Avian Risk Assessment for the Heritage Wind Project

Town of Barre, Orleans County, New York State

Case No. 16-F-0546

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Executive Summary

An avian risk assessment was conducted on behalf of Heritage Wind, LLC (the Applicant) for the proposed Heritage Wind Project (the Facility) in the Town of Barre, Orleans County, New York. The Facility will consist of up to 33 turbines, each having a nameplate capacity of 5.6 megawatts (MW) for a total nameplate capacity of approximately 184.8 MW. Turbines would be primarily located in tilled (corn and soy) and untilled (hay and pasture) agricultural fields, which account for 60% of the Facility Area (the area of land within which all Facility components will ultimately be located; corresponds with the Town of Barre boundary). Based on the model currently under consideration, each turbine would consist of a 125 m (410-foot) tower on which a 162 m (531-foot) diameter rotor would be mounted. The maximum height above ground to the tip of the rotor would be 206 m (676 feet) and the rotor swept height would extend 44 m to 206 m (144 to 676 feet) above ground level. The Facility would also include access roads, an electrical collection substation, an adjacent point of interconnection substation, underground collection lines, two permanent, unguyed meteorological towers about 120 m (394 feet) in height with Aircraft Detection Lighting System (ADLS), a small operations and maintenance (O&M) building, and a laydown area for staging equipment and materials. Turbines would be spaced at an average distance of 2,890 feet (0.55 miles, 881 m) and would be equipped with red flashing L-864 type FAA lights for aviation safety. FAA lights would be controlled by an ADLS and turned on only when the system's radar detects approaching aircraft. Lights at the substations would be illuminated only when maintenance workers are present, consistent with Avian Power-Line Interaction Committee (APLIC) 2012 guidance.

Objective

The objective of this risk assessment is to determine the potential for avian displacement/disturbance, collision fatality, and habitat impacts that could occur as a result of the proposed Facility. Three sources of information were used in this risk assessment:

1) Ten site specific preconstruction field studies were conducted to determine the species and abundance of birds using the Facility Area during the breeding, migration, and wintering seasons. These studies were conducted from 2016 to2018 by Ecology and Environment, Inc. The methods used complied with the New York State Department of Environmental Conservation (NYSDEC) 2016 guidelines and the United States Fish and Wildlife Service (USFWS) 2012 Land-Based Wind Energy Guidelines and 2013 Eagle Conservation Plan Guidance for wind projects and were developed in consultation with NYSDEC. These studies were relied upon to determine the potential for collision fatalities and displacement/disturbance of avian species occurring within the Facility Area.

2) Empirical fatality studies from more than 170 wind energy sites across the United States and Canada were examined, as well as specific studies from Ontario and New York State (NYS), the geographic region in which the Facility is located. A total of more than 76 studies from farm and nonfarm habitats in the Ontario and NYS region were used in this risk assessment. These studies were reviewed and used to determine potential collision risk at the Facility Area.
3) In addition to the site-specific preconstruction field studies, the NYSDEC and USFWS were consulted for information regarding the potential presence of endangered and threatened species at the Facility Area. Responses from the NYS Natural Heritage Program (NHP) and USFWS Ecological Services Field Office were received on April 22 and March 26, 2019, respectively.

Overview

Habitat loss is likely to be minor because the majority of turbines and most infrastructure would be in agricultural fields that are either actively tilled and/or mowed. The mechanical process of tilling/plowing or mowing has already eliminated habitat suitable for successful nesting and foraging for many open country/grassland nesting species in the Facility Area. In addition, very little forest clearing will be required for this project and therefore much of the on-site forested habitat will remain untouched.

Indirect impacts (i.e., displacement/disturbance) are anticipated to be similar to the results of studies in agricultural and grassland habitats in NYS, Texas, Minnesota, and South Dakota. Those studies found displacement was generally limited to within the first 75-100 m of turbines and resulted in slightly fewer birds such as Bobolink after construction. In addition, some species were not impacted at all, and others were actually attracted to the areas around the turbines. Waterbirds of some species are known to be displaced by turbines in foraging areas that are in farm fields. However, these impacts are likely to be minor and not significant because the turbines occupy such a small proportion of these fields and waterfowl often habituate to human structures. Other species such as raptors do not appear to be displaced by turbines situated in tilled and untilled farmland. Overall, only a very small percentage of farm fields and the birds that use them will experience displacement, and these same fields will continue to be available for birds to feed and rest after the Facility is built. The Facility will pose no greater risk than current farming practices on site.

Direct impacts to avian species, as a result of collisions with turbines, are also expected to be minimal. The post-construction fatality studies conducted across the continent during the past 20 years have demonstrated that avian fatalities at wind energy facilities have been minimal and without significant impacts to populations of North American birds. More specifically, the 75 fatality studies from Ontario and NYS, the geographic region in which the Facility is proposed, have found that fatalities have averaged roughly 1 to 3 fatalities per megawatt and about 6 to 8 fatalities per turbine per year (particularly for those in farmlands). However, turbine height at the Facility will be roughly 200 m, or about 50-75 m taller than existing operational wind turbines in NYS, which may potentially lead to slightly greater fatality rates per turbine for some night migrating songbirds. On the other hand, fewer turbines are planned at the Facility (n = 33), which will present fewer obstacles/areas for possible collisions than at wind energy facilities that have considerably more turbines. It is also anticipated that any collision impacts to birds will be spread over multiple species and will not result in significant impacts to populations of any individual species.

With respect to eagles, risk to Golden Eagles is nil with no fatalities expected because none was seen during preconstruction studies. For Bald Eagles, risk is analyzed in a separate Appendix and was determined to be nil as well.

Using the results of previous post-construction fatality studies from Ontario and NYS, as well as the data collected for each of these species on site, risk was determined to be very low for all species, including state-listed endangered or threatened species, and not biologically significant to any species from a population perspective.

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Introduction

Heritage Wind, LLC (the Applicant) is planning to construct and operate the Heritage Wind Project in the Town of Barre, Orleans County, New York (hereafter, the Facility). To date, 10 on-site studies of the bird communities within the Facility Area have been conducted by an independent consulting firm to determine the species and numbers of birds that use the site on a year-round basis. The studies were conducted in compliance with the New York State Department of Environmental Conservation (NYSDEC) 2016 wind energy development guidelines and the United States Fish and Wildlife Service (USFWS) Wind Energy Guidelines and Eagle Conservation Plan Guidance (USFWS, 2012 and 2013).

An integral part of the wind energy permitting process is the evaluation of potential risk to birds resulting from the construction and operation of turbines and other infrastructure at a particular project site (National Academy of Science 2007). Risk assessments are completed to provide the developer, state and federal agencies, and other stakeholders with information regarding potential impacts to birds when a project is being proposed, thus facilitating decision making by these entities. This report details an avian risk assessment that was performed for the Heritage Wind Project.

The specific objectives of this avian risk assessment report are to evaluate the following types of impacts to species in the avian community at the Facility Area:

1) The removal and/or alteration of existing habitat;
2) Behavioral displacement/disturbance (indirect impact) of birds as a result of the presence of turbines and other infrastructure; and,
3) Fatalities (direct impact) of birds resulting from collisions with turbines or other infrastructure on site.

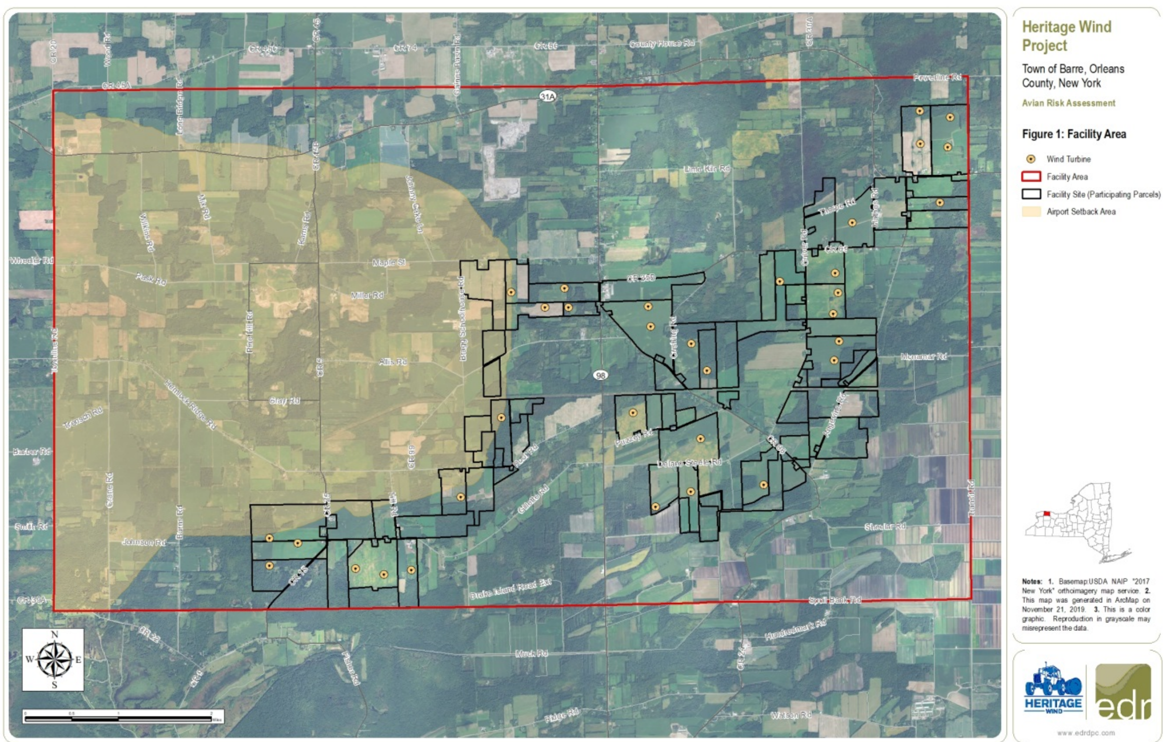
Facility Description

The Facility is a proposed 184.8-MW (maximum) wind farm in the Town of Barre, Orleans County, New York (Figure 1). The Facility will consist of up to 33 turbines, each with a nameplate capacity of 5.6 MW. Based on the current model under consideration the turbines are likely to have a 162 m (531-foot) rotor diameter set on towers 125 m (410 feet) in height. The maximum blade tip height above ground level (AGL) would be 206 m (676 feet). The rotor swept height would extend from 44 m to 206 m (144 to 676 feet) AGL.

The Facility would also include access roads, an electrical collection substation, an adjacent point of interconnection substation, underground collection lines, two permanent meteorological towers, a small O&M building, and a laydown area for staging construction equipment and materials. The meteorological towers would be unguyed and about 120 m in height (394 feet).

The turbines and meteorology tower would be equipped with red flashing L-864 type FAA lights for aviation safety, although the lights would not be illuminated unless aircraft are proximal to the turbines. The Aviation Detection Lighting System (ADLS) would be controlled by radar that detects aircraft, thereby turning lights on for only brief periods during the night. Lights on the electrical substations would be controlled via switch or motion detectors, and otherwise would be unlit. These lighting measures are especially helpful for reducing risk to birds and is consistent with recommendations of USFWS (2012) and the Avian Power Line Interaction Committee (APLIC 2012 chaired by USFWS) guidance document.

Figure 1. Map of the Facility Area, Town of Barre, Orleans County, New York. Provided by the Applicant. The light shaded area west of Facility is the Airport Setback Area.



Habitat Assessment

Habitat within the Facility Area (the area of land within which all Facility components will ultimately be located, which corresponds with the Town of Barre boundaries) consists of agricultural lands (~60%), forest (~33%); wetland and upland), some open wetlands (1.7%), as well as residential dwellings, and roads (see Ecology and Environment studies summarized in Table 1). Tilled row crops account for approximately 42.7% of the Facility Area, consisting mostly of corn and some soybeans. An additional 17.3% of the Facility Area is hay (mowed about three times per year) and pasture. Mixed areas of brush and patches of trees, hedge rows, and other habitat are present, but account for less than 5% of the Facility Area. Twenty-five of the turbines would be located in tilled farm fields, whereas seven would be in forested sites and one in scrub-shrub. Forest clearing is anticipated to total 52.9 acres, which represents 10% percent of the Facility Area.

Habitat loss is expected to be minor because the majority (25 of 33, 75.8%) of turbines and most infrastructure would be in agricultural fields that are actively tilled or mowed. The mechanical process of tilling/plowing or mowing has already eliminated habitat suitable for successful nesting and foraging for most open country/grassland nesting species in the Facility Area. The wildlife concentration areas located outside of the Facility present much more suitable habitat for avian species than the Facility Area. Potential wildlife concentration areas are discussed in more detail below.

Facility components have been sited to avoid and minimize impacts to undisturbed habitat and only approximately 36 acres of potential habitat will be permanently lost to built facilities. In addition, cutting of trees will be done during seasons in which birds are not nesting.

Incidental mortality resulting from construction vehicles and traffic within the Facility is expected to be very low to non-existent and certainly not biologically significant. The rationale for this statement is related to the slower speed of construction vehicles as compared to paved highways where fatalities of birds is greater. Birds can easily avoid collisions of slow-moving vehicles. After construction, traffic will be minimal, and impacts are not expected.

Airport Setback Area

An area within the Facility Area referred to as the "Airport Setback Area" (Figure 1) consists of a small airport (Pine Hill Airport) and a buffer surrounding the airport. This area, consisting mostly of farmland and patches or strips of forest, occupies nearly one-third of the Facility Area. No turbines will be within the Airport Setback Area, although turbines will be located near the boundaries of this Area.

Wildlife Concentration Areas

There are no wildlife concentration areas within the Facility Area, but there are two state wildlife management areas and one national wildlife refuge located within 10 miles of the nearest proposed turbine. The eastern boundary of the Iroquois National Wildlife Refuge (INWR), managed by the USFWS, is located more than 2 miles to the southwest of the closest turbine. The remaining turbines would be more than 3 miles from the INWR boundary. The INWR serves as a nesting, feeding, staging, and resting area, particularly for migrating waterfowl, although there are large upland holdings that include forest, grassland, and other habitats that support an abundant bird community, including NYS listed species and species of concern. The refuge is heavily used by waterfowl during migration and Bald Eagles actively nest and forage within the refuge. It is also a multi-use refuge with deer and waterfowl hunting permitted, as well as fishing and trapping.

The Oak Orchard Wildlife Management Area (OOWMA), a NYSDEC managed area, is located more than 1 mile southwest of the closest turbine and more than 2 miles from the next closest turbine. Wildlife species using this management area are similar to those found in INWR. Hunting, fishing, and trapping are permitted activities. The Tonawanda Wildlife Management Area (TWMA), also managed by the NYSDEC, is located more than 5 miles west of the westernmost turbine at the Facility Area.

The above three wildlife areas attract large numbers of migrating waterfowl, Bald Eagles, and other birds at various times of year. They also support a very abundant and diverse nesting community. The habitat within these areas, which includes large wetland complexes, is far more diverse and attractive to wildlife, including birds, than habitat within the Facility Area.

Risk Assessment for Direct Impacts

This risk assessment for direct impacts is based on two primary sources of information. The first includes preconstruction field studies of birds nesting, migrating, and wintering at the Facility Area (Table 1). These studies were completed following the NYSDEC's *Guidelines for Conducting Bird and Bat Studies at Commercial Wind Energy Projects* (2016) and the USFWS's *Land-based Wind Energy Guidelines, Version 2* (2012), and were summarized in 10 reports to Heritage Wind, LLC during the period between 2016-2018.

The second source of information used in this avian risk assessment is a literature review of empirically demonstrated impacts, both direct (collision fatalities) and indirect (displacement/disturbance), at wind energy projects. The literature review includes both a continental and regional overview and analysis of avian fatalities at wind energy facilities. The continental scale information comes from five reports that include analyses of fatalities from nearly 170 wind projects in the U.S. and Canada (AWWI 2016). The regional analysis focuses primarily on wind energy projects in the same geographic and ecological region and with similar habitat as the Facility. For this analysis, wind projects situated in tilled and untilled farmland in Ontario, and New York State were used. Furthermore, the methodology of the continental and regional studies cited herein has been vetted by both federal and state/provincial wildlife agencies (USFWS and Environment Canada, various state wildlife agencies, Ontario Provincial agencies [Ontario Ministry of Natural Resources and Forestry, and Ontario Ministry of the Environment and Climate Change]). In addition, the results of many of these studies have been used in peer reviewed and published papers or agency reports that analyzed large numbers of fatality studies to examine how variable fatalities are among sites and what types of bird species are involved. Those data were gathered so that agencies, developers, and NGOs would have a more robust idea as to risk to birds as more wind plants are proposed.

Furthermore, the assessment of risk was focused to include the bird species that were found during preconstruction studies to occur within the Facility Area throughout the year. From that information, and from the data provided in post-construction studies that are reviewed herein, a robust assessment of likely impacts at the Facility Area was conducted.

Agency Consultation

Information regarding federal and state endangered and threatened species, as well as species of special concern, and species proposed for listing (candidate species) was obtained through consultation with the USFWS and the NHP. The USFWS responded on March 26, 2019 that there were no records of these types of bird species at or near the Facility Area. The NHP responded on April 22, 2019 and provided a list of NYS-listed endangered and threatened species as well as species of special concern known to have been recorded within 10 miles of the Facility Area. This list included two endangered species (Short-eared Owl and Black Tern) and eight threatened species (Bald Eagle, Henslow's Sparrow, King Rail, Least Bittern, Northern Harrier, Pied-billed Grebe, Sedge Wren, and Upland Sandpiper). No species of special concern were included on the NHP list. Particular attention was given to these species when reviewing the results of the two years of preconstruction studies conducted for the Facility.

Bird Studies Conducted for the Facility

In coordination with the NYSDEC and USFWS, the Applicant and Ecology and Environment, Inc. developed a study plan (2017, Table 1) for preconstruction bird studies at the Facility. The study plan and execution of studies was in compliance with the NYSDEC 2016 *Guidelines for Conducting Bird and Bat Studies at Commercial Wind Energy Projects* (NYSDEC, 2016) and the USFWS (2012) and USFWS (2013) *Eagle Conservation Plan Guidance, Module 1 – Land-based Wind Energy, Version 2.* Ten studies were conducted between 2016 and 2018 (Table 1), with most of the studies occurring during 2017 and 2018. The studies consisted of two spring breeding bird studies (2017 and 2018), two spring and one fall migratory raptor studies, two winter grassland raptor surveys (2016-2018), a raptor nesting survey (2018), and two avian use studies (2016-2018).

