STATE OF MAINE
DEPARTMENT OF TRANSPORTATION
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AUGUSTA, MAINE 04333-0016

Janet T. Mills
GOVERNOR

Bruce A. Van Note
COMMISSIONER

November 18, 2021

The Honorable Janet T. Mills
Governor, State of Maine

Dear Governor Mills,

In March 2020, you directed the Maine Department of Transportation (MaineDOT) to study the feasibility of constructing port infrastructure in the Port of Searsport to support the rapidly evolving offshore wind industry. Pursuant to that directive, we present this Feasibility Study and Concept Design Report by the engineering firm of Moffat & Nichol, dated November 17, 2021.

This study evaluated the physical and technical characteristics of various sites in the Port of Searsport. It concludes that multiple sites should be considered as part of a wind port hub, including Mack Point and a relatively small portion of state-owned land on Sears Island that has been reserved for development. To allow for a proper evaluation of alternatives, the study recommends that the Sears Island site be further evaluated for potential phased development through more detailed environmental assessment, geotechnical study, and preliminary design work. The study also calls for consideration of improvements on the protected portions of the island. This work is necessary to properly evaluate impacts and alternatives, and to answer anticipated questions from interested parties.

A companion study on broader wind port needs in Maine is also underway and will analyze how other Maine ports, including the Ports of Portland and Eastport, can play important roles supporting the offshore wind industry. We expect this companion study to be complete in a few months.

We recognize that these two studies could generate significant interest from the public. It is important to understand that an engineering recommendation at a conceptual feasibility phase is a long way from a final decision on development. We need to perform more analysis and engage with regulatory agencies and the public so we can properly evaluate practicable alternatives.

To do so, we are committed to a robust and transparent stakeholder engagement and public communication process. We have already begun reaching out to the town and stakeholders and are planning to design and implement a process by which stakeholders and the public can ask detailed questions, receive solid answers, and thus inform us before any final decisions are made.

In closing, Maine has a huge opportunity before it. We can become a leader in the floating offshore wind market and capture the clean energy and jobs that come with it. To do so, all interested parties will need to work collaboratively to provide the port infrastructure needed. We look forward to a successful collaboration and to the benefits that generations of Maine people will enjoy as a result.

Respectfully,

Bruce A. Van Note
Commissioner

cc: Dan Burgess, Director, Governor's Energy Office
Hannah Pingree – Director, Governor's Office of Policy, Innovation, and the Future

Maine Department of Transportation: Offshore Wind Port Infrastructure Feasibility Study

Concept Design Report

Prepared for:

MaineDOT

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November 17, 2021

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1. INTRODUCTION

Pursuant to direction from Governor Mills, the Maine Department of Transportation (MaineDOT) retained Moffatt & Nichol (M&N) to study the feasibility of constructing port facilities in the Searsport region to support the offshore wind (OSW) industry on the eastern seaboard. Currently, the 42 MW of installed capacity, 9 GW of awarded OSW power, as well as all future proposed commercial scale projects along the east coast of the United States (US) consist exclusively of turbines supported by fixed bottom foundations (monopiles and jackets) (see Figure 1-1 and Figure 1-2). Fixed bottom foundations are typically used in waters of 200 ft (+/- 60m) or less and works well along the eastern US seaboard due to the wide and shallow continental shelf. However, at water depths beyond 200 ft it becomes uneconomical and inefficient to install this type of foundation.

Figure 1-1: Block Island Wind Turbines with Jacket Foundations (Source: Vineyard Wind).

Figure 1-2: Coastal Virginia Wind Turbines with Monopile Foundations (Source: Dominion Energy)

In the US, wind lease development areas have been located between 15 and 45 nautical miles (nm) off the coastline. The majority of the continental shelf along the eastern seaboard is both wide and shallow with depths of 165 ft and approximately 25 nm from shore. This allows for use of traditional fixed foundations in the US OSW market. There are currently no sanctioned federal lease areas off the coast of Maine. However, ocean seafloor depth in this region differs significantly from the areas to the south. Depths of over 250 ft are routinely reached at distances of no more than 10 nm from the shoreline. This deeper seafloor profile precludes the fixed foundation methodology from use in the vast majority of waters off the state of Maine.

Floating OSW turbines have emerged as a solution for waters deeper than 200 ft. The depth limit of this technology has not been established, however there are currently multiple installations in waters depths greater than 328 ft.

The wind turbine generator (WTG) foundation or hull floats and is held in place via an anchorage system connected to the seafloor. This anchorage system typically consists of chain or wire tendons running from the floating foundation to anchors embedded into the seafloor. There are three main types of floating OSW foundations under consideration (Figure 1-3). Each type can be constructed from concrete or steel, or a combination of these materials.

Figure 1-3: Types of Foundations for Floating Offshore Wind Turbines (Source: NREL)

- Spar Buoy (left-side of Figure 1-3) – Steel or concrete cylinder with a large, ballasted mass at its lower end. This mass and its distance below the waterline are used to maintain stability. The foundation is held on station with a catenary chain or wire tendon attached to an anchorage system embedded into the seafloor. This foundation can extend up to 80 meters.
- Tension Leg Platform (right-side of Figure 1-3) – This foundation system is secured to anchors embedded in the seafloor using tensioned wire tendons. The system uses the buoyancy of the foundation hull to offset the weight of the foundation to maintain tension in the wire tendons at all times.
- Semi-submersible (center of Figure 1-3) – These foundations are buoyant and maintain stability through various geometries, ballasting capabilities and dampening apparatus.

The spar buoy foundation requires water depths of up to 265 ft at the assembly port and during tow out operations and was therefore not considered in this study. The tension leg platform foundation was also not considered in this study due to its lack of popularity with the current announced and operating floating OSW projects.

A full floating turbine assembly (Figure 1-4) is typically comprised of the following elements:

- Nacelle – The outer covering that houses all the energy generating components including the WTG, gearbox and the drive train.
- Tower – Column that elevates the nacelle to the proper hub height to capture the optimal wind speeds. Towers typical come in two to three sections.
- Blades – Used to capture the wind energy and transfer it to the wind turbine.
- Foundation/Hull – Provides a platform for the tower, turbine and blades.

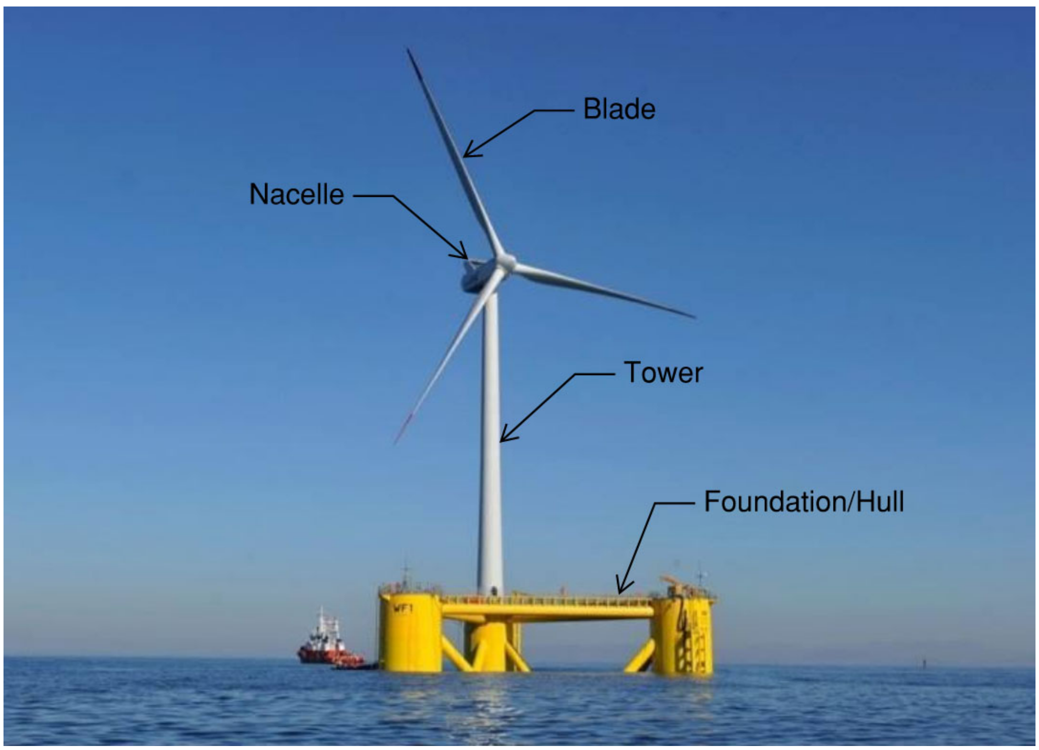


Figure 1-4: Floating OSW Components (Source: EDP Renewables)

Floating turbine technology is in its early stages and there are no existing commercial scale floating OSW installations anywhere in the world. However, there have been a series of demonstration projects installed. These types of projects are typically rated for less than 100 MW and are used as proof of concept for proposed floating OSW foundation and turbine technology. Currently there is a total of 85 MW of installed floating OSW power worldwide with an additional 50 MW now under construction (Table 1-1).

Table 1-1: Current Worldwide Floating Offshore Wind Installations (NREL)

Project Name	Location	Status	Project Size (MW)	Foundation Type	Turbine Size (MW)	Site Water Depth (ft)
Fukushima Phase 1	Japan	Operational	2	Semi-submersible	2	394
Fukushima Phase 2	Japan	Operational	7	Semi-submersible	7	394
Fukushima Phase 2	Japan	Operational	5	Spar buoy	5	394
Goto Sakiyama	Japan	Operational	2	Spar buoy	2	328
Hibiki Demo	Japan	Operational	3	Semi-submersible	3	180
Kitakyushu NEDO	Japan	Operational	3	Semi-submersible	3	328
Floatgen Demo	France	Operational	2	Semi-submersible	2	108
Hywind Demo I	Norway	Operational	2.3	Spar buoy	2.3	722
WindFloat Atlantic	Portugal	Operational	25	Semi-submersible	8.3	328
DEMOSath	Spain	Operational	2	Semi-submersible	2	262
Hywind Scotland	UK	Operational	30	Spar buoy	6	367
Kincardine Phase 1	UK	Operational	2	Semi-submersible	2	203
Kincardine Phase 2	UK	Under Construction	50	Semi-submersible	9.5	203

In North America there is one project, Aqua Ventus, in the permitting stage. This project proposes the installation of a single 10 MW turbine on a concrete semi-submersible foundation in the Gulf of Maine. This project is based at the University of Maine and, therefore, has particular significance to this study. It has also recently gained the backing of both Diamond Offshore Wind (Mitsubishi) and RWE (OSW development company). In addition, the State of Maine has recently filed an application with BOEM to open a floating OSW research array area off the coast of the state. The requested lease area is nearly 30 miles from the Maine mainland, approximately 15 sq miles in size, to support a demonstration project of up to 12 floating turbines. This research area will be one of the first steps in achieving the state's renewable energy goals of 80% by 2030 and 100% by 2050.

It should be noted that while there are currently only 85 MW of floating OSW installed, the prospect of floating bases gaining market share is well supported and, just as the fixed-base installations, have steadily improved their competitive position relative to conventional forms of energy over the past ten years. Floating bases will also leverage improvements in technology and reductions in production costs to improve its competitive offering over the coming decade, bringing its offering closer to both fixed-base and conventional energy sources.

2. STUDY PURPOSE

The purpose of this study is to evaluate the Port of Searsport to support the floating OSW industry in Maine and beyond. When fully assembled, OSW components are too large to be transported by road or rail. Ports are, therefore, an essential part of the supply chain. Each component must be manufactured and/or assembled at a waterfront fabrication facility, transited via vessel or barge to a marshalling facility where they are assembled, and then brought to the installation site.

The ongoing east coast port buildout has also demonstrated that the development of ports for the OSW market can be a significant economic driver for a region.

M&N created required criteria for a marine terminal to serve as a floating OSW port. The existing marine infrastructure and other physical attributes of each of the four sites were examined, compared to these established criteria, and a gap analysis performed to determine the necessary retrofits or upgrades required by each facility. A Class 4 cost estimate for the required work was created along with a construction schedule for required work activities.

The port characteristics and capabilities were examined using a phased approach. This approach would allow the terminal to begin operations with the minimum requirements and then grow over time to support a full commercial scale wind farm project. It also allows for a smaller capital expenditure to start the development process, followed by a larger investment as the industry continues to develop. The time between the initial port installation and full build out should be driven by prevailing market conditions. The parameters of the phases are identified below:

- **Phase 1**: Capable of supporting a research type project of approximately 150 MW to 200 MW.
- **Phase 2**: Capable of supporting a full-scale commercial wind farm installation (over 1000 MW).

Currently, the largest commercially available turbine on the market is the 12 MW GE Haliade X unit. The specifications for this unit are proprietary information and are not publicly available. M&N has had discussions with various WTG component manufacturers regarding the existing and proposed size and weight of WTG components. A generalization of components in the 15 to 20 MW range is provided in Table 2-1. It should be noted that the recent linear relationship between the increase in turbine MW output and the size and weight of the components may not continue. Manufacturers may instead begin to look for optimization of internal components, which may allow for a leveling off of component size.

Table 2-1: Approximate Weight and Dimensions of Considered Turbine Components

Component	Length (ft)	Width (ft)	Height (ft)	Diameter (ft)	Weight (T)
Blade	404	N/A	N/A	21	77
Nacelle	80	36	43	NA	917
Tower 1 (T1)	101	N/A	N/A	30	315
Tower 2 (T2)	155	N/A	N/A	26	324
Tower 3 (T3)	164	N/A	N/A	23	272

The representative foundation size for this study was estimated based on the reported size of the WindFloat Atlantic semi-submersible foundations to support an 8.3 MW turbine. These foundations measure approximately 50 m (164 ft) from center-of-leg to center-of-leg. Assuming a 10-m (33-ft) diameter column and allowance for a dampening plate results in an outside-to-outside dimension of approximately 67 m (220 ft). Scaling these dimensions up for a 12 MW turbine results in an outside-to-outside column dimension of approximately 320 ft. This distance was used for the proposed site layouts.

3. EUROPEAN EXAMPLES

As stated above, there are currently no commercial scale floating OSW installations anywhere in the world. However, there are two demonstration projects of significant enough size that can be used to gain insight into the foundation fabrication and component installation processes.

3.1 WindFloat Atlantic

WindFloat Atlantic was developed via a consortium of four companies: EDP Renewables, Engie, Respol, and Principle Power, Inc. (PPI). The installation site is located 12.5 miles off the coast of Viana de Costello, Portugal, and consists of three 8.3 MW turbines, for a total project size of 25 MW. The substructure is a PPI WindFloat steel semi-submersible hull anchored in approximately 330 feet of water, as shown in Figure 3-1.

The first foundation was built on the quay at the Navantia Shipyard, Port of Fene, Spain. It was then loaded onto a semi-submersible heavy lift vessel and transited approximately 6.5 nm to Outer Harbor quay, Port of Ferrol, Spain. The semi-submersible vessel was then ballasted until the foundation became buoyant. The buoyant foundation was then towed to the adjacent quay where the components were installed.

The second and third foundations were fabricated in a graving dock at Lisnave Shipyard, Portugal. The dock was flooded and the foundations floated out of the dock. They were then towed approximately 380 nm to the quay at Port of Ferrol, Spain. At this harbor, the turbine components were installed onto the moored foundations.

Once the turbine components were in place on the foundations, the fully assembled structures were towed approximately 150 nm to the installation site. As the foundation and turbine structures were constructed, the mooring configuration was assembled at Port of Leixoes, Portugal.

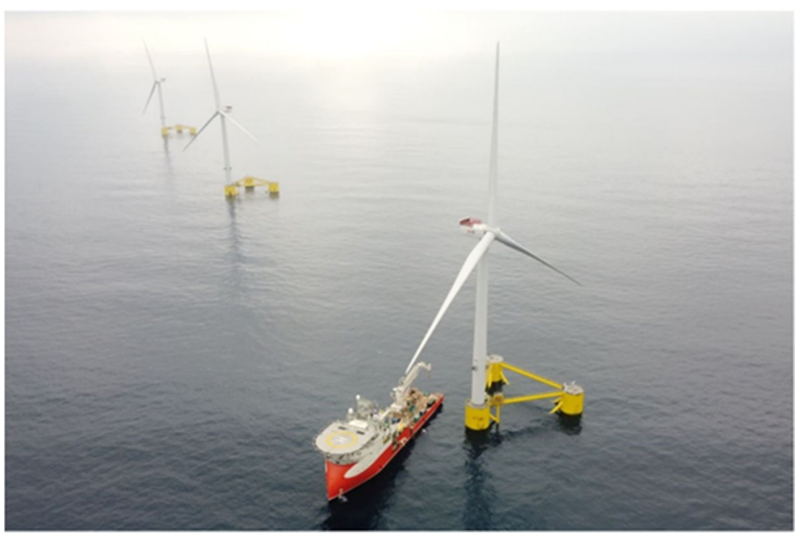


Figure 3-1: WindFloat Atlantic Installation (Source: EDP Renewables)

3.2 Kincardine Phase 2

The Kincardine Phase 2 floating OSW project is being developed by Cobra Group and is currently under construction. It is located 9.5 miles off the coast of Aberdeen, Scotland, and consists of five 9.5 MW turbines, for a total project size of 50 MW. The substructure is a PPI WindFloat steel semi-submersible foundation anchored in approximately 200 ft of water.

One unit is complete and has just been anchored in place. The other two foundations are currently being built at the Navantia Shipyard, Port of Fene, Spain. These fabricated foundations will be loaded onto a semi-submersible vessel and floated off. The foundations will then be towed approximately 780 nm to the quay at the Maasvlakte Quay, Port of Rotterdam, Netherlands where the turbine components are being installed on the foundation. The fully assembled structures will then be towed approximately 380 nm to the installation. Figure 3-2 shows the first foundation being towed to the installation site. As the foundation and turbine structures are constructed, the mooring supply is being assembled at Port of Aberdeen.

Figure 3-2: Completed Kincardine Floating Turbine Being Towed to Installation Site (Source: Cobra Group)

3.3 European Fabrication and Installation Methodology

For both projects, multiple port facilities were utilized to perform the fabrication of the foundations and installation of the components onto the foundations. The transfer towing distance between these ports, as well as to the installation sites, was significant. This methodology involved multiple tow legs and double handling of the foundations.

It appears the two projects were utilizing available port infrastructure with the required capabilities to create a workable supply chain for the required tasks. The units were successfully installed; however, the movement of the components to multiple port facilities may have added cost and time to the fabrication and installation process.

3.4 Recommended Improvements

Efficiencies in this process can likely be created via the consolidation of fabrication and assembly activities in one port location. Under this scenario the foundations would be fabricated, placed into the waterway, and the WTG components installed onto the foundations at one location. This methodology eliminates the double handling and increased transit time of the foundation elements and could, therefore, significantly reduce costs. The criteria for floating OSW ports discussed in Section 4 reflects this single port approach.

Construction of the foundations, as well as attachment of the WTG components to the foundations, in a graving dock is possible. However, there are currently no graving docks in the state of Maine of the size required. Construction of a graving dock with required internal pumping systems and sealing caisson was considered prohibitively expensive. This methodology has, therefore, been ruled out.

4. FLOATING OFFSHORE WIND PORT CRITERIA

4.1 General

The items listed below comprise the required criteria for a floating OSW port capable of fabricating the foundations, moving the foundations into the waterway, and installing the WTG components on top of the foundations.

As noted in Section 17 below, it should be noted that there are currently no purpose designed and built ports to support the floating OSW industry anywhere in the world. Accordingly, this required that we make assumptions based upon our knowledge of the fixed and floating OSW requirements. Although we feel these assumptions are valid, we must acknowledge that our conclusions and design is conceptual and is based upon the best available information at this time. They may require adjustments as this industry continues to develop, environmental and other conditions are more fully considered, and the preliminary design continues.

Under this scenario the raw materials for the foundation fabrication are delivered to the site via road, rail, and/or the quay. These materials are then used to fabricate the foundations at the port site. The WTG components are delivered to the terminal via bulk carrier vessel and/or barge. Consistent with the few floating OSW facilities launched to date, this concept design envisions that the foundations are transferred to the waterway via a semi-submersible barge. The WTG components are installed atop the foundation. Once the floating turbine is complete it is connected to tug boats and towed to the installation site.

4.2 Design Vessels and Required Draft

The vessels expected to call on the proposed port facility will consist of delivery and installation vessels. Delivery vessels will consist of bulk carriers and/or barges bringing both the foundation raw materials and WTG components to the site. The barges will allow for roll-on/roll-off (RORO) delivery operations. The install vessels are assumed to be purpose-built semi-submersible barges. These barges will be used to transfer the finished foundations from quayside to the waterway. The terminal berths should be designed to safely berth, moor, and load/unload vessels consisting of the magnitude of the parameters presented in Table 4-1 through Table 4-3.

For the purposes of this project, the following vessels were used as design vessels:

- Installation Vessel: Purpose-built (or modified) semi-submersible barge
- Bulk Delivery Vessel: Large bulk carrier (ex: SAL Type 183)
- Barge Delivery Vessel: Crowley 455 Series Barge

Table 4-1: Install Design Vessel Parameters

Purpose-built Semi-sub	Feet (meters)
Length overall	400 (122)
Beam	400 (122)
Draft	25.0 (7.6)

Table 4-2: Delivery Bulk Vessel Design Parameters

Item	Feet (meters)
Length overall	525-607 (160-185)
Beam	82-92 (25-28)
Draft	26-32 (8-10)

Table 4-3: Delivery Barge Design Parameters

Crowley 455 Series Barge	Feet (meters)
Length overall	400 (122)
Beam	105 (32)
Draft	19 (5.8)

The fabricated foundation will be required to float next to and be moored at the berth during the installation of the WTG components. The exact draft of different foundation systems is proprietary information and is, therefore, unknown. M&N has had discussions with one developer who reported that their foundation will require 25 to 30 ft of water at the berth. For the purposes of this study, it is assumed that the water required for the foundation at the berth will be no deeper than 35 ft mean lower low water (MLLW).

Typical international standards call for vessel under-keel clearance allowance of 10% of the draft in sheltered conditions and up to 15% of the draft in more exposed conditions, both along the approaches to the berth and at the berth pocket area. The minimum required water depth is, therefore, elevation -35 feet MLLW for the navigation channel, site approach channel, and berth. This considers the deepest drafting design vessels coupled with required under-keel clearance.

4.3 Vessel Clearances

The minimum clearance separation distance between vessels is proposed to be a minimum of 75 ft (22.9 m).

4.4 Uplands and Quay Area

A relatively-level uplands and quay area is required at or near deep water access to provide enough space to fabricate the foundations and transport them to the quayside. Space is also required for the storage and staging of the WTG components. Estimated required areas consist of:

- Phase 1: 40 acres
- Phase 2: 65 acres

The acreage of both Phase 1 and Phase 2 should be considered an estimate based on similar requirements in the fixed foundation OSW industry. As discussed above, there have been no commercial scale floating OSW installations anywhere in the world to date. These required areas can be adjusted as the industry develops, environmental and other conditions are more fully considered, and the preliminary design continues.

4.5 Loading Criteria

Based on the assumed activities, the loading criteria has been divided into the uplands and the heavy lift area directly behind the quay. The loading levels were set based on similar activities in the fixed foundation OSW market.

Both the WTG component and fabricated foundation movement at the facility is assumed to be via self-propelled modular transporter (SPMT). This methodology is used extensively in the OSW industry due to its ability to handle and efficiently spread significant loads to achieve manageable applied loads on the structures below. SPMTs are built up using a series of axles that are connected together to form a “train”. Each axle can support between 40 and 60 tons. If this loading level is distributed over the areas of the SPMT units in the train, the maximum applied uniform load is approximately 3000 psf. This loading level is, therefore, used as the upland criteria.

The WTG components may be preassembled in the area directly behind the quay. These preassembled components will then be lifted onto the foundation using a land-based crawler crane. These activities typically increase the loading demand significantly. Required loadings levels are:

- Uplands: 3000 psf
- Quay and Heavy Lift Area behind the Quay: 5000 psf

4.6 Air Draft

Once the WTG components are fully assembled on the foundation, the height of the unit can be approximately 700 to 800 ft from the waterline. These units are then towed out to the installation site in this finished configuration. Port sites, therefore, require unlimited air draft with direct access to open water. There can be no bridges or overhead electrical wires on the route between the port and the proposed installation site.

4.7 Length of Quay

The quay will be required to service 3 distinct activities in both Phase 1 and Phase 2.

- Delivery of WTG components and/or raw materials to the facility
- Transfer of fabricated foundation from the quay to the water via a semi-submersible barge
- Berthing of floating foundation quayside during installation of WTG components

In Phase 1 it is assumed these activities will share the same space at the berth. In Phase 2 it is assumed that each of the three activities will have a distinct place at the berth and can, therefore, occur simultaneously.

The required length of the berth is directly related to length of the vessels and foundations and the proposed spacing between the two. The relevant measurements are listed below in Table 4-4.

Table 4-4: Parameters for Required Length of Quay

Element	Length (ft)
Foundation	320
Semi-submersible barge	400
Delivery Vessel Phase 1	525
Delivery Vessel Phase 2	607
Required Spacing Between Elements	75

Required length of quay:

- Phase 1 (with mooring dolphins): 500 ft
- Phase 1 (no mooring dolphins): 625 ft
- Phase 2: 1477 ft (400+75+607+75+320)

  Actual quay length may be longer due to logistical requirements of uplands and retention of upland fill constraints.

4.8 Land-Based Crane Requirement

A large land-based crane will be required to lift and install the WTG components onto the foundation floating at the quay. The capacity of this crane must meet both the load and hook height criteria for the proposed project. For the purposes of this study the land-based crane was assumed to be a Liebherr 11350. Other smaller mobile cranes may also be used at the site.

4.9 Distance to Installation Site

The completed floating turbine units will be towed to the installation site. This tow distance will vary and has been as high as 780 nm for the Kincardine Phase 2 project. The acceptable tow distance is primarily dependent on the ability to accurately predict the weather and sea state over a distinct period of time.

A tow can be approved if the predicted weather and sea state, over the predicted length of time required for the tow, are able to meet the required environmental parameters. Currently there are no existing BOEM lease sites off the coast for Maine. However, the Searsport location offers a good, centralized location along the coast.

5. PROPOSED SITES

5.1 Mack Point Terminal

The site at Mack Point Terminal was made available for study by the Maine Port Authority and Sprague Energy. The area currently operates as a liquid and dry bulk cargo terminal. Sprague Energy has identified an approximately 85-acre area for potential development, as shown in Figure 5-1. This area has approximately 2,060 linear feet of undeveloped, available water frontage. Vessel access to the site is via Penobscot Bay and the maintained federal navigation channel. Additionally, there is an active rail line that runs at the eastern and southern extent of the property.

Figure 5-1: Available Area at Mack Point Terminal

5.2 Sears Island

The available area at Sears Island is zoned as a Transportation/Marine Development parcel and owned by the MaineDOT. The area consists of approximately 330 acres of undeveloped land, as shown in Figure 5-2. There is approximately 9,000 linear feet of undeveloped, available water frontage. Vessel access to the site is via Penobscot Bay and the maintained federal navigation channel.

Figure 5-2: Available Area on Sears Island

5.3 Sprague Put Parcel

The area at the Sprague Put Parcel was made available for study by Sprague Energy. This area is located in Long Cove and consists of approximately 29 acres of undeveloped land with an active rail spur transecting the site, as shown in Figure 5-3. There is approximately 1,200 linear feet of available water frontage. Vessel access to the site is via Long Cove, which does not have an existing maintained vessel access channel.

Figure 5-3: Available Area at Sprague Put Parcel

5.4 GAC Chemical Site

The land at GAC Chemical was made available for study by GAC Chemical Corporation and consists of two separate areas for a total of approximately 120 acres, as shown in Figure 5-4. The land is located in Stockton Harbor. Based on the required water frontage needed to support the proposed operations, the northern area was selected. The northern area consists of approximately 55 acres of land and 840 linear feet of available, undeveloped water frontage. Vessel access to this site is through Stockton Harbor, which does not have an existing maintained vessel channel.

