Summary of Physical and Environmental Qualities for the Proposed Long Island – New York City Offshore Wind Project Area

Final Report 10-22
Summary
October 2010

New York State
Energy Research and
Development Authority

The New York State Energy Research and Development Authority (NYSERDA) is a public benefit corporation created in 1975 by the New York State Legislature.

NYSERDA derives its revenues from an annual assessment levied against sales by New York's electric and gas utilities, from public benefit charges paid by New York rate payers, from voluntary annual contributions by the New York Power Authority and the Long Island Power Authority, and from limited corporate funds.

NYSERDA works with businesses, schools, and municipalities to identify existing technologies and equipment to reduce their energy costs. Its responsibilities include:

- Conducting a multifaceted energy and environmental research and development program to meet New York State's diverse economic needs.
- The **New York Energy $mart**SM program provides energy efficiency services, including those directed at the low-income sector, research and development, and environmental protection activities.
- Making energy more affordable for residential and low-income households.
- Helping industries, schools, hospitals, municipalities, not-for-profits, and the residential sector, implement energy-efficiency measures. NYSERDA research projects help the State's businesses and municipalities with their energy and environmental problems.
- Providing objective, credible, and useful energy analysis and planning to guide decisions made by major energy stakeholders in the private and public sectors.
- Since 1990, NYSERDA has developed and brought into use successful innovative, energy-efficient, and environmentally beneficial products, processes, and services.
- Managing the Western New York Nuclear Service Center at West Valley, including: overseeing the State's interests and share of costs at the West Valley Demonstration Project, a federal/State radioactive waste clean-up effort, and managing wastes and maintaining facilities at the shut-down State-Licensed Disposal Area.
- Coordinating the State's activities on energy emergencies and nuclear regulatory matters, and monitoring low-level radioactive waste generation and management in the State.
- Financing energy-related projects, reducing costs for ratepayers.

For more information, contact the Communications unit, NYSERDA, 17 Columbia Circle, Albany, New York 12203-6399; toll-free 1-866-NYSERDA, locally (518) 862-1090, ext. 3250; or on the web at www.nyserda.org

Summary of Physical and Environmental Qualities for the Proposed Long Island – New York City Offshore Wind Project Area

Final Report

Prepared for the

New York State Energy Research and Development Authority

Albany, NY
www.nyserda.org

Jacques Roeth
Project Manager

Prepared by

AWS Truepower LLC

Bruce Bailey, PhD
Project Manager

NYSERDA Report 10-22 | NYSERDA 9998-03 | October 2010

NOTICE

This report was prepared by AWS Truepower, LLC in the course of performing work contracted for and sponsored by the New York State Energy Research and Development Authority (hereafter “NYSERDA"). The opinions expressed in this report do not necessarily reflect those of NYSERDA or the State of New York, and reference to any specific product, service, process, or method does not constitute an implied or expressed recommendation or endorsement of it. Further, NYSERDA, the State of New York, and the contractor make no warranties or representations, expressed or implied, as to the fitness for particular purpose or merchantability of any product, apparatus, or service, or the usefulness, completeness, or accuracy of any processes, methods, or other information contained, described, disclosed, or referred to in this report. NYSERDA, the State of New York, and the contractor make no representation that the use of any product, apparatus, process, method, or other information will not infringe privately owned rights and will assume no liability for any loss, injury, or damage resulting from, or occurring in connection with, the use of information contained, described, disclosed, or referred to in this report.

ACKNOWLEDGEMENTS – This report was written by Bruce Bailey, PhD, Jeffrey Freedman, Esq., PhD, Peter Johnson, and Jason DuBois of AWS Truepower. Information included in the Geophysical Qualities chapter was summarized from the results of a geophysical study conducted jointly with Geo-Marine, Inc. Information included in the Natural Resources and Avian Species chapters was summarized from the results of two environmental studies conducted jointly with Energy & Environmental Analysts, Inc.

ABSTRACT AND KEY WORDS

This report presents a summary of the results of four pre-development assessment studies of physical and environmental qualities that may impact development of a proposed 700 MW offshore wind energy project in the Atlantic Ocean located approximately 14 nautical miles (16 statute miles) southeast of Rockaway Peninsula, Long Island. The information compiled by these studies is intended to provide the Long Island – New York City Offshore Wind Collaborative, which is a coalition of utilities, State and New York City agencies, and other interested parties with a baseline of knowledge to facilitate future project planning, siting, and measurement activities. Using existing data, the studies provide a preliminary review of seabed conditions (geophysical qualities), winds, waves, and currents (meteorology and oceanographic conditions), ecological natural resources, and birds (avian species), and discusses the potential interactions of each of these qualities with a proposed offshore wind project. A review of the existing data indicated that development in the proposed project area appears to be feasible; however, further field studies, data collection, and analysis are recommended to support detailed siting, design, and permitting of project components.

KEY WORDS – offshore wind energy, New York Bight, seabed conditions, winds, waves, currents, ecological natural resources, birds, NYSERDA, AWS Truepower.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

SUMMARY

This report presents the results of a pre-development assessment study of the physical qualities and environmental considerations in the vicinity of a proposed offshore wind energy project in the Atlantic Ocean southeast of Rockaway Peninsula, Long Island. The information compiled by this study is intended to provide the Long Island – New York City Offshore Wind Collaborative, which is a coalition of utilities, State and New York City agencies, and other interested parties with a baseline of knowledge to facilitate future project planning, siting, and measurement activities. The offshore wind facility, which would be developed and operated by one or more developers selected as part of a formal solicitation process by the Collaborative, is envisioned to be located within a 65,000 acre (263 km^2) area approximately 14 nautical miles (16 statute miles) southeast of Rockaway Peninsula, Long Island. This area could support up to 700 MW of nameplate wind capacity, although an initial phase could be as small as 350 MW.

The New York State Energy Research and Development Authority (NYSERDA) engaged AWS Truepower (AWST) and its subcontractors to conduct pre-development assessment studies of the physical and environmental qualities of the proposed project area as relevant to offshore wind development. The assessed qualities, documented in four detailed reports, include seabed conditions (geophysical), winds, waves and currents (meteorological and oceanographic), ecological natural resources, and birds (avian species). These categories were assessed to determine the existence and nature of perceived physical and environmental barriers, conflicts, or other fatal flaws that could preclude development of the proposed project.

This report is a summary of the four detailed reports and provides an overview of the addressed topics and the significant findings and recommendations resulting from these studies. The assessments all relied on existing information (literature, data sources, and consultation with technical experts) to evaluate environmental and physical resources that could impact or be impacted by offshore wind development in the vicinity of the proposed project area. Because of the limited availability of information within the project area, data were also obtained from the surrounding region, which is known as the New York Bight.

<u>Geophysical Qualities</u>

A comprehensive analysis of all existing available geophysical data for the project area indicated that offshore wind development in the proposed project area appears to be feasible. Water depths in the project area range from 18 to 40 m (60 to 130 ft), which is shallow enough for the installation of current wind turbine foundation technologies. The sandy benthic sediments in the proposed project area may limit the suitability of some foundation designs because of their susceptibility to scour effects; however, scour protection may mitigate these effects for other foundation types. Subsurface geology, composed of crystalline granitic rock, is not expected to impose a significant obstacle for project construction. Multiple

faults in the New York Bight region may be sources of low-intensity seismic activity in the vicinity of the proposed project area.

Meteorological and Oceanographic Conditions

Expected meteorological and oceanographic conditions in the project area are compatible with commercially-available offshore wind turbine technologies. Average wind speeds at a representative hub height of 90 m (292 ft) are predicted to be approximately 8.8 m/s (±0.3 m/s; 19.7 mph ±0.7 mph). Ten-minute extreme wind speeds on the order of 50 m/s can be expected to occur every 50 to 100 years, corresponding to a peak three-second gust of about 63 m/s (140 mph). The average turbulence intensity at a reference wind speed of 15 m/s (34 mph) is anticipated to be 0.06 to 0.07. The prevailing winds are from the south and southwest, although they trend from the west and northwest in autumn and winter. Sea breezes are a frequent local phenomenon during the warm season and produce daily wind speed maxima during high electric load periods of hot summer afternoons.

The proposed offshore wind project's energy production was simulated for five different turbine models in both a 350 MW and 700 MW turbine array. The selected turbine models are: GE 4.0 MW (110-m rotor diameter), Vestas V112 3.0 MW (112-m rotor diameter), Multibrid M5000 5.0 MW (116-m rotor diameter), REpower 5.0 MW (126-m rotor diameter), and Siemens 3.6 MW (120-m rotor diameter). For a 350 MW layout, these winds are expected to generate between 1,070 to 1,325 GWh annually, corresponding to a net capacity factor range of 34.9 to 43.4 percent. For a 700 MW layout, expected annually generation ranges from 2,107 to 2,625 GWh, corresponding to a net capacity factor range of 34.3 to 42.8 percent.

Regional waves are composed of the combination of short period/short wavelength locally wind-generated waves and longer period/longer wavelength swells that propagate from the open North Atlantic Ocean. In general, the most energetic waves/swells come from the east and southeast. The mean significant wave height is on the order of 1.1 to 1.6 m, and average wave periods of 8.3 and 9.1 seconds correspond to moderate short-period swells that often traverse the region. The absolute extreme wave height for 50-year and 100-year return periods is estimated to be 16.0 m (52.5 ft) and 17.1 m (56 ft), respectively. The principal current components near the project site are the north Gulf Stream countercurrent, consisting of cold water that is flowing slowly to the west and southwest, and wind-generated near-surface currents. Surface current speeds average about 23 cm/s, but the daily time series shows that velocities can reach in excess of 70 cm/s. Sub-surface current speeds tend to be less than 10 cm/s, and the predominant direction is from the north northeast. Sea floor topography and these sub-surface and bottom currents will determine the magnitude of sediment transport, scouring, and forces impinging upon wind turbine foundation structures. At mean bottom current speeds (5 cm/s or less), sediments up to 0.5 mm in diameter can be transported; at 15 cm/s (maximum observed), particles up to 1 mm are suspended in transport.

Natural Resources

The New York Bight is a highly productive ecosystem that provides habitat for finfish, shellfish, benthic invertebrates, birds, sea turtles, terrapins, marine mammals and vegetative communities. Included are endangered and threatened species, and species of concern. Other important resources and related activities include commercial and recreational fishing, navigation, artificial reefs, sand borrow areas, and visual resources, among others. Offshore wind development has the potential to impact all or most of these resources during the project's construction and operational phases. The nature and intensity of the impact is dependent on the setting, the species found in the project area, the communities using the environment, the selected turbine foundation type(s), and other factors. Construction-related impacts are expected to consist of noise from pile driving (for monopile and jacket foundation types, if used), sediment suspension and deposition caused by cable burial procedures and other activities, and localized closures of areas to fishing and vessel passage, among other impacts. These activities, which can be traumatic to sensitive wildlife, are temporary and their impacts can be mitigated through various measures. For example, jet plowing activities for cable installation will result in temporarily suspended sediment and the physical removal of benthic organisms in the direct path of the jet plow, which is estimated to displace three square feet of sea floor for each linear foot of installed cable; these impacts, however, are not expected to be far-reaching, as benthic communities are expected to regenerate within a year following cable installation.

There may also be impacts to natural resources during the project's lifetime. Operational noise of the turbines that vibrates down the tower structure into the surrounding water and seabed can cause avoidance behavior by some species. Electromagnetic fields generated by electric cables may have an impact on fish, sea turtles and marine mammals, but the significance of this impact is unclear and research has been inconclusive. The benthic habitat directly beneath the turbine foundations and offshore substation platform foundation(s) would be permanently lost by the development of the proposed project. Although wind project footprints are large, the actual area of impact from the foundation footprints is relatively small compared to the surrounding benthic environment. The introduction of submerged hard substrate in the form of wind turbine foundations may initiate the development of a new epibenthic community within the project area. This may in turn attract fish, which may also attract birds.

Commercial fishing activities, especially those using mobile gear types (bottom otter trawl, sea scallop dredge, and ocean quahog/surf clam dredge), that cover large sections of the sea floor as they fish, may be impacted by the presence of wind turbines in fishing grounds. The level of impact will depend on the fishing gear types and by limitations, if any, placed on fishermen. There are not expected to be negative impacts on recreational fishing.

Existing uses of the New York Bight may also impact development. U.S. Coast Guard weapons training areas partially overlap the proposed project area and may impact future turbine siting.

Avian Species

The New York Bight also provides habitat and migratory space for multiple bird species. Species groups such as seaducks, loons, grebes, shearwaters and petrels, gannets, wading birds, raptors, shorebirds, gulls and terns, alcids, and passerines may all be found in these waters. Additionally, a number of endangered, threatened, and species of concern may use project area waters or migrate through the area, including the piping plover, roseate tern, common tern, least tern, listed diurnal raptors, and common loon. Diurnal raptors include the peregrine falcon, northern harrier, bald eagle, osprey, and several hawk species. Regional avian surveys indicate that bird density varies by season and generally decreases with increasing distance offshore, especially beyond five miles from shore.

As with the other regional natural resources, marine and coastal birds and bats may be affected by the installation and operation of offshore wind turbines. Construction activities can cause temporary displacement of birds (e.g., shearwaters, alcids, seaducks and loons) due to increased human and vessel traffic, equipment presence, and noise related to pile driving. Other species, especially those that actively follow vessels to feed on offal, (such as gulls and terns), may be attracted to the area during construction. Cable laying in shoreline areas may directly disturb coastal habitats. Most of these impacts are anticipated to be short-term. During a wind project's long-term operational phase, impacts to birds may include barrier effects (deflection or avoidance of birds around turbine arrays), habitat loss (displacement of bird populations in and/or around the project area), and collision fatalities (direct mortality resulting from birds being struck by or flying into wind project components). Although not generally associated with marine habitats, it is possible that certain bat species may follow Atlantic coast migration corridors, which could potentially make them susceptible to impacts as well.

Several mitigation measures are available and recommended to reduce potential impacts on birds and bats. These include: conducting coastal and offshore surveys to identify important feeding, nesting, staging and wintering areas and to avoid siting facilities and cable paths in or near these areas; timing major construction and noise-generating activities to avoid periods when marine and coastal birds are nesting near construction zones; limiting the use of steady-burning bright lighting in order to reduce attraction of birds to construction and service vessels; and using environmentally-sensitive construction methodologies.

Conclusions

Although impacts to ecological natural resources within the New York Bight are anticipated, no fatal flaws were identified that would currently preclude development of the proposed offshore wind project. Significant barriers to development also were not identified for the geophysical, meteorological, and oceanographic qualities investigated. While the data reviewed and summarized for this pre-development assessment is representative of known conditions in the vicinity of the project area, the collection of site specific field data is required to confidently determine the feasibility of the proposed project area and to support detailed siting, design, and permitting of all components of an offshore wind project. Additionally, environmental (i.e., natural resources and avian) considerations will be further addressed as part of an environmental impact study, which will explore the impact of project development in much greater depth. Regulatory agencies will define the extent and scope of the baseline environmental data collection and follow-on studies that will be necessary.

