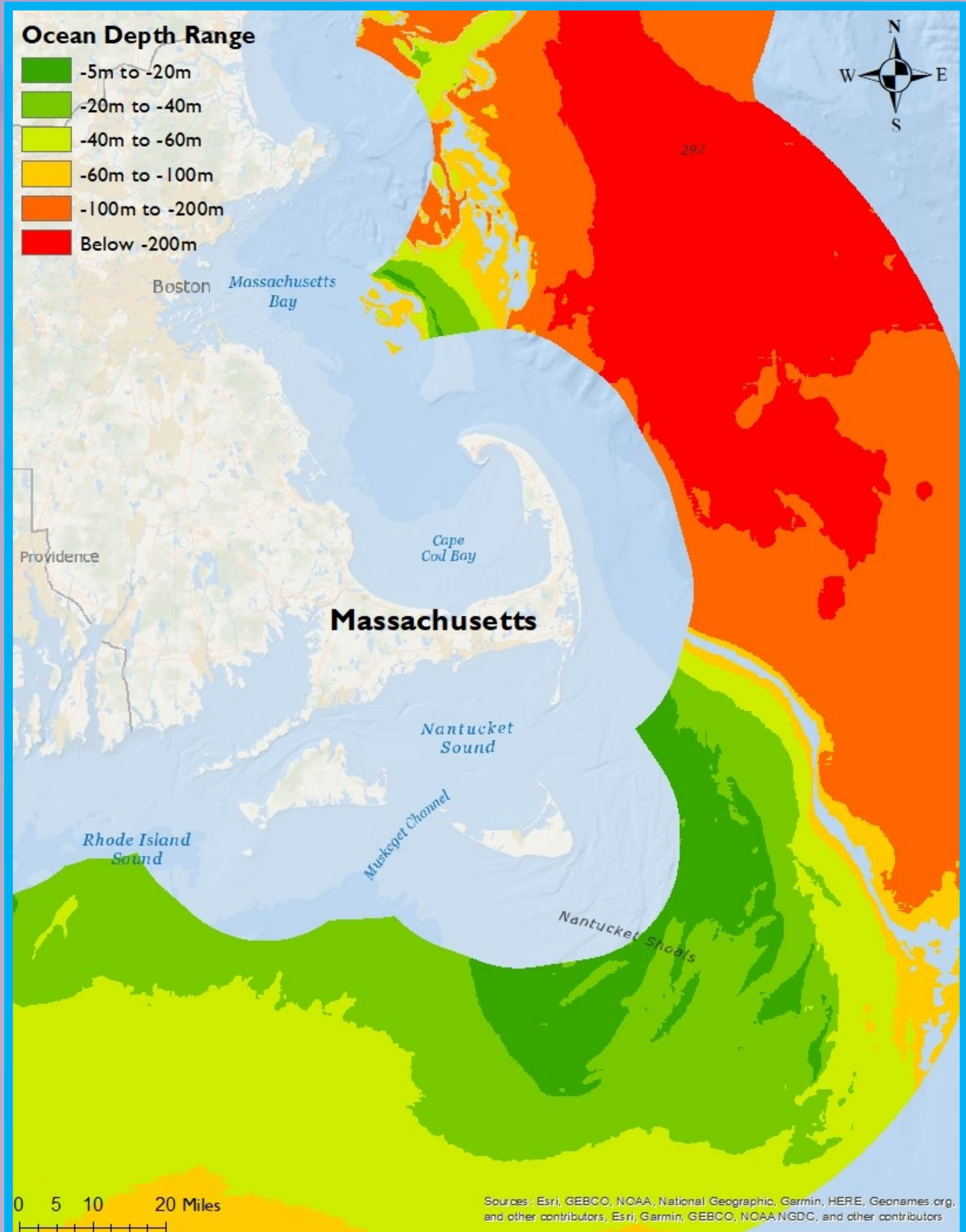
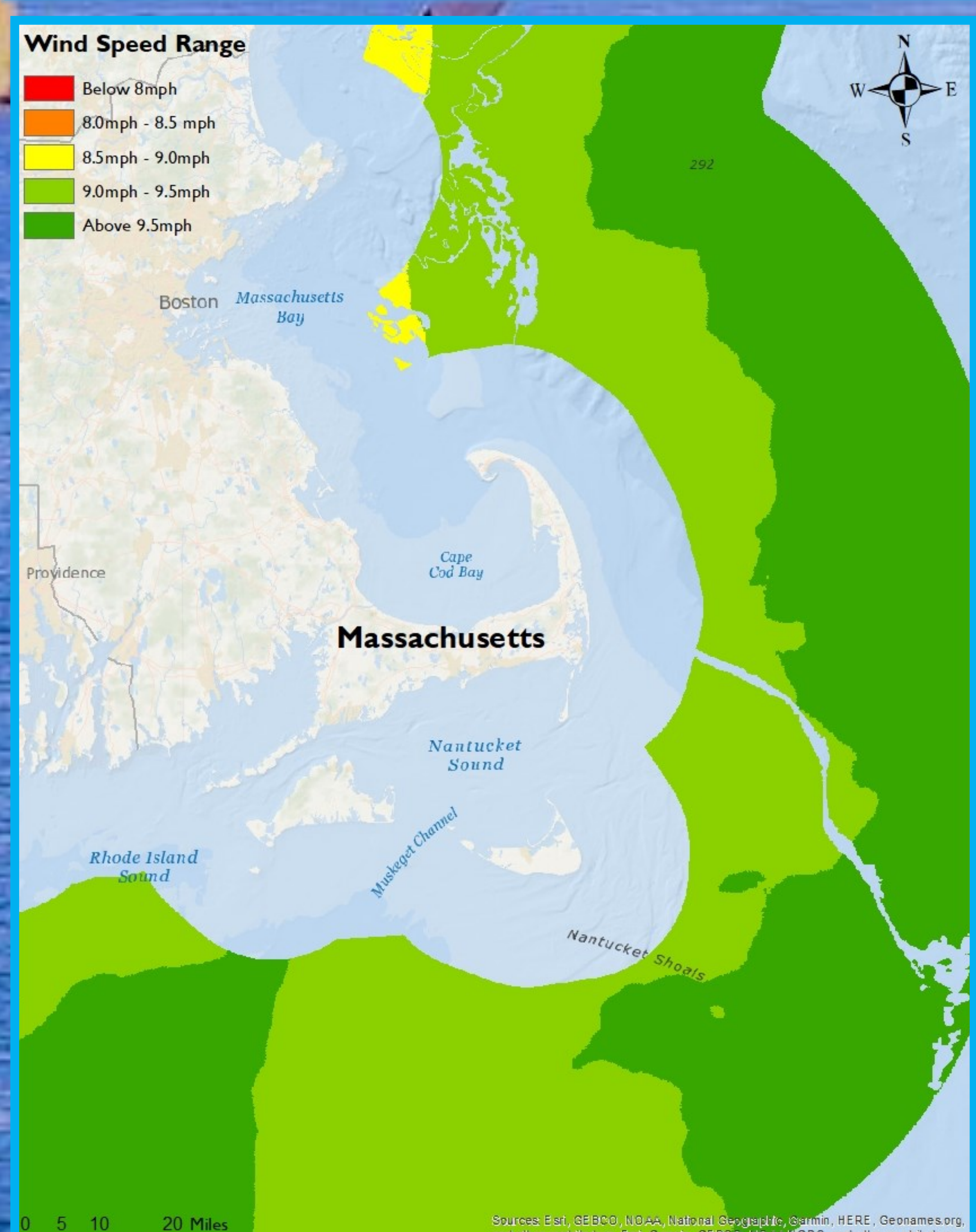
Massachusetts Offshore Wind Energy Suitability Analysis:

