DOCKETED	
Docket Number:	17-MISC-01
Project Title:	California Offshore Renewable Energy
TN #:	248750
Document Title:	State Land Commission's 2023 Alternative Port Assessment to Support Offshore Wind Final Report
Description:	2023 Alternative Port Assessment to Support Offshore Wind Final Report
Filer:	susan fleming
Organization:	California Energy Commission
Submitter Role:	Commission Staff
Submission Date:	2/10/2023 4:16:53 PM
Docketed Date:	2/10/2023

FINAL REPORT

January 31, 2023

ALTERNATIVE PORT ASSESSMENT TO SUPPORT OFFSHORE WIND

FINAL ASSESSMENT REPORT

CALIFORNIA STATE LANDS COMMISSION

moffatt & nichol

Document Verification

Client	State Lands Commission
Project name	Alternative Port Assessment to Support Offshore Wind
Document title	Final Assessment Report
Status	Final
Date	January 31, 2023
Project number	221194/01

Revision	Description	Issued by	Date	Checked
00	Draft Assessment Report	J. Lim	12/15/2022	M. Trowbridge
01	Final Assessment Report	J. Lim	01/31/2023	M. Trowbridge

Authors:

Matt Trowbridge | MTrowbridge@moffattnichol.com

Jennifer Lim | JLim@moffattnichol.com

Ashley Knipe | AKnipe@moffattnichol.com

Produced by:

Moffatt & Nichol

1300 Clay Street, Suite 350

Oakland, CA 94612

+1 510 788 8959

www.moffattnichol.com

Acknowledgements

California State Lands Commission
Reid Boggiano
Nicole Dobroski
Max Liebergesell
Jennifer Mattox
Shahed Meshkati

California Energy Commission
Paul Deaver
Rhetta DeMesa

Aspen Environmental Group
Susan Lee
Negar Vahidi

Boudreau and Associates
Christine Boudreau

Foss Maritime Company, LLC
Paul Gallagher

JC Write
Jim Collins

Mott MacDonald
Aaron Porter

Xodus Group
Hillary Bright
Brooklyn Fox

Table of Contents

List of Figures

List of Tables

List of Acronyms and Abbreviations

Acronym	Meaning
AACE	Association of the Advancement of Cost Engineering
AB	Assembly Bill
ABS	American Bureau of Shipping
ACI	American Concrete Institute
AISC	American Institute for Steel Construction
API	American Petroleum Institute
ASCE	American Society of Civil Engineers
AWS	American Welding Society
BLM	Bureau of Land Management
BOEM	Bureau of Ocean Energy Management
Cal Poly	California Polytechnic State University
CBC	California State Building Code
CDFW	California Department of Fish and Wildlife
CEC	California Energy Commission
CTV	Crew Transfer Vessel
DNV	Det Norske Veritas
e.g.	Exempli gratia, "for example"
EJ	Environmental Justice
etc.	Et cetera, "and others especially of the same kind"
ft	Feet
GW	Gigawatt
i.e.	Id est, "that is"
IDIQ	Indefinite Delivery / Indefinite Quantity
LRFD	Load and Resistance Factor Design
m	Meter
MEG	Mooring Equipment Guidelines
MF	Manufacturing / Fabrication
MW	Megawatt
NCTC	Northern Chumash Tribal Council
NFPA	National Fire Protection Association

Acronym	Meaning
NMFS	National Marine Fisheries Service
No.	Number
NOAA	National Oceanic and Atmospheric Administration
NREL	National Renewable Energy Laboratory
O&M	Operation and Maintenance
OCIMF	Oil Companies International Marine Forum
OCS	Outer Continental Shelf
PCH	Pacific Coast Highway
PIANC	Permanent International Association of Navigation Congresses
psf	Pounds per square foot
RORO	Roll-on/Roll-off
RWQCB	Regional Water Quality Control Board
S&I	Staging and Integration
SB	Senate Bill
SATV	Service Accommodation Transfer Vessels
Schatz	Schatz Energy Research Center
SLC	State Lands Commission
SLO	San Luis Obispo
SOV	Service Operation Vessel
TO	Task Order
TOC	total organic carbon
UC	University of California
UFC	United Facilities Criteria
USACE	United States Army Corps of Engineers
USC	University of Southern California
USDOE	United States Department of Energy
USFWS	U.S. Fish and Wildlife Service
WEA	Wind Energy Area
WG	Working Group
WTG	Wind Turbine Generator

Executive Summary

Background

Senate Bill 100 (De León, Chapter 312, Statutes of 2018), the 100 Percent Clean Energy Act of 2018, establishes a requirement that every retail seller of electricity procure 60 percent of its retail electricity sales from eligible renewable energy resources by 2030 and 100 percent by 2045. In 2021, the California Energy Commission, California Public Utilities Commission, and California Air Resources Board issued a Senate Bill 100 Joint Agency Report showing that offshore wind could contribute at least 10 gigawatts of energy toward California's 2045 clean energy policy. Assembly Bill 525 (Chiu, Chapter 231, Statutes of 2021) was signed by the Governor in 2021 and requires the CEC, in coordination with the Coastal Commission, Ocean Protection Council, State Lands Commission, Office of Planning and Research, Department of Fish and Wildlife, Governor's Office of Business and Economic Development, Independent System Operator, and Public Utilities Commission (and other relevant federal, state, and local agencies as needed) to develop a strategic plan (Assembly Bill 525 Strategic Plan) for offshore wind development in federal waters due June 30, 2023 (Chiu 2021).

Regarding port infrastructure, the Assembly Bill 525 Strategic Plan shall identify available port space and the necessary investments to improve waterfront facilities for the floating offshore wind industry. In addition, the Assembly Bill 525 Strategic Plan shall include identification of sea space for wind energy areas to accommodate the offshore wind planning goals for 2030 and 2045 (Chiu 2021). On August 1, 2022, the California Energy Commission established a preliminary planning goal of 2 to 5 gigawatts of offshore wind by 2030 and 25 gigawatts by 2045 (Flint 2022). To date, the Bureau of Ocean Energy Management has identified two offshore wind energy areas off the state of California, the Humboldt Wind Energy Area and Morro Bay Wind Energy Area. On December 6, 2022, the Bureau of Ocean Energy Management held an offshore wind energy lease sale for five lease areas, two within the Humboldt Wind Energy Area and three within the Morro Bay Wind Energy Area. On December 7, 2022, the lease sale ended and five provisional winners were announced – RWE Offshore Wind Holding LLC, California North Floating LLC, Equinor Wind LLC, Central California Offshore Wind LLC, and Invenergy California Offshore LLC (Bureau of Ocean Energy Management 2022).

The California coast is characterized by rapidly increasing water depths that exceed the feasible limits of traditional fixed-bottom offshore wind turbines. Thus, floating offshore wind technology is more suitable for this region. To construct floating offshore wind turbines, the turbine components will need to be fabricated, assembled, and transported from an onshore port to the offshore wind area. Existing port infrastructure on the U.S. West Coast is not adequate to support these activities, and significant port investment is required to develop the following offshore wind sites:

- **Staging and Integration Site:** a site to receive, stage, and store offshore wind components and to assemble the floating turbine system for towing to the offshore wind area. This site is likely to support the following service:
  - **Turbine Maintenance Site:** a site to perform major maintenance on a fully assembled turbine system that cannot otherwise be performed in the offshore wind area, such as replacement of a nacelle or blade.
- **Operations and Maintenance Site:** a base of wind farm operations with warehouses/offices, spare part storage, and marine facility to support vessel provisioning and refueling/charging for the following operation and maintenance vessels during the operational period of the offshore wind farm.
  - **Crew Transfer Vessel:** transfers small crews to offshore wind turbine installations for day-trip operation and maintenance visits and inspections.
  - **Service Accommodation Transfer Vessel:** intermediate size between Service Operating Vessels and Crew Transfer Vessels, with ability to sleep onboard for multiday trips.
  - **Service Operating Vessel:** vessels that loiter and operate as in-field accommodations for workers and platform assistance for wind turbine servicing and repair work.
- **Manufacturing / Fabrication Site:** a port site located on a navigable waterway that receives raw materials via road, rail, or waterborne transport and creates larger components in the offshore wind supply chain. This site typically includes factory and/or warehouse buildings and space for storage of completed components.

Additional offshore wind port sites that are not included in this study but will be required for offshore wind industry use include:

- **Other Types of Offshore Wind Port Sites:**
  - **Installation Support Site:** a base of construction operations for the fleet of construction vessels necessary for construction and commissioning of the offshore wind farm.
  - **Mooring Line, Anchor, and Electrical Cable Laydown Site:** a site to receive and stage mooring lines, anchors, and electrical cables to support the installation of the offshore wind farm.
  - **Cable Landing Site:** locations for the electrical cables to transition from the offshore (e.g., subsea cables) to a grid connection location. These sites may include electrical infrastructure onshore.
  - **End of Life Decommissioning Site:** a site to decommission, disassemble, recycle, and dispose of turbine systems that are at end of life.

Study Scope

In November 2021, BOEM designated the Morro Bay Wind Energy Area offshore California. The lack of suitable port infrastructure is a critical, unaddressed barrier to launching a floating offshore wind industry that is California-based, especially for deployment off the central coast of California. Leveraging existing port capabilities will help; however, capacity gaps may exist. Therefore, it is important for the state to study whether an alternative port location within Central California is feasible to support floating offshore wind activities in the Morro Bay Wind Energy Area.

This high-level screening study explores the feasibility of developing greenfield (i.e., undeveloped) sites or expanding already developed waterfronts between San Francisco and Long Beach for offshore wind activities. This study identifies potential alternative port locations for staging and integration and operation and maintenance sites and assesses their feasibility to support offshore wind activities along the central to southern coast of California for the Morro Bay Wind Energy Area. This is not a decision-making study, but rather a study meant to inform and help develop the Assembly Bill 525 Strategic Plan. The following tasks were completed as part of this study:

- Review existing applicable and available literature. (Section 2)
- Identify necessary port requirements to support the offshore wind industry. (Section 3)
- Identify potential staging and integration sites, the required infrastructure upgrades, and provide an expected range of construction costs and development timeline. (Section 4)
- Identify potential operation and maintenance sites, the required infrastructure upgrades, and provide an expected range of construction costs and development timeline. (Section 5)

This study, in conjunction with several other ongoing port infrastructure studies, will aid in the development of the Assembly Bill 525 Strategic Plan. While this study assesses the possibility of a new alternative port within Central California, an ongoing study for the Bureau of Ocean Energy Management assesses port sites within California's existing ports (Moffatt & Nichol 2023). Importantly, because this study represents a conceptual, high-level screening of *feasibility* using desktop investigation methods, consultation with Native American tribal governments was not conducted. The presence of any particular site on the different Short Lists provided in the results of this study does not imply a lack of cultural sensitivity or cultural resources. As required by Assembly Bill 525, outreach, coordination, and formal government-to-government consultation with tribal governments will be conducted by state agencies during development of the Assembly Bill 525 Port Readiness Plan (see section 25991.3 of Assembly Bill 525).

The focus of this study is on identifying potential staging and integration and operation and maintenance sites to support the Morro Bay Wind Energy Area. Manufacturing /

fabrication sites are not prioritized within this study due to the results of the California Bureau of Ocean Energy Management study that identified many potential manufacturing / fabrication sites within the Port of Humboldt, Bay Area ports, Port of Los Angeles, Port of Long Beach, and Port of San Diego (Moffatt & Nichol 2023). In the Assembly Bill 525 Port Readiness Plan, the staging and integration and operation and maintenance sites identified within this study will be compared with the results from the California Bureau of Ocean Energy Management study to ensure a comprehensive state port assessment.

Port Site Screening

Staging and Integration Sites

For staging and integration sites, a high-level desktop screening was performed on the California coast between San Francisco and Long Beach to identify potential greenfield or undeveloped sites of 30 to 100 acres. This preliminary screening removed areas that were already developed with populations adjacent to the water, designated as protected lands for resources, or had security restrictions, as the case with military bases or airfields. A complete list of the screening criteria is provided in Section 4. From this exercise, a list of 11 sites were identified as potential staging and integration alternative port candidates, as listed below, numbered from north to south and shown in **Figure ES.1**.

1. Redondo Beach in Half Moon Bay
2. Tunitas Beach
3. Spring Bridge Gulch
4. South of Pigeon Point
5. Davenport
6. Moss Landing
7. Natalie's Cove
8. China Harbor
9. Diablo Canyon
10. Port San Luis
11. Gato Canyon

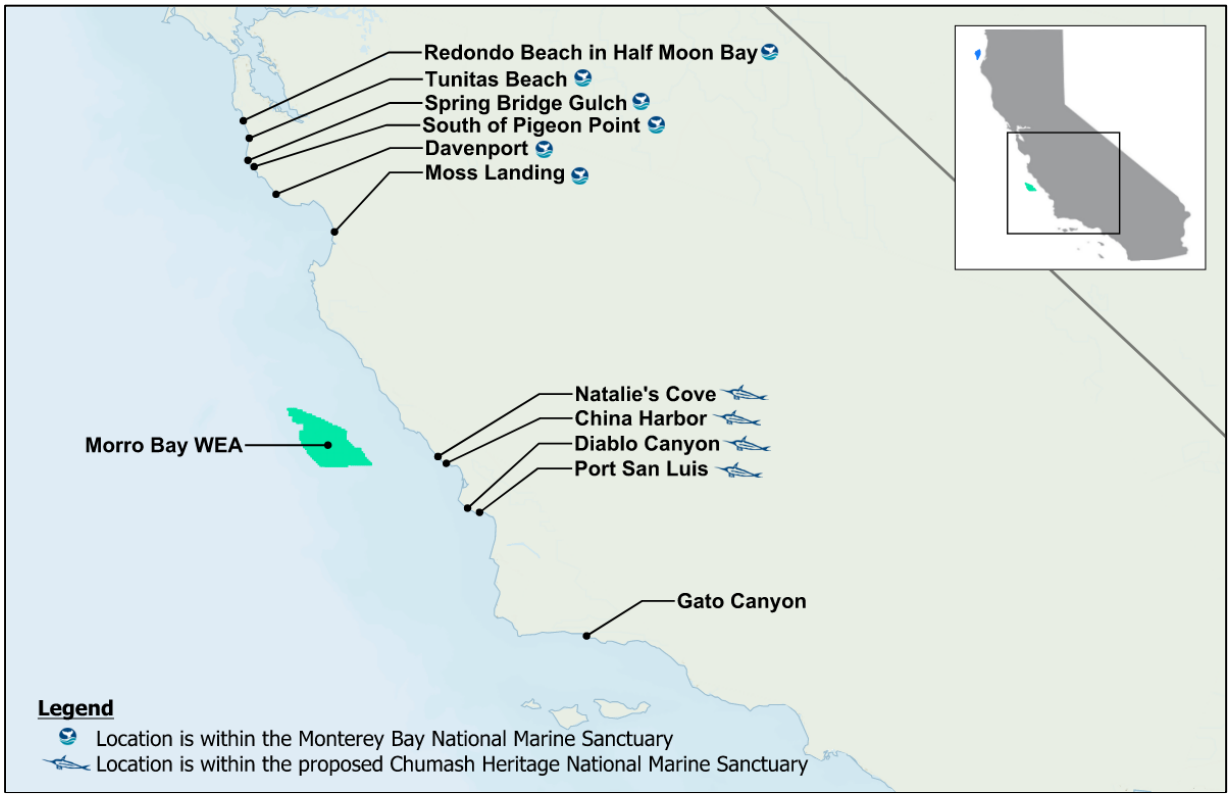

Figure ES.1. Short List of Staging and Integration Sites

The 11 "Short List" sites were then compared and ranked based on high level environmental, conceptual engineering, and workforce assessments. This resulted in the following ranking:

1. **Port San Luis**
2. **China Harbor**
3. **Gato Canyon**
4. Natalie's Cove
5. Diablo Canyon
6. Redondo Beach in Half Moon Bay
7. Tunitas Beach
8. Moss Landing
9. Davenport
10. Spring Bridge Gulch
11. South of Pigeon Point

For the top three sites, an Association of the Advancement of Cost Engineering Class 5 cost estimate was completed to include the following upgrades to develop a staging and integration site:

- Heavy lift wharf that can withstand 6,000 psf
- 80 acres of upland area
- Dredging for a 38-ft berth depth
- Breakwater for metocean protection
- Environmental mitigation allowance

These improvements at Port San Luis are estimated to be approximately $2.4 billion, $2.2 billion at China Harbor, and $2.5 billion at Gato Canyon. This type of estimate has a typical expected variation in cost accuracy of -20% to -50% (low range) and +30% to +100% (high range). A development timeline to construct either of the top three staging and integration sites was also estimated. The build out of an staging and integration site at Port San Luis, China Harbor, or Gato Canyon would take at least 10 to 15 years since a port authority will first need to be established to initiate this type of project with significant environmental studies and approvals required before the project could move forward. There is a risk that this type of project is not permittable at these locations.

All three sites require extensive infrastructure improvements to meet the offshore wind S&I site requirements. When preliminarily compared to the staging and integration sites identified in existing ports from the California Bureau of Ocean Energy Management study (Moffatt & Nichol 2023), these alternative port sites require more investment, pose greater environmental impacts, and have longer development schedules. As part of the Assembly Bill 525 Port Readiness Plan, a more detailed trade off analysis between all potential port sites will be conducted to confirm whether these new staging and integration sites should be further considered for offshore wind development; however, it does not appear likely based on the quantity of suitable sites identified inside existing California ports.

Operation and Maintenance Sites

Operation and maintenance sites require less onshore acreage, less water depth, less wharf capacity, and a shorter segment of waterfront than the staging and integration sites. Therefore, there are a greater number of potential options within the study area. This study focused on leveraging existing harbors and marine facilities to serve as operation and maintenance service centers. Potential operation and maintenance sites were identified by applying a set of suitability criteria to existing harbors and marine facilities, including both the distance from the Morro Bay WEA and facility characteristics. From this exercise, a Short List of 13 sites were identified as potential

operation and maintenance candidates, as listed below, numbered north to south and shown in **Figure ES.2**.

1. Pillar Point Harbor
2. Santa Cruz Wharf
3. Santa Cruz Small Craft Harbor
4. Moss Landing Harbor
5. Monterey Harbor
6. Morro Bay
7. Diablo Canyon
8. Port San Luis Pier and Breakwater
9. Cal Poly Pier
10. Vandenberg Barge Berth
11. Ellwood Pier
12. Santa Barbara Harbor
13. Stearns Wharf

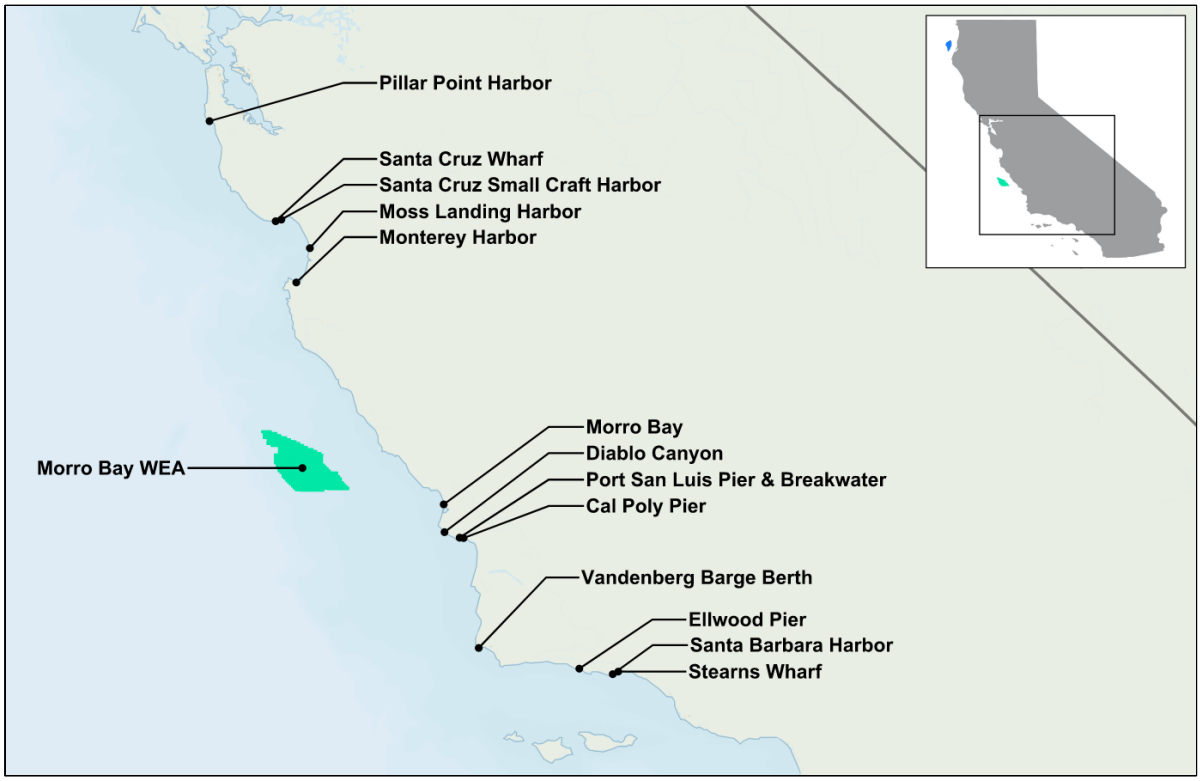

Figure ES.2. Short List of Operation and Maintenance Sites

The 13 sites were further assessed based on engagement with site owners and qualitative conceptual engineering assessments to identify which O&M activities are potentially feasible at each site. All sites were found to potentially serve as vessel crew transfer sites. For Crew Transfer Vessel and Service Accommodation Transfer Vessel moorage, Pillar Point Harbor, Moss Landing Harbor, Monterey Harbor, Morro Bay, and Diablo Canyon were all potential operation and maintenance sites. For Service Operation Vessel moorage, Pillar Point Harbor, Morro Bay, Diablo Canyon, Port San Luis Pier & Breakwater, Cal Poly Pier, Ellwood Pier, and Stearns Wharf were all potential operation and maintenance sites. These results are summarized in **Figure ES.3**.

