Pre-Development Assessment of Meteorological and Oceanographic Conditions for the Proposed Long Island – New York City Offshore Wind Project Area

Final Report 10-22
Task 2
October 2010

New York State
Energy Research and
Development Authority

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Prepared for the

New York State Energy Research and Development Authority

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ABSTRACT AND KEY WORDS

This report presents the results of a pre-development assessment study of the wind, wave and ocean current environment in the vicinity 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 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. Existing data sources, previous field projects, and other relevant information concerning the meteorological and oceanographic characteristics of the region were used to compile and derive the statistics presented in this study. These statistics include mean and extreme conditions, their spatial and temporal variability, and energy production potential using commercially available wind turbine models. The study concludes that the wind, wave, and current environment, together with the induced loads and stresses on structural components, are compatible with the existing generation of offshore turbines and foundation technologies.

KEY WORDS – offshore wind energy, waves, currents, climatology, meteorology, Long Island – New York City Offshore Wind Collaborative, NYSERDA, AWS Truepower.

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SUMMARY

This report presents the results of a pre-development assessment study of the wind, wave and ocean current environment 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.

This report characterizes the wind, wave, and ocean current environment of the proposed project area and its surroundings using existing data sources. Compiled and derived statistics include mean and extreme conditions, their spatial and temporal variability, and energy production potential using commercially available wind turbine models. This information is important for determining the suitability of various wind turbine and foundation options, assessing site accessibility and safety issues, and evaluating overall project feasibility. Average wind speeds across the project area at the 90 m reference height are predicted to be approximately 8.8 m/s (±0.3). Calculated net capacity factors for a selected set of commercial offshore turbine models range from 34.3% to 43.4%, depending on the particular turbine model and project size. For a 350 MW project scenario, the net annual energy production is predicted to range from 1070 to 1325 GWh; for a 700 MW project, production values in the range of 2100 to 2625 GWh are expected. In summer during sea breeze conditions, maximum wind speeds and capacity factors will both tend to occur during high load demand (in the late afternoon and early evening) and will at times be concomitant with periods of peak load brought on by extended heat waves.

Expected extreme wind speeds (100 year return period) are predicted to be 50 m/s for a sustained 10-min period, and 63 m/s for a 3-sec peak gust. A strong category two or minimal category three hurricane is the most intense storm that can be expected to impact the proposed project area. Given a mean turbulence intensity of 0.08 or less, the project area's wind characteristics are well within the suitability for a suite of existing class IA turbines. The wave and current environment is also favorable for the existing generation of offshore turbine foundation technologies, with significant wave heights and extreme wave statistics comparable to offshore wind farms in northern Europe. The predicted 100-year extreme wave height for the proposed project area is approximately 17 m. The most energetic waves/swells tend to come from the east and southeast directions, with average significant wave heights averaging about 1 – 1.5 m across the proposed project site. Surface ocean current speeds within the vicinity of the proposed project area average about 23 cm/s, but daily velocities can reach in excess of 70 cm/s. Sub-surface and ocean bottom currents

tend to average less than 10 cm/s, with maximum speeds approaching 15 cm/s. Other meteorological parameters with the potential to affect wind energy production— principally lightning and atmospheric and sea spray icing—are anticipated to have an insignificant influence.

Detailed siting, design and permitting of all components of an offshore wind project will require more site-specific meteorological and wave environment information than can be developed with further reviews of existing data sets or the relevant literature. The recommended next step to characterize the physical environment of the proposed offshore area is to acquire site-specific meteorological and wave data for a minimum period of one year.

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. 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 and its surroundings. A preliminary review of these qualities is critical in the initial planning stages to determine the existence and nature of any perceived barriers, conflicts, or other fatal flaws that could preclude development of the proposed project. Using existing data, this report characterizes the wind, wave, and ocean current environment of this region. This information is intended to provide interested parties with a baseline of knowledge to facilitate future project planning, siting, and measurement activities.

This report provides information on the average and extreme wind, wave, and current conditions expected in the vicinity of the proposed project area. The definition of these conditions is important for determining the suitability of various wind turbine and foundation options, assessing site accessibility and safety issues, and evaluating overall project feasibility. 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.

[1] A nautical mile equals 1.15 statute miles.

Section 2

2. METEOROLOGICAL CLIMATOLOGY

2.1. AVAILABLE DATA

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 Long Island – New York City offshore 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*** dataset interpolated to a representative point in the project area. The windTrends dataset 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. It is essentially a controlled regional reanalysis dataset developed by AWS Truepower that differs from conventional reanalysis data because it is computed at a finer resolution (20 km) and it relies on twice-daily observations from rawinsonde (weather balloon) data (Taylor et al. 2009). The windTrends dataset 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 our confidence in the windTrends dataset, 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 1. Each data reference location is indicated on the regional map in Figure 1.

Table 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	Modeled dataset	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

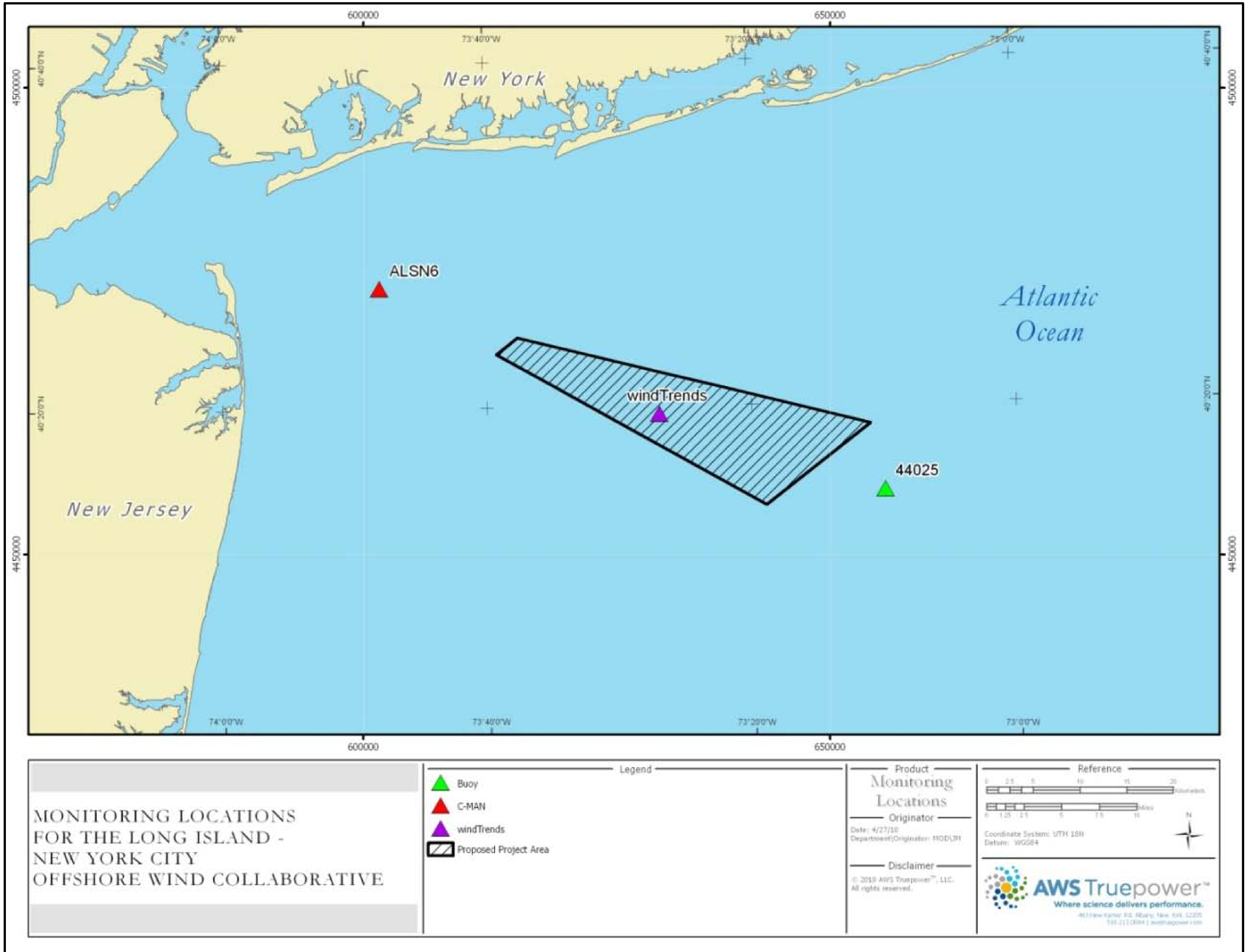

Figure 1. Long Island – New York City Offshore Monitoring Locations

2.2. WIND RESOURCE CHARACTERISTICS

To thoroughly describe the wind resource attributes of a given region, certain variables need to be properly defined to produce a consistent analysis. These parameters include the annualized average wind speed, wind shear exponent, turbulence intensity, Weibull parameters, and air density, and are summarized in Table 2 for the three reference stations. Definitions of these parameters are given below.

In 2002, AWS Truepower (known then as AWS Scientific[2]) authored a preliminary assessment of Long Island's offshore wind energy potential[3] for the Long Island Power Authority (LIPA) in which AWS Truepower's 400-m MesoMap system[4] was used. In collaboration with the National Renewable Energy Laboratory (NREL), AWS Truepower[1] has since remapped the eastern United States offshore area at a 200-m resolution, including 50 nautical miles (93 km) offshore of the contiguous Atlantic coastal states from Rhode Island to South Carolina, the Long Island Sound, Delaware Bay, and Chesapeake Bay. The results were then validated and adjusted using a combination of buoys, tall towers, and other coastal observation stations in the area of interest. The results of this modeling and mapping effort are included in this section's subsequent material.

Annualized Mean Wind Speed. The annualized mean wind speed takes into account repeated months in the data record and weights each calendar month by its number of days. Table 2 indicates the annual average wind speed documented for the three reference locations. Nevertheless, when comparing speed values from different locations having differing measurement heights, it is necessary to normalize speeds to a common height. For the purposes of this study, a reference height of 90 m was selected to be representative of the hub height of an offshore wind turbine. Using appropriate wind shear and uncertainty assumptions (described in greater depth below), an average speed value of approximately 8.8 m/s (±0.3 m/s) was determined for the proposed project area. This value agrees with AWST's offshore wind map predictions for the region, as shown in Figure 2. As expected, annual average wind speeds increase with distance from shore, although during sea breeze events (discussed in Section 2.3), the strongest offshore winds can occur close to shore.

It should be noted that there can be a large uncertainty associated with buoy measurements (i.e., 44025), resulting primarily from wave shadowing and platform tilt, both of which are a consequence of the local sea state (Large et al. 1994). The extrapolation of measured wind speeds from the low monitoring height (5

[2] AWS Scientific and TrueWind Solutions consolidated businesses in October 2004 to form AWS Truewind, which as of 27 April 2010 was renamed AWS Truepower.

[3] AWS Scientific, "Long Island's Offshore Wind Energy Development Potential: A Preliminary Assessment," Prepared for LIPA, April 2002.

[4] The MesoMap system combines mesoscale (Mesoscale Atmospheric Simulation System, or MASS; see Manobianco et al. 1996) and microscale (WindMap; see Brower 1999) models to produce accurate, high resolution wind climate maps. Mesoscale refers to atmospheric phenomena having horizontal scales ranging from a few to several hundred kilometers whereas the microscale refers to spatial scales of 2 km or less.

m) up to the 90 m reference heights adds further uncertainty, given that the average change of wind speed with height (wind shear) in not exactly known and can only be approximated. Therefore a range of average wind speeds at hub height (8.8 m/s – 10.8 m/s), to reflect this greater level of uncertainty, is given for buoy 44025 in Table 2. This indication of higher wind speeds compared to the defined project area is consistent with the mapped wind speeds in Figure 2.

Wind Shear. The wind shear exponent represents the rate of wind speed increase (or decrease) with height above the earth's surface according to the wind profile power law, given by:

$$U(z) = U(r) \cdot \left(\frac{z}{z_r}\right)^{\alpha}$$

where *U* is the wind speed at height *z*, *r* is the reference height, and α is the shear exponent. A shear exponent was only observable at ALSN6 and modeled at the windTrends interpolated location; buoy 44025 did not have multiple monitoring heights. The resulting wind shear values were 0.12 at ALSN6 and 0.14 with windTrends. These similar shear values are consistent with the low surface roughness (a measure of the complexity and roughness of the surface and nearby land) of an offshore environment. Shear exponents observed offshore are usually lower than what can be expected over adjacent land areas, where the surface roughness is much higher. The shear was calculated from the mean wind speeds at the reference levels listed in Table 2 based on concurrent valid records at both heights. Only wind speeds greater than 4 m/s, the range of interest for energy production, were used in the calculations. Episodes of higher shear (typically > 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. < 0.1) are common during the fall and winter seasons, when cold air flows over the relatively warm coastal and offshore waters.

Table 2. Summary of Wind Resource Characteristics

Parameter	ALSN6 (Buoy)	windTrends (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]

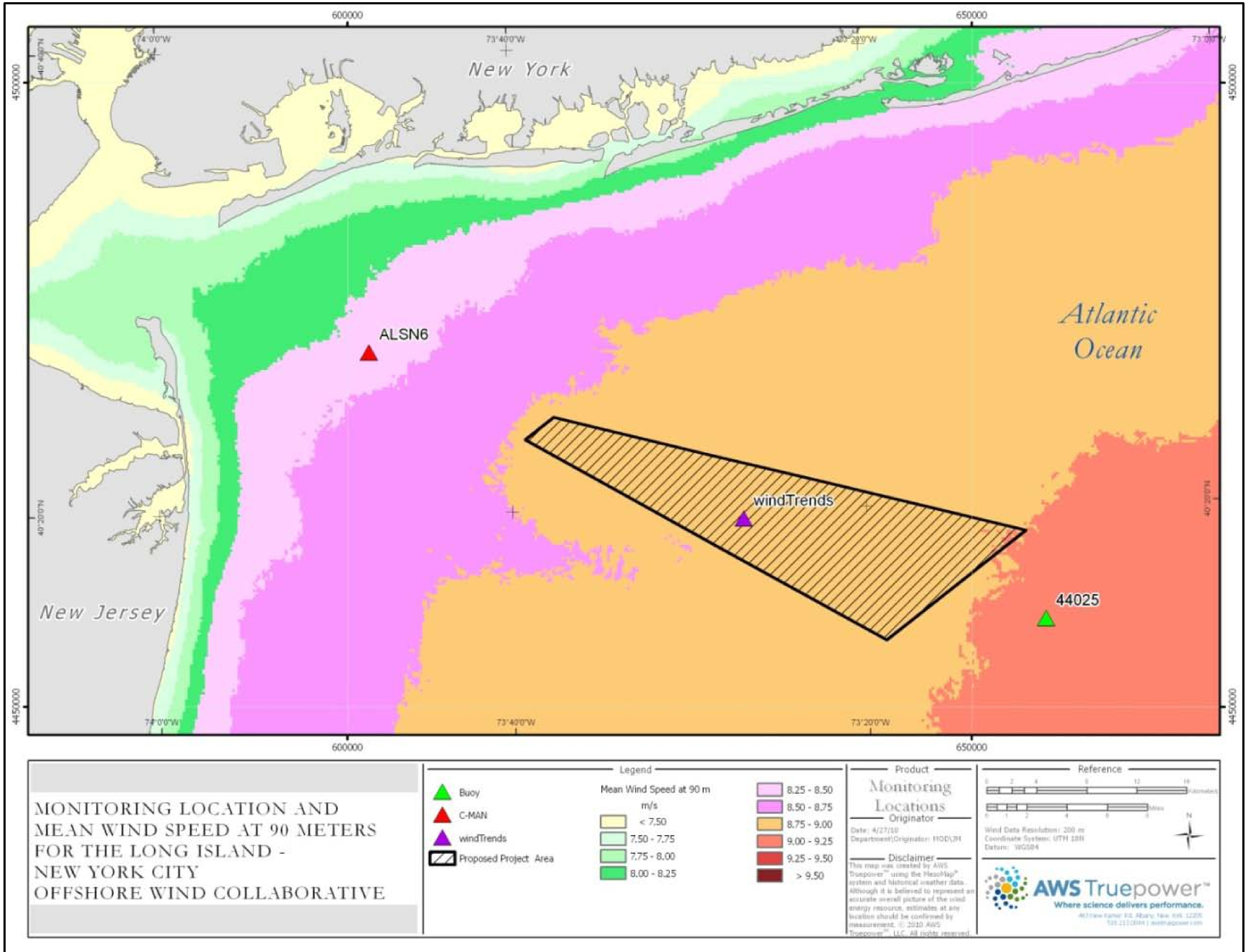

Figure 2. Long Island – New York City Offshore Wind Resource Map

Turbulence Intensity. The turbulence intensity (TI) measures fluctuations in the wind speed recorded by the anemometer in each recording time interval as a fraction of the average speed. Turbulence intensity was only available from ALSN6 and the windTrends dataset. The ALSN6 dataset suggests consistently low TI values when wind speeds are above 4 m/s, with a range from 0.07 to 0.12 (Figure 3). The observed TI at 15 m/s, the value set forth by the International Electrotechnical Commission (IEC) to assess turbine load fatigue, is 0.07 and 0.06 at ALSN6 and windTrends, respectively. The turbulence intensity is expected to be similar in the proposed offshore project area, due to the homogenous surface of the ocean and less turbulent marine atmospheric boundary layer. TI over adjacent land areas can be expected to be much higher (on the order of 0.15 – 0.20).

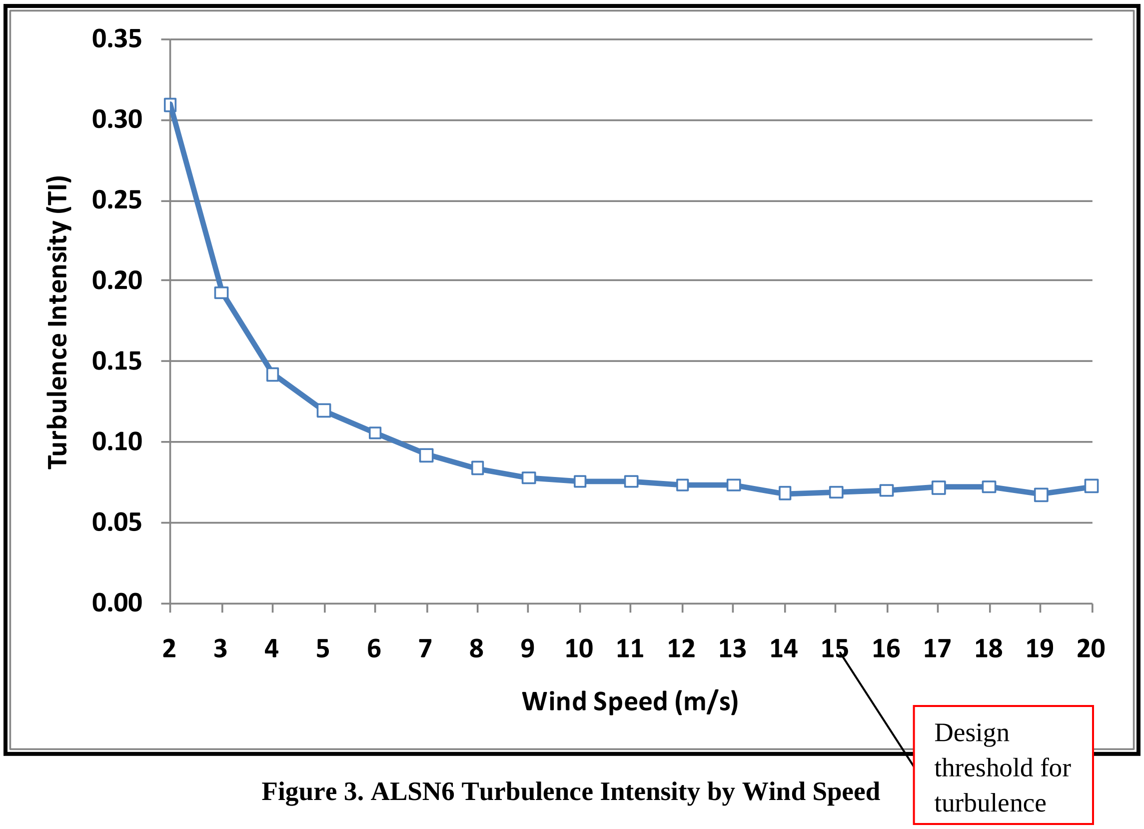

Figure 3. ALSN6 Turbulence Intensity by Wind Speed

Wind Speed Frequency Distribution. The Weibull function is an analytical curve that describes the wind speed frequency distribution, or number of observations in specific wind speed ranges. 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 (44025) to 2.3 (windTrends) and are indicative of a variable wind resource with occasional high wind events. Figure 6 contains a chart for each reference location showing the frequency distribution and the fitted Weibull curve for a height of 90 m.

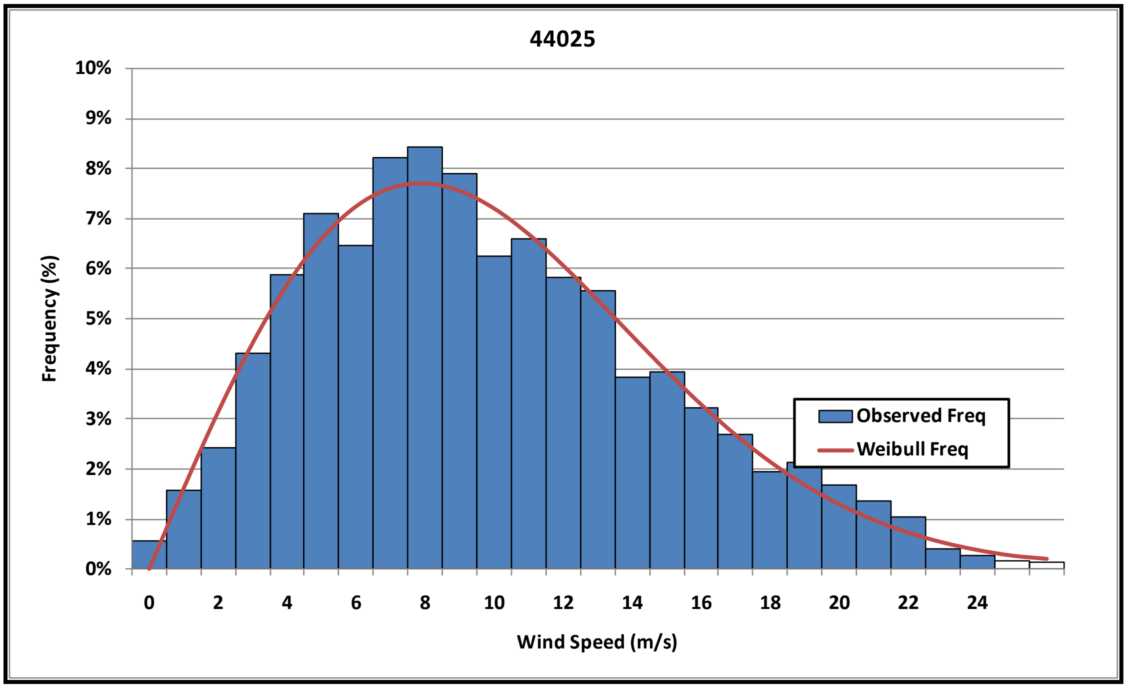

Figure 4. 90-m Wind Speed Frequency Distributions and Fitted Weibull Curves (44025)

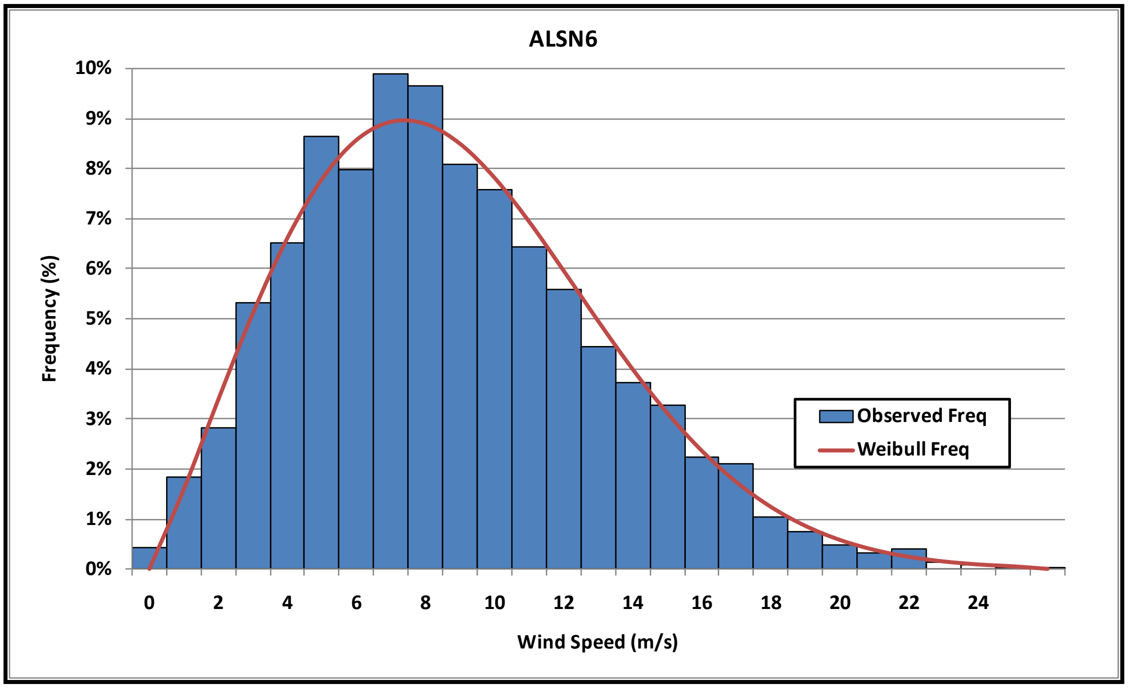

Figure 5. 90-m Wind Speed Frequency Distributions and Fitted Weibull Curves (ASLN6)

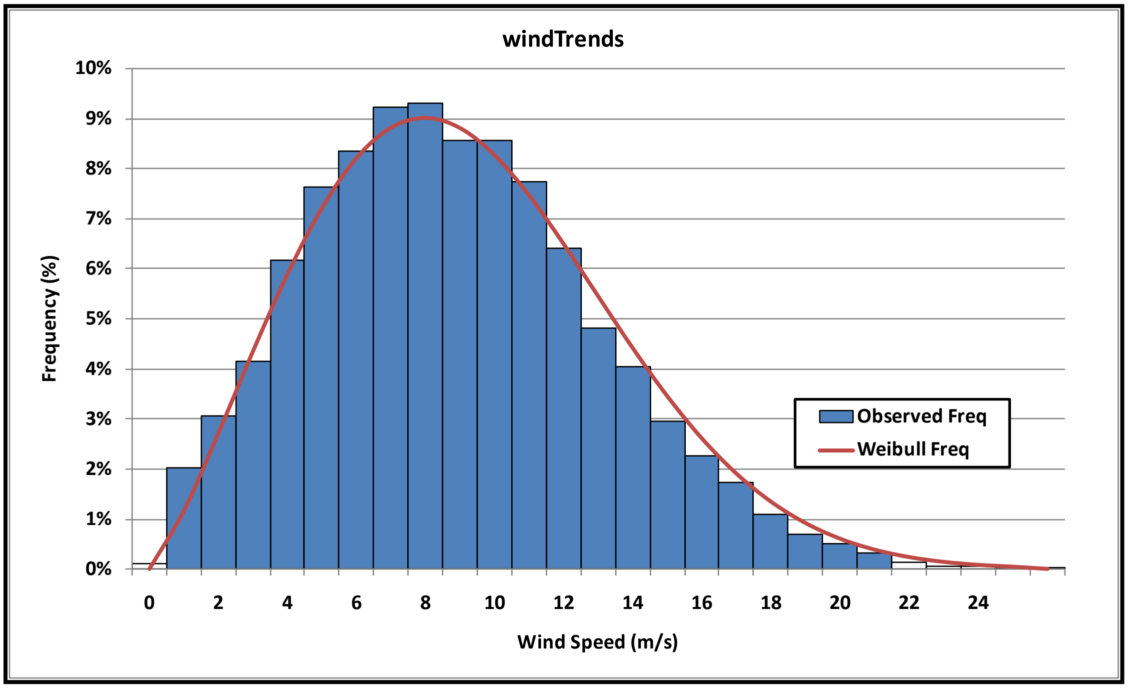

Figure 6. 90-m Wind Speed Frequency Distributions and Fitted Weibull Curves (windTrends)

Air Density. The air density directly affects a wind turbine's energy production: the greater the density, the greater the power output of the turbine for the same speed distribution. The estimated air density at each location was calculated from the following equation:

$$\rho = \frac{P_o e^{\left[-\frac{gz(1.0397-0.000025z)}{RT}\right]}}{RT}$$

where

ρ = Air density (kg/m³)

P_0 = Standard sea-level atmospheric pressure in Pascals (101325 Pa)

R = Specific gas constant for dry air (287 J/Kg·K)

T = Air temperature (ºK)

g = Acceleration due to gravity (9.8 m/sec^2)

z = Elevation of temperature sensor (m)

This equation was applied to each data record, and a weighted average was calculated in which the weight was proportional to the energy content of the wind. The estimated air densities were 1.23 with windTrends [90 m] and 1.26 at buoy 44025 [4 m] and ALSN6 [28.9 m]. The main source of the air density differences is the height of each estimate. Project-specific air densities that are adjusted to the 90 m reference height are described in Section 4.

Seasonal Variation. Patterns of seasonal speed variation are also useful indicators of the wind resource. The 90 m historical wind speeds at the three reference locations track each other reasonably well (Figure 7) from September through March. Still, from April through August, the stronger sea breeze and enhanced thermal circulation near the coast produce higher wind speeds at ALSN6 and the windTrends location than at buoy 44025. Further information regarding the sea breeze and enhanced thermal circulation of this region is presented in the next section. Figure 7 indicates that the strongest winds normally occur during the winter, while the weakest winds occur in the summer. This is consistent with the seasonal climatology, which features stronger atmospheric temperature and pressure gradients during the cold season. The range of variation in the monthly average wind speeds at these monitoring locations range from 2.6 m/s (windTrends) to 4.8 m/s (44025).

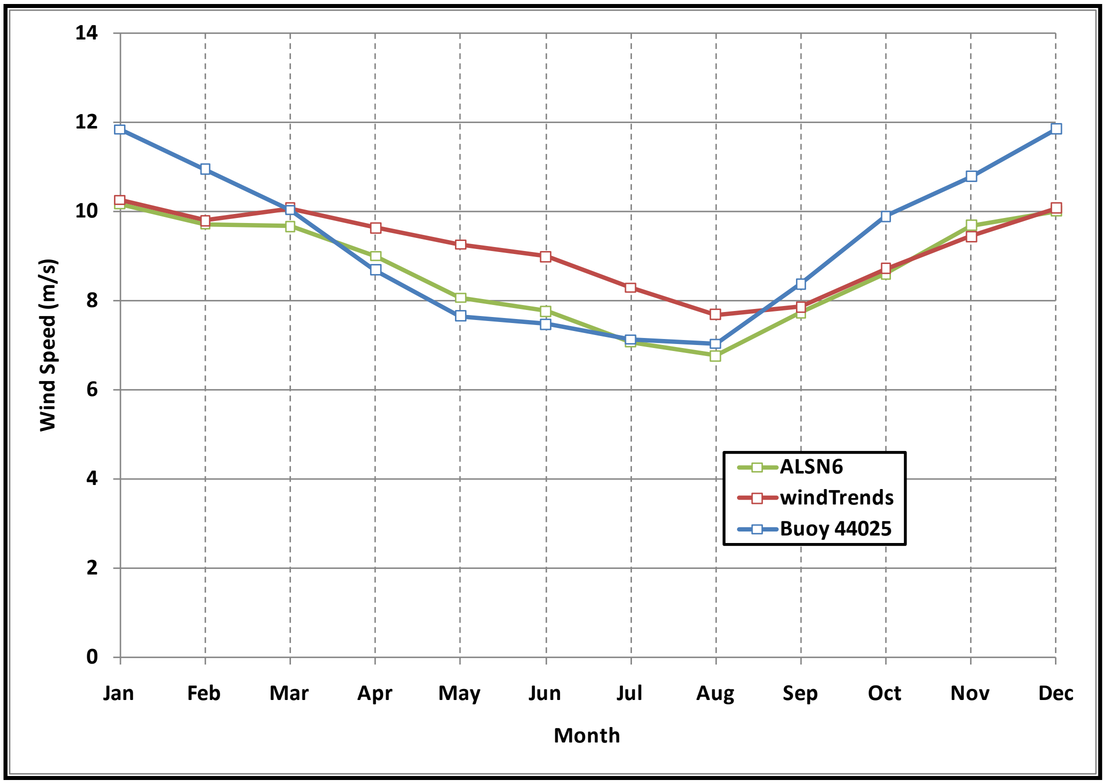

Figure 7. Buoy 44025 and ALSN6 Historical Monthly Mean Wind Speeds

Diurnal Variation. Figure 8 depicts the variation in 90 m average wind speed with time of day at the three locations. The 28.9 m ALSN6 and 5 m buoy 44025 wind speeds were extrapolated to the 90 m hub height using diurnal shear values calculated from ALSN6. The diurnal 90-m wind speed patterns at ALSN6 and from windTrends line up reasonably well and show that energy production at the proposed project area will ordinarily peak during the late afternoon and early evening hours. The diurnal pattern of buoy 44025 does not match up with ALSN6 and windTrends because: (1) its 5-m observed wind speeds were extrapolated a large distance (to 90 m), resulting in a larger uncertainty in the hub height numbers, and (2) it likely suffers from inconsistent wind speed reporting due to wave shadowing and platform tilting as previously discussed in Section 2.2.

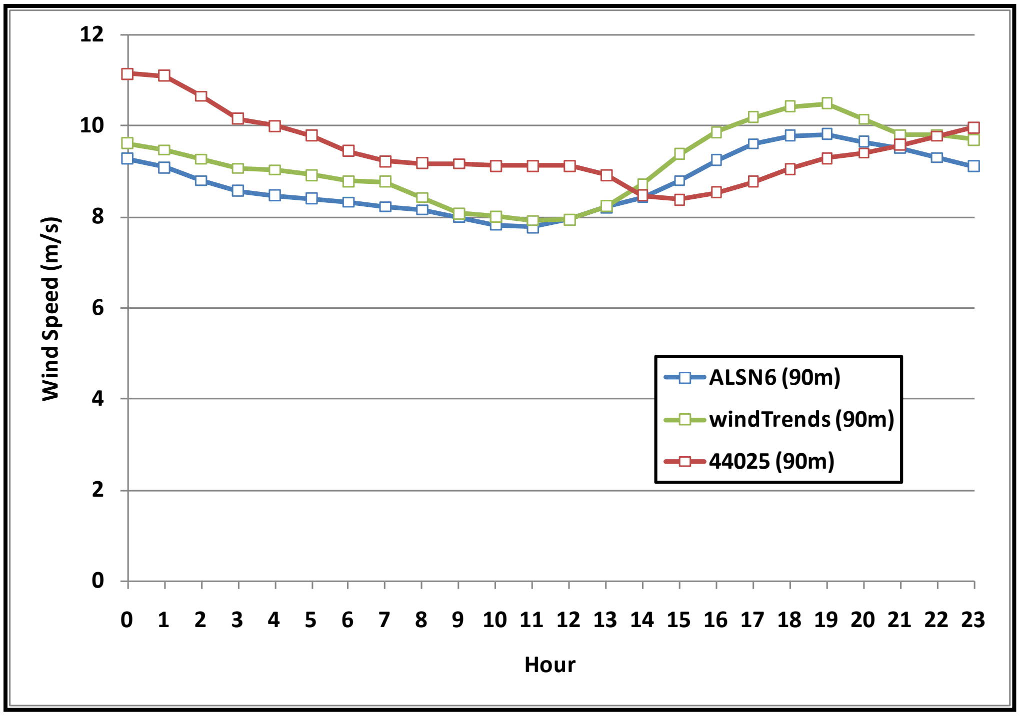

Figure 8. 90-m Diurnal Wind Speed Patterns

Wind Direction. The directional distribution of the wind resource is an important factor to consider when designing a wind project to minimize the wake interference between turbines. The annual wind frequency and energy distribution by direction plots (wind roses) at the three reference locations are shown in Figure 9. The gray wedges indicate the frequency of occurrence out of each direction sector, whereas the blue wedges indicate the percentage of total energy (a function of the cube of wind speed) from each direction sector. Each wind rose indicates that the prevailing wind direction sectors are south through southwest; however there is a discrepancy in which direction sectors contain the most energy.

Due to proximity, the wind rose from ALSN6 is more influenced by land (and shape of the shoreline) to the north and west. The wind roses for the other two locations—windTrends and buoy 44025—would be expected to be similar to each other, being less influenced by the adjacent land masses. windTrends actually shows greater energy from the south-southwest directions than buoy 44025, which is likely due to the influences of wave shadowing and platform tilt at the buoy, especially during windy conditions. The longer fetch to the south and east of the buoy results in stronger winds and correspondingly higher waves. The higher waves cause wave shadowing and buoy platform tilt that result in the underestimation of wind speeds (Taylor et al. 2003). Therefore, it is likely that wind reports from this buoy are biased low under stronger southerly winds. As a result, the frequency out of this direction sector is similar between the two sites but the energy is reported to be much less at the buoy. Accordingly, the windTrends wind rose is considered to be the most representative of the project area.

To define the seasonal variation in the wind rose, Figure 10 presents the three wind roses for the April through August time period, while Figure 11 presents the September through March wind roses.. The prevailing wind direction sectors during the spring and summer are expected to be south-southwest in the project area, while the autumn and winter prevailing wind directions are expected to be from the west through northwest direction sectors.

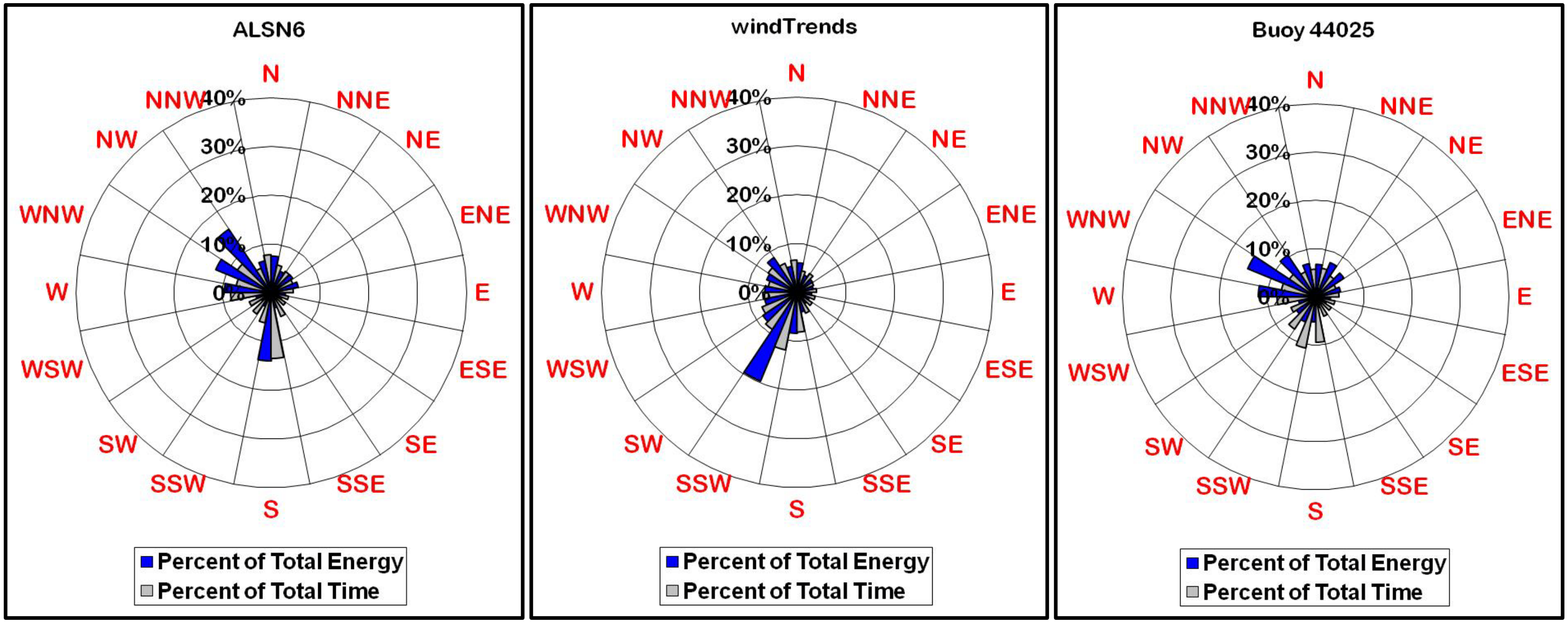

Figure 9. Monitoring Location Annual Wind Roses

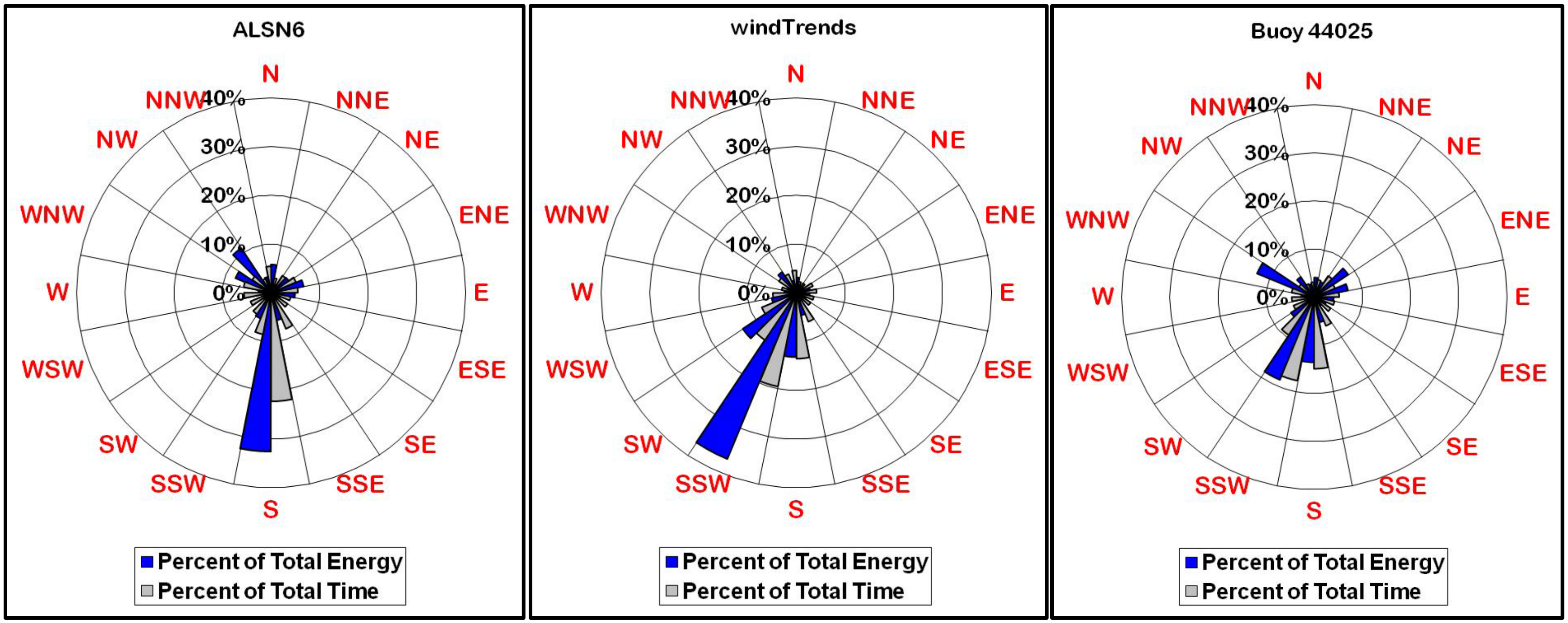

Figure 10. Monitoring Location April – August Wind Roses

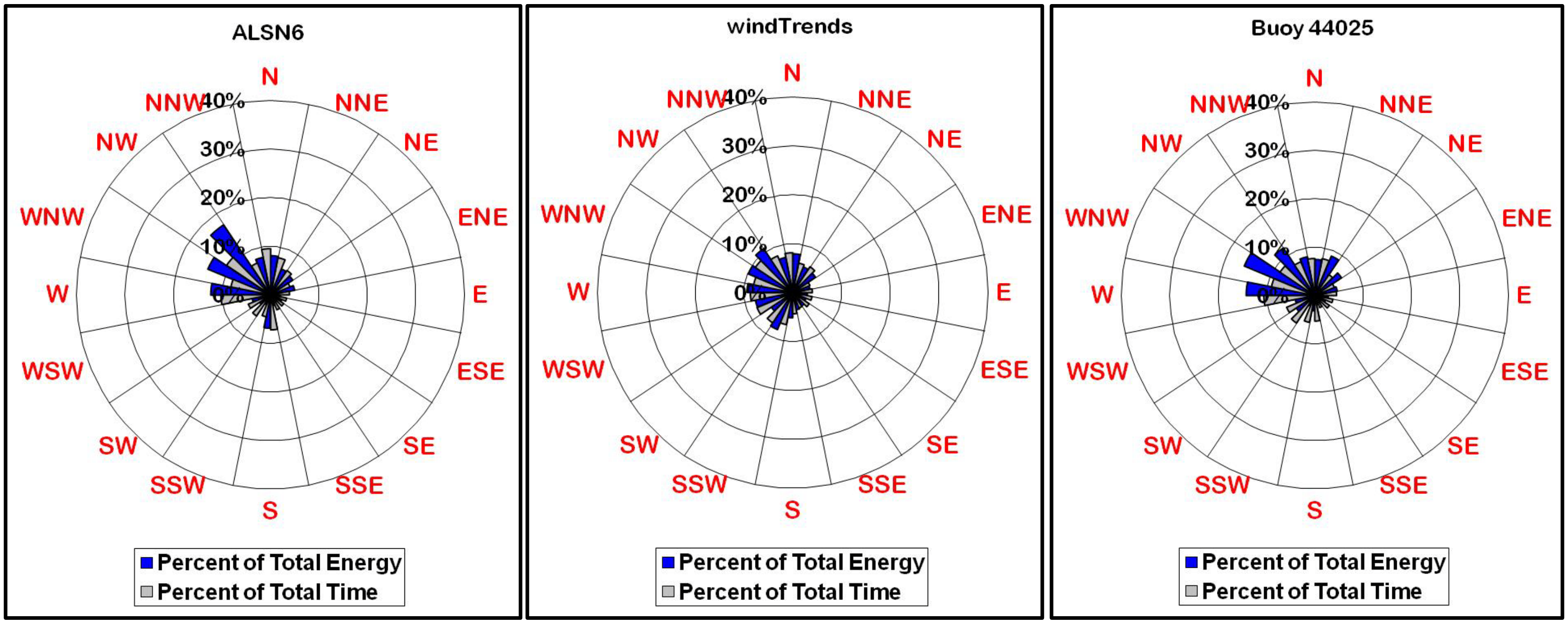

Figure 11. Monitoring Location September – March Wind Roses

Extreme Wind Climatology. The proposed project area 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. Satellite images of an extratropical cyclone and hurricane are shown in Figure 12 and Figure 13, respectively. Thunderstorm gust fronts associated with cold frontal passages are also a potential source of extreme winds as they bring sudden wind shifts and can cause high ramping events.

