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COVER MEMORANDUM

Date: June 10, 2020

To: Walleye Wind Project, LLC

From: Western EcoSystems Technology, Inc.

Subject: Walleye Wind Project – 2016 Bat Acoustic Survey Report Cover Memo

INTRODUCTION

Walleye Wind Project, LLC is developing the Walleye Wind Project (Project) in Rock County, Minnesota (Figure 1). The 2016 Bat Acoustic Survey Report attached to this memorandum was initially prepared for a study area that preceded the current Project, which included infrastructure in South Dakota. The Project now being proposed by Walleye Wind, LLC will have no infrastructure or any part of the Project in South Dakota. Therefore, references in this report to South Dakota are no longer applicable to the current Project. However, this report is provided due to the study area's proximity to and partial overlap with the current Project, as it provides information pertinent to Minnesota state agency review. The study area and current Project boundary are depicted in Figure 1, below.

Please also note that in the attached 2016 Bat Acoustic Survey Report, all references to "Project" and "Project boundary" refer to the area delineated by the 2016 Bat Acoustic Survey study area as shown on Figure 1.

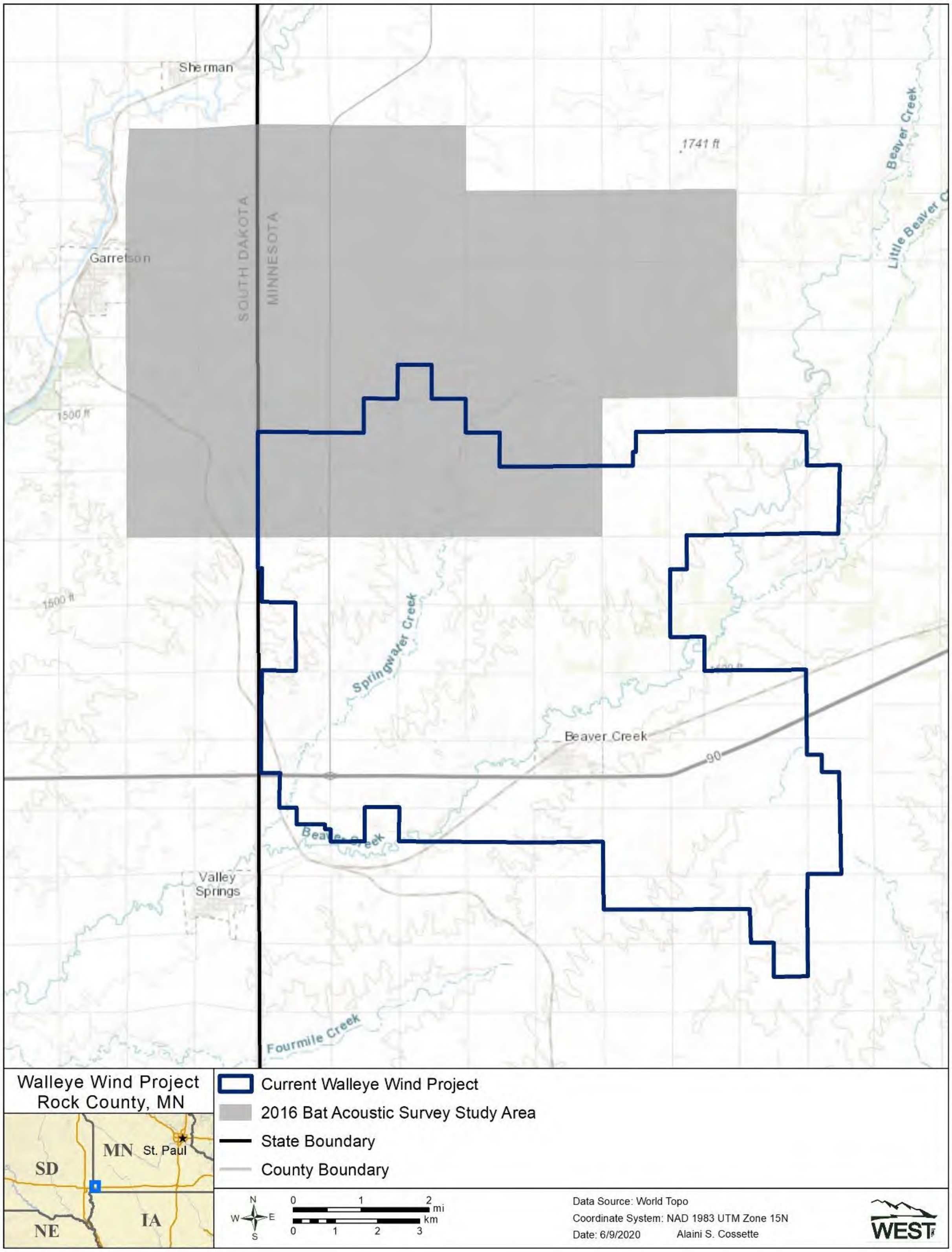

Figure 1. 2016 Bat Acoustic Survey study area in comparison to the current Walleye Wind Project, Rock County, Minnesota.

Bat Acoustic Survey
for the Walleye Wind Project
Rock County, Minnesota and Minnehaha County, South Dakota

Final Report

April 14 – November 3, 2016

Prepared for:

Renewable Energy Systems Americas, Inc.

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Prepared by:

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February 2, 2017

WEST Inc.

EXECUTIVE SUMMARY

In April 2016, Western EcoSystems Technology, Inc. initiated a bat acoustic survey for the proposed Walleye Wind Project (Project) in Rock County, Minnesota, and in Minnehaha County, South Dakota. The bat acoustic survey conducted at the Project was designed to estimate levels of bat activity throughout the Project during the spring, summer, and fall.

Acoustic surveys were conducted between April 14 and November 3, 2016, at two stations located in cropland habitat representative of potential turbine locations, and at one station located in forested edge habitat that contained features attractive to bats (i.e., a bat feature station). AnaBat® SD2 detectors were placed approximately 1.5 m above ground level and were serviced every two weeks.

The AnaBat units placed in cropland habitat detected 1,128 bat passes on 310 detector-nights for a mean (± standard error) of 3.73 ± 0.45 bat passes per detector-night. Weekly activity was highest at the cropland stations from late July to early August, and peaking at 9.17 bat passes per detector-night. This timing coincides with the period of peak bat fatalities at other wind facilities. Approximately 77% of bat passes at cropland stations were classified as low-frequency (e.g., big brown bats, hoary bats, and silver-haired bats) and 23% of bat passes were classified as high-frequency (e.g., eastern red bats [*Lasiurus borealis*], evening bats, and little brown bats).

The bat feature station recorded 7,423 bat passes on 166 detector-nights for a mean of 44.72 ± 4.05 bat passes per detector-night. Activity at the bat feature station was highest in early August, and peaking at 152.29 bat passes per detector-night. Approximately 65% of bat passes were by low-frequency species. The high activity at this station was likely due to bats being attracted to forested habitat for foraging and roosting opportunities.

All eight bat species with potential to occur within the Project were identified at each of the three stations using the auto-classifier component of Kaleidoscope 3.1.7. The northern long-eared bat is the only protected bat species with potential to occur within the Project based on established bat species ranges. All of the potential northern long-eared bat calls identified by Kaleidoscope were determined to be false identifications after qualitative review by an experienced bat biologist, and no protected bat species calls were identified during this survey.

Bat activity was highest in the summer and fall among stations and peaked at cropland stations in early July. Activity during the standardized Fall Migration Period (FMP; defined here as July 30 – October 14) at cropland stations was 6.15 ± 0.78 bat passes per detector-night, which is within the range of other studies in the Midwest region that have reported pre-construction bat activity and post-construction fatality. Bat activity estimates at the cropland stations are comparable with data at other wind energy facilities that have recorded both pre-construction bat activity and post-construction bat fatality. Most facilities in the Midwest region have reported fewer than five bat fatalities/MW/year, and therefore it is possible that bat fatality rates at the

Walleye Project will be comparable (Appendix A). The results of the study indicate that these fatalities will likely occur mainly in the late summer and early fall, and mainly be composed of low-frequency species such as hoary bats and silver-haired bats. The pre-construction bat studies completed at Project will add to the growing body of research regarding the impacts of wind energy development on bats.

STUDY PARTICIPANTS

Western EcoSystems Technology

Adam Kreger	Project Manager
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Carissa Goodman	Technical Editor
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Margaret Neja	Field Technician

REPORT REFERENCE

Bishop-Boros, L., D. I. Solick, and A. Kreger. 2016. Bat Activity Studies for the Walleye Wind Project, Rock County, Minnesota and Minnehaha County, South Dakota. Final Report: April 14 – November 3, 2016. Prepared for Renewable Energy Systems Americas, Inc., Minneapolis, Minnesota. Prepared by Western EcoSystems Technology, Inc. (WEST), Laramie, Wyoming.

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INTRODUCTION

Renewable Energy Systems, Inc. (RES) is considering the development of a wind energy facility at the Walleye Wind Energy Project (Project) in Rock County, Minnesota, and in Minnehaha County, South Dakota. RES contracted Western EcoSystems Technology, Inc. (WEST) to complete a study of bat activity following the recommendations of the US Fish and Wildlife Service (USFWS) Land-based Wind Energy Guidelines (WEG; USFWS 2012) and Kunz et al. (2007b). WEST conducted acoustic monitoring surveys to estimate levels of bat activity throughout the Project during the spring, summer, and fall. The following report describes the results of acoustic monitoring surveys conducted at the Project between April 14 and November 3, 2016.

STUDY AREA

The boundary of the proposed Project encompasses 29,753 acres (120.4 square kilometers [km], 46.5 square miles [mi]) in Rock County, Minnesota, and in Minnehaha County, South Dakota (Figure 1). The Project falls within the Western Corn Belt Plains Ecoregion, which encompasses southern Minnesota (USEPA 2016). The Western Corn Belt Plains Ecoregion is composed of glaciated till plains and undulating loess plains. Much of the region was originally dominated by tall-grass prairie, riparian forest, oak-prairie savannas, and brushy and herbaceous wetlands. Today, most of the area has been cleared for highly productive farms producing corn (*Zea mays*), soybeans (*Glycine max*), and livestock. The Project is on the very southern edge of the part of the Prairie Coteau in Minnesota. The elevation of the Project ranges from approximately 445–527 meters (m; 1,460–1,729 feet [ft]). Topography of the Project is generally flat with some gently rolling hills.

The majority of the Project is used for cultivated crops (83.5%) with additional use of pasture and hay land (7.0%) or developed open space (5.1%). Herbaceous land composes 2.4% of the Project (Figure 1, Table 1). A few streams are present within the Project draining to Beaver Creek in the southeastern portions of the Project, Springwater and westerly to Split Rock Creek in the northern and western portions of the Project. Many smaller streams in this ecoregion have been tilled, ditched and tied into existing drainage systems that has caused a reduction in the amount of aquatic habitat. Wetlands and deciduous forest each comprise 0.7% of the Project and are largely situated as fringe wetlands along riparian corridors within the Project. The remaining land covers (Open Water, Barren Land, and Shrub/Scrub) comprise less than 0.5% of the Project (Figure 1, Table 1).

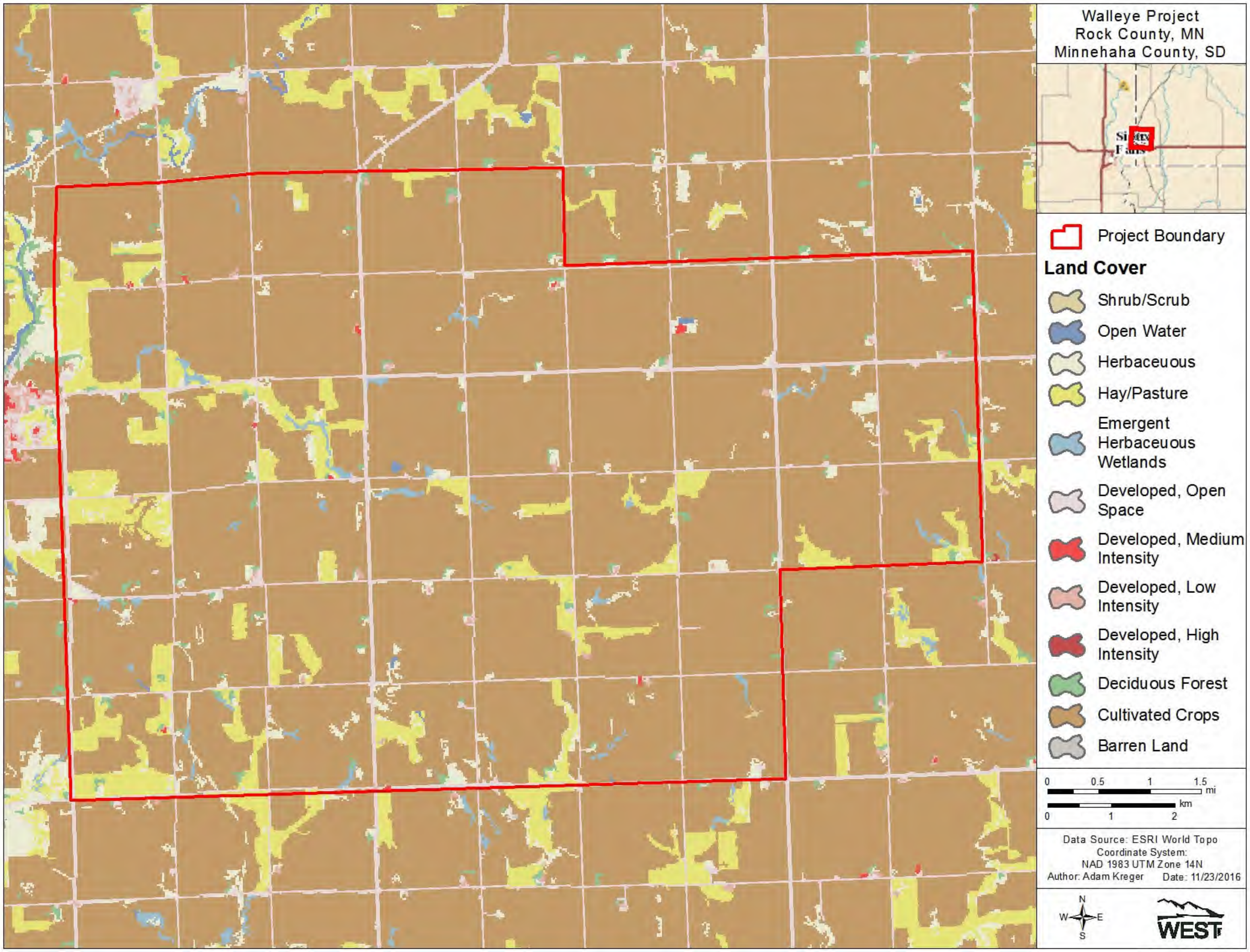

Figure 1. Land cover in the Walleye Wind Project (US Geological Survey National Land Cover Dataset [USGS NLCD] 2001).

Table 1. Land cover in the Walleye Wind Project according to the USGS NLCD (2001).

Land Cover	Acres	% Composition
Cultivated Crops	24,846.8	83.5
Hay/Pasture	2,075.1	7.0
Developed, Open Space	1,531.1	5.1
Herbaceous	719.8	2.4
Emergent Herbaceous Wetlands	215.6	0.7
Deciduous Forest	208.0	0.7
Developed, Low Intensity	98.4	0.3
Developed, Medium Intensity	20.2	0.1
Open Water	19.6	0.1
Barren Land	6.7	0.0
Shrub/Scrub	5.1	0.0
Developed, High Intensity	0.4	0.0
Total	**29,746.8**	**100**

Overview of Bat Diversity

Eight species of bats potentially occur at the Project and all eight species have been found as mortalities at wind energy facilities (Table 2). The northern long-eared bat (*Myotis septentrionalis*) is federally listed as threatened (USFWS 2016). The little brown bat (*Myotis lucifugus*), northern long-eared bat, tri-colored bat (*Perimyotis subflavus*), and big brown bat (*Eptesicus fuscus*) are state species of special concern in Minnesota (MNDNR 2013, Table 2). The northern long-eared bat and silver-haired bat (*Lasionycteris noctivagans*) are considered rare in South Dakota by the South Dakota Natural Heritage Program (SDGFP 2016; Table 2). The evening bat (*Nycticeius humeralis*) was not previously known to occur in Minnesota but was documented in July 2016 by the Minnesota Department of Natural Resources (MNDNR) in Arden Hills, northeast of the Project near Minneapolis, MN (MNDNR 2016). Evening bats have been regularly expanding their range including recent expansions within South Dakota, New York, Nebraska, Michigan, Kansas, and Texas (Mulnzer 2008). Recent records for evening bats show that they occur as far west as the Arizona and New Mexico border, and although there is potential for its presence in the general region, there is a low possibility of occurrence at the Project.

Table 2. Bat species with potential to occur within the Walleye Wind Project (IUCN 2016; USFWS 2016; MNDNR 2016) categorized by echolocation call frequency.

Common Name	Scientific Name
High-Frequency (> 30 kHz)	
eastern red bat[1,2]	*Lasiurus borealis*
evening bat[1,4,5]	*Nycticeius humeralis*
little brown bat[1,4]	*Myotis lucifugus*
northern long-eared bat[1,3,4]	*Myotis septentrionalis*
tri-colored bat[1,4]	*Perimyotis subflavus*
Low-Frequency (< 30 kHz)	
big brown bat[1,4]	*Eptesicus fuscus*
silver-haired bat[1,2]	*Lasionycteris noctivagans*
hoary bat[1,2]	*Lasiurus cinereus*

[1] species known to have been killed at wind energy facilities
[2] long-distance migrant
[3] federally threatened species (USFWS 2016)
[4] state species of special concern (MDNR 2013)
[5] state-listed as rare (SDGFP 2016, South Dakota Bat Working Group 2004)

White-Nose Syndrome

Bats that hibernate 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*) that is thought to act as a chronic disturbance during hibernation (USGS 2010; Minnis and Lindner 2013). Infected bats arouse frequently from hibernation, leading to premature loss of fat reserves and atypical behavior, which in turn leads to starvation prior to spring emergence (Boyles and Willis 2010; Reeder et al. 2012; Warnecke et al. 2012). WNS was first discovered in New York State in 2006. By 2013, WNS had rapidly spread to over 115 caves and mines and it is now confirmed in 28 states and the causative fungus has been identified in four additional states. To date, the full WNS has spread north into five Canadian provinces, reaching as far south as Alabama and as far west as Washington (Heffernan 2016). WNS is the primary reason the USFWS recently listed the northern long-eared bat as threatened under the Endangered Species Act (USFWS 2015a), and is currently reviewing the status of the little brown bat. WNS has not been detected in South Dakota. In Minnesota, the causative fungus was discovered in 2013 at Mystery Cave State Park, approximately 215 mi (346 km) southeast of the Project in Fillmore County and in and Soudan Underground Mine in northeastern Minnesota's St. Louis County. The disease itself was confirmed in February 2016 in St. Louis County.

METHODS

Bat Acoustic Surveys

WEST conducted acoustic monitoring studies to estimate levels of bat activity throughout the Project during the study period. Although it remains unclear whether baseline acoustic data are able to adequately predict post-construction fatality (Hein et al. 2013a), ultrasonic detectors do collect information on the spatial distribution, timing, and species composition that can provide insights into the possible impacts of wind development on bats (Kunz et al. 2007a; Britzke et al. 2013) and inform potential mitigation strategies (Weller and Baldwin 2012).

Survey Stations

Three AnaBat SD2 ultrasonic bat detectors (Titley™ Scientific, Australia) were used during the study. Two detectors were placed near ground level (approximately 1.5 m above ground level [AGL]) in cropland, which is the dominant land cover type (Table 1) and is representative of potential turbine locations (Figure 2). A third detector (station WE3) was placed approximately 1.5 m above ground level along forest edge habitat that contained features potentially attractive to bats for roosting, foraging, or drinking opportunities. This 'bat feature' station was selected to determine an upper level of bat activity for the Project, placing activity data from the other stations in better context. Data from the bat feature station were not used for making the final risk assessment.

Each AnaBat unit was inside a plastic weather-tight container that had a hole cut in the side through which the microphone extended. Each microphone was encased in a 45-degree angle poly-vinyl chloride (PVC) tube, and holes were drilled in the PVC tube to allow water to drain.

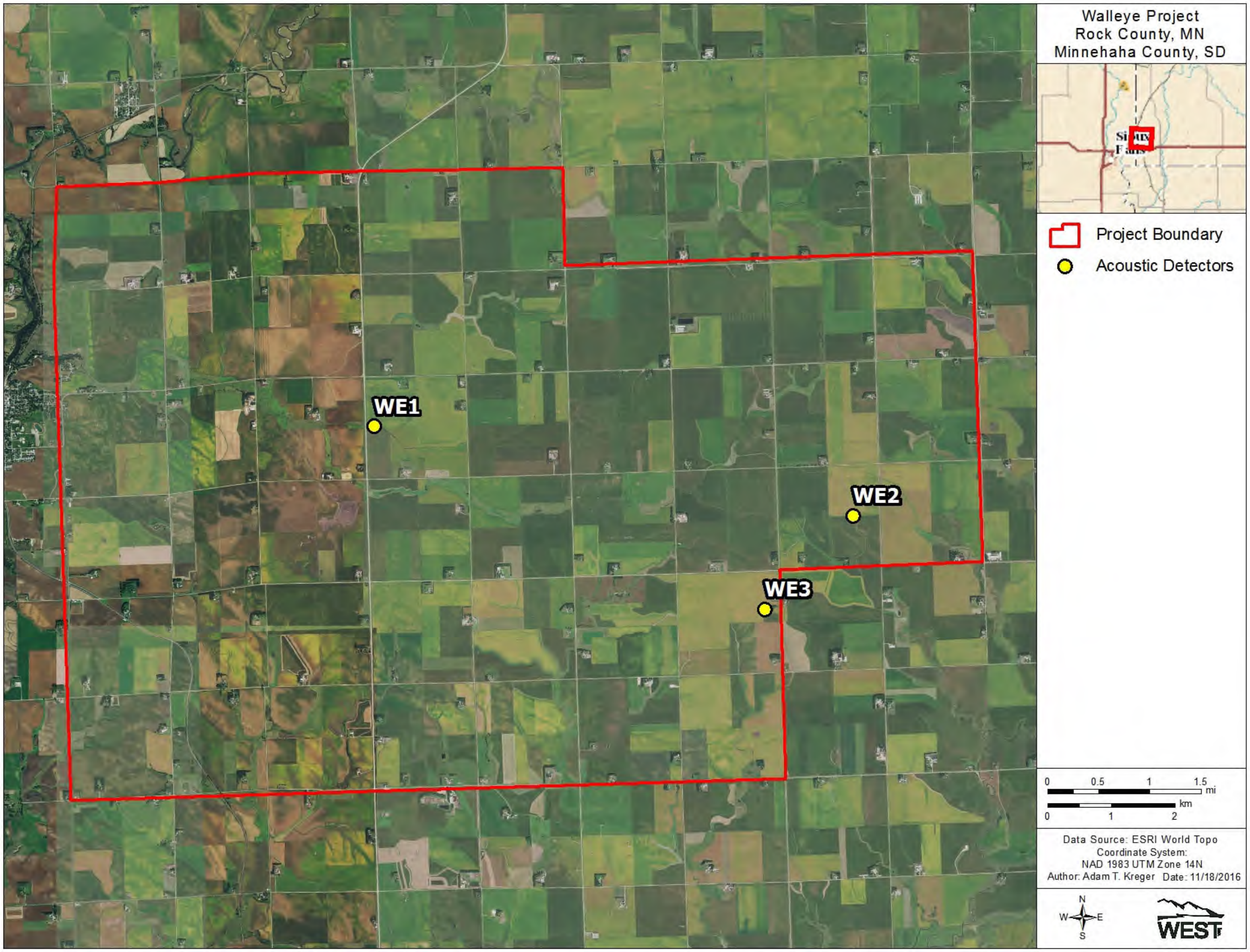

Figure 2. Location of AnaBat stations in the Walleye Wind Project.

Survey Schedule

Bats were surveyed in the Project from April 14 to November 3, 2016, and detectors were programmed to turn on approximately 30 minutes (min) before sunset and turn off approximately 30 min after sunrise each night. Mean bat activity was calculated for the full study period, as well as for a standardized Fall Migration Period (FMP), defined here as July 30 – October 14. The FMP was defined by WEST as a standard for comparison with activity from other wind energy facilities. During this time, bats begin moving toward wintering areas, and many species of bats initiate reproductive behaviors (Cryan 2008). This period of increased landscape-scale movement and reproductive behavior is often associated with increased levels of bat fatalities at operational wind energy facilities (Arnett et al. 2008; Arnett and Baerwald 2013).

Data Collection and Call Analysis

AnaBat detectors use a broadband high-frequency microphone to detect the echolocation calls of bats. Incoming echolocation calls are digitally processed and stored on a high capacity compact flash card. The resulting files can be viewed in appropriate software (e.g., Analook©) as digital sonograms that show changes in echolocation call frequency over time. Frequency versus time displays were used to separate bat calls from other types of ultrasonic noise (e.g., wind, insects, etc.) and to determine the call frequency category and (when possible) the species of bat that generated the calls.

To standardize acoustic sampling effort across the Project, AnaBat units were calibrated and sensitivity levels were set to six (Larson and Hayes 2000), a level that balanced the goal of recording bat calls against the need to reduce interference from other sources of ultrasonic noise (Brooks and Ford 2005).

For each survey location, bat passes were sorted into two groups based on their minimum frequency. High frequency (HF) bats such as eastern red bats, tricolored bats, and *Myotis* species have minimum frequencies greater than 30 kilohertz (kHz). Low frequency (LF) bats such as big brown bats, silver-haired bats, and hoary bats (*Lasiurus cinereus*) typically emit echolocation calls with minimum frequencies below 30 kHz. HF and LF species that may occur in the study area are listed in Table 2.

Identification of calls was completed with the automated identification feature in program Kaleidoscope 3.1.7 (Wildlife Acoustics, Concord, Massachusetts) using the Bats of North America classifier 3.1.0. Kaleidoscope utilizes Hidden Markov Models and other statistical methods known for their application in temporal pattern recognition such as speech analysis, handwriting analysis, and DNA sequencing (Agranat 2012). Despite the capabilities of Kaleidoscope, many bat passes cannot be identified with certainty, either because only call fragments were recorded due to the distance between the bat and microphone or because many bat species produce similar calls with overlapping call characteristics that often cannot be distinguished. The Kaleidoscope output was used to generate a list of species that may have been present in the Project.

An experienced bat acoustic analyst qualitatively reviewed the echolocation calls of files identified by Kaleidoscope as northern long-eared bats through visual comparison of echolocation call metrics (e.g., minimum frequency, slope, duration) to reference calls of known bats (Yates and Muzika 2006).

Statistical Analysis

The standard metric used for measuring bat activity is the number of bat passes per detector-night, and this metric was used as an index of bat activity in the Project. A bat pass was defined as a sequence of at least two echolocation calls (pulses) produced by an individual bat with no pause between calls of more than one second (Fenton 1980). A detector-night was defined as one detector operating for one entire night. The terms bat pass and bat call are used interchangeably. Bat passes per detector-night was calculated for all bats, and for HF and LF bats. Bat pass rates represent indices of bat activity and do not represent numbers of individuals. The number of bat passes was determined by an experienced bat biologist using Analook.

The period of peak sustained bat activity was defined as the seven-day period with the highest average bat activity. If multiple seven-day periods equaled the peak sustained bat activity rate, all dates in these seven-day periods were reported. This and all multi-detector averages in this report were calculated as an unweighted average of total activity at each detector.

Risk Assessment

To assess potential for bat fatalities, bat activity in the Project was compared to existing data at other wind energy facilities in the Midwest region. Among studies measuring both activity and fatality rates, most data were collected during the fall using Anabat detectors placed near the ground. Therefore, to make valid comparisons to the publically available data, this report uses the activity rate recorded at fixed, ground detectors during the FMP as a standard for comparison with activity data from other wind energy facilities. Given the relatively small number of publically available studies and the significant ecological differences between geographically dispersed facilities, the risk assessment is qualitative, rather than quantitative.

RESULTS

Bat Acoustic Surveys

Bat activity was monitored at three sampling locations for a total of 476 detector-nights between April 14 and November 3, 2016. AnaBat units were operating for 77.8% of the sampling period (Figure 3). The primary cause of lost data was due to technician error with detectors, corrupt cards, and low battery power. AnaBat units at cropland stations recorded 1,128 bat passes on 310 detector-nights for a mean (± standard error) of 3.73 ± 0.45 bat passes per detector-night (Table 3). In contrast, the AnaBat unit at the bat feature station recorded 7,423 bat passes on 166 detector-nights for a mean of 44.72 ± 4.05 bat passes per detector-night (Table 3).

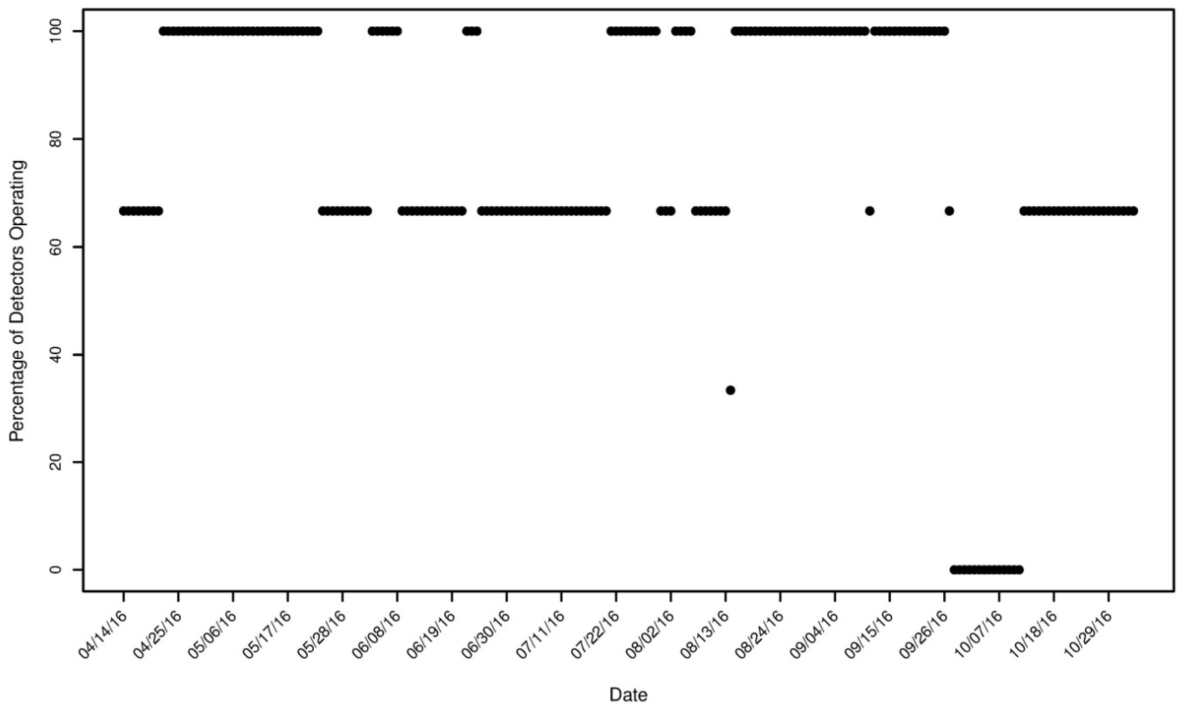

Figure 3. Operational status of bat detectors (n = 3) operating at the Walleye Wind Project during each night of the study period April 14 to November 3 2016.

Table 3. Results of acoustic bat surveys conducted at cropland and bat feature stations within the Walleye Wind Project from April 14 to November 3, 2016. Passes are separated by call frequency: high frequency (HF) and low frequency (LF).

Anabat Station	Habitat	Type	# of HF Bat Passes	# of LF Bat Passes	Total Bat Passes	Detector-Nights	Bat Passes/ Night***
WE1	cropland	fixed	162	642	804	147	5.47 ± 0.66
WE2	cropland	fixed	101	223	324	163	1.99 ± 0.34
WE3	forest edge	bat feature	2,693	4,730	7,423	166	44.72 ± 4.05
Total Cropland Stations			263	865	1,128	310	3.73 ± 0.45
Total Bat Feature Station			2,693	4,730	7,423	166	44.72 ± 4.05
Total			**2,956**	**5,595**	**8,551**	**476**	**17.39 ± 1.27**

*** ± bootstrapped standard error.

Spatial Variation

Bat activity in the Project was varied between the two cropland stations, ranging from 1.99 and 5.47 bat passes per detector-night (Table 3, Figure 4a). Bat activity at the bat feature station was much higher, averaging 44.72 bat passes per detector-night (Table 3, Figure 4b).

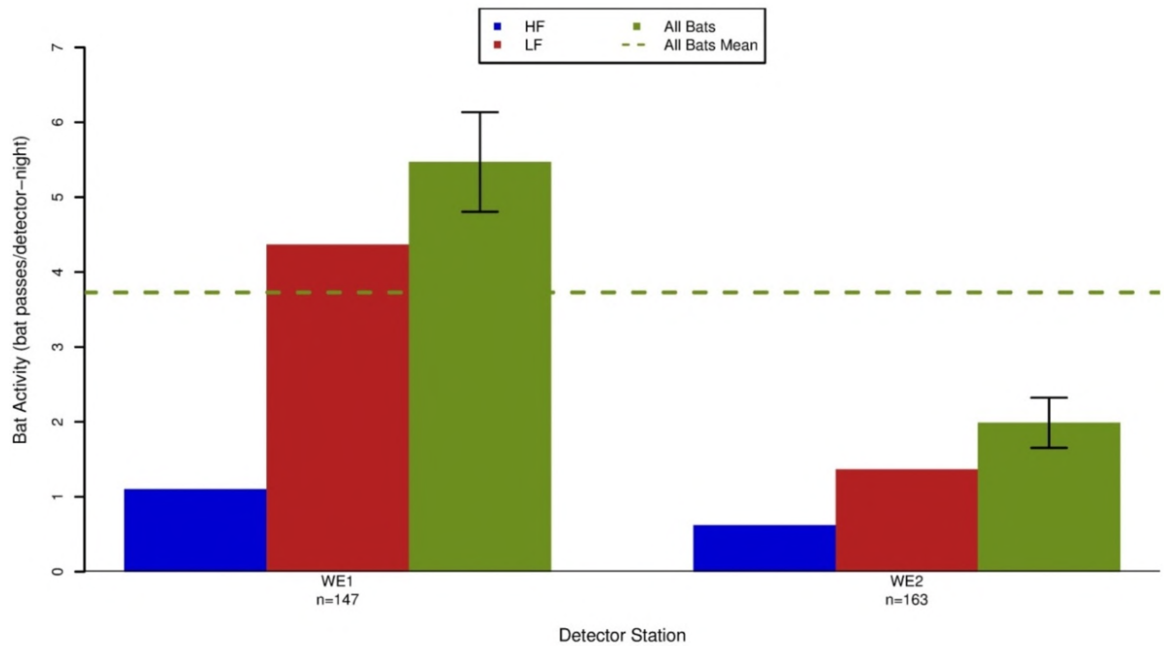

Figure 4a. Number of high-frequency (HF) and low-frequency (LF) bat passes per detector-night recorded at cropland stations in the Walleye Wind Project from April 14 to November 3, 2016. The bootstrapped standard errors are represented by the black error bars on the 'All Bats' columns.

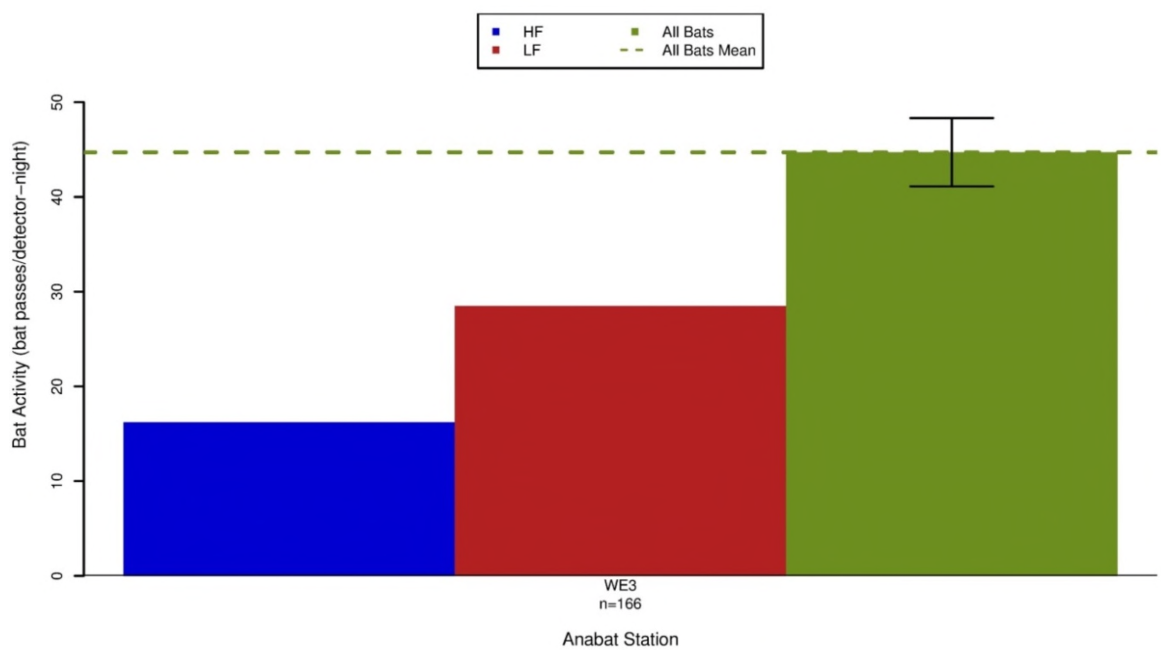

Figure 4b. Number of high-frequency (HF) and low-frequency (LF) bat passes per detector-night recorded at the bat feature station in the Walleye Wind Project from April 14 to November 3, 2016. The bootstrapped standard errors are represented by the black error bars on the 'All Bats' columns.

