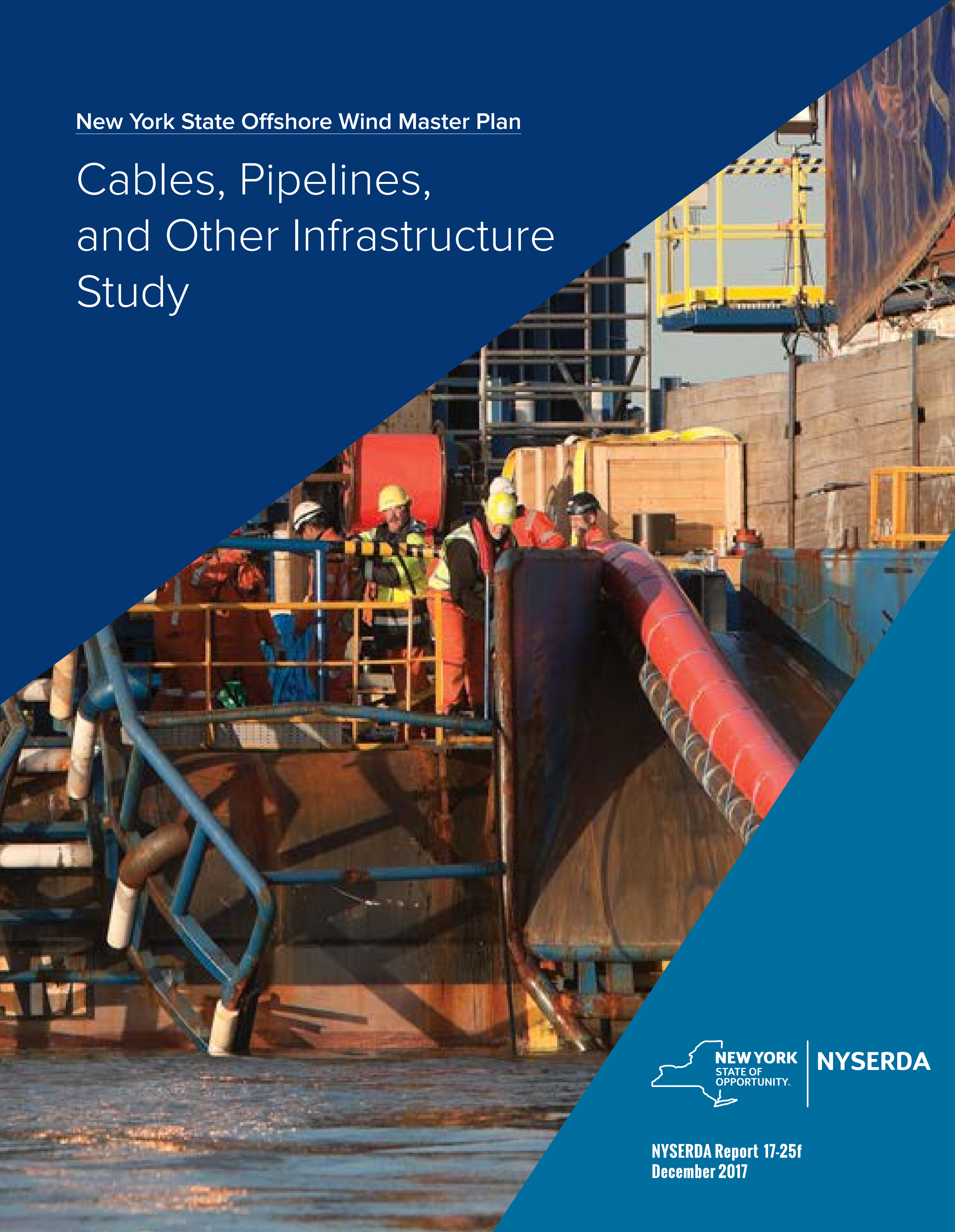
New York State Offshore Wind Master Plan

Cables, Pipelines, and Other Infrastructure Study



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NYSERDA Report 17-25f
December 2017

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Serve as a catalyst – advancing energy innovation, technology, and investment; transforming New York's economy; and empowering people to choose clean and efficient energy as part of their everyday lives.

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New York State Offshore Wind Master Plan

Cables, Pipelines, and Other Infrastructure

Final Report

Prepared for:

New York State Energy Research and Development Authority

Prepared by:

The Renewables Consulting Group, LLC

New York, New York

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Notice

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Acronyms and Abbreviations

AIS	Automatic Identification System
ALARP	As Low as Reasonably Possible
BOEM	Bureau of Ocean Energy Management
GIS	Geographical Information System
ICPC	International Cable Protection Committee
m	meters
Master Plan	New York State Offshore Wind Master Plan
MW	megawatts
NASCA	North American Submarine Cable Association
nm	nautical miles
NOAA	National Oceanic and Atmospheric Administration
OCS	Outer Continental Shelf
OCSLA	Outer Continental Shelf Lands Act
OSA	Offshore Study Area
OSW	Offshore Wind
NYSERDA	New York State Energy Research and Development Authority
Study	Cables, Pipelines, and Other Infrastructure study
RCG	The Renewables Consulting Group LLC
USCG	U.S. Coast Guard
WEA	Wind Energy Area

Executive Summary

This Cables, Pipelines, and Other Infrastructure Study (Study) provides an overview of the submarine cables, gas pipelines, and other infrastructure (collectively referred to as "infrastructure") located within and around the New York offshore study area, and describes how future offshore wind farm developers could approach potential interactions with this infrastructure. It also provides an overview of the potential interactions between other users of the Study's Area of Analysis and the submarine cables and cable protection systems that may be installed as part of offshore wind projects.

This Study refers to publicly available reference documents about submarine cable installations from national and international organizations such as the U.S. Department of Interior, The Crown Estate in the United Kingdom, the European Subsea Cable Association, and the International Cable Protection Committee. The guidance provided by these organizations is based in part on the experiences of European wind farm developments, a key takeaway of which is that early dialogue with infrastructure owners and operators and other users of offshore areas within 1 nautical mile of offshore wind project assets is likely to reduce many of the risks and challenges that projects face with respect to pre-existing infrastructure.

This Study also contains a reference table to aid developers as they consider courses of action for dealing with the distinct types of infrastructure present. Before proceeding with wind projects in the AoA, developers should perform risk assessments to determine the site-specific requirements for crossings and other interactions with existing infrastructure.

1 Introduction

1.1 Introduction

This Cables, Pipelines, and Other Infrastructure 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 in its two-year Offshore Atlantic Ocean Study (DOS 2013). This study area, referred to as the “offshore study area,” 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 (m) (Figure 1). The offshore study area 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 shown below in Figure 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 (WEAs) 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 energy development. The Master Plan identifies the potential future WEAs 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 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 nongovernmental 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 energy 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.

1.2 Background

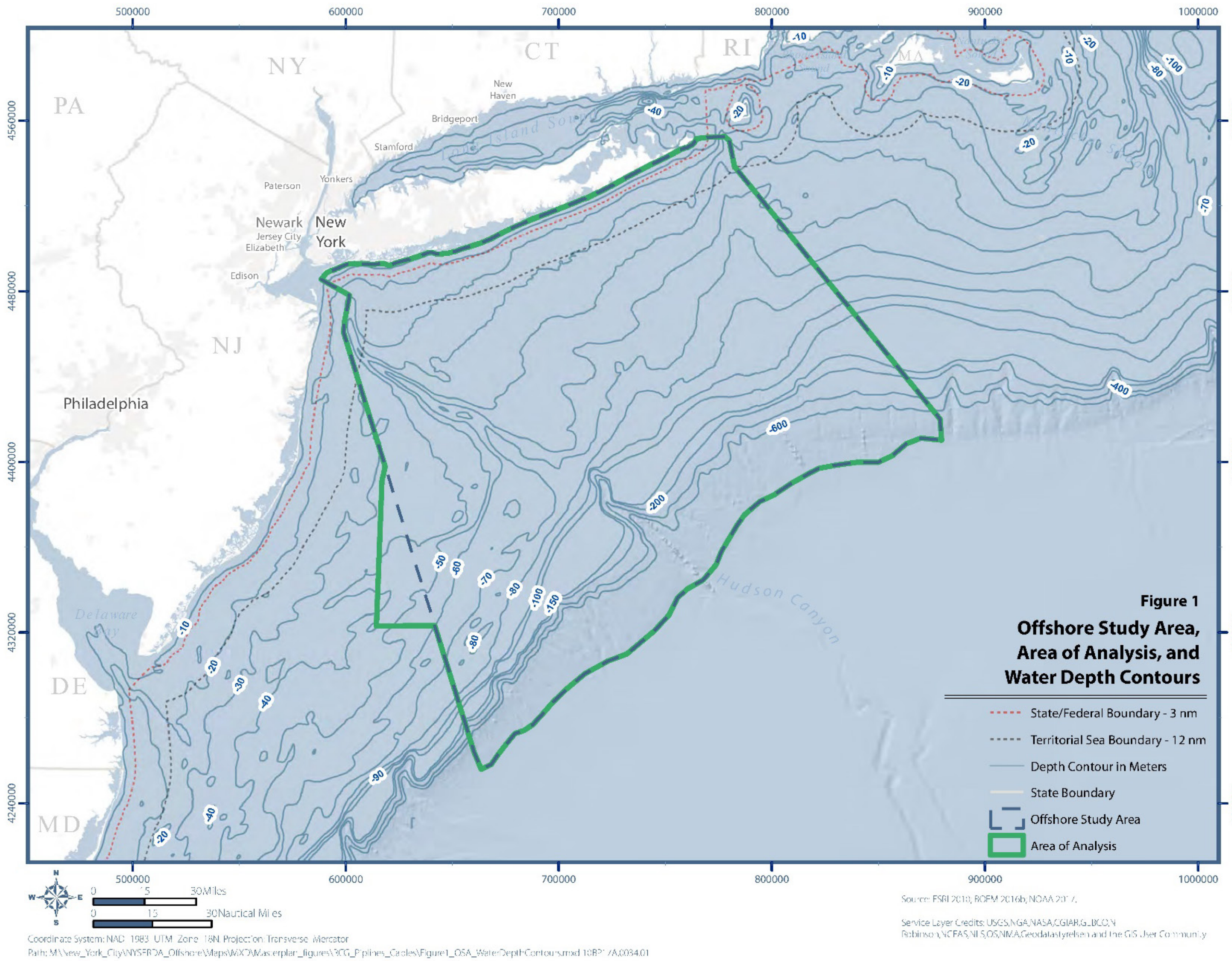
The presence of existing infrastructure can present potential constraints to the future development of offshore wind farms (OSWs). These constraints include limitations on the available locations for potential OSW components due to the physical presence of infrastructure and the need for safety or exclusion zones to provide protection against potential damage.

Damage to existing infrastructure could occur during wind farm construction and maintenance activities such as foundation installation, seabed preparation, array and export cable installation, cable and pipeline crossings, and construction vessel anchoring and jack-up.

Because damage to existing infrastructure (or future wind farm components) could have serious financial and other consequences, these physical constraints must be identified and analyzed early in the OSW planning and development process to ensure that projects are sited appropriately, and risks managed.

Figure 1. Offshore Study Area, Area of Analysis, and Water Depth Contours

Source: ESRI 2010; BOEM 2016b; NOAA 2017



1.3 Study Overview and Objectives

The objectives of this Study are to provide an overview of the existing infrastructure within the AoA, identify potential constraints to development, and suggest some options for managing potential interactions between wind farm projects and existing infrastructure.

The purpose of early identification of infrastructure is to ensure that potential developers are aware of the constraints to development and can address them, in order to

- Achieve acceptable risk levels for electric system reliability.
- Safeguard electric system supply.
- Reach desired cost efficiencies.
- Manage interactions and conflicts with other seabed users (ESCA 2016).

As part of this Study, relevant literature, best practice guidance, and potentially applicable regulations were reviewed, and various infrastructure owners, operators, and trade associations consulted, to develop the guidance and recommendations for future development contained herein.

2 Existing Infrastructure

2.1 Overview

Data gathered from the Marine Cadastre, the National Oceanic and Atmospheric Administration (NOAA), and the North American Submarine Cable Association (NASCA) were formatted into a geographical information system (GIS) model to produce a series of maps characterizing the AoA. Information on other seabed users that may impact where and how OSW cables can be installed was also collected, mapped, and analyzed to develop a comprehensive view of the potential infrastructure constraints to OSW development within the AoA.

