Ørsted
Long Island Wind

Section 8.5

Visibility Study

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List of Acronyms

km	kilometer
mi	mile
WTG	wind turbine generator

8.5 VISIBILITY STUDY

6.2.8.5 The Submission must include both Confidential and Public versions of a visibility study consistent with the Visual Impact Assessment as part of the COP.
The Visibility Study must present visual simulations of the proposed Offshore Wind Generation Facility. Visibility studies must include a map or maps that depict the nearest coastline, the boundary of the proposed site to be developed and any other reasonable reference points (e.g., coastal cities, historic sites, other wind energy areas). The visibility Study must identify the distance in statute miles between the nearest shoreline point and the nearest Offshore Wind Generation Facility turbines. If the nearest shoreline point is not in New York State, the Proposal should also identify the nearest New York shoreline point and include the nearest New York shoreline point in the viewshed impacts discussion. Simulations must be single frame, photographic images with superimposed simulations of the proposed wind turbine technology configured to represent a commercially-scaled and technically feasible scenario that is consistent with the proposed Project including operating capacity, wind turbine size, and generic spacing and configuration. The visibility study may present larger wind turbines than those proposed, but may not present small wind turbines than those proposed. Viewing instructions must be included on each simulation.
Visual simulations must represent, at a minimum, clear, partly cloudy, and overcast conditions during early morning, mid-afternoon, and late day, as well as one simulation at night with the turbines lit under clear conditions. Visual simulations must be provided from a minimum of two representative vantage points which represent the closest points to shore from any turbine within the Offshore Wind Generation Facility and, if applicable, any sensitive or historic viewpoints, consistent with the Visual Impact Assessment required through the COP. Proposals must address any mitigative viewshed impacts considered for the closest points to shore and if applicable any sensitive or historic viewpoints. The visibility study must also include analysis of the percentage of time during which different visibility conditions are expected to occur based on past meteorological data.
The simulations must be provided in a format suitable to be printed or electronically viewed by the public and/or the Scoring Committee.
6.2.8.5.1 Provide supporting GIS shape files that depict the nearest coastline, the boundary of the proposed site to be developed and any other reasonable reference points (e.g., coastal cities, historic sites, other wind energy areas).

[redacted]

[redacted]

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Attachment 8.5-1

Visibility Study

Visibility and Viewshed Impacts
for
Long Island Wind

Prepared for

New York State Energy Research and Development Authority

Submitted by

Bay State Wind LLC
437 Madison Avenue, Suite 1903
New York, NY 10022

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Long Island Wind

September 9, 2024

Portions of this Visibility Study contain confidential, proprietary, and/or commercially sensitive

information which has been redacted from the "Public Version" of this Proposal. Bay State Wind LLC (d/b/a/ Long Island Wind) has submitted a Confidential Version of this Visibility Study which includes the redacted information, and which should be treated as a non-public record that is exempt from disclosure to the extent permitted under applicable laws and/or as expressly set forth in the Request for Proposals.

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List of Acronyms

3D	three-dimensional
BOEM	Bureau of Ocean Energy Management
FAA	Federal Aviation Administration
GIS	geographic information system
GPS	global positioning system
km	kilometer
KOP	Key Observation Point
[redacted]	
m	meter
mi	statute mile
NYSERDA	New York State Energy Research and Development Authority
SLVIA	seascape, landscape, and visual impact assessment
USCG	United States Coast Guard
USFWS	United States Fish and Wildlife Service
WTG	wind turbine generator

