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Technical Memorandum

To:	Rob Holmlund (HBHRCD)
From:	Erik Nielsen (SHN)
Date:	April 23, 2024
Subject:	**Dredge Characterization Sampling and Analysis Plan Considerations**
Project:	Redwood Marine Multipurpose Terminal Replacement Project
Location:	Eureka, CA
M&N Job No:	212991-03
cc:	Shane Phillips (M&N)

Disclaimer: This draft technical memorandum is a work-in-progress and is intended to be an internal document for use by the Humboldt Bay Offshore Wind Heavy Lift Marine Terminal Project team as a part of the conceptual design process and the ongoing permitting process. This memorandum is meant to be read as a part of a comprehensive packet of technical analyses. It is not written to be a standalone document and it is assumed that the reader has substantial project knowledge and context to understand the memorandum's content. All aspects of this memorandum are subject to change and may become less accurate over time. To better understand the project, please review the more comprehensive and up-to-date documents posted to the Humboldt Bay Harbor District's website at https://humboldtbay.org/humboldt-bay-offshore-wind-heavy-lift-marine-terminal-project-3.

Introduction

The Humboldt Bay Harbor, Recreation, and Conservation District (HBHRCD) is in the process of developing a sediment sampling and analysis plan (SAP) for dredging associated with construction of the Redwood Marine Multipurpose Terminal (RMMT) project (Figure 1). This memorandum consolidates existing known project information and describes some of the key considerations for SAP development. Corresponding figures referenced in this memorandum are provided in Attachment 1.

Dredging Area and Material Types

Dredging operations cover approximately 190 acres that extend from the project shoreline, south of the Samoa Federal Navigation Channel, and past the Samoa Channel Turning Basin (Figure 2). Initial dredging for the project is estimated to be in the range of 5 to 6 million cubic yards (cy) with subsequent maintenance dredging conducted at a rate and volume yet to be determined. Dredging depths will need to accommodate berth for vessels, wet storage for floating platforms and fully assembled devices, and a sinking basin for vertical integration of the wind turbine devices that will range from -40 to -60 feet (ft) mean lower low water (MLLW; Figure 3).

Material types known to be present in these areas consist of recently deposited fine-grained material (silty clay) that overlay historical deposits of sand and fine-grained sediment. Upland geotechnical borings completed along the project shoreline show a layer of loose sand beneath the upper deposits followed by alternating sequences of fine and coarse material that increase in density with depth (Figures 4 and 5). Geotechnical borings completed for the Samoa Channel Bridge retrofit show a geologic profile depicting this alternating sequence of deposits north of the RMMT dredging area (Figure 6).

Dredge Methods and Disposal Options

A variety of dredging methods may be used based on sediment conditions present that include bucket/clamshell, hopper, and cutter head suction (Figure 7). The intended placement of dredge material and the possibility of beneficial reuse will also have an influence on the dredging methods selected. Dredge material comprised predominately of fines (clay and silt) may be less desirable for dewatering and upland placement while offshore disposal of mostly coarse material (sand) may be considered misuse of a potential resource. To address final disposition of dredge sediment, options for disposal and potential beneficial reuse are being considered for this project that include:

1. Barge transport for disposal at the Humboldt Open Ocean Disposal Site (HOODS)
2. Pumping to Samoa Beach for beach replenishment
3. Pumping offshore (for example, ¼ mile) of Samoa Beach
4. Hopper placement offshore of Samoa Beach
5. Pumping or mechanical conveyor to the upland for use as fill at the RMMT project site
6. Pumping material to the HBHRCD's temporary storage site for dewatering and future upland placement and reuse
7. Placement onto salt marshes to maintain the elevation required to support salt marsh ecosystems as sea level rises

A combination of dredging methods and beneficial use/disposal options will likely be used; with specifics determined by the results of sediment characterization (chemical and physical) as well as other considerations (Figures 8 and 9).

SAP Development

The RMMT dredge area is considered "new" dredging, has very little available historical data, and can require a large number of samples for consideration of disposal and beneficial reuse options. However, the project area is also predominately comprised of pre-industrial age sediment (>200 years) and a significant amount of coarse material that would allow for reduced testing for adequate evaluation. Identification of project segments having relatively similar characteristics such as texture, potential source impacts (risk), hydraulic energy, and homogeneity of material will be necessary for development of the SAP testing program. Each project segment will be characterized individually with material

collected from multiple core stations within each segment then consolidated prior to sample testing. The number of samples, station locations and collection methods within each segment are not determined at this time.

A preliminary assessment for areas of potential concern would include the nearshore mudflats and the upper 5-feet across the remaining RMMT dredge prism (Figure 10). Using guidance from the Ocean Testing Manual (OTM), this area of increased risk is where a more comprehensive testing program for approval of offshore disposal at HOODS will be required. Tiered testing procedures outlined in the OTM are prescribed in a manner of steps where the results will determine if additional testing is required for compliance evaluation. If the results of sediment chemical testing exceed regulatory screening levels, then further analysis for bioaccumulation and toxicity may be required to ensure dredging and material placement are not harmful on the water column, sediment column, and food web.

Sediment analysis for evaluation of open ocean disposal or beneficial reuse can range from texture analysis for grain size distribution to complete characterization of potential impacts from constituents of concern on the aquatic and benthic environment. Without detailed coring logs mapping the offshore project area stratigraphy, disposal/reuse planning and development of a testing program specific to dredge area project segments will be difficult.

Permitting

Permits to conduct dredging in Humboldt Bay are issued by the U.S. Army Corps of Engineers (USACE) San Francisco District, Dredge Material Management Office (DMMO). The DMMO is comprised of multiple agencies providing oversight specific to the area of dredging and final placement of the material. The offshore disposal of Humboldt Bay dredged material currently occurs at HOODS under the jurisdiction of the U.S. Environmental Protection Agency, Region 9 in San Francisco (EPA).

Any material dredged from Humboldt Bay that is considered for beneficial reuse and upland placement will be under the jurisdiction of North Coast Regional Water Quality Control Board (RWQCB) in Santa Rosa, California. The California Department of Fish and Wildlife (DFW), California Coastal Commission (CCC), USACE, and the State Lands Commission may additionally have permitting requirements for dredging nearshore and upland reuse. The material intended for upland placement and reuse may also be required to undergo a different sampling process such as incremental sampling methodology (ISM), which will vary from the DMMO requirements for aquatic disposal.

Challenges

A range of challenges exist that influence a framework for data collection, analysis, and schedule for completing and implementing an SAP to aid in the determination of dredged material management options for project permitting. Those include the following:

- **Existing Data**—Lack of available subsurface data within the dredging prism located between the navigation channel and upland nearshore zone.

- **Pre-Industrial Layer Depth**—Determining the depth to pre-industrial layer within the dredge area would constitute a different sampling and testing approach.
- **Schedule**—Availability of work windows and qualified vendors for conducting the field program for a comprehensive marine geotechnical investigation (using drilling equipment).
- **Equipment Accessibility**—Accessibility of equipment to conduct the sampling work within the footprint of the large overwater timber wharf structure.

