APPENDIX K

Supplemental Information on Alternatives Development

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Introduction

The Bureau of Ocean Energy Management (BOEM) considered alternatives to the Proposed Action that were identified through coordination with cooperating and participating agencies and through public comments received during the public scoping period for the environmental impact statement (EIS). BOEM evaluated the alternatives and excluded from further consideration alternatives that did not meet the purpose and need, did not meet the screening criteria, or both. The screening criteria are presented below. Alternatives that were considered and carried forward for detailed analysis are presented in Section 2.1, Alternatives, of the EIS, and alternatives excluded from further consideration are presented in Section 2.1.7, Alternatives Considered but Dismissed from Detailed Analysis.

The sections below provide more detail on BOEM's screening criteria followed by additional background on the evolution of the layouts carried forward for Alternatives C1, C2, E1, and E2.

Alternatives Screening Criteria

BOEM applied rule of reason in identifying reasonable alternatives that are both technically and economically feasible and meet the purpose and need of the Proposed Action. An alternative was considered but not analyzed in detail if it met any of the following criteria:

- It is outside the jurisdiction of the lead agency,[1] including resulting in activities that are not allowed under the lease (e.g., requiring locating part or all of the wind energy facility outside of the Lease Area or constructing and operating a facility for another form of energy).
- It would not respond to the purpose and need of BOEM's action, including not furthering the United States' policy to make Outer Continental Shelf energy resources available for expeditious and orderly development, subject to environmental safeguards (43 USC 1332(3).
- It would require a major change to an existing law, regulation, or policy.
- It would not be responsive to the applicant's goals, lease constraints, and obligations, such as alternatives that would
    - partially or completely relocate the Project outside of the defined geographic area where it was proposed; or
    - result in the development of the Project that would not allow the developer to satisfy contractual obligations (e.g., resulting in the Project having a nameplate capacity that is less than what is required under a power purchase agreement (PPA); or
    - result in significant implementation delays that would prevent the Project from initiating commercial operations by the contractually required date in the PPA).[2]

[1] "Include reasonable alternatives not within the jurisdiction of the lead agency" was removed with the Council on Environmental Quality's updated NEPA-implementing regulations. See 43304 *Federal Register* 85, July 16, 2020.

[2] Where present, meeting an offtake agreement(s) is the primary goal of the applicant's proposal. Offtake agreements (in the case of Revolution Wind, the three PPA agreements) are also unlike other private agreements between two for-profit entities involved in an offshore wind project. 1) The offtake agreement is the primary (and often sole) source of revenue for a project. Offshore wind projects will not obtain financing for the capital investment needed for construction without an offtake agreement. This

- It is technically infeasible, meaning implementation of the alternative is unlikely given past and current practice, technology (e.g., experimental turbine design or foundation type), or site conditions (e.g., presence of boulders), as determined by BOEM's technical experts.
- It is economically infeasible, meaning implementation of the alternative is unlikely due to unreasonable costs as determined by BOEM's technical experts; although this does not require cost-benefit analysis or speculation about an applicant's costs and profits, there must be a reasonable basis.
- It cannot be analyzed because its implementation is remote or speculative, or it is too conceptual in that it lacks sufficient detail to meaningfully analyze impacts.
- It is substantially similar in design to an alternative that is or will be analyzed in detail.
- It is environmentally infeasible, meaning implementation of the alternative would not be allowed by another agency from which a permit or approval is required, or implementation results in an obvious and substantial increase in impacts on the human environment.

Alternative C: Habitat Impact Minimization Alternative (Habitat Alternative)

The Revolution Wind Renewable Energy Lease OCS-A 0486 (Lease Area), partially located on Cox Ledge, is dominated by complex benthic habitats, with large contiguous areas of complex habitats located centrally and throughout the entire southern portion of the Lease Area. Smaller, patchy areas of complex habitats also occur throughout the northern portion of the Lease Area (see Appendix X2 [Inspire Environmental 2021] in the *Construction and Operations Plan Revolution Wind Farm* [COP] [vhb 2022] for the benthic habitat mapping report).

BOEM received scoping comments from the U.S. Environmental Protection Agency (EPA), the New England and Mid-Atlantic Fisheries Management Councils, the Defenders of Wildlife, the Nature Conservancy, and the National Marine Fisheries Service (NMFS) that supported the creation of an EIS alternative focused on reducing impacts to complex benthic habitat that may support important commercial and recreational fisheries species in the Lease Area (SWCA Environmental Consultants n.d. [2021]). Some of these comments specifically cited the importance of Cox Ledge and surrounding complex habitat areas for Atlantic cod (*Gadus morhua*) spawning and survival of juvenile cod. The extensive boulders and cobbles in the area also provide habitat for other structure-oriented fish species, such as black sea bass (*Centropristis striata*).

makes the offtake agreement central to the economic feasibility of a project. 2) Offtake agreements are often the result of years of work by states and/or regional/local utilities that may include competitive award processes; are often the result of coordination with a regional independent system operator regarding point of interconnection and the capacity constraints therein; and are subject to considerable regulations regarding electricity pricing, interconnection requirements, and public interest considerations. BOEM finds that the unique position of these agreements necessitates more deference than a typical contract between two private for-profit entities. An alternative that fails to meet the main goal of the applicant would be equivalent to analyzing a no action alternative. Therefore, BOEM considers it appropriate under NEPA to analyze in detail only those alternatives that would allow lessees to meet the obligations under their offtake agreements.

Micrositing,[3] in which the installation location of a WTG foundation is altered slightly from the proposed location to avoid sensitive habitat or seabed hazards, allows for the reduction of impacts to complex habitats at some WTG locations. However, given the density of complex habitats throughout the Lease Area, it would not be feasible to fully avoid impacts to these habitats and meet the existing PPAs with the largest turbine size considered in the project design envelope (PDE). Therefore, Alternative C considers and prioritizes contiguous areas of complex habitat that should be excluded from development to avoid and minimize impacts to complex habitats to the greatest extent possible while meeting BOEM's purpose and need. Alternative C seeks to reduce impacts to sensitive benthic habitats within the Lease Area that are most vulnerable to permanent and long-term impacts from the Proposed Action. The number of WTGs that could be removed in Alternative C is based on the minimum power output for Revolution Wind (704 megawatts [MW]) using the largest capacity WTG in the PDE (12 MW). BOEM determined a maximum of 36 WTG locations could be eliminated from the proposed 100 locations, which includes a minimum of five "spare" WTG positions to allow for installation and engineering flexibility.

Preliminary Screening and Rationale

BOEM sought NMFS's Greater Atlantic Regional Fisheries Office's (GARFO) input on determining which WTG positions should be removed to most effectively reduce impacts to complex benthic habitats in the Lease Area. GARFO provided four priority areas for potential avoidance (Figure K-1). In order of descending priority, GARFO identified Area 1 (8 WTG positions), Area 2 (38 WTG positions), Area 3a (6 WTG positions), and Area 3b (9 WTG positions). These priority areas were based on multibeam backscatter data and the presence of identified large boulders (i.e., > 0.5–1.0 meters in diameter) within the Lease Area; their proximity to Cox Ledge; and the importance of these habitats as EFH, particularly for Atlantic cod. Based on the COP and additional feedback from the applicant, BOEM continues to assume no change to the offshore substation locations due to feasibility constraints that would delay the Project to the extent that it would no longer meet the PPA obligations or BOEM's purpose and need as described in Chapter 1.2 of the EIS. The scientific rationale for the prioritization of the four priority areas is provided in the following paragraphs.

[3] In accordance with 30 CFR 585.634(C)(6), micrositing of WTG foundations may occur within a 500-foot (152-meter) radius around each proposed WTG location. The micrositing allowance for the Project is a diamond shaped area within the 500-foot (152-meter) radius circle surrounding foundation locations, ensuring 1.15-mile (1-nautical mile) spacing on the cardinal directions and no less than 0.7 mile (0.6 nautical mile) on the inter-cardinal directions.

