CUMULATIVE IMPACTS

The New Hampshire Site Evaluation Committee (NH SEC) recently adopted changes to Site 100 and Site 300 rules related to cumulative impacts of wind power development. Site 100 provides a definition of cumulative impacts and Site 300 provides detail on the cumulative analysis required by an applicant and how the NH SEC is required to evaluate this information. The following addresses the Project's potential cumulative impacts with other wind energy facilities in New Hampshire on "natural, wildlife and habitat" resources.

Site 102.18 "Cumulative impacts" means the totality of effects resulting from a proposed wind energy facility, all existing wind energy facilities, all wind energy facilities for which a certificate of site and facility has been granted, and all proposed wind energy facilities for which an application has been accepted.

Site 301.03(h)(6) For a proposed wind energy facility, information regarding the cumulative impacts of the proposed facility on natural, wildlife, habitat, scenic, recreational, historic, and cultural resources, including, with respect to aesthetics, the potential impacts of combined observation, successive observation, and sequential observation of wind energy facilities by the viewer;

Site 301.14(g) In determining whether to grant a certificate of site and facility for a proposed wind energy facility, the committee shall consider cumulative impacts of or from multiple projects or multiple towers, or both, to public health and safety, natural, wildlife, habitat, scenic, recreational, historic, and cultural resources, including aesthetic impacts and sound impacts, and, with respect to aesthetics, the potential impacts of combined observation, successive observation, and sequential observation of energy facilities by the viewer.

WIND POWER DEVELOPMENT: NEW HAMPSHIRE

As of December 2015, there are three operational wind energy facilities in New Hampshire and one that is under construction and expected to be operational in early 2016 (Table 1). The generating capacity of these four facilities is 185.25 MW (rated). With the inclusion of the Project, wind energy facilities will be located in four New Hampshire counties and fairly widely distributed on the landscape. In relationship to these other facilities, the Project will be approximately 13 miles southeast of Lempster, 47 miles south of Groton and over 100 miles southwest of Granite Reliable and Jericho Mountain.

Table 1 Summary of wind power development in New Hampshire as of December 2015.

Facility	Location	Status	Number of Turbines	Megawatts
Antrim	Antrim, Hillsborough County	Under NHSEC review	9	28.8

Lempster	Lempster, Sullivan County	Operational (2008)	12	24
Groton	Groton, Grafton County	Operational (2012)	24	48
Granite Reliable	Coos County	Operational (2011)	33	99
Jericho Mountain	Berlin, Coos County	Under construction[1]	5	14.25

[1] Jericho Mountain is scheduled to be operational in early 2016.

NATURAL, WILDLIFE AND HABITAT RESOURCES

In the context of wind energy development, potential impacts to specific resource categories have been studied or have been discussed in publically available literature. *U.S. Fish and Wildlife Service Land-Based Wind Energy Guidelines* [(Guidelines) USFWS 2012) provides guidelines for assessing species of concern that could potentially be affected by a proposed project including "migratory birds; bats; bald and golden eagles and other birds of prey; prairie and sage grouse; and listed, proposed, or candidate endangered and threatened species." Using available literature and these Guidelines the following categories will be addressed with regard to potential cumulative impacts of the Project with other New Hampshire wind energy facilities: diurnal raptors; passerines; bats; large mammals; listed-species; water resources; and habitat loss and fragmentation. These categories cover the environmental elements of Site 301.03(h)(6) with respect to "natural, wildlife (and) habitat" resources.

Due to the varied nature of each resource type, analysis of cumulative impacts requires that the geographic area subject to assessment is defined for each resource type. Diurnal raptors, passerines, bats, and some listed-species are highly mobile and for the most part are migratory in nature. The geographic areas that should be considered for cumulative effects for these categories are large in extent. The area to be considered for cumulative effects for diurnal raptors includes Canada and the continental United States. The area to be considered for passerines is northeast North America, and cumulative assessment by Bird Conservation Region ("BCR") is appropriate. Given the scientific knowledge about bats, cumulative assessment of bats should encompass the eastern United States. Listed-species can be assessed based on biological criteria and conservation plans. Large mammals such as deer, bear and moose are managed by the State of New Hampshire with Wildlife Management Units (WMUs), as they are species managed for legal harvest by hunters during the hunting season each year. The WMUs are utilized by state biologists to manage populations of large mammals and are at an appropriate scale to assess cumulative effects to large mammals. The WMU is also an appropriate scale to assess cumulative impacts to wildlife habitat and in assessing fragmentation. Water resources are often assessed based on watersheds, with USGS hydrologic units being a standard to define geographic extent of water resource assessment.

