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MEMORANDUM

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

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.*

The purpose of this memorandum is to document Moffatt & Nichol's (M&N's) evaluation process that led to the dimensions and layout of the wharf structures at the Redwood Marine Multi-Purpose Terminal. This memorandum is organized as follows:

1. Introduction
2. Design Criteria
3. Wharf Layout Evaluation
4. Limitations
5. Next Phase Considerations
6. Reference Documents

1. INTRODUCTION

The proposed RMMT site includes two wharves with dolphins and a wet storage tie-up pier to meet the operational needs of a heavy-lift marine terminal facility to support the offshore wind energy industry and other coastal-dependent industries. See Figure 1 for a preliminary layout of the structures.

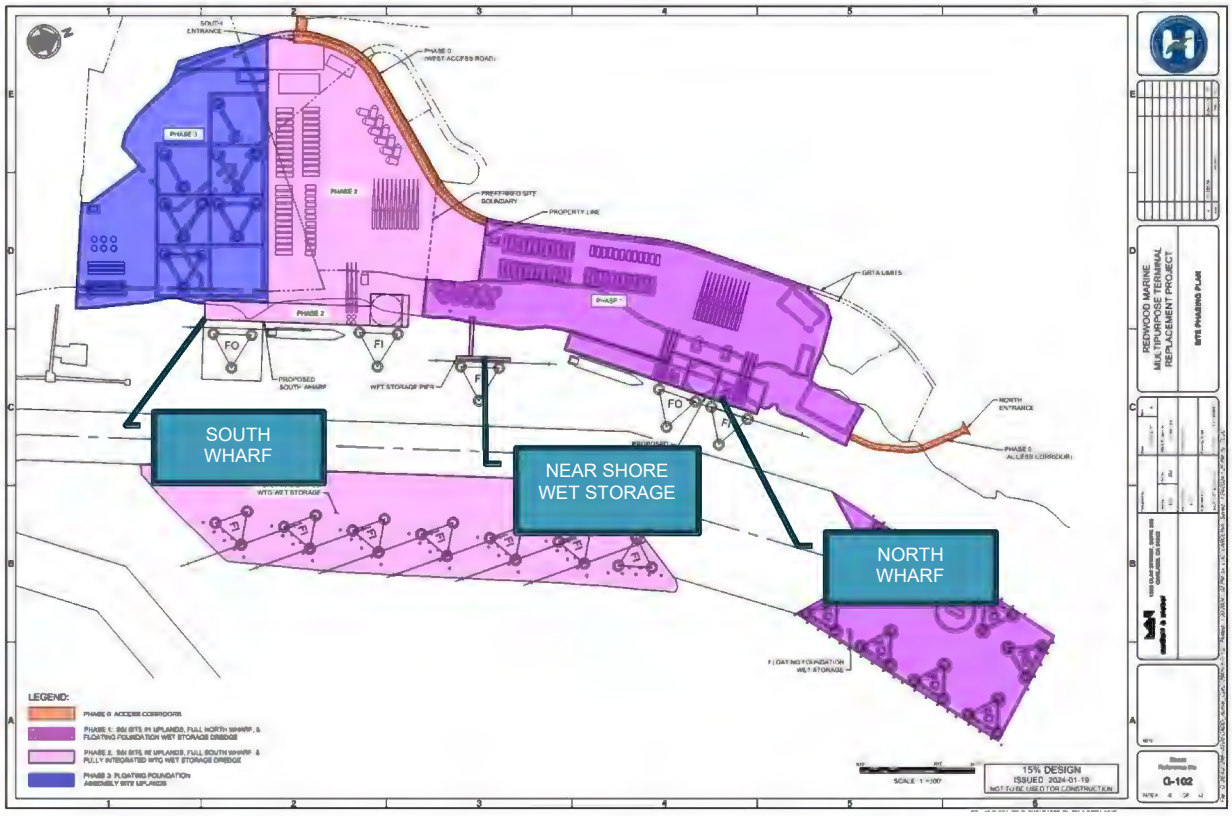
The first wharf will be a replacement of the existing Redwood Marine Terminal 1 (RMT1). The RMMT "North Wharf" will be built in two phases. The first phase wharf will be 800 linear feet (LF) and will be able to accommodate operations and equipment for integration of Wind Turbine Generators (WTG) as well as serve as a delivery berth to receive WTG components. A berthing dolphin and mooring dolphin will be installed north of this wharf to allow the WTG foundation to be shifted off the wharf and allow additional berthing area for the wharf. The second phase will extend the North Wharf an additional 800 LF southward and would be used primarily as a delivery berth. A berthing dolphin and mooring dolphin will be installed further south of the North Wharf extension to allow vessels to be shifted off the wharf and allow additional usable berth area in the middle of the wharf.

The second wharf (the “South Wharf”) will be 1,600 LF and will similarly accommodate both integration and delivery operations. The South Wharf will have one berthing dolphin and one mooring dolphin on both sides of the wharf, similar to the North Wharf.

The main function of the delivery berths are to provide berthing, mooring, and offloading capabilities for the delivery vessels and launching of WTG foundations. The integration berth’s main functions include staging, and assembly of WTGs.

The final structure is a nearshore wet storage to allow for mooring of WTG and landside access. Landside access would be required to perform any final testing or maintenance on the WTG.

Figure 1 – Structures Layout



2. DESIGN CRITERIA

The dimensions of the wharves were determined by the following governing characteristics:

- The pier-head line of the North Wharf is 420 feet offset from the Federal Samoa Channel to accommodate the estimated width of future 25-30MW floating foundations.
- The northernmost limit of the North Wharf is to align with the existing structure to minimize eel grass impacts.
- The width of the delivery wharf is 150 feet to accommodate large crawler crane track width plus additional width to properly distribute crane loads via cribbing.

