SIMULATIONS

006 Cape Hatteras Lighthouse

Late Afternoon

VISUALIZATION STUDY FOR **OFFSHORE NORTH CAROLINA**

006 Cape Hatteras Lighthouse Simulation, Late Afternoon, Existing Conditions

T. J. Boyle Associates
landscape architects • planning consultants

SIMULATION

006 Cape Hatteras Lighthouse

Late Afternoon

Siemens SWT-3.6-107
10 nm

Simulation

006 Cape Hatteras Lighthouse

Late Afternoon

Siemens SWT-3.6-107

10 nm

GENERAL INFORMATION

Base Photograph

Photo Name: HLA_0001-UV
Date: April 14, 2012
Time: 3:50 PM
GPS Coordinates[1]: lat 35.250515°, long -75.528816°
Viewpoint Elevation: 172'

Sun and Weather

Sun Angle/Azimuth: 258°
Sun Elevation: 33°
Lighting Angle: Side lit
Weather Conditions: Sunny
Visibility[2] : 10 mi
Wave Height: 2 - 4'
Period: 4 sec.

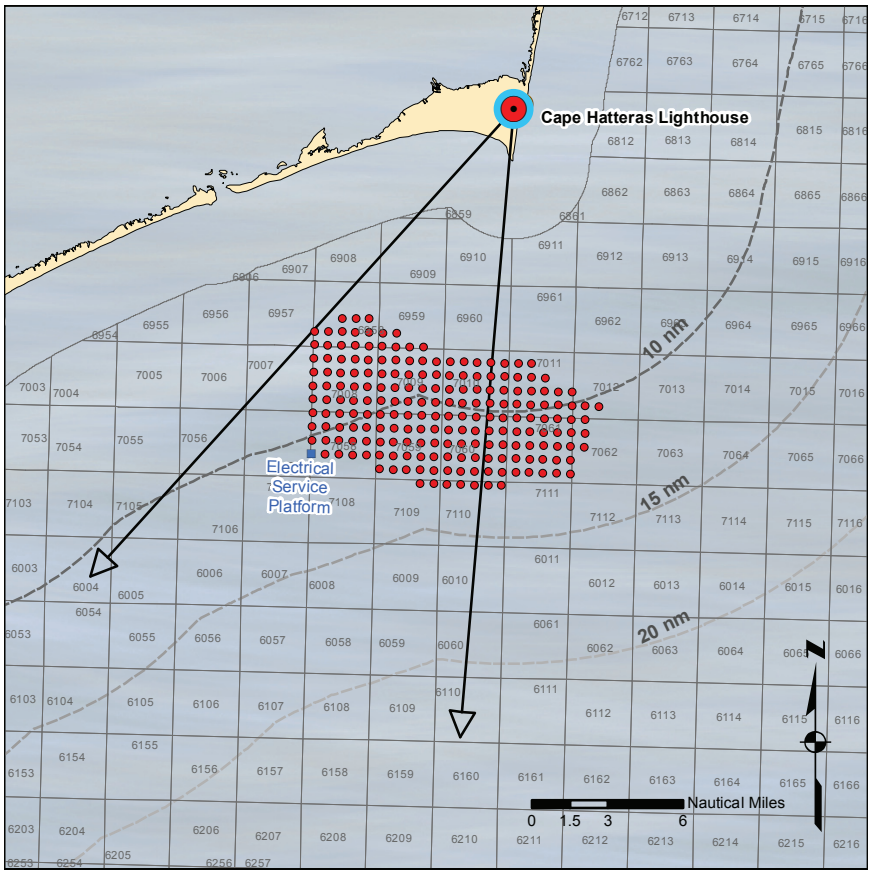
Camera

Camera Make/Model: Nikon D7000
Sensor Dimensions: 23.6 mm X 15.6 mm
Lens Make/Model: Nikkor DX AF-S 35 mm
Lens Focal Length: 35 mm
35 mm Equivalent Focal Length: 52.5 mm
Horizontal and Vertical Angles of View:
37.3° wide and 25.3° high
Camera Height: 1.5 m (5')
Camera Azimuth[3] : 200°

Wind Turbine Information

Number: 200
Make and Model: Siemens SWT-3.6-107
Height/Dimensions:
Support Structure/Monopile Ht.: 13 m (43')
Hub Ht. (above Monopile): 80 m (262')
Rotor Diameter: 107 m (351')
Total Height to Tip of Blade: 147 m (481')
Service Platform: A bldg. 50'H X 100'W X 200' L elevated 50' above the water

CONTEXT MAP



VIEWING INSTRUCTIONS

The simulation is properly printed on an 11" X 17" sheet at actual size. If viewed on a computer monitor, use the highest screen resolution. The simulated image is at the proper perspective when viewed at 23.5" from the eye, or at a distance of approximately twice the image height.