Table 1. Summary of preconstruction avian studies conducted for the Heritage Wind Project.

Study Type	Date(s)	Report Reference Information
Avian and Bat Study Plan	May 2017	Ecology and Environment, Inc. 2017. Avian and Bat Study Plan for the Proposed Heritage Wind Project, Orleans County, New York, May 5, 2017. Prepared for: Heritage Wind, LLC.
Winter Grassland Raptors (Year 1)	November 2016 to March 2017	Justin Zoladz. 2017. Memorandum To: Heritage Wind, LLC. 2016 – 2017 Wintering Grassland Raptor Survey. May 25, 2017.
Breeding Birds (Year 1)	May to June 2017	Justin Zoladz. 2017. Memorandum To: Heritage Wind, LLC. 2017 Breeding Bird Survey Results. September 26, 2017.
Spring Migratory Raptors (Year 1)	March to May 2017	Justin Zoladz. 2017. Memorandum To: Heritage Wind, LLC. 2017 Spring Migratory Raptor Survey Results. October 30, 2017.
Avian Use (Year 1)	December 2016 to December 2017	Ecology and Environment, Inc. 2018. Small Bird, Large Bird, and Eagle Use Survey Report for the Heritage Wind Project, Orleans County, New York. February 2018.
Fall Migratory Raptors	August to December 2017	Justin Zoladz. 2018. Memorandum To: Heritage Wind, LLC. 2017 Fall Migratory Raptor Survey Results February 15, 2018.
Winter Grassland Raptors (Year 2)	November 2017 to April 2018	Ecology and Environment, Inc. 2018. Winter Grassland Raptor Surveys for the Heritage Wind Project. Orleans County, New York. July 2018.
Raptor Nests	May 6-7, 2018	Ecology and Environment, Inc. 2018. Raptor Nest Survey Heritage Wind Farm Orleans County, New York. September 2018.
Breeding Birds (Year 2)	May to July 2018	Ecology and Environment, Inc. Breeding Bird Survey Results for the Heritage Wind Project Orleans County, New York, September 2018.

Study Type	Date(s)	Report Reference Information
Spring Migratory Raptors (Year 2)	March to May 2018	Ecology and Environment, Inc. 2018. 2018 Spring Migratory Raptor Survey Results for the Heritage Wind Project Orleans County, New York. October 2018.
Avian Use (Year 2)	December 2017 to November 2018	Ecology and Environment, Inc. 2019. Year 2 Small Bird, Large Bird, and Eagle Use Survey Report for the Heritage Wind Project, Orleans County, New York. December 2017 – November 2018.

Breeding Bird Studies. Studies were conducted in the spring/summer of 2017 (May 26-June 27) and 2018 (May 24-July 1) during the breeding season to sample birds per the NYSDEC's (2016) guidelines. Seventeen transects were sampled at proposed turbine sites in 2017, and 20 transects were sampled in 2018, with 15 being located at turbines and five being controls within the Facility Area but not near turbines. The latter sites were chosen to serve as reference (control) sites to compare with potential turbine locations. Surveys were conducted in all types of habitats representative of turbine locations.

In 2017, 87 species were observed during 2,115 sightings, with 59 species occurring within 50 m of the transects (although all were within the Facility Area). The most commonly observed species included American Goldfinch, Gray Catbird, and Red-winged Blackbird. These are mostly species of edge habitats or old field/edge habitats, although catbirds are found in a wide variety of habitats where there are trees and shrubs.

In 2018, 94 species were observed during 2,918 sightings, with 73 species seen within 50 m of the transects. The most common species included Red-winged Blackbird, American Goldfinch, Song Sparrow and Horned Lark. These are mostly species of edge habitats or old field/edge habitats, although Horned Lark is a grassland nesting species and is known to use disturbed agricultural fields for nesting.

No federally or state-listed endangered or threatened species were observed in either year of the study. Five state-listed species of special concern were observed during both years: Horned Lark, Vesper Sparrow, Cerulean Warbler, Cooper's Hawk, and Common Nighthawk. Of these, only Horned Lark, Cerulean Warbler, and Vesper Sparrow were observed during 2018. Of these species, the habitat at the turbine sites is not suitable for Cerulean Warbler and this species may have been a late migrant rather than a nesting bird. This species generally nests in tall trees in larger forests rather than in the small patches of trees and fragmented forests found at the Facility

Area. Horned Lark and Vesper Sparrow may nest on the site in grassy or tilled agricultural fields, but if they do so, a vast majority of their nests and offspring will be destroyed by hay mowing or tilling as part of typical agricultural operations (Kerlinger and Guarnaccia 2011). Suitable habitat for Cooper's Hawk can be found on site in forest patches, but for Common Nighthawk, a ground nester, there is little to no suitable or undisturbed habitat present. Any potential nests in tilled farm fields would likely be destroyed by farm equipment.

Raptor Nesting Survey – 2018. An aerial raptor nest survey was conducted from a fixed-wing aircraft to locate and evaluate the status of raptor nests within the Facility Area on May 6-7, 2018, before leaf-out. The survey was conducted by flying standard aerial transects over the study area that were spaced every 0.5 mile within a 4-mile buffer surrounding the Facility Area. In addition, the survey was extended out to 10 miles to determine if Bald Eagle nests were present within this broader area around the Facility Area. INWR is located within the western portion of the 10-mile buffer area but was not surveyed per the request of USFWS. Both the USFWS and the NYSDEC provided information regarding the locations of known bald eagle nests within the 10-mile buffer, and locations outside the INWR were observed during the aerial survey to assess current nest status.

No Bald Eagle or other raptor nests were found within the Facility Area during the spring 2018 survey (i.e., no Bald Eagle nests within the Town of Barre). Three active (occupied) Bald Eagle nests were located outside of the Facility Area. <BEGIN CONFIDENTIAL INFORMATION/> [redacted] </END CONFIDENTIAL INFORMATION> In addition to these three active nests, the USFWS and the NYSDEC identified five additional nests (three active) within the INWR (more than 4 miles outside the Facility Area). In addition, the NYSDEC provided the locations of two additional nests – one located within the TWMA more than 8 miles outside the Facility Area, and another located approximately 5 miles southeast of the Facility Area. Both of these locations were visited during the raptor nest survey and were determined to be unoccupied. The locations of bald eagle nests within 10 miles of the Facility Area can be found in Table 4-2 and Figure 4-1 of the Raptor Nesting report.

Raptor Migration Surveys 2017-2018. Three seasons of weekly raptor migration surveys were conducted to document movement of raptors migrating through the Facility Area. Surveys were completed: March 6-May 22, 2017, August 16-December 13, 2017 and March 8-May 23, 2018. These studies were conducted during the seasons in which more than 90% of all raptors migrate in NYS. Each week during those periods one hour of observations, commencing at 0800 and ending at 1700 hours, were conducted at (alternating) eight of 16 observation points selected for this research. In addition to raw counts of each species during each observation period, the altitude of hawks and vultures in three height categories (0-50 m, 50-200 m [approximate height of rotor zone], and above 200 m) was recorded, as was flight direction, and other flight behaviors.

Note that the total number of all raptor sightings (actively migrating or simply within the observation area) was used in subsequent analyses, rather than the numbers reported as "migrating raptors", which was the smaller of the two metrics. This was done conservatively to ensure that the numbers of migrating raptors were not underestimated.

Turkey Vultures were the most commonly observed species in all three seasons. Cumulatively, they accounted for 2,565 of the 3,414 (75.1%) raptors observed during all three seasons. Red-tailed Hawks accounted for roughly 15%, and the remaining 10% were divided among 8-9 species during the three survey seasons. Bald Eagles (NYS Threatened) accounted for less than about 2% of raptor observations. Flight height of about 50% of observed raptors was estimated within 50-200 m of the ground, which is the approximate rotor height zone. However, no study to date has shown a correlation between the number or percentage of raptors (or other birds) flying within the rotor swept height zone and the rate of fatalities. Migrating raptors were distributed across the Facility Area in a broad front (Kerlinger 1989) rather than being channeled or concentrated in any specific location.

Overall, observations in the three seasons amounted to approximately 10 raptor sightings per hour (Table 2). Turkey Vultures accounted for a large percentage of the raptors seen, whereas other raptor species were observed at a rate of 2.5 per hour. Turkey Vultures accounted for far more sightings than did all other raptors combined. The rate of 2.5 raptors per hour is far less than is counted at significant and well documented migration locations in NYS, such as Braddock Bay, Franklin Mountain, or Derby Hill. This strongly suggests that relatively few raptors migrate through the Facility Area.

Table 2. Summary statistics for raptors observed during three migratory studies conducted for the Heritage Wind Project.

	2017 - Spring	2018 - Spring	2017 - Fall	Totals	Number Per Hour
Hours	104	104	136	344	
Total Raptors	977	1,157	1,280	3,414	9.9
Turkey Vultures	693	763	1,109	2,565 (75.1%)	18.9
Non-Vultures	284	394	171	849 (24.9%)	2.5
Number of Species	11	11	10		

No federally listed species were observed, but seven state-listed species (including threatened species and species of special concern) were observed during all surveys (Table 3). The low abundance observed for these species, especially Sharp-shinned and Cooper's Hawks, and to a lesser extent Ospreys, reflects their broad front distribution in NYS during migration. Broad front migration has been discussed by Kerlinger (1989), who demonstrated that most raptor species are spread out across the landscape with relatively few concentration areas. The latter are generally shorelines of large lakes and long, linear ridges, neither of which are located within many miles of the Facility (the shoreline of Lake Ontario is more than 10 miles north of the northernmost proposed turbine). This fact, along with the topography at the Facility Area and the low raptor numbers observed during the three seasons of study, suggest that there are no concentration sites for migrating raptors on site and that migration through the Facility is minimal.

Table 3. New York State listed raptor species observed during three migration surveys conducted for the Heritage Wind Project.

Species[1]	Spring 2017	Spring 2018	Fall 2017	Total
Peregrine Falcon - E	0	0	1	1
Bald Eagle - T	16	20	11	47
Northern Harrier - T	7	6	0	13
Osprey - SC	11	8	3	22
Cooper's Hawk – SC	8	8	5	21
Sharp-shinned Hawk – SC	11	13	8	32
Red-shouldered Hawk - SC	0	0	1	1

[1]E = endangered, T = threatened, SC = special concern.

Winter Raptor Surveys 2016-2018. Driving and fixed point/stationary raptor surveys were conducted in grassland habitats in the Project area for two winter seasons (2016-2017, 2017-2018). Five stationary observation counts were surveyed for 90 minutes every two weeks from late November through March. Two driving route surveys were established (22.2 miles, 19 stops and 25.6 miles, 18 stops) with each route surveyed two times per month. Observations were made at stops for 3 minutes.

Red-tailed Hawks were the most common species observed during surveys. Although no federally listed species were observed, several species listed by NYS were observed. Note that because surveys result in non-independent counts, a smaller number of birds were likely detected due to likely repeated sightings of the same individuals (Table 4). For example, birds such as Short-eared Owls and Northern Harriers (both Threatened in NYS) move over the landscape while foraging, and thus individuals may be counted more than once during a survey. On the other hand, forest or edge dwelling hawks such as accipiters, may be under-represented in counts.

Of the NYS-listed species observed, Short-eared Owls were observed on several occasions, with 25 sightings being recorded cumulatively (Table 4). Note that most sightings (17 of 25 observations, 68%) were recorded within the Airport Setback area. The Airport Setback area is the area within the Facility Area where no turbines are proposed (Figure 1). These birds may also at times forage within the turbine areas at the Facility, though this is not anticipated to occur often based on the results of the winter raptor surveys. Other species that were seen in the Airport Setback area included 50% of the Bald Eagle sightings and 60% of Northern Harrier sightings (Table 4).

Other NYS-listed species were observed less often, as can be seen from the summary of sightings of those species in Table 4. Species like Peregrine Falcon, as well as Northern Harrier, Sharp-shinned Hawk, and Cooper's Hawk were seen relatively few times over the two winters.

Table 4. Summary of New York State listed raptors observed during two (2016-2018) winter surveys conducted for the Heritage Wind Project.

	Stationary Counts			Driving Surveys
Species[1]	Turbine Area	Airport Setback	Total	
Short-eared Owl - E	8	17	25	0
Peregrine Falcon - E	0	0	0	1
Bald Eagle - T	4	4	8	12
Northern Harrier - T	2	3	5	8
Sharp-shinned Hawk - SC	3	4	7	6
Cooper's Hawk - SC	3	6	9	5

[1]E = endangered, T = threatened, SC = special concern.

Small Bird, Large Bird, and Eagle Use Studies.

During December 2016-November 2018, surveys were conducted at 16-point count locations to monitor bird presence and abundance throughout the year, and to determine behaviors of small birds, large birds, and eagles that may put them at risk due to Facility construction and/or operation. Small birds were monitored within a 100 m radius of the point count locations for a period of 5 minutes. Large birds were monitored out to 800 m from the point counts for a period of 20 minutes. Eagles were monitored out to 800 m from the point count for 60 minutes per count. Behavior of the birds was recorded including type of flight, height, and other activities. Height was assigned to three categories: 0-50 m, 50-200m (within the rotor swept height zone), and >200 m. The study methods were developed in consultation with the NYSDEC and USFWS and in accordance with agency guidelines (NYSDEC 2016, USFWS 2012, 2013).

Small Birds. In 2017, 53 species were identified during the small bird surveys during a total of 33 hours of observation. This is equivalent to 400 counts at 5 minutes each. Depending on season, very few species accounted for roughly one-half of the sightings: Red-winged Blackbird, Barn Swallow, and Horned Lark accounted for 46% of the 1,746 sightings. Most birds observed were common species that use open country (farmland), brushy areas, and forest edge. About 99% of the sightings were estimated below the rotor swept height (<50 m). No federal or state-listed species were sighted during 2017, but one species of special concern, Horned Lark, was observed. This species accounted for 177 sightings, almost entirely in agricultural fields. A vast majority of the Horned Larks observed were in migration or winter, so these birds were not from the New York nesting population. Populations farther to the north are are in the millions, which explains the number observed.

In 2018, 248 minutes of surveys documented the presence of 45 small bird species. Similar to the first year, four species, Horned Lark, Barn Swallow, Red-winged Blackbird, and American Goldfinch accounted for 56% of all sightings in this year. These, and most of the other species observed, inhabit farm fields, brushy fields and forest edge habitats. These are also some of the most common birds in North America.

Large Birds. Surveys for large birds were conducted during 133 hours of observations in 2017 and 82.7 hours in 2018, for a total of 215.7 hours. Thirty-two large birds were recorded in both 2017 and 2018. In 2017, three bird species (Canada Goose. Ring-billed Gull, and Turkey Vulture) accounted nearly 80% of all bird sightings. For the most part, birds observed were species common to edge, brush, and open farmland, with relatively few rare or listed species observed.

In 2018, Canada Goose was again the most often observed species, accounting for one-half of all sightings (50%) whereas Ring-billed Gulls and Turkey Vultures accounted for another 36% of sightings. Thus, very common species accounted for 85% of sightings in that year.

Waterbirds flying in the rotor swept zone accounted for 30.4% of the birds observed in 2017 and 22.7% in 2018.

With respect to endangered and threatened species, no federally threatened birds were observed during either year. One NYS endangered species, a Peregrine Falcon was seen during the 2017 surveys. Two state-listed threatened species were recorded during the two years of surveys: Bald Eagle (n = 17 sightings) and Northern Harrier (n = 10 sightings). Finally, four species listed as species of special concern were observed during the two years of surveys: Osprey (n = 6 sightings) Sharp-shinned Hawk (n = 18), Cooper's Hawk (n = 15), and Red-shouldered Hawk (n = 2).

Bald Eagles. The results of these studies are provided in Appendix II.

Incidental Sightings. In the 2017 survey, one state-listed threatened species (Northern Harrier [n = 3 individuals]) was observed. An additional, five state-listed species of special concern were observed incidentally during the eagle and large bird surveys including Osprey (n = 10 individuals), Cooper's Hawk (n = 8 individuals), Sharp-shinned Hawk (n = 13 individuals), Common Loon (n = 6 individuals), and Red-headed Woodpecker (n = 1 individual).

Direct Impacts - Empirical Studies of Avian Fatalities at Operating Wind Energy Facilities

With respect to assessing risk of collision fatalities at the Facility, the best method is to examine post-construction fatality studies at existing wind projects. Nearly 170 such studies have been done in North America which include studies in 30 states and eight Canadian provinces. These studies were prepared based on the recommendation of USFWS, Environment Canada, various state wildlife agencies, the Ontario Ministry of Natural Resources and Forestry, and various environmental organizations. One of the purposes was to build a database that could be used to evaluate impacts to birds at proposed wind energy facilities. Such studies provide robust fatality estimates and variability of fatality rates that are useful for risk assessment. For assessing risk to birds at a proposed project, the most relevant fatality studies come from the same geographic region as the proposed project. In addition, projects with turbines in the same region and habitats like those at the proposed project offer the best point of comparison.

North American Studies

To date, there have been at least five major analyses of fatalities, each relying on a subset of the nearly 170 (AWWI 2016) studies of wind energy sites from the U.S. and Canada (Table 5). The focus of the present analysis will be on the four studies that used site-specific data, including searcher efficiency, carcass persistence (scavenging rates), carcass counts, and area searched. The use of site-specific metrics differs from the Smallwood (2013) study, which used a fixed value for searcher efficiency and carcass persistence from studies at one wind energy site in California (Smallwood 2013). Smallwood (2013), a consultant from California who has not conducted post-construction studies outside California, conducted a study that was very different from the four others listed in Table 5. That methodology is not comparable to the methodology used in the four other studies, which resulted in much higher fatality rates in the Smallwood paper. In addition, some of Smallwood's reports (Smallwood et al. 2010) have been shown to have critical statistical errors that influence fatality estimates and their confidence intervals (Huso and Erickson 2012). For these reasons, Smallwood (2013) was not used in this review.