Temporal Variation

Weekly acoustic activity at cropland stations was relatively low throughout the spring, with an abrupt peak in activity from June 25 to July 1 (14.29 bat passes per detector-night) driven by LF bat activity (Table 4, Table 5a, Figure 6a). HF bat activity at cropland stations peaked later from August 16 to 22 (4.50 bat passes per detector-night; Table 5a). Bat activity at cropland stations during the FMP was 6.15 ± 0.78. Weekly activity at the bat feature station was low in the spring increasing during the early summer and peaking between August 5 and August 11 (152.29 bat passes per detector-night; Figure 6b, Table 5b). This overall bat peak coincided with the HF bat peak activity at the bat feature station. Low-frequency bat activity also peaked earlier at the bat feature station, from July 18 to 24 (77.14 bat passes per detector-night; Table 5b). Bat activity remained relatively high throughout September. No data were collected from September 27 through the end of the study period at bat feature station WE3 (Figure 3, Figure 6b).

Table 4. The number of bat passes per detector-night recorded at all stations in the Walleye Wind Project during each season in 2016, separated by call frequency: high-frequency (HF), low-frequency (LF), and all bats (AB).

Station	Call Frequency	Spring April 14 – May 31	Summer June 1 – Jul 31	Fall Aug 1 – Oct 27	Fall Migration Period Jul 30 – Oct 14
WE1	LF	0.16	6.89	4.67	6.39
	HF	0.12	1.29	1.43	1.96
	AB	0.28	8.18	6.1	8.35
WE2	LF	0.4	0.94	2.14	2.68
	HF	0.1	0.49	0.99	1.27
	AB	0.5	1.43	3.12	3.95
WE3	LF	11.88	31.2	39.6	39.39
	HF	1.6	12.44	32.58	32.54
	AB	13.48	43.64	72.18	71.93
Cropland Stations Total	LF	0.28 ± 0.07	3.92 ± 0.60	3.40 ± 0.57	4.53 ± 0.72
	HF	0.11 ± 0.04	0.89 ± 0.18	1.21 ± 0.21	1.62 ± 0.26
	AB	0.39 ± 0.09	4.80 ± 0.65	4.61 ± 0.64	6.15 ± 0.78
Bat Feature Station Total	LF	11.88 ± 2.35	31.20 ± 4.64	39.60 ± 4.08	39.39 ± 3.94
	HF	1.60 ± 0.37	12.44 ± 2.74	32.58 ± 4.79	32.54 ± 4.64
	AB	13.48 ± 2.46	43.64 ± 5.89	72.18 ± 6.99	71.93 ± 6.72
Overall	**LF**	**4.14 ± 0.77**	**13.01 ± 1.92**	**15.47 ± 1.31**	**16.15 ± 1.29**
	HF	**0.61 ± 0.15**	**4.74 ± 0.90**	**11.67 ± 1.55**	**11.93 ± 1.49**
	AB	**4.75 ± 0.81**	**17.75 ± 2.32**	**27.13 ± 2.27**	**28.08 ± 2.20**

Table 5a. Periods of peak activity for high frequency (HF), low frequency (LF), and all bats at cropland stations at the Walleye Wind Project for the study period April 14 to November 3, 2016.

Species Group	Start Date of Peak Activity	End Date of Peak Activity	Bat Passes per Detector-Night
HF	August 16	August 22	4.50
LF	June 25	July 1	14.29
All Bats	June 25	July 1	12.64

Table 5b. Periods of peak activity for high frequency (HF), low frequency (LF), and all bats at the bat feature station at the Walleye Wind Project for the study period April 14 to November 3, 2016.

Species Group	Start Date of Peak Activity	End Date of Peak Activity	Bat Passes per Detector-Night
HF	August 5	August 11	91.57
LF	July 18	July 24	77.14
All Bats	August 5	August 11	152.29

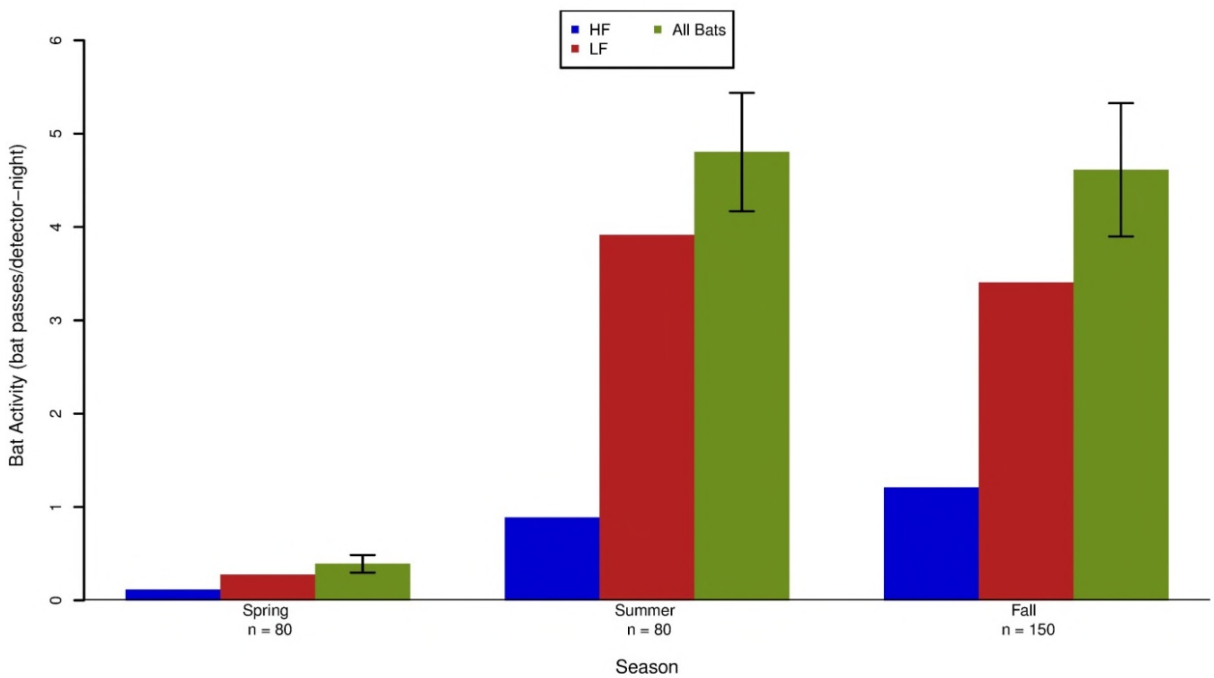

Figure 5a. Seasonal bat activity by high-frequency (HF), low-frequency (LF), and all bats at cropland stations at the Walleye Wind Energy Project from April 14 to October 27, 2016. The bootstrapped standard errors are represented on the 'All Bats' columns.

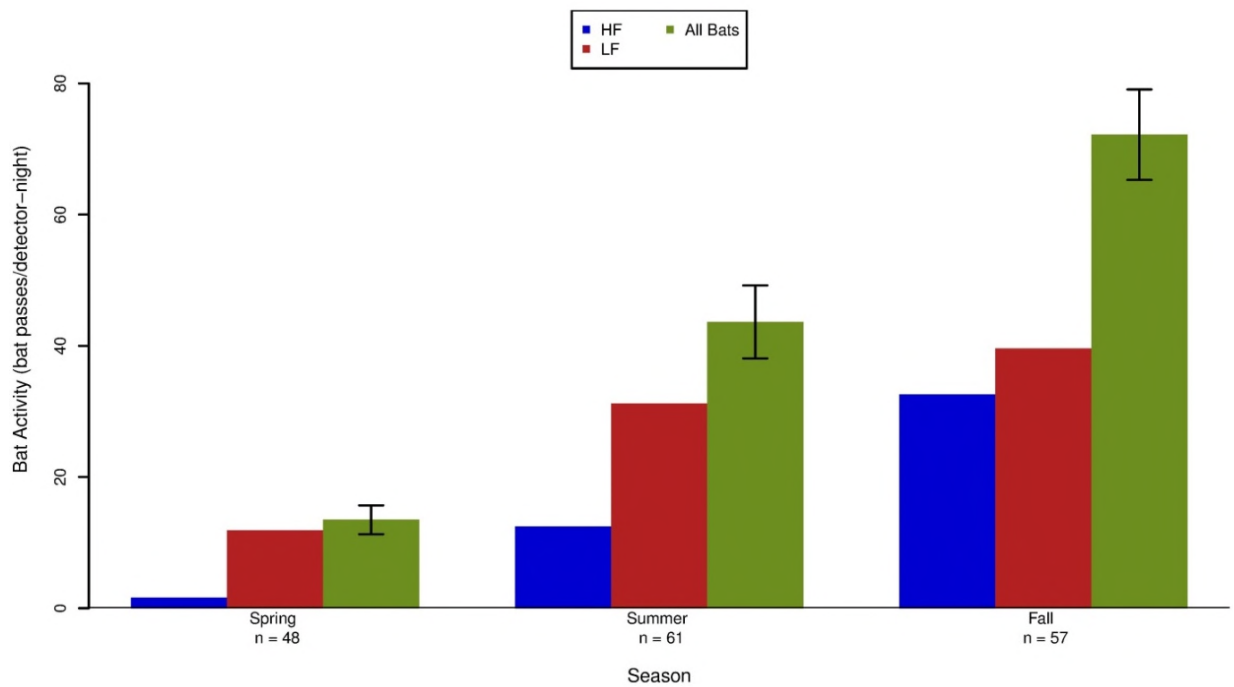

Figure 5b. Seasonal bat activity by high-frequency (HF), low-frequency (LF), and all bats at the bat feature station at the Walleye Wind Energy Project from April 14 to October 27, 2016. The bootstrapped standard errors are represented on the 'All Bats' columns

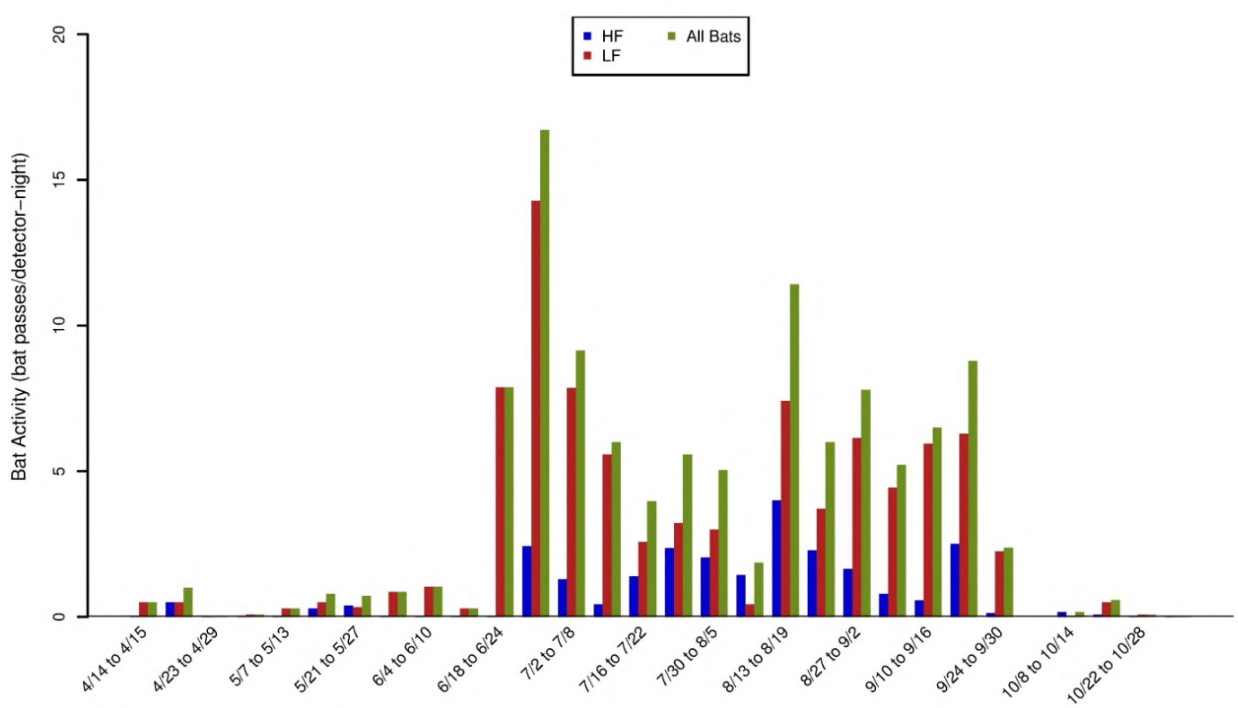

Figure 6a. Weekly patterns of bat activity by high-frequency (HF), low-frequency (LF), and all bats at cropland stations the Walleye Wind Project for the study period April 14 to November 3, 2016.

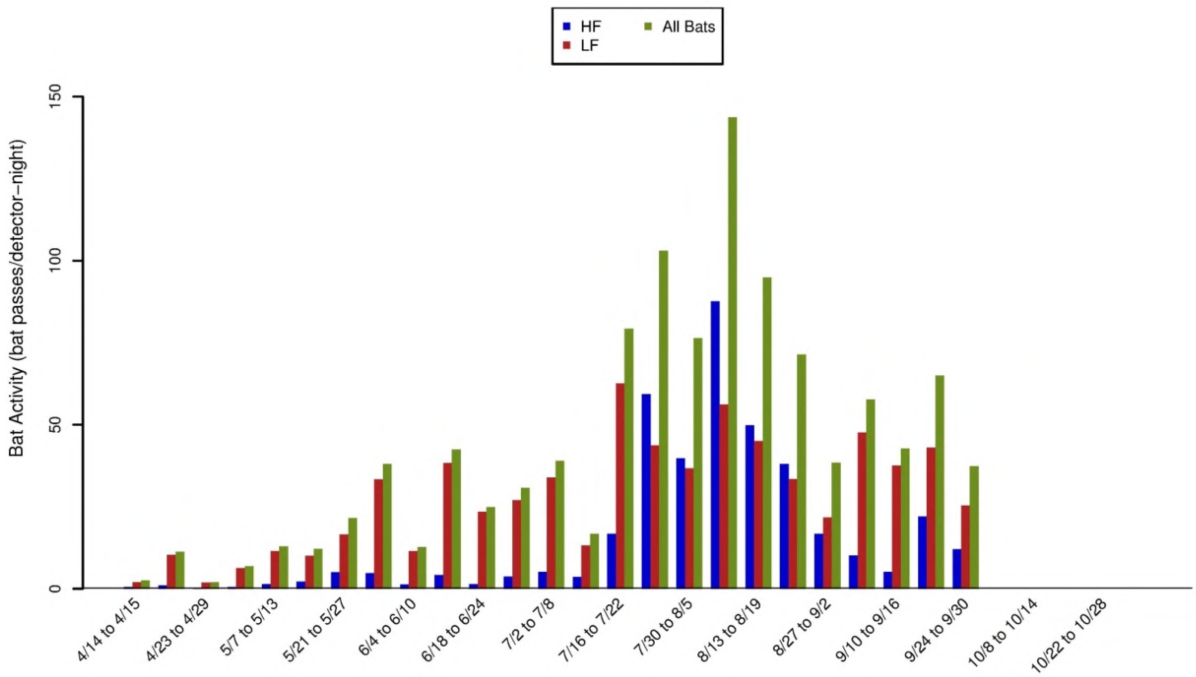

Figure 6b. Weekly patterns of bat activity by high-frequency (HF), low-frequency (LF), and all bats at the bat feature station at the Walleye Wind Project for the study period April 14 to November 3, 2016.

Species Composition

Low-frequency bats (LF; e.g., big brown bats, hoary bats, and silver-haired bats; Table 2) were the most commonly recorded species at both cropland (76.7%) and at bat feature (65.4%) stations (Table 3), suggesting that these species are relatively more abundant than high-frequency species in the Project. High-frequency bats (HF; e.g., tri-colored bats, eastern red bats, and *Myotis* species) composed 23.3% and 34.6% of bat passes recorded at cropland and bat feature stations, respectively (Table 2, Table 3).

All eight bat species with potential to occur within the Project were identified at each of the three stations using the auto-classifier component of Kaleidoscope 3.1.7 (Table 6). All of the potential northern long-eared bat calls identified by Kaleidoscope were determined to be false identifications after qualitative review by an experienced bat biologist. These passes are combined along with those by little brown bats as the *Myotis* group in Table 6. Hoary bats were the most commonly identified species by Kaleidoscope present on 71% of detector-nights. The other two LF species (big brown bats and silver-haired bats) were tied as the second most commonly identified species, detected on 56% of operational detector-nights. The *Myotis* group was the least commonly recorded species at all three stations (Table 6).

Table 6. The number (percent) of presence/absence dates for detector-nights with bat species present by station recorded by the detectors at Walleye Wind Project using Kaleidoscope 3.1.7

Common Name	WE1	WE2	WE3	Total
High-Frequency (> 30 kHz)				
eastern red bat	46 (31)	33 (20)	106 (64)	185 (39)
evening bat	26 (18)	20 (12)	80 (48)	126 (26)
Myotis species	4 (3)	2 (1)	30 (18)	36 (8)
tri-colored bat	5 (3)	3 (2)	33 (20)	41 (9)
Low-Frequency (< 30 kHz)				
big brown bat	74 (50)	48 (29)	146 (88)	268 (56)
hoary bat	120 (82)	113 (69)	103 (62)	336 (71)
silver-haired bat	67 (46)	53 (33)	147 (89)	267 (56)

DISCUSSION

Bat fatalities have been discovered at most wind energy facilities monitored in North America, ranging from 0.0 (Chatfield et al. 2014) to 40.2 bat fatalities/MW/year (Hein et al. 2013a; Appendix A). In 2012, an estimated 600,000 bats died as a result of interactions with wind turbines in the US (Hayes 2013). Proximate causes of bat fatalities are primarily due to collisions with moving turbine blades (Grodsky et al. 2011; Rollins et al. 2012) but to a limited extent may also be caused by barotrauma (Baerwald et al. 2008). The underlying reasons for why bats come near turbines are still largely unknown (Cryan and Barclay 2009). To date, post-construction monitoring studies of wind energy facilities show that 1) migratory tree-roosting species (e.g., eastern red bat, hoary bat, and silver-haired bat) compose approximately 78% 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 m per second [m/s; 19.7 feet per second (ft/s)]; Arnett et al. 2008; Arnett and Baerwald 2013; Arnett et al. 2013).

It is generally expected that pre-construction bat activity is positively related to post-construction bat fatalities (Kunz et al. 2007b). However, to date, few studies of wind energy facilities have recorded both bat passes per detector-night and bat fatality rates are available (Appendix A). Given the limited availability of pre- and post-construction data sets, differences in protocols among studies (Ellison 2012) and significant ecological differences between geographically diverse facilities, the relationship between activity and fatalities has not yet been empirically established. However, Baerwald and Barclay (2009) found a significant positive association between pass rates measured at 30 m/s (98 ft/s) AGL and fatality rates for hoary and silver-haired bats across five sites in southern Alberta.

However, on a continental scale, a similar relationship has proven difficult to establish. The relatively few studies that have estimated both pre-construction activity and post-construction fatalities trend toward a positive association between activity and fatality rates, but they lack statistically significant correlations. Hein, et al. (2013a) compiled data from wind projects that included both pre- and post-construction data from the same projects, as well as pre- and post-construction data from facilities within the same regions to assess if pre-construction acoustic activity predicted post-construction fatality rates. Based on data from 12 sites that had both pre- and post-construction data, they did not find a statistically significant relationship (p=0.07), although the trend was in the expected direction (i.e., low activity was generally associated with low fatalities and vice-versa). They concluded therefore, that pre-construction acoustic data could not currently predict bat fatalities, but acknowledged that the data set was limited and additional data may indicate a stronger relationship. Therefore, the current approach to assessing the risk to bats requires a qualitative analysis of activity levels, spatial and temporal relationships, species composition, and comparison to regional fatality patterns.

Mean bat activity during the FMP at the Project cropland detectors (6.15 ± 0.78 bat passes per detector-night; Table 4) was lower than the North American median and within the range of the activities reported in studies available from the Midwest (Appendix A). Given that over two-thirds of bat fatality studies in the Midwest report fewer than five bat fatalities/MW/year (32 of 38 studies; Appendix A; Figure 7), it is possible that similar fatality rates could be recorded at the Project. However, some studies indicate that facilities in agricultural settings in the Midwest can produce higher levels of bat fatalities (Jain 2005, Baerwald 2008, Gruver et al. 2009a).

Bat activity was high at the bat feature station, likely because this station was located along forest edge habitat, which would have been attractive to bats for foraging and roosting opportunities. Forested habitat composes 0.7% of the Project (Table 1).

Approximately 76.7% of bat passes recorded in the cropland stations and 65.4% of passes at the bat feature station were emitted by LF bats, suggesting greater relative abundance of species such as big brown bats, silver-haired bats, and hoary bats (Table 3). These LF species may be more likely to become casualties because they typically fly at higher altitudes (see Norberg and Rayner 1987). Activity by HF bats composed 23.3% and 34.6% of bat passes recorded at cropland and bat feature stations. Eastern red bats are usually the most common HF species found during carcass searches (Arnett et al. 2008; Arnett and Baerwald 2013). *Myotis* species are recorded less commonly than other species in the rotor-swept zone or as fatalities at most post-construction studies of wind energy facilities (Kunz et al. 2007b; Arnett et al. 2008), with a few notable exceptions (Kerns and Kerlinger 2004b; Jain 2005; Brown and Hamilton 2006a; Gruver et al. 2009a). *Myotis* group bats were the least commonly detected bat species by Kaleidoscope at all three stations (Table 6). Given that hoary bats, eastern red bats, and silver-haired bats are also among the most common bat fatalities at many facilities (Arnett et al. 2008; Arnett and Baerwald 2013), it is expected that these three species would be the most common fatalities at the Project.

Bat activity at cropland stations was highest from late June to early July, while it was highest in early August at the bat feature station. This timing is consistent with peak fatality periods for most wind energy facilities in the US, and suggests that bat fatalities at the Project will be highest during late summer to early fall and may consist largely of migrating individuals. High mid-summer activity may reflect increased foraging by reproductive females during lactation (Kurta et al. 1989) and/or an increased number of foraging bats due to newly volant bat pups (young of the year) being added to the foraging population at this time.

The pre-construction bat studies completed at Project will add to the growing body of research regarding the impacts of wind energy development on bats and will provide a valuable comparison to post-construction studies to be completed at Project.

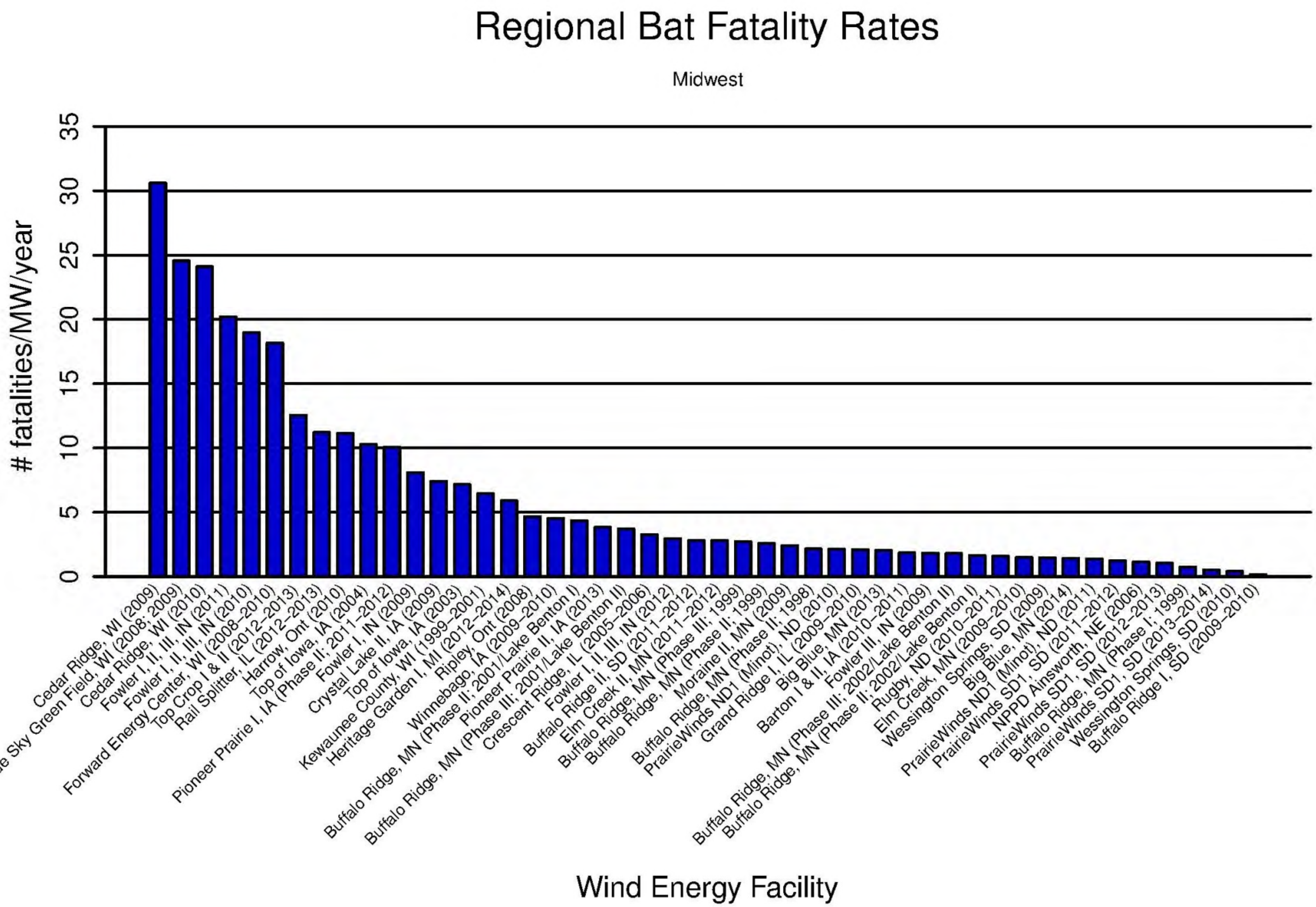

Figure 7. Fatality rates for bats (number of bats per MW per year) from publically available wind energy facilities in the Midwest region of North America.

Figure 7 (*continued*). Fatality rates for bats (number of bats per MW per year) from publically available wind energy facilities in the Midwest region of North America. Data from the following sources:

Facility	Activity Estimate	Fatality Estimate	Facility	Activity Estimate	Fatality Estimate
Cedar Ridge, WI (09)	BHE Environmental 2008	BHE Environmental 2010	Elm Creek II, MN (11-12)		Derby et al. 2012b
Blue Sky Green Field, WI (08; 09)	Gruver 2008	Gruver et al. 2009b	Buffalo Ridge, MN (Phase III; 99)		Johnson et al. 2000
Cedar Ridge, WI (10)	BHE Environmental 2008	BHE Environmental 2011	Buffalo Ridge, MN (Phase II; 99)		Johnson et al. 2000
Fowler I, II, III, IN (11)		Good et al. 2012	Moraine II, MN (09)		Derby et al. 2010d
Fowler I, II, III, IN (10)		Good et al. 2011	Buffalo Ridge, MN (Phase II; 98)		Johnson et al. 2000
Forward Energy Center, WI (08-10)	Watt and Drake 2011	Grodsky and Drake 2011	PrairieWinds ND1 (Minot), ND (10)		Derby et al. 2011c
Top Crop I & II, IL (12-13)		Good et al. 2013a	Grand Ridge I, IL (09-10)		Derby et al. 2010g
Rail Splitter, IL (12-13)		Good et al. 2013b	Big Blue, MN (13)		Fagen Engineering 2014
Harrow, Ont (10)		NRSI 2011	Barton I & II, IA (10-11)		Derby et al. 2011a
Top of Iowa, IA (04)	Jain 2005	Jain 2005	Fowler III, IN (09)		Johnson et al. 2010b
Pioneer Prairie I, IA (Phase II; 11-12)		Chodachek et al. 2012	Buffalo Ridge, MN (Phase III; 02/Lake Benton II)	Johnson et al. 2004	Johnson et al. 2004
Fowler I, IN (09)		Johnson et al. 2010a	Buffalo Ridge, MN (Phase II; 02/Lake Benton I)	Johnson et al. 2004	Johnson et al. 2004
Crystal Lake II, IA (09)		Derby et al. 2010a	Rugby, ND (10-11)		Derby et al. 2011b
Top of Iowa, IA (03)		Jain 2005	Elm Creek, MN (09-10)		Derby et al. 2010c
Kewaunee County, WI (99-01)		Howe et al. 2002	Wessington Springs, SD (09)		Derby et al. 2010f
Heritage Garden I, MI (2012-2014)		Kerlinger et al. 2014	Big Blue, MN (14)		Fagen Engineering 2015
Ripley, Ont (08)		Jacques Whitford 2009	PrairieWinds SD1 (Crow Lake), SD (11-12)		Derby et al. 2012d
Winnebago, IA (09-10)		Derby et al. 2010e	PrairieWinds SD1 (Crow Lake), SD (11-12)		Derby et al. 2012d
Buffalo Ridge, MN (Phase II; 01/Lake Benton I)	Johnson et al. 2004	Johnson et al. 2004	NPPD Ainsworth, NE (06)		Derby et al. 2007
Pioneer Prairie II, IA (13)		Chodachek et al. 2014	PrairieWinds SD1 (Crow Lake), SD (12-13)		Derby et al. 2013a
Buffalo Ridge, MN (Phase III; 01/Lake Benton II)	Johnson et al. 2004	Johnson et al. 2004	Buffalo Ridge, MN (Phase I; 99)		Johnson et al. 2000
Crescent Ridge, IL (05-06)		Kerlinger et al. 2007	PrairieWinds SD1, SD (13-14)		Derby et al. 2014
Fowler I, II, III, IN (12)		Good et al. 2013c	Wessington Springs, SD (10)		Derby et al. 2011d
Buffalo Ridge II, SD (11-12)		Derby et al. 2012a	Buffalo Ridge I, SD (09-10)		Derby et al. 2010b

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Appendix A: North American Fatality Summary Tables

Appendix A1. Wind energy facilities in North America with comparable activity and fatality data for bats, separated by geographic region. Bat activity presented as number of bat passes per detector night. Fatality estimate given as number of fatalities per megawatt (MW) per year.

Wind Energy Facility	Bat Activity Estimate	Bat Activity Dates	Fatality Estimate	No. of Turbines	Total MW
Walleye, MN	**6.15**	7/30/16-11/3/16			
Midwest					
Barton I & II, IA (2010-2011)	NA	NA	1.85	80	160
Big Blue, MN (2013)	NA	NA	2.04	18	36
Big Blue, MN (2014)	NA	NA	1.43	18	36
Blue Sky Green Field, WI (2008; 2009)	7.7[A]	7/24/07-10/29/07	24.57	88	145
Buffalo Ridge I, SD (2009-2010)	NA	NA	0.16	24	50.4
Buffalo Ridge II, SD (2011-2012)	1.75	7/1/08-10/14/08	2.81	105	210
Buffalo Ridge, MN (Phase I; 1999)	NA	NA	0.74	73	25
Buffalo Ridge, MN (Phase II; 1998)	NA	NA	2.16	143	107.25
Buffalo Ridge, MN (Phase II; 1999)	NA	NA	2.59	143	107.25
Buffalo Ridge, MN (Phase II; 2001/Lake Benton I)	2.2[B]	6/15/01-9/15/01	4.35	143	107.25
Buffalo Ridge, MN (Phase II; 2002/Lake Benton I)	1.9[B]	6/15/02-9/15/02	1.64	143	107.25
Buffalo Ridge, MN (Phase III; 1999)	NA	NA	2.72	138	103.5
Buffalo Ridge, MN (Phase III; 2001/Lake Benton II)	2.2[B]	6/15/01-9/15/01	3.71	138	103.5
Buffalo Ridge, MN (Phase III; 2002/Lake Benton II)	1.9[B]	6/15/02-9/15/02	1.81	138	103.5
Cedar Ridge, WI (2009)	9.97[A,B,C,D]	7/16/07-9/30/07	30.61	41	67.6
Cedar Ridge, WI (2010)	9.97[A,B,C,D]	7/16/07-9/30/07	24.12	41	68
Crescent Ridge, IL (2005-2006)	NA	NA	3.27	33	49.5
Crystal Lake II, IA (2009)	NA	NA	7.42	80	200
Elm Creek II, MN (2011-2012)	NA	NA	2.81	62	148.8
Elm Creek, MN (2009-2010)	NA	NA	1.49	67	100
Forward Energy Center, WI (2008-2010)	6.97	8/5/08-11/08/08	18.17	86	129
Fowler I, II, III, IN (2010)	NA	NA	18.96	355	600
Fowler I, II, III, IN (2011)	NA	NA	20.19	355	600
Fowler I, II, III, IN (2012)	NA	NA	2.96	355	600
Fowler I, IN (2009)	NA	NA	8.09	162	301
Fowler III, IN (2009)	NA	NA	1.84	60	99
Grand Ridge I, IL (2009-2010)	NA	NA	2.1	66	99
Harrow, Ont (2010)	NA	NA	11.13	24 (four 6-turb facilities)	39.6
Heritage Garden I, MI (2012-2014)	NA	NA	5.9	14	28
Kewaunee County, WI (1999-2001)	NA	NA	6.45	31	20.46
Moraine II, MN (2009)	NA	NA	2.42	33	49.5
NPPD Ainsworth, NE (2006)	NA	NA	1.16	36	20.5
Pioneer Prairie I, IA (Phase II; 2011-2012)	NA	NA	10.06	62	102.3
Pioneer Prairie II, IA (2013)	NA	NA	3.83	62	102.3
PrairieWinds ND1 (Minot), ND (2010)	NA	NA	2.13	80	115.5
PrairieWinds ND1 (Minot), ND (2011)	NA	NA	1.39	80	115.5

Appendix A1. Wind energy facilities in North America with comparable activity and fatality data for bats, separated by geographic region. Bat activity presented as number of bat passes per detector night. Fatality estimate given as number of fatalities per megawatt (MW) per year.