1.0 PROJECT INFORMATION

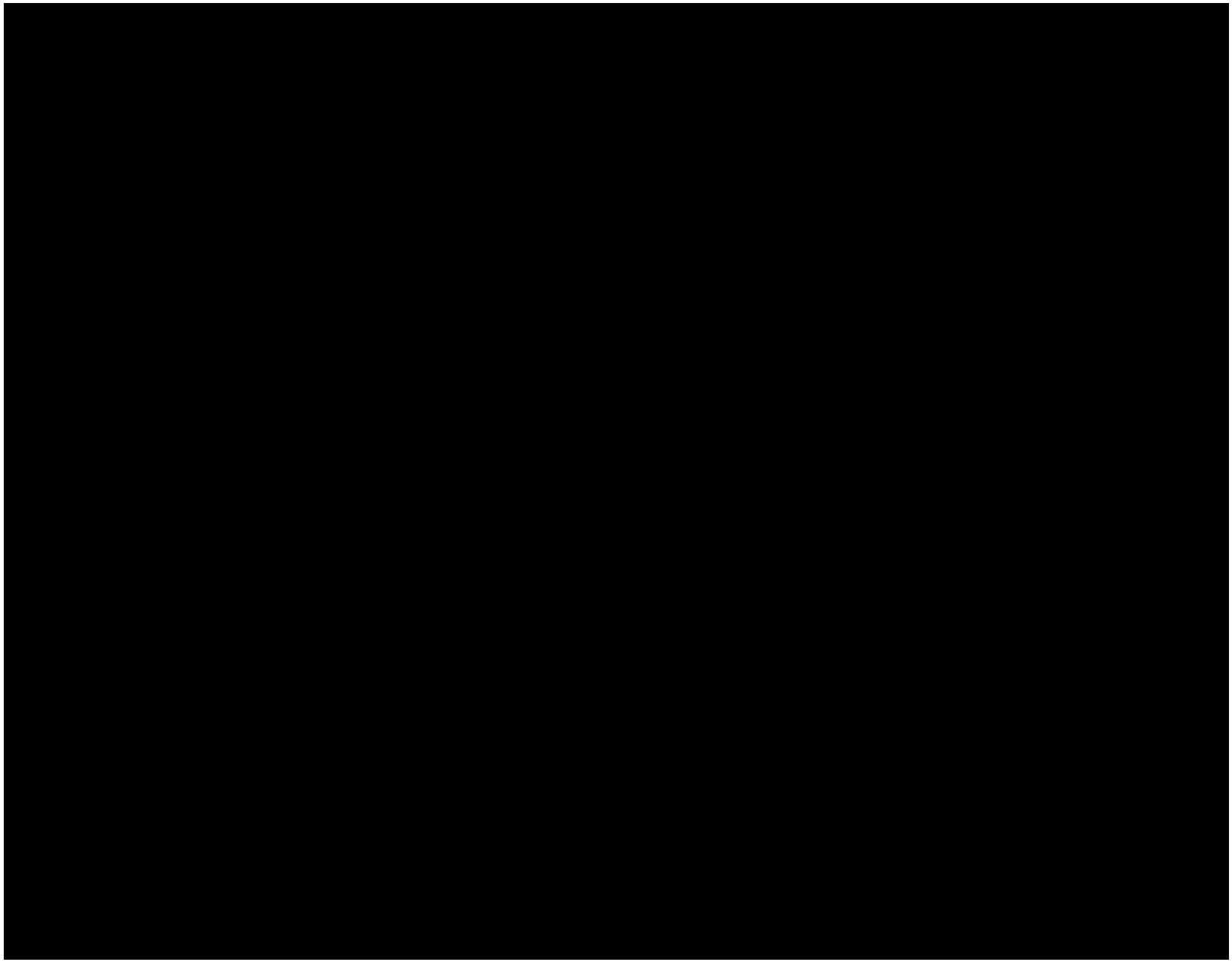
[redacted]

1.1 INTRODUCTION

[redacted]