As described below and throughout the Project's application, the cumulative environmental impact from this Project is expected to be very low given the distance to other wind projects in the State and the low overall impact of the Project. The population level impacts to birds, bats

and other wildlife are not expected to be discernable and there will be no discernable cumulative effect on water resources.

Diurnal Raptors

Diurnal raptors are birds of prey that are typically active during the day and in New Hampshire include eagles, osprey, harrier, hawks, falcons and (New World) vultures. Outside of California the number of diurnal raptors killed by striking wind turbine blades has been relatively small and the number of these fatalities documented in New England has been very limited. Erickson et al. (2014) reviewed avian mortality data compiled from 116 studies conducted at 70 different wind developments in the United States and Canada. This review determined that of the 4,975 observed fatalities[1] at wind energy facilities only 7.8% were diurnal raptors. In New England, only three diurnal raptors fatalities have been documented in association with operational wind energy facilities (Stantec unpublished). These include one red-tailed hawk (*Buteo jamaicensis*) in New Hampshire, one sharp-shined hawk (*Accpiter striatus*) in Vermont and one red-tailed hawk in Maine. Based upon these known fatality levels it is expected that there will be little if any cumulative impact to raptor populations resulting from operational fatalities.

Passerines

Passerines are often referred to as songbirds and include a wide range of resident and migratory species. Passerines represent most of the avian fatalities documented at operational wind energy facilities in the United States and Canada (Erickson et al. 2014). Of 4,975 bird fatalities at North American wind energy facilities, an estimated 62.5 percent were small passerines from 156 species. Erickson et al. (2014) estimated that annual small-passerine fatality from collision with wind turbines is 2.10 to 3.35 small birds/MW of installed capacity. Using Partners in Flight (PIF) Land Bird Population Estimates Database and their analysis of bird fatality data, they estimated that less than one-tenth of one percent of each species' continent-wide population is killed annually by wind turbines (Erickson et al. 2014). Twelve species identified by the U.S. Fish and Wildlife Service as species of conservation concern were documented in the analysis of these 70 facilities, four of which might reasonably be expected to occur as either breeding or migratory in New Hampshire: bay-breasted warbler (*Setophaga castanea*), blue-winged warbler (*Vermivora cyanoptera*), Canada warbler (*Cardellina canadensis*), and wood thrush (*Hylocichla mustelina*). The effects of wind power related mortality on the continental populations of these 12 species were estimated to be 0.016% or less. Of the six biomes addressed in this analysis, the Northern Forest Biome, which included wind energy facilities in Maine, New Hampshire and north-eastern New York, had the lowest average small passerines fatality rate (1.43 birds/MW/year).

For their review, West (2015), included 25 studies at 14 individual wind energy facilities in BCR 14. The estimated small-bird fatalities/MW/year ranged from 0.43 to 4.26 with a mean of 1.99 small birds/MW/year. The estimated average number of small-bird fatalities/MW/year using low estimator and high estimator bias adjustments were 1.97 and 1.55 fatalities/MW/year, respectively (West 2015). Based on this analysis, the highest population impact in BCR 14 was to

[1] Unless otherwise specified, "fatality'' in Erickson et al. (2014) refers to birds colliding with turbines.

the northern mockingbird (*Mimus polyglottos*) population with an estimated impact of 0.06% of the population. Estimated impacts to other regional populations were very low with most estimates of less than 0.01% of individual populations.

