LEGEND**

- 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

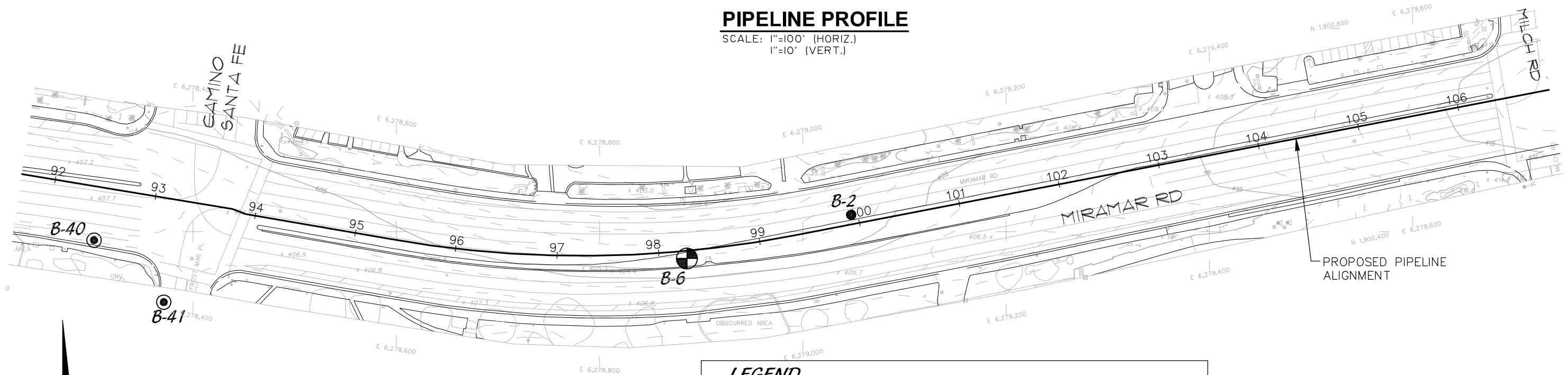


	<b>TERRACOSTA CONSULTING GROUP</b> ENGINEERS AND GEOLOGISTS 3890 MURPHY CANYON ROAD, SUITE 200 SAN DIEGO, CA 92123 (858) 573-6900	FIGURE NUMBER <b>3-7</b>
	PROJECT NAME <b>NCCS MIRAMAR PIPELINE</b>	PROJECT NUMBER <b>2934</b>
<b>PIPELINE ALIGNMENT &amp; PROFILE</b> STA 78+00 TO 92+00		



**PIPELINE PROFILE**

SCALE: 1"=100' (HORIZ.)  
1"=10' (VERT.)



**PLAN VIEW**

SCALE: 1"=100'

**LEGEND**

- B-6 APPROXIMATE LOCATION OF TCG BORING
- B-2 APPROXIMATE LOCATION OF GROUP DELTA BORING (2000)
- B-41 APPROXIMATE LOCATION OF GEOBASE BORING (1993)
- AC + Base PAVEMENT SECTION
- Qaf FILL
- Qt QUATERNARY TERRACE DEPOSITS
- APPROX. GEOLOGIC CONTACT

SCALE: 1"=100'



TERRACOSTA CONSULTING GROUP  
ENGINEERS AND GEOLOGISTS  
3890 MURPHY CANYON ROAD, SUITE 200  
SAN DIEGO, CA 92123 (858) 573-6900

FIGURE NUMBER

**3-8**

PROJECT NAME  
**NCCS MIRAMAR PIPELINE**

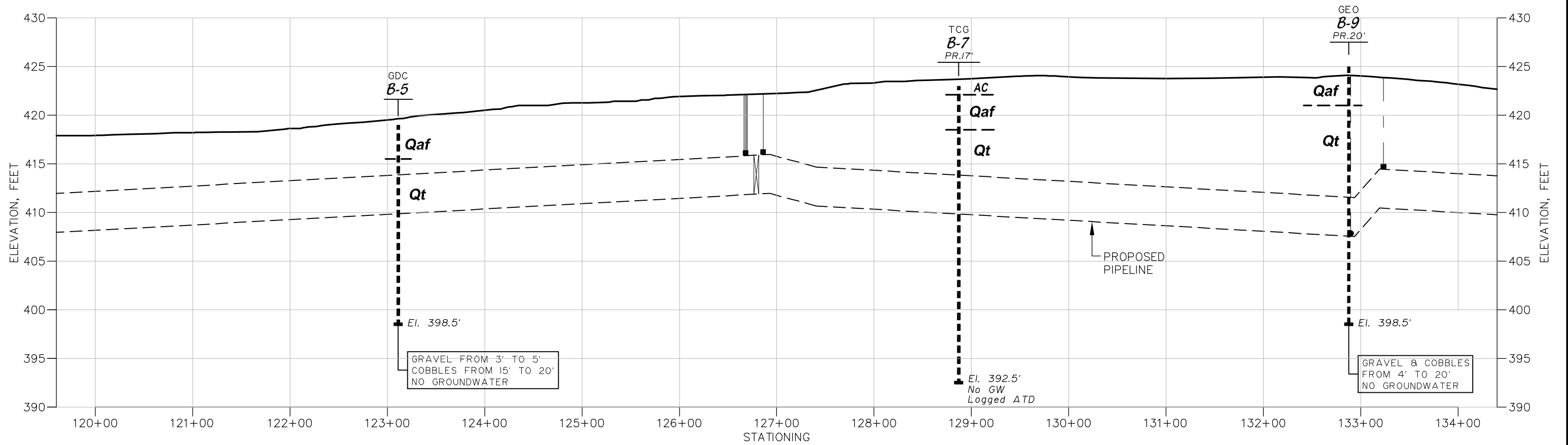
PROJECT NUMBER

2934

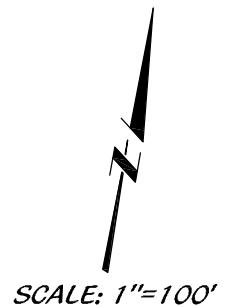
**PIPELINE ALIGNMENT & PROFILE**  
STA 92+00 TO 106+00





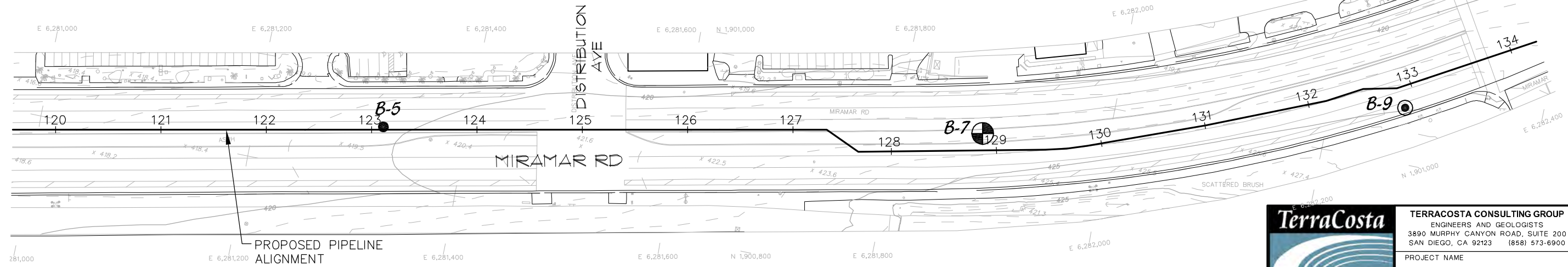


**PIPELINE PROFILE**  
 SCALE: 1"=100' (HORIZ.)  
 1"=10' (VERT.)



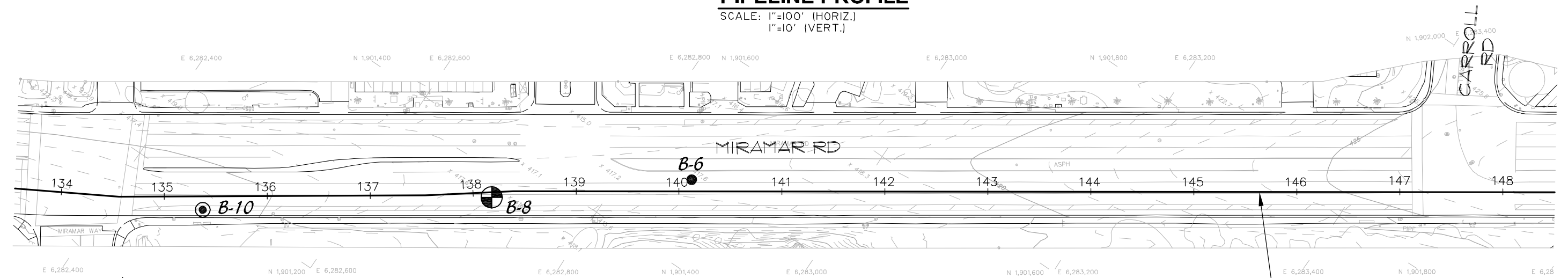
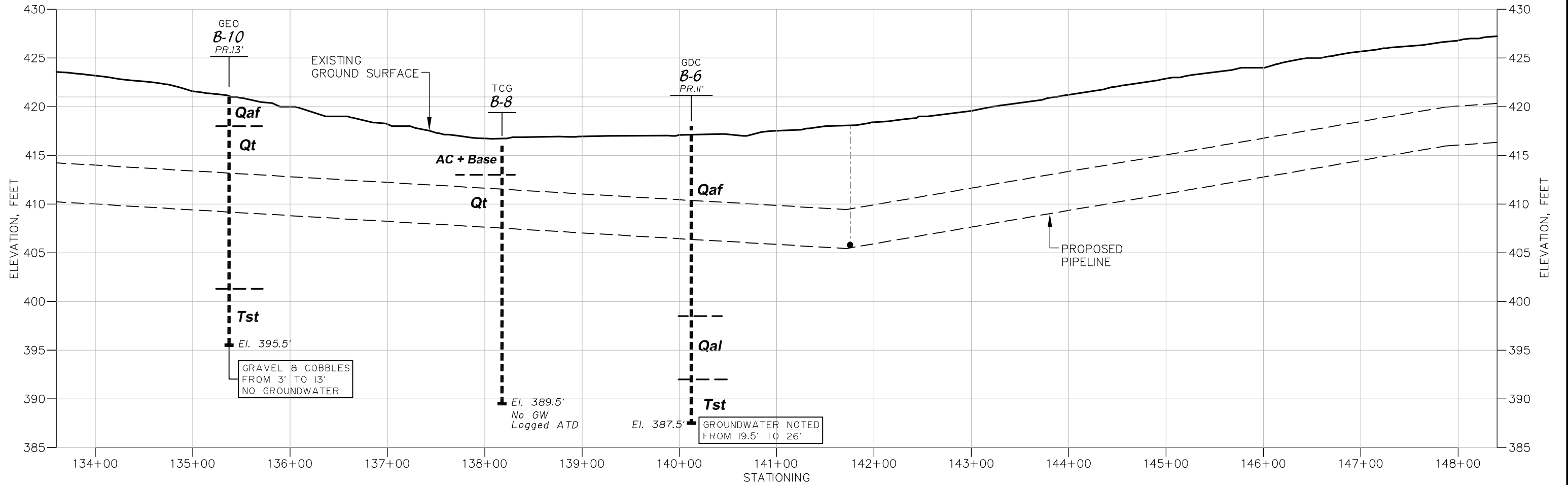
**LEGEND**

<b>B-7</b>	APPROXIMATE LOCATION OF TCG BORING	<b>AC</b>	ASPHALTIC CONCRETE
<b>B-5</b>	APPROXIMATE LOCATION OF GROUP DELTA BORING (2000)	<b>Qaf</b>	FILL
<b>B-9</b>	APPROXIMATE LOCATION OF GEOBASE BORING (1993)	<b>Qt</b>	QUATERNARY TERRACE DEPOSITS
		---	APPROX. GEOLOGIC CONTACT



**PLAN VIEW**  
 SCALE: 1"=100'

	<b>TERRACOSTA CONSULTING GROUP</b> ENGINEERS AND GEOLOGISTS 3890 MURPHY CANYON ROAD, SUITE 200 SAN DIEGO, CA 92123 (858) 573-6900	FIGURE NUMBER <b>3-10</b>
	PROJECT NAME <b>NCCS MIRAMAR PIPELINE</b>	PROJECT NUMBER <b>2934</b>
<b>PIPELINE ALIGNMENT &amp; PROFILE</b> STA 120+00 TO 134+00		

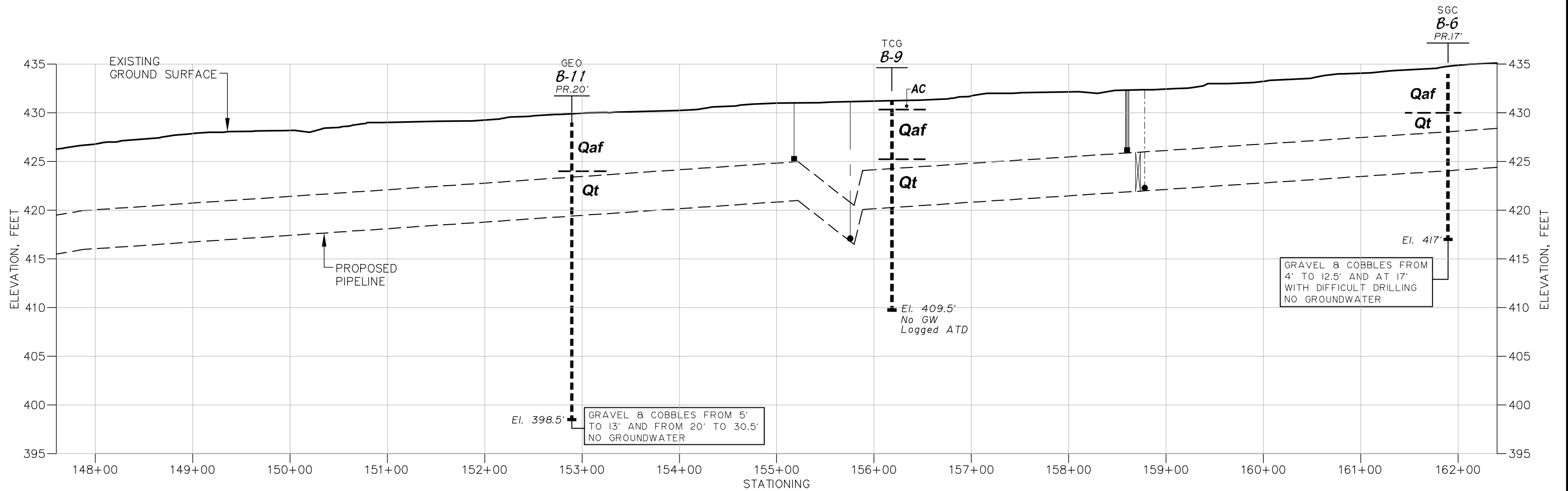


LEGEND	
	APPROXIMATE LOCATION OF TCG BORING
	APPROXIMATE LOCATION OF GROUP DELTA BORING (2000)
	APPROXIMATE LOCATION OF GEOBASE BORING (1993)
	PAVEMENT SECTION
	FILL
	QUATERNARY TERRACE DEPOSITS
	TERTIARY STADIUM CONGLOMERATE
	APPROX. GEOLOGIC CONTACT

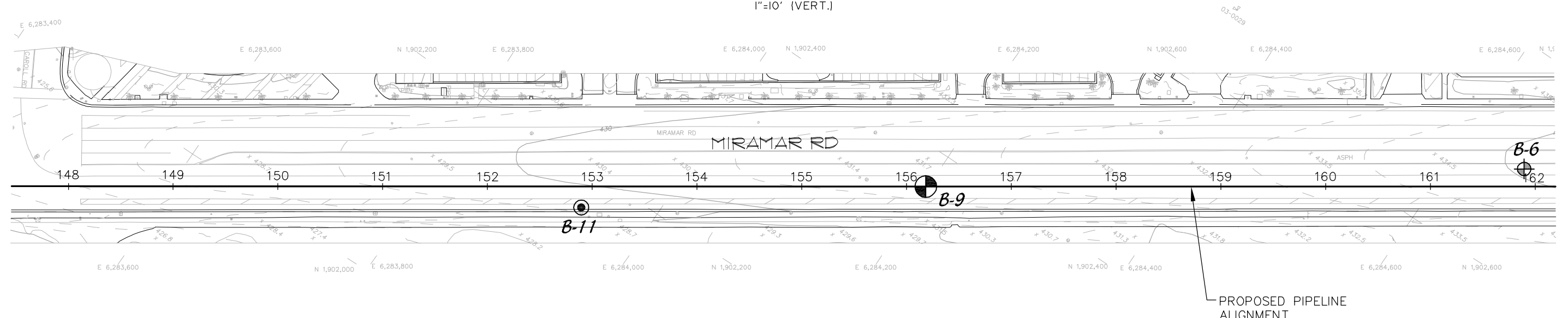


<b>TERRACOSTA CONSULTING GROUP</b> ENGINEERS AND GEOLOGISTS 3890 MURPHY CANYON ROAD, SUITE 200 SAN DIEGO, CA 92123 (858) 573-6900		FIGURE NUMBER <b>3-11</b>
PROJECT NAME <b>NCCS MIRAMAR PIPELINE</b>		PROJECT NUMBER <b>2934</b>
<b>PIPELINE ALIGNMENT &amp; PROFILE</b> STA 134+00 TO 148+00		



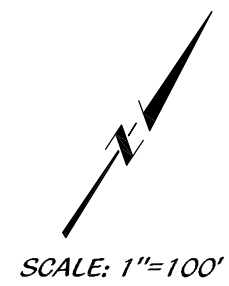


**PIPELINE PROFILE**  
 SCALE: 1"=100' (HORIZ.)  
 1"=10' (VERT.)

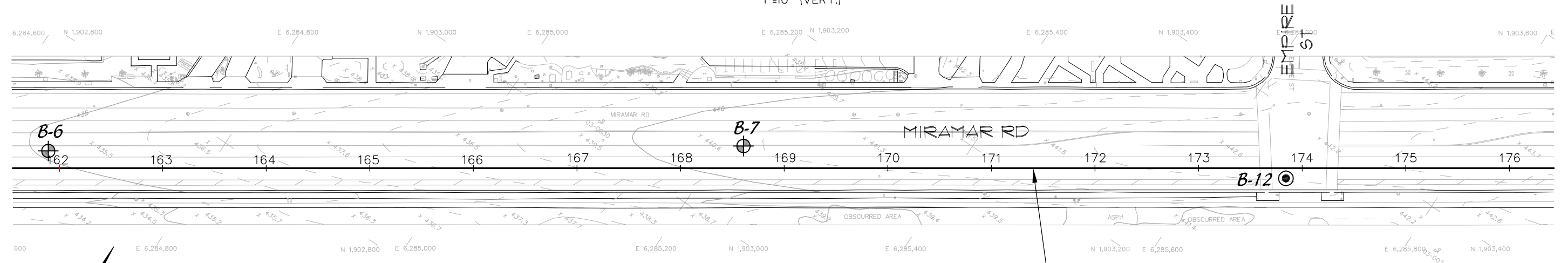
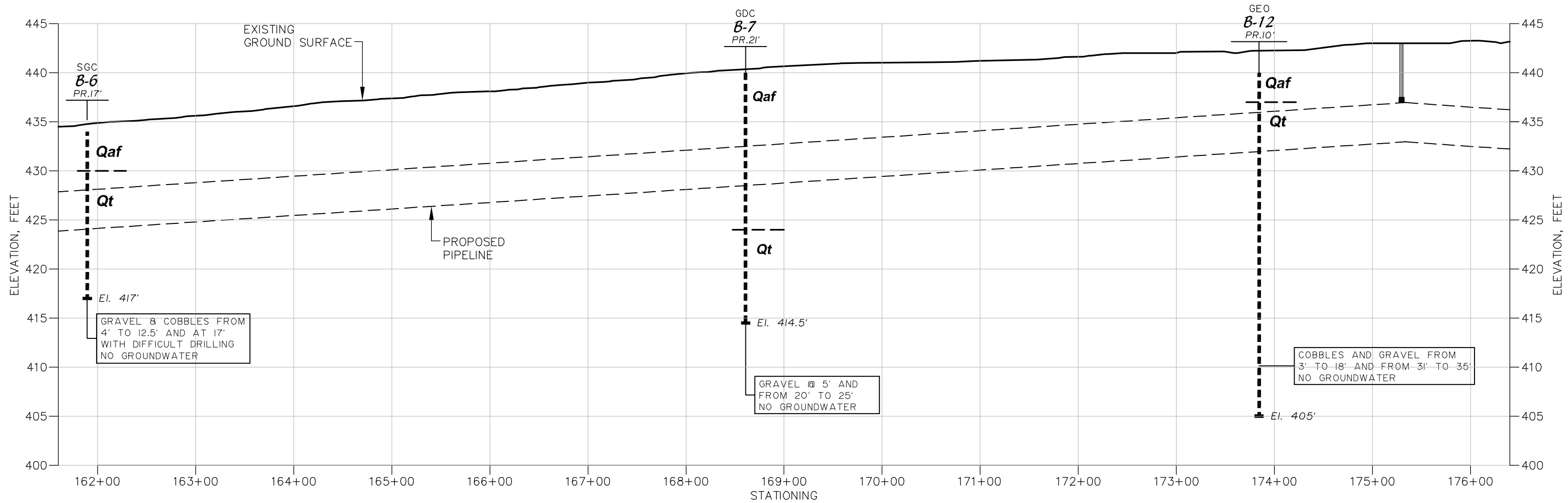


**PLAN VIEW**  
 SCALE: 1"=100'

LEGEND	
B-9	APPROXIMATE LOCATION OF TCG BORING
B-11	APPROXIMATE LOCATION OF GEOBASE BORING (1993)
B-6	APPROXIMATE LOCATION OF SOUTHLAND BORING (1993)
AC	ASPHALTIC CONCRETE
Qaf	FILL
Qt	QUATERNARY TERRACE DEPOSITS
---	APPROX. GEOLOGIC CONTACT



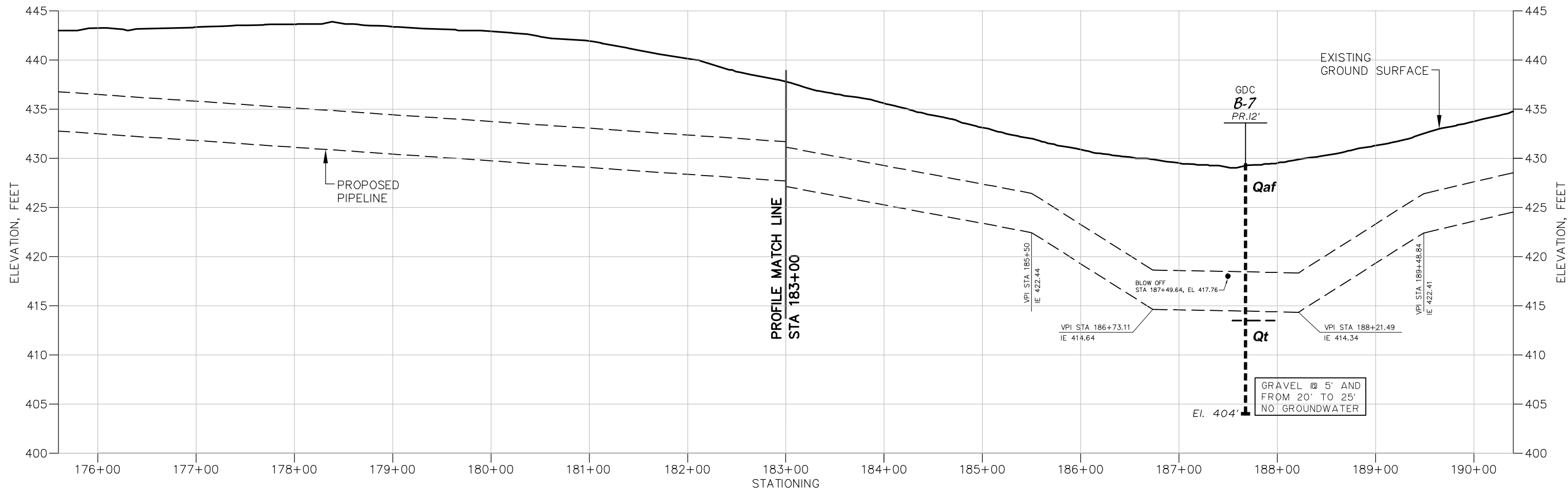
	<b>TERRACOSTA CONSULTING GROUP</b> ENGINEERS AND GEOLOGISTS 3890 MURPHY CANYON ROAD, SUITE 200 SAN DIEGO, CA 92123 (858) 573-6900	FIGURE NUMBER <b>3-12</b>
	PROJECT NAME <b>NCCS MIRAMAR PIPELINE</b>	PROJECT NUMBER <b>2934</b>
<b>PIPELINE ALIGNMENT &amp; PROFILE</b> STA 148+00 TO 162+00		



LEGEND	
B-7 ●	APPROXIMATE LOCATION OF GROUP DELTA BORING (2000)
B-6 ⊕	APPROXIMATE LOCATION OF SOUTHLAND BORING (1993)
B-12 ⊙	APPROXIMATE LOCATION OF GEOBASE BORING (1993)
Qaf	FILL
Qt	QUATERNARY TERRACE DEPOSITS
---	APPROX. GEOLOGIC CONTACT

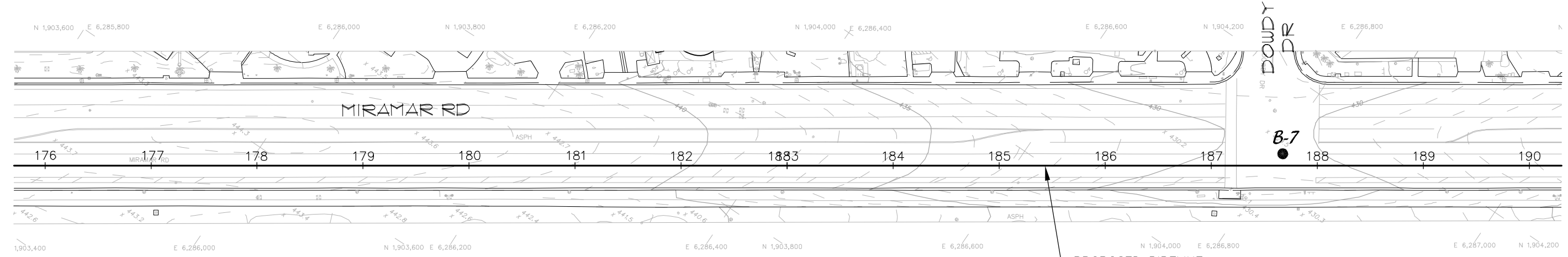
	<b>TERRACOSTA CONSULTING GROUP</b> ENGINEERS AND GEOLOGISTS 3890 MURPHY CANYON ROAD, SUITE 200 SAN DIEGO, CA 92123 (858) 573-6900	FIGURE NUMBER <b>3-13</b>
	PROJECT NAME <b>NCCS MIRAMAR PIPELINE</b>	PROJECT NUMBER <b>2934</b>
	<b>PIPELINE ALIGNMENT &amp; PROFILE</b> STA 162+00 TO 176+00	

SCALE: 1"=100'



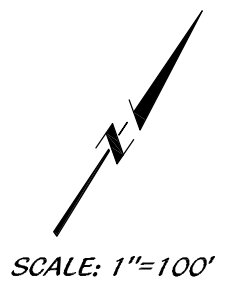
**PIPELINE PROFILE**

SCALE: 1"=100' (HORIZ.)  
1"=10' (VERT.)