Reconnaissance Level Investigation

At this time, using the available information and regulatory guidelines to prepare the RMMT dredge sediment SAP will require many assumptions to be made. Obtaining information through the completion of bores within the dredge area prism is needed for delineation of sediment characteristics at depth and laterally. Several reconnaissance options may be available in the near future that can be utilized for collecting pertinent information for SAP development that include using the HBHRCD's Vibracore sampling system or conducting the marine geotechnical investigation program for project design. A series of initial physical property testing and detailed coring logs completed to support the SAP will allow for a reduction in testing requirements and improved planning for final disposition of the material. Each potential reconnaissance option will have benefits and drawbacks as described below.

- **Method A—District-owned Vibracore System:** Equipment is limited to approximately 10 ft of continuous core length in unconsolidated sediment and will encounter refusal at consolidated material. The vessel will need to remain stable during operations, which will limit use in open water. The drive tube is polyethylene that hangs from a cable, which may also limit abilities in open water and varied conditions such as strong current. This option has a very low cost to implement, is readily available, and can provide quality data for areas such as the nearshore mud flat. The collection of samples for physical testing using this system is effective in unconsolidated material. Noting depths of refusal encountered through this sampling system will additionally provide good information on where consolidated and potentially pre-industrial aged material may be present.

- **Method B—Marine Geotechnical Investigation—Rotary Borings:** This method of drilling will allow for deep borings to be completed throughout the dredge prism via a dedicated vessel or drilling barge. The collection of geotechnical data that includes material density and samples for testing of physical parameters will allow for delineation and mapping of offshore stratigraphy. Alternative methods such as sonic drilling may be employed, but feasibility for the type of material testing work would need to be verified. This level of operation is costly and dependent on the availability of capable vendors, which may be limited.

- **Method C—Marine Geotechnical Investigation—Vibratory Borings:** This method of coring will allow for borings to be completed deeper than the HBHRCD's current Vibracore system at locations throughout the dredge prism. Operation in open water and nearshore will be made capable by a dedicated vessel or drilling barge. The vibratory equipment will be limited in penetrating dense material but should extend to a depth of 20 ft below the sediment surface in

soft material. This level of operation by this method is costly and dependent on the availability of capable vendors which may be limited.

Recommendations

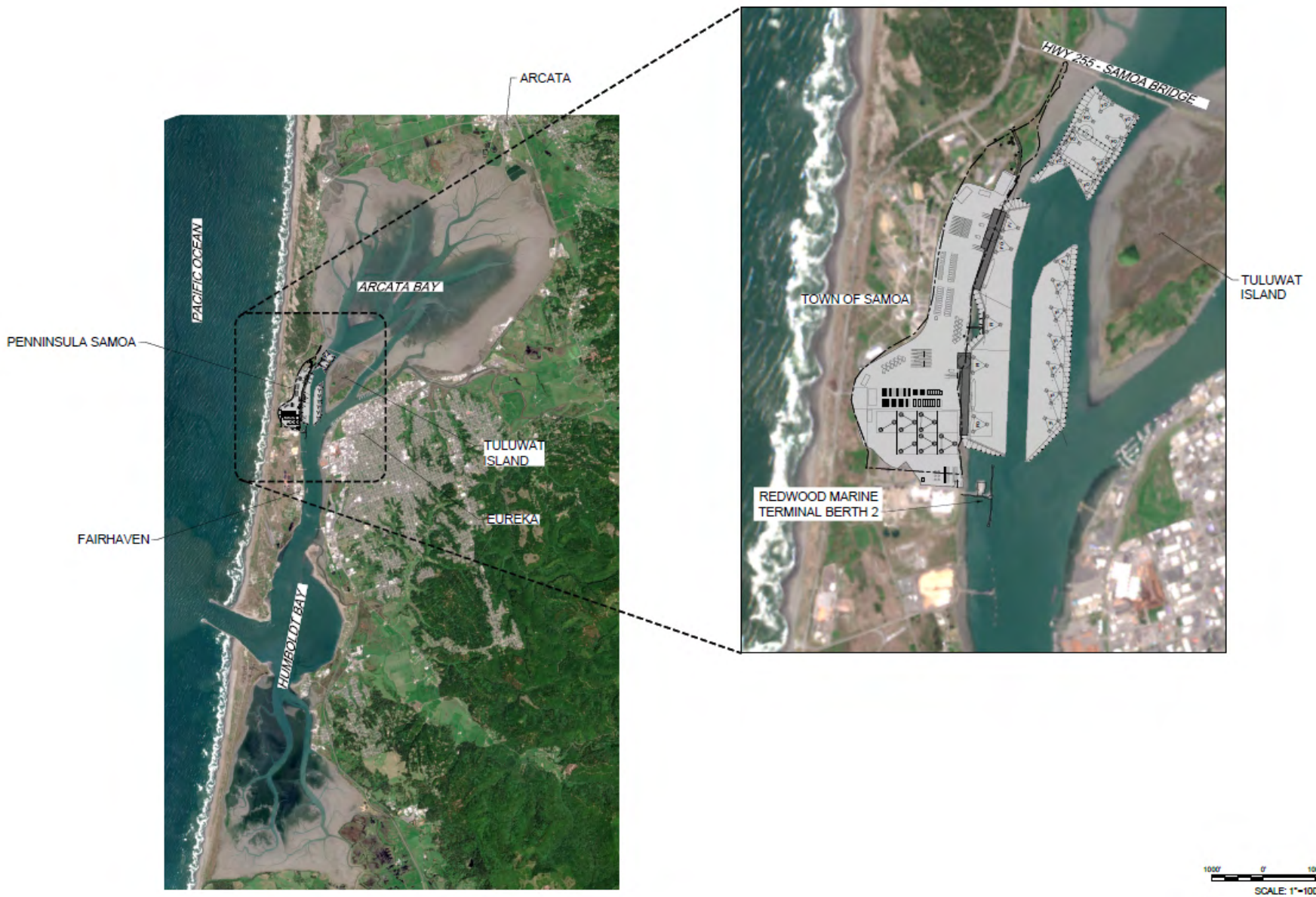
Based on our review of project components and available information for dredging and disposal/beneficial reuse options, field investigation alternatives, and the range of challenges for the project at this stage, we recommend the following:

- **Multi-Step Data Collection Strategy—**Following a multi-step process will help outline the right methods for delineation of project segments within the dredge area relative to sampling, testing requirements, and proposed intended uses of the dredged material. The multistep process framework would be as follows:
    - **Step 1. Reconnaissance**
        - Purpose: Collect data to define the contact layer between finer surface sediments and historic, preindustrial deposits; determine depth from surface to pre-industrial layer. The surface layer would be managed differently for step 2 sampling and testing than the underlying preindustrial layer (Figure 8).
        - Methods: Utilize Method "A" outlined in the Alternatives section (HBHRCD-owned Vibracore).
        - Locations: Locations for sampling would align with the locations outlined by risk level (High, Medium, Low) and within locations accessible with HBHRCD equipment. Locations would be similar to those outlined in Figure 11.
        - Sampling & Testing: The focus of the sampling and testing would be focused on grain size. Testing for chemical constituents would not be conducted as compositing relative to dredge area project segments won't yet be known.
        - Outcomes: Layer depth by location in the dredge area that will allow better determination of volumes of dredged material by location, risk level and testing requirements (pre-industrial vs. post-industrial). The outcome from Step 1 will be used as the basis for the Step 2 SAP development and determination of alternative field investigation methods if needed.
    - **Step 2. SAP Development & Implementation**
        - Purpose: Outline a SAP for approval that will provide for:
            a. data collection to aid in the determination of intent for use of dredged material (HOODS vs. beneficial reuse) for project design purposes, and
            b. inform the sampling and testing requirements for beneficial reuse versus HOODS by type of material and location within the dredge prism.
        - Methods: A combination of methods may be employed based on the outcomes of Step 1.
        - Locations: TBD based on outcome of Step 1.

