Cumulative Impacts Assessment for the High Bridge Wind Project Chenango County, New York

Draft Report

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July 2019

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1.0 INTRODUCTION

High Bridge Wind, LLC (High Bridge Wind) is developing the High Bridge Wind Project in Chenango County, New York. The term Facility will be used to describe all project components including wind turbines, access roads, collection lines, an operations and maintenance (O&M) facility, collection and point of interconnection (POI) substations, temporary and permanent meteorological towers, and a laydown yard. The term Facility Site will be used to describe all parcels upon which Facility components will be located.

The Facility offers a number of environmental benefits, including generating electricity with zero carbon emissions; however, the construction and operation of the Facility may present potential risks to birds and bats. Per the High Bridge Wind Project Scoping Statement and Proposed Stipulations, the objective of this Cumulative Risk Assessment is to evaluate the actual and expected impacts from the construction and operation of the Facility in relation to other proposed and operating wind energy facilities near the Facility Site and in the state of New York.

2.0 FACILITY SITE AND FACILITY COMPONENTS

2.1 Facility Site

The Facility Site is a proposed large wind energy conversion system encompassing approximately 1,586.8 hectares (ha; 3,921 acres [ac]) in Chenango County in southcentral New York (Figure 2.1). The Facility Site lies within the Northern Allegheny Plateau Ecoregion, which is characterized by rolling hills, open valleys, and low mountains (US Environmental Protection Agency 2017). The Facility Site also falls within the New York State Department of Environmental Conservation (NYSDEC) Central Appalachians Ecological Zone of New York (Edinger et al. 2014). Elevation within the Facility Site ranges from approximately 280 meters (m; 919 feet [ft]) above sea level (ASL) in the lowest valley to 617 m (2,024 ft) ASL at the highest peak.

2.2 Facility Components

The Facility will include up to 25 wind turbines with a nameplate generating capacity of up to 100.8 megawatts (MW). The rotor swept height (RSH) of the largest turbine proposed for the Facility will be approximately 46-204 m (151-669 ft) above ground level. Additional Facility details can be found in Exhibit 3 of the Article 10 Application.

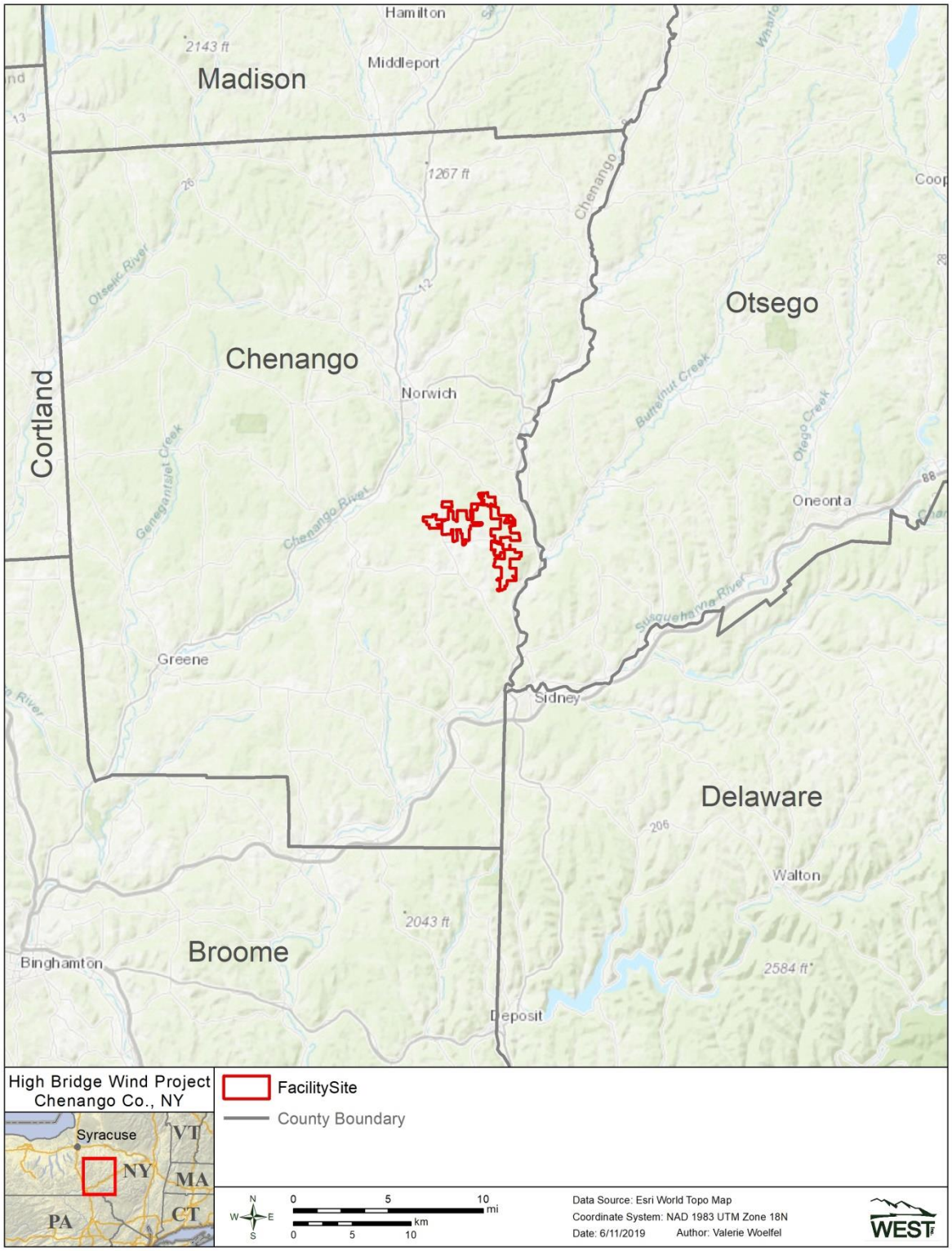

Figure 2.1. Overview of the High Bridge Wind Project Facility Site, Chenango County, New York.

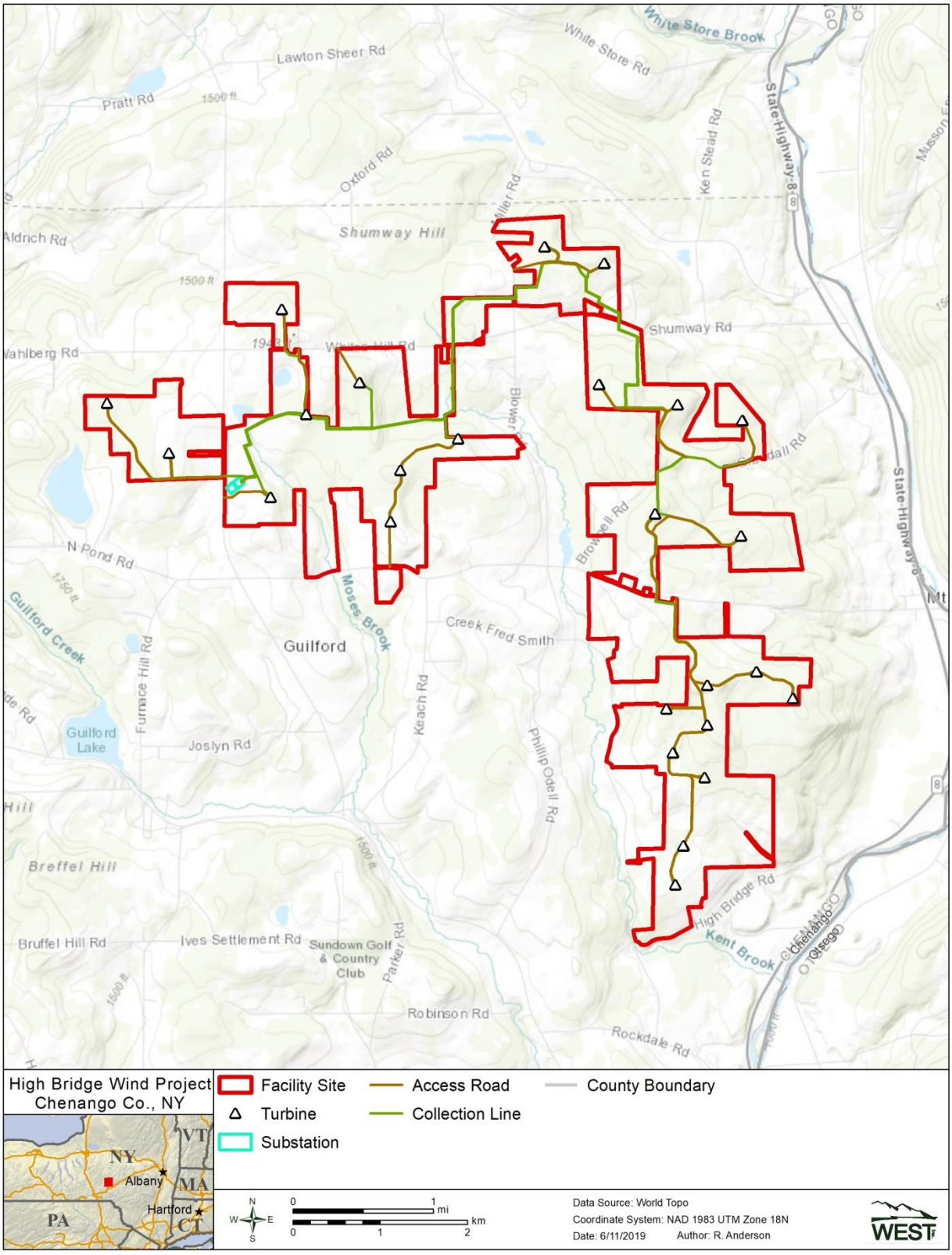

Figure 2.1. Location of the proposed High Bridge Wind Project Facility Site and infrastructure, Chenango County, New York.