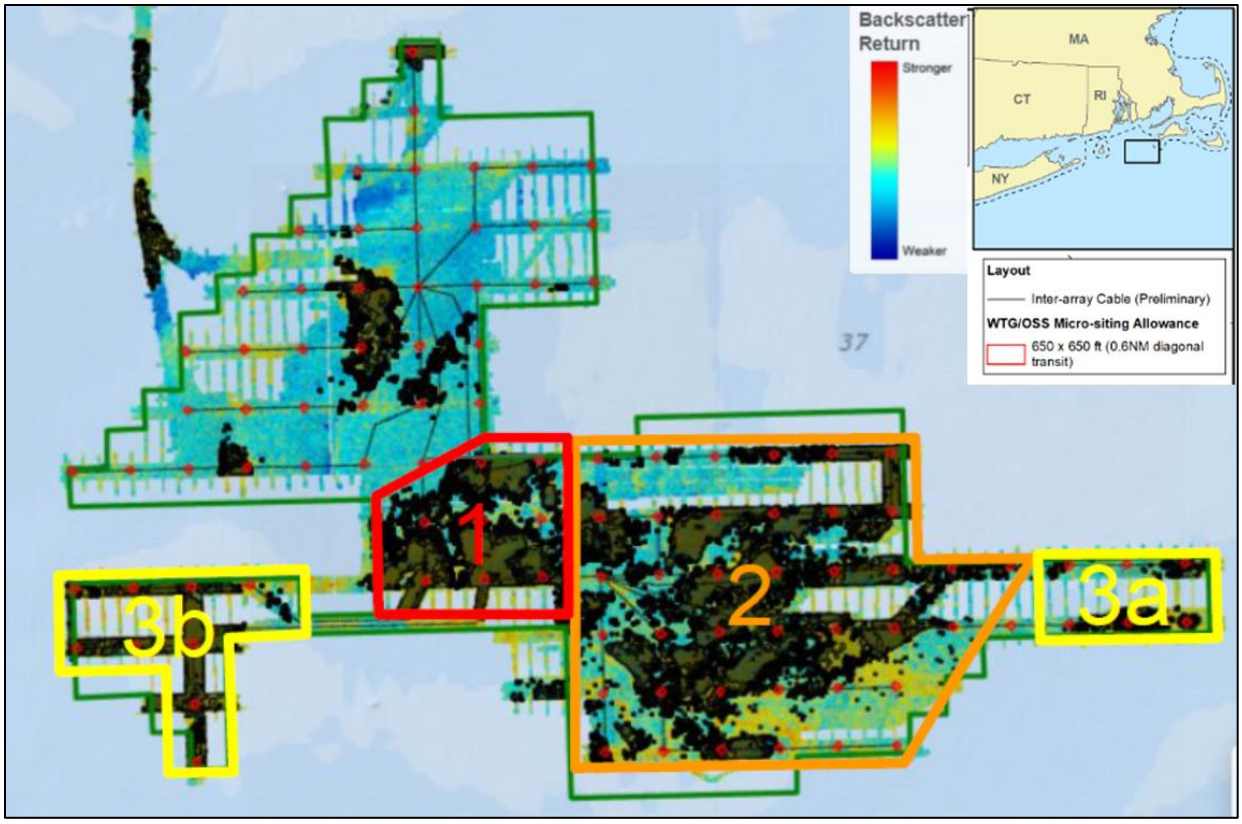

Figure K-1. Alternative C development. Revolution Wind Lease Area with multi-beam backscatter and boulder presence (dark green with black outlines; data from COP Appendix X2) shown in relation to the four priority areas identified for avoidance by GARFO on November 5, 2021.

Area 1 contains contiguous complex habitat illustrated by high multibeam backscatter return and a high density of large boulders (> 0.5–1.0 meters in diameter). This area overlaps with documented cod spawning activity based on recent acoustic, telemetry, and fisheries-dependent biological sample data (Van Hoeck et al. 2022; Van Parijs 2022). GARFO requested no modification in the shape of this area targeted for removal.

Area 2 contains large areas of contiguous complex habitat illustrated by high multibeam backscatter return and a high density of large boulders (> 0.5–1.0 meters in diameter). Acoustic and telemetry data for Atlantic cod in this area are extremely limited (Van Parijs 2022). Ongoing research and emerging data will assist in evaluating the importance of this area for cod spawning. GARFO requested that any modification of this area be limited to modifying the boundaries of the area rather than selection of particular turbine locations within the area and should prioritize maintaining the largest contiguous complex habitat area feasible.

Areas 3a and 3b are areas of complex habitat illustrated by high multibeam backscatter return and identified large boulders (> 0.5–1.0 meters in diameter) in which cod spawning has not been detected previously or is unknown. There is no available information or data to aid in evaluating the importance of these areas for cod spawning. GARFO requested that any development of these areas be considered only if it would allow for the protection and conservation of higher priority areas.

If BOEM omitted all the turbines within the identified priority areas (a total of 61 WTGs), from Alternative C, then Alternative C would not meet the purpose and need. A discussion of the further reduction of impacts to these habitats through the selection of Alternative C in conjunction with Alternative F is provided in EIS Section 3.13.2. BOEM developed the layouts for Alternative C based on the following criteria:

- GARFO's identified priority areas (Figure K-1)
- Maintaining continuity of complex habitat
- Boulder density (higher density areas were avoided over lower density areas)
- Multibeam backscatter data (high backscatter areas were avoided over lower backscatter areas) and,
- Engineering considerations such as maintaining linearity of inter-array cable layouts and maintaining offshore substation locations

BOEM identified two layouts for Alternative C that aim to address these criteria. Alternative C1 removes all WTG positions from Area 1 and 27 WTG positions from Area 2 leaving 65 WTG positions remaining (Figure K-2). Alternative C2 removes all WTG positions from Area 1 and 28 WTG positions from Area 2 leaving 64 WTG positions remaining (Figure K-3). Alternative C1 reduces development in areas of contiguous complex habitat slightly more than Alternative C2. Alternative C2 shifts exclusion of three WTG positions from the southeastern portion to areas further north to reduce development in or adjacent to known cod spawning areas, however, resulting in slightly less complex habitat avoided when compared to Alternative C1. See EIS Section 3.6.2.4 for more information on differences in impacts to complex habitats.