<u>Zimmerling et al. 2013</u>. An estimate of fatalities per turbine per year was made by Zimmerling et al. (2013) and staffers from Environment Canada. Their results relied on fatality studies at 43 wind farms in Canada, 19 of which were in Ontario. Of those 19, almost all were in farmland. Overall, the Zimmerling team estimated fatality rates of 8.2 birds per turbine per year for all of Canada and 10.2 for the 19 wind energy sites in Ontario. This is roughly equivalent to 3-4+ birds per mw per year (Table 5). Data from the Ontario wind energy sites were used to inform the risk assessment for the Heritage Wind Project, as almost all of the Ontario projects were located within similar agricultural landscapes.

<u>Loss et al. 2013</u>. Loss et al. reported an average of about six fatalities per turbine per year at the 47 wind energy installations they reviewed for their analysis (Table 5). Almost all of these sites were in the U.S. Despite including wind energy sites exhibiting a range of habitat types, the

Loss et al. fatality estimates of 6 birds per turbine per year (2-3 fatalities per mw) are similar to those of Zimmerling et al. and Erickson et al. (Table 5, 3-4+ per mw), and are therefore still useful for comparison when evaluating risk for the Facility.

An important conclusion of Loss et al. was that "Regional patterns of collision risk, while not obviating the need for species-specific and local-scale assessments, may inform broad-scale decisions about wind facility siting." What this strongly suggests is that regional data can be very useful for assessing risk. Analyses like those of Loss et al. provide a weight of evidence approach for conducting avian risk assessments because of the large number of studies included.

Erickson et al. 2014. The Erickson et al. report analyzed data from 116 studies from more than 70 wind projects that were mostly in the U.S. That paper focused mostly on songbird migrants, but also made a fatality estimate for all birds. The Erickson et al. estimate, when divided by the number of turbines operating in the U.S. at that time, equates to approximately nine birds killed per turbine per year, or 2-4+ fatalities per megawatt. Erickson et al. (2014) is the largest of the multi-study fatality analyses. The Erickson et al. fatality estimate per turbine is about three birds less than that of Loss et al., approximately one bird greater than that of Bird Studies Canada et al. (2017) for Ontario wind facilities (see below for additional discussion), and one bird greater than that of Zimmerling et al. (see above). Thus, there is consistency in fatality estimates among these four different region-wide analyses.

Collision Fatalities at Ontario and New York State Wind Energy Facilities. Although the large-scale analyses of collision fatalities at wind energy facilities across the continent cited above provide insight into the risk posed by modern wind turbines, more geographically focused analyses provide a more accurate means of assessing risk. To provide a more fine-grained risk assessment for the Facility, data were assembled from wind energy facilities in NYS and Ontario. These wind projects are within the same ecological region (note that most of the wind projects in Ontario are in southern Ontario). In these two geographic areas, there are similarities in habitat at many of the wind plants, with a large majority of turbines being in farmland.

Ontario Studies: Bird Studies Canada 2017. A cooperative effort involving Bird Studies Canada (a non-profit bird conservation and research organization), the Ontario Ministry of Natural Resources, the Ontario Ministry of the Environment, and the Canadian Wind Energy Association analyzed the results from studies of 54 of the 64 wind plants operating as of 2016 in Ontario (Bird Studies Canada et al. 2017). Fifty-seven of the 64 Ontario projects (89.1%) were located in farmland (Table 6), similar to habitat found at the Facility Area. The seven studies that were not included in the analysis did not follow strict Ontario Ministry of Natural Resources methodology for such studies, although they still offered information on fatality rates at wind projects. From the carcass numbers, combined with searcher efficiency and carcass persistence (removal by scavengers), an estimation of overall fatalities was made, along with an average of fatalities on a per turbine basis, including standard errors, for all of Ontario (Appendix I).

The Ontario fatality estimate is relevant to risk posed by the proposed Facility because a vast majority (n = 54, 84.4% of 64) of the wind projects in Ontario are in farmland, and ecologically very similar to the Facility Area. In other words, the Ontario project sites are also dominated by row cropland planted primarily in corn and soy, along with some hayfields and pastureland. Thus, the geographic location, habitat, climate, and bird species are quite comparable, which are important factors when considering comparative risk.

The fatality studies done in Ontario (Table 6) and the fatality estimate per turbine per year represent 117 project years (2007 to 2016) of study. The average of slightly more than two years of study per project resulted in an average fatality rate of 5.94 ± 0.06 birds per turbine per year (per mw estimates were not provided). Thus, the average fatality rate for Ontario is very close to the other estimates provided in Table 5.

New York State Studies. For NYS, the author identified 12 post-construction fatality studies (Table 6). All but one (Madison) received input and review by the NYSDEC. Some had also been submitted to the USFWS and New York State Audubon for review. These studies cumulatively included more than 15,000 individual turbine searches, which represents a robust sample size.

For all but Madison, searcher efficiency and carcass persistence studies were conducted. For these sites, a cumulative total of 20 years of studies were conducted ranging from three years at Maple Ridge, to one year at several other projects. For all 12 studies, the average fatality rate per turbine for the season studied (April-September or November) was 3.3 birds per turbine per study period. For the eight studies where most of the turbines were in farm fields, the average was about 3.5 birds per turbine per study period. It is worth noting that carcass searches stopped at the end of September for some of the projects. Because of this, the fatality rate per turbine per longer study period may have been somewhat greater. This conclusion is based on the fact that some carcasses are found in October and November (Jain et al. 2009), but in the latter months, the rate, as indicated by carcasses found, goes down precipitously. This has been demonstrated at projects like Maple Ridge that continued to conduct carcass searches into November. For winter, the rate is likely to be minimal. Thus, when extrapolating out for an entire year, the fatality rate from these studies is slightly greater than five birds per turbine per year and about 3-4 birds per megawatt per year. Note that gulls (family Laridae) accounted for 52% of the 15.5 bird fatalities per turbine per study period estimate reported for Steel Winds. Thus, the rate for non-gull birds was about 7 per turbine per study period or about 3 per megawatt per year. The non-gull rates were used when calculating approximate averages across multiple studies for the present risk assessment.

Table 5 compares the fatalities and fatality rates for the entire U.S. and Canada including some sites in NYS. As detailed above, the NYS rates are slightly lower, but similar to what is reported elsewhere. These NYS studies were done for turbines that were 40-100 feet shorter than many turbines studied after 2010. Because the Heritage Facility turbines will be taller, it is possible that fatality rates will be slightly greater than for turbines constructed before 2010. However, the number of turbines needed to produce the same amount of energy will be less, and therefore the fatality per megawatt rate should be similar or lower.

Comparison of Fatalities at Wind Turbines to Communication Towers

To examine relative collision risk to birds at wind turbines it is instructive to compare fatality rates at those structures with rates at communication towers of the same height. What is important about this comparison is that it provides perspective on fatalities at structures with very different functions and different structural characteristics.

To accomplish this comparison, data from Gehring, Kerlinger et al. were used (2009, 2011) for Michigan State Public Safety Communication System towers, which are used by first responders, the USDOJ and wildlife agencies (e.g., USFWS,). These towers average 470 feet in height and include both free standing and guyed towers. Fatality estimates for towers using Huso (2011) were compared to wind turbine estimates (Table 5).

As Table 5 shows, for Canada and the United States fatality rates were between about six and 10 birds per turbine per year. Unguyed communication towers averaged nine birds per tower per year, whereas guyed towers averaged 152 birds per tower per year. Thus, unguyed communication towers pose about the same risk to birds as wind turbines, whereas guyed towers are on the order of 17-25 times riskier. One reason for this difference is that communication towers generally have FAA lights that attract large numbers of night migrating birds whereupon birds collide with guy wires (Gehring, Kerlinger et al. 2009, 2011). Wind turbines experience far fewer collisions because they lack the type of FAA lights that attract birds (Kerlinger et al. 2010).

Summary of Results

There are currently four independent, empirical studies that examined avian fatalities at nearly 170 wind energy projects in the United States and Canada. These continent-wide estimates are all peer-reviewed and published by scientists largely working in highly respected academic, conservation or scientific institutions. The estimates from these studies range from six to 10 bird fatalities per turbine per year (~2-4+ fatalities per megawatt). Because of the minimal variation and low values of these four independent estimates, it is highly likely that fatality rates at the Heritage Facility will fall near the mean or within roughly one standard deviation of these estimates.

These studies demonstrate that wind turbines do result in some bird fatalities, but do so in numbers that are relatively small and disproportionately less than other structures of the same height, such as communication towers. Please note that a more detailed comparison of wind turbines to other causes of avian fatalities will be provided in separate studies prepared for Exhibit 22 of the Article 10 Application for the Facility.

Table 5. Comparison of estimated avian fatality rates determined by Smallwood (2013), Loss et al. (2013), Erickson et al. (2014), Zimmerling et al. (2013), and Bird Studies Canada et al. (2017).

	Smallwood 2013	**Loss et al. 2013**	**Erickson et al. 2014**	**Zimmerling et al. 2013**	**Bird Studies Canada et al. 2017**
Total Annual Fatalities	573,000 (U.S.)	234,000 (U.S. & Canada)	368,000 (U.S. & Canada)	24,000 (Canada)	14,655 (Ontario)
Per Turbine Annual Fatalities	15-20	6	~9	8/10	5.94
Per Megawatt Annual Fatalities	Not quantified	2-3+	3-4+	3-4+	1-3+
Number of Projects /Studies Analyzed	71 (studies)	58 (projects)	116 (70+ wind energy projects)	43 (projects)	54 (projects)
Author Affiliations	No institutional affiliations	U.S. Fish and Wildlife Service, Smithsonian Institution (Migratory Birds unit)	Western EcoSystems Technology, Inc., U. S. Geological Survey (Wildlife Research Center), U. S. Federal Communication Commission	Environment Canada, Stantec Consulting Ltd.	Bird Studies Canada, Ontario Ministry of Natural Resources, Ontario Ministry of the Environment, Canadian Wind Energy Association

Table 6. Summary of bird fatality studies conducted at wind energy facilities in New York State.

Wind Energy Facility	Habitat	Number of Turbines	Years of Study	Authors[1]
Altona	Forest and Farmland	65	2010	Jain et al.
Bliss	Farmland	67	2009	Jain et al.
Chateaugay Wind	Forest and Farmland	71	2010	Jain et al.
Clinton	Farmland	67	2008-2009	Jain et al.
Cohocton/Dutch Hill	Farmland	50	2009-2010	Stantec
Ellenburg	Farmland-Forest	54	2008-2009	Jain et al.
High Sheldon	Farmland	75	2010-2011	Tidhar et al.
Madison	Farmland	7	2001	Kerlinger
Maple Ridge	Farmland	195	2006-2008	Jain et al.
Munnsville	Farmland	23	2008	Stantec
Steel Winds	Lakeshore	14	2007-2012	Stantec
Wethersfield	Farmland	10	2010	Jain et al.

[1] Full citations for these studies are provided in the Literature Cited section.

Evaluation of Risk Factors for Collision Fatalities at Heritage Wind

Several factors have been suggested to influence collision risk posed by wind turbines and other tall structures (Table 7). These factors include lighting (Gehring et al. 2009, Kerlinger et al. 2010) of and near structures, height of structures (Gehring et al. 2011, Loss et al. 2013, Kerlinger et al. 2012), and support structures (guy wires vs. free-standing; Gehring et al. 2011).

FAA and Other Lighting. Empirical studies at wind turbines (Kerlinger et al. 2010) and communication towers (Gehring et al. 2009, and earlier anecdotes) have shown that lights, both non-flashing aviation obstruction lighting (FAA lights) and lights on electrical substations (and natural gas pumping stations) attract or disorient night migrating birds causing fatalities. Sometimes, as with the bright lights at substations, dozens to hundreds of birds may collide with structures on a single night (Wylie, 1966).

Kerlinger et al. (2010) also reported dozens of dead songbirds found on one morning at a substation at the Mountaineer wind facility in West Virginia. Kerlinger et al. (2010) and Gehring et al. (2009) conducted research at communication towers and wind turbines that demonstrated non-flashing FAA and other infrastructure lights on these structures result in far greater fatalities than flashing lights, regardless of color. They reported that fatalities at towers where non-flashing FAA lights were extinguished were reduced by 50-70% at communication towers. Kerlinger et al. (2010) demonstrated that turbines with red flashing FAA lights did not result in greater fatalities than turbines without FAA lights. This has been demonstrated at dozens of other wind energy sites studied by Curry & Kerlinger, and WEST scientists.

Because the FAA lights at the Facility will be controlled using a radar driven ADLS, with only red flashing lights and no steady burning lights, the risk of fatalities caused by lights will be essentially nil (i.e., extremely low). Similarly, it is anticipated that switches or motion detectors will be installed on the substations and other structures where safety/security lighting is needed so that those lights will be extinguished when not in use. Thus, FAA and other lights at the Facility infrastructure will not pose a significant risk to birds.

Guy Wires. Guy wires cause a vast majority of collision fatalities at communication towers. Gehring, Kerlinger et al. (2011) showed that guy wires on communication towers the same height as wind turbines (~145 m) were responsible for about 85% of fatalities at those towers. Guy wires pose no risk at the proposed Facility because the turbines and meteorological towers will be unguyed.

Height (and number of turbines). For wind turbines, there has been only one study that examined the role of height with respect to numbers of fatalities. Loss et al. (2013) analyzed 47 post-construction fatality studies at wind turbines of different sizes. The tallest was somewhat greater than 400 feet in height. They found evidence for slightly greater numbers of fatalities at taller turbines, although the relationship was not statistically significant.

The Facility's turbines will be nearly 20-50% taller than turbines that were being erected 5-10 years ago, which ranged up to about 150 m (492 feet). With the Facility turbines being about 200 m (600+ feet) in height and with a larger rotor swept area than most projects that exist today, fatalities resulting from these turbines could be somewhat greater than at existing wind projects. Annual fatality rates of birds at wind projects in NYS are generally between 2 and 4 per MW per year and usually less than about 6 per turbine per year. Thus, with the taller turbines proposed for the Heritage Facility, it is reasonable to expect that both per MW and per turbine fatalities would be above the NYS average rates. However, as described previously, fewer turbines will be needed to produce the same MW capacity, and therefore the fatality rate per MW will likely be similar, or will be lower, in comparison to existing facilities with smaller turbines

Two other factors are relevant to collision risk (Table 7): perch sites and turbine spacing. Neither have been studied, although it follows that turbines with perch sites (lattice structure) attract raptors and other birds, thereby increasing risk. The USFWS guidance (2012) recommends tubular towers for turbines without perch sites. Also, closely spaced turbines likely increase risk. In the case of the Heritage Facility, there will be no perch sites on turbines and spacing of turbines will be much wider than at most other project sites in Ontario and NYS. So no additional risk is likely. With respect to spacing, the Heritage Facility turbines will have much wider spacing than turbines at most other sites in Ontario and NYS, which will minimize spacing risk, if it is indeed a factor. Table 7 below presents a summary of collision risk factors for the Facility.

Table 7. Summary of collision risk factors for the Heritage Wind Project.

Collision Risk Factors[1]	Heritage Wind	Risk
FAA Lights	Present – L-864 Aviation Detection Lighting System (ADLS) – lights extinguished except when planes are in proximity to turbines	No additional risk – little to no risk
Substations and Other Lights	Present – controlled by motion detectors and other devices so night lights will be extinguished	No additional risk – little to no risk
Guy Wires	No guy wires on turbines or meteorology towers	No additional risk
Height	200 m is taller than most wind turbines in North America	Risk likely greater than most towers today per turbine, but risk per MW may be the same or lower
Perch Sites	No perches present	No potential additional risk
Number of Turbines	33 turbines – relatively small number of turbines	Lessens risk – more structures equal more risk
Turbine Spacing/Density	Wider spacing than most previous turbines	Potentially lesser risk

[1]Factors in italics have been tested and demonstrated to influence collision risk at wind turbines and/or communication towers (and some other structures). Other risk factors listed have not been tested empirically but have been included for completeness and because some agencies believe they are part of the collision risk equation.

Collision Fatality Risk Assessments

Songbirds. Songbirds and other small birds account for roughly 70% of collision fatalities at wind projects (Erickson et al. 2014). Because the Facility wind turbines will be roughly 25-50% taller than turbines that have been erected in the mid-2000s and early-mid-2010s, they may impact a greater number of night-migrating songbirds which tend to migrate at higher altitudes. The fatality rate at taller turbines may be slightly greater on a per turbine basis when compared to current impact numbers reported from turbines of about 400 feet in height in NYS, however there are no fatality studies for turbines of the height proposed for the Facility.

Waterbird Fatalities. Overall risk to waterbirds (including state-listed waterbird species identified by the NHP within 10 miles of the Facility Area) at the Facility is likely to be nil to very low on a species specific per turbine and per MW basis. There are three reasons for this conclusion. First, the turbines at the Facility will all be sited in upland habitats and available habitat for waterbirds is minimal within the Facility Area (the great majority of wetlands are forested). Second, very few waterbirds were observed during the extensive on-site field studies (see Table 1 above for list of studies). Third, fatality studies at 60+ wind projects in Ontario (Bird Studies Canada et al. 2017; Appendix I) and 12 studies in New York State (Table 6) have demonstrated waterbird impacts are very low at wind projects in the same region and located in similar farmland habitat.

In Ontario, 32 fatality studies were done at wind projects with turbines located within 3 miles of the Great Lakes. Yet, the numbers of waterbird fatalities are quite small, accounting for less than 4% of all bird carcasses found. There are also several other studies conducted either near the Great Lakes or near National Wildlife Refuges where waterbirds are very abundant. Those studies have shown risk to be minimal for waterbird species, including a study at the 86 turbine Forward Energy project near the Horicon National Wildlife Refuge and Horican Wildlife Management Area (Grodsky et al. 2013), one of the most important waterbird gathering locations in the upper Midwest. Another important example that shows risk is minimal to waterbirds is the Heritage Garden wind project, where all 14 turbines are within 2 miles of Lake Michigan (Kerlinger et al. 2014) in an area considered a “Key Migration Corridor” by the American Bird Conservancy. No waterbirds were found dead at this facility in the two years of fatality searches and raptors and songbird migrants were found in very small numbers. In a continent-wide study (Erickson et al. 2005), waterbirds accounted for less than about 10% of all fatalities. In NYS, that statistic is smaller, with Mallards and Ring-billed Gulls accounting for a majority of waterbirds killed. It appears that, like with other structures, waterbirds mostly avoid collisions with wind turbines. They apparently see well, including in the dark, as has been demonstrated via radar studies off Sweden and elsewhere offshore in Europe (Masden et al. 2009). When the above statistics are combined with the small numbers of waterbirds observed during the 10 studies conducted at Heritage, they indicate that risk to waterbirds at the Facility will be minimal.

