New York State Offshore Wind Master Plan

Sand and Gravel Resources Study

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New York State Offshore Wind Master Plan

Sand and Gravel Resources Study

Final Report

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New York State Energy Research and Development Authority

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Notice

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Acronyms and Abbreviations

AoA	Area of Analysis
ASAP	Atlantic Sand Assessment Project
BMPs	best management practices
BOEM	Bureau of Ocean Energy Management
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
EA	environmental assessment
EIS	environmental impact statement
EPA	U.S. Environmental Protection Agency
GIS	Geographic Information System
MARCO	Mid-Atlantic Regional Council on the Ocean
MMS	Minerals Management Service
MOU	Memorandum of Understanding
NEPA	National Environmental Policy Act
nm	nautical miles
NOAA	National Oceanic and Atmospheric Administration
DOS	New York State Department of State
OCS	Outer Continental Shelf
OCSLA	Outer Continental Shelf Lands Act
OSA	Offshore Study Area
State	New York State
Study	Sand and Gravel Resources Study
U.S.	United States of America
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey

Summary

This Sand and Gravel Resources Study (Study) uses a variety of existing data to examine sand and gravel resources in the Area of Analysis (AoA), a 14,980-square-mile area of the ocean extending from 15 nautical miles from the coast of Long Island and New York City to the continental shelf break, slope, and into oceanic waters to an approximate maximum depth of 2,500 meters. This Study investigates the locations of active and formerly active sand and gravel mining activities in the vicinity of the AoA, as well as the locations of sand and gravel resources that could be mined in the future in and near the AoA. Although sand and gravel mining is not currently occurring in the AoA, and mining has not occurred there in the past, potentially minable sand and gravel is prevalent throughout most of the AoA.

The AoA, which is the geographic scope of analysis for this Study, is a 14,980-square-mile area of the ocean extending from 15 nautical miles (nm) from the coast of Long Island and New York City to the continental shelf break, slope, and into oceanic waters to an approximate maximum depth of 2,500 meters (Figure 1). While this area is the focus of analysis, the area around the AoA also is discussed in order to take into consideration the potential interaction of offshore wind export cables and sand and gravel mining sites closer to shore. Additionally, this Study assesses the sensitivities and risks associated with the development of sand and gravel mining in and around the AoA and provides general guidelines and best management practices (BMPs) that future developers of offshore mining activities and offshore wind projects can follow to reduce potential risks to marine mining resources.

Regulatory Framework. The U.S. Bureau of Ocean Energy Management (BOEM) has jurisdiction over identifying offshore wind development sites within the Outer Continental Shelf (OCS) portion of the OSA and for issuing leases for those sites. Additionally, BOEM is the federal entity responsible for negotiating agreements for offshore mining-related activities in federal waters, which are greater than 3 nm from the New York and New Jersey shorelines. In February 2017, BOEM and the U.S. Army Corps of Engineers (USACE) entered into a Memorandum of Understanding (MOU) in an effort to enhance coordination regarding the management of sand and gravel resources on the OCS (BOEM and USACE 2017). The DOS also closely coordinates with BOEM regarding sand and gravel resources. In 2016, the DOS entered into a Cooperative Agreement with BOEM and a Memorandum of Agreement with the State University of New York to expand the knowledge base on sand resources and develop

management strategies for coastal resiliency and the preservation of offshore ecological systems. Although BOEM is ultimately responsible for the approval of new lease areas for mining, the overall coordination between BOEM, USACE, and state entities such as DOS establishes a framework for inter-agency consultation and regulatory review requirements for companies or states interested in undertaking projects that actively mine and deposit sand and gravel resources within the OSA.

Data and Literature Review. The natural (geomorphological) and human-made features of the seabed, as well as the sand and gravel resources within and adjacent to the AoA for this Study, were identified by conducting literature reviews and a desktop analysis of relevant geospatial data. Geographic information system (GIS) database searches were used to obtain seabed geomorphology and bathymetry and identify the locations of active, formerly active, and potential future sand and gravel mining sites (borrow areas) and other subsea features, such as cable crossings, disposal sites, artificial reefs, and shipwrecks. Literature searches were conducted to identify and obtain the required information from numerous technical reports and open-file reports from various state and federal agencies/entities.

Summary of Findings. Over 120 active, formerly active, or potential future mining borrow areas were identified off the coasts of New York and New Jersey, with 46 located off the coast of New York and 78 located off the coast of New Jersey. All of these mining sites are within 14 nm of the nearest coast; however, none of these sites are located within the AoA for this Study.

The AoA includes known natural features and human-made obstructions that could interfere with sand and gravel mining operations and the development of offshore wind farms and related infrastructure. These natural features and human-made obstructions include cable crossings, disposal sites, artificial reefs, and shipwrecks. Telecommunications cables represent the most widespread human-made obstructions to sand and gravel mining. Various disposal sites for dredging, chemical, or other municipal waste and various unexploded ordnance sites were identified. Two discontinued disposal sites, two larger discontinued disposal/unexploded ordnance sites, and 18 smaller unexploded ordnance sites are located within the AoA. One artificial reef site, known as Shark River, is located within the AoA along the northwestern border, approximately 18 nm east of Point Pleasant, New Jersey. The majority of identified shipwrecks are located outside of the western edge of the AoA for this Study, where shipping and boating tends to be more common, and at the very western end of the Hudson Canyon.

Economic Value and Need. Sand and gravel represent the highest volume of raw material extracted globally, and the extraction rate greatly exceeds the rate of natural renewal (UNEP 2014). As of 2017, sand and gravel used for construction was valued at $8.2 billion for the United States alone, with New York among one of the top seven states producing sand and gravel for construction (USGS 2017a). Worldwide, sand and gravel mined offshore is used primarily for construction material; however, in recent decades, beach nourishment projects (to replace sand after storm events or other erosional causes) have become much more common (Garel et al. 2009; ASBPA 2006). While most sand and gravel used for beach nourishment projects is mined from areas close to the coast, the potential increase in future demand for these resources will encourage the continued exploration of offshore mining sites and likely an increase in offshore sand and gravel mining sites on the OCS. For instance, BOEM authorized the use of sand resources on the OCS for beach nourishment in Florida in an effort to reduce erosion and protect against future storms (BOEM 2017b). Therefore, sand and gravel mining in the AoA could have high economic value in the future.

From 2000 to 2016, New York State used nearly 35 million cubic yards of sand for 15 beach nourishment projects, at a total cost of nearly $325 million. Similarly, from 2000 to 2015, New Jersey used approximately 59 million cubic yards of sand for 13 beach nourishment projects, at a total cost of over $629 million (ASBPA 2017). As nearshore sand sources for beach nourishment projects become depleted, and demand for construction aggregates continues, the increasing distance of the nearest offshore sand sources will likely contribute to rising costs for obtaining the material. Rising material costs, in turn, are likely to increase pressure to develop sources of sand located further from shore.

Sensitivity and Risk. Future offshore wind development could impact the sensitivities of, and cause potential risks to, sand and gravel mining activities. For example, future offshore wind facilities could interfere with current or proposed sand and gravel mining activities. It is also possible that potential sand and gravel borrow areas within the AoA could be impacted by future installation, operation, and/or decommissioning of offshore wind turbines, array cables, and/or export cables. Similarly, active and potential future borrow areas nearshore (outside of the AoA) could be affected by construction activities and development of onshore substations. Additionally, the associated installation methods for any future interconnection of offshore wind facilities, such as laying, directional drilling, or trenching for transmission, could impact nearshore sand and gravel resources (Environmental Law Institute 2013).

Although the AoA contains large amounts of potentially minable sand and gravel, there are no known active or formerly active sand and gravel mining operations or mining leases within the AoA. If future sand and gravel mining exploration commences in the AoA for this Study, wind turbines and the cables associated with wind farm infrastructure could be sited to avoid crossing active or potential sand and gravel mining sites. Since the AoA is large enough to accommodate both wind energy development and mining development, these activities could be sited to avoid conflicts through cooperative ocean planning efforts between BOEM, USACE, and DOS if mining is proposed. These cooperative planning efforts also could be utilized when siting transmission lines and onshore substations to avoid potential conflict between future offshore wind facilities and nearshore active or potential sand and gravel mining sites.