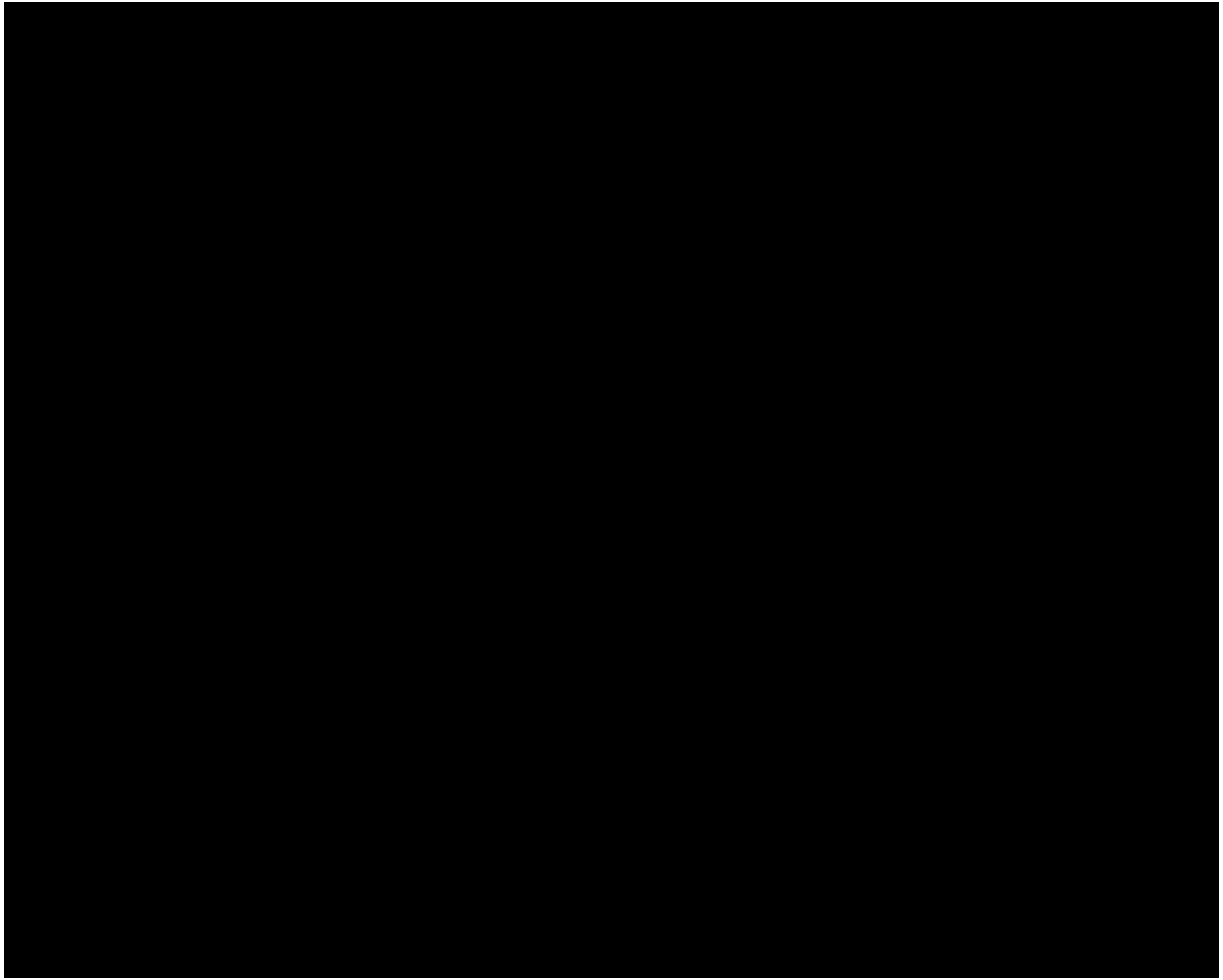
The Project consists of an offshore wind farm proposed to be located in [redacted] to connect power produced by the wind farm to the regional electric transmission system. [redacted]

The focus of this report are [redacted] being developed for the Project, known as the Wind Farm Area. [redacted] Visibility of onshore facilities is not included as part of this document and will be analyzed during Project permitting.



1.2 PROJECT DESCRIPTION

[redacted]



2.0 VISIBILITY STUDY

2.1 OVERVIEW

The closest shoreline to the Long Island Wind Project WTGs is the uninhabited Nomans Land Island, located approximately [redacted]

Nomans Land Island National Wildlife Refuge is a 628-acre island located in Dukes County, Massachusetts, 3 mi (4.8 km) southwest of Martha's Vineyard in the Atlantic Ocean. The United States Fish and Wildlife Services (USFWS) first began managing the eastern third of Nomans Land Island in 1970 under a Joint Management Agreement with the U.S. Navy, while they were actively using the island for military training purposes. In 1998, management of the entire island was transferred from the U.S. Navy to the USFWS for the protection and management of migratory birds. Both the island and its surrounding waters have been closed to public access since the U.S. Navy began leasing it in the 1940s as an aerial bombardment and gunnery range.[1] The island is closed to public use and impacts to the local and state economy and historic and visual resources are therefore not expected.

