US Army Corps of Engineers®

# OAKLAND HARBOR TURNING BASINS WIDENING, CA

## NAVIGATION STUDY

## DRAFT INTEGRATED FEASIBILITY REPORT & ENVIRONMENTAL ASSESSMENT

# APPENDIX B1:

# Channel Design

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# 1. Introduction

The US Army Corps of Engineers (USACE) San Francisco District (SPN) has partnered with Port of Oakland to develop measures to improve the operational efficiency of vessels in the federal navigation channels. This channel design appendix documents the assumptions, methodologies, and analyses that led to the tentative selected plan (TSP).

The alternative analysis process and selection of the proposed TSP starts with a review of the existing information, such as as-built plans, surveys, maps, etc. Some of the existing data were verified during a reconnaissance on 24 August 2021. Because of limited funding and tight schedule from the 3x3x3 constraint, no new tests or surveys were performed at this stage of the study. Therefore, existing data along with design assumptions are used in this study.

During the planning stage, eight proposed variations (footprints), Variations 1 to 6 for Inner Harbor, and Variations 7 and 8 for Outer Harbor, were developed. Variations 3 and 8 are considered in the alternatives for the tentative selected plan (TSP) as described in this appendix. The eliminated variations are also described in the Eliminated Variations section of the appendix.

Variation 3 minimized the total amount of land impacted, but it requires excavation of land in Alameda, Howard Terminal, and Schnitzer Steel. It was ultimately selected because it impacted the least amount of land compared to the other Inner Harbor variations. Variation 8 of the Outer Harbor followed the existing turning basin. It was selected, because it impacted less underwater excavation area compared to Variation 7 of the Outer Harbor. The cross sections of the existing grades demolition work and proposed work of the proposed variations are also shown in this appendix.

# 2. Project Area Description

The Port of Oakland and the Oakland Inner and Outer Harbors are located on the eastern side of the San Francisco Bay in Alameda County, California. They are approximately 4 miles east of downtown San Francisco. The Outer Harbor is located directly south of the San Francisco-Oakland Bay Bridge and the Inner Harbor is located between the cities of Alameda and Oakland.

## 2.1. Existing Outer Harbor Turning Basin

The Oakland Outer Harbor turning basin is located at a bend of the Outer Harbor channel near berths 25 through 30. The existing outer turning basin has a turning diameter of 1,650 ft with a maintained depth of -50 ft by dredging annually. For the study area location map, please see Figure 1. Figure 1 came from Appendix B4 Coastal Engineering.

## 2.2. Existing Inner Harbor Turning Basin

The Oakland Inner Harbor turning basin is located approximately 18,000 ft to the east of the Oakland Harbor entrance. The existing inner turning basin has a turning diameter of 1,500 ft with a maintained depth of -50 ft by dredging annually. Overall, the edge of the land area (Howard Terminal, Schnitzer and Alameda) is mainly supported by piles with bulkheading. There are cranes in Howard Terminal. For the study area location map, please see Figure 1.

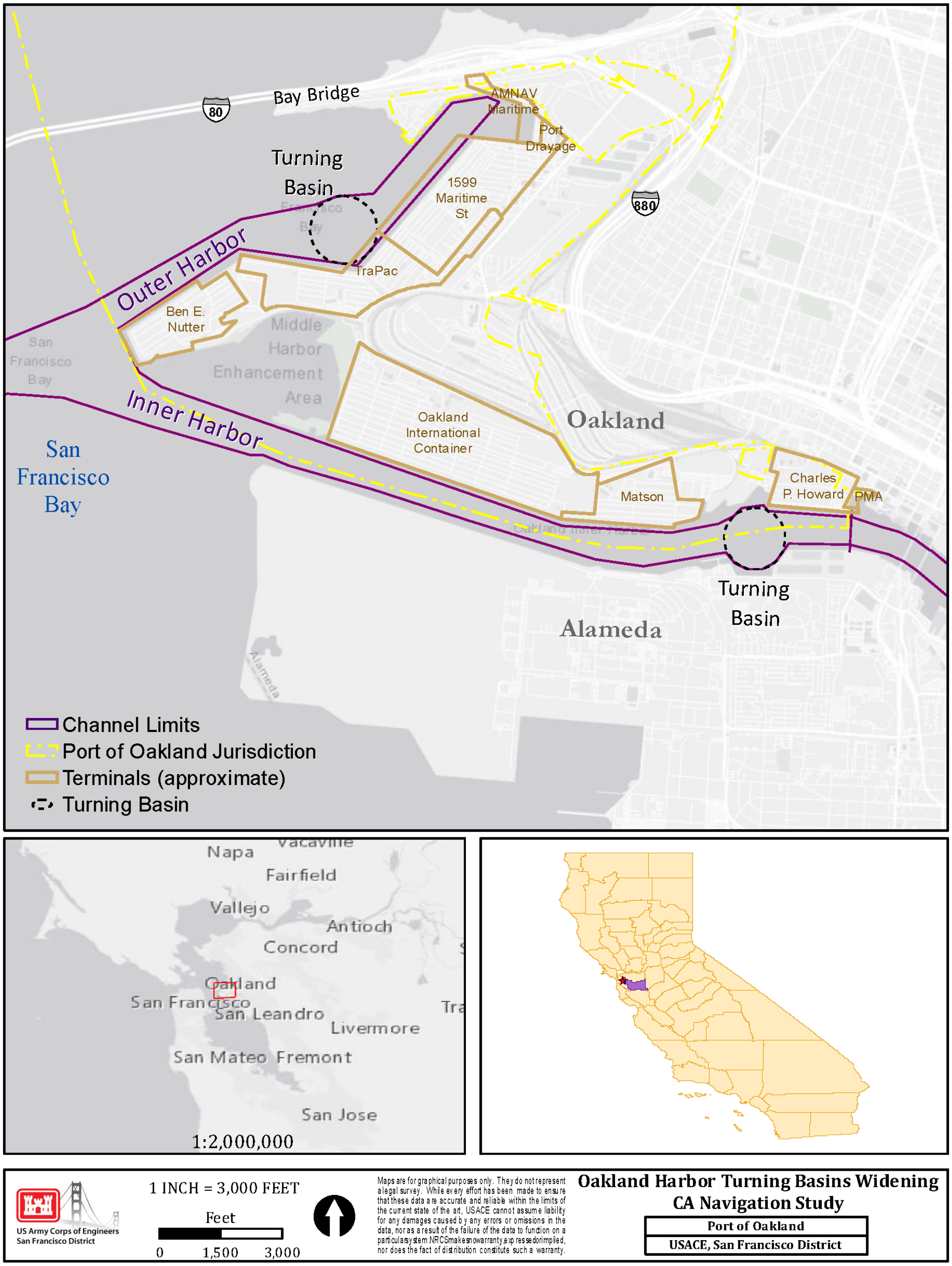



*Figure 1: Project Location*

# 3. Surveying, Mapping, and Other Geospatial Data

## 3.1. Surveys

As the study phase and preliminary designs progressed, the following existing surveys and existing cross sections was used and compared to create the existing condition of the project area.

- The hydrographic survey inside the channel limit, consisting of cross sections was performed in 2020 by SPN from the annual dredging program,
- 2007 topographic LiDAR survey on the land side was provided by Alameda County Public Works Agency,
- Port of Oakland's Geotechnical Investigation Oakland Harbor Navigation Improvement (-50 Foot) Project Final Report (Port of Oakland,1999), prepared by SCI; and,
- As-Built drawings provided by the Port of Oakland (Port of Oakland, 1980) (Port of Oakland, 1981).

During the Preconstruction Engineering & Design (PED) phase, new hydrographic and topographic surveys should be performed to improve the accuracy of the existing condition, which is needed to refine quantities, and prepare plans and specifications for construction.

## 3.2. Maps

Google Earth and ArcGIS Maps were used during the initial and plan formulation phases. Aerial Google Map was converted and used for drawings and analyses.

## 3.3. Datum

### 3.3.1. Horizontal

The Alameda County Public Works Agency LiDAR dataset for the Civil 3D surface model used the North American Datum of 1983 (NAD 83) NAD83 California State Plane Zone III (U.S. Survey feet).

### 3.3.2. Vertical

The Alameda County Public Works Agency LiDAR dataset used the North American Vertical Datum of 1988 (NAVD88). The vertical datum of Mean Lower Low Water (MLLW) was used for calculating new work volumes.

### 3.3.3. Vertical Datum Comparison

Multiple ground surface evaluations were acquired from different sources (County, as-built plans, and USGS data). For example, in Howard Terminal, the existing County LiDAR survey and SPN bathymetric survey were first used to create a surface model in Autodesk AutoCAD Civil 3D. The surface model was then used for comparison with as-built plans (Figure 2), USGS data (Figure 3) and SCI Geotechnical Investigation Report (Port of Oakland, 1999). After comparison, information from as-built plans and SCI Geotechnical Investigation Report, along with subjective judgement from experts, was incorporated into the model and ultimately used for calculating the quantities of the measures in the alternatives. The difference between the different sources is within 3 feet. This may be due to the change of existing condition and survey accuracy. Because the difference is relatively small compared to the overall size of the project, no new topographic survey was conducted at this planning stage of the project.

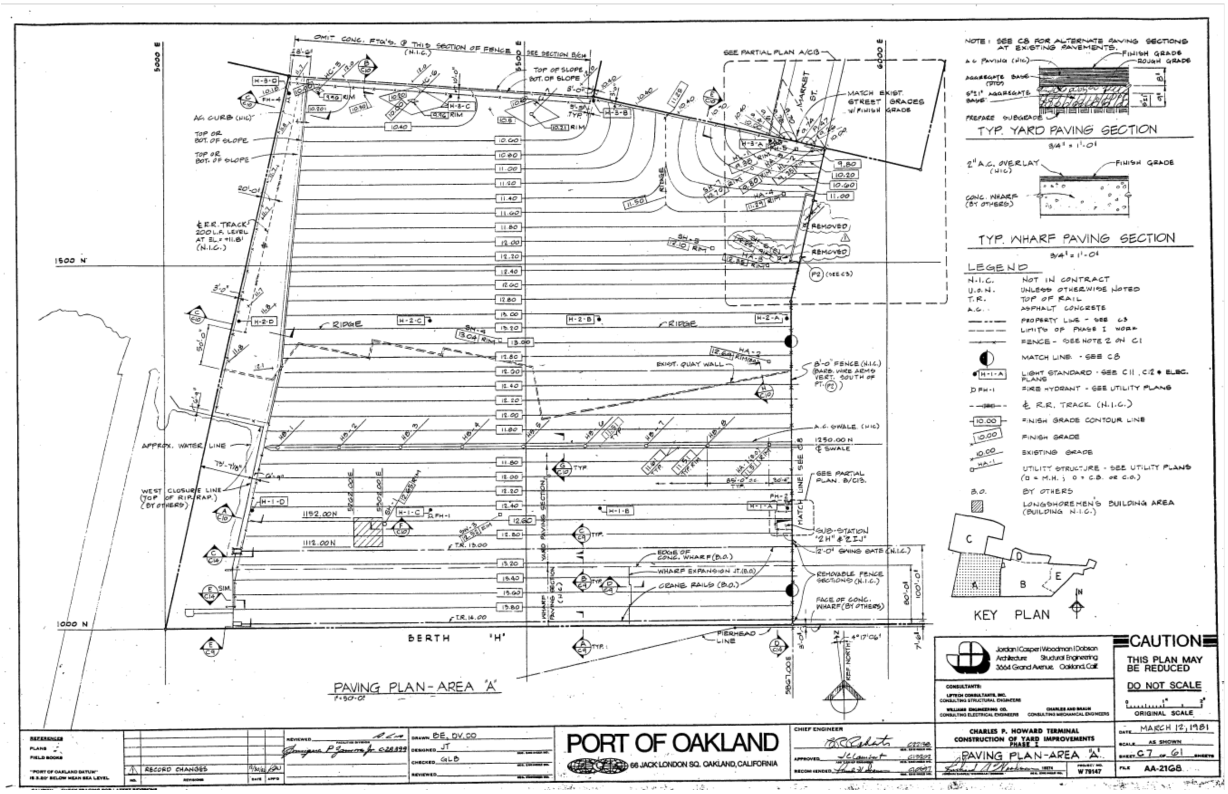


*Figure 2: Sheet C-7 of Howard Terminal Yard As-Built Drawings (AA-2168) shows elevations of wharf deck and backlands pavement.*

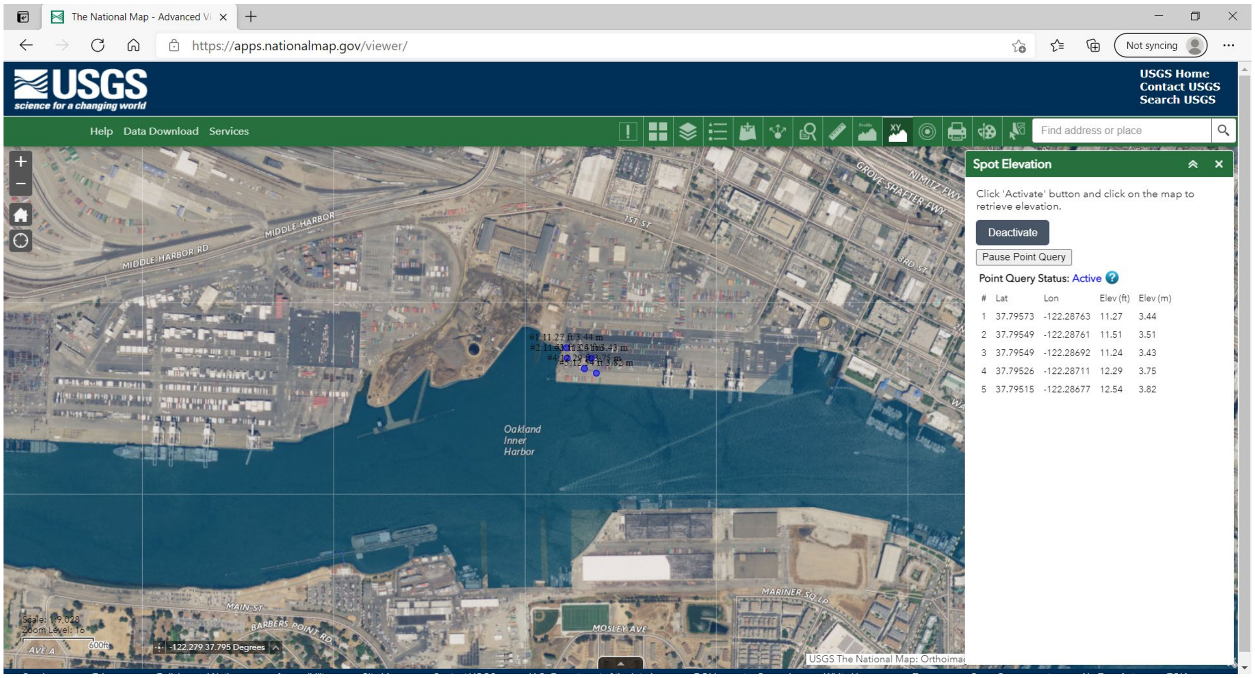



*Figure 3:Elevation spot check in Howard Terminal (USGS)*

# 4. Design Considerations

## 4.1. Field Reconnaissance Verification of Existing Conditions

The reconnaissance was conducted on 24 August 2021 with Port of Oakland representatives. The main purpose of the reconnaissance was to observe the areas which will be affected by the basin widening, verify the information on the as-built drawings for the project locations, and confirm what other demolition and excavation work may be needed as the project proceeds.

### 4.1.1. Howard Terminal

The first location of the reconnaissance was at Howard Terminal. The Terminal ground surface is covered by asphalt pavement. Upon further observation, the asphalt concrete (finish grade) was supported by the concrete wharf (see Figure 4). The evidence shown in Figure 4 reflected the typical wharf paving section in Sheet C7 of Charles P. Howard Terminal Construction of Yard Improvements Phase I (Port of Oakland, 1981). Measurements were taken to verify the offset of 100 ft from the face of the wharf. The Team verified the reinforced concrete piles holding up the wharf were approximately 24" in diameter. As it was low tide, the condition of the piles as well as the rip rap on the rock dike were observed (see Figure 5). The evidence shown in Figure 5 reflected multiple sheets (C-8, C-13, etc.) of the Charles P. Howard Terminal Construction of Dike, Fill, and Concrete Wharf as-built plans (Port of Oakland, 1980).

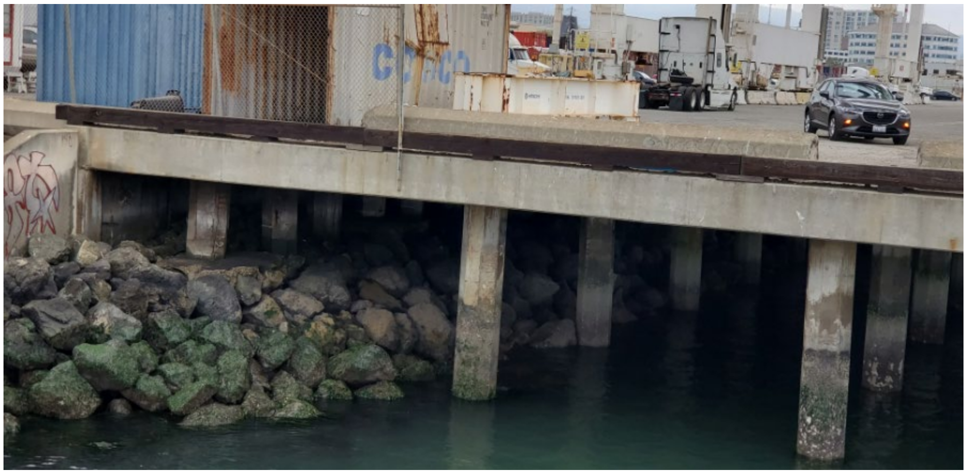


*Figure 4: Typical Wharf Paving Section - Howard Terminal*

*Figure 5: Rip-rap on the Rock Dike - Howard Terminal*

SPN Civil Design PDT verified the as-builts and existing dimensions were close in approximate measurement. A potential obstruction for the project included utility light poles (see Figure 6).

*Figure 6: Light Pole (Potential Obstruction) - Howard Terminal*

Schnitzer Steel was not visited during the reconnaissance.

#### 4.1.2. Alameda

The second location of the reconnaissance was on the Alameda Site (Figure 7).


*Figure 7: Alameda (Second Location of the Reconnaissance)*

The PDT verified the measurement from the SCI Geotechnical report (Port of Oakland, 1999). Some of the measurements are shown in Figure 8 and Figure 9. The existing concrete cap (Figure 10) matches the Widening of Inner Harbor Turning Basin at the Port of Oakland Phase 1A project, part of the Oakland Harbor Navigation Improvement (-50 Foot) project.

*Figure 8: Measurement showing six feet distance between the top sediment layer and top concrete surface - Alameda Site*

*Figure 9: One-foot concrete layer - Alameda Site*

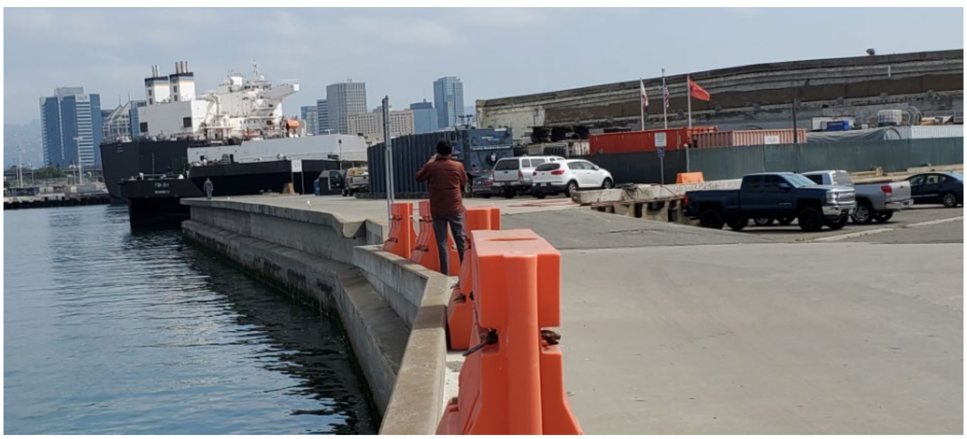


*Figure 10: Existing Concrete Cap for -50 ft Project - Alameda Site*

## 4.2. Design Assumptions

Ship simulation study was not performed as part of this feasibility study. The proposed variations (footprints) are based on a multiplier that is selected in accordance with the guidelines in Engineers Manual (EM 1110-2-1613), Section 9-2. A turning basin multiplier of 1.4 was used for the Inner Harbor area and 1.5 was used for the Outer Harbor. It is assumed that the existing Outer Harbor turning basin has tidal currents that are less than 1.5 knots. Next, it is assumed that the bulkhead clearance is 50 feet from the proposed channel limit. The bulkhead buffer clearance distance is the distance between the proposed channel and the location of the bulkhead. The bulkhead clearance distance assumption is based on the existing bulkhead design in Alameda used for the Phase 1A project.

## 4.3. Vessel Inventory and Forecast

From the Oakland Harbor Turning Basins Widening Navigation Study Integrated Feasibility Report and Environmental Assessment (2021):

> All vessel classes listed in Table 1 regularly call at the Port, except for the Post-Panamax Gen IV (PPX Gen IV). However, while currently infrequent, the Port has received calls from PPX Gen IV vessels. The frequency and number of PPX Gen IV vessels calling the Port is expected to increase into the future.

*Table 1: Container Vessel Fleet Subdivisions and Dimensions*

| VESSEL FLEET SUBDIVISION (CONTAINERSHIPS) | | FROM | TO |
|---|---|---|---|
| **Sub Panamax** | **Beam** | | 98 |
| | **Draft** | 8.2 | 38.1 |
| | **LOA** | 222 | 813.3 |
| | **TEUs** | | 2,800 |
| **Panamax** | **Beam** | 98 | 106 |
| | **Draft** | 30.8 | 44.8 |
| | **LOA** | 572 | 970 |
| | **TEUs** | 2,801 | 4,800 |
| **Post-Panamax Generation I (Post-Panamax)** | **Beam** | 106 | 138 |
| | **Draft** | 35.4 | 47.6 |
| | **LOA** | 661 | 1045 |
| | **TEUs** | 4,801 | 6,800 |
| **Post-Panamax Generation II (Super Post-Panamax)** | **Beam** | 138 | 144 |
| | **Draft** | 39.4 | 49.2 |
| | **LOA** | 911 | 1,205 |
| | **TEUs** | 6,801 | 9,900 |
| **Post-Panamax Generation III (New Panamax, or Ultra Post-Panamax)** | **Beam** | 144 | 168 |
| | **Draft** | | 51.2 |
| | **LOA** | Up to | 1220 |
| | **TEUs** | 9,901 | 15,000 |
| **Post-Panamax Generation IV (New Post-Panamax)** | **Beam** | 168 | 200 |
| | **Draft** | | 52.5 |
| | **LOA** | 1,295 | 1,315 |
| | **TEUs** | 15,000 | 23,000 |

> Table 2 displays the number of container calls by vessel class at the Port between 2014 and 2019. Over this period, the use of Panamax vessels at the Port of Oakland is trending downward while the use of larger vessels is trending upward. Most vessel calls have

shifted from PPX Gen I in 2014 to PPX Gen II by 2019. This shift can be attributed to smaller vessels (i.e., Panamax) being replaced with larger vessels that carry more tonnage on a single voyage, as evidenced by the increase in cargo tonnage and TEUs, and decrease in vessel calls, since 2014. The trend to reduce voyages is an effort to realize economies of scale in the container shipping market.