Guidelines and Best Management Practices. There are no specific guidelines or BMPs for sand and gravel mining activities with respect to potential interactions with offshore wind development. However, the established coordination between BOEM, USACE, DOS, and related stakeholders regarding ocean planning could be utilized to ensure potential interactions are approached thoughtfully. Additionally, the National Oceanic and Atmospheric Administration's (NOAA's) BMPs for sand and gravel mining should be followed to reduce environmental impacts. Since BOEM, USACE, and interested stakeholders coordinate closely regarding sand and gravel leases, consultations with these agencies regarding sand and gravel can serve as an information resource for future offshore wind developers with regard to potential interactions with sand and gravel mining activities and mitigation strategies. Offshore wind developers also should coordinate with the DOS, which is involved in sand and gravel research through the cooperative agreement with BOEM, to navigate concerns related to siting. Additionally, offshore wind developers should take into consideration the BMPs set forth by NOAA in order to appropriately consider the sensitivities and risks to sand and gravel resources posed by future offshore wind development activities, thus allowing the developers to minimize potential impacts on sand and gravel resources during construction and operation of offshore wind farms.

1 Introduction

This Sand and Gravel Resources Study (Study) is one of a collection of studies prepared on behalf of New York State in support of the New York State Offshore Wind Master Plan (Master Plan). These studies provide information on a variety of potential environmental, social, economic, regulatory, and infrastructure-related issues associated with the planning for future offshore wind energy development off the coast of the State. When the State embarked on these studies, it began by looking at a study area identified by the New York State Department of State (DOS) in its two-year Offshore Atlantic Ocean Study (DOS 2013). This study area, referred to as the “offshore study area (OSA),” is a 16,740-square-mile (43,356-square-kilometer) area of the Atlantic Ocean extending from New York City and the south shore of Long Island to beyond the continental shelf break and slope into oceanic waters to an approximate maximum depth of 2,500 meters (Figure 1). The OSA was a starting point for examining where turbines may best be located, and the area potentially impacted. Each of the State’s individual studies ultimately focused on a geographic Area of Analysis (AoA) that was unique to that respective study. The AoA for this study is described below in Section 1.1.

The State envisions that its collection of studies will form a knowledge base for the area off the coast of New York that will serve a number of purposes, including: (1) informing the preliminary identification of an area for the potential locating of offshore wind energy areas that was submitted to the Bureau of Ocean Energy Management (BOEM) on October 2, 2017 for consideration and further analysis; (2) providing current information about potential environmental and social sensitivities, economic and practical considerations, and regulatory requirements associated with any future offshore wind energy development; (3) identifying measures that could be considered or implemented with offshore wind projects to avoid or mitigate potential risks involving other uses and/or resources; and (4) informing the preparation of a Master Plan to articulate New York State’s vision of future offshore wind development. The Master Plan identifies the potential future wind energy areas that have been submitted for BOEM’s consideration, discusses the State’s goal of encouraging the development of 2,400 megawatts (MW) of wind energy off the New York coast by 2030, and sets forth suggested guidelines and best management practices (BMPs) that the State will encourage to be incorporated into future offshore wind energy development.

Each of the studies was prepared in support of the larger effort and was shared for comment with federal and State agencies, indigenous nations, and relevant stakeholders, including non-governmental organizations and commercial entities, as appropriate. The State addressed comments and incorporated feedback received into the studies. Feedback from these entities helped to strengthen the quality of the studies, and also helped to ensure that these work products will be of assistance to developers of proposed offshore wind projects in the future. A summary of the comments and issues identified by these external parties is included in the *Outreach Engagement Summary*, which is appended to the Master Plan.

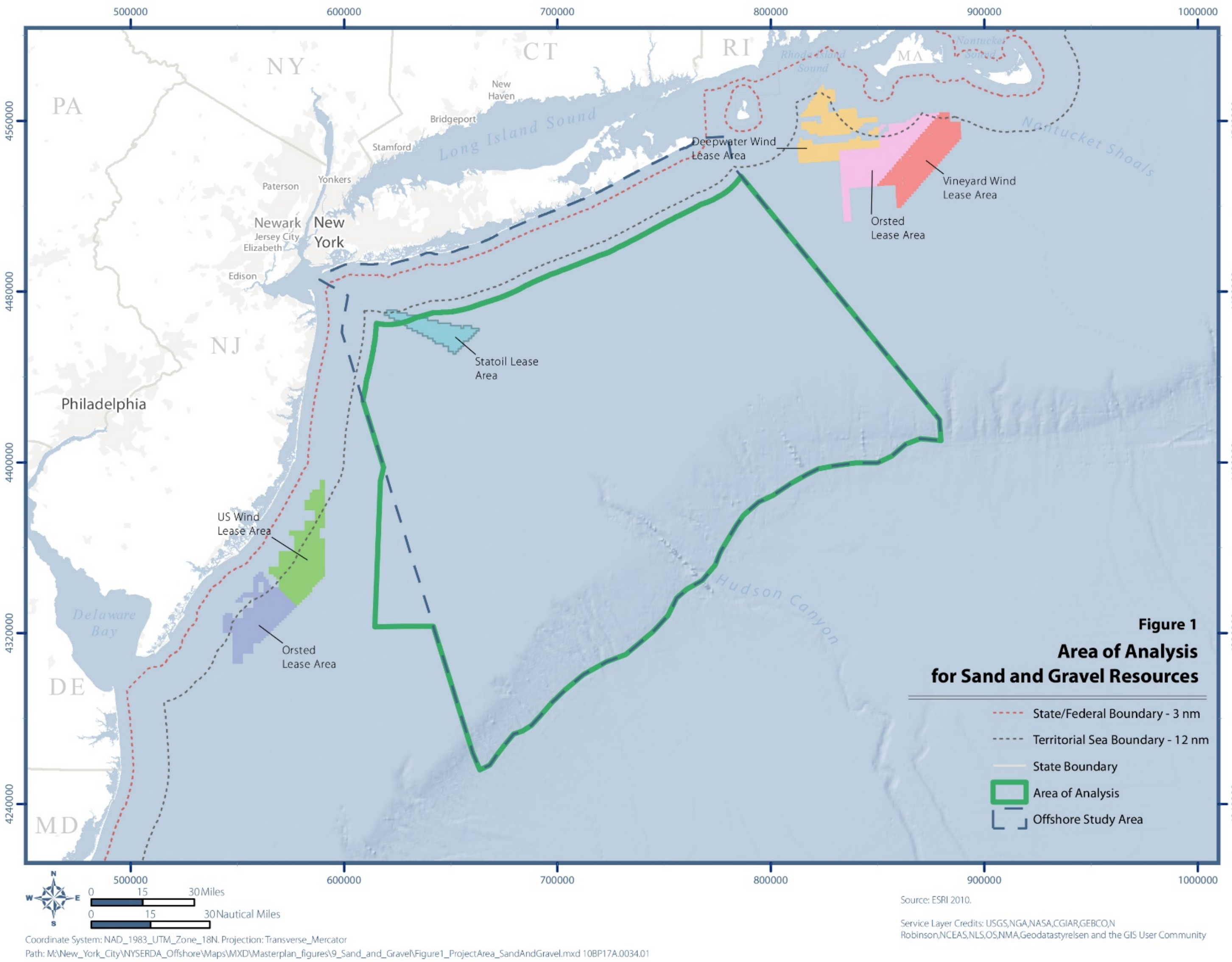
The Energy Policy Act of 2005 amended Section 8 of the Outer Continental Shelf Lands Act (OCSLA) to give BOEM the authority to identify offshore wind development sites within the Outer Continental Shelf (OCS) and to issue leases on the OCS for activities that are not otherwise authorized by the OCSLA, including wind farms. The State recognizes that all development in the OCS is subject to review processes and decision-making by BOEM and other federal and State agencies. Neither this collection of studies nor the State's Master Plan commit the State or any other agency or entity to any specific course of action with respect to offshore wind energy development. Rather, the State's intent is to facilitate the principled planning of future offshore development off the New York coast, provide a resource for the various stakeholders, and encourage the achievement of the State's offshore wind energy goals.

1.1 Scope of Study

This Study investigates the locations of active and formerly active sand and gravel mining activities in the vicinity of the AoA, as well as the locations of sand and gravel resources that could be mined in the future in and near the AoA. The AoA is a 14,980-square-mile area of the ocean extending from 15 nautical miles (nm) from the coast of Long Island and New York City to the continental shelf break, slope, and into oceanic waters to an approximate maximum depth of 2,500 meters (Figure 1). Although sand and gravel mining is not currently occurring in the AoA, and mining has not occurred there in the past, potentially minable sand and gravel is prevalent throughout most of the AoA, as suggested by surficial sediment types that are classed as predominantly sand and/or gravel. Section 1 provides an introduction to the scope and objectives of the Study, as well as the regulatory framework governing development in the OSA. Section 2 presents the methodology and results of the Study, including an estimation of the economic value of current and potential future sand and gravel mining activities in and around the AoA. Section 3 presents the resource sensitivities associated with sand and gravel mining, and the potential risks that future offshore wind development could pose to sand and gravel mining in the AoA for this Study. Section 4 presents guidelines and BMPs to minimize potential conflicts between future offshore wind development and potential future sand and gravel mining operations and other marine resources. Section 5 provides a list of references used to prepare this Study.