Wind Energy Facility	Bat Activity Estimate	Bat Activity Dates	Fatality Estimate	No. of Turbines	Total MW
PrairieWinds SD1, SD (2011-2012)	NA	NA	1.23	108	162
PrairieWinds SD1, SD (2012-2013)	NA	NA	1.05	108	162
PrairieWinds SD1, SD (2013-2014)	NA	NA	0.52	108	162
Rail Splitter, IL (2012-2013)	NA	NA	11.21	67	100.5
Ripley, Ont (2008)	NA	NA	4.67	38	76
Rugby, ND (2010-2011)	NA	NA	1.6	71	149
Top Crop I & II (2012-2013)	NA	NA	12.55	68 (phase I) 132 (phase (II)	300 (102 (phase I) 198 (phase II))
Top of Iowa, IA (2003)	NA	NA	7.16	89	80
Top of Iowa, IA (2004)	35.7	5/26/04-9/24/04	10.27	89	80
Wessington Springs, SD (2009)	NA	NA	1.48	34	51
Wessington Springs, SD (2010)	NA	NA	0.41	34	51
Winnebago, IA (2009-2010)	NA	NA	4.54	10	20
Southern Plains					
Barton Chapel, TX (2009-2010)	NA	NA	3.06	60	120
Big Smile, OK (2012-2013)	NA	NA	2.90	66	132
Buffalo Gap II, TX (2007-2008)	NA	NA	0.14	155	233
Red Hills, OK (2012-2013)	NA	NA	0.11	82	123
Buffalo Gap I, TX (2006)	NA	NA	0.10	67	134
Rocky Mountains					
Summerview, Alb (2006; 2007)	7.65[B]	07/15/06-07-09/30/06-07	11.42	39	70.2
Summerview, Alb (2005-2006)	NA	NA	10.27	39	70.2
Judith Gap, MT (2006-2007)	NA	NA	8.93	90	135
Foote Creek Rim, WY (Phase I; 1999)	NA	NA	3.97	69	41.4
Judith Gap, MT (2009)	NA	NA	3.2	90	135
Milford I, UT (2010-2011)	NA	NA	2.05	58	145
Milford I & II, UT (2011-2012)	NA	NA	1.67	107	160.5 (58.5 I, 102 II)
Foote Creek Rim, WY (Phase I; 2001-2002)	2.2[B,C]	6/15/01-9/1/01	1.57	69	41.4
Foote Creek Rim, WY (Phase I; 2000)	2.2[B,C]	6/15/00-9/1/00	1.05	69	41.4
Southwestern					
Dry Lake I, AZ (2009-2010)	8.80	4/29/10-11/10/10	3.43	30	63
Dry Lake II, AZ (2011-2012)	11.50	5/11/11-10/26/11	1.66	31	65
California					
Alite, CA (2009-2010)	NA	NA	0.24	8	24
Alta VIII, CA (2012-2013)	NA	NA	0	50	150
Alta Wind I, CA (2011-2012)	4.42[E]	6/26/2009 - 10/31/2009	1.28	100	150
Alta Wind II-V, CA (2011-2012)	0.78	6/26/2009 - 10/31/2009	0.08	190	570

Appendix A1. Wind energy facilities in North America with comparable activity and fatality data for bats, separated by geographic region. Bat activity presented as number of bat passes per detector night. Fatality estimate given as number of fatalities per megawatt (MW) per year.

Wind Energy Facility	Bat Activity Estimate	Bat Activity Dates	Fatality Estimate	No. of Turbines	Total MW
Alta Wind I-V, CA (2013-2014)	NA	NA	0.2	290	720 (150 GE, 570 vestas)
Diablo Winds, CA (2005-2007)	NA	NA	0.82	31	20.46
Dillon, CA (2008-2009)	NA	NA	2.17	45	45
High Winds, CA (2003-2004)	NA	NA	2.51	90	162
High Winds, CA (2004-2005)	NA	NA	1.52	90	162
Montezuma I, CA (2011)	NA	NA	1.9	16	36.8
Montezuma I, CA (2012)	NA	NA	0.84	16	36.8
Montezuma II, CA (2012-2013)	NA	NA	0.91	34	78.2
Mustang Hills, CA (2012-2013)	NA	NA	0.1	50	150
Pinyon Pines I & II, CA (2013-2014)	NA	NA	0.04	100	NA
Shiloh I, CA (2006-2009)	NA	NA	3.92	100	150
Shiloh II, CA (2009-2010)	NA	NA	2.6	75	150
Shiloh II, CA (2010-2011)	NA	NA	3.8	75	150
Shiloh III, CA (2012-2013)	NA	NA	0.4	50	102.5
Solano III, CA (2012-2013)	NA	NA	0.31	55	128
Pacific Northwest					
Big Horn, WA (2006-2007)	NA	NA	1.9	133	199.5
Biglow Canyon, OR (Phase I; 2008)	NA	NA	1.99	76	125.4
Biglow Canyon, OR (Phase I; 2009)	NA	NA	0.58	76	125.4
Biglow Canyon, OR (Phase II; 2009-2010)	NA	NA	2.71	65	150
Biglow Canyon, OR (Phase II; 2010-2011)	NA	NA	0.57	65	150
Biglow Canyon, OR (Phase III; 2010-2011)	NA	NA	0.22	76	174.8
Combine Hills, OR (2011)	NA	NA	0.73	104	104
Combine Hills, OR (Phase I; 2004-2005)	NA	NA	1.88	41	41
Elkhorn, OR (2008)	NA	NA	1.26	61	101
Elkhorn, OR (2010)	NA	NA	2.14	61	101
Goodnoe, WA (2009-2010)	NA	NA	0.34	47	94
Harvest Wind, WA (2010-2012)	NA	NA	1.27	43	98.9
Hay Canyon, OR (2009-2010)	NA	NA	0.53	48	100.8
Hopkins Ridge, WA (2006)	NA	NA	0.63	83	150
Hopkins Ridge, WA (2008)	NA	NA	1.39	87	156.6
Kittitas Valley, WA (2011-2012)	NA	NA	0.12	48	100.8
Klondike II, OR (2005-2006)	NA	NA	0.41	50	75
Klondike III (Phase I), OR (2007-2009)	NA	NA	1.11	125	223.6
Klondike IIIa (Phase II), OR (2008-2010)	NA	NA	0.14	51	76.5
Klondike, OR (2002-2003)	NA	NA	0.77	16	24
Leaning Juniper, OR (2006-2008)	NA	NA	1.98	67	100.5
Linden Ranch, WA (2010-2011)	NA	NA	1.68	25	50
Marengo I, WA (2009-2010)	NA	NA	0.17	78	140.4
Marengo II, WA (2009-2010)	NA	NA	0.27	39	70.2
Nine Canyon, WA (2002-2003)	NA	NA	2.47	37	48.1

Appendix A1. Wind energy facilities in North America with comparable activity and fatality data for bats, separated by geographic region. Bat activity presented as number of bat passes per detector night. Fatality estimate given as number of fatalities per megawatt (MW) per year.

Wind Energy Facility	Bat Activity Estimate	Bat Activity Dates	Fatality Estimate	No. of Turbines	Total MW
Palouse Wind, WA (2012-2013)	NA	NA	4.23	58	104.4
Pebble Springs, OR (2009-2010)	NA	NA	1.55	47	98.7
Stateline, OR/WA (2001-2002)	NA	NA	1.09	454	299
Stateline, OR/WA (2003)	NA	NA	2.29	454	299
Stateline, OR/WA (2006)	NA	NA	0.95	454	299
Tuolumne (Windy Point I), WA (2009-2010)	NA	NA	0.94	62	136.6
Vansycle, OR (1999)	NA	NA	1.12	38	24.9
Vantage, WA (2010-2011)	NA	NA	0.4	60	90
White Creek, WA (2007-2011)	NA	NA	2.04	89	204.7
Wild Horse, WA (2007)	NA	NA	0.39	127	229
Windy Flats, WA (2010-2011)	NA	NA	0.41	114	262.2
Northeast					
Beech Ridge, WV (2012)	NA	NA	2.03	67	100.5
Beech Ridge, WV (2013)	NA	NA	0.58	67	100.5
Casselman Curtailment, PA (2008)	NA	NA	4.4	23	35.4
Casselman, PA (2008)	NA	NA	12.61	23	34.5
Casselman, PA (2009)	NA	NA	8.6	23	34.5
Cohocton/Dutch Hill, NY (2009)	NA	NA	8.62	50	125
Cohocton/Dutch Hills, NY (2010)	NA	NA	10.32	50	125
Criterion, MD (2011)	NA	NA	15.61	28	70
Criterion, MD (2012)	NA	NA	7.62	28	70
Criterion, MD (2013)	NA	NA	5.32	28	70
High Sheldon, NY (2010)	NA	NA	2.33	75	112.5
High Sheldon, NY (2011)	NA	NA	1.78	75	112.5
Kibby, ME (2011)	NA	NA	0.12	44	132
Lempster, NH (2009)	NA	NA	3.11	12	24
Lempster, NH (2010)	NA	NA	3.57	12	24
Locust Ridge, PA (Phase II; 2009)	NA	NA	14.11	51	102
Locust Ridge, PA (Phase II; 2010)	NA	NA	14.38	51	102
Maple Ridge, NY (2006)	NA	NA	11.21	120	198
Maple Ridge, NY (2007)	NA	NA	6.49	195	321.75
Maple Ridge, NY (2007-2008)	NA	NA	4.96	195	321.75
Maple Ridge, NY (2012)	NA	NA	7.3	195	321.75
Mars Hill, ME (2007)	NA	NA	2.91	28	42
Mars Hill, ME (2008)	NA	NA	0.45	28	42
Mount Storm, WV (2009)	30.09	7/15/09-10/7/09	17.53	132	264
Mount Storm, WV (2010)	36.67[F]	4/18/10-10/15/10	15.18	132	264
Mount Storm, WV (2011)	NA	NA	7.43	132	264
Mount Storm, WV (Fall 2008)	35.2	7/20/08-10/12/08	6.62	82	164
Mountaineer, WV (2003)	NA	NA	31.69	44	66
Munnsville, NY (2008)	NA	NA	1.93	23	34.5
Noble Altona, NY (2010)	NA	NA	4.34	65	97.5
Noble Bliss, NY (2008)	NA	NA	7.8	67	100
Noble Bliss, NY (2009)	NA	NA	3.85	67	100
Noble Chateaugay, NY (2010)	NA	NA	2.44	71	106.5
Noble Clinton, NY (2008)	2.1[D]	8/8/08-09/31/08	3.14	67	100
Noble Clinton, NY (2009)	1.9[D]	8/1/09-09/31/09	4.5	67	100
Noble Ellenburg, NY (2008)	NA	NA	3.46	54	80

Appendix A1. Wind energy facilities in North America with comparable activity and fatality data for bats, separated by geographic region. Bat activity presented as number of bat passes per detector night. Fatality estimate given as number of fatalities per megawatt (MW) per year.

Wind Energy Facility	Bat Activity Estimate	Bat Activity Dates	Fatality Estimate	No. of Turbines	Total MW
Noble Ellenburg, NY (2009)	16.1[D]	8/16/09-09/15/09	3.91	54	80
Noble Wethersfield, NY (2010)	NA	NA	16.3	84	126
Pinnacle, WV (2012)	NA	NA	40.2	23	55.2
Record Hill, ME (2012)	24.6	4/16/12-10/23/12	2.96	22	50.6
Record Hill, ME (2014)	NA	NA	0.55	22	50.6
Rollins, ME (2012)	NA	NA	0.18	40	60
Stetson Mountain I, ME (2009)	28.5; 0.3[G]	7/10/09-10/15/09	1.4	38	57
Stetson Mountain I, ME (2011)	NA	NA	0.28	38	57
Stetson Mountain I, ME (2013)	NA	NA	0.18	38	57
Stetson Mountain II, ME (2010)	NA	NA	1.65	17	25.5
Stetson Mountain II, ME (2012)	NA	NA	2.27	17	25.5
Wolfe Island, Ont (July-December 2009)	NA	NA	6.42	86	197.8
Wolfe Island, Ont (July-December 2010)	NA	NA	9.5	86	197.8
Wolfe Island, Ont (July-December 2011)	NA	NA	2.49	86	197.8
Southeast					
Buffalo Mountain, TN (2005)	NA	NA	39.70	18	28.98
Buffalo Mountain, TN (2000-2003)	23.70[C]	NA	31.54	3	1.98

A = Activity rate based on pre-construction monitoring; data for all other activity and fatality rates were collected concurrently

B = Activity rate was averaged across phases and/or years

C = Activity rate calculated by WEST from data presented in referenced report

D = Activity rate based on data collected at various heights all other activity rates are from ground-based units only

E = Average of ground-based detectors at CPC Proper (Phase I) for late summer/fall period only

F = Activity rate based on data collected from ground-based units excluding reference stations during the spring, summer and fall seasons

G= The overall activity rate of 28.5 is from reference stations located along forest edges which may be attractive to bats; the activity rate of 0.3 is from one unit placed on a nacelle

Appendix A1 (*continued*). Wind energy facilities in North America with comparable activity and fatality data for bats, separated by geographic region.

Facility	Fatality Estimate	Facility	Fatality Estimate
Alite, CA (09-10)	Chatfield et al. 2010	Lempster, NH (09)	Tidhar et al. 2010
Alta Wind I, CA (11-12)	Chatfield et al. 2012	Lempster, NH (10)	Tidhar et al. 2011
Alta Wind I-V, CA (13-14)	Chatfield et al. 2014	Linden Ranch, WA (10-11)	Enz and Bay 2011
Alta Wind II-V, CA (11-12)	Chatfield et al. 2012	Locust Ridge, PA (Phase II; 09)	Arnett et al.
Alta VIII, CA (12-13)	Chatfield and Bay 2014	Locust Ridge, PA (Phase II; 10)	Arnett et al.
Barton I & II, IA (10-11)	Derby et al. 2011a	Maple Ridge, NY (06)	Jain et al. 2007
Barton Chapel, TX (09-10)	WEST 2011	Maple Ridge, NY (07)	Jain et al. 2009a
Beech Ridge, WV (12)	Tidhar et al. 2013b	Maple Ridge, NY (07-08)	Jain et al. 2009d
Beech Ridge, WV (13)	Young et al. 2014b	Maple Ridge, NY (12)	Tidhar et al. 2013a
Big Blue, MN (13)	Fagen Engineering 2014	Marengo I, WA (09-10)	URS Corporation 2010b
Big Blue, MN (14)	Fagen Engineering 2015	Marengo II, WA (09-10)	URS Corporation 2010c
Big Horn, WA (06-07)	Kronner et al. 2008	Mars Hill, ME (07)	Stantec 2008
Big Smile, OK (12-13)	Derby et al. 2013b	Mars Hill, ME (08)	Stantec 2009a
Biglow Canyon, OR (Phase I; 08)	Jeffrey et al. 2009a	Milford I, UT (10-11)	Stantec 2011b
Biglow Canyon, OR (Phase I; 09)	Enk et al. 2010	Milford I & II, UT (11-12)	Stantec 2012b
Biglow Canyon, OR (Phase II; 09-10)	Enk et al. 2011a	Montezuma I, CA (11)	ICF International 2012
Biglow Canyon, OR (Phase II; 10-11)	Enk et al. 2012b	Montezuma I, CA (12)	ICF International 2013
Biglow Canyon, OR (Phase III; 10-11)	Enk et al. 2012a	Montezuma II, CA (12-13)	Harvey & Associates 2013
Blue Sky Green Field, WI (08; 09)	Gruver et al. 2009b	Moraine II, MN (09)	Derby et al. 2010d
Buffalo Gap I, TX (06)	Tierney 2007	Mount Storm, WV (Fall 08)	Young et al. 2009b
Buffalo Gap II, TX (07-08)	Tierney 2009	Mount Storm, WV (09)	Young et al. 2009a, 2010b
Buffalo Mountain, TN (00-03)	Nicholson et al. 2005	Mount Storm, WV (10)	Young et al. 2010a, 2011b
Buffalo Mountain, TN (05)	Fiedler et al. 2007	Mount Storm, WV (11)	Young et al. 2011a, 2012b
Buffalo Ridge, MN (Phase I; 99)	Johnson et al. 2000	Mountaineer, WV (03)	Kerns and Kerlinger 2004a
Buffalo Ridge, MN (Phase II; 98)	Johnson et al. 2000	Munnsville, NY (08)	Stantec 2009b
Buffalo Ridge, MN (Phase II; 99)	Johnson et al. 2000	Mustang Hills, CA (12-13)	Chatfield and Bay 2014
Buffalo Ridge, MN (Phase II; 01/Lake Benton I)	Johnson et al. 2004	Nine Canyon, WA (02-03)	Erickson et al. 2003
Buffalo Ridge, MN (Phase II; 02/Lake Benton I)	Johnson et al. 2004	Noble Altona, NY (10)	Jain et al. 2011b
Buffalo Ridge, MN (Phase III; 99)	Johnson et al. 2000	Noble Bliss, NY (08)	Jain et al.2009e
Buffalo Ridge, MN (Phase III; 01/Lake Benton II)	Johnson et al. 2004	Noble Bliss, NY (09)	Jain et al. 2010a
Buffalo Ridge, MN (Phase III; 02/Lake Benton II)	Johnson et al. 2004	Noble Chateaugay, NY (10)	Jain et al. 2011c
Buffalo Ridge I, SD (09-10)	Derby et al. 2010b	Noble Clinton, NY (08)	Jain et al. 2009c
Buffalo Ridge II, SD (11-12)	Derby et al. 2012a	Noble Clinton, NY (09)	Jain et al. 2010b
Casselman, PA (08)	Arnett et al. 2009b	Noble Ellenburg, NY (08)	Jain et al. 2009b
Casselman, PA (09)	Arnett et al. 2010	Noble Ellenburg, NY (09)	Jain et al. 2010c
Casselman Curtailment, PA (08)	Arnett et al. 2009a	Noble Wethersfield, NY (10)	Jain et al. 2011a
Cedar Ridge, WI (09)	BHE Environmental 2010	NPPD Ainsworth, NE (06)	Derby et al. 2007
Cedar Ridge, WI (10)	BHE Environmental 2011	Palouse Wind, WA (12-13)	Stantec 2013a
Cohocton/Dutch Hill, NY (09)	Stantec 2010	Pebble Springs, OR (09-10)	Gritski and Kronner 2010b
Cohocton/Dutch Hills, NY (10)	Stantec 2011a	Pinnacle, WV (12)	Hein et al. 2013b
Combine Hills, OR (Phase I; 04-05)	Young et al. 2006	Pinyon Pines I&II, CA (13-14)	Chatfield and Russo 2014
Combine Hills, OR (11)	Enz et al. 2012	Pioneer Prairie I, IA (Phase II; 11-12)	Chodachek et al. 2012
Crescent Ridge, IL (05-06)	Kerlinger et al. 2007	Pioneer Prairie II, IA (13)	Chodachek et al. 2014
Criterion, MD (11)	Young et al. 2012a	PrairieWinds ND1 (Minot), ND (10)	Derby et al. 2011c
Criterion, MD (12)	Young et al. 2013	PrairieWinds ND1 (Minot), ND (11)	Derby et al. 2012c
Criterion, MD (13)	Young et al. 2014a	PrairieWinds SD1 (Crow Lake), SD (11-12)	Derby et al. 2012d
Crystal Lake II, IA (09)	Derby et al. 2010a	PrairieWinds SD1 (Crow Lake), SD (12-13)	Derby et al. 2013a
Diablo Winds, CA (05-07)	WEST 2006, 2008	PrairieWinds SD1, SD (13-14)	Derby et al. 2014
Dillon, CA (08-09)	Chatfield et al. 2009	Rail Splitter, IL (12-13)	Good et al. 2013b
Dry Lake I, AZ (09-10)	Thompson et al. 2011	Record Hill, ME (12)	Stantec 2013b
Dry Lake II, AZ (11-12)	Thompson and Bay 2012	Record Hill, ME (14)	Stantec 2015
Elkhorn, OR (08)	Jeffrey et a. 2009b	Red Hills, OK (12-13)	Derby et al. 2013c
Elkhorn, OR (10)	Enk et al. 2011b	Ripley, Ont (08)	Jacques Whitford 2009
Elm Creek, MN (09-10)	Derby et al. 2010c	Rollins, ME (12)	Stantec 2013c
Elm Creek II, MN (11-12)	Derby et al. 2012b	Rugby, ND (10-11)	Derby et al. 2011b
Foote Creek Rim, WY (Phase I; 99)	Young et al. 2003a	Shiloh I, CA (06-09)	Kerlinger et al. 2009
Foote Creek Rim, WY (Phase I; 00)	Young et al. 2003a, 2003b	Shiloh II, CA (09-10)	Kerlinger et al. 2010
Foote Creek Rim, WY (Phase I; 01-02)	Young et al. 2003a, 2003b	Shiloh II, CA (10-11)	Kerlinger et al. 2013a
Forward Energy Center, WI (08-10)	Grodsky and Drake 2011	Shiloh III, CA (12-13)	Kerlinger et al. 2013b
Fowler I, IN (09)	Johnson et al. 2010a	Solano III, CA (12-13)	AECOM 2013
Fowler III, IN (09)	Johnson et al. 2010b	Stateline, OR/WA (01-02)	Erickson et al. 2004
Fowler I, II, III, IN (10)	Good et al. 2011	Stateline, OR/WA (03)	Erickson et al. 2004
Fowler I, II, III, IN (11)	Good et al. 2012	Stateline, OR/WA (06)	Erickson et al. 2007
Fowler I, II, III, IN (12)	Good et al. 2013c	Stetson Mountain I, ME (09)	Stantec 2009c
Goodnoe, WA (09-10)	URS Corporation 2010a	Stetson Mountain I, ME (11)	Normandeau Associates 2011
Grand Ridge I, IL (09-10)	Derby et al. 2010g	Stetson Mountain I, ME (13)	Stantec 2014
Harrow, Ont (10)	NRSI 2011	Stetson Mountain II, ME (10)	Normandeau Associates 2010
Harvest Wind, WA (10-12)	Downes and Gritski 2012a	Stetson Mountain II, ME (12)	Stantec 2013d
Hay Canyon, OR (09-10)	Gritski and Kronner 2010a	Summerview, Alb (05-06)	Brown and Hamilton 2006b
Heritage Garden I, MI (2012-2014)	Kerlinger et al. 2014	Summerview, Alb (06; 07)	Baerwald 2008

Appendix A1 (*continued*). Wind energy facilities in North America with comparable activity and fatality data for bats, separated by geographic region.

Facility	Fatality Estimate	Facility	Fatality Estimate
High Sheldon, NY (10)	Tidhar et al. 2012a	Top Crop I & II, IL (12-13)	Good et al. 2013a
High Sheldon, NY (11)	Tidhar et al. 2012b	Top of Iowa, IA (03)	Jain 2005
High Winds, CA (03-04)	Kerlinger et al. 2006	Top of Iowa, IA (04)	Jain 2005
High Winds, CA (04-05)	Kerlinger et al. 2006	Tuolumne (Windy Point I), WA (09-10)	Enz and Bay 2010
Hopkins Ridge, WA (06)	Young et al. 2007	Vansycle, OR (99)	Erickson et al. 2000
Hopkins Ridge, WA (08)	Young et al. 2009c	Vantage, WA (10-11)	Ventus 2012
Judith Gap, MT (06-07)	TRC 2008	Wessington Springs, SD (09)	Derby et al. 2010f
Judith Gap, MT (09)	Poulton and Erickson 2010	Wessington Springs, SD (10)	Derby et al. 2011d
Kewaunee County, WI (99-01)	Howe et al. 2002	White Creek, WA (07-11)	Downes and Gritski 2012b
Kibby, ME (11)	Stantec 2012a	Wild Horse, WA (07)	Erickson et al. 2008
Kittitas Valley, WA (11-12)	Stantec Consulting Services 2012	Windy Flats, WA (10-11)	Enz et al. 2011
Klondike, OR (02-03)	Johnson et al. 2003	Winnebago, IA (09-10)	Derby et al. 2010e
Klondike II, OR (05-06)	NWC and WEST 2007	Wolfe Island, Ont (July-December 09)	Stantec Ltd. 2010b
Klondike III (Phase I), OR (07-09)	Gritski et al. 2010	Wolfe Island, Ont (July-December 10)	Stantec Ltd. 2011b
Klondike IIIa (Phase II), OR (08-10)	Gritski et al. 2011	Wolfe Island, Ont (July-December 11)	Stantec Ltd. 2012
Leaning Juniper, OR (06-08)	Gritski et al. 2008		

Appendix A2. Fatality estimates for North American wind energy facilities.

Project	Bat Fatalities (bats/MW/year)	Predominant Habitat Type	Citation
Alite, CA (2009-2010)	0.24	shrub/scrub & grassland	Chatfield et al. 2010
Alta VIII, CA (2012-2013)	0	grassland and riparian	Chatfield et al. 2012
Alta Wind I-V, CA (2013-2014)	0.2	NA	Chatfield et al. 2014
Alta Wind I, CA (2011-2012)	1.28	woodland, grassland, shrubland	Chatfield et al. 2012
Alta Wind II-V, CA (2011-2012)	0.08	desert scrub	Chatfield and Bay 2014
Barton Chapel, TX (2009-2010)	3.06	agriculture/forest	WEST 2011
Barton I & II, IA (2010-2011)	1.85	agriculture	Derby et al. 2011a
Beech Ridge, WV (2012)	2.03	forest	Tidhar et al. 2013b
Beech Ridge, WV (2013)	0.58	forest	Young et al. 2014b
Big Blue, MN (2013)	2.04	agriculture	Fagen Engineering 2014
Big Blue, MN (2014)	1.43	agriculture	Fagen Engineering 2015
Big Horn, WA (2006-2007)	1.9	agriculture/grassland	Kronner et al. 2008
Big Smile, OK (2012-2013)	2.9	grassland, agriculture	Derby et al. 2013b
Biglow Canyon, OR (Phase I; 2008)	1.99	agriculture/grassland	Jeffrey et al. 2009a
Biglow Canyon, OR (Phase I; 2009)	0.58	agriculture/grassland	Enk et al. 2010
Biglow Canyon, OR (Phase II; 2009-2010)	2.71	agriculture	Enk et al. 2011a
Biglow Canyon, OR (Phase II; 2010-2011)	0.57	grassland/shrub-steppe, agriculture	Enk et al. 2012b
Biglow Canyon, OR (Phase III; 2010-2011)	0.22	grassland/shrub-steppe, agriculture	Enk et al. 2012a
Blue Sky Green Field, WI (2008; 2009)	24.57	agriculture	Gruver et al. 2009b
Buffalo Gap I, TX (2006)	0.1	grassland	Tierney 2007
Buffalo Gap II, TX (2007-2008)	0.14	forest	Tierney 2009
Buffalo Mountain, TN (2000-2003)	31.54	forest	Nicholson et al. 2005
Buffalo Mountain, TN (2005)	39.7	forest	Fiedler et al. 2007
Buffalo Ridge I, SD (2009-2010)	0.16	agriculture/grassland	Derby et al. 2010b
Buffalo Ridge II, SD (2011-2012)	2.81	agriculture, grassland	Derby et al. 2012a
Buffalo Ridge, MN (Phase I; 1996)	NA	agriculture	Johnson et al. 2000
Buffalo Ridge, MN (Phase I; 1997)	NA	agriculture	Johnson et al. 2000
Buffalo Ridge, MN (Phase I; 1998)	NA	agriculture	Johnson et al. 2000
Buffalo Ridge, MN (Phase I; 1999)	0.74	agriculture	Johnson et al. 2000
Buffalo Ridge, MN (Phase II; 1998)	2.16	agriculture	Johnson et al. 2000
Buffalo Ridge, MN (Phase II; 1999)	2.59	agriculture	Johnson et al. 2000
Buffalo Ridge, MN (Phase II; 2001/Lake Benton I)	4.35	agriculture	Johnson et al. 2004
Buffalo Ridge, MN (Phase II; 2002/Lake Benton I)	1.64	agriculture	Johnson et al. 2004
Buffalo Ridge, MN (Phase III; 1999)	2.72	agriculture	Johnson et al. 2000
Buffalo Ridge, MN (Phase III; 2001/Lake Benton II)	3.71	agriculture	Johnson et al. 2004
Buffalo Ridge, MN (Phase III; 2002/Lake Benton II)	1.81	agriculture	Johnson et al. 2004
Casselman Curtailment, PA (2008)	4.4	forest	Arnett et al. 2009b

Appendix A2. Fatality estimates for North American wind energy facilities.

Project	Bat Fatalities (bats/MW/year)	Predominant Habitat Type	Citation
Casselman, PA (2008)	12.61	forest	Arnett et al. 2010
Casselman, PA (2009)	8.6	forest, pasture, grassland	Arnett et al. 2009a
Cedar Ridge, WI (2009)	30.61	agriculture	BHE Environmental 2010
Cedar Ridge, WI (2010)	24.12	agriculture	BHE Environmental 2011
Cohocton/Dutch Hill, NY (2009)	8.62	agriculture/forest	Stantec 2010
Cohocton/Dutch Hills, NY (2010)	10.32	agriculture, forest	Stantec 2011a
Combine Hills, OR (2011)	0.73	grassland/shrub-steppe, agriculture	Enz et al. 2012
Combine Hills, OR (Phase I; 2004-2005)	1.88	agriculture/grassland	Young et al. 2006
Crescent Ridge, IL (2005-2006)	3.27	agriculture	Kerlinger et al. 2007
Criterion, MD (2011)	15.61	forest, agriculture	Young et al. 2012a
Criterion, MD (2012)	7.62	forest, agriculture	Young et al. 2013
Criterion, MD (2013)	5.32	forest, agriculture	Young et al. 2014a
Crystal Lake II, IA (2009)	7.42	agriculture	Derby et al. 2010a
Diablo Winds, CA (2005-2007)	0.82		WEST 2006, 2008
Dillon, CA (2008-2009)	2.17	desert	Chatfield et al. 2009
Dry Lake I, AZ (2009-2010)	3.43	desert grassland/forested	Thompson et al. 2011
Dry Lake II, AZ (2011-2012)	1.66	desert grassland/forested	Thompson and Bay 2012
Elkhorn, OR (2008)	1.26	shrub/scrub & agriculture	Jeffrey et al. 2009b
Elkhorn, OR (2010)	2.14	shrub/scrub & agriculture	Enk et al. 2011b
Elm Creek II, MN (2011-2012)	2.81	agriculture, grassland	Derby et al. 2010c
Elm Creek, MN (2009-2010)	1.49	agriculture	Derby et al. 2012b
Foote Creek Rim, WY (Phase I; 1999)	3.97	grassland	Young et al. 2003a
Foote Creek Rim, WY (Phase I; 2000)	1.05	grassland	Young et al. 2003a
Foote Creek Rim, WY (Phase I; 2001-2002)	1.57	grassland	Young et al. 2003a
Forward Energy Center, WI (2008-2010)	18.17	agriculture	Grodsky and Drake 2011
Fowler I, II, III, IN (2010)	18.96	agriculture	Good et al. 2011
Fowler I, II, III, IN (2011)	20.19	agriculture	Good et al. 2012
Fowler I, II, III, IN (2012)	2.96	agriculture	Good et al. 2013c
Fowler I, IN (2009)	8.09	agriculture	Johnson et al. 2010a
Fowler III, IN (2009)	1.84	agriculture	Johnson et al. 2010b
Goodnoe, WA (2009-2010)	0.34	grassland and shrub-steppe	URS Corporation 2010a
Grand Ridge I, IL (2009-2010)	2.1	agriculture	Derby et al. 2010g
Harrow, Ont (2010)	11.13	agriculture	Natural Resource Solutions Inc. (NRSI) 2011
Harvest Wind, WA (2010-2012)	1.27	grassland/shrub-steppe	Downes and Gritski 2012a
Hay Canyon, OR (2009-2010)	0.53	agriculture	Gritski and Kronner 2010a
Heritage Garden I, MI (2012-2014)	5.9	agriculture	Kerlinger et al. 2014

Appendix A2. Fatality estimates for North American wind energy facilities.

Project	Bat Fatalities (bats/MW/year)	Predominant Habitat Type	Citation
High Sheldon, NY (2010)	2.33	agriculture	Tidhar et al. 2012a
High Sheldon, NY (2011)	1.78	agriculture	Tidhar et al. 2012b
High Winds, CA (2003-2004)	2.51	agriculture/grassland	Kerlinger et al. 2006
High Winds, CA (2004-2005)	1.52	agriculture/grassland	Kerlinger et al. 2006
Hopkins Ridge, WA (2006)	0.63	agriculture/grassland	Young et al. 2007
Hopkins Ridge, WA (2008)	1.39	agriculture/grassland	Young et al. 2009c
Judith Gap, MT (2006-2007)	8.93	agriculture/grassland	TRC 2008
Judith Gap, MT (2009)	3.2	agriculture/grassland	Poulton and Erickson 2010
Kewaunee County, WI (1999-2001)	6.45	agriculture	Howe et al. 2002
Kibby, ME (2011)	0.12	forest; commercial forest	Stantec 2012a
Kittitas Valley, WA (2011-2012)	0.12	sagebrush-steppe, grassland	Stantec Consulting Services 2012
Klondike II, OR (2005-2006)	0.41	agriculture/grassland	NWC and WEST 2007
Klondike III (Phase I), OR (2007-2009)	1.11	agriculture/grassland	Gritski et al. 2010
Klondike IIIa (Phase II), OR (2008-2010)	0.14	grassland/shrub-steppe and agriculture	Gritski et al. 2011
Klondike, OR (2002-2003)	0.77	agriculture/grassland	Johnson et al. 2003
Leaning Juniper, OR (2006-2008)	1.98	agriculture	Gritski et al. 2008
Lempster, NH (2009)	3.11	grasslands/forest/rocky embankments	Tidhar et al. 2010
Lempster, NH (2010)	3.57	grasslands/forest/rocky embankments	Tidhar et al. 2011
Linden Ranch, WA (2010-2011)	1.68	grassland/shrub-steppe, agriculture	Enz and Bay 2011
Locust Ridge, PA (Phase II; 2009)	14.11	grassland	Arnett et al. 2011
Locust Ridge, PA (Phase II; 2010)	14.38	grassland	Arnett et al. 2011
Maple Ridge, NY (2006)	11.21	agriculture/forested	Jain et al. 2007
Maple Ridge, NY (2007-2008)	4.96	agriculture/forested	Jain et al. 2009a
Maple Ridge, NY (2007)	6.49	agriculture/forested	Jain et al. 2009d
Maple Ridge, NY (2012)	7.3	agriculture/forested	Tidhar et al. 2013a
Marengo I, WA (2009-2010)	0.17	agriculture	URS Corporation 2010b
Marengo II, WA (2009-2010)	0.27	agriculture	URS Corporation 2010c
Mars Hill, ME (2007)	2.91	forest	Stantec 2008
Mars Hill, ME (2008)	0.45	forest	Stantec 2009a
Milford I & II, UT (2011-2012)	1.67	desert shrub	Stantec 2012b
Milford I, UT (2010-2011)	2.05	desert shrub	Stantec 2011b
Montezuma I, CA (2011)	1.9	agriculture and grasslands	ICF International 2012
Montezuma I, CA (2012)	0.84	agriculture and grasslands	ICF International 2013
Montezuma II, CA (2012-2013)	0.91	agriculture	Harvey & Associates 2013
Moraine II, MN (2009)	2.42	agriculture/grassland	Derby et al. 2010d
Mount Storm, WV (2009)	17.53	forest	Young et al. 2009a, 2010b

Appendix A2. Fatality estimates for North American wind energy facilities.

Project	Bat Fatalities (bats/MW/year)	Predominant Habitat Type	Citation
Mount Storm, WV (2010)	15.18	forest	Young et al. 2010a, 2011b
Mount Storm, WV (2011)	7.43	forest	Young et al. 2011a, 2012b
Mount Storm, WV (Fall 2008)	6.62	forest	Young et al. 2009b
Mountaineer, WV (2003)	31.69	forest	Kerns and Kerlinger 2004a
Munnsville, NY (2008)	1.93	agriculture/forest	Stantec 2009b
Mustang Hills, CA (2012-2013)	0.1	Grasslands and Riparian	Chatfield and Bay 2014
Nine Canyon, WA (2002-2003)	2.47	agriculture/grassland	Erickson et al. 2003
Noble Altona, NY (2010)	4.34	forest	Jain et al. 2011b
Noble Bliss, NY (2008)	7.8	agriculture/forest	Jain et al. 2009e
Noble Bliss, NY (2009)	3.85	agriculture/forest	Jain et al. 2010a
Noble Chateaugay, NY (2010)	2.44	agriculture	Jain et al. 2011c
Noble Clinton, NY (2008)	3.14	agriculture/forest	Jain et al. 2009c
Noble Clinton, NY (2009)	4.5	agriculture/forest	Jain et al. 2010b
Noble Ellenburg, NY (2008)	3.46	agriculture/forest	Jain et al. 2009b
Noble Ellenburg, NY (2009)	3.91	agriculture/forest	Jain et al. 2010c
Noble Wethersfield, NY (2010)	16.3	agriculture	Jain et al. 2011a
NPPD Ainsworth, NE (2006)	1.16	agriculture/grassland	Derby et al. 2007
Palouse Wind, WA (2012-2013)	4.23	agriculture and grasslands	Stantec 2013a
Pebble Springs, OR (2009-2010)	1.55	grassland	Gritski and Kronner 2010b
Pine Tree, CA (2009-2010, 2011)	NA	grassland	BioResource Consultants 2012
Pinnacle, WV (2012)	40.2	forest	Hein et al. 2013b
Pinyon Pines I & II, CA (2013-2014)	0.04	NA	Chatfield and Russo 2014
Pioneer Prairie I, IA (Phase II; 2011-2012)	10.06	agriculture, grassland	Chodachek et al. 2012
Pioneer Prairie II, IA (2013)	3.83	agriculture	Chodachek et al. 2014
PrairieWinds ND1 (Minot), ND (2010)	2.13	agriculture	Derby et al. 2011c
PrairieWinds ND1 (Minot), ND (2011)	1.39	agriculture, grassland	Derby et al. 2012c
PrairieWinds SD1, SD (2011-2012)	1.23	grassland	Derby et al. 2012d
PrairieWinds SD1, SD (2012-2013)	1.05	grassland	Derby et al. 2013a
PrairieWinds SD1, SD (2013-2014)	0.52	grassland	Derby et al. 2014
Rail Splitter, IL (2012-2013)	11.21	agriculture	Good et al. 2013b
Record Hill, ME (2012)	2.96	forest	Stantec 2013b
Record Hill, ME (2014)	0.55	forest	Stantec 2015
Red Hills, OK (2012-2013)	0.11	grassland	Derby et al. 2013c
Ripley, Ont (2008)	4.67	agriculture	Jacques Whitford 2009
Rollins, ME (2012)	0.18	forest	Stantec 2013c
Rugby, ND (2010-2011)	1.6	agriculture	Derby et al. 2011b

Appendix A2. Fatality estimates for North American wind energy facilities.

