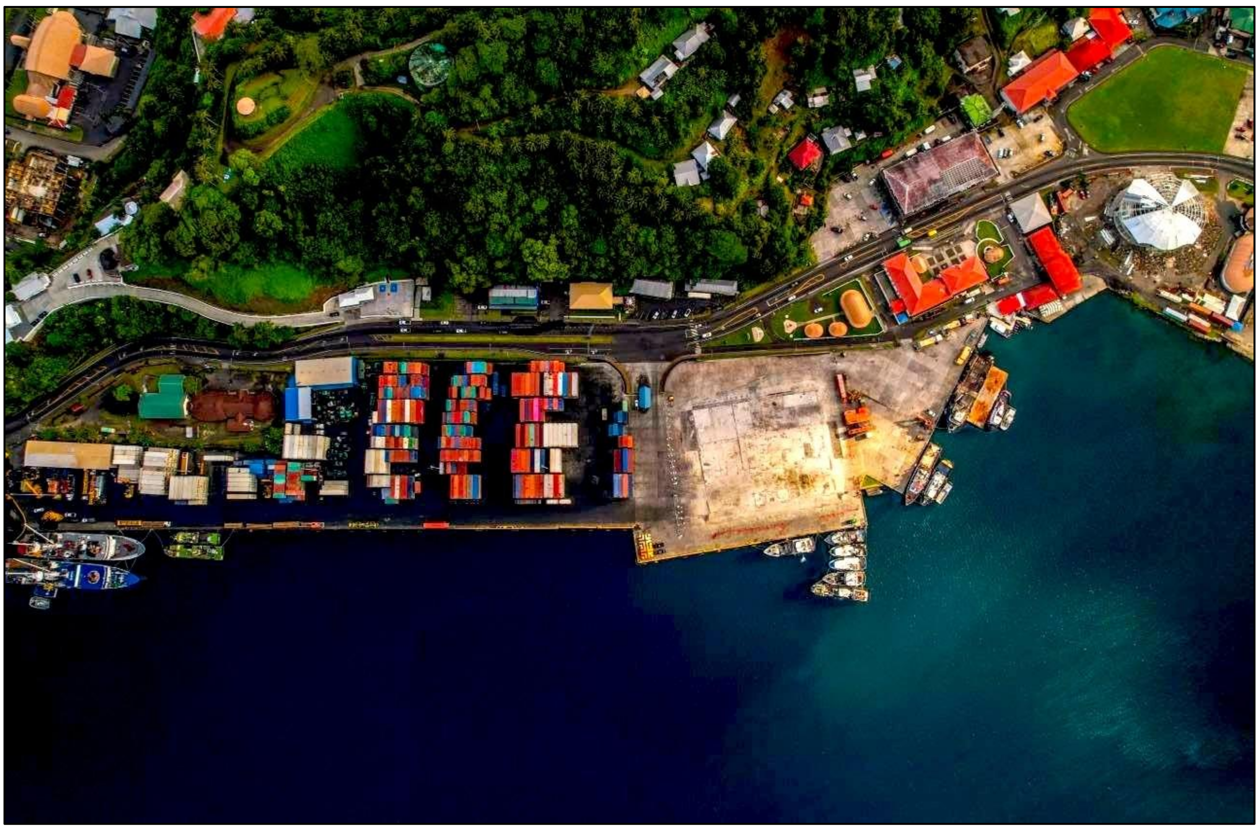
OCS Study
BOEM 2026-038

American Samoa Regional Port Assessment to Support Seabed Mineral Development



U.S. Department of the Interior
Bureau of Ocean Energy Management
Pacific OCS Region, Camarillo, CA

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American Samoa Regional Port Assessment to Support Seabed Mineral Development

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DISCLAIMER

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ABOUT THE COVER

Photo Description: Aerial image of Port of Pago Pago, looking south.

Photo Credit: Port Administration of American Samoa

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The following organizations were consulted and contributed their time and input as part of this study, including agencies and port administrations, consultants and study partners, and deep-sea seabed mineral development industry stakeholders:

Agencies and Port Administrations: Bureau of Ocean Energy Management (BOEM); Port Administration of American Samoa (PAAS).

Consultants and Study Partners: Woolpert, Inc.; SEARCH, Inc.

Industry Stakeholders: Adepth Minerals; Deep Sea Vision; Impossible Metals, Inc.; The Metals Company, Inc.; Wetstone Global.

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List of Abbreviations and Acronyms

Area ID	Area Identification
AUV	Autonomous Underwater Vehicle
BOEM	Bureau of Ocean Energy Management
CFC	Cobalt-rich Ferromanganese Crusts
DBM	Dry Bulk Mineral
DP	Dynamic Positioning
DSHMRA	Deep Seabed Hard Mineral Resources Act
EEZ	Exclusive Economic Zone
LARS	Launch and Recovery System
LoA	Length overall
Mtpa	Million Tonnes Per Annum
NOAA	National Oceanic and Atmospheric Administration
NM	Nautical Mile
O&L	Operations and Logistics
OCS	Outer Continental Shelf
OCSLA	Outer Continental Shelf Lands Act
OSV	Offshore Support Vessel
PAAS	Port Administration of American Samoa
PCF	Per Cubic Foot
PMN	Polymetallic Nodules
PSD	Polymetallic Sulfide Deposits
PSV	Production Support Vessel
RFI	Request for Information
RLS	Riser and Lift System
ROV	Remotely Operated Vehicle
RV	Research Vessel
SMS	Seafloor Massive Sulfides
UNIDO	United Nations Industrial Development Organization

Executive Summary

The 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 issuing leases, easements, and rights-of-way for offshore energy and mineral activities. The Pacific OCS Region includes submerged lands within the U.S. Exclusive Economic Zone (EEZ) offshore California, Oregon, Washington, and Hawai'i, generally extending from three nautical miles to approximately 200 nautical miles from shore, as well as submerged lands within the EEZ adjacent to U.S. territories, as defined under the OCS Lands Act, and as amended by the Inflation Reduction Act of 2022.

In recent years, the U.S. federal government has increased its focus on securing domestic supply chains for critical minerals. This includes policy direction and federal actions to evaluate offshore mineral resources and support their potential development. In April 2025, Executive Order 14285, "Unleashing America's Offshore Critical Minerals and Resources," directed federal agencies to advance seabed mineral development efforts.

In this context, BOEM has initiated planning activities to evaluate the potential for seabed mineral development leasing offshore American Samoa. In April 2025, BOEM received an expression of industry interest for seabed mineral resources in the region. This was followed by the publication of a Request for Information and Interest in the Federal Register on June 16, 2025, to solicit stakeholder input and industry interest. On November 10, 2025, BOEM announced the completion of Area Identification for potential leasing areas offshore American Samoa. On July 16, 2026, BOEM completed environmental review of proposed commercial leases for critical minerals in the form of an environmental assessment pursuant to the National Environmental Policy Act, and also announced the availability of the Proposed Leasing Notice (PLN) for a proposed American Samoa OCS Mineral Lease Sale. These steps may be followed by the publication of a Final Leasing Notice, and potentially a competitive lease sale, consistent with BOEM's OCS mineral leasing framework.

This study supports BOEM's ongoing planning and environmental review efforts by evaluating the readiness of port and harbor infrastructure in American Samoa to support potential seabed mineral development activities. The assessment considers the industry's emerging nature, including current technology concepts, vessel and equipment characteristics, and evolving maritime logistics strategies.

The objective of this study is to assess whether existing port and harbor infrastructure in American Samoa can support near-term potential seabed mineral development activities and to identify infrastructure needs, constraints, and potential development pathways. The study evaluates port infrastructure requirements across different phases of industry development activity considerations and assesses the suitability of existing facilities to support these activities. To support this objective, the study includes:

- Review and summary of deep-sea seabed mineral development industry activities, technology concepts, vessel and equipment characteristics, and evolving maritime logistics strategies.
- Identification of port infrastructure needs and development of evaluation criteria based on industry activities, vessel types, equipment, and logistics concepts.
- Development of representative industry activity scenarios and associated port infrastructure development scenarios.

- Evaluation of existing port and harbor facilities in American Samoa to assess their suitability for supporting near-term potential industry activities.
- Identification of infrastructure gaps, potential development or improvement needs, and next step recommendations.

This study was conducted through a combination of literature review, industry engagement, local port authority and agency outreach, and desktop assessment.

The assessment identified three primary port site types that may be needed to support potential deep-sea seabed mineral development activities in the region:

- Dry Bulk Mineral (DBM) Sites, which would support bulk mineral import, storage, export, and transfer activities.
- Production Support Vessel (PSV) Homeport Sites, which would support large vessel berthing, maintenance, equipment staging, and industrial logistics activities.
- Operations and Logistics (O&L) Sites, which would support routine offshore logistics, resupply, crew transfer, and mission support activities hosting small to mid-size support vessels.

The assessment also developed representative port infrastructure demand scenarios associated with different industry development phases and activity level scenarios. Indicative demand scenarios ranged from approximately 0 to 1 DBM site per PSV operating in the region, 0 to 1 PSV homeport site, and approximately 1 to 2 O&L sites per PSV operating in the region, depending on the scale and phase of industry development.

Based on the port and harbor inventory assessment, existing port and harbor infrastructure in American Samoa may support certain early-stage activities, particularly those associated with planning and pre-commercial phases. However, for commercial-scale and expanded commercial-scale operations, existing infrastructure shows limitations in supporting the full range of potential industry needs, including dry bulk mineral handling and large vessel berthing and operations support capabilities for single or multiple developer operations (e.g., due to lack of large upland space availability, wharf and berthing infrastructure availability, draft at berth constraints, and others).

Key findings from the assessment include:

Dry Bulk Mineral (DBM) Sites: would support import, storage, and export of bulk minerals.

- No suitable existing port sites identified under the assessed port site inventory to support demand scenarios.
- Absence of a local DBM terminal may not necessarily limit industry development, as U.S. West Coast or international dry bulk terminals may support long-distance mineral logistics operations.

Production Support Vessel (PSV) Homeport Sites: could serve as home port, maintenance, and logistics sites for PSVs and other large vessels in the region.

- One moderate candidate site identified among existing ports, Port of Pago Pago, with limitations in draft at berth, upland storage and load capacity, and vessel maintenance capabilities.
- PSV homeporting may also be supported by distant facilities, as PSVs can remain offshore for extended durations and return to port infrequently.

Operations and Logistics (O&L) Sites: would support routine offshore logistics, resupply, crew transfer, and mission support activities conducted and supported by small to mid-size and auxiliary vessels.

- One good candidate site identified, Port of Pago Pago, capable of supporting near-term operations; additional sites or improvements may be required as industry activity and vessel volumes increase.

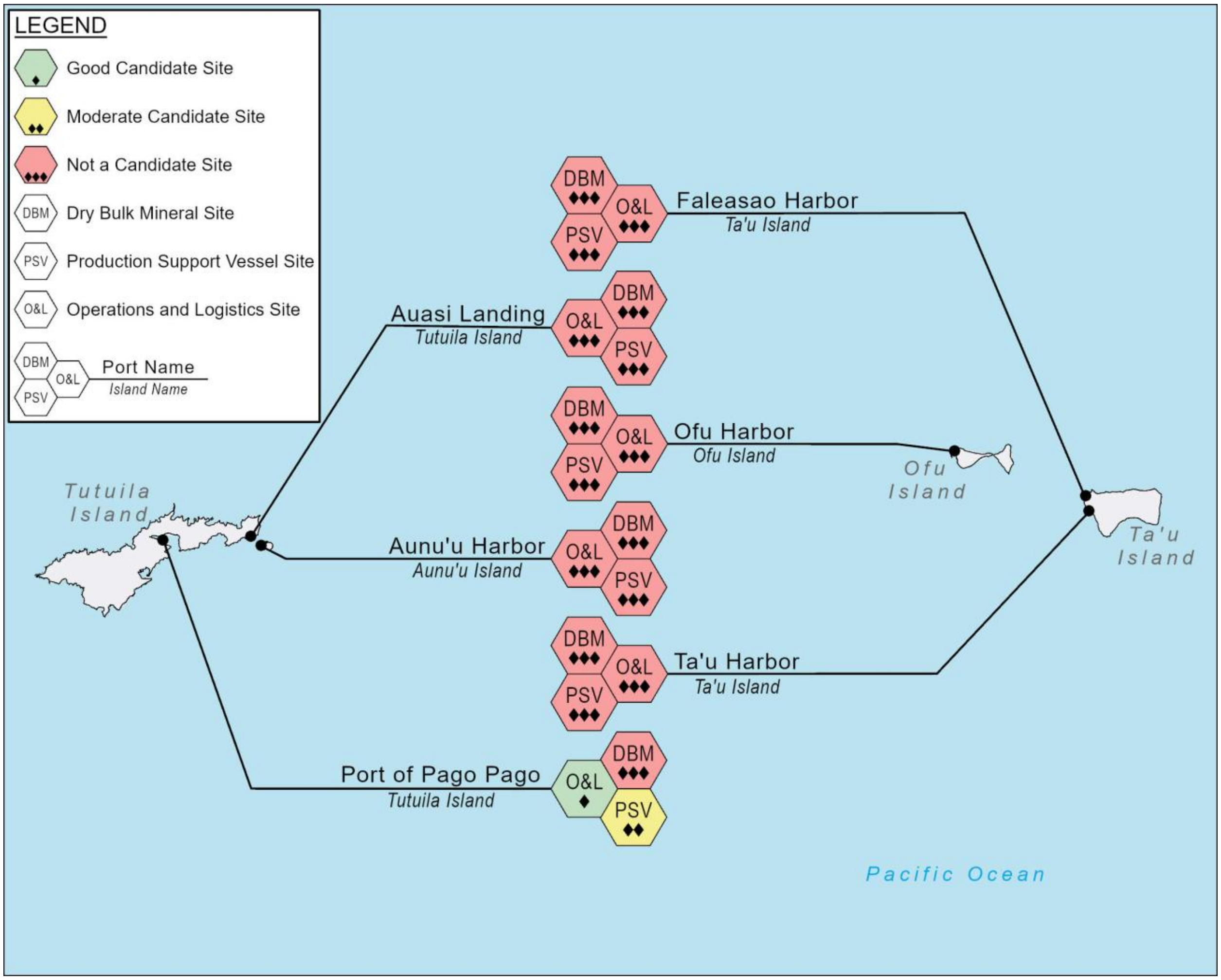


Figure 1: American Samoa Ports and Harbors Inventory and Assessment Summary

Through stakeholder engagement and workshops, the assessment also considered initiatives proposed by the Port Administration of American Samoa (PAAS) to improve existing facilities and develop new marine terminals to support broader maritime industry activities, including potential seabed mineral development operations.

Future infrastructure development initiatives under the PAAS Vision 2030 program (approximately 5 to 10-year planning horizon) could enhance the capacity of American Samoa's port infrastructure through expanded wharf infrastructure, increased upland storage and staging capacity, and development of new waterfront facilities. If implemented, these improvements could increase available capacity to up to two good PSV homeport site candidates and up to three good O&L site candidates, better aligning regional infrastructure with projected demand scenarios (0 to

1 DBM site, 0 to 1 PSV homeport site, and 1 to 2 O&L sites per PSV, depending on industry phase and activity levels).

Without the implementation of Vision 2030 initiatives or similar future infrastructure development efforts, existing infrastructure capacity is expected to remain limited for commercial-scale and expanded commercial-scale deep-sea seabed mineral development operations, particularly with respect to large vessel berthing, bulk mineral handling, upland support capacity, and the ability to support multiple developers and concurrent logistics operations.

However, for planning and pre-commercial phases, existing infrastructure within Pago Pago Harbor may be sufficient to support a single developer or sequential operations by multiple developers. This could potentially be achieved through targeted capital improvements to existing infrastructure, including localized wharf and berth upgrades such as increasing load capacity and upgrading fenders and bollards, upland pavement and load capacity improvements, berth pocket dredging, and provision of lifting and gangway equipment to support crew transfer and logistics operations.

Overall, this assessment provides a baseline evaluation of port readiness in American Samoa and identifies key infrastructure gaps, development opportunities, and potential pathways to support future seabed mineral development activities in the region. The findings are intended to inform BOEM's ongoing planning and environmental review efforts and support coordination with territorial agencies, industry stakeholders, and other partners in evaluating future infrastructure improvement and development needs.

Recommended next steps include feasibility-level evaluation of identified, planned, and proposed port infrastructure improvements and developments, including engineering feasibility, cost estimates, implementation schedules, permitting pathways, and funding strategies. Additional analysis may include assessment of major U.S. West Coast and nearby international dry bulk terminal capabilities and available spare throughput capacity to support import, storage, and export of seabed mineral commodities. This may support the development of long-term bulk mineral logistics strategies and a regional seabed mineral logistics roadmap aligned with evolving industry needs.

1 Introduction

The United States is actively advancing deep-sea seabed mineral development efforts as part of a broader effort to secure domestic supply chains for critical minerals. Federal authority for seabed mineral development is established under the Deep Seabed Hard Mineral Resources Act (DSHMRA) of 1980, which authorizes federal oversight of exploration and development activities (US Congress, 1980). For areas beyond national jurisdiction, National Oceanic and Atmospheric Administration (NOAA) administers licenses and permits (NOAA, 2026), while areas within U.S. national waters are governed under the Outer Continental Shelf Lands Act (OCSLA) and administered by the U.S. Department of the Interior, Bureau of Ocean Energy Management (BOEM) (BOEM, 2026a). This policy direction was further reinforced by Executive Order 14285, "Unleashing America's Offshore Critical Minerals and Resources," issued in April 2025, which directed federal agencies to accelerate seabed mineral development (Exec. Office of the US President, 2025).

This assessment focuses on the BOEM non-energy mineral program on the Outer Continental Shelf (OCS), which addresses mineral resources other than oil, gas, and sulfur located on or beneath the seabed of federal waters seaward of state and territorial coastal waters and within the U.S. Exclusive Economic Zone. These resources may include critical minerals such as nickel, cobalt, lithium, manganese, and rare earth elements. The official list of critical minerals and rare earth elements is maintained by the U.S. Geological Survey (USGS, 2025).