Figure 1. Area of Analysis for Sand and Gravel Resources

Source: ESRI 2010



1.2 Objectives of Study

The objectives of this study are to:

- Identify locations of active and formerly active sand and gravel mining sites within and in the vicinity of the AoA for this Study, as well as locations of sand and gravel resources in the AoA that could potentially be mined in the future.
- Assess and summarize the potential resource sensitivities associated with sand and gravel mining and the potential for conflicts between wind energy development and sand and gravel mining in the AoA.
- Identify guidelines and BMPs that future developers of offshore mining activities and offshore wind facilities can follow to reduce potential risks to marine mining resources.

1.3 Regulatory Framework

The National Environmental Policy Act (NEPA) of 1969, 42 U.S.C. 4321 et seq., requires that prior to making permitting decisions, federal agencies assess the environmental effects of their own activities and development projects, and activities by others that require federal licenses or permits. Federal agencies do this by preparing documents that address the environmental consequences, if any, of the proposed action. An environmental assessment (EA) under NEPA contains an analysis for determining whether the impacts of the action will be significant. If significant, an environmental impact statement (EIS) is prepared and issued by the agency. If not significant, a finding of no significant impact (FONSI) is issued, which effectively ends the agency's NEPA obligations for that project. NEPA requires opportunities for public participation in the environmental impact review process (40 Code of Federal Regulations [CFR] 1500-1508).

NEPA also established the Council on Environmental Quality (CEQ). The CEQ, within the Executive Office of the President, promulgates guidelines for implementing NEPA procedures that apply to all federal agencies. Federal agencies are also free to create their own additional regulations. CEQ reviews and approves federal agency NEPA procedures (40 CFR 1500-1508).

Under the federal Energy Policy Act of 2005, BOEM has the jurisdiction to lease submerged land on the OCS for renewable energy development, including for offshore wind. BOEM published regulations (found in 30 CFR 585) to establish procedures for issuing leases, right-of-way grants, and easements for renewable energy production on the OCS. As the lead agency for permitting offshore wind farms in federal waters, BOEM will, in consultation with other agencies and stakeholders, oversee the required

NEPA process for any such proposed offshore wind projects. For offshore wind farms proposed in federal waters, environmental consultations are required for two phases of the development process—the site assessment and leasing phase and the construction and operations phase. Site assessment and leasing activities for future development would likely require an EA, and an EIS would likely be required for construction and operations activities (NYSERDA 2015).

BOEM is also the federal entity responsible for negotiating agreements for offshore mining-related activities in federal waters, which are greater than 3 nm from the New York and New Jersey shorelines. BOEM administers the Marine Minerals Program, which was established in 1992. The goal of this program is to "facilitate access to and manage the nation's OCS non-energy marine minerals, particularly sand and gravel, through environmentally responsible stewardship of resources, prudent assessments of exploration and leasing activities, coordination with governmental partners, engagement of stakeholders, strategic planning, and mission-focused scientific research to improve decision-making and risk management" (BOEM n.d.[a]).

BOEM regulations cover both competitive lease agreements and negotiated, noncompetitive lease agreements for sand and gravel mining sites. Under the OCSLA, the U.S. Department of the Interior has jurisdiction to lease and regulate mineral extraction from submerged lands seaward of state-owned waters out to the OCS. In 30 CFR Parts 580, 581, and 582, BOEM outlines requirements for competitive lease agreements for prospecting, leasing, and production of non-energy mineral resources on the OCS. Under Public Law 103-426, published in 1994, BOEM has the authority to negotiate leases on a noncompetitive basis for OCS sand, gravel, or shell resources used for public works projects such as shore protection; beach or wetlands restoration projects by federal, state, or local agencies; or construction projects funded or authorized by the federal government. On March 22, 2016, BOEM released a proposed rule to provide additional clarification on negotiated, noncompetitive lease agreements. This proposed rule became final on October 3, 2017, under 30 CFR Part 583 and becomes effective on December 4, 2017.
(BOEM n.d. [b]; 30 CFR Parts 580, 581, 582, 583)

If submitting an unsolicited request for an OCS sand and gravel lease sale, the applicant should submit the request to the Director of BOEM with information regarding area identification, the specific sand and gravel materials of interest, availability of the resource, and environmental considerations specific to the area of interest. Prior to issuing a response, BOEM may issue a Request for Information to identify geological conditions of the seabed, the potential presence of archaeological resources, alternative uses of the proposed area, as well as other socioeconomic, biological, and environmental considerations. If

BOEM proceeds with the lease sale, the agency will determine the appropriate type of environmental analysis required for the area under NEPA and whether an EIS will be required. Depending on the regulatory requirements associated with sand and gravel mining in the specified area, the process could take approximately two years (BOEM 2016a).

Under a noncompetitive, negotiated lease agreement, the requesting party must supply technical and environmental information on the requested sand and gravel lease area to assist BOEM in its evaluation of the proposed project (BOEM n.d.[b]). The preparation of this agreement is a multi-step process that takes approximately 12-14 months to complete after environmental consultations have taken place. The proposed mining project will require coordination between local, state, federal, and private sector partners (BOEM n.d.[b]). BOEM will conduct the following prior to issuing a noncompetitive agreement:

- Review technical and environmental information in the request and project description.
- Consult on endangered species and essential fish habitat.
- Review archaeological surveys.
- Review air quality data.
- Review Coastal Zone Management Act consistency.
- Prepare an environmental analysis (EA or EIS).
- Sign the agreement instrument (Memorandum of Understanding [MOU] or Lease) with terms and conditions.
- Formally notify House and Senate committees when the agreement has been signed for authorized U.S. Army Corps of Engineers (USACE) Civil Works projects (BOEM n.d.[c]).

In response to the impacts of Hurricane Sandy, BOEM instituted the Atlantic Sand Assessment Project (ASAP) in an effort to research potential sand resources in federal waters from Miami, Florida, to Massachusetts. The aim of ASAP is to help coastal communities recover from storms and plan for resilient coastal systems. A sound understanding of the location, composition, and volume of sand resources is important for potential projects and plans centered on coastal resiliency. Throughout 2015, 2016, and 2017, BOEM commissioned geophysical surveys and collection of geological samples in various locations to determine sediment type, grain size, and composition. In select areas off New York, New Jersey, and Delaware, a more detailed analysis determined potential volumes and the extent of potential new sand resources. Through the research efforts conducted under ASAP, the identification and characterization of potential sand resources in the Atlantic is expanding (BOEM 2017a).

In February 2017, BOEM and the USACE set in place an MOU to enhance coordination regarding the management of sand and gravel resources from the OCS (BOEM and USACE 2017). Specifically, the MOU was developed to integrate USACE's civil works and regulatory programs with BOEM processes when USACE is an involved party for permit review of shore protection, coastal storm risk management, aquatic ecosystem restoration, and any other types of projects that may use sand and gravel resources from the OCS (BOEM 2017b). The MOU was established to facilitate consistency between agencies regarding environmental compliance, scheduling, and negotiation for projects proposing the use of sand and gravel from the OCS.

The DOS closely coordinates with BOEM regarding sand and gravel resources. In 2016, the DOS entered into a Cooperative Agreement with BOEM and a Memorandum of Agreement with the State University of New York to "develop management strategies for offshore sand resources that will preserve the ecological function of offshore systems while helping to achieve resilience for coastal communities" (BOEM 2016b). The first step toward this goal was the preparation and publication of the Assessment of Sand Needs and Resources Offshore New York, Summary Report, which provides a compilation and synthesis of existing information relevant to these efforts (BOEM 2016b).

This synthesis of existing information covers several topics related to sand and gravel resources, some of which include resource presence and possible uses in New York, potential impacts due to mining, and suggestions for future research. One summary technical report identifies 44 active, formerly active, or potential future borrow areas in New York State waters off the coast of Long Island (BOEM 2016b), none of which is in the AoA of this Study. An additional two active, formerly active, or potential future borrow areas exist in federal waters off the coast of Long Island (MMS 2004). The presence of these borrow areas along the coast of Long Island necessitates early coordination to minimize potential conflict when siting export cable landfall points for potential offshore wind farms. Therefore, knowledge of these areas and coordination with federal and state entities is important when developing offshore sand and gravel resources and when siting offshore wind farms and cable routes.

The overall coordination between BOEM, USACE, and state entities such as DOS establishes a framework for agencies regarding consultations and regulatory review requirements for companies or states interested in undertaking projects that actively mine and deposit sand and gravel resources within the AoA. Given BOEM's jurisdiction over renewable energy and sand and gravel mining leases, BOEM ultimately is responsible for the approval of new sand and gravel mining areas that could preclude or be co-located with offshore wind infrastructure.

