



Environmental Design & Research,
Landscape Architecture, Engineering & Environmental Services, D.P.C.

217 Montgomery Street, Suite 1000, Syracuse, New York 13202
P. 315.471.0688 • F. 315.471.1061 • www.edrdpc.com

memorandum

To: Melanie Gearon **EDR Project No:** 20073
From: Gordon Perkins
Date: July 21, 2020
Reference: South Fork Wind Farm Cumulative Visual Simulations

Introduction

The following memorandum provides the methods and assumptions used for the production of cumulative visual simulations associated with the South Fork Wind Farm (SFWF). The purpose of these visual simulations is to provide BOEM with illustrations of the potential cumulative visual impacts from five representative key observation points (KOPs) located in Rhode Island and Massachusetts.

The specific KOPs utilized for the development of the visual simulations are listed below and illustrated in Image 1.

Panorama Visual Simulations (Image 1)

1. Southeast Light, New Shoreham, Rhode Island
2. Scarborough Beach, Narragansett Rhode Island
3. Newport Cliff Walk, Newport, Rhode Island
4. Gooseberry Island, Westport, Massachusetts
5. Aquinnah Overlook, Aquinnah, Massachusetts

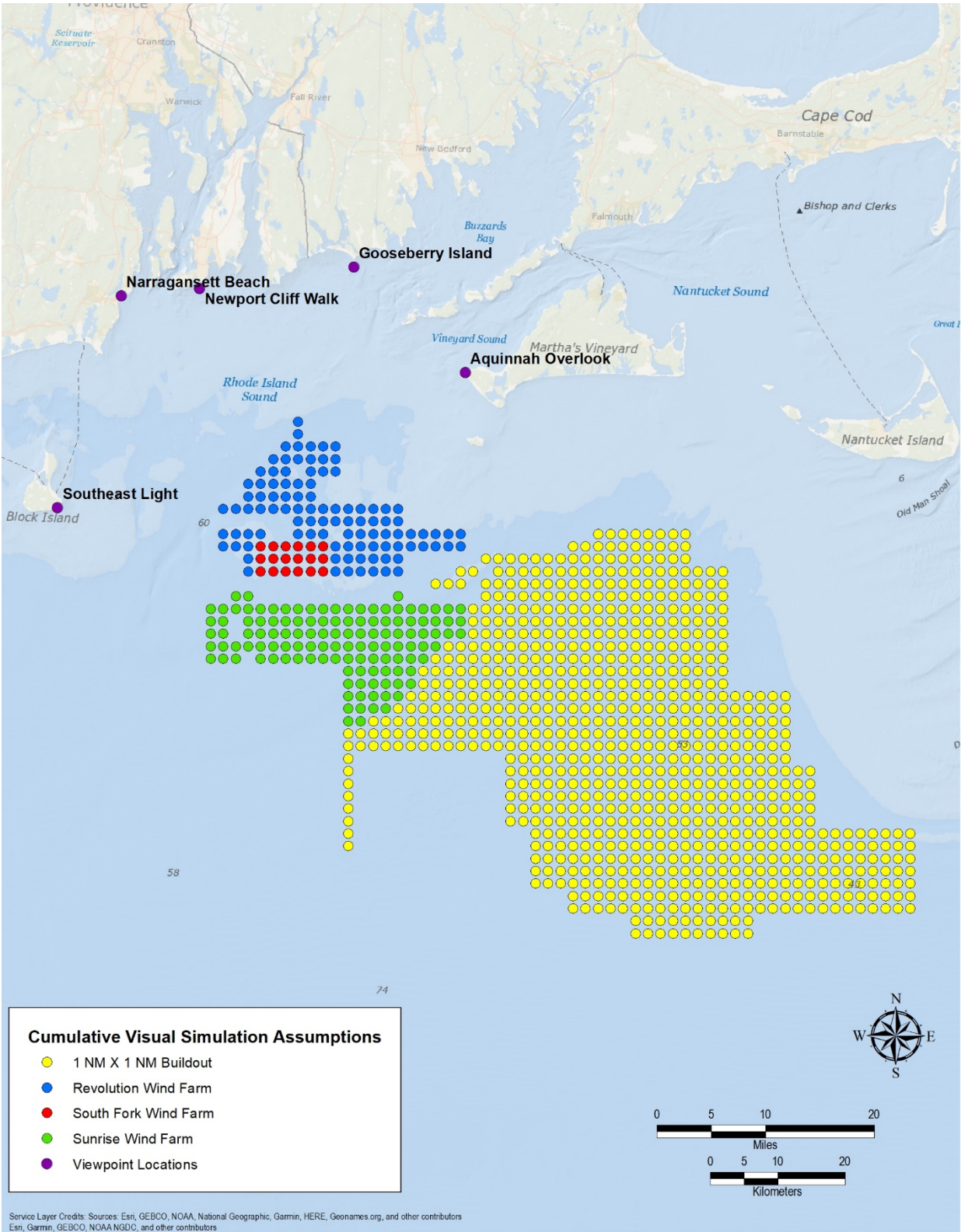


Image 1 – KOP Locations

The visual simulations were developed to illustrate the following Project layout scenarios (Image 3).