Figure 5-4: Available Area at GAC Chemical Site

6. INITIAL ANALYSIS / ELIMINATION OF TWO SITES

An initial screening analysis was performed to rule out sites based on identified fatal flaws. Two sites, Sprague Put Parcel and the GAC Chemical site, were eliminated based on not meeting the specific criteria of this analysis. This elimination does not preclude these sites from being utilized by the OSW industry.

6.1 Sprague Put Parcel

The Sprague Put Parcel is located within Long Cove. This area is a natural shoal with depths of 1 to 5 ft (MLLW) directly adjacent to the site. The site is located approximately 1 nm north of the maintained federal channel. There is a rail spur that runs through the site and would need to remain clear at all times.

Based on the existing bathymetry, required vessel draft, and length of the access channel, it is estimated that the initial dredge quantity could be more than 2 million cubic yards (CY). Dredge and disposal costs in this region are typically between $50 to $100 per CY, which, when multiplied by the estimated quantity, could add over $100 million in costs to the project. In addition, the natural state of this area is a shallow shoal. After the initial dredge has occurred the environmental forces in this area will work to return it to its natural state via sediment transport. This can often lead to a significant requirement for maintenance dredging to keep the channel open for transiting vessels. This would add significant operational maintenance cost over the life of the terminal.

The rail spur through the site is active and required to remain clear to allow for unfettered transit of rail cars to and from Mack Point Terminal. The footprint of this rail line sits directly adjacent to the waterfront access for the site. This area is critical for both storage of WTG components as well as transit of foundations to the wharf.

Due to estimated dredge quantities and associated cost, potential for significant sediment transport and maintenance dredging, and the potential interference from the existing rail spur on site operations, this site was eliminated from consideration.

6.2 GAC Chemical Site

This site is located in Stockton Harbor, however, based on the existing characteristics of the bathymetry and coastline, both the initial dredge and follow-up maintenance dredging will very likely be similar to the requirements discussed for the Sprague Put Parcel above.

M&N was notified by the site owner that the available land contains an approximately 5.5-acre covered landfill in the center of the site. It is unknown what materials were placed in this land fill and the level of compaction applied to this area. Due to the inconsistency in the placed landfill material, the geotechnical properties of the area would not be uniform and would be very difficult to quantify. The OSW industry requires upland loading criteria of up to 3,000 psf. The geotechnical characteristics of the landfill site would typically be considered poor and, therefore, the material in this landfill would require removal and replacement with engineered fill. This procedure would require significant site testing and environmental review and add substantial cost to preparation of this site.

Due to estimated dredge quantities, potential for significant sediment transport and maintenance dredging, and the presence of a landfill in the center of the site, this site was eliminated from consideration.

7. SITE CHARACTERISTICS FOR REMAINING TWO SITES

With certain modifications, both the Mack Point and Sears Island sites can meet the floating OSW Port Criteria discussed in Section 4 of this report. However, existing site characteristics differ at each site and, therefore, the required actions and associated costs to meet these criteria varies between the sites. This section discusses the existing site conditions and required modifications to meet the proposed criteria.

7.1 Bathymetric and Geophysical

Bathymetric and geophysical data used for the evaluation of the proposed Sears Island and Mack Point sites were sourced from the report titled "High Resolution Geophysical Surveys Assembly Site and Turbine Area (WP8-1 and WP8-2) Site Report" written by the Alpine Ocean Seismic Survey, Inc. for the University of Maine Advanced Structures and Composites Center, dated November 2017. The study included both proposed areas, one that partially overlaps with the proposed Mack Point site footprint and the other that fully overlaps with the proposed Sears Island site footprint. Due to the partial coverage at the Mack Point site, significant extrapolation of this data was required.

The bathymetric survey produced contours of the existing mudline at the time of the survey. A shallow penetration sub-bottom profile was also performed. These results produced a basement isopach figure that shows the limit of sub-surface penetration to a mappable reflector. In this study, the mappable reflector was interpreted as the upper surface of bedrock or glacial till overlying bedrock.

In order to reach the required design depth of -35 ft (MLLW), the outshore berthing face of the quayside must be located at or beyond the same elevation of the top of glacial till/bedrock. The depth of existing soil overburden on top of this till/bedrock level will then dictate the required dredge quantities for each site.

7.1.1 Mack Point Site

Results from the bathymetric survey show the seafloor at Mack Point gently dipping to the south from the shoreline at an approximate 3.6-degree slope. The mudline depth remains at or below -17 ft (LAT) for a distance of over 800 ft from the existing shoreline.

Results from the sub-bottom profile data show the thickness of soil overlying the bedrock varying from 3 to 10 ft within this same area. The till/bedrock elevation reaches the required design draft of -35 ft at Mack Point approximately 795 ft from the existing shoreline. This is shown in Figure 7-1 through Figure 7-3 below. The black area above the blue line in cross sections X1 and 114 represents the bottom material that will require dredging.

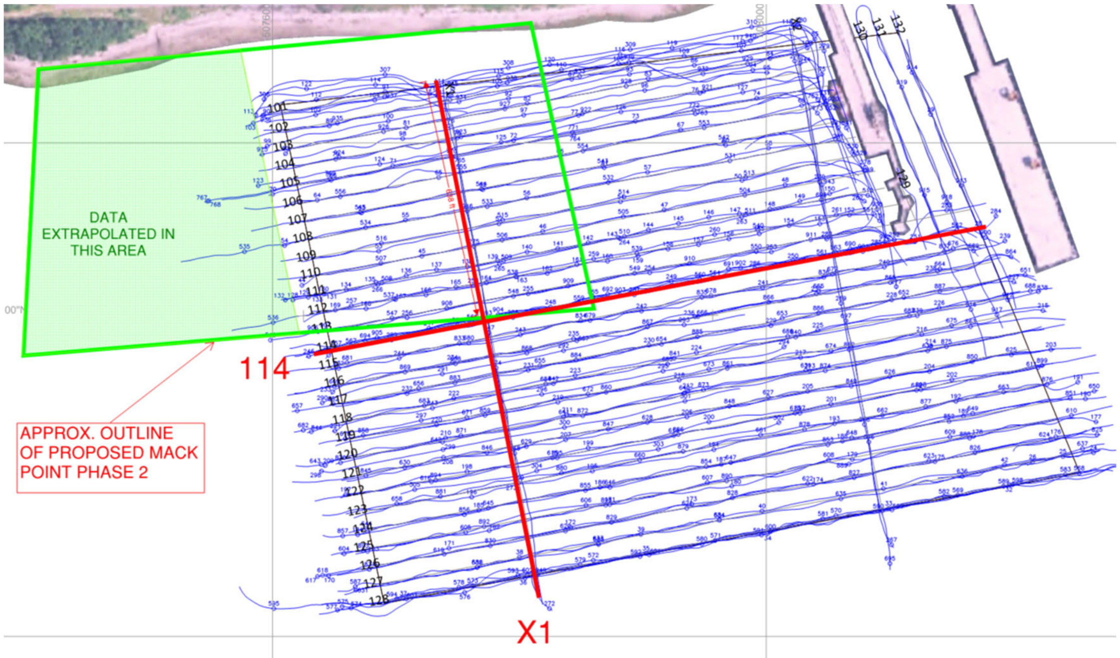


Figure 7-1: Mack Point Survey Data and Project Location

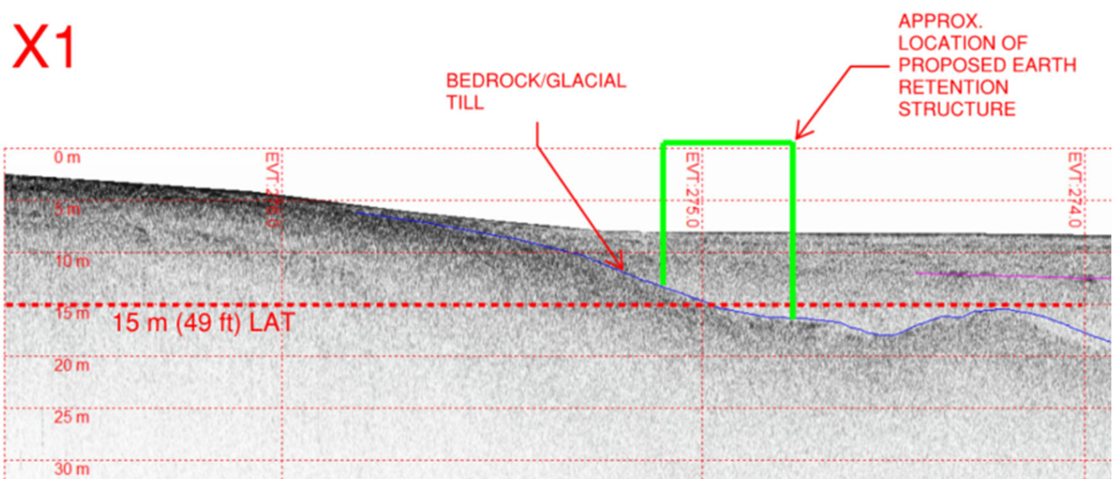


Figure 7-2: Survey Data Profile and Location of Proposed Earth Retention Structure

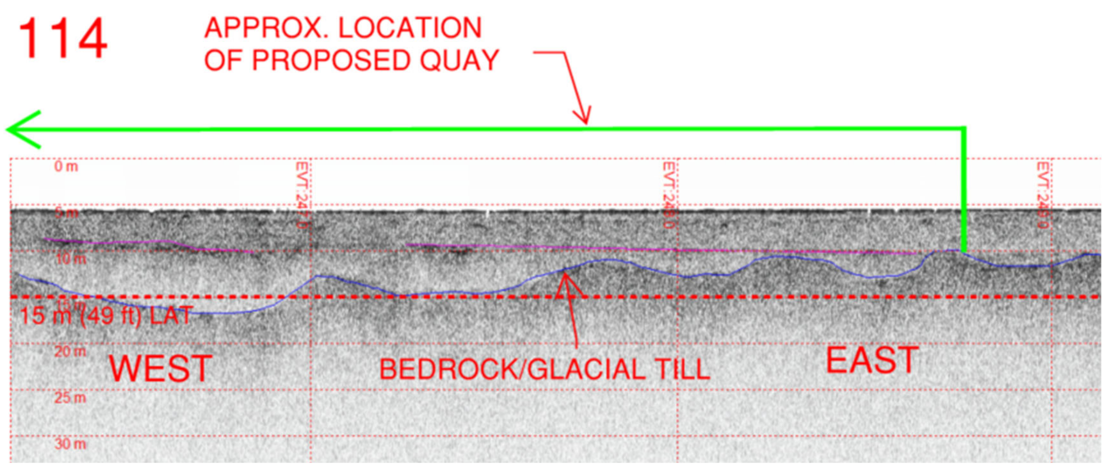


Figure 7-3: Approximate Location of Proposed Quay

7.1.2 Sears Island Site

Results from the bathymetric survey show the existing mudline at Sears Island gently dipping to the west from the shoreline at an approximate 3.0-degree slope for approximately 790 ft at the north, 200 ft at the center, and 970 ft from the southern extents of the site. The depth at the base of this slope is approximately -12 ft (LAT). Just to the west of the base of this slope is an abrupt, approximately 30-degree sloped, 30-ft drop in elevation. The slope runs parallel to the shoreline at Sears Island.

Results from the basement isopach data show the thickness of soil overlying the bedrock at the top of the slope, along the slope, and at the base of the slope to be between 1 and 3 ft. This is shown in Figure 7-4 through Figure 7-6 below. Both cross sections demonstrate that the required depth can be meet (with significant buffer) without dredging at the site.

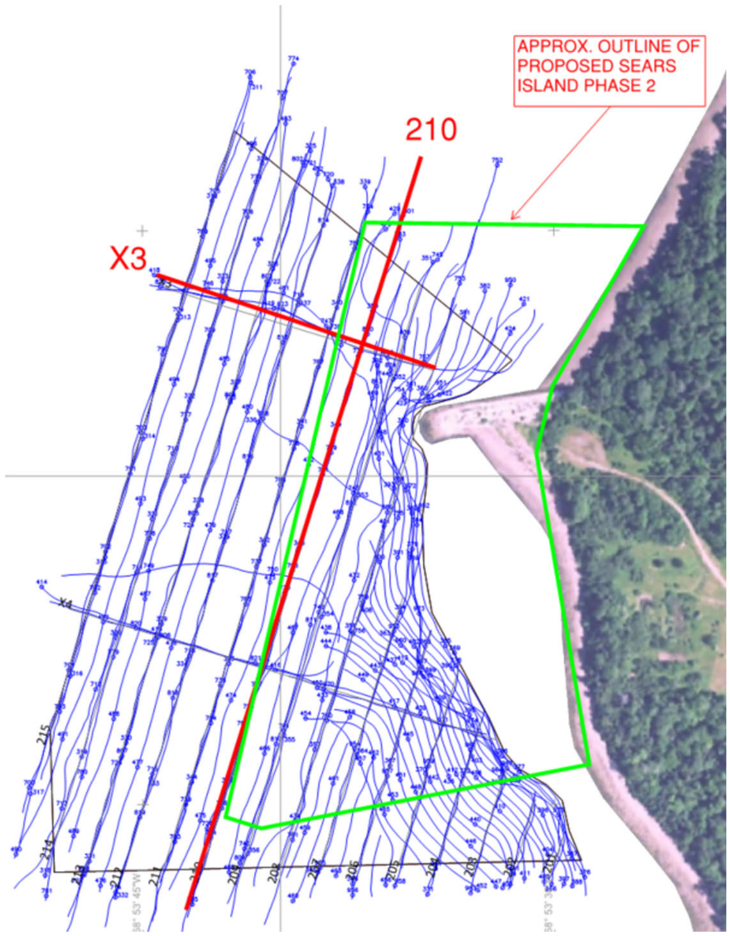


Figure 7-4: Sears Island Survey Data and Project Location

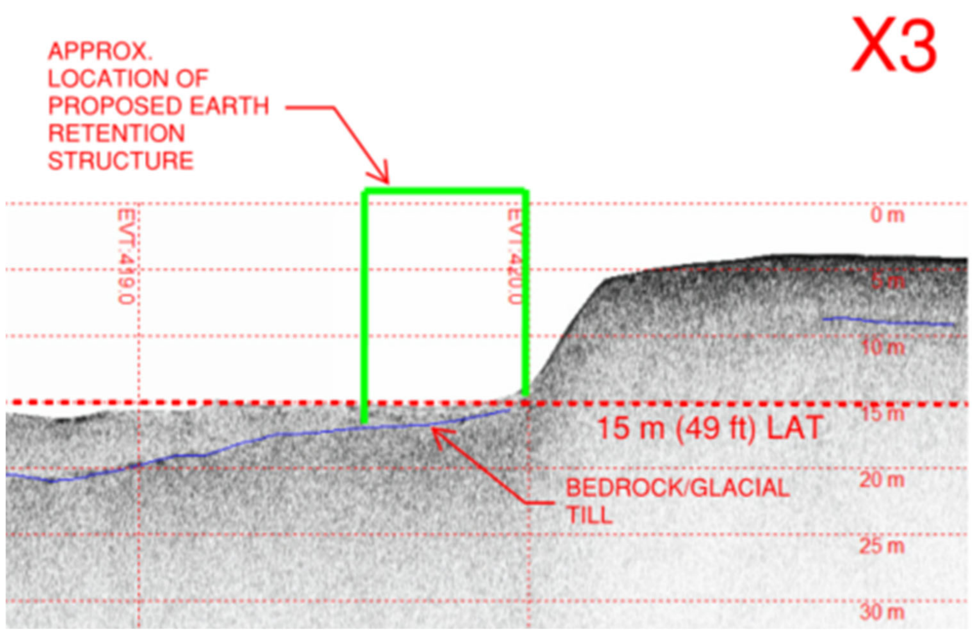


Figure 7-5: Survey Data Profile and Location of Proposed Earth Retention Structure

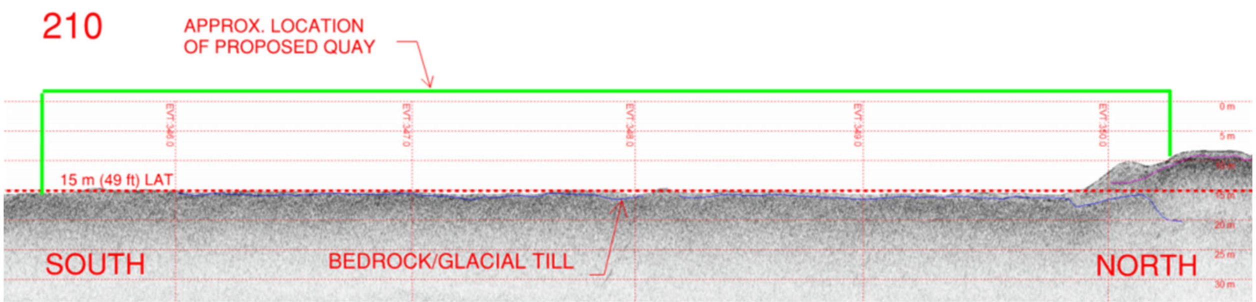


Figure 7-6: Approximate Location of Proposed Quay

7.1.3 Results of Bathymetric and Geophysical Analysis

The results of the bathymetric and geophysical study dictate the following:

- The berthing face of the proposed Mack Point site quay is required to be approximately 795 ft to the south of the existing shoreline in order to achieve the required water depth.
- At Mack Point there is up to a 10-ft depth of soil overburden above the indicated top of bedrock/glacial till elevation. This soil overburden will require dredging to achieve the required water depth at the berth.
- The berthing face of the proposed Sears Island site quay is required to be approximately 795 ft, 200 ft, and 970 ft from the shore at the northern, central, and southern extents of the site, respectively. At these locations, the elevation of the top of till/bedrock exceeds the required water depth. There is little to no soil overburden at any location at the Sears Island site and, therefore, no dredging will be required.

7.2 Geotechnical

Geotechnical data used for the feasibility study is based on a limited number of historical borings provided by Maine DOT. The information from these borings is summarized below.

7.2.1 Mack Point Soil Properties

Geotechnical data used for the Mack Point site analysis consists of information from the report "Explorations and Geotechnical Engineering Services" written by S.W. Cole Engineering Inc., dated April 22, 2013. This information is supplemented by information from the report "Sprague Energy Corporation Preliminary Hydrogeologic Study" written by Aries Engineering, Inc., dated August 1993.

S.W. Cole performed three borings to a depth of approximately 20 ft near the shoreline at the proposed Mack Point site. The soil profile in the location of the borings generally consists of a layer of fill overlying a layer of organic soils that overlie glacial till. The classification of the fill varied randomly throughout the borings. The organic layer was a 2-to 3-ft layer of loose sandy silt that contains organics and wood debris. The borings were terminated at the glacial till, which consisted of medium dense brown silt and sand with some gravel.

The nine borings summarized in the Aries Engineering, Inc. report were performed by Great Works Test Boring, Inc. in June 1992 and are located to the east of the proposed uplands area at Mack Point. The study was primarily focused on the hydrogeological properties at the Sprague Oil Terminal but included geotechnical data as well. The soil profile in the location of the borings generally consists of a layer of a 4-to 16-ft layer of gravelly sand and then an 11-to 22-ft layer of clay and silt. The report also indicates that the bedrock beneath the site is representative of the Penobscot Formation. The report goes on to state that "the Penobscot Formation generally consists of graphitic to sulfidic greenschist facies schist composed of siltstone and pelite" (page 11).

At this point, it is unknown what a majority of the geotechnical properties at the Mack Point site consist of due to limited historical borings. However, the site has been operating commercially for more than 40 years; therefore, it is assumed that the uplands soils have been consolidated to a certain extent and that the required compaction level can be achieved via vibro-compaction. There is no geotechnical data offshore at the proposed site.

7.2.2 Sears Island Soil Properties

Geotechnical data used for the Sears Island site consists of information from the report "Soils Report 83-103" written by the Maine Department of Transportation Materials and Research Division, dated April 1983.

A series of borings and test pits were performed within and nearby the footprint of the proposed uplands area. The soil profile within the studied area generally consisted of a 3-ft layer of topsoil over a 12-to 16-ft-thick layer of silty till. The borings reached a maximum depth of 21.5 ft and were generally classified as AASHTO A-4 soils, silty soils, shown in Table 7-1 below.

Table 7-1: AASHTO Soil Classification (AASHTO)

GENERAL CLASSIFICATION	GRANULAR MATERIALS (35 percent or less of total sample passing No. 200)							SILT-CLAY MATERIALS (More than 35 percent of total sample passing No. 200)			
GROUP CLASSIFICATION	A-1		A-3	A-2				A-4	A-5	A-6	A-7
	A-1-a	A-1-b		A-2-4	A-2-5	A-2-6	A-2-7				A-7-5, A-7-6
Sieve analysis, percent passing:											
2 mm (No. 10)	50 max.										
0.425 mm (No. 40)	30 max.	50 max.	51 min.								
0.075 mm (No. 200)	15 max.	25 max.	10 max.	35 max.	35 max.	35 max.	35 max.	36 min.	36 min.	36 min.	36 min.
Characteristics of fraction passing 0.425 mm (No. 40)											
Liquid limit				40 max.	41 min.	40 max.	41 min.	40 max.	41 min.	40 max.	41 min.
Plasticity index	6 max.		NP	10 max.	10 max.	11 min.	11 min.	10 max.	10 max.	11 min.	11 min.*
Usual significant constituent materials	Stone fragments, gravel and sand		Fine sand	Silty or clayey gravel and sand				Silty soils		Clayey soils	
Group Index**	0		0	0		4 max.		8 max.	12 max.	16 max.	20 max.

Classification procedure: With required test data available, proceed from left to right on chart; correct group will be found by process of elimination. The first group from left into which the test data will fit is the correct classification.

*Plasticity Index of A-7-5 subgroup is equal to or less than LL minus 30. Plasticity Index of A-7-6 subgroup is greater than LL minus 30 (see Fig 4-9).

**See group index formula (Eq. 4-1) Group index should be shown in parentheses after group symbol as: A-2-6(3). A-4(5). A-6(12). A-7-5(17). etc.

Based on this classification, it was assumed that the soils can be reused for infill placement with an appropriate wick drain and soil surcharge program.

There is no geotechnical data offshore at the proposed site.

7.3 Dredge Sediment Characteristics

A study by Ramboll Environ titled "Proposed Strategy for Maintenance Dredging of the Federal Navigation Channel At Searsport Terminal, Maine," dated April 2017, provides valuable information about the dredge material characteristics and appropriate disposal strategies of sediments adjacent to the proposed Mack Point site.

The Ramboll Environ study occurred due to shoaling in the federal navigation channel leading to the Mack Point Terminal. Three dredge material disposal options were evaluated: landfill disposal, ocean disposal, and beneficial reuse. The material in the dredge area was chemically analyzed and the results indicate that the chemical concentrations of the sediment are below required Maine Department of Environmental Protection (Maine DEP), Army Corp of Engineers (ACOE), and US Environmental Protection Agency (USEPA) screening levels for beneficial reuse and ocean disposal. Additional testing was recommended prior to landfill disposal.

In addition to the sediment characterization, the percent fines of the samples were also calculated. Although not specified in the report, this is typically the percentage of the soils passing the standard No. 200 sieve. These results indicated the average percent fines of the 20 samples was 85.5%, with 14 samples above the 90% fines level. Based on these results, the dredged sediment would not be suitable for structural fill without amendment with a binding agent, such as cement.

7.4 FEMA Flood Level Designation

According to the Flood Insurance Rate Map (FIRM) Number 23027C0459E, published by FEMA and made effective on July 5, 2015, both Mack Point and Sears Island fall within Zones VE, AE, and X. The delineation of these three zones generally follows the shoreline with the VE zone outshore of shoreline and the AE zone being inland of the shoreline. Further inland, most of the proposed uplands area is within the X zone. See Figure 7-7 and Figure 7-8 below for site FEMA flood maps.

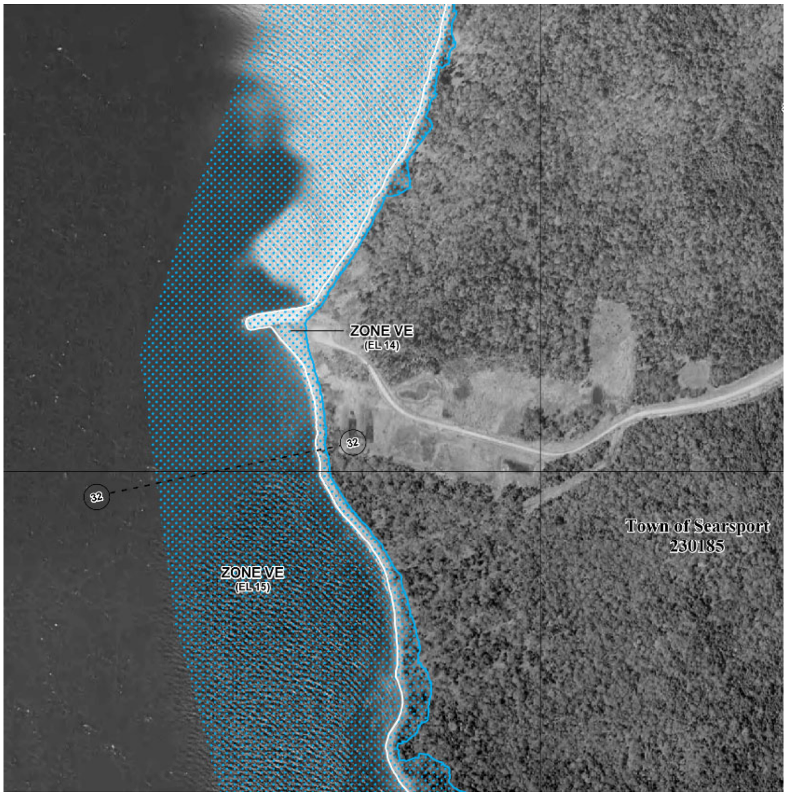


Figure 7-7: Sears Island Site FEMA Flood Map

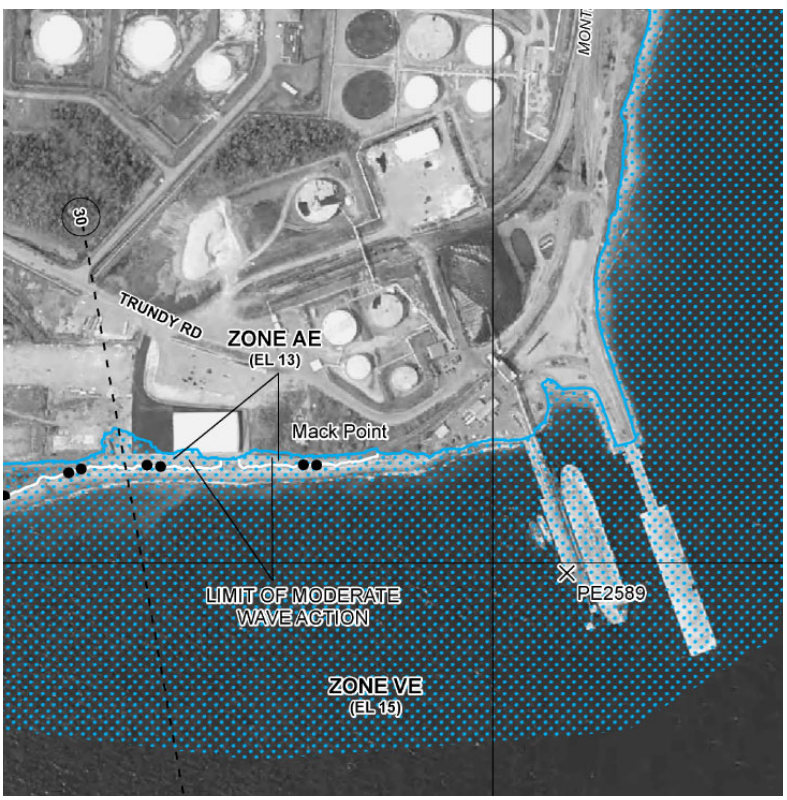


Figure 7-8: Mack Point Site FEMA Flood Map

These three zones are defined as follows:

VE Zone (Site Base Flood Elevation – EL +15 ft NAVD 88): A coastal high hazard area subject to high velocity water including waves; they are defined by the 1% annual chance (base) flood limits (also known as the 100-year flood) and wave effects 3 ft or greater. The hazard zone is mapped with base flood elevations (BFEs) that reflect the combined influence of still-water flood elevations, primary frontal dunes, and wave effects 3 ft or greater.