Note: citations are not included in this summary report but may be found in the full reports.

Section 1

1. INTRODUCTION

The Long Island – New York City Offshore Wind Collaborative (the "Collaborative"), a coalition of utilities, State, and New York City agencies, is seeking to obtain power from a future offshore wind energy facility located in the Atlantic Ocean. The offshore wind facility, which would be developed and operated by one or more developers selected as part of a formal solicitation process, is envisioned to be located within a 65,000 acre (263 km^2) area approximately 14 nautical miles (16 statute miles)[1] southeast of Rockaway Peninsula, Long Island. The proposed project area could support up to 700 MW of nameplate wind capacity, although an initial phase could be as small as 350 MW.

The New York State Energy Research and Development Authority (NYSERDA) engaged AWS Truepower (AWST) and its subcontractors to conduct pre-development assessment studies of the physical and environmental qualities of the proposed project area and its surroundings. The assessed qualities were grouped into four general categories—seabed conditions (geophysical), winds, waves, and currents (meteorological and oceanographic), ecological natural resources, and birds (avian species)—and documented in four detailed reports. A preliminary review of these qualities is critical in the initial planning stages to determine the existence and nature of perceived physical and environmental barriers, conflicts, or other fatal flaws that could preclude development of the proposed project. This information is intended to provide interested parties with a baseline of knowledge to facilitate future project planning, siting and measurement activities. Should the project concept be advanced, future activities would be expected to address these topics in greater depth (such as on-site field measurements) and investigate other important topics (social, economic, cultural, etc.), as well.

This report is a summary of the four detailed reports and provides an overview of the addressed topics and the significant findings and recommendations resulting from these studies. The assessments all relied on existing information (literature, data sources, and consultation with technical experts) to evaluate environmental and physical resources that could impact or be impacted by offshore wind development in the vicinity of the proposed project area. Because of the limited availability of information within the project area, data were also obtained from the surrounding region, which is known as the New York Bight. Figure 1 identifies the project area as well as the New York Bight, which extends from Cape May, New Jersey to Montauk Point, New York. Also shown in the figure are: 1) the Rockaway Peninsula, which is the locale where the transmission cable from the offshore wind project is proposed by the Collaborative to interconnect with the existing transmission grid; and 2) designated shipping lanes that lead to and from New York Harbor.

[1] A nautical mile equals 1.15 statute miles.

The titles of the four detailed reports with complete citations and the contributing firms are as follows:

- *Pre-Development Assessment of Geophysical Qualities for the Proposed Long Island – New York City Offshore Wind Project Area* – AWS Truepower and Geo-Marine
- *Pre-Development Assessment of Meteorological and Oceanographic Conditions for the Proposed Long Island – New York City Offshore Wind Project Area* – AWS Truepower
- *Pre-Development Assessment of Natural Resources for the Proposed Long Island – New York City Offshore Wind Project Area* – AWS Truepower and Energy & Environmental Analysts
- *Pre-Development Assessment of Avian Species for the Proposed Long Island – New York City Offshore Wind Project Area* – AWS Truepower and Energy & Environmental Analysts

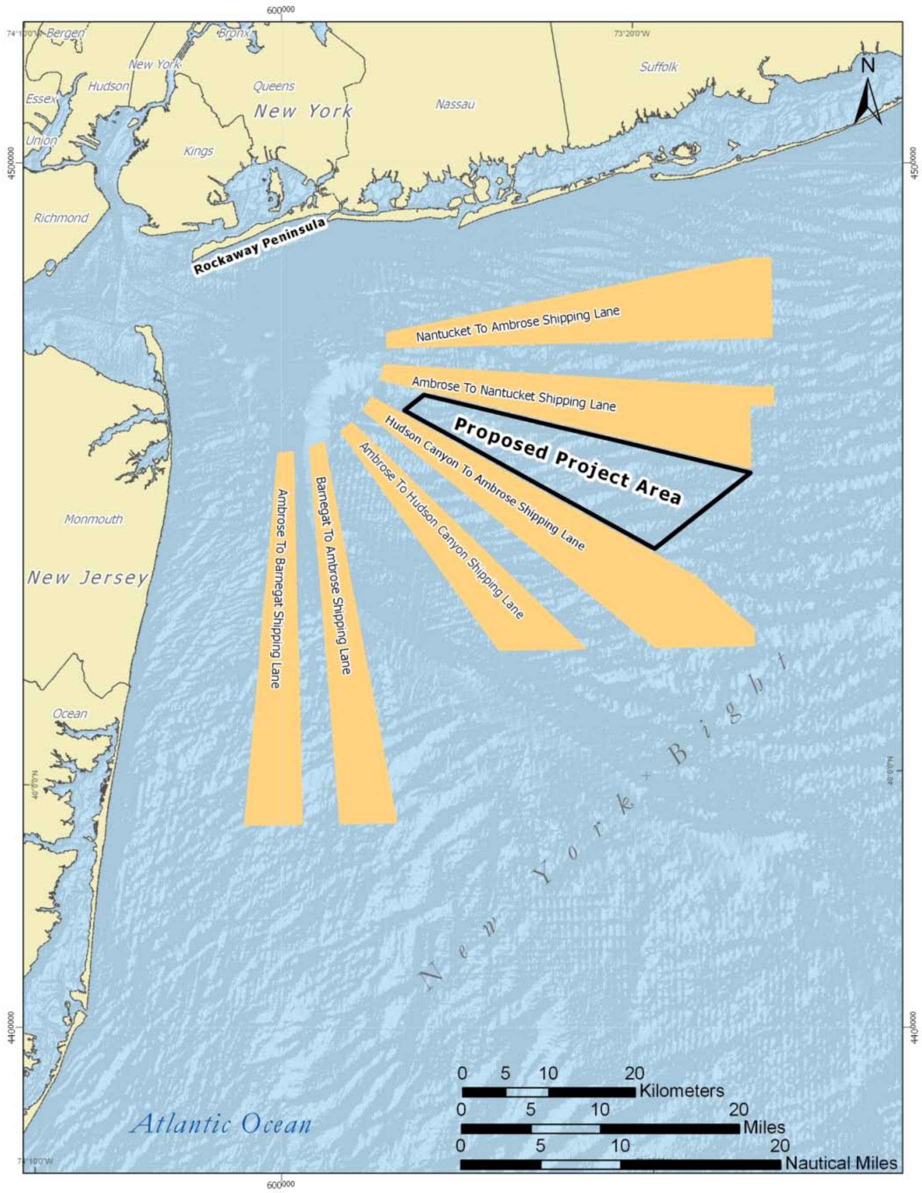

Figure 1.1. Project Area for Proposed Long Island – New York City Offshore Wind Project

Section 2

2. GEOPHYSICAL QUALITIES

Geophysical qualities of the seabed will impact wind project design, particularly with respect to foundations and turbine placement. Water depth and seabed sediment characteristics are significant attributes for foundation design and are construction parameters. The foundation is often driven into the seabed for added stability. Specific geophysical qualities addressed in this assessment include: bathymetry (water depth); bottom (benthic) features and sediments and vulnerability to currents, scouring, and sand waves; subsurface geology; seismicity and side-scan sonar and magnetometer survey data; and obstructions, including wrecks, shallow hazards, unexploded ordinances, and archaeological resources. The relevance of these qualities to wind turbine foundation types is included.

2.1. BATHYMETRY

The continental shelf of the New York Bight slopes gently seaward and to the southeast. Within the proposed project area, water depths range from 18 m to 40 m (60 to 130 ft). These depths are shallow enough for the installation of current wind turbine foundation technologies. The shallowest waters are in the northwest portion in an area known as the Cholera Bank. Sand ridges between 10 km and 50 km (6 and 31 mi in length), and approximately 2 km (1.2 mi) apart exist within the region. These ridges have an average relief of 10 m (33 ft) and are generally oriented northeast to southwest.

2.2. BENTHIC SEDIMENTS

The New York Bight was created about 20,000 years ago at the end of the last Pleistocene glacial advance, of which Long Island represents the southern terminus. Dominant bottom sediments on the continental shelf include fine to medium-grained sand. Additionally, patches of coarse sand and gravel are associated with regions of outcropping coastal plain strata, such as Cholera Bank. With the exception of the Cholera Bank, bottom surficial sediments in the project area are approximately 10 m (33 ft) thick. The sandy sediments are composed mostly of quartz (70 to 95 percent composition) and feldspar (at most 25 percent composition).

Sandy sediments are more susceptible to the scouring effects from currents diverging around installed structures than coarser and consolidated sediments. Therefore, some wind turbine foundation designs may be more suitable for the proposed project area than others; however sufficient scour protection may mitigate scour effects for other foundation types.

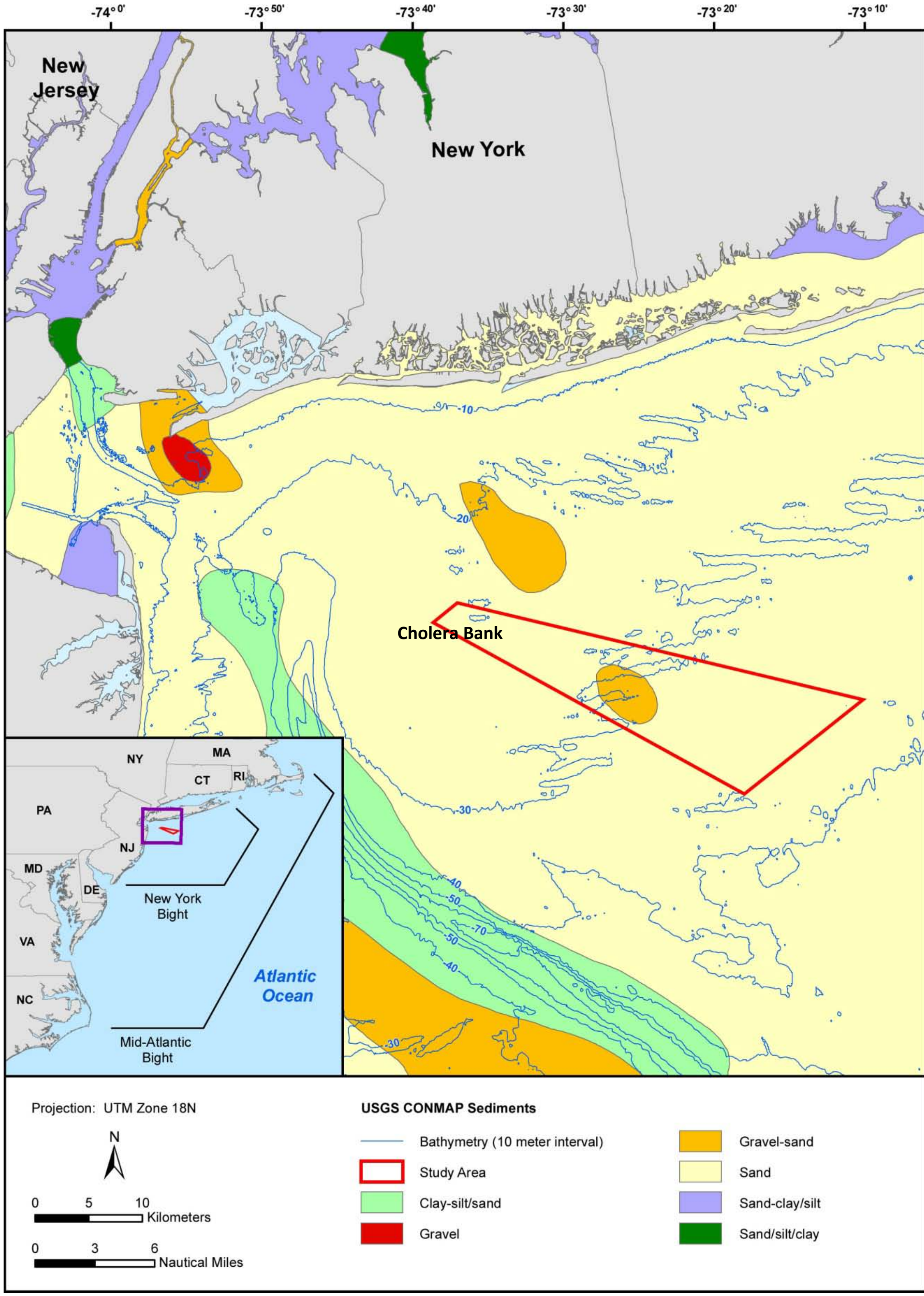

Figure 2.1. Surficial Sediments of the New York Bight

2.3. SUBSURFACE GEOLOGY

Below the benthic sediment layer are strata consisting of semi-consolidated quartzose sand and gravel overlying glauconitic silty sand and clay. Figure 2.1 illustrates the layers of sediment deposits and bedrock existing within the region. The basement geology (bottom or oldest rock layer) is associated with the creation of the Appalachian Mountains and is composed of crystalline granitic rock, which continues beneath the coastal plain and continental shelf deposits.

It is not anticipated that the subsurface geology will impose a significant obstacle to the construction of a wind project. Wind turbine foundation design will be strongly influenced by confirmed, site-specific subsurface geology. Generally, stronger and thicker strata will provide more stability to driven piles.

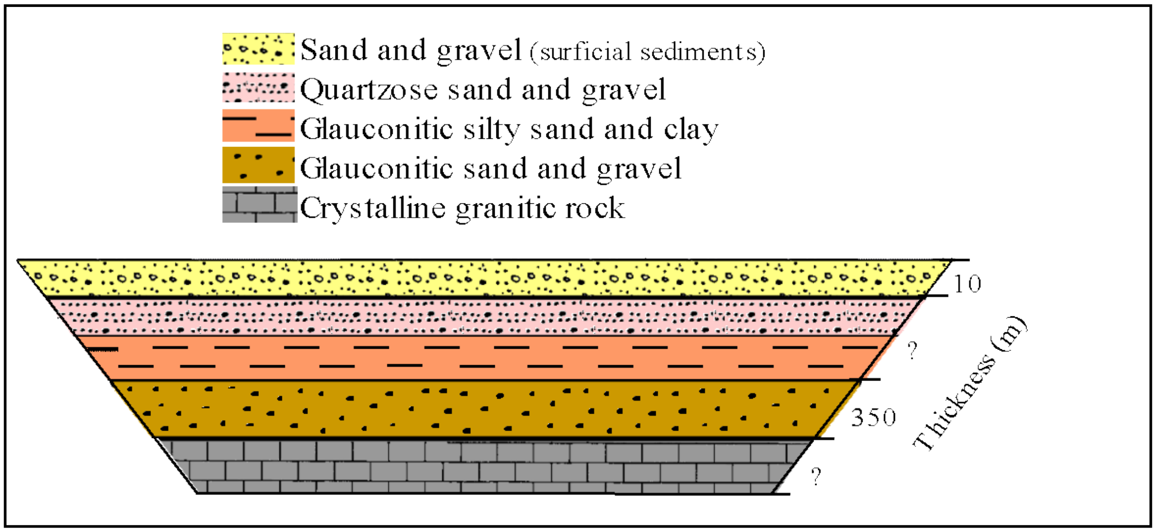

Figure 2.2. Stratigraphic Column of Subsurface Geology in Region

2.4. SEISMICITY

Multiple faults in the New York Bight region may be sources of seismic activity in the vicinity of the proposed project area. Forces exerted on wind turbine structures from seismic events may pose limitations in siting location as well as foundation design.