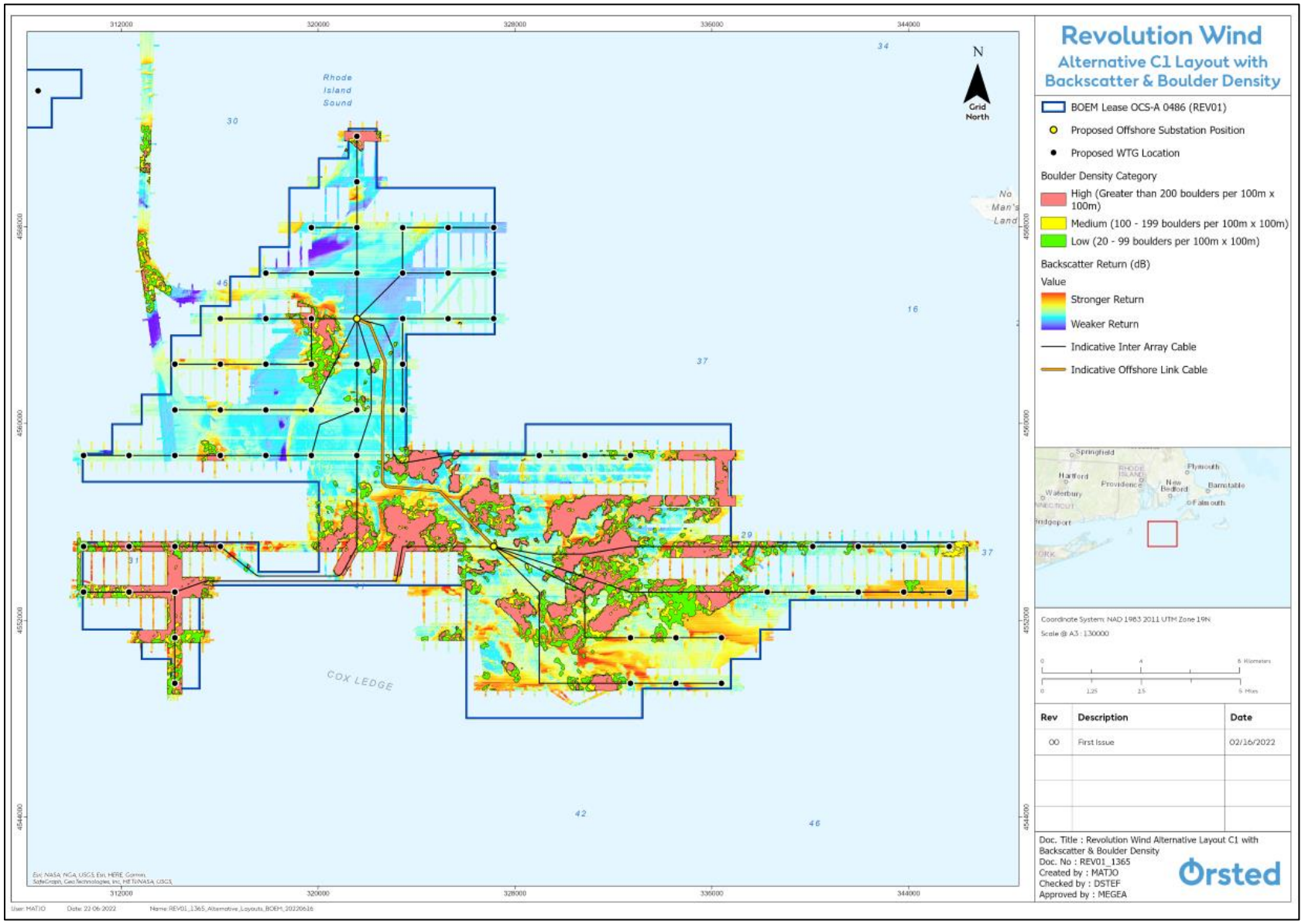

Figure K-2. Alternative C1 layout overlaid with backscatter and boulder density data. Image courtesy of Orsted.

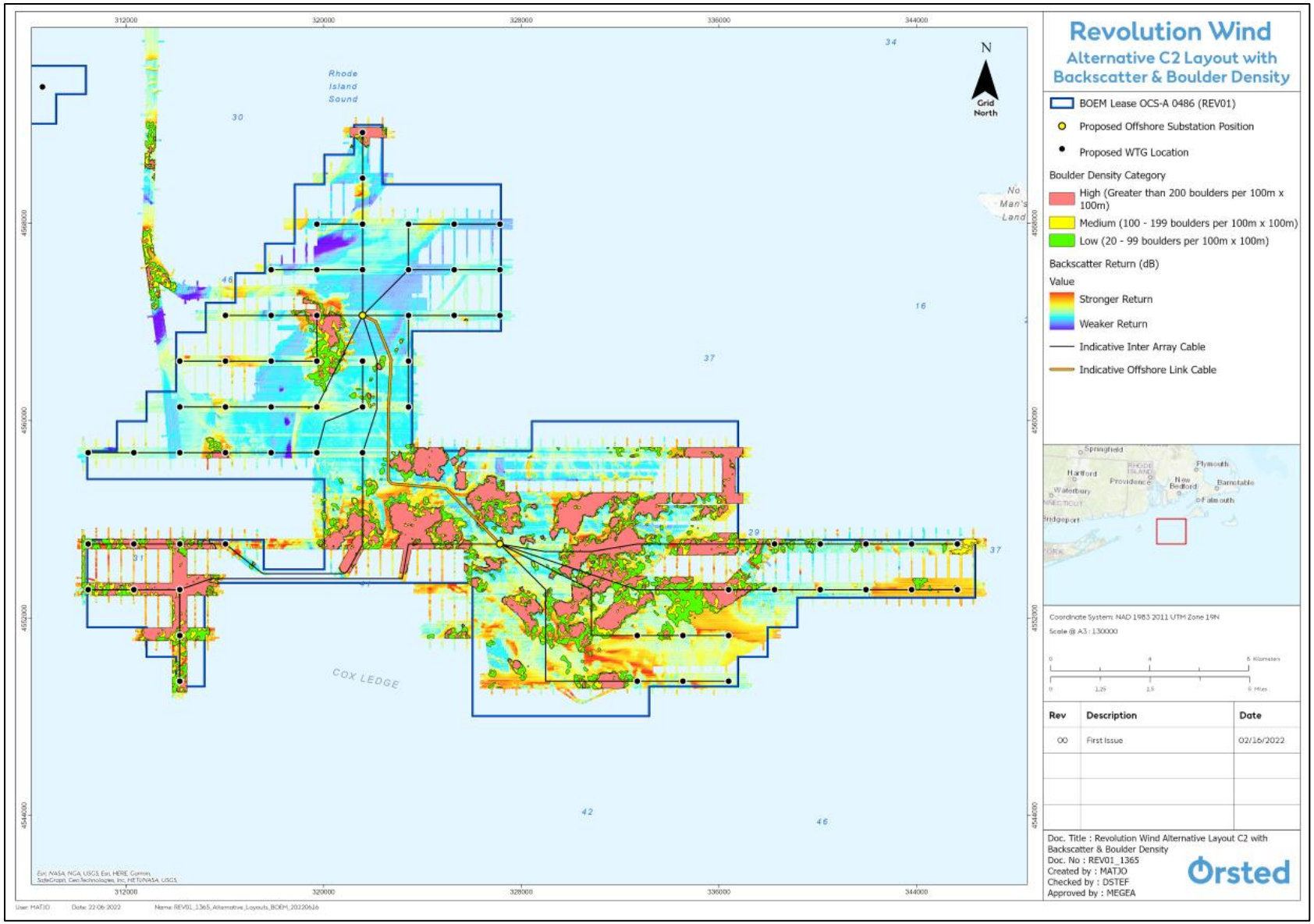

Figure K-3. Alternative C2 layout overlayed with backscatter and boulder density data. Image courtesy of Orsted.

Alternative E: Reduction of Surface Occupancy to Reduce Impacts to Culturally Significant Resources Alternative (Viewshed Alternative)

Background

The federally recognized Wampanoag Tribe of Gay Head (Aquinnah) have identified certain unencumbered views from the Gay Head Cliffs (i.e., Aquinnah Cliffs) on Martha's Vineyard as important to their oral history, traditions, cultural practices, and as a traditional cultural property (TCP) associated with the Wampanoag cultural hero Moshup. Through scoping and ongoing government-to-government consultation, the northernmost WTGs nearest to the Gay Head Cliffs were identified of the highest concern to the Wampanoag Tribe of Gay Head (Aquinnah), especially at sunset when these WTGs would be backlit and silhouetted. In a letter to BOEM on July 12, 2021, the tribe's historic preservation office noted the importance of the tribe's ancestral lands on the west side of Martha's Vineyard that include Gay Head Cliffs, designated as a national natural landmark by the National Park Service (Washington 2021). The letter also provided a map of the wind development area with an east to west line in which the Wampanoag Tribe of Gay Head (Aquinnah) opposes any development north thereof (Figure K-4). The tribe has expressed concerns that the introduction of offshore wind infrastructure will adversely affect the recently identified Vineyard Sound and Moshup's Bridge TCP and the Gay Head Cliffs National Natural Landmark (which is also part of the traditional cultural property). Factoring in the information and concerns of the Wampanoag Tribe of Gay Head (Aquinnah) and other stakeholders, along with balancing the purpose and need in EIS Section 1.2, BOEM considered a suite of options for removing WTG positions aimed at reducing impacts to viewsheds on and surrounding Martha's Vineyard.

Given the proximity of the Project to Martha's Vineyard, visibility of the offshore components cannot be completely eliminated under any action alternative or layout option, while maintaining the minimum positions needed to fulfill the PPA obligations (i.e. 704 MW). To determine which WTG positions could be removed to reduce visual impacts most effectively to these cultural resources, while still meeting the purpose and need, BOEM developed multiple layout options for Alternatives E1 and E2 and directed the Project applicant, Revolution Wind, to produce visual simulations of these layouts. BOEM shared these simulations with the Wampanoag Tribe of Gay Head (Aquinnah) and requested feedback on these potential layouts on September 10, 2021, and again on October 12, 2021, after an additional option was simulated.