**PLAN VIEW**

SCALE: 1"=100'



LEGEND	
B-7 ●	APPROXIMATE LOCATION OF GROUP DELTA BORING (2000)
Qaf	FILL
Qt	QUATERNARY TERRACE DEPOSITS
---	APPROX. GEOLOGIC CONTACT



**TERRACOSTA CONSULTING GROUP**  
ENGINEERS AND GEOLOGISTS  
3890 MURPHY CANYON ROAD, SUITE 200  
SAN DIEGO, CA 92123 (858) 573-6900

FIGURE NUMBER  
**3-14**

PROJECT NAME  
**NCCS MIRAMAR PIPELINE**

PROJECT NUMBER  
**2934**

**PIPELINE ALIGNMENT & PROFILE**  
STA 176+00 TO 190+00

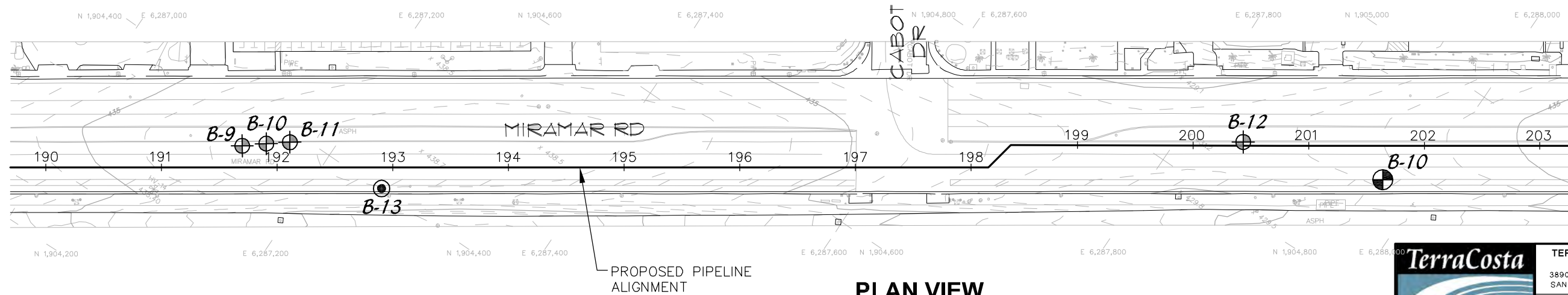
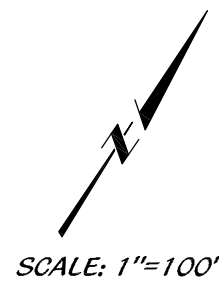


**PIPELINE PROFILE**

SCALE: 1"=100' (HORIZ.)  
1"=10' (VERT.)

**LEGEND**

- B-10 APPROXIMATE LOCATION OF TCG BORING
- B-13 APPROXIMATE LOCATION OF GEOWISE BORING (1993)
- B-11 APPROXIMATE LOCATION OF SOUTHLAND BORING (1993)
- AC + Base PAVEMENT SECTION
- Qaf FILL
- Qal ALLUVIUM
- Qt QUATERNARY TERRACE DEPOSITS
- Tst TERTIARY STADIUM CONGLOMERATE
- - - APPROX. GEOLOGIC CONTACT



**PLAN VIEW**

SCALE: 1"=100'



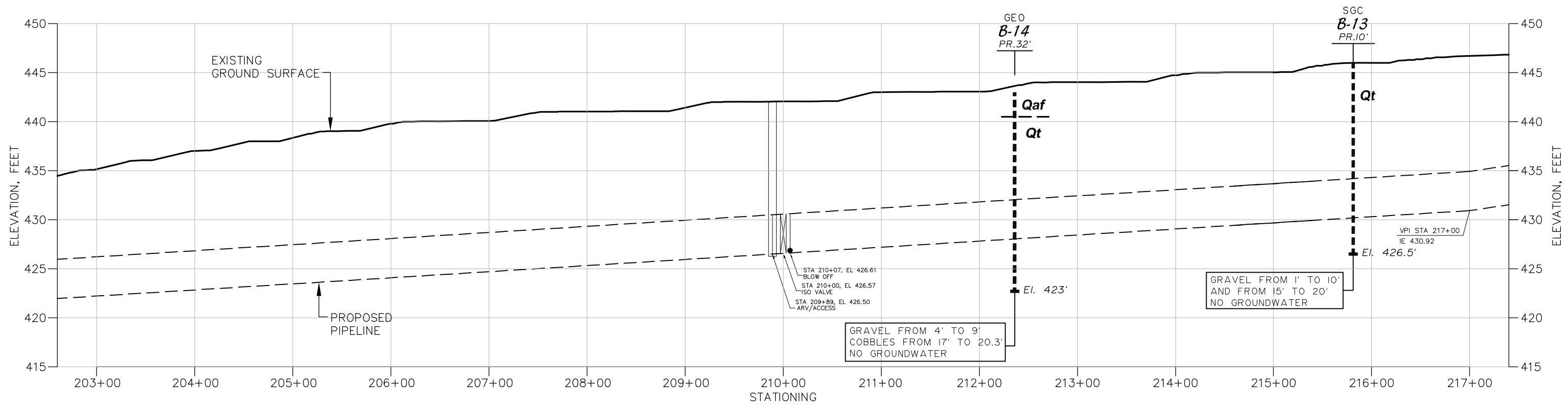
**TERRACOSTA CONSULTING GROUP**  
ENGINEERS AND GEOLOGISTS  
3890 MURPHY CANYON ROAD, SUITE 200  
SAN DIEGO, CA 92123 (858) 573-6900

FIGURE NUMBER  
**3-15**

PROJECT NAME  
**NCCS MIRAMAR PIPELINE**

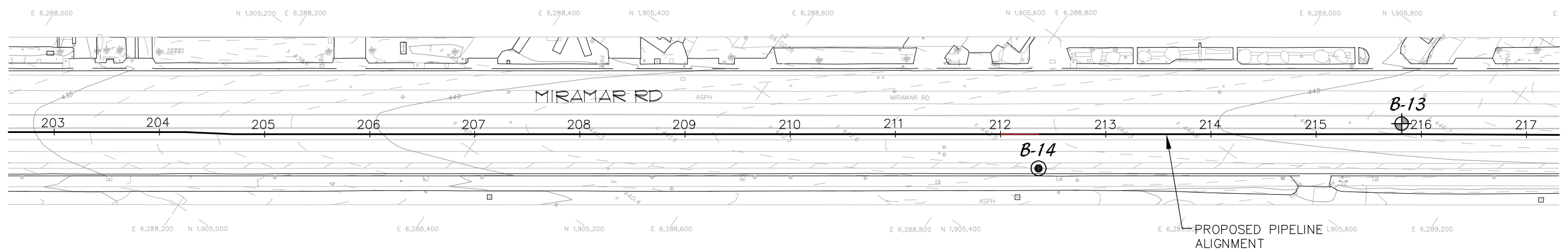
PROJECT NUMBER  
**2934**

**PIPELINE ALIGNMENT & PROFILE**  
STA 190+00 TO 203+00



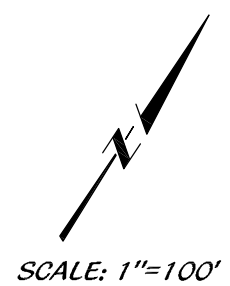
**PIPELINE PROFILE**

SCALE: 1"=100' (HORIZ.)  
1"=10' (VERT.)



**PLAN VIEW**

SCALE: 1"=100'

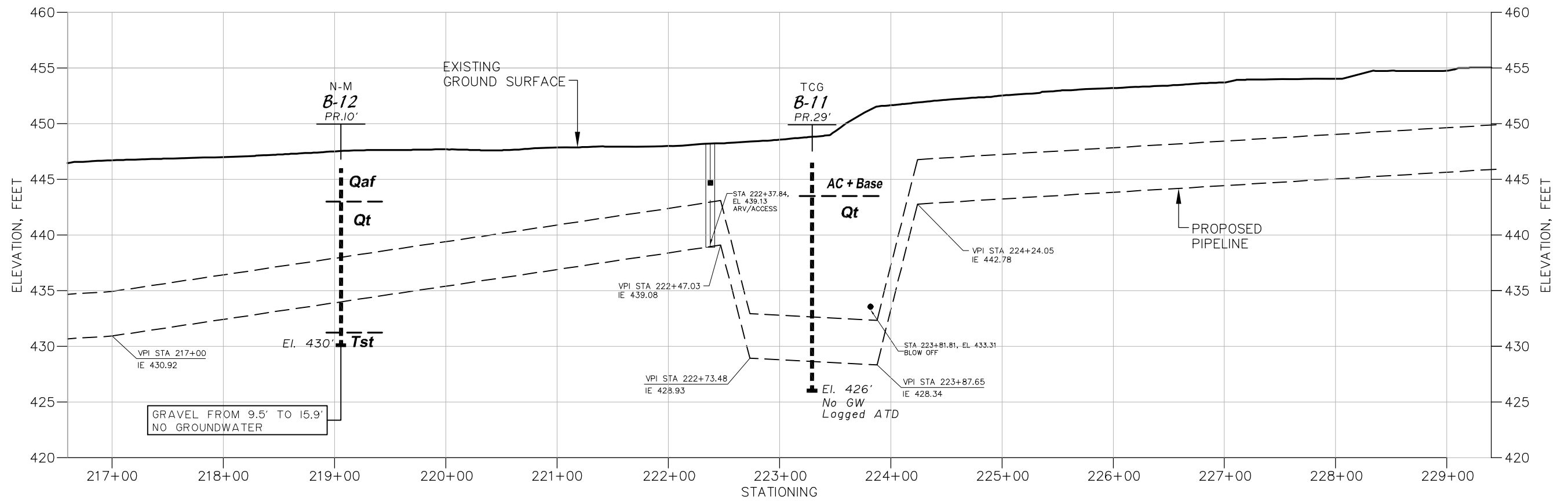


SCALE: 1"=100'

<b>LEGEND</b>	
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

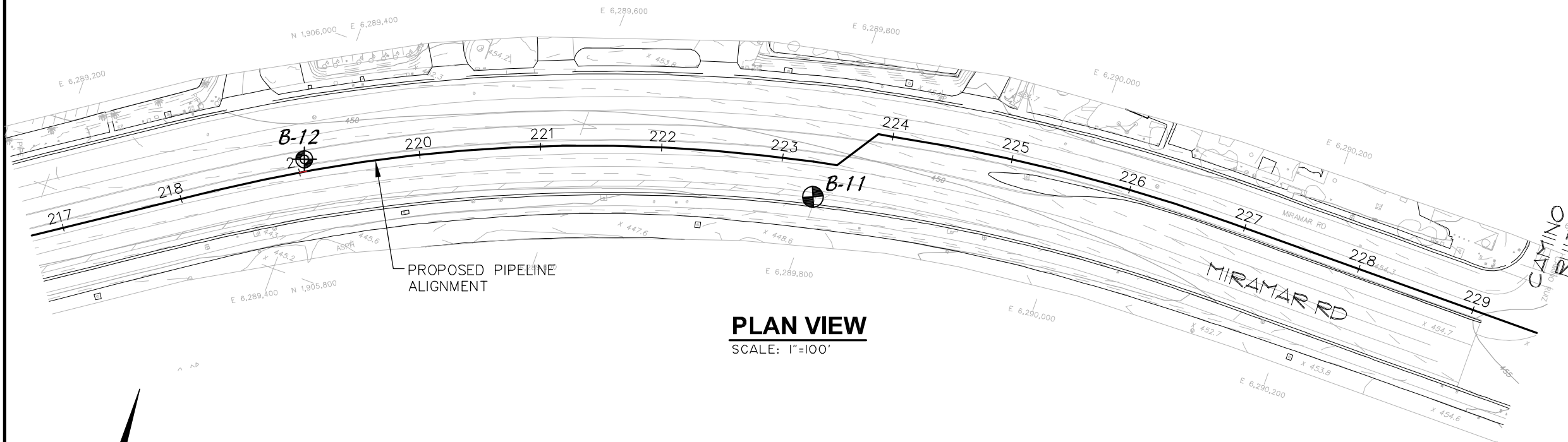
	<b>TERRACOSTA CONSULTING GROUP</b> ENGINEERS AND GEOLOGISTS 3890 MURPHY CANYON ROAD, SUITE 200 SAN DIEGO, CA 92123 (858) 573-6900	FIGURE NUMBER <b>3-16</b>
	PROJECT NAME <b>NCCS MIRAMAR PIPELINE</b>	PROJECT NUMBER <b>2934</b>
	<b>PIPELINE ALIGNMENT &amp; PROFILE</b> STA 203+00 TO 217+00	





**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 CONGLOMERATE
- - -** APPROX. GEOLOGIC CONTACT



SCALE: 1"=100'



**TERRACOSTA CONSULTING GROUP**  
ENGINEERS AND GEOLOGISTS  
3890 MURPHY CANYON ROAD, SUITE 200  
SAN DIEGO, CA 92123 (858) 573-6900

FIGURE NUMBER

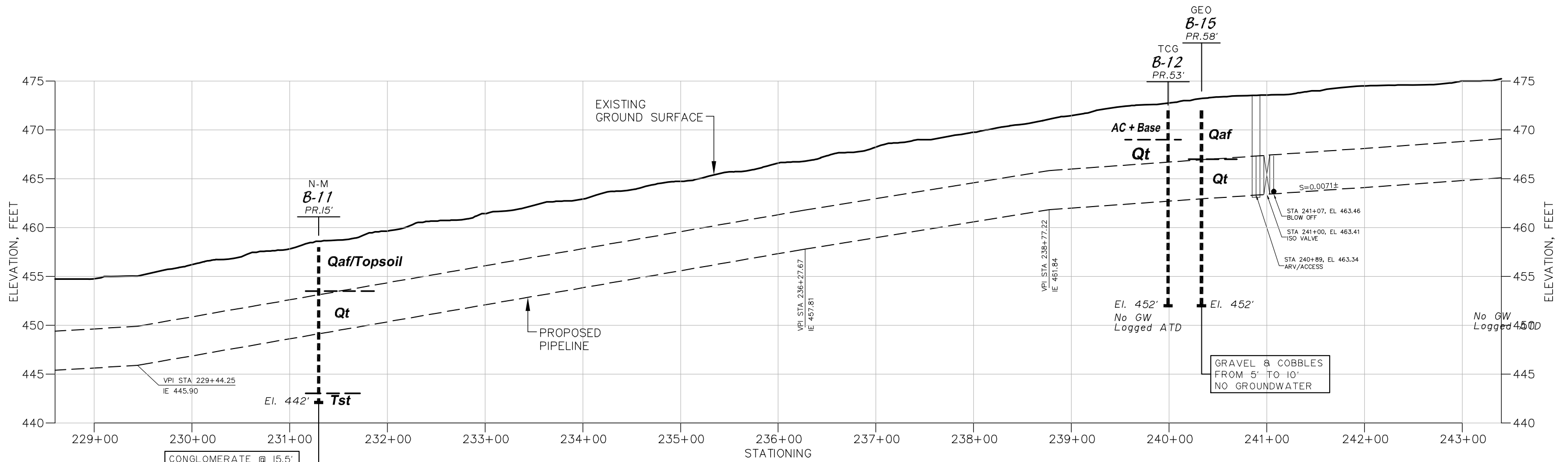
**3-17**

PROJECT NAME  
**NCCS MIRAMAR PIPELINE**

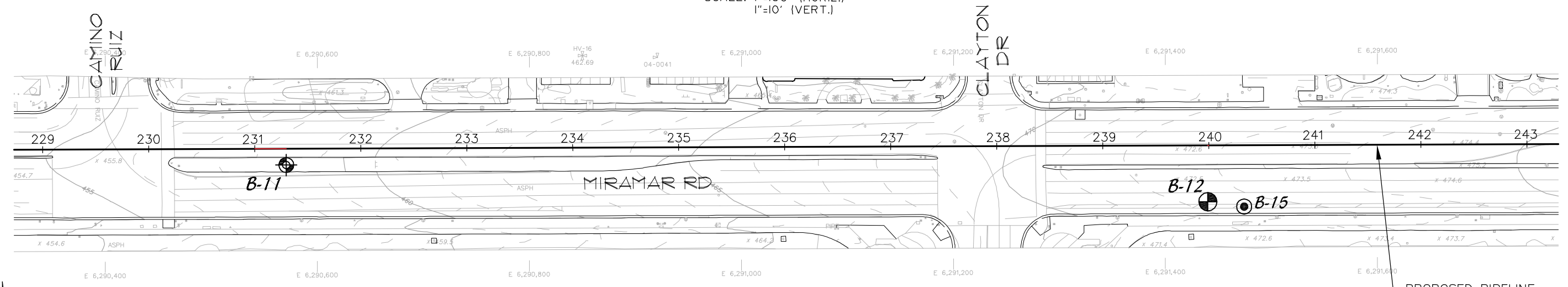
PROJECT NUMBER

**2934**

**PIPELINE ALIGNMENT & PROFILE**  
STA 217+00 TO 229+00



**PIPELINE PROFILE**  
 SCALE: 1"=100' (HORIZ.)  
 1"=10' (VERT.)



**PLAN VIEW**  
 SCALE: 1"=100'

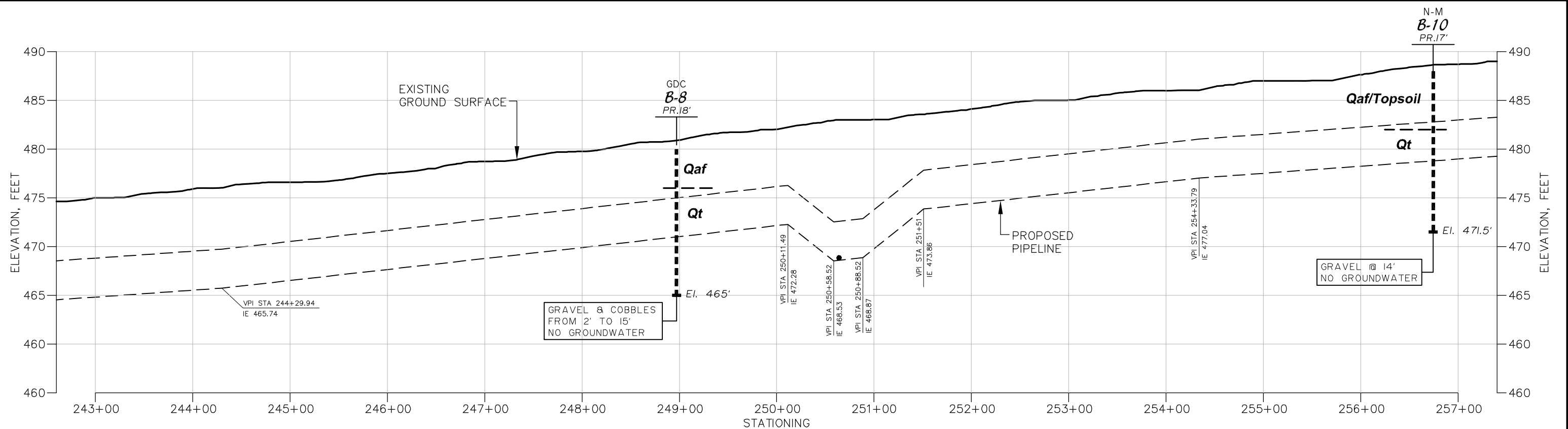
LEGEND	
	APPROXIMATE LOCATION OF TCG BORING
	APPROXIMATE LOCATION OF NINYO-MOORE BORING (1994)
	APPROXIMATE LOCATION OF GEOBASE BORING (1993)
AC + Base	PAVEMENT SECTION
Qaf/Topsoil	FILL/TOPSOIL
Qt	QUATERNARY TERRACE DEPOSITS
Tst	TERTIARY STADIUM CONGLOMERATE
---	APPROX. GEOLOGIC CONTACT

SCALE: 1"=100'

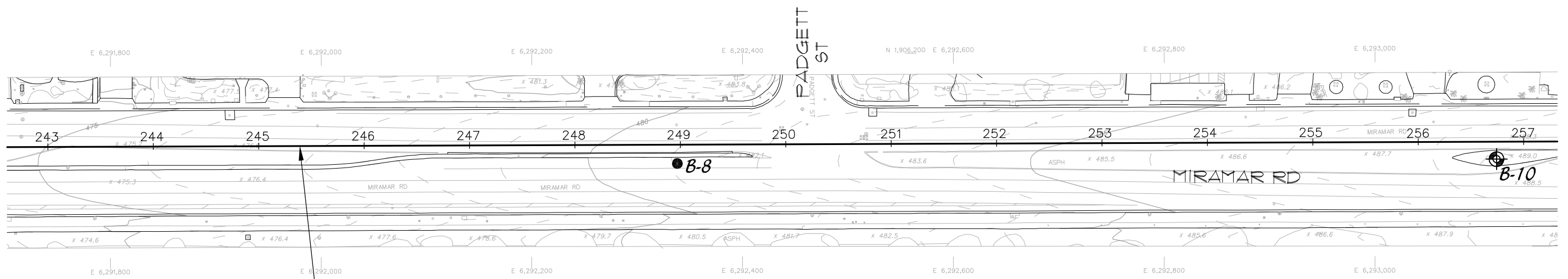


<b>TERRACOSTA CONSULTING GROUP</b> ENGINEERS AND GEOLOGISTS 3890 MURPHY CANYON ROAD, SUITE 200 SAN DIEGO, CA 92123 (858) 573-6900		FIGURE NUMBER <b>3-18</b>
PROJECT NAME <b>NCCS MIRAMAR PIPELINE</b>		PROJECT NUMBER <b>2934</b>
<b>PIPELINE ALIGNMENT &amp; PROFILE</b> STA 229+00 TO 243+00		





**PIPELINE PROFILE**  
 SCALE: 1"=100' (HORIZ.)  
 1"=10' (VERT.)



**PLAN VIEW**  
 SCALE: 1"=100'

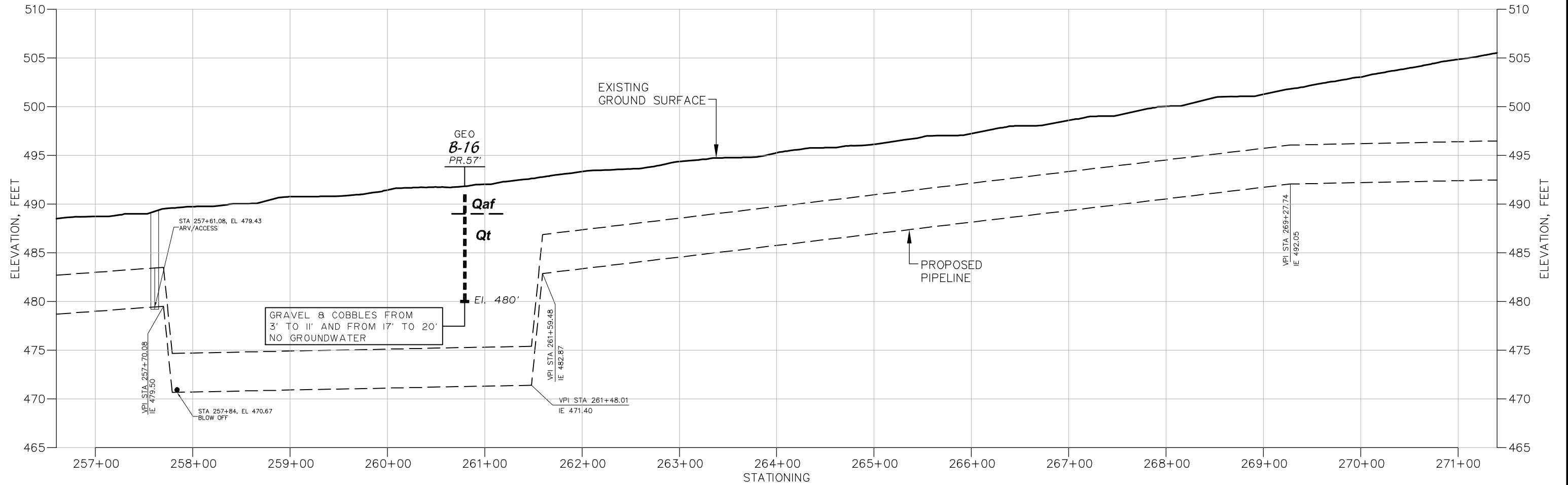
**LEGEND**

- 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

SCALE: 1"=100'



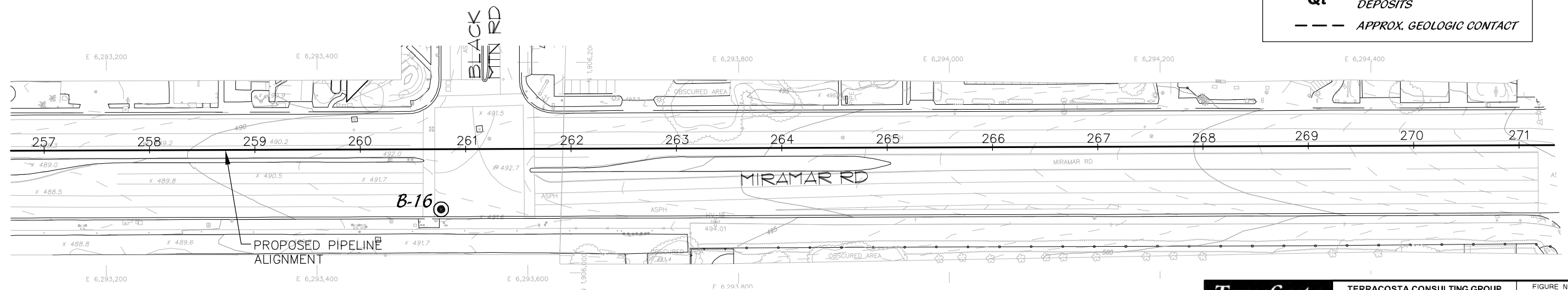
<b>TERRACOSTA CONSULTING GROUP</b> ENGINEERS AND GEOLOGISTS 3890 MURPHY CANYON ROAD, SUITE 200 SAN DIEGO, CA 92123 (858) 573-6900		FIGURE NUMBER <b>3-19</b>
PROJECT NAME <b>NCCS MIRAMAR PIPELINE</b>		PROJECT NUMBER <b>2934</b>
<b>PIPELINE ALIGNMENT &amp; PROFILE</b> STA 243+00 TO 257+00		



**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



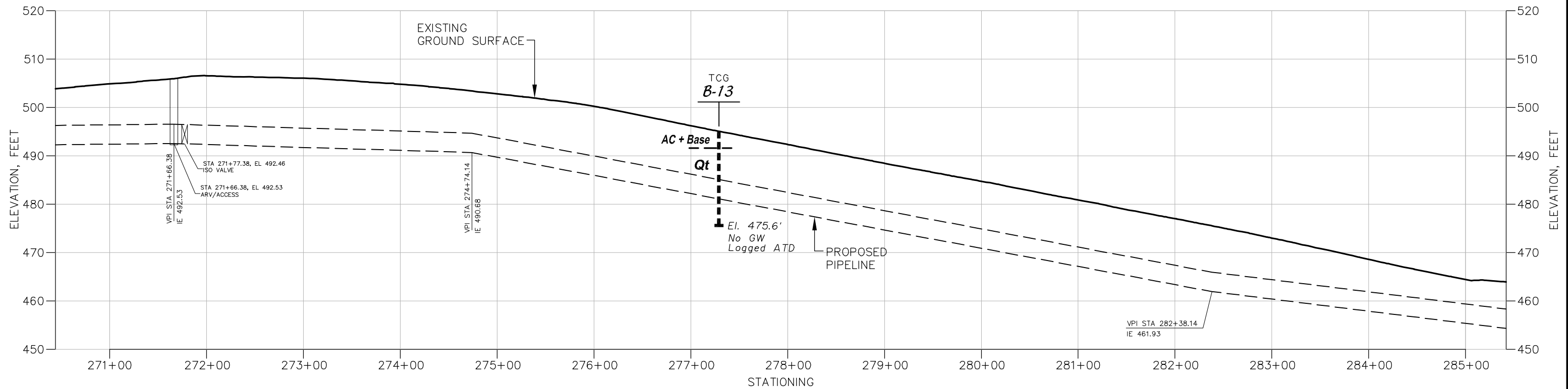
**PLAN VIEW**

SCALE: 1"=100'

SCALE: 1"=100'