This study analyzes visibility from publicly accessible locations on the southwestern shore of Martha's Vineyard and Nantucket, Massachusetts and the closest location in New York as representative sensitive viewing locations. A detailed seascape, landscape, and visual impact assessment (SLVIA) will also be completed for the Construction and Operations Plan per BOEM requirements which would include soliciting agency and stakeholder input as well as technical analysis.

2.2 PROJECT VISIBILITY

The Project is located in the open ocean [redacted] away from the shorelines of surrounding states. While the distance from which the Project will most often be viewed will minimize the visibility of the WTGs, the degree to which the WTGs will be visible or noticeable depends on several factors including:

- WTG height, distance from viewer, viewer elevation, and curvature of the earth;
- topography, vegetation, and buildings/developments that obscure the WTGs from certain viewpoints, especially as views move inland;
- atmospheric conditions, including haze and cloud cover;

[1] Nomans Land Island National Wildlife Refuge | U.S. Fish & Wildlife Service (fws.gov)

- lighting angles as influenced by time of day and year;
- nighttime lighting; and
- viewing context.

These factors are further described in the following sections.

2.2.1 WTG Height/Curvature of the Earth and Atmospheric Refraction

In general, objects or features that are closer to a viewer's location will appear more detailed and more dominant. In the case of offshore wind projects in which WTGs are often located miles offshore, objects viewed on the horizon are often not seen in their entirety because they begin to fall below the visible horizon due the curvature of the earth's surface. As the distance increases, less of the object will be visible. In addition, line of sight curves downward at large distances because of the refraction of light in the earth's atmosphere. This effectively lessens the impact of the earth's curvature on the relative height of an object. The effects of the earth's curvature and refraction are calculated with commonly used formulas for surveying work and reasonable assumptions for the average amount of refraction in the atmosphere. The effects of the curvature of the earth and atmospheric refraction on the apparent height of objects is shown in Figure 2.1.

