United States Department of the Interior

FISH AND WILDLIFE SERVICE
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Shirley, NY 11967

Brandi Sangunett
NEPA Team Lead
Environment Branch for Renewable Energy
Office of Renewable Energy Program
Bureau of Ocean Energy Management
1849 C St NW
Washington, D.C. 20240

Dear Brandi Sangunett:

This document transmits the U.S. Fish and Wildlife Service's (Service) biological opinion (Opinion) based on our review of the Bureau of Ocean Energy and Management's (BOEM) authorization for Equinor and British Petroleum (Empire Wind) to construct the Empire Wind 1 and 2 Projects and their effects in the form of wind turbine collision mortality on the federally-listed red knot (*Calidris canutus rufa*; threatened) and its proposed critical habitat, and the federally-listed piping plover (*Charadrius melodus*; threatened) pursuant to the Endangered Species Act (ESA; 87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.). Your request for formal consultation was received on December 22, 2022. As described in the BA, the federal action agencies that are involved in the permitting and reviewing the effects of the project on listed species are the BOEM (which is the lead federal agency for purposes of this section 7 consultation), the Bureau of Safety and Environmental Enforcement (BSEE), the US Army Corps of Engineers (USACE), the Federal Aviation Administration, the US Coast Guard (USCG), and the National Marine Fisheries Service Office of Protected Resources.

This Opinion is based on information provided in the Biological Assessment (BA; received on December 21, 2022), BA addendum (received on March 28, 2023), Draft Environmental Impact Statement (DEIS; BOEM 2022a), the Construction and Operations Plan (COP; Tetra Tech 2022), and other sources of information. A complete decision file for this consultation is on file in the Service's Long Island Field Office, Shirley, NY.

Concurrences

The BOEM informally consulted with the Service on the following species: northern long-eared bat (*Myotis septentrionalis*; endangered), tri-colored bat (*Perimyotis subflavus*; proposed endangered), roseate tern (*Sterna dougallii dougallii*; endangered), monarch butterfly (*Danaus plexippus*; proposed), and seabeach amaranth (*Amaranthus pumilus*; threatened) (BOEM 2022b, Table 4, p. 25). For each of these species, the BOEM reached not likely to adversely affect determinations. As discussed below, piping plover and red knot were included in the informal consultation for project impacts unrelated to turbine collisions.

Overall, our concurrences are predicated on full implementation of the Conservation Measures provided in the BA and COP, which reflect measures proposed by the BOEM and Empire Wind, some of which were refined after coordination with the Service. Conservation Measures relevant to the Effects

Analysis can be found in Section III of the BO. All other Conservation Measures are listed below.

Conservation Measures

Roseate tern

To minimize attracting birds that are prone to perching, Empire Wind must install bird perching-deterrent devices where such devices can be safely deployed on the WTGs and OSSs. Empire Wind must submit for the BOEM and Service approval a plan to deter perching on offshore infrastructure. The plan must include the type(s) and locations of bird perching-deterrent devices, include a maintenance plan for the life of the project, allow for modifications and updates as new information and technology become available, track the efficacy of the deterrents, and a timeline for installation. The plan will be based on best available science regarding the efficacy of perching deterrent devices on avoiding and minimizing collision risk.

The location of bird-deterrent devices must be proposed by Empire Wind based on BMPs applicable to the appropriate operation and safe installation of the devices. Empire Wind must confirm the locations of bird perching-deterrent devices as part of the documentation it must submit with the Facility Design Report.

Northern long-eared bat

Empire Wind must conduct acoustic bat surveys in 2023 in accordance with the Service's Range-Wide Indiana Bat & Northern Long-eared Bat Survey Guidelines (USFWS 2023a) and submit survey data to the North American Bat Monitoring Program. A negative presence survey must be submitted to the Service, the BOEM, and BSEE to avoid additional conservation measures for tree and vegetation clearing.

Listed avian and bat species

- Onshore components will be sited in previously disturbed areas, existing roadways, or otherwise unsuitable avian habitat or right-of-ways (ROWs) to the extent practicable.
- Temporarily disturbed areas will be revegetated with appropriate native species at EW2, as appropriate.
- Avoidance of key habitats and tree clearing within the Oceanside POI parcel and the EW2 Onshore Substation C site will occur.
- Adherence to time-of-year restrictions, as necessary, at EW2 in sensitive onshore bird habitats, where feasible and required, unless otherwise determined acceptable by the applicable agencies.
- The use of horizontal directional drilling (HDD) or other trenchless technologies for installation of the export cable landfalls at EW2 to avoid surficial disturbances.
- Lighting not required during onshore construction will be limited to the minimum required by regulation and for safety, to reduce attraction of avian and bat species.

- Lighting not required by Federal Aviation Administration (FAA) and US Coast Guard (USCG) and for safety during offshore construction will be limited to reduce attraction of birds and bats, where practicable.

- The development and enforcement of an Oil Spill Response Plan (COP Appendix F; Tetra Tech 2022).

At the present time, the BOEM does not believe that the proposed project would be likely to jeopardize the existence of the tri-colored bat, a proposed species for listing under the ESA. If the tri-colored bat is listed, the BOEM would consult with the Service on the effects of the project on this species.

Offshore Project Construction and Maintenance Activities

Piping plover

We expect piping plover use of the offshore action area, identified as the airspace occupied by each WTG and the water's surface within the Lease Area Outer Continental Shelf (OCS)- A 0512, to be solely limited to migration flights. The Service concurs with the BOEM's determination that adverse effects to any plovers resulting from noise created by project construction and maintenance activities involving vessels, aircraft, pile driving, etc., are expected to be insignificant during the migration period. We also concur (1) that the risk of piping plovers colliding with stationary structures or vessels during daylight hours in the offshore environment is discountable and (2) that the risk of the Empire Wind 1 (EW1) and Empire Wind (EW2) aircraft warning lighting attracting or disorienting listed birds is discountable (i.e., birds are unlikely to be attracted/disoriented) and/or insignificant (i.e., any birds that are attracted/ disoriented by the Aircraft Detection Lighting System (ADLS) are likely to be affected for only between 5 to 10 percent of the night time hours during the migration months of March through May and August through September (Tetra Tech 2022, Appendix BB, Table 1)

Red knot

Juvenile and nonbreeding adult rufa red knots can occur along New York's Atlantic Coast during most months of the year and may spend longer in this region than birds stopping over during migration. Regional movements of rufa red knots are well documented (Burger et al. 2012, Loring et al. 2018). It is likely that moderate numbers of rufa red knots cross the action area on relatively lower-altitude regional flights, and that some percentage of these birds encounter one or more vessels. Such birds may make a minor course adjustment or be temporarily disoriented by noise or lights, but we conclude such effects are minor and generally do not impact fitness of the affected birds. Consequently, the Service concurs with the BOEM's determination that adverse effects to any rufa red knots flying in the offshore portion of the action area from noise during project construction (e.g., from vessels, aircraft, pile driving) are expected to be insignificant. We also concur that the risk of rufa red knots colliding with stationary structures or vessels in the offshore environment is discountable.

Roseate tern

The Service concurs with the BOEM's determination that adverse noise effects to roseate terns flying in the offshore portion of the action area due to construction and maintenance activities (e.g., from vessels, aircraft, pile driving, etc.) are expected to be insignificant. We also concur that the risk of roseate terns colliding with stationary structures or vessels in the offshore environment during daylight hours is discountable.

The best available information on roseate tern flight heights indicates the species generally would fly below the rotor-swept zone (RSZ), defined as 82 ft to 820 ft (25 m to 250 m), during foraging flights and above the RSZ during migration (as reported in Loring et al. 2019). In addition, both collision risk models used by the BOEM and the Service (Band 2012, Gilbert et al. 2022) in the BA and this Opinion, which are discussed later in this document, showed no predicted collisions over the life of the project. Therefore, we expect the risk of roseate terns colliding with operating wind turbine generators is discountable.

Northern long-eared bats

As noted in BOEM (2022b), "Acoustic data collected within the Lease Area (COP Appendix R; Tetra Tech 2022) in 2018 were primarily composed of calls of eastern red bats (*Lasiurus borealis*) and silver-haired bats (*Lasionycteris noctivagans*), concentrated during fall migration. Big brown bats (*Eptesicus fuscus*) were documented infrequently within the Lease Area, and hoary bats (*Lasiurus cinereus*) were also detected in the offshore environment, but closer to shore and not within the Lease Area. These data suggest that tree bats are most likely to pass through the Lease Area, mainly eastern red and silver-haired bats during the migration period (late summer/early fall). Because research on the movements of these bats in the marine environment is limited, there remains uncertainty on if this species travels offshore. If northern long-eared bats were to migrate over water, movements would likely be near the mainland." Potential Myotis detections were made in the Lease Area, but these were not definitive (BOEM 2022b). Following are the results reported in Table R-2, "Total Bat Passes Recorded within the Lease Area for each Species or Group, 2018" in Appendix R of the COP (Tetra Tech 2022):

Big Brown Bat (a) – 17 (2.9%)
Eastern Red Bat (a) – 229 (39.2%)
Silver-haired Bat (b) – 184 (31.5%)
Unidentified High Frequency Bat (a) – 133 (22.8%)
Unidentified Low Frequency Bat – 21 (3.6%)
Overall Total Number of Passes – 584

Notes: Percent of Total Passes for each species or group given in parentheses Notes: a/ Hibernating bat b/ Migratory tree bat

Consequently, the Service concurs that, based on best available evidence, use of the action area airspace over the Lease Area by northern long-eared and tricolored bats is undocumented, and thus the risk of any adverse effects to these species from the offshore components is currently discountable. We note, however, that northern long-eared and tricolored bats do occasionally occur at some distance offshore, that other bat species occur offshore more regularly and in higher numbers, and that our understanding of bats in the offshore environment is far from complete. Thus, we fully support and appreciate the inclusion of bats in the Avian and Bat Post Construction Monitoring Framework (Framework; Appendix C in the BA; see also Section XVIII of this Opinion). The Framework outlines an approach to pursuing post-construction monitoring to advance understanding of bird and bat interactions with offshore wind farms.

Onshore

Piping plover

Other than an occasional transient adult or fledged juvenile, we do not expect piping plovers to occur landward of sandy ocean beaches and dunes in the developed portions of the action area, and in the back bay areas where the cable alignment is proposed. Thus, we concur that any adverse effects to this species from project activities during construction as well as post-construction operations and management (O&M) activities in bays, marshes, or uplands is expected to be insignificant and/or discountable.

Rufa Red knot

We concur that the risk of rufa red knots colliding with an onshore construction vehicle, equipment, or any stationary structure (other than powerlines) is discountable.

Roseate tern

Due to the existing development and previous activity on the proposed substation properties, we do not anticipate any post-construction impacts to roseate terns from noise or lighting stemming from O&M activities at the substations. We concur that the risk of roseate terns colliding with onshore construction vehicles, equipment, or any stationary structures (other than powerlines) is discountable.

Northern long-eared bat

We concur that potential post-construction impacts to northern long-eared bats from electromagnetic fields (stemming from the transmission cables) are insignificant. This is based, in part, on the information provided in Table 1 of the BA (BOEM 2022b), which indicates that offshore export cables will be buried at a minimum target depth of 6 feet (ft) (0.9 meter [m]) and onshore export cables will be housed in concrete duct banks and buried at a minimum depth of 3 ft (0.9m).

We also concur that the risk of northern long-eared bats colliding with onshore construction vehicles, other onshore equipment, offshore vessels, or any stationary structures (on or offshore) is discountable.

Seabeach amaranth

Empire Wind would use trenchless technology (e.g., horizonal directional drilling [HDD] or Direct Pipe) for the EW2 offshore export cable landing, which would avoid open beach and dune habitat for seabeach amaranth (COP Volume 2f, Table 9-1, APMs 85 and 96 Tetra Tech 2022; BOEM 2022b, p.67). It is anticipated that permit conditions may include best management practices (BMPs) such as seasonal work restrictions to avoid and minimize potential adverse effects on seabeach amaranth, clearly demarcating areas where the plant occurs to avoid disturbance during construction and controlling runoff and stabilizing soils to minimize the potential for soil erosion and sedimentation in wetland habitats during construction (BOEM 2022b, p.67). Consequently, the Service concurs with the BOEM's determination that adverse effects to seabeach amaranth are expected to be insignificant and discountable due to the avoidance of open beach and dune habitat and the utilization of BMPs.

Monarch butterfly

We concur with the BOEM's determination that the proposed action is not likely to jeopardize the continued existence of the monarch butterfly. This concurrence is based on the general lack of suitable habitat due to the pre-existing developed nature of the project area, the relative size of potential project impacts to habitat, the restoration of temporarily disturbed habitat and the potential beneficial effect of conversion from shrub and forested habitat to herbaceous habitat. Thus, any adverse effects to this species from project activities is expected to be insignificant and/or discountable.

Although the ESA does not require conferencing on candidate species, the BOEM assessed the effects of the proposed action to monarch butterfly and requested a conference. Therefore, this section shall serve as our conference concurrence that the proposed action is not likely to adversely affect monarch butterfly. If the monarch butterfly is listed under the ESA during the term of this action and there have been no significant changes that could warrant reanalysis of effects to monarch butterfly, the BOEM should contact the Service in writing to affirm the validity of the conference concurrence and request it be adopted as a standard concurrence to ensure continued coverage under the ESA.

Thank you for consulting with the Service on these projects. If you have any questions regarding the Opinion, our response to your concurrence requests, or our shared responsibilities under the ESA, please contact Steve Papa (steve_papa@fws.gov) and Kim Spiller (kimberly_spiller@fws.gov) of the Long Island Field Office.

Sincerely,

IAN DREW Digitally signed by IAN DREW
Date: 2023.06.22 21:16:45
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Ian Drew
Field Supervisor

Biological Opinion on the Effects of the Empire Wind 1 and Empire Wind 2 Projects on the Federally Listed Piping Plover (*Charadrius melodus*; threatened) and rufa Red Knot (*Calidris canutus rufa*; threatened) within the Jurisdiction of the Long Island Field Office, Shirley, New York.

Prepared for:
Bureau of Ocean Energy Management
Office of Renewable Energy Programs
Washington, D.C.

Prepared by:
U.S. Fish and Wildlife Service
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June 2023

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I. BACKGROUND AND INTRODUCTION

Section 7(a)(2) states that each Federal agency shall, in consultation with the Secretary, ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of a listed species or result in the destruction or adverse modification of designated critical habitat. In fulfilling these requirements, each agency is to use the best scientific and commercial data available. This section of the Act sets out the consultation process, which is further implemented by regulation (50 CFR §402).

Both the Service and the BOEM acknowledged that there are significant data gaps relative to our knowledge of bird movement through the wind Lease Area and the BOEM, Empire Wind, and the Service have agreed on measures that would begin to address some of these data gaps. However, as noted in the Service's Consultation Handbook (USFWS and NMFS, 1998), "Where significant data gaps exist there are two options: (1) if the action agency concurs, extend the due date of the biological opinion until sufficient information is developed for a more complete analysis; or (2) develop the biological opinion with the available information giving the benefit of the doubt to the species. Empire Wind and the BOEM decided to proceed with best available information in order to be able to adhere to the Final EIS schedule.

As we note in the BO, the current state of modelling to predict collision risk with WTGs has resulted in estimates that may over or under- estimate collision risk in some scenarios. In recognition of this, we have advised the BOEM that if, and when, additional data or improved modelling become available, reinitiation of consultation may be required pursuant to 50 CFR Part 402.16.

This Opinion is one of several that are being currently being prepared for offshore wind projects off Long Island, NY, Massachusetts, and New Jersey. The models available to quantitatively predict collision impacts include Band (2012) and the Stochastic Collision Risk Assessment Model (SCRAM); (Gilbert et al. 2022). Each model has its strengths and limitations as discussed further in Appendix A. In addition, biological inputs to these models derived from species' tracking also have limitations. For instance, the Motus Wildlife Tracking System (Motus) tracking stations have limitations in how far they can detect birds beyond a certain distance from shore. This adds to the uncertainty of the SCRAM estimates, but nonetheless provides a tool for us to use in quantifying collision mortality and incidental take. However, before arriving at those decision points we had to evaluate the model results, cumulative effects, environmental baseline, and status of the species in combination to determine whether the proposed project would jeopardize the continued existence of listed species. For this project, we have determined that the Empire Wind projects would not be likely to jeopardize the continued existence of the piping plover or rufa red knot, however, we determined that there will be incidental take in the form of collision mortality related to both projects. Through the implementation of the conservation measures by the BOEM and or Empire Wind, along with full implementation of the reasonable and prudent measures and terms and conditions provided in this Opinion, we believe the effect of this take will be minimized.

II. DESCRIPTION OF THE PROPOSED ACTION

As defined in the ESA Section 7 regulations (50 CFR 402.02), "action" means "all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by federal agencies in the United States or upon the high seas." The "action area" is defined as "all areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the action."

The following is a summary of the proposed action which includes the construction of two wind projects in the Lease Area based on information provided in BOEM (2022b) and Tetra Tech 2022). A detailed project description can be found in the *"Empire Offshore Wind: Empire Wind Projects (EW 1 and EW 2) Biological Assessment"* dated November 2022 (BA; BOEM 2022b) and *"Empire Offshore Wind: Empire Wind Project (EW1 and EW2) Construction and Operations Plan"* (COP; Tetra Tech 2022).

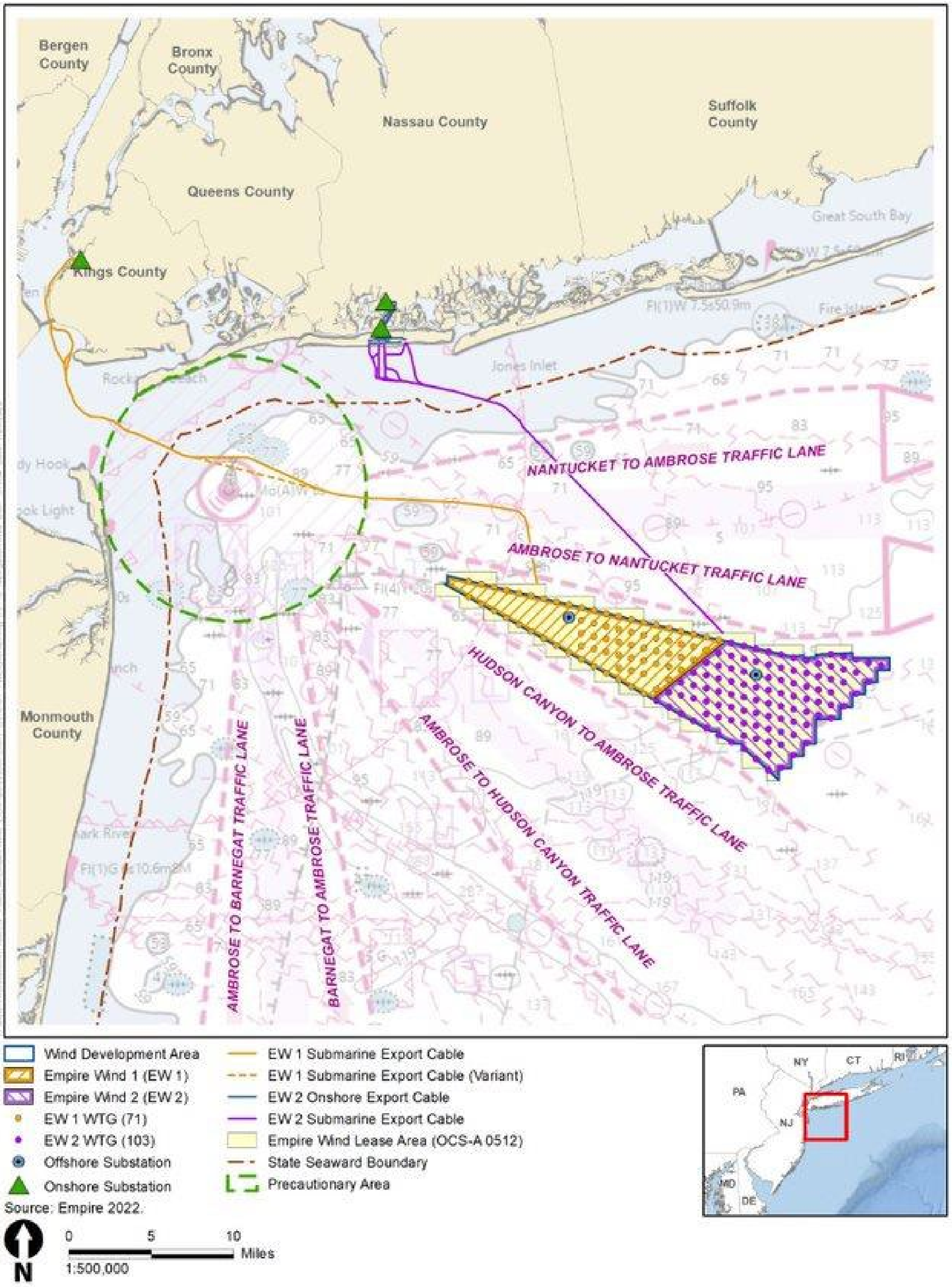

Figure 1. Map showing location of proposed Empire Wind offshore wind power development area, cable routes, landing locations, and onshore substations (From BOEM 2022b).

The proposed action (Alternative A in the Environmental Impact Statement [EIS]) is the BOEM's potential authorization for Empire Wind to construct, operate, maintain, and decommission the EW1 and EW2 projects within the range of design parameters described in Volume 1 of the COP (Tetra Tech 2022).

The EW1 project would consist of up to 57 WTGs, interarray cables, an offshore substation (OSS), up to 40 nautical miles (nm) (74 kilometers [km]) of submarine export cable, a cable landfall at the South Brooklyn Marine Terminal (SBMT), an onshore substation, interconnection cable, and a point of interconnection (POI) at Gowanus Substation in Brooklyn, NY (Tetra Tech 2022). The EW2 project would consist of up to 90 WTGs, interarray cables, an OSS, up to 26 nm (48 km) of submarine export cable, up to two cable landfalls in Long Beach or Lido Beach, NY, onshore cable route options, an onshore substation, and a POI in Oceanside, NY (Tetra Tech 2022).