The New York Bight Fault is the largest fault in the region, and extends at least 50 km (31 mi) in length. From its southern terminus approximately 26 km (16 mi) east of southern Monmouth County in New Jersey, it trends to the north-northeast for about 30 km (19 mi) then angles to the northeast, ending just south of Long Island near the Nassau-Suffolk County border. The fault intersects the project area in the vicinity of the Cholera Bank. Multiple low intensity and magnitude (less than 1.0 to 2.7 Richter magnitude) earthquake events may be associated with this fault.

2.5. OBSTRUCTIONS

A query of the Office of Coast Survey's Automated Wreck and Obstruction Information System database returned 26 submerged obstructions in the vicinity of the project area. Of these, 19 were identified as shipwrecks. Shipwrecks may be considered archaeological resources. Shipwrecks may also provide important habitat for a variety of benthic marine species and commercial fish species, and may be considered biologically sensitive habitats. The discovery of the remains of any historic ship or boat located during subsequent archaeological investigations of the project area would have a high potential to be historically significant on a local, regional, national, or even international level. A review of archaeological resources in the proposed project area would be conducted by the New York State Historic Preservation Office within 30 days of a formal request.

Based on known records, there are no current listings of U.S. Department of Defense-related munitions and explosives of concern or of chemical warfare material in the immediate vicinity of the project area. However, lying adjacent to Cholera Bank, there are one or more former municipal oceanic sewage sludge and acid waste dump sites.

Obstructions (shipwrecks and other shallow hazards) are not likely to materially interfere with development in the proposed project area. General practice is to avoid siting foundations in the immediate vicinity of obstructions.

2.6. WIND TURBINE FOUNDATION DESIGN OPTIONS

A variety of wind turbine foundation designs exist for offshore marine sites. The type(s) of foundation utilized for the proposed project should be determined by site-specific engineering studies of physical environment conditions (sediment and subsurface geologic composition and depth) and processes (winds, waves, and currents). Structural and environmental constraints will ultimately determine which foundation is best suited for the project area. Figure 2.3 illustrates five basic wind turbine foundation designs: monopile, tripod, suction caisson, gravity base, and jacket. A comparison of the different designs and summaries of the benefits and drawbacks of each can be found in the full Geophysical Qualities report.

As noted previously, the project area is dominated by medium-grained sandy sediments. Sands are more susceptible to scour than more cohesive sediments such as mud, silt, and clay. Therefore, scour protection (e.g., seaweed diversion fences or boulder and rock layers at the pile base) may be required for installations within the proposed project area.

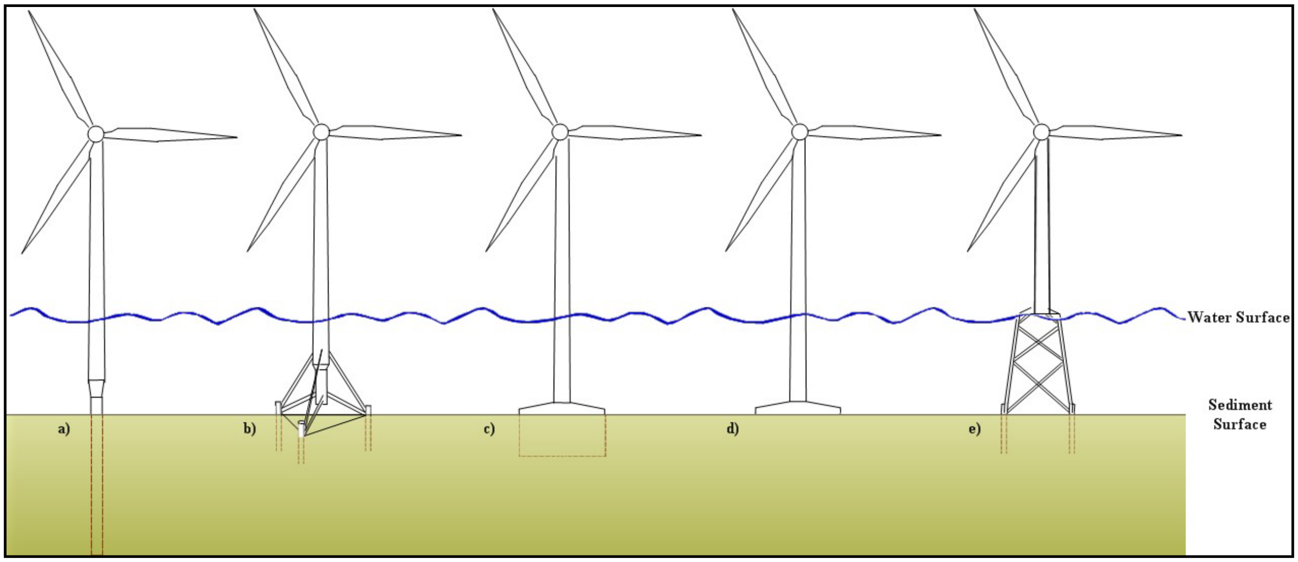

Figure 2.3. Basic Wind Turbine Foundation Designs
(a) Monopile, (b) Tripod, (c) Suction Cassion, (d) Gravity Base, and (e) Jacket

2.7. FOLLOW-ON WORK

Geophysical site-specific conditions (bathymetry and sediment and subsurface geology composition and thickness) are significant factors to be examined for project siting, foundation design, and construction effort.[2] As the next step in further assessing the feasibility of offshore wind development within the proposed project area, technical site surveys are recommended to better understand sediment characteristics, stratification beneath the seabed, and locations of submerged obstructions or hazards.

Sediment, subsurface, and obstruction/hazard surveys may include, but are not limited to:

- Sonar (multibeam and side-scan)
- Sub bottom profiling
- Seismic reflection profiling
- Core sampling
- Magnetometer surveys
- Wave/Current modeling

Each geological survey listed above is useful to obtain specific data relevant to offshore wind project development. While both side-scan and multibeam sonar surveys provide image-based data regarding seabed shape and geologic composition, only multibeam sonar surveys will also indicate bathymetric differences. Sub bottom profiling and seismic reflection surveys are used to identify and measure stratification beneath the seafloor via assessment of structural geology and sedimentation patterns. Core

[2] For example, some turbine foundations are driven into the seabed; therefore, thicker sediments may require longer or multiple monopiles to increase structural stability.

samples are useful to determine sediment/geologic composition representative of the area of intent. Magnetometer surveys detect anomalies in the earth's magnetic field caused by obstructions and hazards composed of or consisting of ferrous metals (steel and iron), which may be partly or wholly buried beneath the sediment. Lastly, waves and currents are dynamic physical processes constantly causing changes at the water-sediment interface. Wave/current modeling may provide information on sediment movement and re-distribution.

2.8. CONCLUSIONS

A comprehensive analysis of all existing available geophysical data for the project area indicated that offshore wind development in the proposed project area appears to be feasible, and no fatal flaws were identified based on existing data. Still, while the data reviewed and summarized for this report is representative of known conditions in the vicinity of the project area, the collection of site specific field data is required to confidently determine the feasibility of the proposed project area and to support detailed siting, design, and permitting of all components of an offshore wind project. The need for recent site specific geophysical data is further supported by the fact that several factors can contribute to changes, sometimes quickly, in the marine environment (i.e., storms, river runoff, and dredging), and historical data may not be reflective of present-day conditions. Therefore, in order to better characterize the seafloor, subsurface geology, and known and unknown submerged hazards, further site specific geophysical and geotechnical analyses are recommended to provide a more complete assessment of present-day conditions of the project area. Suggested surveys include: multibeam and side-scan sonar, magnetometer surveys, sub bottom and seismic reflection profiling, core sampling, and wave and current modeling.

Section 3

3. METEOROLOGICAL AND OCEANOGRAPHIC CONDITIONS

Meteorological and oceanographic conditions will impact project design and the amount of energy produced from the proposed offshore wind project. The wave environment and ocean currents will influence foundation design options, site accessibility, and safety, while the wind resource will affect turbine technology selection, project layout, and annual and seasonal energy production. Other meteorological conditions, such as temperature, pressure, air density, and sea breeze circulations, will also impact overall project feasibility.

This section provides information on the average and extreme wind, wave, and current conditions expected in the vicinity of the proposed project area. In addition, predictions of annual energy production from commercially available turbines are presented, together with indications of seasonal patterns and the electric load matching qualities of the wind resource. Recommendations are given for future field measurement campaigns.

3.1. METEOROLOGICAL CLIMATOLOGY

3.1.1. Wind Resource Characteristics

This study primarily relied on nearby buoys, Coastal-Marine Automated Network (C-MAN) stations, and modeled data to best characterize the climate of the proposed project area. These data sources included National Data Buoy Center (NDBC) archived data from buoy 44025 and the Ambrose Light Coastal-Marine Automated Network (C-MAN) station (ALSN6), and AWS Truepower's modeled ***windTrends*** data set interpolated to a representative point in the project area. The windTrends data set is a simulated hourly time series, beginning in 1997, of Mesoscale Atmospheric Simulation System (MASS) model output covering the conterminous United States and southern Canada. The windTrends data set has been validated using a combination of over 1000 tall meteorological towers and more than 800 National Climatic Data Center (NCDC) long-term climate stations. The typical standard error between the modeled data and actual observations is on the order of 0.35 m/s. Due to the lack of observations near the project area and confidence in the windTrends data set, the modeled data played an important role in this analysis. The coordinates, periods of record, and monitoring configurations of each data source are contained in Table 3.1. Each data reference location is indicated on the regional wind resource map in Figure 3.1.

Table 3.1. Data Source Summary

Name	Station Type	Coordinates (WGS84)		Period of Record	Monitoring Heights (m)			
		Latitude (°N)	Longitude (°W)		Wind Speed	Wind Direction	Temp.	Relative Humidity
ALSN6	C-MAN	40.450	73.800	27 Nov 1984 – 28 Jul 2008	28.9 20 10	28.9	28.9	28.9
windTrends Data Set	Modeled data set	40.326	73.449	1 Jan 1997 – 31 Dec 2009	90 80 50	90 80 50	90 80 50	90 80 50
44025	Buoy	40.250	73.166	29 Apr 1991 – 31 Jan 2010	5	5	4	4

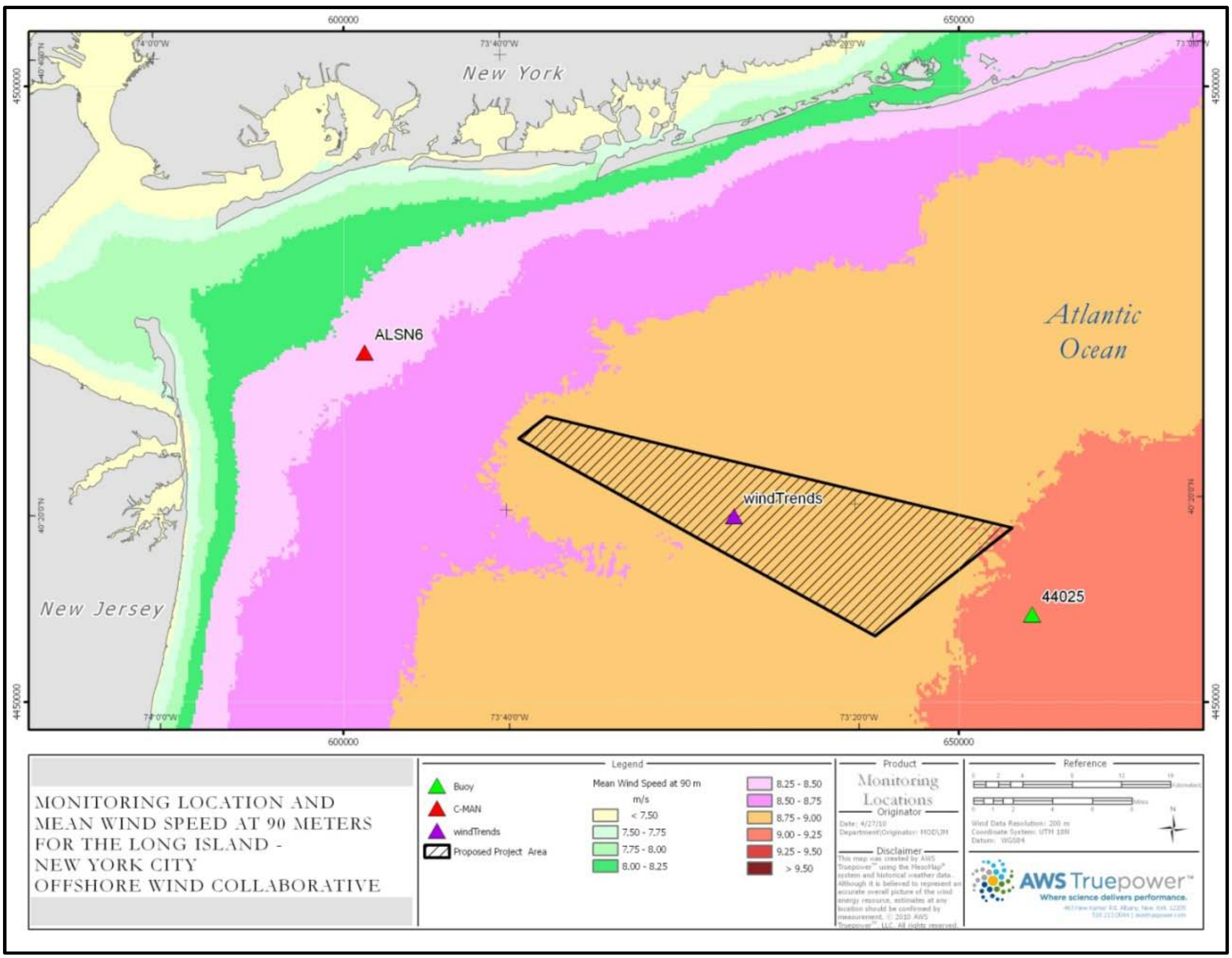

Figure 3.1. New York Bight Offshore Wind Resource Map.