NOTES

- Turbine heights were adjusted to the image's horizon line, which was slightly curved due to camera lens distortion.
- The image was taken with a UV filter.
- Refraction Coefficient[4] (k) = .075

PANORAMA

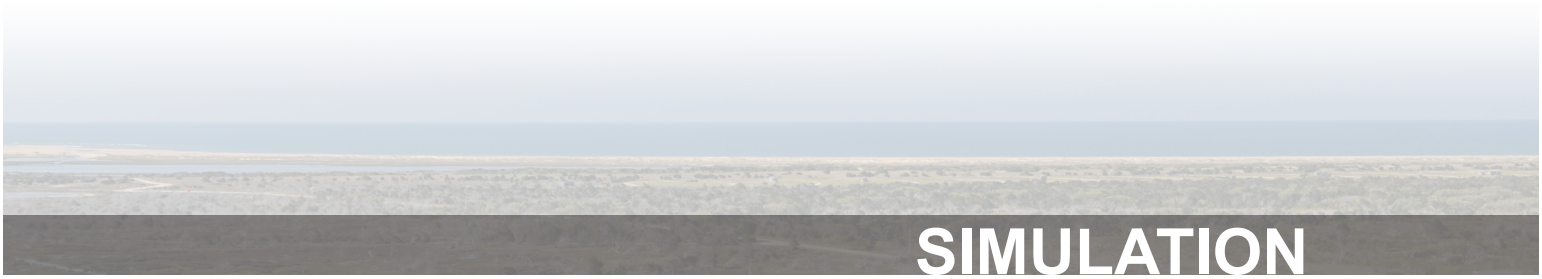
Simulation location within the panorama view (190° X 60°) from the Cape Hatteras Lighthouse site

T. J. Boyle Associates
landscape architects • planning consultants

VISUALIZATION STUDY FOR **OFFSHORE NORTH CAROLINA**

006 Cape Hatteras Lighthouse Simulation, Late Afternoon, Siemens SWT-3.6-107, 10 nm

T. J. Boyle Associates
landscape architects • planning consultants



SIMULATION

006 Cape Hatteras Lighthouse

Late Afternoon

Siemens SWT-3.6-107
15 nm

Simulation

006 Cape Hatteras Lighthouse

Late Afternoon

Siemens SWT-3.6-107

15 nm

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Camera Azimuth[3] : 200°

Wind Turbine Information

Number: 200
Make and Model: Siemens SWT-3.6-107
Height/Dimensions:
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Hub Ht. (above Monopile): 80 m (262')
Rotor Diameter: 107 m (351')
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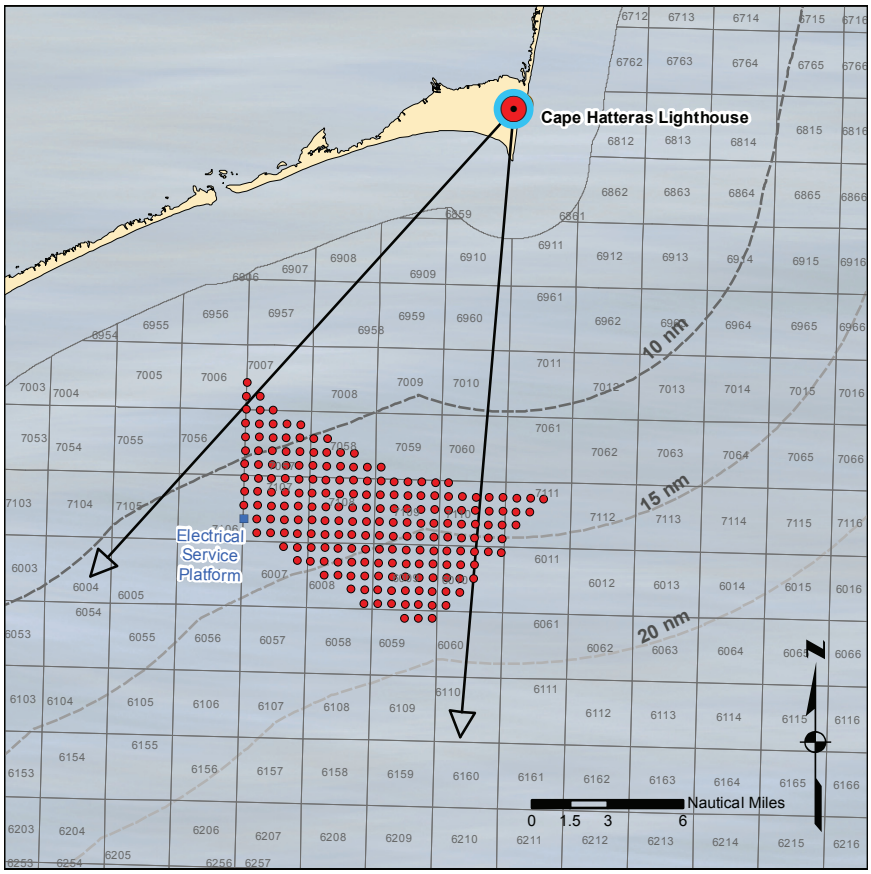
CONTEXT MAP