In total, both projects would install 147 WTGs, 2 OSS, 2 onshore substations, 260 nm of interarray cable, 66 nm of submarine export cable and 3 cable landfall locations.

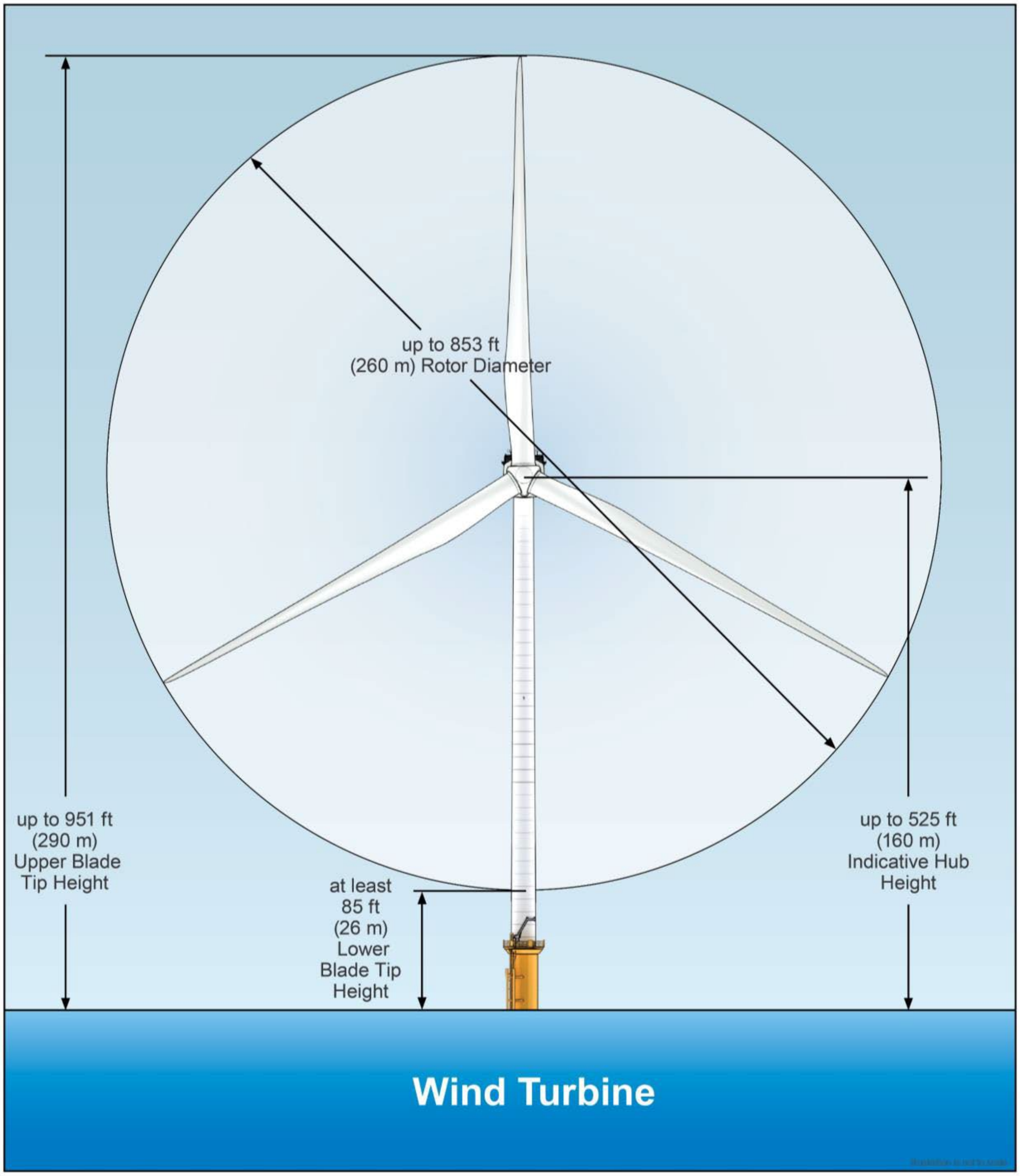

Figure 2. Representative wind turbine (Tetra Tech 2022).

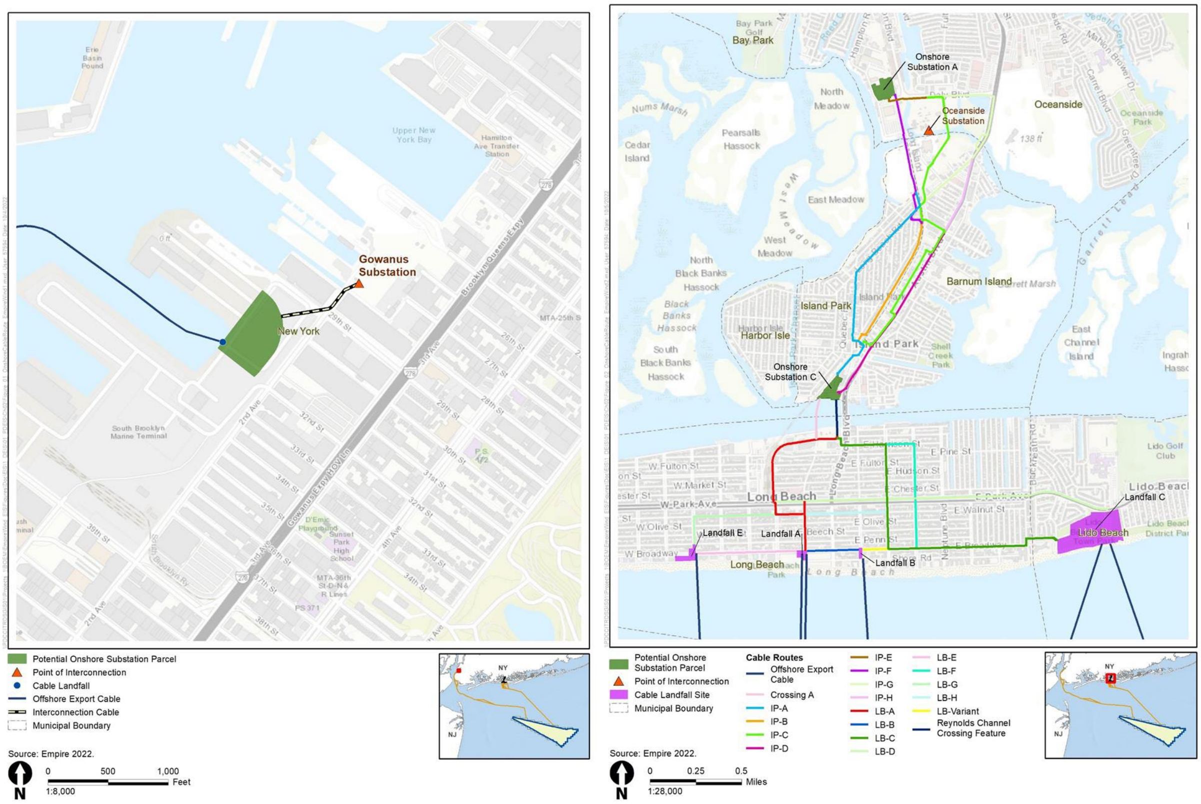

Figure 3. Landfall locations and cable routes for the EW1 and EW2 projects (BOEM 2022b).

Cable Landfalls

The EW1 submarine export cable landfall would be at the SBMT proposed onshore substation site along the Brooklyn Waterfront and adjacent to 1st and 2nd Avenues (BOEM 2022b). The SBMT is a large, paved terminal with a variety of uses (BOEM 2022b). The onshore substation would be constructed within an approximately 4.8-acre (1.9-hectare [ha]) portion of the SBMT property, with a maximum main building height of 49 ft (15m) (BOEM 2022b).

The submarine export cable would be installed along the northeastern side of the 35th Street Pier via dredging. The EW1 submarine export cable would likely connect directly into the onshore substation, with no onshore export cable required, due to the short distance from landfall to the onshore substation (BOEM 2022b). An approximately 0.2-mi (0.3-km) length of interconnection cable would then connect the onshore substation to the Gowanus POI, which is owned and operated by Consolidated Edison (BOEM 2022b). Figure 3 shows the proposed locations for the EW1 landfall, onshore substation, interconnection cable, and connection to the Gowanus POI.

The EW2 onshore substations are planned in Oceanside (Option A) or in Island Park (Option C), NY (Figure 3). The Oceanside location is on 6.4 acres (2.6 ha) of privately owned property on the corner of Daly Boulevard and Hampton Road and currently supports industrial uses. The Island Park location is on 5.2-acres (2.1-ha) of privately owned property adjacent to Railroad Place and currently supports commercial uses. Either onshore substation option would connect into the Oceanside 138-kilovolt (kV) Substation (Oceanside POI) owned by National Grid and operated by Public Service Enterprise Group

(PSEG) Incorporated Long Island. (BOEM 2022b).

Vessels and Port Facilities

The construction and installation phases of the proposed action would make use of both construction and support vessels to complete tasks in the offshore portion of the project area. Construction vessels would travel between the offshore Lease Area and the port facility where equipment and materials would be staged. It is estimated that the EW1 and EW2 projects would each require approximately 18 vessels for construction. COP Volume 1, Table 3.4-1 (Tetra Tech 2022) identifies the types of offshore vessels that would be used during construction. Helicopters are also being considered to support the projects.

Ports under consideration include, but are not limited to, the following:

- **Port of Albany, Albany, New York.** Empire Wind may select Port of Albany as the starting point for transporting WTG components to a local staging area at SBMT, Brooklyn, NY.
- **Port of Coeymans, Coeymans, New York.** Port of Coeymans is under consideration as a possible location for loading rock for foundation scour protection, from where it would be transported directly to the installation locations in the Lease Area.
- **Corpus Christi, Texas.** A port in the Corpus Christi, Texas area could be a starting point for transporting the OSS topsides for EW1 and EW2.
- **South Brooklyn Marine Terminal, Brooklyn, New York**. Empire Wind proposes to lease portions of SBMT for laydown and staging of WTG blades, turbines, and nacelles; foundation transition pieces; or other facility parts during construction of the EW1 and EW2 projects. During this time, Empire Wind would receive, store, assemble, and export Project components via marine vessels and onshore cranes and other equipment. (BOEM 2022, p. 15).

III. CONSERVATION MEASURES

The Service's Consultation Handbook defines "Conservation Measures" as "actions to benefit or promote the recovery of listed species that are included by a Federal agency as an integral part of a proposed action under ESA consultation. These actions will be taken by the Federal agency or applicant and serve to minimize or compensate for project effects on the species under review" (USFWS and NMFS 1998). Conservation Measures may include actions that the Federal agency or applicant have committed to complete in a BA or similar document. When used in the context of the ESA, "Conservation Measures" represent actions pledged in the project description that the action agency or the applicant will implement to further the recovery of the species under review and can contribute to the Federal agency's Section 7(a)(1) responsibilities. Such measures may be tasks recommended in the species' recovery plan, should be closely related to the action, and should be achievable within the authority of the action agency or applicant. Since Conservation Measures are part of the proposed action, their implementation is required under the terms of the consultation (USFWS and NMFS 1998). The Handbook also states, "If the conservation measure…does not minimize impacts to affected individuals in the action area, the beneficial effects of the conservation measure are irrelevant to the incidental take analysis."

the BOEM and Empire Wind have proposed two sets of measures listed in the BA and COP, Volume 2f, Table 9-1, respectively. The first set given in Section III, below are Conservation Measures that avoid or minimize effects of the action on listed species interacting with the turbines in the action area. The second set listed in Section IV are actions that may assist in the recovery of the species via monitoring species presence and movement in the action area into the future and using this information to further our understanding of collision risks and species use of the offshore air and water habitats. As data and knowledge gaps are addressed through implementation of the measures in Section IV, the Conservation Measures given in Section III may be amended or supplemented, as appropriate.

The following measures fall within the authority of the BOEM to incorporate into the project description as measures that would contribute to avoiding and minimizing impacts of this project and, thus, are applicable to the effects analysis in this Opinion.

A. Turbine and Offshore Substation Specific Measures

Empire Wind proposes the installation of up to 57 WTGs for EW1 and up to 90 WTGs for EW2 within the 65,458-acre (26,490-ha) Wind Farm Development Area (Figure 1). The top of the WTGs would extend to a height of up to 951 ft (290 m) above highest astronomical tide with a minimum spacing of no less than 0.65 nm and be oriented in a north-south direction.

- To aid safe navigation, Empire Wind must comply with all FAA, USCG, and the BOEM lighting, marking and signage requirements. Empire Wind will comply with all applicable requirements while minimizing impacts through appropriate application, including directional aviation lights, that minimize visibility from shore. (BOEM 2022b; Table 9, Measure *1c*).

- Empire Wind has committed to lighting reduction measures (BOEM 2022b, p. 62). Empire Wind will use lighting technology that minimizes impacts on avian species to the extent practicable.

- Dependent on technical availability, Empire Wind must use an FAA-approved vendor for the ADLS on WTGs and OSSs, which will activate the FAA hazard lighting only when an aircraft is in the vicinity of the wind facility to reduce visual impacts at night in the offshore environment. To further reduce impacts on birds, Empire Wind would limit, where practicable, lighting which is not required by FAA and USCG, during offshore construction to reduce attraction of birds (Tetra Tech 2022 COP Volume 2f, Table 9-1, APM 82; BOEM 2022b, Table 9 [1b], p. 62).

- Empire Wind is required to light each WTG and OSS in a manner that is visible by mariners in a 360-degree arc around the structure. To minimize the potential of attracting migratory birds, the top of each USCG-required marine navigation light will be shielded to minimize upward illumination (conditional on USCG approval). The Service understands that the USCG-approved lights may not be shielded, but that marine lanterns typically approved for this type of usage are designed to illuminate a horizonal plane near the sea surface, and do not direct light skyward (BOEM 2022b, Table 9, Measure 1c).

- Coordination with USCG regarding maritime navigation lighting occurs post-COP approval, generally at least 120 calendar days prior to installation. The Service will be afforded an opportunity to review a copy of Empire Wind's application to USCG to establish Private Aids to Navigation (PATON), which includes a lighting, marking, and signaling plan. The PATON application will include design specifications for maritime navigation lighting. The Service may offer recommendations to USCG on the PATON application to minimize or reduce avian impacts. However, expertise and jurisdiction for ensuring safe navigation lay with USCG. No measures to minimize avian impacts will be adopted or pursued that are not deemed by USCG as fully compatible with safe navigation

- Following approval of the PATON by the USCG, the BOEM and the Service will work together to evaluate the USCG-approved navigation lighting system. Specifically, we will work together to characterize the color, intensity, and duration of any light from maritime lanterns that is likely to reach the typical flight heights of listed birds and assess the degree to which the light is likely to attract or disorient listed birds. This information will be considered, as appropriate, in future updates to the incidental take statement accompanying this Opinion and in the annual mitigation assessments.

In order for the Service to be kept informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats, we request notification of the implementation of any conservation actions.

IV. OTHER PROJECT MEASURES SUPPORTING SPECIES' MONITORING, MODELING, AND MITIGATION

These measures are intended to address significant data gaps in avian and bat use of offshore areas, collision modelling, and compensatory mitigation. They are not intended to avoid or minimize the collision risk at this time.

A. Monitoring and Data Collection

BOEM will require that Empire Wind develops and implements an Avian and Bat Post-Construction Monitoring Plan (ABPCMP) based on the Avian and Bat Post-Construction Monitoring Framework found in Appendix C of the BA in coordination with Bureau of Safety and Environmental Enforcement (BSEE), the Service, appropriate state agencies, and other relevant regulatory agencies (BOEM 2022b). Annual monitoring reports will be used to determine the need for adjustments to monitoring approaches, consideration of new monitoring technologies, and/or additional periods of monitoring (BOEM 2022b, Table 9 Measure 2b).

Prior to, or concurrent with, offshore construction activities, Empire Wind must submit an ABPCMP for the BOEM, BSEE and Service review. The BOEM, BSEE and the Service will review the ABPCMP and provide any comments on the plan within 60 calendar days of its submittal. Empire Wind must resolve all comments on the ABPCMP to the satisfaction of BOEM, BSEE and the Service before implementing the plan and prior to the commissioning of WTG operations. The goals of the ABPCMP will be: (1) to advance understanding of how the target species utilize the offshore airspace and do (or do not) interact with the wind farm; (2) to improve the collision estimates from SCRAM (or its successor) for listed bird species; and (3) to inform any efforts aimed at minimizing collisions or other project effects on target species.

1. Monitoring

Empire Wind must conduct monitoring as outlined in the Avian and Bat Post-Construction Monitoring Framework (BOEM 2022b Appendix C), which will include use of radio-tags to monitor movement of ESA-listed birds in the vicinity of the project. The ABPCMP will allow for changing methods over time in order to regularly update and refine collision estimates for listed birds. Specific to this purpose, the plan will include an initial monitoring phase involving deployment of Motus radio tags on listed birds in conjunction with installation and operation of Motus receiving stations on turbines in the Lease Area following offshore Motus recommendations (https://motus.org/groups/atlantic-offshore-wind/). The initial phase may also include deployment of satellite-based tracking technologies (e.g., Global Positioning System [GPS] or Argos tags). The monitoring will also include digital aerial surveys to monitor avoidance behavior and densities.

2. Annual Monitoring Reports

Empire Wind must submit to the BOEM (at renewable_reporting@boem.gov), the Service, and the BSEE (via TIMSWeb and at protectedspecies@bsee.gov) a comprehensive report after each full year of monitoring (pre- and post-construction) within 6 months of completion of the last avian survey. The report must include all data, analyses, and summaries regarding ESA-listed and non-ESA-listed birds and bats. The BOEM, BSEE, and the Service will use the annual monitoring reports to assess the need for reasonable revisions (based on subject matter expert analysis) to the ABPCMP. The BOEM, BSEE, and the Service reserve the right to require reasonable revisions to the ABPCMP and may require new technologies as they become available for use in offshore environments.

3. Post-Construction Quarterly Progress Reports

Empire Wind must submit quarterly progress reports during the implementation of the ABPCMP to the BOEM (at renewable_reporting@boem.gov), BSEE and the Service by the 15th day of the month following the end of each quarter during the first full year that the project is operational. The progress reports must include a summary of all work performed, an explanation of overall progress, and any technical problems encountered.

4. Monitoring Plan Revisions

Within 30 calendar days of submitting the annual monitoring report, Empire Wind must meet with the BOEM, BSEE, Service, and appropriate state agencies to discuss the following: the monitoring results; the potential need for revisions to the ABPCMP, including technical refinements or additional monitoring; and the potential need for any additional efforts to reduce impacts. If, based on this annual review meeting, the BOEM and the Service jointly determine that revisions to the ABPCMP are necessary, the BOEM will require Empire Wind to modify the ABPCMP. If the projected collision levels, as informed by monitoring results, deviate substantially from the effects analysis included in this Opinion, Empire Wind must transmit to the BOEM recommendations for new mitigation measures and/or monitoring methods.

The frequency, duration, and methods for various monitoring efforts in future revisions of the ABPCMP will be determined adaptively based on current technology and the evolving weight of evidence regarding the likely levels of collision mortality for each listed bird species. The effectiveness and cost of various technologies/methods will be key considerations when revising the plan. Grounds for revising the ABPCMP include, but are not limited to: (i) greater than expected levels of collision of listed birds; (ii) evolving data input needs for SCRAM (or its successor); (iii) changing technologies for tracking or otherwise monitoring listed birds in the offshore environment that are relevant to assessing collision risk; (iv) new information or understanding of how listed birds utilize the offshore environment and/or interact with wind farms; and (v) coordination and alignment of tracking, monitoring, and other data collection efforts for listed birds across multiple wind farms/leases on the OCS.

The BOEM will require Empire Wind to continue implementation of appropriate monitoring activities for listed birds (under the current and future versions of the ABPCMP) until one of the following occurs: (i) the EW1 and EW2 turbines cease operation; (ii) the Service concurs that a robust weight of evidence has demonstrated that collision risks to all two listed birds from EW1 and EW2 turbine operations are negligible (i.e., the risk of take from WTG operation is discountable); or (iii) the Service concurs that further data collection is unlikely to improve the accuracy or robustness of collision mortality estimates and is unlikely to improve the ability of the BOEM and Empire Wind to reduce or offset collision mortality.

5. Operational Reporting (Operations)

Empire Wind must submit to the BOEM (at renewable_reporting@boem.gov) and BSEE (via TIMSWeb and at protectedspecies@bsee.gov) an annual report summarizing monthly operational data calculated from 10-minute supervisory control and data acquisition data for all turbines together in tabular format: the proportion of time the turbines were operational (spinning at >x revolutions per minute [rpm]) each month, the average rotor speed (rpm) of spinning turbines plus 1 standard deviation, and the average pitch angle of blades (degrees relative to rotor plane) plus 1 standard deviation. The BOEM and BSEE will use this information as inputs for avian collision risk models to assess whether the results deviate substantially from the effects analysis included in this Opinion.

6. Raw Data

Empire Wind must store the raw data from all avian and bat surveys and monitoring activities according to accepted archiving practices. Such data must remain accessible to the BOEM, BSEE and the Service, upon request for the duration of the lease. Empire Wind must work with the BOEM to ensure the data are publicly available. All avian tracking data (i.e., from radio and satellite transmitters) will be stored, managed, and made available to the BOEM, BSEE and the Service following the protocols and procedures outlined in the agency document entitled *Guidance for Coordination of Data from Avian Tracking Studies*, or its successor.