Nor'easters are the most common types of extratropical cyclones in this region and are typically stronger and occur more often during the cold season. Maximum 3-second wind gusts within the strongest such storms are on the order of 50 m/s at an 80-m height; however, maximum gusts of about 25 m/s to 30 m/s are much more common.

Hurricanes, which form in the tropics and are categorized by the Saffir-Simpson Hurricane Wind Scale[5], have return periods for the project area on the order of 10 to 15 years and are characterized by minimum 1-minute sustained wind speeds exceeding 39 m/s at 80 m. In their favorable environments[6], such as the Gulf of Mexico, hurricane wind speeds have exceeded 78 m/s. Still, a hurricane of this magnitude has never been recorded as far north as Long Island due to the cooler water and typically higher wind shear environment.

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 proposed project area. Stronger storms are unlikely due to the shape of the United States eastern coastline, latitudinal sea-surface temperature gradients, and unfavorable atmospheric conditions. A map showing historical hurricane tracks of the project area's vicinity is presented in Figure 14. Over the past 100 years, only two hurricanes tracked through the project area (Belle in 1976 and Gloria in 1985) with 1-minute sustained wind speeds exceeding 40 m/s (89 mph).

[5] The Saffir-Simpson scale is defined by the National Hurricane Center at the following link: http://www.nhc.noaa.gov/aboutsshs.shtml.

[6] Favorable environments for hurricane development and sustainability are where surface temperatures exceed 26 C and low amounts of wind shear are present—here, defined as changes of wind speed and/or direction between 1500 and 10000 m. High shear is disruptive to the storm circulation

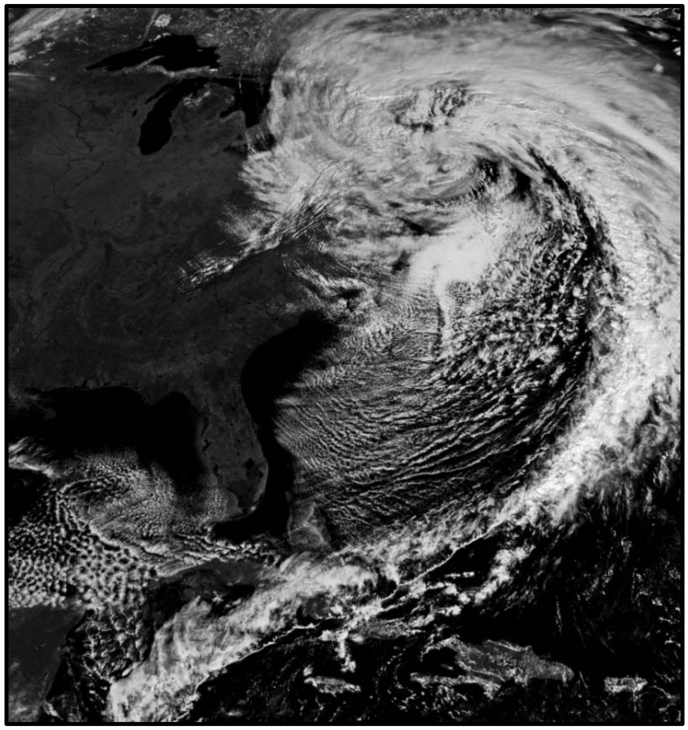

Figure 12. Spring Nor'easter of 2007[7]

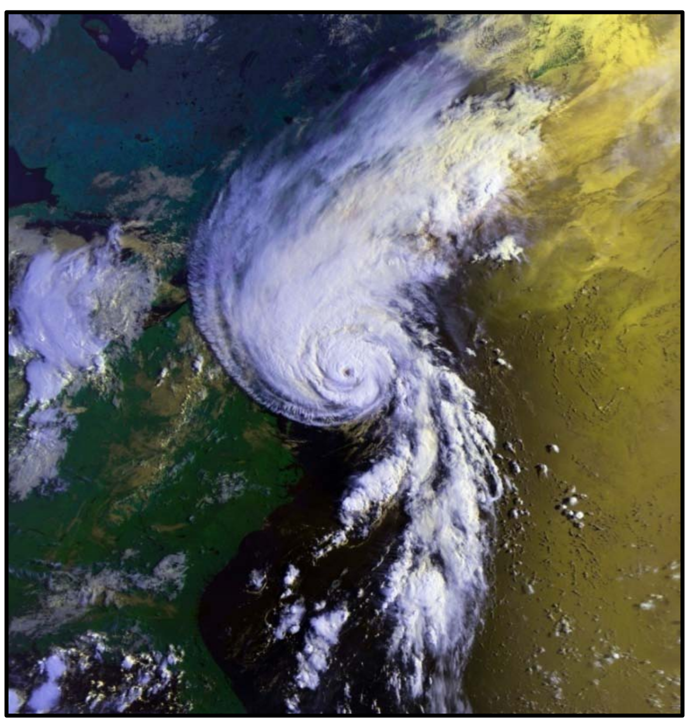

Figure 13. Hurricane Bob on August 19, 1991[8]

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[7] Retrieved from wikipedia web site: http://en.wikipedia.org/wiki/File:0704161533G12I01mod2.jpg
[8] Retrieved from wikipedia web site: http://en.wikipedia.org/wiki/File:Hurricane_Bob_19_aug_1991_1226Z.jpg

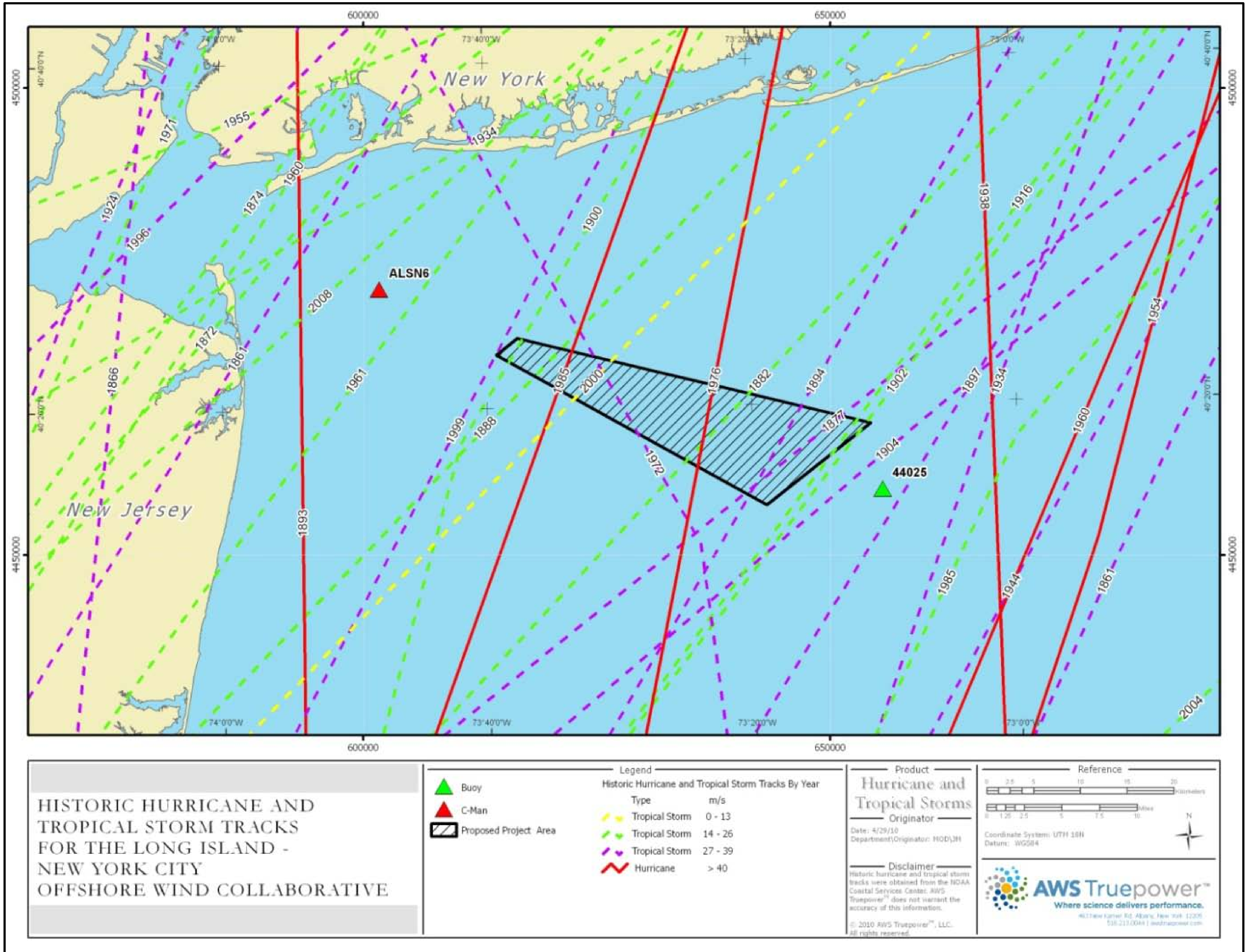

Figure 14. Historical Hurricane and Tropical Storm Tracks

Using data from nearby masts, buoys, and C-MANs, including ALSN6 and 44025 along with the small number of observations collected during major hurricanes that have impacted the Northeast, 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; using a 3-second/10-minute gust factor of 1.25, which is an expected offshore gust factor value (Hsu 2006), corresponds to a peak 3-second gust of about 63 m/s (140 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. Choosing a suitable turbine must include a proper assessment of the extreme wind gusts of a site.

Ten-minute extreme monthly wind speeds for ALSN6 and buoy 44025 are shown in Table 3. These values were derived using the Gumbel distribution and extrapolated to hub height using a 0.08 shear exponent, which is roughly what can be expected in the typical hurricane eyewall (Franklin et al. 2000). Due to the higher frequency of Nor'easters than hurricanes in the project area, the Gumbel distribution is estimating higher extreme wind speeds during the winter months than during the hurricane season months (June – November).

Table 3. 10-minute Extreme Monthly Wind Speeds at 90-m

Month	ALSN6 (m/s)		Buoy 44025 (m/s)	
	50-yr Return	100-yr Return	50-yr Return	100-yr Return
January	44	46	47	49
February	42	45	45	48
March	43	45	48	50
April	37	39	38	40
May	34	36	36	38
June	30	31	31	33
July	30	31	31	33
August	31	33	33	35
September	35	37	39	41
October	39	40	45	48
November	44	46	45	48
December	45	48	48	51

2.3. SEA BREEZE AND ENHANCED THERMAL CIRCULATION

Coastal and offshore locales are favored regions for wind power use because of the generally high wind resource, proximity to major load centers, and existing transmission infrastructure. Since the heaviest power loads in the eastern U.S. occur during the warm season, when sea breezes are most prevalent, understanding the climatology and dynamics of these thermally-induced circulations is key to accurately depicting and matching potential offshore wind power production with onshore energy demand. The proposed project locale is especially favorable for the development of enhanced sea breeze circulations during the warm season, particularly during periods of high load demand.

The sea breeze circulation is an adjustment to the local pressure gradient driven by temperature differences between the onshore (warmer) air-mass and the (cooler) offshore waters (Stull 1988). It often produces afternoon wind speed maxima exceeding 10 m/s, extending from the land-ocean boundary to at least 15 km offshore. A recent study[9] has shown that the coastline morphology of the New York Bight[10] produces an energetic sea breeze circulation south of Long Island (including New York City). This enhanced thermal circulation is characterized by the presence of a sheet-like structure: a local maximum in the wind speed about 70-120 m above the ocean surface (Figure 15). Simulations with a coupled mesoscale-ocean wave modeling system indicate that this low-level maximum in winds speeds typically ranges 3-25 km off the central New Jersey coast extending northwards (30-50 km+) to New York City (Figure 15). Part of the circulation, including the low-level maximum wind speed feature, extends into the proposed project area. Climatological analysis (Freedman et al. 2009) shows that along coastal New York and New Jersey, the sea breeze occurs on about 20% of all warm season (April - September) days.

From an energy production perspective, the enhanced thermal circulation produces wind speed/wind power maxima during high load periods of hot summer afternoons (Figure 17). Although winds well inland may remain light (as illustrated in Figure 15), wind speeds in the near and offshore waters can exceed 15 m/s near hub height during the mid and late afternoon hours, co-incident 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% of all such days (Freedman et al. 2009). In general, the sea breeze diurnal pattern is similar to that depicted in Figure 8, with peak winds occurring about an hour or two earlier (later afternoon versus early evening). 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.

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[9] "Development of Atmospheric Profiling and Modeling Techniques to Evaluate the Design and Operating Environment of Offshore Wind Turbines In the Mid-Atlantic and Lower Great Lakes", a field study (2004 – 2006) sponsored by the Department of Energy (DOE) National Renewable Energy Laboratory (NREL), Long Island Power Authority (LIPA), and NYSERDA.

[10] The NY Bight region is defined as ranging from Cape Cod, MA, to Cape May, NJ, and includes Buzzard's Bay, Long Island Sound, New York Harbor and the New Jersey shore.

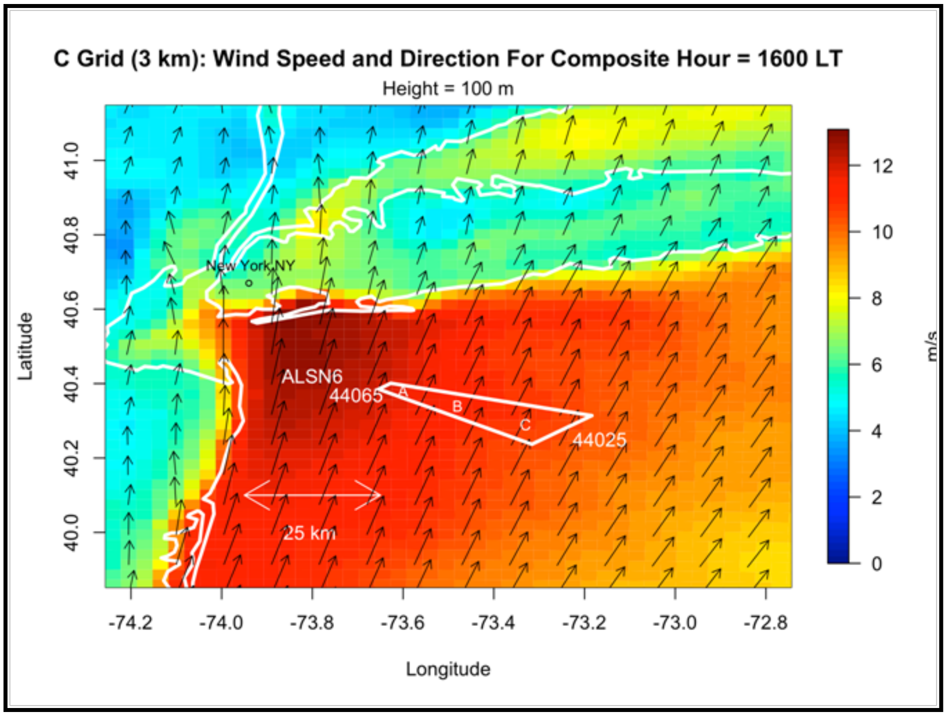

Figure 15. Wind speed (m/s) at 100 m height for composite sea breeze cases[11].

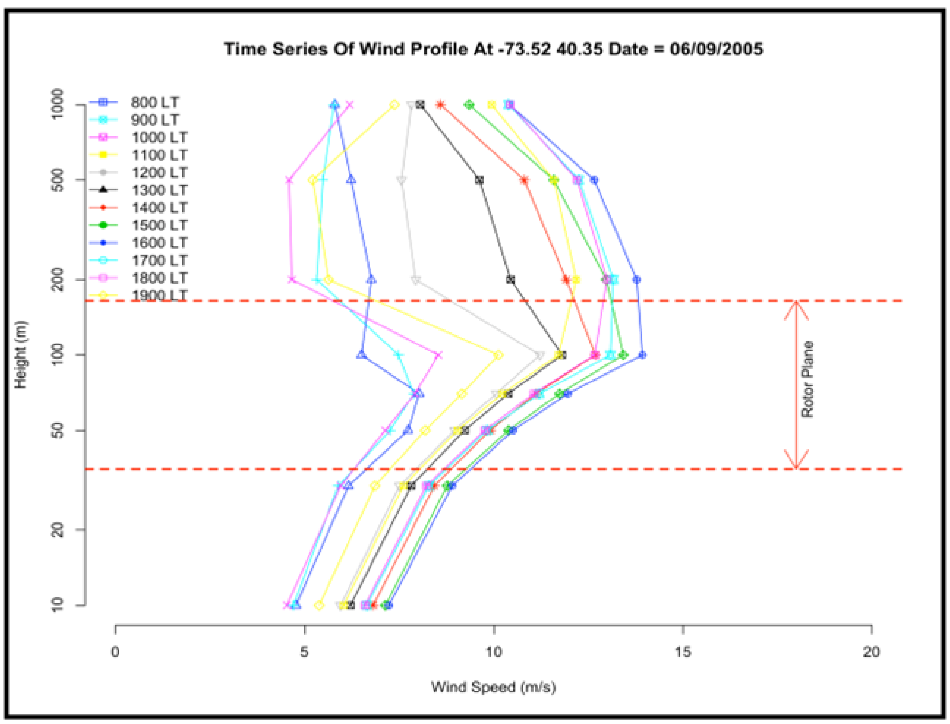

Figure 16. Time series of modeled wind profiles at Point B.[12]

[11] Sea breeze cases include 5 June 2005, 6 June 2005, 8 June 2005, 9 June 2006, 13 June 2006, and 17 June 2006. Arrows depict wind direction (toward which wind is blowing) and magnitude of wind speed. Letters A, B, and C refer to points referenced in text and figures below.

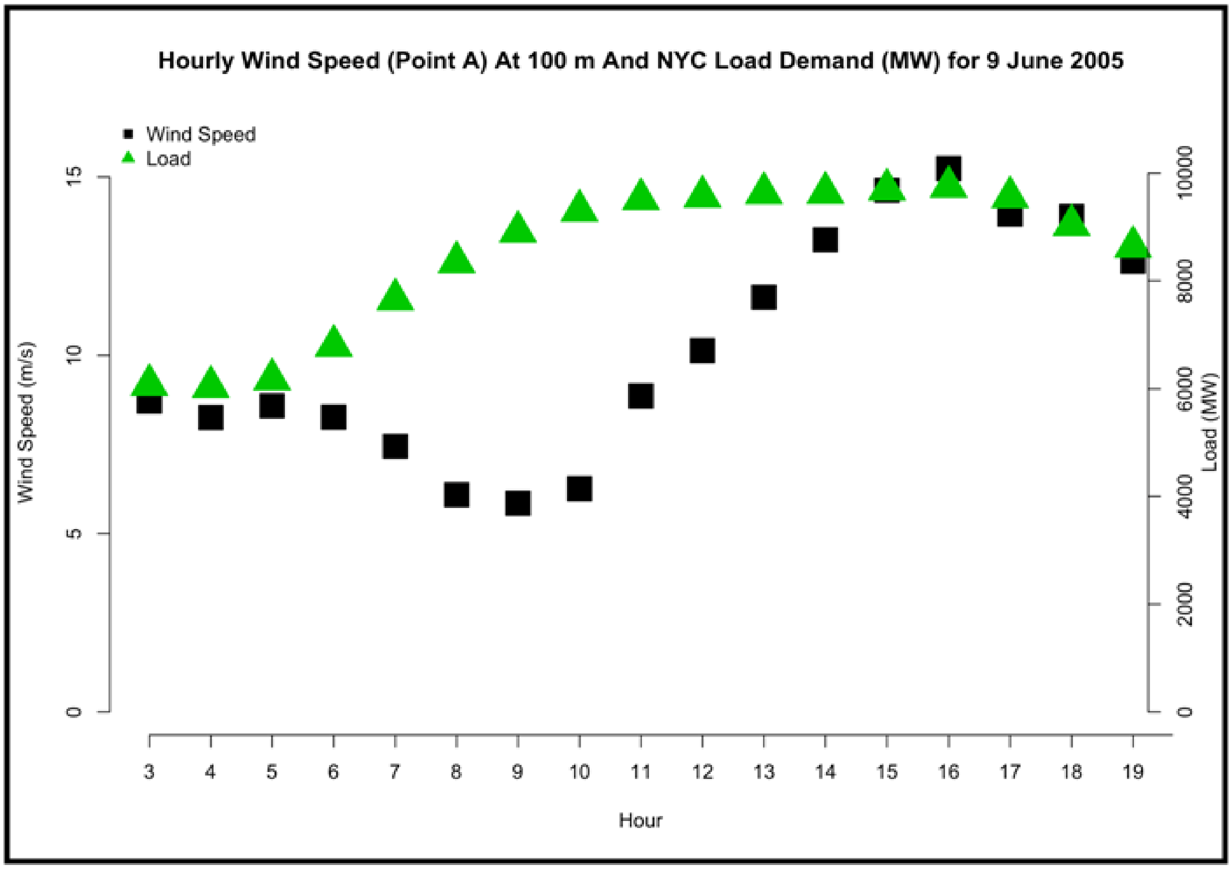

Figure 17. Hourly wind speed (m/s) at 100 m.

For Point A from Figure 5 and load demand (MW) for New York City.13

Previous studies (NYSERDA 2005)have shown that the effective capacities[14] of the inland wind sites in New York are about 10% of their nameplate or rated capacities, even though their energy capacity factors[15] are on the order of 30%. This is due to both the seasonal and daily patterns of the wind generation being largely "out-of-phase" with New York Independent System Operator (NYISO) load patterns. The proposed offshore project area exhibits both annual and peak period effective capacities on the order of 40% – nearly equal to their energy capacity factors. The higher effective capacity is due to the daily wind patterns peaking several hours earlier in the day than the rest of the inland wind sites and therefore being much more in line with the load demand (NYSERDA 2005).

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[12] Sea breeze cases for June 9, 2005 for 0800 – 1900 Local Time (LT). From Freedman et al. (2009).

[13] Load data from the NYISO (at http://www.nyiso.com/public/markets_operations/market_data/load_data/index.jsp)

[14] Effective capacity (a.k.a. capacity credit) is a measure of a generating source's contribution to system reliability and is tied to meeting peak demand/load.

[15] Defined here as the ratio of the actual output of a power plant over a period of time and its output if it had operated at full nameplate capacity the entire time.

2.4. OTHER METEOROLOGICAL PARAMETERS

In addition to the wind resource parameters already discussed, the majority of the monitoring locations considered for this study also measured air temperature, sea-surface temperature, air pressure and relative humidity. These parameters are summarized in Table 4. Assuming the standard atmospheric temperature lapse rate of 6.5 °C per 1000 m, the mean air temperature at each monitoring location extrapolated to the 90 m reference height ranges from 11.6^{o}C (windTrends) to 12.1^{o}C (ALSN6). The observed mean sea-surface temperatures measured at buoy 44025 and ALSN6 are 12.9^{o}C (44025) and 12.7^{o}C (ALSN6), respectively. The mean sea-level air pressure at each location ranges from 1016.2 mb (windTrends) to 1017.1 mb (ALSN6). The average relative humidity at the two monitoring locations that recorded both temperature and dew point is 72.3% (ALSN6) and 77.6% (44025). The seasonal averages of these parameters are also presented in Table 4 through Table 7. As discussed previously in Section 2.2, the larger temperature difference between the warm water and cold air during the winter and fall is accompanied by lower wind shear values due to the tendency for unstable atmospheric conditions, which promote vertical mixing. The minimum and maximum extreme air temperatures that were observed over the respective periods of record at ALSN6 and buoy 44025 are also provided.

Table 4. Summary of Other Meteorological Parameters - Overall

Parameter	ALSN6	windTrends	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

Table 5. Summary of Other Meteorological Parameters - Winter (December – February)

Parameter	ALSN6	windTrends	44025
Sea-Level Air Pressure (mb)	1018.4	1017.2	1017.0
Relative Humidity (%)	63.5	N/A	69.2
Sea-Surface Temperature (°C)	6.2	N/A	7.0
90-m Air Temperature (°C)	1.8	3.4	2.9
SST – Air Temp Difference (°C)	4.4	N/A	4.1

Table 6. Summary of Other Meteorological Parameters - Spring (March – May)

Parameter	ALSN6	windTrends	44025
Sea-Level Air Pressure (mb)	1016.0	1015.3	1015.4
Relative Humidity (%)	71.5	N/A	81.4
Sea-Surface Temperature (°C)	8.2	N/A	7.6
90-m Air Temperature (°C)	8.9	8.0	7.4
SST – Air Temp Difference (°C)	-0.7	N/A	0.2

Table 7. Summary of Other Meteorological Parameters - Summer (June – August)

Parameter	ALSN6	windTrends	44025
Sea-Level Air Pressure (mb)	1015.6	1015.0	1015.1
Relative Humidity (%)	81.2	N/A	85.8
Sea-Surface Temperature (°C)	20.1	N/A	20.4
90-m Air Temperature (°C)	21.0	20.2	20.2
SST – Air Temp Difference (°C)	-0.9	N/A	0.2

Table 8. Summary of Other Meteorological Parameters - Fall (September – November)

Parameter	ALSN6	windTrends	44025
Sea-Level Air Pressure (mb)	1018.5	1017.5	1017.5
Relative Humidity (%)	72.9	N/A	73.9
Sea-Surface Temperature (°C)	16.0	N/A	16.8
90-m Air Temperature (°C)	13.7	14.6	14.5
SST – Air Temp Difference (°C)	2.3	N/A	2.3

Lightning. Using a global lightning climatology database created by NASA's Global Hydrology Resource Center (GHRC) that spans 1995 through 2006, the lightning density in the Long Island – New York City offshore 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. The database shows higher frequencies for the adjacent land area to the west, with values approximately double that of the project area.

Atmospheric Icing. AWS Truepower has recently developed a model-derived high resolution (200 m) icing climatology, validated using available estimates from long-term tall towers, high altitude surface observation stations, and previous in-situ mountain studies, for the coterminous U.S. and southern Canada at levels of 60, 80, 100, 120, and 200 m above ground level (AGL)(Freedman and Alonge 2009). Frequent or prolonged ice accumulation on wind turbine blades can significantly reduce the generation performance of a wind plant. Icing here includes glaze (that is, from liquid rain or drizzle that freezes on contact with a surface) and rime (white or milky and opaque granular deposit of ice formed by the rapid freezing of super-cooled water drops (i.e., fog) as they impinge upon an exposed object). For the proposed project site, the icing frequency is predicted to be less than 0.1% (< 9 hours per year).

Icing from Sea Spray. In the coastal waters of the North Atlantic, icing can also be produced from sea spray lifted from the ocean surface into a sub-freezing atmosphere and deposited on the wind turbine infrastructure. An algorithm developed by Overland et al. (1986) and incorporated by the NDBC in their real-time buoy reports calculates icing accumulation rates for ships up to 70 m in length using wind speed, air temperature, and sea surface temperatures. Frequency of icing accumulation rates (cm/hr) were estimated using data available from ALSN6 and buoy 44025 (Table 9). The lower rates at buoy 44025 reflect the further offshore location of the site where the warmer sea-surface temperatures have more time to modify the air temperature producing fewer periods of icing. The presented icing accumulation rates can be expected on the turbine support structures. Still, as the turbine blades will be, at their lowest approach, at least 27 m above the surface of the ocean, and sea spray icing tends to be limited to elevations below 16 m (Makkonen 1984), losses will likely be much lower than the numbers presented in Table 9, primarily due to limits on access to the offshore infrastructure.

Table 9. Percent sea spray icing frequency at ALSN6 and Buoy 44025

Monitoring Location	Light (< 0.7 cm h-1)	Moderate (0.7 - 2 cm h-1)	Heavy (> 2 cm h-1)
ALSN6	4.35	0.98	0.33
Buoy 44025	3.50	0.22	< 0.01

<u>Structural Corrosion.</u> Any offshore environment is potentially corrosive to structures. Two critical parameters that influence corrosion of infrastructure are the time of wetness, where the structure is immersed or covered by an aqueous film, and the corrosive character of the environment in contact with the structure. The "time of wetness" (TOW) refers to the period of time during which atmospheric conditions are favorable for the formation of a surface layer of moisture on a metal or alloy. For the purposes of ISO (International Organization for Standardization) standard 9223 ("Corrosion of Metals and Alloys–Corrosivity of Atmosphere–Classification"), this has been defined as the time period during which the relative humidity is in excess of 80% and the temperature is above 0^{o}C. For ALSN6, these conditions are met 40% of the time; for buoy 44025, the TOW is 51%. The higher frequencies at buoy 44025 reflect its location further offshore and lower measurement height (3 m versus 26 m for ALSN6).

Section 3

3. ENERGY PRODUCTION ESTIMATES

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). These particular turbines were chosen as a representative cross-section of current offshore turbine technology. A common hub height of 90 m was assumed for the purpose of this analysis.

The long-term wind speed frequency distribution is applied to the appropriate density-adjusted turbine power curves to yield the estimated gross energy output. The average air density was calculated using data from ALSN6 and buoy 44025 and adjusted to the 90-m hub height of the turbines using the standard atmospheric lapse rate. The result was 1.240 kg/m^3.

In determining the 350-MW and 700-MW turbine layouts, a spacing between turbines of 10 rotor diameters was assumed. For example, for the GE 4.0 MW turbine which has a 110 m rotor diameter, turbines were spaced 1,110 m from each other. This spacing is appropriate for projects consisting of numerous turbine rows oriented perpendicular to the prevailing wind. Relatively wide spacing between turbines is desired in this case to reduce the compounding wakes effects as the wind blows through the project. The 350-MW and 700-MW turbine layouts for each turbine model are shown on wind resource maps in Appendix A. The 350-MW layouts were placed in the western half of the project area, where the water is shallower.

Plant losses aside from turbine wake losses were estimated from AWS Truepower's experience with other projects and an analysis of site-specific data. Our loss estimates for six broad categories (along with an itemized summary of turbine production) for each energy estimate are presented in the Wind Speed and Energy Production Detail tables in Appendix A; a detailed explanation for each is contained in Appendix B. The total loss is estimated to range from 20.7% (Vestas V112 and REpower 350-MW) to 23.9% (Multibrid 700-MW). It should be noted that parasitic power usage (such as for site lighting, maintenance building, and auxiliary equipment in the substation) was not considered in this analysis. Such power usage, which is usually on the order of less than 0.1%, should be considered in the project's financial model.

Table 11 and Table 12 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. Annual gross energy production is the amount of energy a plant would produce in a year if acting under 100% efficiency (i.e., with none of the losses listed in Appendix A), whereas annual net energy production is the annual production after all wake and plant losses are subtracted from the gross energy production. The net capacity factor is the ratio of the net energy production to the potential output if it had operated continuously at its full rated capacity. For the 350-MW layouts, the estimated annual net energy production is expected to range from 1069.5 GWh (Multibrid 5.0-MW) to 1324.5 GWh (Vestas V112 3.0-MW), while the net capacity factor is predicted to range from 34.9% (Multibrid 5.0-MW) to 43.4% (Vestas V112 3.0-MW). For the 700-MW layouts, the estimated annual net energy production is expected to range from 2106.6 GWh (Multibrid 5.0-MW) to 2625.3 GWh (Vestas V112 3.0-MW), while the net capacity factor is predicted to range from 34.3% (Multibrid 5.0-MW) to 42.8% (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.

The IEC classifies each turbine in terms of wind speed category (I, II, III, IV) and turbulence intensity (A, B). The IEC class of all five turbine models selected for this analysis is IA. The IEC suitability requirements for this class are summarized in Table 10. All three parameter thresholds far exceed the expected conditions at the project location, so all five turbine models are suitable for the proposed project area. All the same, turbine suitability should be confirmed with the turbine manufacturer before proceeding with development.

Table 10. Suitability of Class IA Turbine Models

Parameter	Suitability Requirement	Measured/Predicted
10-minute Annual Average Wind Speed (m/s)	10	8.4 - 10.8
10-minute 50-year Return Max Wind Speed (m/s)	70	48
Turbulence Intensity @ 15 m/s	0.18	0.07

Table 11. Estimated Annual Energy Production Summary of 350-MW Layouts

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 12. 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%

In addition to the annual energy estimates, it is also useful to understand the monthly and diurnal patterns of energy production. For this purpose, monthly and diurnal (12x24) wind speed and net energy matrices were produced for each turbine model and project size. These matrices are often used to understand the relationship between the predicted peak in energy production and peak in energy demand. The 12x24 net energy matrix and corresponding Energy Production Estimate (EPE) for each scenario is provided in Appendix A. The monthly and diurnal variability of plant output is shown in Figure 18 and Figure 19, respectively. The two charts are composites of the ten different layout and turbine model scenarios. Net energy production is expected to peak in December and January due to the stronger atmospheric temperature and pressure gradients of the cold season. In addition, the late afternoon and evening hours will yield the higher energy production of the day due to the presence of the sea breeze.

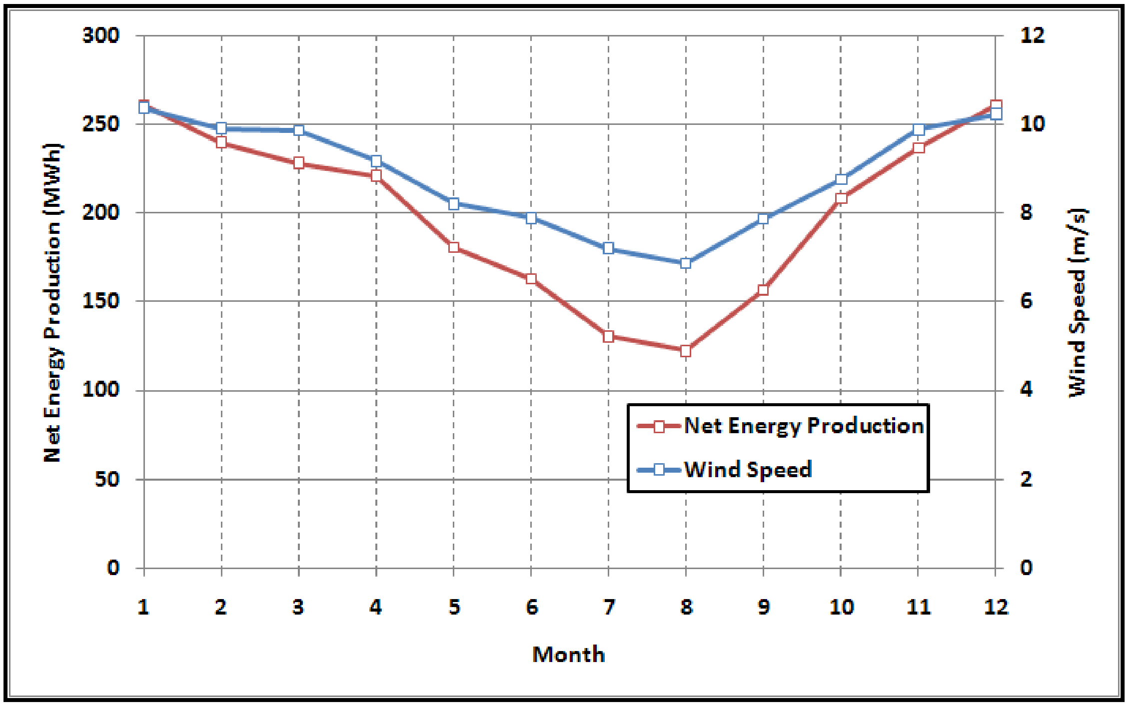

Figure 18. Monthly Wind Speed and Net Energy Production Variability

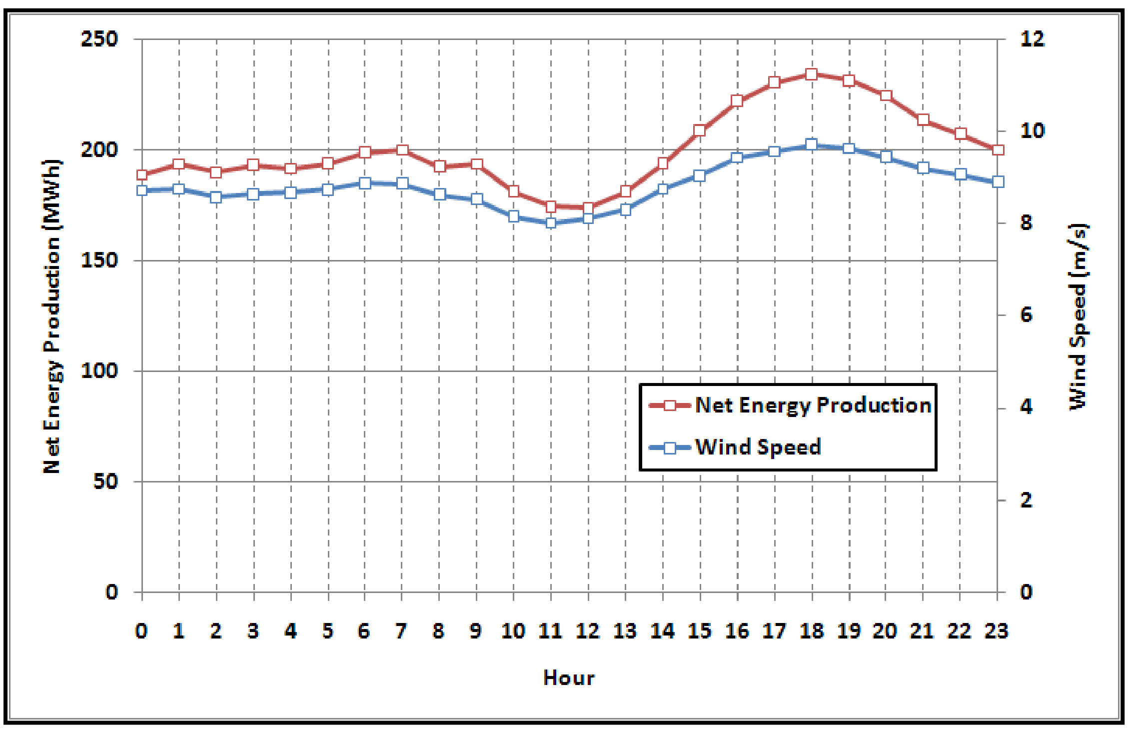

Figure 19. Diurnal Wind Speed and Net Energy Production Variability

Section 4

4. WAVE AND CURRENT ENVIRONMENT

4.1. AVAILABLE DATA

Waves. NDBC historical archives for stations ALSN6 and 44025 include calculated significant wave heights (defined as approximately equal to the average of the highest one-third of the waves during a 20-minute sampling period every hour), the average wave period (in seconds) of all waves during the 20-minute period, and for buoy 44025 the direction from which the waves at the dominant period are coming. Historical data for ALSN6, also known as Ambrose Light, covers the period from 1984 - 2008. (Ambrose Light was severely damaged when a tanker struck it on 3 November 2007; however, it was still collecting data until late July 2008 when it was de-commissioned.) Wave data from ALSN6, however, is available for only 36% of the period of record (POR), or approximately 9 years of observations. The buoy 44025 POR extends back to 1991, with nearly 96% of all observations containing pertinent wave data as described for ALSN6. On 30 October 2008, buoy 44065 (located a 12 kilometers to the southeast of ALSN6; see Figure 21) was commissioned, providing standard meteorological and descriptive wave observations as provided for buoy 44025.

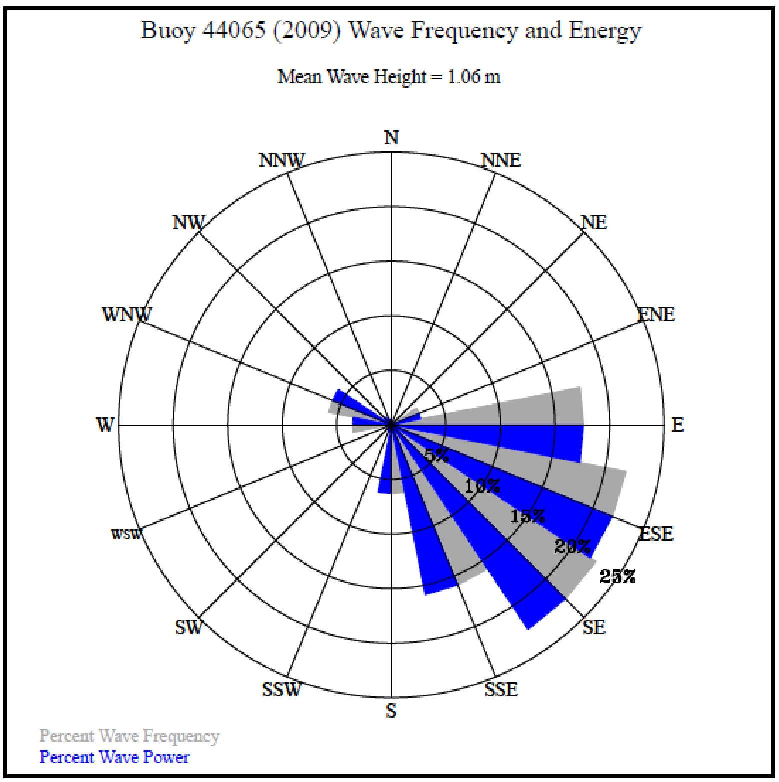

Figure 20. Wave Rose (Buoy 44065).[16]

[16] Grey wedges represent percent frequency of wave direction. Blue wedges depict percent wave power (m^2 Hz^{-1}).