Raptor Fatalities. With respect to raptor species, numbers of fatalities at wind projects in Ontario (Bird Studies Canada et al. 2017) and NYS (Table 6) have been relatively small and have not been shown to impact regional populations. These studies show that fatalities of raptors are relatively low at wind projects, even those that are located at important migration pathways. From the studies that have been completed in NYS, about one raptor per 8 MW of power generated (nameplate) were killed, with Red-tailed Hawks and Turkey Vultures being the species killed most often. Counts of migrant raptors within the Facility Area were low and the rate of migration was miniscule compared to sites like Braddock Bay and Derby Hill on the Lake Ontario shoreline. The Facility is more than 10 miles south of the Lake Ontario shoreline and there are no long ridges at or near the Facility that would concentrate migrating raptors into the Facility Area. Also relevant is the fact that the empirical studies of collision fatalities along the northern shore of Lake Erie (Ontario, Table 6) and 20+ wind projects on Appalachian ridges (Taucher et al. 2012) reveal low fatality rates of migrating raptors. Studies conducted at 31 wind projects in Ontario with turbines within 3 miles of the Lake Erie shoreline, and a few more in the United States (e.g., Kerlinger et al. 2014), have not found fatality rates for raptors to be greater than those documented at wind projects located well away from the lakeshore. These empirical data indicate that migrating raptors are not at significant risk at the Facility.

With respect to nesting and wintering raptors, the numbers observed during seasonal studies at the Facility Area, along with the rates of fatalities reported at the other wind plants in NYS and Ontario, indicate that significant impacts are not expected. The species that may be impacted in small and nonsignificant numbers are most likely Red-tailed Hawk and Turkey Vulture, the most common species found as fatalities at wind farms and the most abundant raptors observed during the Facility's surveys. (Other raptors are considered in the *Listed Species Fatality* section that follows.)

Federally Listed Species. No fatalities of federally listed bird species are anticipated to occur at the Facility because they are not likely to occur on site. None was observed during the two plus years of preconstruction studies and the USFWS letter asserted that federally listed bird species have not been documented within the Facility Area, nor was there critical habitat for those species on site.

State Listed Species. With respect to NYS-listed species, observations during preconstruction studies and consultation with the NHP revealed that two state endangered species, two threatened species, and eight species of special concern could be present at the Facility Area or nearby at sometimes during the annual cycle. The list of these species and fatality numbers from 54 wind energy projects in Ontario and 12 in NYS can be found in Table 7. Based on a review of these fatality data, as well as observations of NYS-listed species during the preconstruction studies conducted at the Facility Area, an assessment of expected collision risk has been made for each of these species (please refer to the far-right column of Table 8). Bald Eagle is not listed here because it is addressed in Appendix II, which is specific to that species.

<u>Short-eared Owl</u>. Small number of individuals were observed during preconstruction winter surveys, especially within the Airport Setback, but this species does not nest on or near the Facility. These owl species generally forage at heights of less than 100 feet, which is below the rotor swept zone for turbines planned for the Facility. Risk is likely to be similar to other owl species, which has been demonstrated as nil to very low. Therefore, risk to Short-eared Owls is also likely to be nil. This conclusion is supported by the absence of this species in the large numbers of fatality studies done in Ontario and New York.

Peregrine Falcon. A single bird was observed during migration and another in winter during preconstruction surveys. This suggests very few of these birds are present on at the Facility and that risk is nil to very low. This is supported by the absence of this species in fatality studies at wind plants in New York and the near absence of fatalities in Ontario studies.

Northern Harrier. This species was not found to be nesting within the Facility, although small numbers were observed during the non-breeding season. Northern Harriers are not likely to be at great risk of colliding with turbines, because their low flight while foraging. The numbers of this species found dead at 54 wind projects in Ontario (n = 2) and 12 in NYS (n = 0) are extremely low. Given the numbers of studies, numbers of turbines and length of time involved in the studies, this is a very low and not significant fatality rate and strongly suggests that this species is not at significant risk.

The species list provided by the NHP indicates that three other grassland birds that are listed as threatened in NYS may be present within the Facility Area, albeit on rare occasions. None of these species was observed within the Facility Area in the preconstruction studies.

Sedge Wren. This species favors wet fields and at the edges of marshes, as well as some upland grasslands, which are rare at the Facility Area. Not being found during preconstruction studies suggests that risk to this species is nil to very low.

Upland Sandpiper. Mature upland grasslands are the preferred habitat of this species. Such habitats are not present at the Facility, so nesting is unlikely to occur. Even if this species attempts to nest in one of the grassland fields on site (e.g., a hayfield or a fallow field), it is likely that their nests and nestlings will be destroyed by hay mowing or tilling activities. Thus, habitat on site at or near turbine locations is not suitable for nesting by this species. It may migrate through the Facility Area because it migrates across the width of NY. Overall, risk to Upland Sandpiper is very low to nonexistent.

Henslow's Sparrow. As with Upland Sandpiper, Henslow's Sparrows prefer mature upland grasslands that have not been mowed for 2-3 years. Like other grassland nesting birds, these birds are susceptible to mowing and other agricultural activities. Note that these birds will not likely pass through the project site during migration, because almost none of these birds nests to the north of the Facility. I could not find any records of fatalities at wind energy facilities in New York or Ontario. For these reasons, risk to these birds is very low to non-existent.

Species of Special Concern. Of the eight species of special concern seen at the Facility Area (Horned Lark, Common Nighthawk, Cerulean Warbler, Vesper Sparrow, Red-shouldered Hawk, Cooper's Hawk, Sharp-shinned Hawk, and Osprey) risk is likely to be greatest for Horned Lark. For the other species, risk is likely to be very low to nil. This conclusion is based on the very small numbers of documented fatalities of these species at wind plants in Ontario and New York (Table 8). These levels of fatality are not biologically significant. Also, the rarity of these species documented during preconstruction studies at the Facility suggest very low impact to these species.

Horned Lark. This species likely nests at the Facility in small numbers, and they presumably migrate through the Facility, as well as potentially spending parts of the winter on site. Documented presence during these seasons and numbers observed on-site suggests greater risk for Horned Lark than for other species. However, risk is still likely to be in the "Low" risk categorization provided in Table 8 because fatalities in NYS have been so low and fatalities will likely not impact populations.

Although 172 fatalities were recorded at Ontario turbines, it is important to note that this number was spread over more than a decade of post-construction studies conducted at more than 50 wind energy projects in that Province. Fatality numbers like this are not concerning because there were roughly 140 million of these birds (Rich et al. 2004) as of 2004.

It is also important to note that_Horned Larks are commonly observed in agricultural areas despite farming practices. Those same farming practices, including mowing of pastureland and hayfields, tilling for corn and soy planting, and application of pesticides regularly destroy nests and young of this species.

Common Nighthawk. During the 2016-2018 preconstruction studies, one Common Nighthawk was observed, but no nesting by this species was documented at the Facility Area. Small numbers likely migrate through or near the Facility Area. Thus, the numbers of Common Nighthawks that may nest on site or nearby, or are present at other times of the year, are very low. In addition, overall fatalities at NYS and Ontario wind farms have included only four Common Nighthawks in Ontario and fewer in NYS. Other aspects of their biology that suggests low risk is the fact that these birds are not present from September through April because they migrate south and winter in the Neotropics. No significant impacts to nighthawks are expected.

Cerulean Warbler. This species was observed during the two preconstruction breeding bird surveys, and likely breeds in very small numbers in the Facility Area. Cerulean Warbler nests are unlikely to be near turbines at the Facility because they require larger stands of, usually mature, unfragmented forest stands with trees that exceed 50 feet in height). Thus, when at or near the Facility Area, Cerulean Warblers will spend most of their time in forested habitat, well away from the proposed turbines. This species has not been found dead at wind projects in Ontario or NYS. Like other Neotropical migrants, these birds are not present in NYS between September and April, because they migrate to South America. Given these considerations, risk to this species is expected to be nil.

Vesper Sparrow. This grassland nesting bird likely nests within the Facility Area, but in small numbers, as was demonstrated during the breeding bird studies conducted in 2017 and 2018. This species nests in hayfields, pastures, and in scrub-shrub areas without much vegetation. Vesper Sparrows leave NYS in fall and return in April and are therefore absent for nearly one-half of the year. Only very small numbers of fatalities of this species have been found at wind energy facilities in Ontario and New York. Thus, collision risk to Vesper Sparrow is likely to be nil or very low.

Red-shouldered Hawk. Risk to this raptor species is likely to be nil because the species was seen rarely on site, and only during migration when risk has never been documented to be great to raptors. The fact that they are rare in the Facility Area, strongly suggests that risk to this species is nil. Furthermore, no Red-shouldered Hawks were found dead at NYS or Ontario wind projects during post-construction studies.

Sharp-shinned Hawks. None of these small raptors were documented do be nesting at the Facility Area and few were observed during migration. Overall risk to this species is very low to nil, as evidenced by the small numbers of fatalities found at the Ontario and NYS wind energy facilities.

Cooper's Hawks. This species may nest within the Facility Area, albeit in very small numbers. However, they were not documented to be nesting on-site, although the habitat is suitable, and a nest may have gone undetected. This species' population is increasing throughout the Northeastern US and their numbers are becoming robust. It has been found dead in small numbers at wind turbines in NYS (n = 1) and Ontario (n = 11) and despite these fatalities, their population in these geographic areas continues to increase. Cooper's Hawks were seen regularly during the preconstruction studies, but in small numbers. Overall, risk to Cooper's Hawks is likely to be very low.

Table 8. New York State endangered (E), threatened (T), and species of special concern (SC) observed during breeding, migration, and winter seasons at the Facility with fatalities found at wind energy facilities in Ontario and NYS.

Species	Fatality Numbers	Fatality Numbers	Collision Risk at Heritage Wind[4]
	Ontario[2]	New York[3]	
Short-eared Owl (E)	0	0	Nil
Peregrine Falcon (E)	1	0	Nil
Bald Eagle (T)	2	1	Nil
Northern Harrier (T)	2	0	Nil
Osprey (SC)	4	0	Nil
Cooper's Hawk (SC) – B[1]	11	1	Very Low - Nil
Sharp-shinned Hawk (SC)	4	5	Very Low - Nil
Red-shouldered Hawk (SC)	0	0	Nil
Common Nighthawk (SC) – B?	4	0	Nil
Horned Lark (SC) – B[1]	172	0	Low
Cerulean Warbler (SC) – B[1]	0	0	Nil
Vesper Sparrow (SC) – B[1]	5	0	Very Low – Nil

[1]"B" indicates the species possibly breeds at the Facility Area.

[2] Fatality numbers for Ontario come from the Bird Studies Canada et al. (2017) report 54 wind farms with a total of 117 years of study at 1,613 turbines and 11 NYS wind farms with a total of 16 years of study at 593 turbines.

[3] Final reports for High Sheldon were not available nor was one year of study at Cohocton/Dutch Hill. <BEGIN CONFIDENTIAL INFORMATION/>[redacted]</END CONFIDENTIAL INFORMATION>.

[4] Assessed risk is as follows on an annual basis: Nil – no fatalities likely in any given year; Very Low – perhaps up to 1 fatality in a given year; Low – perhaps 1-2 fatalities in a given year.

Displacement and Disturbance Risk Assessments

Although displacement and disturbance impacts have not been studied by the scientific community to the extent that fatality impacts have been investigated at wind energy sites, there are some case studies that can be relied upon for assessing the potential for this type of risk to birds at the Heritage Facility.

Songbird Displacement/Disturbance.

Overall, displacement and disturbance impacts at the Facility will be minimal with respect to nesting songbirds because the agricultural habitats in which most turbines will be located are already highly degraded with respect to birds. For nesting birds, suitable habitat has been removed through continued tilling for corn and soybeans, whereas "grassland" habitats are disturbed several times per year as they are mowed to harvest hay and alfalfa.

The response of nesting birds to turbines that is often referred to as displacement or disturbance, might better be referred to as a graded response where the reductions in density near turbines are partial, involving a subset of individuals as opposed to complete displacement involving all individuals abandoning an area. This is because not all birds are displaced, and they react in a variable fashion over a distance gradient going away from turbines. Also, species respond differently, especially over time, in their response to turbines and potential for displacement.

From the studies detailed below it is concluded that some displacement, especially at distances of less than 100 m from turbines can occur among some but not all grassland nesting birds in the Facility. Further, these birds may habituate over a few years to the presence of turbines or respond differently to turbines of different sizes and with different spacing.

Post construction studies at other wind farms in NYS have not demonstrated significant displacement or disturbance impacts to songbirds. For example, a study by Kerlinger and Guarnaccia (2011) found that the effect of turbine displacement on the Bobolink population (a grassland species that is the focus of conservation) at the Maple Ridge Wind Farm in Lewis County, New York does not appear to be significant in the long term. Bobolink was chosen as the surrogate for more rare species that nest in grasslands in New York. They demonstrated habituation which also likely occurs among other grassland nesting species. If impacts from turbines are occurring, they appear to be minor and impact only small numbers of birds. Affected birds are generally limited to those with territories within 75 m of turbines (1.8 ha). Another finding of Kerlinger and Guarnaccia (2011), was that between the first year after construction and the fifth year, Bobolink displacement lessened, and these birds seemingly habituated to the turbines to some extent. Savannah Sparrows, however, were not displaced in either the first year after construction, or the fifth.

A similar gradient analysis at the Wethersfield wind plant in Wyoming County, New York resulted in lower densities of Bobolinks at less than 75 m from turbine bases (Kerlinger and

Guarnaccia 2010), although the difference was not significant. Results were almost identical to those for the Maple Ridge project and likely would have shown significant displacement effects within 75 m of turbines if databases were combined (Kerlinger and Guarnaccia 2011). The sample site for Wethersfield was smaller, which may also explain the non-significant difference.

Overall, at NYS wind projects, turbine displacement is anticipated to be a minor impact for most species, especially when compared to the effect of hay mowing and habitat succession. Wind turbines minimally impact nesting productivity in Bobolinks and other nesting birds, while mowing and tilling virtually eliminates nests and young beneath turbines in hay fields in Lewis County (Kerlinger and Guarnaccia 2011).

Studies conducted in other states have also examined displacement/disturbance impacts. Those studies include Leddy et al. (1999) who studied Conservation Reserve Program grasslands (true grasslands) in southwestern Minnesota and Hale et al. (2014), who studied active pastureland in Texas. Leddy et al. found displacement within 80 m of turbines as opposed to farther away, although the reduction was about 15-20% with respect to breeding males. This study is not entirely comparable to the Facility because the turbines were smaller and more closely spaced (Leddy et al. 1999). They also had shorter turbines with rotors that extended to less than 15 m above the ground and were spaced by about 100 m. At Maple Ridge and Wethersfield in NYS, the turbine rotors were approximately 40 m above the ground and were spaced at about a minimum of about 250 m with many spaced at much larger distances. Some of the displacement demonstrated by Leddy et al. could be related to the fact that the turbines they studied were spaced more closely and their rotors came closer to the ground than did the Maple Ridge and Wethersfield turbines.

With respect to the Hale et al. study, wind turbines in the 100-125 m height class were studied in pastureland. The grassland species they studied did not appear to be greatly displaced and many were not displaced at all. Results from a study in North Dakota by Schaffer and Buhl (2015), however, did show some displacement. Although the methodology was different from that of Kerlinger and Guarnaccia (2011), these researchers found that, like Kerlinger and Guarnaccia, the displacement was most obvious within 100 m of turbines. Schaffer and Buhl also demonstrated that for one bird species, turbines appeared to act as an attraction, and there were more birds of that species present after the turbines were constructed.

Overall, while some displacement and disturbance impacts may occur at the Facility such impacts will be minimal as agricultural habitats in which almost all turbines will be located are already highly degraded and post construction studies to date have not demonstrated significant displacement and disturbance of songbirds at wind facilities.

Waterbird Displacement/Disturbance. Displacement and disturbance of waterbirds by the Facility is likely to be minimal and not significant. First, the turbines will be primarily in tilled agriculture and pasturelands that are unsuitable for nesting by waterbirds, including waterfowl.

The fields will also largely be unsuitable for most species of waterbirds that require marshes or swampy areas for food and/or cover. Any waterbird species that eat fish or other aquatic organisms (including plants) will not be present in tilled agricultural fields, and most waterbirds will be rare to absent in winter, with the exception of species such as the Canada Goose.

Some research has been done involving waterbirds like geese feeding in tilled agricultural fields in proximity to wind turbines. Larsen and Madsen (2000), working in northern Europe with smaller and much more closely spaced turbines than those proposed at the Heritage Facility, studied displacement of the Pink-footed Goose. They found that birds foraging in winter approached and foraged as close as 25 m from turbines. This suggested that there may be a minor, partial displacement of this species in the area within 25 m of turbines. Though many of the proposed turbines at the Heritage Facility will be located in agricultural fields, the Larsen and Madsen (2000) results suggest that displacement of similar species (e.g., Canada Goose) will be minor, and would not represent a significant impact.

Raptor Displacement/Disturbance. With respect to raptors, displacement/disturbance risk does not appear to be an issue at wind facilities. These birds are regularly seen near turbines in habitats where they forage, perch, and migrate. Raptors will continue to forage in the farm fields surrounding the turbines as well as perch at the edges of fields where they often rest and wait for prey to be available. One factor that should be emphasized is that turbines will be separated by roughly one-half mile in much of the area where they will be located. This wide spacing allows raptors and other birds to fly between and among turbines and does not displace them from a large portion of the Facility Area. Thus, if there is any displacement by turbines, that displacement will be restricted to the small area surrounding the turbines and with the wide spacing, raptors (and other birds) will have plenty of room to fly between turbines. Displacement and disturbance to raptors at the Facility Area will be minimal and not significant.

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Appendix I. Summary of fatality studies conducted at wind energy facilities (Bird Studies Canada et al. 2017) in the Province of Ontario.