2 Data and Literature Review

2.1 Data Review Methods

The natural (geomorphological) and human-made features of the seabed, as well as the sand and gravel resources within and adjacent to the AoA for this Study, were identified by conducting a desktop analysis of relevant geospatial data and literature reviews.

2.1.1 Geographic Information System Data

Geographic information system (GIS) database searches were used to obtain seabed forms (subsea geomorphology); sediment composition and thickness; active, formerly active, and potential future sand and gravel mining sites (borrow areas); and bathymetry. Other subsea features were also identified, including obstructions that could interfere with future wind development in the AoA. These features included existing cable crossings, disposal sites (including unexploded ordnances), artificial reefs, and shipwrecks. Database sources included the following:

- The Nature Conservancy.
- DOS.
- U.S. Geological Survey (USGS) Coastal and Marine Geology Program.
- U.S. Department of Commerce, National Oceanic and Atmospheric Administration (NOAA), National Ocean Service, Coastal Services Center.
- NOAA Office of Coastal Management.

2.1.2 Literature Review

In addition to the GIS analysis, a literature review was conducted. Literature searches were conducted using Google, Google scholar, agency websites, and ProQuest, all of which resulted in the identification of additional documents from several agencies and researchers. Search terms included various combinations of: sand, gravel, mining, western Atlantic, northern Atlantic, New York, New Jersey, bight, sediment, offshore, dredging, shoreline, replenishment, and other terms that appeared in the results list. The reference lists from these reports were also evaluated for additional sources that were potentially relevant.

Data was obtained from numerous technical reports and open-file reports from the following agencies/entities:

- NOAA, National Centers for Coastal Ocean Science.
- USGS, Outer Continental Shelf Ecosystem Program.
- BOEM (formerly Minerals Management Service [MMS]), Marine Minerals Program.
- MMS, Leasing Division, Marine Minerals Branch.
- The Nature Conservancy, Eastern U.S. Division.
- New Jersey Geological and Water Survey.
- Northwest Atlantic Marine Ecoregional Assessment.
- National Ocean Economics Program.
- Maryland Geological Survey.
- Delaware Geological Survey.
- Multiple independent technical reports (see reference section).

2.2 Summary of Findings

The following presents information on the locations of active, formerly active, and potential future sand and gravel mining sites (borrow areas) within and adjacent to the AoA for this Study. In addition, this section discusses the geologic features of the AoA and assesses the potential for sand and gravel resources that could be mined in the future.

The designation of a borrow area is determined by a number of factors, including resource quantity and quality, economic feasibility of resource retrieval, and regulatory requirements. In terms of quality, sediment grain size, composition, and color are important designation factors. Borrow areas often require bathymetric, seismic, geotechnical, magnetometer, and sidescan surveys to determine quality and compatibility with projects that will use the resource. Borrow area determination also must take into consideration whether there is adequate volume of material for excavation. Additional constraints on the designation of borrow areas relate to the potential disruption to the site and timeline for replenishment, which requires investigation of potential impacts on cultural and environmental resources. With regard to replenishment, the rate of sediment flow and transport for natural infilling on the seafloor of the excavated site contributes to area determination. Distance from shore and water depth also factor into the suitability of borrow areas and whether or not an area is economically feasible to dredge. Increasingly, borrow areas are being sought farther offshore at distances greater than 6 statute miles from the coast and at depths of up to approximately 100 feet (FDEP 2010; BOEM 2016b).

For the purposes of this Study, the term borrow area is used to describe active and formerly active sand and gravel mining sites, as well as potential future mining sites. For the purposes of this report, reference to a potential future borrow area does not imply that a site will be mined, nor does it imply that a thorough investigation has been conducted to determine suitability for mining. Instead, the term 'potential future borrow area' is used to identify potential resource availability for mining, with the caveat that additional research must first be undertaken.

2.2.1 Active, Formerly Active, and Potential Future Borrow Areas

Over 120 active, formerly active, or potential future borrow areas were identified off the coast of New York and New Jersey, with 46 located off the coast of New York and 78 located off the coast of New Jersey (Figure 2). The farthest identified offshore mining site is approximately 14 nm from shore. No offshore sand and gravel borrow areas (active, formerly active, or potential future) were identified within the AoA for this Study.

The identified active, formerly active, or potential future borrow areas nearest to the AoA are located offshore of Long Island, New York, and Monmouth County, New Jersey, outside the AoA (Figure 2). Based on the information obtained in the literature review, there are also no known sand and gravel mining leases for future development within the AoA for this Study. BOEM regulations dictate that, unless otherwise stipulated or agreed upon, competitive lease agreements for sand and gravel expire after 10 years and noncompetitive, negotiated leases for sand and gravel expire after only 5 years (30 CFR Part 581; 30 CFR Part 583). Therefore, although there are no current or known future sand and gravel mining leases within the AoA, the number, volumes, and locations of current or known future leases are not necessarily indicators of future development given the limited duration of these leases.

2.2.2 Future Sand and Gravel Mining in the AoA

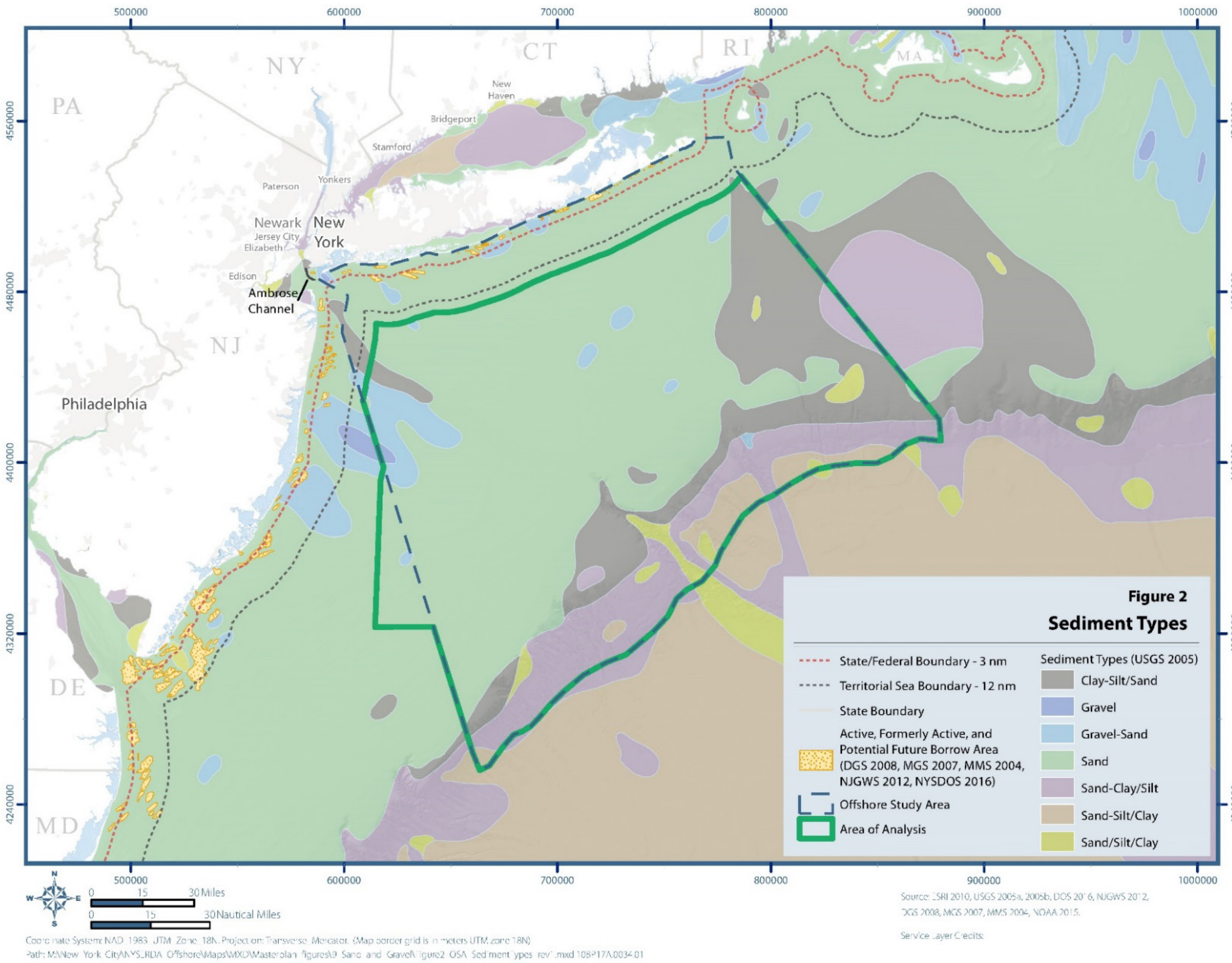
As it pertains to the AoA for this Study, this section includes a description of the subsea conditions, including bottom topography and sediment types and thicknesses, and an assessment of the potential for sand and gravel resources to be mined in the in the future. This assessment is based on the identified subsea conditions, the presence of natural and human-made obstructions, and the potential economic value of sand and gravel resources.

