Produced for Humboldt Bay Harbor, Recreation, and Conservation District

moffatt & nichol

HUMBOLDT HARBOR OFFSHORE WIND PORT

PROGRESS MEETING

GEOTECHNICAL EVALUATIONS

September 01, 2022

Boring Location Map

N

SCALE

0 250 500 Feet

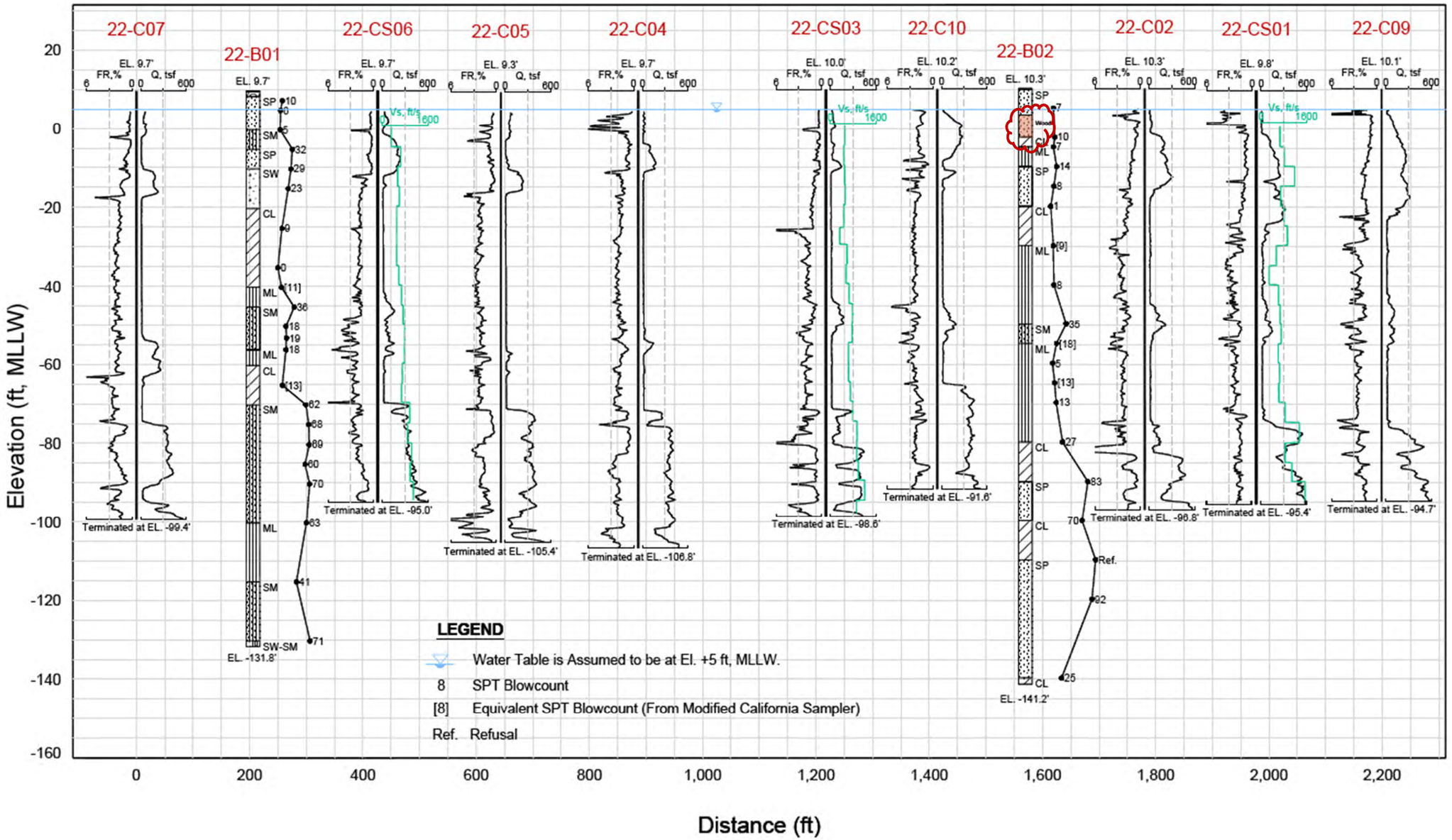
LEGEND

22-C02 CPT Sounding

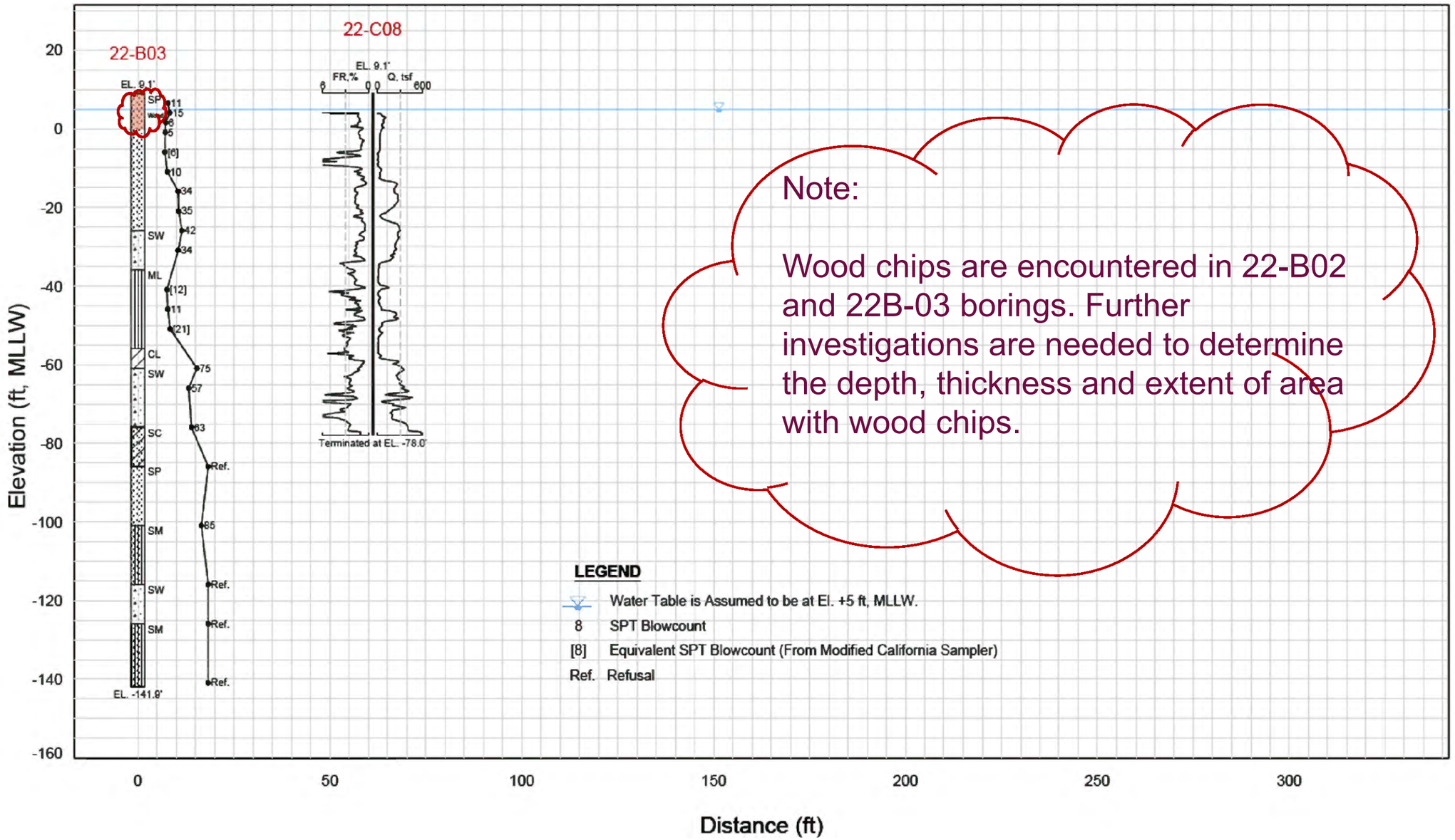
22-CS06 Seismic CPT Sounding

22-B01 Proposed Boring

Subsurface Cross-Sections: Wharf Area



Subsurface Cross-Sections: Crane Area



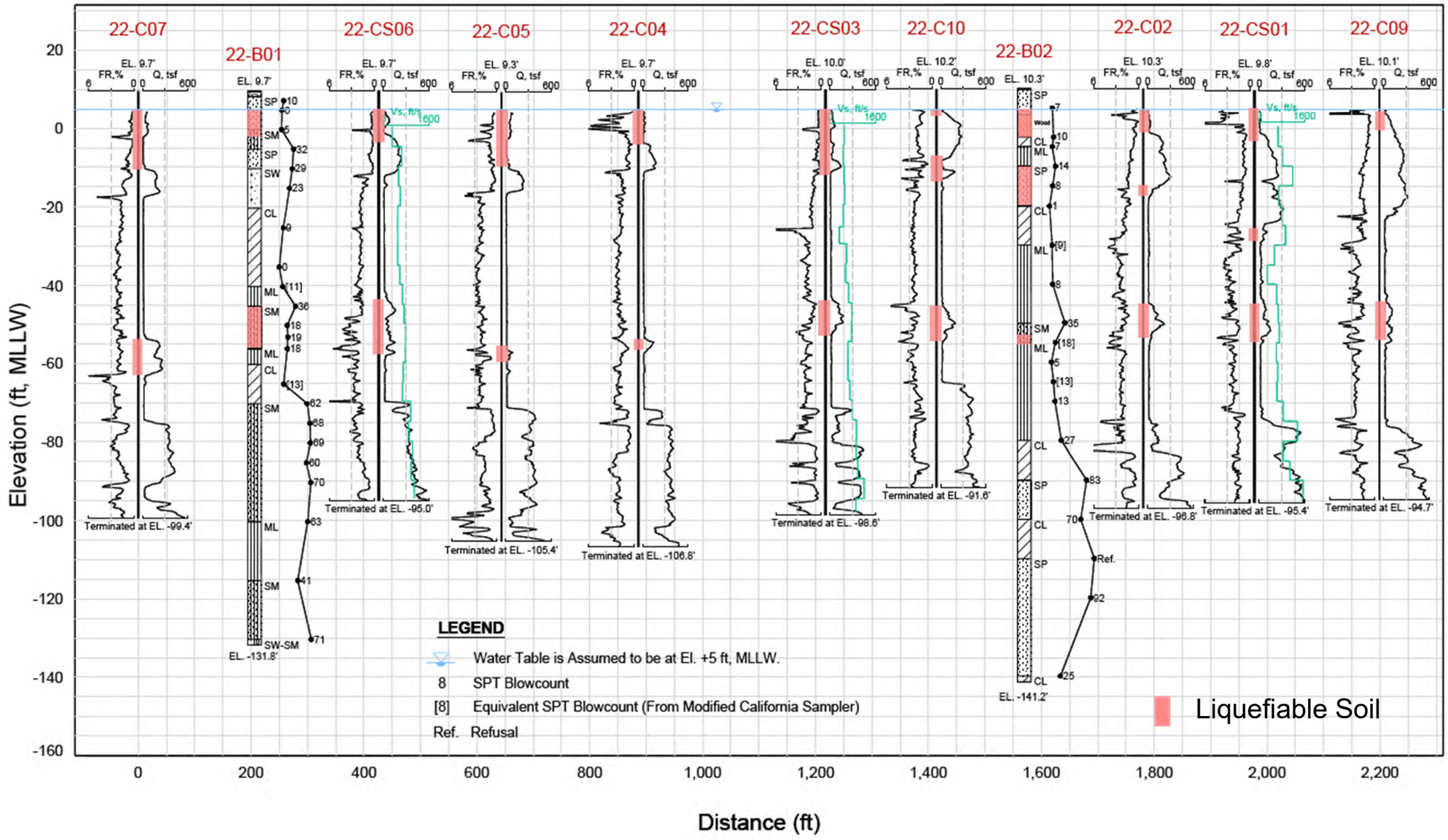
Seismic Analysis Considerations

Structure Type					
	Wharves			Other Structures	
	Wind Port/General Cargo	Liquid/Oil Bulk	Hydrogen	Cruise Terminal	Buildings	Non-Building Structures
Code	No Available Code	MOTEMS (CBC Chapter 31F)	No Available Code	CBC	CBC	CBC
	Not under CBC (no public access)		Recommend using CBC	-	-	-
	Recommend using CBC		Business continuity requirement?			
	Business continuity requirement?					
Seismic	DE/MCE_G ?	2 Levels (High Risk)	DE/MCE_G ?	DE/MCE_G	DE/MCE_G	DE/MCE_G
	Level 1/2 ?					
Tsunami	?	?	?	?	?	?
Sea Level Rise	50Yr/100Yr ?	50Yr/100Yr ?	50Yr/100Yr ?	50Yr/100Yr ?	50Yr/100Yr ?	50Yr/100Yr ?
Jurisdiction / Permitting	County	California State Lands Commission	County	County	County	County

- Preliminary PGA Estimates:
  - **CBC* - PGA_M** (ASCE 7-16): 1.42 g
  - **CBC - PGA_{DE}** (ASCE 7-16): 0.93 g
  - **Level 2** - PGA** - 475 years return period (10% probability of exceedance in 50 years): 0.76 g
  - **Level 1** - PGA** - 72 years return period (50% probability of exceedance in 50 years): 0.23 g