1. Existing View (no turbines)
2. South Fork Wind Farm (SFWF)
3. SFWF, Sunrise Wind Farm (SRWF), Revolution Wind Farm (RWF) & Remaining leases populated with 1x1 NM Grid
4. SRWF, RWF & Remaining leases populated with 1x1 NM Grid; no turbines in SFWF

Please note that the visual simulations of the SFWF produced for the Construction and Operations Plan (COP) consider a different turbine layout than the one presented in the cumulative visual simulations. Additionally, at the request of BOEM, the cumulative visual simulations do not consider offshore substations in the respective layouts. Rather, all potential foundation positions will be treated as turbine positions.

Visual Simulations

To illustrate the potential visual impacts associated with the cumulative build-out of the Massachusetts/Rhode Island lease area, high-resolution, computer-enhanced image processing was used to create realistic photographic simulations of the cumulative turbine layout from five representative KOPs. These photographic simulations were developed by constructing a three-dimensional (3D) computer model of the proposed wind turbine generators (WTGs) and Project layouts, based on design specifications and coordinates provided by Ørsted and BOEM. The cumulative visual simulations consider a single WTG model which generally represents a 12-megawatt (MW) unit. A diagram with the dimensions of the computer model of the WTG is shown below in Image 2.

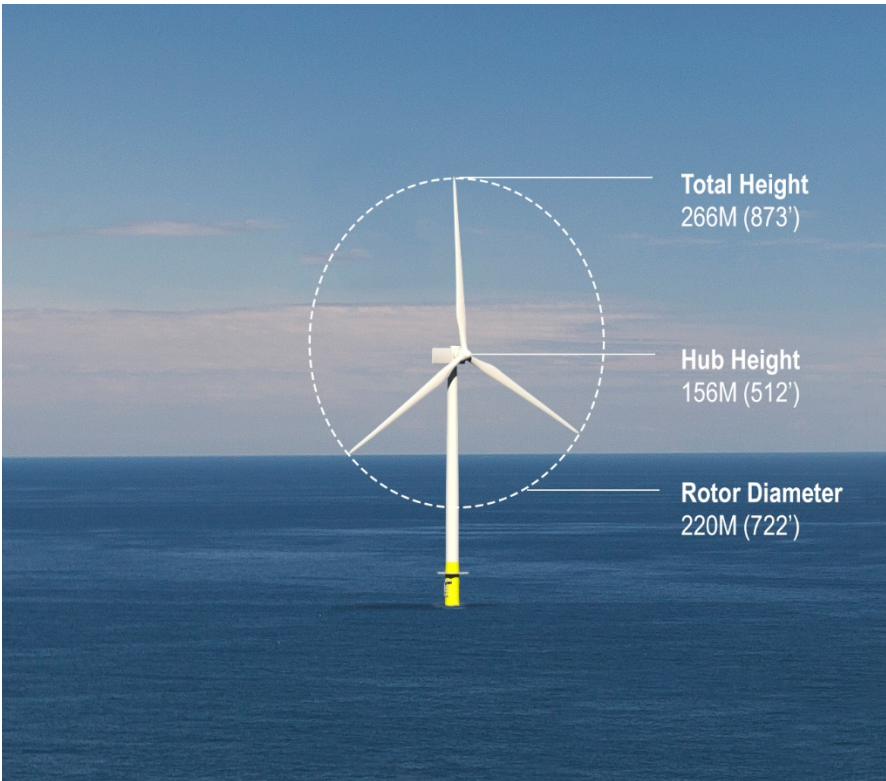


Image 2 – Computer Model of the WTG used in the Cumulative Visual Simulations

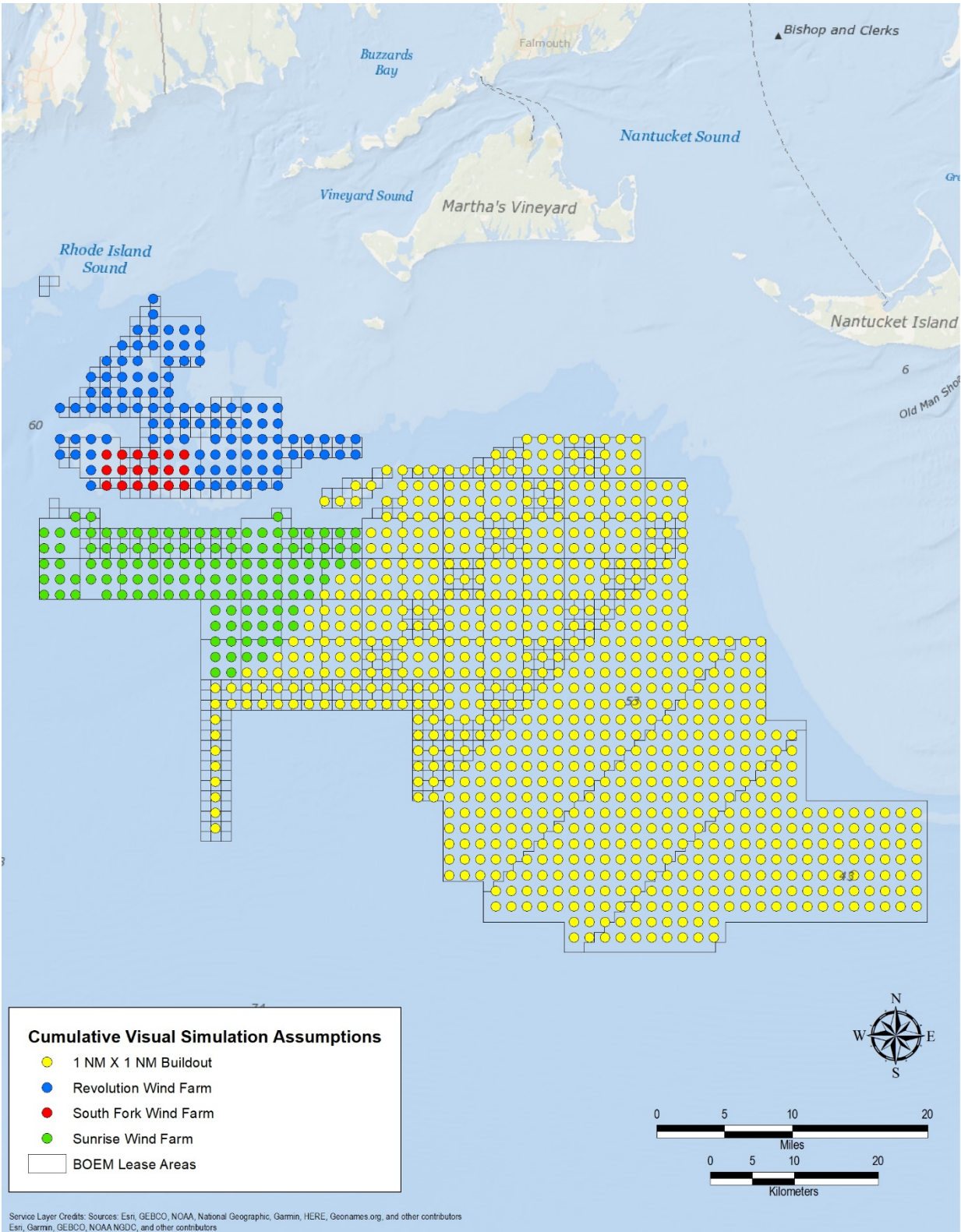


Image 3- Cumulative Visual Simulations Layout Assumptions

Simulations were created by aligning the photos from each selected KOP through a virtual 3D camera, using digitized location data for elements visible in the photograph. This step involves utilizing aerial photographs and global positioning system (GPS) data collected in the field to create an AutoCAD® drawing. The 3D AutoCAD data were then imported into 3DS Max®, and additional components (cameras, modeled scene, etc.) were added. These data were superimposed over the photographs as seen through the virtual camera from each of the KOPs, and minor camera changes (height, roll, bearing) were made as necessary to align all known reference points within the view. This process ensures that Project elements are shown in proportion, perspective, and proper relation to the existing landscape elements in the view. Consequently, the alignment, elevation, dimensions, and scale of the modeled Project components will be accurate and true in their relationship to other landscape elements in each photo.