Table 3.2 provides a summary of key wind resource variables estimated for the vicinity of the project area at a reference height as well as at historic measurement heights. For the purposes of this study, a reference height of 90 m was selected to represent the hub height of an offshore wind turbine. Using appropriate wind shear (change of wind speed with height) and uncertainty assumptions, an annual average wind speed map (Figure 3.1) at the reference height for the vicinity was prepared. Within the proposed project area, the predicted mean wind speed is approximately 8.8 m/s (±0.3 m/s; 19.7 mph ±0.7 mph). This value is comparable to some of the windiest wind development areas in the Great Plains of the United States. Annual average wind speeds increase with distance from shore, although during sea breeze events, the strongest offshore winds can occur close to shore.

Table 3.2. Summary of Wind Resource Characteristics

Parameter	ALSN6 (Buoy)	windTrends Data Set (modeled)	44025 (Buoy)
Measurement Height (m)	28.9	90	5
Mean Wind Speed (m/s)	7.6	8.8	6.6
Annualized Speed (m/s)	7.6	8.8	6.6
Wind Shear Exponent (Heights)	0.12 (28.9 m / 20 m)	0.14 (90 m / 50 m)	N/A
Turbulence Intensity @ 15 m/s Speed Bin	0.07	0.06	N/A
Projected 90-m Wind Speed (m/s)	8.7 (±0.3)	8.8 (±0.3)	9.8 (±1.0)
Weibull Parameters @90m (A/k)	10.0 m/s / 2.1	10.3 m/s / 2.3	11.1 m/s / 2.0
Prevailing Wind and Energy Direction	S / WNW	SSW / SSW	SSW / WNW
Air Density (kg/m^3) [Height]	1.26 [28.9 m]	1.23 [90 m]	1.26 [4 m]

Average wind shear exponents within the project area are expected to be approximately 0.12-0.14. These values are consistent with the low surface roughness of an offshore environment and are much lower than what can be expected over adjacent land areas, where the surface roughness is much higher. Episodes of higher offshore shear (typically greater than 0.2) are expected during the spring and early summer when the atmosphere is most stable, with warm air present above the colder ocean water, whereas periods of lower shear (e.g., less than 0.1) are common during the fall and winter seasons, when cold air flows over the relatively warm coastal and offshore waters.

The expected average turbulence intensity (TI), a measure of wind speed fluctuations at a time scale on the order of seconds, at a reference wind speed of 15 m/s (the value set forth by the International Electrotechnology Commission [IEC] to assess turbine load fatigue) is estimated to range from 0.06 to 0.07 in the vicinity of the project area. TI over adjacent land areas can be expected to be much higher (on the order of 0.15 – 0.20). The expected offshore TI values are well within the requirements for the Class IA turbines that were selected for the energy assessment analysis.

The Weibull function is an analytical curve that describes the wind speed frequency distribution, or number of observations in specific wind speed ranges over the course of the year. Its two adjustable parameters allow a reasonably good fit to a wide range of actual distributions. *A* is a scale parameter related to the mean wind speed while *k* controls the width of the distribution. Values of *k* typically range from 1 to 3.5, the higher values indicating a narrower distribution. The *k* values, which were derived from the observed and modeled data, range from 2.0 to 2.3 and are indicative of a variable wind resource with occasional high wind events. Figure 3.3 contains a chart from the modeled data showing the frequency distribution and the fitted Weibull curve for a height of 90 m.

Seasonally, the strongest average winds normally occur during the winter and early spring, while the weakest winds occur in the summer, although sea breezes produce periods of relatively strong winds. This annual trend is consistent with the seasonal climatology that features stronger atmospheric temperature and pressure gradients during the cold season. During the day, average winds reach a minimum during the late morning and peak during the late afternoon and early evening hours.

Annually, the prevailing wind direction sectors are expected to be south and southwest (Figure 3.2). During the spring and summer, the prevailing sectors are projected to be south and southwest, while the autumn and winter prevailing wind directions are expected to be from the west and northwest sectors.

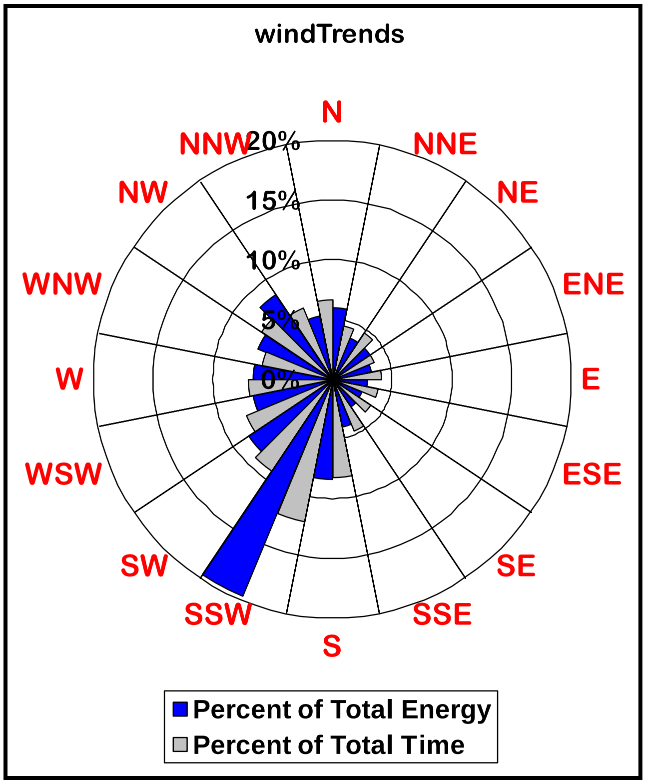

Figure 3.2. New York Bight Expected Annual Wind Rose.

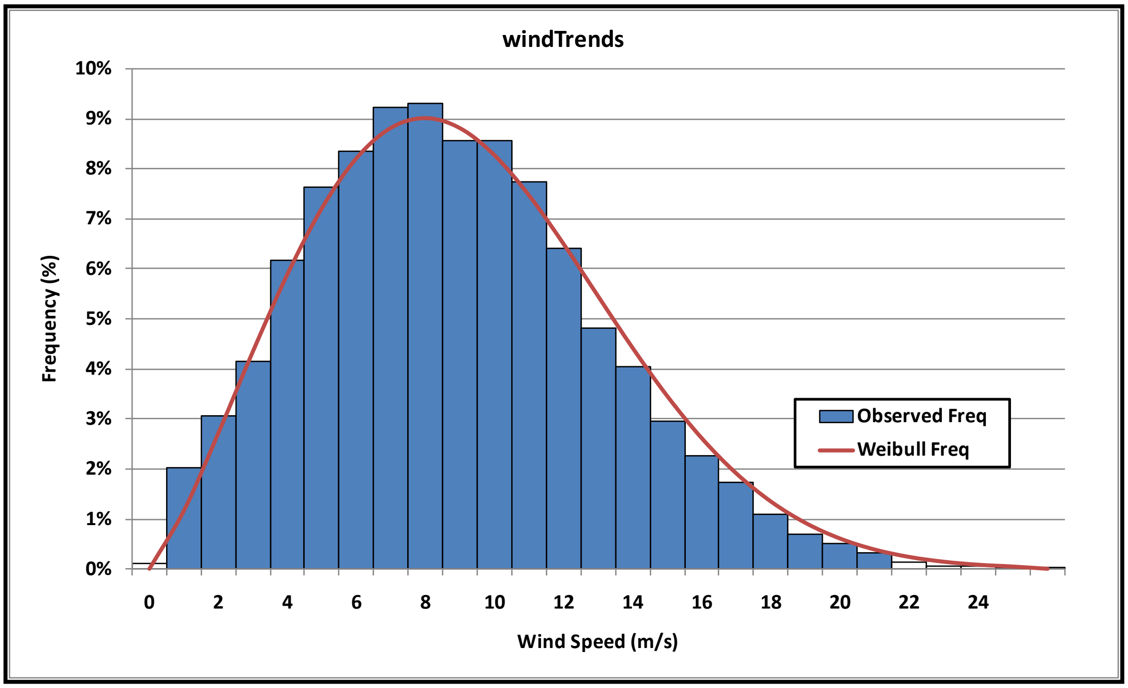

Figure 3.3. 90-m Wind Speed Frequency Distributions and Fitted Weibull Curves (windTrends).

3.1.2. Extreme Wind Climatology

The New York Bight is prone to two types of strong weather systems capable of producing extreme wind conditions: (1) extratropical cyclones, which are low pressure systems that occur in the mid-latitudes, and (2) hurricanes. According to data available from the National Hurricane Center, a strong category two (wind speeds > 42 m/s and < 49 m/s) or a minimal category three (wind speeds > 49 m/s and < 58 m/s) hurricane is the most intense storm that can be expected to impact the region. Over the past 100 years, only two hurricanes tracked through the project area (Belle in 1976 and Gloria in 1985) with one-minute sustained wind speeds exceeding 40 m/s (89 mph).

Extreme maximum gusts are important to consider when assessing the suitability of a wind turbine, as each turbine manufacturer sets forth maximum gust values as part of their extreme loading criteria. Within the proposed project area, 10-minute extreme wind speeds on the order of 50 m/s can be expected to occur every 50 to 100 years at a 90-m hub height: this corresponds to a peak three-second gust of about 63 m/s (140 mph). These extreme values fall within the acceptable range for most commercial offshore wind turbine models.

3.1.3. Sea Breeze and Enhanced Thermal Circulation

The New York Bight is especially favorable for the development of enhanced sea breeze circulations during the warm season, particularly during periods of high electric load demand. From an energy production perspective, the enhanced thermal circulation produces wind speed/wind power maxima during high load periods of hot summer afternoons. Although winds well inland may remain light, wind speeds in the near and offshore waters can exceed 15 m/s near hub height during the mid and late afternoon hours, coincident with the time of peak load demand. The sea breeze circulation within the New York Bight is most common during the warm season (spring and summer), occurring on about 20 percent of all such days. Wind speeds tend to be lower than the annual hourly means in the early morning and overnight hours, but afternoon maxima frequently exceed the mean daily peak wind speeds.

3.1.4. Other Meteorological Parameters

Other meteorological parameters, such as air temperature, sea-surface temperature, air pressure, and relative humidity are important to consider during wind project development. Regionally measured and modeled values for these parameters are summarized in Table 3.3. These average values provide a good representation of what can be expected in the project area.

Statistics on other meteorological phenomena, such as lightning, icing, and structural corrosion, were also compiled. Using a global lightning climatology database, lightning density in the project area is estimated to be approximately 4.7 flashes/km^2/year. This database includes both cloud-to-ground and cloud-to cloud lightning strikes. It is important to realize that this frequency may increase once turbines are installed, as they will be the tallest objects in the area and essentially act as lightning rods.

Frequent or prolonged ice accumulation on wind turbine blades can significantly reduce the generation performance of a wind plant. Two primary types of icing exist within the region: (1) atmospheric icing, which includes glaze (caused by liquid rain or drizzle that freezes on contact with a surface) and rime (white or milky deposit of ice formed by the rapid freezing of super-cooled water drops (i.e., fog) as they impinge upon an exposed object), and (2) icing from sea spray. For the New York Bight area, the atmospheric icing frequency is predicted to be minimal, occurring less than 0.1 percent (below nine hours per year). Icing from sea spray is expected to be limited to elevations below 16 m (52 ft), which is below the lowest approach of the wind turbine blades.

Two critical parameters that influence corrosion of infrastructure are the time of wetness (TOW), where the structure is immersed or covered by an aqueous film, and the corrosive character of the environment in contact with the structure. For the purposes of ISO (International Organization for Standardization) Standard 9223 ("Corrosion of Metals and Alloys–Corrosivity of Atmosphere–Classification"), conditions favorable for the formation of a surface layer of moisture on a metal or alloy has been defined as the time period during which the relative humidity is in excess of 80 percent and the temperature is above 0^{o}C (32^{o}F). According to regional weather buoys, these conditions are met 40 percent to 51 percent of the time.

Table 3.3. Annual Summary of Other Meteorological Parameters

Parameter	ALSN6	windTrends Data Set	44025
Period of Record	11/27/84 – 7/28/08	1/1/97 – 12/31/09	4/29/91 – 1/31/10
Measurement Height (m)	28.9	90	4
Sea-Level Air Pressure (mb)	1017.1	1016.2	1016.3
Relative Humidity (%)	72.3	N/A	77.6
Sea-Surface Temperature (°C)	12.7	N/A	12.9
90-m Air Temperature (°C)	12.1	11.6	11.8
90-m Extreme Minimum Air Temperature (°C)	-19	N/A	-15
90-m Extreme Maximum Air Temperature (°C)	36	N/A	27

3.2. ENERGY PRODUCTION

The proposed offshore wind project's energy production—for annual, monthly, and hourly periods—was simulated for five different turbine models in both a 350 MW and 700 MW turbine array. The arrays were constructed assuming a ten rotor diameter spacing. The selected turbine models are: GE 4.0 MW (110-m rotor diameter), Vestas V112 3.0 MW (112-m rotor diameter), Multibrid M5000 5.0 MW (116-m rotor diameter), REpower 5.0 MW (126-m rotor diameter), and Siemens 3.6 MW (120-m rotor diameter). These particular turbines were chosen as a representative cross-section of current offshore turbine technology. The International Electrotechnology Commission (IEC) classification of all five turbine models selected for this analysis was determined to be wind class IA, indicating that based on the information used in this analysis, the turbine models are suitable for the proposed project area.

In each case, the long-term wind speed frequency distribution for the project area was applied to the appropriate density-adjusted turbine power curve to yield an estimated gross energy output that was then reduced to account for plant and wake losses, excluding parasitic losses. The total losses are estimated to range from 20.7 percent (Vestas V112 and REpower 350 MW layout) to 23.9 percent (Multibrid 700 MW layout).

Table 3.4 and Table 3.5 summarize the estimated annual gross, net energy production, and net capacity factor for each turbine model for the 350 MW and 700 MW layouts, respectively. A common hub height of 90 m was assumed for the purpose of this analysis. For the 350 MW layouts, the estimated annual net energy production is expected to range from 1,069.5 GWh (Multibrid 5.0-MW) to 1,324.5 GWh (Vestas V112 3.0 MW), while the net capacity factor is predicted to range from 34.9 percent (Multibrid 5.0 MW) to 43.4 percent (Vestas V112 3.0 MW). For the 700 MW layouts, the estimated annual net energy production is expected to range from 2,106.6 GWh (Multibrid 5.0 MW) to 2,625.3 GWh (Vestas V112 3.0 MW), while the net capacity factor is predicted to range from 34.3 percent (Multibrid 5.0 MW) to 42.8 percent (Vestas V112 3.0 MW).