* For geotechnical evaluations
** ASCE 61-14

Liquefaction Potential: CBC/Level 2 Events



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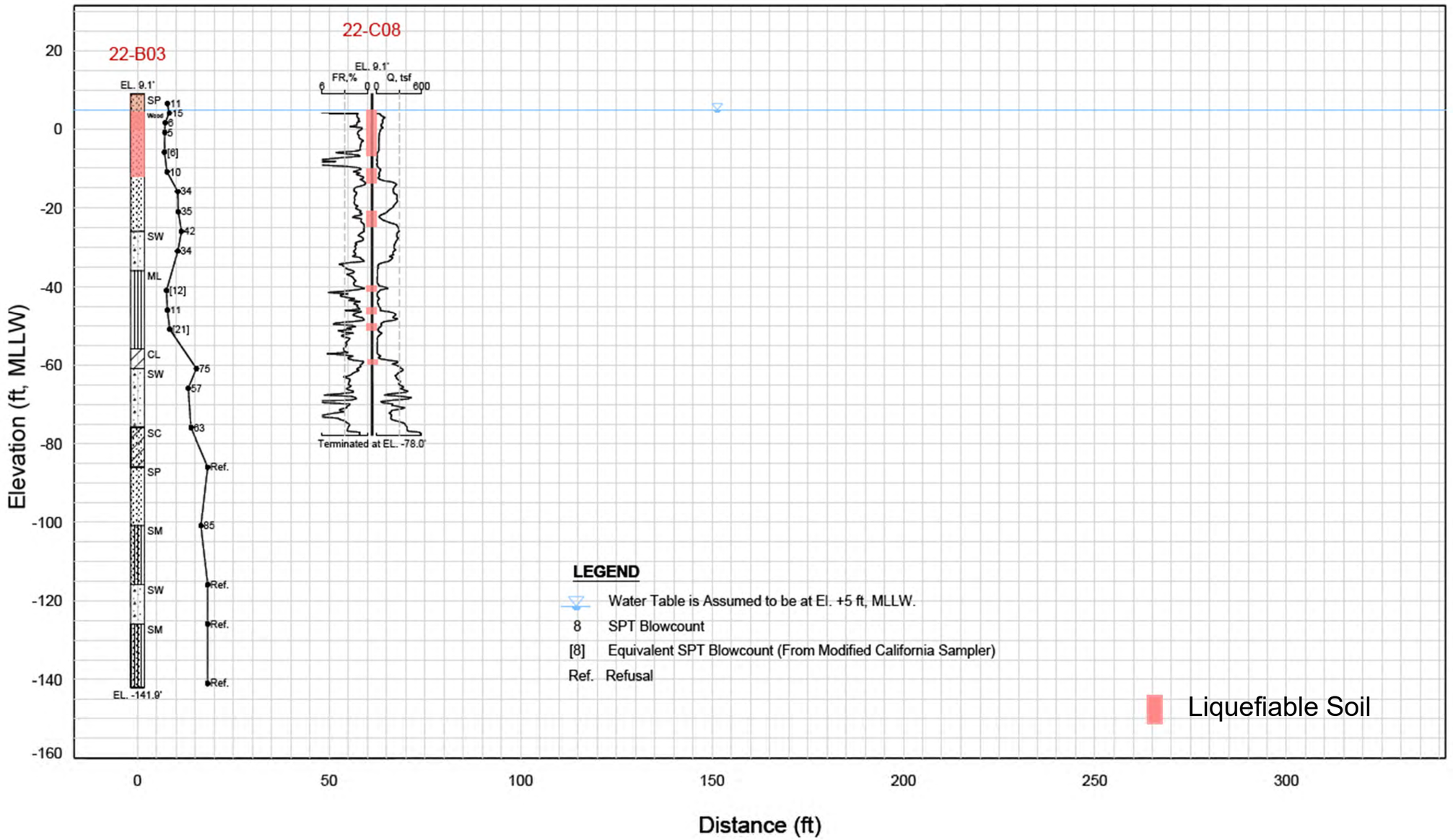
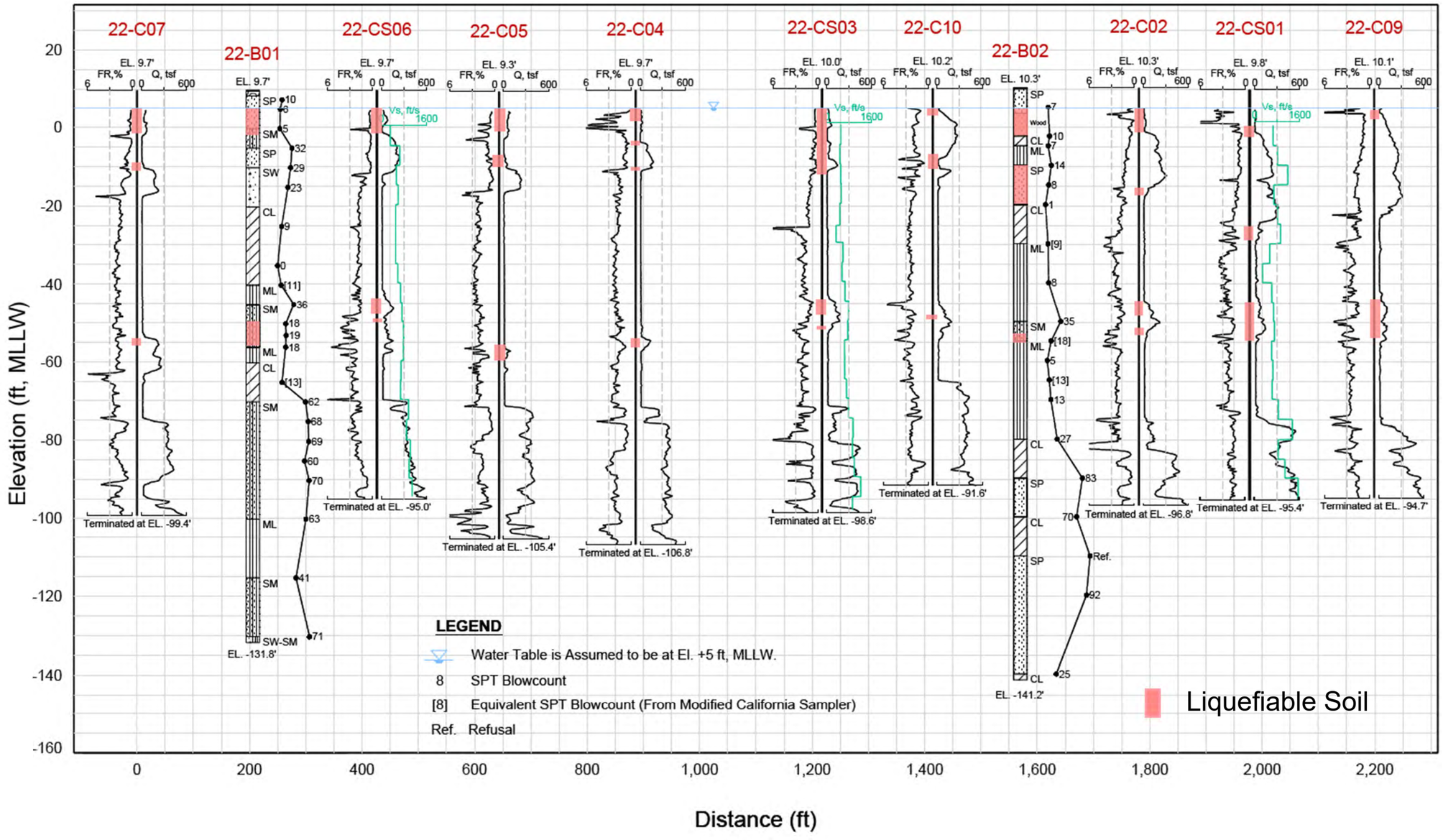
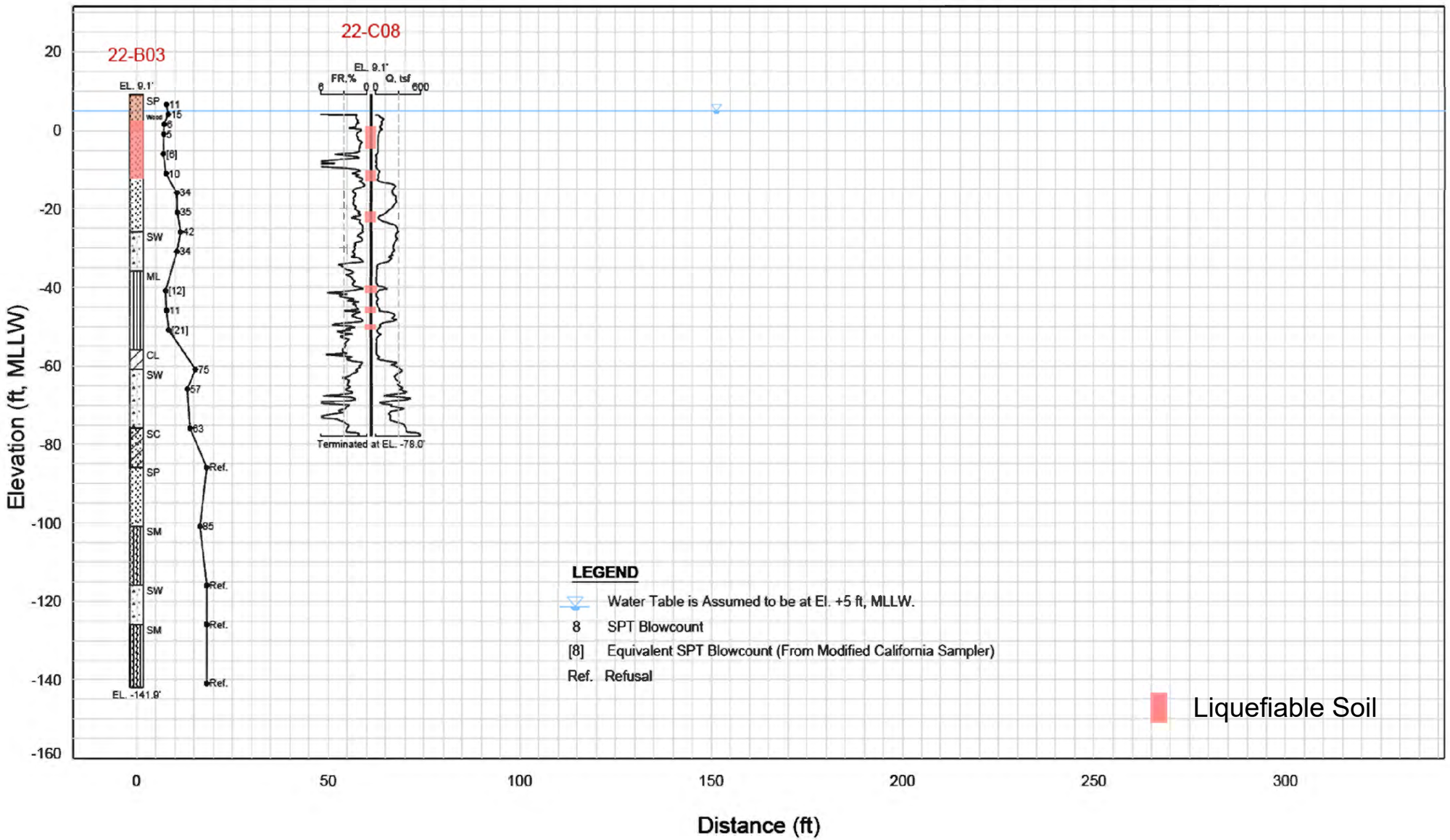


