Cumulative Effects Analysis

Eight Point Wind Energy Center
Steuben County, New York

Stantec

Prepared for:
Eight Point Wind, LLC

Prepared by:
Stantec Consulting Services Inc.
30 Park Drive
Topsham, ME 04086

August 15, 2017

TABLE OF CONTENTS

List of Tables

Stantec

List of Appendices

1.0 INTRODUCTION

Eight Point Wind, LLC (EPW), is proposing to construct and operate the Eight Point Wind Energy Center (Facility) located in Steuben County, New York. The Project, as currently planned, would have a generating capacity of up to 102 megawatts (MW). Project facilities will include 31 commercial-scale wind turbines, access roads, buried (and possibly overhead) electric collection lines, a collection substation, meteorological towers, an operation and maintenance building, and electrical interconnection facilities, in part including a 115-kilovolt (kV) interconnection line approximately 16.5 miles long. EPW retained TRC Companies, Inc. (TRC), to prepare the Project's permit application to New York State Department of Public Service pursuant to Article 10 Law for Electric Generation Siting. In turn, TRC retained Stantec Consulting Services Inc. (Stantec) to provide support in the Article 10 application process and analyze the project's cumulative effects to birds and bats.

1.1 SCOPE OF ANALYSIS

This analysis focuses on cumulative effects associated with collision mortality of birds and bats from the proposed Facility in light of current and projected wind energy development within the state of New York. We selected this spatial scope because we have population estimates for native bird species and two bat species available for the state of New York. We assumed a 30-year operational life of the Facility for the temporal scope for this analysis, and the Facility will begin operating at the end of year 2019. Our analysis assumed the Facility would comprise 32 turbines and up to 102 megawatts (MW) installed capacity. Further, we assumed EPW will implement no operational adjustments. However, the need for and scope of operational adjustments, e.g., seasonal length, nightly period, temperature threshold (if applicable), and cut-in speed will be discussed with the agencies.

To inform mortality predictions related to the Facility, we used publicly available mortality estimates from post-construction studies conducted at operational New York wind energy facilities. For decades, researchers have studied and estimated bird mortality from several sources, such as collision with man-made structures, legal hunting, and domestic cat depredation (USFWS 2002; Erickson et al. 2005). Historically, loss of habitat and direct persecution were considered the largest threats to bats (BCI 2001). The emergence of wind energy development over the past decade has introduced a new source of mortality for birds and bats, as spinning or stationary wind turbines pose a collision risk, particularly for the migratory tree-roosting bats. Post-construction monitoring data, the primary source of knowledge about turbine-collision mortality, and the rapid expansion of wind development have raised concerns about the potential for substantial cumulative impacts to bats from turbine mortality. Carcasses of cave-dwelling bats are not detected as frequently as migratory tree-roosting bats (Arnett and Baerwald 2013). However, this mortality is adding cumulative impacts on cave-dwelling species in the wake of white-nose syndrome (WNS). In addition to mortality at wind energy projects, our cumulative effects analysis also considers impacts associated with other known mortality sources for birds and WNS for bats.

2.0 WIND ENERGY DEVELOPMENT

According to data compiled by the American Wind Energy Association, there were 1,052 turbines with 1,829 MW of installed capacity operating in New York by the end of March 2017 (AWEA 2017; average turbine capacity 1.74 MW). The U.S. Energy Information Administration's energy forecasts recently indicated a nationwide growth rate of 2.5% annually for installed wind energy capacity from 2016 through 2050 (USEIA 2017). EPW plans to bring the Facility on line by the end of year 2019. If we apply the 2.5% annual growth rate to the current installed capacity, this results in an estimated installed capacity of 1,104 turbines and 1,922 MW by the end of 2019. Applying this annual growth over the 30 years of Facility operation, we estimate a total capacity of 2,316 turbines and 4,031 MW in New York by year 2049.

We recognize that whether proposed wind projects are ultimately constructed and become operational is subject to several factors, such as energy markets, policies, regulations, and availability of incentives. We also recognize that average turbine capacity size is likely to increase, and the number of operating turbines in New York may be less than our estimate of 2,316.

Applying the 2.5% annual growth rate is one method for estimating wind energy buildout into the future. In reality, the addition of turbines to the landscape is likely to fluctuate from year to year rather than at a constant rate. In addition to the Facility, we are aware of two other proposed wind energy facilities in Steuben County currently in review under Article 10: Baron Winds Project and Canisteo Wind Energy Center. Our estimate is based on a rate of growth statewide and does not assume the inclusion of any specific projects. However, it is possible that the estimated 2,316 turbines by year 2049 will include these two other facilities as well as EPW's proposed Facility. We do not attempt to predict when these facilities come on line; nor do we attempt to estimate if and when existing facilities may be decommissioned. Rather we assume that existing facilities will continue to operate through the Facility's 30-year life-time, and turbines will be added but not subtracted from the landscape.

In summary, we derived an estimate of turbines in New York using only one method among several that could be implemented. Nonetheless, our method represents a straightforward means of estimating the numbers of operating turbines in New York based on the national average and the state's current policy for continued increase of wind energy as a total share of the electric energy generation in New York (Clean Energy Standard; NYSPSC 2016).