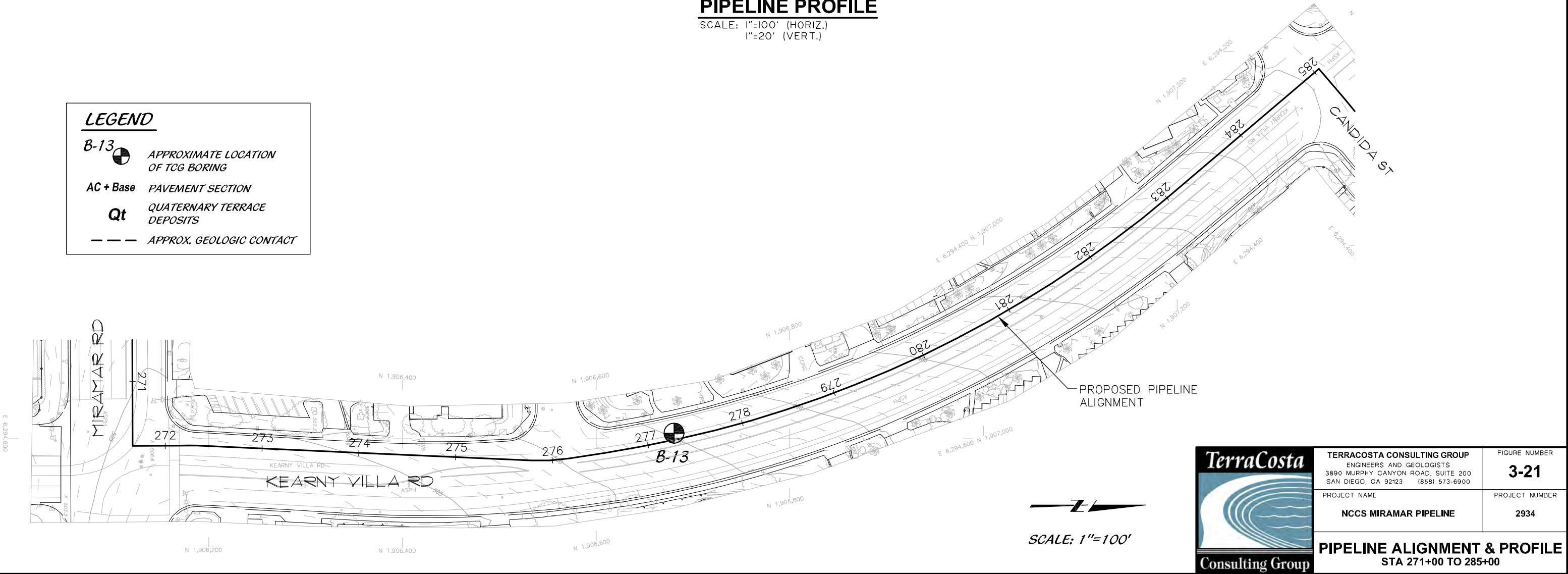


<b>TERRACOSTA CONSULTING GROUP</b> ENGINEERS AND GEOLOGISTS 3890 MURPHY CANYON ROAD, SUITE 200 SAN DIEGO, CA 92123 (858) 573-6900		FIGURE NUMBER <b>3-20</b>
PROJECT NAME <b>NCCS MIRAMAR PIPELINE</b>		PROJECT NUMBER <b>2934</b>
<b>PIPELINE ALIGNMENT &amp; PROFILE</b> STA 257+00 TO 271+00		

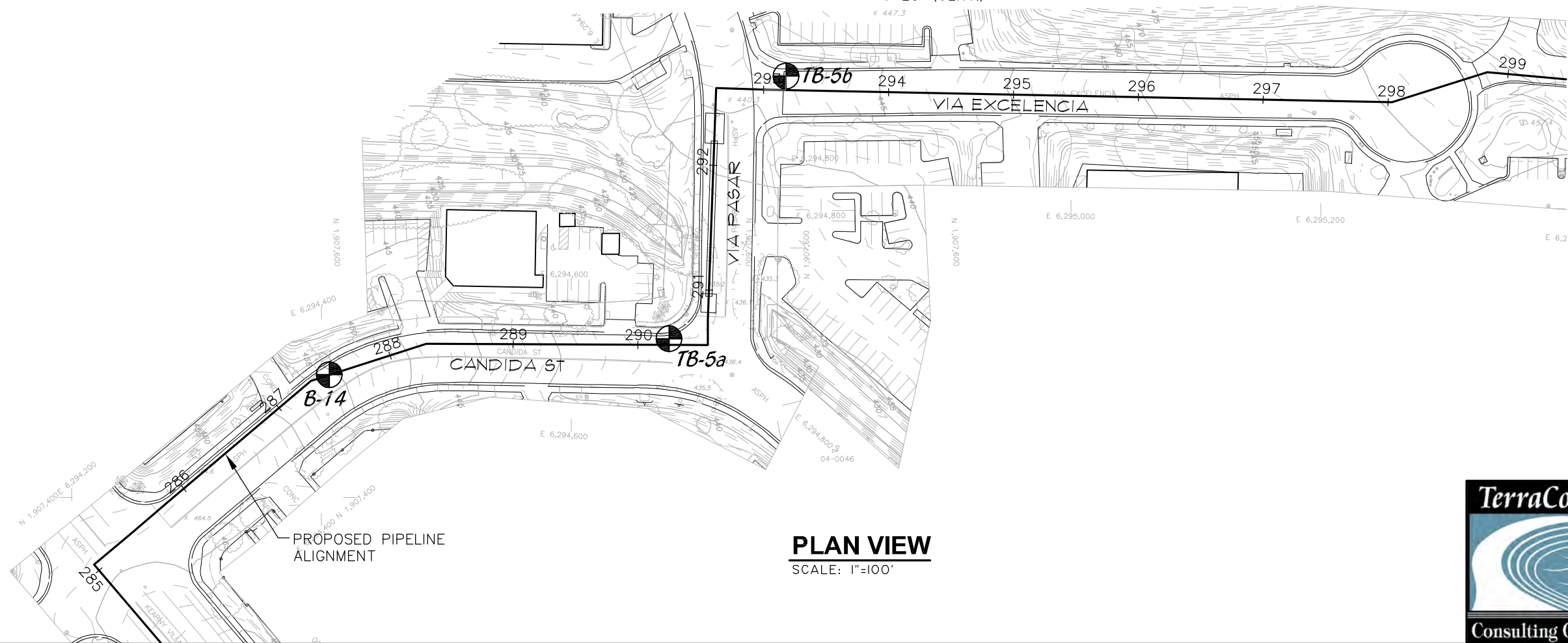
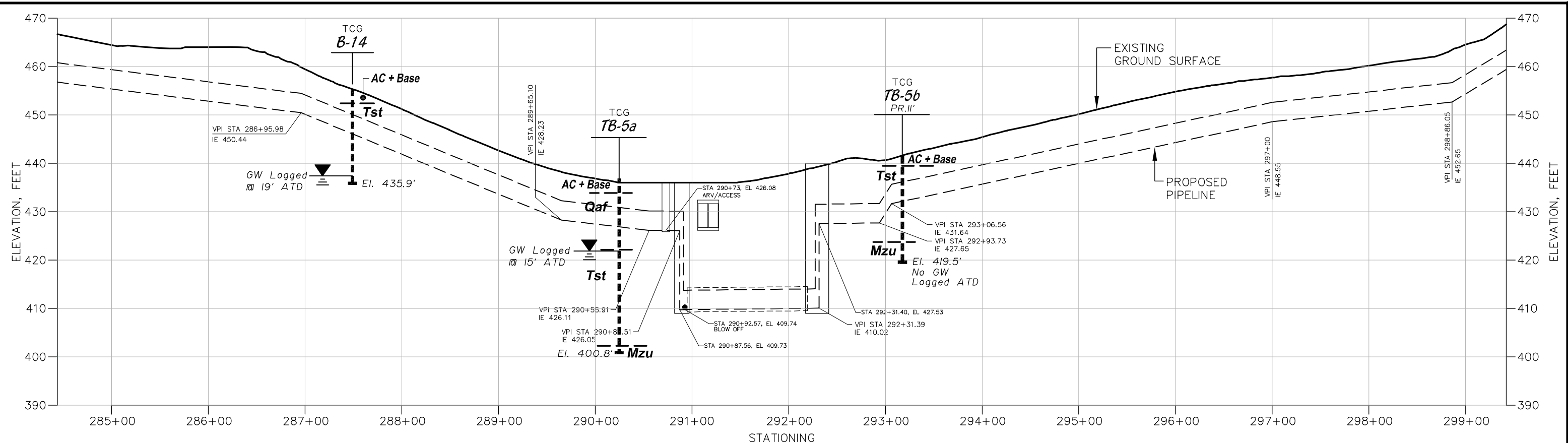


**LEGEND**

	APPROXIMATE LOCATION OF TCG BORING
	PAVEMENT SECTION
	QUATERNARY TERRACE DEPOSITS
	APPROX. GEOLOGIC CONTACT



	<b>TERRACOSTA CONSULTING GROUP</b> ENGINEERS AND GEOLOGISTS 3890 MURPHY CANYON ROAD, SUITE 200 SAN DIEGO, CA 92123 (858) 573-6900	FIGURE NUMBER <b>3-21</b>
	PROJECT NAME <b>NCCS MIRAMAR PIPELINE</b>	PROJECT NUMBER <b>2934</b>
<b>PIPELINE ALIGNMENT &amp; PROFILE</b> STA 271+00 TO 285+00		

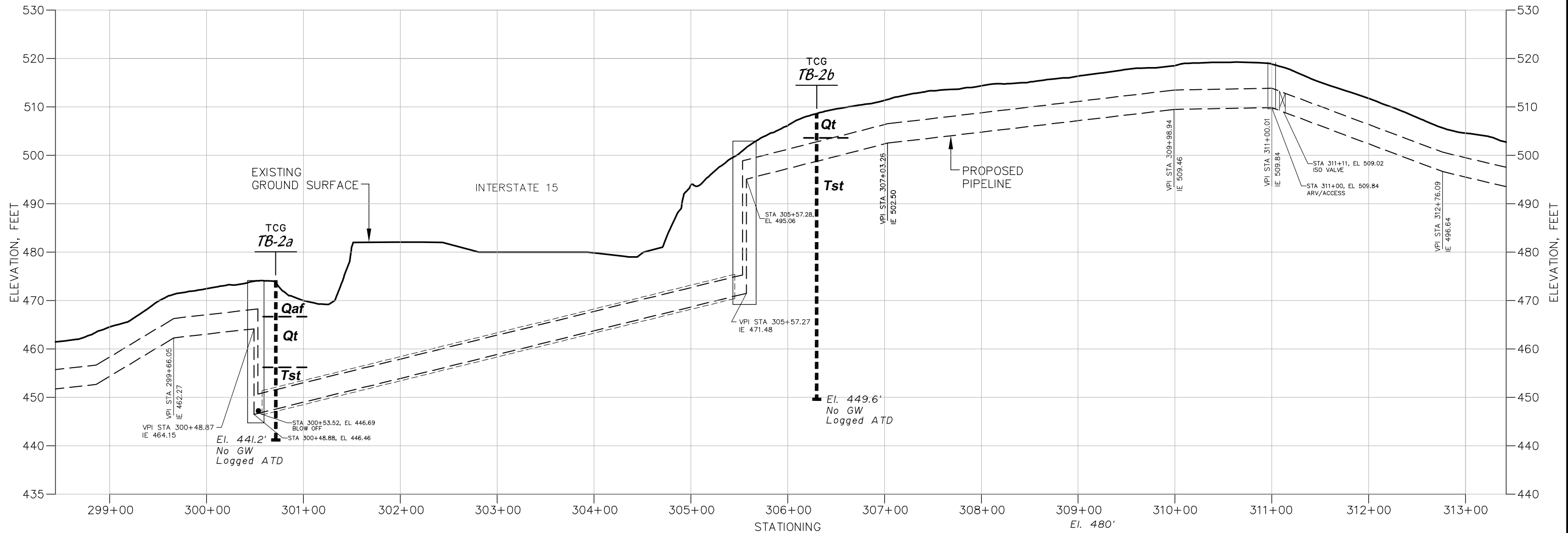


**LEGEND**

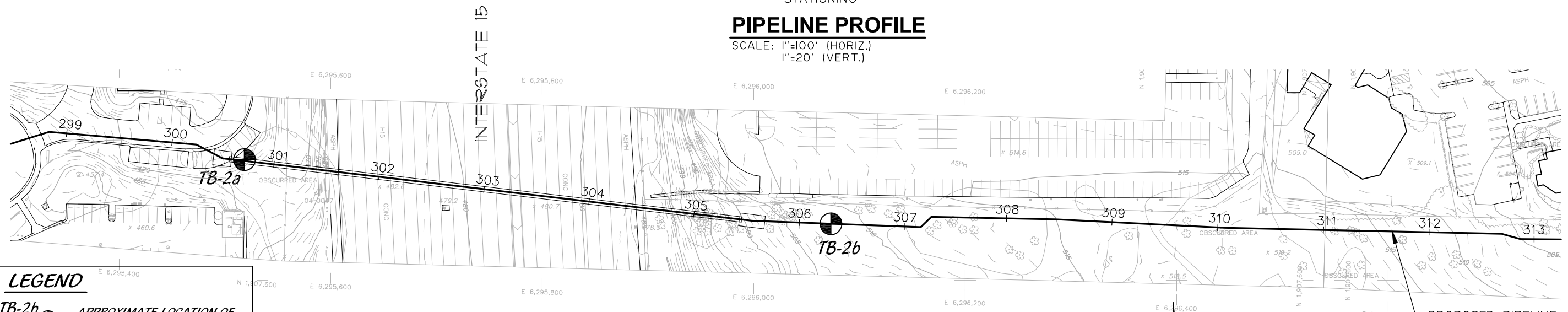
- TB-5a** APPROXIMATE LOCATION OF TCG TRENCHLESS BORING
- AC + Base** PAVEMENT SECTION
- Qaf** FILL
- Tst** TERTIARY STADIUM CONGLOMERATE
- Mzu** MESOZOIC METAMORPHOSED VOLCANIC & SEDIMENTARY ROCKS (UNDIVIDED)
- - -** APPROX. GEOLOGIC CONTACT

	<b>TERRACOSTA CONSULTING GROUP</b> ENGINEERS AND GEOLOGISTS 3890 MURPHY CANYON ROAD, SUITE 200 SAN DIEGO, CA 92123 (858) 573-6900	FIGURE NUMBER <b>3-22</b>
	PROJECT NAME <b>NCCS MIRAMAR PIPELINE</b>	PROJECT NUMBER <b>2934</b>
<b>PIPELINE ALIGNMENT &amp; PROFILE</b> STA 285+00 TO 299+00		





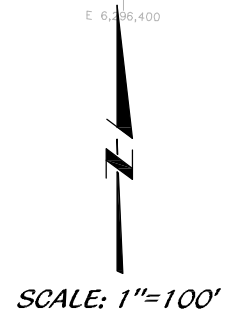
**PIPELINE PROFILE**  
 SCALE: 1"=100' (HORIZ.)  
 1"=20' (VERT.)



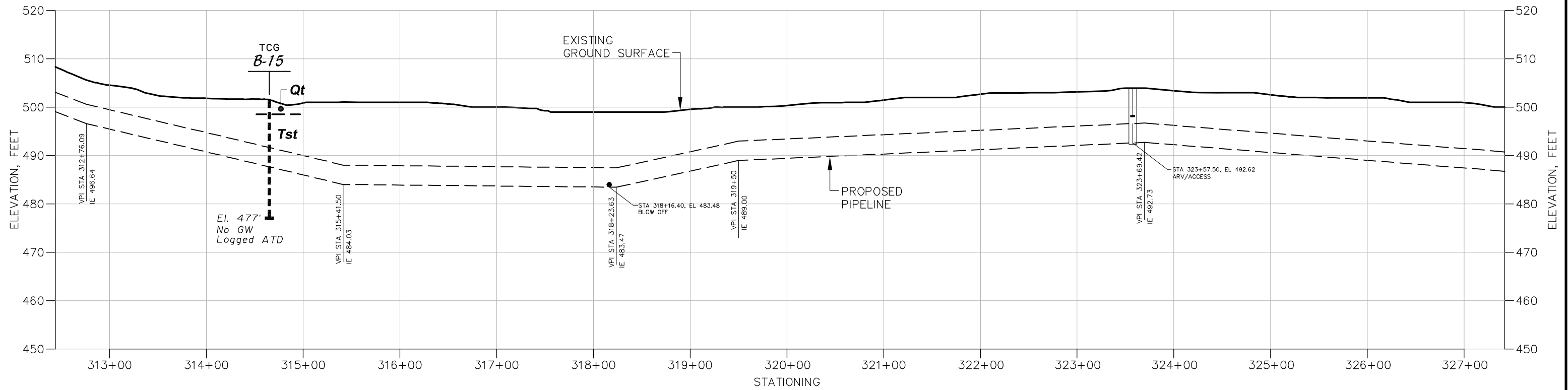
**PLAN VIEW**  
 SCALE: 1"=100'

**LEGEND**

- APPROXIMATE LOCATION OF TCG TRENCHLESS BORING
- FILL
- QUATERNARY TERRACE DEPOSITS
- TERTIARY STADIUM CONGLOMERATE
- APPROX. GEOLOGIC CONTACT

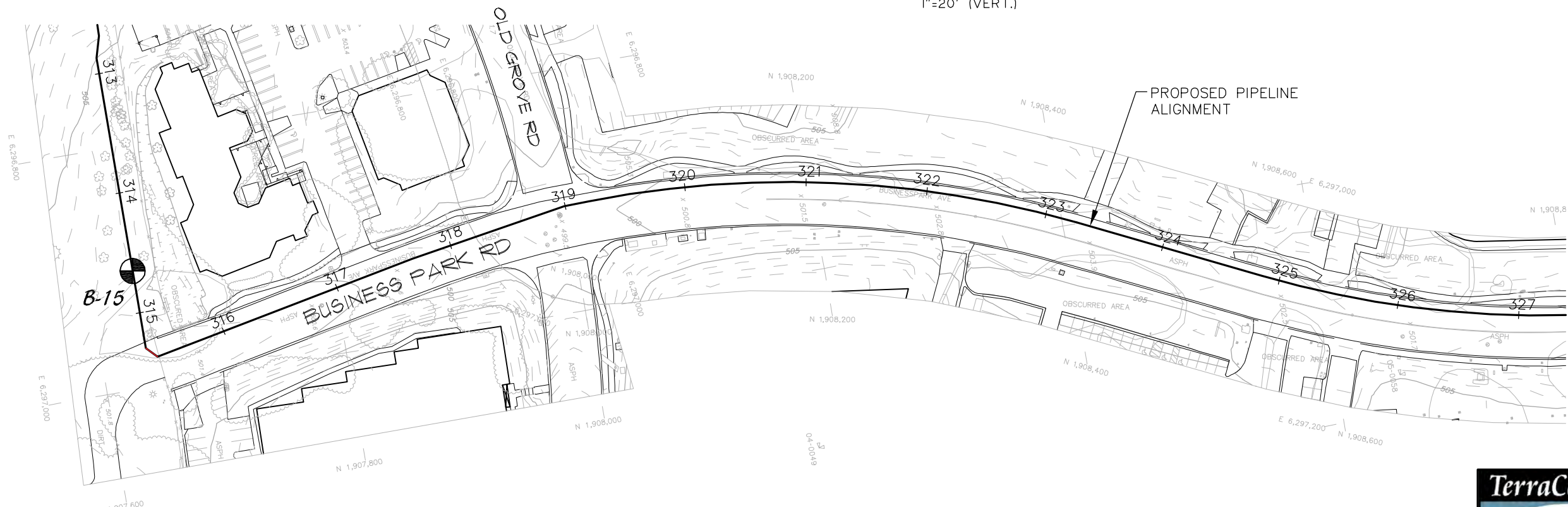


<b>TERRACOSTA CONSULTING GROUP</b> ENGINEERS AND GEOLOGISTS 3890 MURPHY CANYON ROAD, SUITE 200 SAN DIEGO, CA 92123 (858) 573-6900		FIGURE NUMBER <b>3-23</b>
PROJECT NAME <b>NCCS MIRAMAR PIPELINE</b>		PROJECT NUMBER <b>2934</b>
<b>PIPELINE ALIGNMENT &amp; PROFILE</b> STA 299+00 TO 313+00		



**PIPELINE PROFILE**

SCALE: 1"=100' (HORIZ.)  
1"=20' (VERT.)



**PLAN VIEW**

SCALE: 1"=100'

<b>LEGEND</b>	
<b>B-15</b>	APPROXIMATE LOCATION OF TCG BORING
<b>Qt</b>	QUATERNARY TERRACE DEPOSITS
<b>Tst</b>	TERTIARY STADIUM CONGLOMERATE
	APPROX. GEOLOGIC CONTACT



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3890 MURPHY CANYON ROAD, SUITE 200  
SAN DIEGO, CA 92123 (858) 573-6900

FIGURE NUMBER

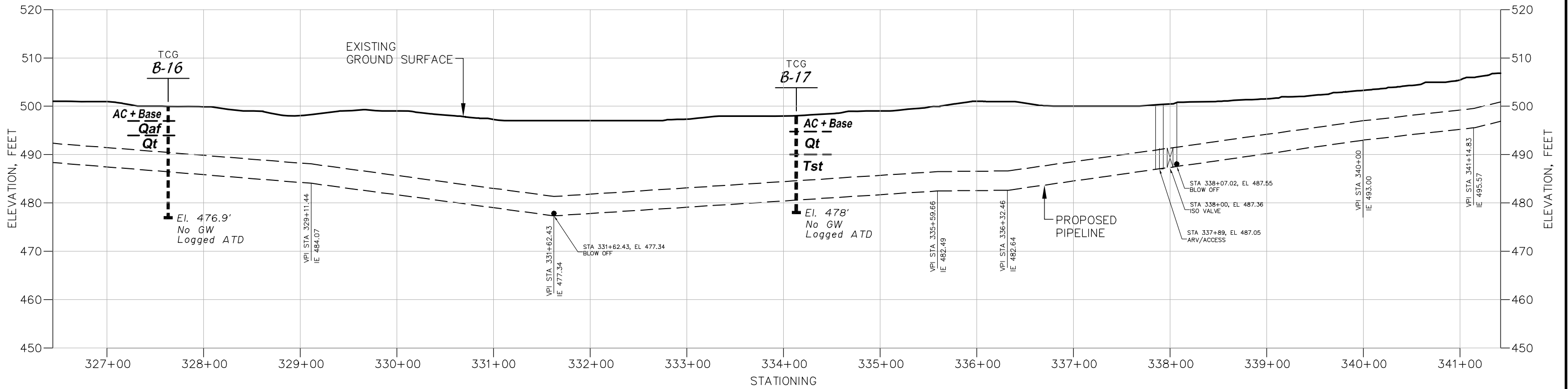
**3-24**

PROJECT NAME  
**NCCS MIRAMAR PIPELINE**

PROJECT NUMBER

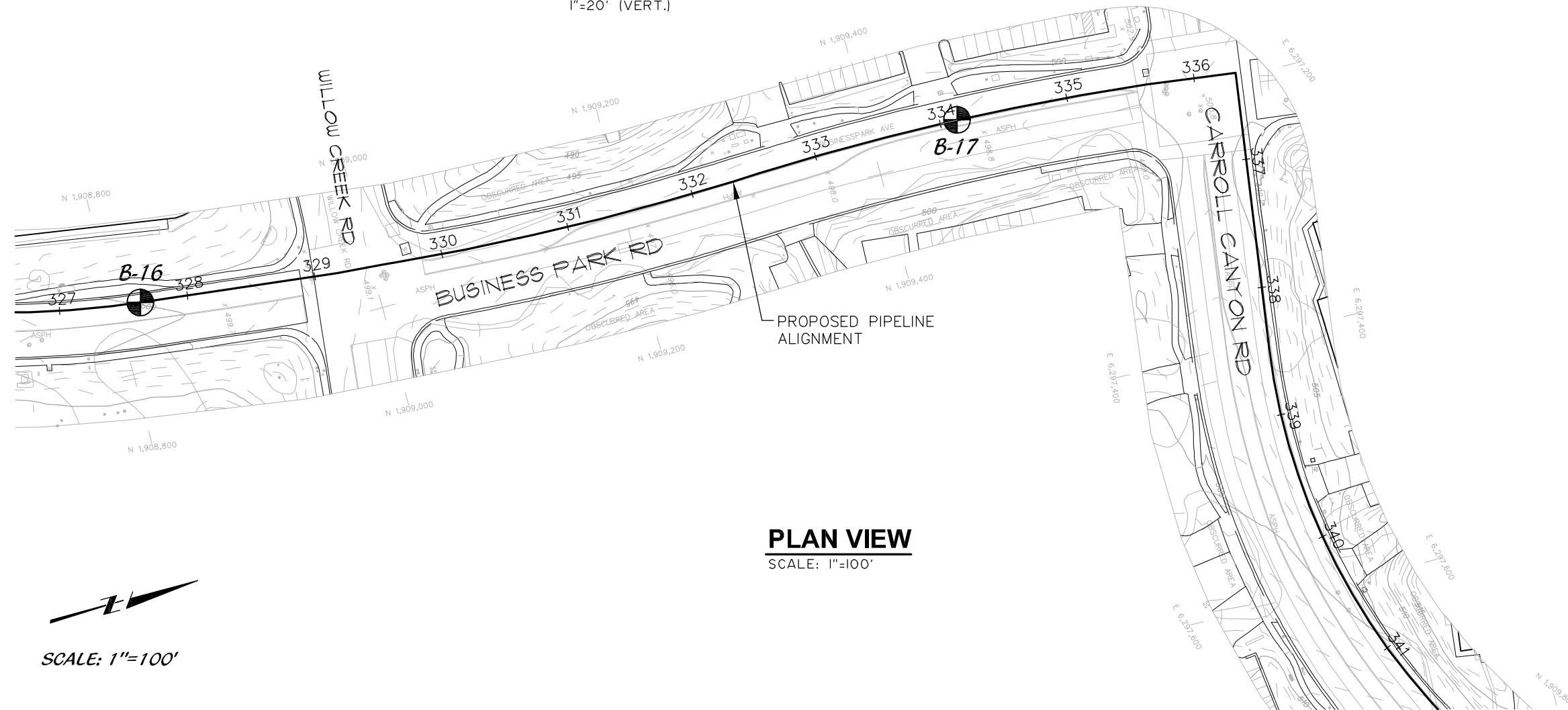
**2934**

**PIPELINE ALIGNMENT & PROFILE**  
STA 313+00 TO 327+00



**PIPELINE PROFILE**

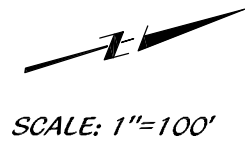
SCALE: 1"=100' (HORIZ.)  
1"=20' (VERT.)