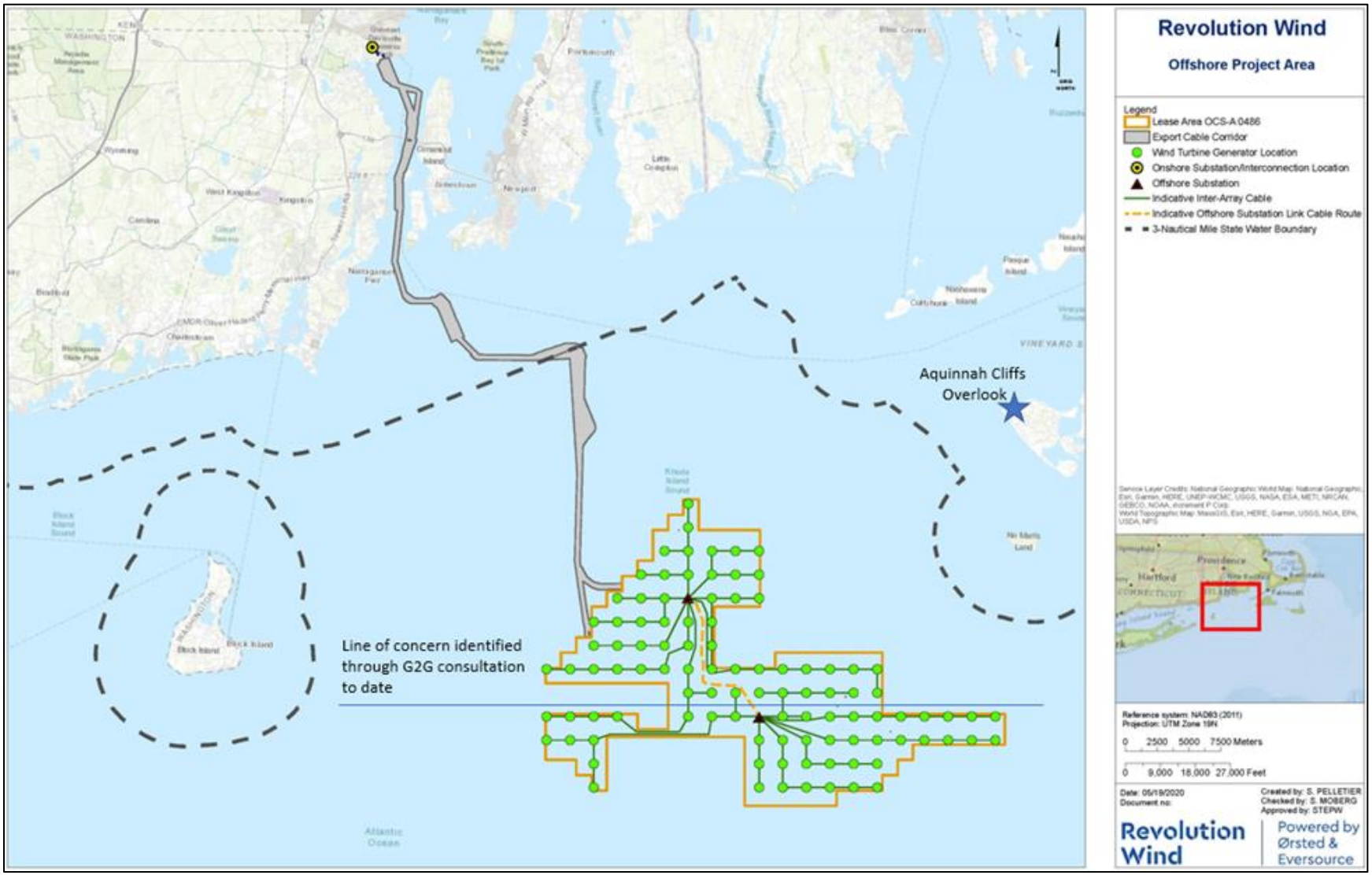

Figure K-4. The line of concern provided by the Wampanoag Tribe of Gay Head (Aquinnah) overlaid with the Lease Area as proposed in Revolution Wind's COP.

Preliminary Screening and Rationale

BOEM directed Revolution Wind to simulate eight potential WTG layouts for the Viewshed Alternative (four for E1 and four for E2). Figures K-5 through K-12 outline the layouts that were simulated and reviewed by BOEM's subject-matter experts and shared with the Wampanoag Tribe of Gay Head (Aquinnah) for input. No specific responses were received from the tribe; however, applying best professional judgement and input previously received by the tribe and other stakeholders, BOEM's subject-matter experts concluded that options E1-3 (Figure K-7) and E2-4 (Figure K-12) were most effective at reducing the visual impacts of concern at or near the Gay Head Cliffs, as well as other national historic landmarks and culturally important resources in Rhode Island and Massachusetts. Therefore, options E1-3 and E2-4 were carried forward for detailed analysis as Alternatives E1 and E2 in the EIS, acknowledging that neither alternative completely eliminates the visual impacts of concern for the reasons outlined above but offer a reasonable range of alternatives for consideration by stakeholders and the decisionmaker.

Layout option E1-3 (see Figure K-7) was carried forward because the WTGs on the northwest end appear further apart, reducing the visual clutter and "curtain effect" from the visual overlapping of WTG towers and blades. The horizontal field-of-view of the Project is also less in E1-3 than in all other layouts simulated except for E2-4, with enough positions remaining to fulfill the PPA agreements (i.e. 704 MW).

Layout option E2-4 (see Figure K-12) was carried forward because it reduces the number of WTGs that occupy the northwest end of the field-of-view within the sunset views from the Gay Head Cliffs overlook. Although this layout does not decrease visual prominence of WTGs further east in the Lease Area, it allows for a larger unobstructed sunset view within the northwestern portion of the Lease Area with enough positions remaining to fulfill the PPA agreements (i.e. 704 MW) up to the maximum potential output of the Project (880 MW). Figure K-13 provides a sunset simulation overlaid with the WTG positions that would be removed north-northwest of the northernmost offshore substation under layout option E2-4.