Project	Bat Fatalities (bats/MW/year)	Predominant Habitat Type	Citation
Shiloh I, CA (2006-2009)	3.92	agriculture/grassland	Kerlinger et al. 2009
Shiloh II, CA (2009-2010)	2.6	agriculture	Kerlinger et al. 2010, 2013a
Shiloh II, CA (2010-2011)	3.8	agriculture	Kerlinger et al. 2013a
Shiloh III, CA (2012-2013)	0.4	NA	Kerlinger et al. 2013b
Solano III, CA (2012-2013)	0.31	NA	AECOM 2013
Stateline, OR/WA (2001-2002)	1.09	agriculture/grassland	Erickson et al. 2004
Stateline, OR/WA (2003)	2.29	agriculture/grassland	Erickson et al. 2004
Stateline, OR/WA (2006)	0.95	agriculture/grassland	Erickson et al. 2007
Stetson Mountain I, ME (2009)	1.4	forest	Stantec 2009c
Stetson Mountain I, ME (2011)	0.28	forest	Normandeau Associates 2011
Stetson Mountain I, ME (2013)	0.18	forest	Stantec 2014
Stetson Mountain II, ME (2010)	1.65	forest	Normandeau Associates 2010
Stetson Mountain II, ME (2012)	2.27	forest	Stantec 2013d
Summerview, Alb (2005-2006)	10.27	agriculture	Brown and Hamilton 2006b
Summerview, Alb (2006; 2007)	11.42	agriculture/grassland	Baerwald 2008
Top Crop I & II (2012-2013)	12.55	agriculture	Good et al. 2013a
Top of Iowa, IA (2003)	7.16	agriculture	Jain 2005
Top of Iowa, IA (2004)	10.27	agriculture	Jain 2005
Tuolumne (Windy Point I), WA (2009-2010)	0.94	grassland/shrub-steppe, agriculture and forest	Enz and Bay 2010
Vansycle, OR (1999)	1.12	agriculture/grassland	Erickson et al. 2000
Vantage, WA (2010-2011)	0.4	Shrub-steppe, grassland	Ventus Environmental Solutions 2012
Wessington Springs, SD (2009)	1.48	grassland	Derby et al. 2010f
Wessington Springs, SD (2010)	0.41	grassland	Derby et al. 2011d
White Creek, WA (2007-2011)	2.04	grassland/shrub-steppe, agriculture	Downes and Gritski 2012b
Wild Horse, WA (2007)	0.39	grassland	Erickson et al. 2008
Windy Flats, WA (2010-2011)	0.41	grassland/shrub-steppe, agriculture	Enz et al. 2011
Winnebago, IA (2009-2010)	4.54	agriculture/grassland	Derby et al. 2010e
Wolfe Island, Ont (July-December 2009)	6.42	grassland	Stantec Ltd. 2010b
Wolfe Island, Ont (July-December 2010)	9.5	grassland	Stantec Ltd. 2011b
Wolfe Island, Ont (July-December 2011)	2.49	grassland	Stantec Ltd. 2012

Appendix A3. All post-construction monitoring studies, project characteristics, and select study methodology.

Project Name	Total # of turbines	Total MW	Tower size (m)	Number turbines searched	Plot Size	Length of Study	Survey Frequency
Alite, CA (2009-2010)	8	24	80	8	200 m x 200 m	1 year	Weekly (spring, fall), bi-monthly (summer, winter)
Alta VIII, CA (2012-2013)	50	150	90	12 plots (equivalent to 15 turbines)	240 x 240 m	1 year	Bi-weekly
Alta Wind I, CA (2011-2012)	100	150	80	25	120-m radius circle	12.5 months	Every two weeks
Alta Wind II-V, CA (2011-2012)	190	570	80	41	120-m radius circle	14.5 months	Every two weeks
Alta Wind I-V, CA (2013-2014)	290	720 (150 GE, 570 vestas)	80	55 (25 at Alta I, 30 at Alta II-V)	120 m radius circles	n/a	Monthly or bi-weekly
Barton Chapel, TX (2009-2010)	60	120	78	30	200 m x 200 m	1 year	10 turbines weekly, 20 monthly
Barton I & II, IA (2010-2011)	80	160	100	35 (9 turbines were dropped in June 2010 due to landowner issues) 26 turbines were searched for the remainder of the study	200 m x 200 m	1 year	Weekly (spring, fall; migratory turbines), monthly (summer, winter; non-migratory turbines)
Beech Ridge, WV (2012)	67	100.5	80	67	40-m radius	7 months	Every two days
Beech Ridge, WV (2013)	67	100.5	80	67	40-m radius	7.5 months	Every two days
Big Blue, MN (2013)	18	36	78 or 90 (according to Gamesa website)	18	200-m diameter	n/a	Weekly, monthly (Nov and Dec)
Big Blue, MN (2014)	18	36	78 or 90 (according to Gamesa website)	18	200-m diameter	n/a	Weekly, monthly (Nov and Dec)
Big Horn, WA (2006-2007)	133	199.5	80	133	180 m x 180 m	1 year	B-monthly (spring, fall), monthly (winter, summer)
Big Smile, OK (2012-2013)	66	132	78	17 (plus one met tower)	100 x 100	1 year	Weekly (spring, summer, fall), monthly (winter)

Appendix A3. All post-construction monitoring studies, project characteristics, and select study methodology.

Project Name	Total # of turbines	Total MW	Tower size (m)	Number turbines searched	Plot Size	Length of Study	Survey Frequency
Biglow Canyon, OR (Phase I; 2008)	76	125.4	80	50	110 m x 110 m	1 year	Bi-monthly (spring, fall), monthly (winter, summer)
Biglow Canyon, OR (Phase I; 2009)	76	125.4	80	50	110 m x 110 m	1 year	Bi-monthly (spring, fall), monthly (winter, summer)
Biglow Canyon, OR (Phase II; 2009-2010)	65	150	80	50	250 m x 250 m	1 year	Bi-monthly (spring, fall), monthly (winter, summer)
Biglow Canyon, OR (Phase II; 2010-2011)	65	150	80	50	252 m x 252 m	1 year	Bi-weekly(spring, fall), monthly (summer, winter)
Biglow Canyon, OR (Phase III; 2010-2011)	76	174.8	80	50	252 m x 252 m	1 year	Bi-weekly(spring, fall), monthly (summer, winter)
Blue Sky Green Field, WI (2008; 2009)	88	145	80	30	160 m x 160 m	fall, spring	Daily(10 turbines), weekly (20 turbines)
Buena Vista, CA (2008-2009)	38	38	45-55	38	75-m radius	1 year	Monthly to bi-monthly starting in September 2008
Buffalo Gap I, TX (2006)	67	134	78	21	215 m x 215 m	10 months	Every 3 weeks
Buffalo Gap II, TX (2007-2008)	155	233	80	36	215 m x 215 m	14 months	Every 21 days
Buffalo Mountain, TN (2000-2003)	3	1.98	65	3	50-m radius	3 years	Bi-weekly, weekly, bi-monthly
Buffalo Mountain, TN (2005)	18	28.98	V47 = 65; V80 = 78	18	50-m radius	1 year	Bi-weekly, weekly, bi-monthly, and 2 to 5 day intervals
Buffalo Ridge, MN (1994-1995)	73	25	37	1994:10 plots (3 turbines/plot), 20 addition plots in Sept & Oct 1994, 1995: 30 turbines search every other week (Jan-Mar), 60 searched weekly (Apr, July, Aug) 73 searched weekly (May-June and Sept-Oct), 30 searched weekly (Nov-Dec)	100 m x 100 m	20 months	Varies; see number turbines searched or page 44 of report
Buffalo Ridge, MN (Phase I; 1996)	73	25	36	21	126 m x 126 m	1 year	Bi-monthly (spring, summer, and fall)

Appendix A3. All post-construction monitoring studies, project characteristics, and select study methodology.

Project Name	Total # of turbines	Total MW	Tower size (m)	Number turbines searched	Plot Size	Length of Study	Survey Frequency
Buffalo Ridge, MN (Phase I; 1997)	73	25	36	21	126 m x 126 m	1 year	Bi-monthly (spring, summer, and fall)
Buffalo Ridge, MN (Phase I; 1998)	73	25	36	21	126 m x 126 m	1 year	Bi-monthly (spring, summer, and fall)
Buffalo Ridge, MN (Phase I; 1999)	73	25	36	21	126 m x 126 m	1 year	Bi-monthly (spring, summer, and fall)
Buffalo Ridge, MN (Phase II; 1998)	143	107.25	50	40	126 m x 126 m	1 year	Bi-monthly (spring, summer, and fall)
Buffalo Ridge, MN (Phase II; 1999)	143	107.25	50	40	126 m x 126 m	1 year	Bi-monthly (spring, summer, and fall)
Buffalo Ridge, MN (Phase II; 2001/Lake Benton I)	143	107.25	50	83	60 m x 60 m	summer, fall	Bi-monthly
Buffalo Ridge, MN (Phase II; 2002/Lake Benton I)	143	107.25	50	103	60 m x 60 m	summer, fall	Bi-monthly
Buffalo Ridge, MN (Phase III; 1999)	138	103.5	50	30	126 m x 126 m	1 year	Bi-monthly (spring, summer, and fall)
Buffalo Ridge, MN (Phase III; 2001/Lake Benton II)	138	103.5	50	83	60 m x 60 m	summer, fall	Bi-monthly
Buffalo Ridge, MN (Phase III; 2002/Lake Benton II)	138	103.5	50	103	60 m x 60 m	summer, fall	Bi-monthly
Buffalo Ridge I, SD (2009-2010)	24	50.4	79	24	200 m x 200 m	1 year	Weekly (migratory), monthly (non-migratory)
Buffalo Ridge II, SD (2011-2012)	105	210	78	65 (60 road and pad, 5 turbine plots)	100 m x 100m	1 year	Weekly (spring, summer, fall), monthly (winter)
Casselman, PA (2008)	23	34.5	80	10	126 m x 120 m	7 months	Daily
Casselman, PA (2009)	23	34.5	80	10	126 m x 120 m	7.5 months	Daily searches
Casselman Curtailment, PA (2008)	23	35.4	80	12 experimental; 10 control	126 m x 120 m	2.5 months	Daily
Castle River, Alb (2001-2002)	60	39.6	50	60	50-m radius	2 years	Weekly, bi-weekly
Castle River, Alb (2001-2002)	60	39.6	50	60	50-m radius	2 years	Weekly, bi-weekly

Appendix A3. All post-construction monitoring studies, project characteristics, and select study methodology.

Project Name	Total # of turbines	Total MW	Tower size (m)	Number turbines searched	Plot Size	Length of Study	Survey Frequency
Cedar Ridge, WI (2009)	41	67.6	80	20	160 m x 160 m	spring, summer, fall	Daily, every 4 days; late fall searched every 3 days
Cedar Ridge, WI (2010)	41	68	80	20	160 m x 160 m	1 year	Five turbines were surveyed daily, 15 turbines surveyed every 4 days in rotating groups each day. All 20 surveyed every three days during late fall
Cohocton/Dutch Hill, NY (2009)	50	125	80	17	130 m x 130 m	spring, summer, fall	Daily (5 turbines), weekly (12 turbines)
Cohocton/Dutch Hills, NY (2010)	50	125	80	17	120 m x 120 m	spring, summer, fall	Daily, weekly
Combine Hills, OR (Phase I; 2004-2005)	41	41	53	41	90-m radius	1 year	Monthly
Combine Hills, OR (2011)	104	104	53	52 (plus 1 MET tower)	180 m x 180 m	1 year	Bi-weekly(spring, fall), monthly (summer, winter)
Condon, OR	84	n/a	n/a	n/a	n/a	n/a	n/a
Crescent Ridge, IL (2005-2006)	33	49.5	80	33	70-m radius	1 year	Weekly (fall, spring)
Criterion, MD (2011)	28	70	80	28	40 to 50-m radius	7.3 months	Daily
Criterion, MD (2012)	28	70	80	14	40 to 50-m radius	7.5 months	Weekly
Criterion, MD (2013)	28	70	80	14	40 to 50 m radius	7.5 months	Weekly
Crystal Lake II, IA (2009)	80	200	80	16 turbines through week 6, and then 15 for duration of study	100 m x 100 m	spring, summer, fall	3 times per week for 26 weeks
Diablo Winds, CA (2005-2007)	31	20.46	50 and 55	31	75 m x 75 m	2 years	Monthly
Dillon, CA (2008-2009)	45	45	69	15	200 m x 200 m	1 year	Weekly, bi-monthly in winter
Dry Lake I, AZ (2009-2010)	30	63	78	15	160 m x 160 m	1 year	Bi-monthly (spring, fall), monthly (winter, summer)
Dry Lake II, AZ (2011-2012)	31	65	78	31: 5 (full plot), 26 (road & pad)	160 m x 160 m	1 year	Twice weekly (spring, summer, fall), weekly (winter)
Elkhorn, OR (2008)	61	101	80	61	220 m x 220 m	1 year	Monthly
Elkhorn, OR (2010)	61	101	80	31	220 m x 220 m	1 year	Bi-monthly (spring, fall), monthly (winter, summer)

Appendix A3. All post-construction monitoring studies, project characteristics, and select study methodology.

Project Name	Total # of turbines	Total MW	Tower size (m)	Number turbines searched	Plot Size	Length of Study	Survey Frequency
Elm Creek, MN (2009-2010)	67	100	80	29	200 m x 200 m	1 year	Weekly, monthly
Elm Creek II, MN (2011-2012)	62	148.8	80	30	200 x 200m (2 random migration search areas 100 m x 100 m)	1 year	20 searched every 28 days, 10 turbines every 7 days during migration)
Erie Shores, Ont (2006)	66	99	80	66	40-m radius	2 years	Weekly, bi-monthly, 2-3 times weekly (migration)
Foote Creek Rim, WY (Phase I; 1999)	69	41.4	40	69	126 m x 126 m	1 year	Monthly
Foote Creek Rim, WY (Phase I; 2000)	69	41.4	40	69	126 m x 126 m	1 year	Monthly
Foote Creek Rim, WY (Phase I; 2001-2002)	69	41.4	40	69	126 m x 126 m	1 year	Monthly
Forward Energy Center, WI (2008-2010)	86	129	80	29	160 m x 160 m	2 years	11 turbines daily, 9 every 3 days, 9 every 5 days
Fowler I, IN (2009)	162	301	78 (Vestas), 80 (Clipper)	25	160 m x 160 m	spring, summer, fall	weekly, bi-weekly
Fowler I, II, III, IN (2010)	355	600	Vestas = 80, Clipper = 80, GE = 80	36 turbines, 100 road and pads	80 m x 80 m for turbines ; 40-m radius for roads and pads	spring, fall	Daily, weekly
Fowler I, II, III, IN (2011)	355	600	Vestas = 80, Clipper = 80, GE = 80	177 road and pads (spring), 9 turbines & 168 roads and pads (fall)	turbines (80 m circular plot), roads and pads (out to 80 m)	spring, fall	Daily, weekly
Fowler I, II, III, IN (2012)	355	600	Vestas = 80, Clipper = 80, GE = 80	118 roads and pads	roads and pads (out to 80 m)	2.5 months	Weekly
Fowler III, IN (2009)	60	99	78	12	160 m x 160 m	10 weeks	Weekly, bi-weekly
Goodnoe, WA (2009-2010)	47	94	80	24	180 m x 180 m	1 year	14 days during migration periods, 28 days during non-migration periods
Grand Ridge I, IL (2009-2010)	66	99	80	30	160 m x 160 m	1 year	Weekly, monthly

Appendix A3. All post-construction monitoring studies, project characteristics, and select study methodology.

Project Name	Total # of turbines	Total MW	Tower size (m)	Number turbines searched	Plot Size	Length of Study	Survey Frequency
Harrow, Ont (2010)	24 (four 6-turb facilities)	39.6	n/a	12 in July, 24 Aug-Oct	50-m radius from turbine base	4 months	Twice-weekly
Harvest Wind, WA (2010-2012)	43	98.9	80	32	180 m x 180 m & 240 m x 240 m	2 years	Twice a week, weekly and monthly
Hay Canyon, OR (2009-2010)	48	100.8	79	20	180 m x 180 m	1 year	Bi-monthly (spring, fall), monthly (winter, summer)
Heritage Garden I, MI (2012-2014)	14	28	90	14	120x120 m except one plot that was 280 m x280 m	1 years	Weekly (spring, summer, and fall) and bi-weekly (winter)
High Winds, CA (2003-2004)	90	162	60	90	75-m radius	1 year	Bi-monthly
High Winds, CA (2004-2005)	90	162	60	90	75-m radius	1 year	Bi-monthly
Hopkins Ridge, WA (2006)	83	150	67	41	180 m x 180 m	1 year	Monthly, weekly (subset of 22 turbines spring and fall migration)
Hopkins Ridge, WA (2008)	87	156.6	67	41-43	180 m x 180 m	1 year	Bi-monthly (spring, fall), monthly (winter, summer)
Jersey Atlantic, NJ (2008)	5	7.5	80	5	130 m x 120 m	9 months	Weekly
Judith Gap, MT (2006-2007)	90	135	80	20	190 m x 190 m	7 months	Monthly
Judith Gap, MT (2009)	90	135	80	30	100 m x 100 m	5 months	Bi-monthly
Kewaunee County, WI (1999-2001)	31	20.46	65	31	60 m x 60 m	2 years	Bi-weekly (spring, summer), daily (spring, fall migration), weekly (fall, winter)
Kibby, ME (2011)	44	132	124	22 turbines	75-m diameter circular plots	22 weeks	Avg 5-day
Kittitas Valley, WA (2011-2012)	48	100.8	80	48	100 m x 102 m	1 year	Bi-weekly from Aug 15 - Oct 31 and March 16 - May 15; every 4 weeks from Nov 1 - March 15 and May 16 - Aug 14
Klondike, OR (2002-2003)	16	24	80	16	140 m x 140 m	1 year	Monthly

Appendix A3. All post-construction monitoring studies, project characteristics, and select study methodology.

Project Name	Total # of turbines	Total MW	Tower size (m)	Number turbines searched	Plot Size	Length of Study	Survey Frequency
Klondike II, OR (2005-2006)	50	75	80	25	180 m x 180 m	1 year	Bi-monthly (spring, fall), monthly (summer, winter)
Klondike III (Phase I), OR (2007-2009)	125	223.6	GE = 80; Siemens= 80, Mitsubishi = 80	46	240 m x 240 m (1.5MW) 252 m x 252 m (2.3 MW)	2 year	Bi-monthly (spring, fall migration), monthly (summer, winter)
Klondike IIIa (Phase II), OR (2008-2010)	51	76.5	GE = 80	34	240 m x 240 m	2 years	Bi-monthly (spring, fall), monthly (summer, winter)
Lakefield Wind, MN (2012)	137	205.5	80	26	100 m x 100 m	7.5 months	3 times per week
Leaning Juniper, OR (2006-2008)	67	100.5	80	17	240 m x 240 m	2 years	Bi-monthly (spring, fall), monthly (winter, summer)
Lempster, NH (2009)	12	24	78	4	120 m x 130 m	6 months	Daily
Lempster, NH (2010)	12	24	78	12	120 m x 130 m	6 months	Weekly
Linden Ranch, WA (2010-2011)	25	50	80	25	110 m x 110 m	1 year	Bi-weekly(spring, fall), monthly (summer, winter)
Locust Ridge, PA (Phase II; 2009)	51	102	80	15	120 m x 126 m	6.5 months	Daily
Locust Ridge, PA (Phase II; 2010)	51	102	80	15	120 m x 126 m	6.5 months	Daily
Madison, NY (2001-2002)	7	11.55	67	7	60-m radius	1 year	Weekly (spring, fall), monthly (summer)
Maple Ridge, NY (2006)	120	198	80	50	130 m x 120 m	5 months	Daily (10 turbines), every 3 days (10 turbines), weekly (30 turbines)
Maple Ridge, NY (2007)	195	321.75	80	64	130 m x 120 m	7 months	Weekly
Maple Ridge, NY (2007-2008)	195	321.75	80	64	130 m x 120 m	7 months	Weekly
Maple Ridge, NY (2012)	195	321.75	80	105 (5 turbines, 100 roads/pads)	100 m x 100 m	3 months	Weekly
Marengo I, WA (2009-2010)	78	140.4	67	39	180 m x 180 m	1 year	Bi-monthly (spring, fall), monthly (winter, summer)
Marengo II, WA (2009-2010)	39	70.2	67	20	180 m x 180 m	1 year	Bi-monthly (spring, fall), monthly (winter, summer)

Appendix A3. All post-construction monitoring studies, project characteristics, and select study methodology.

Project Name	Total # of turbines	Total MW	Tower size (m)	Number turbines searched	Plot Size	Length of Study	Survey Frequency
Mars Hill, ME (2007)	28	42	80.5	28	76-m diameter, extended plot 238-m diameter	spring, summer, fall	Daily (2 random turbines), weekly (all turbines): extended plot searched once per season
Mars Hill, ME (2008)	28	42	80.5	28	76-m diameter, extended plot 238-m diameter	spring, summer, fall	Weekly: extended plot searched once per season
McBride, Alb (2004)	114	75	50	114	4 parallel transects 120-m wide	1 year	Weekly, bi-weekly
Melancthon, Ont (Phase I; 2007)	45	n/a	n/a	45	35 m radius	5 months	Weekly, twice weekly
Meyersdale, PA (2004)	20	30	80	20	130 m x 120 m	6 weeks	Daily (half turbines), weekly (half turbines)
Milford I & II, UT (2011-2012)	107	160.5 (58.5 I, 102 II)	80	43	120 m x 120 m	n/a	Every 10.5 days
Milford I, UT (2010-2011)	58	145	80	24	120 m x 120 m	n/a	Weekly
Montezuma I, CA (2011)	16	36.8	80	16	105-m radius	1 year	Weekly and bi-Weekly
Montezuma I, CA (2012)	16	36.8	80	16	105-m radius	1 year	Weekly and bi-Weekly
Montezuma II, CA (2012-2013)	34	78.2	80	17	105-m radius	1 year	Weekly
Moraine II, MN (2009)	33	49.5	82.5	30	200 m x 200 m	1 year	Weekly (migratory), monthly (non-migratory)
Mount Storm, WV (2009)	132	264	78	44	varied	4.5 months	Weekly (28 turbines), daily (16 turbines)
Mount Storm, WV (2010)	132	264	78	24	20 to 60 m from turbine	6 months	Daily
Mount Storm, WV (2011)	132	264	78	24	varied	6 months	Daily
Mount Storm, WV (Fall 2008)	82	164	78	27	varied	3 months	Weekly (18 turbines), daily (9 turbines)
Mountaineer, WV (2003)	44	66	80	44	60-m radius	7 months	Weekly, monthly
Mountaineer, WV (2004)	44	66	80	44	130 m x 120 m	6 weeks	Daily, weekly
Munnsville, NY (2008)	23	34.5	69.5	12	120 m x 120 m	spring, summer, fall	Weekly

Appendix A3. All post-construction monitoring studies, project characteristics, and select study methodology.

Project Name	Total # of turbines	Total MW	Tower size (m)	Number turbines searched	Plot Size	Length of Study	Survey Frequency
Mustang Hills, CA (2012-2013)	50	150	90	13 plots (equivalent to 15 turbines)	240 m x 240 m	1 year	Bi-weekly
Nine Canyon, WA (2002-2003)	37	48.1	60	37	90-m radius	1 year	Bi-monthly (spring, summer, fall), monthly (winter)
Nine Canyon II, WA (2004)	12	15.6	60	12	90 m x 90 m	3 months	Once every two weeks
Noble Altona, NY (2010)	65	97.5	80	22	120 m x 120 m	spring, summer, fall	Daily, weekly
Noble Altona, NY (2011)	65	97.5	80	22	120 m x 120 m	2 months	Daily
Noble Bliss, NY (2008)	67	100	80	23	120 m x 120 m	spring, summer, fall	Daily (8 turbines), 3-day (8 turbines), weekly (7 turbines)
Noble Bliss, NY (2009)	67	100	80	23	120 m x 120 m	spring, summer, fall	Weekly, 8 turbines searched daily from July 1 to August 15
Noble Bliss/Wethersfield, NY (2011)	151	226	80	48 (24 from each site:12 ag, 12 forest)	road & pad 70 m out from turbine	2 months	Daily
Noble Chateaugay, NY (2010)	71	106.5	80	24	120 m x 120 m	spring, summer, fall	Weekly
Noble Clinton, NY (2008)	67	100	80	23	120 m x 120 m	spring, summer, fall	Daily (8 turbines), 3-day (8 turbines), weekly (7 turbines)
Noble Clinton, NY (2009)	67	100	80	23	120 m x 120 m	spring, summer, fall	Daily (8 turbines), weekly (15 turbines), all turbines weekly from July 1 to August 15
Noble Ellenburg, NY (2008)	54	80	80	18	120 m x 120 m	spring, summer, fall	Daily (6 turbines), 3-day (6 turbines), weekly (6 turbines)
Noble Ellenburg, NY (2009)	54	80	80	18	120 m x 120 m	spring, summer, fall	Daily (6 turbines), weekly (12 turbines), all turbines weekly from July 1 to August 15
Noble Wethersfield, NY (2010)	84	126	80	28	120 m x 120 m	spring, summer, fall	Weekly
NPPD Ainsworth, NE (2006)	36	20.5	70	36	220 m x 220 m	spring, summer, fall	Bi-monthly

Appendix A3. All post-construction monitoring studies, project characteristics, and select study methodology.

Project Name	Total # of turbines	Total MW	Tower size (m)	Number turbines searched	Plot Size	Length of Study	Survey Frequency
Oklahoma Wind Energy Center, OK (2004; 2005)	68	102	70	68	20-m radius	3 months (2 years)	Bi-monthly
Pacific, CA (2012-2013)	70	140	78.5	20	126-m radius	n/a	Twice weekly (fall), and biweekly
Palouse Wind, WA (2012-2013)	58	104.4	80, 90, or 105 M (according to the Vestas website)	19	120 m x 120 m	1 year	Monthly (winter) and Weekly (spring-fall)
Pebble Springs, OR (2009-2010)	47	98.7	79	20	180 m x 180 m	1 year	Bi-monthly (spring, fall), monthly (winter, summer)
Pine Tree, CA (2009-2010, 2011)	90	135	65	40	100-m radius	1.5 year	Bi-weekly, weekly
Pinnacle, WV (2012)	23	55.2	80	11	126 m x 120 m	9 months	Weekly
Pinnacle Operational Mitigation Study (2012)	23	55.2	80	12	126 m x 120 m	2.5 months	Daily
Pinyon Pines I & II, CA (2013-2014)	100	n/a	90	25 plots (approx. 31 turbines)	240 m x 240 m	n/a	Bi-weekly
Pioneer Prairie II, IA (2013)	62	102.3	80	62	80 m x80 m (5 turbines), road and pad within 100 m of turbine (57 turbines)	n/a	Weekly
Pioneer Prairie I, IA (Phase II; 2011-2012)	62	102.3	80	62 (57 road/pad) 5 full search plots	80 m x 80 m	1 year	Weekly (spring and fall), every two weeks (summer), monthly (winter)
Pioneer Trail, IL (2012-2013)	94	150.5	n/a	50	80 m x80 m	fall, spring	Weekly
Prairie Rose, MN (2014)	119	200	80	10	100 m x 100 m	6 months	Weekly
PrairieWinds SD1, SD (2012-2013)	108	162	80	50	200 m x 200 m	1 year	Bi-weekly
PrairieWinds SD1, SD (2013-2014)	108	162	80	45	200 m x 200 m	1 year	Twice monthly (spring, summer, fall), monthly (winter)
PrairieWinds ND1 (Minot), ND (2010)	80	115.5	89	35	minimum of 100 m x 100 m	3 seasons	Bi-monthly

Appendix A3. All post-construction monitoring studies, project characteristics, and select study methodology.

Project Name	Total # of turbines	Total MW	Tower size (m)	Number turbines searched	Plot Size	Length of Study	Survey Frequency
PrairieWinds ND1 (Minot), ND (2011)	80	115.5	80	35	minimum 100 m x 100 m	3 season	Twice monthly
PrairieWinds SD1, SD (2011-2012)	108	162	80	50	200 m x 200 m	1 year	Twice monthly (spring, summer, fall), monthly (winter)
Rail Splitter, IL (2012-2013)	67	100.5	80	34	60-m radius	1 year	Weekly (spring, summer, and fall) and bi-weekly (winter)
Record Hill, ME (2012)	22	50.6	80	22	126.5 m x 126.5 m	5 months	Three times every two weeks
Record Hill, ME (2014)	22	50.6	80	10	varied due to steep terrain and heavily vegetated areas	4.5 months	Daily for 5 days a week
Red Canyon, TX (2006-2007)	56	84	70	28	200 m x 200 m in fall and winter; 160 m x 160 m in spring and summer	1 year	Every 14 days in fall and winter; 7 days in spring, 3 days in summer
Red Hills, OK (2012-2013)	82	123	80	20 (plus one met tower)	100 m x 100 m	1 year	Weekly (spring, summer, fall), monthly (winter)
Ripley, Ont (2008)	38	76	64	38	80 m x 80 m	spring, fall	Twice weekly for odd turbines; weekly for even turbines.
Ripley, Ont (2008-2009)	38	76	64	38	80 m x 80 m	6 weeks	Twice weekly for odd turbines; weekly for even turbines.
Rollins, ME (2012)	40	60	80	20	varied; turbine laydown area and gravel access roads out to 60 m	6 months	Weekly
Roth Rock, MD (2011)	20	50	80	10	80m x 80 m	3 months	Daily
Rugby, ND (2010-2011)	71	149	78	32	200 m x 200 m	1 year	Weekly (spring, fall; migratory turbines), monthly (non-migratory turbines)
San Gorgonio, CA (1997-1998; 1999-2000)	3000	n/a	24.4-42.7		50-m radius	2 years	Quarterly
Searsburg, VT (1997)	11	7	65	11	20- to 55-m radius	spring, fall	Weekly (fall migration)
Sheffield, VT (2012)	16	40	80	8	126 m x 120 m	3 months	Daily
Sheffield Operational Mitigation Study (2012)	16	40	80	16	126 m x 120 m	4 months	Daily
High Sheldon, NY (2010)	75	112.5	80	25	115 m x 115 m	7 months	daily (8 turbines), weekly (17 turbines)

Appendix A3. All post-construction monitoring studies, project characteristics, and select study methodology.

Project Name	Total # of turbines	Total MW	Tower size (m)	Number turbines searched	Plot Size	Length of Study	Survey Frequency
High Sheldon, NY (2011)	75	112.5	80	25	115 m x 115 m	7 months	Daily (8 turbines), weekly (17 turbines)
Shiloh I, CA (2006-2009)	100	150	65	100	105-m radius	3 years	Weekly
Shiloh II, CA (2009-2010)	75	150	80	25	100-m radius	1 year	Weekly
Shiloh II, CA (2010-2011)	75	150	80	25	100-m radius	1 year	Weekly
Shiloh III, CA (2012-2013)	50	102.5	78.5	25	100-m radius	n/a	Weekly
SMUD Solano, CA (2004-2005)	22	15	65	22	60-m radius	1 year	Bi-monthly
Solano III, CA (2012-2013)	55	128	80	19	100-m radius	n/a	Bi-Weekly
Spruce Mountain, ME (2012)	10	20	78	10	100 m x 100 m	7 months	Weekly
Stateline, OR/WA (2001-2002)	454	299	50	124	minimum 126 m x 126 m	17 months	Bi-weekly, monthly
Stateline, OR/WA (2003)	454	299	50	153	minimum 126 m x 126 m	1 year	Bi-weekly, monthly
Stateline, OR/WA (2006)	454	299	50	39	variable turbine strings	1 year	Bi-weekly
Steel Winds I & II, NY (2012)	14	35	80	8 (1 was just gravel pad)	120 m x 120 m	6 months	Weekly, bi-weekly (November only)
Steel Winds I, NY (2007)	8	20	80	8	176 m x 176 m	6.5 months	Every 10 days (spring, fall) every 21 days (summer)
Stetson Mountain I, ME (2009)	38	57	80	19	76-m diameter	27 weeks (spring, summer, fall)	Weekly
Stetson Mountain I, ME (2011)	38	57	80	19	79.45 m x79.45 m	6 months	Weekly
Stetson Mountain I, ME (2013)	38	57	80	19	76-m diameter	6 months	Weekly
Stetson Mountain II, ME (2010)	17	25.5	80	17	74.5 m x 74.5 m	6 months	Weekly (3 turbines twice a week)
Stetson Mountain II, ME (2012)	17	25.5	80	17	laydown area and road up to 60 m	6 months	Weekly

Appendix A3. All post-construction monitoring studies, project characteristics, and select study methodology.

Project Name	Total # of turbines	Total MW	Tower size (m)	Number turbines searched	Plot Size	Length of Study	Survey Frequency
Summerview, Alb (2005-2006)	39	70.2	67	39	140 m x 140 m	1 year	Weekly, bi-weekly (May to July, September)
Summerview, Alb (2006; 2007)	39	70.2	65	39	52-m radius; 2 spiral transects 7 m apart	summer, fall (2 years)	Daily (10 turbines), weekly (29 turbines)
Tehachapi, CA (1996-1998)	3300	n/a	14.7 to 57.6	201	50-m radius	20 months	Quarterly
Top Crop I & II (2012-2013)	68 (phase I) 132 (phase (II)	300 (102 (phase I) 198 (phase II)	65 (phase I) 80 (phase II)	100	61-m radius	1 year	Weekly (spring, summer, and fall) and bi-weekly (winter)
Top of Iowa, IA (2003)	89	80	71.6	26	76 m x 76 m	spring, summer, fall	Once every 2 to 3 days
Top of Iowa, IA (2004)	89	80	71.6	26	76 m x 76 m	spring, summer, fall	Once every 2 to 3 days
Tuolumne (Windy Point I), WA (2009-2010)	62	136.6	80	21	180 m x 180 m	1 year	Monthly throughout the year, a sub-set of 10 turbines were also searched weekly during the spring, summer, and fall
Vansycle, OR (1999)	38	24.9	50	38	126 m x 126 m	1 year	Monthly
Vantage, WA (2010-2011)	60	90	80	30	240 m x 240 m	1 year	Monthly, a subset of 10 searched weekly during migration
Vasco, CA (2012-2013)	34	78.2	80	34	105-m radius	1 year	Weekly, monthly
Wessington Springs, SD (2009)	34	51	80	20	200 m x 200 m	spring, summer, fall	Bi-monthly
Wessington Springs, SD (2010)	34	51	80	20	200 m x 200 m	8 months	Bi-weekly (spring, summer, fall)
White Creek, WA (2007-2011)	89	204.7	80	89	180 m x 180 m & 240 m x 240 m	4 years	Twice a week, weekly and monthly
Wild Horse, WA (2007)	127	229	67	64	110 m from two turbines in plot	1 year	Monthly, weekly (fall, spring migration at 16 turbines)
Windy Flats, WA (2010-2011)	114	262.2	80	36 (plus 1 MET tower)	180 m x 180 m (120m at MET tower)	1 year	Monthly (spring, summer, fall, and winter), weekly (spring and fall migration)
Winnebago, IA (2009-2010)	10	20	78	10	200 m x 200 m	1 year	Weekly (migratory), monthly (non-migratory)

Appendix A3. All post-construction monitoring studies, project characteristics, and select study methodology.

Project Name	Total # of turbines	Total MW	Tower size (m)	Number turbines searched	Plot Size	Length of Study	Survey Frequency
Wolfe Island, Ont (May-June 2009)	86	197.8	80	86	60-m radius	spring	43 twice weekly, 43 weekly
Wolfe Island, Ont (July-December 2009)	86	197.8	80	86	60-m radius	summer, fall	43 twice weekly, 43 weekly
Wolfe Island, Ont (January-June 2010)	86	197.8	80	86	60-m radius	6 months	43 twice weekly, 43 weekly
Wolfe Island, Ont (July-December 2010)	86	197.8	80	86	50-m radius	6 months	43 twice weekly, 43 weekly
Wolfe Island, Ont (January-June 2011)	86	197.8	80	86	50-m radius	6 months	43 twice weekly, 43 weekly
Wolfe Island, Ont (July-December 2011)	86	197.8	80	86	50-m radius	6 months	43 twice weekly, 43 weekly
Wolfe Island, Ont (January-June 2012)	86	197.8	n/a	86	50-m radius	n/a	1/2 searched twice weekly, 1/2 searched weekly

Appendix A3 (continued). All post-construction monitoring studies, project characteristics, and select study methodology.