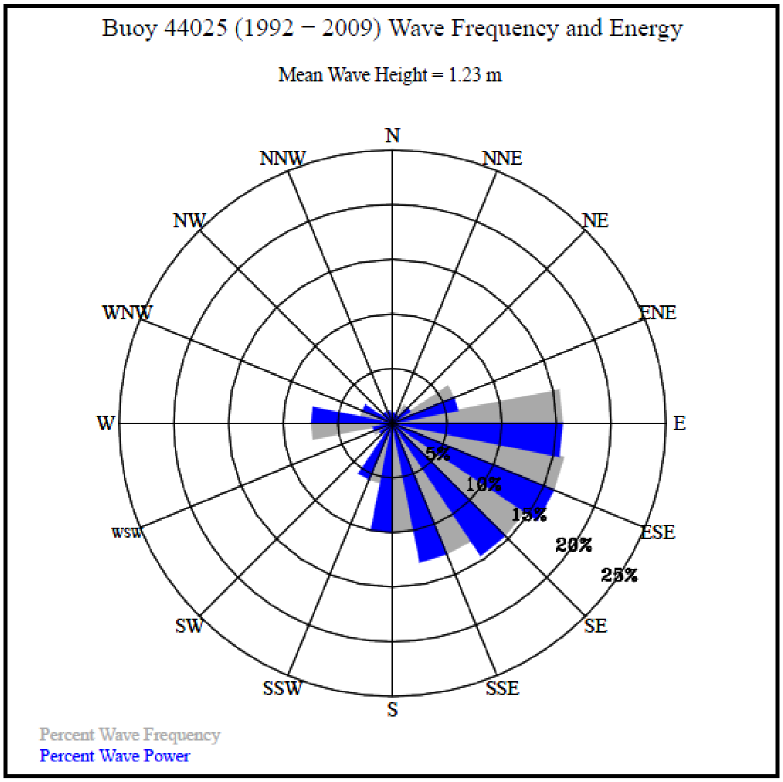

Figure 21. Wave Rose (Buoy 44025).[17]

Ocean Currents. Rutgers University's Coastal Ocean Observation Lab (COOL) has, since 2001, operated several Coastal Ocean Dynamics Applications Radars (CODAR) in the New York-New Jersey region (see http://rucool.marine.rutgers.edu/index.php/COOL-Data/). The long-range system consists of four sites along the New Jersey coast at Sandy Hook, Loveladies, Tuckerton, and Wildwood. This network provides current measurements out to approximately 100 km offshore with a spatial resolution of about 6 km at 3-hr time steps. The standard-range system consists of two sites at Brant Beach and Brigantine, NJ to support Hudson River estuary research. This system provides higher-resolution (1 km) current data out to 20 km at 1-hr time steps.

There is a dearth of sub-surface current profile data in the immediate vicinity of the proposed project area. Still, several studies during the past few decades have deployed instrumentation to determine sub-surface and bottom currents in the New York Bight (Ketchum et al. 1951; MESA 1978; Kohut 2002; Butman et al. 2003; Gong et al. 2010). During December 1999 and April 2000, oceanographic observations were made by the U.S. Geological Survey (USGS) as part of a program to investigate the transport and fate of sediment and associated contaminants in the coastal waters offshore of the New York - New Jersey metropolitan region (Butman et al. 2003). As part of this field study, acoustic Doppler current profilers

[17] Grey wedges represent percent frequency of wave direction. Blue wedges depict percent wave power (m^2 Hz^{-1}).

(ACDPs) were deployed at several sites, including one ACDP, which was located a few km to the south and west of the proposed project site.

The above-referenced data sets and related field studies will be used to describe the wave and current environment as set forth below.

4.2. WAVE ENVIRONMENT

Wind-Generated Waves. Wind-generated waves are surface waves that usually result from the wind blowing over a long enough stretch of water (fetch). Wind waves range in size from small ripples to tens of meters in height. The wave height is the difference between the elevations of a crest (the top of the wave) and a neighboring trough (the minimum height between waves; see Figure 22). The wavelength is the length between crests of two successive waves. A swell consists of wind generated waves that are not generally affected by the local wind. They have been generated elsewhere, or some time ago. The frequency is the number of waves or swells passing a point per unit time, while the period is the time interval between the arrival of consecutive crests at a stationary point (the inverse of the frequency).

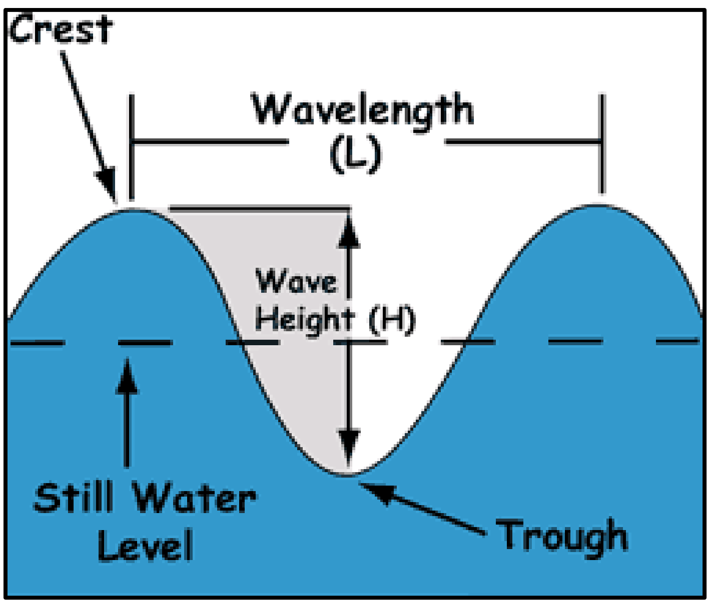

Figure 22. Schematic of a typical ocean wave

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 21).

Wave Heights. The historical wave observations archived by the NDBC represent a mix of wave and swell heights (that is, the archived observations do not differentiate between a more locally induced wave and a long traveling swell). Although only significant wave heights (H_s) are available from NDBC, individual wave heights can be described using a Rayleigh Distribution (Longuet-Higgins 1952), which, for its cumulative probability form, is given as

$$F(x) = 1 - \exp\left[-\frac{x^2}{2}\right], \qquad 0 \le x \le \infty$$

For example, given that H_s = 10 m, then

- 1 wave in 10 will be larger than 10.7 m
- 1 wave in 100 will be larger than 15.1 m
- 1 wave in 1000 will be larger than 18.6 m

Therefore, to get extreme wave heights (H_{ext}) from archived NDBC H_s data, a multiplier of 1.86 is applied.

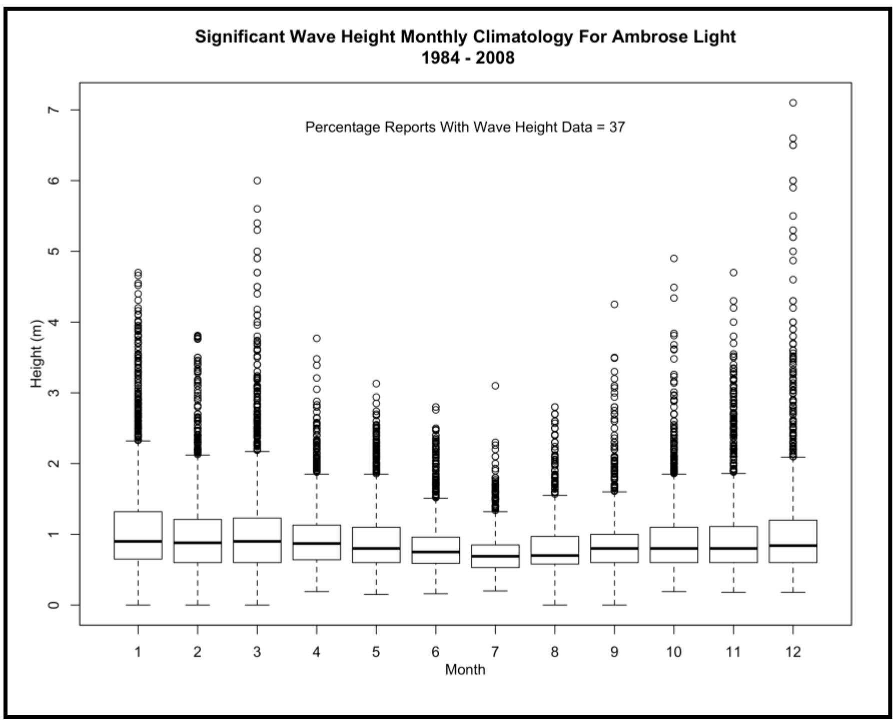

Figure 23. Box-plot of significant wave height (m) for Ambrose Light/ALSN6 (1984 – 2008). Solid horizontal lines represent median value, upper and lower boxes are first and third quartiles, brackets are the 2nd and 98th percentiles, and the open circles are extreme values.

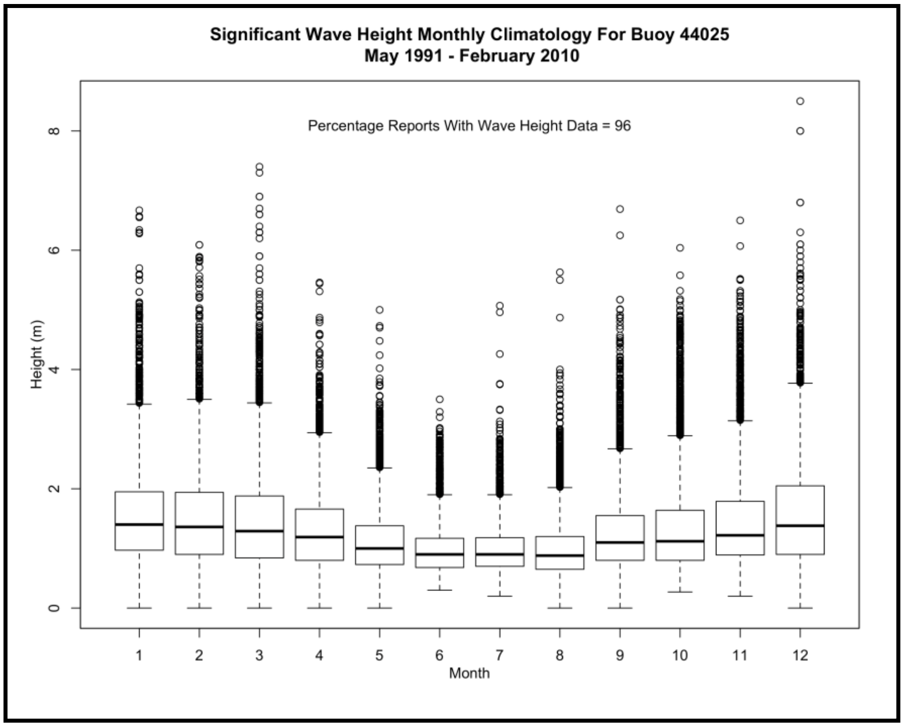

Figure 24. Box-plot of significant wave height (m) for buoy 44025.

Table 13. Mean (H_{Smean}), Max. Significant Wave Height (H_{Smax}) and Extreme Wave Height (H_{ext})

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

For both ALSN6 and buoy 44025, the highest waves tend to occur during the cold season (November - March; see Figure 23, Figure 24, and Table 13) 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. For both ALSN6 and buoy 44025, the highest historical significant wave heights were observed during the 11 - 12 December 1992 storm (Hs of 7.1 and 8.5 m), corresponding to extreme wave heights (Hext) of 13.8 m and 15.1 m. Applying an extremes value analysis (in this case, a Gumbel distribution) to the buoy 44025 POR produces an absolute extreme wave height of 16.0 m (52.5 ft) and 17.1 m (56 ft) for 50-yr and 100-yr 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 (see e.g. Herklotz 2007).

<u>Wave Spectra.</u> NDBC wave measurements are not directly measured by sensors on the buoys. Instead, on-board accelerometers or inclinometers measure the heave acceleration or the vertical displacement of the buoy hull during the wave acquisition time period. A Fast Fourier Transform (FFT) is applied to the data by the processor on board the buoy to transform the data from the temporal domain into the frequency domain. For buoy 44025 and ALSN6, the spectral wave energy (m2 Hz-1) is calculated and archived for frequency bins from 0.03 Hz to 0.40 Hz.

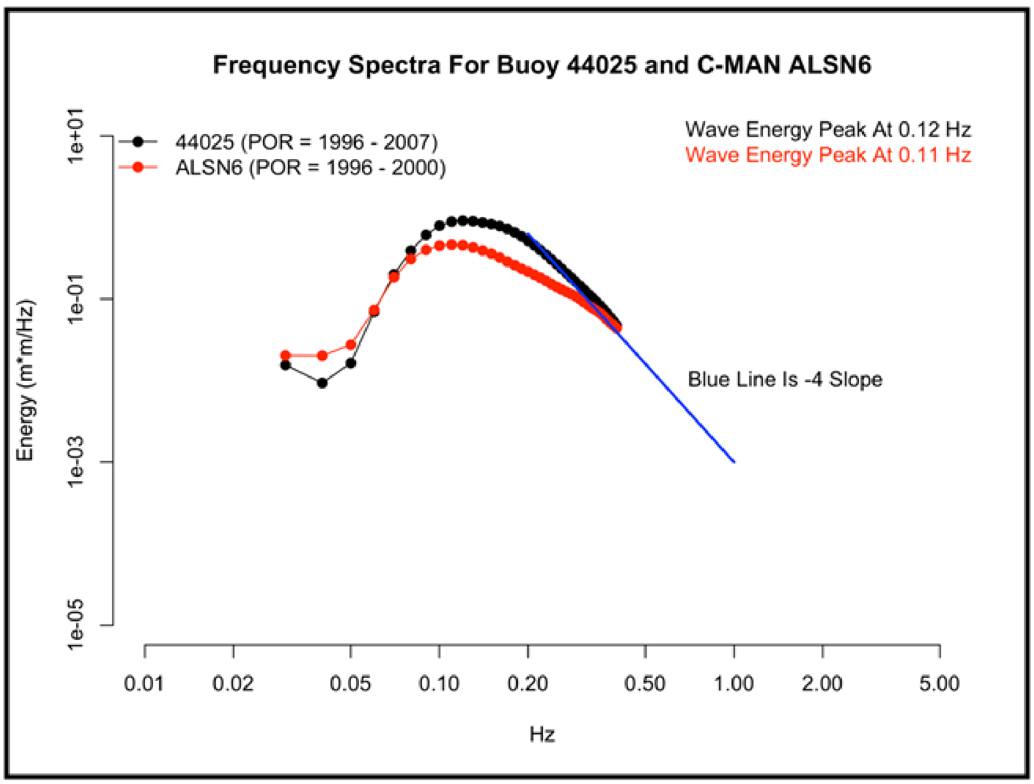

Figure 25. Frequency spectra for buoy 44025 (black) and C-MAN station ALSN6 (red). Plotted on log-log axes Blue line represents the -4 slope

From Figure 25, the spectral wave energy peaks for 44025 and ALSN6 are at 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 peak at buoy 44025 reflects its location further offshore where higher waves and swells are more common. Note also that the wave spectra for both stations decay (that is, the waves tend to lose their energy at these frequencies) at roughly the -4 slope as suggested by Toba (1973).

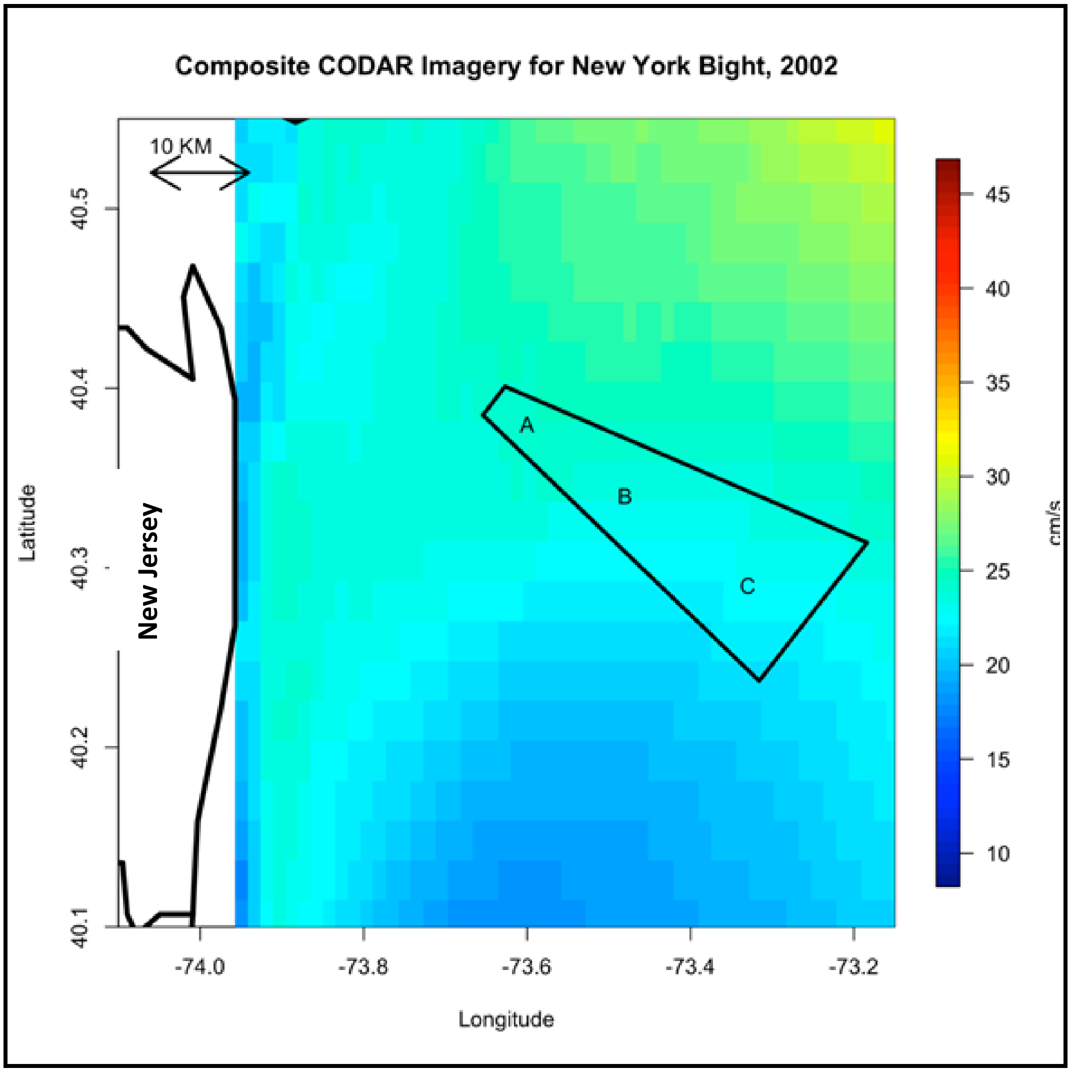

Figure 26. Composite (2002) CODAR image for surface currents (cm/s).[18]

[18] Letters A, B, and C represent points in the project area where time series are shown in Figure 24. Double arrow at top left is represents 10 km distance.

4.3. OCEAN CURRENTS

Currents occur everywhere in the ocean. The forces causing ocean currents come primarily from the wind and unequal heating and cooling of ocean waters. Typically, the speed of surface currents is about 2% of the speed of the wind causing them (e.g. a 10 m/s wind would produce a 20 cm/s surface current). For the water column (from ocean surface to the sea bottom), the deflective force of the Earth's rotation (the Coriolis force) causes a change in direction of currents with depth (the Ekman spiral). Nevertheless, in the more shallow waters such as the proposed project site, these deflective forces are diminished, although they can produce coastal upwelling (Ekman transport) of deeper, colder water given winds blowing parallel to the shore.

There are five primary mechanisms responsible for the ocean currents in the project area. These are:

- The north Gulf Stream countercurrent, consisting of cold water that is flowing slowly to the west and southwest.
- Wind-generated near-surface currents. These currents may reinforce or oppose the general flow of the Gulf Stream countercurrent.
- A swell and surf generated longshore current. The predominant southeast swell generates a net east to west current. This current can reverse with westerly winds and swell from the southwest.
- Swell and surf-generated rip currents, which counteract the net transport of water toward the beach. Rip currents form narrow zones of low waves and rapid (up to 5 knots) seaward flow that extend several hundred meters to a kilometer offshore.
- Tidal Currents. Along the south shore of Long Island, tidal currents are important only in the vicinity of the inlet channels (i.e. Jones Inlet, Fire Island Inlet, Moriches Inlet, Shinnecock Inlet). Flow is along the axis of the channels in and out of the inlets, roughly perpendicular to the coastline. Closer to the entrance the New York Harbor and station ALSN6, tidal currents flow northwest/southeast through the Narrows.

The first two mechanisms are of primary interest, as they are the principal current components in the open waters within and around the project site and also determine the current profile from the ocean surface down to the sea floor. 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 Currents. Relevant CODAR data was downloaded from the COOL website (http://marine.rutgers.edu/cool/codar.html) for the years 2004 (high resolution data focused on New York Harbor and nearby environs) and 2002 (long-range but lower resolution data out to 70+ km east of New Jersey and south of New York City and Long Island). The high resolution data offers partial coverage of the western third of the proposed project site, while the low resolution data covers the entire region. A composite of the long range data (Figure 23) indicates that 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 (Figure 27). There is a distinct seasonal peak (~ 35 cm/s) in April (Figure 27) corresponding to the increased spring outflow from the Hudson River (Gong et al 2010).

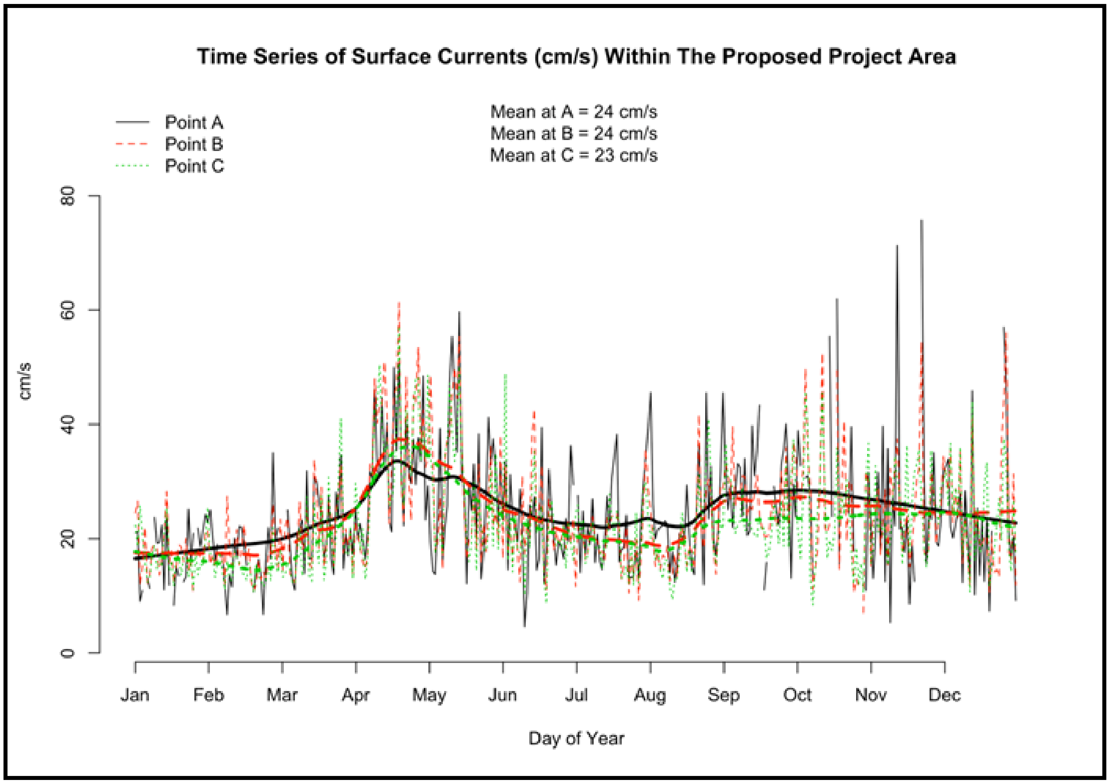

Figure 27. Daily time series of surface currents (cm/s) within the proposed project area.

Sub-surface Currents. Observations from the USGS ACDP deployed nearest the proposed project site indicate that bottom current speeds average less than 5 cm/s, with maximum speeds approaching 15 cm/s (Figure 28). Throughout the column, current speeds tend to be less than 10 cm/s, and the predominant direction during this observation period was 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, 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 (Gross 1977).

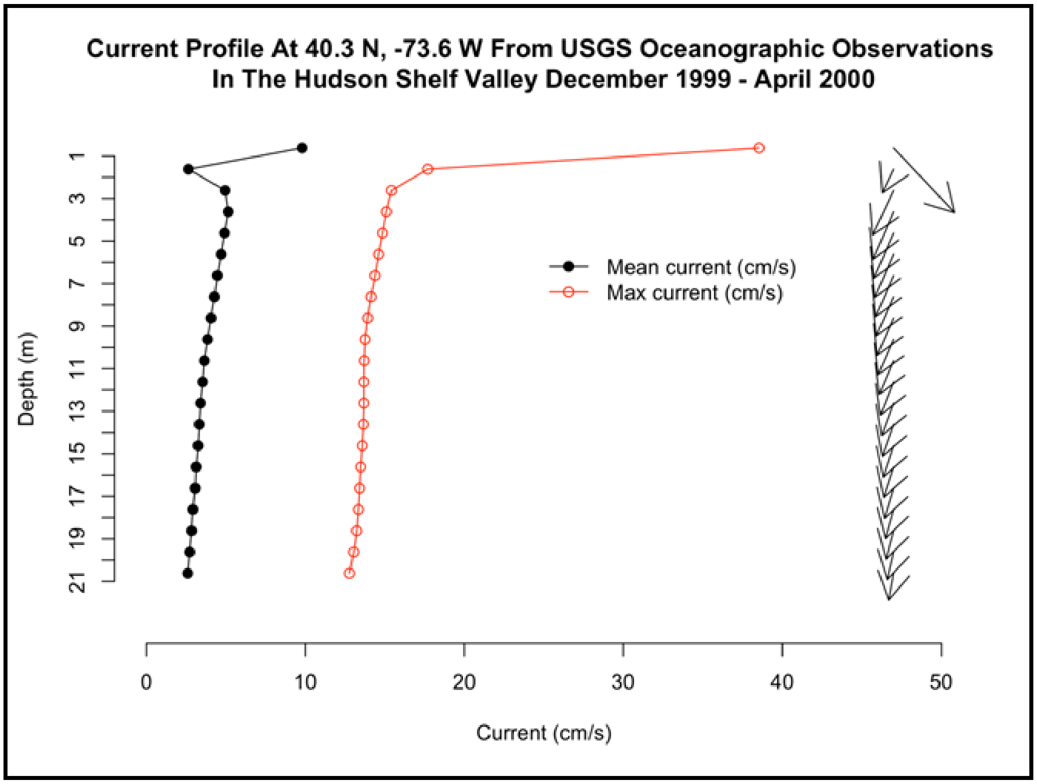

Figure 28. Mean (black) and maximum (red) current profile (cm/s) from an ADCP.[19]

[19] Deployed at a ocean bottom depth of 22 m during December 1999 - April 2000 as part of the USGS Oceanographic Observations in the Hudson Valley study. Arrows represent magnitude and direction toward which current is moving.

Section 5

5. CONCLUSIONS AND RECOMMENDATIONS

Using existing information, this report presents a comprehensive pre-development study of the meteorological, wave, and current environment in the vicinity of the proposed Long Island – New York City offshore project area. Average wind speeds across the project area at the 90 m reference height are predicted to be approximately 8.8 m/s (±0.3); average speeds increase with distance from shore. Calculated net capacity factors for a selected set of commercial offshore turbine models range from 34.3% to 43.4%, depending on the specific turbine model and project size. For a 350 MW project capacity, the net annual energy production is predicted to range from 1070 to 1325 GWh; for a 700 MW project, production values in the range of 2100 to 2625 GWh are expected. In summer, maximum wind speeds and capacity factors will both tend to occur during high load demand (in the late afternoon and early evening) and will at times be concomitant with periods of peak load brought on by extended heat waves.

Expected extreme wind speeds (100 year return period) are predicted to be 50 m/s for a sustained 10-minute period, and 60 m/s for a 3-second peak gust. Given a mean turbulence intensity of 0.08 or less, the project area's wind characteristics are well within the suitability for a suite of existing class IA turbines. The wave and current environment is also favorable for the existing generation of offshore turbine foundation technologies, with significant wave heights and extreme wave statistics comparable to offshore wind farms being considered or under construction in the United Kingdom and northern Europe. The predicted 100-year extreme wave height for the proposed project area is approximately 17 m.

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 physical environment of the proposed offshore 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.

Meteorological Evaluation. The goal here is to develop a comprehensive three-dimensional description of the atmosphere from the surface through the top of a wind turbine's rotor plane (approximately 200 m). This is traditionally accomplished by the installation of at least one meteorological tower (projecting at least 60 m above the 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 remain 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, 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 as well for direct comparisons with reading from regional NDBC 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.

Wave and Current Environment. Ensuring a robust representation of the wind-wave-current environment across the proposed project area will require 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 ADCPs 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.

Section 6

6. REFERENCES

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APPENDIX A

ENERGY PRODUCTION ESTIMATES AND 12X24 MATRICES

LIST OF TABLES

LIST OF FIGURES

Table A1. 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 A2. 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%

Table A3. Loss Accounting 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
Wake Effect (%)	7.2	6.6	7.2	6.6	6.6
Availability (%)	6.1	5.8	6.2	6.1	5.9
Electrical (%)	4.0	4.0	4.1	4.0	4.1
Turbine Performance (%)	1.9	1.7	2.5	1.1	2.3
Environmental (%)	5.2	4.5	4.7	4.7	4.6
Curtailments (%)	0.0	0.0	0.0	0.0	0.0
Average Total Loss (%)	22.2	20.7	22.5	20.7	21.4

Table A4. Loss Accounting 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
Wake Effect (%)	9.0	8.0	8.9	8.3	8.1
Availability (%)	6.1	5.8	6.2	6.1	5.9
Electrical (%)	4.0	4.0	4.1	4.0	4.1
Turbine Performance (%)	1.9	1.7	2.5	1.1	2.3
Environmental (%)	5.2	4.5	4.7	4.7	4.6
Curtailments (%)	0.0	0.0	0.0	0.0	0.0
Average Total Loss (%)	23.8	21.9	23.9	22.1	22.7

GE 4.0-MW ENERGY ESTIMATES

Table A5. GE 350-MW Wind Speed and Energy Production Detail

Project:	**NYSERDA - Offshore LI**	
Date:	**5-Apr-10**	
Comments:		
Turbine Model:	**GE 4MW**	
Turbine Rated Power:	**4.00**	**MW**
Hub Height:	**90**	**m**
Number of Turbines:	**87**	
Plant Capacity:	**348**	**MW**
Site Air Density:	**1.240**	**kg/m^3**

Loss Accounting	
Wake Effect	**7.2%**
Availability	**6.1%**
Electrical	**4.0%**
Turbine Performance	**1.9%**
Environmental	**5.2%**
Curtailments	**0.0%**
Average Total Loss	**22.2%**

Overall Wind Plant Summary	
Average Free Wind Speed (m/s)	**8.84**
Gross Plant Production (MWh/yr)	**1,420,594**
Net Plant Production (MWh/yr)	**1,104,631**
***Net Capacity Factor**	**36.2%**

*The rated capacity of 4000 kW has been used in this capacity factor calculation. Please note that the peak power of the turbine as listed in the power curve is 4070 kW.

Per Turbine Summary

Turbine ID	Mast Association	Coordinates (WGS84 UTM18) Easting (m)	Northing (m)	Free Spd (m/s)	Gross MWh/yr	% Array Eff	% Array Loss	% Total Loss	Net MWh/yr	Turbine Rank	Net Capacity Factor (%)	Turbulence Intensity (%)
1	ALSN6	616021	4472785	8.81	16124	96.6	3.4	19.1	13,044	9	37.2	6.9
2	ALSN6	615145	4472071	8.81	16150	96.5	3.5	19.1	13,058	8	37.2	6.9
3	ALSN6	614271	4471389	8.81	16158	98.5	1.5	17.5	13,331	1	38.0	6.7
4	ALSN6	617049	4472375	8.83	16187	95.2	4.8	20.3	12,903	18	36.8	7.0
5	ALSN6	616173	4471661	8.83	16196	94.7	5.3	20.7	12,849	21	36.6	7.0
6	ALSN6	615299	4470979	8.82	16192	96.8	3.2	18.9	13,132	3	37.5	6.8
7	ALSN6	618081	4471964	8.84	16219	94.5	5.5	20.8	12,837	23	36.6	7.0
8	ALSN6	617206	4471250	8.83	16210	93.9	6.1	21.4	12,746	36	36.4	7.1
9	ALSN6	616331	4470568	8.82	16187	96.4	3.6	19.3	13,065	7	37.3	6.9
10	ALSN6	619985	4472236	8.84	16216	94.1	5.9	21.2	12,777	33	36.4	6.9
11	ALSN6	619111	4471554	8.86	16273	93.8	6.2	21.5	12,780	31	36.4	7.0
12	ALSN6	618235	4470840	8.86	16296	93.5	6.5	21.7	12,758	35	36.4	7.0
13	ALSN6	617361	4470158	8.85	16286	95.9	4.1	19.7	13,080	5	37.3	6.8
14	ALSN6	621025	4471821	8.88	16326	93.2	6.8	22.0	12,740	37	36.3	7.0
15	ALSN6	620151	4471139	8.86	16293	93.0	7.0	22.1	12,695	41	36.2	7.1
16	ALSN6	619275	4470425	8.87	16319	93.0	7.0	22.1	12,711	39	36.3	7.1
17	ALSN6	618401	4469743	8.86	16318	95.3	4.7	20.1	13,032	11	37.2	6.8
18	ALSN6	622050	4471413	8.87	16301	92.9	7.1	22.2	12,682	42	36.2	7.0
19	ALSN6	621176	4470731	8.89	16373	92.6	7.4	22.4	12,706	40	36.2	7.1
20	ALSN6	620301	4470017	8.88	16370	92.8	7.2	22.3	12,718	38	36.3	7.0
21	ALSN6	619426	4469335	8.87	16343	94.9	5.1	20.5	12,994	13	37.1	6.8
22	ALSN6	623077	4471004	8.87	16305	92.5	7.5	22.5	12,639	46	36.0	7.0
23	ALSN6	622203	4470322	8.88	16368	92.2	7.8	22.8	12,639	45	36.0	7.1
24	ALSN6	621327	4469608	8.87	16355	92.3	7.7	22.7	12,638	47	36.0	7.1
25	ALSN6	620453	4468926	8.89	16400	94.7	5.3	20.7	13,011	12	37.1	6.8
26	ALSN6	624110	4470592	8.87	16328	92.3	7.7	22.7	12,623	48	36.0	7.0
27	ALSN6	623236	4469910	8.89	16395	91.7	8.3	23.2	12,588	56	35.9	7.1
28	ALSN6	622360	4469196	8.87	16346	92.1	7.9	22.9	12,609	50	36.0	7.1
29	ALSN6	621486	4468514	8.87	16375	94.4	5.6	21.0	12,942	17	36.9	6.8
30	ALSN6	625149	4470178	8.88	16348	91.9	8.1	23.0	12,591	55	35.9	7.0
31	ALSN6	624275	4469496	8.85	16288	91.0	9.0	23.7	12,422	78	35.4	7.1
32	ALSN6	623399	4468782	8.86	16347	91.4	8.6	23.4	12,516	63	35.7	7.1
33	ALSN6	622525	4468100	8.87	16392	93.0	7.0	22.1	12,773	34	36.4	7.0
34	ALSN6	626179	4469768	8.85	16284	91.6	8.4	23.2	12,499	64	35.6	7.0
35	ALSN6	625305	4469086	8.88	16369	91.0	9.0	23.8	12,472	70	35.6	7.1

Table A5 Cont'd. GE 350-MW Wind Speed and Energy Production Detail

Per Turbine Summary												
Turbine	Mast	Coordinates (WGS84 UTM18)		Free	Gross	% Array	% Array	% Total	Net	Turbine	Net Capacity	Turbulence
ID	Association	Easting (m)	Northing (m)	Spd (m/s)	MWh/yr	Eff	Loss	Loss	MWh/yr	Rank	Factor (%)	Intensity (%)
36	ALSN6	624429	4468372	8.87	16382	91.2	8.8	23.6	12,519	62	35.7	7.1
37	ALSN6	623555	4467690	8.84	16316	92.3	7.7	22.7	12,609	51	36.0	7.0
38	ALSN6	622661	4467000	8.84	16330	94.6	5.4	20.7	12,944	16	36.9	6.8
39	ALSN6	628084	4470066	8.87	16313	92.1	7.9	22.9	12,582	57	35.9	6.9
40	ALSN6	627206	4469359	8.84	16265	91.1	8.9	23.7	12,411	81	35.4	7.0
41	ALSN6	626332	4468677	8.85	16307	90.8	9.2	24.0	12,396	83	35.4	7.1
42	ALSN6	625456	4467962	8.83	16264	91.0	9.0	23.8	12,391	85	35.3	7.1
43	ALSN6	624582	4467280	8.84	16311	91.8	8.2	23.1	12,539	61	35.8	7.1
44	ALSN6	623689	4466591	8.85	16346	93.8	6.2	21.4	12,848	22	36.6	6.8
45	44025	629117	4469654	8.85	16377	91.9	8.1	23.0	12,604	53	35.9	7.5
46	44025	628235	4468949	8.82	16308	91.0	9.0	23.8	12,426	77	35.4	7.7
47	44025	627360	4468267	8.83	16336	90.8	9.2	23.9	12,431	74	35.5	7.7
48	44025	626485	4467553	8.81	16315	90.9	9.1	23.8	12,429	76	35.4	7.7
49	44025	625610	4466871	8.82	16355	91.6	8.4	23.3	12,544	60	35.8	7.6
50	44025	624721	4466179	8.79	16315	93.9	6.1	21.3	12,833	25	36.6	7.4
51	44025	630146	4469244	8.85	16377	91.8	8.2	23.1	12,599	54	35.9	7.5
52	44025	629272	4468536	8.86	16412	90.6	9.4	24.1	12,452	72	35.5	7.7
53	44025	628397	4467854	8.84	16364	90.5	9.5	24.2	12,402	82	35.4	7.7
54	44025	627522	4467139	8.84	16381	90.9	9.1	23.9	12,470	71	35.6	7.7
55	44025	626647	4466457	8.81	16327	91.3	8.7	23.5	12,491	66	35.6	7.7
56	44025	625751	4465769	8.79	16297	93.8	6.2	21.5	12,799	28	36.5	7.5
57	44025	631187	4468830	8.86	16393	91.9	8.1	23.0	12,622	49	36.0	7.5
58	44025	630293	4468129	8.85	16380	90.5	9.5	24.2	12,419	79	35.4	7.7
59	44025	629419	4467447	8.83	16341	90.3	9.7	24.4	12,354	86	35.2	7.7
60	44025	628543	4466732	8.83	16357	90.6	9.4	24.1	12,414	80	35.4	7.7
61	44025	627669	4466050	8.81	16333	91.3	8.7	23.5	12,491	67	35.6	7.7
62	44025	626791	4465355	8.79	16294	93.6	6.4	21.6	12,781	30	36.5	7.5
63	44025	633086	4469103	8.86	16374	93.5	6.5	21.7	12,824	26	36.6	7.4
64	44025	632212	4468421	8.85	16351	92.0	8.0	22.9	12,605	52	35.9	7.6
65	44025	631318	4467720	8.86	16396	91.0	9.0	23.8	12,493	65	35.6	7.7
66	44025	630444	4467038	8.85	16392	90.5	9.5	24.2	12,429	75	35.4	7.7
67	44025	629568	4466324	8.81	16307	90.3	9.7	24.4	12,334	87	35.2	7.7
68	44025	628694	4465642	8.79	16279	90.9	9.1	23.9	12,392	84	35.3	7.7
69	44025	627816	4464946	8.79	16303	92.7	7.3	22.4	12,658	43	36.1	7.6
70	44025	634113	4468694	8.88	16446	93.4	6.6	21.8	12,863	20	36.7	7.5
71	44025	633239	4468012	8.85	16369	92.2	7.8	22.7	12,649	44	36.1	7.6
72	44025	632350	4467309	8.86	16401	91.4	8.6	23.4	12,556	59	35.8	7.6
73	44025	631476	4466627	8.85	16405	90.9	9.1	23.9	12,490	68	35.6	7.7
74	44025	630600	4465913	8.83	16374	90.7	9.3	24.0	12,446	73	35.5	7.7
75	44025	629726	4465231	8.81	16333	91.3	8.7	23.6	12,486	69	35.6	7.7
76	44025	628843	4464537	8.76	16218	92.5	7.5	22.5	12,562	58	35.8	7.6
77	44025	627968	4463855	8.80	16344	94.7	5.3	20.7	12,963	14	37.0	7.4
78	44025	635146	4468283	8.88	16461	95.0	5.0	20.4	13,105	4	37.4	7.4
79	44025	634271	4467601	8.89	16480	94.4	5.6	20.9	13,038	10	37.2	7.4
80	44025	633405	4466888	8.86	16403	93.9	6.1	21.3	12,902	19	36.8	7.5
81	44025	632531	4466206	8.86	16437	93.2	6.8	21.9	12,834	24	36.6	7.5
82	44025	631655	4465492	8.83	16372	93.2	6.8	22.0	12,779	32	36.4	7.5
83	44025	630781	4464810	8.82	16356	93.3	6.7	21.8	12,787	29	36.5	7.5
84	44025	629876	4464126	8.80	16333	93.6	6.4	21.6	12,810	27	36.5	7.5
85	44025	629001	4463444	8.79	16340	94.6	5.4	20.7	12,952	15	36.9	7.4
86	44025	636185	4467869	8.86	16403	96.1	3.9	19.5	13,206	2	37.7	7.3
87	44025	635310	4467187	8.85	16381	95.3	4.7	20.2	13,071	6	37.3	7.3

Table A6. GE 350-MW 12x24 Net Energy Matrix

Project:	NYSERDA - Offshore LI
EPE Completion Date:	5-Apr-2010
Prepared By:	AWS Truepower, LLC
Comments:	Net Energy Output Matrix (MW)
Turbine Model:	GE 4MW
Turbine Rated Power:	4.0 MW
Hub Height:	90
Number of Turbines:	87
Plant Capacity:	348 MW
Net Annual Energy Output:	1,104,631 MWh
Net Capacity Factor:	36.2%