Wind Energy Facility	Habitat – Proximity to Great Lakes[1]	Number of Turbines	Years of Study
Adelaide Wind Farm	Farmland - Inshore	32	2015
Adelaide-Suncor	Farmland - Inshore	18	2015
Arthur Wind Farm Project	Farmland - Inshore	5	2011 - 2013
Bisnett Wind Farm	Farmland – 3 within 3 miles of Lake Erie	5	2010 - 2012
Bluewater Wind Energy Centre	Farmland – <10 within 3 miles of Lake Huron	37	2015
Bornish Wind Project	Farmland - Inshore	43	2015
Comber Wind Farm	Farmland - Inshore	72	2013 - 2015
Conestogo Highlands Wind Farm Project 2	Farmland - Inshore	10	2013 - 2015
Cruickshank Wind Farm Ltd	Farmland – 5 turbines within 3 miles of Lake Huron	5	2009 -2013
Dufferin Wind Power Project	Farmland - Inshore	49	2015
East Lake St. Clair	Farmland – Some within 3 miles of Lake St. Clair	55	2010 -2015
Enbridge Ontario Wind Power Project	Farmland – Perhaps 5 within 3 miles of Lake Huron	110	2009 -2014
Erie Shores Wind Farm	Farmland – 9 within 3 miles of Lake Erie	66	2006 -2007
Erieau Wind Farm	Farmland – 25 turbines within 3 miles of Lake Erie*	55	2014 - 2015
Ernestown Windpark Inc	Farmland – all within 3 miles of Lake Erie	5	2015
Ferndale Wind Farm	Farmland – all within 3 miles of Lake Huron	3	2007
Front Line Wind Farm	Farmland – 4 of 5 turbines within 3 miles Lake Erie	5	2010 - 2013
Gesner Wind Farm	Farmland - Inshore	5	2013 - 2015
Gosfield Wind Project	Farmland - Inshore	22	2011 – 2013
Goshen Wind Energy Centre	Farmland – 13 turbines within 3 miles of Lake Huron	63	2015
Goulais Wind Farm	Forest – 7 of 11 turbines within 3 miles of Lake Superior	11	2015

Wind Energy Facility	**Habitat – Proximity to Great Lakes[1]**	**Number of Turbines**	**Years of Study**
Gracey Wind Farm	Farmland – all turbines within 3 miles of Lake St. Clair	5	2011 – 2013
Grand Renewable Wind	Farmland - Inshore	67	2015 - 2015
Grand Valley Wind Farm I and II	Farmland - Inshore	9	2012 -2014
Greenwich Wind Farm	Forest/Brush - Inshore	50	2013 - 2016
HAF Wind Energy Project	Farmland - Inshore	5	2015 - 2016
Harrow I Wind Farm Project	Farm – 19 turbines within 2.5 mi Lake Erie	24	2010 - 2013
Jericho Wind Energy Centre	Farmland – 11 turbines within 3 miles of Lake Huron	92	2015
Kent Breeze Wind Farms	Farmland - Inshore	8	2011 – 2014
Kingsbridge I Wind Project	Farmland – 11 turbines within 3 miles of Lake Huron	22	2006 -2007
Marsh Line Wind Farm	Farmland – 3 turbines within 3 miles of Lake St. Clair	5	2010
McLean's Mountain Wind Farm	Mixed Forest/Farm – 10 turbines within 3 miles of Lake Superior	24	2015
Melancthon I Wind Farm	Farmland – Inshore	45	2006 - 2007
Melancthon II Wind Farm	Farmland - Inshore	88	2009 - 2010
Mohawk Point Wind Farm	Farmland – all less than 2 miles of Lake Erie	6	2009 - 2013
Naylor Wind Farm	Farmland - Inshore	5	2012 - 2013
North Malden Wind Farm Project	Farmland - Inshore	5	2011 - 2013
Oxley Wind Farm	Farmland – all less than 2 miles of Lake Erie	3	2014 - 2015
Pickering Turbine	Urban Park - <1 mile of Lake Ontario	1	2002
Plateau. All 18 turbines from I, II & III	Farmland - Inshore	18	2012 - 2014
Pointes Aux Roches	Farmland - Inshore	27	2012 - 2014
Port Alma and Chatham Projects Combined KEPA/KEC	Farmland – 10 turbines within 3 miles of Lake Erie	88	2011 – 2012
Port Alma Wind Power Project	Farmland – 18 within 3 miles of Lake Erie	44	2009 – 2010
Port Dover and Nanticoke Wind Project (PDNWP)	Farmland – 13 within 3 miles of Lake Erie	58	2014 - 2015

Wind Energy Facility	**Habitat – Proximity to Great Lakes**[1]	**Number of Turbines**	**Years of Study**
Prince Wind Power Project	Forest – all within 3 miles of Lake Superior	126	2006 -2008
Proof Line Wind Power Project	Farmland – all within 1.5 miles of Lake Huron	4	2010 – 2011
Providence Bay / Spring Bay Wind Farm	Farmland - Inshore	2	2013
Quixote One Wind Energy Converter	Farmland – about 1 mile from Lake Huron	1	2015
Raleigh Wind Farm	Farmland – about 25 are within 3 miles of Lake Erie	52	2012 - 2013
Ravenswood Wind Power Project	Farmland – all within 1.5 miles of Lake Huron	4	2008
Richardson Wind Farm Project	Farmland - Inshore	5	2011 -2012
Ripley Wind Power Project	Farmland – 9 of 33 within 3 miles of Lake Huron	38	2008
Skyway 8 Wind Farm A	Farmland - Inshore	5	2015
South Branch Windfarm	Farmland - Inshore	5	2014 - 2015
South Kent Wind Project	Farmland - Inshore	124	2014 - 2015
South Side Wind Farm Project	Farmland – 1 within 3 miles of Lake Erie	5	2011 - 2013
Springwood Wind Project	Farmland - Inshore	4	2015 -2016
St Columban 1 and 2	Farmland - Inshore	10	2015
Summerhaven Wind	Farmland – 1/3 turbines within 3 miles of Lake Erie	56	2014 - 2015
Swanton Line Wind Farm	Farmland – 1 within 3 miles of Lake Erie	5	2010 - 2013
Talbot Wind Farm	Farmland – Some within 3 miles of Lake St. Clair	43	2011 – 2013
Wainfleet Wind Power Development	Farmland – all within 5 miles of Lake Erie	5	2015 - 2016
Whittington Wind Project	Farmland (Inshore)	3	2015 - 2016
Wolfe Island Wind Farm	Farmland (some forest) – mostly Farm, Island in Lake Ontario	86	2009 - 2012

[1] Habitat was determined by examining current aerial imagery at each project site (Google Earth)

Appendix II. Risk to Bald Eagles at the Heritage Wind Project.

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Purpose and Rationale for Risk Assessment Specific to Bald Eagles

This section of the risk assessment for the Facility is specific to Bald Eagles. A separate risk assessment for these species was undertaken for two reasons. First, an incidental take permit has been requested for several different wind energy facilities by the New York State Department of Environmental Conservation (NYSDEC) and the risk assessment will provide insight into the likely numbers of birds that may be taken at the Facility. Second, there has yet to be a truly comprehensive risk assessment for eagles at wind energy projects in New York. The present risk assessment will provide information that has heretofore not been considered when estimating take. With these in mind, the information that follows considers risk to both Bald Eagles so that stakeholders gain a better understanding of the potential risk faced by these species in the United States (U.S.) and Canada in general and more specifically in New York. The information used herein will combine the results of studies done at the Facility that focused on eagle presence, abundance and behavior, the species health in New York, and empirically determined risk from the 170 post-construction fatality studies that have been conducted in the United States and Canada, focusing on Ontario and New York.

The following are detailed in this risk assessment:

- Laws protecting eagles in the US and New York,
- proposal from NYSDEC to delist Bald Eagle,
- the Bald Eagle population in New York,
- existing sources of mortality to eagles in New York,
- Bald Eagle fatalities at wind plants in the US, New York and Ontario and models used for estimating numbers of eagles that collide with wind turbines and validity of those models,
- preconstruction studies of Bald Eagle use at the Facility, and
- risk to Bald Eagles at the Facility.

Federal and State Laws Protecting Eagles in the U.S. and New York

<u>Federal - Bald and Golden Eagle Protection Act and Eagle Conservation Plan</u>

The USFWS Eagle Conservation Plan of 2013 provides a means for various types of entities (e.g., corporations, railways, owners of roads, governmental agencies, etc.) to legally take eagles at facilities (including renewable energy generation sites) and compensating/mitigating for that take. This incidental take is permitted under the BGEPA and is an administrative pathway to non-prosecution by issuing incidental permits for eagles killed during otherwise legal activity.

State of New York – Environmental Conservation Law. Eagles are protected under five sections of the Environmental Conservation Law of New York (ECL). New York also has its own form of eagle conservation plan that is modeled after the USFWS Eagle Conservation Plan of 2013. As stated in the 2016 Conservation Plan for Bald Eagles in New York State:

> "*Eagles are listed as a State threatened species pursuant to ECL Article 11-0535, which protects eagles and their occupied habitat. Eagles are also protected by ECL Article 11-0537. In addition, bald eagles are defined as wild birds and therefore are considered protected wildlife under ECL Article 11-0103. ECL Article 11-0107 provides protection by making it illegal to take protected wildlife except as permitted by the Fish and Wildlife Law. Finally, ECL 03-0301 (1)c, provides for the propagation, protection, and management of fish and other aquatic life and wildlife and the preservation of endangered species.*"

Proposal from NYSDEC to Delist Bald Eagle

In late October 2019, the NYSDEC announced a proposal (the Part 182.5 pre-proposal) that would delist Bald Eagle. The status of this species would change from Threatened to "species of special concern." The announcement (NYSDEC Delisting Announcement 2019) stated that Bald Eagle and several other listed species had undergone "significant growth in their numbers and range." Delisted species would no longer be "protected through a permit requirement for projects likely to cause harm to these species." The NYSDEC is also proposing draft changes consistent with the New York State Wildlife Action Plan. Decisions regarding the incidental take permit system for Bald Eagles, at this time, have not been announced.

The announcement stated that there are now nearly 400 nesting pairs of eagles in the state and they are "within every region, which is why NYSDEC is considering removing the bald eagle from the threatened species list." The announcement also quoted the following statement by Ana Paula Travares, Executive Director of Audubon New York: "The remarkable recovery of the Bald Eagle in New York State and beyond is one of our nation's best stories of conservation success." She also stated that resources should be "directed to those [species] at greatest risk…"

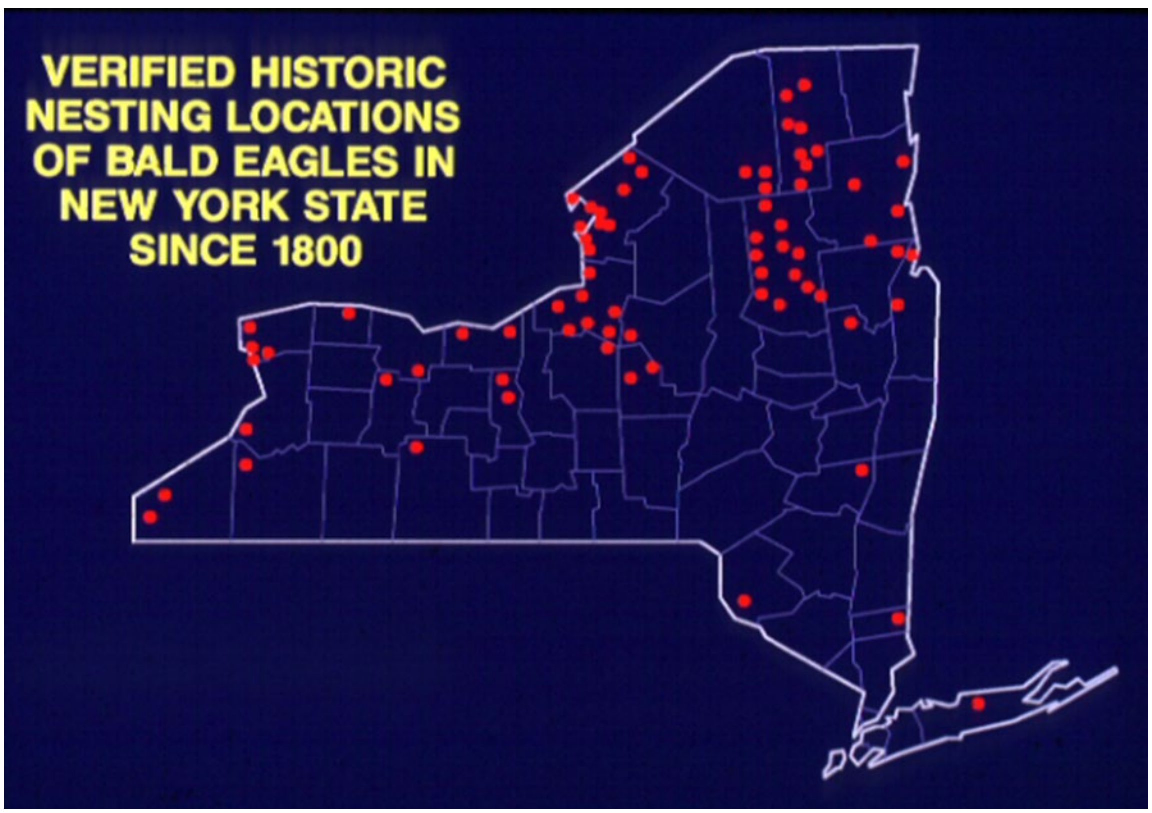
In the sections that follow, data from various Bald Eagle monitoring and surveys will be analyzed and interpreted with respect to risk to the species now that it is deemed fully recovered. It is important to note that the target population for New York was originally determined to be 200 pairs – the current population is now about double that number and continues to grow. The analyses below further describe this growth, including both absolute numbers and rate of growth. The data used in the analyses below were obtained from publicly available information published by NYSDEC and other sources that have informed the delisting process.

Bald Eagle Nesting Population in New York

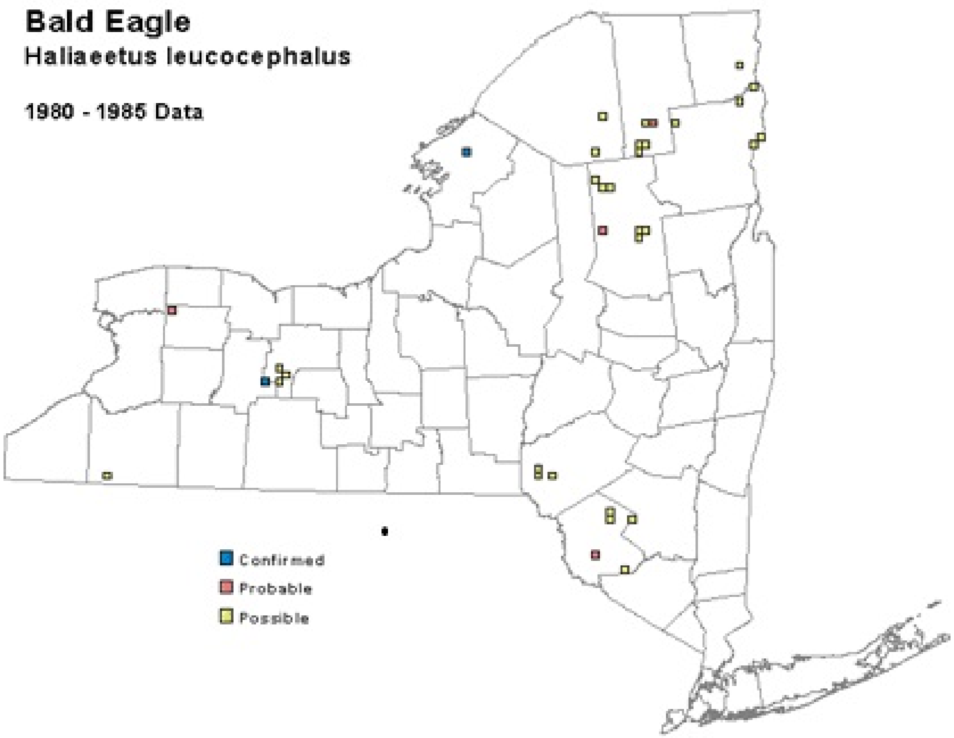
Geographic Distribution of Nesting Pairs. Until recently, nesting Bald Eagles have been restricted largely to the northern and western parts of New York. Figure AII-1 shows that as far back as 1800, most nests were concentrated in upstate New York (specifically the northern and central regions).

Fewer nests were in the southern part of the state and Long Island. More recently, nesting Bald Eagles have spread southward, including Long Island (Figure AII-2). Expansion has been particularly pronounced along the Delaware River and the Hudson River.

Figure AII-1. Historic approximate nesting locations of Bald Eagles in New York State since 1800 (NYSDEC 2016).



AII-2.). Bald Eagle nesting locations from the New York State Breeding Bird Atlas (1980-1985, Andrle and Carroll 1988– top and McGowan and Corwin 2008 (2000-2005, bottom).



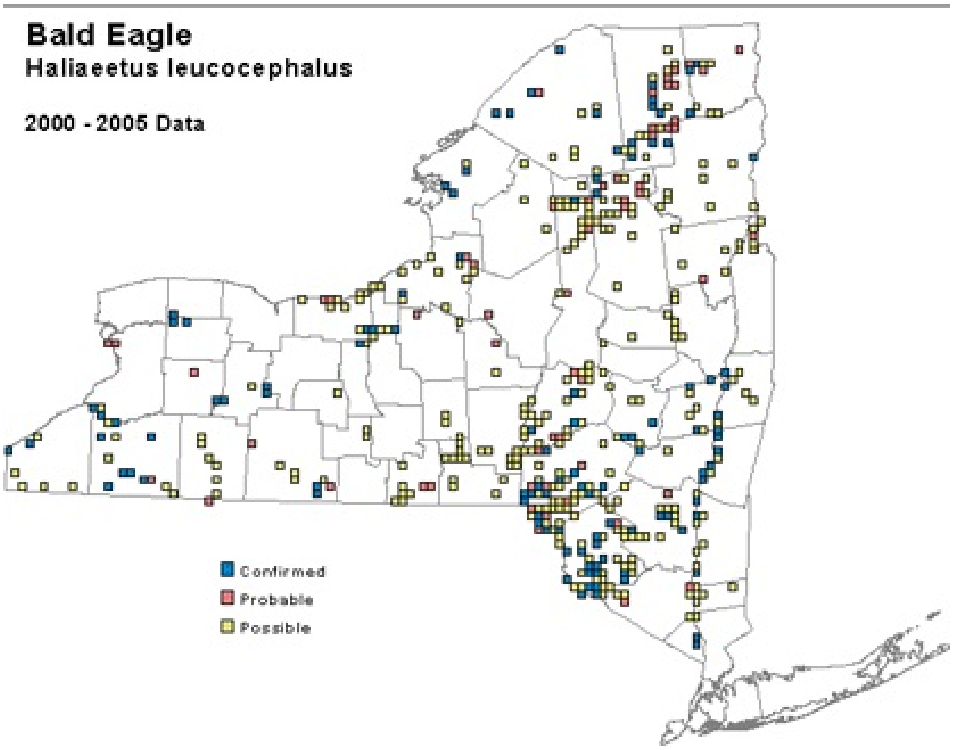


Figure AII-3. Bald Eagle territories (n = 331) as of 2014 (NYSDEC 2016) – 254 territories were active that year.