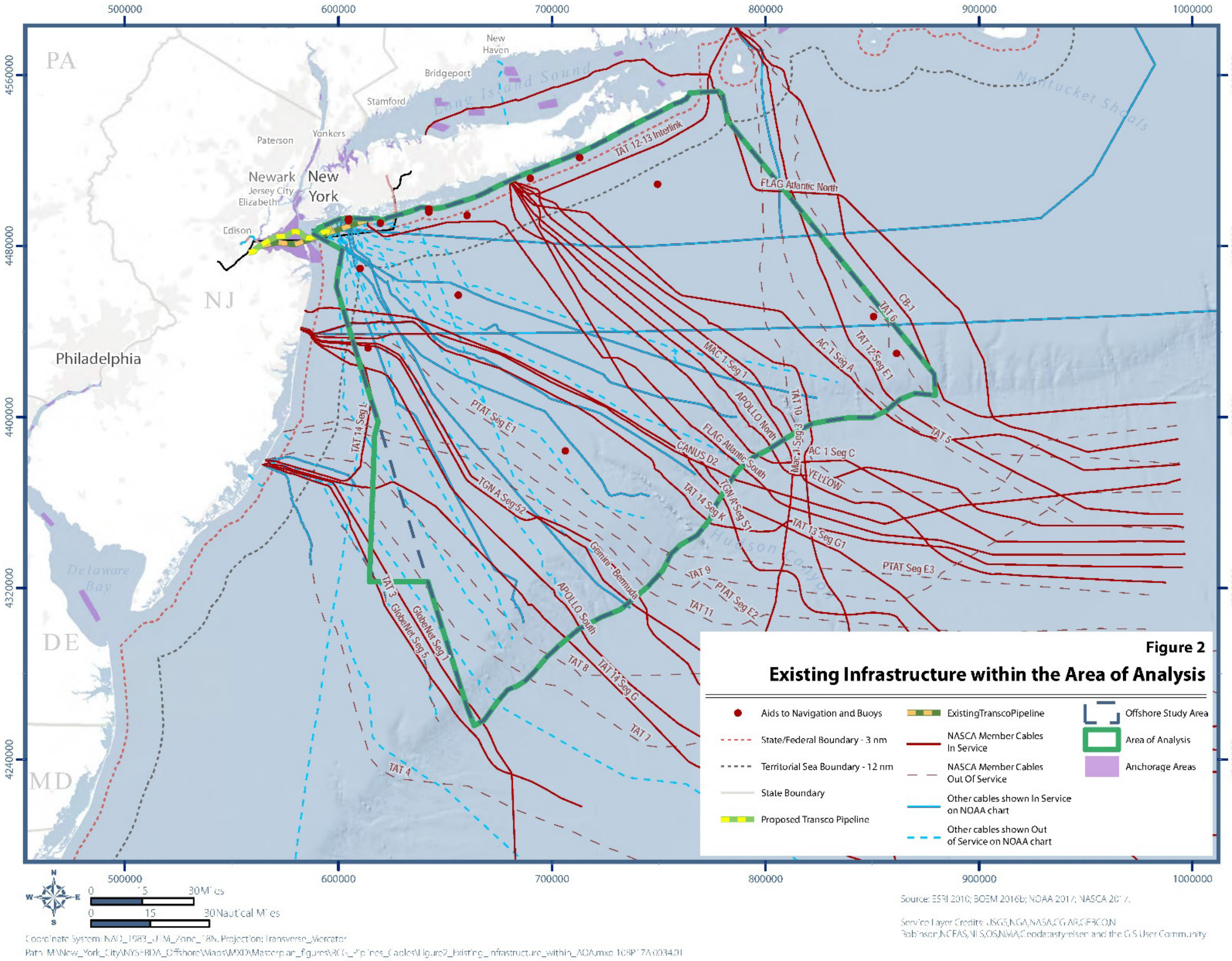
The following types of infrastructure have been identified within the AoA (Figure 2):

- Submarine cables
  - Telecommunication cables
  - Power cables
- Gas pipelines
- Buoys
- Waste water treatment outfalls
- Artificial reefs

In the planning and siting of OSWs, infrastructure located within the vicinity of individual project sites should be considered, as well as infrastructure located along potential export cable routes to shore. Certain infrastructure types such as existing cables and pipelines can be avoided by selecting the least congested offshore areas for development, while other infrastructure types such as buoys can be accommodated by micro-siting—i.e., moving individual turbine locations out of the way—or by moving buoys to new locations. To some degree, all infrastructure types can be accommodated by micro-siting, so the presence of existing infrastructure within a potential OSW site should not prohibit development, but may constrain it somewhat or contribute to extra costs that the project would not face if located in an unconstrained area.

Figure 2. Existing Infrastructure within the Area of Analysis

Source: ESRI 2010; BOEM 2016b; NOAA 2017; NASCA 2017



See Appendix A for detailed inset maps associated with this figure.

2.2 Submarine Cables

Figure 3 provides a list of cables that have been identified within the AoA. Information was gathered with assistance from NASCA, and where possible, the cable system name, type, and operational status was identified. Out-of-service cables are included in this list, as these also require consideration in OSW planning and development, as discussed in Section 1.2.

Table 1. List of Cables Identified within the AoA.

Cable System	NASCA Member	Active?	Type of Cable
PTAT Seg E3	Yes	No	Telecommunications
Unknown	No	Yes	Telecommunications
Unknown	No	Yes	Telecommunications
AC 1 Seg C	Yes	Yes	Telecommunications
Unknown	No	Yes	Telecommunications
TAT 12-13 Interlink	Yes	Yes	Telecommunications
Unknown	No	No	Telecommunications
Unknown	No	No	Telecommunications
Unknown	No	Unknown	Telecommunications
Unknown	No	No	Telecommunications
TAT 6	Yes	No	Telecommunications
Unknown	No	No	Telecommunications
APOLLO South	Yes	Yes	Telecommunications
FLAG Atlantic north	Yes	Yes	Telecommunications
TAT 4	Yes	No	Telecommunications
TAT 5	Yes	No	Telecommunications
APOLLO north	Yes	Yes	Telecommunications
Unknown	No	No	Telecommunications
GlobeNet Seg 1	Yes	Yes	Telecommunications
Unknown	No	Yes	Telecommunications
Unknown	No	No	Telecommunications
FLAG Atlantic South	Yes	Yes	Telecommunications
Unknown	No	No	Telecommunications
Unknown	No	Yes	Telecommunications
Unknown	No	No	Telecommunications
CB-1	Yes	Yes	Telecommunications
Unknown	No	Yes	Telecommunications
Unknown	No	No	Telecommunications
TAT 11	Yes	No	Telecommunications
Unknown	No	Yes	Telecommunications
Unknown	No	No	Telecommunications

Table 1 continued

Cable System	NASCA Member	Active?	Type of Cable
Unknown	No	No	Telecommunications
Unknown	No	Unknown	Telecommunications
TAT 12 Seg E1	Yes	Yes	Telecommunications
Unknown	No	Yes	Telecommunications
TAT 14 Seg L	Yes	Yes	Telecommunications
Gemini – Bermuda	Yes	Yes	Telecommunications
TAT 13 Seg G1	Yes	Yes	Telecommunications
Neptune project	No	Yes	Power
Unknown	No	No	Telecommunications
TAT 8	Yes	No	Telecommunications
Unknown	No	No	Telecommunications
Unknown	No	No	Telecommunications
Unknown	No	Unknown	Telecommunications
TAT 7	Yes	No	Telecommunications
Unknown	No	No	Telecommunications
Unknown	No	Unknown	Unknown
TGN A Seg S1	Yes	Yes	Telecommunications
Unknown	No	Yes	Telecommunications
AC 1 Seg A	Yes	Yes	Telecommunications
TGN A Seg 52	Yes	Yes	Telecommunications
Unknown	No	Yes	Telecommunications
Unknown	No	Yes	Telecommunications
YELLOW	Yes	Yes	Telecommunications
Unknown	No	Unknown	Telecommunications
Unknown	No	No	Telecommunications
Unknown	No	Yes	Telecommunications
TAT 10	Yes	No	Telecommunications
Unknown	No	No	Telecommunications
Unknown	No	No	Telecommunications
TAT 9	Yes	No	Telecommunications
TAT 14 Seg K	Yes	Yes	Telecommunications
CANUS D2	Yes	Yes	Telecommunications
Unknown	No	Yes	Telecommunications
Unknown	No	No	Telecommunications
Unknown	No	No	Telecommunications
Unknown	No	Yes	Telecommunications
Unknown	No	Yes	Telecommunications
Unknown	No	Unknown	Telecommunications
TAT 14 Seg G	Yes	Yes	Telecommunications
Unknown	No	Unknown	Telecommunications
Unknown	No	Yes	Telecommunications

Table 1 continued

Cable System	NASCA Member	Active?	Type of Cable
GlobeNet Seg 5	Yes	Yes	Unknown
TAT 3	Yes	No	Unknown
MAC 1 Seg 1	Yes	Yes	Unknown
MAC 1 Seg 3	Yes	Yes	Unknown
PTAT Seg E1	Yes	No	Telecommunications
PTAT Seg E2	Yes	No	Unknown
Unknown	No	No	Telecommunications

2.2.1 Telecommunications Cables

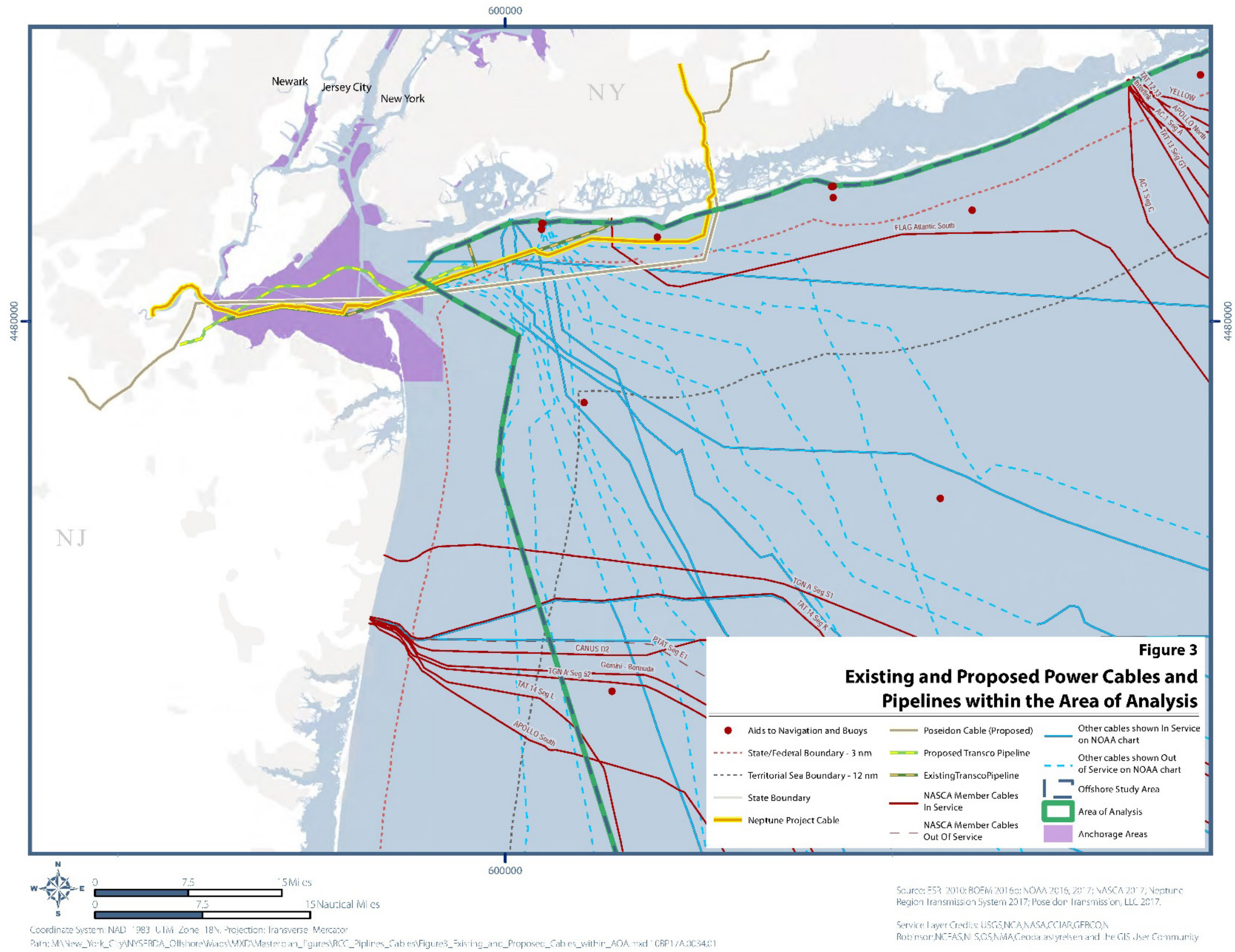
The AoA is traversed by several telecommunications cables, with some areas more congested than others (see Figure 2). Due to the prevalence of telecommunications cables, future OSW export cables will almost certainly require crossings to connect to the grid. Given the size of the AoA, wind farms may be able to avoid or minimize interactions between array cables and existing telecommunications cables, depending on where they are located. Some of the telecommunications cables identified are out of service and may be able to be removed or easily crossed. Telecommunications cables may be armored and buried when located closer to shore where the risk of damage is greater, and surface laid and relatively unprotected when further offshore. The individual designs and burial depths of existing telecommunications cables are not considered at this early point in the planning process but should be confirmed once individual project locations and potential array cable layouts and export cable routes have been identified. Currents and sand waves may have slightly moved, buried, or exposed some of these cables, so surveys of existing cables may be appropriate where crossings are needed for certain OSW developments.