Hour	Month												Average (MWh)	Total (MWh)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
0	159.49	149.81	128.55	95.89	82.19	107.71	77.32	75.25	106.40	126.40	155.94	155.20	118.13	43,146
1	172.24	160.39	130.40	132.39	96.30	81.98	70.31	76.85	106.12	116.81	149.64	163.24	121.14	44,245
2	173.76	158.23	132.07	124.32	94.61	69.10	63.21	72.28	118.21	113.44	147.89	164.90	119.09	43,498
3	177.40	153.84	130.88	125.84	98.14	76.30	66.23	83.20	103.89	123.39	154.63	166.23	121.49	44,376
4	176.88	159.62	130.80	122.17	100.95	68.26	59.72	70.00	109.58	137.64	152.73	161.10	120.58	44,041
5	184.32	169.87	121.87	138.48	94.53	69.63	61.35	60.34	99.31	145.24	157.83	165.01	122.02	44,569
6	184.84	184.04	140.46	135.29	94.08	72.77	56.97	75.20	103.20	141.11	158.73	159.89	125.20	45,728
7	190.17	179.20	144.17	138.89	89.85	70.28	62.01	64.47	111.21	157.61	148.19	160.87	126.11	46,063
8	180.63	181.03	153.53	128.01	81.32	60.35	53.52	62.39	106.84	146.25	141.96	162.37	121.20	44,269
9	179.85	179.97	147.14	141.60	96.08	59.47	50.46	55.15	103.13	134.40	140.69	179.95	122.01	44,565
10	173.71	162.04	129.90	126.35	91.20	54.10	44.90	57.67	97.92	116.85	132.57	182.25	113.89	41,597
11	172.67	138.37	128.40	111.44	81.52	63.17	45.23	64.88	88.52	118.15	143.54	159.98	109.53	40,004
12	160.35	130.59	138.25	118.54	86.05	74.96	71.08	60.08	80.57	104.46	134.55	146.73	108.76	39,724
13	147.36	133.62	135.41	127.18	96.37	98.79	77.94	68.59	79.06	114.82	126.59	153.71	113.19	41,344
14	148.39	125.96	137.86	126.96	115.73	120.97	102.49	73.97	81.65	120.10	140.98	162.00	121.43	44,352
15	146.97	126.62	157.82	147.13	148.22	146.41	102.23	82.65	88.97	125.36	138.06	154.06	130.41	47,631
16	149.36	122.12	169.11	179.95	160.77	146.03	106.25	94.72	83.80	141.37	150.33	166.49	139.31	50,883
17	149.36	132.90	164.09	185.38	174.37	159.83	113.13	86.86	90.53	146.48	173.35	165.93	145.20	53,034
18	152.00	146.50	158.90	184.75	165.17	163.51	125.12	81.09	111.92	143.19	168.95	170.93	147.57	53,901
19	166.02	149.33	158.91	173.81	164.53	148.61	121.20	94.70	101.01	132.97	170.89	171.89	146.11	53,365
20	169.34	149.07	174.27	172.81	142.24	128.48	111.17	82.65	98.54	135.96	158.19	179.03	141.78	51,786
21	167.77	148.54	160.88	154.41	119.92	118.66	87.98	82.25	91.80	130.18	166.02	186.39	134.48	49,119
22	165.23	154.17	144.04	133.14	107.88	113.38	86.17	81.08	103.09	131.06	162.50	182.66	130.21	47,561
23	158.77	161.05	143.26	117.17	104.46	115.86	79.64	75.76	98.69	138.33	145.18	169.82	125.47	45,827
Average (MWh)	166.95	152.37	144.21	139.25	111.94	99.53	78.99	74.25	98.50	130.90	150.83	166.28	126.01	
Total (MWh)	124,213	103,307	107,290	100,257	83,282	71,658	58,765	55,244	70,919	97,388	108,598	123,710		1,104,631

Table A7. GE 700-MW Wind Speed and Energy Production Detail

Project:	NYSERDA - Offshore LI	
Date:	5-Apr-10	
Comments:		
Turbine Model:	GE 4MW	
Turbine Rated Power:	4.00	MW
Hub Height:	90	m
Number of Turbines:	175	
Plant Capacity:	700	MW
Site Air Density:	1.240	kg/m^3

Loss Accounting	
Wake Effect	9.0%
Availability	6.1%
Electrical	4.0%
Turbine Performance	1.9%
Environmental	5.2%
Curtailments	0.0%
Average Total Loss	**23.8%**

Overall Wind Plant Summary	
Average Free Wind Speed (m/s)	8.85
Gross Plant Production (MWh/yr)	2,865,911
Net Plant Production (MWh/yr)	2,184,579
*Net Capacity Factor	35.6%

*The rated capacity of 4000 kW has been used in this capacity factor calculation. Please note that the peak power of the turbine as listed in the power curve is 4070 kW

Per Turbine Summary

Turbine ID	Mast Association	Coordinates (WGS84 UTM18) Easting (m)	Northing (m)	Free Spd (m/s)	Gross MWh/yr	% Array Eff	% Array Loss	% Total Loss	Net MWh/yr	Turbine Rank	Net Capacity Factor (%)	Turbulence Intensity (%)
1	ALSN6	616021	4472785	8.81	16124	96.5	3.5	19.1	13,037	7	37.2	6.9
2	ALSN6	615145	4472071	8.81	16150	96.5	3.5	19.2	13,052	6	37.2	6.9
3	ALSN6	614271	4471389	8.81	16158	98.4	1.6	17.5	13,324	1	38.0	6.7
4	ALSN6	617049	4472375	8.83	16187	95.1	4.9	20.3	12,896	15	36.8	7.0
5	ALSN6	616173	4471661	8.83	16196	94.7	5.3	20.7	12,841	18	36.6	7.0
6	ALSN6	615299	4470979	8.82	16192	96.8	3.2	18.9	13,124	3	37.4	6.8
7	ALSN6	618081	4471964	8.84	16219	94.4	5.6	20.9	12,828	21	36.6	7.0
8	ALSN6	617206	4471250	8.83	16210	93.8	6.2	21.4	12,738	36	36.3	7.1
9	ALSN6	616331	4470568	8.82	16187	96.3	3.7	19.3	13,056	5	37.2	6.9
10	ALSN6	619985	4472236	8.84	16216	94.0	6.0	21.3	12,767	28	36.4	6.9
11	ALSN6	619111	4471554	8.86	16273	93.7	6.3	21.5	12,769	27	36.4	7.0
12	ALSN6	618235	4470840	8.86	16296	93.4	6.6	21.8	12,748	34	36.4	7.0
13	ALSN6	617361	4470158	8.85	16286	95.8	4.2	19.7	13,071	4	37.3	6.8
14	ALSN6	621025	4471821	8.88	16326	93.1	6.9	22.0	12,728	37	36.3	7.0
15	ALSN6	620151	4471139	8.86	16293	92.9	7.1	22.2	12,683	48	36.2	7.1
16	ALSN6	619275	4470425	8.87	16319	92.9	7.1	22.2	12,700	43	36.2	7.1
17	ALSN6	618401	4469743	8.86	16318	95.3	4.7	20.2	13,021	8	37.1	6.8
18	ALSN6	622050	4471413	8.87	16301	92.8	7.2	22.3	12,669	49	36.1	7.0
19	ALSN6	621176	4470731	8.89	16373	92.5	7.5	22.5	12,693	45	36.2	7.1
20	ALSN6	620301	4470017	8.88	16370	92.7	7.3	22.4	12,705	42	36.2	7.0
21	ALSN6	619426	4469335	8.87	16343	94.8	5.2	20.6	12,982	11	37.0	6.8
22	ALSN6	623077	4471004	8.87	16305	92.4	7.6	22.6	12,623	54	36.0	7.0
23	ALSN6	622203	4470322	8.88	16368	92.1	7.9	22.9	12,624	52	36.0	7.1
24	ALSN6	621327	4469608	8.87	16355	92.1	7.9	22.8	12,624	53	36.0	7.1
25	ALSN6	620453	4468926	8.89	16400	94.6	5.4	20.8	12,996	9	37.1	6.8
26	ALSN6	624110	4470592	8.87	16328	92.1	7.9	22.8	12,603	57	35.9	7.0
27	ALSN6	623236	4469910	8.89	16395	91.5	8.5	23.3	12,570	61	35.8	7.1
28	ALSN6	622360	4469196	8.87	16346	92.0	8.0	23.0	12,592	58	35.9	7.1
29	ALSN6	621486	4468514	8.87	16375	94.2	5.8	21.1	12,926	13	36.9	6.8
30	ALSN6	625149	4470178	8.88	16348	91.7	8.3	23.1	12,564	63	35.8	7.0
31	ALSN6	624275	4469496	8.85	16288	90.9	9.1	23.9	12,398	97	35.4	7.1
32	ALSN6	623399	4468782	8.86	16347	91.2	8.8	23.6	12,494	77	35.6	7.1
33	ALSN6	622525	4468100	8.87	16392	92.9	7.1	22.2	12,751	33	36.4	7.0
34	ALSN6	626179	4469768	8.85	16284	91.4	8.6	23.5	12,465	83	35.6	7.0
35	ALSN6	625305	4469086	8.88	16369	90.7	9.3	24.0	12,443	85	35.5	7.1

Table A7 Cont'd. GE 700-MW Wind Speed and Energy Production Detail

Per Turbine Summary													
Turbine ID	Mast Association	Coordinates (WGS84 UTM18) Easting (m)	Northing (m)	Free Spd (m/s)	Gross MWh/yr	% Array Eff	% Array Loss	% Total Loss	Net MWh/yr	Turbine Rank	Net Capacity Factor (%)	Turbulence Intensity (%)
36	ALSN6	624429	4468372	8.87	16382	91.0	9.0	23.8	12,491	79	35.6	7.1
37	ALSN6	623555	4467690	8.84	16316	92.1	7.9	22.9	12,581	60	35.9	7.0
38	ALSN6	622661	4467000	8.84	16330	94.4	5.6	20.9	12,918	14	36.8	6.8
39	ALSN6	628084	4470066	8.87	16313	91.7	8.3	23.1	12,537	66	35.8	6.9
40	ALSN6	627206	4469359	8.84	16265	90.8	9.2	24.0	12,369	102	35.3	7.0
41	ALSN6	626332	4468677	8.85	16307	90.5	9.5	24.2	12,359	106	35.2	7.1
42	ALSN6	625456	4467962	8.83	16264	90.7	9.3	24.0	12,359	107	35.2	7.1
43	ALSN6	624582	4467280	8.84	16311	91.5	8.5	23.3	12,507	74	35.7	7.1
44	ALSN6	623689	4466591	8.85	16346	93.6	6.4	21.6	12,818	23	36.6	6.8
45	44025	629117	4469654	8.85	16377	91.4	8.6	23.5	12,533	67	35.7	7.5
46	44025	628235	4468949	8.82	16308	90.5	9.5	24.2	12,368	103	35.3	7.7
47	44025	627360	4468267	8.83	16336	90.5	9.5	24.2	12,382	101	35.3	7.7
48	44025	626485	4467553	8.81	16315	90.6	9.4	24.1	12,387	99	35.3	7.7
49	44025	625610	4466871	8.82	16355	91.3	8.7	23.5	12,505	75	35.7	7.6
50	44025	624721	4466179	8.79	16315	93.6	6.4	21.6	12,797	26	36.5	7.4
51	44025	630146	4469244	8.85	16377	91.1	8.9	23.7	12,493	78	35.6	7.5
52	44025	629272	4468536	8.86	16412	90.0	10.0	24.7	12,366	104	35.3	7.7
53	44025	628397	4467854	8.84	16364	90.0	10.0	24.6	12,333	112	35.2	7.7
54	44025	627522	4467139	8.84	16381	90.4	9.6	24.3	12,407	94	35.4	7.7
55	44025	626647	4466457	8.81	16327	90.9	9.1	23.8	12,435	88	35.5	7.7
56	44025	625751	4465769	8.79	16297	93.4	6.6	21.8	12,751	32	36.4	7.5
57	44025	631187	4468830	8.86	16393	90.8	9.2	23.9	12,467	82	35.6	7.6
58	44025	630293	4468129	8.85	16380	89.5	10.5	25.0	12,284	126	35.0	7.7
59	44025	629419	4467447	8.83	16341	89.5	10.5	25.0	12,252	132	34.9	7.7
60	44025	628543	4466732	8.83	16357	90.0	10.0	24.7	12,325	115	35.1	7.7
61	44025	627669	4466050	8.81	16333	90.7	9.3	24.0	12,409	93	35.4	7.7
62	44025	626791	4465355	8.79	16294	93.1	6.9	22.0	12,714	41	36.3	7.5
63	44025	633086	4469103	8.86	16374	91.5	8.5	23.3	12,554	64	35.8	7.5
64	44025	632212	4468421	8.85	16351	90.2	9.8	24.4	12,358	108	35.2	7.6
65	44025	631318	4467720	8.86	16396	89.3	10.7	25.2	12,269	127	35.0	7.7
66	44025	630444	4467038	8.85	16392	89.1	10.9	25.3	12,240	135	34.9	7.7
67	44025	629568	4466324	8.81	16307	89.2	10.8	25.3	12,188	153	34.8	7.8
68	44025	628694	4465642	8.79	16279	90.0	10.0	24.6	12,267	128	35.0	7.7
69	44025	627816	4464946	8.79	16303	92.0	8.0	22.9	12,565	62	35.8	7.6
70	44025	634113	4468694	8.88	16446	90.9	9.1	23.9	12,520	71	35.7	7.5
71	44025	633239	4468012	8.85	16369	89.7	10.3	24.9	12,300	121	35.1	7.7
72	44025	632350	4467309	8.86	16401	89.1	10.9	25.4	12,240	136	34.9	7.7
73	44025	631476	4466627	8.85	16405	88.8	11.2	25.6	12,204	147	34.8	7.7
74	44025	630600	4465913	8.83	16374	89.0	11.0	25.4	12,209	145	34.8	7.7
75	44025	629726	4465231	8.81	16333	89.9	10.1	24.7	12,299	122	35.1	7.7
76	44025	628843	4464537	8.76	16218	91.3	8.7	23.5	12,405	96	35.4	7.7
77	44025	627968	4463855	8.80	16344	93.8	6.2	21.5	12,839	19	36.6	7.4
78	44025	635146	4468283	8.88	16461	90.9	9.1	23.9	12,529	68	35.7	7.5
79	44025	634271	4467601	8.89	16480	89.5	10.5	25.0	12,357	109	35.2	7.6
80	44025	633405	4466888	8.86	16403	88.9	11.1	25.5	12,220	143	34.9	7.7
81	44025	632531	4466206	8.86	16437	88.4	11.6	26.0	12,164	155	34.7	7.7
82	44025	631655	4465492	8.83	16372	88.7	11.3	25.7	12,160	158	34.7	7.7
83	44025	630781	4464810	8.82	16356	89.8	10.2	24.8	12,296	123	35.1	7.7
84	44025	629876	4464126	8.80	16333	90.8	9.2	23.9	12,423	89	35.4	7.7
85	44025	629001	4463444	8.79	16340	93.0	7.0	22.1	12,728	38	36.3	7.4
86	44025	636185	4467869	8.86	16403	90.9	9.1	23.9	12,485	80	35.6	7.5
87	44025	635310	4467187	8.85	16381	89.2	10.8	25.3	12,242	133	34.9	7.7
88	44025	634451	4466472	8.87	16463	88.7	11.3	25.7	12,226	139	34.9	7.7
89	44025	633577	4465790	8.87	16470	88.2	11.8	26.2	12,162	156	34.7	7.7
90	44025	632701	4465076	8.83	16379	88.5	11.5	25.9	12,140	163	34.6	7.7
91	44025	631827	4464393	8.84	16425	89.4	10.6	25.1	12,303	120	35.1	7.7
92	44025	630915	4463712	8.83	16394	90.4	9.6	24.3	12,417	91	35.4	7.6
93	44025	630040	4463030	8.78	16306	92.9	7.1	22.2	12,686	47	36.2	7.4
94	44025	637215	4467458	8.87	16449	90.8	9.2	24.0	12,507	73	35.7	7.5
95	44025	636340	4466776	8.87	16452	89.2	10.8	25.3	12,295	124	35.1	7.7
96	44025	635496	4466056	8.86	16456	88.5	11.5	25.9	12,197	150	34.8	7.7
97	44025	634621	4465374	8.86	16466	88.1	11.9	26.2	12,153	159	34.7	7.7
98	44025	633746	4464659	8.86	16453	88.5	11.5	25.9	12,199	149	34.8	7.7
99	44025	632871	4463977	8.84	16433	89.1	10.9	25.4	12,263	130	35.0	7.7
100	44025	631944	4463301	8.83	16412	90.1	9.9	24.5	12,387	98	35.3	7.6

Table A7 Cont'd. GE 700-MW Wind Speed and Energy Production Detail

Per Turbine Summary												
Turbine	Mast	Coordinates (WGS84 UTM18)		Free	Gross	% Array	% Array	% Total	Net	Turbine	Net Capacity	Turbulence
ID	Association	Easting (m)	Northing (m)	Spd (m/s)	MWh/yr	Eff	Loss	Loss	MWh/yr	Rank	Factor (%)	Intensity (%)
101	44025	631070	4462619	8.82	16419	92.6	7.4	22.4	12,741	35	36.3	7.4
102	44025	638242	4467049	8.83	16349	90.7	9.3	24.0	12,418	90	35.4	7.6
103	44025	637367	4466367	8.85	16394	89.0	11.0	25.4	12,223	140	34.9	7.7
104	44025	636534	4465642	8.86	16439	88.2	11.8	26.1	12,143	162	34.6	7.7
105	44025	635659	4464960	8.86	16460	88.0	12.0	26.3	12,135	166	34.6	7.7
106	44025	634784	4464246	8.84	16427	88.4	11.6	26.0	12,161	157	34.7	7.7
107	44025	633909	4463564	8.82	16375	88.9	11.1	25.6	12,188	152	34.8	7.7
108	44025	632972	4462892	8.81	16368	89.9	10.1	24.7	12,327	114	35.2	7.6
109	44025	632097	4462210	8.81	16376	92.5	7.5	22.5	12,688	46	36.2	7.4
110	44025	639270	4466639	8.85	16405	90.6	9.4	24.1	12,445	84	35.5	7.6
111	44025	638396	4465957	8.86	16434	88.8	11.2	25.6	12,227	138	34.9	7.7
112	44025	637561	4465232	8.85	16416	88.0	12.0	26.3	12,096	172	34.5	7.7
113	44025	636687	4464550	8.84	16422	87.8	12.2	26.5	12,076	173	34.4	7.7
114	44025	635811	4463836	8.85	16438	88.1	11.9	26.2	12,128	167	34.6	7.7
115	44025	634937	4463154	8.84	16427	88.8	11.2	25.6	12,221	141	34.9	7.7
116	44025	634000	4462482	8.82	16384	89.7	10.3	24.8	12,314	118	35.1	7.6
117	44025	633126	4461800	8.81	16369	92.4	7.6	22.6	12,667	50	36.1	7.4
118	44025	641183	4466940	8.87	16431	91.6	8.4	23.3	12,605	56	35.9	7.4
119	44025	640307	4466226	8.86	16412	90.1	9.9	24.5	12,384	100	35.3	7.6
120	44025	639433	4465544	8.86	16435	89.1	10.9	25.4	12,261	131	35.0	7.7
121	44025	638595	4464821	8.85	16424	88.3	11.7	26.1	12,144	161	34.6	7.7
122	44025	637720	4464139	8.83	16369	87.9	12.1	26.4	12,050	175	34.4	7.7
123	44025	636845	4463425	8.83	16393	87.9	12.1	26.4	12,069	174	34.4	7.7
124	44025	635970	4462743	8.82	16371	88.4	11.6	25.9	12,123	169	34.6	7.7
125	44025	635037	4462069	8.83	16381	89.8	10.2	24.8	12,323	116	35.1	7.6
126	44025	634163	4461387	8.81	16345	92.3	7.7	22.7	12,635	51	36.0	7.4
127	44025	642204	4466533	8.86	16381	91.3	8.7	23.6	12,523	70	35.7	7.5
128	44025	641329	4465819	8.87	16422	89.8	10.2	24.8	12,355	110	35.2	7.6
129	44025	640454	4465137	8.85	16388	89.0	11.0	25.4	12,220	142	34.9	7.7
130	44025	639680	4464388	8.85	16401	88.0	12.0	26.2	12,096	171	34.5	7.7
131	44025	638805	4463706	8.86	16470	87.9	12.1	26.4	12,128	168	34.6	7.7
132	44025	637930	4462992	8.84	16413	88.1	11.9	26.2	12,110	170	34.5	7.7
133	44025	637055	4462310	8.82	16366	88.6	11.4	25.8	12,139	164	34.6	7.7
134	44025	636059	4461662	8.81	16337	89.2	10.8	25.3	12,201	148	34.8	7.7
135	44025	635184	4460980	8.82	16372	91.5	8.5	23.3	12,554	65	35.8	7.5
136	44025	643229	4466125	8.88	16413	91.7	8.3	23.2	12,607	55	36.0	7.5
137	44025	642354	4465411	8.85	16383	89.8	10.2	24.8	12,321	117	35.1	7.7
138	44025	641479	4464729	8.85	16398	89.3	10.7	25.2	12,264	129	35.0	7.7
139	44025	640713	4463977	8.87	16465	88.3	11.7	26.1	12,172	154	34.7	7.7
140	44025	639839	4463295	8.86	16467	88.0	12.0	26.2	12,144	160	34.6	7.7
141	44025	638963	4462580	8.86	16446	88.1	11.9	26.2	12,139	165	34.6	7.7
142	44025	638089	4461898	8.84	16418	88.6	11.4	25.8	12,189	151	34.8	7.7
143	44025	637084	4461254	8.82	16351	89.3	10.7	25.2	12,236	137	34.9	7.7
144	44025	636209	4460572	8.84	16394	91.1	8.9	23.7	12,504	76	35.7	7.6
145	44025	635334	4459857	8.82	16361	93.5	6.5	21.6	12,820	22	36.6	7.3
146	44025	644262	4465713	8.91	16493	92.3	7.7	22.7	12,755	29	36.4	7.5
147	44025	643386	4464999	8.89	16468	90.2	9.8	24.5	12,436	86	35.5	7.6
148	44025	642512	4464317	8.88	16485	89.3	10.7	25.2	12,334	111	35.2	7.7
149	44025	641768	4463556	8.88	16480	89.0	11.0	25.4	12,290	125	35.0	7.7
150	44025	640893	4462874	8.87	16472	88.5	11.5	25.9	12,209	146	34.8	7.7
151	44025	640018	4462160	8.86	16458	88.6	11.4	25.8	12,219	144	34.8	7.7
152	44025	639143	4461478	8.86	16442	88.9	11.1	25.5	12,242	134	34.9	7.7
153	44025	638116	4460842	8.83	16376	89.8	10.2	24.8	12,312	119	35.1	7.7
154	44025	637241	4460160	8.83	16369	91.0	9.0	23.8	12,480	81	35.6	7.6
155	44025	636366	4459446	8.83	16368	93.0	7.0	22.1	12,754	30	36.4	7.4
156	44025	645317	4465293	8.89	16457	93.2	6.8	22.0	12,843	17	36.6	7.4
157	44025	644441	4464579	8.88	16439	91.4	8.6	23.4	12,588	59	35.9	7.6
158	44025	643567	4463897	8.88	16466	90.7	9.3	24.0	12,508	72	35.7	7.6
159	44025	642792	4463148	8.89	16492	89.8	10.2	24.8	12,407	95	35.4	7.6
160	44025	641918	4462466	8.90	16522	89.9	10.1	24.7	12,436	87	35.5	7.6

Table A7 Cont'd. GE 700-MW Wind Speed and Energy Production Detail

Per Turbine Summary													
Turbine ID	Mast Association	Coordinates (WGS84 UTM18) Easting (m)	Northing (m)	Free Spd (m/s)	Gross MWh/yr	% Array Eff	% Array Loss	% Total Loss	Net MWh/yr	Turbine Rank	Net Capacity Factor (%)	Turbulence Intensity (%)
161	44025	641042	4461752	8.86	16443	89.5	10.5	25.0	12,328	113	35.2	7.7
162	44025	640168	4461070	8.86	16440	89.8	10.2	24.8	12,363	105	35.3	7.7
163	44025	639171	4460422	8.86	16460	90.0	10.0	24.6	12,413	92	35.4	7.6
164	44025	638296	4459740	8.85	16407	91.2	8.8	23.6	12,528	69	35.7	7.6
165	44025	637421	4459026	8.85	16405	93.4	6.6	21.8	12,832	20	36.6	7.4
166	44025	646362	4464876	8.90	16481	95.7	4.3	19.8	13,210	2	37.7	7.2
167	44025	645487	4464162	8.90	16479	94.1	5.9	21.2	12,991	10	37.0	7.4
168	44025	644612	4463480	8.89	16497	93.1	6.9	22.0	12,871	16	36.7	7.4
169	44025	643829	4462735	8.89	16476	92.8	7.2	22.2	12,813	24	36.5	7.4
170	44025	642955	4462053	8.86	16438	92.4	7.6	22.6	12,726	39	36.3	7.4
171	44025	642079	4461339	8.87	16452	92.1	7.9	22.8	12,695	44	36.2	7.4
172	44025	641205	4460657	8.89	16502	92.3	7.7	22.7	12,753	31	36.4	7.4
173	44025	640217	4460005	8.87	16462	92.3	7.7	22.7	12,725	40	36.3	7.4
174	44025	639342	4459323	8.88	16489	92.7	7.3	22.4	12,800	25	36.5	7.4
175	44025	638467	4458609	8.86	16432	94.1	5.9	21.2	12,953	12	36.9	7.3

Table A8. GE 700-MW 12x24 Net Energy Matrix

Project:	NYSERDA - Offshore LI
EPE Completion Date:	5-Apr-2010
Prepared By:	AWS Truepower, LLC
Comments:	Net Energy Output Matrix (MW)
Turbine Model:	GE 4MW
Turbine Rated Power:	4.0 MW
Hub Height:	90
Number of Turbines:	175
Plant Capacity:	700 MW
Net Annual Energy Output:	2,184,579 MWh
Net Capacity Factor:	35.6%

Hour	Month												Average (MWh)	Total (MWh)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
0	317.87	297.45	254.61	188.78	161.74	210.23	150.93	146.63	209.89	250.03	310.04	308.87	233.49	85,282
1	342.91	318.52	258.08	260.99	188.82	159.34	137.66	149.60	209.08	230.90	297.21	324.29	239.28	87,397
2	345.65	314.03	262.23	244.95	185.62	134.41	123.82	140.72	233.77	223.42	294.25	326.96	235.33	85,953
3	353.67	305.65	259.83	248.63	193.04	148.87	129.25	162.44	205.58	244.15	307.41	329.26	240.30	87,770
4	352.01	317.07	259.59	241.73	198.27	133.34	116.57	136.36	217.09	272.60	304.10	319.07	238.56	87,134
5	367.73	337.56	241.03	273.27	185.33	136.33	119.41	117.58	196.47	287.56	313.69	327.30	241.35	88,153
6	368.66	364.90	278.81	266.89	185.10	141.89	111.00	147.22	204.18	279.39	315.53	317.20	247.70	90,472
7	378.59	354.78	286.33	273.96	176.69	136.65	121.72	125.33	220.26	313.63	294.62	319.34	249.58	91,158
8	359.30	358.58	303.97	252.53	160.15	117.84	104.69	121.83	211.47	290.25	282.50	321.48	239.76	87,572
9	357.23	355.48	290.93	279.60	189.60	116.21	98.73	107.60	204.33	265.10	279.58	357.87	241.24	88,113
10	345.01	320.77	256.62	249.67	180.05	105.13	87.25	112.80	193.91	231.17	263.33	362.44	225.21	82,259
11	341.76	274.59	253.64	219.69	160.72	123.02	87.83	127.56	175.89	233.78	284.24	317.84	216.45	79,060
12	317.35	258.68	273.88	234.98	169.69	145.90	139.02	117.60	159.33	206.15	266.49	291.69	214.88	78,485
13	292.01	264.75	268.22	250.69	189.18	192.94	152.96	134.28	156.68	226.61	250.00	305.52	223.47	81,621
14	294.58	249.50	274.22	250.39	227.93	237.61	200.68	145.49	161.47	236.22	279.49	321.88	239.97	87,648
15	291.67	251.53	312.74	290.50	291.68	288.18	200.11	161.75	175.95	246.67	273.03	305.92	257.53	94,062
16	296.29	242.74	335.04	356.20	316.47	287.45	207.53	186.18	165.65	279.39	297.89	330.99	275.38	100,581
17	295.84	264.47	324.56	367.77	344.40	315.38	221.37	170.46	179.03	289.67	344.10	329.69	287.24	104,915
18	302.05	291.14	318.70	366.72	325.92	323.42	245.56	159.20	220.95	282.74	335.78	339.52	292.44	106,815
19	329.52	296.43	315.32	345.50	325.90	293.48	237.40	186.01	199.39	263.42	339.66	340.93	289.30	105,669
20	337.51	296.40	346.79	343.99	280.12	252.67	217.51	161.66	194.24	268.71	315.13	354.88	280.73	102,537
21	334.15	295.15	319.57	307.39	236.32	232.99	172.43	160.40	180.39	257.07	329.63	370.38	266.14	97,209
22	327.98	306.78	286.15	264.04	211.69	222.48	168.51	158.30	203.22	258.92	322.06	362.64	257.41	94,020
23	315.89	319.62	288.14	231.25	204.88	226.61	155.98	147.84	194.97	273.37	288.63	337.11	248.30	90,693
Average (MWh)	331.88	302.36	286.21	275.42	220.39	195.10	154.50	145.20	194.72	258.79	299.52	330.13	249.21	
Total (MWh)	246,922	204,998	212,939	198,303	163,968	140,471	114,945	108,030	140,195	192,540	215,652	245,616		2,184,579

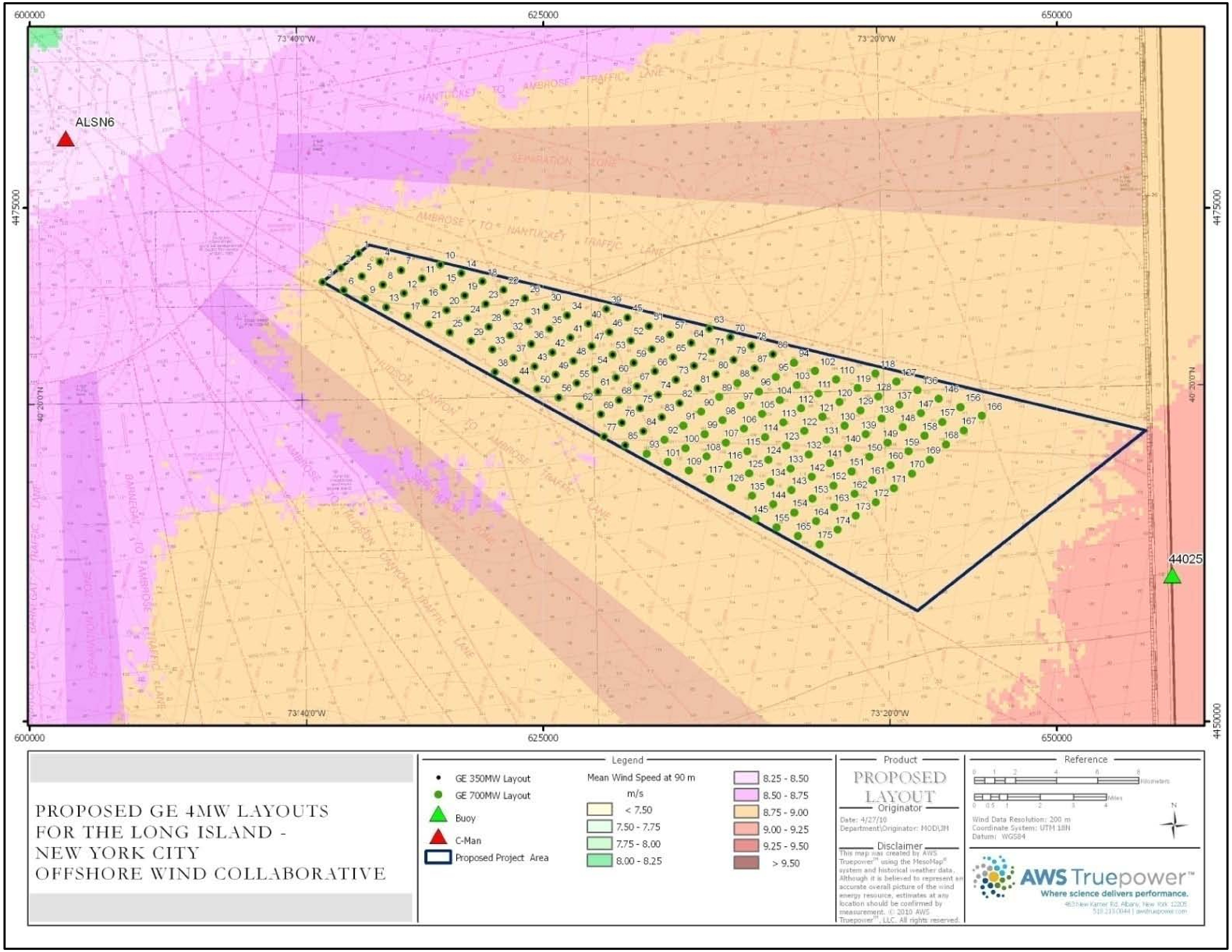

Figure A1. Proposed Long Island – New York City Offshore GE Turbine Layouts

VESTAS V112 3.0-MW ENERGY ESTIMATES

Table A9. Vestas V112 350-MW Wind Speed and Energy Production Detail

Project:	**NYSERDA - Offshore LI**	
Date:	**5-Apr-10**	
Comments:		
Turbine Model:	**Vestas V112**	
Turbine Rated Power:	**3.00**	**MW**
Hub Height:	**90**	**m**
Number of Turbines:	**116**	
Plant Capacity:	**348**	**MW**
Site Air Density:	**1.240**	**kg/m^3**

Loss Accounting	
Wake Effect	**6.6%**
Availability	**5.8%**
Electrical	**4.0%**
Turbine Performance	**1.7%**
Environmental	**4.5%**
Curtailments	**0.0%**
Average Total Loss	**20.7%**

Overall Wind Plant Summary	
Average Free Wind Speed (m/s)	**8.84**
Gross Plant Production (MWh/yr)	**1,669,279**
Net Plant Production (MWh/yr)	**1,324,510**
Net Capacity Factor	**43.4%**

Per Turbine Summary

Turbine ID	Mast Association	Coordinates (WGS84 UTM18) Easting (m)	Northing (m)	Free Spd (m/s)	Gross MWh/yr	% Array Eff	% Array Loss	% Total Loss	Net MWh/yr	Turbine Rank	Net Capacity Factor (%)	Turbulence Intensity (%)
1	ALSN6	616060	4472781	8.80	14285	96.9	3.1	17.7	11,750	11	44.7	7.0
2	ALSN6	615172	4472074	8.81	14309	96.9	3.1	17.7	11,774	10	44.8	7.0
3	ALSN6	614288	4471382	8.81	14311	98.6	1.4	16.3	11,982	1	45.6	6.7
4	ALSN6	617110	4472363	8.83	14338	95.7	4.3	18.8	11,646	17	44.3	7.1
5	ALSN6	616222	4471656	8.83	14349	95.4	4.6	19.0	11,623	20	44.2	7.2
6	ALSN6	615338	4470964	8.82	14336	97.2	2.8	17.4	11,838	3	45.0	6.9
7	ALSN6	618163	4471943	8.84	14369	95.1	4.9	19.3	11,598	24	44.1	7.1
8	ALSN6	617275	4471236	8.83	14357	94.7	5.3	19.6	11,550	32	43.9	7.2
9	ALSN6	616391	4470544	8.82	14340	96.9	3.1	17.7	11,801	5	44.9	6.9
10	ALSN6	620086	4472221	8.85	14383	94.8	5.2	19.5	11,577	27	44.0	7.0
11	ALSN6	619202	4471529	8.86	14403	94.6	5.4	19.7	11,565	29	44.0	7.1
12	ALSN6	618314	4470822	8.86	14423	94.4	5.6	19.8	11,562	30	44.0	7.2
13	ALSN6	617430	4470130	8.85	14423	96.6	3.4	18.0	11,828	4	45.0	6.9
14	ALSN6	621133	4471804	8.88	14453	94.0	6.0	20.2	11,540	35	43.9	7.1
15	ALSN6	620249	4471112	8.87	14438	94.0	6.0	20.2	11,519	38	43.8	7.2
16	ALSN6	619361	4470405	8.87	14438	94.0	6.0	20.2	11,526	36	43.8	7.2
17	ALSN6	618477	4469713	8.86	14435	96.2	3.8	18.4	11,785	6	44.8	6.9
18	ALSN6	622187	4471384	8.86	14422	93.8	6.2	20.4	11,485	42	43.7	7.1
19	ALSN6	621303	4470692	8.89	14491	93.5	6.5	20.6	11,511	40	43.8	7.2
20	ALSN6	620415	4469985	8.89	14484	93.8	6.2	20.3	11,541	34	43.9	7.2
21	ALSN6	619531	4469293	8.88	14477	95.9	4.1	18.6	11,784	7	44.8	6.9
22	ALSN6	623231	4470968	8.87	14427	93.4	6.6	20.7	11,445	50	43.5	7.1
23	ALSN6	622347	4470276	8.89	14474	93.3	6.7	20.8	11,464	46	43.6	7.2
24	ALSN6	621459	4469569	8.87	14456	93.4	6.6	20.7	11,470	45	43.6	7.2
25	ALSN6	620575	4468877	8.88	14501	95.7	4.3	18.8	11,782	8	44.8	6.9
26	ALSN6	624272	4470553	8.87	14444	93.2	6.8	20.9	11,429	52	43.5	7.1
27	ALSN6	623388	4469861	8.89	14504	92.9	7.1	21.2	11,436	51	43.5	7.2
28	ALSN6	622500	4469154	8.87	14470	93.3	6.7	20.8	11,461	47	43.6	7.2
29	ALSN6	621616	4468462	8.87	14487	95.4	4.6	19.0	11,730	13	44.6	6.9
30	ALSN6	625317	4470137	8.87	14464	92.8	7.2	21.2	11,397	55	43.3	7.1
31	ALSN6	624433	4469445	8.85	14435	92.3	7.7	21.6	11,315	74	43.0	7.3
32	ALSN6	623545	4468738	8.86	14465	92.7	7.3	21.3	11,382	59	43.3	7.3
33	ALSN6	622661	4468046	8.87	14507	94.2	5.8	20.0	11,604	23	44.1	7.1
34	ALSN6	627261	4470420	8.86	14446	93.0	7.0	21.0	11,412	54	43.4	7.0
35	ALSN6	626366	4469719	8.85	14424	92.4	7.6	21.6	11,312	75	43.0	7.2

Table A9 Cont'd. Vestas V112 350-MW Wind Speed and Energy Production Detail

Per Turbine Summary												
Turbine ID	Mast Association	Coordinates (WGS84 UTM18) Easting (m)	Northing (m)	Free Spd (m/s)	Gross MWh/yr	% Array Eff	% Array Loss	% Total Loss	Net MWh/yr	Turbine Rank	Net Capacity Factor (%)	Turbulence Intensity (%)
36	ALSN6	625482	4469027	8.88	14493	92.2	7.8	21.7	11,350	67	43.2	7.3
37	ALSN6	624594	4468320	8.86	14484	92.6	7.4	21.4	11,382	60	43.3	7.3
38	ALSN6	623709	4467628	8.84	14454	93.5	6.5	20.6	11,481	43	43.7	7.2
39	ALSN6	622799	4466935	8.84	14473	95.6	4.4	18.8	11,749	12	44.7	6.8
40	ALSN6	628315	4470000	8.86	14426	92.5	7.5	21.5	11,331	71	43.1	7.1
41	ALSN6	627409	4469303	8.84	14409	91.8	8.2	22.0	11,232	94	42.7	7.3
42	ALSN6	626525	4468611	8.85	14429	91.8	8.2	22.0	11,253	85	42.8	7.3
43	ALSN6	625637	4467904	8.83	14411	92.2	7.8	21.7	11,278	80	42.9	7.3
44	ALSN6	624753	4467212	8.84	14448	93.1	6.9	20.9	11,422	53	43.4	7.2
45	ALSN6	623852	4466516	8.85	14470	95.0	5.0	19.3	11,672	14	44.4	6.9
46	44025	629353	4469586	8.85	14346	92.7	7.3	21.2	11,297	76	43.0	7.6
47	44025	628456	4468886	8.83	14303	92.0	8.0	21.9	11,169	106	42.5	7.8
48	44025	627572	4468194	8.83	14316	92.2	7.8	21.7	11,209	97	42.6	7.8
49	44025	626684	4467487	8.81	14298	92.4	7.6	21.5	11,217	95	42.7	7.8
50	44025	625800	4466795	8.83	14350	93.1	6.9	20.9	11,347	68	43.1	7.8
51	44025	624891	4466102	8.81	14347	95.2	4.8	19.2	11,593	25	44.1	7.5
52	44025	630401	4469169	8.85	14358	92.6	7.4	21.4	11,286	78	42.9	7.6
53	44025	629501	4468470	8.85	14360	91.7	8.3	22.1	11,183	104	42.5	7.8
54	44025	628617	4467778	8.84	14344	91.9	8.1	22.0	11,188	102	42.5	7.8
55	44025	627729	4467071	8.84	14347	92.3	7.7	21.6	11,243	88	42.8	7.8
56	44025	626845	4466379	8.80	14291	92.9	7.1	21.2	11,268	81	42.8	7.8
57	44025	625938	4465684	8.80	14315	95.0	5.0	19.3	11,549	33	43.9	7.5
58	44025	631454	4468749	8.86	14362	92.4	7.6	21.6	11,263	82	42.8	7.7
59	44025	630551	4468051	8.85	14359	91.4	8.6	22.4	11,146	107	42.4	7.8
60	44025	629667	4467359	8.83	14321	91.5	8.5	22.3	11,124	113	42.3	7.9
61	44025	628779	4466652	8.83	14333	92.1	7.9	21.8	11,205	99	42.6	7.8
62	44025	627895	4465960	8.80	14309	92.7	7.3	21.3	11,259	83	42.8	7.8
63	44025	626992	4465265	8.79	14295	94.9	5.1	19.4	11,521	37	43.8	7.5
64	44025	633383	4469025	8.88	14361	93.0	7.0	21.1	11,336	70	43.1	7.5
65	44025	632498	4468333	8.84	14328	92.0	8.0	21.9	11,193	100	42.6	7.7
66	44025	631602	4467633	8.84	14337	91.3	8.7	22.5	11,115	115	42.3	7.8
67	44025	630718	4466941	8.86	14388	91.2	8.8	22.5	11,145	108	42.4	7.8
68	44025	629830	4466234	8.81	14306	91.7	8.3	22.2	11,134	110	42.3	7.9
69	44025	628946	4465542	8.80	14296	92.6	7.4	21.4	11,243	87	42.8	7.8
70	44025	628036	4464849	8.78	14289	94.7	5.3	19.6	11,491	41	43.7	7.5
71	44025	634424	4468610	8.88	14388	92.6	7.4	21.3	11,318	73	43.0	7.6
72	44025	633540	4467918	8.88	14401	91.7	8.3	22.1	11,217	96	42.7	7.8
73	44025	632660	4467211	8.86	14362	91.2	8.8	22.5	11,125	112	42.3	7.8
74	44025	631776	4466519	8.86	14391	90.9	9.1	22.8	11,109	116	42.2	7.8
75	44025	630888	4465812	8.82	14344	91.4	8.6	22.4	11,132	111	42.3	7.9
76	44025	630004	4465120	8.82	14352	92.2	7.8	21.7	11,234	93	42.7	7.8
77	44025	629077	4464434	8.76	14255	93.8	6.2	20.4	11,350	66	43.2	7.7
78	44025	635468	4468194	8.88	14407	92.9	7.1	21.1	11,361	63	43.2	7.6
79	44025	634584	4467502	8.89	14418	91.8	8.2	22.1	11,235	91	42.7	7.8
80	44025	633704	4466795	8.87	14407	91.4	8.6	22.4	11,178	105	42.5	7.8
81	44025	632820	4466103	8.86	14400	90.9	9.1	22.8	11,118	114	42.3	7.9
82	44025	631932	4465396	8.82	14354	91.4	8.6	22.4	11,134	109	42.3	7.9
83	44025	631048	4464704	8.82	14356	92.2	7.8	21.7	11,236	90	42.7	7.8
84	44025	630122	4464017	8.80	14342	93.3	6.7	20.8	11,359	64	43.2	7.7
85	44025	629237	4463326	8.79	14346	95.3	4.7	19.1	11,611	21	44.2	7.4
86	44025	636517	4467776	8.87	14394	93.2	6.8	20.9	11,391	58	43.3	7.6
87	44025	635633	4467084	8.86	14372	92.1	7.9	21.8	11,235	92	42.7	7.8
88	44025	634754	4466377	8.86	14403	91.6	8.4	22.2	11,208	98	42.6	7.8
89	44025	633870	4465685	8.87	14441	91.2	8.8	22.5	11,186	103	42.5	7.8
90	44025	632982	4464977	8.84	14399	91.5	8.5	22.3	11,192	101	42.6	7.8