3.0 AVIAN FATALITIES

Nationally, wind turbines are estimated to be responsible for a nominal proportion of all avian fatalities resulting from anthropogenic causes; thus, wind energy is considered a minor contributor to bird mortality compared to other anthropogenic activities (Table 3.1). A recent assessment of fatality data from 116 studies at wind facilities across the US and Canada found that about 134,000 to 230,000 small bird fatalities from collision with wind turbines occur annually, or 2.10 to 3.35 small birds/MW/year of installed capacity (Erickson et al. 2014). When adjusted for species composition, to include large birds, it is estimated that 368,000 bird fatalities may occur per year nationally. These impacts are spread across many species and the effect on any given population is very small and likely negligible with respect to influencing population viability or stability. Erickson et al. (2014) found that small passerine cumulative collision fatalities at wind facilities across the US and Canada were insignificant at a population level. The collision rate per year by species was highest for black-throated blue warbler (*Setophaga caerulescens*) and tree swallow (*Tachycineta bicolor*), estimated at 0.043% of the entire population of each species. For the 18 species with the next highest values, this estimate ranged from 0.008% to 0.038%.

In the northeastern US (New York, Maine, New Hampshire, Maryland, and Pennsylvania) and southern Ontario, Canada, avian fatality rates have ranged from zero birds/MW/year to 11.99 birds/MW/year (zero birds/turbine/year to 23.98 birds/turbine/year; Appendix A1). At facilities in New York, bird fatality rates averaged 1.82 birds/MW/year (3.25 birds/turbine/year) and ranged from 0.37 birds/MW/year to 6.20 birds/MW/year (0.75 birds/turbine/year to 15.50 birds/turbine/year; Appendix A1). According to the US Fish and Wildlife Service (USFWS), one bald eagle fatality has been found at an operational wind energy facility in New York (USFWS 2018). No golden eagle fatalities have been reported at operational wind energy facilities in New York based on publicly available information (Appendix A2).

Table 3.1 Estimated annual avian mortality from anthropogenic causes in the United States.

Mortality Source	Estimated Annual Mortality	Reference
Depredation by domestic cats	1.4 – 3.7 billion	Loss et al. 2013
Collisions with buildings	98 - 980 million	Klem 1990
Collisions with power lines	Tens of Thousands to 174 million	USFWS 2002; Avian Power Line Interaction Committee (APLIC) 2006
Automobiles	60 - 80 million	Erickson et al. 2005
Pesticides	67 million	Pimentel et al. 1991
Communication towers	6.8 million	Longcore et al. 2012
Oil pits	500,000 - 1 million	USFWS 2009
Wind turbines	213,760 – 573,000	Smallwood 2013, Erickson et al. 2014
Aircraft	4,722	Dolbeer et al. 2009

4.0 BAT FATALITIES

Across the US and Canada, it is estimated that 500,000 bats are killed annually by wind turbines (Arnett and Baerwald 2013, Hayes 2013, Smallwood 2013), with adjusted fatality rates in the US ranging from zero bat fatalities/MW/year to 49.7 bat fatalities/MW/year (American Wind Wildlife

Institute [AWWI] 2018a). To date, post-construction monitoring studies of wind energy facilities in the US show the following: 1) migratory tree-roosting species (e.g., eastern red bat [*Lasiurus borealis*], hoary bat [*Lasiurus cinereus*], and silver-haired bat [*Lasionycteris noctivagans*]) compose approximately 72% of reported bat fatalities; 2) the majority of fatalities occur during the fall migration season (August and September); and 3) most fatalities occur on nights with relatively low wind speeds (e.g., less than 6.0 meters/second [m/s; 13.4 miles per hour (mph)]); Arnett et al. 2008, 2013; Arnett and Baerwald 2013; Thompson et al. 2017; AWWI 2018a).

Wind energy development has resulted in higher direct impacts to bats than birds, and collision fatalities at wind energy facilities are considered a serious threat to bat populations in North America (O'Shea et al. 2016). However, population level impacts are largely unknown due to the lack of basic demographic information about bats in general and migratory tree bats specifically (Frick et al. 2017). Migratory tree bats tend to be cryptic and more solitary compared to cave hibernating species, making it even more difficult to estimate population numbers (AWWI 2018a). In addition, the overall migratory pattern of temperate zone bats is difficult to determine because: 1) bats migrate at night, 2) bats are inactive during the day at roosts that are concealed and frequently inaccessible, and 3) there are few observations of bats actively migrating (Cryan 2011). In an attempt to combat these challenges, Frick et al. (2017) used expert elicitation and population viability models to examine if wind turbine fatalities could impact a migratory bat population (hoary bat). Frick et al. (2017) concluded that wind turbine mortality may drastically reduce population size and increase extinction risk for this species; however, the process of expert elicitation created considerable uncertainty regarding the impacts.

There is substantial variation in the magnitude of wind energy related bat fatality rates across sites and regions of North America, with higher and wider ranging fatality estimates recorded in the Midwest, Northeast, and Southwest regions (Ellison 2012, AWWI 2018a). In the northeastern US (New York, Maine, New Hampshire, Maryland, and Pennsylvania) and southern Ontario, Canada, overall bat fatality rates have ranged from zero bats/MW/year to 51.76 bats/MW/year (zero bats/turbine/year to 85.42 bats/turbine/year; Appendix A3). In New York, bat fatality rates averaged 5.74 bats/MW/year (9.90 bats/turbine/year) and ranged from 1.78 bats/MW/year to 16.30 bats/MW/year (2.67 bat/turbine/year to 24.45 bat/turbine/year; Appendix A3). Similar to other wind energy facilities in the US, the three migratory tree bat species have comprised most of the recorded fatalities at New York wind energy facilities and most fatalities have been found during the fall migration period.

None of the wind energy facilities in New York with publicly available data implemented operational turbine curtailment (Appendix A3). However, a substantial reduction in bat fatality has been shown at numerous wind energy facilities where low-wind-speed curtailment has been implemented, as bat activity and fatality have been shown to have an inverse relationship with wind speed (Arnett et al. 2013). For example, curtailing turbines below 5.0 m/s (11.2 miles per hour [mph]) has shown a reduction in overall bat fatalities of 60% or more, with a range in reduction from 60% to 73% depending upon the facility (see Table 4 in AWWI 2018a). To reduce impacts to bats and in particular, reduce the estimated take of the state- and federally threatened northern long-eared bat (*Myotis septentrionalis*), High Bridge will implement a curtailment plan for

all turbines from July 1–October 1, the estimated fall migratory period for bats in New York. Turbine operation will be curtailed from sunrise to sunset when wind speeds are below 5.0 m/s (11.2 mph) and temperatures are above 10 Celsius (C; 50 Fahrenheit [F]). This curtailment is expected to reduce the estimated take of northern long-eared bats by at least 80% to 12 northern long-eared bats during the life of the Facility (see Net Conservation Benefit Plan [Ritzert et al. 2019]) and will benefit all other bats during the fall migration by reducing direct impacts by at least 60% (C. Herzog, NYSDEC, pers. comm.). It is unclear if curtailment will change the species composition of bats found at the Facility; however, it will dramatically reduce the number of all bats directly impacted by the Facility compared to other wind energy facilities in New York operating without curtailment.

5.0 CUMULATIVE IMPACTS

5.1 Avian Cumulative Impacts Assessment

An objective of the cumulative impacts assessment was to evaluate the potential effects of the Facility in combination with the effects of wind energy facilities or turbines that are operating or proposed to be constructed at other sites nearby the Facility Site as of the date of this report. Assuming that impacts to avian species at the Facility would be similar to the average avian impacts reported at other wind energy facilities in New York (average rate of 1.82 birds/MW/year [3.25 birds/turbine/year]), approximately 184 bird fatalities per year would be expected at the Facility during the life of the Facility (approximately 30 years) with the majority being migratory passerines spread across various species, so no particular species would likely experience population level impacts from the Facility itself. Additionally, the planned curtailment regime will likely reduce the amount of direct impacts to night migrating birds, reducing estimated overall avian impacts below 1.82 birds/MW/year.