2.2.2 Power Cables

The Neptune Project cable is the only power cable that has been identified within the AoA. This cable is a 65-mile high voltage direct current transmission line that supplies 660 MW of electricity from Sayreville, NJ, to Levittown on Long Island, NY, and is considered key infrastructure for energy supply on Long Island. The direct current cable consists of three cables: a high voltage cable, a medium voltage return cable, and a fiber-optic cable for system control and communications.
These cables are bundled and buried approximately four to six feet below the river and seabed along the 50-mile submarine portion of the cable route (Neptune 2017).

Figure 3. Existing and Proposed Power Cables and Pipelines within the Area of Analysis

Source: ESRI 2010; BOEM 2016b; NOAA 2016, 2017; NASCA 2017; Neptune Regional Transmission System 2017; Poseidon Transmission LLC 2017



Export cables from potential OSWs that would make landfall between Jones Beach, Long Island, and Sayreville, NJ, would likely interact with this transmission cable.

Since currents and sand waves may have relocated, buried, or revealed some portions of the Neptune Project cable, a cable survey may be needed for any potential crossings being considered in the vicinity of this project.

Another power cable project has been proposed for development in the AoA. The Poseidon Project would be a 78-mile underground/submarine high voltage direct current electric transmission line that would import up to 500 MW of power from the Pennsylvania-New Jersey-Maryland Interconnection into Long Island, as shown in Figure 3. The Poseidon Project filed an application for a Certificate of Environmental Compatibility and Public Need (also known as an "Article VII certificate") with the New York State Public Service Commission in 2013.

2.3 Gas Pipelines

The Williams Transco pipeline is located in the nearshore waters between New Jersey and New York and consists of two sections, the Rockaway Delivery Lateral (26-inch diameter) and the Lower New York Bay Lateral (26-inch diameter), as shown in Figure 3. These pipelines supply a significant amount of natural gas to New York (Williams Transco 2013).

The Northeast Supply Enhancement Project, otherwise known as the Raritan Bay loop, is a proposed 23.4-mile offshore extension of 22-inch-diameter pipeline also shown in Figure 3 (Williams Transco 2017). This project is currently in the permitting phase and is expected to begin construction in summer 2018 and be operational prior to the construction of any OSWs in the AoA.

Export cables from potential OSWs that would make landfall between Rockaway Beach, Long Island, and Middlesex County, NJ, would likely interact with the Lower New York Bay Lateral and potentially cross two pipelines if the Northeast Supply Enhancement Project is completed prior to wind farm construction.

2.4 Buoys

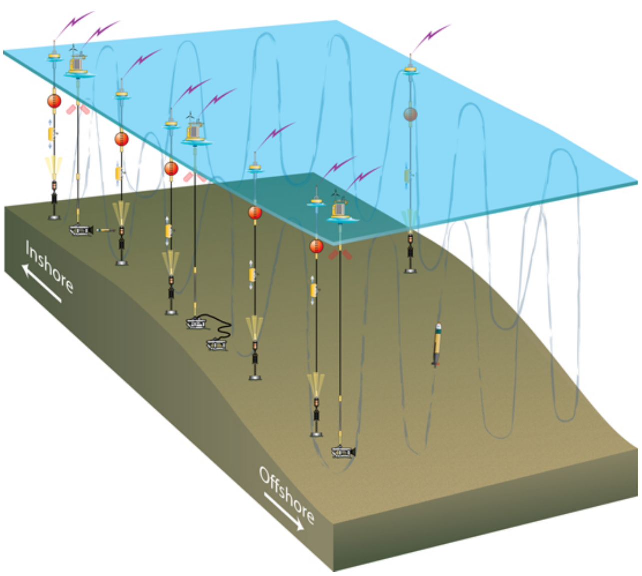
There are 20 buoys within the AoA that measure a range of oceanographic parameters or serve as aids to navigation, marking navigation channels and shipping lane approaches. Figures 4 and 5 show the types of buoys present within the AoA.

Figure 4. Station 44065 NOAA Data Lighted Buoy (Location 11 in Figure 6)

Source: National Data Buoy Center 2017

Figure 5. Woods Hole Institute Pioneer Array (Locations 17–20 in Figure 6)

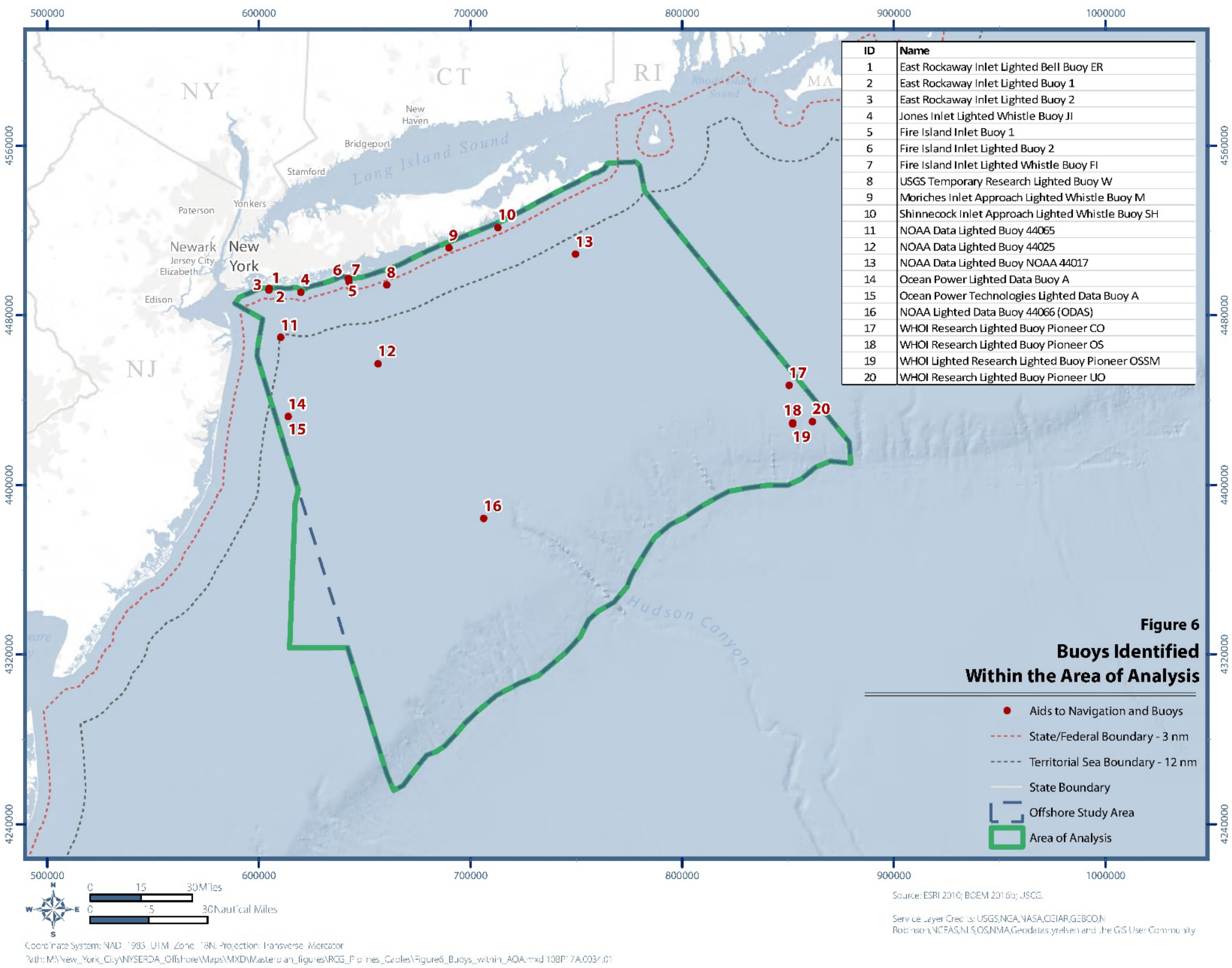
Source: Woods Hole Institute 2017



Buoys do not pose a significant constraint to development since OSW sites can be located to avoid or co-exist with existing buoys. Once OSW sites have been identified, the owners and operators of nearby buoys should be consulted. Furthermore, some of the buoys may be temporary and may have been removed prior to the construction of any offshore wind projects, as in the case of location 8 shown in Figure 6.

Figure 6. Buoys Identified Within the Area of Analysis

Source: ESRI 2010; BOEM 2016b; USCG



The U.S. Coast Guard (USCG) has indicated that moving navigation buoys may be possible prior to or during construction, provided that the developer has issued adequate notice to the USCG and both parties have a mutually agreeable plan in place for the temporary movement and subsequent reinstatement of the buoy.

2.5 Other Infrastructure

The following other types of infrastructure exist within the AoA, but should not constrain OSW development:

- Wastewater treatment outfalls.
- Artificial reefs.
- The DMON (digital passive acoustic monitoring) buoy deployed by the Woods Hole Institute to autonomously detect marine mammals within the New York Bight (WHOI 2017).

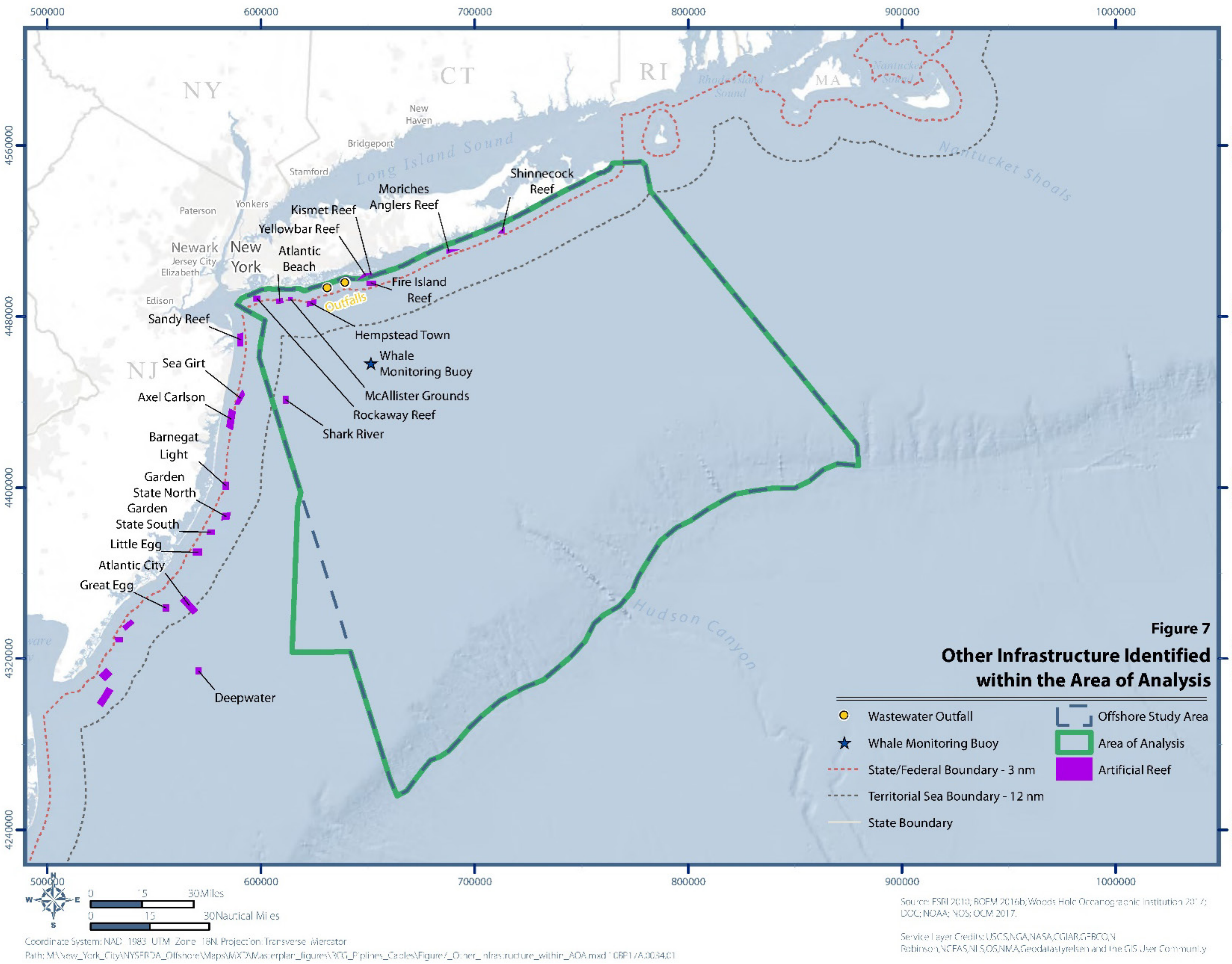
The New York State Department of Environmental Conservation has also indicated that a system of acoustic telemetry buoys will soon be deployed near shipping lanes to detect marine mammals (DEC 2017).

