Oakland Harbor Turning Basins Widening

Geotechnical Engineering

May 2024

PORT OF OAKLAND

1. Introduction

This appendix was developed as part of the Oakland Harbor Turning Basins Widening feasibility study. This appendix summarizes exiting geotechnical conditions at the site and presents the findings of the engineering analysis conducted to support the development of recommend improvements to the Inner and Outer Harbor Turning Basins. This Appendix is based on review of plans and design documents from previous projects, consultant, and agency geotechnical reports, and published geologic reports.

A set of schematic plans depicting the existing conditions, proposed conditions, and geotechnical data are included as Attachment 1 and are referenced throughout this document.

1.1. Project Description

The Port of Oakland Outer Harbor Turning Basin (OHTB) is located in the outer harbor channel near berths 25 through 30. The OHTB has a diameter of 1,650 feet; the bottom elevation of -50 feet (NAVD88) is maintained by annual dredging.

The Inner Harbor Turning Basin (IHTB) is located approximately 18,000 feet to the east of the Oakland Harbor entrance near the Howard Terminal. The IHTB basin had a diameter of 1,500 feet; the bottom elevation of -50 feet is maintained by annual dredging.

The locations of the Outer and Inner Harbor Turning Basins are indicated in Figure 1.

This study considered several alternative geometries for both the OHTB and the IHTB. The Tentatively Selected Plan (TSP) consists of widening both the Inner and Outer Harbor Turning Basins to 1,835 feet and 1,965 feet, respectively. The Turning Basin bottom elevations would remain at Elevation -50 feet. The OHTB Variation 2.1 would not require impacts to the land. The IHTB Variation A would require excavation into the Howard Terminal on the north side of the channel and into private property on the south side of the channel. The proposed footprints for the OHTB and IHTB are shown on Figures 2 and 3, respectively. Refer to the Channel Design Appendix B1 for descriptions of the variations that were considered during the alternative analysis process.

The TSP includes construction of new bulkhead walls at Howard Terminal and on the Fisk Property in Alameda. The TSP also includes a below-grade, in-water retaining structure in front of the Schnitzer Steel property to the northwest of the IHTB. The wall will be approximately 300 to 400 feet long and will be entirely submerged. The wall will likely be a concrete secant wall or driven pile structure. The wall will be offset 10 to 20 feet from the existing Schnitzer Steel wall in the direction of the turning basin. The top of the wall will be flush with the existing grade (mudline) at the base of the Schnitzer wall. The proposed wall will retain approximately 20 to 25 feet of soil.

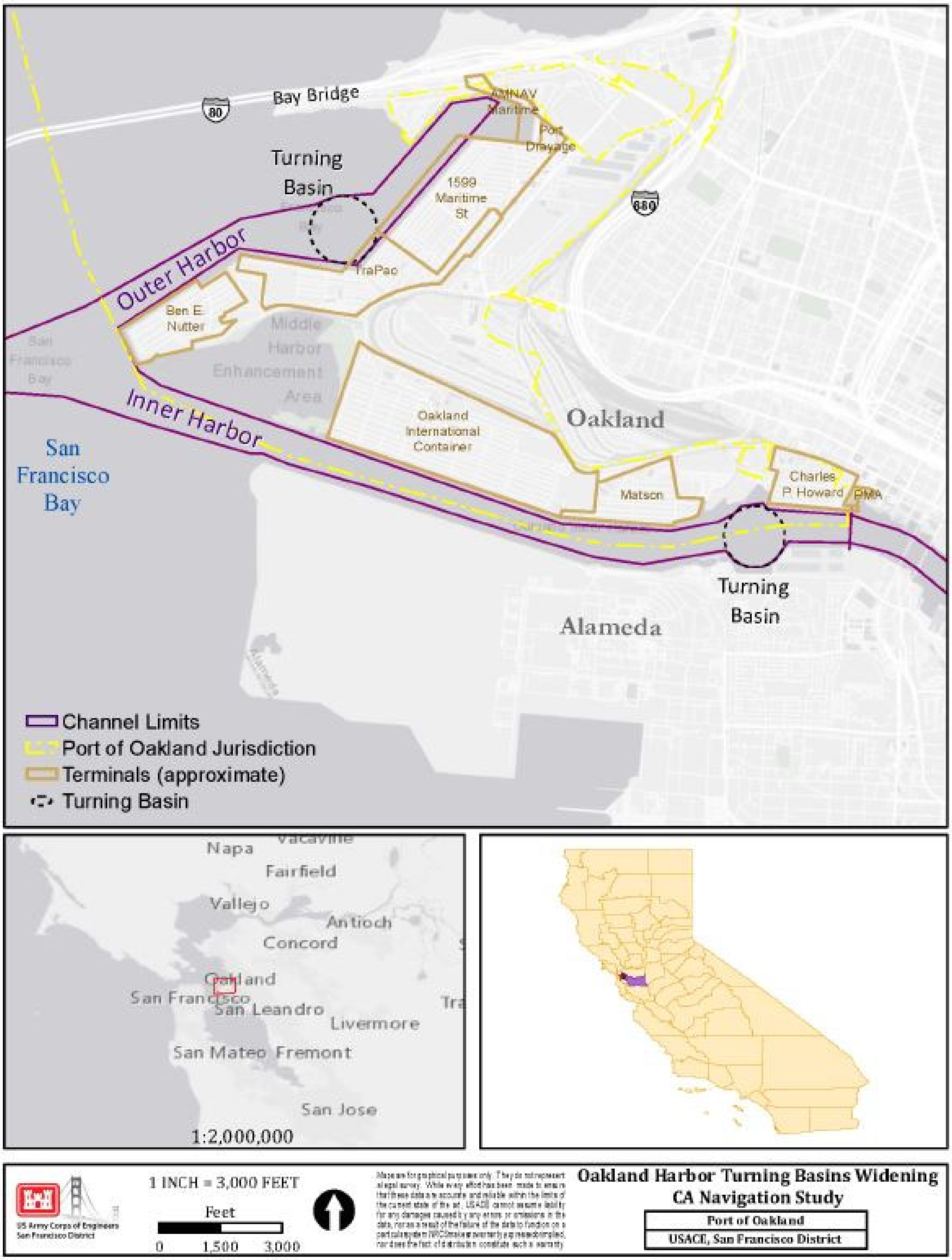


Figure 1: Study Area Location

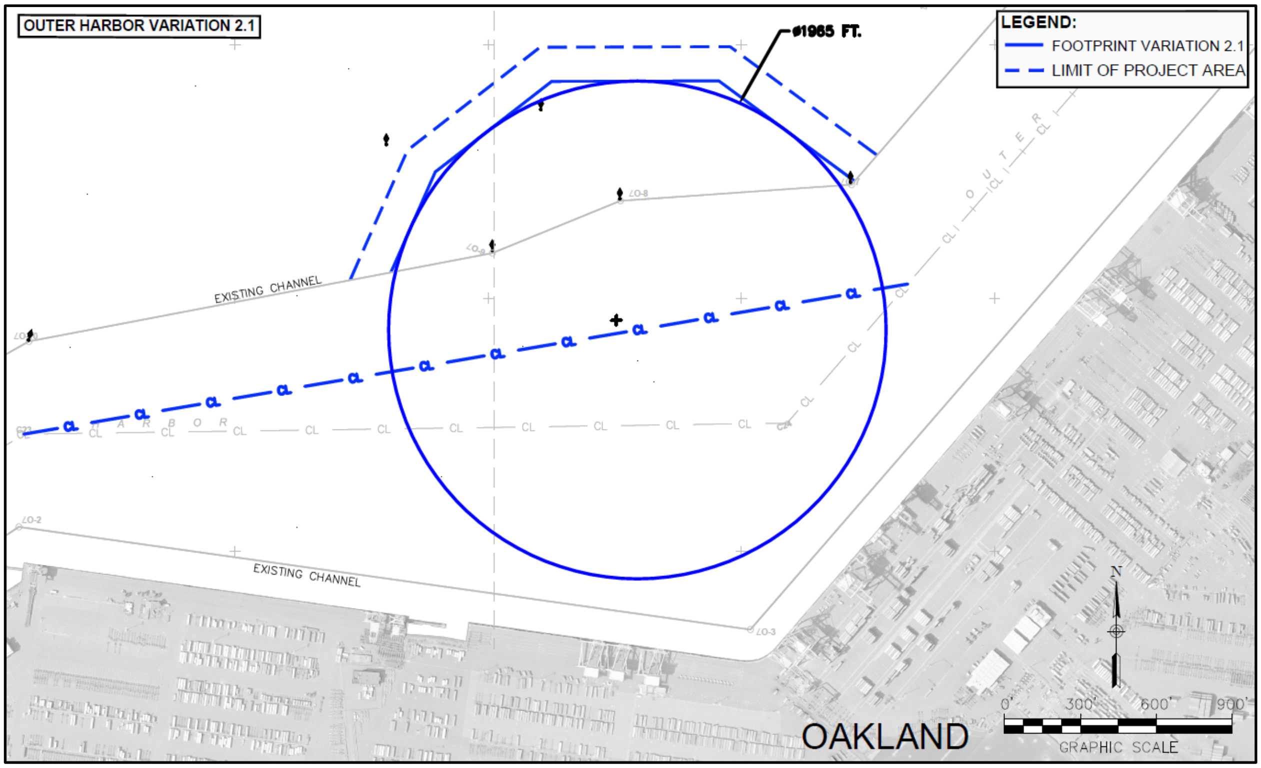


Figure 2: Outer Harbor Turning Basin Proposed Footprint

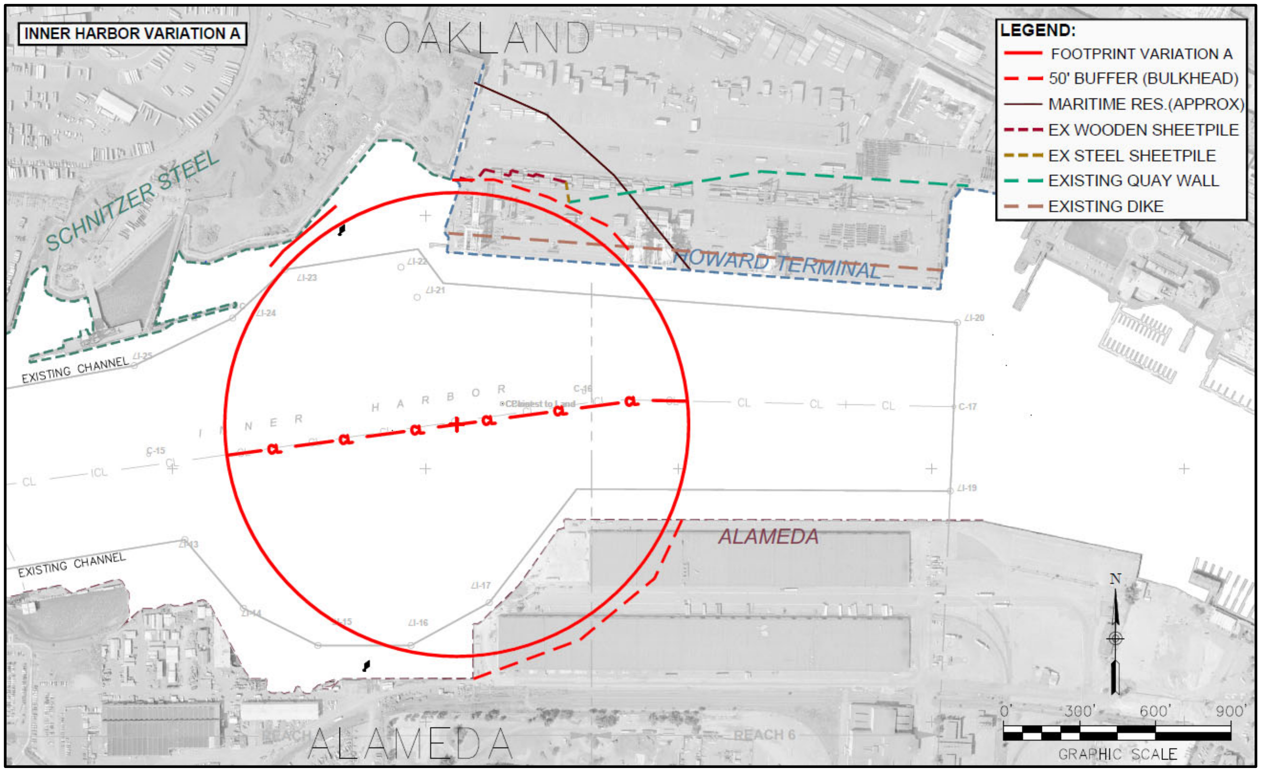


Figure 3: Inner Harbor Turning Basin Proposed Footprint

1.2. Datums

This Appendix relies on existing subsurface information taken from various consultant and agency reports, and as-built plans for existing facilities. The conversion factors presented in Table 1 were used to convert the reported elevations to NAVD88. All Elevations in this Appendix are reported relative to NAVD88 unless otherwise noted. Mean Lower Low Water is approximately equal to NAVD88. These conversions are considered accurate enough for interpretation of subsurface data.

Table 1. Datum Conversions

Datum	Elevation (NAVD88)
MLLW	-0.2
NAVD 29	+ 2.7
Port of Oakland Datum (P.O.D.)	-0.5
City of Oakland Datum	+5.7

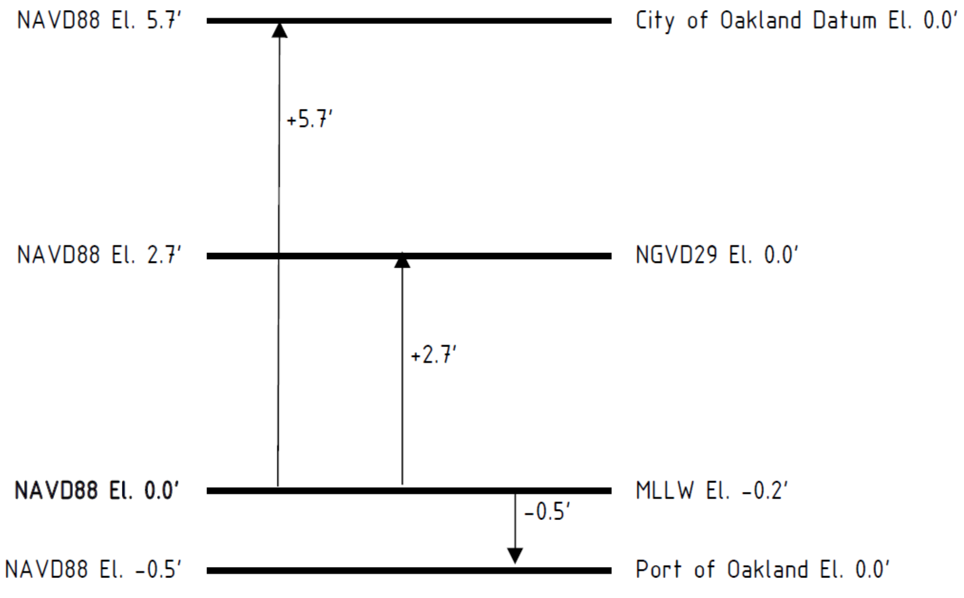


Figure 4: Datum Schematic

2. Project History

The first federal improvement of the Oakland harbor was authorized by the Rivers and Harbors Act adopted June 23, 1874. These improvements consisted of constructing two jetties to act as training walls to confine the flow of the San Antonio Estuary to scour a channel, the jetties were completed in 1894. The jetties no longer serve a navigational purpose and segments have been removed during subsequent improvements to the harbor. Significant changes to the federally authorized channel have taken place in 1931, 1942, 1974-1975, and 2001-2010. In 1931, the Outer Harbor entrance was widened. The Outer Harbor was deepened to -35 feet and the turning basin was expanded in 1942. The deepening of the Inner Harbor to -35 feet was authorized in the Act of 1962 and completed in 1974.

Howard Terminal was constructed between 1980 and 1982. The authorized project for deepening the Entrance Channel, Outer Harbor and Inner Harbor channels to -42 feet was completed in 1998 and authorized by Section 202 of the Water Resources Development Act of 1986. The Inner and Outer Harbor were deepened to Elevation -50 feet between 2001 and 2010. The “-50 foot” project also included construction of a bulkhead wall on the Alameda side of the channel.

3. Geology

The Quaternary sediments that fill the San Francisco basin unconformably overly Franciscan Complex bedrock and include alternating deposits of marine and non-marine origin. Throughout the Quaternary, sea level rose and fell in response to changes in climate (i.e., glacial, and interglacial periods). During the interglacial sea level high stands, the San Francisco Bay typically filled with sea water, and deposits within the San Francisco Bay basin were predominantly of marine and estuarine origin during this time. However, during the glacial periods and sea level low stands, the San Francisco Bay would empty, and deposits during these periods are primarily terrestrial in origin.

The Port of Oakland was constructed in a natural drainage channel, San Antonio Creek, which is located within the broad low-lying plain that borders the eastern shore of San Francisco Bay. San Antonio Creek originally drained the Oakland hills through lake Merritt and the Oakland estuary between downtown Oakland and Alameda. A depiction of the historical creeks, including San Antonio Creek, is included as Figure 5 (Sowers and Richard, 2009).

Since the 1800’s, the bay margin has been significantly altered. Tidal flats and shallow portions of the bay were reclaimed, and artificial fill was placed above the estuarian and bay muds. The majority of the Port of Oakland, including the turning basin areas, are located beyond the historical shoreline. The historical shoreline circa the 1850’s and former tidal flats are depicted in Figure 6 (Radbruch, 1959).

Figure 5: Historical Creeks in Oakland, CA (Sowers and Richard, 2009).

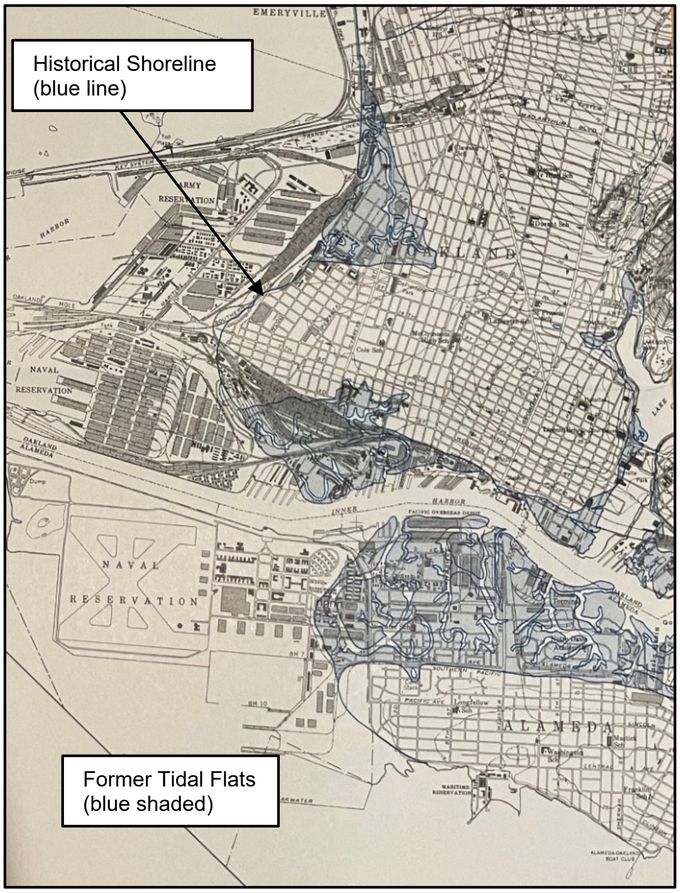


Figure 6: Former Shoreline and Tidal Flats (Radbruch, 1959)

3.1. Geologic Units of the Port of Oakland

The geologic units within the eastern margin of San Francisco Bay consist of Quaternary age sediments overlying Franciscan Complex bedrock. The Quaternary Period was a dynamic time in the Bay Area, and the sedimentary deposits are of alluvial, fluvial, aeolian, lacustrine, estuarine, and marine origin. Researchers have generally grouped these deposits based on their depositional environment and textural characteristics (e.g., Graymer, 2000), or based on their stratigraphic position and age (e.g., Rogers and Figuers, 1991). Materials beneath the East Bay alluvial plain consist of several distinctive geologic units, including:

Artificial Fill (Historical)

Starting in the late 1800's, development in downtown and West Oakland resulted in the gradual infill of the original bay margin. Portions of the San Francisco Bay were reclaimed, and fill was placed to raise the ground above sea level. Fill along the margins of San Francisco Bay are varied in composition, consisting of miscellaneous debris, bay mud and sand dredged from the bay, and in some areas engineered fill. Fill derived from the bay mud or Merritt sands are sometimes difficult to distinguish from the native sediments (e.g., Radbruch, 1957).

Fill emplacement included poorly documented un-engineered placement methods, hydraulic placement, and engineered compacted fill placement. Fill is generally heterogeneous in composition, and may be a mix of cobbles, gravels, sands, silts, clays, and/or debris (potentially including timber piles or maritime equipment). The thickness of fill is varied, but generally less than 12 to 15 feet, and typically less than 5 feet.

Younger Alluvial Deposits (Holocene)

Younger alluvial deposits of Holocene-age include sedimentary deposits of non-marine origin. The deposit is primarily comprised of brown to tan silt and clay but also includes medium dense to dense, gravelly sand, or sandy gravel that grades upward to sandy or silty clay. The deposits are generally confined to narrow valleys and overlay older Pleistocene deposits. At the distal fan edges near the bay margin, alluvial fan deposits interfinger with bay mud and Merritt Sand deposits.

Young Bay Mud (Holocene)

The Young Bay Mud deposits correspond to the most recent sea level high stand starting at the beginning of the Holocene (approximately 12,000 years). Bay Mud within the tidal zone is generally covered with Cordgrass and pickleweed. On geologic maps, the deposit is generally not mapped at the ground surface due to 1) its position below sea level, or 2) the deposit is covered by artificial fill. Young Bay Mud is a soft, highly compressible marine clay that underlies much of the Port of Oakland. It consists of water saturated estuarine mud with a characteristic gray, green, or blueish color. Deposits contain few lenses of well-sorted, fine-grained sand and silt, few shelly layers (oysters), and peat. The Young Bay Mud deposits interfinger with and grade into fine-grained deposits at the distal edge of Holocene alluvial fans. (Rogers and Figuers, 1991).

Merritt Sand (Holocene to Pleistocene)

Merritt Sand is aeolian in origin, and generally mapped in localized areas near downtown Oakland and Alameda. The unit is fine-grained, very well sorted (poorly graded), well-drained, with lenses (stringers) of sandy clay and clay. The deposit is typically yellowish-brown to dark yellowish-orange. The upper few feet are loose and contain humus, and the unit becomes more consolidated and medium dense to dense with increased depth. The thickness of the Merritt Sand varies between several inches and a maximum thickness of about 65 feet, and deposits express a yardang dune morphology (Radbruch, 1957).

San Antonio Formation (Pleistocene)

The San Antonio Formation refers to and is defined by the non-marine sediments deposited between the older and younger bay mud deposits. Deposits are predominantly sands and silts but also can include Merritt and Posey sands when sub-units are not distinguished. Within the upper portion of the San Antonio Formation are channels infilled with firm sandy clay and sandy channel fill, referred to as Posey sands. Merritt Sands are described above and consist of aeolian blown sands typically at the top of the San Antonio Deposits (Rogers and Figuers, 1991).

Old Bay Deposits or Yerba Buena Mud (Pleistocene)

The Old Bay Mud, also known as Yerba Buena Mud, is characteristically firm, dark greenish gray to blue, with varying amounts of sand and gravel. The unit contains less moisture than overlying units and is over consolidated. A thin (10 to 15 feet thick) sandy, shell-rich zone is commonly found within the unit. The unit was deposited when sea level was higher than current conditions, and underlays younger units near the bay margin (Goldman,1969; Rogers and Figuers, 1991)

Older Alluvial Fan deposits (Pleistocene)

The Older Alluvial Deposits are onshore alluvial deposits, characterized as brown dense gravely and clayey sands or clayey gravel that fines upward to sandy clay. Older Alluvial fans are associated with modern stream courses. Older Fan deposits are distinguished from Younger Fan deposits due to 1) their higher topographic position relative to the younger deposits, 2) stronger degree of soil development, and 3) greater degree of dissection. Maximum thickness is unknown but at least 160 feet (Graymer, 2000).

Marine Terrace Deposits (Pleistocene)

Localized areas at the distal edges of Older Alluvial Fans bordering the bay margin are characterized as Marine Terrace Deposits. The terrace surfaces are located about 16 feet above sea level and described to have a 1- to 2-foot-thick bed of oysters at their base. The terraces have an age of 125 ka, which corresponds with the last major interglacial period (Helley and Graymer, 1997).

Alameda Formation (Pleistocene)

The Alameda formation unconformably overlays and is comprised of sediment derived from Franciscan Complex bedrock. The Alameda Formation does not outcrop at the ground surface and is primarily characterized by exploratory boreholes. Rogers and Figuers (1991) subdivide the unit into an upper and lower unit; the upper portion of the unit is predominantly marine in origin, while the lower portion has a non-marine origin. The unit varies in composition but contains sand, sandy clay, and fine gravel. The Old Bay Mud is sometimes grouped with the upper Alameda formation.

Undifferentiated Franciscan Complex Bedrock (Jurassic to Cretaceous)

The Franciscan Complex is a bedrock unit of Jurassic to Cretaceous age, and consists of sheared and metamorphosed graywacke, shale, mafic volcanic rock, chert, ultramafic rock, limestone, and conglomerate. Highly sheared sandstone and shale form the matrix of a mélange sub-member containing blocks of many rock types, including sandstone, chert, greenstone, blueschist, serpentinite, eclogite, and limestone. The bedrock is identified at the ground surface in the Berkely and Oakland Hills, and unconformably underlies the Quaternary sedimentary units that fill the San Francisco Bay. Depth to bedrock is estimated based on regional data and estimated to be at depths of 450 to 600 feet within the project area.

3.2. Geologic Map and Cross Section

Helley and Graymer (1997) map the surface geology of the Port of Oakland as artificial fill (af) over young estuarine mud. The soils immediately underlying the fill in former tidal flats consist of Young Bay Mud (YBM) over San Antonio formation. The Young Bay Mud varies in the thickness across the site and may be locally thicker where it has filled erosional channels in the underlying formation. Within the Federally maintained shipping channel and turning basins, the Young Bay Mud has effectively been removed during previous dredging operations. However, Young Bay Mud and San Antonio Formation sands are exposed in the existing channel side slopes.

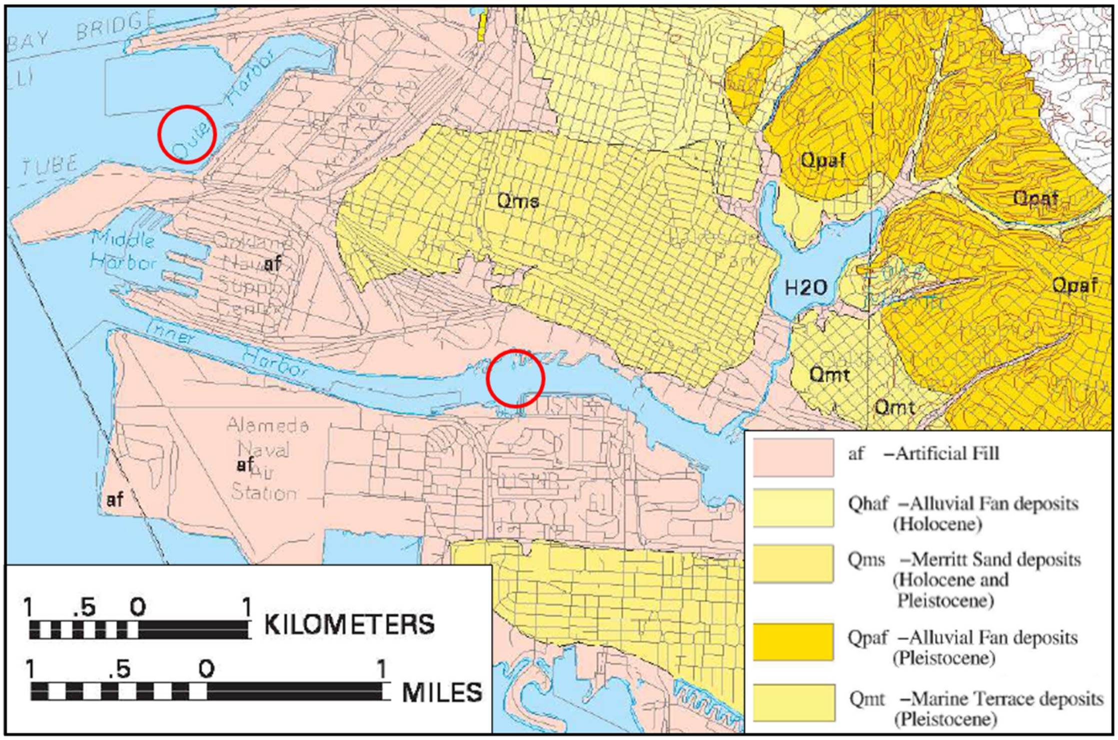


Figure 7: Surficial Geologic Map (Helley and Graymer, 1997)

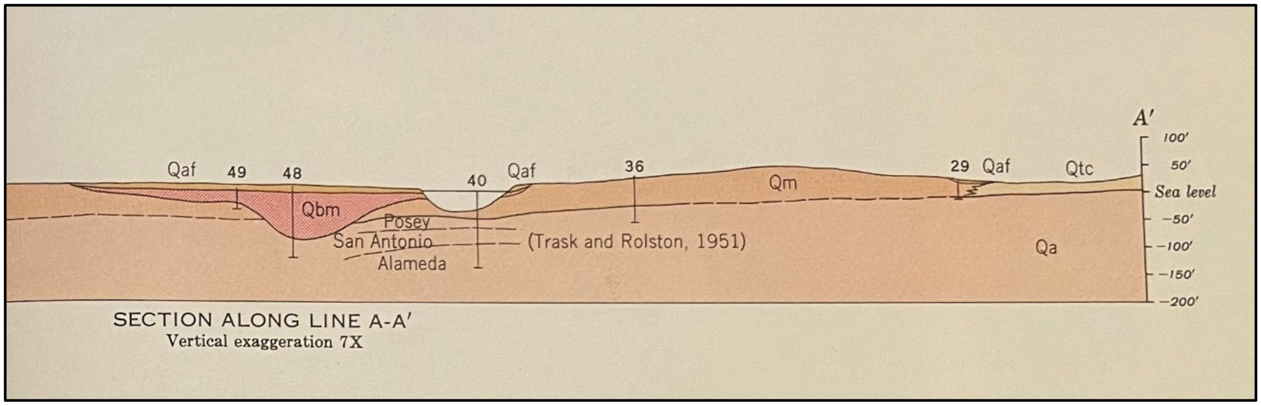


Figure 8: Geologic Cross-Section through the Inner Harbor

3.3. Seismicity

The San Francisco Bay area is recognized as one of the most seismically active regions in the United States. Significant earthquakes occurring in the Bay area are generally associated with crustal movement along well-defined, active fault zones of the San Andreas Fault System. Faults considered capable of generating significant earthquakes have a northwest-southeast trend and have been the locus of previous large-magnitude earthquakes. A regional fault map illustrating the position of significant faults relative to the site is presented as Figure 9. The Hayward Fault is located approximately 4½ miles to the northeast, positioned at the base of the Oakland and Berkeley Hills. The San Andreas Fault is located on the western side of the San Francisco Bay and is about 13 miles southwest of the site. Historical large magnitude earthquakes (i.e., >6.7 Mw) on the San Andreas fault include the great San Francisco earthquake of 1906 and the Loma Prieta earthquake of 1989, while Hayward fault had a large magnitude earthquake in 1868.

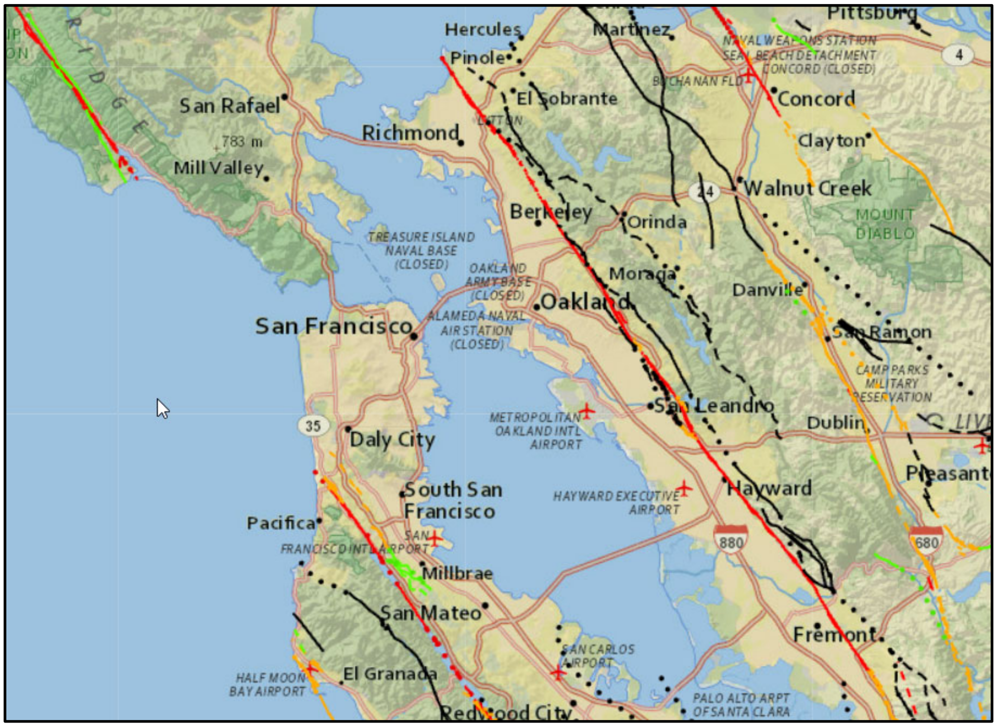


Figure 9: Regional Active Faults

The Working Group on California Earthquake Probabilities developed estimates of future earthquakes in California. Their most recent report, the Uniform California Earthquake Rupture Forecast (2014), estimates that there is a 72% chance of a magnitude 6.7 or greater earthquake on one of the Bay Area faults between 2014 to 2044, and a 90% chance of a magnitude 6 or greater during the same time period (Field and WGCEP, 2015).

Design ground motions and liquefaction hazard for the proposed Inner Harbor Retaining Walls are discussed in Section 5.

4. Outer Harbor

4.1. Existing Conditions

The Oakland Outer Harbor Turning Basin is located in the Outer Harbor Channel near Berths 25 through 30. The diameter of the existing turning basin is 1,650 feet. Figure 10 shows the current Outer Harbor Turning Basin (white circle) and the limit of the existing federal channel (white lines). The areas to the southwest of the white line within the federal channel are maintained to an Elevation of -50 feet by annual maintenance dredging. The side slopes of the federal channel are inclined at 3:1 (H:V). Figure 11 is a bathymetric survey of the area showing the dredged channel.

Figure 10: Outer Harbor

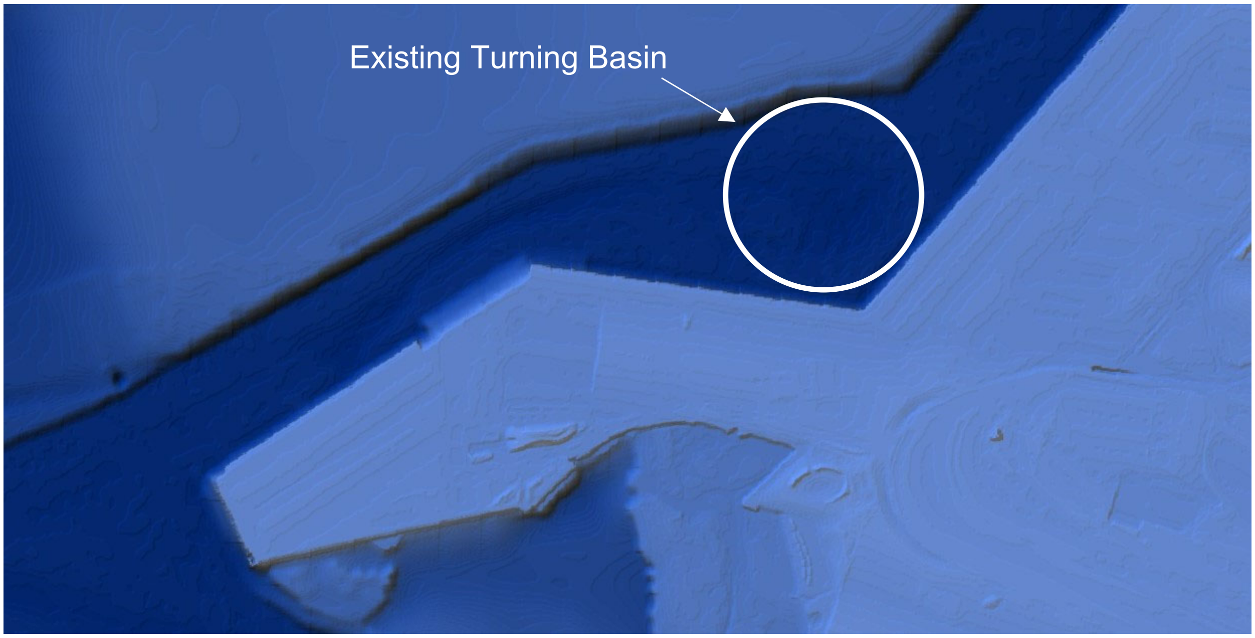


Figure 11: Outer Harbor Bathymetry

Figure 10 depicts the proposed OHTB footprint with a diameter of 1,965 feet. The proposed turning basin area outside of the current federal channel would be dredged to Elevation -50 feet. Side slopes would be dredged at a 3:1 (H:V) slope. No new dredging is required along the dashed portion of the proposed turning basin since the channel is currently maintained at Elevation -50 feet. No changes to the existing wharf structures are required for the project.

The locations of borings near the proposed OHTB expansion are presented in Figure 12 and summarized in Table 2. The listed borings are included in Attachment 2. Borings within the OHTB generally encountered soft YBM over dense San Antonio formation sands. As shown in Table 2, the bottom of YBM elevation is typically deeper than Elevation -40 feet in the area, with GB4 being the outlier at Elevation -34 feet. All borings were performed before the OHTB was deepened to -50 feet; all YBM has been removed from within the federal channel. YBM is expected to be present in the excavation for the proposed turning basin and exposed in the side slopes.

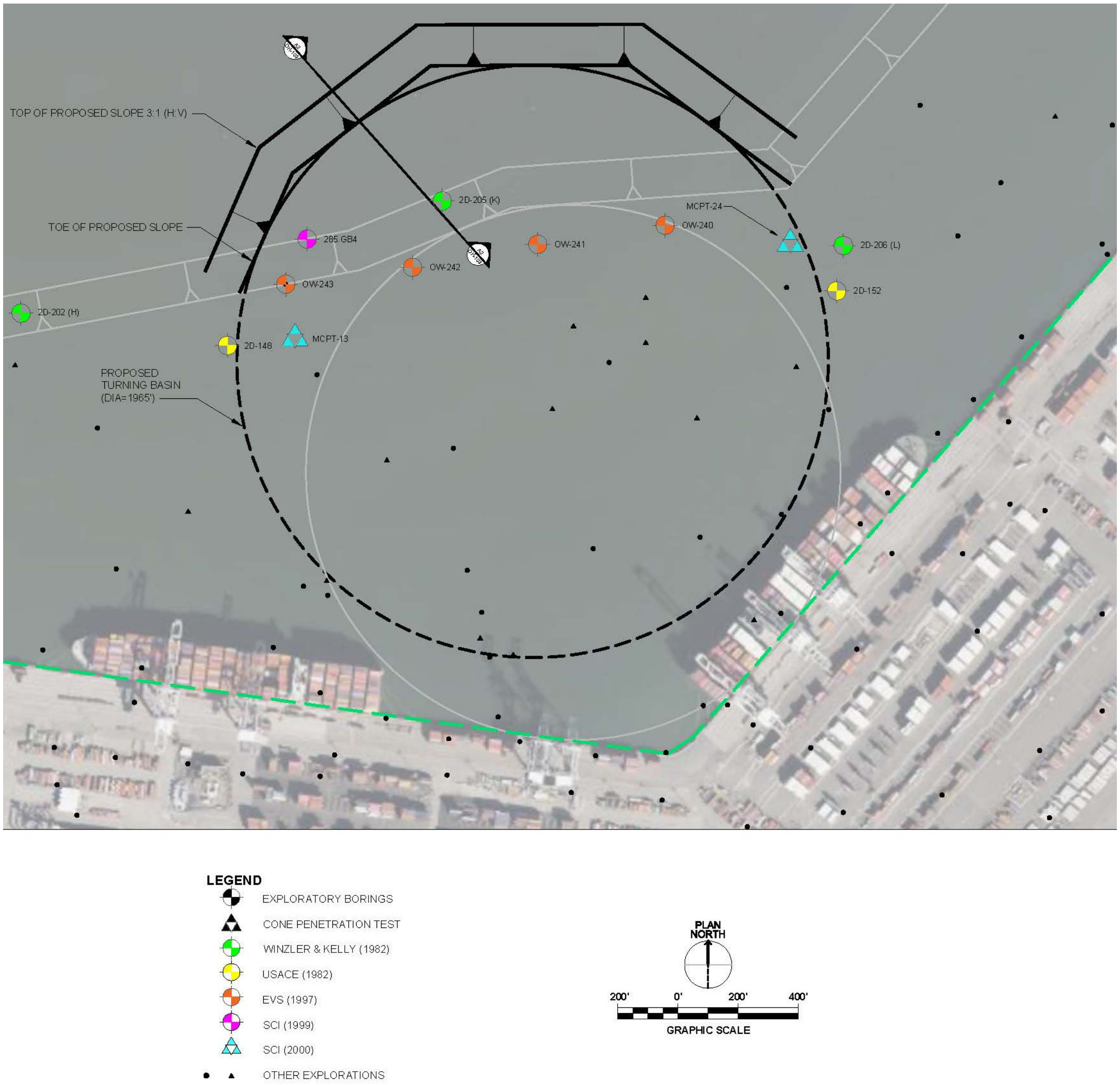


Figure 12: Outer Harbor – Existing Geotechnical Borings

Table 2. Outer Harbor Borings

Boring #	Reference	Drill Date	Boring Depth (ft)	Mudline Elevation (ft)	Terminal Elevation (ft)	Bottom of YBM Elevation (ft)[1]
2D-148	USACE (1982)	7/74	12.5	-35.0	-47.5	> -47.5
2D-152	USACE (1982)	5/75	1.0	-40.5	-41.5	-41
2D-202 (H)	Winzler & Kelly (1982)	5/19/82	22.5	-25.0	-47.5	> -47.5
2D-205 (K)	Winzler & Kelly (1982)	5/18/82	32.5	-14.5	-47.0	-44.5
2D-206 (L)	Winzler & Kelly (1982)	5/20/82	9.0	-38.5	-47.5	- 47.5
OW-240	EVS (1997)	8/4/97	17.8	-39.7	-57.5	> -57.5
OW-241	EVS (1997)	8/4/97	20.5	-31.5	-52.0	-47.9
OW-242	EVS (1997)	8/4/97	17.7	-29.9	-47.6	-47.2
OW-243	EVS (1997)	8/4/97	22.5	-29.5	-52.0	-49.9
GB4[2]	SCI (1999)	9/23/97	32.5	-4.3	-36.8	-33.8
MCPT-13	SCI (2000)	2/2/00	10.2	-42.2	-52.4	-45.8
MCPT-24	SCI (2000)	2/1/00	15.3	-42.5	-57.8	-45

[1] Elevations reported in NAVD88 (~MLLW).
[2] Location of GB4 reported to be uncertain due to GPS malfunction.

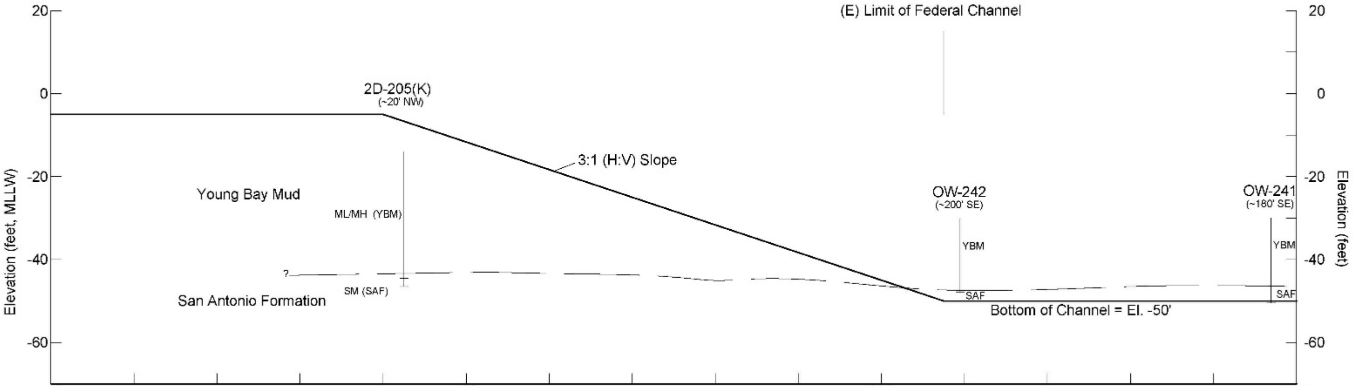


Figure 13: Outer Harbor Cross-Section A-A' (Existing)

Approximately 80 borings and 30 CPTs have been performed in the Outer Harbor. Approximately three-quarters of the borings were performed for environmental testing and offer limited geotechnical data. YBM within the OHTB were generally logged as ranging from Fat Clays to Silts. YBM in GB4 was logged as Fat Clays (CH) and had moisture contents ranging from 99 to 123 percent. Atterberg Limits and moisture content tests on two samples form GB5 and GB6, located approximately ½ mile to the southwest of the OHTB, resulted in Liquid Limits of 70 and 71, Plasticity Indices of 42 and 44, and moisture contents of 101 and 111 percent. Moisture contents and Atterberg Limits tests to the north of the OHTB indicate that the YBM grades siltier to the north.