**PLAN VIEW**

SCALE: 1"=100'

<b>LEGEND</b>	
B-17	APPROXIMATE LOCATION OF TCG BORING
AC + Base	PAVEMENT SECTION
Qaf	FILL
Qt	QUATERNARY TERRACE DEPOSITS
Tst	TERTIARY STADIUM CONGLOMERATE
---	APPROX. GEOLOGIC CONTACT



SCALE: 1"=100'



TERRACOSTA CONSULTING GROUP  
ENGINEERS AND GEOLOGISTS  
3890 MURPHY CANYON ROAD, SUITE 200  
SAN DIEGO, CA 92123 (858) 573-6900

FIGURE NUMBER

**3-25**

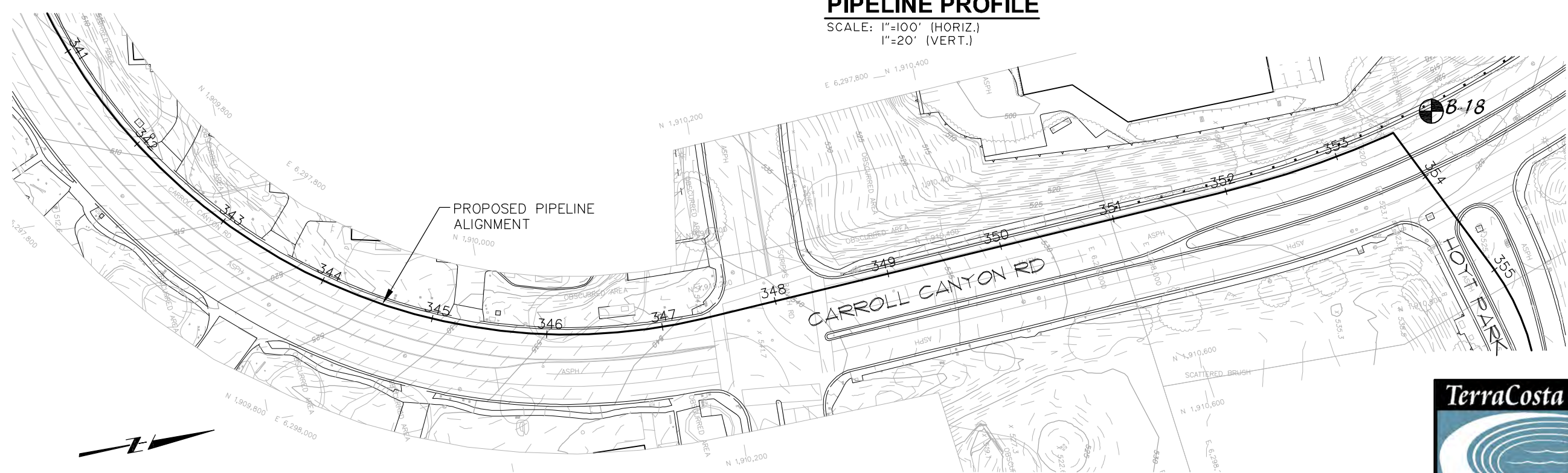
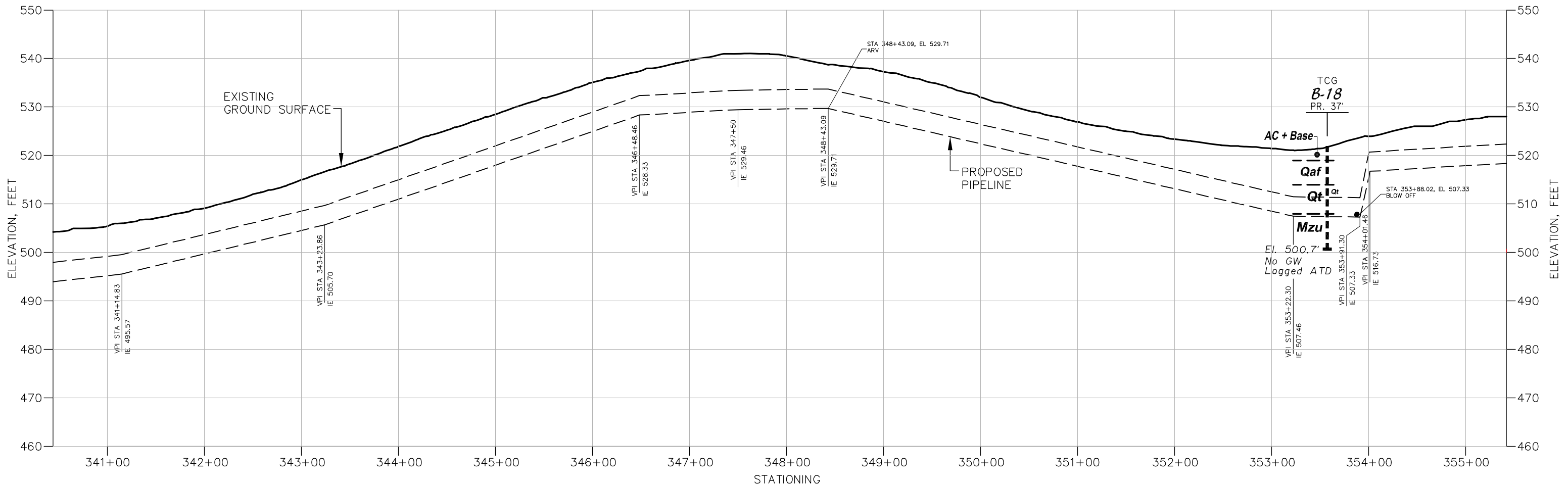
PROJECT NAME  
**NCCS MIRAMAR PIPELINE**

PROJECT NUMBER

**2934**

**PIPELINE ALIGNMENT & PROFILE**  
STA 327+00 TO 341+00

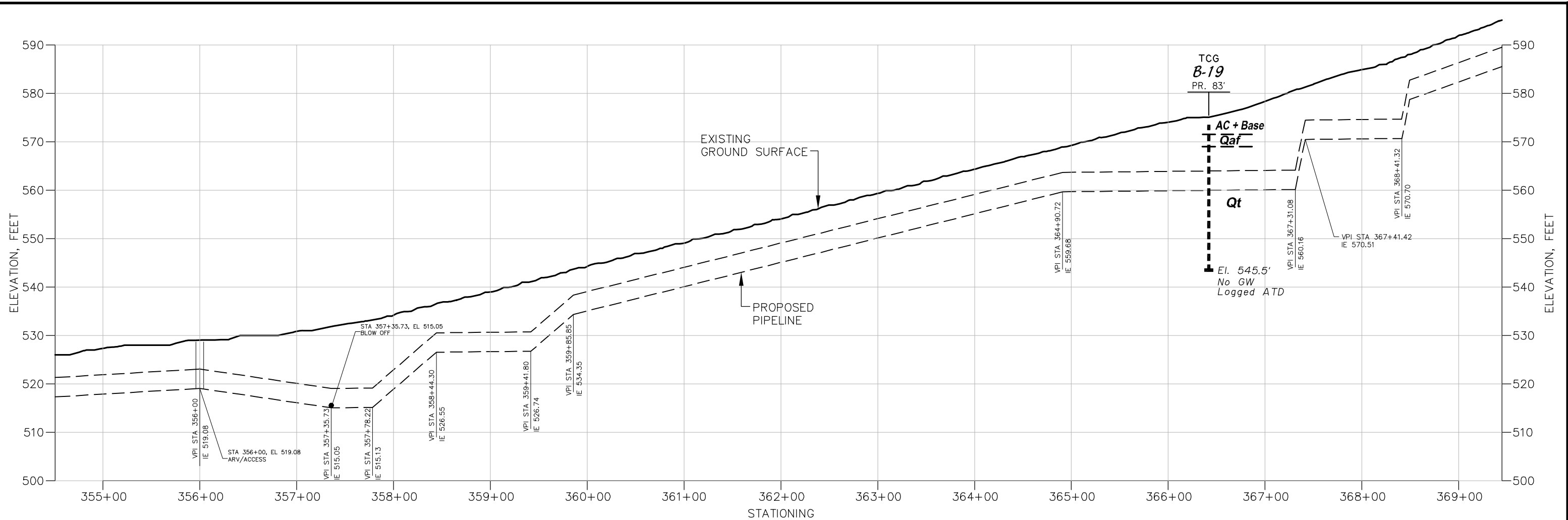




**LEGEND**

- 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

	<b>TERRACOSTA CONSULTING GROUP</b> ENGINEERS AND GEOLOGISTS 3890 MURPHY CANYON ROAD, SUITE 200 SAN DIEGO, CA 92123 (858) 573-6900	FIGURE NUMBER <b>3-26</b>
	PROJECT NAME <b>NCCS MIRAMAR PIPELINE</b>	PROJECT NUMBER <b>2934</b>
<b>PIPELINE ALIGNMENT &amp; PROFILE</b> STA 341+00 TO 355+00		

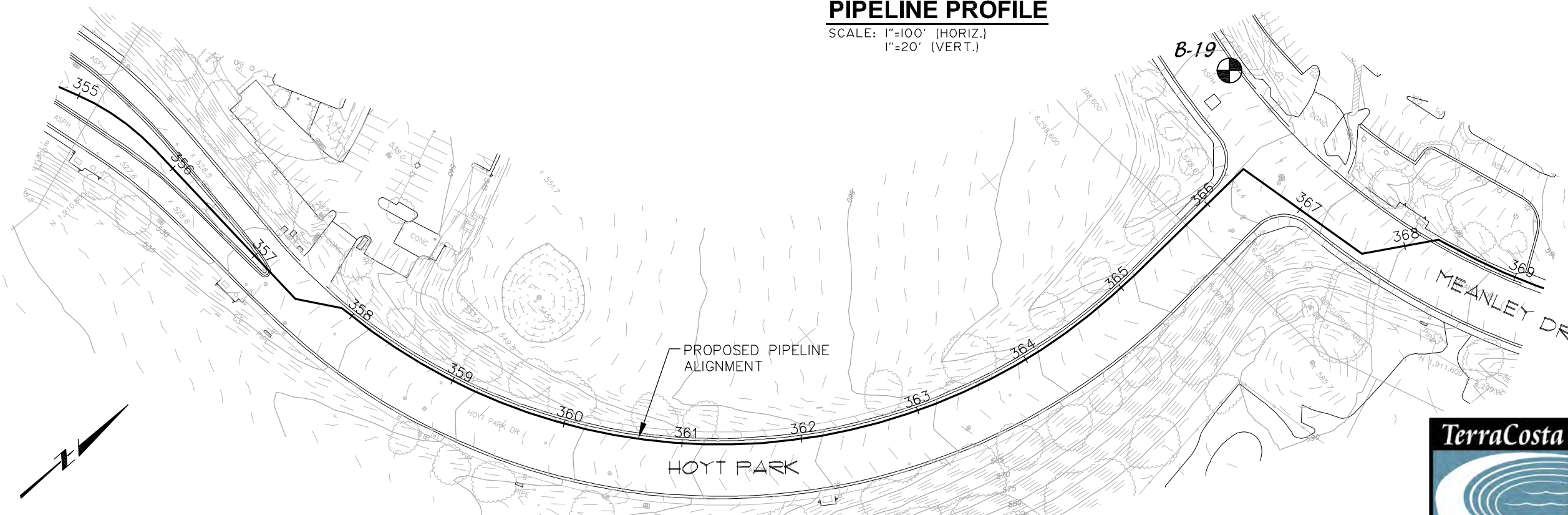


**PIPELINE PROFILE**

SCALE: 1"=100' (HORIZ.)  
1"=20' (VERT.)

**LEGEND**

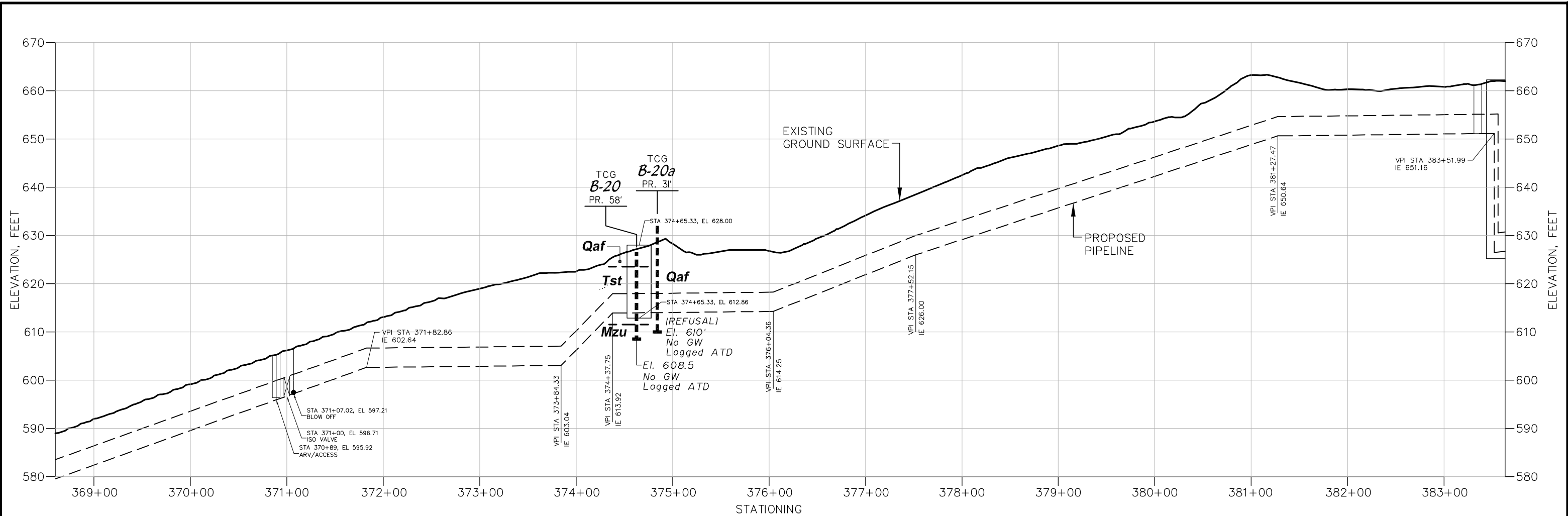
- B-19** APPROXIMATE LOCATION OF TCG BORING
- AC + Base** PAVEMENT SECTION
- Qaf** FILL
- Qt** QUATERNARY TERRACE DEPOSITS
- APPROX. GEOLOGIC CONTACT



**PLAN VIEW**

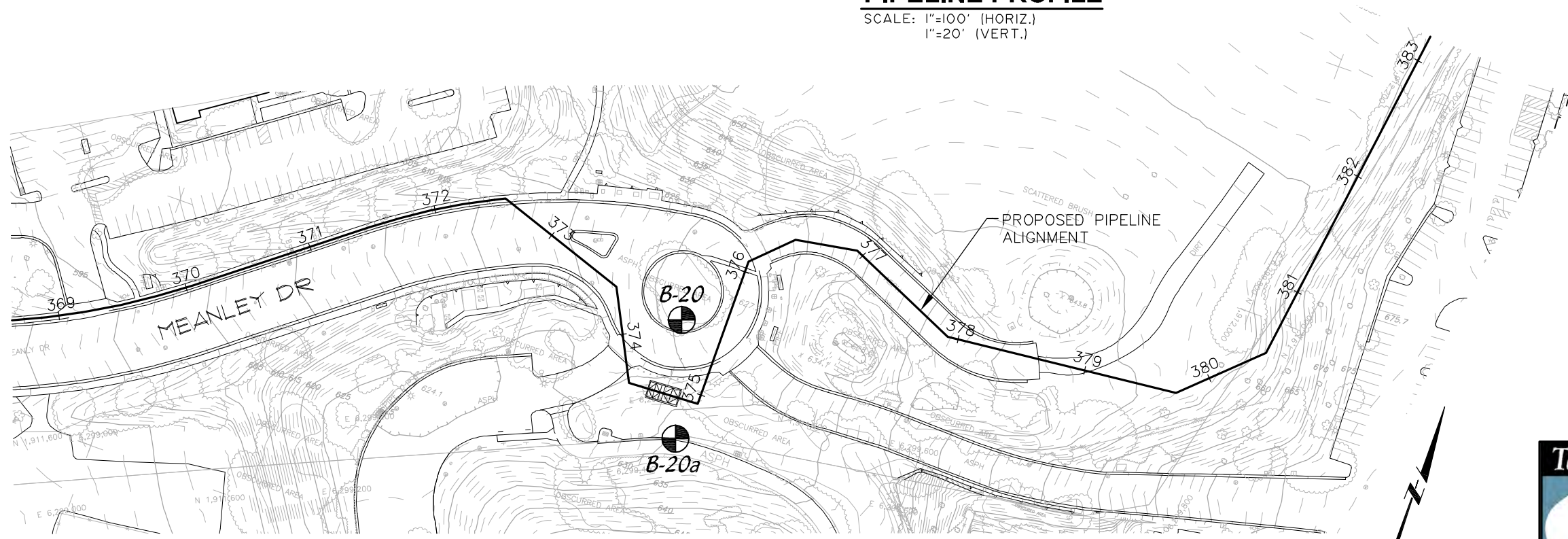
SCALE: 1"=100'

	<b>TERRACOSTA CONSULTING GROUP</b> ENGINEERS AND GEOLOGISTS 3890 MURPHY CANYON ROAD, SUITE 200 SAN DIEGO, CA 92123 (858) 573-6900	FIGURE NUMBER <b>3-27</b>
	PROJECT NAME <b>NCCS MIRAMAR PIPELINE</b>	PROJECT NUMBER <b>2934</b>
<b>PIPELINE ALIGNMENT &amp; PROFILE</b> STA 355+00 TO 369+00		



**PIPELINE PROFILE**

SCALE: 1"=100' (HORIZ.)  
1"=20' (VERT.)



**PLAN VIEW**

SCALE: 1"=100'

SCALE: 1"=100'

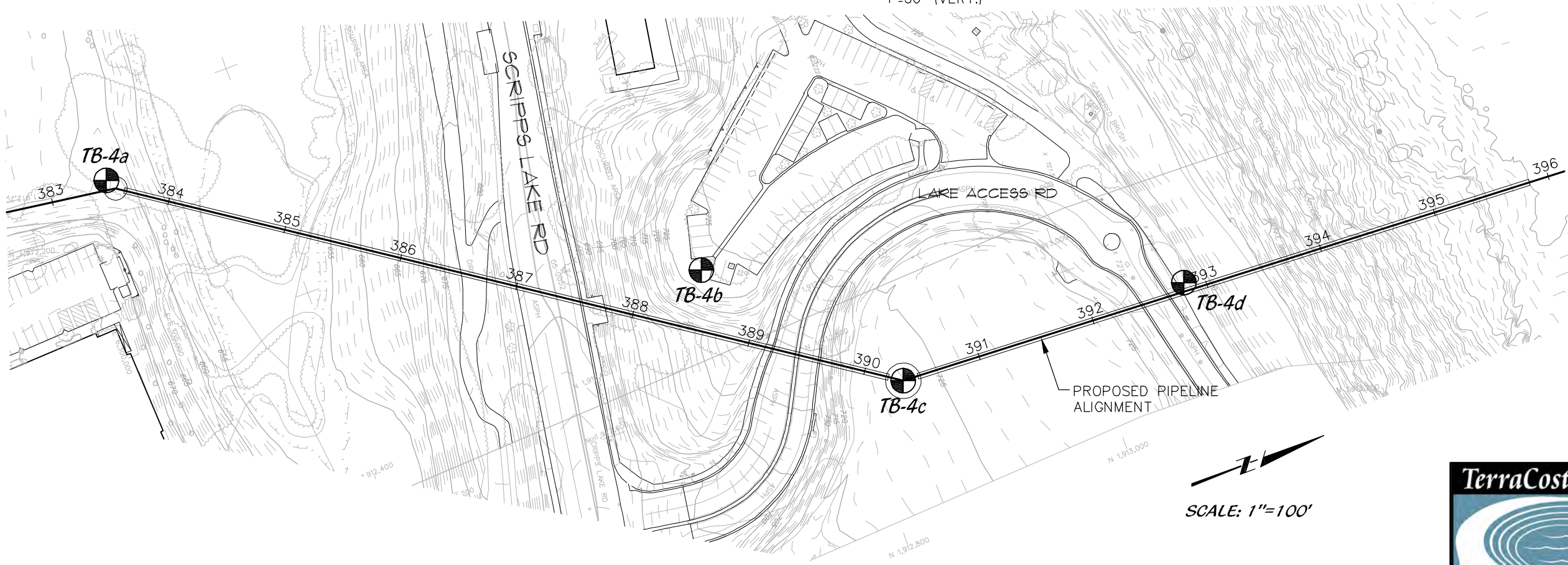
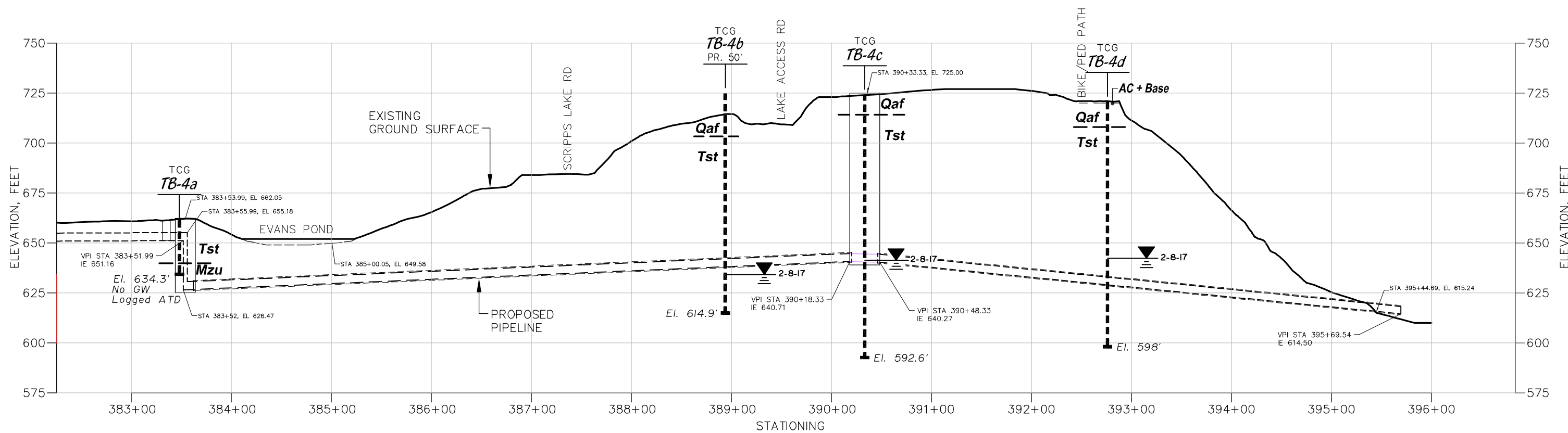
**LEGEND**

- B-20** APPROXIMATE LOCATION OF TCG BORING
- Qaf** FILL
- Tst** TERTIARY STADIUM CONGLOMERATE
- Mzu** MESOZOIC METAMORPHOSED VOLCANIC & SEDIMENTARY ROCKS (UNDIVIDED)
- - -** APPROX. GEOLOGIC CONTACT



<b>TERRACOSTA CONSULTING GROUP</b> ENGINEERS AND GEOLOGISTS 3890 MURPHY CANYON ROAD, SUITE 200 SAN DIEGO, CA 92123 (858) 573-6900		FIGURE NUMBER <b>3-28</b>
PROJECT NAME <b>NCCS MIRAMAR PIPELINE</b>		PROJECT NUMBER <b>2934</b>
<b>PIPELINE ALIGNMENT &amp; PROFILE</b> STA 369+00 TO 383+00		





**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

	<b>TERRACOSTA CONSULTING GROUP</b> ENGINEERS AND GEOLOGISTS 3890 MURPHY CANYON ROAD, SUITE 200 SAN DIEGO, CA 92123 (858) 573-6900	FIGURE NUMBER <b>3-29</b>
	PROJECT NAME <b>NCCS MIRAMAR PIPELINE</b>	PROJECT NUMBER <b>2934</b>
<b>PIPELINE ALIGNMENT &amp; PROFILE</b> STA 383+00 TO 396+00		

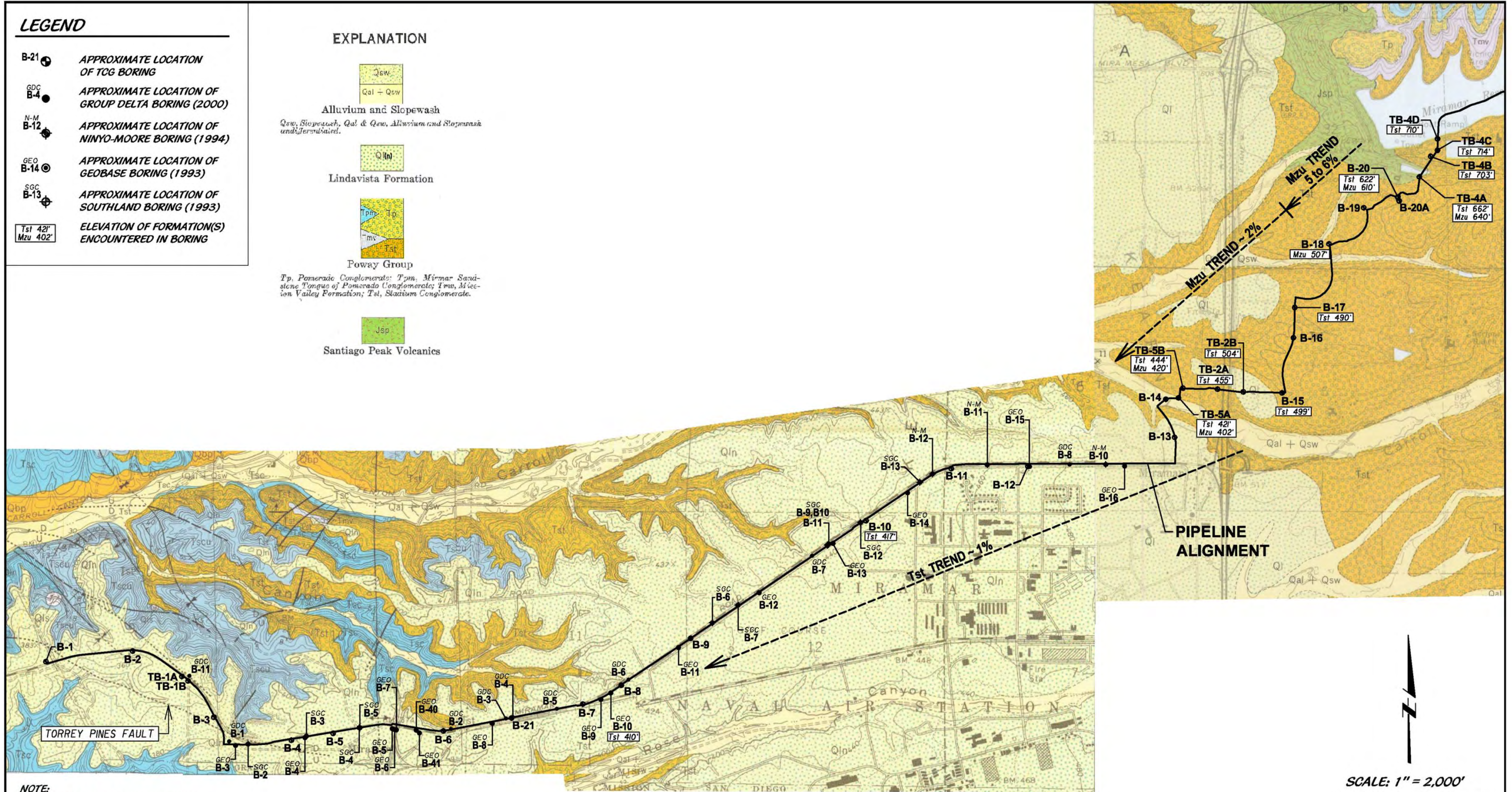


**LEGEND**

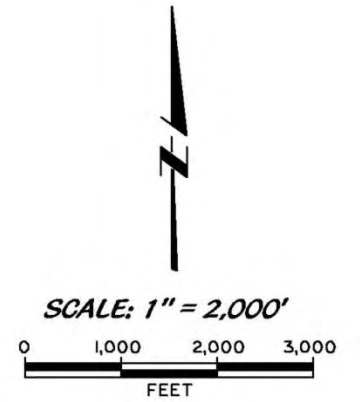
- B-21** APPROXIMATE LOCATION OF TCG BORING
- GDC B-4** APPROXIMATE LOCATION OF GROUP DELTA BORING (2000)
- N-M B-12** APPROXIMATE LOCATION OF NINYO-MOORE BORING (1994)
- GEO B-14** APPROXIMATE LOCATION OF GEOBASE BORING (1993)
- SGC B-13** APPROXIMATE LOCATION OF SOUTHLAND BORING (1993)
- Tst 421'**  
**Mzu 402'** ELEVATION OF FORMATION(S) ENCOUNTERED IN BORING

**EXPLANATION**

- Qal + Qsw**  
Alluvium and Slopewash  
*Qsw, Slopewash, Qal & Qsw, Alluvium and Slopewash undifferentiated.*
- Qln**  
Lindavista Formation
- Tp, Tpm, 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.