2.2.2.1 Subsea Conditions

Geomorphology. The sea bottom on the OCS is a dynamic environment. The sediments are ever changing due to sorting and mixing by waves, tides, currents, and storm events, and the surficial sediments are subject to biogenic mixing from burrowing and other biological activity (Roche et al. 2016). The shallow substrate of the benthic environment exists in a highly dynamic environment, affected by biogenic and anthropogenic factors; however, these factors have little effect on the underlying composition of the seabed (Ostrowski and Pruszak 2011). This general stability allows for reliable characterization of the seabed for sand and gravel mining activities.

Figure 2. Sediment Types

Source: ESRI 2010; USGS 2006a, 2005a, 2005b, DOS 2016, NJGWS 2012; DGS 2008; MGS 2007, MMS 2004, NOAA 2015



The seabed can be defined in terms of its position and slope. From approximately 12 nm east of the New York and New Jersey shorelines, where the territorial sea boundary begins, the seabed largely consists of mid-flat formations (e.g., shelves, plateaus, flat terraces) interspersed with depressions, high-flat formations (e.g., banks, shoals, flats), and high-slope formations (Figure 3). The seabed topography remains relatively constant from 12 nm east of the New York and New Jersey shorelines to the western tail of the Hudson Canyon and the continental shelf. From the continental shelf to the eastern edge of the AoA, the seabed transitions to steep slopes as the sea depth drops from approximately 150 feet to more than 2,000 feet (MARCO 2017).

Sediments within the AoA. General evaluation of sediment in the AoA was performed using publicly available sources such as the Mid-Atlantic Regional Council on the Ocean (MARCO) Data Portal (MARCO 2017) and data from The Nature Conservancy (2017). Sediments off the coasts of New York and New Jersey follow a sorting pattern where larger, coarser sediments are present closer to the eastern shoreline of the United States (with the exception of major shipping channels such as the Ambrose Channel). The sorting pattern transitions to finer, less coarse sediments and very fine sand, silt, and clay farther east in the AoA (Figure 2).

Additional data sources associated with the evaluation of offshore sediments generally concur with this characterization of sediment. CONMAP (USGS 2005a) and usSEABED (USGS 2005b) data also identify much of the AoA as consisting of sand and gravelly sediment (coarser) closer inshore towards the New York and New Jersey shorelines. Much of the AoA shows sandy sediments with a transition to sandy silt (and other finer sediments) towards the continental shelf and beyond (USGS 2005a; Menza et al. 2012). Both the MARCO (2017) and CONMAP (USGS 2005a) data portals identify the majority of the AoA as consisting of a sandy benthic environment.

Ocean sediment thickness (i.e., the depth of sediment at a given location above the next defining layer) varies throughout the AoA, but it follows a general pattern, with sediment in the northwestern extent ranging from 2,000 meters to 4,800 meters thick and a few areas in the southwestern extent where sediment thickness ranges from 8,400 to 12,200 meters over bedrock. Continuing east within the AoA, sediment thickness increases to a range of 5,000 meters to 8,200 meters. Sediment thickness in the far western edge of the AoA increases to a range of 12,400 to 18,000 meters (Figure 4).

Figure 3. Seabed Form and Water Depth

Source: ESRI 2010; The Nature Conservancy (TNC 2010); DOS 2016; NJGWS 2012; DGS 2008; MGS 2007, MMS 2004, NOAA 2015

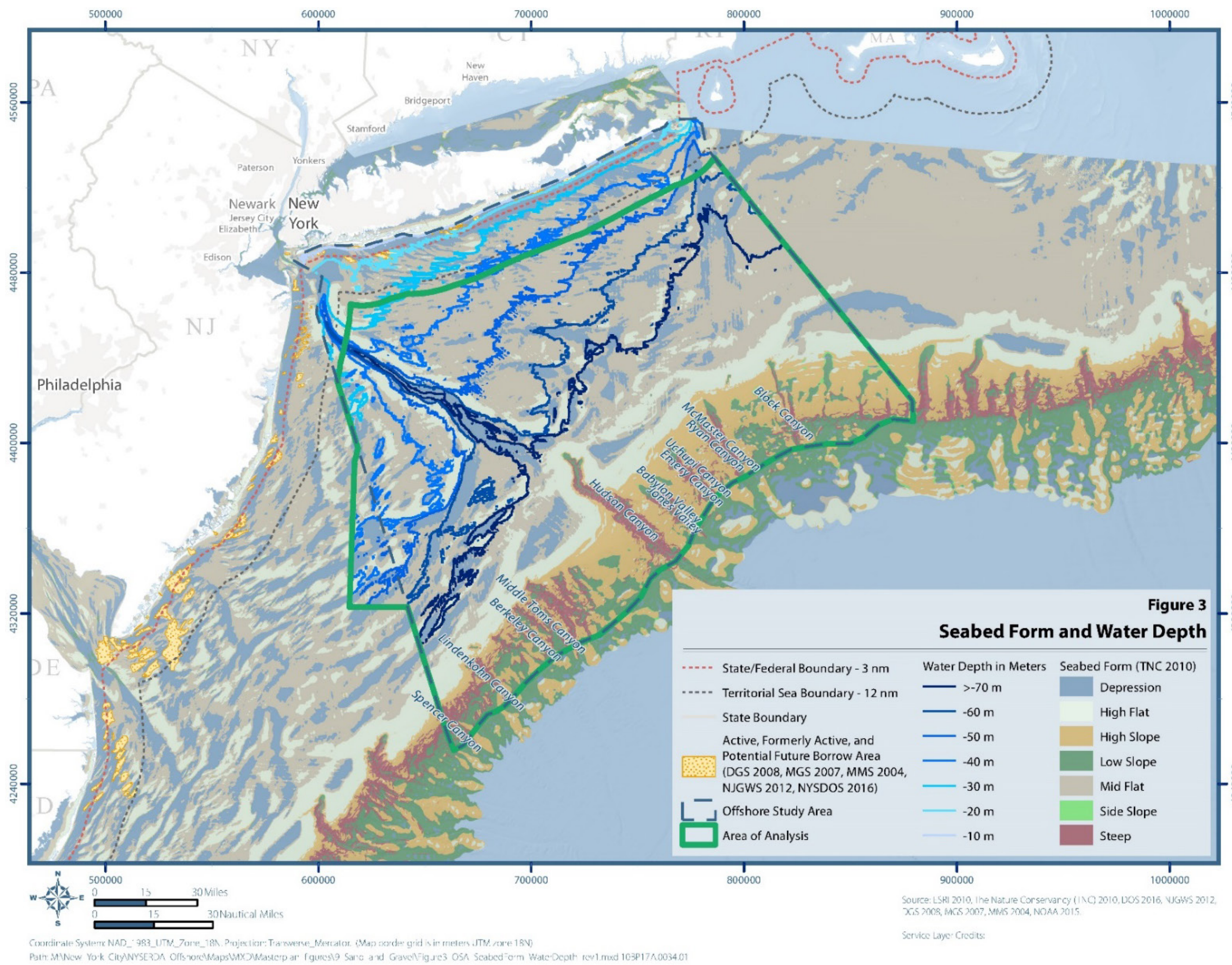
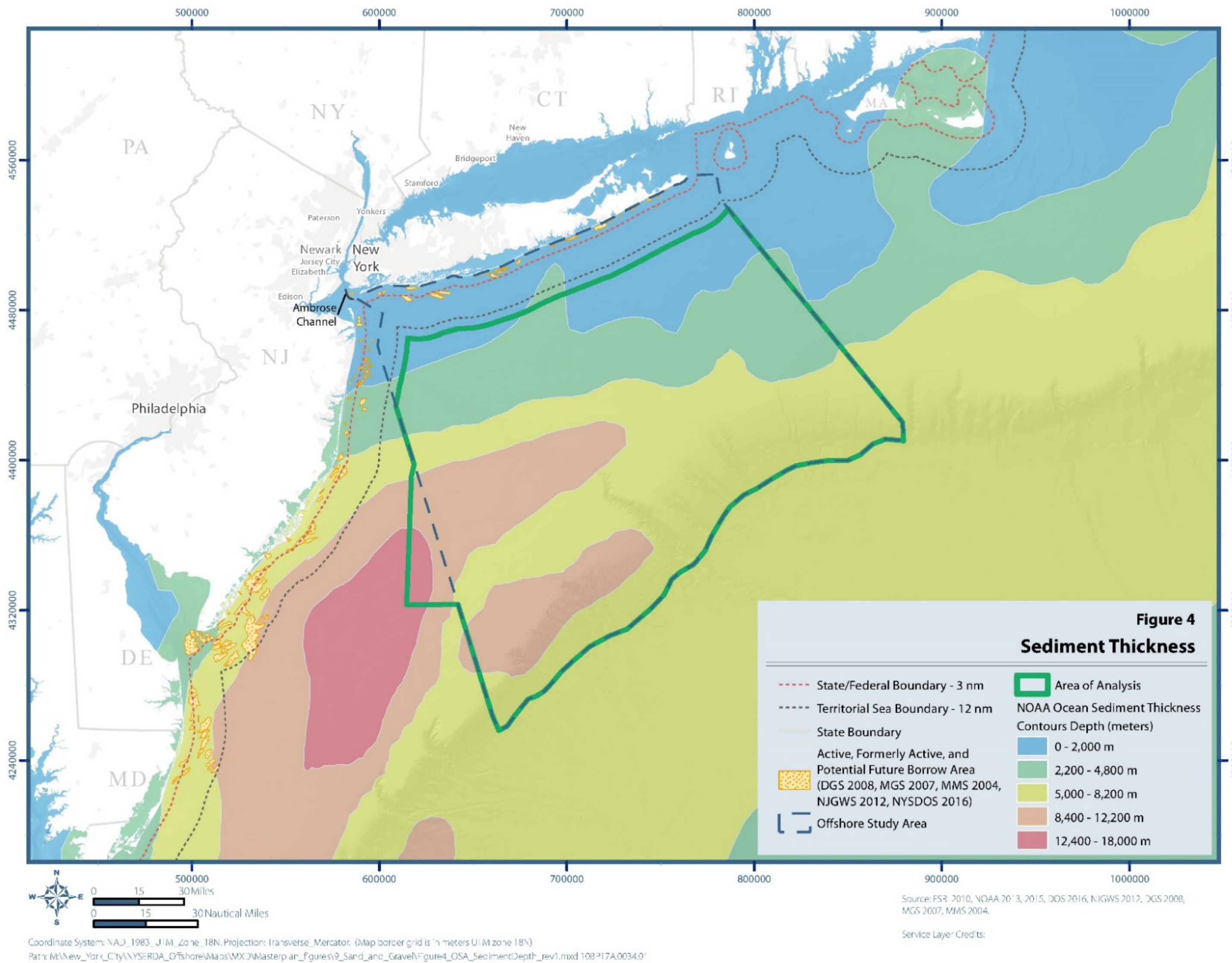