As illustrated in **Figure 2**, critical seabed mineral resources within the Pacific OCS Region occur in multiple geological forms, including ferromanganese crusts, polymetallic nodules, and areas characterized by both crust and nodule occurrences, as well as broader prospective ferromanganese regions (BOEM, 2026b). These deposits occur across a range of water depths, and mineral deposit collection methods and equipment concepts can vary depending on deposit type and geologic setting.

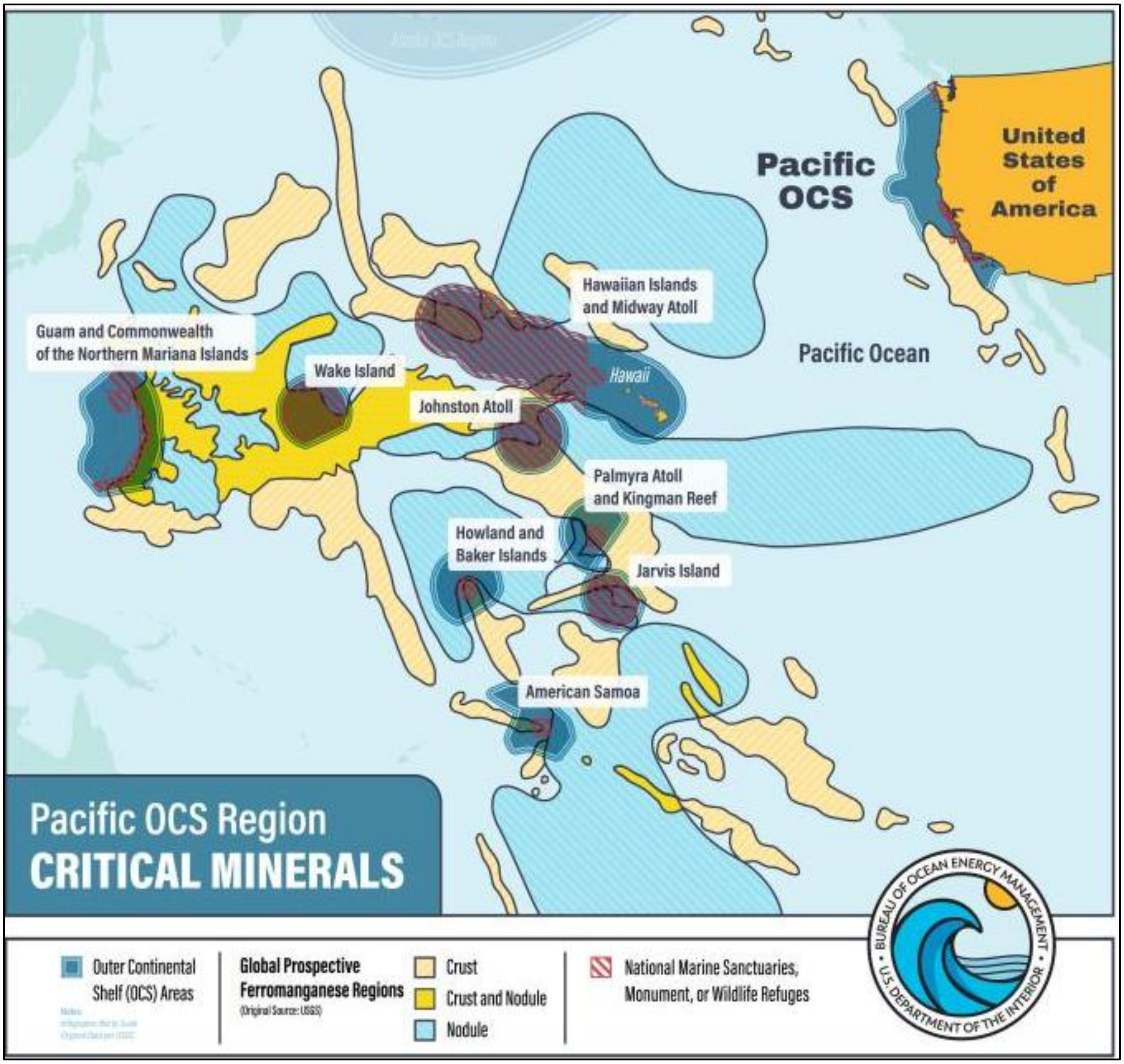


Figure 2: Critical Minerals on the Pacific OCS (BOEM, 2026b)

The territory of American Samoa lies within U.S. national waters and falls under BOEM's regulatory authority pursuant to the Outer Continental Shelf Lands Act (OCSLA). In April 2025, BOEM received an expression of industry interest from a U.S.-based company regarding potential deep-sea seabed mineral development leasing activities offshore American Samoa. In coordination with the American Samoa Government, BOEM initiated planning and leasing evaluation activities for the region. In June 2025, BOEM published a Request for Information and Interest (RFI) in the Federal Register (90 FR 25369) to solicit stakeholder input and industry interest regarding potential offshore seabed mineral development leasing activities offshore American Samoa (BOEM, 2025a). Following this process, BOEM announced completion of Area Identification (Area ID) on November 10, 2025, identifying offshore areas for potential future critical seabed mineral leasing activities on the OCS American Samoa (BOEM, 2025b).Error! Reference source not found.

Following the completion of Area ID, BOEM completed the environmental review of proposed commercial leases for critical minerals in the form of an environmental assessment pursuant to the National Environmental Policy Act, and also announced the availability of the Proposed Leasing Notice (PLN) for a proposed American Samoa OCS Mineral Lease Sale. The PLN outlines the terms and conditions for the potential sale, including blocks under consideration, information to lessees, and proposed lease stipulations. A map of the American Samoa OCS mineral lease sale areas provided in the PLN is shown in **Figure 3**.

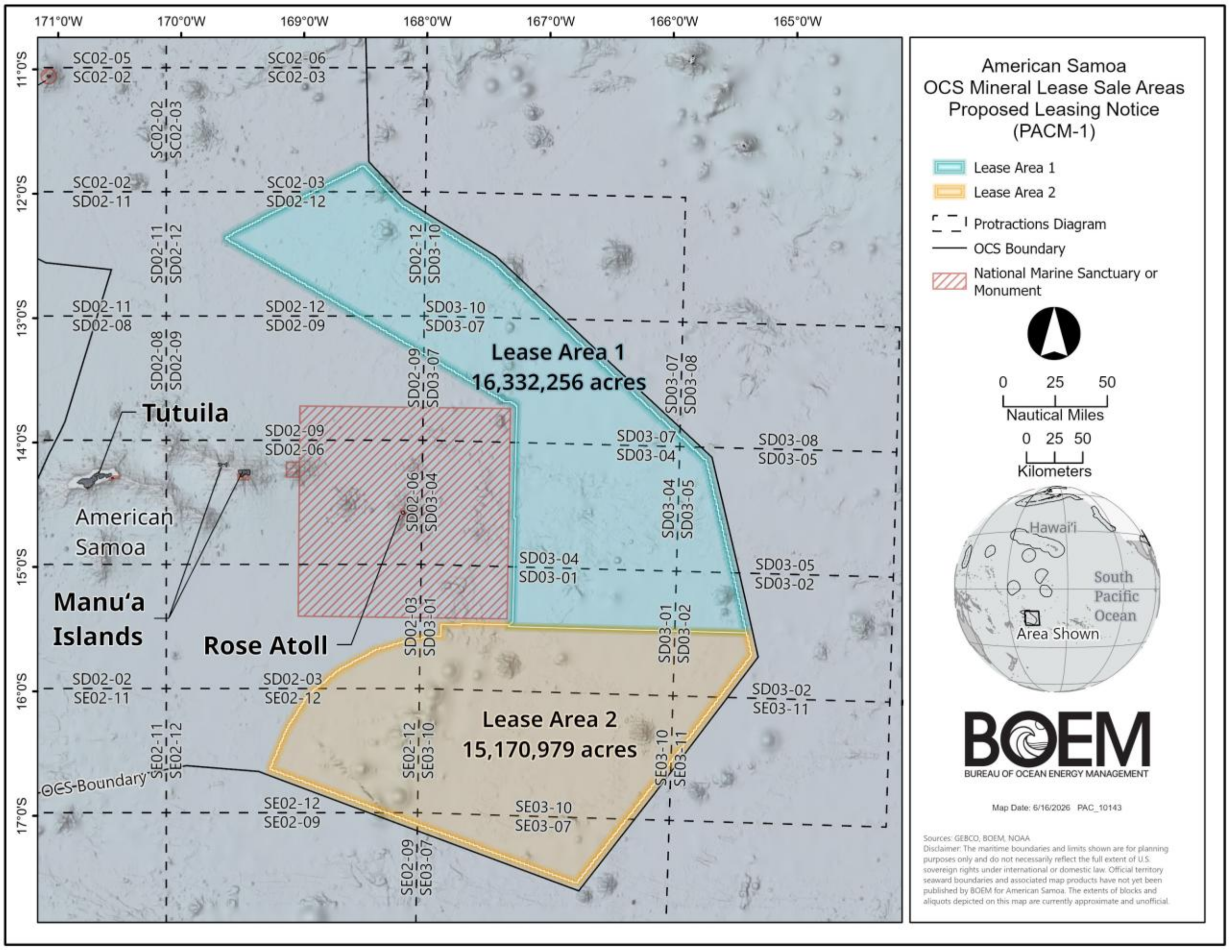


Figure 3: American Samoa OCS Mineral Lease Sale Areas (BOEM, 2026e)

Subsequent steps may include publication of a Final Leasing Notice and, potentially, a Competitive Lease Sale, consistent with BOEM's OCS mineral leasing framework.

It is important to note that the deep-sea seabed mineral development industry is an emerging global industry progressing through varying stages of lease area identification and leasing, technology readiness, commercial operational scale, and offshore logistics development across different regions.

Within this context, this assessment is intended to support BOEM's ongoing environmental analysis and planning and decision-making efforts by identifying representative deep-sea seabed mineral development activities, vessel and equipment characteristics, associated port infrastructure needs, and evaluation criteria for regional port and harbor assessments. The assessment develops representative industry activity and port infrastructure demand scenarios and evaluates the suitability of existing, planned, or proposed port infrastructure in American Samoa to support potential future industry activities. The assessment also evaluates how existing and future port and harbor infrastructure in American Samoa could support varying levels of potential industry demand, considering the following representative port development scenarios:

- Utilize a single port/harbor (or as few as possible) to support all activities.
- Utilize multiple port/harbor facilities to optimize development at the most ideal locations and to spread the economic impact in the territory.
- Relocate existing port/harbor uses and tenants to other sites if that results in a more optimal outcome for stakeholders.
- Construct new port(s)/harbor(s) on the American Samoa Islands.

The study incorporates industry and stakeholder engagement to both inform the assessment approach and assumptions and also to seek stakeholder input. The assessment then evaluates regional port and harbor infrastructure capabilities and constraints, identifies potential infrastructure gaps and development needs, and provides findings and recommendations to support future planning and infrastructure development associated with supporting potential seabed mineral development activities in the region.

This report consists of seven sections. Following this introduction, **Section 2** presents an overview of representative deep-sea seabed mineral development activities, including the deep-sea seabed mineral development and collection processes, types of relevant deep-sea seabed mineral deposits, and industry vessel and equipment concepts and characteristics**. Section 3** summarizes port types and associated infrastructure characteristics that may support varying industry activities and logistics needs, and details the port site evaluation criteria developed for this assessment. **Section 4** presents the representative industry activity and port development scenarios developed for the study. **Section 5** summarizes insights from industry and port stakeholder engagement efforts. **Section 6** presents the findings of the American Samoa ports and harbors inventory assessment. **Section 7** provides conclusions, recommendations and potential next steps.

2 Deep-sea Seabed Mineral Development Industry Activities

Seabed mineral resources occur in different geological forms, settings, and water depths across the OCS. Within the Pacific OCS, mineral deposit types include polymetallic nodules, cobalt-rich ferromanganese crusts, polymetallic sulfide deposits (also referred to as seafloor massive sulfide deposits), as well as nearshore resources such as heavy mineral sands and phosphorites. Areas of the Pacific OCS are recognized as having substantial potential for minerals that are critical to the nation's supply chain needs.

For this assessment, the focus is on seabed mineral deposit types found in deep-water environments that require deep-sea seabed mineral development activities, specifically polymetallic nodules, cobalt-rich ferromanganese crusts, and polymetallic sulfide deposits. These mineral deposits are generally found at water depths on the order of several hundred meters and up to 7,000 meters (about 4.5 miles). Nearshore resources such as heavy mineral sands and phosphorites are not considered further in this assessment.

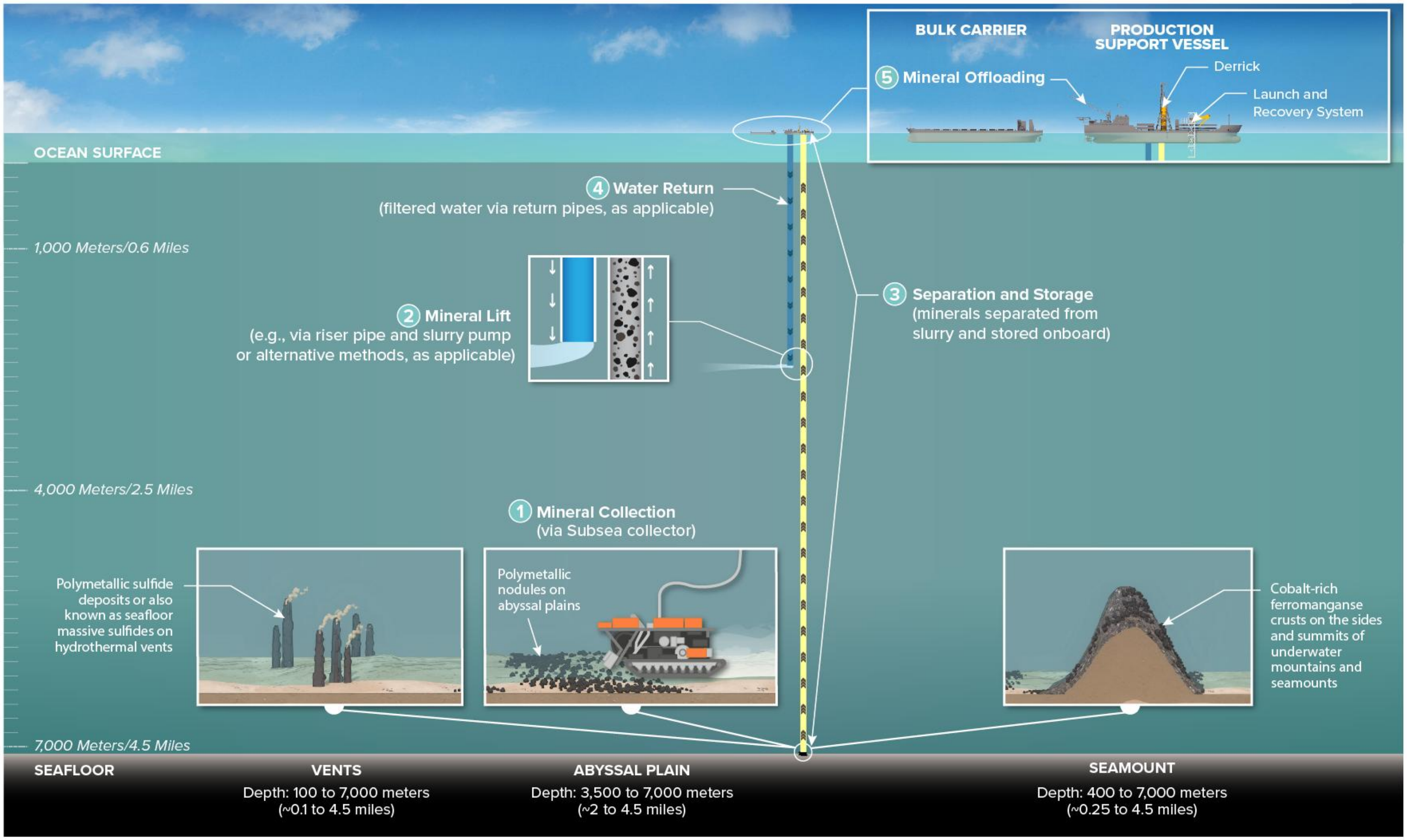
This section provides background information on deep-sea mineral development activities, including the types of relevant deep-sea mineral deposits, their physical characteristics and geological settings, and the general recovery and collection concepts that have been proposed or demonstrated to date. It also shares insights on the vessel types and key equipment systems or concepts associated with deep-sea mineral development operations, based on pilot projects, early-stage commercial concepts, and literature. This background establishes a foundation for identifying potential port infrastructure needs for deep-sea mineral development activities.

2.1 Deep-sea Seabed Mineral Development Process Overview

Deep-sea mineral development generally refers to the recovery and collection of mineral deposits or nodules from the deep ocean using purpose-built vessels, subsea equipment, and machinery. Development activities can be conducted using specialized subsea equipment deployed from surface vessels and supported by lifting, processing, and storage systems. A summary of the processes is provided below, and an illustrative overview is shown in **Figure 4**.

High-Level Deep-sea Seabed Mineral Development and Collection Process

1. **Mineral Collection:** Mineral deposits and nodules are recovered from the deep-ocean seabed at depths up to 7,000 meters (roughly 4.5 miles) using subsea collector machinery.
2. **Mineral Lift:** The collected mineral deposits and nodules are lifted from the seafloor to the Production Support Vessel or surface vessel through the riser and lift system or other lifting concepts, e.g., bucket, conveyor, or via the subsea collector itself.
3. **Separation and Storage:** Mineral deposits may undergo an initial separation from the slurry at the seabed prior to lifting, followed by additional separation onboard the Production Support Vessel. This process removes excess water and other materials from the mineral deposits, which are then stored in the vessel's cargo holds until transfer to shore or to an export vessel, such as a bulk carrier.
4. **Water Return:** Separated and filtered seawater may be returned to the ocean at a controlled depth, for example, on the order of several thousand feet or more, as applicable.
5. **Mineral Offloading:** The stored mineral deposits or nodules may be transferred from the Production Support Vessel (PSV) or surface vessel to port infrastructure or to mineral offtake vessels, e.g., a bulk carrier or ocean-going barges, for transport to logistics hubs or processing facilities.



