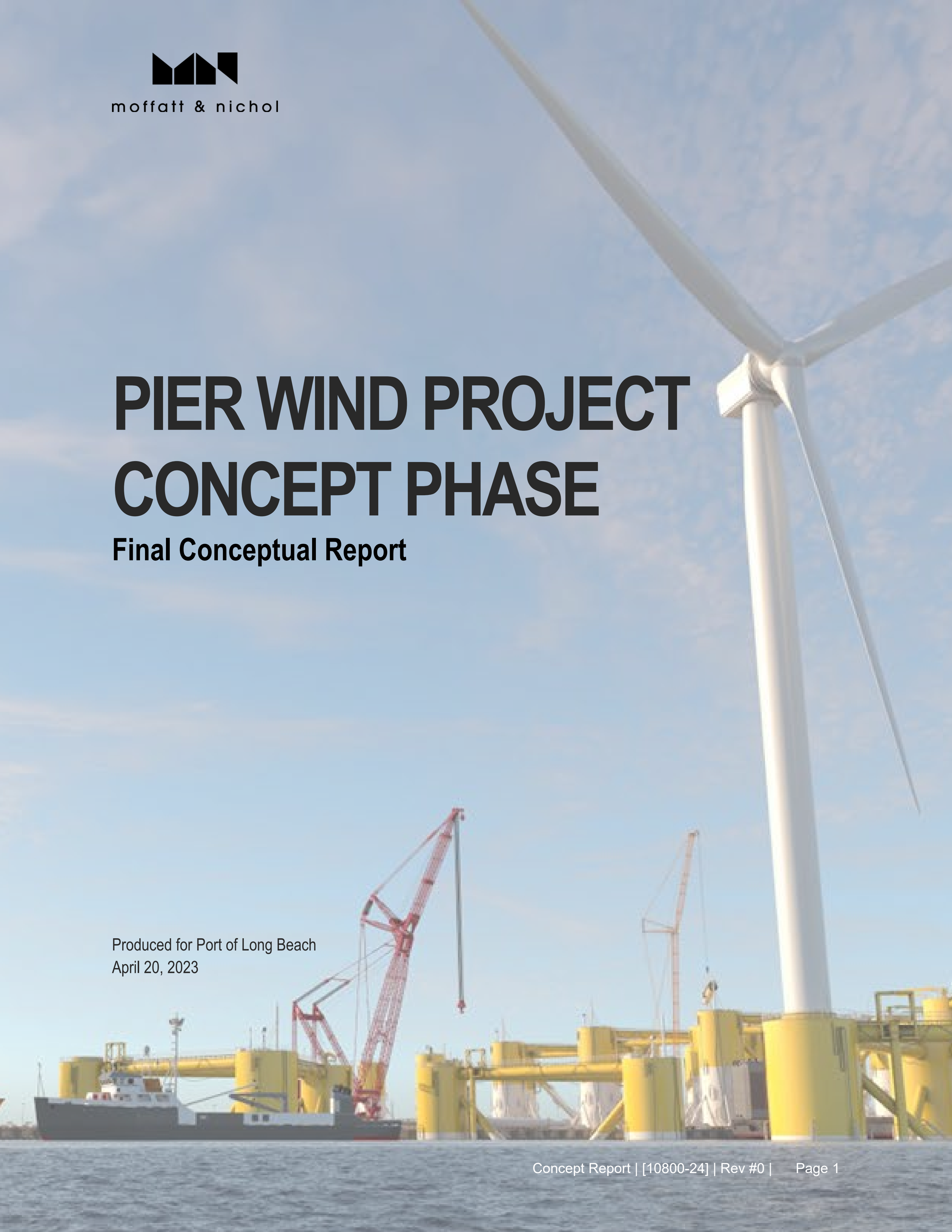
moffatt & nichol



PIER WIND PROJECT CONCEPT PHASE

Final Conceptual Report

Produced for Port of Long Beach
April 20, 2023

Document Verification

Client	Port of Long Beach
Project name	Pier Wind – Concept Phase
Document title	Final Conceptual Report
Status	Draft
Date	April 20, 2023
Project number	10800-24

Revision	Description	Issued by	Date	Checked
00	Final Conceptual Report	Jennifer Lim	4/20/2023	Matt Trowbridge

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Attachment L: Cost Estimate and Basis of Estimate Report

1. Introduction

The offshore wind industry in the Pacific Outer Continental Shelf (OCS) region in the United States (U.S.) is a relatively new industry that is poised for significant growth and development. Multiple states, including California, have passed legislation creating a market for the offshore wind industry. The federal government announced in May 2021 a goal to deploy 30 gigawatts (GW) of offshore wind in the U.S. by 2030 and 110 GW by 2050. In September 2022, the federal government announced an additional goal of 15 GW of floating offshore wind in the U.S. by 2035. California Assembly Bill 525, published September 24, 2021, directs state agencies to develop a strategic plan and set state wide goals for offshore wind production by 2030 and 2045. In a letter to the California Air Resources Board (CARB) dated July 22, 2022, Governor Gavin Newsom urged the California Energy Commission (CEC) to establish an offshore wind planning goal of at least 20 GW by 2045. On August 1, 2022, the CEC established a preliminary offshore wind planning goal of 2–5 GW by 2030 and 25 GW by 2045. These deployment goals will drive the development of the offshore wind industry and the need for purpose-built port infrastructure to support offshore wind projects in the Pacific OCS.

The Pacific OCS is characterized by rapidly increasing water depths that exceed the feasible limits of traditional fixed offshore wind turbines. Thus, floating offshore wind technology is more suitable for this region. To minimize risk and ensure accurate assembly, floating offshore wind turbine systems require port facilities to fabricate the floating foundations, manufacture components, construct or assemble the turbine, and provide maintenance support.

Existing port infrastructure on the U.S. West Coast, including California, is not adequate to support the development of the offshore wind industry, and significant port investment is required to develop purpose-built offshore wind port facilities. This is because offshore wind components are large and require port facilities with significant laydown area and infrastructure with heavy loading capacities to assemble the turbine systems.

To address this issue, the Bureau of Ocean Energy Management (BOEM) performed a study to assess California ports and identify the quantity and size of required port facilities to meet California's offshore wind planning goals – California Floating Offshore Wind Regional Ports Assessment. The study indicated there are limited existing ports that could host staging and integration (S&I) sites due to the air height requirements needed for the fully assembled units. This type of facility would receive, stage, and store offshore wind components and assemble the floating turbine system, which is then towed out to the offshore wind area. The Port of Long Beach (POLB) has the potential to play a critical role in supporting the offshore wind industry to help meet the state and federal offshore wind deployment goals.

Consequently, the Port of Long Beach (POLB) is evaluating the opportunity to develop an approximately 400-acre terminal known as Pier Wind. This offshore wind terminal will be developed to have the flexibility to serve any of the offshore wind industry needs (i.e., staging and integration (S&I), foundation fabrication, component manufacturing, maintenance support, etc.). In addition, the terminal will meet the physical, regulatory, and environmental requirements to accommodate the largest floating offshore wind turbine generator (WTG) components and floating foundations being developed. This report documents the engineering decisions completed during the conceptual phase of the project.

1.1. Site Description and Location

Pier Wind is located within the Port of Long Beach in the Outer Harbor, just south of the Navy Mole, as shown in Figure 1. The western edge of the project is on the border that separates the Port of Long Beach from the Port of Los Angeles. Pier Wind is strategically located off the main channel and near Queen's Gate, the entrance to the port. In addition, the project site is south (outside) of the Long Beach International Gateway Bridge resulting in no height limitations or air draft restrictions for offshore wind industry use. This is critical since the offshore wind turbines can be up to 1,100 feet tall.

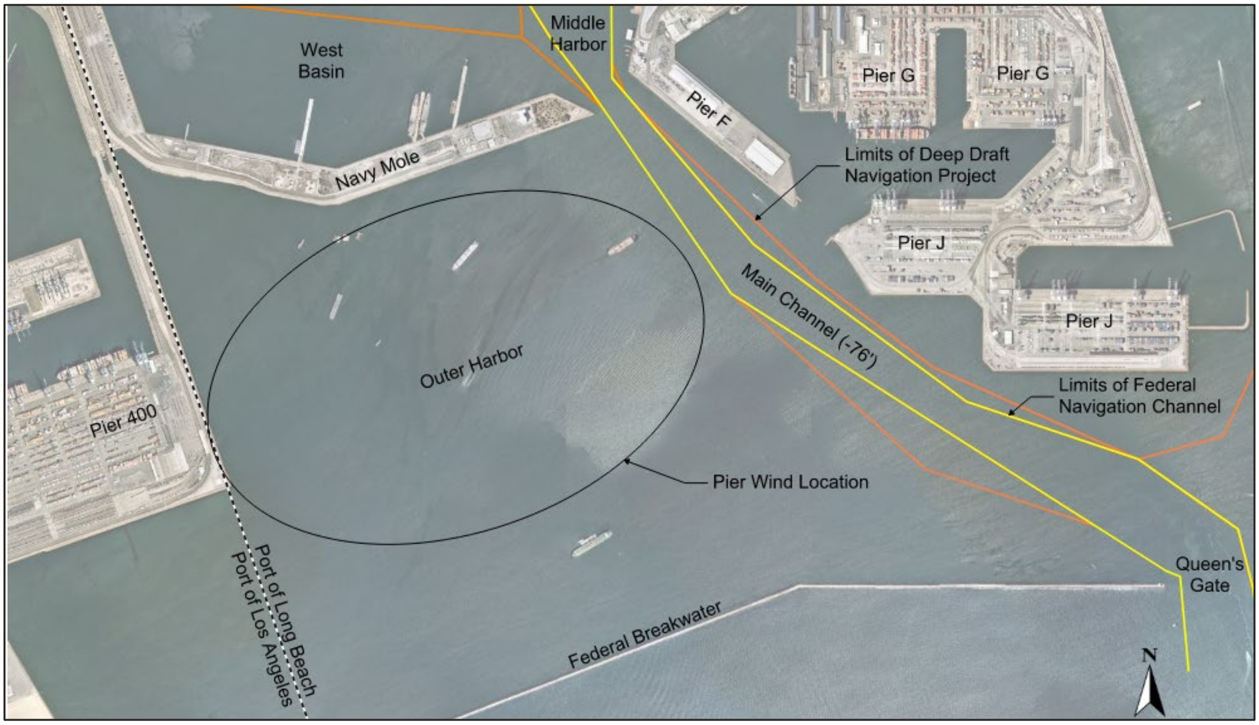


Figure 1. Pier Wind Location in the Outer Harbor of Port of Long Beach

The Approach Channel through Queen's Gate is currently authorized to -76 feet mean lower low water (MLLW) by 1,200 feet wide. The Main Channel is also currently authorized to -76 feet MLLW. The width of the Main Channel ranges from 400 feet at the Navy Mole / Pier F Channel to 1,400 feet at the Pier T Turning Basin. The Outer Harbor has existing water depths ranging from -40 to -70 feet mean lower low water (MLLW).

The Port of Long Beach is currently planning for the Deep Draft Navigation Project with the Final Environmental Impact Statement / Environmental Impact Report (EIS/EIR) being published October 2021. This project would include the following improvements as shown in Figure 2:

- Deepen the entrance to the Main Channel from a project depth of -76 feet to -80 feet MLLW.
- Widen portions of the Main Channel to a depth of -76 feet MLLW.
- Construct an approach channel and turning basin to Pier J South from -50 feet MLLW to a depth of -55 feet MLLW.
- Deepen portions of the West Basin and West Basin Approach from -50 feet to a depth of -55 feet MLLW.
- Deepen the Pier J Basin and berths J266-J270 within the Pier J South Slip to a depth of -55 feet MLLW.

- Perform structural improvements on Pier J breakwaters at the entrance of the Pier J Slip to accommodate deepening of the Pier J Slip and Approach Channel to -55 feet MLLW.
- Place dredged material either at a nearshore placement site, an ocean-dredged material disposal site or a combination of the two.
- Construct a new dredge electric substation.

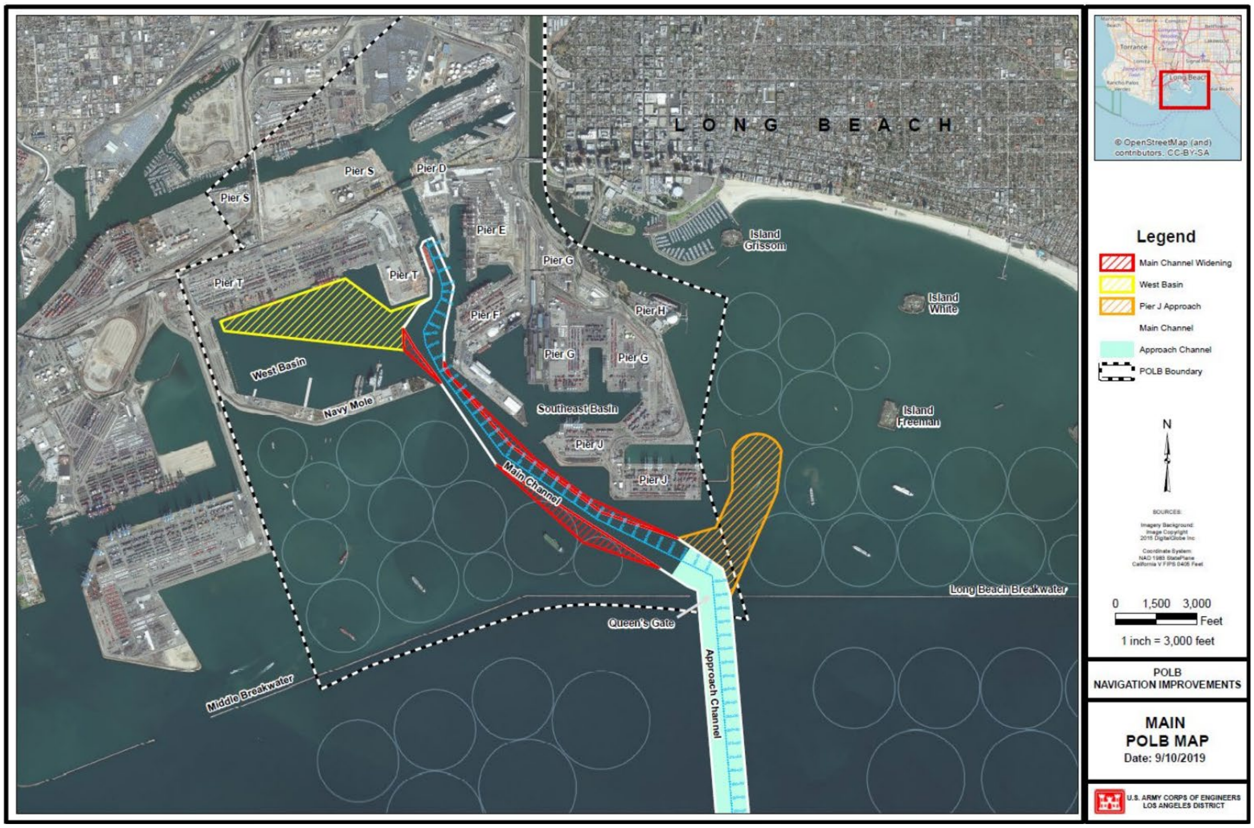


Figure 2. Port of Long Beach Deep Draft Navigation Project Areas (Reference: U.S. Army Corps of Engineers)

1.2. Project Conceptual Phase Goals

During the conceptual phase of the project, the following tasks were completed:

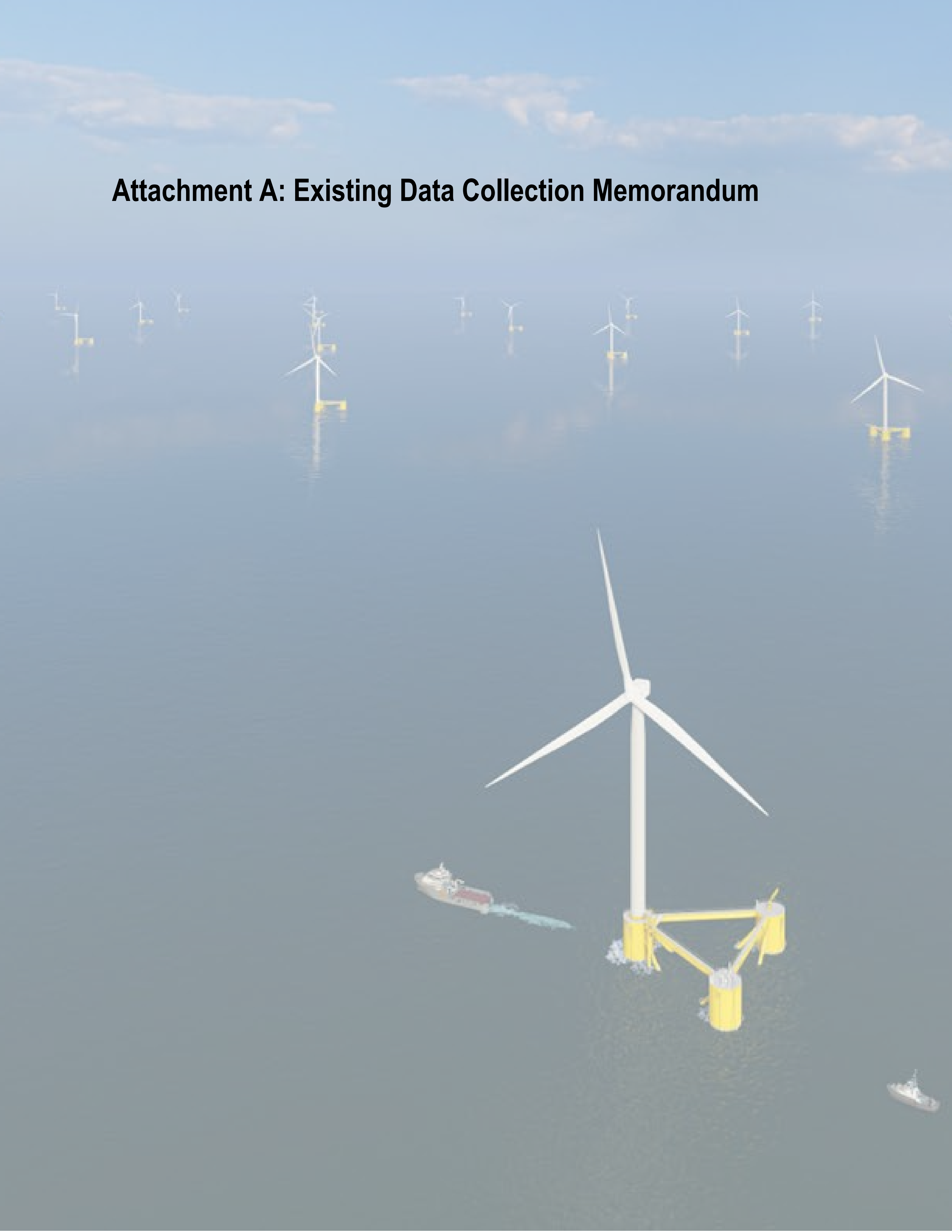
- Determined scope and cost of necessary improvements through conceptual engineering
- Developed an overall project schedule and project cost
- Evaluated options to deliver the terminal on an accelerated schedule while considering environmental and sustainable approaches
- Identified project phasing options for early industry use and to balance funding and fill availability
- Developed a recommended path forward for the next steps of the project

2. Summary of Conceptual Engineering

The conceptual engineering is summarized in the attached documents:

- Attachment A: Existing Data Collection Memorandum
- Attachment B: Basis of Design
- Attachment C: Site Location and Geometry Memorandum
- Attachment D: Wave Study Memorandum
- Attachment E: Dredge, Fill, and Sediment Management Plan
- Attachment F: Geotechnical Engineering Memorandum
- Attachment G: Marine Structures Memorandum
- Attachment H: Transportation Corridor Memorandum
- Attachment I: Electrical Engineering Memorandum
- Attachment J: Conceptual Engineering Drawings
- Attachment K: Project Schedule and Basis Memorandum
- Attachment L: Cost Estimate and Basis of Estimate Report

Attachment A: Existing Data Collection Memorandum



moffatt & nichol

4225 E. Conant Street
Long Beach, CA 90808

(562) 590 - 6500
www.moffattnichol.com

EXISTING DATA COLLECTION MEMORANDUM

To:	Port of Long Beach
From:	Jennifer Lim (Moffatt & Nichol)
Cc:	Matt Trowbridge (Moffatt & Nichol)
Project Name:	Pier Wind Project – Concept Phase
Date:	April 20, 2023
Subject:	Existing Data Collection Memorandum
M&N Job No.:	10800-24

This memorandum documents all the relevant existing data that has been received from the Port of Long Beach (POLB), Moffatt & Nichol (M&N), and Earth Mechanics, Inc. (EMI). Below is a list of the ten (10) categories the received data falls under. For a more detailed list of each file refer to the table on the next three (3) pages where the title/description, date, owner, and file type is documented.

1. As-Builts / Record Drawings
2. Bathymetric Survey and Topographic Survey
3. Geotechnical Data and Reports
4. Utilities
5. Form FAA 7460-1
6. Environmental Documents
7. Port Master Plans
8. CAD Files
9. Wave Analysis Data
10. Miscellaneous

No.	Title/Description	Date	Owner	File Type	Received From
1. As-Builts / Record Drawings					
1.01	B2-0186 | Pier 400 Lead Track	6/28/2001	POLA	.pdf	POLB
1.02	B4-1941 | Historic Naval Station Property & Utilities	7/26/1994	Navy	.pdf	POLB
1.03	F-0891 | US Navy Dept: Misc Drawing: Fleet Operating Base	1942-1946	Navy	.pdf	POLB
1.04	F-0892 | US Navy Dept: Misc Maps: Fleet Operation Base	1946-1952	Navy	.pdf	POLB
1.05	F-0894 | US Navy: Misc Maps - Roosevelt Base	1957	Navy	.pdf	POLB
1.06	F-0895 | US Navy: Various Maps Covering Breakwaters, Dredging, Fencing, etc.	1944-1952	Navy	.pdf	POLB
1.07	F-1232 | LB Harbor Dept - Federal Breakwater	1941	Navy	.pdf	POLB
1.08	HD 02-0602 | 2020 Plan Phase 1,2,3,4 Typical Dike Cross Sections		POLB	.pdf	POLB
1.09	HD 08-0355 | POLA & POLB 2020 Plan Outer Harbor	2/2/1988	POLB	.pdf	POLB
1.10	HD 10-01436 | Pier T Marine Terminal Dredging and Wharf Construction	1/4/1999	POLB	.pdf	POLB
1.11	HD10-01439 | Pier T Marine Terminal Berths T134-T140 Container Yard and Intermodal Yard	6/25/2004	POLB	.pdf	POLB
1.12	HD10-01580 Pier T Marine Terminal Shallow Water Habitat	12/17/2022	POLB	.pdf	POLB
1.13	HD10-01587 | Pier T Marine Terminal Grading Drainage & Utilities	10/29/2002	POLB	.pdf	POLB
1.14	HD10-01632 | Ocean Blvd Terminal Island Interchange Project	6/17/2004	POLB	.pdf	POLB
1.15	HD10-01635 | Pier T Marine Terminal Mole Widening for Railyard	4/19/2000	POLB	.pdf	POLB
1.16	HD10-01641 | Pier T Marine Terminal Berths T132-T134 Dredging and Wharf Extension	12/4/2002	POLB	.pdf	POLB
1.17	HD10-01819 | Pier S Avenue Long Beach Fire Station 24 Phase 1	1/28/2009	POLB	.pdf	POLB
1.18	HD10-01882 | Pier T & S Railroad Crossing	12/15/2004	POLB	.pdf	POLB
1.19	HD10-02014 | Pier T Berths T132-T140 Shore to Ship Power	5/28/2015	POLB	.pdf	POLB
1.20	HD002124 | Proposed Dike & Hydraulic Fill at LB Outer Harbor	2/26/1942	POLB	.pdf	POLB
1.21	HD004066 | Cross Section thru LB Portion of Federal Breakwater	10/16/1950	POLB	.pdf	POLB
1.22	HD008855 | Typical Wharf and Dike Sections, Southwest Basin	12/22/1967	POLB	.pdf	POLB
1.23	HD010280 | Outer Harbor Suggested Location for Navy Base Breakwater	12/2/1943	POLB	.pdf	POLB
1.24	HD010281 | Outer Harbor US Navy Loction for Navy Base Breakwater	1/12/1944	POLB	.pdf	POLB
1.25	1-2018 | Pier 400 Dredging and Landfill Project	3/1994	POLA	.pdf	POLA
1.26	1-2206 | Transportation Corridor	2/1/2003	POLA	.pdf	POLA
1.27	1-2207 | Pier 400 Lead Track	6/28/2001	POLA	.pdf	POLA
1.28	1-2208 | Pier 400 ICTF	11/22/2000	POLA	.pdf	POLA
1.29	1-2209 | Pier 400 Backlands Phase 1	10/2004	POLA	.pdf	POLA
1.30	1-2210 | Pier 400 Wharf Phase 1	1/30/2005	POLA	.pdf	POLA
1.31	1-2213 | Pier 400 Transportation Corridor Bridge 2	01/1999	POLA	.pdf	POLA
1.32	1-2309 | Transportation Corridor Railroad Bridge	8/3/2000	POLA	.pdf	POLA
1.33	1-2331 | Pier 400 Transportation Corridor-North	2000-2001	POLA	.pdf	POLA
1.34	Spec No. 2457 | Specifications for Pier 400 Dredging and Landfill Project	6/1994	POLA	.pdf	POLA
1.35	4013 | Stage 2, POLA Pier 400 Deep Draft Navigation Improvements Specs	3/1997	POLA	.pdf	POLA
2. Bathymetric Survey and Topographic Survey					
2.01	Harbor Sounding Program, Date August 2021	08/2021	POLB	.pdf, .dwg, .xyz, .pro,	POLB
2.02	Port of Long Beach Harbor Sounding Program - Hydrographic Survey Report - 2021	08/2021	POLB	.pdf	POLB
2.03	Port of Long Beach Harbor Sounding Program - Hydrographic Survey Report - 2022	04/2022	POLB	.pdf	POLB
2.04	Pier400 Phase 2 Point Cloud		POLB	.las	POLB
2.05	Pier T Windfarm Phase 2 Group 1 Densified Point Cloud		POLB	.las	POLB
3. Geotechnical Data and Reports					
3.01	GEO-0022-001 | Report of Foundation and Hydraulic Fill Investigation, Proposed New Pier J and Extension of Pier F	7/27/1961	POLB	.pdf	POLB
3.02	GEO-0051-001 | Consultation and Soil Sampling Proposed Hydraulic Dredging Project, Extension of Pier G and Pier J	9/5/1969	POLB	.pdf	POLB
3.03	GEO-0070-002 | Geotechnical Investigation for Proposed Sohio Terminal	7/11/1978	POLB	.pdf	POLB
3.04	GEO-0152-001 | Geotechnical Investigation Data Report Volume I Pier T Container Terminal	1/20/1997	POLB	.pdf	POLB

No.	Title/Description	Date	Owner	File Type	Received From
3.05	GEO-0152-002 | Geotechnical Investigation Data Report Volume II Pier T Container Terminal	1/18/2001	POLB	.pdf	POLB
3.06	GEO-0152-003 | Geotechnical Investigation Data Report Volume III Pier T Container Terminal	10/19/2001	POLB	.pdf	POLB
3.07	GEO-0153-001 | Geotechnical Investigation Volume 1 - Soil Data Report, Pier G Terminal Development Project	6/27/2000	POLB	.pdf	POLB
3.08	GEO-0157-001 | Geotechnical Investigtion Proposed Landfill and Wharf Construction Slip No. 2	12/23/1994	POLB	.pdf	POLB
3.09	GEO-0247-001 | Environmental and Geotechnical Sampling Program, Volume I - Final Report	3/23/1976	POLB	.pdf	POLB
3.10	GEO-0255-001 | Report of Vibracore Sampling Western Anchorage Sediment Storage Area	4/26/2002	POLB	.pdf	POLB
3.11	GEO-0266-001 | Geotechnical Services Offshore Borrow Source Study	7/2/2010	POLB	.pdf	POLB
3.12	GEO-0305-001 | Geotechnical Investigation Pier T Backland Structures	12/15/2000	POLB	.pdf	POLB
3.13	GEO-0308-001 | Geotechnical Design Report Ocean Blvd / Terminal Island Freeway Interchange Project	10/22/2002	POLB	.pdf	POLB
3.14	Geotechnical Data Report for Dredge Material Source Characterization, Phase 1 Vibracore, Middle Harbor Redevelopment Project	11/4/2011	EMI for M&N	.pdf	EMI
3.15	Geotechnical Data Report for Dredge Material Source Characterization, Phase 2 Vibracore, Middle Harbor Redevelopment Project	2/1/2012	EMI for M&N	.pdf	EMI
3.16	Draft Foundation Report, Walls No. 1 & 2 and Walls No. 3 & 4, Mechanically Stabilized Earth (MSE) Walls and Associated Roadways…	9/30/2010	EMI For Parsons	.pdf	EMI
3.17	Draft Foundation Report, Nimitz Grade Separation, Terminal Island Rail Improvement Project, Port of Long Beach, Los Angeles County, California	10/6/2010	EMI For Parsons	.pdf	EMI
3.18	Technical Memorandum: Settlement Estimates for the Proposed Roadway Embankment Due to Placement of Proposed Rock Slope…	7/26/2010	EMI For Parsons	.pdf	EMI
3.19	Geotechnical Services, Offshore Borrow Source Study, Long Beach, California	7/2/2010	DYA for POLB	.pdf	EMI
3.20	Report of Offshore Sampling, Dredge Borrow Western Anchorage Area, North Slip Fill at Pier G, Berths G230 to G236, Port of Long Beach, California	12/17/2007	Kleinfelder for POLB	.pdf	EMI
3.21	Final Foundation Report: Pier 400 Transportation Corridor Railroad Bridge	6/11/2000	EMI for POLA	.pdf	EMI
3.22	Geotechnical Study, Transportation Corridor Bridge, Port of Los Angeles, California	10/1996	Fugro for POLA	.pdf	EMI
3.23	Final Foundation Report: Pier 400 Transportation Corridor Railroad Bridge, - Track Expansion, Port of Los Angeles, California	7/2/2021	EMI to POLA	.pdf	EMI
3.24	Geotechnical Framework Report, Pier 400 Landfill Project, Port of Los Angeles, California	4/16/2001	Fugro for POLA	.pdf	EMI
3.25	Final Soils Report, 2020 Plan Geotechnical Investigation, Port of Los Angeles (Volumes 1 – 3)	12/1992	Fugro-McClelland	hard copy	EMI
3.26	1938 | Existing Data Appendix to Final Soils Report for the 2020 Plan Geotechnical Investigation Port of Los Angeles	12/31/1992	POLA	.pdf	POLA
3.27	4816 | Final Foundation Report Pier 400 Transportation Corridor Port of Los Angeles	10/30/2000	POLA	.pdf	POLA
3.28	4821 | Recommended Structural Pavement Sections, Pier 400 Transportation Corridor Port of Los Angeles San Pedro California	4/24/2000	POLA	.pdf	POLA
	4. Utilities				
4.01	POLB Pier T Utilities Verifiction - Fiber Optic, Stormwater, Sewer, Water, Electric		POLB	.pdf	POLB
	5. Form FAA 7460-1				
5.01	Gerald Desmond Bridge		POLB	.pdf	
	6. Environmental Documents				
6.01	OHPER Site Confined Aquatic Disposal Feasibility Evaluation	10/26/2016	POLB/Anchor QEA	.pdf	M&N
6.02	Final Integrated Feasibility Report and EIS/EIR, Deep Draft Navigation Study	10/2021	POLB	.pdf	M&N
6.03	Final Integrated Feasibility Report and EIS/EIR, Deep Draft Navigation Study - Appendix C: Geotechnical Engineering	10/2021	POLB	.pdf	M&N
6.04	Pier G South Slip Fill Sediment Characterization - Final Sampling and Analysis Plan	10/30/2022	POLB/ITS	.pdf	M&N
6.05	Port Master Plan Update - Draft EIR - OHSPER Technical Report	05/2019	POLB/Anchor QEA	.pdf	M&N
	7. Port Master Plans				
7.01	POLB Port Master Plan - Revised Draft - Update 2022	2022	POLB	.pdf	Public
7.02	POLA Port Master Plan - September 2018	2018	POLA	.pdf	Public
	8. CAD Files				
8.01	Deep Draft Navigation Channel Project	10/13/2022	POLB	.dgn	POLB
8.02	POLB Vicinity Map - Base Map	2007	POLB	.dgn	POLB
8.03	Pier T and Navy Mole Railroad Centerline NAD83-2007	8/17/2022	POLB	.dgn	POLB
8.04	Pier T and Navy Mole Utility Communication NAD83-2007	9/23/2022	POLB	.dgn	POLB
8.05	Pier T and Navy Mole Utility Electric NAD83-2007	9/23/2022	POLB	.dgn	POLB
8.06	Pier T and Navy Mole Utility Fiber Optic NAD83-2007	9/9/2021	POLB	.dgn	POLB
8.07	Pier T and Navy Mole Utility Sewer NAD83-2007	10/19/2022	POLB	.dgn	POLB
8.08	Pier T and Navy Mole Utility Stormwater NAD83-2007	9/23/2022	POLB	.dgn	POLB
8.09	Pier T and Navy Mole Utility Water NAD83-2007	8/12/2022	POLB	.dgn	POLB

No.	Title/Description	Date	Owner	File Type	Received From
8.10	Pier T and Navy Mole Bridge-2018		POLB	.dgn	POLB
8.11	Pier T and Navy Mole Contours-2018		POLB	.dgn	POLB
8.12	Pier T and Navy Mole Plan-2018		POLB	.dgn	POLB
8.13	Pier T and Navy Mole Striping-2018		POLB	.dgn	POLB
8.14	E5567 | Seaplane Lagoon Sounding Map	12/11/2012	POLA	.dwg	POLA
8.15	E5645 | Pier 500 Sounding Map	4/20/2011	POLA	.dwg	POLA
8.16	R6853_F | P400 Navy Way from Reeves to APL/APMT Entrance Topographic Survey	4/3/2019	POLA	.dwg	POLA
8.17	POLB site01		POLB	.dwg	POLB
9. Wave Analysis Data					
9.01	Sea Dyn Letter - Wave Energy Plots	11/21/1996	POLB	.pdf	POLB
9.02	Ship Motion Study - Pier J South	09/1997	POLB	.pdf	POLB
9.03	2007 POLA/POLB Tsunami Hazard Assessment	2007	POLB	.pdf	POLB
9.04	Coastal and Marine Conditions Report	5/17/2012	POLB	.pdf	POLB
9.05	DHI - Validation of Mike 21 BW Wave Modeling of Long Period Response in Port of Long Beach Report	10/2004	POLB	.pdf	POLB
9.06	Draft Report - Moffatt Nichol Piers E G and J Development Numerical Wave and Ship Motion Modeling Study	05/2002	POLB	.pdf	POLB
9.07	Final Pier F Technical Memorandum Alternatives Analysis with Attach	4/23/2012	POLB	.pdf	POLB
9.08	TMDL Hydrodynamic Model Report Final - WRAP Model	2017	POLB	.pdf	POLB
9.09	Hydrodynamic Model Overview - WRAP Model	9/28/2016	POLB	.pdf	POLB
9.10	Port of Long Beach Pier J Breakwater Beach Impacts Study	07/1995	POLB	.pdf	POLB
9.11	TM POLB FS15 Dock Bilge Keel CFD	12/20/2022	POLB	.pdf	POLB
9.12	USACE - Hydraulic Model Study Physical and Numerical Model Studies of Harbor Resonance at Piers E, G, J, POLB	04/2004	POLB	.pdf	POLB
9.13	DataSummary		POLB	.pptx	POLB
9.14	POLB 9-01 processed May11	2010	POLB	.xls	POLB
9.15	POLB 9-02 processed May11	2010	POLB	.xls	POLB
9.16	POLB 9-02 Raw + Process	2010	POLB	.xls	POLB
9.17	POLB 10-02 processed May11	2010	POLB	.xls	POLB
9.18	POLB 10-02 Raw + Process	2010	POLB	.xls	POLB
9.19	Polb Sta 9 raw+process	2010	POLB	.xls	POLB
9.20	Polb Sta 10 raw+process	2010	POLB	.xls	POLB
9.21	Sta 10-01 Processed May11	2010	POLB	.xls	POLB
9.22	Pier J Ship Motion Analysis Incorporating HADCP Current Data -Draft Report	2005	POLB	.pdf	POLB
9.23	Horizontal ADCP Monitoring Pier J Basin Winter Monitoring Report	2003	POLB	.pdf	POLB
9.24	USACE ESPB Final IFR Jan 2022 Appendix A - Coastal Engineering and Design	2022	POLB	.pdf	POLB
9.25	USACE ESPB Final IFR Jan 2022	2022	POLB	.pdf	POLB
10. Miscellaneous					
10.01	Dredge1-line	9/5/2008	POLB	.pdf	POLB
10.02	Pier T One Line	2012	POLB	.pdf	POLB
10.03	H-Portwide Dredge Plan Dredge Elec Sub Eval R1	12/9/2016	POLB	.pdf	POLB

Attachment B: Basis of Design

moffatt & nichol

PIER WIND PROJECT CONCEPT PHASE

Basis of Design

Produced for Port of Long Beach
April 20, 2023

Rev #	Description	Originator	Approver
#00	Draft Basis of Design	Jennifer Lim	Matt Trowbridge
		Date: 12/18/2022	Date: 12/18/2022
#01	Draft Basis of Design	Jennifer Lim	Matt Trowbridge
		Date: 4/10/2023	Date: 4/10/2023
#02	Draft Basis of Design	Jennifer Lim	Matt Trowbridge
		Date: 4/14/2023	Date: 4/14/2023
#03	Draft Basis of Design	Jennifer Lim	Matt Trowbridge
		Date: 4/20/2023	Date: 4/20/2023

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1. Introduction

1.1. Project Background

The offshore wind industry in the Pacific Outer Continental Shelf (OCS) region in the United States (U.S.) is a relatively new industry that is poised for significant growth and development. Multiple states, including California, have passed legislation creating a market for the offshore wind industry. The federal government announced in May 2021 a goal to deploy 30 gigawatts (GW) of offshore wind in the U.S. by 2030. In September 2022, the federal government announced an additional goal of 15 GW of floating offshore wind in the U.S. by 2035. California Assembly Bill 525, published September 24, 2021, directs state agencies to develop a strategic plan and set statewide goals for offshore wind production by 2030 and 2045. In a letter to the California Air Resources Board (CARB) dated July 22, 2022, Governor Gavin Newsom urged the California Energy Commission (CEC) to establish an offshore wind planning goal of at least 20 GW by 2045. On August 1, 2022, the CEC established a preliminary offshore wind planning goal of 2–5 GW by 2030 and 25 GW by 2045. These deployment goals will drive the development of the offshore wind industry and the need for purpose-built port infrastructure to support offshore wind projects in the Pacific OCS.

The Pacific OCS is characterized by rapidly increasing water depths that exceed the feasible limits of traditional fixed offshore wind turbines. Thus, floating offshore wind technology is more suitable for this region. To assemble the turbines, a large crane is used to place the tower sections onto the floating foundation in the water and then the nacelle and blades are placed onto the tower. This operation must be performed within protected waters to minimize risk and ensure accurate placement and safe operations, thus the need for ports.

Existing port infrastructure on the U.S. West Coast, including California, is not adequate to support the development of the offshore wind industry, and significant port investment is required to develop purpose-built offshore wind port facilities. This is because offshore wind components are large and require port facilities with significant laydown area and infrastructure with heavy loading capacities to assemble the turbine systems.

To address this issue, the Bureau of Ocean Energy Management (BOEM) performed a study to assess California ports and identify the quantity and size of required port facilities to meet California's offshore wind planning goals – California Floating Offshore Wind Regional Ports Assessment. The study indicated there are limited existing ports that could host staging and integration (S&I) sites due to the air height requirements needed for the fully assembled units. This type of facility would receive, stage, and store offshore wind components and assemble the floating turbine system, which is then towed out to the offshore wind area. The Port of Long Beach (POLB) has the potential to play a critical role in supporting the offshore wind industry to help meet the state and federal offshore wind deployment goals.

Consequently, the POLB is evaluating the opportunity to develop an approximately 400-acre terminal known as Pier Wind. This offshore wind terminal will be developed to have the flexibility to serve any of the offshore wind industry needs (i.e., staging and integration (S&I), foundation fabrication, component manufacturing, maintenance support, etc.). In addition, the terminal will meet the physical, regulatory, and environmental requirements to accommodate the largest floating offshore wind turbine generator (WTG) components and floating foundations being developed. This facility will help California achieve the AB 525 deployment target of 25 GW of offshore wind power by 2045.

To help meet the 2045 deployment targets, the schedule of the project is critical and must be delivered on an aggressive timeline to be ready for the offshore wind industry. The design criteria, means and methods, and phasing of the project will continue to be evaluated throughout the design process to accelerate delivery to the maximum extent possible.

1.2. Site Description and Location

Pier Wind is located within the Port of Long Beach in the Outer Harbor, just south of the Navy Mole, as shown in **Figure 1**. The western edge of the project is on the border that separates the Port of Long Beach from the Port of Los Angeles. Pier Wind is strategically located off the main channel and near Queen's Gate, the entrance to the port. In addition, the project site is south (outside) of the Long Beach International Gateway Bridge resulting in no height limitations or air draft restrictions for offshore wind industry use.

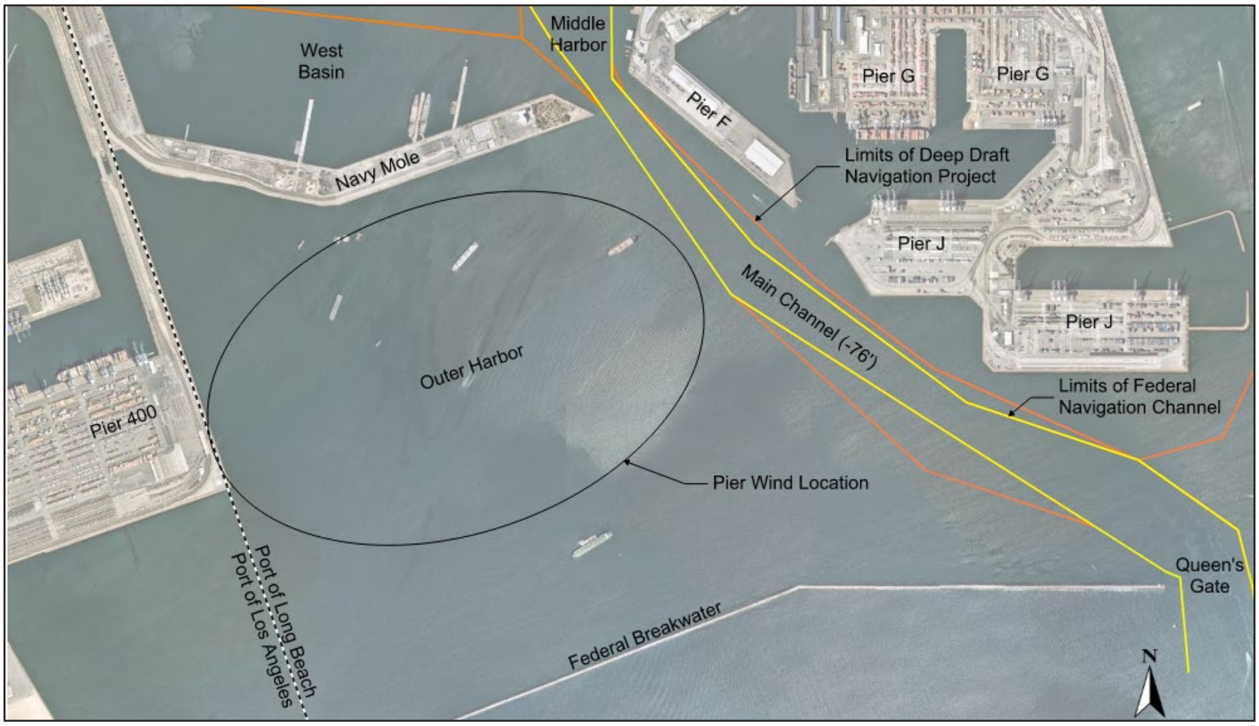


Figure 1: Pier Wind Project Location in the Port of Long Beach

1.3. Project Conceptual Phase Goals

The concept phase of the Pier Wind will assess the feasibility of the project with the following goals and requirements in mind:

- Complete conceptual engineering to identify scope and cost of necessary improvements and to identify potential challenges or issues in the proposed project
- Develop an overall project schedule and evaluate options to deliver the terminal in a cost effective and on an accelerated schedule in an environmental and sustainable manner
- Identify feasible project phasing options for early benefits and to balance funding and fill availability
- Identify feasible business / finance model options
- Develop strategies and project graphics to attract funding and developer interest
- Complete the conceptual phase by April 2023 to position the project for state, federal, and private funding

1.4. Datum and Units

The horizontal datum shall be North American Datum of 1983, 2007 realization (NAD83 2007), State Plane Coordinate System (SPCS), California Zone 5.

The vertical datum for the Port of Long Beach (POLB) is based on NGVD 29 (National Geodetic Vertical Datum of 1924-1932 epoch), with Mean Lower Low Water (MLLW) elevation = 0.0 feet, per POLB Wharf Design Criteria Version 5.0.

United States Customary System (USCS - feet, inches, pounds, etc.) units shall be used.

1.5. Governing Codes, Standards, and References

The following codes, standards, and references shall govern the design of the facility. In addition, unless stated otherwise, all Port of Long Beach Design Criteria Manuals apply.

American Association of State Highway and Transportation Officials (AASHTO):

- AASHTO LRFD (Load Resistance Factor Design) Bridge Design Specifications, Ninth Edition, 2020
- AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals, Sixth Edition, 2013

American Concrete Institute (ACI):

- ACI 224R-01, Control of Cracking in Concrete Structures
- ACI 318-19, Building Code Requirements for Structural Concrete

American Institute for Steel Construction (AISC):

- AISC 303-16, Code of Standard Practice for Steel Buildings and Bridges
- AISC 341-16, Seismic Provisions for Structural Steel Buildings
- AISC 360-16, Specification for Structural Steel Buildings

American Society of Civil Engineers (ASCE):

- ASCE 7-16, Minimum Design Loads for Buildings and Other Structures
- ASCE 61-14, Seismic Design of Piers and Wharves

American Welding Society (AWS):

- AWS D1.1, Structural Welding Code, 2020

California Code of Regulations:

- 2022 California Building Code (CBC)
- 2022 California Electrical Code (CEC)
- 2022 California Mechanical Code (CMC)

Illumination Engineering Society (IES)

- The Lighting Handbook, 10th edition

National Fire Protection Association

- NFPA 307, Standard for the Construction and Fire Protection of Marine Terminals, Piers, and Wharves

Oil Companies International Marine Forum (OCIMF):

- Mooring Equipment Guidelines (MEG4), 4th Edition, 2018

Permanent International Association of Navigation Congresses (PIANC):

- PIANC MarCom WG 145, Berthing Velocity Analysis of Seagoing Vessels over 30,000 dwt, 2022
- PIANC WG 33, Guidelines for the Design of Fenders Systems, 2002
- PIANC WG 34, Seismic Design Guidelines for Port Structures, 2001
- PIANC WG 153, Recommendations for the Design and Assessment of Marine Oil and Petrochemical Terminals, 2016

Port of Long Beach (POLB):

- CADD Standards Manual Version 1.5, November 1, 2016
- Design Criteria Manual, January 2014
- Electrical Design Criteria, December 2017
- Railroad Design Criteria, April 13, 2011
- Wharf Design Criteria, POLB WDC Version 5.0, October 22, 2021

United States Army Corps of Engineers (USACE)

- USACE EM 1110-2-1100, Coastal Engineering Manual, 2002
- USACE EM 1110-2-2502, Retaining and Flood Walls, 1989

Unified Facilities Criteria (UFC)

- UFC 4-152-01 Design: Piers and Wharves, 2017
- UFC 4-159-03 Design: Moorings, 2020

Occupational Safety and Health Administration (OSHA)

- Occupational Safety and Health Standards for Shipyard Employment 1915.82

1.6. Existing Surveys

Below are the surveys that have been provided for reference:

- Port of Long Beach Pier T, Navy Mole, and POLA Pier 400 LIDAR – Elevations, December 2022
- Port of Long Beach Harbor Sounding Program – Bathymetry Maps, August 2021
- Port of Long Beach Harbor Sounding Program – Hydrographic Survey Report, August 2021
- Port of Long Beach Harbor Sounding Program – Hydrographic Survey Report, April 2022

1.7. Functional Requirements

The following requirements represent the functional aspects that shall be incorporated into the project:

1. Minimum water depth at the berth shall be -60 ft mean lower low water (MLLW) in the berth pocket and -80 ft MLLW outside of the berth pocket.
2. To provide for transfer of floating foundations from land to water, a sinking basin with minimum dimensions of 1,000 ft by 600 ft and maintained to a minimum depth of -100 ft MLLW will be provided between the main channel and the terminal site.
3. Wet storage for floating foundations and fully integrated turbine systems will be provided at Pier Wind. Depending on the offshore wind industry needs, the wet storage area can provide pedestrian access and electrical service for maintaining and testing the turbine system prior to tow out.
4. Dredging equipment shall to conform with air quality requirements as defined during the EIR/EIS. Typically, this will require using electric dredges to the extend feasible.

5. The facility must be able to accept fill from less desirable regional sources (engineering strength, contamination, etc.) and consider phasing and construction approaches that can accommodate this material without impact to project schedule.
6. Based on input from Jacobson Pilot Service, a 2,200 diameter navigational turning basin shall be provided on the Main Channel between the Navy Mole and terminal.
7. The transportation corridor must be at least 225 ft wide to accommodate two rail lines, four vehicular lanes, and essential operation facilities (i.e., offices, warehouses, parking, electrical substations, refueling tanks, etc.). This shall also include a utility corridor for potable water, sewer, stormwater, electrical, fiber optic, telecom, etc.
8. The berth shall accommodate roll-on / roll-off (RORO) vessels with a maximum elevation of +18 ft MLLW for offloading components directly from a delivery vessel. The berth shall have adequate fendering and mooring points to accommodate this operation.
9. The north side of the terminal shall be the berthing area to provide wave protection from Queen's Gate. The north side of the terminal shall also accommodate RORO vessels.
10. The terminal site to be designed for a minimum site elevation of +16.5 ft MLLW on the north side and +18.5 ft MLLW on the south side to accommodate the medium-high risk aversion of +4.3 ft of sea level rise.
11. The wharf must be designed for heavy lift crane operation (crawler and/or ring crane).
12. The wharf and uplands shall be designed to accommodate the design vessels and the heavy lifting, transport, and storage loading associated with both wind turbine generator (WTG) components and floating foundations [i.e., cranes and self-propelled modular transporters (SPMTs)]. Based on the anticipated site use, the design uniform live loading criteria shall be 3,000 psf for the uplands and 6,000 psf on the wharf.
13. All areas accessible for crawler cranes and transporting WTG components and floating foundations shall be designed with a flexible pavement of well graded dense grade aggregate of a minimum thickness of 3 ft on the uplands and 3 ft on the wharf.
14. The marine structures are not designed for vessel or barge impact, vehicular impact, blast loading, or other impact loads.
15. For delivery vessels, fenders shall be generally spaced at 50 ft, maximum, and bollards shall be generally spaced at 75 ft, maximum. This spacing requirement shall be used as guidance when laying out the fenders and bollards. However, it is recognized that in some instances the spacing will be exceeded, as needed, or require a different fender system to match structural or operational requirements (i.e., RORO vessels).
16. The site will be designed to prevent local settlement that would inhibit self-propelled modular transporter (SPMT) movement.
17. To mitigate long-term consolidation settlement during construction fill materials will be improved using wick drains and surcharge placement.
18. The terminal will be designed to minimize emissions by using electrified equipment, alternative fuels, and vessel shore power.

1.8. Basis of Operations

The terminal will be developed to have the flexibility to serve any of the offshore wind industry needs (i.e., staging and integration (S&I), foundation fabrication, component manufacturing, maintenance support, etc.). The primary anticipated activities are S&I and manufacturing, including foundation assembly. The high-level concept of operations for the site is as follows.

For S&I sites, wind turbine generator (WTG) and floating foundation components including blades, nacelles, tower sections, and foundation elements are imported to the berth via a delivery vessel. Two methods of transfer from the delivery vessel onto the wharf will be accommodated. The first method consists of using a vessel or wharf-based crane to lift the components from the vessel onto the wharf. The second method consists of a RORO operation. This method uses SPMTs to drive onto the vessel, onboard the components, and then transport the components off the vessel onto the wharf. In both methodologies, SPMTs are used to transport the component from the wharf to the upland storage area. This methodology is used extensively in the offshore wind industry due to its ability to handle and efficiently spread significant loads to achieve manageable applied loads on the structures and/or subgrade below.

For foundation assembly sites, the terminal design will accommodate the fabrication of floating offshore wind turbine foundations on the uplands. This activity can also occur at an alternative site. If the foundation is fabricated at this facility a serial production line will likely be used where foundations are progressively constructed moving toward the wharf. When the foundation unit is complete it is stationed next to the wharf for roll-out onto a semi-sub barge. The semi-sub barge will be moored at the berth and the completed foundation unit is moved onto the semi-sub barge via SPMTs. An example of this procedure is shown in **Figure 2**. The semi-sub barge then transports the foundation to a predetermined deep-water area or sinking basin and performs a "float-off" operation in which the semi-sub barge ballasts down until the foundation becomes buoyant. The foundation is towed back to the berth area where it is outfitted with the WTG components (tower, nacelle and blades), an example of this procedure is shown in **Figure 3**. These components are typically placed onto the foundation using a large land-based crawler or ring crane. The fully assembled wind turbine (foundation and WTG components) is towed out to the wind farm installation site and anchored in place.

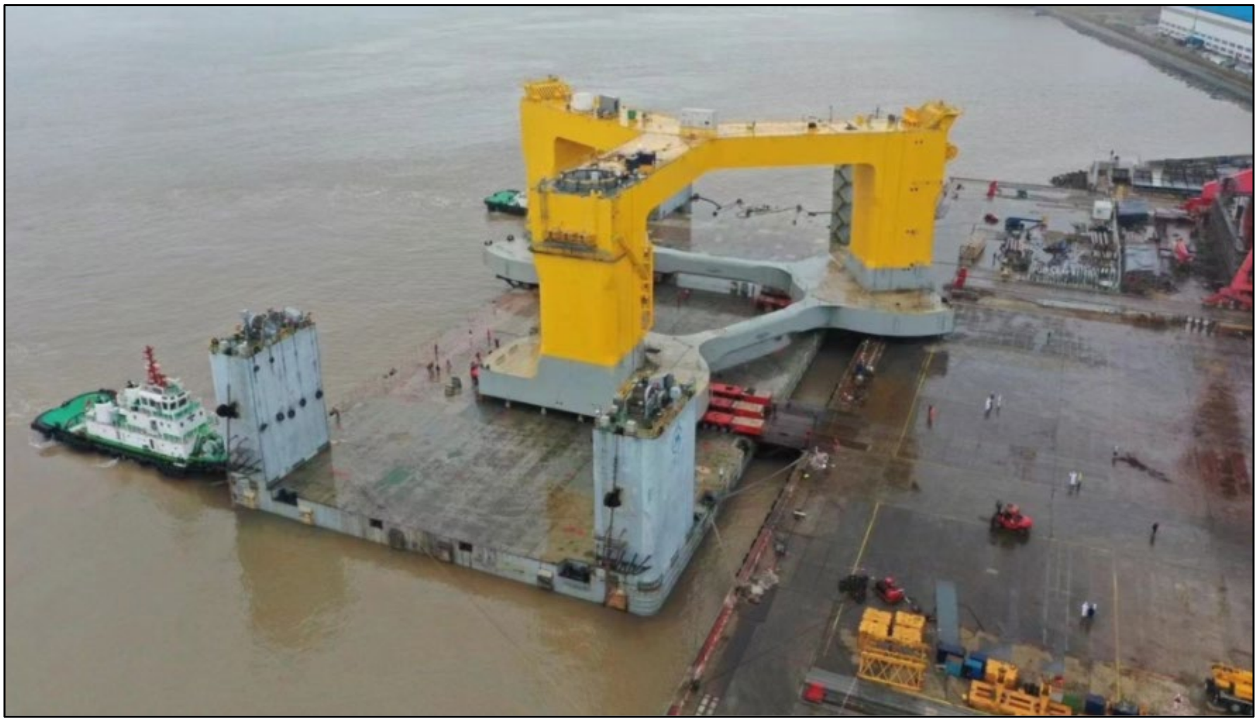


Figure 2: Semi-submersible foundation being loaded onto a Semi-submersible barge using SPMTs. Source: Wison Offshore & Marine

Figure 3: WTG components assembled on semi-submersible foundation at quayside. Source: Principle Power

For component manufacturing sites, the terminal will provide acreage to accommodate manufacturing factories, any storage/ assembly racks, and SPMT transport of components. The components, such as blades, nacelles, and/or tower sections, are produced on-site within the manufacturing facility and can either be transported within the terminal to laydown yards for assembly or be loaded onto vessels and barges for transport to other port locations.

2. Site Conditions

2.1. Metocean Conditions

This section outlines the metocean conditions at the project site.

2.1.1. Tides

Tidal elevations for the POLB are shown in **Table 1** in NGVD 29 and NAVD 88 per POLB WDC Version 5.0.

Table 1: Tidal Elevations per POLB WDC Version 5.0

Description	Datum	Water Level (ft, MLLW)	Water Level (ft, NAVD88)
Highest Observed Water Level [1]	--	+7.54	+7.16
Mean Higher High Water	MHHW	+5.43	+5.05
Mean High Water	MHW	+4.71	+4.33
Mean Sea Level	MSL	+2.80	+2.42
Mean Low Water	MLW	+0.95	+0.57
Mean Lower Low Water	MLLW	0.00	-0.38
Lowest Observed Water Level	--	-2.56	-2.94

[1] The extreme elevations should be used with caution. Irregularities in the predicted tide (seiches) have been known to cause variations of up to 1.0 feet.

2.1.2. Sea Level Rise

The recommended sea level rise (SLR) values by *State of California Sea-Level Rise Guidance (2018)* for the Long Beach area are provided in Table 2 for low, medium-high, and extreme risk aversion scenarios. The SLR projections are in feet with respect to a baseline of year 2000.

Per the Guidance, SLR projections with 0.5% of exceedance probability (medium to high risk aversion) are proper for the structure design at Pier Wind. The predicted SLR in 2080 (end of structure lifespan) for the medium to high risk aversion scenario is between 3.6 ft and 4.3 ft. A SLR of 4.3 ft by 2080 is recommended for this design.

Table 2: Projected SLR (in ft) for Project Site, relative to Year 2000

Year	Emission* Scenarios	Low Risk Aversion (66% probability)	Medium to High Risk Aversion (0.5% probability)	Extreme Risk Aversion
2030	High emissions	0.5	0.7	1.0
2040	High emissions	0.7	1.2	1.7
2050	High emissions	1.0	1.8	2.6
2060	Low emissions	1.1	2.2	3.7
	High emissions	1.3	2.5	
2070	Low emissions	1.3	2.9	5.0
	High emissions	1.7	3.3	
2080	Low emissions	1.6	3.6	6.4
	High emissions	2.2	4.3	
2100	Low emissions	2.1	5.4	9.9
	High emissions	3.2	6.7	

**High emissions represent RCP 8.5; low emissions represent RCP 2.6.*

2.1.3. Wind

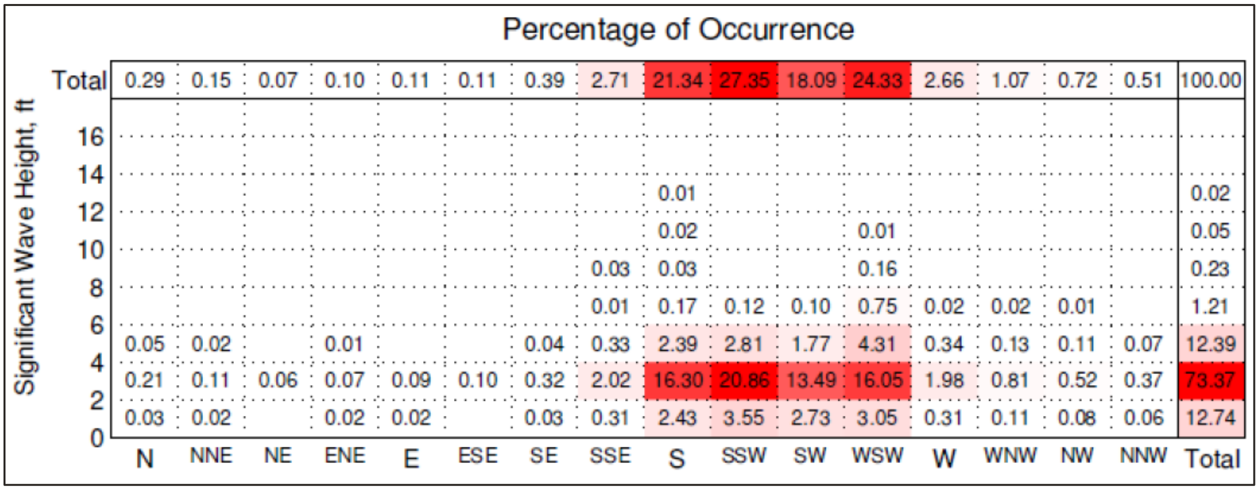
The wind speeds listed in **Table 3** are from extreme value analysis based on the wind observation data at POLB Pier J (NOAA station 9410665), which has data available from 2005 to present. Due to the limited record length (17 years of data is considered short for a 100-yr wind estimation), the wind speeds at 95% non-exceedance level are recommended for design purpose.

Table 3: Extreme Wind Speeds at POLB Pier J (NOAA Station 9410660)

Return Period	Extreme Wind Speeds (30-second, knots)	
	Best Fit Curve	95% Non-Exceedance Level
1-yr	37.3	38.4
5-yr	42.1	44.7
10-yr	44.1	47.5
25-yr	46.8	51.1
50-yr	48.8	53.9
100-yr	50.9	56.7

2.1.4. Wave

The wave statistics at Long Beah Channel (NDBC Buoy 46256), located outside of the Middle Breakwater at 76.3 ft water depth, are show in **Figure 4**. Design wave condition shall be evaluated at the project site considering proper wave transmission through the breakwaters.



	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Total
Total	0.29	0.15	0.07	0.10	0.11	0.11	0.39	2.71	21.34	27.35	18.09	24.33	2.66	1.07	0.72	0.51	100.00
									0.01								0.02
									0.02			0.01					0.05
								0.03	0.03			0.16					0.23
								0.01	0.17	0.12	0.10	0.75	0.02	0.02	0.01		1.21
	0.05	0.02		0.01			0.04	0.33	2.39	2.81	1.77	4.31	0.34	0.13	0.11	0.07	12.39
	0.21	0.11	0.06	0.07	0.09	0.10	0.32	2.02	16.30	20.86	13.49	16.05	1.98	0.81	0.52	0.37	73.37
	0.03	0.02		0.02	0.02		0.03	0.31	2.43	3.55	2.73	3.05	0.31	0.11	0.08	0.06	12.74

Figure 4: Wave Statistics at Long Beach Channel (NDBC Buoy 46256)

2.1.5. Current

Tidal current at the site is expected to be low. Tsunami induced currents will govern for the design.

2.1.6. Tsunami

Per ASCE Tsunami Design Geodatabase Version 2022-1.0, the expected tsunami runup at the project site is approximately 11.5 ft above NAVD 88. Note the ASCE tsunami has a mean recurrence interval of 2475 years and is required to be evaluated for Risk Category III and IV structures.

Design tsunami runup, currents, and corresponding loads on structures shall be evaluated at the detailed design phase.

2.1.7. Extreme Water Level

The extreme high and low water levels at the project site will be referenced from NOAA Station 9410660 as summarized in **Table 4** for different return periods. With 4.3 ft SLR, the 100-yr still water level in 2080 is 12.1 ft, MLLW.

Table 4: Extreme Water Levels (NOAA Station 9410660) Epoch: 1983-2001

Return Period (year)	Extreme High Water Level		Extreme High Water Level	
	(ft, MLLW)	(ft, NAVD88)	(ft, MLLW)	(ft, NAVD88)
1	6.92	6.72	-1.44	-1.64
2	7.31	7.11	-1.87	-2.07
10	7.58	7.38	-2.20	-2.40
100	7.81	7.61	-2.49	-2.69

The Base Flood Elevation (BFE) at the project site is 9 ft above NAVD 88, per FEMA Flood Insurance Rate Map (FIRM).

Extreme water level shall be evaluated in detail design phase, considering tide, sea level rise, wave crest elevation and tsunami runup.

2.2. Geotechnical Conditions

Based on the review of available geotechnical reports, very limited subsurface information is available at the proposed Pier Wind fill site. Review of these reports and other reports in the vicinity of the proposed fill site indicates that the thickness of harbor bottom deposits, consisting of fine-grained soils, varies between a few feet to more than 10 ft. Below the harbor sediments, medium dense to dense fine sand to silty sand, with intermittent layers of silts and clays, is encountered down to approximate -70 ft to -80 ft MLLW. This layer is underlain by interbedded layers of hard silt/clay and dense to very dense silty sand down to deepest explored elevation of approximately -100 ft MLLW.

Existing harbor bottom sediments and proposed fill consisting of fine-grained materials that will be placed within the Pier Wind landmass are expected to experience significant short-term and long-term consolidation settlements. Ground improvement measures consisting of wick drains and surcharge are typically used to accelerate the settlement process to reduce the long-term settlements to within the acceptable limits.

The perimeter rock dike will need to be keyed into the sandy material below the harbor bottom sediment to improve stability during seismic events. This will require dredging within the footprint of the perimeter dike prior to placing the rock.

Piles that will support the proposed wharf will be driven deep into the dense to very dense layers to achieve the required axial capacity.

2.3. Other Site Constraints

The Pier Wind project includes a transportation corridor for road, rail, and utility access with connection at the existing Navy Mole. Note that any improvements required upstream of this connection is excluded from the scope of the Pier Wind project at this time.

3. Offshore Wind Port Requirements

3.1. Offshore Wind Turbine System Dimensions and Weights

Currently 12 megawatt (MW) offshore wind turbine systems are commercially available, however the anticipated size of turbine systems to be installed on the US West Coast will be on the order of 15 MW or larger. **Table 5** summarizes the anticipated dimensions for a floating turbine system with capacity of up to 20 – 25 MW. Turbine device dimensions provided are relative to the future industry needs for 15 to 25 MW size devices. Smaller size devices (beam, draft) are currently in development but are at reduced turbine capacity. The values outlined in the table are those recommended for planning a major port terminal on a 50-year time horizon to meet the anticipated needs of the continuously developing offshore wind industry. In addition, **Figure 5** shows a depiction of the turbine dimensions.

Table 5. Floating offshore wind turbine dimensions

Floating Offshore Wind Turbine	Approximate Dimension (ft)	Approximate Dimension (m)
Foundation Beam / Width	Up to 425 ft x 425 ft	Up to 130 m x 130 m
Draft (Before Integration)	15 – 25 ft	4.5 – 7.5 m
Draft (After Integration)	20 – 50 ft	6 – 15 m
Hub/Nacelle Height (from Water Level)	Up to 600 ft	Up to 183 m
Tip Height (from Water Level)	Up to 1,100 ft	Up to 335 m
Rotor Diameter	Up to 1,000 ft	Up to 305 m

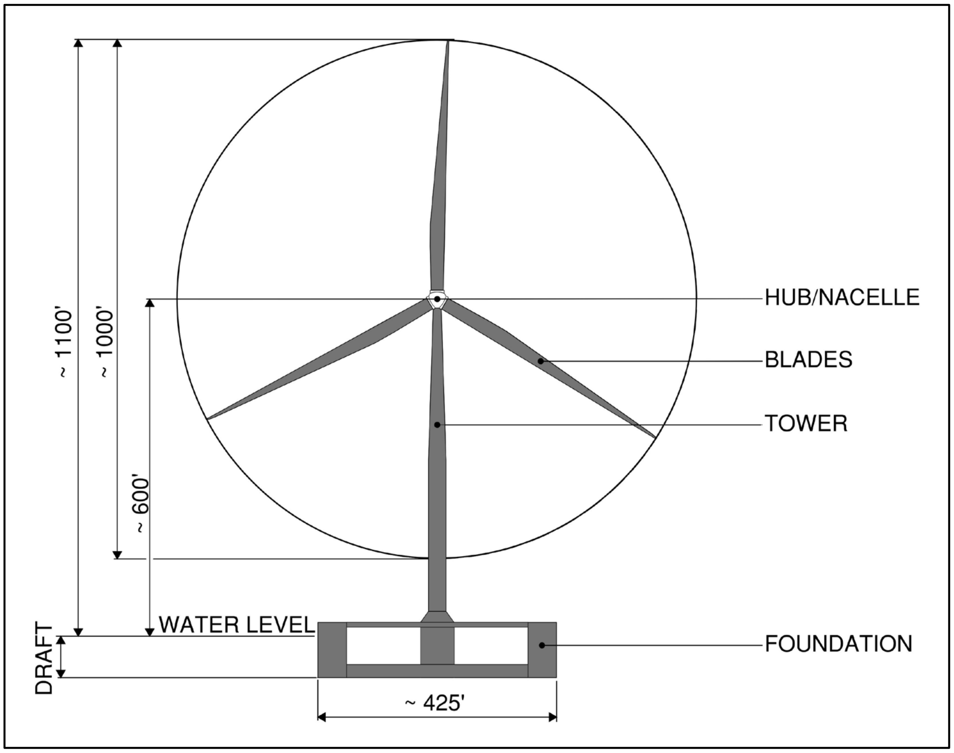


Figure 5. Floating offshore wind turbine dimensions

3.2. Design Vessels

The vessels expected to call on the proposed port facility will consist of delivery vessels and semi-submersible barges. Delivery vessels will consist of bulk carriers and/or barges bringing both the foundation raw materials and WTG components to the site. The semi-submersible barges are assumed to be purpose built smart ballasting barges.

