moffatt & nichol

600 University Street, Suite 610
Seattle, WA 98101

(206) 622-0222 Fax: (206) 622-4764
www.moffattnichol.com

MEMORANDUM

To:	Rob Holmlund (Humboldt Bay Harbor, Recreation, and Conservation District)
From:	Michael Jokerst (M&N)
Date:	April 22, 2024
Subject:	Constructability Memo
Project:	Redwood Marine Multipurpose Terminal Replacement Project
Location:	Eureka, California
M&N Job No.:	212991-03
Cc:	Shane Phillips

Memorandum 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.*

This memorandum is intended to cover the construction methodologies, and scenarios.

Table of Contents

List of Figures

Disclaimer

Moffatt & Nichol devoted effort consistent with (i) the level of diligence ordinarily exercised by competent professionals practicing in the area under the same or similar circumstances, and (ii) the time and budget available for its work, to ensure that the data contained in this report is accurate as of the date of its preparation. This study is based on estimates, assumptions and other information developed by Moffatt & Nichol from its independent research effort, general knowledge of the industry, and information provided by and consultations with the client and the client's representatives. No responsibility is assumed for inaccuracies in reporting by the Client, the Client's agents and representatives, or any third-party data source used in preparing or presenting this study. Moffatt & Nichol assumes no duty to update the information contained herein unless it is separately retained to do so pursuant to a written agreement signed by Moffatt & Nichol and the Client.

Moffatt & Nichol's findings represent its professional judgment. Neither Moffatt & Nichol nor its respective affiliates, makes any warranty, expressed or implied, with respect to any information or methods disclosed in this document. Any recipient of this document other than the Client, by their acceptance or use of this document, releases Moffatt & Nichol and its affiliates from any liability for direct, indirect, consequential or special loss or damage whether arising in contract, warranty (express or implied), tort or otherwise, and irrespective of fault, negligence and strict liability.

This report may not to be used in conjunction with any public or private offering of securities, debt, equity, or other similar purpose where it may be relied upon to any degree by any person other than the Client. This study may not be used for purposes other than those for which it was prepared or for which prior written consent has been obtained from Moffatt & Nichol.

Possession of this study does not carry with it the right of publication or the right to use the name of "Moffatt & Nichol" in any manner without the prior written consent of Moffatt & Nichol. No party may abstract, excerpt or summarize this report without the prior written consent of Moffatt & Nichol. Moffatt & Nichol has served solely in the capacity of consultant and has not rendered any expert opinions in connection with the subject matter hereof. Any changes made to the study, or any use of the study not specifically identified in the agreement between the Client and Moffatt & Nichol or otherwise expressly approved in writing by Moffatt & Nichol, shall be at the sole risk of the party making such changes or adopting such use.

This document was prepared solely for the use by the Client. No party may rely on this report except the Client or a party so authorized by Moffatt & Nichol in writing (including, without limitation, in the form of a reliance letter). Any party who is entitled to rely on this document may do so only on the document in its entirety and not on any excerpt or summary. Entitlement to rely upon this document is conditioned upon the entitled party accepting full responsibility and not holding Moffatt & Nichol liable in any way for any impacts on the forecasts or the earnings from the project resulting from changes in "external" factors such as changes in government policy, in the pricing of commodities and materials, price levels generally, competitive alternatives to the project, the behavior of consumers or competitors and changes in the owners' policies affecting the operation of their projects.

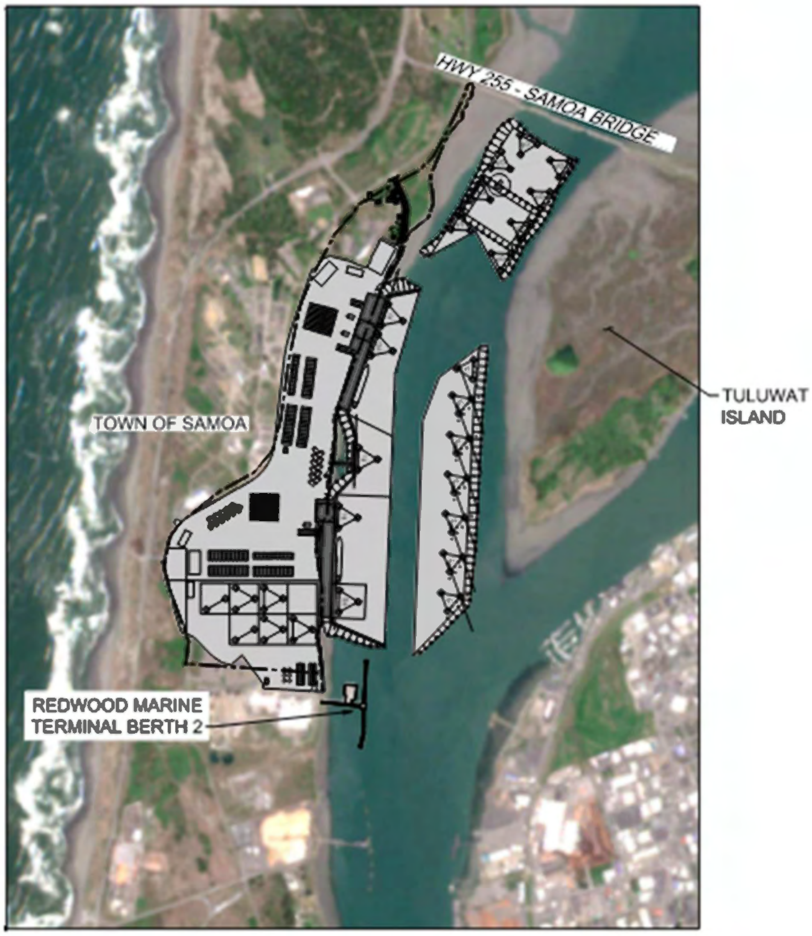
This document may include "forward-looking statements". These statements relate to Moffatt & Nichol's expectations, beliefs, intentions, or strategies regarding the future. These statements may be identified by the use of words like "anticipate," "believe," "estimate," "expect," "intend," "may," "plan," "project," "will," "should," "seek," and similar expressions. The forward-looking statements reflect Moffatt & Nichol's views and assumptions with respect to future events as of the date of this study and are subject to future economic conditions, and other risks and uncertainties. Actual and future results and trends could differ materially from those set forth in such statements due to various factors, including, without limitation, those discussed in this study. These factors are beyond Moffatt & Nichol's ability to control or predict. Accordingly, Moffatt & Nichol makes no warranty or representation that any of the projected values or results contained in this study will actually be achieved.

This study is qualified in its entirety by, and should be considered in light of, these limitations, conditions and considerations.

1. Project Overview

The Redwood Marine Multipurpose Terminal (RMMT) Replacement Project encompasses redeveloping an approximately 168-acre site to provide a new multipurpose, heavy-lift marine terminal facility to support the offshore wind energy industry and other coastal-dependent industries.

Figure 1.1: Overall site plan



Source: Moffatt & Nichol, 15% Design Plans, Sheet No. G-101

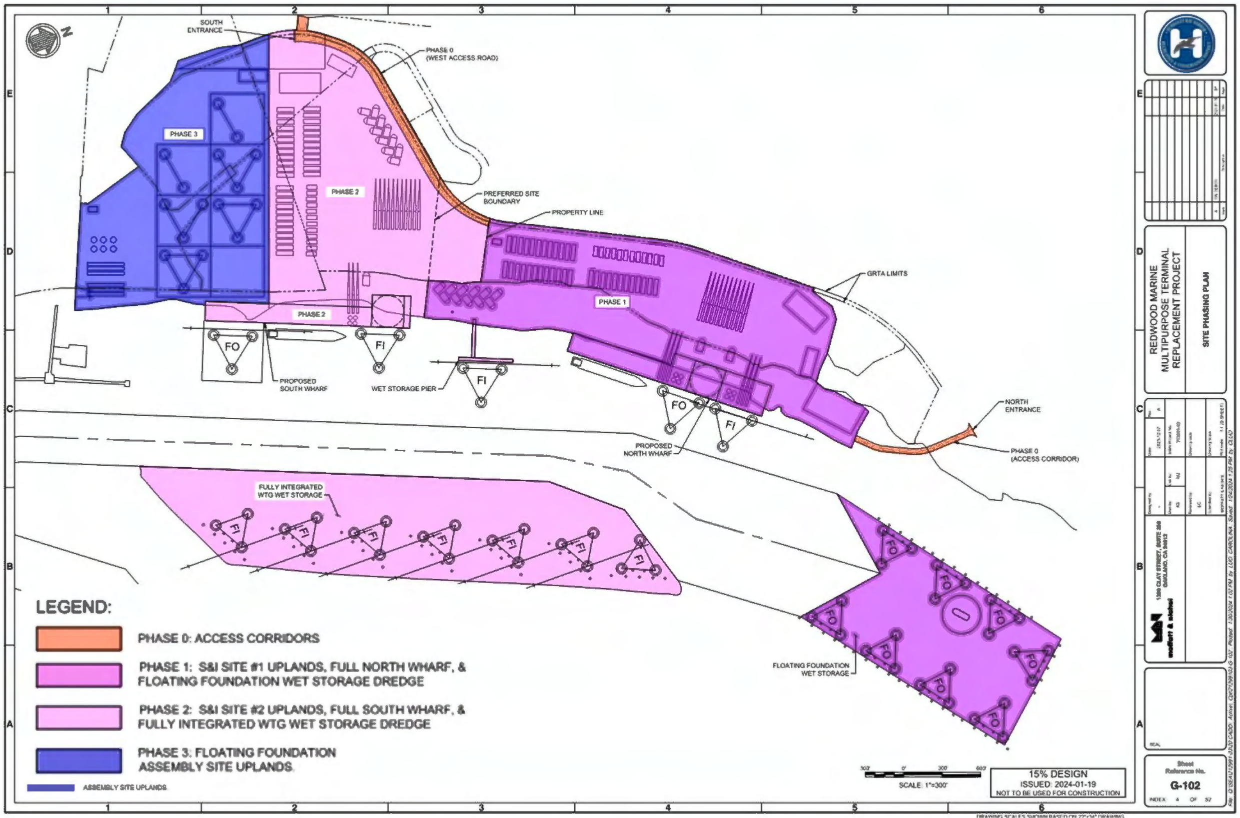
The site is located on the Samoa Peninsula to the west of Eureka, California.

The terminal site is large enough to accommodate two to three independent operations. In order to bring one operation on-line to best meet State and Federal government goals, the overall site development will be broken into multiple phases.

- Phase 0 consists of developing access corridors and performing offsite mitigation
- Phase 1 consists of developing the northern portion of the site and creating a wet storage area
- Phases 2 and 3 consist of developing the southern portion of the site and creating an additional wet storage area.