Concurrence from DMMNC subcommittee is needed regarding the two-step approach and requirements for the step 1 data collection and testing to achieve the outlined purpose and outcomes.

Attachment 1. Figures

FIGURES 1

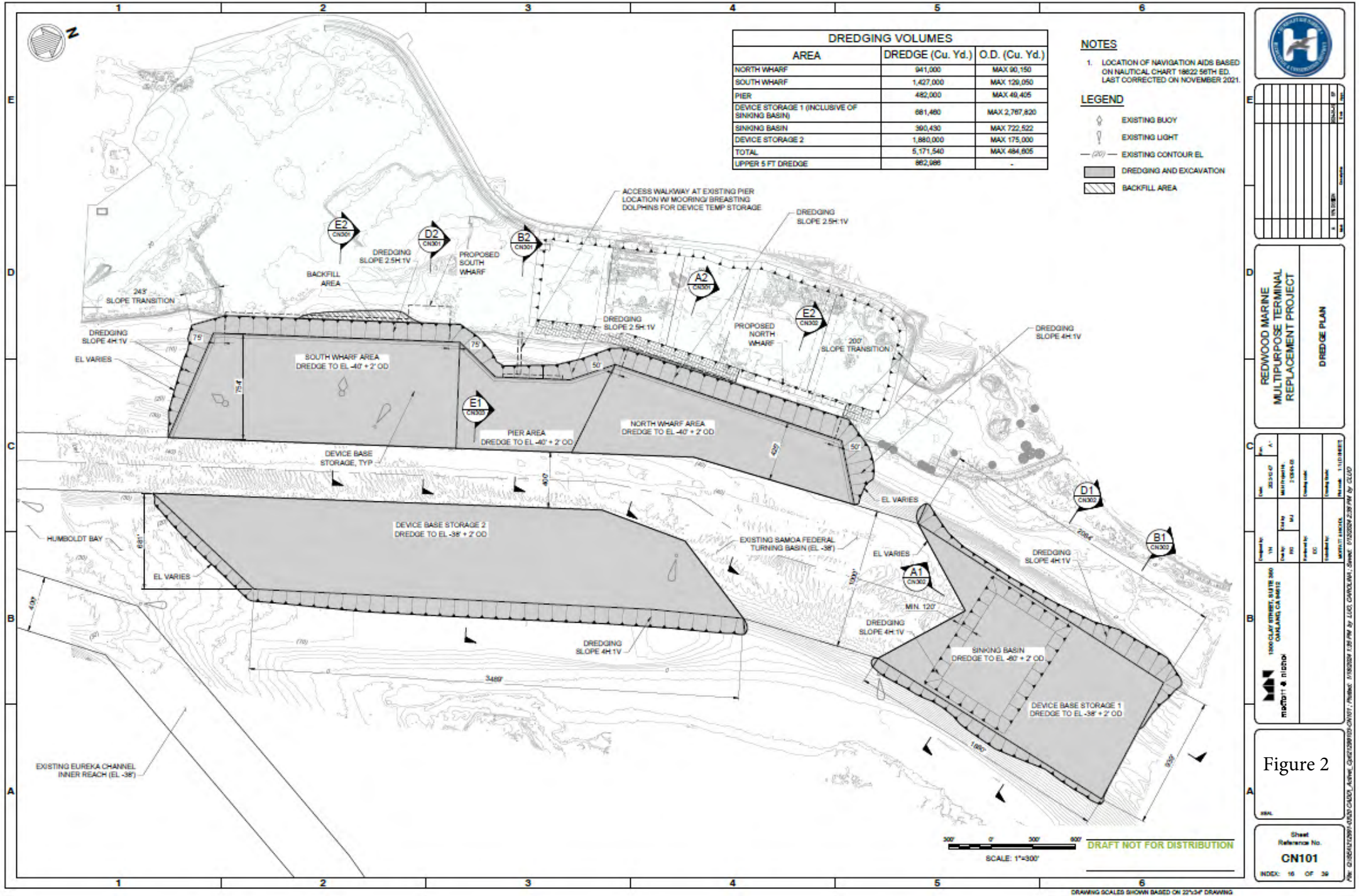


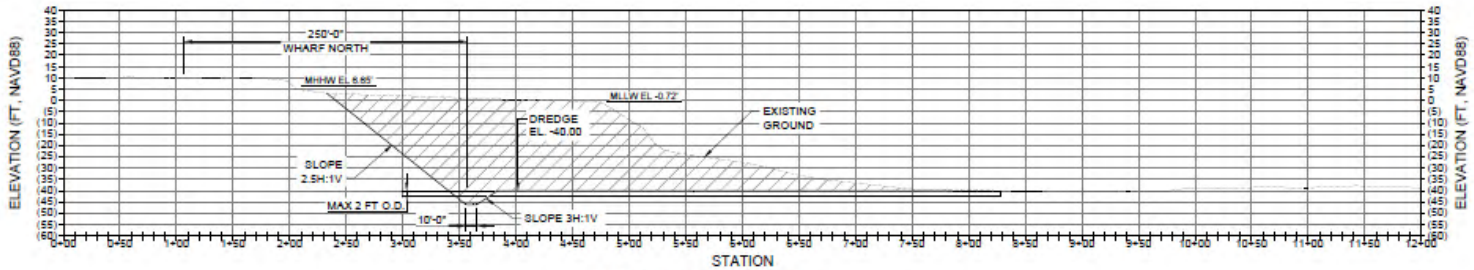
REDWOOD MARINE MULTIPURPOSE TERMINAL REPLACEMENT PROJECT

PROJECT LOCATION

Figure 1

Sheet Reference No.
G-101
INDEX: 3 OF 39


DREDGING VOLUMES
AREA | DREDGE (Cu. Yd.) | O.D. (Cu. Yd.)
NORTH WHARF | 941,000 | MAX 90,150
SOUTH WHARF | 1,427,000 | MAX 129,050
PIER | 482,000 | MAX 49,405
DEVICE STORAGE 1 (INCLUSIVE OF SINKING BASIN) | 681,460 | MAX 2,787,820
SINKING BASIN | 390,430 | MAX 722,522
DEVICE STORAGE 2 | 1,880,000 | MAX 175,000
TOTAL | 5,171,540 | MAX 484,605
UPPER 5 FT DREDGE | 862,986 | -
NOTES
1. LOCATION OF NAVIGATION AIDS BASED ON NAUTICAL CHART 18622 56TH ED. LAST CORRECTED ON NOVEMBER 2021.
LEGEND
EXISTING BUOY
EXISTING LIGHT
EXISTING CONTOUR EL
DREDGING AND EXCAVATION
BACKFILL AREA
ACCESS WALKWAY AT EXISTING PIER LOCATION W/ MOORING/ BREASTING DOLPHINS FOR DEVICE TEMP STORAGE
DREDGING SLOPE 2.5H:1V
PROPOSED SOUTH WHARF
BACKFILL AREA
245' SLOPE TRANSITION
DREDGING SLOPE 4H:1V
EL VARIES
SOUTH WHARF AREA DREDGE TO EL -40' + 2' OD
PIER AREA DREDGE TO EL -40' + 2' OD
NORTH WHARF AREA DREDGE TO EL -40' + 2' OD
PROPOSED NORTH WHARF
200' SLOPE TRANSITION
DEVICE BASE STORAGE, TYP
DEVICE BASE STORAGE 2 DREDGE TO EL -38' + 2' OD
HUMBOLDT BAY
EXISTING SAMOA FEDERAL TURNING BASIN (EL -38')
MIN. 120'
SINKING BASIN DREDGE TO EL -80' + 2' OD
DEVICE BASE STORAGE 1 DREDGE TO EL -38' + 2' OD
EXISTING EUREKA CHANNEL INNER REACH (EL -38')
3489'
1880'
839'
SCALE: 1"=300'
DRAFT NOT FOR DISTRIBUTION
REDWOOD MARINE MULTIPURPOSE TERMINAL REPLACEMENT PROJECT
DREDGE PLAN
Figure 2
Sheet Reference No.
CN101
INDEX: 16 OF 39
DRAWING SCALES SHOWN BASED ON 22"x34" DRAWING