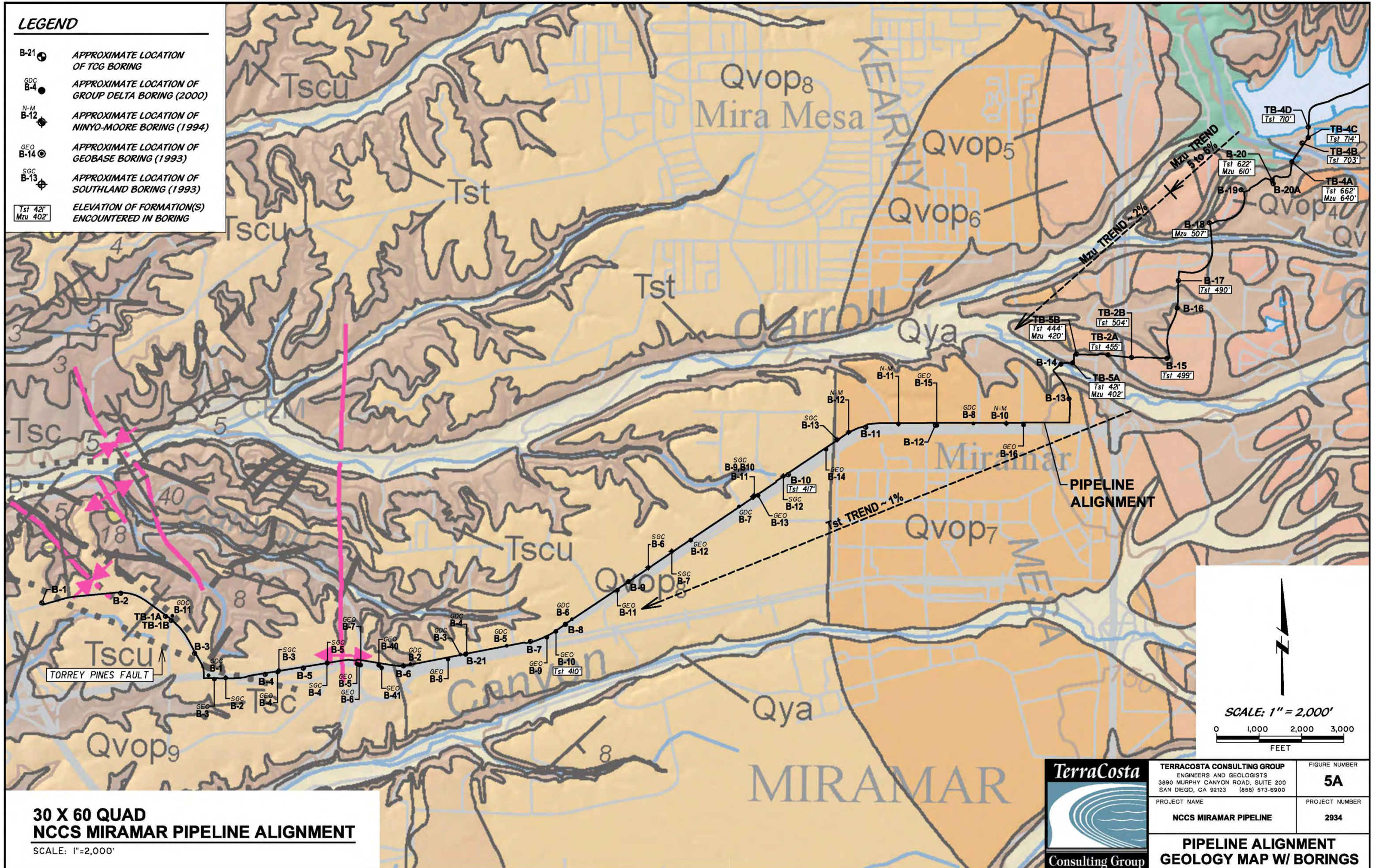
**KENNEDY MAP**  
**NCCS MIRAMAR PIPELINE ALIGNMENT**  
SCALE: 1"=2,000'

	<b>TERRACOSTA CONSULTING GROUP</b> ENGINEERS AND GEOLOGISTS 3890 MURPHY CANYON ROAD, SUITE 200 SAN DIEGO, CA 92123 (858) 573-6900	FIGURE NUMBER <b>4</b>
	PROJECT NAME <b>NCCS MIRAMAR PIPELINE</b>	PROJECT NUMBER <b>2934</b>
<b>PIPELINE ALIGNMENT</b> <b>GEOLOGY MAP W/ BORINGS</b>		



**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 42' Mzu 402' ELEVATION OF FORMATION(S) ENCOUNTERED IN BORING



**30 X 60 QUAD  
NCCS MIRAMAR PIPELINE ALIGNMENT**

SCALE: 1"=2,000'



<b>TERRACOSTA CONSULTING GROUP</b> ENGINEERS AND GEOLOGISTS 3890 MURPHY CANYON ROAD, SUITE 200 SAN DIEGO, CA 92123 (858) 573-6900		FIGURE NUMBER <b>5A</b>
PROJECT NAME <b>NCCS MIRAMAR PIPELINE</b>		PROJECT NUMBER <b>2934</b>
<b>PIPELINE ALIGNMENT GEOLOGY MAP W/ BORINGS</b>		



## 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, interfingering 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<sub>9</sub>** **VERY OLD PARALIC DEPOSITS, UNIT 9 (middle to early Pleistocene)** - Poorly sorted, moderately permeable, reddish-brown, interfingering strandline, beach, estuarine and colluvial deposits composed of siltstone, sandstone and conglomerate. These deposits rest on the 113-115 m Linda Vista terrace.

**Qvop<sub>8</sub>** **VERY OLD PARALIC DEPOSITS, UNIT 8 (middle to early Pleistocene)** - Poorly sorted, moderately permeable, reddish-brown, interfingering strandline, beach, estuarine and colluvial deposits composed of siltstone, sandstone and conglomerate. These deposits rest on the 123-125 m Tierra Santa terrace.

**Qvop<sub>7</sub>** **VERY OLD PARALIC DEPOSITS, UNIT 7 (middle to early Pleistocene)** - Poorly sorted, moderately permeable, reddish-brown, interfingering strandline, beach, estuarine and colluvial deposits composed of siltstone, sandstone and conglomerate. These deposits rest on the 129-131 m Mira Mesa terrace.



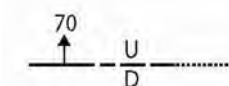



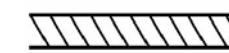




**Qvop<sub>4</sub>** **VERY OLD PARALIC DEPOSITS, UNIT 4 (middle to early Pleistocene)** - Poorly sorted, moderately permeable, reddish-brown, interfingering strandline, beach, estuarine and colluvial deposits composed of siltstone, sandstone and conglomerate. These deposits rest on the 170-174 m Aqueduct terrace.

**Qvop<sub>2</sub>** **VERY OLD PARALIC DEPOSITS, UNIT 2 (middle to early Pleistocene)** - Poorly sorted, moderately permeable, reddish-brown, interfingering strandline, beach, estuarine and colluvial deposits composed of siltstone, sandstone and conglomerate. These deposits rest on the 190-194 m Flores Hill terrace.

**Tsc** **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 slightly metamorphosed rhyolitic to dacitic volcanic and volcanoclastic 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

	<b>Contacts</b> - Contact between geologic units; dotted where concealed
	<b>Contacts</b> - Contact between paralic deposits and their associated marine abrasion platforms. This contact is approximate and generally buried by 1-5 m of marine and/or nonmarine sediment
	<b>Fault</b> - 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.
	<b>Anticline</b> - Solid where accurately located; dashed where approximately located; dotted where concealed. Arrow indicates direction of axial plunge.
	<b>Syncline</b> - Solid where accurately located; dotted where concealed. Arrow indicates direction of axial plunge.
	<b>Landslide</b> - Arrows indicate principal direction of movement.
	<b>Fault Zone</b> - Area of extensively sheared rock within a zone defined by multiple faults.
<b>Strike and dip of beds</b>	
	<b>Inclined</b>
<b>Strike and dip of igneous joints</b>	
	<b>Inclined</b>
	<b>Vertical</b>
<b>Strike and dip of metamorphic foliation</b>	
	<b>Inclined</b>

**SOURCE:**

Reproduced from: Pamphlet from "Geologic Map of the San Diego 30'x60' Quadrangle, California." by Michael P. Kennedy and Siang S. Tan, 2008.

	<b>TERRACOSTA CONSULTING GROUP</b> ENGINEERS AND GEOLOGISTS 3890 MURPHY CANYON ROAD, SUITE 200 SAN DIEGO, CA 92123 (858) 573-6900	FIGURE NUMBER <b>5B</b>
	PROJECT NAME <b>NCCS MIRAMAR PIPELINE</b>	PROJECT NUMBER <b>2934</b>
<b>GEOLOGY MAP LEGEND</b>		





**PROJECT LOCATION**



**TERRACOSTA CONSULTING GROUP**  
 ENGINEERS AND GEOLOGISTS  
 3890 MURPHY CANYON ROAD, SUITE 200  
 SAN DIEGO, CA 92123 (619) 573-6900

FIGURE NUMBER  
**6**  
 PROJECT NUMBER  
 2934

**REGIONAL FAULT MAP**

Faults in northern Baja California are shown more extensively on Plate 1 in pocket of the



APPENDIX A  
FINAL LOGS OF TEST BORING

LOGS OF EXCAVATIONS  
FROM  
TERRACOSTA CONSULTING GROUP  
2015-16



LOG OF TEST BORING										PROJECT NAME		PROJECT NUMBER		BORING LEGEND																																		
SITE LOCATION										START		FINISH		SHEET NO.																																		
San Diego										11/7/2016				1 of 3																																		
DRILLING COMPANY					DRILLING METHOD					LOGGED BY		CHECKED BY																																				
Pacific Drilling / Ruen Drilling					Auger / Core					G. Spaulding																																						
DRILLING EQUIPMENT					BORING DIA. (in)		TOTAL DEPTH (ft)		GROUND ELEV (ft)		DEPTH/ELEV. GROUND WATER (ft)																																					
Marl M5/ LF 70							60				▼ n/a																																					
SAMPLING METHOD								NOTES																																								
SPT / CAL																																																
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										<p align="center"><b>KEY TO EXCAVATION LOGS</b></p> <p>WATER TABLE MEASURED AT TIME OF DRILLING</p> <p><b>OTHER TESTS</b></p> <table border="0"> <tr> <td>CC</td><td>Confined Compression</td> <td>PL</td><td>Acceptable Point Load Test</td> </tr> <tr> <td>CL</td><td>Chloride Content</td> <td>ppm</td><td>parts per million of VOCs*</td> </tr> <tr> <td>CS</td><td>Consolidation</td> <td>R</td><td>Resistivity</td> </tr> <tr> <td>DS</td><td>Direct Shear</td> <td>RV</td><td>R-Value</td> </tr> <tr> <td>EI</td><td>Expansion Index</td> <td>SA</td><td>Sieve Analysis</td> </tr> <tr> <td>GS</td><td>Grain Size Analysis</td> <td>SE</td><td>Sand Equivalent</td> </tr> <tr> <td>LC</td><td>Laboratory Compaction</td> <td>SF</td><td>Sulfate</td> </tr> <tr> <td>pH</td><td>Hydrogen Ion</td> <td>SG</td><td>Specific Gravity</td> </tr> <tr> <td>PI</td><td>Plasticity Index</td> <td>SW</td><td>Swell</td> </tr> </table> <p><b>PENETRATION RESISTANCE (BLOWS/ft)</b></p> <p>Number of blows required to advance the sampler 1 foot.</p> <p>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.</p> <p><b>SAMPLE TYPE</b></p> <p><b>C ("California Sampler")</b> - 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.</p> <p><b>S ("SPT")</b> - a.k.a. Standard Penetration Test, an 18-inch-long, 2-inch O.D., 1-3/8-inch I.D. drive sampler.</p> <p><b>B ("Bulk")</b> - a.k.a. Bulk Sack Sample, a disturbed, but representative sample obtained from a specific depth interval placed in a large plastic bag.</p> <p><b>PB ("Plastic Bag")</b> - A disturbed, but representative sample obtained from a specific depth interval placed in a small sealable plastic bag.</p> <p><b>ROCK CORE</b></p> <p><b>Run No.:</b> Number of the individual coring interval, starting at the top of bedrock.</p> <p><b>Box No.:</b> Number of the core box that contains core from the corresponding run.</p> <p><b>Recovery, %:</b> Amount (in percent) of core recovered from the coring interval; calculated as the length of core recovered divided by the length of the run.</p>			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
CC	Confined Compression	PL	Acceptable Point Load Test																																													
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LC	Laboratory Compaction	SF	Sulfate																																													
pH	Hydrogen Ion	SG	Specific Gravity																																													
PI	Plasticity Index	SW	Swell																																													
			1																																													
			2																																													
			3																																													
15			4																																													

TCG\_METRIC\_LOG(2A)\_WELL\_2934LGN.D.GPJ\_GDCLOG.MT.GDT\_4/12/17



**TerraCosta Consulting Group, Inc.**  
 4455 Murphy Canyon Road, Suite 100  
 San Diego, California 92123

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 <b>LEGEND</b>	
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)		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										<b>KEY TO EXCAVATION LOGS</b> <b>(continued)</b>  <b><u>ROCK CORE, Continued</u></b>  <b>Frac. Freq.:</b> (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.  <b>R.Q.D., %:</b> (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.  <b><u>WELL CONSTRUCTION</u></b>  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  <b><u>Notes on Well Construction</u></b>  Wells consist of 2-inch PVC casing and screen. Surface completion is with a flush-mount traffic-rated cover and locking cap.  <b><u>NOTES ON FIELD INVESTIGATION</u></b>  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), California 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.			
30													
35													

TCG\_METRIC\_LOG(2A)\_WELL\_2934LGN.D.GPJ\_GDCLOGMT.GDT\_4/12/17



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**FIGURE A-1 b**

LOG OF TEST BORING										PROJECT NAME NORTH CITY CONVEYANCE SYSTEM		PROJECT NUMBER 2934		BORING <b>LEGEND</b>	
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										<p align="center"><b>KEY TO EXCAVATION LOGS</b> (continued)</p> <p><b>NOTES ON FIELD INVESTIGATION, Continued</b></p> <p>Free groundwater was encountered in the borings as shown on the logs.</p> <p>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.</p> <p>No evidence of contaminated soils were encountered at time of drilling.</p> <p>Borings were sealed with bentonite per state and local well standards.</p>					
50															
55															

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**FIGURE A-1 c**

LOG OF TEST BORING				PROJECT NAME NORTH CITY CONVEYANCE SYSTEM			PROJECT NUMBER 2934		BORING <b>B-1</b>		
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	DEPTH/ELEV. GROUND WATER (ft) ▼ n/a				
SAMPLING METHOD SPT				NOTES LOCATION: EASTGATE MALL. HOLE BACKFILLED/SEALED W/BENTONITE 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		
	370								TERRACE DEPOSITS (Qvop9) Silty to Fine Sandy CLAY (CL), stiff, light-brown, damp		
									Silty CLAY), hard, mottled gray / yellow-brown, damp		
5	365	S	1	55		20.7					
		PB	2				pH R CL SF GS				
10	360	S	3	72			PI		Silty SAND (SM), dense to very dense, mottled gray / red, damp		
15	355	S	4	72					Fine Sandy SILT (ML) to Silty Fine SAND (SM), hard, mottled gray / red, damp		
		S	5	95/9"			pH R CL SF GS		Boring terminated at depth of 19.5'. No free groundwater encountered.		

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**FIGURE A-2**



LOG OF TEST BORING				PROJECT NAME NORTH CITY CONVEYANCE SYSTEM			PROJECT NUMBER 2934		BORING <b>B-2</b>	
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								<u>FILL</u> <b>Sandy CLAY (CL)</b> , soft, gray, dry	
5	375	S	1	25		24.0			<u>TERRACE DEPOSITS (Qvop9)</u> <b>Fine Sandy SILT (ML) to Silty Fine SAND (SM)</b> , very stiff, mottled gray / red / yellow, damp	
10	370	S	2	40					<ul style="list-style-type: none"> <li>- Seepage at approx. 13 to 14.5 feet</li> <li>- Gray-brown color</li> </ul>	
15	365	S	3	40		22.0				
		S	4	67						
Boring terminated at depth of 19.5'. No free groundwater encountered.										


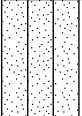
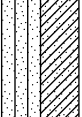
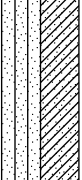
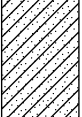
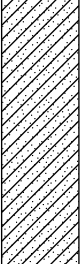

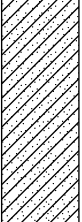
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**FIGURE A-3**

LOG OF TEST BORING				PROJECT NAME NORTH CITY CONVEYANCE SYSTEM			PROJECT NUMBER 2934		BORING <b>TB-1a</b>	
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								<b>FILL</b> <b>Clayey SAND to Sandy CLAY (SC-CL)</b> , loose to medium dense, gray to gray-brown, dry	
									<b>TERRACE DEPOSITS (Qvop9)</b> <b>Silty SAND (SM)</b> , medium dense, brown, damp	
5		PB	1			8.1	-200 PI GS		<b>Silty to Clayey SAND (SM-SC)</b> , medium dense, light brown to yellow brown, damp	
	380								<b>Silty SAND (SC)</b> , dense, yellow-brown to red-brown, damp	
10		PB	2			8.3			- Gravel and cobble layer approx 8" to 9" from 9.5 to 11 feet - Plastic bag sample recovered from 10 to 11 feet	
	375								- Mottled gray-brown to red-brown in color	
15		PB	3			12.2	-200		- Trace of gravel to approx 3/4"	
	370									

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**FIGURE A-4 a**

LOG OF TEST BORING				PROJECT NAME NORTH CITY CONVEYANCE SYSTEM			PROJECT NUMBER 2934		BORING <b>TB-1a</b>	
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	-200 PI GS		
25	360	PB	5			11.4				- 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 <b>TB-1b</b>	
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	
5	380	PB	1			7.9	-200 PI GS		<u>FILL</u> <b>Silty to Clayey SAND (SM-SC)</b> , loose to medium dense, gray to gray-brown, dry to damp, with gravel and cobble approx 10% to 9"	
									<u>TERRACE DEPOSITS (Qvop9)</u> <b>Silty to Clayey SAND (SM-SC)</b> , medium dense, light brown, damp, with occasional gravel to approx 3/4"	
10	375	PB	2				-200		- Gravel and cobble to 9" from 9 to 10 feet  - Becomes mottled gray-brown / red-brown in color	
15	370	PB	3			9.9	-200 PI			
									- Cemented zone	
	365									

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**FIGURE A-5 a**

LOG OF TEST BORING				PROJECT NAME NORTH CITY CONVEYANCE SYSTEM			PROJECT NUMBER 2934		BORING <b>TB-1b</b>	
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	
25	360	PB	4							
		PB	5						<ul style="list-style-type: none"> <li>- Becomes moist, gray in color</li> <li>- Occasional cemented zones</li> <li>- Hard drilling; cemented zone from 27.75 to 29.75 feet</li> </ul>	
30	355	PB	6						<p><b>Silty SAND (SM)</b>, medium dense, gray, damp</p>	
									<p><i>Boring terminated at depth of 31 feet. No free groundwater encountered at time of excavation.</i></p>	
	350									
	345									

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**FIGURE A-5 b**

LOG OF TEST BORING				PROJECT NAME NORTH CITY CONVEYANCE SYSTEM			PROJECT NUMBER 2934		BORING <b>B-3</b>	
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	
5	385	S	1	50/6"		16.7	-200 PI GS		<u>FILL</u> <b>Sandy CLAY to Clayey SAND (SC-CL)</b> , loose, gray to gray-brown, dry, with gravel approx 15% to 3/4"	
									<u>RESIDUUM</u> <b>Sandy CLAY (CL)</b> , very stiff, red-brown, dry to damp	
									- Becomes gray-brown with gravel - Very hard drilling; cemented zone <u>TERRACE DEPOSITS (Qvop9)</u> <b>Silty CLAY (CL)</b> , hard, light brown, dry to damp, calcium carbonate cementation	
									<b>SAND (SM)</b> , dense, gray-brown to gray, damp	
10	380	S	2	43		9.6	-200		- Gravels to 1"	
									<b>Silty SAND (SM)</b> , very dense, mottled red-brown / gray, damp	
15	375	PB	3			9.3	-200 PI GS		- Gravels to 1"	
									<b>Silty SAND (SM)</b> , very dense, mottled red-brown / gray, damp	
	370	S	4	50						

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**FIGURE A-6 a**

LOG OF TEST BORING				PROJECT NAME NORTH CITY CONVEYANCE SYSTEM			PROJECT NUMBER 2934		BORING <b>B-3</b>	
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			
25	365	S	7	93/10"					- Cemented gravels to approx 2"	
									- Gravels to approx 1"	
30	360	S	8	70/9"						
									Boring terminated at depth of 31.5 feet. No free groundwater encountered at time of excavation.	
	355									
35										
	350									

TCG\_METRIC\_LOG(3) 2934.GPJ GDCLOGMT.GDT 4/12/17












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**FIGURE A-6 b**



LOG OF TEST BORING			PROJECT NAME NORTH CITY CONVEYANCE SYSTEM			PROJECT NUMBER 2934		BORING <b>B-4</b>	
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
									<u>BASE</u> Sandy GRAVEL (GW), olive-gray, damp
	395								<u>TERRACE DEPOSITS (Qvop9)</u> Sandy CLAY (CL/CH), hard, olive-brown, damp, with gravel approx 10% to 1"
5		S	1	35/5"					- On rock, no recovery 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								

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**FIGURE A-7 a**

<b>LOG OF TEST BORING</b>				PROJECT NAME NORTH CITY CONVEYANCE SYSTEM			PROJECT NUMBER 2934		BORING <b>B-4</b>	
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	
	375	S	4	42						
	25	C	5	50/6"					<p><i>Boring terminated at depth of 25.5 feet. No free groundwater encountered at time of excavation.</i></p>	
	370									
	30									
	365									
	35									
	360									
								<p>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.</p>		
								<p><b>FIGURE A-7 b</b></p>		

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# LOG OF TEST BORING

<b>PROJECT NAME</b> NORTH CITY CONVEYANCE SYSTEM		<b>PROJECT NUMBER</b> 2934	<b>BORING</b> <b>B-5</b>
<b>SITE LOCATION</b> San Diego		<b>START</b> 11/7/2016	<b>FINISH</b> 11/7/2016
<b>DRILLING COMPANY</b> Pacific Drilling		<b>DRILLING METHOD</b> Hollow Stem Auger	<b>LOGGED BY</b> G. Spaulding
<b>DRILLING EQUIPMENT</b> Marl M5		<b>BORING DIA. (in)</b> 8	<b>TOTAL DEPTH (ft)</b> 21.5
		<b>GROUND ELEV (ft)</b> 402	<b>DEPTH/ELEV. GROUND WATER (ft)</b> ▼ n/a

<b>SAMPLING METHOD</b> SPT	<b>NOTES</b> LOCATION: MIRAMAR ROAD. BORING SEALED PER COUNTY/STATE WELL STANDARDS.
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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
	400								<u>BASE</u> Sandy GRAVEL (GW), olive-gray, damp
									TERRACE DEPOSITS (Qvop9) Sandy CLAY (CL), very stiff to hard, gray-brown, damp, and Clayey SAND (SC), dense, red-brown, damp, with gravels
5		S	1	77		6.4	-200 PI GS		Clayey SAND (SC), very dense, yellow-brown, dry, with gravel approx 10% to 1"  - Increased gravel to approx 20% - Becomes gray-brown
	395								
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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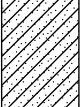
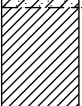




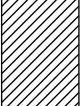







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**FIGURE A-8 a**

<b>LOG OF TEST BORING</b>				PROJECT NAME NORTH CITY CONVEYANCE SYSTEM			PROJECT NUMBER 2934		BORING <b>B-5</b>	
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 <b>Clayey SAND (SC)</b>	
	380								Boring terminated at depth of 21.5 feet. No free groundwater encountered at time of excavation.	
	25									
	375									
	30									
	370									
	35									
	365									
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								<b>FIGURE A-8 b</b>		

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LOG OF TEST BORING				PROJECT NAME NORTH CITY CONVEYANCE SYSTEM			PROJECT NUMBER 2934		BORING <b>B-6</b>	
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"	
5	400	S	1	8		12.2			Sandy CLAY (CL), stiff, dark gray, moist, with occasional gravel	
									- Organic smell	
10	395	PB	2						- 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"	
									- Becomes brown-gray	
15	390	S	3	30/16"					pH	
									CL	
									SF	
									GS	
									-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>B-6</b>	
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	
		⊄	4	49					- Poor recovery; rock in sampler	
	380	PB	5						Sandy CLAY (CL), stiff, mottled gray, yellow-brown, moist	
25		⊄	6	8					Silty SAND (SM), dense, gray / gray-brown, damp to moist	
	375									
	30	⊄	7	30					Boring terminated at depth of 31.5 feet. No free groundwater encountered at time of excavation.	
	370									
	35									
	365									

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**FIGURE A-9 b**

LOG OF TEST BORING				PROJECT NAME NORTH CITY CONVEYANCE SYSTEM			PROJECT NUMBER 2934		BORING <b>B-21</b>		
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	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION		
									2" Asphalt Concrete / Class II Base		
									<u>BASE</u> Gravelly SAND (SP-SM), medium dense, olive-gray, damp		
									<u>FILL</u> Silty SAND (SM???) , medium dense, olive-gray to yellow-brown, damp, with gravel approx 10%		
5	415	B	1			24.7	-200 PI		<u>RESIDUUM</u> Sandy CLAY (CL-CH), medium stiff, olive-gray, moist  - Gravel & cobble to 6"		
		PB	2						<u>TERRACE DEPOSITS (Qvop8)</u> Sandy CLAY (CL), hard, red-brown to light brown, dry  - Cemented zone from 5.5 to 8 feet; harder drilling; cemented with calcium carbonate		
10	410	B	3				pH R CL SF GS		Silty to Clayey SAND (SM-SC), very dense, red-brown, dry, with gravel approx 30% to 1.5" and occasional cobble to 4"  - Becomes damp  - Occasional cobble to 6"		
15	405								Silty to Clayey SAND (SM-SC), dense, light red-brown, damp, with occasional gravel and cobble to 8"		
	400	B	4			23.3	-200 PI		Fine Sandy SILT (SM-ML), dense, light brown, moist		

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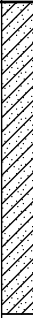



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**FIGURE A-10 a**



<b>LOG OF TEST BORING</b>				PROJECT NAME NORTH CITY CONVEYANCE SYSTEM			PROJECT NUMBER 2934		BORING <b>B-21</b>				
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				
25	395	B	5						Clayey SAND (SC), stiff, light brown, moist				
									<i>Boring terminated at depth of 25 feet. No free groundwater encountered at time of excavation.</i>				
30	390												
35	385												
	380												
								 <b>TerraCosta Consulting Group, Inc.</b> 3890 Murphy Canyon Road, Suite 200 San Diego, California 92123		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.		<b>FIGURE A-10 b</b>	

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LOG OF TEST BORING				PROJECT NAME NORTH CITY CONVEYANCE SYSTEM			PROJECT NUMBER 2934		BORING <b>B-7</b>	
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	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION	
									9" Asphalt Concrete	
									<u>FILL</u> <b>Sandy CLAY (CL-CH)</b> , stiff, mottled red-brown, damp	
5	420	S	1	60/10"		5.8	-200 PI GS		<u>TERRACE DEPOSITS (Qvop9)</u> <b>Sandy CLAY (CL)</b> , very stiff to hard, red-brown, dry, with gravels approx 10%	
		B	2			6.9	-200 GS		- Sampler on rock	
10	415	C	3	72/7"					<b>Sandy CLAY (CL)</b> , hard, gray to brown gray, dry, cemented calcium carbonate	
									- On rock	
									- Gravels 10% to 1"	
15	410	S	4	30/4"					- On rock	
		PB	5						- Very hard drilling on gravel and cobble	
	405						pH R CL SF GS			

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**FIGURE A-11 a**

LOG OF TEST BORING				PROJECT NAME NORTH CITY CONVEYANCE SYSTEM			PROJECT NUMBER 2934		BORING <b>B-7</b>	
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					<b>Sandy CLAY (CL)</b> , hard, yellow-brown, damp	
25		S	7	30/3"					- On rock; no recovery	
	395	PB	8						<b>Sandy CLAY (CL)</b> , very stiff, olive-gray, damp	
30		S	9	50/4"					- Very hard drilling in gravels	
	390							Boring terminated at depth of 30.5 feet. No free groundwater encountered at time of excavation.		
	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>B-8</b>		
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	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION		
	415								9" Asphalt Concrete		
									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		S	1	28		11.9			Silty SAND (SM), medium dense, mottled gray / orange, damp		
	410										
		PB	2						Becomes Clayey SAND to Sandy CLAY (SC-CL), with gravel approx 15% to 1.5"		
10		S	3	52		5.7			Sandy GRAVEL (GP-GW), very dense, gray, dry to damp		
	405								Sandy CLAY (CL), hard, olive-gray to yellow-brown, damp to moist, with gravel approx 25% to 1.5"		
		S	4	52					- Gravels		
	400										

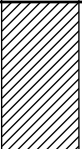
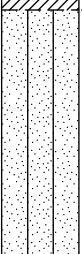
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**FIGURE A-12 a**

<b>LOG OF TEST BORING</b>				PROJECT NAME NORTH CITY CONVEYANCE SYSTEM			PROJECT NUMBER 2934		BORING <b>B-8</b>	
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	
	395	S	5	86/10"					- Gravels; poor recovery	
25	390	S	6	60					Silty SAND (SM), very dense, mottled gray / yellow-brown, damp with occasional gravels	
30	385								Boring terminated at depth of 26.5 feet. No free groundwater encountered at time of excavation.	
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>B-9</b>	
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	
	430								9" Asphalt Concrete	
									<u>FILL</u> <b>Sandy GRAVEL (GP)</b> , dense, olive-gray, damp	
									<b>Sandy CLAY (CL)</b> , stiff, olive-brown, damp	
5	425	S	1	57/11"		7.1			<u>TERRACE DEPOSITS (Qvop8)</u> <b>Sandy CLAY (CL)</b> , hard, light brown, dry, with occasional gravel	
10	420	S	2	28		13.1				
15	415	S	4	26		15.7			- Iron oxide staining	