This Constructability scenario will focus only on Phase 1. However, the majority of the discussion will apply to Phase 2 as well. Phase 3 will not include any of the waterside work but will be similar in scope otherwise. Figure 1.2 below is an extract from the Project Drawings and shows the approximate locations of each of the phases.

Figure 1.2: Site Phasing



Source: Moffatt & Nichol, 15% Design Plans, Sheet No. G-102

The terminal scope of work consists of the following elements:

- Installation of temporary or permanent perimeter fencing and guard access checkpoints/gates.
- Installation of any temporary utilities such as electricity, water, and stormwater to be used by the contractor, or to reroute existing utilities while new infrastructure is installed.
- Demolition of backlands structures, utilities, foundations, etc.
- Demolition of existing wharf structures and removal of piling, and bulkheads.
- Disposal of treated wood waste.
- Removal of debris along rock slope, and regrading of slope as required.
- Site grading to facilitate construction.
- Install wick drains to facilitate pre-loading operation.
- Dredge new berth pocket and wet storage footprints.
- Rehandle dredge spoils suitable for reuse into backlands for use as surcharge, or import surcharge.
- Construct surcharge in backlands for use in pre-loading of soil.
- Perform concrete deep soil mixing (CDSM) soil improvement along shoreline.
- Place rock revetment along shoreline to stabilize the slope.
- Place engineered slope with native planting where required.
- Install waterside and landside piling for new wharf.
- Install cut-off wall.
- Construct new reinforced concrete wharf.
- Install new mooring and breasting dolphins.
- Install new access gangways.

- Install new fendering system and mooring bollards.
- Install storm drain utilities on site and necessary connections to existing infrastructure offsite.
- Install biofiltration planters.
- Install water utilities on site and necessary connections to existing infrastructure offsite.
- Install electrical utilities on site including switchgear and foundations, high-mast light poles and lighting foundations. Install electrical utilities offsite and make necessary connections to existing infrastructure.
- Potentially install temporary mooring system to allow for offloading of dense grade aggregate via barge. If schedule does not permit use of the newly constructed wharf.
- Construct administration buildings.
- Construct storage buildings.
- Bring site to finish grade and install dense grade aggregate and geogrid.
- Construct permanent site fencing or soundwalls, barriers, access gates and security check points.
- Commission utilities.
- Install photovoltaic system offsite at the landfill location.
- Install extension to Woodley Island work dock

2. Project Schedule Milestones and Assumptions

For this preliminary phase of design, a Level 2 construction schedule has been developed which is typical for a 15% level of design and is provided as Attachment A. The expected accuracy for this level of project definition can be expected to vary between -20% to +40%.

For the purposes of this memo, the following are key construction milestones, constraints, and assumptions assumed for the Works. These may change depending on ongoing discussions involving in-water work windows, allowance of hydraulic dredging, beneficial reuse of dredge spoils and project design progress.

Milestones:

1. All permits in hand: October 1, 2026

Constraints:

1. In-Water Work Window: July 1 to Oct 15

Assumptions:

1. Marine Construction Work Hours: 10 hours per day
2. Marine Construction Work Days: 6 days per week
3. Dredging Work Hours: 24 hours per day
4. Dredging Work Days: 7 days per week
5. Upland Work Hours: 12 hours per day
6. Upland Work Days: 6 days per week

The in-water work window is the most notable constraint. In-water work is defined as work that disturbs the sea floor and would specifically prevent pile pulling, pile driving, and dredging between October 16th through June 30th every year unless an exception is granted by the permitting agencies. There is precedent for the window to occasionally be extended at the end of the in-water work window period, but it depends on specific conditions during the year in question and cannot be assumed to be granted ahead of time.

3. Project Organization Plan

Construction of the RMMT Phase 1 Project may be a single source Prime Contractor using specialized subcontractors or by a number of independent Contractors, e.g. marine construction, marine dredging, civil, drilling, mechanical, and building Contractors working concurrently.

For a marine terminal project of this size and complexity, it is typical for the Prime Contractor to self-perform the marine works since it drives the schedule and cost.

4. Contractors

This project is driven by the production rates of waterside demolition, dredging, and waterside pile driving. The project will require experienced contractors who specialize in waterfront construction, especially dredging and pile driving. The Contractor will need relatively large equipment typical of the industry to handle the scale this project requires to be completed in a reasonable amount of time. Given the limited in-water work window the Contractor may have to provide multiple similar pieces of equipment to finish the Work in a timely manner and not delay the overall project schedule.

It is anticipated that the Contractor will utilize labor primarily from local unions with the exception of key personnel such as trade foremen, and any highly specialized labor such as crane operators, dredge captains and crew, pile driving foremen and crew, etc. who will be relocated to the site.

5. Construction Workforce

The construction workforce will fluctuate throughout the project but will be made up of, on average, 90 personnel and up to 165 personnel during the peak for each of the Phases 1 and 2. Phase 3 will have on average 45 personnel and up to 115 when the building and utilities are being installed. This number will include the Contractor(s) team, Construction Management Team (CMT), highly skilled trades, journeymen, and laborers.

The CMT will include, but is not limited to the following staffing:

- Project Director
- Project Managers
- Quality Manager
- Safety Manager
- Project Engineers
- Scheduling Engineer
- Cost Control Engineer
- Field Engineers
- Administrators

The trades will include, but not be limited to the following:

- Foremen – Dredging, Pile Driving, Mechanical and Welding, Carpenter, Concrete, Electrical, and General Labor
- Boat Operators – Tug Captains and crew
- Operators – Cranes, Deck Hands, Excavator, Dozer, Loader, and Dump Trucks
- Skilled Labor – Pile Drivers, Welders, Carpenters, Electricians, Pipefitters, Ironworkers, and Laborers

The labor demand will initially be focused on water-based demolition, backlands demolition, and dredging. The labor will increase to include earthwork and wick drain operations. This will remain constant for the first 18-24 months at which point additional labor will be required to construct the wharf, utilities, and buildings.

The construction workforce will be resourced from the local labor market, except for specialized individuals furnished directly by the Contractor(s). It is anticipated that these specialized individuals will find local housing for the duration of their part of the Works. Therefore, there will be no requirement for a labor camp to be set up for the Works.

6. Environmental Protection/Regulations

The Owner's CMT will appoint qualified construction and environmental inspectors to document the Contractor's compliance with the Environment Regulations, Standards and Codes, Project Specifications, and all Permits. All Inspectors will be qualified in the disciplines they are to monitor, e.g. mechanical, electrical, structural, marine. The number and site presence of Inspectors/Inspections shall be dictated by the activities on site. All Inspectors will report to the CMT. Inspection reports will be filed daily by each inspector noting matters such as:

- Progress of work,
- Quality issues,
- Environmental issues, and
- Any other issues that need to be addressed.

Where construction activities are predicted to have a specific environmental impact or mitigation requirement, a qualified environmental inspector(s) will be required to supervise the Works to ensure good practice is conducted and mitigation plans are followed. Work items that will likely require qualified inspectors are as follows:

- Marine mammal monitoring
- Dredging disposal (periodic)
- Water quality
- Dewatering

7. Quality Control

The Owner's CMT will appoint qualified construction inspectors and testing consultants to document the Contractor's compliance with the Standards and Codes, and Project Specifications. All Inspectors will be qualified in the disciplines they are to monitor, e.g. mechanical, electrical, structural, marine. The number and site presence of Inspectors/Inspections shall be dictated by the activities on site. All Inspectors will report to the CMT. Inspection reports will be filed daily by each inspector noting matters such as:

- Progress of work
- Quality issues
- Environmental issues
- Any other issues that need to be addressed

Where construction activities are predicted to have a specific observation or testing requirements, a qualified inspector(s) will be required to supervise the Works to ensure good practice is conducted and/or prepare and test samples to ensure material conformance. Work items that will likely require qualified inspectors are as follows:

- Surveying
- Compaction of backfill
- Deep soil mixing
- Dredging depths, limits, and disposal

- Rock revetment placement
- Pile driving criteria conformance
- Structural steel placement
- Concrete placement and strength
- Other permanent material conformance
- Utility placement
- Electrical load testing
- Water pressure and quality testing
- Building inspection

8. Construction Access

Construction access will be from both the land and water to the project site.

The backlands Work will have two access points during Phase 1. These access points will be constructed during a preceding phase of work (Phase 0) as shown in Figure 1.2 above. The "North Entrance" will be at the north end of the site and accessed off of Vance Avenue. The "West Entrance" will be at the south end of the site and accessed via a newly built "West Access Road" that connects to New Navy Base Road. During Phases 2 and 3 only the West Access Road will be available, and the North Access will be exclusively available to the tenant as it is anticipated the Phase 1 area will be an actively operating site.

It is expected that any large deliveries, such as crane components, yellow equipment, piles, etc. will be delivered through the West Access Road. A construction road on site will need to be maintained at all times to allow for unobstructed movement on site. The Contractor will be responsible for this and will need to coordinate with all subcontractors to avoid blocking access to Work.

Smaller deliveries, construction workforce, and project management will likely use the North Entrance to gain access to the site but may have to use the West Access Road if certain scopes of Work make this access impractical or unsafe.

The waterfront Works will be accessed directly from Humboldt Bay via tugs and barges. Due to the shallow depths near shore, the Contractor will likely need to perform some amount of the future planned dredging to gain closer access to the Works. Crew boats will be utilized to transport the workforce to the floating equipment. A temporary dock on site or use of an existing nearby dock/marina will be needed to perform crew transfers to the floating equipment.

The Contractor will be required to liaise directly with the appropriate local authorities, such as the Police, Caltrans, and local road departments regarding the use of public roads, particularly with respect to wide, long, or heavy loads. Similarly, the Contractor will be required to liaise with the appropriate local authorities such as the Coast Guard and the Humboldt Bay Harbor District with respect to marine access and mobilization of floating equipment, i.e. derrick barges, flat barges, hydraulic dredges, and tugs to the site.

9. Marine Construction Overview

Constructability methods for complex marine projects primarily involve or focus on the access and logistics to perform the work. These various methods result in the use of different marine construction techniques such as floating crane barges, or a trestle system in which construction progresses from the shore out over the water. All projects of this type contain common and unique challenges that must be overcome in conjunction with the capabilities of the local construction market to produce constructible and cost-effective results. Challenges for these projects include the delivery logistics for the construction materials, equipment, and personnel, and physical impediments associated with the characteristics of the sites and their locations.

Due to the limited in-water work window, those times will become crucial to executing as much work as possible. While the work could be performed using a support system, there does not appear to be an advantage using this method, and there are multiple contractors who would be able to perform this job who are already in possession of floating equipment that is both suitable to this project and more typical of this type of work.