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NOTES

- Turbine heights were adjusted to the image's horizon line, which was slightly curved due to camera lens distortion.
- The image was taken with a UV filter.
- Refraction Coefficient[4] (k) = .075

PANORAMA

Simulation location within the panorama view (190° X 60°) from the Cape Hatteras Lighthouse site

T. J. Boyle Associates
landscape architects • planning consultants

VISUALIZATION STUDY FOR **OFFSHORE NORTH CAROLINA**

006 Cape Hatteras Lighthouse Simulation, Late Afternoon, Siemens SWT-3.6-107, 15 nm

T. J. Boyle Associates
landscape architects • planning consultants

SIMULATION

006 Cape Hatteras Lighthouse

Late Afternoon

Siemens SWT-3.6-107
20 nm

Simulation

006 Cape Hatteras Lighthouse

Late Afternoon

Siemens SWT-3.6-107

20 nm

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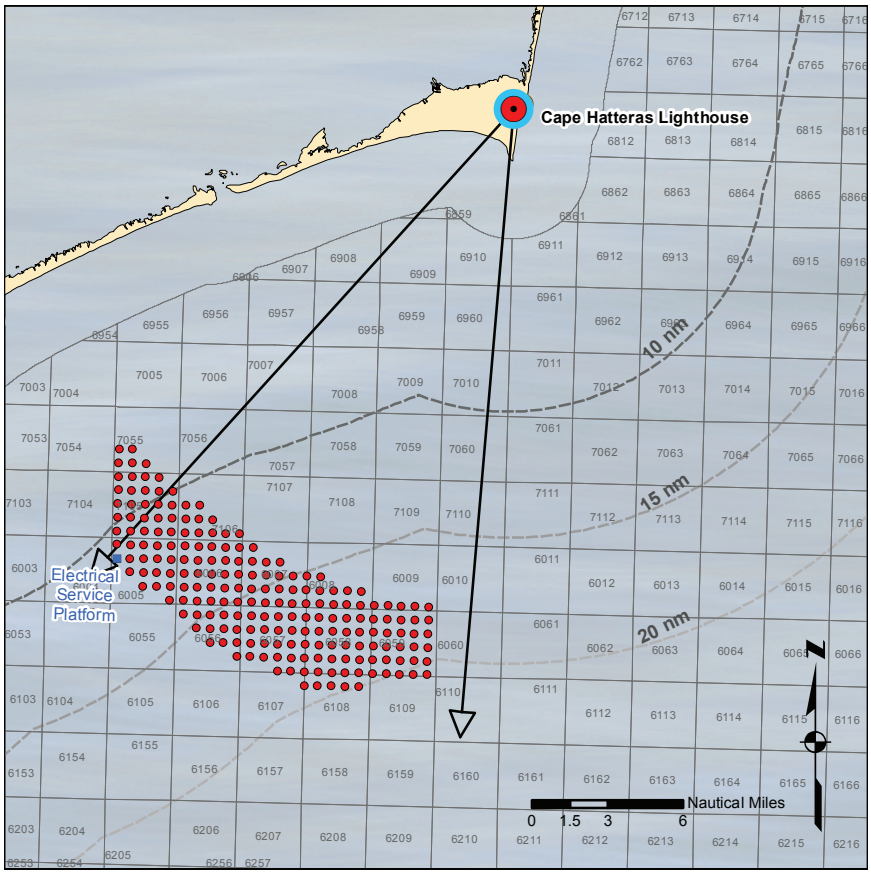