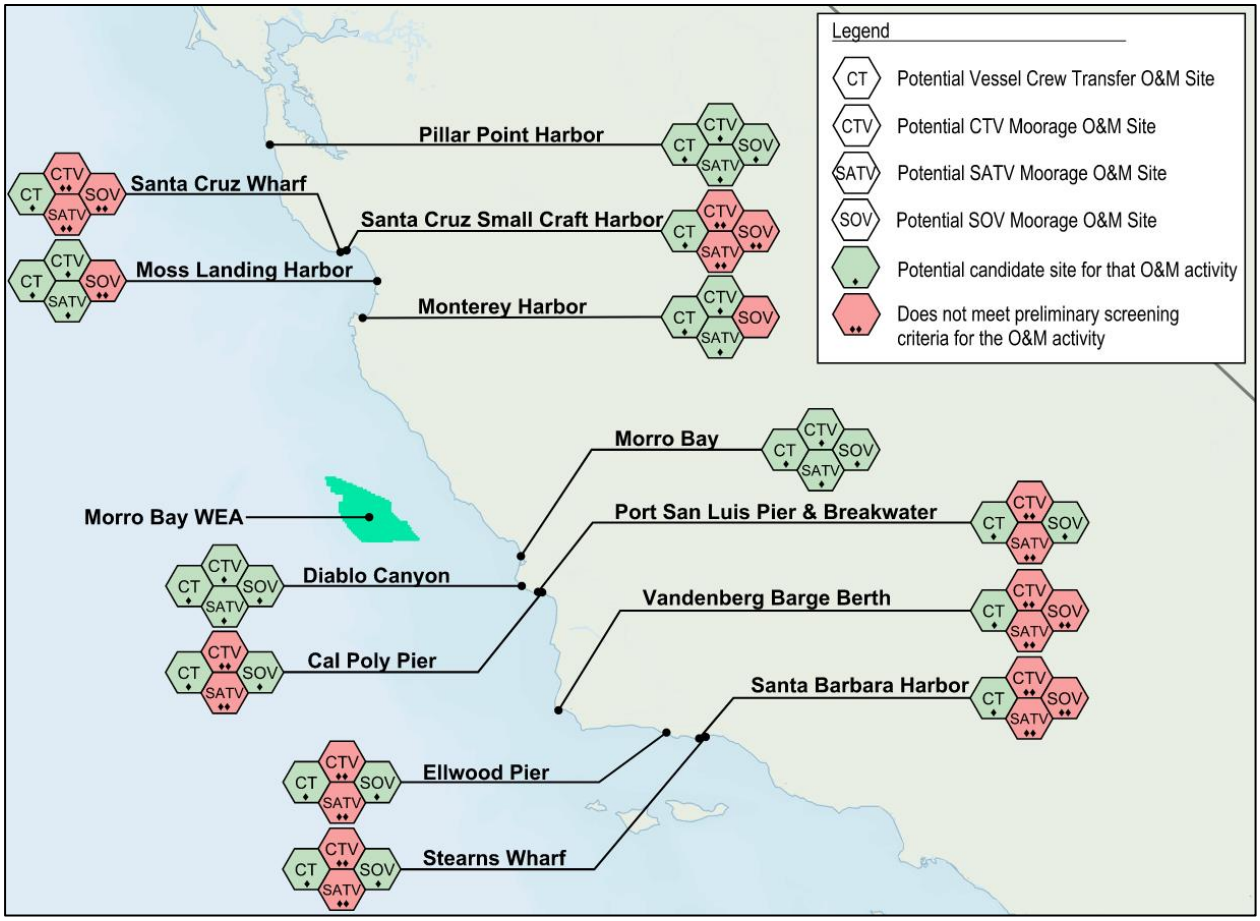

Figure ES.3. Operation and Maintenance Assessment per Activity

For this study, operation and maintenance sites are not comparatively ranked. At this time, it is unknown which purpose each operation and maintenance site will serve, this will mainly be based on the offshore wind developer's strategy and can vary with each developer. In addition, the vessel criteria and dimensions are currently not well defined within the offshore wind industry because some vessels are still in development. Instead, a two-tier classification system based on the potential construction costs needed to improve the facility was used:

- Tier A – The waterfront facility likely requires capital investment on the order of **$10 million to $50 million** to incorporate and construct an operation and maintenance base. This can include improvements such as new waterfront structures (e.g., pile supported wharves or a pier expansion) and/or dredging of navigation channels. With these improvements, facilities in this Tier are intended to support crew transfer, Crew Transfer Vessels, Service Accommodation Transfer Vessels, and in some cases Service Operating Vessel moorage, depending on the size of the Service Operating Vessel.
- Tier B – The waterfront facility likely requires minor upgrades with capital investment on the order of **$1 million to $10 million**. This applies to facilities

with waterfront structures that can be readily converted to operation and maintenance sites with the addition of features such as floating docks, davits, gangways, and/or localized structural rehabilitation.

For Crew Transfer Vessel and Service Accommodation Transfer Vessel moorage, some existing facilities can be leveraged to provide mooring support for operation and maintenance vessels on the smaller end. Monterey Harbor, Morro Bay, and Diablo Canyon have waterfront infrastructure in place that can likely be converted to accommodate smaller vessels (such as Crew Transfer Vessels and potentially Service Accommodation Transfer Vessels) with minor upgrades. Other locations such as Pillar Point Harbor and Moss Landing Harbor will require more investment to support these activities. Locations in San Luis Obispo Bay, Port San Luis Pier, and Cal Poly Pier may be feasible but would require installation of a breakwater to provide a safe harbor. All listed facilities can potentially support vessel crew transfer operations.

- Tier A for Crew Transfer Vessel and Service Accommodation Transfer Vessel Moorage - $10 million to $50 million
  - Pillar Point Harbor
  - Moss Landing Harbor
  - Port San Luis Pier & Breakwater
  - Cal Poly Pier
- Tier B for Crew Transfer Vessel and Service Accommodation Transfer Vessel Moorage - $1 million to $10 million
  - Monterey Harbor
  - Morro Bay
  - Diablo Canyon

There are no existing facilities that can accommodate long-term moorage of Service Operating Vessels without performing upgrades to the existing structures. A new wharf would be required to support berthing of Service Operating Vessels. Several sites have the characteristics that could support a Service Operating Vessel base with investment in new infrastructure and dredging. These include Pillar Point Harbor, Morro Bay, and Diablo Canyon. The size of a Service Operating Vessel in Diablo Canyon will be limited by the size of the harbor and the width of the entrance channel. In the absence of major waterfront infrastructure upgrades, Ellwood Pier, Cal Poly Pier, and Port San Luis Pier & Breakwater may be able to provide moorage to Service Operating Vessels depending on weather. Additional waterfront and onshore upgrades will be required to provide additional services that may be needed, such as fueling, warehouses, offices, parking, and crew support services.

- Tier A for Service Operating Vessel Moorage: $10 million to $50 million
  - Pillar Point Harbor
  - Morro Bay
  - Port San Luis Pier & Breakwater
  - Cal Poly Pier
- Tier B for Service Operating Vessel Moorage: $1 million to $10 million
  - Diablo Canyon
  - Ellwood Pier

The results from this study will be used to inform the Assembly Bill 525 Port Readiness Plan to identify the available port spaces and the necessary investments to improve waterfront facilities for the floating offshore wind industry. The identified potential staging and integration and operation and maintenance sites from this study will be compared with the sites identified as part of the California Bureau of Ocean Energy Management study (Moffatt & Nichol 2023). The next steps to produce the Assembly Bill 525 Port Readiness Plan include:

- Conduct additional outreach to developers, ports, stakeholders, and the public
- Perform a detailed trade off analysis between all identified potential port sites from this study and the California Bureau of Ocean Energy Management study (Moffatt & Nichol 2023)
- Rank the recommended port sites
- Determine workforce development needs, training, and strategy
- Recommend a port development / investment plan

1. Introduction

Senate Bill (SB) 100 (De León, Chapter 312, Statutes of 2018), the 100 Percent Clean Energy Act of 2018, establishes a requirement that every retail seller of electricity procure 60% of its retail electricity sales from eligible renewable energy resources by 2030 and 100 percent by 2045. In 2021, the California Energy Commission (CEC), California Public Utilities Commission, and California Air Resources Board (CARB) issued an SB 100 Joint Agency Report showing that offshore wind could contribute at least ten gigawatts (GW) of energy toward California's 2045 clean energy policy. Assembly Bill (AB) 525 (Chiu, Chapter 231, Statutes of 2021) was signed by the Governor in 2021 and requires the CEC, in coordination with the Coastal Commission, Ocean Protection Council, State Lands Commission (SLC), Office of Planning and Research, Department of Fish and Wildlife, Governor's Office of Business and Economic Development, Independent System Operator, and Public Utilities Commission (and other relevant federal, state, and local agencies as needed) to develop a strategic plan (AB 525 Strategic Plan) for offshore wind development in federal waters due June 30, 2023.

Regarding port infrastructure, the AB 525 Strategic Plan shall identify available port space and the necessary investments to improve waterfront facilities for the floating offshore wind industry. In addition, the AB 525 Strategic Plan shall include identification of sea space for wind energy areas (WEA) to accommodate the offshore wind planning goals for 2030 and 2045 (Chiu 2021). On August 1, 2022, the CEC established a preliminary planning goal of 2 to 5 GW of offshore wind by 2030 and 25 GW by 2045 (Flint 2022).

The U.S. Department of the Interior, Bureau of Ocean Energy Management (BOEM), as mandated by the Outer Continental Shelf (OCS) Lands Act, administers the exploration and development of energy and mineral resources in federal waters. This includes the responsibility of issuing a lease, easement, or right-of-way for offshore energy and mineral resources in the Pacific OCS Region (i.e., federal waters off the coasts of California, Oregon, Washington, and Hawaii). To date, BOEM has identified two offshore WEAs off the State of California, the Humboldt WEA and Morro Bay WEA. On December 6, 2022, BOEM held an offshore wind energy lease sale for five lease areas, two within the Humboldt WEA and three within the Morro Bay WEA (refer to **Figure 1.1**). The size of each lease area ranges from 63,338 to 80,418 acres and has a potential installation capacity of 769 to 976 megawatts (MW). On December 7, 2022, the lease sale ended, and five provisional winners were announced – RWE Offshore Wind Holding LLC, California North Floating LLC, Equinor Wind LLC, Central California Offshore Wind LLC, and Invenergy California Offshore LLC (BOEM 2022).

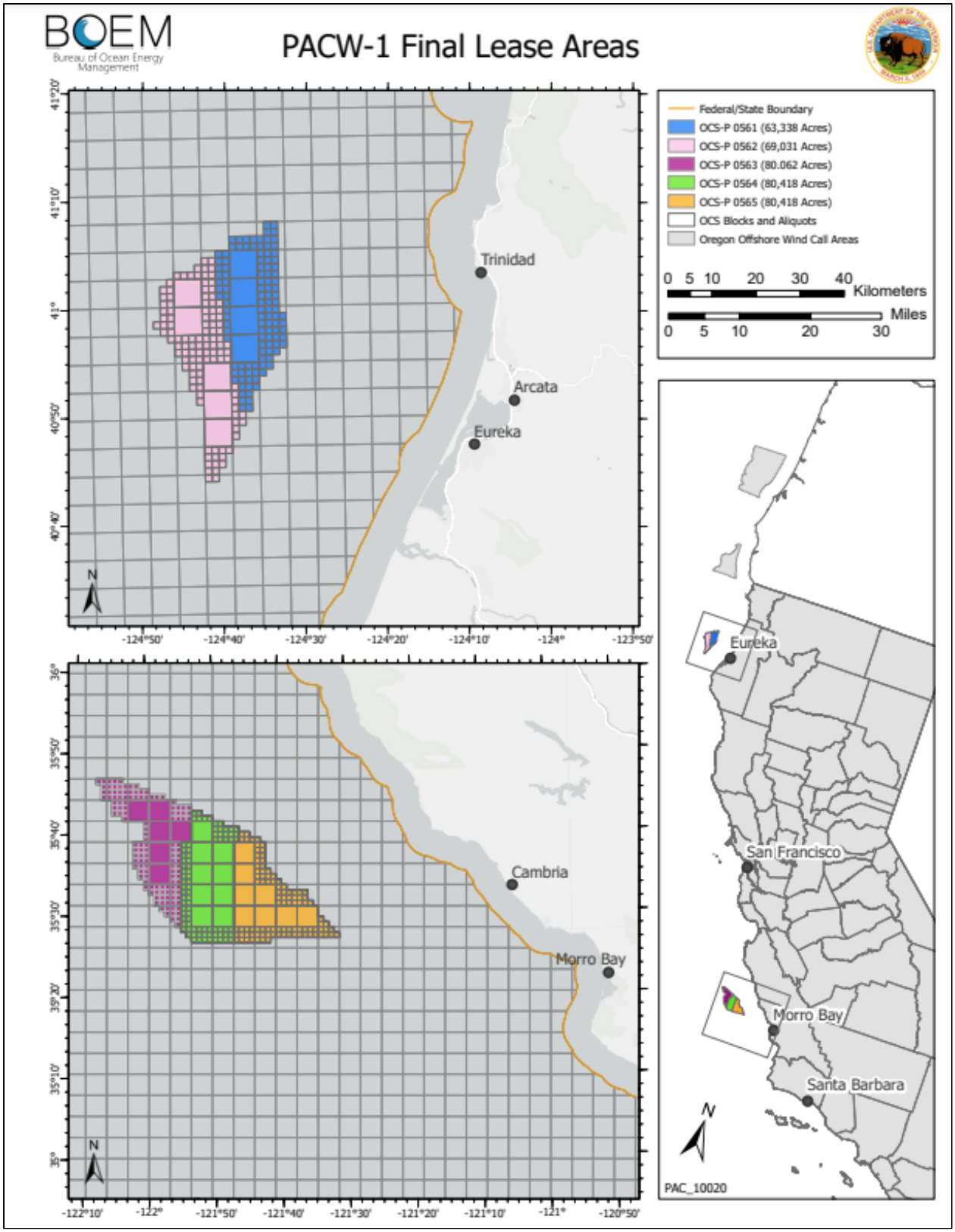

Figure 1.1. California Lease Areas (BOEM 2022)

The coast of California is characterized by rapidly increasing water depths that exceed the feasible limits of traditional fixed-bottom offshore wind turbines. Thus, floating offshore wind technology is more suitable for this region. To construct floating offshore wind turbines, the turbine components will need to be fabricated, assembled, and transported from an onshore port to the offshore WEA. Existing port infrastructure in California is not adequate to support these activities, and significant port investment is required to develop offshore wind port sites. Leveraging existing port capabilities will help, as in the case of the Humboldt Bay Harbor District, which is currently working to upgrade their facilities to support the offshore wind industry and Humboldt WEA; however, capacity gaps may exist. Therefore, it is important for the state to study whether an alternative port location within Central California is feasible to support floating offshore wind in the Morro Bay WEA.

The State of California is interested in a high-level screening study that explores the feasibility of developing or expanding already developed waterfronts between San Francisco and Long Beach for offshore wind activities and the Morro Bay WEA (refer to **Figure 1.2**).

Figure 1.2. Study Area and Morro Bay Wind Energy Area (WEA)

The objective of the screening study is to rank potential port locations utilizing a fatal flaw assessment and to determine the opportunities and limitations for each potential location. The overall goals of this study are to:

1. Identify potential alternative port locations between San Francisco and Long Beach to support offshore wind development.
2. Assess the feasibility of potential port locations to determine the required infrastructure improvements and cost/schedule to develop sites for offshore wind.

Note, this is not a decision-making study, but rather a study meant to inform and help develop the AB 525 Port Readiness Plan which is intended to present findings that will assist the state in making decisions regarding the offshore wind industry within California. The AB 525 Port Readiness Plan will be informed by the following three studies:

- BOEM Study, *Port of Coos Bay Port Infrastructure Assessment for Offshore Wind Development* (Moffatt & Nichol 2022)
  Extensive offshore wind developer outreach was conducted as a part of this Port of Coos Bay, Oregon study to help inform the port facility requirements for offshore wind on the U.S. West Coast. These port requirements are summarized within **Section 3**.
- BOEM Study, *California Floating Offshore Wind Regional Ports Assessment* (Moffatt & Nichol 2023)
  Extensive California port outreach was conducted for the entire state as a part of this study to assess how much capacity the existing California ports have available to support the offshore wind industry.
- CSLC Study, *Alternative Port Assessment to Support Offshore Wind* (this report)
  A feasibility assessment was conducted for the region between San Francisco and Long Beach to determine the opportunities and limitations for creating new alternative port locations to support the offshore wind industry.

In addition to the three studies listed above, the AB 525 Port Readiness Plan will involve and be informed by consideration of potentially impacted cultural resources and impacts to Native American communities; this aspect of the study will include government-to-government consultation with geographically and culturally affiliated tribes as well as evaluation of prior surveys and literature regarding archaeological resources. AB 525 also requires an analysis of potential impacts to natural resources and fisheries, including impacts to coastal resources, and workforce development needs, including safety, wages, training and apprenticeship programs, and recommendations for workforce standards developed through consultation with labor organizations and apprenticeship programs.

2. Literature Review

Information and data were gathered from a range of offshore wind industry and government sources to provide a baseline of the best available information on offshore wind and ports. These sources and their data are listed below.

Bureau of Ocean Energy Management (BOEM):

- California Floating Offshore Wind Regional Ports Assessment (BOEM 2023-xxx, Unpublished Report)
- Determining the Infrastructure Needs to Support Offshore Floating Wind and Marine Hydrokinetic Facilities on the Pacific West Coast and Hawaii (BOEM 2016-011) (https://www.boem.gov/sites/default/files/environmental-stewardship/Environmental-Studies/Pacific-Region/Studies/BOEM-2016-011.pdf)
- Floating Offshore Wind in California: Gross Potential for Jobs and Economic Impacts from Two Future Scenarios (BOEM 2016-029) (https://www.boem.gov/sites/default/files/environmental-stewardship/Environmental-Studies/Pacific-Region/Studies/BOEM-2016-029.pdf)
- Floating Offshore Wind Turbine Development Assessment: Final Report and Technical Summary (BOEM 2021-030) (https://www.boem.gov/renewable-energy/studies/study-number-deliverable-4-final-report-technical-summary)
- Port of Coos Bay Port Infrastructure Assessment for Offshore Wind Development (BOEM 2022-073)
- Potential Offshore Wind Energy Areas in California: An Assessment of Locations, Technology, and Costs (BOEM 2016-074) (https://www.boem.gov/sites/default/files/environmental-stewardship/Environmental-Studies/Pacific-Region/Studies/BOEM-2016-074.pdf)
- Presentation BOEM California Leasing Update – 10-6-22 (BOEM 2022)

California Energy Commission (CEC):

- AB 525 Conceptual Permitting Roadmap, December 15, 2022 (CEC 2022) (https://efiling.energy.ca.gov/GetDocument.aspx?tn=248109)
- AB 525 Goals – Resources Considered (as of March 3, 2022), March 10, 2022 (CEC 2022)
- Commission Report – Offshore Wind Energy Development off the California Coast, August 1, 2022 | CEC-800-2022-001-REV (CEC 2022) (https://www.energy.ca.gov/filebrowser/download/4361)
- Commission Report – Preliminary Assessment of Economic Benefits of Offshore Wind, December 16, 2022 | CEC-700-2022-007-CMD (CEC 2022) (Commission Report Preliminary Assessment of Economic Benefits of Offshore Wind)

- Presentations – AB 525 Workshop, March 3, 2022 (CEC 2022)
- Presentation – Preparing a Strategic Plan for Offshore Wind Energy Development Staff Workshop 10-6-22, October 6, 2022 (CEC 2022)

National Renewable Energy Laboratory (NREL):

- 2014–2015 Offshore Wind Technologies Market Report (NREL 2015) (https://www.nrel.gov/docs/fy15osti/64283.pdf)
- 2016 Offshore Wind Energy Resource Assessment for the United States (NREL 2016) (https://www.nrel.gov/docs/fy16osti/66599.pdf)
- 2017 Offshore Wind Technologies Market Update (NREL 2018) (https://www.energy.gov/sites/default/files/2018/09/f55/71709_V4.pdf)
- 2019 Offshore Wind Technology Data Update (NREL 2019) (https://www.nrel.gov/docs/fy21osti/77411.pdf)
- 2020 Offshore Wind Resource Assessment for the California Pacific Outer Continental Shelf (NREL 2020) (https://www.nrel.gov/docs/fy21osti/77642.pdf)
- An Assessment of the Economic Potential of Offshore Wind in the United States from 2015 to 2030 (NREL 2017) (https://www.nrel.gov/docs/fy17osti/67675.pdf)
- Cost of Floating Offshore Wind Energy Using New England Aqua Ventus Concrete Semisubmersible Technology (NREL 2020) (https://www.nrel.gov/docs/fy20osti/75618.pdf)
- Definition of the IEA Wind 15-Megawatt Offshore Wind Turbine (NREL 2020) (https://www.nrel.gov/docs/fy20osti/75698.pdf)
- Large-Scale Offshore Wind Power in the United States: Assessment of Opportunities and Barriers (NREL 2010) (https://www.nrel.gov/docs/fy10osti/40745.pdf)
- The Cost of Floating Offshore Wind Energy in California Between 2019 and 2032 (NREL 2020) (https://www.nrel.gov/docs/fy21osti/77384.pdf)
- The Demand for a Domestic Offshore Wind Energy Supply Chain (NREL 2022) (https://www.nrel.gov/docs/fy22osti/81602.pdf)