AE Zone (Site Base Flood Elevation – EL +13 ft NAVD 88): A hazard zone area within the 100-year flood limits defined with BFEs that reflect the combined influence of still-water flood elevations and wave effects less than 3 ft.

X Zone (Site Average Flood Elevation – n/a): An area determined to be outside the 0.2% annual chance floodplain.

The port facility will be designed to withstand the impact of a 100-year flood event as defined by FEMA. For the purposes of this study, both the Mack Point and Sears Island port facilities will be set to a minimum site grade of EL +15.0 ft NAVD88 (FEMA 100-year flood elevation).

7.5 Topographic Information

Topographic data was taken from the United States Geological Survey chart Searsport Quadrangle, Maine-Waldo County, 7.5-Minute Series, 2018.

7.6 Water Levels

Water levels are governed by the semi-diurnal tides described in Table 7-2. The Portland, Maine station (ID 8418150) is the tidal gage closest to the project sites.

Table 7-2: Tidal Parameters

Tidal Parameter	Elevation (ft MLLW)	Elevation (ft NAVD88)
Highest Astronomical Tide (HAT)	+11.95	+6.69
Mean Higher High Water (MHHW)	+9.91	+4.65
Mean High Water (MHW)	+9.47	+4.21
North American Vertical Datum of 1988 (NAVD88)	+5.26	0.00
Mean Low Water (MLW)	+0.35	-4.91
Mean Lower Low Water (MLLW)	0.00	-5.26
Lowest Astronomical Tide (LAT)	-2.12	-7.38

Note: All reported data taken from NOAA Station ID 8418150, Portland, ME.

8. SITE LAYOUTS AND REQUIRED INFRASTRUCTURE

8.1 General Structural Considerations

This is preliminary assessment based on available info and more information and analysis is needed for final requirements.

Based on the bathymetric and geophysical analysis, the berthing face of both the Mack Point and Sears Island sites will be required to be located between 200 ft and 900 ft from the existing shoreline. This distance in turn creates a large area of square footage that will need to be incorporated into the structural design. Typically, there are two structural options considered to span from the uplands to the berthing face. These are pile supported and earth filled structures.

Installation of a pile supported structure over such a large area was considered to be cost prohibitive. This was amplified by the presence of the shallow rock ledge and the requirement for each of the piles to be drilled into the bedrock (rock socketed) in order to achieve the required lateral capacity. A detailed estimate of this option was not performed; however, based on prior experience with similar sites, $500/sf can be used as a high-level estimate for this type of construction.

Four earth filled structure types were then investigated. These are listed below.

- Tied back bulkhead with pile supported marginal wharf with pile supported relieving platform
- Tied back king pile combination wall (pipe piles and AZ sheets) with pile supported relieving platform
- Ballasted concrete caissons
- Steel cellular cofferdams

The bulkhead structures were ruled out due to the need for a significant pile supported relieving platform required to support the high loading level directly inshore of the bulkhead. In addition, installation of this type of structure on the rock ledge slope at the Sears Island site would present significant issues.

Concrete caissons are a workable option; however, our experience is that the skill set to manufacture and install this type of system resides in Canada rather than the US. This system is used quite often in the eastern Canadian provinces to deal with the extreme tides. However, they are not prevalent in the Northeastern US.

Steel cellular cofferdams were selected as the most efficient and best value option for the two sites. This system performs well seated on rock and can provide the required earth retention as well as handle the significant loading levels. In order to reduce the required length of cellular cofferdams, armored earth embankments will be used for the transverse closure of the system. This structural system can be installed in phases and grow with the need for additional terminal space.

A further advantage of this is system is the ability to incorporate beneficial reuse of site material as fill behind the cofferdam and earth embankment walls. The large area created behind the structure will need to be filled with earth to create a working surface. This material can be sourced from an upland cut or dredged material from the two proposed sites.

Preliminary calculations were performed in support of this structural system. Steel cells were conservatively sized at 100-ft diameter. At Sears Island the cells were located to the west of the steep rock ledge slope.

8.2 Phased Approach

With only 85 MW installed, the floating OSW market is still in its early stages. It is, therefore, recommended that a phased approach to construction be utilized. This approach would allow the terminal to begin operations with minimal requirements for a demonstration sized project and then grow over time to support a full commercial scale wind farm. It also allows for a smaller capital expenditure to start the development process followed by a larger investment as the industry continues to develop. The time between the initial port installation and full build out should be driven by prevailing market conditions.

Phase 1, to support a research type project, and Phase 2, to support a full commercial scale project, plans were created for both the Mack Point and Sears Island sites.

The following sections describe an approach to phased construction that could be implemented upon completion of environmental review and permitting.

8.3 Sears Island Phase 1 Construction

The Phase 1 cofferdam structure consists of five 100-ft diameter cells with 4 connecting cells, creating a 632-ft berthing face. The 56,058 CY of fill to be placed within the cells will be imported to optimize the coffer cell performance.

Thirty acres of the uplands area will be cleared, graded, and compacted to create a usable area for operations. This will require clearing the trees and cutting into the hillside to remove approximately 755,000 CY of soils. Based on the analysis of the Sears Island geotechnical information and soil classification, these soils will be used as the infill material for the wharf and embankments (both Phase 1 and 2). Extra soil from the cut will be stored in the commercially zoned area on Sears Island.

The transverse earth embankments will also be constructed using soils from the uplands. Approximately 1,600 tons of bedding stone and 25,000 tons of armor stone will be placed on the embankments. On the north side, where wave action is less due to the sheltered harbor, the armor stone may only be placed on the upper half of the embankment.

Approximately 330,000 CY of fill will be placed in the wet behind the cofferdam and earth embankments. This will create approximately 7.2 acres of usable space. Once this fill is in place, the ground improvement program will be implemented. First, wick drains will be installed to provide a drainage path for the compressible soils. Second, a soil surcharge will be placed to accelerate the consolidation of the underlying soils to the proposed loading level (between 3,000 to 5,000 psf). Additionally, the soil may also need to be amended with a binding agent before placed in the fill area. Once the soil reaches the required consolidation, the surcharge will be removed and placed with the extra soil from the upland cut.

Due to the limited length of the quay, two mooring dolphins will be installed south of the berth to provide a storage area for the semi-submersible barge when not in use.

A storm water drainage system will be installed, and electric and water utilities will be brought onto the site from the mainland. Sewage can also be brought from the mainland, or a localized pump-out system can be used.

A conceptual drawing of this proposed work as well as an explanation of the terminal operations and construction sequence is included in Appendix A.

8.4 Sears Island Phase 2 Construction

It is assumed in that the Phase 2 wharf will be built as an addition to the Phase 1 wharf. The Phase 2 structure will add 7 coffer cells to the south to create a cofferdam structure that consists of twelve, 100-ft diameter cells with 11 connecting cells, creating a 1,563-ft berthing face. The additional 96,000 CY of cell fill will be imported to optimize the coffer cell performance.

Fourteen additional acres of the uplands area will be cleared, graded, and compacted to create a usable area for operations, for a total of approximately 44 uplands acres in Phase 2. This will require clearing the trees and cutting into the hillside to remove an additional approximately 460,000 CY of soils.

Approximately 509,000 CY of additional fill will be placed in the wet behind the cofferdam, on top of the south embankment and extend south, integrating Phase 1 into Phase 2. This will create approximately 10 additional acres of usable space. Once the fill is placed, the same ground improvement program as discussed in Phase 1 will be implemented.

The existing southern embankment is buried in the fill and a new southern embankment will be built from the soil from the uplands. This new southern embankment requires approximately 1,100 tons of bedding stone and 25,000 tons of armor stone.

In order to facilitate the installation of the additional berth length, the two Phase 1 mooring dolphins will be demolished.

The storm water drainage, electrical, water, and sewage systems will be upgraded to meet the Phase 2 requirements.

A conceptual drawing of this proposed work as well as an explanation of the terminal operations and construction sequence is included in Appendix A.

8.5 Mack Point Phase 1 Construction

The Phase 1 cofferdam structure consists of five, 100-ft diameter cells with 4 connecting cells, creating a 632-ft berthing face. The 56,058 CY of cell fill will be imported to optimize the coffer cell performance.

Approximately 614,000 CY of dredging will be performed to create an access channel and berthing pocket for the vessels calling on the terminal. The dredge materials will then be dewatered and amended with a binding agent, such as cement, and placed within the infill area.

The embankments will also be constructed from imported soils. This will help ensure a sealed infill area. Approximately 1,400 tons of bedding stone and 23,000 tons of armor stone will be placed on the embankments. The fill placed behind the coffer cells and the embankments will create approximately 8 acres of useable space.

The approximately 236,000 CY of leftover dredge spoils in Phase 1 could be dewatered, amended, and placed in a storage area on site. This material can be used as fill in the Phase 2 infill area.

Due to the limited length of the quay, two mooring dolphins will be installed east of the berth to provide a storage area for the semi-submersible barge when not in use.

Thirty acres of the existing facilities in the uplands will be demolished, graded, and compacted. Additionally, 1,500 linear feet of a rail spur along the existing southern shoreline will need to be relocated to provide access to the newly created infill area.

A conceptual drawing of this proposed work as well as an explanation of the terminal operations and construction sequence is included in Appendix A.

8.6 Mack Point Phase 2 Construction

It is assumed that the Phase 2 wharf will be built as an addition to the Phase 1 wharf. The Phase 2 structure will add 5 coffer cells to the west and 2 coffer cells to the east to create a cofferdam structure that consists of twelve, 100-foot diameter cells with 11 connecting cells, creating a 1,563-ft berthing face. An additional approximately 96,000 CY of cell fill will be imported to optimize the coffer cell performance.

Approximately 235,000 CY of additional dredging for Phase 2 will be performed to allow access to the additional berthing area and create a dedicated vessel turning basin. The vessel traffic in and out of the terminal once Phase 2 is in service may cause the existing maneuvering area in the federal channel, to the south of the existing pier, to become congested. Therefore, this additional turning basin was added. The dredge materials will then be dewatered and amended with a binding agent, such as cement, and placed within the new infill areas. The remaining dredge materials from Phase 1 will also be placed in the newly created infill areas. This will create approximately 17 acres of additional usable area.

The existing Phase 1 embankments will be buried in the fill and new eastern and western embankments will be constructed using the amended dredge material. Approximately 1,400 tons of bedding stone and 23,000 tons of armor stone will be placed on the new embankments

The existing facilities within an additional 10 acres of uplands will be demolished and the soils re-graded and compacted.

In order to facilitate the installation of the additional berth length, the two Phase 1 mooring dolphins will be demolished.

A conceptual drawing of this proposed work as well as an explanation of the terminal operations and construction sequence is included in Appendix A.

9. VHB ENVIRONMENTAL ASSESSMENT BASED ON RECOMMENDED INFRASTRUCTURE

VHB Environmental performed an initial environmental and permitting review of the Mack Point and Sears Island facilities. Each site was reviewed to identify known and potential resource concerns, including wetlands, dredging, fill areas, eel grass, sensitive species, and navigational constraints. The permitting review identifies the federal, state, and local permits that are likely to be required to move forward with development at either site.

Further coordination with state and federal agencies will be required to fully assess environmental impacts.

Pursuant to federal and state environmental laws, an assessment of impacts and an evaluation of alternatives will be conducted before selection of the least environmentally damaging practicable alternative. As part of this to these processes, MaineDOT has directed that a robust stakeholder and public communication process occur.

10. COST ESTIMATING AND CONSTRUCTION SCHEDULES

10.1 General

This section describes the methodology and assumptions used in the development of the Class 4 cost estimate. The estimates included in Appendix B represents an Opinion of Probable Cost (OPC) for the site modifications necessary to construct the floating OSW port. High-level estimates of some associated costs for project risk, engineering/design fees, or contingency allowance are included but may not capture all possible costs.

A preliminary Level 1 construction schedule was prepared for the development of the floating OSW port using MS Project and are included in Appendix B. The schedule includes only statutory holidays and is based on a five (5) day work week.

A Class 4 cost estimate and schedule was developed for both the Phase 1 (research size capable of supporting up to 200 MW production) and the Phase 2 (full size buildout capable of supporting commercial production) at both Sears Island and Mack Point.

10.2 Schedule Durations

10.2.1 Mack Point – Phase 1

The total construction schedule for this phase is estimated at 1.5 years.

10.2.2 Mack Point – Phase 2

The total construction schedule for this phase is estimated at 2.5 years.

10.2.3 Sears Island – Phase 1

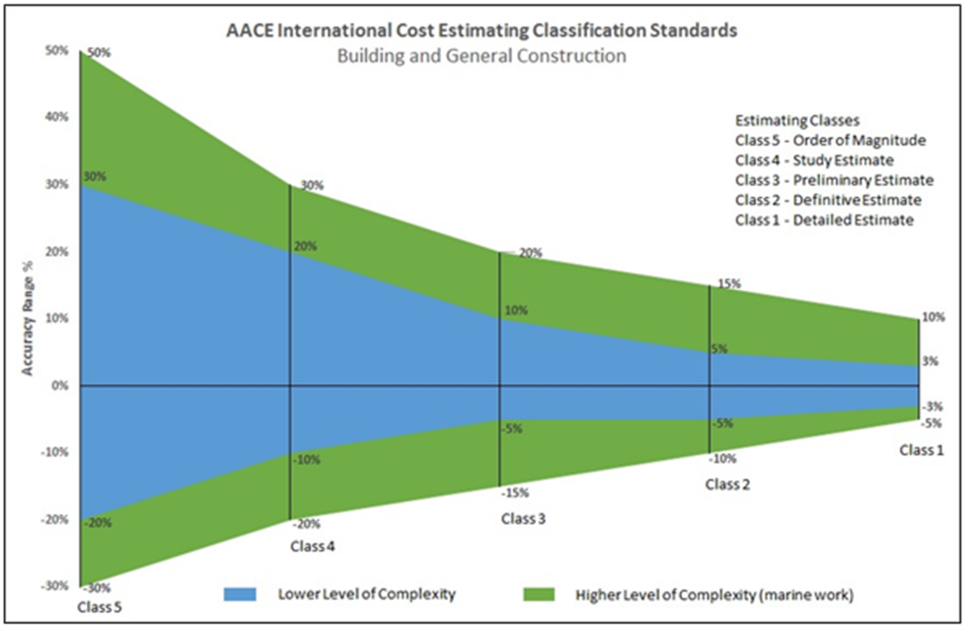
The total construction schedule for this phase is estimated at 2 years.

10.2.4 Sears Island – Phase 2

The total construction schedule for this phase is estimated at 4 years.

10.3 Estimate Class and Accuracy

The estimate is completed to the level of accuracy in accordance with the AACE (Association for the Advancement of Cost Estimating), International Recommended Practice No. 18R-97, Cost Estimate Classification System Guidelines. The accuracy of the estimate is Class 4 and is expected to achieve a range of accuracy from +50% to -30% of the total estimate cost, as shown in the graph below. This level of estimate is appropriate for concept design and planning stages of a project.



10.4 Methodology

Unless otherwise stated in the estimate details, the estimate is based on material take offs (MTOs) generated by the various engineering disciplines. The estimate is based on current and historical costs, vendor/contractor quotations from previous projects, and the estimator's experience. Wage rates were calibrated for the Searsport, ME area. It was assumed the project would be performed under the design-bid-build model with no project labor agreement (PLA). The Phase 2 estimate for each site should be viewed as independent from the Phase 1 estimate. Each estimate was generated as if constructed from the existing conditions, i.e., Phase 2 estimate and quantities do not build off of Phase 1 estimate and quantities.

10.5 Cost Estimation Scenarios

In each scenario, there are two costs stated. The first is the 'Estimated Construction Cost,' which includes all material, labor, and equipment to complete the work and indirect costs including Contractor Supervision, Corporate Overhead and Profit, and Bonds and Insurance costs. The second cost is 'Total Project Cost' (TPC), which includes the construction cost subtotal with a project contingency of 30%.

10.5.1 Mack Point – Phase 1

The total construction cost for this phase is estimated at $127,664,000 USD. The total project cost is estimated at $165,963,000 USD.

10.5.2 Mack Point – Phase 2

The total construction cost for this phase is estimated at $218,957,000 USD. The total project cost is estimated at $284,644,000 USD.

10.5.3 Sears Island – Phase 1

The total construction cost for this phase is estimated at $76,576,000 USD. The total project cost is estimated at $99,548,000 USD.

10.5.4 Sears Island – Phase 2

The total construction cost for this phase is estimated at $141,820,000 USD. The total project cost is estimated at $184,365,000 USD.

10.6 Assumptions and Considerations

When reviewing the estimated costs included in Appendix B, it is important to note the following assumptions and/or considerations:

a) Pricing is based on the concept design drawing set included in Appendix A.

b) Pricing is based on US dollars, Q4 2021.

c) The costs have been developed based on historical and current data using in-house sources.

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

e) The estimated man-hours reflect the type/class (Class 4) of the estimate and are based on average unit rates inclusive of materials, labor, etc. The number of man-hours has been roughly estimated by either: 1) back calculating the number of man-hours by roughly estimating the labor contribution and dividing by the average labor rate; 2) roughly estimating the man-hours required by the scheduled time to complete; or 3) a combination of 1 and 2.

10.7 Direct Costs

Direct costs are based on detailed cost buildups for labor, equipment, and supplies governed by historical or anticipated productivity derived from previous projects with similar scope, supplemented with the preliminary quantities represented by the drawings or as described in the provided text. Mobilization and demobilization for equipment and materials is assumed to be by truck and barge to and from the project site.

10.8 Indirect Costs

Indirect costs include contractor expenses for personnel, upfront project planning and procurements, onsite construction supervision, maintenance, survey, and inspection. Utilities, construction water, electrical, and communication services, are assumed to be available on-site. Various allowances based on the total direct labor cost included in the estimate are as follows:

- Supervision (12%): Considers site supervision of the construction and includes costs such as Project Manager, Superintendents, Project & Field Engineers, Quality Control, and Office Staff.
- Bonds and Insurance (2%): Considers a nominal general liability insurance and performance bonds.
- Corporate Overhead and Profit (17%): This value is included as industry standard.

10.9 Contingency

A 30% 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 estimates but covers items of work that will have to be performed and elements of costs that will be incurred but are not explicitly detailed or described due to the level of investigation, engineering, and estimating completed to date.

11. ASSESSMENT OF PROPOSED SITES

In their existing condition, neither site meets the required criteria to serve as a port facility to support the floating OSW industry. However, with modifications, both the Mack Point and Sears Island sites can achieve or surpass the minimum required criteria.

The criteria discussed in Section 4 of this report deals primarily with the necessary physical characteristics of a port facility, such as quay length and draft at the quay. There are additional criteria that can be used to further evaluate these two sites. This additional criteria is typically graded on a relative scale where one option will outperform another. This additional criteria has been listed and graded in Table 11-1 below. A blue dot in the figure indicates a favorable grading in relation to the other option (site). If there was no discernable advantage in a particular criteria, both sites received a blue dot.

Table 11-1: Site Assessment Criteria

Criteria	Mack Point	Sears Island
Possibilities for expansion		●
Required dredge/disposal quantities		●
Access to existing deep water		●
Existing commercial infrastructure/utilities	●	
Interference with existing operations at site		●
Site length available for quay placement		●
Availability of on-site soils for fill behind earth retaining structure		●
Ease of navigation		●
Remediation cost		●
Rail connectivity	●	
Rail interference		●
Total project cost		●
Construction schedule	●	●

12. PORT OF SEARSPORT OFFSHORE WIND HUB

The Port of Searsport offshore wind hub concept proposes a marine terminal on Sears Island as a centralized hub for assembly and launching of floating foundations as well as erection of the WTG components onto the foundations.

Sears Island as a hub location does not preclude utilizing nearby facilities in the Port of Searsport as the offshore wind marketplace develops. It is anticipated that, as the industry grows in Maine and the region, additional waterfront facilities will be required. These facilities can serve in support roles consisting of (but not limited to) raw materials supply, component manufacturing and operations and maintenance. There are multiple properties in the Port of Searsport that may be able to fulfill these functions.

Figure 12-1 shows additional local facilities can be brought online to serve these roles as the industry grows. These facilities include parcels on and adjacent to the existing Mack Point Terminal, the Sprague Put Parcel and the GAC chemical parcel. These properties are all connected by significant roads and rail lines (Canadian Pacific). Having these commercial/industrial assets within close proximity to the main Sears Island Hub enhances the attractiveness of the site and provides the opportunity to create a larger Searsport area OSW Hub.

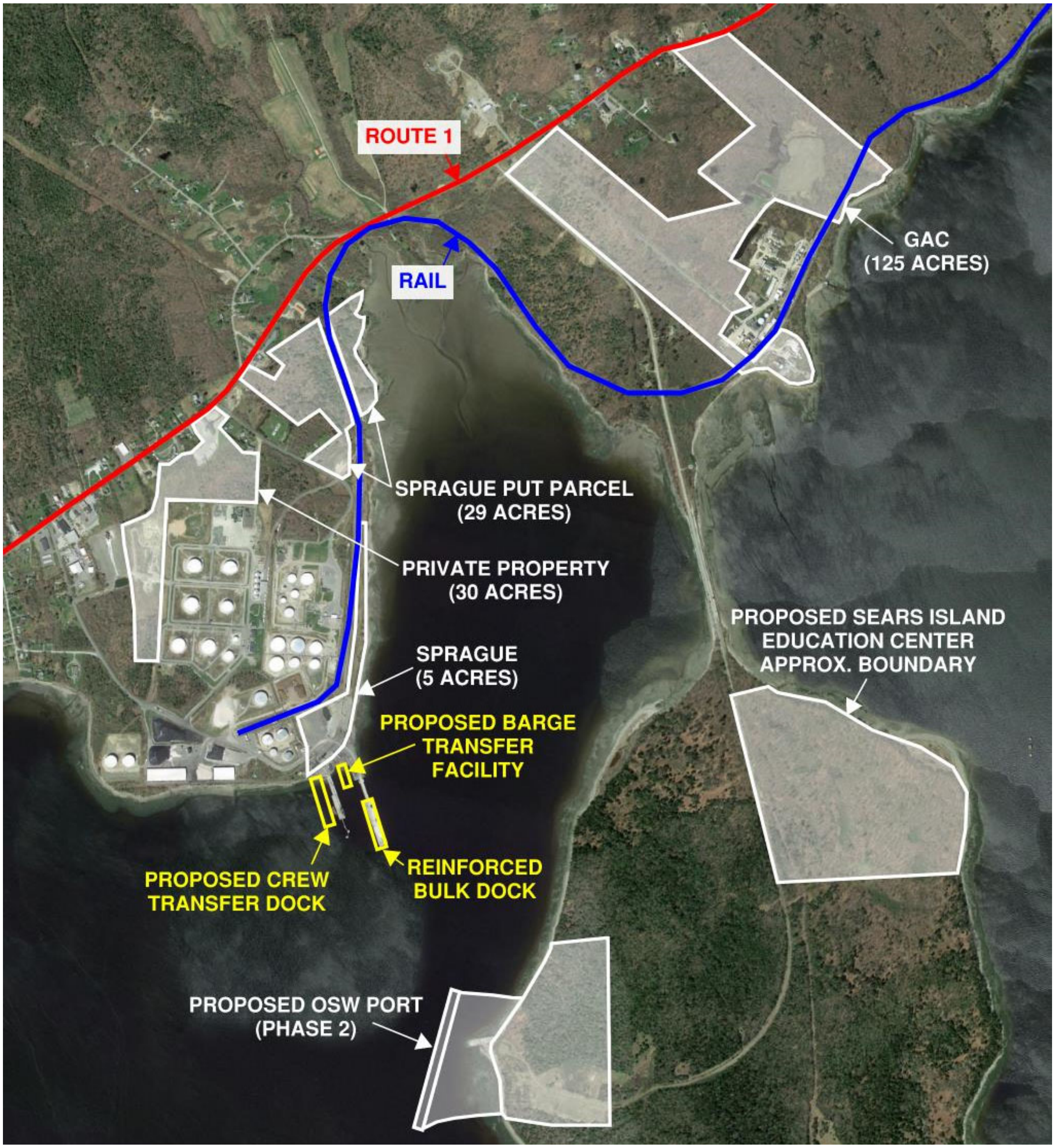


Figure 12-1: Port of Searsport OSW Hub

13. SEARS ISLAND CONSERVATION AREA POTENTIAL IMPROVEMENTS

The feasibility study for offshore wind required an in-depth look at port infrastructure in the Port of Searsport, part of which focused on the transportation parcel of Sears Island. MaineDOT considered a whole island approach and acknowledged that if port development and investment were to occur on the transportation parcel, improvements could be made to the conservation area to improve the experience for visitors to the island.

In an effort to help visualize what potential improvements may look like, Maine DOT has created the renderings shown in Figure 13-1 and Figure 13-2. These renderings show both the whole island to better locate the potential OSW development in relation to the conservation area as well as an enlargement of the proposed infrastructure improvements. These potential improvements include:

- Education Center Building
- Interactive/Interpretive Landscape Zones
- Outdoor Classrooms
- Waterfront & Boating Access Area
- Education Center/Waterfront Access Parking Area
- Trail Head Parking Area
- Cell Tower Road Improvements

As a part of the public process for the OSW port development project, MaineDOT would like to hold discussions with stakeholders regarding the potential maintenance and education improvements on the conservation side of the island. Maine DOT understands that there will be many differing viewpoints on this issue and a final plan will require input from all concerned parties and would occur on a parallel track with the design of the transportation parcel marine facilities.

Figure 13-1: Sears Island Overall Land Use Concept

Figure 13-2: Sears Island Overall Land Use Concept Enlargement

14. OFFSHORE WIND PORT COMMERCIAL ANALYSIS

14.1 Introduction

The US East Coast is expected to experience a rapid increase of activity in the OSW industry over the coming decade, with the operating capacity of installations increasing from the 30 MW today (Block Island and Coastal Virginia) to roughly 29,000 MW (29.0 GW) by 2035 (as presented in Figure 14-1). This would suggest there could be approximately 2,500 turbines[1] in operation by 2035, depending on the per unit capacity of the turbines brought to the installations. In order to accommodate projected growth, the development of dedicated port infrastructure will be necessary to support the staging, manufacturing, and operations and maintenance associated with the newly constructed installations. Both the timing and scale of to-be-developed installations indicates that there is an opportunity for multiple "regional" port hubs to operate simultaneously on the US East Coast to meet the demand of the industry.