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**FIGURE A-13 a**

<h1 style="margin: 0;">LOG OF TEST BORING</h1>				PROJECT NAME NORTH CITY CONVEYANCE SYSTEM			PROJECT NUMBER 2934		BORING <b>B-9</b>	
				SITE LOCATION San Diego			START 11/7/2016		FINISH 11/8/2016	
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	
	410	S	5	47					<p>- Gravel approx 10% to 3/4"</p> <hr/> <p><i>Boring terminated at depth of 21.5 feet. No free groundwater encountered at time of excavation.</i></p>	
25	405									
30	400									
35	395									

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**FIGURE A-13 b**



LOG OF TEST BORING				PROJECT NAME			PROJECT NUMBER		BORING	
San Diego				NORTH CITY CONVEYANCE SYSTEM			2934		B-10	
SITE LOCATION				START		FINISH		SHEET NO.		
Pacific Drilling				11/8/2016		11/8/2016		1 of 2		
DRILLING COMPANY				DRILLING METHOD			LOGGED BY		CHECKED BY	
Marl M5				Hollow Stem Auger			G. Spaulding			
DRILLING EQUIPMENT				BORING DIA. (in)		TOTAL DEPTH (ft)		GROUND ELEV (ft)		DEPTH/ELEV. GROUND WATER (ft)
SPT				8		25.5		432		▼ 15.0 / 417.0
SAMPLING METHOD				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								<u>BASE</u> Gravelly SAND (SP-SW), dense, olive-gray, damp	
									<u>FILL</u> 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								<u>ALLUVIUM</u> 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		S	3	24					- Heavy seepage STADIUM CONGLOMERATE (Tst) Sandy GRAVEL (GP), medium dense, gray, wet, gravel to approx 1 1/2"	
	415								- Very hard drilling with gravels	


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FIGURE A-14 a

LOG OF TEST BORING				PROJECT NAME NORTH CITY CONVEYANCE SYSTEM			PROJECT NUMBER 2934		BORING <b>B-10</b>	
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	
410		S	4	54/8"		15.7			Interbedded <b>Sandy GRAVEL (GP) and Gravelly SAND (SP)</b> , very dense, gray, moist, rocks to approx 1½"	
25		S	5	24/5"					- On rock	
405									Boring terminated at depth of 25.5 feet. Groundwater encountered at depth of 15 feet at time of excavation.	
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>B-11</b>		
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		
									TERRACE DEPOSITS (Q <sub>vop7</sub> ) Sandy CLAY (CL), stiff, red-brown, damp to moist		
5	440	S	1	38		10.9	-200 PI GS		Sandy CLAY (CL), dense, mottled gray / red / red-brown, damp, with gravel approx 15% to 1½"		
10	435	PB	2				pH R CL SF GS		- On rock; no sample - Hard drilling in gravels to approx 1"		
15	430	PB	3						Sandy CLAY to Clayey SAND (SC-CL), hard, red-brown, damp, with gravel approx 10% to 1"		

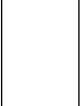

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**FIGURE A-15 a**

<b>LOG OF TEST BORING</b>			PROJECT NAME NORTH CITY CONVEYANCE SYSTEM			PROJECT NUMBER 2934		BORING <b>B-11</b>	
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
	425	U	4	50/6"					Boring terminated at depth of 20.5 feet. No free groundwater encountered at time of excavation.
	25								
	420								
	30								
	415								
	35								
	410								
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								FIGURE A-15 b	

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LOG OF TEST BORING				PROJECT NAME NORTH CITY CONVEYANCE SYSTEM			PROJECT NUMBER 2934		BORING <b>B-12</b>	
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	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION	
									12" Asphalt Concrete	
	470								<u>BASE</u> Gravelly SAND (SP-SM), dense, olive-gray, damp	
									<u>TERRACE DEPOSITS (Q<sub>vop7</sub>)</u> 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	
	460								Sandy CLAY (CL-CH), hard, olive-brown, damp	
									- Becomes red-brown with gravel approx 10% to 1"	
15		S PB	4 5	22/3"					- On rocks	
	455									
		S	6	50/5"					- No recovery	


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**FIGURE A-16 a**

<b>LOG OF TEST BORING</b>			PROJECT NAME NORTH CITY CONVEYANCE SYSTEM			PROJECT NUMBER 2934		BORING <b>B-12</b>		
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	
	450								<p>Boring terminated at depth of 20 feet. No free groundwater encountered at time of excavation.</p>	
	25									
	445									
	30									
	440									
	35									
	435									
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LOG OF TEST BORING				PROJECT NAME NORTH CITY CONVEYANCE SYSTEM			PROJECT NUMBER 2934		BORING <b>B-13</b>	
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	
									<u>BASE</u> 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	C	3	50/6"	122.9	4.8	PI		- Gravel to 1.5"	
		PB	4						Sandy CLAY (CL-CH), very stiff to hard, red-brown, moist	
15	480	S	5	30						
		S	6	46			-200 GS			
									Boring terminated at depth of 19.5'. No free groundwater encountered.	

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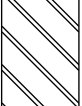
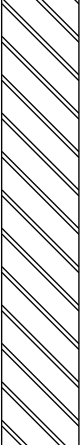

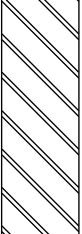




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**FIGURE A-17**



LOG OF TEST BORING				PROJECT NAME NORTH CITY CONVEYANCE SYSTEM			PROJECT NUMBER 2934		BORING <b>B-14</b>		
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		
	455								5" Asphalt Concrete <u>BASE</u> Gravelly SAND (SP-SM), dense, olive-gray, damp		
5	450	S	1	48					FILL (derived from Stadium Conglomerate) Sandy CLAY (CL-CH), very stiff to hard, yellow-brown, dry, with gravel approx 15% to 1"		
	445	S	2	32					- Gravels		
	440	PB	3				pH R CL SF GS		Sandy CLAY (CL-CH), very stiff, red-brown, damp, with gravel approx 10% to 1"		
15		S	4	18					- No recovery; rock in sampler		
		S	5	18					Boring terminated at depth of 19.5'. Groundwater encountered at 19'.		

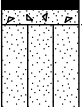
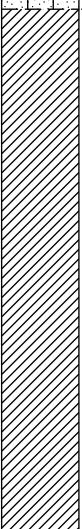
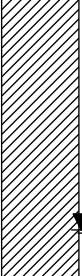

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**FIGURE A-18**

LOG OF TEST BORING				PROJECT NAME		PROJECT NUMBER		BORING	
San Diego				NORTH CITY CONVEYANCE SYSTEM		2934		TB-5a	
SITE LOCATION				START		FINISH		SHEET NO.	
Pacific Drilling				1/10/2017		1/10/2017		1 of 2	
DRILLING COMPANY				DRILLING METHOD		LOGGED BY		CHECKED BY	
Marl M5				Hollow Stem Auger		G. Spaulding			
DRILLING EQUIPMENT				BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/ELEV. GROUND WATER (ft)		
SPT				8	36	437	▼ 15.0 / 422.0		
SAMPLING METHOD				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
									3.5" AC / 6.5" Class II Base
	435								FILL Silty SAND (SM), medium dense, gray, damp, with approximately 20% gravel
5		S	1	15					Sandy CLAY (CL), stiff to very stiff, mottled olive-gray / brown / dark gray, moist, with approximately 10-15% gravel
	430								- Becomes olive-brown in color
10		S	2	10					
	425								- Seepage
15		S	3	47					STADIUM CONGLOMERATE (Tst) Clayey SAND (SC), dense, olive-gray, damp, with approximately 15% gravel up to 2"
	420								

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FIGURE A-19 a

LOG OF TEST BORING				PROJECT NAME NORTH CITY CONVEYANCE SYSTEM			PROJECT NUMBER 2934		BORING <b>TB-5a</b>	
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	
415		S	4	50/6"					<b>Clayey SAND (SC)</b> , very dense, mottled yellow-brown / yellow / light brown, damp, with approximately 30% gravel up to 2"  - Gravels and cobbles up to +6"  * On rock; no sample  - Hard drilling on rock; gravel and cobbles  * Gravels and cobble; no sample  - Very hard drilling from 32 to 36 feet	
25		S	*						<i>Boring terminated at depth of 36 feet due to refusal. Groundwater seepage encountered at depth of 15 feet at time of excavation.</i>	
410		S	*							
30		S	*							
405										
35										
400										

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**FIGURE A-19 b**

LOG OF TEST BORING				PROJECT NAME NORTH CITY CONVEYANCE SYSTEM			PROJECT NUMBER 2934		BORING <b>TB-5b</b>	
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	
									3 1/2" AC / 4" Class II Base	
	440								<u>STADIUM CONGLOMERATE (Tst)</u> <b>Silty to Clayey SAND (SC-SM)</b> , very dense, yellow-brown to light brown, damp, with approximately 30% gravel and cobbles  - Very hard drilling - Sampler on rock	
5		PB	1							
	435									
10		PB	2							
	430								<u>Interbedded Silty SAND to Clayey SAND (SM-SC) and Sandy GRAVELS (GP-GW)</u> , very dense, yellow-brown to light olive-brown, dry to damp	
15										
	425								<u>WEATHERED SANTIAGO PEAK METAVOLCANICS (Mzu)</u> <b>Sandy CLAY (CL-CH)</b> , very stiff to hard, olive-brown, damp to moist, with occasional metavolcanic rock chips	

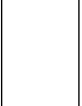
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**FIGURE A-20 a**

LOG OF TEST BORING				PROJECT NAME NORTH CITY CONVEYANCE SYSTEM			PROJECT NUMBER 2934		BORING <b>TB-5b</b>	
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						- Very hard drilling <i>Boring terminated at depth of 22 feet due to refusal.            No free groundwater encountered at time of excavation.</i>	
	420	PB	4							
25										
	415									
30										
	410									
35										
	405									

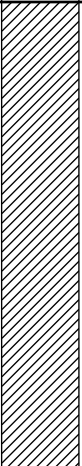
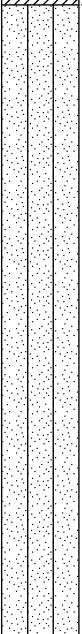
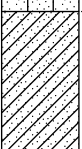
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**FIGURE A-20 b**

LOG OF TEST BORING				PROJECT NAME NORTH CITY CONVEYANCE SYSTEM			PROJECT NUMBER 2934		BORING <b>TB-2a</b>	
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	
5	470	S	1	18		11.4	PI		<u>FILL</u> <b>Sandy CLAY (CL)</b> , medium stiff to very stiff, brown to gray-brown, damp, with occasional gravel to 1"	
10	465	S	2	80/11"			-200		<u>TERRACE DEPOSITS (Qvop6)</u> <b>Silty SAND (SM)</b> , very dense, red-brown, dry to damp, with occasional gravel and cobble to 6"	
15	460	S	3	39		-6.0	PI		- Hard drilling on gravel and cobble <u>STADIUM CONGLOMERATE (Tst)</u> <b>Clayey SAND Matrix (SC)</b> , very dense, light gray-brown, dry	
	455									

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**FIGURE A-21 a**

LOG OF TEST BORING				PROJECT NAME NORTH CITY CONVEYANCE SYSTEM			PROJECT NUMBER 2934		BORING <b>TB-2a</b>		
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		
		PB	4			4.2	-200		- Very hard drilling in gravel and cobble		
25	450	S	5	50/4"							
	445	PB	6								
30											
	440	PB	7								
							pH R CL SF GS			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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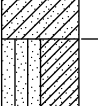



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**FIGURE A-21 b**



LOG OF TEST BORING				PROJECT NAME			PROJECT NUMBER		BORING	
San Diego				NORTH CITY CONVEYANCE SYSTEM			2934		TB-2b	
SITE LOCATION				START		FINISH		SHEET NO.		
Pacific Drilling				2/9/2017		2/9/2017		1 of 3		
DRILLING COMPANY				DRILLING METHOD			LOGGED BY		CHECKED BY	
Earth Drill				Bucket Auger			G. Spaulding			
DRILLING EQUIPMENT				BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/ELEV. GROUND WATER (ft)			
Grab				24	59	509	n/a			
SAMPLING METHOD				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	
5	505	PB	1						<u>TOPSOIL/TERRACE DEPOSITS</u> <b>Clayey SAND (SC)</b> , loose to dense, brown to red-brown, moist to damp, with gravel and cobble ~20% to 6"	
10	500	PB	2						<u>STADIUM CONGLOMERATE</u> <b>Silty to Clayey SAND (SM-SC)</b> , very dense, mottled light brown/gray, damp, trace of gravel  - with 20% gravels to 2"  - ~30% gravel and cobble to 8"	
15	495									
	490									

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FIGURE A-22 a

# LOG OF TEST BORING

PROJECT NAME NORTH CITY CONVEYANCE SYSTEM		PROJECT NUMBER 2934	BORING <b>TB-2b</b>
SITE LOCATION San Diego		START 2/9/2017	FINISH 2/9/2017
DRILLING COMPANY Pacific Drilling		DRILLING METHOD Bucket Auger	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						
25	485	PB	4						<b>Silty to clayey SAND (SM-SC)</b> , very dense, light brown, damp
30	480								<b>Silty SAND (SC)</b> , very dense, light brown, damp, with gravel and cobble to ~6", 20%
35	475								- becomes moist
	470	PB	5						<b>Silty to Clayey SAND (SM-SC)</b> , very dense, light brown to red-brown, damp to moist, with trace of gravel

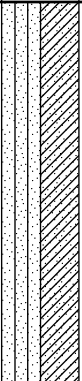
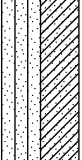
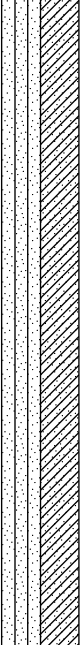

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**FIGURE A-22 b**

LOG OF TEST BORING				PROJECT NAME NORTH CITY CONVEYANCE SYSTEM			PROJECT NUMBER 2934		BORING <b>TB-2b</b>	
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	
45	465	B	6						- trace of gravel	
50	460								<ul style="list-style-type: none"> <li>- harder drilling</li> <li>- with gravel and cobble to 10" ~40 to 50%</li> <li>- switched to auger to drill</li> <li>- becomes light brown to olive-brown in color</li> </ul>	
55	455								- very hard drilling in gravel and cobble ~40% to 8"±	
	450	B	7						<i>Boring terminated at depth of 59 feet due to refusal. No free groundwater encountered at time of excavation.</i>	

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**FIGURE A-22 c**

LOG OF TEST BORING				PROJECT NAME NORTH CITY CONVEYANCE SYSTEM			PROJECT NUMBER 2934		BORING <b>B-15</b>	
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	
	500								<u>TOPSOIL/TERRACE DEPOSITS</u> <b>Silty SAND (SM)</b> , loose to medium dense, red-brown, damp	
5		PB	1						<u>STADIUM CONGLOMERATE</u> <b>Silty SAND (SM)</b> , dense, light brown to yellow-brown, damp, with gravel and cobble to 4" 20 - 40%  - becomes dense, yellow-brown, damp, with trace of gravel  - occasional cobbles to 8"	
	495									
10										
	490								- hard drilling; switched to auger	
15		PB	2						<b>Silty SAND (SM)</b> , very dense, yellow-brown to light brown, moist, with gravel and cobble to 10" ~10%	
	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
480			4						- hard drilling in gravel, cobble, and occasional boulders
25									Boring terminated at depth of 24.5 feet. No free groundwater encountered at time of excavation.
475									
30									
470									
35									
465									

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FIGURE A-23 b

LOG OF TEST BORING				PROJECT NAME NORTH CITY CONVEYANCE SYSTEM			PROJECT NUMBER 2934		BORING <b>B-16</b>		
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		
									<u>BASE</u> <b>Gravelly SAND (SP-SW)</b> , dense, olive-gray, damp		
									<u>FILL</u> <b>Silty SAND (SM)</b> , dense, light brown, damp to moist, with gravel approx 15% to 2"		
5	495	PB	1				-200 GS		- Refusal on rock; hard drilling		
		S	2	33		11.5	-200 GS		<u>TERRACE DEPOSITS (Qvop5)</u> <b>Silty to Clayey SAND (SM-SC)</b> , 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				




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**FIGURE A-24 a**

<h1>LOG OF TEST BORING</h1>			PROJECT NAME NORTH CITY CONVEYANCE SYSTEM			PROJECT NUMBER 2934		BORING <b>B-16</b>			
			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										
 <b>TerraCosta Consulting Group, Inc.</b> 3890 Murphy Canyon Road, Suite 200 San Diego, California 92123									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.		<b>FIGURE A-24 b</b>

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LOG OF TEST BORING				PROJECT NAME		PROJECT NUMBER		BORING	
San Diego				NORTH CITY CONVEYANCE SYSTEM		2934		B-17	
SITE LOCATION				START		FINISH		SHEET NO.	
Pacific Drilling				11/16/2016		11/16/2016		1 of 2	
DRILLING COMPANY				DRILLING METHOD		LOGGED BY		CHECKED BY	
Marl M5				Hollow Stem Auger		G. Spaulding			
DRILLING EQUIPMENT				BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/ELEV. GROUND WATER (ft)		
SPT				8	20	498	n/a		
SAMPLING METHOD				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
									7" Asphalt Concrete
									BASE Silty SAND (SP-SW), medium dense, red-brown, damp, with gravel approx 40% to 3/4"
5	495	S	1	10		13.0	-200 PI GS		TERRACE DEPOSITS (Qvop5) Sandy CLAY (CL), stiff, brown to gray-brown, moist, with gravel approx 15% to 1.5"
	490								- Hard drilling
10		PB	2				pH R CL SF GS		STADIUM CONGLOMERATE (Tst) Silty to Clayey SAND matrix (SM-SC), very dense, gray to gray-brown, damp, gravel and cobble conglomerate
	485								
15									
	480	PB	3			3.5			


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FIGURE A-25 a

<b>LOG OF TEST BORING</b>			PROJECT NAME NORTH CITY CONVEYANCE SYSTEM			PROJECT NUMBER 2934		BORING <b>B-17</b>			
			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		
25	475								<p><i>Boring terminated at depth of 20 feet due to practical refusal. No free groundwater encountered at time of excavation.</i></p>		
	470										
30											
	465										
35											
	460										
 <b>TerraCosta Consulting Group, Inc.</b> 3890 Murphy Canyon Road, Suite 200 San Diego, California 92123									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.		<b>FIGURE A-25 b</b>

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LOG OF TEST BORING				PROJECT NAME NORTH CITY CONVEYANCE SYSTEM			PROJECT NUMBER 2934		BORING <b>B-18</b>	
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	
	520								6" Asphalt Concrete	
									<u>BASE</u> Silty SAND (SP-SW), medium dense, red-brown, damp	
5	515	S	1	15					<u>FILL</u> Clayey SAND (SC), medium dense, mottled red-brown / gray-brown, damp, with occasional gravel to 1.5'	
10	510	S	2	42			pH R CL SF GS		<u>TERRACE DEPOSITS (Qvop4)</u> Silty to Clayey SAND (SM), dense, olive-gray to gray, damp, with gravel approx 20% to 2"	
15	505	S	3	40		9.1	-200		<u>WEATHERED METAVOLCANIC ROCK (Mzu)</u> Sandy CLAY (CL), hard, gray to blue-gray, damp, with gravel	

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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		S	4	25/4"		8.5			- Sampler on rock Boring terminated at depth of 21.33 feet. No free groundwater encountered at time of excavation.
25	495								
30	490								
35	485								

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FIGURE A-26 b

LOG OF TEST BORING				PROJECT NAME NORTH CITY CONVEYANCE SYSTEM			PROJECT NUMBER 2934		BORING <b>B-19</b>	
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	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION	
	570							6" Asphalt Concrete		
								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		
5	565	S	1	30		10.9		TERRACE DEPOSITS (Qvop4) Sandy CLAY (CL), very stiff, light brown to gray-brown, moist, with occasional gravel to 2"		
10	560	S	2	32						
15	555	PB	3				GS			
		S	4	31		11.8	-200 GS			

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**FIGURE A-27 a**

<h1 style="margin: 0;">LOG OF TEST BORING</h1>				PROJECT NAME NORTH CITY CONVEYANCE SYSTEM			PROJECT NUMBER 2934		BORING <b>B-19</b>	
				SITE LOCATION San Diego			START 11/16/2016		FINISH 11/16/2016	
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						
25	545	PB	6						- Gravels to 1" from 23 to 23.5 feet	
30	540								Boring terminated at depth of 30 feet. No free groundwater encountered at time of excavation.	
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>B-20</b>		
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		
									<u>FILL</u> <b>Clayey SAND (SC)</b> , loose, gray to gray-brown, dry to damp, with gravel and cobble approx 30% to 8"		
5	620	S	1	19			GS		<u>STADIUM CONGLOMERATE (Tst)</u> <b>Sandy CLAY (CL)</b> , stiff, mottled gray-brown / yellow-brown, moist, with gravel and cobble approx 30% to 4"		
10	615	PB	2				GS PI		- Hard drilling on rocks  <b>Sandy CLAY (CL)</b> , stiff, mottled yellow-brown / brown, moist, with gravel to approx 1.5"		
15	610	S	3	63/10"		12.0			<u>WEATHERED METAVOLCANIC ROCK (Mzu)</u> <b>Sandy CLAY (CL)</b> , stiff, gray to blue-gray, moist, with gravel		
		PB	4						- Very hard drilling <i>Boring terminated at depth of 18 feet.</i> <i>No free groundwater encountered at time of excavation.</i>		

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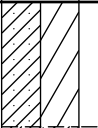









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**FIGURE A-28**



LOG OF TEST BORING				PROJECT NAME NORTH CITY CONVEYANCE SYSTEM			PROJECT NUMBER 2934		BORING <b>B-20a</b>		
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		
	630		1	9		13.4	PI -200		<b>FILL</b> <b>Clayey Fine SAND to Sandy Clay (SC-CL)</b> , medium stiff to stiff, olive-brown, moist		
5			2	26					<b>Sandy CLAY (CL) and Clayey SAND (SC)</b> , stiff to very stiff, mottled yellow-brown / brown / gray-brown, damp, with approximately 15% to 1½" gravel  - Hard drilling - gravel and cobbles		
10	625		3	32					<b>Sandy CLAY (CL) and Clayey SAND (SC)</b> , very stiff, mottled yellow-brown / brown, damp to moist, with gravel and cobbles  - Harder drilling on rocks		
	620								<b>Sandy CLAY (CL-CH)</b> , very stiff, dark gray, moist, organic smell		
15			4	28					<b>Sandy CLAY (CL) and Clayey SAND (SC)</b> , very stiff, mottled yellow-brown / brown, damp to moist, with gravel and cobbles  - Harder drilling on rocks		
	615		5	19					<b>Sandy CLAY (CL) and Clayey SAND (SC)</b> , very stiff, mottled yellow-brown / brown, damp to moist, with gravel and cobbles  - Harder drilling on rocks		

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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 <b>TB-4a</b>	
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	
5	660	PB	1						<b>STADIUM CONGLOMERATE</b> <b>Sandy CLAY (CL)</b> , very stiff to hard, yellow to yellow-brown, damp, with gravel approximately 10-20%  - Occasional cobbles and boulder to 12"  - Cobbles and gravel	
10	655	S	2	3" on rock					becomes <b>Clayey SAND (SC)</b> , olive-gray  - Cobbles  - Plastic bag sampled recovered from 10 to 12 feet  - Hard drilling on cobbles/boulder	
15	650	PB	3							
	645	S	4	68/8"					- On rock  - Gravel and cobbles from 18 to 20 feet	

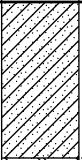
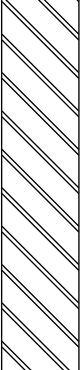
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**FIGURE A-30 a**

LOG OF TEST BORING				PROJECT NAME NORTH CITY CONVEYANCE SYSTEM			PROJECT NUMBER 2934		BORING <b>TB-4a</b>		
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		
640		PB	5						- Very hard drilling <b>SANTIAGO PEAK METAVOLCANICS (Mzu)</b> <b>Sandy CLAY (CL/CH)</b> , very dense, yellow-brown to olive, damp, with small volcanic rock chips		
25		PB	6						Boring terminated at depth of 28.5 feet due to refusal. No free groundwater encountered at time of excavation.		
30											
630											
35											
625											

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**FIGURE A-30 b**

<b>LOG OF CORE BORING</b>		<b>PROJECT NAME</b> North City Conveyance System	<b>PROJECT NUMBER</b> 2934	<b>BORING</b> <b>TB-4b</b>
<b>SITE LOCATION</b> San Diego, CA		<b>DATE(S) DRILLED</b> 12/1 to 12/1	<b>LOGGED BY</b> G. Spaulding	<b>SHEET NO.</b> 1 of 5
<b>DRILLING METHOD</b> Triple Tube Core		<b>DRILL BIT SIZE/TYPE</b> HQ	<b>CHECKED BY</b>	<b>TOTAL DEPTH DRILLED (feet)</b> 110
<b>DRILL RIG TYPE</b> LF 70		<b>DRILLED BY</b> Ruen Drilling	<b>INCLINATION FROM VERTICAL/BEARING</b> 0	
<b>APPARENT GROUNDWATER DEPTH (feet)</b> Groundwater measured at 90.0 feet below ground surface (2/8/2017)			<b>APPROXIMATE SURFACE ELEVATION (feet)</b> 725	
<b>COMMENTS</b> Location - Miramar Lake			<b>BOREHOLE BACKFILL</b> 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., %									
5	720								<b>FILL</b> Sandy CLAY to Clayey SAND (SC-CL), medium dense, mottled olive-gray / brown, damp, with gravel and cobbles						
		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			<b>STADIUM CONGLOMERATE</b> 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						

TCG\_CORE\_LOG\_FT-2\_2934CORE.GPJ ROCK.GDT 4/12/17



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**FIGURE A-31 a**

<b>LOG OF CORE BORING</b>		<b>PROJECT NAME</b> North City Conveyance System	<b>PROJECT NUMBER</b> 2934	<b>BORING</b> <b>TB-4b</b>
<b>SITE LOCATION</b> San Diego, CA		<b>DATE(S) DRILLED</b> 12/1 to 12/1	<b>LOGGED BY</b> G. Spaulding	<b>SHEET NO.</b> 2 of 5
<b>DRILLING METHOD</b> Triple Tube Core		<b>DRILL BIT SIZE/TYPE</b> HQ	<b>CHECKED BY</b>	<b>TOTAL DEPTH DRILLED (feet)</b> 110
<b>DRILL RIG TYPE</b> LF 70		<b>DRILLED BY</b> Ruen Drilling	<b>INCLINATION FROM VERTICAL/BEARING</b> 0	
<b>APPARENT GROUNDWATER DEPTH (feet)</b> Groundwater measured at 90.0 feet below ground surface (2/8/2017)			<b>APPROXIMATE SURFACE ELEVATION (feet)</b> 725	
<b>COMMENTS</b> Location - Miramar Lake			<b>BOREHOLE BACKFILL</b> 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., %									
25	700	5	1	25	N/A	N/A			- Cobbles up to 6" diameter <b>Sandy GRAVEL &amp; COBBLE (GP-GM)</b> , dense, olive-brown to yellow-brown sand matrix, damp, moderately well cemented zones with calcium carbonate						
		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									
40	685	12	2	100	N/A	N/A									
		13	2	100	N/A	N/A									
		14	2	100	N/A	N/A									
		15	2	100	N/A	N/A									
45	680	16	2	70	N/A	N/A									
		17	2	100	N/A	N/A									