Schatz Energy Research Center (Schatz):

- American Jobs Project: The California Offshore Wind Project: A Vision for Industry Growth (Schatz 2019) (http://americanjobsproject.us/wp/wp-content/uploads/2019/02/The-California-Offshore-Wind-Project-Cited-.pdf)
- California North Coast Offshore Wind Studies (Schatz 2020) (http://schatzcenter.org/pubs/2020-OSW-R24.pdf)

- Del Norte County Offshore Wind Preliminary Feasibility Assessment: Final Report (Schatz 2021) (https://tethys.pnnl.gov/sites/default/files/publications/Del-Norte-County-Offshore-Wind-Preliminary-Feasibility-Assessment.pdf)
- Port Infrastructure Assessment Report (Schatz 2020) (http://schatzcenter.org/pubs/2020-OSW-R19.pdf)

U.S. Department of Energy (USDOE):

- Assessment of Ports for Offshore Wind Development in the United States (USDOE 2014) (https://www.energy.gov/eere/wind/downloads/us-offshore-wind-port-readiness)
- National Offshore Wind Strategy (USDOE 2016) (https://www.energy.gov/eere/wind/downloads/national-offshore-wind-strategy-facilitating-development-offshore-wind-industry)
- Offshore Wind Market Report: 2021 Edition (USDOE 2021) (https://www.energy.gov/sites/default/files/2021-08/Offshore%20Wind%20Market%20Report%202021%20Edition_Final.pdf)

Additional CA Regional Port Assessment Studies:

- California Offshore Wind: Workforce Impacts and Grid Integration (UC Berkeley Labor Center 2019) (https://laborcenter.berkeley.edu/pdf/2019/CA-Offshore-Wind-Workforce-Impacts-and-Grid-Integration.pdf)
- California's Offshore Wind Electricity Opportunity (USC Schwarzenegger 2021) (http://schwarzenegger.usc.edu/institute-in-action/article/californias-offshore-wind-electricity-opportunity)
- Economic Impact of Offshore Wind Farm Development on the Central Coast of California (Cal Poly SLO 2021) (https://reachcentralcoast.org/wp-content/uploads/Economic_Value_OSW_REACH.pdf)
- Scenarios for Offshore Wind Power Production for Central California Call Areas (Cal Poly SLO 2020) (https://digitalcommons.calpoly.edu/cgi/viewcontent.cgi?article=1605&context=phy_fac)
- Supply Chain Contracting Forecast for U.S. Offshore Wind Power – The Updated and Expanded 2021 Edition (The Special Initiative on Offshore Wind 2021) (https://nationaloffshorewind.org/wp-content/uploads/SIOW-supply-chain-report-2021-update-FINAL.pdf)

3. Basis of Analysis

This section defines the requirements of the feasibility study, including the design criteria of the offshore wind sites, and outlines the methodology needed to complete the screening study and analysis. The offshore wind port requirements, including floating turbine system size and weight, are based on the work completed in the studies for BOEM titled *Port of Coos Bay Port Infrastructure Assessment for Offshore Wind Development* (Moffatt & Nichol 2022) and *California Floating Offshore Wind Regional Ports Assessment* (Moffatt & Nichol 2023).

3.1. Offshore Wind Port Types

There are several types of port sites that are needed to support the offshore wind industry. The main port sites that need to be identified include:

- **Staging and Integration (S&I) Site:** a site to receive, stage, and store offshore wind components and to assemble the floating turbine system for towing to the offshore wind area. This site is likely to support the following service:
  - **Turbine Maintenance Site:** a site to perform major maintenance on a fully assembled turbine system that cannot otherwise be performed in the offshore wind area such as replacement of a nacelle or blade.
- **Operation and Maintenance (O&M) Site:** a base of wind farm operations with warehouses/offices, spare part storage, and marine facility to support vessel provisioning and refueling/charging for the following O&M vessels during the operational period of the offshore wind farm.
  - **Crew Transfer Vessel (CTV):** transfers small crews to offshore wind turbine installations for day-trip O&M visits and inspections.
  - **Service Accommodation Transfer Vessel (SATV):** intermediate size between Service Operating Vessels and CTVs, with ability to sleep onboard for multiday trips.
  - **Service Operating Vessel (SOV):** vessels that loiter and operate as in-field accommodations for workers and platform assistance for wind turbine servicing and repair work.
- **Manufacturing / Fabrication (MF) Site:** a port site located on a navigable waterway that receives raw materials via road, rail, or waterborne transport and creates larger components in the offshore wind supply chain. This site typically includes factory and/or warehouse buildings and space for storage of completed components.

The focus of this study is on identifying potential S&I and O&M sites to support the Morro Bay WEA. MF sites are not prioritized within this study due to the results of the California BOEM study that identified many potential MF sites within the Port of Humboldt, Bay Area ports, Port of Los Angeles, Port of Long Beach, and Port of San Diego (Moffatt & Nichol 2023). In the AB 525 Port Readiness Plan, the S&I and O&M sites identified within this study will be compared with the results from the California BOEM study to ensure a comprehensive state port assessment.

Additional offshore wind port sites that are not included in this study but will be required for offshore wind industry use include:

- **Other Types of Offshore Wind Port Sites:**
  - **Installation Support Site:** a base of construction operations for the fleet of construction vessels necessary for construction and commissioning of the offshore wind farm.
  - **Mooring Line, Anchor, and Electrical Cable Laydown Site:** a site to receive and stage mooring lines, anchors, and electrical cables to support the installation of the offshore wind farm.
  - **Cable Landing Site:** locations for the electrical cables to transition from the offshore (e.g., subsea cables) to a grid connection location. These sites may include electrical infrastructure onshore.
  - **End of Life Decommissioning Site:** a site to decommission, disassemble, recycle, and dispose of turbine systems that are at end of life.

3.2. Turbine Size

Based on the information obtained from offshore wind industry outreach performed during the Port of Coos Bay BOEM study, 12 MW offshore wind turbine systems are currently commercially available (Moffatt & Nichol 2022). However, the current trend is that turbine sizes increase over time. Therefore, when planning for a major port terminal with a 50-year design life, larger turbines on the order of 15 to 25 MW need to be considered to meet the needs of the continuously developing offshore wind industry. **Table 3.1** summarizes the anticipated dimensions for a floating turbine system with a capacity of up to 15 to 25 MW; **Figure 3.1** is a depiction of the turbine.

Table 3.1. Anticipated Floating Offshore Wind Turbine Dimensions

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

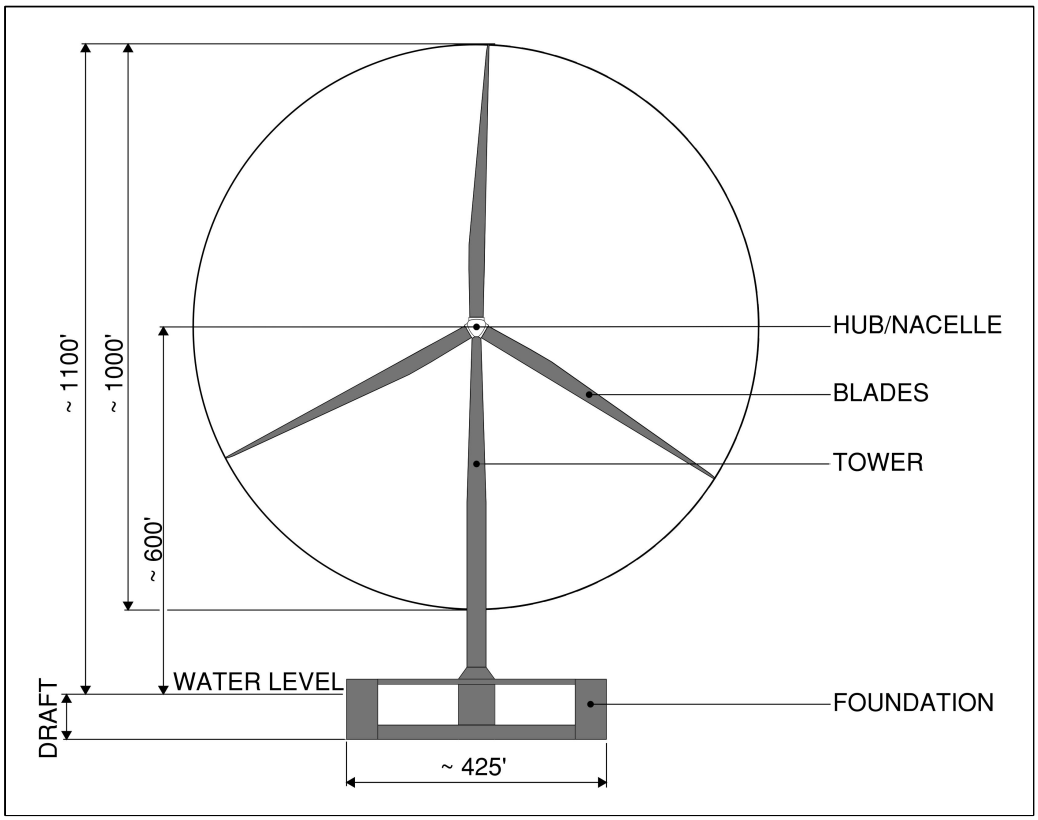

Figure 3.1. Anticipated Floating Offshore Wind Turbine Dimensions

3.3. Port Requirements

The following sections document the required port infrastructure parameters to unload, store, pre-commission, and pre-assemble floating offshore wind farm components per the study performed for BOEM (Moffatt & Nichol 2023).

3.3.1. Port Wharf and Loading Requirements

Per discussions with the offshore wind industry, the S&I wharf shall accommodate the delivery of wind turbine generator (WTG) components and at least two turbine assemblies moored adjacent to one another, resulting in approximately 1,500 feet of quayside space, as summarized in **Table 3.2**. For O&M and component manufacturing sites, the length of the wharf is dependent on the vessel type it serves. For example, SOV and CTV for O&M sites and delivery vessels and delivery barges for component manufacturing sites.

In general, the wharf and uplands area for MF sites shall have a capacity of 2,000 to 3,000 pounds per square foot (psf) to support offshore wind components. At S&I sites, the wharf loading will be higher where the crane for turbine assembly is located. Existing crawler cranes, such as the Liebherr 1300, are not large enough to assemble turbines greater than 15 MW. Thus, ring cranes or larger crawler or mobile cranes will likely be required to integrate components, requiring a loading capacity of 6,000 psf on the wharf. Loading at O&M sites is expected to range from 100 to 500 psf.

The type of site also determines the site's size requirements. For an O&M site, the site shall be approximately 5 to 10 acres. For MF and S&I sites, a range of 30 to 100 acres is requested depending on the developer and their use.

Table 3.2. Port Infrastructure Requirements

Floating Offshore Wind Turbine	Approximate Criteria for S&I	Approximate Criteria for MF	Approximate Criteria for O&M
Acreage, minimum	30 to 100 acres	30 to 100 acres	5 to 10 acres
Wharf Length	1,500 ft [1]	800 ft	300 ft
Minimum Draft at Berth	38 ft	38 ft	20 to 30 ft
Draft at Sinking Basin[2]	40 to 100 ft	N/A	N/A
Wharf Loading	> 6,000 psf [3]	Up to 6,000 psf	100 – 500 psf
Uplands / Yard Loading (for WTG components)	> 2,000 to 3,000 psf	> 2,000 to 3,000 psf	N/A

[1] Minimum length for integration of two turbine systems and delivery of components.
[2] Options for transfer of floating foundation from land to water include use of semi-submersible barge and sinking basin, ramp system, or direct transfer methods (lifting portions or complete foundation units from land into water).
[3] Wharf loading under the crane.

3.3.2. Floating Foundation Type and Launching

Currently, there are three types of floating foundations for floating offshore wind turbines, as shown in **Figure 3.2**:

- **Spar:** A Spar floating foundation, constructed of either concrete, steel, or a hybrid combination, is a cylinder that floats vertically in the water.

- **Tension Leg Platform (TLP):** A TLP floating foundation, constructed of steel, is comprised of multiple columns and pontoons. It's mooring system requires vertical tensioned tendons, which provide stability to the structure.
- **Semi-submersible:** A semi-submersible floating foundation, constructed of either concrete, steel, or a hybrid combination, is comprised of a submerged hull with multiple pontoons and columns.

Figure 3.2. Illustration of floating foundation types (left to right: spar, semi-submersible, TLP) (NREL 2022)

Although a semi-submersible floating foundation requires increased port infrastructure capacity, it is the most probable technology to be used on the U.S. West Coast as Spar foundations are not feasible on the West Coast, due to required deep draft, and offshore wind developers have indicated that semi-submersible foundations are preferred. Therefore, by assuming semi-submersible foundations will be utilized for offshore wind development on the West Coast, the port requirements developed in **Table 3.2** are also suitable for TLP foundations – if utilized – as they are smaller and require less port infrastructure capacity.

A major challenge the offshore wind industry identified is the transfer of the completed floating foundation from the assembly wharf into the water (i.e., launching). Several options are available to overcome this challenge and each developer may prefer a different option; however, a few common approaches were identified:

- **Semi-Submersible Barge**: the floating foundation is moved from the wharf onto the barge and the barge is moved to a 40- to 100-ft-deep sinking basin where the foundation is floated off the barge.
- **Ramp System**: the floating foundation is moved onto a rail system and travels down a sloped ramp into the water. This methodology is similar to a marine railway ship launching system.
- **Direct Transfer**: methods that include lifting the floating foundation directly from the wharf into the water (these include methods that involve placing pieces of the foundation into the water and finalizing the construction in the wet).

3.3.3. Wet Storage Requirements

Wet storage space is also required in addition to the water frontage and upland acreage. Ports must have locations where the floating foundation or integrated turbines can be safely moored to mitigate the risk of weather downtime, vessel traffic, entrance channel congestion, and other transportation risks. This also allows the developers to store completed units to ensure they can deliver to the lease area on schedule. The size of the wet storage area is dependent on the developer's strategy, deployment schedule, and downtime risk.

3.3.4. Additional Port Requirements

Several additional port requirements include the following:

- **Roll-on/Roll-off Capabilities:** port sites shall have roll-on / roll-off (RORO) capability built into the wharf and yard to allow for a range of fabrication and assembly needs. Allowing for inside port transfers between multiple facilities is of particular importance. This may require the construction of a sinking basin deeper than the proposed navigation channel depth.
- **Green Port:** new port terminals shall have the necessary infrastructure and equipment to support state and federal carbon reduction initiatives—such as CARB's Ocean-Going Vessel At-Berth Regulation and the 100 Percent Clean Energy Act of 2018—including electrification of the terminal operations and the ability to accommodate vessel shore power. Greenhouse gas emission reduction initiatives and the desire to develop green ports creates considerable load on the transmission grid. An assessment of these upgrades will be needed for the proposed development site.
- **Shoreside Vessel Services:** port sites will require all standard ship services (e.g., potable water), shore power, and security requirements.
- **Buildings:** offices, bathrooms, and indoor storage/warehouses are required for some items (e.g., floating foundation mechanical equipment, painting, welding, etc.).

3.4. Design Life

All new marine structures at the port shall be designed for a 50-year service life. Design service life is generally considered as the period of time during which a properly built and maintained structure is expected to operate as designed, without requiring major replacement or rehabilitation.

3.5. Governing Codes, Standards, and References

The following codes, standards, and references govern the design of port infrastructure and offshore wind vessels.

American Bureau of Shipping (ABS):

- Guide for Building and Classing Floating Offshore Wind Turbine Installation, updated July 2014

American Concrete Institute (ACI):

- ACI 318-19, Building Code Requirements for Structural Concrete

American Institute for Steel Construction (AISC):

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

American Petroleum Institute (API):

- API RP 2A-LRFD, Recommended Practice for Planning, Designing and Constructing Fixed Offshore Platforms – Load and Resistance Factor Design

American Society of Civil Engineers (ASCE):

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

American Welding Society (AWS):

- AWS D1.1, Structural Welding Code, 2015

California State Building Code (CBC):

- 2022 California Building Code

National Fire Protection Association (NFPA):

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

Oil Companies International Marine Forum (OCIMF):

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

Permanent International Association of Navigation Congresses (PIANC):

- PIANC MarCom WG 145, Berthing Velocity Analysis of Seagoing Vessels over 30,000 dwt, 2022
- PIANC WG 121, Harbour Approach Channels – Design Guidelines, 2014
- PIANC WG 33, Guidelines for the Design of Fender Systems, 2002
- PIANC WG 34, Seismic Design Guidelines for Port Structures, 2001
- PIANC WG 153, Recommendations for the Design and Assessment of Marine Oil and Petrochemical Terminals, 2016

United States Army Corps of Engineers (USACE):

- USACE EM 1110-2-1100, Coastal Engineering Manual, 2002
- USACE EM 1110-2-1613, Hydraulic Design of Deep-Draft Navigation Projects, 2006
- USACE EM 1110-2-2502, Retaining and Flood Walls, 1989

United Facilities Criteria (UFC):

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

4. Staging and Integration Site Screening

This study focused on identifying alternative port sites for S&I and O&M sites between San Francisco and Long Beach. The following S&I sites have been excluded from this study as they are included in the BOEM study, which assesses potential offshore wind port sites within California's existing ports (Moffatt & Nichol 2023):

- Crescent City Harbor District
- Port of Humboldt
- Port of San Francisco
- Port of Oakland
- City of Alameda
- Port of Redwood City
- Port of Richmond
- Port of Benicia
- Port of Stockton
- Port of West Sacramento
- Port of Hueneme
- Port of Los Angeles
- Port of Long Beach
- Port of San Diego

S&I sites require a significant amount of acreage (30 to 100 acres) for offshore wind component storage and turbine assembly along the wharf. To locate potential sites that have both enough flat land and waterborne access, this study focused on identifying undeveloped land (i.e., greenfield sites) along the coast to support offshore wind development.

4.1. Staging and Integration Site Screening Process

On August 25, 2022, the team held a Screening Workshop between SLC, CEC, and the consultant team to agree on the utilized screening criteria and process, as summarized below.

1. **Preliminary screening criteria to aid in determining the "Long List"**
   To identify greenfield or undeveloped areas for the initial Long List of potential S&I sites, portions of the coastline with existing land use designations were eliminated by using Geographic Information System software to overlay the land uses on a map of the coastline. This included the following land uses:
   - Residential Areas / Urban Areas
   - State Parks
   - National Forests
   - State Marine Protected Areas
   - Military Bases
   - Vandenberg Danger Zone
   - Airspace Restrictions

- Islands (e.g., Catalina, San Nicolas, San Clemente)

2. **High-level engineering assessment to determine the Short List**
   From the Long List, additional sites were eliminated based on geographical constraints and existing conditions, such as:
   - Does not possess favorable qualities of a marine / port site (e.g., water depth, natural cove, protected harbor, etc.)
   - Unfavorable connection to land (e.g., cliffs, geological features, roadways, railways)
3. **Rank Short List sites**
   The Short List sites were then compared and ranked based on an assessment of potential environmental impacts and required permitting and environmental approvals, such as:
   - Proximity to state parks and marine protected areas
   - Proximity to federally protected lands (e.g., National Marine Sanctuaries, Bureau of Land Management [BLM] California Coastal National Monument lands)
   - Sensitive land uses (e.g., residences, schools, churches) within one mile
   - Environmental justice populations within five miles
   - Environmental justice demographic index that considers existing environmental burdens
   - Viewshed sensitivity (20-mile viewshed considered)
   - Terrestrial biological resources
   - Marine / aquatic resources
   - Additional ranking factors that were considered included:
   - Workforce and labor availability
   - Marine / aquatic resources
   - Required infrastructure improvements (e.g., wharf, breakwater, upland improvements)
4. **Identify required upgrades and provide planning-level cost estimates / schedule**
   - A Class 5 estimate per the Association of the Advancement of Cost Engineering (AACE) with a typical expected variation in cost accuracy of -20%to -50% (low range) and +30% to +100% (high range) and development timelines were developed for the top ranked S&I sites.

4.2. Existing and Proposed Marine Sanctuaries

According to the National Oceanic and Atmospheric Administration (NOAA), national marine sanctuaries are zones within United States waters designated as protected waters and established to protect marine habitats such as kelp forests, rocky reefs, underwater archaeological sites, and deep-sea canyons. There are currently two existing national marine sanctuaries within the study area, the Monterey Bay National Marine Sanctuary and the Channel Islands National Marine Sanctuary. For a map of the California national marine sanctuaries, refer to **Figure 4.1**.

In July 2015, the Northern Chumash Tribal Council submitted a sanctuary nomination for the proposed Chumash Heritage National Marine Sanctuary on the central coast of California off of San Luis Obispo and Santa Barbara counties, refer to **Figure 4.1**. NOAA has initiated the designation process and is currently reviewing public comments from the public scoping meetings held in December 2021 and January 2022 and preparing draft documents, including the draft management plan, draft environmental impact statement, proposed regulations, and proposed boundaries (NOAA n.d.). The target completion date of the designation process is winter 2023.

Using these three existing and proposed national marine sanctuaries as primary site screening criteria was initially considered. However, this approach would screen out approximately 75% of the coastline within the study area, as shown in **Table 4.1**, leaving few sites for consideration within this study. Therefore, the presence of current or proposed national marine sanctuary was used as one of the criteria to rank the Short List of potential sites after primary screening was completed. This resulted in a more thorough evaluation of potential sites along the coastline within the study area.