The net capacity factor is only a measure of the efficiency of a plant; in addition to this metric, turbine availability, pricing, warranty provisions, and suitability should also be considered when selecting the most appropriate turbine model for a project. Through comparison, the larger area of the 700-MW turbine array results in a lower capacity factor than the 350-MW array of the same turbine model because more wake loss is generated with the greater number of turbines.

Table 3.4. Estimated Annual Energy Production Summary of 350-MW Layouts

Turbine Model	350-MW Layouts				
	GE 4.0-MW	V112 3.0-MW	Multibrid 5.0-MW	REpower 5.0-MW	Siemens 3.6-MW
Average Free Wind Speed (m/s)	8.84	8.84	8.85	8.84	8.84
Plant Capacity (MW)	348	348	350	350	349.2
Gross Energy Output (GWh/yr)	1420.6	1669.3	1380.0	1439.6	1612.8
Gross Capacity Factor	46.6%	54.7%	45.0%	46.9%	52.7%
Overall Losses	22.2%	20.7%	22.5%	20.7%	21.4%
Net Energy Production (GWh/yr)	1104.6	1324.5	1069.5	1142.2	1267.5
Net Capacity Factor	36.2%	43.4%	34.9%	37.2%	41.4%

Table 3.5. Estimated Annual Energy Production Summary of 700-MW Layouts

Turbine Model	700-MW Layouts				
	GE 4.0-MW	V112 3.0-MW	Multibrid 5.0-MW	REpower 5.0-MW	Siemens 3.6-MW
Average Free Wind Speed (m/s)	8.85	8.87	8.85	8.85	8.86
Plant Capacity (MW)	700	699	700	700	698.4
Gross Energy Output (GWh/yr)	2865.9	3359.6	2768.8	2885.6	3232.0
Gross Capacity Factor	46.7%	54.8%	45.1%	47.0%	52.8%
Overall Losses	23.8%	21.9%	23.9%	22.1%	22.7%
Net Energy Production (GWh/yr)	2184.6	2625.3	2106.6	2249.2	2499.5
Net Capacity Factor	35.6%	42.8%	34.3%	36.7%	40.8%

3.3. OCEANOGRAPHIC CLIMATOLOGY

3.3.1. <u>Wave Environment</u>

Waves in the coastal waters south of New York City and Long Island are composed of the combination of short period/short wavelength locally wind-generated waves and longer period/longer wavelength swells that propagate from the open North Atlantic Ocean. When winds are from the north and west, there is relatively limited fetch for the buildup of wind-generated waves. Winds from the east through south have essentially unlimited fetch, and can generate large waves within the project area. In general, the most energetic waves/swells tend to come from the east and southeast (Figure 3.4).

The highest waves tend to occur during the cold season (November - March; see Table 3.6) passage of nor'easters or when tropical storms or hurricanes pass near the region (generally August - September). Lowest average and extreme wave heights occur during the May - August period. The highest historical significant wave heights (H_s) have been observed during the 11 - 12 December 1992 storm (H_s of 7.1 and 8.5 m, or 23.3 and 27.9 ft), corresponding to extreme wave heights (H_{ext}) of 13.8 m and 15.1 m (45.3 and 49.5 ft). Applying an extremes value analysis (i.e., a Gumbel distribution) produces an absolute extreme wave height of 16.0 m (52.5 ft) and 17.1 m (56 ft) for 50-year and 100-year return periods, respectively. The significant wave heights and extreme wave statistics are comparable to the regions where offshore wind farms are being considered or under construction in the United Kingdom and northern Europe. Spectral wave energy peaks at around 0.12 and 0.11 Hz, or wave periods of 8.33 and 9.09 seconds, corresponding to moderate short-period swells that often traverse the region. The higher energy peaks tend to occur farther offshore where larger waves and swells are more common.

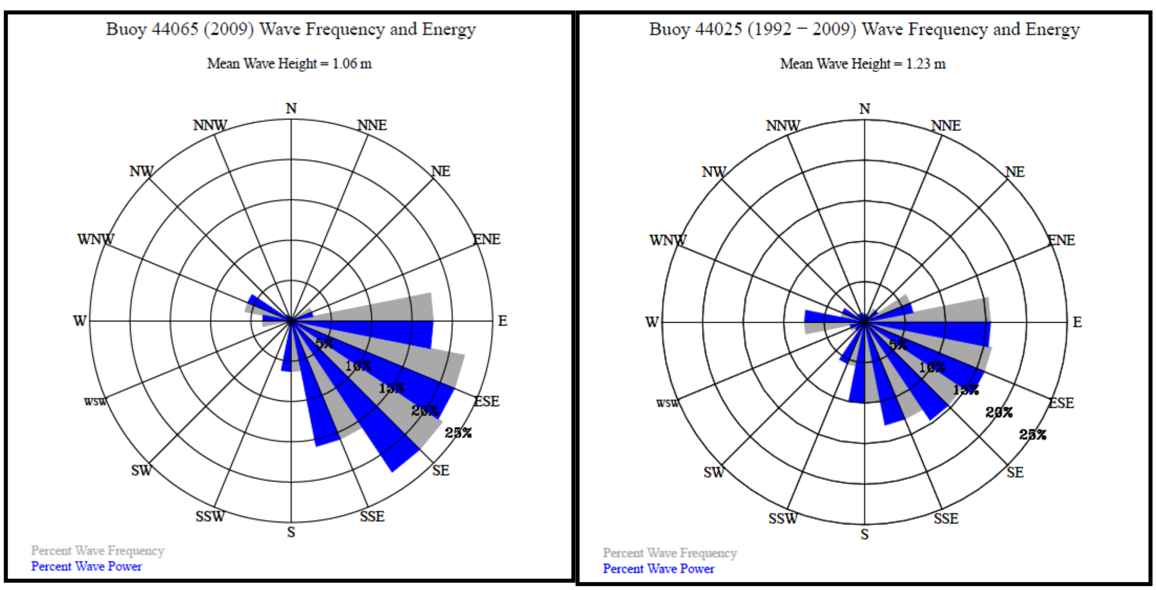

Figure 3.4. Wave Rose (Buoys 44065 and 44025)

Table 3.6. Mean, Max. Significant Wave Height, and Extreme Wave Height

Month	ALSN6 (m)			44025 (m)		
	H_{Smean}	H_{Smax}	H_{ext}	H_{Smean}	H_{Smax}	H_{ext}
January	1.1	4.7	8.7	1.5	6.7	12.5
February	1.0	3.8	7.1	1.5	6.1	11.3
March	1.0	6.0	11.2	1.4	7.4	13.8
April	0.9	3.8	7.1	1.3	5.4	10.0
May	0.9	3.1	5.8	1.1	5.0	9.3
June	0.8	2.8	5.2	1.0	3.5	6.5
July	0.7	3.1	5.8	1.0	5.1	9.5
August	0.8	2.8	5.2	1.0	5.6	10.4
September	0.9	4.3	8.0	1.3	6.7	12.5
October	0.9	4.9	9.1	1.3	6.0	11.2
November	0.9	4.7	8.7	1.4	6.5	12.1
December	1.0	7.1	13.2	1.6	8.5	15.8
Annual	1.1	7.1	13.2	1.6	8.5	15.8
		50-yr return	16.0		100-yr return	17.0

3.3.2. <u>Ocean Currents</u>

The principal current components in the open waters within and around the project site are the north Gulf Stream countercurrent, consisting of cold water that is flowing slowly to the west and southwest, and wind-generated near-surface currents, which may reinforce or oppose the general flow of the Gulf Stream countercurrent. Sea floor topography and these sub-surface and bottom currents will determine the magnitude of sediment transport, scouring, and forces impinging upon wind turbine foundation structures. Surface current speeds within and adjacent to the proposed project site average about 23 cm/s, but the daily time series shows that velocities can reach in excess of 70 cm/s. A distinct seasonal peak (approximately 35 cm/s) in April corresponds to the increased spring outflow from the Hudson River. Sub-surface current speeds tend to be less than 10 cm/s, and the predominant direction is from the NNE, indicating the control on bottom movement of water in and around the proposed project site is the north Gulf Stream countercurrent. At mean bottom current speeds (5 cm/s or less), sediments up to 0.5 mm in diameter can be transported; at 15 cm/s (maximum observed), particles up to 1 mm are suspended in transport.

3.4. FOLLOW-ON WORK

The collection of site-specific meteorological, wave, and current data is generally required to support detailed siting, design and permitting of all components of an offshore wind project. The recommended next step to characterize the meteorological and oceanographic conditions of the project area is to define and mobilize an in-field measurement program. Objectives, requirements, and key elements of a data collection program are briefly described below.

A meteorological monitoring campaign is recommended to develop a comprehensive three-dimensional description of the atmosphere from the water's surface through the top of a wind turbine's rotor plane (approximately 200 m). Traditionally, this is accomplished by the installation of at least one meteorological tower (projecting at least 60 m above the water's surface) equipped at multiple levels with wind and other sensors (such as air temperature). If one tower is used, it should be positioned either near the center of the project area or immediately upwind of the leading edge of the project area, so that the tower can be used for project evaluation after the turbines are installed. Other measurement platforms are available to complement or replace a conventional tall tower. These platforms, preferably fixed, are typically equipped with remote sensing devices, such as LIDAR(s) (light detection and ranging), that can measure the vertical profile of wind conditions above the water's surface. Conventional weather buoys, which only measure wind and weather conditions close to the water's surface, are often used in addition for direct comparisons with readings from regional National Data Buoy Center buoys. The recommended minimum duration of an offshore measurement campaign is one year. Long-term projections of the local wind conditions are then derived through the application of correlation techniques with data from regional reference stations. In turn, atmospheric modeling tools are employed to extrapolate site-specific wind projections derived from the measurement points to the entirety of the project area.

Ensuring a robust representation of the wind-wave-current environment across the proposed project area requires the deployment of at least two met-ocean buoys with measurements of ambient air temperature, sea surface temperature, wave height and calculation of wave spectra, and salinity. At least two acoustic Doppler current profilers would constitute a minimum necessary deployment to acquire representative column profiles of currents within the proposed project site to estimate sediment transport and scouring potential. Wave and current measurements should be concurrent with the wind monitoring program. As with the meteorological evaluation, statistical comparisons with regional reference stations, together with the application of modeling tools, are used to estimate the long-term wave and current characteristics throughout the project area.

3.5. CONCLUSIONS

Expected meteorological and oceanographic conditions in the project area are compatible with commercially-available offshore wind turbine technologies. Average wind speeds at a representative hub height are predicted to be approximately 8.8 m/s, and corresponding wind plant performance is estimated to achieve an annual net capacity factor of between 34 and 43 percent, depending on the turbine model, array spacing, and project size. The significant wave heights and extreme wave statistics are comparable to the regions where offshore wind farms are operating or under development in the United Kingdom and northern Europe. On-site measurements of the meteorological and oceanographic environments are required to verify these estimates and to confirm project feasibility.

Section 4

4. NATURAL RESOURCES IN NEW YORK BIGHT WATERS

Environmental natural resources in the proposed project area may be impacted by offshore wind development. These resources include wildlife, commercial and recreational fishing, navigation, artificial reefs, sand borrow areas, and visual resources, among others. Species native to and traveling through New York Bight waters may be affected by construction activities associated with an offshore wind project and by wind project operation and decommissioning. Finfish, benthic (bottom dwelling) invertebrates, sea turtles, terrapins, marine mammals, vegetative communities, and coastal land use are described in detail. Endangered, threatened, and species of concern may be especially at risk. This pre-development assessment study evaluated the nature of potentially significant impacts to the region's natural resources. The anticipated permitting process for an offshore wind project is also outlined, including specific regulatory approvals and consultations that may be necessary.

Given the limited availability of marine ecological information within the proposed project area, data were also obtained for the surrounding New York Bight region. Data from the New York Bight is pertinent, as the cited marine species that inhabit and migrate through the Bight can be assumed to use the proposed project area as well. For all areas, various biological natural resources and land/water use activities are described, together with the potential positive and negative impacts of offshore wind development.

The study analyzes the impacts to each biological community as a result of wind project construction and operation. Construction impacts can include the noise associated with pile driving, cable installation, and vessel strikes. Operational impacts include turbine noise and electromagnetic fields. The anticipated impacts to the natural resources in the project area are based largely on impacts that have been identified in European waters as a result of several offshore wind projects.

4.1. SUMMARY OF NATURAL RESOURCES

New York Bight is a highly productive ecosystem that provides habitat for finfish, shellfish, benthic invertebrates, birds, sea turtles, terrapins, and marine mammals. Each community is part of the larger Bight ecosystem and is dependent on each other for existence. The back bays, barrier beaches, and nearshore waters along the Atlantic coastline have been designated as significant habitat by the US Fish and Wildlife Service (USFWS) because significant populations of endangered, threatened, special concern, rare, and migratory species occur naturally in the region. USFWS Significant Habitat Complexes (Complexes)are primarily in coastal bays and inlets. Although these Complexes do not extend into the proposed project area, they may cover portions of the transmission cable route.

Essential Fish Habitat (EFH), which applies to waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity, has been designated for many of the federally managed species that are found in the New York Bight. An EFH designation does not indicate exclusion zones for project activity; it does, however, indicate areas with essential habitat for finfish species that should be taken into consideration during the construction process. Federally permitted projects generally require an EFH assessment to determine impacts of a project on EFH listed species as part of the permitting process.

Multiple federal and New York State listed species may be present in the project area. These species are listed in Table 4.1, Table 4.2, Table 4.3, and Table 5.1. Shellfish and finfish species in the New York Bight also support an important fishing community with ports along the New York and New Jersey coastlines.

4.2. CONSTRUCTION IMPACTS

Environmental impacts from offshore wind project construction may range from negligible to major. The nature and intensity of the impact is dependent on the setting, the species found in the project area, the communities making use of the environment, and the selected turbine foundation type(s). The sandy sediments in the region suggest that monopile or jacket foundation types may be used. Installation activities for these foundation types would require pile driving and associated noise. Temporary pile driving activity is expected to be the greatest of all noise impacts, reaching sound pressure levels of 200 decibels or greater. Research indicates that pile driving may result in physical trauma to marine mammals, birds, and fish near the pile driving activity; however, pile-driving activity is likely to prompt avoidance responses as well. Impacts from pile driving noise may be mitigated in several ways, including the use of physical barriers surrounding the work area, by using ramp-up procedures and/or limiting work to daytime and slack tide. Devices that protect marine mammals by creating sounds that cause them to avoid construction areas (known as acoustic harassment devices) may also be implemented to reduce impacts.

Construction activities will also result in temporarily suspended sediment and resultant sediment deposition due to pile driving, cable burial (presumably by jet plowing) between turbines and from the wind plant to shore, and the deployment and retrieval of jack-up barges. These impacts would be temporary and not far reaching. The greatest impact to the benthic community would to be to organisms that are in the direct path of the jet plow, which would be physically removed during the cable installation. Benthic organisms in the area of impact (the area surrounding cable trenching into which sediment falls out of suspension) may be smothered by the sediment. Benthic communities are generally able to recover from disturbance within the yearly reproduction cycle.