3.0 AVIAN RESOURCES

As with all wind projects, we can estimate expected mortality, disturbance, and displacement of birds due to the construction and operation of the Facility. However, our cumulative effects analysis for birds primarily focuses on mortality attributable to the Facility in the context of other existing and future wind facilities in New York. This analysis briefly considers other anthropogenic sources of bird mortality and includes past and present actions and reasonably foreseeable future sources of impacts to birds during the estimated 30-year operation of the Facility.

3.1 ANTHROPOGENIC SOURCES OF AVIAN MORTALITY

Table 1 provides estimates of anthropogenic sources of bird mortality for the U.S. in general. The national level is not our cumulative effects analysis area, but similar data scaled to the state of New York or any other region are not readily available. The values in Table 1 are derived from multiple sources and some from more than a decade ago. Loss et al. (2013) estimated between 140,000 and 328,000 (mean = 234,000) birds are killed annually by collisions with turbines in the contiguous U.S.

Table 1. Estimated annual avian mortality from anthropogenic causes in the U.S.

Mortality source	Estimated annual mortality	% of overall mortality
Depredation by domestic cats	1.4–3.7 billion	71–75
Collisions with buildings (including windows)	97–1,200 million	5–23
Collisions with power lines	130–174 million	3–7
Legal harvest	120 million	6
Automobiles	50–100 million	2–3
Pesticides	67–72 million	4
Communication towers	4–50 million	<1
Oil pits	1.5–2 million	<1
Wind turbines	20,000–440,000	<1
Total mortality	1.9–5.2 billion	

Sources: USFWS (2002), Erickson et al. (2005), Thogmartin et al. (2006), Dauphiné and Cooper (2009), Manville (2009), Loss et al. (2013).

3.2 MORTALITY AT THE PROPOSED FACILITY AND OTHER WIND ENERGY FACILITIES

Table 2 shows estimated numbers of bird fatalities at the Facility and wind energy facilities across New York based on mean, minimum, and maximum fatality rates. Using results from 22 post-construction monitoring studies conducted across 12 wind energy facilities in New York (Appendix A, Table A-1), the mean bird mortality rate is 4.36 birds per turbine per year. Based on this rate, we estimate the Facility will kill 135 birds per year (Table 2). We applied the state-wide mean bird mortality rate to the estimated installed capacity of wind facilities in New York in 2019 (1,104 turbines) to find wind energy facilities in New York may kill roughly 4,800 birds annually. The Facility's contribution to this total annual mortality is 2.8%. Over its estimated 30-year operational life, the Facility is estimated to kill approximately 4,100 birds. After the Facility operates for 30 years, we estimate wind energy projects in New York will have killed more than 200,000 birds over 30 years. The Project's contribution will be roughly 1.9% of the total bird mortality estimated to occur from installed wind energy facilities in New York through year 2049 (Table 2).

In their Final Supplemental Environmental Impact Statement, the NYSDPS (2016) acknowledged a range of estimated bird mortality rates in New York from 0.66 to 9.59 birds per turbine per year. Based on the buildout of facilities at the end of 2019 (1,104 turbines), annual bird mortality in New York may range from 729-10,587 birds. Our calculated mean rate and annual mortality are both near the middle of these two ranges.

We recognize the rates used to calculate mortality for the Facility and facilities state-wide are likely to fluctuate somewhere around the mean (4.36 birds per turbine per year) from year to year. The maximum rate of 15.50 birds per turbine per year is an extraordinarily high value[1], and all rates from other projects are <9.00 birds per turbine per year. Generally speaking, we do not expect wind energy facilities in New York will exhibit such a high rate.

Of the bird mortality estimated to occur at the Facility, more than 70% will be composed of birds from the passerine group based on data from available studies (NRC 2007). It should be noted that no study has documented that a wind energy facility has caused a significant population-level impact to any one species of bird. This is largely because species of nocturnal migrant passerines most frequently found during turbine searches are regionally abundant (Johnson et al. 2002; NRC 2007; Arnold and Zinc 2011). Nonetheless, below we attempt to provide context for consequences of bird mortality at the numbers estimated above for the Facility and other facilities in New York using five example species.

Steuben County is within Partners in Flight Bird Conservation Region Area 28, Appalachian Mountains (Rosenberg et al. 2016), an area dominated by large expanses of forest. The terrain is rugged, and forests are oak-hickory and other deciduous forest types at lower elevations and softwoods of pine, hemlock, spruce, and fir in higher elevations. This forested landscape is interspersed with agriculture in the flatter valleys.

[1] The rate of 15.50 birds per turbine per year is from a facility adjacent to Lake Erie. Bird fatalities in 2012 were heavily influenced by a nearby gull colony.

Table 2. Annual and cumulative bird mortality estimates at the Eight Point Wind Energy Center and current and projected installed wind energy capacity in New York. Mortality rates are expressed in birds per turbine per year (birds/t/y).