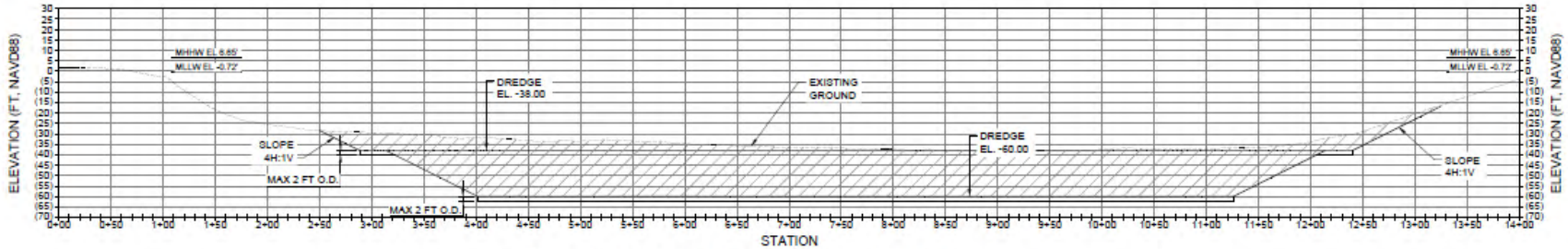


LEGEND

DREDGING AND EXCAVATION

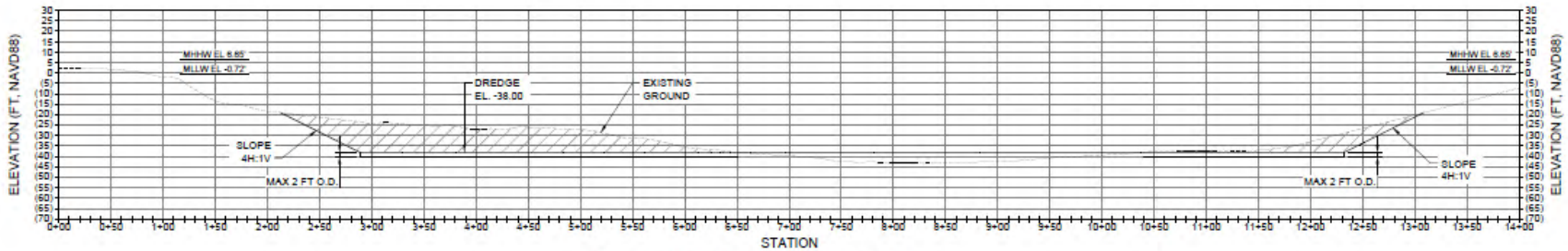
E2 CN101 SECTION - WHARF 1

SCALE: H:1"=60' V:1"=30'



D1 CN302 SECTION - DEVICE BASE STORAGE 1 (SINKING BASIN)

SCALE: H:1"=60' V:1"=30'



B1 CN101 SECTION - DEVICE BASE STORAGE 1

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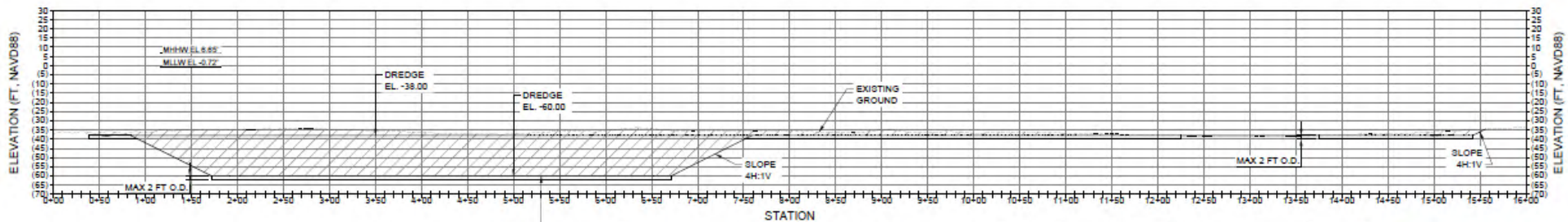


A1 CN302 SECTION - DEVICE BASE STORAGE 1

SCALE: H:1"=60' V:1"=30'

SCALE: V:1"=30'

SCALE: H:1"=60'

DRAFT NOT FOR DISTRIBUTION

REDWOOD MARINE MULTIPURPOSE TERMINAL REPLACEMENT PROJECT

DREDGE SECTIONS (2 OF 3)