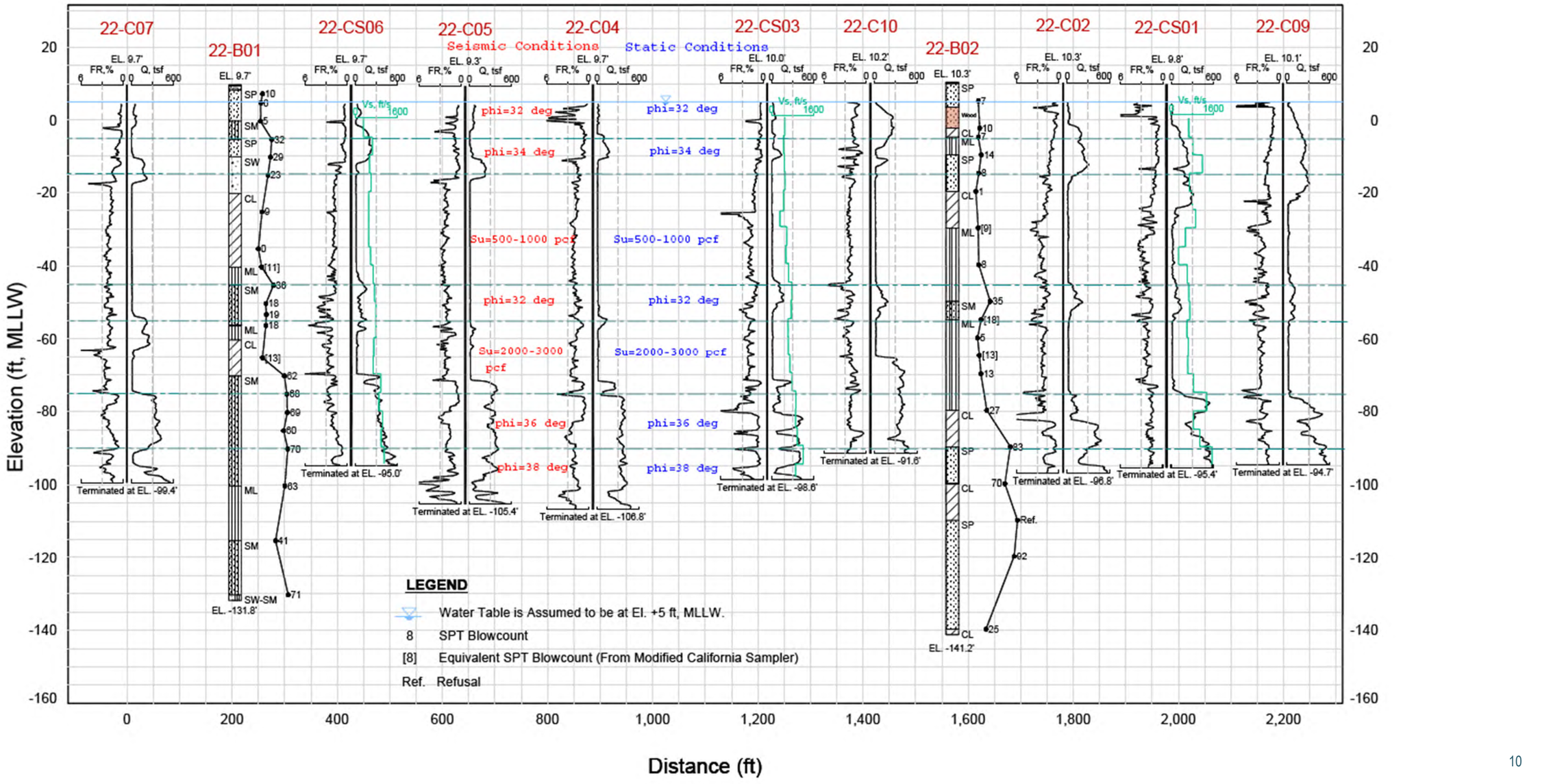
Liquefaction Potential: CBC/Level 1 Event