It is expected the Contractor will need multiple pieces of equipment to increase their production rate, however the waterfront site for Phase 1 and Phase 2 is only large enough to efficiently accommodate 2 -3 pieces of floating equipment along with their support barges. It is expected the Contractor will have a combination of 2 to 3 dredges or derrick barges at a time during the construction phase. Additionally, the Wet Storage work area is far enough away from the wharf work areas that additional dredge work can occur simultaneously.

The following is a brief description of derrick barges and types of dredges that are expected to be used:

9.1. Derrick Barge

Derrick barges are floating platforms that require tugboats to mobilize or demobilize. The barge is modified or designed to support crawler or pedestal mounted cranes. Derrick barges are secured into position through the use of spuds, which are usually pipe piles that can be raised and lowered into the sea floor, or through the use of anchors. Typically, a derrick barge will require a minimum of 5 to 12 feet (ft) of draft.

Derrick barges are typically configured to have longer booms for more head room (distance from working surface to the boom tip), and have additional winches compared to similar floating cranes like clamshell dredges.

Derrick barges will be used for demolition, pile driving, heavy lifts, and wharf construction support.

9.2. Clamshell Dredge

A clamshell dredge is similar to a derrick barge. However, the crane will be configured to be better at cyclic work. Clamshell dredges have winches and lines set up to allow for the operation of a mechanical bucket and aren't necessarily well set up to perform other types of operations like a derrick barge.

Clamshell dredges may also be configured with a "walking spud" which pivots and can be used for small movements without use of a tugboat.

Clamshell dredges will use a bucket to remove material from the sea floor, then transfer it to a scow. The scow will be taken by a tugboat to the dumpsite where the scow will open, and the material will fall out of the bottom of the scow.

Clamshell dredges are more precise than hydraulic dredges but have lower production rates. Clamshell dredges will likely be required for any side slopes, toes, or in areas where obstructions are expected to be encountered.

9.3. Hydraulic Dredge

There are two types of hydraulic dredges which could be used on the project: cutter-suction, and hopper.

Cutter-suction dredges are positioned by a tugboat and then an anchor spread is laid out such that the dredge can move itself for a given area. The dredged material is hydraulically pumped to a disposal site. The material will be moved through pipe that is sunken to allow for other vessel movement across the top of the pipe, the pipe will remain floating supported by pontoons. This pipe is typically handled by smaller purpose-built vessels.

Hopper dredges are self-propelled vessels which use trailing cutter heads to remove material as the dredge moves over the dredge area. The removed material can be pumped to the vessel's internal hopper, or it can be hydraulically pumped to a dump site, similar to the cutter-suction dredge. If the material is placed in the hopper, then hopper dredge will relocate to the dump site and open the hopper to transfer the material, similar to the scow operation described in the Clamshell Dredge section above.

10. Major Construction Work Fronts

The scope of work includes the following work fronts:

- Backlands works (land-based equipment)
- Backlands soil improvements (wick drain machines and cement deep soil mixing (CDSM) drill rigs)
- Waterfront demolition (derrick barges)
- Dredging and slope stabilization (combination of clamshell and hydraulic dredges)
- Wharf and dolphins construction (multiple derrick barges and land-based crawler cranes)

The critical path to completing the work is through the marine work due to the in-water work window constraint. This includes the dredging, slope stabilization, and wharf construction work fronts. The secondary critical path is through the soil improvement work in the backlands due to the required settlement period of approximately 6 months for each surcharge. All other work will be resourced balanced to ensure there are no wide swings in workforce throughout the project.

The goal during each in-water work window will be to advance work to eventually installing the wharf piles. Once the wharf piles are installed, the wharf construction can begin. The wharf construction is not in-water work and can continue after the season ends. Concurrently, the backlands work in the immediate area behind the wharf should be completed prior to the beginning of wharf construction, so that the work is not access constrained. The conceptual schedule is structured to ensure the pre-load behind the wharf will be removed by the time wharf construction begins.

The following is a more detailed description of each work front and their activities.

The backlands work front will include securing the site, demolition of existing structures on site, installing temporary utilities, grading the site as needed to accommodate construction activities, rough grading of the site, final grading of the site, removal of excess fill, install dense grade aggregate and geo-grid top layer, installation of new utilities and infrastructure, installation of engineered slope with native plantings, construct new office and storage buildings, install parking lot, install permanent site access and security barriers.

The backlands soil improvements work front will include installation of wick drains, receiving beneficial reuse dredge material to build preload surcharge, manage the preload surcharge, and cement deep soil mixing CDSM.

The waterfront demolition work front will include removal of the existing wharf structure and piles.

The dredging and slope stabilization work front will include dredging of the wet storage areas, dredging of the berth pockets, rehandle beneficial reuse material from the dredge cuts to the backlands, and placement of rock revetment along the slopes where required.

The wharf and dolphins construction work front will include installation of piling, construction of the wharf and dolphins deck, installation of utilities and vaults within the deck, installation of cut of wall, installation of trench drain, tie-ins to backlands utilities, installation of appurtenances (bollards, fendering systems), and installation of access gangways.

The following construction activities are discussed in further detail.

- Procurement of materials
- Mobilization
- Staging
- Demolition
- Soil improvements
- Dredging and beneficial reuse material
- Marine berths
- Utility installation and commissioning
- Demobilization

10.1. Procurement of Materials

Upon execution of a contract a priority will be the submittal and approval of shop drawings to facilitate procurement and fabrication of long lead-time items and components. A submittal list will be generated as a priority to facilitate an orderly process to submit, update, approve, and order materials and fabricated items as well as track the progress. The following is an abbreviated list that includes:

- Fender components
- Bollards
- Electrical switchgears
- Electrical cable
- Piling
- Access gangways
- Prefabricated structures such as buildings
- Precast concrete components such as storm drains, outfalls, engineered slope components
- Dense grade aggregate
- Slope revetment rock

Procurement of the major and/or long lead time items may be performed by Humboldt Bay Harbor Recreation and Conservation District (HBHRCD) to reduce markup from the Contractor and to eliminate fluctuation in market prices. Coordination on delivery, handling, and storage with the Contractor will be necessary and represents some additional work the Contractor would need to consider in their bid. Purchasing the materials early may create risk if differing site conditions are encountered on the site or if any late design changes are required.

If HBHRCD does not wish to procure materials the Contractor will be responsible for selection of the fabricator or supplier, providing shop drawings, quality control, and ensuring timely delivery to the site of all materials to meet the schedule.

Depending on procurement restrictions due to funding requirements (such as Buy America or Buy American clauses), the steel piles, fendering, bollards, switchgears, and aggregates may either be sourced domestically or internationally. In either scenario the lead time for these items can take over a year, or in the case of highly in-demand switchgears, 2 to 3 years.

Regarding the quantity required of dense grade aggregate, the most economical way to bring this material on site is via barge rather than trucking from a local quarry. The material will be offloaded from the barge into the backlands. This can happen either via a derrick barge and bucket, or a barge that has an integrated conveyor system that can offload material directly from the barge.

The steel piling can either be brought to the project in full lengths via a material barge or in smaller sections by truck and spliced together on site. Once spliced the piles will need to be rehandled onto a material barge for use by the pile driving derrick barges, or for landside operations, the piles can be stockpiled directly behind the landside crane within its swing radius. If the piles come in full lengths, there may be a need to rehandle the piles into the backlands and stockpile to ensure the material barge can be used to receive the next load of piles. Alternatively, if the steel piles can be stockpiled off site they can be brought to the site as needed to supply pile driving activities.

10.2. Mobilization

This activity consists of the mobilization of the Contractor's workforce and equipment necessary for performing the Work. Mobilization includes all activities and associated costs for transportation of the Contractor's personnel, equipment, and operating supplies to the site. This includes off-site fabricated materials, as well as establishment of temporary offices and other necessary general facilities for the Contractor's operations at the site.

Water based equipment will be tied down and travel to site after approval from the United State Coast Guard if not American Bureau of Shipping (ABS) certified. Once on site, the equipment will be un-lashed and made ready for service.

Land-based equipment will be brought onto site via trucks. Some larger equipment such as crawler cranes will require multiple truck loads and multiple days to assemble on site. Some of these large loads will require special permits and coordination with local authorities if the load is too wide, too long, or too heavy per regulations.

10.3. Staging

The project will require staging or laydown areas for the Contractor and subcontractors to accommodate contractor temporary offices, material storage and stockpile areas, maintenance equipment and supplies, and parking for the construction management and construction workforce. This area would typically be given a designated area in the backlands, however due to the site improvements it is anticipated the staging area will need to relocate multiple times throughout the project as the preload surcharge area moves. Schedule permitting, materials could wait to be stockpiled until after the first surcharge area is completed to avoid rehandling.

Additionally, the Contractor will require designated water access staging, and water laydown areas for derrick barges, dredges, material barges, floating pipe sections, tugs, and crew boats. The Contractor may request to install multiple mooring points in the project water work limits to store barges or floating equipment. The water access staging can either be a gangway and float which connects to shore on site, or the Contractor may make use of the existing marinas in the area in which case the floating equipment's crew will park offsite.

10.4. Demolition

The project will require demolition of various structures in the backlands as well as the existing RMMT timber wharf structure and remaining pilings.

The backland structures will be removed using excavators and other yellow equipment (graders, loaders, backhoes, etc.) to demolish and process the structures. The processed materials will be sent via truck to various landfills depending on the material type and their hazardous classification.

The timber wharf deck may be demolished by a backhoe or excavator by driving onto the deck and peeling the deck from the outer edge back to the shore. If the wharf is not sufficiently strong enough to support this then it will be demolished from the water using a floating crane. In this scenario, a floating crane and a water side crew using a combination of work boats (or "skiffs") and work floats for access underneath the wharf will work in tandem to rig the crane into sections of the wharf, then the water side crew will use a saw to disconnect the "rigged up" section from the remaining structure. The removed section will be placed onto a material barge next to the floating crane. Removed sections will then be rehandled into either the backlands or another laydown area to be processed and sent to a landfill.

The remaining piles will be removed either by "dry-pulling" or by vibratory hammer. Dry pulling is performed by wrapping a pile with a chain sling to "choke" it. The chain is attached to rigging and back to a crane, the crane will pull on the pile to remove it. If the crane is sufficiently sized this method would be effective for removing the timber piles. If the piles do not come out, or break during removal, the Contractor may use a vibratory hammer. The vibratory hammer hangs from the crane and will use a hydraulic clamp to attach to the head of the pile. The hammer has an internal mechanism which will oscillate and cause the pile to vibrate and liquefy the soil surrounding the pile allowing the pile to be extracted with less force. The removed piles will be rehandled to the backlands or another laydown area to be processed then sent to a landfill.