*Table 2: Container Vessel Fleet Port Calls by Class, 2014-2019 (Sources: USACE, 2018; Port of Oakland, 2020)*

| | SUB-PANAMAX | PANAMAX | PPX GEN I | PPX GEN II | PPX GEN III | PPX GEN IV | TOTAL |
|---|---|---|---|---|---|---|---|
| **2014** | 109 | 485 | 518 | 273 | 174 | 0 | 1,558 |
| **2015** | 76 | 277 | 424 | 268 | 208 | 1 | 1,252 |
| **2016** | 112 | 316 | 508 | 378 | 247 | 2 | 1,563 |
| **2017** | 99 | 232 | 492 | 416 | 205 | 0 | 1,442 |
| **2018** | 96 | 163 | 498 | 398 | 231 | 0 | 1,386 |
| **2019** | 175 | 140 | 352 | 371 | 210 | 0 | 1,248 |

While no PPX Gen IV vessels called from 2017-2019, there were three calls in 2020, and three more so far in 2021, according to the Port.

Therefore, as mentioned in this section and detailed in the provided data tables, smaller vessels are being replace by larger vessels.

## 4.4. Design Vessel

The proposed design vessel length is 1310 feet. The proposed length is derived from the LOA of Post-Panamax Generation IV. The proposed design vessel length was agreed among the USACE and Port of Oakland PDT at the beginning of planning. For more details of the design vessel, please see Appendix A Economics.

### 4.4.1. Channel Diameter

The proposed design channel diameter for the Inner Harbor is 1834 feet (1310 ft. multiply by 1.4). This is based on EM 1110-2-1613, where the current velocity at this location, which is predominantly less than 0.5 knot. See Section 3.6 of Appendix B4 Coastal Engineering for more information.

The design channel diameter for the Outer Harbor is 1965 feet (1310 ft. multiply by 1.5). The design diameters were agreed among the USACE and Port of Oakland PDT at the beginning stage of planning. It is assumed that the existing Outer Harbor turning basin has tidal currents that are less than 1.5 knots, which is in accordance with EM 1110-2-1613.

## 4.5. Recommended Design

The recommended design is a combination of Variation 3 of the Inner Harbor and Variation 8 of the Outer Harbor. It started out with the proposed design diameter, 1834 feet for the Inner Harbor and 1965 feet for the Outer Harbor. The proposed tangent lines were created for the proposed design diameters. The proposed tangent lines are the proposed channel limit. The proposed buffer of 50 feet for Inner Harbor and 60 feet for Outer Harbor were added for the spacing/clearance of the proposed bulkhead or slope.

## 4.6. Utilities

Based on Howard Terminal As-Built Drawings from 1980s and data collected during the 24 August 2021 reconnaissance, it was observed that existing underground utility would cause obstructions during the construction of the project. Therefore, existing utility plans for Howard Terminal were requested, and provided by the Port, for estimating the impact as well as the quantity of the relocation, removal and abandonment. Existing utility plans on Alameda and Schnitzer sites were not available. Therefore, existing information from the Widening of Inner Harbor Turning Basin at Port of Oakland Phase 1A2 project (see Figure 36) and assumptions were used for the Alameda utility relocation quantities. Because the land impact in Schnitzer is small, the utility relocation quantities should be minimal. The estimated quantities are shown in Section 7.6 of this appendix, Table 13 and 14. It is highly recommended that a series of utility surveys should be performed in the PED phase to determine the degree of impacts to existing utilities.

## 4.7. Dredging

The dredging equipment that is likely to be used for the project are crane with clamshell, barge ship/scow, and tugboat. The total estimated exposed Inner Harbor sediments to be dredged is 319,000 cubic yard (CY). The exposed Inner Harbor sediments are the dredging material between the existing channel limit and the fast land (edge of the pavement/bulkhead). The total estimated inland Inner Harbor sediment to be dredged is 567,000 CY. The total estimated exposed Outer Harbor sediments to be dredged is 862,000 CY. The dredging for the widening of the turning basins would fall within the 26-week dredging in-water environmental window allowed for Oakland Inner and Outer Harbor channels. Construction activities that are allowed outside of the environmental window include but not limited to demolition of bulkheads, pavements, site clearing, establishing access routes and staging area. See Section 8.4 of this appendix for additional details. During the construction of the project (widening of both the Inner and Outer Harbor turning basins), coordination should be made to avoid overlap with the annual O&M channel maintenance dredging effort.  A schedule showing both efforts should be prepared during the PED phase of the project. The dredging information is based on past construction data and experience from PDT. The volume calculation is derived from depth assumptions agreed by PDT and with the assistance of AutoCAD.

The proposed widening work from Variation 3 of the Inner Harbor and Variation 8 of the Outer Harbor will result in an increase of approximately 65,000 cy/yr of paid volume (standard depth and 1$^{st}$ foot overdepth). An overall volume increase of approximately 70,000 cy/yr (standard depth + all overdepth) on top of the annual maintenance dredging quantity is expected. Similar to the federal annual dredging in the area, the maintained depth is -50 feet, with an additional 1-foot paid overdepth and 1-foot unpaid overdepth. A maintenance dredging work window is proposed to follow a yearly schedule between 1 June through 30 November for the project.

### 4.8. Effects of Recommended Plan

The recommended plan (Variation 3 in Figure 11 and Variation 8 in Figure 24) would improve navigation efficiencies, increase economic benefits and realize economies of scale, beneficially use dredged material and increases navigation safety for all vessels. The recommended plan would decrease emissions and environmental risks. Variation 3 (Figure 11) minimizes the total amount of land impacted, but it still impacts land in Alameda, Howard Terminal, and Schnitzer Steel. Variation 8 (Figure 24) in the Outer Harbor would follow the existing turning basin. Variation 8 requires less impacted underwater area than Variation 7 in the Outer Harbor. It may require minor channel alignment/boundary modifications.

## 5. Summary of Variation Comparison and TSP Selection Process

Eight (8) variations were considered in the study: Variations 1 to 6 for Inner Harbor, and Variations 7 and 8 for Outer Harbor. The variations were eliminated in different stages (phases) of the alternative analysis process. In Phase I, Variation 2, 5, 6, and 7 were eliminated. Variation 1,3,4, and 8 became the focused array of alternative plans. In Phase II, Variation 1 and 4 were eliminated. Variation 3 became a part of an Alternative in TSP. Variation 8 was selected for as a part of an Alternative in the TSP. The variations were analyzed in accordance with Planning Guidance Notebook (ER 1105-2-100).

Variation 3 (Figure 11) minimizes the total amount of land impacted, but impacts land in Alameda, Howard Terminal, and Schnitzer Steel. The estimated quantities are shown in Section 7 Quantity Estimates. It is anticipated to have significant land acquisition costs, but less than Variations 1 and 2. Schnitzer Steel land acquisition is required, which likely has contaminated material. Modified channel boundaries are likely unnecessary in the variation. This variation is selected because it impacts the least amount land compared to the other Inner Harbor footprint variations and, while potential operational impacts may be experienced, long term or permanent impacts are minimized or negated with Variation 3. Figure 12 shows the plan view of the cross sections for the existing grade. Figure 13 shows the cross sections of the existing grade. The cross-section profiles correlate to plan view images by the station number. For instance, in Figure 13, Alameda_CrossSection-1 PROFILE is the cross section from Station 10+00 to 17+94 of Figure 12 and Alameda_CrossSection-2 PROFILE is the cross section from Station 20+00 to 27+28 of Figure 12. The cross sections, along with assumptions/information from the Port, were used to estimate the quantities for the project. Figure 14 shows the demolition plan and Figure 15 shows the proposed design plan. The design of the bulkhead is in Structural Engineering Appendix. Figure 16 to Figure 23 present the plan view of cross sections of the existing grade, cross sections of the existing grade, demolition cross section and proposed design cross section for each impacted location of the variation.


*Figure 11:Inner Harbor Variation 3*

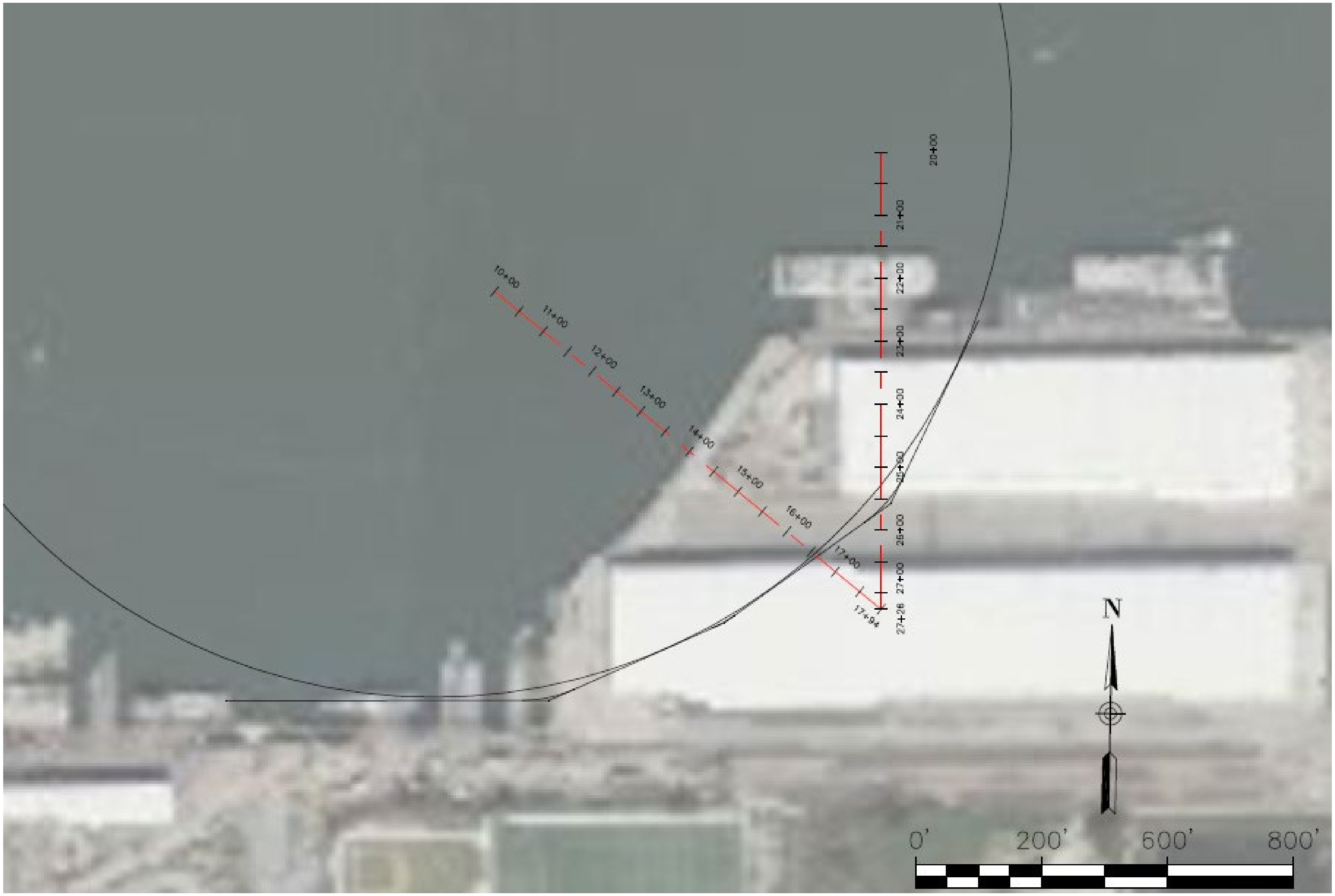
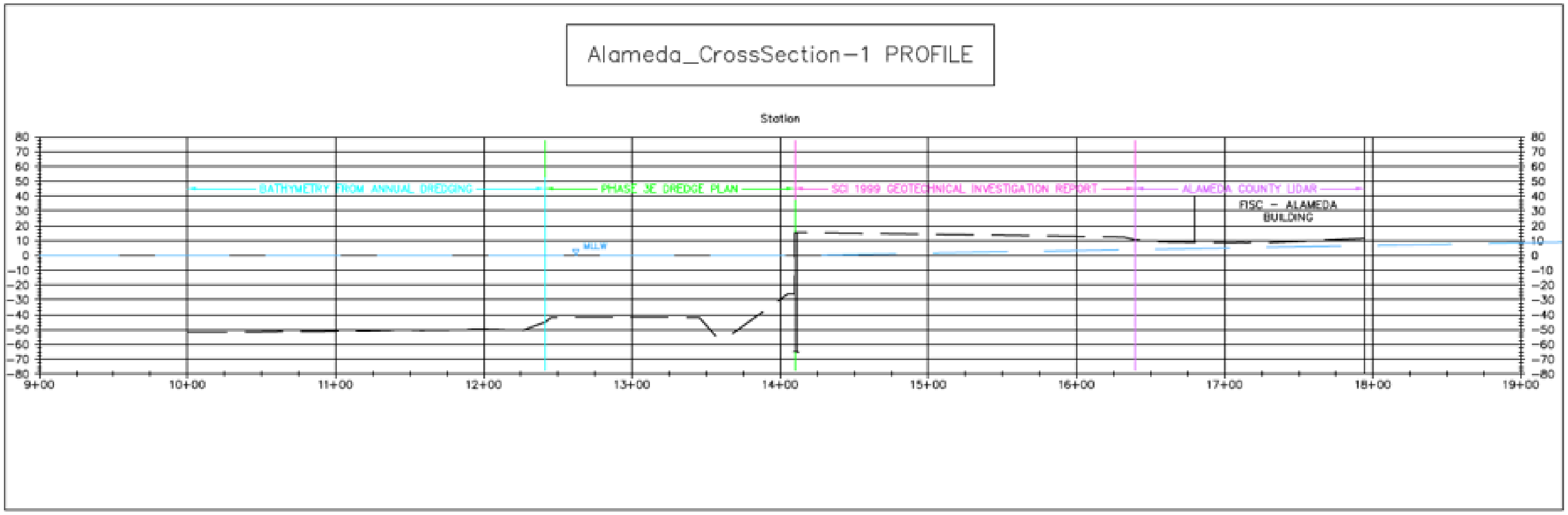