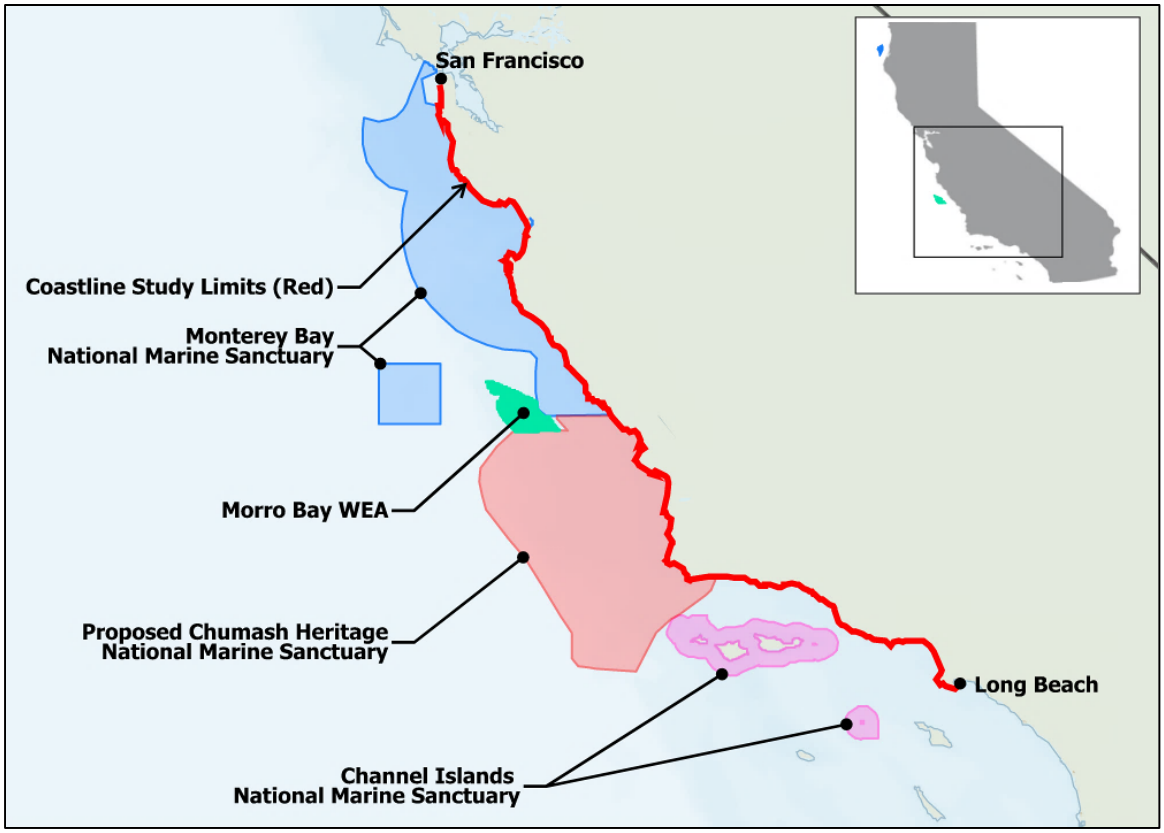

Figure 4.1. Map of Existing and Proposed National Marine Sanctuaries (NOAA)

Table 4.1. National Marine Sanctuaries as Preliminary Screening Criteria

Preliminary Screening Criteria	Approximate Percent of Shoreline
Existing National Marine Sanctuaries	49%
Existing and Proposed National Marine Sanctuaries[1]	75%

[1] Existing and Proposed National Marine Sanctuaries were ultimately not considered as a primary screening criterion.

4.3. Long List

Using the preliminary screening criteria specified in Step 1 in Section 4.1, a significant amount of the shoreline within the study area was screened out. The percentage of the coastline that was screened out of the study area is listed in **Table 4.2** for each individual screening criterion. The study area of the coastline is then shown in **Figure 4.2** through **Figure 4.8** for each individual screening criterion, with portions that were screened out of the study area illustrated with red lines and those still considered illustrated with white lines. Other colors such as green, orange, yellow, and pink were used to denote the dedicated land uses in each figure. These figures aid in the

reasoning behind the amount of coastline being screened out for each individual criterion. In **Figure 4.9**, all screening criteria were applied to the study area and the remaining coastline is shown.

Table 4.2. Preliminary Screening Criteria

Preliminary Screening Criteria	Approximate Percent of Shoreline Screened Out
Residential Area / Urban Areas	26%
State Parks	34%
National Forests	5%
State Marine Protected Areas	24%
Military Base	8%
Vandenberg Danger Zone	9%
Airspace Restrictions	13%
Combined Screening Criteria	77%

Figure 4.2. Residential / Urban Zones (in Red) Screened Out 26% of the Study Area

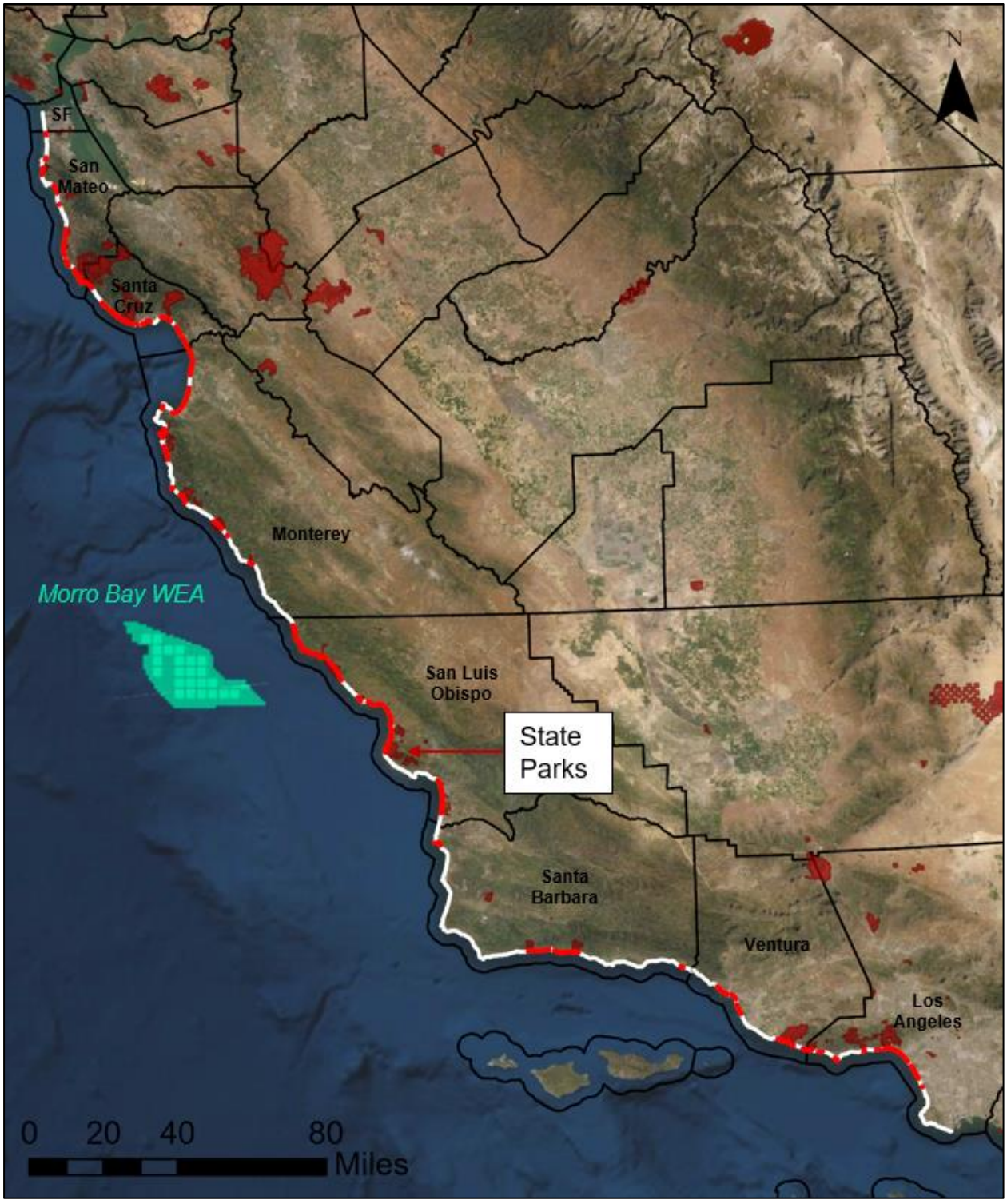

Figure 4.3. State Parks (in Red) Screened Out 34% of the Study Area

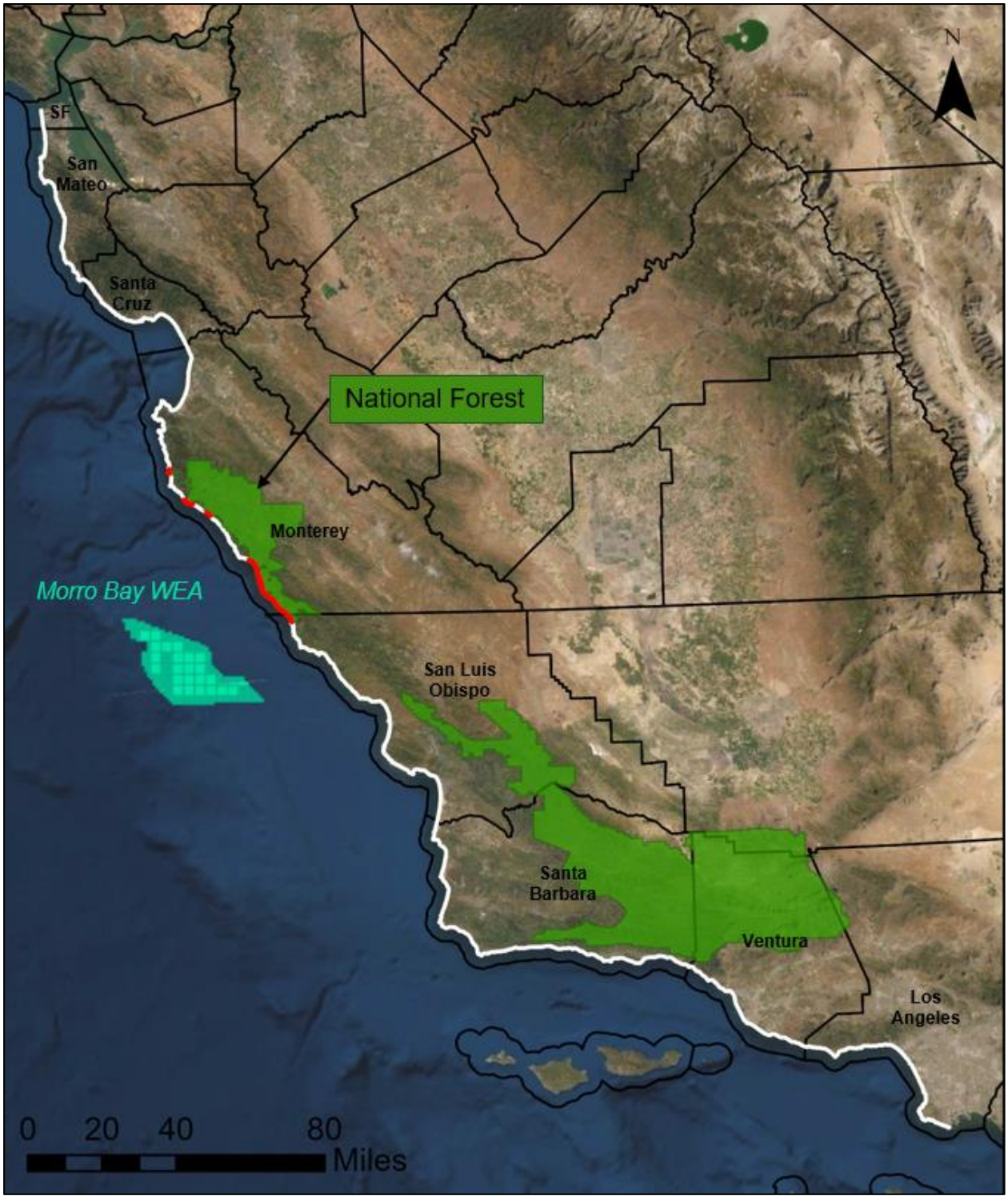

Figure 4.4. National Forests (in Green) Screened Out 5% of the Study Area

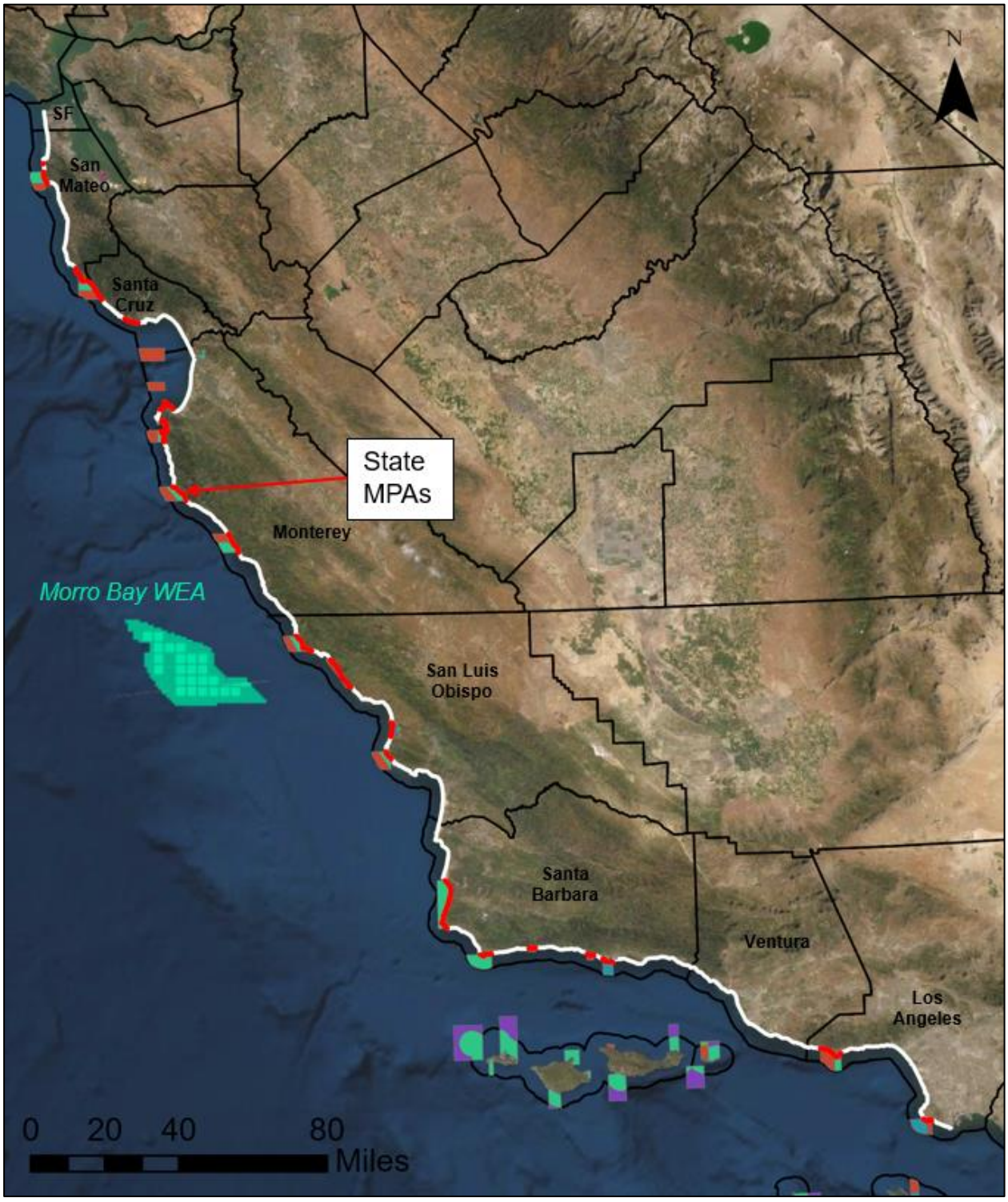

Figure 4.5. State Marine Protected Areas (in Green and Orange) Screened out 24% of the Study Area

Figure 4.6. Military Bases (in Yellow) Screened out 8% of the Study Area

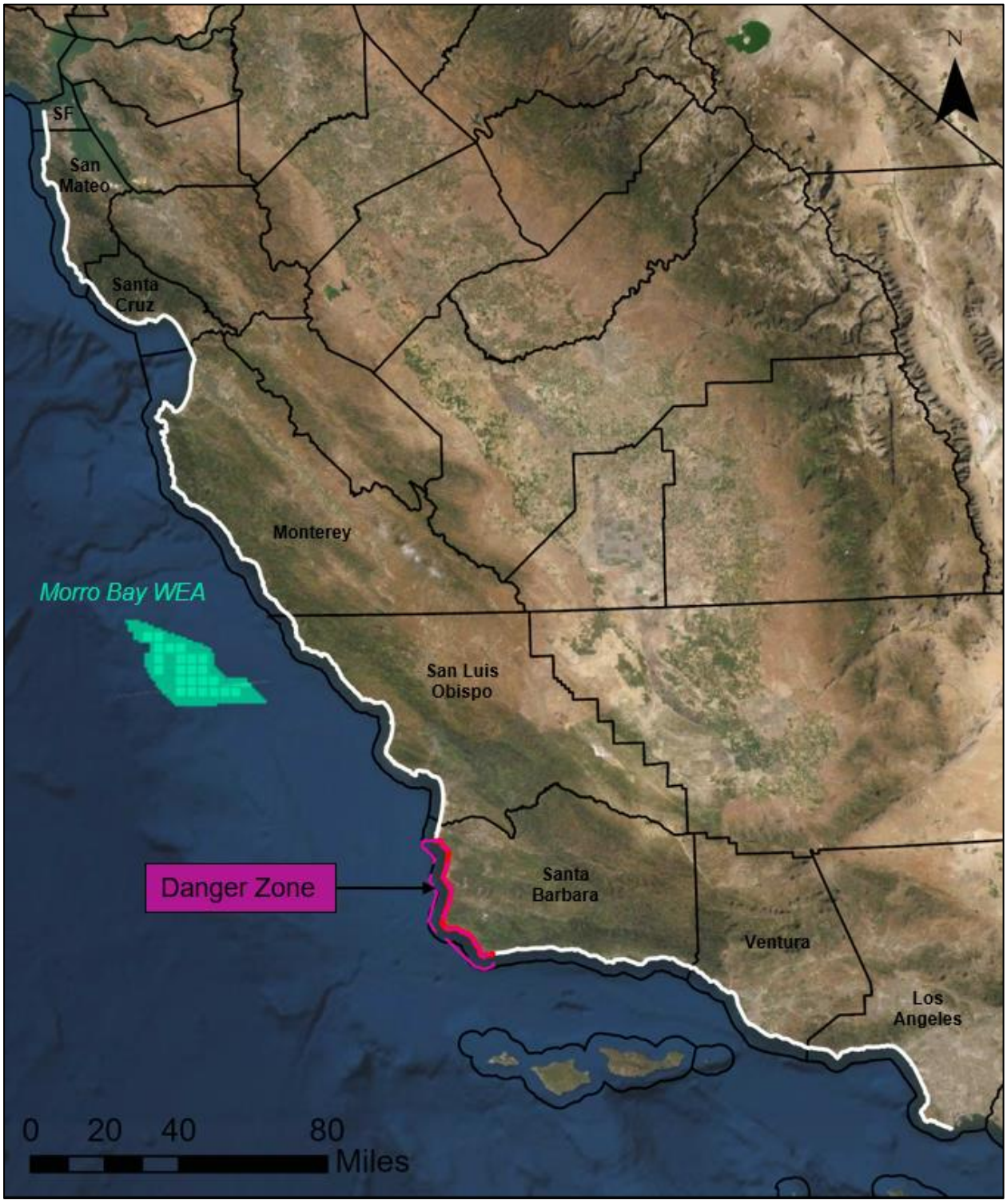

Figure 4.7. Vandenberg Danger Zone (in Purple) Screened out 9% of the Study Area

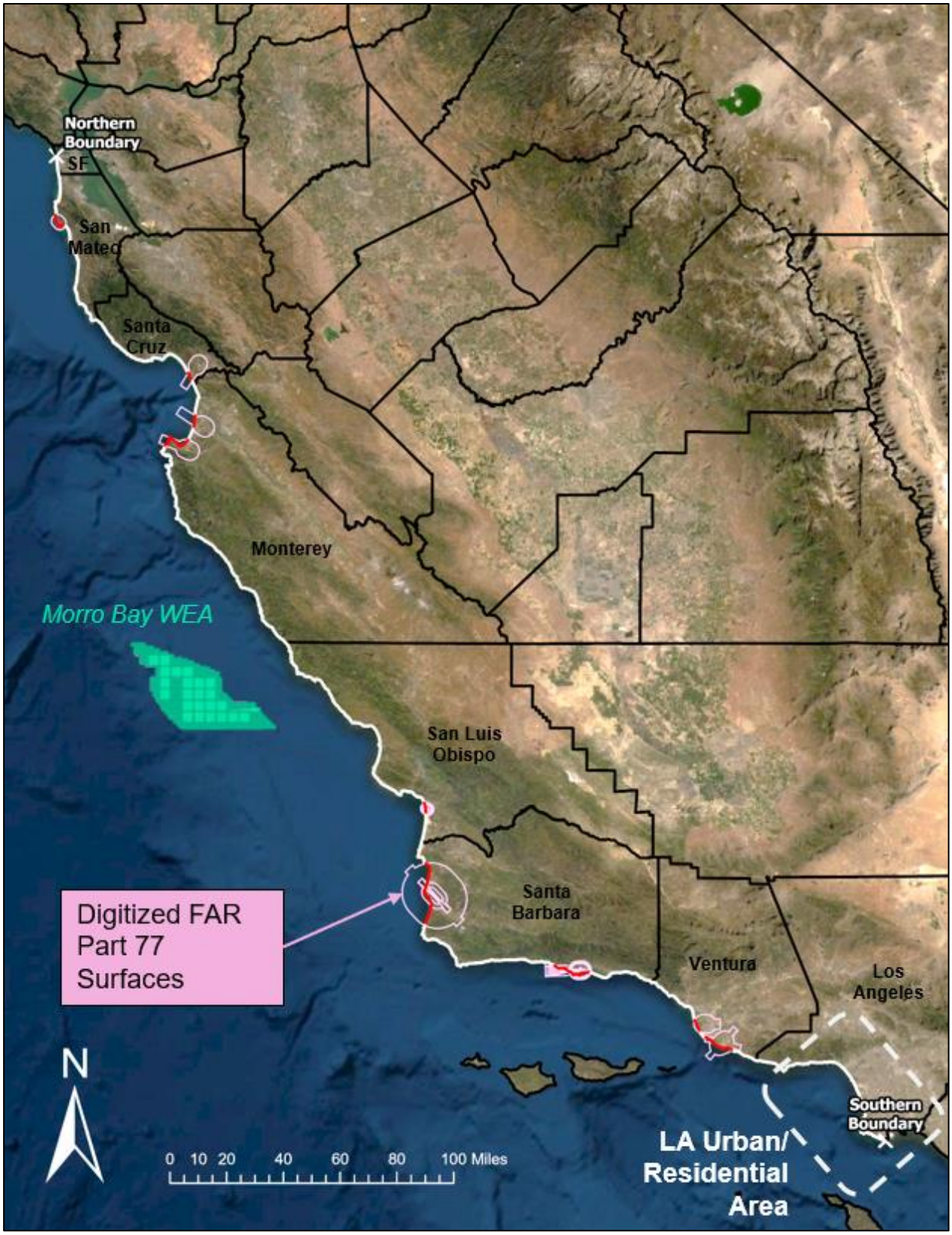

Figure 4.8. Airspace Restrictions (in Pink) Screened Out 13% of the Study Area

Figure 4.9. Combined Screening Criteria Screened Out 77% of the Study Area

This screening process resulted in a Long List of 16 sites. Numbered north to south, the first eight sites are located within the Monterey Bay National Marine Sanctuary and the next five sites are located within the proposed Chumash Heritage National Marine Sanctuary as shown in **Figure 4.10**.