The construction of offshore wind turbines may also impact commercial fishermen and vessel navigation in the project area. The construction activity may result in localized closures of areas of the wind project to fishing and passage. Areas would be closed to prevent collision between traveling or fishing vessels and construction vessels, and to keep fishing gear out of active construction areas.

The potential for vessel strikes from turbine construction and cable laying vessels may be a concern for sea turtles, terrapins, and marine mammals, particularly since many sea turtle species and many marine mammals are endangered or threatened. Transmission cable landfall in sensitive habitats may also impact coastal natural resources. Mitigation measures, such as the implementation of exclusion zones, no-work windows during critical times of the year, and environmentally-sensitive construction methodologies may reduce impacts. Vessel strikes are anticipated to be minor, as it is expected that the construction vessels will move slowly (less than 14 knots) and will be required to follow NOAA Fisheries Regional Viewing Regulations.

4.3. IMPACTS DURING PROJECT LIFETIME

While most construction impacts are expected to be temporary, operational impacts will span the lifetime of the project. Impacts include the physical presence of the turbines and their foundations, the noise generated by the turbines, the electromagnetic fields (EMF) generated by the electrical collection system and transmission line, loss of benthic habitat, gain of epibenthic (organisms living on the surface of the sediment) habitat.

Noise generated by the turbines when operating can vibrate down the towers into the submerged foundations and into the surrounding water and seabed. In turn, this noise may be perceived by fish, sea turtles, and marine mammals within and outside of the proposed wind project area. Consequently, some species may avoid the project area while others may experience no impact. The hearing abilities of each species likely determine the behavior of wildlife near turbines and their typical avoidance behavior and distances.

The impact of EMF on fish, sea turtles, and marine mammals is unclear and research has not been conclusive. It is anticipated that the wind project's collection system will produce 60 Hz time-varying fields. Both electric and magnetic fields will be produced by the transmission line; however, there should be little or no impacts from electric fields, since the cables will be shielded, interrupting electric fields that may affect the environment. Magnetic fields, however, will still be produced. EMF impacts are expected to be similar to those for other industries using underwater transmission cables.

The benthic habitat directly beneath the turbine foundations and offshore substation platform foundation(s) would be permanently lost by the development of the proposed project. The area lost will be dependent on the foundation type(s) chosen, diameter of the supports, and the number of foundations installed. Although wind project footprints are large, the actual area of impact from the foundation footprints is relatively small compared to the surrounding benthic environment. Nevertheless, the introduction of submerged hard substrate in the form of wind turbine foundations may initiate the development of a new epibenthic community within the project area. This may in turn attract fish, which may also attract birds.

The presence of turbines in fishing grounds may impact commercial fishing. The level of impact will depend on the primary gear types used for fishing in the project area and the limitations, if any, placed on fishermen. The most common type of gear used in the area is the bottom otter trawl (large nets used to capture demersal fish that live near the sea bottom), which is dragged across the sea floor. The next most common gear type is the sea scallop dredge and the ocean quahog/surf clam dredge. Both are mobile gear types that cover large sections of the sea floor as they fish, and the presence of turbine structures may limit usable fishing grounds. It will be important to work with commercial fishermen and fishing cooperatives in both New York and New Jersey to address concerns about the offshore wind project. Still, there are not expected to be negative impacts on recreational fishing.

Visual resources may be affected by the development of the proposed project. Temporary visual impact may result from construction activities and permanent visual impact may occur during the life of the project. The first step in a visual impact analysis is to assess existing conditions at the proposed project area and adjacent areas. The assessment should include geographic location, topography, roadways, land use (i.e., residential, industrial, commercial, urban, open space), sensitive areas (i.e., designated historic districts, parks, scenic areas), and dimensions of existing structures. Once existing conditions are known and sensitive areas have been identified, a viewshed can be developed for the proposed project area. A viewshed is comprised of all the surface areas visible from an observer's viewpoint, and includes the locations of viewers likely to be affected by visual changes brought about by the project. The degree of impacts or changes to the existing views will need to be assessed, including an analysis of viewer sensitivity and exposure. Viewer sensitivity is defined as the viewers' concern for scenic quality and response to the change in view as a result of the proposed project. Project dimensions and site selection will determine the severity of the visual impact, and if mitigation is required.

Existing uses of the New York Bight may influence project siting. The proposed project area overlaps multiple weapons training areas (WTAs) designated by the U.S. Coast Guard. The presence of WTAs may not preclude wind development within the project area, but it is likely that wind turbine siting may be affected.

4.4. REGULATORY APPROVALS

A long list of federal and New York State permits and consultations will likely be required for wind project development. Waters inside the three nautical mile line are in State jurisdiction, while waters beyond that line are on the Offshore Continental Shelf (OCS) and are governed by the U.S. Department of Interior's Bureau of Ocean Energy Management, Regulation, and Enforcement (BOEM, formerly Mineral Management Service [MMS]). The BOEM is the lead agency for projects constructed on the outer continental shelf and grants submerged land leases (commercial or limited), easements, and rights-of-way. Generally, the permit application process involves identification of the permits to be acquired, negotiation with the responsible agencies, collection and acquisition of all relevant data needed to support the application, and filling out of the application. After submission, the applications are reviewed and sometimes returned as incomplete with requests for more data. Depending on the permit involved, public hearings may also need to be held.

Site specific field studies will be defined during the Environmental Impact Study (EIS) scoping process by the BOEM, with input from other federal agencies (e.g., U.S. Fish and Wildlife Service, National Marine Fisheries Service, U.S. Army Corps of Engineers), and by applicable New York State agencies (e.g., Department of State, Department of Environmental Conservation, Department of Public Service) as well.

4.5. FOLLOW-ON WORK

Potential natural resource field studies will be defined during the EIS Scoping Process, with input from the applicable federal and New York State agencies. Predicting the nature and depth of future natural resource studies is an educated guess until the scoping process is completed. Even then, other elements can be added at a later date. Nevertheless, the BOEM (then MMS) has prepared a Programmatic EIS (PEIS) for offshore wind projects (details can be found at http://ocsenergy.anl.gov/). The PEIS discusses natural resource inventories and impact analyses that might be used for new projects. It does not, however, mandate the details of any particular studies. The guidance that BOEM does provide suggests that as a minimum there should be a census of marine mammals and threatened and endangered sea turtles. This type of survey need not be a dedicated one, as it could be done in conjunction with avian surveys, which will almost certainly be required. Guidance can be also found from the experience of two U.S. offshore wind projects: Cape Wind in Massachusetts and the Long Island Offshore Wind Park in New York. Cape Wind is still under development, while the Long Island Offshore Wind Park is not.

Another important resource is the extensive databases collected, collated and analyzed by the numerous wind projects constructed in European waters. The environmental documents prepared for those projects explored in detail virtually every conceivable natural resource impact from construction and operation of offshore wind farms. In summary, these databases show that offshore wind farms have only minimal impact on the non-avian natural resources. Results from these studies might well be used to guide the extent and duration of proposed studies for future U.S.-based wind projects.

For the shoreline to the three-mile boundary, marine mammals and sea turtles would be assessed as a continuation of the federal surveys, as would benthic communities. In addition, a surf clam (a commercial resource) survey would likely be needed for the clam beds immediately offshore of the Rockaway Peninsula. Assuming the transmission cable crosses the Rockaway Peninsula and continues under Jamaica Bay, there would need to be a botanical and wildlife study of the crossing zone. In Jamaica Bay, benthic invertebrate community composition and abundance will need to be surveyed along the planned route. In the event that the route is proposed through the intertidal marshes (as opposed to channel waters), a detailed marsh study would be needed as would a mitigation plan for loss or alteration of wetlands. Natural resource impacts along the shoreward route to the substation would likely be negligible since the area (Brooklyn) is so densely urbanized.

The most likely non-avian field programs for federal and State waters would be:

- Surveys for marine mammals
- Surveys for threatened and endangered sea turtles
- Benthic invertebrate species composition and abundance
- Epibenthic colonization plate survey
- Surf clam assessments
- Peninsula crossing zone botanical and wildlife surveys.

4.6. CONCLUSIONS

Although some impacts to local ecological natural resources are possible, this pre-development assessment did not identify major barriers, conflicts or other fatal flaws that would currently preclude development of the proposed offshore wind project. Additional natural resource studies will be necessary should this project proceed to the permitting and development phase. Regulatory agencies will define the extent and scope of the baseline environmental data collection and follow-on studies that will be necessary.

4.7. TABLES OF ENDANGERED, THREATENED, CANDIDATE, AND SPECIES OF CONCERN

Table 4.1. Endangered, Threatened, Candidate, and Species of Concern in the New York Bight - Fish

Species	State Status	Federal Status	Range in North Atlantic	Habitat	Notes
Shortnose Sturgeon	Endangered	Endangered	St. John River (Canada) to St. Johns River (Florida)	Nearshore estuaries of rivers	Significant population in tidal portion of Hudson River
Atlantic Sturgeon	Threatened	Candidate Species	Labrador (Canada) to St. Johns River (Florida)	Rivers to open ocean	Population declining
Atlantic Salmon	Not Listed	Endangered	Greenland to New York Bight	Rivers to open ocean	Last wild population from Gulf of Maine
Dusky Shark	Not Listed	Species of Concern	Southern New England to Southern Brazil	Coastal surf zone to offshore	Major nursery grounds New Jersey to South Carolina nearshore waters
Night Shark	Not Listed	Species of Concern	Delaware to Brazil	Deep water (150 - 350 m)	Tropical shark rarely found in cooler waters
Sand Tiger Shark	Not Listed	Species of Concern	Gulf of Maine to Florida	Coasts to continental shelf	Juveniles dependant on Delaware Estuary
Rainbow Smelt	Not Listed	Species of Concern	Labrador to New Jersey	Rivers to open ocean	Spawn in rivers Overwinter coastally
Alewife	Not Listed	Species of Concern	Newfoundland to North Carolina	Rivers to open ocean	Spawn in rivers Overwinter coastally
Blueback Herring	Not Listed	Species of Concern	Nova Scotia to St. John's River - FL	Rivers to open ocean	Spawn in rivers Overwinter coastally
Thorny Skate	Not Listed	Species of Concern	Labrador to South Carolina	Deep demersal species 20 - 3900 feet deep	Area of Concern - West Greenland to New York
Porbeagle Shark	Not Listed	Species of Concern	Circumglobal - North Atlantic, S. Pacific, & Indian Oceans	Offshore pelagic Surface to 1000 feet deep	Pelagic - cold-temperate coastal and oceanic
Cusk	Not Listed	Candidate Species	NW Atlantic - NJ to Strait of Belle Isle & Grand Banks	Deep water, rocky bottoms Depth of 330 feet	Candidate species - throughout range Area of Concern - Gulf of ME
Atlantic Halibut	Not Listed	Species of Concern	Labrador to Southern New England	Boreal - Coastal to Upper slope	One of the largest fish in area
Warsaw Grouper	Not Listed	Species of Concern	Massachusetts to Gulf of Mexico	Deep water reefs 180 - 1700 feet deep	Population declining
American Shad	Threatened in NJ	Not Listed	Newfoundland to Florida	Rivers to open ocean	Spawning in Hudson River
Atlantic Tomcod	Threatened in NJ	Not Listed	Labrador to Virginia	Brackish water / estuaries	Only known NJ population in Sandy Hook Bay

Sources:

National Marine Fisheries Service. 2010. Andromonous and Marine Fishes. NOAA - Office of Protected Resources. http://www.nmfs.noaa.gov/prot_res?PR3/Fish/fishes.html Accessed 03/10/10.

South Jersey Resource Conservation and Development Council. 2010. Endangered Fish of New Jersey. http://www.sjrcd.org/wildlife/fish.htm Accessed 03/01/10.

Table 4.2. Endangered, Threatened, Candidate, and Species of Concern in the New York Bight – Sea Turtles and Terrapins

Species	State Status	Federal Status	Range in North Atlantic	Habitat	Notes
Atlantic Loggerhead Turtle	Endangered in NJ Threatened in NY	Threatened	Newfoundland to Argentina	Continental shelves, bays, estuaries, lagoons	Nests Florida to Carolinas Nests reported in New Jersey
Atlantic Leatherback Turtle	Endangered	Endangered	Nova Scotia to Puerto Rico	Open seas	Nests Georgia to US Virgin Islands Critical Habitat - waters surrounding St Croix, US Virgin Islands
Kemp's Ridley Turtle	Endangered	Endangered	Nova Scotia to Gulf of Mexico	Coastline, estuaries, bays, lagoons	Most endangered sea turtle
Atlantic Hawksbill Turtle	Endangered	Endangered	Massachusetts to Puerto Rico	Warm coastal vegetated water depths less than 50 feet	Critical Habitat - waters surrounding Puerto Rico
Atlantic Green Turtle	Threatened	Threatened	Massachusetts to Puerto Rico	Shallow vegetated waters, inlets, bays, estuaries	Florida and Mexico breeding populations endangered Critical Habitat - waters surrounding Puerto Rico
Northern Diamondback Terrapin	Special Concern in NJ Not Listed in NY	Not Listed	Cape Cod to Cape Hattaras	Marshes, estuaries, beaches	

Sources:

National Marine Fisheries. Sea Turtle Protection and Conservation. http://www.nmfs.noaa.gov/prot_res/PR3/Turtles/turtles.html

Plotkin, P.T. (Editor). 1995. National Marine Fisheries Service and US Fish and Wildlife Service Status Reviews for Sea Turtles Listed Under the Endangered Species Act of 1973. National Marine Fisheries Service, Silver Spring, Maryland.

Conant, R. & Collins, J.T. 1998. Peterson Field Guides. Reptiles and Amphibians Eastern / Central North America. Houghton Mifflin Company. Boston.