*Figure 12: Alameda Plan View for Cross Section*



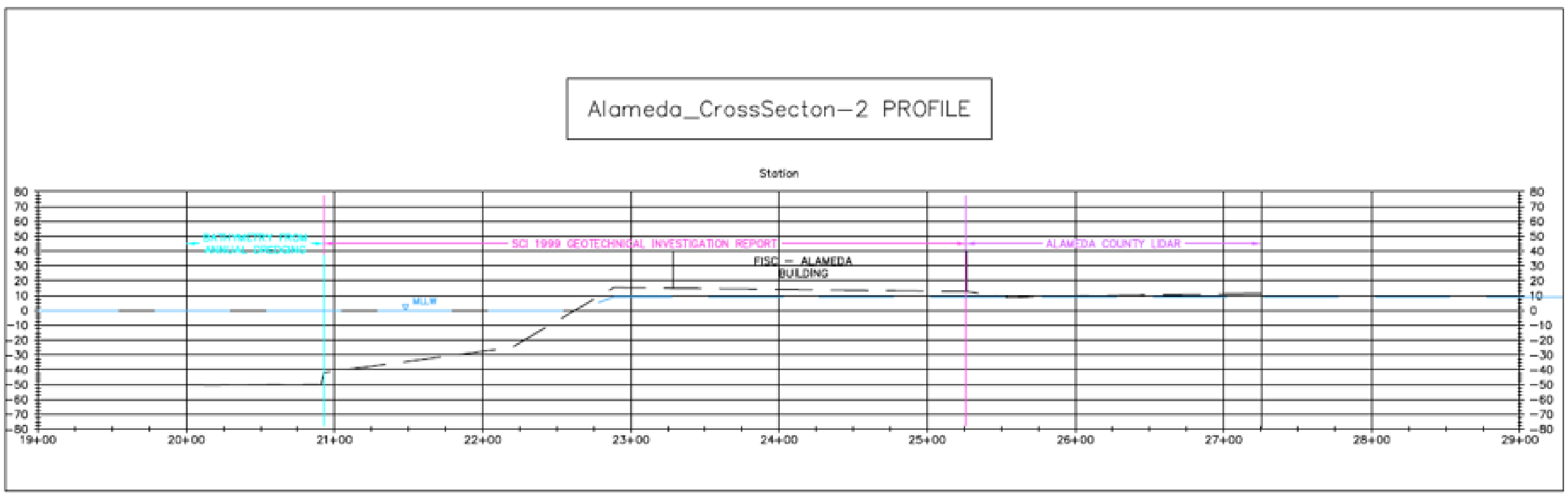




*Figure 13: Alameda Cross Sections of the Existing Grade*

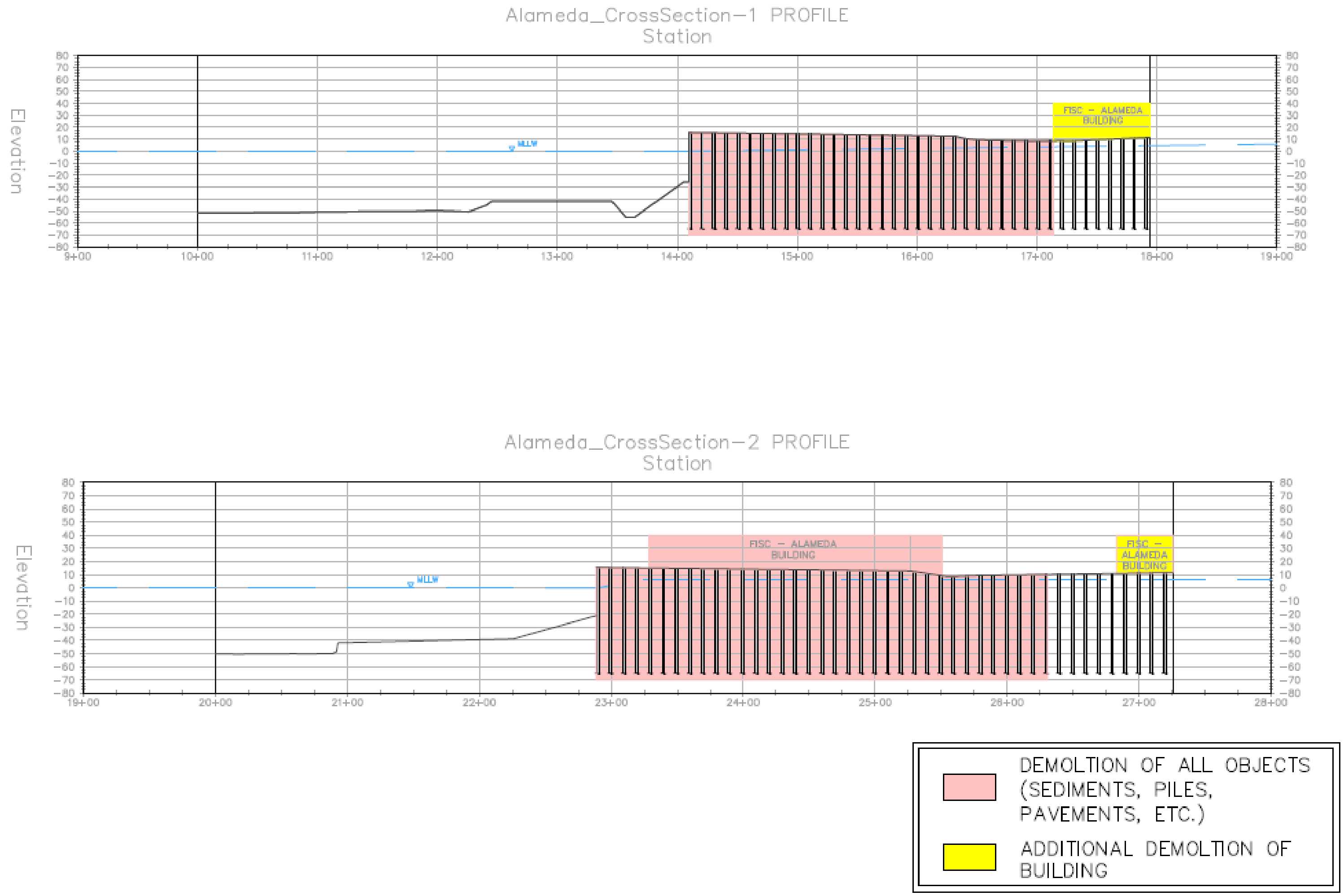



*Figure 14: Alameda Demolition Typical Cross Section*

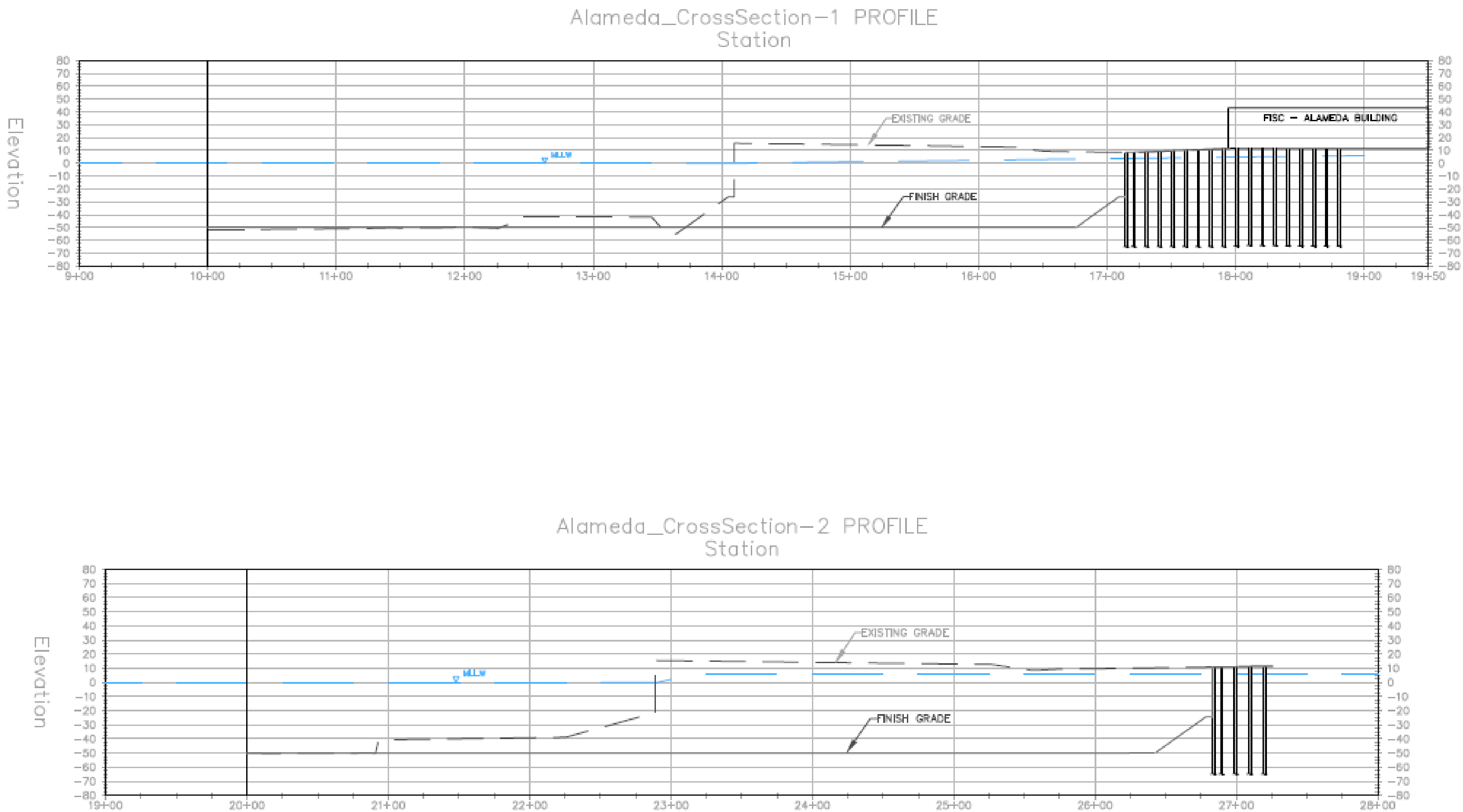



*Figure 15: Alameda Proposed Design Typical Cross Section*

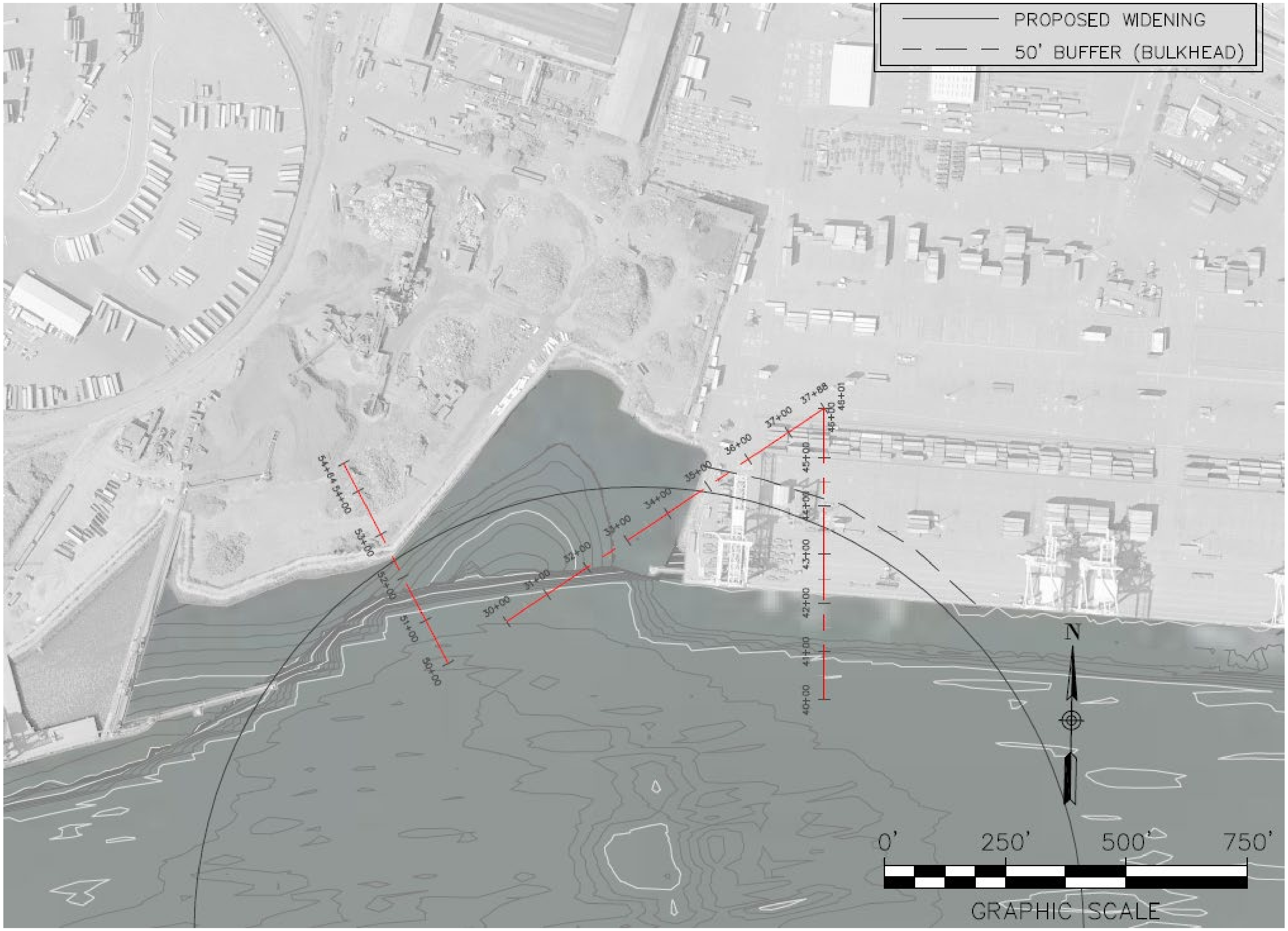
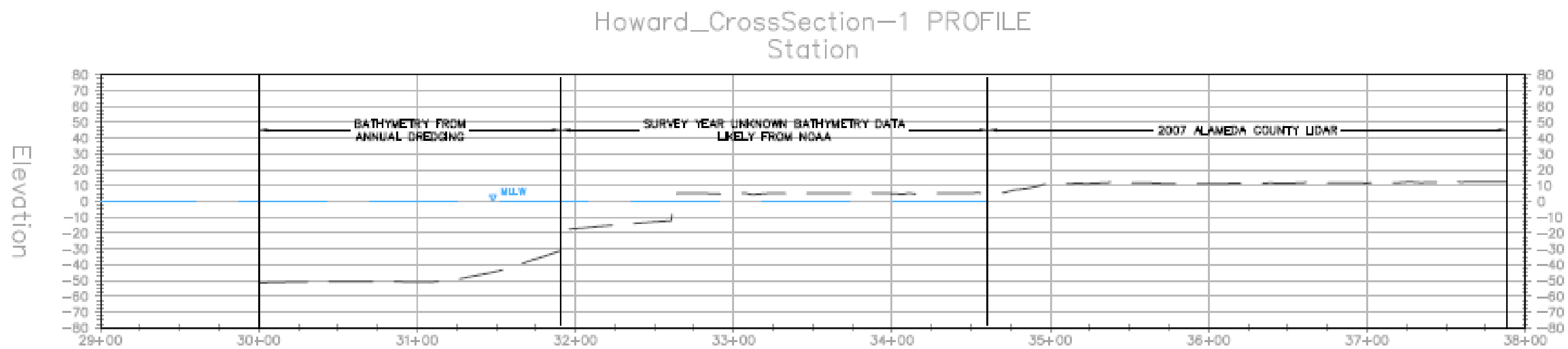



*Figure 16: Howard Terminal Plan View for Cross Sections*



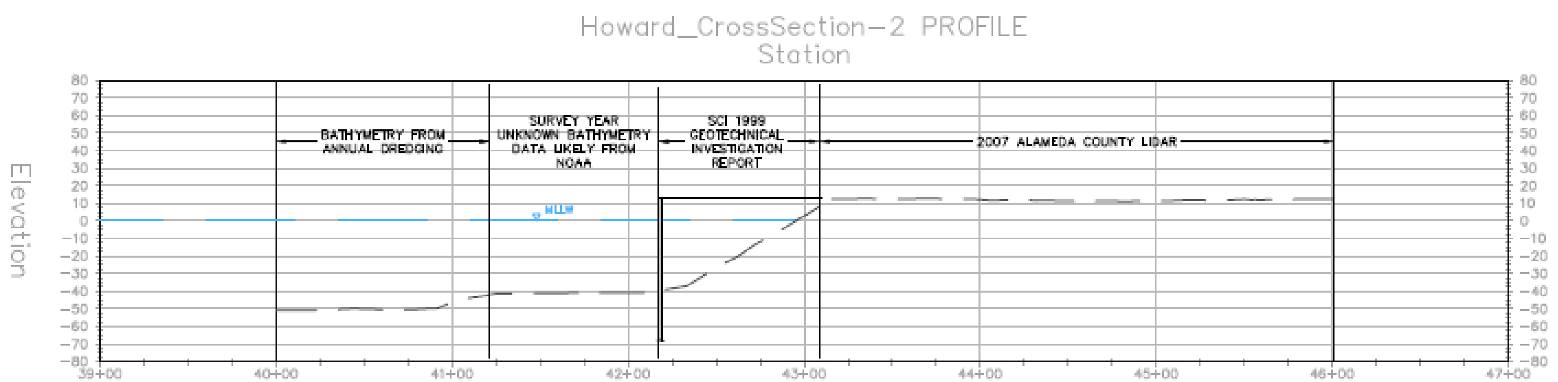




*Figure 17: Howard Terminal Cross Sections of the Existing Grade*

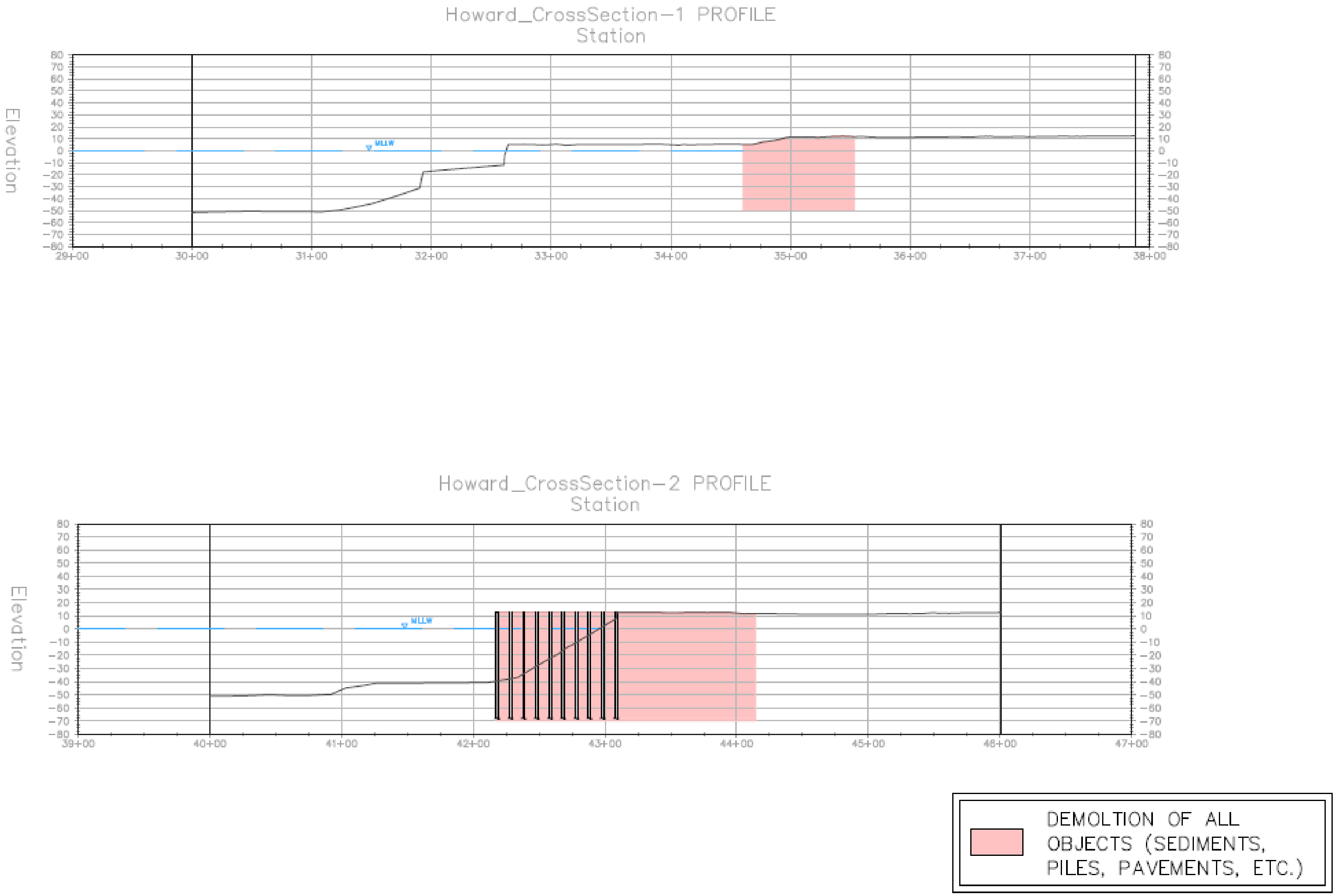
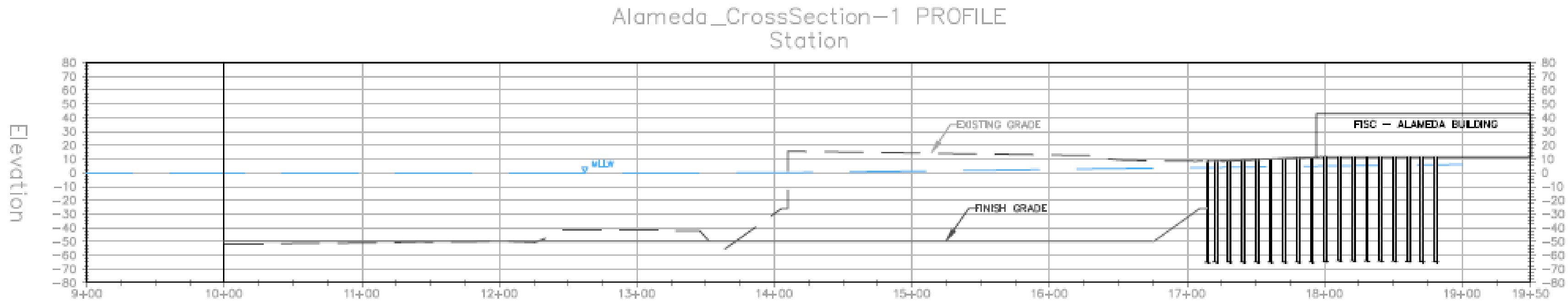



*Figure 18: Howard Terminal Demolition Typical Cross Section*



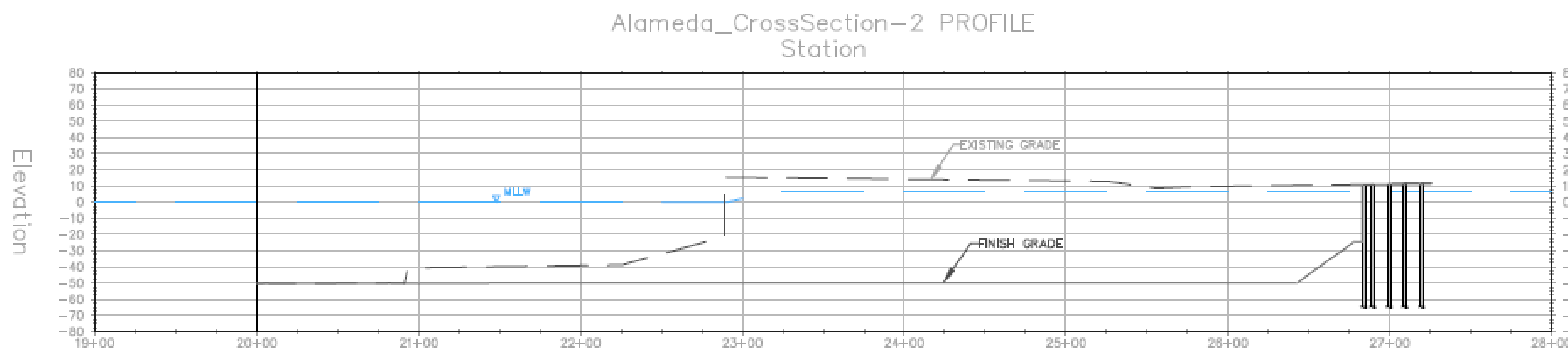




*Figure 19: Howard Terminal Proposed Design Typical Cross Section*

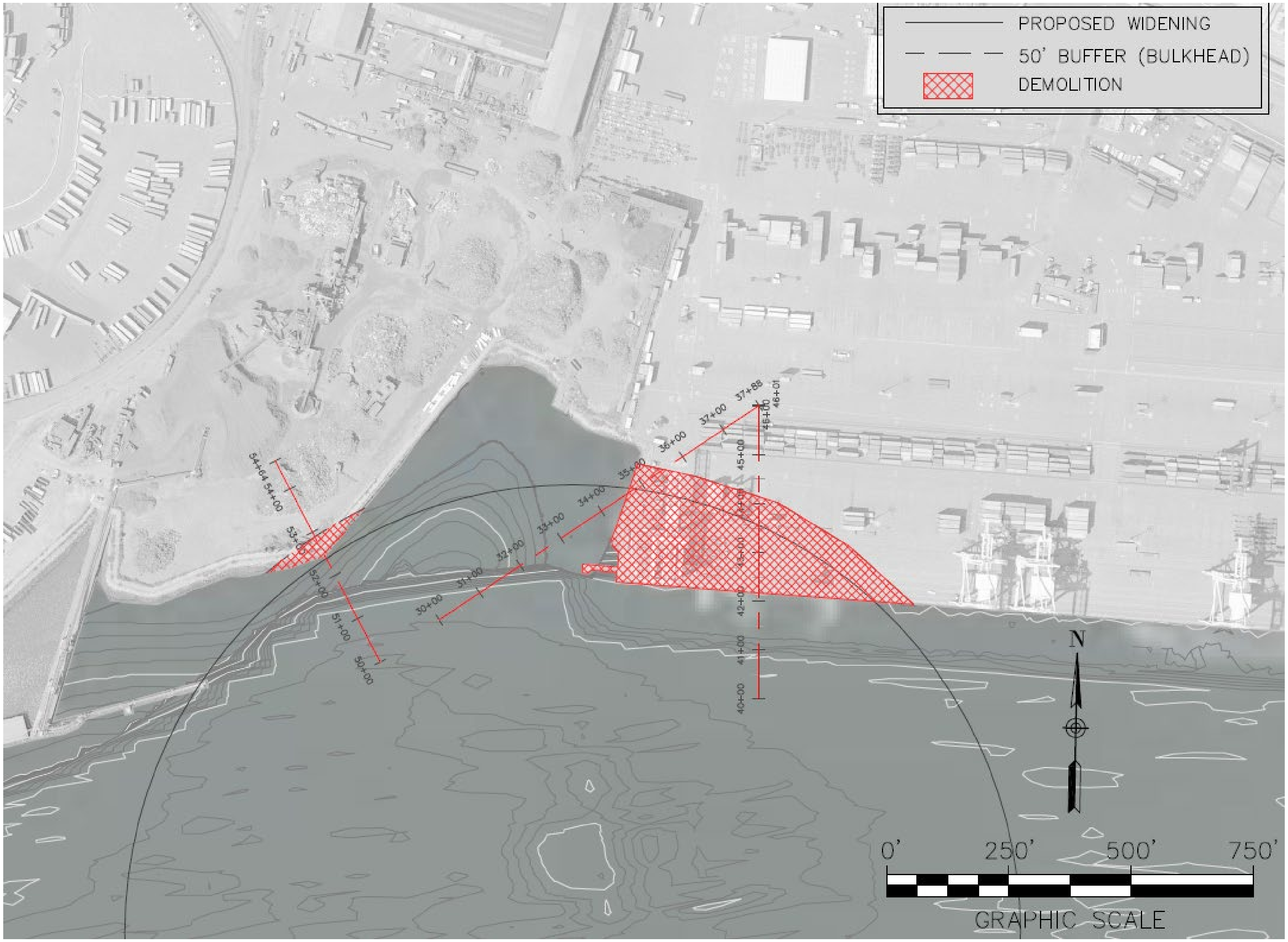



*Figure 20: Schnitzer Steel Plan View for Cross Sections (showing Demo)*

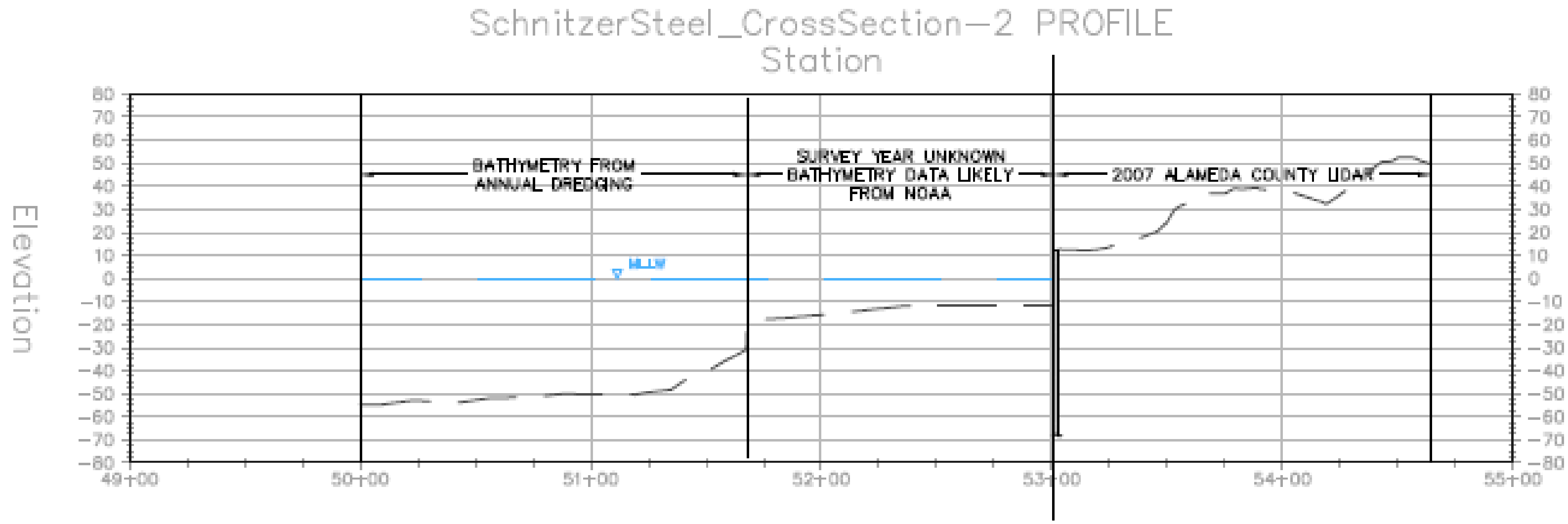
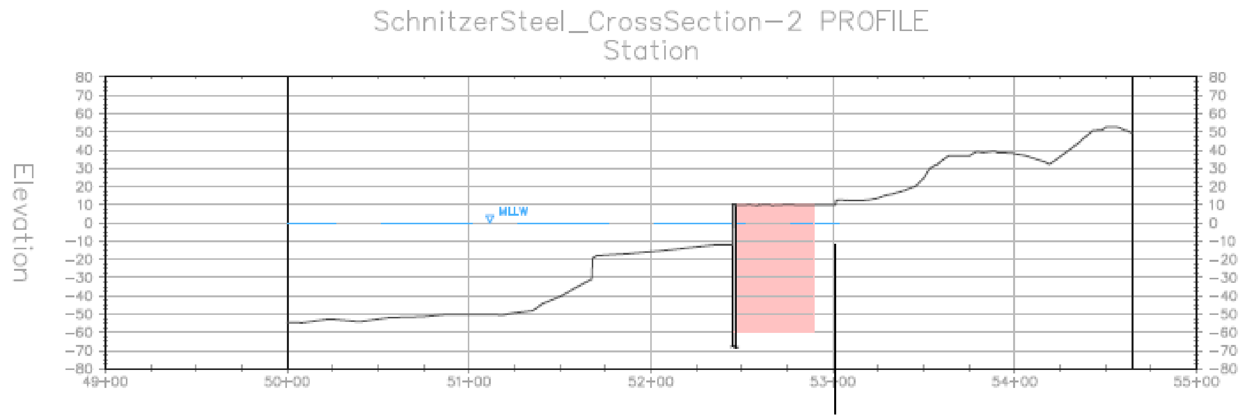