1. Redondo Beach in Half Moon Bay
2. Tunitas Beach
3. South of Pescadero State Beach
4. Spring Bridge Gulch
5. South of Pigeon Point
6. Davenport
7. Moss Landing
8. Lucia Lodge
9. Natalie's Cove
10. China Harbor
11. Toro Creek
12. Diablo Canyon
13. Port San Luis
14. Tajiguas Landfill
15. Gato Canyon
16. Deer Creek Beach

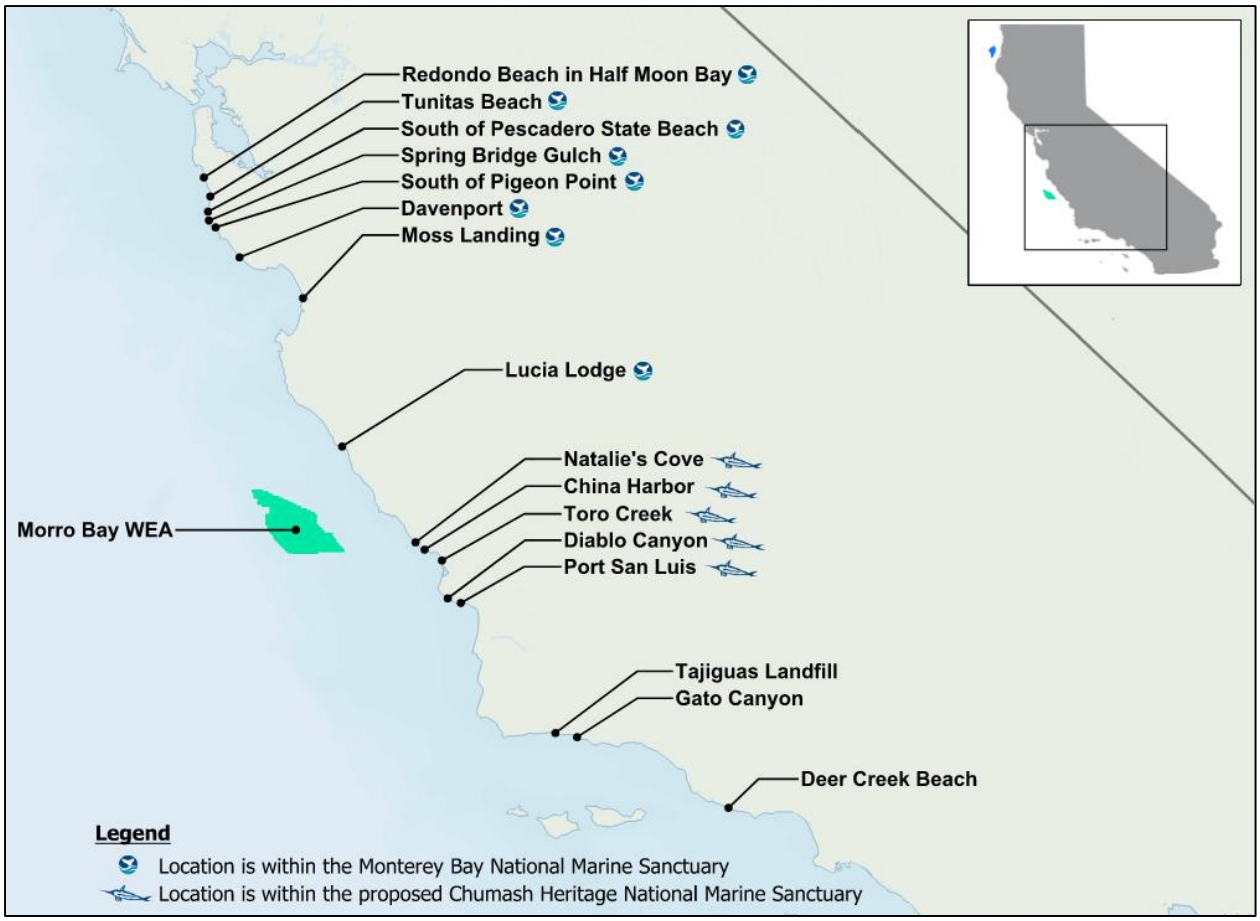

Figure 4.10. Long List of Staging and Integration Sites

4.4. Short List

Geographical and existing constraints were then applied to narrow the 16 Long List sites to 11 Short List sites. South of Pescadero State Beach, Lucia Lodge, Toro Creek, Tajiguas Landfill, and Deer Creek Beach were eliminated due to their proximity to the highway, which greatly reduces the available acreage. The Short List sites, numbered north to south, have six sites within the Monterey Bay National Marine Sanctuary and four sites within the proposed Chumash Heritage National Marine Sanctuary, as shown in **Figure 4.11.** Only one site, Gato Canyon, is located outside the three existing and proposed marine sanctuaries.

1. Redondo Beach in Half Moon Bay
2. Tunitas Beach
3. Spring Bridge Gulch
4. South of Pigeon Point
5. Davenport
6. Moss Landing
7. Natalie's Cove
8. China Harbor
9. Diablo Canyon
10. Port San Luis
11. Gato Canyon

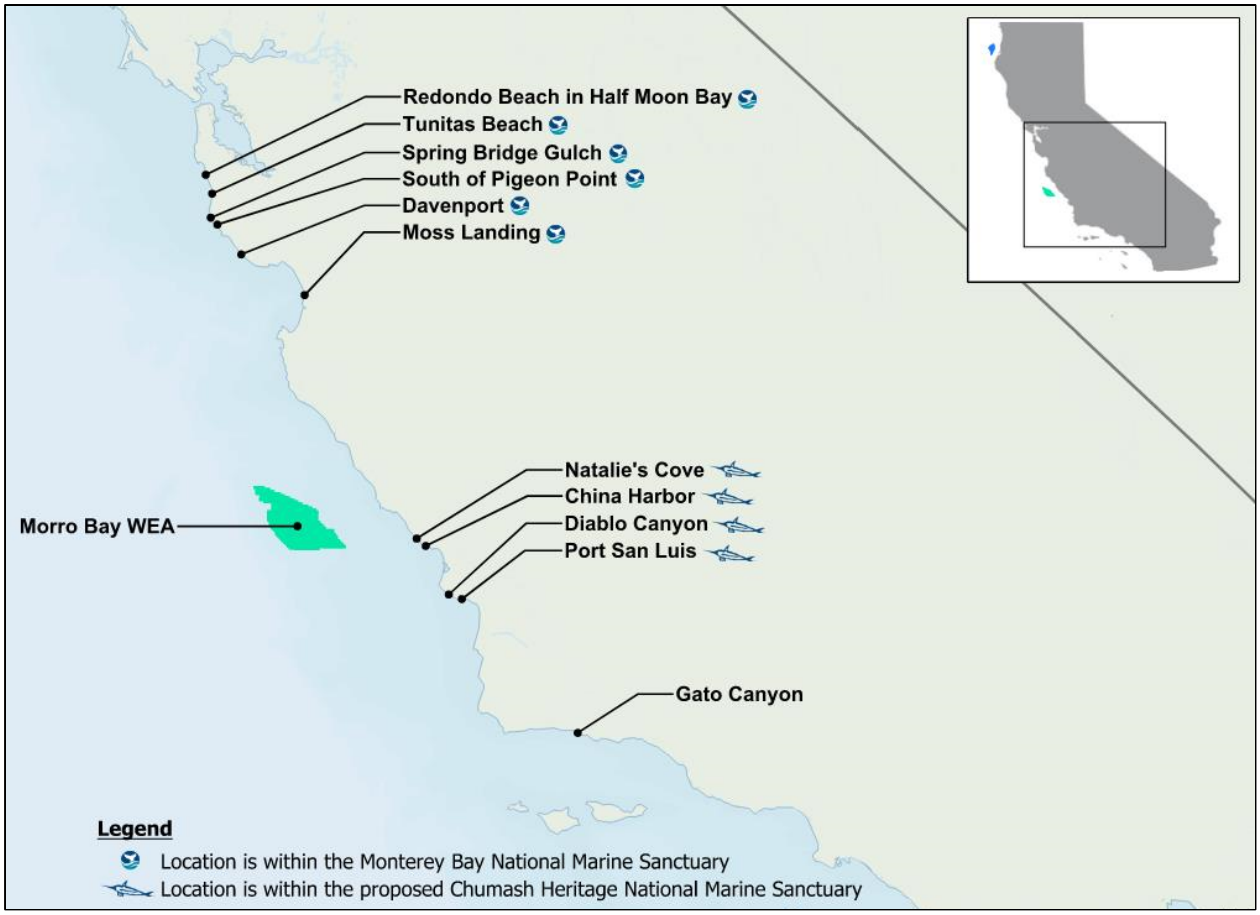

Figure 4.11. Short List of Staging and Integration Sites

4.5. Assessment

The 11 Short List sites were then compared and ranked based on an assessment of the permitting and environmental approvals specified in Section 4.1. Sites in proximity to state parks and marine protected areas or federally protected lands, such as national marine sanctuaries and BLM California coastal national monument lands, were ranked lower. Sites with marine and aquatic resources; terrestrial biological resources; sensitive land uses such as residences, schools, and churches within one mile; as well as environmental justice populations within five miles were also ranked lower. The Environmental Justice Demographic Index, as well as viewshed sensitivity of up to 20 miles was also considered in the ranking process. Some additional assessment factors included workforce and labor availability and required infrastructure improvements such as wharf, breakwater, or upland improvements.

4.5.1. Environmental Assessment

Aspen and Boudreau Associates completed the initial assessment and ranking of the 11 Short List sites. The assessment included research and investigation of environmental and biological resources related to the proposed scope of work, with the results

presented in a tabular/matrix format to facilitate comparisons between sites. Refer to **Attachment A: Environmental Ranking Tables** for the full assessment. The seven factors considered in the environmental assessment and rankings are defined below.

1. California State Parks and Marine Protected Areas
   Site proximity to California State Parks, State Beaches, and California Marine Protected Areas (State Marine Conservation Areas and State Marine Reserves) were evaluated. No sites are within these areas, so sites are ranked based on the number and proximity of protected areas.
2. Federal Protected Lands: California Coastal National Monuments and National Marine Sanctuaries
   - Proximity to federal protected lands, including National Marine Sanctuaries and BLM's California Coastal National Monuments were evaluated. Six sites are within the Monterey Bay National Marine Sanctuary, and four are within the proposed Chumash Heritage National Marine Sanctuary. One site is not within either sanctuary.
   - Subjective weighting of impacts was assigned with greatest severity if the site is within the Monterey Bay National Marine Sanctuary, next tier of severity was assigned if the site is within the proposed Chumash Heritage National Marine Sanctuary. Ranking also considered the proximity and number of California Coastal National Monument features within 1,000 feet.
3. Sensitive Land Uses
   - Presence of residences, churches, schools, and any other sensitive land uses within one mile of the site were evaluated.
   - The sites were ranked based on the estimated population within a one-mile radius, and the proximity of residences, churches, or schools to the site.
4. Environmental Justice
   This discussion is a proxy for a detailed Environmental Justice (EJ) analysis, giving an approximation of the potential size of the EJ population within five miles of each site. This factor does not consider the required analysis of the disproportionate effect on the EJ population because impacts are not yet defined in a way that would allow this analysis to be completed.
   - EJ1: Population Affected
     - The U.S. Environmental Protection Agency's *EJScreen: Environmental Justice Screening and Mapping Tool* (https://www.epa.gov/ejscreen) was used to define the approximate number of people within five miles that are considered to be members of low-income and/or minority populations. The figure was calculated by multiplying the total population within five miles by the EJScreen "demographic index" (the approximate percent of

people considered to be included in low-income and/or minority population categories).

- EJ2: Demographic Index
  - *EJScreen* was used to define the Demographic Index percentage within a five mile radius of the site which was compared with the State average (47%). A higher demographic index indicates the likelihood that there is a greater EJ (lower income and higher minority) population within five miles. Ranking: EJ1 and EJ2 scores were each included at 50% weight

5. Terrestrial Biological Resources
   - This analysis used mapping generated by the California Natural Diversity Database and evaluation of satellite photography (Google Earth). The analysis considered the documented presence of protected species (state and federal endangered species), the level of protection (indication of species rarity) for each species present, the presence of protected native plants, and presence of nearby rivers and streams.
   - The sites were ranked by the number and level of protection of threatened and endangered species.
6. Viewshed Sensitivity
   - Viewshed maps were prepared for each site, showing where the 1,100-foot-tall offshore wind turbines could be seen in a 20-mile radius of the site. These maps were viewed in conjunction with the proximity of each site to protected or populated areas (see Factors 1, 2, and 3 above), and the proximity of the port to designated scenic corridors (i.e., Highway 1).
   - The sites were ranked based on team expertise after considering the factors described above.
7. Aquatic/Marine Biology
   - The sites were ranked based on consideration of several factors. The ranking considered proximity to Marine Protected Areas, then it evaluated the potential presence of species present or mapped in the area. The species considered were: cetaceans (e.g., whales/dolphins); pinnipeds (e.g., seals) and fish, avian, and vegetation/other species (e.g., kelp beds, turtles, abalone, etc.). Evaluation assumed that construction impacts would result from dredging and associated testing and analysis, along with construction of breakwaters and pile driving.
   - The sites were ranked based on their proximity to Marine Protected Areas and the number and type of species that could be affected. The analysis also considered critical habitat, migratory routes, habitats of particular concern, and biologically important areas.

It should be noted that the approach to develop the rankings was very high level and, in some cases, required a qualitative review of environmental and population impact factors typically considered for industrial-scale infrastructure siting. Therefore, the information below is not based on detailed and/or quantitative analysis. **Table 4.3** summarizes the environmental assessment scores in the middle column and the far-right column shows the score converted to a 1 to 11 point scale that is used in the overall ranking in **Section 4.6**.

Table 4.3. Environmental Assessment Summary

Site	Environmental Assessment Score	Converted Score (1-11)
Port San Luis	19.5	**1**
Diablo Canyon	20.0	**2**
China Harbor	34.0	**3**
Natalie's Cove	38.5	**4**
Gato Canyon	47.0	**5**
Redondo Beach in Half Moon Bay	52.0	**6**
Tunitas Beach	57.0	**7**
Moss Landing	58.5	**8**
Spring Bridge Gulch	61.5	**9**
Davenport	62.0	**10**
South of Pigeon Point	67.5	**11**

To develop the rankings shown in **Table 4.3**, all factors except terrestrial biological resources and marine/aquatic resources were ranked from 1 to 11 with 1 indicating least environmental impact and 11 indicating greatest environmental impact. Terrestrial biological resources and marine/aquatic resources were ranked based on three impact levels: least impact, middle range, and most impact. For the detailed ranking matrix refer to **Attachment A: Environmental Ranking Tables**.

Constraints associated with the screening and ranking process completed in this phase of the study of potential port sites are discussed below.

4.5.1.1. Marine and Aquatic Biology

A high-level screening assessment of potential critical issues related to aquatic physical and biological resources was conducted for each of the identified Short List locations. This screening study explored the feasibility of redeveloping or expanding already developed waterfronts for necessary floating offshore wind services. For this study, only a high-level qualitative screening of aquatic resources and potential impacts from conceptual construction methods was reviewed.

The following variables were not considered in the screening process:

- Site specific data regarding species listed as threatened or species of concern was not reviewed. Only data on species readily available for the larger area through California Natural Diversity Database and DataBasin.org websites were used.
- Biological surveys were not conducted nor were delineations to assess shoreline habitats.
- Effects of sea level rise, storm wind/wave or changes to tidal heights and their potential impact on construction and, thus, biological resources were not included in the screening. This level of evaluation is highly dependent on location and other variables that were not feasible to evaluate during this study.
- Calculation of potential sound impacts to marine mammals and other aquatic species was not conducted. Site specific geotechnical data will be required to calculate sound impacts as well as specific size, quantity, and location of proposed piles. It was assumed that based on the probable large pile size and quantity; sound impacts would be significant and associated compensatory mitigation will be significant as well.
- Sediment quality information was not available. Specific site characterization of soil and sediment within the project boundary will need to be conducted to ascertain potential impacts from any contamination or physical (grain size) or conventional (percent solids, total organic carbon [TOC], ammonia, sulfides, etc.) test results.
- Bathymetric data was not reviewed and was not readily available for the proposed locations.
- Calculations on the volume and area of fill could not be conducted. Once conceptual designs are produced then "fill" within the various regulatory agencies' jurisdictions can be assessed and related compensatory mitigation can be estimated.

4.5.1.2. Environmental Factors Not Including Marine or Aquatic Biology

The ranking exercise was very high level and much of it was based on the team's personal experience and knowledge of the coast and its resources. Also, the environmental team considered a variety of potential impacts but did not consider "permitting risk." This is a difficult factor to evaluate because sites of the size and scale required for offshore wind development have not been developed on the west coast yet.

Listed below are other factors that were not included in the qualitative analyses that were completed:

- For visual resources, a detailed analysis of sensitive receptors or viewers (i.e., recreation and residential uses) within the viewsheds affected was not conducted. Consideration of the viewers within those viewsheds may result in different conclusions and ratings.
- For EJ, a formal EJ analysis using detailed quantitative population characteristics and accurate screening criteria was not prepared. With additional time and budget, the *CalEnviroScreen* model would most likely be run, which would analyze effects based on 19 factors.
- For land use concerns, a detailed land use survey and detailed review of applicable planning and zoning requirements surrounding each site were not completed. A desktop, qualitative land use review using Google Earth was conducted to identify potential sensitive receptors.
- The following factors could not be considered:
  - Air emissions from each site resulting from construction and or transport of materials that could affect surrounding land uses.
  - Sensitivity of each site to nighttime lighting.
  - Sensitivity of each site to noise impacts.
  - Transport of construction and operation equipment/materials (distance along local routes/street network and possible conflicts for local land uses).
  - Hazards or concerns from fuel transport and storage (risk would vary depending on transport distance and proximity of surrounding land uses).

Compensatory Mitigation

Another element that was not considered was compensatory mitigation for significant impacts. The regulatory agencies, for permit issuance, will require compensatory mitigation for the project's impacts, both short-term and long-term, on waters of the U.S. and state, biological resources, and other jurisdictional features. Significant impacts need to be assessed for each specific location and the associated impacts related to the conceptual design for each location. At this stage of the screening, conceptual designs for each location were not feasible and the permitting team assumed similar size and configuration for the piers and breakwater structures as well as over 100 large piles (e.g., greater than 30 inches in diameter).

Preliminary impacts to habitat, aquatic vegetation, or biological resources that have been identified but not quantified due to the preliminary stage of the screening are not limited to, but include some of the following:

- Sound impacts to biological resources from pile driving
- Fill/excavation from construction of various structures
- Dredging activities which can affect/disturb/remove existing habitat

- Resuspension of sediment/turbidity issues with construction
- Sediment transport and water quality effects
- Removal or interference with existing structures such as pipelines, outfalls, submarine cables, etc.

Once a specific project's impacts on these resources are identified, development of a draft compensatory mitigation plan to address multiple regulatory and resource agencies' requirements to mitigate for impacts to resources or inconsistency with policies will be necessary. Compensatory mitigation could be provided off-site, through purchasing credits at mitigation banks, contributing fees to ongoing mitigation projects, or other means. It seems unlikely that on-site mitigation components would be feasible at the proposed locations and were not considered as part of the development of any of the locations.