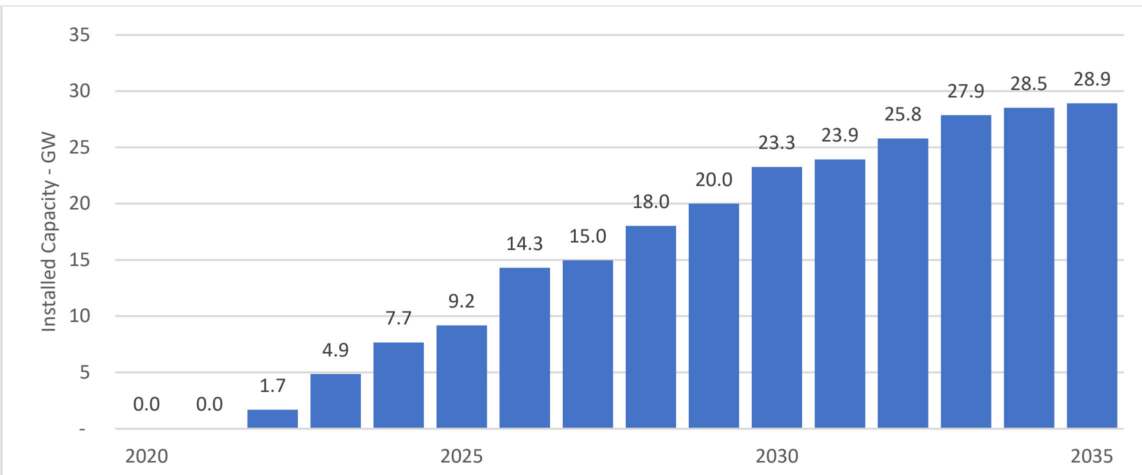


Figure 14-1: Projected Cumulative Installed OSW Capacity on the US East Coast[2] (Source: M&N)

The commercial assessment presented in this section addresses the following:

- The existing pipeline of installations and long-term state-level targets for OSW
- The relative cost competitiveness of floating-base vs. fixed-base turbines
- The lease terms emerging on the US East Coast at other OSW ports and potential operating models

Based on the analysis, the opportunity for Maine, and more specifically the port-hub at Searsport, will emerge in the late 2020s/early 2030s.

[1] Assuming roughly 12 MW per turbine

[2] Includes assumptions around the build up of undefined installations/solicitations that are required to meet the respective state-level 2035 targets

- By this time, many of the identified installations and planned solicitations will have either began operating, be under construction, or be in permitting. These installations will have been established in the shallow-water BOEM areas, which will utilize fixed-foundations.
- Advancement in technology and supply chains of the floating-base turbines will allow them to have become financially competitive with the fixed-base foundations.
- BOEM's official schedule shows the first lease sale in Maine to occur in Q2 – Q4 2024. It can take up to seven- years to complete the permitting and receive approval of the construction operations plan, so even on an accelerated timeline the late 2020's appears likely as the earliest a commercial installation would begin operations.
- The US OSW industry will have matured and will have likely attracted interest from additional private terminal operators and financial investors that could support the development of Maine's OSW industry.
- BOEM may have designated additional deep-water call sites and/or lease areas, presumably both within and outside the Gulf of Maine. This would give the Searsport-hub the potential to serve not just a local Gulf of Maine market but also a more extensive US Northeast floating OSW market.

14.2 Project Pipeline and Implication on Port Infrastructure

The largest clusters of BOEM call areas (by area and potential capacity) available for OSW development in the US Northeast include the Massachusetts cluster (located off the south coast of Martha's Vineyard), the NY Bight cluster (south of Long Island and east of New Jersey) and the South Jersey/Delaware cluster (off the coast of southern New Jersey and Delaware). These clusters are all located in shallow water (<45 meters), as presented in Figure 14-2 and, therefore, will utilize fixed-base installations.

Additionally, BOEM has designated other call areas off the coasts of Virginia and North and South Carolina.

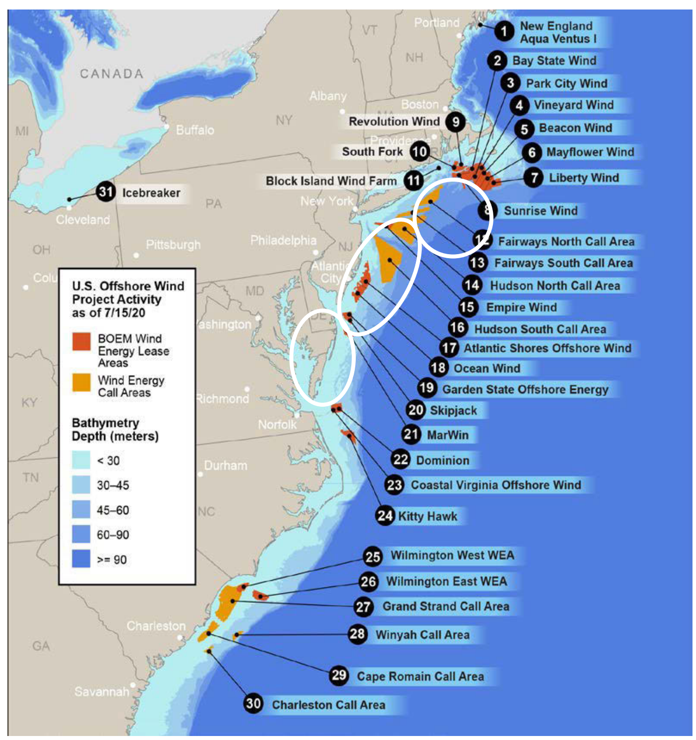


Figure 14-2: BOEM Lease and Call Sites on US East Coast (Source: BOEM)

In the Gulf of Maine there are currently no designated call areas, though the installation of the single Aqua Ventas pilot turbine (12 MW) was approved by Maine's Public Utility Commission and is scheduled to begin operations in 2023. There is limited shallow water available to support a fixed-base installation and, therefore, the Aqua Ventas and future installations in the Gulf of Maine will deploy the floating-bases.

In terms of leased areas, the most advanced are the Massachusetts and South Jersey/Delaware clusters. Within the Massachusetts cluster, as presented in Table 14-1, there are currently six projects in the permitting stage and an additional three under exclusive site control. The Block Island installation, which is operating, is also located in this cluster. Of the projects in permitting, all have Commence Operation Dates (COD) between 2023 and 2025. Of those in site control, it would be expected that COD occur sometime between 2025 and 2035. Generally, site control precedes permitting by one to three years, with COD expected to occur within five years following completion of permitting. It would, therefore, appear that by 2035, all Massachusetts cluster areas available for lease will likely be accounted for and in operation.

Table 14-1: Installation Status & Details

Cluster	Location	Project Name	Status	COD	Announced (MW)	Pipeline (MW)	Offtake	Developers
	ME	New England Aqua Ventus I	Permitting	2023	12	12	ME	Aqua Ventus
MA	MA	Bay State Wind	Site Control	-	-	2,277	-	Ørsted/Eversource
	MA	Park City Wind	Permitting	2025	804	804	CT	Avangrid/CIP
	MA	Vineyard Wind + Residual	Permitting	2023	800	1,221	MA	Avangrid/CIP
	MA	Beacon Wind	Permitting	-	1,230	1,564	NY	Equinor/BP
	MA	Mayflower Wind + Residual	Permitting	2025	804	1,551	MA	EDPR/Shell
	MA	Liberty Wind	Site Control	-	-	1,607	-	Avangrid/CIP
	MA	Sunrise Wind	Permitting	2024	880	880	NY	Ørsted/Eversource
	RI	Revolution Wind	Permitting	2023	704	704	RI & CT	Ørsted/Eversource
	RI	South Fork	Permitting	2023	130	130	NY	Ørsted/Eversource
	RI	Block Island Wind Farm	Operating	2016	30	30	RI	Ørsted/Eversource
NY Bight	NY	Fairways North Call Area	Planning	-	-	-	-	-
	NY	Fairways South Call Area	Planning	-	-	-	-	-
	NY	Hudson North Call Area	Planning	-	-	-	-	-
	NY	Empire Wind 1&2	Permitting	2025 / 2028	2,076	2,400	NY	Equinor/BP
	NY	Hudson South Call Area	Planning	-	-	-	-	-
South NJ	NJ	Atlantic Shores OSW	Permitting	-	1,510	2,500	-	EDF/Shell
	NJ	Ocean Wind + Residual	Permitting	2024	1,100	1,947	NJ	Ørsted/PSEG
	DE	Garden State Energy	Site Control	-	-	1,050	-	Ørsted
	DE	Skipjack	Permitting	2023	120	120	MD	Ørsted
	MD	MarWin + Residual	Permitting	2023	248	966	MD	US Wind
	VA	Dominion	Site Control	-	-	2,640	-	Dominion
	VA	Coastal Virginia OSW	Constructed	2020	12	12	VA	Dominion/Ørsted

Shading indicates projects which are in Permitting or more advanced phases
Source: NREL

Within the Southern NJ cluster, four projects are in permitting and two under exclusive site control. Those in permitting have CODs of 2023 and 2024 (respectively), which indicate that operations should begin in the "near-term." Those under site control would be expected to begin operation between 2025 and 2035. Therefore, it would indicate that all designated BOEM areas would be accounted for and in operation.

The NY Bight cluster has two projects, Empire Wind 1 & 2, in permitting with a COD of 2025 and 2028. There are an additional four areas in planning, which is the first stage of the development pipeline. This implies that installations in these areas may commence operations later in the forecast horizon (2030 – 2035+).

It should be noted that NY and NJ have the largest targets for OSW procurement, 9,000 MW and 7,5000 MW, respectively, by 2035 (as presented in Table 14-2). This indicates that there will need to be a strong procurement effort in order to meet the long-term targets as NY currently has just 3,306 MW under permitting and NJ has just 2,610 MW. Much of the generating capacity needed to reach the long-term goals could be developed in the NY Bight and Southern NJ Cluster.

MA has already reached its 2027 target of 1,600 MW with the projects currently in permitting but will have double this level if it is to reach its 2035 target of 3,200 MW. CT will have to secure additional installation(s) to meet its 2030 target of 2,000 MW. These levels could potentially be sourced by the three projects under site control, namely Bay State Wind (2,227 MW area capacity), Beacon Wind (1,564 MW), and Liberty Wind (1,607 MW)[3].

Within the permitted and site-controlled sites, there is a total 22,415 MW[4] of pipeline capacity (which is greater than the announced capacity of the individual installations) and doesn't include the potential of the large NY Bight areas in the planning stage. Therefore, much, if not all, of the existing 2035 target MW can accommodated in the existing shallow-water call areas.

Table 14-2: State-Level Procurement Targets (Offtake)

Offtake	Permitted (MW)	2030 Target (MW)	2035 Target (MW)
ME	12	NA	NA
MA	1,604	1,600*	3,200
RI	430	NA	NA
CT	1,108	2,000	NA
NY	946	2,400	9,000
NJ	1,100	3,500	7,500
MD	368	1,568	NA
VA	12	2,500*	5,200*
Total	5,568	13,998	28,900

*Source: NREL; M&N. *MA Target 2027, VA Target 2026, 2034*
ME has 80% renewables target for 2030, but does not stipulate a target for OSW

[3] https://www.nrel.gov/wind/offshore-wind.html - October 2020
[4] Pipeline capacity is the total implied capacity of the lease area (based on acreage) vs announced capacity which is project specific (phase)

To prepare for the imminent activity associated with component delivery, staging and installation of the turbines, cables, and substations, the public and private sectors have been actively engaging one another to secure and fund waterfront access and port development. To date, some of the early port developments/administrations in the US Northeast/Mid-Atlantic targeting the OSW industry (staging and manufacturing) include:

- The New Bedford Terminal, MA
- Brayton Point, MA
- State Pier, CT
- Port of Albany & Coeymans, NY
- Port of NYNJ & South Brooklyn Marine Terminal
- Hope Creek & Paulsboro, NJ
- Tradepoint Atlantic, MD
- Portsmouth, VA

While not all sites will be able to offer the same service complement, the intense level of installation activity (between 2022 and 2035) will necessitate that multiple staging facilities operate simultaneously to meet demand.

It is advantageous from a cost perspective for the installation developers (Equinor, Ørsted, Dominion, etc.) to have staging locations that are close to the installation sites (Figure 14-3). This reduces the distance, time, and ultimately, cost of delivering components to the installation site. Therefore, it is not surprising that sites such as New Bedford and State Pier will be utilized for the Vineyard Wind and Mayflower Wind projects (Massachusetts cluster, roughly 53 nm between port and installation areas), Hope Creek for Ocean Wind (South Jersey), and Portsmouth for Dominion. These ports offer the closest option to serve the respective installations.

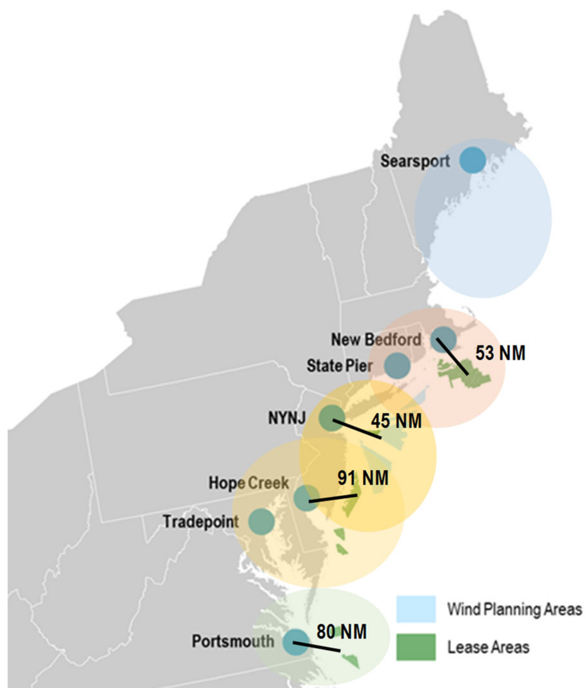


Figure 14-3: Illustrative Port Regions & Installation Areas (Source: M&N)

The implication for the Searsport, ME development is that it would be at a great competitive advantage to serve the needs of installations in the Gulf of Maine but would be at a competitive disadvantage to serve the installation sites to the south (for the existing shallow-water fixed foundation call sites). This competitive disadvantage could be erased, however, should BOEM open deep-water call sites and there are no other floating-base hubs to serve them (in the US Northeast).

In summary, the following can be inferred with respect to the prospect of the port-hub development in Searsport, ME:

1) Installations in the Gulf of Maine will become the primary source of the “Market” for this hub. With an 80% renewables target by 2030 and 100% by 2050, OSW is likely to be required.

    a. The long-standing goal in Maine is to have 5,000 MW of installed capacity by 2030[5].

        i. Note the prospect of having 5,000 MW of capacity in the Gulf of Maine by 2030 is a significant challenge. This would imply that anywhere from 500 to 333 turbines will have been installed by that time, depending on per unit capacity (assuming 10 MW to 15 MW per turbine). In order to reach that target, a single floating-base manufacturer would have to operate continuously for years and/or receive additional bases from alternate locations simultaneously. There are currently no commercial producers of floating-bases in the US. M&N believes a more realistic goal would be to have a single large commercial installation (400 – 1,000 MW e.g.), in operation by 2030.

    b. BOEM will need to designate call areas within the Gulf of Maine and a formal solicitation/procurement process will need take place to secure a developer(s).

2) The ability to serve locations outside of the Gulf of Maine will remain contingent on two market events:

    a. The states need to expand on their respective long-term targets, thereby extending the demand horizon beyond 2035 - all of which will likely have been met by fixed-base installations in existing call areas.

    b. BOEM needs to designate new lease areas in deep water, which necessitates the use of the floating-bases.

Momentum is clearly building behind the floating-base industry. In August of 2020, the Aqua Ventus, RWE Renewables and Diamond Offshore Wind (A Mitsubishi subsidiary), formed the New England Aqua Ventas JV, which will fabricate, develop, and operate the single turbine. Total costs are estimated at $100 million, underscoring the interest by major renewable energy developers to invest in floating wind technology in the US. Other major global developers such as Equinor, Cobra Group, and PPI (EDP and Repsol [major partners]) continue to develop and install floating-base installations in Europe and Asia.

14.3 Competitiveness of Floating Installations

The use of floating bases represents one of the frontiers[6] of the global OSW wind industry, and today remains in its formative stages. There is currently less than 100 MW of installed floating capacity around the world, compared to roughly 29,800 MW of total installed capacity (or just

[5] https://composites.umaine.edu/offshorewind/ - this has been a stated goal since 2009 but has not been formally recognized in executive order or legislation

[6] The scale/capacity of the turbines being developed for fixed-base installations is equally impressive

0.3% of the total). The prospect of floating bases gaining market share, however, is well supported and, just as the fixed-base installations have steadily improved their competitive position relative to conventional forms of energy over the past ten years, floating-bases too will leverage improvements in technology and reductions in production costs to improve its competitive offering over the coming decade, bringing its offering closer to both fixed-base and conventional energy sources.

The Levelized Cost of Electricity (LCOE) from the OSW industry has improved dramatically over the last 10-years and is projected to continue to do so through the coming decades (see Figure 14-4). Globally, the median cost supplied by OSW has fallen by almost 20-30% since 2012 to about $100/MWh in 2019/2020, bringing it in the range of conventional fossil fuels.

The consensus projections[7] indicate that LCOE from OSW will continue to fall through the 2020s and 2030s, reaching roughly $50/MWh by 2030. This would bring the cost of energy roughly in line with the low-end of the fossil fuel range. Indeed, in some markets around the world, particularly in Europe/UK, the cost of power from OSW has fallen below that of conventional fuels.

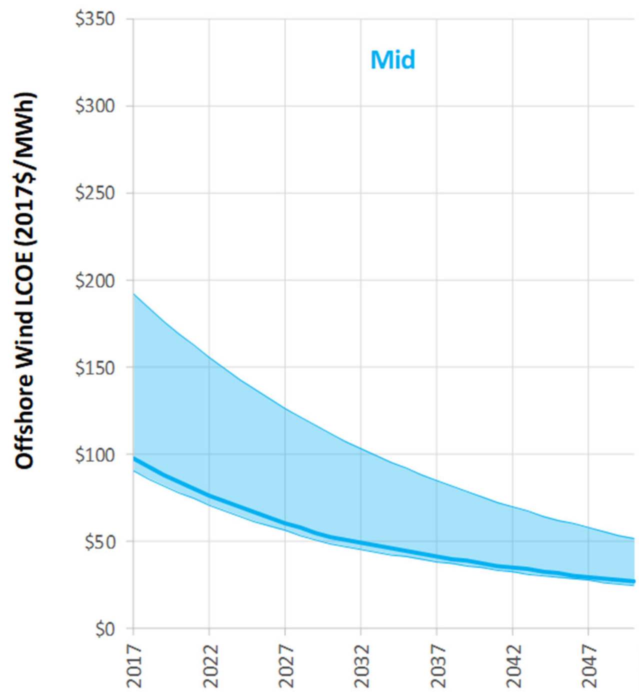


Figure 14-4: LCOE Projections for OSW (Source: NREL)

This decline in LCOE offered by OSW reflects both a reduction in the supply chain costs of the turbines and their installation, as well as the substantial increase in electricity production generated by the larger turbines. As illustrated in Figure 14-5, in 2010 the average capacity per turbine being installed was 3 MW, by 2018 this had increased to 5.5 MW. Ten (10) and 12 MW turbines are now being sourced/manufactured for the installations being permitted today. These, along with the even larger (15 MW+ turbines), will continue to bring the efficiencies of scale to the market in the future.

[7] https://atb.nrel.gov/electricity/2019/index.html?t=inlwowsusdsrscgthpcgcccncb&m=1

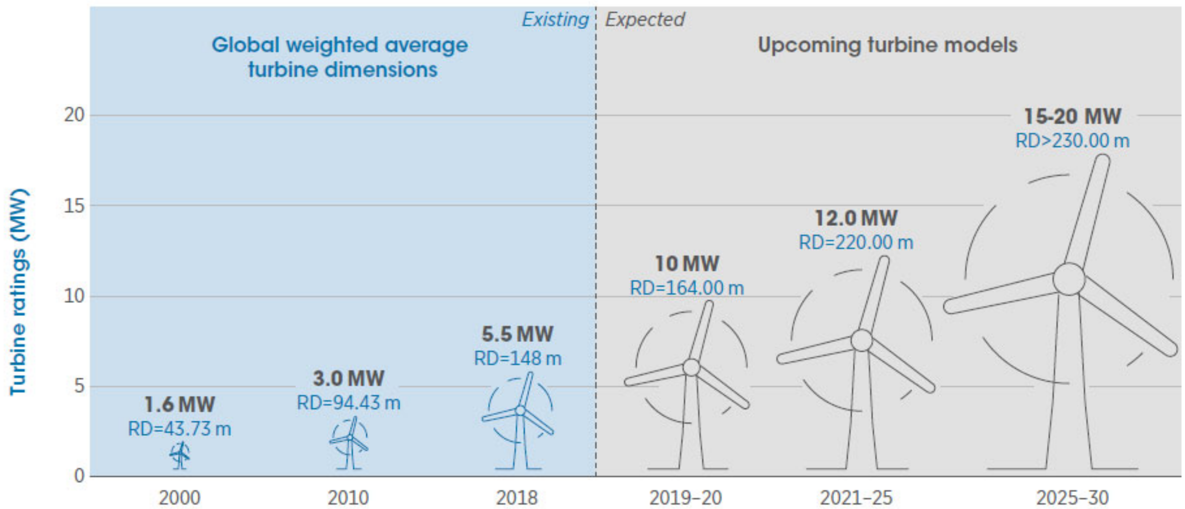


Figure 14-5: Average Size of OSW Turbines (Source: IRENA "Future of Wind – Development, Investment, Technology, Grid Integration and Socio-economic Aspects" 2019)

Being the younger technology, floating-base turbines are currently costlier than the fixed monopile turbines due to more expensive technologies and a lack of the economies of scale that has benefited monopile turbines. The largest operating floating-base installation is Equinor's Hywind Scotland 30 MW installation (5 X 6 MW [Siemens Gamesa]) with COD in 2017. More recent projects, like the Hywind Tampen installation in the Norwegian North Sea (COD 2022) and the upcoming floating wind auctions in France and Japan, will set precedents for the LCOE of floating wind in larger arrays. France's floating wind auction consists of two 250 MW with LCOEs of $142 and $130 per MW hour, which is significantly lower than other ongoing projects.

Equinor is already on record saying that it will seek to reduce the development cost (per MW) of the Hywind Tampen by more than 40% compared to the Hywind Scotland project. Tampen will be a significantly larger installation, delivering 88 MW capacity and utilizing 11 X 8 MW (Siemens Gamesa) turbines.

It is efforts such this, as well as the precedent set by the fixed-base segment of the industry, that gives credence to the assumption that the floating-base option will also be able to bring more competitive LCOE to the market. The Aqua Ventus project is a key example of a technological advancement that could rapidly lower the expected LCOE for floating wind structures. While the current Aqua Ventus plan includes only a single floating turbine, the NREL predicts that the LCOE of a 1,000 MW system, using current Aqua Ventus technology and supply chains, could be $107/MWh[8]. Table 14-3 shows that the NREL study predicts an LCOE decline to $74/MWh in 2027 and $57/MWh in 2032. The reductions in price follow similar patterns to those experienced by fixed bottom turbine technology. With the industry moving towards larger turbines, there is a possibility that the cost of floating turbines will fall faster as they are able be deployed in deeper and more productive areas of the ocean.

[8] https://www.nrel.gov/docs/fy20osti/75618.pdf

Table 14-3: Expected LCOE and Costs of 1,000-MW Aqua Ventus Array

Model Year	**2019**	**2022**	**2027**	**2032**
LCOE ($MW/H)	107	88	74	57
CapEx ($/kW)	4,789	4,129	3,686	2,998
OpEx ($/kW/yr)	84	62	53	38
Net Capacity Factor (%)	46	47	49	51

Source: NREL

Government policy can also play a pivotal role in the adoption of floating wind. The current presidential administration has announced policy that will be far more favorable to renewable energy as well as US-based manufacturing. A government backed emphasis on both could lower the costs of manufacturing in the US and accelerate the rate at which floating wind turbines are deployed. In the coming years, if existing monopile arrays prove to be successful, it could mean BOEM would open deep-water sites off the US East Coast sooner than expected.

As the floating-base option matures through the 2020s and into the 2030s, this could provide the window of opportunity for the Searsport development to enter competitive market, particularly for the deep-water lease areas within the Gulf of Maine which BOEM seeks to auction in 2024.

14.4 Lease Agreements & Operating Model

The analysis presented in this section is meant to identify the terms and key stakeholders of lease agreements being accepted within the new market of designated ports servicing the OSW industry. To date there have been four announced and which are described below and shown in Figure 14-6:

- The New Bedford Terminal with Vineyard Wind and the State of MA
- State Pier with Ørsted/Eversource JV and the CT Port Authority
- Orsted with the Port of Virginia
- Dominion Energy with the Port of Virginia
- Tradepoint Atlantic (private entity) with Ørsted

They show varying terms and must be considered in the context of the infrastructure requirements and funding sources for construction and procurement of equipment.

A fifth agreement (undisclosed lease terms) was made in December 2020:

- $250 million agreement between EEW / Ørsted and State of NJ to build a monopile factory at the Paulsboro site

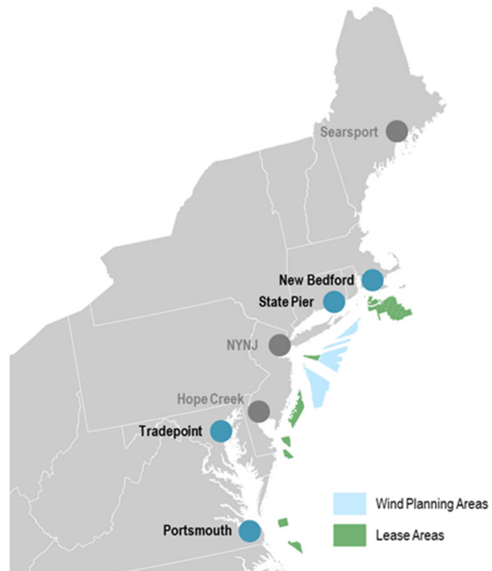


Figure 14-6: Existing Lease Agreements (Source: M&N)

Other commitments include:

- NJ's plan to develop the Hope Creek site's 200 total acres (in two phases) at an estimated total of $300 - $400 million
- NY's $200 million in grants and lending assistance in order to develop port infrastructure in support of the OSW industry (Port of Albany and South Brooklyn Marine Terminal e.g.)

A summary of the OSE Port Lease Agreements and Key Projects is presented at the end of Section 12.4 in Table 14-4.

14.4.1 The New Bedford Terminal, MA

The New Bedford Marine Commerce Terminal is a 29-acre heavy-lift facility constructed and operated by the Massachusetts Clean Energy Center (MassCEC). Complete in 2015, it was funded primarily through state bonds for $113 million, subsequent expenditures have brought the total to $139 million.

In August 2020, Vineyard Wind and Mayflower Wind signed lease agreements worth $32.5 million, committing the facility to OSW work from 2023 to 2027. The Terminal will be used as a staging site for their respective projects in the Massachusetts cluster.

- Vineyard Wind and Mayflower Wind were selected in May 2018 and October 2019, respectively, to provide a total of 1.6 GW of offshore wind power to Massachusetts

The Vineyard Wind agreement is an amended version of an original lease agreement made in August 2019. In December 2019, final approval for the Vineyard Wind project was delayed by BOEM ,which has led to the adjustment of the previous lease agreement.

- The original agreement was an 18-month lease to exclusively use the terminal starting in December 2020 at a cost of $9 million.

Mayflower Wind is a 50/50 joint venture of Shell New Energies US LLC and EDPR Offshore North America LLC, while Vineyard Wind is a joint venture of subsidiary of Avangrid Inc. and Copenhagen Infrastructure Partners (CIP).

14.4.2 State Pier, CT

The proposed State Pier development in New London, CT, shown in Figure 14-7 represents a $150 million (plus) redevelopment agreement between the State of Connecticut and joint venture partners Ørsted and Eversource.

The State Pier Terminal is currently under a lease agreement between the CT Port Authority and Gateway Terminals, a private terminal operator. The standing lease is a 20-year concession granted in May 2019.

The agreement made between Connecticut (via the Port Authority) and the Ørsted/Eversource JV would represent a sublease to the existing agreement, and would redevelop State Pier, into a dedicated OSW terminal[9]. Gateway would remain the terminal operator.

Under the agreement, the Port Authority is guaranteed $20 million from the lease payments (over a ten-year period) and is also receiving $55 million from the JV to help facilitate construction at the port. The state will contribute $80 million in public funds, making it the largest public private partnership (agreed to to-date) for dedicated OSW port infrastructure on the US East Coast.