*Figure 21: Schnitzer Steel Cross Sections of the Existing Grade*



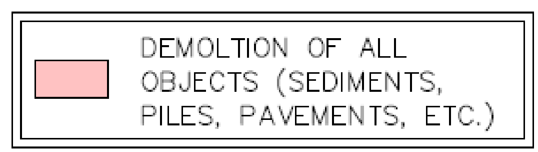




*Figure 22: Schnitzer Steel Demolition Typical Cross Section*

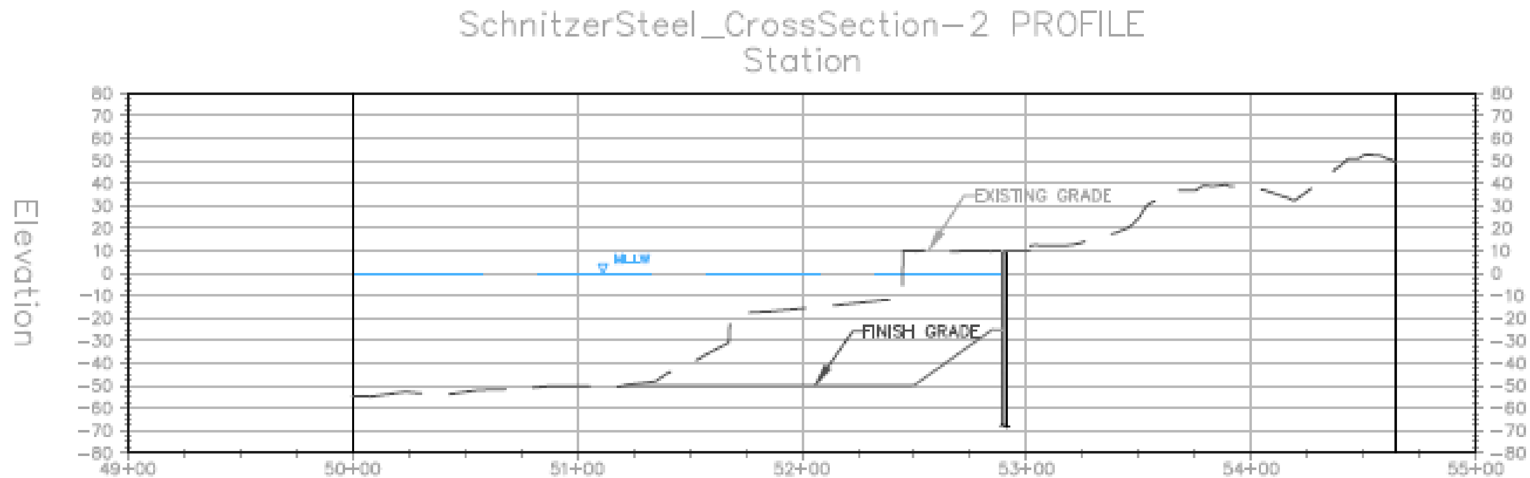
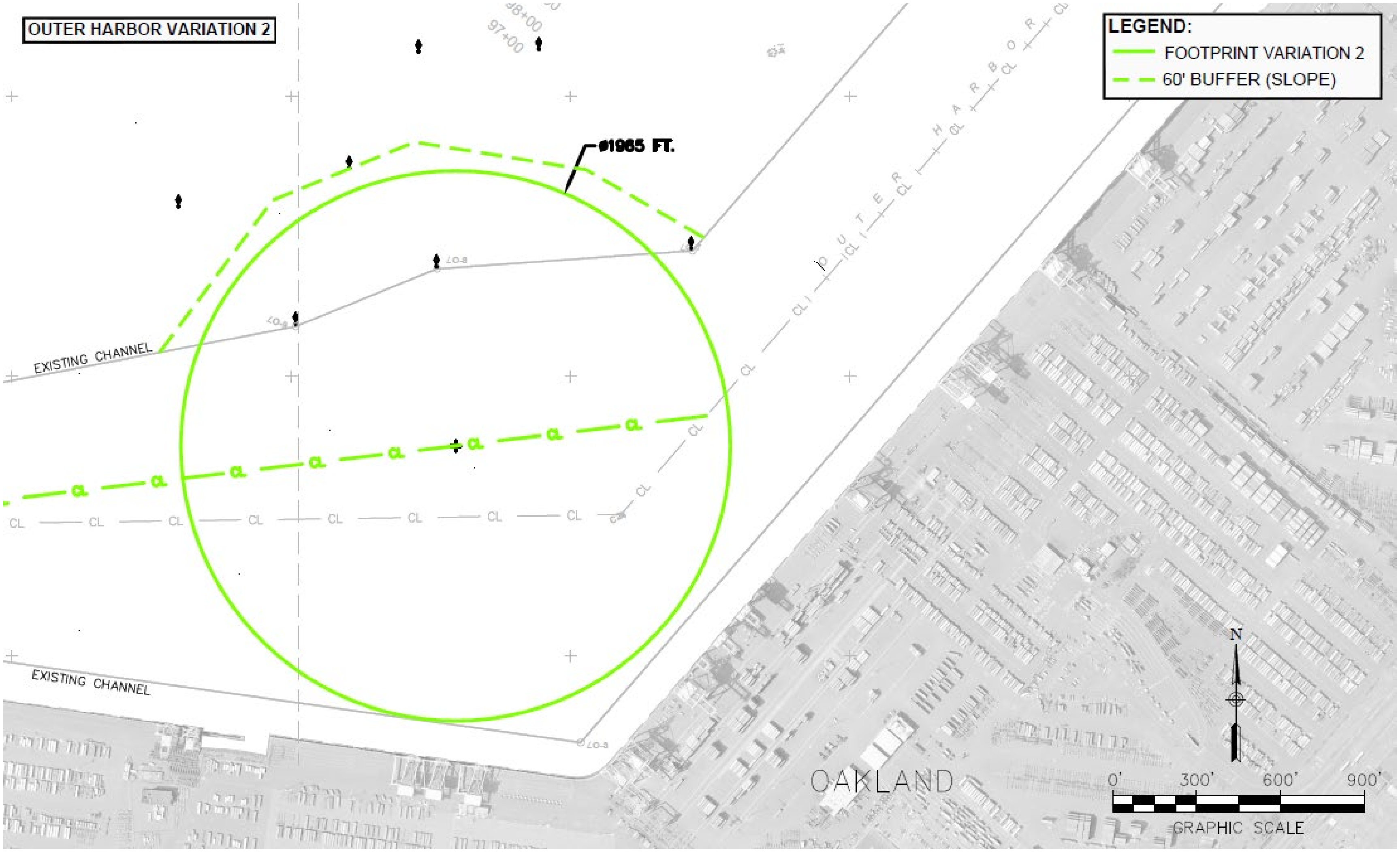



*Figure 23: Schnitzer Steel Proposed Design Typical Cross Section*

Variation 8 (Figure 24) in the Outer Harbor follows the existing turning basin. The estimated quantities are shown in Section 7 Quantity Estimates. It has no land impact and therefore it does not require any bulkhead. It requires less impacted underwater area than Variation 7 in the Outer Harbor. It may require minor channel alignment/boundary modifications. Figure 25 to Figure 28 display the plan view of cross sections of the existing grade, cross sections of the existing grade, demolition cross section and proposed design cross section for the area of the variation.


OUTER HARBOR VARIATION 2
LEGEND:
FOOTPRINT VARIATION 2
60' BUFFER (SLOPE)
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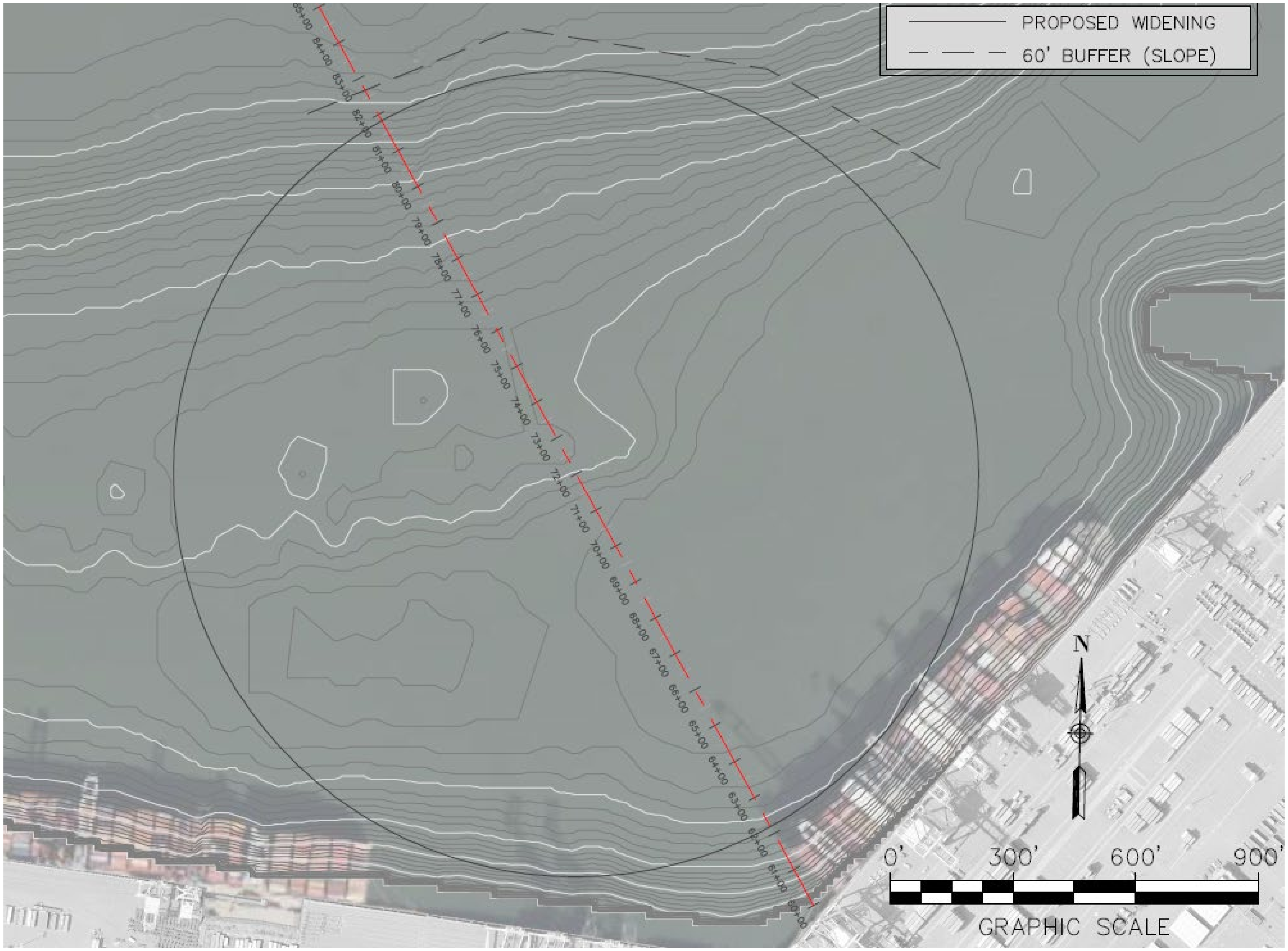
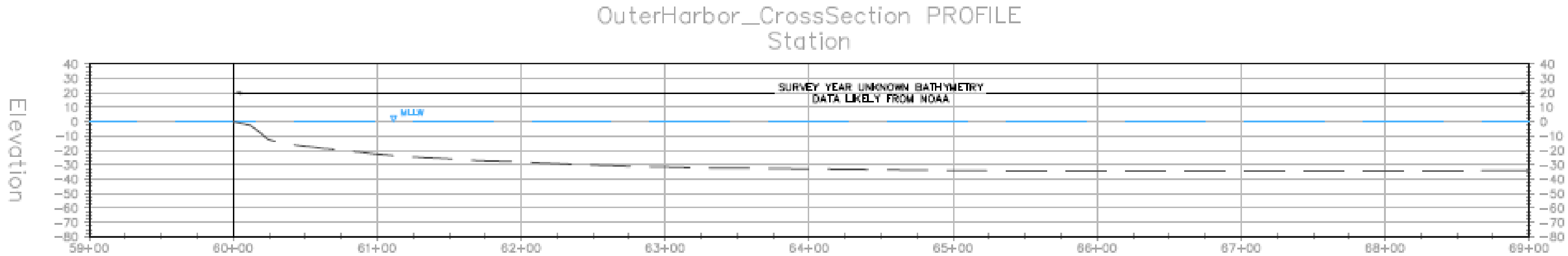
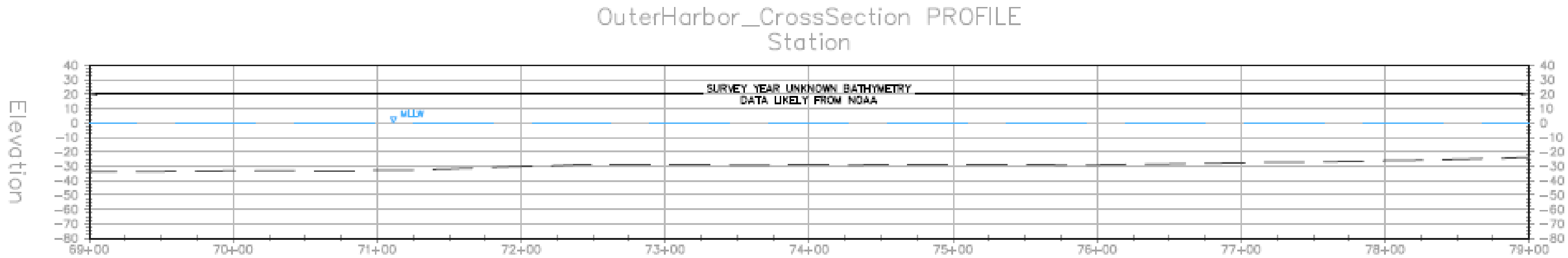
EXISTING CHANNEL
EXISTING CHANNEL
OUTER HARBOR
OAKLAND
0'
300'
600'
900'
GRAPHIC SCALE
N


PROPOSED WIDENING
60' BUFFER (SLOPE)
N
0'
300'
600'
900'
GRAPHIC SCALE


OuterHarbor_CrossSection PROFILE
Station
Elevation
SURVEY YEAR UNKNOWN BATHYMETRY
DATA LIKELY FROM NOAA
MLLW
59+00 60+00 61+00 62+00 63+00 64+00 65+00 66+00 67+00 68+00 69+00


OuterHarbor_CrossSection PROFILE
Station
Elevation
SURVEY YEAR UNKNOWN BATHYMETRY
DATA LIKELY FROM NOAA
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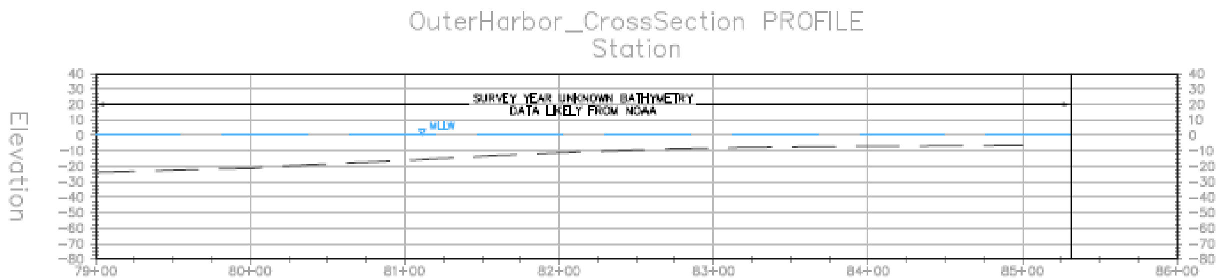
69+00 70+00 71+00 72+00 73+00 74+00 75+00 76+00 77+00 78+00 79+00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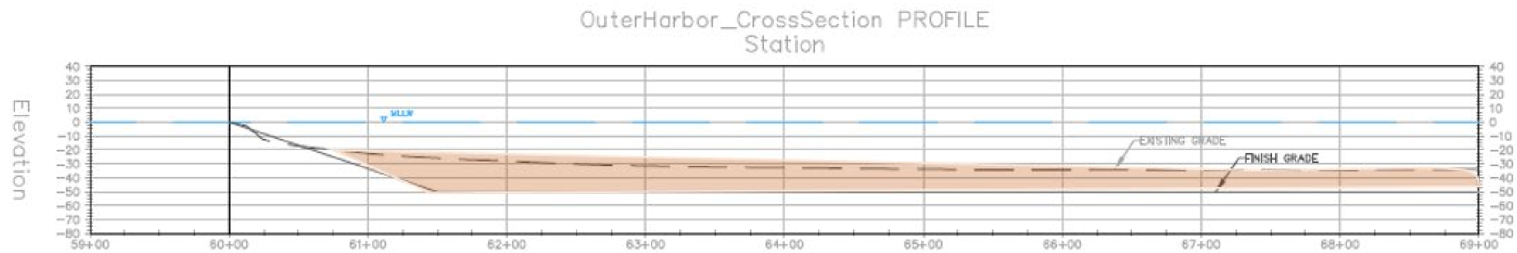
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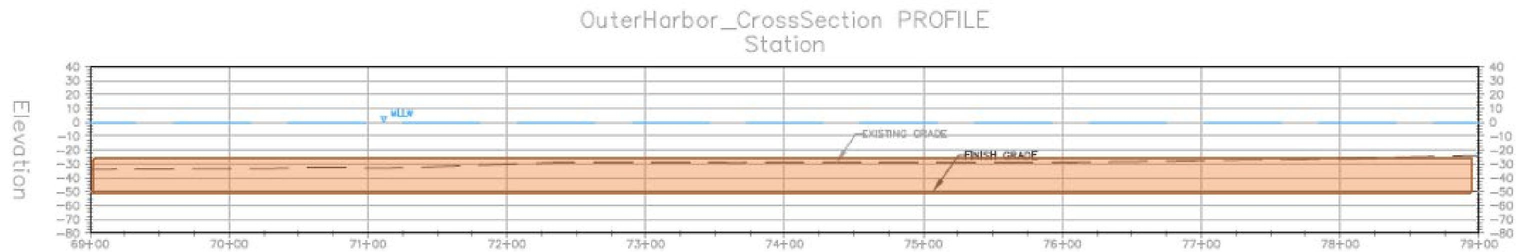
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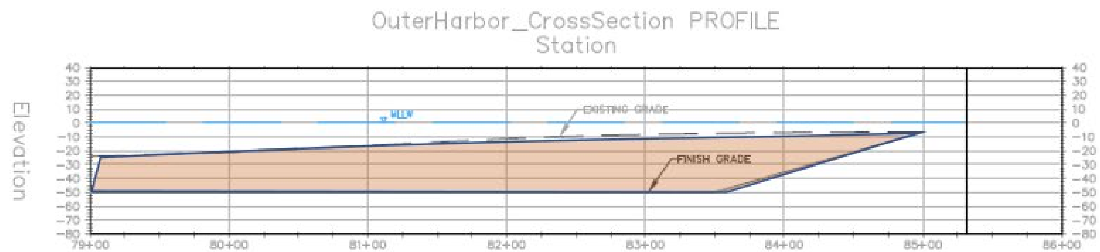
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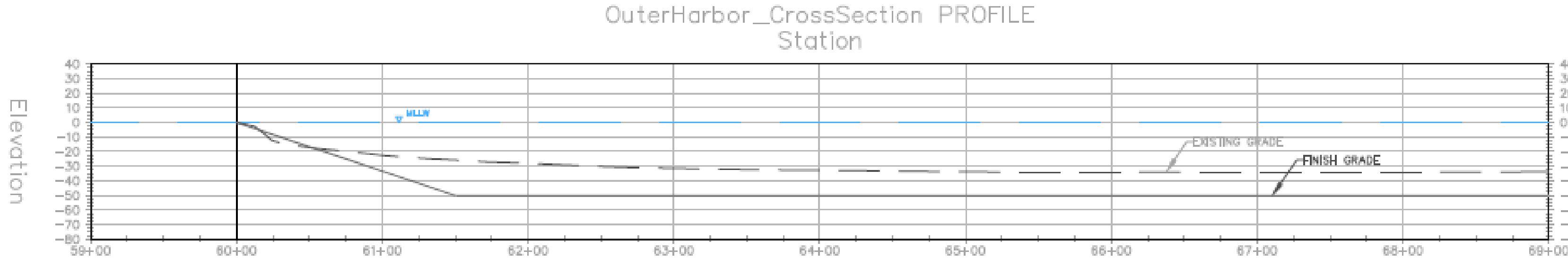
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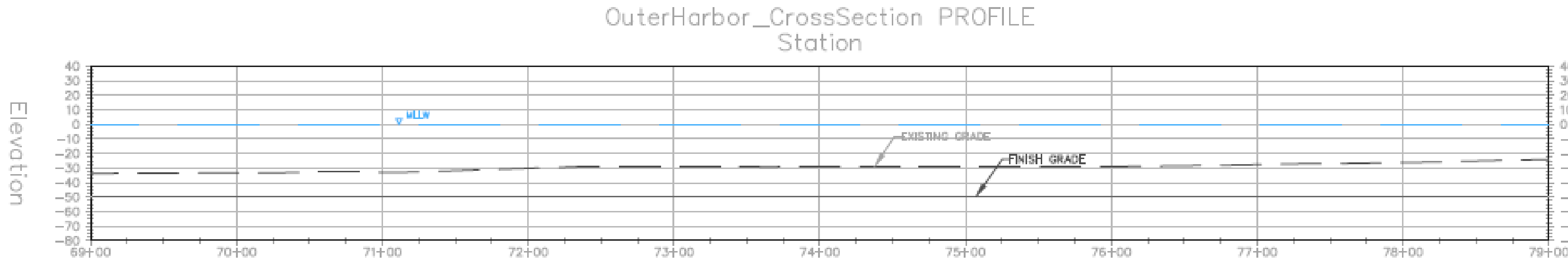
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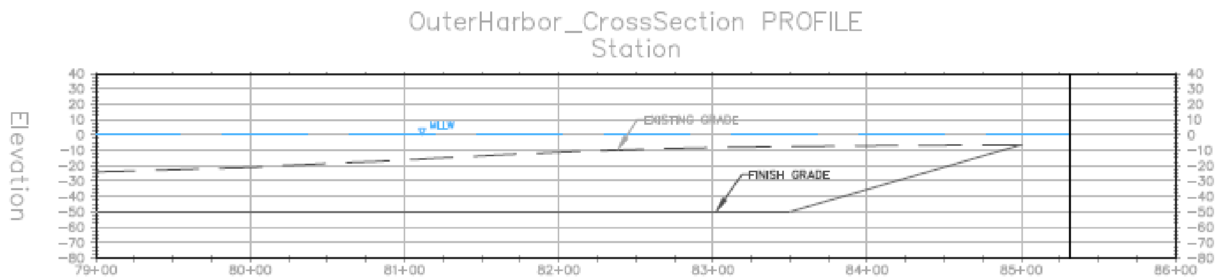
OuterHarbor_CrossSection PROFILE
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MLLW
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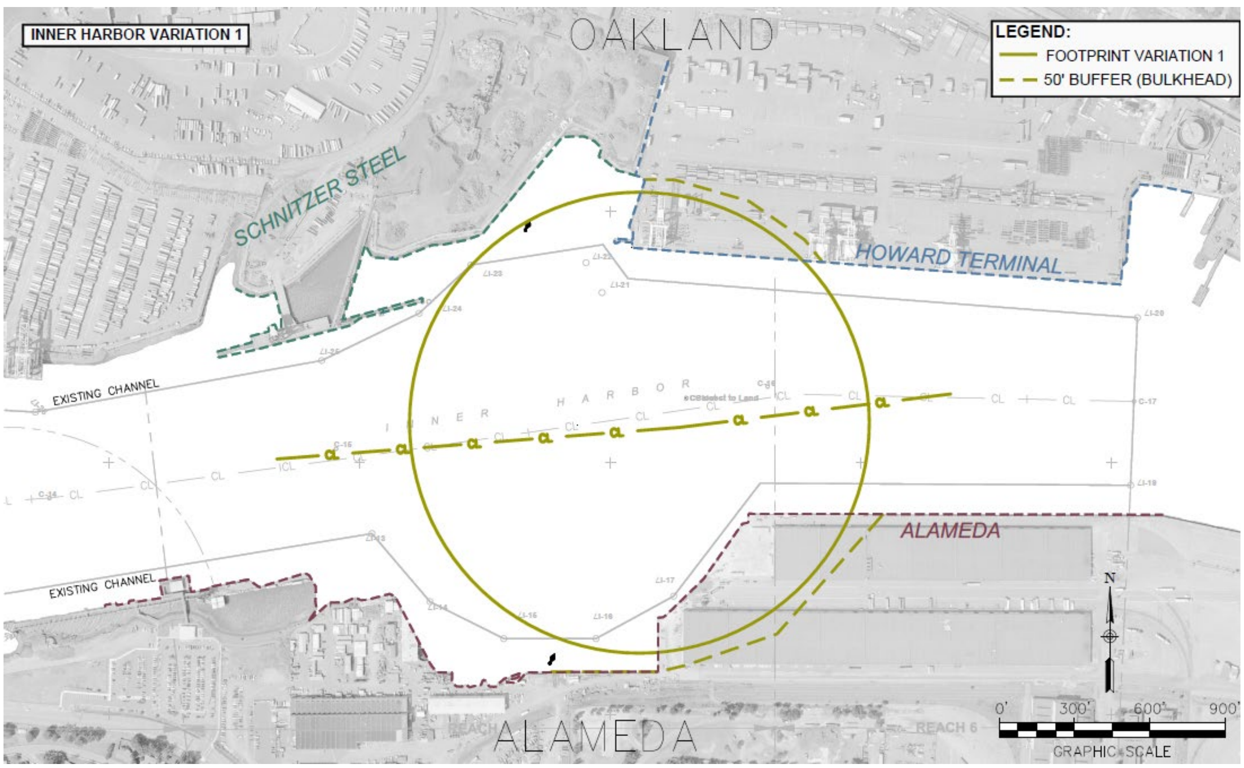
## 6. Eliminated Variations