Population-level effects from wind turbines is extremely minor when compared to other sources of mortality such collisions with communication towers, buildings, power-lines and predation by domestic cats (Erickson et al. 2014 and West 2015). For example, a study of 107 communication towers in central and eastern North America documented over a quarter-million bird fatalities from 239 bird species of which about 97% were passerines (Longcore et al. 2013 in Erickson et al. 2014). The estimated population effects from these communications towers was up to nine percent/year. Domestic cats in the United States are estimated to kill 1.4 to 3.7 billion birds per year and in Canada domestic cat predation is estimated to be 100–350 million birds (Erickson et al. 2014). Erickson et al. (2014) suggest that reducing some of these other sources of mortality would provide greater population benefits than attempting to further reduce wind power related mortality. Based upon the available fatality data, it is expected that that there will not be any discernable cumulative effects on passerine population levels.

Bats

Little is known about the distribution of these bat species in New Hampshire and very is little is known about their summer breeding habitat (NHFGD 2005; DeGraff and Yamasaki 2001). It is known that white-nose syndrome (WNS) has caused a precipitous decline in populations of cave-dwelling bats, principally those bats in the genus *Myotis*. NHFGD estimates that the decline in total cave-dwelling bat populations in the state of New Hampshire is approaching 99% (NHFGD 2015).

It is reasonable to expect some level of bat mortality at the Project, although multi-year post construction surveys at operation wind energy facilities have shown that mortality is variable between sites and between years at individual sites (Taucher et al. 2012). Documented bat mortality rates at Maine and New Hampshire wind energy facilities have been lower than other locations such as Pennsylvania and New York (Taucher et al. 2012; Stantec 20114 unpublished). Generally, it can be expected that there will be some mortality and based on post-construction monitoring coupled with the effects of WNS, migratory tree bats will comprise the majority of fatalities. The Bird and Bat Conservation Strategy that has been developed by the Project in conjunction with NHFG and USFWS includes numerous effective strategies to reduce risk to bats over the life of the Project, including a voluntary curtailment study, tiered consultation process and adaptive management strategy (see Appendix 12F). These elements include or exceed industry best practices and USFWS guidance for land based wind energy facilities to reduce of bat mortality. Based on the strategies to limit overall bat mortality in the BBCS we expect very limited cumulative effect on bat populations.

Large Mammals

There is limited data on the effect of wind energy facilities on mammals in the Northeast. It is expected that there will be some avoidance of an operational facility, particularly when human

presence is high. Because there are no known rare mammals present at the Project, and due to the abundance of similar habitat in the surrounding area, it is unlikely that any such avoidance will result in a population level effect. In Vermont, studies have been conducted on potential impacts from wind energy facilities on black bear populations, but no such negative impacts have been documented (Arnett et al. 2007; Comeau and Hammond 2015). Given the large tracts of contiguous forest in this area of New Hampshire, the limited new impacts associated with this project, the absence of rare mammals in the area, and the fact that no other wind energy facilities are located in the same WMUs, no cumulative impact is expected to large mammal populations resulting from the operational facilities.

Listed-Species

Plants

In a letter dated August 2, 2012, the New Hampshire Natural Heritage Bureau stated that based upon their final site visit that it is "unlikely that the proposed wind facility [the Project] will impact rare plants species or exemplary natural communities". This opinion was reiterated in a letter dated June 26, 2015, from New Hampshire Natural Heritage Bureau. This opinion supports AWE's findings while conducting rare plant surveys and natural community mapping and therefore we expect no cumulative impact to rare plants or exemplary natural communities.

Birds

No federally-listed species were observed during pre-construction Project surveys. State threatened or endangered species observed during pre-construction raptor migration surveys included:

- bald eagle (*Haliaeetus leucocephalus*): state threatened;
- golden eagle(*Aquila chrysaetos*): state endangered;
- peregrine falcon (*Falco peregrinus anatum*): state threatened; and
- northern harrier(*Circus cyaneus*): state endangered.