From 2020 to 2050, the projected 30-year life of the Facility Site, on-shore wind development in New York is estimated to increase from 1.75 gigawatts (GW) to 5.61 GW (US Department of Energy [USDOE] 2019). Based upon the average direct avian impacts per MW from New York wind energy facilities operating as of the date of this report (1.82 birds/MW/year), in 2050 an estimated 10,211 birds per year will be killed by wind energy facilities in New York and the Facility (184 birds per year) will account for approximately 1.8% of bird fatalities from wind energy facilities in New York. However, High Bridge's commitment to operational nighttime curtailment during the fall migration period may reduce the total number of bird fatalities during the fall migration, decreasing the overall contribution of direct avian impacts from the Facility.

5.2 Bat Cumulative Impact Assessment

An objective of the cumulative impacts assessment was to evaluate the potential effects of the Facility in combination with the effects of wind energy or turbines that are operating or proposed to be constructed at other sites nearby the Facility Site as of the date of this report. Assuming that impacts to bat species at the Facility would be similar to the average bat impacts reported at other wind energy facilities in New York (average rate of 5.74 bats/MW/year [9.90 bats/turbine/year]), approximately 579 bat fatalities per year could be expected at the Facility with the majority likely

being migratory tree bats as other wind energy facilities in New York have reported. Assuming that 72% of bat fatalities are migratory tree bats, this would result in approximately 417 hoary bat, eastern red bat, and silver-haired bat fatalities combined.

High Bridge is committed to curtailing turbines below wind speeds of 5.0 m/s (11 mph) from July 1 to October 1 from sunset to sunrise when temperatures are above 10 C (50 F), which is expected to result in at least an 80% reduction in take of the state-threatened northern long-eared bat. If the Facility operates without the aforementioned curtailment regime, it's estimated that it may result in the take of up to 68 northern long-eared bats. However, High Bridge is committed to the aforementioned curtailment regime that will reduce the estimated take of northern long-eared bat to at least 13.4 northern long-eared bats for the life of the Facility. In addition, the proposed curtailment regime will likely have at least a 60% reduction in all bat fatalities (C. Herzog, NYSDEC, pers. comm.; AWWI 2018). Under this curtailment regime, the estimated all bat fatality rate at the Facility is expected to be reduced from 579 bats per year to 231 bats per year. Assuming that bat species composition remains constant after curtailment, this would result in a reduction of migratory tree bat fatalities from 417 per year to 167 per year.

From 2020 to 2050, the projected 30-year life of the Facility, on-shore wind development in New York is estimated to increase from 1.75 gigawatts (GW) to 5.61 GW (USDOE 2019). Based upon the average per MW bat fatality rate at New York wind energy facilities (5.74 bats/MW/year), in 2050 an estimated 32,201 bats per year will be killed by wind energy facilities in New York if no facilities implement curtailment. If a similar curtailment regime that is planned for the Facility is also employed at all wind energy facilities in New York by 2050, the estimated all bat fatality rate for wind energy facilities may be reduced from 32,201 bats per year to 12,880 bats per year. If species composition of bats found at wind energy facilities remains consistent, the estimated migratory tree bat fatality rate in 2050 may be reduced from 24,151 bats per year to 9,660 bats per year, under a curtailment regime. Based upon the estimated annual take of bats at the Facility under curtailment (231 bats per year) and assuming all other wind energy facilities implement curtailment in 2050 (total estimated fatality rate for all facilities of 12,880 bats per year), the Facility may account for approximately 1.8% of bat fatalities from wind energy facilities in New York. If other wind energy facilities do not implement operational curtailment, the Facility will comprise a smaller percentage of all bat fatalities.

Hibernating bats in North America are being severely impacted by white-nose syndrome (WNS) an infectious mycosis in which bats are infected with a psychrophilic fungus from Europe (*Pseudogymnoascus* [formerly *Geomyces*] *destructans*) thought to act as a chronic disturbance during hibernation (US Geological Survey 2010; Minnis and Lindner 2013). Infected bats arouse frequently from hibernation, leading to premature loss of fat reserves and atypical behavior, which in turn can lead to starvation prior to spring emergence (Boyles and Willis 2010, Reeder et al. 2012, Warnecke et al. 2012). Data suggests in 2012 that between 5.7 and 6.7 million bats died as a result of WNS (USFWS 2012). WNS was first discovered in New York State in 2006 (Brooks 2011) and to date the disease has spread to 33 states and seven Canadian provinces (White-Nose Syndrome Response Team 2019), reaching as far south as Alabama, as far north as Newfoundland, and as far west as Washington (Heffernan 2016). White-nose syndrome is the

primary reason the USFWS recently listed the northern long-eared bat as threatened under the Endangered Species Act (USFWS 2015). The NYSDEC has identified WNS as the primary threat to bat species in New York (Carl Herzog, NYSDEC, pers. comm.).

The status of bat populations is not well understood, thus the ecological impacts of wind energy development are not known (AWWI 2018b). Whereas wind energy facilities are known to cause bat fatalities, population level impacts to cave-dwelling species from wind energy are considered minor compared to impacts from WNS (USFWS 2012). Migratory tree bats are known to be killed more often than other species groups at wind energy facilities (AWWI 2018a) and impacts from wind development may cause reductions in hoary bat populations (Frick et al. 2017). Bat fatality at the Facility is not expected to substantially add to the cumulative bat fatality rate from wind energy facilities in New York, especially considering the expected reduction in bat fatalities with implementation of the curtailment regime.

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Appendix A. List of Studies at Wind Energy Facilities in the Northeast Reporting Comparable Bird and Bat Fatality Rates and Studies Reporting Data on Bird and Bat Species Found as Fatalities

Appendix A1. Wind energy facilities in the northeastern US (New York, Maine, New Hampshire, Maryland, and Pennsylvania) and southern Ontario, Canada, with publicly available and comparable fatality rate data for all bird species.

Wind Energy Facility	Fatality Estimate (birds/MW/year)	Fatality Estimate (birds/turbine/ year)
Arthur, ON (2012)	11.99	23.98
Bull Hill, ME (2013)	8.65	15.46
Stetson Mountain I, ME (2013)	6.95	10.42
Naylor Wind Farm, ON (2012)	6.63	13.26
Point-Aux-Roches Wind Farm, ON (2012)	6.46	11.73
Criterion, MD (2011)	6.40	16.01
Wolfe Island Ecopower Centre, ON (2010)	6.38	14.54
Steel Winds I & II, NY (2013)	6.20	15.50
South Side Wind Farm, ON (2012)	5.57	11.14
Spruce Mountain Wind Project, ME (2014)	5.03	10.06
Naylor Wind Farm, ON (2011)	4.00	8.00
Gosfield WPP, ON (2012)	3.97	9.13
Comber WEP, ON (2013)	3.94	9.06
Kent Breeze Wind Farm, ON (2012)	3.80	9.49
Record Hill, ME (2012)	3.70	8.46
Naylor Wind Farm, ON (2013)	3.64	7.26
Criterion, MD (2013)	3.49	8.74
Rollins, ME (2014)	3.43	5.14
North Malden, ON (2012)	3.41	6.82
Lempster, NH (2009)	3.38	6.75
Oakfield, ME (2017)	3.38	10.13
Stetson Mountain II, ME (2012)	3.37	5.06
South Side Wind Farm, ON (2011)	3.31	6.59
Stetson II, ME (2014)	3.25	4.87
Oakfield, ME (2016)	3.14	9.42
Roth Rock, MD (2011)	3.12	7.84
Ripley, ON (2008)	3.09	6.17
Wolfe Island Ecopower Centre, ON (2009)	3.04	6.99
Melancthon Ecopower Centre, ON (2009)	3.00	4.50
Grand Valley Wind Farm Project, ON (2013)	2.99	6.59
Oxley Wind Farm, ON (2015)	2.96	5.93
Kent Breeze Wind Farm, ON (2011)	2.94	7.36
Rollins, ME (2012)	2.90	4.35
Casselman, PA (2009)	2.88	4.32
Record Hill, ME (2016)	2.85	6.51
North Malden, ON (2011)	2.84	5.68
Gracey Wind Farm, ON (2011)	2.76	5.53
Kent Breeze Wind Farm, ON (2013)	2.70	6.70
Raleigh, ON (2012)	2.68	4.03
Stetson Mountain I, ME (2009)	2.68	4.03
Noble Ellenburg, NY (2009)	2.66	3.99
Lempster, NH (2010)	2.64	5.27
Mohawk Point, ON (2011)	2.52	4.16
Arthur Wind Farm, ON (2011)	2.50	5.00
Goshen WEC, ON (2015)	2.50	4.04
Port Alma & Chatham, ON (2011)	2.50	5.77
Bluewater WEC, ON (2016)	2.49	4.04
Groton, NH (2013)	2.45	4.89
Bluewater, ON (2015)	2.44	3.97
Gesner WEP, ON (2015)	2.43	4.86

Appendix A1. Wind energy facilities in the northeastern US (New York, Maine, New Hampshire, Maryland, and Pennsylvania) and southern Ontario, Canada, with publicly available and comparable fatality rate data for all bird species.