B. Incidental Mortality Reporting

Empire Wind must provide an annual report to the BOEM, BSEE and the Service documenting any dead (or injured) birds or bats found on vessels and structures during construction, operations, and decommissioning. The report must contain the following information: the name of species, date found, location, a picture to confirm species identity (if possible), and any other relevant information. Carcasses with federal or research bands must be reported to the USGS Bird Band Laboratory, available at https://www.pwrc.usgs.gov/BBL/bblretrv/.

Incidental observations are extremely unlikely to document any fatalities of listed birds that may occur due to turbine collision. While this Conservation Measure appropriately requires documentation and reporting of any fatalities observed incidental to O&M activities, the ABPCMP will make clear that lack of documented fatalities in no way suggests that fatalities are not occurring. Likewise, the agencies will not presume that any documented fatalities were caused by colliding with a turbine unless there is evidence to support this conclusion.

Any occurrence of a dead or injured ESA-listed bird or bat must be reported to the BOEM, BSEE, and Service as soon as practicable (taking into account crew and vessel safety), but no later than 72 hours after the sighting, and, if practicable, the dead specimen will be carefully collected and preserved in the best possible state (BOEM 2022b, Table 9, Measure 3). The BOEM will coordinate with the Service on procedures and required permits for processing and handling specimens.

C. Collision Risk Model Support

The BOEM has funded the development of a SCRAM, which builds on and improves earlier collision risk modeling frameworks. The Service fully supports SCRAM as a scientifically sound method for integrating best available information to assess collision risk for the two listed bird species. The first generation of SCRAM was released in early 2023 and still reflects a number of consequential data gaps and uncertainties. The BOEM has already committed to funding Phase 2 of the development of SCRAM. We expect that the current limitations of SCRAM will decrease substantially over time as more and more tracking data get incorporated into the model (e.g., from more individual birds, additional geographic areas, improved bird tracking capabilities, and emerging tracking technologies), and as modeling methods and computing power continue to improve.

Via this measure, the BOEM commits to continue funding the refinement and advancement of SCRAM, or its successor, with the goal of continually improving the accuracy and robustness of collision mortality estimates. This commitment is subject to the allocation of sufficient funds to the BOEM from Congress. This commitment will remain in effect until one of the following occurs:

i. the EW1 and EW2 turbines cease operation;
ii. the Service concurs that a robust weight of evidence has demonstrated that collision risks to all two listed birds from EW1 and EW2 turbine operation are negligible (i.e., the risk of take from WTG operation is discountable); or
iii. the Service concurs that further development of SCRAM (or its successor) is unlikely to improve the accuracy or robustness of collision mortality estimates.

D. Collision Risk Model Utilization

The BOEM will work cooperatively with the Service to re-run the SCRAM model (or its successor) for the EW1 and EW2 projects according to the following schedule:

- At least annually for the first 3 years of WTG operation;
- At least every other year for years 4 to 10 of WTG operation (i.e., years 4, 6, 8, and 10);
- At least every 5 years between year 10 and the termination of WTG operation (i.e., years 15, 20, and 25 [and beyond if the lease is extended]).

Between these regularly scheduled model runs, the BOEM will also re-run the SCRAM and Band (2012) models (or its successor) within 90 days of each major model release or update, and at any time upon request by the Service or Empire Wind, and at any time as desired by the BOEM. Based on these periodic updates of estimated collision rates, the incidental take statement accompanying this Opinion will be revised as necessary and appropriate.

The above schedule may be altered upon the mutual agreement of the BOEM and the Service. The schedule is subject to sufficient allocation of funds to the BOEM from Congress. This commitment will remain in effect until one of the following occurs:

i. the EW1 and EW2 turbines cease operation;
ii. the Service concurs that a robust weight of evidence has demonstrated that collision risks to both listed birds from EW1 and EW2 turbine operations are negligible (i.e., the risk of take from WTG operation is discountable); or
iii. the Service concurs that further model runs are unlikely to improve the accuracy or robustness of collision mortality estimates.

The BOEM is currently undertaking a regional environmental assessment of numerous offshore wind leases in the New York Bight, including some leases contiguous with EW1 and EW2 Lease Area OCS-A 0512. To account for potential additive and synergistic effects of offshore wind infrastructure buildout across this section of the coast, the BOEM will consider collision mortality estimates for the EW1 and EW2 projects in its assessment of overall collision risk for the New York Bight. The periodic updating of collision mortality estimates for the EW1 and EW2 projects, according to the above schedule, may eventually be integrated into a regional or coastwide adaptive monitoring and impact minimization framework.

E. Compensatory Mitigation

To minimize population-level effects on listed birds, the BOEM will require Empire Wind to provide appropriate compensatory mitigation as needed to offset projected levels of take of listed birds from WTG collision. Compensatory mitigation will be consistent with the conservation needs of listed species as identified in Service documents including, but not limited to, listing documents, Species Status Assessments, Recovery Plans, Recovery Implementation Strategies (RISs), and 5-Year Reviews. Compensatory mitigation will preferentially address priority actions, activities, or tasks identified in a Recovery Plan, RIS, or 5-Year Review, for piping plover and rufa red knot; however, research, monitoring, outreach, and other recovery efforts that do not materially offset birds lost to collision mortality will not be considered compensatory mitigation.

Compensatory mitigation may include, but is not limited to: restoration or management of lands, waters, sediment, vegetation, or prey species to improve habitat quality or quantity for listed birds; efforts to facilitate habitat migration or otherwise adapt to sea level rise; predator management; management of human activities to reduce disturbance to listed birds; and efforts to curtail other sources of direct human-caused bird mortality such as from vehicles, collision with other structures (e.g., power lines, terrestrial wind turbines), hunting, oil spills, and harmful algal blooms. Geographic considerations may include but are not limited to: (a) any listed species recovery unit(s) or other management unit(s) determined to be disproportionally affected by or vulnerable to collision mortality; and/or (b) those portions of a species' range where compensatory mitigation is most likely to be effective in offsetting collision mortality.

Compensatory mitigation for the EW1 and EW2 projects may be combined with mitigation associated with other offshore wind projects, but in no case will compensatory mitigation be double counted as applying to more than one offshore wind project.

The BOEM will require Empire Wind to prepare a Compensatory Mitigation Plan (Plan) prior to the start of WTG operation. At a minimum, the Plan will provide compensatory mitigation actions to offset projected levels of take of listed birds for the first 5 years of WTG operation at a ratio of 1:1. At its discretion, Empire Wind may include actions to offset projected take over a longer time period and/or at a higher ratio. The Plan will include:

a. detailed description of one or more specific mitigation actions;
b. the specific location for each action;
c. a timeline for completion;
d. itemized costs;
e. a list of necessary permits, approvals, and permissions;
f. details of the mitigation mechanism (e.g., mitigation agreement, applicant-proposed mitigation);
g. best available science linking the compensatory mitigation action(s) to the projected level of collision mortality as described in this Opinion;
h. a schedule for completion; and
i. monitoring to ensure the effectiveness of the action(s) in offsetting the target level of take.

Plan development and implementation will occur according to the following schedule:

- At least 180 days before the start of WTG operation Empire Wind will distribute a draft Plan to the BOEM, BSEE and the Service, the appropriate state agencies, and other identified stakeholders or interested parties for a 60-day review period.
- At least 90 days before the start of WTG operation, Empire Wind will transmit a revised Plan for approval by the BOEM, BSEE, and the Service, along with a record of comments received on the draft. Empire Wind will rectify any outstanding agency comments or concerns before final approval by the BOEM, BSEE and the Service.
- Before or concurrent with the start of WTG operation, Empire Wind will provide documentation to the BOEM, BSEE and the Service showing financial, legal, or other binding commitment(s) to Plan implementation.

The BOEM will require Empire Wind to prepare and implement a new Plan every 5 years for the life of the project, according to a schedule developed by the BOEM and approved by the Service. Compensatory mitigation actions included in each new Plan will reflect:

a. the level and effectiveness of mitigation previously provided by Empire Wind, to date;
b. the level of take over the next 5 years as projected by SCRAM (or its successor) (see D. Collision Risk Model Utilization above);
c. current information regarding any effects of offshore lighting (see Section III); and
d. the effectiveness of any minimization measures that have been implemented as required by the reasonable and prudent measures included in this Opinion.

F. Collision Mitigation Coordination

1. Mitigation Assessments

At least annually, and as detailed below, the BOEM, BSEE, the Service, and Empire Wind will work together to assess the minimization of, and compensatory mitigation for, collisions of listed birds with the EW1 and EW2 turbines. Appropriate state agencies will also be invited to participate in these mitigation assessments. The first mitigation assessment will occur during the EW1 and EW2 construction phase, prior to the start of WTG operation. Subsequent mitigation assessments will be held concurrent with or shortly after the annual monitoring data review. Additional mitigation assessments (addressing minimization and/or compensatory mitigation) may be carried out at any time upon request by the BOEM, BSEE, the Service, appropriate state agencies, or Empire Wind based on substantive new information or changed circumstances. These periodic mitigation assessments for EW1 and EW2 may eventually be integrated into a regional or coastwide adaptive monitoring and impact minimization framework.

2. Minimization

The BOEM will work with the Service, BSEE, appropriate state agencies, and Empire Wind to annually review the best available information regarding technologies and methods for minimizing collision risk to listed species, including but not limited to: WTG coloration/marking, lighting, avian deterrents, and limited WTG operational changes. The BOEM will require Empire Wind to adopt and deploy such minimization technologies/methods as deemed reasonable and prudent as per the minor change rule [50 CFR §402.14] under the ESA. Operational changes may include, but are not limited to, feathering, which involves adjusting the angle of the blades to slow or stop them from turning under certain conditions. The BOEM will specify the timeframe in which any required minimization measure(s) must be implemented, as well as any requirements to monitor, maintain, or adapt the measure(s) over time.

V. ACTION AREA

The action area is defined at (50 CFR 402.02) as "all areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the action. The Service has determined that the action area for this project is presented in the BA (BOEM 2022b) and summarized below:

The Action Area is characterized by urban and suburban areas in the New York metropolitan area and Long Island. The onshore export and interconnection cables, onshore substations, and O&M facility would be primarily along or within existing roadway corridors (BOEM 2022b). The offshore portion of the Action Area includes open coastal waters associated with the New York Bight, New York Harbor, and New York Bay (BOEM 2022b). The offshore action area lies in between major shipping channels and includes fishing grounds frequented by commercial and recreational boats (Figure 4).

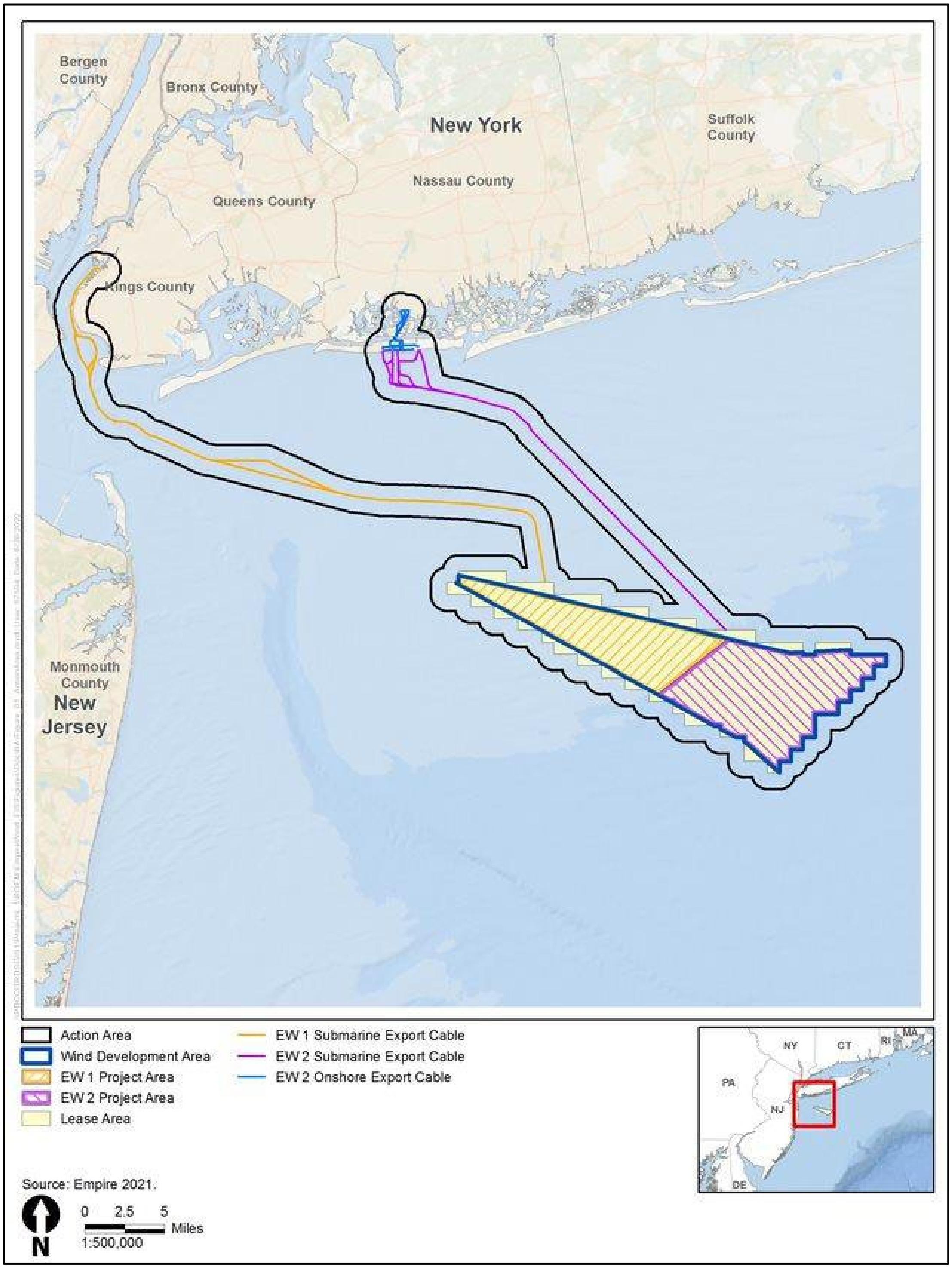

Figure 4. Project wide delineation of the action area. From BOEM (2022b).

VI. STATUS OF THE SPECIES

Per the ESA Section 7 regulations (50 CFR 402.14(g)(2)), it is the Service's responsibility to "evaluate the current status of the listed species or critical habitat."

To assess the current status of the species, it is helpful to understand the species' conservation needs which are generally described in terms of reproduction, numbers, and distribution (RND). The Service frequently characterizes RND for a given species via the conservation principles of resiliency (ability of species/populations to withstand stochastic events – numbers, growth rates), redundancy (ability of a species to withstand catastrophic events – number of populations and their distribution), and representation (variation/ability of a species to adapt to changing conditions).

The following is a summary of the listed bird species general life history that is relevant to the analysis of this Opinion and drawn primarily from Service assessment, listing, and recovery documents. According to the Consultation Handbook (USFWS and NMFS 1998), the Service's jeopardy analysis may be based on an assessment of impacts at the level of recovery units when those units are documented as necessary to both the survival and recovery of the species in a final recovery plan. The Consultation Handbook also notes that, when the Service's review in an Opinion focuses on the effects of the action on a discrete recovery unit, the species status section of the Opinion is to describe the status of that unit and its significance to the species as listed (USFWS and NMFS 1998). Thus, for piping plover and rufa red knot, the information and analysis that follows focuses on birds from those recovery units that are expected to occur in the EW1 and EW2 action area.

A. Piping Plover

Piping plovers breed in three discrete areas, the Atlantic Coast, the Great Lakes, and the Northern Great Plains of the U.S. and Canada. The Atlantic Coast and Northern Great Plains populations are listed under the ESA as threatened (50 FR 50726), while the Great Lakes population is listed as endangered. Birds from all three populations winter along the U.S. coast from North Carolina to Texas, as well as in Mexico and the Caribbean (USFWS 2020a). The Atlantic Coast population is the only breeding population known to occur along the coast of New York.

The Atlantic Coast population breeds on coastal beaches from Newfoundland to North Carolina and winters along the Atlantic Coast from North Carolina south, along the Gulf Coast, and in the Caribbean (USFWS 1996). Piping plovers are present on the New York shore during the breeding season, generally between April 1 and August 31 (USFWS 1996).

The piping plover recovery plan (USFWS 1996) delineates four recovery units for the Atlantic Coast population: Eastern Canada (formerly Atlantic Canada), New England, New York-New Jersey (NY-NJ) and Southern (Delaware, Maryland, Virginia, and North Carolina). Any appreciable reduction in the likelihood of survival of a recovery unit will also reduce the probability of persistence of the entire population (USFWS 1996). The Southern recovery unit is not addressed in this Opinion, as these birds spend their entire life cycle south of the action area. An unverified number of birds from each of the other three recovery units are expected to occur in offshore portion of the action area during spring and fall migration.

The following paragraphs describing the status of piping plovers are excerpted, in whole or in part, from "Abundance and productivity estimates – 2021 update Atlantic Coast piping plover population" (USFWS 2021).

Currently, the range-wide status of the Atlantic Coast piping plover is improving, though unevenly (Table 1). The 2021 Atlantic Coast piping plover population estimate of 2,289 pairs is 22 percent higher than the 2018 estimate and almost triple the estimate of 790 pairs at the time of the 1986 ESA listing (USFWS 1996). Discounting apparent increases in New York, New Jersey, and North Carolina between 1986 and 1989, which likely were due in part to increased census effort (USFWS 1996), the population more than doubled between 1989 and 2021.

Table 1. Estimated numbers of pairs* of Atlantic Coast piping plovers, 2012-2021 (USFWS 2022)

	Eastern Canada	**New England**	**NY-NJ**	**Southern****	**Total**
2012	179	865	463	377	1,884
2013	184	854	397	358	1,793
2014	186	861	378	354	1,779
2015	179	914	416	362	1,871
2016	176	874	496	386	1,932
2017	173	874	497	359	1,903
2018	181	916	486	295	1,878
2019	190	980	540	309	2,019
2020	158	1,047	508	277	1,990
2021	180	1,264	576	269	2,289
average	179	945	476	335	1,935

*Recovery criteria: Atlantic (Eastern) Canada=400. New England=625. NY-NJ=575. Southern=400. Total=2,000 (sustained for at least 5 years)
**Presented for context but not considered in this Opinion.

Overall population growth is tempered by very substantial geographic and temporal variability. The largest population increase between 1989 and 2021 occurred in New England (514 percent). Abundance of breeding pairs in the NY-NJ recovery unit decreased 35 percent to 378 pairs in 2014 following seven years of low productivity. However, the recovery unit experienced an overall net increase of 81 percent between 1989 and 2021. In Eastern Canada, where increases have often been quickly eroded in subsequent years, the population posted a declining overall population trend since 2007 and a net 23-percent decline between 1989 and 2021. The limiting factors now impeding recovery are thought to be occurring during migration or on the wintering grounds (Gratto-Trevor et al. 2013), but specific causal factors have not been identified at this time. Overall, the New England recovery unit is increasing, the NY-NJ recovery unit is currently stable, and the Eastern Canada recovery unit is declining (Figure 5) (USFWS 2022).

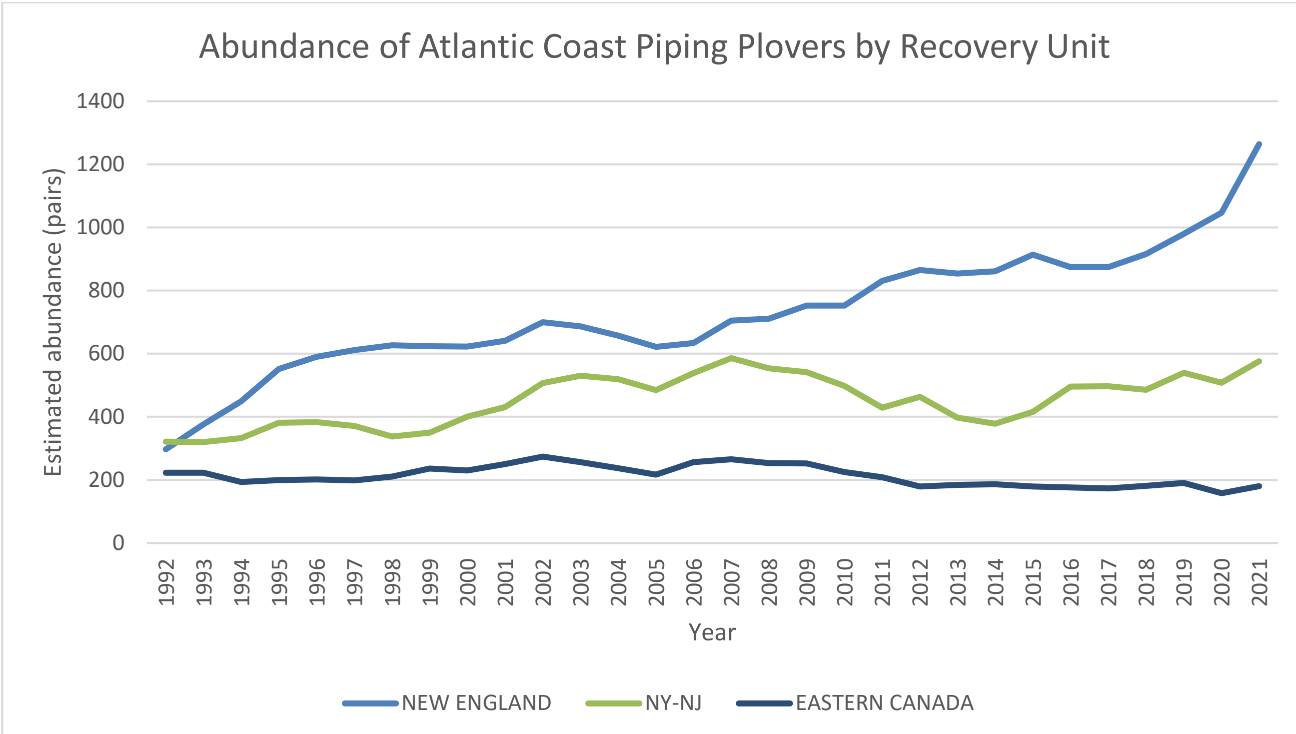

Figure 5. Estimated abundance of Atlantic Coast piping plover pairs by recovery unit from (USFWS 2022).