Construction began in 2021, with anticipated completion in 2023. This facility will support the Revolution, Sunrise, and South Fork Wind installations.

Ørsted, based out of Fredericia, Denmark is one of the world's largest OSW operators. The majority of Ørsted's shares are owned by the Danish Government.

Eversource is a public utility provider in the US Northeast serving roughly 4.3 million customers throughout CT, MA, and NH.

[9] There is flexibility/process stipulated in the sublease agreement that will allow Gateway to handle other commodities/ products during periods when the terminal is not being used for OSW.

Together, Ørsted and Eversource have agreed to jointly develop three installations in the region, namely South Fork, Sunrise, and Revolution Wind.

Figure 14-7: Rendering of the State Pier Development (Source: CT.gov)

14.4.3 Portsmouth Marine Terminal, VA & Dominion Energy

The agreement was announced in January 2020 between Ørsted and the Port of Virginia.

The lease agreement will go through 2026 and will start with an initial lease of 1.7 acres with the option to expand to 40 acres. The lease guarantees $2.2 million for up to six years ($13 million in total). Additionally, Ørsted is contributing $20 million to fund the upgrading of the terminal (for heavy lift capacity) and equipment.

Ørsted will use the terminal to stage components for the Coastal Virginia Offshore Wind project, which consists of two, 6 MW Siemens Gamesa turbines. This is the test program for Dominion's larger 220-turbine project being planned for COD in 2026.

In August 2021, Dominion Energy entered a 10-year lease agreement with the Port of Virginia for a 72-acre site in the Portsmouth Marine Terminal. The lease is valued at $4.4 million annually.

Dominion is one of the US's largest utilities companies. It is based out of Richmond, VA and supplies electricity to customers throughout Virginia, North Carolina, and South Carolina. The company's gas distribution regions include Utah, West Virginia, Ohio, Pennsylvania, North Carolina, South Carolina, and Georgia.

14.4.4 Tradepoint Atlantic, MD

The agreement between Ørsted and Tradepoint Atlantic was announced in July 2019. There are limited, publicly available details of the financial terms. What has been disclosed includes:

- Ørsted is contributing $13.2 million to the construction effort
- The staging areas will encompass 50 acres in total: 5 adjacent to the waterfront for loadout and 45 for laydown and assembly
- Ørsted's intended use of the area is to support the development of the Skipjack installation (15 turbines; 120 MW)

Tradepoint Atlantic is a 3,300-acre multimodal logistics center in Baltimore, MD. It is being developed on the former Bethlehem Steel's Sparrows Point mill site, which sits outside of the Port of Baltimore's major container, auto, and dry bulk terminals. Existing tenants of Tradepoint Atlantic include big box retailers and ecommerce distribution facilities, logistics companies, auto processors, and industrial users.

14.4.5 Paulsboro, NJ

An agreement between Ørsted / EEW and the State of NJ to invest $250 million in the construction of a monopile factory at the Port of Paulsboro, NJ was announced in December 2020. Figure 14-8 shows a rendering of the facility. The new EEW facility is scheduled to open in 2023 and will take up 70 of the port's total 190 acres. The agreement will allow Paulsboro to serve as EEW's manufacturing hub in the US. Holt Logistics will remain the terminal operator, with South Jersey Port Corporation (SJPC) as the landlord.

Figure 14-8: Rendering of EEW Paulsboro Factory (Source: Insidernj.com)

The monopiles produced will be destined first to Ørsted's 1,100 MW Ocean Wind project (COD 2024) but will eventually be utilized at Ørsted's multiple installation locations throughout the US East Coast. The Paulsboro factory will complement the Hope Creek development, which is being developed as a staging and manufacturing hub.

EEW is a German based manufacturer and one of the world's leading producers of monopiles. The company maintains production locations throughout Europe and Asia and the Paulsboro would represent the companies first manufacturing plant in the US.

Table 14-4: Summary of OSW Port Lease Agreements & Key Projects

Port	Port Attributes	Developer / Lessee	Projects	Lease Term	Fixed Annual Payment	Other Contributions – Private Lessee	Other Contributions – Public
New Bedford	29 Acres 1,200’ Quayside 30’ Dredge	Vineyard Wind	Vineyard, Mayflower	4 years	$8.1 mil	NA	$139.0 mil
State Pier	32 Acres 1,400’ Quayside 38’ Dredge	Ørsted/ Eversource	Revolution, Sunrise, South Fork	10 years	$2.0 mil	$55.0 mil	$80.0 mil
Portsmouth	Up to 40 Acres N/A Quayside 41’ Dredge	Ørsted	CVOW	6 years	$2.2 mil	$20.0 mil	$40.0
Portsmouth	72 Acres	Dominion	CVOW	10 years	$4.4 mil	NA	NA
Tradepoint Atlantic	50 Acres 2,000’ Quayside 41’ Dredge	Ørsted	Skipjack	NA	NA	$13.2 mil	NA
Paulsboro Port & (Factory)	Up to 200 acres 3 Berths (850’) 40’ Depth 70-acre (Factory)	State of NJ EEW & Ørsted (Factory)	NA	NA	NA	$15 mil (terminal operator) $250 mil (Factory)	$175 mil
NJ Wind Port	Ph1 = 50 acres (two parcels) Ph2 = 100+ acres	State of NJ	Ocean Wind	NA	NA	NA	$300 - $400 mil at total build out

Source: M&N. NA = Not Available, mil = million

14.4.6 Operating Model

In consideration of potential future operations at the wind port, it could be in the best interest of the state to continue to partner with a private terminal operator to manage and operate the waterfront facilities. This is known as the landlord model, where the state is the owner of the property, leasing it to a tenant operator on a long-term basis (generally 10-years or more). This is currently the model used at the state-owned dry bulk terminal at Searsport with Sprague.

There are several advantages to having a dedicated terminal operator at the site:

- Long-term lease agreement between terminal operator and state would guarantee fixed annual rental payments to the state
- Burden of training and accessing specialized labor force falls on the operator
- The operator will have a long-standing, proven record of dependable service, which will give confidence to potential customers of the terminal
  - Operator will have best-practice experience for specialized cargoes
- The operator may bring in specialized equipment (from existing operations elsewhere) as part of the lease agreement, potentially removing some of the cost burden from the state
- The state will retain ownership of the site at the end of the lease – allowing for it to be repurposed for alternate uses if supported by future market conditions

It should be noted that there is a fundamental difference in the term lengths between the OSW port facilities that are developed/leased for staging and those developed/leased for manufacturing.

The staging sites are generally utilized for short durations (two years or less), the construction timeline it takes to have a single installation ready to begin operations (such as Vineyard and Mayflower Wind in New Bedford). The exception to this would be if a developer has multiple installations it intends to have ready on a sequential basis in generally the same region, then the developer may seek a longer term (such as Ørsted / Eversource in State Pier).

Manufacturing site agreements generally garner longer terms that could cover 15 to 25 years. This is because the manufacturer will be committing a significant amount of fixed capital to develop a factory/manufacturing location (building, equipment, staff relocation). In order to realize a return on this investment, the manufacturer will have to have confidence in both the ability to carve out a distinct segment of market share and a future pipeline of projects that can support demand.

The attractiveness of a new floating-base wind port operation in Searsport in the 2030s could gain traction with private terminal operators, particularly if these companies find success with the fixed-base operations in the 2020s. This would allow for the state to bring a competitive bid process to the market in order to find an operator offering the best value proposition.

Additionally, outside financial investors including private equity, pension funds, and project finance banks for example, and will likely become familiarized with and invested in the US OSW space. In August 2020, Apollo Global Management, one of the world's largest private equity firms, announced a $265 million investment in US Wind, the Maryland based OSW developer that is in the permitting phase for the MarWin installation (COD 2023). This acquisition, along with the RWE/Diamond investment in Agua Ventas, signals that the US OSW industry is already attracting outside interest.

Following the trend in Europe, as the industry matures in the US, access to capital will become easier, as evidenced by the reduction in lending interest rates over the past decade, as presented in Figure 14-9.

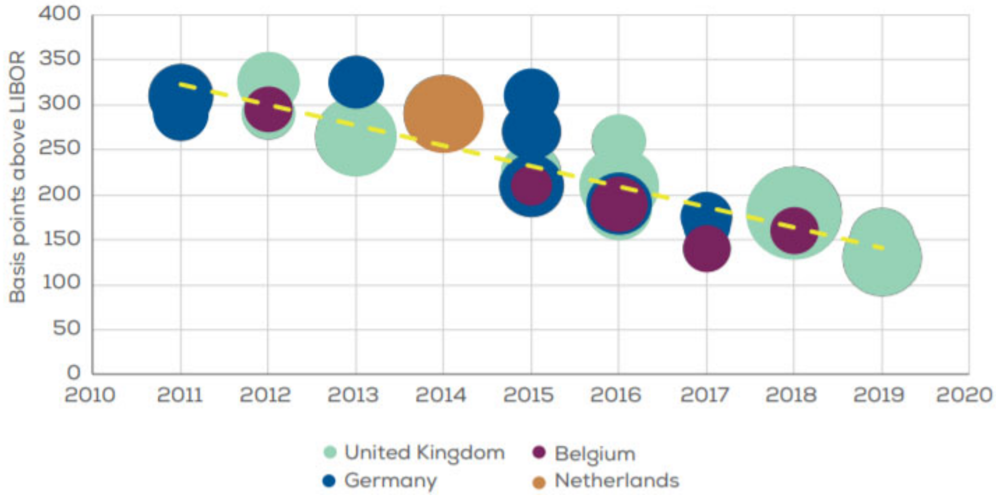


Figure 14-9: Interest Rates for Offshore Projects: Basis Points above LIBOR per MW Finance 2010-2019 (Source: Wind Europe: "Financing and investment Trends: The European Wind Industry in 2019")

As interest builds in larger installations (to be developed), alternative financing options could be leveraged to develop/procure the unique infrastructure and equipment that will be needed to support the OSW wind industry in Maine.

The emergence of the OSW industry on the US East Coast offers a substantial opportunity for all stakeholders.

15. RECOMMENDED NEXT STEPS

15.1 Site Investigations

15.1.1 Geotechnical Boring Program

A full geotechnical boring program, in compliance with ASTM standards, will be required for the detailed design stage of the facility. This program should establish the site soil stratigraphy and soil bearing capacity. Laboratory testing (soil structural properties and characteristics) of soil samples collected during the boring program should be included. If rock is encountered during the borings, this rock should be cored and sampled. The results of this program should be summarized in a site geotechnical report with recommended pile foundation sizing and tip elevations.

15.1.2 Topographic Survey

An upland topographic survey will also be required during the detailed design stage of the project. This survey will establish the elevation of the uplands at the interface between the uplands and the proposed quay. This information will be used to set the elevation of the terminal and establish accurate cut and fill requirements.

15.1.3 Bathymetric Survey

A bathymetric survey that provides coverage of the footprint of the Sears Island Site was provided by the University of Maine. This survey was performed by Alpine in 2017. This survey is three years old and should be updated as a part of this project.

15.1.4 Discussions with Utility Providers

Sears Island currently does not have the utility systems required for the operations of a commercial port. For the purposes of this study, it has been assumed that these services could be supplied by local providers and pulled onto the island. During the 30% design effort it is recommend that the project contact the appropriate utilities to engage in high-level discussions to confirm the feasibility of this assumption.

15.2 Optimization of Design

The design level shown in the submitted drawings should be considered conceptual and preliminary. The concept is subject to local, state and federal permit processes that may require investigation of alternatives that avoid and minimize natural resource impacts. As the design process moves from the concept stage into detailed design, the design can be optimized. This optimization process identifies design items and processes that can be adjusted and translate into cost savings for the project. This can range from pile grid adjustment, to construction materials, to required geometries of proposed structures. The optimization process should explore these potential cost savings while maintaining the required facility functionality. It is recommended the selected layout design be advanced to the 30% level. The cost estimates and construction schedule should be updated to match the 30% design level. The detailed design will also consider natural resource avoidance and minimization measures.

15.3 Consultation and Permitting with State and Federal Resources and Regulatory Agencies

Acquiring the required permits and approvals for a complex marine-based project can quite often be the critical path in the overall project schedule. This project will likely require a Joint Permit Application that is submitted to and reviewed simultaneously by both the Maine DEP and the ACOE. The state environmental agency reviews the proposed work and will establish its impacts on local environmental resources. The ACOE will review the proposed work to establish its effects on navigable waterways as well as federal environmental guidelines. This permit will also pull in numerous other agencies such as national marine fisheries and the US Coast Guard that will also review the proposed work.

It is recommended that the project schedule pre-submission consultation meetings with ACOE and Maine DEP, as well as NOAA and the Coast Guard. These meetings will introduce the project to the resource and regulatory agencies and allow for them to provide initial feedback on the proposed works.

Per the directive of MaineDOT, a robust stakeholder and public communication process will be conducted as part of the permitting process including the assessment of impacts and the evaluation of alternatives.

15.4 Outreach to Aqua Ventus Program at University of Maine

The Aqua Ventus Project will require an assembly and load out port facility to facilitate installation of the turbine units. It is recommended that the State of Maine enter into discussions with the Aqua Ventus Project to establish if there may be a mutually beneficial solution for the development of a port facility to support floating OSW in the state of Maine.

16. PROJECT GEOTECHNICAL RISKS

16.1 Geotechnical Information

There were some shallow historical upland geotechnical borings made available for use in this analysis. Assumptions regarding the structural capabilities of the soils and their ability to serve as infill behind the cellular cofferdams were made based on these borings. Additional geotechnical borings are required to fully understand and calibrate the structural properties of the upland soils. In addition, in water rock cores are required to ensure the quality of rock and its suitability to serve as a bearing surface for the proposed cellular cofferdams.

16.2 Predicted Soil Settlement Time Under Surcharge Program

The methodology to prepare the placed soils in the infill area requires installation of wick drains and a soil surcharge program. Data regarding the time settlement characteristics of the soils proposed for the infill was not available. A conservative prediction for the time to reach 90% of primary consolidation under a soil surcharging program was made in the construction schedule.

This risk is inherent at the preliminary or conceptual phase of projects requiring a soil surcharge remediation program. The time to settlement can be refined using a more widespread soil sampling program during detailed design.

16.3 Placement of Embankment Soils in Tidal Zone

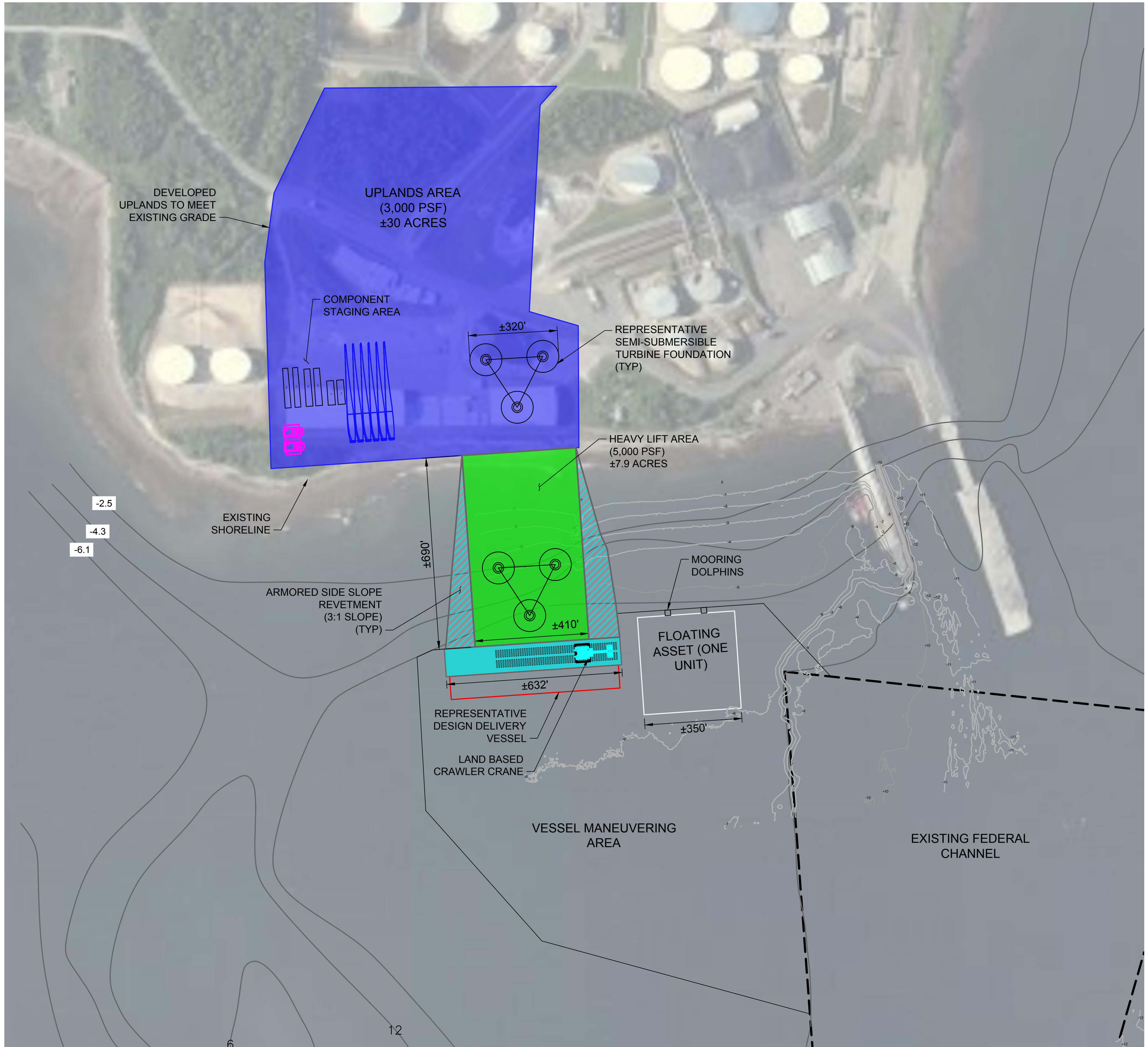
The embankments must be placed first so as to retain the remaining fill to be placed in the infill area. The placement of these initial soils can be difficult in areas with large tidal ranges. As the tide moves in and out, it can carry newly placed sediment away from the intended area, requiring larger amounts of sediments than initially calculated to be placed. This can be mitigated using certain placement techniques and stepping the embankment up slowly from the mudline.

17. LIMITATIONS OF THIS REPORT

M&N is currently involved in the design of various ports to support the fixed foundation OSW industry. Within these design processes we have access to OSW developers and WTG component manufacturers. This has allowed us to develop a firm understanding of the requirements for different types of OSW ports. However, it should be noted that there are currently no purpose-designed and built ports to support the floating OSW industry anywhere in the world.

While there are many similarities between the fixed and floating OSW requirements for port infrastructure, the lack of existing facilities has introduced some assumptions into this study. We feel these assumptions are valid; however, they may require adjustments as this industry continues to develop.

Appendix A – Conceptual Drawings



LAYOUT NOTES

1. LAYOUT SHOWN IS FOR PHASE 1 OF TERMINAL BUILD OUT. THIS LEVEL OF BUILD OUT IS MEANT TO SUPPORT A DEMONSTRATION PROJECT OR PROJECTS.
2. PHASE 1 REPRESENTS THE MINIMUM QUAY LENGTH AND INFILL/UPLAND LAYDOWN AREA REQUIRED TO FABRICATE AND LOADOUT FLOATING FOUNDATIONS AND INSTALLATION OF WTG COMPONENTS ONTO THE FOUNDATION.
3. PHASE 1 BUILD OUT REQUIRES SHARING OF BERTH LENGTH FOR ALL ACTIVITIES:
   - 3.1. DELIVERY OF WTG COMPONENTS
   - 3.2. LOAD OUT OF FABRICATED FOUNDATION ONTO FLOATING ASSET
   - 3.3. INSTALLATION OF WTG COMPONENTS ONTO FLOATING FOUNDATION
4. ADDITIONAL BUILD OUT FOR COMMERCIAL SCALE INSTALLATIONS (PHASE 2) WILL LIKELY BE REQUIRED.
5. THIS LAYOUT SHOULD BE CONSIDERED PRELIMINARY AND IS BASED ON AVAILABLE INFORMATION.
6. WIND TURBINE COMPONENTS SHOWN ARE REPRESENTATIVE IN SIZE AND QUANTITY THAT WILL BE STAGED ON THE TERMINAL.
7. LENGTH OF QUAY ALLOWS FOR WTG COMPONENT DELIVERY BY EITHER BULK CARRIER VESSEL OR BARGE.
8. FABRICATION PROCESS AND LAYOUT IS NOT SHOWN. THIS WILL BE SPECIFIC TO TYPE AND MATERIAL OF FOUNDATION AND LOGISTICS PLAN OF THE TERMINAL USER.
9. FLOATING ASSET IS ASSUMED TO BE A SEMI-SUBMERSIBLE BARGE. SIZING IS TO ACCOMMODATE ASSUMED FOUNDATION SIZE.
10. FOUNDATION SIZE HAS BEEN SCALED FROM EXISTING SEMI-SUBMERSIBLE INSTALLATIONS TO ACCOMMODATE 12-MW TURBINE UNIT.

PHASE 1 TERMINAL OPERATIONS

- A. WTG COMPONENTS (TOWERS, TURBINES, AND BLADES) ARE DELIVERED TO THE TERMINAL VIA BARGE OR VESSEL AND STAGED ON THE UPLANDS.
- B. REQUIRED FOUNDATION MATERIAL IS DELIVERED TO THE SITE VIA DELIVERY VESSEL AND/OR UPLAND TRUCKS.
- C. FOUNDATIONS ARE FABRICATED IN SERIAL MANNER, MOVING FROM NORTH TO SOUTH. FOUNDATION MOVEMENT IS DONE VIA SELF PROPELLED MODULAR TRANSPORTER (SPMT) OR SKIDDING SYSTEM.
- D. COMPLETED FOUNDATION IS MOVED QUAYSIDE AND FLOATING ASSET IS BROUGHT TO BERTH (VIA TUG POWER) AND SECURED IN POSITION.
- E. FOUNDATION IS LOADED OUT ONTO FLOATING ASSET VIA SPMT OR SKID SYSTEM.
- F. FLOATING ASSET IS MOVED (VIA TUG) TO DEEP WATER TO THE SOUTH OF THE TERMINAL.
- G. FLOATING ASSET IS BALLASTED DOWN AND SUBMERGED UNTIL FOUNDATION BECOMES BUOYANT.
- H. FLOATING FOUNDATION IS ATTACHED TO TUGS AND TOWED BACK TO BERTH.
- I. WTG COMPONENTS ARE INSTALLED ONTO FOUNDATION VIA LAND BASED CRANE.
  - I.A. FOUNDATION SERIAL LINE IS INTERRUPTED TO ACCOMMODATE WTG COMPONENT MOVEMENT AND INSTALLATION
- J. COMPLETE FLOATING TURBINE ASSEMBLY IS CONNECTED TO OCEAN GOING TUGS AND TOWED TO INSTALLATION SITE.

DRAWING NOTES

1. TERMINAL GRADE AT THE BERTH IS +15.0'± NAVD88 IN ORDER TO BE ABOVE CURRENT FEMA 100 YEAR FLOOD ELEVATION.
2. ALL BOUNDARIES AND AREAS ARE APPROXIMATE.
3. BATHYMETRIC INFORMATION SHOWN IN METERS LAT.

LEGEND

- CELLULAR COFFERDAM
- HEAVY LIFT AREA
- SIDE SLOPE
- UPLANDS
- LIMIT OF FEDERAL CHANNEL

IMPACT QUANTITIES

	QTY	UNIT
DREDGE	613,740	CY
INFILL	368,655	CY
SLOPES AND INFILL IMPORT	66,972	CY
HEAVY LIFT AREA	7.9	AC
ARMOR STONE	22,929	TON

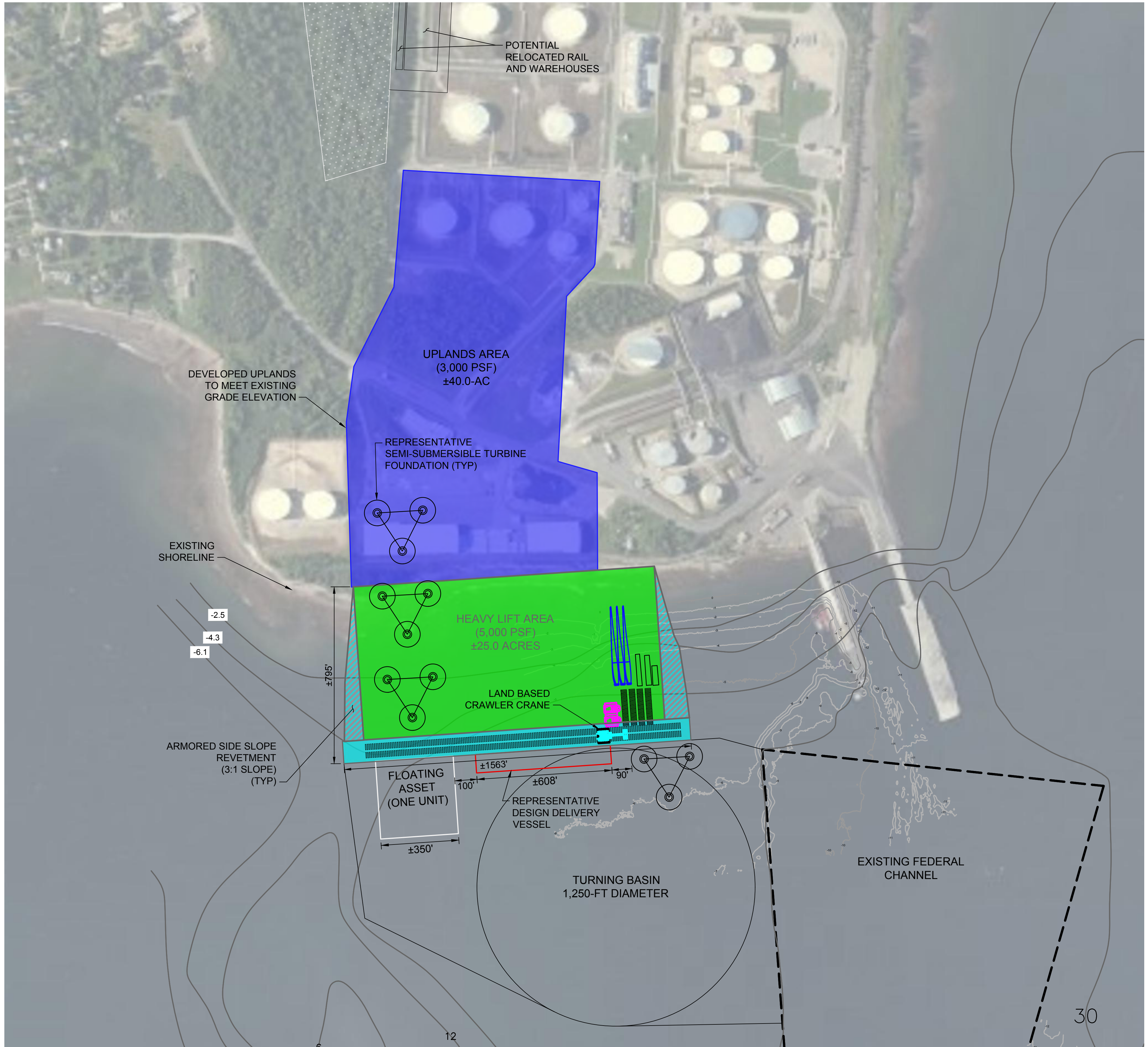
MaineDOT OFFSHORE WIND FEASIBILITY STUDY

moffatt & nichol | 11-17-2021 | MACK POINT - FLOATING OSW OPERATIONAL PLAN - PHASE 1

CONCEPTUAL DRAWING
NOT TO BE USED FOR CONSTRUCTION

200' 0' 200' 400'
SCALE: 1"=200'

ORIGINAL SHEET SIZE METRIC EQUIVALENT (ANSI D) 863.6mm x 558.8mm
DRAWING SCALES ARE BASED ON THIS SHEET SIZE



LAYOUT NOTES

1. LAYOUT SHOWN IS FOR PHASE 2 OF TERMINAL BUILD OUT. THIS LEVEL OF BUILD OUT IS MEANT TO SUPPORT A FULL SCALE COMMERCIAL PROJECT.
2. PHASE 2 ALLOWS FOR SIMULTANEOUS ACTIVITIES AT THE BERTH.
   - 2.1. SERIAL PRODUCTION LINE AND FOUNDATION LOAD OUT
   - 2.2. DELIVERY VESSEL BERTHING
   - 2.3. INSTALLATION OF WTG COMPONENTS ON FLOATING FOUNDATION AT BERTH
3. LENGTH OF BERTH AND SIZE OF INFILL AND UPLANDS AREA ARE MEANT TO SUPPORT ACTIVITIES MENTIONED ABOVE. THESE ELEMENTS CAN BE ADJUSTED BASED ON FINANCIAL CONSTRAINTS AND/OR OPERATIONAL NEEDS.
4. THIS LAYOUT SHOULD BE CONSIDERED PRELIMINARY AND IS BASED ON AVAILABLE INFORMATION.
5. WIND TURBINE COMPONENTS SHOWN ARE REPRESENTATIVE IN SIZE AND QUANTITY THAT WILL BE STAGED ON THE THE TERMINAL.
6. LENGTH OF QUAY ALLOWS FOR WTG COMPONENT DELIVERY BY EITHER BULK CARRIER VESSEL OR BARGE.
7. FABRICATION PROCESS AND LAYOUT IS NOT SHOWN. THIS WILL BE SPECIFIC TO TYPE AND MATERIAL OF FOUNDATION AND LOGISTICS PLAN OF THE TERMINAL USER.
8. FLOATING ASSET IS ASSUMED TO BE A SEMI-SUBMERSIBLE BARGE. SIZING IS TO ACCOMMODATE ASSUMED FOUNDATION SIZE.
9. FOUNDATION SIZE HAS BEEN SCALED FROM EXISTING SEMI-SUBMERSIBLE INSTALLATIONS TO ACCOMMODATE 12-MW TURBINE UNIT.