Approximately 1 to 2 feet of new material is deposited annually within the federal channel and turning basin. The most recent Operations and Maintenance Dredging Sampling and Analysis Report shows that the annual dredge material are typically silts and clays. (USACE, 2017).

4.2. Proposed Conditions

OHTB Variation 2 will require excavating material to the northwest of the existing turning basin. Figure 14 presents the proposed slope configuration. A 3:1 (H:V) slope was selected for preliminary design to match the existing slopes along the federal channel. USACE surveys the lower approximately 20 to 50 feet of the side channels annually. No major slope failures have been observed along the existing slopes, indicating that a 3:1 slope is stable long-term.

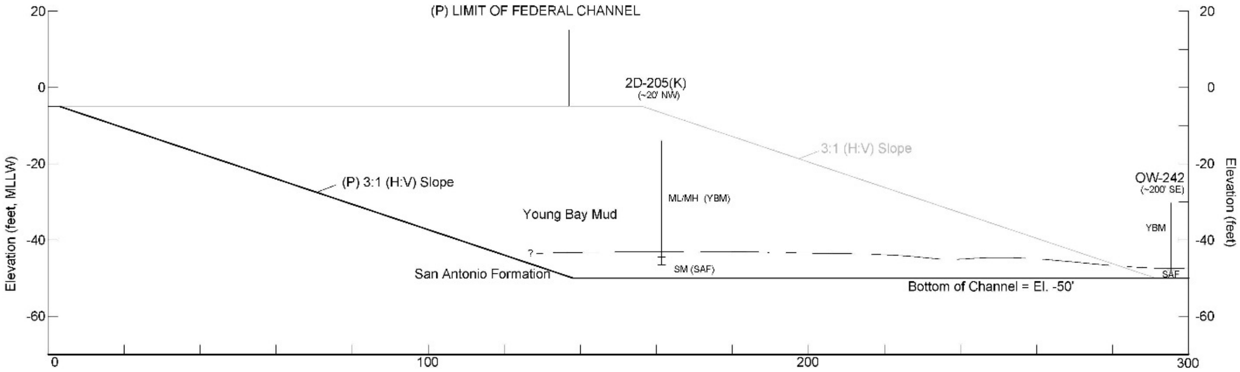


Figure 14: Outer Harbor Cross-Section A-A' (Proposed)

Slope stability analyses were performed to evaluate the end-of-construction and a long-term stability of the cut slopes. The soil properties used in the stability analyses are presented in Table 3. There is limited geotechnical information in the proposed cut area. For this reason, the preliminary stability analyses assumed conservative strength parameters. Figure 15 presents the undrained strength profile used in the analysis and previous vane shear test data in YBM at the Port of Oakland and at sites around the bay. Drained strength parameters were based on published values by soil type. The analysis also assumes that the YBM extends to Elevation -45 feet.

The stability analyses considered shallow and deep circular failure surfaces, as well as block and shallow wedge failure surfaces. Figure 16 shows the analyzed cross-section and critical failure surface for each case. The lowest factors of safety are for shallow wedge failures (less than 5 feet thick) under drained conditions. If shallow failures were to occur, the soils could be removed during maintenance dredging and would not pose a threat to Port operations.

Table 3. Stability Analysis Parameters

Material	γ_{sat} **(pcf)**	**c (psf)**	ϕ **(deg)**	**c' (psf)**	ϕ' **(deg)**
YBM (soft clay)	90	50 + 10/ft	0	0	31
SAF (dense sand)	125	0	35	0	35

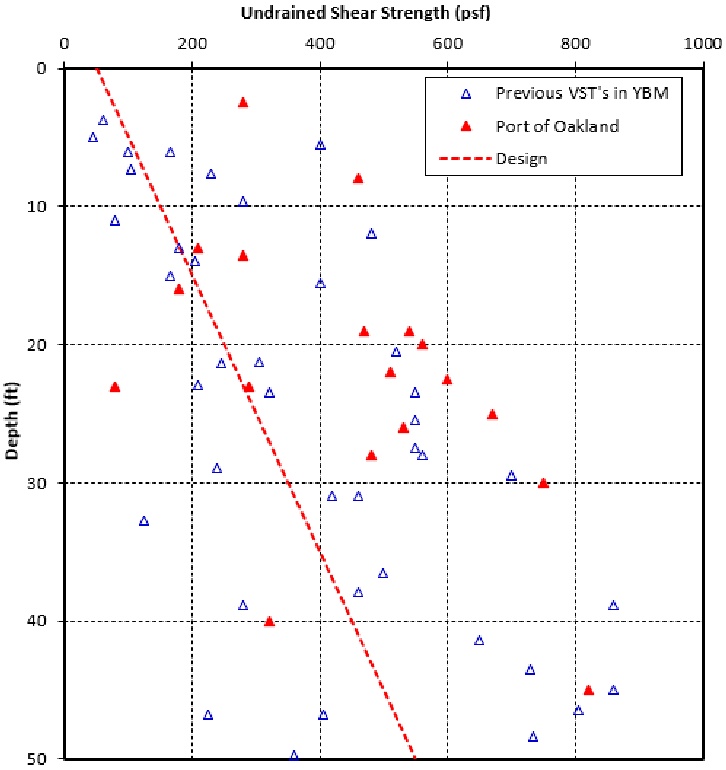


Figure 15: Vane Shear Test Results and Design Undrained Strength Envelope

Table 4. Minimum Factor of Safety

Case	**Undrained**	**Drained**
Circular (Slope/Toe)	2.77	2.01

Wedge (Shallow)	3.14	1.84

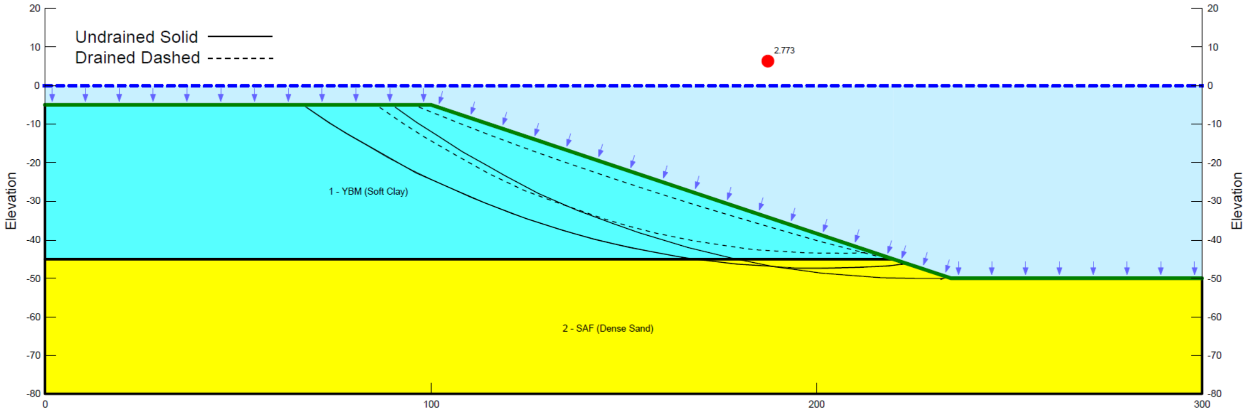


Figure 16: Slope Stabilty Analysis Results

4.3. Design Considerations

Slope stability analyses indicates that the slopes inclined at 3:1 (H:V) would have an acceptable long-term, static factor of safety.

Additional geotechnical explorations should be performed during pre-construction engineering and design (PED) to confirm the soil conditions and design assumptions. Slope reliability, seismic slope stability and deformation analyses may be warranted. It may be feasible to steepen the side slopes to minimize cut volume. If this is to be considered, detailed in-situ and/or laboratory testing should be performed.

The San Antonio Formation sands are dense to very dense. A dredgeability analysis should be performed during PED, including review of dredging records from the -50 Foot Project.

5. Inner Harbor

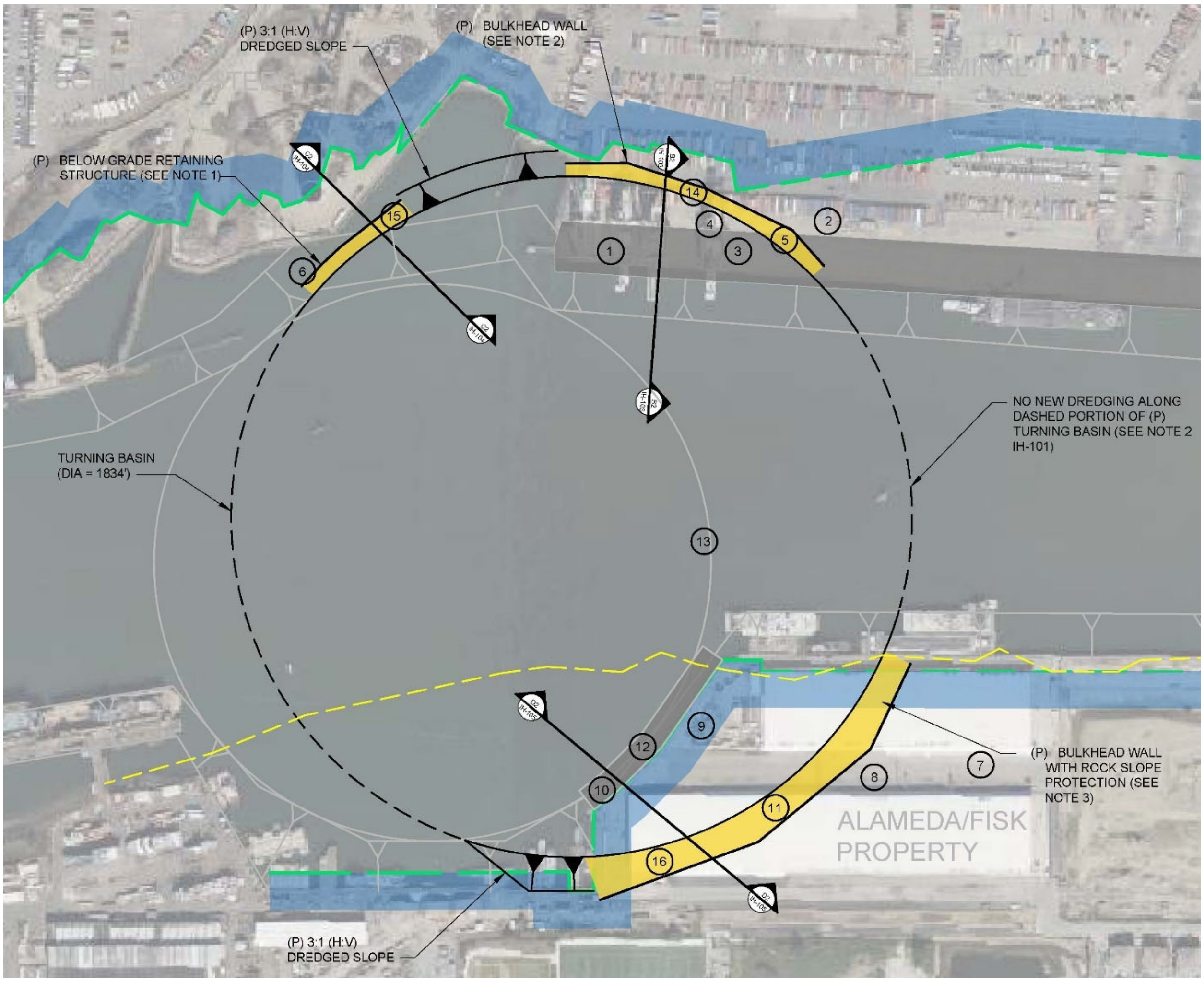
5.1. Existing Conditions

The Oakland Inner Harbor turning basin is located approximately 18,000 feet to the east of the Oakland Harbor entrance. The diameter of the turning basin is 1,500 feet. Areas within the federal channel are dredged to a minimum Elevation or -50 feet annually. Borings within the federal channel are shown on Figure 18. Similar to the Outer Harbor, the soils in the IHTB area consist of YBM over dense San Antonio Formation sands. Borings performed prior to dredging of the channel indicate that the bottom of the YBM generally ranged from Elevation -33 to -40 feet in the turning basin area. Much or all of the YBM within the federal channel has been removed by previous dredging projects.

Approximately 1 to 2 feet of new material is deposited annually within the federal channel and turning basin. The most recent Operations and Maintenance Dredging Sampling and Analysis Report shows that the annual dredge material are typically silts and clays (USACE, 2017).

5.2. Proposed Conditions

Figure 17 shows the proposed improvements and preliminary construction sequence. The three major work areas are Howard Terminal, Schnitzer Steel, and the Fisk Property on the Alameda side of the channel. These areas are discussed in Sections 6, 7, and 8, respectively.



CONSTRUCTION SEQUENCING:

- ① DEMOLISH PILE-SUPPORTED WHARF
- ② INSTALL BULKHEAD WALL AND GROUND IMPROVEMENT, IF NECESSARY
- ③ REMOVE ROCK DIKE AND SOIL ABOVE WATER LEVEL
- ④ REMOVE ROCK DIKE AND SOIL ABOVE WATER LEVEL
- ⑤ INSTALL BATTERED PILES
- ⑥ INSTALL BELOW-GRADE RETAINING STRUCTURE
- ⑦ DEMOLISH EXISTING WAREHOUSE BUILDINGS, WHARF STRUCTURE AND PILES
- ⑧ INSTALL BULKHEAD WALL
- ⑨ EXCAVATE SOIL BETWEEN EXISTING AND PROPOSED BULKHEADS TO APPROXIMATELY WATER LEVEL
- ⑩ REMOVE RIP RAP AT TOE OF EXISTING BULKHEAD
- ⑪ INSTALL BATTERED PILES
- ⑫ DEMOLISH EXISTING BULKHEAD WALL
- ⑬ DREDGE TURNING BASIN
- ⑭ INSTALL RIP RAP SLOPE PROTECTION IN FRONT OF HOWARD TERMINAL
- ⑮ INSTALL RIP RAP SLOPE PROTECTION IN FRONT OF SCHNITZER WALL
- ⑯ INSTALL RIP RAP SLOPE PROTECTION IN FRONT OF ALAMEDA WALL

Figure 17: Inner Harbor – Proposed Improvements

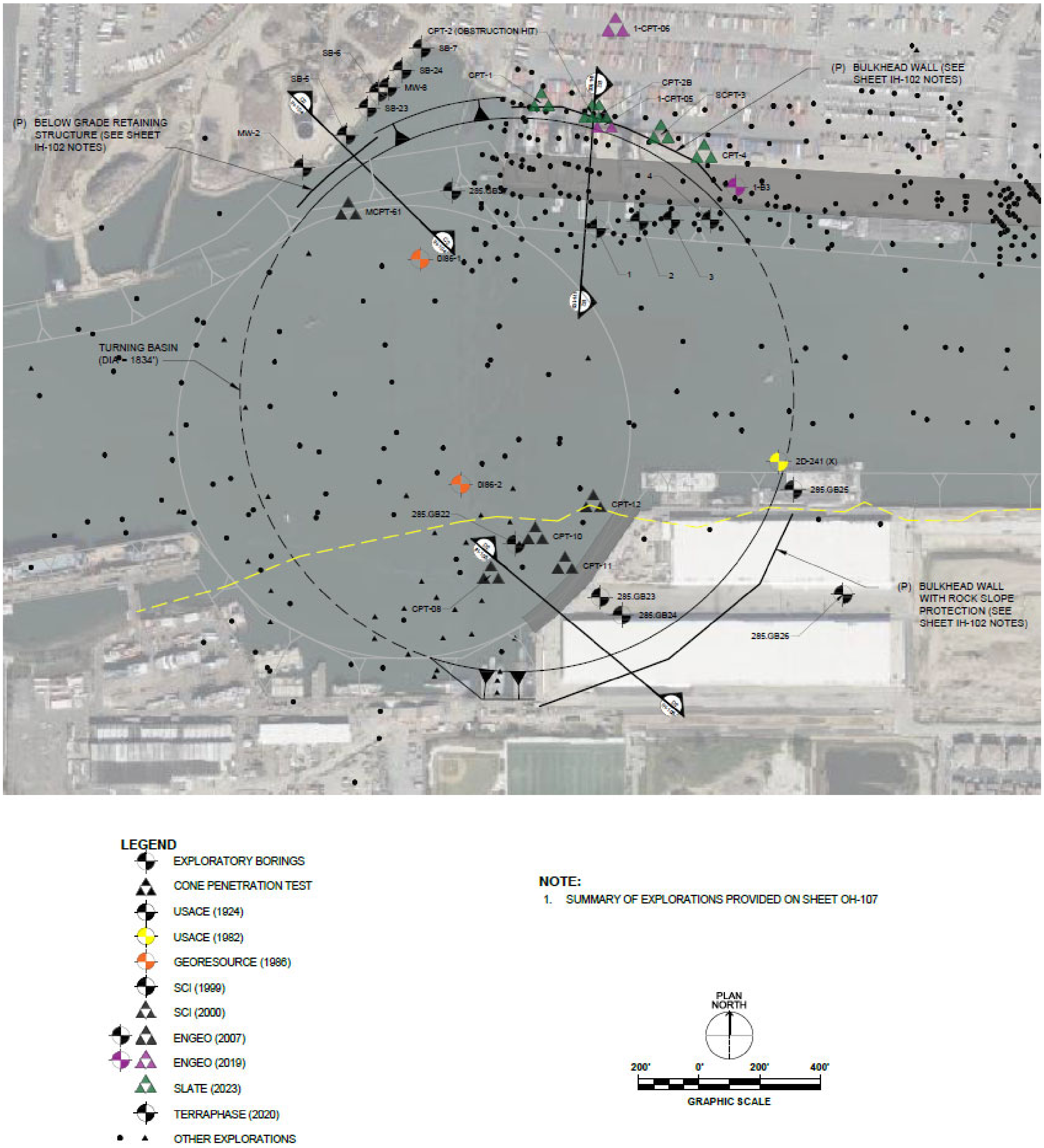


Figure 18: Inner Harbor – Existing Geotechnical Borings

Table 5. Inner Harbor Borings

Boring #	Reference	Drill Date	Boring Depth (ft)	Surface or Mudline Elevation (ft)	Terminal Elevation (ft)	Bottom of YBM Elevation (ft)[1]
1	USACE (1924)	8/1924	2.2	-25	-27.2	-25.9
2	USACE (1924)	8/1924	6	-23.5	-29.3	-26.8
3	USACE (1924)	8/1924	4.5	-24	-28.4	-26.4
4	USACE (1924)	8/1924	7	-23.5	-30.6	-27.8
2D-241 (X)	USACE (1982)	1982	10	-38	-48	-43.5
OI86-1	GeoResource (1986)	10/23/86	39.5	-32.8	-72.3	-33.8[2]
OI86-2	GeoResource (1986)	10/24/86	46	-32.7	-78.7	-33.7[2]
GB22	SCI (1999)	9/13/97	34.5	-29	-63.5	N.E.
GB23	SCI (1999)	8/5/97	83.0	10.3	-73.2	-19.5
GB24	SCI (1999)	8/7/97	104.5	10.4	-94.6	-13.5
GB25	SCI (1999)	9/12/97	44.0	-24.3	-68.8	-38
GB26	SCI (1999)	8/12/97	200.5	9.7	-191.3	-37.3
GB27	SCI (1999)	9/16/97	53.5	-8.4	-62.4	N.E.
MCPT-61	SCI (2000)	2/4/00	11.5	-44.3	-55.8	-50.3
CPT-8	Engeo (2007)	3/22/07	18.7	-39.8	-70.8	-53.4
CPT-10	Engeo (2007)	3/21/07	4.8	-41.8	-49.1	-45.3
CPT-11	Engeo (2007)	3/21/07	8.0	-39.6	-50.8	-45.1
CPT-12	Engeo (2007)	3/21/07	6.7	-38.9	-51.3	-45.3
1-B3	Engeo (2019)	1/30/19	56.5	7	-49.5	-34.5
1-CPT-05	Engeo (2019)	1/15/19	46.4	11	-35.4	N.E.
1-CPT-06	Engeo (2019)	1/15/19	48.7	11	-37.7	N.E.
CPT-1	Slate (2023)	10/24/23	77.2	11	-66.2	-11
CPT-2	Slate (2023)	10/23/23	32.0	11	-21.0	N.E
CPT-2B	Slate (2023)	10/23/23	78.7	11	-67.7	-13
CPT-3	Slate (2023)	10/23/23	81.6	12	-69.6	N.E.
CPT-4	Slate (2023)	10/24/23	83.0	12	-71.0	N.E.

[1] Elevations reported in NAVD88 (~MLLW).

[2] OI86-1 and OI86-2; both borings indicate 1 foot of soft material at top. Material likely recent shoal deposits.

6. Howard Terminal

Howard Terminal was constructed in 1980. There is an existing rock buttresses beneath the Howard Terminal Wharf. As shown on Figure 17, the TSP requires constructing a new bulkhead wall at Howard Terminal.

6.1. Existing Conditions

Howard Terminal is a pile-supported wharf structure with a rock dike beneath. Figure 19 shows a typical cross-section through Howard Terminal based on the construction drawings. The footprint of the rock dike is represented by the gray shading on Figure 17.

Rock Dike: The Woodward-Clyde Consultants (1979) Geotechnical Investigation report for the Howard Terminal recommends that all YBM be removed from beneath the rock dike and that the rock dike should be founded on the underlying dense sand. The typical section shows that the design bottom "elevation varies," but is typically near Elevation -30 feet. The borings summarized in Table 5, as well as the "Bottom of Bay Mud" contour map contained in 1979 Woodward-Clyde Report indicate that the bottom of YBM is typically shallower than Elevation -30 feet within the rock dike footprint, but may be as deep as Elevation -38 feet. Engeo (2019) Boring 1-B3 encountered 2 to 3 feet of YBM at the base of the dike, indicating that some YBM remains in place.

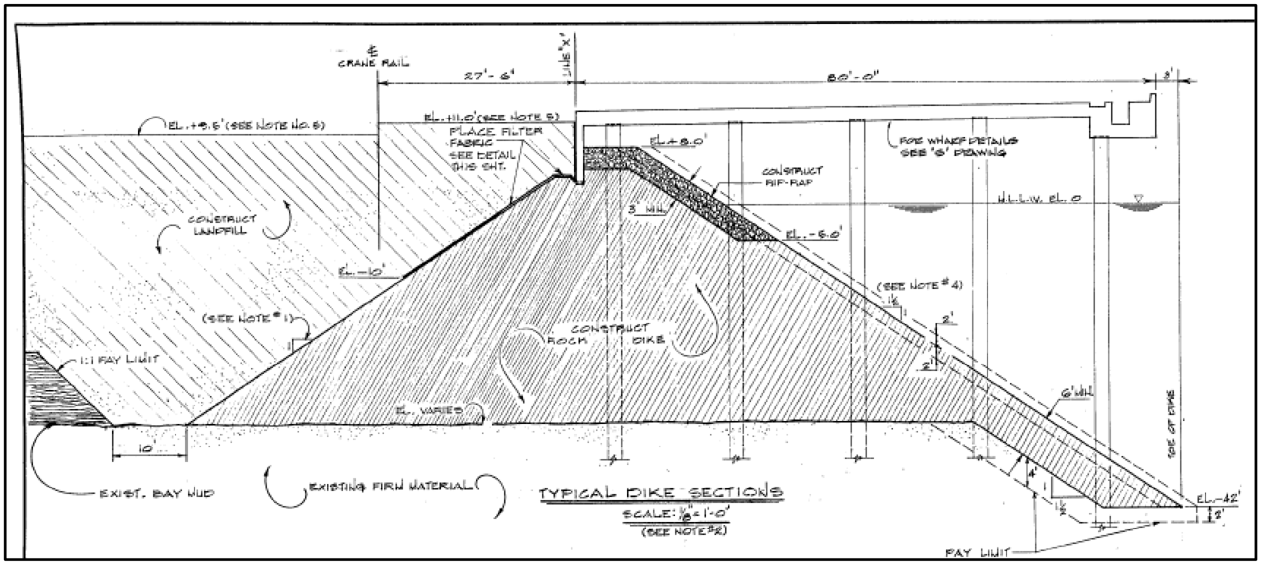


Figure 19: Typical Detail of Howard Terminal

The rock buttress material is described in Woodward-Clyde (1979) as follows: "The rock used in the dike must possess both high strength and durability to be stable at 1½ to 1 slope against all future design loading conditions. In addition, the gradation of the rock should be such that the rock dike is porous enough not to allow any buildup of pore water pressures during seismically induced shaking. This latter requirement would infer that the rock sizes should be as large as possible with little to no fine particles.

However, the subsequent construction of a wharf structure over the dike would entail installation of foundation piles through the dike. If the rock sizes in the dike were too large, it would not be practical to drive the piles through them. For this latter consideration, it was the consensus that if the rock size exceeded 12 inches, then there might be inordinate difficulties in pile installation operations. This consensus, therefore, determined the maximum rock size to be allowed in the dike section (as 12 inches) where piles will be installed. In rock dike areas where no piles will be installed in the future, larger rock sizes can be allowed."

The rock buttress material encountered in Engeo (2019) Boring 1-B3 is consistent with the Woodward Clyde recommendations; "Poorly graded gravel with clay (GP-GC), 1-inch to 2-inch diameter, subangular, very strong."

Samples of the material on the face of the slope were recently collected by a diver from the Port of Oakland collected hand samples. The material was generally 3- to 6-inch, sub-rounded to sub-angular cobbles.

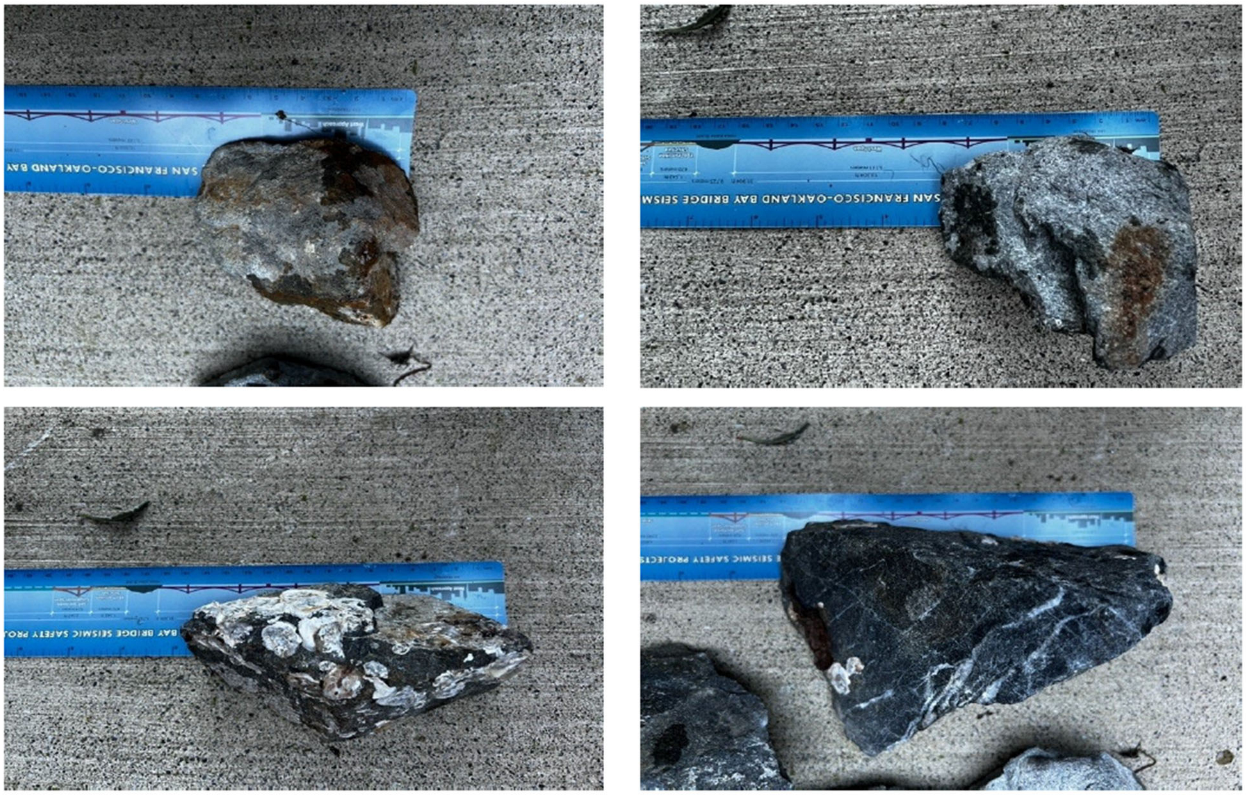


Figure 20: Rock Dike Material Sampled by Diver

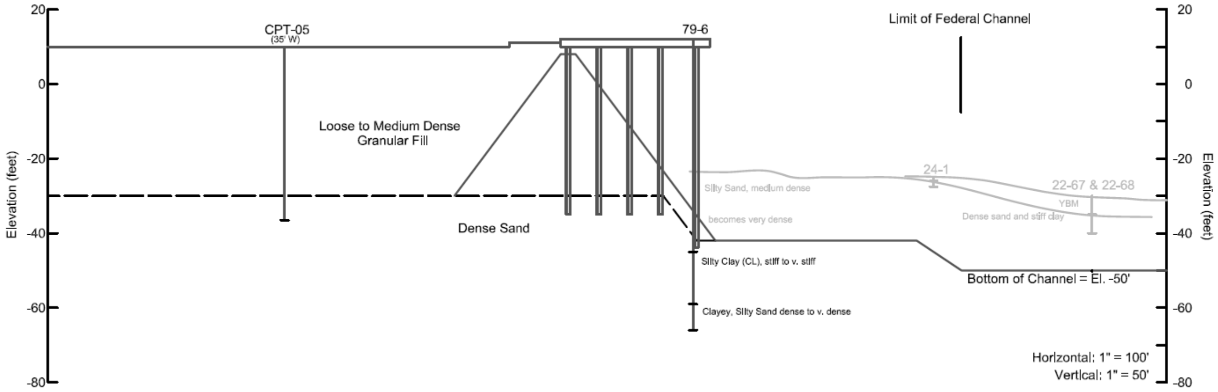


Figure 21: Howard Terminal Cross-Section B-B' (Existing)

Existing Fill: Behind the rock buttress is a zone of artificial fill and was likely hydraulically placed. Woodward-Clyde (1979) report recommends that "fill to be placed under water consist of cohesionless fine to medium and medium to coarse grained sand, with maximum allowable fines content of less than 10 percent by weight." The material encountered in Engeo (2019) CPT-05 was consistent with this description; loose to medium dense sandy soil. Preliminary analysis of CPT-05 indicates that the fill could liquefy during a moderate to large earthquake.

Liquefaction was documented at Howard Terminal following the 1989 Loma Prieta Earthquake: "Liquefaction of the hydraulic fill caused appreciable settlements (max 30 cm) over large areas of the Howard and APL Terminals. Although pavement was damaged at the edges of the wharves and in the inboard container yards, there was no apparent damage to piles or adverse movements of the crane rails. (USGS PP 1551-B)"

An after action report by the Port of Oakland states: "As expected, the wharf structure survived the quake quite well. Damage was confined to subsidence in the backup container yard and to the transit shed building. (Port of Oakland, 1990)"

Analysis of the CPT data confirmed that a portion of the fill at Howard Terminal is potentially liquefiable during an earthquake. The thickness of liquefiable fill ranged from less than 5 feet at CPT-1 to approximately 18 feet at CPT-3. The magnitude of liquefaction-induced settlement ranged from approximately 1 to 5 inches.

Existing Wharf: The wharf deck is founded on five rows of 24" concrete octagonal piles, driven through the buttress and founded in the underlying dense sand. The crane rail is supported on a row of 16" square concrete piles, battered in each direction.

6.2. Proposed Conditions

IHTB Variation 3 would require removal of a portion of the existing rock buttress beneath Howard Terminal and construction of a new bulkhead wall.

Preliminary analysis indicates that it may be feasible to construct a bulkhead wall similar to the wall that was constructed at the Fisk property as part of the -50-foot Project. A detail of the Alameda bulkhead wall is presented in Figure 22. The wall employed vertical and battered piles. The wall should be designed to withstand seismic forces, including the added load of the liquefied fill.

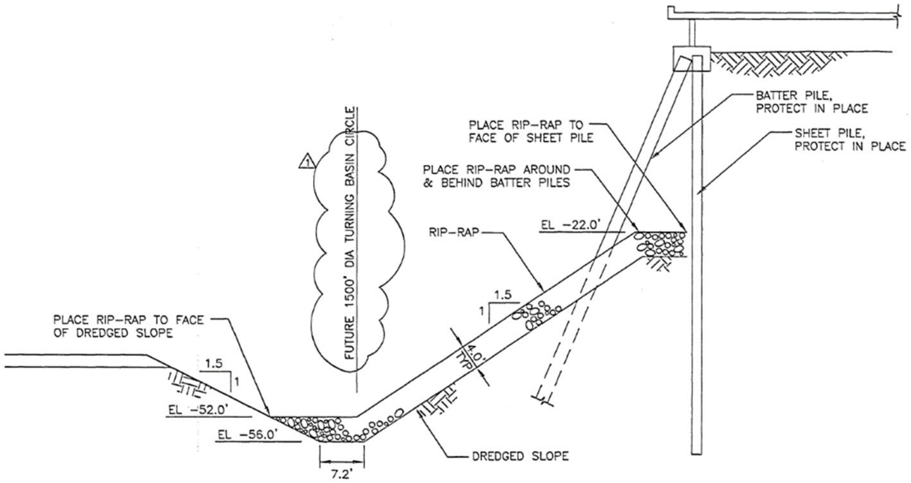


Figure 22: Conceptual Wall Detail

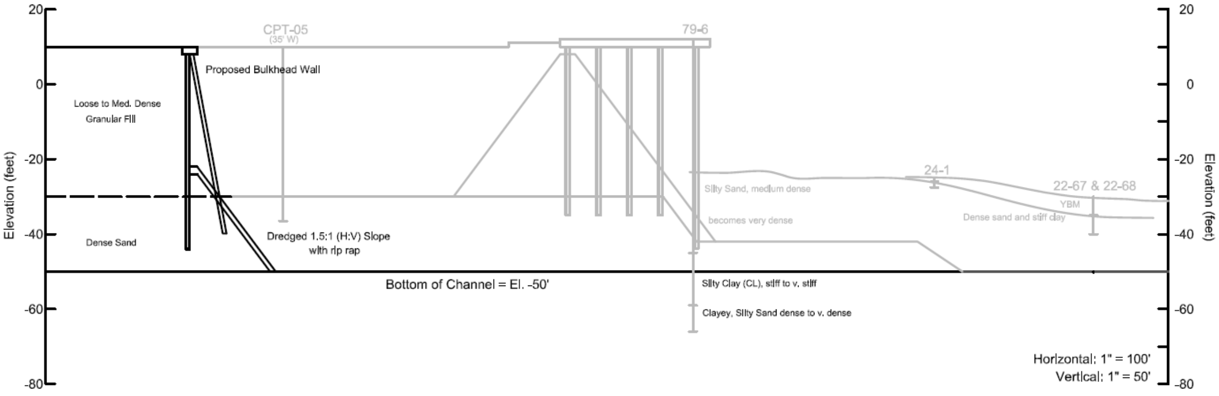


Figure 23: Howard Terminal Cross-Section B-B' (Proposed)

6.3. Design Considerations

The preliminary design assumes that the bulkhead wall will employ vertical and battered piles. The final design may consider other design measures such as tie-backs and/or dead man anchors. The wall should be designed to withstand seismic forces, including the seismic lateral soil pressure and the load of the liquefied fill. It may be necessary and/or economical to perform ground improvement, such as deep soil mixing, jet grouting, or vibratory densification (replacement or non-replacement). Deep soil mixing has been used at port facilities to enhance the seismic behavior of bulkhead walls including the Port of Los Angeles (Gilbert, et al, 2013) and the Port of Alaska (Christie, et al, 2021). Examples of jet grouting and stone columns at port facilities in the Port of

Long Beach (Varatharaj, et al, 2013) and the Port of Tacoma (Jain, et al, 2010), respectively.

The existing rock buttress and underlying dense sand may contribute to difficult pile driving conditions. A preliminary pile driving analysis should be performed during design development.

The San Antonio Formation sands are dense to very dense. A dredgeability analysis should be performed during design development, including review of dredging records from the -50 Foot Project.

7. Schnitzer Steel Cove

7.1. Existing Conditions

Most of the Schnitzer Steel property is built on filled land. Fill was placed in several episodes in the 1950’s and 1960’s. The fill contains debris (wood, metal, etc). The existing bulkhead wall was constructed circa 1973.

A photograph of the wall and plan are shown in Figures 25 and 26, respectively. The wall is constructed of steel H-piles at 9.3 feet on center, with horizontal steel “hatch covers” spanning between piles. The wall is also supported by 50-foot long, 1-3/4” tie rods and dead man anchors at 10 feet on center. There is a zone of compacted fill behind the wall.

Granular fill with varying amounts of debris (concrete, brick, wood, etc.) was encountered in each of the seven borings performed behind the Schnitzer Steel wall. Borings were generally performed to a depth of 20 feet or less. Deeper fill was encountered in MW-8 which is located within a historic slough. Boring SB-5 encountered YBM below the fill to approximately Elevation -6 feet. The boring did not fully penetrate the YBM layer into stiffer soils below; the elevation of the bottom of the YBM was not determined.

The existing federal channel and turning basin in front of the Schnitzer Steel wall have been excavated to Elevation -50 feet. The YBM within the limits of the federal channel has been removed as shown in borings OI86-1 and GB27. The thickness of YBM that remains in front of the wall and inside the cove between Schnitzer and Howard Terminal is unknown.

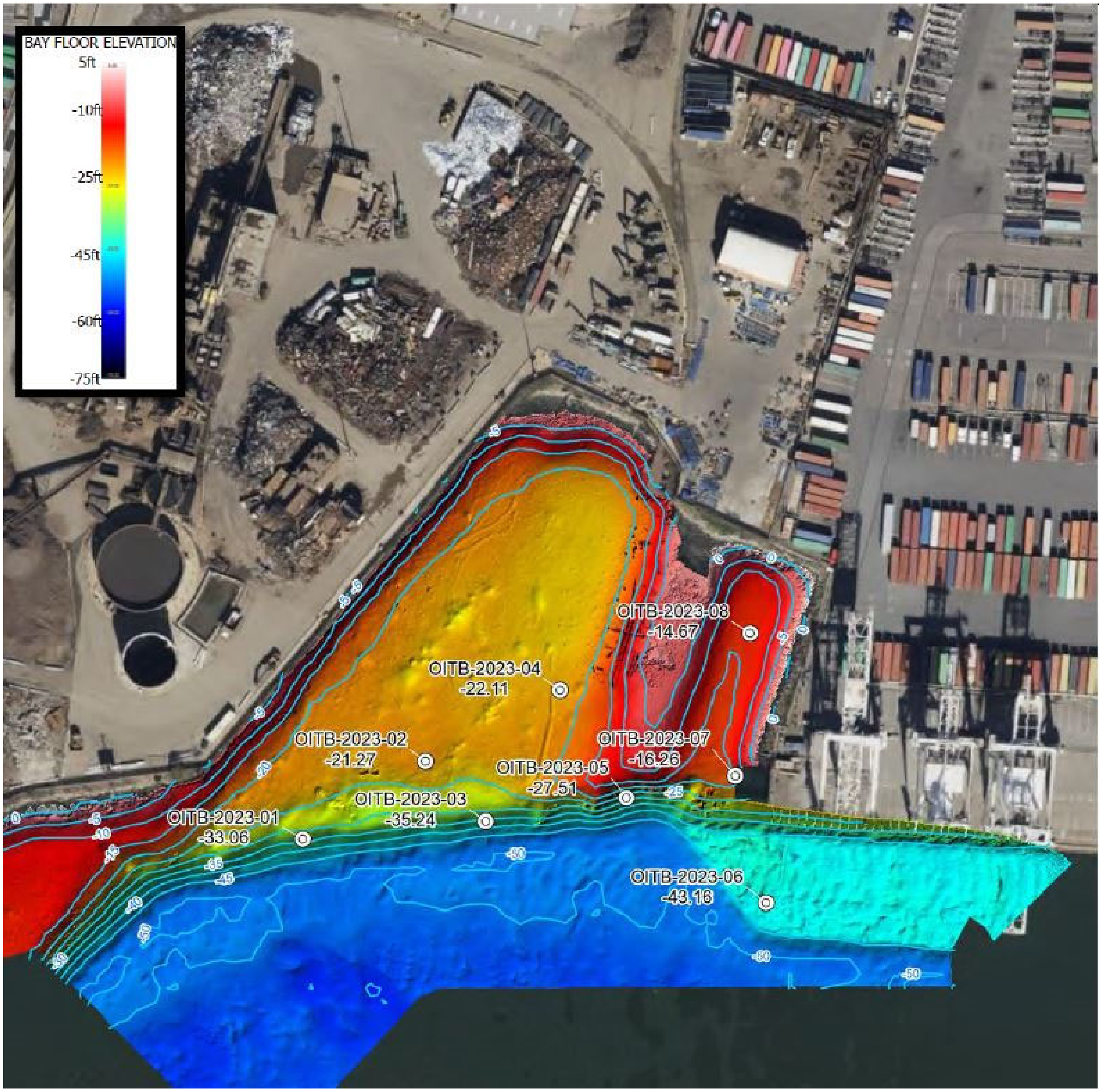


Figure 24: Schnitzer Steel Cove Bathymetry

As part of this study, Geosyntec/eTrac performed a geophysical survey of the Schnitzer Steel cove The approximate limits of the survey area are shown on Figure 24) (Geosyntec/eTrac, 2024). The geophysical survey consisted of four components: Hydrographic survey (bathymetry); side-scan sonar to produce acoustic images of seafloor objects; magnetometer survey to identify for buried ferrous objects; and Sub bottom profiles depicting geologic layers and obstructions below the mudline. The surveys identified many surficial and buried objects, including old pilings and debris. No major obstructions were observed within the proposed wall alignment.

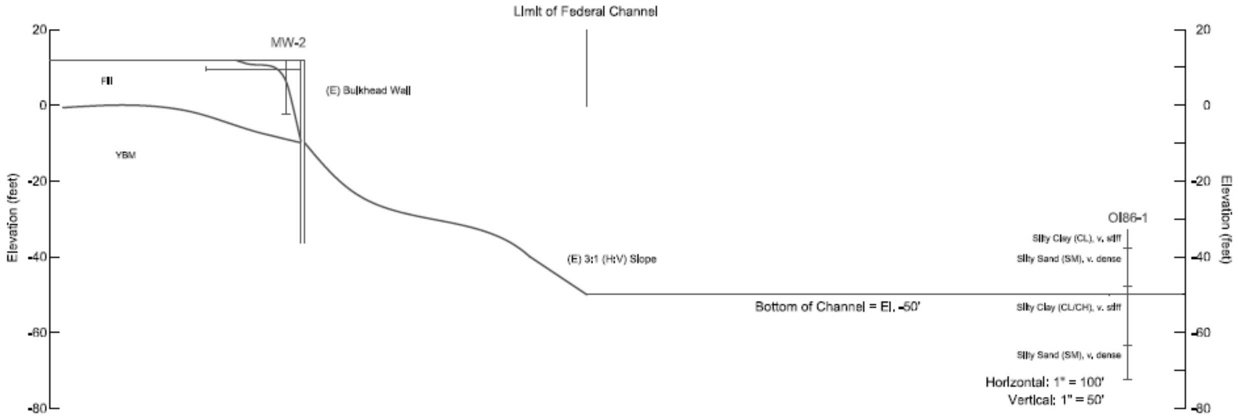


Figure 25: Schnitzer Steel Cross-Section C-C'(Existing)

Figure 26: Schnitzer Steel Wall

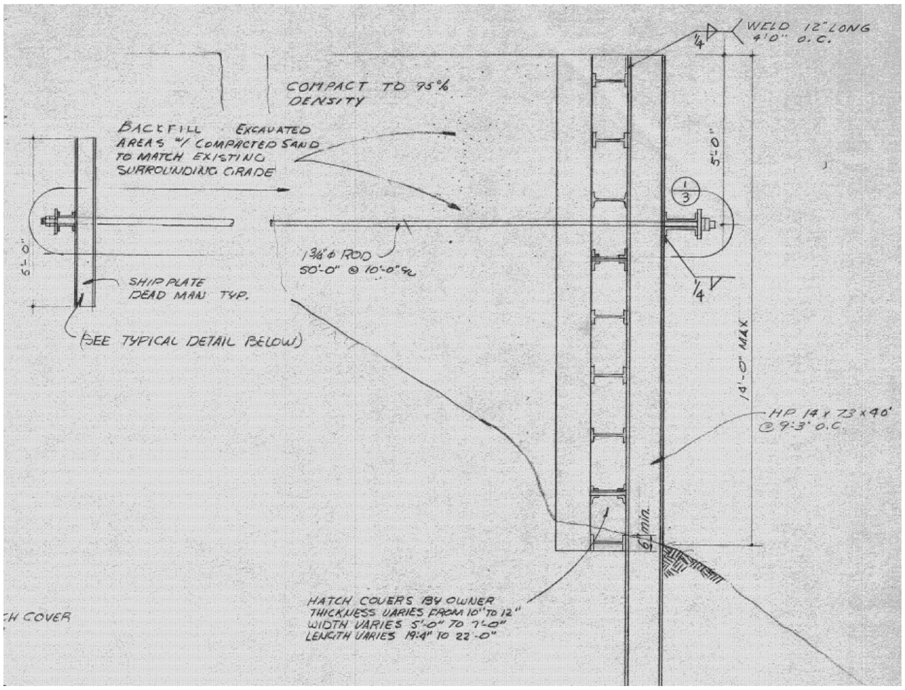


Figure 27: Schnitzer Wall Plan

7.2. Proposed Conditions

The TSP includes a below-grade, in-water wall in front of the Schnitzer Steel property in the northwestern portion of the Turning Basin. The proposed wall location is shown in blue on Figure 17. The wall will be approximately 300 to 400 feet long, and will be entirely submerged. The wall will likely be a concrete secant wall or driven pile structure. The wall will be offset 10 to 20 feet from the existing Schnitzer Steel wall in the direction of the turning basin, and will be designed so that the dredged slope will not undermine on the Schnitzer Steel wall. The top of the wall will be flush with the existing grade (mudline) at the base of the Schnitzer wall. The proposed wall will retain approximately 20 to 25 feet.