The existing grade near the timber wharf is too shallow for a floating barge or material barge to gain access after approximately the first 60 ft are removed (measuring from the face of the wharf towards the backlands). This means the Contractor will need to remove the deck and piles where it can reach, then dredge the exposed area enough to allow barge access (approximately 6 ft). The Contractor can then move the barges over the newly dredged areas to reach more deck and repeat the process until complete. The area of demolition is large enough that a demolition focused crew and a dredge crew could work simultaneously to reduce overall project delays of bookending the two operations.

The piles should be removed in their entirety to allow for hydraulic dredging as timber remnants could cause issues with the cutter heads of the dredges. The piles could also be removed during clamshell dredging if the material is screened. However, this process will reduce the production rate of the dredging operation. Therefore, it is likely the Contractor will make a best attempt at removing the piles in their entirety in all scenarios.

10.5. Soil Improvements

10.5.1. Soil Preloading

The backlands are required to be consolidated via preloading the site with a surcharge of soil to reduce the amount of remaining settlement expected from the future loading when the site is operational. To accelerate the required time the preload surcharge must remain in place wick drains (or prefabricated vertical drains, PVD) will be installed to facilitate the movement of pore water out of the soil.

It is anticipated the Contractor will perform demolition, installation of any temporary utilities, and some amount of site regrading prior to beginning the wick drain operation. Wick drains are expected to be installed approximately 95 ft deep and placed in a 3.5’ ft triangular pattern. As many as 4-wick drain installation machines will be needed to meet schedule demands early in the project and can be scaled back once the surcharge operation becomes the critical path.

The wick drain installation operation initially requires laying out or “flagging” of the wick drain locations. A wick drain installation machine will push or vibrate the wick drain into the location. An assisting worker on the ground will then cut the wick drain and set up the machine to install the next wick drain.

Depending on the conditions of the soil on site, the wick drain machine may experience conditions that are too hard to reach the design tip location. If this happens a pre-drilling operation will need to occur. Pre-drilling involves using a drill mounted on an excavator or specialty drilling rig to drill or auger the location of the wick drains to loosen the soil. If required, this operation would start prior to wicking in a given area and enough drill rigs will be required to not interfere with the required production rate of the wick drain installation. Drilling is slower than wick drain installation so more drill rigs will be required than wick drain installation machines.

The initial surcharge will be created using hydraulically pumped dredge material that is granular (sand as opposed to clay) and ideally, acceptable for reuse once the surcharge work is completed. The material can be used for the fill required on site and excess fill can potentially be used for beach renourishment material on the ocean side of the Samoa peninsula. To create the surcharge, dredge material will be pumped on shore. This material will be primarily water so a berm will need to be installed along the exterior limit of the surcharge footprint to contain the material while it is dewatered. A weir system will be installed in the berm to allow excess water to drain. The contractor will raise the berm as needed to contain the material as the surcharge gains height. If permits do not allow for the dewatered material to enter back into the Samoa Channel the water may need to be drained into a settling area where it can be tested then approved to be allowed to enter the Samoa Channel. Draining directly to the Samoa Channel should be a priority in permitting discussions.

The schedule is based on the assumption that the area immediately behind the new wharf will be preloaded and the surcharge is removed prior to the start of wharf construction. If there is a space restriction the wharf construction will be impacted and prevent efficient progress to the work. To accomplish this, it is assumed a 700,000 cubic yards surcharge will be built. Once built the surcharge will remain in place for 6 months. Once the required settlement is observed the surcharge will be moved to an adjacent footprint where it will sit for another 6-month period. This process will be repeated two more times. After the second surcharge is removed the area behind the wharf will be clear.

Once all of the preload operations are completed the material will be removed from the site or could potentially be left in a stockpile to supply the Phase 2 work. This decision will be influenced by the availability of area to leave the material stockpiled in the future Phase 2 area, and how long it must remain in place before the Phase 2 work begins.

10.5.2. Cement Deep Soil Mixing

The slope along the edge of the project toward the Samoa Channel is expected to fail in a seismic event due to its soil properties, according to the Preliminary Geotechnical Report (EMI, 2024). To strengthen the soil properties and reduce lateral spreading, it is recommended to perform CDSM along the slope.

This work can happen after demolition is completed and can happen concurrently with the wick drain operation. The Contractor will most likely perform this work before the surcharge is built to not be space constrained. If the Contractor performs it after the surcharge there will be a conflict with the wharf construction operation.

The work will be performed by a specialty drilling rig that has soil mixing attachments. The auger will simultaneously drill, inject cementitious grout, and mix the soil as it gets to the required depth as well as inject cementitious grout and mix the soil as it is extracted. The drilling rig will be supplied by a small batch plant of water and grout in the immediate vicinity of the work. During this process cement replaces soil thus at the end of the soil mixing process as much as 40% of the original volume of improved soil becomes residual material. This residual material may be used as backfill, surcharge or berm material, but would not be acceptable for beneficial reuse off site because it will be cementitious.

10.6. Dredging and Beneficial Reuse Material

10.6.1. Dredging Overview

Currently M&N and HBHD are working with the DMMNC to devise a testing and sampling program to analyze the soil from the dredge areas as well as to permit hydraulic dredging methods. The results of the testing will help determine what disposal and reuse options of the dredge material are available. Similarly, hydraulic dredging is typically not allowed in Humboldt Bay outside of the Federal Navigation Channel and this is being discussed as well. Due to the scale of this project, it is paramount to use hydraulic dredging methods to complete the project in a timely manner.

Multiple types of dredging are required to meet project needs in the most efficient manner possible. There is a top layer of historically recent fill across the bay that may need to be disposed of at the Humboldt Open Ocean Disposal Site (HOODS) site as it is assumed this material would not be ideal for beneficial reuse. The remaining material that needs to be dredged is either bay mud or sand. The sand would be ideal for the preloading surcharge material that is required because it could also be used for fill, and any excess material could be used for beach renourishment nearby – rather than a costly operation of having to truck to a landfill. The bay mud material would not be acceptable for fill and would need to go to HOODS.

Hydraulic dredging is the most economical method to remove large quantities material, these methods would be ideal for bulk dredging where possible. Hydraulic dredging should not be used in areas where obstructions are expected such as large rocks, or timber pile remnants.

Clamshell dredging is ideal for more precise work, or if obstructions are expected. For this project, clamshell dredging could be used for initial passes where there could be debris or timber pile remnants, final grade cleanup work, and cutting slopes. If hydraulic dredging is ultimately not allowed, clamshell dredging will be used for all dredging.

To make full use of the in-water work window dredging operations will most likely work continuously 24 hours a day 7 days a week. The dredges will be crewed by either 2 crews working 12 hours, or 3 crews working 8 hours per day. The wharf areas and wet storage areas are far enough away from each other that dredging operations can be run independently of each other.

As discussed in the demolition section above, the timber wharf demolition will need to happen simultaneously with dredging to gain access. For this reason, in Phase 1, it is anticipated there will be slow production for initial dredging operations near the existing timber wharf until all piles are removed. Conceivably, the Contractor will use two pieces of floating equipment to dredge and demolish the wharf. A third piece of floating equipment could simultaneously work on the remaining dredge footprint between the demolition front and the navigation channel. A fourth piece of floating equipment could also work in the wet storage area.

Phase 2 work does not have waterside demolition so dredging work can proceed immediately.

10.6.2. Clamshell Dredging

If clamshell dredging is used a pre-dredge survey will be taken of the site to determine how much material needs to be removed across the entire dredge limit. This information will be available to the clamshell dredge operator as a guide for how much material will be excavated within the project limits. The dredge along with a scow will be located into position via tug. The dredge will use a bucket to excavate material and place it into a scow. Once the scow is full, a tug will bring an empty scow and swap it with the full scow. The tug will tow the full barge from the dredge location out to the offshore disposal area, HOODS, where the barge will bottom dump the material within the boundaries. Periodic surveys will be taken to check progress of the dredging.

The clamshell method will likely be used for the initial pass of the dredge areas to remove newer fill that may contain contaminants that would exclude the material’s use as fill, or any debris. It will also likely be used for meeting final grades of the berth pocket and the slope since hydraulic dredges are not precise enough, though hydraulic dredging methods could be used.

If the clamshell method is used to supply beneficial reuse material to the backlands, the dredge material would be place on a flat barge. The material from the flat barge would then be rehandled into the backlands.

A concern that the Contractor will need to account for is the presence of bay mud. The preliminary borings near shore indicate there is a layer of bay mud that will be present in the slope cut. Bay mud is a weak soil and is not strong enough to support the design slope. The Contractor will need to assume the bay mud will lay at a flatter slope than the design and must employ various techniques to reduce slope failures. If they do not, excessive dredge material will have to be removed and replaced with fill. Dredging in stages to remove overburden on the slope, or dredging and placing quarry run to stabilize the slope are some methods that can be used to reduce material outside of the design dredge slope from failing.

If turbidity is a concern a silt curtain may be deployed around the area of work to prevent the spread of turbid water from the dredging area.

10.6.3. Cutter Suction Dredging

If cutter-suction dredging is used a pre-dredge survey will be taken of the site to determine how much material needs to be removed across the entire dredge limit. This information will be available to the cutter suction dredge operator as a guide for how much material will be excavated within the project limits. The dredge will be located into position via tug and its anchor spread will be laid out by the tug. The dredge will be able to move itself for a certain area based on the anchor spread. A separate crew will layout an assortment of flexible, submerged, and floating pipeline that attaches to the dredge and continues to the disposal area. The dredge will use a cutter head that is lowered to the excavation depth, then the dredge will move in a sweeping motion to remove material. The dredge pumps the material through the pipeline where it is handled by an earthwork crew who manage the material. Periodic surveys will be taken to check progress of both the dredging area and the disposal site fill.

This method of dredging does not produce as much turbidity as a clamshell operation. Additionally, to surround the cut width area and the anchor spread of the dredge with a silt curtain would be too large to be practical. Thus, a silt curtain is not normally used with this type of operation. If turbidity does become an issue, it is more practical to place a silt curtain around the area that is being affected rather than the dredging operation itself.

10.6.4. Hopper Dredging

If hopper dredging is used a pre-dredge survey will be taken of the site to determine how much material needs to be removed across the entire dredge limit. This information will be available to the hopper dredge operators as a guide for how much material will be excavated within the project limits. Hopper dredges are self-propelled and can locate themselves to and within the site. The hopper dredge uses cutter heads that are located on the sides of the vessel and are lowered to the excavation depth. The hopper dredge will make passes over the areas to be dredged to remove material. The material is transferred to a hopper located within the vessel itself. Once the hopper is full the dredge will move to the disposal location and open the hopper to dump the material. Periodic surveys will be taken to check progress of the dredging area.