Half of the observed bald eagles (n = 7), two golden eagles and two northern harriers passed through the Project and the single observed peregrine falcon did not cross through the Project. Three state species of special concern also were observed during these surveys: American kestrel (*Falco sparverius*), northern goshawk (*Accipiter gentilis*), and osprey (*Pandion haliaetus*). Neither the single observed American kestrel nor the northern goshawk crossed through the Project and less than half of the osprey (n = 4) crossed through the Project. Based upon the low documented use of the Project area by these species and the fact that there has been no documented mortality of any of the four species at operational wind energy facilities in the Northeast, the Project is not expected to have any cumulative effects on these populations.

In 2011, incidental observations of common nighthawks (*Chordeiles minor*), a state-listed endangered species, were made in the vicinity of Willard Mountain and Tuttle Hill. One of these observations was auditory and consisted of aerial vocalizations in the area of Willard Mountain. The other observation was visual and auditory, and consisted of several nighthawks foraging

over the valley to the north of Tuttle Hill. All of the nighthawks heard and observed were outside of the Project.. NHFGD recommended measures to minimize the potential for impacts to common nighthawks and post-construction surveys, which have been addressed by AWE and are incorporatedInto the AWE BBCS, As a result of the lack of documented use of the Project area and the proactive steps agreed to in the BBCS, no cumulative impact to nighthawk population levels is expected.

Bats

As discussed above, bat species in New Hampshire include one federally-threated species (northern long-eared bat), one state-endangered species (eastern small-footed bat) and four species of state special concern. It is expected that there will be some resulting bat mortality and it is possible that some of this mortality will be to listed species; however population level effects are unlikely. No listed bat species were captured during the mist netting conducted on the site. Additionally, the Project has adhered to all state and Federal guidance and industry best practices through the BBCS to reduce risks to these bat species over the life of the Project.

Water Resources

There will be small direct impacts to wetlands and waterbody area, as described in Section I.5.b. and Appendix 2A of the application. Due to the wind projects location in different watersheds, there are no cumulative effects on water resources from the Project.

Habitat Loss and Fragmentation

There will be some loss of existing habitat during the development of the Project. Direct habitat loss from wind energy is generally low and affects habitats that are typically common on the landscape (Arnett et al. 2007; Kuvlesky et al. 2007). The mixed forest communities present at the Project are common on the landscape and have undergone timber management both in the past, including more recently. Because the affected habitat at the Project is very common on the landscape, has seen industrial logging over the years, and other wind energy facilities are between 13 and 100 miles away and are not located in the same watershed or WMU, no cumulative effects as a result of the additional habitat loss are expected..

Habitat fragmentation, is evaluated in terms of its potential impacts primarily on various animal species that use the habitat and may be sensitive to fragmentation. Although there may be some behavioral avoidance at the Project during time of high activity, no species known to be particularly sensitive to habitat fragmentation were documented at the Project. Therefore, given that new clearing associated with the Project is a very small “incision” of only 55.3 acres in a much larger habitat block, which will then be reduced to 11.3 acres post construction, and does not create any habitat “islands” and that all other wind projects are located in different WMUs, we do not expect cumulative fragmentation impacts from the construction and operation of the Project..

RISK REDUCTION EFFORTS

The Project construction and operational phases also will include numerous efforts to minimize impacts to wildlife. These efforts are discussed in detail in the Project's bird and bat conservation strategy ("BBCS" see Appendix 12F) Land Conservation and Mitigation Appendix (see Appendix 10) and summarized briefly here. The Project will permanently protect 908 acres of adjacent land through conservation agreements. This permanently conserved land includes large tracts of foraging and nesting/roosting habitat for birds and bats and other wildlife species that would otherwise be susceptible to development. The Project has also committed to fund $100,000 to conserve additional lands offsite, which will provide similar benefits to wildlife. AWE has incorporated the recommendations of NHDES and NHFGD to minimize risks to wildlife, habitat and water resources as detailed in the Application.

CUMULATIVE IMPACTS SUMMARY

Given the careful siting, design, and operational measures employed by Antrim Wind Energy for this Project, overall environmental impacts are expected to be very low and cumulative effects from the Project with other wind energy facilities in New Hampshire are expected to be very limited, if discernable at all.

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