Based on the soil conditions, it may be feasible to steepen the proposed slope to up to 1.5:1 (H:V) in order to provide a greater buffer in front of the existing wall. A steepened slope would be armored with rock slope protection.

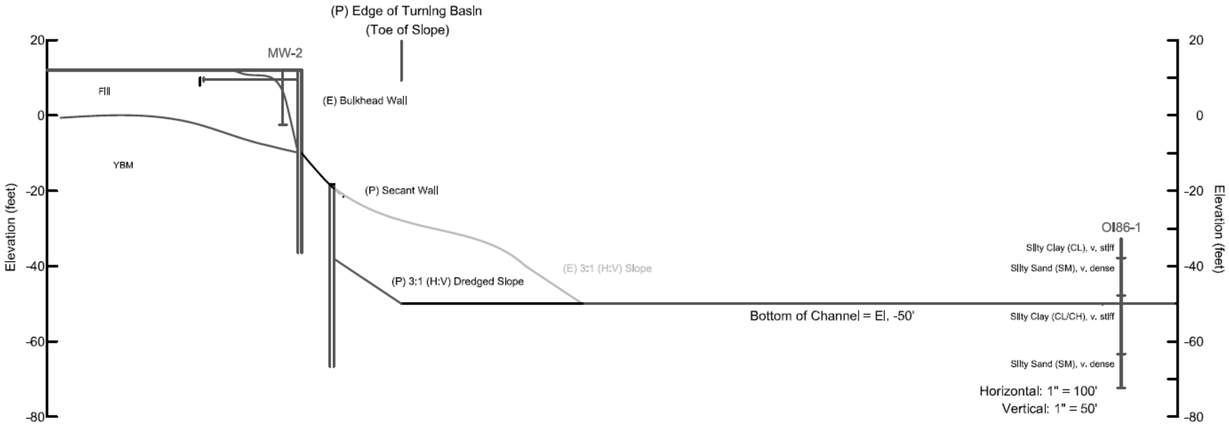


Figure 28: Schnitzer Steel Cross-Section C-C'(Proposed)

7.3. Design Considerations

Due to the previous use of the area, there is a potential for buried debris within the dredge area and proposed wall footprint. Geophysical and bathymetric surveys of the cove between Schnitzer Steel and Howard Terminal are planned during the Feasibility Study. The purpose is to detect buried objects that my conflict with the proposed wall construction.

8. Alameda

8.1. Existing Conditions

The Alameda/Fisk wharf and warehouse structures were constructed between 1939 and 1945 based on aerial photograph review. Based on the former Shoreline Map (Figure 6), the wharf is constructed over former marsh land. The pre-development (1939) shoreline is shown as a yellow dashed line on Figures 17 and 18. The existing warehouse structures and wharf are founded on concrete and timber piles bearing in the underlying dense sand.

The existing bulkhead wall was constructed during the -50 foot project. The bulkhead wall is constructed of vertical and battered, concrete-filled steel piles. The wall is founded in dense sands and very stiff clays. There is a 1.5:1 (H:V) slope in front of the wall with rip rap rock slope protection. The area in front of the wall has been dredged to Elevation -50 feet.

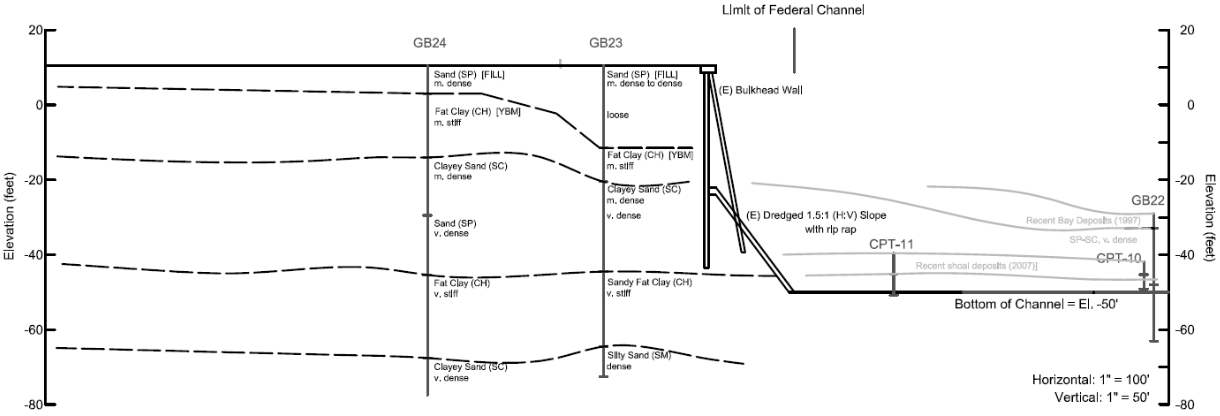


Figure 29: Alameda/Fisk Property Cross-Section D-D'(Existing)

8.2. Proposed Conditions

The TSP includes demolition of the existing bulkhead wall at the Fisk Property and construction of a new bulkhead wall. The location of the proposed bulkhead wall is shown on Figure 17. The project will also include partial demolition of the existing warehouse structures and removal of existing pile foundations. Figure 22 shows a typical detail of the existing bulkhead that was constructed during the -50 foot project, as described above. For preliminary design, it is assumed that the proposed bulkhead wall will be a similar design. The actual foundation depths will be determined during PED based on the loadings and site foundation conditions.

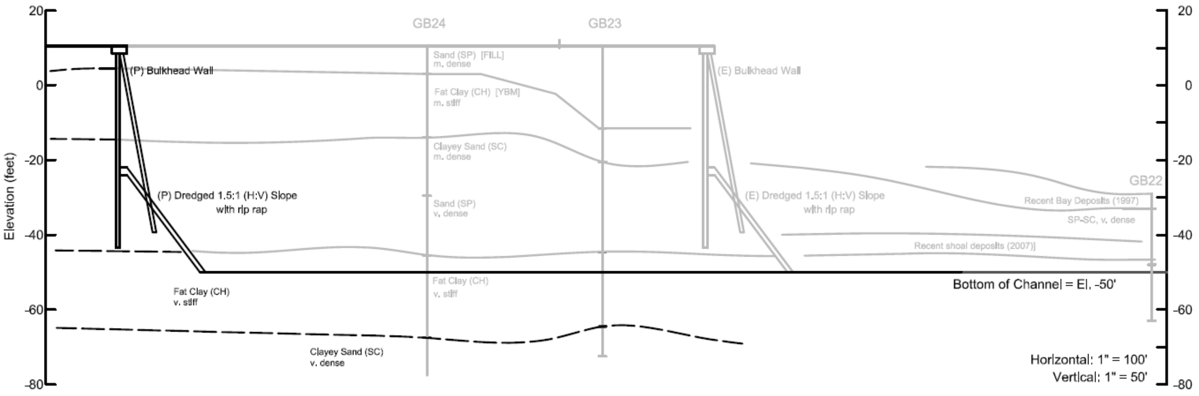


Figure 30: Alameda/Fisk Property Cross-Section D-D'(Proposed)

8.3. Design Considerations

The preliminary design employs vertical and battered piles. The wall is expected to be similar to the existing bulkhead wall.

Construction will require removal of the existing pile foundations for the existing bulkhead and warehouse building. Piles can be removed or cut below the proposed finished grades.

The San Antonio Formation sands are dense to very dense. A dredgeability analysis should be performed during design development, including review of dredging records from the -50 Foot Project.

9. Further Analysis and Design Development

The TSP for the Inner Harbor requires excavation at Howard Terminal and on private property on the Alameda side of the channel. Assumptions about the existing conditions and configuration of the slopes, wharf structures, and bulkhead walls in these areas were based on review of as-built plans and limited site reconnaissance. Existing conditions should be verified during the PED phase. Depending on the type of structural analysis required for design of the bulkhead walls, site-specific seismic hazard and site response analyses may be required.

10. References

Christie, S.R., Dickenson, S.E., Guenther, P., and Walsh, S.A., 2021, Seismic Performance of a Deep Soil Mix Grid, Geostrata August/September Issue.

Engeo, Inc., 2007, Geotechnical Field Services Report, Oakland Inner Harbor Turning Basin, Alameda, California

Engeo, Inc., 2019, Preliminary Geotechnical Exploration Report, Oakland Athletics Ballpark Development, Howard Terminal, Oakland, California

EVS Environmental Consultants, Port of Oakland 50-Foot Harbor Deepening Project, Comprehensive Final Sediment Analyses Report.

Field, E.H., and 2014 Working Group on California Earthquake Probabilities, 2015, UCERF3: A new earthquake forecast for California's complex fault system: U.S. Geological Survey 2015–3009, 6 p., <https://dx.doi.org/10.3133/fs20153009>

Fugro West, Inc., 2003, Geotechnical Study, Oakland Inner Harbor Turning Basin Widening Project, Phase 1B/2, Alameda, California

Geosyntec / eTrac, 2024, Oakland Turning Basin Geophysical Survey.

Geo/Resource Consultants, 1986, Report of Field Activities, Oakland Inner Harbor Overwater Sediment Sampling and Explorations

Gilbert, G.K., Yourman, A.M., Isa, C., and Grossi, C., 2013, Ground Improvement to Enhance Bulkhead Seawall Stability, ASCE Ports 2013.

Graymer, R.W., 2000, Geologic Map and Map Database of the Oakland Metropolitan Area, Alameda, Contra Costa, and San Francisco Counties, California, USGS Miscellaneous Field Studies MF-2343

Helley, E.J., and Graymer, R.W., 1997, Quaternary Geology of Alameda County, and Parts of Contra Costa, Santa Clara, San Mateo, San Francisco, Stanislaus, and San Joaquin Counties, California, USGS OFR 97-97. < https://pubs.usgs.gov/of/1997/0097/>

Jain, P., Phelps, D.S., and Chin, K.H., 2010, Structural-Geo-technical Procedures for New Wharf Design, ASCE Ports 2010.

J.Y. Long Co. Engineers, 1973, Oakland Waterfront Bulkhead, Schnitzer Steel Products; Topographic Survey (Sheet 1A), Plan and Details (Sheet 2), and Bulkhead Details (Sheet 1 of 2).

Port of Oakland, 1990, Loma Prieta Earthquake, Post Action Report.

PLS Surveys, Inc., 2003, Bathymetric Survey of Bay Adjacent to Schnitzer Steel Facility, Oakland, California, May 27.

Radbruch, D.H., 1957, Areal and Engineering Geology of the Oakland West Quadrangle, California, USGS Miscellaneous Geologic Investigations Map I-239.

Radbruch, D.H., 1959, Former Shoreline Features Along the East Side of San

Francisco Bay, California, USGS Miscellaneous Geologic Investigations Map I-298.

Rogers, J.D. and Figuers, S. H., 1991, Engineering Geologic Site Characterization of the Greater Oakland-Alameda Area, Alameda and San Francisco Counties, California.

Subsurface Consultants, Inc., 1999, Geotechnical Investigation, Oakland Harbor Navigation Improvement (-50 foot) Project, Port of Oakland, Oakland and Alameda, California.

Subsurface Consultants, Inc., 2000, Geotechnical Investigation, Bottom Deployed Cone Penetrations Testing, Oakland Harbor Deepening -50 foot Project, Port of Oakland, Oakland and Alameda, California

Sowers, J.M., and Richard, C.M., 2009, Creek & Watershed Map of Oakland & Berkeley (Fourth edition): Oakland Museum of California, Oakland, CA.

Slate Geotechnical Consultants, 2023a, Geotechnical Data Report – Cone Penetration Testing, Oakland Turning Basin Widening Study, November 14.

Subsurface Consultants, Inc., 2000, Geotechnical Evaluation, -50 Foot Slope Optimization, Port of Oakland, Oakland and Alameda, California

Subsurface Consultants, Inc., 2003, Supplemental Design Documentation Report, Inner Harbor Turning Basin, Phase 1B, Appendix D, Oakland Harbor Navigation Improvement (-50 foot) Project, Port of Oakland, Oakland and Alameda, California

Terraphase Engineering, 2019, Soil Summary Report, Schnitzer Steel Facility, Oakland, California.

Terraphase Engineering, 2020, DRAFT Hydrogeologic Investigation Report, Schnitzer Steel Facility, Oakland, California.

USACE, 1972, Oakland Inner Harbor, Locations and Logs of Exploration Holes, revised November.

USACE, 2007, Oakland Harbor Navigation Improvement 50 Foot Project, Inner Harbor Turning Basin Wings, Cone Penetrometer Testing Survey Results

USACE, EM 1110-2-1902, Slope Stability, 2003.

USACE, ER 1110-2-1150, Engineering and Design for Civil Works Projects, 1999.

USACE, ER 1110-2-1806, Earthquake Design and Evaluation for Civil Works Projects, 2016.

USGS, 1998, The Loma Prieta, California, Earthquake of October 17, 1989 –

Liquefaction, Professional Paper 1551-B.

Varatharaj, R.S., Pratheepan, P.K., Arulmoli, A.K., Trowbridge, M., and Baldwin, T., 2013, Jet Grouting Improvement at Pier D, Port of Long Beach, ASCE Ports 2013.

Winzler and Kelly, 1982, Overwater Drilling for Undisturbed Tube Samples Oakland Outer Harbor.

Woodward-Clyde Consultants, 1979, Geotechnical Investigation, Charles P. Howard Container Terminal, Inner Harbor, Oakland, California

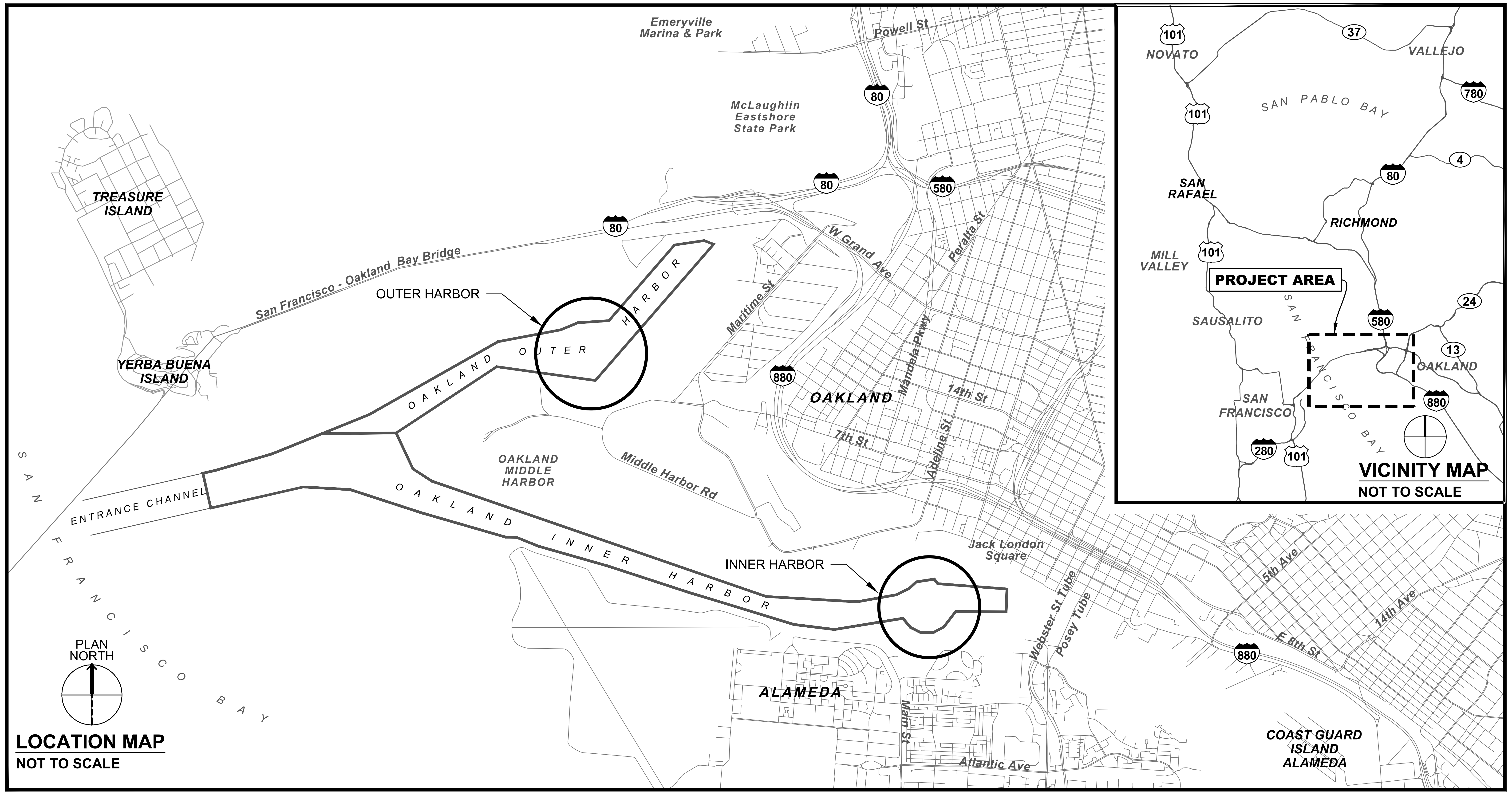
Attachment 1

Oakland Harbor Turning Basin Feasibility Study

Geotechnical Plan Set

US Army Corps of Engineers®
San Francisco District

ALAMEDA COUNTY, CALIFORNIA
OAKLAND HARBOR TURNING BASIN
FEASIBILITY STUDY



ISSUE DATE: SEPTEMBER 2023

SCHEDULE OF DRAWINGS

SHEET ID	DESCRIPTION
G-001	COVERSHEET
OH-101	OUTER HARBOR EXISTING SITE PLAN
OH-102	OUTER HARBOR PROPOSED SITE PLAN
OH-103	OUTER HARBOR GEOTECHNICAL PLAN
OH-104	OUTER HARBOR CROSS-SECTIONS
IH-101	INNER HARBOR EXISTING SITE PLAN
IH-102	INNER HARBOR PROPOSED SITE PLAN
IH-103	INNER HARBOR GEOTECHNICAL PLAN
IH-104	INNER HARBOR CROSS-SECTIONS - HOWARD TERMINAL
IH-105	INNER HARBOR CROSS-SECTIONS - SCHNITZER STEEL
IH-106	INNER HARBOR CROSS-SECTIONS - ALAMEDA
IH-107	SUMMARY OF GEOTECHNICAL DATA

US Army Corps of Engineers®

MARK	DESCRIPTION	DATE

DESIGNED BY: B.WAIR	ISSUE DATE: JULY 2023
DRAWN BY: C.BROCK	SOLICITATION NO: ***
CHECKED BY: D. DEMKO	CONTRACT NO: ***
SUBMITTED BY: ***	PROJECT NO: ***
SIZE: ANSI D	

U.S. ARMY CORPS OF ENGINEERS
SAN FRANCISCO DISTRICT
450 GOLDEN GATE AVE, 4TH FLOOR
SAN FRANCISCO, CA 94102-3404

ALAMEDA COUNTY, CALIFORNIA
OAKLAND HARBOR TURNING BASIN
FEASIBILITY STUDY

COVERSHEET

SHEET ID
G-001

BCDC REVIEW

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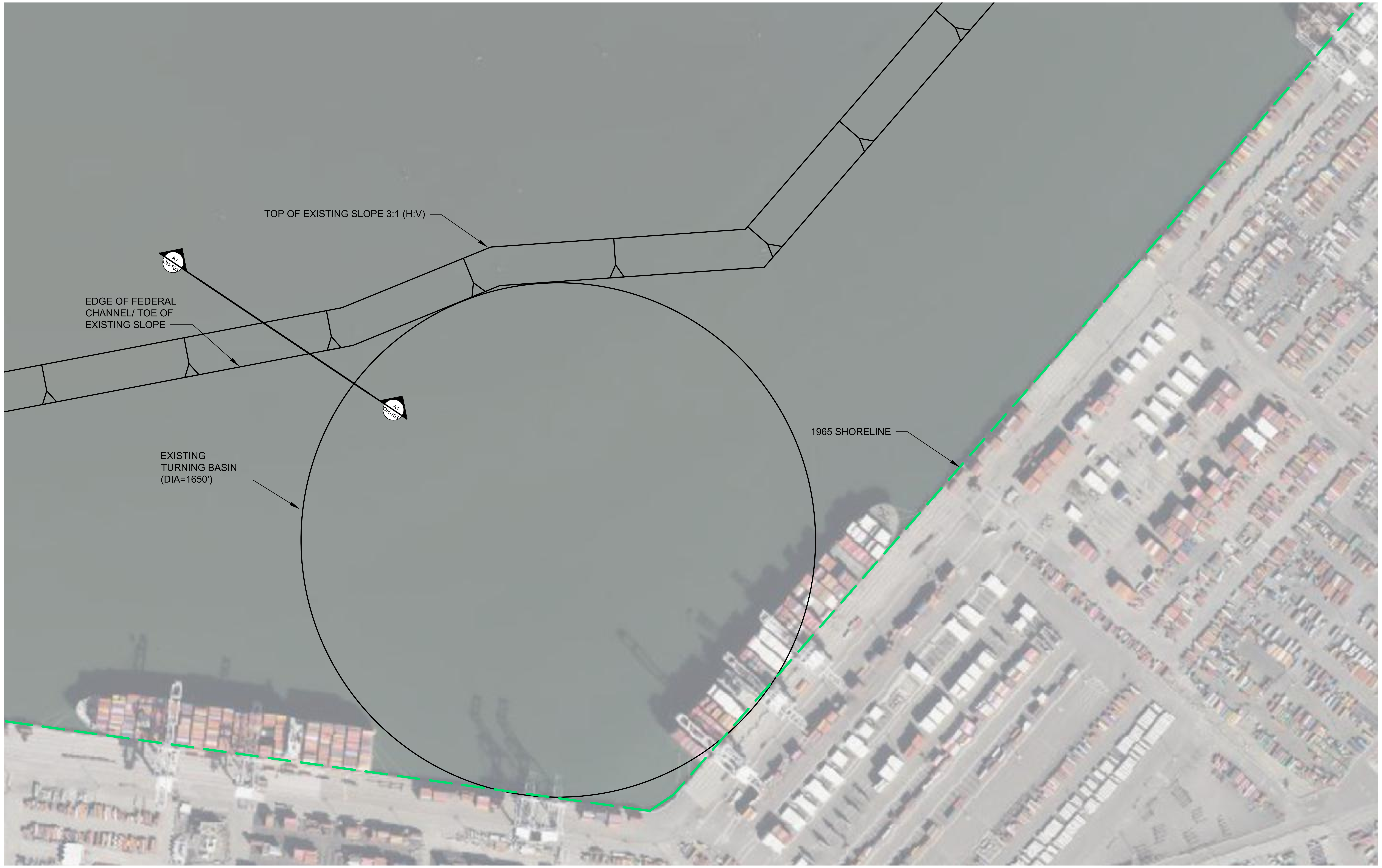
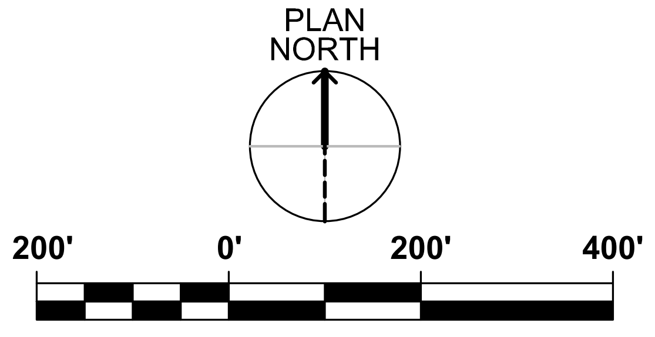


NOTES:

1. BCDC BAY JURISDICTION - AREA BAYWARD OF THE EXISTING BULKHEAD WALL
2. TURNING BASIN AREA AND ADJACENT TERMINAL ARE CONSIDERED BCDC BAY JURISDICTION; ALL PROPOSED WORK IN OUTER HARBER WILL BE WITHIN BAY JURIDICTION
3. EXISTING FEDERAL CHANNEL DREDGED TO ELEVATION -50 FEET MEAN LOWER LOW WATER (MLLW)



GRAPHIC SCALE

US Army Corps of Engineers®

MARK	DESCRIPTION	DATE

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U.S. ARMY CORPS OF ENGINEERS
SAN FRANCISCO DISTRICT
450 GOLDEN GATE AVE, 4TH FLOOR
SAN FRANCISCO, CA 94102-3404

ALAMEDA COUNTY, CALIFORNIA

OAKLAND HARBOR TURNING BASIN
FEASIBILITY STUDY

OUTER HARBOR
EXISTING SITE PLAN

SHEET ID

OH-101

BCDC REVIEW

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L3ECECWB

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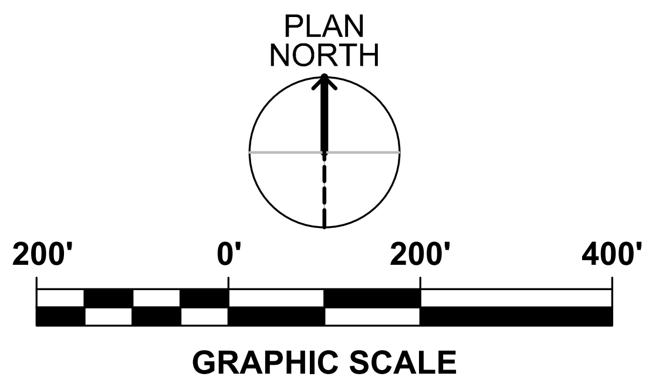
NOTES:

1. BCDC BAY JURISDICTION - AREA BAYWARD OF THE EXISTING BULKHEAD WALL
2. EXISTING FEDERAL CHANNEL AND PROPOSED TURNING BASIN EXPANSION DREDGED TO ELEVATION -50 FEET MEAN LOWER LOW WATER (MLLW) WITH UP TO 2 FEET OF ALLOWABLE OVER-DREDGE
3. THE OUTER HARBOR TURNING BASIN WIDENING WILL NOT INCREASE THE SURFACE AREA OF THE BAY. THE PROJECT WILL INCREASE THE VOLUME BY APPROXIMATELY 1,220,000 CUBIC YARDS DUE TO REMOVAL OF SEDIMENT OUTSIDE OF THE EXISTING FEDERAL CHANNEL.
4. NO KNOWN EELGRASS, MARSHES, WETLANDS, OR MUDFLATS WITHIN THE PROPOSED PROJECT AREA.

CONSTRUCTION SEQUENCING:

① DREDGE TO EXPAND TURNING BASIN



FILL/REMOVAL SUMMARY

PROJECT AREA	BCDC JURISDICTION	Construction Activity	TYPE OF FILL/EXCAVATION	MATERIAL	AREA (FT2)	ADDED (CY)	REMOVED (CY)
OUTER HARBOR	BAY	①	IN-WATER	BAY SEDIMENT	1,004,000	----	1,220,000

US Army Corps of Engineers®

MARK	DESCRIPTION	DATE

DESIGNED BY: B.WAIR
DRAWN BY: C.BROCK
CHECKED BY: D. DEMKO
SUBMITTED BY: ***
SIZE: ANSI D
ISSUE DATE: JULY 2023
SOLICITATION NO: ***
CONTRACT NO: ***
PROJECT NO: ***

U.S. ARMY CORPS OF ENGINEERS
SAN FRANCISCO DISTRICT
450 GOLDEN GATE AVE, 4TH FLOOR
SAN FRANCISCO, CA 94102-3404

ALAMEDA COUNTY, CALIFORNIA
OAKLAND HARBOR TURNING BASIN
FEASIBILITY STUDY

OUTER HARBOR
PROPOSED SITE PLAN

SHEET ID
OH-102

BCDC REVIEW

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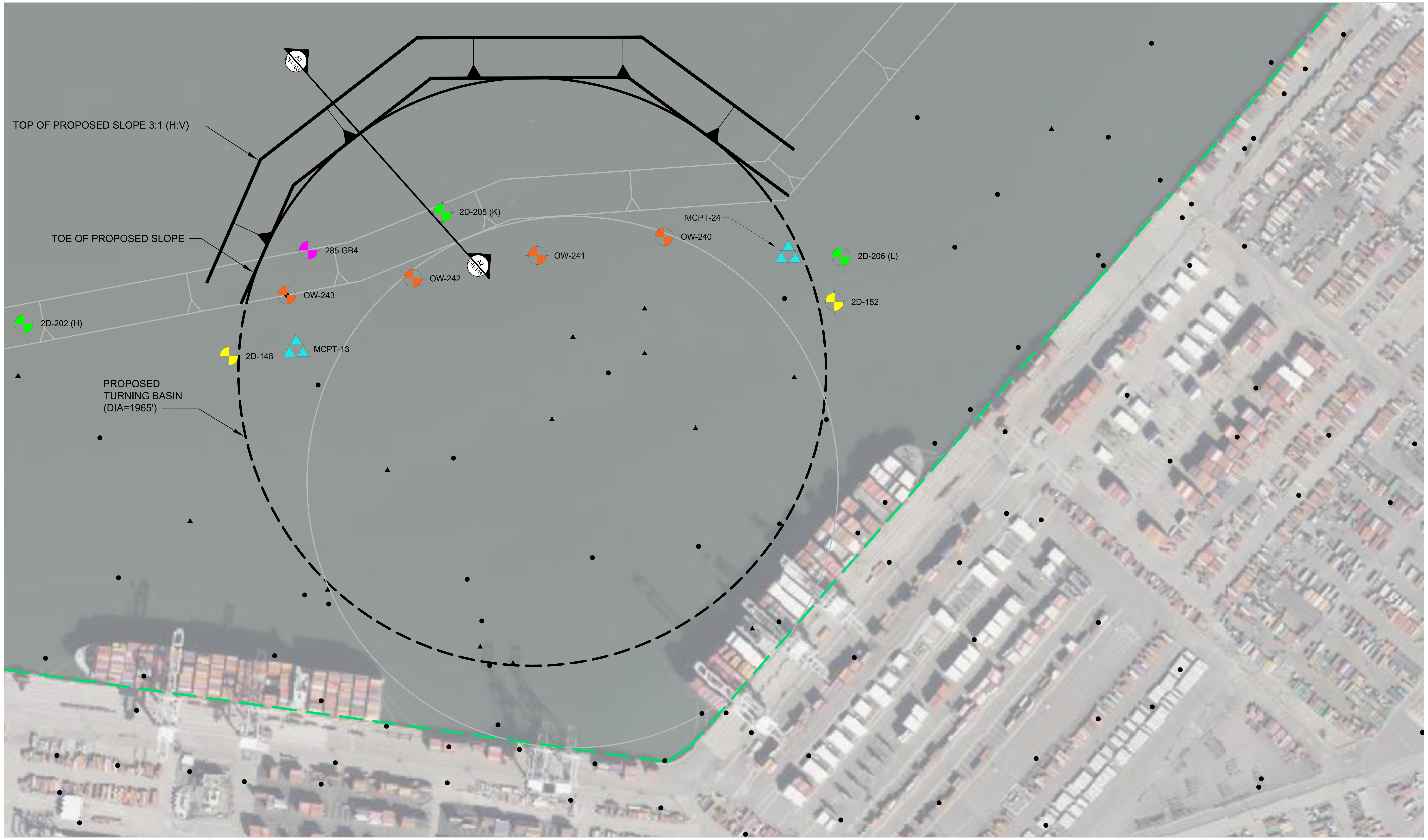
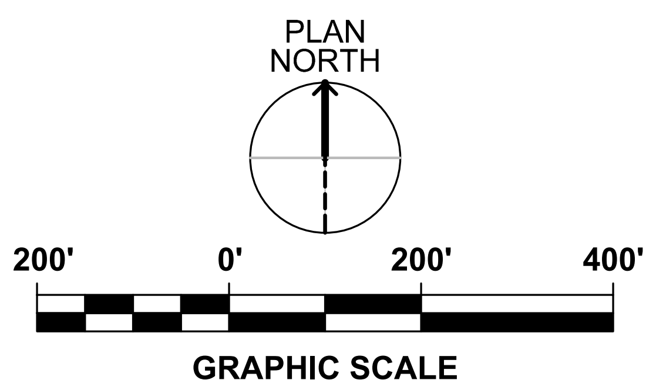
L3ECECWB



LEGEND

- EXPLORATORY BORINGS
- ▲ CONE PENETRATION TEST
- 🟩 WINZLER & KELLY (1982)
- 🟨 USACE (1982)
- 🟧 EVS (1997)
- 🟪 SCI (1999)
- ▲ SCI (2000)
- ● ▲ OTHER EXPLORATIONS



GRAPHIC SCALE

NOTES:

1. SUMMARY OF EXPLORATIONS PROVIDED ON SHEET OH-107

US Army Corps of Engineers®

MARK	DESCRIPTION	DATE

U.S. ARMY CORPS OF ENGINEERS
SAN FRANCISCO DISTRICT
450 GOLDEN GATE AVE, 4TH FLOOR
SAN FRANCISCO, CA 94102-3404

DESIGNED BY: B.WAIR
DRAWN BY: C.BROCK
CHECKED BY: D. DEMKO
SUBMITTED BY: ***
SIZE: ANSI D
ISSUE DATE: JULY 2023
SOLICITATION NO: ***
CONTRACT NO: ***
PROJECT NO: ***

ALAMEDA COUNTY, CALIFORNIA

OAKLAND HARBOR TURNING BASIN
FEASIBILITY STUDY

GEOTECHNICAL SITE PLAN

SHEET ID

OH-103

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BCDC REVIEW

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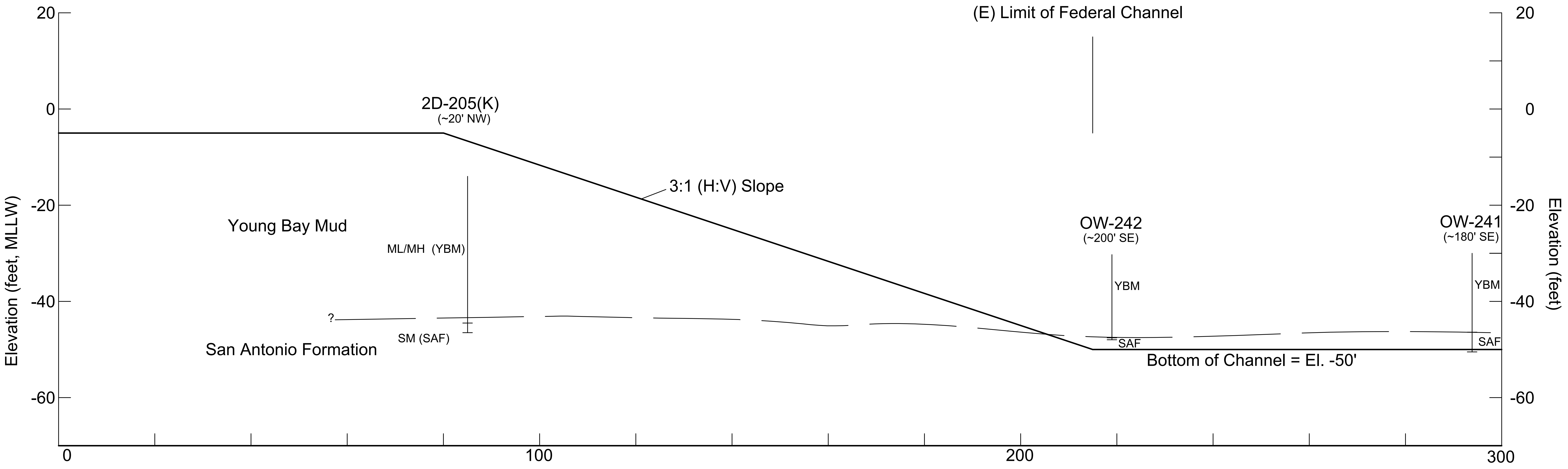
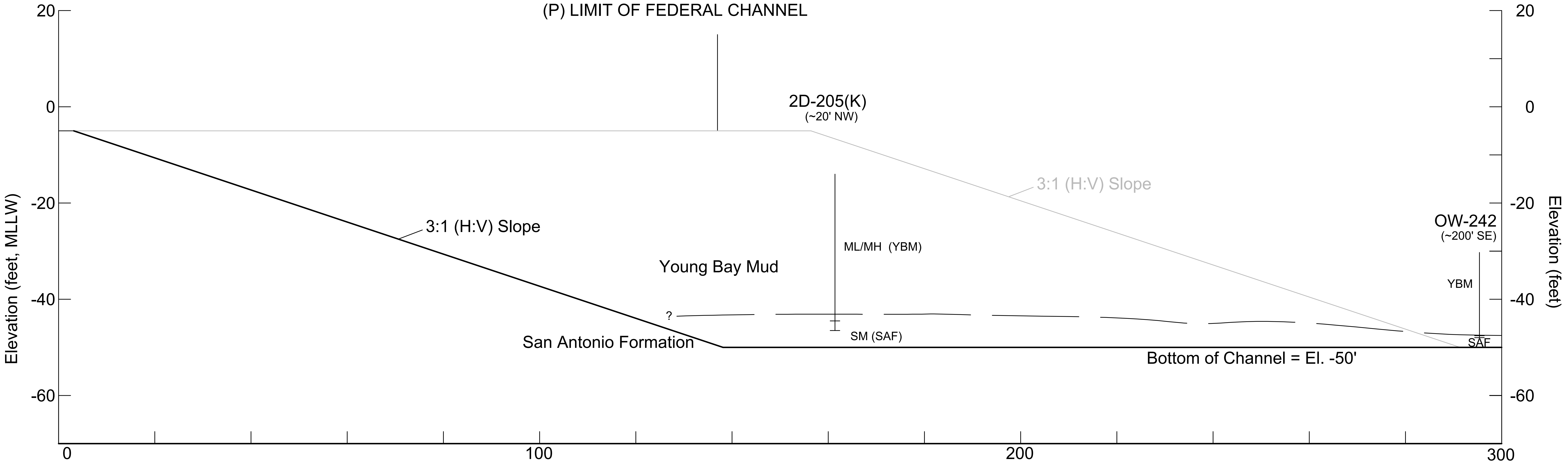


A1 EXISTING CROSS-SECTION
1" = 15'



A2 PROPOSED CROSS-SECTION
1" = 15'

US Army Corps of Engineers®

MARK	DESCRIPTION	DATE

DESIGNED BY: B.WAIR
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ISSUE DATE: JULY 2023
SOLICITATION NO.: ---
CONTRACT NO.: ---
PROJECT NO.: ---

U.S. ARMY CORPS OF ENGINEERS
SAN FRANCISCO DISTRICT
450 GOLDEN GATE AVE, 4TH FLOOR
SAN FRANCISCO, CA 94102-3404

ALAMEDA COUNTY, CALIFORNIA
OAKLAND HARBOR TURNING BASIN
FEASIBILITY STUDY

OUTER HARBOR
CROSS-SECTIONS

SHEET ID
OH-104

BCDC REVIEW

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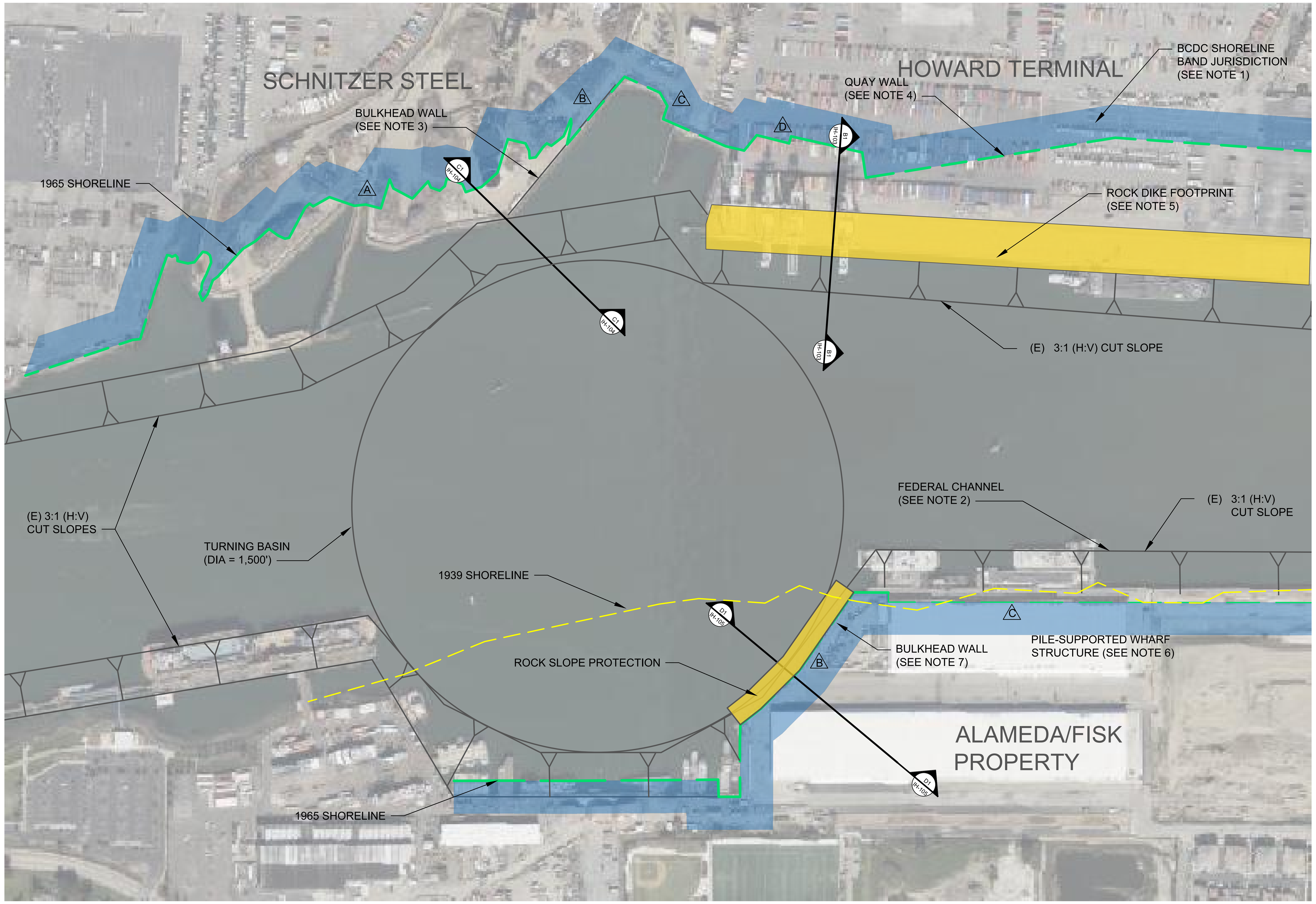
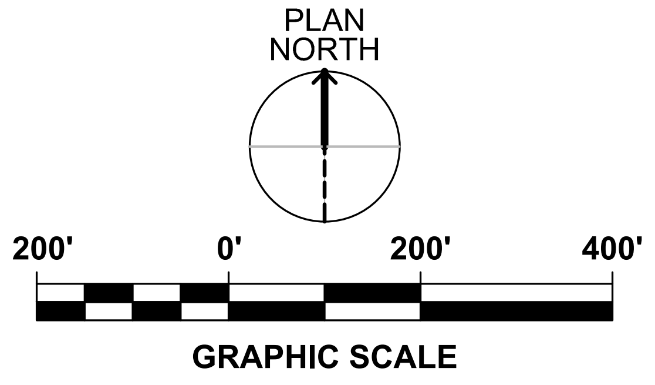


NOTES:

1. BCDC SHORELINE BAND JURISDICTION VARIES. 100 FT INLAND OF:
   - A 1965 SHORELINE
   - B EXISTING BULKHEAD WALL
   - C INTERSECTION OF EXISTING SLOPE AND MEAN HIGH WATER
     MHW = EL 5.98' (MLLW) = EL. 5.75' (NAVD88)
   - D EXISTING QUAY WALL (c. 1910)
2. FEDERAL CHANNEL AND TURNING BASIN DREDGED EL. -50' (MLLW)
3. SCHNITZER STEEL EXISTING BULKHEAD WALL CONSTRUCTED CIRCA 1973. SEE DETAIL 1/IH-104.
4. QUAY WALL CONSTRUCTED CIRCA 1910; WOOD, BELOW GRADE.
5. HOWARD TERMINAL WHARF AND ROCK DIKE CONSTRUCTED IN 1981. SEE DETAIL 1/IH-103
6. PILE SUPPORTED WHARF DECK AND WAREHOUSES CONSTRUCTED BETWEEN 1939 AND 1945.
7. BULKHEAD WALL CONSTRUCTED IN 2003. SEE DETAIL 1/IH-105



US Army Corps of Engineers®

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PROJECT NO: ***

U.S. ARMY CORPS OF ENGINEERS
SAN FRANCISCO DISTRICT
450 GOLDEN GATE AVE, 4TH FLOOR
SAN FRANCISCO, CA 94102-3404

ALAMEDA COUNTY, CALIFORNIA

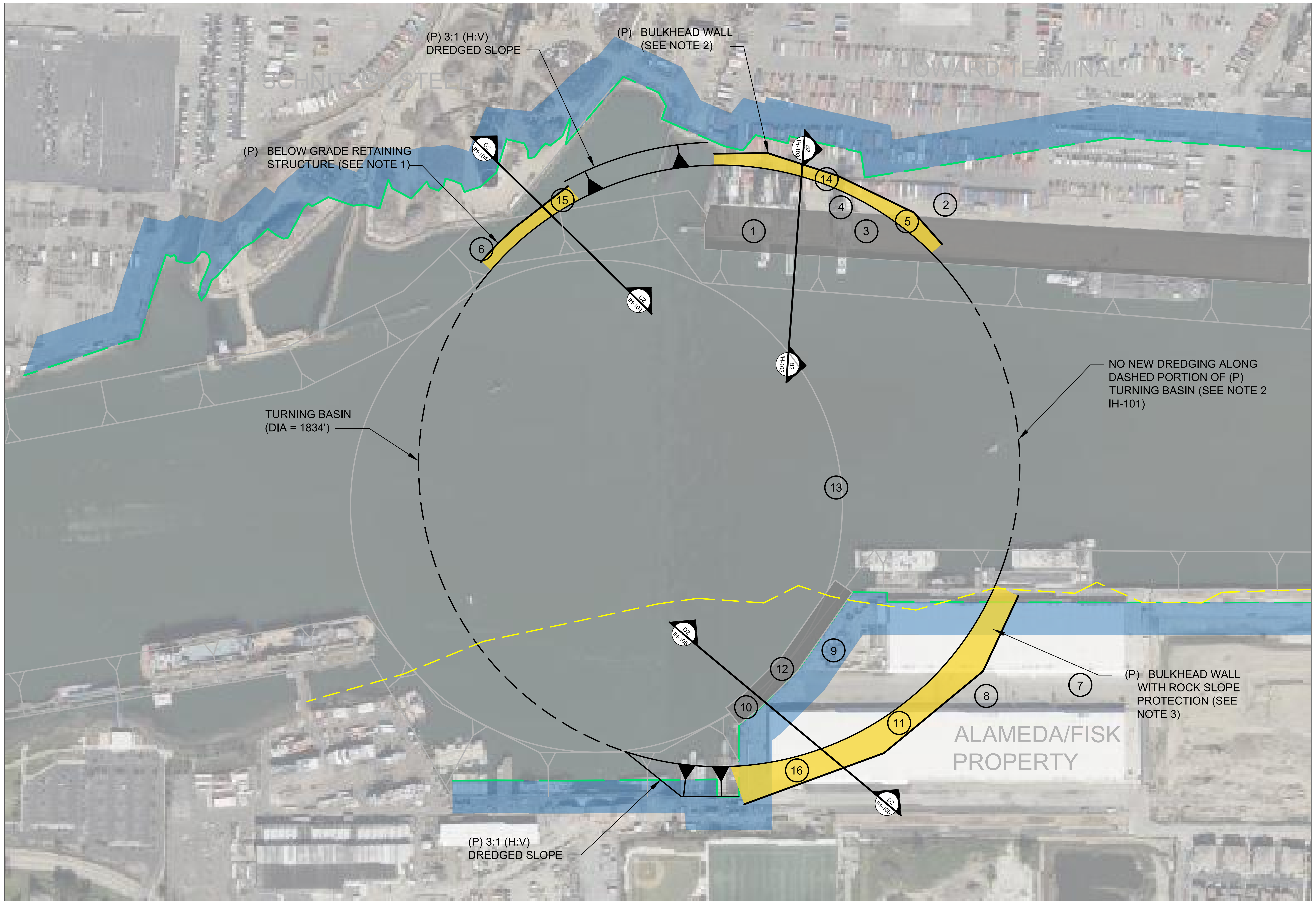
OAKLAND HARBOR TURNING BASIN
FEASIBILITY STUDY

INNER HARBOR
EXISTING SITE PLAN

SHEET ID

IH-101

BCDC REVIEW



CONSTRUCTION SEQUENCING:

① DEMOLISH PILE-SUPPORTED WHARF
② INSTALL BULKHEAD WALL AND GROUND IMPROVEMENT, IF NECESSARY
③ REMOVE ROCK DIKE AND SOIL ABOVE WATER LEVEL
④ REMOVE ROCK DIKE AND SOIL ABOVE WATER LEVEL
⑤ INSTALL BATTERED PILES
⑥ INSTALL BELOW-GRADE RETAINING STRUCTURE
⑦ DEMOLISH EXISTING WAREHOUSE BUILDINGS, WHARF STRUCTURE AND PILES
⑧ INSTALL BULKHEAD WALL
⑨ EXCAVATE SOIL BETWEEN EXISTING AND PROPOSED BULKHEADS TO APPROXIMATELY WATER LEVEL
⑩ REMOVE RIP RAP AT TOE OF EXISTING BULKHEAD
⑪ INSTALL BATTERED PILES
⑫ DEMOLISH EXISTING BULKHEAD WALL
⑬ DREDGE TURNING BASIN
⑭ INSTALL RIP RAP SLOPE PROTECTION IN FRONT OF HOWARD TERMINAL
⑮ INSTALL RIP RAP SLOPE PROTECTION IN FRONT OF SCHNITZER WALL
⑯ INSTALL RIP RAP SLOPE PROTECTION IN FRONT OF ALAMEDA WALL

NOTES:

1. PROPOSED BELOW-GRADE RETAINING STRUCTURE. CONCEPTUAL DESIGNS INCLUDE DRILLED SECANT WALL, DRILLED STITCH PIERS, DRIVEN PILES OR SHEET PILES.