3.2.1. Delivery Vessel

Characteristics of the current industry delivery vessel, the S2L-Type heavy cargo vessel and cargo carrier are shown in **Table 6**. A future cargo carrier is also listed to ensure the project accommodates future growth in the vessel industry. The dimensions for the Future Cargo Carrier were estimated by increasing the existing Cargo Carrier by approximately 33%.

Table 6: Delivery Berth Design Vessel

Vessel Characteristic	S2L-Type	Cargo Carrier	Future cargo carrier
Length Overall	608.3 ft	1,000.0 ft	1,333.0 ft
Beam	83.0 ft	105.0 ft	140.0 ft
Depth	52.2 ft	56.0 ft	61.2 ft
Summer Draft	34.8 ft	34.0 ft	69.8 ft
Deadweight	23,660 MT	82,209 MT	221,250 MT
Displacement	43,500 MT[1]	88,200 MT[1]	288,400 MT

[1] Displacement is assumed based on a block coefficient of 0.85

3.2.2. Semi-Submersible Barge

The characteristics for the semi-submersible barge that will be used to transfer the floating foundations from the wharf into the water are shown in **Table 7**.

Table 7: Purpose-Built Semi-Sub Vessel

Vessel Characteristic	Purpose Built Semi-Sub
Length Overall	500.0 ft
Summer Draft	20.0 ft
Beam	500.0 ft

3.2.3. RORO Vessels

The current industry RORO vessel is the ST-Class RORO vessel and current design delivery barge is the 455 Series Barge with the characteristics shown in **Table 8**. A future RORO vessel is also listed to ensure the project can accommodate future vessels. The dimensions for the Future RORO were determined by increasing the ST-Class RORO dimensions by 33%.

Table 8: RORO Design Vessels at Delivery Berth

Vessel Characteristic	ST-Class RORO	455 Series Barge	Future RORO
Length Overall	496.9 ft	400.0 ft	660.5 ft
Beam	83.3 ft	105.0 ft	110.8 ft
Depth	19.4 ft	25.0 ft	25.8 ft
Summer Draft	18.6 ft	19.0 ft	24.7 ft
Deadweight	9,000 MT	17,442 MT	17,000 MT[2]
Displacement	17,455 MT[1]	20,947 MT	41,000 MT[1]

[1] Displacement is assumed based on a block coefficient of 0.78

[2] Deadweight tonnage is estimated based on industry RORO vessel DWT trend.

3.2.4. Offshore Wind Turbine Device – Foundation Only

The offshore wind turbine foundation is expected to be a semi-submersible floating structure made of steel, concrete, or a hybrid of steel and concrete. Pier Wind shall accommodate the full range of delivery scenarios for the offshore wind turbine foundation. These scenarios can vary from receiving the fully assembly foundations on a semi-submersible vessel to being fully manufactured at the Pier Wind. The most likely scenario to plan Pier Wind for is receiving large foundation subcomponents for final assembly at the terminal.

3.2.5. Offshore Wind Turbine Device – Fully Integrated

It should be noted the draft stated in **Table 5** is assumed for safe navigation through the navigation channels to open ocean conditions. The draft required for mooring stability will likely be greater once installed at the wind farm. There could be device base technologies that are stable during transport under lower ballasted condition or that utilize supplemental flotation to navigate through the confined navigation channels to the open ocean and then adjusted in deeper water. The actual navigation channel parameters needed to support a specific technology type is specific to each type of technology and dependent on the results of detailed maneuvering analysis and bridge simulation work for the tow out environmental conditions and operational plan.

3.3. Channel Width and Depths

Through the Deep Draft Navigation Feasibility Study, POLB plans to deepen and widen the existing navigation channels to increase transportation efficiencies for the current and future fleet of container and liquid bulk vessels operating in the port. The entrance to the Main Channel will be deepened from a project depth of -76 feet to -80 feet MLLW. Bend easing will also be performed on the Main Channel to widen it to a depth of -76 feet MLLW.

3.4. Berth Pocket Requirements

The berth pocket at the offshore wind terminal facility must be deep enough to provide maximum operational flexibility for offshore wind terminal operations. Based on discussions with POLB the berth pocket depth shall be -60 feet MLLW.

3.5. Sinking Basin Requirements

To provide for transfer of assembled floating foundations from land to water, where “float-off” operations will be performed by semi-sub barges, a sinking basin with a minimum depth of -100 feet MLLW will be provided between the terminal and the Navy Mole. The length of the sinking basin shall accommodate both the semi-submersible barge in **Table 7** and a semi-submersible heavy lift vessel that may import the floating foundations from overseas – *Seaway Hawk*. This produces a sinking basin with the approximate dimensions of 600 feet by 1,000 feet at the base. The slopes of the sinking basin shall be 5H:1V slope.

3.6. Wet Storage Requirements

Wet storage is required near Pier Wind to store the following:

- Floating foundations waiting for turbine assembly.
- Fully assembly turbines waiting for the appropriate weather window to make the tow out to the offshore wind project site.

The number of units required in wet storage is dependent upon the developer, their supply chain strategy, the required timeline to install the units offshore, and the size of the offshore wind project (GW and number of units). Due to the distance from the port, transit time, and weather risks, developers will need sufficient wet storage to serve the wind energy areas.

There is sufficient space in the Outer Harbor, both north and south of the terminal for wet storage that can provide water deep enough to accommodate the maximum draft of fully integrated turbines of 50 feet, plus 2 feet of clearance. In addition, fixed piers along the transportation corridor could be used for wet storage and/or commissioning of the fully assembled units, with pedestrian access and electrical service for maintaining and testing the turbine system prior to tow out, as shown in **Figure 6.**

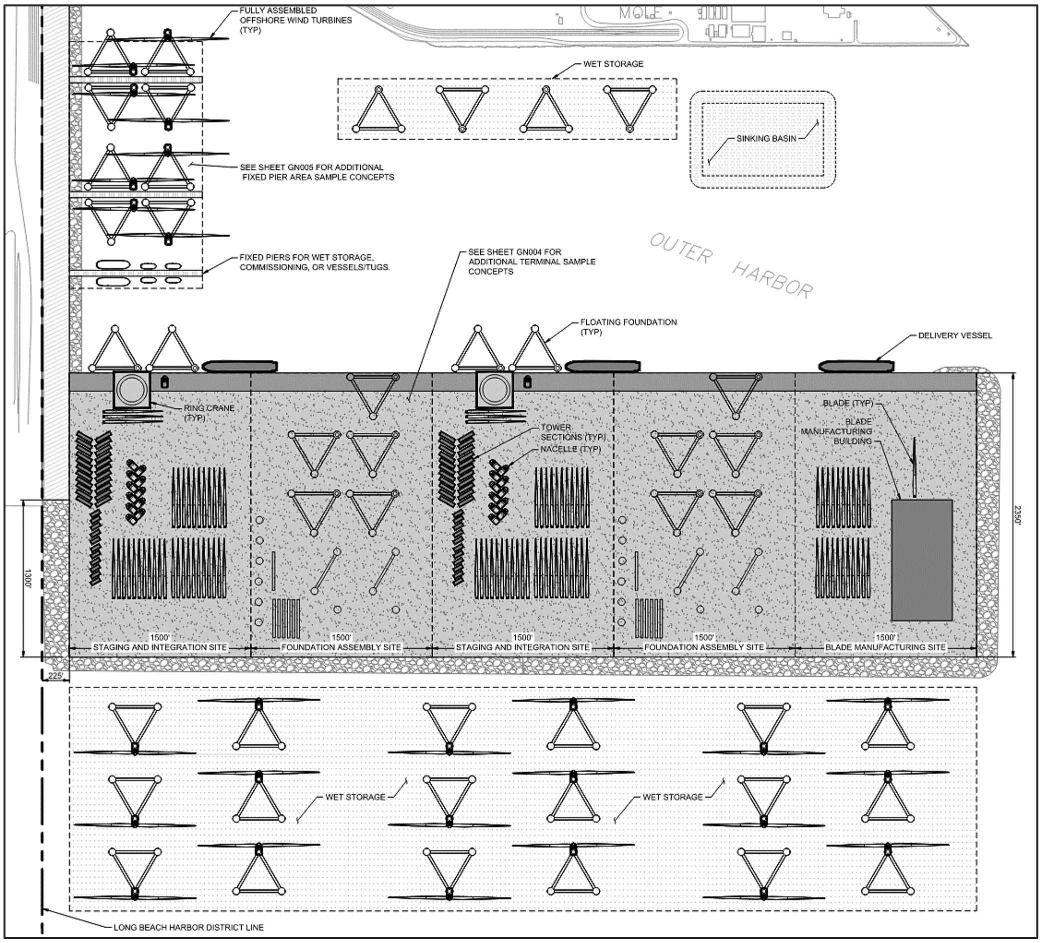


Figure 6. Sample Wet Storage Locations for Pier Wind

4. Permitting

Based on our understanding, the Project will need to comply with the California Environmental Quality Act (CEQA) and National Environmental Policy Act (NEPA). The Port is anticipated to be the CEQA Lead Agency and at this time the U.S. Army Corps of Engineers (USACE) may be the NEPA Lead Agency (to be confirmed). Other federal and state agencies would be cooperating and responsible agencies, respectively. The anticipated CEQA/NEPA environmental document will be an Environmental Impact Report/Environmental Impact Statement (EIR/EIS). Several environmental analyses and studies will be completed to support the EIR/EIS to comply with federal, state and local regulations.

The environmental regulatory framework applicable to this project which includes creation of the new Pier Wind and wharves by in-water construction infilling activities is summarized in **Table 9** This summary is focused on the overarching regulations that apply to the proposed in-water construction and drive BMPs, and potentially impact design considerations, means and methods, schedule, and/or cost.

Table 9: Applicable Regulatory / Permitting Requirements

Agency	Law, Regulation, or Guidance	Project Applicability and Considerations
	Federal	
U.S. Army Corps of Engineers (USACE) (NEPA Lead Agency to be confirmed)	National Environmental Policy Act (NEPA) of 1969, as amended, 42 USC 4321 et seq. and Code of Federal Regulations (CFR) 1500 et seq. Council on Environmental Quality Regulations for Implementing NEPA	NEPA Environmental Document – anticipated to be an Environmental Impact Statement (EIS)
USACE	Rivers and Harbors Act Section 10 of 1899	Requires a permit for work and placement of structures in navigable waters of the U.S.
USACE	Clean Water Act Section 404 of 1977 and 1987	Requires a permit for dredging or backfilling in waters of the U.S.
USACE	Rivers and Harbors Act of 1899	Pierhead Line Modification
U.S. Environmental Protection Agency (USEPA)	Marine Protection, Research and Sanctuaries Act of 1972 (or Ocean Dumping Act)	Regulates disposal of dredge material into the ocean. Applicable to open-water disposal of project dredged material (if needed)
USEPA	Clean Air Act Amendments of 1990	Air Quality Conformity Permits during construction associated with construction equipment
National Oceanic and Atmospheric Administration (NOAA)/ National Marine Fisheries Services (NMFS), United States Fish and Wildlife Services (USFWS)	Federal Endangered Species Act (ESA) of 1973	ESA species may be present in the project area. Consultation is required for Section 404 permitting. Marine mammals are the species with the most potential to impact the project in-water activities with respect to noise and turbidity monitoring, resulting in work stoppages during dredging and pile installation. Impacts could result in a "Take" that triggers mitigation.
NOAA/NMFS, USFWS	Magnuson-Stevens Fishery Conservation and Management Act	Essential fish habitat designation may require consultation; may trigger BMPs

Agency	Law, Regulation, or Guidance	Project Applicability and Considerations
	of 1976	and/or mitigation.
NOAA/NMFS	National Invasive Species Act of 1996	If presence of invasive species is detected could trigger BMPs for construction vessels and equipment.
NOAA/NMFS	Noise Control Act of 1972	Incorporate reasonable and feasible noise abatement measures to reduce or eliminate noise impact.
	State	
Los Angeles Regional Water Quality Control Board (LARWQCB)	Clean Water Act (CWA) Section 401 and Water Quality Certification of 1972, Porter Cologne Act of 1969	Water Quality Certification required for discharge into navigable waters. Drives water quality considerations, BMPs, and turbidity monitoring.
California Coastal Commission (CCC)	California Coastal Act of 1976 and Coastal Zone Management Act of 1972 and Reauthorization Amendments of 1990	CCC certifies the Port Master Plan and any amendments. The Board of Harbor Commissioners approves the Coastal Development Permit for developments that are consistent with the Port Master Plan as part of the Harbor Development Permit process.
California State Lands Commission	Public Trust Doctrine	The Port of Long Beach manages and develops the sovereign lands granted in trust by the Legislature to the City of Long Beach (State Tidelands Trust) in accordance with the Public Trust Doctrine and provisions of the State Tidelands Trust. The State Lands Commission has oversight authority over sovereign lands granted in trust by the Legislature.
California Department of Fish and Wildlife	California Endangered Species Act	2081 Incidental Take Permit
California Environmental Protection Agency (CEPA)/ California Air Resources Board (CARB)	Clean Air Act of 1988	Compliance with CARB regulatory program for emission reduction from stationary and mobile sources.
	Local	
POLB anticipated to be lead agency for CEQA	California Environmental Quality Act (CEQA) 1970	CEQA Environmental Document – anticipated to be Environmental Impact Report (EIR)
POLB	Port Master Plan (PMP)/PMP Update	Assume CCC will approve the Port Master Plan amendment and therefore the Board of Harbor Commissioners will issue the Coastal Development

Agency	Law, Regulation, or Guidance	Project Applicability and Considerations
		Permit as part of the Harbor Development Permit
City of Long Beach (COLB)	City of Long Beach Municipal Code	Building, Fire, Electric, Plumbing and Sanitation Permits anticipated to be required.

5. Rock Revetment

A rock revetment structure will surround the entire terminal and extend along the transportation corridor towards the Navy Mole. The rock revetment is used to contain the fill material and provide wave protection.

5.1. Design of Rock Revetment

The perimeter rock revetment around the terminal will be a multi-lift dike. On the south and east side, the dikes will have a 6 feet layer of armor rock on the outer face. For the dike on the north side and transportation corridor there will be a 3 feet layer of armor rock since it not as exposed to waves. The transportation corridor will be a single lift dike. The approximate quantities of rock required to construct the revetments is estimated to be 8,900,000 CY of quarry run rock (12" minus) and 590,000 CY of armor stone; together this is equivalent to approximately 14,235,000 tons. To meet the high project demand, rock will likley be sourced from domestic and international rock suppliers. The core of the rock revetment will be constructed of quarry run with an upper range diameter of approximately 4 to 12 inch minus minimum gradation. Armor rock of larger gradation than the quarry run will be placed over the quarry run to protect the placed rock slope. Filter fabric to further stabilize the revetment structure will be required in the tidally influenced areas, refer to the Conceptual Engineering Drawings.

Two interim dikes are proposed, one at the 100-acres and another at the 200-acre limit to bisect the total footprint of the project into two 200-acre phases. The interim dike will be a single lift dike with a lower crest elevation.

Facilitation of dredge material placement within the rock dike will require that rock be placed to a minimum height to allow bottom dump hopper barges to transit within the boundaries of the revetment structure. The multi-lift dike will require sandier layers to backfill and stabilize the rock lift prior to the installation of the subsequent lift. The schedule assumes dredge material placement will commence before the rock dike is out of the water.

6. Dredging

Dredging of the navigation channels, berths, sinking basin, and rock dike footprint will be conducted to support development of the terminal. Dredged materials will be placed within the rock revetment to build the terminal to design elevations. To meet the fill volume needs, additional areas will be dredged. Material may be dredged and placed by hydraulic and/or mechanical methods.

Hydraulic dredging using a Cutter Suction Dredge (CSD) is a highly efficient method of removing material using a revolving cutterhead to till material that is suctioned through the intake behind the cutterhead powered by a centrifugal pump and transported via submerged or floating pipeline to the disposal location. The cutterhead is positioned at the end of a ladder that is limited in its reach, even including a ladder extension. Due to the limited depths a CSD is able to achieve, alternative dredging methods may be required at depths greater than approximately El. -80 ft MLLW. Dredging production at depths greater than El. -70 ft MLLW decreases due to the reduced suction capacity experienced when the cutterhead does not make direct contact with the dredge surface. Beyond this depth, clamshell dredges may be necessary to achieve required depth.

Disposal associated with hydraulic dredging relies on maintaining material in a suspension through the CSD pipeline between the removal and deposition points with approximately 15% dredged material and 85% water. Material removed through hydraulic dredging may be placed through the open end of the pipeline or through a pipeline connected to a spill barge while allowed by floatation depth, which diffuses the material and water slurry over a wider placement area. Hydraulically placed material can be pumped to any of the proposed elevations, including surcharge.

A second form of hydraulic dredging uses a Trailing Suction Hopper Dredge (TSHD). TSHD uses centrifugal pumps to draw material through a draghead positioned at the end of a drag arm, which may be raised or lowered depending on the depth of material to be removed. As a TSHD moves forward, suction dragheads are pulled across the dredge surface, utilizing the jetting of water to agitate material that is drawn through the draghead, the pipeline of the drag arm, and is deposited in the hopper. Unlike clamshell dredging, TSHD operations do not cut into the dredge material but instead rely on water jets and suction to loosen material and create a slurry that is transported via pipeline into the hopper. The ability to manage the position of the drag arms and the depth of the draghead lends TSHD dredging to the efficient removal of loose sand, clay, or gravels distributed over large areas at depths up to -80 feet. Beyond this depth, clamshell dredging may be required to remove material to the required grade.

Mechanical dredging uses a clamshell bucket or an excavator to remove material and either place the dredged sediments in a bottom dump hopper barge or side cast into the placement site. Clamshell dredging utilizes cables to raise and lower the bucket through the water column, allowing clamshell dredges to reach greater depths than a hydraulic dredge may be able to achieve. Clamshell buckets may be use-specific, such as an environmental cable arm bucket used to remove contaminated sediments while minimizing risk of contaminant migration or deposition of residuals. Material removed by mechanical means is typically transported via hopper barges to the placement site where material may be bottom dumped by opening a split-hull barge. Mechanical backhoe dredging with a barge mounted excavator may be most effective in relatively shallow waters and are best suited to moderately consolidated to hard-packed materials. Backhoe dredging utilizes the same bottom dump hopper barges to transport material to the placement site or may side cast material as needed.

Mechanical placement with a bottom dump barge is generally limited to unloading material in areas with at least El. -12 ft MLLW navigation clearance. Placement of material by pushing it from a barge into the water with a dozer is also limited by barge clearance access. Once the revetement is shallower than El. -10 ft MLLW, material must be rehandled over the dike or hydraulically placed.

This project assumes all material placed shallower than El. -12 ft MLLW will be done with hydraulic placement methods. Production rates associated with hydraulically dredged material assumes 25,000 CY per day per rig. Production rates associated with mechanically dredged material assumes 4,500 CY per day per rig. Production rates associated with mechanically dredged material assumes 4,500 CY per day per rig. Therefore, the most cost effective and quickest schedule maximizes hydraulic placement methods. Once additional geotechnical information is provided from field exploration, hydraulic placement methods will be further evaluated to determine how to accelerate the project schedule.

The project requires in-water construction activities including dredging, backfill material placement, and rock revetment construction to create the Pier Wind terminal. Sediment will be used as fill and temporary surcharge for the new terminal and transportation corridor. For this program it is assumed that approximately 42,000,000 CY of material is needed for fill and 4,700,000 CY of surcharge, for an estimated total of 48,000,000 CY.

The project is planned to generate an estimated 49,500,000 CY from planning discussions with Port staff. The volumes associated with various dredged material source areas are summarized in **Table 10,** shown in **Figure 7**, and described below.

- **Rock revetment keys:** Both the perimeter rock revetment and the transportation corridor rock revetment require dredging to remove soft/unconsolidated materials beneath rock. This will secure the rock dike and armor stone and mitigate risk of settlement and long-term slope failure from seismic activity. Material will be mechanically dredged and rehandled into interior of the proposed fill site.
- **Area 1**: This area will be El. -80’ MLLW to provide deep draft access to sinking basin and wet storage areas. In the berth pocket adjacent to the wharf, depths will be El. -60 ft MLLW.
- **Area 2**: The Outer Harbor area south of the terminal will be deepened to El. -50 ft MLLW.
- **Sinking Basin**: An El. -100 ft MLLW area will be created to provide a sinking basin to support float-off activities for turbine foundations.
- **Area 3:** The main channel will be further deepened to El. -80 ft MLLW. This program assumes the Deep Draft Navigation Project (DDNP) has been completed and this effort will lower the authorized main channel an additional 4 ft, refer to the main body of the Concept Report for details on the DDNP.
- **Area 4:** To offset the loss of anchorage areas within the Long Beach Outer Harbor, an anchorage area within the Eastern San Pedro Bay will be deepened to El. -60 ft MLLW.
- **Area 3 transition to Area 4:** An access channel will connect the Main Channel to the new El. -60 ft MLLW anchorage area in Eastern San Pedro Bay.
- **Western Anchorage Sediment Storage Site (WASSS) expansion:** This site is designated for permanent and temporary storage of sediment. It is assumed the site will be excavated to accommodate the temporary storage of the surcharge material between project phases, if needed. After the second phase, surcharge will be placed for long-term storage within the WASSS.

Table 10: Anticipated Dredging Program to Support Pier Wind Development

Area	Volume including 1 ft Over Dredge (CY)
Rock revetment keys	5,000,000
Area 1 - Cut to -80 ft MLLW	16,420,000
Area 1 - Cut to -60 ft MLLW	9,161,000
Sinking Basin - Cut to -100 ft MLLW	600,000
Area 2 - Cut to -50 ft MLLW	2,541,000
Area 3 - Cut to -80 ft MLLW	**2,810,000**
Area 4 - Cut to -60 ft MLLW	4,355,000
Area 3 transition to Area 4	3,860,000
WASSS expansion	4,750,000
Total	**49,497,000**

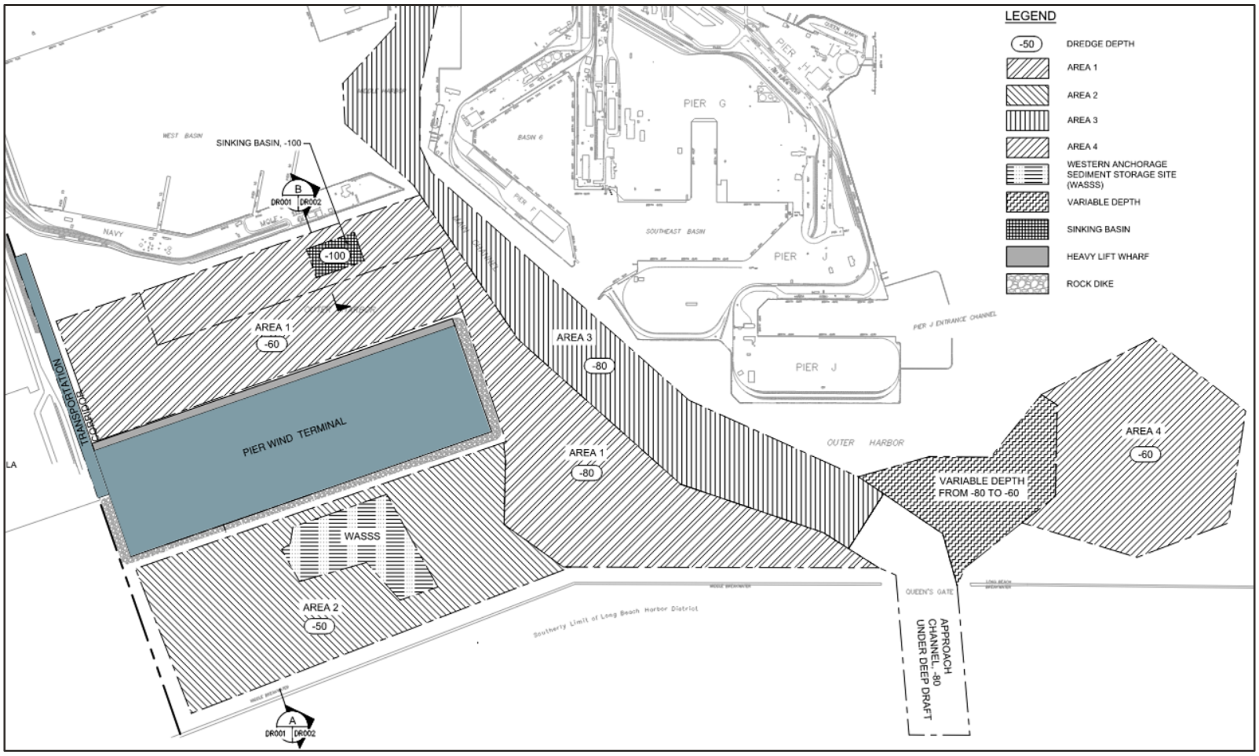


Figure 7: Dredge Material Sources for Pier Wind

6.1. Potential Equipment

It is assumed that the following equipment may be required to complete the project. This assumption is based on the scope of the work, likely bidders, equipment availability, and past project experience.

- Clamshell dredge
- Hydraulic dredge
- Hopper dredge
- Excavator
- Backhoe dredge
- Offloader/conveyor (likely mechanical, but could potentially be hydraulic if return water can be managed without impacting adjacent stockpiles or interfering with material processing and dewatering
- Scow(s)
- Flat barge(s)
- Tug(s)
- Survey vessel(s)
- Crew boat(s)
- Support equipment

7. Fill

The fill will be bounded by the rock dike. Backfill will consist of dredged materials.

7.1. Engineering Criteria for Fill Material

Existing grade will be raised by as much as 60 feet in much of the submerged areas surrounding the terminal. Due to dewatering schedules and long-term settlement requirements, the fill and surcharge must also meet overall engineering and construction requirements. Primarily, all material with less than 50% sand must be placed below elevation -10 ft MLLW. All material above -10 ft MLLW, including surcharge, must have the highest sand content available.

This requirement is built on the following facts:

- Newly placed fine-grained materials within a fill area will go through significant settlement after placement due to consolidation. This pore pressure dissipation process would typically take a long time (several years to decades) due to low permeability of fine-grained materials. Wick drains and surcharge loading are introduced to accelerate pore pressure dissipation and bring down the settlement to acceptable limits for future development.
- To install wick drains a stable firm ground surface will be required since wick drain rigs are heavy. Accumulation of fine-grained materials near the new surface will create a soft, difficult, and unsafe working surface for wick drain installation. When fine-grained materials accumulate near the soil surface, significant earthwork is required to remove / remix / dry to prepare the surface for wick drain installation.
- If planned development includes installation of equipment that is sensitive to settlement, it will need to be removed and replaced with granular soils in that area to support the equipment.

In addition, higher quality fill materials (i.e., sands) are needed adjacent to and to support subsequent rock dike lifts. Without high quality fill materials, wider and larger dike structures may be required which can increase cost and extend the schedule.

7.2. Source Materials

While this project is anticipated to generate sufficient quantity for the fill, there are other programs that are expected to be accommodated within the terminal fill, as detailed below. The volumes anticipated for each element is summarized and in **Table 11.**

- The Deep Draft Navigation Project (DDNP) will generate approximately 7,000,000 CY of sediment will be dredged to expand and deepen the federal navigation channels. There are potential beneficial reuse opportunities for the DDNP material within the Port of Long Beach. All, or a portion of, the DDNP material could be beneficially reused as part of the Pier Wind fill depending on the timing and if there are any other development projects that require landfill.
- Navigation maintenance dredging projects are continuously planned and implemented as standard port operations and maintenance practices.
- POLB sediment cleanup/remediation programs are anticipated to be constructed during the development of the terminal to take advantage of port fill for the management of sediments not suitable for open ocean disposal.
- The sediment management approach should consider requests from other agencies to accommodate regional contaminated sediments. Close coordination will be required to ensure this does not compromise the aggressive schedule needed to construct the facility to meet offshore wind deployment goals.

Table 11. Other Sediment Management Needs to be Considered in Terminal Fill

Area	Volume including 1 ft OD (CY)
Port maintenance programs	500,000
Port sediment quality improvement programs	300,000
Deep Draft Navigation Program	3,500,000
Regional contaminated sediment	1,000,000
Total	**5,300,000**

7.3. Wick Drains and Surcharge

Pier Wind should be ready for infrastructure construction within a short period after its creation. Therefore, mitigation measures are needed to accelerate the settlement period. Similar to other Port fill placement projects, installation of wick drains and surcharge loading are recommended to accelerate the consolidation of the fine-grained materials so that the backland can be developed within the available schedule.

According to the proposed fill sequences, wick drains are expected to be installed from approximately El. +13 ft MLLW. Generally, granular fill materials are recommended to be placed between elevations El. -10 ft MLLW and +13 ft MLLW to provide the necessary horizontal drainage and a working platform for wick drain installations.

Based on the anticipated characteristics of the dredge source materials and our recent experience of fill performance at the Middle Harbor Terminal, a 3.5-ft center-to-center triangular spacing wick drains is recommended. The wick drains are recommended to be installed down to El. -75 ft into the dense sand layer below the harbor bottom sediments (or to refusal) to provide horizontal drainage at the bottom of the wick drains as well. This preliminary design will be further evaluated once additional geotechnical information is provided from field exploration.

In addition to the wick drains, the fill areas will require surcharge to accelerate the consolidation settlement of the foundation and fill materials. Approximately 20 ft of surcharge above the approximate finished grade is expected to need a waiting period of about 7 months. The toe of the surcharge is recommended to be as close as practically possible to the waterside crest of the dike and surrounding existing land. The surcharge is expected to be placed with side slopes of 1.5H:1V. With the wick drains installed at 3.5-ft center-to center triangular spacing, a minimum surcharge period of 7 months is considered adequate to reduce the long-term consolidation (static) settlement to less than 4 inches during project life of 50 years. The surcharge period should be started after surcharge has been placed to full height. If surcharge is to be placed in phases within the fill area, at least a 50-ft overlapping zone of the crest of surcharge between adjacent surcharge areas should be included.

7.3.1. Best Management Practices (BMPs)

A mixture of all available BMPs will be implemented by the contractor at various stages of the construction to best manage TSS and still meet the project schedule. Available best management practices (BMPs) that can limit TSS and transport of TSS outside of construction zone include:

- Silt curtains that limit movement of fines through water column.
- Bottom dump limits fines by limiting water entrained during placement.
- Slow production/placement rates (both hydraulic and bottom dump).
- Using physical site features to help capture or limit fine movement.

- Building certain containment dikes to different elevations that encourage TSS trapping.
- Build sediment traps to capture and manage suspended sediments as they settle.
- Place pipe low in the water column.
- Use diffusers at the end of hydraulic pipe to reduce water flow.

A general summary of BMPs to be evaluated for inclusion may include the following:

- A Water Quality Monitoring Plan (approved by the RWQCB) will be implemented by the Port during dredging. This plan will describe methods and documentation for the monitoring of turbidity, pH, and DO during dredging.
- Any other non-dredged material used for fill, such as CMB, must be placed above the groundwater elevation.
- Contaminated material must be mechanically dredged and bottom-dumped.
- The use of silt curtains during in-water construction activities, when needed and when feasible, based on specific dredging areas and ongoing construction of walls and the rock dike that will control potential turbidity plume movement.
- Use of debris curtains during wharf construction activities to isolate the active construction area from the surrounding waters.
- A study can be conducted to demonstrate turbidity values that are protective of marine resources and serve as a project specific turbidity action level.
- To control turbidity to the maximum extent practical during hydraulic placement, the following BMPs may be recommended.
    - Diffuser pipes. A diffuser can be used to slow the rate of discharge, thereby reducing sediment resuspension in the fill and increasing the settling rates, which will assist in controlling the loss of fines from the fill site.
    - Adjustable pump rates. In some instances, adjusting the pump rate may be required to control the loss of fines from the fill site.
    - Adjust flow rate. Placing material at a slower rate will reduce the amount of sediment being discharged and increase the retention time in the settling basin.
    - Adjust solids concentration at point of discharge. In a settling basin, higher solids concentration may result in higher settling rates and less suspended sediment at the effluent discharge.
    - Move discharge point to maximize retention time. Moving the discharge point to a place in the settling basin that will increase retention time will allow more suspended sediment to settle.
    - Closely monitor and adjust weir level. The weir level should be adjusted as the settling basin is filled to maximize the settlement of fine material and minimize the amount of sediment that escapes in the return water.
    - Silt curtain. A silt curtain could be deployed around the discharge area, creating a physical barrier that contains the suspended sediments and allows them to settle out.
    - Gunderboom. A gunderboom is similar to silt curtain; however, it is made of a permeable material. It filters out the sediment and allows the water to pass through. It also extends all the way from the water surface to the sediment while the silt curtain only extends partially down the water column.

- Controlling turbidity with the use of a weir when the dike is completed.
- Install an overflow weir. Include a weir system designed to maximize the settlement of fine material into the fill and minimize the amount of sediment that escapes in the return water where possible. The specific design of the weir will vary with the fill geometry and fill height.
- Sediment trap. Dig a hole to capture material that has escaped the weir. Sediment trap should be located downstream of the weir. The trap can be mechanically dredged as needed to maintain function as long as weir is discharging.

8. Structural Design Criteria

8.1. Seismic Design Criteria and Performance Requirements

The seismic design and performance criteria shall follow California Building Code 2022 and POLB WDC Version 5.0.

8.2. Settlement Criteria

For static settlement, the site shall be deisgned for a maximum deflection of 1 in. to facility SPMT operations.

The seismic settlement shall be less than 12 in. for Operating Level Earthquake (OLE) and less than 24 in. for Contingency Level Earthquake (CLE) and Design Earthquake (DE).

8.3. Design Loads

<u>Dead Load</u>

Dead load shall include the self-weight of the structure including any permanent attachments.

- Steel: 490 pcf
- Concrete: 150 pcf
- Dense Graded Aggregate: 145 pcf

<u>Buoyancy Load (B)</u>

Buoyancy load shall be considered using a seawater unit weight of 64.1 pcf. All new structures shall be designed to be submerged in an extreme event.

<u>Live Load (L)</u>

The following live loads shall be considered:

- Uplands Storage and Staging Area: 3,000 psf
- Marine Structure (Heavy Lift Wharf): 6,000 psf
- Dolphins and Walkways: 100 psf

<u>Wind Load (W)</u>

Wind loads, on structural components when berth is vacant, shall comply with ASCE 7-16 requirements. Design wind speed shall be 92 mph (3 second gust at 33 feet above ground).

<u>Current Load (C)</u>

Current forces on structural pipe members shall be determined in accordance with API RP 2A. Lift, drag and mass coefficients shall be determined for each member taking into accounts its cross-section and inclination and marine growth. Current forces on vessels shall be determined in accordance with the OCIMF Mooring Equipment Guidelines (MEG4) for static mooring analyses. Design current speed and direction to be confirmed.

<u>Berthing Load (Be)</u>

PIANC Guidelines for the Design of Fenders Systems (2002) shall be used to determine the required berthing energy for the design vessels, size of the fender system, and the berthing load. The structure shall be designed for the maximum fender load, including a +/- 10% tolerance in fender performance. The fender panel shall include ultra-high molecular weight (UHMW) facing to provide a maximum coefficient of friction of 0.2. Horizontal and vertical forces on fender system shall be considered based on friction between the vessel and fender panel.

Mooring Load (M)

The vessel with the strongest mooring line minimum breaking load (MBL) should be used to determine the bollard capacity safe working load (SWL). The mooring load shall be applied 180 degrees horizontally and at an angle of +25, 0, and -25 degrees to the horizontal plane. The bollards shall be designed for one mooring line per bollard. Structures shall be designed to accommodate 100% SWL on a single bollard and 60% SWL on an adjacent bollard(s), simultaneously. Application of the 60% SWL on adjacent bollards shall be based on designer judgement with consideration of mooring line arrangements. In addition, actual mooring forces from the mooring analysis shall be checked.

Earthquake Load (E)

Earthquake loads will be determined per CBC 2022 based on the site classification. The seismic performance criteria for the project, under Level 2 ground motion, is collapse prevention. Under Level 1 Ground Motion, Post-event inspection and repair may be required (to be confirmed in future phases).

Load Combinations

All structures shall be designed using load combinations per UFC 4-152-01. Wind and Current loads shall be operating loads when combined with operating loads (Live, Mooring and/or Berthing). Wind and Current loads shall be extreme loads during vacant / non-operating conditions (no Mooring and/or Berthing). Seismic loads shall coincide only with operating environmental conditions. **Table 12** and **Table 13** shows the Load and Resistance Factor Design (LRFD) and Allowable Service Design (ASD) load combinations that shall be used.

Table 12: Load Combinations – Load and Resistance Factor Design

Load Case	U0	U1	U2	U3	U4	U5	U6	U7	U8	U9
D[a]	1.4	1.2	1.2	1.2	1.2	1.2	1.0+k	1.0-k	1.2	1.2
L	-	1.6[b]	-	1.6[b]	-	1.6[b]	0.1	-	1.6[b]	1.0
B	1.4	1.2	1.2	1.2	1.2	1.2	1.2	0.9	1.2	1.2
Be	-	-	1.6[c]	-	-	-	-	-	-	-
C	-	-	1.2	1.2	1.2	1.2	-	-	-	1.2
H[d]	-	1.6	1.6	1.6	1.6	1.6	1.0	1.0	1.6	1.6
Eq	-	-	-	-	-	-	1.0	1.0	-	-
W	-	-	-	-	1.0	-	-	-	-	1.0
M	-	-	-	-	-	1.6[e]	-	-	-	-
R+S+T	-	-	-	1.2	-	-	-	-	-	-
Ice	-	-	-	0.5	-	-	-	-	1.0	1.0

Table 13: Load Combinations – Allowable Stress Design

Load Case	S0	S1	S2	S3	S4	S5	S6	S7	S8	S9
Da	1.0	1.0	1.0	1.0	1.0	1.0	1.0+k	1.0-k	1.0	1.0
L	-	1.0	-	1.0	-	1.0	0.1	-	1.0	0.75
B	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.6	1.0	1.0
Be	-	-	1.0	-	-	-	-	-	-	-
C	-	-	1.0	1.0	1.0	1.0	-	-	1.0	1.0
Hd	-	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Eq	-	-	-	-	-	-	0.7	0.7	-	-
W	-	-	-	-	0.6	-	-	-	-	0.6
M	-	-	-	-	-	1.0	-	-	-	-
R+S+T	-	-	-	1.0	-	-	-	-	-	-
Ice	-	-	-	0.2	-	-	-	-	0.7	0.7

Notes:

a) 0.9 (0.6 ASD) for checking members for minimum axial load and maximum moment.

b) 1.3 for the maximum outrigger float load from a truck crane.

c) Accidental Berthing: 1.2 support structure, 1.0 fender system components.

d) Where the effect of H resists the primary variable effect, a load factor of 0.9 (0.6 ASD) shall be included with H where H is permanent and H shall be set to zero for all other conditions.

e) 1.6 for the mooring loads from the mooring analysis and 1.0 for the SWL of bollards.

f) k = 0.5 (PGA)

8.4. Material Properties

All materials shall comply with latest applicable ASTM specifications.

Concrete shall be normal-weight concrete with a minimum 28-day compressive strength of 5,000 psi, maximum water-to-cementitious ratio of 0.4 and a minimum clear cover to the reinforcing steel of 3-inches.

8.5. Design Life

The design life of the marine facilities shall be 50 years. Consumable components such as fenders and cathodic protection anodes shall be replaced per the manufacturer’s recommendations. Design life represents the physical condition of the marine facility and its ability to perform its function as originally designed assuming regular inspection and maintenance activities are carried out.

9. Civil Design Criteria

9.1. Stormwater Design

Stormwater systems will be designed to:

- Use the Rational Method for calculating runoff (Q)
- Convey the 10-yr, 24-hr storm event (Q10)
- Use NOAA14 or other local source of rain data (rain gauge at the POLB Maintenance Building)
- A 10-minunte time of concentration (Tc) minimum
- Provide 1-ft of freeboard to building pads for the (Q100)

9.1.1. Stormwater Compliance

The project site lies within the Port of Long Beach's jurisdiction, within the City of Long Beach and County of Los Angeles. The Los Angeles Regional Water Control Board (LARWQCB) has jurisdiction within the project limits. NPDES Construction General Permit (Order No. 2022-0057-DWQ, General Permit No. CAS000002, new order effective September 1, 2023) applies to this project.

In addition, the POLB has developed a Stormwater Design Manual (June 2021) that is consistent with the regulations of the WRAP, COLB Local LID Ordinance, 2014 COLB MS4 Permit and the California State Trash Amendments.

Those activities that are considered industrial and have a Standard industrial Classification (SIC) code will be required to obtain coverage under the Statewide General Permit for Stormwater Discharges Associated with Industrial Activities, Order 2014-0057-DWQ (Industrial General Permit) implements the federally required stormwater regulations in California for stormwater associated with industrial activities discharging to waters of the United States.

9.2. Parking

Project will provide on-site parking and electrical vehicle charging stations for all employees, contractors, visitors, etc. No off-site parking will be allowed.

9.3. Transportation Corridor

The transportation corridor will provide two rail lines and four vehicular lanes. Access will be provided through Navy Mole Road. Roads on the transportation corridor will have a minimum surface elevation of +16.5 ft MLLW. The maximum longitudinal slope of the access roads will be 5%. Access roads will have:

- 14 ft paved lanes
- 8 ft paved shoulders
- 4H:1V max side slope for fill prisms.

Roadway access to the project site shall meet AASHTO or CALTRANS standards. Access roads within the site will follow the criteria in **Section 9.4: Site Grading Design**.

Two rail lines, 15 ft apart will be provided. In addition to allowing access for trains and vehicles, the transportation corridor will provide essential operation facilities. This includes offices, warehouses, parking, electrical substations, refueling tanks, and utilities. A utility corridor can be provided under the shoulder and lanes. Furthermore, along the transportation corridor there will be a few 1,000 ft piers for tug boats and wet storage of offshore wind turbine systems.

9.4. Site Grading Design

Development of the site will require consideration for future SLR and flood protection. SLR criteria is outlined in **Section 2.1.2**. Site Conditions that will be the basis for minimum finished elevations on the marine terminal site are:

- The minimum elevation within the yard will be +16.50 ft MLLW, and the minimum finish floor elevations (FFE) for the buildings will be +17.50 ft MLLW. The minimum elevations for storm drain inverts and the bottom of bioretention basins (bottom of gravel layer) will be +12.00 ft MLLW.
- The minimum slope for the finish grade surface will be between 0.5-1%. Due to the large scale of the site, a flatter grade will help to minimize the amount of fill needed to construct the site, but drainage of the site needs to be considered.
- All paved driving surfaces shall have a 0.5% minimum cross slope.

9.5. Design of Erosion, Sedimentation and Pollution Control

The project shall develop a Stormwater Pollution Prevention Plan (SWPPP) to satisfy the Construction General Permit (CGP).

The project shall develop a post-construction stormwater plan to satisfy the local Low Impact Development (LID) standards and/or Industrial General Permit (IGP).

9.6. Fire Protection Water

Fire water will be needed to provide fire suppression for the various buildings to be constructed on the site. Fire water will also need to serve all fire hydrants throughout the site. Firewater service will be provided by a new line from Nimitz Rd. In the next phase, the existing system pressure/capacity will be assessed to determine if it is adequate for new hydrants/buildings or if the project will need to include booster or upsize upstream source pipes on Navy Mole.

9.7. Potable Water

Potable water will be needed for the various buildings to be constructed on the site. Potable water will be needed for general office use (restrooms, kitchens, etc.). Depending on the activities within each building, there may be additional potable water demands. Potable water will be provided by a new line from Nimitz Rd.

9.8. Sanitary Sewer

Sanitary sewer service will be needed for the various buildings to be constructed on the site. Sanitary sewer service will be limited to demands from general office use (restrooms, kitchens, etc.). If there are industrial processes on the site that generate wastewater, they will need to be evaluated individually to determine if the wastewater generated by these processes can be sent directly to the sanitary sewer system, or if on-site pre-treatment is needed. Onsite treatment and disposal of domestic wastewater is not expected for this site. Depending on the downstream invert connection, lift stations may be required.

9.9. Finished Surface Materials

The terminal surfacing material will be dense grade aggregate with a total thickness of approximately 3 ft. Due to concerns with the potential for mobilizing fines in stormwater runoff, a two layer, 3 ft finished surface will likely be required. The upper finished surface should be a cleaner crushed aggregate product that has been screened to minimize the amount of fines. Pavements are not planned nor desired for the finished surface of the terminal. The heavy loads anticipated on the site make paving the entire site impracticable. Additionally, the crushed aggregate surface allows ease of maintenance for re-grading the finished surface when settlement from the heavy loads occurs. If localized areas of pavement are needed to meet industrial area runoff collection and treatment, that area should be minimized, and additional subsurface soil improvements will likely be needed in order to provide adequate support for pavements.

Pavement will be applied on the transportation corridor for vehicular lanes and parking lots.

9.10. Landscaping

Landscaping is not part of the project design. However, it may be required in the LID water quality treatment devices. Roadway median and shoulders will be evaluated for biofiltration treatment with landscaping.

9.11. Signage

The project shall be designed to meet the Federal Highway Administration Manual on Uniform Transportation Control Device standards.

10. Electrical Design Criteria

Operations at the Pier Wind facility will be continuous and varied for all phases of the build-out and requiring significant power. To be consistent with the Port's Clean Air Action Plan and Zero Emission Energy Resilient Policy, the facility is conceptualized as an all-electric facility. Therefore, reliable power will be essential to the success of the terminal. Conceptualized as an all-electric facility (without diesel/gas engine driven equipment), reliable power will be essential to the success of the terminal. The expected operations and equipment requiring power include:

- Manufacturing/assembly buildings
- Warehouse buildings
- Administrative/office building(s)
- On-site material heavy transport
- On-site light material transport
- Manufacturing/construction equipment and tools
- Cranes
- Site lighting
- Vessel shore power and battery charging
- Miscellaneous electrical loads.

Power will be distributed to the site at medium voltage (e.g., 12,470 volts) and transformed down to utilization voltages (e.g., 480V, 208V and 120V) all at 60 Hz.

10.1. Shore Power

The electrical design will accommodate vessels at berth may be required to plug into power and tugs may plug in to charge batteries. Shore Power will be provided for different applications such as 6.6 kV for vessels and 480 for hoteling applications. Accommodation will be provided for future applications such as 11kV substation and transformer for Ro-Ro’s, which are all custom made and may require long lead times.

10.2. Large Transport Equipment and Vehicle Charging

Yard transport equipment, including self-propelled modular transports (SPMTs), are assumed to be utilized at the facility, the electrical design shall accommodate this.

10.3. Site Lighting

Lighting for the facility will be achieved with high mast light towers (120 ft, height to be determined) using LED light fixtures. The number and location of the light poles will be determined during the design phase to ensure a minimum level of 1 footcandle along the pierhead, average of 5 footcandles with the minimum of 1 footcandle on the wharf, and maximum of 10 footcandles with the lighting uniformity ratio of 10:1 maintained. The lighting control design shall be based on Square D power Link System. Each light fixture is estimated at 900 watts and each light tower will have approximately 12 light fixtures. The total load for each light tower is estimated at 9.6 KW (kilowatts).

10.4. Building Power

The electrical design at Pier Wind will accommodate the various buildings such as fabrication/assembly buildings, manufacturing buildings, and offices. The building design shall meet Title 24 requirements. Equipment and Tools

It is expected that a variety of power tools, including arc-welding equipment will be used at the terminal, and outlets for the equipment will be required.

10.5. Cranes

The wharf crane will have multiple motors for its operational movements, with the hoist motor being the largest. Depending on the type of crane, multiple motors may be used during lifts.

10.6. Equipment Staging Area Loads

Equipment staging is a key component of the offshore wind terminal. Wind turbine equipment including nacelles and tower sections require power while staged for components such as heaters (to prevent condensation and moisture buildup) and electronics. The design may consider portable backup power connection and transfer mechanism to ensure continuity of power flow in the event of outages.This equipment accounts for a considerable terminal load.

Miscellaneous loads may include assembly racks with lighting, lifts, and trolley movements.

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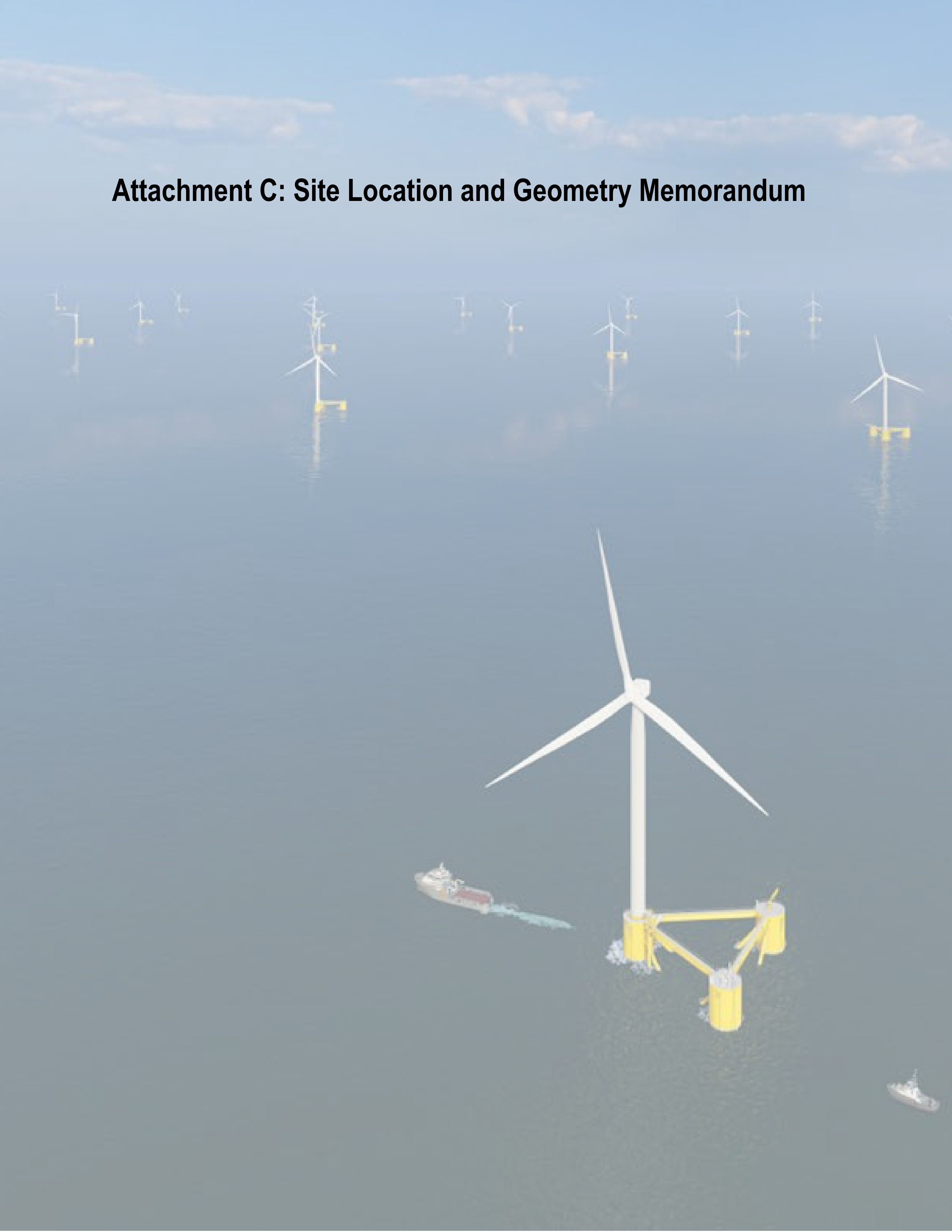
Attachment C: Site Location and Geometry Memorandum



moffatt & nichol

4225 E. Conant Street
Long Beach, CA 90808

(562) 590 - 6500
www.moffattnichol.com

SITE LOCATION AND GEOMETRY MEMORANDUM

To:	Port of Long Beach
From:	Jennifer Lim (Moffatt & Nichol)
Cc:	Matt Trowbridge (Moffatt & Nichol)
Project Name:	Pier Wind Project – Concept Phase
Date:	April 20, 2023
Subject:	Site Location and Geometry Memorandum
M&N Job No.:	10800-24

To determine the size, location, and geometry of the Pier Wind terminal and transportation corridor a layout assessment was performed. This assessment and decisions made to determine the final layout for this phase is summarized herein.

Site Location

Pier Wind is located within the Outer Harbor of the Port of Long Beach, just south of the Navy Mole and east adjacent to the Port of Los Angeles Pier 400, as shown in Figure 1. This location is near Queen's Gate, the entrance to the Port, and west of the Main Channel. Therefore, no air draft restrictions are in place from the Long Beach International Gateway Bridge, making this site ideal for offshore wind staging and integration activities.

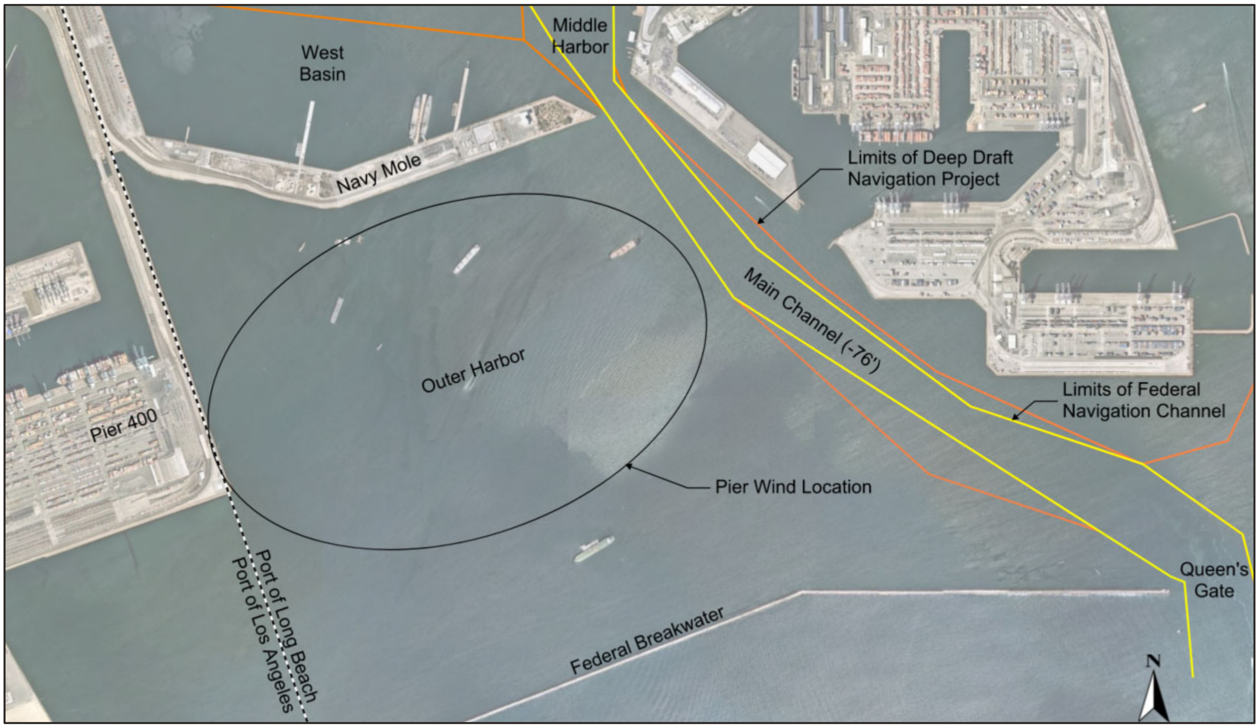


Figure 1: Pier Wind Location in the Outer Harbor of Port of Long Beach

Preliminary Conceptual Design Alternatives

As mentioned in the Bureau of Ocean Energy Management (BOEM) California Floating Offshore Wind Regional Ports Assessment study, the Port of Long Beach can serve as a staging and integration (S&I) and manufacturing / fabrication (MF) site for the offshore wind industry due to no air draft restrictions, deep waters, and the ability to create significant acreage for upland space. Some layout considerations to accommodate S&I and MF activities include:

- Acreage
    - Minimum of 80 acres is needed for an offshore wind developer / manufacturer to have enough space to move in and use a portion of the site.
- Berth Length / Location
    - Ideally 1,500 ft of berth length is needed to accommodate two floating foundations and a delivery vessel.
    - The wharf will be located on the north side of the terminal to provide better protection from waves within the harbor.
- Wet Storage
    - Due to possible weather delays for towing out the fully assembled wind turbines, wet storage space shall be provided to moor / anchor the assembled turbines to wait for the appropriate weather windows.
    - Wet storage can be located either north of the terminal if there is adequate space between the Navy Mole and the terminal or south of the terminal in the outer harbor.

To determine the preferred layout, three conceptual alternatives were produced. For these preliminary layouts, some initial constraints were applied to the northern and eastern edge of the terminal. The northern or top edge of the terminal was aligned with the top edge of Pier 400 to provide enough space for vessels and the sinking basin. For the eastern edge, the terminal ends at the edge of the Navy Mole to maintain some distance from the navigation channel. Besides these two constraints the layouts varied be total acreage and width. All initial alternatives include a transportation corridor that is 225 feet wide for utilities and road and rail access. Below is a high-level summary of the three alternatives.

- Alternative 1: Five (5) 80 acres units with 1500 ft berth each, 400 acres total
- Alternative 2: Five (5) 100 acres units with 1500 ft berth each, 500 acres total
- Alternative 3: Six (6) 80 acres units with 1250 ft berth each, 480 acres total

Alternative 1:

For Alternative 1, the main layout characteristics can be summarized into the following:

- Total Terminal Acreage = 400 acres
- Terminal Length = 7,500 feet
- Terminal Width = 2,350 feet
- Number of Offshore Wind Sites = (5) x 80 acres with a 1,500 feet berth length each
- Wet Storage = Provided south of the terminal
- Transportation Corridor Width = 225 feet

Figure 2 illustrates the site layout for Alternative 1.

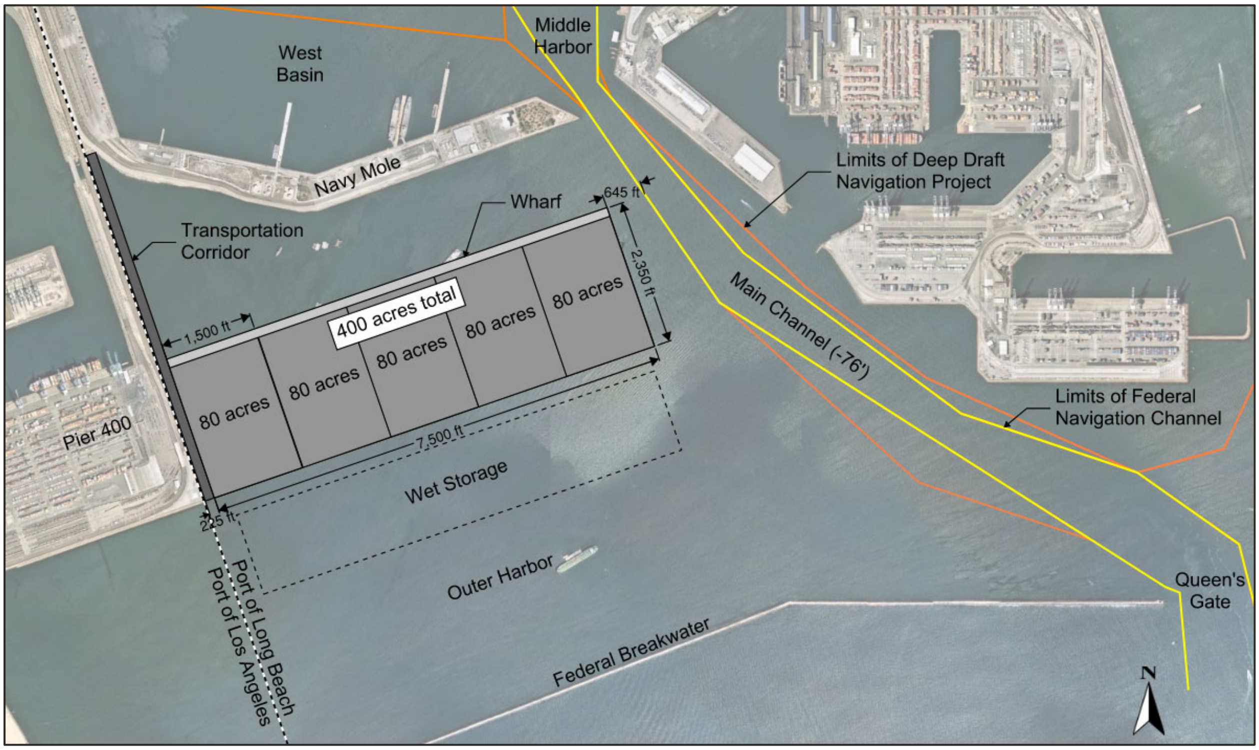


Figure 2: Alternative 1 – 400 Acres Total = Five 80 Acre Units with 1,500 ft Berth Length Each

Alternative 2:

For Alternative 2, the main layout characteristics can be summarized into the following:

- Total Terminal Acreage = 500 acres
- Terminal Length = 7,500 feet
- Terminal Width = 2,900 feet
- Number of Offshore Wind Sites = (5) x 100 acres with a 1,500 feet berth length each
- Wet Storage = Provided south of the terminal
- Transportation Corridor Width = 225 feet

Figure 3 illustrates the site layout for Alternative 2. The most notable difference between Alternative 1 and 2 is the width of the terminal. In Alternative 2 the terminal extends south past Pier 400 and each unit is 100 acres.

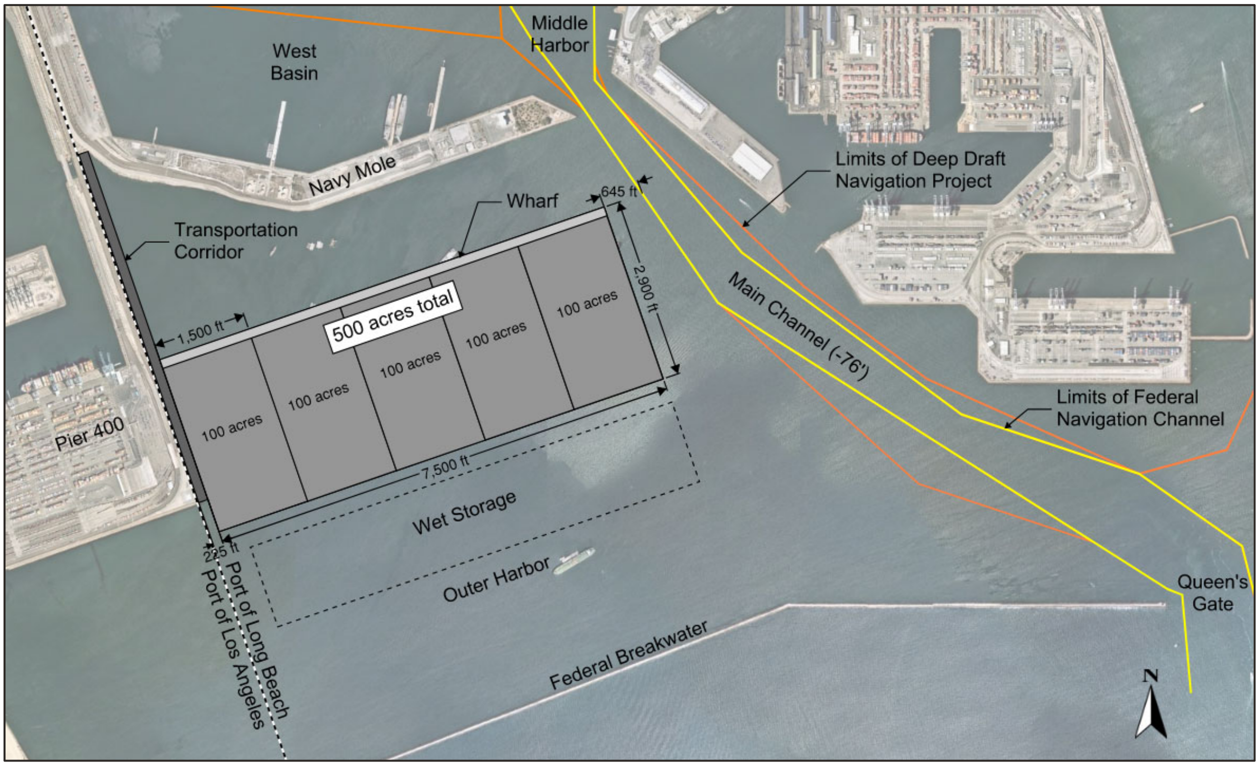


Figure 3: Alternative 2 – 500 Acres Total = Five 100 Acre Units with 1,500 ft Berth Length Each

Alternative 3:

For Alternative 3, the main layout characteristics can be summarized into the following:

- Total Terminal Acreage = 480 acres
- Terminal Length = 7,500 feet
- Terminal Width = 2,800 feet
- Number of Offshore Wind Sites = (6) x 80 acres with a 1,250 feet berth length each
- Wet Storage = Provided south of the terminal
- Transportation Corridor Width = 225 feet

Figure 4 illustrates the site layout for Alternative 3. Similar to Alternative 2 the terminal extends south past Pier 400, however instead of providing a 1,500 feet berth for each unit, it is reduced to 1,250 feet to provide 6 units of 80 acres and not extend past the Navy Mole. Although this alternative provides an additional unit than Alternatives 1 and 2, the configuration is not ideal. A site that is narrow in the direction of the berth is not ideal for offshore wind activities since the components are very large and would have less maneuverability to go to and from the berth.

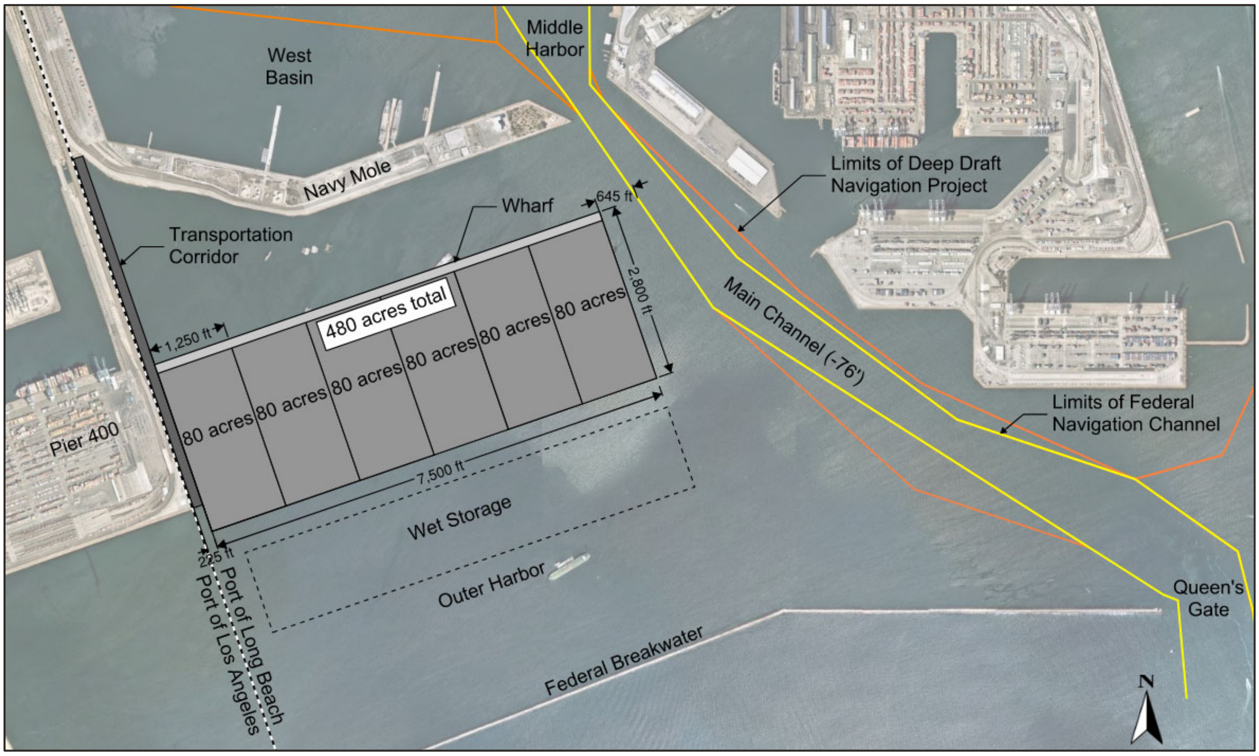


Figure 4: Alternative 3 – 480 Acres Total = Six 80 Acre Units with 1,250 ft Berth Length Each

Of the three alternatives, the Port decided that **Alternative 1** was the preferred layout to proceed with, as it provided adequate acreage and the ideal berth length at each unit. The next step was to share the preferred layout with the Port Pilots and get feedback on any adjustments that should be made.