Eight Point				State-wide Projects					
		Annual mortality	30-year cumulative mortality	Annual mortality in 2019	Facility % contribution to annual mortality	Annual mortality in 2049	30-year cumulative mortality	Facility % contribution to 30-year cumulative mortality
Mortality rate (birds/t/y)[1]		31 turbines	31 turbines	1,104 turbines[2]	31 turbines	2,316 turbines[3]	1,104-2,316 turbines	31 turbines
Minimum	0.75	23[4]	698	828	2.8	1,737	~37,300	1.9
Maximum	15.50	481	14,415	17,118	2.8	35,905	~770, 300	1.9
Mean	4.36	135	4,055	4,815	2.8	10,100	~216,700	1.9

[1] Rates based on the minimum, maximum, and mean of observed fatality rates from 22 post-construction studies at 12 wind energy facilities across New York (Appendix A, Table A-1).
[2] Estimated installed capacity using 2.5% annual growth per year (USEIA 2017) based on installed capacity at end of March 2017 (AWEA 2017).
[3] Estimated installed capacity based on a projected annual growth of 2.5% per year (USEIA 2017) from 2019 through 2049. Assumes no decommissioning of projects.
[4] Values were calculated and often rounded in a spreadsheet application.

Carcass searches during monitoring at 4 wind energy facilities in New York within 50 miles of the Facility collectively documented wood thrush (*Hylocichla mustelina*), black-billed cuckoo (*Coccyzus erythropthalmus*), and bobolink (*Dolichonyx oryzivorus*),[2] all considered to be Partners in Flight species of continental importance for the Appalachian Mountains region (Rosenberg et al. 2016). We also include red-eyed vireo (*Vireo olivaceus*) and golden-crowned kinglet (*Regulus satrapa*), two species that are common in New York and frequently killed at New York wind energy facilities. Based on data during years 2003 through 2016 at wind projects in the northeast and Ontario, post-construction monitoring surveys documented 9 wood thrushes, 10 black-billed cuckoos, 41 bobolinks, 259 red-eyed vireos, and 174 golden-crowned kinglets out of the total 2,167 birds. We used these numbers to derive a proportion of total fatalities for each species (Table 3).

Table 3 provides estimates of annual bird mortality in 2049 and cumulative bird mortality from years 2019 through 2049 for the three important and two common bird species relative to current population estimates in New York. We used the mean mortality rate for New York projects (4.36 birds per turbine per year) as well as the projected number of turbines (2,316) operating in New York in 2049. We estimate wind projects in our cumulative effects analysis area will kill roughly 10,100 birds in 2049 (Table 2). Using the mean fatality rate, wind projects are estimated to affect <1% of the population annually of the three Partners in Flight important species.

It is important to note that the most current bird population estimates reflect data that are 9 or more years old. It is possible that one or more of these species has declined or increased in recent years. This may be particularly true for the black-billed cuckoo, which has been showing a significant trend of decline in New York since 2000 (Sauer et al. 2017). Over 30 years, wind energy facilities in New York are estimated to kill ~1,000 black-billed cuckoos, 3.33% of the estimated New York population at one moment in time.

Cumulatively in 30 years, wind projects in New York are estimated to kill more than 216,700 birds. Based on the available data, red-eyed vireos and golden-crowned kinglets will each make up roughly 12% and 8% of this total mortality, respectively. Using the mean rate, the 30-year cumulative mortality is estimated to affect roughly 5.8% of the golden-crowned kinglet population, which seems high relative to the other species listed in Table 3. The New York population of golden-crowned kinglets is estimated to make up 0.3% of the global population, and this species is not determined to be declining (PIF Science Committee 2013).

[2] Noble Bliss reported red-eyed vireo, wood thrush, and bobolink carcasses (Jain et al. 2009). Cohocton/Dutch Hill reported golden-crowned kinglet, red-eyed vireo, and bobolink carcasses (Stantec 2010, 2011). Howard reported golden-crowned kinglet, red-eyed vireo, and wood thrush carcasses (West 2013). High Sheldon reported bobolink and golden-crowned kinglet carcasses (West 2011). Noble Wethersfield reported red-eyed vireo, bobolink, and black-billed cuckoo carcasses (Jain et al. 2011). Post-construction reports are listed in Appendix A, Table A-1)

Table 3. Estimates of annual and cumulative turbine mortality compared to population estimates for five species of birds that have been detected during post-construction monitoring at wind energy facilities in New York. Mortality estimates are based on the estimated wind turbine buildout for New York in 2049, 2,316 turbines.

Species	New York population[1]	Proportion of total fatalities[2]	Annual mortality in 2049 based on mean rate, 4.36 birds/t/y	Percent of population affected	Cumulative mortality in 2049 based on mean rate, 4.36 birds/t/y	Percent of population affected	Breeding Bird Survey trend in New York, 2005-2015[3]
Wood thrush	620,000	0.0042	42	0.007	900	0.145	Declining-significant trend
Black-billed cuckoo	30,000	0.0046	47	0.155	1,000	3.333	Declining, significant trend
Bobolink	420,000	0.0189	191	0.045	4,100	0.976	Declining, significant trend
Red-eyed vireo	3,800,000	0.1195	1,207	0.032	25,897	0.682	Increasing, non-significant trend
Golden-crowned kinglet	300,000	0.0803	811	0.270	17,398	5.799	Increasing, non-significant trend

[1] Taken from Partners in Flight population estimates database (PIF Science Committee 2013). These data are based on an average of Breeding Bird Survey data from 1998–2007 (Blancher et al. 2013).
[2] Based on a list of species and their numbers killed at wind energy facilities in the northeast U.S. and Ontario from 2003–2016 as reported in post-construction monitoring reports. Proportions by species were calculated relative to the total number, i.e., 2,167 birds.
[3] North American Breeding Bird Survey 1966–2013 Analysis (Sauer et al. 2017).