In addition, there are two WEAs located off New Jersey that are currently leased by US Wind and Ocean Wind. If constructed prior to OSW development within the AoA, projects within these WEAs could pose a constraint to export cable routes, depending on the location of New York OSW sites and grid connection points.

Due to the location and nature of these “other infrastructure” assets, they are not expected to significantly impact OSW siting and development within the AoA.

Figure 7. Other Infrastructure Identified within the Area of Analysis

Source: ESRI 2010; BOEM 2016b; Woods Hole Oceanographic Institution. 2017;DOC; NOAA, NOS; OCM 2017



3 Potential Interactions with Existing Assets

Damage to existing telecommunications cables, power cables, gas pipelines, and buoys could potentially occur during OSW construction and operation activities. Assuming that appropriate physical setbacks between OSW assets and existing infrastructure are applied in the siting and planning process, the main potential risk is limited to cable and pipeline crossings, where damage to existing infrastructure could occur if crossing locations are not appropriately characterized before site investigation or construction activities take place, or due to contractor error.

The level of protection for existing submarine cables and gas pipelines is typically determined by the risk of damage from external factors such as shipping and fishing. Cable crossings should maintain the existing degrees and types of protection and should be performed in a way that minimizes the risk of damage. Owners of existing assets may also need space to maintain them, which could necessitate the use of additional protection measures such as increased separation distances (DOE 2014).

The guidelines below are provided for dealing with existing infrastructure that may be identified through project siting and detailed site characterization. Existing assets can be identified and characterized relatively early in the development process of an OSW, allowing for early engagement with the asset owner. In the event that existing assets are identified late in the development phase, asset owners should be engaged immediately to mitigate potential effects on development and project planning.

3.1 Options for Developers

The following options may be considered by developers to minimize potential conflicts with infrastructure located within the AoA.

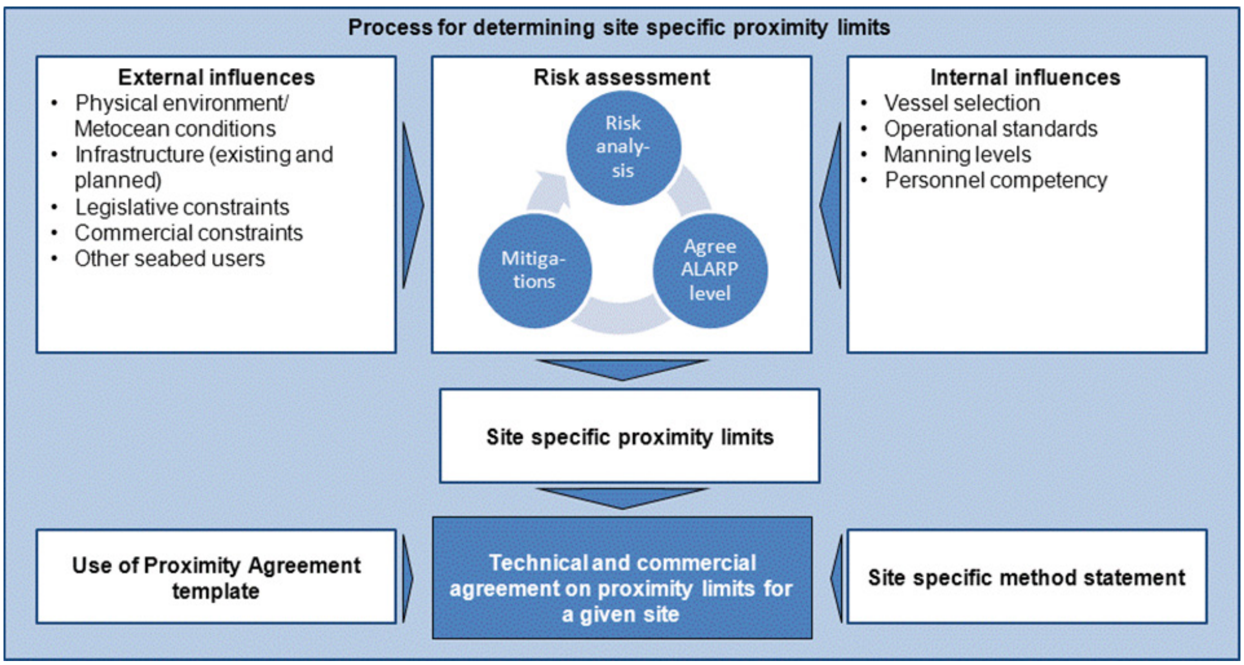
3.1.1 Avoidance

If possible, developers should avoid existing infrastructure, as part of either the siting process for OSWs or the planning of individual turbine or offshore substation locations within a WEA or export cable route(s) to shore.

Typically, cable and pipeline owners will require separation distances between their assets and those of an OSW, and certain mitigation measures for construction activities taking place within such buffers. Proximity agreements enable the parties to agree on separation schemes and methods of interaction between new and existing infrastructure. Proximity limits will vary depending on site-specific and project-specific factors (environmental, legal, commercial, technical) and should be determined following a risk assessment. An example of the process for determining site-specific proximity limits has been developed by the European Subsea Cable Association and is shown in Figure 8.

Figure 8. Model Process for Determining Site-specific Proximity Limits between New and Existing Infrastructure

Source: ESCA 2016



3.1.2 Removal

Out-of-service submarine cables can be removed if the owner can be identified and an agreement can be made to remove them (ICPC 2016). There are no clear international requirements for decommissioning telecommunications cables (The Crown Estate 2012). In the U.S., if cables are located within marine sanctuaries, owners may be required to undertake a pre-decommissioning assessment to determine the extent of decommissioning needed and additional permits required to do so (NOAA Office of National Marine Sanctuaries 2011). Typically, to remove a section of cable to accommodate new infrastructure, a section of the existing cable is removed on either side of where the new cable needs to be laid and the resulting ends are anchored to the seabed to ensure they cannot be snagged by other users.

In the U.S., pipeline decommissioning is more heavily regulated than in other countries; permits must be obtained from the U.S. Department of Interior Bureau of Safety and Environmental Enforcement for the decommissioning of oil and gas assets per 30 Code of Federal Regulations 250.1700. OSW developers are therefore not likely to encounter out-of-service pipelines since owners are required to decommission them once they cease operation.

3.1.3 Crossings

Due to the prevalence of telecommunications cables, and the presence of power cables and gas pipelines in the AoA, some crossings of these structures will likely be needed as part of any potential OSW development in the AoA.

Cable crossing and cable protection methods have individual advantages and disadvantages, depending on the site-specific circumstances. The non-exhaustive list below provides an overview of the most common methods currently available to developers and their contractors.

3.1.3.1 Mattresses

Mattresses (made of concrete, plastic, or other materials) placed over the installed cable (as shown in Figure 9) provide one means of cable protection (and scour prevention—some mattresses also include fronds for this purpose). Mattresses are easily installed and provide effective protection for existing and overlaid cables from trawling gear and other fishing equipment. Mattresses are designed to be relatively flexible and adaptable to the shape of the cable or pipeline and can accommodate anomalies in the surrounding seabed. Some forms of mattressing can pose a hazard to certain types of fishing (e.g., dredging), so local fishing activity should be considered in their design and use.

Figure 9. Typical Concrete Mattress

Source: Subsea Protection Systems n.d.

If an existing cable is buried deep enough, the overlaid cable can be installed directly over it without the need for additional protection. Based on typical target burial requirements for power and telecommunications cables (within the continental shelf break), a jet plow or other device used to install array and export cables may need to be lifted partially or entirely out of the seabed to cross an existing power or telecommunications cable. Depending on the results of the crossing agreement and design of the cable protection system, mattresses may be placed between cables, and/or on top of the overlaid cable if it does not meet its target burial depth due to the crossing.

3.1.3.2 Crossing Bridges

Where pipeline crossings are anticipated, a crossing bridge (as shown in Figure 10) can be installed to provide a safe route for a cable to pass over a pipeline with minimal interaction between the two. Since the cable passing over the bridge is exposed above, other protective measures such as mattresses and/or cable protection systems are often used in conjunction with crossing bridges.

Figure 10. Typical Pipeline Crossing Bridge

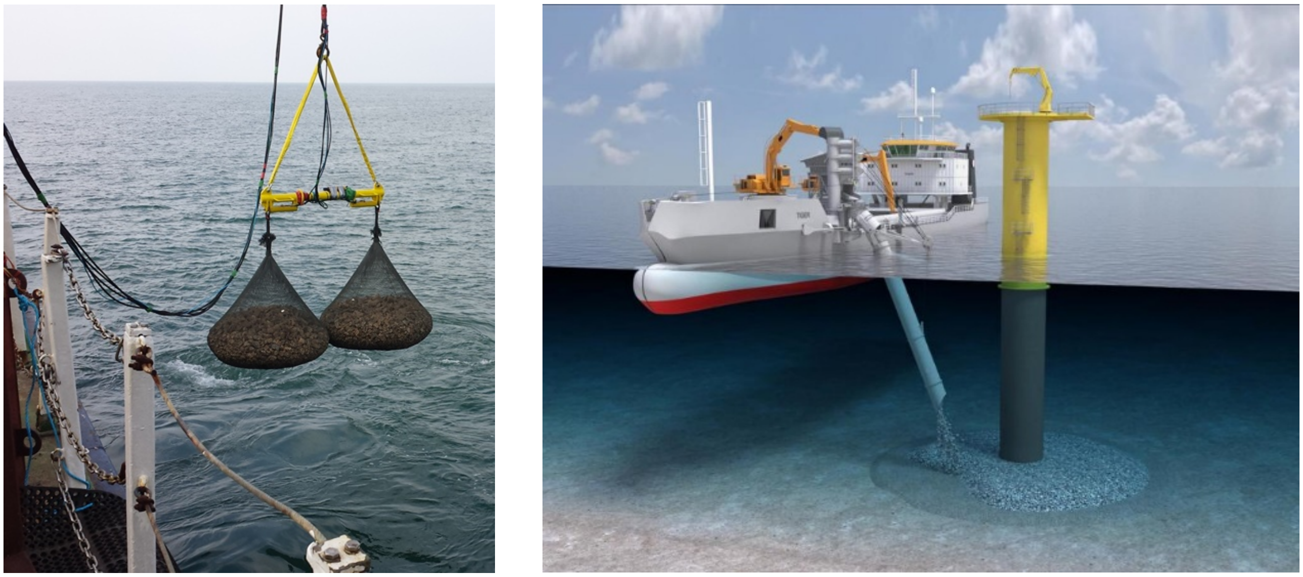
Source: Subsea Protection Systems n.d.

3.1.3.3 Rock Armor

Rock armor is a common method of cable protection that protects array and export cables (and prevents scour) around turbine and offshore substation foundations. Rock armor can also be used to protect existing or overlaid submarine cables in a cable crossing. The size and quantity of the rocks and height of the berm depends on the amount of cable and scour protection required at the location. Depending on the design and purpose of the cable protection system, the rocks may be placed either within bags (see Figure 11) or directly on the seabed via a chute (see Figure 13) or bucket.

Figure 11. Rock Armor Bag Placement, Using Bags and Using a Chute

Source: Mojo Maritime 2015 *Source: Mojo Maritime 2015, Jan De Nul n.d.*



3.1.3.4 Principles of Crossing Agreements

According to 2014 International Cable Protection Committee guidance, if a cable crossing is required, a crossing agreement between the OSW developer and existing cable or pipeline owner is recommended to ensure the protection of each party's assets.

The OSW developer proposing the crossing should design and install the crossing according to the requirements of the existing asset owner as set forth in the crossing agreement. The design of the crossing should stipulate the angles at which the overlaid cable should cross the existing asset and the type of protection required, if any.

Based on European experience, it should be relatively easy for OSW developers to execute crossing agreements with cable and pipeline operators, since cable and pipeline owners are accustomed to entering into crossing and proximity agreements with each other and with other asset owners.

Crossing agreements typically address:

- Liabilities and rights of both parties, including the inclusion/exclusion of consequential losses.
- Physical area to which the agreement applies.
- Design and installation methods.
- Rights of the existing asset owner to supervise crossing activities during installation.

4 Potential Interactions between Other Seabed Users and Array and Export Cables

Other users of the seabed, such as fishing and cargo vessels, have the potential to damage array and export cables, or cause injury to themselves or their property, if they are not suitably protected from the risks of contacting the energized cables. Accidental contact between vessel anchors (from emergency stopping or anchoring) and fishing gear can be readily mitigated by appropriate project siting and cable burial and protection.

4.1 Means of Protecting Array and Export Cables from Other Seabed Users

Burial is the most common means of protecting array and export cables from third party interaction. In areas where cable burial is not possible, such as where cable or pipeline crossings occur, where the contractor is not able to meet target burial depth, or where the cable exits a turbine or substation foundation, additional cable protection is needed, as explained in the following sections.