Port Pilot Input and Additional Considerations

On January 17, 2023, the Port and M&N met with the Port Pilots to present Alternative 1 of Pier Wind with an illustration of a vessel backing in and pulling out on the north side of the terminal, as shown in Figure 5.

Figure 5: Alternative 1 with Vessel Backing In / Pulling Out

The initial feedback from the Port Pilots was focused on getting ships into the Southeast Basin (east of Pier Wind) and Pier Wind. A computer simulation was performed for each of these scenarios. Figure 6 shows the computer simulation into the Southeast Basin with Pier Wind reduced to 7,000 ft long, instead of 7,500 ft. There was an additional concern about a potential funnel effect for south swells and wave energy because of the orientation of Pier Wind in relation to Pier F. This will be further assessed in the future wave study for the Port, refer to the Wave Study Memorandum. Figure 7 show the computer simulation for bringing a ship into Pier Wind, which was accomplished by further reducing the width to 6,750 feet. Based on these comments, the terminal either needed to be reconfigured or shifted south.

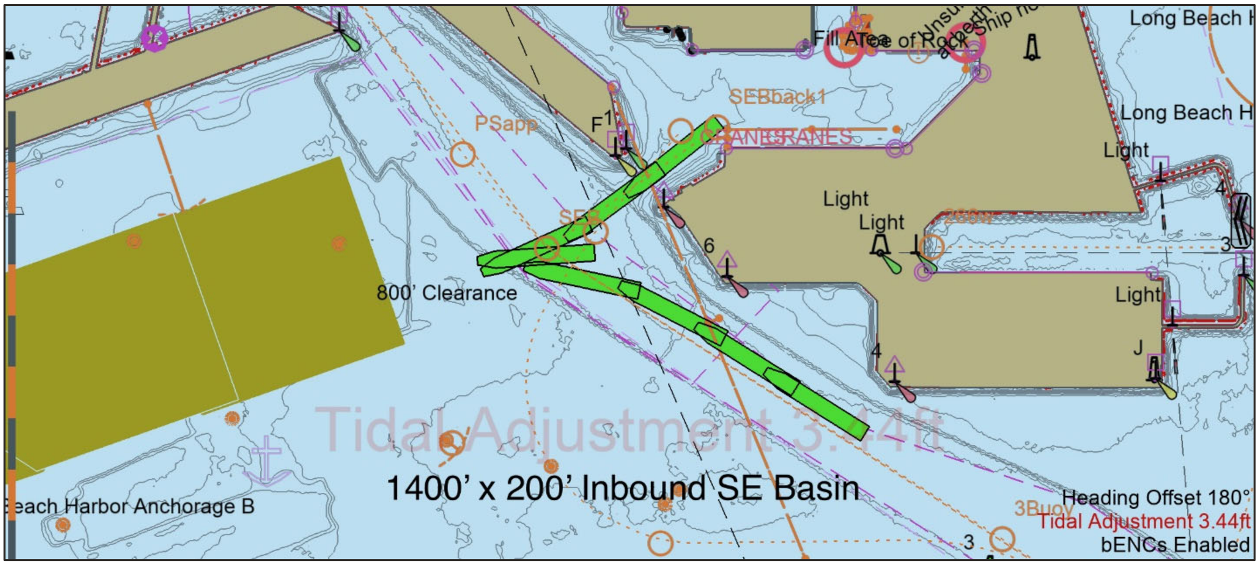


Figure 6: Port Pilots Computer Simulation into Southeast Basin with Pier Wind reduced to 7,000 ft

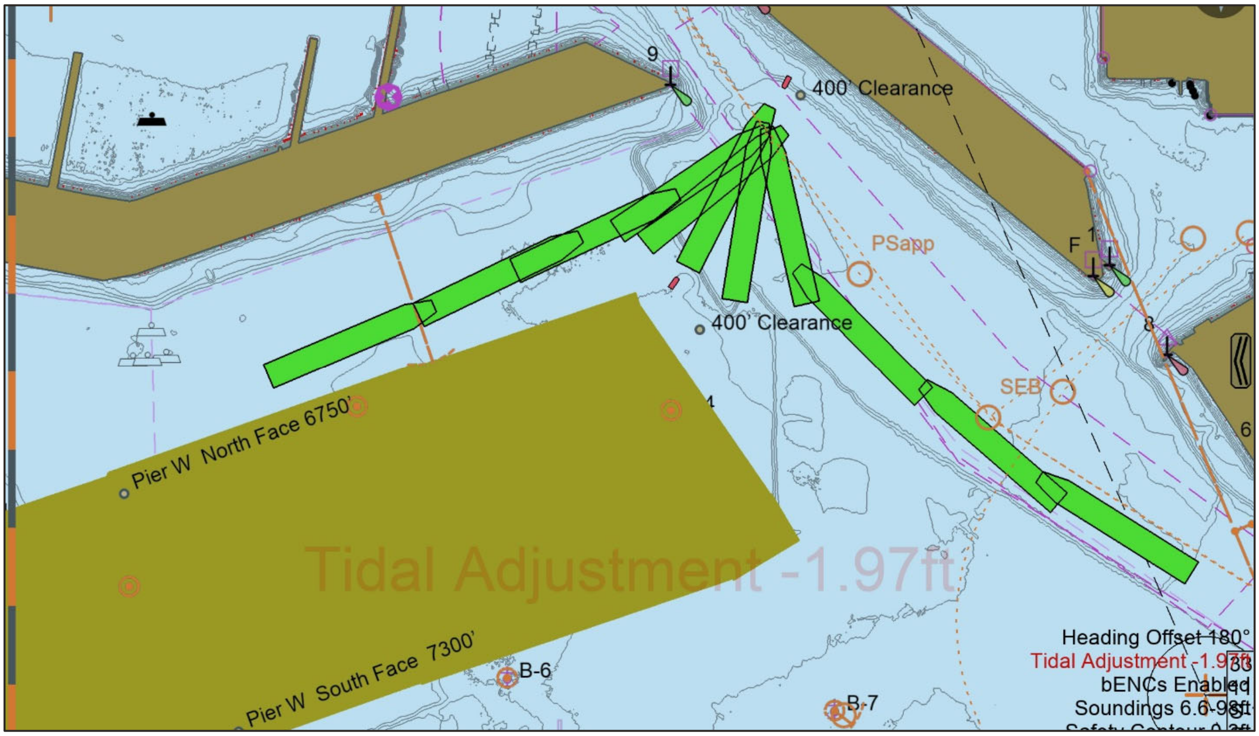


Figure 7: Port Pilots Computer Simulation into Pier Wind with Pier Wind reduced to 6,750 feet on the North Side

Maintaining the size of the terminal will provide the necessary acreage to help achieve the federal and state offshore wind deployment goals. Therefore, the 400-acre terminal was shifted 1,300 feet south to accommodate a 2,200 feet diameter navigation turning basin. Another benefit to shifting the terminal south is creating space north of the terminal to accommodate wet storage and tugs needed to tow offshore wind turbines to the wind farms, as shown in Figure 8.

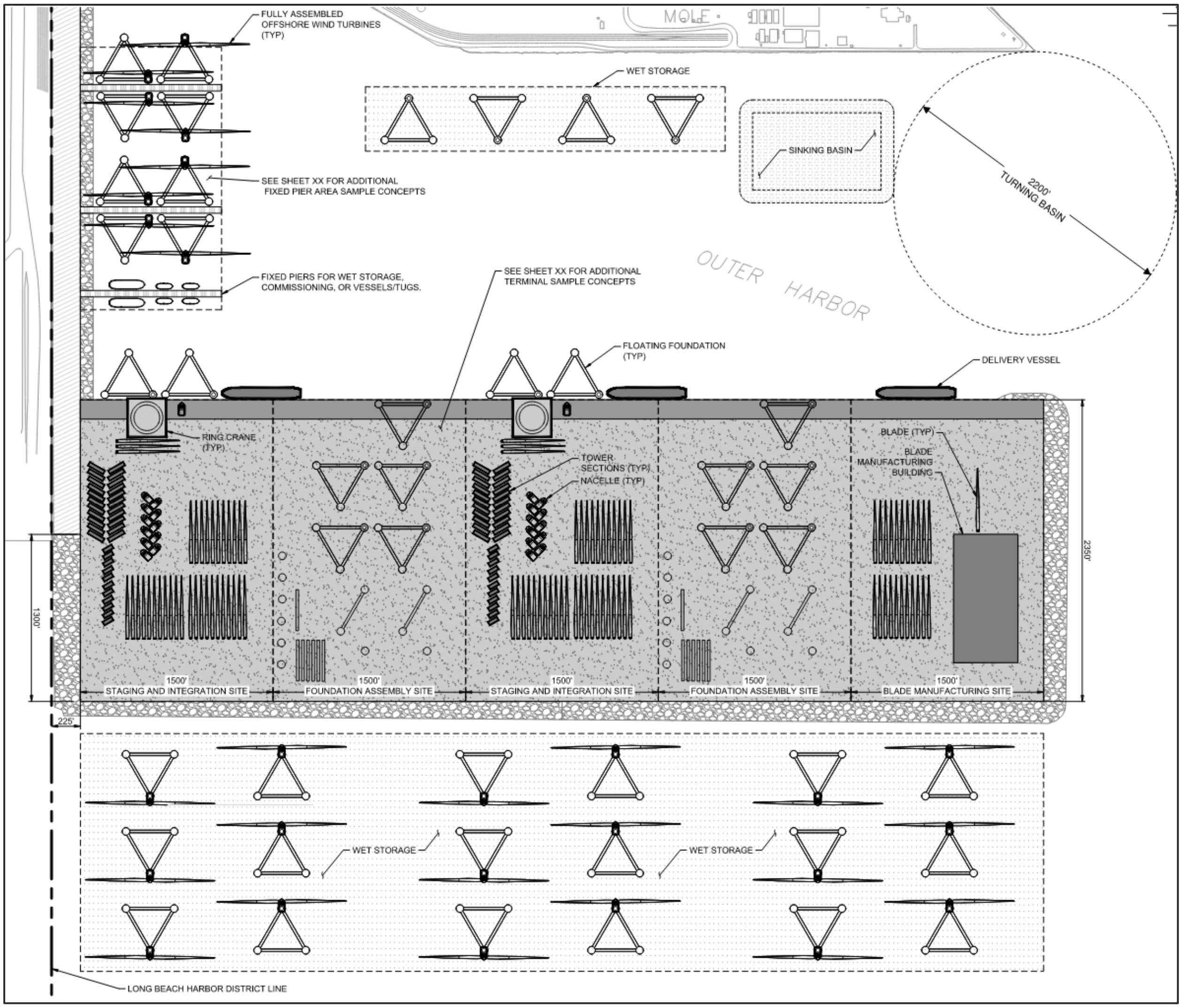


Figure 8: Pier Wind Terminal Southern Shift Due to Turning Basin

Selected Terminal Layout

Based on the above adjustments to Alternative 1, the final layout for the concept phase includes the following:

- Total Acreage = 400 acres
- Terminal Length = 7,500 feet
- Terminal Width = 2,350 feet
- Number of Offshore Wind Sites = (5) x 80 acres with a 1,500 feet berth length each
- Wet Storage = Provided north and south of the terminal
- Transportation Corridor Width = 225 feet
- Tug Facility

The actual type of offshore wind site at each unit (i.e., staging and integration (S&I), foundation fabrication, component manufacturing, etc.) is flexible and will be dependent on the offshore wind industry needs. The terminal can also accommodate all different types of technology and equipment including:

- Various floating foundation designs (semi-submersible and tension leg platform)
- Heavy lift cranes (ring or mobile)

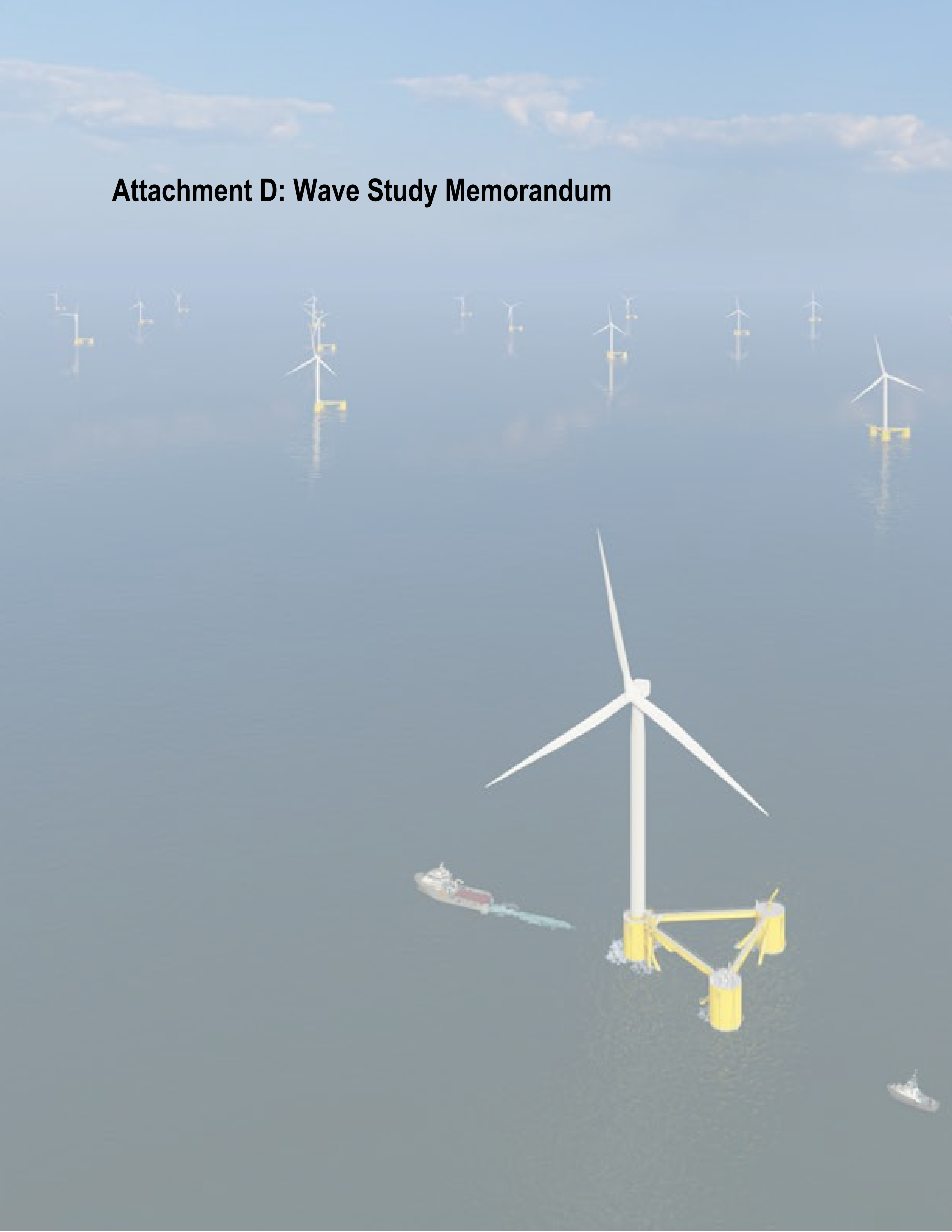
- Heavy lift self-propelled modular transporter (SPMT)
- Full fleet of vessels (tugs, delivery vessel / barges, semi-submersible barges, etc.)

Figure 8 illustrates the final site layout for Pier Wind with an example of an operational offshore wind terminal with two (2) S&I, two (2) foundation assembly, and one (1) blade manufacturing site. Note, these may not be the actual offshore wind activities that will occur at this site (to be determined by industry needs).

For the arrangement shown in Figure 8, the S&I site receives components such as the blades, nacelles, and tower sections at the berth via a delivery vessel, stages them in the uplands, and then fully assembles the turbine at the quayside with the ring crane.

For the floating foundation assembly site, a serial production line moving towards the wharf will likely be used as shown in Figure 8. When the foundation unit is complete, it will be stationed next to the wharf for roll-out or direct lift onto a semi-submersible (semi-sub) barge. The semi-sub barge will be moored at the berth and the completed foundation unit is moved onto the semi-sub barge via self-propelled modular transporters (SPMTs). The semi-sub barge then transports the foundation to a predetermined deep-water area or sinking basin and performs a “float-off” operation in which the semi-sub barge ballasts down until the foundation becomes buoyant. The foundation is towed back to the berth area where it is outfitted with the wind turbine components (tower, nacelle, and blades). Each complete foundation unit can be up to 425 ft in diameter. Therefore, the 1,500 ft long berth at each unit provides enough space for two (2) complete foundation units and one (1) delivery vessel stationed along the terminal at the same time.

Attachment D: Wave Study Memorandum



moffatt & nichol

4225 E. Conant Street
Long Beach, CA 90808

(562) 590 - 6500
www.moffattnichol.com

WAVE STUDY MEMORANDUM

To:	Port of Long Beach
From:	Xiuying Xing (Moffatt & Nichol)
Cc:	Matt Trowbridge, Jennifer Lim (Moffatt & Nichol)
Project Name:	Pier Wind Project – Concept Phase
Date:	April 20, 2023
Subject:	Wave Study Memorandum
M&N Job No.:	10800-24

The Port of Long Beach (POLB or Port) is evaluating the opportunity to develop an approximately 400-acre terminal known as Pier Wind. This offshore wind terminal will be developed to have the flexibility to serve any of the offshore wind industry needs (i.e., staging and integration (S&I), foundation fabrication, component manufacturing, maintenance support, etc.). Moffatt & Nichol (M&N) is engaged by POLB to provide a conceptual design to assess the project feasibility. This memorandum summarizes the existing wave information and studies available with the Port. In addition, this memorandum provides a proposed approach to studying the current wave conditions and the wave conditions on the proposed terminal and adjacent terminals after the construction of Pier Wind.

Existing Relative Wave Studies and Wave Data

Existing Wave Studies

Table 1 lists the existing relative wave (and ship motion) studies, including the firm name, time, report title, and numerical models and wave data applied. These wave studies were either provided by POLB or from M&N's own project data.

The numerical models listed in Table 1 include:

- BW – Boussinesq wave model
- BOUSS-2D – a Boussinesq-type wave model
- CMS-WAVE – a spectral wave model
- GENESIS – a shoreline evolution model
- HARBSHIP – a frequency domain wave agitation model
- HD – hydrodynamic model
- HYDRO – a model for interaction of waves with a harbor basin and a moored ship
- SW – spectral wave model
- TERMSIM – a dynamic mooring software
- TDBERTH – a time domain ship motion model
- OpenFOAM – a open-source computational fluid dynamics model

Table 1: Existing Relative Wave Studies and Wave Data

Firm Name	Time	Report Title/Study Purpose	Provided By	Numerical Models Applied	Wave Data Applied or Analyzed
M&N	2018	Seal Beach Ammunition Pier Coastal Engineering Study	M&N	SW; BW	Wave data at offshore Buoys: Long Beach Channel, San Pedro, and San Pedro South
	2010	Sea Level Rise Impact Assessment at POLB/POLA (internal study, not published)	M&N	BW	-
	2007	POLA/POLB Tsunami Hazard Assessment	POLB	HD; BW	-
	2004/2005	Pier J Ship Motion Analysis Incorporating HADCP Current Data	POLB	HYDRO; TDBERTH	Horizontal acoustic doppler current profile current data in Pier J basin
	2002	POLB Piers E, G and J Development Numerical Wave and Ship Motion Modeling Study (draft report)	POLB	HARBSHIP; TERMSIM	Wave data at Platform Edith wave gauge (1994-1999)
	1997	Pier J Ship Motion Study	POLB	HYDRO; TDBERTH	Wave spectra at Platform Edith wave gauge
DHI[1]	2004	Validation of Mike21 BW Wave Model for Long Period Wave Response in Port of Long Beach	POLB	SW; BW	Wave data at Platform Edith, San Pedro and Dana Point CDIP[2] buoys; Wave data (1999-2003) at Queens Gate, Berth 243, Navy Mole and Pier J (by USACE WES[3])
Halcrow	2012	Coastal and Marine Site Condition Assessment, Pier F and Queen Mary Boat Basins (Report); Alternatives Analysis Fixed Breakwater at FS 15 Projective Boat Basin (Technical memorandum)	POLB POLB	SW; BW	Wave hindcast data at MOP point 187 (by SIO[4])
Jacobs	2022	POLB Fire Station 15 Floating Dock Bilge Keel Computation Fluid Dynamics Analysis	POLB	OpenFOAM	-
Sea Dyn	1996	Wave Monitoring Data for Pier J	POLB	-	Long period wave energy at west end of the Pier J slip (1993-1996)
	1995	POLB Pier J Breakwater Beach Impacts Study	POLB	SW (by SIO[4]); GENESIS	Measurement at San Nicolas Island (1992) and Harvest Platform (1992-1994)
USACE[3]	2022	East San Pedro Bay Ecosystem Restoration Feasibility Study, Attachment A: Coastal Engineering and Design	POLB	CMS-WAVE; BOUSS-2D	Wave data at San Pedro buoy; Wave Information Studies (WIS) station 83101
	2004	Physical and Numerical Model Studies or harbor Resonance at Piers E, G and J, POLB, California	POLB	Physical model; HARBSHIP	-

Note: [1]Danish Hydraulic Institute; [2]Costal Data Information Program; [3]United States Army Corps of Engineers Waterways Experiment Station; [4]Scripps Institution of Oceanography

Limitations in Existing Wave Studies

The limitations in the existing wave studies are summarized below:

- The newly installed Coastal Data Information Program (CDIP) buoys outside of the breakwaters, station Long Beach Channel (2015 - present) and station San Pedro South (2014 - present), provide better data to help understand the wave conditions outside of the breakwaters. This data was not available for the previous wave studies in POLB.
- The bathymetry has changed so some of the previous wave observations cannot be applied directly for model calibration.
- Sea level rise impacts have not been specifically studied.
- Ship motion studies were based on single point wave data (at the end of Pier J slip) or two point current data. The two dimensional wave fields (resonance modes), which are highly related with ship motions, have not been investigated in detail. Ship motions have not been fully duplicated/verified through models.
- The limited observation data inside the breakwaters cannot facilitate a better understanding of wave transmission through the breakwaters (as a function of water level, wave period, height and direction), which is essential for the wave study at Pier Wind

Proposed Scope of Detailed Wave Study

Wave Study Goals

A detailed wave study is anticipated to begin in April 2023 and is proposed to evaluate the wave conditions for the Pier Wind terminal, identify challenging conditions that may impact current and future operations at the proposed Pier Wind terminal and other existing terminals. The goals of the study include:

- Evaluate the wave conditions at the proposed Pier Wind
- Identify potential wave resonance at the proposed Pier Wind berths
- Evaluate the ship response to the wave environment at Pier Wind
- Identify any critical operating limits and assess the potential downtime at Pier Wind
- Optimize the Pier Wind terminal layout
- Evaluate the impacts to existing terminals and navigation channels
- Evaluate sea level rise (SRL) impacts and breakwater elevations

Scope of Work

The scope of work for the detailed wave study includes the following:

1. Field Data Collection (ADCP Deployment):

    Wave measurement inside the breakwater will help to evaluate the breakwater transmission and calibrate wave models (both numerical and physical). Two acoustic doppler current profilers (ADCP) are proposed to be deployed to measure waves and currents, ideally for a period of one year. This data will also benefit the dredge placement modeling study. The ADCPs can be deployed at the Pier W site and near the entrance of or inside middle harbor (to be confirmed). Continuous time series of directional wave spectra and vertical current profile throughout the full water column will be obtained at the two locations. After 1 month of deployment, the ADCP units will be retrieved to confirm data is accurately being recorded. This initial data set will be used to progress the project engineering. Over the course of the deployment, data will be retrieved at regular service intervals (typically 3-4 months) for battery changes to the unit. As data is obtained, it will be used to support and calibrate the wave models and progress project engineering.

2. Offshore Wave Evaluation (Spectral Wave Modeling):

    Spectral wave (SW) modeling will be performed to evaluate the wave conditions outside of the breakwaters. This task will investigate the wave variation and provide both time series and extreme wave conditions, along the boundary of the local wave agitation model.

3. Local Wave Propagation/Agitation Study (3D Wave or 2D BW Modeling):

   Mike3 Wave or Mike21 BW modeling will be performed to study the wave agitation inside the breakwaters. Input wave conditions at the boundary will be results from Task 2 and a white noise spectrum. The former is to evaluate the wave conditions at the terminals and navigation channels. The latter will help to identify resonance frequencies at the terminals.

   This task will consider multiple harbor layouts (existing layout, interim and ultimate layouts with Pier Wind), multiple water levels (MLLW, MHHW, MHHW+SLR), and different breakwater conditions (original design and possible upgrades).

4. Wave Resonance Identification (Elliptic Mild Slope Modeling)

   Mike21 Elliptic Mild Slope model will be applied to identify wave resonance frequencies and the corresponding resonance modes (wave patterns). This result will be used to validate the wave agitation results from Task 3, which will be applied to investigate the ship responses.

   Similarly, multiple layouts (existing harbor layout and one proposed layout) and multiple water levels (MLLW and MHHW+SLR) will be included in this task.

5. Ship Response Study (Mooring Analysis)

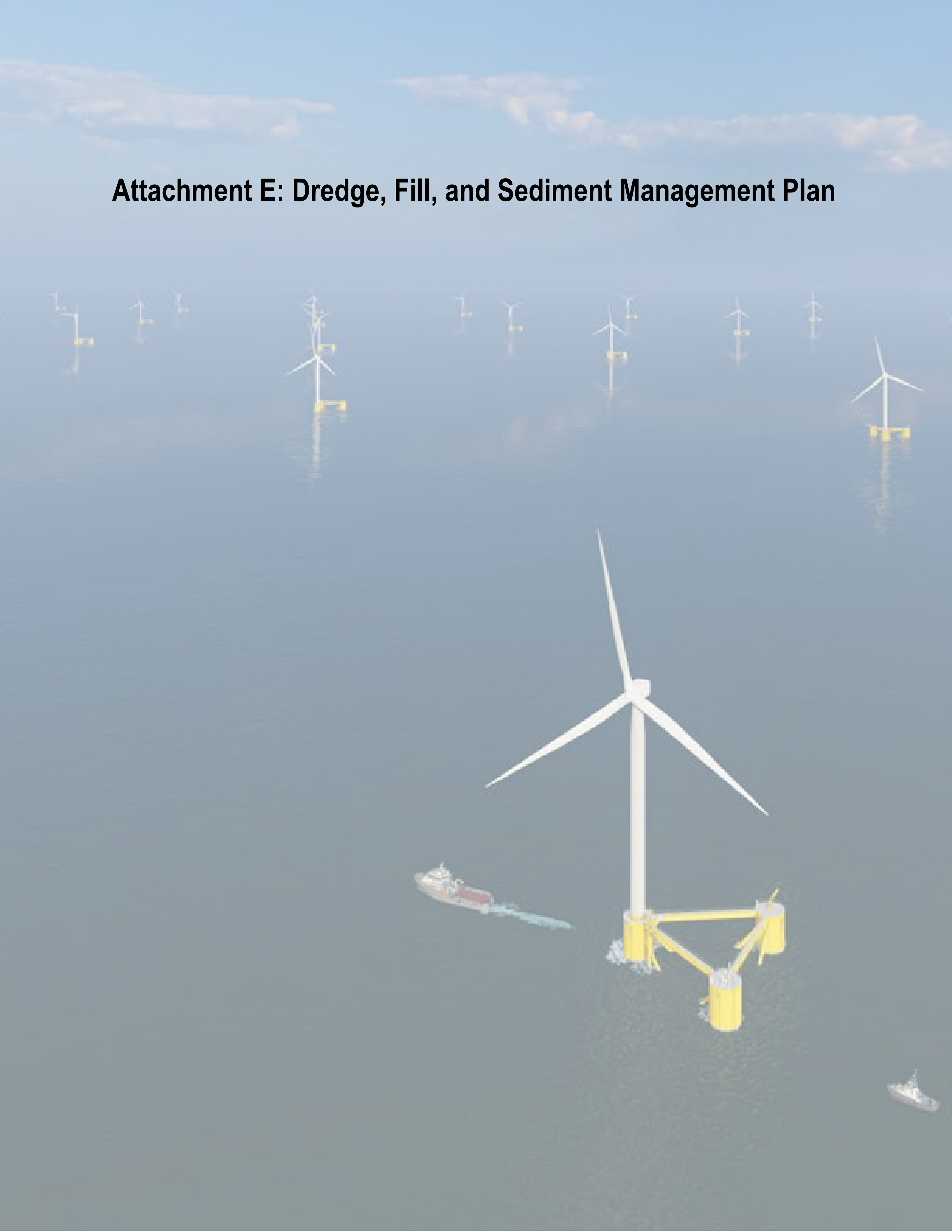
   MIKE21 Mooring Analysis (MA) tool will be applied to evaluate the ship responses to the wave environment at the terminals. This model can directly apply the 2-D or 3-D wave modeling result as the ship excitation force, thus is appropriate for cases with varying bathymetry and complex surrounding structures.

   The delivery vessel, barge, Ro-Ro, semi-submersible barge, and future vessels will be tested at the designated berths at Pier Wind to evaluate the operating limits. One container vessel at Pier J will be analyzed to duplicate historical accidents to validate the model.

6. Downtime Assessment

   Operational downtime will be estimated based on wave and mooring study results. The downtime could be caused by both loads and vessel motions. The downtime for the wet storage area will be based on operating limits provided by manufacturers or existing terminals.

Attachment E: Dredge, Fill, and Sediment Management Plan



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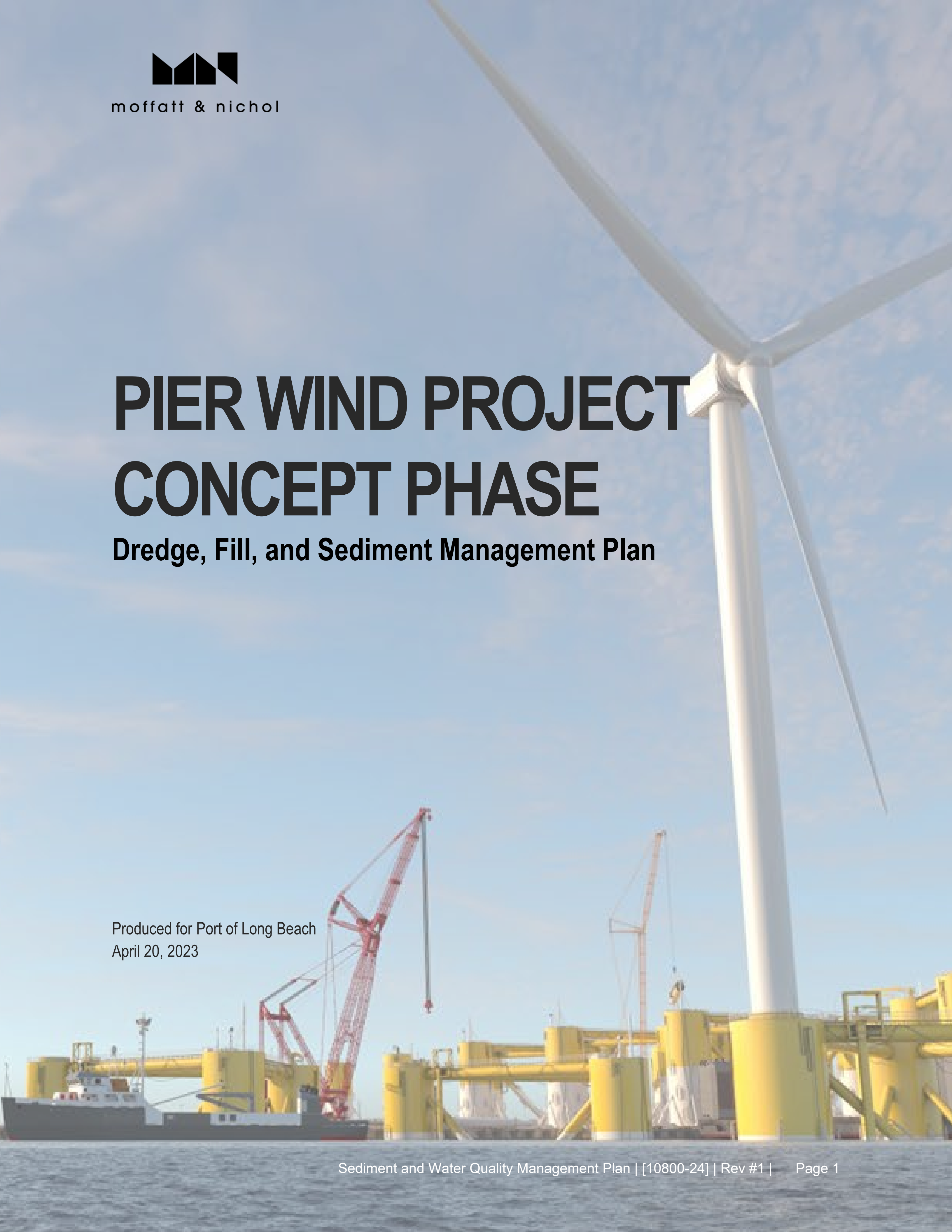

PIER WIND PROJECT CONCEPT PHASE

Dredge, Fill, and Sediment Management Plan

Produced for Port of Long Beach
April 20, 2023

Document Verification

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00	Dredge, Fill, and Sediment Management Plan	Shelly Anghera	4/20/2023	Alan Alcorn and Seann Perez

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1. Introduction

The Port of Long Beach (Port) is evaluating the opportunity to develop a 400-acre terminal designed to support the offshore wind industry floating offshore wind structure staging and integration with potential for inclusion of manufacturing and/or fabrication of platform components. The terminal will be developed to meet the physical, regulatory, and environmental requirements to accommodate the largest floating offshore wind turbine generator components and floating foundations being developed. The Pier Wind project (Project) is currently in the feasibility stage. It is necessary to progress conceptual engineering to determine the investment, environmental commitments, and schedule required to prepare the facility for industry use. This study provides early planning approaches for the management of sediment during the construction, from sourcing of materials to logistical constraints and environmental considerations.

1.1. Site Description and Location

The proposed Pier Wind terminal is located within the Long Beach Outer Harbor, just south of the Navy Mole. The western edge of the project is on the border of the Port of Los Angeles, adjacent to Pier 400. The terminal is located off the Main Channel and near Queen's Gate, the entrance to the Port.

1.2. Sediment Management Needs

The proposed terminal will include 400 acres of new land when fully built out. The creation of land will require the placement of an estimated 9,500,000 cubic yards (CY) of rock, 42,000,000 CY of fill, and 4,700,000 CY of surcharge to an elevation of +38 ft MLLW. This project-specific Sediment Management Plan documents conceptual level design approaches and assumptions for the Project. It is anticipated that the land will be constructed in phased increments to allow early occupation for the initial fill. The information is discussed through the following sections in this study:

- **Section 2. Base Design Features**
    - This section provides a summary of the assumed major construction elements, including rock placement, dredging, in-water placement (i.e., filling), and pile driving.
- **Section 3. Sediment Budget**
    - This section provides a proposed sediment budget to balance project generated material and planned imported material to meet the project fill needs.
- **Section 4. Sediment Management Planning**
    - This section provides an approach to manage project sediments to optimize design needs with anticipated permit conditions.
- **Section 5. Water Quality Management**
    - This section summarizes the anticipated water quality challenges associated with the preferred construction methods and the available best management practices (BMPs) that may be used to minimize impacts.
- **Section 6. Next Steps**
    - This section provides a summary of recommended actions to prepare for permitting information needs.

2. Base Design Features

Pier Wind is designed to be a 400-acre terminal and transportation corridor built within the Outer Harbor with a rock revetment containment dike and dredge material fill. The 400-acre terminal may be built in two 200-acre phases. The entire Outer Harbor would be dredged to accommodate project draft needs. The berth pocket will be deepened to EL -60 ft MLLW. While the navigation approach channels will be EL -80 ft MLLW and a sinking basin north of Pier Wind will be EL -100 ft MLLW. The terminal will be built in an area that is currently underwater where depths vary from EL -30 ft EL in the western area to -70 ft EL toward the main channel. The terminal will be built by infilling a rock containment dike. Major construction elements relevant to this study include rock dike construction, dredging of sediment, filling of sediment, placement and removal of surcharge, and pile driving for wharf construction.

2.1. Rock Dike Construction

A rock revetment structure will surround the entire terminal and extend along the transportation corridor to the Navy Mole. The north side (wharf/berth side) of Pier Wind will have an El. -60 ft MLLW at the berth pocket. The east side will be adjacent to the El. -80 ft MLLW deep draft access channel. The south side of the Pier Wind will have a minimum of EL -50 ft MLLW draft (actual will vary based on existing bathymetry). Figure 1 illustrates these dredge depths around the terminal.

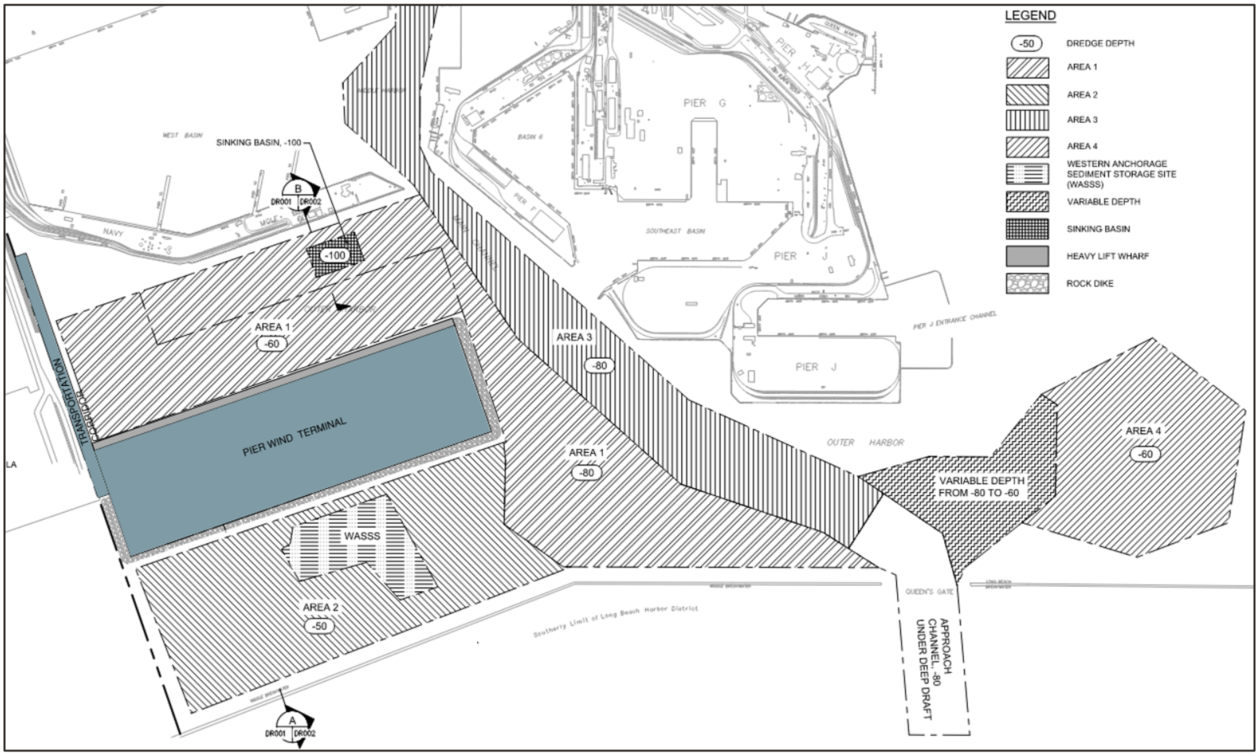

Figure 1: Dredge Depths Surrounding Pier Wind Terminal

The perimeter rock revetment around the terminal will be a multi-lift dike. On the south and east side, the dikes will have a 6 feet layer of armor rock on the outer face. For the dike on the north side and transportation corridor there will be a 3 feet layer of armor rock since it not as exposed to waves. The transportation corridor will be a single lift dike, refer to the Conceptual Engineering Drawings. The approximate quantities of rock required to construct the revetments is estimated to be 8,900,000 CY of quarry run rock (12” minus) and 590,000 CY of armor stone; together this is equivalent to approximately 14,235,000 tons. To meet the high project demand, rock will be sourced from domestic and international rock suppliers. The core of the rock revetment will be constructed of quarry run with an upper range diameter of approximately 4 to 12 inch minus minimum gradation. Armor stone of larger gradation than the quarry run will be placed over the quarry run to protect the placed rock slope. Filter fabric to further stabilize the revetment structure will be required in the tidally influenced areas, refer to the Conceptual Engineering Drawings. Two interim dikes are proposed, one at the 100-acres and another at the 200-acre limit to bisect the total footprint of the project into two 200-acre phases. The interim dike will be a single lift dike with a lower crest elevation.

Facilitation of dredge material placement within the rock dike will require that rock be placed to a minimum height to allow bottom dump hopper barges to transit within the boundaries of the revetment structure. The multi-lift dike will require sandier layers to backfill and stabilize the rock lift prior to the installation of the subsequent lift. The schedule assumes dredge material placement will commence before the rock dike is out of the water.

2.2. Dredging of Sediment

Dredging of the navigation channels, berths, sinking basin, and rock dike footprint will be conducted to support development of the terminal. Dredged materials will be placed within the rock revetment to build the terminal to design elevations. To meet the fill volume needs, additional areas will be dredged (see Section 3 Sediment Budget). Material may be dredged and placed by hydraulic and/or mechanical methods.

Hydraulic dredging using a Cutter Suction Dredge (CSD) is a highly efficient method of removing material using a revolving cutterhead to till material that is suctioned through the intake behind the cutterhead powered by a centrifugal pump and transported via submerged or floating pipeline to the disposal location. The cutterhead is positioned at the end of a ladder that is limited in its reach, even including a ladder extension. Due to the limited depths a CSD is able to achieve, alternative dredging methods may be required at depths greater than approximately El. -80 ft MLLW. Dredging production at depths greater than El. -70 ft MLLW decreases due to the reduced suction capacity experienced when the cutterhead does not make direct contact with the dredge surface. Beyond this depth, clamshell dredges may be necessary to achieve required depth.

Disposal associated with hydraulic dredging relies on maintaining material in a suspension through the CSD pipeline between the removal and deposition points with approximately 15% dredged material and 85% water. Material removed through hydraulic dredging may be placed through the open end of the pipeline or through a pipeline connected to a spill barge while allowed by floatation depth, which diffuses the material and water slurry over a wider placement area. Hydraulically placed material can be pumped to any of the proposed elevations, including surcharge.

A second form of hydraulic dredging uses a Trailing Suction Hopper Dredge (TSHD). TSHD uses centrifugal pumps to draw material through a draghead positioned at the end of a drag arm, which may be raised or lowered depending on the depth of material to be removed. As a TSHD moves forward, suction dragheads are pulled across the dredge surface, utilizing the jetting of water to agitate material that is drawn through the draghead, the pipeline of the drag arm, and is deposited in the hopper. Unlike clamshell dredging, TSHD operations do not cut into the dredge material but instead rely on water jets and suction to loosen material and create a slurry that is transported via pipeline into the hopper. The ability to manage the position of the drag arms and the depth of the draghead lends TSHD dredging to the efficient removal of loose sand, clay, or gravels distributed over large areas at depths up to -80 feet. Beyond this depth, clamshell dredging may be required to remove material to the required grade.

Environmental considerations associated with hopper dredging includes the possibility of a plume resulting from the discharge of water from the hopper. The material and water slurry deposited in the hopper is dewatered in place as sediment settles into the bottom of the hopper and water is transported through weirs to or butterfly valves and discharged beneath the dredge. TSHD removal of material that includes a significant percentage of fines may result in the creation of a dredge plume due to fine particulates remaining in suspension and being transported with water out of the hopper and back into the dredge area

Mechanical dredging uses a clamshell bucket or an excavator to remove material and either place the dredged sediments in a bottom dump hopper barge or side cast into the placement site. Clamshell dredging utilizes cables to raise and lower the bucket through the water column, allowing clamshell dredges to reach greater depths than a hydraulic dredge may be able to achieve. Clamshell buckets may be use-specific, such as an environmental cable arm bucket used to remove contaminated sediments while minimizing risk of contaminant migration or deposition of residuals. Material removed by mechanical means is typically transported via hopper barges to the placement site where material may be bottom dumped by opening a split-hull barge. Mechanical backhoe dredging with a barge mounted excavator may be most effective in relatively shallow waters and are best suited to moderately consolidated to hard-packed materials. Backhoe dredging utilizes the same bottom dump hopper barges to transport material to the placement site or may side cast material as needed.

Mechanical placement with a bottom dump barge is generally limited to unloading material in areas with at least El. -12 ft MLLW navigation clearance. Placement of material by pushing it from a barge into the water with a dozer is also limited by barge clearance access. Once the revetement is shallower than El. -10 ft MLLW, material must be rehandled over the dike or hydraulically placed.

This project assumes all material placed shallower than El. -12 ft MLLW will be done with hydraulic placement methods. Production rates associated with hydraulically dredged material assumes 25,000 CY per day per rig. Production rates associated with mechanically dredged material assumes 4,500 CY per day per rig. Production rates associated with mechanically dredged material assumes 4,500 CY per day per rig. Therefore, the most cost effective and quickest schedule maximizes hydraulic placement methods.

2.3. Filling of Sediment

As discussed above, each dredging method is capable of placing material in the project fill area. Larger terminals in the San Pedro Bay area are built from dredged sediments from the region, either from associated navigation deepening needed for the terminal or from nearby borrow sites. The largest terminals (e.g., Pier 400) are built from hydraulically placed sediments because it is the most efficient method for transporting large quantities of material over varying distances as quickly as possible. Historically these sediments are placed prior to the rock dike extending out of the water. During hydraulic placement, water mobilizes the sediments for transport; and therefore, promotes the suspension of fines (clays and silts). The fine materials stay in suspension for prolonged periods of time which allow for migration from the placement area. This maximizes the sand content in the fill and provides optimal structural stability. However, water quality regulations have changed and restrict the loss of fines (i.e., sediment plumes) from construction sites. Therefore, this project will need to consider all in-water construction methods and the potential for environmental impacts to support advancement of the conceptual level design assumptions.

2.3.1. Placement Method Assumptions

For mechanically dredged material, it is expected that barges or scows maneuvered by tugboats will transport the dredged material to the fill site. Barges would deposit the dredged material behind the containment dike inside the rock revetment. Material may be placed by bottom dump scow to an elevation of approximately El. -12.0 ft MLLW in accessible areas. Accessibility will be dependent on existing bathymetry and ability to safely transit across the rock revetment bounding the fill as well as site geometry, existing structures, and ship traffic. When the fill site reaches an elevation of approximately El. -10 feet MLLW, it will be infeasible for bottom-dump barges to enter the fill area. From this point forward, hydraulic dredging or rehandling of dredged material will be necessary. For rehandling, it is assumed that the dredged material will be lifted over the dike and into the fill by a clamshell bucket, hydraulic offloader, material conveyor, or similar methodology at the contractor’s discretion.

For hydraulically dredged material, it is expected the material will be pumped into the area at depth. Diffusers and physical barriers (e.g., rock revetment, silt curtains) may be used to limit the movement of fine materials that become entrained in the currents.

TSHDs are typically self-propelled and capable of both mechanical and hydraulic placement of material. When mechanically placing material, a TSDH will utilize its split hull design to bottom dump material in a single location. For mechanical placement, the increased draft of the TSHD as compared to a bottom dump hopper barge will require rock dikes or other fully submerged features to be built elevations lower than EL -10 ft MLLW to allow the TSHD the required clearance to safely transit into the placement area. Alternatively, material from a TSHD may be placed by rainbowing material into a placement area for wide dispersion of sediment or through a pipeline. Rainbowing or pumping of material from the hopper will allow material to be placed at any elevation within the fill profile.

During filling operations, the water quality outside of the construction area will be monitored and compared to specified criteria within the permits. See Section 5 for discussion on anticipated water quality requirements.

2.3.2. Engineering Criteria for Fill

Existing grade will be raised by as much as 60 feet in much of the submerged areas surrounding the terminal. Due to dewatering schedules and long-term settlement requirements, the fill and surcharge must also meet overall engineering and construction requirements. Primarily, all material with less than 50% sand must be placed below elevation -10 ft MLLW. All material above -10 ft MLLW, including surcharge, must have the highest sand content available.

This requirement is built on the following facts:

- Newly placed fine-grained materials within a fill area will go through significant settlement after placement due to consolidation. This pore pressure dissipation process would typically take a long time (several years to decades) due to low permeability of fine-grained materials. Wick drains and surcharge loading are introduced to accelerate pore pressure dissipation and bring down the settlement to acceptable limits for future development.
- To install wick drains a stable firm ground surface will be required since wick drain rigs are heavy. Accumulation of fine-grained materials near the new surface will create a soft, difficult, and unsafe working surface for wick drain installation. When fine-grained materials accumulate near the soil surface, significant earthwork is required to remove / remix / dry to prepare the surface for wick drain installation.
- Further, if future developments include installation of equipment that are sensitive to settlement, it will need to be removed and replaced with granular soils in that area to support the equipment.

In addition, higher quality fill materials (i.e., sands) are needed adjacent to and to support subsequent rock dike lifts. Without high quality fill materials, wider and larger dike structures may be required which can increase cost and extend the schedule.

2.3.3. Environmental Quality for Fill

The material to be used as fill must meet minimum chemical criteria. Clean and contaminated sediments from regional harbor maintenance and capital improvement projects are, in general, chemically acceptable for port fill. Heavily contaminated sediment would require further review to confirm the fill will be designed in a manner to provide long-term containment. Specific areas of the fill with specified placement methods may accommodate more contaminated materials. See Section 4.2 for further discussion on the management of contaminated sediments.

In general, the USEPA will not allow terrestrial generated materials to be placed in the marine environment for prolonged periods of time. Therefore, it is assumed all material will be marine sourced.

The Port has adopted a practice of demonstrating open water suitability for maintenance dredging of material that is hydraulically placed (native is assumed to be free of contaminants). It allows the Port to demonstrate that any fine material lost from the fill during filling operations is not anticipated to result in any impacts to aquatic life, both in the water column and on the seafloor. Since the baseline assumption is to place as much material using hydraulic dredging methods, it is expected the Port will require open water suitability testing. It should be noted that native material (material that is at depths below previously dredged horizons) is assumed to be free of contaminants, therefore standard testing procedures for port fills is supported.

2.4. Placement and Removal of Surcharge

Passive dewatering through settlement would take decades, therefore surcharge is used to weigh down the sediment and essentially squeeze the water out using wick drains. Surcharge is used to compress the fill site (with weight) to dewater the fill. The surcharge will be placed 20 ft above the final design elevation, El. +16’ MLLW on the north side and El. +18’ MLLW on the south side. For this program it is assumed the surcharge material will be placed hydraulically. After the dewatering period is over the material will be removed. The design assumes 100 acres will be surcharged at a given time. After the first 100 acre dewatering time is complete, the surcharge is “rolled” to the next 100 acres. The volume of material to complete the first 200 acres is 4,700,000 CY. This quantity is too large to feasibly import and offload by truck. We have assumed some surcharge materials (approximately 100,000 CY) will be imported by truck to create the containment bunds. Once the bunds are in place the remainder of the surcharge will be hydraulically placed dredge material. Once dewatering is complete, it is assumed the surcharge would be managed at an approved open water sediment placement site as directed in the permit (e.g., WASSS, beach nourishment, open water disposal site). Therefore, the surcharge must be tested and approved for open water placement prior to dredging.

It should be noted that the highest sand content (>80% sands) is preferred for fill if available because it will be the most efficiently placed out of water and it will facilitate dewatering schedules. See discussion in Section 2.3.2.

2.5. Pile Driving for Wharf Construction

Construction of the new wharf will include installation of concrete or steel piles. These piles and other wharf support elements will be installed through the previously placed quarry-run rock dikes and armour stone. Pile driving is an in-water construction activity that will require jetting to facilitate driving and be evaluated for environmental impacts related to water quality and noise. Mitigation measures will be included in the 404/401 permits.

3. Sediment Budget

Sediment will be used as fill and temporary surcharge for the new terminal and transportation corridor. For this program it is assumed that approximately 42,000,000 CY of material is needed for fill and 4,700,000 CY of surcharge, for an estimated total of 48,000,000[1] CY.

3.1. Project Generated Material

The project is planned to generate an estimated 49,500,000 CY from planning discussions with Port staff. The volumes associated with various dredged material source areas are summarized in Table 1 and shown in Figure 2, and detailed below.

- **Rock revetment keys:** Both the perimeter rock revetment and the transportation corridor rock revetment require dredging to remove soft/unconsolidated materials beneath rock. This will secure the rock dike and armor stone and mitigate risk of settlement and long-term slope failure from seismic activity. Material will be mechanically dredged and rehandled into interior of the proposed fill site.
- **Area 1**: This area will be El. -80’ MLLW to provide deep draft access to sinking basin and wet storage areas. In the berth pocket adjacent to the wharf, depths will be El. -60 ft MLLW.
- **Area 2**: The Outer Harbor area south of the terminal will be deepened to El. -50 ft MLLW.
- **Sinking Basin**: An El. -100 ft MLLW area will be created to provide a sinking basin to support float-off activities for turbine foundations.
- **Area 3:** The main channel will be further deepened to El. -80 ft MLLW. This program assumes the Deep Draft Navigation Project (DDNP) has been completed and this effort will lower the authorized main channel an additional 4 ft, refer to the main body of the Concept Report for details on the DDNP.
- **Area 4:** To offset the loss of anchorage areas within the Long Beach Outer Harbor, an anchorage area within the Eastern San Pedro Bay will be deepened to El. -60 ft MLLW.
- **Area 3 transition to Area 4:** An access channel will connect the Main Channel to the new El. -60 ft MLLW anchorage area in Eastern San Pedro Bay.
- **Western Anchorage Sediment Storage Site (WASSS) expansion:** This site is designated for permanent and temporary storage of sediment. It is assumed the site will be excavated to accommodate the temporary storage of the surcharge material between project phases, if needed. After the second phase, surcharge will be placed for long-term storage within the WASSS.

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[1] A dredge cut to fill conversion factor of 1.15 has been applied to the total quantity needed. In other words, 15% more volume of dredged material is needed to meet the compacted fill volume. In addition, these quantities include allowance for settlement during placement.

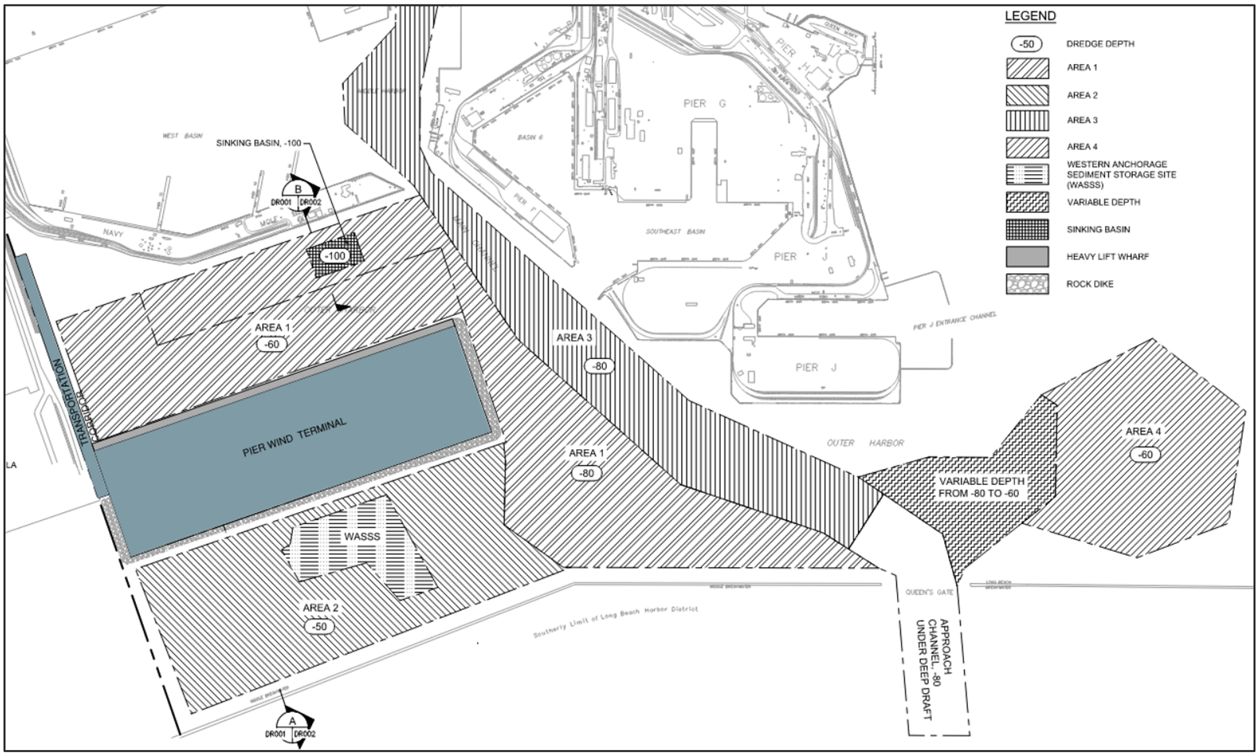

Figure 2: Dredge Material Sources for Pier Wind

Table 1. Anticipated Dredging Program to Support Pier Wind Development

Area	Volume including 1 ft Over Dredge (CY)
Rock revetment keys	5,000,000
Area 1 - Cut to -80 ft MLLW	16,420,000
Area 1 - Cut to -60 ft MLLW	9,161,000
Sinking Basin - Cut to -100 ft MLLW	600,000
Area 2 - Cut to -50 ft MLLW	2,541,000
Area 3 - Cut to -80 ft MLLW	**2,810,000**
Area 4 - Cut to -60 ft MLLW	4,355,000
Area 3 transition to Area 4	3,860,000
WASSS expansion	4,750,000
Total	**49,497,000**

3.2. Other Materials to be Considered in the Fill

While this project is anticipated to generate sufficient quantity for the fill, there are other programs that are expected to be accommodated within the terminal fill, as detailed below. The volumes anticipated for each element is summarized and in Table 2.

Port maintenance program: Navigation maintenance dredging projects are continuously planned and implemented as standard port operations and maintenance practices.

Port sediment quality improvement programs: The Port sediment clean-up / remediation programs are anticipated to be constructed during the development of the terminal to take advantage of port fill for the management of sediments not suitable for open ocean disposal. A placeholder of 300,000 CY has been included in Table 2.

The Deep Draft Navigation Project (DDNP): The Deep Draft Navigation Project (DDNP) will generate approximately 7,000,000 CY of sediment will be dredged to expand and deepen the federal navigation channels. There are potential beneficial reuse opportunities for the DDNP material within the Port of Long Beach. All, or a portion of, the DDNP material could be beneficially reused as part of the Pier Wind fill depending on the timing and if there are any other development projects that require landfill. A placeholder of 3,500,000 CY has been included in Table 2.

Regional contaminated sediment: The sediment management approach should consider requests from other agencies to accommodate regional contaminated sediments. A placeholder of 1,000,000 CY has been included in Table 2. It is expected the material will be composed of contaminated fine materials.

Table 2. Other Sediment Management Needs to be Considered in Terminal Fill

Area	Volume including 1 ft OD (CY)
Port maintenance programs	500,000
Port sediment quality improvement programs	300,000
Deep Draft Navigation Program	3,500,000
Regional contaminated sediment	1,000,000
Total	**5,300,000**

3.3. Borrow Sites

Over 2,000,000 CY of sand is needed to support the multi-lift dike design (1,000,000 CY for each phase). In addition, 4,700,000 CY of sand is needed as surcharge to support the dewatering schedule. The needed surcharge quantity may double if the first phase of surcharge is used as fill for the second phase. Therefore, up to 12,000,000 CY of high-quality sand may be needed to optimally build the terminal.

Based on recent investigations, sand is limited within the port complex. The sinking basin and the WASSS expansion may generate some sand, but it will not be enough. Therefore, this program should consider dredging at approved borrow sites to provide clean, geotechnically suitable fill material for specific areas of the fill.

3.4. Budget Summary

For early planning, it should be assumed between 7,000,000 and 12,000,000 CY of sand from a sand borrow site will be required to optimize schedule of the program. Early geotechnical investigations may locate some sand within Area 1. To this, 54,000,000 CY of material has been identified as potential source material for the fill (Tables 1 and 2) that has a capacity of 48,000,000. This is a potential overage of 9,000,000 to 14,000,000 CY more fill than required. This balance will be further adjusted throughout the project to reduce the potential overage.

Planned dredging programs:	*54,000,000 CY*
Sand from borrow area:	*+7,000,000 to 12,000,000 CY*
	61,000,000 to 66,000,000 CY
Fill site capacity:	*48,000,000 CY*
WASSS capacity:	*+ 4,000,000 CY*
	52,000,000 CY
Potential overage of fill quantity:	***9,000,000 to 14,000,000 CY***

4. Sediment Management Planning

A conceptual sediment management plan has been developed to describe the logistical and technical considerations associated with maintaining water quality during the placement of materials in the Pier Wind terminal fill site. The Pier Wind project will be designed in a manner that minimizes the potential for significant impacts related to water quality.

4.1. Early Construction Activities

The fill will be bounded by the rock dike that is submerged at early stages of the fill. Existing grade will be raised by as much as 60 feet in the submerged areas. Soft/unconsolidated sediments must be removed from the dike foundation. These sediments will be mechanically dredged and placed interior to the rock dike location. The sediments will be placed at a distance from the perimeter dike that prevents migration outside of the fill area prior to rock placement. Other materials may be mechanically placed within the area as long as it can be demonstrated the material will not migrate from the fill area. Weekly/daily hydrographic surveys may be used to monitor placed material. Limitations on sediment chemical quality may be recommended if material is anticipated to stay exposed to the marine environment for long periods of time. Hydraulic dredging placement will begin once the rock achieves a specified height, which for the purpose of the concept design is assumed to be -12 ft EL but will be refined during preliminary design and discussion with regulatory agencies.

4.2. Mechanically Placed Dredged Material

As previously discussed, mechanical placement of material with the use of a bottom dump scow can continue until the rock dike achieves an elevation of EL. -12 ft MLLW due to vessel clearance limits.

If sediments planned for placement in the fill that have been characterized as contaminated by PCBs, PAHs, metals, or other contaminants of potential concern (COPCs), it is recommended for placement at lower elevations within the fill profile as a means of containing contaminated material. If prolonged exposure of these contaminated materials to marine life is anticipated, the placement of clean material over these potentially contaminated sediments would function as a cap to contain and minimize the exposure of COPCs.

4.3. Hydraulically Placed Dredged Material

The concept design and schedule assumes the fill will be predominately constructed through hydraulically placed material. It is anticipated sediments will be mobilized in currents and dispersed to areas outside of the fill during placement operations. The Port will consider the sediment quality as part of the evaluation of materials recommended for hydraulic placement. For example, if material is native or has been found suitable for open water placement, then any losses during filling operations will not result in unacceptable aquatic life impacts in the area the sediments settle. A discussion of proposed water quality measures to plan for and manage turbidity is discussed in Section 5.

It is anticipated that a specified height difference between the perimeter rock dike elevation and the fill elevation is observed during hydraulic placement. In addition, some rehandling of material from sediment traps or other containment devises may be necessary.

4.4. Surcharge Management Alternatives

After surcharge is used, it will need to be managed. The most efficient management would be to transfer to bottom dump barge for placement at designated area in-water receiver area. This would require that the material be marine in origin (i.e., no soil or aggregate) and has already been demonstrated to be suitable for open water placement or placement within an approved confined aquatic disposal location.

4.5. Western Anchorage Sediment Storage Site

The baseline assumptions is to manage the surcharge in the south lobe of the WASSS because it has already been designated for this purpose. Currently, there is 1,000,000 CY of stockpiled clean material that is planned for placement in the fill. This project assumes an additional 3,750,000 CY of material will be dredged to create a sediment trap to manage fines during filling operations. The south lobe is adjacent to the containment dike and located in an area that may be optimal for placement of a weir during final filling stages. The sediments captured within the sediment trap can be rehandled over the dike into the fill. In addition, the WASSS dredge design will create capacity for the estimated 4,000,000 CY of surcharge requiring management at the end of the project as well as an additional capacity to manage 1,000,000 CY of future sediment management needs under the yet to be approved Outer Harbor Sediment Placement and Ecosystem Restoration (OHSPER) site designation.

4.6. Alternative Surcharge Management Areas

As discussed in Section 3, there is already a surplus of material available for the fill. While dredging at the WASSS south lobe will meet multiple objectives, the surcharge could also be managed in other areas. Consideration of these alternatives may create flexibility in the permitting process.

4.6.1. Shallow Water Habitat

Shallow water habitat (SWH) may be created by placing clean or contaminated dredged sediments behind a subaqueous dike at depths that support essential fish habitat (e.g., eelgrass [Zostera marina] at EL. -10 to El. -15 feet [-3 to -4.5 meters] MLLW). If contaminated sediments are used, it would be capped with clean material (i.e., surcharge). Due to the significant loss of SWHs in bays, harbors, and estuaries in the region and the need for mitigation due to habitat loss, SWH creation is a preferred beneficial reuse alternative in southern California.

4.6.2. Placement at the Beach or Nearshore

If developed as currently assumed, the surcharge material should be greater than 80% sand and therefore consider a resource for beach or nearshore beach replenishment areas near Seal Beach. Currently, the City of Long Beach could use up to 2,000,000 CY of sand for beach restoration at Belmont Shores Peninsula.

4.6.3. Return to Borrow Site

The planning process could include considerations for returning the sand to the borrow site to be used for long-term beach replenishment programs.

4.6.4. Ocean Disposal

Ocean disposal should only be considered when all other available alternatives have been considered and determined to be unavailable or not suitable. The Port is currently authorized to use the permanently designated LA-2, offshore of San Pedro. The LA-2 Ocean Dredged Material Disposal Site (ODMDS) may receive up to 1 million CY of dredged material annually. Approval for ocean disposal is dependent on material meeting suitability requirements as outlined in the USEPA and USACE's guidance document, Evaluation of Dredged Material Proposed for Ocean Disposal: Testing Manual (1991), and the discretion of the USEPA and CSTF. To manage the surcharge would take up to 4 years and limit the placement of other dredging programs.

4.7. Regional Contaminated Sediment Management in Port Fill

It is anticipated the Port will be asked to accommodate contaminated sediments from outside the Port because it is impractical for the material to be managed in the upland environment. The Port may open this opportunity to others if it can be used to support overall net benefits of project and offset unavoidable impacts. To do this will require the material meet specified qualifications, similar to Middle Harbor Fill requirements for third parties. In addition, the inclusion of 3rd party materials must be done in a manner that does not conflict with Pier Wind construction schedule.

To avoid potential schedule and construction conflicts, the Port may consider allowing the regional contaminated materials to be placed in the soon to be authorized north lobe of the OHSPER site. This site will be within the footprint of the Pier Wind terminal which would provide long-term containment. These materials can be placed prior to the Pier Wind construction.

5. Water Quality Management

A terminal of this scale has not been built since 2000 in Los Angeles County. Since then the water and sediment quality regulations have changed requiring new approaches to building a terminal and sustaining it. Water quality regulations related to marine construction are included in the construction permits (401/404). These permits now include consultation with all resource agencies (USF&W, NOAA, CCC) that examine a broader range of marine resources than were evaluated in historical terminal developments. Also, the Regional Water Quality Control Board (RWQCB) has included more robust water quality standards than previously implemented. These standards are reviewed through a water quality monitoring compliance program.

Based on the most recent understanding of how these agencies support construction programs, we anticipate water quality measures for turbidity to be the most impactful to assumed construction schedule and costs. The greatest levels of turbidity will be generated during terminal filling operations of hydraulically dredged material.