Table A9 Cont'd. Vestas V112 350-MW Wind Speed and Energy Production Detail

Per Turbine Summary													
Turbine ID	Mast Association	Coordinates (WGS84 UTM18) Easting (m)	Northing (m)	Free Spd (m/s)	Gross MWh/yr	% Array Eff	% Array Loss	% Total Loss	Net MWh/yr	Turbine Rank	Net Capacity Factor (%)	Turbulence Intensity (%)
91	44025	632098	4464285	8.81	14367	92.1	7.9	21.8	11,241	89	42.7	7.8
92	44025	631170	4463600	8.83	14406	93.0	7.0	21.0	11,382	61	43.3	7.7
93	44025	630286	4462908	8.80	14358	94.9	5.1	19.4	11,576	28	44.0	7.5
94	44025	637561	4467360	8.87	14384	93.8	6.2	20.4	11,452	49	43.5	7.6
95	44025	636677	4466668	8.88	14426	92.6	7.4	21.4	11,341	69	43.1	7.8
96	44025	635798	4465961	8.87	14436	92.0	8.0	21.9	11,280	79	42.9	7.8
97	44025	634914	4465269	8.86	14435	91.8	8.2	22.0	11,254	84	42.8	7.8
98	44025	634026	4464562	8.85	14415	91.9	8.1	22.0	11,248	86	42.8	7.8
99	44025	633141	4463870	8.83	14396	92.4	7.6	21.6	11,290	77	42.9	7.8
100	44025	632214	4463184	8.81	14379	93.0	7.0	21.1	11,351	65	43.2	7.7
101	44025	631330	4462492	8.81	14386	95.0	5.0	19.3	11,609	22	44.1	7.5
102	44025	638608	4466943	8.85	14366	94.4	5.6	19.8	11,517	39	43.8	7.6
103	44025	637723	4466251	8.87	14416	93.1	6.9	21.0	11,394	57	43.3	7.7
104	44025	636862	4465537	8.84	14389	92.7	7.3	21.3	11,321	72	43.0	7.8
105	44025	635977	4464845	8.86	14421	92.8	7.2	21.2	11,366	62	43.2	7.8
106	44025	635089	4464138	8.84	14404	93.2	6.8	20.9	11,395	56	43.3	7.7
107	44025	634205	4463446	8.82	14372	93.9	6.1	20.3	11,460	48	43.6	7.6
108	44025	633261	4462767	8.81	14359	94.1	5.9	20.1	11,479	44	43.7	7.6
109	44025	632377	4462075	8.81	14377	95.4	4.6	19.0	11,649	16	44.3	7.4
110	44025	640541	4467234	8.85	14354	97.2	2.8	17.5	11,845	2	45.0	7.2
111	44025	639653	4466526	8.86	14387	96.4	3.6	18.1	11,778	9	44.8	7.4
112	44025	638769	4465834	8.85	14390	95.5	4.5	18.9	11,666	15	44.4	7.5
113	44025	637914	4465118	8.85	14398	95.1	4.9	19.3	11,626	19	44.2	7.5
114	44025	637030	4464426	8.84	14399	94.8	5.2	19.5	11,586	26	44.1	7.5
115	44025	636142	4463718	8.84	14393	94.5	5.5	19.7	11,552	31	43.9	7.5
116	44025	635257	4463027	8.84	14411	95.0	5.0	19.3	11,626	18	44.2	7.4

Table A10. Vestas V112 350-MW 12x24 Net Energy Matrix

Project:	NYSERDA - Offshore LI
EPE Completion Date:	5-Apr-2010
Prepared By:	AWS Truepower, LLC
Comments:	Net Energy Output Matrix (MW)
Turbine Model:	Vestas V112
Turbine Rated Power:	3.0 MW
Hub Height:	90
Number of Turbines:	116
Plant Capacity:	348 MW
Net Annual Energy Output:	1,324,510 MWh
Net Capacity Factor:	43.4%

Hour	Month												Average (MWh)	Total (MWh)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
0	177.48	173.83	151.95	122.36	107.35	144.82	107.16	103.48	131.70	151.29	177.34	173.42	143.28	52,333
1	192.89	185.71	155.49	161.34	125.96	118.34	95.03	105.79	130.95	141.63	171.93	184.54	147.20	53,764
2	196.40	182.96	153.09	152.41	123.80	98.52	83.82	100.09	141.55	140.55	166.58	189.80	143.89	52,554
3	194.93	177.53	152.84	153.37	125.12	104.45	88.66	111.09	122.95	146.65	177.57	193.10	145.52	53,150
4	199.18	181.86	152.80	147.81	130.20	93.76	82.82	96.20	128.51	160.89	174.79	188.49	144.59	52,812
5	202.47	193.53	146.65	169.78	126.45	94.24	85.36	83.58	119.15	168.68	181.26	188.83	146.37	53,463
6	204.69	213.39	163.21	165.79	120.49	100.06	79.04	99.54	123.50	165.53	179.94	184.06	149.54	54,620
7	212.52	211.95	165.75	168.70	114.51	99.75	81.21	91.42	131.67	174.51	169.42	184.79	150.14	54,840
8	203.46	210.85	180.73	157.12	102.00	82.43	73.24	85.03	126.73	168.72	159.67	190.86	144.72	52,860
9	204.64	216.24	175.12	167.67	115.27	80.80	68.98	75.93	121.48	162.27	161.81	202.10	145.64	53,195
10	199.22	191.28	157.49	153.12	109.33	77.42	65.21	77.24	116.90	139.61	153.19	202.37	136.58	49,887
11	202.87	161.96	156.52	137.15	100.25	87.55	65.31	82.76	101.91	140.10	168.04	181.22	132.01	48,215
12	190.94	153.42	162.56	139.90	106.58	106.06	95.91	80.76	96.91	128.10	158.48	165.70	132.02	48,222
13	175.73	158.00	159.60	156.87	124.58	131.34	102.35	89.57	92.16	140.12	155.18	174.84	138.26	50,500
14	171.59	150.28	158.73	154.72	146.90	154.15	135.45	94.98	99.29	150.08	165.94	184.59	147.24	53,781
15	168.55	143.56	185.31	175.96	186.56	181.42	137.38	110.47	107.74	156.77	166.08	177.89	158.25	57,802
16	173.19	138.94	199.68	210.84	198.09	181.27	144.28	120.74	102.30	169.96	175.83	188.99	167.21	61,075
17	176.51	150.92	197.48	212.05	209.40	190.38	150.25	111.79	109.03	175.06	196.45	187.52	172.34	62,949
18	172.86	166.31	191.94	211.22	197.51	193.19	161.31	104.47	137.22	172.04	190.73	194.10	174.37	63,690
19	188.71	172.50	184.93	195.95	190.62	178.11	159.39	120.30	124.18	156.78	192.46	199.05	171.90	62,787
20	184.94	171.87	198.90	191.14	173.98	161.11	147.63	110.70	122.36	164.16	176.44	206.60	167.50	61,181
21	185.18	169.91	184.69	172.55	149.12	152.14	118.26	113.63	117.44	157.96	188.30	210.98	159.96	58,427
22	187.29	176.02	166.15	152.96	139.39	145.81	115.64	111.30	128.80	157.00	188.68	208.92	156.38	57,116
23	178.96	188.10	166.79	142.01	134.66	152.72	106.43	103.95	122.11	164.67	165.44	193.02	151.36	55,285
Average (MWh)	189.38	176.71	169.52	165.53	139.92	129.58	106.26	99.37	119.02	156.38	173.40	189.82	151.10	
Total (MWh)	140,901	119,806	126,120	119,184	104,102	93,296	79,054	73,928	85,696	116,347	124,846	141,230		1,324,510

Table A11. Vestas V112 700-MW Wind Speed and Energy Production Detail

Project:	NYSERDA - Offshore LI	
Date:	5-Apr-10	
Comments:		
Turbine Model:	Vestas V112	
Turbine Rated Power:	3.00	MW
Hub Height:	90	m
Number of Turbines:	233	
Plant Capacity:	699	MW
Site Air Density:	1.240	kg/m^3

Loss Accounting	
Wake Effect	8.0%
Availability	5.8%
Electrical	4.0%
Turbine Performance	1.7%
Environmental	4.5%
Curtailments	0.0%
Average Total Loss	**21.9%**

Overall Wind Plant Summary	
Average Free Wind Speed (m/s)	8.87
Gross Plant Production (MWh/yr)	3,359,595
Net Plant Production (MWh/yr)	2,625,268
Net Capacity Factor	42.8%

Per Turbine Summary

Turbine ID	Mast Association	Coordinates (WGS84 UTM18) Easting (m)	Northing (m)	Free Spd (m/s)	Gross MWh/yr	% Array Eff	% Array Loss	% Total Loss	Net MWh/yr	Turbine Rank	Net Capacity Factor (%)	Turbulence Intensity (%)
1	ALSN6	616060	4472781	8.80	14285	96.8	3.2	17.8	11,748	13	44.7	7.0
2	ALSN6	615172	4472074	8.81	14309	96.9	3.1	17.7	11,771	10	44.8	7.0
3	ALSN6	614288	4471382	8.81	14311	98.6	1.4	16.3	11,980	2	45.6	6.7
4	ALSN6	617110	4472363	8.83	14338	95.6	4.4	18.8	11,642	19	44.3	7.1
5	ALSN6	616222	4471656	8.83	14349	95.4	4.6	19.0	11,620	22	44.2	7.2
6	ALSN6	615338	4470964	8.82	14336	97.2	2.8	17.4	11,835	4	45.0	6.9
7	ALSN6	618163	4471943	8.84	14369	95.0	5.0	19.3	11,593	25	44.1	7.1
8	ALSN6	617275	4471236	8.83	14357	94.7	5.3	19.6	11,546	38	43.9	7.2
9	ALSN6	616391	4470544	8.82	14340	96.9	3.1	17.7	11,797	6	44.9	6.9
10	ALSN6	620086	4472221	8.85	14383	94.7	5.3	19.5	11,571	31	44.0	7.0
11	ALSN6	619202	4471529	8.86	14403	94.5	5.5	19.7	11,559	35	44.0	7.1
12	ALSN6	618314	4470822	8.86	14423	94.4	5.6	19.9	11,557	36	43.9	7.2
13	ALSN6	617430	4470130	8.85	14423	96.5	3.5	18.0	11,823	5	45.0	6.9
14	ALSN6	621133	4471804	8.88	14453	94.0	6.0	20.2	11,533	41	43.9	7.1
15	ALSN6	620249	4471112	8.87	14438	93.9	6.1	20.3	11,513	44	43.8	7.2
16	ALSN6	619361	4470405	8.87	14438	94.0	6.0	20.2	11,520	43	43.8	7.2
17	ALSN6	618477	4469713	8.86	14435	96.1	3.9	18.4	11,780	7	44.8	6.9
18	ALSN6	622187	4471384	8.86	14422	93.7	6.3	20.4	11,478	54	43.6	7.1
19	ALSN6	621303	4470692	8.89	14491	93.5	6.5	20.6	11,503	50	43.7	7.2
20	ALSN6	620415	4469985	8.89	14484	93.8	6.2	20.4	11,534	40	43.9	7.2
21	ALSN6	619531	4469293	8.88	14477	95.8	4.2	18.7	11,776	8	44.8	6.9
22	ALSN6	623231	4470968	8.87	14427	93.3	6.7	20.7	11,436	63	43.5	7.1
23	ALSN6	622347	4470276	8.89	14474	93.2	6.8	20.9	11,455	60	43.6	7.2
24	ALSN6	621459	4469569	8.87	14456	93.4	6.6	20.7	11,462	58	43.6	7.2
25	ALSN6	620575	4468877	8.88	14501	95.6	4.4	18.8	11,774	9	44.8	6.9
26	ALSN6	624272	4470553	8.87	14444	93.1	6.9	21.0	11,418	66	43.4	7.1
27	ALSN6	623388	4469861	8.89	14504	92.8	7.2	21.2	11,426	65	43.4	7.2
28	ALSN6	622500	4469154	8.87	14470	93.2	6.8	20.9	11,452	61	43.5	7.2
29	ALSN6	621616	4468462	8.87	14487	95.3	4.7	19.1	11,720	15	44.6	6.9
30	ALSN6	625317	4470137	8.87	14464	92.7	7.3	21.3	11,384	70	43.3	7.1
31	ALSN6	624433	4469445	8.85	14435	92.2	7.8	21.7	11,304	87	43.0	7.3
32	ALSN6	623545	4468738	8.86	14465	92.6	7.4	21.4	11,371	72	43.2	7.3
33	ALSN6	622661	4468046	8.87	14507	94.1	5.9	20.1	11,592	26	44.1	7.1
34	ALSN6	627261	4470420	8.86	14446	92.9	7.1	21.1	11,398	69	43.3	7.0
35	ALSN6	626366	4469719	8.85	14424	92.2	7.8	21.7	11,297	90	43.0	7.2

Table A11Cont'd. Vestas V112 700-MW Wind Speed and Energy Production Detail

Per Turbine Summary												
Turbine ID	Mast Association	Coordinates (WGS84 UTM18) Easting (m)	Northing (m)	Free Spd (m/s)	Gross MWh/yr	% Array Eff	% Array Loss	% Total Loss	Net MWh/yr	Turbine Rank	Net Capacity Factor (%)	Turbulence Intensity (%)
36	ALSN6	625482	4469027	8.88	14493	92.1	7.9	21.8	11,336	78	43.1	7.3
37	ALSN6	624594	4468320	8.86	14484	92.4	7.6	21.5	11,368	74	43.2	7.3
38	ALSN6	623709	4467628	8.84	14454	93.4	6.6	20.7	11,467	57	43.6	7.2
39	ALSN6	622799	4466935	8.84	14473	95.5	4.5	18.9	11,736	14	44.6	6.8
40	ALSN6	628315	4470000	8.86	14426	92.3	7.7	21.6	11,313	81	43.0	7.1
41	ALSN6	627409	4469303	8.84	14409	91.6	8.4	22.2	11,215	114	42.6	7.3
42	ALSN6	626525	4468611	8.85	14429	91.7	8.3	22.1	11,237	108	42.7	7.3
43	ALSN6	625637	4467904	8.83	14411	92.0	8.0	21.9	11,262	97	42.8	7.3
44	ALSN6	624753	4467212	8.84	14448	93.0	7.0	21.1	11,406	68	43.4	7.2
45	ALSN6	623852	4466516	8.85	14470	94.9	5.1	19.4	11,657	18	44.3	6.9
46	44025	629353	4469586	8.85	14346	92.5	7.5	21.4	11,274	94	42.9	7.6
47	44025	628456	4468886	8.83	14303	91.8	8.2	22.1	11,149	140	42.4	7.8
48	44025	627572	4468194	8.83	14316	92.0	8.0	21.8	11,190	123	42.5	7.8
49	44025	626684	4467487	8.81	14298	92.2	7.8	21.7	11,199	119	42.6	7.8
50	44025	625800	4466795	8.83	14350	93.0	7.0	21.1	11,328	79	43.1	7.8
51	44025	624891	4466102	8.81	14347	95.0	5.0	19.3	11,574	30	44.0	7.5
52	44025	630401	4469169	8.85	14358	92.3	7.7	21.6	11,255	99	42.8	7.6
53	44025	629501	4468470	8.85	14360	91.5	8.5	22.3	11,156	138	42.4	7.8
54	44025	628617	4467778	8.84	14344	91.6	8.4	22.2	11,162	136	42.4	7.8
55	44025	627729	4467071	8.84	14347	92.1	7.9	21.8	11,219	112	42.7	7.8
56	44025	626845	4466379	8.80	14291	92.7	7.3	21.3	11,245	104	42.8	7.8
57	44025	625938	4465684	8.80	14315	94.8	5.2	19.5	11,528	42	43.8	7.5
58	44025	631454	4468749	8.86	14362	92.0	8.0	21.8	11,226	111	42.7	7.7
59	44025	630551	4468051	8.85	14359	91.1	8.9	22.6	11,108	157	42.2	7.8
60	44025	629667	4467359	8.83	14321	91.2	8.8	22.6	11,090	164	42.2	7.9
61	44025	628779	4466652	8.83	14333	91.8	8.2	22.0	11,176	128	42.5	7.8
62	44025	627895	4465960	8.80	14309	92.4	7.6	21.5	11,232	109	42.7	7.8
63	44025	626992	4465265	8.79	14295	94.7	5.3	19.6	11,495	52	43.7	7.5
64	44025	633383	4469025	8.88	14361	92.5	7.5	21.5	11,279	92	42.9	7.6
65	44025	632498	4468333	8.84	14328	91.5	8.5	22.3	11,139	146	42.4	7.7
66	44025	631602	4467633	8.84	14337	90.9	9.1	22.8	11,068	173	42.1	7.8
67	44025	630718	4466941	8.86	14388	90.9	9.1	22.8	11,103	158	42.2	7.8
68	44025	629830	4466234	8.81	14306	91.3	8.7	22.4	11,097	161	42.2	7.9
69	44025	628946	4465542	8.80	14296	92.3	7.7	21.6	11,211	116	42.6	7.8
70	44025	628036	4464849	8.78	14289	94.4	5.6	19.8	11,461	59	43.6	7.5
71	44025	634424	4468610	8.88	14388	92.0	8.0	21.8	11,246	103	42.8	7.6
72	44025	633540	4467918	8.88	14401	91.1	8.9	22.7	11,135	148	42.3	7.8
73	44025	632660	4467211	8.86	14362	90.7	9.3	23.0	11,059	178	42.1	7.8
74	44025	631776	4466519	8.86	14391	90.4	9.6	23.2	11,053	183	42.0	7.9
75	44025	630888	4465812	8.82	14344	91.0	9.0	22.8	11,080	167	42.1	7.9
76	44025	630004	4465120	8.82	14352	91.8	8.2	22.1	11,186	126	42.5	7.8
77	44025	629077	4464434	8.76	14255	93.4	6.6	20.7	11,310	83	43.0	7.7
78	44025	635468	4468194	8.88	14407	92.0	8.0	21.8	11,259	98	42.8	7.6
79	44025	634584	4467502	8.89	14418	90.8	9.2	22.9	11,121	153	42.3	7.8
80	44025	633704	4466795	8.87	14407	90.6	9.4	23.1	11,085	165	42.2	7.8
81	44025	632820	4466103	8.86	14400	90.2	9.8	23.4	11,033	197	42.0	7.9
82	44025	631932	4465396	8.82	14354	90.7	9.3	23.0	11,058	179	42.0	7.9
83	44025	631048	4464704	8.82	14356	91.6	8.4	22.2	11,169	132	42.5	7.8
84	44025	630122	4464017	8.80	14342	92.8	7.2	21.2	11,305	86	43.0	7.8
85	44025	629237	4463326	8.79	14346	94.9	5.1	19.4	11,565	33	44.0	7.4
86	44025	636517	4467776	8.87	14394	91.9	8.1	22.0	11,231	110	42.7	7.6
87	44025	635633	4467084	8.86	14372	90.6	9.4	23.1	11,057	180	42.0	7.8
88	44025	634754	4466377	8.86	14403	90.3	9.7	23.3	11,046	189	42.0	7.8
89	44025	633870	4465685	8.87	14441	90.1	9.9	23.5	11,049	186	42.0	7.8
90	44025	632982	4464977	8.84	14399	90.6	9.4	23.1	11,079	169	42.1	7.9
91	44025	632098	4464285	8.81	14367	91.3	8.7	22.4	11,142	145	42.4	7.8
92	44025	631170	4463600	8.83	14406	92.4	7.6	21.5	11,310	84	43.0	7.8
93	44025	630286	4462908	8.80	14358	94.4	5.6	19.8	11,511	46	43.8	7.5
94	44025	637561	4467360	8.87	14384	91.8	8.2	22.0	11,213	115	42.6	7.6
95	44025	636677	4466668	8.88	14426	90.6	9.4	23.1	11,098	160	42.2	7.8
96	44025	635798	4465961	8.87	14436	90.1	9.9	23.5	11,043	191	42.0	7.8
97	44025	634914	4465269	8.86	14435	89.9	10.1	23.7	11,019	201	41.9	7.8
98	44025	634026	4464562	8.85	14415	90.4	9.6	23.2	11,064	176	42.1	7.8
99	44025	633141	4463870	8.83	14396	91.2	8.8	22.6	11,147	143	42.4	7.8
100	44025	632214	4463184	8.81	14379	92.0	8.0	21.8	11,238	107	42.7	7.8

Table A11 Cont'd. Vestas V112 700-MW Wind Speed and Energy Production Detail

Per Turbine Summary												
Turbine	Mast	Coordinates (WGS84 UTM18)		Free	Gross	% Array	% Array	% Total	Net	Turbine	Net Capacity	Turbulence
ID	Association	Easting (m)	Northing (m)	Spd (m/s)	MWh/yr	Eff	Loss	Loss	MWh/yr	Rank	Factor (%)	Intensity (%)
101	44025	631330	4462492	8.81	14386	94.2	5.8	20.0	11,512	45	43.8	7.5
102	44025	638608	4466943	8.85	14366	91.7	8.3	22.1	11,187	125	42.5	7.7
103	44025	637723	4466251	8.87	14416	90.4	9.6	23.2	11,071	172	42.1	7.8
104	44025	636862	4465537	8.84	14389	89.8	10.2	23.7	10,975	218	41.7	7.8
105	44025	635977	4464845	8.86	14421	89.9	10.1	23.6	11,014	203	41.9	7.8
106	44025	635089	4464138	8.84	14404	90.3	9.7	23.3	11,048	187	42.0	7.8
107	44025	634205	4463446	8.82	14372	90.9	9.1	22.8	11,095	162	42.2	7.8
108	44025	633261	4462767	8.81	14359	91.9	8.1	22.0	11,205	118	42.6	7.8
109	44025	632377	4462075	8.81	14377	94.1	5.9	20.1	11,485	53	43.7	7.5
110	44025	640541	4467234	8.85	14354	91.9	8.1	21.9	11,207	117	42.6	7.6
111	44025	639653	4466526	8.86	14387	91.2	8.8	22.5	11,145	144	42.4	7.7
112	44025	638769	4465834	8.85	14390	90.2	9.8	23.4	11,024	199	41.9	7.8
113	44025	637914	4465118	8.85	14398	89.7	10.3	23.8	10,970	221	41.7	7.8
114	44025	637030	4464426	8.84	14399	89.8	10.2	23.8	10,977	216	41.7	7.9
115	44025	636142	4463718	8.84	14393	90.1	9.9	23.5	11,013	204	41.9	7.9
116	44025	635257	4463027	8.84	14411	90.8	9.2	22.9	11,115	155	42.3	7.8
117	44025	634306	4462350	8.82	14376	91.7	8.3	22.1	11,196	121	42.6	7.8
118	44025	633422	4461658	8.81	14368	94.0	6.0	20.2	11,471	56	43.6	7.5
119	44025	641591	4466815	8.88	14404	91.5	8.5	22.3	11,197	120	42.6	7.6
120	44025	640703	4466108	8.86	14370	90.8	9.2	22.9	11,078	170	42.1	7.8
121	44025	639819	4465416	8.85	14382	89.9	10.1	23.6	10,981	214	41.8	7.8
122	44025	638968	4464698	8.85	14392	89.5	10.5	24.0	10,934	230	41.6	7.9
123	44025	638084	4464006	8.83	14367	89.5	10.5	24.0	10,915	232	41.5	7.9
124	44025	637196	4463298	8.82	14376	89.8	10.2	23.7	10,963	222	41.7	7.9
125	44025	636312	4462606	8.82	14368	90.4	9.6	23.3	11,027	198	41.9	7.9
126	44025	635356	4461932	8.81	14359	91.6	8.4	22.2	11,169	133	42.5	7.8
127	44025	634472	4461240	8.81	14365	93.8	6.2	20.3	11,446	62	43.5	7.5
128	44025	642641	4466396	8.86	14353	91.5	8.5	22.3	11,152	139	42.4	7.6
129	44025	641753	4465689	8.88	14403	90.6	9.4	23.1	11,082	166	42.1	7.8
130	44025	640869	4464997	8.86	14377	90.1	9.9	23.5	11,001	207	41.8	7.8
131	44025	640022	4464277	8.84	14372	89.3	10.7	24.2	10,899	233	41.4	7.9
132	44025	639138	4463586	8.86	14417	89.5	10.5	24.0	10,955	226	41.7	7.8
133	44025	638250	4462878	8.87	14448	89.6	10.4	23.9	10,989	211	41.8	7.8
134	44025	637366	4462186	8.82	14375	90.1	9.9	23.5	10,993	210	41.8	7.9
135	44025	636407	4461513	8.82	14371	91.0	9.0	22.8	11,100	159	42.2	7.8
136	44025	635522	4460821	8.83	14385	93.1	6.9	21.0	11,371	73	43.2	7.6
137	44025	643700	4465975	8.89	14410	91.4	8.6	22.4	11,189	124	42.5	7.6
138	44025	642812	4465268	8.86	14377	90.4	9.6	23.2	11,041	192	42.0	7.8
139	44025	641927	4464576	8.87	14406	89.9	10.1	23.7	10,994	208	41.8	7.8
140	44025	641087	4463853	8.87	14429	89.4	10.6	24.0	10,961	224	41.7	7.8
141	44025	640203	4463161	8.86	14410	89.4	10.6	24.1	10,937	229	41.6	7.8
142	44025	639315	4462454	8.86	14409	89.7	10.3	23.9	10,972	220	41.7	7.9
143	44025	638430	4461762	8.85	14420	90.3	9.7	23.3	11,055	181	42.0	7.8
144	44025	637465	4461091	8.82	14355	91.0	9.0	22.7	11,092	163	42.2	7.8
145	44025	636581	4460400	8.83	14388	92.5	7.5	21.4	11,306	85	43.0	7.7
146	44025	635693	4459692	8.82	14366	94.7	5.3	19.6	11,552	37	43.9	7.4
147	44025	644743	4465559	8.91	14427	91.4	8.6	22.4	11,195	122	42.6	7.6
148	44025	643855	4464852	8.90	14424	90.3	9.7	23.3	11,066	175	42.1	7.8
149	44025	642971	4464160	8.90	14456	90.0	10.0	23.6	11,049	185	42.0	7.8
150	44025	642149	4463430	8.89	14453	89.3	10.7	24.1	10,963	223	41.7	7.8
151	44025	641264	4462738	8.89	14454	89.4	10.6	24.1	10,972	219	41.7	7.8
152	44025	640376	4462031	8.86	14421	89.7	10.3	23.8	10,985	212	41.8	7.9
153	44025	639492	4461339	8.85	14413	90.3	9.7	23.4	11,047	188	42.0	7.8
154	44025	638509	4460676	8.84	14397	90.9	9.1	22.8	11,119	154	42.3	7.8
155	44025	637624	4459984	8.85	14408	92.3	7.7	21.6	11,292	91	42.9	7.7
156	44025	636736	4459276	8.83	14368	94.2	5.8	20.0	11,499	51	43.7	7.4
157	44025	646678	4465832	8.90	14417	92.1	7.9	21.8	11,277	93	42.9	7.5
158	44025	645794	4465140	8.90	14423	91.0	9.0	22.7	11,149	141	42.4	7.7
159	44025	644906	4464433	8.88	14401	90.3	9.7	23.3	11,044	190	42.0	7.8
160	44025	644022	4463741	8.89	14430	89.9	10.1	23.6	11,018	202	41.9	7.8
161	44025	643195	4463013	8.89	14437	89.2	10.8	24.2	10,941	228	41.6	7.8
162	44025	642311	4462321	8.88	14428	89.3	10.7	24.1	10,945	227	41.6	7.8
163	44025	641423	4461614	8.88	14442	89.6	10.4	23.9	10,993	209	41.8	7.8
164	44025	640539	4460922	8.86	14410	90.2	9.8	23.4	11,034	196	42.0	7.8
165	44025	639559	4460257	8.87	14445	91.0	9.0	22.7	11,160	137	42.4	7.8

Table A11 Cont'd. Vestas V112 700-MW Wind Speed and Energy Production Detail

Per Turbine Summary												
Turbine	Mast	Coordinates (WGS84 UTM18)		Free	Gross	% Array	% Array	% Total	Net	Turbine	Net Capacity	Turbulence
ID	Association	Easting (m)	Northing (m)	Spd (m/s)	MWh/yr	Eff	Loss	Loss	MWh/yr	Rank	Factor (%)	Intensity (%)
166	44025	638675	4459565	8.85	14389	92.1	7.9	21.8	11,248	102	42.8	7.7
167	44025	637787	4458858	8.87	14449	94.2	5.8	20.0	11,562	34	44.0	7.4
168	44025	647721	4465417	8.92	14433	91.9	8.1	22.0	11,265	96	42.8	7.6
169	44025	646837	4464725	8.90	14436	90.8	9.2	22.9	11,134	149	42.3	7.7
170	44025	645949	4464017	8.90	14452	90.3	9.7	23.4	11,076	171	42.1	7.8
171	44025	645065	4463325	8.90	14466	89.9	10.1	23.7	11,038	194	42.0	7.8
172	44025	644246	4462595	8.89	14447	89.3	10.7	24.2	10,957	225	41.7	7.8
173	44025	643362	4461903	8.86	14399	89.4	10.6	24.1	10,926	231	41.5	7.8
174	44025	642474	4461195	8.86	14421	89.6	10.4	23.9	10,976	217	41.7	7.8
175	44025	641590	4460503	8.86	14427	90.2	9.8	23.4	11,053	182	42.0	7.8
176	44025	640603	4459841	8.86	14423	91.0	9.0	22.7	11,148	142	42.4	7.8
177	44025	639718	4459149	8.86	14423	92.0	8.0	21.8	11,274	95	42.9	7.7
178	44025	638830	4458442	8.87	14430	94.2	5.8	20.0	11,544	39	43.9	7.4
179	44025	648785	4464993	8.95	14490	92.1	7.9	21.7	11,339	76	43.1	7.5
180	44025	647901	4464301	8.91	14440	90.8	9.2	22.9	11,131	151	42.3	7.7
181	44025	647013	4463593	8.92	14494	90.5	9.5	23.2	11,135	147	42.3	7.8
182	44025	646129	4462901	8.91	14461	89.9	10.1	23.7	11,035	195	42.0	7.8
183	44025	645302	4462174	8.89	14446	89.5	10.5	24.0	10,980	215	41.8	7.8
184	44025	644418	4461482	8.88	14457	89.5	10.5	24.0	10,982	213	41.8	7.8
185	44025	643530	4460775	8.87	14431	89.8	10.2	23.8	11,002	206	41.8	7.8
186	44025	642646	4460083	8.86	14417	90.3	9.7	23.3	11,053	184	42.0	7.8
187	44025	641666	4459417	8.87	14449	91.0	9.0	22.7	11,172	131	42.5	7.8
188	44025	640782	4458725	8.88	14456	92.1	7.9	21.8	11,311	82	43.0	7.7
189	44025	639894	4458018	8.89	14469	94.3	5.7	20.0	11,581	27	44.0	7.4
190	44025	649838	4464573	8.96	14542	92.6	7.4	21.4	11,434	64	43.5	7.5
191	44025	648953	4463881	8.95	14532	91.2	8.8	22.6	11,249	101	42.8	7.7
192	44025	648065	4463174	8.93	14494	90.7	9.3	23.0	11,166	134	42.5	7.8
193	44025	647181	4462482	8.93	14500	90.2	9.8	23.4	11,112	156	42.3	7.8
194	44025	646331	4461765	8.91	14497	89.7	10.3	23.8	11,041	193	42.0	7.8
195	44025	645447	4461073	8.90	14475	89.7	10.3	23.8	11,023	200	41.9	7.8
196	44025	644559	4460366	8.88	14451	89.7	10.3	23.8	11,012	205	41.9	7.8
197	44025	643675	4459674	8.87	14447	90.2	9.8	23.4	11,062	177	42.1	7.8
198	44025	642719	4458998	8.87	14431	91.2	8.8	22.6	11,173	130	42.5	7.8
199	44025	641834	4458306	8.89	14471	92.3	7.7	21.7	11,338	77	43.1	7.7
200	44025	640946	4457599	8.88	14451	94.3	5.7	19.9	11,570	32	44.0	7.4
201	44025	650892	4464153	9.00	14603	93.4	6.6	20.7	11,576	29	44.0	7.5
202	44025	650008	4463461	8.97	14564	91.9	8.1	22.0	11,365	75	43.2	7.7
203	44025	649120	4462754	8.96	14549	91.5	8.5	22.3	11,301	88	43.0	7.7
204	44025	648235	4462062	8.93	14499	90.8	9.2	22.9	11,179	127	42.5	7.8
205	44025	647381	4461347	8.93	14508	90.4	9.6	23.3	11,134	150	42.3	7.8
206	44025	646496	4460655	8.92	14509	90.3	9.7	23.3	11,123	152	42.3	7.8
207	44025	645608	4459948	8.89	14446	90.2	9.8	23.4	11,067	174	42.1	7.8
208	44025	644724	4459256	8.86	14415	90.5	9.5	23.1	11,080	168	42.1	7.8
209	44025	643773	4458578	8.85	14398	91.4	8.6	22.4	11,174	129	42.5	7.8
210	44025	642889	4457886	8.86	14424	92.4	7.6	21.6	11,313	80	43.0	7.7
211	44025	642001	4457179	8.90	14490	94.5	5.5	19.8	11,622	21	44.2	7.4
212	44025	651946	4463733	9.01	14635	94.1	5.9	20.1	11,697	16	44.5	7.4
213	44025	651062	4463041	8.99	14606	92.7	7.3	21.2	11,503	49	43.7	7.6
214	44025	650174	4462334	8.98	14582	92.2	7.8	21.7	11,412	67	43.4	7.7
215	44025	649290	4461642	8.96	14548	91.5	8.5	22.3	11,301	89	43.0	7.7
216	44025	648434	4460927	8.93	14503	91.3	8.7	22.5	11,245	105	42.8	7.7
217	44025	647550	4460235	8.92	14502	91.3	8.7	22.5	11,240	106	42.7	7.7
218	44025	646662	4459528	8.91	14484	91.2	8.8	22.6	11,217	113	42.7	7.7
219	44025	645778	4458836	8.86	14399	91.3	8.7	22.5	11,163	135	42.4	7.8
220	44025	644827	4458158	8.87	14425	91.9	8.1	22.0	11,255	100	42.8	7.7
221	44025	643943	4457466	8.88	14433	92.8	7.2	21.2	11,379	71	43.3	7.7
222	44025	643055	4456759	8.89	14464	94.8	5.2	19.5	11,639	20	44.3	7.4
223	44025	653010	4463309	9.01	14645	96.6	3.4	18.0	12,010	1	45.7	7.2
224	44025	652126	4462617	9.00	14619	95.4	4.6	19.0	11,839	3	45.0	7.3
225	44025	651238	4461910	8.99	14597	94.8	5.2	19.5	11,754	11	44.7	7.4
226	44025	650354	4461218	8.97	14569	94.4	5.6	19.9	11,674	17	44.4	7.4
227	44025	649473	4460513	8.95	14527	94.1	5.9	20.1	11,612	24	44.2	7.4
228	44025	648589	4459822	8.94	14520	93.9	6.1	20.3	11,578	28	44.0	7.4
229	44025	647701	4459114	8.91	14457	93.7	6.3	20.4	11,509	47	43.8	7.5
230	44025	646816	4458422	8.88	14415	93.7	6.3	20.4	11,474	55	43.6	7.5
231	44025	645892	4457734	8.89	14427	93.9	6.1	20.2	11,507	48	43.8	7.5
232	44025	645007	4457042	8.92	14512	94.3	5.7	19.9	11,617	23	44.2	7.4
233	44025	644119	4456335	8.92	14499	95.5	4.5	18.9	11,754	12	44.7	7.3

Table A12. Vestas V112 700-MW 12x24 Net Energy Matrix

Project:	NYSERDA - Offshore LI
EPE Completion Date:	5-Apr-2010
Prepared By:	AWS Truepower, LLC
Comments:	Net Energy Output Matrix (MW)
Turbine Model:	Vestas V112
Turbine Rated Power:	3.0 MW
Hub Height:	90
Number of Turbines:	233
Plant Capacity:	699 MW
Net Annual Energy Output:	2,625,268 MWh
Net Capacity Factor:	42.8%

Hour	Month												Average (MWh)	Total (MWh)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
0	353.25	345.05	301.24	241.24	211.22	284.82	209.97	202.99	260.12	299.80	352.73	345.57	283.53	103,560
1	384.02	369.05	308.06	319.70	248.19	231.43	186.49	207.74	259.06	280.71	341.61	367.38	291.42	106,440
2	390.65	363.58	303.97	301.82	243.85	192.77	164.94	196.37	280.94	278.01	331.27	377.70	285.00	104,096
3	388.98	352.59	303.14	303.82	246.82	205.02	174.18	218.53	243.79	290.89	352.91	383.64	288.35	105,318
4	396.12	361.49	303.42	292.60	256.96	184.03	162.37	188.92	255.05	319.97	347.30	374.47	286.52	104,650
5	403.72	385.24	290.23	336.44	248.46	185.16	167.32	164.07	235.95	335.65	360.31	375.52	290.08	105,953
6	407.84	424.20	324.22	327.88	237.49	196.35	154.98	196.25	244.69	328.85	358.04	365.98	296.44	108,276
7	423.19	420.66	329.24	334.02	225.79	195.38	159.74	179.22	261.02	348.57	336.97	367.40	297.69	108,733
8	405.10	418.96	358.91	310.88	201.36	161.99	143.61	166.94	251.29	335.43	318.01	379.35	286.96	104,812
9	407.26	429.38	347.70	332.81	228.60	158.68	135.35	149.12	240.95	321.71	321.55	402.62	288.88	105,513
10	396.86	379.96	311.77	303.57	217.09	151.43	127.54	152.03	231.60	276.85	304.31	403.36	270.81	98,912
11	402.96	321.37	309.76	271.51	198.31	171.90	127.71	163.32	202.39	277.88	333.97	360.68	261.55	95,531
12	378.39	304.10	322.34	277.60	210.64	207.86	188.61	158.69	191.85	253.53	314.79	329.80	261.34	95,456
13	348.21	313.36	316.62	310.37	245.76	258.50	201.38	176.29	182.77	277.73	307.25	347.60	273.62	99,940
14	340.80	297.81	315.19	306.35	290.00	304.36	266.64	187.40	196.42	296.89	329.03	367.56	291.57	106,496
15	335.19	285.84	367.93	349.01	368.83	358.98	270.21	217.40	213.12	310.06	329.18	353.35	313.47	114,496
16	344.04	276.44	396.03	419.18	392.24	358.54	283.30	238.17	202.33	336.98	349.41	376.17	331.47	121,068
17	350.44	300.30	391.64	422.23	415.41	378.02	295.66	220.48	215.74	347.30	391.37	373.20	342.02	124,922
18	343.60	330.92	384.73	420.68	392.11	383.93	317.91	205.81	271.32	341.07	379.57	386.00	346.40	126,522
19	375.99	342.81	366.91	389.97	379.10	353.02	313.96	237.40	245.26	310.92	383.34	395.76	341.17	124,613
20	368.90	341.46	395.30	381.01	344.67	318.39	290.40	217.75	241.93	325.18	351.06	411.08	332.29	121,369
21	369.19	337.58	366.84	343.66	294.90	299.90	232.29	223.02	231.46	312.98	374.62	419.95	317.10	115,820
22	373.20	349.58	329.91	304.13	274.85	287.53	227.12	218.36	254.10	311.07	374.90	416.06	309.82	113,163
23	356.45	373.28	332.55	281.45	265.71	301.24	209.23	204.04	241.25	326.88	329.44	384.55	300.09	109,608
Average (MWh)	376.85	351.04	336.57	328.41	276.60	255.38	208.79	195.43	235.60	310.20	344.71	377.70	299.48	
Total (MWh)	280,375	238,007	250,406	236,457	205,789	183,877	155,338	145,400	169,632	230,792	248,188	281,007		2,625,268

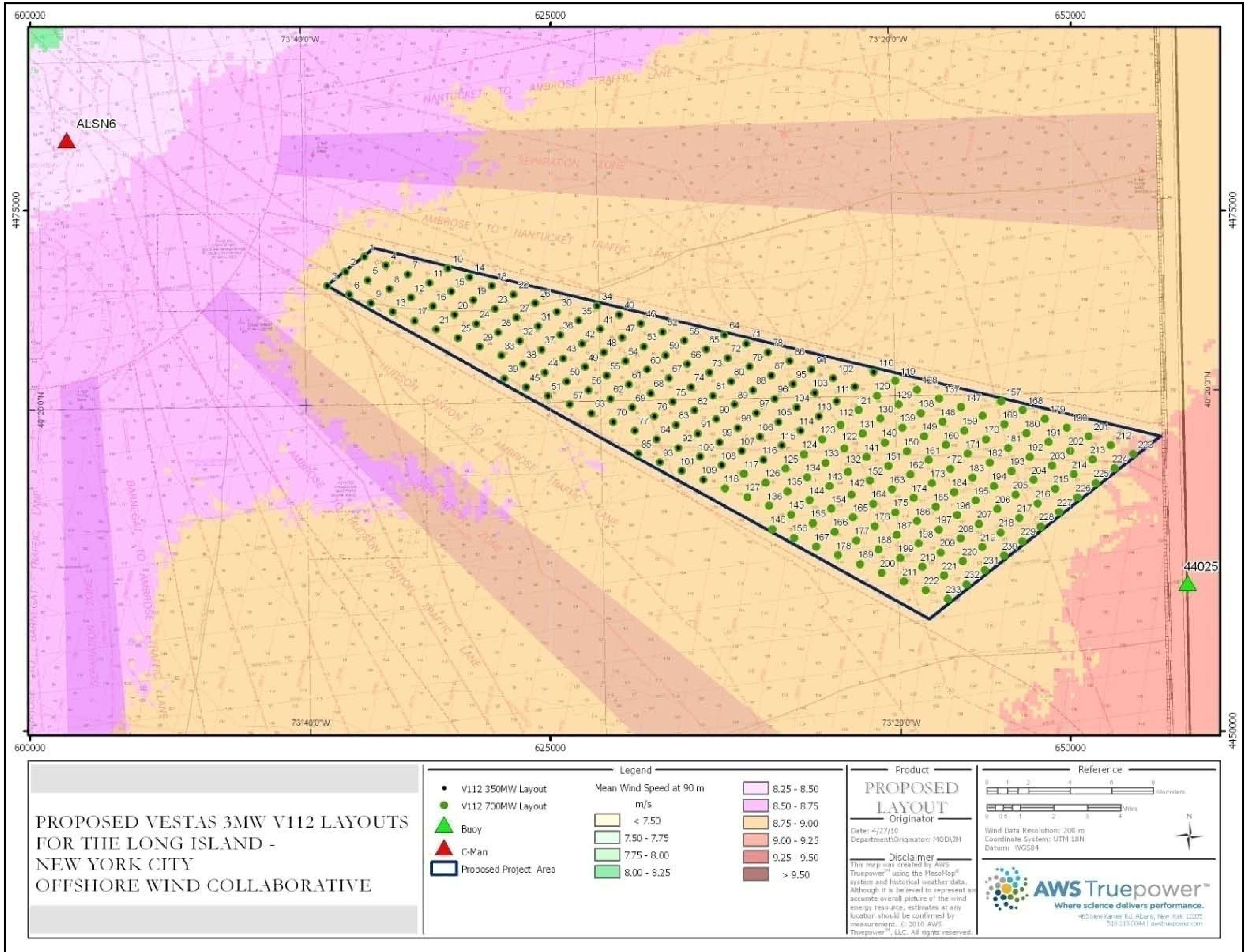

Figure A2. Proposed Long Island – New York City Offshore Vestas V112 Turbine Layouts

MULTIBRID 5.0-MW ENERGY ESTIMATES

Table A13. Multibrid 350-MW Wind Speed and Energy Production Detail

Project:	**NYSERDA - Offshore LI**	
Date:	**5-Apr-10**	
Comments:		
Turbine Model:	**Multibrid 5MW**	
Turbine Rated Power:	**5.00**	**MW**
Hub Height:	**90**	**m**
Number of Turbines:	**70**	
Plant Capacity:	**350**	**MW**
Site Air Density:	**1.240**	**kg/m^3**

Loss Accounting	
Wake Effect	7.2%
Availability	6.2%
Electrical	4.1%
Turbine Performance	2.5%
Environmental	4.7%
Curtailments	0.0%
Average Total Loss	**22.5%**

Overall Wind Plant Summary	
Average Free Wind Speed (m/s)	8.85
Gross Plant Production (MWh/yr)	1,380,047
Net Plant Production (MWh/yr)	1,069,455
Net Capacity Factor	34.9%