Average annual productivity for the U.S. Atlantic Coast during 1989-2018 was 1.25 fledged chicks per pair. The overall U.S. Atlantic Coast productivity estimates in 2019 and 2020 were 1.38 and 1.25 fledged chicks per pair, respectively. In 2021, average U.S. Atlantic productivity (1.09 fledged chicks per pair) was the fifth lowest since 1989 (USFWS 2022). The primary factors influencing the status of the Atlantic Coast piping plover population include habitat loss and degradation; human disturbance of nesting birds; predation; and oil spills (USFWS 1996). Habitat loss and degradation result from development and other physical alterations to the beach ecosystem. Severe threats from human disturbance and predation remain ubiquitous along the Atlantic Coast (USFWS 2022). These disturbances can result in crushing of eggs, failure of eggs to hatch, and death of chicks (e.g., through effects to their energy budgets).

Wind turbines are likely to affect Atlantic Coast piping plovers throughout their annual cycle (USFWS 2020a) via the risk of collisions, although the magnitude of this effect remains unknown at this time. Information that has become available in the past decade will help assess effects of future proposed projects, but some key risk factors (e.g., avoidance rates, variation in flight altitude, differences in migratory routes and timing) need further study (USFWS 2020a). The number and locations of future proposed offshore turbines is becoming more foreseeable due to the BOEM's leasing and authorization programs; however, the timing and extent of full coastwide buildout of WTGs on the OCS is still unknown, and any effects of the turbines on migrating birds (e.g., collision, behavioral effects, etc.) are even more difficult to study and characterize offshore than on land.

As described in the recovery plan (USFWS 1996), the recovery criteria of the Atlantic Coast piping plover population include: (1) a total of 2,000 breeding pairs, distributed among the four recovery units sustained for at least 5 years; (2) a 5-year average productivity rate of 1.5 chicks per pair in each recovery unit; and (3) long-term maintenance of wintering habitat sufficient in quantity, quality, and distribution to maintain survival rates needed for a 2,000-pair population. These recovery criteria reflect the conservation tenets of representation, redundancy, and resiliency (3Rs). Sufficient information about piping plover flight behavior and the likelihood of wind turbine construction in areas used by piping plovers is not yet available to assess the need for a recovery criterion pertinent to threats from wind turbines (USFWS 2020a). We note the issuance of a biological opinion authorizing the incidental of five piping plovers over the 35-year life of the project (USFWS 2023d).

For a more detailed account of the species description, life history, population dynamics, threats, and conservation needs, refer to https://ecos.fws.gov/ecp/species/6039.

B. Rufa Red Knot

Six subspecies of red knot, *Calidris canutus,* are recognized, each with distinctive migration routes, and annual cycles. One subspecies, the rufa red knot, was listed as threatened under the ESA in 2015 (79 FR 73705). This species is medium-sized (9 to 10 inches [23 to 25 cm] long) with a wingspan of 20 inches (50.8 cm) and migrates annually between its breeding grounds in the central Canadian Arctic and four wintering regions. Each wintering location is considered to support separate populations which include: (1) the Southeast U.S. and through the Caribbean (SEC); (2) the Western Gulf of Mexico from Mississippi through Central America and along the western coast of South America, known as the Western population; (3) the northern coast of South America (NCSA); and (4) the Atlantic coasts of Argentina and Chile, known as the Southern population (USFWS 2023b). The subspecies shows very high fidelity to wintering region, with habitat, diet, and phenology varying appreciably among birds from different regions (USFWS 2014). Although birds from the Western population are known to occasionally occur in the Atlantic Coast (USFWS 2014), we consider the likelihood that they will be affected by the proposed project discountable. Therefore, the Western population is not addressed in this Opinion.

The timing of spring and fall migration varies across the range (USFWS 2014). Many rufa red knots marked in Argentina and Chile are seen on the southeast Atlantic coasts of Florida, Georgia, South Carolina, and North Carolina during, but not before, May. Available data indicate that rufa red knots wintering in the Southeast use at least two distinct spring migration routes—coastal (moving north along the coast to the mid-Atlantic before departing for the Arctic) and inland (departing overland for the Arctic directly from the Southeast coast) (USFWS 2021b).

Departure from the breeding grounds in Canada begins in mid-July and continues through August (USFWS 2020b). Adult rufa red knots pass through stopover sites along the migratory route earlier in years with low reproductive success than in years with high reproductive success. Along the U.S. Atlantic Coast, southbound rufa red knots start arriving in July. Adult abundance peaks in mid-August and most migrants depart by late September, although geolocators and resightings have shown some birds (especially northern-wintering rufa red knots) stay through November (USFWS 2020b).

In one study of northern-wintering rufa red knots, the total time spent along the U.S. Atlantic Coast, including spring, fall, and winter, averaged 218 days (range 121 to 269 days), or about 60 percent of the calendar year (USFWS 2020b).

Coastal habitats used by rufa red knots in migration and wintering areas are similar in character, and consist of coastal marine and estuarine habitats with large areas of exposed intertidal sediments.

Migration and wintering habitats include both high-energy ocean- or bay-front areas, as well as tidal flats in more sheltered bays and lagoons (USFWS 2020b).

The essential recovery strategy for the rufa red knot is to prevent reduction of this subspecies' adaptive capacity by maintaining representation and improving resiliency and redundancy, to support the rufa subspecies as it copes with changing conditions (i.e., from climate change) across its range and across its annual cycle. The Service has delineated four recovery units corresponding to the four wintering populations listed above. The recovery plan establishes population targets for each recovery unit, based on 10- year average abundance. The plan also addresses other conservation needs for the rufa red knot, chiefly a wide-ranging network of nonbreeding habitats managed in a manner compatible with the population goals (USFWS 2023b). We note recent permit and biological opinion issuance authorizing the mortality of up to six rufa red knots per year to be injured or killed incidental to research activities over the next 5 years (30 birds total) (USFWS 2023c) and 35 birds over the 35 years (USFWS d).

Based on best available information, the current rangewide abundance estimate is just under 64,800 rufa red knots, distributed across the four recovery units (Table 2). The Southern recovery unit experienced declines in the 1980s and 2000s, the key causal factor being overharvest of horseshoe crab in Delaware Bay which is now considered adequately managed.

Table 2. Current estimates of rufa red knot abundance by recovery unit.*

Wintering Population	Current Abundance Estimate	Estimated Decline in Population Since 1980s	Population Stability	Certainty	Source
Southern (mean 2021-2022)	12,704	75%	Stable	High	Norambuena et al. 2022, Matus 2021, WHSRN 2020
North Coast of South America	31,065	None	Stable**	Moderate	Mizrahi 2020
Southeast U.S./Caribbean	15,500	None	Stable	Moderate	Lyons et al. 2017
Western***	5,500	Unknown	Declining	Low	Newstead pers. comm. 2019, 2020
Total	**64,769**				

*Recovery criteria: Southern=35,000. Western=10,000
**North Coast of South America and the Southeast U.S./Caribbean=stable or increasing
***Presented for context but not considered in this Opinion.

Although the rufa red knot benefits from long-term and widespread conservation efforts, birds from all four recovery units face threats from habitat loss and from several climate-driven ecosystem changes. Additional threats include hunting, increased predation pressure, harmful algal blooms, human disturbance, and oil spills. Cumulatively, these threats along with wind power development are believed to be impairing the resiliency (as measured by population size) of the Southern and the Western wintering populations (USFWS 2020b).

Wind energy development is identified as a secondary, moderate threat to the rufa red knot's migration life phase (USFWS 2020b). Research has documented the presence of rufa red knot movement through wind energy lease areas in the Atlantic OCS (Loring et al. 2018). Threats from offshore WTGs are foreseeable, but the magnitude of this threat remains poorly understood. Information is lacking to assess site-specific effects and strategies to address cumulative effects of future offshore wind energy projects have not been developed. Offshore wind energy development is likely to make at least modest additional contributions to mortality in the coming decades (USFWS 2021b). Watts et al. (2015, pp. 37, 40) found that rufa red knots have notably low limits of sustainable mortality from anthropogenic causes, such as hunting, oil spills, and wind turbine collisions.

Individually, moderately severe threats are not expected to have effects at the level of the listed taxon. Cumulatively, however, moderate threats are presumed to exacerbate the effects of the primary threats, as they likely further reduce the subspecies' resiliency and possibly representation and redundancy.

For a more detailed account of the species description, life history, population dynamics, threats, and conservation needs, refer to https://ecos.fws.gov/ecp/species/1864.

VII. STATUS OF CRITICAL HABITAT

Critical habitat for wintering piping plovers, including the Atlantic Coast breeding population, has been designated along the coasts of North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, and Texas (66 FR 36037). The designated critical habitat does not overlap the action area; therefore, critical habitat for this species is not considered in this Opinion.

Critical habitat for the rufa red knot was proposed in 2021 (86 FR 37410) and a revision to the proposal was published in April 2023 (88 FR 22530); no final rule has been published to date. The proposed critical habitat does not overlap the action area; therefore, critical habitat for this species is not considered in this Opinion.

VIII. ENVIRONMENTAL BASELINE

Regulations implementing the ESA (50 CFR 402.02) define the environmental baseline as the past and present impacts of all federal, state, or private actions and other human activities in the action area. Also included in the environmental baseline are the anticipated and/or ongoing impacts of all proposed federal projects in the action area that have undergone Section 7 consultation, and the impacts of state and private actions which are contemporaneous with the consultation in progress.

A. Status of Listed Species in the Action Area

Tracking data used to assess the number and behavior of listed birds in the action area has been collected since 2007 and tracking technologies have advanced considerably over that time. However, studies far offshore are logistically and technologically challenging, and our understanding of how these species use the action area remains incomplete. Based on the accuracy of the tracking data available to date, we make the assumption that all parts of the action area are equally likely to be utilized by listed species (i.e., we attempt to characterize levels of bird use within the action area relative to the surrounding OCS and adjacent coastline, but do not attempt to discern differences in bird utilization that may exist across the latitudinal or longitudinal gradients of the action area).

In terms of listed species avian use, the action area is located within a migration corridor for piping plovers and rufa red knots (Figure 6) and may also be transited by seasonally resident rufa red knots undertaking regional movements across the OCS. For purposes of our effects analysis, we have decided to limit the action area air space to the rotor swept zone (RSZ), which extends from 72 ft to 925 ft (23 m to 282 m) above mean low water (Tetra Tech 2022, Vol. 1).

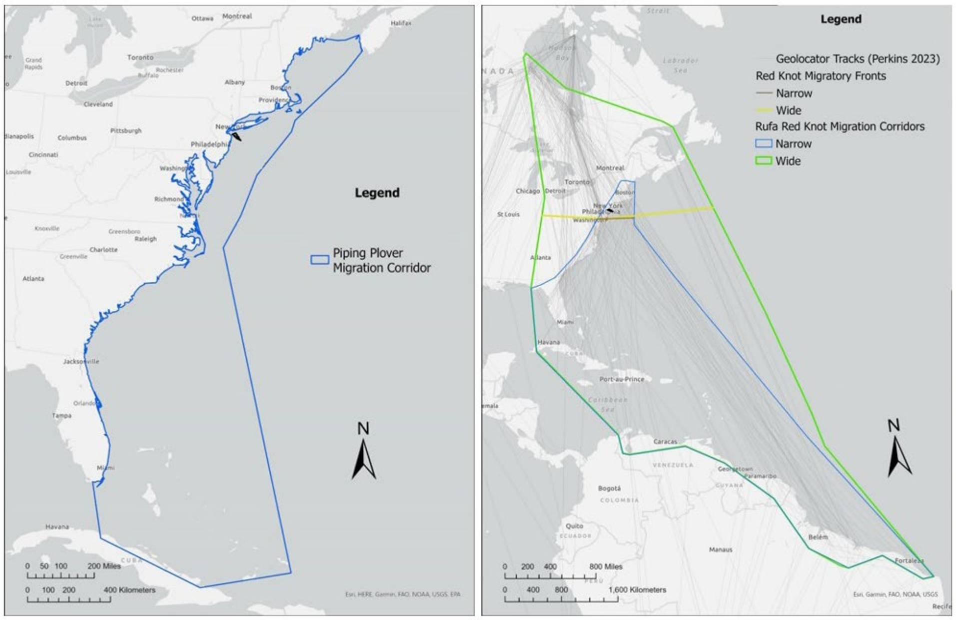

Figure 6. Piping plover (left) and rufa red knot (right) migration corridors.

1. Offshore

For the purposes of this section on the status of the species, the offshore area extends from the Lease Area to the onshore open water interface.

Piping plover

Piping plovers and red knots transit the offshore areas during spring and fall migrations (Loring et al. 2018, Loring et al. 2019, Loring et al 2020a, Loring et al 2020b, BOEM 2022b), but there is limited data on the species' migration routes, flight altitudes, exposure time, and abundances in the offshore Lease Area as a portion of their migration route. Loring et al. (2019) fitted 150 piping plovers with digital Very High Frequency (VHF) radio transmitters at select nesting areas in Massachusetts and Rhode Island from 2015 to 2017. Tagged individuals were tracked using an array of automated VHF telemetry stations within a study area encompassing a portion of the U.S. Atlantic OCS, extending from Cape Cod, Massachusetts to southern Virginia. Peak exposure of piping plovers to Federal waters occurred in late July and early August. Piping plovers departing from their breeding grounds in Massachusetts and Rhode Island primarily used offshore routes to stopover areas in the mid-Atlantic.

Loring et al. (2019) reported that most offshore flight altitudes of piping plovers occurred above the RSZ. An estimated 21.3 percent of piping plover flights in Federal waters occurred within the RSZ. However, the RSZ for this study was between 25 m and 250 m (82 ft to 820 ft) above sea level and thus slightly smaller than the EW1 and EW2 project's RSZs. Further analyzing this same set of 150 tagged piping plovers, Loring et al. (2020b) presents altitudes for 17 individual migratory flights across the mid-Atlantic Bight.

Piping plovers from the New England recovery unit are likely occur in the EW1 and EW2 Lease Area no more than two times per year, on spring and fall migration flights. We have no information regarding occurrence of birds from the Atlantic (Eastern) Canada or NY-NJ recovery units, but we assume they may also be present in the action area. We have very little information on the flight paths or altitudes of spring migrants but presume that spring flight paths in the EW1 and EW2 Lease Area RSZs is similar to fall.

Rufa red knots

Perkins (2023) summarized the migration patterns and wintering locations of rufa red knots based on 93 individuals tagged between 2009 and 2017. All rufa red knot tracks were reviewed and categorized into subpopulations following discussion with experts and draft recovery plan mapping. Individuals were assigned under the following categories SEC (31 birds, including 10 that wintered in the Caribbean), NCSA (22 birds), Western (24 birds), and Southern (9 birds). Seven individuals, all tagged in Texas, were unable to be classified confidently to a subpopulation. The location estimates are within an error margin of about 155 miles (mi; 250 km) (Perkins 2023).

Rufa red knots from the SEC, NCSA, and Southern recovery units are likely to occur in the action area, though it is not yet known if birds from these three recovery units use the airspace with similar frequency, timing, or altitudes. Far greater numbers of rufa red knots are believed to cross the OCS on fall migration flights compared to spring migration flights. However, this species is not limited to migration flights across the OCS, as it also makes offshore regional flights during periods of seasonal residence in the mid-Atlantic. Best available information indicates substantial overlap between rufa red knot flights and the EW1 and EW2 Lease Area.

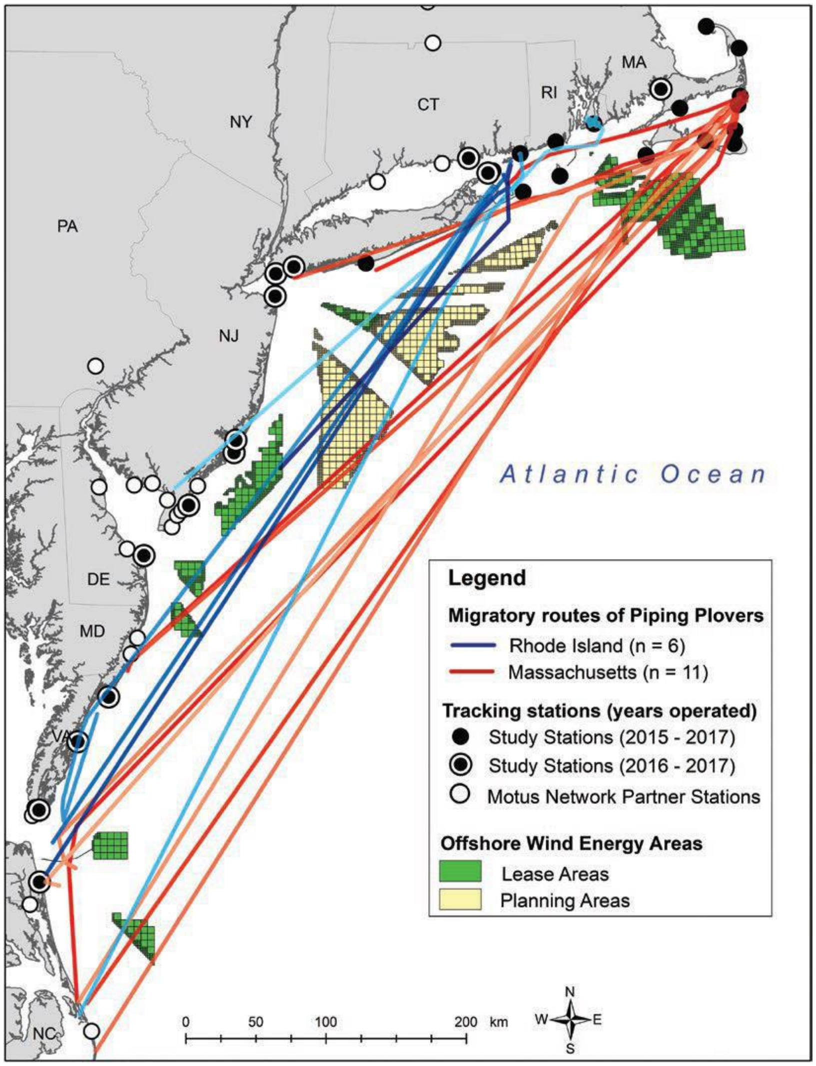

Figure 7. Figure shows individual piping plovers tracked across a broader portion of the mid-Atlantic Bight from breeding areas in Rhode Island (n = 6) and Massachusetts (n = 11). From Loring et al. (2020b).

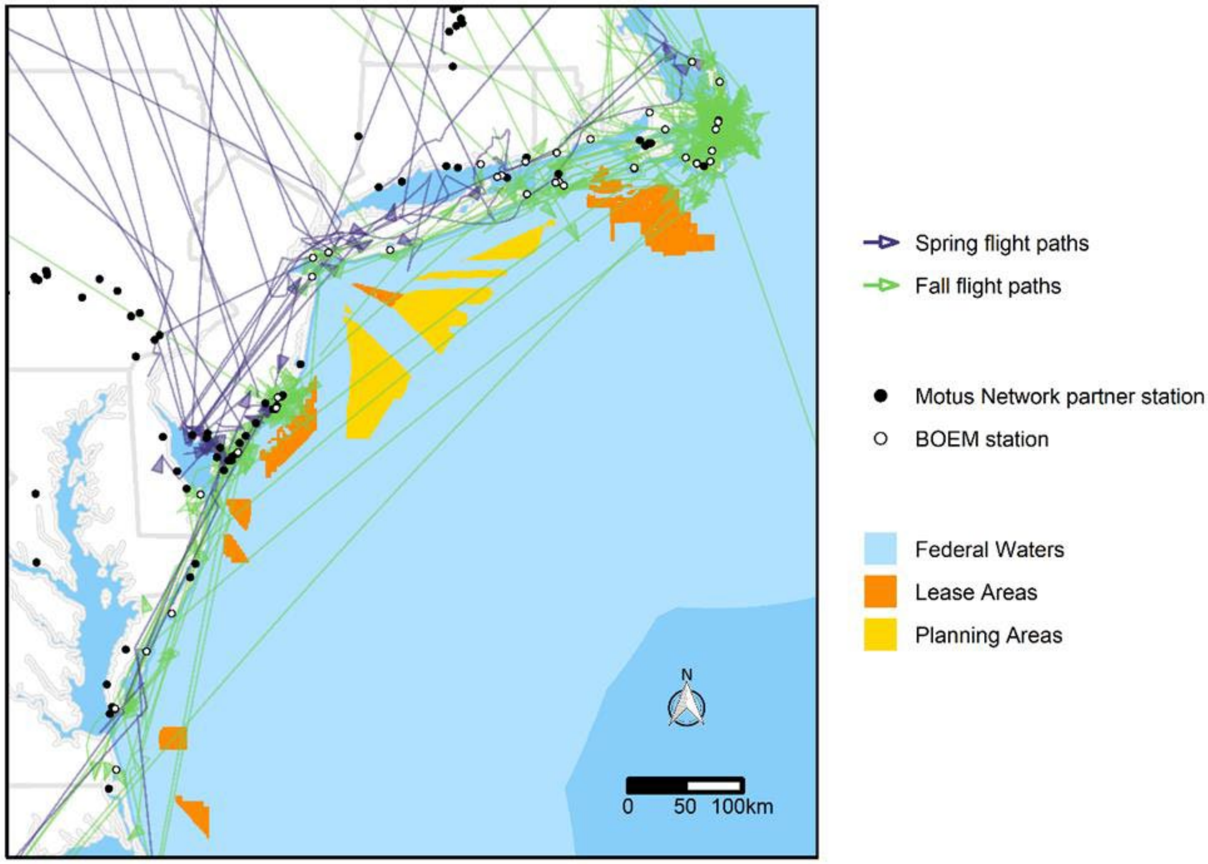

Figure 8. Modeled Flight Paths of Rufa Red Knots during Spring Migration (n = 31) and Fall Migration (n = 146) from 2014 to 2017. Source: Loring et al. 2020a, Figure 14. From BOEM (2022).