4.1.1 Burial

Submarine cables are typically buried using a subsea cable jet plow (see Figure 12) that is towed along the seabed and lowers the cable into a narrow trench (typically 1 to 1.5 m wide) by using a jet of water to fluidize an area of seabed under the plow temporarily. In this method, cables may be laid and then buried, or laid and buried simultaneously, depending on the seabed conditions and type of plow utilized. Burial of cables may not be uniform along the length of the cable route and may not be possible in some circumstances, so additional protection may be required.

In areas with dense sediments or shallow bedrock, rock-cutting equipment (trenchers) may be used to manually cut a trench to lay the cable in. Alternatively, cables may be surface laid and protected in these circumstances.

In most cases, contractors prefer to conduct a pre-lay grapnel run, whereby a vessel drags a hook along the exact cable route to clear or collect existing obstacles. Pre-lay grapnel runs are usually performed shortly before cable-laying to ensure that the cable route is clear of obstacles.

Figure 12. Typical Jet Plow

Source: KIS-ORCA n.d.

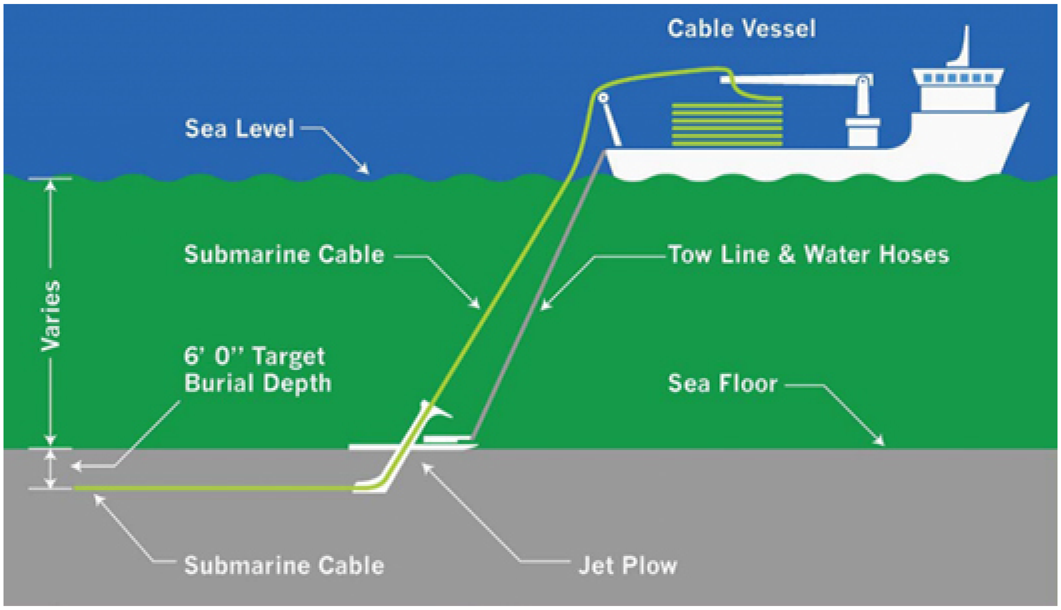
The depth to which cables can be buried depends on several factors, including seabed conditions, environmental conditions, and equipment type and performance. Cable burial depths should be determined following a risk assessment that is conducted once seabed surveys are completed and anchoring and fishing impacts have been considered (Carbon Trust 2015). Due to the mobile nature of seabed, cables may become exposed during their lifespans. To account for this, seabed conditions and sand wave characteristics should also be studied to determine appropriate burial depth.

The Block Island Wind Farm had a target burial depth of 1.8 m (6 feet), but it was expected that this would likely vary with varying seabed conditions. A minimum depth of 1.2 m (4 feet) was set; if this could not be achieved, then additional cable protection was installed (Tetra Tech, Inc. 2013). The permit applications for the Cape Wind project propose the same burial depth (Cape Wind Associates 2011).

The target burial depths for these projects were primarily driven by the need to protect the cables from large vessel anchors, which pose a greater risk of deep seabed penetration than trawling and scallop dredging activities.

Figure 13. Block Island Wind Farm Cable Burial Schematic

Source: National Grid 2016



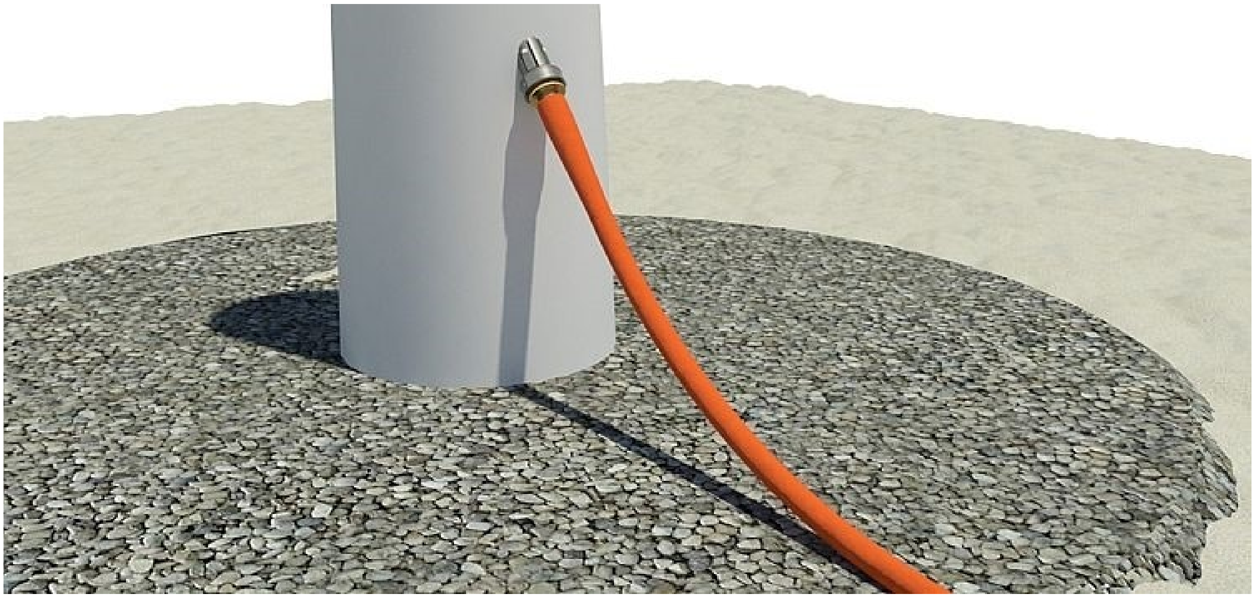
4.1.2 Cable Protection Systems

Specialized cable protection systems are typically used to protect small lengths of cable between exit points at turbine and offshore substation foundations and points where burial commences (as shown in Figure 14), or over cable crossings or other special scenarios.

Typically, cable protection systems consist of polyurethane bend restrictors, and protective polyurethane knuckles and steel split pipes, among other features. Cable protection systems keep the cables protected from fatigue and from third-party interactions (for example, recreational fishing gear or small vessel anchors). The use of rock armor scour protection should also be considered in the design of cable protection systems to ensure that the cables are sufficiently protected between foundation and seabed. Rock armor can be designed for installation above or below cable protection systems, depending on installation sequence.

Figure 14. Cable Protection System on a Monopile Foundation

Source: Offshore Wind Journal 2016



4.2 Shipping Risks to Array and Export Cables

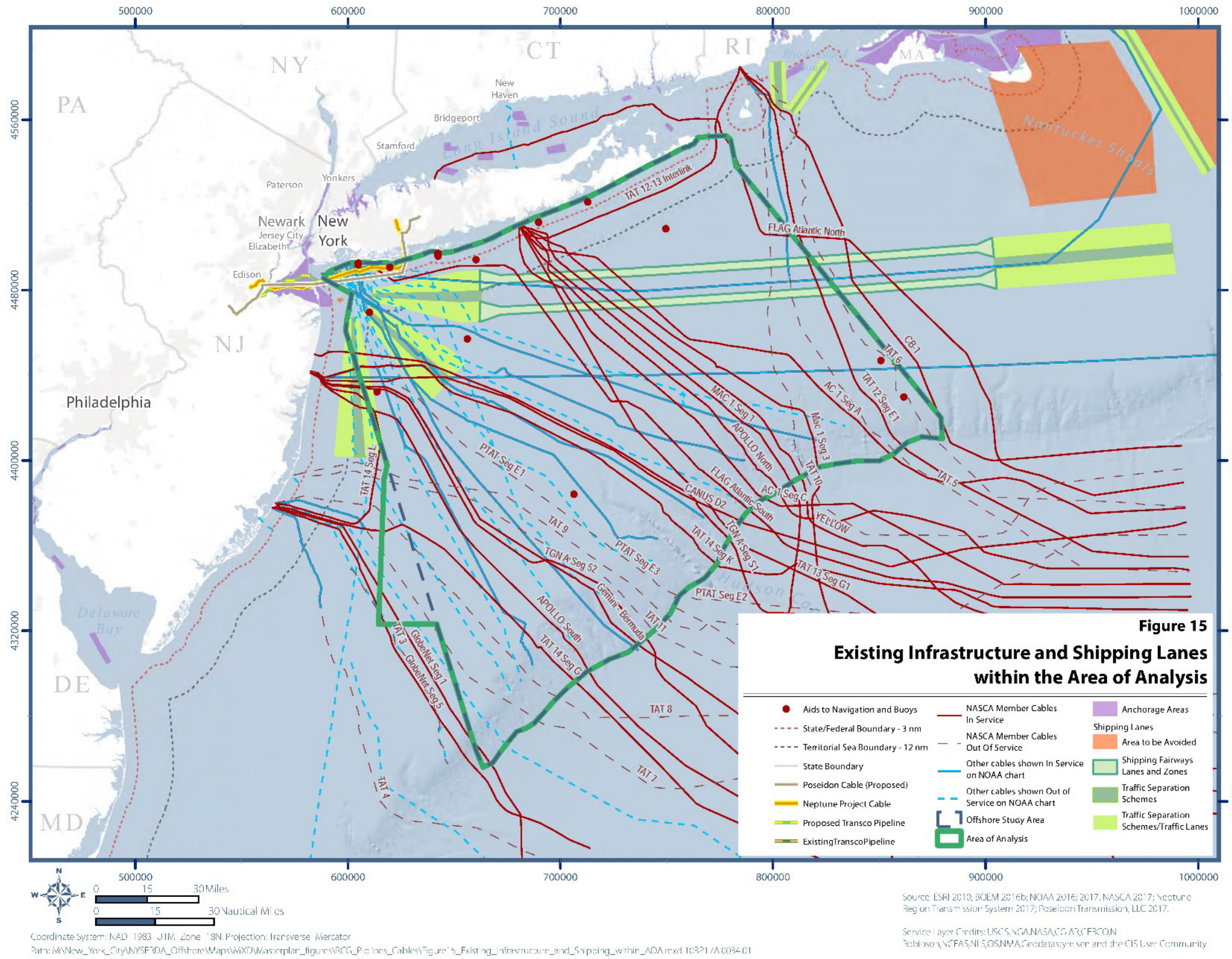
Vessel anchors pose a significant hazard to submarine cables, as they are designed to penetrate the seabed. They are generally deployed to provide a temporary mooring or to slow or stop a vessel in an emergency.

No anchorages have been identified within the AoA, so the risk of a third-party vessel anchor snagging a submarine cable arises only in extenuating circumstances in which the anchor is deployed in an emergency and is large and heavy enough to exceed the burial depth or other protective feature of the array or export cable.

The potential siting constraints imposed by shipping and navigation requirements are discussed in the *Shipping and Navigation Study*, which is appended to the Master Plan,, but the additional WEAs identified by BOEM within the AoA should be appropriately set back from navigation lanes such that most or all array cables will not be located in major shipping lanes, and only export cables will cross under major shipping lanes and be subject to significant burial depth requirements to ensure protection from very large vessel anchors.

Figure 15. Existing Infrastructure and Shipping Lanes within the Area of Analysis

Source: ESRI 2010; BOEM 2016b, NOAA 2016, 2017; NASCA 2017; Neptune Regional Transmission System 2017, Poseidon Transmission LLC., 2017



Recreational craft are also expected to be present within the AoA. These craft are not prohibited from anchoring outside of a designated anchorage area, but the anchors they use are not likely to be large enough to penetrate the seabed to exceed the burial depth of array or export cables (governed by anchor penetration depths of larger vessels) or pose a problem to other protective measures such as cable protection systems around foundations or over the seabed.

In any case, developers of future OSWs within the AoA should perform cable burial risk assessments based on the types of vessels and anchor penetrations that could occur in their project locations to determine the level of protection required.

4.3 Fishing Risks to Array and Export Cables

Figures 17 to 19 show that bottom fishing takes place throughout the AoA with clear "hotspots" located within the AoA's northwestern quadrant, and beyond the 60 m depth contour for larger vessels.

The level and types of seabed fishing activity should be considered by OSW developers in cable burial risk assessments, and the resulting cable protection system(s) should be designed in consultation with local fishermen. Assuming that cables are buried to sufficient depth, fishing can continue over buried cables without impact. However, the use of other cable protection systems should be coordinated with fishermen to minimize potential interactions.