5.1. Environmental Considerations for Dredged Material Placement Activities

Placement of dredged material is not expected to result in any long-term impacts to water quality after the operations have ceased. Short-term impacts to water quality could occur via temporary increases in turbidity during dredging, but turbidity would be expected to dissipate rapidly once placement activities are stopped. The temporary resuspension of sediments would occur during the filling activities, which are anticipated to last several years.

Most of the material planned for placement in the fill will be native sediments[2] from the region. The chemical nature of these native dredged materials and resulting water column chemistry is not anticipated to be a concern. The primary concern will involve impacts related to the sediment plumes, specifically, increased total suspended solids (TSS) in the water column. Based on our understanding, the 401 permit will limit elevated turbidity (TSS) to 300 feet from discharge weir or from edge of construction boundary. The suspended solids are mobilized in currents, creating a plume that can transport sediments to areas outside of construction boundary and bury marine life. Elevated TSS will temporarily reduce light transmittance which affects animal behavior and limits photosynthesis.

In anticipation of these permit limitations, the following measures may be proposed during early environmental planning and design stages:

- Propose the use of all available BMPs in a manner that limits elevated TSS to the greatest extent within project schedule. Available BMPs are described in Section 5.2.
- Recognize the overall environmental benefits of the project compared to the relatively short impact related to turbidity plumes (e.g., critical to State's sustainable energy production goals, accommodating regional contaminated material early in the fill).
- Conduct hydrologic modeling to demonstrate the following:
    - Describe the anticipated physical and chemical features of the sediment plumes;
    - Extent of deposition of sediments outside of fill area and/or construction boundary; and,
    - Effectiveness of available BMPs

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[2] Native sediments are sediment below which previous dredging has ever occurred.

- Quantify and qualify the real potential impacts associated with elevated TSS in the project area. Establish project specific TSS or transmissivity standard that is relevant to the protection of marine resources within the Outer Harbor waterbody.
- Expand the construction boundary to cover the area with the greatest impacts from TSS.
- Phase the dredging components to address areas with excessive deposition at the end of the project; essentially creating a project clean up phase that addresses any area where long-term impacts may be observed.
- Illustrate that deposited sediment generated from plumes are cleaner than current surface; creating a natural capping process as a benefit of the suspended and dispersed sediments.
- Demonstrate all hydraulically placed material meet open ocean disposal requirements; therefore, will not be spreading contaminated sediments over large areas.
- Implement a project-specific water quality monitoring plan to illustrate attainment of previously approved project-specific standards.
- Develop out of kind or offsite mitigation to address the elevated TSS during filling operations. This may include accommodating regional contaminated material early in the fill.
- Develop sediment trap or depositional area in the permit that allows for higher sediment deposits.
- Require that all highly contaminated materials be mechanically placed.

5.2. Best Management Practices for In-Water Construction

A mixture of all available BMPs will be implemented by the contractor at various stages of the construction to best manage TSS and still meet the project schedule. Available best management practices (BMPs) that can limit TSS and transport of TSS outside of construction zone include:

- Silt curtains that limit movement of fines through water column.
- Bottom dump limits fines by limiting water entrained during placement.
- Slow production/placement rates (both hydraulic and bottom dump).
- Using physical site features to help capture or limit fine movement.
- Building certain containment dikes to different elevations that encourage TSS trapping.
- Build sediment traps to capture and manage suspended sediments as they settle.
- Place pipe low in the water column.
- Use diffusers at the end of hydraulic pipe to reduce water flow.

A general summary of BMPs to be evaluated for inclusion may include the following:

- A Water Quality Monitoring Plan (approved by the RWQCB) will be implemented by the Port during dredging. This plan will describe methods and documentation for the monitoring of turbidity, pH, and DO during dredging.
- Any other non-dredged material used for fill, such as CMB, must be placed above the groundwater elevation.

- Contaminated material must be mechanically dredged and bottom-dumped.
- The use of silt curtains during in-water construction activities, when needed and when feasible, based on specific dredging areas and ongoing construction of walls and the rock dike that will control potential turbidity plume movement.
- Use of debris curtains during wharf construction activities to isolate the active construction area from the surrounding waters.
- A study can be conducted to demonstrate turbidity values that are protective of marine resources and serve as a project specific turbidity action level.
- To control turbidity to the maximum extent practical during hydraulic placement, the following BMPs may be recommended.
    - Diffuser pipes. A diffuser can be used to slow the rate of discharge, thereby reducing sediment resuspension in the fill and increasing the settling rates, which will assist in controlling the loss of fines from the fill site.
    - Adjustable pump rates. In some instances, adjusting the pump rate may be required to control the loss of fines from the fill site.
    - Adjust flow rate. Placing material at a slower rate will reduce the amount of sediment being discharged and increase the retention time in the settling basin.
    - Adjust solids concentration at point of discharge. In a settling basin, higher solids concentration may result in higher settling rates and less suspended sediment at the effluent discharge.
    - Move discharge point to maximize retention time. Moving the discharge point to a place in the settling basin that will increase retention time will allow more suspended sediment to settle.
    - Closely monitor and adjust weir level. The weir level should be adjusted as the settling basin is filled to maximize the settlement of fine material and minimize the amount of sediment that escapes in the return water.
    - Silt curtain. A silt curtain could be deployed around the discharge area, creating a physical barrier that contains the suspended sediments and allows them to settle out.
    - Gunderboom. A gunderboom is similar to silt curtain; however, it is made of a permeable material. It filters out the sediment and allows the water to pass through. It also extends all the way from the water surface to the sediment while the silt curtain only extends partially down the water column.
    - Controlling turbidity with the use of a weir when the dike is completed.
    - Install an overflow weir. Include a weir system designed to maximize the settlement of fine material into the fill and minimize the amount of sediment that escapes in the return water where possible. The specific design of the weir will vary with the fill geometry and fill height.
    - Sediment trap. Dig a hole to capture material that has escaped the weir. Sediment trap should be located downstream of the weir. The trap can be mechanically dredged as needed to maintain function as long as weir is discharging.

6. Next Steps

The primary effort needed in the next phase of planning for Pier Wind include the following actions:

1. Identify sediment source for high quality sands to support specific engineering and geotechnical requirements to facilitate dewatering and support rock lifts.
2. Characterize the ecologically meaningful impact related to elevated TSS in the Outer Harbor to allow for hydraulic filling operations to be used to the greatest extent possible.
3. Balance the sediment budget for the fill to meet all project goals.
4. Confirm fill phases and schedule.
5. Evaluate the potential to accommodate regional contaminated materials prior to construction of Pier Wind within WASSS north lobe.
6. Design sediment borrow area for WASSS south lobe to confirm it has the borrowing capacity proposed within this fill plan.

Attachment F: Geotechnical Engineering Memorandum

Earth Mechanics, Inc.
Geotechnical & Earthquake Engineering

DATE: April 20, 2023 **EMI PROJECT NO:** 22-162

TO: Matt Trowbridge, P.E., S.E. / Moffatt & Nichol (M&N)
Jennifer Lim, P.E. / M&N

FROM: Raj Varatharaj, P.E., G.E. / Earth Mechanics, Inc. (EMI)
Arul Arulmoli, P.E., G.E. / EMI

SUBJECT: ***Preliminary Geotechnical Input to Pier Wind Terminal Conceptual Study***
Port of Long Beach (POLB), Long Beach, California

This memorandum summarizes the preliminary geotechnical input to the POLB Pier Wind Terminal Conceptual Study. The work was performed by EMI to support the conceptual study performed by Moffatt & Nichol.

Available Subsurface Data

Very limited subsurface information is available in the vicinity of the proposed Pier Wind site. The depths of the available boring are also limited.

Subsurface Conditions

Based on the limited available soil borings information at and around the Pier Wind Terminal site, soft fine-grained soils with varying thickness of 5 to 25 ft exist below the harbor bottom. Below this layer, silty sand soils with varying thickness of interbedded silt and clay layers are found down to the deepest available soil boring with the site around at El. -100 ft.

Subsurface conditions at the proposed bridge site were evaluated using information gathered from past geotechnical investigations in the vicinity. The native material at the channel bottom contains varying thickness of clay and silt. Below this, a very stiff layer of sandy silt and clayey silt overly very dense sand down to the deepest boring termination elevation of El. -126 feet.

Design Response Spectra Recommendations

POLB Wharf Design Criteria (WDC), version 5.0 (POLB, 2021) recommends that a new wharf should be designed for three level earthquakes: Operating Level Earthquake (OLE) with a 50% probability of exceedance in 50 years (72 years return period), Contingency Level Earthquake (CLE) with a 10% probability of exceedance in 50 years (475 years return period), and the Code-Level Design Earthquake (DE). Port-wide site-specific response spectra for OLE, CLE, and DE for the entire POLB have been developed by EMI in a recent study (EMI, 2020). The summary of earthquake design parameters is provided in Table 1.

TABLE 1: SUMMARY OF DESIGN EARTHQUAKE PARAMETERS

Earthquake Event	Probability of Exceedance in 50 Yrs (Return Period)	Peak Ground Acceleration (PGA) (Geotechnical)	Earthquake Magnitude	Earthquake Event
OLE	50% (72 yrs)	0.20g	6.5	OLE
CLE	10% (475 yrs)	0.48g	7.3	CLE
3rd Level (DE) per CBC	N/A	0.59g	7.3	3rd Level (DE) per CBC

Liquefaction Potential

Fill materials are proposed to be placed above existing mudline to El. +13 ft MLLW (above water table). Fill materials will be improved using wick drains and surcharge placement to mitigate long-term consolidation settlement. However, granular materials placed below water table are potentially liquefiable during OLE, CLE, and DE events.

Seismically Induced Settlement

The liquefied soils reconsolidate following the excess pore pressure dissipation after the earthquake shaking, leading to ground settlement. The extent of ground surface settlement depends on several factors such as characteristics of the soil, level and duration of shaking and extent of the liquefaction zone. The estimated seismically induced settlement values are approximate and may vary depending on several factors, such as the depth to dense/firm non-liquefiable soils, layered nature of subsurface soils, amount of fines content, and excess pore pressure dissipation pattern of fill materials. It is our judgement that fill materials placed to create the landmass may show up to 12 to 24 inches of seismically induced settlements under the OLE, CLE and DE events.

Preliminary Wharf Dike Recommendations

POLB WDC recommends that the free-field wharf dike movement during seismic event should be less than 3, 12 and 36 inches during OLE, CLE and DE events, respectively, for the 24-inch octagonal precast, prestressed concrete piles to have acceptable strains due to kinematic loading. Typical POLB container wharf dikes are constructed with a slope of 1.75H:1V on the waterside (wharf side) using quarry rock with 3-ft-thick armor stones on top. It is recommended to use similar or flatter than 1.75H:1V slope on the waterside. For this conceptual phase, full lift (or near full-lift) perimeter dikes are also proposed with a slope of 1.75H:1V or flatter. Weak fine-grained materials at the harbor bottom should be dredged prior to placing the dikes. Dikes designed following the above recommendations are expected to meet the minimum global static factor safety of 1.5 using the backland loading requirements per POLB WDC.

Existing compressible and weak, silty and clayey materials under the future dike below mudline down to dense sand layer is recommended to be dredged out before placing the quarry rock dike. Dredge cut slope of 3H:1V is recommended to ensure stability during dredge operation. For the wharf dike with future mudline El. -60 ft MLLW at the Pierhead Line, dike key down to El. -75 ft MLLW is considered appropriate for the conceptual design. For the perimeter dikes, dredging at least 10 ft of existing mudline is recommended.

In order to minimize long settlement in the backland adjacent to the wharf, sand berm consisting of sandy materials with less than 35% fines are recommended to be placed over a distance of about 100 to 150 ft immediately behind (landside of) the wharf.

Preliminary Backland Development Recommendations

Dredge materials from various sources are expected to be used as fill material to develop the Pier Wind landmass. The physical and engineering properties of the proposed fill material are not known currently. Therefore, it is difficult to estimate the settlement and required waiting period for the reclaimed land accurately. However, the very soft fine-grained harbor bottom sediments and fill materials that are anticipated to be composed of mostly fine-grained materials, are expected to show significant settlement during and after construction.

Dredge materials consisting of fine-grained materials are recommended to be placed below El.-10 ft. Above this elevation, dredge materials with more granular materials are recommended. Above El. +13 ft MLLW, compacted sandy materials are recommended to be placed.

The settlement period of dredge materials after construction is expected to be very long if no mitigation measures are taken. Based on our past experience on fill projects in San Pedro Bay and the anticipated characteristics of dredge source materials, the settlement of the fill materials and harbor bottom sediments during placement is expected to be on the order of 5 to 7 ft; settlement after fill placement is expected to be on the order of 2 ft to 3 ft. The anticipated settlement period after construction depends on the fill material characteristics and construction methods used and could extend up to 5 to 15 years without any mitigation measures.

It is our understanding that the newly reclaimed land should be ready for infrastructure construction within a short period after its creation. Therefore, mitigation measures are needed to accelerate the settlement period. Similar to other Port fill placement projects, installation of wick drains and surcharge loading are recommended to accelerate the consolidation of the fine-grained materials so that the backland can be developed within the available schedule.

Wick Drains

According to the proposed fill sequences, wick drains are expected to be installed from approximately El. +13 ft MLLW. Generally, granular fill materials are recommended to be placed between elevations El. -10 ft MLLW and +13 ft MLLW to provide the necessary horizontal drainage and a working platform for wick drain installations.

Based on the anticipated characteristics of the dredge source materials and our recent experience of fill performance at the Middle Harbor Terminal, a 3.5-ft center-to-center triangular spacing wick drains is recommended. The wick drains are recommended to be installed down to El. -75 ft into the dense sand layer below the harbor bottom sediments (or to refusal) to provide horizontal drainage at the bottom of the wick drains as well.

Surcharge

In addition to the wick drains, the fill areas will require surcharge to accelerate the consolidation settlement of the foundation and fill materials. Approximately 20 ft of surcharge above the approximate finished grade El. +18 ft MLLW for the terminal and El. +16.5 ft MLLW for the transportation corridor (i.e., approximate surcharge to El. +38 ft MLLW and El. +36.5 ft MLLW, respectively) is expected to need a waiting period of about 7 months. The toe of the surcharge is recommended to be as close as practically possible to the waterside crest of the dike and surrounding existing land. The surcharge is expected to be placed with side slopes of 1.5H:1V. With the wick drains installed at 3.5-ft center-to center triangular spacing, a minimum surcharge period of 7 months is considered adequate to reduce the long-term consolidation (static) settlement to less than 4 inches during project life of 50 years. The surcharge period should be started after surcharge has been placed to full height. If surcharge is to be placed in phases within the fill area, at least a 50-ft overlapping zone of the crest of surcharge between adjacent surcharge areas should be included.

Wharf Piles

It is our understanding that the proposed wharf for the wind terminal operation will be required to be designed for 6,000 psf uniform loading, which is significantly higher than typical container wharf loading. Therefore, several different pile types are considered in addition to the standard 24-inch octagonal precast prestressed concrete piles. The different pile types considered and their cons and pros are briefly discussed below. Preliminary pile tip elevations provided below are based on the assumption that dense to very dense sandy soils are present at the deeper elevations. Available very limited soil borings within the vicinity of the site are not deep enough. Detailed geotechnical field investigation will be required to verify the assumptions made on soil profile.

24-inch octagonal precast prestresses concrete piles: Standard wharf piles widely used at POLB. 635 kips allowable axial capacity can be achieved around tip elevation of El. -115 ft MLLW. Piles will likely require jetting during driving. Therefore, permit application should include jetting. Due to high wharf loading, piles are expected to be closely spaced compared to typical POLB wharf pile configurations. Pile misalignment up to 12 inches and occasional misalignment up to 24 inches should be anticipated.

28-inch and 30-inch precast prestressed octagonal concrete piles: These large diameter piles have never been installed at POLB or within the San Pedro harbors. However, the pile capacities would be 30 and 55% more for 28-inch and 30-inch piles respectively compared to the 24-inch octagonal concrete piles. These piles will also likely require jetting during driving. Experienced contractors input and a test pile program are recommended during the detailed design process.

24-inch and 30-inch diameter closed end steel pipe piles: 635 kips and 850 kips allowable axial capacity can be achieved around tip elevation of El. -125 ft MLLW for closed end pipe piles. Open ended steel pipe piles may need to be driven to much deeper elevation to achieve these axial capacities. Seismic performance and long-term maintenance against corrosion should be evaluated closely.

Preliminary Recommendations for Transportation Corridor Development

Containment dike will be constructed parallel to existing Port of Los Angeles (POLA) Pier 400 transportation corridor and dredge materials from various sources will be placed between the newly constructed dike and existing POLA transportation corridor dike on the east side. Wick drains will be installed, and surcharge will be placed to consolidate the newly placed fill. Preliminary triangular spacing of 3.5 ft for the wick drains and 20 ft surcharge height for a period of 6 months are recommended. Surcharge placement adjacent to the existing POLA Pier 400 transportation corridor may cause a few inches of settlement in vicinity of the surcharge. Resurfacing of the rail tracks may be required after surcharge removal.

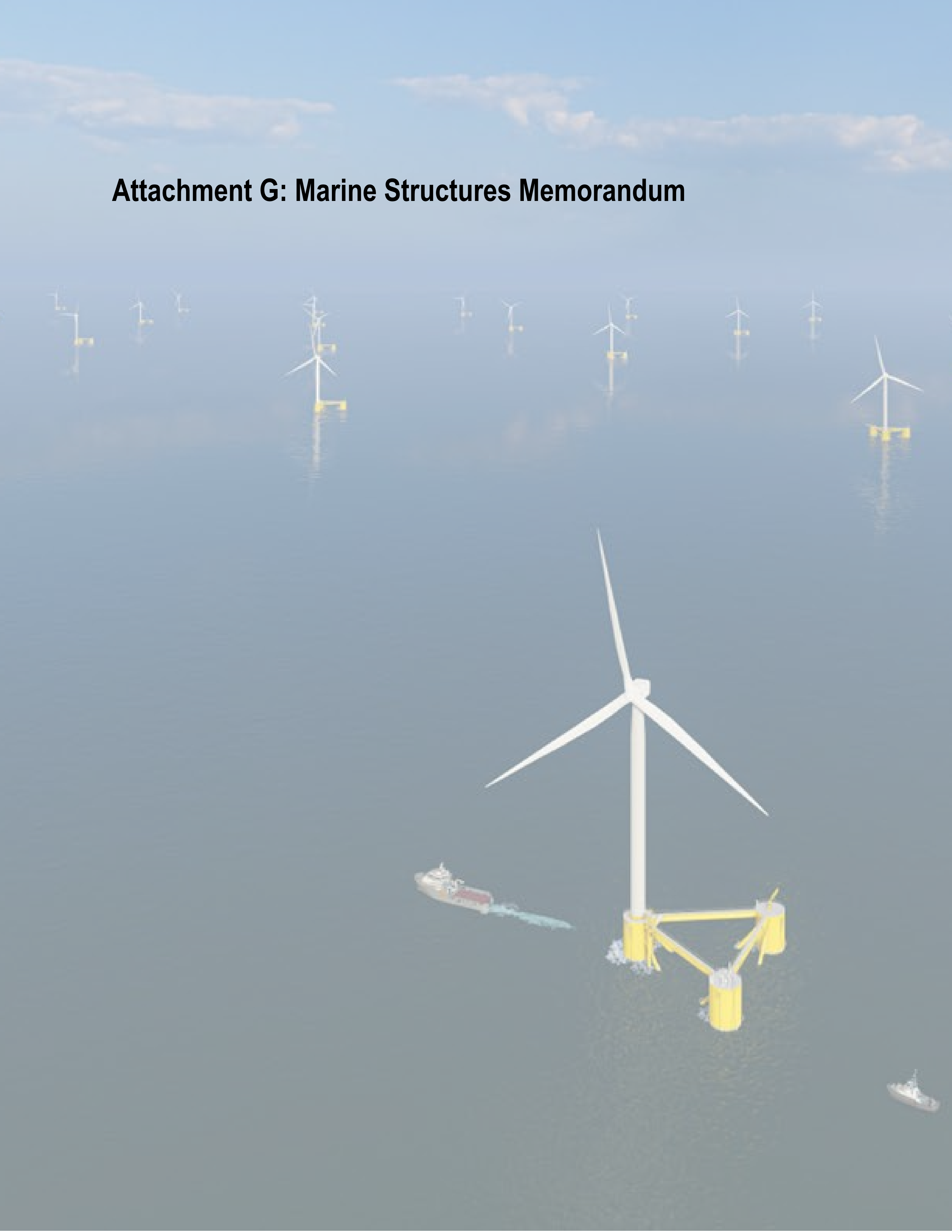
Proposed transportation corridor bridge will be supported on piles. Similar to existing bridges, 24-inch octagonal concrete piles driven to approximate El. -125 ft may be considered suitable.

REFERENCES

Earth Mechanics, Inc., (2020) "Port-Wide Ground Motion Study Update, Port of Long Beach, California," Final Report prepared for the Port of Long Beach, October 26.

Port of Long Beach., (2021) "Wharf Design Criteria, Version 5

Attachment G: Marine Structures Memorandum



moffatt & nichol

4225 E. Conant Street
Long Beach, CA 90808

(562) 590 - 6500
www.moffattnichol.com

MARINE STRUCTURES MEMORANDUM

To:	Port of Long Beach
From:	Khoa Pham (Moffatt & Nichol)
Cc:	Matt Trowbridge, Jennifer Lim (Moffatt & Nichol)
Project Name:	Pier Wind Project – Concept Phase
Date:	April 20, 2023
Subject:	Marine Structures Memorandum
M&N Job No.:	10800-24

This memorandum summarizes the design of the wharf and piers during the concept phase of the Pier Wind project.

Wharf Elevation and Geometry

The wharf deck elevation is set to **+16.5 ft MLLW**, considering the maximum elevation for vessel roll-on / roll-off (RORO) operational requirements is +18 ft MLLW. Sea level rise values are based on *State of California Sea-Level Rise Guidance (2018).* For the Long Beach area, a SLR of 4.3 feet by 2080 is recommended for this design.

Based on the selected terminal layout (refer to the Site Location and Geometry Memorandum), the wharf is located on the north side of the terminal to reduce wave exposure within the Outer Harbor. The length of the wharf is **7,500 feet long**, which covers the full length of the terminal, and the **width is 150 feet** to provide adequate space for offshore wind (OSW) operations. The wharf deck may also support ring crane operations. Depending on the configuration, the wharf may be wider at certain locations to accommodate the ring crane footprint. The particulars of the ring crane foundation will be determined in the next phase.

Wharf Deck Features

The proposed deck system is a flat deck with uniform deck thickness between piles which will simplify work required if piles are misaligned or out of tolerance after installation. A cut-off wall will likely be required on the landside edge of the wharf. A drop-down beam section may be considered on the waterside edge of the wharf deck for connection of the fender system and the bollards. The next phase of the project should evaluate whether a continuous or discrete fender system is required to provide adequate fendering for the proposed floating foundations, barges, and vessels at the site. In addition, the next phase should confirm geometrical requirements for accommodating a RORO vessel (fendering, bollard spacing, etc.).

Wharf Demand

Based on similar projects and offshore wind port requirements from the Bureau of Ocean Energy Management (BOEM) California Floating Offshore Wind Regional Ports Assessment, the distributed live load on the wharf is estimated to be 6,000 psf. This live load is not reducible. In addition, a 3 feet thick layer of dense grade aggregate (DGA) will be placed on top of the wharf deck to distribute the load from crawler cranes and other equipment. The combined wharf demand load consists of the weight of the

DGA, the weight of the wharf deck and pile, and the 6,000 psf live load. The unfactored combined distributed load on the deck is 7,150 psf.

Wharf Loading:

- Live Load = 6,000 psf (Non reducible)
- Dense grade aggregate working surface / pavement = 3 feet thick
- Wharf deck thickness = 3 feet
- Total Combined Unfactored Load = 6,890 psf

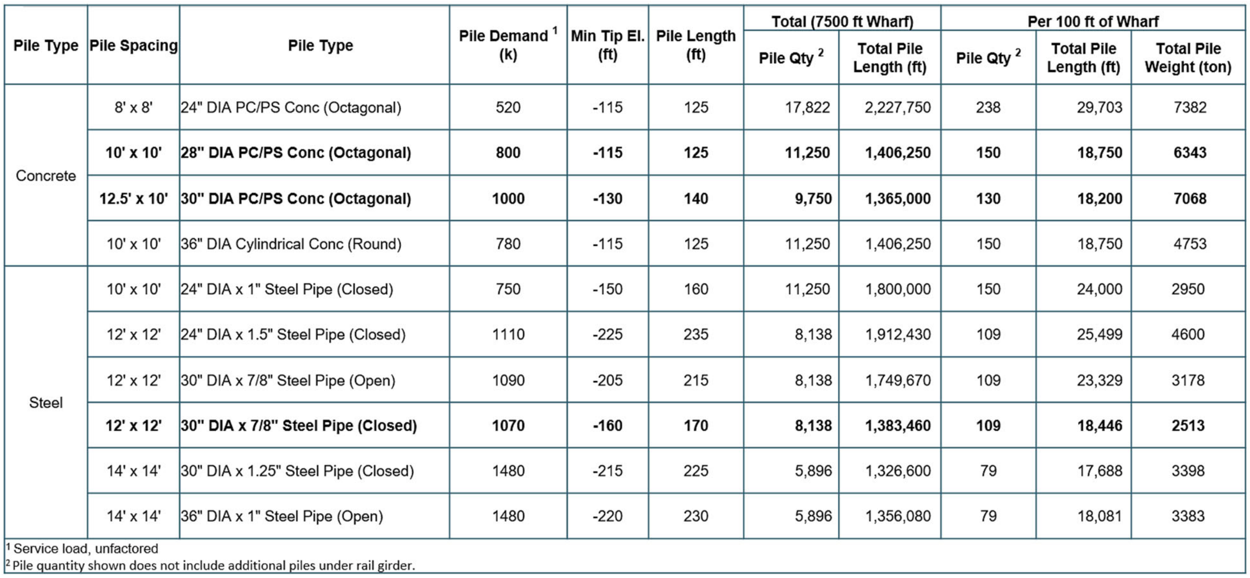
Wharf Pile Types and Pile Selection

The following pile types and sizes were considered for the wharf design:

- 24-in. Dia. Precast Prestressed Octagonal Concrete Pile
- 28-in. Dia. Precast Prestressed Octagonal Concrete Pile
- 30-in. Dia. Precast Prestressed Octagonal Concrete Pile
- 36-in. Dia. Precast Prestressed Cylindrical Concrete Pile
- 24-in. Dia. x 1-in. Steel Pipe Pile (Closed End)
- 24-in. Dia. x 1.5-in. Steel Pipe Pile (Closed End)
- 30-in. Dia. x 7/8-in. Steel Pipe Pile (Open End)
- 30-in. Dia. x 7/8-in. Steel Pipe Pile (Closed End)
- 30-in. Dia. x 1.25-in. Steel Pipe Pile (Closed End)
- 36-in. Dia. x 1-in. Steel Pipe Pile (Open End)

The following additional design considerations shown in Table 1 were discussed with the Port for each pile type.

Table 1: Pile Type Comparison



Pile Type	Pile Spacing	Pile Type	Pile Demand [1] (k)	Min Tip El. (ft)	Pile Length (ft)	Total (7500 ft Wharf)		Per 100 ft of Wharf		
						Pile Qty [2]	Total Pile Length (ft)	Pile Qty [2]	Total Pile Length (ft)	Total Pile Weight (ton)
Concrete	8' x 8'	24" DIA PC/PS Conc (Octagonal)	520	-115	125	17,822	2,227,750	238	29,703	7382
	10' x 10'	**28" DIA PC/PS Conc (Octagonal)**	**800**	**-115**	**125**	**11,250**	**1,406,250**	**150**	**18,750**	**6343**
	12.5' x 10'	**30" DIA PC/PS Conc (Octagonal)**	**1000**	**-130**	**140**	**9,750**	**1,365,000**	**130**	**18,200**	**7068**
	10' x 10'	36" DIA Cylindrical Conc (Round)	780	-115	125	11,250	1,406,250	150	18,750	4753
Steel	10' x 10'	24" DIA x 1" Steel Pipe (Closed)	750	-150	160	11,250	1,800,000	150	24,000	2950
	12' x 12'	24" DIA x 1.5" Steel Pipe (Closed)	1110	-225	235	8,138	1,912,430	109	25,499	4600
	12' x 12'	30" DIA x 7/8" Steel Pipe (Open)	1090	-205	215	8,138	1,749,670	109	23,329	3178
	12' x 12'	**30" DIA x 7/8" Steel Pipe (Closed)**	**1070**	**-160**	**170**	**8,138**	**1,383,460**	**109**	**18,446**	**2513**
	14' x 14'	30" DIA x 1.25" Steel Pipe (Closed)	1480	-215	225	5,896	1,326,600	79	17,688	3398
	14' x 14'	36" DIA x 1" Steel Pipe (Open)	1480	-220	230	5,896	1,356,080	79	18,081	3383

[1] Service load, unfactored
[2] Pile quantity shown does not include additional piles under rail girder.

Based on discussions with the Port, a pile grid of 10 feet by 10 feet shall be the minimum. Thus, eliminating the 24-in. octagonal concrete piles. Cylindrical 36-in. diameter concrete piles were also eliminated from the selection due to lack of seismic performance. Ultimately, the following three pile types were selected to be further considered in the next phase of the project.

- 28-in. Dia. Precast Prestressed Octagonal Concrete Pile
- 30-in. Dia. Precast Prestressed Octagonal Concrete Pile
- 30-in. Dia. Steel Pipe Pile

For the conceptual phase, the 28-in Dia. Precast Prestressed Octagonal Concrete Pile was selected for costing and for use in the project schedule. However, the next phase of the project should evaluate the following considerations to confirm pile type and size selection:

- Complete geotechnical investigation at the site
- Perform drivability analysis
- Perform wharf seismic analyses
- Evaluate pile to deck seismic capacity and details
- Evaluate options and cost for protection of steel piles (anodes, sleeves/jackets, etc)
- Evaluate pile sourcing options including transportation options to site
- Consider performing lab testing of proposed piles to verify seismic performance
- Complete a test pile program

Fixed Piers for Wet Storage or Tugs

Located north of the terminal off the transportation corridor will be three fixed piers for tugs and fully assembled offshore wind turbines. For this concept phase, 24-in. precast prestressed octagonal concrete piles are selected. The deck thickness for these piers will be confirmed in the next phase.

Attachment H: Transportation Corridor Memorandum

moffatt & nichol

4225 E. Conant Street
Long Beach, CA 90808

(562) 590-6500
www.moffattnichol.com

TRANSPORTATION CORRIDOR MEMORANDUM

To:	Port of Long Beach
From:	Jennifer Lim (Moffatt & Nichol)
Cc:	Matt Trowbridge (Moffatt & Nichol)
Project Name:	Pier Wind Project – Concept Phase
Date:	April 20, 2023
Subject:	Transportation Corridor Memorandum
M&N Job No.:	10800-24

Pier Wind will be connected to the existing Navy Mole by a new transportation corridor, shown in Figure 1. The connection will allow access for vehicles, rail, utilities, and provide space for additional operations (i.e. offices, warehouses, parking, etc.). Note, for the concept phase it is assumed that all the necessary improvements needed on Navy Mole Road to bring vehicles, rail, and utilities to the beginning of the Pier Wind transportation corridor are addressed.

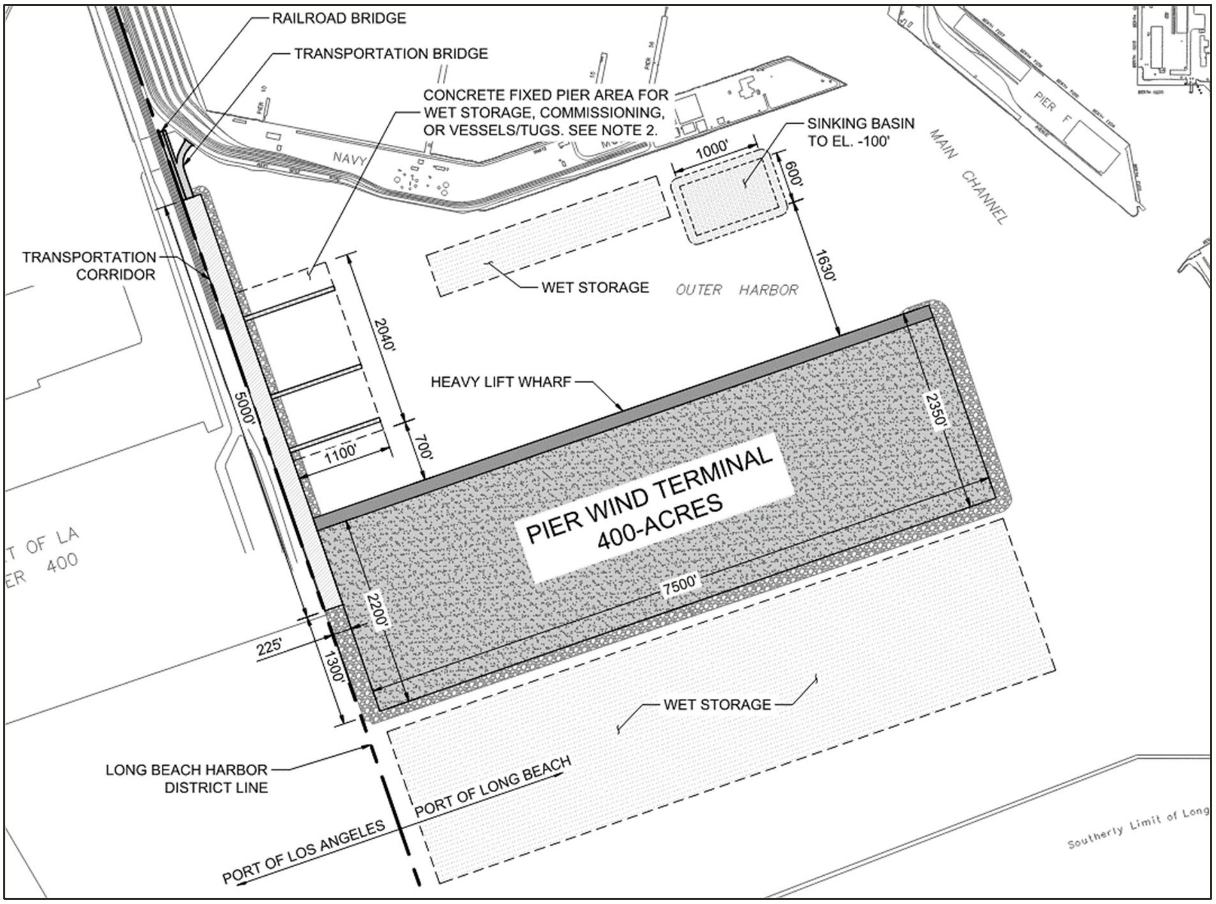


Figure 1. Pier Wind Site Plan with Transportation Corridor

The beginning of the connection will consist of two bridges – one for rail and one for vehicular traffic – that start on the Navy Mole, extend over the existing channel, and end on the new Pier Wind transportation corridor. The length of the bridges will range from 700 to 850 feet to maintain the same width of the existing channel and will be constructed out of concrete. The bridge for railway transportation will have two tracks. The distance between the center of the railroads will be 15 ft. The vehicular bridge will have four (4) lanes total – two (2) lanes in each direction. The lanes on the bridge will be 14 ft wide. All necessary utilities will come down either the rail or the vehicular bridge, this will be determined as the design progresses. The railroads, vehicle lanes, and utilities will continue from the bridges onto the transportation corridor.

The transportation corridor will be constructed of fill with a rock dike on the eastern side. It will be approximately 5,500 ft long and 225 ft wide. The west side of the transportation corridor will be adjacent to the existing Port of Los Angeles Pier 400 Transportation Corridor and the easter edge will be a new rock revetment, as shown in Figure 2. The new rock revetment slope will be 1.75H:1V and the top of dike elevation is +16.5 ft MLLW.

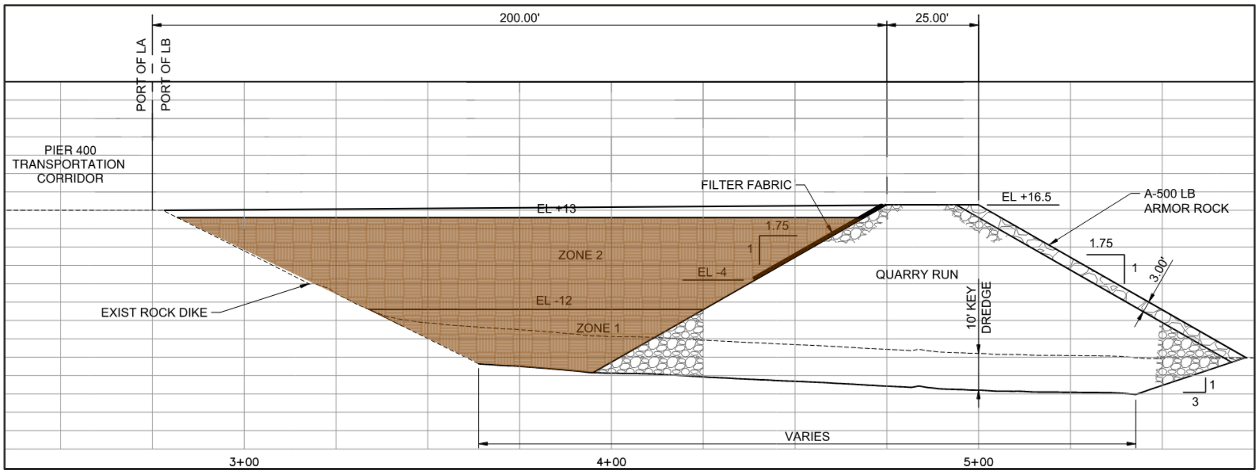


Figure 2. Pier Wind Transportation Corridor Fill and Dike Cross Section

In addition to allowing access for trains and vehicles, the transportation corridor will provide essential operation facilities – refer to Figure 3. This includes offices, warehouses, parking, electrical substations, refueling tanks, and utilities. A utility corridor can be provided under the shoulder and lanes. Furthermore, along the transportation corridor there will be a few 1,100 ft piers for tug boats and wet storage of offshore wind turbine systems.

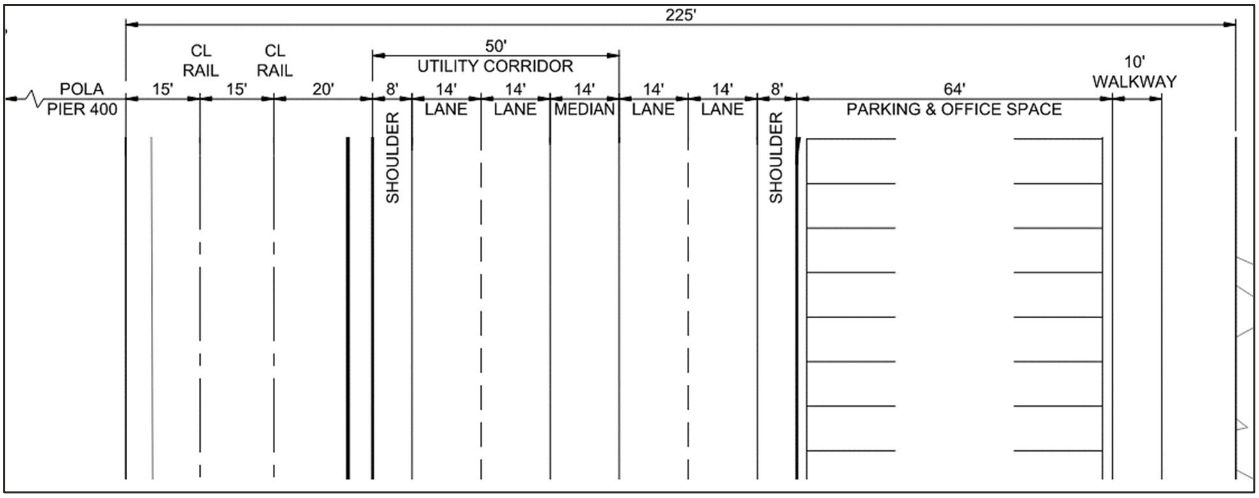
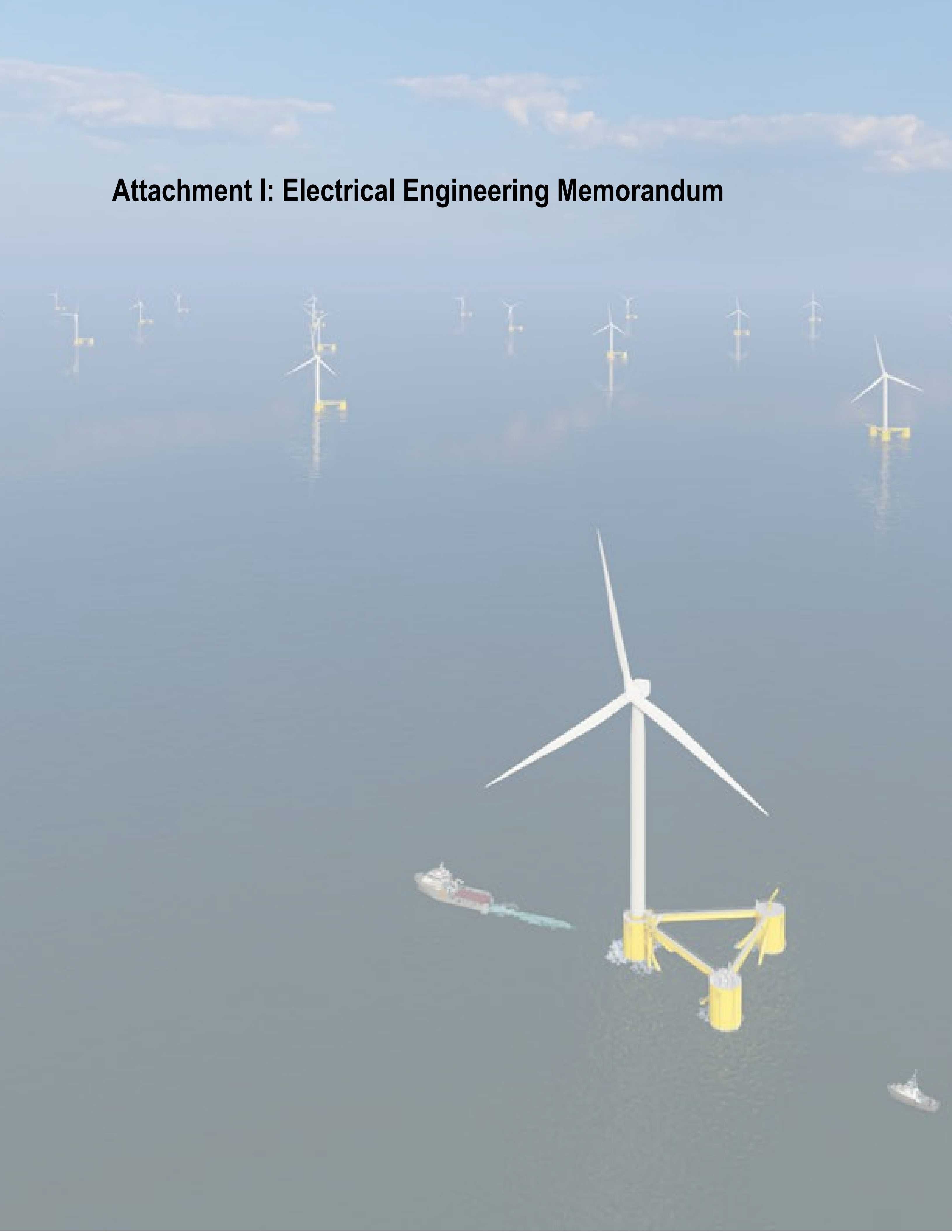


Figure 3. Pier Wind Transportation Corridor Plan

Preliminary traffic counts are estimated to be the following based on the type of offshore wind activity:

- Staging and Integration Site (80 acres) = 500 trips / day
- Foundation Assembly Site (80 acres) = 750 trips / day
- Component Manufacturing Site (80 acres) = 1,500 trips / day

Attachment I: Electrical Engineering Memorandum



moffatt & nichol

4225 E. Conant Street
Long Beach, CA 90808

(562) 590-6500
www.moffattnichol.com

ELECTRICAL MEMORANDUM

To: Port of Long Beach
From: Kamran Kermani (Moffatt & Nichol)
Cc: Matt Trowbridge, Jennifer Lim (Moffatt & Nichol)
Project Name: Pier Wind Project – Concept Phase
Date: April 20, 2023
Subject: Electrical Engineering Memorandum
M&N Job No.: 10800-24

This memorandum summarizes the electrical design for the concept phase of Pier Wind. For this phase the electrical demand was estimated during construction for the dredge equipment and when the terminal is fully operational.

Dredge Electrical Demand for Construction

Currently the Port of Long Beach (Port) has one 66 kV dredging substation at Pier T. It is likely that an additional dredging substation will be needed to support the construction activities for Pier Wind. For the accelerated or fast construction schedule it is assumed that 3 hydraulic and 3 mechanical dredges are working simultaneously. Each clamshell is assumed to draw 2 MW at peak while hydraulic dredges consume 22-24 MW at their peak, based on Table 1 and Table 2. If all dredges are in operation, the total power consumption could be approximately 70-80 MW.

Table 1. Range of Power Drop based on Horse Power Use for Cutter Suction Dredge

Power being Used	Power Drop Required
10,000 HP	8 – 9 MW
12,500 HP	10 - 12 MW
15,000 HP	12 – 14 MW
17,500 HP	14 – 16 MW
20,000 HP	17 – 19 MW

Table 2. List of Existing Cutter Suction Dredge and Horse Power Use

Dredge	Total Installed HP
Gen Bradley	9,260
Venture	9,680
Robert White	10,000
Capt Frank	10,722
Illinois	11,300
Alaska	11,315
HR Morris	12,166
Morgan	12,427

Dredge	Total Installed HP
Texas	14,400
Carolina	15,620
McCaskill	17,400
Ellefson	17,400
Weeks	17,619
Ohio	18,300
Chatry	23,200
Gen Mac Arthur	24,000
Gen Arnold	24,000

This assumes that no other construction equipment needs to be electrified during construction concurrently or if they do, they are not pulling from the same location as the dredges.

Booster pump needs are based on the size of the dredge being used and the material being dredged. The distance at which a booster pump is required will vary on a case by case basis. The “standard” ranges are as follows: for the smaller cutter suction dredges (CSD), anything over 15,000 ft of pipeline would require a booster (Morris/Alaska size) whereas for the larger CSDs, they usually require boosters once you get around 20,000 ft to 25,000 ft (Ohio/McCaskill size). Booster pump sizes also range quite a bit. The high end for booster pumps is around 10,000 Horsepower. The majority of booster pumps used in the US are in the 3,000-6,000 HP range. Based on the HP, power draw is expected to be on the order of 4 to 5 MW per booster.

Terminal Electrical Demand

Based on similar offshore wind terminals on the east coast the electrical demands for Pier Wind during operation are shown in Table 3.

Table 3. Operational Electrical Demands for Pier Wind

Load Type	Quantity	Connected Loads		Demand Loads	
		Unit KVA	KVA	DF%	KVA
Shore Power Substations	8	2,000.0	16,000	**65%**	**10,400**
Crane Substations	1	9,600.0	9,600	**50%**	**4,800**
SPMT Charging Stations	100	27.0	2,700	**90%**	**2,430**
Mobile Crane Charging Stations	20	250.0	5,000	**90%**	**4,500**
Work Truck Charging Stations	100	35.0	3,500	**90%**	**3,150**
Staff Vehicle Charging Stations	100	35.0	3,500	**30%**	**1,050**
Nacelle Staging Area Power	60	50.0	3,000	**100%**	**3,000**
Tower Staging Area Power	240	10.0	2,400	**100%**	**2,400**
Wet Storage Pier Power	12	90.0	1,080	**100%**	**1,080**
Blade Manufacturing Building	1	15,000.0	15,000	**80%**	**12,000**
Terminal High mast Light Poles	110	8.4	928	**125%**	**1,160**
Tug Charging Stations	16	258.0	4,128	**65%**	**2,683**
Total Demand:			**66,836**		**48,653**
Contingency:		**15%**	**76,861**		**55,951**

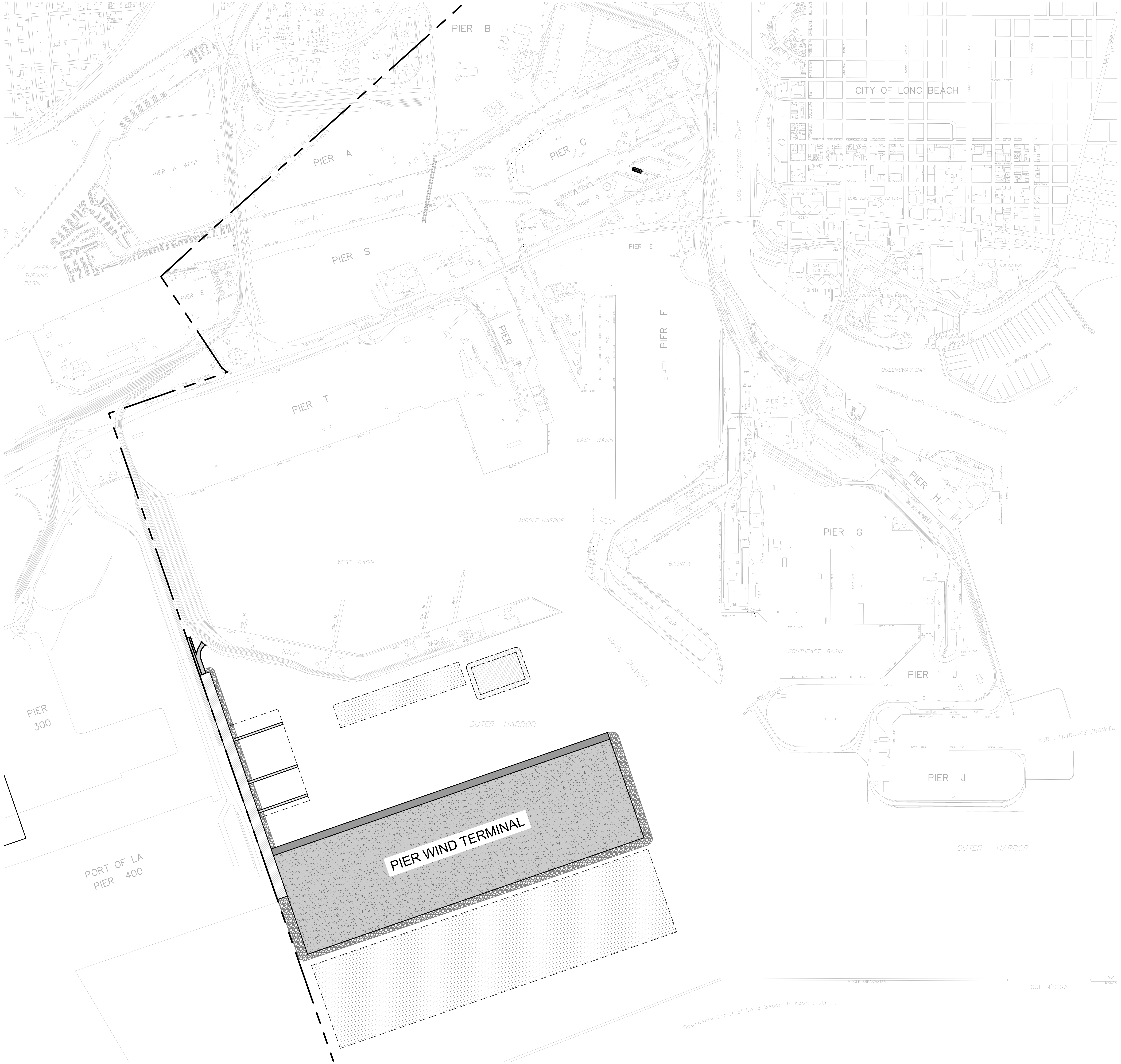
In the above summary we considered eight shore power stations each adds 2 MW average demand which is conservative for offshore wind vessels. We also assumed ten crawler cranes, three ring cranes operating 50% of the time. We estimated twenty SPMT charging stations per 80-acre unit 90% of which is charging at any one time. We assumed ten small mobile cranes at a foundation fabrication site to support with production. We considered sixteen charging stations for the tugs.

Next steps:

In the next phase of the project the team will consider the following:

- Team to determine an efficiency factor for realistic use to continue planning efforts with Southern California Edison (i.e. design demand versus actual use). For example, at the Middle Harbor Terminal, initial planning demand was 3 to 4 times higher than what was used.
- Consider phasing schedule for the electrical demand (Phase 1 vs Phase 2)
- Coordinate with Southern California Edison on the schedule of the project

Attachment J: Conceptual Engineering Drawings



SCOPE OF WORK

PROJECT PROVIDES A NEW OFFSHORE WIND TERMINAL IN THE OUTER HARBOR FOR STAGING AND INTEGRATION OF FLOATING OFFSHORE WIND TURBINES, FLOATING FOUNDATION FABRICATION, AND/OR MANUFACTURING OF COMPONENTS. THIS INCLUDES, BUT IS NOT LIMITED TO CONSTRUCTION OF A TRANSPORTATION CORRIDOR, NEW HEAVY LIFT WHARF, SINKING BASIN, FIXED PIERS FOR TUGS AND WET STORAGE, AND 400 ACRE TERMINAL.

PROJECT VERTICAL DATUM

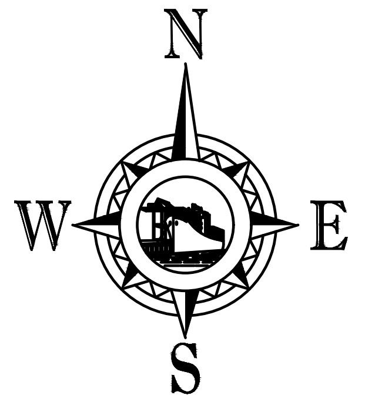
THE VERTICAL DATUM SHOWN IS BASED ON NATIONAL GEODETIC VERTICAL DATUM OF 1929 (NGVD '29), MEAN LOWER LOW WATER ELEVATION (MLLW) IN FEET.

PROJECT HORIZONTAL DATUM

THE HORIZONTAL DATUM SHOWN IS BASED ON NORTH AMERICAN DATUM OF 1983, 2007 REALIZATION (NAD '83), STATE PLANE COORDINATE SYSTEM (SPCS), CALIFORNIA ZONE 5.

SHEET LIST TABLE

PAGE NO.	SHEET NO.	SHEET TITLE
1	GN001	PROJECT LOCATION - SHEET INDEX
2	GN002	SITE PLAN
3	GN003	OFFSHORE WIND - OVERALL SITE PLAN SAMPLE
4	GN004	OFFSHORE WIND - TERMINAL SAMPLES
5	GN005	OFFSHORE WIND - PIER AREA SAMPLES
6	GN006	PHASING PLAN
7	DR001	DREDGE PLAN
8	DR002	TYPICAL DREDGE SECTIONS
9	DR003	ROCK REVETMENT PLAN
10	DR004	FILL AND SURCHARGE PLAN
11	DR005	ROCK REVETMENT, FILL & SURCHARGE SECTION 1
12	DR006	ROCK REVETMENT, FILL & SURCHARGE SECTION 2
13	DR007	ROCK REVETMENT, FILL & SURCHARGE SECTION 3
14	DR008	WICK DRAIN SECTION
15	ST001	WHARF GENERAL PLAN
16	ST002	WHARF SECTION
17	RD001	TRANSPORTATION CORRIDOR PLAN



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moffatt & nichol
4225 EAST CONANT STREET
LONG BEACH, CA 90808
TEL. (562) 590-6500

MARK	DATE	BY	REVISION DESCRIPTION

Suzanne C. Plezia
SUZANNE C. PLEZIA, P.E. NO. C-59164
SENIOR DIRECTOR/CHIEF HARBOR ENGINEER
4/21/2023
DATE

Clint Herrera
CLINT C. HERRERA, P.E. NO. C-61471
ASSISTANT DIRECTOR OF ENGINEERING DESIGN
4/21/2023
DATE

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PIER WIND
CONCEPT PHASE
PROJECT LOCATION - SHEET INDEX

10-02445-GN001
SHEET 1 OF 17

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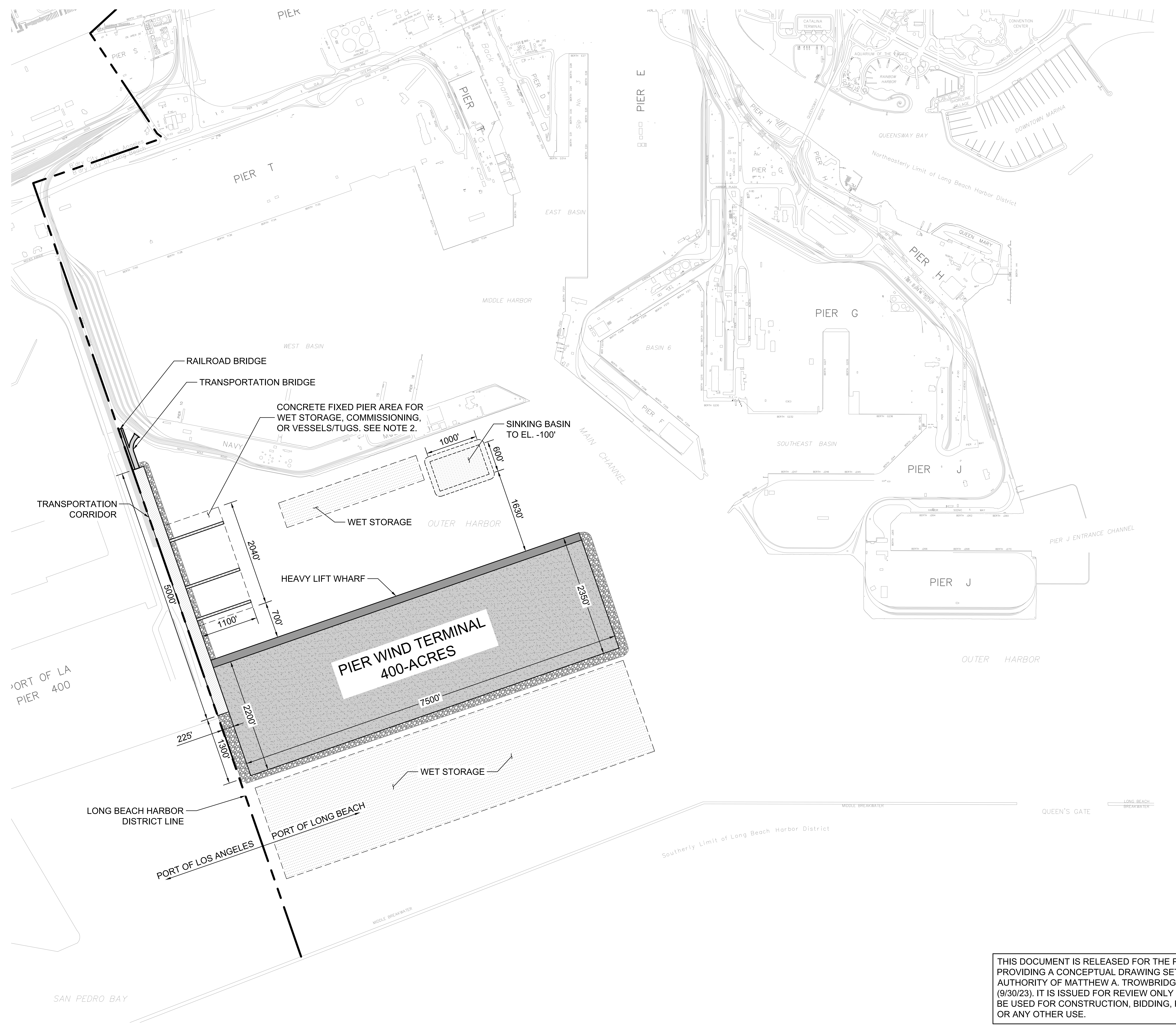

SITE PLAN LEGEND

— - — - —	LONG BEACH HARBOR DISTRICT LIMIT
■	HEAVY LIFT WHARF
▨	TERMINAL
▭	TRANSPORTATION CORRIDOR
▭	SINKING BASIN
▭	WET STORAGE
▭	BRIDGE
▩	ROCK DIKE
▭	CONCRETE FIXED PIER

NOTES

1. THESE CONCEPTUAL PLANS DOCUMENT THE DESIGN DECISIONS MADE FOR THE PIER WIND CONCEPT PHASE.
2. THE SHOWN DIMENSIONS AND SPACING OF CONCRETE FIXED PIERS ARE JUST AN EXAMPLE. DIMENSIONS, SPACING, USE, AND NUMBER OF CONCRETE FIXED PIERS IS FLEXIBLE BASED ON OFFSHORE WIND INDUSTRY NEEDS. SEE SHEET 4 FOR ADDITIONAL EXAMPLES OF THIS AREA AND POTENTIAL USES.

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4225 EAST CONANT STREET
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PIER WIND
CONCEPT PHASE
SITE PLAN

10-02445-GN002
SHEET 2 OF 17

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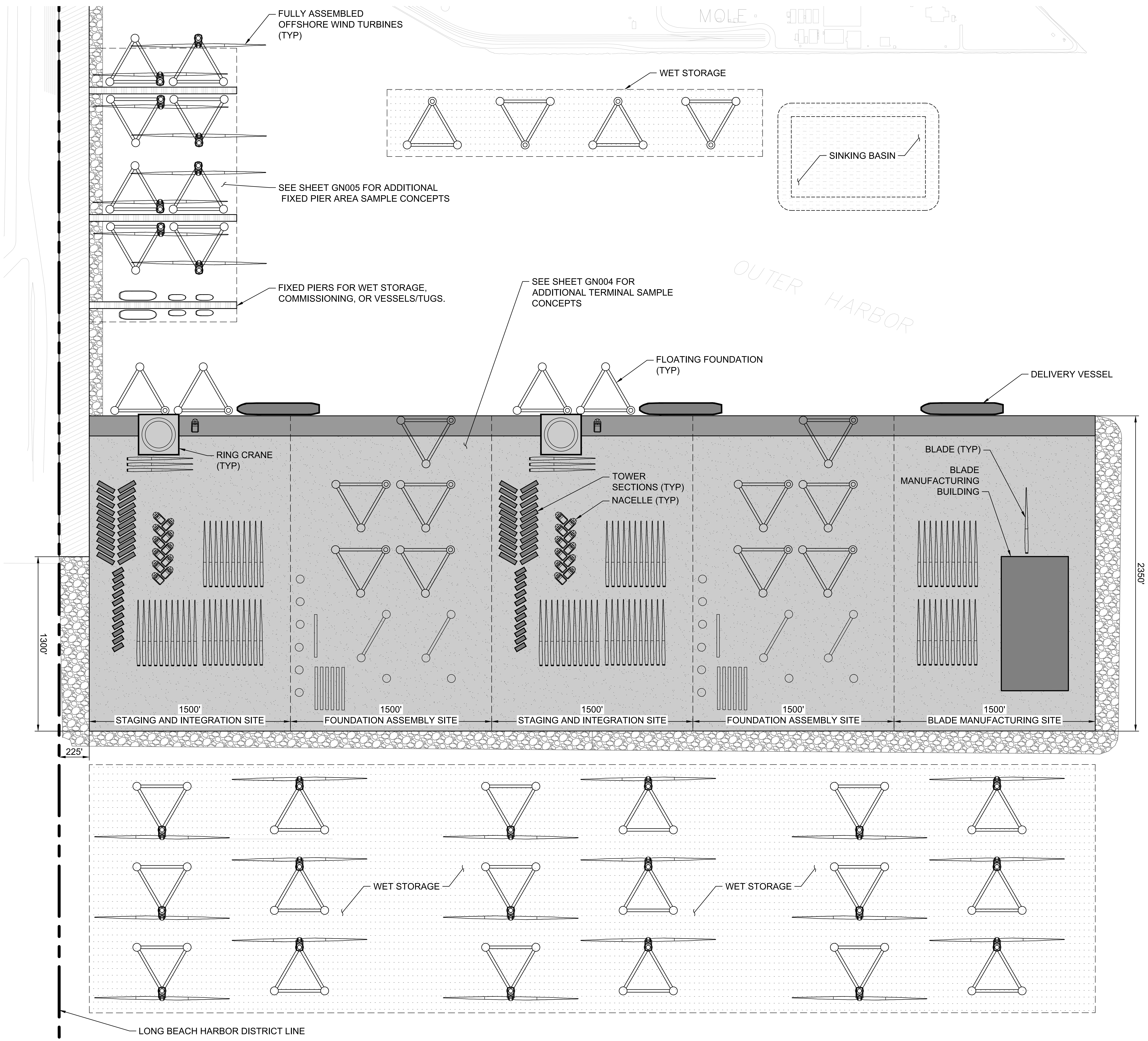

SAMPLE CONCEPT PLAN LEGEND

— - — - —	LONG BEACH HARBOR DISTRICT LIMIT
■	HEAVY LIFT WHARF
▨	TERMINAL
▭	TRANSPORTATION CORRIDOR
▭	SINKING BASIN
▭	WET STORAGE
▭	BRIDGE
▨	ROCK DIKE
▬	CONCRETE FIXED PIER
▽ △	FULLY ASSEMBLED OFFSHORE WIND TURBINE
▽ △	FLOATING FOUNDATION
—	BLADE
≷	TOWER SECTION(S)
▯	NACELLE
◎	RING CRANE
■	MANUFACTURING FACILITY
▬	DELIVERY VESSEL
⬭	TUG(S)

NOTES

1. OFFSHORE WIND TURBINE COMPONENTS SHOWN ARE ASSUMED FOR A 20 MEGAWATT (MW) TURBINE.
2. COMPONENT SIZES ARE REPRESENTATIVE BASED ON AVAILABLE INFORMATION AND INDUSTRY TRENDS.
3. IT IS ASSUMED THAT A 20 MW TURBINE WILL USE FOUR TOWER SECTIONS.
4. APPROXIMATELY 80 ACRES IS PROVIDED FOR EACH OFFSHORE WIND SITE/PARCEL.
5. EACH STAGING AND INTEGRATION SITE WILL INCLUDE A RING CRANE ADJACENT TO THE BERTH.