Wind Energy Facility	Fatality Estimate (birds/MW/year)	Fatality Estimate (birds/turbine/ year)
Summerhaven Wind Energy Centre, ON (2015)	2.43	5.39
Port Alma, ON (2010)	2.42	5.56
Maple Ridge, NY (2007)	2.34	3.87
Hancock, ME (2017)	2.33	6.99
Plateau Wind Farm, ON (2012)	2.31	3.48
Noble Bliss, NY (2009)	2.28	3.42
Talbot Wind Farm, ON (2012)	2.22	5.10
Plateau Wind Farm, ON (2013)	2.20	3.29
Conestogo WEC, ON (2013)	2.19	5.03
Gosfield WPP, ON (2011)	2.18	5.02
St. Columbian Wind Project, ON (2016)	2.18	4.80
Criterion, MD (2012)	2.14	5.34
Oxley Wind Farm, ON (2014)	2.12	4.24
Maple Ridge, NY (2007-2008)	2.07	3.42
Comber WEP, ON (2014)	1.99	4.59
Dufferin Wind, ON (2015)	1.99	3.73
Kent Breeze Wind Farm, ON (2014)	1.98	4.95
Port Alma & Chatham, ON (2012)	1.95	4.49
Passadumkeag, ME (2016)	1.91	6.32
Noble Altona, NY (2010)	1.84	2.76
Record Hill, ME (2014)	1.84	4.20
Mohawk Point, ON (2009)	1.82	3.02
Bingham Wind Project, ME (2017)	1.81	5.98
Melancthon Wind Plant, ON (2010)	1.81	2.73
Raleigh, ON (2011)	1.79	2.68
High Sheldon, NY (2010)	1.76	2.64
Mars Hill, ME (2008)	1.76	2.65
Summerhaven Wind Energy Centre, ON (2014)	1.76	3.91
Jericho WEC, ON (2015)	1.73	2.84
Kibby, ME (2014)	1.72	5.18
Comber WEP, ON (2015)	1.70	3.91
Noble Wethersfield, NY (2010)	1.70	2.55
East Lake St. Clair, ON (2015)	1.68	3.03
South Kent Wind Project, ON (2015)	1.68	3.69
Mars Hill, ME (2007)	1.67	2.47
Point-Aux-Roches Wind Farm, ON (2013)	1.67	3.03
Gesner WEP, ON (2014)	1.66	3.32
Noble Chateaugay, NY (2010)	1.66	2.48
Erieau Wind Farm, ON (2015)	1.65	2.99
Enbridge Ontario Wind Power, ON (2009)	1.64	2.70
Grand Valley Wind Farm Project, ON (2012)	1.64	3.78
Arthur Wind Project, ON (2013)	1.62	3.25
Gracey Wind Farm, ON (2013)	1.62	3.21
Wolfe Island Ecopower Centre, ON (2011)	1.61	3.71
Noble Clinton, NY (2008)	1.59	2.39
Cohocton/Dutch Hill, NY (2013)	1.58	3.96
Gesner Wind Energy, ON (2013)	1.58	3.16
Harrow Wind Farm, ON (2011)	1.57	2.59
High Sheldon, NY (2011)	1.57	2.36
North Malden, ON (2013)	1.53	3.05

Appendix A1. Wind energy facilities in the northeastern US (New York, Maine, New Hampshire, Maryland, and Pennsylvania) and southern Ontario, Canada, with publicly available and comparable fatality rate data for all bird species.

Wind Energy Facility	Fatality Estimate (birds/MW/year)	Fatality Estimate (birds/turbine/ year)
Casselman, PA (2008)	1.51	2.27
Groton, NH (2014)	1.50	3.01
Munnsville, NY (2008)	1.48	2.22
Stetson Mountain II, ME (2010)	1.42	2.14
Cohocton/Dutch Hill, NY (2009)	1.39	3.43
Conestogo WEC, ON (2015)	1.36	3.13
Bornish WEC, ON (2015)	1.34	2.17
Cohocton/Dutch Hills, NY (2010)	1.32	1.98
Noble Bliss, NY (2008)	1.30	1.95
East Lake St. Clair, ON (2014)	1.29	2.33
Howard, NY (2012)	1.29	2.50
Conestogo WEC, ON (2014)	1.24	2.83
Stetson Mountain I, ME (2011)	1.18	1.77
Erieau Wind Farm, ON (2014)	1.15	2.08
Gracey Wind Farm, ON (2012)	1.14	2.25
Cruickshank Wind Farm, ON (2010)	1.13	1.87
Noble Clinton, NY (2009)	1.11	1.67
Bornish WEC, ON (2016)	1.10	1.78
Mohawk Point, ON (2010)	1.05	1.73
Grand Renewable Wind, ON (2015)	0.98	2.17
Groton, NH (2015)	0.98	1.96
Melancthon 1 Wind Plant, ON (2007)	0.93	1.40
Cruickshank Wind Farm, ON (2009)	0.90	1.49
Locust Ridge, PA (Phase II; 2009)	0.84	1.68
Noble Ellenburg, NY (2008)	0.83	1.25
Wolfe Island Ecopower Centre, ON (2012)	0.77	1.76
Enbridge Ontario Wind Power, ON (2010)	0.76	1.25
Locust Ridge, PA (Phase II; 2010)	0.76	1.51
Ernestown Wind Park, ON (2015)	0.70	1.40
Port Alma, ON (2009)	0.70	1.60
Grand Valley, ON (2016)	0.68	1.69
Talbot Wind Farm, ON (2011)	0.65	1.49
Adelaide Wind, ON (2016)	0.44	0.98
Howard, NY (2013)	0.37	0.75
Quixote One, ON (2015)	0	0
Springwood Wind Project, ON (2015)	0	0

Appendix A1 (*continued*). Wind energy facilities in the northeastern US (New York, Maine, New Hampshire, Maryland, and Pennsylvania) and southern Ontario, Canada, with publicly available and comparable fatality rate data for all bird species.

Wind Energy Facility	Citation	Wind Energy Facility	Citation
Adelaide Wind, ON (2016)	Stantec Consulting Ltd. (Stantec Ltd.) 2017a	Mars Hill, ME (2007)	Stantec 2008
Arthur Wind Farm, ON (2011)	M.K. Ince and Associates, Ltd. 2012a	Mars Hill, ME (2008)	Stantec 2009a
Arthur Wind Project, ON (2013)	Natural Resource Solutions, Inc. (NRSI) 2014a	Melancthon 1 Wind Plant, ON (2007)	Stantec Ltd. 2008
Arthur, ON (2012)	Natural Resource Solutions, Inc. 2013a	Melancthon Ecopower Centre, ON (2009)	Stantec Ltd. 2010c
Bingham Wind Project, ME (2017)	TRC 2017a	Melancthon Wind Plant, ON (2010)	StantecLtd. 2010d
Bluewater WEC, ON (2016)	NRSI 2017a	Mohawk Point, ON (2009)	NRSI 2010
Bluewater, ON (2015)	NRSI 2016b	Mohawk Point, ON (2010)	NRSI 2011b
Bornish WEC, ON (2015)	NRSI 2016c	Mohawk Point, ON (2011)	NRSI 2012b
Bornish WEC, ON (2016)	NRSI 2017b	Munnsville, NY (2008)	Stantec 2009b
Bull Hill, ME (2013)	Stantec Consulting, Inc. (Stantec) 2014a	Naylor Wind Farm, ON (2011)	NRSI 2012c
Casselman, PA (2008)	Arnett et al. 2009b	Naylor Wind Farm, ON (2012)	NRSI 2013e
Casselman, PA (2009)	Arnett et al. 2010	Naylor Wind Farm, ON (2013)	NRSI 2014f
Cohocton/Dutch Hill, NY (2009)	Stantec 2010	Noble Altona, NY (2010)	Jain et al. 2011a
Cohocton/Dutch Hill, NY (2013)	Stantec 2014b	Noble Bliss, NY (2008)	Jain et al.2009c
Cohocton/Dutch Hills, NY (2010)	Stantec 2011	Noble Bliss, NY (2009)	Jain et al. 2010c
Comber WEP, ON (2013)	Stantec Ltd. 2014a	Noble Chateaugay, NY (2010)	Jain et al. 2011b
Comber WEP, ON (2014)	Stantec Ltd. 2014b	Noble Clinton, NY (2008)	Jain et al. 2009d
Comber WEP, ON (2015)	Stantec Ltd. 2016b	Noble Clinton, NY (2009)	Jain et al. 2010a
Conestogo WEC, ON (2013)	NRSI 2014b	Noble Ellenburg, NY (2008)	Jain et al. 2009e
Conestogo WEC, ON (2014)	NRSI 2015a	Noble Ellenburg, NY (2009)	Jain et al. 2010b
Conestogo WEC, ON (2015)	NRSI 2016d	Noble Wethersfield, NY (2010)	Jain et al. 2011c
Criterion, MD (2011)	Young et al. 2012	North Malden, ON (2011)	NRSI 2012d
Criterion, MD (2012)	Young et al. 2013	North Malden, ON (2012)	NRSI 2013f
Criterion, MD (2013)	Young et al. 2014	North Malden, ON (2013)	NRSI 2014g
Cruickshank Wind Farm, ON (2009)	Stantec Ltd. 2010a	Oakfield, ME (2016)	Stantec 2017b
Cruickshank Wind Farm, ON (2010)	Stantec Ltd. 2012a	Oakfield, ME (2017)	TRC 2018
Dufferin Wind, ON (2015)	NRSI 2016e	Oxley Wind Farm, ON (2014)	NRSI 2014h
East Lake St. Clair, ON (2014)	Dillon Consulting 2015a	Oxley Wind Farm, ON (2015)	NRSI 2016i
East Lake St. Clair, ON (2015)	Dillon Consulting 2016a	Passadumkeag, ME (2016)	Ritzert et al. 2017
Enbridge Ontario Wind Power, ON (2009)	Stantec Ltd. 2010b	Plateau Wind Farm, ON (2012)	NRSI 2013g