Selection of the possible mitigation strategies will be based on a comparison of the potential impacts with the benefits to be derived from the proposed mitigation measure and the cost to implement the mitigation measure. A mitigation package will need to identify the location of the mitigation, description of the mitigation action, functional benefits of the action, property ownership, approximate cost to implement the mitigation action, and potential partnering opportunities. The final mitigation agreements would be documented in multiple pertinent permits (e.g., USACE/Biological Opinions from National Marine Fisheries Service [NMFS] and U.S. Fish and Wildlife Service [USFWS], Regional Water Quality Control Board [RWQCB], California Department of Fish and Wildlife [CDFW] and/or memoranda of understanding with a particular resource trustee).

Since impacts are unknown at this time, mitigation fees cannot be estimated but a placeholder should be included in the overall assessment for project costs.

4.5.2. Engineering Assessment

Understanding the complexities of each potential port site from an engineering perspective is important in determining the final rankings of the Short List sites. Moffatt & Nichol performed a high-level engineering assessment of the 11 potential S&I port sites, which included investigation of land and water resources related to the proposed scope of work. A 1 to 3 point scoring system was used for each screening category with 1 being a better score than 2, and 2 better than 3. The criteria considered in the engineering assessment and rankings is defined below.

1. Landside Connection
    - The water to landside connection of each site was evaluated with the following point designations:
        - 1: a site's landside connection is relatively flat with significant acreage at the same elevation

- 2: a site's landside connection may have some elevation change
- 3: a site's landside connection has significant elevation change (i.e., cliffs)

2. Water Depth
   - The required water depth for an S&I site shall be at a minimum, 38 feet to accommodate delivery vessels and the floating foundations of the offshore wind turbines. Therefore, deeper water at the site is preferred and will also reduce dredging costs. The following point designation was used:
     - 1: a site's water depth is adequate (38 feet)
     - 2: a site's water depth is not 38 feet but may gradually drop off (e.g., a harbor or cove)
     - 3: a site's water depth at the landside connection is minimal (e.g., a beach)
3. Distance to Pacific Coast Highway (PCH)
   - PCH runs along the California coast and in several areas is just a short distance from the shoreline and restricts the amount of acreage available for use. The following point designation was used:
     - 1: a site's distance to PCH provides at least 80 acres of land between water and PCH
     - 2: a site's distance to PCH provides less than 40 acres of land between water and PCH for a site
     - 3: a site's distance to PCH provides minimal acreage of land between water and PCH, requiring modifications to the highway.
4. Metocean Protection
   - Providing protection from metocean conditions (e.g., waves, currents, etc.) is critical to ensure safe working conditions for assembling the offshore wind turbines. The following point designation was used:
     - 1: a site provides adequate protection from metocean conditions
     - 2: a site provides some protection from metocean conditions but will require construction of additional protection
     - 3: a site provides no protection from metocean conditions and will require construction of a protected harbor
5. Dredging / Fill
   - Each site will require some form of dredging and fill to meet the S&I port site requirements (e.g., berth depth, upland acreage, etc.). The following point designation was used:

- 1: a site requires minimal dredging/fill
- 2: a site requires a fair amount of dredging/fill
- 3: a site requires significant dredging/fill

With this engineering criteria, the 11 sites were assessed and assigned point values, as summarized in **Table 4.4.** The total score was then converted to a 1 to 11 point scale in the last column for use in the overall ranking in **Section 4.6**.

Table 4.4. Engineering Assessment Summary

Site	Landside Connection	Water Depth	Distance to PCH	Metocean Protection	Dredging / Fill	Total Score	Converted Score (1-11)
Port San Luis	2	2	1	2	3	10	**1.5**
Gato Canyon	2	2	1	3	2	10	**1.5**
Redondo Beach in Half Moon Bay	1	3	1	3	3	11	**4**
Natalie's Cove	2	2	1	3	3	11	**4**
China Harbor	2	2	1	3	3	11	**4**
Tunitas Beach	1	3	2	3	3	12	**7**
Davenport	1	3	2	3	3	12	**7**
Moss Landing	1	3	2	3	3	12	**7**
Diablo Canyon	3	2	2	3	3	13	**9**
South of Pigeon Pt.	2	3	2	3	3	13	**10**
Spring Bridge Gulch	3	3	3	3	3	15	**11**

4.5.3. Workforce Assessment

A high-level workforce screening was conducted around the 11 potential alternative S&I sites for the development of offshore wind. The development of a skilled and trained workforce in California will be crucial to the success of a local floating offshore wind industry. The majority of the job roles required to develop a floating offshore wind farm will be quayside roles, as any potential future manufacturing or assembly facilities will need to be located at the sites due to the size of components being manufactured, structures being assembled, and the preferred offshore wind industry tow-out method required to install floating wind turbines offshore. With the highest demand for workforce associated with near-port activities, labor availability can be an influencing factor when identifying potential sites for offshore wind development. Proximity to high population centers is indicative of the potential size of an available workforce. Publicly available data was used to observe the populations for the five counties within which the 11 potential sites reside, including San Mateo, Santa Cruz, Monterey, San Luis Obispo, and Santa Barbara. Using publicly available datasets, the size of the workforce employed in industries needed for offshore wind support was analyzed for each county,

as shown in **Figure 4.12** and **Table 4.5. Full-time Employment in Supporting Industries Adjacent to Offshore Wind Development Sites for Counties in** California**.**

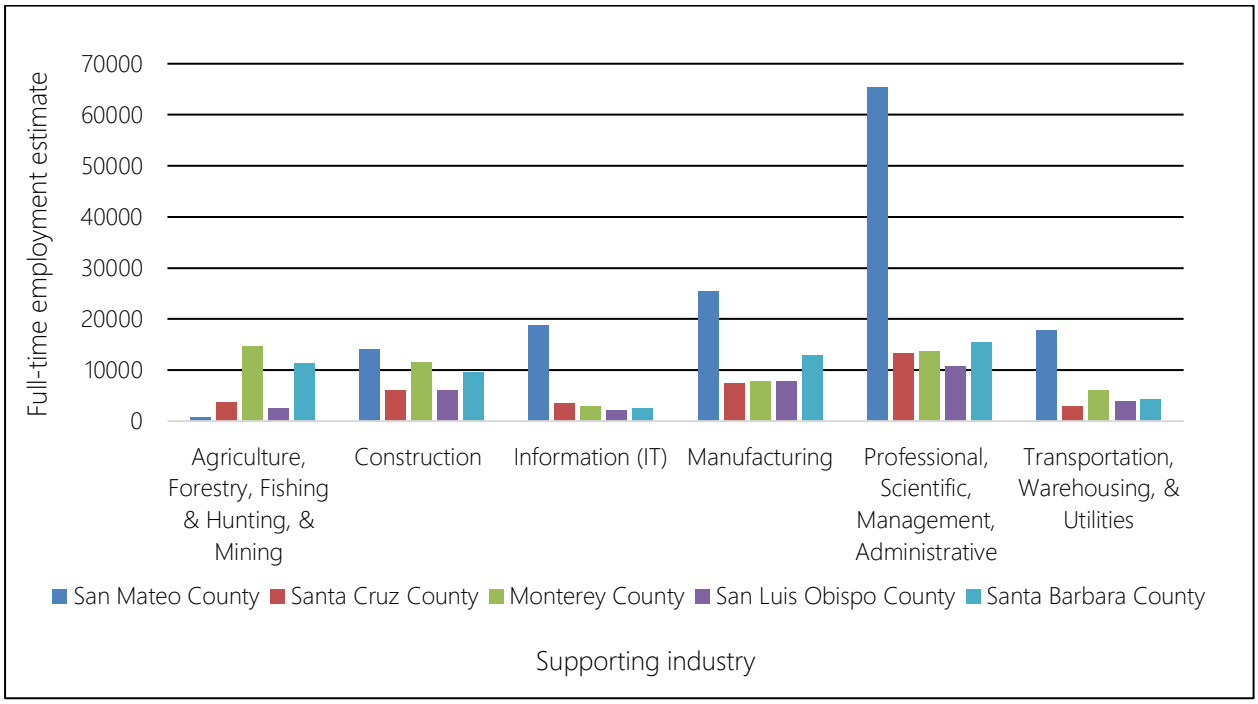

Figure 4.12. Full-time Employment in Supporting Industries Adjacent to Offshore Wind Development Sites for Different Counties in California

Table 4.5. Full-time Employment in Supporting Industries Adjacent to Offshore Wind Development Sites for Counties in California

Industry	San Mateo	Santa Cruz	Monterey	San Luis Obispo	Santa Barbara
Agriculture, Forestry, Fishing & Hunting, Mining	860	3,598	14,680	2,497	11,275
Construction	14,025	6,054	11,551	6,043	9,520
Information (IT)	18,636	3,573	2,876	2,020	2,613
Manufacturing	25,400	7,513	7,679	7,823	12,900
Professional, Scientific, Management, Administrative	65,385	13,357	13,737	10,684	15,473
Transportation, Warehousing, Utilities	17,727	2,881	5,994	3,969	4,367

The sites were scored with a 1 to 4 point scoring system with 1 being an optimal location and 4 being the least optimal in terms of workforce as described in **Table 4.6. Workforce Assessment Scoring Mechanism**

Table 4.6. Workforce Assessment Scoring Mechanism

Score	Definition
1	The port is surrounded by densely populated regions, with sufficient workforce working in adjacent industries.
2	The port is either in a relatively populated region or nearby to a highly populated region, where there is a workforce in adjacent industries. Workforce recruitment may still be necessary.
3	The port is surrounded by relatively low populated regions where a workforce may be recruited, and population centers are commutable distances. The county has workforce representation in adjacent industries.
4	The port is surrounded by significantly low populated regions. A shortage in workforce is noted; however, the location is within a commutable distance to population centers, where limited workforce could potentially be recruited.

The outcome of the assessment is shown in **Table 4.7. Workforce Assessment Summary**, with the middle column showing a site's workforce assessment score of 1 to 4 and the right column showing the scores converted to a 1 to 11 point scale that is used in the overall ranking in **Section 4.6**. The results of this study indicate San Mateo County has a significantly larger workforce in all applicable industries than the other counties observed, due to the population size. This implies sufficient workforce exists and workforce recruitment will likely not be necessary. The remaining counties have scored similarly in terms of workforce availability in the applicable industries. When comparing Santa Cruz, Monterey, San Luis Obispo, and Santa Barbara, Santa Barbara is viewed best in terms of existing workforce in the Manufacturing and Professional industries.

Table 4.7. Workforce Assessment Summary

Site	Workforce Assessment Score	Converted Score (1-11)
Redondo Beach in Half Moon Bay	1	**1.5**
Tunitas Beach	1	**1.5**
Spring Bridge Gulch	2	**4**
South of Pigeon Point	2	**4**
Moss Landing	2	**4**
Gato Canyon	3	**6**
Davenport	4	**9**
Natalie's Cove	4	**9**
China Harbor	4	**9**
Diablo Canyon	4	**9**
Port San Luis	4	**9**

An in-depth assessment of the workforce around the identified potential sites will be necessary to better inform the need for a workforce strategy and recruitment plan, to ensure a sufficient workforce is available for the anticipated magnitude of projects in California.

4.6. Overall Ranking, Cost, and Timeline

Once the environmental, engineering, and workforce assessments were completed, the 11 potential S&I sites were then ranked, taking all three assessments into consideration. This was accomplished by creating a consistent scoring system through all three assessments by assigning a point value between 1 and 11 to each site based on how it was scored in each assessment. A weight percentage was also applied to each assessment with the environmental assessment weighted at 60%, the engineering assessment weighted at 35%, and the workforce assessment weighted at 5%. This process is summarized in **Table 4.8** below.

Table 4.8. Overall Assessment Summary

Site	Environmental Converted Scores (1-11) 60%	Workforce Converted Scores (1-11) 5%	Engineering Converted Scores (1-11) 35%	Weighted Total
Port San Luis	1	9	1.5	1.58
China Harbor	3	9	4	3.65
Gato Canyon	5	6	1.5	3.83
Natalie's Cove	4	9	4	4.25
Diablo Canyon	2	9	9.5	4.98
Redondo Beach in Half Moon Bay	6	1.5	4	5.08
Tunitas Beach	7	1.5	7	6.73
Moss Landing	8	4	7	7.45
Davenport	10	9	7	8.90
Spring Gulch Beach	9	4	11	9.45
South of Pigeon Point	11	4	9.5	10.13

The sites were then ranked according to **Table 4.8** above, with the lowest value for 'Weighted Total' ranked as more favorable and the highest value ranked as the least favorable.

1. **Port San Luis**
2. **China Harbor**
3. **Gato Canyon**
4. Natalie's Cove
5. Diablo Canyon
6. Redondo Beach in Half Moon Bay
7. Tunitas Beach
8. Moss Landing
9. Davenport
10. Spring Gulch Beach
11. South of Pigeon Point

High-Level Cost

For the top three sites, an AACE Class 5 cost estimate was completed to include the following upgrades to develop an S&I site:

- Heavy lift wharf that can withstand 6,000 psf
- 80 acres of high-capacity upland area
- Dredging for a 38-ft berth depth
- Breakwater for metocean protection
- Environmental mitigation allowance

These improvements at Port San Luis are estimated to be approximately $2.4 billion, $2.2 billion at China Harbor, and $2.5 billion at Gato Canyon, in 2022 dollars. This type of estimate has a typical expected variation in cost accuracy of -20% to -50% (low range) and +30% to +100% (high range). Prior project experience, conceptual engineering analyses, and professional judgement aided in the development of these cost estimates. As the full scale of potential offshore wind port sites is still unknown, it is important to note that costs will likely vary.

Projected Timeline

A development timeline to construct either of the top three S&I sites was also estimated. The build out of an S&I site at Port San Luis, China Harbor, or Gato Canyon will take approximately 10 to 15 years since a port authority will first need to be established to then initiate this type of project with significant impacts.

5. Operation and Maintenance Site Screening

To support the operations and maintenance of offshore wind turbines, a fleet of vessels can work from a supply base that is relatively close to the offshore project site. The location of the supply base has a direct impact on operational efficiencies in order to ensure offshore workers have the shortest possible transit time. O&M sites require less onshore acreage, less water depth, and a shorter segment of waterfront than the S&I sites, and therefore, there are a greater number of potential options within the study area. Multiple O&M bases are likely required to support the multiple offshore wind farms within the study area. Thus, the intent of this assessment is to identify suitable existing harbors and marine facilities that may serve as O&M sites within the study area.

For this study, an O&M site refers to a facility that is a home port site for O&M vessels and supporting warehouse/offices during the operation period of the offshore wind farm. It is assumed that other maintenance activities which require a turbine system to be towed back to port from the offshore wind farm would be performed at an S&I site where large assembly cranes are located.

Generally speaking, a waterfront facility that can accommodate a variety of O&M vessels is preferred. This allows a more flexible arrangement of the O&M fleet and, therefore, a higher utilization of the harbor/waterfront facility. In this study, it is assumed that the O&M vessel fleet may consist of a combination of CTVs, SATVs, and SOVs, as shown in **Table 5.1**. Note that ranges for the assumed vessel geometry are provided because the actual dimensions may vary depending on vessel availability, water depths, length of cabling, wave conditions, and vessel access constraints. In addition, some of the O&M vessels that will serve the floating offshore wind industry are still in development and may not be ready at this time.

Table 5.1. Description and Assumed Geometry of O&M Vessels

Vessel Type	Description	Assumed Geometry
Crew Transfer Vessel (CTV)	Transfers small crews to offshore wind turbine installations for day-trip O&M visits and inspections.	Length: 65 to 90 ft (20 to 27 m) Beam: 22 to 30 ft (7 to 9 m) Draft: 5 to 10 ft (2 to 3 m)
Service Accommodation Transfer Vessel (SATV)	Intermediate size between SOVs and CTVs, with ability to sleep onboard for multiday trips.	Length: 100 to 130 ft (30 to 40 m) Beam: 30 to 50 ft (9 to 15 m) Draft: 10 to 16 ft (3 to 5 m)
Service Operating Vessel (SOV)	Vessels that loiter and operate as in-field accommodations for workers and platform assistance for wind turbine servicing and repair work.	Length: 200 to 400 ft (61 to 122 m) Beam: 50 to 80 ft (15 to 24 m) Draft: 16 to 25 ft (5 to 8 m)

5.1. Operation and Maintenance Site Screening Process

The criteria and process utilized for screening O&M sites is described below.

1. **Identify Long List**

   The O&M screening assessment was initiated by identifying a Long List of existing ports, harbors, and waterfront facilities located within the study area.

2. **High-level engineering assessment to determine the Short List**

   The Long List was screened against a set of suitability criteria that included both distance from the call area and facility characteristics, such as:

   - Navigable Access: channel dimensions and turning basin diameter vary with vessel type, but generally require water depths of 15 to 25+ feet (deeper for larger vessels). It is typically more challenging, with a longer lead time, to re-configure and significantly deepen an existing harbor than to plan and construct new waterfront structures.
   - Waterfront Moorage: CTVs require boarding floats for berthing. SOVs require a fixed wharf.
   - Wave Exposure: a protected harbor is needed for long-term moorage of smaller vessels such as CTVs and SATVs.
   - Upland Area: an area of two to ten acres is likely needed for office, equipment staging, parking, and other purposes.
   - Current Uses: there is a very strong preference for upgrading underutilized areas rather than displacing existing waterfront dependent uses, such as recreation, commercial fishing, and other port operations.

3. **Assess Short List sites**

   The Short List sites were then assessed and categorized based on site infrastructure and apparent capability to support the following:

   - Crew Transfer: Transfer of crew personnel only – no moorage
   - CTV Moorage: Long-term moorage of CTVs
   - SATV Access: Long-term moorage of SATVs
   - SOV Access: Long-term moorage of SOVs

   In addition, outreach to the Short List sites was conducted to determine their interest in supporting offshore wind development.

4. **Identify required upgrades and provide planning-level cost estimates / schedule**
   The expected range of construction costs and a development timeline is provided for two tiers of O&M facility upgrades.

5.2. Long List

A Long List of sites was developed based on visual inspection of the shoreline to identify existing marine facilities such as harbors, piers, and small craft marinas. A total of 41 sites were identified during this assessment, as shown in **Figure 5.1**. Important characteristics of each site, such as extent of wave protection and depths and widths of navigation channels, if present, were recorded to provide a basis for concept evaluation (refer to Attachment B). The majority of sites are municipally owned with a primary function of supporting either recreation and/or commercial fishing. This assessment utilized publicly available data from Google Earth, NOAA Nautical Charts, and USACE Hydrographic Surveys.

1. Pacific Municipal Pier
2. Pillar Point Harbor
3. Santa Cruz Wharf
4. Santa Cruz Small Craft Harbor
5. Capitola Wharf
6. Seacliff Pier
7. Moss Landing Harbor
8. Monterey Harbor
9. Stillwater Cove Boat Ramp
10. William Randolph Hearst Beach
11. Water Treatment Plant/Abalone Farm
12. Cayucos Pier
13. Morro Bay
14. Diablo Canyon
15. Port San Luis Pier & Breakwater
16. Cal Poly Pier
17. Avila Pier
18. Pismo Beach Pier
19. Vandenberg Barge Berth
20. Gaviota Beach
21. Gaviota Substation
22. Ellwood Pier
23. Goleta Pier and Slough
24. Santa Barbara Harbor
25. Stearns Wharf
26. Casitas Pier
27. Richfield Pier
28. Ventura Pier
29. Ventura Harbor
30. Channel Island Harbor
31. Port of Hueneme
32. Port Hueneme Fishing Pier
33. Paradise Cove Pier
34. Malibu Pier
35. Santa Monica Fishing Pier
36. Venice Fishing Pier
37. Marina Del Rey
38. Playa Del Rey Beach Pier
39. Manhattan Beach Pier
40. Hermosa Beach Pier
41. King Harbor

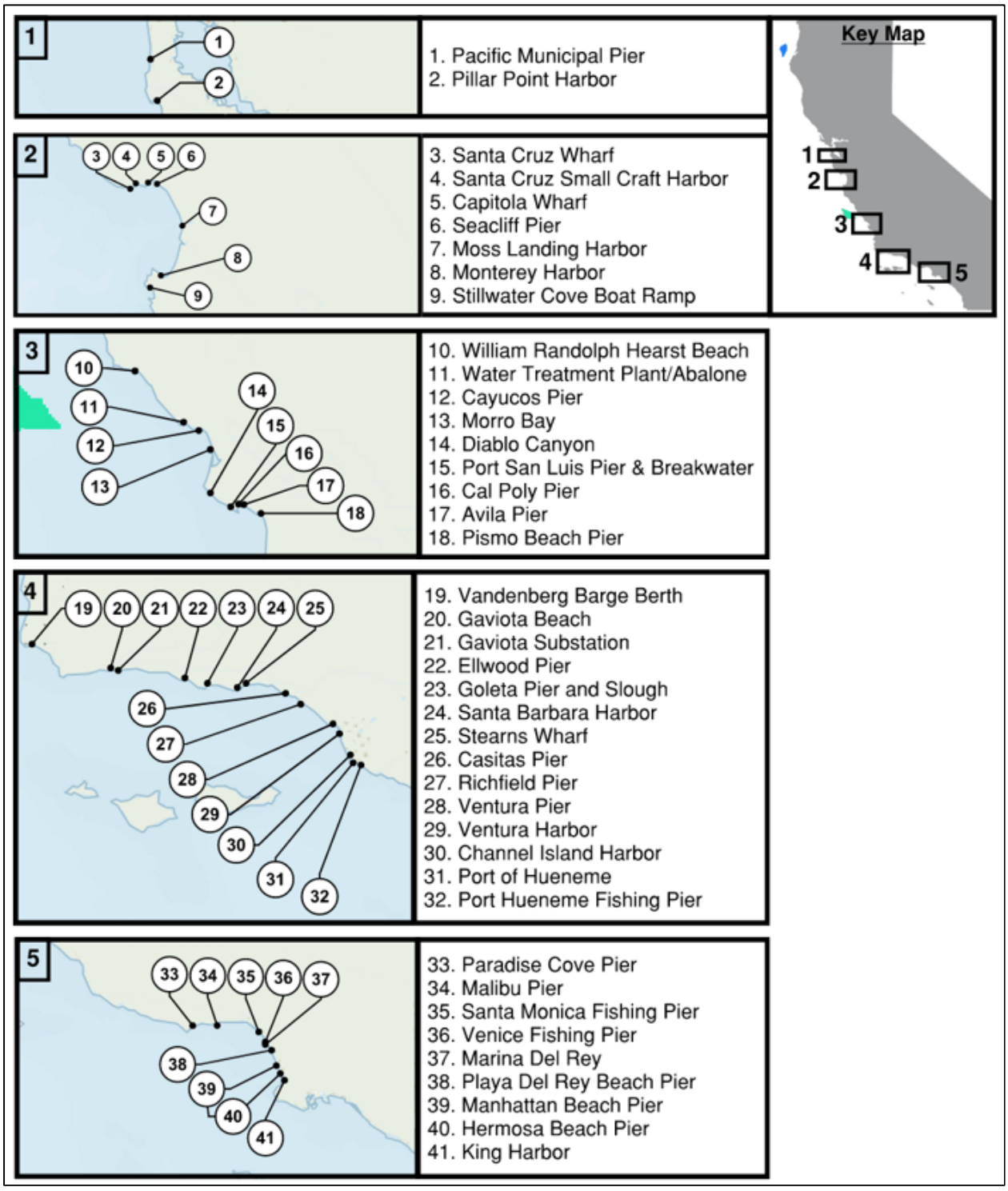

Figure 5.1. Long List of Operation and Maintenance Sites

5.3. Short List

The first step to screening the Long List was eliminate the facilities located a substantial distance from the Morro Bay WEA. This included any site further than 160 miles south of the Morro Bay WEA, which is the distance from the Morro Bay WEA to the entrance of the San Francisco Bay. It was decided that upgrading existing waterfront infrastructure further than this distance is likely not favorable considering there are several facilities within the Bay Area that may be suitable for O&M activities.