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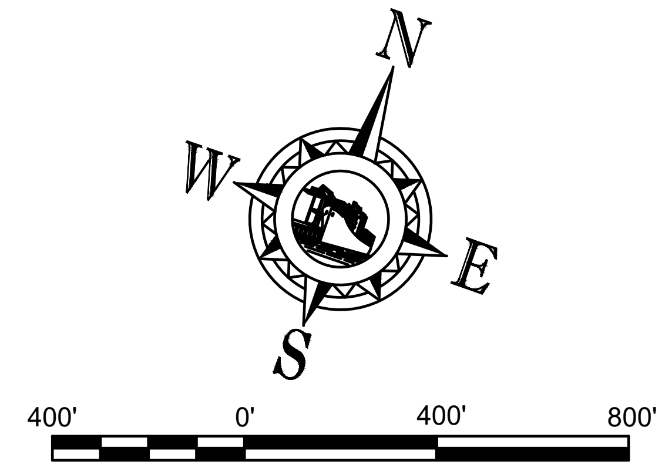

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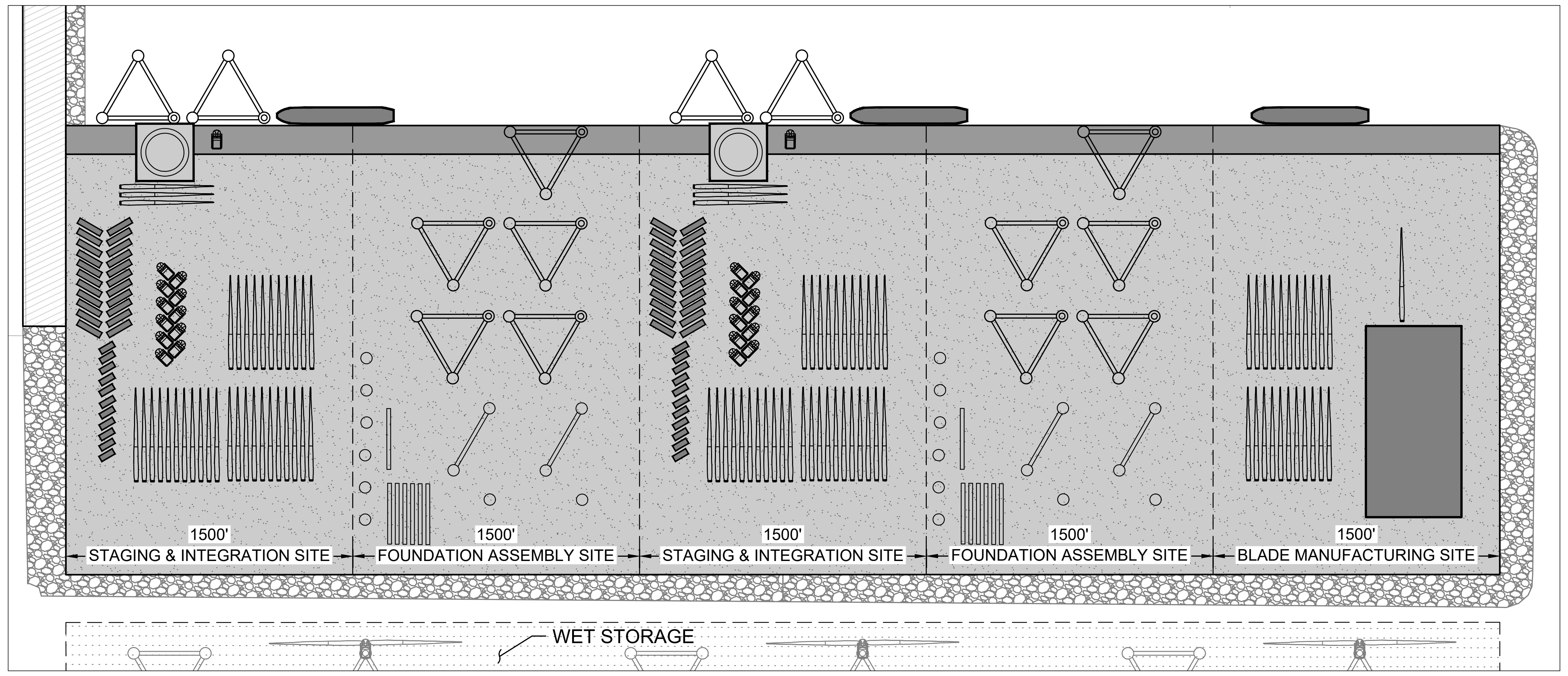
PIER WIND
CONCEPT PHASE
OFFSHORE WIND – OVERALL SITE PLAN SAMPLE

10-02445-GN003
SHEET 3 OF 17



TERMINAL SAMPLE CONCEPT A

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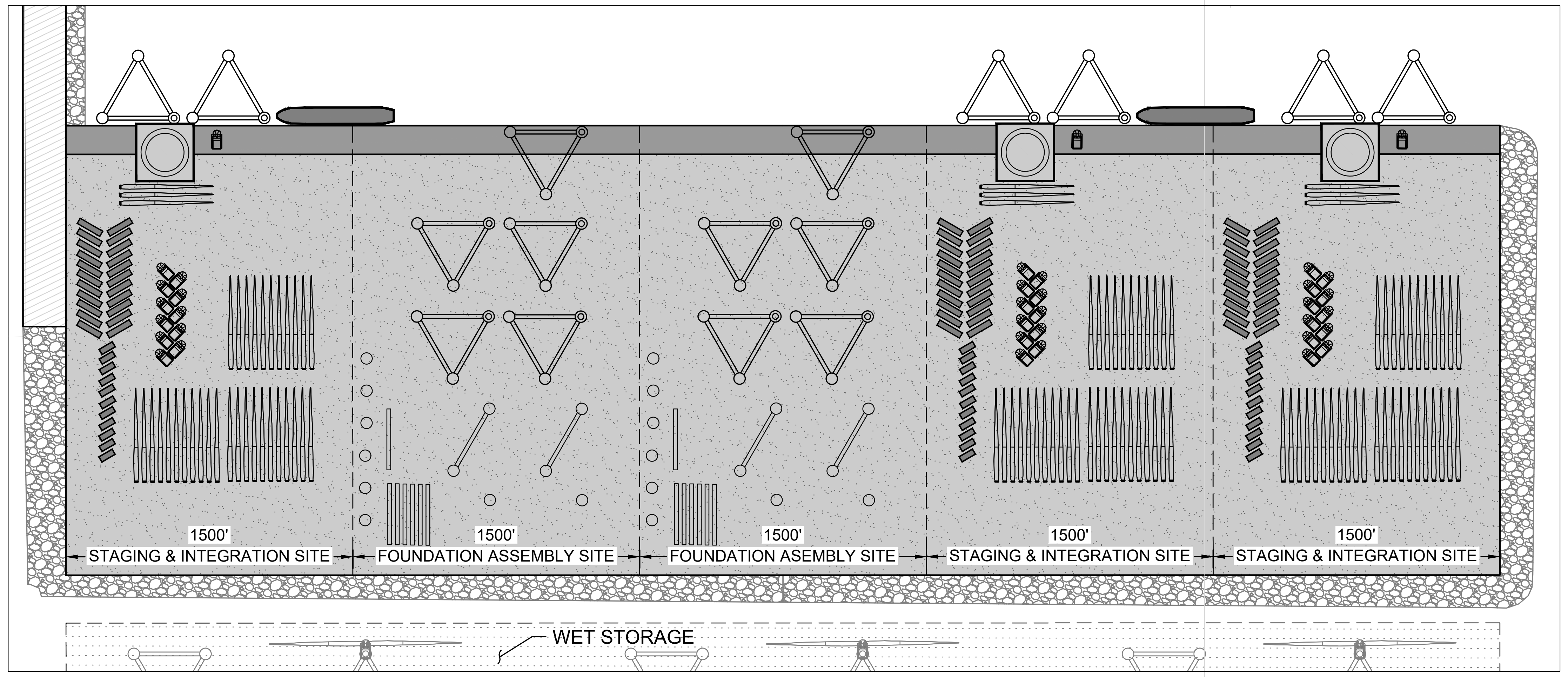

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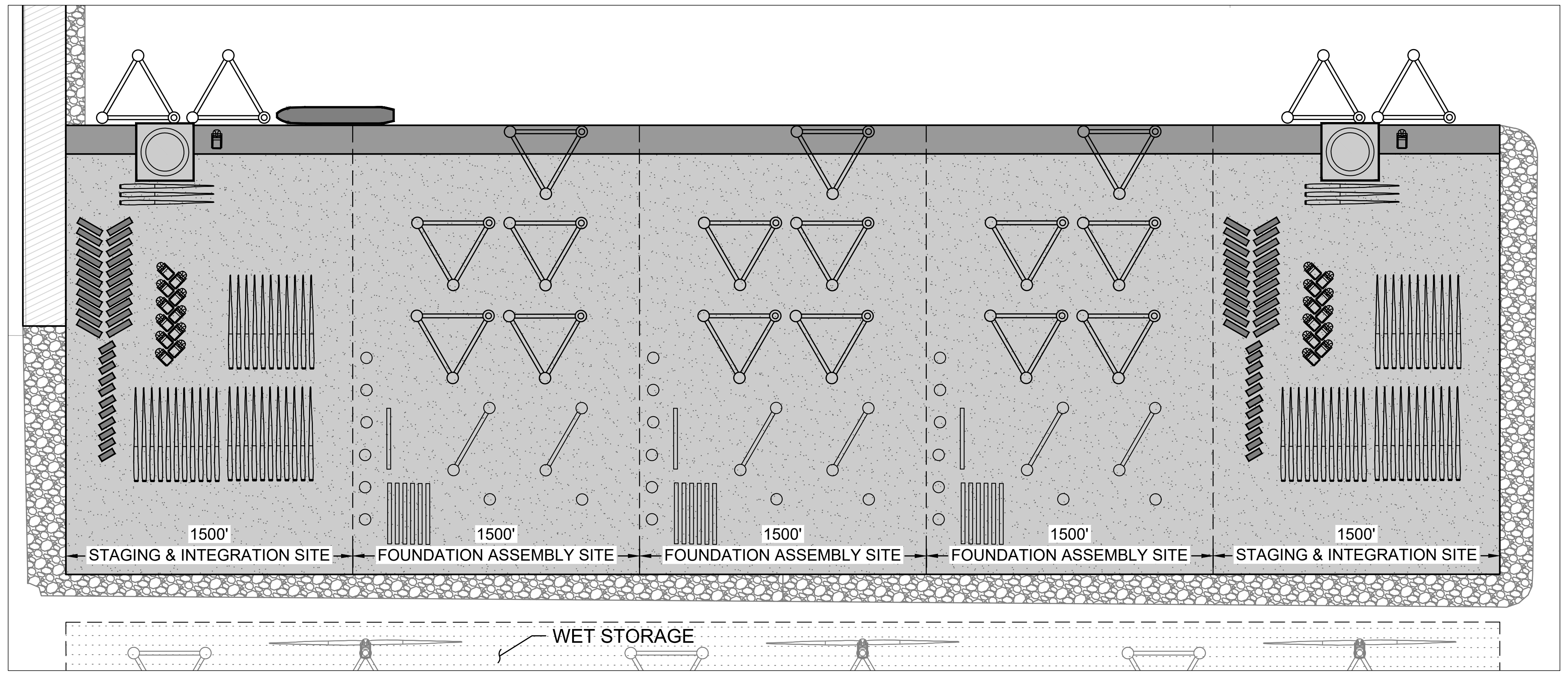

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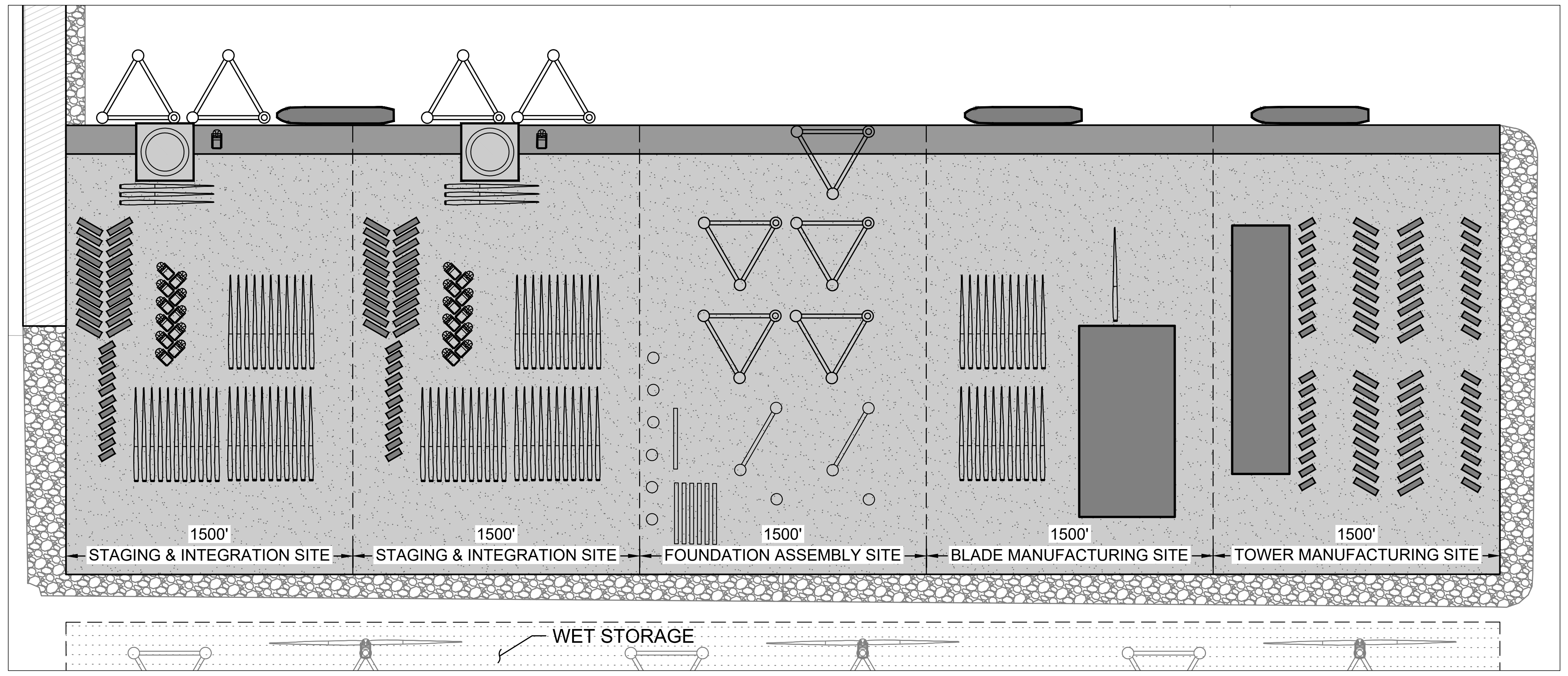

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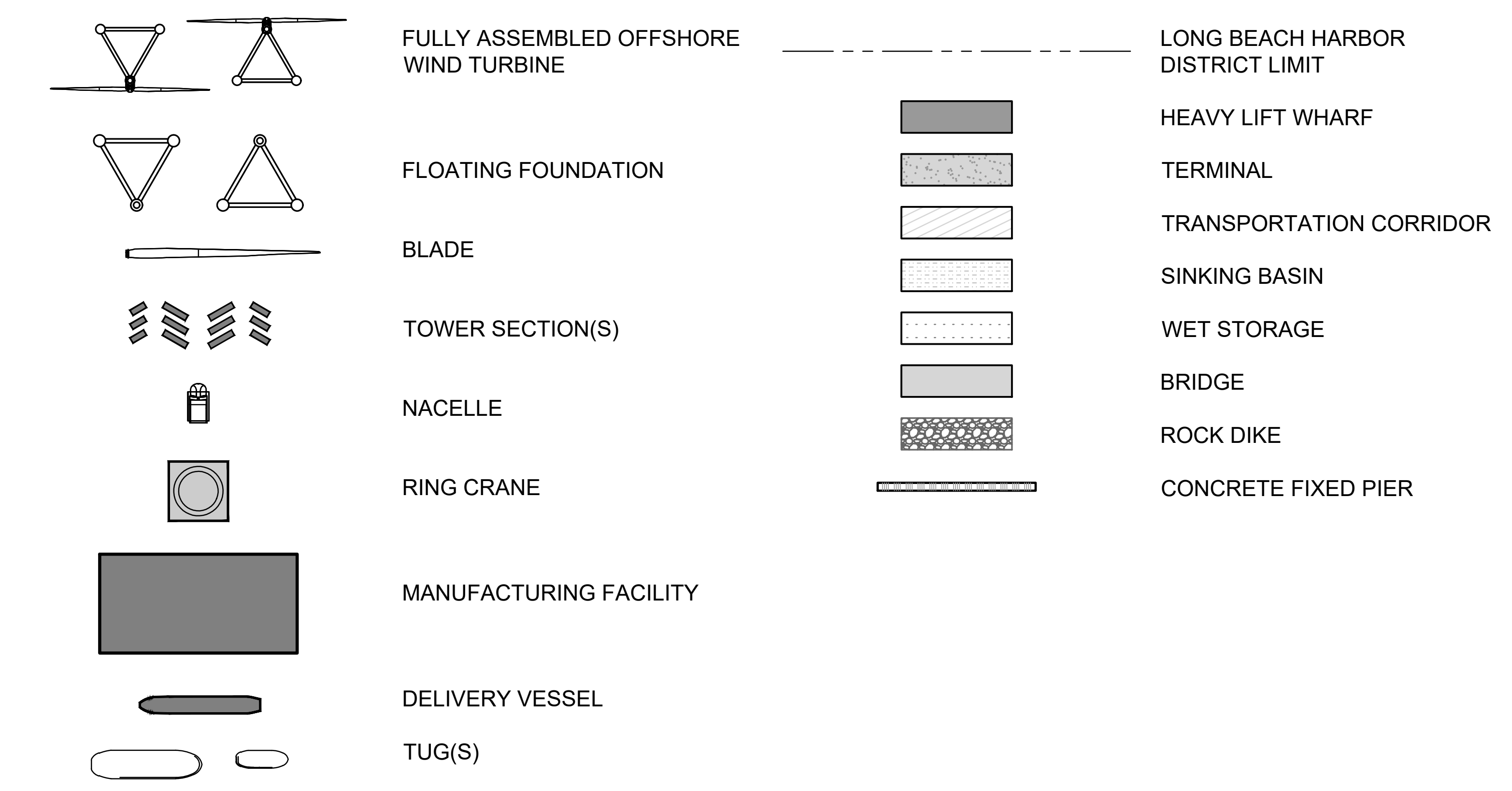
SAMPLE CONCEPT PLAN LEGEND



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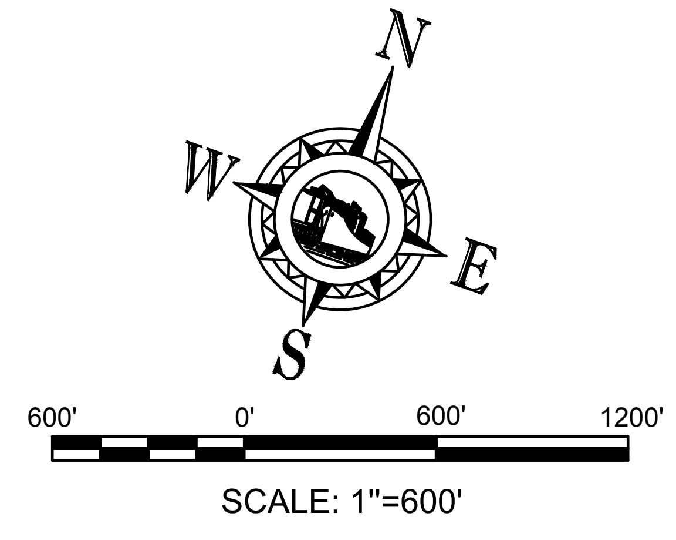

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PIER WIND
CONCEPT PHASE
OFFSHORE WIND – TERMINAL SAMPLES

10-02445-GN004
SHEET 4 OF 17

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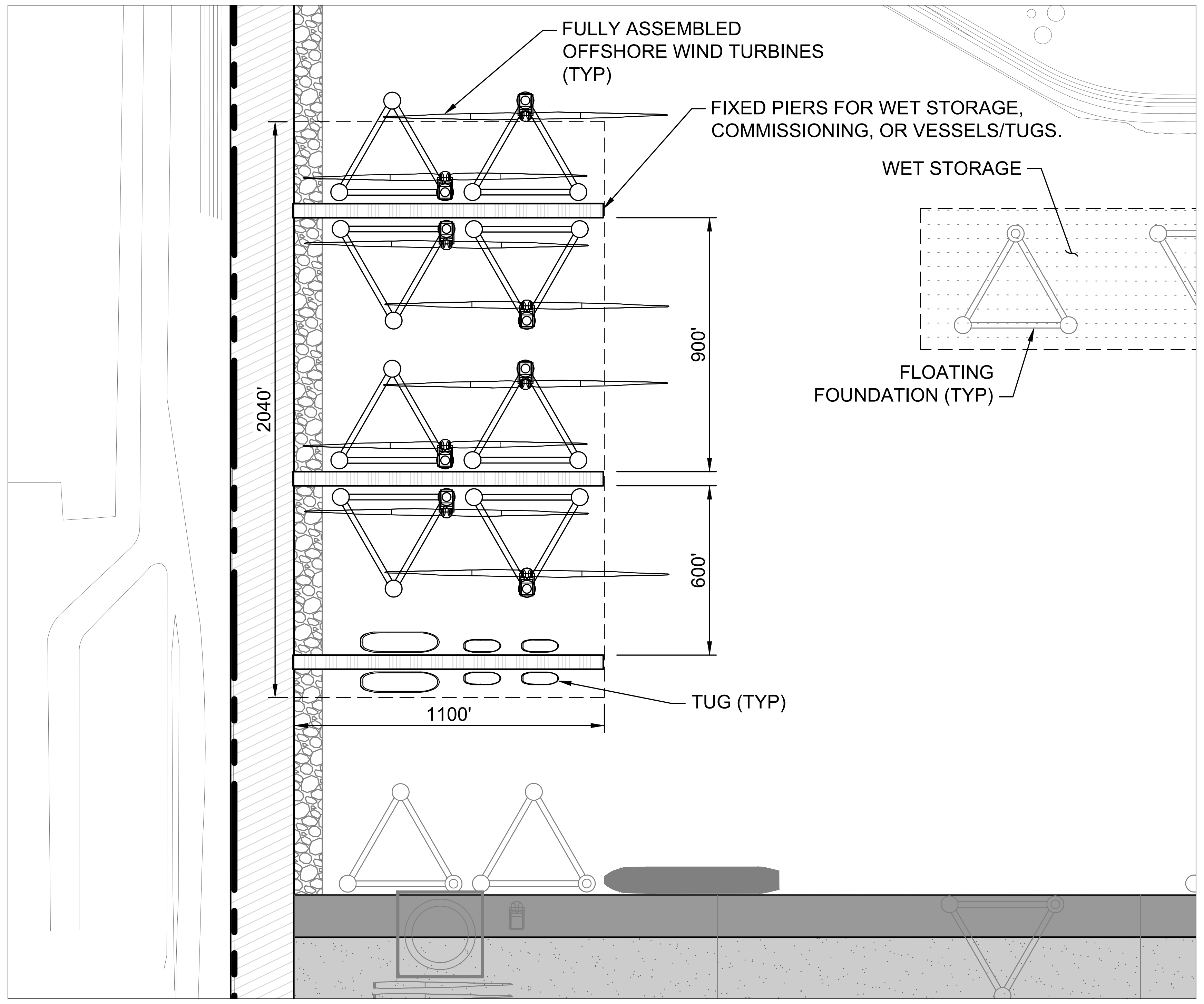

PIER AREA SAMPLE CONCEPT A

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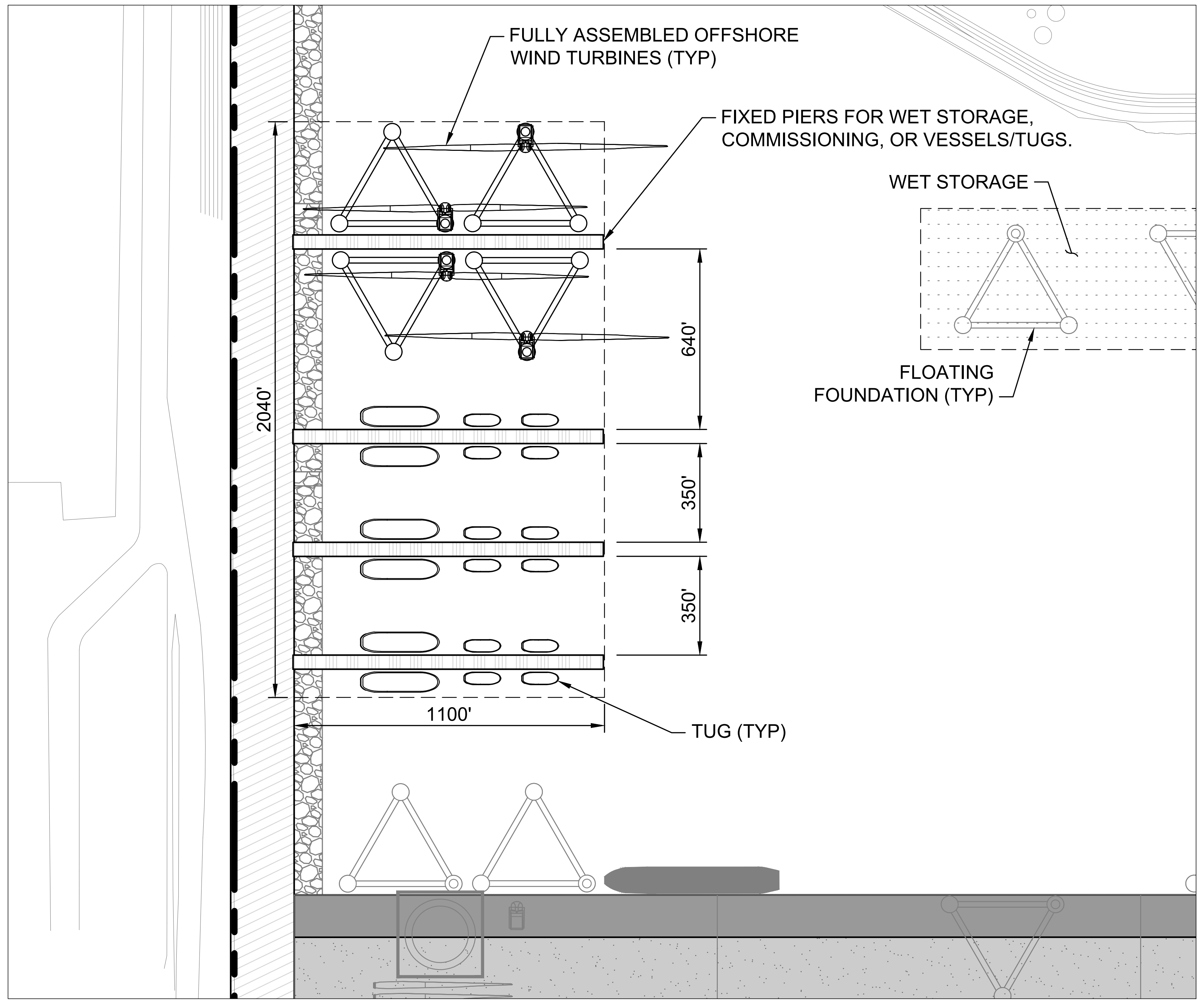

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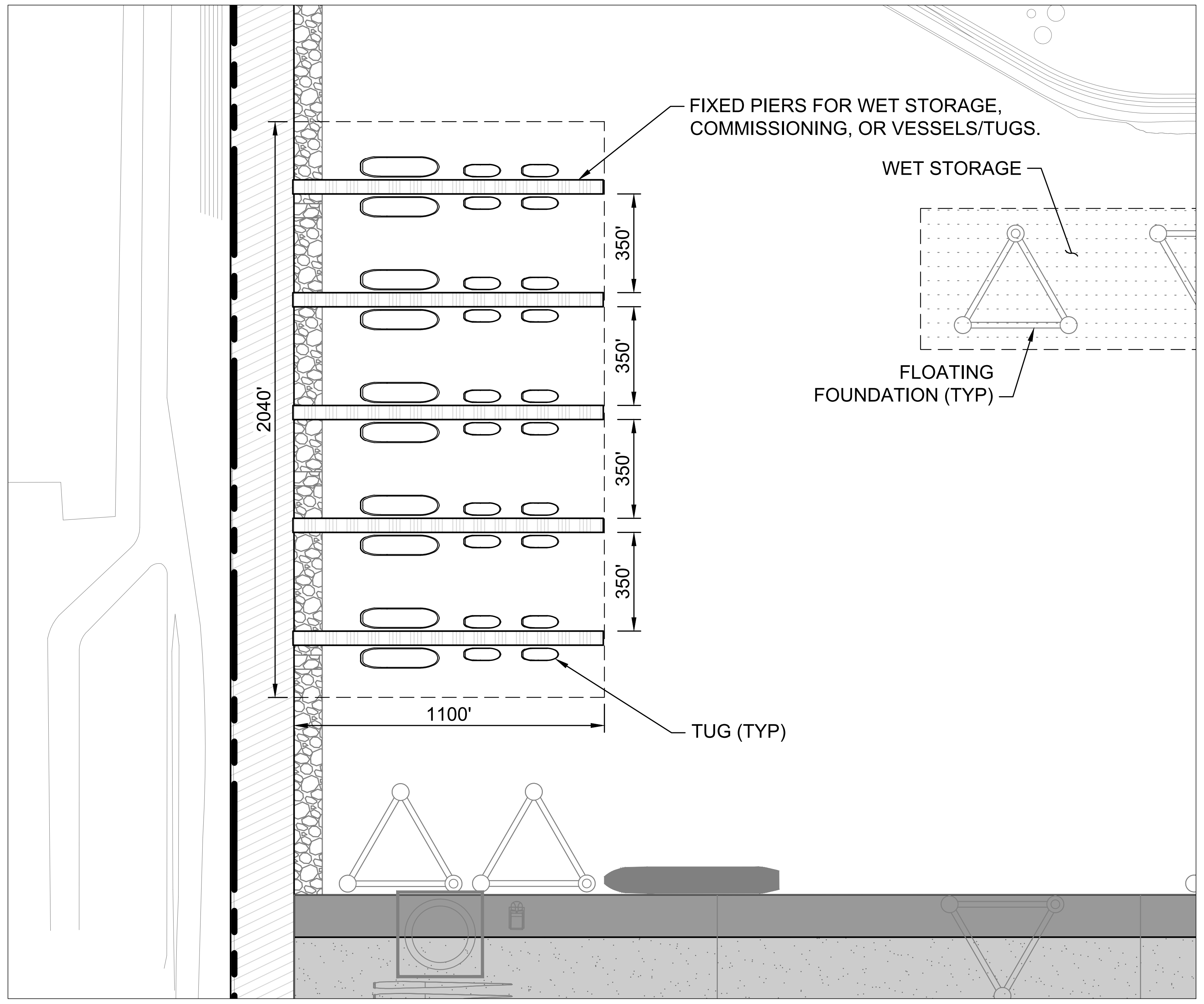

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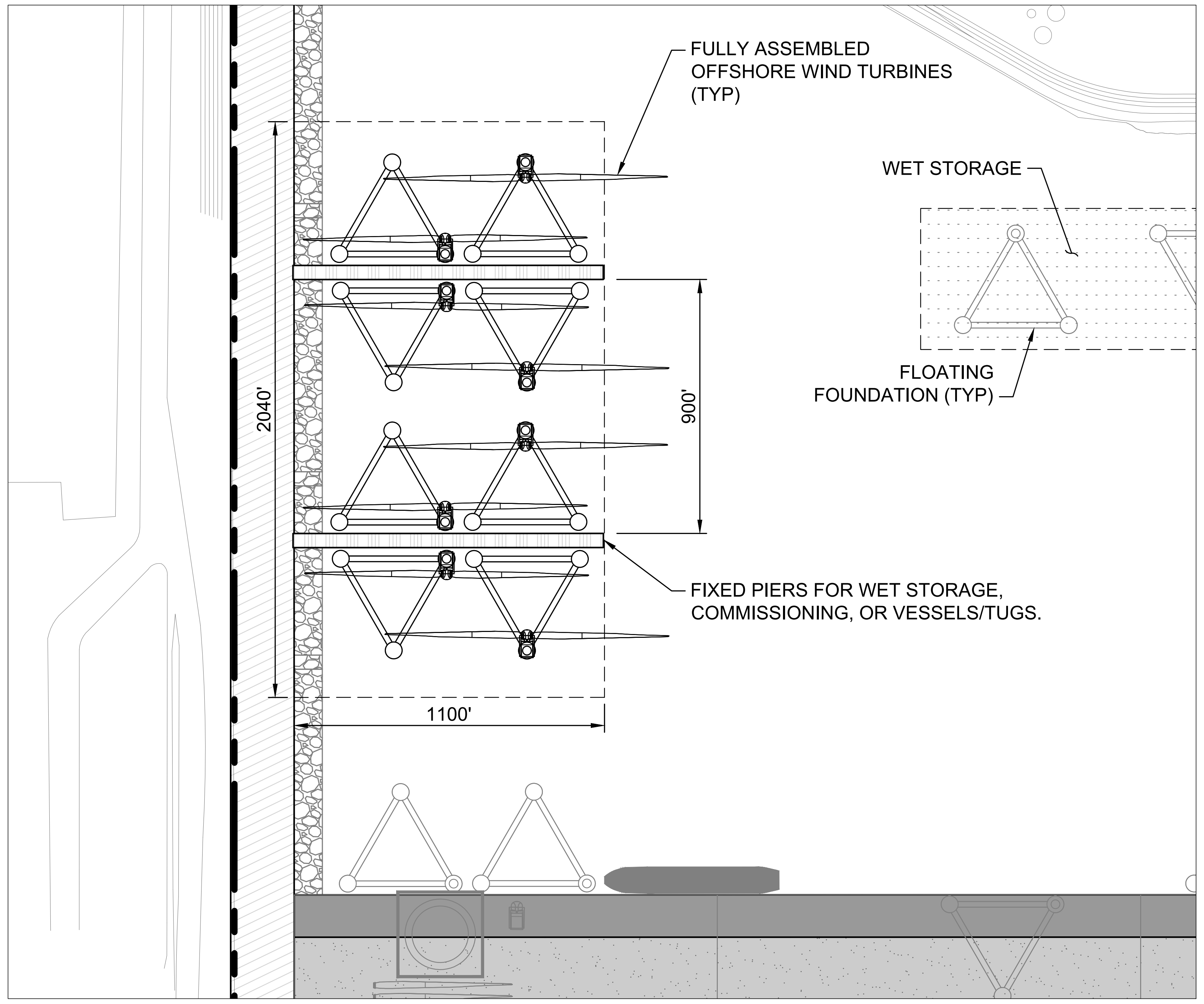

PIER AREA SAMPLE CONCEPT D

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SAMPLE CONCEPT PLAN LEGEND

— · — · —	LONG BEACH HARBOR DISTRICT LIMIT
▬	HEAVY LIFT WHARF
▨	TERMINAL
▨	TRANSPORTATION CORRIDOR
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▨	WET STORAGE
▭	BRIDGE
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■	MANUFACTURING FACILITY
▬	DELIVERY VESSEL
⬭	TUG(S)

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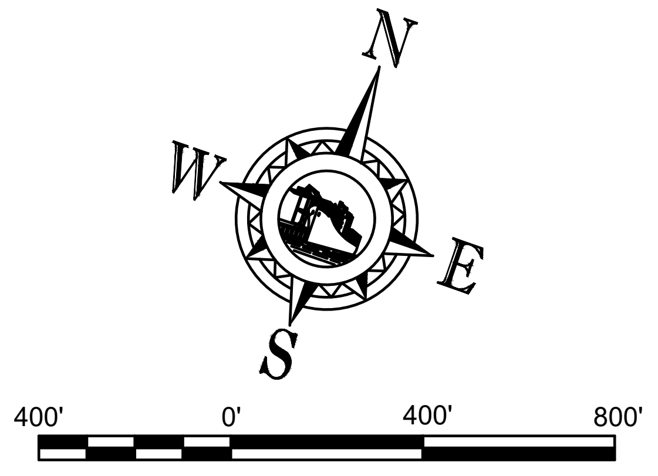

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DATE:
POLB DM:
POLB PM:

PIER WIND
CONCEPT PHASE
OFFSHORE WIND – PIER AREA SAMPLES

10–02445–GN005
SHEET 5 OF 17

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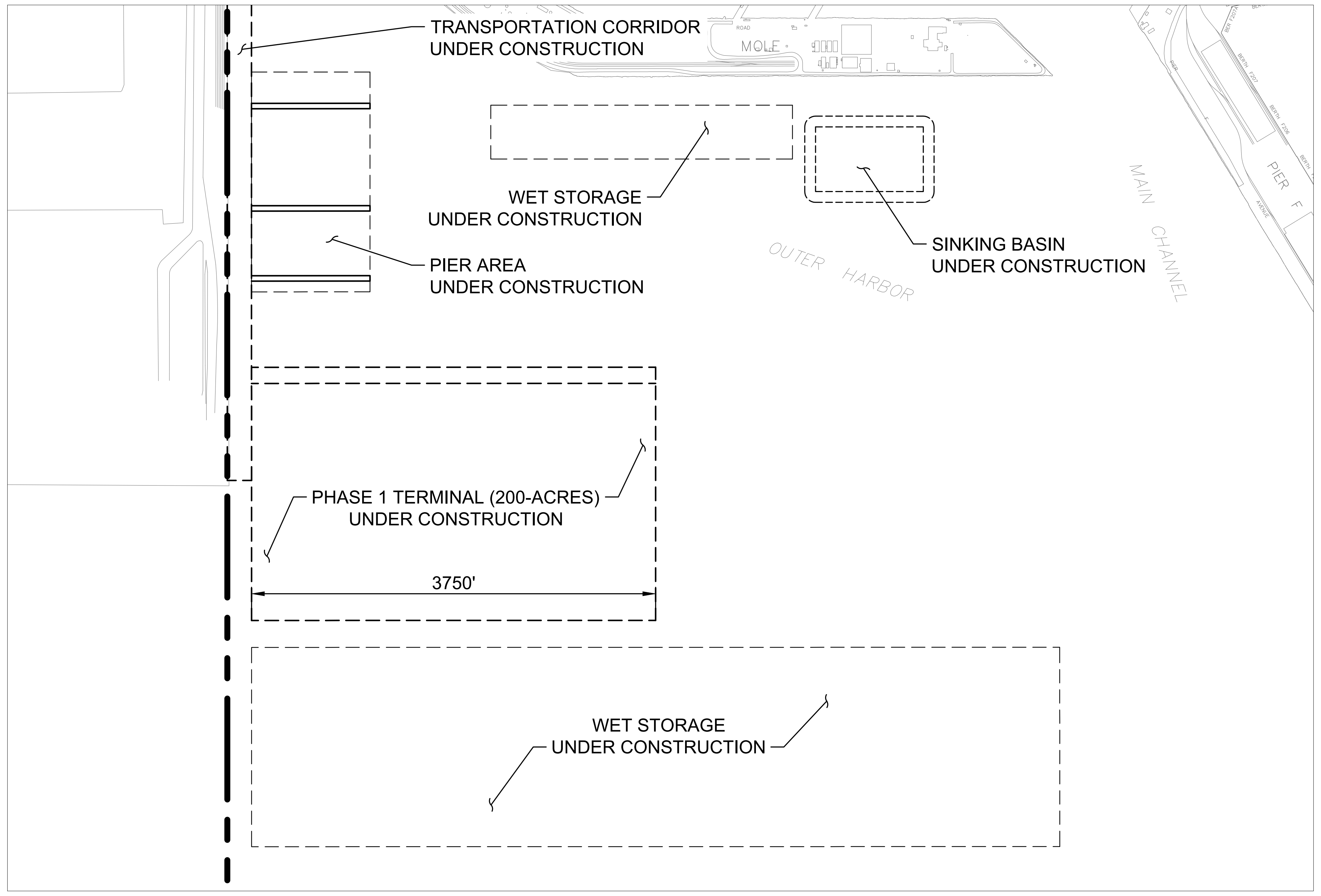
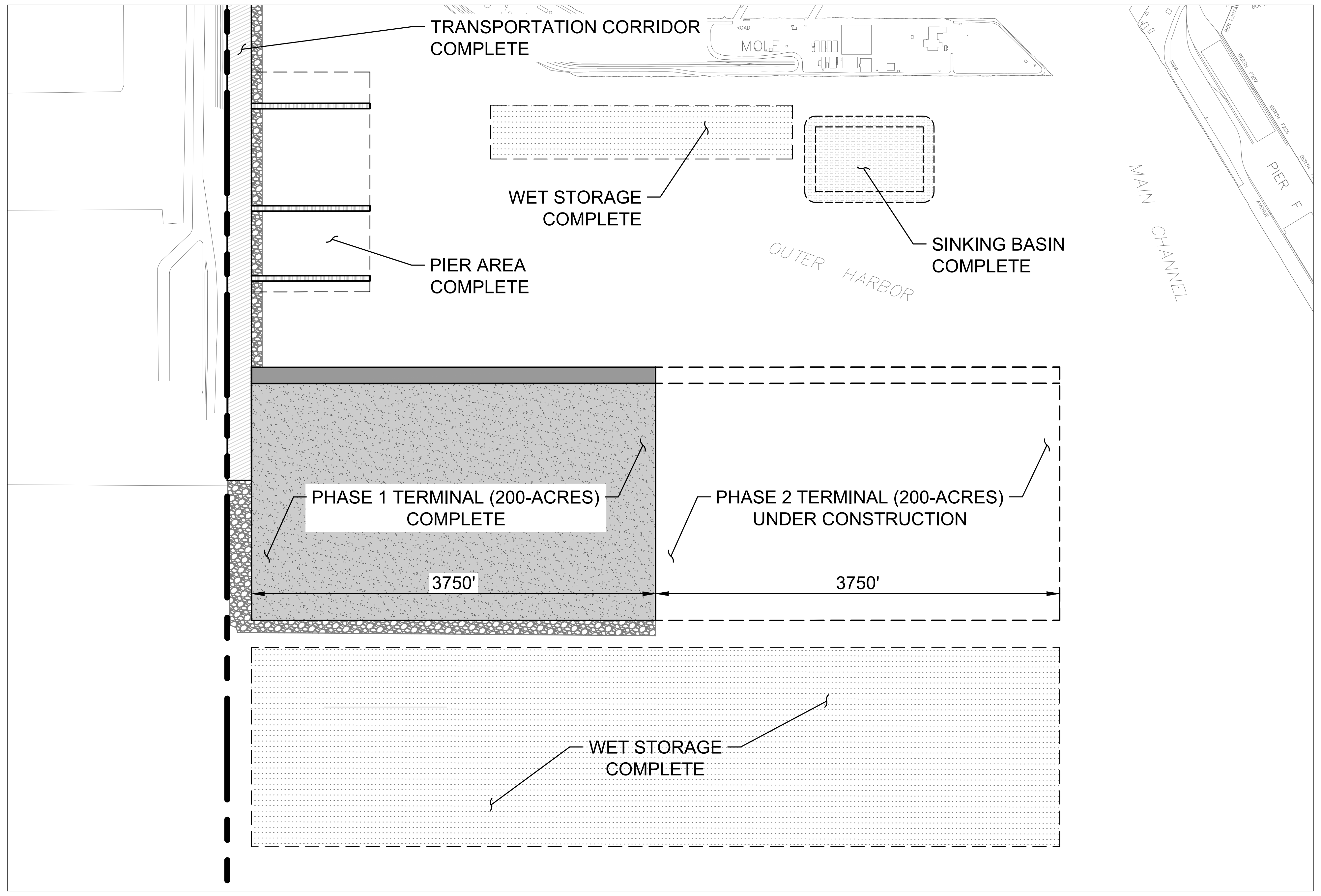
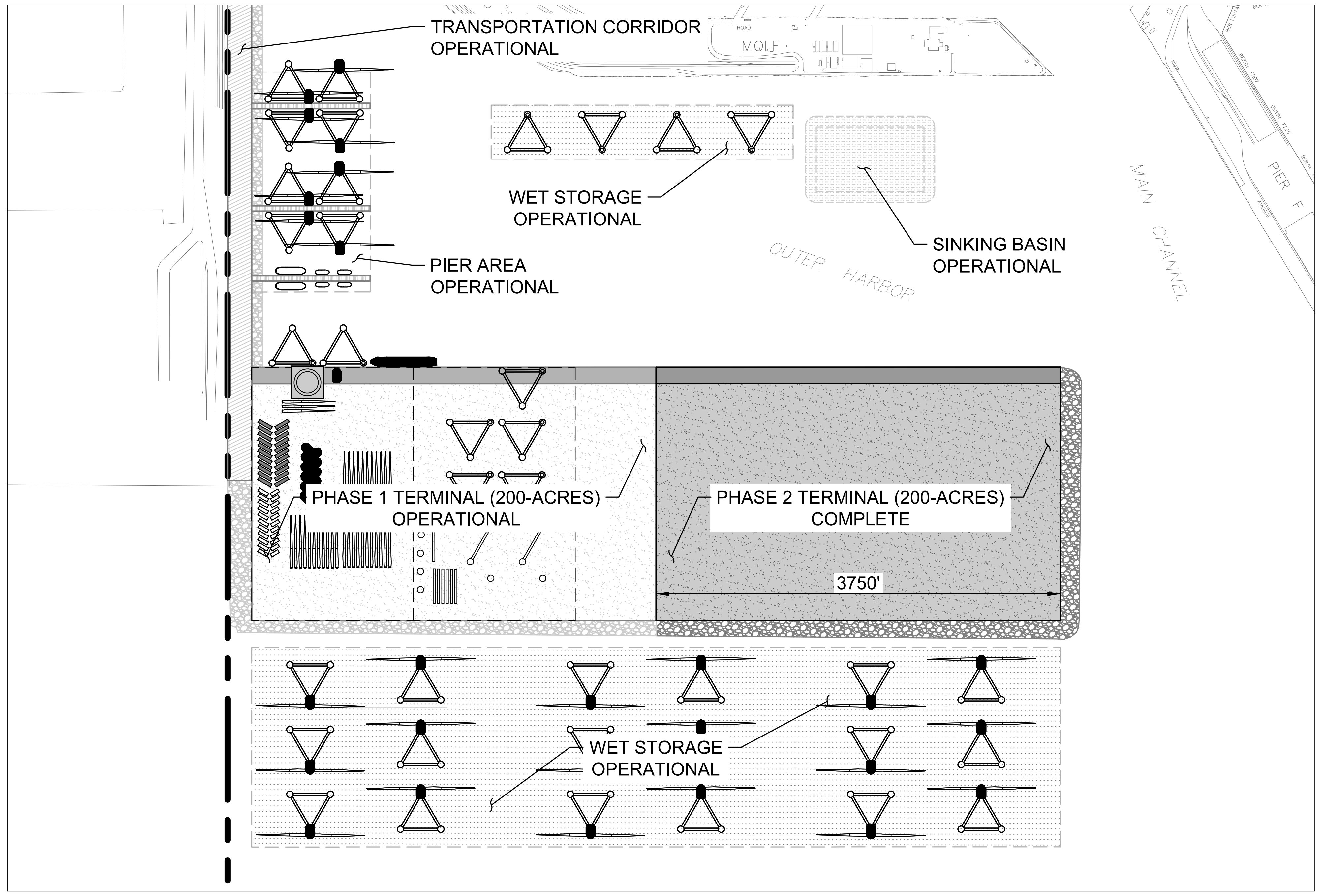


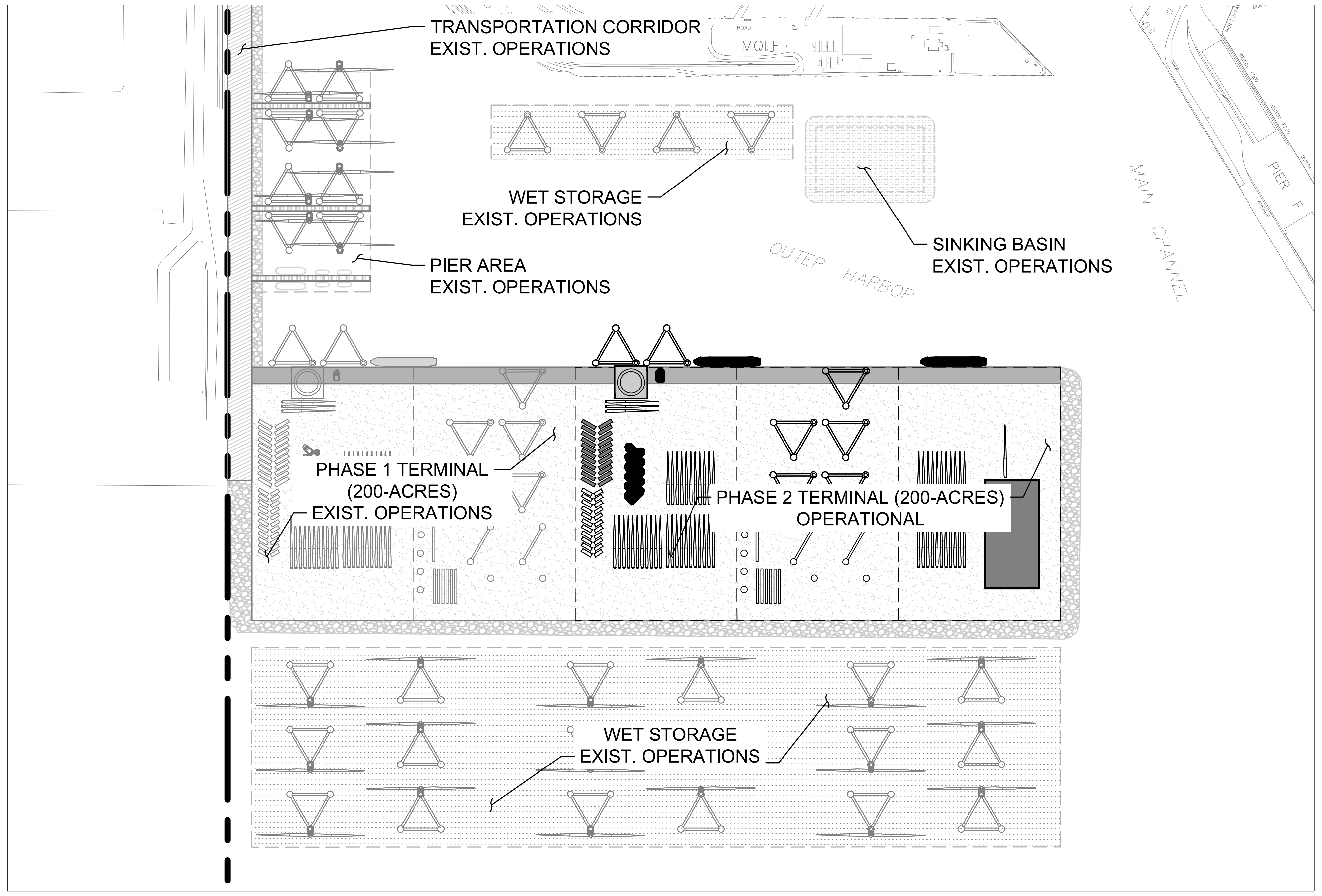
PHASE 1: UNDER CONSTRUCTION
SCALE: 1"=1000'



PHASE 1: COMPLETE, PHASE 2: UNDER CONSTRUCTION
SCALE: 1"=1000'



PHASE 1: OPERATIONAL, PHASE 2: COMPLETE
SCALE: 1"=1000'



PHASE 1 AND 2: OPERATIONAL
SCALE: 1"=1000'

NOTES

1. PHASE 1 INCLUDES THE BRIDGES, TRANSPORTATION CORRIDOR, FLOATING DOCKS, FIXED PIERS, AND WESTERN 200 ACRES OF TERMINAL.

2. PHASE 2 INCLUDES THE REMAINING 200 ACRES OF THE TERMINAL.

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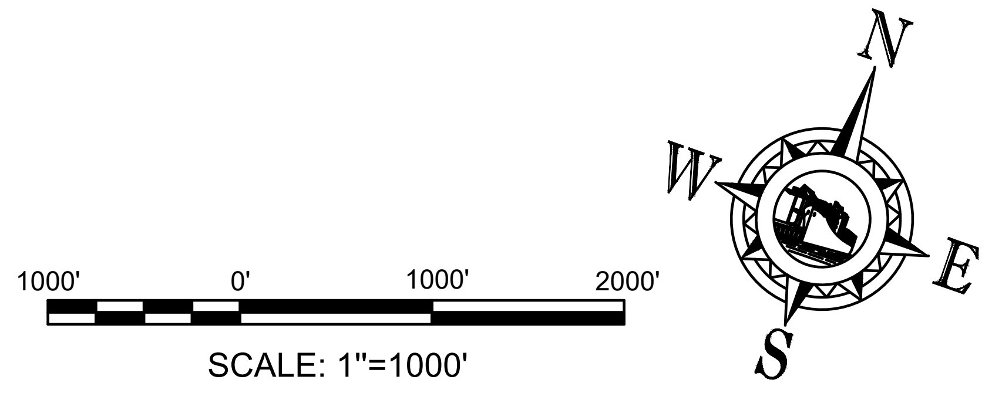


moffatt & nichol
4225 EAST CONANT STREET
LONG BEACH, CA 90808
TEL. (562) 590-6500

MARK	DATE	BY	REVISION DESCRIPTION

Suzanne Plezia
SUZANNE C. PLEZIA, P.E. NO. C-59164
SENIOR DIRECTOR/CHIEF HARBOR ENGINEER
4/21/2023
DATE

Clint Herrera
CLINT C. HERRERA, P.E. NO. C-61471
ASSISTANT DIRECTOR OF ENGINEERING DESIGN
4/21/2023
DATE

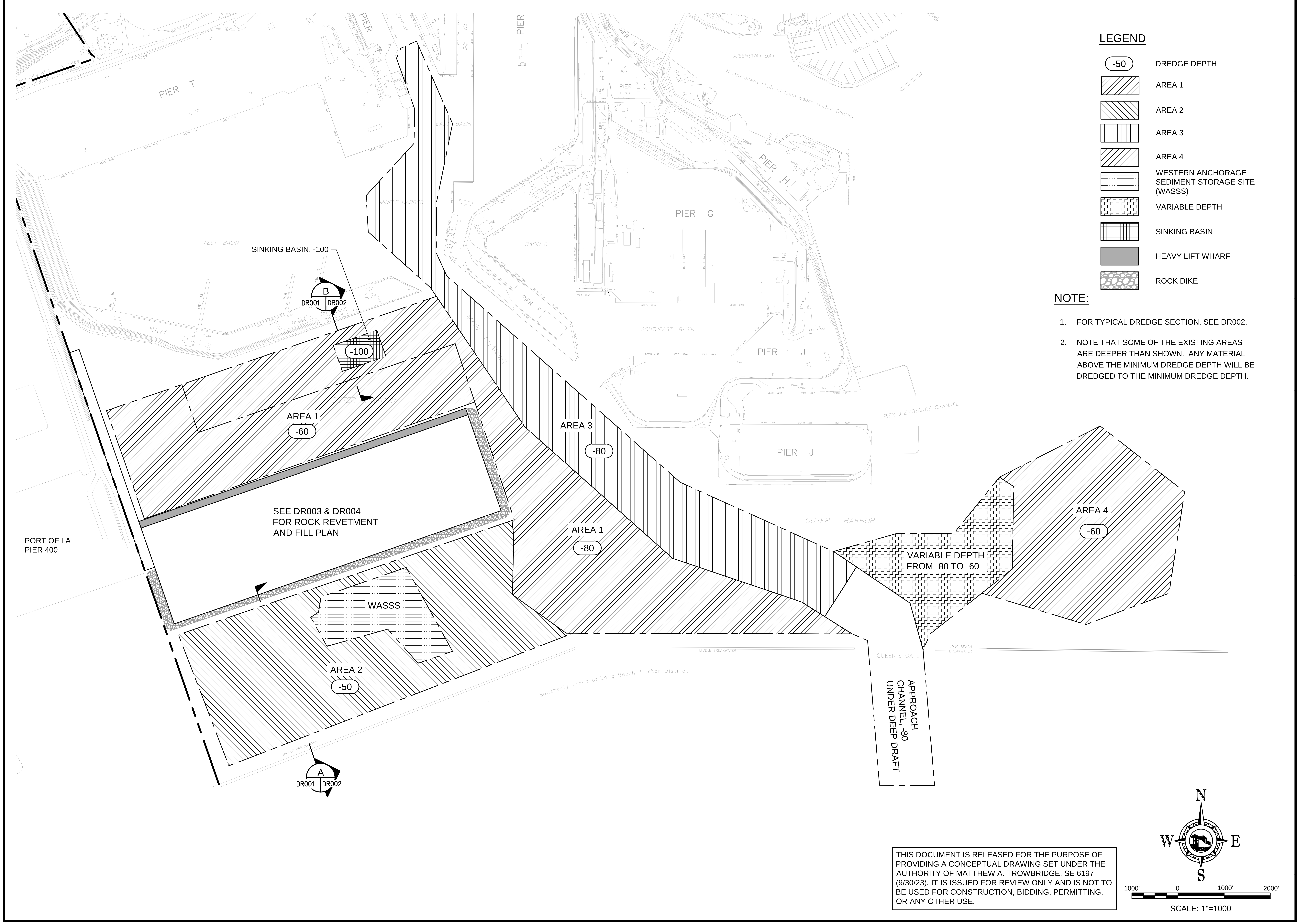
Port of
LONG BEACH
THE PORT OF CHOICE

SPEC. NO:
CADD STD. VER: –
DWG. SCALE:
EPOCH:
PROJECT MGR.: –
HORIZONTAL CONTROL: –
CONSTRUCTION REV: –
CHECKED BY:
DRAWN BY:
DESIGNED BY:
DESIGN MGR.: –
VERTICAL CONTROL:
DATE: –
DATE:
DATE:
POLB DM:
POLB PM:

PIER WIND
CONCEPT PHASE
PHASING PLAN

10-02445-GN006
SHEET 6 OF 17

File: Q:\LB\10800-24\20 CADD_Active_SheetSet\10-XXXXX-GN006 ; Plotted: 4/19/2023 1:21 AM by LIM, JENNIFER ; Saved: 4/18/2023 11:17 PM by JLIM



LEGEND

-50	DREDGE DEPTH
▨	AREA 1
▧	AREA 2
▥	AREA 3
▨	AREA 4
▤	WESTERN ANCHORAGE SEDIMENT STORAGE SITE (WASSS)
▨	VARIABLE DEPTH
▦	SINKING BASIN
■	HEAVY LIFT WHARF
▩	ROCK DIKE

NOTE:

1. FOR TYPICAL DREDGE SECTION, SEE DR002.
2. NOTE THAT SOME OF THE EXISTING AREAS ARE DEEPER THAN SHOWN. ANY MATERIAL ABOVE THE MINIMUM DREDGE DEPTH WILL BE DREDGED TO THE MINIMUM DREDGE DEPTH.

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SENIOR DIRECTOR/CHIEF HARBOR ENGINEER DATE

Clint Herrera 4/21/2023
CLINT C. HERRERA, P.E. NO. C-61471
ASSISTANT DIRECTOR OF ENGINEERING DESIGN DATE

Port of
LONG BEACH
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SPEC. NO:
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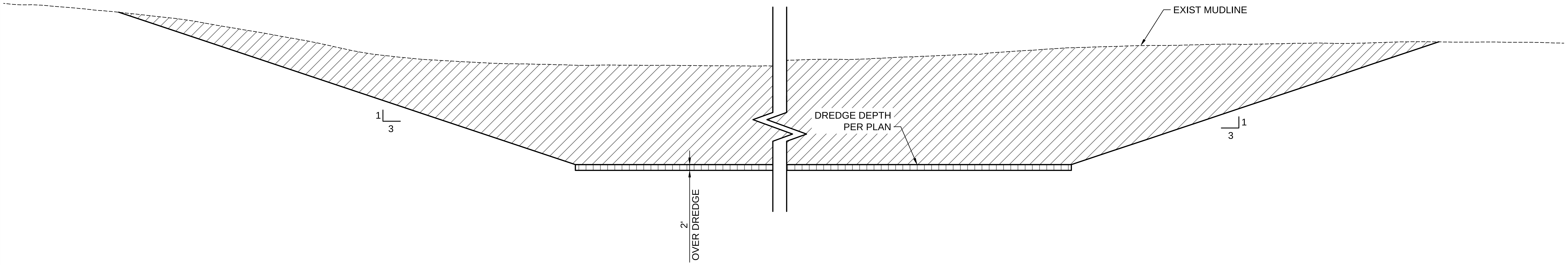
EPOCH:
PROJECT MGR.: –
HORIZONTAL CONTROL: –
CONSTRUCTION REV: – DATE: –
CHECKED BY: DATE:
DRAWN BY: DATE:
DESIGNED BY: POLB DM:
DESIGN MGR.: – POLB PM:
VERTICAL CONTROL:

PIER WIND
CONCEPT PHASE
DREDGE PLAN

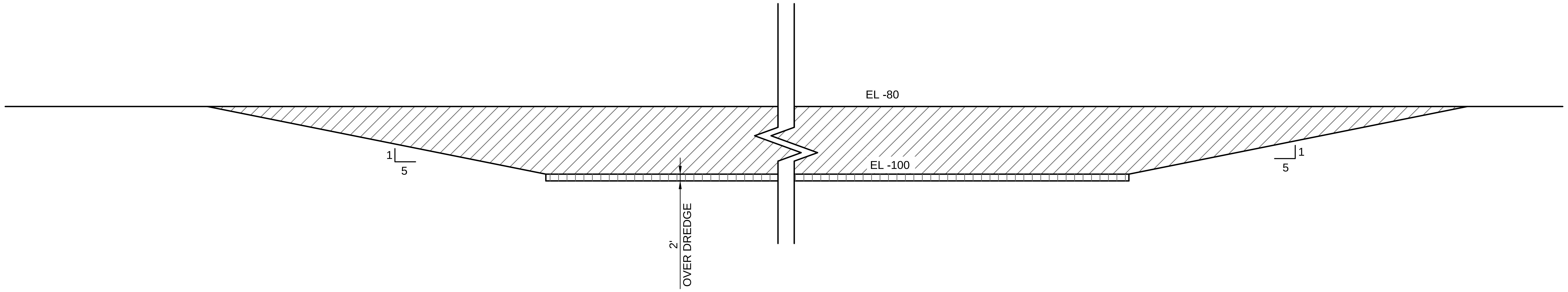
10–02445–DR001
SHEET 7 OF 17



A
DR001 | DR002

TYPICAL DREDGE SECTION

SCALE: 1" = 20'



B
DR001 | DR002

SINKING BASIN SECTION

SCALE: 1" = 20'

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SENIOR DIRECTOR/CHIEF HARBOR ENGINEER
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Clint Herrera 4/21/2023
CLINT C. HERRERA, P.E. NO. C-61471
ASSISTANT DIRECTOR OF ENGINEERING DESIGN
DATE

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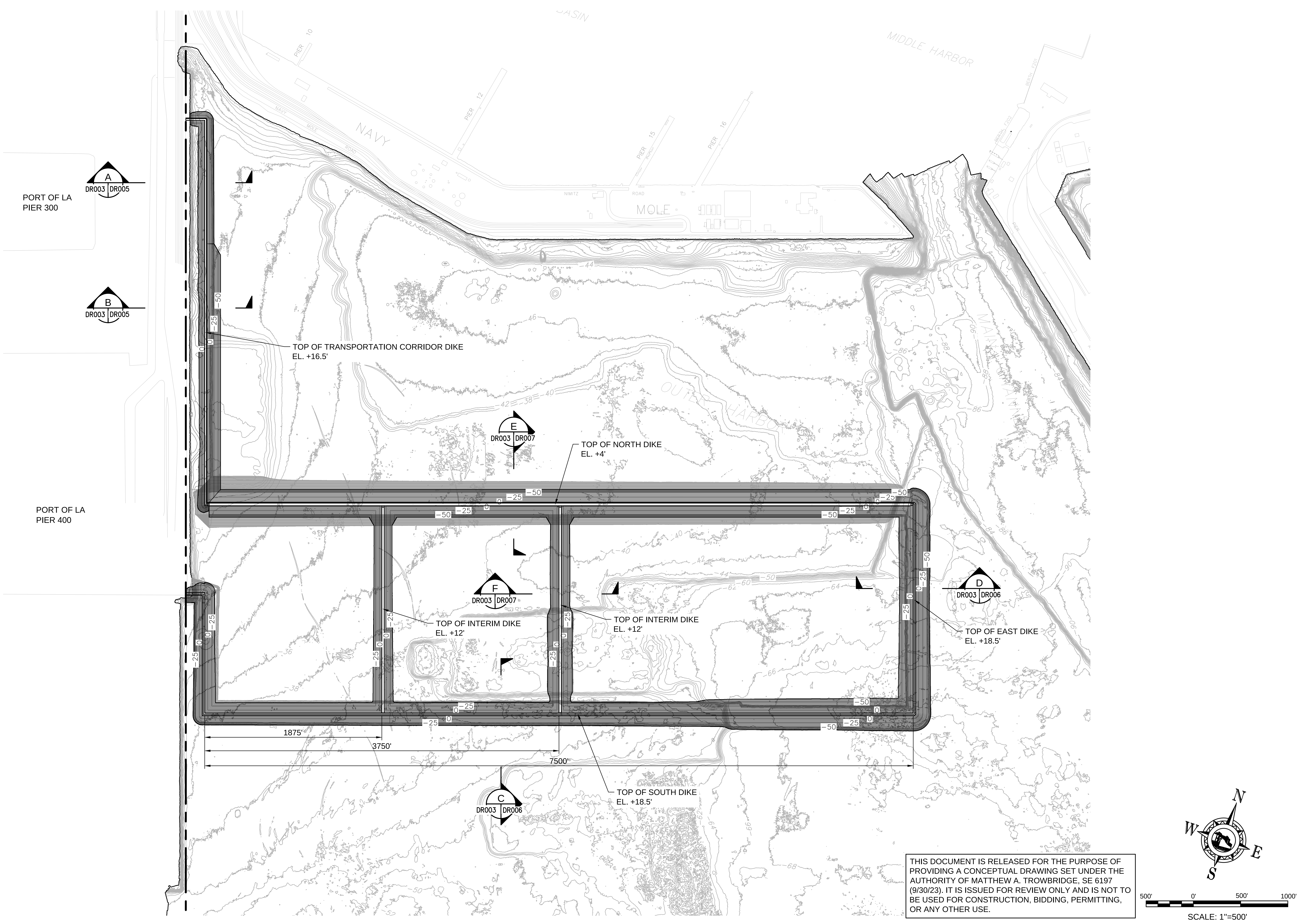
HORIZONTAL CONTROL: –
CONSTRUCTION REV: –
CHECKED BY:
DRAWN BY:
DESIGNED BY:
DESIGN MGR.: –
VERTICAL CONTROL:
DATE: –
DATE:
DATE:
POLB DM:
POLB PM:

PIER WIND
CONCEPT PHASE
TYPICAL DREDGE SECTIONS

10-02445-DR002
SHEET 8 OF 17

File: Q:\LB\10800-24\20 CADD_Active_SheetSet\10800-24-DR002 ; Plotted: 4/19/2023 6:31 PM by LIM, GEE ; Saved: 4/19/2023 2:23 AM by JLIM__



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4/21/2023
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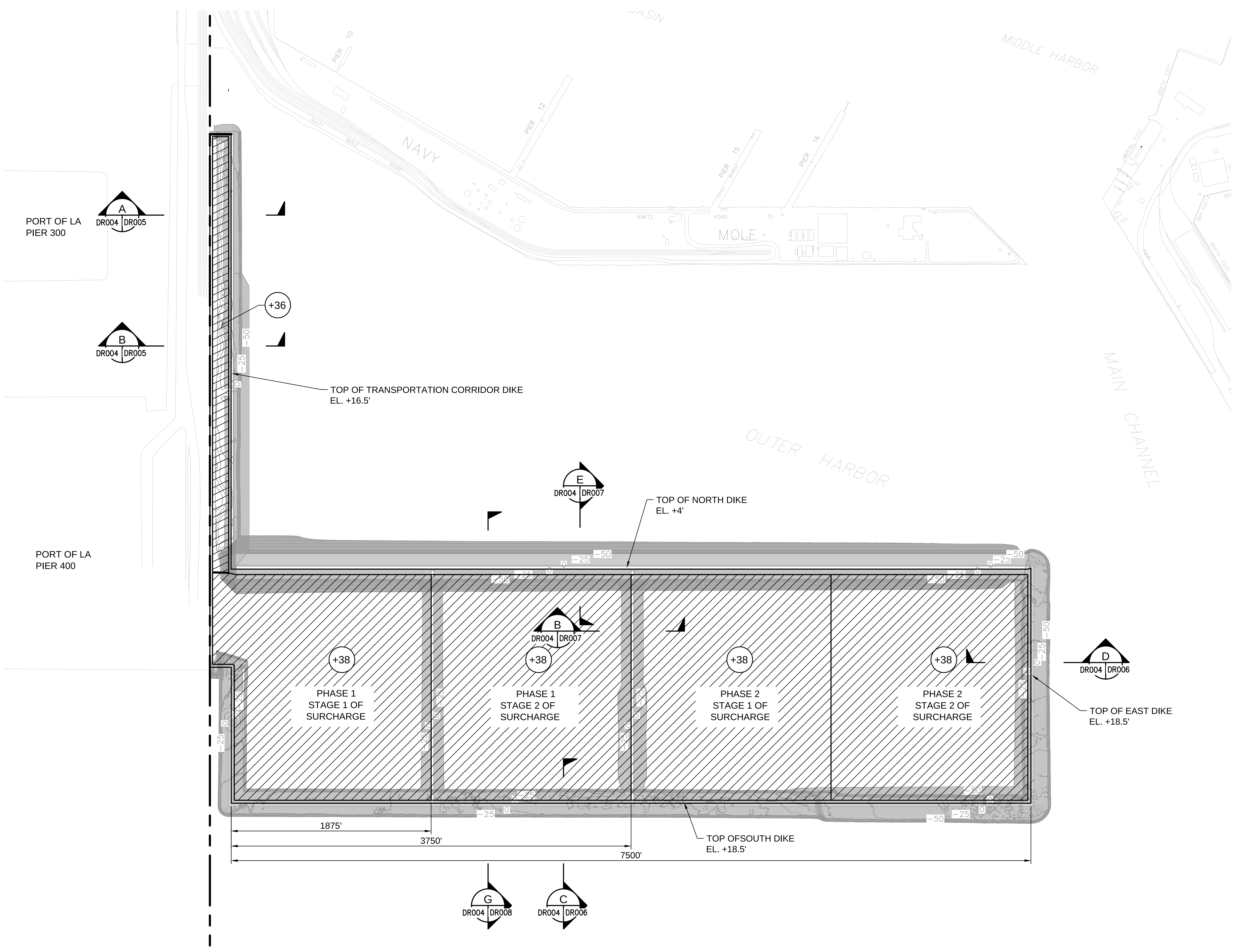
EPOCH:
PROJECT MGR.: -
HORIZONTAL CONTROL: -

CONSTRUCTION REV: - DATE: -
CHECKED BY: DATE:
DRAWN BY: DATE:
DESIGNED BY: POLB DM:
DESIGN MGR.: - POLB PM:
VERTICAL CONTROL:

PIER WIND
CONCEPT PHASE
ROCK REVETMENT PLAN

10-02445-DR003
SHEET 9 OF 17

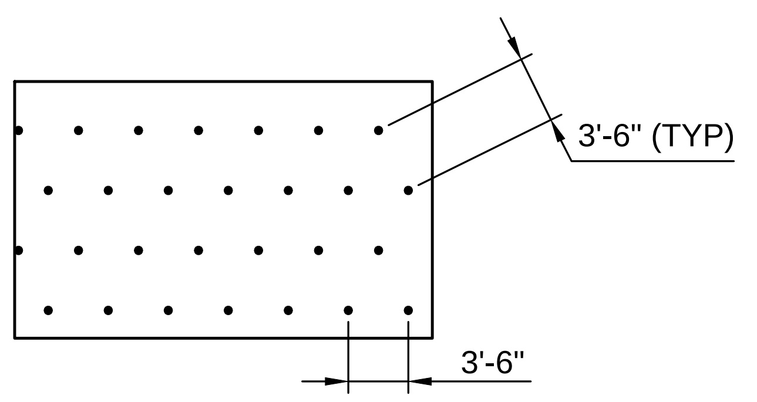


LEGEND

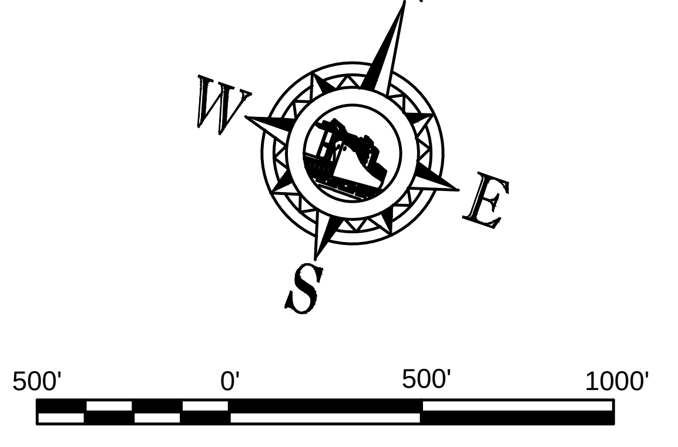
▨	SURCHARGE
(+38)	SURCHARGE ELEVATION

NOTES

1. WICK DRAINS ARE INSTALLED PRIOR TO SURCHARGE IS BROUGHT ON. SEE WICK DRAIN LAYOUT ON THIS SHEET.
2. SURCHARGE ELEVATION IS APPROXIMATELY 20 FEET ABOVE THE FINAL FINISHED GRADE. REQUIRED SETTLEMENT PERIOD IS 7 MONTHS.
3. SURCHARGE FOR THE TRANSPORTATION CORRIDOR IS PLACED AND REMOVED DURING PHASE 1.
4. SURCHARGE FOR THE TERMINAL IS PERFORMED IN FOUR STAGES - TWO STAGES IN EACH PHASE.
    - A. PHASE 1 / STAGE 1 = SURCHARGE IS PLACED ON THE FIRST 100 ACRES OF THE TERMINAL.
    - B. PHASE 1 / STAGE 2 = SURCHARGE FROM PHASE 1 / STAGE 1 IS ROLLED OVER TO THE SECOND 100 ACRES OF THE TERMINAL. FOLLOWING THE SETTLEMENT PERIOD, THIS SURCHARGE WILL BE ROLLED OVER AS GENERAL FILL TO THE PHASE 2, STAGE 1 AND STAGE 2 AREAS.
    - C. PHASE 2 / STAGE 1 = SURCHARGE IS PLACED OVER THE THIRD 100 ACRES OF THE TERMINAL.
    - D. PHASE 2 / STAGE 2 = SURCHARGE FROM PHASE 2 / STAGE 1 IS ROLLED OVER TO THE FINAL 100 ACRES OF THE TERMINAL AND THEN REMOVED.