Appendix A1 (*continued*). Wind energy facilities in the northeastern US (New York, Maine, New Hampshire, Maryland, and Pennsylvania) and southern Ontario, Canada, with publicly available and comparable fatality rate data for all bird species.

Enbridge Ontario Wind Power, ON (2010)	Stantec Ltd. 2011a	Plateau Wind Farm, ON (2013)	NRSI 2014i
Erieau Wind Farm, ON (2014)	Dillon Consulting 2015b	Point-Aux-Roches Wind Farm, ON (2012)	NRSI 2013h
Erieau Wind Farm, ON (2015)	Dillon Consulting 2016b	Point-Aux-Roches Wind Farm, ON (2013)	NRSI 2014j
Ernestown Wind Park, ON (2015)	Bowfin Environmental Consulting, Inc. 2016	Port Alma & Chatham, ON (2011)	Stantec Ltd. 2012c
Gesner WEP, ON (2014)	M. K. Ince and Associates, Ltd. 2015	Port Alma & Chatham, ON (2012)	Stantec Ltd. 2013b
Gesner WEP, ON (2015)	NRSI 2016f	Port Alma, ON (2009)	M. K. Ince and Associates Ltd. 2010a
Gesner Wind Energy, ON (2013)	Stantec Ltd. 2014c	Port Alma, ON (2010)	Stantec Ltd. 2011b
Gosfield WPP, ON (2011)	Stantec Ltd. 2012b	Quixote One, ON (2015)	Leader Resources Services Corp. 2016
Gosfield WPP, ON (2012)	Stantec Ltd. 2013a	Raleigh, ON (2011)	Dillon Consulting 2012a
Goshen WEC, ON (2015)	NRSI 2016g	Raleigh, ON (2012)	Dillon Consulting 2013b
Gracey Wind Farm, ON (2011)	NRSI 2012a	Record Hill, ME (2012)	Stantec 2013a
Gracey Wind Farm, ON (2012)	NRSI 2013b	Record Hill, ME (2014)	Stantec 2015b
Gracey Wind Farm, ON (2013)	NRSI 2014c	Record Hill, ME (2016)	Stantec 2017a
Grand Renewable Wind, ON (2015)	Dillon Consulting 2016c	Ripley, ON (2008)	Jacques Whitford 2009
Grand Valley Wind Farm Project, ON (2012)	Stantec Ltd. 2015	Rollins, ME (2012)	Stantec 2013b
Grand Valley Wind Farm Project, ON (2013)	Stantec Ltd. 2015	Rollins, ME (2014)	Stantec 2015c
Grand Valley, ON (2016)	Stantec Ltd. 2017b	Roth Rock, MD (2011)	Atwell, LLC 2012
Groton, NH (2013)	Stantec and WEST 2014	South Kent Wind Project, ON (2015)	NRSI 2016k
Groton, NH (2014)	Stantec and WEST 2015a	South Side Wind Farm, ON (2011)	NRSI 2012f
Groton, NH (2015)	Stantec and WEST 2015b	South Side Wind Farm, ON (2012)	NRSI 2013j
Hancock, ME (2017)	TRC 2017b	Springwood Wind Project, ON (2015)	McIntosh Perry Consulting Engineers, Ltd. 2016
Harrow Wind Farm, ON (2011)	NRSI 2011a	Spruce Mountain Wind Project, ME (2014)	Tetra Tech, Inc. 2015
High Sheldon, NY (2010)	Tidhar et al. 2012a	St. Columban Wind Project, ON (2016)	Cole Engineering Group, Ltd. 2017
High Sheldon, NY (2011)	Tidhar et al. 2012b	Steel Winds I & II, NY (2013)	Stantec 2014c
Howard, NY (2012)	Tidhar et al. 2013b	Stetson II, ME (2014)	Stantec 2015d
Howard, NY (2013)	Lukins et al. 2014	Stetson Mountain I, ME (2009)	Stantec 2009c
Jericho WEC, ON (2015)	NRSI 2016h	Stetson Mountain I, ME (2011)	Normandeau Associates 2011
Kent Breeze Wind Farm, ON (2011)	BioLogic Incorporated 2012	Stetson Mountain I, ME (2013)	Stantec 2014d

Appendix A1 (*continued*). Wind energy facilities in the northeastern US (New York, Maine, New Hampshire, Maryland, and Pennsylvania) and southern Ontario, Canada, with publicly available and comparable fatality rate data for all bird species.

Kent Breeze Wind Farm, ON (2012)	BioLogic Incorporated 2013	Stetson Mountain II, ME (2010)	Normandeau Associates 2010
Kent Breeze Wind Farm, ON (2013)	BioLogic Incorporated 2014	Stetson Mountain II, ME (2012)	Stantec 2013d
Kent Breeze Wind Farm, ON (2014)	BioLogic Incorporated 2015	Summerhaven Wind Energy Centre, ON (2014)	NRSI 2015e
Kibby, ME (2014)	TRC Engineers LLC 2015	Summerhaven Wind Energy Centre, ON (2015)	NRSI 2016l
Lempster, NH (2009)	Tidhar et al. 2010	Talbot Wind Farm, ON (2011)	Dillon Consulting 2011
Lempster, NH (2010)	Tidhar et al. 2011	Talbot Wind Farm, ON (2012)	Dillon Consulting 2012b
Locust Ridge, PA (Phase II; 2009)	Arnett et al. 2011	Wolfe Island Ecopower Centre, ON (2009)	Stantec Ltd. 2010e
Locust Ridge, PA (Phase II; 2010)	Arnett et al. 2011	Wolfe Island Ecopower Centre, ON (2010)	Stantec Ltd. 2011c
Maple Ridge, NY (2007)	Jain et al. 2009a	Wolfe Island Ecopower Centre, ON (2011)	Stantec Ltd. 2012d
Maple Ridge, NY (2007-2008)	Jain et al. 2009b	Wolfe Island Ecopower Centre, ON (2012)	Stantec, Ltd. 2014d

Appendix A2. Wind energy facilities in the northeastern US (New York, Maine, New Hampshire, Maryland, and Pennsylvania) and southern Ontario, Canada, with cumulative fatality data for all bird and bat species.