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**FIGURE A-31 b**

<b>LOG OF CORE BORING</b>		<b>PROJECT NAME</b> North City Conveyance System	<b>PROJECT NUMBER</b> 2934	<b>BORING</b> <b>TB-4b</b>
<b>SITE LOCATION</b> San Diego, CA		<b>DATE(S) DRILLED</b> 12/1 to 12/1	<b>LOGGED BY</b> G. Spaulding	<b>SHEET NO.</b> 3 of 5
<b>DRILLING METHOD</b> Triple Tube Core		<b>DRILL BIT SIZE/TYPE</b> HQ	<b>CHECKED BY</b>	<b>TOTAL DEPTH DRILLED (feet)</b> 110
<b>DRILL RIG TYPE</b> LF 70		<b>DRILLED BY</b> Ruen Drilling	<b>INCLINATION FROM VERTICAL/BEARING</b> 0	
<b>APPARENT GROUNDWATER DEPTH (feet)</b> Groundwater measured at 90.0 feet below ground surface (2/8/2017)			<b>APPROXIMATE SURFACE ELEVATION (feet)</b> 725	
<b>COMMENTS</b> Location - Miramar Lake			<b>BOREHOLE BACKFILL</b> 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., %										
50	675	18	3	100	N/A	N/A			<p>- Cobbles up to ±10" diameter</p>							
		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										
70	655	23	4	100	N/A	N/A										

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**FIGURE A-31 c**



<b>LOG OF CORE BORING</b>		<b>PROJECT NAME</b> North City Conveyance System	<b>PROJECT NUMBER</b> 2934	<b>BORING</b> <b>TB-4b</b>
<b>SITE LOCATION</b> San Diego, CA		<b>DATE(S) DRILLED</b> 12/1 to 12/1	<b>LOGGED BY</b> G. Spaulding	<b>SHEET NO.</b> 4 of 5
<b>DRILLING METHOD</b> Triple Tube Core		<b>DRILL BIT SIZE/TYPE</b> HQ	<b>CHECKED BY</b>	<b>TOTAL DEPTH DRILLED (feet)</b> 110
<b>DRILL RIG TYPE</b> LF 70		<b>DRILLED BY</b> Ruen Drilling	<b>INCLINATION FROM VERTICAL/BEARING</b> 0	
<b>APPARENT GROUNDWATER DEPTH (feet)</b> Groundwater measured at 90.0 feet below ground surface (2/8/2017)			<b>APPROXIMATE SURFACE ELEVATION (feet)</b> 725	
<b>COMMENTS</b> Location - Miramar Lake			<b>BOREHOLE BACKFILL</b> 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., %												
75	650	24	4	100	N/A	N/A			- Cobbles up to 8 to 9" diameter  □ Groundwater measured at 90.0 feet below ground surface (2/8/2017)  <u>Note:</u> Material stuck in drill string									
		25	5	100	N/A	N/A												
80	645	26	5	100	N/A	N/A												
		27	5	100	N/A	N/A												
85	640																	
		28	5	100	N/A	N/A												
90	635																	
		29	6	0	N/A	N/A												
		30	6	100	N/A	N/A												
		31	6	100	N/A	N/A												
95	630																	

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**FIGURE A-31 d**

<b>LOG OF CORE BORING</b>		<b>PROJECT NAME</b> North City Conveyance System	<b>PROJECT NUMBER</b> 2934	<b>BORING</b> <b>TB-4b</b>
<b>SITE LOCATION</b> San Diego, CA		<b>DATE(S) DRILLED</b> 12/1 to 12/1	<b>LOGGED BY</b> G. Spaulding	<b>SHEET NO.</b> 5 of 5
<b>DRILLING METHOD</b> Triple Tube Core		<b>DRILL BIT SIZE/TYPE</b> HQ	<b>CHECKED BY</b>	<b>TOTAL DEPTH DRILLED (feet)</b> 110
<b>DRILL RIG TYPE</b> LF 70		<b>DRILLED BY</b> Ruen Drilling	<b>INCLINATION FROM VERTICAL/BEARING</b> 0	
<b>APPARENT GROUNDWATER DEPTH (feet)</b> Groundwater measured at 90.0 feet below ground surface (2/8/2017)			<b>APPROXIMATE SURFACE ELEVATION (feet)</b> 725	
<b>COMMENTS</b> Location - Miramar Lake			<b>BOREHOLE BACKFILL</b> 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., %											
100	625	32	6	92	N/A	N/A			<p>Boring terminated at depth of 110 feet. Groundwater measured at 90.0 feet below ground surface (2/8/2017)</p> <p><u>Monitoring Well Construction:</u>  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</p>								
105	620	33	6	100	N/A	N/A											
110	615	34	6	98	N/A	N/A											
115	610																
120	605																

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**FIGURE A-31 e**

<b>LOG OF CORE BORING</b>		<b>PROJECT NAME</b> North City Conveyance System	<b>PROJECT NUMBER</b> 2934	<b>BORING</b> <b>TB-4c</b>
<b>SITE LOCATION</b> San Diego, CA		<b>DATE(S) DRILLED</b> 11/28 to 11/30	<b>LOGGED BY</b> G. Spaulding	<b>SHEET NO.</b> 1 of 6
<b>DRILLING METHOD</b> Triple Tube Core		<b>DRILL BIT SIZE/TYPE</b> HQ	<b>CHECKED BY</b>	<b>TOTAL DEPTH DRILLED (feet)</b> 131.5
<b>DRILL RIG TYPE</b> LF 70		<b>DRILLED BY</b> Ruen Drilling	<b>INCLINATION FROM VERTICAL/BEARING</b> 0	
<b>APPARENT GROUNDWATER DEPTH (feet)</b> - Groundwater measured at 82.8 feet below ground surface (2/8/2017)			<b>APPROXIMATE SURFACE ELEVATION (feet)</b> 724	
<b>COMMENTS</b> Location - Miramar Lake			<b>BOREHOLE BACKFILL</b> 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., %									
				pipe	N/A	N/A			<u>FILL</u> Sandy CLAY to Clayey SAND (SC-CL), brown, moist, with gravel and cobbles approx 40% up to 4" diameter						
5	-720	1	1	50	N/A	N/A									
		2	1	0	N/A	N/A									
	-715	3	1	60	N/A	N/A									
		4	1	66	N/A	N/A			<u>STADIUM CONGLOMERATE</u> 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						
		5	1	60	N/A	N/A									
		6	1	60	N/A	N/A			<u>Notes</u> 1452: Pulled drill string to check bit 1520: Advanced conductor pipe to -11'						
	-710	7	1	90	N/A	N/A									
		8	1	40	N/A	N/A									
		9	1	40	N/A	N/A									
	-705	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									

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**FIGURE A-32 a**

<b>LOG OF CORE BORING</b>		<b>PROJECT NAME</b> North City Conveyance System	<b>PROJECT NUMBER</b> 2934	<b>BORING</b> <b>TB-4c</b>
<b>SITE LOCATION</b> San Diego, CA		<b>DATE(S) DRILLED</b> 11/28 to 11/30	<b>LOGGED BY</b> G. Spaulding	<b>SHEET NO.</b> 2 of 6
<b>DRILLING METHOD</b> Triple Tube Core		<b>DRILL BIT SIZE/TYPE</b> HQ	<b>CHECKED BY</b>	<b>TOTAL DEPTH DRILLED (feet)</b> 131.5
<b>DRILL RIG TYPE</b> LF 70		<b>DRILLED BY</b> Ruen Drilling	<b>INCLINATION FROM VERTICAL/BEARING</b> 0	
<b>APPARENT GROUNDWATER DEPTH (feet)</b> - Groundwater measured at 82.8 feet below ground surface (2/8/2017)			<b>APPROXIMATE SURFACE ELEVATION (feet)</b> 724	
<b>COMMENTS</b> Location - Miramar Lake			<b>BOREHOLE BACKFILL</b> 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., %									
25		14	1	75	N/A	N/A			<p>Note: Switched to polymer</p> <p>Interbedded Clayey SAND/Sandy CLAY (SC/CL), hard, damp</p> <p>- Gravel from 36 to 38 feet</p> <p>- Gravel from 48 to 50 feet</p>						
		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									
		19	2	100	N/A	N/A									
	690	20	2	100	N/A	N/A									
35															
		21	2	100	N/A	N/A									
	685														
40		22	2	100	N/A	N/A									
	680														
45		23	3	100	N/A	N/A									
	675														
		24	3	100	N/A	N/A									

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**FIGURE A-32 b**

<b>LOG OF CORE BORING</b>		<b>PROJECT NAME</b> North City Conveyance System	<b>PROJECT NUMBER</b> 2934	<b>BORING</b> <b>TB-4c</b>
<b>SITE LOCATION</b> San Diego, CA		<b>DATE(S) DRILLED</b> 11/28 to 11/30	<b>LOGGED BY</b> G. Spaulding	<b>SHEET NO.</b> 3 of 6
<b>DRILLING METHOD</b> Triple Tube Core		<b>DRILL BIT SIZE/TYPE</b> HQ	<b>CHECKED BY</b>	<b>TOTAL DEPTH DRILLED (feet)</b> 131.5
<b>DRILL RIG TYPE</b> LF 70		<b>DRILLED BY</b> Ruen Drilling	<b>INCLINATION FROM VERTICAL/BEARING</b> 0	
<b>APPARENT GROUNDWATER DEPTH (feet)</b> - Groundwater measured at 82.8 feet below ground surface (2/8/2017)			<b>APPROXIMATE SURFACE ELEVATION (feet)</b> 724	
<b>COMMENTS</b> Location - Miramar Lake			<b>BOREHOLE BACKFILL</b> 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., %									
50		25	3	100	N/A	N/A									
670		26	3	100	N/A	N/A			- Occasional gravel						
55		27	4	100	N/A	N/A			Gravel and cobbles						
665		28	4	85	N/A	N/A									
60		29	4	100	N/A	N/A									
660		30	4	100	N/A	N/A			Sandy CLAY (CL), hard mottled olive-gray / yellow / red, damp, with occasional gravel and cobbles						
65		31	5	60	N/A	N/A									
655															
70															

**Note:** 1300-1415: Core stuck in casing. Pulled casing to clear blockage

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**FIGURE A-32 c**

<b>LOG OF CORE BORING</b>		<b>PROJECT NAME</b> North City Conveyance System	<b>PROJECT NUMBER</b> 2934	<b>BORING</b> <b>TB-4c</b>
<b>SITE LOCATION</b> San Diego, CA		<b>DATE(S) DRILLED</b> 11/28 to 11/30	<b>LOGGED BY</b> G. Spaulding	<b>SHEET NO.</b> 4 of 6
<b>DRILLING METHOD</b> Triple Tube Core		<b>DRILL BIT SIZE/TYPE</b> HQ	<b>CHECKED BY</b>	<b>TOTAL DEPTH DRILLED (feet)</b> 131.5
<b>DRILL RIG TYPE</b> LF 70		<b>DRILLED BY</b> Ruen Drilling	<b>INCLINATION FROM VERTICAL/BEARING</b> 0	
<b>APPARENT GROUNDWATER DEPTH (feet)</b> - Groundwater measured at 82.8 feet below ground surface (2/8/2017)			<b>APPROXIMATE SURFACE ELEVATION (feet)</b> 724	
<b>COMMENTS</b> Location - Miramar Lake			<b>BOREHOLE BACKFILL</b> 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., %												
75	650	32	5	60	N/A	N/A			- Gravel and cobbles up to 4" diameter  - Gravel and cobbles up to 6" diameter  - Groundwater measured at 82.8 feet below ground surface (2/8/2017)  - Interbedded sand and gravel  - 10" diameter rock - Gravel and cobbles from 92 to 93.5 feet  - Sand  - Gravel and cobbles up to 6" diameter from 96.5 to 100 feet									
		33	5	100	N/A	N/A												
		34	5	98	N/A	N/A												
	645	35	5	100	N/A	N/A												
	80	36	5	100	N/A	N/A												
	640	37	5	100	N/A	N/A												
	85		6															
	635	38	6	100	N/A	N/A												
	90	39	6	85	N/A	N/A												
		40	6	88	N/A	N/A												
	630	41	6	100	N/A	N/A												
	95		6															

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**FIGURE A-32 d**

<b>LOG OF CORE BORING</b>		<b>PROJECT NAME</b> North City Conveyance System	<b>PROJECT NUMBER</b> 2934	<b>BORING</b> <b>TB-4c</b>
<b>SITE LOCATION</b> San Diego, CA		<b>DATE(S) DRILLED</b> 11/28 to 11/30	<b>LOGGED BY</b> G. Spaulding	<b>SHEET NO.</b> 5 of 6
<b>DRILLING METHOD</b> Triple Tube Core		<b>DRILL BIT SIZE/TYPE</b> HQ	<b>CHECKED BY</b>	<b>TOTAL DEPTH DRILLED (feet)</b> 131.5
<b>DRILL RIG TYPE</b> LF 70		<b>DRILLED BY</b> Ruen Drilling	<b>INCLINATION FROM VERTICAL/BEARING</b> 0	
<b>APPARENT GROUNDWATER DEPTH (feet)</b> - Groundwater measured at 82.8 feet below ground surface (2/8/2017)			<b>APPROXIMATE SURFACE ELEVATION (feet)</b> 724	
<b>COMMENTS</b> Location - Miramar Lake			<b>BOREHOLE BACKFILL</b> 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., %									
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									

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**FIGURE A-32 e**



<b>LOG OF CORE BORING</b>		<b>PROJECT NAME</b> North City Conveyance System	<b>PROJECT NUMBER</b> 2934	<b>BORING</b> <b>TB-4c</b>
<b>SITE LOCATION</b> San Diego, CA		<b>DATE(S) DRILLED</b> 11/28 to 11/30	<b>LOGGED BY</b> G. Spaulding	<b>SHEET NO.</b> 6 of 6
<b>DRILLING METHOD</b> Triple Tube Core		<b>DRILL BIT SIZE/TYPE</b> HQ	<b>CHECKED BY</b>	<b>TOTAL DEPTH DRILLED (feet)</b> 131.5
<b>DRILL RIG TYPE</b> LF 70		<b>DRILLED BY</b> Ruen Drilling	<b>INCLINATION FROM VERTICAL/BEARING</b> 0	
<b>APPARENT GROUNDWATER DEPTH (feet)</b> - Groundwater measured at 82.8 feet below ground surface (2/8/2017)			<b>APPROXIMATE SURFACE ELEVATION (feet)</b> 724	
<b>COMMENTS</b> Location - Miramar Lake			<b>BOREHOLE BACKFILL</b> 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			<p>Silty SAND (SM), dense, red-brown, damp to moist</p>						
595		48	9	100	N/A	N/A									

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**FIGURE A-32 f**

<b>LOG OF CORE BORING</b>		<b>PROJECT NAME</b> North City Conveyance System	<b>PROJECT NUMBER</b> 2934	<b>BORING</b> <b>TB-4d</b>
<b>SITE LOCATION</b> San Diego, CA		<b>DATE(S) DRILLED</b> 12/5 to 12/7	<b>LOGGED BY</b> G. Spaulding	<b>SHEET NO.</b> 1 of 6
<b>DRILLING METHOD</b> Triple Tube Core		<b>DRILL BIT SIZE/TYPE</b> HQ	<b>CHECKED BY</b>	<b>TOTAL DEPTH DRILLED (feet)</b> 123
<b>DRILL RIG TYPE</b> LF 70		<b>DRILLED BY</b> Ruen Drilling	<b>INCLINATION FROM VERTICAL/BEARING</b> 0	
<b>APPARENT GROUNDWATER DEPTH (feet)</b> Groundwater measured at 78.75 feet below ground surface (2/8/2017)			<b>APPROXIMATE SURFACE ELEVATION (feet)</b> 722	
<b>COMMENTS</b> Location - Miramar Lake			<b>BOREHOLE BACKFILL</b> 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., %									
								2 to 3 inches AC / 10 to 12" Class II Base							
	720							<b>FILL</b> Clayey and Gravelly SAND (SP-SM), medium dense, gray-brown, damp to moist, with gravel and cobbles up to 8" diameter							
5															
	715														
	710														
	705	1	1	100	N/A	N/A									
	700	2	1	90	N/A	N/A									

TCG\_CORE\_LOG\_FT-2\_2934CORE.GPJ ROCK.GDT 4/12/17



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San Diego, California 92123

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-33 a**

<b>LOG OF CORE BORING</b>		<b>PROJECT NAME</b> North City Conveyance System	<b>PROJECT NUMBER</b> 2934	<b>BORING</b> <b>TB-4d</b>
<b>SITE LOCATION</b> San Diego, CA		<b>DATE(S) DRILLED</b> 12/5 to 12/7	<b>LOGGED BY</b> G. Spaulding	<b>SHEET NO.</b> 2 of 6
<b>DRILLING METHOD</b> Triple Tube Core		<b>DRILL BIT SIZE/TYPE</b> HQ	<b>CHECKED BY</b>	<b>TOTAL DEPTH DRILLED (feet)</b> 123
<b>DRILL RIG TYPE</b> LF 70		<b>DRILLED BY</b> Ruen Drilling	<b>INCLINATION FROM VERTICAL/BEARING</b> 0	
<b>APPARENT GROUNDWATER DEPTH (feet)</b> Groundwater measured at 78.75 feet below ground surface (2/8/2017)			<b>APPROXIMATE SURFACE ELEVATION (feet)</b> 722	
<b>COMMENTS</b> Location - Miramar Lake			<b>BOREHOLE BACKFILL</b> 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., %									
25		3	1	98	N/A	N/A			Soft zone Becomes clayier Interbedded clayey sands and gravels, gray to light olive-brown color matrix						
	695	4	1	100	N/A	N/A									
30		5	1	58	N/A	N/A									
	690														
		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														

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**FIGURE A-33 b**

<b>LOG OF CORE BORING</b>		<b>PROJECT NAME</b> North City Conveyance System	<b>PROJECT NUMBER</b> 2934	<b>BORING</b> <b>TB-4d</b>
<b>SITE LOCATION</b> San Diego, CA		<b>DATE(S) DRILLED</b> 12/5 to 12/7	<b>LOGGED BY</b> G. Spaulding	<b>SHEET NO.</b> 3 of 6
<b>DRILLING METHOD</b> Triple Tube Core		<b>DRILL BIT SIZE/TYPE</b> HQ	<b>CHECKED BY</b>	<b>TOTAL DEPTH DRILLED (feet)</b> 123
<b>DRILL RIG TYPE</b> LF 70		<b>DRILLED BY</b> Ruen Drilling	<b>INCLINATION FROM VERTICAL/BEARING</b> 0	
<b>APPARENT GROUNDWATER DEPTH (feet)</b> Groundwater measured at 78.75 feet below ground surface (2/8/2017)			<b>APPROXIMATE SURFACE ELEVATION (feet)</b> 722	
<b>COMMENTS</b> Location - Miramar Lake			<b>BOREHOLE BACKFILL</b> 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., %										
50		10	3	98	N/A	N/A			<b>Sandy GRAVEL</b> , 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															
	665	13	3	100	N/A	N/A										
	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															

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**FIGURE A-33 c**

<b>LOG OF CORE BORING</b>		<b>PROJECT NAME</b> North City Conveyance System	<b>PROJECT NUMBER</b> 2934	<b>BORING</b> <b>TB-4d</b>
<b>SITE LOCATION</b> San Diego, CA		<b>DATE(S) DRILLED</b> 12/5 to 12/7	<b>LOGGED BY</b> G. Spaulding	<b>SHEET NO.</b> 4 of 6
<b>DRILLING METHOD</b> Triple Tube Core		<b>DRILL BIT SIZE/TYPE</b> HQ	<b>CHECKED BY</b>	<b>TOTAL DEPTH DRILLED (feet)</b> 123
<b>DRILL RIG TYPE</b> LF 70		<b>DRILLED BY</b> Ruen Drilling	<b>INCLINATION FROM VERTICAL/BEARING</b> 0	
<b>APPARENT GROUNDWATER DEPTH (feet)</b> Groundwater measured at 78.75 feet below ground surface (2/8/2017)			<b>APPROXIMATE SURFACE ELEVATION (feet)</b> 722	
<b>COMMENTS</b> Location - Miramar Lake			<b>BOREHOLE BACKFILL</b> 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., %										
75		17	4	100	N/A	N/A			- Groundwater measured at 78.75 feet below ground surface (2/8/2017)							
645																
80		18	5	100	N/A	N/A										
640																
85		19	5	99	N/A	N/A										
635																
90		20	5	100	N/A	N/A										
630																
95		21	6	99	N/A	N/A										
625																

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**FIGURE A-33 d**

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PL

<b>LOG OF CORE BORING</b>		<b>PROJECT NAME</b> North City Conveyance System	<b>PROJECT NUMBER</b> 2934	<b>BORING</b> <b>TB-4d</b>
<b>SITE LOCATION</b> San Diego, CA		<b>DATE(S) DRILLED</b> 12/5 to 12/7	<b>LOGGED BY</b> G. Spaulding	<b>SHEET NO.</b> 5 of 6
<b>DRILLING METHOD</b> Triple Tube Core		<b>DRILL BIT SIZE/TYPE</b> HQ	<b>CHECKED BY</b>	<b>TOTAL DEPTH DRILLED (feet)</b> 123
<b>DRILL RIG TYPE</b> LF 70		<b>DRILLED BY</b> Ruen Drilling	<b>INCLINATION FROM VERTICAL/BEARING</b> 0	
<b>APPARENT GROUNDWATER DEPTH (feet)</b> Groundwater measured at 78.75 feet below ground surface (2/8/2017)			<b>APPROXIMATE SURFACE ELEVATION (feet)</b> 722	
<b>COMMENTS</b> Location - Miramar Lake			<b>BOREHOLE BACKFILL</b> 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., %									
100		22	6	100	N/A	N/A									
620															
105		23	6	100	N/A	N/A			Silty sand lense, moist, yellow-brown, with occasional gravel from 106 to 112 feet						
615															
110		24	7	100	N/A	N/A									
610									<b>Silty-Sandy GRAVEL (GM-GP)</b> , dense, brown to yellow-brown, moist						
115		25	7	100	N/A	N/A									
605															
120		26	7	100	N/A	N/A									
600															

TCG\_CORE\_LOG\_FT-2\_2934CORE.GPJ ROCK.GDT 4/12/17



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**FIGURE A-33 e**

<b>LOG OF CORE BORING</b>		<b>PROJECT NAME</b> North City Conveyance System	<b>PROJECT NUMBER</b> 2934	<b>BORING</b> <b>TB-4d</b>
<b>SITE LOCATION</b> San Diego, CA		<b>DATE(S) DRILLED</b> 12/5 to 12/7	<b>LOGGED BY</b> G. Spaulding	<b>SHEET NO.</b> 6 of 6
<b>DRILLING METHOD</b> Triple Tube Core		<b>DRILL BIT SIZE/TYPE</b> HQ	<b>CHECKED BY</b>	<b>TOTAL DEPTH DRILLED (feet)</b> 123
<b>DRILL RIG TYPE</b> LF 70		<b>DRILLED BY</b> Ruen Drilling	<b>INCLINATION FROM VERTICAL/BEARING</b> 0	
<b>APPARENT GROUNDWATER DEPTH (feet)</b> Groundwater measured at 78.75 feet below ground surface (2/8/2017)			<b>APPROXIMATE SURFACE ELEVATION (feet)</b> 722	
<b>COMMENTS</b> Location - Miramar Lake			<b>BOREHOLE BACKFILL</b> 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., %									
125	595								<p><i>Boring terminated at depth of 123 feet.</i></p> <p><i>Groundwater measured at 78.75 feet below ground surface (2/8/2017)</i></p> <p><u>Monitoring Well Construction:</u></p> <p><i>PCC Grout: 3 to 40 feet</i></p> <p><i>#3 Sand: 40 to 123 feet</i></p> <p><i>2" Blank Casing: 0 to 52 feet</i></p> <p><i>2" Slotted Casing: 52 to 122 feet</i></p>						
130	590														
135															
140															
145															
150															
155															
160															
165															
170															
175															
180															

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**FIGURE A-33 f**

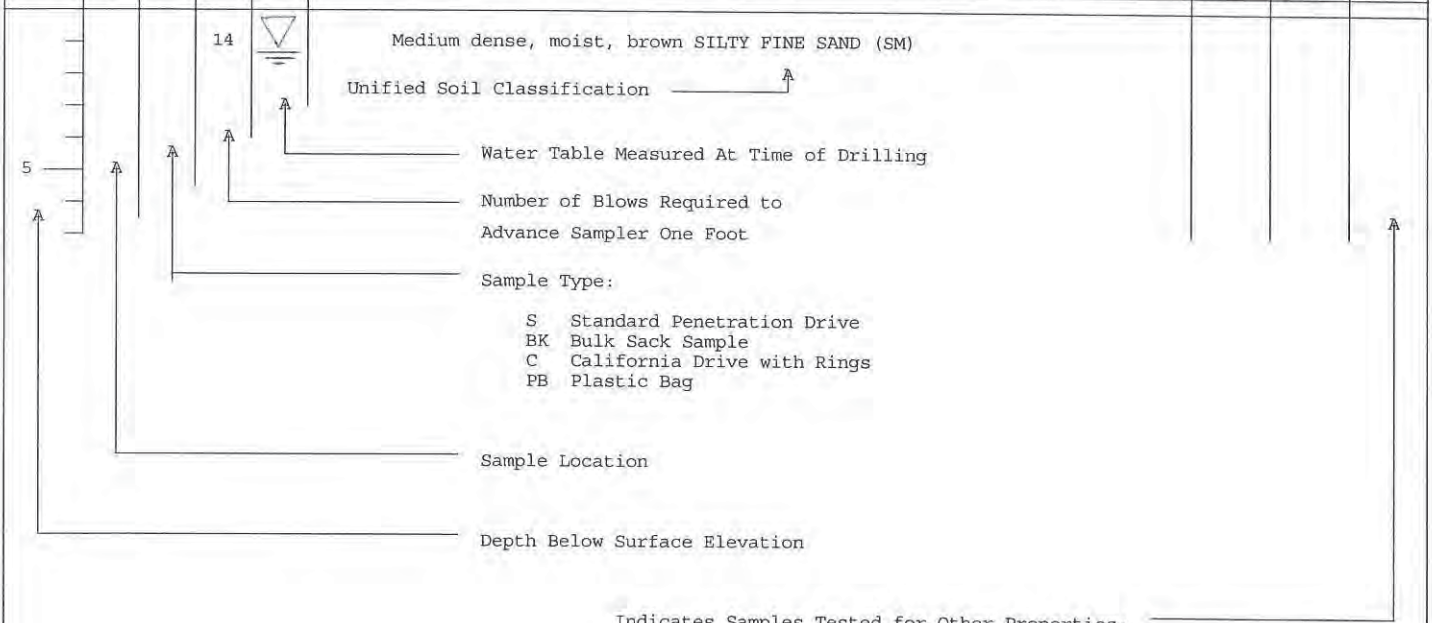


LOGS OF EXCAVATIONS  
FROM  
GROUP DELTA CONSULTANTS  
2000

K E Y   T O   E X C A V A T I O N   L O G S

LOGGED BY:	DATE DRILLED:	BORING ELEVATION:	BORING NO. :
DRILL RIG:	BORING DIAMETER:	HAMMER WT.:	DROP:

DEPTH (feet)	SAMPLE NO.	TYPE	BLOWS/FOOT	GROUNDWATER	DESCRIPTION	MOISTURE CONTENT %	DRY DENSITY (pcf)	OTHER TESTS
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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
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B O R I N G   L O G

LOGGED BY: <b>J. Brown</b>	DATE DRILLED: <b>4/13/00</b>	BORING ELEVATION: <b>392.5 feet</b>	BORING NO.:
DRILL RIG: <b>CME 85</b>	BORING DIAMETER: <b>8 inches</b>	HAMMER WT.: <b>140 lbs</b> DROP: <b>30 in.</b>	<b>B - 1</b>

DEPTH (feet)	SAMPLE NO.	TYPE	BLOWS/FOOT	GROUNDWATER	DESCRIPTION	MOISTURE CONTENT %	DRY DENSITY (pcf)	OTHER TESTS
1					11" Asphalt Concrete			
2	1	S	30		Moist, light yellowish-brown, SILTY MEDIUM TO FINE SAND (SM) with few small rock fragments <span style="float: right;"><u>FILL</u></span>			
3	2	BK			Dense, moist, gray-brown, CLAYEY MEDIUM TO FINE SAND (SC) <span style="float: right;"><u>LINDAVISTA FORMATION</u></span>	23.4		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)  moderately cemented			CL LC PH PI RS SA SL
5	3	C	100 4"					
8	4	BK				7.3		
11	5	S	90					
13	6	BK			Very dense, moist, yellowish-gray, CLAYEY COARSE TO FINE SAND (SC)			
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								

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.: <b>1 9 1 0</b>	<b>M I R A M A R   R O A D   P I P E L I N E</b>	FIGURE: <b>A - 2, Page 1 of 1</b>
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**B O R I N G L O G**