This figure provides a conceptual illustration of representative mining and collection processes only. Geological features, water depths, and vessel or equipment configurations are not to scale and may vary by deposit type, environmental conditions, technology maturity, and developer-specific designs and operation concepts.

Figure 4: High-level Illustration of Deep-sea Seabed Mineral Development and Collection Processes

2.2 Types of Relevant Deep-sea Seabed Mineral Deposits

This assessment focuses on three deep-sea seabed mineral deposit types that are relevant to recovery and collection activities at abyssal depths: polymetallic nodules, cobalt-rich ferromanganese crusts, and polymetallic sulfide deposits, also referred to as seafloor massive sulfide deposits. This section provides a high-level overview of the physical form, geological setting, typical water depths, and general mineral composition of each deposit type, informed by *Types of Relevant Marine Mineral Deposits* (BOEM, 2026c).

2.2.1 Polymetallic Nodules

Polymetallic nodules (PMN) are manganese-rich concretions that rest loosely on the seafloor, typically rounded or potato-shaped in form. They generally measure approximately 2 to 15 centimeters in diameter (roughly 1 to 6 inches) and form extremely slowly, accumulating at rates on the order of 2 to 10 millimeters (roughly 0.08 to 0.4 inches) per million years as metal layers precipitate around small nuclei. These deposits are most commonly found on abyssal plains at water depths of approximately 3,500 to 7,000 meters (roughly 2 to 4.5 miles), particularly in regions with soft sediment cover such as the central and south Pacific, including the American Samoa OCS. PMN may contain manganese along with concentrations of nickel, copper, and cobalt, as well as trace amounts of rare earth elements and, in some cases, elements such as titanium, tellurium, and lithium.

2.2.2 Cobalt-rich Ferromanganese Crusts

Cobalt-rich ferromanganese crusts (CFC) are hard, rock-like mineral layers that form on exposed bedrock surfaces along the flanks and summits of seamounts and underwater mountain chains. These crusts typically range from about 5 to 20 centimeters in thickness (roughly 2 to 8 inches) and can approach up to 25 centimeters (roughly 10 inches). They grow extremely slowly at rates of approximately 1 to 4 millimeters (roughly 0.04 to 0.16 inches) per million years as metals precipitate from seawater. Cobalt-rich crusts occur across a wide range of water depths, generally from approximately 400 to 7,000 meters (roughly 0.25 to 4.5 miles), and are most commonly associated with seamounts in the central and western Pacific. These deposits may be rich in cobalt and manganese, with additional concentrations of nickel, copper, and rare earth elements, and may also contain elements such as tellurium, scandium, and platinum.

2.2.3 Polymetallic Sulfide Deposits

Polymetallic sulfide deposits (PSD), also referred to as seafloor massive sulfides (SMS), form at hydrothermal vent systems, where metal-rich fluids circulate through the Earth's crust and discharge into the ocean. As these fluids cool rapidly upon contact with seawater, they precipitate sulfide minerals that accumulate into mounds and chimney-like structures – size may range from approximately 1 to 50 meters in height (roughly 3 to 165 feet) (NOAA, 2025a). Under active venting conditions, hydrothermal chimneys may grow rapidly, at rates of up to about 2 centimeters (roughly 0.8 inches) per day. These deposits can occur across a broad range of water depths, from roughly 100 to 7,000 meters (roughly 0.1 to 4.5 miles), and are typically associated with undersea volcanoes, mid-ocean ridges, and tectonic spreading centers. PSD may be enriched in copper and zinc, with additional concentrations of gold and silver, and may also contain elements such as antimony, bismuth, gallium, tellurium, and germanium.

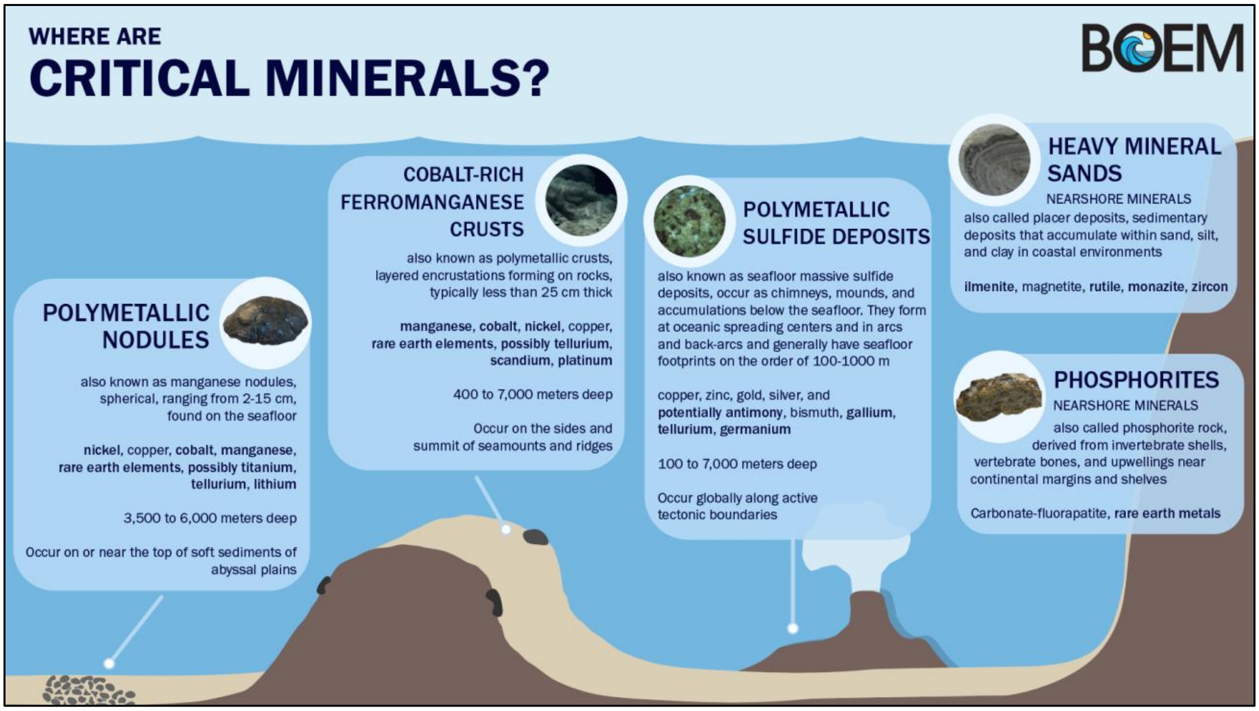


Figure 5: Types of Relevant Deep-sea Seabed Mineral Deposits (BOEM, 2026c)

2.3 Deep-sea Seabed Mineral Development and Collection Concepts by Deposit Type

Deep-sea seabed mineral recovery and collection concepts can vary by deposit type due to differences in seabed morphology, mineral deposit physical properties, and geological setting. As a result, the methods and equipment used to recover and collect PMN, CFC, and PSD or SMS may differ in their physical characteristics and collection approach. Concepts known to date use specialized subsea collector machines of varying sizes and capabilities, and are deployed from surface vessels and lift systems to transport collected material to production support vessels. The following subsections describe alternative concepts of recovery and collection approaches that have been identified for each deep-sea mineral deposit type, recognizing that operational methods may continue to develop as subsea collector technologies mature.

For PMN, remotely operated vehicles or autonomous subsea collector machines may move across relatively flat seabed areas and scoop, pick up, or vacuum loose mineral deposit nodules from the surface without significant penetration into the seabed. The collected nodules are then transported to surface vessels with mineral lift systems.

For CFC deposits, underwater collection machines may use cutting heads or mechanical scrapers to operate on the steep slopes of underwater mountains and seamounts. These systems may shave or peel the thin metal-rich crust layer, which can be a few centimeters thick. The removed material is collected and lifted to the production support vessel.

For PSD or SMS, recovery and collection concepts may involve cutting machines similar to underwater rock cutters or robotic excavators. These systems may break and fragment hard sulfide rock at hydrothermal vent mounds. This method may work like underwater quarrying, cutting and breaking hard rock so it can be collected and removed. The fragmented material can then be collected and lifted to the surface vessel.

2.4 Deep-sea Seabed Mineral Development Vessels and Equipment Concepts

Deep-sea mineral development activities are expected to be supported and conducted by a fleet of vessels and subsea equipment. Deep-sea exploration, environmental monitoring, mineral recovery and collection, supply logistics, and mineral transport activities may occur sequentially or simultaneously and at different locations within a lease area or across multiple lease areas within a region, supported by multiple vessel types and equipment systems with distinct operational roles and onshore infrastructure requirements.

This section identifies and briefly describes the vessel types and key equipment systems that are expected to support deep-sea activities, based on exploration and pilot projects, early commercial concepts, industry stakeholder outreach, and available literature. The descriptions are intended to outline a range of functional roles and a baseline range of physical characteristics relevant to port and harbor infrastructure planning, rather than to define fixed or final design characteristics for vessels or equipment, recognizing that vessel configurations and equipment concepts may evolve as the industry matures.

Specifically, this section outlines the general roles, expected capabilities, and baseline ranges of physical characteristics for production support vessels and their associated systems, as well as research vessels, offshore support vessels, bulk carriers, and other auxiliary vessel classes and concepts that may support deep-sea seabed mineral development industry activities. Refer to **Table 1** for baseline ranges of physical dimensions for production support vessels, research vessels, offshore support vessels, and bulk carriers, and to **Figure 6** for illustrative vessel and equipment examples.

2.4.1 Production Support Vessels

A Production Support Vessel (PSV) may act as the primary offshore base for deep-sea mineral exploration, recovery and collection operations. This includes deploying subsea equipment, collecting mineral deposits, lifting minerals from the seabed, and temporarily storing recovered minerals during operations. Current PSVs are typically converted or purpose-built vessels derived from offshore drillships used in the oil and gas industry. As the deep-sea seabed mineral industry matures, PSV design concepts may evolve beyond existing offshore drillship classes and configurations, or other vessel classes may be converted or purpose-built to serve similar operational purposes and responsibilities, such as bulk carriers.

It may deploy subsea collector machinery using a launch and recovery system. Depending on the mineral lifting method employed, the vessel may also assemble and deploy riser and lift system components using the ship’s derrick, or alternatively deploy bucket lift or conveyor-based systems, as described by industry stakeholders. These mineral lift systems will be responsible for transporting collected minerals from seabed depths up to the surface vessel.

Once mineral deposits reach the surface, they would be stored in onboard cargo holds, and filtered water would be returned to a controlled depth in the water column, as applicable, depending on the recovery and collection method and technology employed. When onboard storage capacity is reached, the recovered minerals may be transferred through several pathways depending on the phase and scale of operations and the available port and logistics infrastructure:

- Transport by the PSV or another surface vessel to a suitable dry bulk mineral site
- Transfer to a bulk carrier, barge, or other vessel for transportation to suitable ports and facilities

PSVs can approach lengths of up to approximately 800 feet and draft at berth approaching 50 feet or more, depending on class. The PSV provides power to all subsea equipment, pumps, onboard processing and storage systems, and the dynamic positioning (DP) system as applicable to maintain vessel position in deep water during operations. The vessel will accommodate the crew responsible for operating and maintaining the ship, subsea systems and equipment throughout the duration of offshore activities.

Because the deep-sea seabed mineral industry, its methodologies, and associated technologies are still emerging, only a limited number of prototype or converted PSVs currently exist worldwide that are capable of supporting deep-sea marine mineral recovery and collection operations on a commercial scale. Demonstrated commercial-scale capable deep-sea mineral recovery and collection technologies and equipment also remain limited. Most developers do not yet operate fully integrated production systems that include subsea collectors, complete riser and lift systems or alternative mineral lifting systems, and large onboard mineral storage capacity. As a result, full-scale PSVs are rare and, in many cases, remain under planning or development. Existing vessels are primarily used for equipment trials, engineering testing, pilot seabed mineral development programs, and environmental studies, rather than sustained commercial production. As multiple deep-sea seabed mineral development initiatives progress in parallel globally, vessel needs and availability may evolve over time depending on global and regional industry activity levels and individual project timelines.

PSVs may be equipped with the following systems and equipment:

- Subsea Collector
- Launch and Recovery System
- Mineral Lifting System
- Remotely Operated Vehicles and Autonomous Underwater Vehicles

Subsea Collector: The subsea collector machinery is the primary marine mineral recovery and collection unit operating on the seafloor. Subsea collectors may be operated through tethered control systems similar to large-class remotely operated vehicles or may incorporate autonomous vehicle functions depending on the technology concept. As such, they can generally be treated as dedicated deep-sea mineral recovery and collection machinery rather than conventional remotely operated or autonomous underwater vehicle systems due to their larger size, weight, complexity of integrated equipment, and the scale of mineral deposit collection and handling operations they perform.

It can be deployed from the PSV using a launch and recovery system and may receive continuous power and data communication through an umbilical cable or operate with varying levels of autonomy depending on the selected technology and system design.

The collector may move across the seafloor or other subsea geological formations using tracked systems or hovering mechanisms, depending on seabed morphology, mineral deposit characteristics, and geologic setting, and the availability and economic feasibility of the selected technology. Its primary function is to recover and collect mineral deposits and either temporarily store them onboard the collector or transfer them into the intake of the riser and lift system or other mineral lift systems. Where a riser and lift system is used, collected material can be mixed with seawater to form a slurry that can be pumped vertically to the surface.

Subsea collector system characteristics may vary depending on the mineral deposit type being targeted:

- PMN: Collectors may vacuum, fluidize, or mechanically gather loose nodules from the sediment surface with minimal sediment penetration.
- CFC: Collectors may use mechanical cutting heads or scrapers to remove thin crust layers from seamount slopes.
- PSD or SMS: Collectors may employ cutting wheels, rock grinders, or robotic excavation heads to break and fragment hard sulfide rock.

Subsea collector concepts and designs remain under ongoing development and demonstration. Based on pilot-scale and pre-commercial concepts, as well as industry stakeholder information, subsea collectors may weigh from several hundred metric tonnes (approximately 1.10 short tons per metric tonne) to several thousand metric tonnes for commercial-scale operations, with characteristic dimensions on the order of approximately 5 to 10 meters or more in length and width (approximately 15 to 35 feet or greater). These systems require PSVs designed to accommodate their storage, deployment, recovery, and operational loads through robust launch and recovery systems.

Launch and Recovery System: The Launch and Recovery System (LARS) support the deployment and retrieval of subsea collectors and other heavy subsea equipment used in deep-sea seabed mineral development operations. LARS may consist of an A-frame or heavy-duty crane, hydraulic winches, motion-compensated handling systems, and guide frames, typically installed at the stern or side of a PSV or other support vessels, depending on the subsea collector technology, equipment configuration, developer-specific concepts, and vessel suitability.

The LARS may be used to lower and recover subsea equipment to and from deep waters, manage large umbilical cables that supply power, hydraulics, and communications where applicable, and compensate for vessel motions such as heave, roll, and pitch.

Mineral Lifting Systems: Several concepts are proposed and noted for lifting collected deep-sea mineral deposits from the seafloor to a surface vessel. Depending on deposit type, water depth, production scale, and technology developer, mineral lifting may be accomplished using different approaches, including riser and lift systems (RLS) employing pipes and pumps, mechanical bucket or hoist systems, conveyor-based systems, or subsea collector concepts with integrated storage and lift capability. These approaches are at varying levels of technical maturity, with initial large-scale pilot and pre-commercial concepts to date utilizing RLS, similar to those employed in offshore drilling activities.

The RLS consists of a long, vertical pipe system that enables the transport of collected mineral deposits from the seafloor to the surface vessel, drawing on design principles used in oil and gas industry and offshore drilling operations. Within the riser, subsea pumps would assist with lifting a slurry of mineral material mixed with seawater from varying water depths.

The RLS may be assembled, deployed, and recovered from the PSV using the vessel's derrick if available and RLS handling equipment. The derrick may support the vertical handling of individual riser joints, help control alignment during installation, and manage the loads generated by the riser during operations.

In addition to lifting minerals, the RLS can be used to manage return water with an additional return pipe, as applicable. After mineral separation onboard the vessel, the filtered seawater can be discharged back into the ocean through a dedicated return line or an auxiliary pipe. The return water may be released at a controlled water depth, for example, on the order of several thousand feet below the surface.

Remotely Operated Vehicles and Autonomous Underwater Vehicles: Remotely Operated Vehicles (ROVs) and Autonomous Underwater Vehicles (AUVs) are underwater equipment that may support exploration, environmental assessment, and recovery and collection operations. They can perform high-resolution seabed inspections, seabed mapping, equipment checks, and mineral deposit collection.

ROVs remain connected to the vessel through an umbilical cable that may provide power, video, data transfer, and real-time control from operators on the ship. AUVs may operate without an umbilical cable, following pre-programmed missions to collect geophysical, oceanographic, and environmental data or perform other tasks before returning to the vessel. ROVs and AUVs can assist with tasks including but not limited to:

- Map the seabed, identify mineral deposits, and collect mineral deposits
- Guide and monitor the subsea collector machinery
- Inspect the mineral lift system and equipment
- Track sediment plumes and environmental conditions
- Support engineering tasks during exploration, deployment, and recovery

2.4.2 Research Vessels

Research vessels (RVs) can provide scientific, environmental, and engineering capabilities that can support multiple stages of deep-sea seabed mineral development activities. Unlike a PSV, an RV is not intended for large-scale mineral collection, deployment of riser and lift systems, or storage of significant mineral volumes. Instead, RVs can support seabed mapping, environmental conditions and impact assessment, resource evaluation, technology and equipment test and demonstration, and monitoring during and post-development activities.

RVs can deploy ROVs, AUVs, oceanographic sensors, water sampling systems, sediment coring equipment, geophysical survey tools, and other mission specific instruments as required. These systems support the collection of geological, biological, chemical, and physical data necessary for planning, monitoring, and operational support.

Large RVs can approach lengths of up to approximately 450 feet and draft at berth approaching 40 feet or more, depending on class. Functional arrangements can include laboratories, equipment storage and preparation areas, equipment launch and recovery systems, and accommodations for crew and other personnel. Ocean-class RVs can be equipped with DP systems to maintain station during deepwater operations.