Wind Energy Facility	Estimate Reference	Wind Energy Facility	Estimate Reference
Bingham Wind Project, ME (2017)	TRC 2017a	Noble Ellenburg, NY (2008)	Jain et al. 2009e
Bull Hill, ME (2013)	Stantec Consulting, Inc. (Stantec) 2014a	Noble Ellenburg, NY (2009)	Jain et al. 2010b
Bull Hill, ME (2014)	Stantec 2015a	Noble Wethersfield, NY (2010)	Jain et al. 2011c
Casselman, PA (2008)	Arnett et al. 2009b	Oakfield, ME (2016)	Stantec 2016
Casselman, PA (2009)	Arnett et al. 2010	Oakfield, ME (2017)	TRC 2018
Cohocton/Dutch Hill, NY (2009)	Stantec 2010	Passadumkeag, ME (2016)	Ritzert et al. 2017
Cohocton/Dutch Hill, NY (2013)	Stantec 2014b	Prince Wind Farm, ON (2006)	NRSI 2008
Cohocton/Dutch Hills, NY (2010)	Stantec 2011	Prince Wind Farm, ON (2007)	NRSI 2008
Criterion, MD (2011)	Young et al. 2012	Prince Wind Farm, ON (2008)	NRSI 2009
Criterion, MD (2012)	Young et al. 2013	Record Hill, ME (2012)	Stantec 2013a
Criterion, MD (2013)	Young et al. 2014	Record Hill, ME (2014)	Stantec 2015b
Hancock, ME (2017)	TRC 2017b	Record Hill, ME (2016)	Stantec 2017a
Harrow, ON (2010)	Natural Resources Solutions Inc. (NRSI) 2011a	Ripley, ON (2008)	Jacques Whitford 2009
Howard, NY (2012)	Tidhar et al. 2013b	Ripley, ON (Fall 2009)	Golder Associates 2010
Howard, NY (2013)	Lukins et al. 2014	Rollins, ME (2012)	Stantec 2013b
Kibby, ME (2011)	Stantec 2012	Rollins, ME (2014)	Stantec 2015c
Lempster, NH (2009)	Tidhar et al. 2010	Roth Rock, MD (2011)	Atwell, LLC 2012
Lempster, NH (2010)	Tidhar et al. 2011	Sheldon, NY (2010)	Tidhar et al. 2012a
Locust Ridge, PA (Phase II; 2009)	Arnett et al. 2011	Sheldon, NY (2011)	Tidhar et al. 2012b
Locust Ridge, PA (Phase II; 2010)	Arnett et al. 2011	Spruce Mountain, ME (2012)	Tetra Tech 2013
Madison, NY (2001-2002)	Kerlinger 2002	Spruce Mountain Wind Project, ME (2014)	Tetra Tech 2015
Maple Ridge, NY (2006)	Jain et al. 2007	Steel Winds I & II, NY (2012)	Stantec 2013c
Maple Ridge, NY (2007)	Jain et al. 2009a	Steel Winds I & II, NY (2013)	Stantec 2014c
Maple Ridge, NY (2007-2008)	Jain et al. 2009b	Steel Winds I, NY (2007)	Grehan 2008
Maple Ridge, NY (2012)	Tidhar et al. 2013a	Stetson II, ME (2014)	
Mars Hill, ME (2007)	Stantec 2008	Stetson Mountain I, ME (2009)	Stantec 2009c
Mars Hill, ME (2008)	Stantec 2009a	Stetson Mountain I, ME (2011)	Normandeau Associates 2011
Melancthon, ON (Phase I; 2007)	Stantec Ltd. 2008	Stetson Mountain I, ME (2013)	Stantec 2014d

Appendix A2. Wind energy facilities in the northeastern US (New York, Maine, New Hampshire, Maryland, and Pennsylvania) and southern Ontario, Canada, with cumulative fatality data for all bird and bat species.

Wind Energy Facility	Estimate Reference	Wind Energy Facility	Estimate Reference
Meyersdale, PA (2004)	Arnett et al. 2005	Stetson Mountain II, ME (2010)	Normandeau Associates 2010
Munnsville, NY (2008)	Stantec 2009b	Stetson Mountain II, ME (2012)	Stantec 2013d
Noble Altona, NY (2010)	Jain et al. 2011a	Wolfe Island, ON (May-June 2009)	Stantec Consulting Ltd. (Stantec Ltd.) 2010e
Noble Altona, NY (2011)	Kerlinger et al. 2011a	Wolfe Island, ON (July-December 2009)	Stantec Ltd. 2010f
Noble Bliss, NY (2008)	Jain et al.2009c	Wolfe Island, ON (January-June 2010)	Stantec Ltd. 2011c
Noble Bliss, NY (2009)	Jain et al. 2010c	Wolfe Island, ON (July-December 2010)	Stantec Ltd. 2011d
Noble Bliss/Wethersfield, NY (2011)	Kerlinger et al. 2011	Wolfe Island, ON (January-June 2011)	Stantec Ltd. 2011e
Noble Chateaugay, NY (2010)	Jain et al. 2011b	Wolfe Island, ON (July-December 2011)	Stantec Ltd. 2012d
Noble Clinton, NY (2008)	Jain et al. 2009d	Wolfe Island, ON (January-June 2012)	Stantec Ltd. 2014d
Noble Clinton, NY (2009)	Jain et al. 2010a		

Appendix A3. Wind energy facilities in the northeastern US (New York, Maine, New Hampshire, Maryland, and Pennsylvania) and southern Ontario, Canada, with publicly available and comparable fatality rate data for bat species. Fatality estimate given as the number of fatalities per megawatt (MW) year, or the number of fatalities per turbine (Turb) per year.

Wind Energy Facility	Fatality Estimate (per MW)	Fatality Estimate (per Turb)
Mohawk Point, ON (2011)	51.76	85.42
Mohawk Point, ON (2009)	31.09	51.84
Mohawk Point Wind Farm, ON (2012)	30.64	50.55
Arthur, ON (2012)	29.49	58.94
Mohawk Point, ON (2010)	27.94	46.11
Proof Line, ON (2011)	19	31
Cruickshank Wind Farm, ON (2010)	17.54	28.94
Noble Wethersfield, NY (2010)	16.3	24.45
Plateau Wind Farm, ON (2012)	16.2	24.31
North Malden, ON (2011)	15.81	31.6
Raleigh, ON (2012)	15.73	23.58
Criterion, MD (2011)	15.61	39.03
Naylor Wind Farm, ON (2011)	15	30
Naylor Wind Farm, ON (2012)	14.93	29.87
Mohawk Point Wind Farm, ON (2013)	14.72	24.27
Locust Ridge, PA (Phase II; 2010)	14.38	28.76
Locust Ridge, PA (Phase II; 2009)	14.11	28.22
Gesner Wind Energy, ON (2013)	13.74	27.47
South Side Wind Farm, ON (2012)	13.64	27.26
Casselman, PA (2008)	12.61	18.91
Harrow Wind Farm, ON (2011)	12.07	19.91
Arthur Wind Farm, ON (2011)	12.00	23.00
Enbridge Ontario Wind Power, ON (2009)	11.95	19.72
Wolfe Island Ecopower Centre, ON (2010)	11.77	27.06
Ernestown Wind Park, ON (2015)	11.74	23.47
Gracey Wind Farm, ON (2012)	11.74	23.46
Talbot Wind Farm, ON (2012)	11.56	26.61
Gracey Wind Farm, ON (2011)	11.39	22.76
Richardson Wind Farm, ON (2011)	11.25	22.49
Summerhaven Wind Energy Centre, ON (2014)	11.24	24.99
Maple Ridge, NY (2006)	11.21	18.49
Harrow, ON (2010)	11.13	18.36
Point-Aux-Roches Wind Farm, ON (2012)	10.67	19.39
Grand Valley Wind Farm Project, ON (2012)	10.48	24.11
Cruickshank Wind Farm, ON (2009)	10.34	17.07
Cohocton/Dutch Hills, NY (2010)	10.32	15.48
Howard, NY (2012)	10	20.09
South Side Wind Farm, ON (2011)	8.92	17.81
Proof Line, ON (2012)	8.74	7.2
Cohocton/Dutch Hill, NY (2009)	8.62	21.52
Casselman, PA (2009)	8.6	12.9
Gosfield WPP, ON (2012)	8.37	19.25
Noble Bliss, NY (2008)	7.8	11.7
East Lake St. Clair, ON (2014)	7.79	14.02
Enbridge Ontario Wind Power, ON (2010)	7.78	12.39
Raleigh Wind Energy Center, ON (2013)	7.73	11.59
Criterion, MD (2012)	7.62	19.06
Maple Ridge, NY (2012)	7.3	12.05
Port Alma, ON (2010)	6.88	15.82

Appendix A3. Wind energy facilities in the northeastern US (New York, Maine, New Hampshire, Maryland, and Pennsylvania) and southern Ontario, Canada, with publicly available and comparable fatality rate data for bat species. Fatality estimate given as the number of fatalities per megawatt (MW) year, or the number of fatalities per turbine (Turb) per year.