Variation 1 (Figure 29) continues to the focused array. This footprint avoids impacting Schnitzer Steel land but impacts Howard Terminal and Alameda land. The approximate land impacted is 10.00 acres. The approximate length of bulkhead needed is 2,400 feet. There are significant land acquisition costs anticipated with the variation. There may be a high amount of structural demolition (e.g., warehouses) and associated risks that comes with the unknown type of material. The amount of land required and impacts to businesses located at Alameda to implement Variation 1 is significant. Therefore, while it does not have land impact on Schnitzer Steel, it was eliminated because of heavy land impact on Alameda and Howard Terminal, when compared to Variation 3.




Variation 2 (Figure 30) avoids impacting land in Alameda but impacts Howard Terminal and Schnitzer Steel land. The approximate land impacted is 10.10 acres. The approximate amount of bulkhead needed is 2,500 feet. Schnitzer Steel has contaminated material and depth of contamination is unknown; excavation and disposal cost for this variation will be high. It would negatively impact Schnitzer Steel's business significantly, with the possibility of ending Schnitzer Steel's operations entirely, which would have negative impact to international commerce. It would likely require construction of a new or partial Schnitzer Steel wharf structure rebuild/relocation. It has a slightly higher amount of structural demolition and associated risks that comes with the unknown type of waste. Vertical bulkhead design will likely need to consider uplands

contamination.

Therefore, while the area of land impacted and amount of bulkheading estimate to be required is slightly less than that required for Variation 1, the land to implement Variation 2 is more likely to be contaminated and would likely prohibit Schnitzer Steel from further operations.

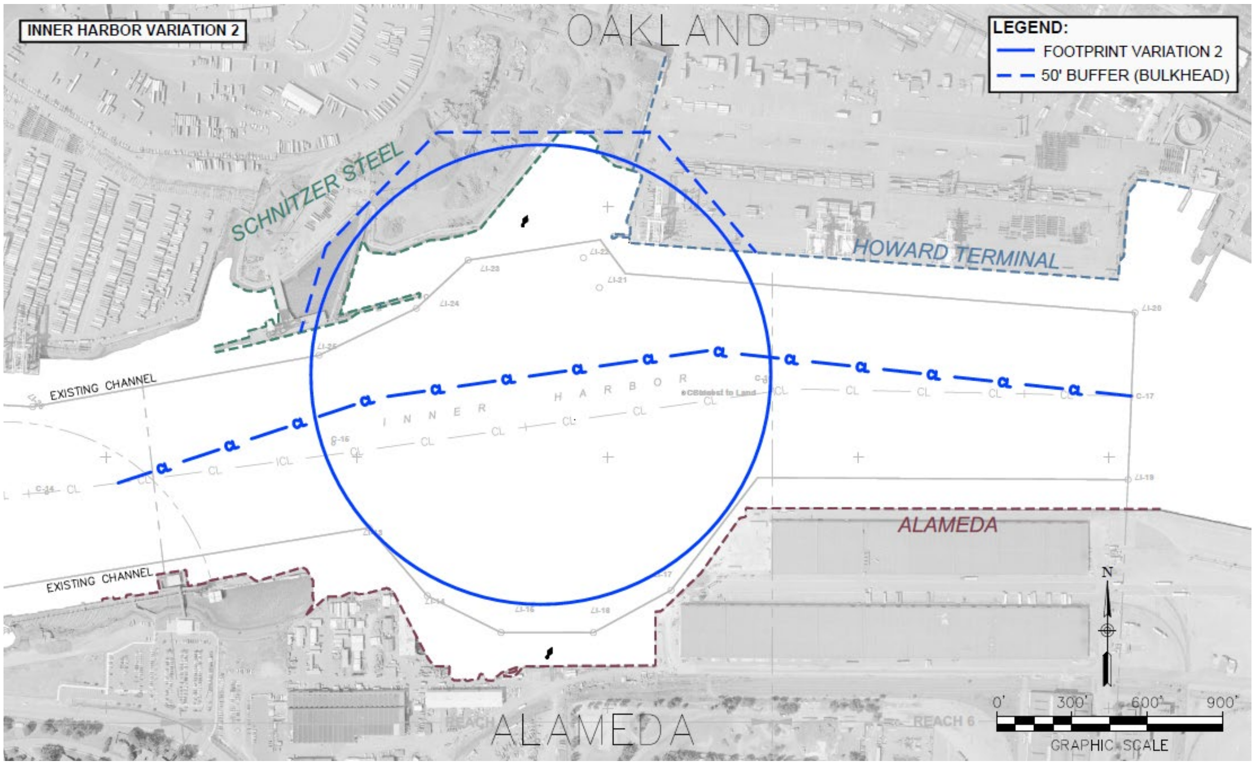



*Figure 30: Inner Harbor Variation 2*

Variation 4 (Figure 31) was created with the assistance from the Port of Oakland, using a past ship simulation (CSU Maritime Academy, 2019). This footprint impacts land at Howard Terminal, Schnitzer Steel and Alameda. Because the alignment is based on a ship model performed by CSU Maritime Academy, no turning basin multiplier was used for the footprint. The approximate land impacted is 12 acres. The approximate amount of bulkhead needed is 2,400 feet. Land at Howard Terminal is owned by non-federal sponsor and some contaminated soils are expected at Howard Terminal. Acquisition of property at Schnitzer Steel is required and soil contamination is expected, both resulting in significant costs. Impacts to Schnitzer's operations are expected and structures at Schnitzer Steel may need to be investigated for stability. This variation may have significant amount of structural demolition and associated risks that comes with the unknown type of material. It was eliminated due to the anticipated high cost from the removal and processing of contaminated soil and other unknowns in the area.

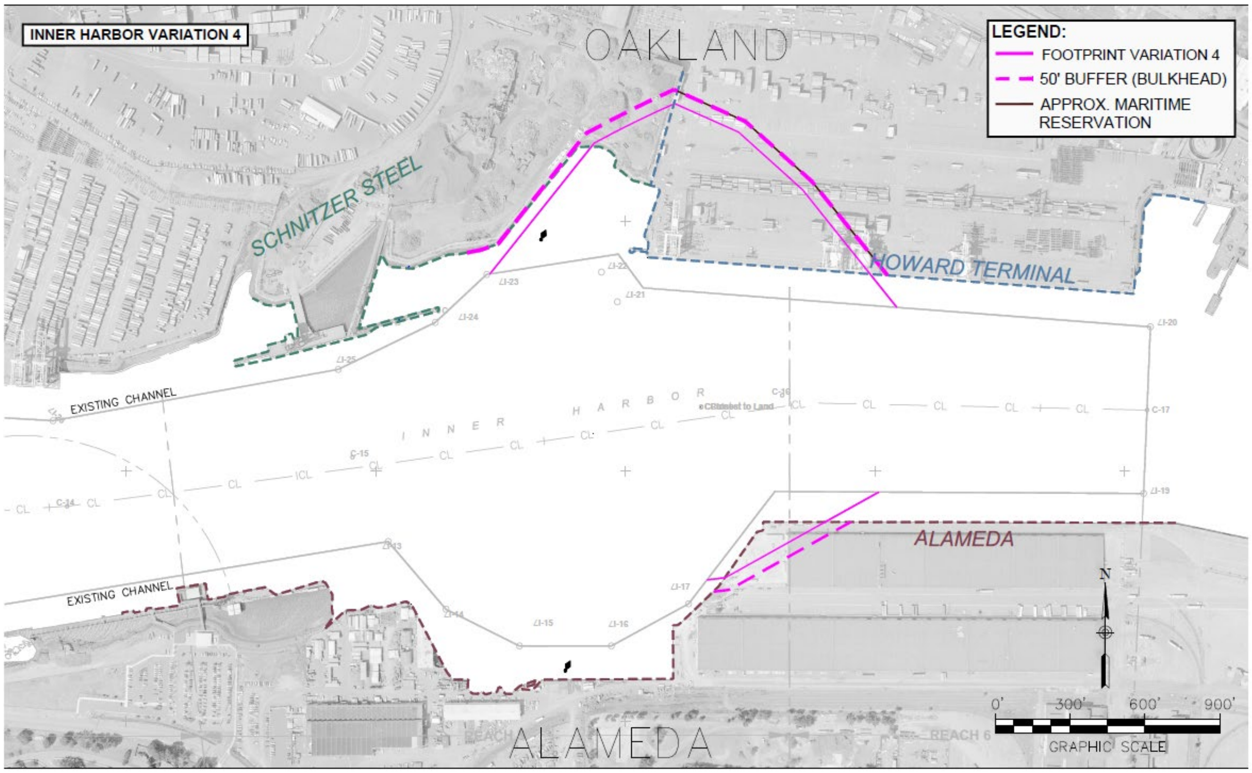



*Figure 31: Inner Harbor Variation 4*

The Variation 5 (Figure 32) is a footprint that impacts the open space designated as open space at the formal naval base in Alameda. The approximate land impacted is 54 acres. The approximate amount of bulkhead needed is 4,100 feet. Significant channel limit modifications are required, this additional volume adds to material removal costs, and significant vertical bulkhead/riprap construction. It is significantly more expensive to remove the excess soil and dredge material than expanding the existing turning basin. This variation is estimated to require a significant amount more bulkhead and would impact at least 3.8 times the amount of land as variations 1 through 4. Furthermore, Variation 5 would add restrictions to the vessel size and crane operations at the adjacent marine terminal berths, whereas, the other variations considered would not.

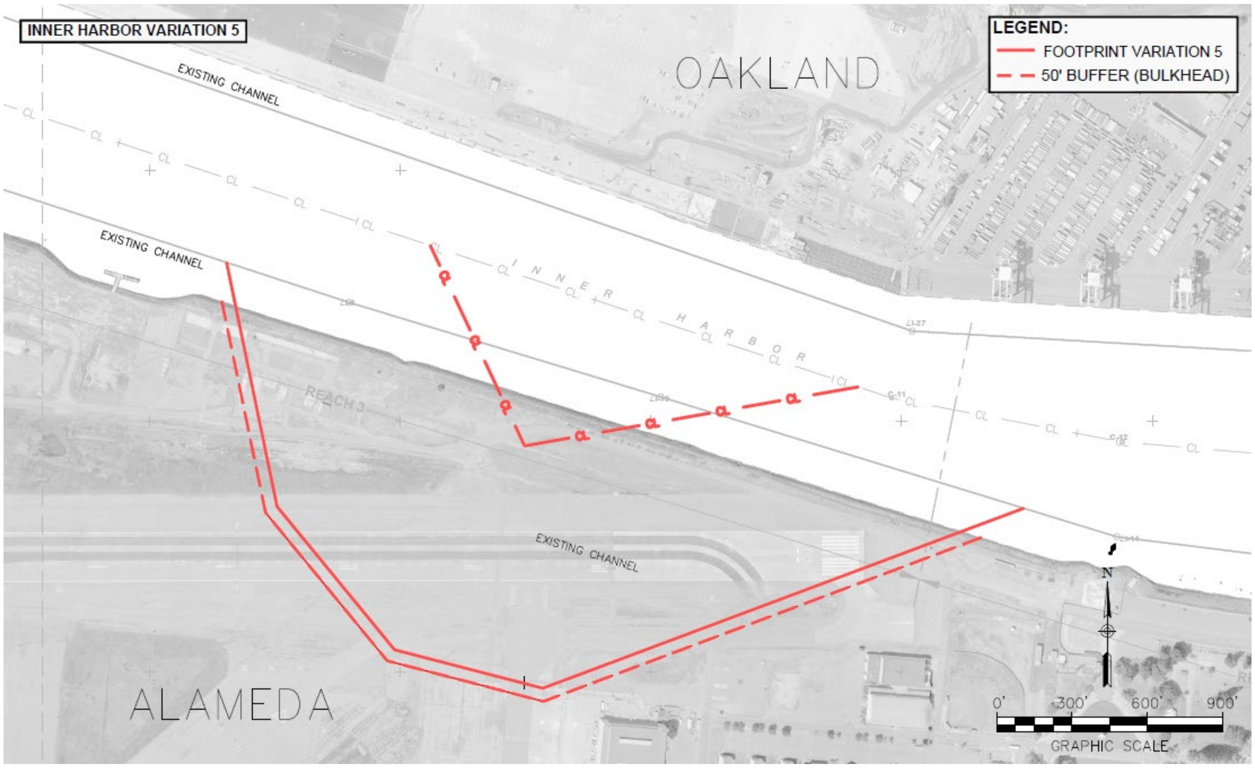



*Figure 32: Inner Harbor Variation 5*

Variation 6 (Figure 33) is the footprint that avoids land impacts and is located outside of Middle Harbor. It would not impact any land and no bulkhead is needed. However, the location has high probability of increased current velocity that would require modeling for an elongated (noncircular) turning basin. This variation may need a jetty to minimize current velocity if using a circular turning basin. The location of the Jetty needs to be modeled to choose a location that effectively reduces the current velocity. It has potentially significant amount of dredged material and environmental impacts due to shallow bottom. Therefore, it was removed from further consideration because the need for either a jetty or an elongated turning basin would lead to increased costs. Variation 6 would provide limited benefits because large container vessels would be restricted to backing out of, and turning around outside, the Inner Harbor, further restricting other commercial vessel traffic during a transit. Variation 6 does not improve inefficiencies, has no benefit to the Pilots, and was screened out.

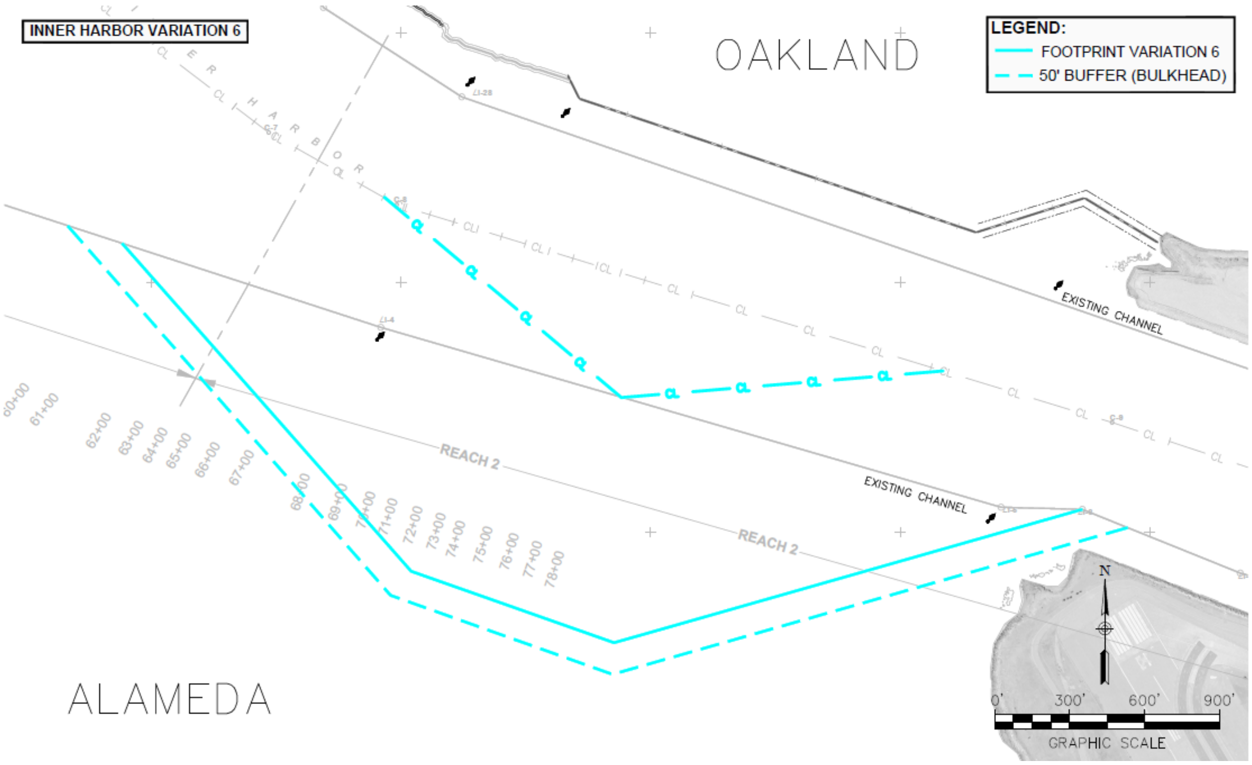



*Figure 33: Inner Harbor Variation 6*

Variation 7 in the Outer Harbor (Figure 34) is a footprint that is northeast of the existing turning basin to decrease impacts to shallow water habitat. The variation would move to deeper water. It would require a larger impacted underwater area than the Outer Harbor TSP. Minor channel alignment/boundary modifications required, but more than the Outer Harbor TSP. Therefore, it is removed from further consideration because it is more costly and could have more environmental impacts than the Outer Harbor TSP.