RVs may operate in offshore locations during various stages of the industry lifecycle, from early exploration and environmental studies to operational monitoring and post-activity monitoring and assessment, depending on regulatory requirements and project needs.

2.4.3 Offshore Support Vessels

Offshore Support Vessels (OSVs) can provide a range of supply, equipment, crew logistics, operational support, and safety functions required to support deep-sea seabed mineral development activities at offshore locations and between offshore work sites and port infrastructure. They can serve to enable continuity of offshore operations by transporting personnel, supplies, spare parts, equipment, fuel, and other materials. They may also provide towing capability, emergency response, standby functions, and temporary accommodation support during exploration, pilot, pre-commercial, commercial, and post activity demobilization periods.

The specific mix, size, and capabilities of OSVs would depend on factors such as offshore distance from the logistics port, environmental conditions, mission duration, and intensity of offshore tasks. Vessel classes may include platform supply vessels, anchor handling vessels, multipurpose support vessels, crew transfer vessels, and others. Deck arrangements can include flexible cargo handling and rapid loading and discharge equipment rather than permanent installation of heavy industrial systems, though cranes, winches, gangways, and other mission-specific equipment are common.

OSVs can approach lengths of up to approximately 450 feet and draft at berth approaching 40 feet or more, depending on class. They can have frequent port calls, short turnaround windows, and recurring demand for staging of supplies, spare parts, and equipment. Shoreside needs may include crew transfer areas, offices, maintenance services such as hull cleaning and machinery repair, storage and handling of umbilical cable reels and tensioning, and other subsea components, fueling, potable water, and industrial waste handling facilities.

2.4.4 Bulk Carriers

Dry Bulk Carriers may be used to transport collected seabed mineral deposits from PSVs to dry bulk port terminals or downstream processing locations. Their function is to transport dry bulk mineral cargo between offshore operations and port or downstream receiving facilities.

Following temporary storage onboard the PSV, mineral material may be transferred to a dry bulk vessel at sea through ship-to-ship transfer systems or via port discharge if the PSV returns to shore. Offshore ship-to-ship transfer of dry bulk material is described in the literature as operationally complex. Concepts discussed by the industry include crane-based transfer, conveyor systems, slurry transfer arrangements, or other mechanical handling methods, depending on vessel configuration, sea state limits, and developer-specific system designs.

The size and configuration of bulk carriers serving deep-sea seabed mineral operations may vary depending on project location, production volumes, voyage distances, and dry bulk terminal capabilities. Vessel classes discussed in industry stakeholder engagement and within the literature range from Handymax size to larger Panamax or Capesize vessels. Representative baseline vessel dimensions may therefore range from approximately 100 to 300 meters (330 to 985 feet) or more in length, with beam potentially reaching 45 meters (150 feet) or more. Draft at berth measurements can reach 18 meters (60 feet) or more.

These vessels and their operational activities typically drive the most demanding upland area and load capacity requirements for a dry bulk handling port infrastructure, as well as berth and navigation channel characteristics, associated with accommodating these large vessels and their cargo.

Key marine infrastructure considerations include access to a deep navigation channel, adequate turning basin geometry, and sufficient draft at berth. Berthing infrastructure requirements include adequate berth length and mooring capacity, as well as wharf structural strength to support heavy bulk loading and unloading equipment.

Landside requirements include the availability of material handling systems (e.g., conveyors, ship loaders, unloaders, or cranes) and stockpile or storage yard areas sized to buffer fluctuations between offshore production rates and vessel arrival schedules, along with marine traffic management considerations where multiple PSVs or concurrent lease areas are being supported.

Port call frequency will depend on offshore production rates, PSV storage capacity, and distance to receiving facilities, etc. Under higher production scenarios, multiple bulk carrier calls per week may be required, while early or pilot phases may require few or no calls.

Large dry bulk carriers, including Panamax and Capesize vessels, commonly operate on intercontinental shipping routes spanning several thousand to more than 10,000 nautical miles. As such, long-distance transport of bulk mineral commodities is considered standard practice within the global dry bulk shipping industry and may not necessarily represent a limiting factor for future seabed mineral logistics operations.

Depending on project-specific logistics strategies, offshore production rates, transfer methods, and receiving facility locations, developers may utilize a combination of local or regional dry bulk mineral port facilities and long-distance bulk transport operations. If available, smaller local dry bulk mineral port facilities may provide operational flexibility by enabling the use of smaller vessels better suited for offshore ship-to-ship transfer operations under varying sea conditions, while recovered material may subsequently be consolidated and transported to downstream processing or export locations using larger dry bulk carriers. Similar hub-and-spoke logistics approaches are commonly used within the global bulk commodities industry.

As the industry remains in the development stage, mineral transport concepts and vessel classes and sizes may differ among developers. Some developers may favor larger, less frequent shipments, while others may use smaller vessels with higher call frequency. Port infrastructure evaluation and design criteria should therefore allow flexibility to accommodate a range of vessel sizes and operating frequencies.

2.4.5 Other Vessels

Other vessels and equipment may support deep-sea seabed mineral development activities depending on offshore distance, operational strategy, regional logistics capabilities, and vessel availability. Where operations occur closer to shore or where transit times allow the use of smaller craft, these vessels may supplement larger offshore support or dry bulk carriers.

Such vessels may include small survey vessels, ocean-going tugboats or workboats for monitoring, light transport, and operations support. Crew transfer vessels may shuttle personnel, technicians, and light supplies and equipment between offshore areas and port facilities when distance and sea conditions allow. In some cases, helicopter transfer may also be feasible if aviation facilities are available on the host vessel and the distance of travel is suitable. Guard vessels or patrol boats may also be deployed to maintain safety and exclusion zones, manage marine traffic, support communications, and assist with emergency readiness. These vessels can help ensure separation between other activities and maritime users and operate independently, in coordination with other project vessels, or from a larger offshore unit. Ocean-going barges may also be used in certain project configurations for equipment and supply transport, mineral transport, or operations support purposes.

The fleet combination, size, and utilization of these supporting vessels would vary based on project location and needs, regulatory requirements, and developer operational preferences.

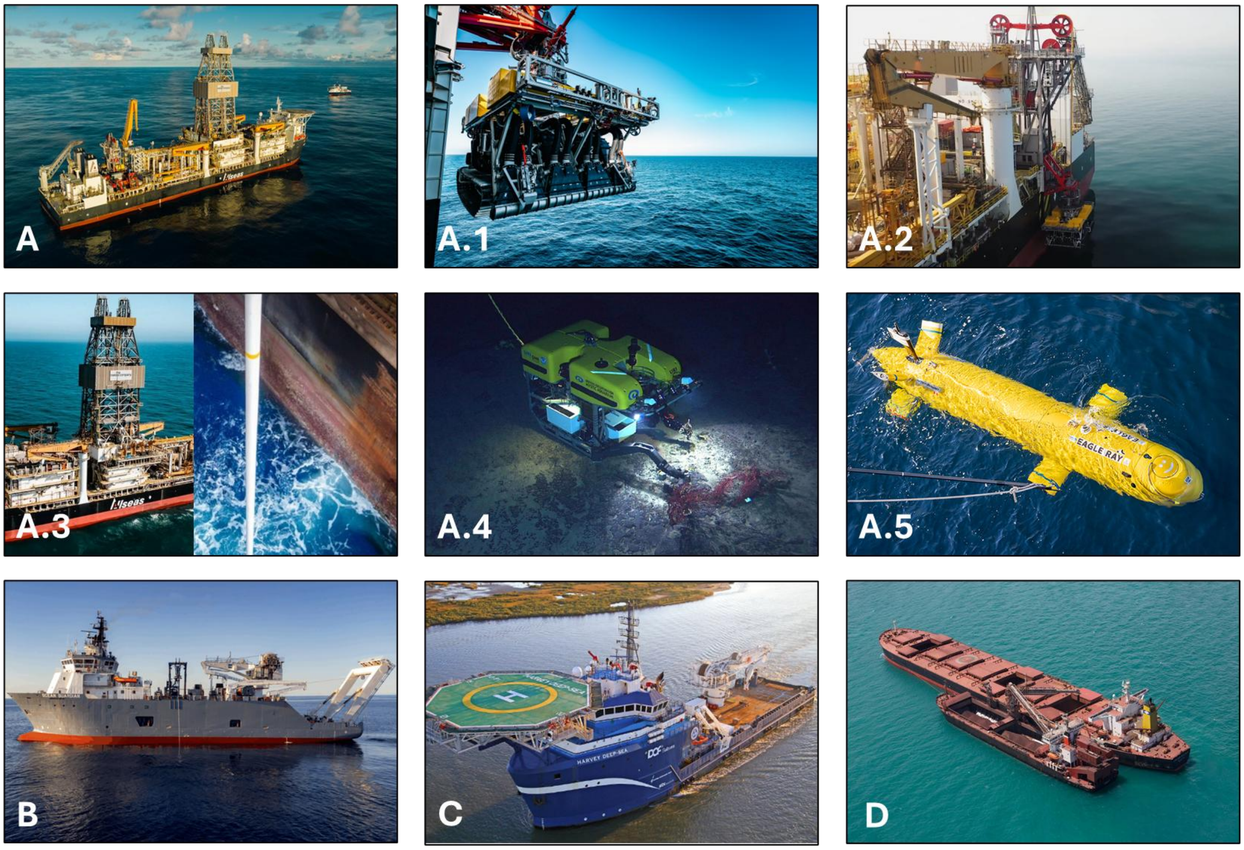


Figure 6: Deep-sea Seabed Mineral Development Vessels and Equipment
(A) Production support vessel (PSV), (A.1) subsea collector, (A.2) launch and recovery system (LARS), (A.3) derrick and riser and lift system (RLS), (A.4) remotely operated vehicle (ROV), and (A.5) autonomous underwater vehicle (AUV); (B) research vessel (RV); (C) offshore support vessel (OSV); and (D) bulk carrier. (Source: Allseas & The Metals Company (A–A.3); NOAA (A.4–A.5); Stabbert Maritime (B); Harvey Gulf (C); CSL Ships (D).)

Table 1: Deep-sea Seabed Mineral Development Vessels and Range of Specifications

Baseline Range of Physical Characteristics	A. Production Support Vessels (PSV)	B. Research Vessels (RV) & C. Offshore Support Vessels (OSV)	D - Bulk Carriers (Handymax Size to Panamax and Capesize Vessels)
Length Overall (LoA)	90 to 260 meters / 300 to 800 feet	55 to 135 meters / 180 to 450 feet	100 to 300 meters / 330 to 985 feet
Beam	25 to 45 meters / 80 to 150 feet	12 to 20 meters / 40 to 65 feet	30 to 45 meters / 100 to 150 feet
Draft at Berth, min	6 to 15 meters / 20 to 50 feet	3 to 12 meters / 10 to 40 feet	10 to 18 meters / 33 to 60 feet
Air Draft Restrictions, min	90 to 150 meters / 300 to 500 feet	5 to 40 meters / 17 to 130 feet	20 to 70 meters / 65 to 230 feet

(Source Note: PSV information is adapted from and informed by Marine Insight, 2024 and industry stakeholder outreach. RV and OSV information is adapted from and informed by NOAA, 2020, EMA, 2025, and industry stakeholder outreach. Bulk carrier information is adapted from and informed by the USDA, *Bulk Vessel Fleet,* and Clarksons, *A Guide to Bulk Vessel Sizes*, Bulk Carrier Guide, 2010, and industry stakeholder outreach.)

3 Port Infrastructure Needs and Evaluation Criteria

Deep-sea seabed mineral development industry activities, where developed, are expected to involve a sequence of offshore exploration, monitoring and assessment, equipment testing, and pre-commercial and commercial scale recovery and collection operations. These activities may be supported by a range of vessel types, including research vessels, PSVs, bulk carriers, OSVs, crew transfer vessels, and other auxiliary craft as described in the previous section.

Depending on the stage of industry development, activities may occur sequentially or in parallel and may be distributed across multiple offshore locations. As a result, port and harbor infrastructure needs associated with supporting deep-sea seabed mineral development activities are not expected to be uniform across regions, project locations, or industry phases. Infrastructure demands may change as regulatory and environmental requirements evolve, operational concepts mature, vessel and equipment characteristics become better defined, production volumes standardize or increase, and economic factors (including economies of scale), and downstream processing and logistics strategies are further developed.

This section defines representative port site types and presents the evaluation criteria developed to assess the capability and readiness of regional port infrastructure to support deep-sea seabed mineral development activities.

3.1 Port Site Types

Not all ports located near deep-sea mineral recovery and collection areas are expected to support all types of industry activity or vessels. For planning purposes, ports were grouped into different functional site types based on the kinds of industrial activities, vessel operations, logistics, and supply chain services they may support. Each site type has different infrastructure and operational needs.

These categories are intended to help evaluate existing port facilities and identify where upgrades, expansion, or new development may be needed. They are not intended to represent fixed or final port development configurations.

3.1.1 Dry Bulk Mineral Site

Dry Bulk Mineral (DBM) Sites may support the handling of recovered marine mineral deposits during pre-commercial or commercial-scale operations. Alternatively, minerals could be transported to downstream processing facilities where processing may occur, provided such facilities exist and have suitable waterborne access and infrastructure capable of receiving and handling bulk carriers and dry bulk mineral commodities. Activities at a DBM port may include berthing of large vessels and bulk carriers, transfer of mineral cargo, temporary storage, and onward shipment by water, road, or rail to downstream processing or other import and export locations.

DBM sites may function primarily as export terminals, import terminals, or hybrid operations depending on site configuration and logistics pathways. Export-oriented facilities typically work on efficient yard-to-vessel loading, coordination with inland transport systems, and may handle varying commodity streams. Import-oriented facilities generally prioritize high productivity vessel discharge, larger storage areas, and integration with onward distribution networks. In many ports and locations, terminals may combine both roles, requiring flexible layouts, adaptable material handling systems, and operational strategies capable of accommodating variable vessel sizes, arrival patterns, product grades, and throughput rates. Overall terminal capacity is influenced by berth characteristics, yard size, equipment productivity, stockpile management, and coordination between marine and landside logistics. DBM port sites may require:

- Upland area sufficient for staging, stockpiling, and supporting onward transport of mineral commodities
- Wharf and berthing infrastructure capable of accommodating long and deep draft vessels, including PSVs and large bulk carriers
- Upland load capacity adequate to support mineral stockpiles under varying stacking patterns and heights
- Wharf structural capacity sufficient to support ship loading or unloading systems and heavy mobile or fixed cargo handling equipment and cranes
- Adequate berth and navigation channel width, depth, and vertical clearance (e.g., bridge clearance) for vessel transit and maneuvering
- Bulk material handling systems capable of continuous operations, which may include ship unloaders such as cranes with grabs and hoppers, conveyors and transfer towers, temporary storage such as stockpiles, sheds, domes, or bunkers, reclaim systems, outbound loading to truck, rail, or waterborne transport, and associated environmental controls, including dust suppression and stormwater runoff management
- Connectivity to external transportation networks to support outbound transfer or export of stored mineral material via waterborne transport, road, or rail

Mineral deposit processing is not assumed to occur at these locations during early phases of industry development, and mineral bulk material is expected to be shipped to established processing facilities elsewhere.

3.1.2 Production Support Vessel Site

PSV Sites, depending on location and regional port capabilities, may serve as a home port or long-term staging location for PSVs, bulk carriers, and other large vessels supporting deep-sea mining activities in the region. These sites may support vessel berthing, maintenance, crew changes, resupply, bunkering, and broader operational logistics. Such ports may require:

- Infrastructure capable of berthing large and deep draft vessels, including PSVs, bulk carriers, and other large vessels
- Adequate navigation channel width, depth, and vertical clearance (e.g., bridge clearance)
- Fuel supply, utilities, shore power where applicable, cranes for equipment and cargo handling, and maintenance capability
- Crew transfer, provisioning, and operational logistics support infrastructure
- PSV Sites, depending on location and regional port capabilities, may serve as a home port or long-term staging location for PSVs, bulk carriers, and other large vessels supporting deep-sea mining activities in the region. These sites may support vessel berthing, maintenance, crew changes, resupply, bunkering, and broader operational logistics.

Industry stakeholders noted that PSVs and other large vessels are generally expected to remain offshore for extended durations while conducting operations. During commercial activity, PSV port calls may be infrequent and could occur only a few times over multi-year operating cycles, typically driven by major maintenance or regulatory requirements rather than routine weekly or monthly port calls.

Routine offshore resupply, personnel movement, and day-to-day operational support may instead be provided by smaller or mid-sized vessels operating between offshore work sites and regional ports. As a result, this port type would primarily support large vessel homeporting, major maintenance, equipment laydown, or emergency response functions, rather than mineral handling. Where a suitable port with such capabilities is located within practical transit distance of offshore activity areas, it may serve for large vessel homeport and maintenance functions. However, if no such port exists nearby with required infrastructure and supply chain capabilities, proximity to the offshore areas becomes less critical for PSVs or other large vessels, as these vessels are expected to remain offshore for extended periods. In this case, the more important consideration is the availability of regional port infrastructure capable of supporting the smaller or mid-size vessels, which will be responsible for sustaining routine logistics, crew transfer, and resupply operations.

3.1.3 Operations and Logistics Site

Operations and Logistics (O&L) Sites may support routine offshore logistics, resupply, crew transfer, and mission support activities conducted by small to mid-size and auxiliary vessels operating between offshore work areas and regional port terminals. These sites can serve RVs and OSVs, crew transfer craft, workboats, harbor craft, and ocean-going barges. Their function is to act as an onshore base that enables routine movements of personnel, consumables, spare parts, and mission equipment while allowing large production vessels to remain offshore.

Where feasible, O&L facilities are most effective when located within a practical day-to-day round-trip transit distance of offshore activity areas. This allows logistics support to be performed by smaller vessels while providing sheltered access for inspections, maintenance, and crew or project team transport and accommodation.