Wind Energy Facility	Fatality Estimate (per MW)	Fatality Estimate (per Turb)
Maple Ridge, NY (2007)	6.49	10.7
Wolfe Island Ecopower Centre, ON (2009)	6.42	14.77
Roth Rock, MD (2011)	6.24	15.56
Gosfield WPP, ON (2011)	6.17	14.19
Dufferin Wind, ON (2015)	6.14	11.44
Steel Winds I & II, NY (2013)	6.14	15.3
Erieau Wind Farm, ON (2015)	5.99	10.76
Harrow Wind Farm, ON (2013)	5.99	9.9
Goshen WEC, ON (2015)	5.94	9.61
Richardson Wind Farm, ON (2012)	5.92	11.84
Jericho WEC, ON (2015)	5.91	9.64
Gesner WEP, ON (2014)	5.87	11.75
Grand Renewable Wind, ON (2015)	5.78	12.83
Harrow Wind Farm, ON (2012)	5.72	9.45
Oxley Wind Farm, ON (2015)	5.68	11.38
Bluewater, ON (2015)	5.64	9.14
Point-Aux-Roches Wind Farm, ON (2014)	5.6	10.13
Bornish WEC, ON (2015)	5.56	9.01
Erieau Wind Farm, ON (2014)	5.47	9.85
Talbot Wind Farm, ON (2013)	5.4	12.41
Criterion, MD (2013)	5.32	13.3
Maple Ridge, NY (2007-2008)	4.96	8.18
Adelaide, ON (2015)	4.78	7.74
Port Alma & Chatham, ON (2011)	4.78	10.99
Port Dover and Nanticoke, ON (2015)	4.78	8.58
Ripley, ON (2008)	4.67	9.33
Kent Breeze Wind Farm, ON (2011)	4.51	11.27
Melancthon Ecopower Centre, ON (2009)	4.5	6.8
Noble Clinton, NY (2009)	4.5	6.75
South Kent Wind Project, ON (2015)	4.48	9.73
Casselman Curtailment, PA (2008)	4.4	6.6
East Lake St. Clair, ON (2015)	4.39	7.9
Noble Altona, NY (2010)	4.34	6.51
Comber WEP, ON (2014)	4.32	9.93
Conestogo WEC, ON (2013)	4.2	9.66
Gesner WEP, ON (2015)	4.16	8.32
Naylor Wind Farm, ON (2013)	4.13	8.24
Bornish WEC, ON (2016)	4.10	6.65
Port Alma & Chatham, ON (2012)	4.09	9.4
Conestogo WEC, ON (2015)	4.06	9.27
Noble Ellenburg, NY (2009)	3.91	5.86
Adelaide, ON (2015)	3.89	8.57
Noble Bliss, NY (2009)	3.85	5.77
Gracey Wind Farm, ON (2013)	3.76	7.5
Arthur Wind Project, ON (2013)	3.74	7.47
Comber WEP, ON (2015)	3.66	8.41
Summerhaven Wind Energy Centre, ON (2015)	3.63	8.06
Lempster, NH (2010)	3.57	7.13
Noble Ellenburg, NY (2008)	3.46	5.19

Appendix A3. Wind energy facilities in the northeastern US (New York, Maine, New Hampshire, Maryland, and Pennsylvania) and southern Ontario, Canada, with publicly available and comparable fatality rate data for bat species. Fatality estimate given as the number of fatalities per megawatt (MW) year, or the number of fatalities per turbine (Turb) per year.

Wind Energy Facility	Fatality Estimate (per MW)	Fatality Estimate (per Turb)
Skyway 8 Wind Farm, ON (2015)	3.42	6.49
Talbot Wind Farm, ON (2011)	3.41	7.85
South Kent Wind Project, ON (2014)	3.37	7.33
Cohocton/Dutch Hill, NY (2013)	3.22	8.03
Noble Clinton, NY (2008)	3.14	4.71
St. Columbian Wind Project, ON (2016)	3.14	6.9
Bluewater WEC, ON (2016)	3.13	14
Lempster, NH (2009)	3.11	6.21
Conestogo WEC, ON (2014)	3.07	7.02
Kent Breeze Wind Farm, ON (2012)	3	7.58
Record Hill, ME (2012)	2.96	6.78
Melancthon 1 Wind Plant, ON (2007)	2.93	1.95
Mars Hill, ME (2007)	2.91	4.37
Melancthon Wind Plant, ON (2010)	2.87	4.31
Plateau Wind Farm, ON (2013)	2.62	3.92
Raleigh, ON (2011)	2.56	3.85
Wolfe Island Ecopower Centre, ON (2011)	2.49	5.73
Noble Chateaugay, NY (2010)	2.44	3.66
High Sheldon, NY (2010)	2.33	3.5
Point-Aux-Roches Wind Farm, ON (2013)	2.28	4.14
Stetson Mountain II, ME (2012)	2.27	3.41
Plateau Wind Farm, ON (2014)	2.14	3.22
Howard, NY (2013)	2.13	4.29
Grand Valley Wind Farm Project, ON (2013)	2.05	4.52
Ravenswood, ON (2008)	2.05	3.38
Port Alma, ON (2009)	2.00	4.60
Munnsville, NY (2008)	1.93	2.9
Kent Breeze Wind Farm, ON (2014)	1.86	4.66
Adelaide Wind, ON (2016)	1.84	4.08
Grand Valley, ON (2016)	1.84	4.58
High Sheldon, NY (2011)	1.78	2.67
Groton, NH (2015)	1.74	3.49
Kent Breeze Wind Farm, ON (2013)	1.7	4.2
Sky Generation Inc., ON (2010)	1.7	2.8
Stetson Mountain II, ME (2010)	1.65	2.48
Groton, NH (2014)	1.63	3.27
Bull Hill, ME (2013)	1.62	2.87
Stetson Mountain I, ME (2009)	1.4	2.11
Record Hill, ME (2016)	1.36	3.1
Groton, NH (2013)	1.31	2.62
Stetson II, ME (2014)	0.86	1.25
Record Hill, ME (2014)	0.55	1.24
Mars Hill, ME (2008)	0.45	0.68
Hancock, ME (2017)	0.38	1.14
Oakfield, ME (2017)	0.33	1.00
Rollins, ME (2014)	0.33	0.49
Wolfe Island Ecopower Centre, ON (2012)	0.32	0.73
Spruce Mountain Wind Project, ME (2014)	0.31	0.61
Stetson Mountain I, ME (2011)	0.28	0.43
Rollins, ME (2012)	0.18	0.26

Appendix A3. Wind energy facilities in the northeastern US (New York, Maine, New Hampshire, Maryland, and Pennsylvania) and southern Ontario, Canada, with publicly available and comparable fatality rate data for bat species. Fatality estimate given as the number of fatalities per megawatt (MW) year, or the number of fatalities per turbine (Turb) per year.

Wind Energy Facility	Fatality Estimate (per MW)	Fatality Estimate (per Turb)
Stetson Mountain I, ME (2013)	0.18	0.26
Kibby, ME (2011)	0.12	0.37
Bingham Wind Project, ME (2017)	0.10	0.32
Quixote One, ON (2015)	0	0

Appendix A3 (*continued*). Wind energy facilities in the northeastern US (New York, Maine, New Hampshire, Maryland, and Pennsylvania) and southern Ontario, Canada, with publicly available and comparable fatality rate data for bat species.

Wind Energy Facility	Citation	Wind Energy Facility	Citation
Adelaide Wind, ON (2016)	Stantec Consulting Ltd. (Stantec Ltd.) 2017a	Mars Hill, ME (2008)	Stantec 2009a
Adelaide Wind, ON ([3.89 fatalities/MW/year] 2015)	Stantec Ltd. 2016a	Melancthon 1 Wind Plant, ON (2007)	Stantec Ltd. 2008
Adelaide Wind, ON ([4.78 fatalities/MW/year] 2015)	Natural Resource Solutions, Inc. (NRSI) 2016a	Melancthon Ecopower Centre, ON (2009)	Stantec Ltd. 2010c
Arthur Wind Farm, ON (2011)	M.K. Ince and Associates, Ltd. 2012a	Melancthon Wind Plant, ON (2010)	StantecLtd. 2010d
Arthur Wind Project, ON (2013)	NRSI 2014a	Mohawk Point Wind Farm, ON (2012)	NRSI 2013d
Arthur, ON (2012)	NRSI 2013a	Mohawk Point Wind Farm, ON (2013)	NRSI 2014e
Bingham Wind Project, ME (2017)	TRC 2017a	Mohawk Point, ON (2009)	NRSI 2010
Bluewater WEC, ON (2016)	NRSI 2017a	Mohawk Point, ON (2010)	NRSI 2011b
Bluewater, ON (2015)	NRSI 2016b	Mohawk Point, ON (2011)	NRSI 2012b
Bornish WEC, ON (2015)	NRSI 2016c	Munnsville, NY (2008)	Stantec 2009b
Bornish WEC, ON (2016)	NRSI 2017b	Naylor Wind Farm, ON (2011)	NRSI 2012c
Bull Hill, ME (2013)	Stantec Consulting, Inc. (Stantec) 2014a	Naylor Wind Farm, ON (2012)	NRSI 2013e
Casselman, PA (2008)	Arnett et al. 2009b	Naylor Wind Farm, ON (2013)	NRSI 2014f
Casselman, PA (2009)	Arnett et al. 2010	Noble Altona, NY (2010)	Jain et al. 2011a
Casselman Curtailment, PA (2008)	Arnett et al. 2009a	Noble Bliss, NY (2008)	Jain et al.2009c
Cohocton/Dutch Hill, NY (2009)	Stantec 2010	Noble Bliss, NY (2009)	Jain et al. 2010c
Cohocton/Dutch Hill, NY (2013)	Stantec 2014b	Noble Chateaugay, NY (2010)	Jain et al. 2011b
Cohocton/Dutch Hills, NY (2010)	Stantec 2011	Noble Clinton, NY (2008)	Jain et al. 2009d
Comber WEP, ON (2014)	Stantec Ltd. 2014b	Noble Clinton, NY (2009)	Jain et al. 2010a
Comber WEP, ON (2015)	Stantec Ltd. 2016b	Noble Ellenburg, NY (2008)	Jain et al. 2009e
Conestogo WEC, ON (2013)	NRSI 2014b	Noble Ellenburg, NY (2009)	Jain et al. 2010b
Conestogo WEC, ON (2014)	NRSI 2015a	Noble Wethersfield, NY (2010)	Jain et al. 2011c
Conestogo WEC, ON (2015)	NRSI 2016d	North Malden, ON (2011)	NRSI 2012d
Criterion, MD (2011)	Young et al. 2012	Oakfield, ME (2017)	TRC 2018
Criterion, MD (2012)	Young et al. 2013	Oxley Wind Farm, ON (2015)	NRSI 2016i
Criterion, MD (2013)	Young et al. 2014	Plateau Wind Farm, ON (2012)	NRSI 2013g
Cruickshank Wind Farm, ON (2009)	Stantec Ltd. 2010a	Plateau Wind Farm, ON (2013)	NRSI 2014i
Cruickshank Wind Farm, ON (2010)	Stantec Ltd. 2012a	Plateau Wind Farm, ON (2014)	NRSI 2015b
Dufferin Wind, ON (2015)	NRSI 2016e	Point-Aux-Roches Wind Farm, ON (2012)	NRSI 2013h