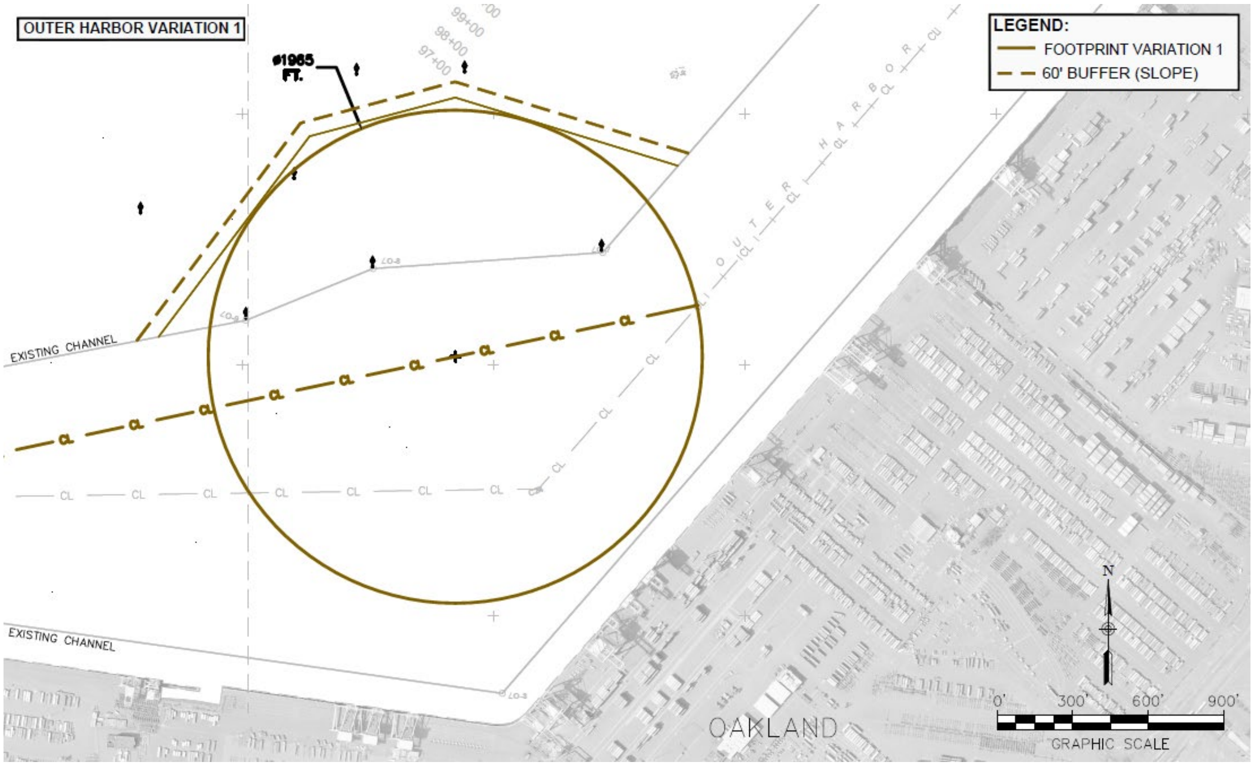



*Figure 34: Outer Harbor Variation 7*

# 7. Quantity Estimates

## 7.1. Existing Grade

Using past topographic and bathymetric surveys, USACE annual dredging plan, geotechnical investigation report, cross sections of the existing grade for each impacted area of the Inner Harbor and Outer Harbor were created. Figures 13, 17, 21 and 26 show the cross sections of the existing grade in the impacted area of the project. Note that the cross section from the closest location in SCI Investigation Report (Port of Oakland, 1999) was used to create the existing grade. A typical cross section in Phase 3E Dredge Plan (USACE, 2006) was used in creating the existing grade.

The cross sections of the existing grade, along with field verification, assumptions, and professional judgment were used to estimate the quantities for the project. In the PED phase of the design, topographic and bathymetric surveys are recommended to be performed to update the existing grade.

## 7.2. Field Verification of Existing Condition

The existing condition for the quantity estimates (such as existing bulkheads, types of pavement, etc.) was verified during the reconnaissance on 24 August 2021. See earlier Section 4.1.

## 7.3. Estimate Assumptions

The volume calculation for the area without existing survey is based on the closest cross sections from 1999 SCI Geotechnical Investigation report, 3:1 slope assumption for sediment, and professional judgment. The depths of different soil layers in the project area were assumed by working with the Port and their consultant in numerous PDT meetings (verbal and written communication). The assumptions were reviewed and compared with the Geotechnical Investigation Report from SCI. The following assumptions, along with the table in Attachment II, were provided by the Port of Oakland on 24 May 2021.

**Howard Terminal:**

- Top 15' (Below Ground Surface (BGS) to lowest level of groundwater contact); Assume 90% material will require disposal at a Class II Landfill; assume the remaining 10% of material requires Class 1 Landfill disposal.
- 15' BGS to contact with Old Bay Mud/Merritt Sand/Posey Formation (OBM/MS) Suitable for Wetland Non-Cover (Montezuma Wetlands).
- Below contact point with OBM/MS, suitable for any reuse (wetland cover, construction, ocean disposal)
- Groundwater can be released to the Bay during construction unless the historic sheet pile wall behind the wharf is breeched for construction. In that case, groundwater will require treatment prior to release to the Bay (or alternative disposal). Further, the new bulkhead will need to be constructed to prevent discharges to the Bay unless the groundwater is completely remediated.

**Alameda:**

- Top 15' BGS to lowest level of groundwater contact; Assume 95% material will require disposal at a Class II Landfill and 5% of the volume will require Class I landfill disposal.
- 15' BGS to contact with OBM/MS Suitable for Wetland Non-Cover (Montezuma Wetlands).
- Below contact point with OBM/MS, suitable for any reuse (wetland cover, construction, ocean disposal).
- Groundwater can be released to the Bay during construction.

**Schnitzer Steel:**

- Assume 75% of the volume of the soil down to 15' BGS requires Class II landfill disposal and 25% requires Class I disposal.
- Material from 15' BGS to contact with OBM/MS will need Class II landfill disposal.
- OBM/MS suitable for any reuse or disposal.
- Groundwater within the site liner will require treatment and offsite disposal. Groundwater below monitoring wells can be discharged to the Bay.
- Any bulkhead will need to be designed to meet environmental mitigation needs (contain and possibly treat groundwater).

**All Exposed Inner Harbor Sediments (currently not under land):**

- Young Bay Mud (and Recent Bay Mud) acceptable as Wetland Non-Cover at Montezuma Wetlands.
- OBM/MS Suitable for any reuse.

- For the basin area between Schnitzer and Howard Terminal assume 20% of the volume excavated between Schnitzer and Howard require Class II disposal. That is, this material will require placement at Berth 10 – dredge rehandling site – for drying prior to landfill disposal.

**All Exposed Outer Harbor Sediments (currently not under land):**

- Young Bay Mud (and Recent Bay Mud) acceptable as Wetland Non-Cover at Montezuma Wetlands.
- OBM/MS Suitable for any reuse.

From these assumptions, along with meetings with the Port, the thicknesses for the volume calculation in each location of the Inner Harbor are presented in the Table 3 to Table 5. Seventeen feet (17') below ground surface (BGS) was used instead of 15' BGS to account for the uncertain depth of the contaminated soil, which was assumed as a further conservative estimate.

*Table 3: Howard Terminal Soil Layer Thickness*

**Howard Terminal**

| Type of Soil (Fast Land Side) | Thickness (ft) |
|---|---|
| Class II (Excavation) | 15.30 |
| Class I (Excavation) | 1.70 |
| OBM/MS Formation (Dredging) | 30.00 |
| Below OBM/MS (Dredging) | 15.00 |

*Table 4: Alameda Soil Layer Thickness*

**Alameda**

| Type of Soil (Fast Land Side) | Thickness (ft) |
|---|---|
| Class II (Excavation) | 16.15 |
| Class I (Excavation) | 0.85 |
| OBM/MS Formation (Dredging) | 30.00 |
| Below OBM/MS (Dredging) | 15.00 |

*Table 5:Schnitzer Steel Soil Layer Thickness*

**Schnitzer Steel**

| Type of Soil (Fast Land Side) | Thickness (ft) |
|---|---|
| Class II (Excavation) | 12.75 |
| Class I (Excavation) | 4.25 |
| OBM/MS Formation (Class II) * | 20.00 |
| Below OBM/MS (Dredging) | 25.00 |

* Use the excavation method, but will use the dredge method in the area where excavation is not feasible.

Other assumptions include:

- land impacted areas (Howard, Alameda and Schnitzer) were calculated using AutoCAD, and they are within ±20% accuracy.
- the length of the existing sheet removal and bulkhead installation were calculated using AutoCAD, but professional judgment was made. They are within ±40% accuracy.

## 7.4. Quantity Estimates for Inner Harbor

The quantities for the Inner Harbor are separated in different tables (Table 6 to Table 10).

*Table 6: Demolition and Construction Quantities for Inner Harbor*

**Demolition and Construction**

| Activity | Qty | Unit |
|---|---|---|
| Demo (Pavement Removal) | 12,600 | CY |
| Demo (Pile Removal on Howard) | 300 | EA |
| Demo (Pile Removal on Alameda) | 2,300 | EA |
| Existing Sheet Removal | 2,800 | LF |
| Bulkhead Installation | 2,500 | LF |

*Table 7: Soil Volume for Disposal from Inner Harbor*

**Howard Terminal**

| Type of Soil (Fast Land Side) | Vol (CY) |
|---|---|
| Class II (Excavation) | 65,200 |
| Class I (Excavation) | 7,200 |
| OBM/MS Formation (Dredging) | 127,800 |
| Below OBM/MS (Dredging) | 63,900 |
| | |
| | |

**Alameda**

| Type of Soil (Fast Land Side) | Vol (CY) |
|---|---|
| Class II (Excavation) | 128,600 |
| Class I (Excavation) | 6,800 |
| OBM/MS Formation (Dredging) | 238,900 |
| Below OBM/MS (Dredging) | 119,000 |
| | |
| | |

| Schnitzer Steel | |
|---|---|
| **Type of Soil (Fast Land Side)** | **Vol (CY)** |
| Class II (Excavation) | 4,700 |
| Class I (Excavation) | 1,600 |
| OBM/MS Formation (Class II) (Dredging) | 7,400 |
| Below OBM/MS (Dredging) | 9,300 |
| | |

*Table 8: Sediment Volume for Disposal in Inner Harbor*

**All Exposed Inner Harbor Sediments**

| Type of Sediment (Water Side) (Dredging) | Volume (CY) |
|---|---|
| YBM | 254,800 |
| Class II Disposal | 63,700 |

*Table 9: Pile Volume for Disposal on Howard Terminal*

**Howard Terminal Pile Removal**

| Number of Piles | Length of Piles (ft) | Total Vol (CY) |
|---|---|---|
| 300 | 125 | 4,400 |

*Table 10: Pile Volume for Disposal on Alameda*

**Alameda Pile Removal**

| Number of Piles | Length of Piles (ft) | Total Vol (CY) |
|---|---|---|
| 2,300 | 65 | 17,400 |

Using the information provided by the Port and the estimated quantities, Table 11 presents the quantities of material for each disposal site.

*Table 11:Volume of Material to Disposal Site for Inner Harbor*

**Inner Harbor**

| Material Type | Volume (CY) | Disposal Location |
|---|---|---|
| Class II Landfill (including piles) | 291,300 | Keller Canyon |
| Class I Landfill | 15,600 | Kettleman Hills |
| OBM/MS (Old Bay Mud/ Merritt Sand) | 366,700 | Montezuma (non-cover) |
| Below (OBM/MS) | 192,600 | Montezuma (cover) |
| YBM (Young Bay Mud) | 254,800 | Montezuma (non-cover) |

## 7.5. Quantity Estimates for Outer Harbor

Using the estimated quantities and the information provided by the Port, Table 12 shows the quantities of material for each of the disposal site for the Outer Harbor.

*Table 12: Volume of Material to Disposal Site for Outer Harbor*

| Outer Harbor | | |
|---|---|---|
| **Material Type** | **Volume (CY)** | **Disposal Location** |
| YBM (Young Bay Mud) | 862,000 | Montezuma (non-cover) |

## 7.6. Utilities Quantities

Table 13 and 14 show the estimated quantities for removal and/or relocation of the identified utility/facilities for the project. Relocations typically fall under LERRDs crediting (RE costs). See Real Estate appendix for more information. The estimated utility quantities were derived from the existing plans provided by the Port of Oakland (see Figure 35 for Howard Terminal), and -50' deepening project (see Figure 36 for Alameda). Additional utility map data from the draft EIR for the Oakland A's Waterfront Ballpark District at Howard Terminal Project were reviewed and analyzed for the estimated quantities. Because the -50' deepening plan did not show (extend) the existing utility information to the project area, professional judgment was used in developing the quantities. Also, no utility plans were available for the Schnitzer Property, however the impacted land area is small, therefore, the utility quantities should be minimal.

*Table 13:Estimated Utility Work for Howard Terminal*

| Howard Terminal Utility Quantities | | |
|---|---|---|
| **Activity** | **Qty** | **UOM** |
| **6" Sanitary Pipe Removal** | 425 | LF |
| **8" Sanitary Pipe Removal** | 200 | LF |
| **Sanitary Manhole Removal** | 3 | EA |
| **3" Water Pipe Removal** | 100 | LF |
| **4" Water Pipe Removal** | 500 | LF |
| **6" Water Pipe Removal** | 50 | LF |
| **8" Water Pipe Removal** | 500 | LF |
| **Fire Hydrant Removal** | 9 | EA |
| **12" Storm Pipe Removal** | 200 | LF |
| **15" Storm Pipe Removal** | 160 | LF |
| **18" Storm Pipe Removal** | 280 | LF |
| **72" Storm Pipe Removal** | 120 | LF |
| **Catch Basin/Storm Structure Removal** | 4 | EA |
| **Light Pole Removal and Relocate** | 1 | EA |

*Table 14: Estimated Utility Work for Alameda Site*

**Alameda Site Utility Quantities**

| Activity | Qty | UOM |
|---|---|---|
| **6" Sanitary Pipe Removal** | 665 | LF |
| **Sanitary Manhole Removal** | 4 | EA |
| **6" Sanitary Pipe Removal and Relocate** | 1,000 | LF |
| **Sanitary Manhole Removal and Relocate** | 5 | EA |
| **2" Gas with Valve Removal** | 665 | LF |
| **2" Gas with Valve Removal and Relocate** | 1,000 | LF |
| **Electrical Conduit with 4.16 KV Cable Removal** | 665 | LF |
| **Electrical Manhole Removal** | 4 | EA |
| **Electrical Conduit with 4.16 KV Cable Removal and Relocate** | 1,000 | LF |
| **Electrical Manhole Removal and Relocate** | 5 | EA |
| **10" Water Line Removal** | 1,050 | LF |
| **Valve Removal** | 6 | EA |
| **Fire Hydrant Removal** | 3 | EA |
| **10" Water Line Removal and Relocate** | 1,550 | LF |
| **Valve Removal and Relocate** | 8 | EA |
| **Fire Hydrant Removal and Relocate** | 4 | EA |
| **6"-10" Storm Drain Pipe Removal** | 650 | LF |
| **Storm Inlet Removal** | 9 | EA |
| **10" Storm Drain Pipe Removal** | 500 | LF |
| **8" Storm Drain Pipe Removal** | 330 | LF |
| **Catch Basin/Storm Structure Removal** | 4 | EA |
| | | |
| **Note: Assume new pipes and structures for the relocation** | | |

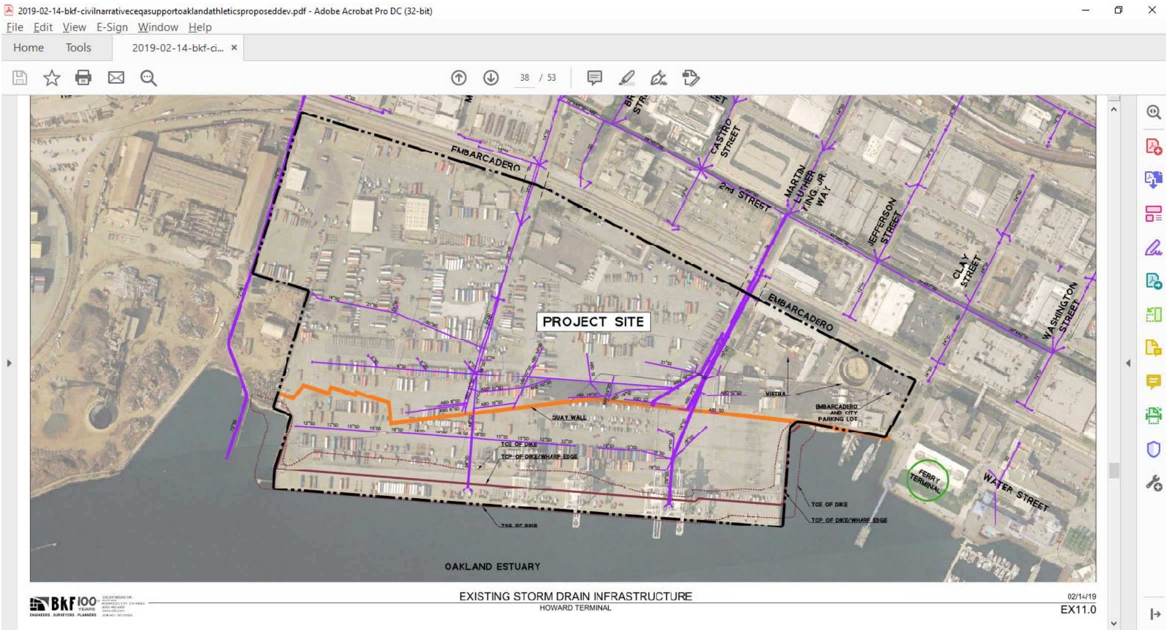



*Figure 35: Existing Utility Plans (Provided by the Port)*

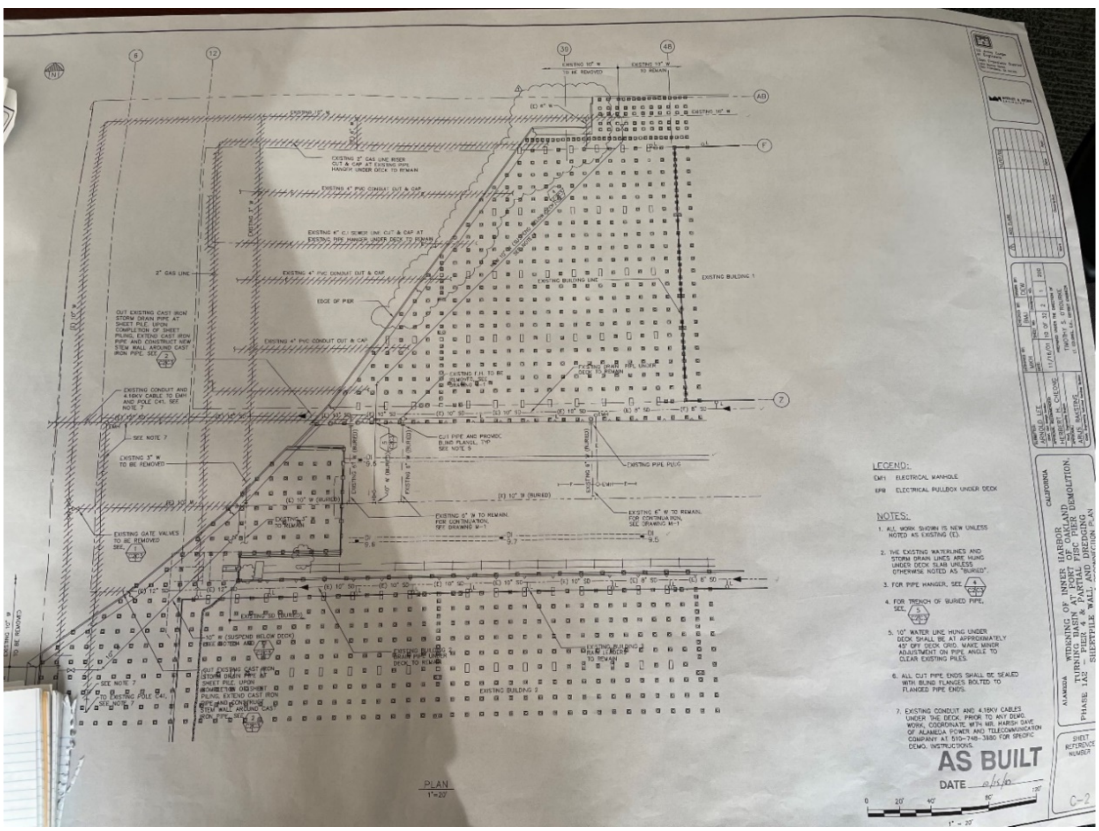



*Figure 36: Widening of Inner Harbor Turning Basin Phase 1A2 Utility Demolition and Reconnection Plan (2001)*

# 8. Construction

The general project limit (proposed work and general proposed staging areas) are shown in the shaded areas on Figure 40 to Figure 42.

## 8.1. Access Routes

For construction site access and access route: the Outer Harbor laydown area can be accessed via 880N/7th Street, 80W/Maritime Street, 880S/W.Grand Ave. The Inner Harbor can be access via 880N/Market St., 880S/Broadway Ave., 980W/12Street. Port of Oakland is the owner of Howard Terminal and the area near the Outer Harbor (Berth 10). Alameda and Schnitzer Steel are privately owned. See Figures 37, 38 and 39 for the haul routes.