Figure 16. Vessel Density within the Area of Analysis

Source: ESRI 2010; BOEM 2016b; NOAA 2017, NASCA 2017; NOAA NMFS 2013

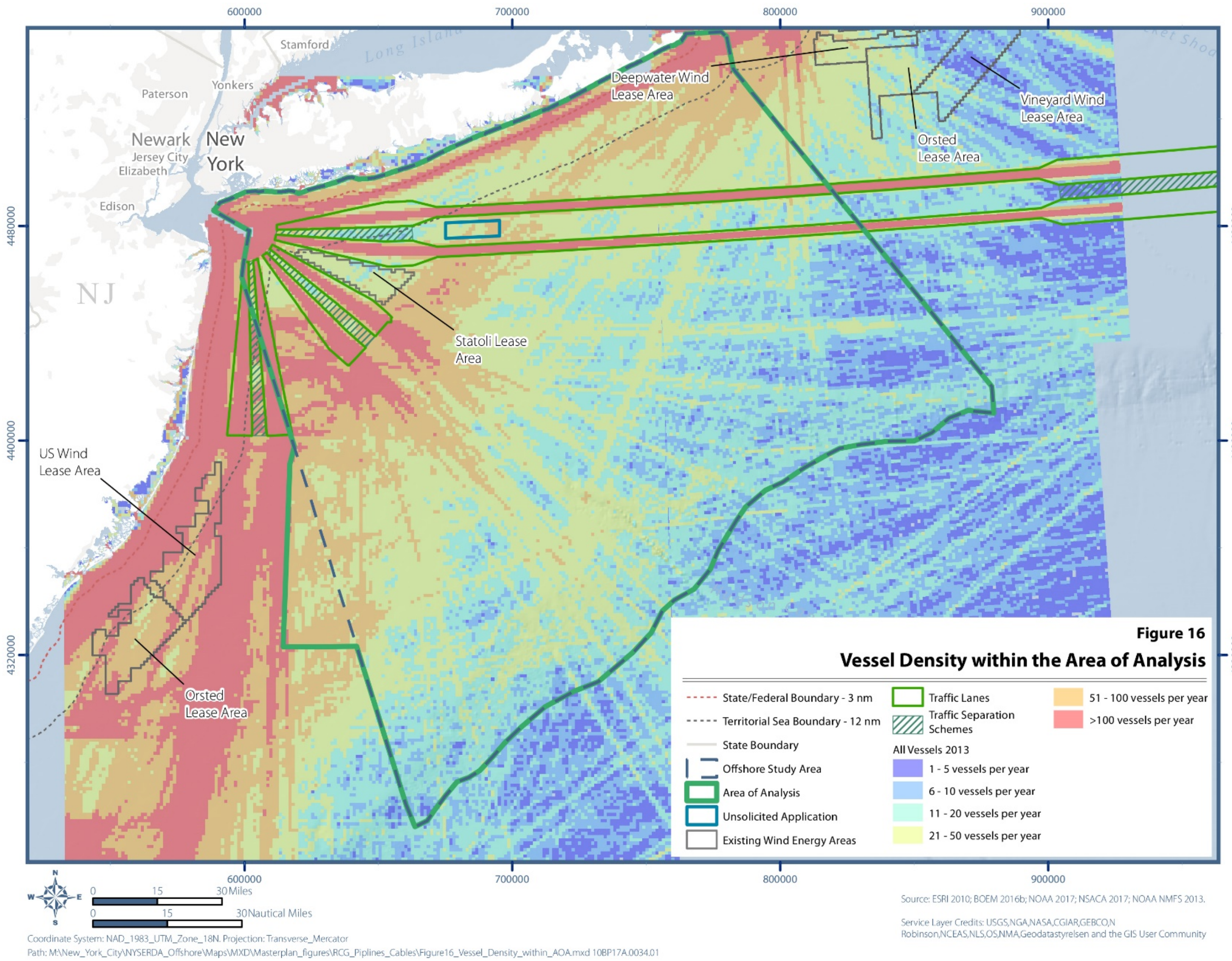


Figure 17. 2011–2013 Bottom Trawl Fishing Density within the Area of Analysis (Vessels under 65 Feet)

Source: ESRI 2010; BOEM 2016b; NOAA 2017, NASCA 2017; NOAA NMFS 2013

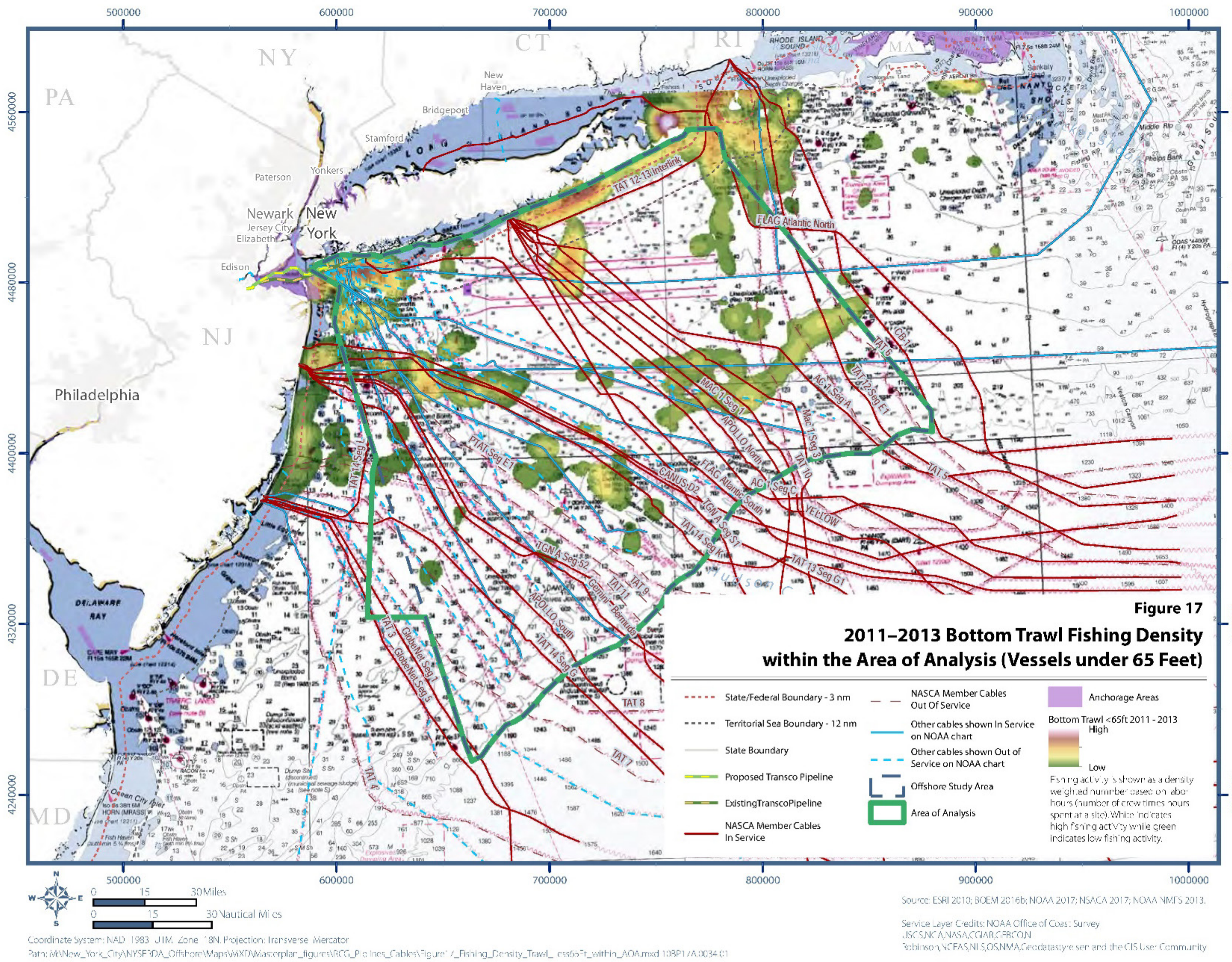
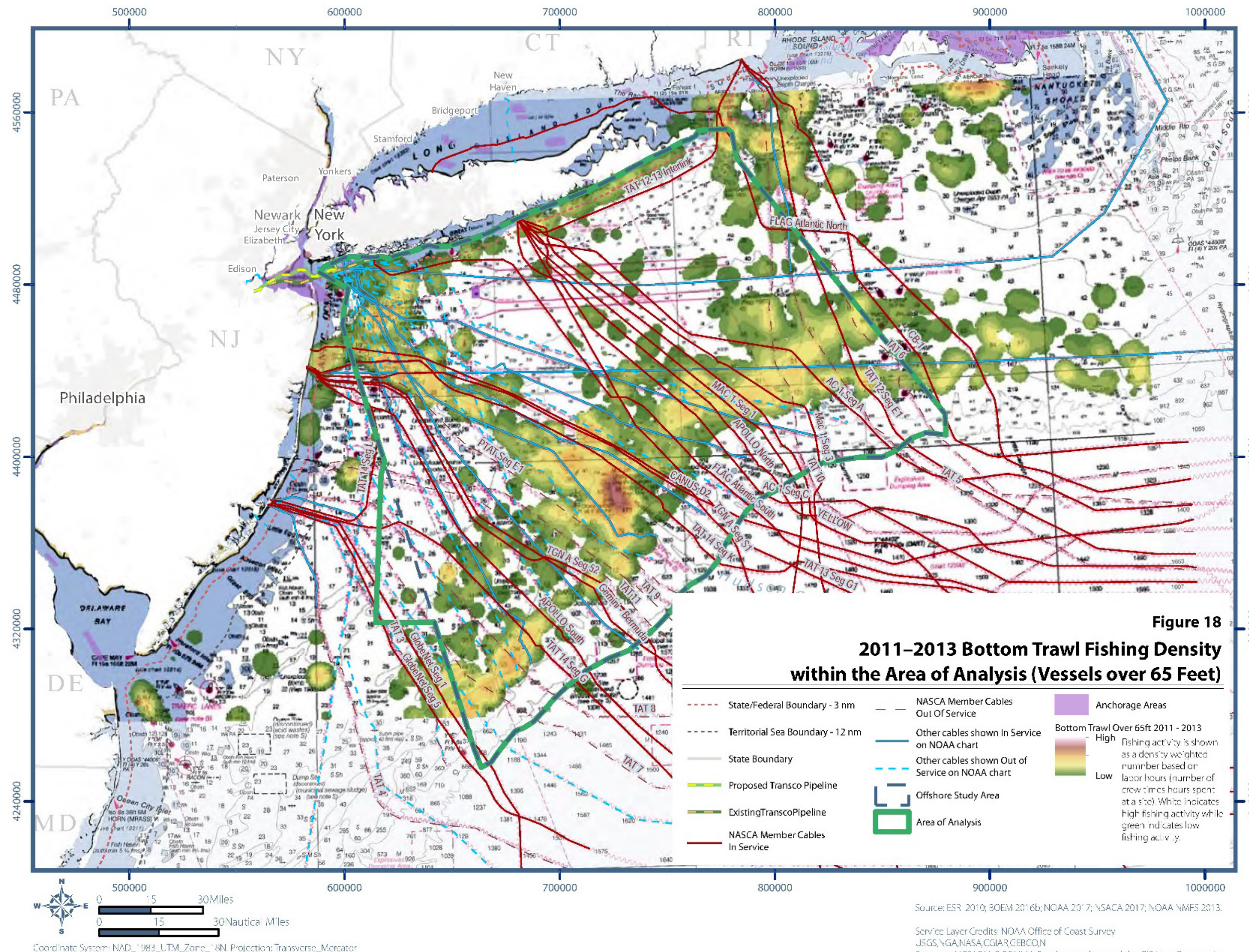


Figure 18. 2011–2013 Bottom Trawl Fishing Density within the Area of Analysis (Vessels over 65 Feet)