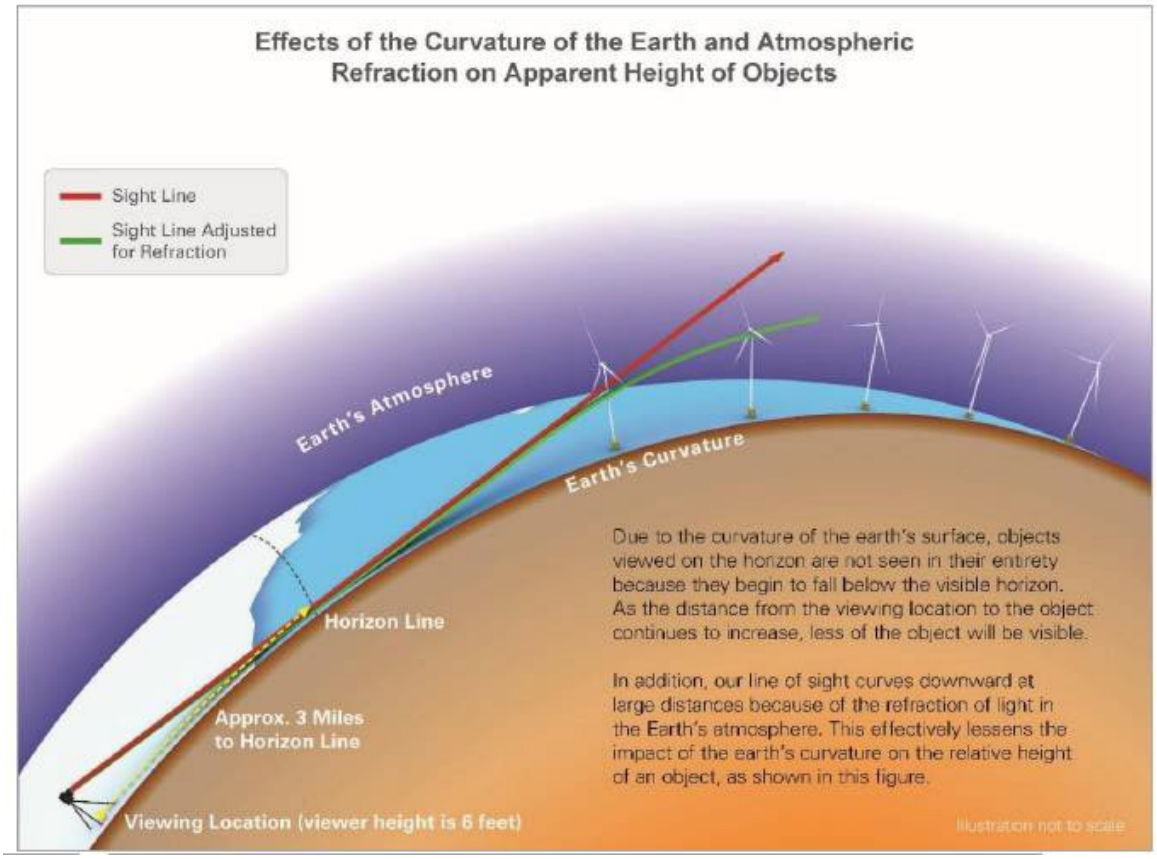


Figure 2.1 Curvature of the Earth and Atmospheric Refraction

2.2.2 Viewer Distance

Viewer distance from an area is a key factor in determining the level of visual effect, with perceived impact generally diminishing as distance between the viewer and the affected area increases (BOEM 2007). The Bureau of Land Management Visual Resource Management program categorizes views into foreground/middle ground, background, and seldom seen distance zones. These distance zones provide a frame of reference for classifying the degree to which details of the viewed Long Island Wind project will affect visual resources.

- The "foreground/middle ground" area, identified as occurring from 0 to 5 mi (0 to 8 km) from the Project, is considered to be the location from which Project element details will be visually clear (in the foreground) and where viewers still have the potential to distinguish individual forms, and texture and color are still identifiable, but become muted and less detailed (middle ground).
- In the "background," classified as the area from 5 to 15 mi (8 to 24 km), texture has disappeared, and color has flattened making objects appear "washed out", however, landform ridgelines are still distinguishable.
- The "seldom seen" area, also referred to as the "extended background," includes lands visible beyond 15 mi (24 km) or lands frequently hidden from view, due to atmospheric conditions, from key locations.

[redacted]

2.2.3 Angle of Observation

Angle of observation refers to the angle between the viewer's line of sight and an object's location. There are some areas that have superior views towards the Wind Farm Area from potentially sensitive viewpoints. When distance from the WTGs is consistent, viewers at higher elevations (superior views) will see larger portions of the WTGs when compared to viewers at beach level.

2.2.4 Meteorological Conditions

Two existing studies were consulted to determine the frequency of various meteorological conditions that would impact visibility of the offshore components in the Wind Farm Area. The New York State Offshore Wind Master Plan, Visibility Threshold Study (NYSERDA 2017) analyzed frequency of certain meteorological conditions and the impact of those conditions on visibility of WTGs over distance. The NYSERDA study, indicated that "…offshore wind energy projects would have minimal visual impact at a distance of 20 miles from shore and negligible impact beyond 25 miles". [redacted]

As the Long Island Wind WTGs will be located more than [redacted] from New York and are not anticipated to be highly visible, and the NYSERDA study focused on frequency of conditions and visibility within 30 mi (48 km), a second study was reviewed that assessed conditions in the geographic area most closely related to the Wind Farm Area.