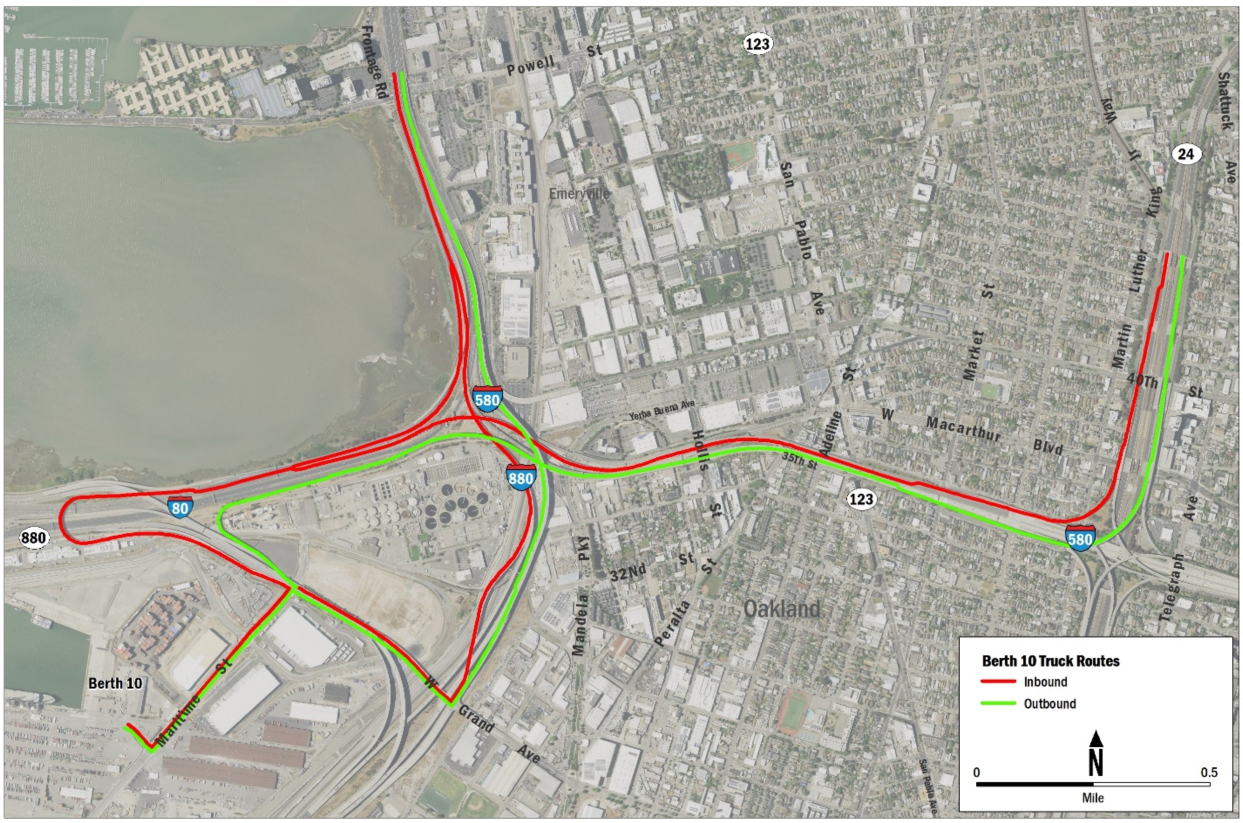



*Figure 37: Truck Routes for Berth 10 (Provided by the Port)*

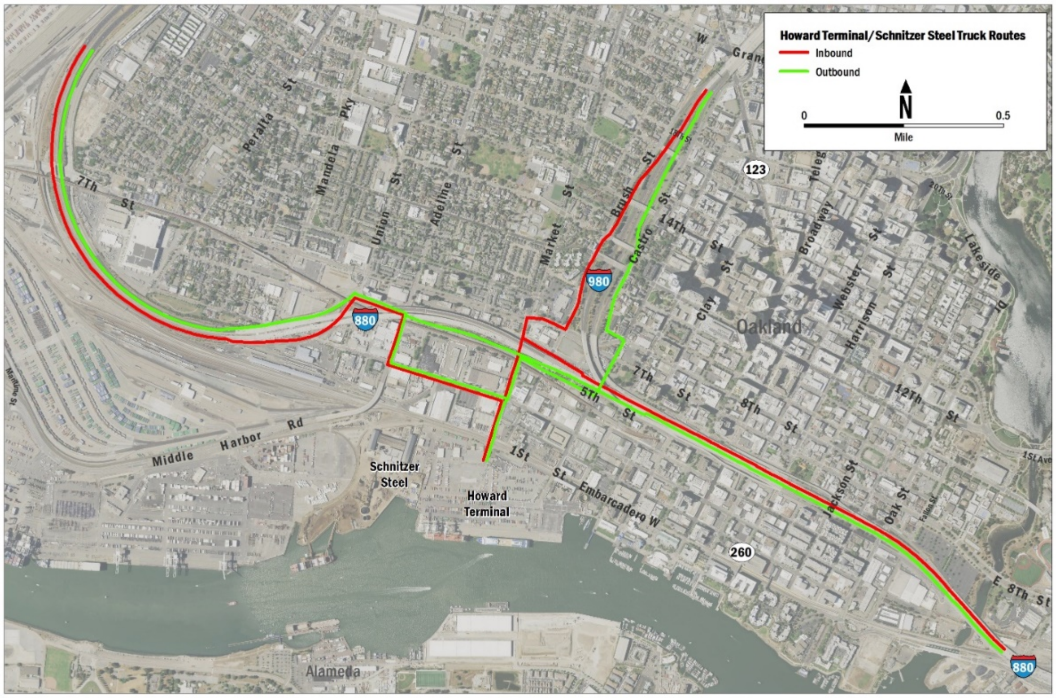



*Figure 38: Truck Routes for Schnitzer and Howard Terminal (Provided by the Port)*

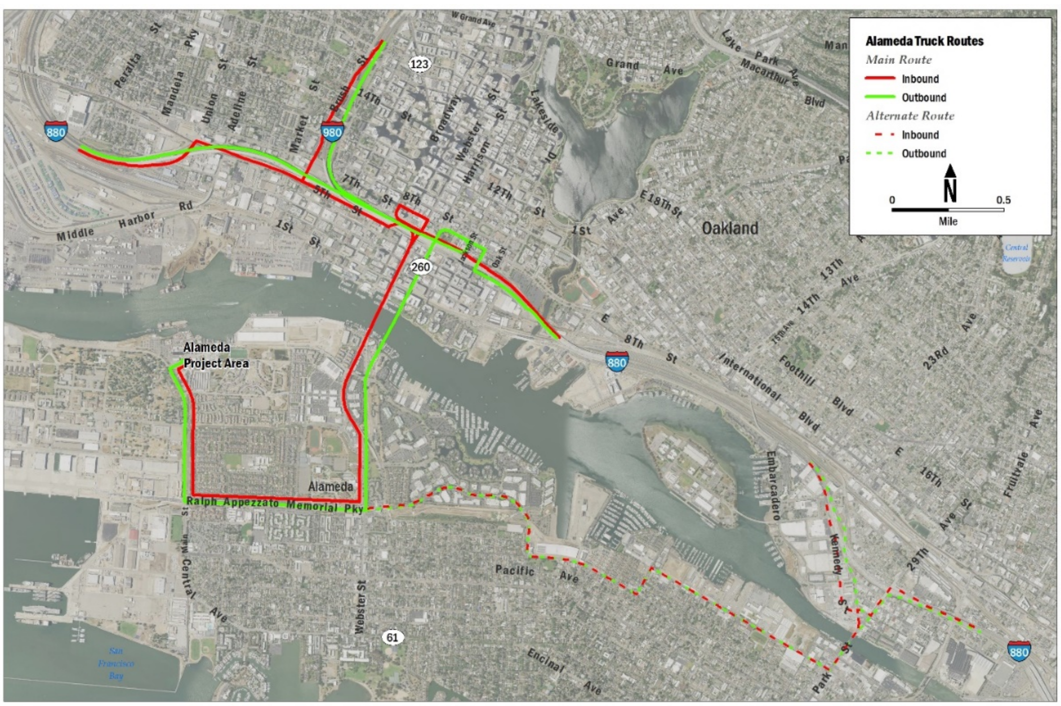



*Figure 39: Truck Routes for Alameda (Provided by the Port)*

## 8.2. Staging Area

The staging areas can be located within the construction area. The area should be adequate to stage for equipment, material, contractor and USACE temporary construction office. See Figures 40-42 for the generally proposed and subject to change construction/staging areas (blue areas). In Figure 40, the estimated area is 11 acres. In Figure 41, the estimated area is 9 acres. In Figure 42, the estimated area is 5 acres. Other areas can be considered during the PED phase of the project.


*Figure 40: Howard Terminal/Schnitzer Steel Proposed Construction Area (Provided by the Port)*


*Figure 41: Alameda Proposed Construction Area (Provided by the Port)*

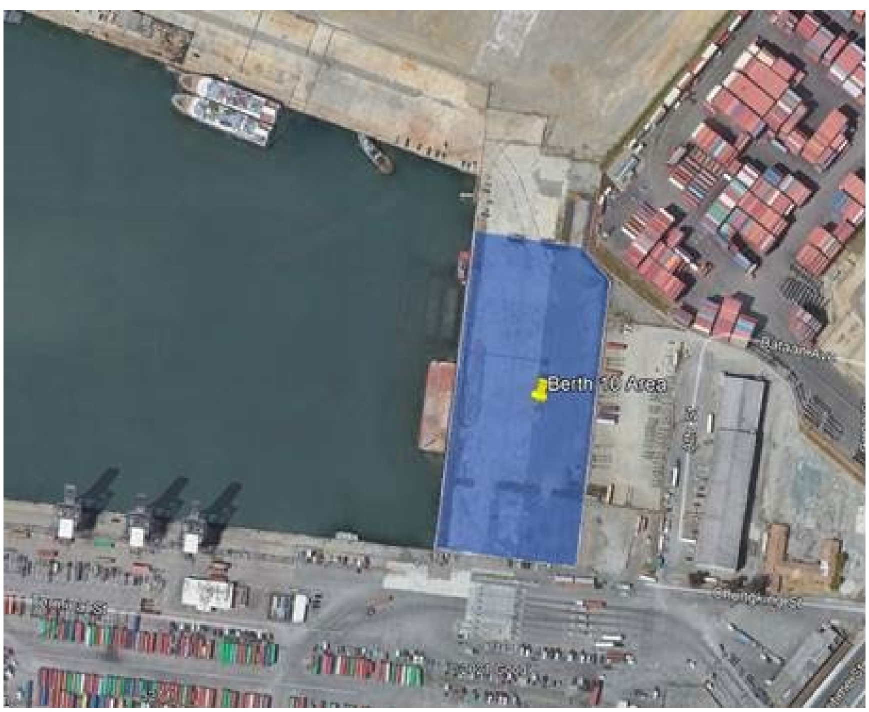



*Figure 42: Outer Harbor Proposed Construction Area (Provided by the Port)*

The maintenance of traffic (MOT) plan can be developed at the PED phase. Most of the traffic is within the project limit.

The disposal sites for the material are Keller Canyon, Kettleman Hills and Montezuma. The dredging material that is Class II would require rehandling at Berth 10.

- The Keller Canyon Landfill (KCL) is located at 901 Bailey Road, in unincorporated Contra Costa County near Pittsburg, CA. At the time of writing, KCLC's application proposes to modify the existing Conditions of Approval (COA) to increase the current maximum daily tonnage limit for disposal from 3,500 to 4,900 tons per day (TPD). Class II material from the project would go to Keller Canyon.
- Kettleman Hills Facility (KHF) is a privately owned hazardous waste and chemical waste landfill. It is located southwest of the Interstate 5 and Highway 41 intersection and approximately 3.5 miles southwest of Kettleman City in Kings County, California. KHF accepts PCB waste and most other types of hazardous waste for disposal. It also accepts non-hazardous solid waste for disposal. KHF is permitted to receive a maximum of 2,000 tons of MSW per day (TPD), however typically receives an average of only about 1,350 TPD. Class I material from the project would go to Kettleman Hills.
- Montezuma Wetland Restoration Site is a privately owned, ongoing restoration project that accepts both wetland cover and wetland non-cover (foundation) quality material from new work and O&M projects. Foundation material is allowed only in the deepest portions of the site and must be covered with at least 3 feet of clean cover material. This site is currently accepting sediment and has an operating off-loader in place. The project site is approximately 17 miles southeast of Fairfield, California. The capacity is 14,000,000 cy. Young Bay Mud and Old Bay Mud from the project would go to Montezuma Wetland Restoration Site or comparable restoration site.
- The Berth 10 is near Maritime Street by TraPac terminal in Oakland Harbor, California. The dredging material identified as Class II, if unsuitable for wetland restoration purposes, would go to Berth 10 for rehandling and landfill disposal at Keller Canyon.

## 8.3. Labor, Material and Equipment Estimates

The equipment, labor, and production rate estimates in Table 15 to Table 27 were developed from past projects and available publication for construction production rates.

*Table 15: Concrete Pavement Removal Activity*

**Concrete Pavement Removal Activity (01)**

| Production Rate /8-10 hours/crew | 1,000 | SY |
|---|---|---|
| **1 Crew Including:** | | |
| Backhoe | 1 | each |
| Concrete Saw | 1 | each |
| Dozer/Front Loader | 1 | each |
| Dump Truck | 2 | each |
| Equipment Operator | 4 | person |
| Labor | 4 | person |

*Table 16: Sheetpile/ Bulkhead Installation Activity*

**Sheetpile/ Bulkhead Installation Activity (02)**

| Production Rate /8-10 hours/crew | 350 | SF |
|---|---|---|
| **1 Crew Including:** | | |
| Backhoe | 1 | each |
| Crane | 1 | each |
| Diesel Hammer (Delmag D30) | 1 | each |
| Dump Truck | 1 | each |
| Equipment Operator | 3 | person |
| Labor | 5 | person |

*Table 17: Land Excavation Activity*

**Land Excavation Activity (03)**

| Production Rate /8-10 hours/crew | 1,500 | CY |
|---|---|---|
| **1 Crew Including:** | | |
| Excavator | 2 | each |
| Dozer | 0 | each |
| Dump Truck | 2 | each |
| Equipment Operator | 4 | person |
| Labor | 6 | person |

*Table 18: Hauling Activity*

**Hauling Activity (04)**

| | | |
|---|---|---|
| Production Rate /8-10 hours/crew | 1,500 | CY |
| **1 Crew Including:** | | |
| Excavator | 2 | each |
| Dump Truck | 75 | each |
| with Trailers (10 CY) | | |
| 2 Trips/Truck/day | | |
| Driver | 75 | person |
| Labor | 4 | person |

*Table 19: Anchor/ Tie back Installation Activity*

**Anchor/ Tie back Installation Activity (05)**

| | | |
|---|---|---|
| Production Rate /8-10 hours/crew | 300 | LF |
| **1 Crew Including:** | | |
| Drilling Rig | 1 | each |
| Backhoe/Excavator | 1 | each |
| Equipment Operator | 2 | person |
| Labor | 6 | person |

*Table 20: Howard Pile Removal Activity*

**Howard Pile Removal Activity (06H)**

| | | |
|---|---|---|
| Production Rate /8-10 hours/crew | 9 | each |
| **1 Crew Including:** | | |
| Barge | 1 | each |
| Dive Vessel | 1 | each |
| Crane | 1 | each |
| Excavator | 1 | each |
| Vibrator | 1 | each |
| Dive Compressor | 1 | each |
| Generator | 1 | each |
| Equipment Operator | 5 | person |
| Labor | 8 | person |

*Table 21: Alameda Pile Removal Activity*

**Alameda Pile Removal Activity (06A)**

| Production Rate /8-10 hours/crew | 18 | each |
|---|---|---|
| **1 Crew Including:** | | |
| Barge | 1 | each |
| Dive Vessel | 1 | each |
| Crane | 1 | each |
| Excavator | 1 | each |
| Vibrator | 1 | each |
| Dive Compressor | 1 | each |
| Generator | 1 | each |
| Equipment Operator | 6 | person |

*Table 22: Sheetpile/Bulkhead Removal Activity*

**Sheetpile/Bulkhead Removal Activity (07)**

| Production Rate /8-10 hours/crew | 1,000 | SF |
|---|---|---|
| **1 Crew Including:** | | |
| Barge | 1 | each |
| Dive Vessel | 1 | each |
| Crane | 1 | each |
| Excavator | 1 | each |
| Torch | 1 | each |
| Dive Compressor | 1 | each |
| Generator | 1 | each |
| Equipment Operator | 6 | person |
| Labor | 8 | person |

*Table 23: Dredging Activity*

**Dredging Activity (08)**

| Production Rate /24-7/crew | 7,000 | CY |
|---|---|---|
| **1 Crew Including:** | | |
| Dredge | 1 | each |
| Crane w/ Clamshell | 1 | each |
| Barge Ship/Scow | 2 | each |
| Equipment Operator | 21 | person |
| Labor | 5 | person |
| Tugboat | 2 | each |

*Table 24: Warehouse Demo Activity*

**Warehouse Demo Activity (09) [1]**

| | | |
|---|---|---|
| Production Rate /8-10 hours/crew | 10,000 | SF |
| **1 Crew Including:** | | |
| Excavator | 1 | each |
| Roll-off High Dumpster | 4 | each |
| Demo Dump Truck | 2 | each |
| Concrete Saw | 2 | each |
| Torch | 2 | each |
| Compressor | 1 | person |
| Equipment Operator | 3 | person |
| Labor | 10 | person |
| **[1] - Does not include asbestos abatement. Assume 3-person crew, 4,000 SF per day abatement rate.** | | |

*Table 25: Pile Hauling Activity*

**Pile Hauling Activity (10)**

| | | |
|---|---|---|
| Production Rate /8-10 hours/crew | 18 | each |
| **1 Crew Including:** | | |
| Excavator | 1 | each |
| Dump Truck | 1 | each |
| with Trailers | | |
| 2 Trip/Truck/day | | |
| Driver | 1 | person |
| Labor | 4 | person |

*Table 26: Berth 10 Class II Loading Activity (11)*

**<u>Berth 10 Class II Loading (11)</u>**

| Production Rate /24-7/crew | 5,000 | CY |
|---|---|---|
| **1 Crew Including:** | | |
| Crane w/ Clamshell | 1 | each |
| Barge Ship/Scow | 2 | each |
| Excavator | 1 | each |
| Dozer | 1 | each |
| Equipment Operator | 23 | person |
| Labor | 5 | person |
| Tugboat | 2 | each |

*Table 27: Berth 10 Class II Loading Activity (12)*

**<u>Berth 10 Class II Hauling (12)</u>**

| Production Rate /24-7/crew | 750 | CY |
|---|---|---|
| **1 Crew Including:** | | |
| Excavator | 1 | each |
| Dozer | 1 | each |
| Dump Truck | 38 | each |
| with Trailers (10 CY) | | |
| 2 Trips/Truck/day | | |
| Driver | 38 | person |
| Equipment Operator | 2 | person |
| Labor | 2 | person |

Using the assumptions above, the construction phasing was created for each impacted area of the project (Table 28 to Table 32).

*Table 28: Howard Terminal Construction Phasing*

**Howard Terminal**

| Item No. | Project Item | QTY | | Crew No. | Working Days |
|---|---|---|---|---|---|
| **01H** | Concrete Pavement Removal Area | 12,780 | SY | 1 | 13 |
| **02H** | Sheetpile/ Bulkhead Installation | 42,250 | SF | 1 | 121 |
| **06H** | Howard Pile Removal Activity | 300 | EA | 1 | 33 |
| **10H** | Pile Hauling | 300 | EA | 1 | 17 |
| **03H** | Land Excavation | 72,407 | CY | 1 | 48 |
| **04H** | Hauling | 72,407 | CY | 1 | 48 |
| **05H** | Anchor/ Tie back Installation | 1,300 | LF | 1 | 4 |
| **07H** | Sheetpile/ Bulkhead Removal | 58,500 | SF | 1 | 59 |
| **08H** | Dredging | 191,667 | CY | 1 | 27 |

*Table 29: Alameda Construction Phasing*

**Alameda**

| Item No. | Project Item | QTY | | Crew No. | Working Days |
|---|---|---|---|---|---|
| **09A** | Warehouse Demo Activity | 260,000 | SF | 1 | 26 |
| **01A** | Concrete Pavement Removal Area | 24,000 | SY | 1 | 24 |
| **02A** | Sheetpile/ Bulkhead Installation | 68,250 | SF | 1 | 195 |
| **03A** | Land Excavation | 135,370 | CY | 1 | 90 |
| **04A** | Hauling | 135,370 | CY | 1 | 90 |
| **06A** | Alameda Pile Removal Activity | 2,300 | EA | 1 | 128 |
| **10A** | Pile Hauling | 2,300 | EA | 1 | 128 |
| **05A** | Anchor/ Tie back Installation | 2,100 | LF | 1 | 7 |
| **06A** | Sheetpile/ Bulkhead Removal | 81,250 | SF | 1 | 81 |
| **07A** | Dredging | 358,333 | CY | 1 | 51 |

*Table 30: Schnitzer Steel Construction Phasing*

**Schnitzer Steel**

| Item No. | Project Item | QTY | | Crew No. | Working Days |
|---|---|---|---|---|---|
| **01S** | Concrete Pavement Removal Area | 1,200 | SY | 1 | 1 |
| **02S** | Sheetpile/ Bulkhead Installation | 20,150 | SF | 1 | 58 |
| **03S** | Land Excavation | 6,296 | CY | 1 | 4 |
| **04S** | Hauling | 6,296 | CY | 1 | 4 |
| **03S-A** | Land Excavation OBM/MS (Class II) | 7,407 | CY | 1 | 5 |
| **04S-A** | Hauling OBM/MS (Class II) | 7,407 | CY | 1 | 5 |
| **05S** | Anchor/ Tie back Installation | 700 | LF | 1 | 2 |
| **06S** | Sheetpile/ Bulkhead Removal | 20,800 | SF | 1 | 21 |
| **07S** | Dredging | 16,667 | CY | 1 | 2 |

*Table 31: All Exposed Inner Harbor Sediments Construction Phasing*

**All Exposed Inner Harbor Sediments (Dredging)**

| Item No. | Project Item | QTY | | Crew No. | Working Days |
|---|---|---|---|---|---|
| **07IN-II** | Dredging - Class II | 63,704 | CY | 1 | 9 |
| **11+12IN** | Berth 10 Class II Handling | 63,704 | CY | 1 | |
| **07IN** | Dredging - YBM | 254,815 | CY | 1 | 36 |

*Table 32: Outer Harbor Sediment Construction Phasing*

**Outer Harbor Sediment Dredging**

| Item No. | Project Item | QTY | | Crew No. | Working Days |
|---|---|---|---|---|---|
| **07OH** | Dredging - YBM | 862,000 | CY | 1 | 123 |

## 8.4. Construction and Dredging Schedule

The construction and dredging schedule were created using the assumptions and durations in Section 8.3. The activities that can be performed inside the environmental window (1 June – 30 Nov) are any activities that are related to dredging, including dredging in the fast land area of the Inner Harbor. The activities that can be performed outside of the environmental window are any activities that are not related to dredging, for instance, concrete pavement removal in the fast land, sheetpile/bulkhead removal and installation, etc. (Table 33)

*Table 33: Allowable Activity Outside the Environmental Window*

**Allowable Activity Outside the Environmental Window**

| |
|---|
| **Concrete Pavement Removal Area** |
| **Sheetpile/ Bulkhead Installation** |
| **Pile Removal Activity** |
| **Pile Hauling** |
| **Land Excavation** |
| **Hauling** |
| **Anchor/ Tie back Installation** |

| Sheetpile/ Bulkhead Removal |
| --- |
| Warehouse Demo Activity (Alameda) |

The complete schedules are shown in Attachment I.

## 8.5. Dredging Method and Equipment

The TSP includes the use of an electric clamshell dredge for all dredging activities. After reviewing the existing Phase 3B and 3C Electrical plans (USACE, 2004) and information provided by the Port, it is assumed that a new substation in the Outer Harbor is not required for the electric dredge. Assumed costs include, new metering equipment (from Port of Oakland), switch gear equipment, high chain link fence with access gate, electric vault, and other miscellaneous items in the Outer Harbor. The cost is taken into account in the contingency of the cost estimate. See Table 34 for the quantities of the minor equipment in the Outer Harbor. See Figure 43 for the proposed location.