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VISUALIZATION STUDY FOR **OFFSHORE NORTH CAROLINA**

006 Cape Hatteras Lighthouse Simulation, Late Afternoon, Siemens SWT-3.6-107, 20 nm

T. J. Boyle Associates
landscape architects • planning consultants

SIMULATION

006 Cape Hatteras Lighthouse

Late Afternoon

Vestas V164-7.0 MW
10 nm

Simulation

006 Cape Hatteras Lighthouse

Late Afternoon

Vestas V164-7.0 MW

10 nm

GENERAL INFORMATION

Base Photograph

Photo Name: HLA_0001-UV
Date: April 14, 2012
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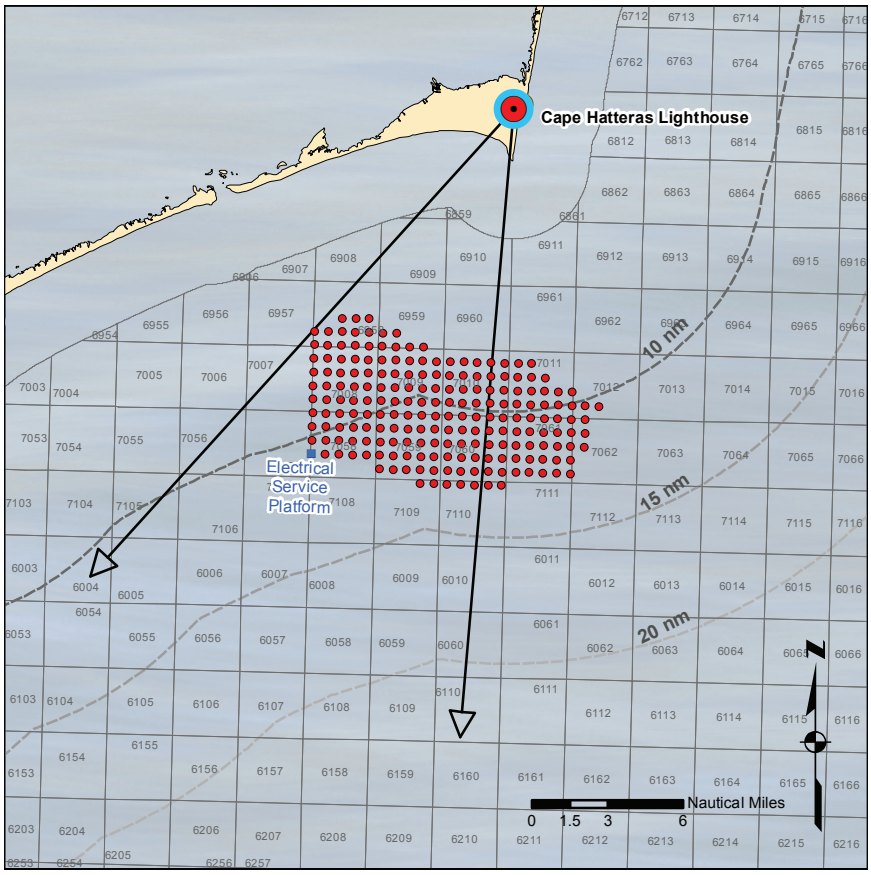
Wind Turbine Information

Number: 200
Make and Model: Vestas V164-7.0 MW
Height/Dimensions:
Support Structure/Monopile Ht.: 13 m (43')
Hub Ht. (above Monopile): 105 m (345')
Rotor Diameter: 164 m (538')
Total Height to Tip of Blade: 200 m (656')
Service Platform: A bldg. 50'H X 100'W X 200' L elevated 50' above the water