- The width of the integration wharf is 250 feet to accommodate the estimated size of a ringer crane base which will be used for WTG integration. The full width of the base will be supported on the wharf section to ensure there is no differential settlement between the wharf and backlands.
- The wharf shall accommodate 6,000 pounds per square foot live loading to accommodate the crane loading. Based on designs of similar demands this requires a 3-foot flat-slab concrete deck.
- The top of the wharf is expected to have an 18" Dense Aggregate layer with 2-layers of geo-grid.
- The offshore 150' section of wharf deck structure will be sloped towards land to collect storm water runoff in trench drains. The slope of the wharf deck will continue to slope towards land to match the backlands slope.
- The backlands elevation interface with the wharf is NAVD88 +16.1' elevation to account for projected Sea Level Rise (reference Coastal Resiliency Memo).
- The front beam of the wharf shall have periodic drop-down sections to accommodate a fender sized for delivery vessels at the bent in which the fender is located. Fenders will be located along the entire wharf. Design of the drop-down section will be developed in the next phase.
- The front beam of the wharf shall have periodic drop-down sections to accommodate a large pneumatic fender sized for the floating foundations in the vicinity of where pneumatic fenders will be located. Pneumatic fenders are only located in the sections of the wharf where floating foundations will be moored. Design of the drop-down section will be developed in the next phase.
- The minimum viable length of the delivery wharf is 800 feet.
- To accommodate simultaneous delivery, foundation launching, and integration, the minimum viable length is 1,600 feet.
- The total length of the integration wharf section for the North Wharf will be 800 feet. This allows for flexibility in where the ringer crane is placed once the remaining 800 feet delivery wharf extension is constructed.
- The total length of the integration wharf section for the South Wharf will be 250 feet. This will keep the ringer crane in an isolated area at the southern end of the South Wharf and leaves the remaining wharf length available for delivery operations.
- Water and power vaults are located approximately 50 feet from either end of the wharves and approximately every 350 feet along the wharves. Water and power vaults are for incidental dock use and maintenance. Locations will be refined in final design.
- Shore power vaults are located approximately 50 feet from either end of the wharves and approximately every 350 feet along the wharves. Shore power vaults are for providing shore power (also referred to as cold ironing) to delivery vessels, electric tugs, etc. Locations will be refined in final design.
- Crane power vaults are located approximately 250 feet from either end of the integration wharf. The vaults are located to provide connection points for various locations of the electrified ringer crane used for integration. Locations will be refined in final design.

3. WHARF LAYOUT EVALUATION

The wharf length is based on the concept of having one integration area of 400 linear feet, one foundation launching area of 400 linear feet, and one delivery area of 800 linear feet and all three areas operating simultaneously for a total of 1,600 linear feet of wharf. See the Terminal Permitting and Programmatic Operations Memo (M&N, 2024) for further explanation of these lengths.

The northern most 800 linear feet of the North Wharf (Phase 1) is expected to be built first as it is the minimum viable length of wharf that could allow for a functioning Offshore Wind facility. An additional 800 linear feet will be added in a future phase. Once the extension is built it is envisioned that the location where individual operations occur will shift from when the wharf was only 800 linear feet long. To allow for the greatest flexibility of where the individual operations will occur when the final 1,600 linear foot "North Wharf" is operational, the first 800 linear feet of wharf will be a full 250 feet wide. This allows the vertical integration operation to be located anywhere along the Phase 1 wharf.

A mooring point will be required approximately 100' from the end of the wharf to allow for a vessel to utilize the full length of the wharf. To make even greater use of the wharf, a second mooring point will be added beyond the first mooring point. The first mooring point will be designed as a berthing dolphin to be able to take a loading from a vessel or foundation. The second mooring point will only be a mooring dolphin with a mooring point on it. Exact locations of the dolphins will be evaluated in the next phase when specific vessel data is available.

Wharf drainage slope of 0.8% is a standard slope but could potentially be altered to between 0.5% and 1% if needed. The wharf drains to a trench drain system at the low point of the deck.

Drop down sections at the fender locations are isolated to the immediate area of the fenders rather than a continuous drop-down section to reduce the amount of concrete and rebar.

Utility vaults are located to avoid being directly behind fenders to avoid rebar interferences. They are spaced to provide periodic tie in points along the wharf.

4. LIMITATIONS

The purpose for the work conducted in this phase was to help advance a conceptual design for purposes of project planning, initiation of environmental permitting and regulatory processes, and to aid in development of an overall project narrative and budget estimate. Additional geotechnical investigation and analysis will be required in subsequent phases of work to refine and update the results and recommendations outlined in this memorandum. Outreach to and input from potential developers will be needed to ensure the wharf features will satisfy the requirements of the floating offshore wind industry as the size of WTGs is not known and can only be estimated based on previous experience of M&N and publicly available information.

5. NEXT PHASE CONSIDERATIONS

At the start of the next design phase of work, the following are critical steps in the continuation of the planning, analysis, and design work.

- Verifying the idealized ringer crane's sensitivity to differential settlement. If the base can accommodate some amount of settlement it would be far more cost effective to only use a 150' section across the entire wharf.
- Confirm the type of fender system that will be used for the floating foundations and modify the front beam to accommodate loadings.
- Optimize wharf and dolphin layout by looking closely at vessel and foundation arrangements
- Optimize pile spacing based on marine boring data from geotechnical study
- Optimize locations of all utility vaults based on vessel dimensions, electrified crane dimensions, and expected working locations, and future wharf uses.

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6. REFERENCE DOCUMENTS

- Terminal Permitting and Programmatic Operations Memo (M&N, Jan 2024)
- Coastal Resiliency Memorandum, (M&N, April 2024)