What are the ideal coastal regions for offshore wind energy development?



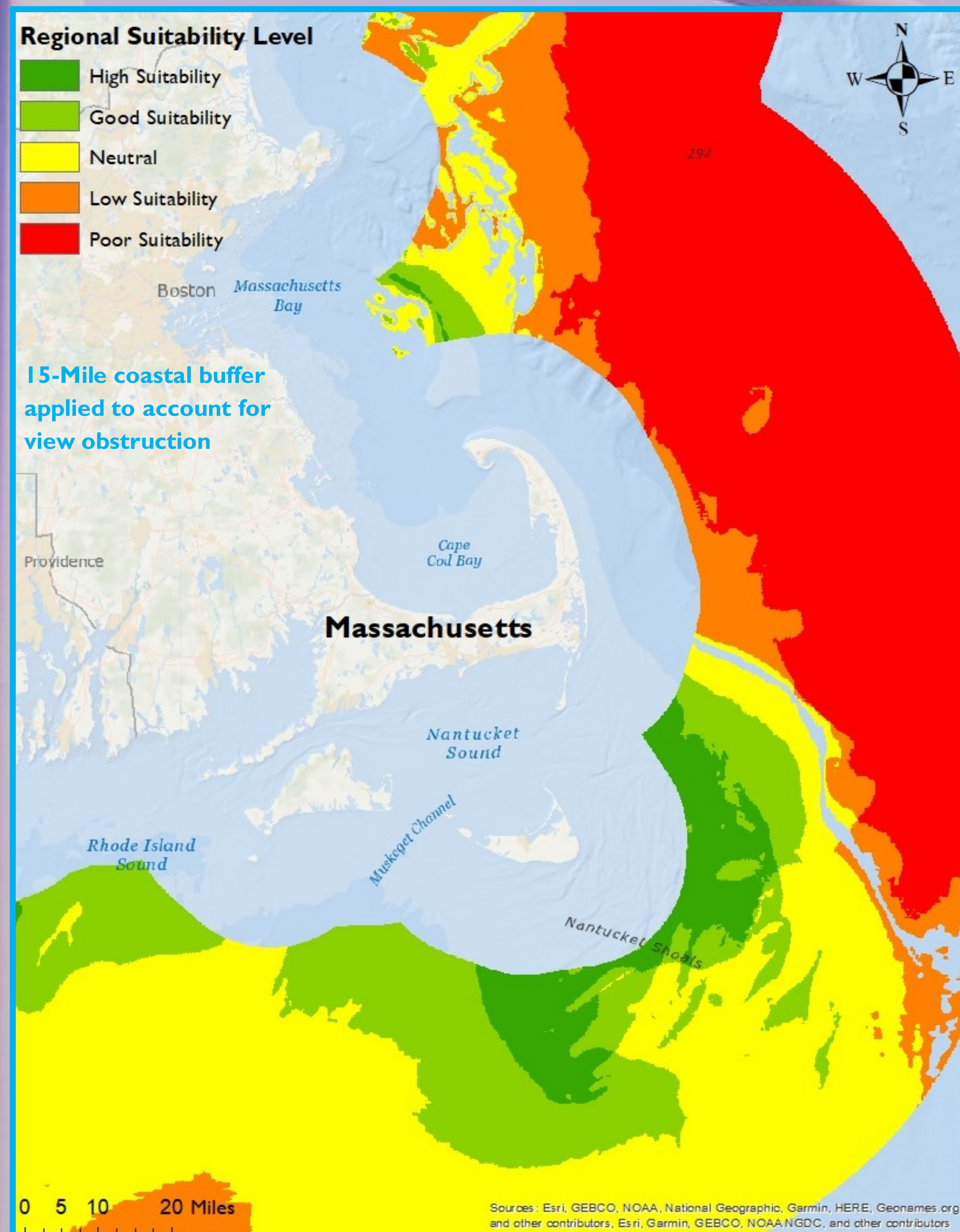
Limitations

One limitation to my analysis was that the wind data I found to be accessible was only annual average speeds. Daily or hourly averages would have potentially made my analysis more accurate. Secondly, my analysis, by choice, only included bathymetry and wind as its input attributes. A more realistic analysis would have included shapefiles such as shipping routes and marine life concentration.



Methodology

The first shapefile for my project was a Mass GIS Gulf of Maine bathymetric map (top left) that I converted from vector to raster format using the Polygon-to-Raster tool. The second map (bottom left), also converted using Polygon-to-Raster, was an Atlantic Coast NREL shapefile of annual average 90m-height offshore wind speeds. Once these rasters were generated, I used the Reclassify tool to establish the "breaks" relevant to this analysis. The extent of the two shapefiles was unified, prior to the raster conversion, by applying the Intersect tool, in order to render the bathymetry shapefile's extent identical to the wind speed shapefile. Following this process, I applied the Raster Calculator tool to generate a suitability analysis, combining the two attributes (bathymetry and wind) into one suitability scale. I chose to weight bathymetry at 60% and wind at 40% due to the relatively universal high wind speeds of the region. Lastly, I reclassified the scale into a 1-5 rating system and then translated this to a "Regional Suitability Level" scale (below).