Per Turbine Summary

Turbine ID	Mast Association	Coordinates (WGS84 UTM18) Easting (m)	Northing (m)	Free Spd (m/s)	Gross MWh/yr	% Array Eff	% Array Loss	% Total Loss	Net MWh/yr	Turbine Rank	Net Capacity Factor (%)	Turbulence Intensity (%)
1	ALSN6	616166	4472819	8.80	19458	96.4	3.6	19.4	15,674	8	35.8	6.9
2	ALSN6	615226	4472101	8.81	19513	96.3	3.7	19.6	15,697	7	35.8	6.9
3	ALSN6	614292	4471380	8.81	19513	98.5	1.5	17.7	16,052	2	36.6	6.7
4	ALSN6	617247	4472375	8.83	19565	94.8	5.2	20.8	15,497	15	35.4	7.0
5	ALSN6	616313	4471668	8.84	19596	94.2	5.8	21.3	15,429	21	35.2	7.1
6	ALSN6	615379	4470947	8.82	19554	96.7	3.3	19.2	15,793	4	36.0	6.9
7	ALSN6	618336	4471949	8.84	19618	94.1	5.9	21.4	15,426	22	35.2	7.0
8	ALSN6	617390	4471221	8.83	19588	93.5	6.5	21.9	15,299	31	34.9	7.1
9	ALSN6	616462	4470516	8.81	19549	96.2	3.8	19.6	15,713	6	35.8	6.9
10	ALSN6	619426	4471515	8.86	19640	93.6	6.4	21.8	15,356	29	35.0	7.0
11	ALSN6	618473	4470790	8.86	19692	92.9	7.1	22.4	15,282	33	34.9	7.1
12	ALSN6	617553	4470081	8.85	19688	95.6	4.4	20.1	15,724	5	35.9	6.9
13	ALSN6	621430	4471805	8.88	19735	93.3	6.7	22.0	15,388	27	35.1	6.9
14	ALSN6	620502	4471086	8.90	19794	93.1	6.9	22.3	15,389	26	35.1	7.0
15	ALSN6	619555	4470359	8.87	19706	92.7	7.3	22.6	15,256	34	34.8	7.1
16	ALSN6	618643	4469647	8.85	19692	95.2	4.8	20.4	15,670	9	35.8	6.9
17	ALSN6	622523	4471379	8.85	19613	92.1	7.9	23.0	15,098	44	34.4	7.0
18	ALSN6	621582	4470656	8.88	19769	92.3	7.7	22.9	15,241	36	34.8	7.1
19	ALSN6	620633	4469929	8.90	19822	92.1	7.9	23.1	15,249	35	34.8	7.1
20	ALSN6	619724	4469216	8.87	19753	94.7	5.3	20.9	15,633	11	35.7	6.9
21	ALSN6	623620	4470942	8.87	19698	91.9	8.1	23.2	15,130	42	34.5	7.0
22	ALSN6	622663	4470225	8.88	19771	91.6	8.4	23.5	15,129	43	34.5	7.1
23	ALSN6	621720	4469496	8.86	19713	92.0	8.0	23.1	15,156	41	34.6	7.1
24	ALSN6	620809	4468784	8.86	19744	94.2	5.8	21.3	15,537	13	35.4	6.9
25	ALSN6	624691	4470515	8.86	19687	91.5	8.5	23.5	15,053	49	34.3	7.1
26	ALSN6	623743	4469795	8.87	19770	90.9	9.1	24.1	15,012	56	34.3	7.2
27	ALSN6	622820	4469057	8.88	19803	91.2	8.8	23.8	15,091	45	34.4	7.2
28	ALSN6	621893	4468352	8.88	19826	92.9	7.1	22.4	15,386	28	35.1	7.0
29	ALSN6	625779	4470082	8.87	19738	91.4	8.6	23.7	15,067	47	34.4	7.1
30	ALSN6	624826	4469363	8.87	19767	90.6	9.4	24.3	14,965	62	34.1	7.2
31	ALSN6	623903	4468626	8.85	19731	91.0	9.0	24.0	15,004	58	34.2	7.2
32	ALSN6	622978	4467920	8.87	19794	92.0	8.0	23.1	15,214	38	34.7	7.1
33	ALSN6	622051	4467190	8.86	19792	94.6	5.4	20.9	15,648	10	35.7	6.8
34	ALSN6	627774	4470389	8.88	19730	92.1	7.9	23.1	15,174	39	34.6	6.9
35	ALSN6	626861	4469651	8.85	19663	90.7	9.3	24.2	14,908	66	34.0	7.1

Table A13 Cont'd. Multibrid 350-MW Wind Speed and Energy Production Detail

Per Turbine Summary												
Turbine	Mast	Coordinates (WGS84 UTM18)		Free	Gross	% Array	% Array	% Total	Net	Turbine	Net Capacity	Turbulence
ID	Association	Easting (m)	Northing (m)	Spd (m/s)	MWh/yr	Eff	Loss	Loss	MWh/yr	Rank	Factor (%)	Intensity (%)
36	ALSN6	625909	4468932	8.85	19676	90.4	9.6	24.5	14,858	68	33.9	7.2
37	ALSN6	624989	4468193	8.87	19776	90.7	9.3	24.2	14,990	60	34.2	7.2
38	ALSN6	624059	4467489	8.85	19728	91.4	8.6	23.6	15,065	48	34.4	7.1
39	ALSN6	623147	4466756	8.84	19725	93.7	6.3	21.7	15,448	19	35.2	6.9
40	ALSN6	628877	4469953	8.86	19665	91.4	8.6	23.6	15,019	53	34.3	7.0
41	ALSN6	627945	4469219	8.85	19650	90.3	9.7	24.6	14,820	69	33.8	7.2
42	ALSN6	626992	4468500	8.84	19631	90.1	9.9	24.7	14,776	70	33.7	7.2
43	ALSN6	626074	4467761	8.85	19715	90.3	9.7	24.5	14,880	67	34.0	7.2
44	ALSN6	625155	4467052	8.84	19703	90.9	9.1	24.0	14,971	61	34.2	7.1
45	ALSN6	624235	4466315	8.83	19675	93.7	6.3	21.7	15,409	25	35.2	6.9
46	44025	629968	4469518	8.85	19807	92.1	7.9	23.1	15,237	37	34.8	7.6
47	44025	629031	4468786	8.86	19807	90.7	9.3	24.2	15,006	57	34.2	7.7
48	44025	628085	4468064	8.83	19730	90.7	9.3	24.2	14,951	65	34.1	7.8
49	44025	627160	4467328	8.82	19750	90.7	9.3	24.2	14,963	63	34.1	7.8
50	44025	626232	4466623	8.81	19762	91.1	8.9	23.9	15,041	52	34.3	7.7
51	44025	625332	4465878	8.79	19709	93.8	6.2	21.6	15,448	18	35.2	7.5
52	44025	631063	4469082	8.85	19793	92.5	7.5	22.7	15,294	32	34.9	7.6
53	44025	630120	4468352	8.84	19766	90.8	9.2	24.1	14,998	59	34.2	7.7
54	44025	629165	4467634	8.83	19747	90.7	9.3	24.3	14,957	64	34.1	7.8
55	44025	628249	4466894	8.83	19791	90.8	9.2	24.1	15,017	54	34.3	7.8
56	44025	627316	4466191	8.81	19720	91.1	8.9	23.9	15,016	55	34.3	7.8
57	44025	626417	4465446	8.79	19689	93.8	6.2	21.7	15,426	23	35.2	7.5
58	44025	632150	4468648	8.86	19793	93.3	6.7	22.0	15,436	20	35.2	7.5
59	44025	631191	4467926	8.86	19826	91.5	8.5	23.5	15,159	40	34.6	7.7
60	44025	630246	4467204	8.84	19784	91.1	8.9	23.9	15,051	50	34.3	7.7
61	44025	629333	4466462	8.83	19767	91.1	8.9	23.9	15,044	51	34.3	7.8
62	44025	628416	4465753	8.80	19714	91.5	8.5	23.6	15,070	46	34.4	7.7
63	44025	627506	4465012	8.79	19692	94.0	6.0	21.5	15,459	17	35.3	7.5
64	44025	633249	4468210	8.85	19784	95.9	4.1	19.9	15,847	3	36.2	7.3
65	44025	632270	4467496	8.85	19795	94.1	5.9	21.4	15,566	12	35.5	7.5
66	44025	631335	4466770	8.85	19827	93.7	6.3	21.8	15,514	14	35.4	7.5
67	44025	630419	4466030	8.83	19790	93.2	6.8	22.1	15,416	24	35.2	7.5
68	44025	629502	4465320	8.80	19686	93.1	6.9	22.2	15,320	30	35.0	7.6
69	44025	628587	4464582	8.75	19580	94.6	5.4	21.0	15,468	16	35.3	7.5
70	44025	635268	4468483	8.89	19906	97.3	2.7	18.7	16,176	1	36.9	7.1

Table A14. Multibrid 350-MW 12x24 Net Energy Matrix

Project:	NYSERDA - Offshore LI
EPE Completion Date:	5-Apr-2010
Prepared By:	AWS Truepower, LLC
Comments:	Net Energy Output Matrix (MW)
Turbine Model:	Multibrid 5MW
Turbine Rated Power:	5.0 MW
Hub Height:	90
Number of Turbines:	70
Plant Capacity:	350 MW
Net Annual Energy Output:	1,069,455 MWh
Net Capacity Factor:	34.9%

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Hour	Month												Average (MWh)	Total (MWh)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
0	157.08	146.52	124.30	91.93	78.01	102.20	72.27	69.44	102.86	123.04	152.51	151.98	**114.12**	**41,684**
1	169.30	157.09	126.37	129.23	92.23	77.43	65.07	70.95	101.83	111.98	146.37	160.02	**117.06**	**42,757**
2	171.03	154.49	128.59	121.03	89.53	63.59	58.40	66.75	114.02	108.45	143.71	162.56	**114.93**	**41,979**
3	174.57	150.74	127.31	122.03	93.53	71.49	60.10	76.92	99.48	119.51	150.63	163.95	**117.35**	**42,860**
4	172.96	155.30	126.75	118.03	96.32	63.38	55.24	64.80	106.01	131.98	148.86	157.91	**116.25**	**42,461**
5	179.72	166.16	117.51	134.92	89.71	65.11	55.78	55.63	94.61	140.80	153.99	161.74	**117.67**	**42,981**
6	181.04	180.19	136.22	131.44	89.67	67.82	52.22	71.75	98.29	136.61	154.86	155.68	**120.96**	**44,182**
7	186.23	177.15	139.25	134.41	84.75	65.35	57.70	60.31	106.49	153.33	144.57	157.07	**121.91**	**44,528**
8	176.87	177.43	150.17	123.32	76.94	55.36	48.94	58.57	102.60	143.61	138.55	159.20	**117.32**	**42,851**
9	176.34	176.12	143.24	138.45	92.58	54.42	46.28	51.58	98.01	129.87	136.11	176.11	**117.95**	**43,081**
10	170.02	157.84	125.73	123.37	88.27	49.58	41.62	54.13	93.13	113.83	129.27	178.94	**110.25**	**40,268**
11	168.73	133.76	124.32	107.60	78.04	57.98	41.25	61.87	85.20	114.83	140.46	156.51	**105.76**	**38,628**
12	157.42	125.13	133.96	114.02	81.77	71.07	66.94	55.35	77.01	100.52	132.45	143.23	**104.82**	**38,286**
13	143.68	129.23	131.54	123.06	90.97	94.80	73.85	63.71	75.14	111.06	124.46	150.09	**109.20**	**39,886**
14	144.82	121.89	133.47	122.51	110.68	115.80	97.26	69.72	76.87	116.64	137.96	159.03	**117.23**	**42,818**
15	142.71	123.70	153.11	142.90	144.13	143.12	97.13	79.29	85.04	122.00	134.76	150.46	**126.55**	**46,223**
16	144.80	118.18	165.50	176.54	156.16	142.33	100.77	91.02	79.02	139.82	147.48	163.18	**135.52**	**49,498**
17	145.98	129.11	159.83	183.52	169.65	156.03	108.53	82.93	85.84	143.13	169.80	161.83	**141.36**	**51,631**
18	148.23	143.11	155.64	181.03	161.12	160.18	120.08	76.14	106.40	138.85	166.68	167.00	**143.60**	**52,451**
19	161.69	146.15	154.61	170.87	160.63	144.32	117.21	90.34	96.95	129.31	167.26	169.17	**142.32**	**51,982**
20	167.16	146.41	170.00	169.68	137.86	124.94	106.43	78.63	94.21	132.86	155.15	175.02	**138.16**	**50,462**
21	164.61	144.58	156.70	151.78	115.76	114.80	82.98	77.35	86.90	127.26	162.14	183.00	**130.57**	**47,690**
22	162.14	150.64	139.86	129.55	103.16	109.29	81.08	75.82	97.96	126.82	158.01	179.46	**125.99**	**46,018**
23	155.44	156.75	137.83	114.23	100.57	110.54	74.66	69.68	94.19	135.32	141.62	165.32	**121.15**	**44,249**
Average (MWh)	**163.44**	**148.65**	**140.08**	**135.64**	**107.59**	**95.04**	**74.24**	**69.69**	**94.09**	**127.14**	**147.40**	**162.85**	**122.00**	
Total (MWh)	**121,599**	**100,787**	**104,216**	**97,663**	**80,044**	**68,428**	**55,236**	**51,853**	**67,742**	**94,594**	**106,130**	**121,163**		**1,069,455**

Table A15. Multibrid 700-MW Wind Speed and Energy Production Detail

Project:	NYSERDA - Offshore LI	
Date:	5-Apr-10	
Comments:		
Turbine Model:	Multibrid 5MW	
Turbine Rated Power:	5.00	MW
Hub Height:	90	m
Number of Turbines:	140	
Plant Capacity:	700	MW
Site Air Density:	1.240	kg/m^3

Loss Accounting	
Wake Effect	8.9%
Availability	6.2%
Electrical	4.1%
Turbine Performance	2.5%
Environmental	4.7%
Curtailments	0.0%
Average Total Loss	23.9%

Overall Wind Plant Summary	
Average Free Wind Speed (m/s)	8.85
Gross Plant Production (MWh/yr)	2,768,804
Net Plant Production (MWh/yr)	2,106,597
Net Capacity Factor	34.3%

Per Turbine Summary

Turbine ID	Mast Association	Coordinates (WGS84 UTM18) Easting (m)	Northing (m)	Free Spd (m/s)	Gross MWh/yr	% Array Eff	% Array Loss	% Total Loss	Net MWh/yr	Turbine Rank	Net Capacity Factor (%)	Turbulence Intensity (%)
1	ALSN6	616166	4472819	8.80	19458	96.4	3.6	19.5	15,666	8	35.7	6.9
2	ALSN6	615226	4472101	8.81	19513	96.2	3.8	19.6	15,688	6	35.8	6.9
3	ALSN6	614292	4471380	8.81	19513	98.4	1.6	17.8	16,042	1	36.6	6.7
4	ALSN6	617247	4472375	8.83	19565	94.7	5.3	20.8	15,487	15	35.3	7.0
5	ALSN6	616313	4471668	8.84	19596	94.2	5.8	21.3	15,417	18	35.2	7.1
6	ALSN6	615379	4470947	8.82	19554	96.6	3.4	19.3	15,781	3	36.0	6.9
7	ALSN6	618336	4471949	8.84	19618	94.0	6.0	21.4	15,414	20	35.2	7.0
8	ALSN6	617390	4471221	8.83	19588	93.4	6.6	22.0	15,287	39	34.9	7.1
9	ALSN6	616462	4470516	8.81	19549	96.1	3.9	19.7	15,700	5	35.8	6.9
10	ALSN6	619426	4471515	8.86	19640	93.5	6.5	21.9	15,342	30	35.0	7.0
11	ALSN6	618473	4470790	8.86	19692	92.8	7.2	22.5	15,268	41	34.8	7.1
12	ALSN6	617553	4470081	8.85	19688	95.5	4.5	20.2	15,710	4	35.8	6.9
13	ALSN6	621430	4471805	8.88	19735	93.2	6.8	22.1	15,371	25	35.1	6.9
14	ALSN6	620502	4471086	8.90	19794	93.0	7.0	22.3	15,374	23	35.1	7.1
15	ALSN6	619555	4470359	8.87	19706	92.6	7.4	22.7	15,240	42	34.8	7.1
16	ALSN6	618643	4469647	8.85	19692	95.2	4.8	20.5	15,655	9	35.7	6.9
17	ALSN6	622523	4471379	8.85	19613	92.0	8.0	23.1	15,078	55	34.4	7.0
18	ALSN6	621582	4470656	8.88	19769	92.2	7.8	23.0	15,222	44	34.7	7.1
19	ALSN6	620633	4469929	8.90	19822	92.0	8.0	23.2	15,231	43	34.8	7.1
20	ALSN6	619724	4469216	8.87	19753	94.6	5.4	20.9	15,616	10	35.6	6.9
21	ALSN6	623620	4470942	8.87	19698	91.8	8.2	23.3	15,103	51	34.5	7.0
22	ALSN6	622663	4470225	8.88	19771	91.4	8.6	23.6	15,105	50	34.5	7.1
23	ALSN6	621720	4469496	8.86	19713	91.9	8.1	23.2	15,132	49	34.5	7.2
24	ALSN6	620809	4468784	8.86	19744	94.0	6.0	21.4	15,511	14	35.4	6.9
25	ALSN6	624691	4470515	8.86	19687	91.3	8.7	23.7	15,019	66	34.3	7.1
26	ALSN6	623743	4469795	8.87	19770	90.7	9.3	24.2	14,980	69	34.2	7.2
27	ALSN6	622820	4469057	8.88	19803	91.0	9.0	23.9	15,062	60	34.4	7.2
28	ALSN6	621893	4468352	8.88	19826	92.7	7.3	22.5	15,357	27	35.0	7.0
29	ALSN6	625779	4470082	8.87	19738	91.1	8.9	23.9	15,023	64	34.3	7.1
30	ALSN6	624826	4469363	8.87	19767	90.4	9.6	24.5	14,928	76	34.1	7.2
31	ALSN6	623903	4468626	8.85	19731	90.8	9.2	24.1	14,968	72	34.1	7.2
32	ALSN6	622978	4467920	8.87	19794	91.8	8.2	23.3	15,180	45	34.6	7.1
33	ALSN6	622051	4467190	8.86	19792	94.4	5.6	21.1	15,613	11	35.6	6.8
34	ALSN6	627774	4470389	8.88	19730	91.6	8.4	23.5	15,100	53	34.5	6.9
35	ALSN6	626861	4469651	8.85	19663	90.4	9.6	24.5	14,849	92	33.9	7.1

Table A15 Cont'd. Multibrid 700-MW Wind Speed and Energy Production Detail

Per Turbine Summary												
Turbine	Mast	Coordinates (WGS84 UTM18)		Free	Gross	% Array	% Array	% Total	Net	Turbine	Net Capacity	Turbulence
ID	Association	Easting (m)	Northing (m)	Spd (m/s)	MWh/yr	Eff	Loss	Loss	MWh/yr	Rank	Factor (%)	Intensity (%)
36	ALSN6	625909	4468932	8.85	19676	90.0	10.0	24.8	14,802	99	33.8	7.2
37	ALSN6	624989	4468193	8.87	19776	90.4	9.6	24.4	14,944	75	34.1	7.2
38	ALSN6	624059	4467489	8.85	19728	91.1	8.9	23.9	15,020	65	34.3	7.1
39	ALSN6	623147	4466756	8.84	19725	93.5	6.5	21.9	15,405	22	35.1	6.9
40	ALSN6	628877	4469953	8.86	19665	90.7	9.3	24.2	14,906	80	34.0	7.0
41	ALSN6	627945	4469219	8.85	19650	89.7	10.3	25.1	14,721	121	33.6	7.2
42	ALSN6	626992	4468500	8.84	19631	89.6	10.4	25.1	14,695	125	33.5	7.2
43	ALSN6	626074	4467761	8.85	19715	89.9	10.1	24.9	14,811	97	33.8	7.2
44	ALSN6	625155	4467052	8.84	19703	90.6	9.4	24.3	14,912	79	34.0	7.1
45	ALSN6	624235	4466315	8.83	19675	93.4	6.6	22.0	15,355	28	35.0	6.9
46	44025	629968	4469518	8.85	19807	91.0	9.0	23.9	15,063	58	34.4	7.6
47	44025	629031	4468786	8.86	19807	89.9	10.1	24.9	14,870	87	33.9	7.7
48	44025	628085	4468064	8.83	19730	90.0	10.0	24.8	14,839	93	33.9	7.8
49	44025	627160	4467328	8.82	19750	90.1	9.9	24.7	14,870	88	33.9	7.8
50	44025	626232	4466623	8.81	19762	90.6	9.4	24.3	14,958	74	34.1	7.7
51	44025	625332	4465878	8.79	19709	93.4	6.6	22.0	15,373	24	35.1	7.5
52	44025	631063	4469082	8.85	19793	90.9	9.1	24.1	15,031	63	34.3	7.6
53	44025	630120	4468352	8.84	19766	89.4	10.6	25.3	14,763	110	33.7	7.8
54	44025	629165	4467634	8.83	19747	89.6	10.4	25.1	14,782	106	33.7	7.8
55	44025	628249	4466894	8.83	19791	89.8	10.2	24.9	14,857	90	33.9	7.8
56	44025	627316	4466191	8.81	19720	90.4	9.6	24.5	14,895	81	34.0	7.8
57	44025	626417	4465446	8.79	19689	93.2	6.8	22.2	15,325	32	35.0	7.5
58	44025	632150	4468648	8.86	19793	90.7	9.3	24.2	15,002	68	34.2	7.6
59	44025	631191	4467926	8.86	19826	89.1	10.9	25.5	14,765	109	33.7	7.8
60	44025	630246	4467204	8.84	19784	89.1	10.9	25.5	14,736	115	33.6	7.8
61	44025	629333	4466462	8.83	19767	89.7	10.3	25.1	14,812	96	33.8	7.8
62	44025	628416	4465753	8.80	19714	90.2	9.8	24.7	14,849	91	33.9	7.8
63	44025	627506	4465012	8.79	19692	93.0	7.0	22.3	15,295	38	34.9	7.5
64	44025	633249	4468210	8.85	19784	90.2	9.8	24.6	14,916	77	34.0	7.6
65	44025	632270	4467496	8.85	19795	88.8	11.2	25.8	14,688	127	33.5	7.8
66	44025	631335	4466770	8.85	19827	88.9	11.1	25.7	14,726	117	33.6	7.8
67	44025	630419	4466030	8.83	19790	89.2	10.8	25.5	14,752	113	33.7	7.8
68	44025	629502	4465320	8.80	19686	90.0	10.0	24.8	14,809	98	33.8	7.8
69	44025	628587	4464582	8.75	19580	92.7	7.3	22.6	15,158	47	34.6	7.5
70	44025	635268	4468483	8.89	19906	91.2	8.8	23.8	15,170	46	34.6	7.5
71	44025	634335	4467778	8.90	19926	89.9	10.1	24.9	14,962	73	34.1	7.6
72	44025	633353	4467064	8.86	19826	88.7	11.3	25.9	14,690	126	33.5	7.8
73	44025	632425	4466335	8.85	19843	88.5	11.5	26.1	14,673	130	33.5	7.8
74	44025	631507	4465596	8.84	19811	88.7	11.3	25.9	14,683	129	33.5	7.8
75	44025	630584	4464889	8.82	19756	89.4	10.6	25.3	14,761	111	33.7	7.8
76	44025	629677	4464147	8.80	19734	91.6	8.4	23.5	15,102	52	34.5	7.6
77	44025	636371	4468060	8.87	19854	90.8	9.2	24.1	15,066	57	34.4	7.6
78	44025	635430	4467342	8.86	19817	89.2	10.8	25.5	14,765	108	33.7	7.7
79	44025	634444	4466629	8.88	19920	88.5	11.5	26.1	14,724	118	33.6	7.8
80	44025	633506	4465905	8.88	19923	88.4	11.6	26.1	14,721	120	33.6	7.8
81	44025	632591	4465164	8.83	19803	88.5	11.5	26.0	14,647	133	33.4	7.8
82	44025	631665	4464458	8.83	19829	89.4	10.6	25.3	14,814	95	33.8	7.8
83	44025	630768	4463713	8.82	19809	90.9	9.1	24.0	15,053	62	34.3	7.7
84	44025	629850	4462983	8.77	19692	93.6	6.4	21.8	15,407	21	35.2	7.4
85	44025	637454	4467628	8.87	19855	90.8	9.2	24.1	15,063	59	34.4	7.6
86	44025	636508	4466912	8.87	19870	89.1	10.9	25.6	14,792	102	33.7	7.7
87	44025	635531	4466196	8.88	19926	88.4	11.6	26.2	14,710	122	33.6	7.8
88	44025	634588	4465473	8.86	19914	88.1	11.9	26.4	14,663	132	33.5	7.8
89	44025	633668	4464735	8.86	19892	88.5	11.5	26.1	14,706	124	33.6	7.8
90	44025	632755	4464024	8.84	19846	89.2	10.8	25.4	14,796	101	33.8	7.8
91	44025	631853	4463280	8.83	19840	90.5	9.5	24.4	15,007	67	34.2	7.7
92	44025	630933	4462546	8.81	19802	92.9	7.1	22.4	15,364	26	35.1	7.5
93	44025	638547	4467193	8.85	19798	91.0	9.0	23.9	15,058	61	34.4	7.6
94	44025	637606	4466474	8.85	19831	88.9	11.1	25.8	14,723	119	33.6	7.7
95	44025	636619	4465763	8.85	19864	88.2	11.8	26.3	14,645	134	33.4	7.8
96	44025	635662	4465045	8.87	19908	88.2	11.8	26.3	14,670	131	33.5	7.8
97	44025	634754	4464302	8.84	19846	88.2	11.8	26.3	14,618	137	33.4	7.8
98	44025	633837	4463593	8.82	19802	89.1	10.9	25.5	14,744	114	33.6	7.8
99	44025	632941	4462847	8.81	19786	90.0	10.0	24.8	14,881	85	34.0	7.7
100	44025	632026	4462111	8.81	19781	92.8	7.2	22.5	15,336	31	35.0	7.5

Table A15 Cont'd. Multibrid 700-MW Wind Speed and Energy Production Detail

Per Turbine Summary												
Turbine ID	Mast Association	Coordinates (WGS84 UTM18) Easting (m)	Northing (m)	Free Spd (m/s)	Gross MWh/yr	% Array Eff	% Array Loss	% Total Loss	Net MWh/yr	Turbine Rank	Net Capacity Factor (%)	Turbulence Intensity (%)
101	44025	639630	4466762	8.84	19790	91.1	8.9	23.8	15,071	56	34.4	7.6
102	44025	638710	4466035	8.86	19868	89.1	10.9	25.6	14,787	104	33.7	7.7
103	44025	637702	4465331	8.85	19860	88.2	11.8	26.3	14,635	136	33.4	7.8
104	44025	636745	4464614	8.84	19842	88.2	11.8	26.3	14,616	138	33.3	7.8
105	44025	635841	4463869	8.84	19861	88.2	11.8	26.3	14,638	135	33.4	7.8
106	44025	634929	4463158	8.84	19857	89.1	10.9	25.6	14,775	107	33.7	7.8
107	44025	634021	4462416	8.82	19797	90.0	10.0	24.8	14,881	84	34.0	7.7
108	44025	633108	4461679	8.80	19762	92.7	7.3	22.6	15,298	37	34.9	7.5
109	44025	640710	4466331	8.85	19832	91.4	8.6	23.6	15,152	48	34.6	7.6
110	44025	639800	4465600	8.85	19855	89.2	10.8	25.5	14,798	100	33.8	7.7
111	44025	638782	4464901	8.86	19883	88.4	11.6	26.1	14,685	128	33.5	7.8
112	44025	637825	4464184	8.82	19785	88.3	11.7	26.2	14,599	140	33.3	7.8
113	44025	636926	4463437	8.83	19819	88.2	11.8	26.3	14,613	139	33.3	7.8
114	44025	636018	4462723	8.82	19788	89.1	10.9	25.6	14,729	116	33.6	7.8
115	44025	635105	4461984	8.82	19773	90.0	10.0	24.8	14,864	89	33.9	7.7
116	44025	634195	4461246	8.81	19764	92.7	7.3	22.6	15,299	36	34.9	7.5
117	44025	641806	4465895	8.87	19866	92.2	7.8	23.0	15,302	35	34.9	7.5
118	44025	640881	4465169	8.85	19826	89.9	10.1	24.9	14,894	82	34.0	7.7
119	44025	639851	4464475	8.84	19814	89.1	10.9	25.5	14,754	112	33.7	7.8
120	44025	638907	4463752	8.86	19908	88.9	11.1	25.7	14,782	105	33.7	7.8
121	44025	638016	4463002	8.85	19883	88.5	11.5	26.0	14,707	123	33.6	7.8
122	44025	637107	4462290	8.82	19788	89.5	10.5	25.3	14,789	103	33.7	7.8
123	44025	636191	4461552	8.82	19766	90.1	9.9	24.7	14,885	83	34.0	7.7
124	44025	635277	4460815	8.82	19795	92.8	7.2	22.5	15,350	29	35.0	7.4
125	44025	642898	4465459	8.86	19825	93.1	6.9	22.2	15,421	16	35.2	7.5
126	44025	641967	4464737	8.86	19839	91.1	8.9	23.9	15,095	54	34.4	7.7
127	44025	640933	4464044	8.87	19892	90.1	9.9	24.7	14,979	70	34.2	7.7
128	44025	639991	4463321	8.86	19878	89.6	10.4	25.2	14,879	86	33.9	7.7
129	44025	639111	4462566	8.86	19879	89.3	10.7	25.4	14,826	94	33.8	7.7
130	44025	638194	4461857	8.84	19849	89.9	10.1	24.9	14,912	78	34.0	7.7
131	44025	637268	4461122	8.82	19776	90.6	9.4	24.3	14,969	71	34.2	7.7
132	44025	636359	4460384	8.84	19819	93.1	6.9	22.2	15,421	17	35.2	7.4
133	44025	644002	4465020	8.89	19891	95.7	4.3	20.1	15,898	2	36.3	7.3
134	44025	643062	4464301	8.90	19964	93.9	6.1	21.5	15,670	7	35.8	7.4
135	44025	642037	4463604	8.88	19929	93.2	6.8	22.1	15,516	13	35.4	7.5
136	44025	641071	4462890	8.87	19922	92.6	7.4	22.6	15,415	19	35.2	7.5
137	44025	640207	4462130	8.86	19885	92.2	7.8	23.0	15,312	34	34.9	7.5
138	44025	639275	4461426	8.85	19866	92.3	7.7	22.9	15,315	33	34.9	7.5
139	44025	638338	4460696	8.84	19829	92.2	7.8	23.0	15,274	40	34.8	7.5
140	44025	637439	4459953	8.84	19828	93.9	6.1	21.5	15,556	12	35.5	7.4

Table A16. Multibrid 700-MW 12x24 Net Energy Matrix

Project:	NYSERDA - Offshore LI
EPE Completion Date:	5-Apr-2010
Prepared By:	AWS Truepower, LLC
Comments:	Net Energy Output Matrix (MW)
Turbine Model:	Multibrid 5MW
Turbine Rated Power:	5.0 MW
Hub Height:	90
Number of Turbines:	140
Plant Capacity:	700 MW
Net Annual Energy Output:	2,106,597 MWh
Net Capacity Factor:	34.3%

Hour	Month												Average (MWh)	Total (MWh)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
0	311.83	289.50	245.22	180.12	152.72	199.11	140.44	134.61	202.26	242.37	302.23	301.55	224.72	82,081
1	335.98	310.37	249.31	253.84	180.26	149.78	126.68	137.61	200.02	219.82	289.70	316.88	230.34	84,131
2	338.95	305.54	254.54	237.85	174.83	123.17	113.86	129.28	223.96	212.48	284.60	321.02	226.18	82,613
3	346.45	298.32	251.60	239.78	183.26	139.09	116.89	149.66	196.09	235.52	298.08	323.56	231.17	84,434
4	343.21	307.37	250.57	232.19	188.58	122.98	107.26	125.67	209.19	259.62	295.08	311.51	229.01	83,646
5	357.23	328.66	231.53	265.06	174.99	126.90	108.12	107.61	186.37	277.32	304.43	319.70	231.73	84,639
6	359.52	355.79	269.22	258.43	175.82	131.87	101.15	139.87	193.87	269.37	306.75	307.84	238.43	87,086
7	369.31	349.66	275.38	264.55	165.72	126.64	112.67	116.96	210.10	302.97	286.44	310.75	240.32	87,777
8	350.06	350.15	296.19	242.40	151.00	107.36	95.32	113.91	202.05	283.56	274.07	314.25	231.08	84,401
9	348.99	346.23	282.53	272.60	182.41	105.93	90.25	100.27	193.26	255.52	269.21	348.72	232.39	84,881
10	335.80	310.70	247.37	242.52	173.75	95.96	80.58	105.42	184.03	223.96	255.90	354.89	217.12	79,304
11	333.30	264.46	244.58	211.70	153.41	112.36	79.81	121.19	168.61	226.60	277.34	309.69	208.34	76,098
12	310.52	247.07	264.54	224.92	160.49	137.66	130.01	107.57	151.81	197.39	260.69	283.56	206.18	75,309
13	283.35	254.90	259.26	241.78	177.75	184.71	144.25	124.27	148.40	218.31	244.89	297.12	214.72	78,428
14	286.39	240.18	264.29	240.66	216.72	226.40	189.43	136.33	151.27	228.45	272.64	314.26	230.60	84,226
15	282.41	245.11	301.66	280.95	282.57	280.40	189.08	154.68	167.54	239.27	265.48	298.00	248.96	90,933
16	286.29	233.93	326.81	347.79	306.32	278.78	196.24	178.32	155.71	275.24	290.70	323.31	266.85	97,466
17	287.98	255.72	314.59	362.03	333.57	306.31	211.71	161.96	169.26	281.71	335.88	320.21	278.42	101,692
18	293.61	283.60	309.70	357.81	317.46	314.97	234.92	148.85	209.26	273.00	330.53	330.50	283.47	103,538
19	319.57	289.05	305.81	338.48	317.05	284.02	229.05	176.49	190.51	254.99	331.47	334.43	280.79	102,559
20	331.61	289.70	336.67	336.99	271.15	244.42	207.40	153.05	184.93	261.58	307.75	345.74	272.50	99,530
21	326.86	286.10	310.18	301.32	227.44	224.63	161.57	149.96	170.17	249.51	320.82	362.52	257.41	94,020
22	320.78	298.73	276.81	255.29	201.43	213.72	157.68	147.41	192.37	249.82	311.95	354.36	248.04	90,596
23	307.58	309.87	276.83	224.49	196.99	215.23	145.45	135.03	185.38	266.56	280.04	326.51	238.77	87,212
Average (MWh)	323.65	293.78	276.88	267.23	211.07	185.52	144.58	135.67	185.27	250.21	291.53	322.12	240.31	
Total (MWh)	240,795	199,182	206,001	192,407	157,037	133,572	107,565	100,936	133,393	186,153	209,899	239,657		2,106,597

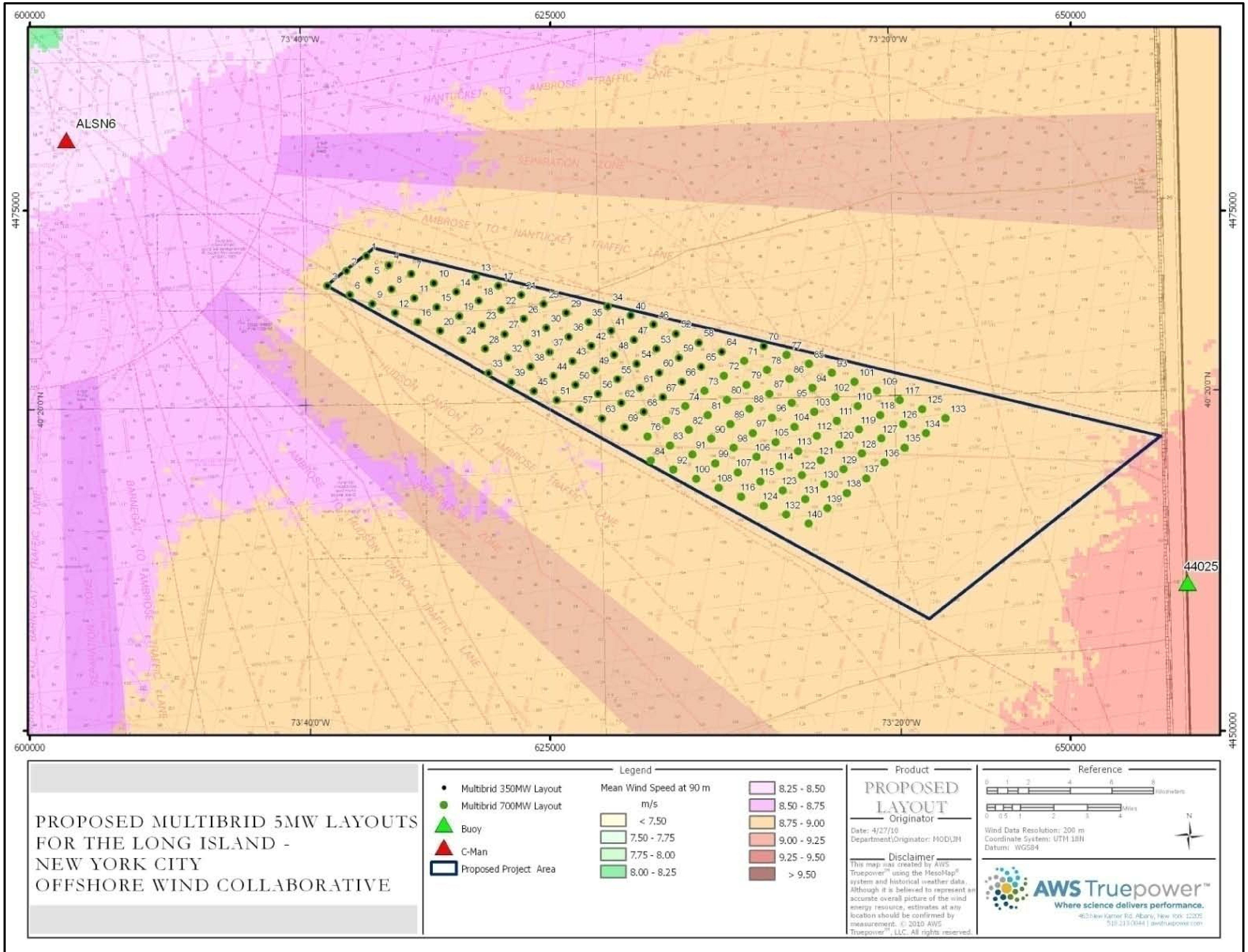

Figure A3. Proposed Long Island – New York City Offshore Multibrid Turbine Layouts

REPOWER 5.0-MW ENERGY ESTIMATES

Table A17. REpower 350-MW Wind Speed and Energy Production Detail

Project:	NYSERDA - Offshore LI	
Date:	5-Apr-10	
Comments:		
Turbine Model:	REPower 5MW	
Turbine Rated Power:	5.00	MW
Hub Height:	90	m
Number of Turbines:	70	
Plant Capacity:	350	MW
Site Air Density:	1.240	kg/m^3

Loss Accounting	
Wake Effect	6.6%
Availability	6.1%
Electrical	4.0%
Turbine Performance	1.1%
Environmental	4.7%
Curtailments	0.0%
Average Total Loss	20.7%

Overall Wind Plant Summary	
Average Free Wind Speed (m/s)	8.84
Gross Plant Production (MWh/yr)	1,439,591
Net Plant Production (MWh/yr)	1,142,201
Net Capacity Factor	37.2%

Per Turbine Summary

Turbine ID	Mast Association	Coordinates (WGS84 UTM18) Easting (m)	Northing (m)	Free Spd (m/s)	Gross MWh/yr	% Array Eff	% Array Loss	% Total Loss	Net MWh/yr	Turbine Rank	Net Capacity Factor (%)	Turbulence Intensity (%)
1	ALSN6	616268	4472959	8.81	20346	96.7	3.3	17.9	16,714	8	38.1	6.9
2	ALSN6	615283	4472170	8.82	20395	96.6	3.4	18.0	16,734	6	38.2	6.9
3	ALSN6	614292	4471380	8.81	20382	98.5	1.5	16.3	17,059	1	38.9	6.7
4	ALSN6	617447	4472490	8.83	20430	95.3	4.7	19.1	16,537	15	37.7	7.0
5	ALSN6	616463	4471700	8.84	20462	94.7	5.3	19.5	16,467	21	37.6	7.1
6	ALSN6	615472	4470910	8.82	20424	96.9	3.1	17.7	16,819	3	38.4	6.9
7	ALSN6	618616	4472024	8.84	20486	94.7	5.3	19.5	16,490	18	37.6	7.0
8	ALSN6	617632	4471234	8.84	20480	94.0	6.0	20.1	16,354	31	37.3	7.1
9	ALSN6	616641	4470445	8.83	20463	96.4	3.6	18.1	16,768	5	38.3	6.9
10	ALSN6	619796	4471554	8.85	20517	94.3	5.7	19.9	16,441	23	37.5	7.0
11	ALSN6	618811	4470764	8.87	20570	93.5	6.5	20.6	16,341	32	37.3	7.1
12	ALSN6	617820	4469975	8.87	20606	95.9	4.1	18.5	16,794	4	38.3	6.8
13	ALSN6	620975	4471084	8.88	20603	94.1	5.9	20.1	16,468	20	37.6	7.0
14	ALSN6	619990	4470294	8.88	20616	93.3	6.7	20.8	16,338	33	37.3	7.1
15	ALSN6	618999	4469505	8.87	20601	95.6	4.4	18.8	16,733	7	38.2	6.9
16	ALSN6	622152	4470615	8.87	20587	93.8	6.2	20.3	16,400	27	37.4	7.0
17	ALSN6	621167	4469825	8.90	20699	92.9	7.1	21.1	16,330	34	37.3	7.1
18	ALSN6	620176	4469036	8.87	20627	95.2	4.8	19.1	16,683	9	38.1	6.9
19	ALSN6	624329	4470932	8.87	20577	93.3	6.7	20.7	16,319	35	37.2	6.9
20	ALSN6	623338	4470143	8.88	20643	93.0	7.0	21.0	16,302	37	37.2	7.1
21	ALSN6	622353	4469353	8.86	20594	92.7	7.3	21.2	16,224	40	37.0	7.1
22	ALSN6	621362	4468563	8.87	20642	94.9	5.1	19.4	16,646	11	38.0	6.9
23	ALSN6	625510	4470461	8.88	20613	92.4	7.6	21.5	16,188	43	36.9	7.0
24	ALSN6	624519	4469672	8.84	20512	91.9	8.1	21.9	16,021	56	36.6	7.1
25	ALSN6	623535	4468882	8.85	20578	91.9	8.1	21.9	16,075	53	36.7	7.2
26	ALSN6	622544	4468092	8.87	20668	93.5	6.5	20.5	16,424	26	37.5	7.0
27	ALSN6	626690	4469991	8.87	20582	92.4	7.6	21.5	16,153	44	36.9	7.0
28	ALSN6	625699	4469202	8.86	20565	91.6	8.4	22.2	16,001	63	36.5	7.1
29	ALSN6	624714	4468412	8.87	20635	91.9	8.1	21.9	16,108	50	36.8	7.1
30	ALSN6	623723	4467623	8.84	20575	92.8	7.2	21.2	16,213	41	37.0	7.1
31	ALSN6	622729	4466845	8.84	20596	95.1	4.9	19.2	16,633	13	37.9	6.8
32	ALSN6	627870	4469521	8.84	20507	92.2	7.8	21.7	16,058	54	36.6	7.0
33	ALSN6	626879	4468732	8.86	20563	91.3	8.7	22.5	15,942	68	36.4	7.2
34	ALSN6	625894	4467942	8.84	20536	91.3	8.7	22.4	15,937	70	36.4	7.2
35	ALSN6	624903	4467152	8.86	20605	92.2	7.8	21.7	16,139	46	36.8	7.1