PHASE 2 TERMINAL OPERATIONS

A. WTG COMPONENTS (TOWERS, TURBINES, AND BLADES) ARE DELIVERED TO THE TERMINAL VIA BARGE OR VESSEL AND STAGED ON THE UPLANDS.
B. REQUIRED FOUNDATION MATERIAL IS DELIVERED TO THE SITE VIA DELIVERY VESSEL AND/OR UPLAND TRUCKS.
C. FOUNDATIONS ARE FABRICATED IN SERIAL MANNER, MOVING FROM NORTH TO SOUTH. FOUNDATION MOVEMENT IS DONE VIA SELF PROPELLED MODULAR TRANSPORTER (SPMT) OR SKIDDING SYSTEM.
D. COMPLETED FOUNDATION IS MOVED QUAYSIDE.
E. FOUNDATION IS LOADED OUT ONTO FLOATING ASSET VIA SPMT OR SKID SYSTEM.
F. FLOATING ASSET IS MOVED (VIA TUG) TO DEEP WATER TO THE SOUTHEAST OF THE TERMINAL.
G. FLOATING ASSET IS BALLASTED DOWN AND SUBMERGED UNTIL FOUNDATION BECOMES BUOYANT.
H. FLOATING FOUNDATION IS ATTACHED TO TUGS AND TOWED BACK TO BERTH.
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DRAWING NOTES

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2. ALL BOUNDARIES AND AREAS ARE APPROXIMATE.
3. BATHYMETRIC INFORMATION SHOWN IN METERS LAT.

LEGEND

- CELLULAR COFFERDAM
- HEAVY LIFT AREA
- SIDE SLOPE
- UPLANDS
- LIMIT OF FEDERAL CHANNEL

IMPACT QUANTITIES

	QTY	UNIT
DREDGE	848,139	CY
INFILL	1,029,396	CY
SLOPES AND INFILL IMPORT	181,257	CY
HEAVY LIFT AREA	25.0	AC
ARMOR STONE	22,019	TON

MaineDOT OFFSHORE WIND FEASIBILITY STUDY

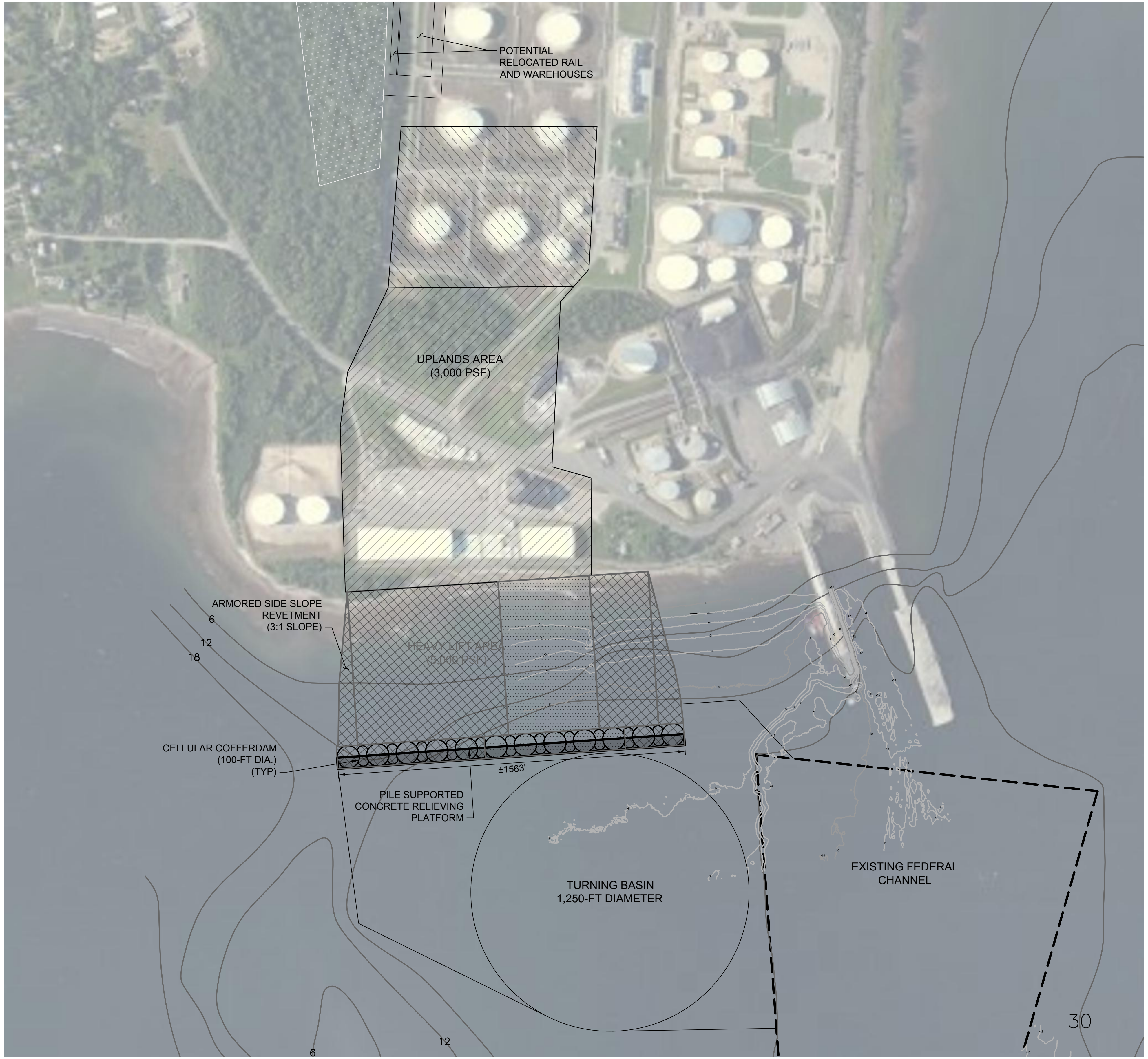
moffatt & nichol | 11-17-2021 | MACK POINT - FLOATING OSW OPERATIONAL PLAN - PHASE 2

CONCEPTUAL DRAWING
NOT TO BE USED FOR CONSTRUCTION

250' 0' 250' 500'

SCALE: 1"=250'

ORIGINAL SHEET SIZE METRIC EQUIVALENT (ANSI D) 863.6mm x 558.8mm
DRAWING SCALES ARE BASED ON THIS SHEET SIZE



CONSTRUCTION SEQUENCE NOTES

1. STEEL CELLULAR COFFERDAMS ARE INSTALLED AND FILLED VIA BARGE.
2. UPLANDS STRUCTURES ARE DEMOLISHED, LAND IS GRADED AND COMPACTED.
3. ACCESS CHANNEL IS DREDGED.
4. DREDGED MATERIAL IS DEWATERED AND AMENDED TO BE PREPARED FOR USE IN INFILL AREA.
5. BERMS AT EASTERN AND WESTERN EXTENTS OF CONSTRUCTION PHASE ARE PLACED FIRST IN ORDER TO RETAIN ADDITIONAL FILL.
6. AMENDED DREDGE MATERIAL IS PLACED IN INFILL AREA.
7. INFILL AREA IS COMPACTED IN LIFTS.
8. FINAL DENSE GRADED AGGREGATE TOPPING SURFACE IS PLACED.

DRAWING NOTES

1. FULL BUILDOUT WITH BOTH PHASE 1 AND 2 INSTALLED IS SHOWN. REFER TO PHASE PLANS FOR SPECIFIC PHASE DETAILS.
2. PROJECT DATUM IS NAVD88.
3. TERMINAL GRADE AT THE BERTH IS +15.0'± IN ORDER TO BE ABOVE CURRENT FEMA 100 YEAR FLOOD ELEVATION.
4. ALL BOUNDARIES AND AREAS ARE APPROXIMATE.

LEGEND

- PHASE 1 UPLANDS
- PHASE 2 UPLANDS
- PHASE 1 INFILL AREA
- PHASE 2 INFILL AREA
- CONCRETE RELIEVING PLATFORM

MaineDOT OFFSHORE WIND FEASIBILITY STUDY

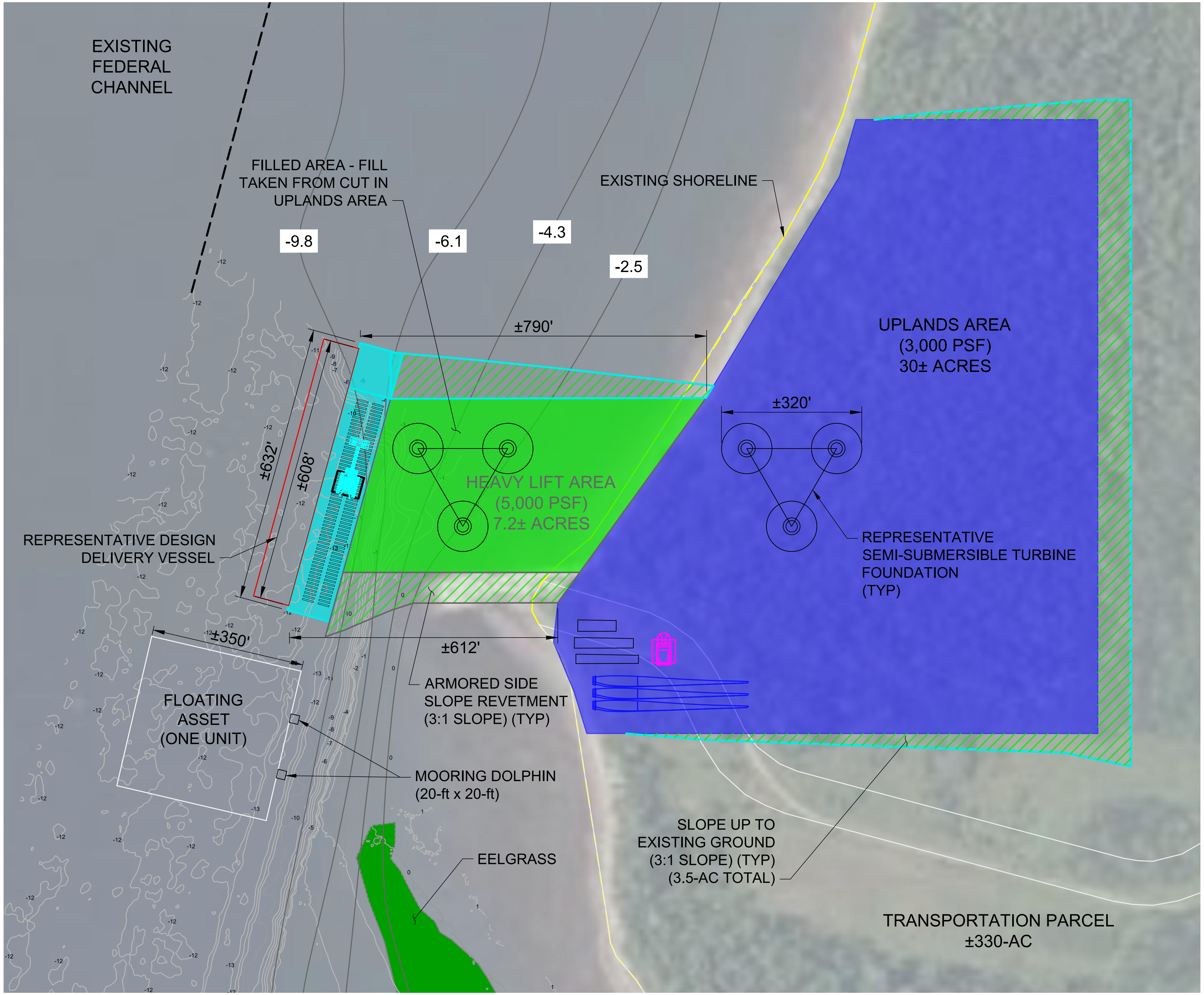
moffatt & nichol | 11-17-2021 | MACK POINT - FLOATING OSW STRUCTURAL PLAN

CONCEPTUAL DRAWING
NOT TO BE USED FOR CONSTRUCTION

250' 0' 250' 500'

SCALE: 1"=250'

ORIGINAL SHEET SIZE METRIC EQUIVALENT (ANSI D) 863.6mm x 558.8mm
DRAWING SCALES ARE BASED ON THIS SHEET SIZE



LAYOUT NOTES

1. LAYOUT SHOWN IS FOR PHASE 1 OF TERMINAL BUILD OUT. THIS LEVEL OF BUILD OUT IS MEANT TO SUPPORT A DEMONSTRATION PROJECT OR PROJECTS.
2. PHASE 1 REPRESENTS THE MINIMUM QUAY LENGTH AND INFILL/UPLAND LAYDOWN AREA REQUIRED TO FABRICATE AND LOADOUT FLOATING FOUNDATIONS AND INSTALLATION OF WTG COMPONENTS ONTO THE FOUNDATION.
3. PHASE 1 BUILD OUT REQUIRES SHARING OF BERTH LENGTH FOR ALL REQUIRED ACTIVITIES:
   - 3.1. DELIVERY OF WTG COMPONENTS
   - 3.2. LOAD OUT OF FABRICATED FOUNDATION ONTO FLOATING ASSET
   - 3.3. INSTALLATION OF WTG COMPONENTS ONTO FLOATING FOUNDATION
4. ADDITIONAL BUILD OUT FOR COMMERCIAL SCALE INSTALLATIONS (PHASE 2) WILL LIKELY BE REQUIRED.
5. THIS LAYOUT SHOULD BE CONSIDERED PRELIMINARY AND IS BASED ON AVAILABLE INFORMATION.
6. WIND TURBINE COMPONENTS SHOWN ARE REPRESENTATIVE IN SIZE AND QUANTITY THAT WILL BE STAGED ON THE TERMINAL.
7. LENGTH OF QUAY ALLOWS FOR WTG COMPONENT DELIVERY BY EITHER BULK CARRIER VESSEL OR BARGE.
8. FABRICATION PROCESS AND LAYOUT IS NOT SHOWN. THIS WILL BE SPECIFIC TO TYPE AND MATERIAL OF FOUNDATION AND LOGISTICS PLAN OF THE TERMINAL USER.
9. FLOATING ASSET IS ASSUMED TO BE A SEMI-SUBMERSIBLE BARGE. SIZING IS TO ACCOMMODATE ASSUMED FOUNDATION SIZE.
10. FOUNDATION SIZE HAS BEEN SCALED FROM EXISTING SEMI-SUBMERSIBLE INSTALLATIONS TO ACCOMMODATE 12-MW TURBINE UNIT.

PHASE 1 TERMINAL OPERATIONS

- A. WTG COMPONENTS (TOWERS, TURBINES, AND BLADES) ARE DELIVERED TO THE TERMINAL AND STAGED ON THE UPLANDS.
- B. REQUIRED FOUNDATION MATERIAL IS DELIVERED TO THE SITE VIA DELIVERY VESSEL AND/OR UPLAND TRUCKS.
- C. FOUNDATIONS ARE FABRICATED IN SERIAL MANNER, MOVING FROM EAST TO WEST. FOUNDATION MOVEMENT IS DONE VIA SELF PROPELLED MODULAR TRANSPORTER (SPMT) OR SKIDDING SYSTEM.
- D. COMPLETED FOUNDATION IS MOVED QUAYSIDE AND FLOATING ASSET IS BROUGHT TO BERTH (VIA TUG POWER) AND SECURED IN POSITION.
- E. FOUNDATION IS LOADED OUT ONTO FLOATING ASSET VIA SPMT OR SKID SYSTEM.
- F. FLOATING ASSET IS MOVED (VIA TUG) TO DEEP WATER TO SOUTH OF THE TERMINAL.
- G. FLOATING ASSET IS BALLASTED DOWN AND SUBMERGED UNTIL FOUNDATION BECOMES BUOYANT.
- H. FLOATING FOUNDATION IS ATTACHED TO TUGS AND TOWED BACK TO BERTH.
- I. WTG COMPONENTS ARE INSTALLED ONTO FOUNDATION VIA LAND BASED CRANE.
   - I.A. FOUNDATION SERIAL LINE IS INTERRUPTED TO ACCOMMODATE WTG COMPONENT MOVEMENT AND INSTALLATION
- J. COMPLETE FLOATING TURBINE ASSEMBLY IS CONNECTED TO OCEAN GOING TUGS AND TOWED TO INSTALLATION SITE.

DRAWING NOTES

1. TERMINAL GRADE IS +15.0'± NAVD88 IN ORDER TO BE ABOVE CURRENT FEMA 100 YEAR FLOOD ELEVATION.
2. ALL BOUNDARIES AND AREAS ARE APPROXIMATE.
3. BATHYMETRIC INFORMATION SHOWN IN METERS LAT.

LEGEND

- CELLULAR COFFERDAM
- HEAVY LIFT AREA
- SIDE SLOPE
- UPLANDS
- LIMIT OF FEDERAL CHANNEL

IMPACT QUANTITIES

	QTY	UNIT
DREDGE	-	CY
INFILL	314,554	CY
SLOPES AND INFILL IMPORT	56,185	CY
HEAVY LIFT AREA	7.2	AC
ARMOR STONE	25,884	TON

MaineDOT OFFSHORE WIND FEASIBILITY STUDY

moffatt & nichol | 11-17-2021 | SEARS ISLAND - FLOATING OSW OPERATIONAL PLAN - PHASE 1

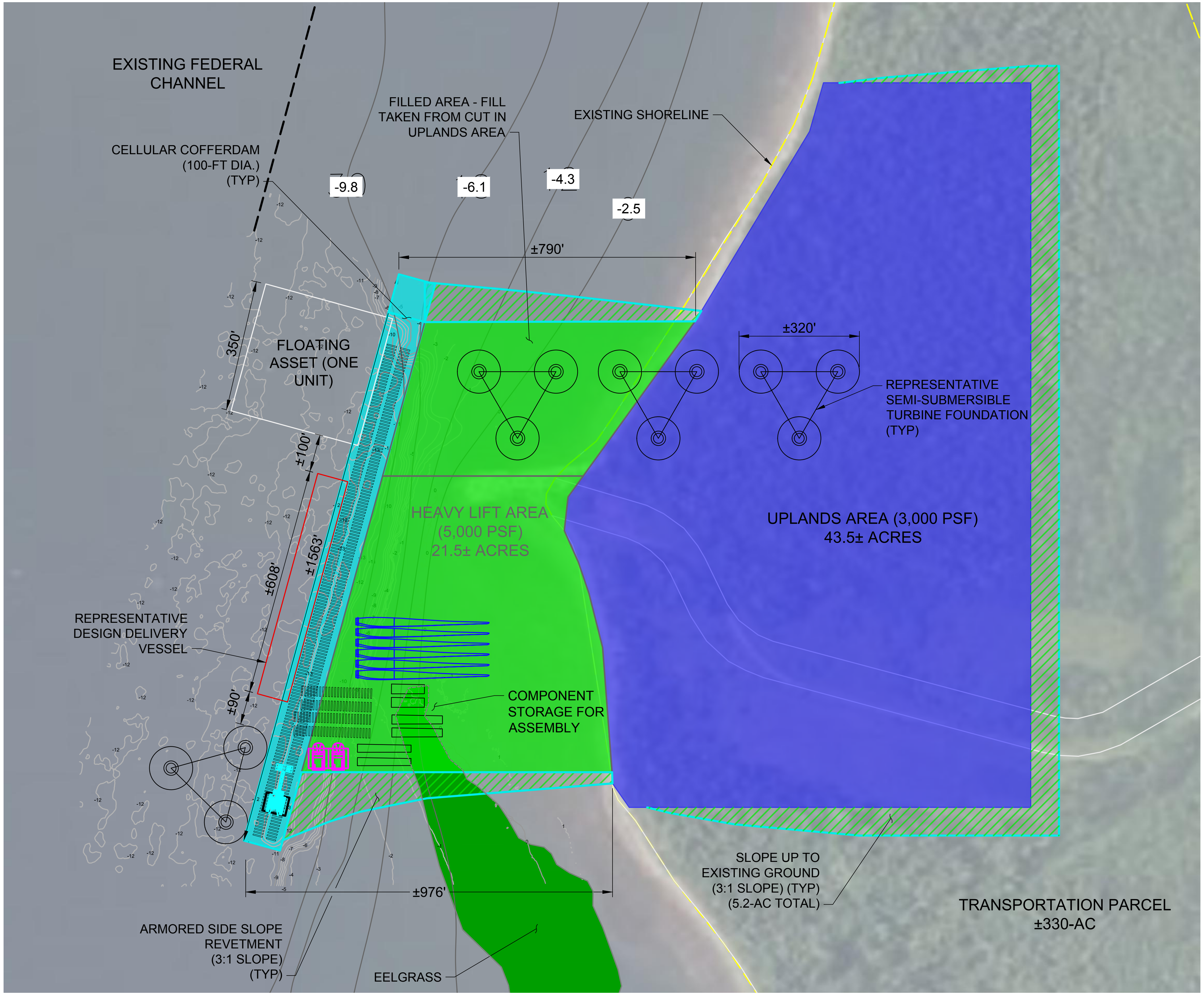
CONCEPTUAL DRAWING
NOT TO BE USED FOR CONSTRUCTION

N

120' 0' 120' 240'

SCALE: 1"=120'

ORIGINAL SHEET SIZE METRIC EQUIVALENT (ANSI D) 863.6mm x 558.8mm
DRAWING SCALES ARE BASED ON THIS SHEET SIZE



LAYOUT NOTES

1. LAYOUT SHOWN IS FOR PHASE 2 OF TERMINAL BUILD OUT. THIS LEVEL OF BUILD OUT IS MEANT TO SUPPORT A FULL SCALE COMMERCIAL PROJECT.
2. PHASE 2 ALLOWS FOR SIMULTANEOUS ACTIVITIES AT THE BERTH.
   - 2.1. SERIAL PRODUCTION LINE AND FOUNDATION LOAD OUT
   - 2.2. DELIVERY VESSEL BERTHING
   - 2.3. INSTALLATION OF WTG COMPONENTS ON FLOATING FOUNDATION AT BERTH
3. LENGTH OF BERTH AND SIZE OF INFILL AND UPLANDS AREA ARE MEANT TO SUPPORT ACTIVITIES MENTIONED ABOVE. THESE ELEMENTS CAN BE ADJUSTED BASED ON FINANCIAL CONSTRAINTS AND/OR OPERATIONAL NEEDS.
4. THIS LAYOUT SHOULD BE CONSIDERED PRELIMINARY AND IS BASED ON AVAILABLE INFORMATION.
5. WIND TURBINE COMPONENTS SHOWN ARE REPRESENTATIVE IN SIZE AND QUANTITY THAT WILL BE STAGED ON THE TERMINAL.
6. LENGTH OF QUAY ALLOWS FOR WTG COMPONENT DELIVERY BY EITHER BULK CARRIER VESSEL OR BARGE.
7. FABRICATION PROCESS AND LAYOUT IS NOT SHOWN. THIS WILL BE SPECIFIC TO TYPE AND MATERIAL OF FOUNDATION AND LOGISTICS PLAN OF THE TERMINAL USER.
8. FLOATING ASSET IS ASSUMED TO BE A SEMI-SUBMERSIBLE BARGE. SIZING IS TO ACCOMMODATE ASSUMED FOUNDATION SIZE.
9. FOUNDATION SIZE HAS BEEN SCALED FROM EXISTING SEMI-SUBMERSIBLE INSTALLATIONS TO ACCOMMODATE 12-MW TURBINE UNIT.

PHASE 2 TERMINAL OPERATIONS

A. WTG COMPONENTS (TOWERS, TURBINES, AND BLADES) ARE DELIVERED TO THE TERMINAL AND STAGED ON THE UPLANDS.
B. REQUIRED FOUNDATION MATERIAL IS DELIVERED TO THE SITE VIA DELIVERY VESSEL AND/OR UPLAND TRUCKS.
C. FOUNDATIONS ARE FABRICATED IN SERIAL MANNER, MOVING FROM EAST TO WEST. FOUNDATION MOVEMENT IS DONE VIA SELF PROPELLED MODULAR TRANSPORTER (SPMT) OR SKIDDING SYSTEM.
D. COMPLETED FOUNDATION IS MOVED QUAYSIDE.
E. FOUNDATION IS LOADED OUT ONTO FLOATING ASSET VIA SPMT OR SKID SYSTEM.
F. FLOATING ASSET IS MOVED (VIA TUG) TO DEEP WATER TO SOUTH OF TERMINAL.
G. FLOATING ASSET IS BALLASTED DOWN AND SUBMERGED UNTIL FOUNDATION BECOMES BUOYANT.
H. FLOATING FOUNDATION IS ATTACHED TO TUGS AND TOWED BACK TO BERTH.
I. WTG COMPONENTS ARE INSTALLED ONTO FOUNDATION VIA LAND BASED CRANE.
J. COMPLETE FLOATING TURBINE ASSEMBLY IS CONNECTED TO OCEAN GOING TUGS AND TOWED TO INSTALLATION SITE.

DRAWING NOTES

1. TERMINAL GRADE IS +15.0'± NAVD88 IN ORDER TO BE ABOVE CURRENT FEMA 100 YEAR FLOOD ELEVATION.
2. ALL BOUNDARIES AND AREAS ARE APPROXIMATE.
3. BATHYMETRIC INFORMATION SHOWN IN METERS LAT.
4. PHASE 2 BUILD OUT AFFECTS APPROXIMATELY 0.7 ACRES OF EXISTING EELGRASS BED.