1300 CLAY STREET, SUITE 600 OAKLAND, CA 94612

moffatt & nichol

Figure 3

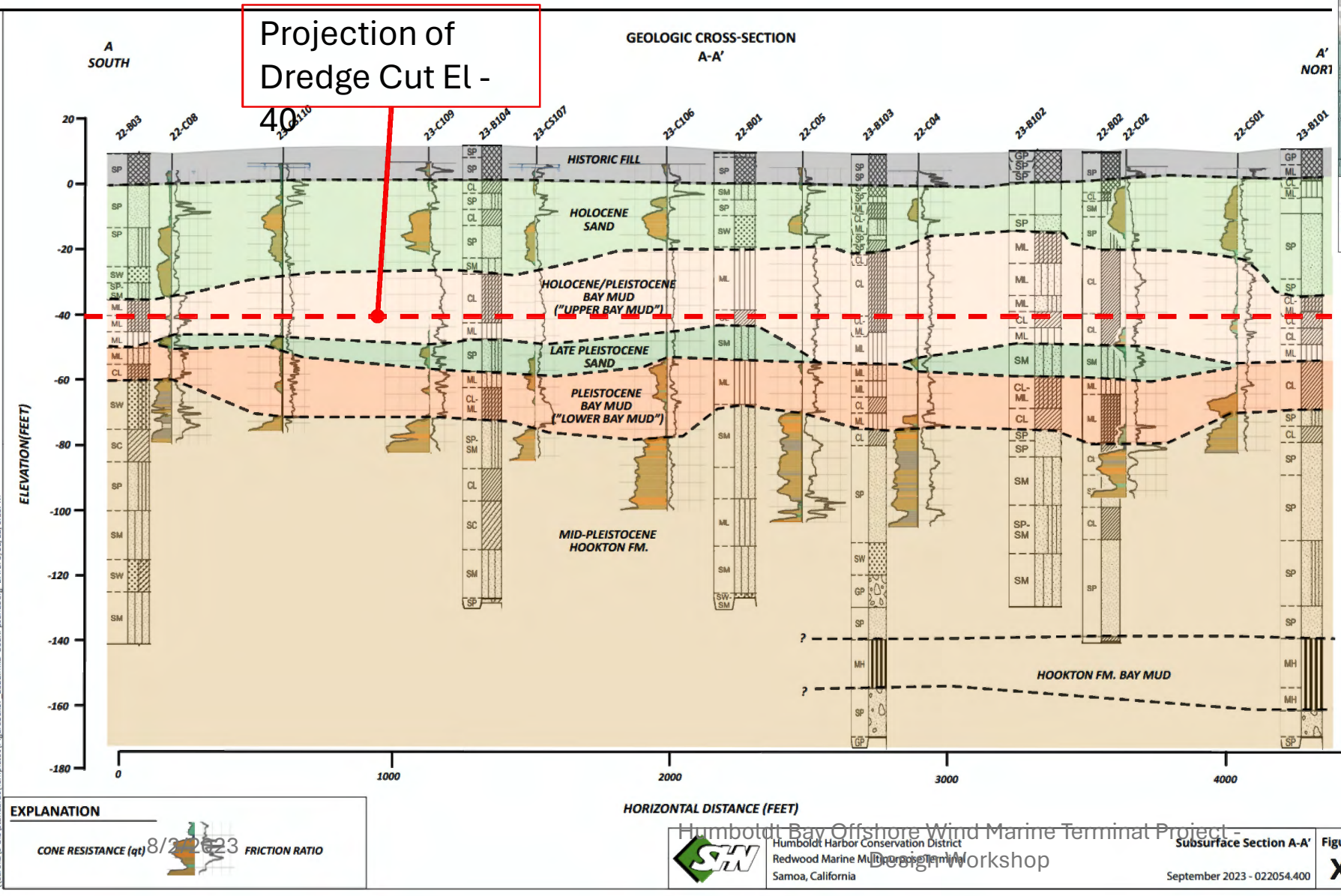
SEAL

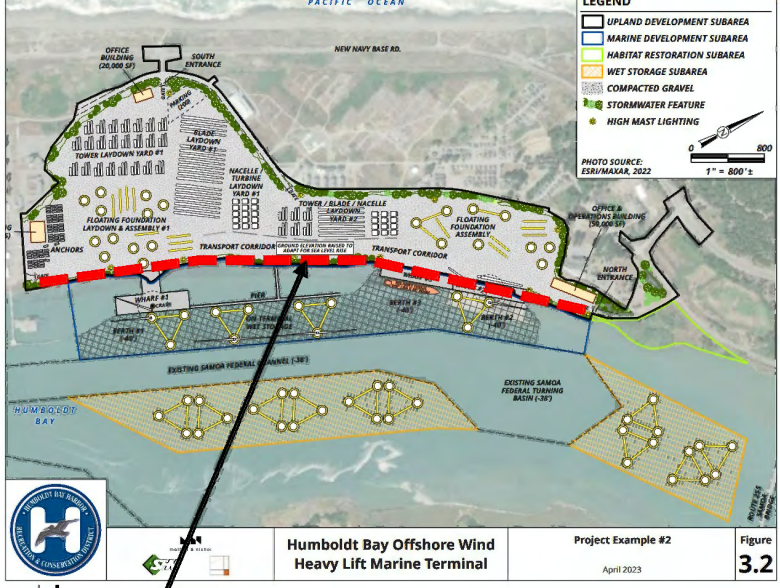
Sheet Reference No. CN302

INDEX: 21 OF 39

Channel Sediments – Harbor District (Shoreline Edge)