Source: ESRI 2010; BOEM 2016b; NOAA 2017, NASCA 2017; NOAA NMFS 2013



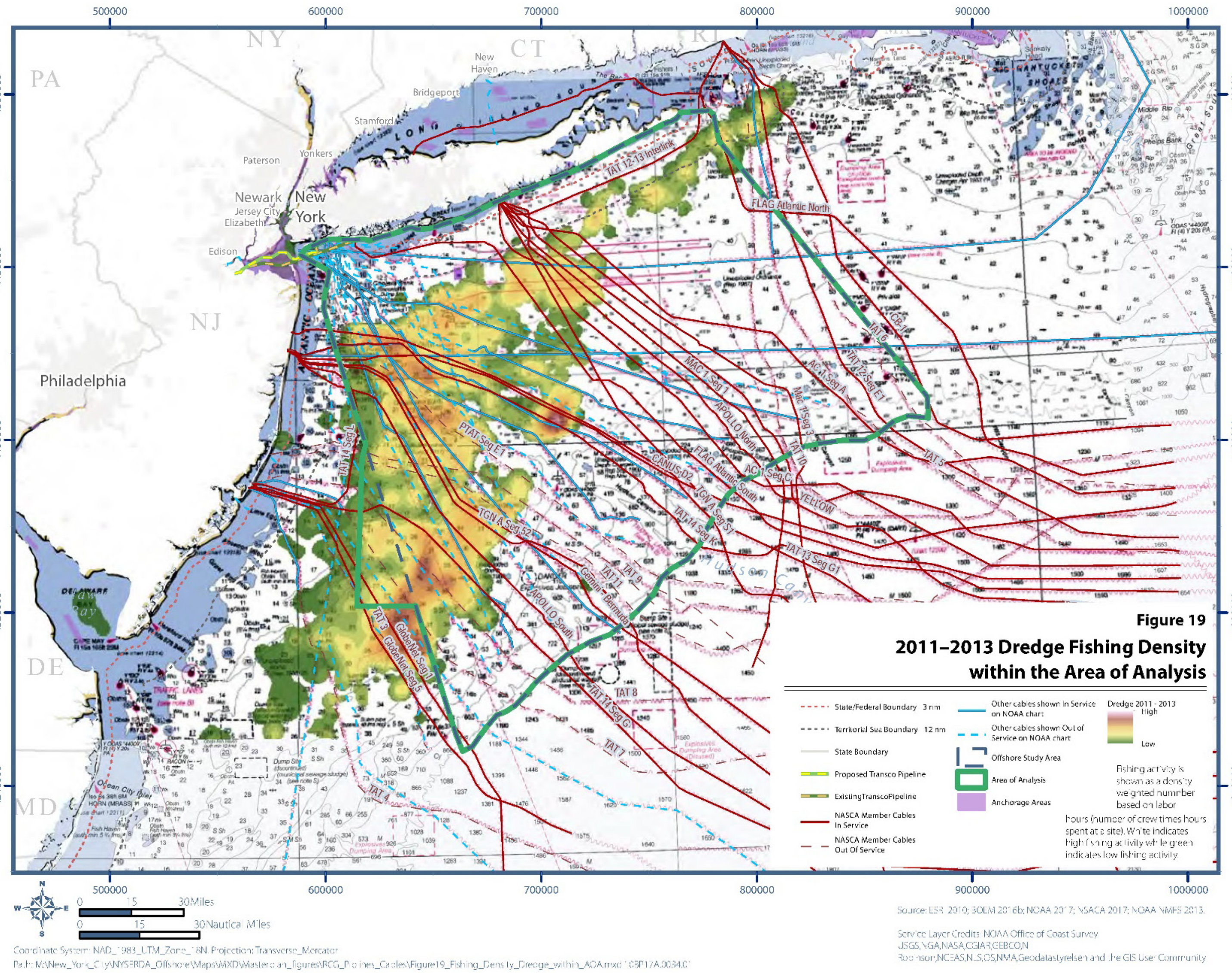
Source: ESRI 2010; BOEM 2016b; NOAA 2017; NSACA 2017; NOAA NMFS 2013.

Service Layer Credits: NOAA Office of Coast Survey USGS, NGA, NASA, CGIAR, GEBCO, N Robinson, NCEAS, NLS, OS, NMA, Geodatastyrelsen and the GIS User Community

Coordinate System: NAD_1983_UTM_Zone_18N Projection: Transverse_Mercator

Figure 19. 2011–2013 Dredge Fishing Density within the Area of Analysis

Source: ESRI 2010; BOEM 2016b; NOAA 2017, NASCA 2017; NOAA NMFS 2013



5 Options Available for Interfacing with Existing Infrastructure

Table 2, below, shows various options available to OSW developers for interacting with the existing infrastructure types discussed in this study. Each interaction should be designed and executed according to site-specific conditions and the requirements of third parties that may be affected. The list of options is non-exhaustive, since new methods may also be available at the time that a site-specific plan is developed.

Table 2. Potential Options Available for Interacting with Existing Infrastructure within the AoA

Type of Infrastructure	Surface Lay and Protect	Mattress	Rock Armor	Burial	Crossing Bridge	Remove	Avoid
Live cables (power or telecommunications)	✓	✓ In areas where fishing is present, some forms of mattressing may be preferable due to the ability to trawl over this type of cable protection.	✓	✓			✓
Live pipelines	✓	✓			✓		✓
Out of service pipelines					✓	✓ Removal might be possible if the pipeline is empty; otherwise, it could be crossed using a bridge.	✓
Out of service cables	✓ If removal of the out of service cable is not possible	✓	✓			✓ Removal possible with the permission of the owner	
Navigation aids							✓ Preferred option
Buoys							✓ preferred option
Other infrastructure							✓ preferred option

6 Conclusions

Although various types of infrastructure are present throughout the AoA, existing assets are spread out, and future OSW developments should be able to avoid interacting with the majority this infrastructure with appropriate project siting. The types of mitigation measures used by developers who are not able to avoid interaction with certain assets, will be site-specific and based on risk assessments that can be performed once more detailed project information is available. In any case, OSW developers should be able to implement a variety of solutions to mitigate risks to the parties involved.

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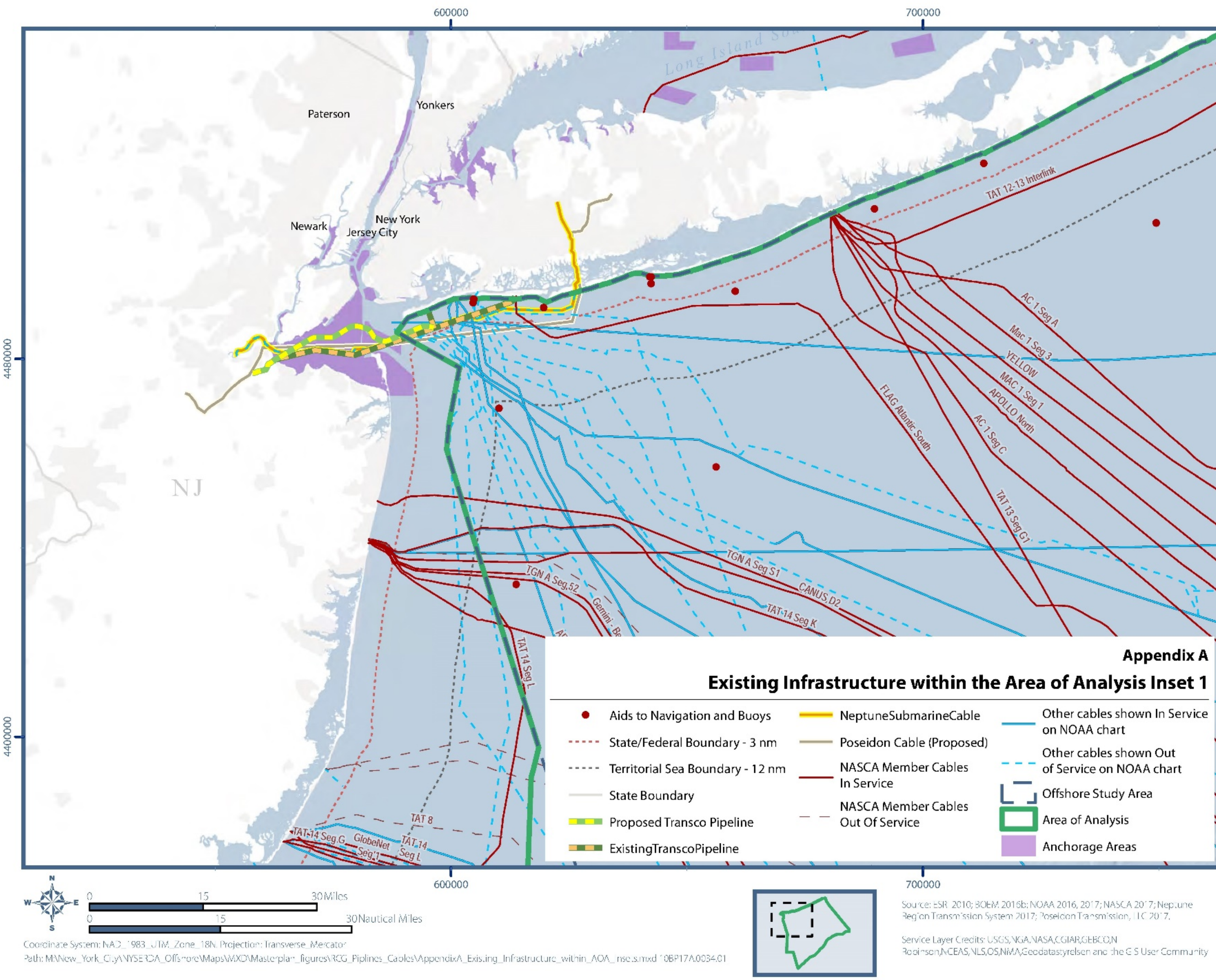
Appendix A. Detailed Inset Maps for Figure 2