LOGGED BY: <b>J. Brown</b>	DATE DRILLED: <b>4/13/00</b>	BORING ELEVATION: <b>403.2 feet</b>	BORING NO. : <b>B - 2</b>
DRILL RIG: <b>CME 85</b>	BORING DIAMETER: <b>8 inches</b>	HAMMER WT. : <b>140 lbs</b> DROP: <b>30 in</b>	

DEPTH (feet)	SAMPLE NO.	TYPE	BLOWS/FOOT	GROUNDWATER	DESCRIPTION	MOISTURE CONTENT %	DRY DENSITY (pcf)	OTHER TESTS	
1	1	S	60 6"		8" Asphalt Concrete				
2						Moist, light yellowish-brown, SILTY MEDIUM TO FINE SAND (SM), with some small rock fragments <span style="float:right"><u>FILL</u></span>			
3									
4	2	PB	80		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							
6									
7			70		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	14.2	CL LC EC PH RS SS SA SL		
8	4	BK							
9									
10									
11	5	S							
12					↓ change to dark gray-brown color				
13									
14	6	PB							
15					drive sample attempt at 15 ft on gravel - no penetration/50 blows				
16									
17	7	PB							
18									
19			40						
20	8	S				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			

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. : <b>1 9 1 0</b>	<b>M I R A M A R   R O A D   P I P E L I N E</b>	FIGURE: <b>A - 3, Page 1 of 2</b>
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B O R I N G   L O G

LOGGED BY: <b>J. Brown</b>	DATE DRILLED: <b>4/13/00</b>	BORING ELEVATION: <b>403.2 feet</b>	BORING NO.:
DRILL RIG: <b>CME 85</b>	BORING DIAMETER: <b>8 inches</b>	HAMMER WT.: <b>140 lbs</b> DROP: <b>30 in</b>	<b>B - 2</b>

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	<u>FILL</u>		
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			
27					Unable to continue boring to native due to time constraints			
28					Localized wet zones encountered 18½ to 22 feet. However, no free groundwater table identified at time of excavation			
29					Backfilled with cuttings; patched with cuttings			
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.: <b>1 9 1 0</b>	<b>M I R A M A R   R O A D   P I P E L I N E</b>	FIGURE: <b>A - 3, Page 2 of 2</b>
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**B O R I N G   L O G**

LOGGED BY: <b>J. Brown</b>	DATE DRILLED: <b>4/13/00</b>	BORING ELEVATION: <b>417.6 feet</b>	BORING NO. :  <b>B - 3</b>
DRILL RIG: <b>CME 85</b>	BORING DIAMETER: <b>8 inches</b>	HAMMER WT.: <b>140 lbs</b> DROP: <b>30 in</b>	

DEPTH (feet)	SAMPLE NO.	TYPE	BLOWS/FOOT	GROUNDWATER	DESCRIPTION	MOISTURE CONTENT %	DRY DENSITY (pcf)	OTHER TESTS
1	1	S	65 6"		8" Asphalt Concrete			
2						Moist, light yellowish-brown, SILTY MEDIUM TO FINE SAND (SM), with some small rock fragments <span style="float:right"><u>FILL</u></span>		
3	2	BK				Hard, moist, reddish-brown, SANDY FAT CLAY (CH) <span style="float:right"><u>RESIDUAL CLAY</u></span>		
4						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  <u>LINDAVISTA FORMATION</u>	6.2	CL PH RS SA SL
5								
6								
7								
8	3	BK			drive sample attempt at 10 ft on gravel; no penetration/50 blows			
9								
10								
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								
20					drive sample attempt at 20 ft; no penetration/50 blows			
					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. : <b>1 9 1 0</b>	<b>M I R A M A R   R O A D   P I P E L I N E</b>	FIGURE: <b>A - 4, Page 1 of 1</b>
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**B O R I N G   L O G**

LOGGED BY: <b>J. Brown</b>	DATE DRILLED: <b>4/12/00</b>	BORING ELEVATION: <b>417.5 feet</b>	BORING NO.:
DRILL RIG: <b>CME 85</b>	BORING DIAMETER: <b>8 inches</b>	HAMMER WT.: <b>140 lbs</b> DROP: <b>30 in</b>	<b>B - 4</b>

DEPTH (feet)	SAMPLE NO.	TYPE	BLOWS/FOOT	GROUNDWATER	DESCRIPTION	MOISTURE CONTENT %	DRY DENSITY (pcf)	OTHER TESTS
1					8" Asphalt Concrete			
2					Moist, light yellowish-brown, SILTY MEDIUM TO FINE SAND (SM), with few rock fragments <span style="float:right"><u>FILL</u></span>			
3	1	BK			Hard, moist, dark reddish-brown, SANDY FAT CLAY (CH), with few small gravels <span style="float:right"><u>RESIDUAL CLAY</u></span>			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 <span style="float:right"><u>LINDAVISTA FORMATION</u></span>			
6	2	PB						
8	3	BK						
10	4	S	$\frac{100}{4}$		Very dense, moist, gray CLAYEY COARSE TO FINE SAND (SC) with some small gravels (est. <5% gravel)	12.2	CL PH RCH SPA SL	
12	5	BK						
14								
15	6	C	$\frac{80}{6}$		Very dense, moist, light brown, SILTY MEDIUM TO FINE SAND (SM)			
16								
17								
18								
19								
20	7	S	$\frac{80}{6}$		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.: <b>1 9 1 0</b>	<b>M I R A M A R   R O A D   P I P E L I N E</b>	FIGURE: <b>A - 5, Page 1 of 1</b>
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B O R I N G   L O G

LOGGED BY: <b>J. Brown</b>	DATE DRILLED: <b>4/12/00</b>	BORING ELEVATION: <b>419.0 feet</b>	BORING NO. :
DRILL RIG: <b>CME 85</b>	BORING DIAMETER: <b>8 inches</b>	HAMMER WT.: <b>140 lbs</b> DROP: <b>30 in</b>	<b>B - 5</b>

DEPTH (feet)	SAMPLE NO.	TYPE	BLOWS/FOOT	GROUNDWATER	DESCRIPTION	MOISTURE CONTENT %	DRY DENSITY (pcf)	OTHER TESTS
1					12" Asphalt Concrete			
2					Moist, light brown, poorly graded SAND (SP), with many small gravels <u>BASE</u>			
3	1	S	$\frac{131}{10}^*$		Moist, mottled gray-brown/reddish-brown and gray, LEAN TO FAT CLAY (CL/CH), with some small gravel <u>FILL</u>			
4	2	BK		* sampler driven on gravel				
5	3	C	$\frac{100}{4}$		Very dense, moist, light brown, VERY CLAYEY MEDIUM TO FINE SAND (SC), with few small gravels (<5% gravel, to 2" across), moderate cementation no recovery from sampler <u>LINDAVISTA FORMATION</u>			
6								
7	4	BK						
8								
9								
10	5	C	$\frac{100}{3}$		no recovery from sampler			
11	6	PB						
12								
13								
14					Hard, moist, gray with reddish-brown mottles, SANDY LEAN CLAY (CL), with some gravels			
15	7	S	$\frac{100}{3}$					
16					large gravel slow drilling below 15½ feet			
17	8	BK						
18								
19					Very dense, moist, light brown to light gray, SILTY MEDIUM TO FINE SAND (SM)			
20	9	C	$\frac{100}{4}$		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. : <b>1 9 1 0</b>	<b>M I R A M A R   R O A D   P I P E L I N E</b>	FIGURE: <b>A - 6, Page 1 of 1</b>
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B O R I N G   L O G

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
1					10" Asphalt Concrete			
2					Moist, gray-brown, SILTY MEDIUM TO FINE SAND (SM), with some rock fragments	<u>FILL</u>		
3	1	S	16		Moist, dark gray-brown, FINE SANDY LEAN TO FAT CLAY (CL/CH)			
4	2	BK						
5								
6	3	C	30		Moist, dark reddish-brown, FINE SANDY LEAN TO FAT CLAY (CL/CH), with trace small (<1" in size) gravel			
7								
8								
9	4	BK						
10								
11	5	S	20		moist, dark gray-brown, FINE SANDY LEAN TO FAT CLAY (CL/CH), with coarse sand-sized pieces of yellowish-brown sandstone			
12								
13								
14	6	PB						
15								
16	7	C	70					
17								
18	8	PB						
19				▽	groundwater encountered at 19½ feet			
20	9	S	70 6"	≡	Dense, wet, dark gray-brown, VERY SILTY COARSE TO FINE SAND (SM)	<u>ALLOUVIUM</u>		

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.: **1 9 1 0**

**M I R A M A R   R O A D   P I P E L I N E**

FIGURE: **A - 7, Page 1 of 2**



**B O R I N G   L O G**

LOGGED BY: <b>J. Brown</b>	DATE DRILLED: <b>4/13/00</b>	BORING ELEVATION: <b>417.8 feet</b>	BORING NO. :
DRILL RIG: <b>CME 85</b>	BORING DIAMETER: <b>8 inches</b>	HAMMER WT.: <b>140 lbs</b> DROP: <b>30 in</b>	<b>B - 6</b>

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
21	9	S	70 6"		Dense, wet, dark gray-brown, VERY SILTY COARSE TO FINE SAND (SM) <span style="float:right"><u>ALLUVIUM</u></span>			
22					with some gravel			
25	10	S	60 5"		Very dense, wet, dark brown, CLAYEY COARSE TO FINE SAND (SC), with many clasts of yellowish sandstone			
27					Very dense, moist, interlayered pale gray and yellowish-brown, VERY CLAYEY FINE SAND (SC), with zones of FINE SANDY LEAN CLAY (CL)			
					<u>LINDAVISTA FORMATION</u>			
30	11	S	50 6"		BOTTOM OF BORING at 30½ feet			
					Groundwater in alluvium (19½ to 26 feet)			
					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.: <b>1 9 1 0</b>	<b>M I R A M A R   R O A D   P I P E L I N E</b>	FIGURE: <b>A - 7, Page 2 of 2</b>
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B O R I N G   L O G

LOGGED BY: <b>J. Brown</b>	DATE DRILLED: <b>4/13/00</b>	BORING ELEVATION: <b>429.5 feet</b>	BORING NO. : <b>B - 7</b>
DRILL RIG: <b>CME 85</b>	BORING DIAMETER: <b>8 inches</b>	HAMMER WT.: <b>140 lbs</b> DROP: <b>30 in</b>	

DEPTH (feet)	SAMPLE NO.	TYPE	BLOWS/FOOT	GROUNDWATER	DESCRIPTION	MOISTURE CONTENT %	DRY DENSITY (pcf)	OTHER TESTS
1					8" Asphalt Concrete			
2	1	S	47		Moist, yellowish-brown, SILTY MEDIUM TO FINE SAND (SM)	<u>FILL</u>		
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*		* sampler driven on gravel; no recovery			
6			6"					
8	4	BK					14.1	CL PH PI RS SA SL
10								
11	5	S	30					
12					↓ primarily dark gray-brown to dark brown color			
13	6	BK						
14								
15								
16	7	C	55					
17					Hard, moist, olive-gray with brown mottles, FAT CLAY (CH), with trace fine sand			
18					<u>LINDAVISTA FORMATION</u>			
19								
20					Very dense, moist, yellowish-brown, CLAYEY FINE SAND (SC), with many small (<2" in size) gravels 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.: <b>1 9 1 0</b>	M I R A M A R   R O A D   P I P E L I N E	FIGURE: <b>A - 8, Page 1 of 2</b>
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**B O R I N G L O G**

LOGGED BY: <b>J. Brown</b>	DATE DRILLED: <b>4/14/00</b>	BORING ELEVATION: <b>480.4 feet</b>	BORING NO.:
DRILL RIG: <b>CME 85</b>	BORING DIAMETER: <b>8 inches</b>	HAMMER WT.: <b>140 lbs</b> DROP: <b>30 in</b>	<b>B - 8</b>

DEPTH (feet)	SAMPLE NO.	TYPE	BLOWS/FOOT	GROUNDWATER	DESCRIPTION	MOISTURE CONTENT %	DRY DENSITY (pcf)	OTHER TESTS
1					8" Asphalt Concrete			
2	1	BK			Moist, brown, CLAYEY MEDIUM TO FINE SAND (SC), with many small rock fragments drive sample attempt at 1½ feet; no penetration/50 blows	<u>FILL</u>		
3					Moist, brown, CLAYEY FINE SAND (SC)	↓		
4					Hard, moist, reddish-brown LEAN CLAY (CL)	<u>RESIDUAL CLAY</u>		
5					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  <u>LINDAVISTA FORMATION</u>	7.8	CL PH RS SL	
6								
7	2	BK						
8								
9								
10	3	S	20 6"					
11								
12								
13								
14	4	PB						
15					drive sample attempt at 15 feet; no penetration/50 blows			
16					BOTTOM OF BORING at 15 feet			
17					No free groundwater encountered at time of excavation			
18					Backfilled with cuttings; patched with concrete			
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. : <b>1 9 1 0</b>	<b>M I R A M A R   R O A D   P I P E L I N E</b>	FIGURE: <b>A - 9, Page 1 of 1</b>
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**B O R I N G   L O G**

LOGGED BY: <b>J. Brown</b>	DATE DRILLED: <b>4/14/00</b>	BORING ELEVATION: <b>512.3 feet</b>	BORING NO. :  <b>B - 9</b>
DRILL RIG: <b>CME 85</b>	BORING DIAMETER: <b>8 inches</b>	HAMMER WT. : <b>140 lbs</b> DROP: <b>30 in</b>	

DEPTH (feet)	SAMPLE NO.	TYPE	BLOWS/FOOT	GROUNDWATER	DESCRIPTION	MOISTURE CONTENT %	DRY DENSITY (pcf)	OTHER TESTS
1	1	S	60 4"		6" Asphalt Concrete			
2	2	PB				Moist, brown, SILTY COARSE TO FINE SAND (SM), with some small (<1" in size) rock fragments	<u>FILL</u>	
3								
4	3	BK	80		Hard, moist, reddish-brown, SANDY FAT CLAY (CH)	<u>RESIDUAL CLAY</u>		RV
5						no recovery from sampler		
6	4	C						
7	5	BK	100 3"		Very dense, moist, gray-brown, VERY CLAYEY MEDIUM TO FINE SAND (SC)	<u>LINDAVISTA FORMATION</u>		
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	80 6"					
11	7	BK						
12								
13								
14								
15	8	S						
16					BOTTOM OF BORING at 15 1/4 feet			
17					No free groundwater encountered at time of excavation			
18					Backfilled with cuttings; patched with concrete			
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. : <b>1 9 1 0</b>	<b>M I R A M A R   R O A D   P I P E L I N E</b>	FIGURE: <b>A - 10, Page 1 of 1</b>
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**B O R I N G   L O G**

LOGGED BY: <b>J. Brown</b>	DATE DRILLED: <b>6/7/00</b>	BORING ELEVATION: <b>386.5 feet</b>	BORING NO. : <b>B - 1 1</b>
DRILL RIG: <b>CME 85</b>	BORING DIAMETER: <b>8 inches</b>	HAMMER WT.: <b>140 lbs</b> DROP: <b>30 in</b>	

DEPTH (feet)	SAMPLE NO.	TYPE	BLOWS/FOOT	GROUNDWATER	DESCRIPTION	MOISTURE CONTENT %	DRY DENSITY (pcf)	OTHER TESTS
					2½" Asphalt Concrete			
1	1	PB	64		Moist, light yellowish-brown, SILTY MEDIUM TO FINE SAND (SM), with gravel (est. 20% gravel up to 3/4" in size) <span style="float:right">BASE/FILL</span>			
2	2	S			Moist, dark brown, SILTY MEDIUM TO FINE SAND (SM) <span style="float:right">FILL</span>			
3					Moist, gray-brown, CLAYEY COARSE TO FINE SAND (SM) <span style="float:right">↓</span>			
4	3	BK	82		Very dense, moist, pale reddish-brown, CLAYEY COARSE TO FINE SAND (SC) <span style="float:right">LINDAVISTA FORMATION</span>			
5	4	C			Very dense, moist, reddish-gray to gray-brown, CLAYEY COARSE TO FINE SAND (SC)	10.4	109.8	
6								
7								
8			41					
9	5	BK						
10	6	S			Dense, moist, light reddish-brown, SILTY FINE SAND (SM)			
11	7	BK						
12					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 <span style="float:right">↓</span>			

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. : <b>1 9 1 0</b>	<b>M I R A M A R   R O A D   P I P E L I N E</b>	FIGURE: <b>A - 12, Page 1 of 1</b>
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B O R I N G   L O G

LOGGED BY: <b>J. Brown</b>	DATE DRILLED: <b>6/5/00</b>	BORING ELEVATION: <b>492.2 feet</b>	BORING NO.:
DRILL RIG: <b>CME 85</b>	BORING DIAMETER: <b>8 inches</b>	HAMMER WT.: <b>140 lbs</b> DROP: <b>30 in</b>	<b>B - 1 2</b>

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)	<u>FILL</u>		
2								
3								
4	2	C	34			11.8	113.9	
5								
6	3	BK			Moist, brown, very CLAYEY COARSE TO FINE SAND (SC), with many gravels (est. 20 to 25% gravel, up to 8" in size)			SA
7								
8								
9	4	S	26					
10	5	BK						
11								
12								
13					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)			
14	6	C	<u>50</u> 5"		— on rock - no recovery			
15	7	C	<u>68</u> 6"		— sampler driven through gravels (relatively disturbed)			
16								
17								
18					Dense, moist, yellowish-brown, CLAYEY MEDIUM TO FINE SAND (SC), with reddish-brown mottles			
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.: <b>1 9 1 0</b>	M I R A M A R   R O A D   P I P E L I N E	FIGURE: <b>A - 13, Page 1 of 2</b>
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B O R I N G   L O G

LOGGED BY: <b>J. Brown</b>	DATE DRILLED: <b>6/5/00</b>	BORING ELEVATION: <b>492.2 feet</b>	BORING NO.:
DRILL RIG: <b>CMB 85</b>	BORING DIAMETER: <b>8 inches</b>	HAMMER WT.: <b>140 lbs</b> DROP: <b>30 in</b>	<b>B - 1 2</b>

DEPTH (feet)	SAMPLE NO.	TYPE	BLOWS/FOOT	GROUNDWATER	DESCRIPTION	MOISTURE CONTENT %	DRY DENSITY (pcf)	OTHER TESTS
21 22 23 24	8	C	50 5"		<p style="text-align: right;"><u>STADIUM CONGLOMERATE</u></p> <p>Dense, moist, yellowish-brown, CLAYEY MEDIUM TO FINE SAND (SC) with reddish-brown mottles</p> <hr style="border: 0.5px solid black;"/> <p>Very dense, moist, yellowish-brown, CLAYEY GRAVEL WITH SAND (GC) (est. 40 to 50% gravel up to 8" in size)</p>			
25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40					<p>BOTTOM OF BORING at 24 feet</p> <p>No free groundwater encountered at time of excavation</p> <p>Backfilled with cuttings</p>			

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.: <b>1 9 1 0</b>	<b>M I R A M A R   R O A D   P I P E L I N E</b>	FIGURE: <b>A - 13, Page 2 of 2</b>
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**B O R I N G   L O G**

LOGGED BY: <b>J. Brown</b>	DATE DRILLED: <b>6/5/00</b>	BORING ELEVATION: <b>494.5 feet</b>	BORING NO.:
DRILL RIG: <b>CME 85</b>	BORING DIAMETER: <b>8 inches</b>	HAMMER WT.: <b>140 lbs</b> DROP: <b>30 in</b>	<b>B - 1 3</b>

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)			
2								
3								
4								
5	2	C	15					
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)	10.3	106.0	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)			
14					<u>STADIUM CONGLOMERATE</u>			
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			

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.:	<b>1 9 1 0</b>	<b>M I R A M A R   R O A D   P I P E L I N E</b>	FIGURE: <b>A - 14, Page 1 of 1</b>
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**B O R I N G   L O G**

LOGGED BY: <b>J. Brown</b>	DATE DRILLED: <b>6/5/00</b>	BORING ELEVATION: <b>495.9 feet</b>	BORING NO. : <b>B - 1 4</b>
DRILL RIG: <b>CME 85</b>	BORING DIAMETER: <b>8 inches</b>	HAMMER WT.: <b>140 lbs</b> DROP: <b>30 in</b>	

DEPTH (feet)	SAMPLE NO.	TYPE	BLOWS/FOOT	GROUND-WATER	DESCRIPTION	MOISTURE CONTENT %	DRY DENSITY <sub>pcf</sub>	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 <u>TOPSOIL</u> (est. 15 to 20% gravel up to 8" in size)			
2					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) <u>STADIUM CONGLOMERATE</u>			
3								
4	2	BK			drive sample attempt at 5 feet on gravel; no advance/50 blows			
5					Dense, moist, yellowish-brown, CLAYEY MEDIUM TO FINE SAND (SC)			
6								
7								
8					sampler driven on gravel			
9	3	BK						
10								
11	4	C	<u>65</u>		Very dense, moist, yellowish-brown with reddish-brown mottles, CLAYEY GRAVEL (GC) (est. 40 to 50% gravel up to 8" in size)			SA
12	5	BK	<u>8"</u>					
13					BOTTOM OF BORING at 20 <sup>3</sup> / <sub>4</sub> feet No free groundwater encountered at time of excavation Backfilled with cuttings			
14								
15								
16	6	S	<u>86</u>					
17			<u>9"</u>					
18								
19								
20	7	C	<u>94</u>					
			<u>10"</u>					

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.: <b>1 9 1 0</b>	<b>M I R A M A R   R O A D   P I P E L I N E</b>	FIGURE: <b>A - 15, Page 1 of 1</b>
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**B O R I N G   L O G**

LOGGED BY: <b>J. Brown</b>	DATE DRILLED: <b>6/5/00</b>	BORING ELEVATION: <b>513.0 feet</b>	BORING NO.:
DRILL RIG: <b>CME 85</b>	BORING DIAMETER: <b>8 inches</b>	HAMMER WT.: <b>140 lbs</b> DROP: <b>30 in</b>	<b>B - 1 5</b>

DEPTH (feet)	SAMPLE NO.	TYPE	BLOWS/FOOT	GROUND-WATER	DESCRIPTION	MOISTURE CONTENT %	DRY DENSITY pcf	OTHER TESTS
1					3 3/4" AC over 4" yellowish-brown SILTY GRAVEL WITH SAND (GM) <u>PAVEMENT SECTION</u>			
2					Moist, yellowish-brown, CLAYEY MEDIUM TO FINE SAND (SC), with few gravel (est. 5% gravel to 1" in size)			
3	1	S	33		5" AC over 4" black, SILTY GRAVEL WITH SAND (GM)			
4				▽	Moist, black, SILTY COARSE TO FINE SAND (SM), with few to some small gravel			
5	2	C	21	≡	wet, perched water zone			
6					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)			
7								
8								
9								
10	3	S	22					
11								
12								
13								
14					Moist, very dark, very CLAYEY COARSE TO FINE SAND (SC), with few gravels			
15	4	C	25					
16								
17								
18					Very dense, moist, yellowish-brown, CLAYEY MEDIUM TO FINE SAND (SC), with many gravels (est. 30 to 40% gravel up to 5" in size)			
19	5	S	50		<u>STADIUM CONGLOMERATE</u>			
20			4"					

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.: <b>1 9 1 0</b>	<b>M I R A M A R   R O A D   P I P E L I N E</b>	FIGURE: <b>A - 16, Page 1 of 2</b>
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B O R I N G   L O G

LOGGED BY: <b>J. Brown</b>	DATE DRILLED: <b>6/5/00</b>	BORING ELEVATION: <b>513.0 feet</b>	BORING NO.:
DRILL RIG: <b>CME 85</b>	BORING DIAMETER: <b>8 inches</b>	HAMMER WT.: <b>140 lbs</b> DROP: <b>30 in</b>	<b>B - 1 5</b>

DEPTH (feet)	SAMPLE NO.	TYPE	BLOWS/FOOT	GROUND- WATER	DESCRIPTION	MOISTURE CONTENT %	DRY DENSITY pcf	OTHER TESTS
21					<u>STADIUM CONGLOMERATE</u>			
22					Very dense, moist, yellowish-brown, CLAYEY MEDIUM TO FINE SAND (SC), with many gravels (est. 30 to 40% gravel up to 5" in size)	↓	13.5	104.1
24	6	C	$\frac{80}{6}$ "					
26	7	BK						
28	8	S	$\frac{60}{6}$ "					SA
34	9	C	$\frac{75}{4}$ "		no recovery			
35					BOTTOM OF BORING at 34½ feet			
36					Perched water zone 4 - 4¾ feet			
37					Backfilled with cuttings; patched with asphalt			
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.: <b>1 9 1 0</b>	<b>M I R A M A R   R O A D   P I P E L I N E</b>	FIGURE: <b>A - 16, Page 2 of 2</b>
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**B O R I N G   L O G**

LOGGED BY: <b>J. Brown</b>	DATE DRILLED: <b>6/7/00</b>	BORING ELEVATION: <b>499.0 feet</b>	BORING NO.:
DRILL RIG: <b>CME 85</b>	BORING DIAMETER: <b>8 inches</b>	HAMMER WT.: <b>140 lbs</b> DROP: <b>30 in</b>	<b>B - 1 6</b>

DEPTH (feet)	SAMPLE NO.	TYPE	BLOWS/FOOT	GROUNDWATER	DESCRIPTION	MOISTURE CONTENT %	DRY DENSITY (pcf)	OTHER TESTS	
1	1	S	32		Moist, dark brown, CLAYEY GRAVEL WITH SAND (GC) (est. 40% gravel up to 6" in size) <span style="float:right"><u>FILL</u></span>				
2									
3	2	PB							
4									
5									
6	3	C	32		no recovery - possibly pushed rock during drive				
7				▽					
8	4	C	7	≡	Loose, moist, dark brown, SILTY MEDIUM TO FINE SAND (SM) <span style="float:right"><u>ALLUVIUM</u></span> - wet zone (perched water)	27.0	92.6		
9	5	BK		Firm, moist, brown, FAT CLAY (CH) - 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) <span style="float:right"><u>LINDAVISTA FORMATION</u></span>				
12					- with some gravel (est. 20% gravel up to 3" in size)				
13									
14									
15					- with trace gravel (est. <5% gravel)				
16	7	C	75			17.8	105.9		
17	8	BK							
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.: <b>1 9 1 0</b>	<b>M I R A M A R   R O A D   P I P E L I N E</b>	FIGURE: <b>A - 17, Page 1 of 2</b>
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B O R I N G   L O G

LOGGED BY: <b>J. Brown</b>	DATE DRILLED: <b>6/7/00</b>	BORING ELEVATION: <b>499.0 feet</b>	BORING NO.:
DRILL RIG: <b>CME 85</b>	BORING DIAMETER: <b>8 inches</b>	HAMMER WT.: <b>140 lbs</b> DROP: <b>30 in</b>	<b>B - 1 6</b>

DEPTH (feet)	SAMPLE NO.	TYPE	BLOWS/FOOT	GROUNDWATER	DESCRIPTION	MOISTURE CONTENT %	DRY DENSITY (pcf)	OTHER TESTS
21	9	S	37		Interbedded dense, moist, brown and gray-brown, <u>LINDAVISTA FORMATION</u> 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								
26	10	C	$\frac{85}{9}$					
27					BOTTOM OF BORING at 26 $\frac{1}{4}$ feet Perched water zone 7 $\frac{1}{2}$ - 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.: <b>1 9 1 0</b>	<b>M I R A M A R   R O A D   P I P E L I N E</b>	FIGURE: <b>A - 17, Page 2 of 2</b>
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LOGS OF EXCAVATIONS  
FROM  
NINYO & MOORE  
1994-95



DEPTH (foot)	SAMPLES		BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DATE DRILLED _____ BORING NO. _____ SAMPLE _____
	Bulk	Dry						GROUND ELEVATION _____ SHEET 1 OF 1
								METHOD OF DRILLING _____
								DRIVE WEIGHT _____ DROP _____
								SAMPLED BY _____ LOGGED BY _____ REVIEWED BY _____
								DESCRIPTION/INTERPRETATION
0								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
3								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
								h: Bedding
								c: Contact
								j: Joint
								f: Fracture
								F: Fault
								cs: Clay Seam
								s: Shear
								hss: Basal Slide Surface
								sf: Shear Fracture
								sz: Shear Zone
								sbs: Sheared Bedding Surface
20								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.  
SAMPLE

DATE  
Rev. 9/94

FIGURE