*Table 34: Electrical Equipment for Outer Harbor*

| Project Item | QTY | |
| --- | --- | --- |
| 12” PVC Conduit (Reuse Existing) | 160 | FT |
| 2 X 6” PVC Conduits 750 MCM (Reuse Existing) | 30 | FT |
| Chain Link Fence | 80 | FT |
| Metering Equipment | 1 | EA |
| Switch Gear Equipment | 1 | EA |
| Electrical Vault | 1 | EA |

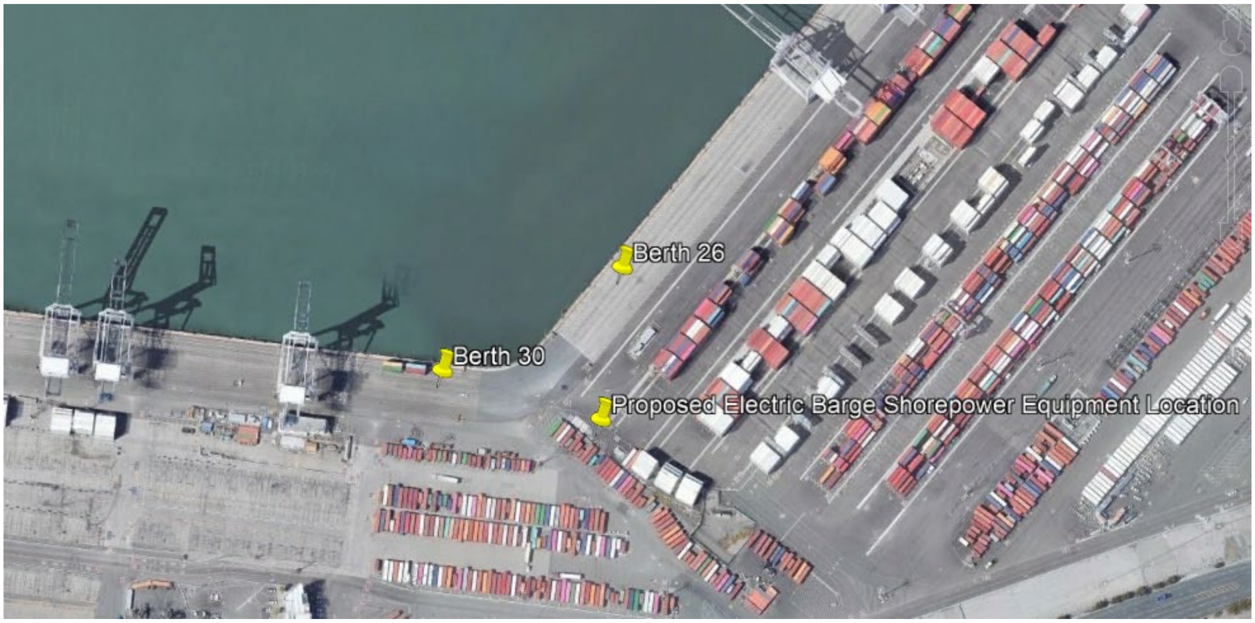



*Figure 43: Outer Harbor Substation Location (Information Provided by the Port)*

There is an existing substation in the Inner Harbor (see Figure 44 for the location), however, it is used by others. It is assumed that a new substation would be needed as a worst-case scenario, and it is taken into account in the contingency of the estimate.

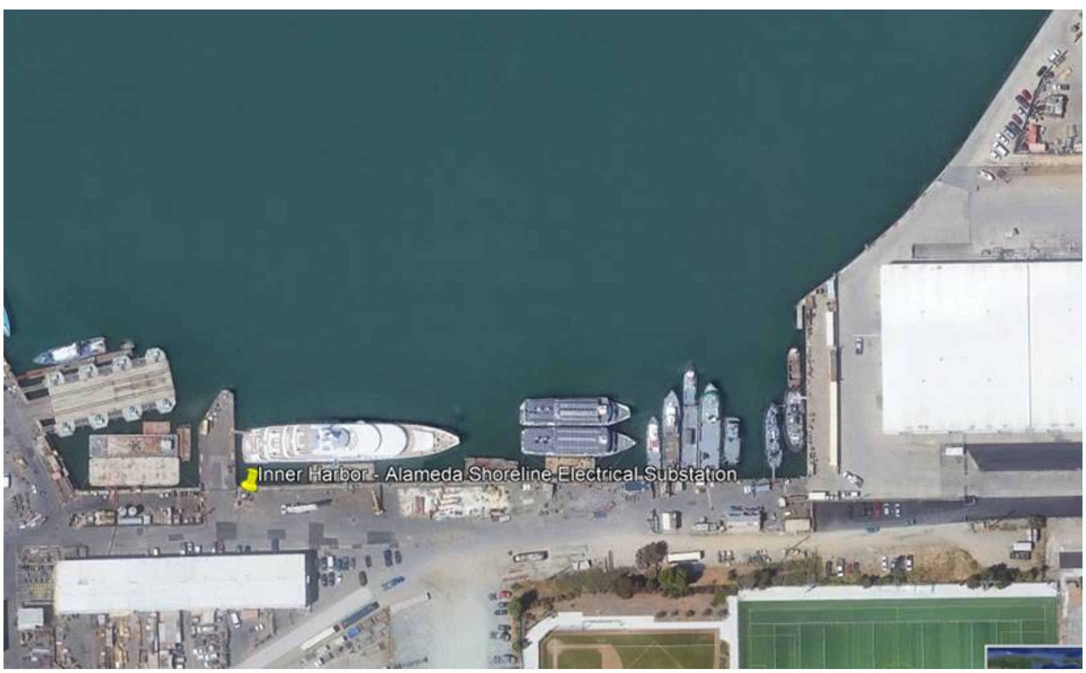



*Figure 44: Inner Harbor Substation Location (Information Provided by the Port)*

## 8.6. Disclaimer

The equipment, labor and production rate assumptions were created using past construction experience of similar construction projects, as well as using professional judgement. The construction schedule for the NEPA analyses is created from the equipment, labor, and production rate assumptions. A dredging schedule is also created. The schedules are developed using professional judgment. Construction means and methods are usually developed by the Contractor. The level of detail is high level and only appropriate for NEPA analyses. Additional details and refinements will be included during the next milestone of the study and during the PED phase of the project. Schedules are subject to change at the time of construction.

# 9. Further Analysis and Design Development Needs

To meet the 3x3x3 constraints, no new data were collected for analysis during the feasibility study. Limited data from the prior harbor deepening study, discussions with the Port, and professional judgment were used for the analysis. While this is acceptable in the feasibility phase, suggested data collection and analysis to be conducted during the PED phase are discussed below.

## 9.1. Topographic & Bathymetric Survey

Topographic and bathymetric surveys are recommended in the areas with limited or no survey data. Also, surveys are recommended in the entire project area to refine the cost, since the surveys used in the feasibility study are outdated.

## 9.2. Soil Testing

Soil testing is recommended to refine the quantities of different types of soil and sediment, including assumed contaminated soil, in the project area.

## 9.3. Utility Survey

Utility survey is needed for construction plans and specifications.

## 9.4. Ship Simulation

Because the proposed footprints (variations) were created using a turning basin multiplier, a ship simulation is recommended in the PED phase to verify that the proposed footprints would work for the project and Pilots.

# 10. References

CSU Maritime Academy, (2019). “Port of Oakland Navigation Ultra Large Container Vessel (ULCV 400m X 59m) Inner Harbor Feasibility Study”.

Port of Oakland, (2021). “Berth 67 Condition Survey”. January 26, 2021.

Port of Oakland, (2021). “Berth 68 Condition Survey”. January 26, 2021.

Port of Oakland, (1980). “Charles P. Howard Terminal Construction of Dike, Fill, and Concrete

Wharf". File AA-2124.

Port of Oakland, (1981). "Charles P. Howard Terminal Construction of Yard Improvements Phase I". File AA-2168.

Port of Oakland (2019). "Civil Narrative-CEQA Support Oakland Athletics Proposed Development".

Port of Oakland, (1999). "Geotechnical Investigation Oakland Harbor Navigation Improvement (-50 Foot) Project, Port of Oakland." February 12, 1999.

Texas Department of Transportation, (2020). Construction Production Rates". March 31, 2020.

U.S. Army Corps of Engineers, San Francisco District, (2001). "Oakland Harbor Navigation Improvement (-50 Foot) Project, Final Initial Design Documentation Report." March 2001.

U.S. Army Corps of Engineers, San Francisco District, (2006). "Oakland Harbor Navigation Improvement -50 Foot Deeping Project Phase 3E." Sheet C8. February 27, 2006.

U.S. Army Corps of Engineers, San Francisco District, (2001). "Widening of Inner Harbor Turning Basin at Port of Oakland Phase 1A2 – Pier 4 & Partial FISC Pier Demolition, Sheetpile Wall and Dredging" Sheet C-2. November 16, 2001.

U.S. Army Corps of Engineers, San Francisco District, (2004). "Oakland Harbor Navigation Improvement -50' Deepening Project Inner and Outer Harbors: Phase 3B and 3C Electrical Plans" June 24, 2004.

USACE (2006). Hydraulic Design of Deep Draft Navigation Projects. (EM 1110-2-1613).

# Attachment I: Construction and Dredging Schedule

## Howard Terminal

| | Activity | QTY | | Crew No. | Working Day(s) | Backhoe/ Front Ldr | Concrete Saw | Crane | Dozer | Dump Truck | Drilling Rig | Barge Ship | Dive Vessel | Dredging Vessel | Diesel Hammer | Excavator | Vibratory Hammer | Tug Boat | Compressor | Generator | Torch | Equipment Operator | Labor | Driver | Weeks (5 Working Days) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Per Day | | | | | | | | | | | | | | | | | | | | |
| 01H | Concrete Pavement Removal Area | 12,780 | SY | 1 | 13 | 1 | 1 | | 1 | 2 | | | | | | | | | | | | 4 | 4 | | 3 | 3 |
| 02H | Sheetpile/ Bulkhead Installation | 42,250 | SF | 1 | 121 | 1 | | 1 | | 1 | | | | | 1 | | | | | | | 3 | 5 | | 25 | 26 |
| 06H | Howard Pile Removal Activity | 300 | EA | 1 | 33 | | | 1 | | | | 1 | 1 | | | 1 | 1 | | 1 | 1 | | 5 | 8 | | 7 | 10 |
| 10H | Pile Hauling | 300 | EA | 1 | 17 | | | | | | | | | | | 1 | | | | | | 1 | 2 | 1 | 4 | 10 |
| 03H | Land Excavation | 72,407 | CY | 1 | 48 | | | | 0 | 2 | | | | | | 2 | | | | | | 4 | 6 | | 10 | 36 |
| 04H | Hauling | 72,407 | CY | 1 | 48 | | | | | 75 | | | | | | 2 | | | | | | | 4 | 75 | 10 | 36 |
| 05H | Anchor/ Tie back Installation | 1,300 | LF | 1 | 4 | 1 | | | | | 1 | | | | | | | | | | | 2 | 6 | | 1 | 37 |
| 07H | Sheetpile/ Bulkhead Removal | 58,500 | SF | 1 | 59 | | | 1 | | | | 1 | 1 | | | 1 | | | 1 | 1 | 1 | 6 | 8 | | 12 | 49 |
| 08H | Dredging | 191,667 | CY | 1 | 27 | | | 1 | | | | 2 | | 1 | | | | 2 | | | | 21 | 5 | | 6 | 55 |

## Alameda

| | Activity | QTY | | Crew No. | Working Day(s) | Backhoe/ Front Ldr | Concrete Saw | Crane | Dozer | Dump Truck | Drilling Rig | Barge Ship | Dive Vessel | Dredging Vessel | Diesel Hammer | Excavator | Vibratory Hammer | Tug Boat | Compressor | Generator | Torch | Equipment Operator | Labor | Driver | Weeks (5 Working Days) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Per Day | | | | | | | | | | | | | | | | | | | | |
| 09A | **Warehouse Demo Activity** | 260,000 | SF | 1 | 26 | | 2 | | | 2 | | | | | | 1 | | | 2 | | 1 | 3 | 10 | 2 | 6 | 6 |
| 01A | Concrete Pavement Removal Area | 24,000 | SY | 1 | 24 | 1 | 1 | | 1 | 2 | | | | | | | | | | | | 4 | 4 | | 5 | 5 |
| 02A | Sheetpile/ Bulkhead Installation | 68,250 | SF | 1 | 195 | 1 | | 1 | | 1 | | | | | 1 | | | | | | | 3 | 5 | | 39 | 40 |
| 03A | Land Excavation | 135,370 | CY | 1 | 90 | | | | 0 | 2 | | | | | | 2 | | | | | | 4 | 6 | | 19 | 59 |
| 04A | Hauling | 135,370 | CY | 1 | 90 | | | | | 75 | | | | | | 2 | | | | | | | 4 | 75 | 19 | 59 |
| 06A | Alameda Pile Removal Activity | 2,300 | EA | 1 | 128 | | | 1 | | | | 1 | 1 | | | 1 | 1 | | 1 | 1 | | 5 | 8 | | 26 | 85 |
| 10A | Pile Hauling | 2,300 | EA | 1 | 128 | | | | | | | | | | | 1 | | | | | | 1 | 2 | 1 | 26 | 85 |
| 05A | Anchor/ Tie back Installation | 2,100 | LF | 1 | 7 | 1 | | | | | 1 | | | | | | | | | | | 2 | 6 | | 2 | 61 |
| 06A | Sheetpile/ Bulkhead Removal | 81,250 | SF | 1 | 81 | | | 1 | | | | 1 | 1 | | | 1 | | | 1 | 1 | 1 | 6 | 8 | | 17 | 78 |
| 07A | Dredging | 358,333 | CY | 1 | 51 | | | 1 | | | | 2 | | 1 | | | | 2 | | | | 21 | 5 | | 11 | 89 |

## Schnitzer Steel

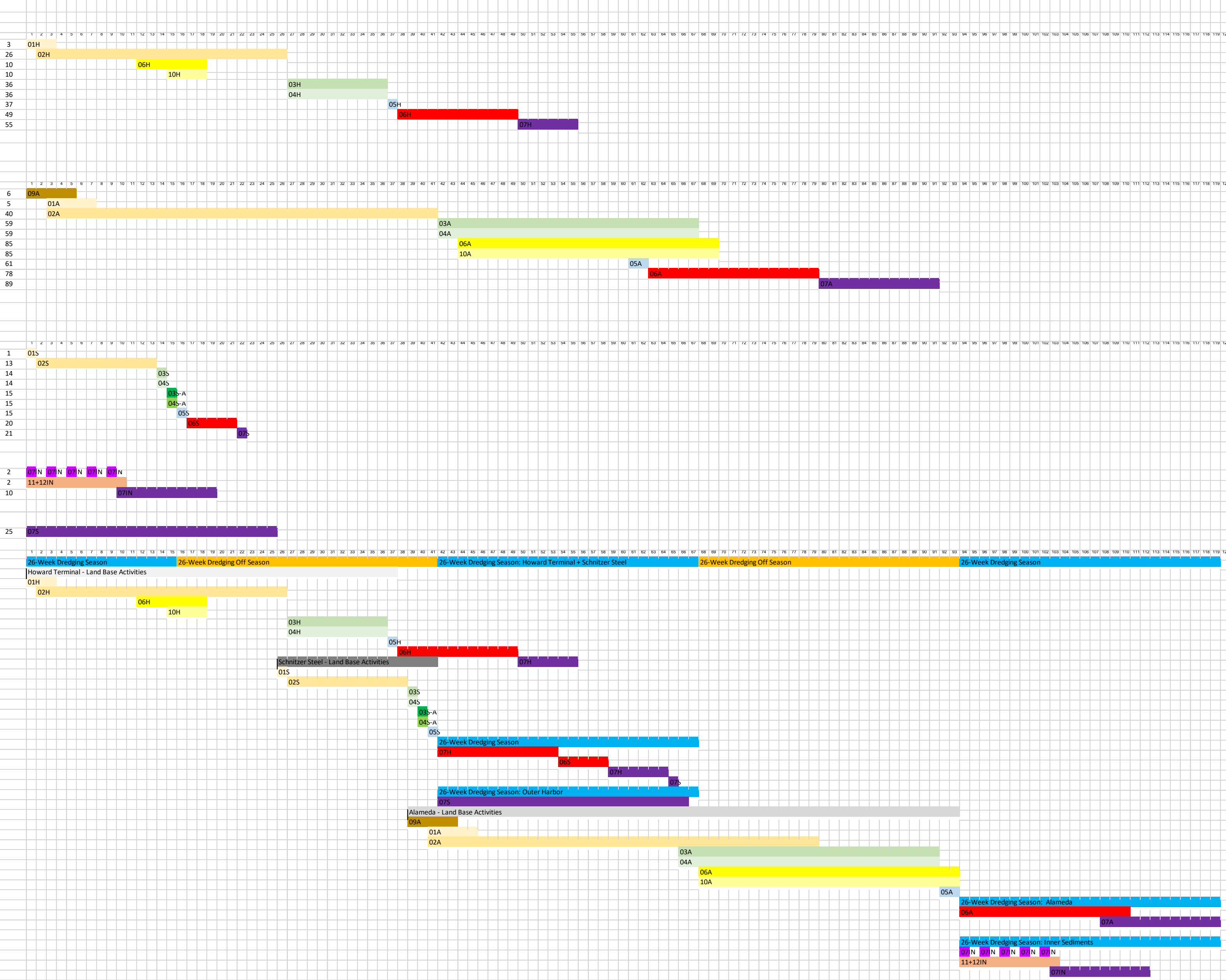
| | Activity | QTY | | Crew No. | Working Day(s) | Backhoe/ Front Ldr | Concrete Saw | Crane | Dozer | Dump Truck | Drilling Rig | Barge Ship | Dive Vessel | Dredging Vessel | Diesel Hammer | Excavator | Vibratory Hammer | Tug Boat | Compressor | Generator | Torch | Equipment Operator | Labor | Driver | Weeks (5 Working Days) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Per Day | | | | | | | | | | | | | | | | | | | | |
| 01S | Concrete Pavement Removal Area | 1,200 | SY | 1 | 1 | 1 | 1 | | 1 | 2 | | | | | | | | | | | | 4 | 4 | 0 | 1 | 1 |
| 02S | Sheetpile/ Bulkhead Installation | 20,150 | SF | 1 | 58 | 1 | | 1 | | 1 | | | | | 1 | | | | | | | 3 | 5 | 0 | 12 | 13 |
| 03S | Land Excavation | 6,296 | CY | 1 | 4 | | | | 0 | 2 | | | | | | 2 | | | | | | 4 | 6 | 0 | 1 | 14 |
| 04S | Hauling | 6,296 | CY | 1 | 4 | | | | | 75 | | | | | | 2 | | | | | | | 4 | 75 | 1 | 14 |
| 03S-A | Land Excavation OBM/MS (Class II) | 7,407 | CY | 1 | 5 | | | | 0 | 2 | | | | | | 2 | | | | | | 4 | 6 | 0 | 1 | 15 |
| 04S-A | Hauling OBM/MS (Class II) | 7,407 | CY | 1 | 5 | | | | | 75 | | | | | | 2 | | | | | | | 4 | 75 | 1 | 15 |
| 05S | Anchor/ Tie back Installation | 700 | LF | 1 | 2 | 1 | | | | | 1 | | | | | | | | | | | 2 | 6 | 0 | 1 | 15 |
| 06S | Sheetpile/ Bulkhead Removal | 20,800 | SF | 1 | 21 | | | 1 | | | | 1 | 1 | | | 1 | | | 1 | 1 | 1 | 6 | 8 | 0 | 5 | 20 |
| 07S | Dredging | 16,667 | CY | 1 | 2 | | | 1 | | | | 2 | | 1 | | | | 2 | | | | 21 | 5 | 0 | 1 | 21 |

## Inner Harbor Sediments

| | Activity | QTY | | Crew No. | Working Day(s) | Backhoe/ Front Ldr | Concrete Saw | Crane | Dozer | Dump Truck | Drilling Rig | Barge Ship | Dive Vessel | Dredging Vessel | Diesel Hammer | Excavator | Vibratory Hammer | Tug Boat | Compressor | Generator | Torch | Equipment Operator | Labor | Driver | Weeks (5 Working Days) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 07IN-II | Dredging - Class II | 63,704 | CY | 1 | 9 | | | 1 | | | | 2 | | 1 | | | | 2 | | | | 21 | 5 | | 2 | 2 |
| 11+12IN | Berth 10 Class II Handling | 63,704 | CY | 1 | | | | 1 | 1 | 38 | | 2 | | 1 | | 1 | | 2 | | | | 23 | 5 | 38 | 0 | 2 |
| 07IN | Dredging - YBM | 254,815 | CY | 1 | 36 | | | 1 | | | | 2 | | 1 | | | | 2 | | | | 21 | 5 | | 8 | 10 |

## Outer Harbor

| | Activity | QTY | | Crew No. | Working Day(s) | Backhoe/ Front Ldr | Concrete Saw | Crane | Dozer | Dump Truck | Drilling Rig | Barge Ship | Dive Vessel | Dredging Vessel | Diesel Hammer | Excavator | Vibratory Hammer | Tug Boat | Compressor | Generator | Torch | Equipment Operator | Labor | Driver | Weeks (5 Working Days) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 07OH | Dredging - YBM | 862,000 | CY | 1 | 123 | | | 1 | | | | 2 | | 1 | | | | 2 | | | | 21 | 5 | | 25 | 25 |



## Attachment II: Oakland Harbor Turning Basins Feasibility Study

| | | | |
|---|---|---|---|
| **<u>SOIL/SEDIMENT SUITABILITY ASSUMPTIONS</u>** | | | |
| **Howard Terminal** | | **Disposal** | |
| | Top 15' BGS | 90% Class II Landfill, 10% Class I Landfill | |
| | 15' BGS to OBM/MS | Wetland Non-Cover | |
| | Below OBM/MS | SF-DODS or Wetland Cover | |
| | | | |
| **Alameda** | | **Disposal** | |
| | Top 15' BGS | 95% Class II Landfill, 5% Class I Landfill | |
| | 15' BGS to OBM/MS | Wetland Non-Cover | |
| | Below OBM/MS | SF-DODS or Wetland Cover | |
| | | | |
| **Schnitzer** | | **Disposal** | |
| | Top 15' BGS | 75% Class II landfill, 25% Class I Landfill | |
| | 15' BGS to OBM/MS | Class II Landfill | |
| | Below OBM/MS | SF-DODS or Wetland Cover | |
| | | | |
| **All Exposed Inner Harbor Sediments** | | **Disposal** | |
| | YBM | Wetland Non-Cover | |
| | OBM/MS | SF-DODS or Wetland Cover | |
| | Basin between Schnitzer/Howard | 20% Class II Disposal | |
| | | | |
| **All Exposed Outer Harbor Sediments** | | **Disposal** | |
| | YBM | Wetland Non-Cover | |
| | OBM/MS | SF-DODS or Wetland Cover | |
| | | | |
| **Notes** | | | |
| | Based on information provided in 5/9/21 APEX memo and 5/21/21 AECOM memo | | |
| | "BGS" = Below Ground Surface | | |
| | "OBM" = Old Bay Mud | | |
| | "MS" = Merrit Sand | | |
| | "YBM" = Young Bay Mud | | |
| | | | |

Note: As of TSP milestone, SF-DODS is no longer under consideration for the OBM/MS disposal site.