This method of dredging does not produce as much turbidity as a clamshell operation, the area the hopper dredge works in is also too large to practically surround with a silt curtain. Thus, a silt curtain is not normally used with this type of operation. If turbidity does become an issue, it is more practical to place a silt curtain around the area that is being affected rather than the dredging operation itself.

10.7. Marine Berths

The construction of the berths will consist of the following structures:

- North and South Marginal wharves
- Near shore berthing dolphins
- Near shore mooring dolphins
- Wet storage berthing dolphins
- Wet storage mooring dolphins

The structures will be comprised of concrete decks supported by piling. The wharves will be located above a slope in the dredged berth area. The slopes under the wharves will require rock revetment for slope stabilization and to prevent scouring. The near shore dolphins will be located on either end of the wharves and may or may not be located within a slope or dredge berth area. The wet storage dolphins will be located in the wet storage areas which do not require rock revetment.

10.7.1. Rock Revetment

Rock revetment will be placed once dredging is complete. Some amount of revetment may be placed to stabilize the dredge slope during the dredge operation. Rock revetment will be brought to site via a material barge loaded at an offsite quarry and tended by a tugboat . The material barge will be moored to a floating crane which will be positioned such that revetment stone can be pushed off the side of the material barge using a loader in the desired location. More precise placement of rock to either fill low points, or when getting close to design thickness, will be placed by the floating crane using a rock tub. The rock tub is loaded by the loader on the material barge, the crane will hold the rock tub over the location it intends to dump the rock and will tilt the bucket to dump the rock. Periodic survey will be performed to confirm grades are met.

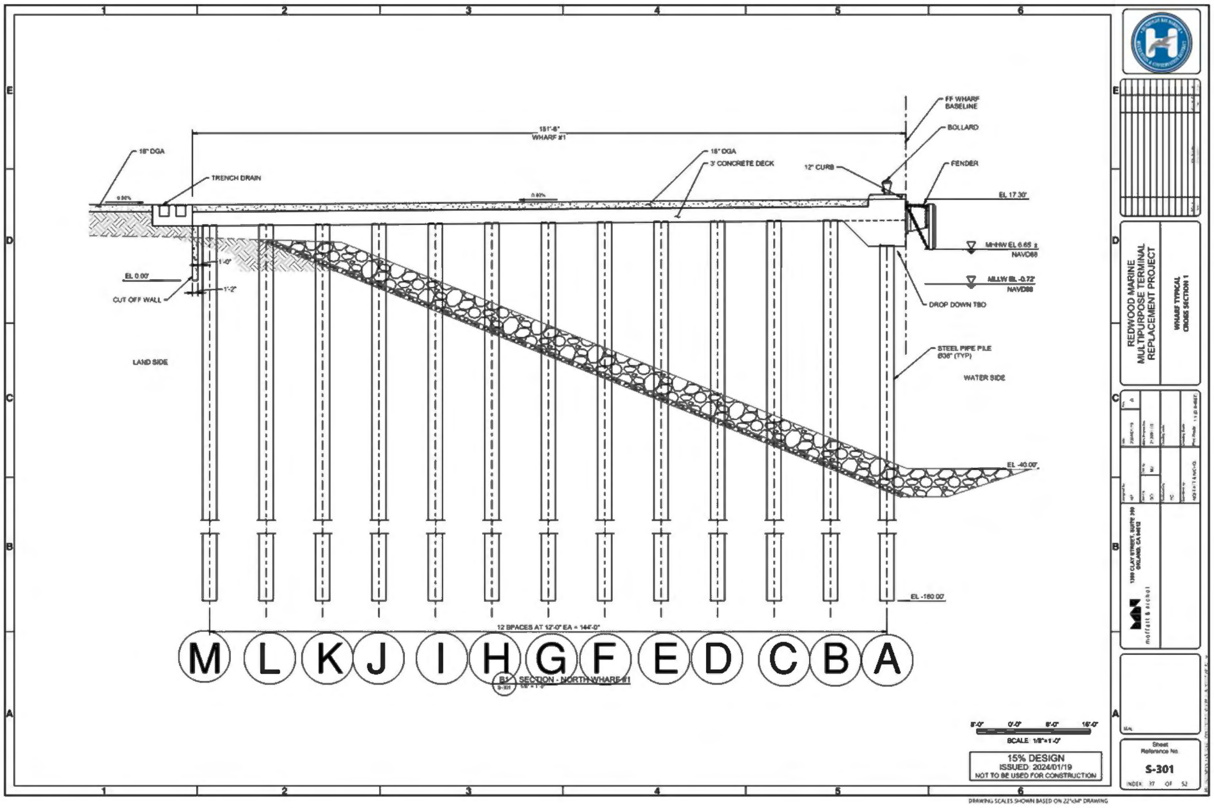
10.7.2. Pile Driving

The piling will be driven once all rock revetment is in place to avoid any damage to the pile during rock placement. Additionally access to the slope to place rock and to perform quality control surveys would be hindered if the piles were already in place.

See Figure 10.1 for typical cross section of wharf. Piles from rows “A” though “I” or “J” will be installed by a derrick barge. Piles from rows “J” or “K” landward will be installed by a land-based crane. It is less expensive to install piling using land-based equipment compared to a derrick barge. For this reason, the Contractor will attempt to install as many piles as possible with land-based equipment. However, due to the in-water work window, piles in row “J” may have to be installed with a derrick barge depending on how the Contractor phases their work.

Piles will be installed in a “type-writer” order in which about 5 rows will be driven out further than the succeeding 5 rows, this will continue until all rows are completed for a given length of the wharf. The length of wharf in which all rows are driven corresponds to the concrete pour lengths as described in Section 10.7.3 below. The amount of rows driven at a time is based on the crane’s capacity and reach. The distance between groups of rows for the waterside operation is based on the width of the derrick barge and material barge to leave enough space to avoid interference between installed piles and the floating equipment. For the landside operation it is based on the width of the crane to avoid interference.

Figure 10.1: Typical Wharf Cross Section



Source: Moffatt & Nichol, 15% Design Plans, Sheet No. S-301

To make the most use of the limited in-water work window it is assumed the Contractor will have two derrick barges driving piles. One will start in the middle of the wharf and the second will start on the north end. Piles in row “K” and landward are not affected by the in-water work window. The Contractor will install these piles ahead of the waterside piles to ensure a full section of wharf will not be delayed waiting for landside piles to be installed. To reduce the amount of equipment on site, it is likely the Contractor will only use one landside pile driving crane and begin work many months prior to the commencement of waterside driving.

It is anticipated all piles will be open ended steel pipe piles. These types of piles are usually installed using a vibratory hammer for initial positioning and driving. The pile will be driven as deep as possible before either advancement is too slow, or to an elevation some distance above design tip where the Engineer will require the pile to be driven by an impact hammer. The Engineer requires final driving to be performed by an impact hammer because piles installed only by vibratory methods have lower capacity at the end of drive. Piles will be driven with an impact hammer until they reach design tip elevation, or the pile meets refusal. Refusal is measured in blows (or pile strikes) per foot and is defined by the Engineer. If a pile meets refusal above the design tip it means it has adequate capacity and does not need to be driven any further.

All the pile driving will be performed in a similar manner. The crane will be supplied with piles to be driven (further explanation is given in Section 11.1 above), the pile will be lofted, and the vibratory hammer will use a hydraulic clamp to grab the pile head. The pile will be placed into location either with the help of a surveyor and the use of a fixed leads system attached to a crane, or by using a template system (which is a fixed guide installed near the pile locations with openings for the piles) which would be installed prior to the lofting of the pile. There are many types of commonly used templates, and the Contractor will use whichever they are most comfortable with. A template is slower than using fixed leads because it requires additional steps to install and remove. The benefit is that a smaller crane could be used to install piles, and the accuracy of the installed piles are typically higher than with leads.

Once the pile is in location the vibratory hammer will be turned on and begin to vibrate to set the pile into position. The pile will be driven slowly to ensure it is staying on location. If it begins to move the pile will be pulled and the process will begin again. Once the pile maintains position it will be allowed to be driven deeper. The pile will continue to be driven to the Engineer designated elevation above design tip or once advancement slows. The Contractor will drive multiple piles using the vibratory hammer before switching to an impact hammer to reduce inefficiencies caused by changing hammers. Once the Contractor has switched to the impact hammer, they will continue to drive the partially installed piles.

The impact hammer will be positioned on top of a partially installed pile, then the impact hammer will begin to drive. The surveyor will monitor the blows per foot and elevation of the pile and inform the pile driving crew to stop driving once refusal or the design tip elevation has been met. Piles begin to “set-up” after driving stops once the disturbed soil around the pile is no longer being agitated. This means that the longer the wait after pile driving stops, the harder it will be to re-mobilize the pile. A pile typically should not be allowed to set-up for more than a few days, otherwise there is potential that it will be incur damage due to the additional amount of force required to remobilize driving.

10.7.3. Wharf Deck Construction

Once piles are driven for the full width of the wharf for a given length of wharf (usually about 200 ft, to maintain a safe working distance from pile driving operations) falsework will be installed on the piles by a water-based crew using work boats and work floats to gain access to the piles. The falsework is a supporting structure that attaches to the piles which is designed to hold the weight of forms, rebar, concrete, and other construction live loads. It is typically made up of “friction collars” which are beams that are squeezed onto the piles with enough force to support a vertical load. Steel beams are then placed from collar to collar. Alternatively, a hanging support could be attached to the pile which a steel beam would rest on. In this scenario some portion of the support would be “lost” in the concrete pour, whereas a friction collar can be removed in its entirety after the concrete pour.

A crane will assist this crew by holding the falsework in position while the crew erects the falsework. This crane can be either land or water-based but will likely be land based because it is cheaper for the Contractor, and one should already be mobilized since landside pile driving would be completed around this time.

Formwork is placed on top of the falsework to create the form of the concrete pour. The formwork is placed by the same assist crane to a separate crew which is focused on form installation. Formwork is typically made of wood beams which span between the falsework steel beams and is topped with specialty plywood that has a smooth surface and is less likely to bond to concrete so it can be used multiple times. The Contractor may also choose to use reusable forms; EFCO is one such company that makes reusable forms. These forms are modular and made of steel. The advantage of one product over the other depends on current material pricing, or whether the Contractor already owns form material.