In 2017, BOEM developed an analysis of the meteorological conditions associated with the offshore Massachusetts and Rhode Island Wind Energy Areas. The report was developed to help understand the meteorological conditions experienced from select viewpoint locations on Martha's Vineyard, Nantucket, and the southern coast of Massachusetts and Rhode Island, and how they may influence the visibility of offshore wind energy projects. A total of 24 viewpoint locations were identified that represent points the public may frequent that could have a view of any offshore wind energy projects developed in the Wind Energy Areas (BOEM 2017). The analysis was based on hourly meteorological surface data collected at the National Weather Service measurement sites (also referred to as meteorological sites) in Massachusetts and Rhode Island over a 10-year period. Data collected included wind speed and direction, cloud cover, cloud ceiling height, visibility, precipitation, and temperature (BOEM 2017). The BOEM report was reviewed to identify the typical or average weather conditions and visibility that occur within the Project area.

Based on data collected from the three meteorological sites used in the report (i.e., airport locations in Martha's Vineyard, Nantucket, Massachusetts and Newport, Rhode Island) and the results of the analysis, clear conditions occurred between 51 and 56 percent of the daylight hours over the course of one year, with visibility during clear conditions averaging approximately 17 to 20 nautical miles (19 to 23 mi; 32 to 37 km). During nighttime hours, clear conditions occurred between 50 and 57 percent of the time over the course of one year, with visibility during clear conditions averaging approximately 16 to 20 nautical miles (18 to 23 mi; 30 to 37 km). Furthermore, visibility was generally found to be greater in winter and lower in summer. Tables 2.1 and 2.2 provide a summary of the results of the meteorological conditions and visibility, respectively, observed at each of the meteorological sites.

Table 2.1 Summary of Meteorological Conditions – Distribution of Hourly Daylight/Nighttime Observations

Conditions[1]	Meteorological Sites					
	Newport		Nantucket		Martha's Vineyard	
	Daytime	Nighttime	Daytime	Nighttime	Daytime	Nighttime
Clear	56%	57%	51%	50%	53%	54%
Foggy	15%	13%	22%	21%	17%	15%
Rainy	7%	7%	6%	7%	7%	7%
Hazy	1%	1%	2%	1%	1%	1%
Cloudy	21%	22%	19%	21%	22%	23%

[1] Data in the table presents the annual distribution of the five meteorological conditions during daylight hours as a percentage. Each hour is characterized as either clear, foggy, rainy, hazy, or cloudy.

Source: BOEM 2017.

Table 2.2 Summary of Average Daytime/Nighttime Visibility (Nautical Miles) at Meteorological Sites

Conditions[1]	Meteorological Sites					
	Newport		Nantucket		Martha's Vineyard	
	Daytime	Nighttime	Daytime	Nighttime	Daytime	Nighttime
Clear	20	20	17	16	20	18
Foggy	3	3	3	3	3	3
Rainy	8	9	9	9	9	9
Hazy	4	4	4	4	5	5
Cloudy	12	13	12	13	13	13

[1] Data in the table presents the average annual visibility distance for clear, foggy, rainy, hazy, or cloudy conditions for daytime and nighttime hours.

Source: BOEM 2017.

2.3 VISUAL SIMULATIONS

Visual simulations (simulations) were created to depict the commercially scaled and technically feasible scenario for the Long Island Wind generation facility and its potential changes to the existing landscape. The simulations illustrate various weather conditions including clear, partly cloudy, and overcast conditions in the early morning, mid- afternoon, late day, and nighttime. The simulations were used to determine the level of contrast between the existing seascape/landscape and the expected seascape/landscape after the Project is commissioned. Visual simulations are included as Attachment 8.5-2 to this Proposal.

The simulations were created using geographic information system (GIS) software, Autodesk 3D Studio Max®, and rendering software combined with site photography to depict what would be seen if the Project is developed. To create the simulations, the location data captured in the field with a global positioning system (GPS) device for each photographed location, in addition to heading data to the Wind Farm Area centroid point, were transferred to GIS software, where it was combined with GIS data of the preliminary layouts of Project components and facilities. A map showing the data was exported at true scale and imported into 3D Studio Max®. Using this scaled map as a base, 3D models of the offshore Project area were created to scale. These 3D models of the Project WTGs, previously modeled to scale in 3D Studio Max®, were added in their appropriate locations and elevations. The views from the existing digital photographs were then matched in the 3D model using virtual cameras with the same focal length and field of view as the camera used to capture the photography. After date- and time-specific lighting was added to the 3D model, renderings from the virtual cameras were created. These renderings were then blended into the photographs in Adobe Photoshop software. Any necessary modifications to the existing foreground landscape were completed in Photoshop as well. This process of creating a 3D model at true scale and rendering images using the same specifications used by the camera ensures that the spatial relationships of the landscape, Project features, and viewer perspective are accurate and match the existing site photographs. Each simulation was then scaled to be viewed at a specified distance (whether on a printed sheet or computer monitor) to represent the actual size of the WTGs.