Figure 4

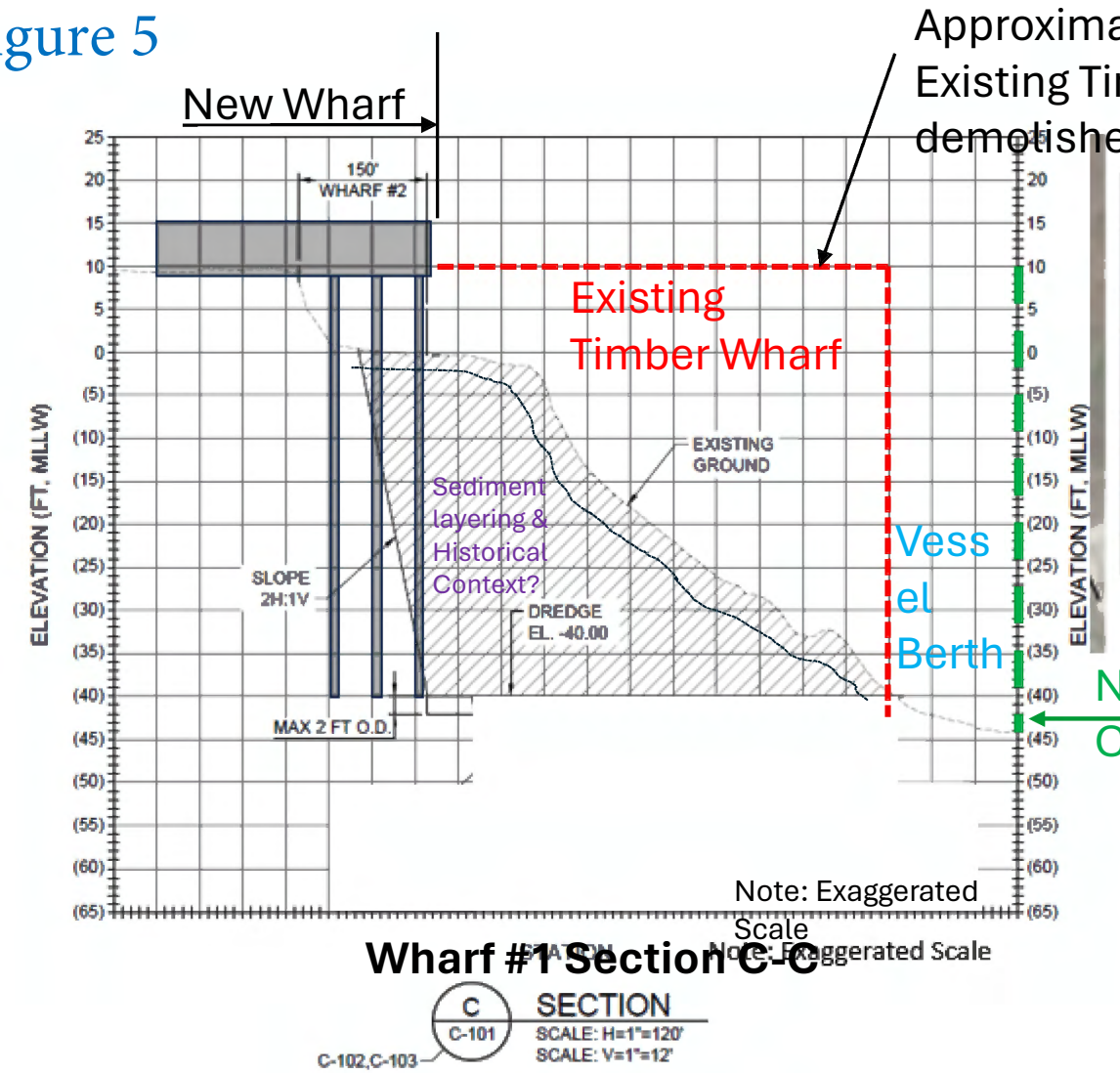




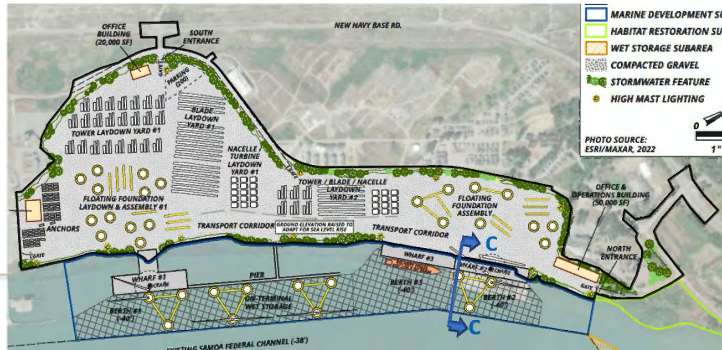
- Layering of silts/mud and sand depending on elevation are expected

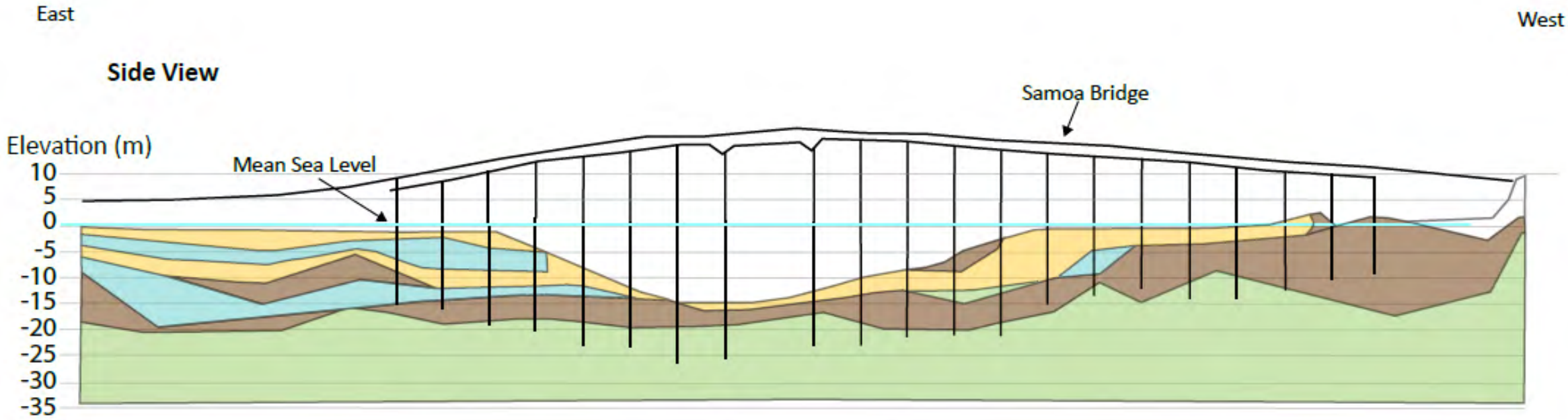
Berth Dredging – Outline of Work & Quantities

Figure 5



DREDGING VOLUMES		
AREA	DREDGE (Cu Yd)	O.D. (Cu Yd)
WHARF 1	535,000	MAX 31,500
WHARF 2 (INCLUSIVE OF SINKING BASIN)	723,200	MAX 42,000
SINKING BASIN	148,200	MAX 12,000
WHARF 3	1,990,000	MAX 150,000
DEVICE STORAGE 1	310,100	MAX 121,000
DEVICE STORAGE 2	1,705,500	MAX 175,000
TOTAL	5,263,800	MAX 519,500