Once the formwork is installed rebar will be installed as well as any embedded items such as utility conduits (water, electrical) and vaults, bolts, and anchors, etc. Once all embedded items are installed concrete for the main deck is poured. Concrete pour lengths are limited by the amount of concrete that can be poured, finished, and curing methods implemented in a work shift. The main wharf is 150 ft wide and 3 ft deep, so the length of pours will likely span 4-6 bents for an approximately pour length of 50 to 80 ft per pour. The concrete will be placed using a concrete pump truck that can reach all areas of the concrete pour. The pump truck is positioned on the landside of the wharf and is supplied by a continuous supply of concrete from concrete trucks. There are two ready-mix concrete suppliers in the area, Eureka Ready Mix and Mercer-Fraser Co, with multiple locations that can supply the project. If acceptable concrete mixes cannot be produced by either of these suppliers, or if they cannot meet the demand of the project, a batch plant can be installed on site to produce the concrete. Material for making the concrete will be trucked onto site and stockpiled if a batch plant is needed. On the pour days a large crew of upwards of 10 laborers and cement masons will be needed. After the pour day the crew will not come back until the next pour day.

Once the concrete reaches sufficient strength and curing is complete, the falsework and formwork is removed. This operation is performed by a water-based crew in work boats and work floats with the assistance of a crane. Once the falsework and formwork are dropped they are rehandled into the backlands to be reused, or demobilized once all pours are complete.

The main deck is poured separate from deeper sections of wharf (such as where the fenders will attach or breast), where the concrete is above the elevation of the main deck pour (such as any curbs), or any embeds which have critical elevation requirements such as vaults. These areas are poured separately for ease of construction and happen after the main deck pour has cured and falsework and formwork has been removed. Concrete trucks can drive directly onto the new wharf deck for access to pour the concrete.

Once the secondary pours are completed the bollards and fenders can be installed. These can be installed by a smaller crew with either a small mobile crane or forklift that drives directly on the new wharf deck.

10.8. Offsite Construction

10.8.1. Photovoltaic (Solar) Array

The photovoltaic array will be installed offsite at the District's fly ash landfill site. There are no conceptual drawings of this work yet, but in general the following can be assumed for construction. Foundations will be installed, and a super structure will be attached to the foundation. The photovoltaic system will be attached to the super structure. Utility infrastructure will need to be installed on site and run back to existing infrastructure to allow the system to be integrated into PG&E's grid.

10.8.2. Woodley Island Marina Work Dock

The work dock is envisioned to be an extension to the existing work dock at the Woodley Island Marine. There are no conceptual drawings of this work yet, but in general, the following can be assumed for construction. Maintenance dredge may be required to extend the berth envelope from the existing dock to the footprint of the new dock. Piles will be driven to support the new structure. Pile caps, beams, joists, and finally decking, will be installed on top of the piles to complete the structure. Fendering and mooring appurtenances will be installed last.

Smaller equipment will be used to construct this dock compared to the main wharves due to access restrictions. The scale of this dock does not require large equipment so this would not be a constraint. This work could be sourced to a separate subcontractor or put out to bid as its own contract because it is different equipment and a different site.

10.9. Utility Installation and Commissioning

Utilities will be installed by specialty contractors specific to their trade. Water, sewer, and storm drain is typically one subcontractor and electrical is another. Utilities in the backlands will be installed after the pre-loading operation is completed in a given area and the surcharge has been removed. The first activity for all trades will be trenching to place buried conduits, pipes, and structures (such as utility vaults). The trench will be dug to accommodate the depth and width required to place all of the utility conduits or pipe. The trench will be excavated with appropriate side slopes to ensure stability of the excavation. At deeper locations, such as for vaults, the excavation will likely require an engineered shoring system. The Contractor will supply this design. Once the utility pipes, conduit, and vaults are installed the excavation will be backfilled and compacted or slurry will be poured to fill the remaining void. The excess material can be used on site as fill and should be accounted for by the Contractor in their cut/fill calculations.

In locations where the utilities surface a stub will be left to be tied into. The water and sewer utilities will have stub-ups at surface features, such as at the buildings and fire hydrant locations. The electrical utilities will have stub-up locations at surface features such as the buildings, switchgears, high mast light poles, and the nacelle storage area . The water and electrical utilities will also tie into the wharf where utility piping and conduit would have been embedded and poured into the wharf during the concrete pours.

Utility subcontractor crews follow behind the trenching operation. Each utility crew consists of a small crew of roughly 5 people consisting of an operator in an excavator or backhoe to assist with placement of conduit and piping and ground crew to install the conduit and make connections. The trenching crew also consists of a small crew of only a few people, a backhoe operator, a surveyor, and potentially an additional crew member to assist the operator. The Contractor may choose to mobilize multiple crews of all trades to meet schedule demands.

The electrical switchgears are a long lead time item that may take well over 2 years to arrive on site once ordered. Prior to the switchgear's arrival the Contractor will pour a concrete pad with necessary embedded stub ups that connect to the site electrical conduit. Once the electrical utility conduit, vaults, and switchgears have been installed the subcontractor can begin to pull cable. Cables are pulled from switchgears to intermediate vaults to their final termination points. The cables can be damaged if they are pulled too hard. The subcontractor would need to perform a cable pulling analysis to ensure the cables will not be overstressed. This analysis can affect the locations of the intermediate vaults and needs to be submitted prior to the placement of the vaults. After the lines are pulled and terminated, testing will take place to ensure all equipment is in working order. This process can take many months as it involves coordination with public utilities as well as some test may require pieces of equipment mobilized to perform test loads (such as an electrified vessel or crane).

Once the water, sewer, and storm drain utilities are installed they will require pressure testing and water quality testing prior to commissioning.

10.10. Demobilization

This activity consists of demobilizing the Contractor's workforce and equipment from the worksite and staging areas. This includes all activities and associated costs for transportation of Contractor's personnel, equipment, and operating supplies off of the site, including temporary offices and other general facilities the Contractor may have installed. The Contractor is responsible for cleaning up and restoring all work areas prior to demobilizing. The staging areas shall be restored to their original condition unless required otherwise. All waste, contaminants, temporary works and facilities shall be removed in accordance with the Project Specifications.

Water based equipment will be lashed down and can only leave the site after approval from the United State Coast Guard if not ABS certified.

Land-based equipment will be demobilized via trucks. Some larger equipment such as crawler cranes will require multiple truck loads and multiple days to disassemble. Some of these large loads will require special permits and coordination with local authorities if the load is too wide, too long, or too heavy per regulations.

11. Alternative Approaches

11.1. Isolate the Work Area

Isolating the work area to not be considered in-water work could be a strategy to reduce the time of construction. This would be performed by installing a sheet wall around the work area. However, the sheet wall can only be installed once the dredging is completed, otherwise it would interfere with the operation. Pile installation is the next major operation to occur after dredging so it would be more beneficial to just install the wharf and dolphin piles rather than the sheet wall, and then the wharf and dolphin piles.

11.2. Reorder the Phasing

Build the Phase 2 wharf before the Phase 1 wharf. The South Wharf does not require any demolition of existing water structures so dredging can begin immediately and at a higher production rate. An entire in-water work window would no longer be required, and the wharf could be in operation one year sooner.

The considerations to make this work would be if sufficient backlands could be made available to allow for relatively efficient work for the future tenant Operator (no necking issues traveling from Phase 1 area to Phase 2 area). Operations would need to be swapped to the North Wharf once ready. There may be implications regarding permitting footprints since the North Wharf would be partially covering an existing structure, whereas the South Wharf would be new.

11.3. Extend the In-Water Work Window

The in-water work window is only 3.5 months. The Phase 1 project will need 4 seasons to complete the in-water work. If the window were extended by 1 month each season it would eliminate the need for one of the seasons and would save approximately one year to the schedule. This would reduce overhead and potentially inflation costs for the project, impacts to the community from construction, and allow a tenant to begin their operations sooner to help meet the overall projects goals.

Further expansion to the in-water work window would reduce the costs of the marine work significantly due to reduced amounts of mobilizations of equipment, yearly labor cost increases, and inefficiencies related to starting and stopping work. However, the overall project schedule would not reduce much because the secondary critical path of the surcharge work will become the critical path if the wharf finishes sooner.

12. Construction Work Packages

The scope of work discussed above can be broken down into construction work packages (CWP) that may be subcontractor or even contracted on a separate basis. The following are suggested CWPs:

- Demolition: backlands structures demolition and processing of waterside demolition spoils
- Earthwork: clearing, surcharge construction, rough, and final grading, removal of excess fill
- Soil Improvements: one or two specialty contractors may be used
    - Wick Drain Installation
    - CDSM
- Dredging
- Each distinct area could be bid separately to ensure in-water work window is maximized by the amount of equipment working (assuming multiple contractors would be on site simultaneously). A contractor could subcontract additional dredging companies if they do not own enough equipment or have enough operators to handle all the work by themselves in order to meet schedule demands
- Rock revetment supply and installation
- Marine construction
- Reinforcing steel supply and installation
- Concrete placement and finishing of decks
- Building construction
- Water utilities supply and installation
- Electrical utilities supply and installation
- Miscellaneous structures: soundwall or perimeter fencing, or utility infrastructure items water and electrical subs are not savvy with (such as outfall containments, light pole, and switchgear foundations, etc.)

The dredging of the wet storage areas and initial demolition work (up to the point where the earthwork subcontractor can prepare the site) are the only work packages that could be under separate contracts. The remaining work is interconnected and should remain with a prime contractor so they can manage their work.

13. Schedule

The Contractor will be required to create and maintain a construction schedule created using the most current version of Oracle Primavera Project Planner (P6 or newer) or an approved alternate program. The methodology used by the program will be the Critical Path Method. The baseline schedule developed for this construction project are one of the most important products for managing the construction. The schedule is the roadmap for how the Project will be executed.

The schedule will define the approach to execute the work in a complete logical plan that can realistically be accomplished to execute the Project. The schedule will take into account the work constraints and defined milestones as well as other contractual terms and conditions. Activities will be sufficiently defined and detailed to ensure that there is adequate planning for the entire program. Additionally, activities necessary to depict the submittal and procurement process will include sufficient detail to manage the process of review and approval of shop drawings, working drawings, and fabrication drawings for construction to proceed. The schedule will be resource loaded by activity to manage resources, cash flow, and activity relationships.

Critical Path Analysis shall be carried out on all schedules. This will include analysis of total float, logic diagrams, and constraints. Monthly float and critical path reports will be issued for review by the Construction Management team to ensure an understanding of schedule movement.

The following is a list of scheduling best practices that the Contractor should use while developing and maintaining the project schedules. These practices can be defined as requirements in the Project Specifications.

- All milestones clearly identified
- All activities logically tied
- Key dates and key activities identified by Construction Work Packages
- Critical path and secondary critical path (near critical path) clearly identified
- Resource loading to validate execution approach, feasibility, cost/schedule alignment, labor evaluation, and resource leveling
- Earned value reporting
- Avoidance of high duration activities (no longer than 21 calendar days)
- Avoidance of fixed start and end dates
- Avoidance of use of constraints, except those specifically addressed
- Avoidance of excessive float

Weekly schedule reporting will include a one-week look behind and a three-week look ahead.