Appendix A3 (*continued*). Wind energy facilities in the northeastern US (New York, Maine, New Hampshire, Maryland, and Pennsylvania) and southern Ontario, Canada, with publicly available and comparable fatality rate data for bat species.

East Lake St. Clair, ON (2014)	Dillon Consulting 2015a	Point-Aux-Roches Wind Farm, ON (2013)	NRSI 2014j
East Lake St. Clair, ON (2015)	Dillon Consulting 2016a	Point-Aux-Roches Wind Farm, ON (2014)	NRSI 2015c
Enbridge Ontario Wind Power, ON (2009)	Stantec Ltd. 2010b	Port Alma & Chatham, ON (2011)	Stantec Ltd. 2012c
Enbridge Ontario Wind Power, ON (2010)	Stantec Ltd. 2011a	Port Alma & Chatham, ON (2012)	Stantec Ltd. 2013b
Erieau Wind Farm, ON (2014)	Dillon Consulting 2015b	Port Alma, ON (2009)	M. K. Ince and Associates Ltd. 2010a
Erieau Wind Farm, ON (2015)	Dillon Consulting 2016b	Port Alma, ON (2010)	Stantec Ltd. 2011b
Ernestown Wind Park, ON (2015)	Bowfin Environmental Consulting, Inc. 2016	Port Dover and Nanticoke, ON (2015)	Stantec Ltd. 2016c
Gesner WEP, ON (2014)	M. K. Ince and Associates, Ltd. 2015	Proof Line, ON (2011)	M. K. Ince and Associates 2012c
Gesner WEP, ON (2015)	NRSI 2016f	Proof Line, ON (2012)	M. K. Ince and Associates 2012b
Gesner Wind Energy, ON (2013)	Stantec Ltd. 2014c	Quixote One, ON (2015)	Leader Resources Services Corp. 2016
Gosfield WPP, ON (2011)	Stantec Ltd. 2012b	Raleigh Wind Energy Center, ON (2013)	Dillon Consulting 2013a
Gosfield WPP, ON (2012)	Stantec Ltd. 2013a	Raleigh, ON (2011)	Dillon Consulting 2012a
Goshen WEC, ON (2015)	NRSI 2016g	Raleigh, ON (2012)	Dillon Consulting 2013b
Gracey Wind Farm, ON (2011)	NRSI 2012a	Ravenswood, ON (2008)	M. K. Ince and Associates 2010b
Gracey Wind Farm, ON (2012)	NRSI 2013b	Record Hill, ME (2012)	Stantec 2013a
Gracey Wind Farm, ON (2013)	NRSI 2014c	Record Hill, ME (2014)	Stantec 2015b
Grand Renewable Wind, ON (2015)	Dillon Consulting 2016c	Record Hill, ME (2016)	Stantec 2017a
Grand Valley Wind Farm Project, ON (2012)	Stantec Ltd. 2015	Richardson Wind Farm, ON (2011)	NRSI 2012e
Grand Valley Wind Farm Project, ON (2013)	Stantec Ltd. 2015	Richardson Wind Farm, ON (2012)	NRSI 2013i
Grand Valley, ON (2016)	Stantec Ltd. 2017b	Ripley, ON (2008)	Jacques Whitford 2009
Groton, NH (2013)	Stantec and WEST 2014	Rollins, ME (2012)	Stantec 2013b
Groton, NH (2014)	Stantec and WEST 2015a	Rollins, ME (2014)	Stantec 2015c
Groton, NH (2015)	Stantec and WEST 2015b	Roth Rock, MD (2011)	Atwell, LLC 2012
Hancock, ME (2017)	TRC 2017b	Sky Generation Inc., ON (2010)	M. K. Ince and Associates 2010c
Harrow Wind Farm, ON (2011)	NRSI 2011a	Skyway 8 Wind Farm, ON (2015)	NRSI 2016j
Harrow Wind Farm, ON (2012)	NRSI 2013c	South Kent Wind Project, ON (2014)	NRSI 2015d
Harrow Wind Farm, ON (2013)	NRSI 2014d	South Kent Wind Project, ON (2015)	NRSI 2016k
Harrow, ON (2010)	NRSI 2011a	South Side Wind Farm, ON (2011)	NRSI 2012f

Appendix A3 (*continued*). Wind energy facilities in the northeastern US (New York, Maine, New Hampshire, Maryland, and Pennsylvania) and southern Ontario, Canada, with publicly available and comparable fatality rate data for bat species.

High Sheldon, NY (2010)	Tidhar et al. 2012a	South Side Wind Farm, ON (2012)	NRSI 2013j
High Sheldon, NY (2011)	Tidhar et al. 2012b	Spruce Mountain Wind Project, ME (2014)	Tetra Tech, Inc. 2015
Howard, NY (2012)	Tidhar et al. 2013b	St. Columban Wind Project, ON (2016)	Cole Engineering Group, Ltd. 2017
Howard, NY (2013)	Lukins et al. 2014	Steel Winds I & II, NY (2013)	Stantec 2014c
Jericho WEC, ON (2015)	NRSI 2016h	Stetson II, ME (2014)	Stantec 2015d
Kent Breeze Wind Farm, ON (2011)	BioLogic Incorporated 2012	Stetson Mountain I, ME (2009)	Stantec 2009c
Kent Breeze Wind Farm, ON (2012)	BioLogic Incorporated 2013	Stetson Mountain I, ME (2011)	Normandeau Associates 2011
Kent Breeze Wind Farm, ON (2013)	BioLogic Incorporated 2014	Stetson Mountain I, ME (2013)	Stantec 2014d
Kent Breeze Wind Farm, ON (2014)	BioLogic Incorporated 2015	Stetson Mountain II, ME (2010)	Normandeau Associates 2010
Kibby, ME (2014)	TRC Engineers LLC 2015	Stetson Mountain II, ME (2012)	Stantec 2013d
Lempster, NH (2009)	Tidhar et al. 2010	Summerhaven Wind Energy Centre, ON (2014)	NRSI 2015e
Lempster, NH (2010)	Tidhar et al. 2011	Summerhaven Wind Energy Centre, ON (2015)	NRSI 2016l
Locust Ridge, PA (Phase II; 2009)	Arnett et al. 2011	Talbot Wind Farm, ON (2011)	Dillon Consulting 2011
Locust Ridge, PA (Phase II; 2010)	Arnett et al. 2011	Talbot Wind Farm, ON (2012)	Dillon Consulting 2012b
Maple Ridge, NY (2006)	Jain et al. 2007	Talbot Wind Farm, ON (2013)	Dillon Consulting 2013c
Maple Ridge, NY (2007)	Jain et al. 2009a	Wolfe Island Ecopower Centre, ON (2009)	Stantec Ltd. 2010e
Maple Ridge, NY (2007-2008)	Jain et al. 2009b	Wolfe Island Ecopower Centre, ON (2010)	Stantec Ltd. 2011c
Maple Ridge, NY (2012)	Tidhar et al. 2013a	Wolfe Island Ecopower Centre, ON (2011)	Stantec Ltd. 2012d
Mars Hill, ME (2007)	Stantec 2008	Wolfe Island Ecopower Centre, ON (2012)	Stantec, Ltd. 2014d