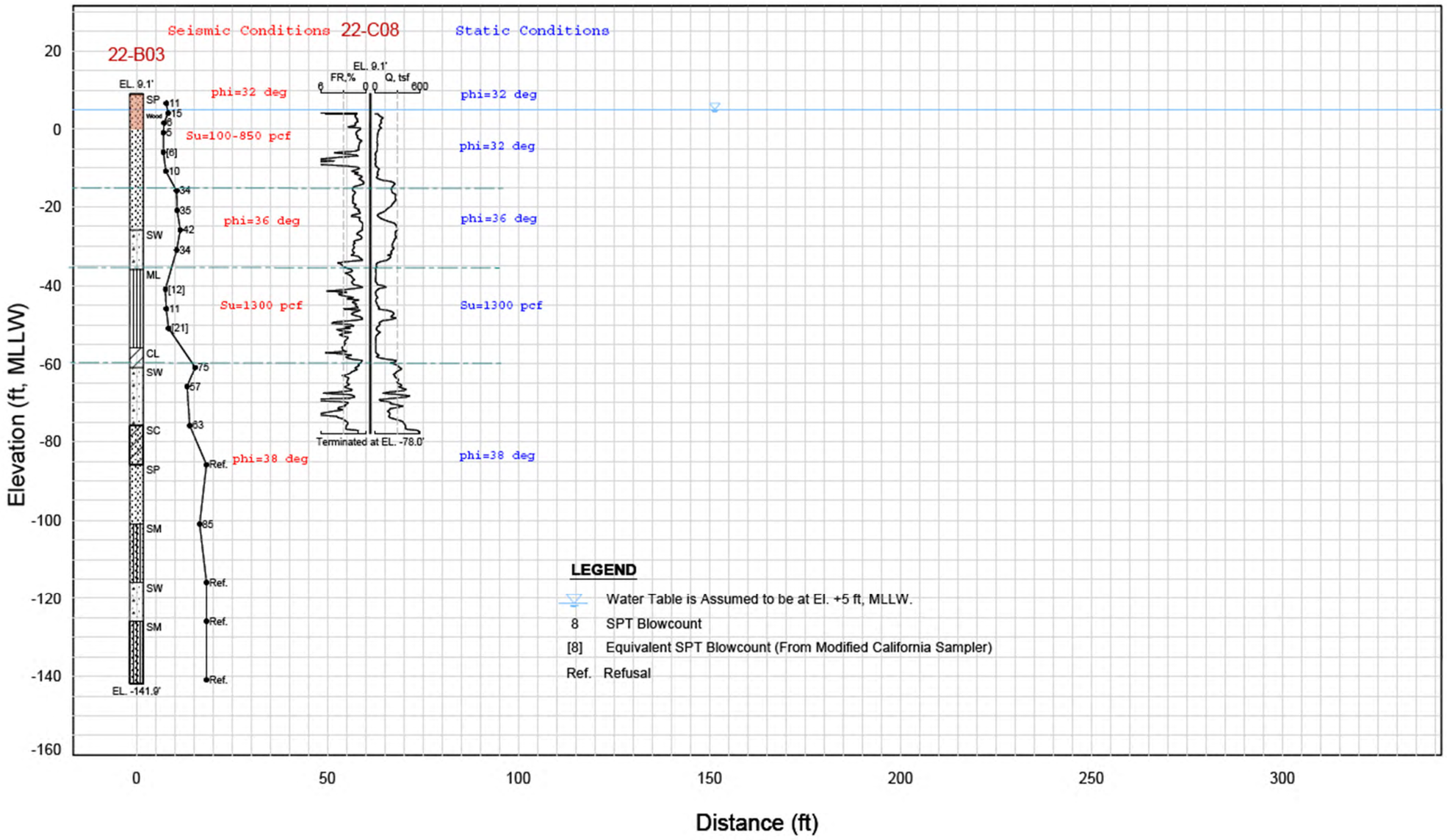
Liquefaction Potential: CBC/Level 1 Event



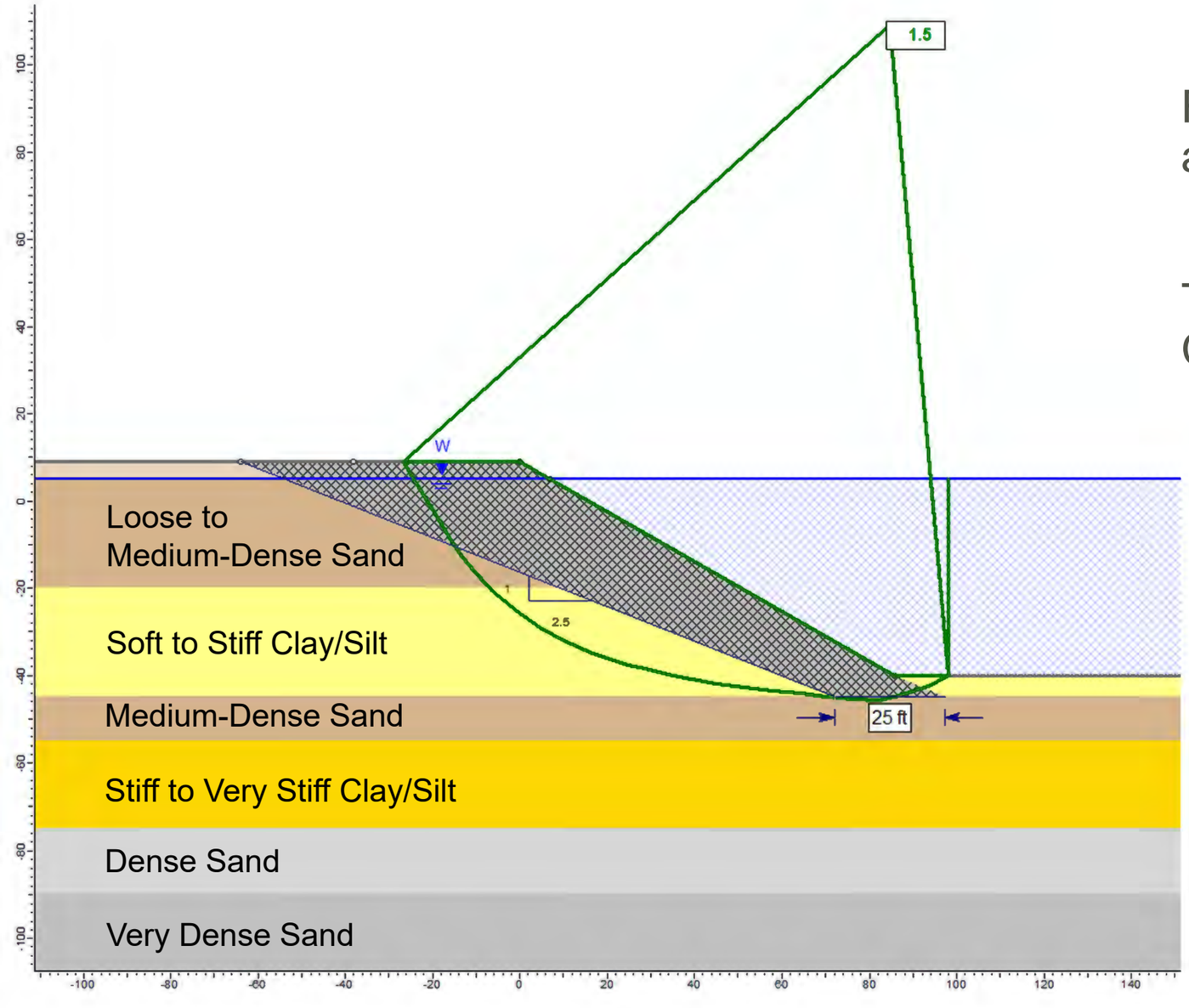
Idealized/Generalized Soil Profile: Wharf Area