14. Construction Services

The Engineer of Record (EOR) for the project has the responsibility of ensuring the project is constructed in accordance with plans and specifications.

A project of this complexity involving numerous work fronts to meet an early completion schedule milestone will require at least one (1) Resident Engineer (RE) to participate in the engineering management of the construction. This includes the day-to-day activities of reporting the progress and deficiencies of the project to the Construction Management Team, as well as answering engineering questions as they arise.

The RE is present to manage engineering requests for information (RFI's), submittals, shop drawings, participate in the evaluation of supplemental agreements, as well as establishing punch list work. Also included is coordinating all changes to the original plans and specifications into a set of as-built drawings and manuals for the Operator's staff. Coordination of all changes will be completed by the Contractor and all changes will be approved through the RFI process. All documents will be placed in a turnover binder by the Contractor, including copies of the completed as-built drawings. These will be vetted by the RE as to their completeness and the turnover group will manage the turnover binders.

Construction Services starts at the time the Contract is awarded through commissioning.

15. References

- Preliminary Geotechnical Report, EMI 2024

Appendix A. Level 2 Summary Schedule

Moffatt Nichol
RMMT
Conceptual Construction Schedule - Phase 1 Buildout

BY: MSJ
Udpdated: 4/22/2024

					2026		2027				2028				2029				2030			
					Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Demo	**QTY**	**UOM**	**RATE**	**Duration**																		
Demo Existing Wharf 1 (1)	3165	Piles	70/Day	3 months																		
Demo Phase 1 Backlands				6 months																		
Backlands																						
Grade Phase 1 Backlands				6 months																		
Area 1 Wick Drains	3,500	kLF	10kLF/day x 4	4 months																		
Build Surcharge - Area 1				3 months																		
Area 2 Wick Drains	4,140	kLF	10kLF/day x 3	6 months																		
Area 3 Wick Drains	4,048	kLF	10kLF/day x 3	6 months																		
Area 4 Wick Drains	4,080	kLF	10kLF/day x 2	10 months																		
Build Surcharge - Area 2	700	kCY	10kCY/day	2 months																		
Build Surcharge - Area 3	700	kCY	10kCY/day	2 months																		
Build Surcharge - Area 4	700	kCY	10kCY/day	2 months																		
Move Surcharge Off Site	700	kCY	10kCY/day	2 months																		
CDSM Ground Improvement				6 months																		
Install Phase 1 Utilities				6 months																		
Buildings				9 months																		
Finish Phase 1 Backlands				3 months																		
Dredging																						
Initial Pass (2)	235	kCY	4.6kCY/Day	2 months																		
Beneficial Reuse - Pump to Shore	700	kCY	19.8 kCY/Day	1.5 months																		
Final Grade Cut	247	kCY	4.6kCY/Day	2 months																		
Dredge Wet Storage 1	681	kCY	4.6kCY/Day	5.5 months																		
Revetment																						
Rock Wharf 1 - Quarry Run (3)	11,200	Tons	3.2kT/day	0.5 months																		
Rock Wharf 1 - Armor Stone	50,400	Tons	1.1kT/day - AS	2 months																		
Pile Driving																						
LS Wharf 1	660	piles	35/week	5 months																		
Phase 1 Mooring Dolphin Piles	232	piles	30/week	1 month																		
WS Wharf 1 (4)	600	piles	60/week	2.5 months																		
Structure Construction																						
Wharf 1	800	LF		8 months																		
Wet Storage Moorings	8	SETS	1 SET/mo	8 months																		
Near Shore Dolphins	2	EA	2 ea/mo	1 month																		
Demobilization																						
Demobilize (5)	1	EA		3 months																		

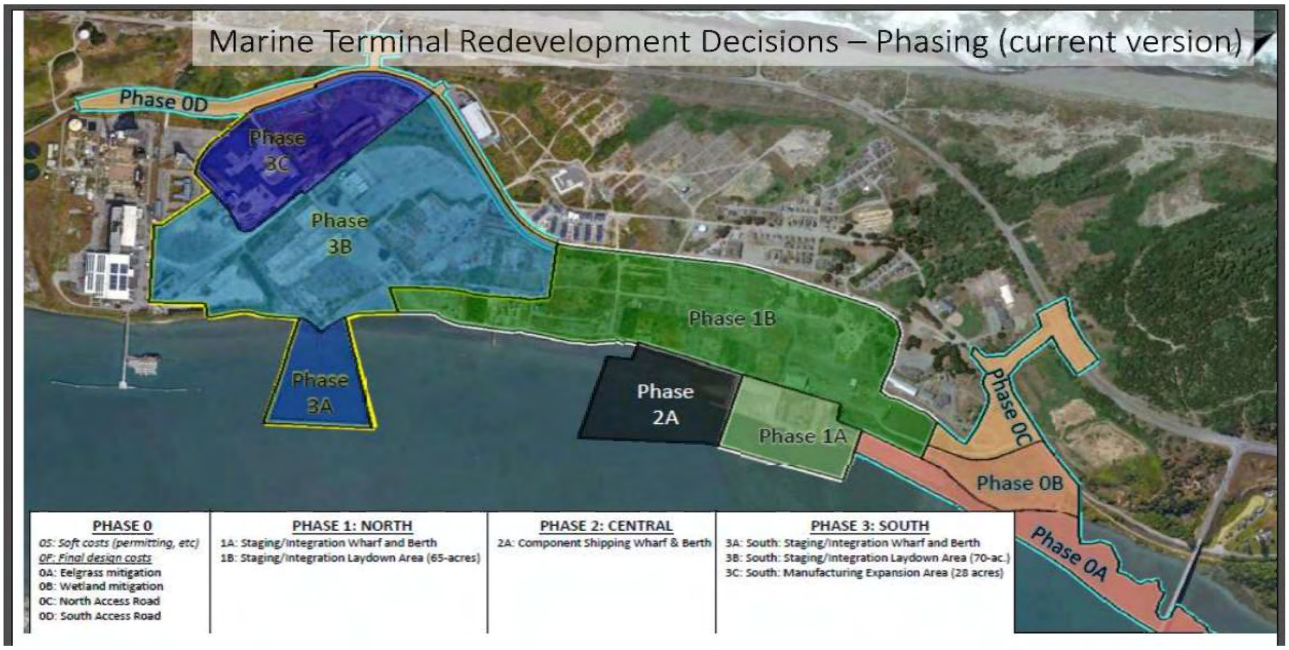
Note: Only Phase 1 shown since the start of Phase 2 is unknown and would introduce too many uncertainties with labor/equipment resourcing depening on its start
(1) Assume all piles must be pulled due to allow for hydraulic dredging and beneficial reuse. Use 2 rigs for demo to finish in one IWW. Extra four weeks for removal of deck
(2) Initial Pass is a 5' cut for the dredge footprint -30' MLLW or greater where sand is expected. Top 5' is expected to not be suitable for reuse
(3) Incidental with Final Grade Cut for slope stability
(4) Assumed 2 water side driving rigs
(5) Site could be ready for beneficial occupancy prior to demobilization

= No In Water Work
= Work
= Waiting Period

Appendix B. Class IV Cost Estimate

SUMMARY
HUMBOLDT PHASING COSTS - DRAFT - 8/8/23

Phase	Total Direct Cost	Total Construction Costs	Total Construction Costs with Contingency	Total Project Cost
Phase 0&1 (MEGA GRANT)	$356,825,300	$460,630,000	$585,000,100	$776,490,600
Phase 2	$121,778,000	$159,987,200	$207,983,300	$217,725,600
Phase 3	$257,481,400	$338,268,800	$439,749,500	$463,848,100
TOTAL	$736,084,700	$958,886,000	$1,232,732,900	$1,458,064,300



DRAFT

moffatt & nichol				
CLIENT	Humboldt Bay Harbor District	JOB NO		212991
PROJECT	Humboldt Bay Offshore Wind Marine Terminal	SHEET	1	OF 1
DESIGN FOR	PHASE 1 - Estimated Development Cost Summary Sheet	DESIGNER		DATE 08-Aug-23
		CHECKER		DATE

Item	Description	Total Direct Cost	Total Construction Cost[3]	Total Construction Cost (with Contingency)[4]
1	Contractor Mobilization/Demobilization	$ 17,150,100	$ 22,139,300	$ 28,117,000
2	Site Preparation	$ 19,461,500	$ 25,123,100	$ 31,906,400
3	Site Improvements and Tarmac	$ 67,864,500	$ 87,607,000	$ 111,260,900
4	Stormwater	$ 4,200,000	$ 5,421,900	$ 6,885,900
5	Power and Utilities	$ 14,400,000	$ 18,589,100	$ 23,608,200
6	Buildings	$ -	$ -	$ -
7	Shoreline Transition/Protection	$ 289,170	$ 373,300	$ 474,100
8	Wharf	$ 194,060,000	$ 250,514,400	$ 318,153,300
9	Mechanical Dredge (Disposal in HOODS)	$ 39,400,000	$ 50,861,900	$ 64,594,700
Sub-Total		**$ 356,825,300**	**$ 460,630,000**	**$ 585,000,100**
12	Road Improvements			$ 13,350,000
13.1	Terrestrial Mitigation/Restoration			$ 30,000,000
13.2	Aquatic Mitigation/Restoration			$ 25,000,000
14	Soft Costs (12%)			$ 40,000,000
15	Administrative Activities			$ 7,000,000
16	Escalation (3.5% over 5 years)			$ 76,140,564
Total Project Cost				**$ 776,490,600**