Compared with DBM sites or PSV home ports, O&L site locations typically prioritize logistics performance, quay availability, and flexible laydown and warehouse capacity rather than very deep draft berths, heavy wharf and upland loading capacity, or extensive upland storage areas. O&L port sites may require:

- Wharf and berthing infrastructure for RVs, OSVs, crew transfer vessels, tugs, and ocean-going barges with a range of length overall and draft at berth characteristics
- Sufficient quay length to accommodate frequent port calls, simultaneous calls, and short duration port stays of small to mid-size vessels, e.g., up to 450 feet long overall vessels
- Warehousing and open staging areas for spare parts, consumables, containers, and project cargo
- Lifting equipment or mobile and fixed cranes for loading tools, supplies, and subsea or operational equipment
- Designated areas for staging, spooling, inspection, testing, and light maintenance of umbilical, hoses, reels, and deck systems, depending on mission and vessel requirements
- Fuel supply, potable water, shore power where available, and waste handling capabilities for domestic and industrial waste
- Office space and facilities supporting marine activities coordination, logistics, and temporary personnel accommodation
- Safe and efficient crew transfer arrangements with access to airports, roads, and other regional transportation links as applicable
- Sheltered harbor conditions suitable for small and mid-size vessel operations under a range of weather scenarios

Figure 7: Port Site Types
(A.1–A.2) Dry bulk mineral (DBM) site; (B.1–B.2) production support vessel (PSV) site; (C.1–C.2) operations and logistics (O&L) site. (Source: Port of Rotterdam (A.1); CSL Ships (A.2); Allseas (B.1–B.2); Karmsund Port Authority (C.1); Haugesund Luftfoto AS (C.2).)

3.2 Port Site Evaluation Criteria

Building on the port site types and roles described above, a set of evaluation criteria has been developed to support screening of regional ports for their potential suitability to support deep-sea seabed mineral development industry activities. The criteria provide reference ranges that can be used to screen existing infrastructure and available waterfront sites, identify potential constraints, and highlight where upgrades or new developments may be needed.

The criteria focus on physical infrastructure and site characteristics, vessel and equipment support capability, and logistics support functionality associated with offshore industrial operations of similar scale. They are intended to inform relative suitability assessments across ports and harbors with different characteristics and are not meant to represent final engineering design requirements.

Table 2: Baseline Port Infrastructure Evaluation Criteria for Deep-sea Seabed Mineral Development Industry Activities

Baseline Port Infrastructure Evaluation Criteria	A - Dry Bulk Mineral (DBM) Site	B - Production Support Vessel (PSV) Site	C - Operations and Logistics (O&L) Site
Acreage, min	40 to 80 acres	2 to 10 acres	2 to 10 acres
Wharf / Berthing Length, min	1,000 to 2,500 feet	1,000 feet	500 to 750 feet
Draft at Berth, min	40 to 65 feet	40 to 65 feet	10 to 50 feet
Wharf Load Capacity, min	1,000 psf	1,000 to 3,000 psf	100 to 500 psf
Uplands Load Capacity, min	1,000 to 3,000 psf	1,000 to 3,000 psf	100 to 500 psf

DBM Site: DBM sites were evaluated for their ability to accommodate large bulk carriers, dry bulk cargo handling, temporary storage, import and export activities associated with deep-sea seabed mineral development and logistics operations.

For screening and evaluation purposes, DBM terminals were assessed assuming supporting iron ore-like commodities and baseline annual throughput capacities ranging from approximately 3 to 12 million tonnes per annum (Mtpa). Estimated upland area requirements were developed based on dry bulk mineral storage needs, cargo handling operations and equipment staging, terminal traffic circulation, buildings, facilities and parking, wharf and berthing area requirements, and environmental control areas associated with island-based marine terminal operations.

The primary driver of terminal footprint requirements was identified to be the mineral storage area. For evaluation purposes, a minimum on-site storage capacity was assumed to be approximately 17 percent of annual throughput capacity, consistent with dry bulk industry rule-of-thumb planning values (van Vianen et al., 2014), particularly for island based terminals operating exclusively via waterborne logistics with no import or export connectivity via roadway or railway infrastructure. Storage assumptions were also considered representative of operational buffer requirements associated with marine bulk logistics, including vessel scheduling variability, temporary cargo accumulation between loading and unloading cycles, and weather related operational disruptions. This corresponds to a baseline of approximately 0.5 to 2.0 million tonnes of stored material across the evaluated throughput range.

Mineral storage acreage estimations were based on the following assumptions:

- Approximately 60,000 tonnes of mineral storage and staging capacity, equivalent to roughly 1.5 times a 40,000-tonne Handymax-sized carrier load, was estimated to require approximately 2 to 2.5 acres of operational stockpile area.
- This estimation was based on a conceptual stockpile block or storage building of approximately 180 meters (~600 feet) in length, 40 meters (~130 feett) in width, and 4.5 meters (~15 feet) in height, with an assumed effective stockpiling width of approximately 32 meters (~105 feet) to allow sufficient operational clearance for bulk mineral handling equipment and circulation within the stockpile area.
- Other assumptions:
    - Representative iron ore-like bulk mineral commodity density of approximately 2.3 tonnes per cubic meter (t/m^3), equivalent to approximately 145 pounds per cubic foot (pcf)
    - Bulk material angle of repose of approximately 35 degrees
    - Typical operational stockpile utilization efficiencies associated with conventional dry bulk terminal operations
    - Acreage estimates generally assumed open stockpile storage configurations, although enclosed or partially enclosed storage systems may be preferable in environmentally sensitive coastal or island settings for dust and material containment purposes.
- Actual storage area requirements may increase where:
    - Multiple developer mineral streams are handled
    - Blending operations are required
    - Material segregation requirements are necessary
- With these assumptions, mineral stacking area needs were estimated at approximately 22 to 85 acres for 3 to 12 Mtpa operations.

Additional upland acreage allocations were applied to account for supporting terminal infrastructure and operations space, including:

- Internal roadways and circulation areas (generally 10 to 20 percent of the estimated mineral storage area; approximately 10 percent considered), reflecting terminal truck and equipment circulation needs within island based operations with limited external landside logistics connectivity.
- Material handling systems (generally 10 to 15 percent of the estimated mineral storage area; approximately 15 percent considered), including conveyors, transfer towers, stacker reclaimers, and associated operational clearances and equipment support areas.
- Buildings and facilities (generally 2 to 5 percent of the estimated mineral storage area; approximately 5 percent considered), including administration buildings, workshops, maintenance facilities, and control rooms, with the upper bound percentage applied considering limited supporting industrial infrastructure in the surrounding island conditions.
- Parking and staging areas (generally 3 to 10 percent of the estimated mineral storage area; approximately 10 percent considered), including staff parking, equipment staging, and operational laydown areas, with the upper bound percentage applied considering limited external parking and staging availability in the surrounding island region.
- Wharf and berthing zones (generally 10 to 20 percent of the estimated mineral storage area; approximately 20 percent considered), including berth aprons, ship loader systems, operational buffers, vessel berthing and support areas, and mineral transfer infrastructure supporting both import and export activities.

- Environmental and buffer areas (generally 10 to 25 percent of the estimated mineral storage area; approximately 20 percent considered), including stormwater management systems, dust control zones, setbacks, and environmental compliance area considerations.

Based on these assumptions, estimated upland area requirements for representative dry bulk mineral terminal throughput scenarios were developed and are summarized in **Table 3**:

Table 3: Representative Estimated Upland Area Needs for DBM Terminal Throughput Scenarios

Throughput Scenario	Mineral Storage Area	Additional Infrastructure & Operations Area	Estimated Total Upland Area Requirement
~3 Mtpa	~22 acres	~17 acres	~38–40 acres
~6 Mtpa	~43 acres	~34 acres	~75–80 acres
~12 Mtpa	~85 acres	~68 acres	~150–155+ acres

Accordingly, baseline screening criteria of approximately 40 to 80 acres were identified for dry bulk mineral terminal facilities supporting throughput capacities generally on the order of 3 to 6 Mtpa, while recognizing that substantially larger footprints may be required for higher throughput and multiple developer operations, increased dwell times, expanded storage requirements, or more complex bulk handling and environmental controls configurations.

Baseline berth lengths between approximately 1,000 and 2,500 feet correspond to the potential need to accommodate one or multiple bulk carriers and barges or a large vessel configuration simultaneously, as noted by the industry stakeholders, consistent with the vessel dimensions summarized in **Table 1**.

Draft at berth criteria ranges of 40 to 65 feet correspond to the deep draft bulk carrier characteristics detailed in **Table 1**.

Minimum wharf load capacity of approximately 1,000 pounds per square foot (psf) represents order of magnitude loading conditions associated with heavy cargo handling equipment installations or operations, such as cranes, mobile equipment, and temporary stockpiling of dry bulk mineral cargo during transfer operations.

Upland load capacities ranging from approximately 1,000 to 3,000 psf reflect estimated loading conditions associated with dry bulk storage stockpiles approximately 7 to 15 feet in height, in addition to heavy mobile equipment operations. Actual requirements would vary depending on dry bulk material characteristics, stockpile geometry, and operational practices.

PSV Site: For screening and evaluation purposes, these port site types are considered to act as a homeport for large production and operations vessels and to support their maintenance and logistics activities over relatively low and infrequent port calls across multi-year offshore operating periods, rather than supporting DBM deposit handling or bulk cargo storage.

The upland space evaluation criteria in the range of 2 to 10 acres are estimated to support warehousing, offices, equipment staging, and maritime logistics services functions.

A berth length of approximately 1,000 feet is considered to correspond to accommodating at least one PSV at a time, considering the baseline vessel dimension ranges previously summarized.

Draft at berth needs are consistent with the PSV draft at berth values detailed in **Table 1**, extending into the 40-to-65-foot range depending on vessel class and equipment or load installed or carried onboard.

Wharf and upland load capacities between approximately 1,000 and 3,000 psf reflect the need to support heavy lift equipment, cranes, subsea equipment and collector staging and handling, considering subsea collectors may weigh from several hundred tonnes to several thousand tonnes conservatively for commercial scale operations, with dimensions on the order of approximately 5 to 10 meters or more in length and width (approximately 15 to 35 feet or greater), and associated staging and handling loads. These values are screening level estimates and are subject to vary depending on the specific port operations equipment, staging, and lift strategy that would be utilized by operators.

In an additional note, these port sites should have access to navigation channels with sufficient width, depth, and vertical clearance to accommodate large and deep draft vessels. PSVs may have an air draft of approximately 300 to 500 feet above sea level due to the presence of derricks and riser handling equipment.

O&L Site: For screening and evaluation purposes, these port site types are considered to serve frequent calls by small to mid-size vessels, for example, up to approximately 450 feet in length, providing routine resupply, personnel transfer, and mission support.

Upland space needs in the range of 2 to 10 acres are intended to accommodate warehousing, containerized and project cargo, operations equipment staging or maintenance, offices, and open laydown areas.

Baseline berthing length needs between approximately 500 and 750 feet reflect the capability of accommodating and servicing at least one or multiple small to mid-size vessels simultaneously. In practice, higher activity levels may require additional berth length beyond this baseline, potentially three times the identified length, to allow simultaneous calls and efficient turnaround of offshore support vessels.

Draft at berth requirements are typically driven by OSVs and RVs and may extend toward the upper end of the 10-to-50-foot range, depending on the vessel classes supported.

Wharf and upland load capacities between roughly 100 and 500 psf are generally associated with light cargo and supply storage and handling, forklifts or mobile crane operations, mission equipment handling, and other supply operations rather than very heavy industrial lifts and maintenance services.

In an additional note, these port sites may need to be located within practical round-trip transit distances for small-sized vessels, such as crew transfer vessels with approximately up to 130 feet in length, for example on the order of approximately 100 nautical miles, to support routine logistics and crew transfer operations (BOEM, 2024).

4 Development Scenarios

This section summarizes deep-sea seabed mineral development industry activities scenarios, together with associated port infrastructure development scenarios. The scenarios are informed by available literature, industry reports and disclosures, and stakeholder engagement, and describe a range of development phases, durations, mineral collection volumes, vessel presence and activities, and demand that regional ports and harbors may need to be prepared to support. For this assessment, the geographic focus is the American Samoa territory.

The deep-sea seabed mineral development industry is in an emerging state. Regulatory processes, technology readiness, operational concepts, and supply chain and logistics arrangements continue to evolve across different jurisdictions. In American Samoa, BOEM's completion of Area ID for potential leasing in November 2025 represents an early planning milestone. The following subsections, therefore, present structured and order-of-magnitude development scenarios that illustrate how industry activities, mineral collection volume ranges, vessel presence and activities, and associated shoreside infrastructure demand may change across different phases of industry growth.

4.1 Deep-sea Seabed Mineral Development Industry Activities Scenarios

This section presents a range of representative industry development phases, associated durations, primary activity descriptions, indicative annual mineral collection volumes, and the vessels that may operate in a region during each stage. These scenarios provide a base for evaluating how industry and port activity levels and associated infrastructure demands may evolve over time.

For planning purposes, industry development activities are considered across four broad phases: Planning, Pre-commercial, Commercial, and Expanded Commercial. Scenarios developed and details associated with each phase are summarized in **Table 4**. In alignment with the BOEM regulatory framework for commercial leasing and operations related to OCS marine minerals, the Planning phase would likely coincide with any potential activities occurring during the leasing process up to a lease sale; the Pre-commercial phase would coincide with any potential activities related to the preliminary activities or the submission of a Delineation, Testing, or Mining plan by a lessee to BOEM for technical and environmental review; the Commercial phase would coincide with any potential activities related to an approved mining plan, including OCS mineral development, production, and processing activities (BOEM, 2026d); and the Expanded Commercial phase would coincide with continued operations under approved mining plans at increased scale as needed, including the potential deployment of additional PSVs and/or subsea collectors within a lease area or across multiple lease areas.

Available literature and industry reports provide reference points for the potential scale of commercial-level deep-sea mineral deposit collection. These sources are used only to inform order-of-magnitude industry activities scenarios and do not represent forecasts or regulatory expectations.

Early assessments identified benchmark production on the order of approximately 3 million tonnes per year of dry PMN sustained for about 20 years (United Nations Ocean Economics and Technology Branch, 1987). United Nations Industrial Development Organization (UNIDO) discussions also observed that output in the 1.5 to 3 million tonnes per year range may be marginal relative to large terrestrial mining projects, with stronger economics potentially linked to higher recovery efficiency, targeting dense fields, or simultaneous operation of multiple collectors

(UNIDO, 1993). Subsequent work under the International Seabed Authority cited similar magnitudes, commonly noting roughly 1.5 to 3 million tonnes per year, and considering two parallel systems each producing roughly 1.5 million tonnes annually (ISA, 2008).

Kang, 2021 noted that typical production models assume approximately 250 operating days per year and recovery rates near 250 tonnes per hour of dry nodules, equivalent to wet rates of roughly 360 tonnes per hour per system. These values represent assumptions for conceptual commercial-scale production activities.

Pilot-scale activities reported in recent industry trials have demonstrated lower collection rates. For example, Chen et al., 2024 noted a 4,500 meters deep-sea trial activity in the Clarion Clipperton Zone with collection rates of approximately 110–120 tonnes per hour, and a 4,300 meters collection and lifting test activity with rates of approximately 86.4 tonnes per hour. Actual commercial-scale performance will depend on mineral deposit availability, seabed conditions, subsea collector productivity, and operational constraints.

Recent information shared by industry stakeholders and developers describe larger systems. The Metals Company has outlined concepts targeting approximately 12 million tonnes per year of wet nodule collection at steady state following ramp-up of deployed vessel and equipment numbers, potentially sustained for approximately two decades within a contract area (The Metals Company, 2025). These values reflect project-specific configurations rather than an industry norm.

Following the review of literature and publicly available industry reports, stakeholder engagement was conducted with deep-sea exploration, survey, marine mineral development companies and technology developers. Insights received through these engagements informed and confirmed scenarios summarized in **Table 4** and provided additional input into the criteria developed for port site screening and planning purposes.

For the pre-commercial phase, stakeholders indicated the duration could range from 5 to 15 years, with mineral collection volumes remaining below roughly 100 thousand tonnes per year. The associated vessel spreads detailed in the **Table 4** were viewed as potentially conservative but reasonable for planning purposes.

For the commercial phase, stakeholders aligned with representative marine mineral collection volume ranges of approximately 1 to 3 million tonnes per year per PSV or offshore production base over operating periods of 15 to 25 years. They noted that operation support vessel numbers would vary with offshore distance and availability of logistics ports, with more remote locations generally requiring additional offshore support vessels and bulk carriers actively supporting a single PSV or offshore production base.

For the expanded commercial phase, it was shared that production volumes could scale with the number of PSVs and subsea collectors deployed within a given year. Developers have described concepts in which, after roughly five years of commercial operations, as many as four PSVs or an increased number of subsea collectors could operate within a single lease area, increasing total annual throughput to on the order of up to 12 million tonnes per year.

These values and scenarios are used solely as contextual planning references to support understanding of the likely scale of offshore vessel operations and the order-of-magnitude logistics and port interface demands that may arise under commercial-scale deep-sea seabed mineral development activities.

Each scenario is defined considering variables most relevant to port and harbor infrastructure considerations, including primary activity type such as exploration, equipment and technology testing, pilot-scale operations, or commercial-scale operations, the number and classes of vessels expected in the region, the presence or absence large vessels, e.g., PSVs or bulk carriers, production capacity ranges on a per PSV basis, and the role of auxiliary and logistics vessels.

These values are not intended to represent project-specific commitments. They are developed as planning references to detail the likely scale of industry operations, and the associated order of magnitude demands on port infrastructure, logistics networks, and maritime facilities.