Idealized/Generalized Soil Profile: Crane Area



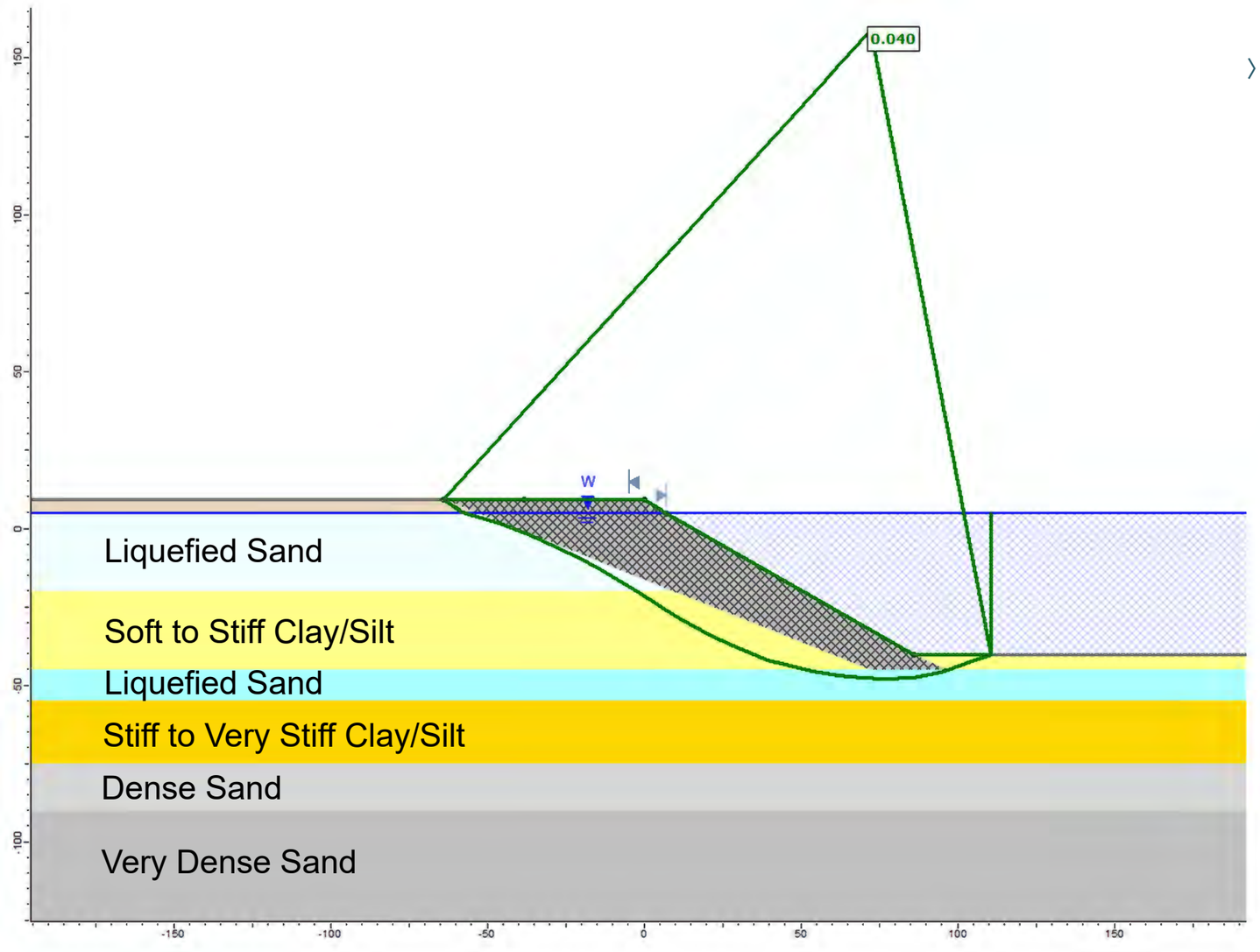
Global Slope Stability under Static Conditions



For a dyke with 25 ft-wide bottom dimension and 2.5H:1V dredge slope:

The preliminary Factor of Safety under Static Conditions is 1.5.

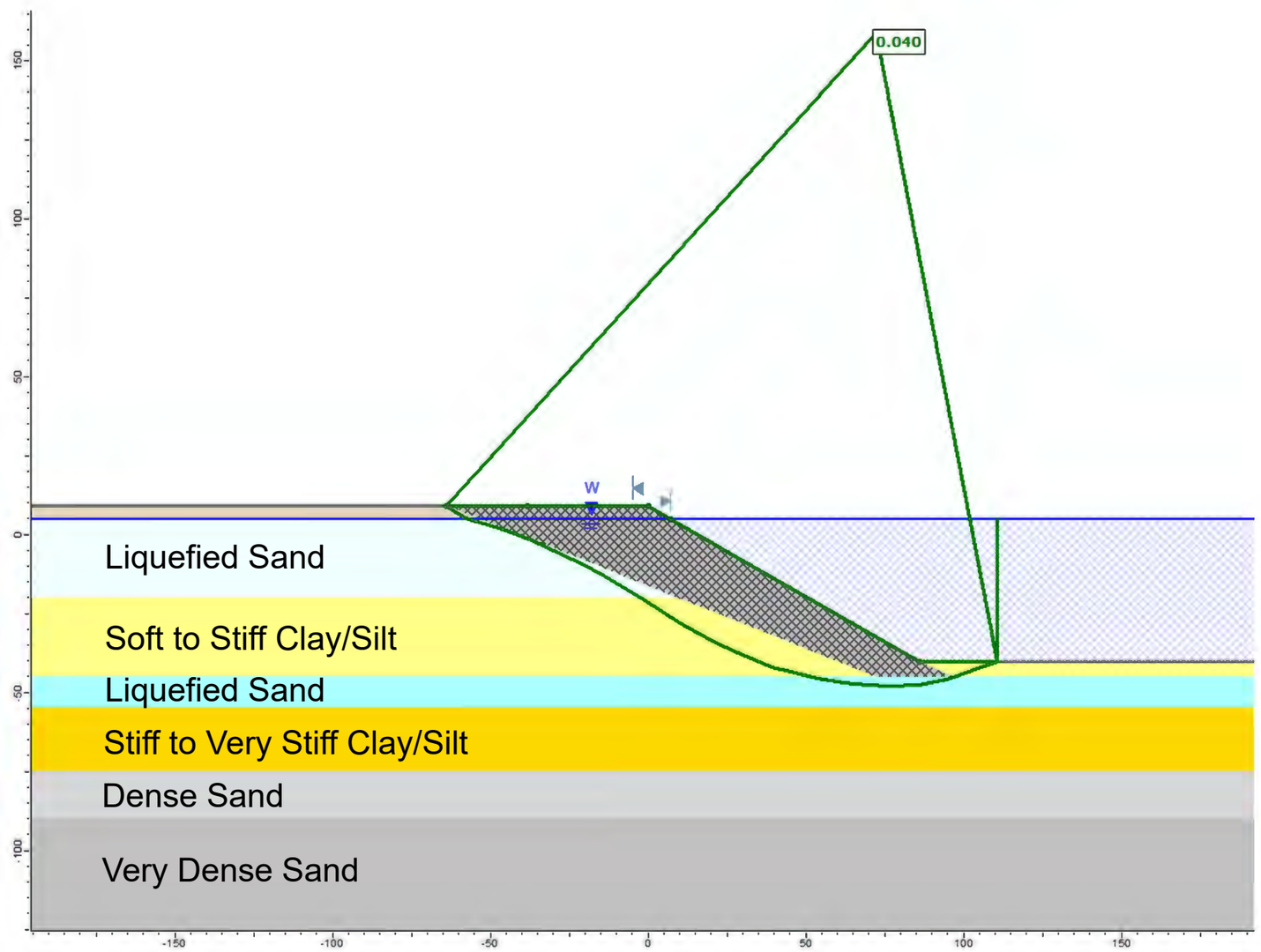
Slope Movement under Seismic Events



- Assuming a “Yield Acceleration” of 0.04 g; the preliminary slope movement estimates*:
  - CBC (1.4 g): >10 ft
  - CBC-DE (0.93 g): >10 ft
  - ASCE 61, Level 2 (0.76 g): >5 ft
  - ASCE 61, Level 1 (0.22 g): ~1 ft