LEGEND

- CELLULAR COFFERDAM
- HEAVY LIFT AREA
- SIDE SLOPE
- UPLANDS
- LIMIT OF FEDERAL CHANNEL

IMPACT QUANTITIES

	QTY	UNIT
DREDGE	-	CY
INFILL	817,797	CY
SLOPES AND INFILL IMPORT	64,731	CY
HEAVY LIFT AREA	21.5	AC
ARMOR STONE	33,938	TON

MaineDOT OFFSHORE WIND FEASIBILITY STUDY

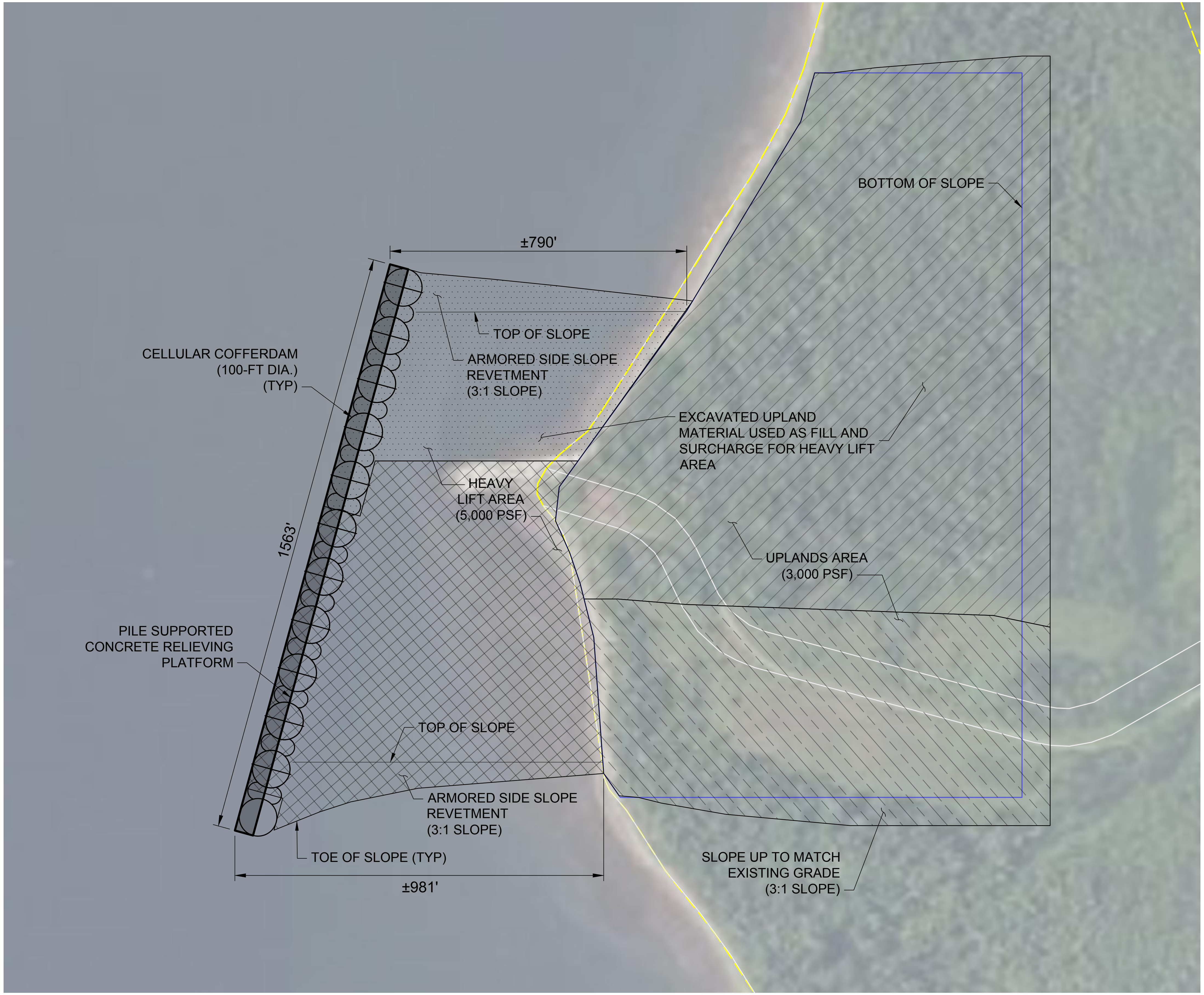
moffatt & nichol | 11-17-2021 | SEARS ISLAND - FLOATING OSW OPERATIONAL PLAN - PHASE 2

CONCEPTUAL DRAWING
NOT TO BE USED FOR CONSTRUCTION

140' 0' 140' 280'
SCALE: 1"=140'

ORIGINAL SHEET SIZE METRIC EQUIVALENT (ANSI D) 863.6mm x 558.8mm
DRAWING SCALES ARE BASED ON THIS SHEET SIZE

N



CONSTRUCTION SEQUENCE NOTES

1. STEEL CELLULAR COFFERDAMS ARE INSTALLED AND FILLED VIA BARGE.
2. UPLANDS AREA IS CLEARED.
3. UPLANDS CUT IS EXCAVATED AND PLACED IN INFILL AREA. BERMS AT NORTHERN AND SOUTHERN EXTENT OF CONSTRUCTION ARE PLACED FIRST IN ORDER TO RETAIN ADDITIONAL FILL.
4. EXCAVATED CUT MATERIAL IS PLACED IN REMAINING INFILL AREA AND SIDE SLOPES ARE ARMORED.
5. WICK DRAINS ARE INSTALLED AND SOIL SURCHARGE IS PLACED ON TOP OF INFILL AREA.
6. UPLANDS AREA IS GRADED AND PREPARED.
7. SOIL SURCHARGE IS REMOVED.
8. FINAL DENSE GRADED AGGREGATE TOPPING SURFACE IS PLACED.

DRAWING NOTES

1. FULL BUILDOUT WITH BOTH PHASE 1 AND 2 INSTALLED IS SHOWN. SEE PHASING PLANS FOR SPECIFIC PHASE DETAILS.
2. PROJECT DATUM IS NAVD88.
3. TERMINAL GRADE IS +15.0'± IN ORDER TO BE ABOVE CURRENT FEMA 100 YEAR FLOOD ELEVATION.
4. ALL BOUNDARIES AND AREAS ARE APPROXIMATE.

LEGEND

- PHASE 1 UPLANDS
- PHASE 2 UPLANDS
- PHASE 1 INFILL AREA
- PHASE 2 INFILL AREA
- CONCRETE RELIEVING PLATFORM

MaineDOT OFFSHORE WIND FEASIBILITY STUDY

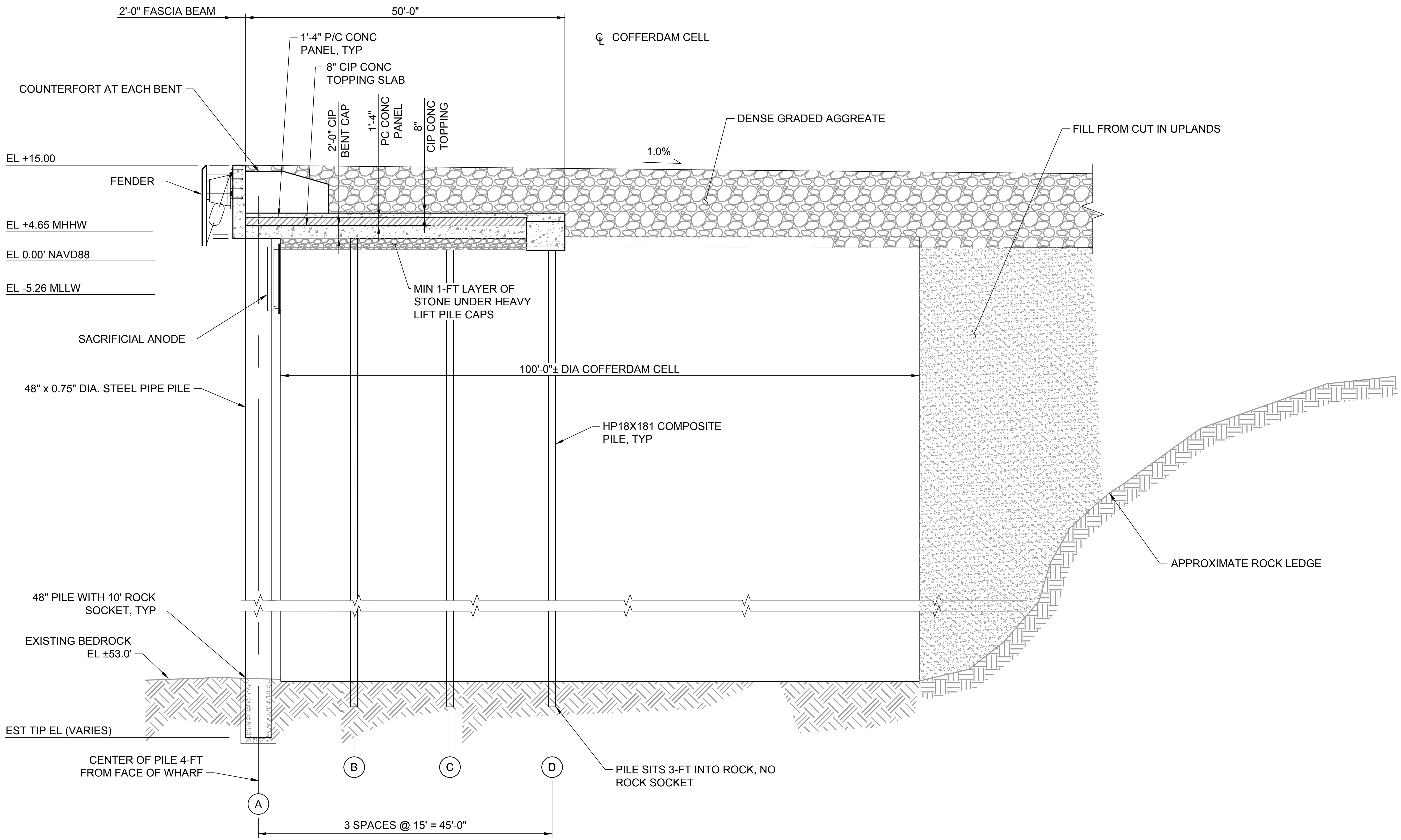
moffatt & nichol | 11-17-2021 | SEARS ISLAND - FLOATING OSW STRUCTURAL PLAN

CONCEPTUAL DRAWING
NOT TO BE USED FOR CONSTRUCTION

140' 0' 140' 280'
SCALE: 1"=140'

ORIGINAL SHEET SIZE METRIC EQUIVALENT (ANSI D) 863.6mm x 558.8mm
DRAWING SCALES ARE BASED ON THIS SHEET SIZE

N



A1
S-301
SECTION - TYPICAL COFFERDAM CELL
SCALE: 1"=10'

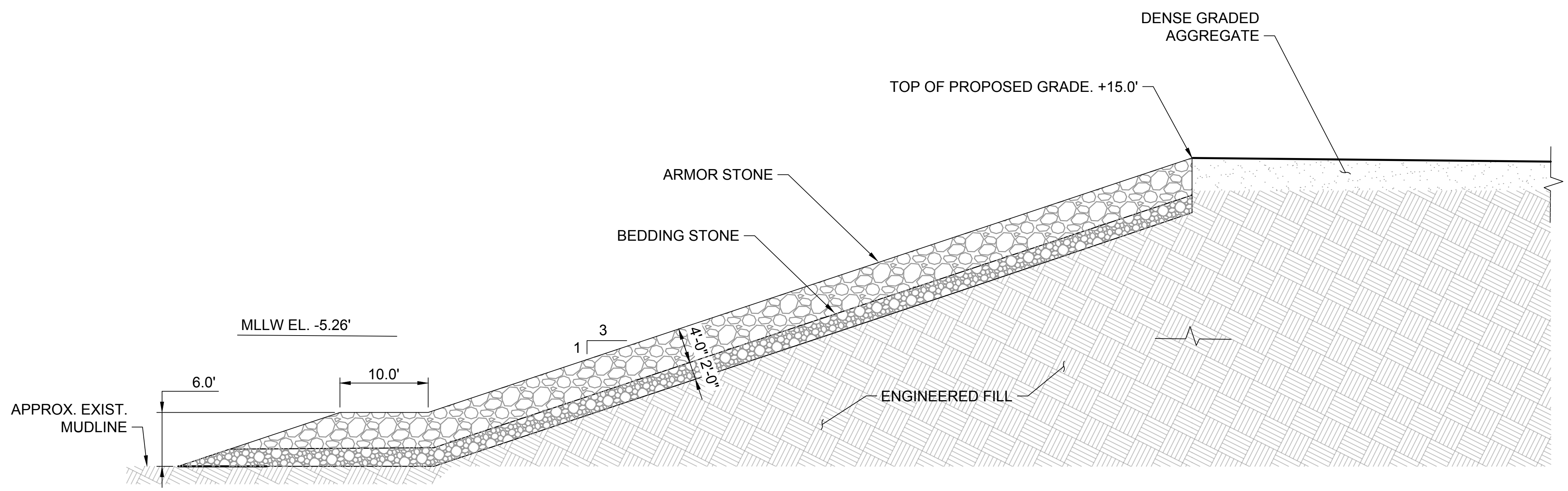
MaineDOT OFFSHORE WIND FEASIBILITY STUDY

moffatt & nichol | 11-17-2021 | COFFERDAM CELL CROSS-SECTION

NOTES
1. ELEVATIONS ARE IN NAVD88.
2. COFFERDAM SECTION IS SHOWN FOR SEARS ISLAND. MACK POINT HAS A SIMILAR SECTION.

CONCEPTUAL DRAWING
NOT TO BE USED FOR CONSTRUCTION

ORIGINAL SHEET SIZE METRIC EQUIVALENT (ANSI D) 863.6mm x 558.8mm
DRAWING SCALES ARE BASED ON THIS SHEET SIZE



A1
S-301

SIDE SLOPE REVETMENT DETAIL

SCALE: 1-1/2"=1'-0"

NOTES

1. ALL ELEVATIONS ARE IN NAVD88

CONCEPTUAL DRAWING
NOT TO BE USED FOR CONSTRUCTION

0'

SCALE: AS NOTED

ORIGINAL SHEET SIZE METRIC EQUIVALENT (ANSI D) 863.6mm x 558.8mm
DRAWING SCALES ARE BASED ON THIS SHEET SIZE

N

Appendix B – Cost Estimates and Schedules

MaineDOT

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Date : 17-Nov-2021

Estimated Development Cost Summary Table

Construction Costs and TPC

	Site Layout	Total Construction Cost Subtotal*	Total Project Cost (with contingency)**
Mack Point	**Phase 1**	**$127,664,000**	**$165,963,000**
	Phase 2	**$218,957,000**	**$284,644,000**
Sears Island	**Phase 1**	**$76,576,000**	**$99,548,000**
	Phase 2	**$141,820,000**	**$184,365,000**

* Estimated Construction Cost includes all material, labor and equipment to complete the work and indirect costs including Contractor Supervision, Corporate Overhead and Profit, and Bonds and Insurance costs.

** MN TPC includes the construction cost subtotal with a project contingency of 30%.

Mack Point
Phase 1

Date : 17-Nov-2021

Item	Description	Quantity	Unit	Unit Price	Subtotal	TOTAL
1	**Contractor Mobilization/Demobilization**					**$2,782,000**
1.1	Mobilization	1	ls	$2,782,000	$2,782,000	
2	**Earth Retention Structures**					**$21,188,066**
2.1	Installation of Steel Cellular Cofferdams (Includes fill and relieving platform)	632	lf	$27,861	$17,608,317	
2.2	Placement of Embankment Armor Stone	22,929	ton	$150	$3,439,308	
2.3	Placement of Embankment Underlayer Stone	1,404	ton	$100	$140,440	
3	**Earth Fill, Dredge and Soil Improvments**					**$47,776,417**
3.1	Dredge (with Amendment)	613,740	cy	$70	$42,961,800	
3.2	Placement of Soils in Infill Area	368,655	cy	$3.25	$1,198,129	
3.3	Imported Soil for Embankments	66,972	cy	$54.00	$3,616,488	
4	**Uplands**					**$19,014,957**
4.1	Site Demolition	1	LS	$250,000.00	$250,000	
4.2	Grading and Compaction of Uplands Soils	1,316,962	sf	$0.18	$237,053	
4.3	Installation of Dense Graded Aggregate Topping Surface	180,103	cy	$64.00	$11,526,606	
4.4	Site Stormwater system	30	ac	$100,000	$3,023,317	
4.5	Site Water system	30	ac	$20,000	$604,663	
4.6	Site Electrical system	30	ac	$100,000	$3,023,317	
4.7	Rerouting of southern rail spur	3,500	lf	$100	$350,000	
5	**Mooring Dolphins**					**$1,750,000**
5.1	20'x20' Dolphins for Floating Asset	2	ea	$875,000	$1,750,000	
6	**Remediation**					**$3,000,000**
6.1	Remediation/In Ground Debris	1	ls	$3,000,000	$3,000,000	
	Subtotal Costs					**$95,511,439**
7	**Construction Indirects**					**$32,152,000**
7.1	Supervision (General Conditions)	12	%		$11,462,000	
7.2	Bonds & Insurance	2	%		$2,140,000	
7.3	Corporate Overhead & Profit	17	%		$18,550,000	
	Total Construction Costs					**$127,663,439**
8	**Contingency**					**$38,299,032**
		30	%		38,299,032	
	Total Project Cost					**$165,962,471**

Mack Point Date : 17-Nov-2021
Phase 1

Notes:
1) Pricing is based on US dollars.
2) Volumes for site preparation are based on M&N understanding of site conditions, no survey information is available at this time.
3) Price is based on aerial diagrams of site.
4) Pricing assumes all resources are readily available locally.
5) Price is based on unencumbered contractor access to the site.
6) Price does not include any costs for construction site property lease or acquisition expenses.
7) No extreme weather risk included (force majeure).
8) Minimal geotechnical information is available at this time.
9) Cost escalation is not included.
10) Price does not include environmental restrictions.
11) Price does not include any associated costs due to hazardous waste.
12) Price does not include any associated costs due to rock dredging.
13) Price does not include any associated costs due to pile driving/drilling into rock.
14) Price does not include any costs for post construction site remediation or reconstruction
15) Costs for owner's project management or overhead expenses are not included.

When reviewing the above estimated costs it is important to note the following:

- The costs have been developed based on historical and current data using in-house sources.
- A 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 estimates 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.
- This construction cost estimate is an 'Opinion of Probable Cost' made by a consultant. In providing opinions of construction cost, it is recognized that neither the client nor the consultant has control over the cost of labor, equipment, materials, or the contractor's means and methods of determining constructability, pricing or schedule. This opinion of construction cost is based on the consultant's reasonable professional judgement and experience and does not constitute a warranty, expressed or implied, that contractor's bids or negotiated prices for the work will not vary from the client's.

MaineDOT

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Mack Point
Phase 2

Date : 17-Nov-2021

Item	Description	Quantity	Unit	Unit Price	Subtotal	TOTAL
1	**Contractor Mobilization/Demobilization**					**$4,772,000**
1.1	Mobilization	1	ls	$4,772,000	$4,772,000	
2	**Earth Retention Structures**					**$49,449,999**
2.1	Installation of Steel Cellular Cofferdams (Includes fill and relieving platform)	1,563	lf	$29,437	$46,010,649	
2.2	Placement of Embankment Armor Stone	22,019	ton	$150	$3,302,921	
2.3	Placement of Embankment Underlayer Stone	1,364	ton	$100	$136,429	
3	**Earth Fill, Dredge and Soil Improvments**					**$75,413,323**
3.1	Dredge (with Amendment)	848,139	cy	$70	$59,369,763	
3.2	Placement of Soils in Infill Area	848,139	cy	$3.25	$2,756,453	
3.3	Imported Soil for Infill	181,257	cy	$54.00	$9,787,853	
3.4	Imported Soil for Embankments	64,801	cy	$54.00	$3,499,254	
4	**Uplands**					**$29,178,332**
4.1	Site Demolition	1	LS	$350,000.00	$350,000	
4.2	Grading and Compaction of Uplands Soils	1,738,464	sf	$0.18	$312,924	
4.3	Installation of Dense Graded Aggregate Topping Surface	302,896	cy	$64.00	$19,385,323	
4.4	Site Stormwater system	40	ac	$100,000	$3,990,948	
4.5	Site Water system	40	ac	$20,000	$798,190	
4.6	Site Electrical system	40	ac	$100,000	$3,990,948	
4.7	Rerouting of southern rail spur	3,500	lf	$100	$350,000	
5	**Remediation**					**$5,000,000**
5.1	Remediation/In Ground Debris	1	ls	$5,000,000	$5,000,000	
	Subtotal Costs					**$163,813,654**
6	**Construction Indirects**					**$55,143,000**
6.1	Supervision (General Conditions)	12	%		$19,658,000	
6.2	Bonds & Insurance	2	%		$3,670,000	
6.3	Corporate Overhead & Profit	17	%		$31,815,000	
	Total Construction Costs					**$218,956,654**
7	**Contingency**					**$65,686,996**
		30	%		$ 65,686,996	
	Total Project Cost					**$284,643,650**

Mack Point

Phase 2

Date : 17-Nov-2021

Notes:

1) Pricing is based on US dollars.
2) Volumes for site preparation are based on M&N understanding of site conditions, no survey information is available at this time.
3) Price is based on aerial diagrams of site.
4) Pricing assumes all resources are readily available locally.
5) Price is based on unencumbered contractor access to the site.
6) Price does not include any costs for construction site property lease or acquisition expenses.
7) No extreme weather risk included (force majeure).
8) Minimal geotechnical information is available at this time.
9) Cost escalation is not included.
10) Price does not include environmental restrictions.
11) Price does not include any associated costs due to hazardous waste.
12) Price does not include any associated costs due to rock dredging.
13) Price does not include any associated costs due to pile driving/drilling into rock.
14) Price does not include any costs for post construction site remediation or reconstruction
15) Costs for owner's project management or overhead expenses are not included.

When reviewing the above estimated costs it is important to note the following:

- The costs have been developed based on historical and current data using in-house sources.
- A 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 estimates 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.
- This construction cost estimate is an 'Opinion of Probable Cost' made by a consultant. In providing opinions of construction cost, it is recognized that neither the client nor the consultant has control over the cost of labor, equipment, materials, or the contractor's means and methods of determining constructability, pricing or schedule. This opinion of construction cost is based on the consultant's reasonable professional judgement and experience and does not constitute a warranty, expressed or implied, that contractor's bids or negotiated prices for the work will not vary from the client's.

MaineDOT

Opinion of Probable Cost

moffatt & nichol

Sears Island
Phase 1

Date : 17-Nov-2021

Item	Description	Quantity	Unit	Unit Price	Subtotal	TOTAL
1	**Contractor Mobilization/Demobilization**					**$1,669,000**
1.1	Mobilization	1	ls	$1,669,000	$1,669,000	
2	**Earth Retention Structures**					**$21,718,182**
2.1	Installation of Steel Cellular Cofferdams (Includes fill and relieving platform)	632	lf	$27,974	$17,679,387	
2.2	Placement of Embankment Armor Stone	25,884	ton	$150	$3,882,605	
2.3	Placement of Embankment Underlayer Stone	1,562	ton	$100	$156,190	
3	**Earth Cut / Fill and Soil Improvments**					**$7,098,740**
3.1	Clear Site	30	ac	$10,000	$299,967	
3.2	Soil Cut from Uplands	754,999	cy	$5	$3,774,994	
3.3	Placement of Soils in Infill Area	314,554	cy	$3.25	$1,022,301	
3.4	Placement of Soil Surcharge	231,385	cy	$3.25	$752,001	
3.5	Removal of Soil Surcharge	208,246	cy	$6	$1,249,478	
4	**Uplands**					**$23,053,145**
4.1	Grading and Compaction of Uplands Soils	1,306,663	sf	$0.18	$235,199	
4.2	Installation of Dense Graded Aggregate Topping Surface	175,292	cy	$64	$11,218,666	
4.3	Site Stormwater system	30	ac	$100,000	$2,999,673	
4.4	Site Water system	30	ac	$20,000	$599,935	
4.5	Site Electrical system	30	ac	$100,000	$2,999,673	
4.6	Pulling Utilities from Providers onto Island	1	ls	$5,000,000	$5,000,000	
5	**Mooring Dolphins**					**$1,750,000**
5.1	20'x20' Dolphins for Floating Asset	2	ea	$875,000	$1,750,000	
6	**Remediation**					**$2,000,000**
6.1	Remediation/In Ground Debris	1	ls	$2,000,000	$2,000,000	
	Subtotal Costs					**$57,289,068**
7	**Construction Indirects**					**$19,286,000**
7.1	Supervision (General Conditions)	12	%		$6,875,000	
7.2	Bonds & Insurance	2	%		$1,284,000	
7.3	Corporate Overhead & Profit	17	%		$11,127,000	
	Total Construction Costs					**$76,575,068**
8	**Contingency**					**$22,972,520**
		30	%		$22,972,520	
	Total Project Cost					**$99,547,588**

Sears Island
Phase 1

Date : 17-Nov-2021

Notes:

1) Pricing is based on US dollars.
2) Volumes for site preparation are based on M&N understanding of site conditions, no survey information is available at this time.
3) Price is based on aerial diagrams of site.
4) Pricing assumes all resources are readily available locally.
5) Price is based on unencumbered contractor access to the site.
6) Price does not include any costs for construction site property lease or acquisition expenses.
7) No extreme weather risk included (force majeure).
8) Minimal geotechnical information is available at this time.
9) Cost escalation is not included.
10) Price does not include environmental restrictions.
11) Price does not include any associated costs due to hazardous waste.
12) Price does not include any associated costs due to rock dredging.
13) Price does not include any associated costs due to pile driving/drilling into rock.
14) Price does not include any costs for post construction site remediation or reconstruction
15) Costs for owner's project management or overhead expenses are not included.

When reviewing the above estimated costs it is important to note the following:

- The costs have been developed based on historical and current data using in-house sources.
- A 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 estimates 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.
- This construction cost estimate is an 'Opinion of Probable Cost' made by a consultant. In providing opinions of construction cost, it is recognized that neither the client nor the consultant has control over the cost of labor, equipment, materials, or the contractor's means and methods of determining constructability, pricing or schedule. This opinion of construction cost is based on the consultant's reasonable professional judgement and experience and does not constitute a warranty, expressed or implied, that contractor's bids or negotiated prices for the work will not vary from the client's.

MaineDOT

Opinion of Probable Cost

moffatt & nichol

Sears Island
Phase 2

Date : 17-Nov-2021

Item	Description	Quantity	Unit	Unit Price	Subtotal	TOTAL
1	**Contractor Mobilization/Demobilization**					**$3,091,000**
1.1	Mobilization	1	ls	$3,091,000	$3,091,000	
2	**Earth Retention Structures**					**$49,355,394**
2.1	Installation of Steel Cellular Cofferdams (Includes fill and relieving platform)	1,563	lf	$28,198	$44,072,922	
2.2	Placement of Embankment Armor Stone	33,938	ton	$150	$5,090,749	
2.3	Placement of Embankment Underlayer Stone	1,917	ton	$100	$191,724	
3	**Earth Cut / Fill and Soil Improvments**					**$15,492,725**
3.1	Clear Site	44	ac	$10,000	$436,829	
3.2	Soil Cut from Uplands	1,213,925	cy	$5	$6,069,624	
3.4	Placement of Soils in Infill Area	838,658	cy	$3.25	$2,725,639	
3.5	Placement of Soil Surcharge	723,773	cy	$3.25	$2,352,261	
3.6	Removal of Soil Surcharge	651,395	cy	$6	$3,908,372	
4	**Uplands**					**$34,413,066**
4.1	Grading and Compaction of Uplands Soils	1,902,834	sf	$0.18	$342,510	
4.2	Installation of Dense Graded Aggregate Topping Surface	304,068	cy	$64	$19,460,324	
4.3	Site Stormwater system	44	ac	$100,000	$4,368,287	
4.4	Site Water system	44	ac	$20,000	$873,657	
4.5	Site Electrical system	44	ac	$100,000	$4,368,287	
4.6	Pulling Utilities from Providers onto Island	1	ls	$5,000,000	$5,000,000	
5	**Remediation**					**$3,750,000**
5.1	Remediation/In Ground Debris	1	ls	$3,750,000	$3,750,000	
	Subtotal Costs					**$106,102,185**
6	**Construction Indirects**					**$35,717,000**
6.1	Supervision (General Conditions)	12	%		$12,733,000	
6.2	Bonds & Insurance	2	%		$2,377,000	
6.3	Corporate Overhead & Profit	17	%		$20,607,000	
	Total Construction Costs					**$141,819,185**
7	**Contingency**					**$42,545,756**
		30	%		42,545,756	
	Total Project Cost					**$184,364,941**

MaineDOT

moffatt & nichol

Sears Island

Phase 2

Date : 17-Nov-2021

Notes:
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3) Price is based on aerial diagrams of site.
4) Pricing assumes all resources are readily available locally.
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6) Price does not include any costs for construction site property lease or acquisition expenses.
7) No extreme weather risk included (force majeure).
8) Minimal geotechnical information is available at this time.
9) Cost escalation is not included.
10) Price does not include environmental restrictions.
11) Price does not include any associated costs due to hazardous waste.
12) Price does not include any associated costs due to rock dredging.
13) Price does not include any associated costs due to pile driving/drilling into rock.
14) Price does not include any costs for post construction site remediation or reconstruction
15) Costs for owner's project management or overhead expenses are not included.