2. PROPOSED BULKHEAD WALL AT HOWARD TERMINAL. SEE CONCEPTUAL DESIGN DETAIL 2/SHEET IH-104. LATERAL SUPPORTS MAY BE DERIVED FROM BATTERED PILES, TIE-BACKS, AND DEAD MAN ANCHORS. IMPROVEMENT OF BACKFILL SOILS MAY BE REQUIRED PENDING UPCOMING CPT'S.

3. PROPOSED BULKHEAD WALL. DESIGN WILL INCLUDE PLACEMENT OF ROCK SLOPE PROTECTION IN FRONT OF WALL. SEE CONCEPTUAL DETAIL 1/SHEET IH-106.

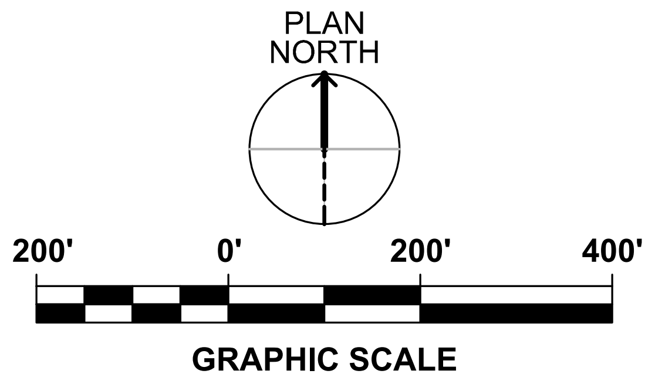
4. CONSTRUCTION SEQUENCING DESCRIBED THE MAJOR COMPONENTS OF WORK AND ASSUMED SEQUENCING. SEQUENCING SUBJECT TO CHANGE AS DESIGN PROGRESSES AND AT THE DISCRETION OF THE CONTRACTOR.

5. EXISTING FEDERAL CHANNEL AND PROPOSED TURNING BASIN EXPANSION DREDGED TO ELEVATION -50 FEET MEAN LOWER LOW WATER LEVEL (MLLW) WITH UP TO 2 FEET OF ALLOWABLE OVER-DREDGE.

6. THE INNER HARBOR TURNING BASIN WIDENING WILL INCREASE THE SURFACE AREA OF THE BAY BY APPROXIMATELY 418,000 SQUARE FEET (170,000 S.F. AT HOWARD TERMINAL AND 248,000 S.F. NEAR ALAMEDA. THE IHTB WIDENING PROJECT WILL INCREASE THE VOLUME BY APPROXIMATELY 852,000 CUBIC YARDS DUE TO REMOVAL OF FILL AND NATURAL SEDIMENT (224,000 CY AT HOWARD TERMINAL, 520,000 CY AT ALAMEDA/FISK PROPERTY, AND 130,000 DREDGED FROM BAY) MINUS APPROXIMATELY 22,000 OF NEW IN-WATER PILES AND ROCK SLOPE PROTECTION.

8. SOILS ABOVE MEAN HIGH WATER (EL ~ 5.75' (NAVD88) WERE CONSIDERED "OVER-WATER" SOILS BELOW MHW WERE CONSIDERED "IN-WATER".

9. NO KNOWN EELGRASS, MARSHES, WETLANDS OR MUDFLATS WITHIN THE PROPOSED PROJECT AREA.



US Army Corps of Engineers®

MARK	DESCRIPTION	DATE

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CHECKED BY: D. DEMKO
SUBMITTED BY: ---
SIZE: ANSI D
ISSUE DATE: JULY 2023
SOLICITATION NO: ---
CONTRACT NO: ---
PROJECT NO: ---

U.S. ARMY CORPS OF ENGINEERS
SAN FRANCISCO DISTRICT
450 GOLDEN GATE AVE. 4TH FLOOR
SAN FRANCISCO, CA 94102-3404

ALAMEDA COUNTY, CALIFORNIA
OAKLAND HARBOR TURNING BASIN
FEASIBILITY STUDY

INNER HARBOR
PROPOSED SITE PLAN

SHEET ID
IH-102

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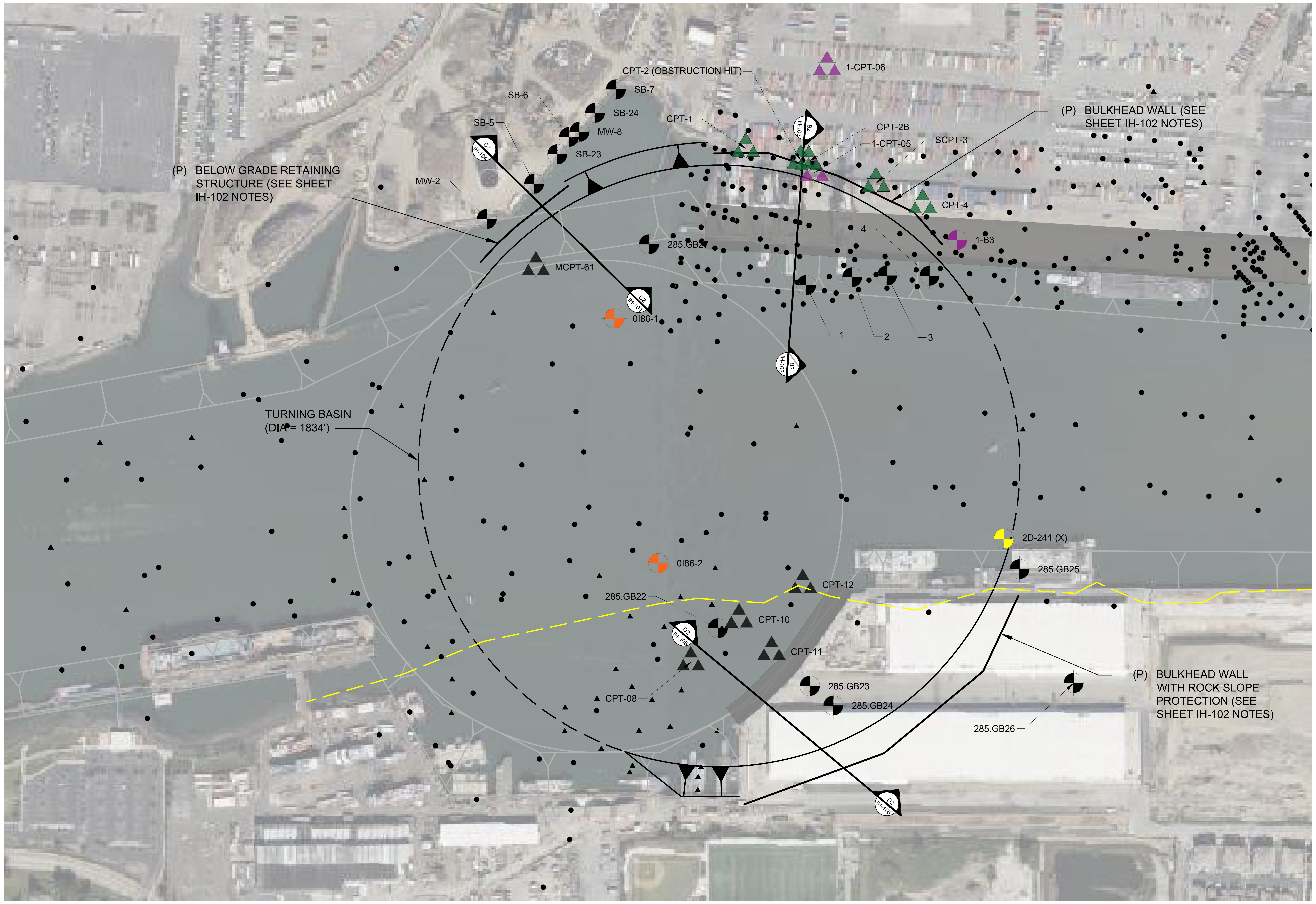
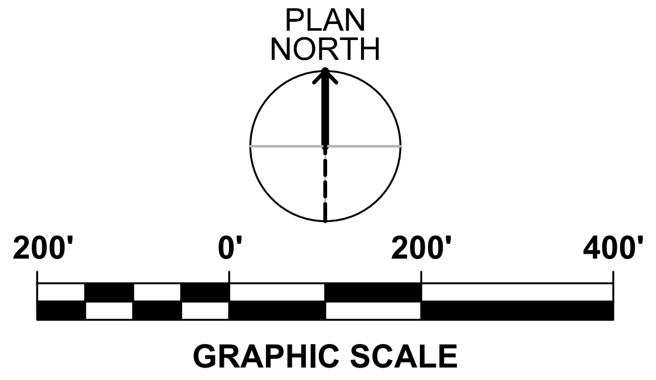


LEGEND

- ◐ EXPLORATORY BORINGS
- ▲ CONE PENETRATION TEST
- ◐ USACE (1924)
- ◐ USACE (1982)
- ◐ GEORESOURCE (1986)
- ◐ SCI (1999)
- ▲ SCI (2000)
- ◐ ▲ ENGEO (2007)
- ◐ ▲ ENGEO (2019)
- ▲ SLATE (2023)
- ◐ TERRAPHASE (2020)
- ● ▲ OTHER EXPLORATIONS

NOTE:

1. SUMMARY OF EXPLORATIONS PROVIDED ON SHEET OH-107



GRAPHIC SCALE

US Army Corps of Engineers®

MARK	DESCRIPTION	DATE

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SUBMITTED BY: ***
SIZE: ANSI D
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PROJECT NO: ***

U.S. ARMY CORPS OF ENGINEERS
SAN FRANCISCO DISTRICT
450 GOLDEN GATE AVE, 4TH FLOOR
SAN FRANCISCO, CA 94102-3404

ALAMEDA COUNTY, CALIFORNIA
OAKLAND HARBOR TURNING BASIN
FEASIBILITY STUDY

GEOTECHNICAL SITE PLAN

SHEET ID
IH-103

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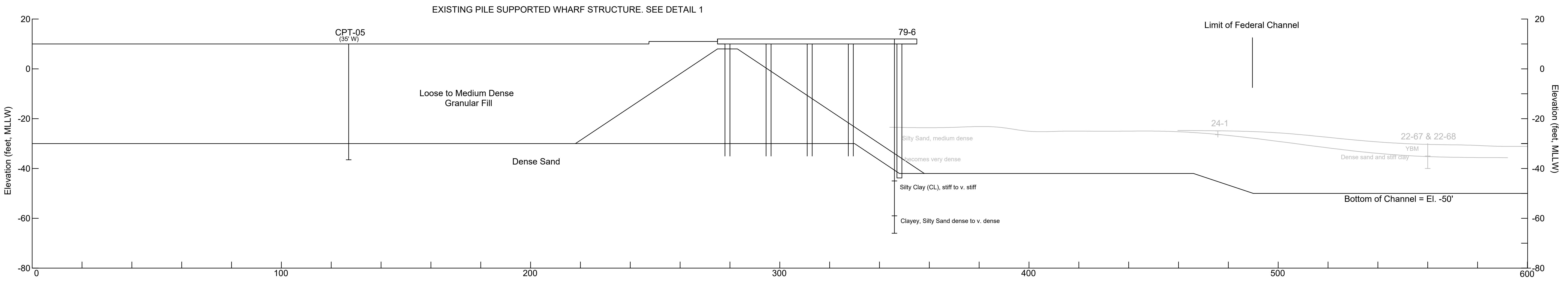
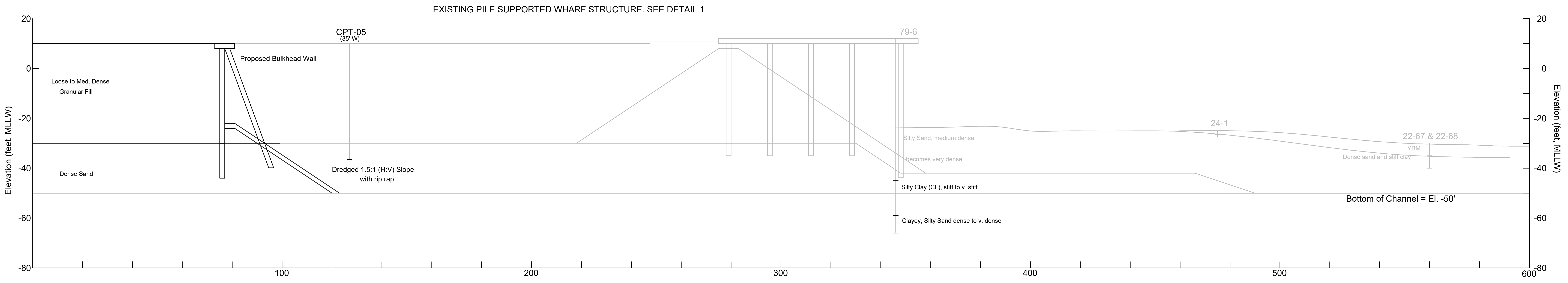
L3ECECWB



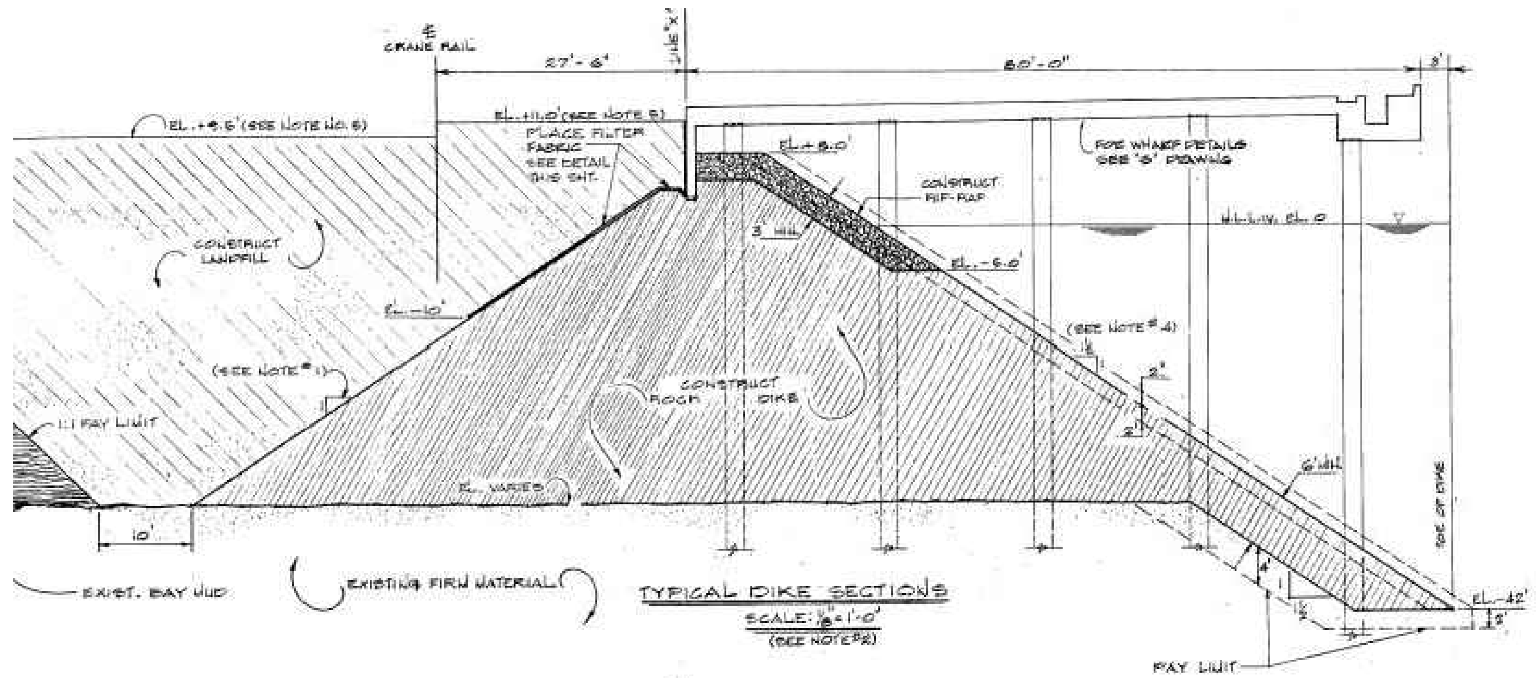
B1 EXISTING CROSS-SECTION
1" = 25'



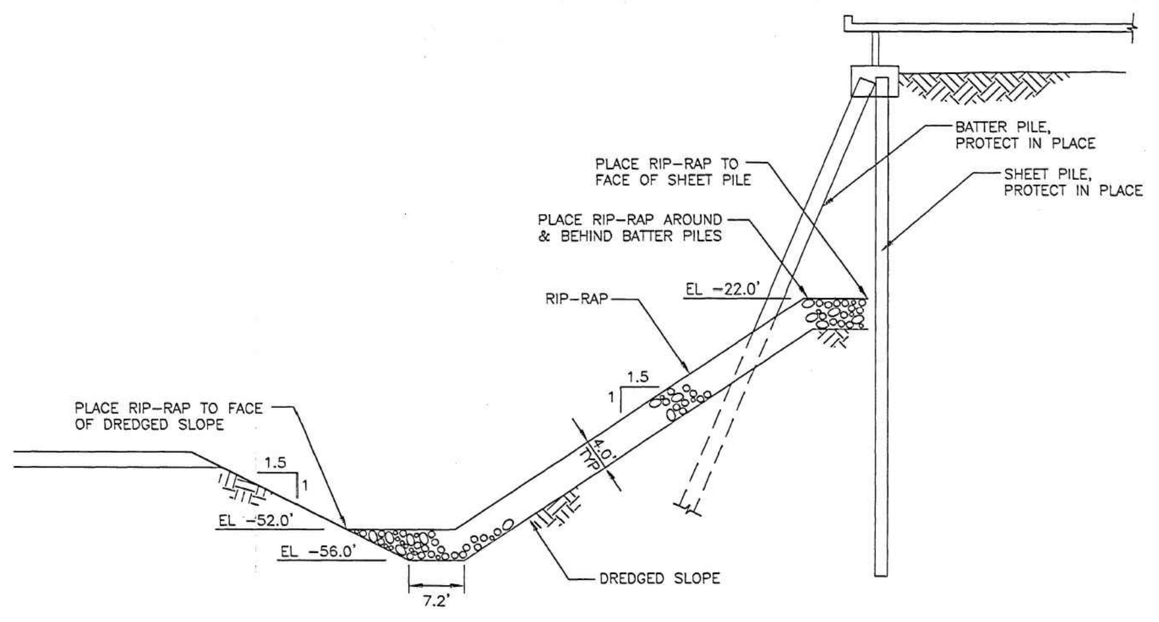
B2 PROPOSED CROSS-SECTION
1" = 25'

NOTE:

1. PROPOSED BULKHEAD WALL AT HOWARD TERMINAL. LATERAL SUPPORT MAY BE DERIVED FROM BATTERED PILES, AND DEAD MAN ANCHORS. IMPROVEMENT OF BACKFILL SOIL MAY BE REQUIRED PENDING UPCOMING CPT'S.



DETAIL 1 / HOWARD TERMINAL TYPICAL COSS-SECTION



DETAIL 2 / CONCEPTUAL BULKHEAD WALL DETAIL

US Army Corps of Engineers®

MARK	DESCRIPTION	DATE

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DRAWN BY: C.BROCK
CHECKED BY: D. DEMKO
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SIZE: ANSI D
ISSUE DATE: JULY 2023
SOLICITATION NO: ***
CONTRACT NO: ***
PROJECT NO: ***

U.S. ARMY CORPS OF ENGINEERS
SAN FRANCISCO DISTRICT
450 GOLDEN GATE AVE, 4TH FLOOR
SAN FRANCISCO, CA 94102-3404

ALAMEDA COUNTY, CALIFORNIA
OAKLAND HARBOR TURNING BASIN
FEASIBILITY STUDY

INNER HARBOR
CROSS-SECTIONS
HOWARD TERMINAL

SHEET ID
IH-104

BCDC REVIEW

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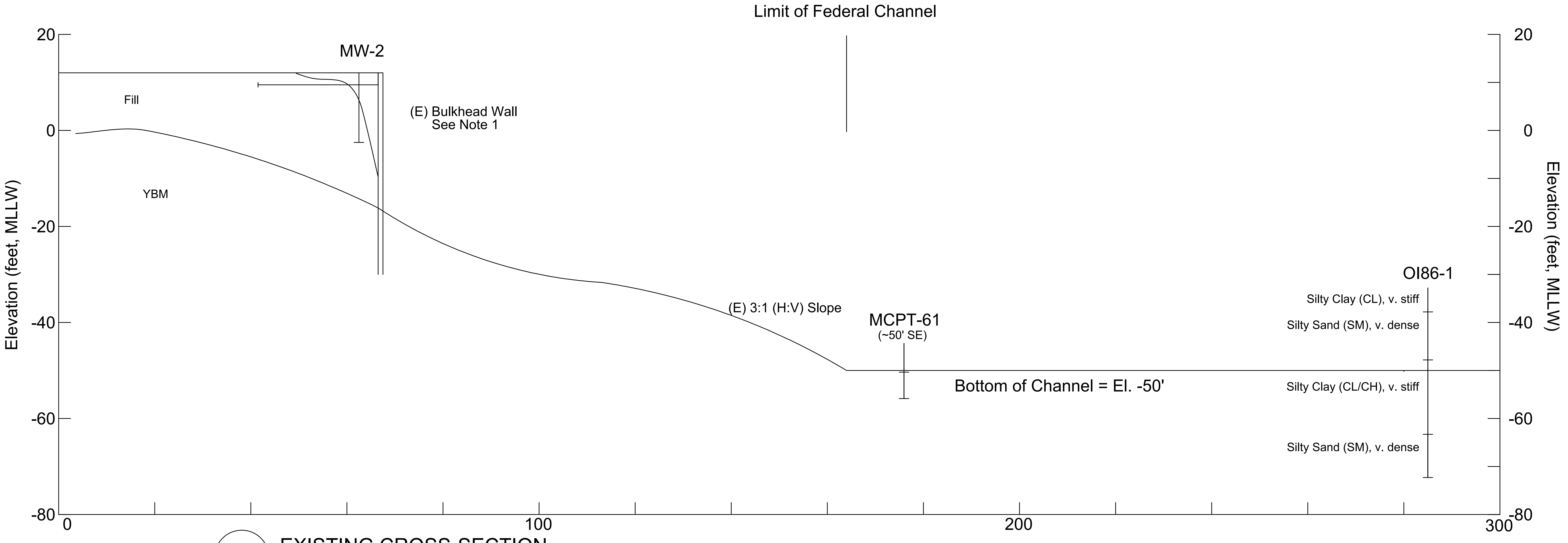
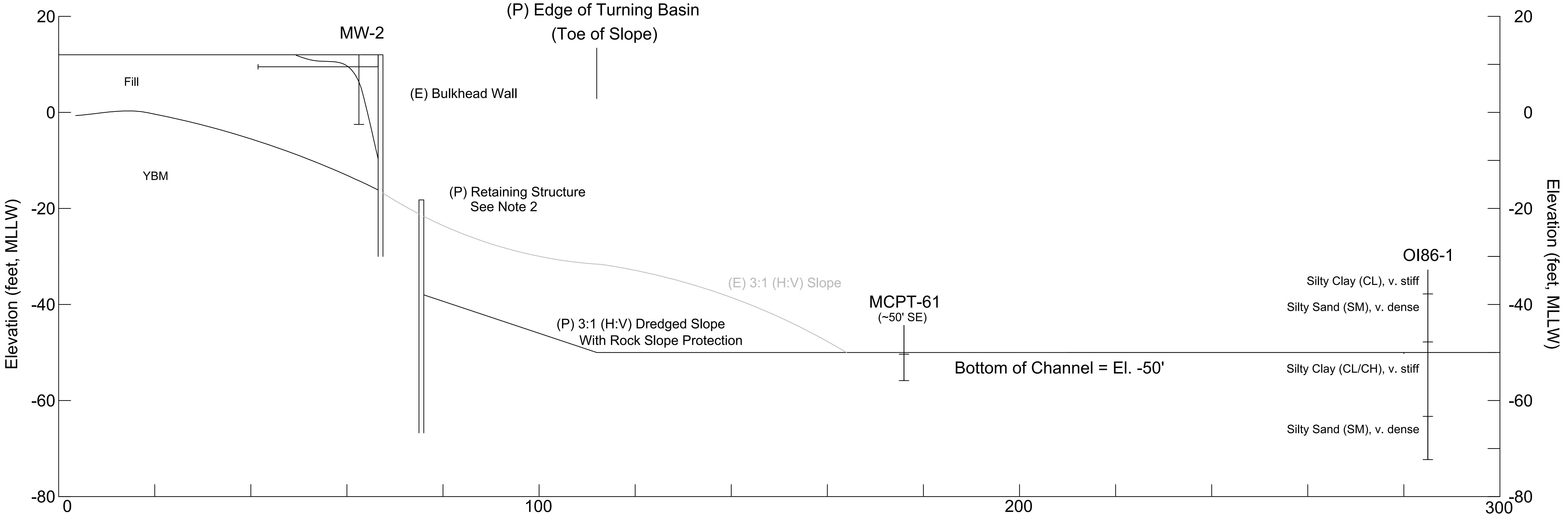


C1 EXISTING CROSS-SECTION

1" = 15'

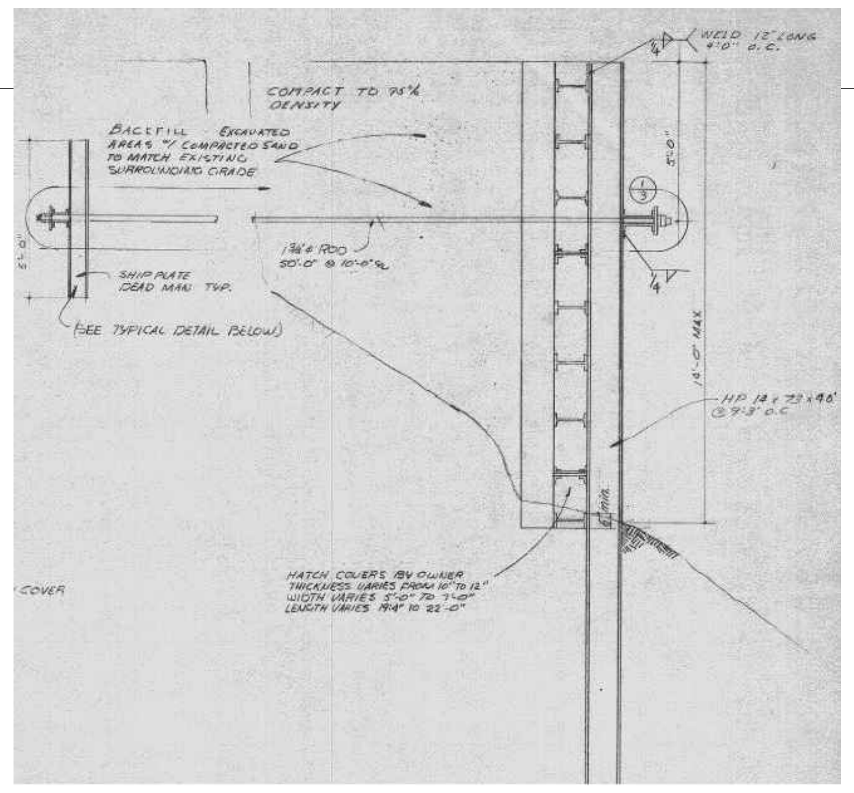


C2 PROPOSED CROSS-SECTION

1" = 15'

NOTES:

1. EXISTING BULKHEAD WALL CONSTRUCTED CIRCA 1973. STEEL H-PILES (HP 14x73, 40 FEET LONG @ 9.3' O.C.) WITH $1\frac{3}{4}$" TIE RODS AND DEAD MAN ANCHORS AT 10' O.C. SEE DETAIL 1.
2. PROPOSED BELOW-GRADE RETAINING STRUCTURE. CONCEPTUAL DESIGNS INCLUDE DRILLED SECANT WALL, DRILLED STITCH PIERS, DRIVEN PILES OR SHEET PILES.



DETAIL 1

US Army Corps of Engineers®

MARK	DESCRIPTION	DATE

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SUBMITTED BY: ***
SIZE: ANSI D
ISSUE DATE: JULY 2023
SOLICITATION NO: ***
CONTRACT NO: ***
PROJECT NO: ***

U.S. ARMY CORPS OF ENGINEERS
SAN FRANCISCO DISTRICT
450 GOLDEN GATE AVE, 4TH FLOOR
SAN FRANCISCO, CA 94102-3404

ALAMEDA COUNTY, CALIFORNIA
OAKLAND HARBOR TURNING BASIN
FEASIBILITY STUDY

INNER HARBOR
CROSS-SECTIONS
SCHNITZER STEEL

SHEET ID

IH-105

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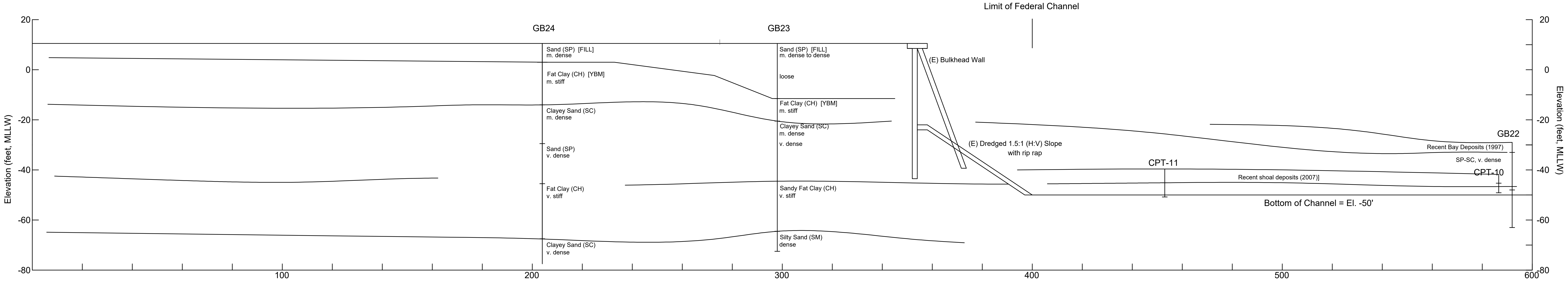
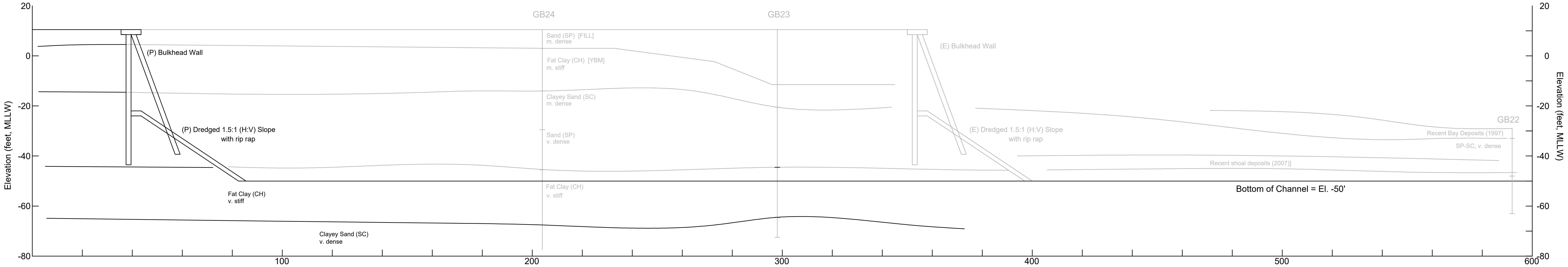
BCDC REVIEW



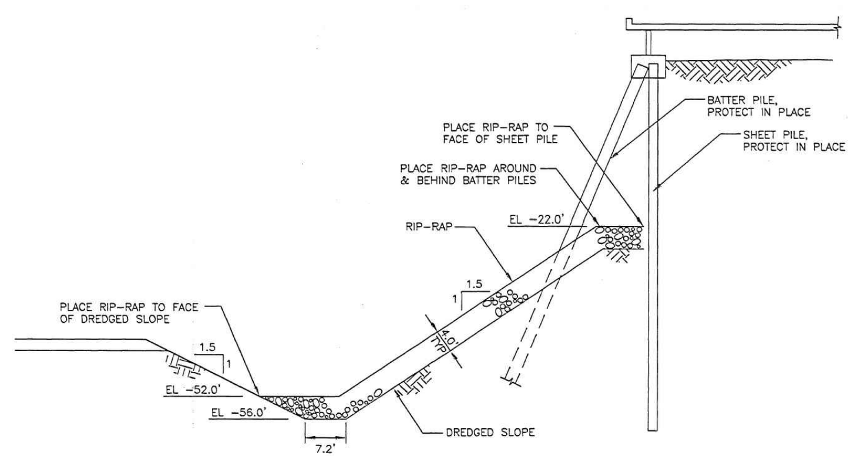
D1 EXISTING CROSS-SECTION
1" = 25'



D2 PROPOSED CROSS-SECTION
1" = 25'

NOTE:

1. CONCEPTUAL BULKHEAD WALL DESIGN BASED ON EXISTING WALL DESIGN CONSTRUCTED IN 2003 AS PART OF THE -50 FOOT DEEPENING PROJECT



DETAIL 1 / CONCEPTUAL BULKHEAD WALL DETAIL

US Army Corps
of Engineers®

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U.S. ARMY CORPS OF ENGINEERS
SAN FRANCISCO DISTRICT
450 GOLDEN GATE AVE, 4TH FLOOR
SAN FRANCISCO, CA 94102-3404

ALAMEDA COUNTY, CALIFORNIA
OAKLAND HARBOR TURNING BASIN
FEASIBILITY STUDY

INNER HARBOR
CROSS-SECTIONS
ALAMEDA

SHEET ID
IH-106

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L3ECECWB

BCDC REVIEW

OUTER HARBOR BORING SUMMARY

BORING ID	DATE	LATITUDE	LONGITUDE	DATE	DEPTH (FT)	MUDLINE ELEVATION (FT)[1]	TERMINAL ELEVATION (FT)	BOTTOM OF YBM ELEVATION (FT)
2D-148	USACE (1982)	37.813754	-122.328241	7/1974	12.5	-35.0	-47.5	> -47.5
2D-152	USACE (1982)	37.814360	-122.321247	5/1975	1.0	-40.5	-41.5	-41
2D-202 (H)	Winzler & Kelly (1982)	37.814012	-122.330621	5/19/1982	22.5	-25.0	-47.5	> -47.5
2D-205 (K)	Winzler & Kelly (1982)	37.815109	-122.325802	5/18/1982	32.5	-14.5	-47.0	-44.5
2D-206 (L)	Winzler & Kelly (1982)	37.814775	-122.321181	5/20/1982	9.0	-38.5	-47.5	-47.5
OW-240	EVS (1997)	37.814928	-122.323235	8/4/1997	17.8	-39.7	-57.5	N.E.
OW-241	EVS (1997)	37.814732	-122.324695	8/4/1997	20.5	-31.5	-52.0	-47.9
OW-242	EVS (1997)	37.814500	-122.326130	8/4/1997	17.7	-29.9	-47.6	-47.2
OW-243	EVS (1997)	37.814324	-122.327585	8/4/1997	22.5	-29.5	-52.0	-49.9
GB4[2]	SCI (1999)	37.814739	-122.327348	9/23/1997	32.5	-4.3	-36.8	-33.8
MCPT-13	SCI (2000)	37.813830	-122.327464	2/2/2000	10.2	-42.2	-52.4	-45.8
MCPT-24	SCI (2000)	37.814783	-122.321792	2/1/2000	15.3	-42.5	-57.8	-45

[1] Elevations reported in NAVD88 / MLLW.

[2] Location of GB4 reported to be uncertain due to GPS malfunction.

INNER HARBOR BORING SUMMARY

BORING ID	DATE	LATITUDE	LONGITUDE	DATE	DEPTH (FT)	MUDLINE ELEVATION (FT)[1]	TERMINAL ELEVATION (FT)	BOTTOM OF YBM ELEVATION (FT)
1	USACE (1924)	37.794608	-122.286875	8/1924	2.2	-25	-27.2	-25.9
2	USACE (1924)	37.794681	-122.286391	8/1924	6	-23.5	-29.3	-26.8
3	USACE (1924)	37.794700	-122.286024	8/1924	4.5	-24	-28.4	-26.4
4	USACE (1924)	37.794705	-122.285576	8/1924	7	-23.5	-30.6	-27.8
2D-241 (X)	USACE (1982)	37.792517	-122.284739	1982	10	-38	-48	-43.5
OI86-1	GeoResource (1986)	37.794298	-122.288893	10/23/1986	39.5	-32.8	-72.3	-33.82
OI86-1	GeoResource (1986)	37.792257	-122.288380	10/24/1986	46	-32.7	-78.7	-33.72
GB22	SCI (1999)	37.791723	-122.287737	9/13/1997	34.5	-29	-63.5	N.E.
GB23	SCI (1999)	37.791254	-122.286757	8/5/1997	83	10.3	-73.2	-19.5
GB24	SCI (1999)	37.791094	-122.286505	8/7/1997	104.5	10.4	-94.6	-13.5
GB25	SCI (1999)	37.792265	-122.284566	9/12/1997	44	-24.3	-68.8	-38
GB26	SCI (1999)	37.791320	-122.283974	8/12/1997	200.5	9.7	-191.3	-37.3
GB27	SCI (1999)	37.794924	-122.288541	9/16/1997	53.5	-8.4	-62.4	N.E.
MCPT-61	SCI (2000)	37.794714	-122.289731	2/4/2000	11.5	-44.3	-55.8	-50.3
CPT-8	Engeo (2007)	37.791433	-122.288017	3/22/2007	18.7	-39.8	-70.8	-53.4
CPT-10	Engeo (2007)	37.791800	-122.287517	3/21/2007	4.8	-41.8	-49.1	-45.3
CPT-11	Engeo (2007)	37.791533	-122.287167	3/21/2007	8	-39.6	-50.8	-45.1
CPT-12	Engeo (2007)	37.792100	-122.286850	3/21/2007	6.7	-38.9	-51.3	-45.3
1-B3	Engeo (2019)	37.795010	-122.285291	1/30/2019	56.5	7	-49.5	-34.5
1-CPT-05	Engeo (2019)	37.795552	-122.286810	1/15/2019	46.4	11	-35.4	N.E.
1-CPT-06	Engeo (2019)	37.796435	-122.286700	1/15/2019	48.7	11	-37.7	N.E.

[1] Elevations reported in NAVD88 / MLLW.

[2] OI86-1 and OI86-2; both borings indicate 1 foot of soft material at top. Material likely recent shoal deposits.