Data from the following sources:

Project, Location	Reference	Project, Location	Reference
Alite, CA	Chatfield et al. 2010	Klondike II, OR	NWC and WEST 2007
Alta Wind I, CA (11)	Chatfield et al. 2012	Klondike III (Phase I), OR	Gritski et al. 2010
Alta Wind II-V, CA (11)	Chatfield et al. 2012	Klondike IIIa (Phase II), OR	Gritski et al. 2011
Barton I&II, IA	Derby et al. 2011a	Leaning Juniper, OR	Gritski et al. 2008
Barton Chapel, TX	WEST 2011	Lempster, NH (09)	Tidhar et al. 2010
Beech Ridge, WV	Tidhar et al. 2013b	Lempster, NH (10)	Tidhar et al. 2011
Big Horn, WA	Kronner et al. 2008	Linden Ranch, WA	Enz and Bay 2011
Big Smile, OK	Derby et al. 2013b	Locust Ridge, PA (Phase II; 09)	Arnett et al. 2011
Biglow Canyon, OR (Phase I; 08)	Jeffrey et al. 2009a	Locust Ridge, PA (Phase II; 10)	Arnett et al. 2011
Biglow Canyon, OR (Phase I; 09)	Enk et al. 2010	Madison, NY	Kerlinger 2002b
Biglow Canyon, OR (Phase II; 09/10)	Enk et al. 2011a	Maple Ridge, NY (06)	Jain et al. 2007
Biglow Canyon, OR (Phase II; 10/11)	Enk et al. 2012b	Maple Ridge, NY (07)	Jain et al. 2009a
Biglow Canyon, OR (Phase III; 10/11)	Enk et al. 2012a	Maple Ridge, NY (08)	Jain et al. 2009d
Blue Sky Green Field, WI	Gruver et al. 2009b	Marengo I, WA (09)	URS Corporation 2010b
Buena Vista, CA	Insignia Environmental 2009	Marengo II, WA (09)	URS Corporation 2010c
Buffalo Gap I, TX	Tierney 2007	Mars Hill, ME (07)	Stantec 2008
Buffalo Gap II, TX	Tierney 2009	Mars Hill, ME (08)	Stantec 2009a
Buffalo Mountain, TN (00-03)	Nicholson et al. 2005	McBride, Alb (04)	Brown and Hamilton 2004
Buffalo Mountain, TN (05)	Fiedler et al. 2007	Melancthon, Ont (Phase I)	Stantec Ltd. 2008
Buffalo Ridge, MN (94/95)	Osborn et al. 1996, 2000	Meyersdale, PA (04)	Arnett et al. 2005
Buffalo Ridge, MN (Phase I; 96)	Johnson et al. 2000	Moraine II, MN	Derby et al. 2010d
Buffalo Ridge, MN (Phase I; 97)	Johnson et al. 2000	Mount Storm, WV (Fall 08)	Young et al. 2009b
Buffalo Ridge, MN (Phase I; 98)	Johnson et al. 2000	Mount Storm, WV (09)	Young et al. 2009a, 2010b
Buffalo Ridge, MN (Phase I; 99)	Johnson et al. 2000	Mount Storm, WV (10)	Young et al. 2010a, 2011b
Buffalo Ridge, MN (Phase II;98)	Johnson et al. 2000	Mount Storm, WV (11)	Young et al. 2011a, 2012b
Buffalo Ridge, MN (Phase II; 99)	Johnson et al. 2000	Mountaineer, WV (03)	Kerns and Kerlinger 2004a
Buffalo Ridge, MN (Phase II; 01/Lake Benton I)	Johnson et al. 2004	Mountaineer, WV (04)	Arnett et al. 2005
Buffalo Ridge, MN (Phase II; 02/Lake Benton I)	Johnson et al. 2004	Munnsville, NY (08)	Stantec 2009b
Buffalo Ridge, MN (Phase III; 99)	Johnson et al. 2000	Nine Canyon, WA	Erickson et al. 2003
Buffalo Ridge, MN (Phase III; 01/Lake Benton II)	Johnson et al. 2004	Noble Altona, NY	Jain et al. 2011b
Buffalo Ridge, MN (Phase III; 02/Lake Benton II)	Johnson et al. 2004	Noble Bliss, NY (08)	Jain et al.2009e
Buffalo Ridge I, SD (10)	Derby et al. 2010b	Noble Bliss, NY (09)	Jain et al. 2010a
Buffalo Ridge II, SD (11)	Derby et al. 2012a	Noble Chateaugay, NY	Jain et al. 2011c
Casselman, PA (08)	Arnett et al. 2009b	Noble Clinton, NY (08)	Jain et al. 2009c
Casselman, PA (09)	Arnett et al. 2010	Noble Clinton, NY (09)	Jain et al. 2010b
Casselman Curtailment, PA (08)	Arnett et al. 2009a	Noble Ellenburg, NY (08)	Jain et al. 2009b
Castle River, Alb (01)	Brown and Hamilton 2006a	Noble Ellenburg, NY (09)	Jain et al. 2010c
Castle River, Alb (02)	Brown and Hamilton 2006a	Noble Wethersfield, NY	Jain et al. 2011a
Cedar Ridge, WI (09)	BHE Environmental 2010	NPPD Ainsworth, NE	Derby et al. 2007
Cedar Ridge, WI (10)	BHE Environmental 2011	Oklahoma Wind Energy Center, OK	Piorkowski and O'Connell 2010
Cohocton/Dutch Hill, NY (09)	Stantec 2010	Pebble Springs, OR	Gritski and Kronner 2010b
Cohocton/Dutch Hills, NY (10)	Stantec 2011a	Pine Tree, CA	BioResource Consultants 2012
Combine Hills, OR	Young et al. 2006	Pioneer Prairie I, IA (Phase II)	Chodachek et al. 2012
Combine Hills, OR (11)	Enz et al. 2012	PrairieWinds ND1 (Minot), ND	Derby et al. 2011c
Condon, OR	Fishman Ecological Services 2003	PrairieWinds ND1 (Minot), ND (11)	Derby et al. 2012c
Crescent Ridge, IL	Kerlinger et al. 2007	PrairieWinds SD1, SD	Derby et al. 2012d
Criterion, MD (11)	Young et al. 2012a	Prince Wind Farm, Ont (06)	Natural Resource Solutions 2009
Criterion, MD (12)	Young et al. 2013	Prince Wind Farm, Ont (07)	Natural Resource Solutions 2009
Crystal Lake II, IA	Derby et al. 2010a	Prince Wind Farm, Ont (08)	Natural Resource Solutions 2009
Diablo Winds, CA	WEST 2006, 2008	Red Canyon, TX	Miller 2008
Dillon, CA	Chatfield et al. 2009	Red Hills, OK	Derby et al. 2013c
Dry Lake I, AZ	Thompson et al. 2011	Ripley, Ont (08)	Jacques Whitford 2009
Dry Lake II, AZ	Thompson and Bay 2012	Ripley, Ont (Fall 09)	Golder Associates 2010
Elkhorn, OR (08)	Jeffrey et a. 2009b	Rugby, ND	Derby et al. 2011b
Elkhorn, OR (10)	Enk et al. 2011b	San Gorgonio, CA	Anderson et al. 2005
Elm Creek, MN	Derby et al. 2010c	Searsburg, VT (07)	Kerlinger 2002a
Elm Creek II, MN	Derby et al. 2012b	Shiloh I, CA	Kerlinger et al. 2009
Erie Shores, Ont	James 2008	Shiloh II, CA	Kerlinger et al. 2010
Foote Creek Rim, WY (Phase I; 99)	Young et al. 2003a	SMUD Solano, CA	Erickson and Sharp 2005
Foote Creek Rim, WY (Phase I; 00)	Young et al. 2003a	Stateline, OR/WA (02)	Erickson et al. 2004
Foote Creek Rim, WY (Phase I; 01-02)	Young et al. 2003a	Stateline, OR/WA (03)	Erickson et al. 2004
Forward Energy Center, WI	Grodsky and Drake 2011	Stateline, OR/WA (06)	Erickson et al. 2007
Fowler I, IN (09)	Good et al. 2011	Stetson Mountain I, ME (09)	Stantec 2009c
Fowler I, II, III, IN (10)	Good et al. 2011	Stetson Mountain I, ME (11)	Normandeau Associates 2011
Fowler I, II, III, IN (11)	Good et al. 2012	Stetson Mountain II, ME (10)	Normandeau Associates 2010
Fowler I, II, III, IN (12)	Good et al. 2013c	Summerview, Alb (06)	Brown and Hamilton 2006b
Fowler III, IN (09)	Good et al. 2011	Summerview, Alb (08)	Baerwald 2008
Goodnoe, WA	URS Corporation 2010a	Tehachapi, CA	Anderson et al. 2004

Appendix A3 (continued). All post-construction monitoring studies, project characteristics, and select study methodology.

Data from the following sources:

Project, Location	Reference	Project, Location	Reference
Grand Ridge I, IL	Derby et al. 2010g	Top of Iowa, IA (03)	Jain 2005
Harrow, Ont (10)	Natural Resource Solutions 2011	Top of Iowa, IA (04)	Jain 2005
Harvest Wind, WA (10-12)	Downes and Gritski 2012a	Tuolumne (Windy Point I), WA	Enz and Bay 2010
Hay Canyon, OR	Gritski and Kronner 2010a	Vansycle, OR	Erickson et al. 2000
High Sheldon, NY (10)	Tidhar et al. 2012a	Vantage, WA	Ventus Environmental Solutions 2012
High Sheldon, NY (11)	Tidhar et al. 2012b	Wessington Springs, SD (09)	Brown et al. 2013
High Winds, CA (04)	Kerlinger et al. 2006	Wessington Springs, SD (10)	Derby et al. 2010f
High Winds, CA (05)	Kerlinger et al. 2006	White Creek, WA (07-11)	Downes and Gritski 2012b
Hopkins Ridge, WA (06)	Young et al. 2007	Wild Horse, WA	Erickson et al. 2008
Hopkins Ridge, WA (08)	Young et al. 2009c	Windy Flats, WA	Enz et al. 2011
Jersey Atlantic, NJ	NJAS 2008a, 2008b, 2009	Winnebago, IA	Derby et al. 2010e
Judith Gap, MT (06-07)	TRC 2008	Wolfe Island, Ont (May-June 09)	Stantec Ltd. 2010a
Judith Gap, MT (09)	Poulton and Erickson 2010	Wolfe Island, Ont (July-Dec 09)	Stantec Ltd. 2010b
Kewaunee County, WI	Howe et al. 2002	Wolfe Island, Ont (Jan-June 10)	Stantec Ltd. 2011a
Kibby, ME (11)	Stantec 2012a	Wolfe Island, Ont (July-Dec 10)	Stantec Ltd. 2011b
Kittitas Valley, WA (11-12)	Stantec Consulting 2012	Wolfe Island, Ont (Jan-June 11)	Stantec Ltd. 2011c
Klondike, OR	Johnson et al. 2003	Wolfe Island, Ont (July-Dec 11)	Stantec Ltd. 2012

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COVER MEMORANDUM

Date: June 10, 2020

To: Walleye Wind Project, LLC

From: Western EcoSystems Technology, Inc.

Subject: Walleye Wind Project – 2018 Bat Activity Survey Report Cover Memo

INTRODUCTION

Walleye Wind Project, LLC is developing the Walleye Wind Project (Project) in Rock County, Minnesota (Figure 1). The 2018 Bat Activity Survey Report attached to this memorandum was initially prepared for a study area that preceded the current Project. This report is provided due to the study area's proximity to and partial overlap with the current Project, as it provides information pertinent to Minnesota state agency review. The 2018 Bat Activity Survey study area and current Project are depicted in Figure 1, below.

Please also note that in the attached 2018 Bat Activity Survey Report, all references to "Project" and "Project area" refer to the area delineated by the 2018 Bat Activity Survey study area as shown on Figure 1.

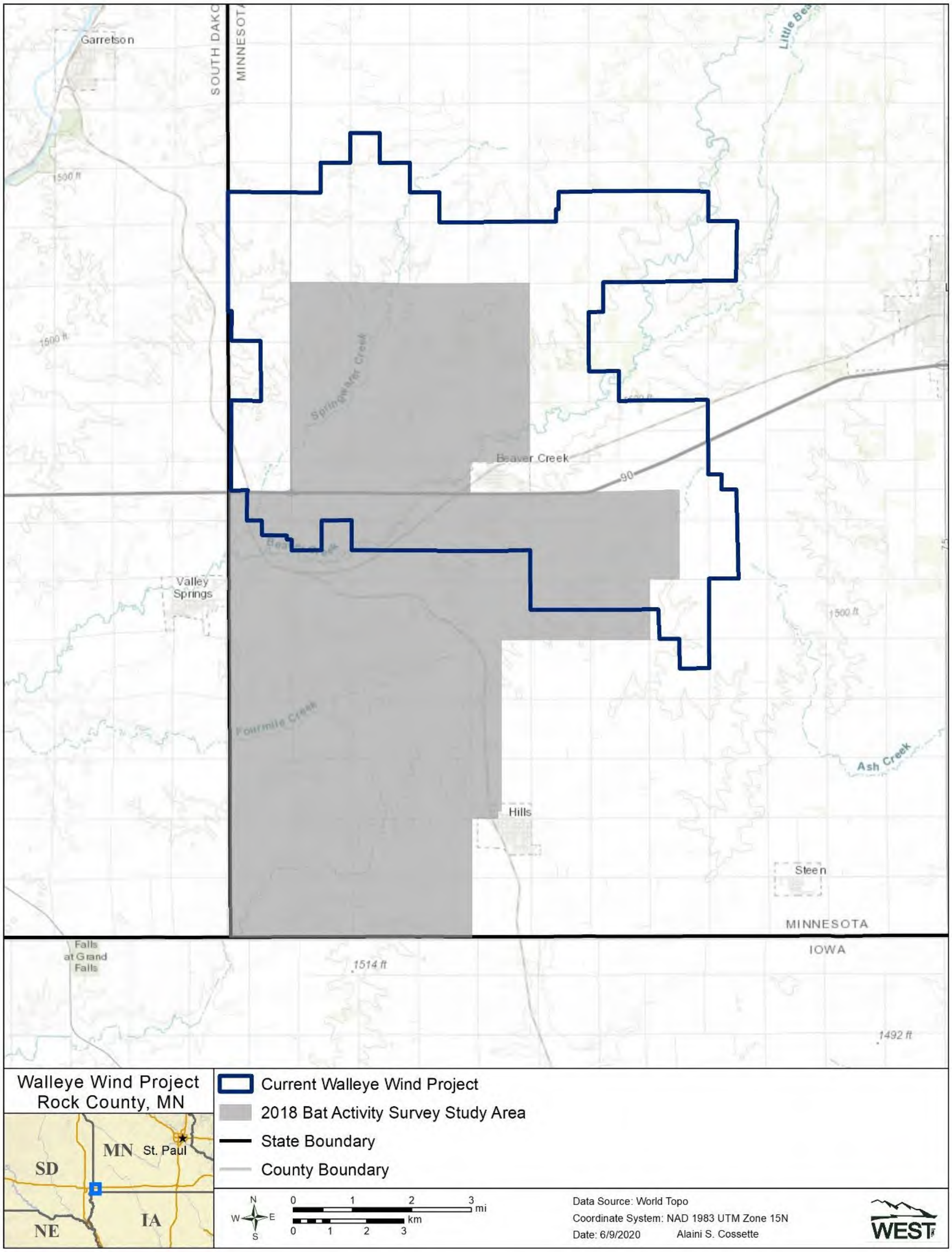

Figure 1. 2018 Bat Activity Survey study area in comparison to the current Walleye Wind Project, Rock County, Minnesota.

Bat Activity Surveys for the Walleye Wind Project Rock County, Minnesota

Final Report

June 28 – October 29, 2018

Prepared for:

Walleye Wind Project, LLC

330 2nd Avenue South, Suite 820
Minneapolis, Minnesota 55401

Prepared by:

Adam Kreger, Brenna Hyzy, Donald Solick

Western EcoSystems Technology, Inc.
7575 Golden Valley Road, Suite 300
Golden Valley, Minnesota 55427

March 2019

EXECUTIVE SUMMARY

In 2018, Western EcoSystems Technology, Inc. initiated a bat acoustic activity survey for the proposed Walleye Wind Project (Project) in Rock County, Minnesota. The bat acoustic survey was designed to estimate levels of bat activity throughout the Project area during the summer and fall.

Acoustic surveys were conducted from June 28 – October 29 at four monitoring stations within the Project area. Two AnaBat™ SD2 ultrasonic bat detectors were paired at one meteorological tower with one microphone placed near the ground at 5.0 feet (ft; 1.5 meters [m]) and the other placed within the rotor-swept zone at 148 ft (45 m). An additional detector was placed near the ground at another location. All three stations were located in cropland habitat, which is the dominant land cover type and, therefore, representative of future turbine placement (representative stations). A fourth detector was also designated as a 'bat feature' station and was located near the ground in forest edge habitat potentially attractive to bats.

All stations recorded a combined mean (± standard error) of 37.81 ± 3.53 bat passes per detector-night. Ground detectors in representative habitat recorded an average bat activity of 10.62 ± 0.90 bat passes per detector-night, and raised detectors recorded 13.91 ± 1.48 bat passes per detector-night. The bat feature station recorded 116.08 ± 14.21 bat passes per detector-night.

Bat activity at representative stations varied among the two seasons with lower activity in the fall and higher activity in summer. At these stations, activity by low-frequency (LF; e.g., big brown bats, hoary bats, and silver-haired bats) and high-frequency (HF; e.g., eastern red bats and *Myotis* species) bats peaked during the middle of July. At representative stations, 11.2% of bat passes were classified as HF, and 88.7% of bat passes were classified as LF.

Bat activity recorded at the Project area at ground representative stations during the Fall Migration Period (11.20 ± 1.18 bat passes per detector-night) was higher than activity recorded at other facilities in the Midwest. The closest operating wind energy facility to the Project with public post-construction fatality data is the Prairie Rose Wind Farm, located approximately 9.2 miles (14.8 kilometers) to the north of the Project. Both projects are located in landscapes dominated by corn and soybean fields, with little topography and few woodlots. There are no documented pre-construction bat activity estimates from ground-based detectors at the Prairie Rose Wind Project. Bat casualty rates at Prairie Rose have been estimated at 0.41 bats/megawatt/study period for the spring and fall, and it is expected that fatality rates would be similar at the Project due to the close proximity and similarities in landscape features. However, the precise level of fatalities expected for the Project site is difficult to predict given the broad range of fatality rates observed at other wind-energy facilities in the Midwest, and the lack of a direct link between pre-construction bat activity and post-construction fatality rates.

STUDY PARTICIPANTS

Western EcoSystems Technology

Adam Kreger	Project Manager
Todd Mattson	Senior Review
Brenna Hyzy	Bat Biologist, Bat Data Labeler, Data Analyst
Donald Solick	Bat Biologist
Casi Lathan	Bat Activity Project Coordinator
Carmen Boyd	Project Tracking and Data Manager
Julie Bushey	Statistician
Wes Conway	GIS Technician
Brenna Hyzy	Report Writer
Linda Koepsell	Technical Editor
Aaorn Suehring	Field Supervisor
Ben Chistiansen	Field Technician
Ron Moore	Field Technician

REPORT REFERENCE

Kreger, A., B. Hyzy, and D. Solick. 2019. Bat Activity Surveys for the Walleye Wind Project, Rock County, Minnesota. Final Report: June 28 – October 29, 2018. Prepared for Walleye Wind Project, LLC. Prepared by Western EcoSystems Technology, Inc. (WEST), Golden Valley, Minnesota. January 23, 2019.

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INTRODUCTION

Resource Environmental Solutions, Inc. (RES) is considering the development of the Walleye Project (Project) in Rock County, Minnesota (Figure 1). RES contracted Western EcoSystems Technology, Inc. (WEST) to complete a bat activity surveys following the recommendations of the US Fish and Wildlife Service (USFWS) *Land-based Wind Energy Guidelines* (USFWS 2012a) and Kunz et al. (2007b). The objective of these surveys was to conduct acoustic monitoring surveys to estimate levels of bat activity throughout the Project area during summer and fall. This report describes the results of the acoustic monitoring surveys conducted within the Project area between June 28 and October 29, 2018. This report also presents existing information and results of bat monitoring surveys conducted at other wind facilities. When possible, comparisons with regional and local surveys were made to help assess risk to bats at the Project.

SURVEY AREA

The proposed 34,515-acre (13,967-hectare) Project is located in the bottom southwestern corner of Rock County, Minnesota (Figure 1). The Project area has elevations ranging from 1,325 – 1,601 feet (ft; 404 – 488 meters [m]). The Project is located in the Western Corn Belt Plains Ecoregion, which contains glaciated till plains and undulating loess plains (US Environmental Protection Agency 2017). Historically, much of the region was dominated by tallgrass prairie, riparian forest, oak-prairie savannas, and woody and herbaceous wetlands, but most of the area has been cleared for agricultural purposes. According to the National Land Cover Database (NLCD; US Geological Survey [USGS] NLCD 2011, Homer et al. 2015), the majority of the Project area is cultivated cropland (84.2%; Table 1; Figure 2). Less prominent land cover types include developed open space (6.3%) and hay/pasture (6.3%). The remaining land cover types are less than 2% of the Project area and include herbaceous grassland, deciduous forest, emergent herbaceous wetland, and open water. Deciduous forest provides potential habitat for several bat species, including the federally and state-threatened northern long-eared bat (*Myotis septentrionalis*; USFWS 2013).

Table 1. Land cover types present within the Walleye Wind Project in Rock County, Minnesota.

	Project Area	
Cover Type	**Acres**	**Percent**
Cultivated Crops	29,056.35	84.2
Hay/Pasture	2,179.39	6.3
Developed	2,176.74	6.3
Herbaceous (Grassland)	675.61	2.0
Deciduous Forest	217.59	0.6
Emergent Herbaceous Wetlands	161.95	0.5
Open Water	23.80	0.1
Barren Land	20.47	0.1
Shrub/Scrub	3.34	< 0.1
Total*	**34,515,24**	**100**

Data Source: US Geological Survey National Land Cover Database 2011, Homer et al. 2015.

* Totals may not equal sum of values shown due to rounding.

Overview of Bat Diversity

Seven bat species potentially occur within the Project area (Table 2; International Union for Conservation of Nature 2017, USFWS 2017). The northern long-eared bat is federally listed as threatened (USFWS 2018). The tri-colored bat (*Perimyotis subflavus*) has been proposed for federal listing under the Endangered Species Act (Center for Biological Diversity and Defenders of Wildlife 2016). The USFWS announced on December 20, 2017, that listing may be warranted and initiated a 12-month status review.

Table 2. Bat species with potential to occur within the Walleye Wind Project, Rock County, Minnesota, categorized by echolocation call frequency.

Common Name	**Scientific Name**
High-Frequency (greater than or equal to 30)	
eastern red bat[1,2]	*Lasiurus borealis*
little brown bat[1]	*Myotis lucifugus*
northern long-eared bat[1,3]	*Myotis septentrionalis*
tri-colored bat[1]	*Perimyotis subflavus*
Low-Frequency (less than 30 kHz)	
big brown bat[1]	*Eptesicus fuscus*
silver-haired bat[1,2]	*Lasionycteris noctivagans*
hoary bat[1,2]	*Lasiurus cinereus*

[1] Species known to have been killed at wind energy facilities (American Wind Wildlife Institute 2018)

[2] Long-distance migrant

[3] Federally threatened species (US Fish and Wildlife Service 2018)

kHz = kilohertz

* Sources: (International Union for Conservation of Nature 2018, US Fish and Wildlife Service 2018)

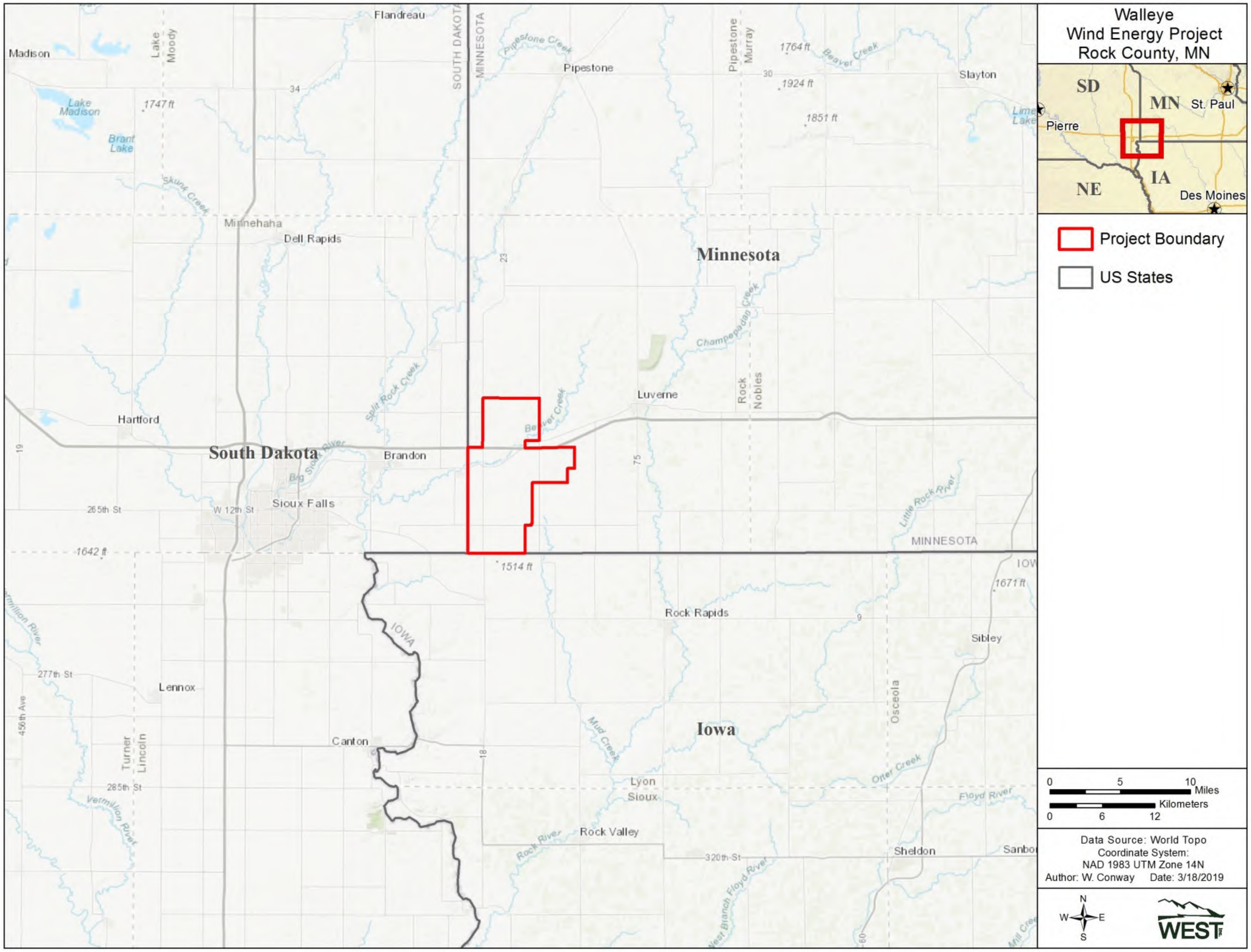

Figure 1. Location of the Walleye Wind Project, Rock County, Minnesota.

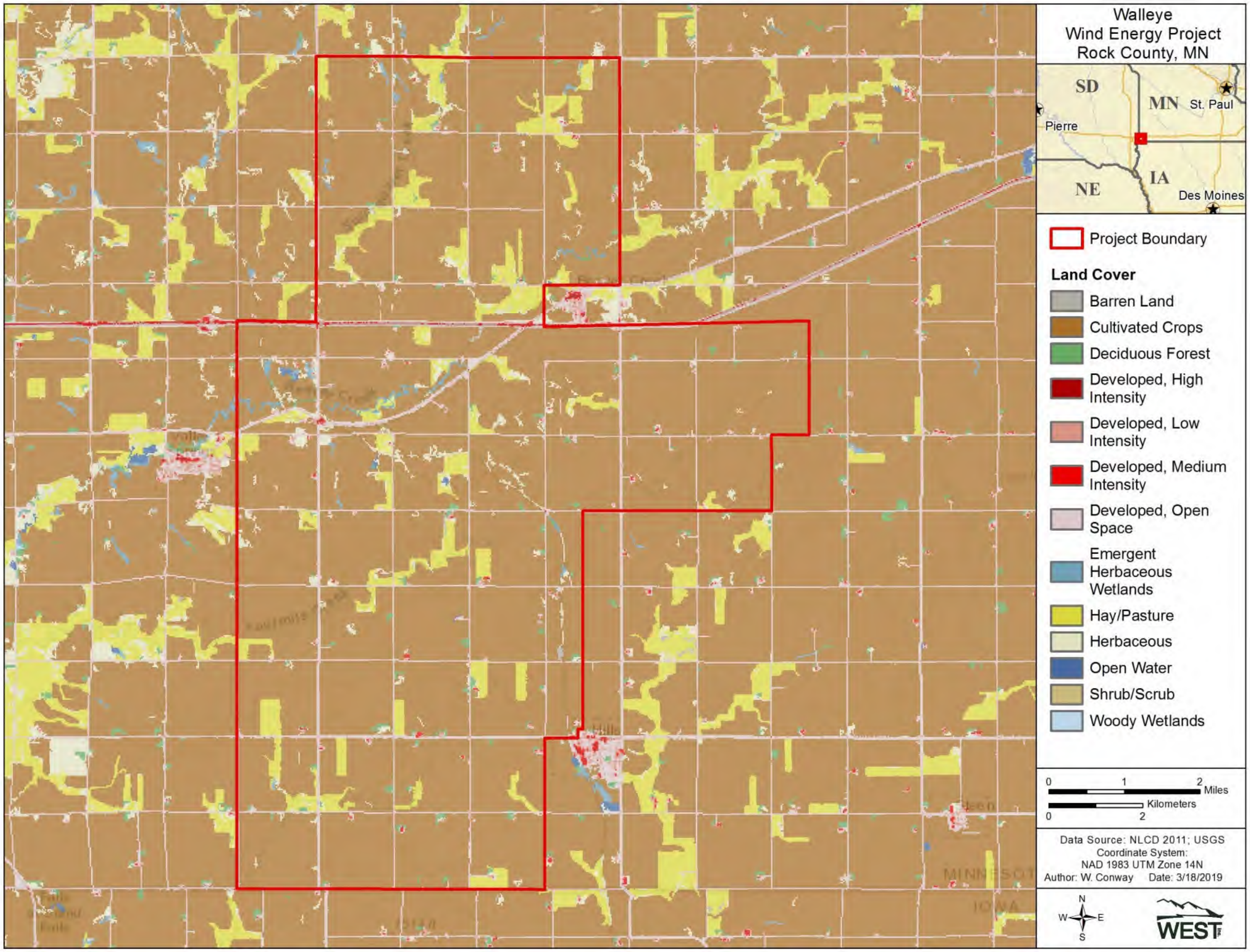

Figure 2. Land cover types and coverage within the Walleye Wind Project, Rock County, Minnesota (US Geological Survey National Land Cover Database 2011, Homer et al. 2015]).

White-Nose Syndrome

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 (USGS 2010, Minnis and Lindner 2013). Infected bats arouse from hibernation more frequently than normal, 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 suggest that by 2012 between 5.7 and 6.7 million bats died as a result of WNS (USFWS 2012b). WNS is the primary reason the USFWS recently listed the northern-long-eared bat as threatened under the Endangered Species Act (USFWS 2015). WNS was first discovered in New York State in 2006 and to date the disease has spread to 33 states and seven Canadian provinces, reaching as far south as Alabama, as far north as Newfoundland, and as far west as Washington (Heffernan 2016). Recently, the causative fungus was identified in an additional three states: Wyoming, Kansas, and South Dakota. In Minnesota, the causative fungus was discovered in 2013 at Mystery Cave State Park, approximately 217 miles (mi; 349 kilometers [km]) west of the Project in Fillmore County, and in the Soudan Underground Mine in northeastern Minnesota's St. Louis County, approximately 440 mi (708 km) north of the Project. In 2018, WNS was confirmed in an additional two counties in Minnesota: Wabasha County and Winona County (White-Nose Syndrome.org 2018). The nearest county in Minnesota to confirm WNS is Hennepin County, 167 mi (269 km) to the northeast of the Project (White-Nose Syndrome.org 2018).

METHODS

Bat Activity Surveys

The bat activity acoustic surveys were conducted to estimate the level of bat activity throughout the Project area during June 28 – October 29, 2018.

Survey Stations

Four AnaBat™ SD2 ultrasonic bat detectors (Titley™ Scientific, Columbia, Missouri) were used during the surveys. One AnaBat™ detector was placed at ground level ('ground station'; approximately 5.0 feet [ft; 1.5 meters (m)] above ground level [AGL]) in cropland habitat that was representative of future turbine placement ('representative station'; station WE1g; Figure 3). A second detector was placed along forest edge habitat attractive to bats for foraging and commuting ('bat feature station' WE2g; Figure 3). An experienced bat biologist selected the location of the bat feature station. Monitoring at the bat feature station provides an upper threshold for bat activity in the Project area for comparison with representative stations.

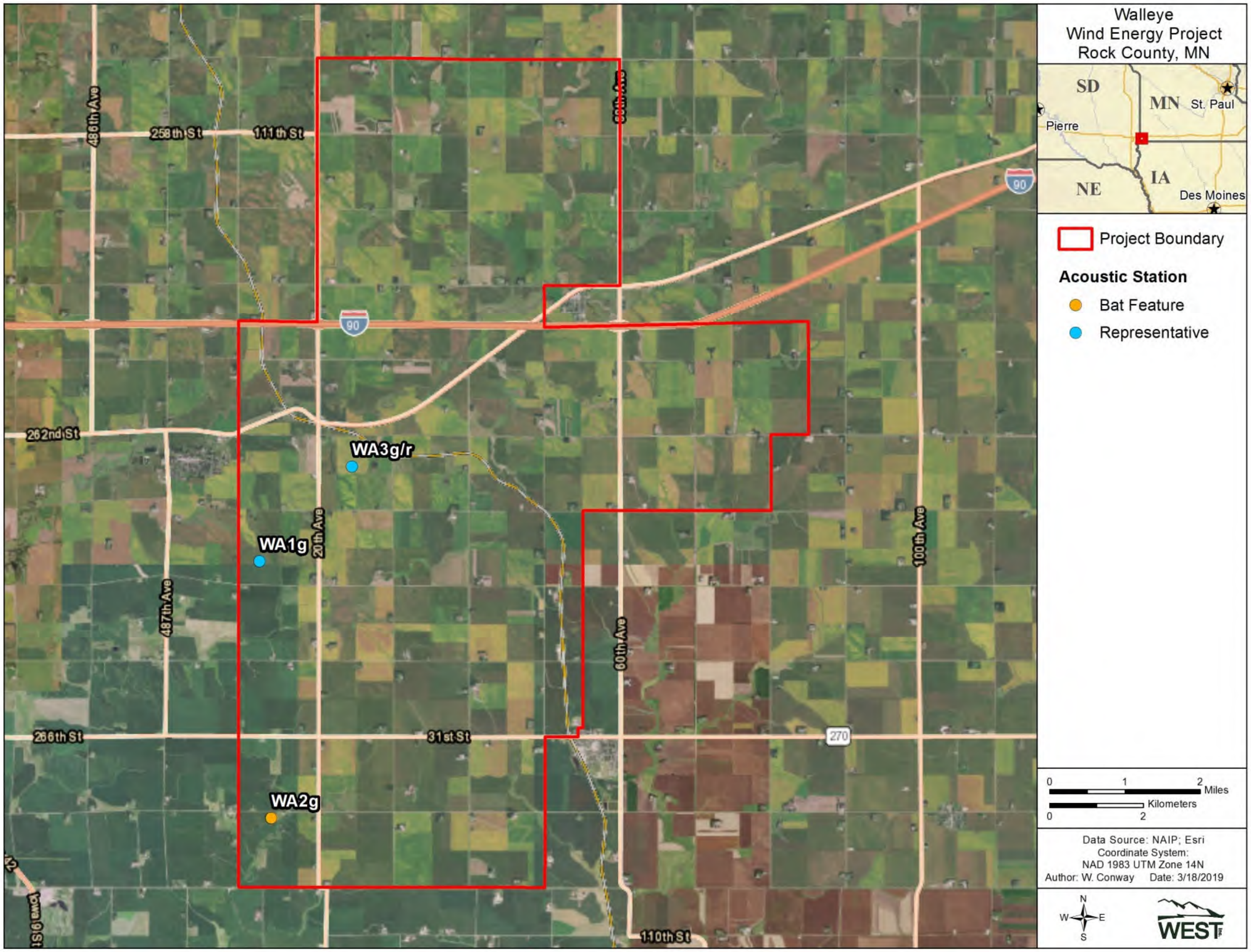

Figure 3. Location of bat stations within the Walleye Wind Project, Rock County, Minnesota.