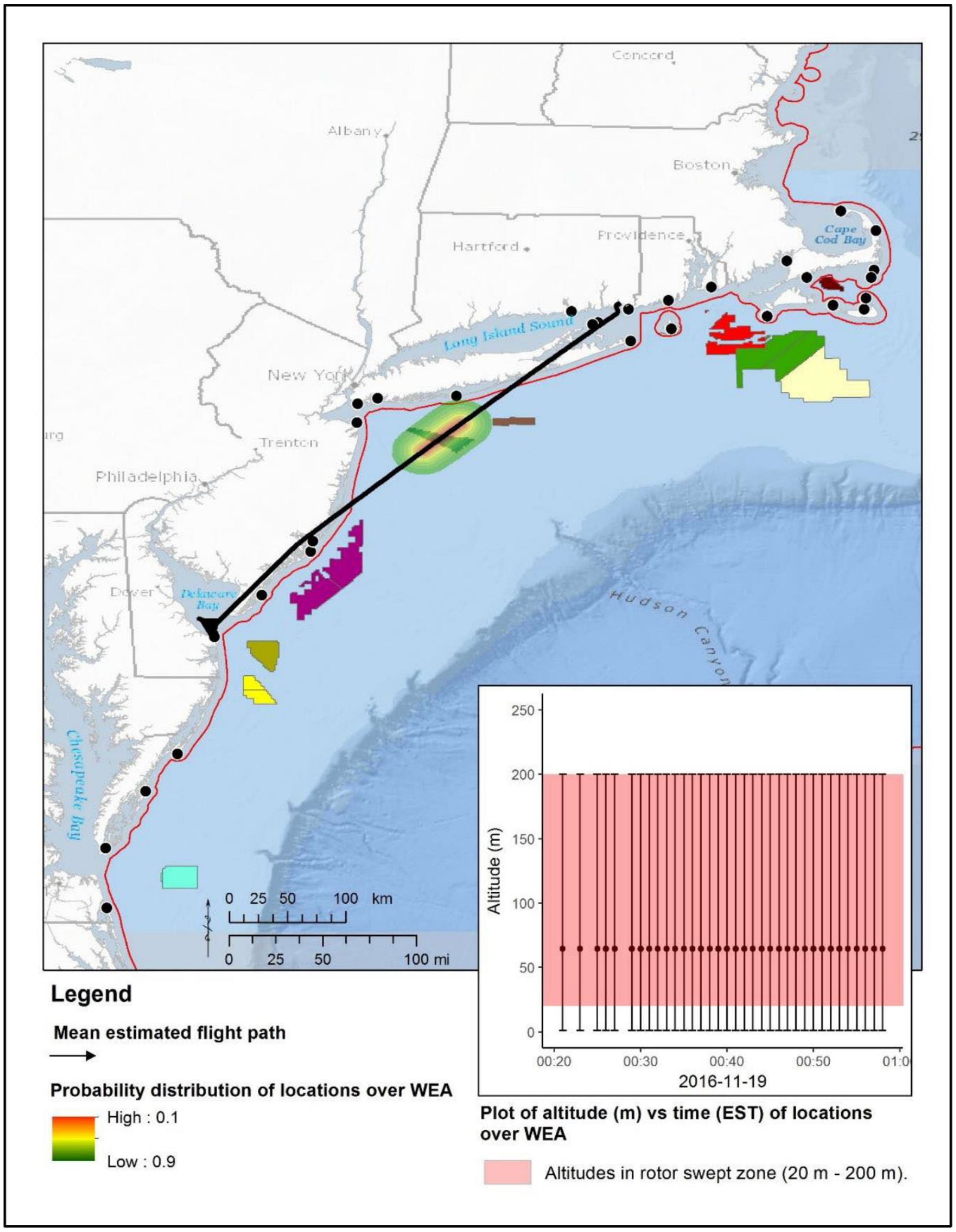

Figure 9. Estimated flight path of a rufa red knot tracked with nanotags that was estimated to have passed through Empire Wind's Lease Area on November 11, 2016. From BOEM (2022b).

2. Onshore

Each of the two species are known or expected to use the beach habitats in the onshore portion of the action area. As noted below, the highest level of information is present for the piping plover, as breeding location data has been collected in many areas of Long Island, including the action area, since its listing. Rufa red knots and piping plovers are known from observations by shorebird monitors and amateur bird watchers.

Piping plovers

Piping plover are known to breed on the eastern end of Long Beach Island from the eastern border of the City of Long Beach to Point Lookout, NY. This stretch of beach falls with the NYSDEC's Point Lookout Colonial Waterbird and Piping Plover Survey breeding area. They are monitored and managed by the Town of Hempstead's Department of Conservation and Waterways.

Piping plover are known to occur over 2,000 m to the east of Landfall Option A, Riverside Boulevard, Long Beach, NY. Lido Beach, the proposed EW1 Landfall C site, is composed of vegetated dunes that may provide nesting habitat to piping plovers. In 2018, 14 pairs of piping plovers produced a total of 26 piping plover chicks (BOEM 2022b). Over the past decade, there have numerous piping plover sightings at or near Lido Beach (BOEM 2022b). There are no known occurrences of piping plovers in the vicinity of the EW1 landfall location at the heavily urbanized and developed, hardened shoreline at the SBMT in Brooklyn, NY.

Red knots

In New York and New Jersey, red knots use sandy beaches and back-bay areas during spring and fall migration (Niles et al. 2008). However, the Service is not aware of comprehensive monitoring of red knots within the onshore portion of the Action Area. The bulk of rufa red knot observations are from eBird.org. records from Long Beach Island, but these may not accurately represent the full extent of red knot presence near the EW2 Landfall Option C. There are no known occurrences of red knots in the vicinity of the EW1 landfall location at the heavily urbanized and developed SBMT in Brooklyn, NY.

B. Factors Affecting the Species within the Action Area

Structures

There are currently no structures within the offshore action area (Landers pers comm. 2023), thus no collision hazards and no potential effects on bird behavior by way of structures or stationary sources of lighting or noise.

Vessels

The COP (Volume II, Section 2.3.6) presents information on vessel traffic specific to the action area. Vessel traffic in the vicinity of the Wind Farm Area is much less dense than near the coast. Data for March 2019 to February 2020 show that about 5 transits per day enter the Wind Farm Area, 1,632 per year in total, including some minor double-counting and including vessel traffic tied to OW1 project research vessels. Vessel traffic west of the Wind Farm Area is predominantly comprised of tug transits, while the majority of the coastal traffic further south is predominantly pleasure and fishing vessels. Traffic east of the Wind Farm Area is predominantly deep draft commercial vessels. Deep draft vessels and tugs are not expected to enter the Wind Farm Area, except in emergency circumstances (HDR 2022).

Compared to WTGs, vessels do not extend very high above the ocean surface and move at relatively slow speeds. Thus, we conclude that vessels do not present a collision hazard to listed birds in the action area. Noise, activity, lighting, and air emissions associated with vessel traffic in the action area could potentially influence the behavior and/or fitness of listed birds. Any such influences are likely greater on seasonally resident birds making lower-altitude movements within or across the OCS, compared to the typically higher-altitude migration flights (Loring et al. 2018, Loring et al. 2019).

As noted in our concurrence with the BOEM's not likely to adversely affect determination for piping plovers due to vessel traffic, piping plovers are not known to occur on the OCS during the breeding season, and this species does not overwinter in New York, except for the occasional individual. Therefore, we expect piping plover use of the action area to be solely limited to migration flights, and thus conclude that vessel traffic in the action area has a negligible effect on this species.

As noted in our concurrence with the BOEM's not likely to adversely affect determination for red knots due to vessel traffic, juvenile and nonbreeding adult rufa red knots can occur along New York's Atlantic Coast during most months of the year and may spend longer in this region than birds stopping over during migration. Regional movements of rufa red knots are well documented (Burger et al. 2012, Loring et al. 2018). It is likely that moderate numbers of rufa red knots cross the action area on relatively lower-altitude regional flights, and that some percentage of these birds encounter one or more vessels. Such birds may make a minor course adjustment or be temporarily disoriented by noise or lights, but we conclude such effects are minor and generally do not impact fitness of the affected birds.

Direct Mortality

Listed birds in the action area may be indirectly affected by direct removals from their populations (i.e., mortality) by human activities. The overall numbers of listed birds, rangewide and within different management units, may affect the frequency with which individuals occur in the action area, and could also influence flight behavior and/or energetics if overall abundance also influences flock sizes. In addition, changes in the relative population sizes of various management units may influence patterns of timing and trajectories of flights in the action area, because birds from different units are known to exhibit differences in migration timing and routes. Sources of direct removals from populations include vehicles, collisions with human structures, hunting, oil spills, harmful algal blooms, and research activities. Direct removals are generally considered to be exerting only a minor influence on the listed bird population sizes and are not cited as a primary threat to piping plover or rufa red knots (USFWS 2020a and b). Any influence of these factors on bird use of the action area is unknown and would be extremely difficult to measure.

Climate Change

Changes in the frequency, intensity, or timing of storms in the action area may impact listed birds using this air space. Storm impacts to birds on migration flights include energetic costs from a longer migration route as birds avoid storms, blowing birds off course, and mortality (USFWS 2014). For example, geolocator tracking of rufa red knots found three of four birds likely detoured from normal migration paths to avoid adverse weather during the fall migration. These birds travelled an extra 640 to 1,000 mi (1,030 to 1,609 km) to avoid storms (Niles et al. 2010, Niles 2014). The extra flying represents substantial additional energy expenditure, which on some occasions may lead to mortality (Niles et al. 2010).

The Intergovernmental Panel on Climate Change (IPCC) has concluded that while climate change may not lead to more frequent tropical cyclone (e.g., hurricanes) formation, the global proportion of stronger tropical cyclone instances has increased over the past four decades. The proportion of tropical cyclone intensification events, the average peak wind speeds, the peak wind speeds of the most intense tropical cyclones, and the average and maximum rain rates associated with tropical cyclones are all projected to increase on a global scale in the future (Seneviratne et al. 2021). Regarding extratropical cyclones (e.g., nor'easters), average and maximum rain rates are also projected to increase with climate change. Future wind speed changes in extratropical storms are generally expected to be small, though certain regions may experience substantial changes in extreme wind speeds. The frequency of spring severe convective storms (e.g., tornadoes, thunderstorms) is projected to increase in the U.S., resulting in a longer severe convective storm season (Seneviratne et al. 2021).

In addition to storms, flights of listed birds in the action area may also be impacted by climate-driven changes in weather, such as shifting average or extreme temperatures or changing wind patterns (Simmons 2022, Fernández-Alvarez et al. 2023). We have little information to assess the extent to which piping plovers and rufa red knots may be experiencing such shifts in climatic conditions in the action area, or their vulnerability to any such changes.

Synthesis

There are currently no fixed structures in the action area, and we conclude that baseline levels of vessel traffic in the action area are having a negligible effect on listed birds. Climate change is likely influencing listed birds during their offshore flights, but how such changes may be manifesting in the action area is unknown. The magnitude of any effects from direct removal of individuals from populations of listed birds (i.e., on the usage of the action area by the remaining members of the population) is highly uncertain but presumed to be small. In summary, the environmental baseline includes no factors that are appreciably diminishing or otherwise affecting usage of the action area by listed birds.

IX. EFFECTS OF THE ACTION

Effects of the action are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action (50 CFR §402.02).

A. Collisions with Wind Turbine Generators

Wind turbines are known to present a collision hazard to birds in flight (Drewitt and Langston 2006, Croll et al. 2022). The level of risk is associated with factors such as the number, location, height, lighting, and operational time of the WTGs; the population size and movement patterns of the bird species in question, its typical flight altitudes, and its ability to avoid collision; the landscape setting (e.g., topography on land, distance offshore); and weather conditions. For most species, collision risk levels vary seasonally and differ between day and night (Drewitt and Langston 2006, Croll et al. 2022). Collision risk levels may change over time as population sizes expand or contract and as prevalent bird behaviors, major flyways, or patterns of habitat usage change in response to environmental trends or human-driven factors. For example, over time birds may become acclimated and better able to avoid WTGs. Conversely, on a local or regional scale, additive effects on collision risk levels may emerge as various offshore wind projects go into operation.

Listed birds will eventually encounter and be forced to negotiate up to 3,092 WTGs projected upon full build out of currently leased offshore areas in New England and the mid-Atlantic, not including additional areas under consideration for leasing such as the Central Atlantic and Gulf of Maine (Hildreth pers. comm. 2023 as cited in USFWS 2023d). Additive or synergistic effects may also emerge between offshore wind operation and ecosystem shifts driven by climate change (e.g., changing assemblages/distribution of prey species; phenological shifts; changing patterns of storm activity).

The only adverse effect of the proposed projects evaluated in this Opinion is collision of piping plover and red knot with the 147 EW1 and EW2 turbines. If these listed species collide with any of WTGs, then take under the ESA would occur by wounding or, more likely, killing individuals of these species. Due to the relative difficulty in observing collision mortality in the offshore environment versus on land, the effects determination primarily focuses on the statistical probability and numerical quantification of take. The Service's standard for issuance of an incidental take statement is "reasonable certainty" that take will occur (50 CFR 402.14(g)(7)). A conclusion of reasonably certain to occur must be based on clear and substantial information, using the best scientific and commercial data available (50 CFR 402.17).

The BOEM assessed the collision risk expressed as numbers of piping plovers and rufa red knot likely to collide with the WTGs annually and over the 35-year life of the project using two models, 1) Band (2012) and 2) SCRAM. Both models have their limitations in terms of predictive accuracy, and we discuss these along with the high uncertainties this creates in the results given in Tables 2 and 3, below. We also used collision projections from both models to determine whether there were any refinements needed in the model runs the BOEM conducted for the BA. For SCRAM, we relied on the March 28, 2023. addendum to the BA in which BOEM presents the outputs from SCRAM version 1.0.3. SCRAM uses estimated flight paths and altitudes of tagged birds, combined with monthly population size estimates, to assess exposure of each species to the RSZ (that area of air space through which the rotors revolve). SCRAM uses movement modeling derived from Motus tracking data to determine monthly occupancy rates within half degree grid cells and then links those values to monthly population estimates to estimate species density across the Atlantic OCS where tracking data were available. SCRAM uses these density estimates at specific flight heights (data also derived from Motus tracking) along with other species and site characteristics (e.g., species-specific flight speeds and number of turbines in a specified turbine array) to estimate collision risk for locations across a portion of the Atlantic OCS where tracking data were available (Adams et al. 2022).

For Band (2012) we input WTG specifications provided by the BOEM (Bigger pers. comm. 2023), and we utilized the same species-specific flight height distributions (i.e., derived from Motus radio tracking data) as are used in SCRAM (Adams et al. 2022). We followed the guidance from Band (2012) to develop a best estimate, not a "worst case" scenario. For red knots and piping plovers, we used Annex 6 – Assessing collision risks for birds on migration. We expect piping plovers in the action area to be limited to birds on migration flights. However, for rufa red knots, use of Annex 6 means omitting from the Band (2012) analysis birds that may be seasonally resident in the mid-Atlantic and present in the action area on non-migration flights (i.e., regional movements for knots). Although Annex 6 is unable to account for seasonally resident birds, we selected it for the following reasons: (1) Stage B of the Band (2012) basic model (i.e., for resident birds) requires an estimate of observed bird density on an area basis, and this information is unavailable for any of the listed bird species in the vicinity of the EW1 and EW2 Lease Area during any month; and (2) far greater numbers of migrating knots and terns are present on the mid-Atlantic OCS compared to seasonally resident birds. Thus, we conclude that Annex 6 is the most appropriate application of the Band (2012) model. However, we note that if, and when, seasonally resident knots occur offshore, they may spend more time in the action area, and at different flight heights, compared to migrants, and this represents an additional source of collision risk that is not reflected in the Band (2012) outputs presented below.

The Band (2012) model for rufa red knot was based on geolocator tracking data collected from 93 individual birds (with tags deployed across the species range) between 2009 and 2017 (Perkins 2023). The data encompasses all rufa red knot geolocator tracks except those that are clearly associated with the Western recovery unit.

Table 3. SCRAM model results as given in BOEM (2023), showing annual and life of project mortality estimates with 95 percent prediction intervals at a 92.97 percent collision avoidance rate.

	Piping Plover			Rufa Red Knot		
Timeframe	**Mean**	**Lower**	**Upper**	**Mean**	**Lower**	**Upper**
Annual	0.05	0.01	0.19	1.05	0.53	2.03
Operational (over 35 years)	1.76	0.41	6.62	36.75	18.69	71.05

Table 4. Band (2012) model results generated by the Service (Appendix B), showing turbine mortality estimates over 35 years using 92.97 and 98 percent collision avoidance rates.

Piping Plover (35 years)		Rufa Red Knot (35 years)	
92.97%	**98%**	**92.97%**	**98%**
18	5	60	17

X. CUMULATIVE EFFECTS

Cumulative effects are those “effects of future State or private activities, not involving federal activities, that are reasonably certain to occur within the action area” considered in this Opinion (50 CFR 402.02).

The Service is not aware of any future state, tribal, local, or private actions that are reasonably certain to occur within the onshore or offshore portions of the action area at this time. We do not expect any change in the types or levels of non-project-related vessel traffic in the action area that would have any appreciable effect on listed birds. We expect direct mortality of listed birds from various sources (off-road vehicles, pedestrians) to remain low and continue exerting negligible effects on birds in the action area. It is reasonably certain that human caused climate change will continue into the foreseeable future, although there is large uncertainty around the rate and magnitude of climate change (mostly related to the uncertain trajectory of mitigation actions) (USFWS 2020b). There is also high uncertainty around how climate change may affect usage of the action area by listed birds. We note that greenhouse gas emissions are generally not considered an action (in this case a State or private action) based only on its contribution to climate change, per the DOI Solicitor’s Opinion M-37017. Therefore, no cumulative effects are anticipated.

XI. JEOPARDY ANALYSIS

Section 7(a)(2) of the ESA requires that federal agencies ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of designated critical habitat.

A. Jeopardy Analysis Framework

Impacts to Individuals – For this analysis, we presume that 100 percent of listed birds that collide with a

WTG will be fatally wounded and die.

Impacts to Populations – As we have concluded that individual piping plover and red knot are likely to be killed, we need to assess the aggregated consequences of the anticipated losses of the exposed individuals on the population to which these individuals belong.

Piping Plover

Extinction risk of Atlantic Coast piping plovers is highly sensitive to small changes in adult and/or juvenile survival rates (USFWS 2009). However, the 10-year (2012 to 2021) average population size across the Atlantic (Eastern) Canada, New England, and NY-NJ recovery units combined was 1,600 pairs, or 3,200 birds (USFWS 2021a). Given this current abundance level and long-term population trajectory, we conclude that the SCRAM predicted mortality of 2 (mean 1.76; 95 percent prediction interval 0.4 to 6.6) piping plovers or the Band (2012) predicated loss of 5 birds (98 percent avoidance rate) or 18 birds (92.97 percent avoidance rate) over 35 years will have no appreciable effect on survival rates.

Piping plover collisions may be most likely to affect the New England recovery unit, based its sheer size, which also makes it the least vulnerable to demographic effects from loss of these birds. However, available information suggests that birds from the Atlantic (Eastern) Canada recovery unit may also have significant exposure to collision risk (Rock pers. comm. 2023), which has not yet been assessed. The Atlantic (Eastern) Canada recovery unit is the most sensitive to loss of individuals, with a long-term average of only 179 pairs (358 birds). However, we conclude it is unlikely that all of the projected collisions would come from the Atlantic (Eastern Canada unit, simply based on the much larger size (5.3 times larger) of the New England unit. The NY-NJ unit would be intermediate in sensitivity between the Atlantic (Eastern) Canada and New England recovery units. Based on current demographic data, we conclude that predicted loss of Atlantic Coast piping plovers over 35 years will have no measurable effects on any of the three recovery units. This conclusion assumes that no more than 1 bird will come from the Atlantic (Eastern) Canada population, and that no more than 1 bird (from any unit) will be lost in any given year. Demographic rates are associated with uncertainty and can change over the 35-year project life. However, any risk of population-level effects is likely to be further reduced by the provisions for Empire Wind to provide compensatory mitigation (Section IV, E of the Opinion).

Based on current demographic data, lack of cumulative effects, and status of the species in the action area, we conclude that the SCRAM or Band (2012) model mortality predictions of Atlantic Coast piping plovers over 35 years will have no appreciable effects on any of the three recovery units with the noted caution about the Atlantic (Eastern) Canada recovery unit.

We acknowledge that demographic rates are associated with uncertainty and can change over the 35-year project life.

Rufa Red Knot

Given the population size estimates shown in Table 2, and apparent population stability (USFWS 2014), we conclude that SCRAM predicted mortality of 37 (mean 36.75; 95 percent prediction interval 18.69 to 71.05) rufa red knots or the Band (2012) predicted mortality of 17 (98 percent avoidance rate) or 60 (92.97 percent avoidance rate) rufa red knots over 35 years will have no appreciable effect on the SEC or NCSA recovery units.