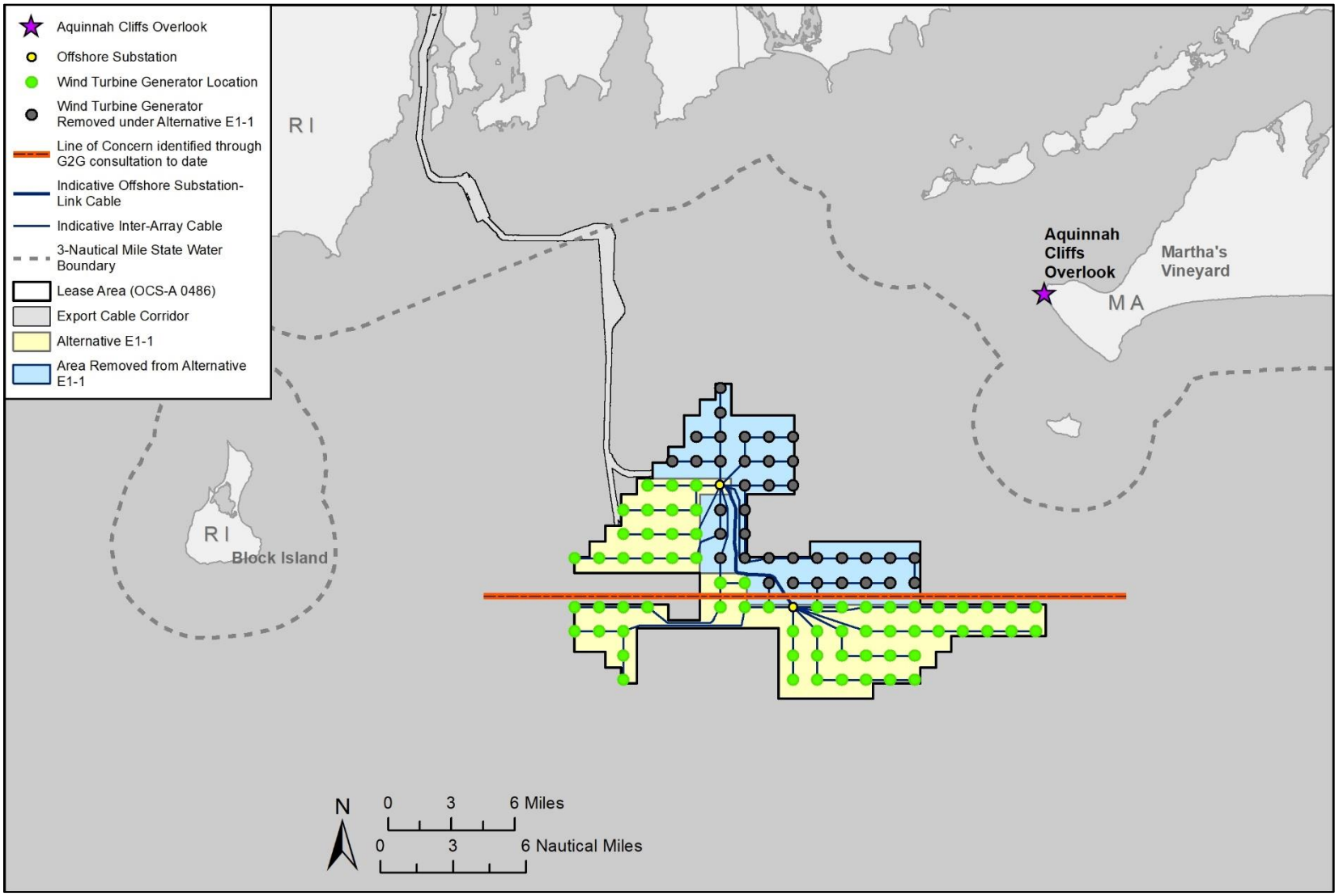

Figure K-5. Layout option 1 simulated for Alternative E1 (Alternative E1-1). Gray shaded WTG positions in the blue field are those that would be eliminated from consideration. 704 MW maximum output; removal of 36 WTG positions (leaves 64 positions available).

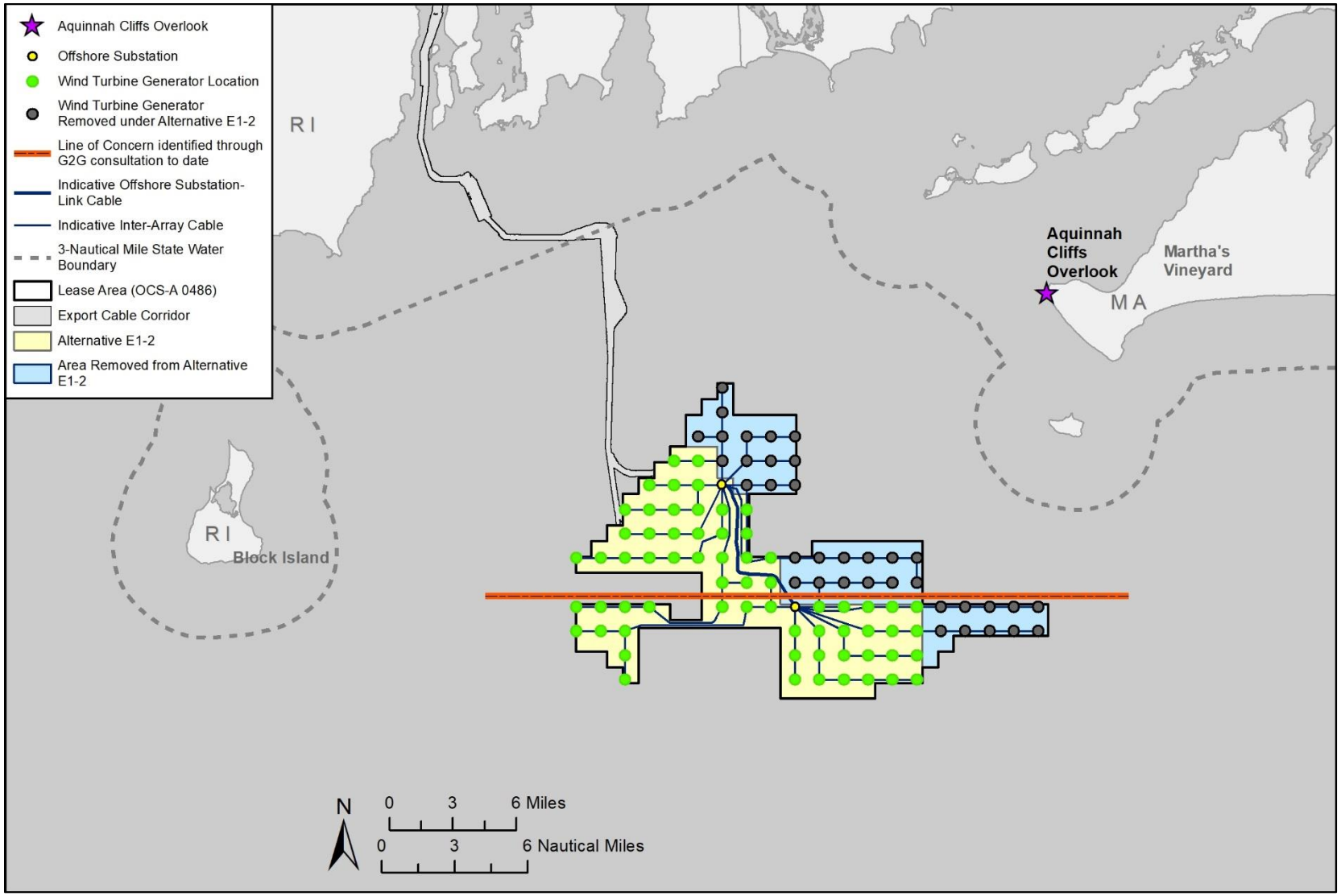

Figure K-6. Layout option 2 simulated for Alternative E1 (Alternative E1-2). Gray shaded WTG positions in the blue field are those that would be eliminated from consideration. 704 MW maximum output; removal of 36 WTG positions (leaves 64 positions available).

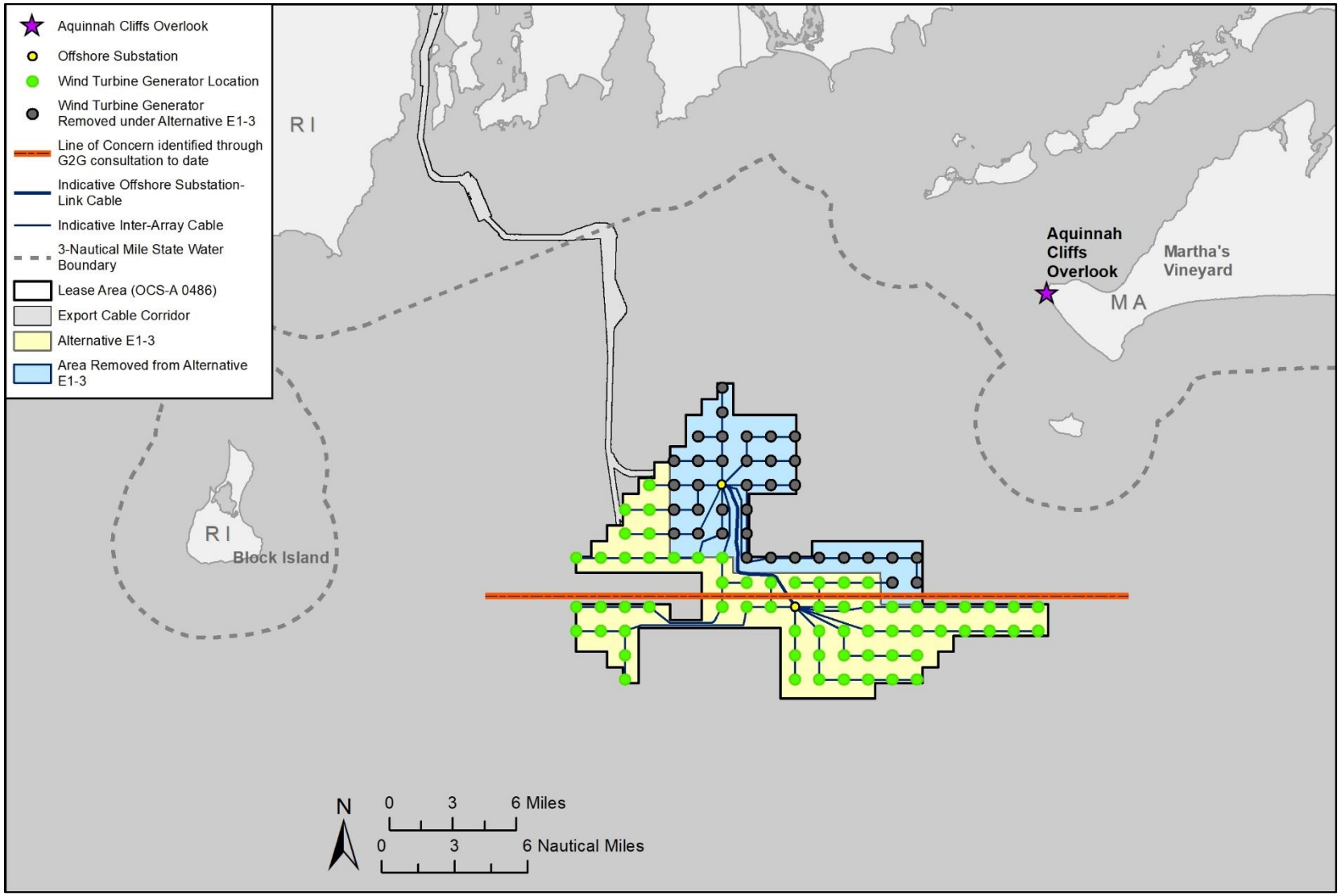

Figure K-7. Layout option 3 simulated for Alternative E1 (Alternative E1-3). Gray shaded WTG positions in the blue field are those that would be eliminated from consideration. 704 MW maximum output; removal of 36 WTG positions (leaves 64 positions available).