US Army Corps
of Engineers®

MARK	DESCRIPTION	DATE

ISSUE DATE: JULY 2023
SOLICITATION NO: ***
CONTRACT NO: ***
PROJECT NO: ***
DESIGNED BY: B.WAIR
DRAWN BY: C.BROCK
CHECKED BY: D. DEMKO
SUBMITTED BY: ***
SIZE: ANSI D

U.S. ARMY CORPS OF ENGINEERS
SAN FRANCISCO DISTRICT
450 GOLDEN GATE AVE, 4TH FLOOR
SAN FRANCISCO, CA 94102-3404

ALAMEDA COUNTY, CALIFORNIA

OAKLAND HARBOR TURNING BASIN
FEASIBILITY STUDY

SUMMARY OF GEOTECHNICAL DATA

SHEET ID
IH-107

BCDC REVIEW

C:\USERS\L3ECECWB\DOCUMENTS\PROJECTS\OAKLAND TB\CAD\OAKLANDTB_8-29-2023.DWG
L3ECECWB

Attachment 1

Oakland Harbor Turning Basin Feasibility Study

Geotechnical Plan Set

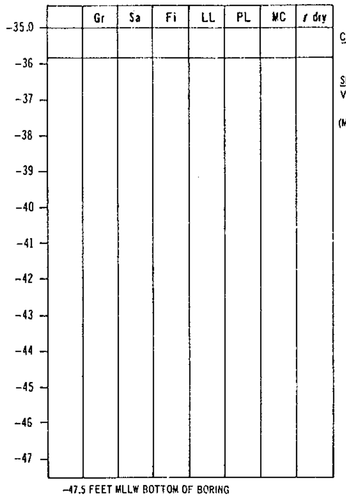
Attachment 2

Selected Borings

Outer Harbor

2D-148

JULY 1974



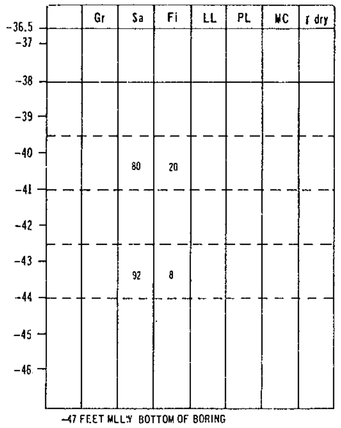
CLAYEY SILT GRAYISH TAN, VERY SOFT, WET.

SILTY CLAY VERY DARK GRAY,
VERY SOFT, WET.

(MAY RANGE FROM HIGH TO LOW PLASTICITY)

2D-149

JULY 1974



SILTY CLAY VERY DARK GRAY, VERY SOFT,
WET, HIGH PLASTICITY.

CLAYEY TO SILTY SAND YELLOWISH GRAY, DENSE,
FINE-GRAINED, SATURATED.

N = 34 (ESTIMATED 20% FINES OF LOW PLASTICITY.)

N = 77 (NON-PLASTIC FINES)

N = 44 (ESTIMATED 10% FINES OF LOW PLASTICITY.)

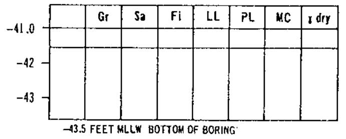
N = 65 (NON-PLASTIC FINES)

N = 76 (ESTIMATED 10% FINES, NON-PLASTIC)

N = 66 (ESTIMATED 10% FINES, NON-PLASTIC)

2D-104

AUGUST 1973

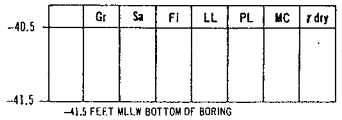


SILT BROWNISH GRAY, VERY SOFT, SATURATED.

SAND TAN, FINE-GRAINED, CLEAN, DENSE, WET.

2D-152

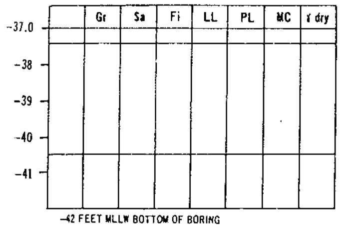
MAY 1975



SILTY SAND GRAY, DENSE, FINE-GRAINED, WET.

2D-107

AUGUST 1973



SILT BROWNISH GRAY, VERY SOFT, VERY WET,

SILTY CLAY DARK GRAY, VERY SOFT, SATURATED.

(MAY RANGE FROM HIGH TO LOW PLASTICITY)

SILTY SAND GRAY, DENSE, FINE- GRAINED, WET.

SYMBOL	DESCRIPTION	DATE	APPROVAL

REVISIONS

U. S. ARMY ENGINEER DISTRICT, SAN FRANCISCO
CORPS OF ENGINEERS
SAN FRANCISCO, CALIFORNIA

DRAWN BY: KH

TRACED BY S. D.

CHECKED BY: KH

DESIGNED:

PROJECT COORDINATOR

ALAMEDA COUNTY CALIFORNIA

OAKLAND OUTER HARBOR

LOGS OF EXPLORATION BORINGS

SUBMITTED:

CHIEF, DESIGN BRANCH

APPROVAL RECOMMENDED: DATE:

CHIEF PLANNING/ENGINEERING DIVISION

PREPARED UNDER THE DIRECTION OF
GALEN H. YANAGIHARA
COLONEL, C.E. DISTRICT ENGINEER

SCALE:

JOB NO

DRAWING NUMBER

SHEET 7 2 5 25

FOR OFFICIAL USE ONLY

PROJECT NAME OVERWATER DRILLING OAKLAND OUTER HARBOR DATE MAY 19, 1982

CONTRACT # DACW07-82-D-0002 TIME 09:00

HOLE # H HOLE DIAMETER 2 1/8" DRILL RIG FAILING 1500 SAMPLER PLASTIC LINED PUSH TUBES

HOLE ELEV. -25.0 MLLW GROUNDWATER LEVEL N/A QUANTITY 9 LOGGED BY B. NOBLE

WIND 3 TO 5 KNOTS

MLLW DEPTH (FT)	SAMPLE #	CLASSIFICATION	PRESENCE OF OTHER MAT.	COLOR	GRAIN SIZE	MOISTURE	CONSISTENCY OR DENSITY	CEMENTATION	STRATA THICKNESS	N VALUE BLOWS/FT.	REMARKS
-25.0		BOTTOM BAY									
-27.5	H-1	SILT	-	GRAY TO BLUE GRAY	FINE	WET	SOFT	-	COLOR BREAK @ -25.7	N/A	ALL SAMPLES ARE PLASTIC LINED PUSH TUBES
-30.0	H-2	SILT	-	BLUE GRAY	FINE	WET	SOFT	-	-	N/A	
-32.5	H-3	SILT	-	BLUE GRAY	FINE	WET	SOFT	-	-	N/A	
-35.0	H-4	SILT	-	BLUE GRAY	FINE	WET	SOFT	-	-	N/A	
-37.5	H-5	SILT	-	BLUE GRAY	FINE	WET	SOFT	-	-	N/A	
-40.0	H-6	SILT	-	BLUE GRAY	FINE	WET	SOFT	-	-	N/A	
-42.5	H-7	SILT	-	BLUE GRAY	FINE	WET	SOFT	-	-	N/A	
-45.0	H-8	SILT	-	BLUE GRAY	FINE	WET	SOFT	-	-	N/A	
-47.5	H-9	SILT	-	BLUE GRAY	FINE	WET	SOFT	-	-	N/A	

FOR OFFICIAL USE ONLY

1492 5OGETE

PROJECT NAME OVERWATER DRILLING OAKLAND OUTER HARBOR
DATE MAY 18, 1982
CONTRACT # DACW07-82-D-0002
TIME 08:40
HOLE # K
HOLE DIAMETER 2 1/8"
DRILL RIG FAILING 1500
SAMPLER PLASTIC LINED PUSH TUBE
HOLE ELEV. -14.5
GROUNDWATER LEVEL N/A
QUANTITY 13
LOGGED BY B. NOBLE
WIND CALM

MLLW DEPTH (FT)	SAMPLE #	CLASSIFICATION	PRESENCE OF OTHER MAT.	COLOR	GRAIN SIZE	MOISTURE	CONSISTENCY OR DENSITY	CEMENTATION	STRATA THICKNESS	N VALUE BLOWS/FT.	REMARKS
-14.5		BOTTOM BAY									
-17.0	K-1	SILT	-	BLUE GRAY	FINE	WET	SOFT	-	-	N/A	
-19.5	K-2	SILT	-	BLUE GRAY	FINE	WET	SOFT	-	-	N/A	
-22.0	K-3	SILT	-	BLUE GRAY	FINE	WET	SOFT	-	-	N/A	ALL SAMPLES ARE PLASTIC LINED PUSH TUBES
-24.5	K-4	SILT	-	BLUE GRAY	FINE	WET	SOFT	-	-	N/A	
-27.0	K-5	SILT	-	BLUE GRAY	FINE	WET	SOFT	-	-	N/A	
-29.5	K-6	SILT	-	BLUE GRAY	FINE	WET	SOFT	-	-	N/A	
-32.0	K-7	SILT	-	BLUE GRAY	FINE	WET	SOFT	-	-	N/A	
-34.5	K-8	SILT	-	BLUE GRAY	FINE	WET	SOFT	-	-	N/A	
-37.0	K-9	SILT	-	BLUE GRAY	FINE	WET	SOFT	-	-	N/A	
-39.5	K-10	SILT	-	BLUE GRAY	FINE	WET	SOFT	-	-	N/A	
-42.0	K-11	SILT	-	BLUE GRAY TO GRAY	FINE	WET	SOFT	-	SILTY SAND @ -41.0	N/A	
-44.5	K-12	SILTY SAND	SHELL	GRAY	FINE TO MED.	MOIST	VERY LOOSE	-	-	N/A	
-47.0	K-13	SILTY SAND	SHELL	GRAY	FINE TO MED.	MOIST	VERY LOOSE	-	-	N/A	

FOR OFFICIAL USE ONLY

PROJECT NAME OVERWATER DRILLING OAKLAND OUTER HARBOR DATE MAY 20, 1982

CONTRACT # DACW07-82-D-0002 TIME 07:50

HOLE # "L" HOLE DIAMETER 2 1/8" 7 2 1/2" DRILL RIG FAILING 1500 SAMPLER

HOLE ELEV. -38.5 MLLW GROUNDWATER LEVEL N/A QUANTITY 4 LOGGED BY B. NOBLE

WIND 5-10 KNOTS

MLLW DEPTH (FT)	SAMPLE #	CLASSIFICATION	PRESENCE OF OTHER MAT.	COLOR	GRAIN SIZE	MOISTURE	CONSISTENCY OR DENSITY	CEMENTATION	STRATA THICKNESS	N VALUE BLOWS/FT.	REMARKS
-38.5		BOTTOM BAY									
-41.0	L-1	SILTY SAND	-	BLUE GRAY	FINE	WET	SOFT	-	-	N/A	PLASTIC PUSH TUBES USED L-1, L-2, L-3
-43.5	L-2	SILTY SAND	-	BLUE GRAY	FINE	WET	SOFT	-	-	N/A	
-45.0	L-3	SANDY SILT TO SILTY SAND	-	BLUE GRAY	COARSE TO FINE	WET	LOOSE TO SOFT	-	COARSE SAND TO -44.5 THEN SILT TO -45.0	N/A	
-47.5	L-4	SANDY SILT	-	BLUE GRAY	COARSE	MOIST	DENSE	-	-	1) 9) 16) 22) 50) BLOWS PER 1/2 FT.	STEEL TUBE WITH 140 LB. DRIVE HAMMER USED L-4

LOG OF BORING NO. GB4

Sheet 1 of 2

Project Name & Location:
Geotechnical Investigation, -50 Foot Navigation Improvement Project,
Port of Oakland, Oakland and Alameda, California

Ground Surface Elevation:
-4.8 Feet (Mudline)

Elevation Datum:
Port of Oakland Datum

Drilling Coordinates:
N2124280, E6033840

Start: Date 9/23/97 Time 9:00 am

Finish: Date 9/23/97 Time 2:30 pm

Drilling Company & Driller:
Western Strata Exploration, Inc.; Tony Young

Rig Type & Drilling Method:
Concore A5; Rotary Wash

Drilling Fluid:
Sea Water & Bentonite Mud

Hole Diameter:
3.7-inch Rotary Wash Bit

Sampler Type(s): A) SPT Sampler (2.0-inch O.D.)
B) Modified California Sampler (3.0-inch O.D.)
C) Shelby Tube with Piston Sampler (3.0-inch O.D.)

Logged By:
John Wolfe

Sampling Method(s): A) 140 lb hammer falling 30 inches (Rope and Cathead)
B) 140 lb hammer falling 30 inches (Rope and Cathead)
C) Hydraulic push

Backfill Method:
Cement Grout

Date:
9/23/97

Elevation (feet)	Depth (feet)	Sampler Type	Blows/6 inches or Pressure	SPT N-Value	Sample Interval	Graphic Log	SOIL DESCRIPTIONS GROUP NAME (GROUP SYMBOL) color, consistency/density, moisture condition, other descriptions (Local Name or Material Type)	LABORATORY DATA Moisture Content (%)	Dry Density (pcf)	Other
-5	0						Water level at 9:00 am was at Elevation +3.7 feet			
		C					**FAT CLAY (CH)** very dark gray N 3/, soft, wet (Young Bay Mud)			
-10	5									
		C								
								122.8	38	TV = 80
-15	10									
		C						122.7	38	TxUU = 120 (1,600) TV = 100 FV = 210
-20	15									
		B	0 0 0	0				113.8	39	TV = 100
-25	20									
		B	0 0 0	0				112.7	40	TV = 160
-30	25						4-inch-diameter steel conductor casing set to -30 feet elevation			
		C						99.6	45	TxUU = 90 (3,100) TV = 100
	30						Boring continued on next page			

SCI Subsurface Consultants, Inc.
Geotechnical & Environmental Engineers

PORT OF OAKLAND
530 WATER STREET, OAKLAND, CALIFORNIA

JOB NUMBER 133.007
DATE 10/15/97
APPROVED

PLATE **B4a**

LOG OF BORING NO. GB4

Sheet 2 of 2

Project Name & Location:
Geotechnical Investigation, -50 Foot Navigation Improvement Project,
Port of Oakland, Oakland and Alameda, California

Start Date:
9/23/97

Logged By:
John Wolfe

Elevation (feet)	Depth (feet)	Sampler Type	Blows/6 inches or Pressure	SPT N-Value	Sample Interval	Graphic Log	SOIL DESCRIPTIONS GROUP NAME (GROUP SYMBOL) color, consistency/density, moisture condition, other descriptions (Local Name or Material Type)	LABORATORY DATA Moisture Content (%)	Dry Density (pcf)	Other
-35	30						**POORLY GRADED SAND WITH SILT (SP-SM)** dark greenish-gray 10Y 4/1, very dense, wet (San Antonio Formation)			
		A	26 51/6"	51/6"			Boring was terminated at 32.5 feet			
-40	35									
-45	40									
-50	45									
-55	50									
-60	55									
-65	60									
	65									

SCI

Subsurface Consultants, Inc.
Geotechnical & Environmental Engineers

PORT OF OAKLAND
530 WATER STREET, OAKLAND, CALIFORNIA

JOB NUMBER
133.007
DATE
10/15/97
APPROVED

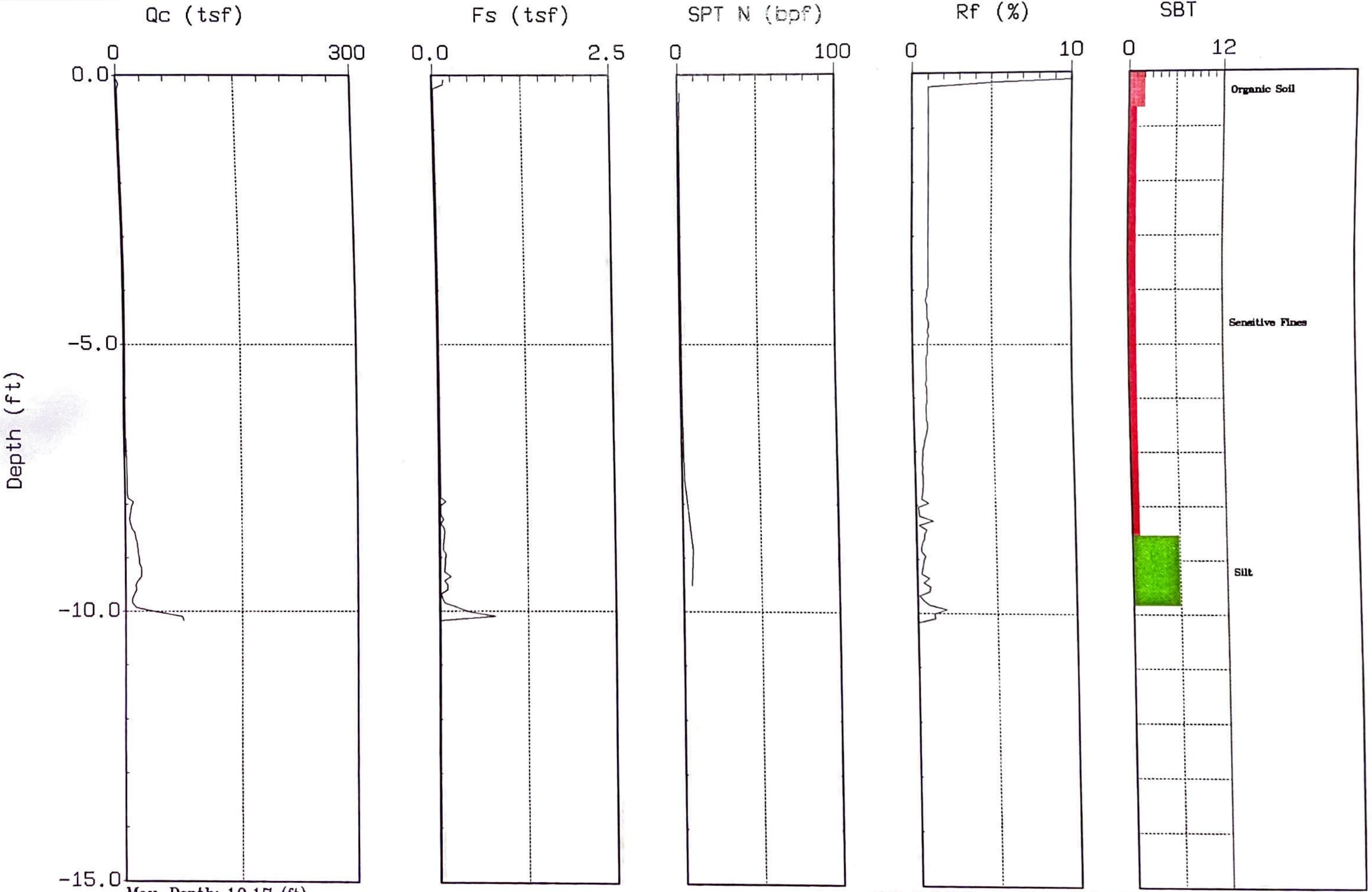
PLATE
B4b

GREGG

SUBSURFACE

Site : Oakland Hbr.
Location : MCPT-13

Geologist : J. Wolfe
Date : 2/2/00 14:08



Max. Depth: 10.17 (ft)

Depth Inc.: 0.082 (ft)

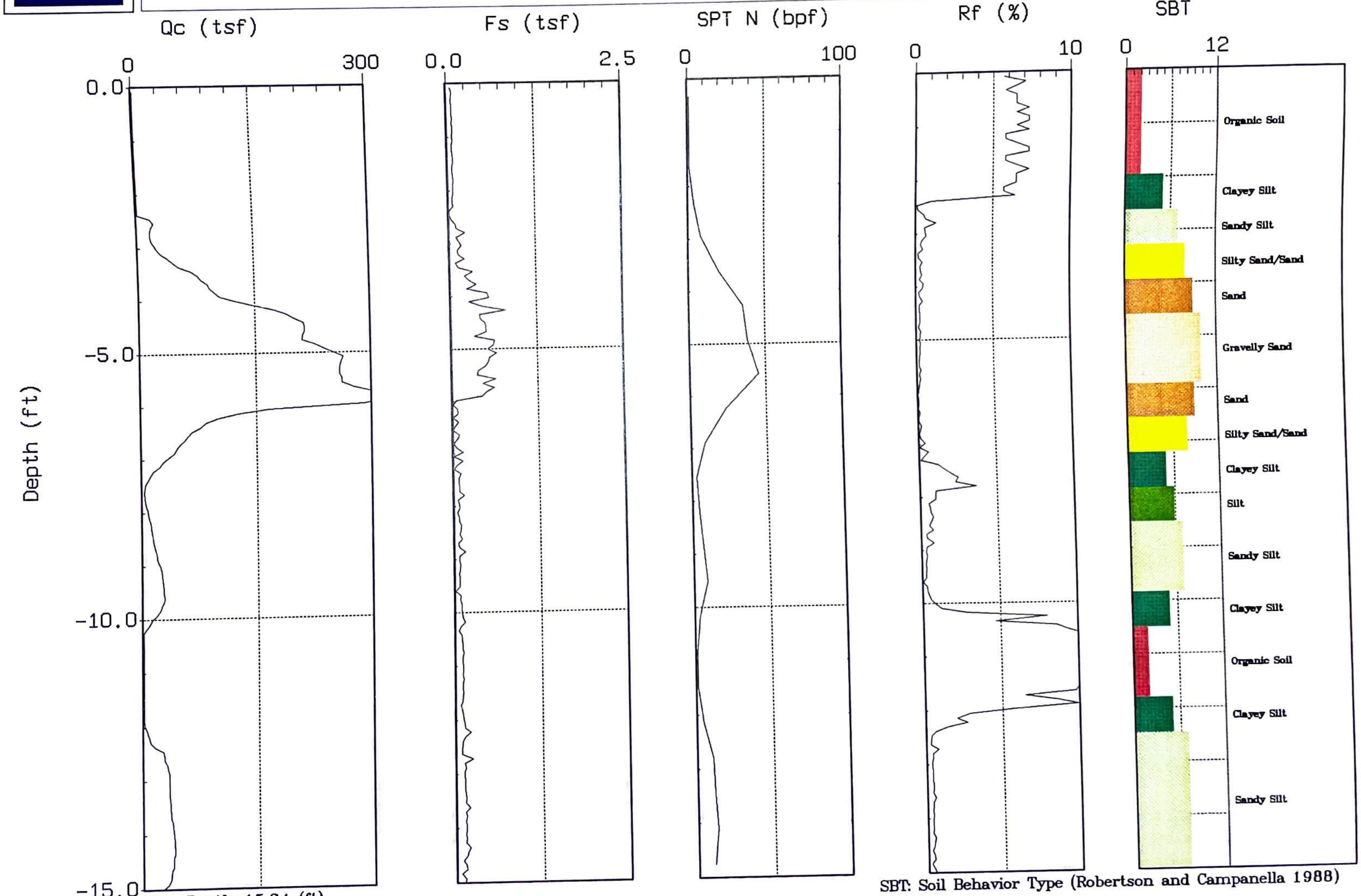
SBT: Soil Behavior Type (Robertson and Campanella 1988)

GREGG

SUBSURFACE

Site : Oakland Harbor
Location : MCPT-24

Geologist : J. Wolfe
Date : 2/1/00 12:02



Max. Depth: 15.34 (ft)

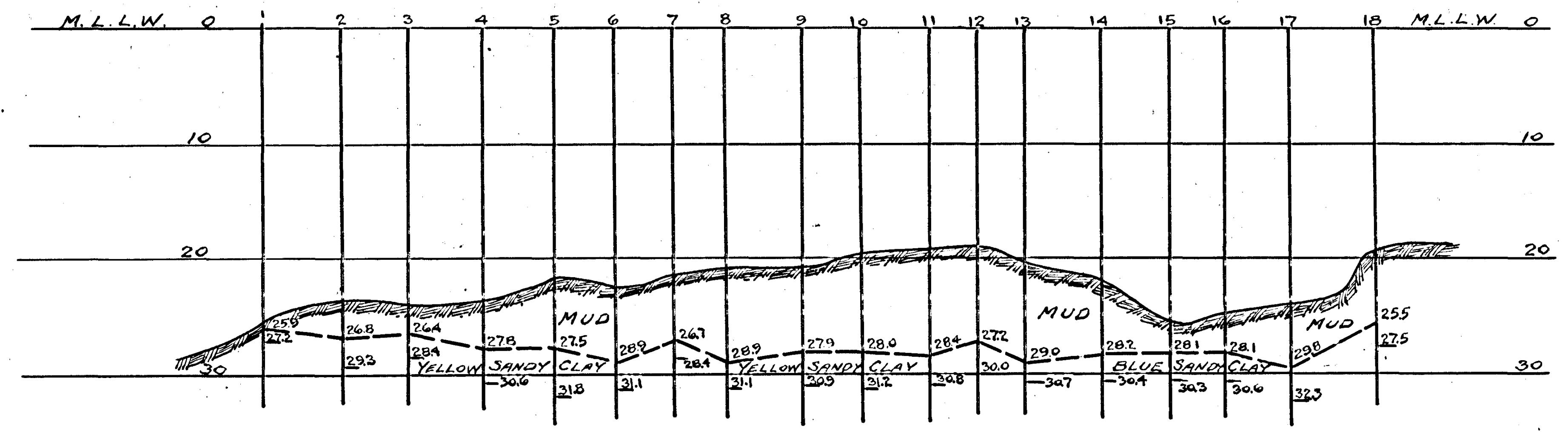
Depth Inc.: 0.082 (ft)

SBT: Soil Behavior Type (Robertson and Campanella 1988)

Attachment 3

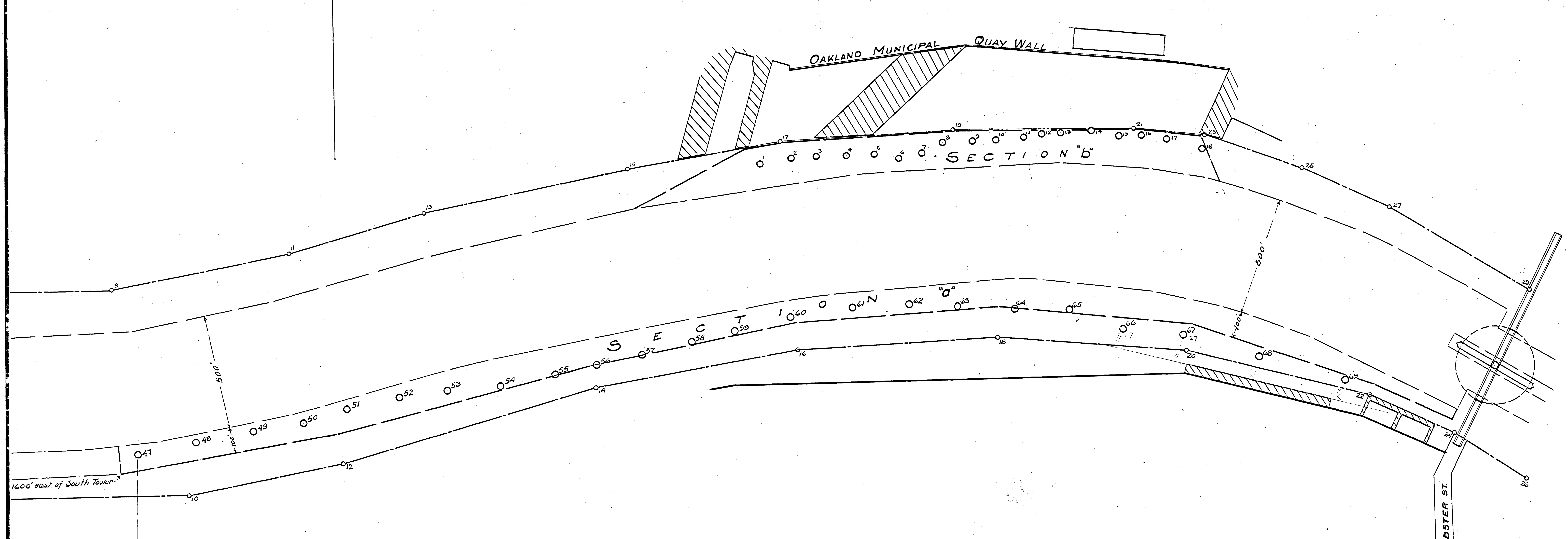
Selected Borings

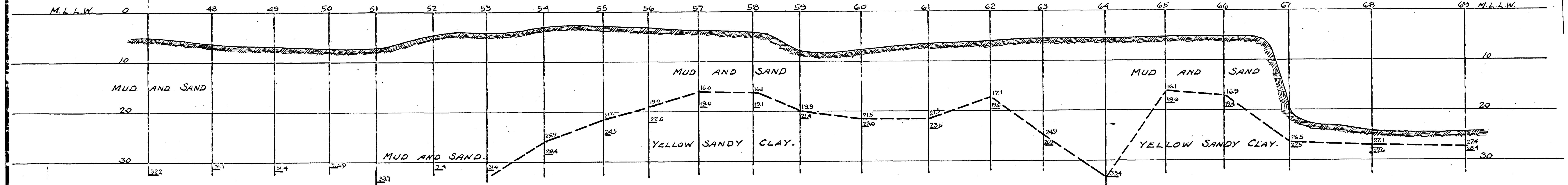
Inner Harbor



PROFILE

LOWER FIGURE SHOWS DEPTH BORED TO.





PROFILE

LOWER FIGURE SHOWS DEPTH BORED TO.

Borings in Sections "a&b" under specification for dredging in Oakland Harbor, Calif., dated August 20, 1924. All depths refer to the plane of mean lower low water as given in paragraph 22 of the specifications.

BORINGS
OAKLAND HARBOR
CALIFORNIA

Scale 1" = 200'

U.S. Engineer Office 1st Dist. San Francisco, Calif., Sept. 3, 1924

DOC.FILE	FILE	DIV.	SHEET
	2	5	4

SAMPLE LOG

DISTRICT: San Francisco	PROJECT: OAKLAND INNER HARBOR	HOLE NO. 2D-241(X)
REMARKS: Steel Push Tubes		SHEET 1 OF 2

DIV. NO.	F.S.NO.	DEPTH (FT.)	TYPE & CONDITION OF SAMPLE, REMARKS	SYMBOL	CLASSIFICATION OF SOIL	FIELD MOISTURE
78241	PT-1	0 1	Bay mud, black, wet, soft, highly plastic fines, several 1/8" lenses of fine sand, sand about 15-20% of total sample.	CH	Sandy Clay	
		2 3				
78243	PT-3	4 5	Bay mud, black, wet, soft, HP fines, less than 5% sand in clay but one 3/8" brown sand lens @ 4.6'.	CH	Clay	
			Reddish-brown, damp, dense, med to fine sand, 30-35% HP fines.	SC	Clayey Sand	
		6 7 8				

PLATE 7

SAMPLE LOG

DISTRICT San Francisco
PROJECT: OAKLAND INNER HARBOR
HOLE NO.: 2D-241(X)
REMARKS: Steel Push Tubes
SHEET 2 OF 2

DIV. NO.	F.S.NO.	DEPTH (FT.)	TYPE & CONDITION OF SAMPLE, REMARKS	SYMBOL	CLASSIFICATION OF SOIL	FIELD MOISTURE
78245	PT-5	8 9 10	Gray, damp, very stiff, med. plasticity fines, 40-45% med to fine sand.	CL	Sandy Clay	

Total Casing Embedded below Harbor Bottom = 10.2'

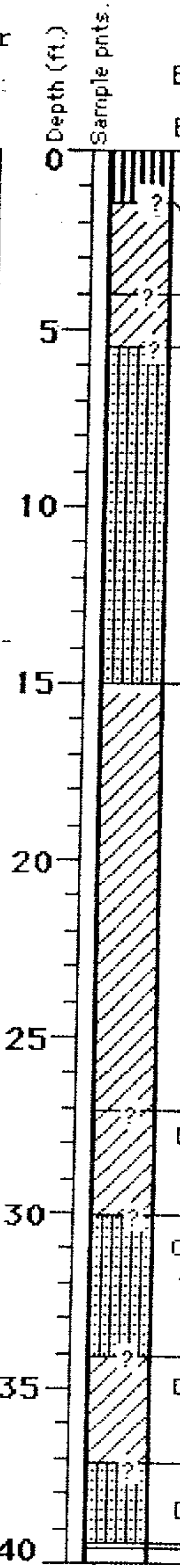
LOG OF BORING OI86-1

Equipment Rotary Wash

Elevation -32.8'MLLW Date 10/23/86

EHEG03.3077

Sample Number	Sampler	Blow Count
1-1-0.0'	Shelby	
1-2-2.8'	Shelby	
1-3-5.6'	Shelby	
1-4-8.4'	SPT	50/4"
1-5-9.3'	SPT	50/4"
1-6-10.1'	SPT	50/4"
1-7-10.9'	SPT	64/5"
1-8-11.8'	SPT	110/6"
1-9-12.8'	SPT	128/6"
1-10-13.8'	SPT	81/12"
1-11-15.3'	Shelby	
1-12-18.1'	Shelby	
1-13-20.9'	Shelby	
1-14-23.7'	Shelby	
1-15-26.5'	Shelby	
1-16-33.0'	SPT	100/6"
1-17-33.5'	Shelby	
1-18-39.0'	SPT	100/6"



Very Dark Grey Sandy Silt (MH), very soft w/some peat

Yellowish Brown Silty Clay (CL), very stiff

Yellowish Olive Silty Clay (CL), very stiff

Fine to Medium Olive Brown Silty Sand (SM) very dense

Dark Olive Grey Silty Clay (CL /CH), very stiff

Dark Olive Grey Silty Clay (CL), very stiff

Olive Grey Silty Sand (SM), mostly fine sand, very dense

Dark Olive Grey Silty Clay (CL), very stiff

Dark Olive Grey Silty Sand (SM), very dense

End of Hole @ 39.5'

Geo/Resource Consultants, Inc.

Consulting Engineers, Geologists, Geophysicists

Job No. 447-06S Appr: M.D.C. Date 11/5/86

LOG OF BORING OI86-1

OAKLAND INNER HARBOR
OVERWATER SEDIMENT SAMPLING
AND EXPLORATIONS

FIGURE 3

Total Casing Embeded below Harbor Botton=40.3'

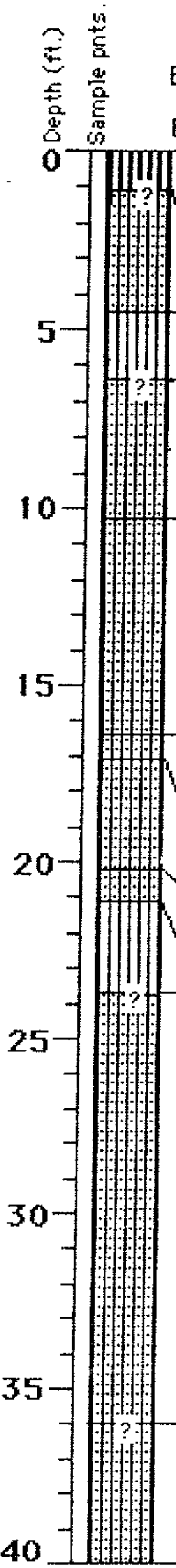
LOG OF BORING 0186-2

Equipment Rotary Wash

Elevation -32.7'MLLW Date 10/24/86

EHEG03 3079

Sample Number	Sampler	Blow Count
2-1-0.0'	Bag/from Tube	
2-2-1.0'	Shelby	
2-3-2.8'	SPT	62/12"
2-4-4.3'	SPT	31/12"
2-5-5.8'	Shelby	
2-6-7.3'	Shelby	
2-7-10.1'	SPT	80/6"
2-8-11.1'	SPT	73/6"
2-9-12.1'	SPT	131/12"
2-10-13.6'	SPT	78/6"
2-11-14.6'	SPT	65/6"
2-12-15.6'	SPT	101/12"
2-13-17.1'	SPT	106/12"
2-14-18.6'	SPT	110/12"
2-15-20.1'	SPT	40/12"
2-16-21.6'	Shelby	
2-17-23.6'	SPT	126/12"
2-18-25.1'	SPT	75/12"
2-19-30.0'	SPT	94/12"
No sample left	SPT	54/12"
2-20-36.5'	SPT	100/12"



Very Dark Grey Clayey Silt (MH), very soft w/some peat

Fine to Medium Yellowish Brown Silty Sand (SM), dense

Yellowish Brown Sandy Silt (ML), stiff

Fine to Medium Yellowish Brown Silty Sand (SM), dense

Fine to Medium Olive Grey Silty Sand (SM), very dense

Fine to Medium Olive Grey Silty Sand (SM), w/reddish brown streaks, very dense

Fine to Medium Greyish Brown Silty Sand (SM), very dense

Same As Above, dense

Greyish Brown Sandy Silt (ML), Stiff

Greyish Brown Silty Sand (SM), very dense

Same AS Above, Olive Grey

Geo/Resource Consultants, Inc.
Consulting Engineers, Geologists, Geophysicists

Job No. 447-06S Appr: M.D.C. Date 11/5/86

LOG OF BORING 0186-2
OAKLAND INNER HARBOR
OVERWATER SEDIMENT SAMPLING
AND EXPLORATIONS

FIGURE
4

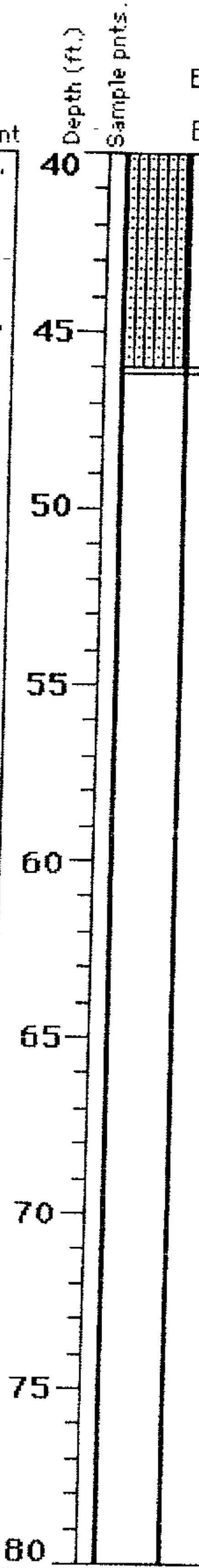
LOG OF BORING 0186-2

Equipment Rotary Wash

Elevation ____________ Date 10/24/86

EHEG03 3081

Sample Number	Sampler	Blow Count	Depth (ft.)
2-21-41.5'	SPT	107/12"	40
No sample left	SPT	105/12"	45



Fine to Medium Olive Grey Silty Sand (SM), very dense

End of Hole @ 46.0'

Geo/Resource Consultants, Inc.

Consulting Engineers, Geologists, Geophysicists

Job No. 447-06S Appr: M.D.C. Date: 11/5/86

LOG OF BORING 0186-2

OAKLAND INNER HARBOR
OVERWATER SEDIMENT SAMPLING
AND EXPLORATIONS

FIGURE

5

LOG OF BORING NO. GB22

Sheet 1 of 2

Project Name & Location:
Geotechnical Investigation, -50 Foot Navigation Improvement Project,
Port of Oakland, Oakland and Alameda, California

Ground Surface Elevation:
-29 Feet (Mudline)

Elevation Datum:
Port of Oakland Datum

Drilling Coordinates:
N2115680, E6045120

Start: Date 9/13/97 Time 9:00 am

Finish: Date 9/13/97 Time 2:00 pm

Drilling Company & Driller:
Western Strata Exploration, Inc.; Gordon Jensen

Drilling Fluid:
Sea Water

Hole Diameter:
3.7-inch Rotary Wash Bit

Rig Type & Drilling Method:
Concore A5; Rotary Wash

Sampler Type(s): A) SPT Sampler (2.0-inch O.D.)
B) Modified California Sampler (3.0-inch O.D.)
C) Shelby Tube with Piston Sampler (3.0-inch O.D.)

Logged By:
John Wolfe

Sampling Method(s): A) 140 lb hammer falling 30 inches (Rope and Cathead)
B) 140 lb hammer falling 30 inches (Rope and Cathead)
C) Hydraulic push

Backfill Method:
Cement Grout

Date:
9/13/97

Elevation (feet)	Depth (feet)	Sampler Type	Blows/6 inches or Pressure	SPT N-Value	Sample Interval	Graphic Log	SOIL DESCRIPTIONS **GROUP NAME (GROUP SYMBOL)** color, consistency/density, moisture condition, other descriptions (Local Name or Material Type)	LABORATORY DATA Moisture Content (%)	Dry Density (pcf)	Other
	0						Water level at 9:00 am was at Elevation +4.5 feet			
-30		C					**FAT CLAY (CH)** black N 2.5/, soft, wet (Recent Bay Deposits)	130.6	36	TV = 80
							4-inch-diameter steel conductor casing set to -32.5 feet elevation			
	5						**POORLY GRADED SAND WITH CLAY (SP-SC)** light olive-brown 2.5Y 5/4, very dense, wet (San Antonio Formation)			
-35		B	29 50	35/6"			Becomes brown 10YR 4/3 at 7 feet	21.9	106	
	10									
-40										
		A	42 53	53/6"						MA -200 = 6.5%
	15									
-45										
		A	12 14 16	30			**FAT CLAY WITH SAND (CH)** dark greenish-gray 10GY 4/1, stiff to very stiff, moist (Old Bay Mud)			
	20									
-50										
		B	60/3"	42/3"						
	25									
-55										
		B	15 30 40	49				25.9	101	
	30									
							Boring continued on next page			

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Geotechnical & Environmental Engineers

PORT OF OAKLAND
530 WATER STREET, OAKLAND, CALIFORNIA

JOB NUMBER
133.007
DATE
10/14/97
APPROVED

PLATE
B22a

LOG OF BORING NO. GB22

Sheet 2 of 2

Project Name & Location: Geotechnical Investigation, -50 Foot Navigation Improvement Project, Port of Oakland, Oakland and Alameda, California	Start Date: 9/13/97
	Logged By: John Wolfe

Elevation (feet)	Depth (feet)	Sampler Type	Blows/6 inches or Pressure	SPT N-Value	Sample Interval	Graphic Log	SOIL DESCRIPTIONS **GROUP NAME (GROUP SYMBOL)** color, consistency/density, moisture condition, other descriptions (Local Name or Material Type)	LABORATORY DATA Moisture Content (%)	Dry Density (pcf)	Other
	30					▨				
-60						▨				
		B	42 64	45/6"	■	░	**POORLY GRADED SAND WITH CLAY (SP-SC)** olive-gray 5Y 4/2, very dense, wet (Old Bay Deposits) Boring was terminated at 34.5 feet	17.1	118	
	35									
-65										
	40									
-70										
	45									
-75										
	50									
-80										
	55									
-85										
	60									
-90										
	65									

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PORT OF OAKLAND
530 WATER STREET, OAKLAND, CALIFORNIA

JOB NUMBER 133.007
DATE 10/14/97
APPROVED

PLATE **B22b**

LOG OF BORING NO. GB23

Sheet 1 of 3

Project Name & Location:
Geotechnical Investigation, -50 Foot Navigation Improvement Project,
Port of Oakland, Oakland and Alameda, California

Ground Surface Elevation: +9.8 Feet

Elevation Datum: Port of Oakland Datum

Drilling Coordinates: N2115503.9, E6045400.1

Start: Date 8/4/97 Time 9:45 am

Finish: Date 8/5/97 Time 10:00 am

Drilling Company & Driller: Western Strata Exploration, Inc.; Tony Young

Drilling Fluid: Bentonite Mud

Hole Diameter: 8.0-inch Hollow-Stem Auger
3.7-inch Rotary Wash Bit

Rig Type & Drilling Method: Mobile B-61; Hollow-Stem Auger and Rotary Wash

Sampler Type(s): A) SPT Sampler (2.0-inch O.D.)
B) Modified California Sampler (3.0-inch O.D.) Note: X = Sand Catcher Used
C) Shelby Tube with Piston Sampler (3.0-inch O.D.)