The Southern unit would be far more sensitive to loss of individuals, based not only on its smaller size but also the challenges that face these birds on their very long migrations (USFWS 2020b). However, we conclude it is unlikely that all of the projected collisions would come from the Southern unit, based on its smaller size and on the tracking data discussed above. Based on current demographic data, we conclude that predicted loss of rufa red knots generated from both models over 35 years will have no measurable effects on any of the three recovery units. This conclusion assumes that no more than 9 birds total—and no more than 1 bird in any given year—will come from the Southern population. Demographic rates are associated with uncertainty and can change over the 35-year project life. However, any risk of population-level effects is further reduced by the compensatory mitigation commitments given in Section IV of this Opinion.

Impacts to Species – Given our conclusion that the projected levels of collision mortality will have no measurable effect on any populations (i.e., recovery or management units), and that any risk of population-level effects is further offset by compensatory mitigation, we conclude that the operation of the EW1 and EW2 projects will have no appreciable effect on the numbers of any of the two listed bird species, and no effect on reproduction or distribution of either of the two listed bird species. Thus, the project will not affect the viability of the Atlantic Coast piping plover and rufa red knot.

XII. CONCLUSION

We considered the current overall rangewide status of the piping plover (improving) and rufa red knot (stable) and the stable condition of red knots and piping plovers within the action area (environmental baseline). We then assessed the effects of the proposed action and the potential for cumulative effects in the action area on individuals, populations, and the species as a whole. As stated in the Jeopardy Analysis, we do not anticipate any reductions in the overall reproduction, numbers, or distribution of these species. It is the Service's Opinion that the operation of the EW1 and EW2 offshore wind energy projects, as proposed, are not likely to jeopardize the continued existence of the Atlantic Coast piping plover or the rufa red knot.

XIII. INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and federal regulation pursuant to Section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without a special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns including breeding, feeding, or sheltering (50 CFR § 17.3). Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of Section 7(b)(4) and Section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of this incidental take statement.

The measures described below are nondiscretionary and must be undertaken by the BOEM so that they become binding conditions of any grant or permit issued to Empire Wind, as appropriate, for the exemption in Section 7(o)(2) to apply. The BOEM has a continuing duty to regulate the activity covered by this incidental take statement. If the BOEM: (1) fails to assume and implement the terms and conditions or (2) fails to require Empire Wind to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protective coverage of Section 7(o)(2) may lapse. To monitor the impact of incidental take, the BOEM and Empire Wind must report the progress of the action and its impact on the species to the Service as specified in the incidental take statement [50 CFR 402.14(i)(3)].

XIV. AMOUNT OR EXTENT OF TAKE ANTICIPATED

The Service expects the following lethal take of listed species resulting from collision of birds with operating wind energy turbines on the BOEM Renewable Energy Lease Area OCS-A 0512 over the 35-year life of the EW1 and EW2 projects:

Piping Plovers

We compared the SCRAM mean mortality estimate and the Band (2012) mortality estimate at the 92.97 percent collision avoidance rate and selected the lower of the two to establish mortality estimates for incidental take and reintiation exceedance criteria:

1. SCRAM-derived piping plover mortality estimate: 2 (mean 1.76; 95 percent prediction interval 0.41 to 6.6) piping plover adults and juveniles due to collision mortality over 35 years (BOEM 2023).

2. Band (2012)-derived piping plover mortality estimate: 18 piping plover adults and juveniles due to collision over 35 years.

Comparing 1 and 2 above, we selected the SCRAM model results for the incidental take of piping plover, that is, 2 piping plovers over 35 years as it provides the most conservative estimate for establishing a take exceedance value for the purposes of reinitiation of consultation.

Rufa Red Knots

3. SCRAM-derived rufa red knot mortality estimate: 37 (mean 36.75; 95 percent prediction interval 18.69 and 71.05) rufa red knots adults and juveniles due to collision over 35 years (BOEM 2023).

4. Band (2012)-derived rufa red knot mortality estimate: 60 rufa red knots adults and juveniles due to collision over 35 years.

Comparing 3 and 4, above we selected the SCRAM results to define incidental take of red knots, that is, 37 rufa red knots over 35 years as it provides a reasonable estimate for establishing a take exceedance value for the purposes of reinitiation of consultation.

The Service analyzed the effects to the piping plover and red knot and has determined that the levels of take anticipated, as described above, from the Federal actions covered in this Opinion are not likely to result in jeopardy to these species.

We conclude that take of Atlantic Coast piping plovers in the form of collision mortality from operation of the EW1and EW2 projects is reasonably certain to occur. Absent sufficient information to more precisely estimate avoidance rates and other data limitations described above, we considered and adopted the full range of collision estimates presented in Tables 3 and 4. We note that the estimated levels of take are associated with high uncertainty, and we expect that it will be refined over time in accordance with the monitoring and modelling efforts proposed in Section IV of this Opinion.

XV. REASONABLE AND PRUDENT MEASURES

The physical and operational parameters of WTGs are known to influence the risk of wildlife collision. At this time, the Service is not aware of any specific physical or operational WTG adjustments that would be reasonably likely to appreciably reduce collisions of listed birds in the offshore environment, except for curtailment of turbines during maximum migration periods. However, technology and research in this area are advancing rapidly, and new methods for reducing collisions may become available over the long operational life of the EW1 and EW2 projects. Therefore, the Service believes the following reasonable and prudent measures are necessary and appropriate to minimize take of piping plovers and rufa red knots.

1. Periodically review current technologies and methods for minimizing collision risk of listed birds, including but not limited to: WTG coloration/marking, lighting, avian deterrents, and limited WTG operational changes. Operational changes may include, but are not limited to, feathering, which involves adjusting the angle of the blades to slow or stop them from turning under certain conditions

2. Implement those technologies and methods deemed reasonable and prudent.

XVI. TERMS AND CONDITIONS

In order for the above-described anticipated take to be exempt from the prohibitions of Section 9 of the ESA, the BOEM must comply with the following terms and conditions, which implement the reasonable and prudent measures described above. These terms and conditions are nondiscretionary.

1. *Periodically review current technologies and methods for minimizing collision risk of listed birds.*

    a. Prior to the commissioning of WTG operations at EW1 and EW2 projects, the BOEM must extract from existing project documentation (e.g., the BA, other consultation documents, the final EIS, the COP) a stand-alone summary of technologies and methods that were evaluated by the BOEM to reduce or minimize bird collisions at the EW1 and EW2 WTGs.

    b. Within 5 years of the start of WTG operation, and then every 5 years for the life of the project, the BOEM must prepare a Collision Minimization Report, reviewing best available scientific and commercial data on technologies and methods that have been implemented, or are being studied, to reduce or minimize bird collisions at WTGs. The review must be global in scope and include both offshore and onshore WTGs.

    c. The BOEM must distribute a draft Collision Minimization Report to the Service, Empire Wind, and appropriate state agencies for a 60-day review period. The BOEM must address all comments received during the review period and issue the final report within 60 days of the close of the review period.

d. Within 60 days of issuing the final Collision Minimization Report, the BOEM must convene a meeting with BSEE, the Service and Empire Wind. Meeting participants will discuss the report and seek consensus on whether implementation of any technologies/methods are reasonable and prudent. However, if consensus cannot be reached, the Service will make the final determination of whether any minimization measures are reasonable and prudent (i.e., necessary, or appropriate, to minimize the amount or extent of incidental take), after considering input from the BOEM, BSEE, Empire Wind, and appropriate state agencies.

2. *Implement those technologies and methods deemed reasonable and prudent.*

    a. The BOEM will require Empire Wind to adopt and deploy such minimization technologies/methods as deemed reasonable and prudent. BOEM will specify the Service-approved timeframe in which any required minimization measure(s) must be implemented, as well as any requirements to monitor, maintain, or adapt the measure(s) over time.

    b. The BOEM will require Empire Wind to provide periodic reporting on the implementation of any minimization measure(s) according to a schedule developed by the BOEM and approved by the Service.

Monitoring and Reporting

In the event of take, a system of notification shall be implemented following the guidelines:

Notification of injured or dead listed species will be made to USFWS Law Enforcement and Long Island Field Office. Exercise care in handling any specimens of dead specimens to preserve biological material in the best possible state. In conjunction with the preservation of any specimens, the BOEM is responsible for ensuring that evidence intrinsic to determining the cause of death of the specimen is not unnecessarily disturbed. Finding dead or non-viable specimens does not imply enforcement proceedings pursuant to the ESA. Reporting dead specimens is required for the Service to determine if take is reached or exceeded and to ensure that the terms and conditions are appropriate and effective.

Upon locating a dead piping plover or red knot (or other listed species), initial notification must be made to the following Service offices:

Resident Agent in Charge
U.S. Fish and Wildlife Service
Office of Law Enforcement
70 East Sunrise Highway, Ste. 419
Valley Stream, NY 11581
516-825-3950

and

U.S. Fish and Wildlife Service
Long Island Field Office
340 Smith Road
Shirley, NY 11967

(631) 286-0485

XVII. COORDINATION OF INCIDENTAL TAKE STATEMENT WITH OTHER LAWS, REGULATIONS, AND POLICIES

The Service will not refer the incidental take of any migratory bird for prosecution under the Migratory Bird Treaty Act of 1918, as amended (16 U.S.C. S 703-712), if such take is in compliance with the Terms and Conditions specified herein. Take resulting from activities that are not in conformance with this Opinion (e.g., deliberate harassment of wildlife) are not considered part of the proposed action and are not covered by this Incidental Take Statement and may be subject to enforcement action against the individual responsible for the act

XVIII. CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

Recommendation 1: Adopt compensatory mitigation ratios greater than 1:1.

As discussed throughout this Opinion, estimated levels of collision mortality are associated with high uncertainty. Future advancements in SCRAM are expected to substantially reduce, but not eliminate uncertainty. In addition, compensatory mitigation actions will likely be associated with their own levels of uncertainty (e.g., probability of success, actual number of bird mortalities offset), and may occur later in time that the project-induced mortality. Thus, a compensatory mitigation ratio greater than 1:1 is advisable to insure against jeopardy, particularly given the extent of full buildout of WTGs on the OCS.

Recommendation 2: Establish an Offshore Wind Adaptive Monitoring and Impact Minimization Framework, developed and carried out through a partnership of government agencies and industry representatives, to guide and coordinate monitoring, research, and avian impacts coastwide.

To address Service concerns related to potential effects of WTG operation on listed and other species of concern, at both the project and coastwide scales, we recommend that the BOEM develop and adopt an Offshore Wind Adaptive Monitoring and Impact Minimization Framework (Framework) for flying wildlife. Many details will need to be worked out, but here we provide some basic principles for establishment, adoption, and operation of the Framework.

1. Establish a Framework Principals Group to consist of representatives from the BOEM, BSEE, the Service, State natural resource agencies responsible for management of birds, bats, and insect, and offshore wind energy developers/operators.

2. Develop and adopt a written Framework foundational document specifying:

    a. the governance structure of the Principals Group;

b. the geographic coverage of the Framework (at a minimum, Federal waters from Maine to Virginia—optionally also Federal Atlantic waters from North Carolina to Florida and/or State waters);

c. the species coverage of the Framework (at a minimum, federally listed, proposed, and candidate birds, insects, and bat species likely to occur in the offshore environment—optionally also other flying species of concern in the offshore environment such as certain Bird Species of Conservation Concern, At-Risk species, State-listed species, and Species of Greatest Conservation Need as identified in State Wildlife Action Plans); and

d. the duration of the Framework (at a minimum, the entire length of time that any offshore wind energy generation is operational OR until all members of the Principals Group are in agreement that a robust weight of scientific evidence indicates that flying wildlife are not impacted by offshore WTG operation).

3. Establish an annual operating budget for the Framework to be funded by offshore wind energy developers/operators.

4. Arrange for the Principals Group to meet at least annually, and for the Framework foundational document to be updated at least every 5 years.

5. Provide for experts (both internal and external to the Principals Group) to regularly assess new and improved technologies and methods for estimating collision risk of covered species and consider measuring or detecting collisions. Adopt and deploy such methods deemed most critical to addressing collision risk by the Principals Group.

6. Coordinate monitoring and research across wind energy projects. Share and pool data and research results coastwide.

7. Provide for experts (both internal and external to the Principals Group) to regularly assess new and improved technologies and methods for minimizing collision risk of covered species, including but not limited to WTG coloration/marking, lighting, avian/bat deterrents, and limited WTG operational changes that would not unduly impact energy production. At local, regional, and coastwide scales, adopt and deploy such technologies/methods deemed most promising by the Principals Group.

8. Provide for experts (both internal and external to the Principals Group) to periodically assess new and improved technologies and methods for evaluating indirect effects to covered species from WTG avoidance behaviors (e.g., impacts to time and energy budgets).

9. Periodically assess the level and type of compensatory mitigation necessary to offset any unavoidable direct effects (collision) and indirect effects (reduced survival rates from avoidance) of WTG operation on covered species. Adopt and deploy such levels and types of mitigation as deemed appropriate by the Principals Group.

10. Consider partnering with a stakeholder or cross-sector organization, such as the Regional Wildlife Science Collaborative for Offshore Wind, to provide administrative, institutional, and technical support to the Principals Group.

Recommendation 3: Conduct a coastwide buildout analysis that considers all existing, proposed, and future offshore wind energy development on the Atlantic OCS.

The definition of "cumulative effects" in the Consultation Handbook excludes future Federal actions because such actions will be subject to their own consultations. Further, the analysis of environmental baseline conditions for each subsequent consultation is limited to the action area of that particular project. This creates a situation where the effects analysis for each individual offshore wind energy project cannot fully take into account the possible additive and/or synergistic effects that may occur at full build-out of offshore wind infrastructure along the coast.

Besides the two existing offshore wind energy facilities (Block Island Wind offshore Rhode Island and Coastal Virginia Offshore Wind), there are 26 additional offshore wind projects in being developed from Maine to Virginia. As the DOI continues moving toward the national goal of deploying 30 gigawatts of offshore wind by 2030, we anticipate still more projects beyond those 26 (e.g., within the New York Bight, Central Atlantic, and Gulf of Maine). While a thorough and robust assessment of potential direct effects (collision) and indirect effects (behavioral change) will be completed for each individual offshore wind project, a coastwide analysis may indicate or suggest additive and/or synergistic effects among projects. Therefore, the Service recommends that the BOEM analyze potential aggregate effects from WTG operation at a coastwide scale. A coastwide analysis will work in concert with the Offshore Wind Adaptive Monitoring and Impact Minimization Framework to comprehensively assess, monitor, and manage avian impacts from wind energy development along the U.S. Atlantic Coast. Programmatic consultation for wind energy development in the New York Bight is already underway and could set the stage for a full coastwide analysis. Ultimately, a coastwide programmatic biological opinion may emerge as the most effective and efficient mechanism for assessing, monitoring, minimizing, and offsetting effects to listed birds from WTG operation on the OCS.

XIX. REINITIATION NOTICE

This concludes formal consultation on the Proposed Action outlined in the BOEM's request for formal consultation. As provided in 50 CFR 402.16, reinitiation of formal consultation is required where discretionary federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this Opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this Opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

XX. LITERATURE CITED

Adams, E.M., A. Gilbert, P. Loring, and K.A. Williams. (Biodiversity Research Institute, Portland, ME and U.S. Fish and Wildlife Service, Charlestown, RI). 2022. Transparent modeling of collision risk for three federally-listed bird species in relation to offshore wind energy development: final report. Contract No.: M19PG00023. Unpublished report prepared for U.S. Department of the Interior, Bureau of Ocean Energy Management, Washington, DC.

Band, B. 2012. Using a collision risk model to assess bird collision risks for offshore wind farms. Report by British Trust for Ornithology for The Crown Estate. Thetford, Norfolk, United Kingdom. 62 pp. Available from: https://tethys.pnnl.gov/publications/using-collision-risk-model-assess-bird-collision-risks-offshore-wind-farms [Accessed May 4, 2023].

Blanco, P. 2012. *Charadrius melodus Linnaeus*, 1758 Frailecillo Blanco, piping plover. Libro rojo de los vertebrados de Cuba: 18:222-224.

Bureau of Ocean Energy and Management [BOEM]. 2022a. Empire Offshore Wind, Empire Wind projects (EW 1 and EW 2) Draft Environmental Impact Statement. Office of Renewable Energy Programs, Sterling, Virginia. 510 pp. + Appendices. Available from: https://www.boem.gov/sites/default/files/documents/renewable-energy/state-activities/Empire_Wind_DEIS_Vol1.pdf [Accessed May 4, 2023].

Bureau of Ocean Energy and Management [BOEM]. 2022b. Empire Offshore Wind: Empire Wind Projects (EW 1 and EW 2) Biological Assessment for the United States Fish and Wildlife Service. Office of Renewable Energy Programs, Sterling, Virginia. 82 pp. + Appendices.

Bureau of Ocean Energy and Management [BOEM]. 2023. Biological Assessment Addendum. Office of Renewable Energy Programs, Sterling, Virginia. 2 pp.

Burger, J., L.J Niles, R.R. Porter, A.D. Dey, S. Koch, and C. Gordon. 2012. Using a shore bird (red knot) fitted with geolocators to evaluate a conceptual risk model focusing on offshore wind. Renewable Energy 43(2012):370-377.

Croll, D.A., A.A. Ellis, J. Adams, A.S.C.P. Cook, S. Garthe, M.W. Goodale, C.S. Hall, E. Hazen, B.S. Keitt, E.C. Kelsey, J.B. Leirness, D.E. Lyons, M.W. McKown, A. Potiek, K.R. Searle, F.H. Soudijn, R.C. Rockwood, B.R. Tershy, M. Tinker, E.A. VanderWerf, K.A. Williams, L. Young and K. Zilliacus. 2022. Framework for assessing and mitigating the impacts of offshore wind energy development on marine birds. Biological Conservation 276:109795.

Chamberlain, D.E., M.R. Rehfisch, A.D. Fox, M. Desholm, and A.J. Anthony. 2006. The effect of avoidance rates on bird mortality predictions made by wind turbine collision risk models. Ibis 148:198–202.

Cook, A.S.C.P. 2021. Additional analysis to inform SNCB recommendations regarding collision risk modelling. BTO Research Report 739. Report to Natural England by British Trust for Ornithology, Thetford, Norfolk, United Kingdom. 47pp. Available from:

https://www.bto.org/sites/default/files/publications/bto_rr_739_cook_collision_risk_models_final_web.pdf [Accessed May 6, 2023].

del Hoyo, J., A. Elliot, and J. Sargatal. 2011. Handbook of the birds of the world. Lynx Editions; Barcelona, Spain.

Drewitt, A.L., and R.H.W. Langston. 2006. Assessing the impacts of wind farms on birds. Ibis 148:29-42.

Elliott-Smith, E., M. Bidwell, A.E. Holland, and S.M. Haig. 2015. Data from the 2011 International Piping Plover Census. U.S. Geological Survey Data Series 922.

Elliott-Smith, E., and S.M. Haig. 2020. Piping plover (*Charadrius melodus*), version 1.0. In Birds of the World. Cornell Lab of Ornithology; Ithaca, New York. Available from: https://doi.org/10.2173/bow.pipplo.01 [Accessed May 6, 2023].

Fernández-Alvarez, J.C., X. Costoya, A. Pérez-Alarcón, S. Rahimi, R. Nieto, and L. Gimeno. 2023. Dynamic downscaling of wind speed over the North Atlantic Ocean using CMIP6 projections: Implications for offshore wind power density. Energy Reports 9(2023):873-885.

Gilbert, A.T., E.M. Adams, P.H. Loring, and K.A. Williams. 2022. User documentation for the Stochastic Collision Risk Assessment for Movement (SCRAM). Unpublished report prepared for U.S. Department of the Interior, Bureau of Ocean Energy Management, Washington, DC. 37 pp.

Gordon, C.E., and C. Nations. 2016. Collision risk model for “rufa” red knots (*Calidris canutus rufa*) interacting with a proposed offshore wind energy facility in Nantucket Sound, Massachusetts. Sterling, Virginia: U.S. Department of the Interior, Bureau of Ocean Energy Management. OCS Study BOEM 2016-045. 90 pp. + frontmatter and appendix. Available from: https://www.boem.gov/sites/default/files/environmental-stewardship/Environmental-Studies/Renewable-Energy/Red-Knot-Collision-Risk-Final-Report.pdf [Accessed May 6, 2023].

Gratto-Trevor, C.L., G.J. Robertson, and C.A. Bishop. 2013. Scientific review of the recovery program for piping plover (*melodus* subspecies) in Eastern Canada. Unpublished report prepared for Science and Technology Branch, Environment Canada, Saskatoon, Saskatchewan.

Kleyheeg-Hartman, J.C., K.L. Krijgsveld, M.P. Collier, M.J.M. Poot, A.R. Boon, T.A. Troost, and S. Dirksen. 2018. Predicting bird collisions with wind turbines: comparison of the new empirical Flux Collision Model with the SOSS Band model. Ecological Modelling 387:144-153.

Lamb, J.S., P.H. Loring, and P.W.C. Paton. 2023. Distributing transmitters to maximize population-level representativeness in automated radio telemetry studies of animal movement. Movement Ecology 11:1.

Loring, P.H., J.D. McLaren, P.A. Smith, L.J. Niles, S.L. Koch, H.F. Goyert, and H. Bai. 2018. Tracking movements of threatened migratory rufa Red Knots in U.S. Atlantic Outer Continental Shelf waters. Sterling, Virginia: U.S. Department of the Interior, Bureau of Ocean Energy Management. OCS Study BOEM 2018-046. 145 pp. Available from: https://espis.boem.gov/Final%20Reports/BOEM_2018-046.pdf [Accessed May 9, 2023].

Loring, P.H., P.W. Paton, J.D. McLaren, H. Bai, R. Janaswamy, H.F. Goyert, C.R. Griffin, and P.R. Sievert. 2019. Tracking offshore occurrence of common terns, Endangered roseate terns, and Threatened piping plovers with VHF arrays. Sterling, Virginia: U.S. Department of the Interior, Bureau of Ocean Energy Management. OCS Study BOEM 2019-017. 149 pp. Available from: https://espis.boem.gov/final%20reports/BOEM_2019-017.pdf [Accessed May 9, 2023].