* Free-field slope movement estimates (without considering pile pinning benefits)

Building Foundations within Slope Movement Zone



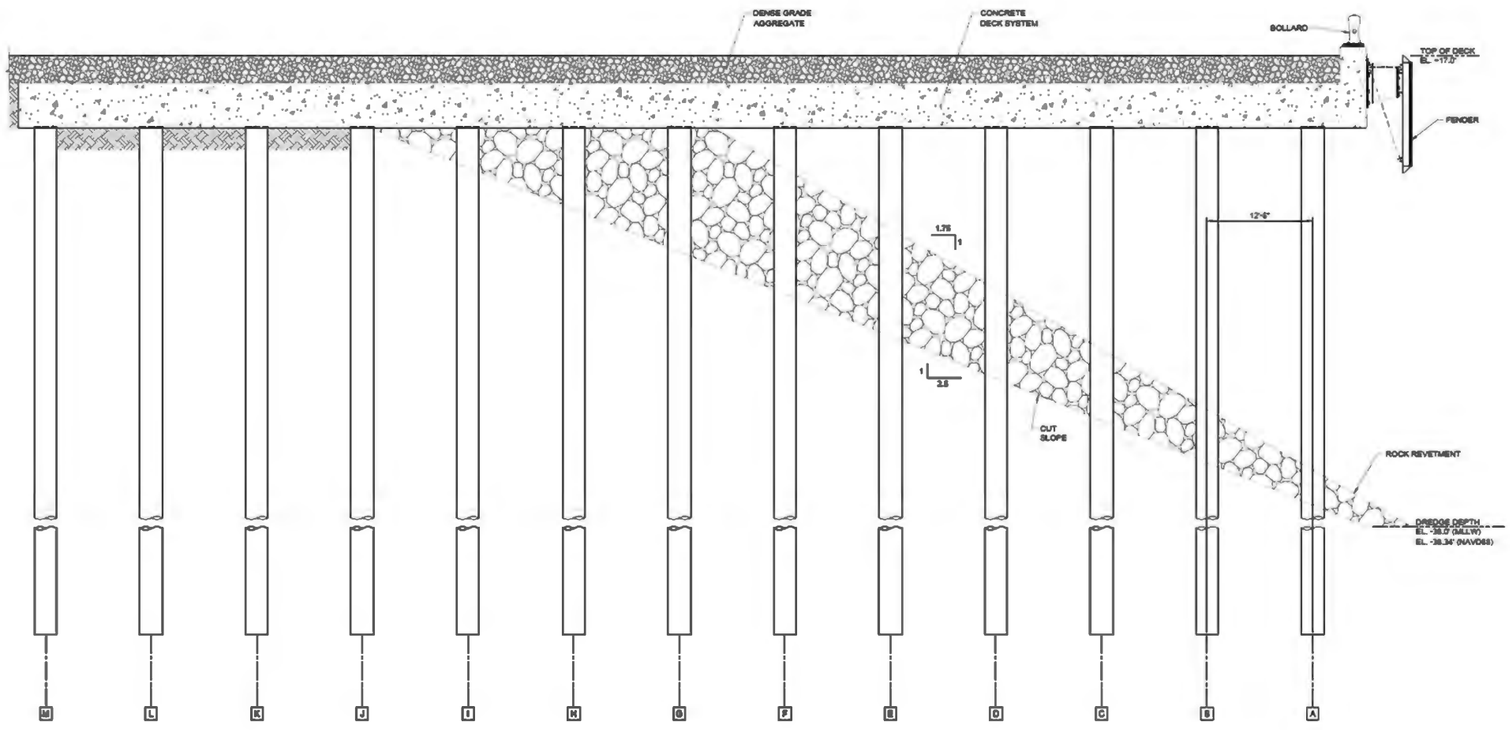
- Per ASCE 7-16, any human occupancy structure within the lateral slope movement zone with movement more than 18 inches under the Maximum Considered Earthquake (MCEG) event, cannot be supported on shallow foundation.

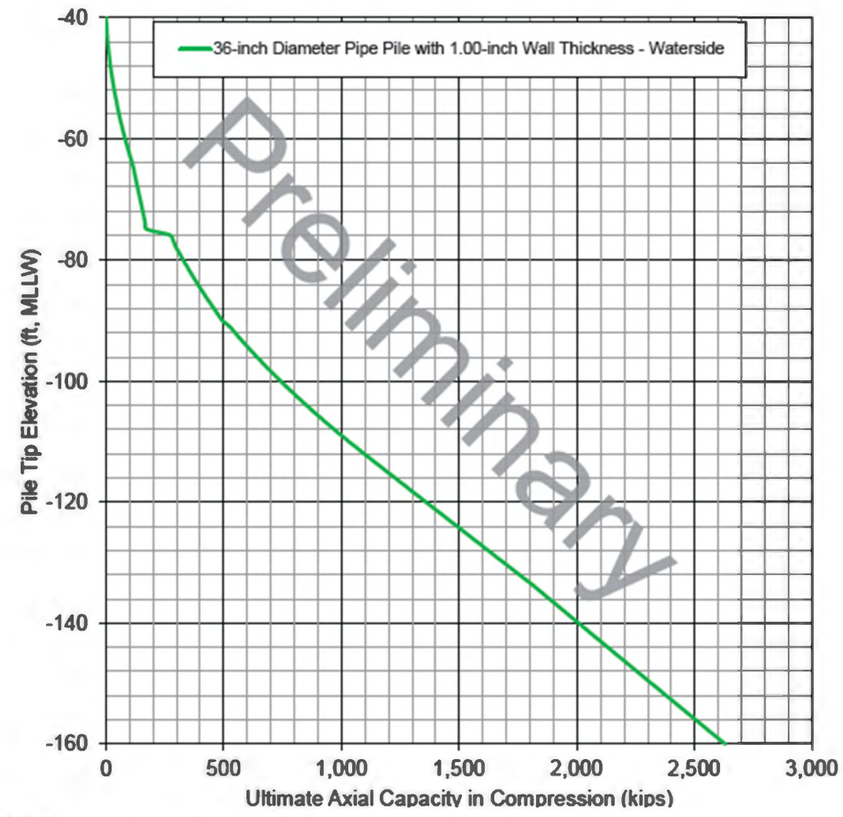
Table 12.13-2 Upper Limit on Lateral Spreading Horizontal Ground Displacement for Shallow Foundations Beyond Which Deep Foundations Are Required

Risk Category	I or II	III	IV
Limit (in. (mm))	18 (455)	12 (305)	4 (100)

- **Possible Solutions**:
  - Moving the building further backland; or
  - Improving the Ground; or
  - Using Pile foundations

Preliminary Wharf Pile Design





Notes:
1) Pile weight is not included in the axial capacity estimate.