The next step involves positioning the WTG layout in each of the aligned views at the appropriate distance in front of, at, or below the horizon (depending on the distance from the viewer). This was done by first determining the distance to the horizon (ocean to sky interface) visible in the photograph. This is accomplished by entering the viewer position and elevation into the Haversine Formula, which uses the radius of the earth (corrected for refraction¹) to calculate the mathematical distance to the horizon (D), or the point at which the sky meets the water (see Image 4, below). This distance is then used to draw a horizontal line (virtual horizon) in the 3D model representing the mathematical horizon line, which is visible through the virtual camera. The virtual horizon is then precisely aligned to the visible horizon (D) in the photograph by making minor adjustments to the virtual camera target on the vertical axis. With the virtual horizon aligned to the photographed horizon, the positions of the individual WTGs were all placed relative to this horizon line. The Haversine Formula was then used to determine each turbine's position, relative to the horizon (X). For example, if the WTG appears in front of the horizon, the returned value is zero and the WTG will be placed at the horizon. If the WTG appears behind the visible horizon, the returned value will be a negative number (-X). This value was then applied to the turbine's vertical position in the model so that it appears on or below the visible horizon.

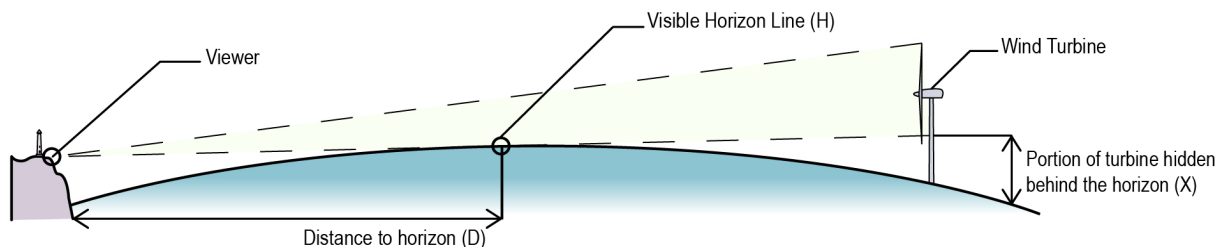


Image 4 Curvature of the Earth and Refraction Diagram

At this point, a “wire frame” model of the Project and known reference points are shown on each of the photographs. The proposed exterior color/finish of the WTGs was then added to the model, and the appropriate sun angle was simulated based on the specific date, time, and location (latitude and longitude) at which each photo was taken. This information allows the computer to accurately illustrate highlights, shading, and shadows for each individual WTG shown in the view. All simulations show the WTGs with rotors oriented toward the KOP. The resulting simulations show a field of view of 38.7 degrees, which is equivalent to the field of view of a standard 50 mm camera lens. This is

¹ Refraction values assume “typical” viewing conditions and do not account for atmospheric anomalies such as the mirage effect which is typically rare and of short duration but may temporarily increase turbine visibility.

the standard focal length used in VIAs because it most closely approximates normal human perception of spatial relationships and scale in the landscape. The individual 50 mm simulations were then stitched using panorama stitching and projection software which minimizes potential distortion generally associated with panorama images. The resulting panorama illustrates a horizontal field of view equal to 124 degrees and a vertical field of view equal to 55 degrees.

In order to demonstrate the high contrast lighting conditions, a sunset simulation was prepared for a single KOP (Aquinnah Overlook) where the setting sun falls behind the proposed WTGs. . To prepare the sunset simulation, EDR used the original daytime photograph as a base to maintain the documented location and existing conditions at the KOP. Computer modeling and camera alignment were prepared in the same manner described above for the daytime simulations. However, to simulate sunset conditions, the Mental Ray Daylight System® was adjusted in 3DS Max to represent the highest contrast sunset conditions set precisely at 3:58 PM on November 25, 2017 (i.e. sunset directly behind the proposed WTGs). Once the Daylight System was adjusted, the proposed WTGs were rendered to reflect the sunset lighting conditions. Similarly, the exact sun position and atmospheric conditions were generated, and an infinite plane representing the ocean was modeled and materialized to simulate sunset lighting conditions and/or reflections on the water. To alter the original daytime photo to reflect sunset conditions, the 3D generated sunset atmosphere was used as a reference to replace the existing daytime sky. Using this reference, an existing photo of a sunset sky from Aquinnah Overlook (photographed at 3:58 on November 25, 2017) was positioned and overlaid onto the 3D generated sunset atmosphere maintaining the exact location of the sun. The 3D generated ocean representing sunset conditions was overlaid as a blending mode over the existing photo daytime ocean. The original photographs taken of the Aquinnah Overlook location required a low shutter speed which resulted in severe blurring of the movement of people in the foreground of the photograph. Rather than attempt to remove the artifacts from the resulting panorama, the daytime photograph taken from the exact location of the sunset photograph was used as a base for composing the resulting image.

Viewing instruction for the panorama simulations are provided in Appendix A.

Copies To: Dan Forrest, PAL Joy Prescott, Stantec