WICK DRAIN LAYOUT
SCALE: NTS



SCALE: 1"=500'

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LONG BEACH, CA 90808
TEL. (562) 590-6500

MARK	DATE	BY	REVISION DESCRIPTION

SUZANNE C. PLEZIA, P.E. NO. C-59164
SENIOR DIRECTOR/CHIEF HARBOR ENGINEER
4/21/2023
DATE

Clint Herrera
CLINT C. HERRERA, P.E. NO. C-61471
ASSISTANT DIRECTOR OF ENGINEERING DESIGN
4/21/2023
DATE

Port of
LONG BEACH
THE PORT OF CHOICE

SPEC. NO:	CONSTRUCTION REV: -	DATE: -
CADD STD. VER: -	CHECKED BY:	DATE:
DWG. SCALE:	DRAWN BY:	DATE:
EPOCH:	DESIGNED BY:	POLB DM:
PROJECT MGR.: -	DESIGN MGR.: -	POLB PM:
HORIZONTAL CONTROL: -	VERTICAL CONTROL:	

PIER WIND
CONCEPT PHASE
FILL AND SURCHARGE PLAN

10-02445-DR004
SHEET 10 OF 17

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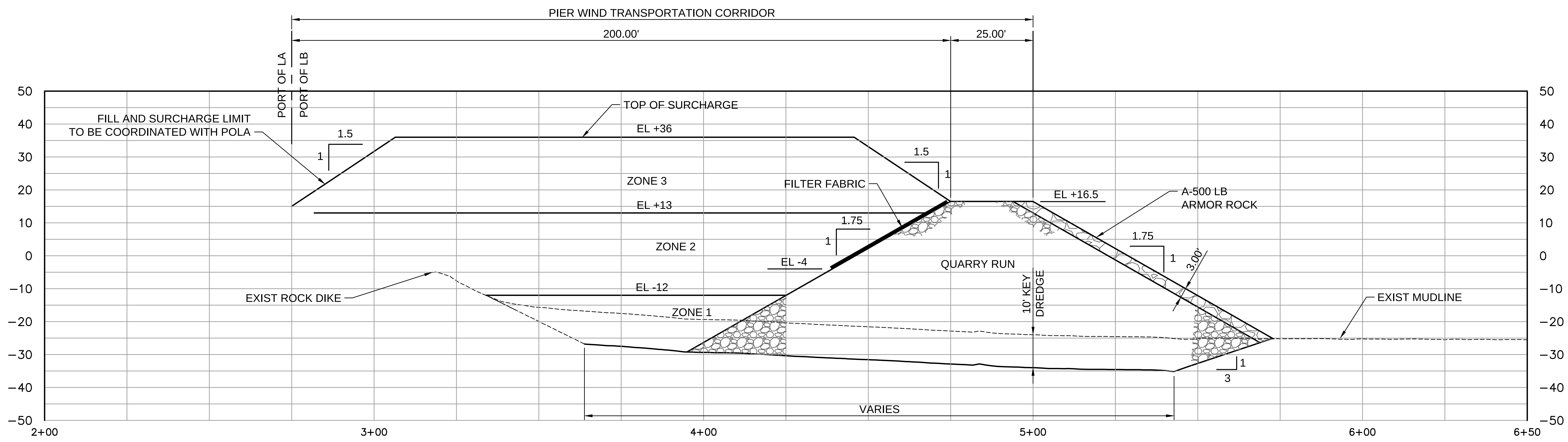
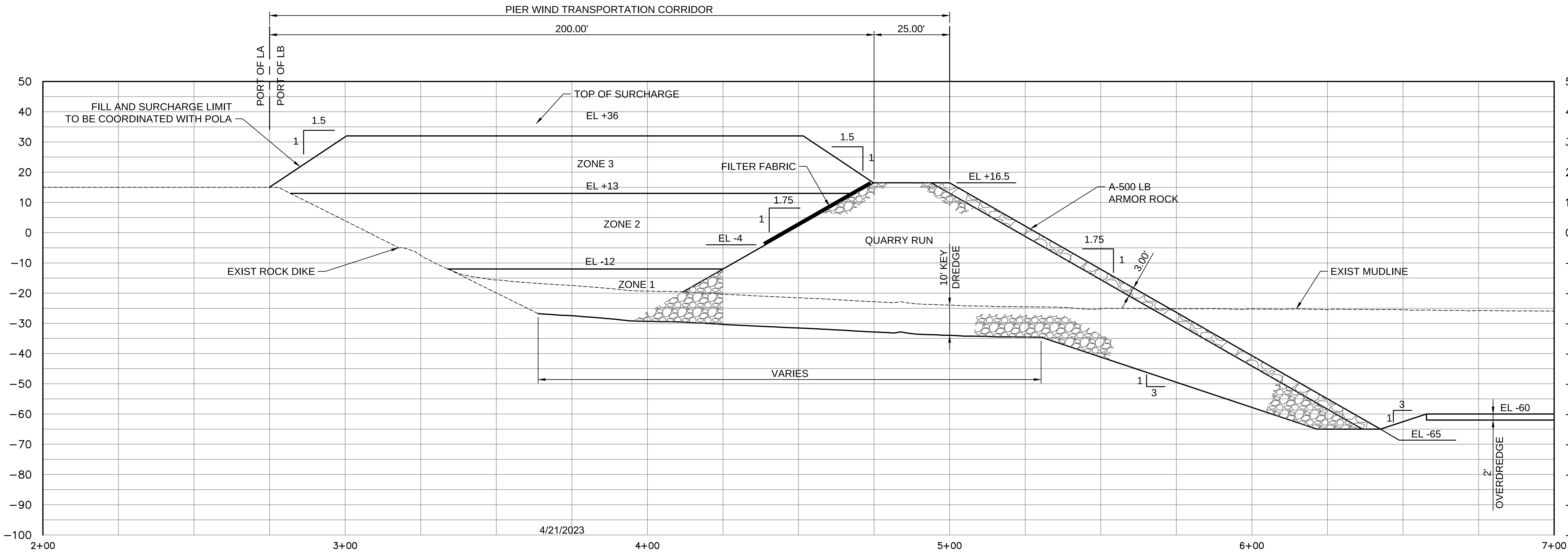


A SECTION
SCALE: 1" = 20'
DR003 DR005
DR004



B SECTION
SCALE: 1" = 20'
DR003 DR005
DR004

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Suzanne C. Plezia
SUZANNE C. PLEZIA, P.E. NO. C-59164
SENIOR DIRECTOR/CHIEF HARBOR ENGINEER
4/21/2023
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CLINT C. HERRERA, P.E. NO. C-61471
ASSISTANT DIRECTOR OF ENGINEERING DESIGN
4/21/2023
DATE

Port of
LONG BEACH
THE PORT OF CHOICE

SPEC. NO:
CADD STD. VER: –
DWG. SCALE:
EPOCH:
PROJECT MGR.: –
HORIZONTAL CONTROL: –
CONSTRUCTION REV: –
DATE: –
CHECKED BY:
DATE:
DRAWN BY:
DATE:
DESIGNED BY:
POLB DM:
DESIGN MGR.: –
POLB PM:
VERTICAL CONTROL:

PIER WIND
CONCEPT PHASE
ROCK REVETMENT, FILL & SURCHARGE SECTION 1

10–02445–DR005
SHEET 11 OF 17

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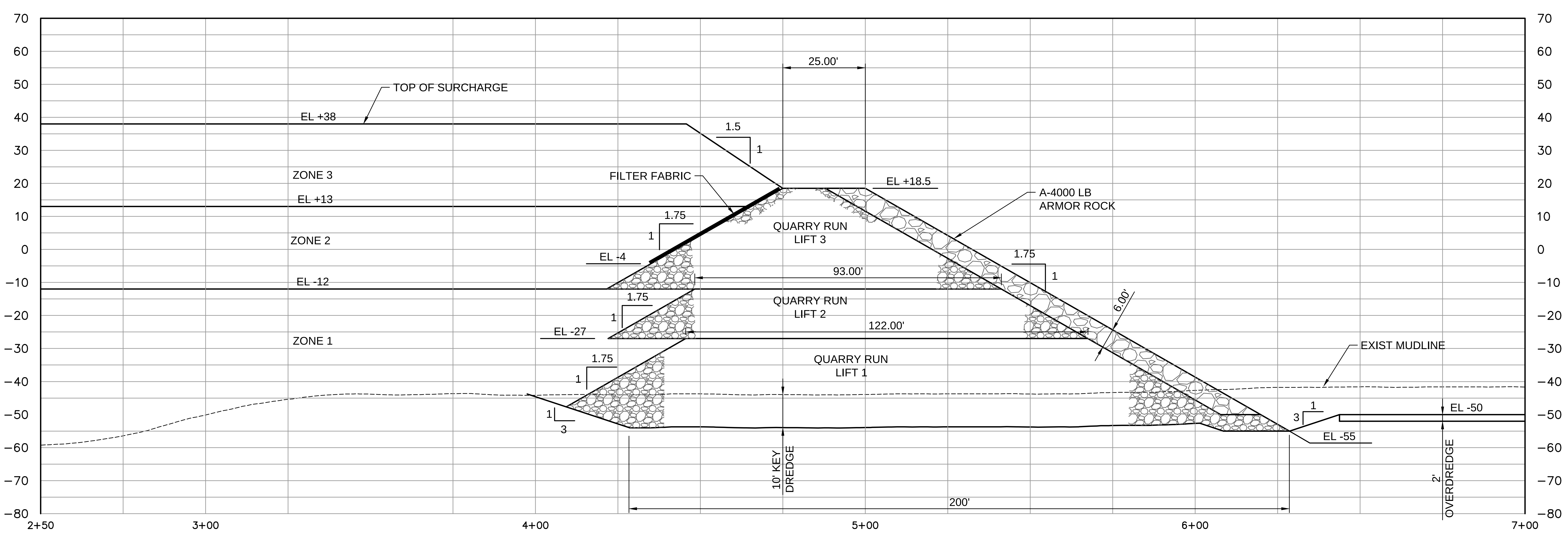

C
DR003 DR006
DR004

SECTION

SCALE: 1" = 20'

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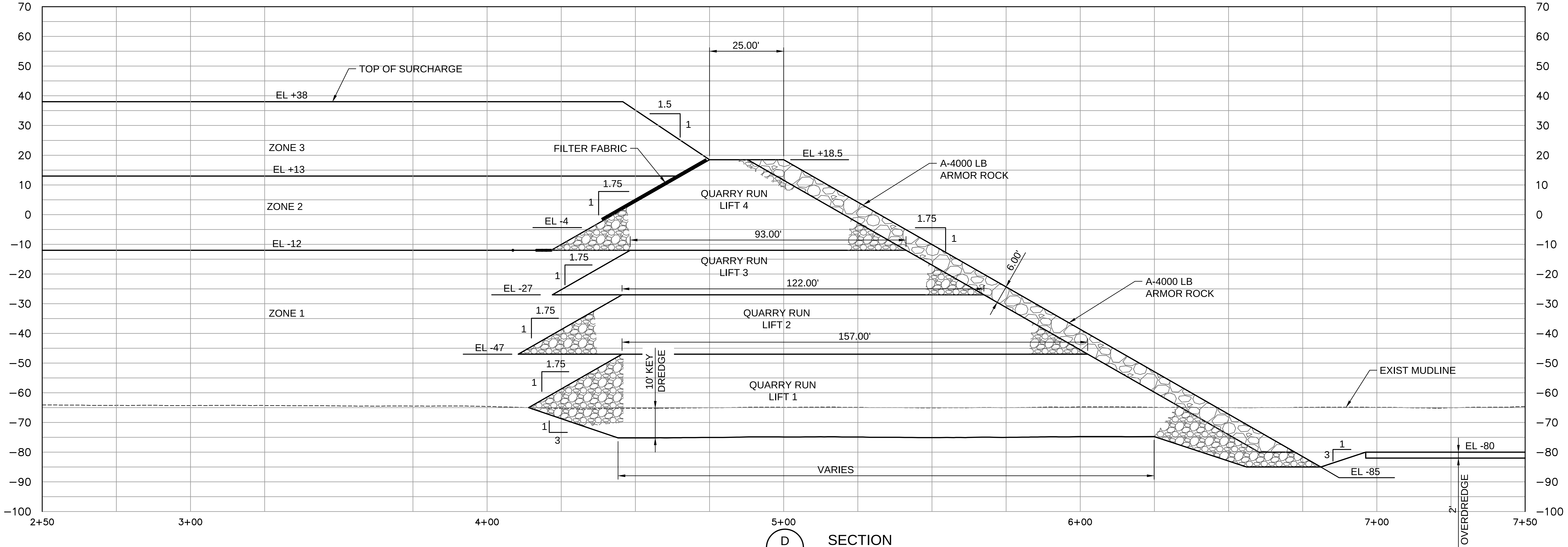

D
DR003 DR006
DR004

SECTION

SCALE: 1" = 20'

7+00

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LONG BEACH, CA 90808
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MARK | DATE | BY | REVISION DESCRIPTION

SUZANNE C. PLEZIA, P.E. NO. C-59164
SENIOR DIRECTOR/CHIEF HARBOR ENGINEER
4/21/2023
DATE

Clint Herrera
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ASSISTANT DIRECTOR OF ENGINEERING DESIGN
4/21/2023
DATE

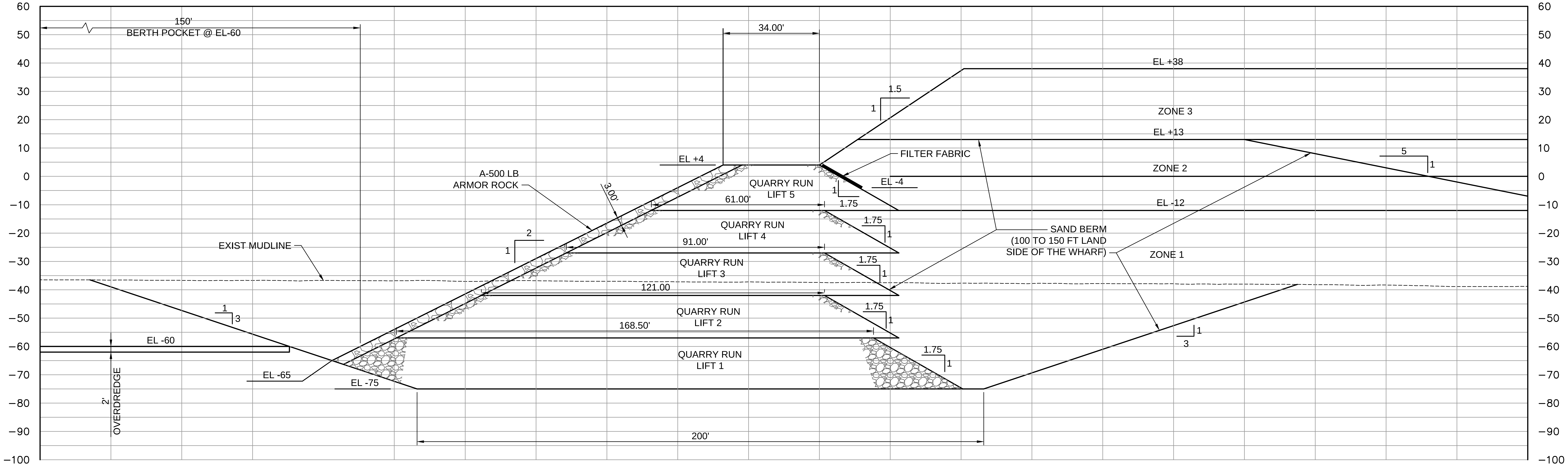
Port of LONG BEACH
THE PORT OF CHOICE

SPEC. NO:
CADD STD. VER: –
DWG. SCALE:
EPOCH:
PROJECT MGR.: –
HORIZONTAL CONTROL: –
CONSTRUCTION REV: –
CHECKED BY:
DRAWN BY:
DESIGNED BY:
DESIGN MGR.: –
VERTICAL CONTROL:
DATE: –
DATE:
DATE:
POLB DM:
POLB PM:

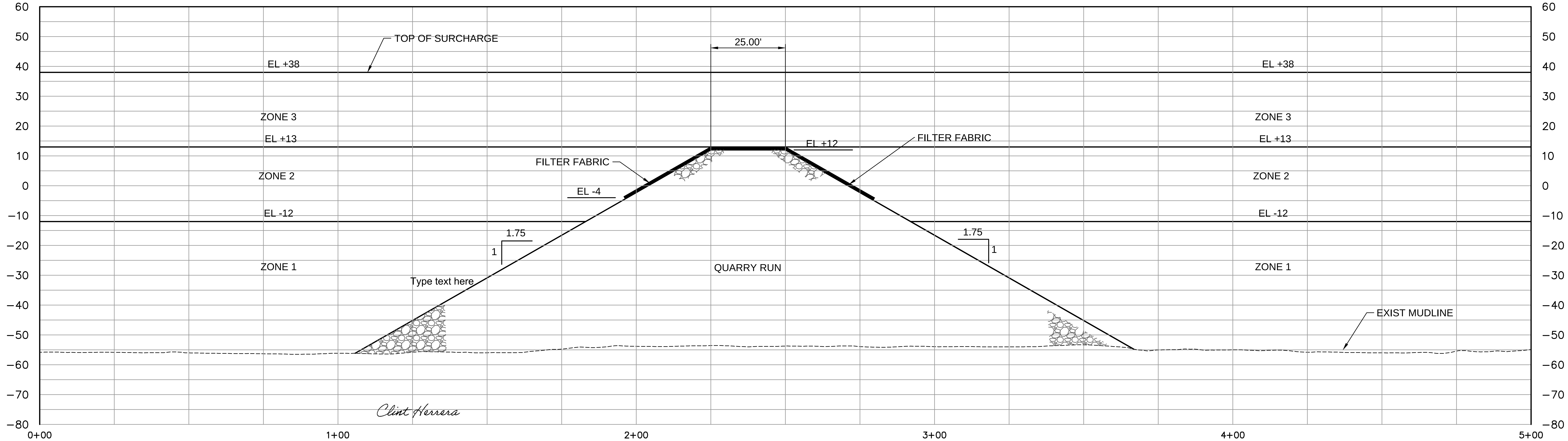
PIER WIND
CONCEPT PHASE
ROCK REVETMENT, FILL & SURCHARGE SECTION 2

10-02445-DR006
SHEET 12 OF 17

File: Q:\LB\10800-24\20 CADD_Active_SheetSet\10800-24-DR006 ; Plotted: 4/19/2023 7:17 PM by LIM, GEE ; Saved: 4/19/2023 2:21 AM by JLIM



E SECTION
DR003 DR007
DR004
SCALE: 1" = 20'



F SECTION
DR003 DR007
DR004
SCALE: 1" = 20'

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4/21/2023
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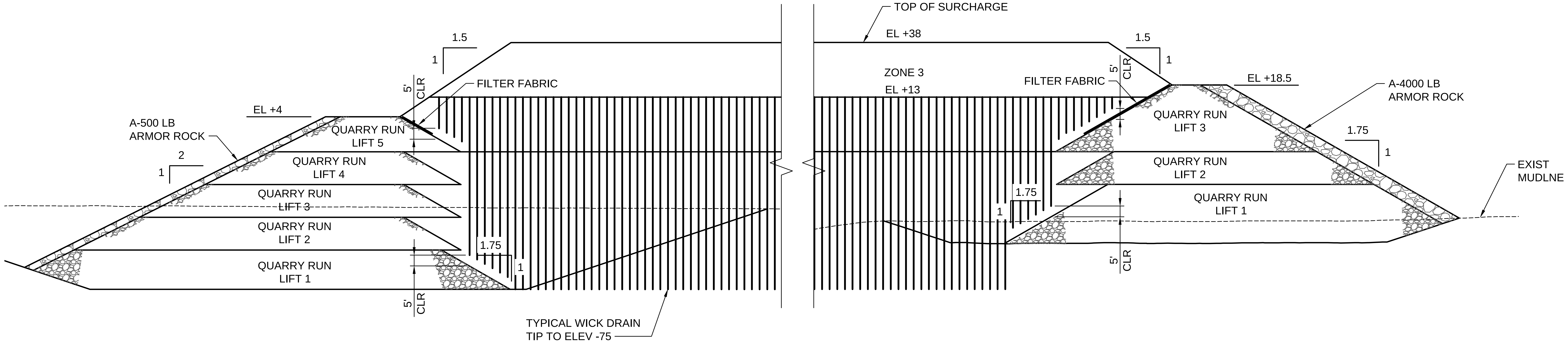
Port of
LONG BEACH
THE PORT OF CHOICE

SPEC. NO:
CADD STD. VER: –
DWG. SCALE:
EPOCH:
PROJECT MGR.: –
HORIZONTAL CONTROL: –
CONSTRUCTION REV: –
CHECKED BY:
DRAWN BY:
DESIGNED BY:
DESIGN MGR.: –
VERTICAL CONTROL:
DATE: –
DATE:
DATE:
POLB DM:
POLB PM:

PIER WIND
CONCEPT PHASE
ROCK REVETMENT, FILL & SURCHARGE SECTION 3

10-02445-DR007
SHEET 13 OF 17



G
DR004 | DR008

SECTION
SCALE: 1" = 30'

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30' 0' 30' 60'
SCALE: 1"=30'

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LONG BEACH, CA 90808
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EPOCH:
PROJECT MGR.: –
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CONSTRUCTION REV: –
CHECKED BY:
DRAWN BY:
DESIGNED BY:
DESIGN MGR.: –
VERTICAL CONTROL:
DATE: –
DATE:
DATE:
POLB DM:
POLB PM:

PIER WIND
CONCEPT PHASE
WICK DRAIN SECTION

10–02445–DR008
SHEET 14 OF 17

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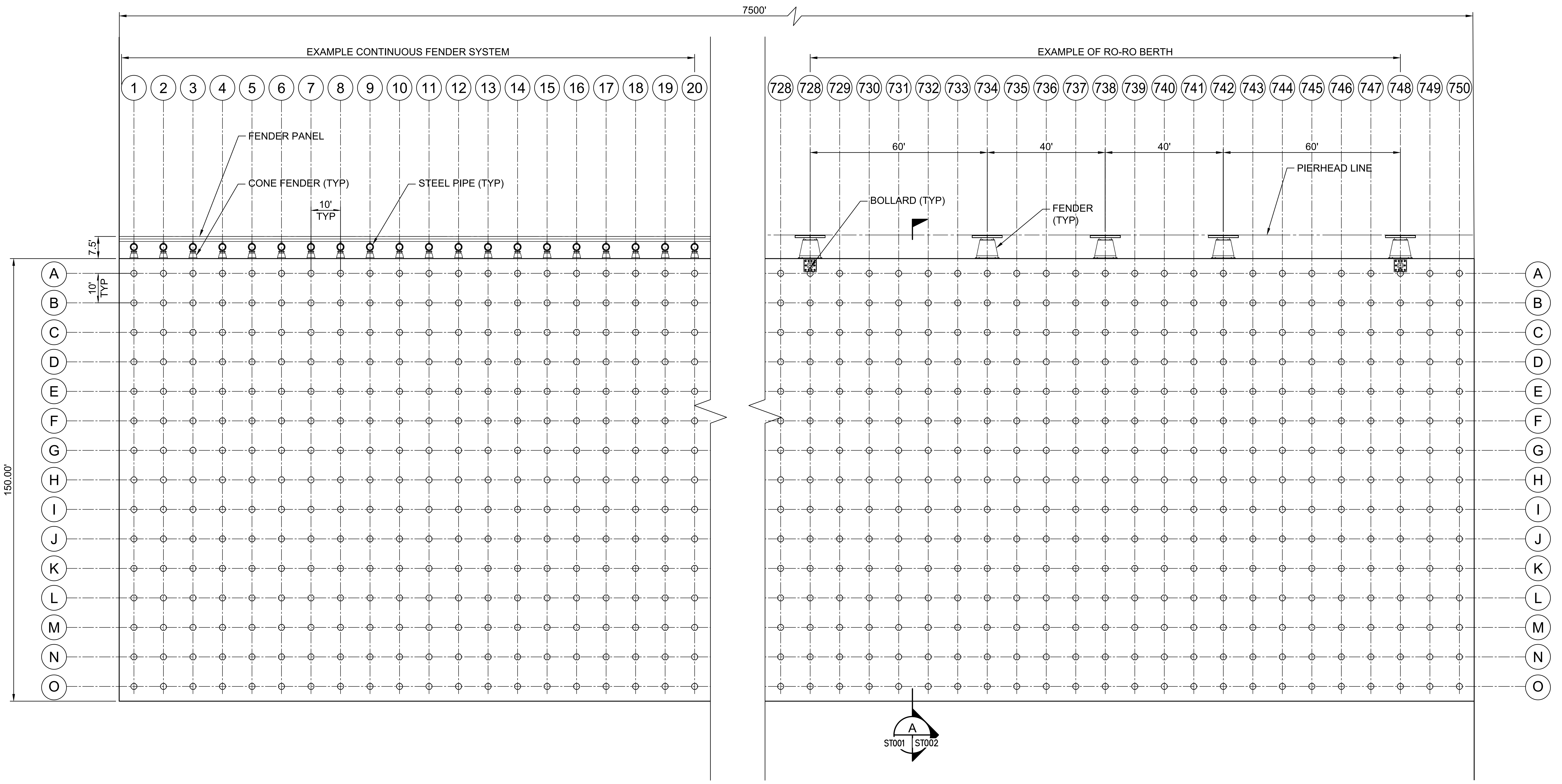

NOTES

1. PILE LAYOUT IS PRELIMINARY AND BASED ON LIVE LOAD OF 6,000 PSF.
2. PILE TYPES CONSIDERED INCLUDE 28-IN PC/PS OCTAGONAL CONCRETE, 30-IN PC/PS OCTAGONAL CONCRETE, 30-IN DIAMETER STEEL PIPE PILES. PILE TYPE WILL BE FURTHER ANALYZED IN THE NEXT PHASE OF THE PROJECT.
3. WHARF SURFACE SHALL BE 3-FT OF DENSE GRADE AGGREGATE.
4. FENDER SYSTEMS SHOWN ARE EXAMPLES OF THE POSSIBLE VARIOUS TYPES. THE FENDER SYSTEM IS PRELIMINARY AND WILL BE FURTHER EVALUATED TO MEET THE NEEDS OF THE OFFSHORE WIND INDUSTRY.

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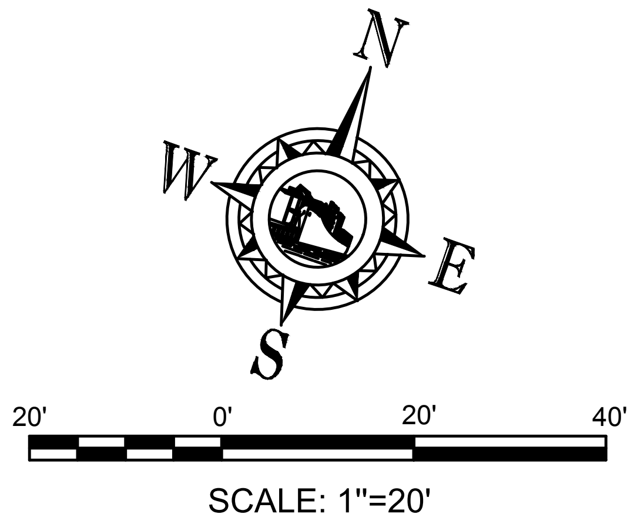

SCALE: 1"=20'

moffatt & nichol
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4/21/2023 DATE

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Port of LONG BEACH
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CONSTRUCTION REV:- DATE:-
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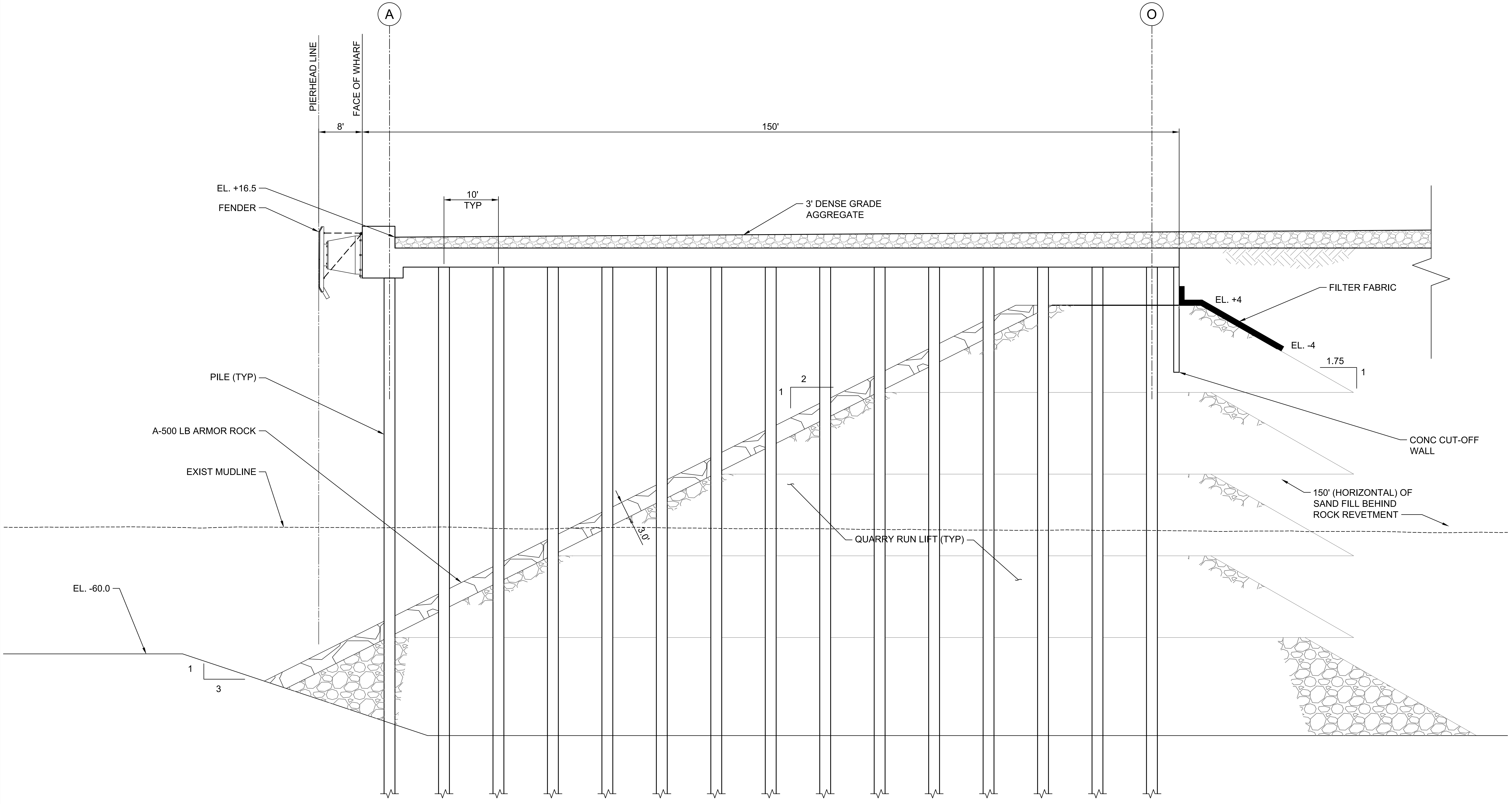
DESIGN MGR.:- POLB PM:
VERTICAL CONTROL:

PIER WIND
CONCEPT PHASE
WHARF GENERAL PLAN

10-02445-ST001
SHEET 15 OF 17

NOTES

1. WHARF SECTION AND FENDER SYSTEM SHOWN IS FOR AN EXAMPLE RO-RO BERTH.
2. THE FENDER SYSTEM IS PRELIMINARY AND WILL BE FURTHER EVALUATED TO MEET THE NEEDS OF THE OFFSHORE WIND INDUSTRY.



A SECTION
SCALE: 1" = 10'
ST001 ST002

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10' 0' 10' 20'
SCALE: 1"=10'

moffatt & nichol
4225 EAST CONANT STREET
LONG BEACH, CA 90808
TEL. (562) 590-6500

MARK	DATE	BY	REVISION DESCRIPTION

Suzanne C. Plezia 4/21/2023
SUZANNE C. PLEZIA, P.E. NO. C-59164
SENIOR DIRECTOR/CHIEF HARBOR ENGINEER
DATE

Clint Herrera 4/21/2023
CLINT C. HERRERA, P.E. NO. C-61471
ASSISTANT DIRECTOR OF ENGINEERING DESIGN
DATE

Port of
LONG BEACH
THE PORT OF CHOICE

SPEC. NO:
CADD STD. VER: -
DWG. SCALE:
EPOCH:
PROJECT MGR.:-
HORIZONTAL CONTROL: -
CONSTRUCTION REV:- DATE:-
CHECKED BY: DATE:
DRAWN BY: DATE:
DESIGNED BY: POLB DM:
DESIGN MGR.:- POLB PM:
VERTICAL CONTROL:

PIER WIND
CONCEPT PHASE
WHARF SECTION

10-02445-ST002
SHEET 16 OF 17

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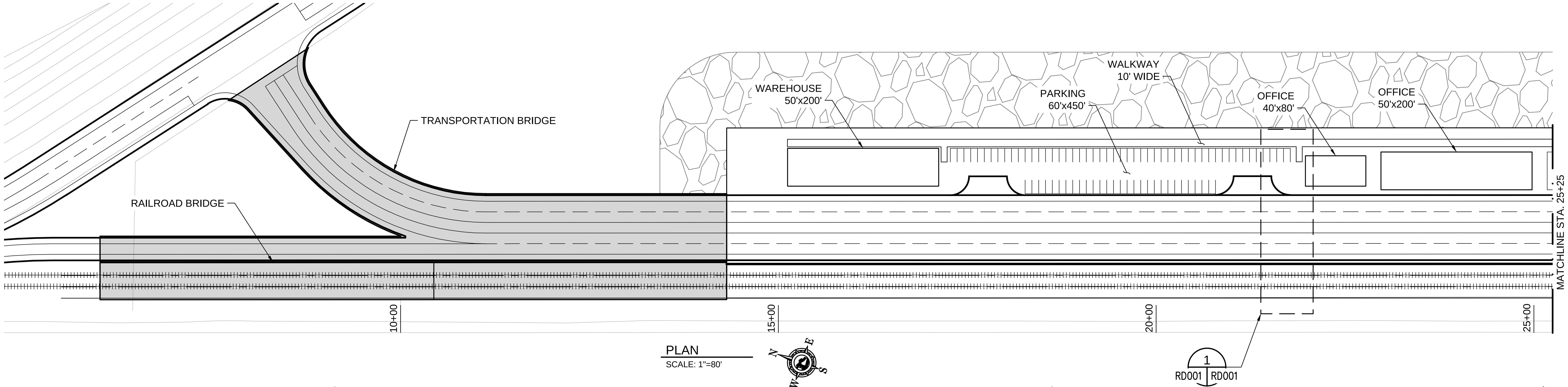

PLAN
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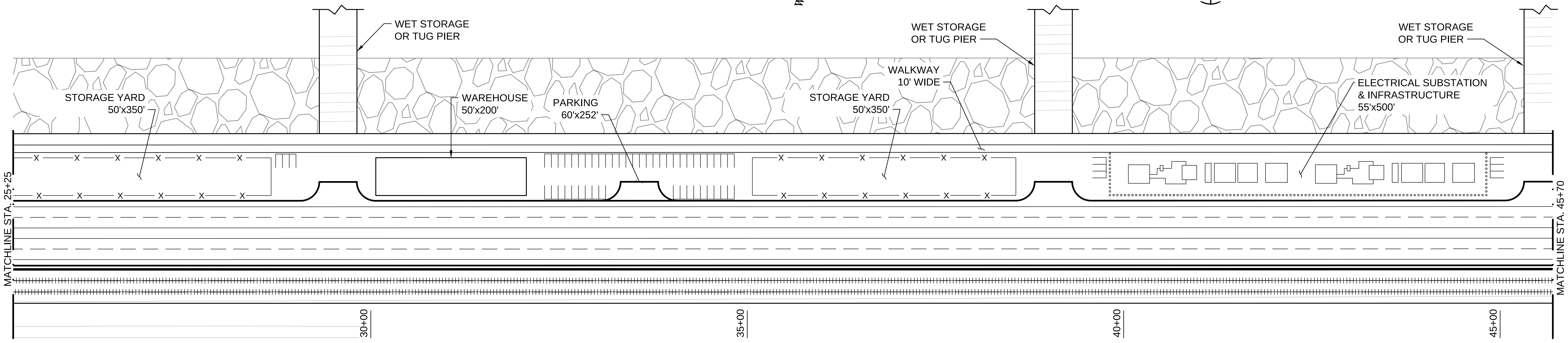

PLAN
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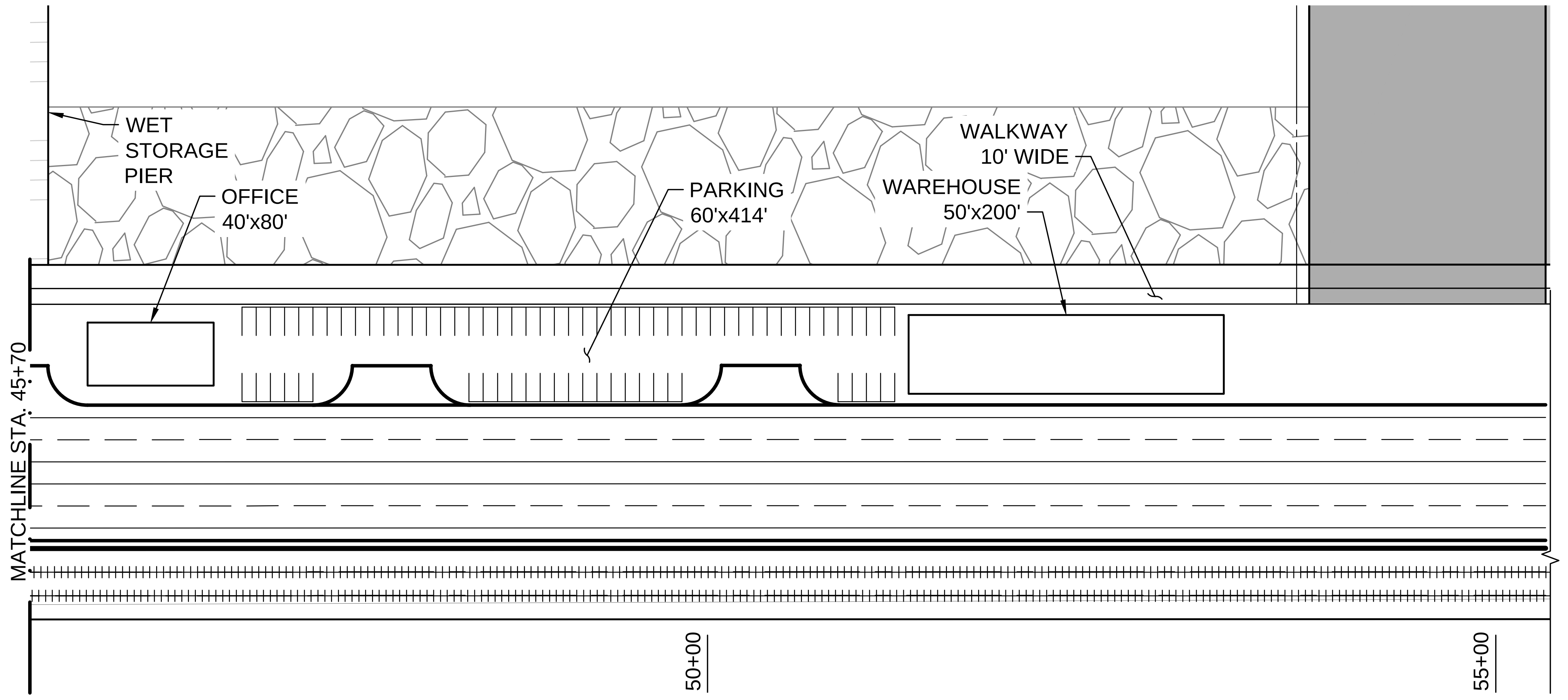

PLAN
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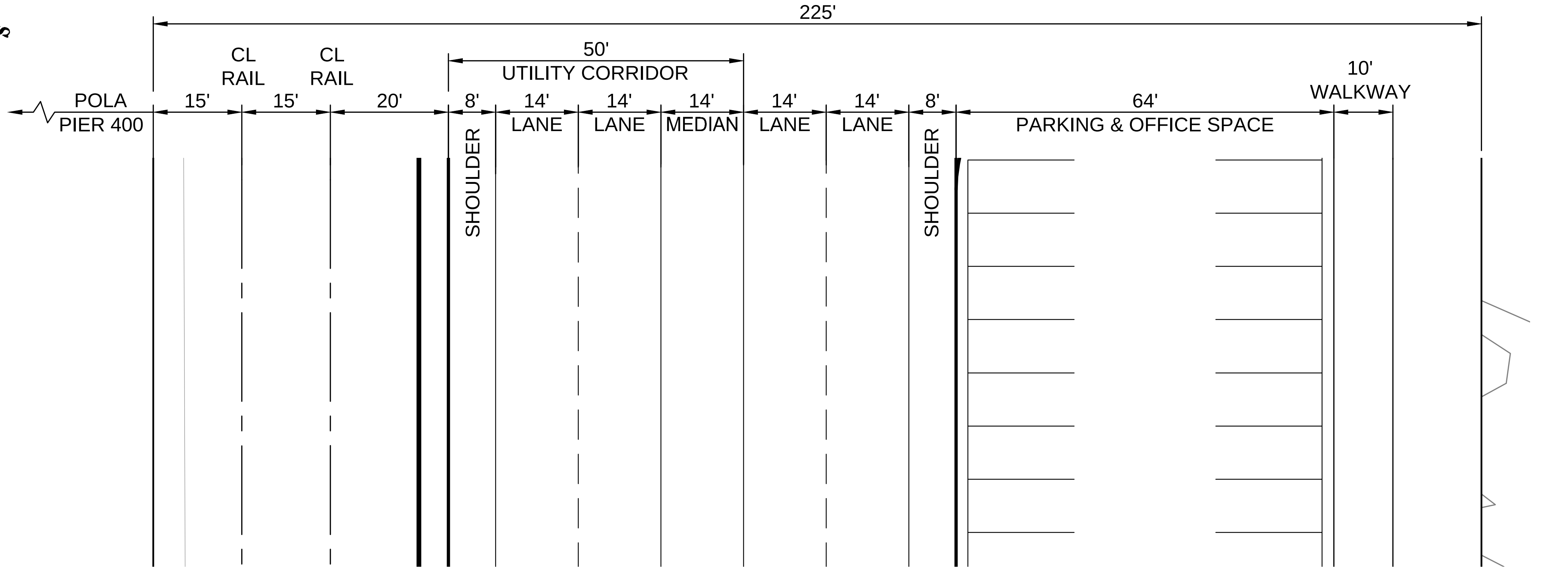

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RD001 RD001
ENLARGED PLAN
SCALE: 1" = 20'

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80' 0' 80' 160'
SCALE: 1"=80'

20' 0' 20' 40'
SCALE: 1"=20'

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LONG BEACH, CA 90808
TEL. (562) 590-6500

MARK	DATE	BY	REVISION DESCRIPTION

SUZANNE C. PLEZIA, P.E. NO. C-59164
SENIOR DIRECTOR/CHIEF HARBOR ENGINEER
4/21/2023
DATE

Clint Herrera
CLINT C. HERRERA, P.E. NO. C-61471
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DRAWN BY:
DESIGNED BY:
DESIGN MGR.: –
VERTICAL CONTROL:
DATE: –
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POLB DM:
POLB PM:

PIER WIND
CONCEPT PHASE
TRANSPORTATION CORRIDOR PLAN

10-02445-RD001
SHEET 17 OF 17

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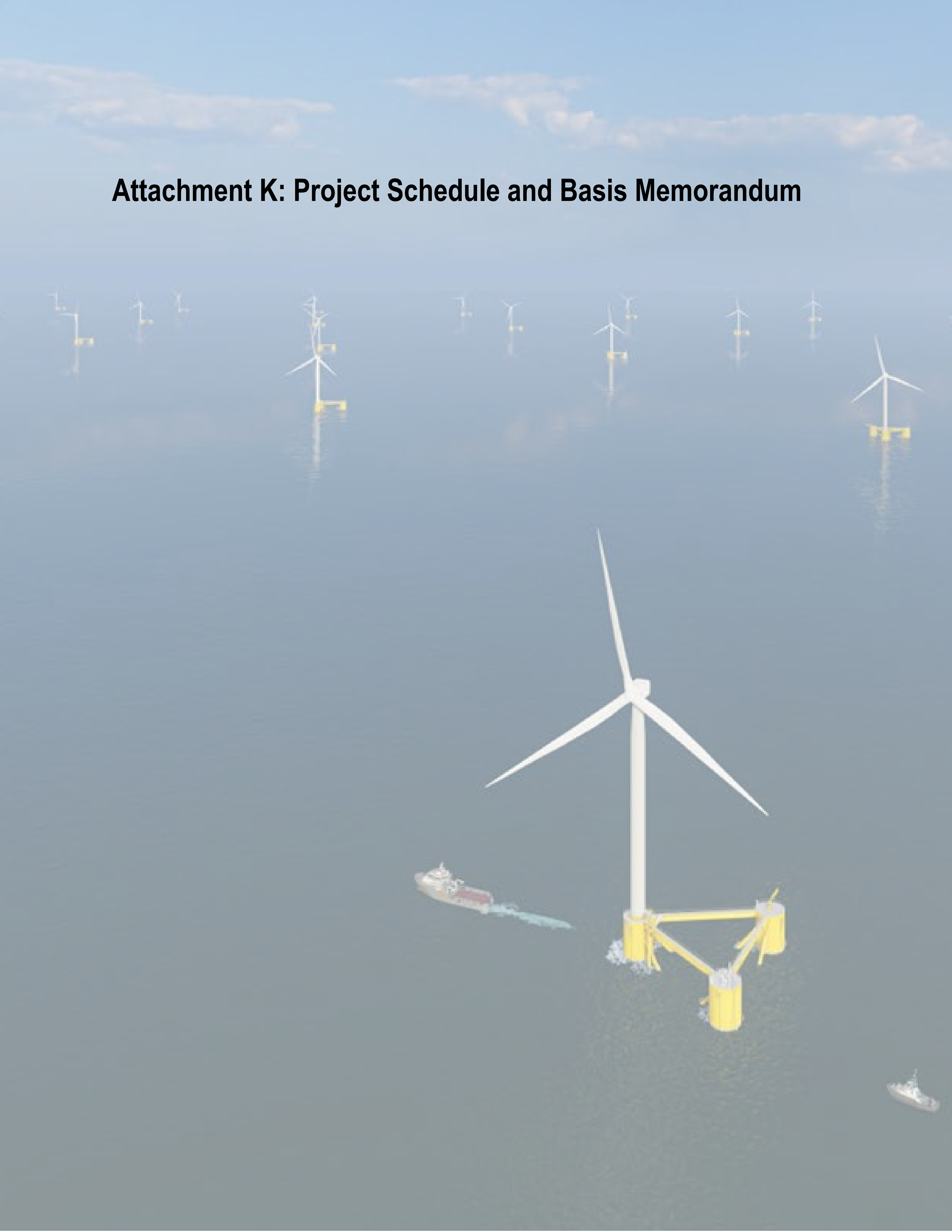
Attachment K: Project Schedule and Basis Memorandum



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4225 E. Conant Street
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PROJECT SCHEDULE MEMORANDUM

To: Port of Long Beach
From: Adel Salahi, Seann Perez, Jerry Neal & Jennifer Lim (Moffatt & Nichol)
Cc: Matt Trowbridge (Moffatt & Nichol)
Project Name: Pier Wind Project – Concept Phase
Date: April 20, 2023
Subject: Project Schedule Memorandum
M&N Job No.: 10800-24

For the Pier Wind concept phase, three project schedules (Aggressive, Accelerated, and Standard) were developed for the agreed upon site layout. The site layout, shown in **Figure 1**, illustrates the main project components such as the transportation corridor, railroad and transportation bridges, 400-acre terminal, wharf, sinking basin, and piers for wet storage and/or tugs.

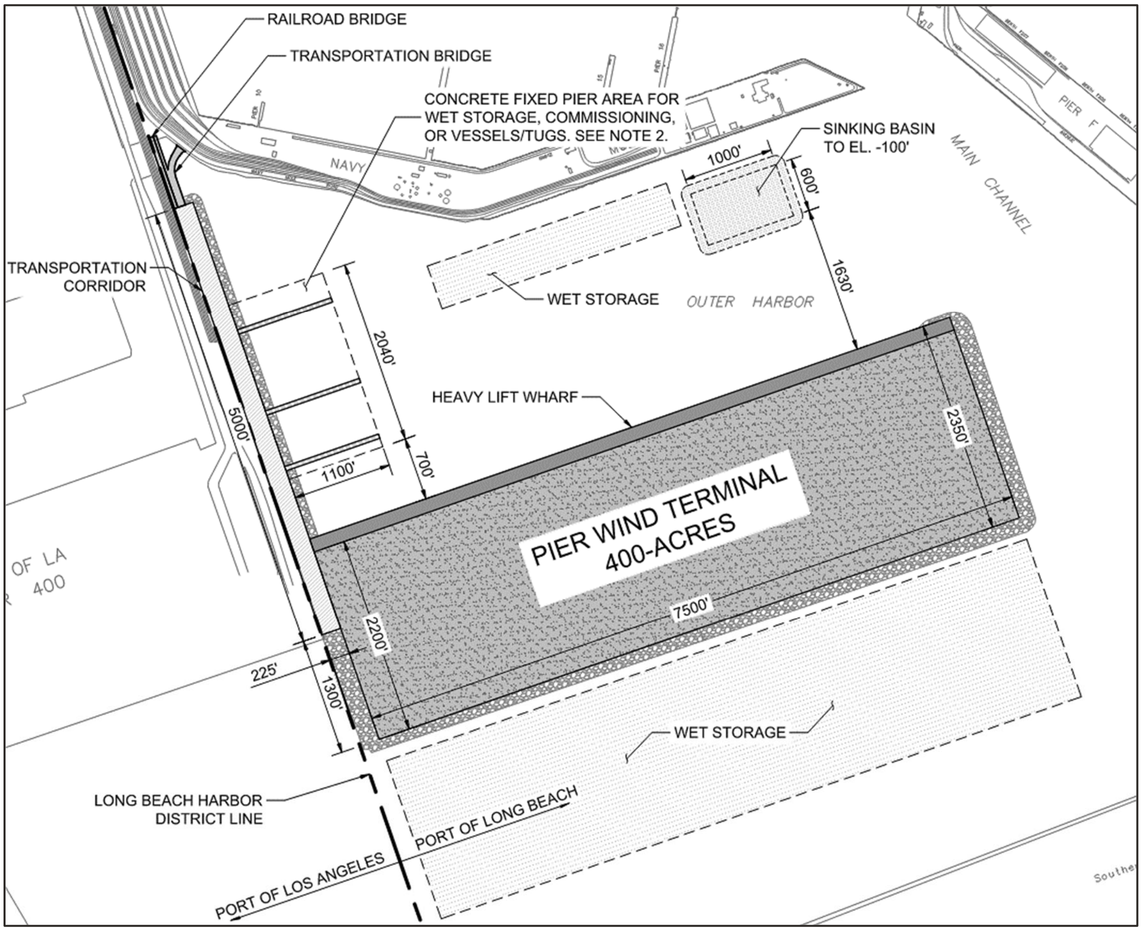

Figure 1. Pier Wind Concept Phase Site Plan

Project Schedule Options

The project schedules were developed to a Level 2 detail (approximately 100-200 items, management summary) for each of the three schedule options:

- Aggressive Schedule
    - The aggressive schedule includes all accelerations for construction activities such as production rates, equipment availability, and working hours.
- Accelerated Schedule
    - The accelerated schedule includes some accelerations for construction activities, but not all.
- Standard Schedule
    - The standard schedule includes normal or traditional assumptions for construction activities.

The following approach was used to develop the proposed schedules:

1. Coordinate with the Port on the proposed schedule activities and following design assumptions:
    - Site layout
    - Fill / sediment sources and durations
    - Equipment availability
    - Terminal phasing plan
2. Develop schedule considerations and identify acceleration options in a workshop held on January 18, 2023.
3. Develop aggressive, accelerated, and standard project schedules based on feedback from the workshop.

Table 1 provides a summary of the various production rate, equipment availability, and working hour assumptions used for the Fast, Medium, and Slow schedules as discussed in the January 18th workshop.

Table 1. Construction Activity Assumptions for Aggressive, Accelerated, and Standard Schedule Levels

Schedule		Aggressive Schedule	Accelerated Schedule	Standard Schedule
Phases	**Phase 1a**	First 100 acres Transportation Corridor Sinking Basin Piers	First 200 acres Transportation Corridor Sinking Basin Piers	First 200 acres Transportation Corridor Sinking Basin Piers
	Phase 1b	Second 100 acres		
	Phase 2	Last 200 acres	Last 200 acres	Last 200 acres
No. of Hydraulic Dredges		3	2	1
No. of Mechanical Dredges		3	2	2

Table 1. Construction Activity Assumptions for Aggressive, Accelerated, and Standard Schedule Levels (continued)

Schedule		Fast Schedule	Medium Schedule	Slow Schedule
Dredge Production Rate		Cutter Suction Dredge 75,000 CY / day	Cutter Suction Dredge 50,000 CY / day	Cutter Suction Dredge 25,000 CY / day
Dredge Production Rate		Mechanical Dredge 13,500 CY / day	Mechanical Dredge 9,000 CY / day	Mechanical Dredge 9,000 CY / day
Rock Production		Range 10k – 25k / day	Range 6k – 15k / day	Range 4k-10k / day
Rock Source		Catalina + Canada	Catalina Only	Catalina Only
Start Hydraulic Material Placement		Dike reaches EL. -12 ft (Multi-lift dike)	Dike reaches EL. -12 ft (Multi-lift dike)	Dike reaches EL. +5 ft (Single lift dike)
Surcharge Duration		7 months	7 months	7 months
Work Hours and Days Per Week	**Dredging**	24 hours, 7 days	24 hours, 7 days (24 hours, 6 days for mechanical)	24 hours, 7 days (24 hours, 6 days for mechanical)
	Rock Placement	24 hours, 7 days	24 hours, 7 days	12 hours, 5 days
	Wick Drain Placement	24 hours, 7 days	24 hours, 6 days	10 hours, 5 days
	Material Surcharge Placement	24 hours, 7 days	24 hours, 7 days	24 hours, 7 days
	Surcharge Rolling	24 hours, 7 days	12 hours, 6 days	12 hours, 5 days
	Surcharge Removal	24 hours, 7 days	12 hours, 6 days	12 hours, 5 days
	Pile Driving	24 hours, 7 days	10 hours, 5 days	10 hours, 5 days
	Wharf Construction	24 hours, 7 days	10 hours, 5 days	10 hours, 5 days

Project Schedule Summary

Based on discussions during the Concept Phase, it was agreed upon that Phase 1 includes the transportation corridor, railroad and transportation bridges, 200-acre terminal, 3,750 feet of wharf, sinking basin, tug dock, and wet storage piers. Phase 2 includes the remaining 200 acres and 3,750 feet of wharf.

For the Aggressive Schedule, assuming the Contractor receives notice to proceed (NTP) on January 1, 2027, Phase 1 would be complete by Q3 2031 and Phase 2 would be complete Q4 2035. Since the schedule for the first 100 acres is critical to turnover to an offshore wind developer to start producing turbines to help the State of California reach their deployment goals by 2045, the schedule for Phase 1 has been broken up into Phase 1, Stage 1 and Phase 1, Stage 2. Phase 1, Stage 1 includes construction of the transportation corridor, railroad and transportation bridges, 100-acre terminal, 1,875 feet of wharf, sinking basin, and piers for wet storage and/or tugs. Phase 1, Stage 2 includes the next 100 acres and 1,875 feet of wharf to close out Phase 1. This aggressive schedule assumes an alternate delivery model for the project where design and construction are streamlined and progressing simultaneously.

For the Accelerated Schedule, assuming the Contractor receives notice to proceed (NTP) on January 1, 2029, Phase 1 would be complete Q3 2040, and Phase 2 would be complete Q3 2043. For the Standard Schedule, assuming the Contractor receives notice to proceed (NTP) on January 1, 2030, Phase 1 would be complete Q4 2044, and Phase 2 would be complete Q3 2050. Since these two schedule options do not show the terminal ready in time to help meet the State and Federal offshore wind goals, it is recommended they no longer be pursued.

Table 2. Milestone Summary for Aggressive, Accelerated, and Standard Schedules

Milestone	Aggressive Schedule	Accelerated Schedule	Standard Schedule
Notice to Proceed	January 01, 2027	January 01, 2029	January 01, 2030
Phase 1, Stage 1 Complete (Total = 100 ac)	February 23, 2031	August 9, 2040	December 09, 2044
Phase 1, Stage 2 Complete (Total = 200 ac)	August 04, 2031		
Phase 2 Complete (Total = 400 ac)	November 29, 2035	July 10, 2043	July 01, 2050

Notes and Assumptions

Below is a summary of additional notes and assumptions that were made to determine the schedules.

1. Port pays the Quarry to stockpile rock ahead of start of construction, so there is no delay in schedule.
2. Assumes Test Pile Program is performed shortly after Notice to Proceed or during the design period, so there is no delay in the schedule.
3. Initial rock dike will be constructed to a 100-acre footprint to supply an 80-acre site ready for use.
4. Once the rock dike has reached full construction height for a 500 linear foot stretch, the pile driving for the wharf will begin.
5. As equipment becomes available during the construction of the first 80 acres, it will be shifted over to begin construction of the transportation corridor.
6. As equipment becomes available during the construction of the transportation corridor, it will be shifted over to continue construction of the remaining 300 acres.
7. A laydown area will be established for the delivery of piles during the dredging and dike work.
8. The transportation corridor does not include any railroad work.
9. The bridge work and corridor roadwork can proceed simultaneously.
10. Pile installation will have enough room for 5 pile driving rigs to operate simultaneously.
11. Wharf work can proceed prior to the corridor being completed.
12. Main substation equipment and switchgear can be procured within 2 years of NTP.

13. Corridor bridge will be comprised of a precast deck.
14. Rollover and movement of surcharge after settlement period will have a production of 30,000 cy per day.
15. Electrical substations will be installed by others and available for contractor use during dredging.