NOTES/ASSUMPTIONS

1. *This cost estimate is an 'Opinion of Probable Construction Cost' made by a consultant. In providing opinions of construction cost, it is recognized that neither the client nor the consultant has control over the cost of labor, equipment, materials, or the contractor's means and methods of determining constructability, pricing or schedule. This opinion of construction cost is based on the consultant's reasonable professional judgement and experience and does not constitute a warranty, expressed or implied, that contractor's bids or negotiated prices for the work will not vary from the estimate.*
2. *The costs have been developed based on historical and current data using in-house sources, information from previous studies as well as budget price quotations solicited from local suppliers and contractors. All costs are in 2023 US Dollars. Estimate does not include escalation.*
3. *Total Construction Cost includes all material, labor and equipment to complete the work and indirect costs including Contractor Supervision (General Conditions), Corporate Overhead and Profit, and Bonds and Insurance costs.*
4. *Total Construction Cost (with Contingency) includes a project contingency of 30%. The contingency amount has been included to cover undefined items, due to the level of engineering carried out at this time. The contingency is not a reflection of the accuracy of the estimate but covers items of work which will have to be performed, and elements of costs which will be incurred, but which are not explicitly detailed or described due to the level of investigation, engineering and estimating completed today.*
5. *This cost estimate represents an AACE 18R-97 Class 5 Estimate.*
6. *Volumes for uplands site preparation and required berth improvements are based on currently available bathymetric and topographic information. Additional surveys and exploration will be required. Results of this additional exploration program may require quantity and price updates.*
7. *Site improvements is based on preliminary geotechnical information. Additional geotechnical invesitgations are required to finalize this activity.*
8. *Mechanical dredging is assumed for the berth with 3:1 side slopes and no reinforcement on side slopes. Estimate does not include any associated costs due to rock dredging or blasting.*
9. *Estimate assumes piles are driven to grade with no obstructions and does not include any associated costs due to pile driving/drilling into rock*
10. *Pricing assumes all resources are readily available locally.*
11. *Estimate is based on unencumbered contractor access to the site.*
12. *Estimate does not include any costs for construction site property lease or acquisition expenses.*
13. *No extreme weather risk included (force majeure).*
14. *Estimate is based on currently available geotechnical information. Additional geotechnical explorations will be required. Results of this additional exploration program may require price update. Estimated fee for additional geotechnical exploration has been included as a soft cost.*
15. *Price does not include environmental restrictions.*
16. *Price does not include any associated costs due to hazardous waste.*
17. *Price does not include any costs for post construction site remediation or reconstruction*
18. *Costs for owner's project management or overhead expenses are not included.*
19. *Estimate assumes federal navigation channel requires no additional dredging.*
20. *Estimate includes utilities designed to site limit of work and assumes adequate municipal water and electrical service is available and can be tapped for project needs. Additional offsite utility infrastructure costs are not included.*

DRAFT

moffatt & nichol	CLIENT	Humboldt Bay Harbor District	JOB NO	212991
	PROJECT	Humboldt Bay Offshore Wind Marine Terminal	SHEET 1	OF 2
	DESIGN FOR	PHASE 2 - Estimated Development Cost Summary Sheet	DESIGNER	DATE 25-Apr-24
			CHECKER	DATE

Item	Description	Total Direct Cost	Total Construction Cost[3]	Total Construction Cost (with Contingency)[4]
1	Contractor Mobilization/Demobilization	$ 4,892,000	$ 6,427,000	$ 8,355,100
2	Site Preparation	$ -	$ -	$ -
3	Site Improvements and Tarmac	$ -	$ -	$ -
4	Stormwater	$ -	$ -	$ -
5	Power and Utilities	$ -	$ -	$ -
6	Buildings	$ -	$ -	$ -
7	Shoreline Transition/Protection	$ -	$ -	$ -
8	Wharf	$ 81,520,000	$ 107,097,800	$ 139,227,200
9	Mechanical Dredge (Disposal in HOODS)	$ 35,366,000	$ 46,462,500	$ 60,401,300
Sub-Total		**$ 121,778,000**	**$ 159,987,200**	**$ 207,983,300**
12	Road Improvements			$ -
13.1	Terrestrial Mitigation/Restoration			$ -
13.2	Aquatic Mitigation/Restoration			$ -
14	Soft Costs (6%)			$ 9,742,300
Total Project Cost				**$ 217,725,600**

NOTES/ASSUMPTIONS

1. *This cost estimate is an 'Opinion of Probable Construction Cost' made by a consultant. In providing opinions of construction cost, it is recognized that neither the client nor the consultant has control over the cost of labor, equipment, materials, or the contractor's means and methods of determining constructability, pricing or schedule. This opinion of construction cost is based on the consultant's reasonable professional judgement and experience and does not constitute a warranty, expressed or implied, that contractor's bids or negotiated prices for the work will not vary from the estimate.*
2. *The costs have been developed based on historical and current data using in-house sources, information from previous studies as well as budget price quotations solicited from local suppliers and contractors. All costs are in 2023 US Dollars. Estimate does not include escalation.*
3. *Total Construction Cost includes all material, labor and equipment to complete the work and indirect costs including Contractor Supervision (General Conditions), Corporate Overhead and Profit, and Bonds and Insurance costs.*
4. *Total Construction Cost (with Contingency) includes a project contingency of 30%. The contingency amount has been included to cover undefined items, due to the level of engineering carried out at this time. The contingency is not a reflection of the accuracy of the estimate but covers items of work which will have to be performed, and elements of costs which will be incurred, but which are not explicitly detailed or described due to the level of investigation, engineering and estimating completed today.*
5. *This cost estimate represents an AACE 18R-97 Class 5 Estimate.*
6. *Volumes for uplands site preparation and required berth improvements are based on currently available bathymetric and topographic information. Additional surveys and exploration will be required. Results of this additional exploration program may require quantity and price updates.*
7. *Site improvements is based on preliminary geotechnical information. Additional geotechnical invesitgations are required to finalize this activity.*
8. *Mechanical dredging is assumed for the berth with 3:1 side slopes and no reinforcement on side slopes. Estimate does not include any associated costs due to rock dredging or blasting.*
9. *Estimate assumes piles are driven to grade with no obstructions and does not include any associated costs due to pile driving/drilling into rock*
10. *Pricing assumes all resources are readily available locally.*
11. *Estimate is based on unencumbered contractor access to the site.*
12. *Estimate does not include any costs for construction site property lease or acquisition expenses.*
13. *No extreme weather risk included (force majeure).*
14. *Estimate is based on currently available geotechnical information. Additional geotechnical explorations will be required. Results of this additional exploration program may require price update. Estimated fee for additional geotechnical exploration has been included as a soft cost.*
15. *Price does not include environmental restrictions.*
16. *Price does not include any associated costs due to hazardous waste.*
17. *Price does not include any costs for post construction site remediation or reconstruction*
18. *Costs for owner's project management or overhead expenses are not included.*
19. *Estimate assumes federal navigation channel requires no additional dredging.*
20. *Estimate includes utilities designed to site limit of work and assumes adequate municipal water and electrical service is available and can be tapped for project needs. Additional offsite utility infrastructure costs are not included.*

DRAFT

moffatt & nichol	CLIENT	Humboldt Bay Harbor District	JOB NO	212991
	PROJECT	Humboldt Bay Offshore Wind Marine Terminal	SHEET 1	OF 2
	DESIGN FOR	PHASE 3 - Estimated Development Cost Summary Sheet	DESIGNER	DATE 14-Mar-23
			CHECKER	DATE

Item	Description	Total Direct Cost	Total Construction Cost[3]	Total Construction Cost (with Contingency)[4]
1	Contractor Mobilization/Demobilization	$ 12,242,000	$ 16,083,100	$ 20,908,100
2	Site Preparation	$ 4,000,000	$ 5,255,100	$ 6,831,700
3	Site Improvements and Tarmac	$ 29,407,300	$ 38,634,100	$ 50,224,400
4	Stormwater	$ 10,290,000	$ 13,518,600	$ 17,574,200
5	Power and Utilities	$ 30,380,000	$ 39,912,000	$ 51,885,600
6	Buildings	$ -	$ -	$ -
7	Shoreline Transition/Protection	$ 156,060	$ 205,100	$ 266,700
8	Wharf	$ 129,790,000	$ 170,512,900	$ 221,666,800
9	Mechanical Dredge (Disposal in HOODS)	$ 41,216,000	$ 54,147,900	$ 70,392,300
Sub-Total		**$ 257,481,400**	**$ 338,268,800**	**$ 439,749,500**
12	Road Improvements			$ 3,500,000
13.1	Terrestrial Mitigation/Restoration			$ -
13.2	Aquatic Mitigation/Restoration			$ -
14	Soft Costs (6%)			$ 20,598,600
Total Project Cost				**$ 463,848,100**

NOTES/ASSUMPTIONS

1 *This cost estimate is an 'Opinion of Probable Construction Cost' made by a consultant. In providing opinions of construction cost, it is recognized that neither the client nor the consultant has control over the cost of labor, equipment, materials, or the contractor's means and methods of determining constructability, pricing or schedule. This opinion of construction cost is based on the consultant's reasonable professional judgement and experience and does not constitute a warranty, expressed or implied, that contractor's bids or negotiated prices for the work will not vary from the estimate.*

2 *The costs have been developed based on historical and current data using in-house sources, information from previous studies as well as budget price quotations solicited from local suppliers and contractors. All costs are in 2023 US Dollars. Estimate does not include escalation.*

3 *Total Construction Cost includes all material, labor and equipment to complete the work and indirect costs including Contractor Supervision (General Conditions), Corporate Overhead and Profit, and Bonds and Insurance costs.*

4 *Total Construction Cost (with Contingency) includes a project contingency of 30%. The contingency amount has been included to cover undefined items, due to the level of engineering carried out at this time. The contingency is not a reflection of the accuracy of the estimate but covers items of work which will have to be performed, and elements of costs which will be incurred, but which are not explicitly detailed or described due to the level of investigation, engineering and estimating completed today.*

5 *This cost estimate represents an AACE 18R-97 Class 5 Estimate.*

6 *Volumes for uplands site preparation and required berth improvements are based on currently available bathymetric and topographic information. Additional surveys and exploration will be required. Results of this additional exploration program may require quantity and price updates.*

7 *Site improvements is based on preliminary geotechnical information. Additional geotechnical invesitgations are required to finalize this activity.*

8 *Mechanical dredging is assumed for the berth with 3:1 side slopes and no reinforcement on side slopes. Estimate does not include any associated costs due to rock dredging or blasting.*

9 *Estimate assumes piles are driven to grade with no obstructions and does not include any associated costs due to pile driving/drilling into rock*

10 *Pricing assumes all resources are readily available locally.*

11 *Estimate is based on unencumbered contractor access to the site.*

12 *Estimate does not include any costs for construction site property lease or acquisition expenses.*

13 *No extreme weather risk included (force majeure).*

14 *Estimate is based on currently available geotechnical information. Additional geotechnical explorations will be required. Results of this additional exploration program may require price update. Estimated fee for additional geotechnical exploration has been included as a soft cost.*

15 *Price does not include environmental restrictions.*

16 *Price does not include any associated costs due to hazardous waste.*

17 *Price does not include any costs for post construction site remediation or reconstruction*

18 *Costs for owner's project management or overhead expenses are not included.*

19 *Estimate assumes federal navigation channel requires no additional dredging.*

20 *Estimate includes utilities designed to site limit of work and assumes adequate municipal water and electrical service is available and can be tapped for project needs. Additional offsite utility infrastructure costs are not included.*

21 *Dredge unit cost in Phase 3 includes disposal.*