Logged By: Kenneth Jung

Sampling Method(s): A) 140 lb hammer falling 30 inches (Cable and Drum)
B) 140 lb hammer falling 30 inches (Cable and Drum)
C) Hydraulic push

Backfill Method: Cement Grout

Date: 8/5/97

Elevation (feet)	Depth (feet)	Sampler Type	Blows/6 inches or Pressure	SPT N-Value	Sample Interval	Graphic Log	SOIL DESCRIPTIONS **GROUP NAME (GROUP SYMBOL)** color, consistency/density, moisture condition, other descriptions (Local Name or Material Type)	LABORATORY DATA Moisture Content (%)	 Dry Density (pcf)	 Other
+10	0						Asphalt Concrete, 8 inches thick			
							POORLY GRADED SAND (SP) brown 7.5Y 5/4, dense, moist (Fill)			
		Ax	10 22 15	37						
							▽ Groundwater level during drilling			
		Ax	10 12 12	24			**POORLY GRADED SAND (SP)** dark greenish-gray 10G 3/1, medium dense, wet, fine-grained sand (Fill)			
+5	5									
		Ax	24 40? —							
0	10									MA -200 = 2.3%
		Ax	3 4 5	9						
-5	15						Loose at 15 feet			
							8-inch-diameter hollow-stem auger to 19 feet, removed augers, set 19 feet of 6-inch-diameter steel conductor casing, continued drilling using rotary wash method with 3.7-inch-diameter bit			
-10	20	Ax	2 2 2	4			Silty at 20 feet			MA -200 = 8.8%
		C	0 psi							
-15	25						**FAT CLAY WITH SAND (CH)** greenish-gray 5G 4/1, medium stiff, moist (Young Bay Mud)	67.8	59	LL = 75, PI = 48 TxUU = 800 (2,500) -200 = 73.1% TV = 600
							Sandy zone likely at 27 feet			
-20	30									

Boring continued on next page

LOG OF BORING NO. GB23

Sheet 2 of 3

Project Name & Location:
Geotechnical Investigation, -50 Foot Navigation Improvement Project,
Port of Oakland, Oakland and Alameda, California

Start Date:
8/4/97

Logged By:
Kenneth Jung

Elevation (feet)	Depth (feet)	Sampler Type	Blows/6 inches or Pressure	SPT N-Value	SOIL DESCRIPTIONS **GROUP NAME (GROUP SYMBOL)** color, consistency/density, moisture condition, other descriptions (Local Name or Material Type)	LABORATORY DATA Moisture Content (%)	LABORATORY DATA Dry Density (pcf)	LABORATORY DATA Other
	30							
		B	14 13 17	21	**CLAYEY SAND (SC)** brown 10YR 4/3, medium dense, wet (San Antonio Formation)			LL = 21, PI = 11 -200 = 34.9%
-25	35							
		Ax	20 27 42	69	**SILTY SAND (SM)** olive-brown 2.5Y 4/4, very dense, wet (San Antonio Formation, Merritt Sand (?))			
-30	40							
		Ax	19 29 40	69				-200 = 17.4%
-35	45							
		Ax	36 50/4.5"	50/4.5"				
-40	50							
		Ax	47 50/6"	50/6"				
					SANDY CLAY (CH) dark greenish-gray 10G 4/1, very stiff, moist, with sandier lenses (Old Bay Mud)			
-45	55							
		B	13 18 26	31				PP = 2,200
-50	60				**FAT CLAY (CH)** dark greenish-gray 10G 4/1, very stiff, moist (Old Bay Mud)			
		C	500 psi			25.3	98	LL = 65, PI = 50 TxUU = 3,200 (6,300) TV = 2,600
-55	65							

Boring continued on next page

LOG OF BORING NO. GB23

Sheet 3 of 3

Project Name & Location: Geotechnical Investigation, -50 Foot Navigation Improvement Project, Port of Oakland, Oakland and Alameda, California	Start Date: 8/4/97 Logged By: Kenneth Jung

Elevation (feet)	Depth (feet)	Sampler Type	Blows/6 inches or Pressure	SPT N-Value	Sample Interval	Graphic Log	SOIL DESCRIPTIONS **GROUP NAME (GROUP SYMBOL)** color, consistency/density, moisture condition, other descriptions (Local Name or Material Type)	LABORATORY DATA Moisture Content (%)	Dry Density (pcf)	Other
	65					▨				
-60	70					▨				
-65	75					⁙				
						⁙	**SILTY SAND (SM)** dark greenish-gray 10G 4/1, dense, wet, fine-grained sand (Old Bay Deposits)			
-70	80	C	300 psi		■	⁙				PP = 3,000 -200 = 22.8%
					■	⁙	Boring was terminated at 83 feet			
-75	85									
-80	90									
-85	95									
-90	100									

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PORT OF OAKLAND
530 WATER STREET, OAKLAND, CALIFORNIA

JOB NUMBER
133.007
DATE
9/26/97
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PLATE
B23c

LOG OF BORING NO. GB24

Sheet 1 of 4

Project Name & Location:
Geotechnical Investigation, -50 Foot Navigation Improvement Project,
Port of Oakland, Oakland and Alameda, California

Ground Surface Elevation: +9.9 Feet

Elevation Datum: Port of Oakland Datum

Drilling Coordinates: N2115444.4, E6045471.8

Start: Date 8/5/97 Time 12:00 pm

Finish: Date 8/7/97 Time 10:00 am

Drilling Company & Driller: Western Strata Exploration, Inc.; Tony Young

Rig Type & Drilling Method: Mobile B-61, Hollow-Stem Auger and Rotary Wash

Drilling Fluid: Bentonite Mud

Hole Diameter: 8.0-inch Hollow-Stem Auger, 3.7-inch Rotary Wash Bit

Sampler Type(s): A) SPT Sampler (2.0-inch O.D.)
B) Modified California Sampler (3.0-inch O.D.) Note: X = Sand Catcher Used
C) Shelby Tube with Piston Sampler (3.0-inch O.D.)

Logged By: Kenneth Jung

Sampling Method(s): A) 140 lb hammer falling 30 inches (Cable and Drum)
B) 140 lb hammer falling 30 inches (Cable and Drum)
C) Hydraulic push

Backfill Method: Cement Grout

Date: 8/7/97

Elevation (feet) / Depth (feet)	Sampler Type	Blows/6 inches or Pressure	SPT N-Value	Sample Interval	Graphic Log	SOIL DESCRIPTIONS **GROUP NAME (GROUP SYMBOL)** color, consistency/density, moisture condition, other descriptions (Local Name or Material Type)	LABORATORY DATA Moisture Content (%)	Dry Density (pcf)	Other
+10 / 0						Asphalt Concrete, 8 inches thick			
						POORLY GRADED SAND (SP) brown 7.5YR 5/4, medium dense, moist (Fill)			
	Ax	11 13 17	30						
	Ax	3 6 10	16			**POORLY GRADED SAND (SP)** dark greenish-gray 10G 3/1, medium dense, wet, with shell fragments (Fill)			
+5 / 5						▽ Groundwater level during drilling			
	Ax	1 2 3	5			**FAT CLAY (CH)** dark greenish-gray 5G 4/1, medium stiff, moist (Young Bay Mud)	74.2	56	
0 / 10									
	C	0 psi							
-5 / 15						With shell fragments to 1-inch long	58.6	65	TxUU = 600 (1,500) TV = 520
						8-inch-diameter hollow-stem auger to 19 feet, removed augers, set 19 feet of 6-inch-diameter steel conductor casing, continued drilling using rotary wash method with 3.7-inch-diameter bit			FV = 540 RFV = 100
-10 / 20									
									FV = 600 RFV = 110
-15 / 25						**CLAYEY SAND (SC)** brown 10YR 4/3, medium dense, wet (San Antonio Formation)			
	B	4 5 9	14						
20 / 30									
						Boring continued on next page			

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PORT OF OAKLAND
530 WATER STREET, OAKLAND, CALIFORNIA

JOB NUMBER 133.007
DATE 9/26/97
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PLATE **B24a**

LOG OF BORING NO. GB24

Sheet 2 of 4

Project Name & Location:
Geotechnical Investigation, -50 Foot Navigation Improvement Project,
Port of Oakland, Oakland and Alameda, California

Start Date: 8/5/97

Logged By: Kenneth Jung

Elevation (feet)	Depth (feet)	Sampler Type	Blows/6 inches or Pressure	SPT N-Value	SOIL DESCRIPTIONS GROUP NAME (GROUP SYMBOL) color, consistency/density, moisture condition, other descriptions (Local Name or Material Type)	LABORATORY DATA Moisture Content (%)	Dry Density (pcf)	Other
	30							
		Ax	5 7 9	16				LL = 21, PI = 12 -200 = 29.9%
-25	35							
-30	40	Ax	18 20 24	44				
					POORLY GRADED SAND (SP) olive-brown 2.5Y 4/4, very dense, wet (San Antonio Formation)			
-35	45							
		Ax	52/6"	52/6"				
-40	50							
		Ax	50/5"	50/5"				
-45	55							
					SANDY CLAY (CH) dark greenish-gray 10G 4/1, very stiff, moist (Old Bay Mud)			
		Ax	7 13 18	31				
-50	60					22.0	105	
					FAT CLAY (CH) dark greenish-gray 10G 4/1, very stiff, moist (Old Bay Mud)			
		C	600 psi			28.3	97	LL = 69, PI = 53 TxUU = 2,200 (6,400) TV = 2,300
-55	65							

Boring continued on next page

LOG OF BORING NO. GB24

Sheet 3 of 4

Project Name & Location:
Geotechnical Investigation, -50 Foot Navigation Improvement Project,
Port of Oakland, Oakland and Alameda, California

Start Date:
8/5/97

Logged By:
Kenneth Jung

Elevation (feet)	Depth (feet)	Sampler Type	Blows/6 inches or Pressure	SPT N-Value	Sample Interval	Graphic Log	SOIL DESCRIPTIONS: GROUP NAME (GROUP SYMBOL) color, consistency/density, moisture condition, other descriptions (Local Name or Material Type)	LABORATORY DATA: Moisture Content (%)	LABORATORY DATA: Dry Density (pcf)	LABORATORY DATA: Other
	65									
							SANDY FAT CLAY (CH) dark greenish-gray 10G 4/1, hard, moist (Old Bay Mud)			
		B	25 38 50	62				20.9	107	PP > 4,500
-60	70									
							FAT CLAY WITH SAND (CH) greenish-gray 5G 5/1, very stiff, moist (Old Bay Mud)			
		B	23 25 31	39				30.9	93	PP = 2,500
-65	75									
-70	80									
		B	35 42 44	60			**CLAYEY SAND (SC)** dark greenish-gray 10G 4/1, very dense, moist, with shell fragments (Old Bay Deposits)	21.9	104	
-75	85									
-80	90									
		C	300 psi				**FAT CLAY (CH)** dark greenish-gray 10G 4/1, very stiff, moist (Old Bay Mud)			
-85	95							43.9	77	TxUU = 3,200 (9,400) TV = 1,700
-90	100									
							Boring continued on next page			

LOG OF BORING NO. GB24

Sheet 4 of 4

Project Name & Location:
Geotechnical Investigation, -50 Foot Navigation Improvement Project,
Port of Oakland, Oakland and Alameda, California

Start Date:
8/5/97

Logged By:
Kenneth Jung

Elevation (feet) Depth (feet)	Sampler Type	Blows/6 inches or Pressure	SPT N-Value	Sample Interval	Graphic Log	SOIL DESCRIPTIONS **GROUP NAME (GROUP SYMBOL)** color, consistency/density, moisture condition, other descriptions (Local Name or Material Type)	LABORATORY DATA Moisture Content (%)	Dry Density (pcf)	Other
100					▨				
	B	26 33 46	55	■	▨	Boring was terminated at 104.5 feet	30.0	93	TV = 3,400
-95 105									
-100 110									
-105 115									
-110 120									
-115 125									
-120 130									
-125 135									

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PORT OF OAKLAND
530 WATER STREET, OAKLAND, CALIFORNIA

JOB NUMBER
133.007
DATE
9/26/97
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PLATE
B24d

LOG OF BORING NO. GB25

Sheet 1 of 2

Project Name & Location:
Geotechnical Investigation, -50 Foot Navigation Improvement Project, Port of Oakland, Oakland and Alameda, California

Ground Surface Elevation: -24.8 Feet (Mudline)

Elevation Datum: Port of Oakland Datum

Drilling Coordinates: N2115860, E6046040

Start: Date 9/12/97 Time 3:30 pm

Finish: Date 9/12/97 Time 7:00 pm

Drilling Company & Driller: Western Strata Exploration, Inc.; Gordon Jensen

Rig Type & Drilling Method: Concore A5; Rotary Wash

Drilling Fluid: Sea Water

Hole Diameter: 3.7-inch Rotary Wash Bit

Sampler Type(s): A) SPT Sampler (2.0-inch O.D.)
B) Modified California Sampler (3.0-inch O.D.)
C) Shelby Tube with Piston Sampler (3.0-inch O.D.)

Logged By: John Schmitt

Sampling Method(s): A) 140 lb hammer falling 30 inches (Rope and Cathead)
B) 140 lb hammer falling 30 inches (Rope and Cathead)
C) Hydraulic push

Backfill Method: Cement Grout

Date: 9/12/97

Elevation (feet)	Depth (feet)	Sampler Type	Blows/6 inches or Pressure	SPT N-Value	Sample Interval	Graphic Log	SOIL DESCRIPTIONS **GROUP NAME (GROUP SYMBOL)** color, consistency/density, moisture condition, other descriptions (Local Name or Material Type)	LABORATORY DATA Moisture Content (%)	Dry Density (pcf)	Other
	0						Water level at 3:30 pm was at Elevation +2.7 feet			
-25										
	5	C			■		**FAT CLAY (CH)** black N 2.5/ to dark greenish-gray 10GY 3/1, very soft, wet, with some shells (Recent or Young Bay Mud)	120.8	39	LL = 82, PI = 54 TV = 80
-30										
	10						4-inch-diameter steel conductor casing set to -34 feet elevation			
-35										
							POORLY GRADED SAND WITH CLAY (SP-SC) dark grayish-brown 10YR 4/2, dense, wet (San Antonio Formation)			
	15									
-40										
		A	43 25 25	50	■			16.9	113	-200 = 9.5%
	20									
-45										
		B	24 46 50	67	■					
	25									
-50										
							FAT CLAY (CH) dark greenish-gray 10Y 4/1, very stiff, moist (Old Bay Mud)			
		A	8 11 11	22	■			26.8	98	
	30						Boring continued on next page			

LOG OF BORING NO. GB25

Sheet 2 of 2

Project Name & Location:
Geotechnical Investigation, -50 Foot Navigation Improvement Project,
Port of Oakland, Oakland and Alameda, California

Start Date: 9/12/97

Logged By: John Schmitt

Elevation (feet)	Depth (feet)	Sampler Type	Blows/6 inches or Pressure	SPT N-Value	Sample Interval	Graphic Log	SOIL DESCRIPTIONS **GROUP NAME (GROUP SYMBOL)** color, consistency/density, moisture condition, other descriptions (Local Name or Material Type)	LABORATORY DATA Moisture Content (%)	Dry Density (pcf)	Other
-55	30					▨				
		B	14 20 23	30	■	▨		28.3	97	TV = 1,600 PP = 1,750
-60	35					▨				
		B	22 22 27	34	■	▨		27.2	99	TxUU = 3,000 (5,500) PP = 1,800
-65	40					▨				
		B	7 14 25	27	■	▨	With sand lenses at 43 feet Boring was terminated at 44 feet	25.2	103	
-70	45									
-75	50									
-80	55									
-85	60									
	65									

LOG OF BORING NO. GB26

Sheet 1 of 6

Project Name & Location:
Geotechnical Investigation, -50 Foot Navigation Improvement Project, Port of Oakland, Oakland and Alameda, California

Ground Surface Elevation:
+9.2 Feet

Elevation Datum:
Port of Oakland Datum

Drilling Coordinates:
N2115512.6, E6046204.5

Start: Date 8/7/97 Time 10:55 am

Finish: Date 8/12/97 Time 3:00 pm

Drilling Company & Driller:
Western Strata Exploration, Inc.; Tony Young

Drilling Fluid:
Bentonite Mud

Hole Diameter:
8.0-inch Hollow-Stem Auger
3.7-inch Rotary Wash Bit

Rig Type & Drilling Method:
Mobile B-61, Hollow-Stem Auger and Rotary Wash

Sampler Type(s): A) SPT Sampler (2.0-inch O.D.) E) Bag of Cuttings
B) Modified California Sampler (3.0-inch O.D.) Note: X = Sand Catcher Used
C) Shelby Tube with Piston Sampler (3.0-inch O.D.)

Logged By:
Kenneth Jung

Sampling Method(s): A) 140 lb hammer falling 30 inches (Cable and Drum)
B) 140 lb hammer falling 30 inches (Cable and Drum)
C) Hydraulic push

Backfill Method:
Cement Grout

Date:
8/12/97

Elevation (feet)	Depth (feet)	Sampler Type	Blows/6 inches or Pressure	SPT N-Value	Sample Interval	Graphic Log	SOIL DESCRIPTIONS **GROUP NAME (GROUP SYMBOL)** color, consistency/density, moisture condition, other descriptions (Local Name or Material Type)	LABORATORY DATA Moisture Content (%)	Dry Density (pcf)	Other
	0						Asphalt Concrete, 10 inches thick			
							POORLY GRADED SAND WITH GRAVEL (SP) dark brown 7.5YR 3/2, dry, (Fill)			
		Ax	8 18 16	34	☒		**POORLY GRADED SAND WITH SILT (SP-SM)** dark greenish-gray 10G 3/1, dense, moist, with shell fragments and siltier zones (Fill)			
+5	5	Ax	14 18 9	27	☒					
							∇ Groundwater level during drilling			
0	10	Ax	3 3 5	8	■		**FAT CLAY (CH)** dark greenish-gray 5G 4/1, medium stiff, moist, with fibrous and decayed organics (Young Bay Mud)			
-5	15	C	0 psi		■			81.3	52	LL = 76, PI = 51 TxUU = 300 (1,500) TV = 450
							Soft and less organics at 16.5 feet			
-10	20	Ax	1 1 2	3	■		8-inch-diameter hollow-stem auger to 19 feet, removed augers, set 19 feet of 6-inch-diameter conductor steel casing, continued drilling using rotary wash method with 3.7-inch-diameter drill bit	70.2	59	
										FV = 290 RFV = 60
-15	25									
										FV = 530 RFV = 90
-20	30									
							Boring continued on next page			

SCI Subsurface Consultants, Inc.
Geotechnical & Environmental Engineers

PORT OF OAKLAND
530 WATER STREET, OAKLAND, CALIFORNIA

JOB NUMBER 133.007
DATE 9/29/97
APPROVED

PLATE B26a

LOG OF BORING NO. GB26

Sheet 2 of 6

Project Name & Location:
Geotechnical Investigation, -50 Foot Navigation Improvement Project,
Port of Oakland, Oakland and Alameda, California

Start Date:
8/7/97

Logged By:
Kenneth Jung

Elevation (feet)	Depth (feet)	Sampler Type	Blows/6 inches or Pressure	SPT N-Value	Sample Interval	Graphic Log	SOIL DESCRIPTIONS **GROUP NAME (GROUP SYMBOL)** color, consistency/density, moisture condition, other descriptions (Local Name or Material Type)	LABORATORY DATA Moisture Content (%)	LABORATORY DATA Dry Density (pcf)	LABORATORY DATA Other
	30	C	100 psi							
								100.1	44	TxUU = 700 (3,100)
		C	100 psi							
-25										
	35						With decayed organics			TV = 520
		B								
-30										
	40									
							FAT CLAY (CH) greenish-black 10Y 2.5/1, medium stiff, moist, with some sand (Young Bay Mud)			
		C	0 psi							
-35										
	45							56.3	64	-200 = 91.1%
							CLAYEY SAND (SC) greenish-gray 5G 5/1, dense, moist, with decayed organic specs (San Antonio Formation)			
-40		B	11 19 28	33				22.4	107	
	50									
		C					Shelby tube lost in hole			
							Becoming very dense			
-45	55									
-50	60									
-55	65									
							Boring continued on next page			

Subsurface Consultants, Inc.
Geotechnical & Environmental Engineers

PORT OF OAKLAND
530 WATER STREET, OAKLAND, CALIFORNIA

JOB NUMBER
133.007
DATE
9/29/97
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PLATE
B26b

LOG OF BORING NO. GB26

Sheet 3 of 6

Project Name & Location:	Start Date:
Geotechnical Investigation, -50 Foot Navigation Improvement Project, Port of Oakland, Oakland and Alameda, California	8/7/97
	Logged By: Kenneth Jung

Elevation (feet)	Depth (feet)	Sampler Type	Blows/6 inches or Pressure	SPT N-Value	Sample Interval	Graphic Log	SOIL DESCRIPTIONS **GROUP NAME (GROUP SYMBOL)** color, consistency/density, moisture condition, other descriptions (Local Name or Material Type)	LABORATORY DATA Moisture Content (%)	LABORATORY DATA Dry Density (pcf)	LABORATORY DATA Other
	65	Bx	50 50/5"	35/5"			With metal fragments from Shelby (blow counts may be inaccurate due to metal fragments); disturbed sample			
-60										
	70	C	400 psi							
-65										
	75	Bx	46 50/3"	35/3"						
-70										
	80	C	600 psi				**POORLY GRADED SAND (SP)** greenish-black 10Y 2.5/1, very dense, wet (San Antonio Formation)			
-75										
	85						**FAT CLAY (CH)** dark greenish-gray 10G 4/1, very stiff, moist (Old Bay Mud)			
		B	8 13 18	28				40.4	82	TV = 2,300
-80										
	90									
-85		B	22 30 39	48						
	95						Hard at 95 feet	31.6	91	TV > 4,500
-90										
	100						Boring continued on next page			

SCI **Subsurface Consultants, Inc.**
Geotechnical & Environmental Engineers

PORT OF OAKLAND
530 WATER STREET, OAKLAND, CALIFORNIA

JOB NUMBER 133.007
DATE 9/29/97
APPROVED

PLATE **B26c**

LOG OF BORING NO. GB26

Sheet 4 of 6

Project Name & Location:
Geotechnical Investigation, -50 Foot Navigation Improvement Project,
Port of Oakland, Oakland and Alameda, California

Start Date:
8/7/97

Logged By:
Kenneth Jung

Elevation (feet)	Depth (feet)	Sampler Type	Blows/6 inches or Pressure	SPT N-Value	Sample Interval	Graphic Log	SOIL DESCRIPTIONS **GROUP NAME (GROUP SYMBOL)** color, consistency/density, moisture condition, other descriptions (Local Name or Material Type)	LABORATORY DATA Moisture Content (%)	LABORATORY DATA Dry Density (pcf)	LABORATORY DATA Other
	100	B	14 25 44	48	■	▨		33.4	88	
-95										
	105	E			☒					
-100										
	110	E			☒					
-105										
	115	E			☒					
-110										
	120	E			☒					
-115										
	125	E			☒					
-120										
	130	E			☒		Beginning of Alameda Formation (based on geophysical logs)			
-125										
	135						Boring continued on next page			

SCI Subsurface Consultants, Inc.
Geotechnical & Environmental Engineers

PORT OF OAKLAND
530 WATER STREET, OAKLAND, CALIFORNIA

JOB NUMBER
133.007
DATE
9/29/97
APPROVED

PLATE
B26d

LOG OF BORING NO. GB26

Sheet 5 of 6

Project Name & Location:
Geotechnical Investigation, -50 Foot Navigation Improvement Project,
Port of Oakland, Oakland and Alameda, California

Start Date:
8/7/97

Logged By:
Kenneth Jung

							SOIL DESCRIPTIONS	LABORATORY DATA		
Elevation (feet)	Depth (feet)	Sampler Type	Blows/6 inches or Pressure	SPT N-Value	Sample Interval	Graphic Log	**GROUP NAME (GROUP SYMBOL)** color, consistency/density, moisture condition, other descriptions (Local Name or Material Type)	Moisture Content (%)	Dry Density (pcf)	Other
	135	E	☒			▨				
						▨	Becoming harder			
-130						▨				
	140	E			☒	▨				
-135						▨				
	145	E			☒	▨				
						▨	Becoming softer			
-140						▨				
	150	E			☒	▨				
-145						▨				
	155	E			☒	▨				
						▨	Becoming harder and sandier			
-150						▨				
	160	E			☒	▨	Becoming softer			
-155						▨				
	165	E			☒	▨				
-160						▨				
	170						Boring continued on next page			

LOG OF BORING NO. GB26

Sheet 6 of 6

Project Name & Location:
Geotechnical Investigation, -50 Foot Navigation Improvement Project,
Port of Oakland, Oakland and Alameda, California

Start Date:
8/7/97

Logged By:
Kenneth Jung

Elevation (feet)	Depth (feet)	Sampler Type	Blows/6 inches or Pressure	SPT N-Value	Sample Interval	Graphic Log	SOIL DESCRIPTIONS **GROUP NAME (GROUP SYMBOL)** color, consistency/density, moisture condition, other descriptions (Local Name or Material Type)	LABORATORY DATA Moisture Content (%)	LABORATORY DATA Dry Density (pcf)	LABORATORY DATA Other
	170	E			☒	▨				
-165	175	E			☒	▨				
-170	180	E			☒	▨				
-175	185	E			☒	▨				
-180	190	E			☒	▨				
-185	195	E			☒	▨				
-190	200	E			☒	▨	Boring was terminated at 200.5 feet			
-195	205									

SCI Subsurface Consultants, Inc.
Geotechnical & Environmental Engineers

PORT OF OAKLAND
530 WATER STREET, OAKLAND, CALIFORNIA

JOB NUMBER 133.007
DATE 9/29/97
APPROVED

PLATE **B26f**

LOG OF BORING NO. GB27

Sheet 1 of 2

Project Name & Location:
Geotechnical Investigation, -50 Foot Navigation Improvement Project,
Port of Oakland, Oakland and Alameda, California

Ground Surface Elevation:
-8.9 Feet (Mudline)

Elevation Datum:
Port of Oakland Datum

Drilling Coordinates:
N2116850, E6044910

Drilling Company & Driller:
Western Strata Exploration, Inc.; Tony Young

Rig Type & Drilling Method:
Concore A5; Rotary Wash

Start: Date	Time	Finish: Date	Time
9/16/97	10:00 am	9/16/97	5:30 pm

Drilling Fluid:
Bentonite Mud

Hole Diameter:
3.7-inch Rotary Wash Bit

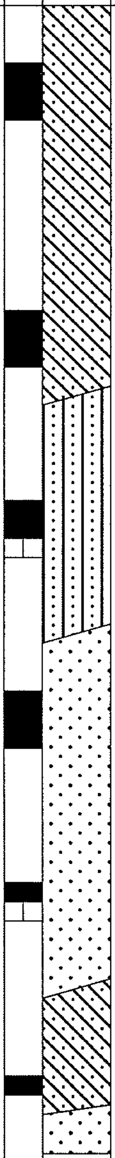
Sampler Type(s): A) SPT Sampler (2.0-inch O.D.)
B) Modified California Sampler (3.0-inch O.D.)
Note: X = Sand Catcher Used

Logged By:
John Wolfe

Sampling Method(s): A) 140 lb hammer falling 30 inches (Rope and Cathead)
B) 140 lb hammer falling 30 inches (Rope and Cathead)

Backfill Method:
Cement Grout

Date:
9/16/97



Elevation (feet)	Depth (feet)	Sampler Type	Blows/6 inches or Pressure	SPT N-Value	Sample Interval	Graphic Log	SOIL DESCRIPTIONS **GROUP NAME (GROUP SYMBOL)** color, consistency/density, moisture condition, other descriptions (Local Name or Material Type)	LABORATORY DATA Moisture Content (%)	Dry Density (pcf)	Other
	0						Water level at 9:30 am was at Elevation +3.1 feet			
-10							**CLAYEY SAND (SC)** brown 10YR 4/3, loose to medium dense, wet (Fill?)			
		B	5 4 3	5						-200 = 38.2%
	5									
-15										
		A	3 4 4	8				17.8	111	
	10									
-20							**SILTY SAND (SM)** light olive-brown 2.5Y 5/3, dense, wet (San Antonio Formation)			
		A	10 22 21	43			4-inch-diameter steel conductor casing set to -22 feet elevation			
	15									-200 = 16.9%
-25										
		A	16 25 36	61			**POORLY GRADED SAND (SP)** dark yellowish-brown 10YR 4/4, very dense, wet (San Antonio Formation)	19.4	107	
	20									
-30										
		A	36 50/6"	50/6"						
	25									
-35							**CLAYEY SAND (SC/CL)** light olive-brown 2.5Y 5/3, very dense, moist (San Antonio Formation)			
		B	52/6"	36/6"						LL = 38, PI = 24
	30									
							Boring continued on next page			

LOG OF BORING NO. GB27

Sheet 2 of 2

Project Name & Location:
Geotechnical Investigation, -50 Foot Navigation Improvement Project,
Port of Oakland, Oakland and Alameda, California

Start Date:
9/16/97

Logged By:
John Wolfe

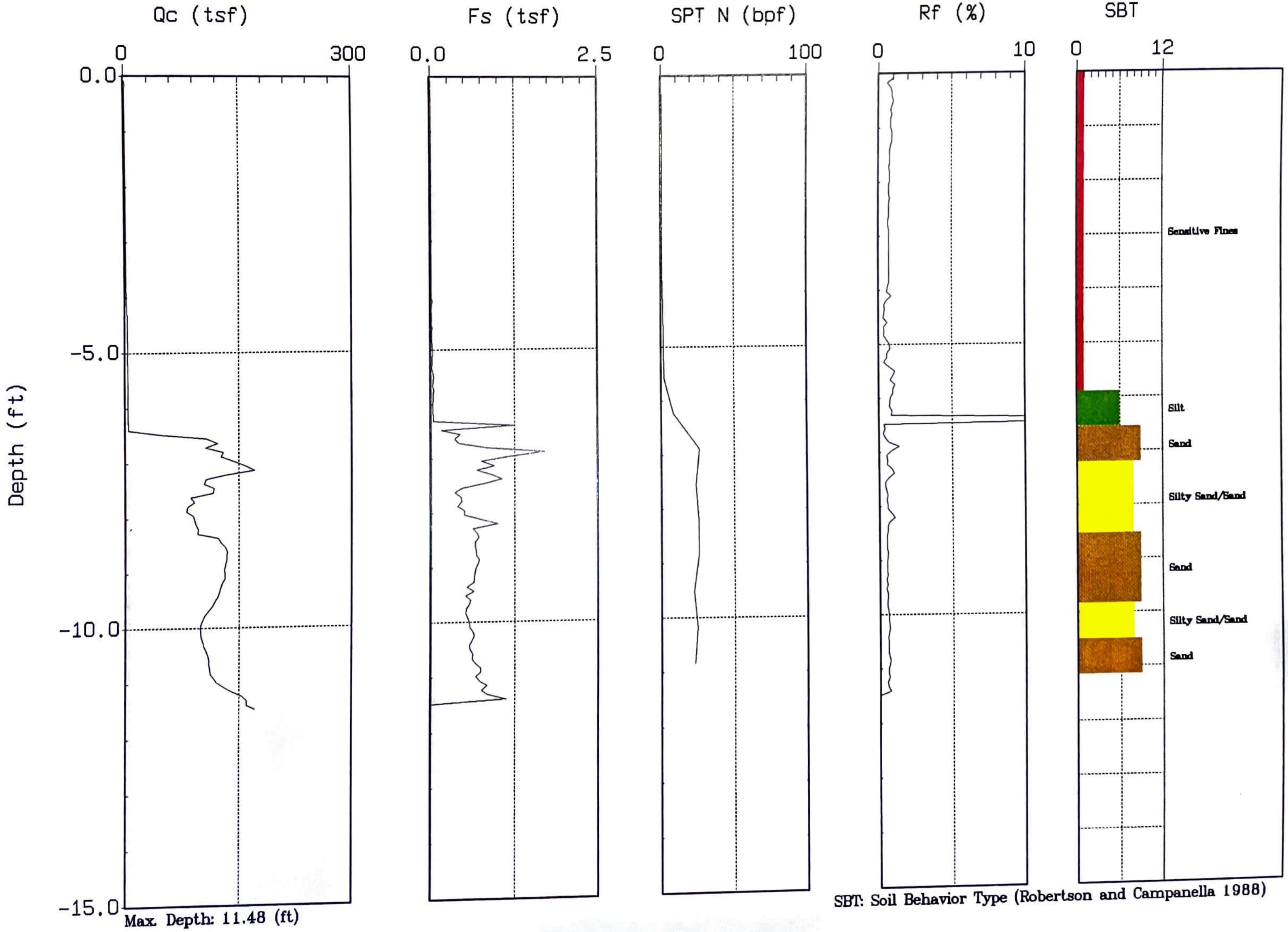
Elevation (feet)	Depth (feet)	Sampler Type	Blows/6 inches or Pressure	SPT N-Value	Sample Interval	Graphic Log	SOIL DESCRIPTIONS **GROUP NAME (GROUP SYMBOL)** color, consistency/density, moisture condition, other descriptions (Local Name or Material Type)	LABORATORY DATA Moisture Content (%)	LABORATORY DATA Dry Density (pcf)	LABORATORY DATA Other
	30					⁘	**POORLY GRADED SAND (SP)** olive-brown 2.5Y 4/3, very dense, wet (San Antonio Formation)			
-40						⁘				
		A	53/6"	53/6"	■	⁘		18.6	110	
	35					⁘				
-45						⁘				
		A	21 49/6"	49/6"	■	⁘				
	40					⁘				
-50						⁘				
		Bx	25 49/6"	38/6"	■	▧	**FAT CLAY (CH)** dark greenish-gray 10GY 4/1, stiff to very stiff, moist, with very thin lenses of fine sand (Old Bay Mud)	19.4	111	TxUU = 2,050 (5,000) PP = 4,250
	45					▧				
-55						▧				
		B	50/5"	35/5"	■	▧		23.6	103	PP = 1,750
	50					▧				
-60						▧				
		B	56/6"	39/6"	■	▧	Boring was terminated at 53.5 feet			PP = 3,500
	55									
-65										
	60									
-70										
	65									

GREGG

SUBSURFACE

Site : Oakland Harbor
Location : MCPT-61

Geologist : J. Wolfe
Date : 2/4/00 14:03



Max. Depth: 11.48 (ft)

Depth Inc.: 0.082 (ft)

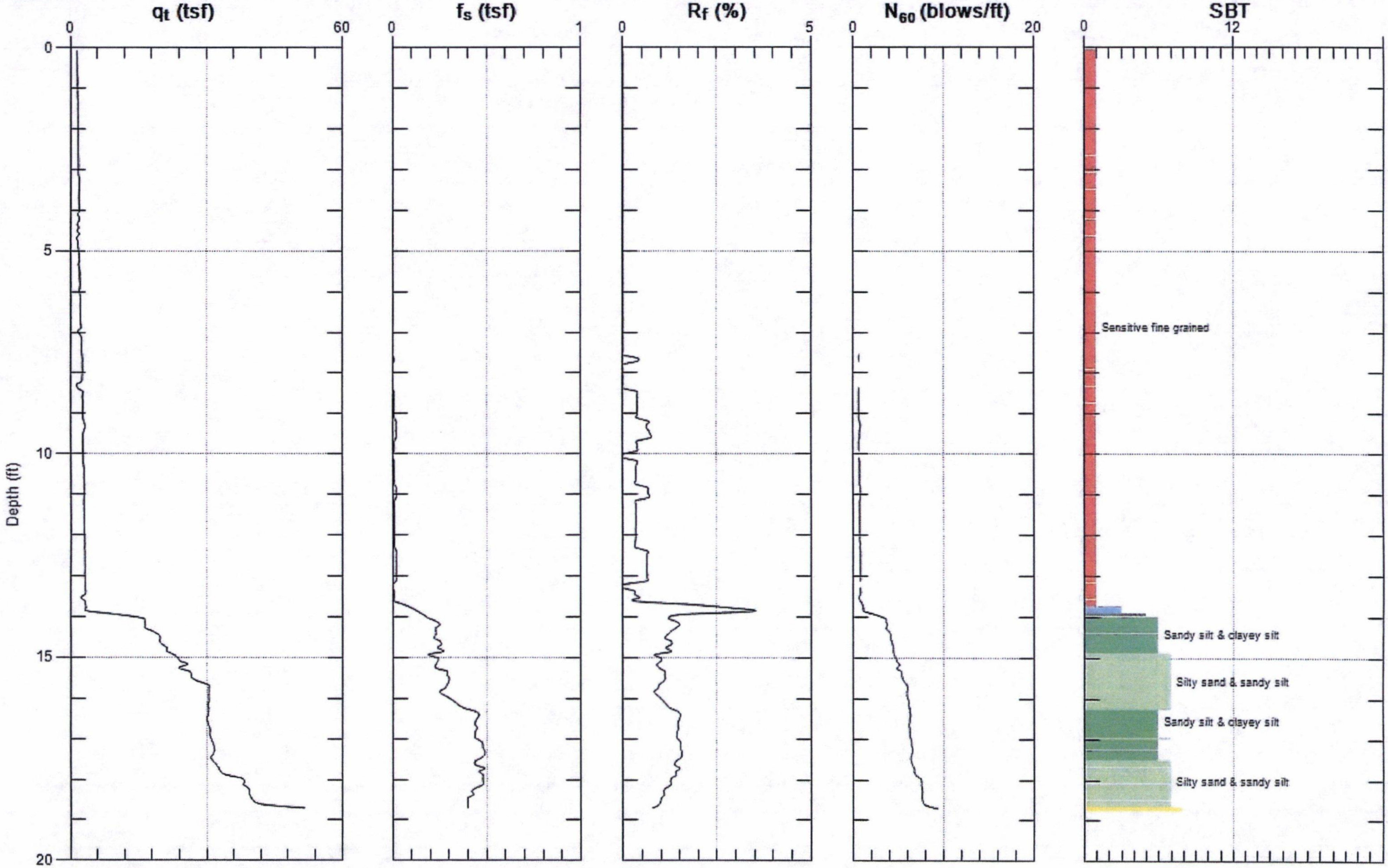
SBT: Soil Behavior Type (Robertson and Campanella 1988)

GREGG

ARMY CORPS OF ENGINEERS

Site: INTERHARBOR BASIN
Sounding: CPT-08

Engineer: A.REIS
Date: 3/22/2007 07:56



Max. Depth: 18.700 (ft)
Avg. Interval: 0.082 (ft)

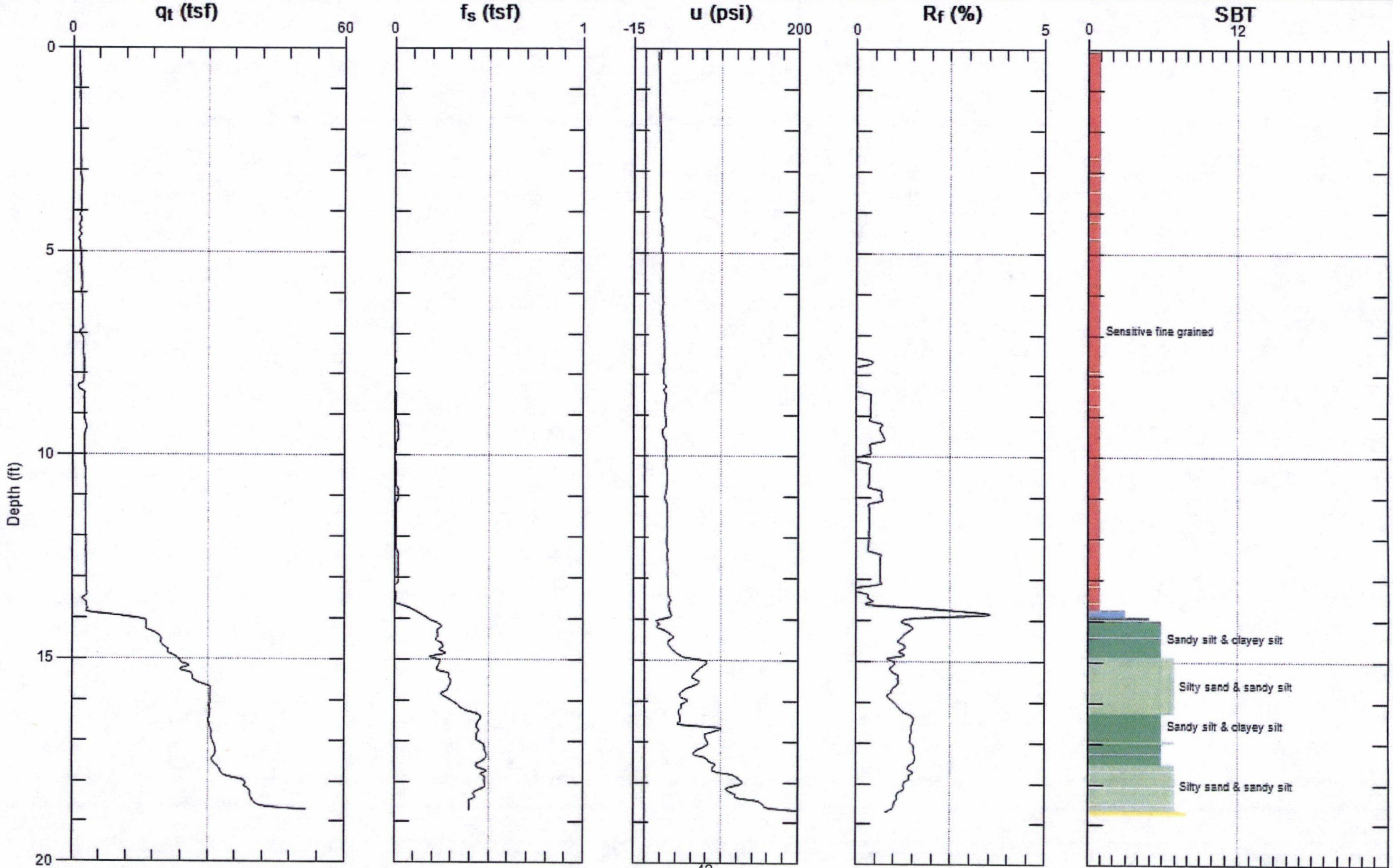
SBT: Soil Behavior Type (Robertson 1990)

GREGG

ARMY CORPS OF ENGINEERS

Site: INTERHARBOR BASIN
Sounding: CPT-08

Engineer: A.REIS
Date: 3/22/2007 07:56



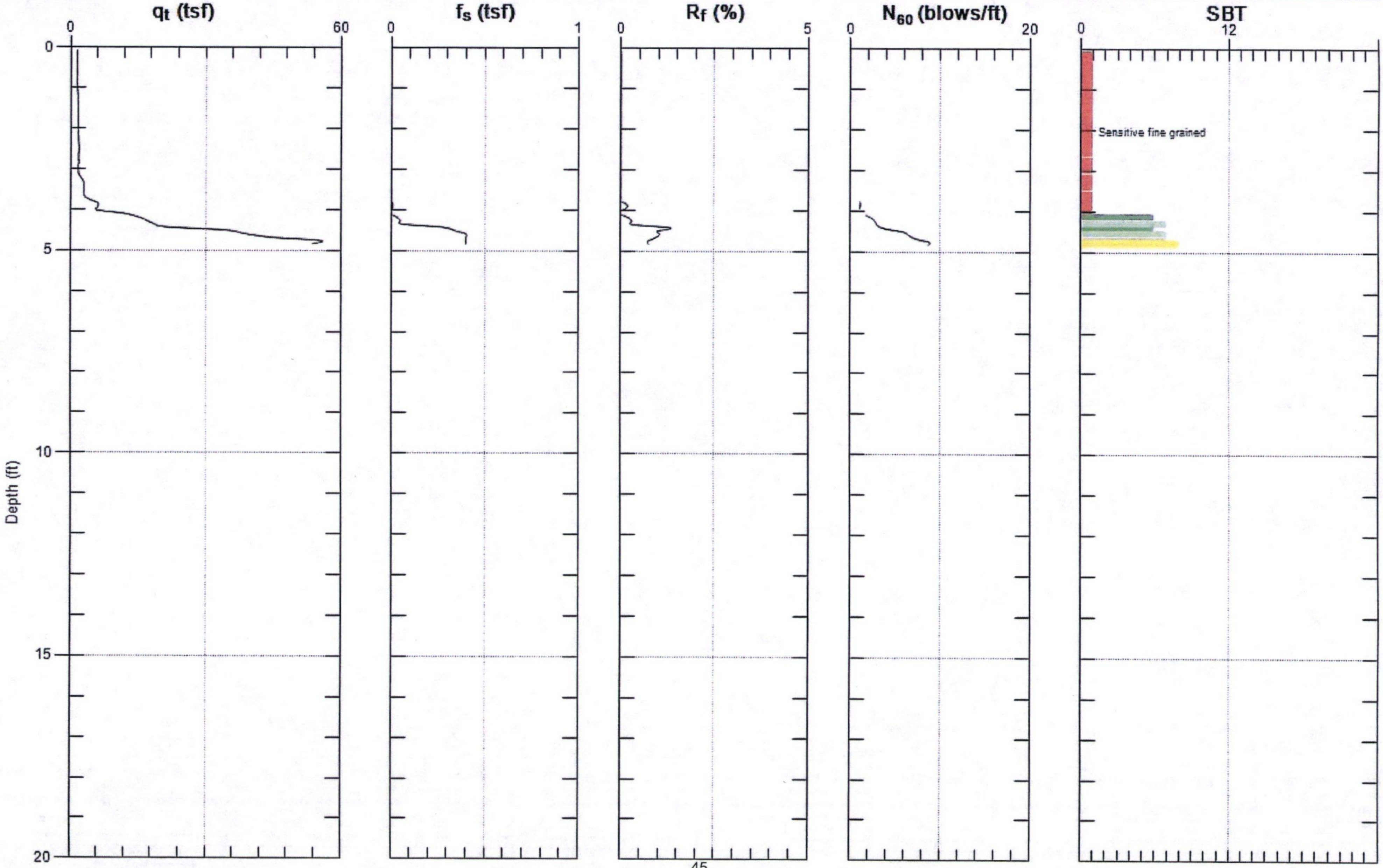
Max. Depth: 18.700 (ft)
Avg. Interval: 0.082 (ft)

SBT: Soil Behavior Type (Robertson 1990)