When reviewing the above estimated costs it is important to note the following:

- The costs have been developed based on historical and current data using in-house sources.
- A 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 estimates 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.
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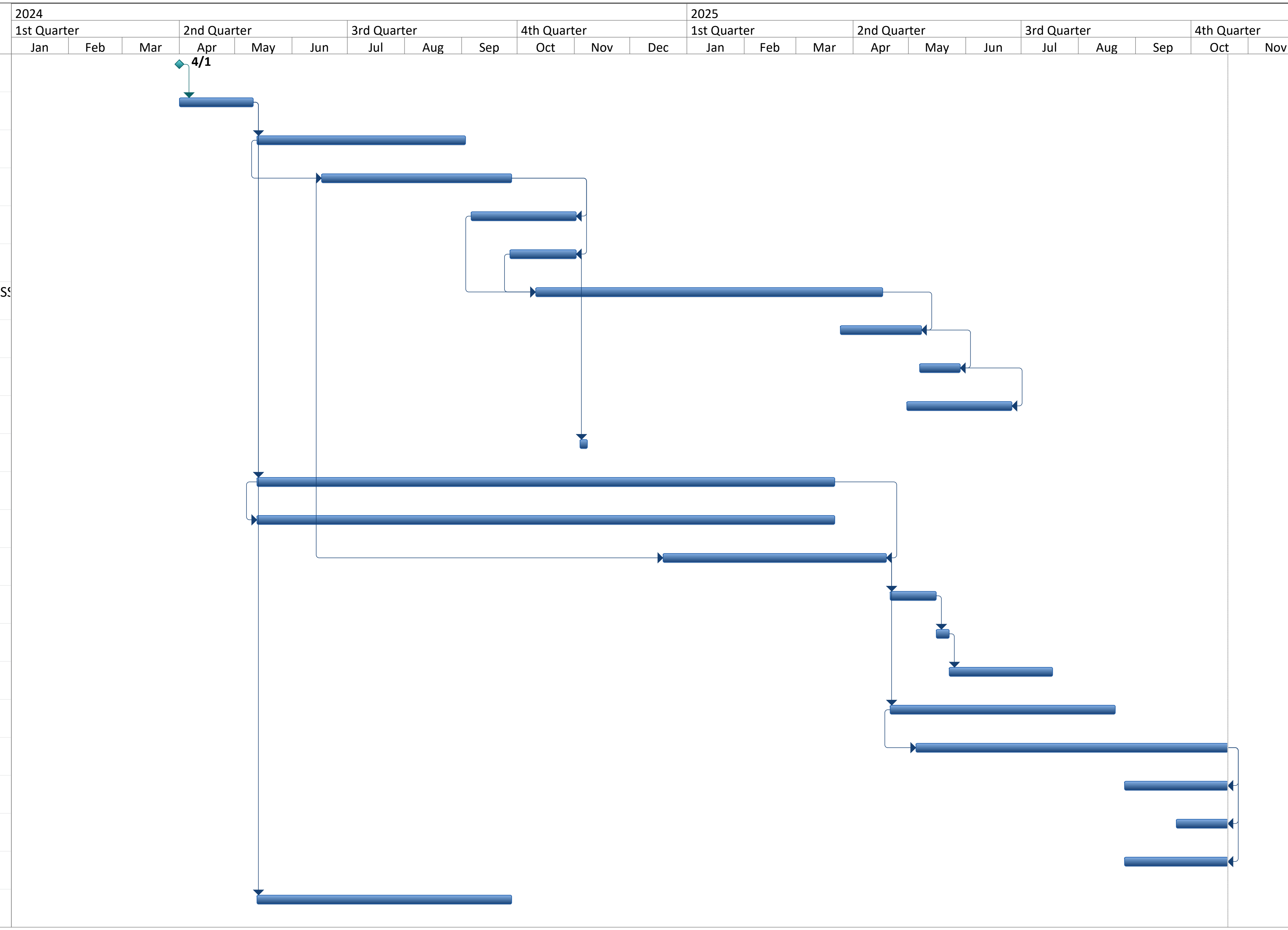
Construction Schedule: Mack Point Phase 1

ID		Task Mode	Task Name	Duration	Start	Finish	Predecessors
1			NTP	0 days	Mon 4/1/24	Mon 4/1/24	
2			Mobilization	30 days	Mon 4/1/24	Fri 5/10/24	1
3			Drive Coffer Sheets	81 days	Mon 5/13/24	Mon 9/2/24	2
4			Fill Coffer Sheets	75 days	Mon 6/17/24	Fri 9/27/24	3SS+25 days
5			Install Interior Piles	41 days	Fri 9/6/24	Fri 11/1/24	4FF+25 days
6			Install Exterior Piles	26 days	Fri 9/27/24	Fri 11/1/24	4FF+25 days
7			Concrete Cap (CIP)	134 days	Fri 10/11/24	Wed 4/16/25	5SS+20 days,6S
8			Concrete Panel (Precast)	32 days	Tue 3/25/25	Wed 5/7/25	7FF+15 days
9			Concrete Deck Slab (CIP)	16 days	Wed 5/7/25	Wed 5/28/25	8FF+15 days
10			Concrete Conterfort and Fascia	41 days	Wed 4/30/25	Wed 6/25/25	9FF+20 days
11			Dolphin Installation	4 days	Mon 11/4/24	Thu 11/7/24	6
12			Dredging	225 days	Mon 5/13/24	Fri 3/21/25	2
13			Amendment of Dredged Material	225 days	Mon 5/13/24	Fri 3/21/25	12SS
14			Placement of Soils in Infill Area	87 days	Thu 12/19/24	Fri 4/18/25	12FF+20 days,4SS+20
15			Placement of Imported Fill for Embankments	19 days	Mon 4/21/25	Thu 5/15/25	14
16			Placement of Underlayer Stone	5 days	Fri 5/16/25	Thu 5/22/25	15
17			Placement of Armor Stone	40 days	Fri 5/23/25	Thu 7/17/25	16
18			Grading and Compaction of Upland Soils	88 days	Mon 4/21/25	Wed 8/20/25	14
19			Installation of Dense Graded Aggregate	121 days	Mon 5/5/25	Mon 10/20/25	18SS+10 days
20			Site Stormwater System	40 days	Tue 8/26/25	Mon 10/20/25	19FF
21			Site Water System	20 days	Tue 9/23/25	Mon 10/20/25	19FF
22			Site Electrical System	40 days	Tue 8/26/25	Mon 10/20/25	19FF
23			Site Remediation	100 days	Mon 5/13/24	Fri 9/27/24	2

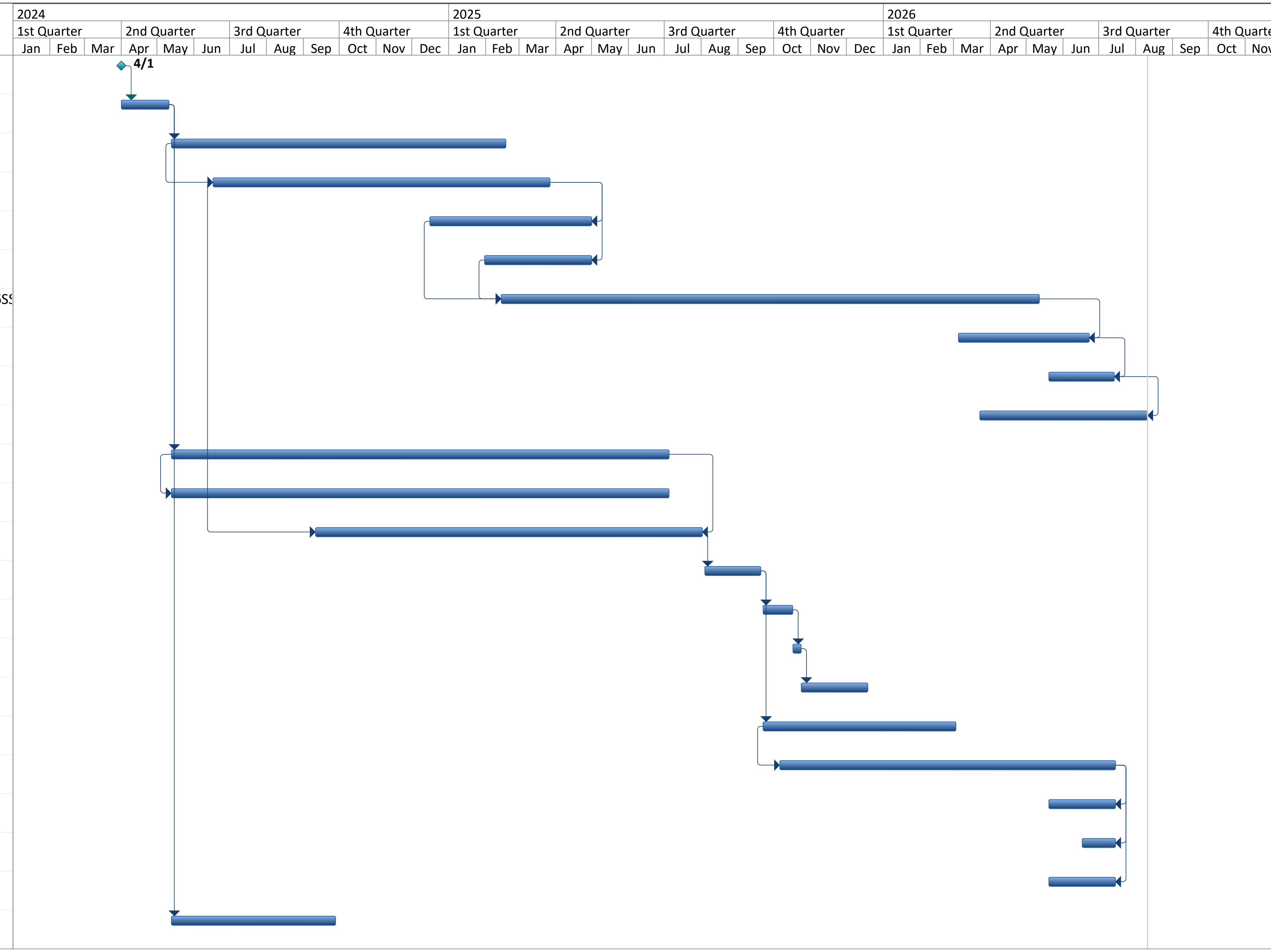


Mack Point Phase 1
11/17/21

Task	Summary	External Milestone	Inactive Summary	Manual Summary Rollup	Finish-only
Split	Project Summary	Inactive Task	Manual Task	Manual Summary	Deadline
Milestone	External Tasks	Inactive Milestone	Duration-only	Start-only	Progress

Construction Schedule: Mack Point Phase 2

ID	Task Mode	Task Name	Duration	Start	Finish	Predecessors
1		NTP	0 days	Mon 4/1/24	Mon 4/1/24	
2		Mobilization	30 days	Mon 4/1/24	Fri 5/10/24	1
3		Drive Coffer Sheets	201 days	Mon 5/13/24	Mon 2/17/25	2
4		Fill Coffer Sheets	203 days	Mon 6/17/24	Wed 3/26/25	3SS+25 days
5		Install Interior Piles	98 days	Mon 12/16/24	Wed 4/30/25	4FF+25 days
6		Install Exterior Piles	64 days	Fri 1/31/25	Wed 4/30/25	4FF+25 days
7		Concrete Cap (CIP)	322 days	Fri 2/14/25	Mon 5/11/26	5SS+20 days,6S
8		Concrete Panel (Precast)	78 days	Thu 3/5/26	Mon 6/22/26	7FF+30 days
9		Concrete Deck Slab (CIP)	39 days	Wed 5/20/26	Mon 7/13/26	8FF+15 days
10		Concrete Conterfort and Fascia	101 days	Mon 3/23/26	Mon 8/10/26	9FF+20 days
11		Dredging	300 days	Mon 5/13/24	Fri 7/4/25	2
12		Amendment of Dredged Material	300 days	Mon 5/13/24	Fri 7/4/25	11SS
13		Placement of Dredged Soils in Infill Area	233 days	Wed 9/11/24	Fri 8/1/25	11FF+20 days,4SS+20
14		Placement of Imported Fill for Infill	35 days	Mon 8/4/25	Fri 9/19/25	13
15		Placement of Imported Fill for Embankments	19 days	Mon 9/22/25	Thu 10/16/25	14
16		Underlayer Stone Placement	5 days	Fri 10/17/25	Thu 10/23/25	15
17		Armor Stone Placement	40 days	Fri 10/24/25	Thu 12/18/25	16
18		Grading and Compaction of Upland Soils	116 days	Mon 9/22/25	Mon 3/2/26	14
19		Installation of Dense Graded Aggregate	202 days	Mon 10/6/25	Tue 7/14/26	18SS+10 days
20		Site Stormwater System	40 days	Wed 5/20/26	Tue 7/14/26	19FF
21		Site Water System	20 days	Wed 6/17/26	Tue 7/14/26	19FF
22		Site Electrical System	40 days	Wed 5/20/26	Tue 7/14/26	19FF
23		Site Remediation	100 days	Mon 5/13/24	Fri 9/27/24	2

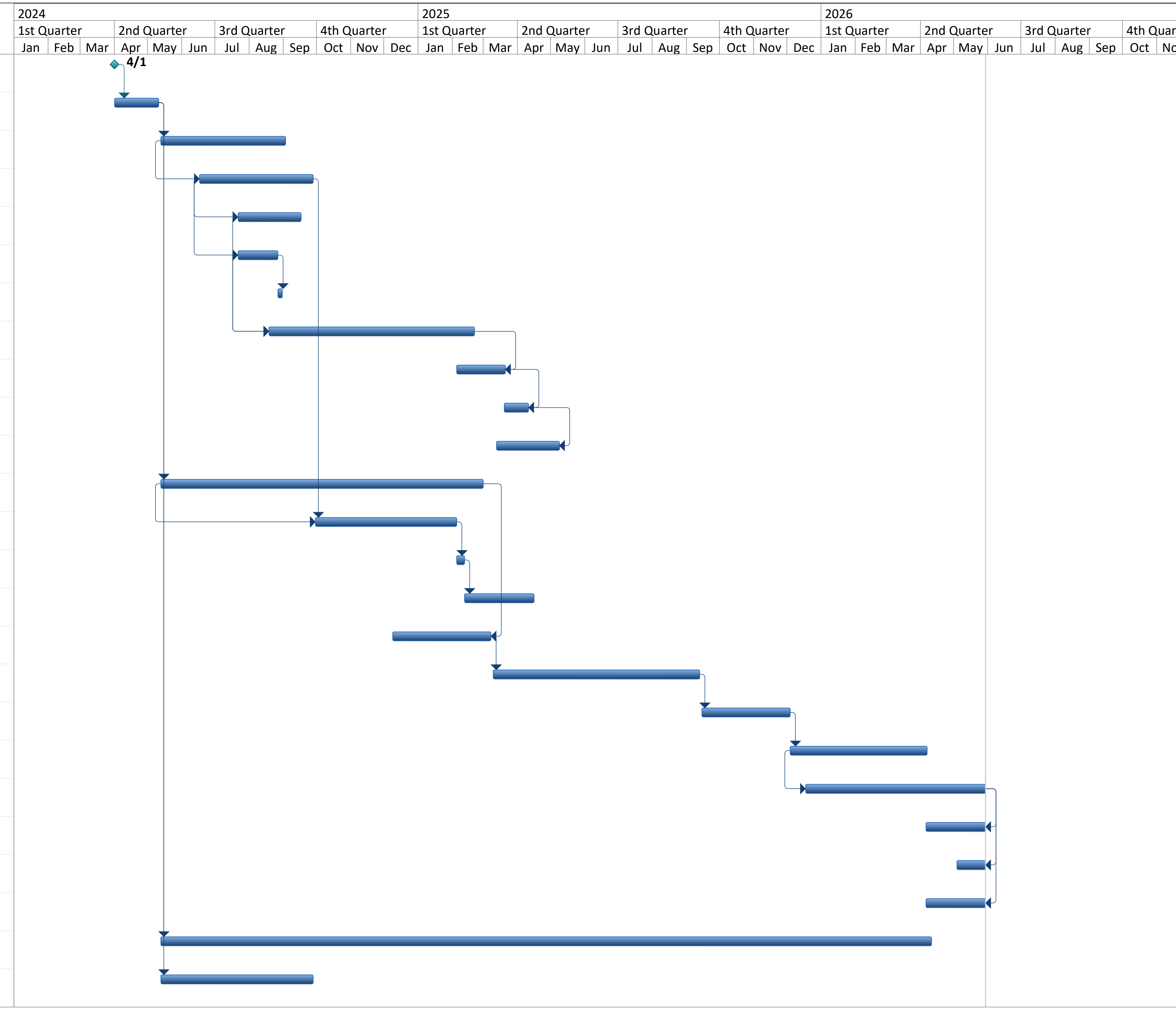


Mack Point Phase 2
11/17/21

Task	Summary	External Milestone	Inactive Summary	Manual Summary Rollup	Finish-only
Split	Project Summary	Inactive Task	Manual Task	Manual Summary	Deadline
Milestone	External Tasks	Inactive Milestone	Duration-only	Start-only	Progress

Construction Schedule: Sears Island Phase 1

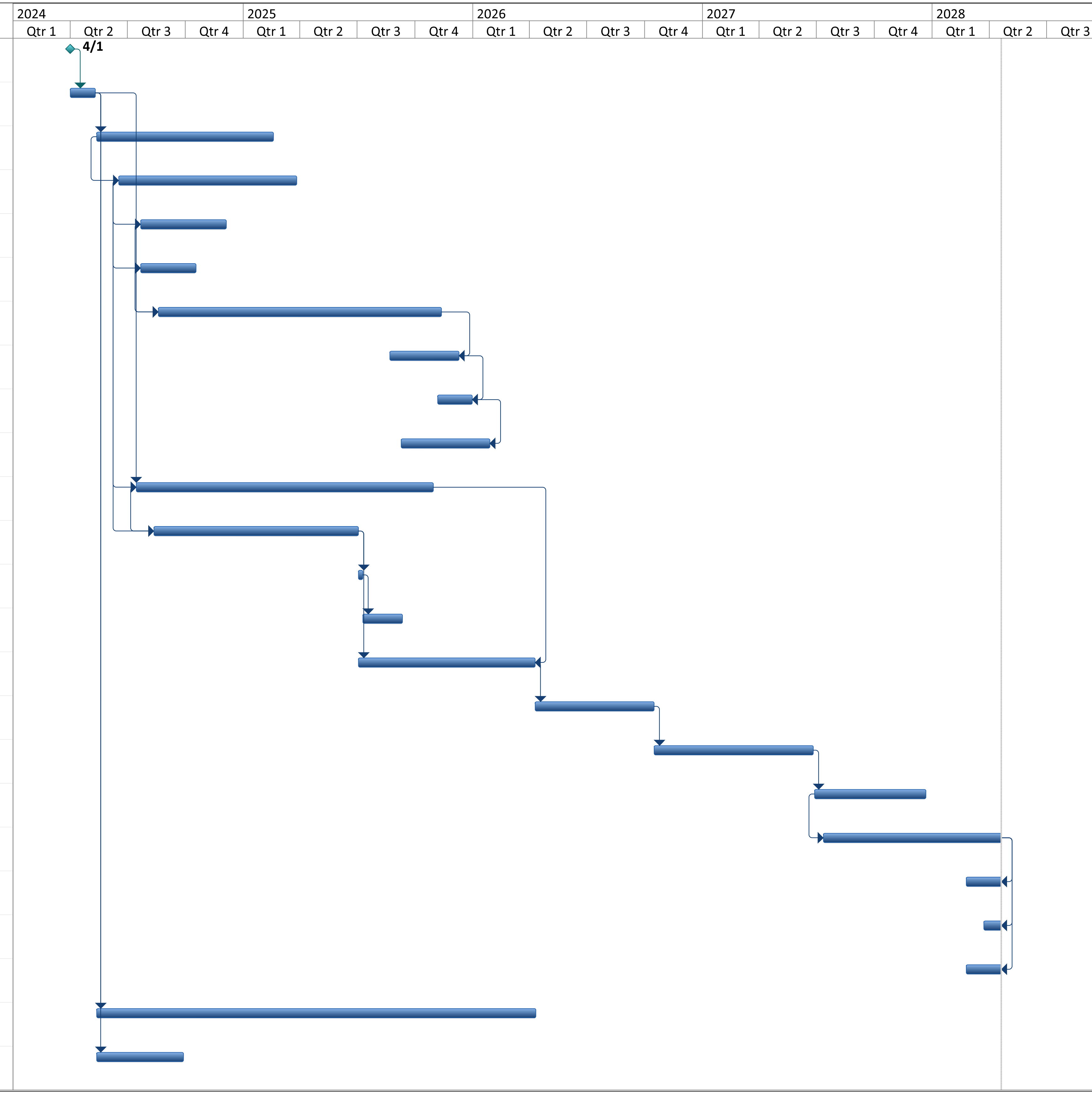
ID	Task Mode	Task Name	Duration	Start	Finish	Predecessors	Resource Names
1		NTP	0 days	Mon 4/1/24	Mon 4/1/24		
2		Mobilization	30 days	Mon 4/1/24	Fri 5/10/24	1	
3		Drive Coffer Sheets	81 days	Mon 5/13/24	Mon 9/2/24	2	
4		Fill Coffer Sheets	75 days	Mon 6/17/24	Fri 9/27/24	3SS+25 days	
5		Install Interior Piles	41 days	Mon 7/22/24	Mon 9/16/24	4SS+25 days	
6		Install Exterior Piles	26 days	Mon 7/22/24	Mon 8/26/24	4SS+25 days	
7		Dolphin Pile Installation	4 days	Tue 8/27/24	Fri 8/30/24	6	
8		Concrete Cap (CIP)	134 days	Mon 8/19/24	Thu 2/20/25	5SS+20 days,6S	
9		Concrete Panel (Precast)	32 days	Wed 2/5/25	Thu 3/20/25	8FF+20 days	
10		Concrete Deck Slab (CIP)	16 days	Thu 3/20/25	Thu 4/10/25	9FF+15 days	
11		Concrete Conterfort and Fascia	41 days	Thu 3/13/25	Thu 5/8/25	10FF+20 days	
12		Soil Cut from Uplands	210 days	Mon 5/13/24	Fri 2/28/25	2	
13		Placement of Soils in Infill Area	92 days	Mon 9/30/24	Tue 2/4/25	12SS+20 days,4	
14		Underlayer Stone Placement	5 days	Wed 2/5/25	Tue 2/11/25	13	
15		Armor Stone Placement	45 days	Wed 2/12/25	Tue 4/15/25	14	
16		Placement of Soil Surcharge	65 days	Mon 12/9/24	Fri 3/7/25	12FF+5 days	
17		Surcharge Duration	135 days	Mon 3/10/25	Fri 9/12/25	16	
18		Removal of Soil Surcharge	58 days	Mon 9/15/25	Wed 12/3/25	17	
19		Grading and Compaction of Upland Soils	88 days	Thu 12/4/25	Mon 4/6/26	18	
20		Installation of Dense Graded Aggregate	117 days	Thu 12/18/25	Fri 5/29/26	19SS+10 days	
21		Site Stormwater System	40 days	Mon 4/6/26	Fri 5/29/26	20FF	
22		Site Water System	20 days	Mon 5/4/26	Fri 5/29/26	20FF	
23		Site Electrical System	40 days	Mon 4/6/26	Fri 5/29/26	20FF	
24		Utilities onto Island	500 days	Mon 5/13/24	Fri 4/10/26	2	
25		Site Remediation	100 days	Mon 5/13/24	Fri 9/27/24	2	



Sears Island Phase 1 11/17/21	Task		Summary		External Milestone		Inactive Summary		Manual Summary Rollup		Finish-only
	Split		Project Summary		Inactive Task		Manual Task		Manual Summary		Deadline
	Milestone		External Tasks		Inactive Milestone		Duration-only		Start-only		Progress

Construction Schedule: Sears Island Phase 2

ID	Task Mode	Task Name	Duration	Start	Finish	Predecessors	Resource Names
1		NTP	0 days	Mon 4/1/24	Mon 4/1/24		
2		Mobilization	30 days	Mon 4/1/24	Fri 5/10/24	1	
3		Drive Coffer Sheets	201 days	Mon 5/13/24	Mon 2/17/25	2	
4		Fill Coffer Sheets	203 days	Mon 6/17/24	Wed 3/26/25	3SS+25 days	
5		Install Interior Piles	98 days	Mon 7/22/24	Wed 12/4/24	4SS+25 days	
6		Install Exterior Piles	64 days	Mon 7/22/24	Thu 10/17/24	4SS+25 days	
7		Concrete Cap (CIP)	322 days	Mon 8/19/24	Tue 11/11/25	5SS+20 days,6S	
8		Concrete Panel (Precast)	78 days	Fri 8/22/25	Tue 12/9/25	7FF+20 days	
9		Concrete Deck Slab (CIP)	39 days	Thu 11/6/25	Tue 12/30/25	8FF+15 days	
10		Concrete Conterfort and Fascia	101 days	Tue 9/9/25	Tue 1/27/26	9FF+20 days	
11		Soil Cut from Uplands	338 days	Mon 7/15/24	Wed 10/29/25	2,4SS+20 days	
12		Placement of Soils in Infill Area	233 days	Mon 8/12/24	Wed 7/2/25	11SS+20 days,4SS+20	
13		Underlayer Stone Placement	5 days	Thu 7/3/25	Wed 7/9/25	12	
14		Armor Stone Placement	45 days	Thu 7/10/25	Wed 9/10/25	13	
15		Placement of Soil Surcharge	201 days	Thu 7/3/25	Thu 4/9/26	11FF+5 days,12	
16		Surcharge Duration	135 days	Fri 4/10/26	Thu 10/15/26	15	
17		Removal of Soil Surcharge	181 days	Fri 10/16/26	Fri 6/25/27	16	
18		Grading and Compaction of Upland Soils	127 days	Mon 6/28/27	Tue 12/21/27	17	
19		Installation of Dense Graded Aggregate	203 days	Mon 7/12/27	Wed 4/19/28	18SS+10 days	
20		Site Stormwater System	40 days	Thu 2/24/28	Wed 4/19/28	19FF	
21		Site Water System	20 days	Thu 3/23/28	Wed 4/19/28	19FF	
22		Site Electrical System	40 days	Thu 2/24/28	Wed 4/19/28	19FF	
23		Utilities onto Island	500 days	Mon 5/13/24	Fri 4/10/26	2	
24		Site Remediation	100 days	Mon 5/13/24	Fri 9/27/24	2	



Sears Island Phase 2
11/17/21

Task	Summary	External Milestone	Inactive Summary	Manual Summary Rollup	Finish-only
Split	Project Summary	Inactive Task	Manual Task	Manual Summary	Deadline
Milestone	External Tasks	Inactive Milestone	Duration-only	Start-only	Progress