The annual and cumulative mortality estimates were applied to single population values at one moment in time, and the calculations do not include other variables often used in population dynamics such as recruitment and other sources of mortality. Despite these limitations, the results do indicate a relatively low risk for significant population declines caused by wind power in New York. Wind projects in 2049 would kill <1% of the most current estimated New York population sizes of five species. In summary, we do not expect that wind projects in New York will cause population-level effects to avian resources, even those species of conservation concern.

Our cumulative fatality estimates for New York are based on one approach to understanding cumulative effects to birds. However, this approach is conservative and uses the best available information to analyze the effect of wind energy development as one source of avian mortality among several.

3.3 SUMMARY OF CUMULATIVE EFFECTS TO AVIAN RESOURCES

Bird mortality at wind energy facilities contributes to overall sources of anthropogenic mortality. Compared to other anthropogenic sources of avian mortality (Table 1), the effect of avian mortality at wind energy facilities is minor.

The proposed Facility is not expected to cause naturally occurring populations of common or rare birds to be reduced to numbers below levels for maintaining viability at local or regional levels. Resulting bird mortality will contribute cumulatively to other causes of mortality, specifically other wind projects and other anthropogenic sources as listed above in Table 1. Less than 1% of all estimated anthropogenic bird mortality is attributed to wind projects. We do not anticipate that mortality at wind facilities in New York is likely to result in population-level impacts to any species of bird.

4.0 BAT RESOURCES

The Project has the potential to kill bats during operations. For this analysis, we assume that bats will sustain these same effects at all wind energy facilities in New York. This analysis also considers the effects of WNS, which has resulted in significant bat mortality since its discovery in 2006.

4.1 MORTALITY AT THE PROPOSED FACILITY AND OTHER WIND ENERGY FACILITIES

Table 4 provides a summary of cumulative effects to bats estimated for the Facility, other existing wind facilities in New York, and future installed capacity of wind energy in New York. Rates of mortality of bats vary substantially among projects and depend on factors such as operational decisions, turbine type, and landscape characteristics. For the purposes of assessing cumulative impacts to bats at the Facility and statewide, we used information from 19 post-construction studies conducted at 12 wind energy facilities in New York (Appendix A, Table A-2) to derive a minimum, maximum, and mean bat fatality rate (Table 4). These studies were conducted from

2009 through 2014 to reflect data collected after WNS was discovered for most of New York.[3] The mean mortality rate is 12.36 bats per turbine per year. Absent measures to minimize potential impacts (i.e., feathering and curtailment strategy), the Facility could result in bat mortality of 383 bats annually and 11,495 bats over a 30-year term.

To estimate cumulative effects to bats at wind energy facilities in New York during the assumed 30-year operational life of the Facility, we used the mean mortality rate of 12.36 bats per turbine per year. Bat mortality rates from these projects were based on operations that implemented no feathering or curtailment.

We assumed that migratory tree-roosting bats (eastern red bat [*Lasiurus borealis*], hoary bat [*Lasiurus cinereus*], and silver-haired bat [*Lasionycteris noctivagans*]) account for 78% of all bat fatalities (Arnett and Baerwald 2013). Generally speaking, this percentage has been observed at wind energy facilities throughout the eastern and Midwestern U.S. We assumed the fatality rate of 12.36 bats per turbine per year is applicable for all facilities in New York and will remain constant during the 30 years of Facility operation with no behavioral modification in bats and no mitigation measures in facilities' operations. Applying this rate to the 1,104 turbines projected to be installed in New York in 2019 yields a mortality estimate of roughly 13,700 bats (Table 4).

Applying this rate to the projected installed capacity of 2,316 turbines in year 2049 indicates an annual mortality of approximately 28,600 bats in New York and a cumulative total of roughly 614,300 bats taken during this 30-year period, of which more than 479,000 will be migratory tree-roosting bats, and the remaining will be cave-dwelling bats. Applying the highest rate observed at wind energy facilities in New York (40.04 bats per turbine per year), fatalities would more than triple (Table 4). However, this rate is extraordinarily high, and we do not anticipate that bat mortality rates would typically be this high at all facilities statewide.[4] Of the 19 post-construction studies we reviewed, 5 projects had rates >20 bats per turbine per year, and 6 projects had rates >15 bats per turbine per year. Twelve of the studies (63%) reported rates <10 bats per turbine per year. We have assumed that the rate of 12.36 bats per turbine per year is the appropriate rate, and the statewide mortality rate for bats could become less as the implementation of operational adjustments is becoming more common and may significantly reduce the average statewide mortality rate.

---

[3] The spread of WNS in New York occurred over several years: 2006–2010. Spread maps available at https://www.whitenosesyndrome.org/resources/map indicate confirmed detections happened through the winter of 2008-2009. Hence, we used data from post-construction studies beginning in the 2009 active-bat season.

[4] The 40.04 bats per turbine per year was from a post-construction study conducted in 2009 where many of the carcasses were little brown bats. Post-construction monitoring at the same project in 2010 and 2013 reported much lower mortality rates. It is possible that WNS had not yet fully affected cave-dwelling bats in this region until after 2009.

Table 4. Cumulative bat mortality estimates at the Eight Point Wind Energy Center and current and projected installed wind energy capacity in New York. Data are from studies of facilities that did not employ feathering or other operational adjustments to minimize bat mortality. Mortality rates are expressed as bats/turbine/year (bats/t/y).