2) Axial capacity estimates are based on assuming a uniform pile wall thickness (i.e., no variation in the inside diameter of the pipe pile).

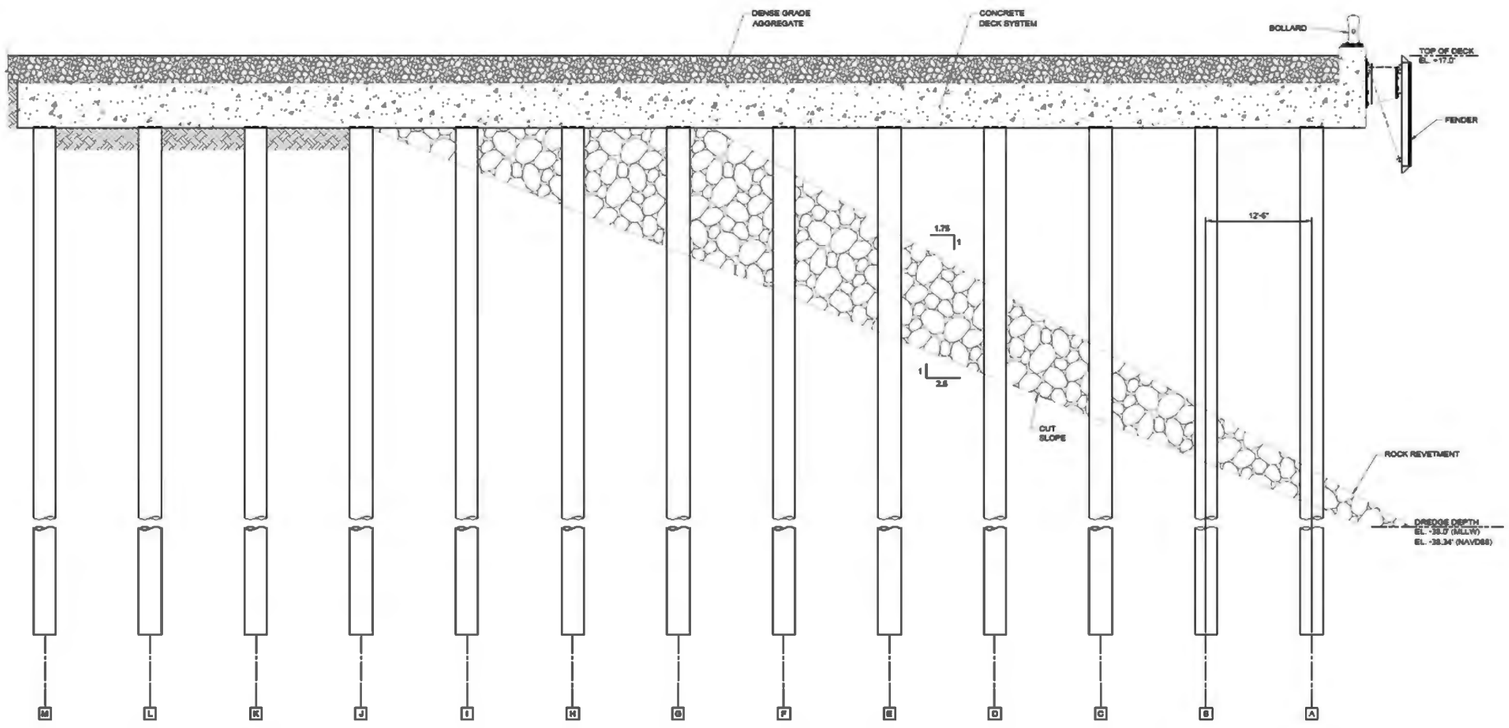
3) Pile group effects on axial capacity can be neglected if the center-to-center spacing is equal to or greater than 2.5 times the pile diameter.

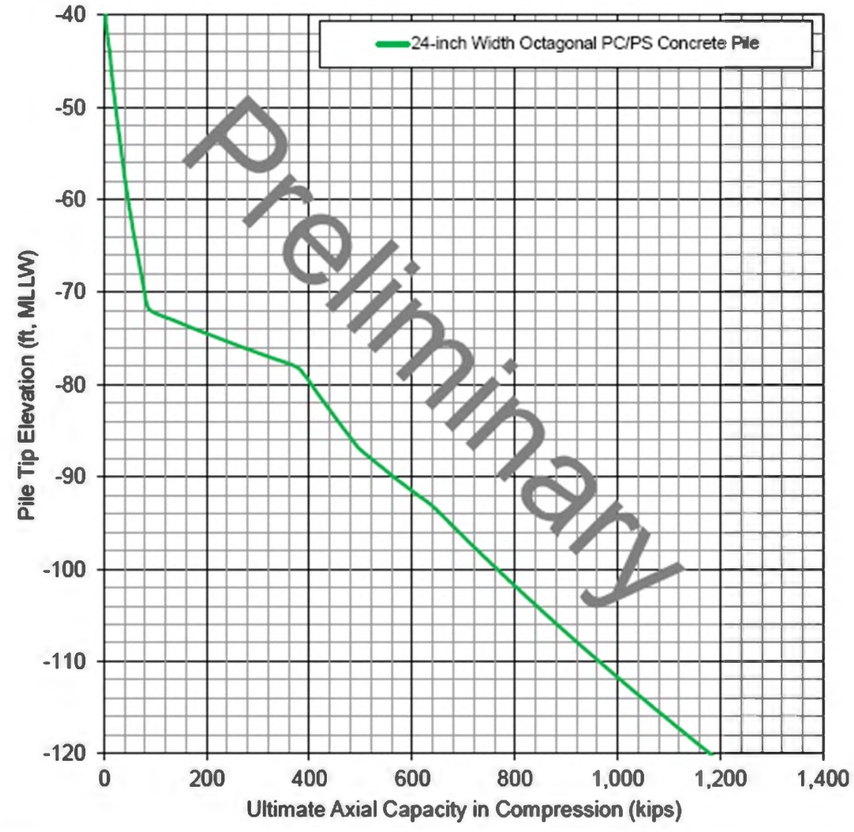
4) Mudline elevation is assumed to be at El. -40 ft, MLLW.

5) The factor of safety under static conditions is 2.0.

- 36 inch diameter steel pipe piles with 1 inch wall thickness
- Preliminary pile tip El. -155 ft, MLLW for 1,200 kips allowable capacity

Preliminary Wharf Pile Design





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4) The factor of safety under static conditions is 2.0.

- 24 inch width PC/PS concrete piles

Preliminary Earthquake Induced Settlement

- Estimated preliminary liquefaction-induced settlement:
  - MCEG/DE/Level 2: ~6 inches
  - Level 1: ~5 inches

- Additionally, about ½ of the lateral slope movement should be considered as the vertical movement (settlement).

Backland Preliminary Consolidation Settlement

- Raising the grade from EL. +11 ft to EL.+17 ft, MLLW: 1.5 ft
  (0.4 ft and 0.5 ft occur in first 6 months and 1 year, respectively.)

- Additional consolidation settlement due to permanent Live Loads:
  - For 1,000 psf : 1.5 ft
  - For 2,000 psf : 2.0 ft
  - For 3,000 psf : 2.5 ft

Note: The above estimates are based on C_{ce} = 0.15 from limited lab test results and assuming C_v = 20 ft^2/yr. The amount and the rate of the estimated settlement might be updated based on additional lab test results.

Settlement Mitigation Recommendations

› Settlement Mitigation Recommendations: Wick Drains and Surcharge