CONTEXT MAP



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VISUALIZATION STUDY FOR **OFFSHORE NORTH CAROLINA**

006 Cape Hatteras Lighthouse Simulation, Late Afternoon, Vestas V164-7.0 MW, 10 nm

T. J. Boyle Associates
landscape architects • planning consultants

SIMULATION

006 Cape Hatteras Lighthouse

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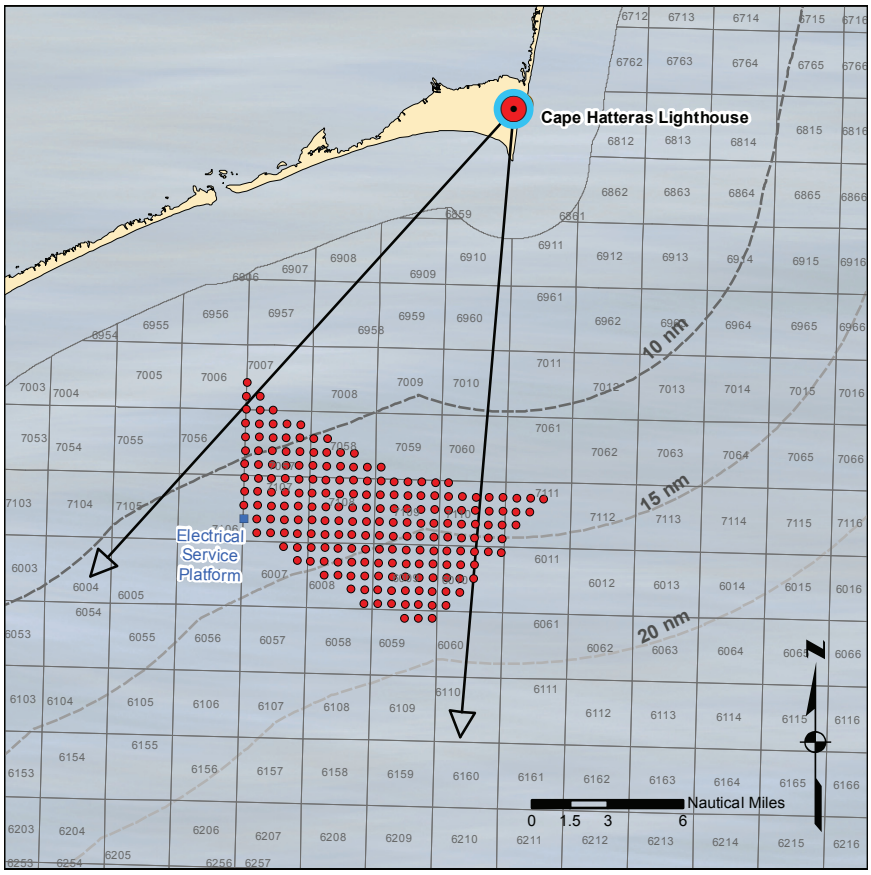