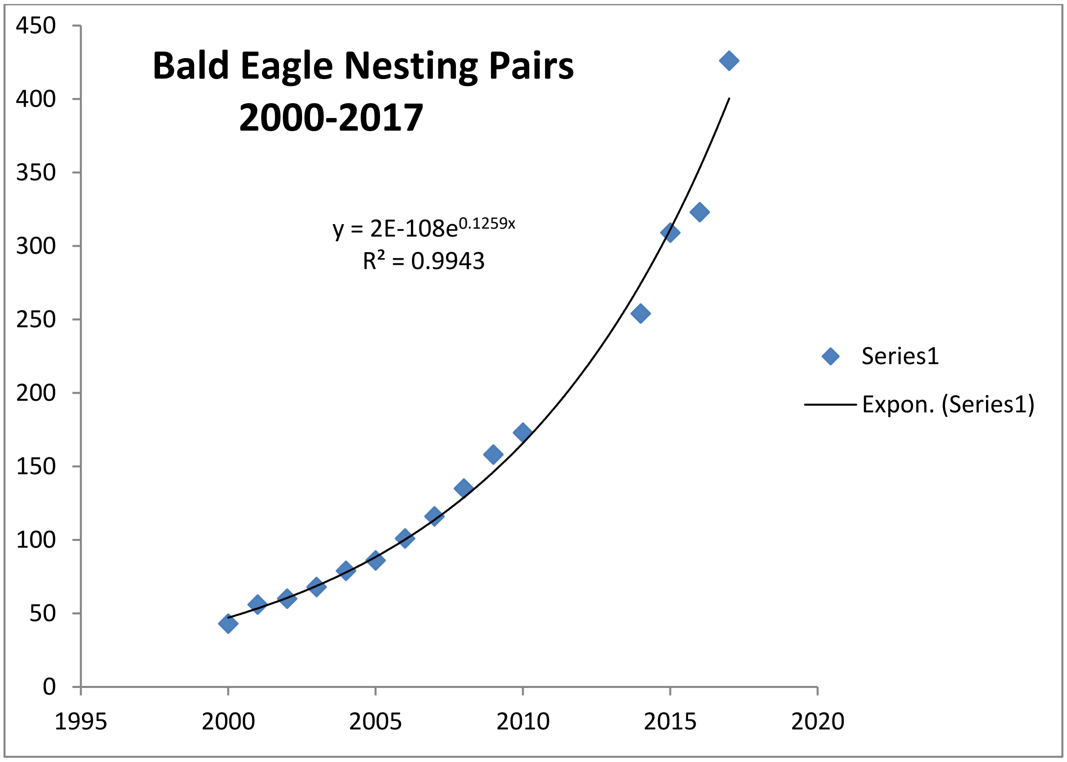
The fact that Bald Eagles are now present, including nesting, in fairly populated and semi-suburban areas, strongly suggests that they are habituating to human activity. In Figures AII-1, AII-2, and AII-3 it is obvious that in recent years nests have become more abundant in the southern portion of the state, including Staten Island and Long Island. The reason for nesting in seemingly inappropriate areas in southern New York is likely related to the need for new territories as the population expands rapidly upstate. It may also be that they have habituated to not being shot at or disturbed at their nests. This is likely because of laws protecting these birds and more importantly education. The latter has been mostly a result of the NYSDEC educating the public which has reduced shooting and poisoning of these and other birds. In addition, federal laws have banned the use of DDT and some other toxic chemicals that almost eliminated nesting birds in the state. Finally, the NYSDEC also conducted a strong restoration project in the 1970s and 1980s, which laid the foundation for the recovery of New York's eagle population.

Numbers of nesting pairs of Bald Eagles. The legacy of DDT lingered for many years after it was banned in 1972. At that time, there were about 20 nests in New York. The population grew slowly until in about 2000 at which time the numbers had risen to about 50 nesting pairs. After 2000, the number of nesting pairs increased more rapidly to nearly 400 pairs in 2017.

When graphed, the regression line (Figure AII-4) of number of nesting pairs in each year since 2000 follows a very rapidly rising curve. The fit is statistically significant at $p<0.001$ level and explains 98% of the variance. This indicates that the population is growing at an extraordinary rate. The strength of this relation and the steepness of the curve also shows that the NYSDEC recovery efforts over the years have worked and that their plan for recovery has resulted in a healthy and strong population in New York. Between the 400+ nesting pairs and young birds (hatching year to 4 year olds), there are now likely more than 1,200 Bald Eagles in the state at the end of the nesting season. This assumes only one immature eagle per nest, which is a very conservative estimate. Also see the wintering bird data below.

Just as important as growth in the number of nesting pairs is the fact that the average numbers of young fledged per nest has remained steady as the increase in nesting numbers has risen. With this increase has also come an increase in new territories every year.

Figure A-II-4. Growth of Bald Eagle nesting pairs in New York 2000-2017 (data from Nye 2010).



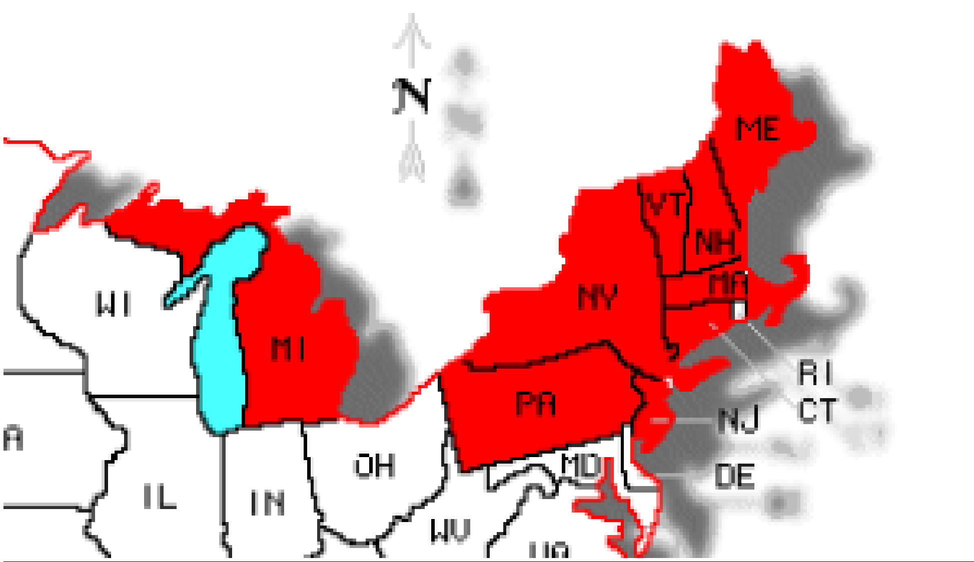
Another measure of robustness and health of the Bald Eagle "population" that nests in New York is the number and geographic range of immature birds that have dispersed or migrated to other states and Canadian Provinces surrounding the state. Figure AII-5 shows the states to which Bald Eagles that hatched in New York nests dispersed and subsequently nested. These birds were found in 9 states, ranging as far east as Maine and as far west as the Upper Peninsula of Michigan, with birds nesting in those states plus Ohio, Pennsylvania, New Hampshire Vermont, Massachusetts, Connecticut, New Jersey, Delaware, and Maryland.

In cases of states where the population was not recovering as quickly as New York after DDT was banned, emigrants from New York likely helped to repopulate other states that had undergone massive population declines. These "excess" individuals from New York nests wander during the first four years of life before they become sexually mature. This dispersal serves to prevent inbreeding as well as to spread genes in areas where "population" bottlenecks occurred. In those states, nests had been reduced in the 1970s to a very few nests (e.g., Pennsylvania 2 or 3, Ohio 4, Vermont 0 nests). It is also possible that as the number of nesting pairs increased in New York, fewer and less suitable habitats were available in which to nest. In these situations, birds wander until they find unmated adults with territories or they find unoccupied territories.

Ontario and Quebec are not included in the map, but eagle populations in those two Provinces have likely benefitted from the growing abundance and nesting success in New York and eagles from those Provinces have likely dispersed into New York, as well as other nearby states, thereby increasing genetic diversity.

This geographic fluidity of eagles dispersing from New York throughout northeastern North America suggests that there is no true population in the state. This dispersal strongly suggests that the true population (in biological terms) includes the Great Lakes, New England, and the Mid-Atlantic region because there is free gene flow among these areas. This expansion of dispersing individuals far beyond the borders of New York is also a very strong indicator that New York eagles are healthy and continue to increase in numbers, including beyond the borders of the state.

Figure AII-5. States outside of New York where eagle fledglings have nested. Map does not show data from Ontario, which also hosted New York fledglings as nesting birds (from NYSDEC 2016) .

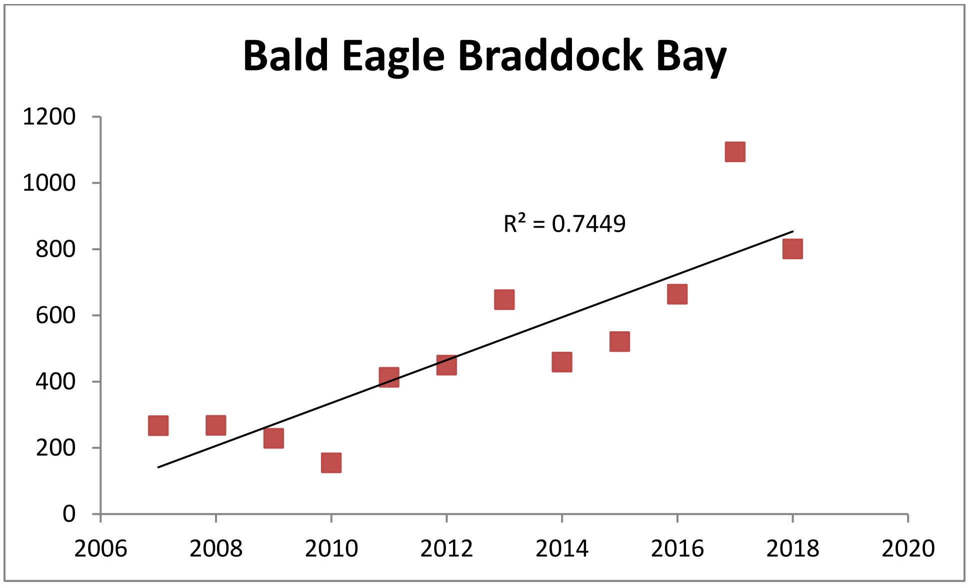


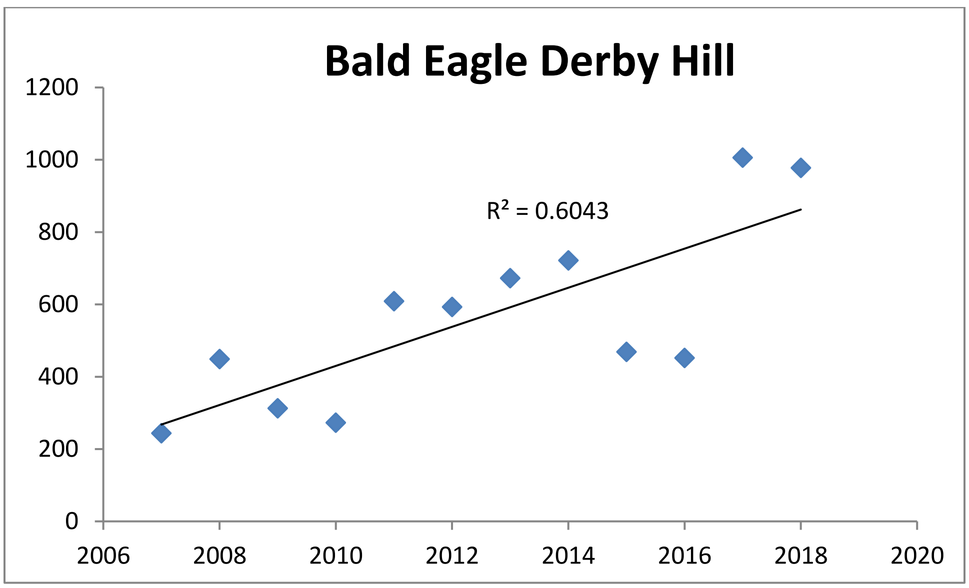
Bald Eagle Migration Numbers in New York

Similar to nesting numbers, the numbers of eagles migrating within or through New York have increased dramatically over the past dozen years. Counts of migrating hawks have been used as indicators of whether populations are increasing, decreasing or stable (Bednarz and Kerlinger 1989). Birds that migrate in New York add to the numbers of birds that could, potentially be at risk of colliding with turbines and it is of heuristic value when assessing risk to explore whether there is significant migration at or near the Facility Area and whether those migrants are increasing. To do that in New York, Bald Eagles documented sightings was used of migration at the two most important spring hawk migration sites in the state: Braddock Bay near Rochester and Derby Hill in Oswego County. Both sites are located along the shoreline of Lake Ontario many miles from the Facility.

Both Braddock Bay and Derby Hill Bald Eagle counts increased dramatically during the period examined. Prior to 2007, Bald Eagle numbers had already been increasing, but after 2012, the numbers rose at a more rapid rate. The slopes in Figure AII-6 both are linearly positive and statistically very significant. The regression lines show some variation among years, but both lines showed a strong upward trend explaining 60-74% of the variation among years. Between 2007 and 2018, the migration count of eagles at Braddock Bay and Derby Hill showed a roughly four-fold increase in that 12-year period. Also, note that the average numbers of Bald Eagles counted per year at these two sites were not significantly different (Braddock Bay = 497 ± 271 standard deviation vs. Derby Hill = 565 ± 251 standard deviation, not statistically significant, $p = >0.10$ for both randomized and paired t-tests). Also note that the Bald Eagles counted at these sites are likely to be breeders in Ontario and New York, and possibly Quebec suggesting robust and growing nesting populations in both the US and Canadian populations that migrate through New York.

Figure AII-6. Bald Eagle migration numbers counted at Braddock Bay and Derby Hill NY in Spring during 12, 2007-2018 (data from www.hawkcount.org).





Elsewhere in New York, there do not appear to be any major concentrations of migrating Bald Eagles, like those at Braddock Bay and Derby Hill in Monroe and Oswego Counties, respectively. There are a very small number of observation sites where upwards of about 20 Bald Eagles are seen in fall. The closest concentration points for larger concentrations of fall migrating Bald Eagles are more than 120 miles southwest of the Facility. Those are in eastern Broome County (Sanford) and on the border of Delaware and Otsego counties near Oneonta (Franklin Mountain). Those sites generally report less than one-quarter of the numbers reported for Braddock Bay and Derby Hill. They are both located in the northern extension of the

Appalachian mountains and are on ridges. Franklin Mountain overlooks the Susquehanna River a few miles to the north and birds may follow that river.

The Sanford and Franklin Mountain sites are also located on ridge-tops that concentrate migrants that are seeking orographic updrafts to aid their flight. For these reasons, the migration of Bald Eagles at the Facility Area is expected to be minimal because there are no ridges. This is substantiated by the migration counts done in three seasons at the Facility. Numbers of Bald Eagle sightings were minimal with between 9 and 20 sightings per migration season (0.07-0.19 per hour). Some of these sightings may also have been the same bird(s) sighted multiple times.

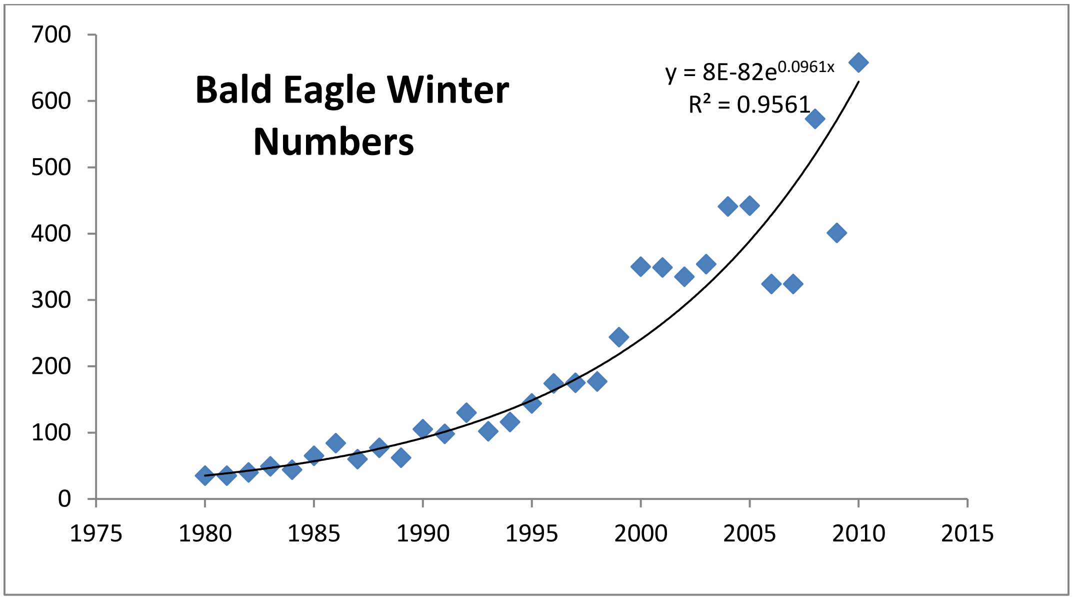
The migration concentration areas in New York have very different topography from the Facility Area. The Facility Area is more than 10 miles south of Lake Ontario in relatively flat country with very gently rolling hills. Unlike Braddock Bay and Derby Hill, there is no lakeshore or prominent topography that may concentrate large numbers of Bald Eagles near turbines during spring or fall migration.