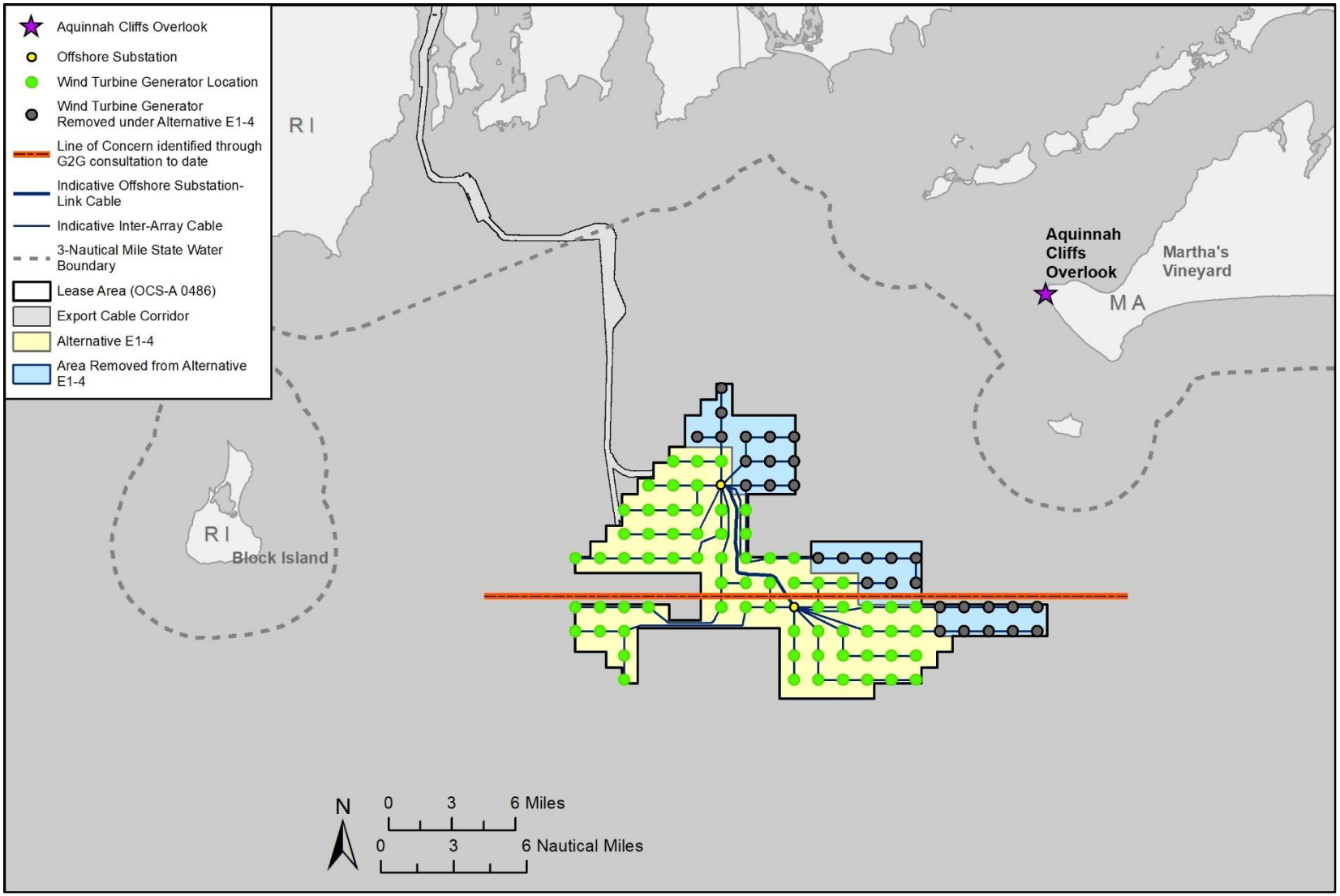

Figure K-8. Layout option 4 simulated for Alternative E1 (Alternative E1-4). Gray shaded WTG positions in the blue field are those that would be eliminated from consideration. 828 MW maximum output; removal of 31 WTG positions (leaves 69 positions available).

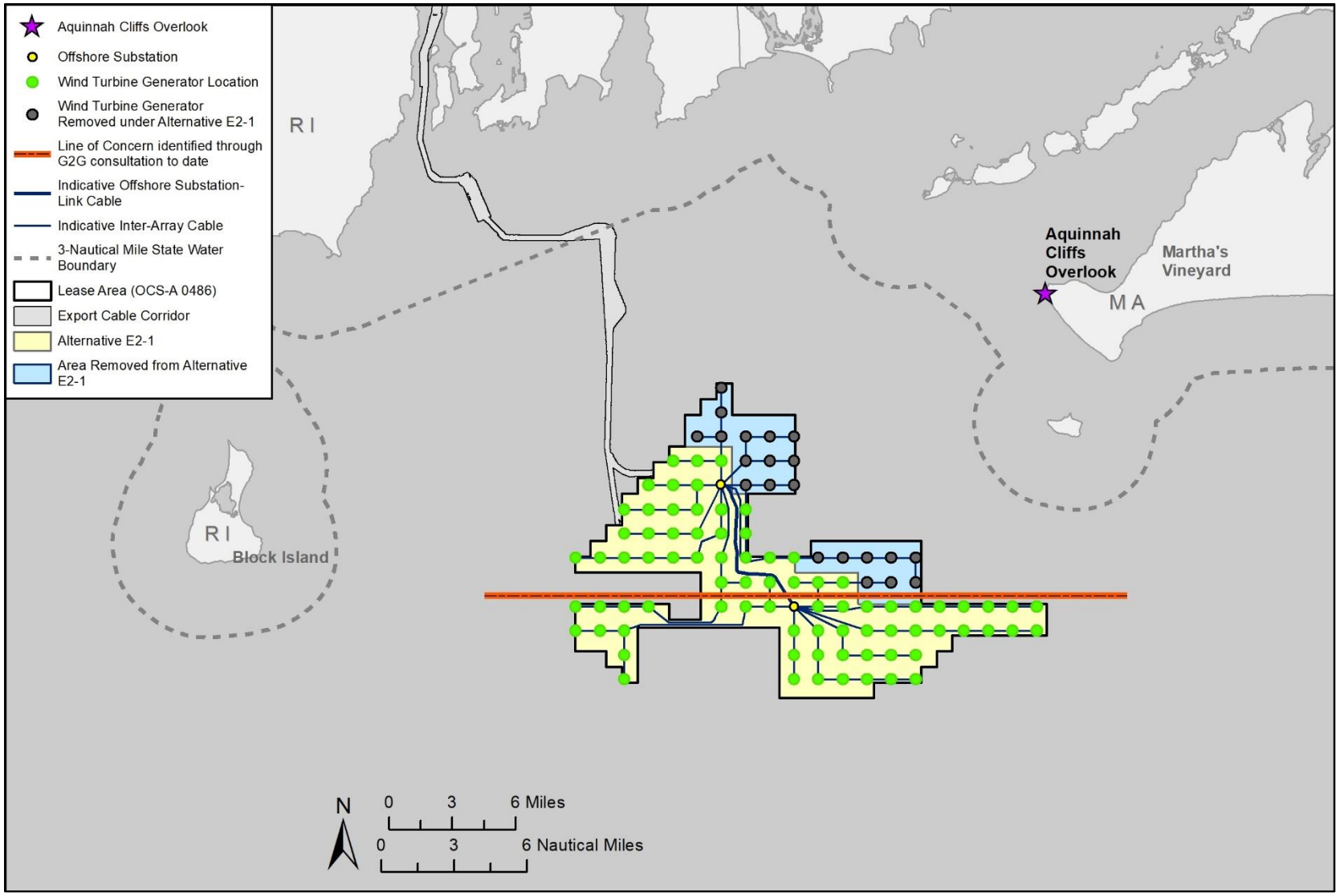

Figure K-9. Layout option 1 simulated for Alternative E2 (Alternative E2-1). Gray shaded WTG positions in the blue field are those that would be eliminated from consideration. 880 MW maximum output; removal of 21 WTG positions (leaves 79 positions available).