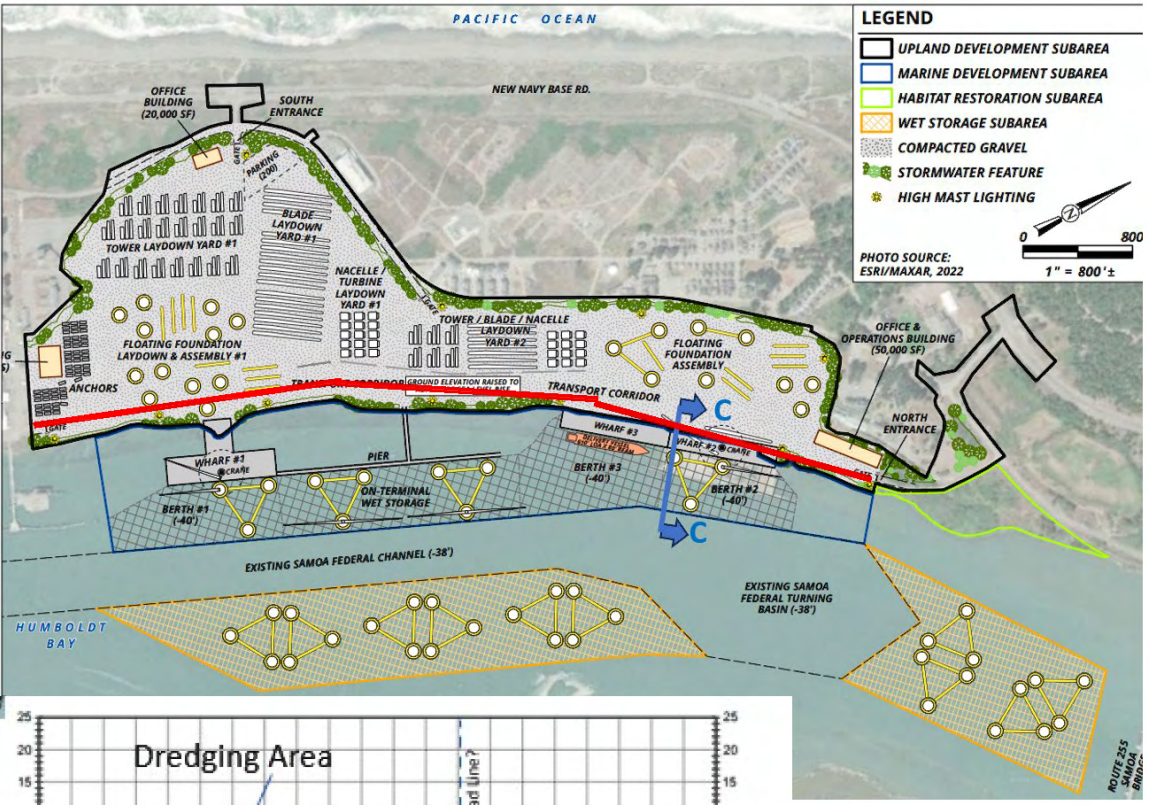
EXPLANATION

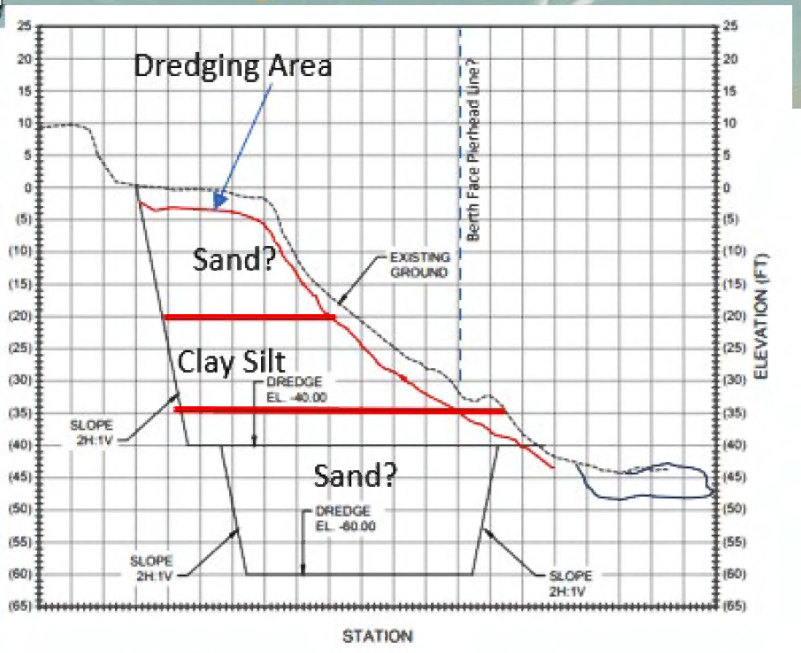
- Very soft silty clay (0-9 blows/ft)
- Slightly compact silt (10-19 blows/ft)
- Compact gray sand (20-69 blows/ft)
- Very dense sand (>70 blows/ft)

Geologic Profile of Samoa Channel Bridge

Figure 6

Coastal Engineering - Berth Dredging





SECTION C-C

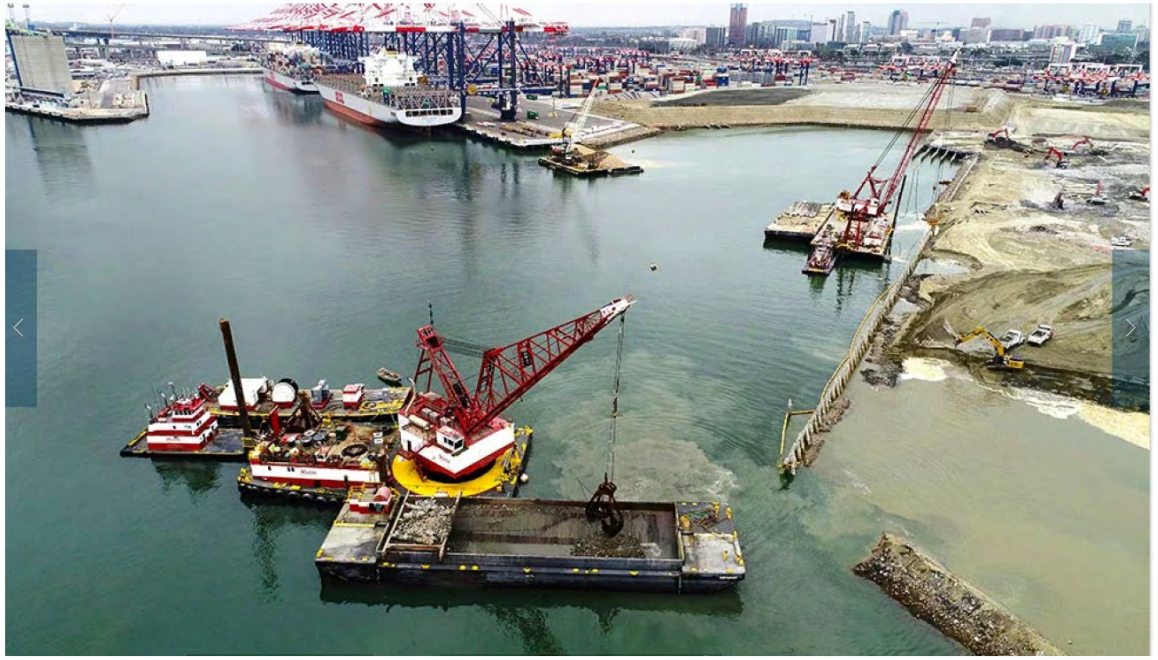


Figure 7

- Layers of sand, silt, clay
- What to do with ~ 5 million cubic yards of dredging

- The size of the project requires a different approach to design/construction

Coastal Engineering – Disposal & Beneficial Reuse Varying Requirements for Sediment Testing

Figure 8

Near or on-shore?

Hotspot Locations Along Ocean Beach; Beach compatible sand from berth area.

HOODS excess dredged material and silt/clay

In-Bay beneficial reuse

For mitigation purposes (north or south bay) TBD

Onsite Use Sand for reloading site for settlement mitigation, raising grade for SLR mitigation.

Trucked beneficial reuse?