Appendix A
Existing Infrastructure within the Area of Analysis Inset 1
Aids to Navigation and Buoys
State/Federal Boundary - 3 nm
Territorial Sea Boundary - 12 nm
State Boundary
Proposed Transco Pipeline
ExistingTranscoPipeline
NeptuneSubmarineCable
Poseidon Cable (Proposed)
NASCA Member Cables In Service
NASCA Member Cables Out Of Service
Other cables shown In Service on NOAA chart
Other cables shown Out of Service on NOAA chart
Offshore Study Area
Area of Analysis
Anchorage Areas
600000
700000
4480000
4400000
Paterson
Yonkers
Newark
New York
Jersey City
NJ
Long Island Sound
TAT 12-13 Interlink
AC 1 Seg A
Mac 1 Seg 3
YELLOW
MAC 1 Seg 1
APOLLO North
AC 1 Seg C
FLAG Atlantic South
TAT 13 Seg G1
TGN A Seg S1
CANUS D2
TAT-14 Seg K
TGN A Seg S2
TAT 14 Seg L
TAT 8
TAT-14 Seg G
GlobeNet Seg 1
TAT 14 Seg L
0
15
30 Miles
0
15
30 Nautical Miles
N
S
E
W
Coordinate System: NAD_1983_UTM_Zone_18N Projection: Transverse_Mercator
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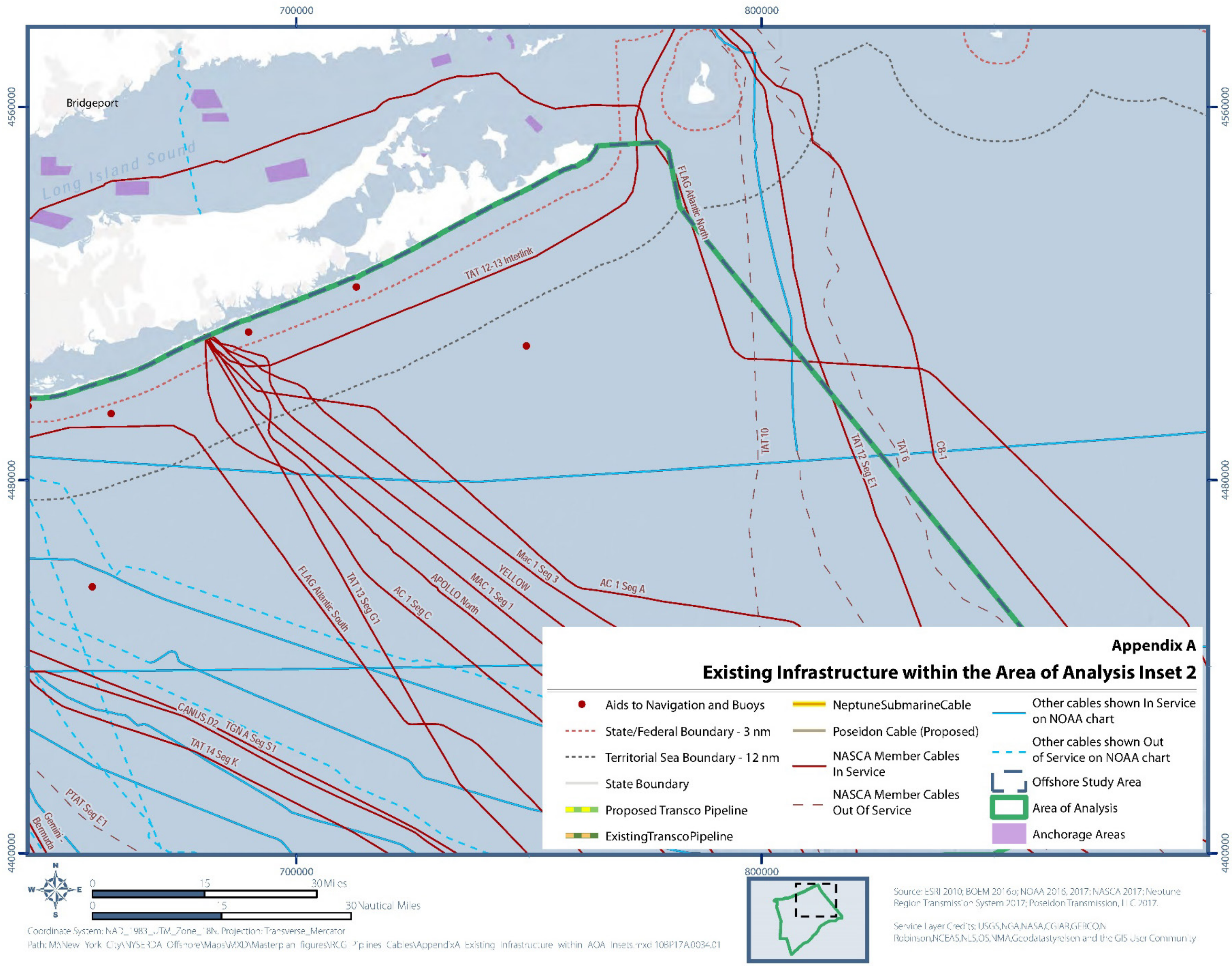
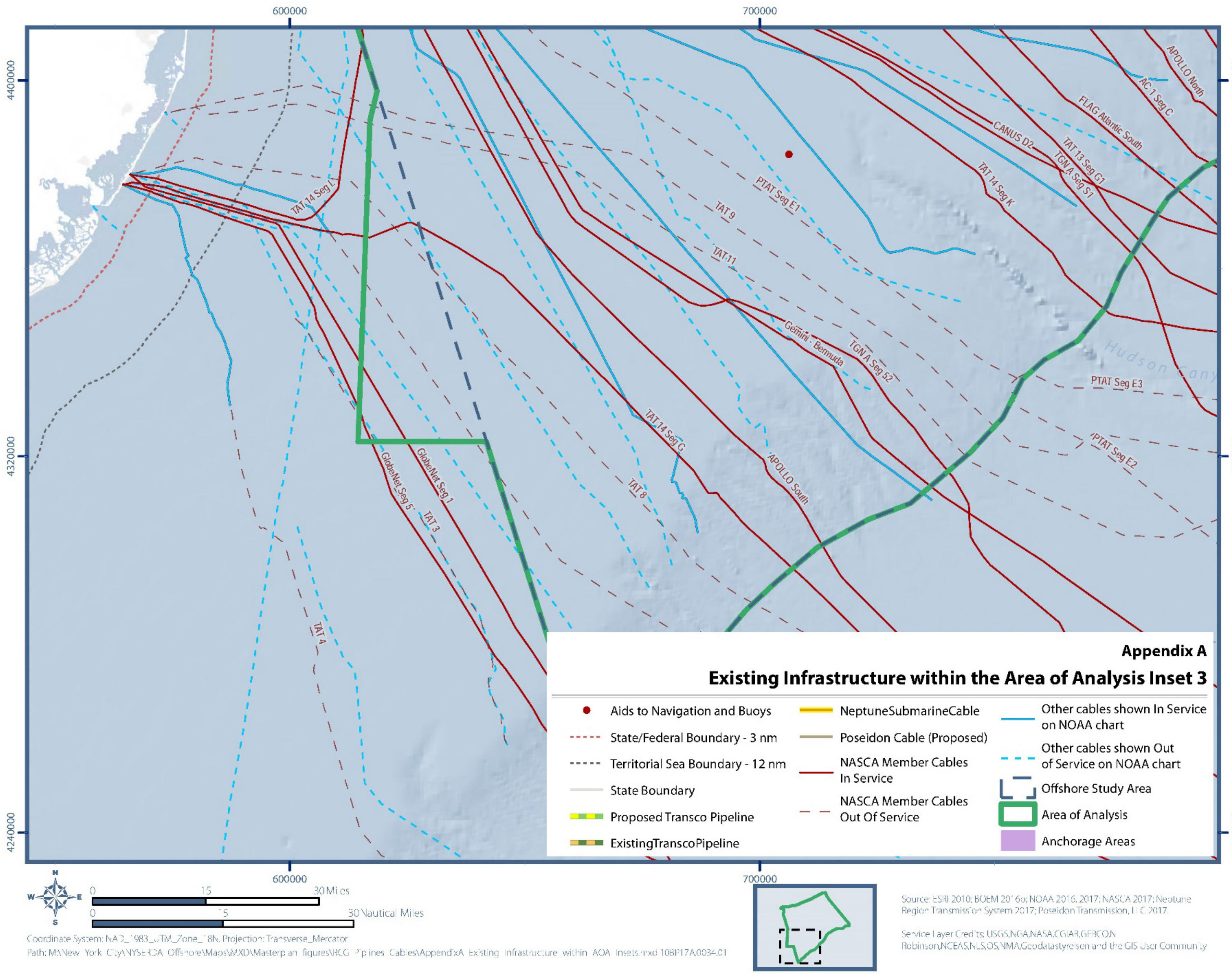
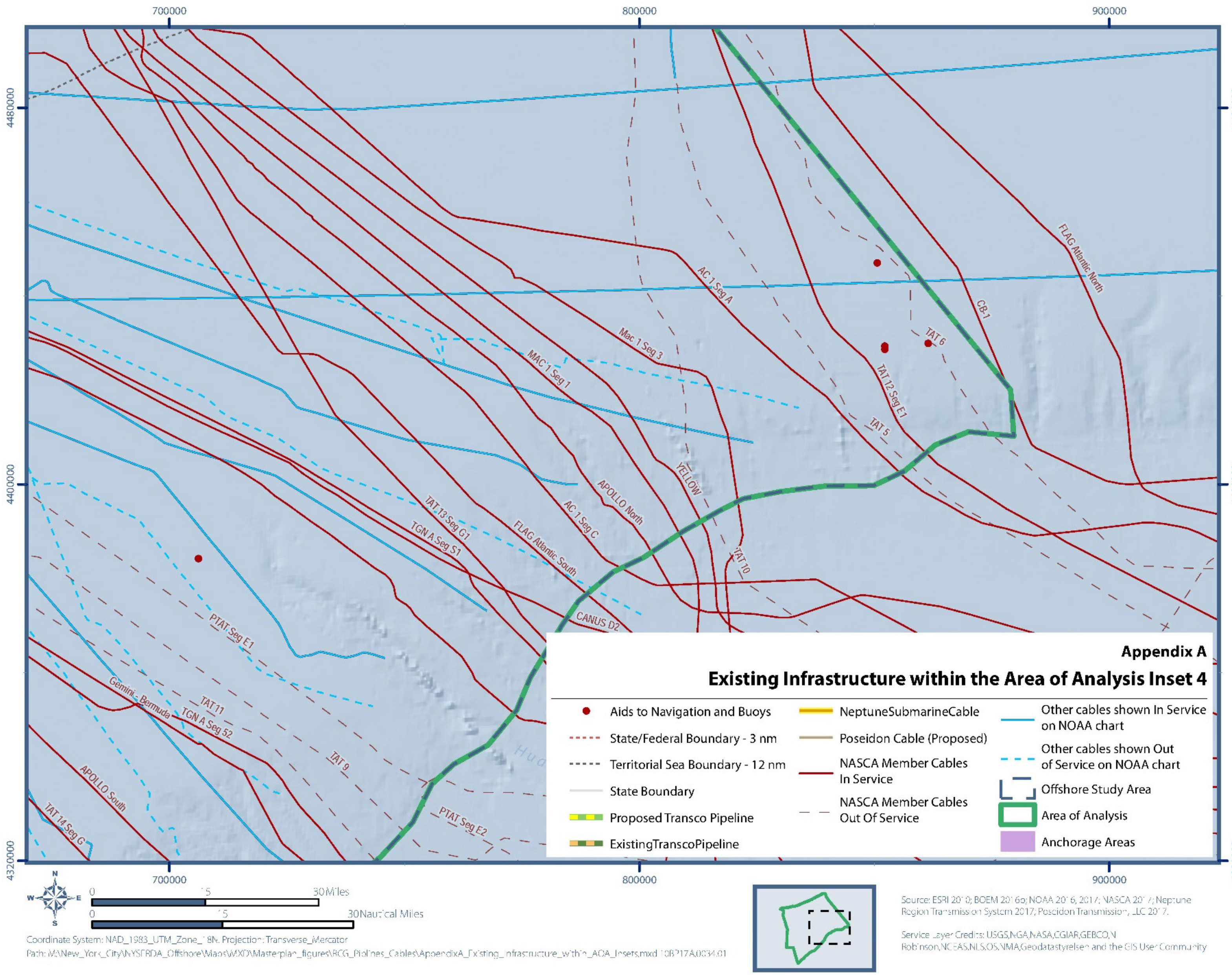
Source: ESRI 2010; BOEM 2016b; NOAA 2016, 2017; NASCA 2017; Neptune Region Transmission System 2017; Poseidon Transmission, LLC 2017.
Service Layer Credits: USGS,NGA,NASA,CGIAR,GEBCO,N Robinson,NCEAS,NLS,OS,NMA,Geodatastyrelsen and the GIS User Community



Appendix A
Existing Infrastructure within the Area of Analysis Inset 2
Bridgeport
Long Island Sound
FLAG Atlantic North
TAT 12-13 Interlink
TAT 10
TAT 12 Seg E1
TAT 6
CB-1
Mac 1 Seg 3
YELLOW
MAC 1 Seg 1
APOLLO North
AC 1 Seg C
TAT 13 Seg G1
FLAG Atlantic South
AC 1 Seg A
CANUS D2
TGN A Seg S1
TAT 14 Seg K
PTAT Seg E1
Gemini Bermuda
700000
800000
4560000
4480000
4400000
Aids to Navigation and Buoys
State/Federal Boundary - 3 nm
Territorial Sea Boundary - 12 nm
State Boundary
Proposed Transco Pipeline
ExistingTranscoPipeline
NeptuneSubmarineCable
Poseidon Cable (Proposed)
NASCA Member Cables In Service
NASCA Member Cables Out Of Service
Other cables shown In Service on NOAA chart
Other cables shown Out of Service on NOAA chart
Offshore Study Area
Area of Analysis
Anchorage Areas
0 15 30 Miles
0 15 30 Nautical Miles


Appendix A
Existing Infrastructure within the Area of Analysis Inset 3
Aids to Navigation and Buoys
State/Federal Boundary - 3 nm
Territorial Sea Boundary - 12 nm
State Boundary
Proposed Transco Pipeline
ExistingTranscoPipeline
NeptuneSubmarineCable
Poseidon Cable (Proposed)
NASCA Member Cables In Service
NASCA Member Cables Out Of Service
Other cables shown In Service on NOAA chart
Other cables shown Out of Service on NOAA chart
Offshore Study Area
Area of Analysis
Anchorage Areas
600000
700000
4400000
4320000
4240000
TAT 14 Seg L
PTAT Seg E1
TAT 9
TAT 11
Gemini - Bermuda
TGN A Seg 52
PTAT Seg E3
PTAT Seg E2
TAT 14 Seg G
APOLLO South
TAT 8
GlobeNet Seg 5
GlobeNet Seg 1
TAT 3
TAT 4
CANUS D2
TAT 13 Seg G1
TGN A Seg S1
TAT 14 Seg K
FLAG Atlantic South
AC 1 Seg C
APOLLO North
Hudson Cany
N
W
E
S
0
15
30 Miles
0
15
30 Nautical Miles
Coordinate System: NAD_1983_UTM_Zone_18N, Projection: Transverse_Mercator
Path: M:\New_York_City\NYSERDA_Offshore\Maps\MXD\Masterplan_figures\BCG_Pipelines_Cables\AppendixA_Existing_Infrastructure_within_AOA_Insets.mxd 10BP17A.0034.01
Source: ESRI 2010; BOEM 2016a; NOAA 2016, 2017; NASCA 2017; Neptune Region Transmission System 2017; Poseidon Transmission, LLC 2017.
Service Layer Credits: USGS,NGA,NASA,CGIAR,GEBCO,N Robinson,NCEAS,NLS,OS,NMA,Geodatastyrelsen and the GIS User Community


Appendix A
Existing Infrastructure within the Area of Analysis Inset 4
Aids to Navigation and Buoys
State/Federal Boundary - 3 nm
Territorial Sea Boundary - 12 nm
State Boundary
Proposed Transco Pipeline
ExistingTranscoPipeline
NeptuneSubmarineCable
Poseidon Cable (Proposed)
NASCA Member Cables In Service
NASCA Member Cables Out Of Service
Other cables shown In Service on NOAA chart
Other cables shown Out of Service on NOAA chart
Offshore Study Area
Area of Analysis
Anchorage Areas
700000
800000
900000
4480000
4400000
4320000
AC 1 Seg A
Mac 1 Seg 3
MAC 1 Seg 1
CB-1
TAT 6
TAT 12 Seg E1
TAT 5
FLAG Atlantic North
APOLLO North
AC 1 Seg C
YELLOW
TAT 10
TAT 13 Seg G1
TGN A Seg S1
FLAG Atlantic South
CANUS D2
PTAT Seg E1
Gemini - Bermuda
TAT 11
TGN A Seg S2
TAT 9
APOLLO South
TAT 14 Seg G
PTAT Seg E2
N
W
E
S
0
15
30Miles
0
15
30Nautical Miles
Coordinate System: NAD_1983_UTM_Zone_18N. Projection: Transverse_Mercator

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