Attachments:

- Aggressive Schedule
- Accelerated Schedule
- Standard Schedule

Schedule date:Apr-14-23
Confidential Draft

Pier Wind Project - Concept Phase
Aggressive Schedule

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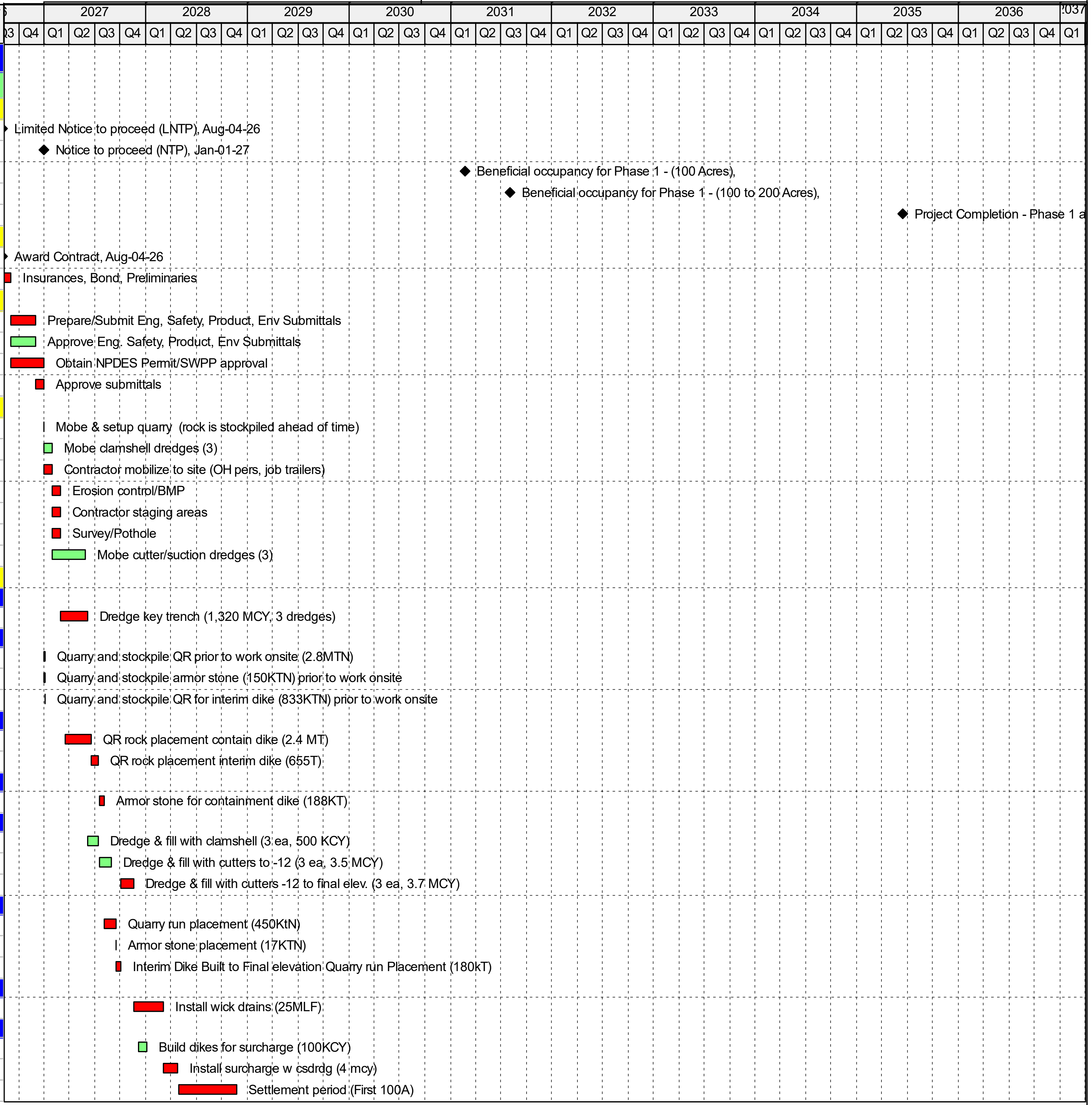
Activity ID	Activity Name	Original Duration	Start	Finish	Total Float	Calendar
Wind Project Schedule 4.13.23 - Aggressive Scenario		3239	Aug-04-26	Jun-16-35	0	
POLB Windport-Aggressive		3239	Aug-04-26	Jun-16-35	0	
Milestones		3239	Aug-04-26	Jun-16-35	0	FIXED 7 Days Per Week
MS013	Limited Notice to proceed (LNTP)	0	Aug-04-26		0	FIXED 7 Days Per Week
MS001	Notice to proceed (NTP)	0	Jan-01-27		0	FIXED 7 Days Per Week
MS002	Beneficial occupancy for Phase 1 - (100 Acres)	0		Feb-23-31*	0	FIXED 7 Days Per Week
MS003	Beneficial occupancy for Phase 1 - (100 to 200 Acres)	0		Aug-04-31*	0	FIXED 7 Days Per Week
MS004	Project Completion - Phase 1 and Phase 2 (300 and 40	0		Jun-16-35	0	FIXED 7 Days Per Week
Preconstruction		30	Aug-04-26	Sep-02-26	0	FIXED 7 Days Per Week
PCN001	Award Contract	0	Aug-04-26		0	FIXED 7 Days Per Week
PCN002	Insurances, Bond, Preliminaries	30	Aug-04-26	Sep-02-26	0	FIXED 7 Days Per Week
Documentation/Permits		120	Sep-03-26	Dec-31-26	0	FIXED 7 Days Per Week
DP001	Prepare/Submit Eng, Safety, Product, Env Submittals	90	Sep-03-26	Dec-01-26	0	FIXED 7 Days Per Week
DP002	Approve Eng. Safety, Product, Env Submittals	90	Sep-03-26	Dec-01-26	30	FIXED 7 Days Per Week
DP003	Obtain NPDES Permit/SWPP approval	120	Sep-03-26	Dec-31-26	0	FIXED 7 Days Per Week
DP004	Approve submittals	30	Dec-02-26	Dec-31-26	0	FIXED 7 Days Per Week
Mobilization		150	Jan-01-27	May-30-27	30	FIXED 7 Days Per Week
MOB001	Mobe & setup quarry (rock is stockpiled ahead of time)	1	Jan-01-27	Jan-01-27	69	FIXED 7 Days Per Week
MOB002	Mobe clamshell dredges (3)	30	Jan-01-27	Jan-30-27	30	FIXED 7 Days Per Week
MOB003	Contractor mobilize to site (OH pers, job trailers)	30	Jan-01-27	Jan-30-27	0	FIXED 7 Days Per Week
MOB004	Erosion control/BMP	30	Jan-31-27	Mar-01-27	0	FIXED 7 Days Per Week
MOB005	Contractor staging areas	30	Jan-31-27	Mar-01-27	0	FIXED 7 Days Per Week
MOB006	Survey/Pothole	30	Jan-31-27	Mar-01-27	0	FIXED 7 Days Per Week
MOB007	Mobe cutter/suction dredges (3)	120	Jan-31-27	May-30-27	30	FIXED 7 Days Per Week
Construction of First 100A		1514	Jan-02-27	Feb-23-31	0	
Dredge the key trench		97	Mar-02-27	Jun-06-27	0	FIXED Dredging 7 x 24
CN200A0020	Dredge key trench (1,320 MCY, 3 dredges)	97	Mar-02-27	Jun-06-27	0	FIXED Dredging 7 x 24
Rock quarry & placement		2	Jan-02-27	Jan-03-27	912	
CN100A22	Quarry and stockpile QR prior to work onsite (2.8MTN)	1	Jan-02-27	Jan-02-27	69	FIXED 7 Days Per Week
CN100A24	Quarry and stockpile armor stone (150KTN) prior to work	1	Jan-02-27	Jan-02-27	913	FIXED Dredging 7 x 24
CN100A23	Quarry and stockpile QR for interim dike (833KTN) prior t	1	Jan-03-27	Jan-03-27	226	FIXED 7 Days Per Week
Rock plmnt/contain dike to -12		122	Mar-17-27	Jul-16-27	0	FIXED Dredging 7 x 24
CN100A26	QR rock placement contain dike (2.4 MT)	96	Mar-17-27	Jun-20-27	0	FIXED Dredging 7 x 24
CN100A27	QR rock placement interim dike (655T)	26	Jun-21-27	Jul-16-27	0	FIXED Dredging 7 x 24
Armor stone plmnt/contain dike to -12		19	Jul-17-27	Aug-04-27	0	FIXED Dredging 7 x 24
CN100A29	Armor stone for containment dike (188KT)	19	Jul-17-27	Aug-04-27	0	FIXED Dredging 7 x 24
Dredge & fill w/ clams & cutters (9 MCY)		167	Jun-07-27	Nov-20-27	0	FIXED Dredging 7 x 24
CN100A31	Dredge & fill with clamshell (3 ea, 500 KCY)	37	Jun-07-27	Jul-13-27	67	FIXED Dredging 7 x 24
CN100A32	Dredge & fill with cutters to -12 (3 ea, 3.5 MCY)	46	Jul-17-27	Aug-31-27	32	FIXED Dredging 7 x 24
CN100A33	Dredge & fill with cutters -12 to final elev. (3 ea, 3.7 MC)	49	Oct-03-27	Nov-20-27	0	FIXED Dredging 7 x 24
Rock plmnt/contain dike -12 to final elevation		59	Aug-05-27	Oct-02-27	0	FIXED Dredging 7 x 24
CN100A35	Quarry run placement (450KtN)	41	Aug-05-27	Sep-14-27	0	FIXED Dredging 7 x 24
CN100A36	Armor stone placement (17KTN)	2	Sep-15-27	Sep-16-27	0	FIXED Dredging 7 x 24
CN100A46	Interim Dike Built to Final elevation Quarry run Placemer	16	Sep-17-27	Oct-02-27	0	FIXED Dredging 7 x 24
Wick Drains		105	Nov-21-27	Mar-04-28	0	FIXED Dredging 7 x 24
CN100A38	Install wick drains (25MLF)	105	Nov-21-27	Mar-04-28	0	FIXED Dredging 7 x 24
Surcharge 100 A		487	Dec-05-27	Apr-05-29	0	FIXED Dredging 7 x 24
CN100A39	Build dikes for surcharge (100KCY)	32	Dec-05-27	Jan-05-28	59	FIXED Dredging 7 x 24
CN100A40	Install surcharge w csdrdg (4 mcy)	53	Mar-05-28	Apr-26-28	0	FIXED Dredging 7 x 24
CN100A41	Settlement period (First 100A)	210	Apr-27-28	Nov-22-28	0	FIXED Dredging 7 x 24



▬ Actual Level of Effort	🟩 Remaining Work	◆ ◆ Milestone
▬ Actual Work	🟥 Critical Remaining Work	

TASK filter: All Activities

Schedule date:Apr-14-23
Confidential Draft

Pier Wind Project - Concept Phase
Aggressive Schedule

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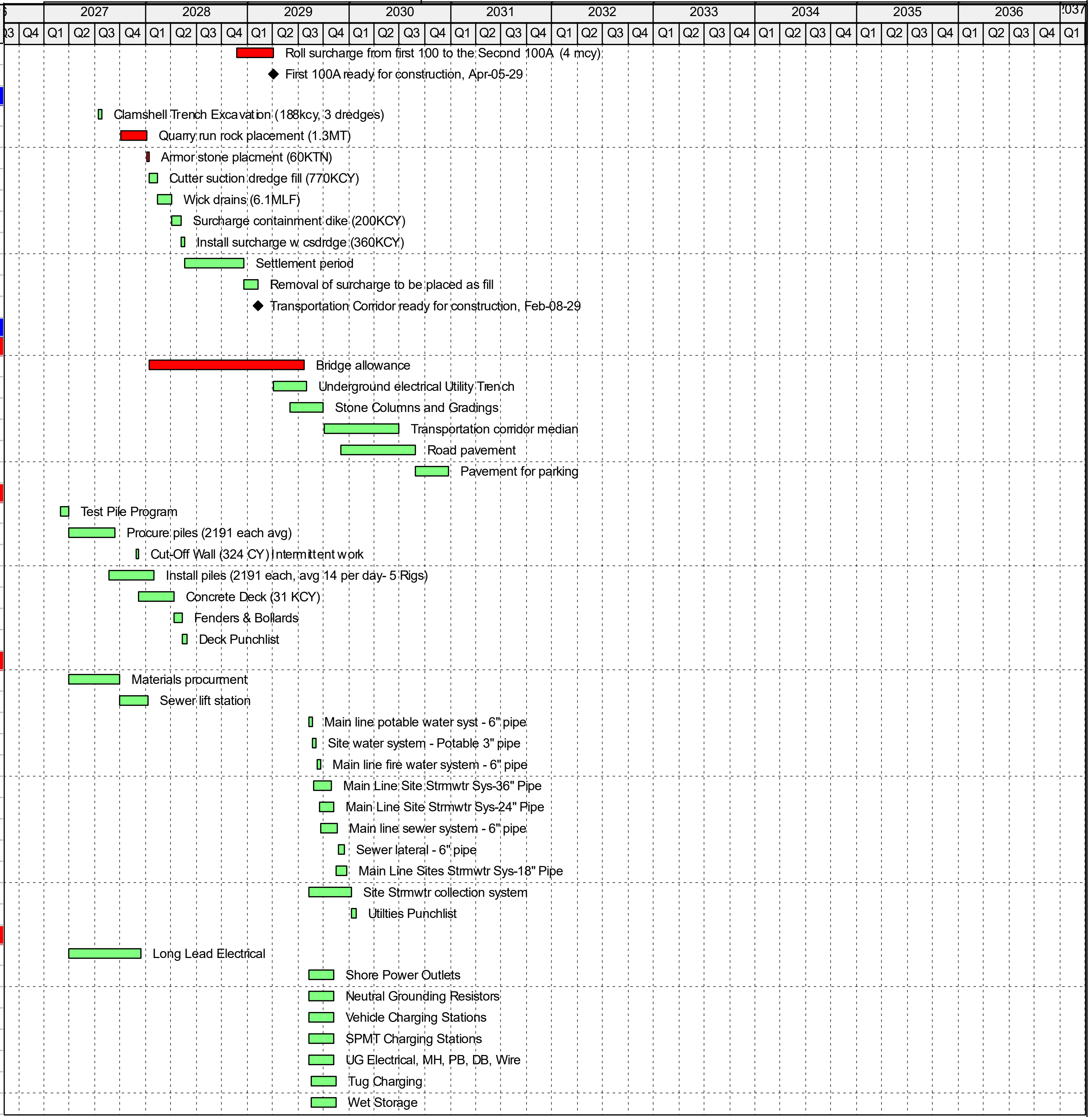
Activity ID	Activity Name	Original Duration	Start	Finish	Total Float	Calendar
CN100A42	Roll surcharge from first 100 to the Second 100A (4 mc	133	Nov-23-28	Apr-04-29	0	FIXED Dredging 7 x 24
CN100A45	First 100A ready for construction	0	Apr-05-29		0	FIXED Dredging 7 x 24
Transportation Corridor (Rock, Dredge, Fill)		**575**	**Jul-14-27**	**Feb-08-29**	**356**	**FIXED Dredging 7 x 24**
CN100A47	Clamshell Trench Excavation (188kcy, 3 dredges)	14	Jul-14-27	Jul-27-27	67	FIXED Dredging 7 x 24
CN100A48	Quarry run rock placement (1.3MT)	93	Oct-03-27	Jan-03-28	0	FIXED Dredging 7 x 24
CN100A49	Armor stone placment (60KTN)	9	Jan-04-28	Jan-12-28	0	FIXED Dredging 7 x 24
CN100A50	Cutter suction dredge fill (770KCY)	30	Jan-13-28	Feb-11-28	317	FIXED Dredging 7 x 24
CN100A51	Wick drains (6.1MLF)	51	Feb-12-28	Apr-02-28	317	FIXED Dredging 7 x 24
CN100A52	Surcharge containment dike (200KCY)	34	Apr-03-28	May-06-28	356	FIXED Dredging 7 x 24
CN100A53	Install surcharge w csdrdge (360KCY)	15	May-07-28	May-21-28	356	FIXED Dredging 7 x 24
CN100A54	Settlement period	210	May-22-28	Dec-17-28	356	FIXED Dredging 7 x 24
CN100A55	Removal of surcharge to be placed as fill	52	Dec-18-28	Feb-07-29	356	FIXED Dredging 7 x 24
CN100A56	Transportation Corridor ready for construction	0	Feb-08-29		356	FIXED Dredging 7 x 24
Wharf Construction first 100A		**1455**	**Mar-02-27**	**Feb-23-31**	**0**	**FIXED 7 Days Per Week**
Transportation Corridor Bridges & Paving		**1078**	**Jan-13-28**	**Dec-25-30**	**60**	**FIXED 7 Days Per Week**
WCN100A.104	Bridge allowance	560	Jan-13-28	Jul-25-29	0	FIXED 7 Days Per Week
WCN100A.115	Underground electrical Utility Trench	120	Apr-05-29	Aug-02-29	5	FIXED 7 Days Per Week
WCN100A.125	Stone Columns and Gradings	120	Jun-04-29	Oct-01-29	60	FIXED 7 Days Per Week
WCN100A.107	Transportation corridor median	270	Oct-02-29	Jun-28-30	60	FIXED 7 Days Per Week
WCN100A.105	Road pavement	270	Dec-01-29	Aug-27-30	60	FIXED 7 Days Per Week
WCN100A.106	Pavement for parking	120	Aug-28-30	Dec-25-30	60	FIXED 7 Days Per Week
Wharf		**453**	**Mar-02-27**	**May-27-28**	**583**	**FIXED 7 Days Per Week**
WCN100A.59	Test Pile Program	30	Mar-02-27	Mar-31-27	724	FIXED 7 Days Per Week
WCN100A.60	Procure piles (2191 each avg)	166	Apr-01-27	Sep-13-27	724	FIXED 7 Days Per Week
WCN100A.62	Cut-Off Wall (324 CY) Intermittent work	7	Nov-28-27	Dec-04-27	583	FIXED 7 Days Per Week
WCN100A.61	Install piles (2191 each, avg 14 per day- 5 Rigs)	166	Aug-20-27	Feb-01-28	583	FIXED 7 Days Per Week
WCN100A.63	Concrete Deck (31 KCY)	130	Dec-05-27	Apr-12-28	583	FIXED 7 Days Per Week
WCN100A.64	Fenders & Bollards	30	Apr-13-28	May-12-28	583	FIXED 7 Days Per Week
WCN100A.65	Deck Punchlist	15	May-13-28	May-27-28	583	FIXED 7 Days Per Week
Utilities		**1031**	**Apr-01-27**	**Jan-25-30**	**394**	**FIXED 7 Days Per Week**
WCN100A.82	Materials procurment	183	Apr-01-27	Sep-30-27	766	FIXED 7 Days Per Week
WCN100A.83	Sewer lift station	100	Oct-01-27	Jan-08-28	766	FIXED 7 Days Per Week
WCN100A.77	Main line potable water syst - 6" pipe	15	Aug-08-29	Aug-22-29	146	FIXED 7 Days Per Week
WCN100A.78	Site water system - Potable 3" pipe	15	Aug-23-29	Sep-06-29	146	FIXED 7 Days Per Week
WCN100A.79	Main line fire water system - 6" pipe	13	Sep-07-29	Sep-19-29	146	FIXED 7 Days Per Week
WCN100A.75	Main Line Site Strmwtr Sys-36" Pipe	63	Aug-28-29	Oct-29-29	412	FIXED 7 Days Per Week
WCN100A.74	Main Line Site Strmwtr Sys-24" Pipe	50	Sep-17-29	Nov-05-29	412	FIXED 7 Days Per Week
WCN100A.80	Main line sewer system - 6" pipe	63	Sep-20-29	Nov-21-29	146	FIXED 7 Days Per Week
WCN100A.81	Sewer lateral - 6" pipe	25	Nov-22-29	Dec-16-29	146	FIXED 7 Days Per Week
WCN100A.73	Main Line Sites Strmwtr Sys-18" Pipe	38	Nov-16-29	Dec-23-29	412	FIXED 7 Days Per Week
WCN100A.76	Site Strmwtr collection system	156	Aug-08-29	Jan-10-30	394	FIXED 7 Days Per Week
WCN100A.84	Utilities Punchlist	15	Jan-11-30	Jan-25-30	394	FIXED 7 Days Per Week
Electrical		**1425**	**Apr-01-27**	**Feb-23-31**	**0**	**FIXED 7 Days Per Week**
WCN100A.86	Long Lead Electrical	260	Apr-01-27	Dec-16-27	600	FIXED 7 Days Per Week
WCN100A.92	Shore Power Outlets	90	Aug-08-29	Nov-05-29	430	FIXED 7 Days Per Week
WCN100A.93	Neutral Grounding Resistors	90	Aug-08-29	Nov-05-29	430	FIXED 7 Days Per Week
WCN100A.94	Vehicle Charging Stations	90	Aug-08-29	Nov-05-29	430	FIXED 7 Days Per Week
WCN100A.95	SPMT Charging Stations	90	Aug-08-29	Nov-05-29	430	FIXED 7 Days Per Week
WCN100A.100	UG Electrical, MH, PB, DB, Wire	90	Aug-08-29	Nov-05-29	187	FIXED 7 Days Per Week
WCN100A.101	Tug Charging	90	Aug-17-29	Nov-14-29	421	FIXED 7 Days Per Week
WCN100A.97	Wet Storage	90	Aug-17-29	Nov-14-29	421	FIXED 7 Days Per Week



▬ Actual Level of Effort	🟩 Remaining Work	◆ ◆ Milestone
▬ Actual Work	🟥 Critical Remaining Work	

TASK filter: All Activities

Schedule date:Apr-14-23
Confidential Draft

Pier Wind Project - Concept Phase
Aggressive Schedule

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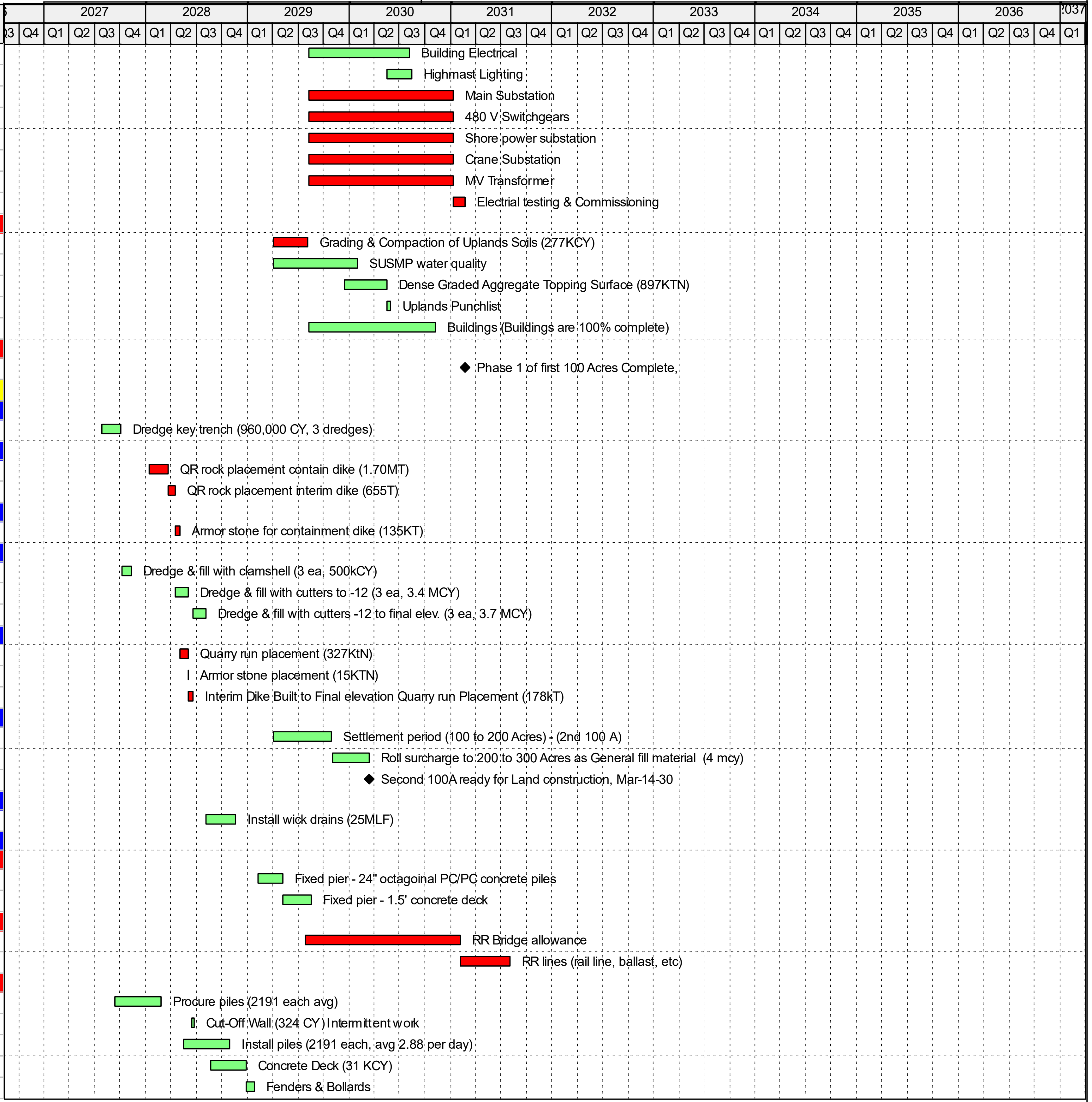
Port of LONG BEACH THE PORT OF CHOICE

Activity ID	Activity Name	Original Duration	Start	Finish	Total Float	Calendar
WCN100A.96	Building Electrical	365	Aug-08-29	Aug-07-30	155	FIXED 7 Days Per Week
WCN100A.99	Highmast Lighting	90	May-19-30	Aug-16-30	146	FIXED 7 Days Per Week
WCN100A.87	Main Substation	520	Aug-08-29	Jan-09-31	0	FIXED 7 Days Per Week
WCN100A.89	480 V Switchgears	520	Aug-08-29	Jan-09-31	0	FIXED 7 Days Per Week
WCN100A.88	Shore power substation	520	Aug-08-29	Jan-09-31	0	FIXED 7 Days Per Week
WCN100A.90	Crane Substation	520	Aug-08-29	Jan-09-31	0	FIXED 7 Days Per Week
WCN100A.91	MV Transformer	520	Aug-08-29	Jan-09-31	0	FIXED 7 Days Per Week
WCN100A.102	Electrial testing & Commissioning	45	Jan-10-31	Feb-23-31	0	FIXED 7 Days Per Week
Uplands		**582**	**Apr-05-29**	**Nov-07-30**	**108**	**FIXED 7 Days Per Week**
WCN100A.67	Grading & Compaction of Uplands Soils (277KCY)	125	Apr-05-29	Aug-07-29	0	FIXED 7 Days Per Week
WCN100A.69	SUSMP water quality	300	Apr-05-29	Jan-29-30	375	FIXED 7 Days Per Week
WCN100A.68	Dense Graded Aggregate Topping Surface (897KTN)	150	Dec-17-29	May-15-30	146	FIXED 7 Days Per Week
WCN100A.71	Uplands Punchlist	15	May-16-30	May-30-30	269	FIXED 7 Days Per Week
WCN100A.70	Buildings (Buildings are 100% complete)	457	Aug-08-29	Nov-07-30	108	FIXED 7 Days Per Week
Phase 1 Complete		**0**	**Feb-23-31**	**Feb-23-31**	**0**	**FIXED 7 Days Per Week**
WCN100A.116	Phase 1 of first 100 Acres Complete	0		Feb-23-31	0	FIXED 7 Days Per Week
Construction of Second 100A		**1469**	**Jul-28-27**	**Aug-04-31**	**0**	
Dredge the key trench		**70**	**Jul-28-27**	**Oct-05-27**	**154**	**FIXED Dredging 7 x 24**
CON200A.980	Dredge key trench (960,000 CY, 3 dredges)	70	Jul-28-27	Oct-05-27	154	FIXED Dredging 7 x 24
Rock plmnt/contain dike to -12		**96**	**Jan-13-28**	**Apr-17-28**	**0**	**FIXED Dredging 7 x 24**
CON200A.990	QR rock placement contain dike (1.70MT)	70	Jan-13-28	Mar-22-28	0	FIXED Dredging 7 x 24
CON200A.1000	QR rock placement interim dike (655T)	26	Mar-23-28	Apr-17-28	0	FIXED Dredging 7 x 24
Armor stone plmnt/contain dike to -12		**14**	**Apr-18-28**	**May-01-28**	**0**	**FIXED Dredging 7 x 24**
CON200A.1040	Armor stone for containment dike (135KT)	14	Apr-18-28	May-01-28	0	FIXED Dredging 7 x 24
Dredge & fill w/ clams & cutters (8.8 MCY)		**305**	**Oct-06-27**	**Aug-05-28**	**192**	**FIXED Dredging 7 x 24**
CON200A.730	Dredge & fill with clamshell (3 ea, 500kCY)	37	Oct-06-27	Nov-11-27	258	FIXED Dredging 7 x 24
CON200A.740	Dredge & fill with cutters to -12 (3 ea, 3.4 MCY)	46	Apr-18-28	Jun-02-28	207	FIXED Dredging 7 x 24
CON200A.750	Dredge & fill with cutters -12 to final elev. (3 ea, 3.7 MC	49	Jun-18-28	Aug-05-28	192	FIXED Dredging 7 x 24
Rock plmnt/contain dike -12 to final elevation		**47**	**May-02-28**	**Jun-17-28**	**0**	**FIXED Dredging 7 x 24**
CON200A.760	Quarry run placement (327KtN)	30	May-02-28	May-31-28	0	FIXED Dredging 7 x 24
CON200A.770	Armor stone placement (15KTN)	1	Jun-01-28	Jun-01-28	0	FIXED Dredging 7 x 24
CON200A.780	Interim Dike Built to Final elevation Quarry run Placemer	16	Jun-02-28	Jun-17-28	0	FIXED Dredging 7 x 24
Surcharge 100 to 200 Acres		**343**	**Apr-05-29**	**Mar-14-30**	**55**	**FIXED Dredging 7 x 24**
CON200A.840	Settlement period (100 to 200 Acres) - (2nd 100 A)	210	Apr-05-29	Oct-31-29	55	FIXED Dredging 7 x 24
CON200A.830	Roll surcharge to 200 to 300 Acres as General fill materi	133	Nov-01-29	Mar-13-30	55	FIXED Dredging 7 x 24
CON200A.870	Second 100A ready for Land construction	0	Mar-14-30		55	FIXED Dredging 7 x 24
Wick Drains		**105**	**Aug-06-28**	**Nov-18-28**	**192**	**FIXED Dredging 7 x 24**
CON200.800	Install wick drains (25MLF)	105	Aug-06-28	Nov-18-28	192	FIXED Dredging 7 x 24
Wharf Construction Second 100A		**1421**	**Sep-14-27**	**Aug-04-31**	**0**	**FIXED 7 Days Per Week**
Wet storage		**190**	**Feb-08-29**	**Aug-16-29**	**421**	**FIXED 7 Days Per Week**
WCN200A.111	Fixed pier - 24" octagoinal PC/PC concrete piles	90	Feb-08-29	May-08-29	421	FIXED 7 Days Per Week
WCN200A.110	Fixed pier - 1.5' concrete deck	100	May-09-29	Aug-16-29	421	FIXED 7 Days Per Week
Transportation Corridor (RR Bridge, and RR Line)		**740**	**Jul-26-29**	**Aug-04-31**	**0**	**FIXED 7 Days Per Week**
WCN200.118	RR Bridge allowance	560	Jul-26-29	Feb-05-31	0	FIXED 7 Days Per Week
WCN100A.108	RR lines (rail line, ballast, etc)	180	Feb-06-31	Aug-04-31	0	FIXED 7 Days Per Week
Wharf		**517**	**Sep-14-27**	**Feb-11-29**	**575**	**FIXED 7 Days Per Week**
WCN200.220	Procure piles (2191 each avg)	166	Sep-14-27	Feb-26-28	821	FIXED 7 Days Per Week
WCN200.240	Cut-Off Wall (324 CY) Intermittent work	7	Jun-16-28	Jun-22-28	634	FIXED 7 Days Per Week
WCN200.210	Install piles (2191 each, avg 2.88 per day)	166	May-17-28	Oct-29-28	575	FIXED 7 Days Per Week
WCN200.230	Concrete Deck (31 KCY)	130	Aug-21-28	Dec-28-28	575	FIXED 7 Days Per Week
WCN200.250	Fenders & Bollards	30	Dec-29-28	Jan-27-29	575	FIXED 7 Days Per Week



▬	Actual Level of Effort	🟩	Remaining Work
🟦	Actual Work	🟥	Critical Remaining Work
◆	◆ Milestone		

TASK filter: All Activities

Schedule date:Apr-14-23
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Pier Wind Project - Concept Phase
Aggressive Schedule

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Port of LONG BEACH
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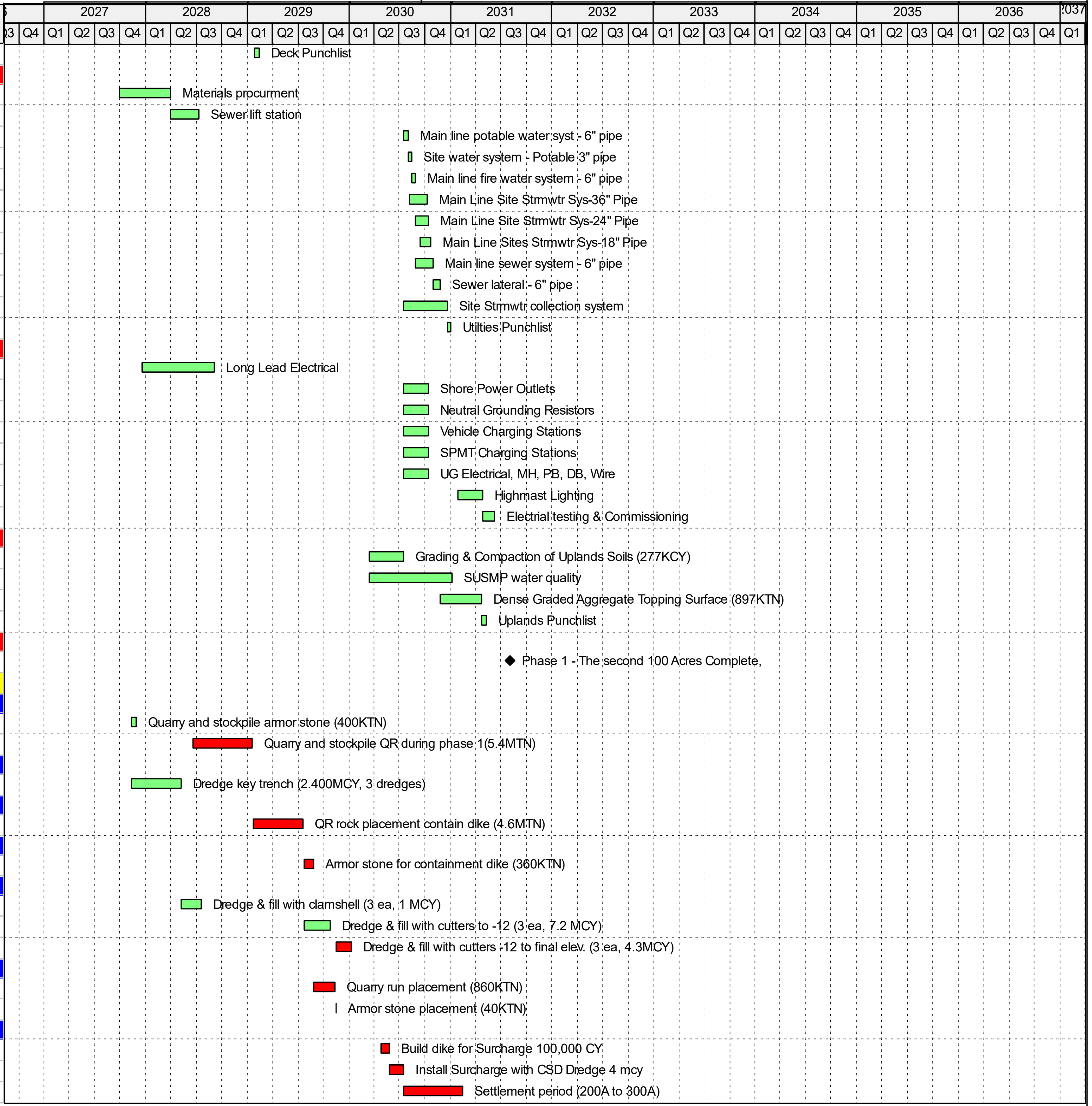
Activity ID	Activity Name	Original Duration	Start	Finish	Total Float	Calendar
WCN200.260	Deck Punchlist	15	Jan-28-29	Feb-11-29	575	FIXED 7 Days Per Week
Utilities		1191	Oct-01-27	Jan-03-31	213	FIXED 7 Days Per Week
WCN200.430	Materials procurment	183	Oct-01-27	Mar-31-28	835	FIXED 7 Days Per Week
WCN200.420	Sewer lift station	100	Apr-01-28	Jul-09-28	835	FIXED 7 Days Per Week
WCN200.370	Main line potable water syst - 6" pipe	15	Jul-17-30	Jul-31-30	55	FIXED 7 Days Per Week
WCN200.380	Site water system - Potable 3" pipe	15	Aug-01-30	Aug-15-30	55	FIXED 7 Days Per Week
WCN200.390	Main line fire water system - 6" pipe	13	Aug-16-30	Aug-28-30	55	FIXED 7 Days Per Week
WCN200.350	Main Line Site Strmwtr Sys-36" Pipe	63	Aug-06-30	Oct-07-30	271	FIXED 7 Days Per Week
WCN200.340	Main Line Site Strmwtr Sys-24" Pipe	50	Aug-26-30	Oct-14-30	271	FIXED 7 Days Per Week
WCN200.330	Main Line Sites Strmwtr Sys-18" Pipe	38	Sep-15-30	Oct-22-30	271	FIXED 7 Days Per Week
WCN200.400	Main line sewer system - 6" pipe	63	Aug-29-30	Oct-30-30	55	FIXED 7 Days Per Week
WCN200.410	Sewer lateral - 6" pipe	25	Oct-31-30	Nov-24-30	55	FIXED 7 Days Per Week
WCN200.360	Site Strmwtr collection system	156	Jul-17-30	Dec-19-30	213	FIXED 7 Days Per Week
WCN200.440	Utilties Punchlist	15	Dec-20-30	Jan-03-31	213	FIXED 7 Days Per Week
Electrical		1272	Dec-17-27	Jun-10-31	55	FIXED 7 Days Per Week
WCN200.590	Long Lead Electrical	260	Dec-17-27	Sep-01-28	932	FIXED 7 Days Per Week
WCN200.630	Shore Power Outlets	90	Jul-17-30	Oct-14-30	249	FIXED 7 Days Per Week
WCN200.640	Neutral Grounding Resistors	90	Jul-17-30	Oct-14-30	249	FIXED 7 Days Per Week
WCN200.650	Vehicle Charging Stations	90	Jul-17-30	Oct-14-30	249	FIXED 7 Days Per Week
WCN200.660	SPMT Charging Stations	90	Jul-17-30	Oct-14-30	249	FIXED 7 Days Per Week
WCN200.710	UG Electrical, MH, PB, DB, Wire	90	Jul-17-30	Oct-14-30	96	FIXED 7 Days Per Week
WCN200.700	Highmast Lighting	90	Jan-27-31	Apr-26-31	55	FIXED 7 Days Per Week
WCN200.720	Electrial testing & Commissioning	45	Apr-27-31	Jun-10-31	55	FIXED 7 Days Per Week
Uplands		421	Mar-14-30	May-08-31	88	FIXED 7 Days Per Week
WCN200.280	Grading & Compaction of Uplands Soils (277KCY)	125	Mar-14-30	Jul-16-30	55	FIXED 7 Days Per Week
WCN200.300	SUSMP water quality	300	Mar-14-30	Jan-07-31	194	FIXED 7 Days Per Week
WCN200.290	Dense Graded Aggregate Topping Surface (897KTN)	150	Nov-25-30	Apr-23-31	55	FIXED 7 Days Per Week
WCN200.310	Uplands Punchlist	15	Apr-24-31	May-08-31	88	FIXED 7 Days Per Week
Phase 1 Complete		0	Aug-04-31	Aug-04-31	0	FIXED 7 Days Per Week
WCN200.550	Phase 1 - The second 100 Acres Complete	0		Aug-04-31	0	FIXED 7 Days Per Week
Construction of the Remaining 200A (200A to 400A)		2774	Nov-12-27	Jun-16-35	0	
Rock quarry & placement		435	Nov-12-27	Jan-19-29	183	FIXED Dredging 7 x 24
CN400A122	Quarry and stockpile armor stone (400KTN)	18	Nov-12-27	Nov-29-27	600	FIXED Dredging 7 x 24
CN400A121	Quarry and stockpile QR during phase 1(5.4MTN)	216	Jun-18-28	Jan-19-29	0	FIXED Dredging 7 x 24
Dredge the key trench		177	Nov-12-27	May-06-28	258	FIXED Dredging 7 x 24
CN400A119	Dredge key trench (2.400MCY, 3 dredges)	177	Nov-12-27	May-06-28	258	FIXED Dredging 7 x 24
Rock plmnt/contain dike to -12		183	Jan-20-29	Jul-21-29	0	FIXED Dredging 7 x 24
CN400A124	QR rock placement contain dike (4.6MTN)	183	Jan-20-29	Jul-21-29	0	FIXED Dredging 7 x 24
Armor stone plmnt/contain dike to -12		37	Jul-22-29	Aug-27-29	0	FIXED Dredging 7 x 24
CN400A126	Armor stone for containment dike (360KTN)	37	Jul-22-29	Aug-27-29	0	FIXED Dredging 7 x 24
Dredge & fill w/ clams & cutters (12.5MCY)		614	May-07-28	Jan-10-30	0	FIXED Dredging 7 x 24
CN400A128	Dredge & fill with clamshell (3 ea, 1 MCY)	73	May-07-28	Jul-18-28	388	FIXED Dredging 7 x 24
CN400A129	Dredge & fill with cutters to -12 (3 ea, 7.2 MCY)	95	Jul-22-29	Oct-24-29	20	FIXED Dredging 7 x 24
CN400A130	Dredge & fill with cutters -12 to final elev. (3 ea, 4.3MCY	58	Nov-14-29	Jan-10-30	0	FIXED Dredging 7 x 24
Rock plmnt/contain dike -12 to final elevation		82	Aug-28-29	Nov-17-29	2037	FIXED Dredging 7 x 24
CN400A132	Quarry run placement (860KTN)	78	Aug-28-29	Nov-13-29	0	FIXED Dredging 7 x 24
CN400A133	Armor stone placement (40KTN)	4	Nov-14-29	Nov-17-29	2037	FIXED Dredging 7 x 24
Surcharge 200 to 400 A		956	Apr-26-30	Dec-06-32	0	FIXED Dredging 7 x 24
CN400A178	Build dike for Surcharge 100,000 CY	30	Apr-26-30	May-25-30	0	FIXED Dredging 7 x 24
CN400A188	Install Surcharge with CSD Dredge 4 mcy	53	May-26-30	Jul-17-30	0	FIXED Dredging 7 x 24
CN400A138	Settlement period (200A to 300A)	210	Jul-18-30	Feb-12-31	0	FIXED Dredging 7 x 24



▬ Actual Level of Effort	🟩 Remaining Work
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◆ Milestone	

TASK filter: All Activities

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Pier Wind Project - Concept Phase
Aggressive Schedule

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Port of LONG BEACH
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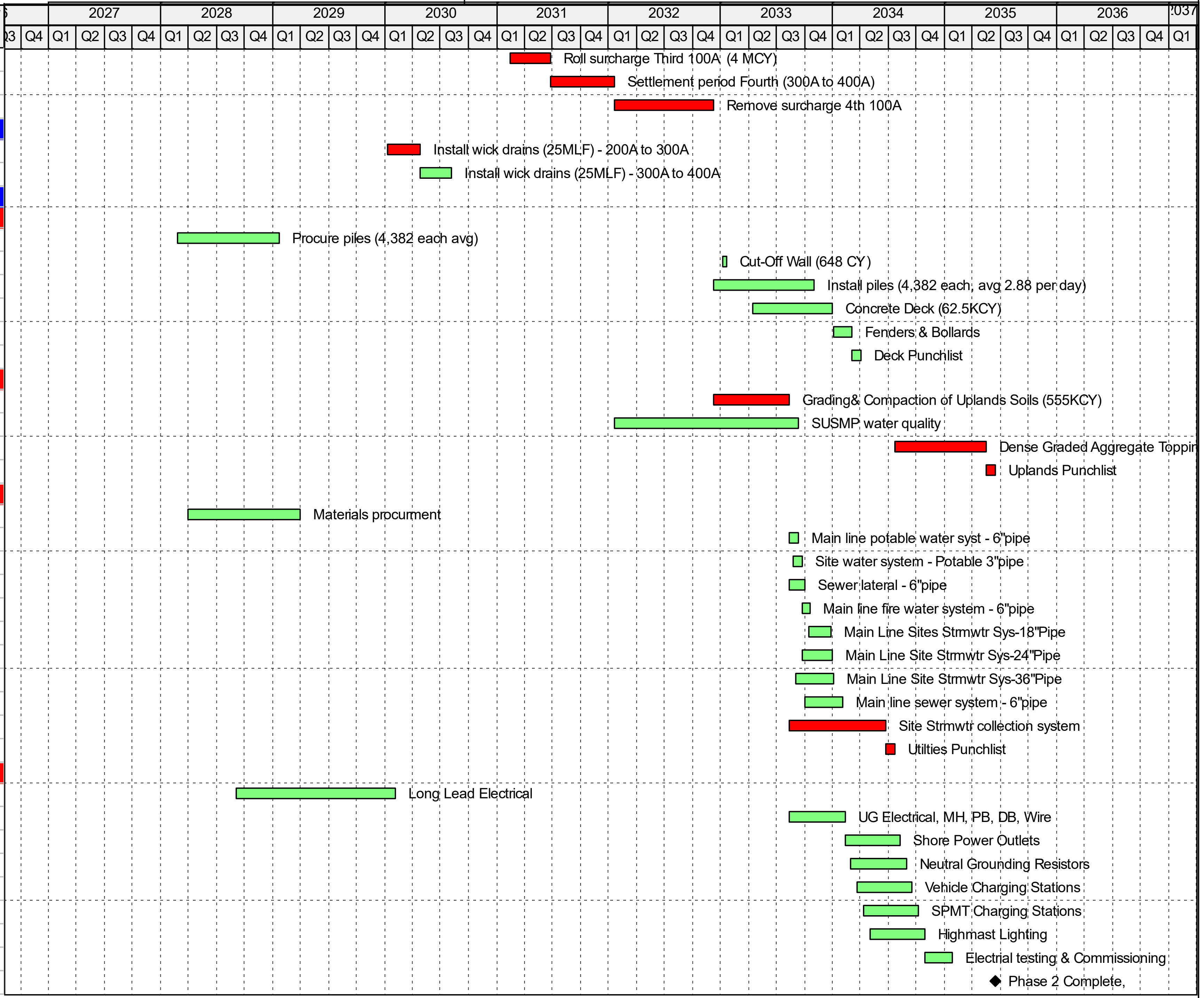
Activity ID	Activity Name	Original Duration	Start	Finish	Total Float	Calendar
CN400A139	Roll surcharge Third 100A (4 MCY)	133	Feb-13-31	Jun-25-31	0	FIXED Dredging 7 x 24
CN400A140	Settlement period Fourth (300A to 400A)	210	Jun-26-31	Jan-21-32	0	FIXED Dredging 7 x 24
CN400A141	Remove surcharge 4th 100A	320	Jan-22-32	Dec-06-32	0	FIXED Dredging 7 x 24
Wick Drains		210	Jan-11-30	Aug-08-30	321	FIXED Dredging 7 x 24
CN400A135.2	Install wick drains (25MLF) - 200A to 300A	105	Jan-11-30	Apr-25-30	0	FIXED Dredging 7 x 24
CN400A135.4	Install wick drains (25MLF) - 300A to 400A	105	Apr-26-30	Aug-08-30	321	FIXED Dredging 7 x 24
Wharf Construction second (200A to 400A)		2667	Feb-27-28	Jun-16-35	0	FIXED 7 Days Per Week
Wharf		2226	Feb-27-28	Apr-01-34	441	FIXED 7 Days Per Week
WCN400A.144	Procure piles (4,382 each avg)	331	Feb-27-28	Jan-22-29	1855	FIXED 7 Days Per Week
WCN400A.146	Cut-Off Wall (648 CY)	13	Jan-06-33	Jan-18-33	529	FIXED 7 Days Per Week
WCN400A.145	Install piles (4,382 each, avg 2.88 per day)	331	Dec-07-32	Nov-02-33	441	FIXED 7 Days Per Week
WCN400A.147	Concrete Deck (62.5KCY)	260	Apr-17-33	Jan-01-34	441	FIXED 7 Days Per Week
WCN400A.148	Fenders & Bollards	60	Jan-02-34	Mar-02-34	441	FIXED 7 Days Per Week
WCN400A.149	Deck Punchlist	30	Mar-03-34	Apr-01-34	441	FIXED 7 Days Per Week
Uplands		1242	Jan-22-32	Jun-16-35	0	FIXED 7 Days Per Week
WCN400A.151	Grading& Compaction of Uplands Soils (555KCY)	250	Dec-07-32	Aug-13-33	0	FIXED 7 Days Per Week
WCN400A.153	SUSMP water quality	600	Jan-22-32	Sep-12-33	612	FIXED 7 Days Per Week
WCN400A.152	Dense Graded Aggregate Topping Surface (1.794KTN)	299	Jul-23-34	May-17-35	0	FIXED 7 Days Per Week
WCN400A.154	Uplands Punchlist	30	May-18-35	Jun-16-35	0	FIXED 7 Days Per Week
Utilities		2304	Apr-01-28	Jul-22-34	0	FIXED 7 Days Per Week
WCN400A.165	Materials procurment	365	Apr-01-28	Mar-31-29	1596	FIXED 7 Days Per Week
WCN400A.160	Main line potable water syst - 6"pipe	30	Aug-14-33	Sep-12-33	138	FIXED 7 Days Per Week
WCN400A.161	Site water system - Potable 3"pipe	30	Aug-24-33	Sep-22-33	138	FIXED 7 Days Per Week
WCN400A.164	Sewer lateral - 6"pipe	50	Aug-14-33	Oct-02-33	263	FIXED 7 Days Per Week
WCN400A.162	Main line fire water system - 6"pipe	25	Sep-23-33	Oct-17-33	138	FIXED 7 Days Per Week
WCN400A.156	Main Line Sites Strmwtr Sys-18"Pipe	75	Oct-13-33	Dec-26-33	178	FIXED 7 Days Per Week
WCN400A.157	Main Line Site Strmwtr Sys-24"Pipe	100	Sep-23-33	Dec-31-33	173	FIXED 7 Days Per Week
WCN400A.158	Main Line Site Strmwtr Sys-36"Pipe	125	Sep-03-33	Jan-05-34	168	FIXED 7 Days Per Week
WCN400A.163	Main line sewer system - 6"pipe	125	Oct-03-33	Feb-04-34	138	FIXED 7 Days Per Week
WCN400A.159	Site Strmwtr collection system	313	Aug-14-33	Jun-22-34	0	FIXED 7 Days Per Week
WCN400A.166	Utlities Punchlist	30	Jun-23-34	Jul-22-34	0	FIXED 7 Days Per Week
Electrical		2479	Sep-02-28	Jun-16-35	0	FIXED 7 Days Per Week
WCN400A.168	Long Lead Electrical	520	Sep-02-28	Feb-03-30	1609	FIXED 7 Days Per Week
WCN400A.175	UG Electrical, MH, PB, DB, Wire	180	Aug-14-33	Feb-09-34	142	FIXED 7 Days Per Week
WCN400A.169	Shore Power Outlets	180	Feb-10-34	Aug-08-34	142	FIXED 7 Days Per Week
WCN400A.170	Neutral Grounding Resistors	180	Mar-02-34	Aug-28-34	142	FIXED 7 Days Per Week
WCN400A.171	Vehicle Charging Stations	180	Mar-22-34	Sep-17-34	142	FIXED 7 Days Per Week
WCN400A.172	SPMT Charging Stations	180	Apr-11-34	Oct-07-34	142	FIXED 7 Days Per Week
WCN400A.174	Highmast Lighting	180	May-01-34	Oct-27-34	142	FIXED 7 Days Per Week
WCN400A.176	Electrial testing & Commissioning	90	Oct-28-34	Jan-25-35	142	FIXED 7 Days Per Week
WCN400A.177	Phase 2 Complete	0		Jun-16-35	0	FIXED 7 Days Per Week



▬ Actual Level of Effort
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TASK filter: All Activities

Schedule date:Apr-14-23
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Pier Wind Project - Concept Phase
Accelerated Schedule

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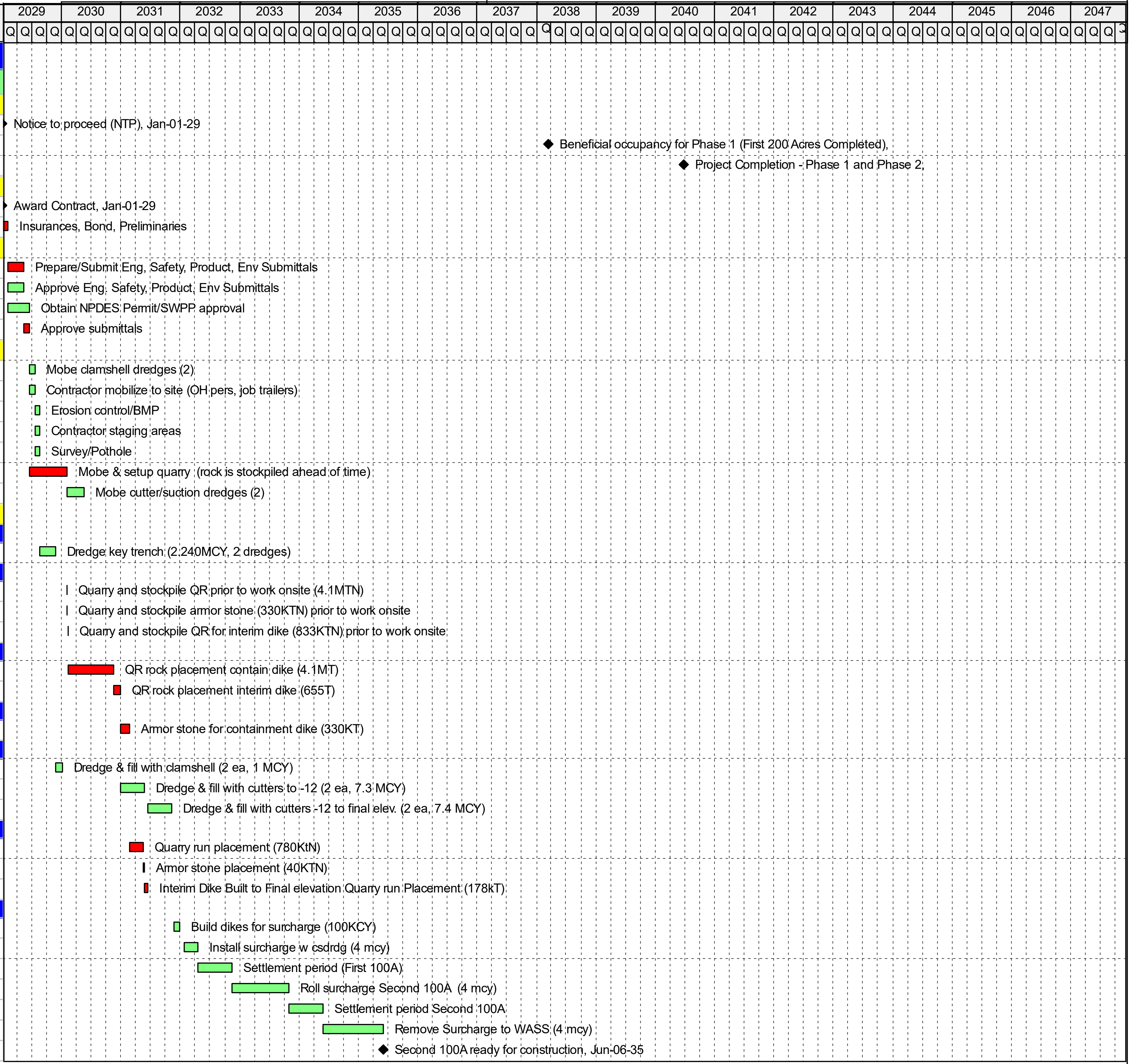
Port of LONG BEACH
THE PORT OF CHOICE

Activity ID	Activity Name	Original uration	Start	Finish	Total Float	Calendar
Wind Project Schedule 4.14.23 - Accelerated Scenari		4194	Jan-01-29	Jun-25-40	0	
POLB Windport		4194	Jan-01-29	Jun-25-40	0	
Milestones		2996	Jan-01-29	Jun-25-40	0	5x10
MS001	Notice to proceed (NTP)	0	Jan-01-29		0	5x10
MS002	Beneficial occupancy for Phase 1 (First 200 Acres Comp	0		Mar-17-38*	593	5x10
MS003	Project Completion - Phase 1 and Phase 2	0		Jun-25-40	0	5x10
Preconstruction		24	Jan-01-29	Feb-02-29	0	5x10
PCON01	Award Contract	0	Jan-01-29		0	5x10
PCON02	Insurances, Bond, Preliminaries	24	Jan-01-29	Feb-02-29	0	5x10
Documentation/Permits		96	Feb-02-29	Jun-18-29	119	5x10
DP001	Prepare/Submit Eng, Safety, Product, Env Submittals	72	Feb-02-29	May-15-29	0	5x10
DP002	Approve Eng. Safety, Product, Env Submittals	72	Feb-02-29	May-15-29	143	5x10
DP003	Obtain NPDES Permit/SWPP approval	96	Feb-02-29	Jun-18-29	119	5x10
DP004	Approve submittals	24	May-15-29	Jun-18-29	0	5x10
Mobilization		240	Jun-18-29	May-20-30	768	5x10
MOB001	Mobe clamshell dredges (2)	24	Jun-18-29	Jul-20-29	143	5x10
MOB002	Contractor mobilize to site (OH pers, job trailers)	24	Jun-18-29	Jul-20-29	119	5x10
MOB003	Erosion control/BMP	24	Jul-20-29	Aug-23-29	119	5x10
MOB004	Contractor staging areas	24	Jul-20-29	Aug-23-29	119	5x10
MOB005	Survey/Pothole	24	Jul-20-29	Aug-23-29	119	5x10
MOB006	Mobe & setup quarry (rock is stockpiled ahead of time)	168	Jun-18-29	Feb-07-30	0	5x10
MOB007	Mobe cutter/suction dredges (2)	72	Feb-07-30	May-20-30	768	5x10
Construction of First 200A		3163	Jul-20-29	Mar-17-38	831	
Dredge the key trench		82	Aug-23-29	Nov-27-29	143	6x24
CN200A0020	Dredge key trench (2.240MCY, 2 dredges)	82	Aug-23-29	Nov-27-29	143	6x24
Rock quarry & placement		2	Feb-07-30	Feb-08-30	1174	
CN200A22	Quarry and stockpile QR prior to work onsite (4.1MTN)	1	Feb-07-30	Feb-07-30	0	7 Days per
CN200A24	Quarry and stockpile armor stone (330KTN) prior to work	1	Feb-07-30	Feb-07-30	1134	Dredging 7 X
CN200A23	Quarry and stockpile QR for interim dike (833KTN) prior t	1	Feb-08-30	Feb-08-30	1174	7 Days per
Rock plmnt/contain dike to -12		321	Feb-12-30	Dec-29-30	0	Dredging 7 X
CN200A26	QR rock placement contain dike (4.1MT)	277	Feb-12-30	Nov-15-30	0	Dredging 7 X
CN200A27	QR rock placement interim dike (655T)	44	Nov-16-30	Dec-29-30	0	Dredging 7 X
Armor stone plmnt/contain dike to -12		54	Dec-30-30	Feb-21-31	0	Dredging 7 X
CN200A29	Armor stone for containment dike (330KT)	54	Dec-30-30	Feb-21-31	0	Dredging 7 X
Dredge & fill w/ clams & cutters (15 MCY)		711	Nov-27-29	Nov-07-31	831	
CN200A31	Dredge & fill with clamshell (2 ea, 1 MCY)	37	Nov-27-29	Jan-09-30	440	6x24
CN200A32	Dredge & fill with cutters to -12 (2 ea, 7.3 MCY)	147	Dec-30-30	May-25-31	850	Dredging 7 X
CN200A33	Dredge & fill with cutters -12 to final elev. (2 ea, 7.4 MCY	147	Jun-14-31	Nov-07-31	831	Dredging 7 X
Rock plmnt/contain dike -12 to final elevation		112	Feb-22-31	Jun-13-31	0	Dredging 7 X
CN200A35	Quarry run placement (780KtN)	87	Feb-22-31	May-19-31	0	Dredging 7 X
CN200A36	Armor stone placement (40KTN)	5	May-20-31	May-24-31	0	Dredging 7 X
CN200A46	Interim Dike Built to Final elevation Quarry run Placemer	20	May-25-31	Jun-13-31	0	Dredging 7 X
Surcharge 200 A		1289	Nov-25-31	Jun-06-35	831	
CN200A39	Build dikes for surcharge (100KCY)	32	Nov-25-31	Dec-26-31	864	7x12
CN200A40	Install surcharge w csdrdg (4 mcy)	80	Jan-29-32	Apr-17-32	831	Dredging 7 X
CN200A41	Settlement period (First 100A)	210	Apr-18-32	Nov-13-32	831	Dredging 7 X
CN200A42	Roll surcharge Second 100A (4 mcy)	300	Nov-13-32	Oct-29-33	712	6x12
CN200A43	Settlement period Second 100A	210	Oct-30-33	May-27-34	831	Dredging 7 X
CN200A44	Remove Surcharge to WASS (4 mcy)	320	May-27-34	Jun-05-35	712	6x12
CN200A45	Second 100A ready for construction	0	Jun-06-35		831	Dredging 7 X



▬ Actual Level of Effort	🟩 Remaining Work	◆	◆ Milestone
▬ Actual Work	🟥 Critical Remaining Work		

TASK filter: All Activities

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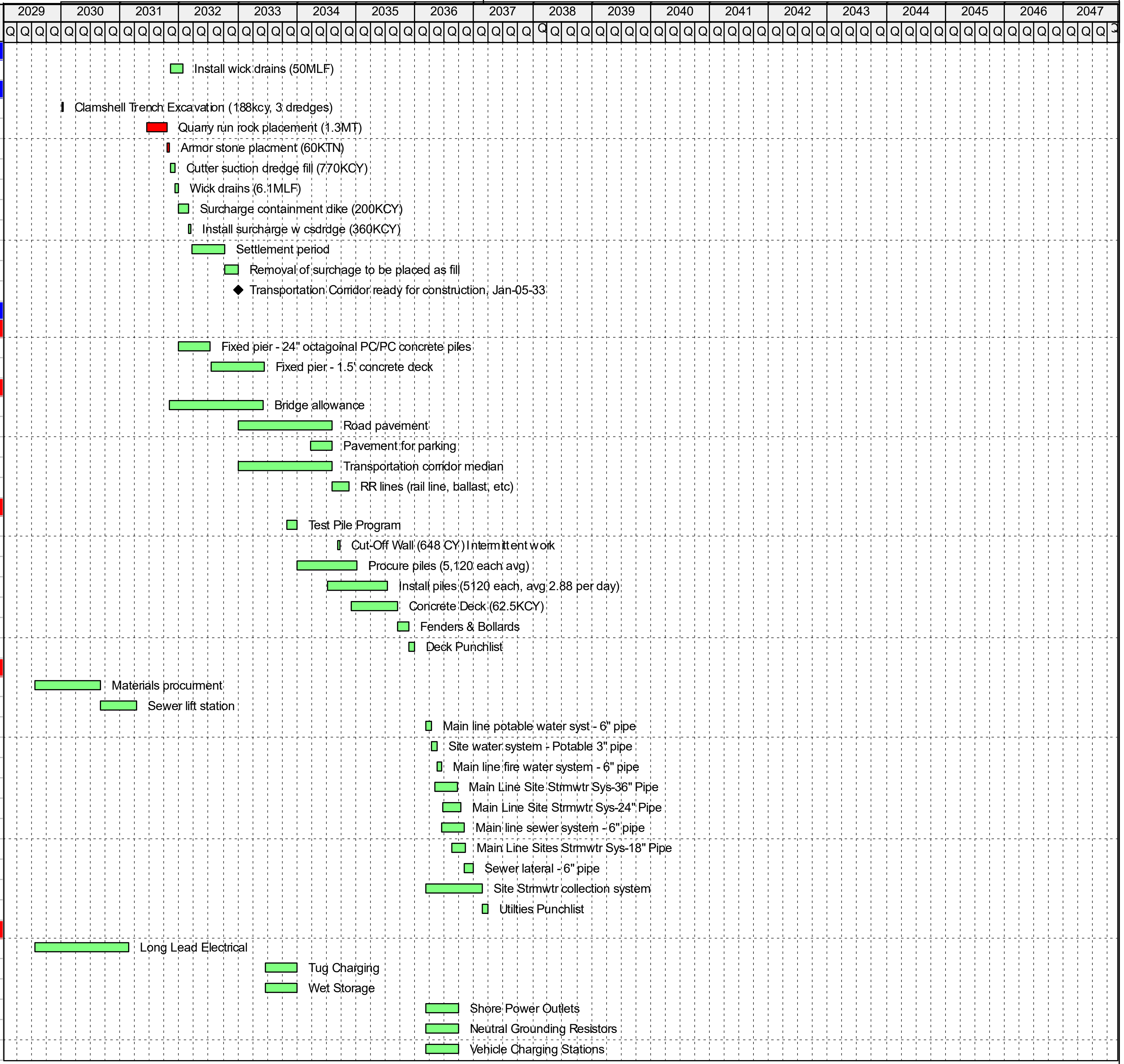
Activity ID	Activity Name	riginal uration	Start	Finish	Total Float	Calendar
Wick Drains		70	Nov-07-31	Jan-28-32	713	6x24
CN200A38	Install wick drains (50MLF)	70	Nov-07-31	Jan-28-32	713	6x24
Transportation Corridor (Rock, Dredge, Fill)		1093	Jan-09-30	Jan-05-33	2044	
CN200A47	Clamshell Trench Excavation (188kcy, 3 dredges)	7	Jan-09-30	Jan-17-30	440	6x24
CN200A48	Quarry run rock placement (1.3MT)	130	Jun-14-31	Oct-21-31	0	Dredging 7 X
CN200A49	Armor stone placment (60KTN)	10	Oct-22-31	Oct-31-31	0	Dredging 7 X
CN200A50	Cutter suction dredge fill (770KCY)	31	Nov-08-31	Dec-08-31	2044	Dredging 7 X
CN200A51	Wick drains (6.1MLF)	17	Dec-08-31	Dec-27-31	1752	6x24
CN200A52	Surcharge containment dike (200KCY)	67	Dec-28-31	Mar-03-32	2044	7x12
CN200A53	Install surcharge w csdrdge (360KCY)	15	Mar-04-32	Mar-18-32	2044	Dredging 7 X
CN200A54	Settlement period	210	Mar-19-32	Oct-14-32	2044	Dredging 7 X
CN200A55	Removal of surchage to be placed as fill	71	Oct-14-32	Jan-05-33	1752	6x12
CN200A56	Transportation Corridor ready for construction	0	Jan-05-33		2044	Dredging 7 X
Wharf Construction first 200A		2259	Jul-20-29	Mar-17-38	593	5x10
Wet storage		384	Dec-29-31	Jun-16-33	1616	5x10
WCN200A.111	Fixed pier - 24" octagoinal PC/PC concrete piles	144	Dec-29-31	Jul-15-32	1616	5x10
WCN200A.110	Fixed pier - 1.5' concrete deck	240	Jul-16-32	Jun-16-33	1616	5x10
Transportation Corridor (Exc dredge, rock revetment, & fill)		796	Oct-31-31	Nov-20-34	1460	5x10
WCN200A.104	Bridge allowance	416	Oct-31-31	Jun-06-33	1768	5x10
WCN200A.105	Road pavement	416	Jan-05-33	Aug-10-34	1460	5x10
WCN200A.106	Pavement for parking	96	Mar-29-34	Aug-10-34	1532	5x10
WCN200A.107	Transportation corridor median	416	Jan-05-33	Aug-10-34	1460	5x10
WCN200A.108	RR lines (rail line, ballast, etc)	72	Aug-10-34	Nov-20-34	1460	5x10
Wharf		565	Oct-31-33	Dec-31-35	645	5x10
WCN200A.59	Test Pile Program	48	Oct-31-33	Jan-04-34	773	5x10
WCN200A.62	Cut-Off Wall (648 CY) Intermittent work	10	Sep-14-34	Sep-28-34	691	5x10
WCN200A.60	Procure piles (5,120 each avg)	265	Jan-05-34	Jan-10-35	773	5x10
WCN200A.61	Install piles (5120 each, avg 2.88 per day)	265	Jul-10-34	Jul-16-35	645	5x10
WCN200A.63	Concrete Deck (62.5KCY)	208	Dec-04-34	Sep-20-35	645	5x10
WCN200A.64	Fenders & Bollards	48	Sep-20-35	Nov-27-35	645	5x10
WCN200A.65	Deck Punchlist	24	Nov-27-35	Dec-31-35	645	5x10
Utilities		2007	Jul-20-29	Mar-30-37	845	5x10
WCN200A.82	Materials procurment	292	Jul-20-29	Sep-03-30	1731	5x10
WCN200A.83	Sewer lift station	160	Sep-03-30	Apr-15-31	1942	5x10
WCN200A.77	Main line potable water syst - 6" pipe	24	Mar-12-36	Apr-15-36	593	5x10
WCN200A.78	Site water system - Potable 3" pipe	24	Apr-15-36	May-19-36	593	5x10
WCN200A.79	Main line fire water system - 6" pipe	20	May-19-36	Jun-16-36	593	5x10
WCN200A.75	Main Line Site Strmwtr Sys-36" Pipe	100	May-05-36	Sep-22-36	919	5x10
WCN200A.74	Main Line Site Strmwtr Sys-24" Pipe	80	Jun-26-36	Oct-16-36	919	5x10
WCN200A.80	Main line sewer system - 6" pipe	100	Jun-16-36	Nov-03-36	593	5x10
WCN200A.73	Main Line Sites Strmwtr Sys-18" Pipe	60	Aug-20-36	Nov-12-36	919	5x10
WCN200A.81	Sewer lateral - 6" pipe	40	Nov-03-36	Dec-29-36	593	5x10
WCN200A.76	Site Strmwtr collection system	250	Mar-12-36	Feb-24-37	845	5x10
WCN200A.84	Utlties Punchlist	24	Feb-24-37	Mar-30-37	845	5x10
Electrical		2259	Jul-20-29	Mar-17-38	593	5x10
WCN200A.86	Long Lead Electrical	416	Jul-20-29	Feb-24-31	1650	5x10
WCN200A.101	Tug Charging	144	Jun-17-33	Jan-04-34	1616	5x10
WCN200A.97	Wet Storage	144	Jun-17-33	Jan-04-34	1616	5x10
WCN200A.92	Shore Power Outlets	144	Mar-12-36	Sep-30-36	903	5x10
WCN200A.93	Neutral Grounding Resistors	144	Mar-12-36	Sep-30-36	903	5x10
WCN200A.94	Vehicle Charging Stations	144	Mar-12-36	Sep-30-36	903	5x10



🟦 Actual Level of Effort	🟩 Remaining Work
🟦 Actual Work	🟥 Critical Remaining Work
◆ Milestone	

TASK filter: All Activities

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Activity ID	Activity Name	Original Duration	Start	Finish	Total Float	Calendar
WCN200A.95	SPMT Charging Stations	144	Mar-12-36	Sep-30-36	903	5x10
WCN200A.100	UG Electrical, MH, PB, DB, Wire	144	Mar-12-36	Sep-30-36	657	5x10
WCN200A.96	Building Electrical	292	Mar-12-36	Apr-24-37	755	5x10
WCN200A.87	Main Substation	416	Mar-12-36	Oct-15-37	631	5x10
WCN200A.89	480 V Switchgears	416	Mar-12-36	Oct-15-37	631	5x10
WCN200A.88	Shore power substation	416	Mar-12-36	Oct-15-37	631	5x10
WCN200A.90	Crane Substation	416	Mar-12-36	Oct-15-37	631	5x10
WCN200A.91	MV Transformer	416	Mar-12-36	Oct-15-37	631	5x10
WCN200A.99	Highmast Lighting	144	May-19-37	Dec-07-37	593	5x10
WCN200A.102	Electrial testing & Commissioning	72	Dec-07-37	Mar-17-38	593	5x10
Uplands		671	Jun-06-35	Dec-31-37	647	5x10
WCN200A.67	Grading & Compaction of Uplands Soils (555KCY)	200	Jun-06-35	Mar-12-36	593	5x10
WCN200A.69	SUSMP water quality	480	Jun-06-35	Apr-08-37	815	5x10
WCN200A.70	Buildings (Buildings are 100% complete)	366	Mar-12-36	Aug-05-37	753	5x10
WCN200A.68	Dense Graded Aggregate Topping Surface (1.794KTN)	239	Dec-29-36	Nov-27-37	593	5x10
WCN200A.71	Uplands Punchlist	24	Nov-27-37	Dec-31-37	647	5x10
Phase 1 Complete		0	Mar-17-38	Mar-17-38	593	5x10
WCN200A.116	Phase 1 Complete	0		Mar-17-38	593	5x10
Construction of Second 200A		3813	Jan-17-30	Jun-25-40	0	
Rock quarry & placement		216	Nov-01-31	Jun-03-32	305	Dredging 7 X
CN400A122	Quarry and stockpile armor stone (400KTN)	18	Nov-01-31	Nov-18-31	503	Dredging 7 X
CN400A121	Quarry and stockpile QR during phase 1(5.4MTN)	216	Nov-01-31	Jun-03-32	0	Dredging 7 X
Dredge the key trench		89	Jan-17-30	Apr-30-30	657	6x24
CN400A119	Dredge key trench (2.400MCY, 2 dredges)	89	Jan-17-30	Apr-30-30	657	6x24
Rock plmnt/contain dike to -12		305	Jun-04-32	Apr-04-33	0	Dredging 7 X
CN400A124	QR rock placement contain dike (4.6MTN)	305	Jun-04-32	Apr-04-33	0	Dredging 7 X
Armor stone plmnt/contain dike to -12		59	Apr-05-33	Jun-02-33	0	Dredging 7 X
CN400A126	Armor stone for containment dike (360KTN)	59	Apr-05-33	Jun-02-33	0	Dredging 7 X
Dredge & fill w/ clams & cutters (16.1MCY)		1372	Apr-30-30	Jan-31-34	0	
CN400A128	Dredge & fill with clamshell (2 ea, 1 MCY)	37	Apr-30-30	Jun-12-30	888	6x24
CN400A129	Dredge & fill with cutters to -12 (2 ea, 7.3 MCY)	147	Apr-05-33	Aug-29-33	8	Dredging 7 X
CN400A130	Dredge & fill with cutters -12 to final elev. (2 ea, 7.3MCY	147	Sep-07-33	Jan-31-34	0	Dredging 7 X
Rock plmnt/contain dike -12 to final elevation		101	Jun-03-33	Sep-11-33	223	Dredging 7 X
CN400A132	Quarry run placement (860KTN)	96	Jun-03-33	Sep-06-33	0	Dredging 7 X
CN400A133	Armor stone placement (40KTN)	5	Sep-07-33	Sep-11-33	223	Dredging 7 X
Surcharge 200 A		1288	Feb-17-34	Aug-27-37	0	
CN400A136	Build dikes for surcharge (100KCY)	32	Feb-17-34	Mar-20-34	33	Dredging 7 X
CN400A137	Install surcharge w csdrdg (4 mcy)	80	Apr-23-34	Jul-11-34	0	Dredging 7 X
CN400A138	Settlement period (Third 100A)	210	Jul-12-34	Feb-06-35	0	Dredging 7 X
CN400A139	Roll surcharge Third 100A (4 mcy)	300	Feb-06-35	Jan-22-36	0	6x12
CN400A140	Settlement period Fourth 100A	210	Jan-23-36	Aug-19-36	0	Dredging 7 X
CN400A141	Remove surcharge 4th (4 mcy)	320	Aug-19-36	Aug-27-37	0	6x12
Wick Drains		70	Jan-31-34	Apr-22-34	0	6x24
CN400A135	Install wick drains (50MLF)	70	Jan-31-34	Apr-22-34	0	6x24
Wharf Construction second 200A		2560	Sep-03-30	Jun-25-40	0	5x10
Wharf		1071	Jan-10-35	Feb-17-39	352	5x10
WCN400A.144	Procure piles (5,120 each avg)	265	Jan-10-35	Jan-16-36	773	5x10
WCN400A.146	Cut-Off Wall (648 CY)	10	Nov-17-37	Dec-01-37	389	5x10
WCN400A.145	Install piles (5120 each, avg 2.88 per day)	265	Aug-27-37	Sep-02-38	352	5x10
WCN400A.147	Concrete Deck (62.5KCY)	208	Jan-21-38	Nov-09-38	352	5x10
WCN400A.148	Fenders & Bollards	48	Nov-09-38	Jan-14-39	352	5x10