Table A17 Cont'd. REpower 350-MW Wind Speed and Energy Production Detail

Per Turbine Summary													
Turbine ID	Mast Association	Coordinates (WGS84 UTM18) Easting (m)	Northing (m)	Free Spd (m/s)	Gross MWh/yr	% Array Eff	% Array Loss	% Total Loss	Net MWh/yr	Turbine Rank	Net Capacity Factor (%)	Turbulence Intensity (%)
36	ALSN6	623908	4466375	8.83	20557	94.1	5.9	20.0	16,440	24	37.5	6.9
37	44025	629048	4469051	8.86	20601	92.5	7.5	21.4	16,192	42	36.9	7.6
38	44025	628057	4468262	8.83	20536	91.5	8.5	22.3	15,964	66	36.4	7.7
39	44025	627072	4467472	8.81	20503	91.6	8.4	22.2	15,958	67	36.4	7.7
40	44025	626081	4466683	8.82	20559	92.1	7.9	21.8	16,086	52	36.7	7.7
41	44025	625077	4465909	8.79	20518	94.3	5.7	19.9	16,434	25	37.5	7.5
42	44025	630226	4468582	8.84	20552	92.3	7.7	21.6	16,111	48	36.8	7.6
43	44025	629235	4467793	8.83	20541	91.3	8.7	22.4	15,941	69	36.4	7.8
44	44025	628250	4467003	8.83	20574	91.5	8.5	22.3	15,992	65	36.5	7.8
45	44025	627259	4466213	8.80	20507	91.9	8.1	22.0	16,005	61	36.5	7.7
46	44025	626257	4465439	8.79	20477	94.2	5.8	19.9	16,395	28	37.4	7.5
47	44025	632391	4468922	8.85	20566	93.1	6.9	20.9	16,273	38	37.1	7.5
48	44025	631403	4468113	8.86	20621	92.0	8.0	21.9	16,110	49	36.8	7.6
49	44025	630412	4467324	8.85	20618	91.4	8.6	22.4	16,003	62	36.5	7.7
50	44025	629427	4466534	8.84	20574	91.5	8.5	22.2	15,998	64	36.5	7.7
51	44025	628436	4465745	8.80	20503	91.9	8.1	21.9	16,008	59	36.5	7.7
52	44025	627436	4464970	8.79	20478	94.2	5.8	20.0	16,392	29	37.4	7.5
53	44025	633570	4468452	8.89	20698	93.2	6.8	20.8	16,390	30	37.4	7.5
54	44025	632574	4467646	8.85	20586	92.0	8.0	21.8	16,090	51	36.7	7.7
55	44025	631583	4466857	8.85	20607	91.4	8.6	22.3	16,005	60	36.5	7.7
56	44025	630599	4466067	8.83	20592	91.6	8.4	22.2	16,017	57	36.5	7.7
57	44025	629608	4465278	8.80	20510	91.9	8.1	21.9	16,013	58	36.5	7.7
58	44025	628613	4464500	8.75	20378	94.2	5.8	20.0	16,303	36	37.2	7.5
59	44025	634749	4467982	8.89	20712	93.8	6.2	20.3	16,513	16	37.7	7.5
60	44025	633750	4467178	8.88	20680	92.4	7.6	21.5	16,229	39	37.0	7.6
61	44025	632759	4466389	8.86	20664	92.0	8.0	21.8	16,149	45	36.8	7.7
62	44025	631774	4465599	8.83	20586	91.8	8.2	22.0	16,057	55	36.6	7.7
63	44025	630783	4464809	8.82	20563	92.3	7.7	21.6	16,125	47	36.8	7.7
64	44025	629799	4464028	8.80	20536	94.4	5.6	19.8	16,477	19	37.6	7.5
65	44025	635926	4467513	8.86	20615	96.2	3.8	18.2	16,857	2	38.5	7.3
66	44025	634933	4466706	8.87	20687	94.8	5.2	19.4	16,667	10	38.0	7.4
67	44025	633942	4465917	8.87	20697	94.2	5.8	20.0	16,563	14	37.8	7.5
68	44025	632958	4465127	8.85	20671	94.0	6.0	20.2	16,502	17	37.7	7.5
69	44025	631967	4464338	8.83	20624	93.8	6.2	20.3	16,443	22	37.5	7.5
70	44025	630980	4463557	8.82	20614	95.0	5.0	19.3	16,645	12	38.0	7.4

Table A18. REpower 350-MW 12x24 Net Energy Matrix

Project: NYSERDA - Offshore LI
EPE Completion Date: 5-Apr-2010
Prepared By: AWS Truepower, LLC
Comments: Net Energy Output Matrix (MW)
Turbine Model: REPower 5MW
Turbine Rated Power: 5.0 MW
Hub Height: 90
Number of Turbines: 70
Plant Capacity: 350 MW
Net Annual Energy Output: 1,142,201 MWh
Net Capacity Factor: 37.2%

Hour	Month												Average (MWh)	Total (MWh)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
0	163.84	154.47	132.55	100.27	85.96	112.66	81.44	78.83	110.60	131.14	159.98	159.36	122.37	44,696
1	176.75	165.34	134.63	137.68	100.81	87.21	73.71	80.26	109.77	120.64	153.67	168.14	125.46	45,824
2	178.61	162.54	136.06	129.02	98.37	72.80	65.86	75.79	121.84	117.36	151.42	170.45	123.10	44,962
3	181.45	158.26	135.04	130.62	102.00	80.18	68.79	86.72	106.67	127.50	158.77	171.95	125.49	45,835
4	180.88	163.50	134.61	126.32	105.08	71.80	62.86	72.97	112.96	140.99	156.66	166.16	124.36	45,421
5	187.41	174.17	125.95	143.87	99.23	73.22	64.05	63.15	102.32	149.38	162.33	169.71	125.94	45,999
6	188.84	189.35	144.31	140.58	98.34	76.33	59.69	78.54	106.04	145.20	162.64	164.28	129.15	47,172
7	194.62	185.71	147.73	143.51	93.41	74.00	64.47	68.03	114.29	161.05	152.24	165.10	130.03	47,494
8	185.81	186.55	158.99	132.56	83.99	63.08	55.86	65.42	110.04	150.80	145.49	167.30	125.17	45,719
9	184.88	186.02	151.80	146.90	99.31	62.07	52.59	57.95	105.29	138.54	144.04	184.56	125.84	45,962
10	178.78	167.31	134.02	131.45	94.32	56.87	47.30	60.44	100.21	121.03	136.50	186.89	117.68	42,984
11	177.70	142.28	132.51	115.62	84.13	66.11	47.57	67.43	90.76	121.82	147.77	164.18	113.03	41,283
12	166.02	133.55	142.49	121.65	89.39	79.31	74.66	62.61	82.90	108.18	139.74	150.35	112.49	41,086
13	152.09	137.33	139.69	132.10	100.21	103.63	81.85	71.34	80.65	119.05	131.91	157.62	117.20	42,806
14	152.55	129.83	141.92	131.59	120.65	126.02	107.34	76.88	84.16	125.32	145.45	166.55	125.70	45,912
15	150.84	129.93	162.59	152.07	154.37	153.11	107.53	86.83	92.06	130.98	142.63	158.36	135.15	49,363
16	153.12	124.86	174.81	185.72	166.61	152.48	111.56	98.90	86.12	147.78	155.39	171.01	144.16	52,656
17	154.17	135.87	169.85	191.88	180.07	165.72	118.98	91.07	93.34	151.86	177.77	170.10	150.08	54,819
18	156.22	149.64	174.62	189.85	170.53	169.66	130.43	84.39	115.59	147.93	173.98	175.58	153.13	55,931
19	170.50	153.38	173.07	178.93	169.56	153.69	127.20	98.85	104.84	137.55	175.34	177.61	151.68	55,401
20	173.56	153.44	178.79	177.20	147.33	134.50	116.57	86.90	102.39	141.27	162.06	184.13	146.49	53,504
21	171.36	152.52	165.16	158.80	124.90	124.06	92.58	86.76	95.45	135.69	170.47	191.67	139.04	50,784
22	169.71	158.31	147.91	137.11	112.34	118.70	90.32	85.31	106.84	135.17	166.88	188.30	134.59	49,159
23	162.84	165.44	148.36	121.98	108.71	121.07	83.38	79.42	102.34	143.67	149.16	174.28	129.86	47,431
Average (MWh)	171.36	156.65	149.48	144.05	116.23	104.10	82.77	77.70	101.56	135.41	155.10	170.99	130.30	
Total (MWh)	127,489	106,209	111,212	103,718	86,479	74,948	61,584	57,809	73,124	100,747	111,669	127,213		1,142,201

Table A19. REpower 700-MW Wind Speed and Energy Production Detail

Project:	NYSERDA - Offshore LI
Date:	5-Apr-10
Comments:	
Turbine Model:	REPower 5MW
Turbine Rated Power:	5.00 MW
Hub Height:	90 m
Number of Turbines:	140
Plant Capacity:	700 MW
Site Air Density:	1.240 kg/m^3

Loss Accounting	
Wake Effect	8.3%
Availability	6.1%
Electrical	4.0%
Turbine Performance	1.1%
Environmental	4.7%
Curtailments	0.0%
Average Total Loss	22.1%

Overall Wind Plant Summary	
Average Free Wind Speed (m/s)	8.85
Gross Plant Production (MWh/yr)	2,885,636
Net Plant Production (MWh/yr)	2,249,176
Net Capacity Factor	36.7%

Per Turbine Summary

Turbine ID	Mast Association	Coordinates (WGS84 UTM18) Easting (m)	Northing (m)	Free Spd (m/s)	Gross MWh/yr	% Array Eff	% Array Loss	% Total Loss	Net MWh/yr	Turbine Rank	Net Capacity Factor (%)	Turbulence Intensity (%)
1	ALSN6	616268	4472959	8.81	20346	96.6	3.4	17.9	16,706	8	38.1	6.9
2	ALSN6	615283	4472170	8.82	20395	96.5	3.5	18.0	16,726	6	38.2	6.9
3	ALSN6	614292	4471380	8.81	20382	98.5	1.5	16.4	17,050	1	38.9	6.7
4	ALSN6	617447	4472490	8.83	20430	95.2	4.8	19.1	16,529	14	37.7	7.0
5	ALSN6	616463	4471700	8.84	20462	94.7	5.3	19.6	16,458	18	37.6	7.1
6	ALSN6	615472	4470910	8.82	20424	96.9	3.1	17.7	16,808	3	38.3	6.9
7	ALSN6	618616	4472024	8.84	20486	94.7	5.3	19.6	16,480	16	37.6	7.0
8	ALSN6	617632	4471234	8.84	20480	93.9	6.1	20.2	16,342	30	37.3	7.1
9	ALSN6	616641	4470445	8.83	20463	96.4	3.6	18.1	16,756	5	38.2	6.9
10	ALSN6	619796	4471554	8.85	20517	94.2	5.8	19.9	16,426	22	37.5	7.0
11	ALSN6	618811	4470764	8.87	20570	93.4	6.6	20.6	16,328	32	37.3	7.1
12	ALSN6	617820	4469975	8.87	20606	95.9	4.1	18.6	16,781	4	38.3	6.8
13	ALSN6	620975	4471084	8.88	20603	94.0	6.0	20.1	16,452	19	37.5	7.0
14	ALSN6	619990	4470294	8.88	20616	93.2	6.8	20.8	16,324	33	37.2	7.1
15	ALSN6	618999	4469505	8.87	20601	95.5	4.5	18.8	16,718	7	38.1	6.9
16	ALSN6	622152	4470615	8.87	20587	93.7	6.3	20.4	16,383	27	37.4	7.0
17	ALSN6	621167	4469825	8.90	20699	92.8	7.2	21.2	16,314	35	37.2	7.1
18	ALSN6	620176	4469036	8.87	20627	95.1	4.9	19.2	16,666	9	38.0	6.9
19	ALSN6	624329	4470932	8.87	20577	93.2	6.8	20.8	16,298	39	37.2	6.9
20	ALSN6	623338	4470143	8.88	20643	92.8	7.2	21.1	16,281	41	37.1	7.0
21	ALSN6	622353	4469353	8.86	20594	92.6	7.4	21.3	16,204	47	37.0	7.1
22	ALSN6	621362	4468563	8.87	20642	94.8	5.2	19.4	16,628	10	37.9	6.9
23	ALSN6	625510	4470461	8.88	20613	92.3	7.7	21.6	16,158	50	36.9	7.0
24	ALSN6	624519	4469672	8.84	20512	91.8	8.2	22.0	15,995	69	36.5	7.1
25	ALSN6	623535	4468882	8.85	20578	91.8	8.2	22.0	16,048	62	36.6	7.2
26	ALSN6	622544	4468092	8.87	20668	93.4	6.6	20.7	16,396	25	37.4	7.0
27	ALSN6	626690	4469991	8.87	20582	92.2	7.8	21.7	16,114	54	36.8	7.0
28	ALSN6	625699	4469202	8.86	20565	91.4	8.6	22.4	15,966	74	36.4	7.1
29	ALSN6	624714	4468412	8.87	20635	91.7	8.3	22.1	16,077	61	36.7	7.1
30	ALSN6	623723	4467623	8.84	20575	92.6	7.4	21.3	16,182	49	36.9	7.1
31	ALSN6	622729	4466845	8.84	20596	94.9	5.1	19.4	16,602	13	37.9	6.8
32	ALSN6	627870	4469521	8.84	20507	91.9	8.1	21.9	16,007	67	36.5	7.0
33	ALSN6	626879	4468732	8.86	20563	91.0	9.0	22.7	15,901	87	36.3	7.2
34	ALSN6	625894	4467942	8.84	20536	91.1	8.9	22.6	15,898	88	36.3	7.2
35	ALSN6	624903	4467152	8.86	20605	92.0	8.0	21.8	16,103	56	36.7	7.1

Table A19 Cont'd. REpower 700-MW Wind Speed and Energy Production Detail

Per Turbine Summary												
Turbine ID	Mast Association	Coordinates (WGS84 UTM18) Easting (m)	Northing (m)	Free Spd (m/s)	Gross MWh/yr	% Array Eff	% Array Loss	% Total Loss	Net MWh/yr	Turbine Rank	Net Capacity Factor (%)	Turbulence Intensity (%)
36	ALSN6	623908	4466375	8.83	20557	93.9	6.1	20.2	16,404	23	37.4	6.9
37	44025	629048	4469051	8.86	20601	92.2	7.8	21.7	16,131	52	36.8	7.6
38	44025	628057	4468262	8.83	20536	91.2	8.8	22.5	15,907	85	36.3	7.7
39	44025	627072	4467472	8.81	20503	91.3	8.7	22.4	15,912	84	36.3	7.7
40	44025	626081	4466683	8.82	20559	91.8	8.2	22.0	16,040	65	36.6	7.7
41	44025	625077	4465909	8.79	20518	94.0	6.0	20.1	16,391	26	37.4	7.5
42	44025	630226	4468582	8.84	20552	91.7	8.3	22.1	16,015	66	36.5	7.6
43	44025	629235	4467793	8.83	20541	90.9	9.1	22.8	15,856	95	36.2	7.8
44	44025	628250	4467003	8.83	20574	91.1	8.9	22.6	15,922	81	36.3	7.8
45	44025	627259	4466213	8.80	20507	91.5	8.5	22.2	15,945	77	36.4	7.7
46	44025	626257	4465439	8.79	20477	93.9	6.1	20.2	16,341	31	37.3	7.5
47	44025	632391	4468922	8.85	20566	92.2	7.8	21.7	16,102	57	36.7	7.5
48	44025	631403	4468113	8.86	20621	91.2	8.8	22.5	15,977	73	36.5	7.7
49	44025	630412	4467324	8.85	20618	90.7	9.3	22.9	15,887	91	36.2	7.7
50	44025	629427	4466534	8.84	20574	90.9	9.1	22.7	15,897	89	36.3	7.8
51	44025	628436	4465745	8.80	20503	91.4	8.6	22.4	15,916	82	36.3	7.8
52	44025	627436	4464970	8.79	20478	93.8	6.2	20.3	16,316	34	37.2	7.5
53	44025	633570	4468452	8.89	20698	91.5	8.5	22.2	16,093	58	36.7	7.6
54	44025	632574	4467646	8.85	20586	90.6	9.4	23.1	15,837	98	36.1	7.7
55	44025	631583	4466857	8.85	20607	90.3	9.7	23.2	15,818	103	36.1	7.8
56	44025	630599	4466067	8.83	20592	90.6	9.4	23.0	15,847	96	36.2	7.8
57	44025	629608	4465278	8.80	20510	91.1	8.9	22.6	15,882	92	36.2	7.7
58	44025	628613	4464500	8.75	20378	93.6	6.4	20.5	16,197	48	37.0	7.5
59	44025	634749	4467982	8.89	20712	91.4	8.6	22.4	16,079	60	36.7	7.6
60	44025	633750	4467178	8.88	20680	90.1	9.9	23.5	15,829	99	36.1	7.7
61	44025	632759	4466389	8.86	20664	90.1	9.9	23.5	15,816	106	36.1	7.7
62	44025	631774	4465599	8.83	20586	90.3	9.7	23.2	15,801	111	36.1	7.8
63	44025	630783	4464809	8.82	20563	90.9	9.1	22.7	15,888	90	36.2	7.7
64	44025	629799	4464028	8.80	20536	93.4	6.6	20.6	16,299	38	37.2	7.5
65	44025	635926	4467513	8.86	20615	91.1	8.9	22.6	15,956	75	36.4	7.6
66	44025	634933	4466706	8.87	20687	89.7	10.3	23.8	15,764	113	36.0	7.7
67	44025	633942	4465917	8.87	20697	89.6	10.4	23.9	15,756	114	35.9	7.8
68	44025	632958	4465127	8.85	20671	90.1	9.9	23.5	15,817	104	36.1	7.7
69	44025	631967	4464338	8.83	20624	90.8	9.2	22.8	15,912	83	36.3	7.7
70	44025	630980	4463557	8.82	20614	93.1	6.9	20.9	16,309	36	37.2	7.5
71	44025	637112	4467040	8.86	20641	90.8	9.2	22.8	15,928	79	36.3	7.6
72	44025	636113	4466236	8.87	20688	89.4	10.6	24.1	15,711	123	35.8	7.7
73	44025	635122	4465447	8.86	20689	89.1	10.9	24.3	15,667	127	35.7	7.8
74	44025	634137	4464657	8.86	20696	89.4	10.6	24.1	15,714	122	35.9	7.8
75	44025	633146	4463868	8.84	20631	90.2	9.8	23.4	15,803	109	36.1	7.7
76	44025	632160	4463087	8.80	20587	92.1	7.9	21.8	16,106	55	36.7	7.6
77	44025	639285	4467359	8.86	20606	91.6	8.4	22.1	16,042	64	36.6	7.5
78	44025	638294	4466569	8.86	20640	90.3	9.7	23.3	15,839	97	36.1	7.6
79	44025	637288	4465768	8.84	20624	89.2	10.8	24.2	15,638	130	35.7	7.7
80	44025	636297	4464979	8.87	20717	89.0	11.0	24.3	15,673	126	35.8	7.8
81	44025	635312	4464189	8.85	20651	89.2	10.8	24.2	15,658	129	35.7	7.8
82	44025	634322	4463399	8.82	20584	90.1	9.9	23.5	15,749	115	35.9	7.8
83	44025	633340	4462617	8.82	20577	91.5	8.5	22.2	15,999	68	36.5	7.7
84	44025	632347	4461814	8.81	20578	94.0	6.0	20.2	16,426	21	37.5	7.4
85	44025	640464	4466889	8.87	20640	91.1	8.9	22.6	15,980	72	36.5	7.6
86	44025	639473	4466100	8.87	20697	89.9	10.1	23.6	15,813	108	36.1	7.7
87	44025	638472	4465296	8.85	20654	89.0	11.0	24.4	15,621	134	35.6	7.8
88	44025	637481	4464507	8.84	20612	88.7	11.3	24.7	15,526	140	35.4	7.8
89	44025	636496	4463717	8.83	20600	89.0	11.0	24.4	15,578	138	35.5	7.8
90	44025	635505	4462928	8.83	20593	89.9	10.1	23.6	15,726	118	35.9	7.8
91	44025	634518	4462148	8.82	20584	91.1	8.9	22.6	15,928	80	36.3	7.7
92	44025	633519	4461347	8.80	20546	93.2	6.8	20.8	16,268	43	37.1	7.4
93	44025	641644	4466419	8.87	20620	91.2	8.8	22.5	15,983	71	36.5	7.6
94	44025	640653	4465629	8.85	20598	89.7	10.3	23.8	15,696	125	35.8	7.7
95	44025	639645	4464829	8.84	20594	89.0	11.0	24.4	15,579	137	35.5	7.8
96	44025	638654	4464040	8.84	20639	88.6	11.4	24.7	15,531	139	35.4	7.8
97	44025	637669	4463250	8.84	20630	88.9	11.1	24.5	15,581	136	35.5	7.8
98	44025	636678	4462460	8.83	20611	89.8	10.2	23.7	15,720	121	35.9	7.8
99	44025	635685	4461667	8.82	20565	90.8	9.2	22.9	15,858	94	36.2	7.7
100	44025	634694	4460879	8.81	20549	93.1	6.9	20.9	16,251	46	37.1	7.4

Table A19 Cont'd. REpower 700-MW Wind Speed and Energy Production Detail

Per Turbine Summary												
Turbine ID	Mast Association	Coordinates (WGS84 UTM18) Easting (m)	Northing (m)	Free Spd (m/s)	Gross MWh/yr	% Array Eff	% Array Loss	% Total Loss	Net MWh/yr	Turbine Rank	Net Capacity Factor (%)	Turbulence Intensity (%)
101	44025	642822	4465949	8.86	20613	91.3	8.7	22.4	15,994	70	36.5	7.6
102	44025	641831	4465160	8.86	20625	89.7	10.3	23.8	15,711	124	35.8	7.7
103	44025	640825	4464359	8.86	20648	89.1	10.9	24.3	15,624	133	35.6	7.8
104	44025	639834	4463569	8.86	20692	88.8	11.2	24.6	15,602	135	35.6	7.8
105	44025	638849	4462779	8.86	20681	89.0	11.0	24.4	15,637	132	35.7	7.8
106	44025	637858	4461990	8.83	20611	89.8	10.2	23.7	15,721	120	35.9	7.8
107	44025	636857	4461200	8.82	20568	90.6	9.4	23.0	15,829	100	36.1	7.7
108	44025	635878	4460407	8.83	20609	93.1	6.9	20.9	16,306	37	37.2	7.4
109	44025	644000	4465480	8.90	20712	91.8	8.2	22.0	16,147	51	36.8	7.5
110	44025	643009	4464691	8.89	20701	89.9	10.1	23.6	15,814	107	36.1	7.7
111	44025	642014	4463885	8.89	20738	89.2	10.8	24.2	15,722	119	35.9	7.7
112	44025	641023	4463095	8.88	20727	88.8	11.2	24.6	15,638	131	35.7	7.8
113	44025	640038	4462306	8.86	20692	89.1	10.9	24.3	15,664	128	35.7	7.8
114	44025	639048	4461516	8.86	20674	89.9	10.1	23.7	15,782	112	36.0	7.7
115	44025	638044	4460727	8.83	20581	90.7	9.3	22.9	15,866	93	36.2	7.7
116	44025	637058	4459937	8.82	20541	93.2	6.8	20.8	16,261	44	37.1	7.4
117	44025	645177	4465011	8.90	20694	92.5	7.5	21.4	16,259	45	37.1	7.5
118	44025	644186	4464222	8.88	20666	90.6	9.4	23.1	15,902	86	36.3	7.7
119	44025	643199	4463413	8.89	20733	89.9	10.1	23.7	15,827	101	36.1	7.7
120	44025	642209	4462623	8.89	20748	89.3	10.7	24.1	15,740	116	35.9	7.7
121	44025	641224	4461833	8.87	20691	89.5	10.5	24.0	15,731	117	35.9	7.8
122	44025	640233	4461044	8.86	20669	90.1	9.9	23.5	15,817	105	36.1	7.7
123	44025	639256	4460267	8.87	20713	91.2	8.8	22.5	16,042	63	36.6	7.6
124	44025	638233	4459469	8.85	20620	93.3	6.7	20.7	16,342	29	37.3	7.4
125	44025	646349	4464544	8.91	20741	93.4	6.6	20.7	16,452	20	37.5	7.5
126	44025	645358	4463755	8.90	20718	91.6	8.4	22.2	16,123	53	36.8	7.6
127	44025	644372	4462945	8.89	20722	90.6	9.4	23.0	15,947	76	36.4	7.7
128	44025	643381	4462156	8.87	20680	89.9	10.1	23.6	15,802	110	36.1	7.7
129	44025	642396	4461366	8.87	20680	90.1	9.9	23.5	15,822	102	36.1	7.7
130	44025	641405	4460577	8.87	20706	90.5	9.5	23.1	15,928	78	36.3	7.7
131	44025	640445	4459793	8.86	20667	91.6	8.4	22.2	16,088	59	36.7	7.6
132	44025	639416	4458997	8.86	20692	93.6	6.4	20.5	16,460	17	37.6	7.4
133	44025	647524	4464076	8.92	20800	95.9	4.1	18.5	16,953	2	38.7	7.2
134	44025	646533	4463286	8.91	20763	94.2	5.8	19.9	16,623	11	37.9	7.4
135	44025	645559	4462473	8.91	20780	93.6	6.4	20.5	16,518	15	37.7	7.4
136	44025	644568	4461683	8.88	20706	93.0	7.0	21.0	16,355	28	37.3	7.5
137	44025	643583	4460893	8.87	20679	92.7	7.3	21.2	16,284	40	37.2	7.5
138	44025	642592	4460104	8.86	20665	92.7	7.3	21.2	16,280	42	37.1	7.5
139	44025	641602	4459294	8.88	20732	93.1	6.9	20.9	16,397	24	37.4	7.4
140	44025	640589	4458530	8.88	20724	94.3	5.7	19.9	16,607	12	37.9	7.3

Table A20. REpower 700-MW 12x24 Net Energy Matrix

Project:	NYSERDA - Offshore LI
EPE Completion Date:	5-Apr-2010
Prepared By:	AWS Truepower, LLC
Comments:	Net Energy Output Matrix (MW)
Turbine Model:	REPower 5MW
Turbine Rated Power:	5.0 MW
Hub Height:	90
Number of Turbines:	140
Plant Capacity:	700 MW
Net Annual Energy Output:	2,249,176 MWh
Net Capacity Factor:	36.7%

AWS Truepower
Where science delivers performance.

Hour	Month												Average (MWh)	Total (MWh)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
0	324.87	305.14	261.33	196.53	168.36	219.61	158.52	153.17	217.38	258.37	316.68	315.74	240.87	87,977
1	350.26	326.62	265.46	270.48	197.12	169.13	143.70	155.94	215.54	237.14	303.88	332.60	246.81	90,147
2	353.71	321.14	269.04	253.43	192.28	141.31	128.54	147.14	239.60	230.14	299.71	336.55	242.23	88,473
3	359.81	312.96	266.75	256.84	199.97	156.20	133.96	168.92	210.11	251.27	313.95	339.27	247.15	90,273
4	358.40	323.41	265.93	248.58	205.72	139.74	122.33	141.85	222.76	277.62	310.21	327.69	244.93	89,460
5	371.93	344.38	248.05	282.82	193.84	142.87	124.40	122.59	201.51	294.38	320.89	335.26	247.98	90,575
6	374.58	373.64	285.05	276.47	192.85	148.51	115.94	153.29	208.96	286.27	321.77	324.56	254.44	92,935
7	385.51	366.39	291.95	282.28	182.89	143.63	126.01	132.09	225.34	318.49	301.25	326.35	256.23	93,588
8	367.73	368.05	313.46	260.54	164.85	122.64	108.91	127.43	216.72	297.76	287.80	329.99	246.52	90,042
9	365.59	365.85	299.13	289.13	195.51	120.92	102.55	112.78	207.56	272.44	284.72	365.19	247.82	90,515
10	353.16	329.60	263.60	258.50	185.61	110.28	91.78	117.85	197.62	238.22	269.94	370.28	231.72	84,637
11	350.55	281.11	260.65	227.27	165.30	128.45	92.20	132.11	179.43	240.15	291.54	324.68	222.53	81,277
12	327.37	263.39	281.19	239.93	175.58	154.03	145.42	122.07	163.29	212.62	275.23	297.43	221.29	80,827
13	299.94	270.79	275.36	259.52	195.99	202.10	160.12	139.39	159.07	234.00	259.51	311.79	230.45	84,170
14	301.42	255.78	280.84	258.46	236.56	246.65	209.43	150.51	165.59	245.62	287.28	329.06	247.29	90,322
15	298.15	257.10	320.47	299.02	302.70	300.25	209.70	169.51	181.29	256.98	280.94	313.16	265.84	97,099
16	302.45	246.95	345.00	366.06	326.91	298.99	217.38	193.85	169.48	291.02	306.39	338.40	283.83	103,669
17	303.98	268.90	334.39	378.69	354.23	325.65	232.20	178.07	183.88	299.04	351.40	336.31	295.60	107,969
18	309.20	296.14	344.11	375.14	335.61	333.97	255.26	165.14	227.27	290.91	344.59	347.19	301.89	110,265
19	336.93	303.08	342.23	354.17	334.63	302.38	248.63	193.38	206.10	271.16	347.14	350.97	299.17	109,271
20	344.21	303.49	353.77	351.34	289.50	263.57	227.51	169.45	200.95	278.19	321.30	363.55	288.84	105,500
21	339.78	301.68	326.61	314.81	245.27	242.91	180.62	168.63	186.96	266.47	337.09	379.38	274.02	100,084
22	335.50	313.51	292.49	270.39	219.62	232.15	176.00	166.11	209.77	266.08	329.34	371.86	264.92	96,763
23	322.11	326.79	293.11	239.74	212.78	236.09	162.72	154.37	201.27	282.96	294.96	344.28	255.54	93,336
Average (MWh)	339.05	309.41	295.00	283.76	228.07	203.42	161.41	151.48	199.89	266.55	306.56	337.98	256.58	
Total (MWh)	252,251	209,781	219,479	204,304	169,684	146,460	120,089	112,704	143,924	198,316	220,725	251,458		2,249,176

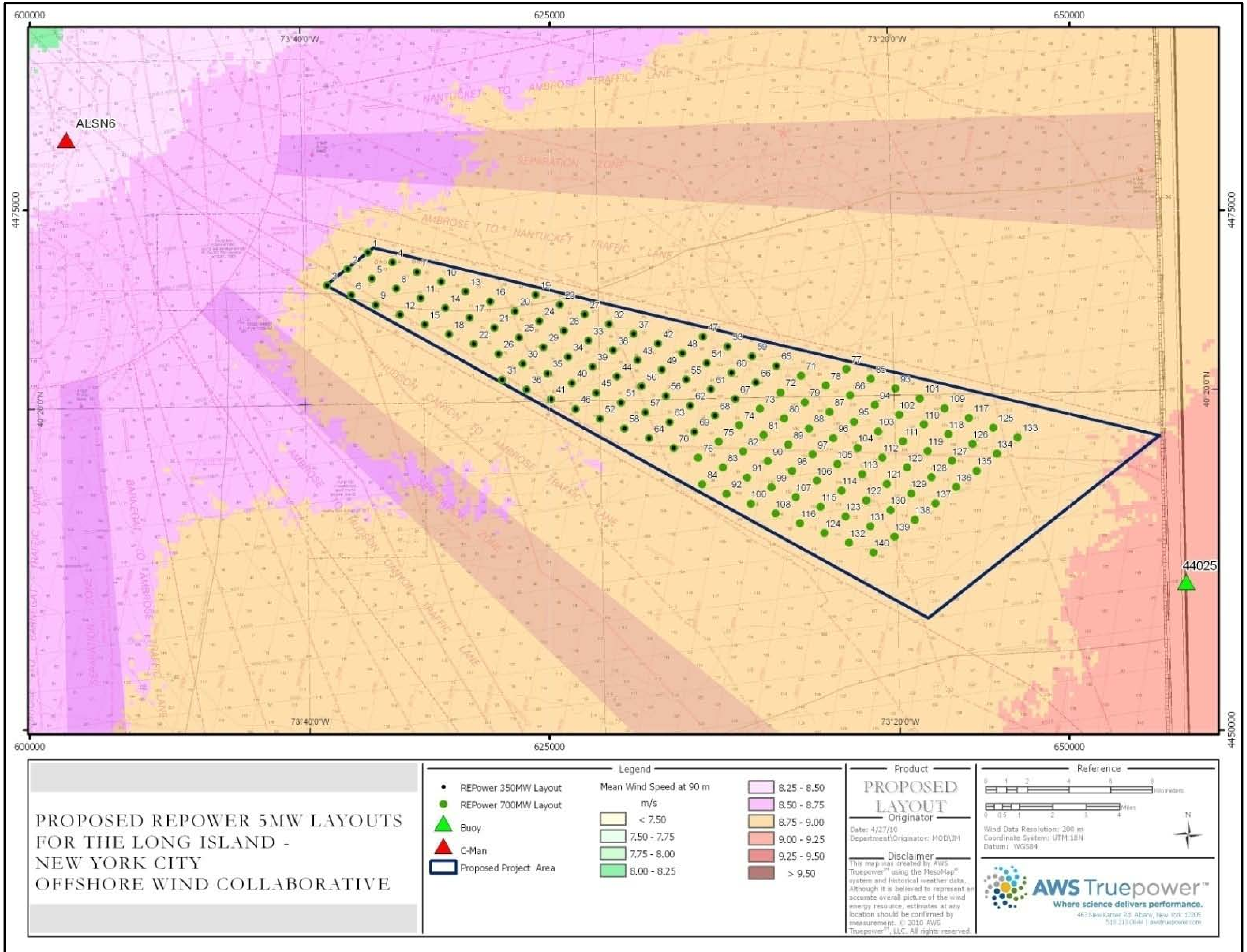

Figure A4. Proposed Long Island – New York City Offshore REpower Turbine Layouts

SIEMENS 3.6-MW ENERGY ESTIMATES

Table A21. Siemens 350-MW Wind Speed and Energy Production Detail

Project:	**NYSERDA - Offshore LI**	
Date:	**5-Apr-10**	
Comments:		
Turbine Model:	**Siemens 3.6MW 120m RD**	
Turbine Rated Power:	**3.60**	**MW**
Hub Height:	**90**	**m**
Number of Turbines:	**97**	
Plant Capacity:	**349.2**	**MW**
Site Air Density:	**1.240**	**kg/m^3**

Loss Accounting	
Wake Effect	**6.6%**
Availability	**5.9%**
Electrical	**4.1%**
Turbine Performance	**2.3%**
Environmental	**4.6%**
Curtailments	**0.0%**
Average Total Loss	**21.4%**

Overall Wind Plant Summary	
Average Free Wind Speed (m/s)	**8.84**
Gross Plant Production (MWh/yr)	**1,612,799**
Net Plant Production (MWh/yr)	**1,267,537**
Net Capacity Factor	**41.4%**

Per Turbine Summary

Turbine ID	Mast Association	Coordinates (WGS84 UTM18) Easting (m)	Northing (m)	Free Spd (m/s)	Gross MWh/yr	% Array Eff	% Array Loss	% Total Loss	Net MWh/yr	Turbine Rank	Net Capacity Factor (%)	Turbulence Intensity (%)
1	ALSN6	616189	4472903	8.81	16487	96.8	3.2	18.6	13,418	10	42.5	7.0
2	ALSN6	615245	4472137	8.82	16524	96.6	3.4	18.7	13,426	8	42.5	7.0
3	ALSN6	614316	4471379	8.81	16517	98.5	1.5	17.1	13,690	1	43.4	6.7
4	ALSN6	617307	4472460	8.83	16548	95.4	4.6	19.7	13,283	17	42.1	7.1
5	ALSN6	616367	4471694	8.84	16577	94.9	5.1	20.2	13,235	24	41.9	7.2
6	ALSN6	615435	4470941	8.82	16548	97.1	2.9	18.4	13,507	3	42.8	6.9
7	ALSN6	618426	4472015	8.84	16602	95.0	5.0	20.1	13,261	21	42.0	7.1
8	ALSN6	617488	4471247	8.84	16582	94.3	5.7	20.6	13,158	32	41.7	7.3
9	ALSN6	616542	4470479	8.82	16563	96.8	3.2	18.6	13,481	5	42.7	7.0
10	ALSN6	619543	4471570	8.85	16622	94.5	5.5	20.5	13,207	26	41.8	7.2
11	ALSN6	618611	4470800	8.86	16655	93.9	6.1	21.0	13,152	35	41.7	7.3
12	ALSN6	617663	4470032	8.86	16677	96.3	3.7	19.0	13,510	2	42.8	7.0
13	ALSN6	621609	4471869	8.89	16697	94.3	5.7	20.7	13,249	22	42.0	7.0
14	ALSN6	620665	4471123	8.87	16660	94.0	6.0	21.0	13,169	29	41.7	7.2
15	ALSN6	619729	4470354	8.87	16663	93.7	6.3	21.2	13,135	39	41.6	7.3
16	ALSN6	618781	4469587	8.86	16670	96.1	3.9	19.2	13,473	6	42.7	7.0
17	ALSN6	622733	4471423	8.85	16612	93.3	6.7	21.5	13,036	49	41.3	7.2
18	ALSN6	621787	4470675	8.87	16686	93.3	6.7	21.5	13,097	42	41.5	7.3
19	ALSN6	620852	4469907	8.91	16782	93.3	6.7	21.6	13,162	31	41.7	7.3
20	ALSN6	619905	4469139	8.88	16731	95.7	4.3	19.5	13,460	7	42.7	7.0
21	ALSN6	623853	4470979	8.86	16660	93.3	6.7	21.5	13,077	45	41.4	7.2
22	ALSN6	622912	4470227	8.87	16702	92.7	7.3	22.1	13,019	52	41.3	7.3
23	ALSN6	621979	4469457	8.87	16687	93.2	6.8	21.6	13,082	44	41.5	7.3
24	ALSN6	621027	4468692	8.85	16672	95.3	4.7	19.9	13,357	12	42.3	7.0
25	ALSN6	624972	4470532	8.87	16673	93.0	7.0	21.8	13,035	50	41.3	7.2
26	ALSN6	624036	4469779	8.86	16683	92.1	7.9	22.5	12,923	66	41.0	7.3
27	ALSN6	623103	4469010	8.88	16736	92.5	7.5	22.2	13,025	51	41.3	7.3
28	ALSN6	622150	4468244	8.88	16772	94.1	5.9	20.9	13,273	19	42.1	7.1
29	ALSN6	626086	4470088	8.85	16651	92.9	7.1	21.9	13,003	54	41.2	7.2
30	ALSN6	625155	4469333	8.88	16727	91.9	8.1	22.7	12,935	65	41.0	7.3
31	ALSN6	624219	4468565	8.86	16697	92.4	7.6	22.3	12,973	58	41.1	7.4
32	ALSN6	623269	4467798	8.86	16724	93.3	6.7	21.5	13,122	40	41.6	7.2
33	ALSN6	622320	4467050	8.84	16702	95.5	4.5	19.6	13,420	9	42.5	6.9
34	ALSN6	627208	4469641	8.84	16624	92.6	7.4	22.1	12,943	63	41.0	7.2
35	ALSN6	626276	4468887	8.86	16685	91.6	8.4	23.0	12,855	80	40.7	7.4

Table A21 Cont'd. Siemens 350-MW Wind Speed and Energy Production Detail

Per Turbine Summary												
Turbine ID	Mast Association	Coordinates (WGS84 UTM18) Easting (m)	Northing (m)	Free Spd (m/s)	Gross MWh/yr	% Array Eff	% Array Loss	% Total Loss	Net MWh/yr	Turbine Rank	Net Capacity Factor (%)	Turbulence Intensity (%)
36	ALSN6	625343	4468117	8.85	16663	92.1	7.9	22.6	12,903	69	40.9	7.4
37	ALSN6	624390	4467352	8.84	16674	92.8	7.2	22.0	13,013	53	41.2	7.3
38	ALSN6	623447	4466607	8.85	16702	94.9	5.1	20.2	13,325	14	42.2	7.0
39	44025	629294	4469938	8.84	16572	93.1	6.9	21.7	12,970	59	41.1	7.6
40	44025	628330	4469195	8.86	16591	92.6	7.4	22.1	12,918	67	40.9	7.8
41	44025	627396	4468440	8.84	16577	92.0	8.0	22.6	12,832	84	40.7	7.9
42	44025	626462	4467671	8.82	16552	92.4	7.6	22.3	12,866	76	40.8	7.9
43	44025	625509	4466906	8.82	16591	92.8	7.2	22.0	12,946	62	41.0	7.8
44	44025	624571	4466153	8.80	16552	95.0	5.0	20.1	13,229	25	41.9	7.5
45	44025	630414	4469492	8.84	16585	92.5	7.5	22.2	12,906	68	40.9	7.7
46	44025	629457	4468745	8.86	16625	92.0	8.0	22.7	12,859	77	40.7	7.9
47	44025	628508	4467997	8.83	16556	91.8	8.2	22.8	12,776	88	40.5	8.0
48	44025	627582	4467225	8.83	16577	92.1	7.9	22.5	12,843	82	40.7	7.9
49	44025	626622	4466463	8.81	16554	92.5	7.5	22.2	12,880	73	40.8	7.9
50	44025	625687	4465704	8.78	16533	94.8	5.2	20.2	13,186	27	41.8	7.6
51	44025	631535	4469046	8.87	16631	92.5	7.5	22.2	12,935	64	41.0	7.7
52	44025	630588	4468295	8.85	16600	91.5	8.5	23.0	12,775	89	40.5	7.9
53	44025	629637	4467548	8.83	16561	91.5	8.5	23.0	12,748	94	40.4	8.0
54	44025	628711	4466775	8.83	16575	92.0	8.0	22.6	12,824	86	40.6	7.9
55	44025	627747	4466014	8.81	16558	92.4	7.6	22.3	12,866	75	40.8	7.9
56	44025	626802	4465258	8.79	16526	94.7	5.3	20.3	13,167	30	41.7	7.6
57	44025	632653	4468600	8.86	16590	92.4	7.6	22.3	12,894	70	40.9	7.7
58	44025	631708	4467848	8.83	16561	91.3	8.7	23.3	12,710	97	40.3	7.9
59	44025	630762	4467099	8.86	16641	91.2	8.8	23.3	12,771	91	40.5	8.0
60	44025	629838	4466326	8.81	16545	91.7	8.3	22.8	12,766	92	40.5	8.0
61	44025	628871	4465566	8.80	16526	92.4	7.6	22.3	12,841	83	40.7	7.9
62	44025	627933	4464811	8.79	16538	94.5	5.5	20.5	13,147	37	41.7	7.6
63	44025	633793	4468166	8.88	16659	92.5	7.5	22.2	12,963	60	41.1	7.7
64	44025	632818	4467406	8.85	16598	91.3	8.7	23.2	12,748	93	40.4	7.9
65	44025	631886	4466651	8.86	16644	91.0	9.0	23.4	12,743	95	40.4	8.0
66	44025	630962	4465878	8.82	16586	91.3	8.7	23.3	12,730	96	40.3	8.0
67	44025	629997	4465118	8.82	16594	91.9	8.1	22.7	12,828	85	40.6	7.9
68	44025	629050	4464364	8.76	16477	93.5	6.5	21.3	12,962	61	41.1	7.8
69	44025	635850	4468488	8.88	16652	93.7	6.3	21.2	13,122	41	41.6	7.6
70	44025	634916	4467718	8.89	16684	92.6	7.4	22.1	12,991	55	41.2	7.8
71	44025	633943	4466958	8.88	16690	91.8	8.2	22.8	12,891	72	40.8	7.9
72	44025	633007	4466205	8.85	16649	91.3	8.7	23.2	12,779	87	40.5	7.9
73	44025	632080	4465433	8.83	16616	91.4	8.6	23.1	12,773	90	40.5	8.0
74	44025	631117	4464671	8.82	16603	92.1	7.9	22.6	12,855	79	40.7	7.9
75	44025	630181	4463953	8.80	16589	93.1	6.9	21.7	12,986	56	41.1	7.8
76	44025	629255	4463175	8.78	16565	95.3	4.7	19.9	13,276	18	42.1	7.5
77	44025	636968	4468042	8.88	16667	93.8	6.2	21.1	13,142	38	41.6	7.6
78	44025	636033	4467273	8.87	16654	92.6	7.4	22.1	12,976	57	41.1	7.8
79	44025	635067	4466510	8.85	16621	92.2	7.8	22.4	12,891	71	40.8	7.9
80	44025	634131	4465757	8.87	16700	91.5	8.5	23.1	12,848	81	40.7	7.9
81	44025	633204	4464985	8.86	16680	91.8	8.2	22.8	12,875	74	40.8	7.9
82	44025	632217	4464233	8.81	16603	92.1	7.9	22.6	12,855	78	40.7	7.9
83	44025	631302	4463506	8.83	16674	93.2	6.8	21.6	13,071	46	41.4	7.8
84	44025	630370	4462751	8.80	16601	95.1	4.9	20.1	13,272	20	42.1	7.5
85	44025	638090	4467588	8.85	16609	94.4	5.6	20.6	13,185	28	41.8	7.6
86	44025	637157	4466826	8.86	16648	93.3	6.7	21.5	13,062	47	41.4	7.8
87	44025	636203	4466057	8.87	16686	93.2	6.8	21.6	13,085	43	41.5	7.8
88	44025	635254	4465309	8.87	16699	93.0	7.0	21.8	13,060	48	41.4	7.8
89	44025	634337	4464533	8.84	16658	93.9	6.1	21.0	13,153	34	41.7	7.7
90	44025	633335	4463788	8.84	16649	93.9	6.1	21.0	13,148	36	41.7	7.6
91	44025	632424	4463059	8.81	16621	94.1	5.9	20.9	13,153	33	41.7	7.6
92	44025	631490	4462305	8.80	16619	95.6	4.4	19.6	13,362	11	42.3	7.5
93	44025	639219	4467138	8.85	16604	96.7	3.3	18.7	13,501	4	42.8	7.4
94	44025	638279	4466413	8.86	16644	95.4	4.6	19.8	13,353	13	42.3	7.5
95	44025	637330	4465608	8.84	16643	94.9	5.1	20.2	13,289	16	42.1	7.6
96	44025	636375	4464862	8.86	16689	94.4	5.6	20.6	13,247	23	42.0	7.6
97	44025	635478	4464079	8.85	16670	95.0	5.0	20.1	13,314	15	42.2	7.5

Table A22. Siemens 350-MW 12x24 Net Energy Matrix

Project: NYSERDA - Offshore LI
EPE Completion Date: 5-Apr-2010
Prepared By: AWS Truepower, LLC
Comments: Net Energy Output Matrix (MW)
Turbine Model: Siemens 3.6MW 120m RD
Turbine Rated Power: 3.6 MW
Hub Height: 90
Number of Turbines: 97
Plant Capacity: 349.2 MW
Net Annual Energy Output: 1,267,537 MWh
Net Capacity Factor: 41.4%

AWS Truepower
Where science delivers performance.