Figure 4. Sediment Thickness

Source: ESRI 2010; NOAA 2013, 2015; DOS 2006; NJGWA 2012; DGS 2006; MGS 2007; MMS 2004



2.2.2.2 Natural Features and Human-Made Obstructions

The AoA includes known natural features and human-made obstructions that could interfere with both sand and gravel mining operations and the development of offshore wind farms and related infrastructure (Figure 5). These natural features and human-made obstructions are discussed below.

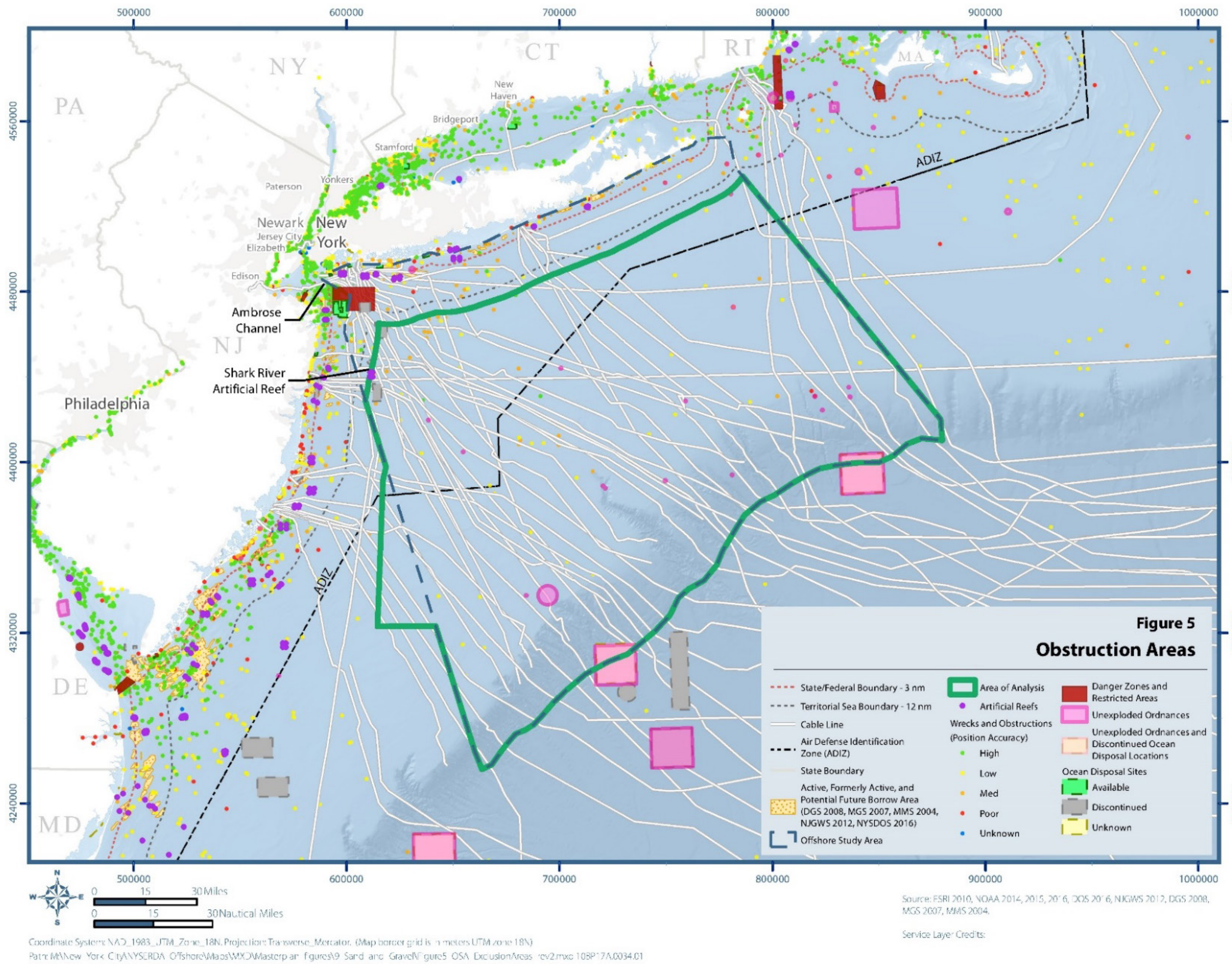
Cable Crossings. Telecommunications cables are the most widespread human-made obstructions to sand and gravel mining throughout the AoA. A large number of cables cross the AoA, making landfall in New York, New Jersey, and Rhode Island (Figure 5). These small-diameter cables have typically been laid on the sea floor when installed and only buried by passive ocean processes, leaving them vulnerable to interaction with equipment that would be deployed during a mining operation. Locating areas devoid of these cables may be a limiting factor for siting future sand and gravel mining locations, though several are no longer operational and could be partially removed following an appropriate historical investigation and approval from the current cable owner(s), if applicable.

Disposal Sites. Various disposal sites for dredging, chemical, or other municipal waste and various unexploded ordnance sites are located within the vicinity of the AoA (Figure 5). Two discontinued disposal sites, two larger discontinued disposal/unexploded ordnance sites, and 18 smaller unexploded ordnance sites are located within the AoA. Ocean disposal sites have historically received material from local dredging activities in ports and harbors and may contain contaminants (EPA 2016). While localized contaminant removal has been a benefit of many dredging operations, much of the dredging is conducted primarily to ensure that adequate depths for vessel transit are maintained in navigation channels, and ocean disposal is often utilized (EPA n.d.).

The two discontinued disposal sites are located in the northwestern portion of the AoA for this Study, near the Ambrose Channel, approximately 20 nm from the nearest mainland point (New Jersey shoreline). The two larger discontinued disposal sites/unexploded ordnance sites are located along the southern border of the AoA, while the 18 smaller unexploded ordnance sites are scattered throughout the western and southeastern portions of the AoA (Figure 5). The presence of these disposal sites may limit the potential for sand and gravel mining operations and restrict certain areas from energy development projects unless further characterization were conducted for these sites to determine whether unsuitable material can be sufficiently screened or avoided during future mining activities or installation of offshore infrastructure.