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VISUALIZATION STUDY FOR **OFFSHORE NORTH CAROLINA**

006 Cape Hatteras Lighthouse Simulation, Late Afternoon, Vestas V164-7.0 MW, 15 nm

T. J. Boyle Associates
landscape architects • planning consultants

SIMULATION

006 Cape Hatteras Lighthouse

Late Afternoon

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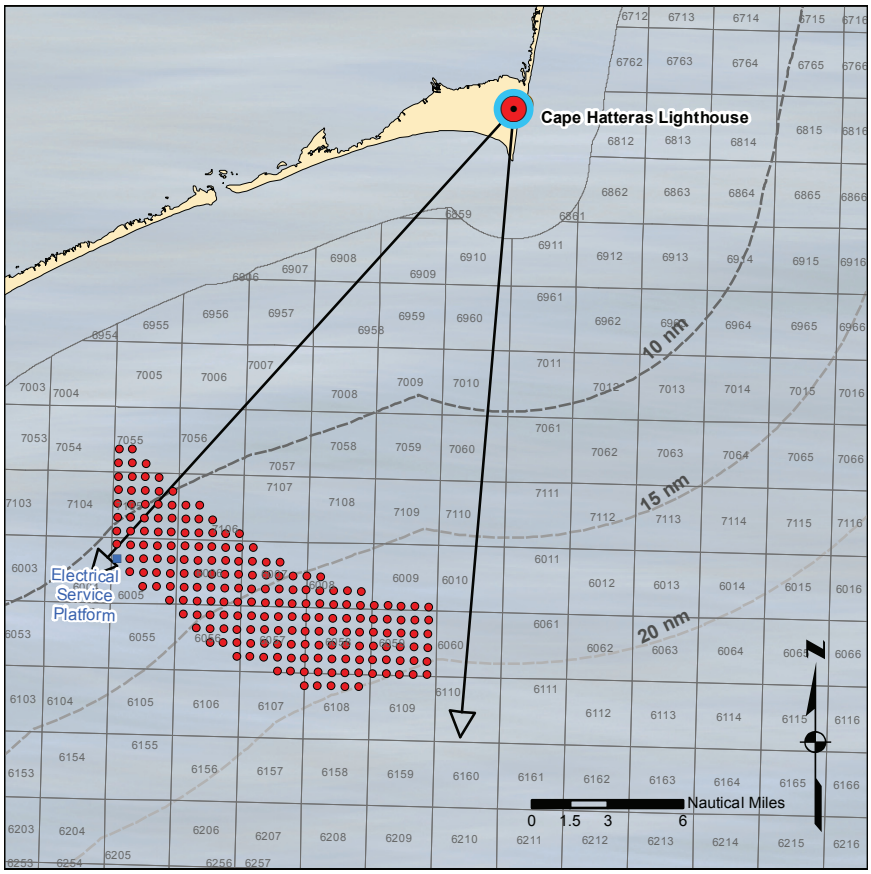

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VISUALIZATION STUDY FOR **OFFSHORE NORTH CAROLINA**

006 Cape Hatteras Lighthouse Simulation, Late Afternoon, Vestas V164-7.0 MW, 20 nm

T. J. Boyle Associates
landscape architects • planning consultants

Footnotes

INFORMATION PAGE FOOTNOTES

[1]GPS Coordinates
Location coordinates as used in WindPRO to register the wireframe diagram to the photograph. Due to slight errors and lens distortion, these values may differ at the fourth significant digit as obtained from a handheld GPS device at the time the photographs were taken and as shown on the Project Location Map.

[2]Visibility
Visibility is obtained from the closest airport weather station (see chart at right). The chart shows which weather station was used for each site. Visibility is measured up to ten statute miles.

[3]Camera Azimuth
Camera azimuth was obtained using a magnetic compass at the time of photography. However magnetic anomalies in the study area make some of these measurements unreliable. The camera azimuth reported here is for true north and reflects the bearing used to register the wind turbines to the photograph in WindPRO.

[4]Refraction Coefficient
The correction for refraction comes from Technical Appendix F Earth Curvature and Refraction of Light, in the report *Visual Representation of Windfarms Good Practice Guidance*, prepared for Scottish Natural Heritage (h+m 2006). The coefficient of refraction k is commonly defined as the ratio between the radius of the earth and the radius of the light in the line of sight between an object and the observer (Hirt 2010). The value reported here is half this value, but it is multiplied by two in the Technical Appendix's equation.

Closest Airport Weather Station to Sites

Site	Weather Station Location NC
001 Corolla Lighthouse	Kill Devil Hills
002 Beach at Duck	Kill Devil Hills
003 Kitty Hawk	Kill Devil Hills
004 Coquina Beach	Kill Devil Hills
005 Bodie Island Lighthouse	Hatteras
006 Cape Hatteras Lighthouse	Hatteras
007 Lighthouse Beach	Hatteras
008 Ocracoke Beach	Hatteras
009 Portsmouth Life Saving Station Tower	Hatteras
010 Long Point Camps	Hatteras
011 Great Island Camps	Beaufort
012 Cape Lookout Lighthouse	Beaufort
013 Cape Point	Beaufort
014 Atlantic Beach	Beaufort
015 Bald Head Island	Southport
016 Oak Island	Southport
017 Holden Beach	Southport
018 Sunset Beach	Southport

ABBREVIATIONS

nm	nautical miles
mi	statute miles
mm	millimeters
m	meters
sec.	seconds
‘	feet
“	inches
°	degrees
lat	latitude
long	longitude

REFERENCES

h+m and envision. 2006. Visual Representation of Windfarms Good Practice Guidance. Scottish Natural Heritage.

Hirt C., Guillaume S., Wisbar A., Bürki B. and Sternberg, H. 2010. Monitoring of the refraction coefficient of the lower atmosphere using a controlled set-up of simultaneous reciprocal vertical angle measurements. Journal of Geophysical Research, 115, D21102, doi:10.1029/2010JD014067