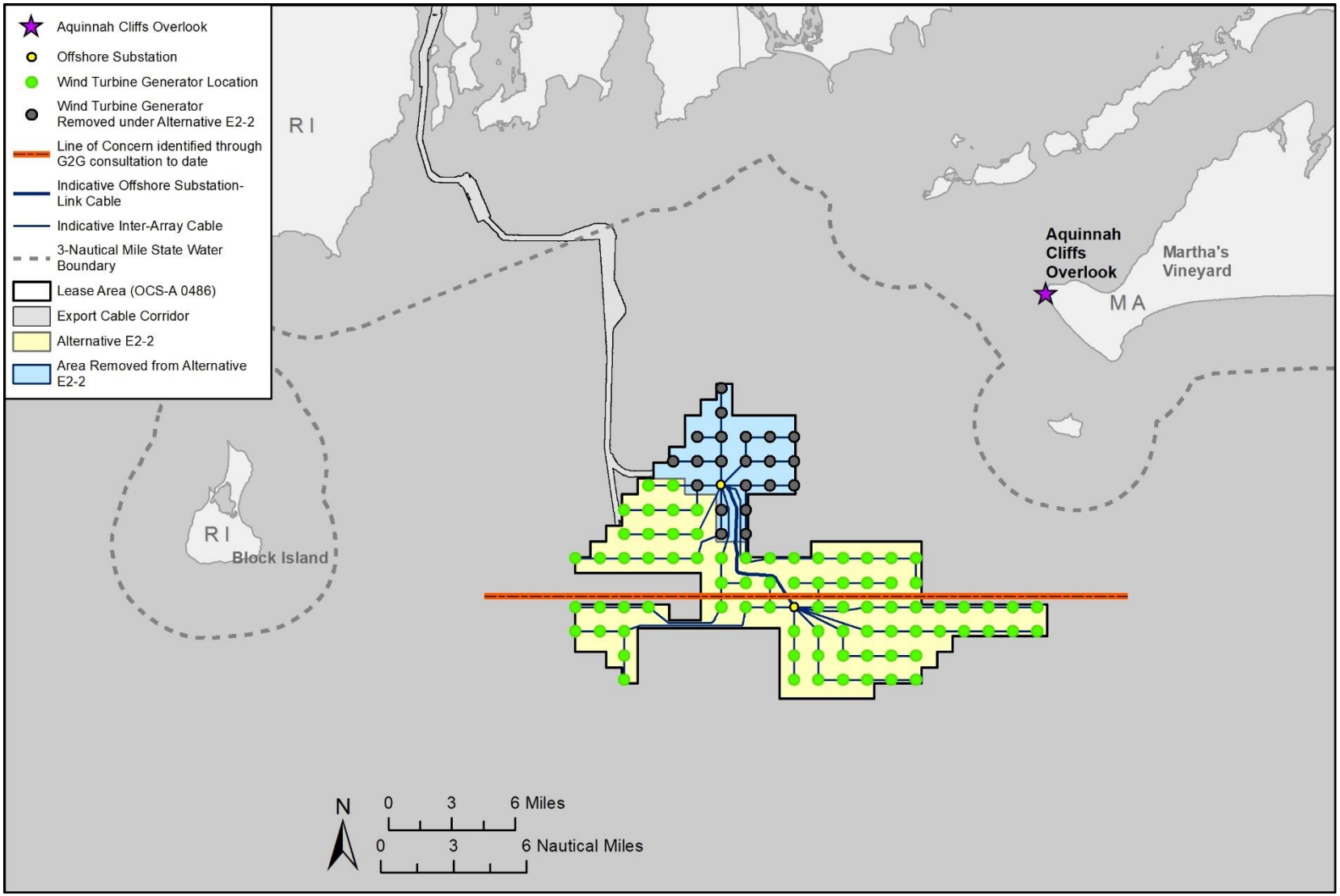

Figure K-10. Layout option 2 simulated for Alternative E2 (Alternative E2-2). Gray shaded WTG positions in the blue field are those that would be eliminated from consideration. 880 MW maximum output; removal of 21 WTG positions (leaves 79 positions available).

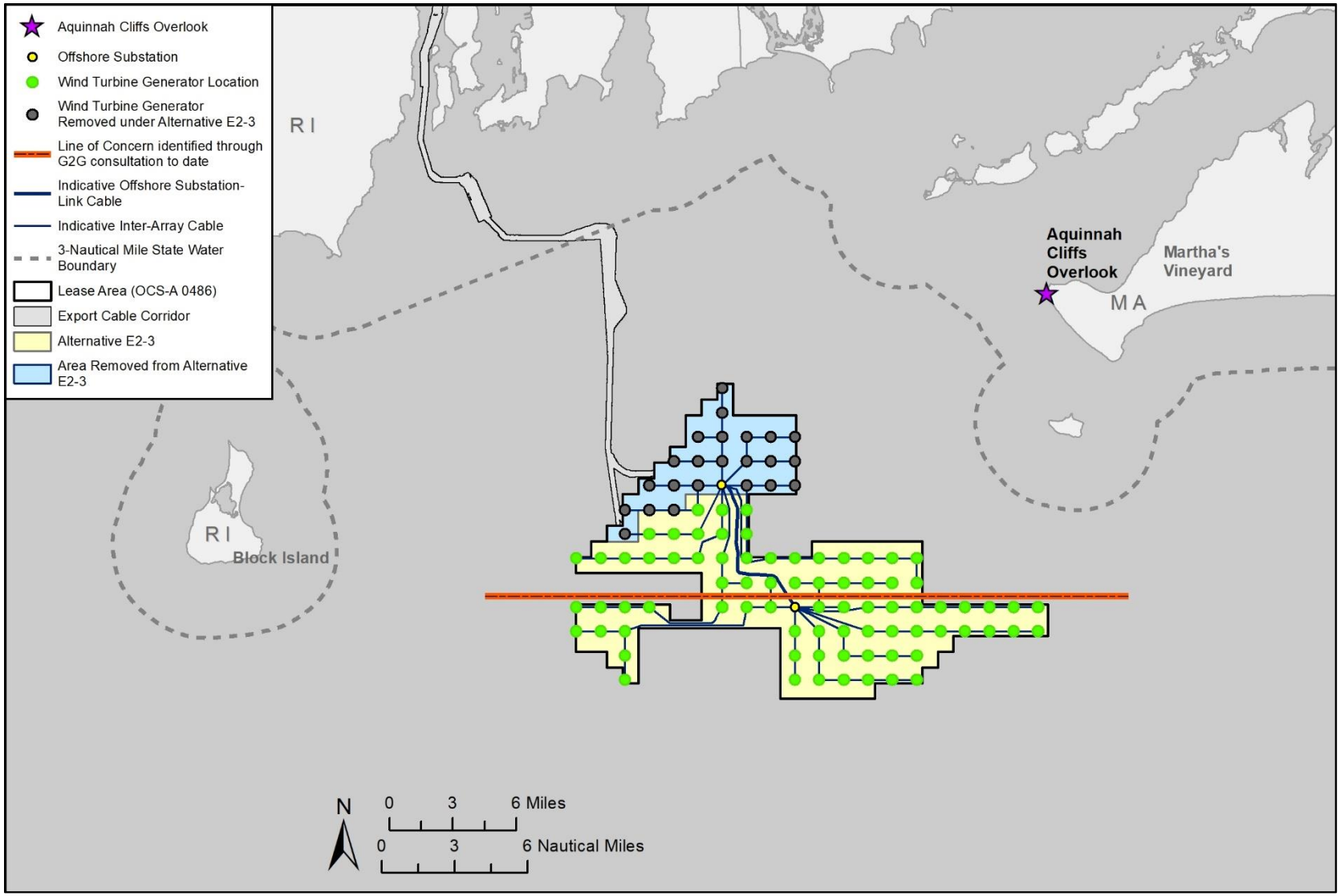

Figure K-11. Layout option 3 simulated for Alternative E2 (Alternative E2-3). Gray shaded WTG positions in the blue field are those that would be eliminated from consideration. 880 MW maximum output; removal of 23 WTG positions (leaves 77 positions available).