		Eight Point		Statewide Projects				
		Annual mortality	**30-year cumulative mortality**	**Annual mortality in 2019**	**Facility % contribution to annual mortality**	**Annual mortality in 2049**	**30-year cumulative mortality**	**Facility % contribution to 30-year cumulative mortality**
Mortality rate (bats/t/y)[1]		**31 turbines**	**31 turbines**	**1,104 turbines[2]**	**31 turbines**	**2,316 turbines[3]**	**1,104-2,316 turbines**	**31 turbines**
Minimum	2.67	83[4]	2, 483	2,949	2.8	6,185	~132,700	1.9
Maximum	40.04	1,241	37,237	44,219	2.8	92,752	~2 million	1.9
Mean	12.36	383	11,495	13,650	2.8	28,632	~614,300	1.9

[1] Rates based on the minimum, maximum, and average of observed mortality rates from 19 post-construction studies at 12 wind energy facilities across New York in years 2009–2014 (post-WNS; Appendix A, Table A-2).

[2] Estimated installed capacity using 2.5% annual growth per year (USEIA 2017) based on installed capacity as of end of March 2017 (AWEA 2017).

[3] Based on a projected annual growth of 2.5% a year (USEIA 2017). Assumes no decommissioning of projects.

[4] Values were calculated and often rounded in a spreadsheet application.

Cumulative mortality at the proposed Facility will account for roughly 1.9% of the cumulative mortality of bats in the assumed 30 years of operation. Each wind energy facility will contribute to all-bat mortality, and each facility's contribution will be proportional to the number of turbines. Looking at future wind energy development in New York, it is impossible to determine to what extent the cumulative estimate of 614,300 bat fatalities over 30 years may result in population-level impacts as no baseline population estimates exist for those species that will experience the greatest mortality, i.e., the migratory tree-roosting bat species. Populations have been estimated for only the Indiana bat (*Myotis sodalis*) and northern long-eared bat (*M. septentrionalis*).

4.2 WHITE-NOSE SYNDROME

WNS has emerged as the largest single source of mortality for cave-hibernating bats in recent years. As of March 2016, WNS has been confirmed in 30 states and 5 Canadian provinces and as far west as King County, Washington (east of Seattle; WDFW 2016). The USFWS estimated WNS has killed more than 6 million bats since discovery of the disease in 2006 (USFWS 2017a). Turner et al. (2011) documented an 88% decline in overall numbers of hibernating bats comparing pre- and post-WNS counts at 42 sites in 5 northeastern states. At these sites, northern long-eared bats decreased by 98%, little brown bats (*Myotis lucifugus*) by 91%, tri-colored bats (*Perimyotis subflavus*) by 75%, Indiana bats by 72%, big brown bats (*Eptesicus fuscus*) by 41%, and eastern small-footed bats (*M. leibii*) by 12% (Turner et al. 2011). To date, causative fungus, *Pseudogymnoascus destructans*, has been found in two migratory tree-roosting bat species (eastern red bat and silver-haired bat) without confirmation of the WNS disease (USFWS 2017b).

4.3 SUMMARY OF CUMULATIVE EFFECTS TO BAT RESOURCES

We acknowledge that bat mortality at wind energy facilities contributes to overall bat mortality, and the Facility's resulting bat mortality will contribute cumulatively to other wind facility mortality. Compared to the effects of WNS, cave-dwelling bat mortality at wind energy facilities is minor. However, wind energy facilities kill more migratory tree-roosting bats than any other known mortality source. Because these species' population sizes are not known, it is unclear how wind energy will impact their populations.

By 2049, wind facilities in New York are predicted to result in more than 600,000 bat fatalities, most of these being migratory tree-roosting bats (~78%). The effect of cumulative mortality on bat populations is highly uncertain because estimates of current population sizes are unknown. Bat mortality at the Facility is not expected to be a significant addition to the cumulative bat mortality at wind energy facilities in New York, given the relatively small number of turbines.

5.0 REFERENCES

Arnett E. B., and E. F. Baerwald. 2013. Impacts of wind energy development on bats: implications for conservation. Pages 435-456 *in* R. A. Adams and S. C. Peterson, editors. Bat evolution, ecology, and conservation. Springer, New York, New York, USA.

Arnold, T. W., and R. M. Zinc. 2011. Collision fatality has no discernible effect on population trends in North American Birds. PLoS ONE 6(9): e24708. Doi:10.1371/journal.pone.0024708.

AWEA (American Wind Energy Association). 2017. U.S. wind energy state facts, New York wind energy. <http://awea.files.cms-plus.com/FileDownloads/pdfs/New%20York.pdf>. Accessed 23 June 2017.

BCI (Bat Conservation International). 2001. Bats of eastern woodlands. Bat Conservation International, Austin, Texas, USA.

Blancher, P. J., K. V. Rosenberg, A. O. Panjabi, B. Altman, A. R. Couturier, W. E. Thogmartin, and Partners in Flight Science Committee. 2013. Handbook to the Partners in Flight population estimates database, version 2.0. PIF Technical Series No 6. <pif.birdconservancy.org/PopEstimates/downloads/Handbook%20to%20the%20PIF%20Population%20Estimates%20Database%20Version%202.0.pdf>. Accessed 27 June 2017.