Two AnaBat™ detectors were placed at a meteorological (met) tower in a representative station, with one microphone at ground level and another within the rotor-swept zone ('raised station'; approximately 148 ft [45 m] AGL; station WE3; Figure 3). Due to a delay in erecting the met tower, the paired detectors (WA3g and WA3t) did not become operational until July 21, 2018. Microphones at ground stations likely detect a more complete sample of the bat species present within the Project area, whereas microphones at raised stations may give a more accurate assessment of risk to bat species flying at rotor-swept heights (Kunz et al. 2007b, Collins and Jones 2009, Müeller et al. 2013, Roemer et al. 2017).

Each AnaBat™ detector was enclosed within a plastic weather-tight container with a hole cut in the side through which the microphone extended. Each microphone was encased in a 45-degree angle polyvinyl chloride (PVC) tube and holes were drilled in the PVC tube to allow water to drain. The container was placed on a PVC pole approximately 5.0 ft AGL and secured to the ground with guy lines and tent stakes. The raised microphone was elevated to approximately 148 ft (45 m) on the met tower using a pulley system. Standard bat-hat weatherproof housing was modified to use a 45-degree angle PVC elbow and an audio cable connected the microphone to the AnaB AnaBat™ at inside the container at the base of the met tower.

Survey Schedule

Bat activity surveys were conducted from June 28 – October 29, 2018, and detectors were programmed to turn on 30 minutes (min) before sunset and turn off 30 min after sunrise each night. To highlight seasonal activity patterns, the surveys were divided into two survey periods: summer (June 28 – August 14) and fall (August 15 – October 29). Mean bat activity was also calculated for a standardized Fall Migration Period (FMP), defined here as July 30 – October 14. WEST defined the FMP as a standard for comparison with activity from other wind projects. During this time, bats begin moving toward wintering areas, and many species of bats initiate reproductive behaviors (Cryan 2008). This period of increased landscape-scale movement and reproductive behavior is often associated with increased levels of bat fatalities at operational wind energy facilities (Arnett et al. 2008, Cryan 2008, Arnett and Baerwald 2013, Barclay et al. 2017).

Data Collection and Call Analysis

AnaBat™ detectors use a broadband high-frequency microphone to detect the echolocation calls of bats. To standardize acoustic sampling effort across the Project, AnaBat™ detectors were calibrated and sensitivity levels were set to six (Larson and Hayes 2000), a level that balanced the goal of recording bat calls against the need to reduce interference from other sources of ultrasonic noise (Brooks and Ford 2005). Incoming echolocation calls are digitally processed and stored on a high capacity compact flash card. The resulting files can be viewed in appropriate software (e.g., Analook™) as digital sonograms that show changes in echolocation call frequency over time. Frequency versus time displays were used to separate bat calls from other types of ultrasonic noise (e.g., wind, insects, etc.) and to determine the call frequency category of the bat that generated the calls.

For each survey location, bat passes were sorted into two groups based on their minimum call frequency. A bat pass was defined as a sequence of at least two echolocation calls (pulses) produced by an individual bat with no pause between calls of more than one second (Fenton 1980, Gannon et al. 2003). High-frequency (HF) bats such as eastern red bats (*Lasiurus borealis*) and *Myotis* species have minimum frequencies greater than 30 kiloHertz (kHz). Low-frequency (LF) bats such as big brown bats (*Eptesicus fuscus*), silver-haired bats (*Lasionycteris noctivagans*), and hoary bats (*Lasiurus cinereus)* typically emit echolocation calls with minimum frequencies equal to or below 30 kHz. HF and LF species that may occur in the Project area are listed in Table 2.

Statistical Analysis

The standard metric used for measuring bat activity is the number of bat passes per detector-night; this metric was used as an index of bat activity in the Project area. A detector-night was defined as one detector operating for one entire night. Bat passes per detector-night were calculated for all bats, HF bats, and LF bats. Bat pass rates represent indices of bat activity and do not represent numbers of individuals. An experienced bat biologist determined the number of bat passes using Analook™. Additionally, the calculation of bat passes per detector-night was based on the first and last call sequence positively identified during the study period. This removed the inclusion of operational days where no bat calls were recorded from the analysis.

The period of peak sustained bat activity was defined as the seven-day period with the highest average bat activity. If multiple seven-day periods equaled the peak sustained bat activity rate, all dates in these seven-day periods were reported. This and all multi-detector averages in this report were calculated as an unweighted average of total activity at each detector. Data from the bat feature station was excluded from temporal analysis because seasonal changes in activity at bat feature stations likely reflects changes in insect abundance or roosting behavior, whereas activity at representative stations reflects bats commuting through the Project area.

Risk Assessment

To assess potential for bat fatalities, bat activity in the Project area was compared to existing data at other wind energy facilities in the Midwest. Among studies measuring both activity and fatality rates, most data were collected during the fall using AnaBat™ detectors placed near the ground in habitat representative of turbine placement. Therefore, to make valid comparisons to the publically available data, this report uses the activity rate recorded at fixed, ground detectors for stations in habitat representative of turbine placement during the FMP as a standard for comparison with activity data from other wind energy facilities. Given the relatively small number of publically available studies and the significant ecological differences between geographically dispersed facilities, the risk assessment is qualitative, rather than quantitative.

RESULTS

Bat Activity Surveys

Bat activity was monitored at four stations for a total of 440 detector-nights between June 28 and October 29, 2018. Detectors and microphones were operating for 97.7% of the sampling period for all stations (Figure 4).

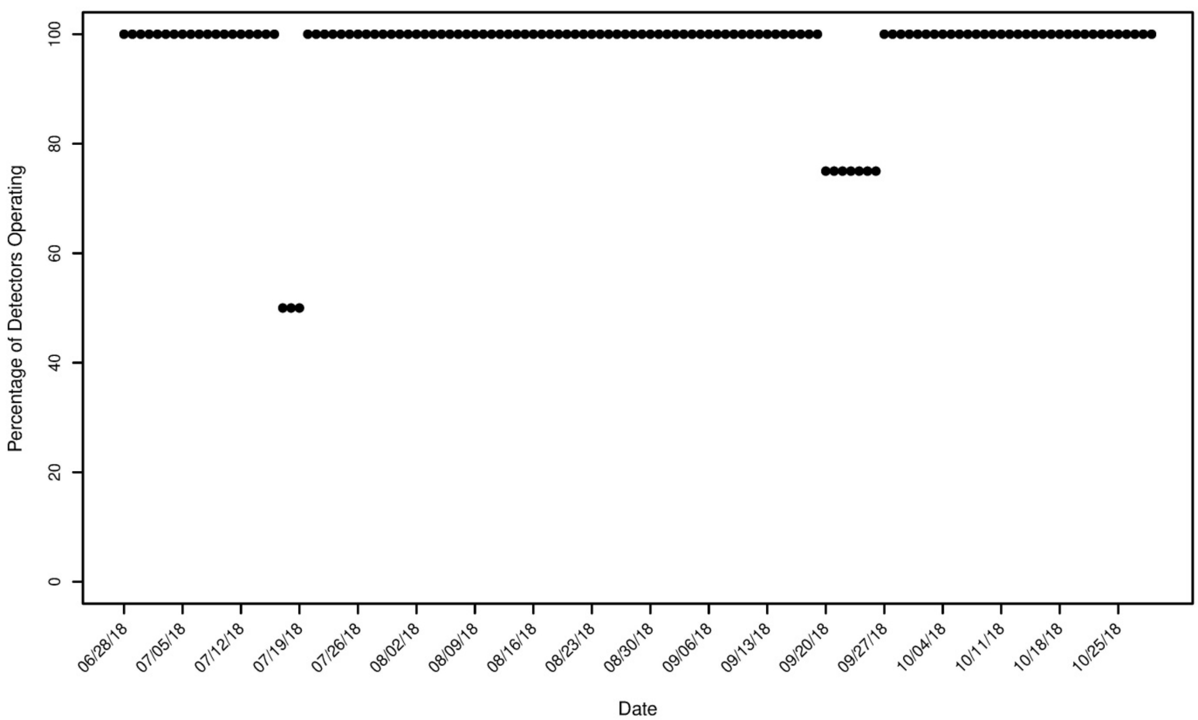

Figure 4. Operational status of all bat detectors and microphones (n=4) operating at the Walleye Wind Project, Rock County, Minnesota, during each night of the survey period June 28 – October 29, 2018.

Spatial Variation

Bat activity within the Project area varied among representative stations (Figure 5). Activity was consistently higher at the raised station (13.91 ± 1.55 bat passes per detector-night), compared to activity at ground stations (10.62 ± 0.90; Table 3). However, at the met tower paired station, activity was higher at the ground microphone (17.13 ± 1.80 bat passes per detector-night) than at the raised microphone (13.91 ± 1.55; Figure 6; Table 3). Among ground stations, station WA3g recorded the most bat passes per detector-night (17.13 ± 1.80), while station WA1g recorded the fewest (4.11 ± 0.46). Activity at the bat feature station was over ten times greater (116.08 ± 13.74 bat passes per detector-night) than activity at representative stations (11.72 ± 1.13; Table 3).

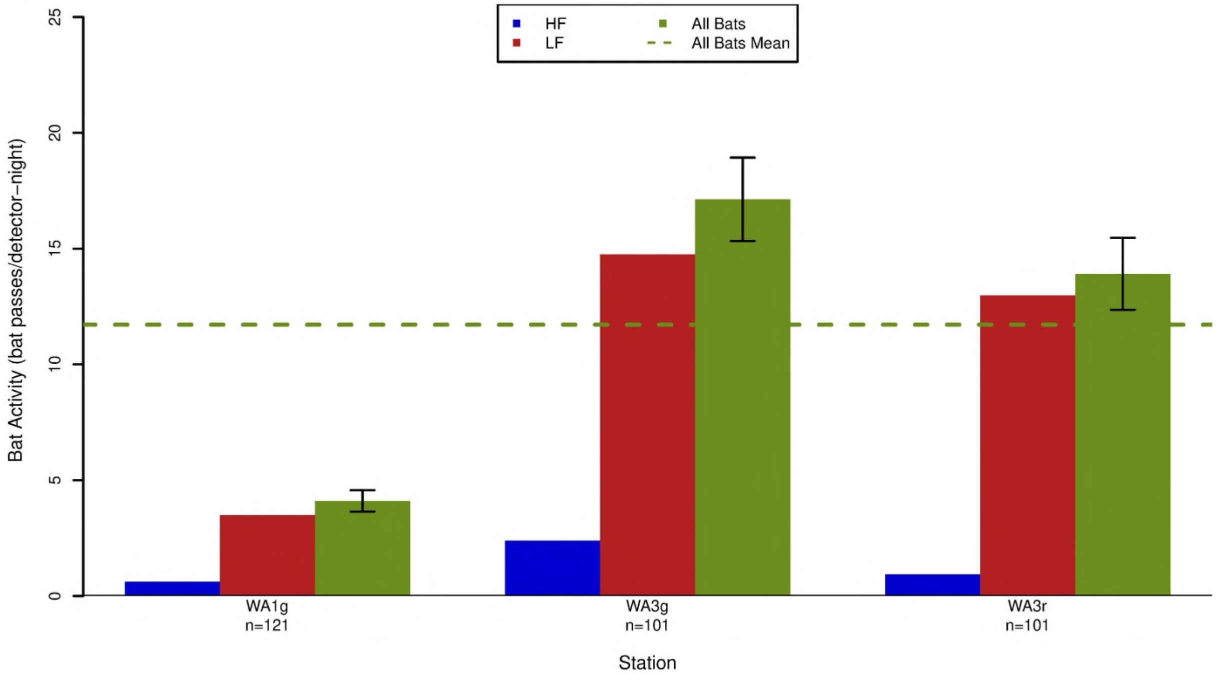

Figure 5. Number of high-frequency (HF) and low-frequency (LF) bat passes per detector-night recorded at stations within the Walleye Wind Project, Rock County, Minnesota, from June 28 – October 29, 2018. The bootstrapped standard errors are represented by the black error bars on the 'All Bats' columns.

Table 3. Results of bat activity surveys conducted at stations within the Walleye Wind Project, Rock County, Minnesota, from June 28 – October 29, 2018. Passes are separated by call frequency: high frequency and low frequency.

Station	Location	Type	Number of HF Bat Passes	Number of LF Bat Passes	Total Bat Passes	Detector-Nights	Bat Passes/Night[1]
WA1g	Ground	Representative	74	423	497	121	4.11 ± 0.47
WA2g	Ground	Bat Feature	5,435	8,146	13,581	117	116.08 ± 14.18
WA3g	Ground	Representative	241	1,489	1,730	101	17.13 ± 1.63
WA3r	Raised	Representative	94	1,311	1,405	101	13.91 ± 1.62
Total Representative Ground			315	1,912	2,227	222	10.62 ± 0.90
Total Representative Raised			94	1,311	1,405	101	13.91 ± 1.48
Total Representative			409	3,223	3,632	323	11.72 ± 1.13
Total Bat Feature			5,435	8,146	13,581	117	116.08 ± 14.21
Total			5,844	11,369	17,213	440	37.81 ± 3.53

[1]± bootstrapped standard error.

HF = high frequency; LF = low frequency

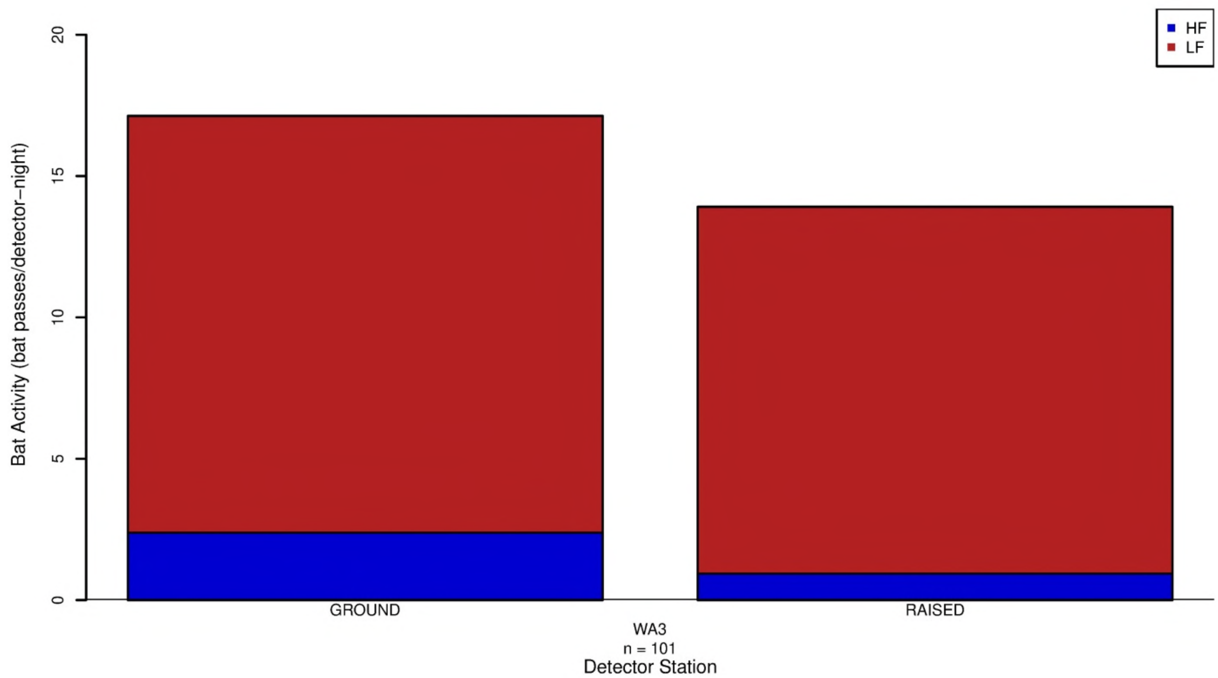

Figure 6. Number of high-frequency (HF) and low-frequency (LF) bat passes per detector-night recorded at paired stations within the Walleye Wind Project area, Rock County, Minnesota, from June 28 – October 29, 2018.

Temporal Variation

Bat activity at representative stations was relatively low in the fall and higher in summer (Table 4; Figure 7). Bat activity at ground representative stations was 11.20 during the FMP (Table 4). Weekly acoustic activity at representative stations was relatively low from June through early July (Figure 8), but increased sharply in mid-July and August, peaking from July 15 to July21 (33.0 bat passes per detector-night; Table 5; Figure 8). Overall bat activity gradually decreased for the remainder of the survey period (Figure 8). At paired stations, weekly activity was higher at ground microphones throughout most of the study period during nights that ground and raised microphones were both operating (Figure 9).

Table 4. The number of bat passes per detector-night recorded at representative stations within the Walleye Wind Project area, Rock County, Minnesota, during each season, separated by call frequency: low-frequency, high-frequency, and all bats.

Station	Call Frequency	Summer Jun 28 – Aug 14	Fall Aug 15 – Nov 5	Fall Migration Period Jul 30 – Oct 14
WA1g	LF	4.73	2.76	3.16
	HF	0.76	0.53	0.68
	AB	5.49	3.29	3.83
WA3g	LF	30.2	9.66	15.94
	HF	5.72	1.29	2.64
	AB	35.92	10.95	18.57
WA3r	LF	25.44	8.88	14.25
	HF	2.28	0.49	1.04
	AB	27.72	9.37	15.29
Ground Totals	**LF**	17.47 ± 1.73	6.21 ± 0.82	9.55 ± 1.03
	HF	3.24 ± 0.42	0.91 ± 0.15	1.66 ± 0.21
	AB	20.70 ± 2.04	7.12 ± 0.91	11.20 ± 1.18
Raised Totals	**LF**	25.44 ± 2.56	8.88 ± 1.56	14.25 ± 1.74
	HF	2.28 ± 0.54	0.49 ± 0.10	1.04 ± 0.22
	AB	27.72 ± 2.51	9.37 ± 1.62	15.29 ± 1.82
Overall	**LF**	20.12 ± 1.58	7.10 ± 1.09	11.11 ± 1.20
	HF	2.92 ± 0.41	0.77 ± 0.13	1.45 ± 0.18
	AB	23.04 ± 1.81	7.87 ± 1.18	12.56 ± 1.32

AB = all bats; HF = high frequency; LF = low frequency

Table 5. Periods of peak activity for high-frequency, low-frequency, and all bats at the Walleye Wind Project, Rock County, Minnesota from June 28 – October 29, 2018.

Species Group	Start Date of Peak Activity	End Date of Peak Activity	Bat Passes per Detector-Night
High Frequency	7/30/18	8/5/18	4.0
Low Frequency	7/15/18	7/21/18	30.4
All Bats	7/15/18	7/21/18	33.0

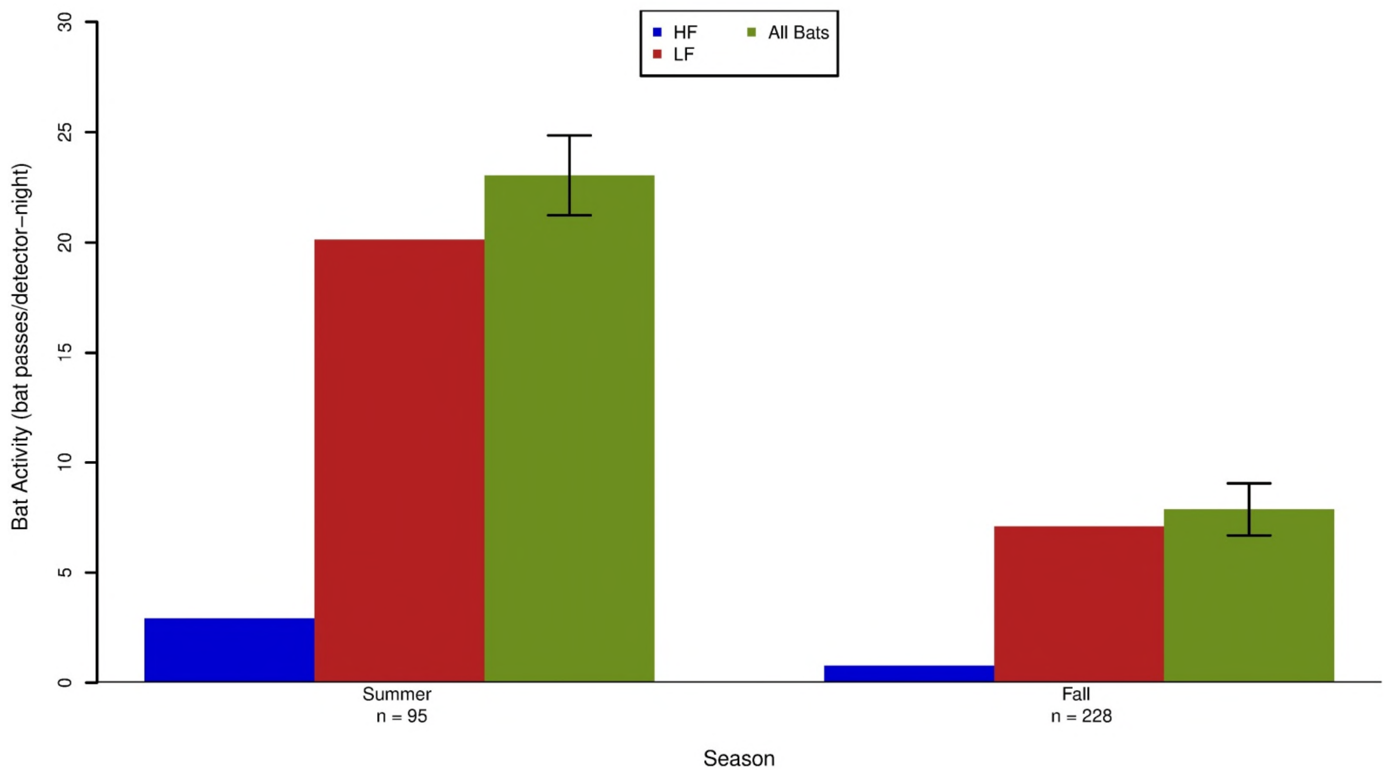

Figure 7. Seasonal bat activity by high-frequency (HF), low-frequency (LF), and all bats at the Walleye Wind Project, Rock County, Minnesota, from June 28 – October 29, 2018. The bootstrapped standard errors are represented on the 'All Bats' columns.

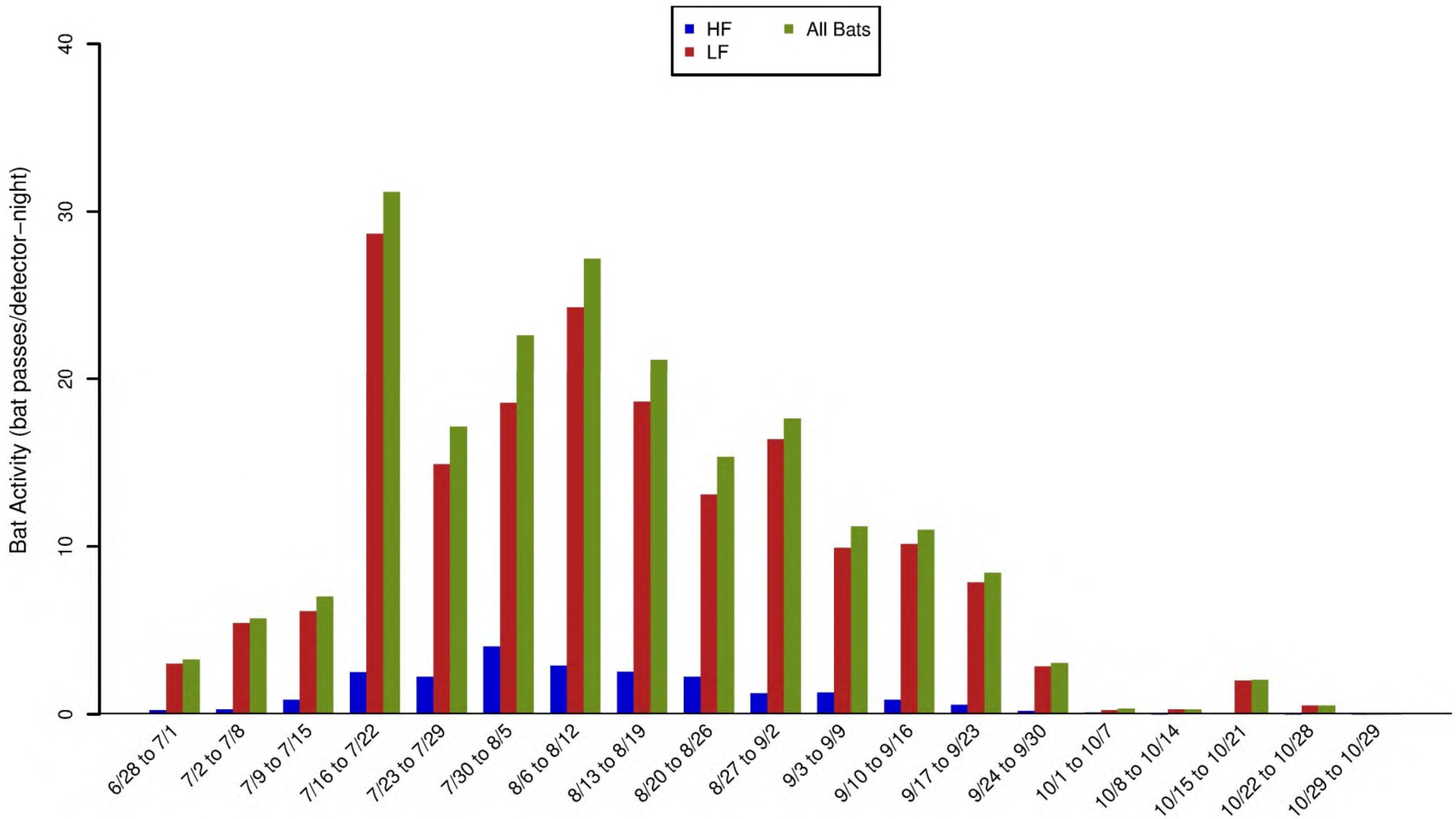

Figure 8. Weekly patterns of bat activity by high-frequency (HF), low-frequency (LF), and all bats at the Walleye Wind Project, Rock County, Minnesota, from June 28 – October 29, 2018.

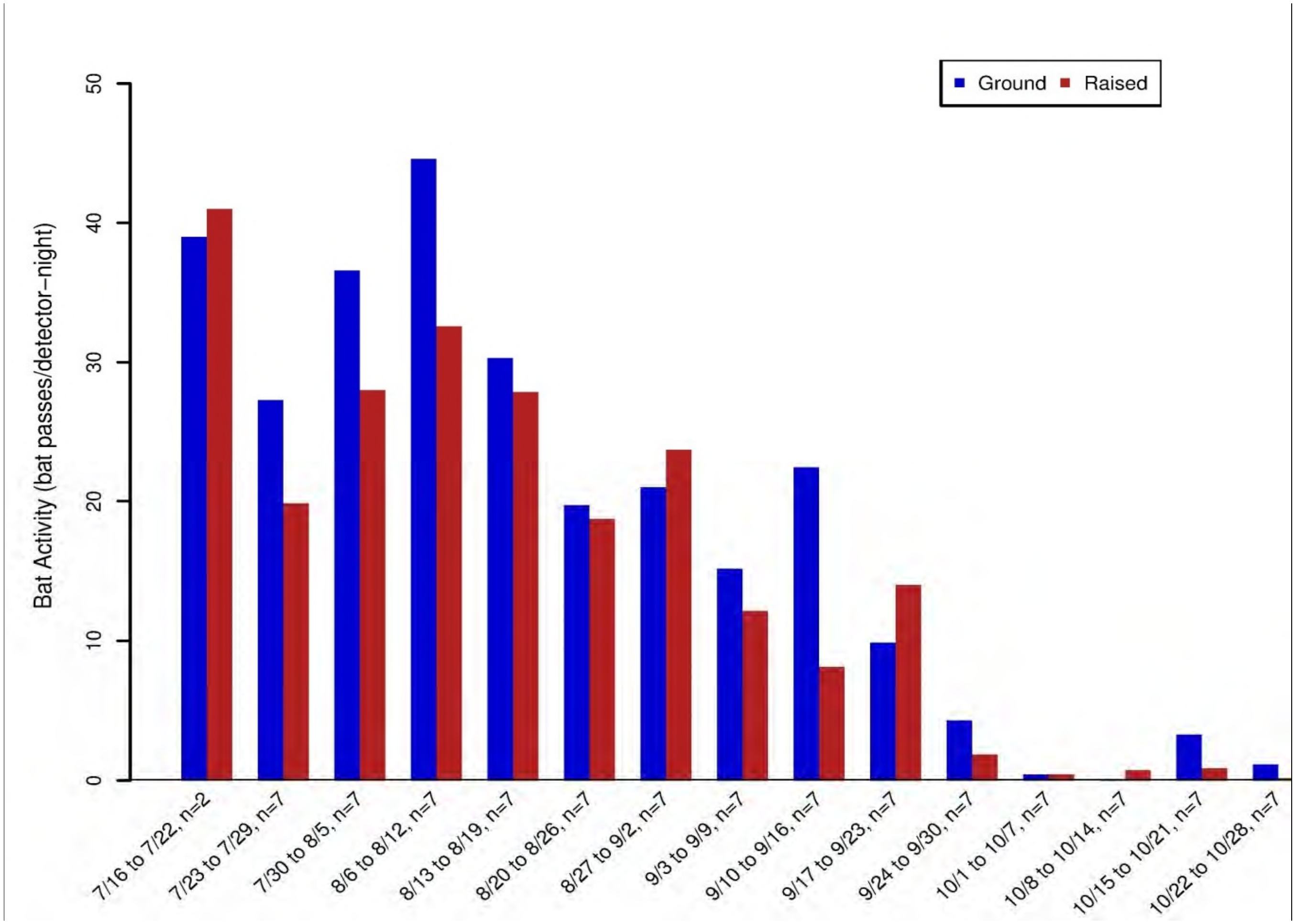

Figure 9. Weekly patterns of bat activity from July 16 – October 29, 2018 at ground and raised meteorological tower stations at the Walleye Wind Project, Rock County, Minnesota.

* Paired Met tower detectors became operational on July 21

Call Frequency Composition

Of the total bat passes recorded at all stations, 34.0% of bat passes were classified as HF(e.g., tri-colored bats, eastern red bats, and *Myotis* species), and 60.7% were classified as LF(e.g., big brown bats, hoary bats, and silver-haired bats; Tables 2 and 3; Figure 10). LF bats were most commonly recorded at representative ground stations (85.9%; Table 3), and were also the most commonly recorded species at raised stations (93.3%; Table 3). At bat feature stations, the majority of recorded calls were produced by LF bats (60.0%; Table 3).

DISCUSSION

Bat fatalities have been discovered at most wind energy facilities monitored in North America, with fatality estimates ranging from zero to 49.70 bat fatalities/megawatt (MW)/year (American Wind Wildlife Institute [AWWI] 2018). A summary of 202 studies at 137 wind energy facilities in the US found that the majority reported fewer than five bat fatalities/MW/year, with a nationwide median of 2.66 bat fatalities/MW/year (AWWI 2018). In 2012, an estimated 600,000 bats died as a result of interactions with wind turbines in the US (Hayes 2013). Wind development may pose a threat to populations of migratory bats in particular. Projection models estimate that populations of hoary bats could decline as much as 90% in the next 50 years (Frick et al. 2017). Proximate causes of bat fatalities are primarily due to collisions with moving turbine blades (Grodsky et al. 2011, Rollins et al. 2012), but also, to a limited extent, by barotrauma (Baerwald et al. 2008e). The underlying reason(s) why bats come near turbines is still largely unknown (Cryan and Barclay 2009, Barclay et al. 2017).

To date, post-construction monitoring studies of wind energy facilities in the US show the following: a) migratory tree-roosting species (e.g., eastern red bat, hoary bat, and silver-haired bat) compose approximately 72% of reported bat fatalities; b) the majority of fatalities occur during the fall migration season (August and September); and c) most fatalities occur on nights with relatively low wind speeds (e.g., less than 20 ft/second [6.0 m/second]; Arnett et al. 2008, Arnett and Baerwald 2013, Arnett et al. 2013, AWWI 2018, Thompson et al. 2017).

Few studies of wind energy facilities are available that have recorded both bat activity and bat fatality rates (Appendix A). Hein et al. (2013a) compiled data from 12 wind projects that measured bat activity and fatality rates and found a non-significant ($p = 0.07$), positive correlation where low activity was generally associated with low fatalities and vice-versa. Researchers concluded pre-construction acoustic data could not currently predict bat fatalities, but acknowledged that the data set was limited and additional data may indicate a stronger relationship. Complicating matters, recent evidence suggests the main species killed at wind turbines, hoary bats, often fly without echolocation (Corcoran and Weller 2018) and are therefore not recorded on ultrasonic detectors. However, Baerwald and Barclay (2009) found a significant positive association between pass rates measured at 98 ft (30 m) and fatality rates for hoary and silver-haired bats across five sites in southern Alberta. Yet, on a continental scale, a similar relationship has proven difficult to establish.

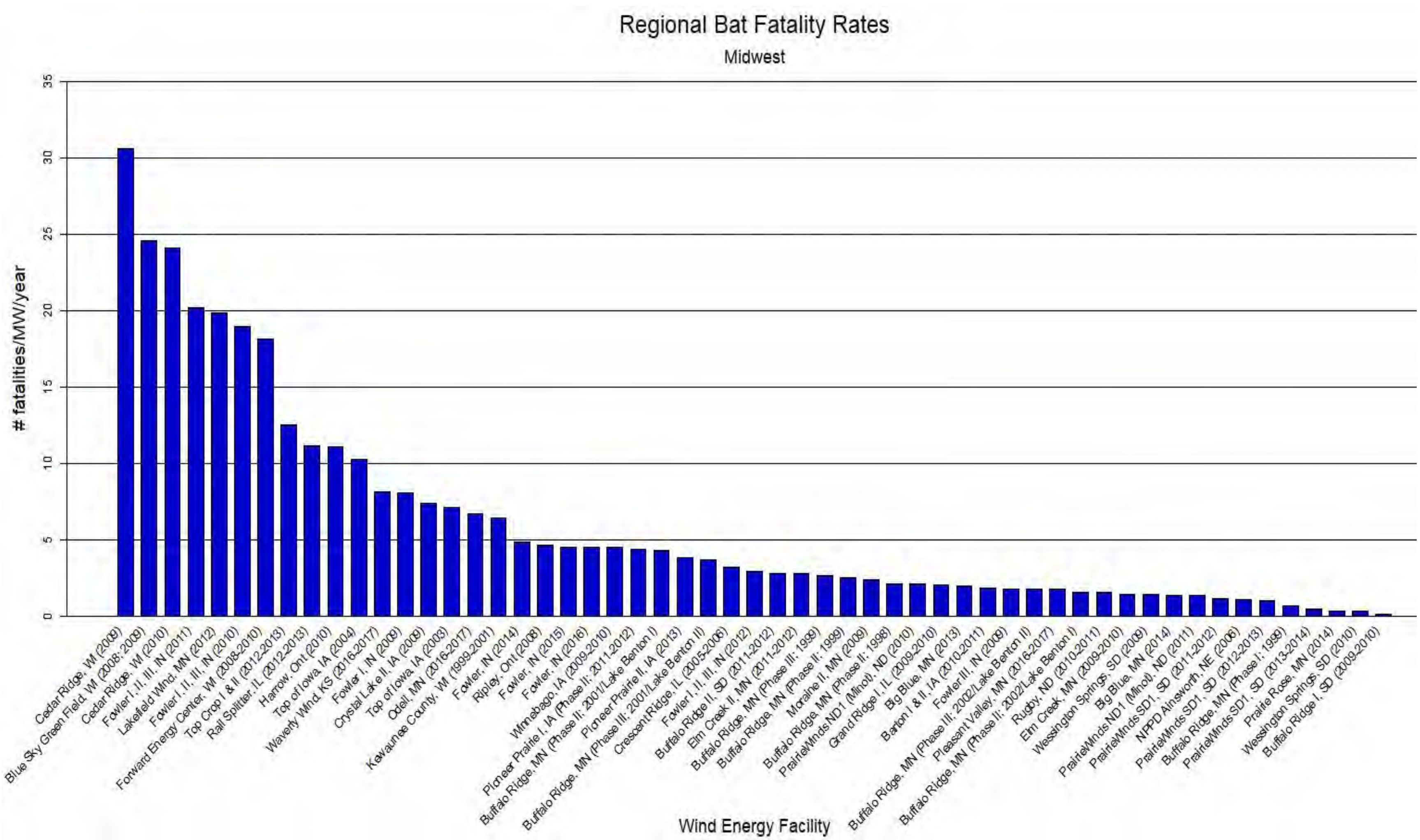

Figure 10. Fatality rates for bats (number of bats per megawatts per year) from publically available wind energy facilities in the Midwest region of North America (references provided in Appendix A).