Commercial reuse or other nearshore restoration/SLR mitigation need

Dredging & Disposal/Reuse Design & Strategy

DREDGE METHOD

DISPOSAL/REUSE OPTIONS

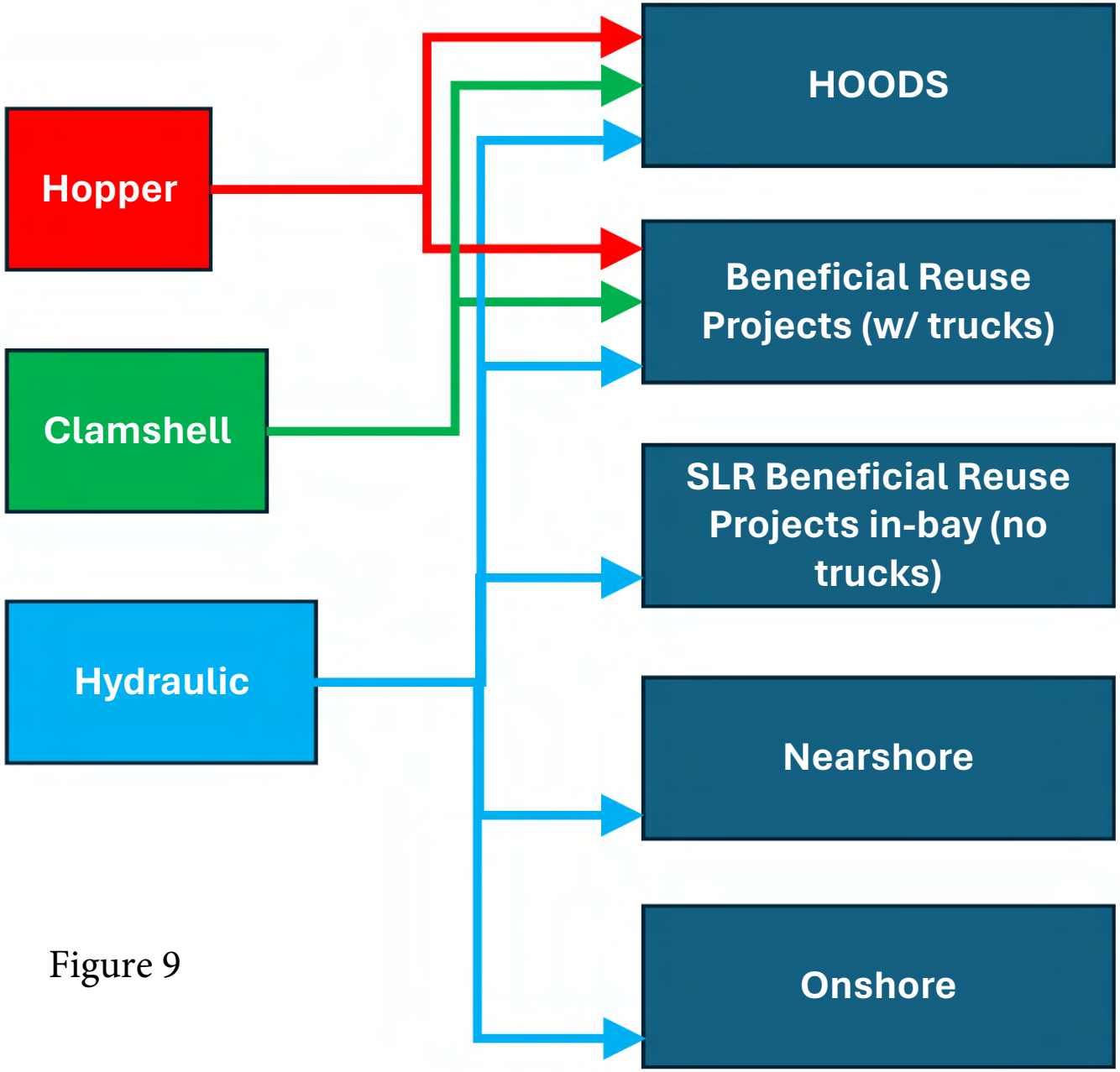
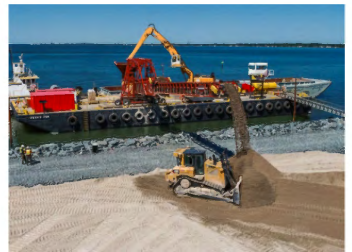
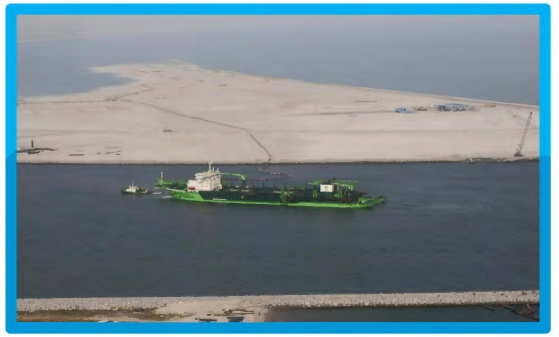


Figure 9



DREDGE METHOD



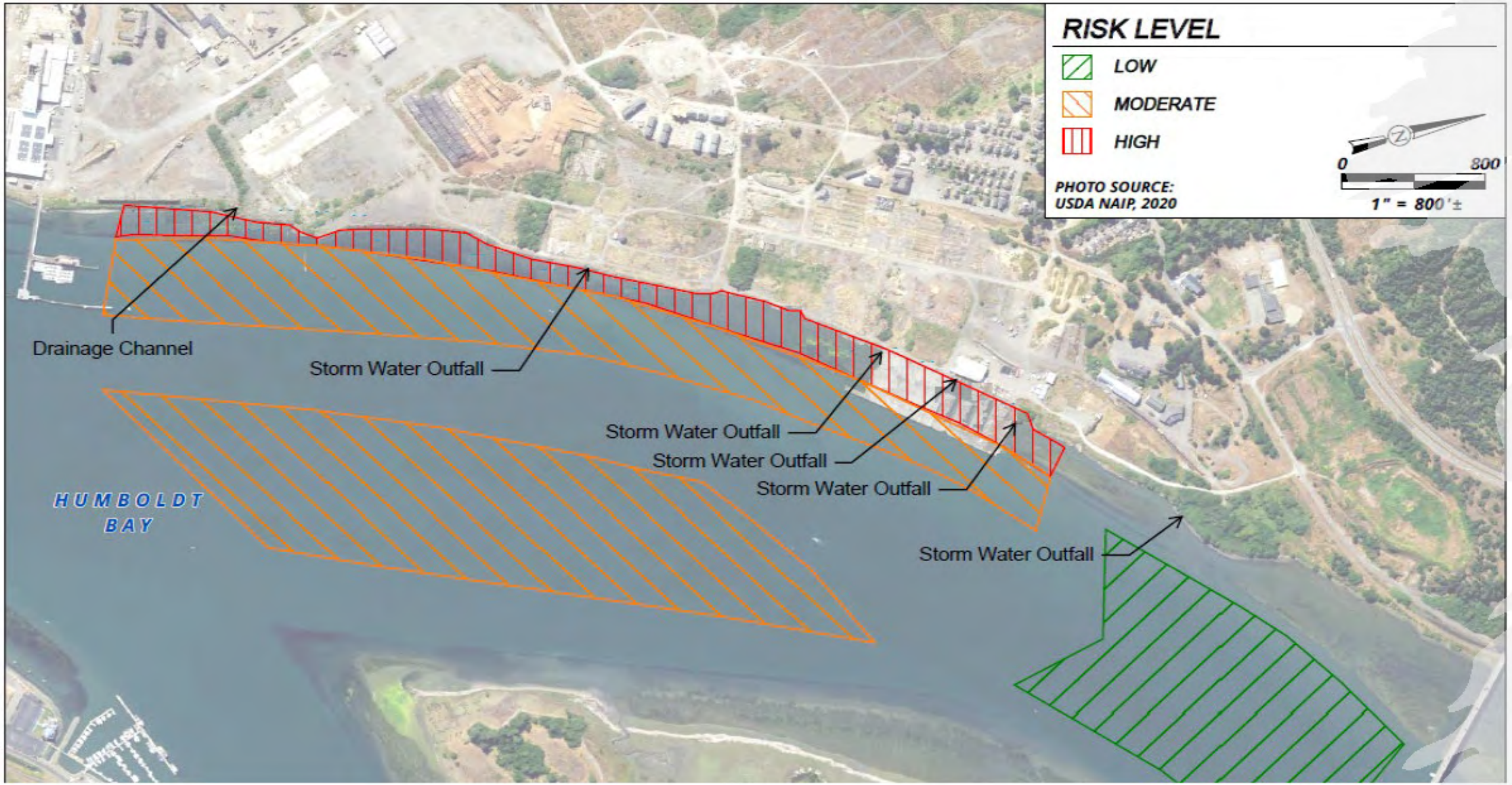

RISK LEVEL
LOW
MODERATE
HIGH
PHOTO SOURCE:
USDA NAIP, 2020
0
800
1" = 800'±
Drainage Channel
Storm Water Outfall
Storm Water Outfall
Storm Water Outfall
Storm Water Outfall
Storm Water Outfall
HUMBOLDT
BAY

Figure 10


P:\Eureka\2022\022054-Humboldt-RMMT\GIS\GEO_BORE_Fig2_PVibracoreExpLocations.mxd USER: pix4d DATE: 12/4/23, 2:25PM
PACIFIC OCEAN
HUMBOLDT BAY
EXPLANATION
PROPOSED VIBRACORE BORING
0
800
1" = 800' ±
PHOTO SOURCE:
USDA NAIP, 2020

Figure 11