Table 4: Deep-sea Seabed Mineral Development Industry Activities Scenarios

Development Phases	Phase Period	Primary Activities	Mineral Collection Volumes	Regional Vessel Activities
Planning Phase, assumed baseline ranges	3 to 5 years	Environmental analysis, surveys, leasing, and initial explorations	0 to less than a few thousand tonnes	1–2 RVs; 2–5 auxiliary vessels (survey, support, crew, small workboats)
Pre-commercial Phase, assumed baseline ranges	5 to 15 years	Vessel and equipment trials, exploration, pre-mining plan pilot-scale activities	Less than 100 thousand tonnes per year	Per 1 PSV; supported by 1-2 OSVs; 2–5 auxiliary vessels (crew, barges, small workboats)
Commercial Phase, assumed baseline ranges	15 to 25 years	Initial commercial-scale activities	1 to 3 million tonnes per year	Per 1 PSV; supported by 1-2 OSVs; 2–5 auxiliary vessels; 1 - 2 bulk carrier calls per week
Expanded Commercial Phase, assumed baseline ranges	May begin following several years of commercial operations	Expanded commercial-scale activities via additional PSVs and subsea collectors	May scale with the number of operating PSVs and subsea collectors	Multiple PSVs operating concurrently; 1–2 OSVs; 2-5 auxiliary vessels; 1-2 bulk carrier calls per week per PSV

4.2 Port Infrastructure Development Scenarios

Considering the port site types, their functional roles, and the baseline port site evaluation criteria defined in **Table 2**, and in reference to the industry development phases, activity levels, and indicative mineral collection volume ranges summarized in **Table 4**, **Table 5** presents representative port infrastructure demand and development scenarios for supporting deep-sea seabed mineral development activities.

The term *per PSV* is used as a proxy for the level of industrial activity associated with a single marine mineral production base or vessel and the corresponding range of onshore infrastructure that may be required. It reflects the primary industry phase activities, mineral collection volumes, and associated supporting vessel activity described in **Table 4**, rather than representing port development needs based solely on the presence or number of PSVs or offshore production bases in a region.

The quantities presented in **Table 5** indicate how many sites may be required if each were developed approximately at the baseline scale described in **Table 2**. Fewer sites, or potentially a single larger port facility, could accommodate the same demand if developed with greater upland capacity, extended berthing, or higher throughput material handling capability.

Table 5: Port Infrastructure Development Scenarios

Development Phases	Dry Bulk Mineral (DBM) Site	Production Support Vessel (PSV) Site	Operations and Logistics (O&L) Site
Planning Phase, assumed baseline ranges	0	0	1
Pre-Commercial Phase, assumed baseline ranges	0 to 1 per PSV	0 to 1	1 per PSV
Commercial Phase, assumed baseline ranges	0 to 1 per PSV	0 to 1	1 to 2 per PSV
Expanded Commercial Phase, assumed baseline ranges	May scale with the regional mineral production and port throughput demand	0 to 1	May scale with the number of operating PSVs and the offshore activity in the region

The representative development scenarios summarized in **Table 5** provide a baseline for evaluating how existing and future port infrastructure in American Samoa may support different phases and scales of deep-sea seabed mineral development activities. Subsequent sections apply these scenarios to the regional ports and harbors inventory assessment.

5 Industry and Ports Stakeholder Outreach

As part of the *Industry and Ports Stakeholder Outreach* task, Moffatt & Nichol (M&N) conducted targeted engagement with the regional port administration and industry stakeholders, including selected deep-sea exploration, survey, seabed mineral development companies and technology developers.

Engagements with the American Samoa Port Administration informed local stakeholders on the goals and current status of the assessment, requested information regarding local port and harbor infrastructure, and gathered input to support subsequent evaluation steps. Similarly, meetings with industry stakeholders communicated the objectives and progress of the assessment and sought general information regarding each organization's role, capabilities, and expected activities within the emerging deep-sea seabed mineral development industry. Discussions included technology and equipment concepts, vessel characteristics, operational concepts, and expected onshore port infrastructure needs, characteristics, and functional needs.

Assessment findings related to a range of industry activities, vessel and equipment concepts and physical characteristics, port and harbor evaluation criteria, and industry activities and development scenarios were shared to seek feedback and confirmation. Input received through these engagements supported refinement of assumptions, evaluation criteria, scenario frameworks developed for the study, and port infrastructure assessment.

The **Table 6** summarizes stakeholder engagement activities conducted to date.

Table 6: Summary of Stakeholder Engagement Meetings

Stakeholder	Stakeholder Type
Port Administration of American Samoa	Port Administration
Adepth Minerals	Industry Stakeholder
Deep Sea Vision	Industry Stakeholder
Impossible Metals, Inc.	Industry Stakeholder
The Metals Company, Inc.	Industry Stakeholder
Wetstone Global	Industry Stakeholder

Summary of Port Administration Engagements: The Port Administration of American Samoa (PAAS) is the primary agency responsible for the territory's maritime and aviation gateways. PAAS was engaged to present the goals and to request information regarding existing port and harbor infrastructure, operational capabilities, and potential considerations for supporting deep-sea seabed mineral development activities in the region. Discussions focused on existing facilities, site conditions, availability, operational constraints, infrastructure limitations, and actions that may be required to accommodate potential future industry demand.

PAAS oversees one container terminal and multiple small boat harbors that support workboats, interisland ferry services, fishing activities, and small cargo operations across several islands, including the Port of Pago Pago on Tutuila Island, Auasi Landing on Tutuila Island, Aunuʻu Harbor on Aunuʻu Island, Ofu Harbor on Ofu Island, and the Faleasao and Taʻu Harbors and wharves on Taʻu Island.

PAAS shared that several existing port facilities may be capable of supporting exploration and early-stage activities in the near term, including research vessels and other small to mid-size vessel operations and logistics needs, potentially with minor facility improvements. However, it was emphasized that expansion or upgrades would likely be required if vessel activity levels increase, particularly in scenarios involving multiple operators, larger vessels, or sustained production logistics, given that current facilities are already utilized for existing maritime, cargo, and fishing industry services.

It was discussed that neither currently developed sites nor undeveloped uplands within the territory of American Samoa would likely be large enough to support a full-scale DBM terminal under evaluation criteria and representative commercial-scale scenarios evaluated in this assessment. Within the broader region, limited opportunities for such development were noted. Due to its naturally deep harbor and existing maritime infrastructure, Pago Pago Harbor was identified as the most feasible location should such development ever be pursued, although substantial land reclamation or fill may be required to create sufficient terminal and upland storage areas.

Existing drafts at berths were noted as variable, generally on the order of approximately 30 to 40 feet deep or more in some areas, with shallower conditions occurring toward certain berth ends and berth pocket dredging potentially required in some locations. The navigation channel itself was described as naturally deep, approximately 200 feet. PAAS noted that air draft limitations are not a controlling constraint because there are no bridges or overhead obstructions affecting harbor access. Instead, terrestrial topography and the limited availability of flat waterfront land were identified as the primary physical constraints to large-scale industrial development or expansion.

The discussion also referenced near and long-term development plans and Vision 2030 initiatives, including a potential future super port concept that could create approximately 20 to 30 acres or more of additional upland area through partial fill and waterfront expansion. PAAS noted that these initiatives currently reflect varying stages of planning and conceptual development, with the Port of Pago Pago improvement project identified as the most advanced initiative progressing through design activities. Other proposed developments were generally described as in conceptual or planning phases with limited to no confirmed funding or finalized engineering details available at the time of this assessment. Discussions also noted the continued importance of existing containerized cargo, fuel handling, fishing, and tuna industry operations within Pago Pago Harbor, which remain critical to the territory's economy and supply chain operations and should be considered for future infrastructure planning and operational considerations.

Vision 2030 elements discussed included continued and expanded operation of the main container terminal facilities, development of new interisland ferry terminals and mid-size vessel pier facilities, relocation or modernization of certain liquid bulk and fuel handling infrastructure, waterfront expansion opportunities, and ongoing planning for cruise terminal and berthing infrastructure improvements and developments.

Detailed port and harbor facility data were requested following the meeting. Requested materials included upland acreage and load capacity, berth length and approximate structural capacity, water depth at berths and within navigation channels, facility limitations, tenant or site use information, planned capital improvements, and near and long-term development visions. Information subsequently provided by PAAS has been incorporated into the infrastructure inventory and informed the evaluation summarized in **Section 6** of **Table 9** and **Table 10**.

Additional discussions included long-term development planning considerations and perspectives regarding potential deep-sea seabed mineral development activities within the territory. PAAS noted that perspectives within the territory regarding deep-sea seabed mineral development activities are mixed, including concerns related to environmental, fisheries, and community impacts, while others expressed interest in potential economic development and maritime industry opportunities associated with future offshore activities.

Regarding infrastructure readiness, PAAS noted that modernization and expansion would likely be necessary to support transshipment, marine services, logistics support, and supply operations associated with future offshore industrial activities. Needs discussed included dedicated berth capacity, upland areas for warehousing and commercial staging activities, lifting and equipment handling capability, and facilities capable of supporting workforce and service provider activities.

Discussions also included regional supply chain capability, workforce availability, and coordination with other local agencies and stakeholders. PAAS noted that current supply chain capability within the territory is constrained by existing port infrastructure and that the availability of specialized maritime labor within American Samoa is limited, although additional labor resources may potentially be available from neighboring Samoa depending on future workforce demand and operational requirements.

Summary of Industry Stakeholder Engagements: Targeted outreach was conducted with industry stakeholders and technology developers representing a range of offshore exploration, mineral collection, transportation, and logistics support approaches and capabilities currently under development.

As port infrastructure requirements for this emerging industry are expected to be driven by vessel characteristics, mineral collection and handling rates, operational logistics concepts, and offshore support requirements, discussions focused on expected operational models, vessel and equipment characteristics and utilization strategies, project cargo and supply needs, dry bulk mineral handling methods, and anticipated port infrastructure capability requirements.

Given the evolving nature of the industry, stakeholders emphasized that vessel characteristics and dimensional specifications, subsea collector technologies, and logistics approaches continue to develop. As a result, port evaluation criteria and planning considerations should remain flexible and scalable to accommodate potential future increases in vessel size, throughput volumes, and operational activity.

Insights gathered from these discussions were incorporated into the port evaluation criteria and representative industry development scenarios detailed in previous sections. Summaries of insights shared by industry stakeholders during outreach meetings are provided below.

Industry stakeholders generally described deep-sea seabed mineral development and collection systems involving subsea collectors operating on the seabed and transporting recovered mineral deposits to a surface PSV or bulk carriers. Several mineral lifting concepts were identified, including riser and lift systems, bucket-based lifting, conveyor approaches, and autonomous subsea collector machinery with onboard mineral storage capacity. Initial separation of mineral deposits from sediments may occur on the seabed and/or onboard the PSV prior to temporary storage and eventual offloading.

Stakeholders indicated that different mineral deposit types will require different subsea collector technologies and operational approaches. As a result, subsea equipment configuration, vessel class and size, and logistics requirements may vary depending on mineral deposit type, operational location, and stage of industry development.

Several vessel categories were consistently identified as relevant to industry operations, including production support vessels, research vessels, offshore support vessels, and bulk carriers. Production support vessels were described as potentially ranging from approximately 90 to over 250 meters (300 to 800 feet) in length, with draft at berth characteristics approaching approximately 15 meters (50 feet). Research vessels and offshore support vessels supporting exploration, equipment testing, and supply activities were generally described in the range of approximately 80 to 135 meters (260 to 450 feet) in length, with draft at berth characteristics approaching approximately 40 feet or more in some offshore support vessel classes.

During early exploration and pilot phases, stakeholders indicated that activities would likely rely on research vessels and offshore support vessels deploying ROVs, AUVs, and seabed mineral sampling equipment. Stakeholders noted that this pre-commercial exploration phase may extend approximately 5 to 15 years, with mineral collection volumes remaining below approximately 100 thousand tonnes per year and offshore activity generally conducted by a single PSV or offshore support vessel supported by smaller or mid-sized auxiliary vessels.

Exploration missions using such vessels may last approximately four to six weeks at a time, with crews typically ranging from approximately 20 to more than 30 personnel, depending on operational scope. Supporting ports should therefore, at a minimum, be capable of accommodating research and offshore support vessels reaching approximately 450 feet in length with draft at berth approaching approximately 40 feet or more, together with moderate wharf loading capacity and lifting capability for equipment and supply provisions handling.

Offshore operations may require dynamic positioning capability for deep-sea conditions, subsea equipment launch and recovery capability, and umbilical cable handling systems for the vessels. One example noted was a spooling system capable of managing an umbilical length of approximately 4,000 meters together with hydraulic handling equipment. Within American Samoa, the Port of Pago Pago was generally viewed as the most suitable existing facility for supporting early exploration and pilot activities, although larger-scale operations may require infrastructure expansion or mission-specific support infrastructure improvements.

Stakeholders emphasized the importance of operations and logistics facilities capable of receiving specialized equipment and tools arriving through customs if mobilized internationally. Required functions include warehousing, staging, spare parts storage, fueling, maintenance servicing, hull inspection and cleaning, lifting services, and umbilical cable reel handling and tensioning support.

For larger-scale operations, stakeholders described subsea equipment that may weigh from tens of tonnes to several hundred or several thousand tonnes, depending on the collection technology type and scale of operations. Some equipment modules were described as weighing approximately 10 tonnes, with dimensions comparable to a 20 to 40-foot container and mineral payload capacities of approximately 4 tonnes or more per operational cycle, with operational cycles occurring approximately every four to six hours. Other subsea collector machinery was described as larger and as potentially operating with riser and lift systems to continuously transport recovered mineral deposits to the surface vessel.

As development progresses toward commercial operations, PSVs may operate offshore for extended durations and return to port infrequently, potentially only several times per year, primarily for major maintenance, inspections, or equipment overhaul. Offshore operations may instead rely on smaller supply vessels providing crew transfer, equipment resupply, and logistics support between offshore production areas and shoreside facilities.

For mineral logistics, stakeholders noted that bulk carriers would likely be used to transport recovered mineral deposits to port facilities and downstream processing locations. Vessel sizes may range from Handymax class vessels to larger Panamax or Capesize vessels approaching approximately 300 meters (985 feet) in length or more, with beam widths approaching approximately 45 meters (150 feet) and draft at berth characteristics approaching approximately 18 meters (60 feet) or more.

The number of bulk carriers required for the operations may vary depending on mineral collection rates and transport distance, with stakeholder insights suggesting approximately one to four bulk carriers per production system or PSV to maintain continuous offshore operations. Some stakeholders also described operational concepts involving bulk carriers serving both production and transport functions, depending on project-specific strategies.

Commercial production volumes discussed by stakeholders generally ranged from approximately 1 to 3 million metric tonnes per year per production system or PSV. Stakeholders indicated that commercial production phases could extend approximately 15 to 25 years, depending on resource conditions, regulatory approvals, and operational performance. Operational footprints were described on the order of approximately 100 square kilometers per year per production system, with mineral nodule densities of approximately 15 kilograms per square meter cited as favorable resource conditions. Higher production volumes may be achieved by increasing subsea collector numbers or adding additional surface vessels within a lease area.

Port infrastructure needs discussed with stakeholders fall into three categories as mentioned earlier: O&L sites, PSV homeport sites, and DBM sites. O&L facilities would require infrastructure supporting single or multiple small to mid-size vessel berthing, spare parts storage, crew transfer, fueling, maintenance activities, equipment lifting, and supply chain access supporting offshore operations. These facilities may need to accommodate vessels approaching approximately 135 meters (450 feet) in length with a draft at berth of approximately 40 feet or more, including research vessels, offshore support vessels, and other auxiliary vessels.

Regarding PSV homeporting, stakeholders noted that these facilities may not need to be located near lease areas because PSVs may remain offshore for extended durations and return to port infrequently, sometimes less than several times per year, primarily for major maintenance activities. During operations, PSVs may instead be supported offshore by smaller or mid-sized vessels.

DBM terminal facilities, where developed, could require substantial upland areas for mineral storage and bulk material handling. Stakeholder insights suggested that terminals supporting approximately 6 to 12 million tonnes per year of throughput may require on the order of approximately 170 acres of terminal area, with berthing infrastructure capable of accommodating multiple bulk carriers simultaneously and draft at berth approaching approximately 20 meters (65 feet). These terminals would also need to be connected with established utilities and connectivity to external transportation networks to support outbound transfer of stored mineral material via waterborne transport, road, or rail.

Some stakeholders shared that they are prepared to operate either with or without a nearby DBM terminal. If such a port facility exists locally, it may be utilized for temporary mineral storage and logistics operations; otherwise, recovered mineral deposits could be transported to established dry bulk terminals along the U.S. West Coast or elsewhere. Stakeholders noted that long-distance transport of bulk commodities using large dry bulk carriers is a common practice within the global bulk commodities industry, with intercontinental transport routes routinely extending several thousand nautical miles between offshore operational regions, storage terminals, and downstream processing locations.

Several stakeholders also noted that existing dry bulk terminals along the U.S. West Coast may represent practical near-term receiving locations for seabed mineral commodities, particularly where established bulk material handling infrastructure, rail connectivity, large upland storage capacity, and deep-draft vessel accommodation already exist. Stakeholders noted that the capability of a terminal to handle dry bulk commodities does not necessarily confirm available throughput capacity for future seabed mineral logistics operations, and that additional coordination with terminal operators and state agencies would be required to confirm operational suitability, available capacity, and broader policy considerations associated with supporting future deep-sea seabed mineral development industry activities.

Stakeholders emphasized that port infrastructure must also be supported by broader local infrastructure, including airport access, accommodations, transportation networks, customs capability, and supply chain services capable of supporting rotational offshore workforces. Large vessel operations were described as potentially requiring crews of approximately 30 to 40 personnel or more operating on rotational schedules.

For the American Samoa region and Pago Pago Harbor, some stakeholders noted potential interest in the availability of a regional DBM facility if mineral transport occurs locally, allowing temporary mineral storage prior to shipment to downstream processing locations. In the absence of such facilities, focus may shift toward ports capable of efficiently supporting vessel logistics, resupply operations, equipment staging, and crew transfer activities rather than bulk mineral handling.

Finally, stakeholders noted that many aspects of deep-sea seabed mineral development technology, logistics systems, and operational scale remain under development. As technologies mature and regulatory frameworks evolve, vessel configurations, logistics concepts, and associated port infrastructure requirements may continue to change. Improved access to environmental and seabed survey data collected by agencies and research programs was identified as important for supporting future industry planning and technology development activities.

6 Ports and Harbors Inventory Assessment

In this assessment, an evaluation of American Samoa ports and harbors was conducted. The task included a desktop assessment on existing ports and harbors, followed by engagement with the PAAS to request additional information regarding American Samoa ports and harbors, including their physical characteristics, current conditions, and future development planning for existing port and harbor infrastructure and available undeveloped waterfront sites that might be suitable for waterfront infrastructure development. Based on the desktop assessment, information, documentation, and additional insights provided by PAAS, an inventory of American Samoa ports and harbors was developed.