Wintering Numbers of Bald Eagles in New York

As with nesting and migration numbers, winter numbers of Bald Eagles in New York have increased at a non-linear rate (Figure AII-7). Before 1980, not shown in Figure AII-7, fewer than 40 eagles were known to winter in the state. In the mid-1980s the numbers increased dramatically and by 2010, the numbers were increasing at a steep, non-linear rate. The fitted line explains 95% ($p < 0.01$) of the variance, which means that there was a very steady increase. This indicates the increase was very robust.

The mid-winter eagle survey does not appear to have continued after 2010, although it is possible that it has been done, but no results are available. From the previously published data, the large concentrations were in southern New York along the Hudson River and Delaware River, with lesser concentrations closer to the Great Lakes and other bodies of water. Overall, the mid-winter counts of eagles in New York has mirrored the nesting bird and migration count numbers, with a steady and strong increase since the late 1990s or early 2000s. It should be noted that the migrating and wintering numbers reflect not only increases in New York but also in Canada and, to a lesser degree, other states.

Figure AII-7. Mid-winter Bald Eagle survey numbers gathered during standardized surveys from 1980 to 2010 when surveys ended (from Nye 2010).



Sources of Bald Eagle Fatalities in New York

Bald Eagles are killed by different natural and human activities in New York (Table AII-1A and AII-1B). Excluding natural mortality such as eagles killing each other over food or territory, there are roughly ten human activities that kill eagles in New York. These include collisions with automobiles, collisions with Amtrak trains, other collision trauma, lead poisoning from hunting ammunition, other toxins/pesticides, electrocution, collision with aircraft, shooting, fishing paraphernalia and trapping (NYSDEC 2016; testimony of DEC in Baron Hearing – Bald Eagle 4, Figure 1). Not all activities listed in Tables AII-1A, AII-1B killed eagles annually. During the period 2000-2017, human activities killed 276 Bald Eagles including one fatality resulting from a collision with a wind turbine. During the period 2007-2013 none of the 137 Bald Eagles killed by human activities were found at wind turbines.

Existing Eagle Mortality Databases. The USFWS has an eagle mortality database, but limits public access. Some state wildlife agencies, such as the Michigan DNR, maintain a database of eagle mortality that is accessible. The Michigan DNR database is one of the most extensive and accessible databases when it comes to eagle mortality records. The database dates back more than 30 years and has 1,000+ records of eagle fatalities during the 25-year period ending in 2012. The database details the causes of death and includes toxicological information, when tests were performed. The average number of fatalities in that 25-year period was about 40 per year.

The NYSDEC was queried during an agency meeting on 27 September 2019 in Albany as to whether the agency maintained an eagle mortality database and if so, was it available to the public. The NYSDEC biologists did not confirm if the State of New York maintains an eagle mortality database. However, the NYSDEC submitted document (NYSDEC-BA-4,) as an exhibit in the Baron Wind Energy hearing that listed the causation of 481 Bald Eagle fatalities found during the 18 year period from 2000 to 2017.

A review of Table A-II-1A shows 276 (57.4%) of the 481 Bald Eagle fatalities found in NYS and presented as an exhibit in the Baron Wind hearing, were a result of human activity. A second list of Bald Eagle fatalities and causes was presented in the 2016 Bald Eagle Conservation Plan (NYSDEC 2016). Fatalities caused by human activities in the latter document are presented in Table A-II-1B. That table differs slightly from Table AII-1A and shows a wider variety of human caused fatalities than does the previous table, despite the fact that the data presented for the Baron Wind hearing included a period of years that was twice as long (2000-2017 vs. 2007-2013). Nevertheless, the types of human activities that caused the greatest numbers of fatalities were similar between the two time periods.

The human activity that was responsible for the most fatalities in both datasets was collisions with automobiles followed by collisions with trains. Together, these two categories accounted for one-half of human caused fatalities, and equaled roughly 7-10 eagle fatalities per year. Lead poisoning accounted for 16-17 percent in the two databases or about 3.2 fatalities per year. The remaining human caused mortality, accounted for much lower percentages of the overall fatalities. Overall, human activities caused 15-19 fatalities per year (Table A-II-1A, Table A-II-1B). Eagle fatalities from wind energy facilities were not included in the NYSDEC hearing exhibit . However, one documented Bald Eagle was killed at an operational NY wind farm during in 2015 period (included in Table A-II-1A). This single Bald Eagle fatality accounted for 0.3 percent of the total human caused eagle fatalities during that 18-year period or 0.06 birds per year. Lead poisoning between 2000 and 2017 accounted for 59 times more eagle fatalities in New York than did wind turbines. On a per turbine basis, the single eagle fatality represented one fatality at nearly 1,000 turbines or 0.001 birds per turbine per year. The rate is actually lower because hundreds of turbines were standing during the years prior to 2015, which were not included in the 0.001 birds per turbine per year statistic. Also, no fatalities were reported between 2016 and 2018 when upwards of >1,100 turbines were operating in the state.

Table A-II-1A. Summary of human activity causes of death for Bald Eagles found in New York 2000-2017. Natural causes not included.

Cause of Death	Number of Fatalities	Percentage of Total (Only for COD Determined)	Fatalities per Year (18 years)
Motor Vehicle Collision	101	36.6%	5.6
Electrocution	33	12.0%	1.8
Shot	9	3.3%	0.5
Other Poisoning	9	3.3%	0.5
Lead Poisoning	59	21.4%	3.3
Train Collision	64	23.1%	3.6
Wind Turbines	**1**	**0.4%**	**0.06**
Total	**276**		**15.3**

Source: Baron Wind Energy Hearing - Bald Eagle Figure 4 Figure 1

Table A-II-1B. Summary of human activity causes of death for Bald Eagles found in New York 2007-2013 (data from NYSDEC 2016).

Cause	**2007-2013**	**Percentage of Total**	**Fatalities Per Year**
			(7 years)
Vehicle Collisions	46	33.5%	6.6
Train Collisions	32	23.4%	4.6
Other Collisions	10	7.3%	1.4
Airplane Collisions	2	1.5%	0.3
Lead Poisoning -hunter ammunition	22	16.1%	3.1
Other Poisons	7	5.1%	1.0
Electrocution	10	7.3%	1.4
Shooting	5	3.6%	0.7
Fishing Tackle	3	2.2%	0.4
Total	**137**		**19.6**

Of importance, none of the 137 human caused eagle fatalities reported in the NYSDEC Plan (Table AII-1B) data were attributed to operational wind turbines. Thus, as wind turbines increased from 263 to 986 over the seven year period between 2007 to 2013, there were no documented Bald Eagle fatalities in NYS.

Lead Poisoning. Bald Eagle fatalities found near wind turbines have, to date, been assumed to be caused by wind turbines, despite the fact that toxicological screening of those carcasses has not been reported by USFWS or other agencies involved. The numbers of Bald Eagles killed by lead poisoning may be underrepresented in the NYSDEC datasets presented in Tables AII-1A, AII-1B.. The reason is because birds that have eaten lead may die in remote, uninhabited areas (i.e., forested tracts), whereas birds killed by motor vehicles or trains generally die close to where the collision occurred and are quite visible to passersby.

According to Dr. Krysten Schuler, a wildlife disease ecologist with the Cornell University College of Veterinary Medicine at the New York State Animal Health Diagnostic Center, 83 percent of 300 Bald Eagles tested over the past 22 years for toxins were positive for exposure to lead in New York. Of the 300 Bald Eagles tested, 51 or 17 percent had levels high enough to cause death (https://news.cornell.edu/media-relations/tip-sheets/tracing-lethal-legacy-lead-poisoning-nys-bald-eagles). This level of lead concentration can impair a multitude of behavioral attributes ranging from minor neurological interference to muscular impairment. This level of lead concentrations in New York Bald Eagles could be an impairment that increases the risk of collisions with cars or trains more often than birds without such levels. Thus, it is possible that elevated lead concentration levels within Bald Eagles increases the probability of collisions with anthropogenic sources. Without toxic substance screening of Bald Eagle found dead along roads, rail lines, or even at wind turbines, the ultimate causes of death to these birds cannot be conclusively determined.

Bald Eagle Fatalities at Wind Turbines in the US, New York and Ontario

Since the 1990s, there have been roughly 170 post-construction fatality studies done at wind projects in the US and Canada (Allison et al. 2019). As of 2018, 55 Bald Eagles had been found dead at operational U.S. wind farms (Kritzler et al. 2018). Of those Bald Eagles, 41% were adults, with 10% being juveniles (1st year), and 6% being immature (2-4 years). For the remaining 31%, age was not reported. At that time, there were about 57,000 wind turbines operating in the US.

US Bald Eagle Wind Turbine Fatalities. According to the USFWS website, a roughly 50% increase in Bald Eagle nesting pairs in the lower 48 states occurred between 2000 and 2006. In 2000, there were 6,471 nesting pairs and in 2006 there were 9,789 nesting pairs. In 2007, the conterminous U.S. population was determined to be "recovered" by USFWS and it was removed from the Endangered Species Act threatened species list. As of 2015, the population grew to about 14,000 nesting pairs (https://www.eagles.org/what-we-do/educate/learn-about-eagles/bald-eagle-demographics/#toggle-id-5). This number is more than 4,000 pairs (40%) greater than the original Bald Eagle recovery plan considered to be "recovered."

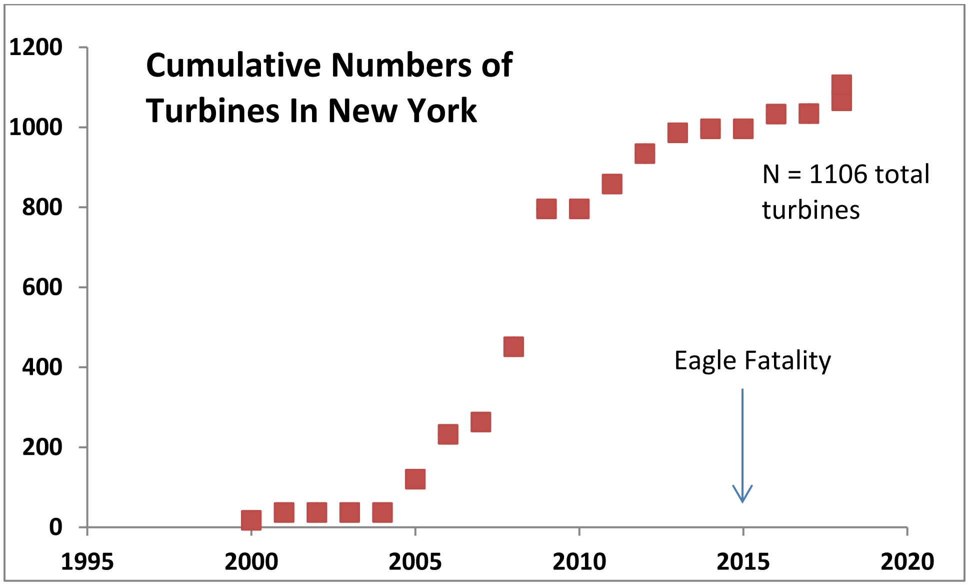
Fatalities have increased as more turbines have been built, but the numbers of fatalities do not appear to have had an impact on the overall nesting population in the U.S. nor on nesting numbers in any state. This strongly suggests that Bald Eagles are not particularly susceptible to colliding with wind turbines and that Bald Eagle collisions with wind turbines are very rare events. This is a rate of approximately one fatality per 1,036 turbines for all years in which wind turbines have been operating. Obviously, there were fewer turbines in earlier years (Figure AII-8), but note that the fatality rate increased after 2016 as many more wind turbines were added to the landscape (https://www.fws.gov/midwest/eagle/NestingData/countatdelist.html). Also, because the total numbers of Bald Eagles nesting in the US is now likely more than 14,000 nesting pairs, the fatality of small numbers of Bald Eagles poses no significant threat to that population, especially when considering that the fatalities were spread over several years and many states (Kritz et al. 2018). Thus the fatality rate is very low, despite the recent increase in the number of operational wind turbines in the US.

New York Wind Turbine Fatality. In New York, to date, only one Bald Eagle has been found dead at a wind project. <BEGIN CONFIDENTIAL INFORMATION/> [redacted] </END CONFIDENTIAL INFORMATION> The Forensic Necropsy Report, done by a NYSDEC forensic scientist, did not include toxicology information about that bird and the report did not mention whether such an analysis was done. Thus, it is not known if the bird was toxicologically or in other ways compromised at the time of its death by some sort of poison, such as ingested lead (i.e., elevated lead concentration levels) or illness. The bird likely died in 2015. By the end of 2015 there were 996 wind turbines operating in New York State at more than 20 different project sites. (Note: Carbofuran, an agricultural pesticide, was believed to have killed about 20 Bald Eagles in the Delmarva between 2016 and 2019. [Baltimore Sun May, 2019])

Canada Wind Turbine Fatality. As of 2017, there were 83 wind projects for which post-construction fatality studies had been done across Canada with 63 in Ontario (Bird Studies Canada et al. 2017). The total numbers of turbines for Canada at that time was 2,570 and for Ontario it was 1,613. From the 83 fatality studies conducted at wind projects in Canada, only 2 Bald Eagle fatalities were noted, both from Ontario. These studies were conducted 2006-2016, during 135 study years of study (average – 2.1 years of study per project). The very low rate per turbine per year (2 of 1,613; 0.001 per turbine per year in Ontario) was similar to that found in New York. Again, this very low fatality rate and absolute number of fatalities adds credence to the earlier suggestion that this species is not very susceptible to colliding with turbines, nor are wind turbines significantly influencing the population in Ontario or other parts of Canada.

Overall Bald Eagle Wind Turbine Fatalities. In conclusion, Bald Eagle fatality rates at wind turbines have been low in both the U.S. and Canada. Fatalities have been especially low in eastern states and Ontario, where eagle nesting numbers have increased dramatically, in parallel with increasing wind turbine numbers. The very low rate and absolute numbers of eagles killed over the past 20 years at wind turbines strongly suggests that impacts are not resulting in population level impacts to eagle numbers in any state. Of note, there are no publicly available toxicological reports for the <60 Bald Eagles that have collided with wind turbines. Such information is needed to confirm the actual causes of death to eagles that are found dead beneath wind turbines and those reported killed by vehicles, trains and other human sources of mortality. If those birds are demonstrated to have elevated lead levels, eagle fatality numbers will necessarily need to be adjusted to reflect the actual cause of death. To date, it has been assumed, perhaps incorrectly, that turbines have been responsible for any and all eagle fatalities found near these structures.

Figure AII-8. Cumulative numbers of turbines at 25 wind energy projects in New York since 2000. Bald Eagle fatality was in 2015 (shown on x-axis).



Collision Risk Models (CRM) For Predicting Collision Numbers at Wind Facilities and Tests of Those Models

As part of their incidental take permit system for eagles, the USFWS (2013) attempted to provide a means of proactively determining fatality numbers of eagles at wind energy facilities. Prior to attempts to quantitatively predict numbers of fatalities, qualitative estimates were sometimes used by agencies and consultants. Those predictions were in essence, guesses in which risk was characterized as "low", "moderate," or "high", and none of which were of value for managing and protecting eagles.

The USFWS 2013 model was the product of an evolving risk assessment process that had been in existence since the early 2000s when wind energy was expanding from California to many other states. The process for model construction has been iterative with the earliest models being crude and not having predictive value. The model has even evolved since the USFWS 2013 model appeared. In 2015, New et al. (2015) introduced a new type of model that relied on three factors and utilized a more probabilistic approach. That model focused on Golden Eagles, as opposed to Bald Eagles. Since then, there have been revisions by the USFWS such as their USFWS (2016) and more recently changed to the 2015 model that was a very sophisticated Bayesian statistical approach that incorporated "priors" (https://www.fws.gov/birds/management/managed-species/eagle-management.php). The Bayesian prior probability distribution methodology was based on prior knowledge of risk to eagles from different geographic areas, as well as site specific information on the birds in question. Thus, risk exposure is part of the model, with several different measures of risk exposure coming from data collected at a given site prior to construction of turbines. These parameters are then put into a model with the output being the numbers of eagles likely to be killed per year at a given wind energy project. Thus, the model is adaptive and changes as more is learned.

Note that, to date, no models presented in peer reviewed journal papers have focused specifically on Bald Eagles. Previous models were mostly based on Golden Eagles, for which fatalities at turbines have been orders of magnitude greater than fatalities of Bald Eagles. The fatalities of Golden Eagles have primarily been at the 5,400 turbine Altamont Pass Wind Resource Area and a few other sites, all on the western Great Plains to the Pacific Ocean. The reason Golden Eagles are killed in far larger numbers than Bald Eagles appears to be mostly related to differences in foraging behavior of these two species (personal observations in Altamont, California, Michigan, and elsewhere). Golden Eagles actively pursue or ambush their prey while flying at low altitudes whereas Bald Eagles generally forage at higher altitudes and are less aggressive during foraging bouts. The latter species relies largely on finding carcasses which do not require chase or other activities that distract them from seeing obstacles such as turbines. Thus, collision risk models developed for Golden Eagles may not be applicable to Bald Eagles and those models for Golden Eagles have barely been tested and shown to be accurate predictors of risk.

Another recent development that has not yet been truly validated or implemented has been announced recently by the USFWS (2019 website) and will appear in the Federal Register in 2019. This latest effort is a means of identifying “low risk sites” for eagles. It is an expedited process that involves the identification of low risk sites and what is needed for permitting wind projects. These new rules would also reduce the amount of preconstruction studies needed to get such permits. It is not known how this “model” will fare when tested and it appears as though it may have been discontinued, at least in the short term.

There are several criticisms that have been leveled at the CRMs. Most important is the fact that the models keep evolving. The time between revisions does not permit a rigorous test of the predictions made by each iteration of the CRMs. Validation testing would include predictions of the model using calculations based on preconstruction data vs, results of post-construction studies. This would allow the CRM to make a prediction as to how many eagles would be killed at a particular site and then compare that prediction to how many eagles were actually killed. In addition, confidence intervals should be examined and compared to all other wind energy sites to make sure that a particular iteration can predict without having confidence intervals that are so wide that they capture all levels of mortality (e.g., 0 birds per year at a given site to 50 birds per year). Field testing of models is particularly important because the mitigations and even testing of successive models is very costly and takes years to accomplish. There have been a few de facto tests of the CRMs. The model as of 2012 was field tested and shown to be inaccurate.