3.0 POTENTIAL EFFECTS TO VISUAL RESOURCES

Where visible and noticeable, the Project facilities have the potential to create visual effects. The Project will introduce several vertical, moving objects (i.e., WTGs) and one offshore converter station into a landscape setting dominated by open expanses of water and defined by the horizon line. The Wind Farm Area is located approximately [redacted] The farther away objects are from the viewer, the smaller they appear, features lose details and become less distinct, and surface textures become difficult to discern. In addition, as described in Figure 2.1 above, objects viewed on the horizon are often not seen in their entirety because they begin to fall below the visible horizon due to the curvature of the earth's surface.

It is anticipated that views of the Project from the southern coast of mainland Rhode Island and Massachusetts will be limited primarily to coastal beaches that have unobstructed views of the Atlantic Ocean. In seascapes, atmospheric haze reduces the practical visibility, sometimes significantly. Potential viewers located along the southern coast of Rhode Island and Massachusetts, [redacted] It is anticipated that actual visibility at [redacted]

Potential views of the Project from the south or west shores of Martha's Vineyard and Nantucket will also be limited primarily to locations at coastal beaches and bluffs. [redacted] Visibility of WTGs is not the only factor that needs to be considered when determining potential visual impacts of the Project. For example, potential visual effects not only consider how much of the WTG is visible, but distance of the WTG from the viewer, number of WTGs visible and the relative portion of a person's field of view they occupy, perceived scale of the WTGs, spatial dominance, and meteorological conditions.

Though there are no inhabited land masses [redacted]

[redacted] If the weather is overcast, hazy or foggy, the WTGs will produce less contrast because the white/light grey color of the WTGs will be similar to the white/grey color of the backdrop and will be less noticeable.

From areas along the southern coastline of Martha's Vineyard and along the southern coastline of Nantucket, the WTGs will be the tallest elements in the seascape setting. However, the perceived scale of the WTGs will be relatively small, amounting to fractions of an inch or less for viewers onshore.