Dauphiné, N., and R. J. Cooper. 2009. Impacts of free-ranging domestic cats (*Felis catus*) on birds in the United States: a review of recent research with conservation and management recommendations. Pages 205-219 in T. D. Rich, C. Arizmendi, D. W. Demarest, and C. Thompson, editors. Tundra to tropics: connecting birds, habitats and people. Proceedings of the fourth international Partners in Flight conference, 2008.

Erickson, W. P., G. D. Johnson, and D. P. Young, Jr. 2005. A summary and comparison of bird mortality from anthropogenic causes with an emphasis on collisions. Pages 1029-1042 in C. J. Ralph and T. D. Rich, editors. Bird conservation implementation and integration in the Americas. USDA Forest Service General Technical Report PSW-GTR-191. Pacific Southwest Research Station, Albany, California, USA.

Johnson, G. D., W. P. Erickson, M. D. Strickland, M. F. Shepherd, D. A. Shepherd, and S. A. Sarappo. 2002. Collision fatality of local and migrant birds at a large-scale wind-power development on Buffalo Ridge, Minnesota. Wildlife Society Bulletin 30: 879-887.

Loss, S. R., T. Will, and P. P. Marra. 2013. The impact of free-ranging domestic cats on wildlife of the United States. Nature Communications 4: 1396. <https://www.nature.com/articles/ncomms2380.pdf>. Accessed 11 July 2017.

Manville, A. M., II. 2009. Towers, turbines, power lines, and buildings—steps being taken by the U.S. Fish and Wildlife Service to avoid or minimize take of migratory birds at these structures. Pages 262-272 in T. D. Rich, C. Arizmendi, D. W. Demarest, and C. Thompson, editors. Tundra to tropics: connecting birds, habitats and people. Proceedings of the fourth international Partners in Flight conference, 2008.

NRC (National Research Council of the National Academies). 2007. Environmental impacts of wind-energy projects. Committee on Environmental Impacts of Wind Energy Projects. Board on Environmental Studies and Toxicology Division on Earth and Life Studies. The National Academies Press, Washington, D.C.

NYSPSC (State of New York Public Service Commission). 2016. Final supplemental environmental impact statement in [multiple cases on implementing a large-scale renewable program and clean energy standard]. New York State Department of Public Service, Albany, New York, USA. 19 May.

PIF (Partners in Flight Science Committee). 2013. Population estimates database, version 2013. <http://pif.birdconservancy.org/PopEstimates/Database.aspx>. Accessed 27 June 2017.

Rosenberg, K. V., J. A. Kennedy, R. Dettmers, R. P. Ford, D. Reynolds, J.D. Alexander, C. J. Beardmore, P. J. Blancher, R. E. Bogart, G. S. Butcher, A. F. Camfield, A. Couturier, D. W. Demarest, W. E. Easton, J.J. Giocomo, R.H. Keller, A. E. Mini, A. O. Panjabi, D. N. Pashley, T. D. Rich, J. M. Ruth, H. Stabins, J. Stanton, and T. Will. 2016. Partners in Flight landbird conservation plan: 2016 revision for Canada and Continental United States. Partners in Flight Science Committee. < https://www.partnersinflight.org/resources/the-plan/>. Accessed 27 June 2017.

Sauer, J. R., D. K. Niven, J. E. Hines, D. J. Ziolkowski, Jr., K. L. Pardieck, J. E. Fallon, and W. A. Link. 2017. The North American Breeding Bird Survey, results and analysis 1966 - 2015. Version 2.07.2017 USGS Patuxent Wildlife Research Center, Laurel, Maryland, USA. <https://www.mbr-pwrc.usgs.gov/bbs/bbs.html>. Accessed 27 June 2017.

Thogmartin, W. E., F. P. Howe, F. C. James, D. H. Johnson, E. T. Reed, J. R. Sauer, and F. R. Thompson, III. 2006. A review of the population estimation approach of the North American landbird conservation plan. The Auk 123: 892-904.

Turner, G. G., D. M. Reeder, and J. T. Coleman. 2011. A five-year assessment of mortality and geographic spread of white-nose syndrome in North American bats and a look to the future. Bat Research News 52: 13–27

USEIA (U.S. Energy Information Administration). 2017. Annual energy outlook 2017 with projections to 2050. <https://www.eia.gov/outlooks/aeo/>. Accessed 27 June 2017.

USFWS (U.S. Fish and Wildlife Service). 2002. Migratory bird mortality: many human-caused threats afflict our bird populations. Division of Migratory Bird Management, Arlington, Virginia, USA. January.

_____. 2017a. White-nose syndrome: the devastating disease of hibernating bats in North American. U.S. Fish and Wildlife Service. June. <https://www.whitenosesyndrome.org/sites/default/files/white_nose_fact_sheet_06_2017_0.pdf>. Accessed 10 July 2017.

_____. 2017b. Bats affected by WNS. <https://www.whitenosesyndrome.org/about/bats-affected-wns>. Accessed 10 July 2017.

WDFW (Washington Department of Fish and Wildlife). 2016. Bat with white-nose syndrome confirmed in Washington state. Press release. Washington Department of Fish and Wildlife, Olympia, Washington, USA. 31 March. <https://www.whitenosesyndrome.org/news/bat-white-nose-syndrome-confirmed-washington-state>. Accessed 6 May 2016.