The baseline port infrastructure evaluation criteria presented in **Table 2** were then applied to the inventory of ports and harbors to evaluate their potential to support deep-sea seabed mineral development industry activities and potential port infrastructure needs. The inventory of existing ports and harbors in American Samoa includes the Port of Pago Pago on Tutuila Island, Auasi Landing on Tutuila Island, Aunuʻu Harbor on Aunuʻu Island, Ofu Harbor on Ofu Island, and the Faleasao and Taʻu Harbors and wharves on Taʻu Island.

For each port and harbor facility, key infrastructure characteristics were compiled and documented in **Table 9**, including approximate upland area, wharf or berthing length, draft at berth, navigation channel characteristics (width, depth, and air draft clearance), and current use cases. Based on this inventory and the evaluation criteria established earlier in the assessment, each facility was assessed for its suitability to support potential deep-sea seabed mineral development industry port infrastructure needs, including DBM site suitability, PSV homeport site suitability, and O&L site suitability.

It should be noted that existing ports and harbors in American Samoa are currently not in a condition, configuration, or availability to support potential commercial-scale deep-sea seabed mineral development industry operations in the region in their “as-is” condition from a port infrastructure perspective. Limitations found include, but are not limited to, available wharf and berth length, draft at berth, upland area and load capacity, wharf load capacity, and additional supply and industrial equipment handling capacity. As such, any potential use of these ports and harbors for emerging deep-sea seabed mineral development industry activities would require some level of expansion or dedicated improvements to enable the use of existing facilities in support of this new industry and its potential port infrastructure needs and services.

Such expansion and improvements may include improving or expanding upland areas capable of supporting industrial equipment laydown and storage, offices, warehouse space, and/or dry bulk mineral deposit storage and laydown areas; expanding existing or constructing new wharves and docks to accommodate vessels of varying sizes and draft at berth characteristics; strengthening existing wharves and upland areas to accommodate heavier loading; and dredging berth pockets and, in some cases, navigation channels or harbor entrances; and equipping these waterfront facilities with the necessary systems and equipment to support cargo handling, crew transfer, supply operations, and vessel and machinery maintenance activities.

This study did not consider the displacement or relocation of existing port operators or tenants, or established maritime industry activities, particularly existing fishing and tuna industry facilities and associated marine infrastructure within Pago Pago Harbor. Existing fishing industry facilities were noted as an important component of the territory’s maritime economy and ongoing port operations, and tuna facilities are understood to support long-term existing operational uses and agreements. However, depending on future industry needs and coordination with facility owners and operators, certain facilities or marine infrastructure may potentially support limited or case-by-case deep-sea seabed mineral development-related logistics or vessel activities and berthing.

In addition, a detailed assessment of undeveloped waterfront sites was not included in this study beyond locations identified by PAAS for evaluation by the assessment team at this time. However, the PAAS Vision 2030 initiatives, including planned and proposed improvements to existing port infrastructure as well as conceptual waterfront development projects at undeveloped locations, were reviewed within this section to understand how such projects could potentially enhance future port infrastructure capabilities for an emerging industry if implemented.

This assessment focuses on the evaluation of potential DBM, PSV homeport, and O&L port site types. The following general criteria were used to assess each port and harbor site:

- Availability of adequate upland acreage capable of supporting or being improved to support equipment staging and laydown, bulk material storage, and loading operations.
- Availability of adequate wharf or berthing length and structural load capacity to support vessels of varying sizes for docking, loading, and unloading operations, including adequate draft at berth conditions.
- Adequacy of the existing navigation channel characteristics, including channel depth and width, and air draft clearance where applicable.
- Availability of harbor protection and sheltering (e.g., breakwaters or natural harbor conditions).
- Current use cases and the availability and compatibility of potential future industrial uses.

6.1 Dry Bulk Mineral Sites

DBM sites would be supporting the import, temporary storage, and onward transport or export of recovered seabed mineral deposits. Dry bulk port facilities typically require large upland areas for stockpiling and staging, long wharf infrastructure and berths with deep drafts capable of accommodating large bulk carriers and vessels. DBM terminals also need to be equipped with bulk material handling systems and landside access to logistics networks to enable efficient transfer of mineral cargo to downstream processing or export locations.

Based on the American Samoa ports and harbors inventory and identified site characteristics within this assessment, no existing port or harbor sites were identified as suitable candidates to support DBM terminal operations in their current condition. The existing facilities generally lack the large upland areas, long and high load capacity wharf infrastructure, deep-draft berths, and dedicated bulk handling infrastructure and utilities required to support large-scale dry bulk mineral terminal activities. Development of such a facility would likely require new waterfront facilities, potentially through partial fill or land reclamation, capable of supporting bulk carrier operations and associated mineral handling activities.

In another note, industry stakeholder outreach and publicly available industry planning insights indicated that the industry is evaluating operational concepts that may allow seabed mineral development and collection activities to proceed without the need for a nearby local DBM terminal. In such concepts, recovered mineral material may be transferred to a bulk carrier offshore and transported to existing dry bulk terminals located elsewhere in the Pacific region for handling, storage, or onward export.

As a result, the absence of a DBM terminal within close proximity to offshore mineral recovery and collection areas may not necessarily represent a limiting factor for potential industry development in the region. Where suitable local or nearby DBM terminal capacity exists, mineral developers may elect to utilize those facilities to improve logistics efficiency. Where such infrastructure is not available locally, mineral transport to more distant dry bulk terminals may still provide a viable operational pathway depending on project logistics, transport distance, and economic considerations.

6.1.1 Alternative Dry Bulk Mineral Sites

Alternatively, existing dry bulk terminal facilities within the Pacific may potentially support deep-sea seabed mineral import, export, storage, and associated logistics activities if a suitable DBM terminal site is not available within American Samoa. **Table 7** lists selected ports located on the U.S. West Coast, and **Table 8** lists selected ports located in non-U.S. jurisdictions that currently support dry bulk cargo operations, including iron ore or like and other dry bulk commodities. Approximate sailing distances from American Samoa are also summarized below.

Table 7: Some of the U.S. Ports with Dry Bulk Terminals in the Pacific Region

Port Name and Location	Distance to American Samoa (NM)
Port of Long Beach (Long Beach, CA)	~4,200 NM
Port of Los Angeles (Los Angeles, CA)	~4,200 NM
Port of Stockton (Stockton, CA)	~4,400 NM
Port of Portland (Portland, OR)	~4,500 NM
Port of Vancouver (Vancouver, WA)	~4,500 NM
Port of Longview (Longview, WA)	~4,500 NM

The ports listed above represent selected U.S. Pacific ports with existing dry bulk terminal infrastructure capable of accommodating large dry bulk commodity vessels and handling dry bulk materials such as iron ore and similar commodities. Distances represent approximate sailing distances from American Samoa. For reference, assuming an average vessel speed of approximately 14 knots, estimated transit times would be approximately 7 days to Hawaiʻi and approximately 13 days to the U.S. West Coast.

Table 8: Some of the Non-US Ports with Dry Bulk Terminals near American Samoa

Port Name and Location	Distance to American Samoa (NM)
Port of Suva (Fiji)	~700 NM
Port of Nouméa (New Caledonia)	~1,400 NM
Port of Tauranga (New Zealand)	~1,600 NM
Port of Taranaki (New Zealand)	~1,900 NM
Lyttelton Port (New Zealand)	~2,000 NM

The ports listed above show some of the dry bulk terminals within approximately 2,000 nautical miles of American Samoa that handle iron ore-like and other dry bulk commodities and could support bulk mineral import, storage, and export logistics activities.

Note that the ports listed above were identified through a desktop review of existing Pacific dry bulk terminal facilities and publicly available information regarding current bulk commodity handling activities and approximate distance from American Samoa. Direct engagement with these ports and terminal operators was not conducted as part of this assessment to confirm their interest, suitability, available capacity, or capability to support future seabed mineral logistics activities. Further coordination and detailed assessment of these facilities would be required as part of future studies.

6.2 Production Support Vessel Sites

Based on the American Samoa ports and harbors inventory, no existing port or harbor sites were identified as a good candidate for the PSV homeport site in their current condition. PSV homeport sites will generally require infrastructure capable of accommodating large and deep-draft vessels, including PSVs and other large vessels, together with adequate wharf structure and upland areas with structural load capacity to support heavy industrial equipment storage and lifting, maintenance activities, and vessel logistics operations.

Several limitations were identified across the existing American Samoa port and harbor facilities. These include insufficient draft at berth to accommodate large deep-draft vessels (which may require depths approaching approximately 65 feet), limited upland areas and load capacity to support heavy industrial equipment and staging operations, and constrained wharf infrastructure to support large vessel berthing and associated cargo or equipment handling activities. As a result, existing sites would require targeted capital improvements and or expansion to support PSV homeporting activities, major maintenance operations, and associated logistics support functions.

The Port of Pago Pago was identified as a moderate candidate site for this port facility type. The port meets some of the baseline criteria presented in **Table 2,** but would require targeted infrastructure improvements to sufficiently support PSV homeport operations. Potential improvements may include, but are not limited to, dredging of berth pockets to provide sufficient draft at berth, strengthening targeted sections of existing wharf infrastructure to support higher structural loading requirements, and improving upland load capacity in designated areas to accommodate heavy equipment staging, lifting operations, and equipment storage.

With such targeted improvements, the Port of Pago Pago could potentially support PSV homeporting functions, including vessel berthing and logistics and supply support, certain maintenance activities, equipment staging and lifting, and other activities to accommodate and support large and deep-draft PSV and large vessel operating in the region. Routine operational logistics, resupply activities, and crew transfers may also be supported by this port site or continue to be supported by smaller or mid-sized vessels operating between offshore work areas and regional ports, depending on the industry developer's preference.

Industry stakeholder insights indicated that PSV homeport locations may not necessarily need to be located near offshore mineral recovery and collection areas. PSVs conducting deep-sea seabed mineral development activities may remain offshore for extended durations and return to port infrequently, primarily for major maintenance, regulatory inspections, or equipment overhaul. When major maintenance or homeport services are required, PSVs can travel long distances to reach suitable port infrastructure capable of supporting such activities. Where suitable local PSV homeport capacity exists, developers may elect to utilize those facilities; where such infrastructure is not available locally, more distant port terminals may still provide a viable operational pathway depending on project logistics, transport distance, and economic considerations.

6.3 Operations and Logistics Sites

Based on the American Samoa ports and harbors inventory, the Port of Pago Pago was identified as the only port facility that is a good candidate site for the O&L port facility type and meets the criteria presented in **Table 2**. The port could support routine logistics functions associated with deep-sea seabed mineral development activities in the region, including spare equipment and supply receiving and staging, crew transfers, resupply operations, and mission support activities conducted by small to mid-size vessels operating between offshore work areas and port facilities. These vessels may include research vessels, offshore support vessels, crew transfer craft, workboats, harbor craft, and barges supporting offshore operations.

The Port of Pago Pago currently provides several characteristics suitable to serve as this type of port facility and its supporting activities. These include adequate wharf length and water depth at berth to accommodate multiple vessels with lengths overall reaching approximately 450 feet or more and drafts reaching approximately 30 feet or more. The port also provides access to upland areas of approximately 7 acres that may support staging of equipment, spare parts, consumables, and project cargo required for offshore logistics support. Additional favorable characteristics include sheltered harbor conditions suitable for routine vessel movements, a naturally deep navigation channel with no air draft restrictions, and existing maritime operations that support container vessels, fishing vessels, and other regional maritime activities.

While the existing infrastructure at Port of Pago Pago could generally support the needs of this port facility type, the existing infrastructure may require upgrades and/or maintenance to extend the service life to support sustained offshore logistics activities as industry operations develop. Potential improvements may include, but are not limited to, development of office and warehouse space for spare parts, equipment, and supply storage; designation of areas to support crew logistics and transportation activities; targeted upgrades to upland and wharf areas to support higher load capacities and lifting operations; and provision of facilities capable of supporting vessel maintenance activities such as hull cleaning, umbilical cable reel handling, and equipment lifting. Additional improvements may also include dredging of berth pockets to provide deeper draft conditions (e.g., approximately 50 feet or more) to accommodate larger vessels, installation or upgrades of fenders and bollards, and other capital improvements or expansions as industry development evolves in the region.

6.4 Summary

A map that combines the DBM, PSV, and O&L site candidate status at each port and harbor is shown in **Figure 8**. **Table 9** summarizes the key infrastructure characteristics and the evaluation results for each facility within the detailed ports and harbors inventory of American Samoa, including DBM, PSV homeport, and O&L site suitability status.

The figures and tables below use a symbol and color-coding system to represent each port or harbor's potential to support deep-sea seabed mineral development industry port infrastructure needs for each facility type:

- ♦ (green): Port or harbor is a good candidate site for the identified port facility type and meets the criteria presented in **Table 2**.
- ♦♦ (yellow): Port or harbor is a moderate candidate site for the identified port facility type and meets some of the criteria presented in **Table 2**, but would require targeted expansion or capital improvements to fully support the identified port facility type and associated operations.
- ♦♦♦ (red): Port or harbor is not a suitable candidate site for the identified port facility type and does not meet the criteria presented in **Table 2**.

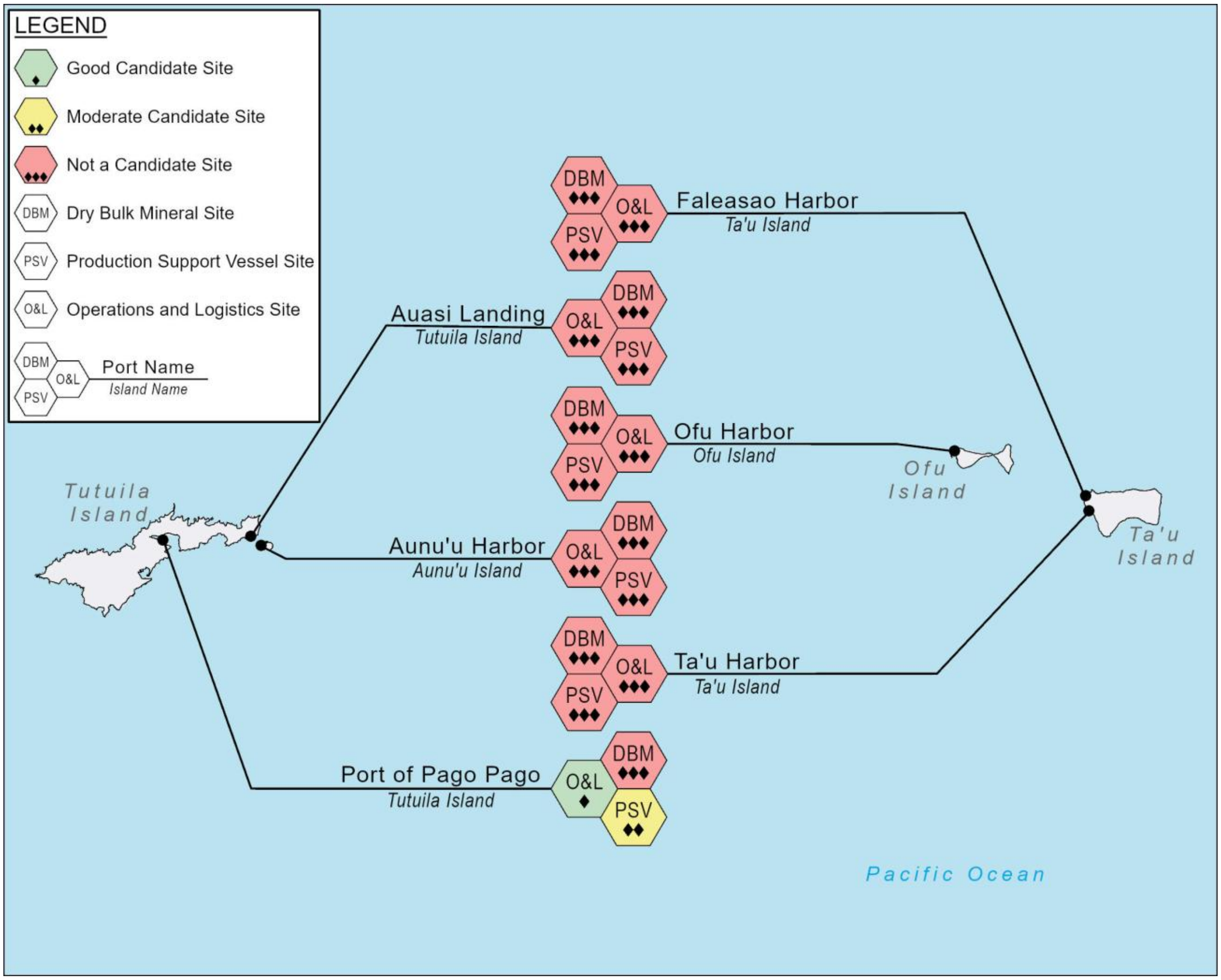


Figure 8: American Samoa Ports and Harbors Inventory and Assessment Summary

Based on the inventory assessment findings summarized in **Figure 8** and **Table 9**, the existing port and harbor infrastructure within American Samoa shows limited capability to support the full range of potential deep-sea seabed mineral development port infrastructure needs under the representative demand scenarios developed in this assessment. While certain planning, pre-commercial, and logistics support activities may potentially be accommodated using existing facilities with targeted improvements, particularly at the Port of Pago Pago, additional infrastructure development and operational strategies may be required to support commercial-scale and expanded commercial-scale industry activities.