Table 4.3. Marine Mammals in the New York Bight*

Species	Range In North Atlantic	Distance from Shore	Notes
Cetaceans			
Atlantic Spotted Dolphin	New England to Venezuela	Continental Shelf to Slope Shallow, Inshore Water South of the Chesapeake Bay	Near 200m Isobath Within 350km of Coast
Atlantic White-Sided Dolphin	West Greenland to North Carolina	Continental Shelf to 100m Contour	January - May Few Individuals Present Temperate and Sub-Polar Waters
Blainsville's Beaked Whale	Nova Scotia to Florida	Continental Shelf Edge to Slope	Sighted in Gulf Stream Features Few Observed in Tropical Waters
Blue Whale	Arctic to Mid-Lattitude Waters	Open Ocean	Possible Occurrence to Florida
Bottlenose Dolphin	New Jersey to Florida	Shoreline to 25m Isobath Continental Shelf Break to Slope	Coastal Stock Offshore Stock
Common Dolphin	Georges Bank to Cape Hatteras	Continental Shelf to Slope	Near 200 - 300m Isobaths
Cuvier's Beaked Whale	Nova Scotia to the Caribbean	Continental Shelf Edge	
Dwarf Sperm Whale	Georges Bank to Florida Keys	Continental Shelf	
Fin Whale	Nova Scotia to Cape Hatteras	Continental Shelf to Deep Ocean	Dominant Large Cetacean in Area
Gervias' Beaked Whale	Georges Bank to Caribbean	Open Ocean	Observed in Gulf Stream Features
Harbor Porpoise	Arctic to North Carolina	Coastline to > 200m Isobath	Large Populations off NJ in Fall & Winter
Humpback Whale	Newfoundland to Chesapeake Bay	Continental Shelf	Water off the Mid-Atlantic & Southern States Provide Important Habitat for Juveniles
Killer Whale	Arctic to Massachusetts Bay	Offshore	Rare in US Atlantic EEZ
Long-Finned Pilot Whale	Iceland to Cape Hatteras	Continental Shelf Edge	Associated w/ Gulf Stream & Thermal Fronts on Shelf
Minke Whale	Davis Strait to Gulf of Mexico	US EEZ Continental Shelf	Most Abundant Spring and Summer Polar, Temperate, & Tropical Waters
North Atlantic Right Whale	Bay of Fundy to Florida	Coastal Waters to Continental Shelf	World's Most Endangered Large Whale
Pantropical Spotted Dolphin	Georges Bank to Florida	Continental Shelf Edge to Slope	Prefer Deeper Water
Pygmy Sperm Whale	Georges Bank to Florida Keys	Deep Continental Shelf to Shelf Edge	
Risso's Dolphin	Newfoundland to Florida	Continental Shelf Edge to Open Ocean	Associated w/ Bathymetric Features & Gulf Stream Warm-Core Rings & Gulf Stream North Wall
Rough-Toothed Dolphin	All Oceans	Shelf and Oceanic Waters	Travel in Groups of 10 - 20 individuals
Sei Whale	Nova Scotia to Cape Hatteras	Offshore	Will Move Inshore w/ Food Source
Short-Finned Pilot Whale	Georges Bank to Florida	Continental Shelf and Slope	Observed in the Gulf Stream
Sperm Whale	Georges Bank to Cape Hatteras	Continental Shelf Edge to Mid-Ocean	Associated with Gulf Stream Edge
Striped Dolphin	Nova Scotia to Jamaica	Continental Slope to Gulf Stream	Associated w/ Gulf Stream North Wall, Warm-Core Rings, & New England Sea Mounts Associated w/ 1000m Isobath
True's Beaked Whale	Nova Scotia to Bahamas	Offshore	Associated w/ Gulf Stream Features
White-Beaked Dolphin	Nova Scotia to Cape Hatteras	Continental Slope	
White-Sided Dolphin	Bay of Fundy to North Carolina	Continental Shelf	Associated with 100m Isobath
Pinnipeds			
Gray Seal	New England to Labrador	Nearshore Waters	Numbers Increasing in Region
Harbor Seal	Arctic to South Carolina	Nearshore Waters	Seasonal Interval in Southern New England to New Jersey Increasing
Harp Seal	Arctic to New Jersey	Nearshore Waters	Sightning Increasing from Maine to NJ
Hooded Seal	Arctic to Puerto Rico	Offshore	Increased Occurrences from ME to FL

*All marine mammals are protected under the Marine Mammal Protection Act and some are also protected by the Ecological Society of America.

Source: National Marine Fisheries Service. September 2002. U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessment - 2008. NOAA Technical Memorandum NMFS-NE-210.

Section 5

5. AVIAN SPECIES IN THE NEW YORK BIGHT REGION

In order to better characterize avian use in the proposed project area, a review of existing data was conducted to determine potential impacts to birds in the New York Bight region. The assessment relied on available resources and literature to determine bird species that may inhabit the proposed project area. Potential impacts on bat species were addressed as well. The possible impacts of offshore wind development were evaluated based on habitat use and species behavior, and focused on both impacts from construction activities (i.e., for turbines, foundations, cabling, and substations) and impacts during the project's lifetime (i.e., barrier effect, habitat loss, collisions). Results from studies at European offshore wind projects are summarized, as some of these results may be relevant to a project developed in the New York Bight. Assessment methodologies that may be useful in further characterizing avian use in the proposed project area are described. Overall, the review provides a preliminary assessment of potential impacts to birds and bats resulting from offshore wind development in the New York Bight.

5.1. AVIAN SPECIES IN THE PROJECT AREA

The New York Bight provides habitat for multiple avian species and also may be used by numerous avian species during migration. Species groups such as seaducks, loons, grebes, shearwaters and petrels, gannets, wading birds, raptors, shorebirds, gulls and terns, alcids, and passerines may all be found in New York Bight waters. Densities vary by season, as shown in Figure 5.1. Additionally, a number of endangered, threatened, and species of concern may use project area waters or migrate through the area, including the piping plover, roseate tern, common tern, least tern, listed diurnal raptors, and common loon. Diurnal raptors include the peregrine falcon, northern harrier, bald eagle, osprey, and several hawk species. Avian species that are endangered, threatened, candidate, and species of concern are listed in Table 5.1.

Regional avian surveys indicate that bird density generally decreases with increasing distance offshore, especially beyond five miles from shore. The winter season appears to have the lowest density of offshore birds compared to other seasons; however some avian species still use of the area during these months. As large numbers of birds are not expected to congregate offshore at any one time, avian impacts would be expected to be minimized; however, avian species in the area are sensitive and should be carefully considered when siting and constructing the project.

Although not an avian species, bats are an aerial mammalian species that warrants environmental consideration with respect to wind project operation. Bats are not generally associated with marine habitats; however saltwater crossings have been documented for migratory tree bats. Although studies have not been conducted to track migration patterns of bats along the east coast, it is possible that certain species of migratory bats follow migration corridors along the Atlantic coast in a manner similar to those followed by migratory birds. Historic observations of marine habitats are limited and generally outdated, but silverhaired bats, eastern red bats, and hoary bats have occasionally been observed on ships at sea and offshore islands, such as Bermuda. These observations confirm that these bat species are able to travel long distances over water. Long distance migratory bats travel south to winter ranges in the southern U.S. between August and early October and return during April and May. There is little known about the migratory movements of bats within the proposed project area. Further study may be necessary in order to fully understand potential impacts. Regulatory agencies will determine the level of study that may be required to investigate potential use of project area waters by migrating bats.

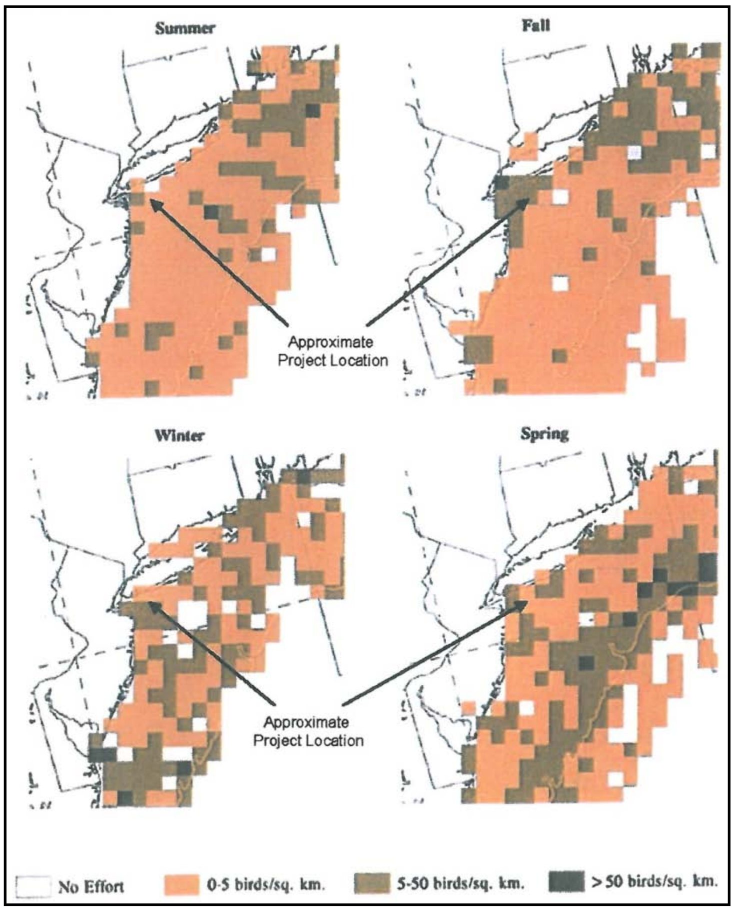

Figure 5.1. Seabird Densities in the New York Bight by Season, 1980-1988.[3]

5.2. CONSTRUCTION IMPACTS

Construction activities associated with installing an offshore wind project may impact birds in the area. The nature and magnitude of the impacts to marine and coastal birds will depend on the location of project

[3] Source: USFWS. Selected Seabirds of the New York Bight. In: Volume 3, Part 1 of Deepwater Port License Application.

components, the timing of project-related activities, and the nature and magnitude of the project-related activities.

Marine and coastal birds may be affected by the installation of offshore wind turbines, cable trenching, cable laying, and the construction of onshore and offshore substations. Construction in coastal areas may directly disturb coastal habitats. Construction will cause temporary displacement of birds (e.g., shearwaters, alcids, seaducks and loons) due to increased human and vessel traffic, equipment presence, and noise related to pile driving. Other species, especially those that actively follow vessels to feed on offal (such as gulls and terns), may be attracted to the area during construction. Most of these impacts will be short-term, lasting only until construction is completed.

The most significant nearshore construction impacts would likely result from land-based construction activities at the location of cable landing and any onshore substation(s). Nearshore areas are used by numerous species of shorebirds and wading birds, and these species may be temporarily displaced during construction activities.

In summary, construction activities may temporarily disturb avian habitats, and cause the greatest risk for endangered, threatened and species of concern. In order to mitigate the risk to local avian populations, construction could be scheduled outside of primary breeding periods. Careful siting of the location for cable landing and onshore substation(s), supported by data from coastal and offshore surveys, will be necessary to avoid disrupting critical avian habitats nearshore. Mitigation measures recommended by the BOEM with regard to construction related activities include:

- Conducting surveys of coastal and offshore areas to identify important feeding, nesting, staging and wintering areas and to avoid siting facilities and cable paths in or near these areas.
- Timing major construction and noise-generating activities, such as pile driving and cable trenching, to avoid periods when marine and coastal birds are nesting near construction zones.
- Limiting the use of steady-burning bright lighting in order to reduce attraction of birds to construction and service vessels and thus further reduce potential for ingestion of or entanglement with accidental releases of solid debris from these ships.

5.3. IMPACTS DURING PROJECT LIFETIME

Offshore wind projects generally pose three broad types of threats or impacts to birds: barrier effects, habitat loss, and collision fatalities. Impacts to avian species during the project lifetime include barrier effects due to avoidance of wind turbines, habitat loss due to turbine operation and/or the physical presence of the structures, and fatalities due to collisions.

The placement of turbines in the offshore environment may create barriers to avian movement, causing deflection or avoidance of birds around turbine arrays (see Figure 5.2). These deflections can cause effects on migrating birds and on birds moving between roosting/nesting and feeding sites. Avoidance can result in increased flight distance, increasing the birds' energy expenditure. As with other impacts, barrier effects are dependent on a range of factors, including species, type of bird movement (i.e., migratory vs. local movements), flight altitude, turbine spacing, and weather conditions. European studies have found that certain species of seabirds (such as migrating seaducks) avoid operational wind projects, while others are less likely to display avoidance behavior. Barrier effects may not be permanent for all species, as recent European studies suggest that some species may begin to become habituated to the presence of wind turbines a number of years after construction and re-enter the project waters.

The physical loss of habitat may result from offshore wind project development due to the permanent displacement and modification of flora and fauna in the region and the displacement of birds due to the disturbance of operating turbines. The magnitude of impact will be different for each species depending on the availability of suitable alternative feeding areas around the project area. Species with very specific habitat requirements (such as seaducks, loons, grebes, comorants, and alcids) will be more vulnerable to the effect of displacement than habitat generalists. At offshore wind projects in German waters, the red-throated loon, Artic loon, gannet, common scoter, common murre, and razorbill were found to strongly avoid offshore wind projects, and the long-tailed duck was found in much lower numbers; however, the presence of some gull species increased after project construction. As with barrier effects, some species may become habituated to the turbines and eventually re-enter the project area to forage. The creation of epibenthic habitat in the form of turbine foundations may also draw some avian species to the region, although results from European studies are not conclusive.

The BOEM's PEIS cites bird collisions with turbines as an area of concern for offshore wind projects. In contrast to avian movements near onshore projects, many marine and coastal avian species exhibit flocking behavior and daily onshore and offshore movements, and many marine and coastal birds undergo migrations along the Atlantic coast. Direct mortality at wind projects can result from birds being struck by revolving blades or from flying into towers, nacelles, or associated structures. Collision risks are dependent on many factors. The greatest risk is in areas regularly used by large numbers of feeding or roosting birds or along migratory flyways and local flight paths. Establishing the risk for collisions at offshore wind projects is problematic. Methods developed to track onshore and coastal mortalities due to collisions rely heavily on ground searches for carcasses, which is not possible in the offshore environment.

Seabirds entering offshore wind projects can be considered at risk for collision. The level of risk is influenced by species flight behavior: species that regularly fly within the rotor swept area are more susceptible to collisions, as are species with less flight maneuverability. Species that tend to avoid turbines will be at less risk of collision. The additive mortality risk to seabirds due to collisions with turbines in offshore locations is difficult to assess. Further investigation into the offshore behavior of migrating landbirds and raptors will be necessary to judge the potential risks to these species. It is also recommended that, as allowed by the Federal Aviation Administration and the U.S. Coast Guard, the use of bright lights on offshore structures be avoided to reduce the attractiveness to birds.