A review of 40 US studies found that bat mortality might be inversely related to the percent grassland cover surrounding wind facilities (Thompson et al. 2017). That is, the more open the landscape, the less risk of turbine collisions by bats. However, exceptions to this pattern exist (e.g., Jain 2005, Arnett and Baerwald 2013) and it may not be applicable to all regions (Thompson et al. 2017). Bat activity in the rotor-swept zone is representative of bat exposure to turbines (Baerwald and Barclay 2009, Collins and Jones 2009, Roemer et al. 2017), but it is unclear how bat activity at raised stations might relate to bat fatality, or even if such a relationship exists.

Mean bat activity during the FMP at representative ground detectors (11.20 bat passes per detector-night; Table 4) was higher than the national median bat activity (7.68 bat passes per detector-night) and the activity for the majority of studies available from the Midwest (Appendix A).

Bat activity at representative stations varied among the two seasons with lower activity in the fall and higher activity in summer. At these stations, activity by LF (e.g., big brown bats, hoary bats, and silver-haired bats) and HF (e.g., eastern red bats and *Myotis* species) bats peaked during the middle of July. This timing is consistent with peak fatality periods for most wind energy facilities in the US (AWWI 2018), and suggests that bat fatalities at the Project will be highest during late summer.

At all stations, 34.0% of bat passes were classified as HF bats. Eastern red bats are usually the most common HF species found during carcass searches (Arnett et al. 2008, Arnett and Baerwald 2013, AWWI 2018). *Myotis* species are recorded less commonly than other species in the rotor-swept zone or as fatalities at most post-construction studies of wind energy facilities (Kunz et al. 2007a, Arnett et al. 2008, AWWI 2018), with a few notable exceptions (Kerns and Kerlinger 2004b, Jain 2005, Brown and Hamilton 2006, Gruver et al. 2009a).

Approximately 66.0% of bat passes were classified as LF at the Project. LF species may become casualties because they fly at higher altitudes, as demonstrated by their greater prevalence at raised detectors (Table 3; Figure 6). Given that hoary bats and silver-haired bats are among the most common bat fatalities at many facilities (Arnett et al. 2008, Arnett and Baerwald 2013, AWWI 2018), it is expected that these species would be the most common fatalities at the Project.

Over two-thirds of bat fatality studies in the Midwest report fewer than five bat fatalities/MW/year (Appendix A; Figure 10) and it is possible that similar fatality rates could be recorded at the Project, even though the pre-construction activity rate during the FMP is higher than average. The closest operating wind-energy facility to the Project with public post-construction fatality data is the Prairie Rose Wind Farm, located approximately 9.2 mi (14.8 km) to the north of the Project. Both projects are located in landscapes dominated by corn and soybean fields, with little topography and few woodlots. There are no documented pre-construction bat activity estimates from ground-based detectors at the Prairie Rose Wind Project. However, bat casualty rates at the Prairie Rose Wind Farm have been estimated at 0.41 bat/MW/study period for the spring and fall, and it is expected that fatality rates would be similar at the Project, due to the close proximity and similarities in landscape features. However, the precise level of fatalities expected for the Project site is difficult to predict given the broad range of fatality rates observed at other wind-energy facilities in the Midwest, and the lack of a direct link between pre-construction bat activity and post-construction fatality rates.

In summary, while bat activity rates at the Project area are higher than other wind projects in the Midwest, the lack of relationship between pre-construction activity rates and post-construction fatality rates, coupled with the low fatality rates documented at the Prairie Rose Wind Farm 9.2 miles away, leads to the conclusion that bat fatality rates are expected to be similar to other projects in the region. Data suggest that most bat fatalities will occur during the summer and will primarily consist of LF bat species based on the timing of bat activity and the call frequency composition. The pre-construction bat studies completed at the Project area will add to the growing body of research regarding the impacts of wind energy development on bats.

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Appendix A: North American Fatality Summary Tables

Appendix A1. Wind energy facilities in North America with comparable activity and fatality data for bats, separated by geographic region. Bat activity presented as number of bat passes per detector night. Fatality estimate given as number of fatalities per megawatt (MW) per year.

Wind Energy Facility	Bat Activity Estimate[A]	Bat Activity Dates	Fatality Estimate[B]	No. of Turbines	Total MW
Walleye, Minnesota	**11.20**	**7/31/18 – 10/14/18**			
Midwest					
Barton I & II, IA (2010-2011)	NA	NA	1.85	80	160
Big Blue, MN (2013)	NA	NA	2.04	18	36
Big Blue, MN (2014)	NA	NA	1.43	18	36
Blue Sky Green Field, WI (2008; 2009)	7.7	7/24/07-10/29/07	24.57	88	145
Buffalo Ridge I, SD (2009-2010)	NA	NA	0.16	24	50.4
Buffalo Ridge II, SD (2011-2012)	NA	NA	2.81	105	210
Buffalo Ridge, MN (Phase I; 1999)	NA	NA	0.74	73	25
Buffalo Ridge, MN (Phase II; 1998)	NA	NA	2.16	143	107.25
Buffalo Ridge, MN (Phase II; 1999)	NA	NA	2.59	143	107.25
Buffalo Ridge, MN (Phase II; 2001/Lake Benton I)	2.2	6/15/01-9/15/01	4.35	143	107.25
Buffalo Ridge, MN (Phase II; 2002/Lake Benton I)	1.9	6/15/02-9/15/02	1.64	143	107.25
Buffalo Ridge, MN (Phase III; 1999)	NA	NA	2.72	138	103.5
Buffalo Ridge, MN (Phase III; 2001/Lake Benton II)	2.2	6/15/01-9/15/01	3.71	138	103.5
Buffalo Ridge, MN (Phase III; 2002/Lake Benton II)	1.9	6/15/02-9/15/02	1.81	138	103.5
Cedar Ridge, WI (2009)	9.97	7/16/07-9/30/07	30.61	41	67.6
Cedar Ridge, WI (2010)	9.97	7/16/07-9/30/07	24.12	41	68
Crescent Ridge, IL (2005-2006)	NA	NA	3.27	33	49.5
Crystal Lake II, IA (2009)	NA	NA	7.42	80	200
Elm Creek II, MN (2011-2012)	NA	NA	2.81	62	148.8
Elm Creek, MN (2009-2010)	NA	NA	1.49	67	100
Forward Energy Center, WI (2008-2010)	6.97	8/5/08-11/08/08	18.17	86	129
Fowler I, II, III, IN (2010)	NA	NA	18.96	355	600
Fowler I, II, III, IN (2011)	NA	NA	20.19	355	600
Fowler I, II, III, IN (2012)	NA	NA	2.96	355	600
Fowler I, IN (2009)	NA	NA	8.09	162	301
Fowler III, IN (2009)	NA	NA	1.84	60	99
Fowler, IN (2014)	NA	NA	4.86	355	600
Fowler, IN (2015)	NA	NA	4.54	420	NA
Fowler, IN (2016)	NA	NA	4.54	420	750
Grand Ridge I, IL (2009-2010)	NA	NA	2.1	66	99
Harrow, Ont (2010)	NA	NA	11.13	24 (four 6-turb facilities)	39.6
Kewaunee County, WI (1999-2001)	NA	NA	6.45	31	20.46
Lakefield Wind, MN (2012)	NA	NA	19.87	137	205.5
Moraine II, MN (2009)	NA	NA	2.42	33	49.5
NPPD Ainsworth, NE (2006)	NA	NA	1.16	36	20.5
Odell, MN (2016-2017)	NA	NA	6.74	100	200
Pioneer Prairie I, IA (Phase II; 2011-2012)	NA	NA	4.43	62	102.3
Pioneer Prairie II, IA (2013)	NA	NA	3.83	62	102.3
Pleasant Valley, MN (2016-2017)	NA	NA	1.8	100	200
Prairie Rose, MN (2014)	NA	NA	0.41	119	200

Appendix A1. Wind energy facilities in North America with comparable activity and fatality data for bats, separated by geographic region. Bat activity presented as number of bat passes per detector night. Fatality estimate given as number of fatalities per megawatt (MW) per year.

Wind Energy Facility	Bat Activity Estimate[A]	Bat Activity Dates	Fatality Estimate[B]	No. of Turbines	Total MW
PrairieWinds ND1 (Minot), ND (2010)	NA	NA	2.13	80	115.5
PrairieWinds ND1 (Minot), ND (2011)	NA	NA	1.39	80	115.5
PrairieWinds SD1, SD (2011-2012)	NA	NA	1.23	108	162
PrairieWinds SD1, SD (2012-2013)	NA	NA	1.05	108	162
PrairieWinds SD1, SD (2013-2014)	NA	NA	0.52	108	162
Rail Splitter, IL (2012-2013)	NA	NA	11.21	67	100.5
Ripley, Ont (2008)	NA	NA	4.67	38	76
Rugby, ND (2010-2011)	NA	NA	1.6	71	149
Top Crop I & II (2012-2013)	NA	NA	12.55	68(phase I) 132(phase (II)	300(102 (phase I) 198(phase II))
Top of Iowa, IA (2003)	NA	NA	7.16	89	80
Top of Iowa, IA (2004)	35.7	5/26/04-9/24/04	10.27	89	80
Waverly Wind, KS (2016-2017)	NA	NA	8.2	95	199
Wessington Springs, SD (2009)	NA	NA	1.48	34	51
Wessington Springs, SD (2010)	NA	NA	0.41	34	51
Winnebago, IA (2009-2010)	NA	NA	4.54	10	20
Southern Plains					
Barton Chapel, TX (2009-2010)	NA	NA	3.06	60	120
Big Smile, OK (2012-2013)	NA	NA	2.9	66	132
Buffalo Gap II, TX (2007-2008)	NA	NA	0.14	155	233
Red Hills, OK (2012-2013)	NA	NA	0.11	82	123
Buffalo Gap I, TX (2006)	NA	NA	0.1	67	134
Rocky Mountains					
Summerview, Alb (2006; 2007)	7.65	07/15/06-07-09/30/06-07	11.42	39	70.2
Summerview, Alb (2005-2006)	NA	NA	10.27	39	70.2
Judith Gap, MT (2006-2007)	NA	NA	8.93	90	135
Foote Creek Rim I, WY (1999)	NA	NA	3.97	69	41
Judith Gap, MT (2009)	NA	NA	3.2	90	135
Top of the World, WY (2010-2011)	NA	NA	2.74	110	200
Top of the World, WY (2011-2012)	NA	NA	2.43	110	200
Top of the World, WY (2012-2013)	NA	NA	2.34	110	200
Milford I, UT (2010-2011)	NA	NA	2.05	58	145
Milford I & II, UT (2011-2012)	NA	NA	1.67	107	160.5 (58.5 I, 102 II)
Foote Creek Rim I, WY (2001-2002)	NA	NA	1.57	69	41
Foote Creek Rim I, WY (2000)	NA	NA	1.05	69	41
Southwestern					
Spring Valley, NV (2012-2013)	NA	NA	3.73	66	152
Dry Lake I, AZ (2009-2010)	8.8	4/29/10-11/10/10	3.43	30	63
Dry Lake II, AZ (2011-2012)	11.5	5/11/11-10/26/11	1.66	31	65
California					
Alite, CA (2009-2010)	NA	NA	0.24	8	24
Alta I, CA (2013-2014)	NA	NA	0.36	290	720
Alta I, CA (2015-2016)	NA	NA	0.7	290	720
Alta II-V, CA (2013-2014)	NA	NA	0	290	720
Alta II-V, CA (2015-2016)	NA	NA	0	290	720

Appendix A1. Wind energy facilities in North America with comparable activity and fatality data for bats, separated by geographic region. Bat activity presented as number of bat passes per detector night. Fatality estimate given as number of fatalities per megawatt (MW) per year.

Wind Energy Facility	Bat Activity Estimate[A]	Bat Activity Dates	Fatality Estimate[B]	No. of Turbines	Total MW
Alta VIII, CA (2012-2013)	NA	NA	0	50	150
Alta VIII, CA (2014-2015)	NA	NA	0.17	100	300
Alta Wind I, CA (2011-2012)	4.42	6/26/2009 - 10/31/2009	1.28	100	150
Alta Wind II-V, CA (2011-2012)	0.78	6/26/2009 - 10/31/2009	0.08	190	570
Alta X, CA (2014-2015)	NA	NA	0.42	48	137
Alta X, CA (2015-2016)	NA	NA	0.8	48	137
Cameron Ridge/Section 15, CA (2014-2015)	NA	NA	0.15	34	102
Cameron Ridge/Section 15, CA (2015-2016)	NA	NA	0.19	34	102
Diablo Winds, CA (2005-2007)	NA	NA	0.82	31	20.46
Dillon, CA (2008-2009)	NA	NA	2.17	45	45
Hatchet Ridge, CA (2011)	NA	NA	2.23	44	101
Hatchet Ridge, CA (2012)	NA	NA	5.22	44	101
Hatchet Ridge, CA (2012-2013)	NA	NA	4.2	44	NA
High Winds, CA (2003-2004)	NA	NA	2.51	90	162
High Winds, CA (2004-2005)	NA	NA	1.52	90	162
Lower West, CA (2012-2013)	NA	NA	2.17	7	14
Lower West, CA (2014-2015)	NA	NA	1.13	7	14
Lower West, CA (2016-2017)	NA	NA	0	7	14
Montezuma I, CA (2011)	NA	NA	1.9	16	36.8
Montezuma I, CA (2012)	NA	NA	0.84	16	36.8
Montezuma II, CA (2012-2013)	NA	NA	0.91	34	78.2
Mustang Hills, CA (2012-2013)	NA	NA	0.1	50	150
Mustang Hills, CA (2014-2015)	NA	NA	0	100	300
Mustang Hills, CA (2016-2017)	NA	NA	0.33	100	300
Pacific Wind, CA (2014-2015)	NA	NA	0.21	70	144
Pacific Wind, CA (2015-2016)	NA	NA	0	70	144
Pinyon Pines I & II, CA (2013-2014)	NA	NA	0.04	100	NA
Pinyon Pines I & II, CA (2015-2016)	NA	NA	0.18	100	300
Rising Tree, CA (2017-2018)	NA	NA	0	60	198
Shiloh I, CA (2006-2009)	NA	NA	3.92	100	150
Shiloh II, CA (2009-2010)	NA	NA	2.6	75	150
Shiloh II, CA (2010-2011)	NA	NA	3.8	75	150
Shiloh II, CA (2011-2012)	NA	NA	3.4	75	150
Shiloh III, CA (2012-2013)	NA	NA	0.4	50	102.5
Solano III, CA (2012-2013)	NA	NA	0.31	55	128
Windstar, CA (2012-2013)	NA	NA	0	53	106
Pacific Northwest					
Big Horn, WA (2006-2007)	NA	NA	1.9	133	199.5
Biglow Canyon, OR (Phase I; 2008)	NA	NA	1.99	76	125.4
Biglow Canyon, OR (Phase I; 2009)	NA	NA	0.58	76	125.4
Biglow Canyon, OR (Phase II; 2009-2010)	NA	NA	2.71	65	150
Biglow Canyon, OR (Phase II; 2010-2011)	NA	NA	0.57	65	150

Appendix A1. Wind energy facilities in North America with comparable activity and fatality data for bats, separated by geographic region. Bat activity presented as number of bat passes per detector night. Fatality estimate given as number of fatalities per megawatt (MW) per year.

Wind Energy Facility	Bat Activity Estimate[A]	Bat Activity Dates	Fatality Estimate[B]	No. of Turbines	Total MW
Biglow Canyon, OR (Phase III; 2010-2011)	NA	NA	0.22	76	174.8
Chopin, OR (2016-2017)	NA	NA	1.9	6	10
Combine Hills, OR (2011)	NA	NA	0.73	104	104
Combine Hills, OR (Phase I; 2004-2005)	NA	NA	1.88	41	41
Elkhorn, OR (2008)	NA	NA	1.26	61	101
Elkhorn, OR (2010)	NA	NA	2.14	61	101
Goodnoe, WA (2009-2010)	NA	NA	0.34	47	94
Harvest Wind, WA (2010-2012)	NA	NA	1.27	43	98.9
Hay Canyon, OR (2009-2010)	NA	NA	0.53	48	100.8
Hopkins Ridge, WA (2006)	NA	NA	0.63	83	150
Hopkins Ridge, WA (2008)	NA	NA	1.39	87	156.6
Kittitas Valley, WA (2011-2012)	NA	NA	0.12	48	100.8
Klondike II, OR (2005-2006)	NA	NA	0.41	50	75
Klondike III (Phase I), OR (2007-2009)	NA	NA	1.11	125	223.6
Klondike IIIa (Phase II), OR (2008-2010)	NA	NA	0.14	51	76.5
Klondike, OR (2002-2003)	NA	NA	0.77	16	24
Leaning Juniper, OR (2006-2008)	NA	NA	1.98	67	100.5
Linden Ranch, WA (2010-2011)	NA	NA	1.68	25	50
Marengo I, WA (2009-2010)	NA	NA	0.17	78	140.4
Marengo II, WA (2009-2010)	NA	NA	0.27	39	70.2
Nine Canyon, WA (2002-2003)	NA	NA	2.47	37	48.1
Palouse Wind, WA (2012-2013)	NA	NA	4.23	58	104.4
Pebble Springs, OR (2009-2010)	NA	NA	1.55	47	98.7
Stateline, OR/WA (2001-2002)	NA	NA	1.09	454	299
Stateline, OR/WA (2003)	NA	NA	2.29	454	299
Stateline, OR/WA (2006)	NA	NA	0.95	454	299
Tucannon River, WA (2015)	NA	NA	2.22	116	267
Tuolumne (Windy Point I), WA (2009-2010)	NA	NA	0.94	62	136.6
Vansycle, OR (1999)	NA	NA	1.12	38	24.9
Vantage, WA (2010-2011)	NA	NA	0.4	60	90
White Creek, WA (2007-2011)	NA	NA	2.04	89	204.7
Wild Horse, WA (2007)	NA	NA	0.39	127	229
Windy Flats, WA (2010-2011)	NA	NA	0.41	114	262.2
Northeast					
Beech Ridge, WV (2012)	NA	NA	2.03	67	100.5
Beech Ridge, WV (2013)	NA	NA	0.58	67	100.5
Bingham Wind Project, ME (2017)	NA	NA	0.23	56	185
Bull Hill, ME (2013)	NA	NA	1.62	19	34
Casselman Curtailment, PA (2008)	NA	NA	4.4	23	35.4
Casselman, PA (2008)	NA	NA	12.61	23	34.5
Casselman, PA (2009)	NA	NA	8.6	23	34.5
Cohocton/Dutch Hill, NY (2009)	NA	NA	8.62	50	125
Cohocton/Dutch Hill, NY (2013)	NA	NA	1.37	50	125
Cohocton/Dutch Hills, NY (2010)	NA	NA	10.32	50	125
Criterion, MD (2011)	NA	NA	15.61	28	70
Criterion, MD (2012)	NA	NA	7.62	28	70
Criterion, MD (2013)	NA	NA	5.32	28	70

Appendix A1. Wind energy facilities in North America with comparable activity and fatality data for bats, separated by geographic region. Bat activity presented as number of bat passes per detector night. Fatality estimate given as number of fatalities per megawatt (MW) per year.

Wind Energy Facility	Bat Activity Estimate[A]	Bat Activity Dates	Fatality Estimate[B]	No. of Turbines	Total MW
Groton, NH (2013)	NA	NA	1.31	24	48
Groton, NH (2014)	NA	NA	1.63	24	48
Groton, NH (2015)	NA	NA	1.74	24	48
Hancock, ME (2017)	NA	NA	0.3	17	51
High Sheldon, NY (2010)	NA	NA	2.33	75	112.5
High Sheldon, NY (2011)	NA	NA	1.78	75	112.5
Howard, NY (2012)	NA	NA	10	27	54
Howard, NY (2013)	NA	NA	2.13	27	54
Kibby, ME (2011)	NA	NA	0.12	44	132
Lempster, NH (2009)	NA	NA	3.11	12	24
Lempster, NH (2010)	NA	NA	3.57	12	24
Locust Ridge, PA (Phase II; 2009)	NA	NA	14.11	51	102
Locust Ridge, PA (Phase II; 2010)	NA	NA	14.38	51	102
Maple Ridge, NY (2006)	NA	NA	11.21	120	198
Maple Ridge, NY (2007)	NA	NA	6.49	195	321.75
Maple Ridge, NY (2007-2008)	NA	NA	4.96	195	321.75
Maple Ridge, NY (2012)	NA	NA	7.3	195	321.75
Mars Hill, ME (2007)	NA	NA	2.91	28	42
Mars Hill, ME (2008)	NA	NA	0.45	28	42
Mount Storm, WV (2009)	30.09	7/15/09-10/7/09	17.53	132	264
Mount Storm, WV (2010)	36.67	4/18/10-10/15/10	15.18	132	264
Mount Storm, WV (2011)	NA	NA	7.43	132	264
Mount Storm, WV (Fall 2008)	35.2	7/20/08-10/12/08	6.62	82	164
Mountaineer, WV (2003)	NA	NA	31.69	44	66
Munnsville, NY (2008)	NA	NA	1.93	23	34.5
Noble Altona, NY (2010)	NA	NA	4.34	65	97.5
Noble Bliss, NY (2008)	NA	NA	7.8	67	100
Noble Bliss, NY (2009)	NA	NA	3.85	67	100
Noble Chateaugay, NY (2010)	NA	NA	2.44	71	106.5
Noble Clinton, NY (2008)	2.1	8/8/08-09/31/08	3.14	67	100
Noble Clinton, NY (2009)	1.9	8/1/09-09/31/09	4.5	67	100
Noble Ellenburg, NY (2008)	NA	NA	3.46	54	80
Noble Ellenburg, NY (2009)	16.1	8/16/09-09/15/09	3.91	54	80
Noble Wethersfield, NY (2010)	NA	NA	16.3	84	126
Oakfield, ME (2017)	NA	NA	0.51	48	148
Pinnacle, WV (2012)	NA	NA	40.2	23	55.2
Record Hill, ME (2012)	24.6	4/16/12-10/23/12	2.96	22	50.6
Record Hill, ME (2014)	NA	NA	0.55	22	50.6
Record Hill, ME (2016)	NA	NA	1.25	22	51
Rollins, ME (2012)	NA	NA	0.18	40	60
Rollins, ME (2014)	NA	NA	0.33	40	60
Roth Rock, MD (2011)	NA	NA	6.24	20	50
Spruce Mountain Wind Project, ME (2014)	NA	NA	0.31	10	20
Steel Winds I & II, NY (2013)	NA	NA	6.14	14	35
Stetson II, ME (2014)	NA	NA	0.83	17	26
Stetson Mountain I, ME (2009)	28.5; 0.3	7/10/09-10/15/09	1.4	38	57
Stetson Mountain I, ME (2011)	NA	NA	0.28	38	57
Stetson Mountain I, ME (2013)	NA	NA	0.18	38	57

Appendix A1. Wind energy facilities in North America with comparable activity and fatality data for bats, separated by geographic region. Bat activity presented as number of bat passes per detector night. Fatality estimate given as number of fatalities per megawatt (MW) per year.

Wind Energy Facility	Bat Activity Estimate[A]	Bat Activity Dates	Fatality Estimate[B]	No. of Turbines	Total MW
Stetson Mountain II, ME (2010)	NA	NA	1.65	17	25.5
Stetson Mountain II, ME (2012)	NA	NA	2.27	17	25.5
Wolfe Island, Ont (July-December 2009)	NA	NA	6.42	86	197.8
Wolfe Island, Ont (July-December 2010)	NA	NA	9.5	86	197.8
Wolfe Island, Ont (July-December 2011)	NA	NA	2.49	86	197.8
Southeast					
Buffalo Mountain, TN (2005)	NA	NA	39.7	18	28.98
Buffalo Mountain, TN (2000-2003)	23.7	NA	31.54	3	1.98

A = Bat passes per detector-night
B = Number of fatalities per megawatt per year
C = Activity rate based on data collected at various heights all other activity rates are from ground-based units only
D = Activity rate was averaged across phases and/or years
E = Activity rate calculated by WEST from data presented in referenced report
F= Activity rate based on pre-construction monitoring; data for all other activity and fatality rates were collected concurrently
G = The overall activity rate of 28.5 is from reference stations located along forest edges which may be attractive to bats; the activity rate of 0.3 is from one unit placed on a nacelle

Appendix A1 (*continued*). Wind energy facilities in North America with comparable activity and fatality data for bats. Data from the following sources:

Facility	Activity Citation	Fatality Citation	Facility	Activity Citation	Fatality Citation
Lake Benton II, MN (2018)	This study.				
Alite, CA (2009-2010)		Chatfield et al. 2010	Lempster, NH (2010)		Tidhar et al. 2011
Alta Wind I, CA (2011-2012)	Solick et al. 2010	Chatfield et al. 2012	Linden Ranch, WA (2010-2011)		Enz and Bay 2011
Alta Wind I, CA (2013-2014)		Chatfield et al. 2014	Locust Ridge, PA (Phase II; 2009)		Arnett et al. 2011
Alta I, CA (2015-2016)		Thompson et al. 2016a	Locust Ridge, PA (Phase II; 2010)		Arnett et al. 2011
Alta Wind II-V, CA (2011-2012)	Solick et al. 2010	Chatfield et al. 2012	Lower West, CA (2012-2013)		Levenstein and Bay 2013a
Alta II-V, CA (2013-2014)		Chatfield et al. 2014	Lower West, CA (2014-2015)		Levenstein and DiDonato 2015
Alta II-V, CA (2015-2016)		Thompson et al. 2016a	Lower West, CA (2016-2017)		WEST 2017b
Alta VIII, CA (2012-2013)		Chatfield and Bay 2014	Maple Ridge, NY (2006)		Jain et al. 2007
Alta VIII, CA (2014-2015)		Western EcoSystems Technology, Inc. (WEST) 2016c	Maple Ridge, NY (2007)		Jain et al. 2009a
Alta X, CA (2014-2015)		Chatfield et al. 2015	Maple Ridge, NY (2007-2008)		Jain et al. 2009b
Alta X, CA (2015-2016)		Thompson et al. 2016b	Maple Ridge, NY (2012)		Tidhar et al. 2013b
Barton I & II, IA (2010-2011)		Derby et al. 2011b	Marengo I, WA (2009-2010)		URS 2010b
Barton Chapel, TX (2009-2010)		WEST 2011	Marengo II, WA (2009-2010)		URS 2010c
Beech Ridge, WV (2012)		Tidhar et al. 2013a	Mars Hill, ME (2007)		Stantec 2008a
Beech Ridge, WV (2013)		Young et al. 2014a	Mars Hill, ME (2008)		Stantec 2009a
Big Blue, MN (2013)		Fagen Engineering 2014	Milford I, UT (2010-2011)		Stantec 2011b
Big Blue, MN (2014)		Fagen Engineering 2015	Milford I & II, UT (2011-2012)		Stantec 2012b
Big Horn, WA (2006-2007)		Kronner et al. 2008	Montezuma I, CA (2011)		ICF International 2012
Big Smile, OK (2012-2013)		Derby et al. 2013b	Montezuma I, CA (2012)		ICF International 2013
Biglow Canyon, OR (Phase I; 2008)		Jeffrey et al. 2009b	Montezuma II, CA (2012-2013)		Harvey & Associates 2013
Biglow Canyon, OR (Phase I; 2009)		Enk et al. 2010	Moraine II, MN (2009)		Derby et al. 2010f
Biglow Canyon, OR (Phase II; 2009-2010)		Enk et al. 2011b	Mount Storm, WV (Fall 2008)	Young et al. 2009c	Young et al. 2009c
Biglow Canyon, OR (Phase II; 2010-2011)		Enk et al. 2012b	Mount Storm, WV (2009)	Young et al. 2009a, 2010b	Young et al. 2009a, 2010b
Biglow Canyon, OR (Phase III; 2010-2011)		Enk et al. 2012a	Mount Storm, WV (2010)	Young et al. 2010a, 2011b	Young et al. 2010a, 2011b

Appendix A1 (*continued*). Wind energy facilities in North America with comparable activity and fatality data for bats. Data from the following sources:

Facility	Activity Citation	Fatality Citation	Facility	Activity Citation	Fatality Citation
Bingham Wind Project, ME (2017)		TRC 2017a	Mount Storm, WV (2011)		Young et al. 2011a, 2012a
Blue Sky Green Field, WI (2008; 2009)	Gruver 2008	Gruver et al. 2009	Mountaineer, WV (2003)		Kerns and Kerlinger 2004
Buffalo Gap I, TX (2006)		Tierney 2007	Munnsville, NY (2008)		Stantec 2009b
Buffalo Gap II, TX (2007-2008)		Tierney 2009	Mustang Hills, CA (2012-2013)		Chatfield and Bay 2014
Buffalo Mountain, TN (2000-2003)	Fiedler 2004	Nicholson et al. 2005	Mustang Hills, CA (2014-2015)		WEST 2016c
Buffalo Mountain, TN (2005)		Fiedler et al. 2007	Mustang Hills, CA (2016-2017)		WEST 2018
Buffalo Ridge, MN (Phase I; 1999)		Johnson et al. 2000	Nine Canyon, WA (2002-2003)		Erickson et al. 2003
Buffalo Ridge, MN (Phase II; 1998)		Johnson et al. 2000	Noble Altona, NY (2010)		Jain et al. 2011a
Buffalo Ridge, MN (Phase II; 1999)		Johnson et al. 2000	Noble Bliss, NY (2008)		Jain et al.2009c
Buffalo Ridge, MN (Phase II; 2001/Lake Benton I)	Johnson et al. 2004	Johnson et al. 2004	Noble Bliss, NY (2009)		Jain et al. 2010c
Buffalo Ridge, MN (Phase II; 2002/Lake Benton I)	Johnson et al. 2004	Johnson et al. 2004	Noble Chateaugay, NY (2010)		Jain et al. 2011b
Buffalo Ridge, MN (Phase III; 1999)		Johnson et al. 2000	Noble Clinton, NY (2008)	Reynolds 2010a	Jain et al. 2009d
Buffalo Ridge, MN (Phase III; 2001/Lake Benton II)	Johnson et al. 2004	Johnson et al. 2004	Noble Clinton, NY (2009)	Reynolds 2010a	Jain et al. 2010a
Buffalo Ridge, MN (Phase III; 2002/Lake Benton II)	Johnson et al. 2004	Johnson et al. 2004	Noble Ellenburg, NY (2008)		Jain et al. 2009e
Buffalo Ridge I, SD (2009-2010)		Derby et al. 2010d	Noble Ellenburg, NY (2009)	Reynolds 2010b	Jain et al. 2010b
Buffalo Ridge II, SD (2011-2012)		Derby et al. 2012a	Noble Wethersfield, NY (2010)		Jain et al. 2011c
Bull Hill, ME (2013)		Stantec Consulting (Stantec) 2014a	NPPD Ainsworth, NE (2006)		Derby et al. 2007
Cameron Ridge/Section 15, CA (2014-2015)		WEST 2016b	Oakfield, ME (2017)		TRC 2018
Cameron Ridge/Section 15, CA (2015-2016)		Rintz and Thompson 2017	Odell, MN (2016-2017)		Chodachek and Gustafson 2018
Casselman, PA (2008)		Arnett et al. 2009b	Pacific Wind, CA (2014-2015)		WEST 2016a
Casselman, PA (2009)		Arnett et al. 2010	Pacific Wind, CA (2015-2016)		WEST 2017a
Casselman Curtailment, PA (2008)		Arnett et al. 2009a	Palouse Wind, WA (2012-2013)		Stantec 2013a
Cedar Ridge, WI (2009)	BHE Environmental 2008	BHE Environmental 2010	Pebble Springs, OR (2009-2010)		Gritski and Kronner 2010b
Cedar Ridge, WI (2010)	BHE Environmental 2008	BHE Environmental 2011	Pinnacle, WV (2012)		Hein et al. 2013b

Appendix A1 (*continued*). Wind energy facilities in North America with comparable activity and fatality data for bats. Data from the following sources:

Facility	Activity Citation	Fatality Citation	Facility	Activity Citation	Fatality Citation
Chopin, OR (2016-2017)		Hallingstad and Riser-Espinoza 2017	Pinyon Pines I & II, CA (2013-2014)		Chatfield and Russo 2014
Cohocton/Dutch Hill, NY (2009)		Stantec 2010	Pinyon Pines I & II, CA (2015-2016)		Rintz and Starcevich 2016
Cohocton/Dutch Hills, NY (2010)		Stantec 2011a	Pioneer Prairie I, IA (Phase II; 2011-2012)		Chodachek et al. 2012
Cohocton/Dutch Hill, NY (2013)		Stantec 2014b	Pioneer Prairie II, IA (2013)		Chodachek et al. 2014
Combine Hills, OR (Phase I; 2004-2005)		Young et al. 2006	Pleasant Valley, MN (2016-2017)		Tetra Tech 2017b
Combine Hills, OR (2011)		Enz et al. 2012	Prairie Rose, MN (2014)		Chodachek et al. 2015
Crescent Ridge, IL (2005-2006)		Kerlinger et al. 2007	PrairieWinds ND1 (Minot), ND (2010)		Derby et al. 2011d
Criterion, MD (2011)		Young et al. 2012b	PrairieWinds ND1 (Minot), ND (2011)		Derby et al. 2012d
Criterion, MD (2012)		Young et al. 2013	PrairieWinds SD1, SD (2011-2012)		Derby et al. 2012c
Criterion, MD (2013)		Young et al. 2014b	PrairieWinds SD1, SD (2012-2013)		Derby et al. 2013a
Crystal Lake II, IA (2009)		Derby et al. 2010b	PrairieWinds SD1, SD (2013-2014)		Derby et al. 2014
Diablo Winds, CA (2005-2007)		WEST 2006, 2008	Rail Splitter, IL (2012-2013)		Good et al. 2013b
Dillon, CA (2008-2009)		Chatfield et al. 2009	Record Hill, ME (2012)	Stantec 2008b	Stantec 2013b
Dry Lake I, AZ (2009-2010)	Thompson et al. 2011	Thompson et al. 2011	Record Hill, ME (2014)		Stantec 2015b
Dry Lake II, AZ (2011-2012)	Thompson and Bay 2012	Thompson and Bay 2012	Record Hill, ME (2016)		Stantec 2017
Elkhorn, OR (2008)		Jeffrey et a. 2009a	Red Hills, OK (2012-2013)		Derby et al. 2013c
Elkhorn, OR (2010)		Enk et al. 2011a	Ripley, Ont (2008)		Jacques Whitford 2009
Elm Creek, MN (2009-2010)		Derby et al. 2010e	Rising Tree, CA (2017-2018)		Chatfield et al. 2018
Elm Creek II, MN (2011-2012)		Derby et al. 2012b	Rollins, ME (2012)		Stantec 2013c
Foote Creek Rim I, WY (1999)		Young et al. 2003a	Rollins, ME (2014)		Stantec 2015c
Foote Creek Rim I, WY (2000)		Young et al. 2003a	Roth Rock, MD (2011)		Atwell, LLC 2012
Foote Creek Rim I, WY (2001-2002)		Young et al. 2003a	Rugby, ND (2010-2011)		Derby et al. 2011c
Forward Energy Center, WI (2008-2010)	Watt and Drake 2011	Grodsky and Drake 2011	Shiloh I, CA (2006-2009)		Kerlinger et al. 2009
Fowler I, IN (2009)		Johnson et al. 2010a	Shiloh II, CA (2009-2010)		Kerlinger et al. 2010, 2013a
Fowler I, II, III, IN (2010)		Good et al. 2011	Shiloh II, CA (2010-2011)		Kerlinger et al. 2013a
Fowler I, II, III, IN (2011)		Good et al. 2012	Shiloh II, CA (2011-2012)		Kerlinger et al. 2013a
Fowler I, II, III, IN (2012)		Good et al. 2013a	Shiloh III, CA (2012-2013)		Kerlinger et al. 2013b

Appendix A1 (*continued*). Wind energy facilities in North America with comparable activity and fatality data for bats. Data from the following sources:

Facility	Activity Citation	Fatality Citation	Facility	Activity Citation	Fatality Citation
Fowler III, IN (2009)		Johnson et al. 2010b	Solano III, CA (2012-2013)		AECOM 2013
Fowler, IN (2014)		Good et al. 2015	Spring Valley, NV (2012-2013)		WEST 2014
Fowler, IN (2015)		Good et al. 2016	Spruce Mountain Wind Project, ME (2014)		Tetra Tech 2015
Fowler, IN (2016)		Good et al. 2017	Stateline, OR/WA (2001-2002)		Erickson et al. 2004
Goodnoe, WA (2009-2010)		URS Corporation (URS) 2010a	Stateline, OR/WA (2003)		Erickson et al. 2004
Grand Ridge I, IL (2009-2010)		Derby et al. 2010a	Stateline, OR/WA (2006)		Erickson et al. 2007
Groton, NH (2013)		Stantec and WEST 2014	Steel Winds I & II, NY (2013)		Stantec 2014c
Groton, NH (2014)		Stantec and WEST 2015a	Stetson II, ME (2014)		Stantec 2015d
Groton, NH (2015)		Stantec and WEST 2015b	Stetson Mountain I, ME (2009)	Stantec 2009c	Stantec 2009c
Hancock, ME (2017)		TRC 2017b	Stetson Mountain I, ME (2011)		Normandeau Associates 2011
Harrow, Ont (2010)		Natural Resources Solutions Inc. (NRSI) 2011	Stetson Mountain I, ME (2013)		Stantec 2014d
Harvest Wind, WA (2010-2012)		Downes and Gritski 2012a	Stetson Mountain II, ME (2010)		Normandeau Associates 2010
Hatchet Ridge, CA (2011)		Tetra Tech 2013	Stetson Mountain II, ME (2012)		Stantec 2013d
Hatchet Ridge, CA (2012)		Tetra Tech 2013	Summerview, Alb (2005-2006)		Brown and Hamilton 2006b
Hatchet Ridge, CA (2012-2013)		Tetra Tech 2014	Summerview, Alb (2006; 2007)	Baerwald 2008	Baerwald 2008
Hay Canyon, OR (2009-2010)		Gritski and Kronner 2010a	Top Crop I & II, IL (2012-2013)		Good et al. 2013c
High Sheldon, NY (2010)		Tidhar et al. 2012a	Top of Iowa, IA (2003)		Jain 2005
High Sheldon, NY (2011)		Tidhar et al. 2012b	Top of Iowa, IA (2004)	Jain 2005	Jain 2005
High Winds, CA (2003-2004)		Kerlinger et al. 2006	Top of the World, WY (2010-2011)		Rintz and Bay 2012
High Winds, CA (2004-2005)		Kerlinger et al. 2006	Top of the World, WY (2011-2012)		Rintz and Bay 2013
Hopkins Ridge, WA (2006)		Young et al. 2007	Top of the World, WY (2012-2013)		Rintz and Bay 2014
Hopkins Ridge, WA (2008)		Young et al. 2009b	Tucannon River, WA (2015)		Hallingstad et al. 2016
Howard, NY (2012)		Tidhar et al. 2013c	Tuolumne (Windy Point I), WA (2009-2010)		Enz and Bay 2010
Howard, NY (2013)		Lukins et al. 2014	Vansycle, OR (1999)		Erickson et al. 2000
Judith Gap, MT (2006-2007)		TRC Environmental Corporation 2008	Vantage, WA (2010-2011)		Ventus Environmental Solutions 2012

Appendix A1 (*continued*). Wind energy facilities in North America with comparable activity and fatality data for bats. Data from the following sources:

Facility	Activity Citation	Fatality Citation	Facility	Activity Citation	Fatality Citation
Judith Gap, MT (2009)		Poulton and Erickson 2010	Waverly Wind, KS (2016-2017)		Tetra Tech 2017a
Kewaunee County, WI (1999-2001)		Howe et al. 2002	Wessington Springs, SD (2009)		Derby et al. 2010c
Kibby, ME (2011)		Stantec 2012a	Wessington Springs, SD (2010)		Derby et al. 2011a
Kittitas Valley, WA (2011-2012)		Stantec Consulting Services 2012	White Creek, WA (2007-2011)		Downes and Gritski 2012b
Klondike, OR (2002-2003)		Johnson et al. 2003	Wild Horse, WA (2007)		Erickson et al. 2008
Klondike II, OR (2005-2006)		Northwest Wildlife Consultants (NWC) and WEST 2007	Windstar, CA (2012-2013)		Levenstein and Bay 2013b
Klondike III (Phase I), OR (2007-2009)		Gritski et al. 2010	Windy Flats, WA (2010-2011)		Enz et al. 2011
Klondike IIIa (Phase II), OR (2008-2010)		Gritski et al. 2011	Winnebago, IA (2009-2010)		Derby et al. 2010g
Lakefield Wind, MN (2012)		Minnesota Public Utilities Commission 2012	Wolfe Island, Ont (July-December 2009)		Stantec Ltd. 2010
Leaning Juniper, OR (2006-2008)		Gritski et al. 2008	Wolfe Island, Ont (July-December 2010)		Stantec Ltd. 2011
Lempster, NH (2009)		Tidhar et al. 2010	Wolfe Island, Ont (July-December 2011)		Stantec Ltd. 2012

Appendix A2. Fatality estimates for North American wind energy facilities.