Figure 5. Obstruction Areas

Source: ESRI 2010; NOAA 2014, 2015, 2016; DOS 2016; NJGWS 2012; DGS 2008; MGS 2007; MMS 2004



Artificial Reefs. One artificial reef site is located in the AoA for this Study, along the northwestern border, approximately 18 nm east of Point Pleasant, New Jersey (Figure 5). This reef, Shark River, is a popular scuba diving location that contains approximately 4 million cubic yards of dredged rock material and encompasses an area of 0.72 square miles (New Jersey Department of Environmental Protection n.d.). The presence of this artificial reef generally precludes sand and gravel mining activities in the area. No other artificial reefs were identified within the AoA.

Shipwrecks. Numerous shipwrecks are scattered throughout the AoA and are detailed in a companion study, *Cultural Resources Study*, which is also appended to the Master Plan. The majority of shipwrecks are located outside of the western edge of the AoA for this Study, where shipping and boating tend to be more common (MARCO 2017). In the AoA, known shipwreck locations are more sparsely distributed throughout the remainder of the area (MARCO 2017). Shipwreck density increases at the western end of the Hudson Canyon, where the sea depth ranges from approximately 56 feet to 148 feet (MARCO 2017) (Figures 3 and 5). The presence of shipwrecks can limit sand and gravel mining, but they do not necessarily preclude nearby mining activities if the wreck site is sufficiently characterized and buffers are employed.

2.2.2.3 Economic Value and Need

According to the United Nations Environmental Programme (UNEP 2014), other than water, sand and gravel are the highest volume of raw material extracted globally, and extraction of this resource greatly exceeds natural renewal rates. The use of sand and gravel in the construction industry is a major contributor to the economic well-being of the United States (Bolen 2013). In the United States in 2014, sand and gravel used for construction is valued at $6.6 billion, with a total of 819 million metric tons produced. The total value of construction sand and gravel increased by 4 percent in 2014 compared with the total value in 2013. The average unit value of sand and gravel increased by 3 percent in 2014 compared with that of 2013. Foreign exports of construction sand and gravel, while totaling 87,000 metric tons and experiencing an increase of 49 percent in 2014 compared to 2013, remained relatively low compared to total consumption of the resource in the United States. Imports of construction sand and gravel also remained relatively low at 4.3 million metric tons (Willett 2017). While the USGS has yet to release 2017 comprehensive survey data on production levels and trade, the USGS estimates the 2017 value of construction sand and gravel at a total of $8.9 billion for the United States, with New York among one of the top seven states producing construction sand and gravel (USGS 2017).

Mining of construction aggregates (i.e., materials used in construction such as sand, gravel, and crushed stone) is a cyclical industry. Production responds to increased or decreased activities in projects such as public infrastructure and commercial/residential construction. As such, construction sand and gravel production experienced a decline in 2006 due to the weakening of the residential construction market. However, the residential construction market has recovered, with recent levels of growth that have driven above-average annual increases in demand for construction aggregates (Willett 2017). While construction material market trends can be an indicator of future demand for offshore sand and gravel resources, predicting that future demand is difficult and subject to several variables. Other economic factors, political drivers, environmental considerations, domestic supply, and international demand and supply are all variables influencing the demand of offshore sand and gravel resources (Garel et al. 2009).

While sand and gravel mined offshore is used primarily for construction material, the use of sand and gravel in beach nourishment and coastal development projects has become more common in recent decades, and is predicted to grow (Garel et al. 2009; ASBPA 2006). Additionally, the occurrence of damaging hurricanes and storms has increased the erosion of coastlines of the United States (Holland 2012). As a result of these threats, human intervention increasingly has been required to mitigate impacts along the coasts of the United States. While the most common sources of sand and gravel for beach nourishment projects occur close to the coast, the depletion of the nearest offshore sources and the potential increase in future demand for these resources will encourage the continued exploration of mining sites and likely increase the number of sand and gravel mining sites farther offshore, including areas of the OCS. For instance, BOEM authorized the use of sand resources on the OCS for beach nourishment in Florida in an effort to reduce erosion and protect against future storms. Even though the AoA is generally in deeper waters than those where current sand and gravel mining operations occur, subsea conditions, as well as advances in the technical feasibility of mining in deeper waters, indicate that sand and gravel mining may be feasible farther offshore in the future (Garel et al. 2009; BOEM 2017b). Therefore, sand and gravel mining in the AoA could have greater economic value in the future than it does today.

From 2000 to 2016, New York State used nearly 35 million cubic yards of sand for 15 beach nourishment projects, at a total cost of nearly $325 million. Similarly, from 2000 to 2015, New Jersey used approximately 59 million cubic yards of sand for 13 beach nourishment projects, at a total cost of over $629 million (ASBPA 2017; Table 1). Many of the East Coast states have required significant volumes of sand for beach nourishment projects in the past, and this demand is likely to increase in the future (Garel et al. 2009). As nearshore sand sources for beach nourishment projects become depleted, and demand for construction aggregates continues, the increasing distance of the nearest offshore sand sources will likely contribute to rising costs for obtaining the material. Rising material costs, in turn, are likely to increase development pressure for sources of sand located further from shore.

Although sand and gravel mining in the AoA could have higher economic value in the future, the overall economic viability of offshore mining within any portion of the AoA is currently low. This low economic viability is due to physical constraints, such as the abundance of human-made seafloor obstructions, and the relatively high costs associated with mining sand and gravel in deep water and transporting the material long distances to shore compared to currently available onshore and nearshore alternatives.

Table 1. Beach Nourishment Projects (2000–2016)

Source: ASBPA 2017.

State and Project	Range (years)	Volume[a] (cubic yards)	Cost[b] (dollars)
New York			
Bridgehampton/Sagaponack	2013	2,500,000	$25,000,000
Coney Island	2001–2014	794,000	$33,447,835
Fire Island	2004–2009	3,079,277	Not available
Jones Beach	2000–2014	6,530,957	$59,009,441
Moriches Inlet	2004–2013	450,250	$4,076,275
Orchard Beach	2011	254,200	$12,000,000
Plumb Beach	2012	100,000	Not available
Point Lookout/Jones Inlet	2008–2014	1,291,095	$15,612,237
Robert Moses	2002–2014	769,807	$20,089,475
Rockaway Beach	2001–2016	8,018,094	$74,750,276
Shinnecock Inlet	2005–2014	1,360,000	$24,581,507
Smith Point County Park	2009–2016	1,660,000	$15,000,000
Southampton	2014	2,627,000	Not available
Tiana Beach	2013	124,000	Not available
Westhampton Beach	2001–2014	5,218,927	$41,311,780
New York Total	**2000–2016**	**34,777,607**	**$324,878,826**

Table notes are on the next page.

Table 1 continued

State and Project	Range (years)	Volume[a] (cubic yards)	Cost[b] (dollars)
New Jersey			
Asbury Park/Manasquan Federal Coastal Storm Damage Reduction Project	2003	1,200,000	$15,689,946
Atlantic City	2004–2012	7,250,000	$68,756,612
Atlantic Highlands	2002	22,000	Not available
Avalon	2001–2011	5,426,000	$23,905,405
Brigantine	2001–2014	4,032,000	$45,514,761
Cape May	2001–2013	4,592,000	$45,628,371
Keansburg	2014	1,136,000	Not available
Long Beach Island	2007–2012	6,551,363	$67,685,207
Ocean City	2000–2015	7,151,000	$41,074,000
Sea Bright/Ocean Township	2002–2013	16,211,230	$249,041,776
Sea Isle City	2001	461,000	Not available
Shark River Inlet	2006	168,670	$4,194,453
Strathmere/Beesleys Point	2015	4,700,000	$67,845,356
New Jersey Total	**2000–2015**	**58,901,263**	**$629,335,888**
Total	**2000–2016**	**93,678,870**	**$954,214,714**

[a] Volume is aggregated across projects over the given timeframe.

[b] Cost is aggregated across projects over the given timeframe. Cost is unreported in some circumstances, thus direct comparisons between cost and volume should not be inferred from Table 1.

2.2.2.4 Summary

While sand and gravel mining does not currently occur in the AoA for this Study, there are several active, formerly active, or potential future borrow areas off the coasts of New York and New Jersey. Most are well outside of the AoA and extend along the New Jersey and New York coasts. However, due to the nature and extent of sand and gravel deposits across the entire sea bottom of the AoA for this Study, the area is potentially attractive for future mining development except in areas of deep water and canyons (i.e., a 20- to 30-nm-wide area along the eastern edge of the AoA for this Study).