Appendix A POST-CONSTRUCTION STUDIES USED TO ESTIMATE BIRD AND BAT MORTALITY

TABLE A-1. POST-CONSTRUCTION STUDIES USED TO CALCULATE BIRD MORTALITY ESTIMATES FOR THE EIGHT POINT WIND ENERGY CENTER AND THE STATE OF NEW YORK.

Project Name and Survey Year	Mortality Rate Per Turbine	Survey Period	Search Interval	No. Turbines	Total MW	Reference
Cohocton/Dutch Hills 2009	4.70	April 15–November 15	daily	50	125.00	Stantec. 2010. Cohocton and Dutch Hill Wind Farms year 1 post-construction monitoring report, 2009.
Cohocton/Dutch Hills 2010	2.06	July 15–September 17	daily	50	125.00	Stantec. 2011. Cohocton and Dutch Hill Wind Farms year 2 post-construction monitoring report, 2010.
Cohocton/Dutch Hills 2013	3.96	July 8–October 15	5-day	50	125.00	Stantec. 2014. Cohocton and Dutch Hill Wind Farms 2013 post-construction wildlife monitoring report.
Hardscrabble 2012	6.86	April 15–October 15	daily	37	74.00	West. 2013. 2012 post-construction study and AnaBat study, Hardscrabble Wind Project, Herkimer County, New York, April 15–October 15, 2012.
High Sheldon 2010	2.64	April 15–November 15	daily/weekly	75	112.50	West. 2011. 2010 post-construction fatality monitoring study and bat acoustic study for the High Sheldon Wind Farm, Wyoming County, New York, final report April 15–November 15, 2010.
High Sheldon 2011	2.36	April 15–November 15	daily/weekly	75	112.50	West. 2012. 2011 post-construction fatality monitoring study and bat acoustic study for the High Sheldon Wind Farm, Wyoming County, New York, final report April 15–November 15, 2011.
Howard 2012	2.59	April 15–November 15	daily/weekly	27	55.35	West. 2013. 2012 post-construction monitoring studies for the Howard Wind Project, Steuben County, New York, final report April 13–November 16, 2012.
Howard 2013	0.75	May 15–November 15	daily/weekly	27	55.35	West. 2014. 2013 post-construction monitoring studies for the Howard Wind Project, Steuben County, New York, final report May 15–November 15, 2013.
Maple Ridge 2006	9.59	June 17–November 15	daily	195	321.75	Jain et al. 2007. Annual report for the Maple Ridge Wind Power Project, post-construction bird and bat fatality study – 2006. Final report. June 25, 2007.
Maple Ridge 2007	3.87	April 30–November 14	weekly	195	321.75	Jain et al. 2009. Annual report for the Maple Ridge Wind Power Project, post-construction bird and bat fatality study – 2007. May 6, 2009.
Maple Ridge 2008	3.42	April 15–November 9	weekly	195	321.75	Jain et al. 2009. Annual report for the Maple Ridge Wind Power Project, post-construction bird and bat fatality study – 2008. May 14, 2009.

Project Name and Survey Year	Mortality Rate Per Turbine	Survey Period	Search Interval	No. Turbines	Total MW	Reference
Noble Altona 2010	2.76	April 26–October 15	daily/weekly	65	97.50	Jain et al. 2011. Annual report for the Noble Altona Windpark, LLC, post-construction bird and bat fatality study – 2010.
Noble Bliss 2008	4.30	April 21–November 14	daily	65	97.50	Jain et al. 2009. Annual report for the Noble Bliss Windpark, LLC, post-construction bird and bat fatality study – 2008.
Noble Bliss 2009	4.45	April 15–November 15	daily	67	100.00	Jain et al. 2010. Annual report for the Noble Bliss Windpark, LLC, post-construction bird and bat fatality study – 2009.
Noble Chateaugay 2010	2.40	April 26–October 15	weekly	71	106.50	Jain et al. 2011. Report for the Noble Chateaugay Windpark. LLC, post-construction bird and bat fatality study – 2010.
Noble Clinton 2008	3.26	April 26–October 13	3-day	67	100.00	Jain et al. 2009. Annual report for the Noble Clinton Windpark, LLC, post-construction bird and bat fatality study – 2008.
Noble Clinton 2009	1.76	April 15–November 15	daily/weekly	67	100.00	Jain et al. 2010. Annual report for the Noble Clinton Windpark, LLC, post-construction bird and bat fatality study – 2009.
Noble Ellenburg 2008	2.09	April 28–October 13	daily	54	80.00	Jain et al. 2009. Annual report for the Noble Ellenburg Windpark, LLC, post-construction bird and bat fatality study – 2008.
Noble Ellenburg 2009	5.69	April 15–November 15	daily	54	80.00	Jain et al. 2010. Annual report for the Noble Ellenburg Windpark, LLC, post-construction bird and bat fatality study – 2009.
Noble Wethersfield 2010	2.55	April 26–October 15	weekly	84	126.00	Jain et al. 2011. Annual report for the Noble Wethersfield Windpark, LLC, post-construction bird and bat fatality study – 2010.
Steel Winds 2012	8.46	March 10–May 31 and July 15–September 30; November 1–30	weekly and biweekly in November	14	35.00	Stantec. 2013. Steel Winds I and II post-construction monitoring report, 2012.
Steel Winds 2013	15.50	March 21–May 31 and July 15–September 30	weekly	14	35.00	Stantec. 2014. Steel Winds I & II Year 2 post-construction wildlife monitoring report, 2013.
Average Rate	**4.36**					

TABLE A-2. POST-CONSTRUCTION STUDIES USED TO CALCULATE BAT MORTALITY ESTIMATES FOR THE EIGHT POINT WIND ENERGY CENTER AND THE STATE OF NEW YORK.