Table 9: American Samoa Ports and Harbors Inventory and Assessment Summary

American Samoa Ports and Harbors Inventory	Upland Area (appx. acres)	Wharf / Berthing Length (appx. ft)	Draft at Berth (appx. ft)	Navigation Channel Characteristics (appx. ft)	Current Use Cases	DBM Site Suitability	PSV Site Suitability	O&L Site Suitability
Port of Pago Pago, Tutuila Island	7 acres	Old Main Dock: 400' New Dock: 1100' Fuel Dock: 400' Marina Dock: 300'	Old Main Dock: 32' New Dock: 30' Fuel Dock: 41' Marina Dock: 25'	Width: +600' Depth: 200' Air Draft Clearance: None	A	♦♦♦	♦♦	♦
Auasi Landing, Tutuila Island	N/A	20' with ramp	8'	Width: 50' Depth: 8' Air Draft Clearance: None	B	♦♦♦	♦♦♦	♦♦♦
Aunu'u Harbor, Aunu'u Island	N/A	20' with ramp	12'	Width: 50' Depth: 12' Air Draft Clearance: None	B	♦♦♦	♦♦♦	♦♦♦
Ofu Harbor, Ofu Island	N/A or 2 acres	100'	14'	Width: +50' Depth: 14' Air Draft Clearance: None	C	♦♦♦	♦♦♦	♦♦
Faleasao Harbor, Ta'u Island	N/A or 2 acres	115'	14'	Width: +50' Depth: 14' Air Draft Clearance: None	C	♦♦♦	♦♦♦	♦♦
Ta'u Harbor, Ta'u Island	N/A or 2 acres	100' + 20' small outboard vessel dock	15'	Width: +50' Depth: 15' Air Draft Clearance: None	C	♦♦♦	♦♦♦	♦♦

A) Cargo container vessels, cruise ships, and tuna purse seine fishing vessel operations. Supports cargo container, cruise, and purse seine fishing vessel operations and would require expansion and dedicated improvements to accommodate additional maritime operations and vessel calls.
B) Used by small fishing vessels and aliases for transporting light cargo and passengers. Upland and wharf load capacity supports small forklifts, pickup trucks, and flatbed trucks for cargo transport.
C) Used by small fishing vessels, aliases, and other small vessels, including the MV Manuatele and private LCUs, for cargo and passenger operations. Cargo handling is primarily roll-on/roll-off, with cargo typically transported on pallets rather than in containers. Wharfs in the Manu'a Island Group include the Ofu, Faleasao, and Ta'u wharfs.
♦ (green): Port or harbor is a good candidate site for the identified port facility type and meets the criteria presented in **Table 2**.
♦♦ (yellow): Port or harbor is a moderate candidate site for the identified port facility type and meets some of the criteria presented in **Table 2**, but would require targeted expansion or capital improvements to fully support the identified port facility type and associated operations.
♦♦♦ (red): Port or harbor is not a suitable candidate site for the identified port facility type and does not meet the criteria presented in **Table 2**.

6.4.1 Cultural Heritage Considerations

Additionally, a desktop review of cultural heritage-related considerations was conducted for the assessed ports and harbor locations in American Samoa by SEARCH, including review of publicly available archaeological studies, NOAA maritime heritage inventories, and records maintained by the American Samoa Historic Preservation Office. The review identified that several assessed port and harbor locations are situated near previously documented cultural heritage resources and historically sensitive areas. Identified resources and considerations include prehistoric rock and gravel foundations, burial sites, terracing features, coastal fish weirs, pottery and lithic sites, legendary and culturally significant locations, World War II coastal fortifications and infrastructure, historic structures, and submerged maritime resources, including known or suspected vessel wreck sites.

On Tutuila Island, documented cultural heritage resources and historically sensitive areas were identified in the vicinity of Pago Pago Harbor, Fagaʻitua, Leone Bay, Auasi Harbor, and surrounding coastal areas. Around Pago Pago Harbor, identified resources include the prehistoric Fatu-ma Futi Village site near the harbor entrance, historic naval-related structures, World War II-era pillboxes, bunkers, and coastal fortifications, as well as several documented maritime wreck locations. The assessment also noted the wreck of USS *Chehalis* (AOG-48), a World War II-era gasoline tanker scuttled in 1949 following a major fire during fuel offloading operations. The wreck lies approximately 300 feet offshore near existing fuel dock infrastructure within Pago Pago Harbor and remains a notable maritime heritage site associated with wartime and postwar harbor operations.

At Leone Bay, documented cultural resources include prehistoric archaeological sites, submerged whetstone features, prehistoric coastal fishery-related stone mounds and fish weirs, lithic material scatters, and the Papaloa petroglyph site. Historical investigations also identified reported vessel debris associated with the possible wreck location of the steamer *Tutuila* (1940), together with several World War II coastal fortifications and pillboxes in the surrounding area. Additional coastal fortification features and pillboxes were also identified near Fagaʻitua and Auasi Harbor.

On Aunuʻu Island, previous investigations identified culturally significant archaeological and legendary sites, including prehistoric ceramic and lithic finds, defensive wall remnants, historic village-related features, and traditional cultural locations associated with local legends and oral history.

On Ofu Island, previous archaeological investigations documented prehistoric settlement areas, ceramic middens, domestic site complexes, terraced mound features, and culturally significant burial and settlement locations associated with early Polynesian occupation of the Manuʻa Islands.

On Taʻu Island and around Faleāsao and Taʻu Harbors, documented cultural heritage resources include prehistoric settlement complexes, ceramic middens, terraced stone features, burial areas, petroglyphs, fish bait cup and whetstone features, legendary sites, and culturally significant archaeological areas such as the Papatea Sacrifice/Burial Site, Tui Manuʻa Tomb site, and Taʻu Marsh area. Previous archaeological investigations in these areas recommended caution and archaeological monitoring for future ground disturbance activities due to the potential presence of buried cultural resources.

This assessment did not include cultural resource surveys, archaeological investigations, or site-specific heritage evaluations for assessed port and harbor locations or undeveloped waterfront areas. If future port or harbor improvements, expansion activities, dredging, reclamation, or new waterfront development are pursued within the territory, additional cultural heritage review, stakeholder coordination, and site-specific investigations may need to be considered as part of future planning, engineering, environmental review, and permitting processes. Potential future efforts may include marine archaeological remote sensing surveys, terrestrial archaeological investigations, architectural history surveys, and coordination with the American Samoa Historic Preservation Office and other relevant territorial stakeholders.

6.5 Summary of PAAS Vision 2030 Initiatives

During engagement with PAAS, the administration noted several planned or proposed improvements and potential waterfront developments that form their Vision 2030 planning initiative (PAAS, 2026). These initiatives are noted to generally reflect a 5- to 10-year development vision for modernization and expansion of port and harbor infrastructure across the territory. The proposed improvements and new developments are also summarized on the PAAS Vision 2030 website.

The initiative includes upgrades to existing port and harbor infrastructure as well as the development of new waterfront infrastructure and facilities. If implemented, these projects could expand berth capacity, increase waterfront upland storage areas, and improve the capability of American Samoa's port infrastructure to support a wider range of maritime operations. The **Table 10** below summarizes the key infrastructure characteristics of the proposed developments and their conceptual in-service dates, assuming the projects proceed through engineering planning, design, permitting, and construction phases with sufficient funding secured.

Based on engagement with PAAS, the Vision 2030 initiatives currently reflect a range of planning and development stages. The Port of Pago Pago improvement project was noted to be the most advanced initiative currently progressing through design activities, with partial funding secured to support ongoing engineering and development efforts. PAAS also noted that the Port of Pago Pago remains a critical marine gateway supporting containerized cargo and essential island supply operations, and therefore, its existing maritime uses and operational priorities should be considered in future infrastructure planning scenarios. Other Vision 2030 initiatives and proposed waterfront developments detailed in **Table 10** were generally described as conceptual or planning-stage initiatives, and no final confirmed construction schedules, final engineering designs, or secured full project funding information were identified during this assessment.

For the purposes of this assessment, these Vision 2030 initiatives were reviewed to understand how the proposed infrastructure could enhance future capabilities. Each proposed facility was considered qualitatively in relation to the baseline port infrastructure evaluation criteria presented earlier in the study, including potential suitability to support DBM sites, PSV homeport sites, and O&L sites once implemented. This comparison provides an indication of how the proposed developments could contribute toward meeting the potential port infrastructure demand scenarios summarized in **Table 5**.

High-level summary of PAAS Vision 2030 initiatives are listed below. For additional details, refer to the PAAS Vision 2030 website.

- **Port of Pago Pago, Tutuila Island:** Proposed improvements include expanding to approximately 2,000 feet of continuous wharf infrastructure, expansion of uplands storage capacity by approximately 40 percent, and other supporting port facility upgrades.

- **New Inter-Island Ferry Terminal and Mid-size Vessel Piers, Tutuila Island:** Development of four new piers in Pago Pago harbor with approximately 300 feet in length each to support ferry operations and mid-size vessel berthing.
- **New Future Super Port (Onesosopo), Tutuila Island:** Development of a new port terminal in Pago Pago harbor, including approximately 1,850 feet of new wharf/berthing infrastructure and 20 to 30 acres of upland development area.
- **Palo Lagoon Seaport (New Seaport Ferry Terminal), Tutuila Island:** Development of a new ferry terminal facility, including approximately 600 feet of wharf/berthing infrastructure.
- **Leone Seaport (New Seaport Ferry Terminal), Tutuila Island:** Development of a new ferry terminal facility, including approximately 600 feet of wharf/berthing infrastructure.
- **Fagaitua Seaport (New Seaport Ferry Terminal), Tutuila Island:** Development of a new ferry terminal facility, including approximately 480 feet of wharf/berthing infrastructure.
- **Ofu, Manu‘a Seaport (Updated Seaport and Ferry Terminal), Ofu Island:** Improvements to the Ofu harbor, including installation of two floating docks approximately 120 feet in length.
- **Faleasao, Manu‘a Seaport (Updated Seaport and Ferry Terminal), Ta‘u Island:** Improvements to the Faleasao harbor, including installation of three floating docks approximately 120 feet in length.
- **Ta‘u, Manu‘a Seaport (Updated Seaport and Ferry Terminal), Ta‘u Island:** Improvements to the Ta‘u harbor, including installation of two floating docks approximately 120 feet in length.

Without the Vision 2030 improvements and new developments, the American Samoa ports and harbors inventory assessment identified one moderate PSV homeport candidate site and one good O&L candidate site, which is the Port of Pago Pago, as summarized in **Figure 8** and **Table 9**. The existing infrastructure shows limited capacity to support potential commercial-scale deep-sea seabed mineral development industry activities in the region, especially when considering the existing use, utilization levels, and infrastructure conditions of these facilities.

Assuming that some or all Vision 2030 initiatives are implemented and become operational, the number of sites capable of supporting the deep-sea seabed mineral development industry maritime activities may increase. Under this scenario, up to two good PSV candidate sites and up to three good O&L candidate sites could become available, with several additional moderate O&L candidate sites providing supplementary capacity for shallow-draft vessels, as summarized in **Table 10**.

These additional facilities could help meet the potential port infrastructure demand scenarios summarized in **Table 5**, which estimated the approximate need of 0–1 DBM site per PSV, 0-1 PSV homeport site, and 1–2 O&L sites per PSV, depending on the phase of industry development.

If implemented, PAAS Vision 2030 initiatives could therefore enhance the ability of American Samoa's port infrastructure to support multiple deep-sea seabed mineral developers or PSV operations in the region, particularly with respect to O&L site demand. Without some of these improvements and developments, or similar future port and harbor developments, limitations may arise in meeting the potential O&L facility needs associated with emerging potential commercial-scale deep-sea seabed mineral development activities in the region.

However, for the planning and pre-commercial phases of industry maritime and vessel activities, as described in **Section 4**, existing port and harbor infrastructure within Pago Pago Harbor may be sufficient to support a single developer's operations or sequential activities by multiple developers. This may require and be achievable with minimal targeted capital improvements to existing infrastructure, such as minor wharf and berthing upgrades (e.g., replacing fenders and bollards, and structural improvements as applicable), improvements to upland load capacity and pavement conditions, and provision of lifting and gangway equipment to support crew transfer and supply logistics, etc.

Table 10: PAAS Vision 2030 Initiatives Assessment Summary

American Samoa Ports and Harbors Inventory	Planned or Proposed In-Service Date (year)	Upland Area (appx. acres)	Wharf / Berthing Length (appx. ft)	Draft at Berth (appx. ft)	Navigation Channel Characteristics (appx. ft)	DBM Site Suitability	PSV Site Suitability	O&L Site Suitability	General Notes
Port of Pago Pago, Tutuila Island	N/A	10 acres	2,000'	41'	Width: +600' Depth: 200' Air Draft Clearance: None	♦♦♦	♦	♦	Improved wharf and uplands load capacity and draft at berth are assumed.
New Inter-Island Ferry Terminal & Mid-size Vessel Piers, Tutuila Island	2029 - 2030	N/A	4 x 300'	TBD	Width: +600' Depth: 200' Air Draft Clearance: None	♦♦♦	♦♦♦	♦	Some of the O&L vessels are assumed to be able to dock and be supported by these piers.
New Future Super Port (Onesosopo), Tutuila Island	2033	20 - 30 acres	+1,850'	TBD	Width: +600' Depth: 200' Air Draft Clearance: None	♦♦♦	♦	♦	The upland area is assumed to be under 40 acres, and therefore likely insufficient to support DBM operations.
Palo Lagoon Seaport (New Seaport Ferry Terminal), Tutulia Island	2032	N/A	600'	16'	Width: 250' Depth: 18' Air Draft Clearance: None	♦♦♦	♦♦♦	♦♦	Some of the O&L vessels are assumed to be able to dock and be supported by this dock if built with the required water draft.
Leone Seaport (New Seaport Ferry Terminal), Tutuila Island	2034	N/A	600'	16'	Width: 250' Depth: 18' Air Draft Clearance: None	♦♦♦	♦♦♦	♦♦	Some of the O&L vessels are assumed to be able to dock and be supported by this dock if built with the required water draft.
Fagaitua Seaport (New Seaport Ferry Terminal), Tutuila Island	2035	N/A	480'	16'	Width: 250' Depth: 18' Air Draft Clearance: None	♦♦♦	♦♦♦	♦♦	Some of the O&L vessels are assumed to be able to dock and be supported by this dock if built with the required water draft.
Ofu, Manu'a Seaport (Updated Seaport and Ferry Terminal), Ofu Island	2028 - 2030	N/A	2 x 120'	16'	Width: +150' Depth: 18' Air Draft Clearance: None	♦♦♦	♦♦♦	♦♦	Some of the O&L vessels are assumed to be able to dock and be supported by this dock if built with the required water draft.
Faleasao, Manu'a Seaport (Updated Seaport and Ferry Terminal), Ta'u Island	2028 - 2033	N/A	3 x 120'	16'	Width: +160' Depth: 18' Air Draft Clearance: None	♦♦♦	♦♦♦	♦♦	Some of the O&L vessels are assumed to be able to dock and be supported by this dock if built with the required water draft.
Ta'u, Manu'a Seaport (Updated Seaport and Ferry Terminal), Ta'u Island	2030	N/A	2 x **120'**	16'	Width: +180' Depth: 18' Air Draft Clearance: None	♦♦♦	♦♦♦	♦♦	Some of the O&L vessels are assumed to be able to dock and be supported by this dock if built with the required water draft.

♦ (green): Port or harbor is a good candidate site for the identified port facility type and meets the criteria presented in **Table 2**.
♦♦ (yellow): Port or harbor is a moderate candidate site for the identified port facility type and meets some of the criteria presented in **Table 2**, but would require targeted expansion or capital improvements to fully support the identified port facility type and associated operations.
♦♦♦ (red): Port or harbor is not a suitable candidate site for the identified port facility type and does not meet the criteria presented in **Table 2**.

7 Conclusion and Next Steps

Based on the assessment results, supporting a potential deep-sea seabed mineral development industry in the region may require a range of port facility types with varying characteristics and capabilities across different phases of development (planning, pre-commercial, commercial-scale, and expanded commercial-scale), including DBM, PSV homeport, and O&L sites. As outlined in the assessment, indicative port and harbor infrastructure demand may include 0–1 DBM site per PSV, 0–1 PSV homeport site, and 1–2 O&L sites per PSV, depending on the phase of industry development and scale of operations in the region.

For the near-term planning and pre-commercial phases, American Samoa appears to have sufficient port infrastructure to support potential industry maritime and vessel activities, particularly for O&L site needs. These activities could be supported by existing facilities, potentially with targeted capital improvements, and may accommodate a single developer or multiple developers operating sequentially within the region.

However, for commercial-scale and expanded commercial-scale phases, the existing ports and harbors in American Samoa show limited capacity to support potential deep-sea seabed mineral industry activities across all site types, including DBM, PSV homeport, and O&L. These limitations are particularly evident when considering existing site uses, utilization levels, and infrastructure conditions, and may constrain the ability to support one or multiple developers operating sequentially or simultaneously.

Considering the PAAS Vision 2030 initiatives, if implemented, these proposed or planned improvements and developments could enhance the ability of American Samoa's port infrastructure to support multiple developers or PSV operations in the region, particularly with respect to O&L site demand and PSV homeport capability. Without such improvements, or similar future port and harbor improvements and developments, limitations may arise in meeting O&L site demand and industrial vessel support needs associated with commercial-scale activities in the region. Identification of these initiatives and sites as potential candidates does not mean confirmed schedules for development.

The next steps to continue planning for potential deep-sea seabed mineral development activities and port infrastructure capabilities in American Samoa include further coordination with PAAS to confirm the scope, timing, and feasibility of Vision 2030 initiatives or similar future port and harbor improvements and developments. This should be supported by feasibility-level studies for proposed or planned infrastructure improvements and developments, including engineering feasibility, preliminary cost estimates, implementation schedules, permitting pathways, and funding strategies.

Additional analysis may include evaluation of phased infrastructure development strategies aligned with projected demand, as well as operational approaches such as the use of off-island DBM terminals to support seabed mineral logistics activities. This could include further assessment of Pacific dry bulk terminal capabilities, including major U.S. and nearby international ports, to determine their suitability and available capacity to support seabed mineral commodities or similar bulk materials.

Such an assessment may consider terminal physical characteristics, available storage and handling capacity, annual dry bulk throughput (million tonnes per annum), remaining capacity beyond existing operations, import and export capabilities, and connectivity to onward transport or processing locations. This work could support the development of a long-term regional Pacific seabed mineral logistics roadmap aligned with industry development phases, projected activity levels, and associated port infrastructure needs.

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