Following this geographic screening, sites were further eliminated if they didn't have adequate channel geometry, wave protection, and/or infrastructure that could provide adequate vessel access and/or moorage for O&M. The specific criteria utilized are listed in **Table 5.2** and were compared against the site conditions of the facilities within the geographic screening area.

Table 5.2. Screening Criteria for Different O&M Activities

O&M Activity	Screening Criteria
Crew Transfer (no permanent moorage or onshore facilities)	Channel and berth dimensions to accommodate CTV, SATV, or SOV at most water levels.
CTV Moorage and O&M Base	• Channel and berth dimensions to accommodate CTV at all water levels, or the potential to conduct moderate levels of dredging. • Protected harbor.
SATV Moorage and O&M Base	• Channel and berth dimensions to accommodate SATV at all water levels, or the potential to conduct moderate levels of dredging. • Protected harbor.
SOV Access and O&M Base	Channel and berth dimensions to accommodate SOVs at all water levels, or the potential to conduct moderate levels of dredging.

This resulted in 13 remaining sites that appear more favorable for servicing the offshore wind industry (refer to **Figure 5.2**). The 13 Short List sites are:

1. Pillar Point Harbor
2. Santa Cruz Wharf
3. Santa Cruz Small Craft Harbor
4. Moss Landing Harbor
5. Monterey Harbor
6. Morro Bay
7. Diablo Canyon
8. Port San Luis Pier & Breakwater
9. Cal Poly Pier
10. Vandenberg Barge Berth
11. Ellwood Pier
12. Santa Barbara Harbor
13. Stearns Wharf

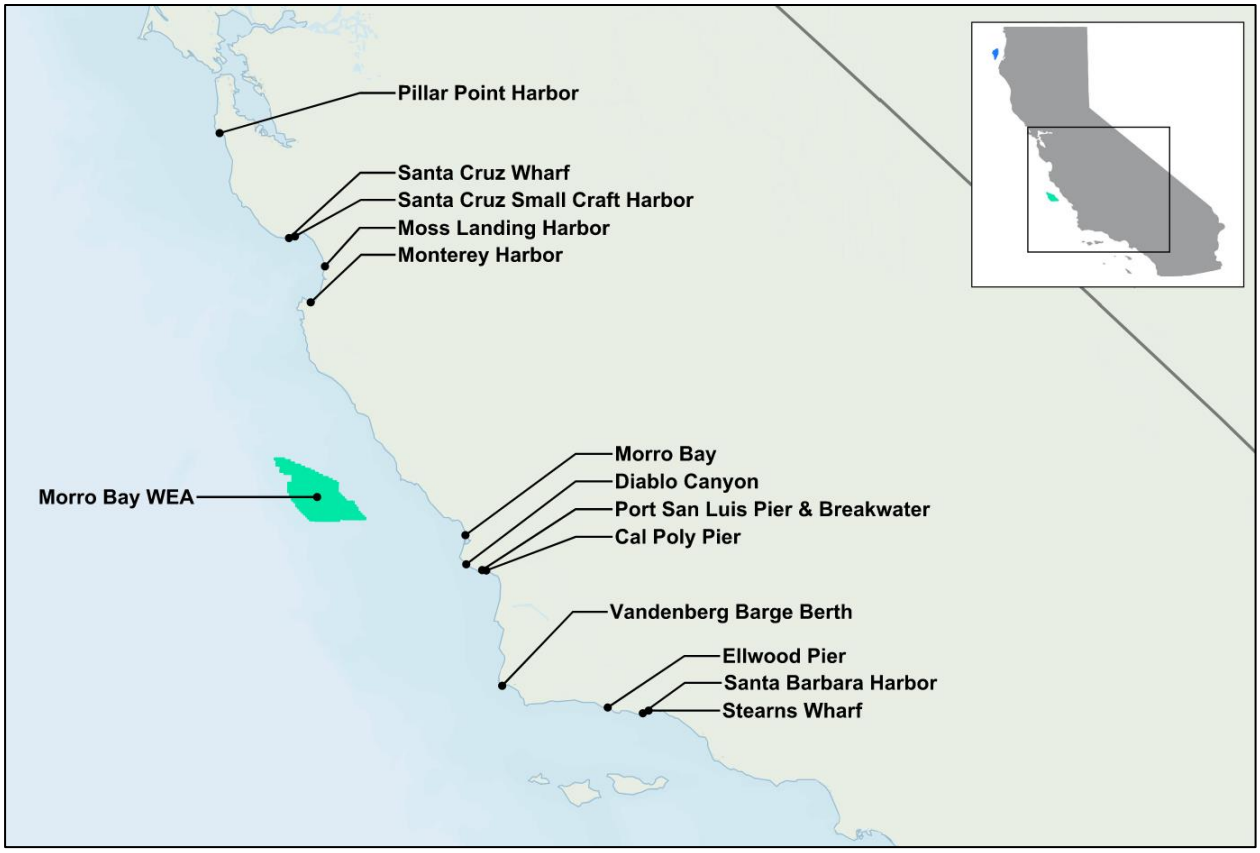

Figure 5.2. Short List of Operation and Maintenance Sites

5.4. Assessment

The 13 sites were further assessed based on engagement with site owners and qualitative conceptual engineering assessments to identify which O&M activities are potentially feasible at each site. Outreach to multiple harbors was conducted as part of this study to better understand existing conditions and potential limits/constraints as it relates to the activities assessed. Inputs from the owners have been summarized below for the sites denoted by an asterisk. Additional input has been received from other site owners as parts of either prior or parallel studies, and is not included herein, but has been incorporated into the results provided in **Figure 5.3. Operation and Maintenance Assessment per Activity**.

1. Pillar Point Harbor*
    - Potential candidate for crew transfer, CTV, SATV, and SOV moorage because the site is a protected harbor with adequate channel width but will require improvements such as a new waterfront facility and dredging.
    - Input from owners:

- The harbor is split into an inner and outer harbor by an internal breakwater. The inner harbor is at capacity and is unlikely to accommodate additional O&M vessels.
- It may be possible to redevelop a demolished pier, Romeo Pier, located west of the inner harbor to support various activities. Expansion of the existing navigation channels with dredging is needed for vessel access to this area.
- Currently, vessels are being anchored in the outer harbor year-round.

2. Santa Cruz Wharf*
   - Potential candidate for crew transfer, but it would be seasonal – possible during the summer, but not during the winter because of weather and large waves. CTV, SATV, and SOV moorage are not favorable at this site because there is no protected harbor and winter conditions are not ideal.
   - Input from owners:
     - No acreage for warehouses and offices were identified.
3. Santa Cruz Harbor*
   - Potential candidate for crew transfer but shoaling and limited water depth within the harbor restrict vessel size and moorage of CTV, SATV, and SOVs.
   - Input from owners:
     - The dredging depth for the harbor entrance is limited to 20 ft only per USACE. However, due to shoaling, the typical range for the channel is 12 to 15 ft.
     - The harbor has an t-ft deep fairway. Shoaling in the channel has occurred.
     - The harbor is small in size with limited space for vessels over 60 ft in length.
     - There is no industrial space around the harbor. Upland space is limited and likely insufficient for a warehouse or new offices.
4. Moss Landing Harbor*
   - Potential candidate for crew transfer, CTV, and SATV moorage because the site is a protected harbor; however, SOV moorage is unlikely due to site geometry.
   - Input from owners:
     - Most waterfront areas on the south side of the harbor are private property, it may be possible to develop a portion of waterfront space north of the harbor entrance as an O&M base. Additional in-water infrastructure would likely be required.

- The parking lot north of the main area is used heavily during the fishing season for boat launching from trailers and may cause user conflict.
- Major harbor re-configuration and dredging would likely be needed to allow SOVs to access the harbor on a consistent basis.
- There is low clearance on the Highway 1 bridge, which limits motorized vessels inland of the bridge.

5. Monterey Harbor*
   - Potential candidate for crew transfer, CTV, and SATV moorage site because the site is a protected harbor; however, SOV moorage is unlikely due to site geometry.
   - Input from owners:
     - A currently vacant dock that is approximately 200-ft-long and owned by the U.S. Coast Guard may be an appropriate area for this type of use.
     - The vessels that have previously docked at the pier were 90 ft in length, although the dock has not been used for 13 years or so. It is unlikely that an SOV will be able to access this pier.
     - The amount of upland space that can be used to support O&M operations is limited at approximately 10,000 sq ft (approximately 0.2 acres). Additional upland space would likely need to be identified to support onshore activities.
6. Morro Bay
   - Potential candidate for crew transfer, CTV, SATV, and SOV moorage site because it is a protected harbor with favorable geometry.
7. Diablo Canyon
   - Potential candidate for crew transfer, CTV, SATV, and SOV moorage site because it is a protect harbor; however, the SOV size may be limited because of the size of the harbor.
8. Port San Luis Pier & Breakwater
   - Potential candidate for crew transfer and possibly SOV moorage if a new breakwater was constructed to provide shelter year-round. The existing timber pier would need upgrades to support berthing of SOVs. CTV and SATV moorage are not preferrable at this site since it's not a protected harbor.
9. Cal Poly Pier
   - Potential candidate for crew transfer and SOV moorage with investment in upgrades to existing infrastructure. CTV and SATV moorage are not preferrable at this site since it's not a protected harbor.

10. Vandenberg Barge Berth
    - Potential candidate for crew transfer; however, the site is not a protected harbor to support CTV and SATV moorage. In addition, the site conditions are not favorable to SOV moorage.
11. Ellwood Pier*
    - Potential candidate for crew transfer and SOV moorage site because only minor upgrades to onshore structures may be required. The site is not a protected harbor and cannot support CTV and SATV moorage.
    - Input from owners:
        - Owned by SLC, but the uplands are privately held. Site access improvements may be required. Site access would also need to be negotiated with the uplands owner, either via lease or purchase, which would likely entail significant added cost.
        - Historically used for oil industry activities; most recently used to transfer crew to oil platforms. Has accommodated vessels up to 130 ft in length.
        - Not currently in use
        - Structural repairs are planned.
        - Exposed to swell waves – may require wave protection.
12. Santa Barbara Harbor
    - Potential candidate for crew transfer. The site is a protected harbor; however, may not have capacity for CTV and SATV moorage, and site's geometry is not preferable to SOV moorage.
13. Stearns Wharf
    - Potential candidate for crew transfer and SOV moorage site; however, the site is not a protected harbor to support CTV and SATV moorage.

All sites were found to potentially serve as a vessel crew transfer site. Pillar Point Harbor, Moss Landing Harbor, Monterey Harbor, Morro Bay, and Diablo Canyon were all potential O&M sites for CTV and SATV moorage because they have protected harbors and adequate channel and berth dimensions to accommodate CTV and SATVs. Pillar Point Harbor, Morro Bay, Diablo Canyon, Port San Luis Pier & Breakwater, Cal Poly Pier, Ellwood Pier, and Stearns Wharf were all potential O&M sites for SOV moorage. These results are summarized in **Figure 5.3** by activity.

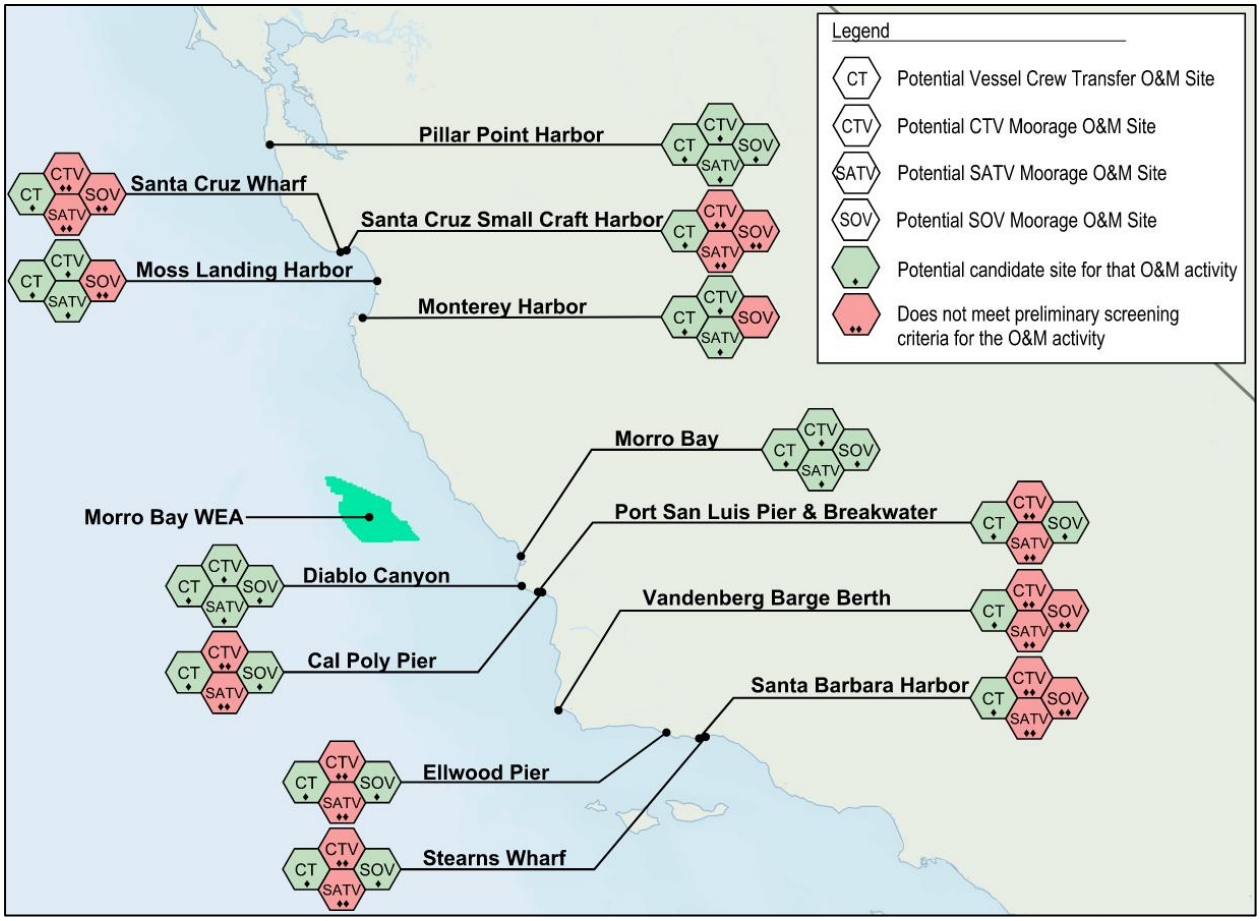

Figure 5.3. Operation and Maintenance Assessment per Activity

5.4.1. Overall Classification, Cost, and Timeline

For this study, O&M sites are not comparatively ranked. At this time, it is unknown which purpose each O&M site will serve as this is mainly based on the offshore wind developer's strategy and can vary between developers. In addition, the vessel criteria and dimensions are currently not well defined within the offshore wind industry because the vessels are still in development. Instead, a two-tier classification system based on the potential construction costs needed to improve the facility was used. Note that construction costs for infrastructure upgrades were not developed in detail for this study. Relative construction costs were developed based on similar project experience for the various identified infrastructure improvements. The description for the two tiers is as follows:

- Tier A – The waterfront facility likely requires capital investment on the order of **$10 million to $50 million** to incorporate and construct port infrastructure for an O&M operation. This includes improvements such as new waterfront structures—such as pile supported wharves or a pier expansion—and/or dredging of navigation channels, such as with Morro Bay. With these improvements,

facilities in this Tier A are intended to support crew transfer, CTVs, SATVs, and in some cases SOV moorage, depending on the size of the SOV.

- Tier B – The waterfront facility likely requires minor upgrades with capital investment on the order of **$1 million to $10 million**. This applies to facilities with waterfront structures that can be readily converted to O&M sites with the addition of such features as floats, davits, gangways, and/or localized structural rehabilitation. Facilities in Tier B may have limited operationality due to wave exposure (e.g., Ellwood Pier), require coordination with other users, or have site geometry constraints (e.g., Diablo Canyon due to the harbor size).

CTV and SATV Moorage

Some existing facilities can be leveraged to provide mooring support for smaller sized O&M vessels. Monterey Harbor, Morro Bay, and Diablo Canyon have waterfront infrastructure in place that can likely be converted to accommodate smaller vessels (such as CTVs and potentially SATVs) with minor upgrades. Other locations such as Pillar Point Harbor and Moss Landing Harbor will require more investment to support these activities. Locations in San Luis Obispo Bay (Port San Luis Pier and Cal Poly Pier) may be feasible but would require installation of a breakwater to provide safe harbor.

- Tier A – $10 million to $50 million
  - Pillar Point Harbor
  - Moss Landing Harbor
  - Port San Luis Pier
  - Cal Poly Pier
- Tier B – $1 million to $10 million
  - Monterey Harbor
  - Morro Bay
  - Diablo Canyon

SOV Moorage

There are no existing facilities that can accommodate long-term moorage of SOVs without performing upgrades to the existing structures. A new wharf would be required to support berthing of SOVs.

Several sites have the characteristics that could support an SOV base with investment in new infrastructure and dredging. These include Pillar Point, Morro Bay, and Diablo Canyon. The size of an SOV in Diablo Canyon will be limited by the size of the harbor and the width of the entrance channel. In the absence of major waterfront infrastructure upgrades, Ellwood Pier, Cal Poly Pier, and Port San Luis Pier may be able to provide moorage to SOVs depending on weather. Additional waterfront and onshore

upgrades will be required to provide additional services that may be needed such as fueling, warehouses, offices, parking, and crew support services.

- Tier A - $10 million to $50 million
  - Pillar Point Harbor
  - Morro Bay
  - Port San Luis Pier
  - Cal Poly Pier
- Tier B - $1 million to $10 million
  - Diablo Canyon
  - Ellwood Pier

There are multiple facilities that could potentially support offshore wind O&M activities, but all require some level of investment and construction to support a change in use to meet the specific O&M vessel requirements. See **Table 5.3** for a detailed breakdown of potential needed upgrades by Tier. These construction upgrades are projected to have a development timeline of approximately five years. More detailed analysis needs to be conducted to refine site concepts, compare the relative suitability in more detail, and provide more accurate cost estimates.

Table 5.3. Potential Structural Upgrades and Tier Ratings

Tier	Existing Facility Name	Distance to Lease Area	Screening Results	Potential upgrades
A	**Morro Bay**	57 miles	CTV, SATV, SOV	• A new wharf is required to support moorage of larger vessels (SOVs) and equipment transfer. • Dredging is needed to allow larger SOVs to navigate into the harbor. Berth dredging likely needed.
A	**Port San Luis Pier (Harford Pier)**	76 miles	SOV	• A new breakwater would be needed to provide sheltered conditions for all-season moorage of small craft (such as CTV, SATV). • The existing timber PSL pier will need upgrades to support berthing of SOVs. Localized pier improvements or widening is likely needed. Office and warehouse space may need to be identified at an onshore area. A new fuel dock likely required.
A	**Cal Poly Pier**	76 miles	SOV	• The existing concrete pier may require an expansion of the footprint of the head pier to allow for truck access needed to support SOVs. A fuel dock would be required either here or at PSL.
A	**Moss Landing Harbor**	100 miles	CTV, SATV	• Construction of a new floats is likely necessary to supporting O&M activities due North of the harbor. • Dredging is likely required to support access to the new floats.