Project Name	Per Turbine	Survey Period	Interval	No. Turbines	Total MW	Reference
Cohocton/Dutch Hills 2009	40.04	April 15–November 15	daily	50	125.00	Stantec. 2010. Cohocton and Dutch Hill Wind Farms year 1 post-construction monitoring report, 2009.
Cohocton/Dutch Hills 2010	25.62	July 15–September 17	daily	50	125.00	Stantec. 2011. Cohocton and Dutch Hill Wind Farms year 2 post-construction monitoring report, 2010.
Cohocton/Dutch Hills 2013	8.03	July 8–October 15	5-day	50	125.00	Stantec. 2014. Cohocton and Dutch Hill Wind Farms 2013 post-construction wildlife monitoring report.
Hardscrabble 2012	21.34	April 15–October 15	daily	37	74.00	West. 2013. 2012 post-construction study and AnaBat study, Hardscrabble Wind Project, Herkimer County, New York, April 15 -October 15, 2012.
Hardscrabble 2013	4.40	Unknown	Unknown	37	74.00	NYSDEC testimony from Cassadaga Siting Board hearings[1]
Hardscrabble 2014	8.20	Unknown	Unknown	37	74.00	NYSDEC testimony from Cassadaga Siting Board hearings[2]
High Sheldon 2010	3.50	April 15–November 15	daily/weekly	75	112.50	West. 2011. 2010 post-construction fatality monitoring study and bat acoustic study for the High Sheldon Wind Farm, Wyoming County, New York, final report April 15–November 15, 2010.
High Sheldon 2011	2.67	April 15–November 15	daily/weekly	75	112.50	West. 2012. 2011 post-construction fatality monitoring study and bat acoustic study for the High Sheldon Wind Farm, Wyoming County, New York, final report April 15–November 15, 2011.
Howard 2012	20.09	April 15–November 15	daily/weekly	27	55.35	West. 2013. 2012 Post-Construction Monitoring Studies for the Howard Wind Project, Steuben County, New York, Final Report April 13–November 16, 2012.
Howard 2013	4.29	May 15–November 15	daily/weekly	27	55.35	West. 2014. 2013 post-construction monitoring studies for the Howard Wind Project, Steuben County, New York, final report May 15–November 15, 2013.
Maple Ridge 2012	13.83	July 12–October 15	weekly	195	321.75	West. 2013. 2012 post-construction fatality monitoring study for the Maple Ridge Wind Farm, Lewis County, New York, final report July 12–October 15, 2012.
Noble Altona 2010	6.51	April 26–October 15	daily/weekly	65	97.50	Jain et al. 2011. Annual report for the Noble Altona Windpark, LLC, post-construction bird and bat fatality study – 2010.

Project Name	Per Turbine	Survey Period	Interval	No. Turbines	Total MW	Reference
Noble Bliss 2009	8.24	April 15–November 15	daily	67	100.00	Jain et al. 2010. Annual report for the Noble Bliss Windpark, LLC, post-construction bird and bat fatality study – 2009.
Noble Chateaugay 2010	3.66	April 26–October 15	weekly	71	106.50	Jain et al. 2011. Annual report for the Noble Chateaugay Windpark. LLC, post-construction bird and bat fatality study - 2010
Noble Clinton 2009	9.72	April 15–November 15	daily/weekly	67	100.00	Jain et al. 2010. Annual report for the Noble Clinton Windpark, LLC, post-construction bird and bat fatality study – 2009.
Noble Ellensburg 2009	8.01	April 15–November 15	daily	54	80.00	Jain et al. 2010. Annual Report for the Noble Ellenburg Windpark, LLC, Post-construction Bird and Bat Fatality Study - 2009
Noble Wethersfield 2010	24.45	April 26–October 15	weekly	84	126.00	Jain et al. 2011. Annual report for the Noble Wethersfield Windpark, LLC, post-construction bird and bat fatality study – 2010.
Steel Winds 2012	6.88	March 10–May 31 and July 15–September 30; November 1–30	weekly and biweekly in November	14	35.00	Stantec. 2013. Steel Winds I and II post-construction monitoring report, 2012.
Steel Winds 2013	15.30	March 21–May 31 and July 15–September 30	weekly	14	35.00	Stantec. 2014. Steel Winds I & II year 2 post-construction wildlife monitoring report, 2013.
Average Rate	**12.36**					

[1] Information on Hardscrabble 2013 is derived from B. Denoncour and C. J. Herzog, direct testimony in the matter of the application of Cassadaga Wind LLC for a Certificate of Environmental Compatibility and Public Need pursuant to Article 10 to construct a wind energy facility. Case No.: 14-F-0490. May 12, 2017.
[2] Information on Hardscrabble 2014 is derived from B. Denoncour and C. J. Herzog, direct testimony in the matter of the application of Cassadaga Wind LLC for a Certificate of Environmental Compatibility and Public Need pursuant to Article 10 to construct a wind energy facility. Case No.: 14-F-0490. May 12, 2017.