GREGG

ARMY CORPS OF ENGINEERS

Site: INTERHARBOR BASIN
Sounding: CPT-10
Engineer: A.REIS
Date: 3/21/2007 08:38

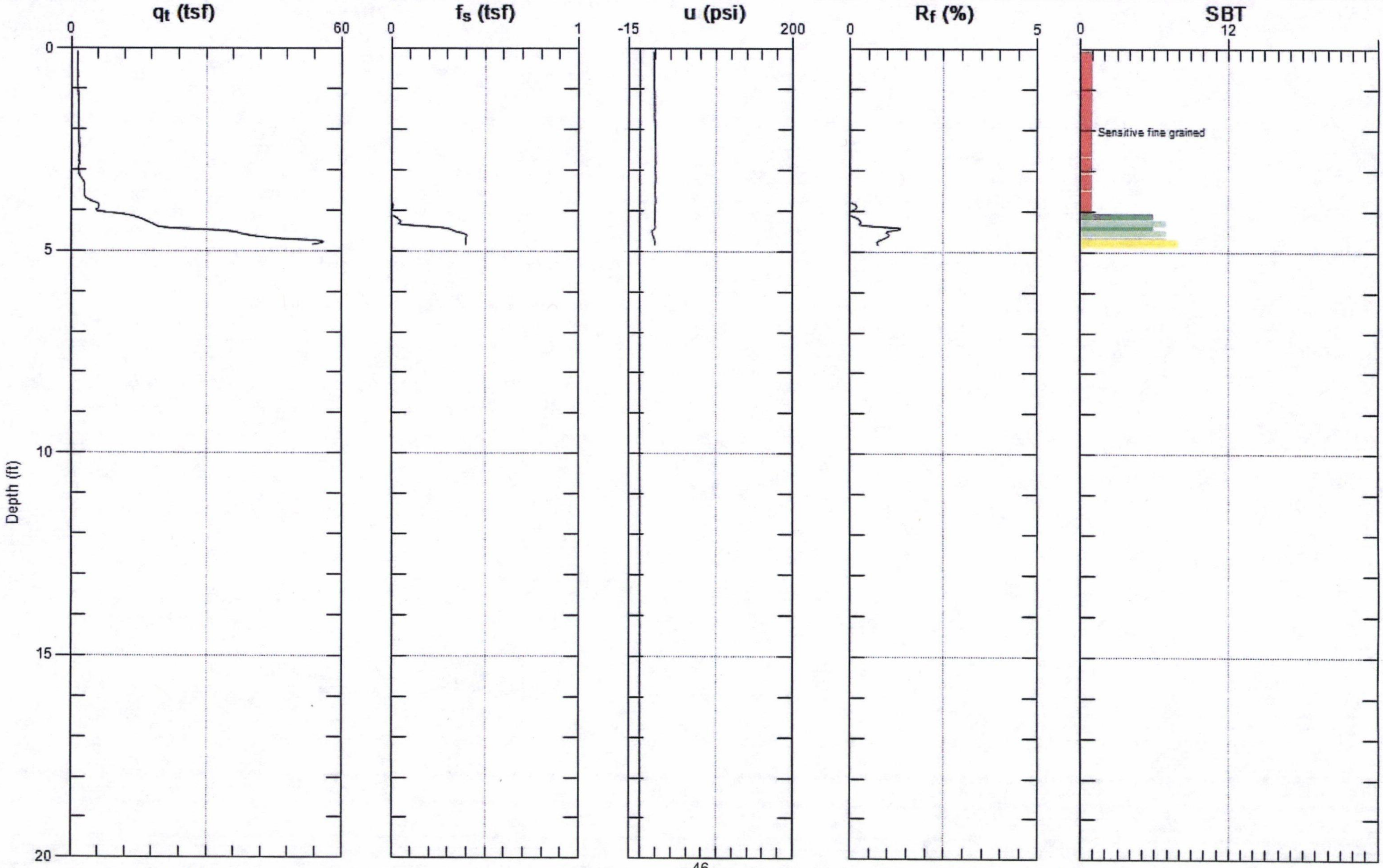


Max. Depth: 4.840 (ft)
Avg. Interval: 0.082 (ft)

SBT: Soil Behavior Type (Robertson 1990)

ARMY CORPS OF ENGINEERS

Site: INTERHARBOR BASIN
Sounding: CPT-10
Engineer: A.REIS
Date: 3/21/2007 08:38



Max. Depth: 4.840 (ft)
Avg. Interval: 0.082 (ft)

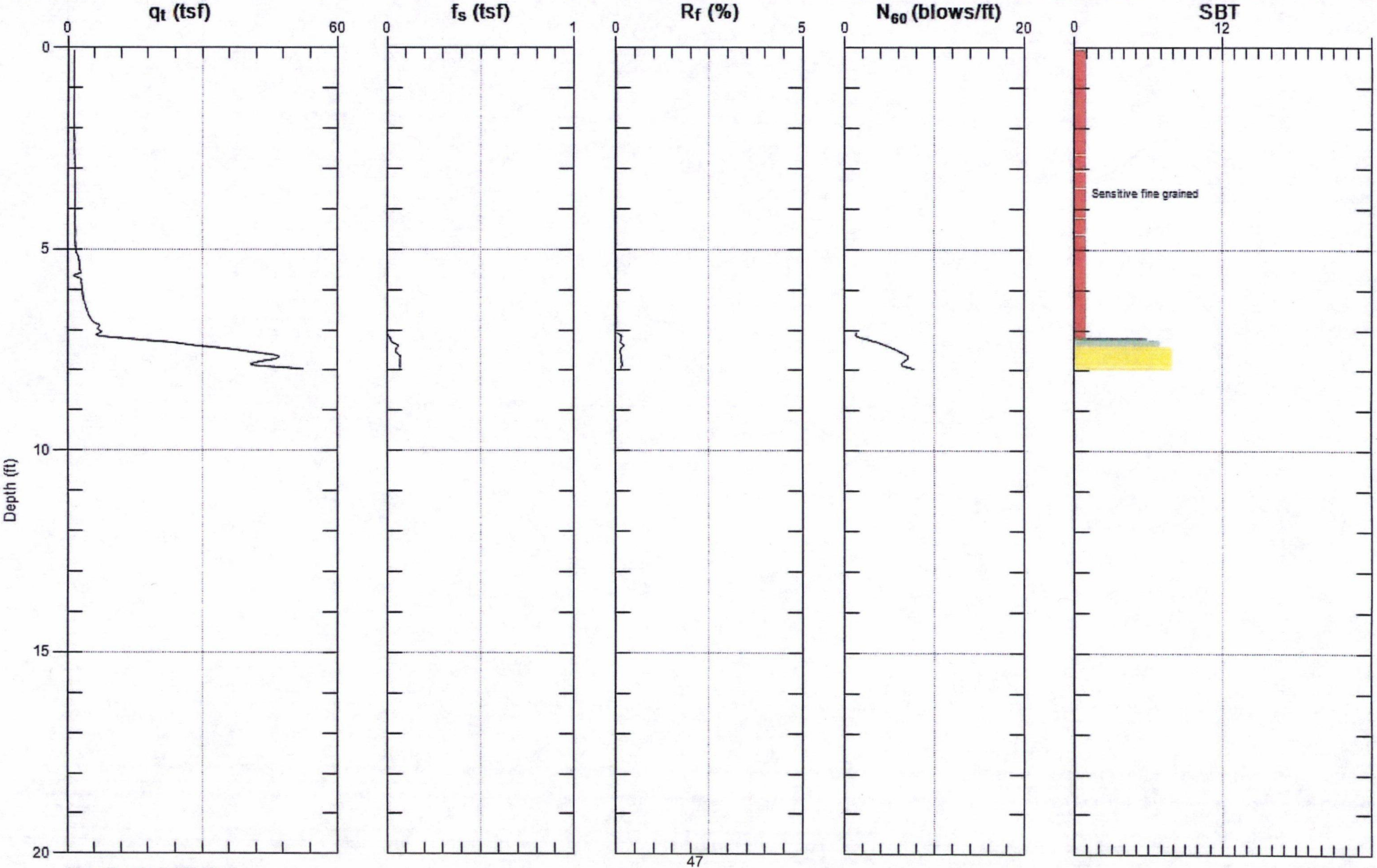
SBT: Soil Behavior Type (Robertson 1990)

GREGG

ARMY CORPS OF ENGINEERS

Site: INTERHARBOR BASIN
Sounding: CPT-11

Engineer: A.REIS
Date: 3/21/2007 09:40



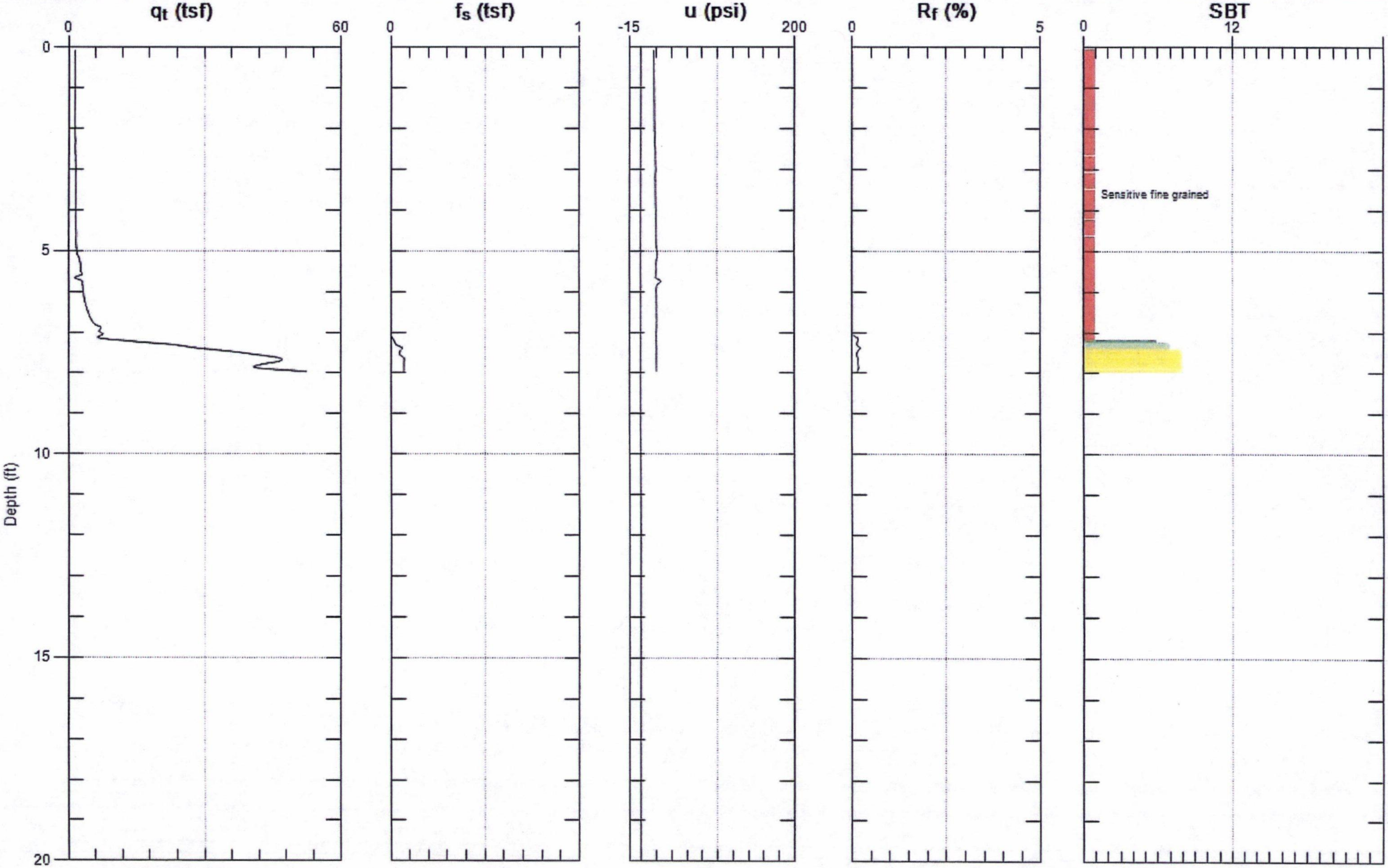
Max. Depth: 7.960 (ft)
Avg. Interval: 0.082 (ft)

SBT: Soil Behavior Type (Robertson 1990)

ARMY CORPS OF ENGINEERS

Site: INTERHARBOR BASIN
Sounding: CPT-11

Engineer: A.REIS
Date: 3/21/2007 09:40



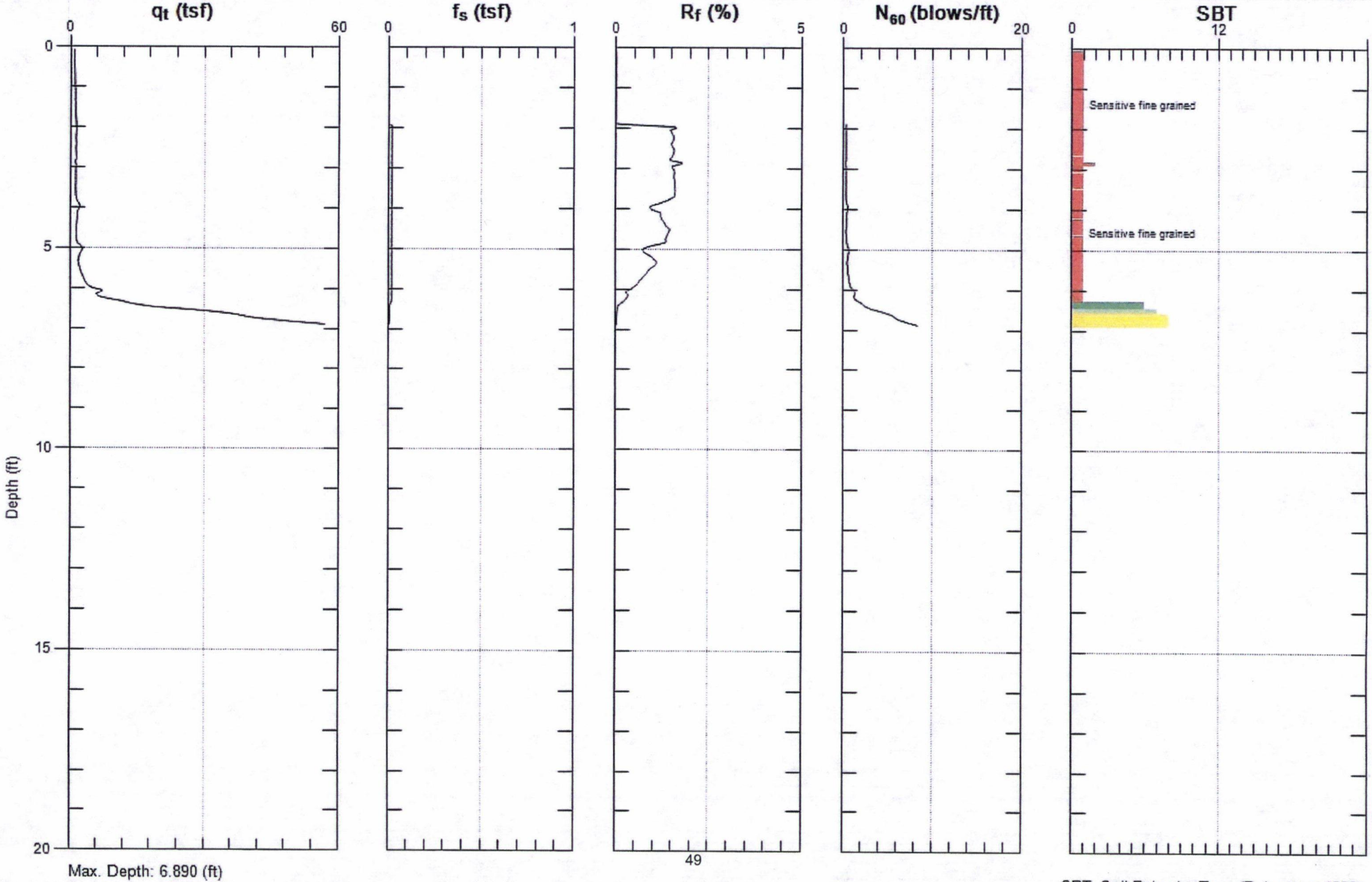
Max. Depth: 7.960 (ft)
Avg. Interval: 0.082 (ft)

SBT: Soil Behavior Type (Robertson 1990)

ARMY CORPS OF ENGINEERS

Site: INTERHARBOR BASIN
Sounding: CPT-12

Engineer: A.REIS
Date: 3/21/2007 10:43



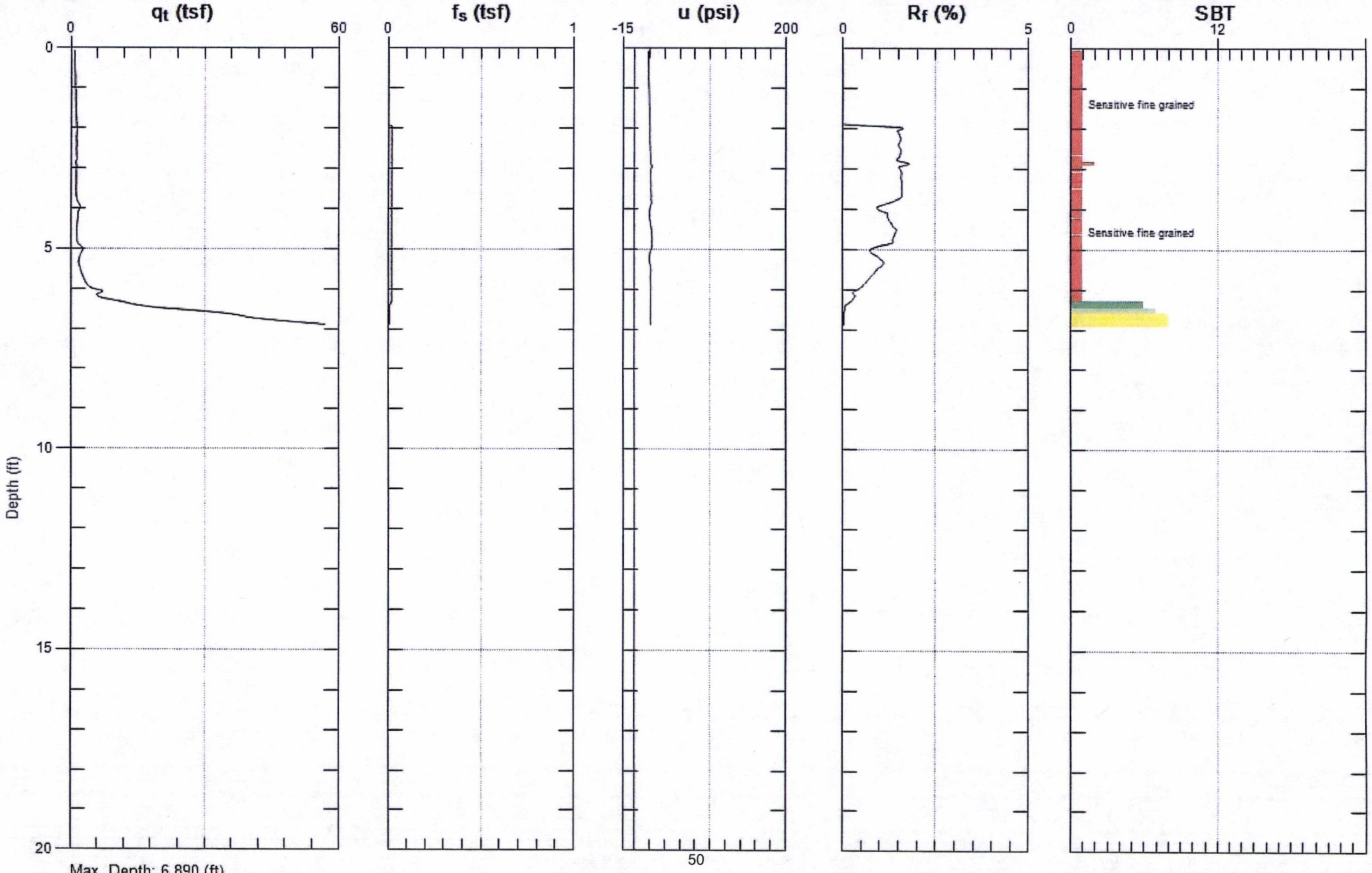
Max. Depth: 6.890 (ft)
Avg. Interval: 0.082 (ft)

SBT: Soil Behavior Type (Robertson 1990)

GREGG

ARMY CORPS OF ENGINEERS

Site: INTERHARBOR BASIN
Sounding: CPT-12
Engineer: A.REIS
Date: 3/21/2007 10:43



Max. Depth: 6.890 (ft)
Avg. Interval: 0.082 (ft)

SBT: Soil Behavior Type (Robertson 1990)

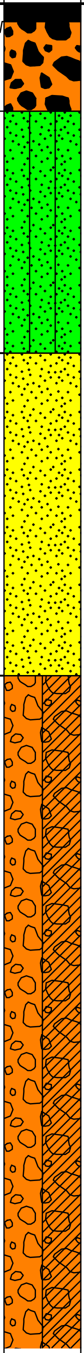
ENGEO
Expect Excellence

LOG OF BORING 1-B3

LATITUDE: 37.79501
LONGITUDE: -122.285291

Geotechnical Exploration
Oakland A's Ballpark
Oakland, CA
14682.000.000

DATE DRILLED: 1/30/2019
HOLE DEPTH: Approx. 56½ ft.
HOLE DIAMETER: 4.0 in.
SURF ELEV (WGS84): Approx. 7 ft.
LOGGED / REVIEWED BY: J. Allen / JAF
DRILLING CONTRACTOR: H1 Drilling
DRILLING METHOD: HSA/Mud Rotary
HAMMER TYPE: 140 lb. Auto Trip



Depth in Feet	Elevation in Feet	Sample Type	DESCRIPTION	Log Symbol	Water Level	Blow Count/Foot	Atterberg Limits: Liquid Limit	Atterberg Limits: Plastic Limit	Atterberg Limits: Plasticity Index	Fines Content (% passing #200 sieve)	Moisture Content (% dry weight)	Dry Unit Weight (pcf)	Shear Strength (psf) *field approximation	Unconfined Strength (tsf) *field approximation	Strength Test Type
			ASPHALT, 4-inches thick.												
			AGGREGATE BASE [FILL]												
	5														
			SILTY SAND (SM) with clay, dark olive gray (5Y 3/2), medium dense, very moist [FILL].												
		✋								21					
5															
			Very dark gray (5Y 3/1) to black (5Y 2.5/1)												
			POORLY GRADED SAND (SP), very dark greenish gray (Gley 1 3/1/10Y), medium dense, very moist to wet, samples collected in gallon bags from 5 to 9 feet [FILL].												
	0														
					▽										
10		◣				11				3	21.2				
	-5														
			POORLY GRADED GRAVEL WITH CLAY (GP-GC) with sand, dark olive gray (5Y 3/2), medium dense, wet, 1-inch to 2-inch diameter sub-angular, very strong, gravels of chloritized bluish-gray graywacke sandstone [ROCK DIKE].												
15		◣				16				6	10.2				
	-10														
20		◣	Difficult sampling and loss of circulation at various depths			22									
	-15														
25															

ENGEO
Expect Excellence

LOG OF BORING 1-B3

LATITUDE: 37.79501
LONGITUDE: -122.285291

Geotechnical Exploration
Oakland A's Ballpark
Oakland, CA
14682.000.000

DATE DRILLED: 1/30/2019
HOLE DEPTH: Approx. 56½ ft.
HOLE DIAMETER: 4.0 in.
SURF ELEV (WGS84): Approx. 7 ft.

LOGGED / REVIEWED BY: J. Allen / JAF
DRILLING CONTRACTOR: H1 Drilling
DRILLING METHOD: HSA/Mud Rotary
HAMMER TYPE: 140 lb. Auto Trip

Depth in Feet	Elevation in Feet	Sample Type	DESCRIPTION	Log Symbol	Water Level	Blow Count/Foot	Atterberg Limits			Fines Content (% passing #200 sieve)	Moisture Content (% dry weight)	Dry Unit Weight (pcf)	Shear Strength (psf) *field approximation	Unconfined Strength (tsf) *field approximation	Strength Test Type
							Liquid Limit	Plastic Limit	Plasticity Index						
		■	POORLY GRADED GRAVEL WITH CLAY (GP-GC) with sand, dark olive gray (5Y 3/2), medium dense, wet, 1-inch to 2-inch diameter sub-angular, very strong, gravels of chloritized bluish-gray graywacke sandstone [ROCK DIKE].			24				2					
	-20														
30															
		■				26					7.2				
	-25														
35															
		◣				20									
			SANDY GRAVEL (GW), very dark greenish gray (Gley 1 3/1/10Y), medium dense to dense, wet [ROCK DIKE].												
	-30														
40															
		◣				45									
	-35														
45															
		◣				17				12	18.1				
			FAT CLAY (CH), black to greenish black (Gley 1 2.5/1/N), soft, wet, in-situ bay floor below rock dike [YOUNG BAY MUD - NATIVE].												
	-40														
			POORLY GRADED SAND (SP), olive brown (2.5Y 4/3), dense to very dense, wet [MERRIT SAND].												
50															

ENGEO
Expect Excellence

LOG OF BORING 1-B3

LATITUDE: 37.79501
LONGITUDE: -122.285291

Geotechnical Exploration
Oakland A's Ballpark
Oakland, CA
14682.000.000

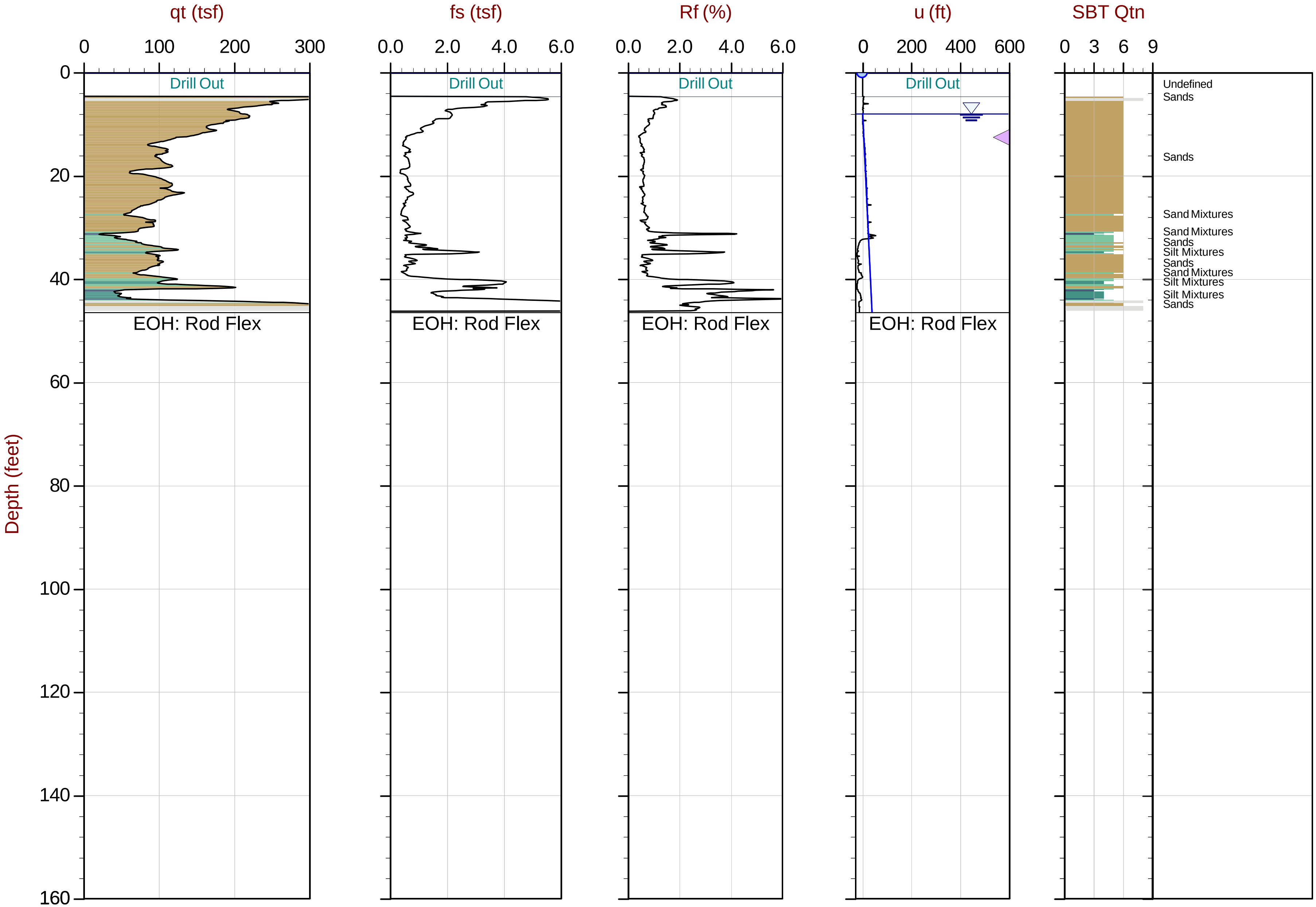
DATE DRILLED: 1/30/2019
HOLE DEPTH: Approx. 56½ ft.
HOLE DIAMETER: 4.0 in.
SURF ELEV (WGS84): Approx. 7 ft.
LOGGED / REVIEWED BY: J. Allen / JAF
DRILLING CONTRACTOR: H1 Drilling
DRILLING METHOD: HSA/Mud Rotary
HAMMER TYPE: 140 lb. Auto Trip

Depth in Feet	Elevation in Feet	Sample Type	DESCRIPTION	Log Symbol	Water Level	Blow Count/Foot	Atterberg Limits			Fines Content (% passing #200 sieve)	Moisture Content (% dry weight)	Dry Unit Weight (pcf)	Shear Strength (psf) *field approximation	Unconfined Strength (tsf) *field approximation	Strength Test Type
							Liquid Limit	Plastic Limit	Plasticity Index						
		■	POORLY GRADED SAND (SP), olive brown (2.5Y 4/3), dense to very dense, wet [MERRIT SAND].			>50					16.7				
	-45														
55		◣				54									
			Boring terminated at 56½ feet below ground surface (bgs). Groundwater encountered at 9 feet bgs at time of drilling.												

CONETEC

ENGEO

Job No: 19-56005
Date: 2019-01-15 13:16
Site: Howard Terminal
Sounding: 1-CPT-05
Cone: 488:T1500F15U500



Max Depth: 14.150 m / 46.42 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 19-56005_CP05.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: UTM 10 N N: 4183371m E: 562790m
Sheet No: 1 of 1

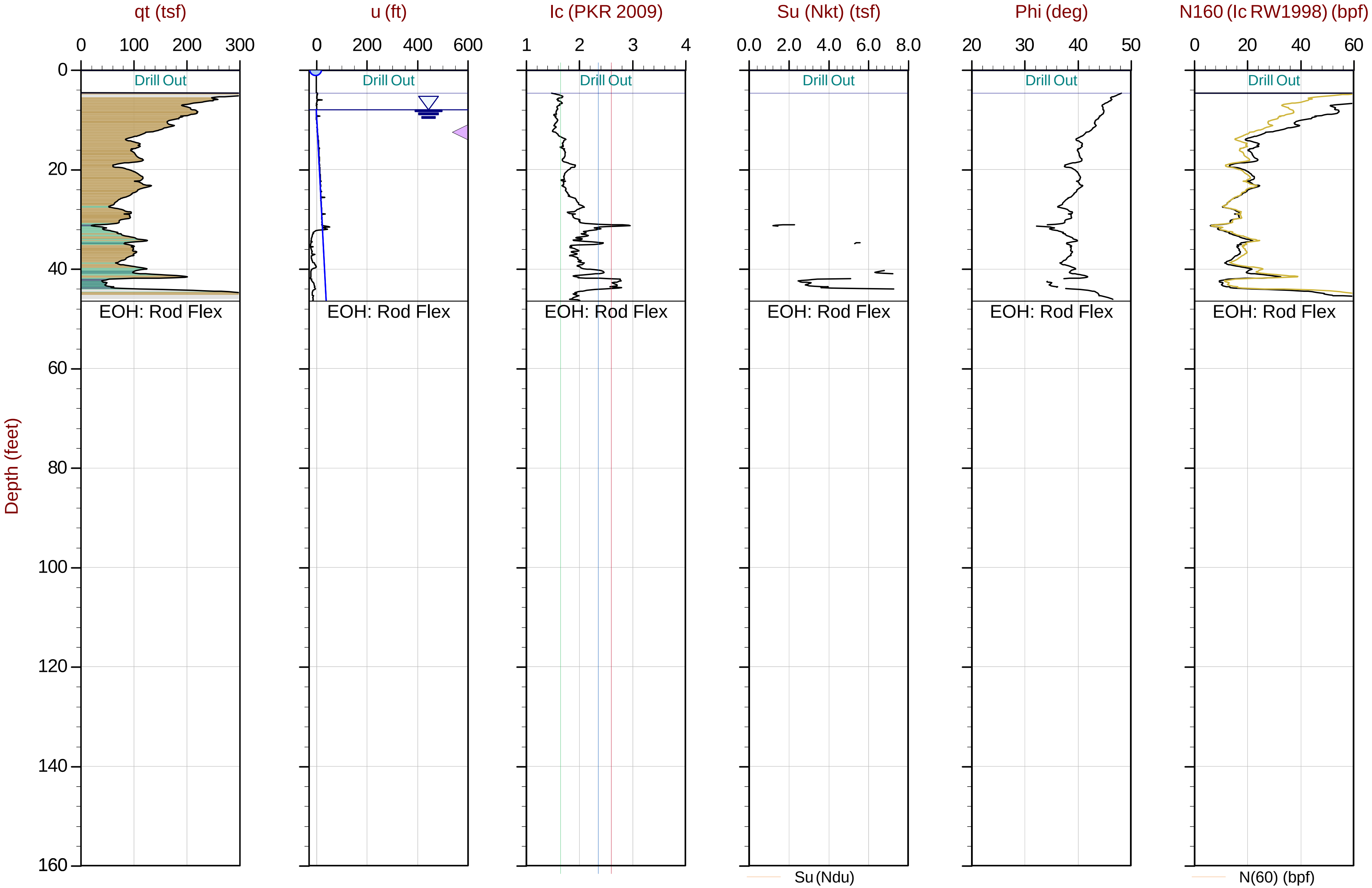
Overplot Item: ● Ueq ● Assumed Ueq ◁ Dissipation, Ueq achieved ◁ Dissipation, Ueq not achieved — Hydrostatic Line

The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

ENGEO

Job No: 19-56005
Date: 2019-01-15 13:16
Site: Howard Terminal

Sounding: 1-CPT-05
Cone: 488:T1500F15U500



Max Depth: 14.150 m / 46.42 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 19-56005_CP05.COR
Unit Wt: SBTQtn (PKR2009)
Su Nkt: 15.0

SBT: Robertson, 2009 and 2010
Coords: UTM 10 N N: 4183371m E: 562790m
Sheet No: 1 of 1

Overplot Item: ● Ueq ● Assumed Ueq ◁ Dissipation, Ueq achieved ◁ Dissipation, Ueq not achieved — Hydrostatic Line

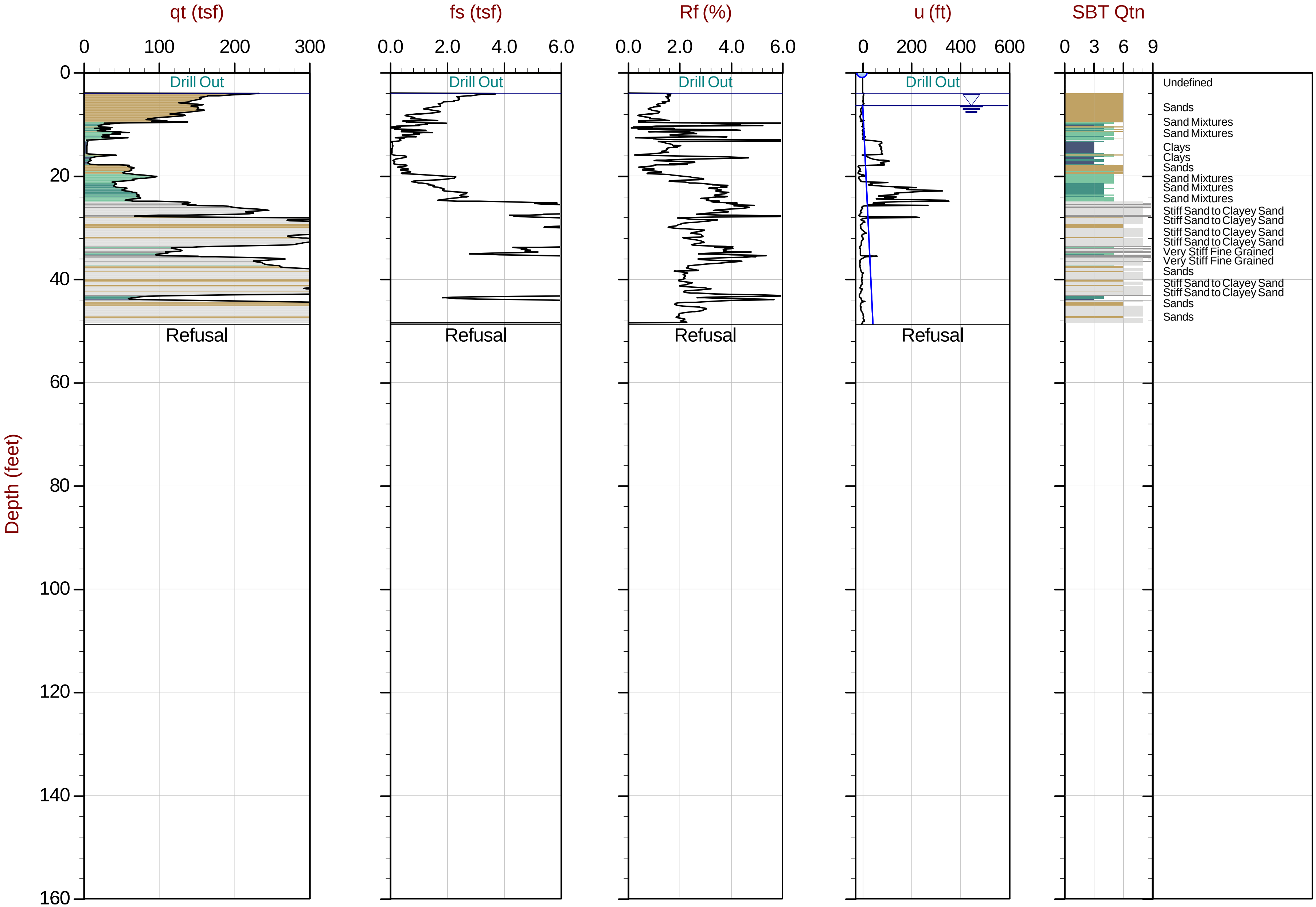
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

ENGEO

Job No: 19-56005
Date: 2019-01-15 14:15
Site: Howard Terminal

Sounding: 1-CPT-06
Cone: 488:T1500F15U500



Max Depth: 14.850 m / 48.72 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 19-56005_CP06.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: UTM 10N N: 4183469m E: 562799m
Sheet No: 1 of 1

Overplot Item: ● Ueq ● Assumed Ueq ◁ Dissipation, Ueq achieved ◁ Dissipation, Ueq not achieved — Hydrostatic Line

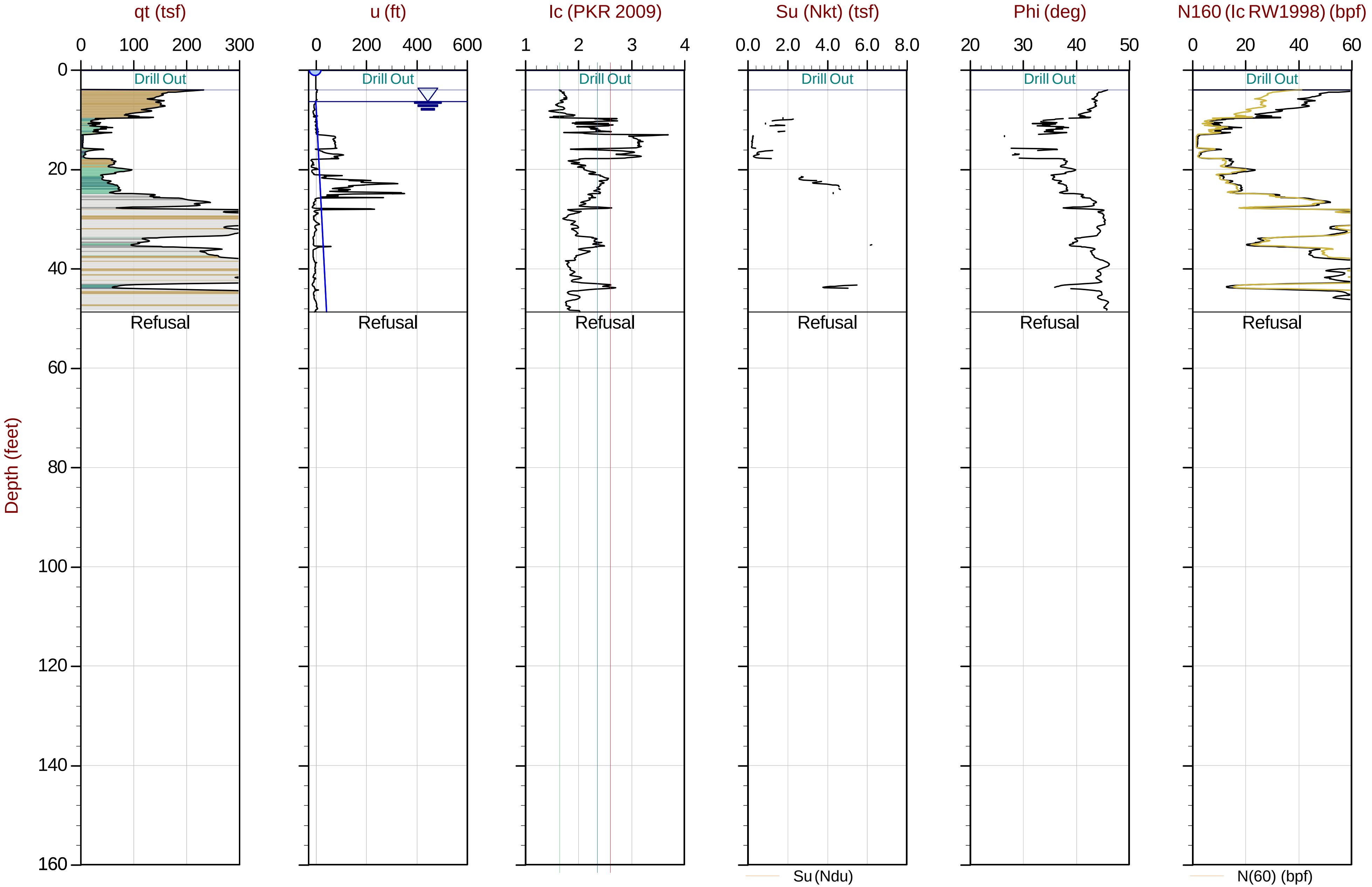
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

ENGEO

Job No: 19-56005
Date: 2019-01-15 14:15
Site: Howard Terminal

Sounding: 1-CPT-06
Cone: 488:T1500F15U500



Max Depth: 14.850 m / 48.72 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 19-56005_CP06.COR
Unit Wt: SBTQtn (PKR2009)
Su Nkt: 15.0

SBT: Robertson, 2009 and 2010
Coords: UTM 10 N N: 4183469m E: 562799m
Sheet No: 1 of 1

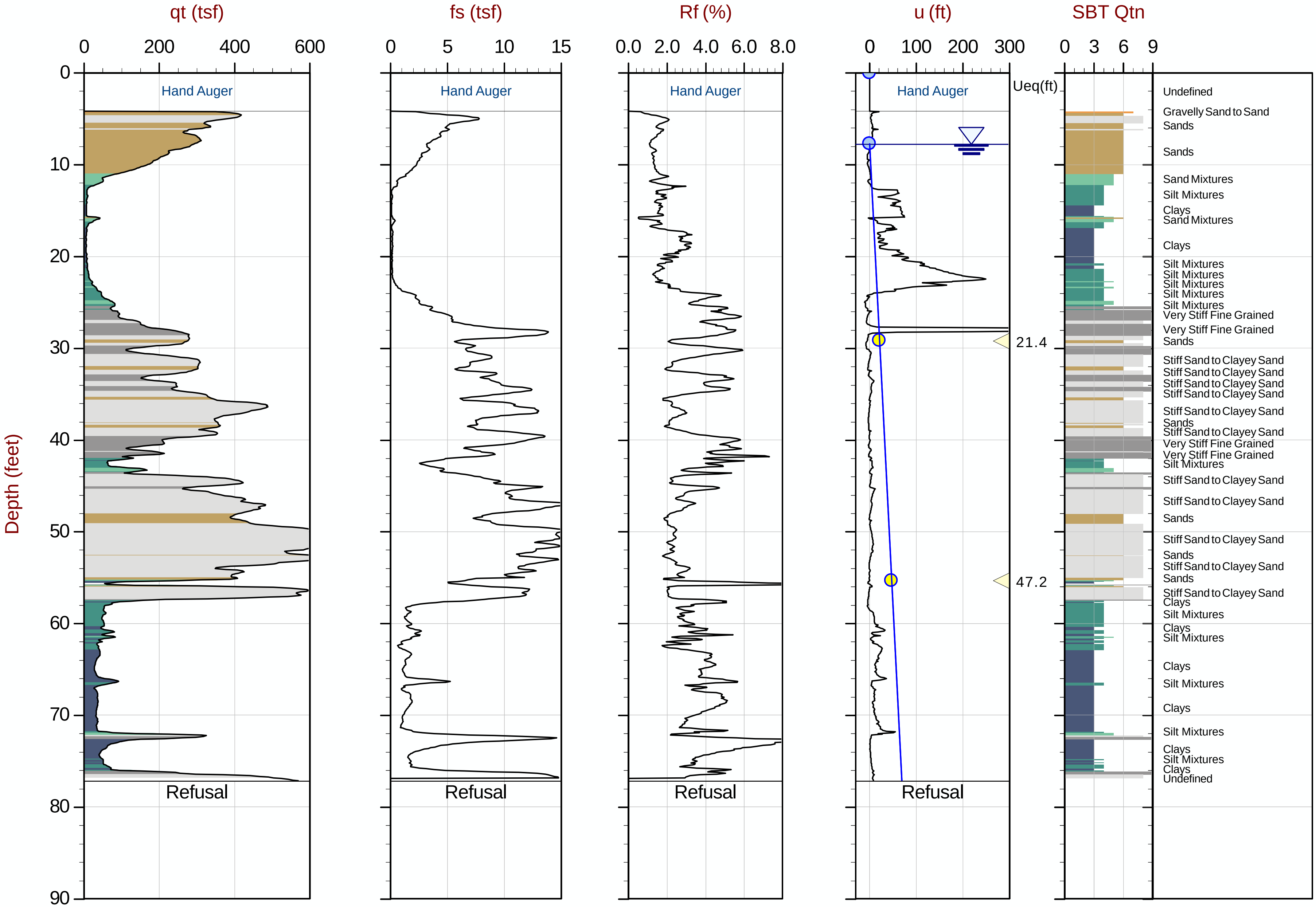
Overplot Item: ● Ueq ● Assumed Ueq ◁ Dissipation, Ueq achieved ◁ Dissipation, Ueq not achieved — Hydrostatic Line