Tier	Existing Facility Name	Distance to Lease Area	Screening Results	Potential upgrades
A	**Pillar Point Harbor**	143 miles	CTV, SATV, SOV	• Construction of a new waterfront facility is needed in the outer harbor since the inner harbor is at max capacity. • New floats, piers and mooring dolphins may be considered as part of the development program. • Dredging in the vicinity of pier is required to allow berthing of vessels.
B	**Morro Bay**	57 miles	CTV, SATV	• Smaller vessels such as CTVs and potentially SATVs can be moored at existing waterfront facilities, with minor upgrades.
B	**Diablo Canyon**	63 miles	CTV, SATV, SOV	• Construction of new floats is needed. • SOV size would be limited due to the size of the harbor. Construction of a new wharf, or leveraging the intake structure as a berth, would be needed for SOVs.
B	**Monterey Harbor**	90 miles	CTV, SATV	• Floats/piles/fenders/gangways/paving upgrades likely required. Likely can support CTVs and SATVs. SOVs are unlikely to be accommodated. • No large-scale changes to be applied to the pier and harbor.
B	**Ellwood Pier**	154 miles	SOV	• Minor upgrades to onshore structures may be required to support moorage of SOVs and crew/equipment transfer. • Onshore facility development is owned by a private party and may require more significant upgrades for truck access, offices, warehouses, etc. • Site access would also need to be negotiated with the uplands owner, either via lease or purchase, which would likely entail significant added cost.

All listed facilities can potentially support vessel crew transfer operations.

6. Conclusion and Next Steps

The goals of this study were to:

1. Identify potential alternative port locations between San Francisco and Long Beach to support offshore wind development.
2. Assess the feasibility of potential port locations to determine the required infrastructure improvements and cost/schedule to develop sites for offshore wind.

Staging and Integration Sites

For S&I sites, a high-level desktop screening was performed on the California coast between San Francisco and Long Beach to identify potential greenfield or undeveloped sites of 30 to 100 acres. This preliminary screening removed areas that were already developed with populations adjacent to the water; designated as protected lands for resources; or had security restrictions, as the case with military bases or airfields. From this exercise, a list of 11 sites were identified as potential S&I alternative port candidates. Environmental, engineering, and workforce assessments were then performed for each of the 11 sites.

The environmental assessment included research and investigation of environmental and biological resources. These resources consisted of California state parks and marine protected areas; federal protected lands, such as California coastal national monuments and national marine sanctuaries; sensitive land uses; environmental justice; terrestrial biological resources; viewshed sensitivity; and aquatic / marine biology. Using this research, each of the 11 potential sites was then assessed and, subsequently, ranked.

The engineering assessment considered the landside connection, water depth, distance to Pacific Coast Highway, metocean protection, and dredging / fill requirements for each potential site.

The workforce assessment determined that a majority of the job roles required to develop a floating offshore wind farm will be quayside roles. The workforce assessment used publicly available data to determine the size of the workforce employed in industries needed for offshore wind development for the five counties that the 11 potential sites reside – San Mateo, Santa Cruz, Monterey, San Luis Obispo, and Santa Barbara.

Using the results from the environmental, engineering, and workforce assessment, the 11 potential sites were ranked. The three potential S&I sites that were identified from this alternative port assessment were Port San Luis, China Harbor, and Gato Canyon. All three sites would require extensive infrastructure improvements to meet the offshore wind S&I site requirements, such as a heavy lift wharf that can withstand 6,000 psf, 80

acres of high-capacity upland area, dredging for a 38-ft berth depth, a breakwater for metocean protection, and significant environmental mitigation cost.

An AACE Class 5 cost estimate was performed for each of the identified sites to create 80 acres of port space for offshore wind industry use. The improvements at Port San Luis are estimated to cost (in 2022 dollars) approximately $2.4 billion, $2.2 billion at China Harbor, and $2.5 billion at Gato Canyon. This type of estimate has a typical expected variation in cost accuracy of -20% to -50% (low range) and +30% to +100% (high range). Additionally, the buildout of an S&I site at Port San Luis, China Harbor, or Gato Canyon will take approximately 10 to 15 years since a port authority will first need to be established to initiate this type of project with significant impacts.

When preliminarily compared to the S&I sites identified in existing ports from the California BOEM study (Moffatt & Nichol 2023), these alternative port sites require more investment, pose greater environmental impacts, and have longer development schedules. As part of the AB 525 Port Readiness Plan, a more detailed trade off analysis between all potential port sites will be conducted to confirm whether these new S&I sites should be further considered for offshore wind development.

Operation and Maintenance Sites

The O&M screening assessment was initiated by identifying a Long List of existing ports, harbors, and waterfront facilities located within the study area. The Long List was then screened against a set of suitability criteria that included both distance from the call area and facility characteristics, such as navigable access, waterfront moorage, wave exposure, upland area, and current uses to create a Short List of sites. The sites identified in this Short List were then assessed and categorized based on site infrastructure and apparent capability to support crew transfer, long-term moorage of CTVs, long-term moorage of SATVs, and long-term moorage of SOVs. In addition, outreach to the Short List sites was conducted to determine their interest in supporting offshore wind development.

All sites were found to potentially serve as a vessel crew transfer site. Pillar Point Harbor, Moss Landing Harbor, Monterey Harbor, Morro Bay, and Diablo Canyon were all potential O&M sites for CTV and SATV moorage because they have protected harbors and adequate channel and berth dimensions to accommodate CTV and SATVs. Pillar Point Harbor, Morro Bay, Diablo Canyon, Port San Luis Pier & Breakwater, Cal Poly Pier, Ellwood Pier, and Stearns Wharf were all potential O&M sites for SOV moorage. These results are summarized in **Figure 5.3** by activity.

For this study, O&M sites are not comparatively ranked. Instead, a two-tier classification system based on the potential construction costs to improve the facility was used. Relative construction costs were developed based on similar project experience for the various identified infrastructure improvements. Construction upgrades are projected to have a development timeline of approximately five years. The description for the two tiers is as follows:

- Tier A – The waterfront facility likely requires capital investment on the order of **$10 million to $50 million** to incorporate and construct port infrastructure for an O&M operation. This includes improvements such as new waterfront structures—such as pile supported wharves or a pier expansion—and/or dredging of navigation channels, such as with Morro Bay. With these improvements, facilities in this Tier A are intended to support crew transfer, CTVs, SATVs, and in some cases SOV moorage, depending on the size of the SOV.

- Tier B – The waterfront facility likely requires minor upgrades with capital investment on the order of **$1 million to $10 million**. This applies to facilities with waterfront structures that can be readily converted to O&M sites with the addition of such features as floats, davits, gangways, and/or localized structural rehabilitation. Facilities in Tier B may have limited operationality due to wave exposure (e.g., Ellwood Pier), require coordination with other users, or have site geometry constraints (e.g., Diablo Canyon due to the harbor size).

Cost breakdown for CTV and SATV moorage at potential O&M sites:

- Tier A – $10 million to $50 million
  - Pillar Point Harbor
  - Moss Landing Harbor
  - Port San Luis Pier
  - Cal Poly Pier
- Tier B – $1 million to $10 million
  - Monterey Harbor
  - Morro Bay
  - Diablo Canyon

Cost breakdown for SOV moorage at potential O&M sites:

- Tier A - $10 million to $50 million
  - Pillar Point Harbor
  - Morro Bay
  - Port San Luis Pier
  - Cal Poly Pier
- Tier B - $1 million to $10 million
  - Diablo Canyon
  - Ellwood Pier

Three of the locations—Port San Luis, Diablo Canyon, and Morro Bay— were also identified within the California BOEM study (Moffatt & Nichol 2023). As part of the AB 525 Port Readiness Plan, a more detailed trade off analysis will be performed to compare all potential O&M sites.

Additional next steps to produce the AB 525 Port Readiness Plan include:

- Conduct additional outreach to developers, ports, stakeholders, and the public
- Perform a detailed trade off analysis between all identified potential port sites from this study and the California BOEM study (Moffatt & Nichol 2023)
- Rank the recommended port sites
- Determine workforce development needs, training, and strategy
- Recommend a port development / investment plan

7. References

Bureau of Ocean Energy Management [BOEM]. (2022, Dec 15). California Activities. https://www.boem.gov/renewable-energy/state-activities/california.

Chiu. 2021, Sept 24. Assembly Bill No. 525: offshore wind generation. *California Legislative Information*. https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=202120220AB525.

De León. 2018, Sept 10. Senate Bill No. 100: emissions of greenhouse gases. California Legislative Information. https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201720180SB100

Flint, Scott, Rhetta deMesa, Pamela Dougham, and Elizabeth Huber. 2022. *Offshore Wind Development off the California Coast: Maximum Feasible Capacity and Megawatt Planning Goals for 2030 and 2045.* California Energy Commission. Publication Number: CEC-800-2022-001-REV.

Moffatt & Nichol. 2022. *Port of Coos Bay Port Infrastructure Assessment for Offshore Wind Development*. Camarillo (CA): U.S. Department of the Interior, Bureau of Ocean Energy Management. 91 p. Report No.: OCS Study BOEM 2022-073.

Moffatt & Nichol. 2023. *California Floating Offshore Wind Regional Ports Assessment*. [Unpublished Report]. Camarillo (CA): U.S. Department of the Interior, Bureau of Ocean Energy Management. Report No.: OCS Study BOEM 2023-xxx.

National Oceanic and Atmospheric Administration [NOAA]. (n.d.) *Proposed Designation of Chumash Heritage National Marine Sanctuary*. https://sanctuaries.noaa.gov/chumash-heritage/.

[NREL] National Renewable Energy Laboratory. 2022. Offshore Wind Energy: Technology below the water. Presentation.

Attachment A: Environmental Ranking Tables

Site ranking results were separated into three categories as shown in **Table A.1**:

1. Least Impact Sites: sites ranked 1 to 3 or Top
2. Medium Impact Sites: sites ranked 4 to 8 or Middle
3. Most Severe Impact Sites: sites ranked 9 to 11 or Bottom

Table A.1. Ranking of Short List Port Sites (with comparative rankings)

Short List of Port Sites	State Parks & CA Marine Protected Areas	Federal Protected Lands: CA Coastal Nat'l Mon. and Nat'l Marine Sanctuaries	Sensitive Land Uses w/in 1 Mile	EJ Population w/in 5-miles	EJ Demographic Index	CNDDB – Terrestrial Bio**	Viewshed Sensitivity*	Marine Bio Issues (Boudreau Assoc.)**
1. Gato Canyon Santa Barbara Co.	Ranking: 9	Ranking: 1	Ranking: 6	Ranking: 5	Ranking: 10	Ranking: MIDDLE	Ranking: 4	Ranking: BOTTOM
2. Port San Luis San Luis Obispo Co.	Ranking: 1	Ranking: 2	Ranking: 4	Ranking: 8	Ranking: 2	Ranking: TOP	Ranking: 3	Ranking: TOP
3. Diablo Canyon San Luis Obispo Co.	Ranking: 7	Ranking: 3	Ranking: 1	Ranking: 1	Ranking: 1	Ranking: TOP	Ranking: 1	Ranking: TOP
4. China Harbor San Luis Obispo Co.	Ranking: 3	Ranking: 5	Ranking: 3	Ranking: 2	Ranking: 6	Ranking: MIDDLE	Ranking: 7	Ranking: TOP
5. Nikki's Beach San Luis Obispo Co.	Ranking: 6	Ranking: 4	Ranking: 2	Ranking: 9	Ranking: 3	Ranking: TOP	Ranking: 7	Ranking: MIDDLE
6. Moss Landing Monterey County	Ranking: 11	Ranking: 6	Ranking: 7	Ranking: 11	Ranking: 11	Ranking: BOTTOM	Ranking: 2	Ranking: MIDDLE
7. Davenport Santa Cruz County	Ranking: 5	Ranking: 9	Ranking: 10	Ranking: 7	Ranking: 4	Ranking: MIDDLE	Ranking: 9	Ranking: BOTTOM
8. South of Pigeon Point San Mateo County	Ranking: 10	Ranking: 10	Ranking: 5	Ranking: 3	Ranking: 7	Ranking: BOTTOM	Ranking: 10	Ranking: BOTTOM
9. Spring Gulch Beach San Mateo County	Ranking: 4	Ranking: 11	Ranking: 8	Ranking: 4	Ranking: 8	Ranking: MIDDLE	Ranking: 10	Ranking: BOTTOM
10. Tunitas Beach San Mateo County	Ranking: 8	Ranking: 8	Ranking: 9	Ranking: 6	Ranking: 9	Ranking: MIDDLE	Ranking: 6	Ranking: MIDDLE
11. Redondo Beach San Mateo County	Ranking: 2	Ranking: 7	Ranking: 11	Ranking: 10	Ranking: 5	Ranking: MIDDLE	Ranking: 5	Ranking: MIDDLE

* Viewshed rankings resulted in 2 sets of subjectively "tied" ranked pairs of sites
** Terrestrial and Marine Biological concerns are scored only as being in the top, middle, or bottom tiers. There was not enough site-specific data to allow a more fine-tuned comparison of sites for these issues.

Attachment B: Site Characteristics for Long List of Waterfront Facilities

Table B.1. Site Characteristics for Waterfront Facilities

No	Name	Longitude	Latitude	Existing Infrastructure Type	Limiting Nav. Channel/ Approach Depth	Limiting Nav. Channel/ Approach Width	Wave Protection?	Approx. distance to Morro Bay Call Area (Miles)	Current Use
1	Pacifica Municipal Pier	-122.4980	37.6335	Pier	~18ft at end of pier	NA	Exposed	153	Public Fishing pier
2	Pillar Point Harbor	-122.4824	37.5014	Marina with two layers of breakwater	15ft at first layer of breakwater, ~10ft at second layer	First layer: 350ft Second Layer: 250ft	Fully protected	143	Protected harbor for the commercial fishing industry, sport fishermen and to pleasure boaters
3	Santa Cruz Wharf	-122.0174	36.9575	Wharf	26ft at end of pier	NA	Exposed	100	Public fishing, boat tours, dining and gift shops
4	Santa Cruz Small Craft Harbor	-122.0025	36.9656	Marina	Entrance: 8ft Inner channel: 6ft-13ft	250ft	Protected	102	Public use boating and marine activities
5	Capitola Wharf	-121.9534	36.9696	Wharf	12ft at end of pier	NA	Exposed	105	Dining and whale sightseeing
6	Seacliff Pier	-121.9137	36.9702	Pier	~8ft at end of pier	NA	Exposed	100	Fishing pier with a damaged ship located at the end of pier
7	Moss Landing Harbor	-121.7852	36.8031	Marina	Project depth: 15ft	200ft	Protected	100	Federal Navigation Channel, commercial fishing harbor (public accessible) in the Monterey Bay with 600+ slips for recreational boaters and commercial vessels
8	Monterey Harbor	-121.8917	36.6064	Marina, Breakwater	Entrance: 30ft Marina: 10ft-18ft	First layer: 800ft Second layer: 550ft	Protected	90	Recreational and commercial harbor for residents and visitors
9	Stillwater Cove Boat Ramp	-121.9429	36.5659	Boat Launch	~6ft at end of boat ramp	NA	Exposed to waves from the S	70	Boat launch for guided kayak tours and stand-up paddle boards
10	William Randolph Hearst Beach	-121.1878	35.6427	Pier	6ft (at end of pier)	NA	Some from SE, S to E Exposed	36	Recreational state beach that allows fishing on piers and ocean kayaking

No	Name	Longitude	Latitude	Existing Infrastructure Type	Limiting Nav. Channel/ Approach Depth	Limiting Nav. Channel/ Approach Width	Wave Protection?	Approx. distance to Morro Bay Call Area (Miles)	Current Use
11	Water Treatment Plant/Abalone Farm	-120.9796	35.4604	Water Treatment Plant, may have small derelict boat ramp	0ft (at end of small boat ramp)	NA	Exposed	53	Private abalone farm
12	Cayucos Pier	-120.9064	35.4487	Pier	4ft (at end of pier)	NA	Exposed	56	Fishing pier well known for night fishing
13	Morro bay	-120.8677	35.3620	Morro Bay, Breakwaters, small marina	Entrance: 30ft Inner A: 16ft Inner B: 12ft	Entrance: 350ft Inner A: 350ft Inner B: 150ft	Protected, Existing Breakwaters, sheltered cove.	57	Small scale commercial and recreational marina with > 100 moorings
14	Diablo Canyon	-120.8566	35.2065	Power Plant, Protected Basin.	Depths inside basin ~26-33ft	Entrance Width~70-140ft	Protected by Breakwaters	63	Breakwater offers protection to the Diablo Canyon Nuclear Powerplant
15	Port St. Luis Pier	-120.7560	35.1712	Pier & Breakwater	Depths ~10-20ft along pier	NA	Small breakwater to south	76	Fishing pier with restaurants and fish markets, driving on the pier is allowed. Boat lift.
16	Cal Poly Pier	-120.7408	35.1699	Three Piers, small boat lift	42ft (at end of pier)	NA	Exposed	73	Marine research facility for Cal Poly
17	Avila Pier	-120.7347	35.1747	Pier	24ft at end of pier	NA	Exposed	78	closed for structural reasons; suffered major storm damage historically. Prior was fishing and passenger wharf.
18	Pismo Beach Pier	-120.6464	35.1380	Pier	10ft (at end of pier)	NA	Exposed	78	Recreational state beach mostly used for sightseeing and tourism purposes
19	Vandenberg Barge Berth	-120.6100	34.5550	Boat Launch	~10ft berth depth	NA	Breakwater to South, Exposed from East.	105	Boat/vessel launching area within Vandenberg AFB, used by the US space force for hardware delivery & recovery activities.
20	Gaviota Beach	-120.2286	34.4709	Pier	12ft (at end of pier)	NA	Exposed	133	Unused pier awaiting reconstruction after receiving damage from a severe storm
21	Gaviota Substation	-120.2052	34.4727	Substation	NA	NA	Exposed	133	
22	Ellwood Pier	-119.9229	34.4335	Pier	15ft (at end of pier)	NA	Exposed	154	Privately owned pier for loading and unloading personnel and O&G supplies

No	Name	Longitude	Latitude	Existing Infrastructure Type	Limiting Nav. Channel/ Approach Depth	Limiting Nav. Channel/ Approach Width	Wave Protection?	Approx. distance to Morro Bay Call Area (Miles)	Current Use
23	Goleta Pier and Slough	-119.8289	34.4166	Pier	18ft (at end of pier)	NA	Exposed	159	Fishing Pier
24	Santa Barbara Harbor	-119.6866	34.4059	Marina	Entrance: 15ft Inner: 16ft	Entrance: 150-200ft Inner: 300ft	Protected	170	Private yacht club providing social and recreational activities
25	Stearns Wharf	-119.6857	34.4099	Wharf	18ft at end of pier	NA	Semi-exposed	170	Restaurants, parking, Natural History Museum, fishing, recreation.
26	Casitas Pier	-119.5078	34.3843	Pier	13-27ft at end of pier (https://media.fisheries.noaa.gov/dam-migration/venococasitaspier_2017iha_app.pdf)	NA	Exposed	180	Private Pier operated by Venoco (energy company); used for transfer of personnel and equipment to service oil platforms. Parking lot used for temporary storage.
27	Richfield Pier	-119.4452	34.3477	Pier	48ft at end of pier	NA	Exposed	183	Connects the Rincon Island, public land leased from CSL to mainland California
28	Ventura Pier	-119.2926	34.2723	Pier	19ft at end of pier	NA	Exposed	189	Historic landmark, now a fishing pier
29	Ventura Harbor	-119.2657	34.2495	Marina	Outer entrance: 40ft Inner entrance: 20ft	Outer entrance: 400ft Inner entrance: 300ft	Protected	191	Federal Navigation Channel, marina for commercial fishing businesses and recreational boaters
30	Channel Island Harbor	-119.2269	34.1573	Marina	Entrance: 20ft Inner channel: 10ft - Varies	Entrance: 300ft Inner channel: 550+ft	Protected	192	Federal Navigation Channel, county-owned harbor for recreational and sport fishing
31	Port of Hueneme	-119.2119	34.1455	Port for large vessels	40ft	350ft	Protected	195	Existing Port
32	Port Hueneme Fishing Pier	-119.1957	34.1394	Pier	20ft at end of pier	NA	Exposed	195	Recreational fishing pier
33	Paradise Cove Pier	-118.7860	34.0200	Pier	6ft at end of pier	NA	Exposed	224	Fishing pier that is occasionally used in movies and television films
34	Malibu Pier	-118.6756	34.0357	Pier	15ft at end of pier	NA	Exposed	231	Dining and sightseeing pier
35	Santa Monica Fishing Pier	-118.4999	34.0075	Pier	18ft at end of pier	NA	Exposed	238	Public fishing pier
36	Venice Fishing Pier	-118.4707	33.9769	Pier	20ft at end of pier	NA	Exposed	238	Recreational fishing pier

No	Name	Longitude	Latitude	Existing Infrastructure Type	Limiting Nav. Channel/ Approach Depth	Limiting Nav. Channel/ Approach Width	Wave Protection?	Approx. distance to Morro Bay Call Area (Miles)	Current Use
37	Marina Del Rey	-118.4602	33.9622	Marina	Entrance: 20ft Inner channel: 10ft - 15ft	Varies - 650ft	Protected	239	Federal Navigation Channel, major boating and water recreation destination
38	Playa Del Rey Beach Pier	-118.4454	33.9443	Pier	6ft at end of pier	NA	Exposed	239	
39	Manhattan Beach Pier	-118.4146	33.8834	Pier	12ft at end of pier	NA	Exposed	243	Concrete pier with an aquarium at the end of the pier
40	Hermosa Beach Pier	-118.4056	33.8612	Pier	18ft at end of pier	NA	Exposed	244	Recreational pier for fishing and picnic parties
41	King Harbor	-118.3950	33.8418	Marina	Entrance: 30ft Marina: 15ft - 20ft	Entrance: 350ft Marina: 100ft	Protected	244	Privately owned marina for commercial and recreational use