Loring P.H., A.K. Lenske, J.D. McLaren, M. Aikens, A.M. Anderson, Y. Aubrey, E. Dalton, A. Dey, C. Friis, D. Hamilton, B. Holberton, D. Kriensky, D. Mizrahi, L. Niles, K.L. Parkins, J. Paquet, F. Sanders, A. Smith, Y. Turcotte, A. Vitz, and P.A. Smith. 2020a. Tracking movements of migratory shorebirds in the U.S. Atlantic Outer Continental Shelf region. Sterling, Virginia: U.S. Department of the Interior, Bureau of Ocean Energy Management. OCS Study BOEM 2021-008. 104 pp. Available from: https://www.boem.gov/sites/default/files/documents/renewable-energy/studies/Tracking-Migratory-Shorebirds-Atlantic-OCS.pdf [Accessed May 9, 2023].

Loring, P.H., J.D. McLaren, H.F. Goyert, and P.W.C. Paton. 2020b. Supportive wind conditions influence offshore movements of Atlantic Coast piping plovers during fall migration. Condor 122:1–16.

Lyons, J.E., B. Winn, T. Teyes, and K.S. Kalasz. 2017. Post-breeding migration and connectivity of red knots in the Western Atlantic. The Journal of Wildlife Management 82(Supplement 1):1-14.

Lyons, J.E., B.A. Harrington, and S. Koch. 2019. Stopover population dynamics and migratory connectivity of red knots at Cape Cod, Massachusetts. Unpublished report prepared for U.S. Fish and Wildlife Service, Hadley, Massachusetts. 35 pp.

Marques, A.T., H. Batalha, and J. Bermandino. 2021. Bird displacement by wind turbines: assessing current knowledge and recommendations for future studies. Birds 2(4):460-475.

Masden, E. 2015. Developing an avian collision risk model to incorporate variability and uncertainty. Scottish Marine and Freshwater Science 6(14).

Masden, E.A., and A.S.C.P. Cook. 2016. Avian collision risk models for wind energy impact assessments. Environmental Impact Assessment Review 56: 43–49.

Matus, R. 2021. Results of the 2021 Aerial Census at Bahía Lomas, Chile. Centro de Rehabilitación de Aves Leñadura. Western Hemisphere Shorebird Reserve Network. https://whsrn.org/results-of-the-2021-aerial-census-at-bahia-lomas-chile/ [Accessed May 9, 2023].

May, R.F. 2015. A unifying framework for the underlying mechanisms of avian avoidance of wind turbines. Biological Conservation (190):179–187.

Mizrahi, D.S. 2020. Aerial surveys for shorebirds wintering along northern South America's Atlantic Coast with an emphasis on semipalmated sandpipers and red knots – phase 2. Report to National Fish and Wildlife Foundation, Project # 59145. New Jersey Audubon Society, Cape May Court House, New Jersey. 26 pp.

Niles, L.J., H.P. Sitters, A.D. Dey, P.W. Atkinson, A.J. Baker, K.A. Bennett, R. Carmona, K.E. Clark, N.A. Clark, and C. Espoz. 2008. Status of the red knot (*Calidris canutus rufa*) in the Western Hemisphere. Studies in Avian Biology 36: 1-185.

Niles, LJ. 2014. Braving Brazil. Available from https://www.arubewithaview.com/2014/02/25/braving-brazil/ [Accessed on May 16, 2023].

Niles, L.J., J. Burger, R.R. Porter, A.D. Dey, C.D.T. Minton, P.M. González, A.J. Baker, J.W. Fox, and C. Gordon. 2010. First results using light level geolocators to track red knots in the Western Hemisphere show rapid and long intercontinental flights and new details of migration pathways. Wader Study Group Bulletin 117(2):123-130.

Norambuena, H.V., R. Matus, A. Larrea, and C. Espoz. 2022. Censos aéreos de aves playeras en el santuario de la naturaleza Bahía Lomas, Enero 2022. University Santo Tomás (Chile).

Perkins, G. 2023. Geolocator project coordinator: Using geolocator tracking data to advance understanding of red knot migration habits. EC Contract No: 3000738325. Prepared For: Environment and Climate Change Canada, and the United States Fish and Wildlife Service by Ninox Consulting Ltd., Smithers, British Columbia, Canada. 36 pp. + Appendices.

Rebke, M., V. Dierschke, C.N. Weiner, R. Aumüller, and K. Hill. 2019. Attraction of nocturnally migrating birds to artificial light: The influence of colour, intensity and blinking mode under different cloud cover conditions. Biological Conservation 233: 220–227.

Robinson Willmott, J. C., G. Forcey, and A. Kent. 2013. The relative vulnerability of migratory bird species to offshore wind energy projects on the Atlantic Outer Continental Shelf: an assessment method and database. Final report to the U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs. OCS Study BOEM 2013-207. 275 pp. Available from: https://espis.boem.gov/final%20reports/5319.pdf [Accessed May 10, 2023].

Schwarzer, A.C. 2011. Demographic rates and energetics of red knots wintering in Florida. University of Florida, Gainesville, Florida.

Scottish Natural Heritage [SNH]. 2018. Avoidance rates for the onshore SNH Wind Farm Collision Risk. SNH Guidance Note. Stilligarry, South Uist, Scotland. 4 pp. Available from: https://www.nature.scot/sites/default/files/2018-09/Wind%20farm%20impacts%20on%20birds%20-%20Use%20of%20Avoidance%20Rates%20in%20the%20SNH%20Wind%20Farm%20Collision%20Risk%20Model.pdf [Accessed May 8, 2023].

Seneviratne, S.I., X. Zhang, M. Adnan, W. Badi, C. Dereczynski, A. Di Luca, S. Ghosh, I. Iskandar, J. Kossin, S. Lewis, F. Otto, I. Pinto, M. Satoh, S.M. Vicente-Serrano, M. Wehner, and B. Zhou.

2021. Weather and Climate Extreme Events in a Changing Climate. In Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte, V., P. Zhai, A. Pirani, S.L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M.I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T.K. Maycock, T. Waterfield, O. Yelekçi, R. Yu, and B. Zhou (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, New York, pp. 1513–1766, doi:10.1017/9781009157896.013.

Sherfy, M.H., M.J. Anteau, T.L. Shaffer, M.A. Sovada, and J.H. Stucker. 2012. Foraging ecology of least terns and piping plovers nesting on Central Platte River sandpits and sandbars. U.S. Geological Survey Open-File Report 2012–1059. Reston, Virginia. 50 pp. Available from: https://pubs.usgs.gov/of/2012/1059/of12-1059.pdf [Accessed May 9, 2023].

Simmons, AJ. 2022. Trends in the tropospheric general circulation from 1979 to 2022. Weather and Climate Dynamics 3: 777–809. https://doi.org/10.5194/wcd-3-777-2022.

Staine, K.J., and J. Burger. 1994. Nocturnal foraging behavior of breeding piping plovers (*Charadrius melodus*) in New Jersey. The Auk 111(3): 579-587.

Stantial, M.L., and J.B. Cohen. 2022. Twenty-four-hour activity patterns of breeding Atlantic coast piping plovers. Wader Study 129(1): 65–68.

Tetra Tech. 2022. Empire Offshore Wind: Empire Wind project (EW 1 and EW 2) construction and operations plan. Submitted by Equinor to Bureau of Ocean Energy Management. 200 pp. + Appendices. Available from: https://www.boem.gov/renewable-energy/state-activities/empire-wind-construction-and-operations-plan [Accessed May 4, 2023].

Thaxter, C.B., G.M. Buchanan, J. Carr, S.H.M. Butchart, T. Newbold, R.E. Green, J.A. Tobias, W.B. Foden, S. O'Brien, and J.W. Pearce-Higgins. 2017. Bird and bat species' global vulnerability to collision mortality at wind farms revealed through a trait-based assessment. Proceedings of the Royal Society B 284: 20170829. Available from: http://dx.doi.org/10.1098/rspb.2017.0829 [Accessed May 9, 2023].

U.S. Fish and Wildlife Service [USFWS]. 1996. Piping plover (*Charadrius melodus*), Atlantic Coast population, revised recovery plan. Northeast Region, Hadley, Massachusetts. 258 pp. https://ecos.fws.gov/docs/recovery_plan/960502.pdf [Accessed May 9, 2023].

U.S. Fish and Wildlife Service [USFWS]. 2009. Piping plover (*Charadrius melodus*) 5-year review: summary and evaluation. Northeast Region, Hadley, Massachusetts and Michigan Field Office, East Lansing, Michigan. 206 pp. https://ecos.fws.gov/docs/five_year_review/doc3009.pdf [Accessed May 9, 2023].

U.S. Fish and Wildlife Service [USFWS]. 2014. Rufa red knot background information and threats assessment. Supplement to Endangered and Threatened wildlife and plants; final Threatened status for the rufa red knot (*Calidris canutus rufa*) [Docket No. FWS–R5–ES–2013–0097; RIN AY17]. Pleasantville, New Jersey. 376 pp. + Appendices. Available from: https://www.regulations.gov/document/FWS-R5-ES-2013-0097-0703 [Accessed May 9, 2023].

U.S. Fish and Wildlife Service [USFWS]. 2020a. Piping plover (*Charadrius melodus*) 5-year review: summary and evaluation. Michigan Field Office, East Lansing, Michigan and Northeast Region, Hadley, Massachusetts. 164 pp. Available from: https://ecos.fws.gov/docs/five_year_review/doc6378.pdf [Accessed May 5, 2023].

U.S. Fish and Wildlife Service. 2020b. Species status assessment report for the rufa red knot (*Calidris canutus rufa*). Version 1.1. Ecological Services, New Jersey Field Office, Galloway, New Jersey. Available from: https://ecos.fws.gov/ServCat/DownloadFile/187781 [Accessed May 9, 2023].

U.S. Fish and Wildlife Service [USFWS]. 2021a. Abundance and productivity estimates - 2021 update Atlantic Coast piping plover population. Hadley, Massachusetts. 16 pp. Available from: https://www.fws.gov/media/abundance-and-productivity-estimates-2021-update-atlantic-coast-piping-plover-population [Accessed May 5, 2023].

U.S. Fish and Wildlife Service [USFWS]. 2021b. Rufa red knot (*Calidris canutus rufa*) 5-year review: summary and evaluation. New Jersey Field Office, Galloway, New Jersey. 35 pp. Available from: https://ecos.fws.gov/docs/tess/species_nonpublish/3624.pdf [Accessed May 5, 2023]

U.S. Fish and Wildlife Service [USFWS]. 2022. Abundance and productivity estimates – 2021 update: Atlantic Coast piping plover population. Northeast Region, Hadley, Massachusetts. https://www.fws.gov/sites/default/files/documents/piping-plover-abundance-and-productivity-update-2021.pdf [Accessed May 11, 2023].

U.S. Fish and Wildlife Service [USFWS]. 2023a. Range-wide Indiana Bat and Northern Long-eared Bat Survey Guidelines. Region 3, Bloomington, Minnesota. 76 pp. Available from: https://www.fws.gov/media/range-wide-indiana-bat-and-northern-long-eared-bat-survey-guidelines [Accessed May 15, 2023].

U.S. Fish and Wildlife Service [USFWS]. 2023b. Recovery plan for the rufa red knot (*Calidris canutus rufa*). Northeast Region, Hadley, Massachusetts. 22 pp. Available from: https://ecos.fws.gov/docs/recovery_plan/2023_red%20knot%20recovery%20plan_final_508%20compliant%20signed.pdf [Accessed May 9, 2023].

USFWS. 2023c. Native Threatened Species Recovery -Threatened Wildlife Permit Number ESPER0049780 for rufa red knot (Calidris canutus rufa). Issued by USFWS, Northeast Region, Hadley, Massachusetts. 9 pp.

U.S. Fish and Wildlife Service. 2023d. Ocean Wind 1 Biological Opinion on the Effects of the Ocean Wind 1 Wind Energy Project, Offshore Atlantic County, New Jersey on Three Federally Listed Species. New Jersey Field Office. 98 pp.

U.S. Fish and Wildlife Service and National Marine Fisheries Service [USFWS and NMFS]. 1998. Endangered species consultation handbook procedures for conducting consultation and conference activities under section 7 of the Endangered Species Act. 51 pp. Available from: https://www.fws.gov/sites/default/files/documents/endangered-species-consultation-handbook.pdf [Accessed May 6, 2023].

Watts, B.D. 2015. Establishing sustainable mortality limits for shorebirds using the Western Atlantic Flyway. Wader Study 122(1):37–53.

Western Hemisphere Shorebird Reserve Network [WHSRN]. 2020. Results of the 2020 aerial survey of rufa red knot in Tierra del Fuego. Available from: https://whsrn.org/results-of-the-2020-aerial-survey-of-rufa-red-knot-in-tierra-del-fuego/ [Accessed May 9, 2023].

Wilson, S., and R.I.G. Morrison. 2018. Appendix 1. Proportions of juvenile, sub-adult, and adult birds in populations of Red Knot. Unpublished data. Committee on the Status of Endangered Wildlife in Canada, Ottawa, Canada. 2 pp.

PERSONAL COMMUNICATIONS

Bigger, D. 2023. Email of February 23, 2023. Environmental Protection Specialist. Office of Renewable Energy Programs, Bureau of Ocean Energy Management, Sterling, Virginia.

Davis, C. 2018. Email of July 17, 2018. Environmental Specialist. Endangered and Nongame Species Program, New Jersey Division of Fish and Wildlife, Trenton, New Jersey.

Hecht, A. 2023. Email of March 15, 2023. Endangered Species Biologist. U.S. Fish and Wildlife Service, Sudbury, Massachusetts.

Landers, L. 2023. Email of April 6, 2023. NEPA Coordinator, Environment Branch for Renewable Energy. Bureau of Ocean Energy Management, Sterling, Virginia.

Newstead, D. 2020. Emails of March 6 and June 3, 2020. Manager, Coastal Waterbird Program. Coastal Bend Bays and Estuaries Program, Corpus Christi, Texas.

Newstead, D. 2019. Email of October 3, 2019. Manager, Coastal Waterbird Program. Coastal Bend Bays and Estuaries Program, Corpus Christi, Texas.

Rock, J. 2023. Email of February 1, 2023. Wildlife Biologist. Environment and Climate Change, Sackville, New Brunswick, Canada.

CONSULTATION HISTORY

August 11, 2022 – The BOEM transmits draft BA to the Service for review.
October 19, 2022 – The Service transmits comments on draft BA to BOEM.
November 18, 2022 – The BOEM transmits BA to the Service for the Empire Wind Projects.
March 27, 2023 – The BOEM transmits addendum to BA to the Service which includes an updated SCRAM model assessment of collisions for red knot, piping plover, and roseate tern.
March 28, 2023 – The BOEM transmits slightly revised version addendum to Empire BA.
May 11, 2023 – The BOEM confirms to the Service that they and Empire Wind made the decision to proceed with the BA and consultation using best available information and foregoing the collection of

additional data (such as more Motus tracking) so that consultation could be completed in the timeframe necessary to complete the Final EIS.

APPENDIX A

Analysis and Assumptions Associated with SCRAM and Band (2012) Model Results

Available Collision Risk Models

Technology does not currently exist to detect a collision of either a piping plover or rufa red knot with a WTG, and the likelihood of finding a bird carcass in the offshore environment is negligible. Thus, we anticipate relying on collision risk modeling to estimate collision rates after construction (see IV Other Project Measures D and E), as well as for pre-construction assessments including the effects analysis in this Opinion, which is informed by a body of literature that has developed in recent decades. However, considerable uncertainty remains because most studies to date have been conducted at wind farms on land and/or in Europe. In the BA, BOEM (2022b) presents results from two different models, estimating collision risk for listed birds from the EW1 and EW2 projects.

The first, a model by Band (2012), is an established method to assess collision risk for offshore wind farms. This model estimates the number of annual collisions using input data on the target species (e.g., numbers, flight height, avoidance, body size, flight speed) and turbine details (e.g., number, size, and rotation speed of blades). The Band (2012) model has several known limitations, which are summarized here from Masden (2015) and Masden and Cook (2016).

1. Limited transparency. The Excel spreadsheet that underpins the Band (2012) model does not allow for easy reproducibility or review of underlying code and data, thus hindering independent verification of results.
2. Unable to account for variability, thus cannot reflect the inherent heterogeneity of the environment. The Band (2012) model is sensitive to the choice of input parameters. Variability in input parameters such as bird density, flight speed, and turbine rotor speed are likely to contribute uncertainty to the final collision estimates.
3. Deterministic. Band (2012) is not a stochastic model, so it does not account for the stochasticity that pervades natural systems.
4. Limited ability to quantify uncertainty. Recent versions of the Band (2012) model guidance provide an approach under which uncertainty can be expressed. However, this approach is relatively simplistic and can only be applied when the sources of variability are independent of one another. Properly accounting for uncertainty becomes increasingly important as collision risk estimates are extrapolated over time, such as the 35-year lifespan of EW1 and EW2 projects.

The second model, SCRAM (Gilbert et al. 2022), builds on the Band (2012) model and introduces stochasticity via repeated model iterations. The wind farm and WTG operational inputs to SCRAM are similar to those used in the Band (2012) model. Unlike Band (2012), SCRAM estimates species' exposure to a proposed wind farm using bird passage rates based on modeled flight paths of birds fitted with Motus tags (Gilbert et al. 2022). The tagged birds are detected by a network of land-based receiving stations operated in coordination with the Motus network. Future versions of SCRAM will be updated with new tracking data as it becomes available, but the current version of SCRAM applied to the BA and this Opinion is informed by a fixed number of Motus tag detections that were collected from 2015 to 2017 for piping plovers, and in 2016 for rufa red knots.

SCRAM estimates monthly collision risk for those months when the species-specific tracking data were collected, and these monthly collision estimates are summed to produce annual collision estimates reflecting the months evaluated (Adams et al. 2022). We note that SCRAM currently evaluates collision risk only for those months with movement data from Motus which, in turn, is limited by 1) tag battery life; 2) temporary tag attachment method/duration (i.e., to minimize risks to tagged individuals); 3) locations of tag deployment; and 4) the detection range of land-based Motus stations (typically less than 12 mi [20 km]), which during the study periods were unevenly distributed along the U.S. Atlantic Coast, with core station coverage at coastal sites from Massachusetts to Virginia.

The Service appreciates the BOEM's past and ongoing support for the development of SCRAM. We continue to support the development and refinement of SCRAM as a scientifically sound predictive method for integrating best available information to assess collision risk for these two listed birds. However, the first version of SCRAM was only released in early 2023 and still reflects a number of consequential gaps and uncertainties. In addition to the limited data available to inform the model parameters, discussed above, there has also been limited validation of the model, resulting in substantial uncertainty in the results (Adams et al. 2022). Specific gaps and uncertainties of concern include:

Sample size. The tracking data sample sizes are relatively small, and do not include all tracks now available (e.g., newer Motus data; any satellite, GPS, or geolocator data).

Accuracy. All of the flight tracks and altitudes are estimated from land-based receiving stations. This results in limited accuracy because offshore bird movements were interpolated rather than measured directly. Model evaluation using a simulated data set suggest that the interpolations are reasonably accurate nearshore (where the vast majority of the Motus stations are located) but less accurate farther offshore. Even in nearshore areas, movement estimates are biased by the detection range. Estimates of flight altitude from Motus data are currently coarse approximations (Adams et al. 2022).

Detection range. The detection range of Motus receiving stations varies with altitude of the tagged bird, but is typically less than 12 mi (20 km) on average for birds in flight. Both EW1 and EW2 are at least 14 mi from the Long Island shoreline. Thus, there were likely gaps in coverage of the Empire Wind Lease Area that could lead to underestimates of collision risk.

Temporal gaps. Both movement and flight height data are currently limited to those times of year during which the tracking studies were carried out (Adams et al. 2022). There are no spring data for piping plover or rufa red knot in SCRAM due to small sample sizes of available data (e.g., only two northbound piping plovers tagged in the Bahamas with tracks in the U.S.) and limited tagging locations (e.g., most rufa red knots tagged in spring were in Delaware Bay). Any collision estimates from SCRAM are limited to the time periods listed below. Thus, "annual" SCRAM outputs should be considered only partial estimates of projected collision levels because they reflect summing across only those months for which data are available.

Piping plovers:

- Collision risk evaluated: mid-incubation period and through fall migratory departure from tagging sites
- Collision risk NOT evaluated: latter portion of fall migratory flights, spring migration and staging.

Red knots:

- Collision risk evaluated: fall migratory departure from tagging sites
- Collision risk NOT evaluated: latter portion of fall migratory flights, spring migration and staging

Spatial bias. SCRAM assumes that the movement models represent bird airspace use in an unbiased manner. However, it is likely that collision risk outputs from SCRAM are biased by the proximity of a lease area to the locations of Motus tag deployment and/or its location relative to the distribution of land-based receiving stations during the tracking study periods (Lamb et al. 2022). As Motus stations are unequally distributed on the landscape, and different numbers of Motus stations were operated each year of the tracking study, the locations of each year's Motus stations inevitably bias resulting estimates of bird use of the offshore airspace (Adams et al. 2022). Thus, SCRAM could underestimate collision risk for projects more distant from the tagging areas or more distant from those receiving stations that were in operation during the study periods.