▬	Actual Level of Effort
▬	Actual Work
🟩	Remaining Work
🟥	Critical Remaining Work
◆ ◆	Milestone

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Accelerated Schedule

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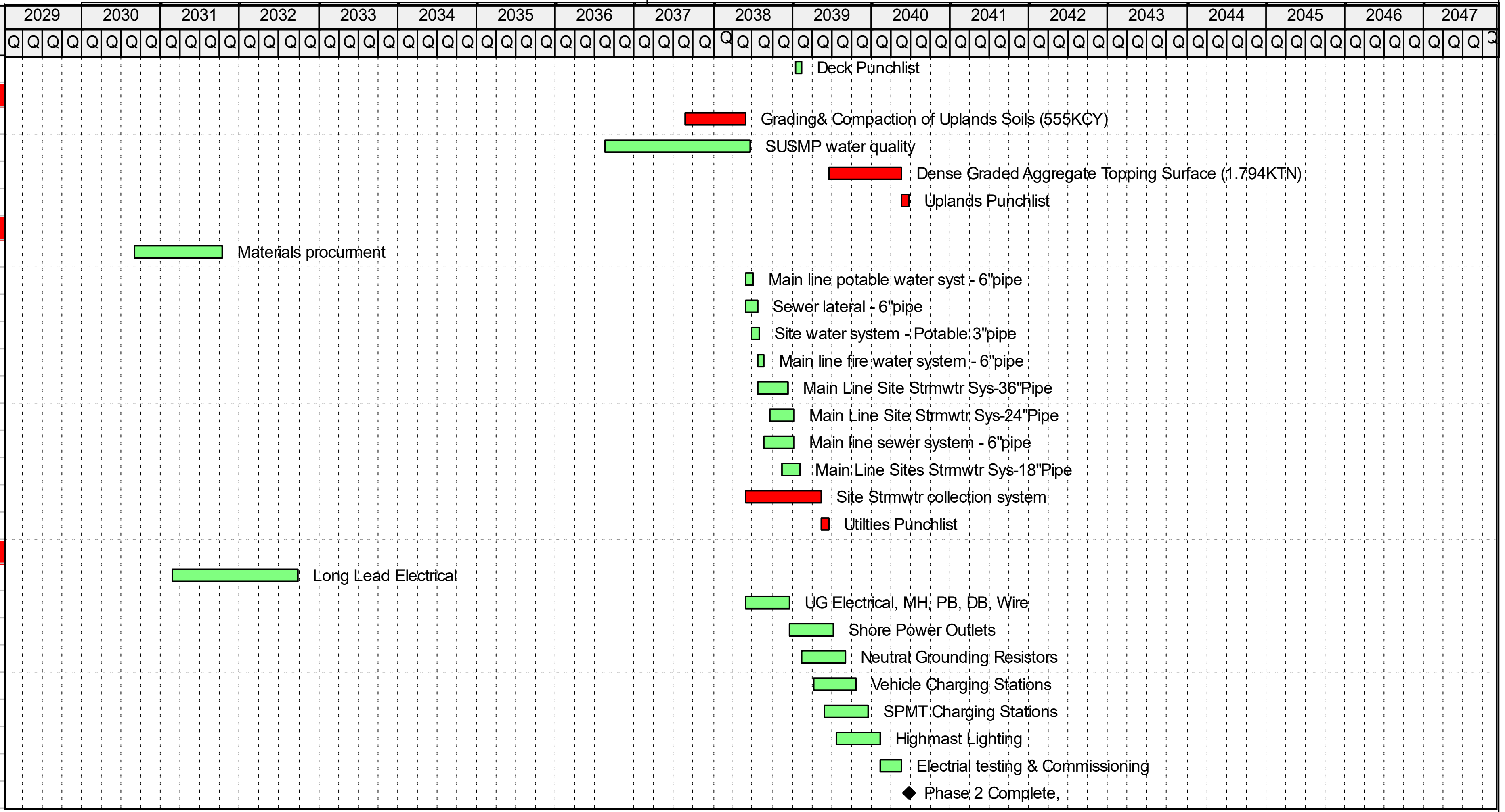
Activity ID	Activity Name	Original uration	Start	Finish	Total Float	Calendar
WCN400A.149	Deck Punchlist	24	Jan-14-39	Feb-17-39	352	5x10
Uplands		1004	Aug-19-36	Jun-25-40	0	5x10
WCN400A.151	Grading& Compaction of Uplands Soils (555KCY)	200	Aug-27-37	Jun-03-38	0	5x10
WCN400A.153	SUSMP water quality	480	Aug-19-36	Jun-22-38	500	5x10
WCN400A.152	Dense Graded Aggregate Topping Surface (1.794KTN)	239	Jun-22-39	May-22-40	0	5x10
WCN400A.154	Uplands Punchlist	24	May-22-40	Jun-25-40	0	5x10
Utilities		2296	Sep-03-30	Jun-22-39	0	5x10
WCN400A.165	Materials procurment	292	Sep-03-30	Oct-16-31	1731	5x10
WCN400A.160	Main line potable water syst - 6"pipe	24	Jun-03-38	Jul-07-38	92	5x10
WCN400A.164	Sewer lateral - 6"pipe	40	Jun-03-38	Jul-29-38	210	5x10
WCN400A.161	Site water system - Potable 3"pipe	24	Jul-01-38	Aug-04-38	92	5x10
WCN400A.162	Main line fire water system - 6"pipe	20	Jul-28-38	Aug-25-38	92	5x10
WCN400A.158	Main Line Site Strmwtr Sys-36"Pipe	100	Jul-28-38	Dec-15-38	74	5x10
WCN400A.157	Main Line Site Strmwtr Sys-24"Pipe	80	Sep-20-38	Jan-10-39	74	5x10
WCN400A.163	Main line sewer system - 6"pipe	100	Aug-24-38	Jan-11-39	92	5x10
WCN400A.156	Main Line Sites Strmwtr Sys-18"Pipe	60	Nov-12-38	Feb-04-39	74	5x10
WCN400A.159	Site Strmwtr collection system	250	Jun-03-38	May-19-39	0	5x10
WCN400A.166	Utilities Punchlist	24	May-19-39	Jun-22-39	0	5x10
Electrical		2436	Feb-24-31	Jun-25-40	0	5x10
WCN400A.168	Long Lead Electrical	416	Feb-24-31	Sep-28-32	1650	5x10
WCN400A.175	UG Electrical, MH, PB, DB, Wire	144	Jun-03-38	Dec-22-38	24	5x10
WCN400A.169	Shore Power Outlets	144	Dec-22-38	Jul-12-39	24	5x10
WCN400A.170	Neutral Grounding Resistors	144	Feb-15-39	Sep-05-39	24	5x10
WCN400A.171	Vehicle Charging Stations	144	Apr-08-39	Oct-27-39	24	5x10
WCN400A.172	SPMT Charging Stations	144	Jun-02-39	Dec-21-39	24	5x10
WCN400A.174	Highmast Lighting	144	Jul-26-39	Feb-13-40	24	5x10
WCN400A.176	Electrial testing & Commissioning	72	Feb-13-40	May-23-40	24	5x10
WCN400A.177	Phase 2 Complete	0		Jun-25-40	0	5x10



▬ Actual Level of Effort	🟩 Remaining Work	◆ Milestone
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TASK filter: All Activities

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Pier Wind Project - Concept Phase
Standard Schedule

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Port of LONG BEACH
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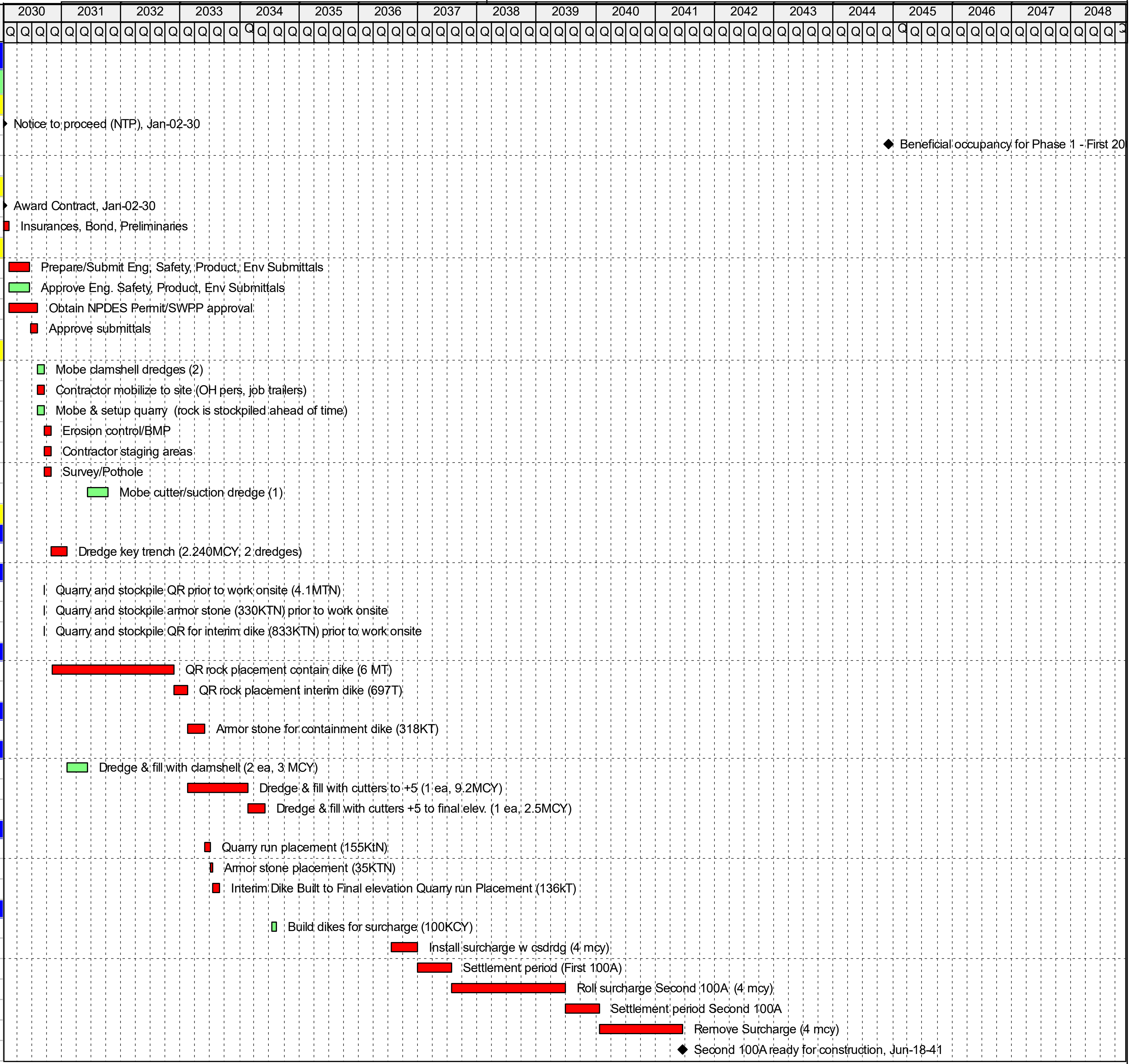
Activity ID	Activity Name	)riginal uration	Start	Finish	Total Float	Calendar
Wind Project Schedule 4.14.23 - Standard Scenario \$		7227	Jan-02-30	Oct-15-49	0	
POLB Windport		7227	Jan-02-30	Oct-15-49	0	
Milestones		5154	Jan-02-30	Oct-15-49	0	5x8
MS001	Notice to proceed (NTP)	0	Jan-02-30		0	5x8
MS002	Beneficial occupancy for Phase 1 - First 200 Acres Com	0		Dec-09-44*	0	5x8
MS003	Project Completion - Phase 1 and Phase 2	0		Oct-15-49	0	5x8
Preconstruction		30	Jan-02-30	Feb-13-30	0	5x8
PCON001	Award Contract	0	Jan-02-30		0	5x8
PCON002	Insurances, Bond, Preliminaries	30	Jan-02-30	Feb-13-30	0	5x8
Documentation/Permits		120	Feb-14-30	Aug-05-30	0	5x8
DP001	Prepare/Submit Eng, Safety, Product, Env Submittals	90	Feb-14-30	Jun-21-30	0	5x8
DP002	Approve Eng. Safety, Product, Env Submittals	90	Feb-14-30	Jun-21-30	30	5x8
DP003	Obtain NPDES Permit/SWPP approval	120	Feb-14-30	Aug-05-30	0	5x8
DP004	Approve submittals	30	Jun-24-30	Aug-05-30	0	5x8
Mobilization		307	Aug-06-30	Oct-15-31	352	5x8
MOB001	Mobe clamshell dredges (2)	30	Aug-06-30	Sep-17-30	30	5x8
MOB002	Contractor mobilize to site (OH pers, job trailers)	30	Aug-06-30	Sep-17-30	0	5x8
MOB003	Mobe & setup quarry (rock is stockpiled ahead of time)	30	Aug-06-30	Sep-17-30	31	5x8
MOB004	Erosion control/BMP	30	Sep-18-30	Oct-30-30	0	5x8
MOB005	Contractor staging areas	30	Sep-18-30	Oct-30-30	0	5x8
MOB006	Survey/Pothole	30	Sep-18-30	Oct-30-30	0	5x8
MOB007	Mobe cutter/suction dredge (1)	90	Jun-12-31	Oct-15-31	352	5x8
Construction of First 200A		5197	Sep-18-30	Dec-09-44	0	
Dredge the key trench		82	Oct-30-30	Feb-03-31	0	6x24
CN200A0020	Dredge key trench (2.240MCY, 2 dredges)	82	Oct-30-30	Feb-03-31	0	6x24
Rock quarry & placement		2	Sep-18-30	Sep-19-30	2420	
CN200A22	Quarry and stockpile QR prior to work onsite (4.1MTN)	1	Sep-18-30	Sep-18-30	44	7 Days per
CN200A24	Quarry and stockpile armor stone (330KTN) prior to wor	1	Sep-18-30	Sep-18-30	2421	Dredging 7 X
CN200A23	Quarry and stockpile QR for interim dike (833KTN) prior	1	Sep-19-30	Sep-19-30	883	7 Days per
Rock plmnt/contain dike to +5		598	Nov-05-30	Feb-18-33	0	5x10
CN200A26	QR rock placement contain dike (6 MT)	536	Nov-05-30	Nov-24-32	0	5x10
CN200A27	QR rock placement interim dike (697T)	62	Nov-24-32	Feb-18-33	0	5x10
Armor stone plmnt/contain dike to+5		73	Feb-18-33	Jun-01-33	1	5x10
CN200A29	Armor stone for containment dike (318KT)	73	Feb-18-33	Jun-01-33	1	5x10
Dredge & fill w/ clams & cutters (14.7 MCY)		1218	Feb-03-31	Jun-05-34	0	
CN200A31	Dredge & fill with clamshell (2 ea, 3 MCY)	110	Feb-03-31	Jun-11-31	422	6x24
CN200A32	Dredge & fill with cutters to +5 (1 ea, 9.2MCY)	369	Feb-18-33	Feb-22-34	0	Dredging 7 X
CN200A33	Dredge & fill with cutters +5 to final elev. (1 ea, 2.5MCY)	103	Feb-22-34	Jun-05-34	0	Dredging 7 X
Rock plmnt/contain dike +5 to final elevation		63	Jun-01-33	Aug-29-33	1	5x10
CN200A35	Quarry run placement (155KtN)	25	Jun-01-33	Jul-06-33	1	5x10
CN200A36	Armor stone placement (35KTN)	8	Jul-06-33	Jul-18-33	1	5x10
CN200A46	Interim Dike Built to Final elevation Quarry run Placeme	30	Jul-18-33	Aug-29-33	1	5x10
Surcharge 200 A		2528	Jul-17-34	Jun-18-41	0	
CN200A39	Build dikes for surcharge (100KCY)	32	Jul-17-34	Aug-18-34	706	7x12
CN200A40	Install surcharge w csdrdg (4 mcy)	160	Jul-24-36	Dec-31-36	0	Dredging 7 X
CN200A41	Settlement period (First 100A)	210	Dec-31-36	Jul-29-37	0	Dredging 7 X
CN200A42	Roll surcharge Second 100A (4 mcy)	600	Jul-29-37	Jun-29-39	0	6x12
CN200A43	Settlement period Second 100A	210	Jun-29-39	Jan-25-40	0	Dredging 7 X
CN200A44	Remove Surcharge (4 mcy)	437	Jan-25-40	Jun-18-41	0	6x12
CN200A45	Second 100A ready for construction	0	Jun-18-41		0	Dredging 7 X



▬	Actual Level of Effort
▬	Actual Work
🟩	Remaining Work
🟥	Critical Remaining Work
◆ ◆	Milestone

TASK filter: All Activities

Schedule date:Apr-14-23
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Pier Wind Project - Concept Phase
Standard Schedule

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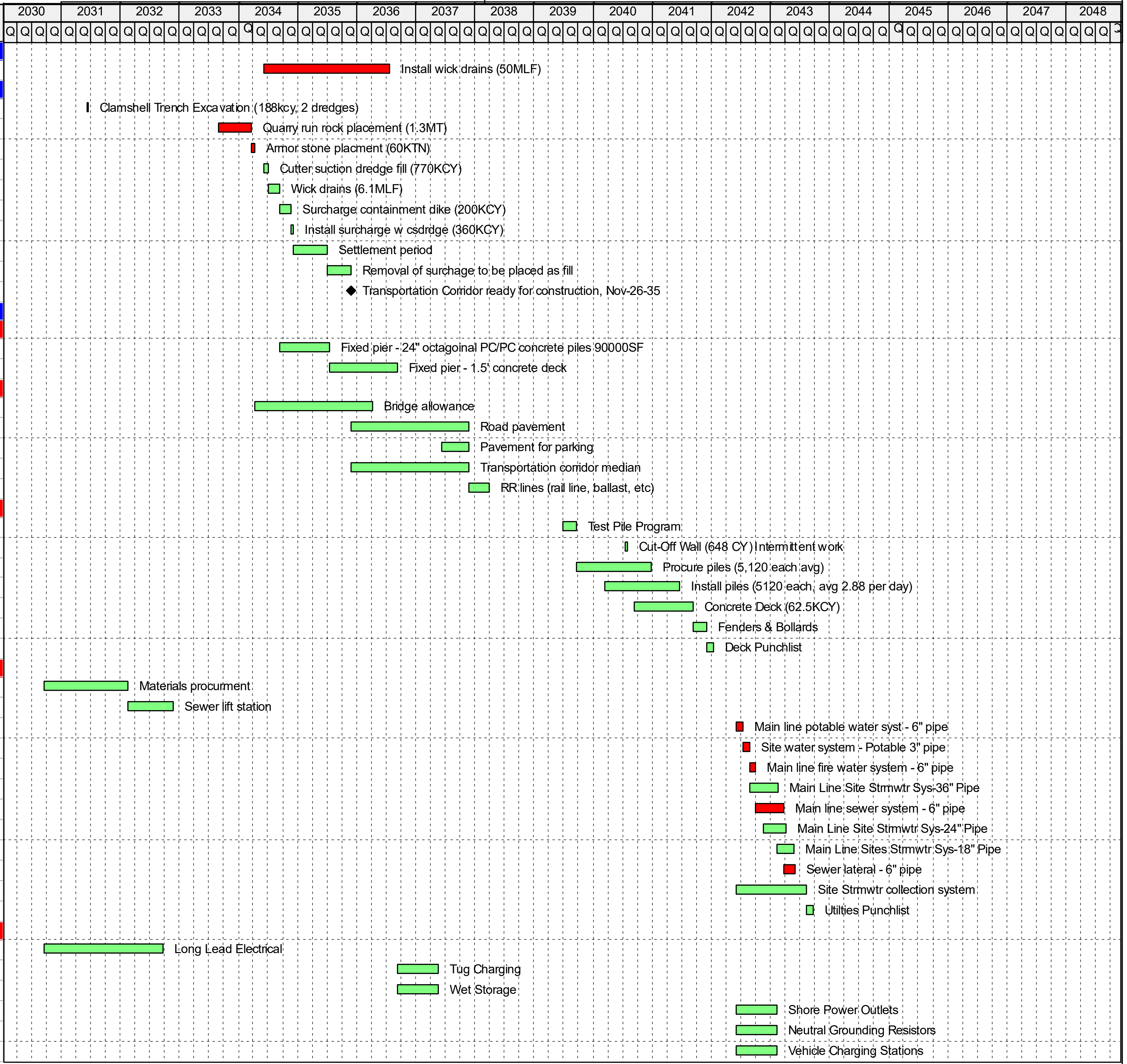
Activity ID	Activity Name	riginal uration	Start	Finish	Total Float	Calendar
Wick Drains		558	Jun-05-34	Jul-24-36	0	5x12
CN200A38	Install wick drains (50MLF)	558	Jun-05-34	Jul-24-36	0	5x12
Transportation Corridor (Rock, Dredge, Fill)		1629	Jun-11-31	Nov-26-35	2450	
CN200A47	Clamshell Trench Excavation (188kcy, 2 dredges)	7	Jun-11-31	Jun-19-31	688	6x24
CN200A48	Quarry run rock placement (1.3MT)	148	Aug-29-33	Mar-23-34	1	5x10
CN200A49	Armor stone placment (60KTN)	14	Mar-23-34	Apr-12-34	1	5x10
CN200A50	Cutter suction dredge fill (770KCY)	31	Jun-05-34	Jul-06-34	2450	Dredging 7 X
CN200A51	Wick drains (6.1MLF)	51	Jul-06-34	Sep-15-34	1750	5x12
CN200A52	Surcharge containment dike (200KCY)	67	Sep-15-34	Nov-21-34	2450	7x12
CN200A53	Install surcharge w csdrdge (360KCY)	15	Nov-21-34	Dec-06-34	2450	Dredging 7 X
CN200A54	Settlement period	210	Dec-06-34	Jul-04-35	2450	Dredging 7 X
CN200A55	Removal of surchage to be placed as fill	103	Jul-04-35	Nov-26-35	1750	5x12
CN200A56	Transportation Corridor ready for construction	0	Nov-26-35		2450	Dredging 7 X
Wharf Construction first 200A		3709	Sep-18-30	Dec-09-44	0	5x8
Wet storage		520	Sep-15-34	Sep-12-36	1881	5x8
WCN200A.111	Fixed pier - 24" octagoinal PC/PC concrete piles 90000S	220	Sep-15-34	Jul-20-35	1881	5x8
WCN200A.110	Fixed pier - 1.5' concrete deck	300	Jul-20-35	Sep-12-36	1881	5x8
Transportation Corridor (Exc dredge, rock revetment, & fill)		1033	Apr-13-34	Mar-29-38	1750	5x8
WCN200A.104	Bridge allowance	520	Apr-13-34	Apr-09-36	2172	5x8
WCN200A.105	Road pavement	520	Nov-26-35	Nov-23-37	1750	5x8
WCN200A.106	Pavement for parking	120	Jun-08-37	Nov-23-37	1840	5x8
WCN200A.107	Transportation corridor median	520	Nov-26-35	Nov-23-37	1750	5x8
WCN200A.108	RR lines (rail line, ballast, etc)	90	Nov-23-37	Mar-29-38	1750	5x8
Wharf		664	Jun-29-39	Jan-14-42	100	5x8
WCN200A.59	Test Pile Program	60	Jun-29-39	Sep-21-39	223	5x8
WCN200A.62	Cut-Off Wall (648 CY) Intermittent work	13	Jul-16-40	Aug-02-40	128	5x8
WCN200A.60	Procure piles (5,120 each avg)	331	Sep-21-39	Dec-27-40	223	5x8
WCN200A.61	Install piles (5120 each, avg 2.88 per day)	331	Mar-12-40	Jun-18-41	100	5x8
WCN200A.63	Concrete Deck (62.5KCY)	260	Sep-11-40	Sep-10-41	100	5x8
WCN200A.64	Fenders & Bollards	60	Sep-10-41	Dec-03-41	100	5x8
WCN200A.65	Deck Punchlist	30	Dec-03-41	Jan-14-42	100	5x8
Utilities		3392	Sep-18-30	Sep-23-43	317	5x8
WCN200A.82	Materials procurment	365	Sep-18-30	Feb-16-32	2570	5x8
WCN200A.83	Sewer lift station	200	Feb-17-32	Nov-22-32	2570	5x8
WCN200A.77	Main line potable water syst - 6" pipe	30	Jun-03-42	Jul-14-42	0	5x8
WCN200A.78	Site water system - Potable 3" pipe	30	Jul-15-42	Aug-25-42	0	5x8
WCN200A.79	Main line fire water system - 6" pipe	25	Aug-26-42	Sep-29-42	0	5x8
WCN200A.75	Main Line Site Strmwtr Sys-36" Pipe	125	Aug-26-42	Feb-16-43	374	5x8
WCN200A.80	Main line sewer system - 6" pipe	125	Sep-30-42	Mar-23-43	0	5x8
WCN200A.74	Main Line Site Strmwtr Sys-24" Pipe	100	Nov-18-42	Apr-06-43	374	5x8
WCN200A.73	Main Line Sites Strmwtr Sys-18" Pipe	75	Feb-10-43	May-25-43	374	5x8
WCN200A.81	Sewer lateral - 6" pipe	50	Mar-24-43	Jun-01-43	0	5x8
WCN200A.76	Site Strmwtr collection system	312	Jun-03-42	Aug-12-43	317	5x8
WCN200A.84	Utilties Punchlist	30	Aug-13-43	Sep-23-43	317	5x8
Electrical		3709	Sep-18-30	Dec-09-44	0	5x8
WCN200A.86	Long Lead Electrical	520	Sep-18-30	Sep-20-32	2579	5x8
WCN200A.101	Tug Charging	180	Sep-12-36	May-22-37	1881	5x8
WCN200A.97	Wet Storage	180	Sep-12-36	May-22-37	1881	5x8
WCN200A.92	Shore Power Outlets	180	Jun-03-42	Feb-09-43	389	5x8
WCN200A.93	Neutral Grounding Resistors	180	Jun-03-42	Feb-09-43	389	5x8
WCN200A.94	Vehicle Charging Stations	180	Jun-03-42	Feb-09-43	389	5x8



Actual Level of Effort
Actual Work
🟩 Remaining Work
🟥 Critical Remaining Work
◆ ◆ Milestone

TASK filter: All Activities

Schedule date:Apr-14-23
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Pier Wind Project - Concept Phase
Standard Schedule

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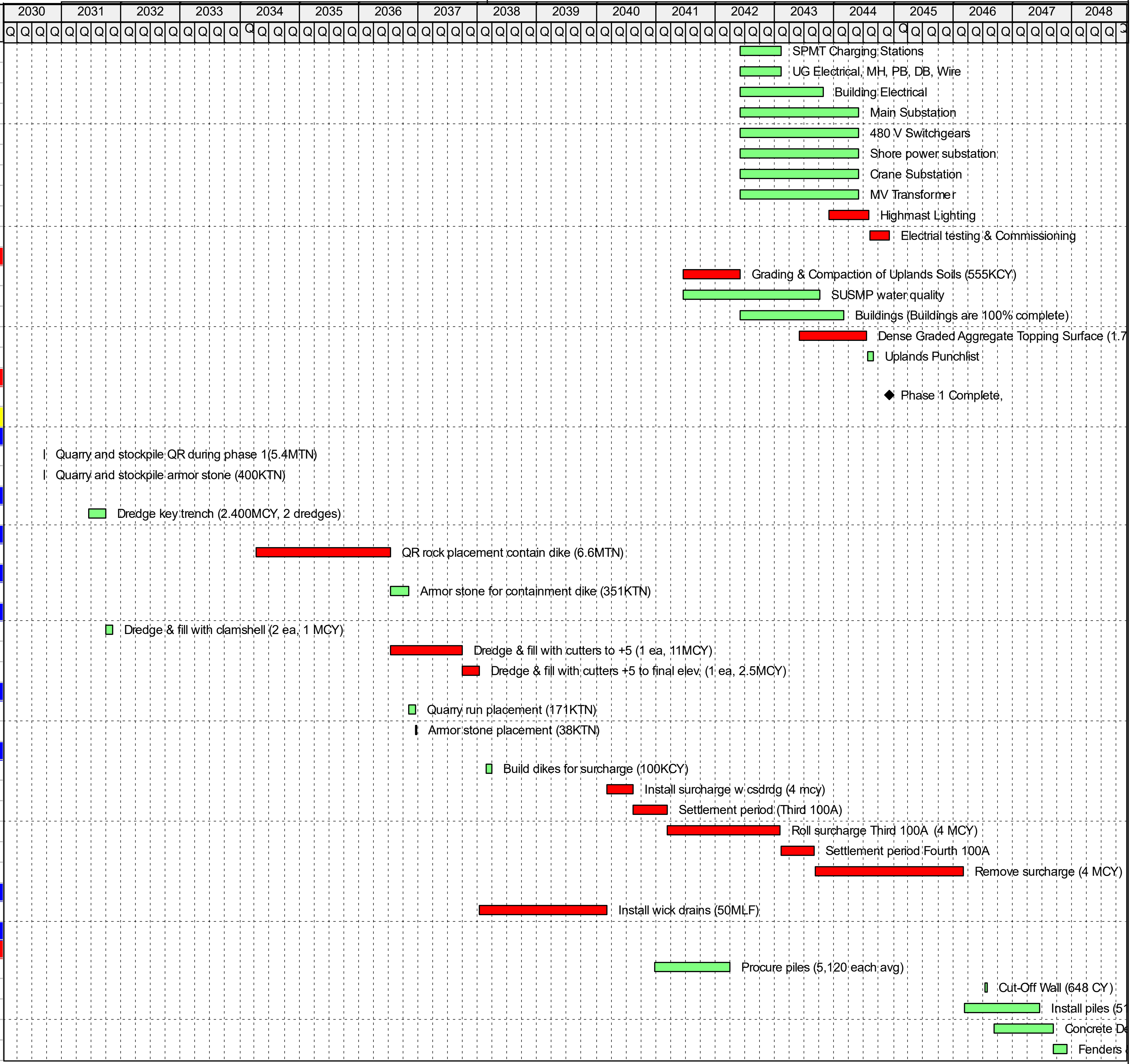
Activity ID	Activity Name	Original uration	Start	Finish	Total Float	Calendar
WCN200A.95	SPMT Charging Stations	180	Jun-03-42	Feb-09-43	389	5x8
WCN200A.100	UG Electrical, MH, PB, DB, Wire	180	Jun-03-42	Feb-09-43	80	5x8
WCN200A.96	Building Electrical	365	Jun-03-42	Oct-26-43	204	5x8
WCN200A.87	Main Substation	520	Jun-03-42	May-30-44	49	5x8
WCN200A.89	480 V Switchgears	520	Jun-03-42	May-30-44	49	5x8
WCN200A.88	Shore power substation	520	Jun-03-42	May-30-44	49	5x8
WCN200A.90	Crane Substation	520	Jun-03-42	May-30-44	49	5x8
WCN200A.91	MV Transformer	520	Jun-03-42	May-30-44	49	5x8
WCN200A.99	Highmast Lighting	180	Nov-30-43	Aug-05-44	0	5x8
WCN200A.102	Electrial testing & Commissioning	90	Aug-08-44	Dec-09-44	0	5x8
Uplands		**839**	**Jun-18-41**	**Sep-02-44**	**70**	**5x8**
WCN200A.67	Grading & Compaction of Uplands Soils (555KCY)	250	Jun-18-41	Jun-02-42	0	5x8
WCN200A.69	SUSMP water quality	600	Jun-18-41	Oct-05-43	279	5x8
WCN200A.70	Buildings (Buildings are 100% complete)	457	Jun-03-42	Mar-02-44	202	5x8
WCN200A.68	Dense Graded Aggregate Topping Surface (1.794KTN)	299	Jun-02-43	Jul-22-44	0	5x8
WCN200A.71	Uplands Punchlist	30	Jul-25-44	Sep-02-44	70	5x8
Phase 1 Complete		**0**	**Dec-09-44**	**Dec-09-44**	**0**	**5x8**
WCN200A.116	Phase 1 Complete	0		Dec-09-44	0	5x8
Construction of Second 200A		**6967**	**Sep-19-30**	**Oct-15-49**	**0**	
Rock quarry & placement		**1**	**Sep-19-30**	**Sep-19-30**	**2421**	**Dredging 7 X**
CN400A121	Quarry and stockpile QR during phase 1(5.4MTN)	1	Sep-19-30	Sep-19-30	1302	Dredging 7 X
CN400A122	Quarry and stockpile armor stone (400KTN)	1	Sep-19-30	Sep-19-30	2421	Dredging 7 X
Dredge the key trench		**89**	**Jun-19-31**	**Oct-01-31**	**793**	**6x24**
CN400A119	Dredge key trench (2.400MCY, 2 dredges)	89	Jun-19-31	Oct-01-31	793	6x24
Rock plmnt/contain dike to +5		**590**	**Apr-12-34**	**Jul-17-36**	**1**	**5x10**
CN400A124	QR rock placement contain dike (6.6MTN)	590	Apr-12-34	Jul-17-36	1	5x10
Armor stone plmnt/contain dike to +5		**80**	**Jul-17-36**	**Nov-06-36**	**210**	**5x10**
CN400A126	Armor stone for containment dike (351KTN)	80	Jul-17-36	Nov-06-36	210	5x10
Dredge & fill w/ clams & cutters (16.1MCY)		**2296**	**Oct-01-31**	**Jan-13-38**	**1**	
CN400A128	Dredge & fill with clamshell (2 ea, 1 MCY)	37	Oct-01-31	Nov-13-31	1465	6x24
CN400A129	Dredge & fill with cutters to +5 (1 ea, 11MCY)	442	Jul-17-36	Oct-02-37	1	Dredging 7 X
CN400A130	Dredge & fill with cutters +5 to final elev. (1 ea, 2.5MCY)	103	Oct-02-37	Jan-13-38	1	Dredging 7 X
Rock plmnt/contain dike +5 to final elevation		**36**	**Nov-06-36**	**Dec-26-36**	**832**	**5x10**
CN400A132	Quarry run placement (171KTN)	27	Nov-06-36	Dec-15-36	210	5x10
CN400A133	Armor stone placement (38KTN)	9	Dec-15-36	Dec-26-36	832	5x10
Surcharge 200 A		**2936**	**Feb-24-38**	**Mar-09-46**	**0**	
CN400A136	Build dikes for surcharge (100KCY)	32	Feb-24-38	Mar-28-38	709	7x12
CN400A137	Install surcharge w csdrdg (4 mcy)	160	Mar-05-40	Aug-12-40	1	Dredging 7 X
CN400A138	Settlement period (Third 100A)	210	Aug-12-40	Mar-10-41	1	Dredging 7 X
CN400A139	Roll surcharge Third 100A (4 MCY)	600	Mar-11-41	Feb-07-43	0	6x12
CN400A140	Settlement period Fourth 100A	210	Feb-08-43	Sep-05-43	1	Dredging 7 X
CN400A141	Remove surcharge (4 MCY)	655	Sep-07-43	Mar-09-46	0	5x12
Wick Drains		**558**	**Jan-13-38**	**Mar-05-40**	**1**	**5x12**
CN400A135	Install wick drains (50MLF)	558	Jan-13-38	Mar-05-40	1	5x12
Wharf Construction second 200A		**4609**	**Feb-17-32**	**Oct-15-49**	**0**	**5x8**
Wharf		**1838**	**Dec-27-40**	**Jan-13-48**	**459**	**5x8**
WCN400A.144	Procure piles (5,120 each avg)	331	Dec-27-40	Apr-04-42	1485	5x8
WCN400A.146	Cut-Off Wall (648 CY)	13	Jul-16-46	Aug-01-46	487	5x8
WCN400A.145	Install piles (5120 each, avg 2.88 per day)	331	Mar-12-46	Jun-17-47	459	5x8
WCN400A.147	Concrete Deck (62.5KCY)	260	Sep-11-46	Sep-09-47	459	5x8
WCN400A.148	Fenders & Bollards	60	Sep-10-47	Dec-02-47	459	5x8



▬ Actual Level of Effort
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◆ ◆ Milestone

TASK filter: All Activities

Schedule date:Apr-14-23
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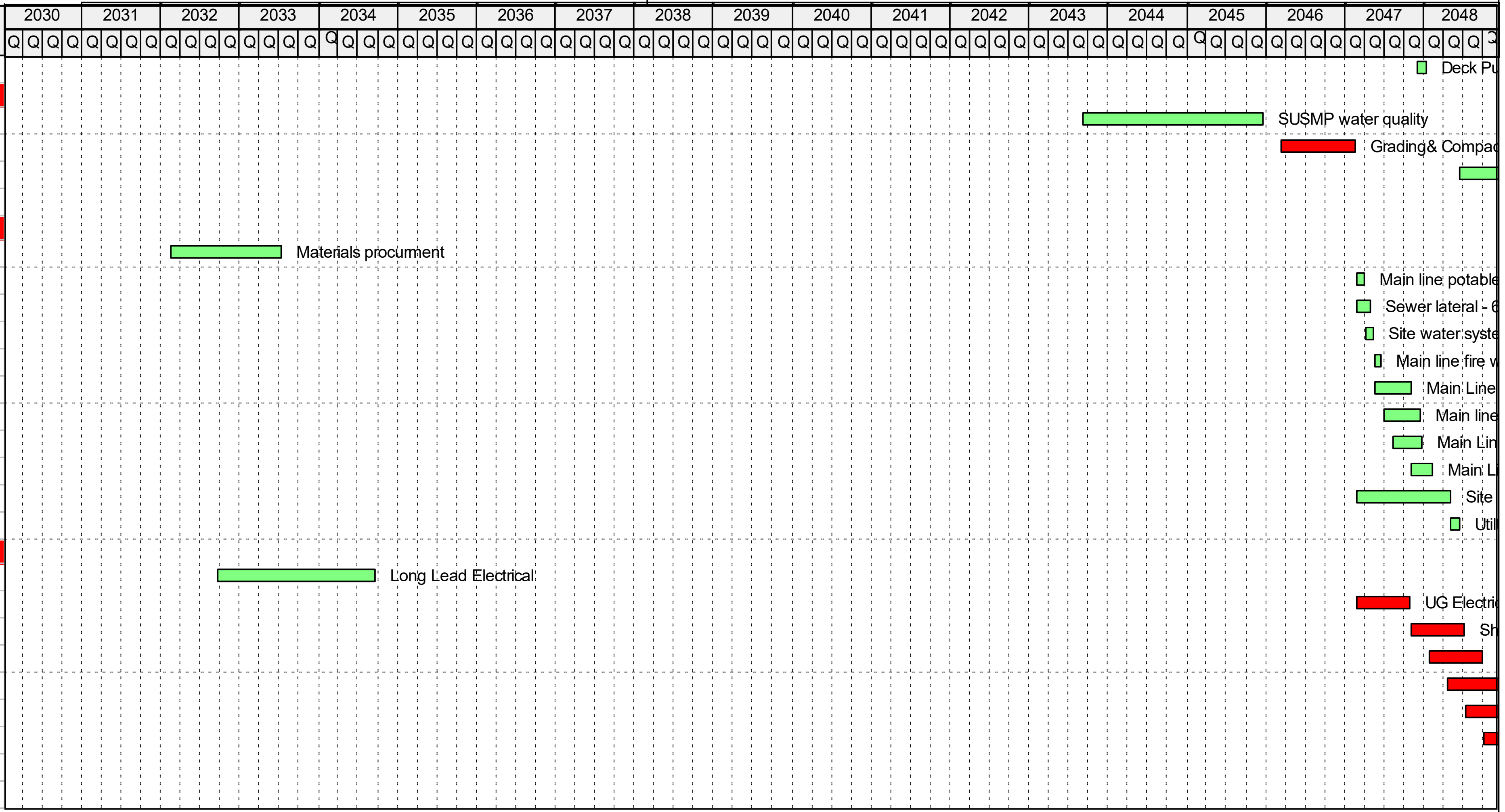
Pier Wind Project - Concept Phase
Standard Schedule

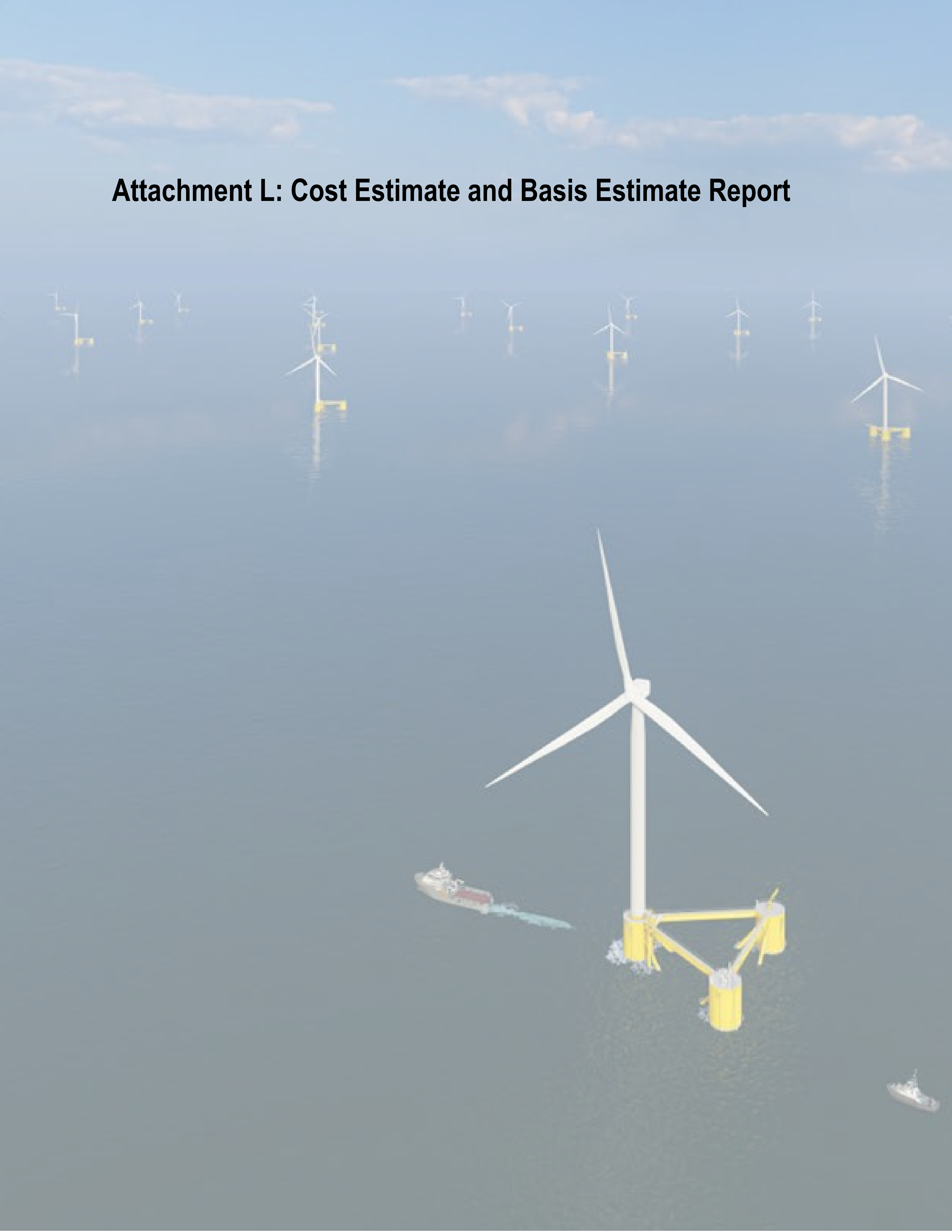
Activity ID	Activity Name	Original uration	Start	Finish	Total Float	Calendar
WCN400A.149	Deck Punchlist	30	Dec-03-47	Jan-13-48	459	5x8
Uplands		1576	Sep-07-43	Sep-20-49	19	5x8
WCN400A.153	SUSMP water quality	600	Sep-07-43	Dec-22-45	965	5x8
WCN400A.151	Grading& Compaction of Uplands Soils (555KCY)	250	Mar-12-46	Feb-22-47	0	5x8
WCN400A.152	Dense Graded Aggregate Topping Surface (1.794KTN)	299	Jun-17-48	Aug-09-49	19	5x8
WCN400A.154	Uplands Punchlist	30	Aug-10-49	Sep-20-49	19	5x8
Utilities		4261	Feb-17-32	Jun-16-48	19	5x8
WCN400A.165	Materials procurment	365	Feb-17-32	Jul-11-33	3573	5x8
WCN400A.160	Main line potable water syst - 6"pipe	30	Feb-25-47	Apr-05-47	116	5x8
WCN400A.164	Sewer lateral - 6"pipe	50	Feb-25-47	May-03-47	281	5x8
WCN400A.161	Site water system - Potable 3"pipe	30	Apr-08-47	May-17-47	116	5x8
WCN400A.162	Main line fire water system - 6"pipe	25	May-20-47	Jun-21-47	116	5x8
WCN400A.158	Main Line Site Strmwtr Sys-36"Pipe	125	May-20-47	Nov-08-47	76	5x8
WCN400A.163	Main line sewer system - 6"pipe	125	Jul-01-47	Dec-20-47	116	5x8
WCN400A.157	Main Line Site Strmwtr Sys-24"Pipe	100	Aug-12-47	Dec-27-47	76	5x8
WCN400A.156	Main Line Sites Strmwtr Sys-18"Pipe	75	Nov-04-47	Feb-14-48	76	5x8
WCN400A.159	Site Strmwtr collection system	312	Feb-25-47	May-05-48	19	5x8
WCN400A.166	Utilities Punchlist	30	May-06-48	Jun-16-48	19	5x8
Electrical		4454	Sep-21-32	Oct-15-49	0	5x8
WCN400A.168	Long Lead Electrical	520	Sep-21-32	Sep-18-34	3424	5x8
WCN400A.175	UG Electrical, MH, PB, DB, Wire	180	Feb-25-47	Nov-01-47	0	5x8
WCN400A.169	Shore Power Outlets	180	Nov-04-47	Jul-10-48	0	5x8
WCN400A.170	Neutral Grounding Resistors	180	Jan-27-48	Oct-02-48	0	5x8
WCN400A.171	Vehicle Charging Stations	180	Apr-20-48	Dec-25-48	0	5x8
WCN400A.172	SPMT Charging Stations	180	Jul-13-48	Mar-19-49	0	5x8
WCN400A.174	Highmast Lighting	180	Oct-05-48	Jun-11-49	0	5x8
WCN400A.176	Electrial testing & Commissioning	90	Jun-14-49	Oct-15-49	0	5x8
WCN400A.177	Phase 2 Complete	0		Oct-15-49	0	5x8



▬ Actual Level of Effort	🟩 Remaining Work	◆	◆ Milestone
▬ Actual Work	🟥 Critical Remaining Work		

TASK filter: All Activities

Attachment L: Cost Estimate and Basis Estimate Report



moffatt & nichol

4225 E. Conant Street
Long Beach, CA 90808

(562) 590 - 6500
www.moffattnichol.com

COST ESTIMATE MEMORANDUM

To:	Port of Long Beach
From:	Seann Perez & Jennifer Lim (Moffatt & Nichol)
Cc:	Matt Trowbridge (Moffatt & Nichol)
Project Name:	Pier Wind Project – Concept Phase
Date:	April 20, 2023
Subject:	Cost Estimate Memorandum
M&N Job No.:	10800-24

For the Pier Wind concept phase, a construction cost estimate was developed for the agreed upon site layout. The site layout, shown in **Figure 1**, illustrates the main project components such as the transportation corridor, railroad and transportation bridges, 400-acre terminal, wharf, sinking basin, tug dock, and wet storage piers.

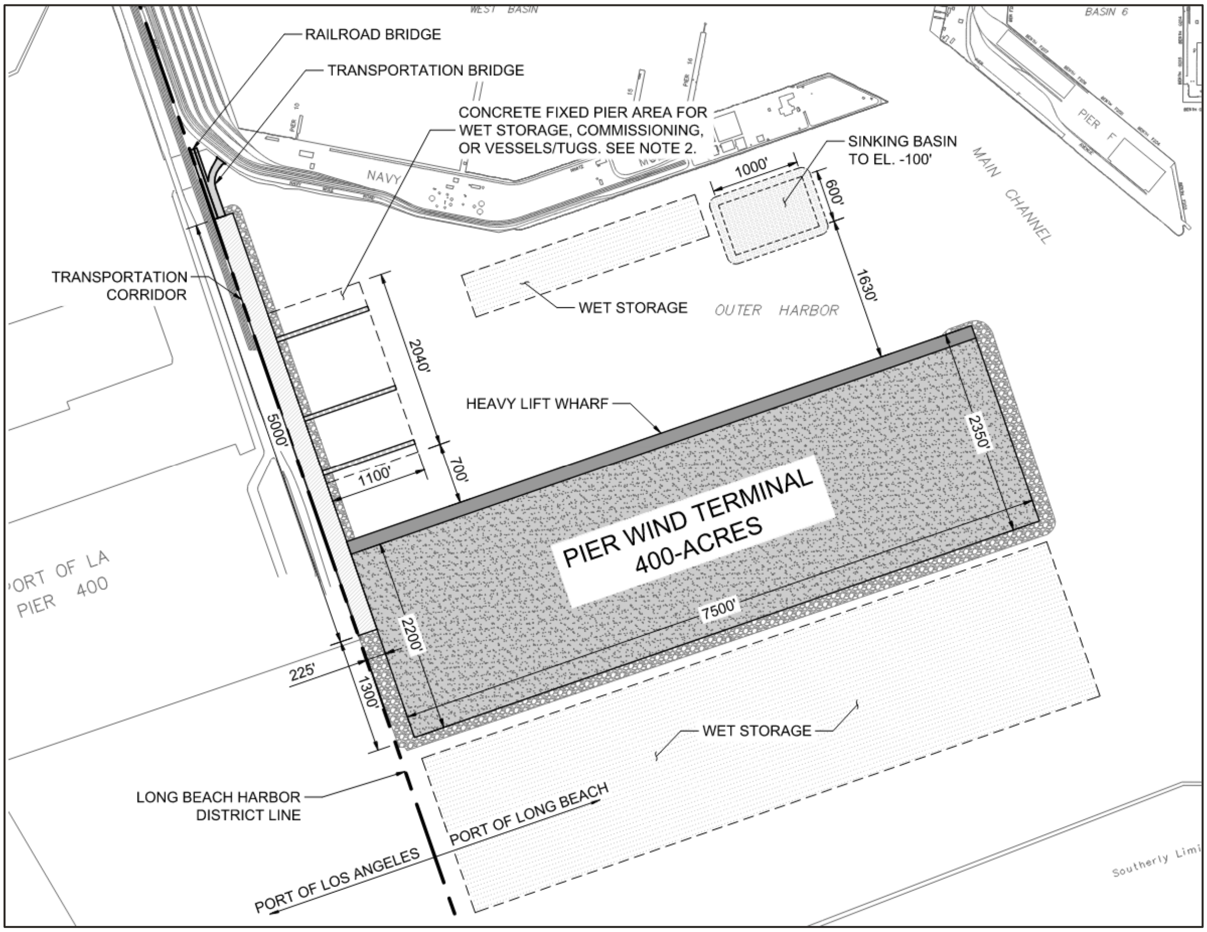


Figure 1. Pier Wind Concept Phase Site Plan

AACE Class 5 Cost Estimate

The cost estimate was developed to an AACE International Class 5 level with an accuracy of -30% / +50%. The estimate was developed using historical and current data using in-house sources, information from previous studies, and budget price quotations from suppliers and contractors. The cost estimate is broken up into the following main line items:

1. Contractor Mobilization / Demobilization
    - Item 1 includes 5% of 'Total Direct Costs' for Items 2 through 9.
2. Dredging / Fill
    - Item 2 includes construction activities such as dredging, placement of fill, placement and removal of surcharge, and installation of wick drains for the transportation corridor and terminal. The terminal build is broken up into two phases with the first phase being 200 acres and the second phase being the remaining 200 acres.
3. Rock Revetment
    - Item 3 includes construction activities for the rock revetments. A multi-lift rock revetment is used along the perimeter of the terminal and a single lift rock revetment is used for the transportation corridor and interim dike between the two phases.
4. Heavy Lift Wharf
    - Item 4 includes infrastructure for the 150-feet wide heavy lift wharf with 28" octagonal precast / prestressed concrete piles, 3-feet thick deck, additional appurtenances such as a fender and bollard system, and 3-feet of dense grade aggregate on top to create the working surface.
5. Uplands
    - Item 5 includes grading and compaction, 3 feet of dense grade aggregate, and water quality measures for the uplands area once the fill and surcharge are completed.
6. Utilities
    - Item 6 includes utilities such as stormwater, potables water, fire water, sewer systems, lift stations, and communications for the transportation corridor and terminal. This assumes there will be adequate connections provided at the Navy Mole connection.
7. Electrical
    - Item 7 includes the necessary electrical infrastructure to power and charge the terminal, equipment, and vessels that will be operating at Pier Wind.
8. Transportation Corridor (Roadway, Bridge, and Rail)
    - Item 8 includes the roadway and rail infrastructure for the transportation corridor that has two rail lines and four traffic lanes going to the terminal and a utility corridor.
9. Wet Storage
    - Item 9 includes the infrastructure for three fixed 1,100 feet long concrete piers for wet storage of assembled offshore wind turbines, commissioning, or tugs.

Table 1 provides a summary of the cost estimate prepared to an AACE Class 5 level of accuracy with a range of -30% / +50%. The total construction cost for Pier Wind is approximately $4.7 billion and can range from $3.3 to $7.0 billion. This includes indirect costs from the Contractor, 30% contingency, and 15% soft costs. Also provided is cost per 80 acres, the space required for an offshore wind developer to utilize the site for staging and integration or manufacturing activities.

A more detailed breakdown that includes quantities and unit prices is provided as an attachment to this memorandum.

Table 1. Pier Wind AACE Class 5 Cost Estimate (-30% / +50%)

Item	Description	Total Direct Cost	Total Construction Cost [1]	Total Construction Cost (with Contingency) [2]
1	Contractor Mobilization / Demobilization	$ 116,000,000	$ 149,640,000	$ 194,532,000
2	Dredging / Fill	$ 560,000,000	$ 722,400,000	$ 939,120,000
3	Rock Revetment	$ 524,000,000	$ 675,960,000	$ 878,748,000
4	Heavy Lift Wharf	$620,000,000	$ 799,800,000	$ 1,039,740,000
5	Uplands	$ 324,000,000	$ 417,960,000	$ 543,348,000
6	Utilities	$71,000,000	$ 94,170,000	$ 122,421,000
7	Electrical	$147,000,000	$ 189,630,000	$ 246,519,000
8	Transportation Corridor (Roadway, Bridge, & Rail)	$42,000,000	$ 54,180,000	$ 70,434,000
9	Wet Storage	$28,000,000	$ 36,120,000	$ 46,956,000
Sub-Total		**$ 2,432,000,000**	**$ 3,140,000,000**	**$ 4,082,000,000**
Soft Costs (15%)				$ 613,000,000
Total Project Cost				**$ 4,695,000,000**
Total Project Cost Per Acre				**$ 11,737,500**
Total Project Cost Per 80 Acres				**$ 939,000,000**

Footnotes:

[1] 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.

[2] 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.

Notes and Assumptions

Below is a summary of additional notes and assumptions that were made to determine the cost.

1. This cost estimate is an opinion of construction cost made by the Consultant. In providing opinions on construction costs, it is recognized that neither the Client nor the Consultant controls the cost of labor, equipment, materials, or the Contractors' methods of determining prices and bids. This estimate does not constitute a warranty, expressed or implied, that the Contractors' bids or negotiated prices of work will correspond with the Owner's budget or opinion of the construction cost prepared by the Consultant.

2. Costs are in 2023 USD.
3. Escalation is not included in the cost estimate.
4. Costs assume a work schedule of 7 days a week / 24 hours a day for all operations.
5. Assumed there is no time of year restriction on the work.
6. Estimate assumes there are 3 Electric Clamshell Dredges working concurrently.
7. Estimate assumes there are 3 Electric Cutter Suction Dredges working concurrently.
8. Clamshell dredging bottom dumps the dredge material from a scow into the fill areas
9. Cutter Suction dredging pumps material directly into the fill areas.
10. Cutter Suction dredging does not begin until the rock dike is built to elevation -12.0 feet MLLW.
11. Assumes all fill material is dredged from within the limits of the Port. No offshore dredging or potential nearshore borrow areas were estimated to be used.
12. Wick drains are spaced on a 3.5 feet triangle spacing.
13. Surcharge layer of material is placed to 20 feet above finished grade.
14. Surcharge is installed in the first 100 acres, then rolled following the settlement period.
15. Surcharge settlement period is estimated at 7 months per stage.
16. Surcharge removal at project completion assumes material is loaded into barges and bottom dumped at an offshore disposal site. Costs assume there is adequate space for contractor laydown and staging areas.
17. Assumes Port pays the quarry to stockpile rock ahead of start of construction so there is no delay in schedule.
18. Rock placement assumes 4 derricks working concurrently.
19. Wick drain installation assumes 8 rigs working concurrently.
20. No costs have been included for locating, protecting, or moving any underground utilities and assumes the adequate utility connections will be provided at the Navy Mole interface.
21. No costs have been included for any geotechnical exploration.
22. Assumes Port will provide adequate laydown space for contractor to stockpile and dewater dredge material for use as surcharge later in the project.
23. Volumes for dredge and fill are based on currently available bathymetry.
24. Estimate is based on currently available geotechnical information. Additional geotechnical explorations will be conducted to refine cost and schedule in the next phase of the project.
25. Estimate assumes piles are driven to grade with no unforeseen obstructions.

moffatt & nichol	CLIENT:	Port of Long Beach	JOB NO	10800-24		
	PROJECT:	Pier Wind Project - Concept Phase	DESIGNER	SP	DATE	4/12/2023
	DESIGN FOR:	Staging and Integration Facility - 400 acres	CHECKER	JL	DATE	4/14/2023
		Opinion of Probable Cost				

Item	Description	Quantity	Unit	Unit Price	Subtotal	Total
1	**Contractor Mobilization/Demobilization**					**$116,000,000**
1.1	Construction Mobilization	5	%			
2	**Dredging / Fill**					**$560,000,000**
2.1	**Phase 1 - 200 acres**					**$268,327,923**
2.11	Phase 1 - 200 acres Dredge/Fill (Clamshell)	3,239,082	CY	$14	$45,347,149	
2.12	Phase 1 - 200 acres Dredge/Fill (Cutter Section)	14,697,631	CY	$6	$88,185,786	
2.13	Phase 1 - 200 acres Surcharge (Up to EL.+38')	4,000,000	CY	$19.28	$77,100,000	
2.14	Phase 1 - 200 acres Wick Drains (3.5' x 3.5' Spacing)	57,694,988	LF	$1	$57,694,988	
2.2	**Phase 1 - Transportation Corridor**					**$26,312,234**
2.21	Transportation Corridor - Dredge/Fill (Clamshell)	188,323	CY	$14	$2,636,522	
2.22	Transportation Corridor - Dredge/Fill (Cutter Section)	770,125	CY	$6	$4,620,750	
2.23	Transportation Corridor - Surcharge (Up to EL.+36')	567,511	CY	$22.72	$12,893,850	
2.24	Transportation Corridor - Wick Drains (3.5' x 3.5' Spacing)	6,161,112	LF	$1	$6,161,112	
2.3	**Phase 2 - Remaining 200 acres**					**$264,806,040**
2.31	Phase 2 - 200 acres Dredge/Fill (Clamshell)	3,416,346	CY	$14	$47,828,850	
2.32	Phase 2 - 200 acres Dredge/Fill (Cutter Section)	11,520,367	CY	$6	$69,122,202	
2.33	Phase 2 - 200 acres Surcharge (Up to EL.+38')	4,000,000	CY	$22.54	$90,160,000	
2.34	Phase 2 - 200 acres Wick Drains (3.5' x 3.5' Spacing)	57,694,988	CY	$1	$57,694,988	
3	**Rock Revetment**					**$524,000,000**
3.1	**Terminal Perimeter Rock Revetment - Multi-Lift**					**$414,289,182**
3.11	Quarry Run (includes key)	10,359,743	TON	$35	$362,590,988	
3.12	Armor Rock (A-4000 lb)	742,725	TON	$65	$48,277,125	
3.13	Double Layer Filter Fabric	1,121,662	SF	$3.05	$3,421,069	
3.2	**Terminal Interim Rock Revetment - Single Lift (Two Interim Dikes)**					**$58,785,343**
3.21	Quarry Run (includes key)	1,667,216	TON	$35	$58,352,560	
3.22	Double Layer Filter Fabric	141,896	SF	$3.05	$432,783	
3.3	**Transportation Corridor - Single Lift**					**$50,174,390**
3.31	Quarry Run (includes key)	1,296,789	TON	$35	$45,387,615	
3.32	Armor Rock (A-500 lb)	62,294	CY	$65	$4,049,078	
3.33	Double Layer Filter Fabric	241,868	SF	$3.05	$737,697	
4	**Wharf**					**$620,000,000**
4.01	28" Octagonal PC/PS Concrete Piles (10'x10' spacing) PM	1,533,125	LF	$212	$324,256,000	
4.02	28" Octagonal PC/PS Concrete Piles (10'x10' spacing) Install	12,265	EA	$9,000	$110,385,000	
4.03	Concrete Deck (3' thick)	125,000	CY	$1,200	$150,000,000	
4.04	Cut-Off Wall (14" Thick, 10' Tall, 7,500' Long)	3,241	CY	$1,500	$4,861,111	
4.05	Dense Graded Aggregate (DGA) Topping Surface (3' Thick)	244,688	TON	$75	$18,351,600	
4.06	Bollards	136	EA	$25,000	$3,400,000	
4.07	Fenders	126	EA	$50,000	$6,300,000	
4.08	Expansion Joint Seal	1,440	CY	$1,000	$1,440,000	
4.09	Shear Key (Steel Wide Flange Beams)	106	TON	$6,000	$636,000	
5	**Uplands**					**$324,000,000**
5.1	Grading and Compaction of Uplands Soils	16,500,000	SF	$3.00	$49,500,000	
5.2	Dense Graded Aggregate Topping Surface (3' Thick)	3,588,750	TON	$75	$269,156,300	
5.3	SUSMP water quality	881,250	SF	$5	$4,406,300	
6	**Utilities**					**$73,000,000**
6.01	Main Line Site Stormwater system - 18" pipe	16,000	LF	$250	$4,000,000	
6.02	Main Line Site Stormwater system - 24" pipe	16,000	LF	$300	$4,800,000	
6.03	Main Line Site Stormwater system - 36" pipe	16,000	LF	$420	$6,720,000	
6.04	Site Stormwater collection system	45,000	LF	$500	$22,500,000	
6.05	Main Line Water system - 12" pipe	5,600	LF	$300	$1,680,000	
6.06	Site Water system - Potable - 4" pipe	17,350	LF	$150	$2,602,500	
6.07	Main Line Fire Water system - 12" pipe	5,600	LF	$300	$1,680,000	
6.08	Fire Water System - 6" pipe	17,350	LF	$230	$3,990,500	
6.09	Main Line Sewer system - 12" pipe	4,425	LF	$200	$885,000	
6.10	Sewer Lateral - 6" pipe	7,500	LF	$230	$1,725,000	
6.11	Sewer Lift Station	1	LS	$500,000	$500,000	
6.12	Communications	16,000	LF	$300	$4,800,000	
6.13	Stormwater Treatment System	1	LS	$10,000,000	$10,000,000	
6.14	Booster Pump Station	1	LS	$5,000,000	$5,000,000	
6.15	Gas Line - 4"	16,000	LF	$91	$1,456,000	

moffatt & nichol	CLIENT:	Port of Long Beach	JOB NO	10800-24		
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Item	Description	Quantity	Unit	Unit Price	Subtotal	Total
7	**Electrical**					**$147,000,000**
7.01	Main Substation	1	EA	$590,000	$590,000	
7.02	Shore Power Substation	8	EA	$2,000,000	$16,000,000	
7.03	480V Switchgears	2	EA	$350,000	$700,000	
7.04	Crane Substation	2	EA	$420,000	$840,000	
7.05	MV Transformer	4	EA	$1,050,000	$4,200,000	
7.06	Shore Power Outlets	16	EA	$480,000	$7,680,000	
7.07	Neutral Grounding Resistors	10	EA	$42,000	$420,000	
7.08	Vehicle Charging Stations	12	EA	$145,500	$1,746,000	
7.09	SPMT Charging Stations	100	EA	$30,000	$3,000,000	
7.10	Building electrical	501,200	SF	$63	$31,575,600	
7.11	Staging Area/Assembly Racks	1	Lot	$210,000	$210,000	
7.12	Highmast Lighting	120	EA	$254,000	$30,480,000	
7.13	Manholes	30	EA	$50,000	$1,500,000	
7.14	Pullboxes	240	EA	$21,000	$5,040,000	
7.15	Ductbank	1	Lot	$17,022,460	$17,022,500	
7.16	Wirings	1	Lot	$19,526,514	$19,526,600	
7.17	Tug Charging	20	EA	$35,100	$702,000	
7.18	Miscellaneous	1	Lot	$5,000,000	$5,000,000	
8	**Transportation Corridor (Roadway, Bridge, and Rail)**					**$42,000,000**
8.01	Bridge Allowance (2 bridges)	1	LS	$32,200,000	$32,200,000	
8.02	Pavement for Raod, Curb, Gutter, Striping, Etc.	403,200	SF	$11	$4,265,856	
8.03	Pavement for Parking, Office, and Warehouse Region	100,000	SF	$11	$1,100,000	
8.04	Transportation Corridor Median	855	CY	$800	$684,000	
8.05	Railroad Lines (rail line, ballast, etc.)	10,000	LF	$250	$2,500,000	
8.06	Roadway and Rail Lighting	100	EA	$7,500	$750,000	
9	**Wet Storage**					**$28,000,000**
9.01	Concrete Deck - 1.5' thick x 1100' long x 20' wide	99,000	SF	$87	$8,613,000	
9.02	24" Octagonal PC/PS Concrete Piles	72,000	LF	$192	$13,824,000	
9.03	24" Octagonal PC/PS Concrete Piles (Install)	600	EA	$9,000	$5,400,000	
	Direct Costs Subtotal					**$2,434,000,000**
	Construction Indirects					**$706,000,000**
	Supervision (General Conditions)	12	%		$292,080,000	
	Bonds & Insurance	2	%		$48,680,000	
	Corporate Overhead & Profit	15	%		$365,100,000	
	Total Construction Costs					**$3,140,000,000**
	Contingency					**$942,000,000**
	Design Contingency	15	%		$471,000,000	
	Owner Contingency	5	%		$157,000,000	
	Construction Contingency	10	%		$314,000,000	
	Total Construction Costs with Contingency					**$4,082,000,000**
	Soft Costs					**$613,000,000**
	Soft Costs	15	%		$612,300,000	
	Total Project Cost					**$4,695,000,000**