3 Potential Sensitivity and Risk

Although the AoA contains large amounts of potentially minable sand and gravel, the AoA has no known active or formerly active sand and gravel mining operations or mining leases. Since the AoA is large enough to accommodate both future wind energy development and future mining development, these activities could be sited to avoid conflicts with each other through the cooperative ocean planning efforts between BOEM, USACE, and DOS. For example, coordinated planning efforts could prevent future wind turbines, transmission lines, and onshore substations from being sited in close proximity to nearshore active or potential sand and gravel mining sites.

Offshore sand and gravel mining in the U.S. is generally performed using a hopper (trailer suction) or cutterhead (pipeline) dredge, both of which use hydraulic pumps to draw up ocean floor material (Michel et al. 2013; USACE 2015). Hopper dredging involves pulling a draghead connected to suction pipes along the seafloor, which can create linear furrows in the seafloor up to 4 meters wide and up to 0.5 meter deep (Garel et al. 2009; Michel et al. 2013). Repeated passes in the same area can lead to large dredged depressions in the seafloor. Hopper dredges may either retain all dredged material on the vessel for nearshore placement or onshore processing, or immediately process sediment using onboard equipment and discharge unwanted water and material at the dredge site. Cutterhead dredging uses a rotating cutter apparatus surrounding the intake end of a suction pipe to loosen material and transport it in a slurry through a pipeline to a barge or a designated placement site (USACE 2015). The cutterhead is swept in front of the vessel, which is pulled forward using anchors. Cutterhead dredging is typically limited to water depths of 65 feet, while hopper dredging may occur at depths up to 140 feet (USACE 2015).

The alteration of the environment due to dredging can lead to environmental impacts, such as changes in sea floor topography and creation of turbidity plumes (Greene 2002; Garel et al. 2009; Michel et al. 2013). Total cut depths can exceed 10 meters (Michel et al. 2013). These depressions may take from one year to several decades to naturally fill in (Greene 2002; NOAA 2008; Michel et al. 2013). In some cases, scour can occur in these depressions, causing the original excavations to enlarge rather than fill in. Whether the excavations refill or are further scoured is dependent upon tides, currents, and sediment characteristics. If the borrow areas do not fill in with the same materials, their physical and chemical characteristics after mining may be different from the conditions prior to mining and different from surrounding areas (Greene 2002; NOAA 2008). These alterations to the bottom topography also can cause changes in current strengths and can alter wave and tidal patterns (Greene 2002; NOAA 2008;

Garel et al. 2009). In addition, offshore mining may cause chemical instability in surrounding sediments. Chemical instabilities may include the release of contaminants bound up in the sediments or the release of organic matter, which can settle in depressions and cause anoxic (oxygen-deprived) conditions, resulting in loss of habitat for marine organisms (NOAA 2008).

Aside from the environmental sensitivities of sand and gravel mining, many other risks determine desirability when prospecting for mining sites. As part of the prospecting process, assessing desirable offshore mining locations within the AoA requires coordination with proper state and federal agencies prior to initiating any dredging activities to ensure all regulatory requirements are met. Finer-scale grain-size analysis and bathymetric assessments of the AoA would be required to accurately identify areas of desirable grain size and geomorphic features that fit the specific needs of the future project for which the resource is being excavated (Garel et al. 2009). Additionally, economic factors will contribute to the siting of future offshore mining locations. For instance, cost is influenced by the size of a project, distance from shore, depth of water, exposure of borrow area to open ocean conditions, seasonal restrictions, characteristics of excavated material, sediment thickness, and potential to reduce costs by combining dredging activities with other work in the area (Byrnes et al. 2000).

Based on the aforementioned factors, each potential future mining site would typically be identified after a cost-benefit analysis is undertaken. In general, the farther offshore a mining operation occurs and the greater the depth, the greater the cost of the operation (Byrnes et al. 2000). As such, from the perspective of a cost-benefit analysis, potential future mining sites closer to shore generally would be expected to be more economically feasible for use relative to those farther offshore and/or in deeper waters.

Development of offshore wind farms could present risks to sand and gravel mining by precluding sand and gravel mining in areas developed for offshore wind farms, including ancillary facilities. In addition, future offshore wind infrastructure development could interfere with current or proposed sand and gravel mining activities by the installation, operation, and/or decommissioning of offshore wind turbines, array cables, and export cables. Active and potential future borrow areas nearshore could be affected by construction activities and development of onshore substations. Additionally, the associated installation methods for interconnection, such as laying, directional drilling, or trenching for transmission, could impact nearshore sand and gravel resources (Environmental Law Institute 2013).

4 Guidelines and Best Management Practices

This section provides general guidelines and BMPs that future developers of offshore wind farms should be cognizant of for managing potential risks between offshore wind development and sand and gravel mining. While no specific guidelines or BMPs exist with respect to potential interactions between sand and gravel mining activities and offshore wind development, the following BMPs and guidelines for offshore mining include agency coordination and assessment of marine resources to reduce potential environmental impacts and ensure that potential interactions are approached appropriately and thoughtfully. These BMPs and guidelines are similar to those that have been developed for offshore wind energy developers. In addition, new guidance, technologies, or regulations also may arise after publication of this Study. For example, in 2016, the DOS entered into a Cooperative Agreement with BOEM and a Memorandum of Agreement with the State University of New York to "develop management strategies for offshore sand resources that will preserve the ecological function of offshore systems while helping to achieve resilience for coastal communities" (BOEM 2016b). Developers should consult federal and state agency contacts for up-to-date regulatory recommendations and requirements.

According to the MOU between BOEM and USACE (BOEM and USACE 2017), if mining operations of sand, gravel, and shell resources from the OCS are to occur when USACE is involved in the construction or regulatory permit review, then coordination with BOEM and USACE will be required early in the NEPA process. The purpose of the MOU is to establish a framework for coordination and consistency regarding environmental compliance, project scheduling, and requirements of negotiated lease agreements. While being inclusive of applicants and stakeholders, these guidelines state that agencies will:

- Work together on processes when BOEM coordination is needed or cooperative environmental documents are required.
- Identify and resolve issues.
- Provide environmental and technical review of requests for use of OCS sand and gravel resources.
- Streamline the overall environmental review and consultation processes through regional partnership.
- Develop mitigation strategies and ensure environmental compliance, including post-construction monitoring and reporting requirements.
- Share pertinent, non-sensitive geological, geographical, and environmental data.
- Identify partnership and leveraging opportunities to fill critical data gaps, supplement scientific research, and inform resource management decisions (BOEM and USACE 2017).

According to NOAA (2008), the following conservation measures and BMPs are recommended if offshore mining operations are to occur:

- Assess the area for indicators of sensitive or unique marine and benthic habitats. Avoid areas displaying such indicators.
- Conduct a full characterization of the potential mining site before permit completion. Thorough assessments include prioritizing low-impact locations for mining; determining optimum dimensions of the mining site; assessing infill rates of the site after mining is completed; assessing seabed stability of the mining site in terms of sediment migration patterns and slope; and assessing noise impacts from mining operations on marine mammals and finfish. Additionally, thorough assessments include determining the effect of dredging on the surrounding habitat and estimating the effect of extensive or long-term mining on the shoreface, sand budgets, and surrounding seabed, including effects on the ecological structure of the seabed.
- Use appropriate analyses to determine the proper extraction parameters and depth for accelerated and/or complete recovery and recolonization.
- Use appropriate modeling, such as sediment dispersion models, to inform the design of mining operations based on the characterization of sediment resuspension and dispersion. Use model outputs to limit the impacts of suspended sediment and turbidity on fisheries.
- Consider the cumulative impacts of past, present, and reasonably foreseeable development activities on habitats.
- Abide by seasonal restrictions, if applicable, to avoid temporary impacts on habitat during critical life history stages of species.

Many of these same measures and practices would be raised during the NEPA process for any offshore wind development project that is proposed in the future. Since BOEM, USACE, and interested stakeholders coordinate closely regarding sand and gravel leases, consultations with these agencies regarding sand and gravel can serve as an informative resource for future offshore wind developers when considering potential interactions with sand and gravel mining activities and mitigation strategies. Future offshore wind developers also should coordinate with the DOS, which is involved in sand and gravel research through a cooperative agreement with BOEM, to navigate concerns related to siting. Additionally, offshore wind developers should take into consideration the BMPs set forth by NOAA in order to appropriately consider the sensitivities and risks to sand and gravel resources from development activities, thus allowing them to minimize or avoid any potential impacts on sand and gravel resources during future construction and operation of offshore wind farms.

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