Bias in tagged birds. Both movement and flight height data are currently limited to those specific tagged populations tracked during the study periods (Adams et al. 2022). It is not yet clear if the bird tracks that underpin the current version of SCRAM are representative of all piping plovers and rufa red knots utilizing the offshore airspace. Even within the seasons/regions for which tracks are available and incorporated into SCRAM, these tracks represent birds from a relatively small number of sites at which tagging took place. For example, the tracks informing SCRAM for piping plover were all derived from Motus tag deployment at just two nesting areas in New England. No tracks derived from the NY-NJ Recovery Unit, or the Atlantic (Eastern) Canada portion of the piping plover breeding range, which is part of the taxon listed under the ESA and fully protected when they are in the U.S, are not yet available. Preliminary results from a previous mark/resight study found that 42 percent of piping plovers marked in Atlantic (Eastern) Canada were subsequently detected in New Jersey and 52 percent were detected in North Carolina (Rock pers comm. 2023). These Canadian nesters could have significant exposure to offshore wind that is not yet reflected in SCRAM collision risk estimates. Rufa red knot trapping sites covered a greater geographic area but may still not be fully representative of the overall population's use of the offshore airspace.

Variability. SCRAM cannot yet produce a range of plausible risk levels by varying certain "baked in" assumptions (e.g., avoidance rate, population size, flight height) to which the model might be quite sensitive, and which are associated with high uncertainty.

We appreciate the BOEM's cooperative efforts to work with the Service on the development of SCRAM with the goal of reducing uncertainty around collision risk estimates (see provisions in the project description for continued model development in Section IV of the Opinion). We expect that many of the limitations of SCRAM will decrease substantially over time as Motus tags are deployed in more areas, as receiving stations are deployed offshore, and/or as new tracking technologies become available.

In spite of the limitations of the SCRAM model and the high level of uncertainty in its results, we conclude that SCRAM outputs provide the best estimates of mortality at this time, as the model estimates are a quantitative measure that the Service and the BOEM can jointly adopt and work to refine through addressing limitations and data gaps in the variables that underpin the model calculations. This is preferable to the Service unilaterally applying a corrective factor to the model results to derive an estimate of collision mortality. Our adopted approach is supported by the current efforts of the Service along with the offshore wind power community and the BOEM to work on refining the models and addressing specific data gaps.

Methods for Estimating Numbers of Collisions

In light of the high uncertainty associated with both Band (2012) and SCRAM, as discussed above, we used collision projections from both models. For SCRAM, we relied on the March 28, 2023, addendum to the BA (BOEM 2023) in which the BOEM presents the outputs from SCRAM version 1.0.3. As noted above, SCRAM uses estimated flight paths and altitudes of tagged birds, combined with monthly population size estimates, to assess exposure of each species to the RSZ (that area of air space through which the rotors revolve). Compared to Band (2012), SCRAM uses the monthly population estimates in a different way. SCRAM uses movement modeling derived from Motus tracking data to determine monthly occupancy rates within half degree grid cells and then links those values to monthly population estimates to estimate species density across the Atlantic OCS where tracking data were available. SCRAM uses these density estimates at specific flight heights (data also derived from Motus tracking) along with other species and site characteristics (e.g., species-specific flight speeds and number of turbines in a specified turbine array) to estimate collision risk for locations across a portion of the Atlantic OCS where tracking data were available (Adams et al. 2022).

For Band (2012) we input WTG specifications provided by the BOEM (Bigger pers. comm. 2023), and we utilized the same species-specific flight height distributions (i.e., derived from Motus radio tracking data) as are used in SCRAM (Adams et al. 2022). We followed the guidance from Band (2012) to develop a best estimate, not a "worst case" scenario. For red knots and piping plovers, we used Annex 6 – Assessing collision risks for birds on migration. We expect piping plovers in the action area to be limited to birds on migration flights. However, for rufa red knots, use of Annex 6 means omitting from the Band (2012) analysis birds that may be seasonally resident in the mid-Atlantic and present in the action area on non-migration flights (i.e., regional movements for knots). Although Annex 6 is unable to account for seasonally resident birds, we selected it for the following reasons: (1) Stage B of the Band (2012) basic model (i.e., for resident birds) requires an estimate of observed bird density on an area basis, and this information is unavailable for any of the listed bird species in the vicinity of the EW1 and EW2 Lease Area during any month; and (2) far greater numbers of migrating knots and terns are present on the mid-Atlantic OCS compared to seasonally resident birds. Thus, we conclude that Annex 6 is the most appropriate application of the Band (2012) model for the EW1 and EW2 projects. However, we note that if and when seasonally resident knots or terns occur offshore, they may spend more time in the action area, and at different flight heights, compared to migrants, and this represents an additional source of collision risk that is not reflected in the Band (2012) outputs presented below.

Under Annex 6, Band (2012) makes the following assumptions:

1. the entire bird population uses a migratory corridor twice each year;
2. the birds are evenly distributed across a migration corridor; and
3. the width of the corridor can be measured at the latitude of the wind farm (i.e., this "migratory front" is an imaginary line passing through the EW1 and EW2 Lease Area and extends to the western and eastern edges of the migratory corridor used by each species).

Regarding assumption 1, we conclude that it generally holds true that piping plovers cross the migration front only twice per year. However, we know from tracking and resighting data that rufa red knots may engage in reverse migration over regional geographic scales in pursuit of favorable food and other stopover conditions (USFWS 2014). Thus, an unknown number of migrating rufa red knots violate this assumption by crossing the migration front more than twice per year. Regarding assumption 2, we conclude from tracking data that that piping plovers and rufa red knots are not evenly distributed across their respective migration corridors. However, we still find it necessary and appropriate to consider Band (2012) outputs given the known gaps in SCRAM.

We used best available tracking and other data (including range maps) to inform the delineation of the migration corridors as shown in section VIII (A) of the Opinion. For piping plover, the corridor was based on radio tracking data for birds departing from Chatham, Massachusetts, several sites in Rhode Island (Loring et al. 2020b, figures 5 and 6), and the known wintering distribution of the Atlantic Coast population (Blanco 2012, Elliott-Smith et al. 2015, Gratto-Trevor et al. 2016, Elliot-Smith and Haig 2020).

For rufa red knot, we delineated a migration corridor based on geolocator tracking data collected from 93 individual birds (with tags deployed across the species range) between 2009 and 2017 (Perkins 2023). The corridor encompasses all rufa red knot geolocator tracks except those that are clearly associated with the Western recovery unit. A considerable number of satellite/GPS tracking devices have been deployed on rufa red knots since 2020. Preliminary data from these satellite tags were evaluated but ultimately not utilized in delineating the migration corridor because the data are still undergoing quality control and, in many cases, metadata is not yet available. Although not relied upon for this mapping exercise, the preliminary satellite data do show broadly similar geographic patterns to the geolocator data and lend confidence to our delineation of the migration corridor.

The final input required to run Band (2012), Annex 6, is the number of birds crossing the migration front each month. Table 4 presents the population data we used for this purpose. All monthly numbers were multiplied by 35 to estimate number of collisions over the operational life of the EW1 and EW2 projects.

Table 4. Population data inputs to Band (2012), Annex 6

	Piping Plover	Rufa Red Knot
Total northbound (NB)	3,771	59,269
Young of the year (YOY)	2,448	27,041
Total southbound (SB)	6,259	86,310
# of Jan crossings	0	0
# of Feb crossings	0	0
# of Mar crossings	378 (10% of NB)	0
# of Apr crossings	2,261 (60% of NB)	0
# of May crossings	1,132 (30% of NB)	59,269 (100% of NB)
# of Jun crossings	629 (10% of SB)	2,371 (3% of SB)
# of Jul crossings	3,752 (60% of SB)	7,009 (8% of SB)
# of Aug crossings	1,878 (30% of SB)	25,893 (30% of SB)
# of Sep crossings	0	25,893 (30% of SB)
# of Oct crossings	0	15,651 (18% of SB)
# of Nov crossings	0	8,631 (10% of SB)
# of Dec crossings	0	863 (1% of SB)

Table 4 Notes:

Piping Plover:

(1) Population data are from 2021 (USFWS 2021a) and exclude an unknown (but likely small) number of nonbreeding birds.
(2) The Southern recovery unit population is excluded.
(3) The SB total includes YOY, calculated as the unweighted mean 20-year productivity rates (2002 - 2021) times the 2021 breeding pair estimate for each state within the Atlantic (Eastern) Canada, New England, and NY-NJ recovery units.
(4) The eastern edge of the migration corridor runs southwest parallel to the general orientation of the coast to account for major migration staging areas in North Carolina. The eastern edge of the corridor south of Cape Hatteras is also constrained westward to account for much larger numbers of piping plovers wintering in the western Bahamas (however, this has no effect on the width of the corridor at the latitude of the EW1 and EW2 Lease Area).

<u>Rufa Red Knot</u>

(1) Population data are from Table 2, above.
(2) Birds from the Western recovery unit population are sometimes documented on the Atlantic coast. However, available tracking and resighting data show that the prevailing migration corridor for these birds is overland across the mid-continent (Perkins 2023, USFWS 2021b, USFWS 2014). On this basis, birds from the Western recovery unit are excluded from this analysis.
(3) In many years, a percentage of northbound birds do not depart the mid-Atlantic until early June. But for the purposes of this analysis, we attribute them all to May.
(4) Some juveniles and nonbreeding adults remain south of the migration front, others cross the migration front once in spring and spend the breeding season just south of the breeding grounds, while still others may remain resident in the mid-Atlantic for prolonged periods and may cross the migration front multiple times. We have no estimate of the total number of nonbreeding adults in a typical year, or their distribution across the species nonbreeding range. However, we do estimate the total number of juveniles. Modeling by Schwarzer (2011) found that the Florida population was stable at around 8.75 percent juveniles among wintering birds, and available data suggest the three populations considered in this analysis are currently stable (USFWS 2021b). Thus, we assume 8.75 percent of the total wintering birds are juveniles (i.e., of the 59,269 total birds, we assume 5,186 are juveniles.) We have little information on the distribution of juveniles across the species' range during any month. In light of data gaps, we assume all breeding adults, nonbreeding adults, and juveniles cross the migration front twice per year.
(5) The SB total includes YOY, calculated as 1 chick per pair. Number of pairs is calculated as [the total wintering population (59,269) minus juveniles (5,186)] divided by 2. We have no way to estimate nonbreeding adults, so we include them with breeding adults, then attempt to compensate by using a reproductive rate of 1 chick per pair, below the range estimated by Wilson and Morrison (2018) as needed for a stable population.

Analysis of Model Outputs and Projected Numbers of Collisions

The complete SCRAM (Gilbert et al. 2022) and Band (2012) output reports are on file in the Long Island Field Office and summary information is presented in Tables 5 and 6. As previously discussed in this Opinion, these estimates are associated with very high uncertainty.

Table 5. Estimated numbers of collisions over 35 Years of WTG operation as projected by two different collision risk models (SCRAM 95 percent prediction interval; 92.9 percent avoidance rate).

	Piping Plover			Rufa Red Knot		
Timeframe	**Mean**	**Lower**	**Upper**	**Mean**	**Lower**	**Upper**
Annual	0.05	0.01	0.19	1.05	0.53	2.03
Operational (over 35 years)	1.76	0.41	6.62	36.75	18.69	71.05

Table 6. Band (2012) model results generated by the Service, showing turbine mortality estimates over 35 years using 92.97 and 98 percent avoidance rates.

Piping Plover (35 years)		Rufa Red Knot (35 years)	
92.97%	**98%**	**92.97%**	**98%**
18	5	60	17

SCRAM uses only one avoidance rate (0.929) for the red knot and piping plover (Adams et al. 2022). Collision risk models are sensitive to the selection of avoidance rates (Chamberlain et al. 2006, Robinson-Willmott et al. 2013, Gordon and Nations 2016, Masden and Cook 2016, Kleyheeg-Hartman et al. 2018). We are not aware of any empirical, species-specific avoidance rates available for piping plovers or rufa red knots. The selection of 0.929 for use in SCRAM was based on a review of available literature for gulls and terns in Europe (Cook 2021), as we are unaware of any empirical avoidance rates specific to other shorebirds that may be applicable to this modelling simulation. Cook (2021) presents avoidance rates for three tern species for use in the extended Band (2012) model, ranging from 85 to 99 percent. We used the average of this range, 92.9 percent, in the SCRAM model.

In addition to the lack of species-specific empirical data, we note that blanket application of any avoidance rate does not account for differences among individual birds; acclimation to the wind farm; flocking behavior; flight height or type (e.g., foraging, migratory, regional transit); weather conditions or visibility; time of day; and any behavioral influence of the wind farm on the bird (e.g., displacement, attraction) (May 2015, Gordon and Nations 2016, Masden and Cook 2016, Marques et al. 2021). In light of the sensitivity and uncertainty around this parameter, we consider a range of avoidance rates, consistent with the recommendation of Band (2012). The Service considered a full range of Band (2012) outputs with avoidance rates of 92.97, 98, 99, and 99.5 percent. However, based on the best available science, we primarily consider the 92.97 and 98 percent avoidance rates in our analysis (Band 2012, Gordon and Nations 2016, Kleyheeg-Hartman et al. 2018, Scottish National Heritage 2018, Cook 2021, Adams et al. 2022).

The collision estimates presented in Tables 5 and 6 do not account for any attraction of listed birds to the action area by marine navigation lighting. Studying passerines migrating over the German Wadden Sea, Rebke et al. (2019) found that nocturnally migrating birds at sea were generally attracted by a single light source, and that even relatively weak sources of light (compared to others in the distant surroundings) attract nocturnal migrants flying over the sea. Based on the range of the microphones used to record bird calls in this study, the authors concluded that attraction of birds leads them close to the sources of light. The results of this study are consistent with the body of literature showing generally stronger avian attraction to artificial light during nights with cloud cover. In this study, no light variant (e.g., color) was constantly avoided by nocturnally migrating passerines crossing the sea. While intensity did not influence the number attracted, birds were drawn more towards continuous than towards blinking illumination, when stars were not visible. Continuous green, blue and white light attracted significantly more birds than continuous red light in overcast situations (Rebke et al. 2019). The applicability of this study to shorebirds and terns is not yet clear. Section III of the Opinion is part of the project description and ensures future reassessment of collision projections for listed birds following approval of the maritime navigation lighting plan by the USCG.

Piping Plover

Tables 5 and 6 present estimates of 1.76 (95 percent prediction interval 0.4 to 6.6) piping plover collisions (SCRAM; Gilbert et al. 2022) and 5 (98 percent avoidance rate) or 18 (92.97 percent avoidance rate) piping plover collisions (Band 2012) over the 35-year life of the EW1 and EW2 projects, respectively. The SCRAM estimates are likely too low based on the lack of spring data, the limited detection range of land-based receivers, and the limited tag deployment sites that were restricted to only one of the three recovery units covered in this Opinion.

We know of no studies of avoidance behaviors for any shorebird species, and hence we believe that the 92.97 percent estimate recommended by Cook (2021) is the best available estimate for piping plovers. We recognize several factors suggesting the possibility of a piping plover avoidance rate greater than 92.97 percent. First, unlike the species studied by Cook (2021), piping plovers are not pelagic feeders. Hence, they will not be distracted by foraging activities during migration. Second, there is evidence of good nocturnal vision inferred by nocturnal foraging behavior (Staine and Burger 1994, Stantial and Cohen 2022) and nocturnal flights during the breeding season (Sherfy et al. 2012). Charadriidae (plovers) have specialized visual receptors and are known to possess excellent visual acuity with the ability to routinely forage during poor light conditions (del Hoyo et al. 2011). Third, agility of adult plovers has been observed in distraction displays, including abrupt flights to escape potential predators during broken-wing displays (Hecht pers. comm. 2023). Finally, Loring et al. (2020b) found that visibility was high during their sample of southbound offshore piping plover flights (mean: 11 mi [18 km], range: 9 to 12 mi [14 to 20 km]). Loring et al. (2020b) shows a range of southward migratory departure times and dates from Massachusetts and Rhode Island. Birds that departed on the same day often had variable flight durations to cover the similar distances. This information is consistent with informal observations of staggered arrivals and departures during both northward and southward migration and, in turn, reduces concerns that a large proportion of the plover population could simultaneously encounter weather conditions (e.g., dense fog) that would impair visibility, exerting a large effect on the average avoidance rate (Hecht pers. comm. 2023). Countervailing information, however, includes data from 2 birds tagged in the Bahamas and tracked during their northbound offshore flights that included periods of low visibility and precipitation (Loring et al. 2019, Appendix I). It is also uncertain whether agility of flights and the plovers' attention to visual cues observed on land extend to their behaviors during offshore migratory flights.

Rufa Red Knot

Tables 5 and 6 present estimates of 36.75 (95 percent prediction interval 18.69 to 71.05) rufa red knot collisions (SCRAM; Gilbert et al. 2022) and 17 (98 percent avoidance rate) or 60 (92.97 percent avoidance rate) rufa red knot collisions (Band 2012) over the 35-year life of the EW1 and EW2 projects, respectively. Several factors suggest collision rates on the higher end of this range:

- Data gaps bias SCRAM to underestimate collision, (e.g., lack of spring data, limited deployment areas, limited detection range of land-based receivers).
- The Band (2012) estimates consider only two migration flights per bird per year, omitting regional flights over the OCS which are known to occur with some regularity. This would cause underestimation of collision risk.
- Gordon and Nations (2016) used an avoidance rate of 93 percent in good weather and 75 percent in poor weather. As discussed above, rufa red knot migration flights are typically associated

with fair weather (Loring et al. 2018), but birds have been known to encounter storms on their long flights (Niles et al. 2010, Niles 2014).

However, other factors suggest collision rates on the lower end of the range:

- While Band (2012) assumes even distribution of birds across the migration front, SCRAM accounts for the known spatial heterogeneity in rufa red knot tracks.
- While Band (2012) assumes each bird crosses the migration front twice each year, SCRAM accounts for regional flights by seasonally resident birds, as it is informed by the full data set reported by Loring et al. (2018).
- Although important gaps still need to be addressed in the radio tracking data underpinning SCRAM, the sample sizes and distribution of tagging locations are far more robust for rufa red knots than for the piping plovers, lending more weight to the SCRAM estimates.
- The lack of spring data in SCRAM is less consequential for rufa red knots than for the piping plover, because a substantial fraction of birds is known to fly overland in spring from the Atlantic Coast (Florida to Delaware Bay) directly to Hudson Bay in Canada.

APPENDIX B _

SCRAM and Band (2012) Model Results

March 28, 2023

Addendum to the Empire Wind Biological Assessment to USFWS

Pursuant to Section 7(a)(2) of the Endangered Species Act (ESA) of 1973, on November 18, 2022, the Bureau of Ocean Energy Management (BOEM) requested formal consultation with the U.S. Fish and Wildlife Service (USFWS) regarding species that may be affected by the approval of a Construction and Operations Plan (COP) for the for the Empire Wind project, a commercial wind energy facility located within BOEM's OCS-A 0512 Lease Area offshore New York.

Since the submission of the Biological Assessment (BA), the Stochastic Collision Risk Assessment for Movement (SCRAM) model was very recently updated. In addition, BOEM received some information from the lessee regarding the width of the air gap between the lower tip of the blade to the surface of the water. BOEM then re-ran the SCRAM model for the piping plover, red knot, and roseate tern with the updated information. Tables 1 and 2 summarize the results of the runs. The model input file and SCRAM reports are provided as attachments to the email that transmitted this addendum.

SCRAM predicted that the annual probability of a collision for piping plover and roseate terns as extremely low <0.001 (Table 1) suggesting that collision with turbines was very unlikely. However, for red knot, SCRAM predicted that the annual probability of a collision was 0.572 (Table 1) suggesting that collision with turbines was likely, and SCRAM also predicted that the average annual number of collisions was 1 (Table 1). Not surprisingly, the probability of a collision event during the 35-year operational period is also very likely 1.00 for red knot (Table 2). The average number of collisions were less than one for roseate terns but not for the piping plover and red knot (Table 2).

However, the estimated number of Red Knot collisions are very likely biased high for a couple reasons: 1) SCRAM uses Red Knot population sizes that is larger than the number of birds that are likely to be transiting waters near the US Atlantic offshore leases during fall migration. A recent study found that 81% (118 out 146) of the red knots fitted with radio transmitters could transit the US Atlantic region where offshore leases are located during fall migration (Loring et al. 2020); this suggests that the fall population sizes used in SCRAM are likely biased high by 19 precent. 2) SCRAM uses population sizes and movement data to estimate the number of birds within a 50km x 50 km gird cell containing the project. In some grid cells, the modeled estimate of the number of birds can be very large. For example, in a grid cell for another project, the estimated number of birds during September exceeds the population size of 72,250 by more than 10,000 animals, thus leading to wildly inflated estimates of collisions. The grid cell that contains Empire Wind is estimated to have 1,668 birds in November out of a November population size of 41,400. For these reasons, BOEM believes that the estimated number of red knot collisions are likely biased high and should be interpreted not as absolutes but as a relative number of collisions.

Based on the updated SCRAM model, BOEM's determinations in the BA (November 18, 2022) for roseate terns remain the same where the Proposed Action would not likely to adversely affect roseate terns. However, BOEM has revised its previous determination of not likely to adversely affect for the piping plover and red knot and has now determined that the Proposed Action is likely to adversely affect piping plover and red knot.

Table 1. Annual model outputs. Values greater than one are in bold.

Species	SCRAM Probability of collision [a]	SCRAM Collisions (95% Prediction Interval) [b]
Piping Plover	< 0.001	0.050(0.012-0.189)
Red Knot	0.572	**1.05** (0.534-2.03)
Roseate Tern	< 0.001	0.000 (0.000-0.000)

[a] SCRAM report, SCRAM run details, p. 2
[b] SCRAM report, Table 9

Table 2. Life of project (35 years) - Extrapolated from model outputs. Values greater than one are in bold.

Species	Probability of collision [a]	Collisions (95% Prediction Interval) [b]
Piping Plover	0.034	**1.8** (0.4-6.6)
Red Knot	1.000	**36.8** (18.7-71.1)
Roseate Tern	0.034	0.0 (0.0-0.0)

[a] $\text{Probability}_{\text{life}} = 1-(1-\text{Probability}_{\text{annual}})^{\text{Years}}$
[b] $\text{Collisions}_{\text{life}} = \text{Collisions}_{\text{annual}} \times \text{Years}$