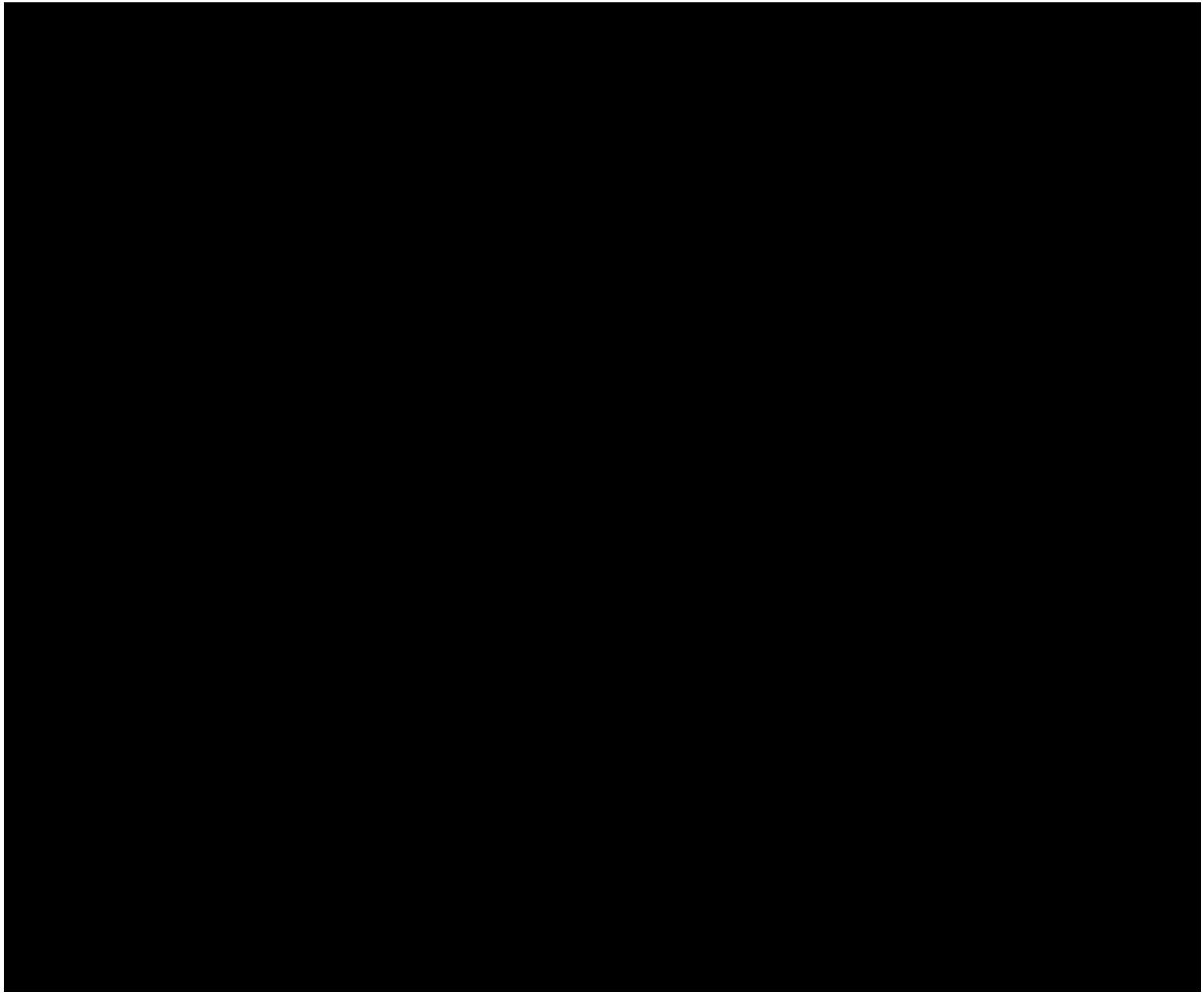
Typically, viewers located away from the coast, including residents, recreational users associated with parks, and motorists along local travel routes will not have views of the offshore Project area, because they will be screened by vegetation and/or urban development. Exceptions will be viewers with an elevated or superior viewing position who have unobstructed views toward the Wind Farm Area.

[redacted]

Construction impacts of the Project were not considered for the purposes of this study. The Construction Operations Plan and associated Seascape, Landscape, and Visual Impact Assessment will be submitted to BOEM and will analyze those potential effects in detail.

3.1 KEY OBSERVATION POINTS

Three Key Observation Points (KOPs) representing critical or typical viewpoints within, or along, an identified viewing location were selected and used to assess the visibility and potential visual effects of the Long Island Wind Project [redacted] The sensitivity of viewers at each KOP is based on the following criteria: type of use, expected concern for aesthetics, and special status or designation. Identifying groups of individuals that will likely be sensitive to visual changes is an important part of the visual assessment process and helps to define specific locations from which to assess changes to the visual character of the seascape/landscape.



[redacted]

4.0 CONCLUSIONS

The level of change perceived by viewers will be dependent upon multiple factors, including distance between the viewer and the structure, the height of the WTGs, the elevation of the viewer, the curvature of the earth, and meteorological conditions. [redacted]

5.0 REFERENCES

BOEM (Bureau of Ocean Energy Management). 2007. Programmatic Environmental Impact Statement for Alternative Energy Development and Production and Alternative Use of Facilities on the Outer Continental Shelf – Final Environmental Impact Statement, Section 5 Potential Impacts of Alternative Energy Development. Available online at: https://www.boem.gov/Renewable-Energy-Program/Regulatory- Information/Alt_Energy_FPEIS_VolIIFrontMatter.aspx. Accessed January 2023.

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Attachment 8.5-2

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Attachment 8.5-3

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