One test of the USFWS model was done at the 14 turbine Garden Wind project in the Upper Peninsula of Michigan. Matt Stuber of the USFWS Michigan Field Office provided an estimate (prediction) of take for that project which amounted to 1.6 (without confidence limits) Bald Eagles killed per year. Garden Wind assumed that the model was the most recent used by USFWS (described in the 2013 ECPG document). The Garden Wind site is in the Garden Peninsula, which is a relatively high use area for Bald Eagles, including both nesting and migration. There were 6 nests within 10 miles of the turbines, and one wind turbine being only 1.4 miles from the nearest Bald Eagle nest. More eagles were known to nest on the peninsula at farther distances from the project. The USFWS model was tested by conducting a bird fatality study for two years (2012 to 2014). During the study, a total of 1,100 turbine searches were conducted year-round including all turbines. No Bald or Golden eagles were found dead at that site during the two-year study, and none has been reported since then. (One field observer did find a dead adult Bald Eagle on a public road more than 10 miles from the project site.) Thus, the model failed to accurately predict collisions of Bald Eagles. There is no evidence that the information from this test of the model has been used by USFWS or anyone for revising the model, although the post-construction study report was delivered to the Michigan Field Office and the Region 3 Office. It is not known why the model incorrectly predicted so many fatalities when none occurred. No other tests of the CRMs could be found in the literature.

One of the problems with predicting fatalities of individual species is that there is little to no data on the avoidance behavior of birds. In other words, birds have been shown to see and avoid wind turbines, but there is little data on what percentage of eagles or other birds see and avoid colliding with these structures. With the complexity of some of the models, it is difficult to understand how a factor for "avoidance" behavior is or could be included, thereby potentially increasing the predictive accuracy. Because Bald Eagles regularly fly through, over, or close to fields of wind turbines, avoidance may be greater than 99%. That can be determined via observations at operating wind plants.

Another problem, which may be the most important, is the fact that there have been so few Bald Eagle fatalities at wind turbines that predicting such low values of mortality is virtually impossible. With actual fatality values being so low (e.g., 0 or 1 fatality during 5-15 years of operation) for Bald Eagles at wind energy facilities that confidence intervals will be difficult to calculate and may prove too great for statistically accurate prediction of such small annual fatality rates. With only about 60 collisions of Bald Eagles at more than 60,000 turbines now operating in the U.S. and Canada over the past 20 years, the potential variability from site to site and year to year is daunting. Most wind projects have never killed an eagle. Models may not be able to predict less than 1 or 0.1 eagle fatalities per year per wind project. Add to that the potential for eagles to have varying levels of lead or other toxins in their systems makes prediction almost impossible. Statistical control for toxicological issues might be possible if the agency data from toxicology screening of eagle fatalities at turbines were available and could be used as a factor in the CRMs.

NYSDEC Collision Risk Model. The NYSDEC has used a collision risk model to estimate incidental take for at least two wind projects in New York. Those include Baron Wind (2019, 69 turbines) in Steuben County and Bluestone Wind (2019, 27 turbines) in Broome County. The NYSDEC, in written testimony submitted for both of those Article 10 projects, estimated that 41 Bald Eagles would be taken during the life of the project at Baron Wind and that 6 Bald Eagles and 3 Golden Eagles would be taken during the life of the Bluestone project. The NYSDEC fatality estimate for Bald Eagles included young or eggs in the nest that would not survive if a parent were taken by the project. The Baron estimate of 41 Bald Eagle fatalities provided by the NYSDEC is one of the highest take estimates in the US. This is especially the case when considering that only about 60 Bald Eagles have been demonstrated to be killed by the tens of thousands of turbines in the US and Canada during the entire history of wind energy. However, because no details regarding the NYSDEC CRM or calculations used by the NYSDEC, model results may not be credible.

It is important to note that there is no documentation for Golden Eagles being killed by a wind turbine in the eastern United States, including New York and Ontario. Based on a review of the Bluestone NYSDEC written testimony, the estimate was based on the fact that Golden Eagles migrate through the project area in Steuben County. However, there has never been demonstrated risk to actively migrating Golden Eagles. These birds migrate along the Great Lakes Shorelines and there are 32 projects in Ontario with turbines within 3 miles of Lake Erie and Lake Erie. There are also some projects in the United States that are close to the Great Lakes and migration pathways for Golden Eagles, yet no fatalities of these birds have been reported from any of the wind projects close to the Great Lakes.

The shoreline of Lake Erie in Ontario also has one of the highest densities of Bald Eagle nests in Ontario (perhaps eastern Canada) and is a primary corridor for Bald Eagles migrating southward out of Ontario during fall. There are actually more projects along the Great Lakes shorelines if the other Great Lakes are considered. Yet, despite the fact that there have been fatality studies at all of these projects, only two Bald Eagle fatalities were reported as of 2017 (Bird Studies Canada, et al. 2017). There were also no fatalities at any of the 24 wind projects (1,000+ turbines) that have been studied along Appalachian ridges. Hundreds of Bald and Golden eagles migrate along the Great Lakes Coastlines and Appalachian ridges. Thus, in direct contrast to empirical data, the NYSDEC model predicted 6 Bald Eagles and 3 Golden Eagles would be killed at Bluestone.

With these high estimates in mind, Heritage Wind inquired how the NYSDEC conducts risk assessments and the basis for their model. The NYSDEC revealed that their fatality model was not based on quantitative calculations. The NYSDEC also stated that the methods did not follow any rigorous methodology. In addition, the NYSDEC does not rely on the USFWS CRMs that are required for the issuance of eagle take permits through the Eagle Rule. Lastly, the NYSDEC model has also not been validated with empirical data. With only one Bald Eagle fatality in New York reported since 2000, how could any model predict to such a low fatality rate?

A key criticism of the 41 Bald Eagle estimate for Baron Wind is that the model was not based on an accepted or previously peer-reviewed methodology. Other parts of the NYSDEC model included the lack of replacement of nesting adult eagles that were part of a pair raising young. In other words, the NYSDEC fatality model does not consider the basic biology of eagles in that a new mate could replace mates who died. Such pair replacement, when a mate dies, is very common (Grubb et al. 1988) and is the reason why so many territories are occupied year after year. When one of a pair dies, the other will readily accept a new mate so that its reproductive success is insured. Replacement is particularly important because in New York there are large numbers of unpaired, adult eagles that are looking for mates and open territories. The fact that the population in New York has expanded so rapidly is the reason why there are so many adults and subadults that are not currently nesting and are available to join an unmated individual that has an established territory. As was noted earlier, some of the surplus birds are moving to other states or Provinces where they have found open territories and unpaired adults.

Two other shortcomings of the NYSDEC model, is that it does not take into account the lower value of a young bird in a population as opposed to an adult nor does it consider toxicological impairment. Young birds naturally die at a higher rate than adults, mostly because of inexperience. According to the USFWS in 2018, about 48% of the Bald Eagles reportedly killed by turbines in the US, and the one bird killed in NY, were immature birds. This suggests that the NYSDEC model, which is based only on adults, will overestimate impacts. The issue of toxicological impairment was previously discussed above in the section that detailed known causes of Bald Eagle fatalities in New York. Without the calculations used by the NYSDEC, it cannot be determined if these factors were considered or how they were incorporated in the model.

The above shortcomings of the NYSDEC model suggest that the estimate of 41 Bald Eagle fatalities predicted at Baron is far too high.

Preconstruction Studies of Bald Eagle Use at the Facility

During the period 2016-2018 several types of studies were conducted to determine eagle presence, use, abundance and behavior at the Facility. Most important among those studies were the use studies and aerial nest survey. See Table 1 in the main body of the avian risk assessment for a list of studies done.

Although not focused on eagles, breeding bird studies were done in 2017 and 2018. These studies were conducted along 17 transects in 2017 and 20 (turbine and control/reference sites) in 2018. These transects covered most of the Facility, certainly enough to detect Bald Eagles if they were present and nesting in the Facility Area. The studies were done in May and June of those years. No Bald Eagles were found nesting within the Facility Area.

The Small Bird, Large Bird, and Bald Eagle studies were done over the course of two years, December 2016-November 2018, using methodology directly from USFWS Eagle Conservation Plan (2013) guidance document. They were done in cooperation with the NYSDEC and totaled 648 hours of observations spread throughout both years. The studies included observations at 16 point count locations where eagle behavior, including height, time within 800 m of the observation point and age of the eagles was recorded. A total of 63 Bald Eagle sightings were recorded: 35 in 2017 (0.09 per hour) and 28 in 2018 (0.11 per hour). This constitutes relatively low use at the Facility. Most eagles were observed in March and April in both years (March-April 2017 = 13 sightings; March-May 2018 = 20 sightings). Thus, 33 of 63 (52.4%) sightings were in the spring. Other eagle sightings were spread throughout the year. Hourly rates (0.09 per hour in 2017; 0.11 in 2018) strongly suggest low use but relatively consistent presence of eagles, which may be the same individual eagles being counted repeatedly. Eagles were distributed throughout the Facility Area. During the two-year survey period, 39 of 63 (61.9%) eagle sightings were estimated to be flying between 50 and 200 m, which is within the rotor swept height.

An aerial nesting survey was conducted in 2018 on May 6-7. At the time of the survey, trees had not leafed out so eagle nests would be visible if present. No nests were found within the Facility boundary. Flights included the buffers, Facility and out to 4 and 10 miles from the Facility boundary. Although no eagle nests were found within the Facility, three active nests were detected. <BEGIN CONFIDENTIAL INFORMATION/>[redacted]</END CONFIDENTIAL INFORMATION> A second was 8 miles from the Facility Area and the third was more than 5 miles outside the Facility. All of these nests were outside the ½ inter-nest distance from turbines, as recommended by USFWS.

The USFWS provided information on additional nests, three of which were active and within the Iroquois National Wildlife Refuge (INWR) more than 4 miles outside the Facility Area. In addition, the NYSDEC provided the locations of two additional nests – one located within the Tonawanda Wildlife Management Area (TWMA) more than 8 miles outside the Facility Area, and another located approximately 5 miles southeast of the Facility Area. Both of these locations were visited and determined to be unoccupied.

Raptor migration surveys were conducted during three migration seasons: spring 2017 and 2018 and fall 2017. These were done at 16 observation points alternating half of the points per week. It is important to note that the spring migration seasons overlap completely with the nesting season. No nests were observed, suggesting none were present within the Facility Area. During the three seasons 47 eagle sightings were made, for a rough average of about 15 sightings per season. These may not have been independent sightings because eagles often have territories in winter, so some of the sightings were likely of the same individuals counted more than once. These numbers of eagle sightings are not great nor do they suggest high risk to eagles.

Winter raptor studies were done for 2016-2017 and 2017-2018. The surveys were accomplished every two weeks by driving along roads within the Facility Area two times per month from November through late March and conducting observations at 8 fixed point locations. A total of 16 Bald Eagle sightings were made during two winters within the Facility Area. An additional 4 eagles were sighted adjacent to the Facility Area within the airport setback area. As with the migration surveys, some sightings may have been repeated observations of the same individuals.

Surveys were done to determine eagle presence and abundance, both nesting and non-nesting, their migration numbers, their winter numbers, as well as their flight behavior while at the Facility. The methodologies used followed the USFWS's ECPG (2013) and were done in cooperation with the NYSDEC and their guidelines from 2016. Two full years of observations were made in an effort to gather the data needed to determine risk to these birds. Note that there is no precise or validated method for using such numbers to predict risk. It is believed that the type of data collected provide some indication as to risk of these birds with respect to collisions with turbines.

Risk to Bald Eagles at the Facility

With so few fatalities of Bald Eagles in the US, Ontario, and New York, there are no known or empirically demonstrated risk factors for Bald Eagle collisions with wind turbines. No peer reviewed studies have examined this issue, probably because fatality data are so scarce and with such a small sample size to work with, it would be almost impossible to find statistically significant relations between hypothesized risk factors and actual fatality numbers. Thus, with such small sample sizes, despite 20 years of intensive searches at wind turbines, it is extremely difficult to determine if there are risk factors and what they are.

The following list of turbine structures and layout have been hypothesized or demonstrated to present risk to Golden Eagles in the Altamont of California:

- Perch sites on turbines (lattice structure and work platforms) on which Golden Eagles perch regularly
- Narrow spacing of turbines at only 10 m (blade to blade) and blades close to the ground (8-10 m)
- Steep terrain (canyons and ridges) on which turbines are located
- Large, dense turbine layout - 5,400 turbines in Altamont, CA
- Massive prey concentrations: dense ground squirrel numbers at Altamont, CA, attract large numbers of Golden Eagles throughout much of the year

The above risk factors are not present at the Facility. Most importantly, there will only be 33 turbines, making the Facility a modest-sized project as opposed to the Altamont which has thousands of turbines packed tightly on the landscape. The Facility will not have tightly packed turbines because they require more than 1,000 m of separation. This allows passage of birds throughout the Facility well away from the turbines. The Facility also lacks the steep terrain that includes ridges and canyons that are present in Altamont. Finally, there are no dense prey concentrations present at the Facility, so there will not be large numbers of Bald Eagles roaming the site on a year-round basis. Thus, none of the high-risk factors implicated to cause collisions of Golden Eagles at older turbines in Altamont are present at the Facility.

Another factor that contributes to low risk is the fact that Bald Eagles have recently proven to be remarkably adaptable to human activity. In New York, Bald Eagles made a remarkable comeback from the edge of extinction once they were not persecuted or poisoned. Since DDT was banned in 1972 and shooting of these birds virtually ended, New York nesting pairs have increased rapidly to more than 400 pairs in the state and have spread to areas where NYSDEC biologists have been baffled by their presence and success (e.g., Staten Island and Long Island). This shows that the New York "population" is robust and resilient. What this means for potential wind turbine impacts is that the population size is large and that small numbers of fatalities caused by wind turbines will not impact the "population". Note that this is the case in many other states like New York, as well as Ontario. Nesting numbers of Bald Eagles, as well as migrating and wintering numbers, have dramatically increased in all Great Lakes states and beyond, even though thousands of wind turbines have been erected. Thus, turbines have not negatively impacted Bald Eagle numbers and are not a significant risk factor.

Fatality numbers also suggest that risk factors are minor, if present at all, or not significant with respect to the recovery and stability of Bald Eagle numbers. The 33 turbines at the Facility do not pose any greater risk than other wind turbine projects in the state. Of the 25 projects (1,100 turbines) now operating in New York, only one turbine at one project has killed a Bald Eagle. That means that in 2015 when that immature Bald Eagle was killed the annual fatality rate would have been 1 bird per 996 turbines or 0.001 per turbine per year. If that bird had elevated lead levels that caused neurological (proprioceptive or visual impairment) or muscular impairment, the rate could have been 0. Without a toxicology report on that bird, we cannot eliminate this possibility.) Whatever the case, the rate, and therefore risk, is minute and close to zero.

It is important to state that lead poisoning as a risk to eagles is preventable through changes in hunting regulations as occurred for duck hunting in the early 1990s. Recently, California banned all lead in hunting ammunition, recognizing that it was killing Golden Eagles outright and potentially would kill condors, a highly endangered species. Lead is still permitted by the NYSDEC, but if it were banned, it would be eliminated as a potential factor in collisions with cars, trains, and outright fatalities of these birds. This action would also likely increase the numbers of Bald Eagles in the state as well as the entire region.

Two factors are actually increasing risk in New York. They include the larger geographic range of Bald Eagles and number of eagles in the state and the geographic range and numbers of wind turbines on the landscape. With more eagles and more obstacles, there could be greater risk. However, the fact that only one eagle fatality occurred during a time when 1,000 new turbines populated the New York landscape between 2000 and 2015 along with 300+ additional pairs of eagles, does not suggest high or even moderate risk. While it is possible that risk will increase, the fatality rate will still be very, very low and there is no reason to believe that fatalities at the Facility will occur. In other words, without risk factors, the next fatality could occur anywhere in the state. Thus, the probability of a collision at the Facility is extremely low and close to zero.

Overall, there are no high-risk collision factors present at the Facility Area and risk is likely to be very low to zero. The evidence for this includes the fact that collisions of Bald Eagles with wind turbines has been very low across North America, as well as in New York and Ontario. In the latter two, fatalities have been near zero despite the presence of thousands of turbines and a rapidly growing number of eagles. In addition to fatality data, the two years of eagle and other bird studies provide no indication that risk to eagles is anything but very low. Although it is possible that an eagle will be killed by a turbine at the Facility, the likelihood is very low in any given year and that such small numbers of fatalities will not impact the numbers of nesting pairs, migrants, or wintering birds in a significant way. In other words, the "populations" of these birds will not be impacted in a negative way. Finally, the models used by USFWS and

NYSDEC will not be useful for determining potential fatalities at the Facility because no models can predict to such low fatality rates with statistical confidence.

Conclusions

Risk to Bald Eagles at the Facility is likely to be very low to near zero. There are multiple lines of evidence that support this conclusion:

1. Bald Eagles do not nest within the Facility Area <BEGIN CONFIDENTIAL INFORMATION/>[redacted]</END CONFIDENTIAL INFORMATION> although small numbers migrate through the Facility Area and small numbers occur in the Facility Area during winter. Thus, overall use of the Facility Area is very low to low.
2. The species has not proven to be highly susceptible to colliding with wind turbines, which is supported by the small numbers of these birds that collided with wind turbines in the U.S., Canada, and New York during a period of rapid growth of wind energy. During the past 20 years, as wind turbines have rapidly increased in numbers and geographic range across eastern North America, fatalities of Bald Eagles have been minimal, with only two recorded at 63 wind projects in Ontario and one at 25 projects in New York.
3. During the period of rapid increase in numbers of turbines in the past 20 years in Ontario and New York, nesting pairs of eagles have risen to all-time highs, with a quadrupling of nesting pairs and migrants and a tripling of wintering birds in the state. This rapid growth in numbers of turbines has not impacted the nesting, migrating, and wintering numbers of eagles in New York, which continue to increase.
4. By comparison, fatalities caused by collisions with vehicles and trains, lead poisoning, shooting by hunters, electrocution, fur trapping, and a few other activities dwarf the numbers of Bald Eagles killed by wind turbines in New York and the U.S.

Overall, these different lines of evidence strongly indicate that the species population in the region is robust and continues to increase. There is no suggestion that the Facility's wind turbines will have a significant negative impact on the Bald Eagle population in the region or in the state. Risk to these birds from turbines at the Facility is very low to near zero.