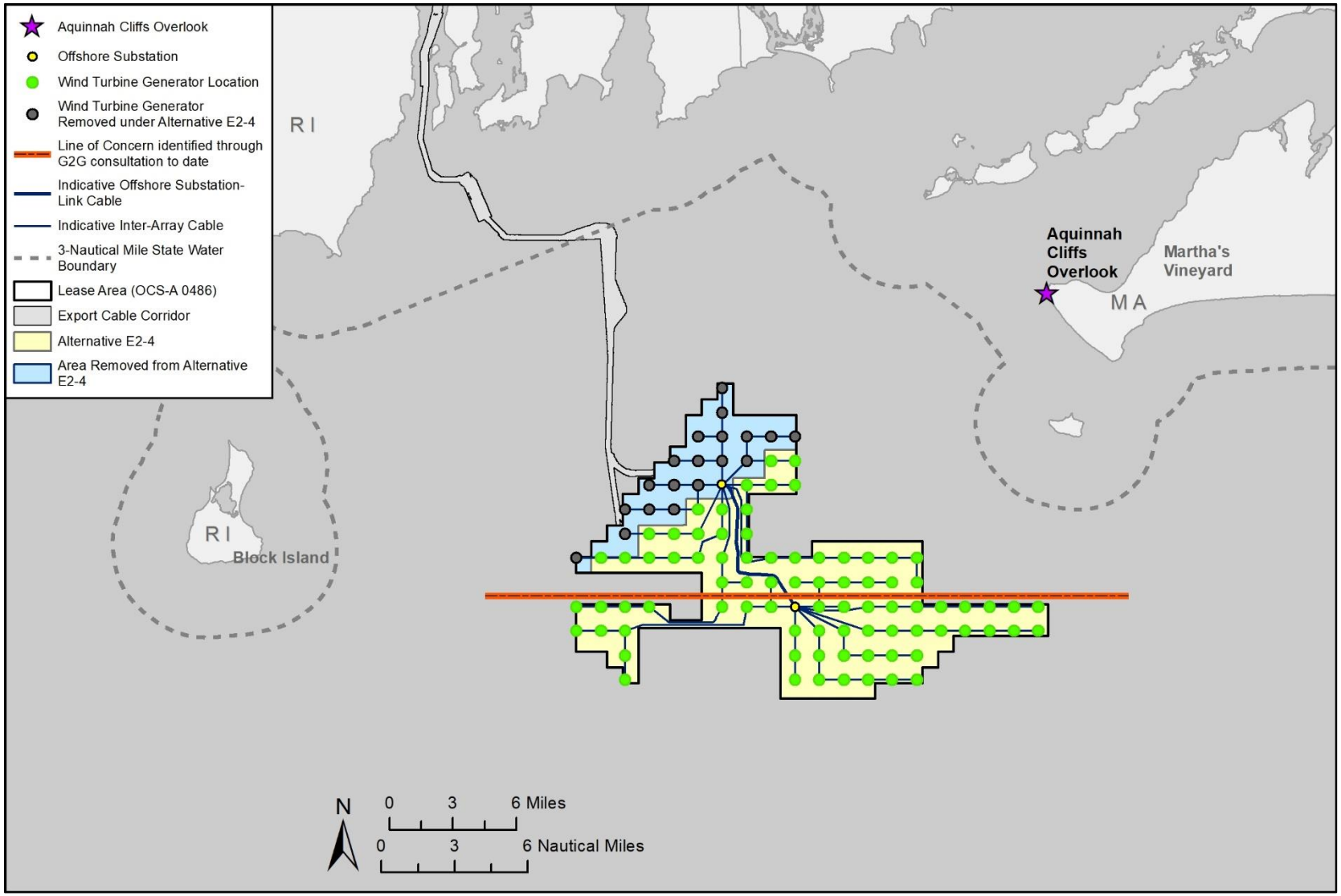

Figure K-12. Layout option 4 simulated for Alternative E2 (Alternative E2-4). Gray shaded WTG positions in the blue field are those that would be eliminated from consideration. 880 MW maximum output; removal of 23 WTG positions (leaves 77 positions available).

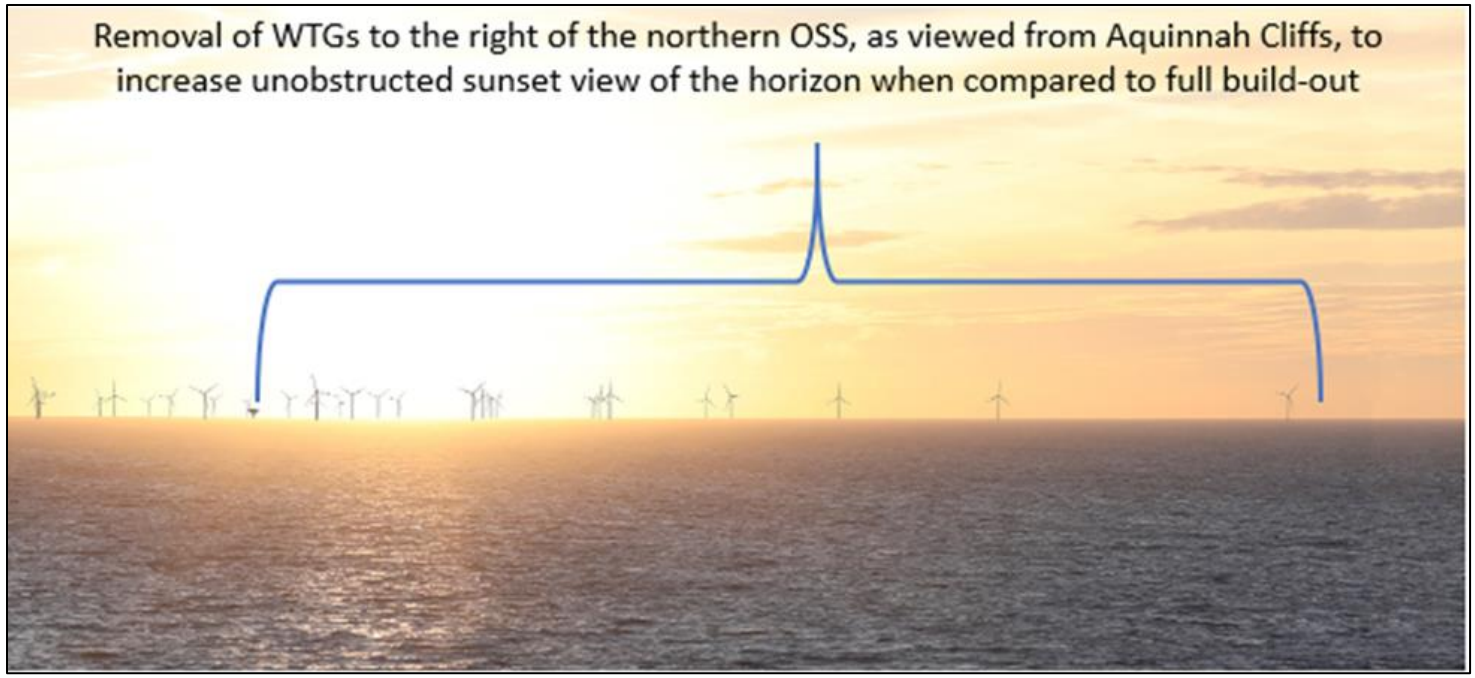

Figure K-13. Simulated sunset view facing the Project from Aquinnah Cliffs, indicating the WTG positions that would be removed under layout option E2-4.

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