The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

Slate Geotechnical

Job No: 23-56-26740
Date: 2023-10-24 10:49
Site: Oakland Turning Basin Widening

Sounding: CPT-01
Cone: 964:T1500F15U35 (15 cm²)



Max Depth: 23.525 m / 77.18 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 23-56-26740_CP01.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: UTM Zone 10 North N: 4183391 m E: 562725 m
Sheet No: 1 of 1

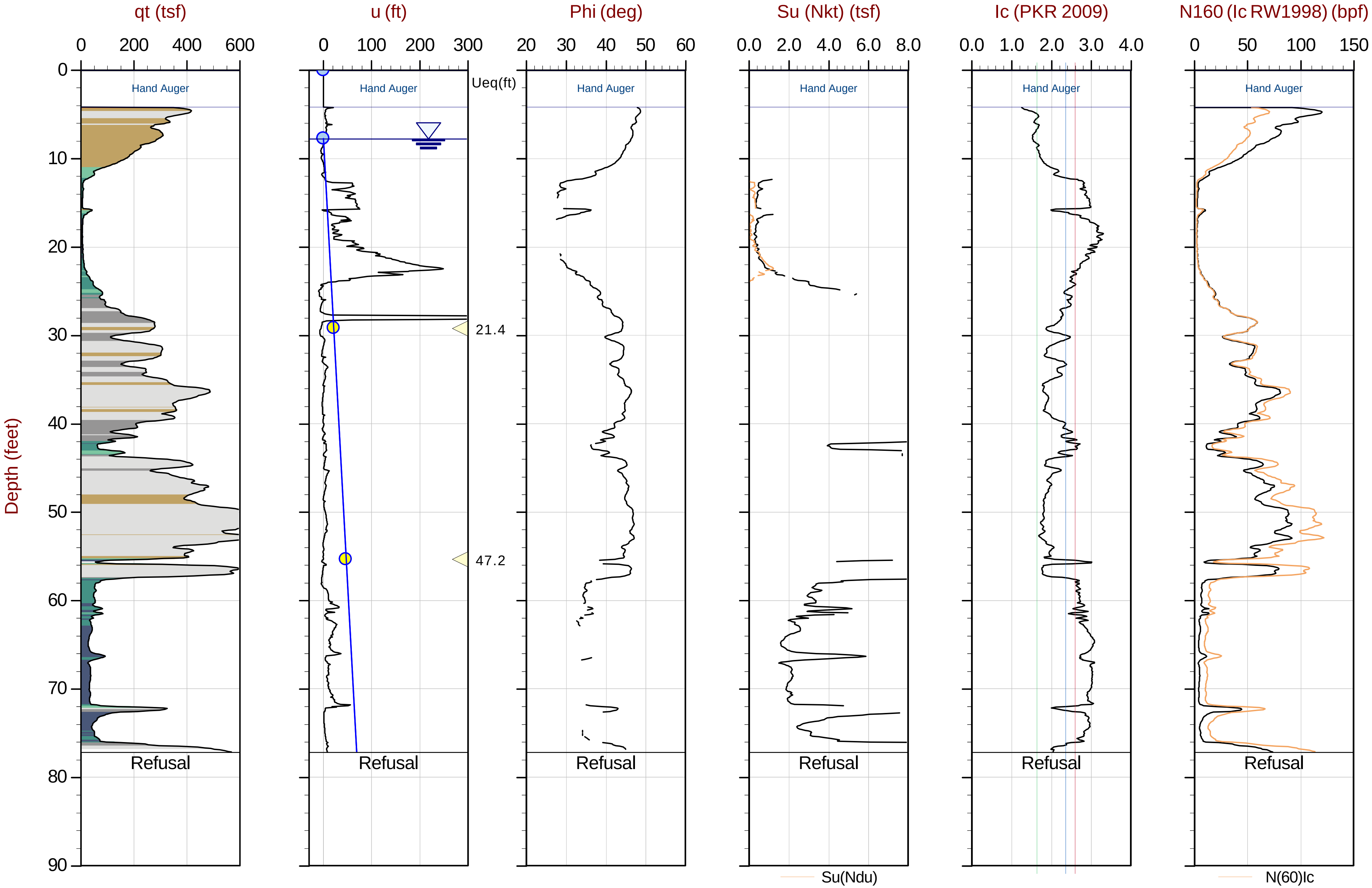
Overplot Item: ● Ueq ● Assumed Ueq ◁ Dissipation, Ueq achieved ◁ Dissipation, Ueq not achieved ◁ Dissipation, Ueq assumed — Hydrostatic Line

The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

Slate Geotechnical

Job No: 23-56-26740
Date: 2023-10-24 10:49
Site: Oakland Turning Basin Widening

Sounding: CPT-01
Cone: 964:T1500F15U35 (15 cm²)



Max Depth: 23.525 m / 77.18 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 23-56-26740_CP01.COR
Unit Wt: SBTQtn (PKR2009)
Su Nkt/Ndu: 15.0 / 6.0

SBT: Robertson, 2009 and 2010
Coords: UTM Zone 10 North N: 4183391 m E: 562725 m

Overplot Item: ● Ueq ● Assumed Ueq ◁ Dissipation, Ueq achieved ◁ Dissipation, Ueq not achieved ◁ Dissipation, Ueq assumed — Hydrostatic Line

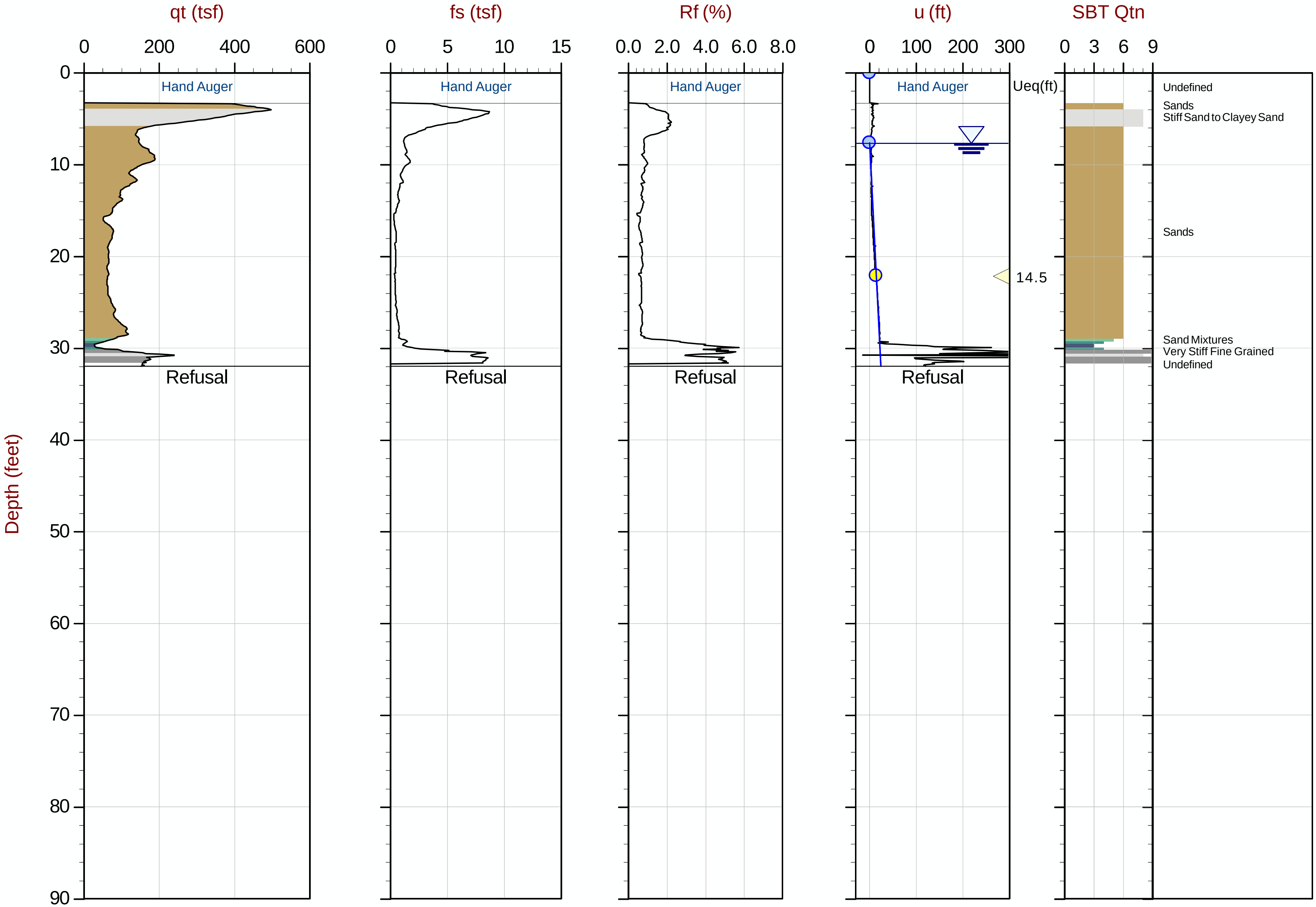
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Slate Geotechnical

Job No: 23-56-26740
Date: 2023-10-23 12:17
Site: Oakland Turning Basin Widening

Sounding: CPT-02
Cone: 964:T1500F15U35 (15 cm²)



Max Depth: 9.750 m / 31.99 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 23-56-26740_CP02.COR
Unit Wt: SBTQtn (PKR2009)

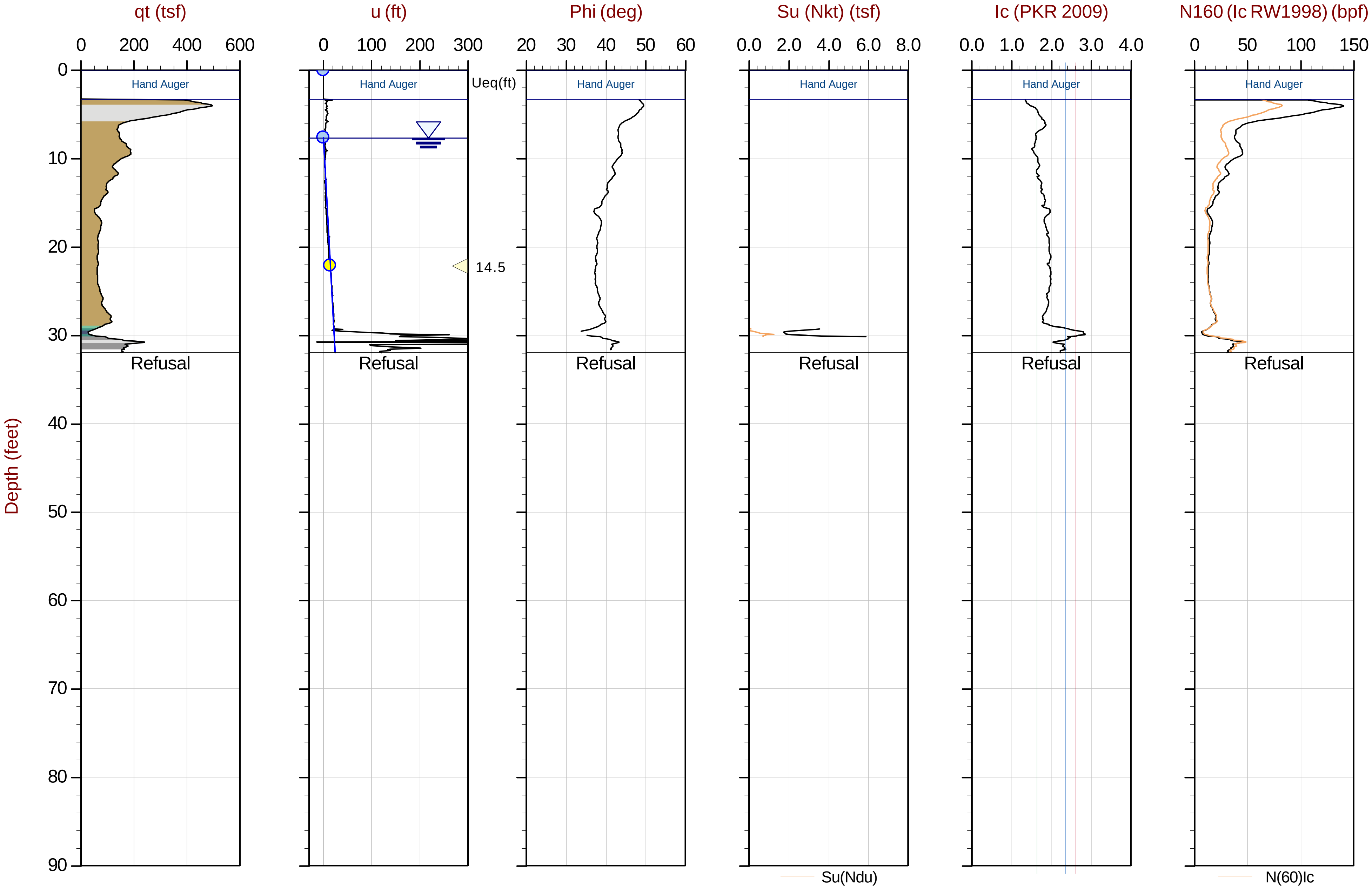
SBT: Robertson, 2009 and 2010
Coords: UTM Zone 10 North N: 4183380 m E: 562776 m
Sheet No: 1 of 1

Overplot Item: ● Ueq ● Assumed Ueq ◁ Dissipation, Ueq achieved ◁ Dissipation, Ueq not achieved ◁ Dissipation, Ueq assumed — Hydrostatic Line

The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

Slate Geotechnical

Job No: 23-56-26740
Date: 2023-10-23 12:17
Site: Oakland Turning Basin Widening
Sounding: CPT-02
Cone: 964:T1500F15U35 (15 cm²)



Max Depth: 9.750 m / 31.99 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 23-56-26740_CP02.COR
Unit Wt: SBTQtn (PKR2009)
Su Nkt/Ndu: 15.0 / 6.0

SBT: Robertson, 2009 and 2010
Coords: UTM Zone 10 North N: 4183380 m E: 562776 m

Overplot Item: ● Ueq ● Assumed Ueq ◁ Dissipation, Ueq achieved ◁ Dissipation, Ueq not achieved ◁ Dissipation, Ueq assumed — Hydrostatic Line

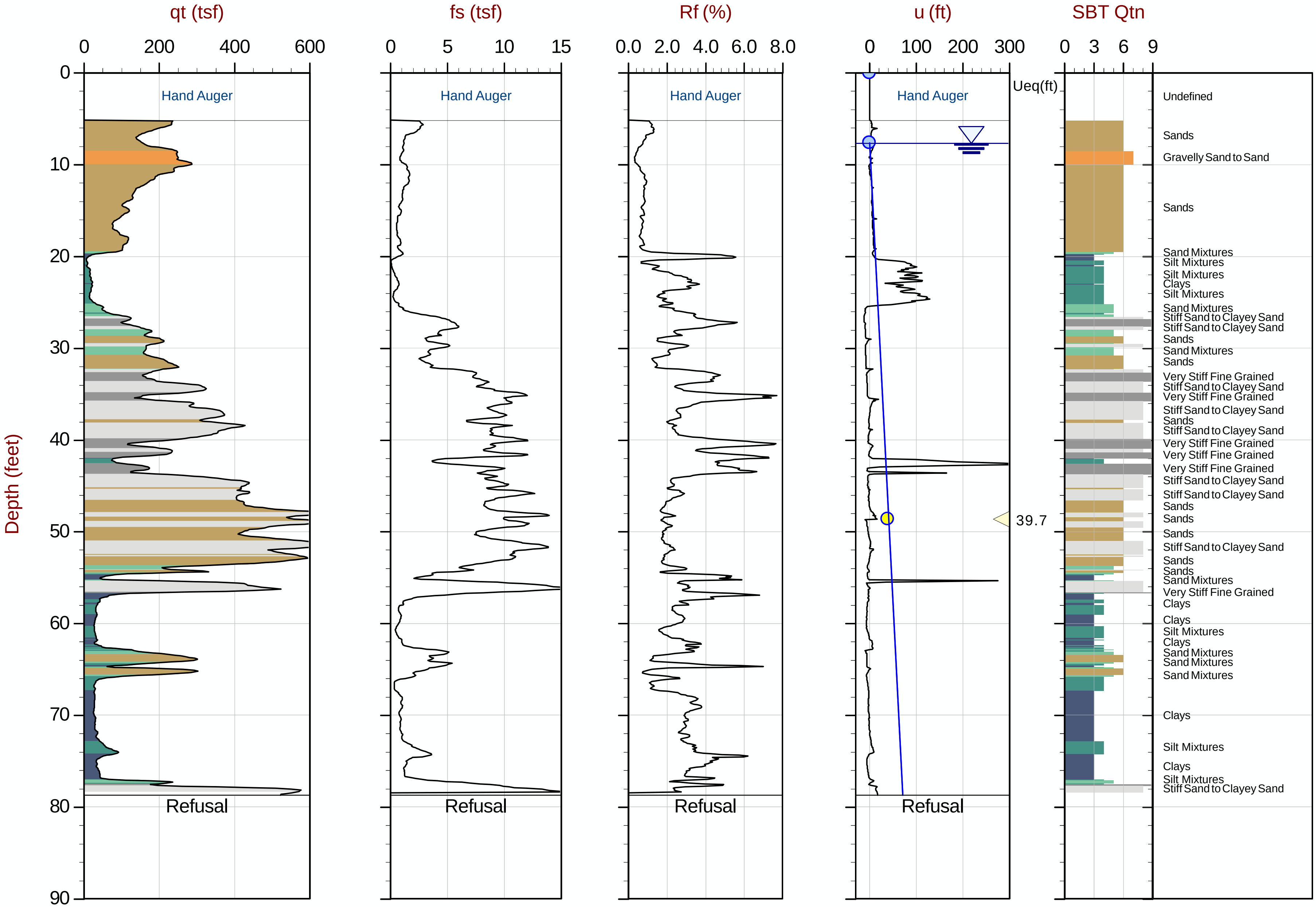
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Slate Geotechnical

Job No: 23-56-26740
Date: 2023-10-23 13:39
Site: Oakland Turning Basin Widening

Sounding: CPT-02B
Cone: 964:T1500F15U35 (15 cm²)



Max Depth: 24.000 m / 78.74 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 23-56-26740_CP02B.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: UTM Zone 10 North N: 4183382 m E: 562784 m
Sheet No: 1 of 1

Overplot Item: ● Ueq ● Assumed Ueq ◁ Dissipation, Ueq achieved ◁ Dissipation, Ueq not achieved ◁ Dissipation, Ueq assumed — Hydrostatic Line

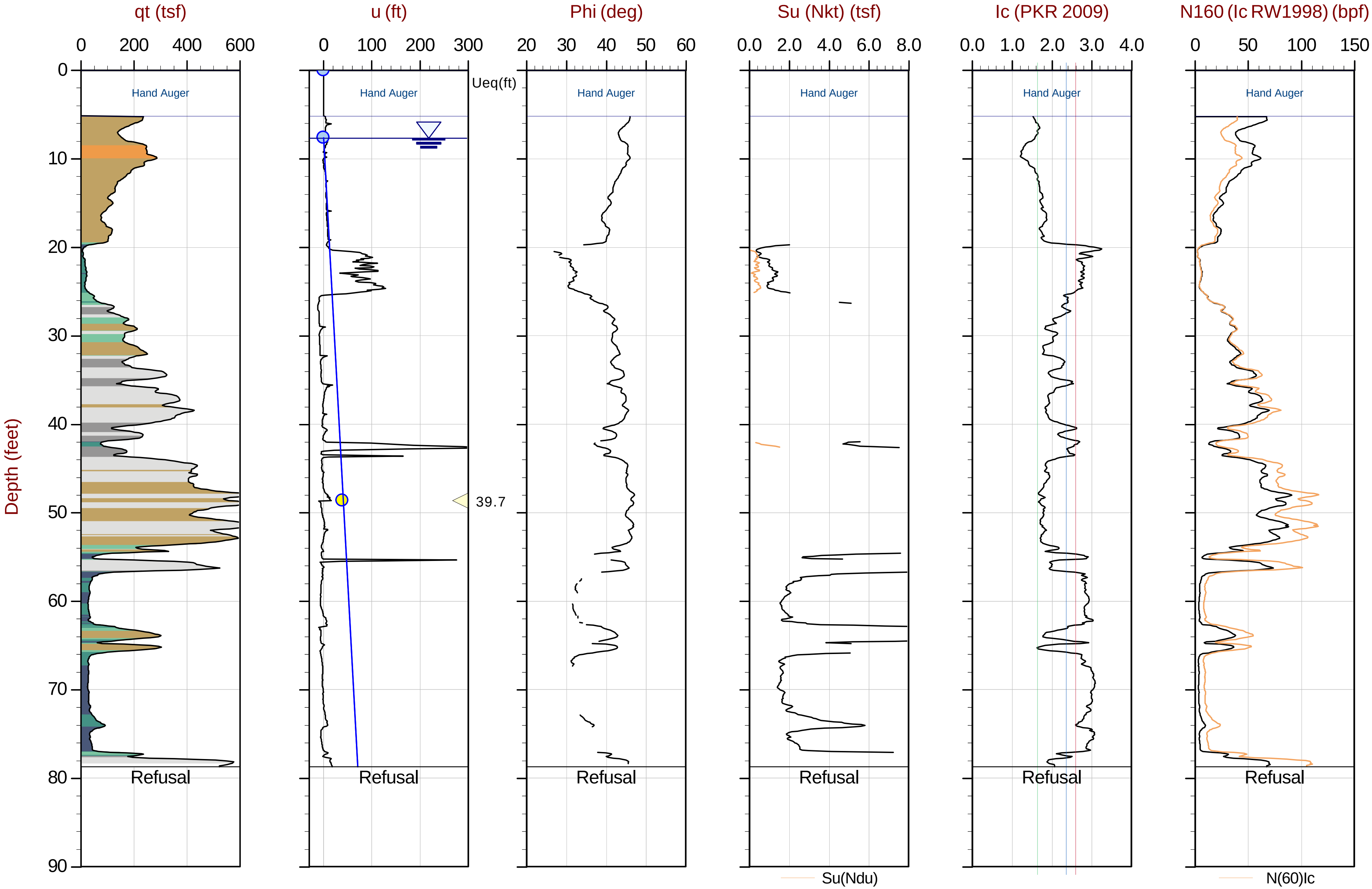
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Slate Geotechnical

Job No: 23-56-26740
Date: 2023-10-23 13:39
Site: Oakland Turning Basin Widening

Sounding: CPT-02B
Cone: 964:T1500F15U35 (15 cm²)



Max Depth: 24.000 m / 78.74 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 23-56-26740_CP02B.COR
Unit Wt: SBTQtn (PKR2009)
Su Nkt/Ndu: 15.0 / 6.0

SBT: Robertson, 2009 and 2010
Coords: UTM Zone 10 North N: 4183382 m E: 562784 m

Overplot Item: ● Ueq ● Assumed Ueq ◁ Dissipation, Ueq achieved ◁ Dissipation, Ueq not achieved ◁ Dissipation, Ueq assumed — Hydrostatic Line

The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Slate Geotechnical

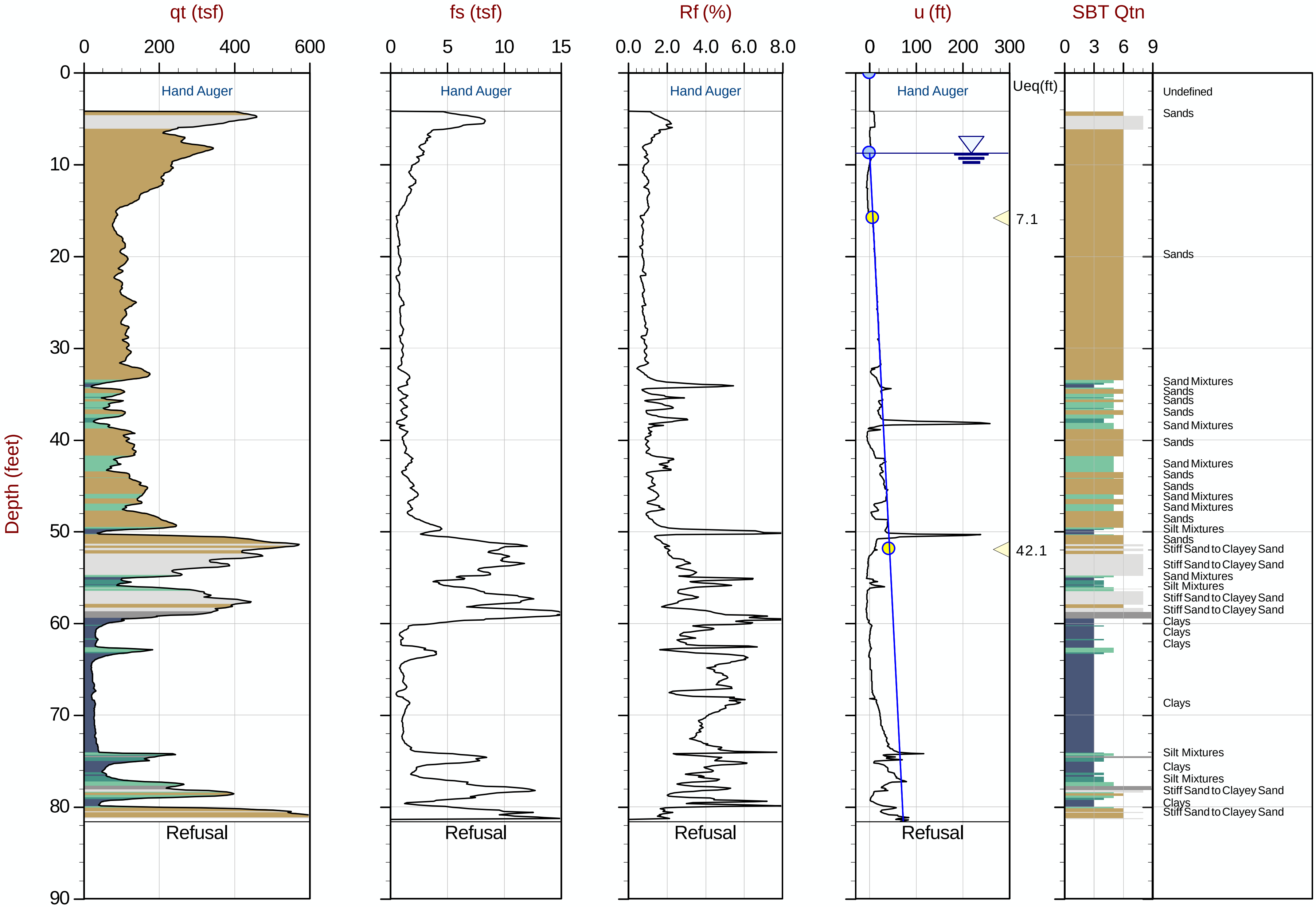
Job No: 23-56-26740

Date: 2023-10-23 09:19

Site: Oakland Turning Basin Widening

Sounding: SCPT-03

Cone: 964:T1500F15U35 (15 cm²)



Max Depth: 24.875 m / 81.61 ft

Depth Inc: 0.025 m / 0.082 ft

Avg Int: Every Point

File: 23-56-26740_SP03.COR

Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010

Coords: UTM Zone 10 North N: 4183363 m E: 562847 m

Sheet No: 1 of 1

Overplot Item: ● Ueq ● Assumed Ueq ◁ Dissipation, Ueq achieved ◁ Dissipation, Ueq not achieved ◁ Dissipation, Ueq assumed — Hydrostatic Line

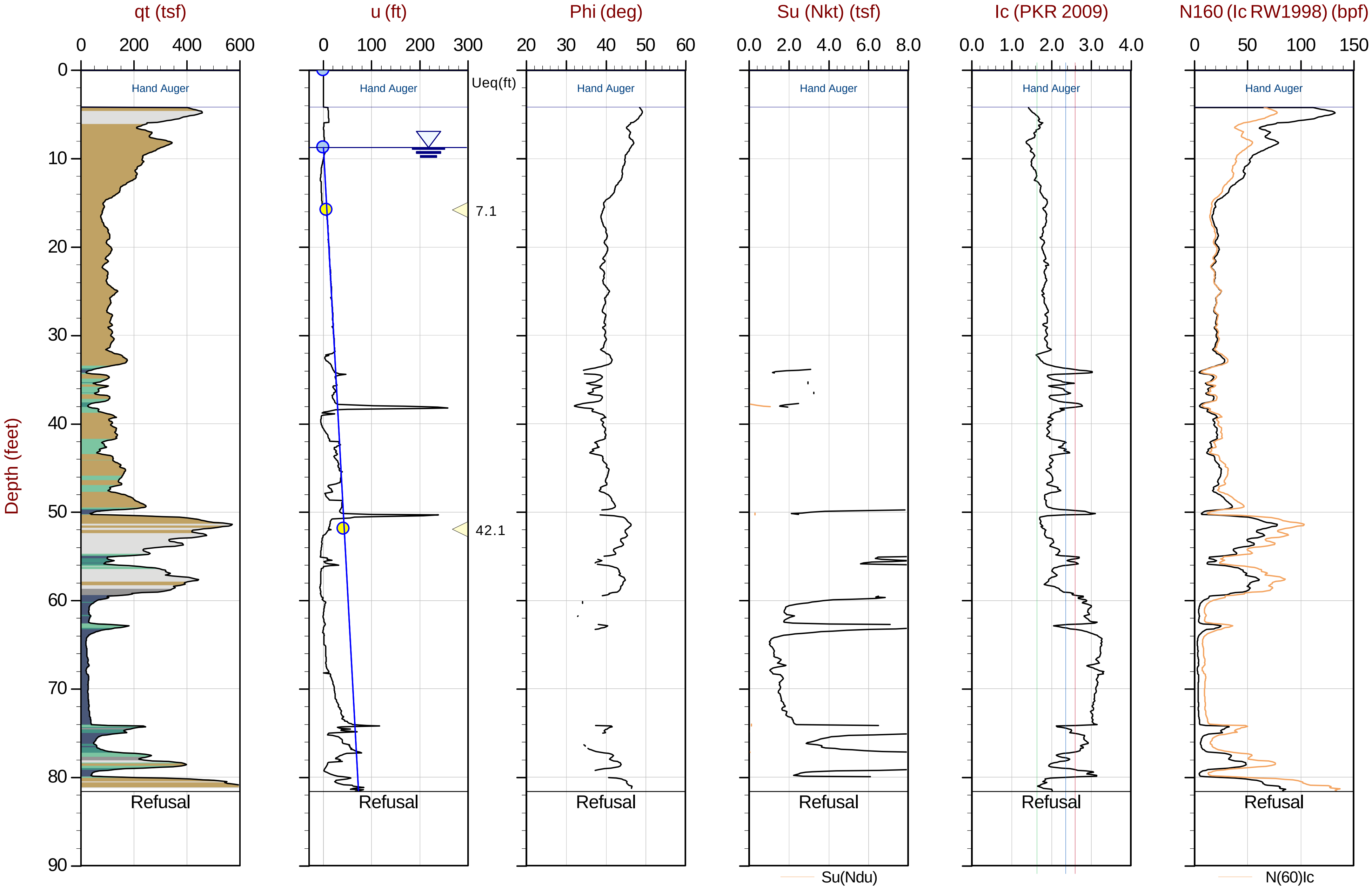
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Slate Geotechnical

Job No: 23-56-26740
Date: 2023-10-23 09:19
Site: Oakland Turning Basin Widening

Sounding: SCPT-03
Cone: 964:T1500F15U35 (15 cm²)



Max Depth: 24.875 m / 81.61 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 23-56-26740_SP03.COR
Unit Wt: SBTQtn (PKR2009)
Su Nkt/Ndu: 15.0 / 6.0

SBT: Robertson, 2009 and 2010
Coords: UTM Zone 10 North N: 4183363 m E: 562847 m

Overplot Item: ● Ueq ● Assumed Ueq ◁ Dissipation, Ueq achieved ◁ Dissipation, Ueq not achieved ◁ Dissipation, Ueq assumed — Hydrostatic Line

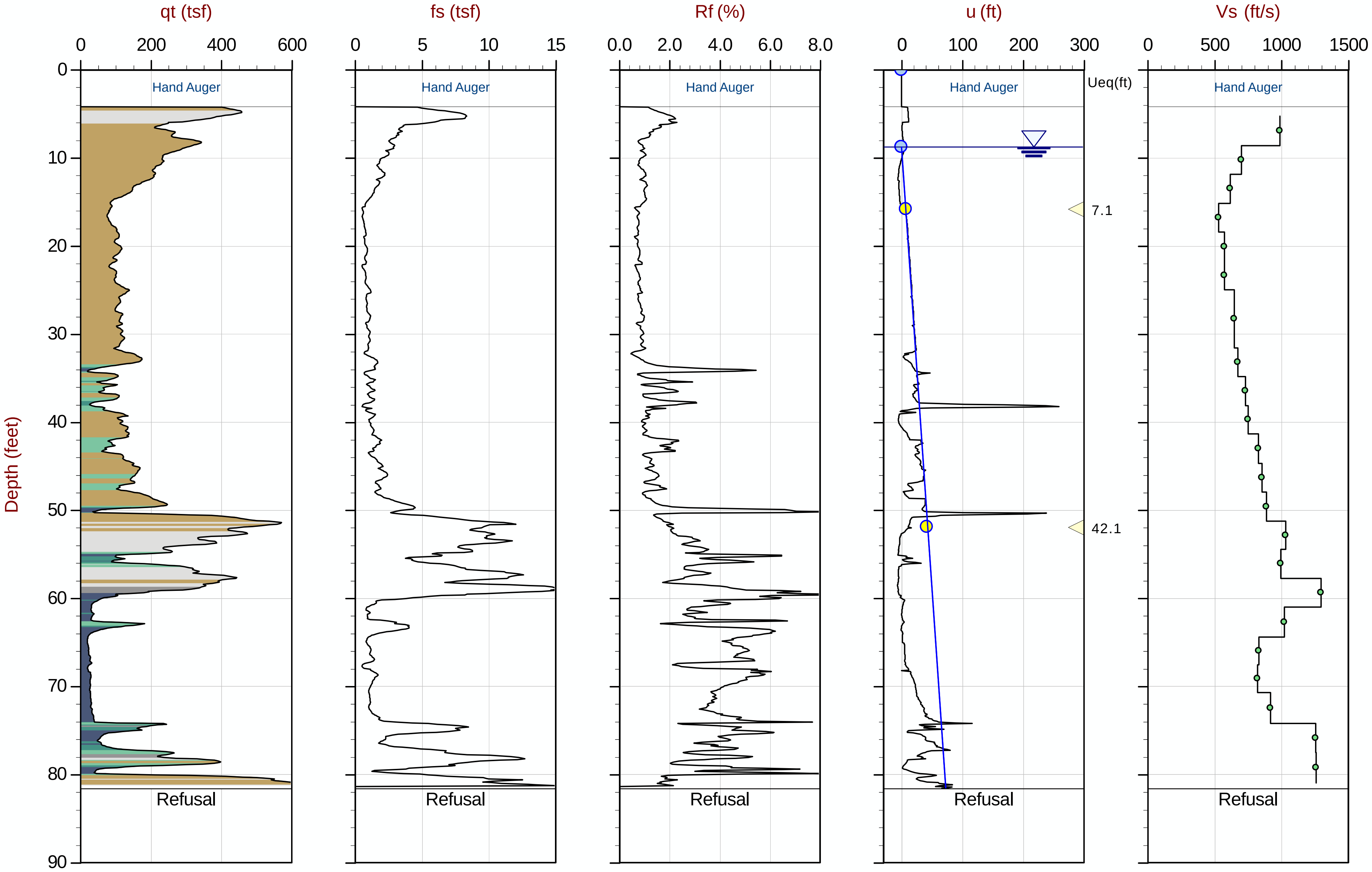
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Slate Geotechnical

Job No: 23-56-26740
Date: 2023-10-23 09:19
Site: Oakland Turning Basin Widening

Sounding: SCPT-03
Cone: 964:T1500F15U35 (15 cm²)



Max Depth: 24.875 m / 81.61 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 23-56-26740_SP03.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: UTM Zone 10 North N: 4183363 m E: 562847 m
Sheet No: 1 of 1

Overplot Item: ● Ueq ● Assumed Ueq ◁ Dissipation, Ueq achieved ◁ Dissipation, Ueq not achieved ◁ Dissipation, Ueq assumed — Hydrostatic Line

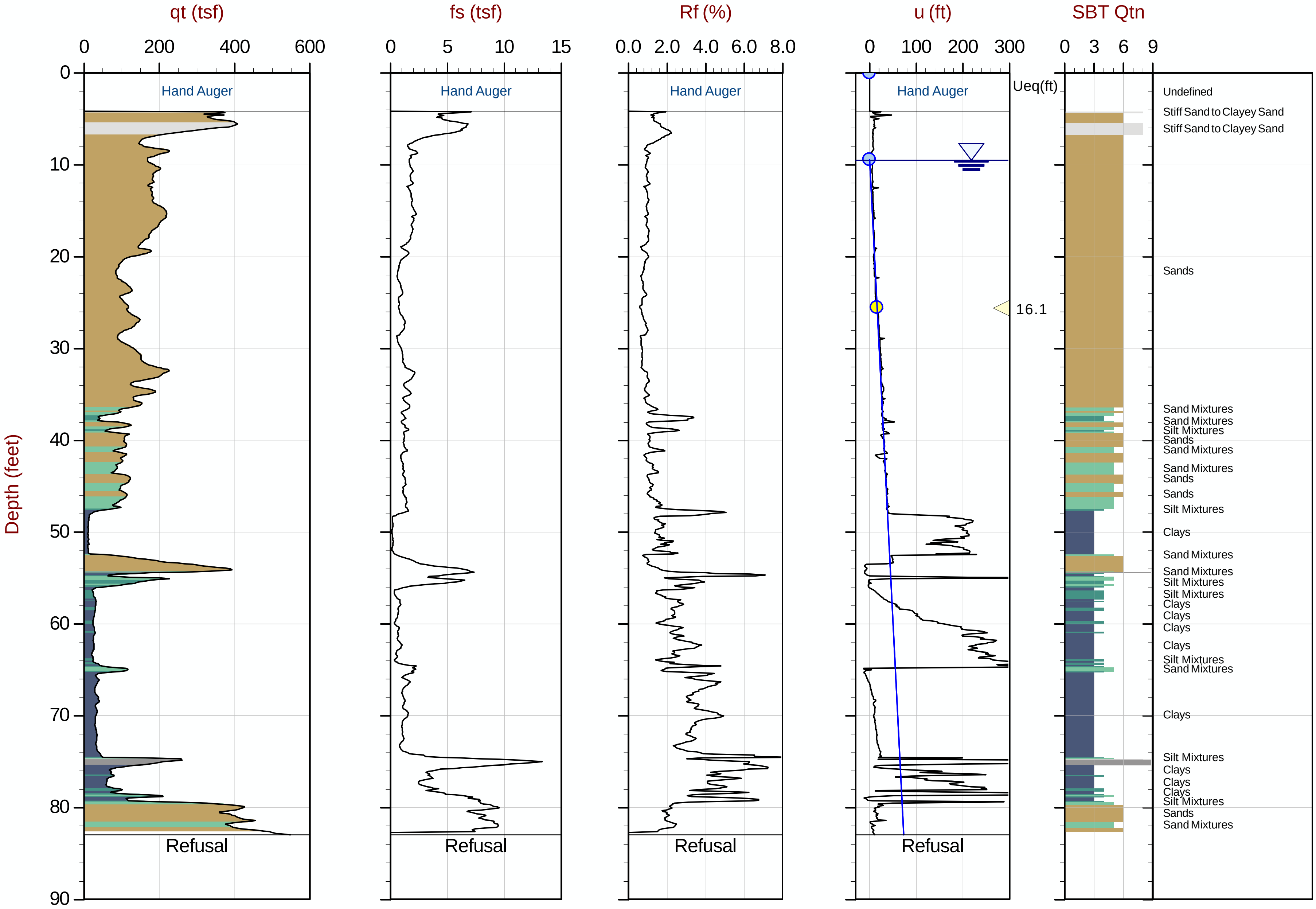
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Slate Geotechnical

Job No: 23-56-26740
Date: 2023-10-24 08:27
Site: Oakland Turning Basin Widening

Sounding: CPT-04
Cone: 964:T1500F15U35 (15 cm²)



Max Depth: 25.300 m / 83.00 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 23-56-26740_CP04.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: UTM Zone 10 North N: 4183347 m E: 562891 m
Sheet No: 1 of 1

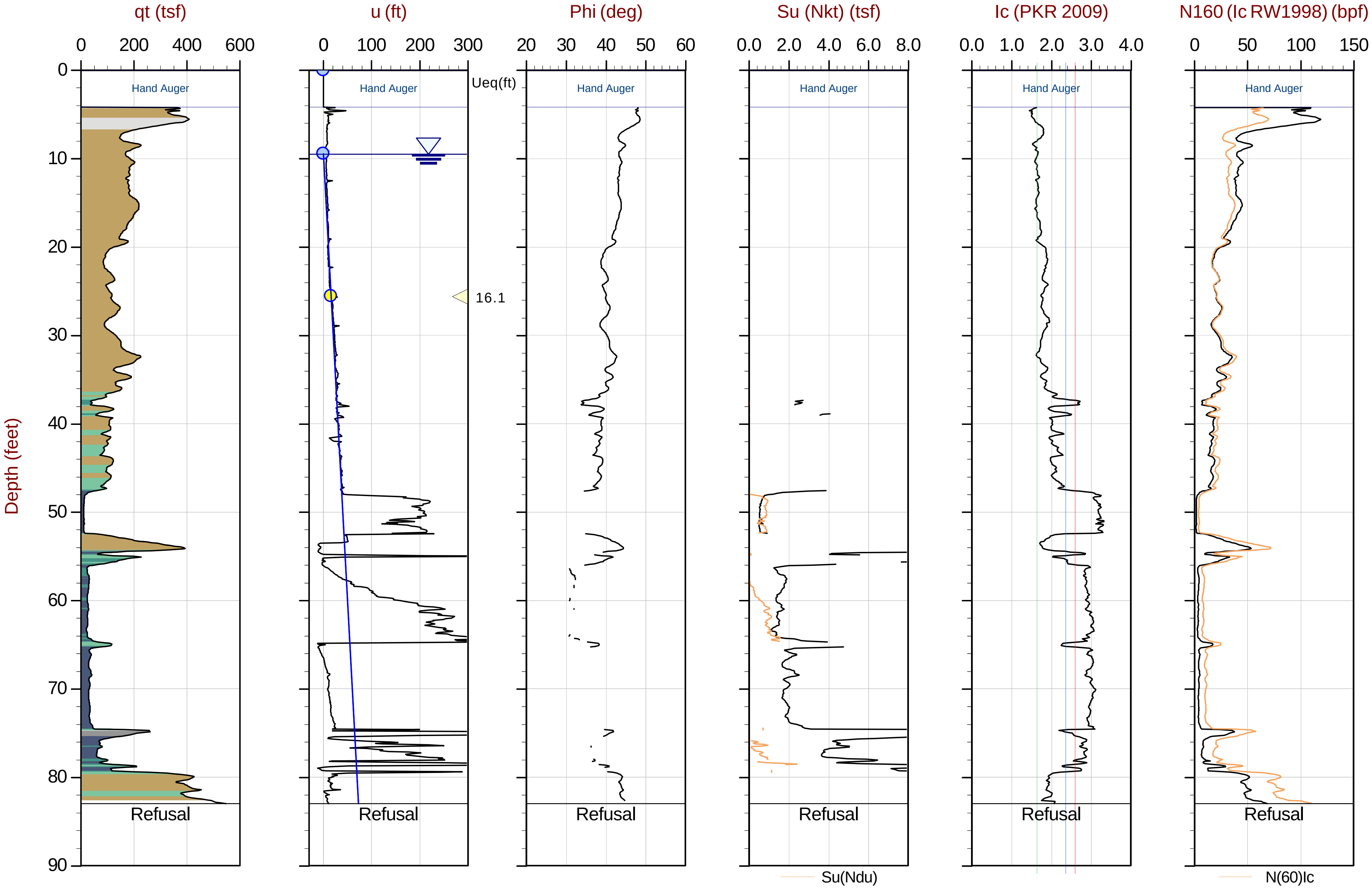
Overplot Item: ● Ueq ● Assumed Ueq ◁ Dissipation, Ueq achieved ◁ Dissipation, Ueq not achieved ◁ Dissipation, Ueq assumed — Hydrostatic Line

The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

Slate Geotechnical

Job No: 23-56-26740
Date: 2023-10-24 08:27
Site: Oakland Turning Basin Widening

Sounding: CPT-04
Cone: 964:T1500F15U35 (15 cm²)



Max Depth: 25.300 m / 83.00 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 23-56-26740_CP04.COR
Unit Wt: SBTQtn (PKR2009)
Su Nkt/Ndu: 15.0 / 6.0

SBT: Robertson, 2009 and 2010
Coords: UTM Zone 10 North N: 4183347 m E: 562891 m

Overplot Item: ● Ueq ● Assumed Ueq ◁ Dissipation, Ueq achieved ◁ Dissipation, Ueq not achieved ◁ Dissipation, Ueq assumed — Hydrostatic Line

The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.