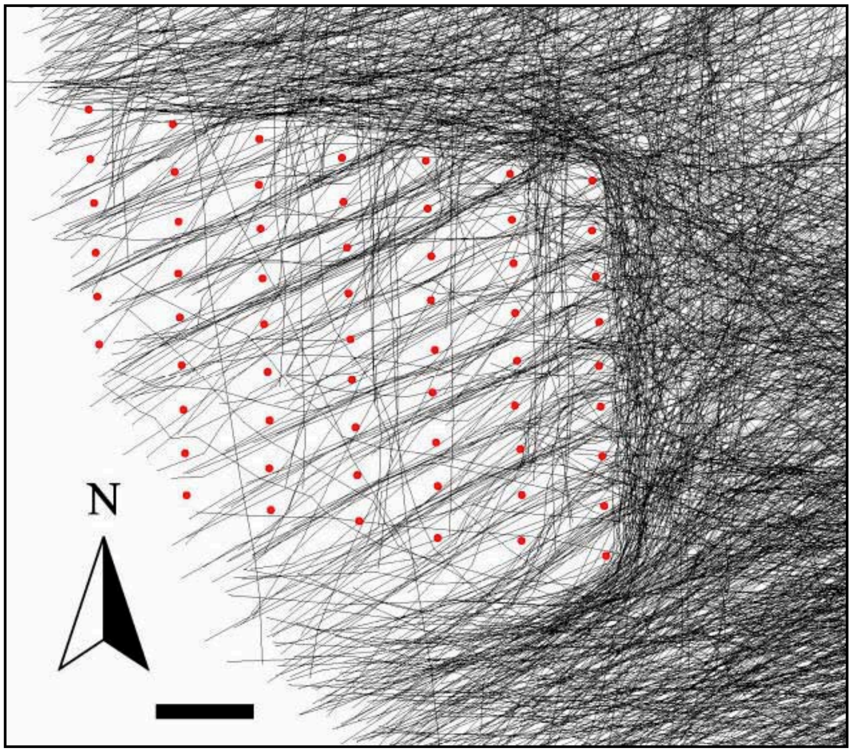

Figure 5.2. Flight Trajectories during Initial Operation of Wind Turbines.[4]

5.4. REGULATORY APPROVALS

The proposed project will be located in federal waters and will require an environmental impact assessment (EIS) under the National Environmental Policy Act (NEPA). Additional federal environmental review is required under the Federal Energy Policy Act of 2005 which directed the BOEM to establish the Outer Continental Shelf Alternative Energy and Alternate Use program.

In addition to the development of these policies by the BOEM, offshore wind energy will involve additional New York State and/or federal environmental review. Avian resources that may occur in the project area are protected under the Endangered Species Act, the Migratory Bird Treaty Act, and the Bald

[4] Source: Desholm M. and J Kahlert Avian collision risk at an offshore wind farm. Biol Lett. 2005 September 22; 1(3): 296–298. Published online 2005 June 9. doi: 10.1098/rsbl.2005.0336. Copyright © 2005 The Royal Society. Copyright © 2005 The Royal Society

and Golden Eagle Protection Act, all of which are administered by the U.S. Fish and Wildlife Service. The proposed project will be required to conform with specific regulations relating to these Acts.

5.5. FOLLOW-ON WORK

Assessing the potential impacts to seabirds requires baseline studies to determine the use of the project and surrounding areas by both migrating and foraging birds. As no offshore wind projects have been developed in the U.S. to date, avian assessment requirements and methodologies are not yet firmly established. Federal agency (BOEM) guidance provides a framework to assess the broad, regional environmental issues that will require consideration in order to proceed with offshore wind development. This includes Best Management Practices that may be adopted as mitigation measures in order to facilitate future preparation of site-specific permit application documents. The amount and extent of ecological baseline data required will be determined on a project-by- project basis.

Many European countries have established minimum requirements for environmental assessments, including the need to identify key areas of concern and establish research projects that quantify effects. These activities require recommendations for pre- and post-construction control impact studies that: (1) determine bird distribution and density using transect surveys, (2) detect movements (including flight height) of local foraging birds and long distant migrants (both day and night) using a combination of visual observations, radar and flight call recordings, and (3) study collision risk and mortality using infra-red technologies.

As the project progresses, it is expected that an EIS will be conducted, which will explore the impact of project development in much greater depth. Additional field studies and data collection will likely be required by governing agencies as part of the EIS review process to further define how offshore wind project development in the New York Bight region might affect local and migrating birds. Baseline data collection will likely be necessary to determine local avian species, numbers, distribution, and movements. Assessment methodologies may include aerial and boat surveys, radio telemetry, avian acoustic monitoring, thermal imaging cameras, and radar studies. Also, general information on the effects of offshore wind projects on pelagic birds may require further study, as current information is limited. Regulatory agencies will define the extent and scope of the baseline and follow-on studies that will be necessary.

5.6. CONCLUSIONS

Based on available information, the project area does not present any apparent barriers or other fatal flaws for the development of an offshore wind project with regards to avian impacts; however, although the data reviewed and summarized for this report is representative of known avian species in the vicinity of the project area, the current body of knowledge regarding avian species use of the proposed project area is limited, and further data collection and analysis will likely be required by government agencies in order to obtain development approval.

Before this project site can be judged suitable for wind energy generation and an acceptable environmental impact assessment completed, baseline field studies of the project area will likely be undertaken to determine avian use. Baseline field studies would determine the current distribution and usage of the project area by avian resources. These studies will be useful for assessing the potential impacts of the proposed project on species present in the project area.

5.7. TABLE OF ENDANGERED, THREATENED, CANDIDATE, AND SPECIES OF CONCERN

Table 5.1. Endangered, Threatened, Candidate, and Species of Concern in the New York Bight – Birds

Species	State Status	Federal Status	Habitat & Nest Areas	Breeding Status	Notes
Least Tern	Threatened NY Endangered NJ	Endangered	Beaches	Breeding / Migrant	Ground nester Forrage in bays, estuaries, & rivers
Roseate Tern	Endangered NY Endangered NJ	Endangered	Beaches / Marshes	Breeding / Migrant	Ground nester (among common terns) Forrage along coasts, inlets, & offshore
Bald Eagle	Threatened NY Endangered NJ	Threatened	Forests Near Water	Breeding / Migrant / Winters	Dividing Creek has only active nest site in NJ
Piping Plover	Endangered NY Endangered NJ	Threatened	Beaches	Breeding / Migrant	Ground nester Forrage on intertidal beaches
American Bittern	Special Concern NY Endangered NJ	Special Concern	Wetlands / Marshes	Breeding / Migrant	
Northern Harrier	Threatened NY Endangered NJ	Special Concern	Marshes / Grasslands	Breeding / Migrant / Winters	Observed inland - Kittatinny Ridge Hunts over coastal marshes
Sedge Wren	Threatened NY Endangered NJ	Special Concern	Meadows / High Marshes	Breeding / Migrant	Delaware Bay Estuary
Short-Eared Owl	Endangered NY Endangered NJ	Special Concern	Marshes / Grasslands	Breeding / Migrant / Winters	Only breeding population endangered Ground nester
Black Skimmer	Special Concern NY Endangered NJ	Not Listed	Beaches / Coastal Bays	Breeding / Migrant	Ground nester Forrage in tidal creeks & inlets
Golden Eagle	Endangered NY Not Listed NJ	Not Listed	Tundra / Grasslands / Deserts	Not Locally Breeding	Winters coastally with Bald Eagles
Henslow's Sparrow	Not Listed NY Endangered NJ	Not Listed	Grassy Fields / Marsh Edges	Breeding / Migrant	All inland and coastal nesting areas appear unoccupied
Peregrine Falcon	Endangered NY Endangered NJ	Not Listed	Bulidings / Bridges / Marsh Platforms	Breeding / Migrant / Winters	Hunt over marshes, beaches, and open water
Pied-Billed Grebe	Threatened NY Endangered NJ	Not Listed	Ponds / Creeks / Marshes	Breeding / Migrant / Winters	One nesting population - Kearny Marsh Breeding status Endangered
Yellow-Crowned Night-Heron	Not Listed NY Endangered NJ	Not Listed	Barrier Islands / Shrub Thickets	Breeding / Migrant	Forrage in tidal creeks and marshes
Black Rail	Endangered NY Threatened NJ	Special Concern	Marshes	Breeding / Migrant	
Black-Crowned Night-Heron	Not Listed NY Threatened NJ	Not Listed	Forests / Marshes	Breeding / Migrant	Forrage in marshes and ponds
Bobolink	Not Listed NY Threatened NJ	Not Listed	Meadows / Hayfields / Marshes	Breeding / Migrant	Breeds in northwest part of NJ Found in marshes during migration
Ipswich Sparrow	Not Listed NY Threatened NJ	Not Listed	Grassy Beach Dunes	Migrant / Winters	Only breeds on Cape Sable Island - Nova Scotia
Long-Eared Owl	Not Listed NY Threatened NJ	Not Listed	Forests / Marshes	Breeding / Migrant / Winters	
Osprey	Special Concern NY Threatened NJ	Not Listed	Marshes / Bays / Rivers / Lakes	Breeding / Migrant	Nests on transmission towers, light poles, channel markers, & platforms
Red Knot	Not Listed NY Threatened NJ	Not Listed	Beaches / Inlet Spits / Marshes	Migrant	Delaware Bay - migration stopover Feeds on horseshoe crab eggs
Savannah Sparrow	Not Listed NY Threatened NJ	Not Listed	Grassy Fields / Salt Marshes / Dunes	Breeding / Migrant / Winters	Coastline and farm fields

Table 5.1 (Continued). Endangered, Threatened, Candidate, and Species of Concern in the New York Bight – Birds

Species	State Status	Federal Status	Habitat & Nest Areas	Breeding Status	Notes
American Oystercatcher	Not Listed NY Special Concern NJ	Not Listed	Ocean Shores / Salt Marshes	Breeding / Migrant	Nests on the Ground
Caspian Tern	Not Listed NY Special Concern NJ	Not Listed	Beaches	Migrant	Breeding status of Special Concern
Cattle Egret	Not Listed NY Special Concern NJ	Not Listed	Marshes	Breeding / Migrant	Nests in Trees Breeds in Colonies w/ other Herons
Common Loon	Special Concern NY Not Listed NJ	Not Listed	Lakes of Adirondack Mountains / Rivers	Not Locally Breeding	Winter Along the Coast of Long Island
Common Nighthawk	Special Concern NY Special Concern NJ	Not Listed	Sand / Dirt / Gravel / Bare Rock	Breeding / Migrant	Breeds on Coastal Dunes
Common Tern	Threatened NY Special Concern NJ	Not Listed	Beaches	Breeding / Migrant	Breeding status of Special Concern Ground nester
Glossy Ibis	Not Listed NY Special Concern NJ	Not Listed	Marshes	Breeding / Migrant	Nests on the Ground
Great Blue Heron	Not Listed NY Special Concern NJ	Not Listed	Marshes / Swamps / Lakes	Breeding / Migrant / Winters	Breeding status of Special Concern 3 breeding colonies in NJ inland swamps
Gull-Billed Tern	Not Listed NY Special Concern NJ	Not Listed	Shoreline / Beaches / Salt Marshes	Breeding / Migrant	Breeds on Gravelly Beaches Winters in marshes
Horned Lark	Special Concern NY Special Concern NJ	Not Listed	Fields / Beaches	Breeding / Migrant / Winters	Breeding status of Special Concern
King Rail	Threatened NY Special Concern NJ	Not Listed	Marshes / Swamps	Breeding / Migrant	
Least Bittern	Threatened NY Special Concern NJ	Not Listed	Marshes	Breeding / Migrant	Breeding status of Special Concern
Little Blue Heron	Not Listed NY Special Concern NJ	Not Listed	Marshes	Breeding / Migrant	
Saltmarsh Sharp-Tailed Sparrow	Not Listed NY Special Concern NJ	Not Listed	Marshes	Breeding / Migrant	
Sanderling	Not Listed NY Special Concern NJ	Not Listed	Beaches / Tidal Flats	Migrant / Winters	
Seaside Sparrow	Special Concern NY Not Listed NJ	Not Listed	Maritime Areas / Elevated Vegetation	Breeding / Migrant	Barrier Islands South Shore of Long Island
Semipalmated Sandpiper	Not Listed NY Special Concern NJ	Not Listed	Mudflats / Sandy Beaches	Migrant	Breeds in Open Tundra
Short-Billed Marsh Wren	Not Listed NY Special Concern NJ	Not Listed	Brackish Marshes / Inland Meadows	Breeding / Migrant / Winters	Coastline and Meadows
Snowy Egret	Not Listed NY Special Concern NJ	Not Listed	Marshes	Breeding / Migrant	Nests in Trees
Spotted Sandpiper	Not Listed NY Special Concern NJ	Not Listed	Marshes / Wetlands / Uplands	Breeding / Migrant	Breeding status of Special Concern
Tricolor Heron	Not Listed NY Special Concern NJ	Not Listed	Marshes	Breeding / Migrant	Breeding status of Special Concern
Virginia Rail	Not Listed NY Special Concern NJ	Not Listed	Marshes	Breeding / Migrant	Nests on the Ground

Sources for Table 5.1

NJ Division of Fish and Wildlife. Endangered and Threatened Wildlife of NJ. Birds of NJ. http://www.nj/gov/dep/fgw/tandespp.htm. and http://www.nj.gov/dep/fgw/chkbirds.htm

South Jersey Resource Conservation and Development Council. Endangered Birds of NJ and More Endangered Birds of NJ. http://www.sjrcd.org/wildlife/bird1.htm and http://www.sjrcd.org/wildlife/bird2.htm

Peterson, R.T. 1980. Peterson Field Guides. Eastern Birds. Houghton Mifflin Company. Boston.

NYSDEC. List of Endangered, Threatened, and Special Concern Fish & Wildlife Species of NYS. http://www.dec.ny.gov/animals/7494.html Accessed 03/01/10.

The Cornell Lab of Ornithology. All About Birds. http://www.allaboutbords.org/guide/search Accessed 03/16/10.

Section 6

6. CONCLUSIONS AND RECOMMENDATIONS

A review of existing data did not identify the existence of any major physical or environmental barriers, conflicts, or other fatal flaws that would currently preclude development of the Collaborative's proposed offshore wind project. The geophysical, meteorological and oceanographic conditions are compatible with state-of-the-art offshore turbine and foundation technologies. Although impacts from project construction and operations on coastal and marine wildlife, commercial fishing, and other resources are anticipated, they appear to be manageable and not severe enough to preclude further planning and assessment activities within the proposed project area.

While the data reviewed and summarized for this pre-development assessment is representative of known conditions in the vicinity of the project area, the collection of site specific field data is required to confidently determine the feasibility of the proposed project area and to support detailed siting, design, and permitting of all components of an offshore wind project. Additionally, environmental (i.e., natural resources and avian) considerations can be further addressed as part of an environmental impact study, which would explore the impact of project development in much greater depth. Regulatory agencies will define the extent and scope of the baseline environmental data collection and follow-on studies that will be necessary.

For information on other
NYSERDA reports, contact:

New York State Energy Research
and Development Authority
17 Columbia Circle
Albany, New York 12203-6399

toll free: 1 (866) NYSERDA
local: (518) 862-1090
fax: (518) 862-1091

info@nyserda.org
www.nyserda.org

Summary of Physical and Environmental Qualities for the Proposed Long Island – New York City Offshore Wind Project Area

Final Report 10-22 Summary