Tufts

Cartographer:

William Ross

Data Sources

Mass GIS (2013), BOEM (2019), NREL (2014)

Projection:

Lambert Conformal Conic

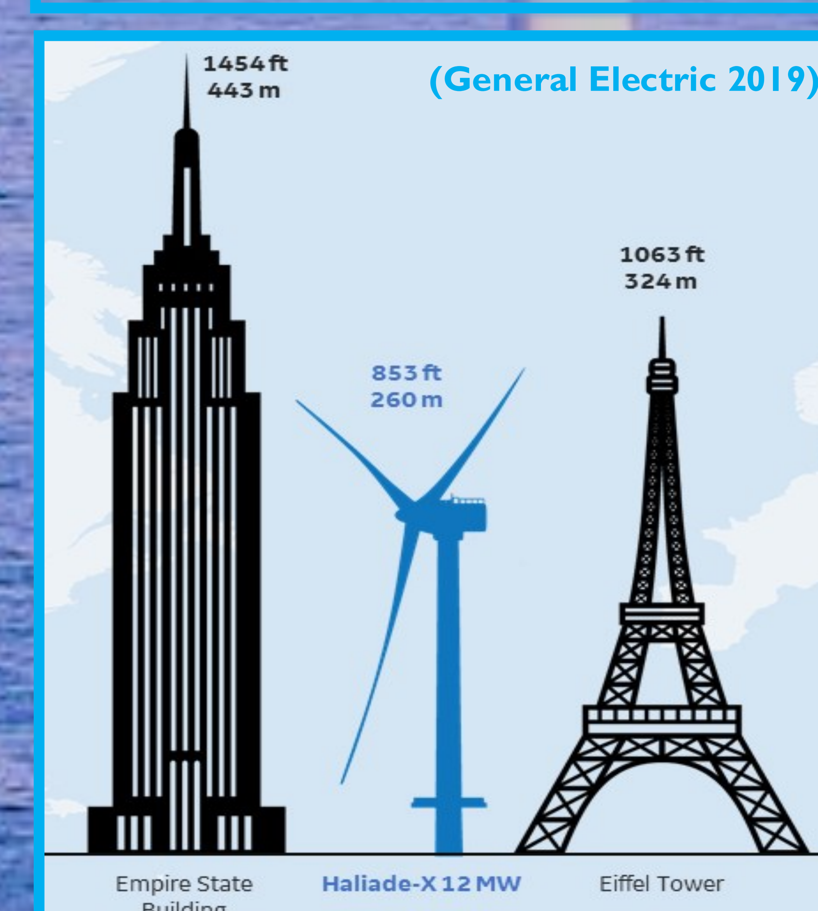
Coordinate System:

GCS_North_American_1983

Poster Background: Walney Wind Farm

A Look into The Future

Over the course of the 2020s and 2030s, Massachusetts, along with the rest of the Atlantic Coast and eventually the Pacific, will gradually witness the proliferation of offshore wind energy. The Ocean Wind project, for example, set to be installed off the coast of New Jersey by mid-2020s, will hypothetically cover upwards of 15% of New Jersey's electricity needs (Ørsted). The developer is expected to use GE's new Haliade-X 12MW turbine (displayed below) to complete the project's 1100 MW capacity. As investment into larger, more efficient, eventually floating offshore turbines rises, the cost of the produced electricity from these systems will decline, as has already been observed over the past decade. The International Energy Agency estimates that the global offshore wind industry will surpass $1 trillion by 2040 (IEA).



Background

There is no stand-alone solution to the climate crisis. However, offshore wind energy has the potential to generate massive amounts of green energy and substantially assist in satisfying the increasing demand for clean energy being driven by state government mandates.

Drawing upon bathymetric and wind speed data, this analysis highlights regions off the Massachusetts coast that will be ideal for the construction of offshore wind energy projects. In 2019, the industry is on the verge of technologically enabling the exploitation of ocean winds farther from the coast than ever before. The onset of this advancement is thanks to the application of new and existing floating technologies to offshore wind energy.

For many years, oil rigs have used floating technology to enable installment in ocean depths surpassing 1000m. Offshore wind energy projects, however, have been limited to ocean depths generally shallower than 60m, in order to feasibly install fixed-bottom foundations on the ocean floor for each wind turbine. Projects being installed in the immediate future will most likely be limited to fixed-bottom installation. My project focuses on these conditions that are immediately accessible to Massachusetts.

Findings

Despite the mentioned limitations, a crucial piece to gauging the effectiveness of my analysis was to overlay a shapefile of the ocean lots that the Bureau of Ocean & Energy Management has already leased specifically to offshore wind energy developers (below). As can be seen, the leased lots aligned almost perfectly with my choice of a 15-mile coastal buffer and also fell within the "Neutral" to "High Suitability" range of the suitability raster. This alignment serves as reassurance that my assumptions produced an effective representation of the ideal conditions for offshore wind development.