Hour	Month												Average (MWh)	Total (MWh)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
0	172.36	167.33	145.76	115.61	100.98	136.13	100.15	96.69	125.44	145.02	171.36	168.23	136.86	49,988
1	187.05	178.88	148.81	154.11	118.70	110.08	88.98	98.78	124.75	135.23	165.70	178.80	140.56	51,339
2	190.07	176.22	147.44	145.43	116.48	91.53	78.53	93.34	135.26	133.80	161.38	183.21	137.48	50,215
3	189.71	170.98	147.04	146.42	118.31	97.60	83.05	104.34	117.84	140.56	171.23	185.96	139.25	50,861
4	192.70	175.66	146.65	141.09	122.99	87.57	77.09	89.63	123.33	154.82	168.55	181.19	138.25	50,496
5	196.85	186.74	140.11	161.94	118.69	88.29	79.47	77.72	113.81	162.62	174.92	182.34	140.00	51,136
6	198.77	205.41	156.99	158.03	113.94	93.34	73.41	93.33	118.12	159.23	173.99	177.52	143.12	52,275
7	206.12	203.25	159.83	161.05	108.43	92.51	76.11	84.94	126.25	169.60	163.67	178.19	143.81	52,526
8	197.27	202.79	173.65	149.55	96.35	76.71	68.26	79.49	121.42	162.68	154.55	183.15	138.49	50,582
9	197.76	206.73	167.73	161.01	110.21	75.29	64.03	70.57	116.20	155.23	155.87	195.94	139.35	50,897
10	192.29	183.58	150.28	146.31	104.65	71.70	59.81	72.31	111.73	133.70	147.48	196.59	130.60	47,701
11	194.67	155.36	149.19	130.49	95.41	81.65	60.22	77.98	98.07	134.26	161.43	175.40	126.05	46,039
12	183.09	147.14	156.05	134.06	101.29	98.52	89.64	75.60	92.47	121.98	152.48	160.21	125.96	46,006
13	168.33	151.55	153.11	149.53	117.68	123.55	96.63	84.38	88.32	133.81	147.81	168.92	131.87	48,166
14	165.20	143.89	153.08	147.64	139.35	146.19	127.70	89.40	94.51	142.82	159.23	178.13	140.61	51,358
15	162.55	138.64	178.16	168.54	177.27	173.16	129.16	103.63	102.76	149.23	158.70	171.42	151.20	55,226
16	166.58	133.87	191.75	202.86	188.93	172.89	135.47	114.19	97.32	163.04	169.18	182.83	160.10	58,475
17	169.19	145.65	189.09	205.24	200.65	182.75	141.68	105.89	104.11	167.91	189.84	181.51	165.38	60,406
18	166.98	160.42	183.29	204.15	189.29	185.86	152.76	98.81	130.86	164.64	184.77	187.81	167.43	61,152
19	182.45	166.18	177.94	190.03	183.92	170.83	150.61	114.03	118.48	150.65	186.56	192.06	165.29	60,373
20	180.34	165.58	192.22	185.82	166.24	153.51	139.00	103.89	116.47	157.25	171.29	199.25	160.91	58,774
21	179.86	163.92	178.22	167.39	142.03	144.32	111.01	106.33	111.24	151.10	182.18	204.45	153.45	56,048
22	181.16	169.85	160.10	147.62	131.72	138.00	108.56	104.07	122.38	150.14	181.70	202.00	149.65	54,659
23	173.12	180.78	160.02	135.63	127.21	143.93	99.66	97.29	116.29	158.11	159.70	186.65	144.66	52,838
Average (MWh)	183.10	170.02	162.77	158.73	132.95	122.33	99.62	93.19	113.64	149.89	167.23	183.41	144.60	
Total (MWh)	136,228	115,272	121,102	114,287	98,912	88,077	74,120	69,335	81,823	111,520	120,407	136,454		1,267,537

Table A23. Siemens 700-MW Wind Speed and Energy Production Detail

Project:	NYSERDA - Offshore LI	
Date:	5-Apr-10	
Comments:		
Turbine Model:	Siemens 3.6MW 120m RD	
Turbine Rated Power:	3.60	MW
Hub Height:	90	m
Number of Turbines:	194	
Plant Capacity:	698.4	MW
Site Air Density:	1.240	kg/m^3

Loss Accounting	
Wake Effect	8.1%
Availability	5.9%
Electrical	4.1%
Turbine Performance	2.3%
Environmental	4.6%
Curtailments	0.0%
Average Total Loss	**22.7%**

Overall Wind Plant Summary	
Average Free Wind Speed (m/s)	8.86
Gross Plant Production (MWh/yr)	3,232,035
Net Plant Production (MWh/yr)	2,499,493
Net Capacity Factor	40.8%

Per Turbine Summary

Turbine ID	Mast Association	Coordinates (WGS84 UTM18) Easting (m)	Northing (m)	Free Spd (m/s)	Gross MWh/yr	% Array Eff	% Array Loss	% Total Loss	Net MWh/yr	Turbine Rank	Net Capacity Factor (%)	Turbulence Intensity (%)
1	ALSN6	616189	4472903	8.81	16487	96.7	3.3	18.6	13,414	10	42.5	7.0
2	ALSN6	615245	4472137	8.82	16524	96.6	3.4	18.8	13,423	9	42.5	7.0
3	ALSN6	614316	4471379	8.81	16517	98.5	1.5	17.1	13,687	2	43.4	6.7
4	ALSN6	617307	4472460	8.83	16548	95.4	4.6	19.8	13,278	18	42.1	7.1
5	ALSN6	616367	4471694	8.84	16577	94.9	5.1	20.2	13,230	26	41.9	7.2
6	ALSN6	615435	4470941	8.82	16548	97.0	3.0	18.4	13,503	5	42.8	6.9
7	ALSN6	618426	4472015	8.84	16602	94.9	5.1	20.2	13,254	24	42.0	7.1
8	ALSN6	617488	4471247	8.84	16582	94.3	5.7	20.7	13,152	39	41.7	7.3
9	ALSN6	616542	4470479	8.82	16563	96.7	3.3	18.6	13,476	6	42.7	7.0
10	ALSN6	619543	4471570	8.85	16622	94.4	5.6	20.6	13,199	30	41.8	7.2
11	ALSN6	618611	4470800	8.86	16655	93.8	6.2	21.1	13,145	40	41.7	7.3
12	ALSN6	617663	4470032	8.86	16677	96.3	3.7	19.0	13,504	4	42.8	6.9
13	ALSN6	621609	4471869	8.89	16697	94.3	5.7	20.7	13,240	25	42.0	7.0
14	ALSN6	620665	4471123	8.87	16660	93.9	6.1	21.0	13,160	36	41.7	7.2
15	ALSN6	619729	4470354	8.87	16663	93.7	6.3	21.2	13,127	43	41.6	7.3
16	ALSN6	618781	4469587	8.86	16670	96.0	4.0	19.2	13,464	7	42.7	7.0
17	ALSN6	622733	4471423	8.85	16612	93.2	6.8	21.6	13,026	55	41.3	7.2
18	ALSN6	621787	4470675	8.87	16686	93.2	6.8	21.6	13,087	50	41.5	7.3
19	ALSN6	620852	4469907	8.91	16782	93.2	6.8	21.6	13,152	38	41.7	7.3
20	ALSN6	619905	4469139	8.88	16731	95.6	4.4	19.6	13,450	8	42.6	7.0
21	ALSN6	623853	4470979	8.86	16660	93.2	6.8	21.6	13,064	53	41.4	7.2
22	ALSN6	622912	4470227	8.87	16702	92.6	7.4	22.1	13,006	59	41.2	7.3
23	ALSN6	621979	4469457	8.87	16687	93.1	6.9	21.7	13,071	52	41.4	7.3
24	ALSN6	621027	4468692	8.85	16672	95.2	4.8	19.9	13,346	15	42.3	7.0
25	ALSN6	624972	4470532	8.87	16673	92.8	7.2	21.9	13,019	56	41.3	7.2
26	ALSN6	624036	4469779	8.86	16683	92.0	8.0	22.6	12,909	74	40.9	7.3
27	ALSN6	623103	4469010	8.88	16736	92.4	7.6	22.3	13,011	58	41.2	7.3
28	ALSN6	622150	4468244	8.88	16772	94.0	6.0	20.9	13,260	21	42.0	7.1
29	ALSN6	626086	4470088	8.85	16651	92.7	7.3	22.0	12,984	62	41.1	7.2
30	ALSN6	625155	4469333	8.88	16727	91.8	8.2	22.8	12,918	72	40.9	7.3
31	ALSN6	624219	4468565	8.86	16697	92.3	7.7	22.4	12,957	64	41.1	7.4
32	ALSN6	623269	4467798	8.86	16724	93.2	6.8	21.6	13,106	47	41.5	7.2
33	ALSN6	622320	4467050	8.84	16702	95.4	4.6	19.8	13,403	12	42.5	6.9
34	ALSN6	627208	4469641	8.84	16624	92.4	7.6	22.3	12,921	70	40.9	7.2
35	ALSN6	626276	4468887	8.86	16685	91.4	8.6	23.1	12,833	94	40.7	7.4

Table A23 Cont'd. Siemens 700-MW Wind Speed and Energy Production Detail

Per Turbine Summary												
Turbine ID	Mast Association	Coordinates (WGS84 UTM18) Easting (m)	Northing (m)	Free Spd (m/s)	Gross MWh/yr	% Array Eff	% Array Loss	% Total Loss	Net MWh/yr	Turbine Rank	Net Capacity Factor (%)	Turbulence Intensity (%)
36	ALSN6	625343	4468117	8.85	16663	91.9	8.1	22.7	12,880	83	40.8	7.4
37	ALSN6	624390	4467352	8.84	16674	92.6	7.4	22.1	12,990	60	41.2	7.3
38	ALSN6	623447	4466607	8.85	16702	94.7	5.3	20.4	13,303	17	42.2	7.0
39	44025	629294	4469938	8.84	16572	92.8	7.2	21.9	12,937	67	41.0	7.6
40	44025	628330	4469195	8.86	16591	92.4	7.6	22.3	12,889	81	40.8	7.8
41	44025	627396	4468440	8.84	16577	91.8	8.2	22.8	12,804	104	40.6	7.9
42	44025	626462	4467671	8.82	16552	92.2	7.8	22.4	12,841	92	40.7	7.9
43	44025	625509	4466906	8.82	16591	92.6	7.4	22.1	12,921	69	40.9	7.8
44	44025	624571	4466153	8.80	16552	94.9	5.1	20.2	13,206	28	41.8	7.5
45	44025	630414	4469492	8.84	16585	92.2	7.8	22.5	12,860	86	40.8	7.7
46	44025	629457	4468745	8.86	16625	91.7	8.3	22.9	12,820	97	40.6	7.9
47	44025	628508	4467997	8.83	16556	91.5	8.5	23.0	12,741	125	40.4	8.0
48	44025	627582	4467225	8.83	16577	91.9	8.1	22.7	12,813	101	40.6	7.9
49	44025	626622	4466463	8.81	16554	92.3	7.7	22.4	12,852	90	40.7	7.9
50	44025	625687	4465704	8.78	16533	94.6	5.4	20.4	13,159	37	41.7	7.6
51	44025	631535	4469046	8.87	16631	92.0	8.0	22.6	12,876	84	40.8	7.7
52	44025	630588	4468295	8.85	16600	91.1	8.9	23.4	12,720	128	40.3	7.9
53	44025	629637	4467548	8.83	16561	91.2	8.8	23.3	12,703	132	40.3	8.0
54	44025	628711	4466775	8.83	16575	91.7	8.3	22.9	12,784	112	40.5	7.9
55	44025	627747	4466014	8.81	16558	92.1	7.9	22.5	12,832	96	40.7	7.9
56	44025	626802	4465258	8.79	16526	94.5	5.5	20.5	13,135	41	41.6	7.6
57	44025	632653	4468600	8.86	16590	91.9	8.1	22.7	12,820	98	40.6	7.7
58	44025	631708	4467848	8.83	16561	90.8	9.2	23.7	12,642	155	40.1	7.9
59	44025	630762	4467099	8.86	16641	90.8	9.2	23.6	12,709	131	40.3	8.0
60	44025	629838	4466326	8.81	16545	91.3	8.7	23.2	12,711	130	40.3	8.0
61	44025	628871	4465566	8.80	16526	92.0	8.0	22.6	12,790	111	40.5	7.9
62	44025	627933	4464811	8.79	16538	94.2	5.8	20.8	13,103	48	41.5	7.6
63	44025	633793	4468166	8.88	16659	91.7	8.3	22.9	12,847	91	40.7	7.7
64	44025	632818	4467406	8.85	16598	90.5	9.5	23.9	12,638	156	40.0	7.9
65	44025	631886	4466651	8.86	16644	90.4	9.6	24.0	12,654	148	40.1	8.0
66	44025	630962	4465878	8.82	16586	90.6	9.4	23.8	12,645	151	40.1	8.0
67	44025	629997	4465118	8.82	16594	91.4	8.6	23.1	12,762	115	40.4	8.0
68	44025	629050	4464364	8.76	16477	93.1	6.9	21.7	12,899	79	40.9	7.8
69	44025	635850	4468488	8.88	16652	92.2	7.8	22.4	12,919	71	40.9	7.6
70	44025	634916	4467718	8.89	16684	91.2	8.8	23.3	12,795	107	40.5	7.8
71	44025	633943	4466958	8.88	16690	90.6	9.4	23.8	12,717	129	40.3	7.9
72	44025	633007	4466205	8.85	16649	90.2	9.8	24.1	12,634	157	40.0	8.0
73	44025	632080	4465433	8.83	16616	90.5	9.5	23.9	12,647	150	40.1	8.0
74	44025	631117	4464671	8.82	16603	91.3	8.7	23.2	12,750	121	40.4	8.0
75	44025	630181	4463953	8.80	16589	92.4	7.6	22.3	12,898	80	40.9	7.8
76	44025	629255	4463175	8.78	16565	94.8	5.2	20.3	13,205	29	41.8	7.5
77	44025	636968	4468042	8.88	16667	91.7	8.3	22.9	12,858	87	40.7	7.7
78	44025	636033	4467273	8.87	16654	90.7	9.3	23.7	12,701	133	40.2	7.9
79	44025	635067	4466510	8.85	16621	90.3	9.7	24.1	12,620	166	40.0	7.9
80	44025	634131	4465757	8.87	16700	89.9	10.1	24.4	12,631	160	40.0	7.9
81	44025	633204	4464985	8.86	16680	90.3	9.7	24.1	12,665	144	40.1	7.9
82	44025	632217	4464233	8.81	16603	91.1	8.9	23.4	12,722	127	40.3	8.0
83	44025	631302	4463506	8.83	16674	92.2	7.8	22.5	12,928	68	41.0	7.9
84	44025	630370	4462751	8.80	16601	94.3	5.7	20.7	13,164	34	41.7	7.5
85	44025	638090	4467588	8.85	16609	91.8	8.2	22.8	12,820	99	40.6	7.7
86	44025	637157	4466826	8.86	16648	90.4	9.6	24.0	12,654	147	40.1	7.9
87	44025	636203	4466057	8.87	16686	90.3	9.7	24.0	12,675	141	40.2	7.9
88	44025	635254	4465309	8.87	16699	89.9	10.1	24.4	12,630	161	40.0	8.0
89	44025	634337	4464533	8.84	16658	90.2	9.8	24.1	12,645	152	40.1	8.0
90	44025	633335	4463788	8.84	16649	91.0	9.0	23.4	12,751	120	40.4	7.9
91	44025	632424	4463059	8.81	16621	91.6	8.4	23.0	12,805	103	40.6	7.9
92	44025	631490	4462305	8.80	16619	94.2	5.8	20.8	13,163	35	41.7	7.5
93	44025	639219	4467138	8.85	16604	91.6	8.4	22.9	12,800	106	40.6	7.7
94	44025	638279	4466413	8.86	16644	90.4	9.6	24.0	12,656	145	40.1	7.9
95	44025	637330	4465608	8.84	16643	90.1	9.9	24.3	12,607	167	39.9	8.0
96	44025	636375	4464862	8.86	16689	90.0	10.0	24.3	12,632	159	40.0	8.0
97	44025	635478	4464079	8.85	16670	90.1	9.9	24.2	12,629	162	40.0	8.0
98	44025	634505	4463321	8.83	16624	90.8	9.2	23.6	12,692	134	40.2	7.9
99	44025	633551	4462610	8.82	16610	91.6	8.4	23.0	12,793	108	40.5	7.9
100	44025	632602	4461862	8.80	16613	93.9	6.1	21.0	13,123	44	41.6	7.5

Table A23 Cont'd. Siemens 700-MW Wind Speed and Energy Production Detail

Per Turbine Summary												
Turbine ID	Mast Association	Coordinates (WGS84 UTM18) Easting (m)	Northing (m)	Free Spd (m/s)	Gross MWh/yr	% Array Eff	% Array Loss	% Total Loss	Net MWh/yr	Turbine Rank	Net Capacity Factor (%)	Turbulence Intensity (%)
101	44025	640337	4466693	8.86	16637	91.5	8.5	23.0	12,806	102	40.6	7.7
102	44025	639404	4465964	8.87	16680	90.3	9.7	24.0	12,670	142	40.1	7.9
103	44025	638484	4465180	8.85	16646	89.8	10.2	24.5	12,574	176	39.8	8.0
104	44025	637548	4464426	8.83	16618	89.6	10.4	24.7	12,518	190	39.7	8.0
105	44025	636615	4463657	8.83	16626	90.0	10.0	24.3	12,592	169	39.9	8.0
106	44025	635662	4462892	8.83	16633	90.7	9.3	23.7	12,683	138	40.2	7.9
107	44025	634682	4462159	8.82	16614	91.5	8.5	23.0	12,790	110	40.5	7.9
108	44025	633731	4461412	8.81	16610	93.8	6.2	21.1	13,109	46	41.5	7.5
109	44025	641472	4466240	8.88	16650	91.1	8.9	23.4	12,760	116	40.4	7.7
110	44025	640522	4465526	8.85	16621	90.0	10.0	24.3	12,586	171	39.9	7.9
111	44025	639598	4464736	8.84	16613	89.6	10.4	24.6	12,527	189	39.7	8.0
112	44025	638667	4463981	8.85	16669	89.2	10.8	24.9	12,511	191	39.6	8.0
113	44025	637732	4463212	8.84	16644	89.8	10.2	24.5	12,567	177	39.8	8.0
114	44025	636781	4462445	8.83	16624	90.5	9.5	23.9	12,654	146	40.1	7.9
115	44025	635802	4461713	8.81	16597	91.3	8.7	23.2	12,744	124	40.4	7.9
116	44025	634856	4460964	8.81	16602	93.7	6.3	21.2	13,081	51	41.5	7.5
117	44025	643564	4466563	8.88	16629	91.9	8.1	22.7	12,853	89	40.7	7.6
118	44025	642592	4465794	8.86	16616	90.7	9.3	23.7	12,681	139	40.2	7.8
119	44025	641671	4465061	8.86	16634	89.8	10.2	24.5	12,566	178	39.8	7.9
120	44025	640720	4464289	8.86	16659	89.6	10.4	24.7	12,551	182	39.8	8.0
121	44025	639788	4463534	8.86	16677	89.0	11.0	25.2	12,479	192	39.5	8.0
122	44025	638855	4462764	8.86	16675	89.6	10.4	24.7	12,563	180	39.8	8.0
123	44025	637903	4461999	8.84	16647	90.2	9.8	24.1	12,633	158	40.0	7.9
124	44025	636913	4461270	8.82	16603	91.3	8.7	23.2	12,748	123	40.4	7.9
125	44025	635980	4460516	8.83	16635	93.5	6.5	21.3	13,089	49	41.5	7.5
126	44025	644693	4466113	8.90	16672	91.5	8.5	23.0	12,832	95	40.7	7.6
127	44025	643716	4465346	8.88	16661	90.5	9.5	23.9	12,676	140	40.2	7.8
128	44025	642786	4464595	8.88	16681	89.6	10.4	24.7	12,566	179	39.8	7.9
129	44025	641842	4463842	8.89	16711	89.5	10.5	24.7	12,579	174	39.9	7.9
130	44025	640908	4463088	8.87	16693	88.8	11.2	25.3	12,473	193	39.5	8.0
131	44025	639974	4462318	8.86	16690	89.3	10.7	24.9	12,533	185	39.7	8.0
132	44025	639021	4461553	8.86	16673	89.8	10.2	24.5	12,590	170	39.9	8.0
133	44025	638037	4460822	8.83	16612	90.8	9.2	23.6	12,687	135	40.2	7.9
134	44025	637101	4460069	8.83	16603	92.7	7.3	22.0	12,950	65	41.0	7.7
135	44025	645820	4465664	8.89	16669	91.7	8.3	22.9	12,856	88	40.7	7.7
136	44025	644846	4464896	8.89	16670	90.3	9.7	24.0	12,665	143	40.1	7.9
137	44025	643912	4464137	8.88	16667	89.6	10.4	24.6	12,562	181	39.8	7.9
138	44025	642969	4463392	8.89	16707	89.5	10.5	24.7	12,578	175	39.9	7.9
139	44025	642020	4462644	8.90	16735	89.0	11.0	25.1	12,527	188	39.7	7.9
140	44025	641094	4461872	8.87	16682	89.3	10.7	24.9	12,534	184	39.7	8.0
141	44025	640134	4461110	8.86	16678	89.8	10.2	24.5	12,600	168	39.9	7.9
142	44025	639161	4460374	8.87	16701	90.9	9.1	23.5	12,776	113	40.5	7.9
143	44025	638225	4459621	8.85	16649	92.1	7.9	22.5	12,900	77	40.9	7.8
144	44025	637298	4458849	8.85	16658	94.6	5.4	20.4	13,256	23	42.0	7.4
145	44025	646955	4465212	8.90	16682	91.8	8.2	22.8	12,884	82	40.8	7.6
146	44025	645970	4464448	8.90	16694	90.3	9.7	24.0	12,685	136	40.2	7.8
147	44025	645037	4463689	8.90	16702	89.6	10.4	24.6	12,585	173	39.9	7.9
148	44025	644100	4462942	8.89	16703	89.6	10.4	24.7	12,586	172	39.9	7.9
149	44025	643149	4462195	8.87	16673	88.9	11.1	25.2	12,470	194	39.5	8.0
150	44025	642223	4461422	8.87	16684	89.3	10.7	24.9	12,535	183	39.7	7.9
151	44025	641259	4460661	8.88	16722	89.9	10.1	24.4	12,649	149	40.1	7.9
152	44025	640298	4459922	8.86	16686	90.9	9.1	23.5	12,758	117	40.4	7.9
153	44025	639348	4459174	8.87	16702	91.9	8.1	22.7	12,913	73	40.9	7.8
154	44025	638431	4458398	8.86	16662	94.2	5.8	20.8	13,198	31	41.8	7.5
155	44025	648086	4464761	8.94	16746	92.2	7.8	22.4	12,989	61	41.2	7.6
156	44025	647099	4463998	8.92	16754	90.6	9.4	23.8	12,767	114	40.5	7.8
157	44025	646155	4463240	8.91	16723	89.9	10.1	24.4	12,644	154	40.1	7.9
158	44025	645220	4462495	8.90	16726	89.8	10.2	24.5	12,627	164	40.0	7.9
159	44025	644274	4461746	8.87	16696	89.2	10.8	25.0	12,528	187	39.7	7.9
160	44025	643350	4460973	8.85	16659	89.4	10.6	24.8	12,531	186	39.7	8.0

Table A23 Cont'd. Siemens 700-MW Wind Speed and Energy Production Detail

Per Turbine Summary												
Turbine ID	Mast Association	Coordinates (WGS84 UTM18) Easting (m)	Northing (m)	Free Spd (m/s)	Gross MWh/yr	% Array Eff	% Array Loss	% Total Loss	Net MWh/yr	Turbine Rank	Net Capacity Factor (%)	Turbulence Intensity (%)
161	44025	642384	4460213	8.86	16679	90.0	10.0	24.3	12,624	165	40.0	7.9
162	44025	641424	4459473	8.88	16704	91.0	9.0	23.4	12,791	109	40.5	7.9
163	44025	640470	4458727	8.87	16699	91.8	8.2	22.7	12,900	78	40.9	7.8
164	44025	639572	4457943	8.89	16735	94.3	5.7	20.7	13,272	20	42.1	7.5
165	44025	649222	4464309	8.95	16799	92.8	7.2	21.9	13,114	45	41.6	7.6
166	44025	648220	4463551	8.94	16794	91.4	8.6	23.1	12,908	75	40.9	7.8
167	44025	647292	4462786	8.91	16738	90.6	9.4	23.8	12,754	118	40.4	7.9
168	44025	646331	4462053	8.92	16771	90.4	9.6	24.0	12,748	122	40.4	7.9
169	44025	645398	4461299	8.90	16744	89.8	10.2	24.5	12,645	153	40.1	7.9
170	44025	644474	4460525	8.87	16694	89.9	10.1	24.4	12,627	163	40.0	7.9
171	44025	643509	4459765	8.87	16705	90.3	9.7	24.1	12,684	137	40.2	7.9
172	44025	642569	4459021	8.87	16691	91.3	8.7	23.2	12,818	100	40.6	7.9
173	44025	641604	4458279	8.89	16735	92.0	8.0	22.7	12,944	66	41.0	7.8
174	44025	640708	4457482	8.88	16691	94.4	5.6	20.6	13,256	22	42.0	7.5
175	44025	650347	4463861	8.99	16887	93.8	6.2	21.1	13,322	16	42.2	7.5
176	44025	649337	4463106	8.96	16827	91.9	8.1	22.7	13,013	57	41.2	7.7
177	44025	648425	4462316	8.94	16787	91.4	8.6	23.1	12,906	76	40.9	7.8
178	44025	647455	4461605	8.93	16797	91.1	8.9	23.4	12,870	85	40.8	7.8
179	44025	646519	4460852	8.92	16783	90.7	9.3	23.7	12,803	105	40.6	7.8
180	44025	645593	4460080	8.90	16735	90.6	9.4	23.8	12,753	119	40.4	7.9
181	44025	644629	4459318	8.86	16667	90.8	9.2	23.6	12,728	126	40.3	7.9
182	44025	643689	4458574	8.86	16661	91.6	8.4	22.9	12,838	93	40.7	7.9
183	44025	642740	4457826	8.87	16680	92.4	7.6	22.3	12,960	63	41.1	7.8
184	44025	641827	4457036	8.91	16770	94.6	5.4	20.4	13,350	14	42.3	7.4
185	44025	651464	4463415	9.00	16916	96.4	3.6	18.9	13,717	1	43.5	7.2
186	44025	650483	4462650	9.00	16909	95.1	4.9	20.0	13,524	3	42.9	7.4
187	44025	649539	4461891	8.96	16833	94.4	5.6	20.6	13,366	13	42.4	7.5
188	44025	648579	4461157	8.95	16803	93.9	6.1	21.0	13,274	19	42.1	7.5
189	44025	647643	4460404	8.93	16793	93.6	6.4	21.3	13,216	27	41.9	7.5
190	44025	646716	4459632	8.90	16729	93.6	6.4	21.2	13,174	33	41.7	7.6
191	44025	645729	4458880	8.85	16631	93.3	6.7	21.5	13,048	54	41.3	7.6
192	44025	644820	4458124	8.87	16677	93.6	6.4	21.3	13,133	42	41.6	7.6
193	44025	643855	4457382	8.89	16716	93.8	6.2	21.1	13,191	32	41.8	7.6
194	44025	642943	4456591	8.89	16721	95.3	4.7	19.8	13,403	11	42.5	7.4

Table A24. Siemens 700-MW 12x24 Net Energy Matrix

Project:	NYSERDA - Offshore LI
EPE Completion Date:	5-Apr-2010
Prepared By:	AWS Truepower, LLC
Comments:	Net Energy Output Matrix (MW)
Turbine Model:	Siemens 3.6MW 120m RD
Turbine Rated Power:	3.6 MW
Hub Height:	90
Number of Turbines:	194
Plant Capacity:	698.4 MW
Net Annual Energy Output:	2,499,493 MWh
Net Capacity Factor:	40.8%

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Where science delivers performance.

Hour	Month												Average (MWh)	Total (MWh)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
0	341.56	330.57	287.51	226.73	197.68	266.14	195.09	188.52	246.47	285.90	339.23	333.74	269.47	98,426
1	370.68	353.75	293.44	303.69	232.58	213.93	173.59	192.75	245.48	266.57	327.65	354.23	276.84	101,115
2	376.31	348.48	291.42	286.47	228.13	177.98	153.63	182.01	266.97	263.16	319.44	362.66	270.90	98,947
3	376.77	338.04	290.34	288.50	232.11	190.45	162.17	204.04	232.44	277.36	338.68	367.55	274.53	100,273
4	381.53	347.54	289.83	277.87	241.35	170.84	150.28	174.96	243.53	306.20	333.41	358.18	272.58	99,560
5	390.72	369.87	275.93	319.13	231.90	172.46	154.82	151.53	224.27	321.77	346.01	360.80	276.02	100,816
6	394.25	406.17	310.39	310.94	223.44	182.01	143.01	182.87	232.90	314.66	344.53	351.17	282.27	103,099
7	408.51	401.43	315.94	317.19	212.60	180.08	148.87	165.48	249.07	336.93	324.00	352.53	283.69	103,617
8	390.88	400.84	343.05	294.35	189.20	149.80	133.06	155.14	239.51	321.78	306.30	362.10	273.17	99,774
9	391.64	408.14	331.23	317.87	217.40	147.01	124.88	137.70	229.32	306.10	308.29	388.45	274.95	100,424
10	381.09	362.76	295.94	288.49	206.68	139.36	116.22	141.46	220.31	263.73	291.60	389.90	257.59	94,086
11	384.68	306.79	293.76	256.94	187.70	159.32	116.96	153.02	193.86	264.96	319.17	347.37	248.46	90,748
12	361.05	290.23	307.97	264.66	199.17	191.84	175.17	147.69	182.18	240.11	301.26	317.31	248.05	90,600
13	331.95	299.08	302.17	294.26	230.83	241.73	189.08	165.12	174.26	263.81	291.17	334.23	259.62	94,825
14	326.54	283.71	302.62	290.74	273.66	287.04	249.93	175.40	185.95	280.93	314.29	352.85	277.00	101,175
15	321.69	274.67	351.86	332.46	348.60	340.71	252.55	202.78	202.27	293.55	312.95	338.91	297.93	108,820
16	329.29	265.04	378.49	401.12	371.96	340.00	264.47	224.08	191.50	321.57	334.42	362.16	315.71	115,311
17	334.24	288.49	373.03	406.46	395.90	360.75	277.18	207.65	205.02	331.35	376.22	359.44	326.48	119,246
18	330.38	317.69	366.03	404.46	373.77	367.29	299.44	193.58	257.46	324.65	366.02	371.68	330.94	120,877
19	361.56	328.63	351.40	376.40	363.89	336.81	295.03	223.72	232.86	297.28	369.79	380.00	326.41	119,220
20	357.99	327.42	380.29	368.70	327.52	301.62	271.91	203.07	229.05	309.93	339.29	394.36	317.61	116,007
21	356.93	324.20	352.34	331.86	279.40	282.94	216.78	207.38	218.09	297.74	360.71	405.03	302.67	110,550
22	359.08	335.86	316.44	291.96	258.22	270.56	211.97	203.00	240.18	295.91	359.19	400.16	294.96	107,733
23	343.09	357.09	318.64	267.34	249.60	282.16	194.85	189.78	228.66	312.18	316.44	369.88	285.40	104,244
Average (MWh)	362.60	336.10	321.67	313.27	261.39	239.70	194.62	182.20	223.82	295.76	330.84	363.11	285.13	
Total (MWh)	269,775	227,878	239,322	225,558	194,472	172,586	144,800	135,555	161,148	220,042	238,202	270,156		2,499,493

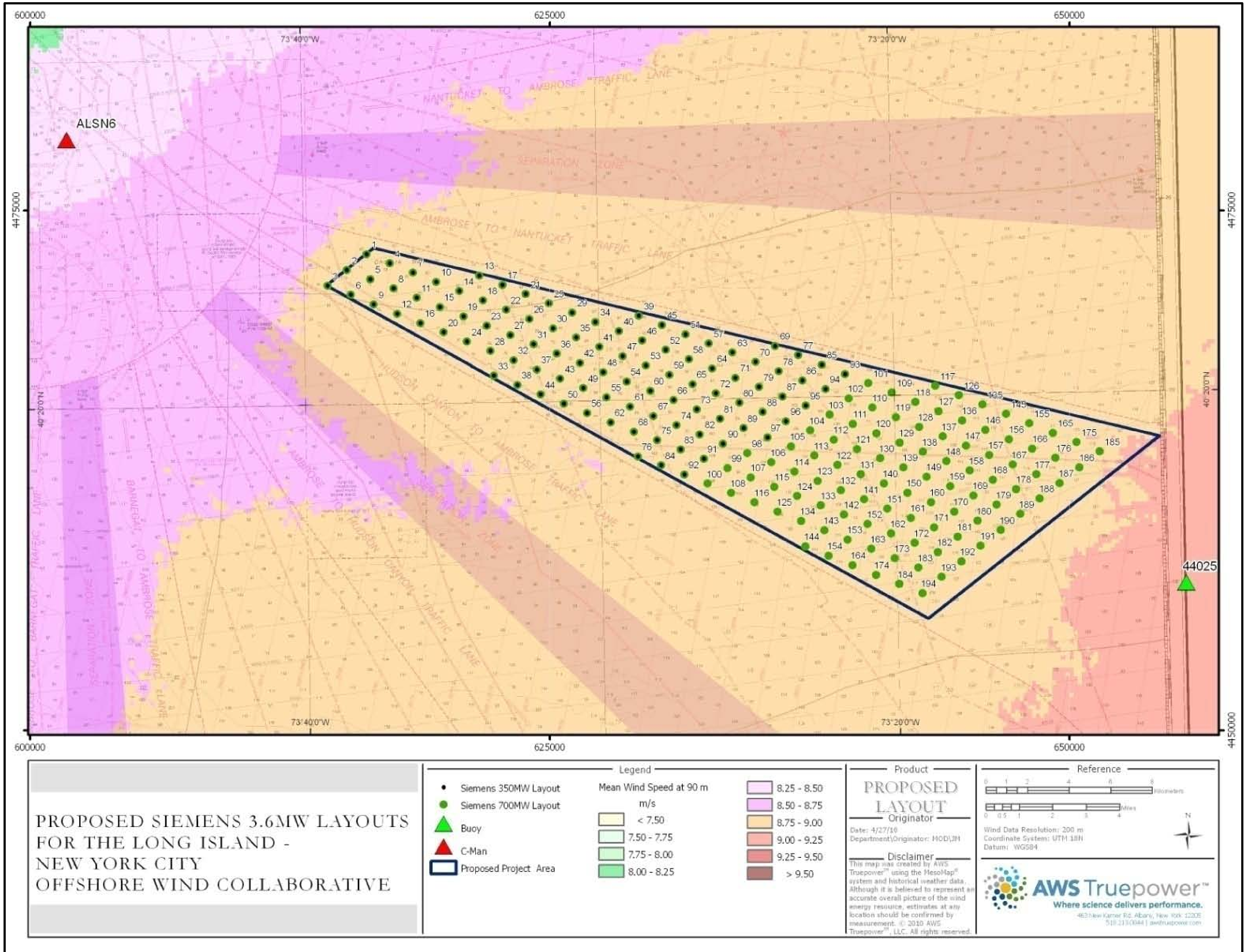

Figure A5. Proposed Long Island – New York City Offshore Siemens Turbine Layouts

APPENDIX B

ENERGY PRODUCTION LOSSES

The summarized loss categories presented in the main report are explained in detail below.

WAKE EFFECT

Wind turbines produce wakes that may reduce the energy production of downwind turbines. Losses due to this wake effect are divided into three categories:

- Internal Wake Effect of the Project – This loss accounts for the wake effect from turbines within the project being studied.
- Wake Effect of Existing or Planned Projects – This loss accounts for the wake effect of neighboring existing or planned projects for which sufficient information was available to make a precise estimate of their impact on the project being studied.
- Wake Effect of Future Projects – If future wind projects at the site appear likely, but insufficient information is available to calculate their effect with precision, an approximate loss may nonetheless be estimated and included in this category.

AVAILABILITY

A plant or turbine is said to be available when it is capable of generating its full rated output, given sufficient wind. Availability losses occur when some turbines in a project, or an entire project, are inoperative for some reason. They are divided into the following categories.

- Availability of Wind Turbines – Data reviewed by AWS Truepower shows that the typical onshore wind plant is likely to average 95% availability in long-term operation. Limited data is available for offshore wind plants; however turbine downtime is expected to be comparable to that of onshore plants. Increased turbine repair time is expected, which is accounted for in the site access loss, described in the Environmental section. Of the implied 5% downtime, AWS Truepower attributes 4.3% to the turbines. Some turbine downtime is traditionally covered under availability warranties (while in effect); the rest, including typically force majeure events, scheduled maintenance, and repair delays due to high winds, is not. The remaining 0.7% downtime is divided between Availability of Collection and Substation, Availability of Utility Grid, and Plant Restart after Grid Outage, which are described below.
- Long-term Availability Correlation with High Wind Event (LACHWE) – This factor accounts for the likelihood that the turbines will experience shutdowns more often in high winds than at other times, resulting in energy losses not accounted for by downtime alone. Shutdowns tend to occur in high winds because that is when turbine components are most likely to exceed limits specified in the control software. AWS Truepower's estimate of this loss, which depends on the turbine type, expected downtime, and capacity factor, is based on detailed study of losses in operating onshore wind projects.
- Availability of Collection and Substation – This loss accounts for outages of the collection system and substation. It is typically assigned a value of 0.2%, which corresponds to 2 events per year of 8 hours average duration.

- Availability of Utility Grid – This loss accounts for outages of the utility grid. It is typically assigned a value of 0.3%, which corresponds to four events per year of 6-hours average duration.
- Plant Restart after Grid Outage – This loss is typically assigned a value of 0.2%, which assumes that 4 utility grid outages per year are accompanied by a 5-hour average standby period while the turbine components are brought within temperature, humidity, and other operating specifications.
- First-Year Plant Availability – This value is typically set to 4% to account for the likelihood of additional turbine and plant downtime during the first year of operation.

ELECTRICAL

- Electrical Efficiency – Losses are experienced in electrical components of the wind project. These losses are established in the electrical system design. A value of 4% is assumed here to account for losses between the low-voltage terminals of the turbine (where the output is measured in a power curve test) and the revenue meter located on land. This value includes losses due to turbine transformers, collections system cabling, offshore sub-station transformer, and high voltage cable between the offshore sub-station and the land based revenue meter.
- Power Consumption of Cold Weather Package – This loss is intended to account of the energy consumed by the equipment in the turbine's Cold-Weather Package, if the turbine is so equipped. Power consumption for site lighting, O&M facilities, and other site facilities not associated with the turbines are not included as loss items and should be considered in the project's financial modeling.

TURBINE PERFORMANCE

- Sub-Optimal Operation – This factor accounts for shortfalls from ideal performance due to suboptimal turbine settings. Typical examples include yaw misalignments, control anemometer calibration, blade pitch inaccuracies or misalignments, and other control setting issues.
- Power curve adjustment – This value accounts for cases where the turbine is not expected to meet the warranted power curve under IEC test conditions. It is typically set to zero. Certain turbulence, shear, and inclined flow conditions occurring in a wind farm may depart from IEC test conditions. These factors are treated separately below.
- High Wind Control Hysteresis – For most turbines, once the wind speed measured on the turbine nacelle exceeds the turbine's design cut-out speed and the machine shuts down, the control software waits until the speed drops below a lower speed threshold (the reset-from-cut-out speed) before allowing the turbine to restart. This loss accounts for the energy lost in this hysteresis loop. It is calculated from wind data collected at the site and the manufacturer's specified cut-out and reset-from-cut-out speeds.
- Wind Shear –If the wind shear at the project site is significantly different from the shear on which the power curve is based, the power production may be affected. AWS Truepower has not found that a correction is necessary for most sites, so this loss is typically set to zero.

- Inclined Flow – This loss has been included to account for the estimated impact of inclined (non-horizontal) flow on power production. Inclined flow affects both the anemometer and the wind turbine, so the loss estimate considers both the anemometer type and the slope at the mast and the turbine locations.

ENVIRONMENTAL

- Icing – This loss reflects decreased rotor aerodynamic efficiency caused by the accumulation of ice during plant operation, as well as turbine shutdowns caused by excessive ice accumulation. The icing losses are estimated from site weather data, including the expected frequency and duration of freezing precipitation and rime ice formation.
- Blade Degradation – This loss reflects the effects of accretion of insects and dirt on the aerodynamic efficiency of the turbine blades. It is estimated from the expected dust and insect accumulation in the area as well as the frequency of rainfall, which cleans blades.
- Low/High Temperature Shutdown – This loss value is chosen based on the energy that will be lost when the turbine shuts down due to temperatures outside the operating design envelope.
- Site Access – Turbine downtime will be larger for offshore projects than typical land based projects due to access constraints. Loss of production results from repair delays when personnel are not able to safely transfer to a failed turbine due to excessive wave heights. The magnitude of this loss is determined using the assumed turbine availability. Since the turbine availability loss is assumed to be higher in the first year, the associated site access loss is also assumed to be higher.
- Lightning – Lightning can damage turbine components and cause electrical faults resulting in shutdowns. This loss is estimated from meteorological data indicating the likely frequency of lightning at the site.

CURTAILMENTS

- Directional Curtailment – If turbines are spaced closer than three rotor diameters from each other, a directional curtailment strategy may be imposed by the manufacturer to limit the fatigue losses on the affected turbines caused by wake-induced turbulence. For such layouts, AWS Truepower estimates a representative loss until a detailed curtailment strategy is specified by the manufacturer. At that time, a more detailed calculation of this loss can be performed.
- PPA Curtailment – If the wind farm is forced to curtail production according to the Power Purchase Agreement (PPA), loss of revenue could result from the sale of energy and or loss of production incentives. Typically, AWS Truepower is not provided with sufficient information to assign a value to this loss. Consequently, it is typically set to zero unless loss data is supplied by the client.

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Pre-Development Assessment of Meteorological and Oceanographic Conditions for the Proposed Long Island – New York City Offshore Wind Project Area

Final Report 10-22 Task 2

State of New York
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