Project	Bat Fatalities (bats/MW/ year)	Predominant Habitat Type	Citation
Alite, CA (2009-2010)	0.24	Shrub/scrub & grassland	Chatfield et al. 2010
Alta I, CA (2011-2012)	1.28	Woodland, grassland, shrubland	Chatfield et al. 2012
Alta I, CA (2013-2014)	0.36	Desert scrub, grassland	Chatfield et al. 2014
Alta I, CA (2015-2016)	0.7	Desert scrub, grassland	Thompson et al. 2016a
Alta II-V, CA (2011-2012)	0.08	Desert scrub	Chatfield et al. 2012
Alta II-V, CA (2013-2014)	0	Desert scrub, grassland	Chatfield et al. 2014
Alta II-V, CA (2015-2016)	0	Desert scrub, grassland	Thompson et al. 2016a
Alta VIII, CA (2012-2013)	0	Grassland and riparian	Chatfield and Bay 2014
Alta VIII, CA (2014-2015)	0.17	NA	Western EcoSystems Technology, Inc. (WEST) 2016c
Alta X, CA (2014-2015)	0.42	Desert scrub, woodland	Chatfield et al. 2015
Alta X, CA (2015-2016)	0.8	Desert scrub	Thompson et al. 2016b
Barton I & II, IA (2010-2011)	1.85	Agriculture	Derby et al. 2011b
Barton Chapel, TX (2009-2010)	3.06	Agriculture/forest	WEST 2011
Beech Ridge, WV (2012)	2.03	Forest	Tidhar et al. 2013a
Beech Ridge, WV (2013)	0.58	Forest	Young et al. 2014a
Big Blue, MN (2013)	2.04	Agriculture	Fagen Engineering 2014
Big Blue, MN (2014)	1.43	Agriculture	Fagen Engineering 2015
Big Horn, WA (2006-2007)	1.9	Agriculture/grassland	Kronner et al. 2008
Big Smile, OK (2012-2013)	2.9	Grassland, agriculture	Derby et al. 2013b
Biglow Canyon, OR (Phase I; 2008)	1.99	Agriculture/grassland	Jeffrey et al. 2009b
Biglow Canyon, OR (Phase I; 2009)	0.58	Agriculture/grassland	Enk et al. 2010
Biglow Canyon, OR (Phase II; 2009-2010)	2.71	Agriculture	Enk et al. 2011b
Biglow Canyon, OR (Phase II; 2010-2011)	0.57	Grassland/shrub-steppe, agriculture	Enk et al. 2012b
Biglow Canyon, OR (Phase III; 2010-2011)	0.22	Grassland/shrub-steppe, agriculture	Enk et al. 2012a
Bingham Wind Project, ME (2017)	0.23	NA	TRC 2017a
Blue Sky Green Field, WI (2008; 2009)	24.57	Agriculture	Gruver et al. 2009
Buffalo Gap I, TX (2006)	0.1	Grassland	Tierney 2007
Buffalo Gap II, TX (2007-2008)	0.14	Forest	Tierney 2009
Buffalo Mountain, TN (2000-2003)	31.54	Forest	Nicholson et al. 2005
Buffalo Mountain, TN (2005)	39.7	Forest	Fiedler et al. 2007
Buffalo Ridge, MN (Phase I; 1999)	0.74	Agriculture	Johnson et al. 2000
Buffalo Ridge, MN (Phase II; 1998)	2.16	Agriculture	Johnson et al. 2000
Buffalo Ridge, MN (Phase II; 1999)	2.59	Agriculture	Johnson et al. 2000
Buffalo Ridge, MN (Phase II; 2001/Lake Benton I)	4.35	Agriculture	Johnson et al. 2004
Buffalo Ridge, MN (Phase II; 2002/Lake Benton I)	1.64	Agriculture	Johnson et al. 2004

Appendix A2. Fatality estimates for North American wind energy facilities.

Project	Bat Fatalities (bats/MW/ year)	Predominant Habitat Type	Citation
Buffalo Ridge, MN (Phase III; 1999)	2.72	Agriculture	Johnson et al. 2000
Buffalo Ridge, MN (Phase III; 2001/Lake Benton II)	3.71	Agriculture	Johnson et al. 2004
Buffalo Ridge, MN (Phase III; 2002/Lake Benton II)	1.81	Agriculture	Johnson et al. 2004
Buffalo Ridge I, SD (2009-2010)	0.16	Agriculture/grassland	Derby et al. 2010d
Buffalo Ridge II, SD (2011-2012)	2.81	Agriculture, grassland	Derby et al. 2012a
Bull Hill, ME (2013)	1.62	Forest	Stantec Consulting (Stantec) 2014a
Cameron Ridge/Section 15, CA (2014-2015)	0.15	Desert scrub	WEST 2016b
Cameron Ridge/Section 15, CA (2015-2016)	0.19	NA	Rintz and Thompson 2017
Casselman, PA (2008)	12.61	Forest	Arnett et al. 2009b
Casselman, PA (2009)	8.6	Forest, pasture, grassland	Arnett et al. 2010
Casselman Curtailment, PA (2008)	4.4	Forest	Arnett et al. 2009a
Cedar Ridge, WI (2009)	30.61	Agriculture	BHE Environmental 2010
Cedar Ridge, WI (2010)	24.12	Agriculture	BHE Environmental 2011
Chopin, OR (2016-2017)	1.9	Agriculture	Hallingstad and Riser-Espinoza 2017
Cohocton/Dutch Hill, NY (2009)	8.62	Agriculture/forest	Stantec 2010
Cohocton/Dutch Hills, NY (2010)	10.32	Agriculture/forest	Stantec 2011a
Cohocton/Dutch Hill, NY (2013)	1.37	Agriculture, forest	Stantec 2014b
Combine Hills, OR (Phase I; 2004-2005)	1.88	Agriculture/grassland	Young et al. 2006
Combine Hills, OR (2011)	0.73	Grassland/shrub-steppe, agriculture	Enz et al. 2012
Crescent Ridge, IL (2005-2006)	3.27	Agriculture	Kerlinger et al. 2007
Criterion, MD (2011)	15.61	Forest, agriculture	Young et al. 2012b
Criterion, MD (2012)	7.62	Forest, agriculture	Young et al. 2013
Criterion, MD (2013)	5.32	Forest, agriculture	Young et al. 2014b
Crystal Lake II, IA (2009)	7.42	Agriculture	Derby et al. 2010b
Diablo Winds, CA (2005-2007)	0.82	NA	WEST 2006, 2008
Dillon, CA (2008-2009)	2.17	Desert	Chatfield et al. 2009
Dry Lake I, AZ (2009-2010)	3.43	Desert grassland/forested	Thompson et al. 2011
Dry Lake II, AZ (2011-2012)	1.66	Desert grassland/forested	Thompson and Bay 2012
Elkhorn, OR (2008)	1.26	Shrub/scrub & agriculture	Jeffrey et a. 2009a
Elkhorn, OR (2010)	2.14	Shrub/scrub & agriculture	Enk et al. 2011a
Elm Creek, MN (2009-2010)	1.49	Agriculture	Derby et al. 2010e
Elm Creek II, MN (2011-2012)	2.81	Agriculture, grassland	Derby et al. 2012b
Foote Creek Rim I, WY (1999)	3.97	Grassland	Young et al. 2003a
Foote Creek Rim I, WY (2000)	1.05	Grassland	Young et al. 2003a
Foote Creek Rim I, WY (2001-2002)	1.57	Grassland	Young et al. 2003a
Forward Energy Center, WI (2008-2010)	18.17	Agriculture	Grodsky and Drake 2011

Appendix A2. Fatality estimates for North American wind energy facilities.

Project	Bat Fatalities (bats/MW/year)	Predominant Habitat Type	Citation
Fowler I, IN (2009)	8.09	Agriculture	Johnson et al. 2010a
Fowler I, II, III, IN (2010)	18.96	Agriculture	Good et al. 2011
Fowler I, II, III, IN (2011)	20.19	Agriculture	Good et al. 2012
Fowler I, II, III, IN (2012)	2.96	Agriculture	Good et al. 2013a
Fowler III, IN (2009)	1.84	Agriculture	Johnson et al. 2010b
Fowler, IN (2014)	4.86	Agriculture	Good et al. 2015
Fowler, IN (2015)	4.54	Agriculture	Good et al. 2016
Fowler, IN (2016)	4.54	Agriculture	Good et al. 2017
Goodnoe, WA (2009-2010)	0.34	Grassland and shrub-steppe	URS Corporation (URS) 2010a
Grand Ridge I, IL (2009-2010)	2.1	Agriculture	Derby et al. 2010a
Groton, NH (2013)	1.31	Foothills, forest	Stantec and WEST 2014
Groton, NH (2014)	1.63	Foothills, forest	Stantec and WEST 2015a
Groton, NH (2015)	1.74	Foothills, forest	Stantec and WEST 2015b
Hancock, ME (2017)	0.3	Gravel, grassland	TRC 2017b
Harrow, Ont (2010)	11.13	Agriculture	Natural Resources Solutions Inc. 2011
Harvest Wind, WA (2010-2012)	1.27	Grassland/shrub-steppe	Downes and Gritski 2012a
Hatchet Ridge, CA (2011)	2.23	NA	Tetra Tech 2013
Hatchet Ridge, CA (2012)	5.22	NA	Tetra Tech 2013
Hatchet Ridge, CA (2012-2013)	4.2	NA	Tetra Tech 2014
Hay Canyon, OR (2009-2010)	0.53	Agriculture	Gritski and Kronner 2010a
High Sheldon, NY (2010)	2.33	Agriculture	Tidhar et al. 2012a
High Sheldon, NY (2011)	1.78	Agriculture	Tidhar et al. 2012b
High Winds, CA (2003-2004)	2.51	Agriculture/grassland	Kerlinger et al. 2006
High Winds, CA (2004-2005)	1.52	Agriculture/grassland	Kerlinger et al. 2006
Hopkins Ridge, WA (2006)	0.63	Agriculture/grassland	Young et al. 2007
Hopkins Ridge, WA (2008)	1.39	Agriculture/grassland	Young et al. 2009b
Howard, NY (2012)	10	Agriculture	Tidhar et al. 2013c
Howard, NY (2013)	2.13	Agriculture	Lukins et al. 2014
Judith Gap, MT (2006-2007)	8.93	Agriculture/grassland	TRC Environmental Corporation 2008
Judith Gap, MT (2009)	3.2	Agriculture/grassland	Poulton and Erickson 2010
Kewaunee County, WI (1999-2001)	6.45	Agriculture	Howe et al. 2002
Kibby, ME (2011)	0.12	Forest; commercial forest	Stantec 2012a
Kittitas Valley, WA (2011-2012)	0.12	Sagebrush-steppe, grassland	Stantec Consulting Services 2012
Klondike, OR (2002-2003)	0.77	Agriculture/grassland	Johnson et al. 2003
Klondike II, OR (2005-2006)	0.41	Agriculture/grassland	Northwest Wildlife Consultants (NWC) and WEST 2007
Klondike III (Phase I), OR (2007-2009)	1.11	Agriculture/grassland	Gritski et al. 2010
Klondike IIIa (Phase II), OR (2008-2010)	0.14	Grassland/shrub-steppe and agriculture	Gritski et al. 2011
Lakefield Wind, MN (2012)	19.87	Agriculture	Minnesota Public Utilities Commission 2012
Leaning Juniper, OR (2006-2008)	1.98	Agriculture	Gritski et al. 2008

Appendix A2. Fatality estimates for North American wind energy facilities.

Project	Bat Fatalities (bats/MW/ year)	Predominant Habitat Type	Citation
Lempster, NH (2009)	3.11	Grasslands/forest/rocky embankments	Tidhar et al. 2010
Lempster, NH (2010)	3.57	Grasslands/forest/rocky embankments	Tidhar et al. 2011
Linden Ranch, WA (2010-2011)	1.68	Grassland/shrub-steppe, agriculture	Enz and Bay 2011
Locust Ridge, PA (Phase II; 2009)	14.11	Grassland	Arnett et al. 2011
Locust Ridge, PA (Phase II; 2010)	14.38	Grassland	Arnett et al. 2011
Lower West, CA (2012-2013)	2.17	NA	Levenstein and Bay 2013a
Lower West, CA (2014-2015)	1.13	NA	Levenstein and DiDonato 2015
Lower West, CA (2016-2017)	0	Desert scrub, Joshua tree	WEST 2017b
Maple Ridge, NY (2006)	11.21	Agriculture/forested	Jain et al. 2007
Maple Ridge, NY (2007-2008)	4.96	Agriculture/forested	Jain et al. 2009a
Maple Ridge, NY (2007)	6.49	Agriculture/forested	Jain et al. 2009b
Maple Ridge, NY (2012)	7.3	Agriculture/forested	Tidhar et al. 2013b
Marengo I, WA (2009-2010)	0.17	Agriculture	URS 2010b
Marengo II, WA (2009-2010)	0.27	Agriculture	URS 2010c
Mars Hill, ME (2007)	2.91	Forest	Stantec 2008a
Mars Hill, ME (2008)	0.45	Forest	Stantec 2009a
Milford I, UT (2010-2011)	2.05	Desert shrub	Stantec 2011b
Milford I & II, UT (2011-2012)	1.67	Desert shrub	Stantec 2012b
Montezuma I, CA (2011)	1.9	Agriculture and grasslands	ICF International 2012
Montezuma I, CA (2012)	0.84	Agriculture and grasslands	ICF International 2013
Montezuma II, CA (2012-2013)	0.91	Agriculture	Harvey & Associates 2013
Moraine II, MN (2009)	2.42	Agriculture/grassland	Derby et al. 2010f
Mount Storm, WV (Fall 2008)	6.62	Forest	Young et al. 2009c
Mount Storm, WV (2009)	17.53	Forest	Young et al. 2009a, 2010b
Mount Storm, WV (2010)	15.18	Forest	Young et al. 2010a, 2011b
Mount Storm, WV (2011)	7.43	Forest	Young et al. 2011a, 2012a
Mountaineer, WV (2003)	31.69	Forest	Kerns and Kerlinger 2004
Munnsville, NY (2008)	1.93	Agriculture/forest	Stantec 2009b
Mustang Hills, CA (2012-2013)	0.1	Grasslands and riparian	Chatfield and Bay 2014
Mustang Hills, CA (2014-2015)	0	NA	WEST 2016c
Mustang Hills, CA (2016-2017)	0.33	Desert scrub, Joshua tree	WEST 2018
Nine Canyon, WA (2002-2003)	2.47	Agriculture/grassland	Erickson et al. 2003
Noble Altona, NY (2010)	4.34	Forest	Jain et al. 2011a
Noble Bliss, NY (2008)	7.8	Agriculture/forest	Jain et al. 2009c
Noble Bliss, NY (2009)	3.85	Agriculture/forest	Jain et al. 2010c
Noble Chateaugay, NY (2010)	2.44	Agriculture	Jain et al. 2011b
Noble Clinton, NY (2008)	3.14	Agriculture/forest	Jain et al. 2009d
Noble Clinton, NY (2009)	4.5	Agriculture/forest	Jain et al. 2010a
Noble Ellenburg, NY (2008)	3.46	Agriculture/forest	Jain et al. 2009e
Noble Ellenburg, NY (2009)	3.91	Agriculture/forest	Jain et al. 2010b
Noble Wethersfield, NY (2010)	16.3	Agriculture	Jain et al. 2011c
NPPD Ainsworth, NE (2006)	1.16	Agriculture/grassland	Derby et al. 2007
Oakfield, ME (2017)	0.51	Grassland	TRC 2018

Appendix A2. Fatality estimates for North American wind energy facilities.

Project	Bat Fatalities (bats/MW/ year)	Predominant Habitat Type	Citation
Odell, MN (2016-2017)	6.74	Agriculture	Chodachek and Gustafson 2018
Pacific Wind, CA (2014-2015)	0.21	NA	WEST 2016a
Pacific Wind, CA (2015-2016)	0	NA	WEST 2017a
Palouse Wind, WA (2012-2013)	4.23	Agriculture and grasslands	Stantec 2013a
Pebble Springs, OR (2009-2010)	1.55	Grassland	Gritski and Kronner 2010b
Pinnacle, WV (2012)	40.2	Forest	Hein et al. 2013b
Pinyon Pines I & II, CA (2013-2014)	0.04	NA	Chatfield and Russo 2014
Pinyon Pines I & II, CA (2015-2016)	0.18	NA	Rintz and Starcevich 2016
Pioneer Prairie I, IA (Phase II; 2011-2012)	4.43	Agriculture, grassland	Chodachek et al. 2012
Pioneer Prairie II, IA (2013)	3.83	Agriculture	Chodachek et al. 2014
Pleasant Valley, MN (2016-2017)	1.8	NA	Tetra Tech 2017b
Prairie Rose, MN (2014)	0.41	Agriculture	Chodachek et al. 2015
PrairieWinds ND1 (Minot), ND (2010)	2.13	Agriculture	Derby et al. 2011d
PrairieWinds ND1 (Minot), ND (2011)	1.39	Agriculture, grassland	Derby et al. 2012d
PrairieWinds SD1, SD (2011-2012)	1.23	Grassland	Derby et al. 2012c
PrairieWinds SD1, SD (2012-2013)	1.05	Grassland	Derby et al. 2013a
PrairieWinds SD1, SD (2013-2014)	0.52	Grassland	Derby et al. 2014
Rail Splitter, IL (2012-2013)	11.21	Agriculture	Good et al. 2013b
Record Hill, ME (2012)	2.96	Forest	Stantec 2013b
Record Hill, ME (2014)	0.55	Forest	Stantec 2015b
Record Hill, ME (2016)	1.25	Forest	Stantec 2017
Red Hills, OK (2012-2013)	0.11	Grassland	Derby et al. 2013c
Ripley, Ont (2008)	4.67	Agriculture	Jacques Whitford 2009
Rising Tree, CA (2017-2018)	0	Desert scrub, woodland	Chatfield et al. 2018
Rollins, ME (2012)	0.18	Forest	Stantec 2013c
Rollins, ME (2014)	0.33	Gravel	Stantec 2015c
Roth Rock, MD (2011)	6.24	Rocky	Atwell, LLC 2012
Rugby, ND (2010-2011)	1.6	Agriculture	Derby et al. 2011c
Shiloh I, CA (2006-2009)	3.92	Agriculture/grassland	Kerlinger et al. 2009
Shiloh II, CA (2009-2010)	2.6	Agriculture	Kerlinger et al. 2010, 2013a
Shiloh II, CA (2010-2011)	3.8	Agriculture	Kerlinger et al. 2013a
Shiloh II, CA (2011-2012)	3.4	Agriculture	Kerlinger et al. 2013a
Shiloh III, CA (2012-2013)	0.4	NA	Kerlinger et al. 2013b
Solano III, CA (2012-2013)	0.31	NA	AECOM 2013
Spring Valley, NV (2012-2013)	3.73	Grassland, shrub steppe	WEST 2014
Spruce Mountain Wind Project, ME (2014)	0.31	NA	Tetra Tech 2015
Stateline, OR/WA (2001-2002)	1.09	Agriculture/grassland	Erickson et al. 2004
Stateline, OR/WA (2003)	2.29	Agriculture/grassland	Erickson et al. 2004
Stateline, OR/WA (2006)	0.95	Agriculture/grassland	Erickson et al. 2007

Appendix A2. Fatality estimates for North American wind energy facilities.

Project	Bat Fatalities (bats/MW/ year)	Predominant Habitat Type	Citation
Steel Winds I & II, NY (2013)	6.14	Steel Winds I: grassland, shrub forest; Steel Wind II: gravel, steel slag	Stantec 2014c
Stetson II, ME (2014)	0.83	Forest	Stantec 2015d
Stetson Mountain I, ME (2009)	1.4	Forest	Stantec 2009c
Stetson Mountain I, ME (2011)	0.28	Forest	Normandeau Associates 2011
Stetson Mountain I, ME (2013)	0.18	Forest	Stantec 2014d
Stetson Mountain II, ME (2010)	1.65	Forest	Normandeau Associates 2010
Stetson Mountain II, ME (2012)	2.27	Forest	Stantec 2013d
Summerview, Alb (2005-2006)	10.27	Agriculture	Brown and Hamilton 2006b
Summerview, Alb (2006; 2007)	11.42	Agriculture/grassland	Baerwald 2008
Top Crop I & II, IL (2012-2013)	12.55	Agriculture	Good et al. 2013c
Top of Iowa, IA (2003)	7.16	Agriculture	Jain 2005
Top of Iowa, IA (2004)	10.27	Agriculture	Jain 2005
Top of the World, WY (2010-2011)	2.74	Scrub-shrub, grassland	Rintz and Bay 2012
Top of the World, WY (2011-2012)	2.43	Scrub-shrub, grassland	Rintz and Bay 2013
Top of the World, WY (2012-2013)	2.34	Scrub-shrub, grassland	Rintz and Bay 2014
Tucannon River, WA (2015)	2.22	Agriculture	Hallingstad et al. 2016
Tuolumne (Windy Point I), WA (2009-2010)	0.94	Grassland/shrub-steppe, agriculture and forest	Enz and Bay 2010
Vansycle, OR (1999)	1.12	Agriculture/grassland	Erickson et al. 2000
Vantage, WA (2010-2011)	0.4	Shrub-steppe, grassland	Ventus Environmental Solutions 2012
Waverly Wind, KS (2016-2017)	8.2	NA	Tetra Tech 2017a
Wessington Springs, SD (2009)	1.48	Grassland	Derby et al. 2010c
Wessington Springs, SD (2010)	0.41	Grassland	Derby et al. 2011a
White Creek, WA (2007-2011)	2.04	Grassland/shrub-steppe, agriculture	Downes and Gritski 2012b
Wild Horse, WA (2007)	0.39	Grassland	Erickson et al. 2008
Windstar, CA (2012-2013)	0	NA	Levenstein and Bay 2013b
Windy Flats, WA (2010-2011)	0.41	Grassland/shrub-steppe, agriculture	Enz et al. 2011
Winnebago, IA (2009-2010)	4.54	Agriculture/grassland	Derby et al. 2010g
Wolfe Island, Ont (July-December 2009)	6.42	Grassland	Stantec Consulting Ltd. (Stantec Ltd.) 2010
Wolfe Island, Ont (July-December 2010)	9.5	Grassland	Stantec Ltd. 2011
Wolfe Island, Ont (July-December 2011)	2.49	Grassland	Stantec Ltd. 2012

Appendix A3. All post-construction monitoring studies, project characteristics, and select survey methodology.

Project Name	Total # of turbines	Total MW	Tower size (m)	Number turbines searched	Plot Size	Length of Study	Survey Frequency
Alite, CA (2009-2010)	8	24	80	8	200 m x 200 m	1 year	Weekly (spring, fall), bi-monthly (summer, winter)
Alta I, CA (2011-2012)	100	150	80	25	120-m radius circle	12.5 months	Every two weeks
Alta I, CA (2013-2014)	290	720	80	NA	120-m radius circle	1 year	Monthly ; bi-monthly
Alta I, CA (2015-2016)	290	720	80	NA	120-m radius circle	1 year	Monthly; bi-monthly
Alta II-V, CA (2011-2012)	190	570	80	41	120-m radius circle	14.5 months	Every 2 weeks
Alta II-V, CA (2013-2014)	290	720	80	NA	120-m radius circle	1 year	Monthly ; bi-monthly
Alta II-V, CA (2015-2016)	290	720	80	NA	120-m radius circle	1 year	Monthly; bi-monthly
Alta VIII, CA (2012-2013)	50	150	90	12 plots (equivalent to 15 turbines)	240 m x 240 m	1 year	Bi-weekly
Alta VIII, CA (2014-2015)	100	300	90	NA	240 m x 240 m	NA	Bi-monthly
Alta VIII, CA (2016-2017)	100	300	100	NA	240 m x 240 m	1 year	Bi-weekly
Alta X, CA (2014-2015)	48	137	100	NA	240 m x 240 m	1 year	Bi-monthly
Alta X, CA (2015-2016)	48	137	100	NA	240 m x 240 m	1 year	Bi-monthly
Barton Chapel, TX (2009-2010)	60	120	78	30	200 m x 200 m	1 year	10 turbines weekly, 20 monthly

Appendix A3. All post-construction monitoring studies, project characteristics, and select survey methodology.

Project Name	Total # of turbines	Total MW	Tower size (m)	Number turbines searched	Plot Size	Length of Study	Survey Frequency
Barton I & II, IA (2010-2011)	80	160	100	35 (9 turbines were dropped in June 2010 due to landowner issues) 26 turbines were searched for the remainder of the study	200 m x 200 m	1 year	Weekly (spring, fall; migratory turbines), monthly (summer, winter; non-migratory turbines)
Beech Ridge, WV (2012)	67	100.5	80	67	40-m radius	7 months	Every 2 days
Beech Ridge, WV (2013)	67	100.5	80	67	40-m radius	7.5 months	Every 2 days
Big Blue, MN (2013)	18	36	78 or 90 (according to Gamesa website)	18	200-m diameter	NA	Weekly, monthly (Nov. and Dec.)
Big Blue, MN (2014)	18	36	78 or 90 (according to Gamesa website)	18	200-m diameter	NA	Weekly, monthly (Nov. and Dec.)
Big Horn, WA (2006-2007)	133	199.5	80	133	180 m x 180 m	1 year	Bi-monthly (spring, fall), monthly (winter, summer)
Big Smile, OK (2012-2013)	66	132	78	17 (plus one MET tower)	100 m x 100 m	1 year	Weekly (spring, summer, fall), monthly (winter)
Biglow Canyon, OR (Phase I; 2008)	76	125.4	80	50	110 m x 110 m	1 year	Bi-monthly (spring, fall), monthly (winter, summer)
Biglow Canyon, OR (Phase I; 2009)	76	125.4	80	50	110 m x 110 m	1 year	Bi-monthly (spring, fall), monthly (winter, summer)
Biglow Canyon, OR (Phase II; 2009-2010)	65	150	80	50	250 m x 250 m	1 year	Bi-monthly (spring, fall), monthly (winter, summer)
Biglow Canyon, OR (Phase II; 2010-2011)	65	150	80	50	252 m x 252 m	1 year	Bi-weekly (spring, fall), monthly (summer, winter)

Appendix A3. All post-construction monitoring studies, project characteristics, and select survey methodology.

Project Name	Total # of turbines	Total MW	Tower size (m)	Number turbines searched	Plot Size	Length of Study	Survey Frequency
Biglow Canyon, OR (Phase III; 2010-2011)	76	174.8	80	50	252 m x 252 m	1 year	Bi-weekly (spring, fall), monthly (summer, winter)
Bingham Wind Project, ME (2017)	56	185	94	NA	Within 80m; within 140 m	7 months	Twice weekly
Blue Sky Green Field, WI (2008; 2009)	88	145	80	30	160 m x 160 m	fall, spring	Daily (10 turbines), weekly (20 turbines)
Buffalo Gap I, TX (2006)	67	134	78	21	215 m x 215 m	10 months	Every 3 weeks
Buffalo Gap II, TX (2007-2008)	155	233	80	36	215 m x 215 m	14 months	Every 21 days
Buffalo Mountain, TN (2000-2003)	3	1.98	65	3	50-m radius	3 years	Bi-weekly, weekly, bi-monthly
Buffalo Mountain, TN (2005)	18	28.98	V47 = 65; V80 = 78	18	50-m radius	1 year	Bi-weekly, weekly, bi-monthly, and 2- to 5-day intervals
Buffalo Ridge, MN (Phase I; 1996)	73	25	36	21	126 m x 126 m	1 year	Bi-monthly (spring, summer, and fall)
Buffalo Ridge, MN (Phase I; 1997)	73	25	36	21	126 m x 126 m	1 year	Bi-monthly (spring, summer, and fall)
Buffalo Ridge, MN (Phase I; 1998)	73	25	36	21	126 m x 126 m	1 year	Bi-monthly (spring, summer, and fall)
Buffalo Ridge, MN (Phase I; 1999)	73	25	36	21	126 m x 126 m	1 year	Bi-monthly (spring, summer, and fall)
Buffalo Ridge, MN (Phase II; 1998)	143	107.25	50	40	126 m x 126 m	1 year	Bi-monthly (spring, summer, and fall)
Buffalo Ridge, MN (Phase II; 1999)	143	107.25	50	40	126 m x 126 m	1 year	Bi-monthly (spring, summer, and fall)
Buffalo Ridge, MN (Phase II; 2001/Lake Benton I)	143	107.25	50	83	60 m x 60 m	Summer, fall	Bi-monthly
Buffalo Ridge, MN (Phase II; 2002/Lake Benton I)	143	107.25	50	103	60 m x 60 m	Summer, fall	Bi-monthly

Appendix A3. All post-construction monitoring studies, project characteristics, and select survey methodology.

Project Name	Total # of turbines	Total MW	Tower size (m)	Number turbines searched	Plot Size	Length of Study	Survey Frequency
Buffalo Ridge, MN (Phase III; 1999)	138	103.5	50	30	126 m x 126 m	1 year	Bi-monthly (spring, summer, and fall)
Buffalo Ridge, MN (Phase III; 2001/Lake Benton II)	138	103.5	50	83	60 m x 60 m	Summer, fall	Bi-monthly
Buffalo Ridge, MN (Phase III; 2002/Lake Benton II)	138	103.5	50	103	60 m x 60 m	Summer, fall	Bi-monthly
Buffalo Ridge I, SD (2009-2010)	24	50.4	79	24	200 m x 200 m	1 year	Weekly (migratory), monthly (non-migratory)
Buffalo Ridge II, SD (2011-2012)	105	210	78	65 (60 road and pad, 5 turbine plots)	100 m x 100 m	1 year	Weekly (spring, summer, fall), monthly (winter)
Bull Hill, ME (2013)	19	34	95	19	80-m radius	6 months	Weekly (spring), daily and weekly (fall)
Cameron Ridge/Section 15, CA (2014-2015)	34	102	80	NA	62.5-m radius circle	1 year	Weekly
Cameron Ridge/Section 15, CA (2015-2016)	34	102	80	NA	125-m radius circle	NA	Weekly
Casselman Curtailment, PA (2008)	23	35.4	80	12 experimental; 10 control	126 m x 120 m	2.5 months	Daily
Casselman, PA (2008)	23	34.5	80	10	126 m x 120 m	7 months	Daily
Casselman, PA (2009)	23	34.5	80	10	126 m x 120 m	7.5 months	Daily searches
Cedar Ridge, WI (2009)	41	67.6	80	20	160 m x 160 m	Spring, summer, fall	Daily, every 4 days; late fall searched every 3 days
Cedar Ridge, WI (2010)	41	68	80	20	160 m x 160 m	1 year	5 turbines were surveyed daily, 15 turbines surveyed every 4 days in rotating groups each day. All 20 surveyed every three days during late fall

Appendix A3. All post-construction monitoring studies, project characteristics, and select survey methodology.

Project Name	Total # of turbines	Total MW	Tower size (m)	Number turbines searched	Plot Size	Length of Study	Survey Frequency
Chopin, OR (2016-2017)	6	10	NA	NA	270 m x 270 m	1 year	Monthly
Cohocton/Dutch Hill, NY (2009)	50	125	80	17	130 m x 130 m	Spring, summer, fall	Daily (5 turbines), weekly (12 turbines)
Cohocton/Dutch Hills, NY (2010)	50	125	80	17	120 m x 120 m	Spring, summer, fall	Daily, weekly
Cohocton/Dutch Hill, NY (2013)	50	125	80	NA	120 m x 120 m	Late summer, fall	Weekly
Combine Hills, OR (Phase I; 2004-2005)	41	41	53	41	90-m radius	1 year	Monthly
Combine Hills, OR (2011)	104	104	53	52 (plus 1 MET tower)	180 m x 180 m	1 year	Bi-weekly(spring, fall), monthly (summer, winter)
Crescent Ridge, IL (2005-2006)	33	49.5	80	33	70-m radius	1 year	Weekly (fall, spring)
Criterion, MD (2011)	28	70	80	28	40- to 50-m radius	7.3 months	Daily
Criterion, MD (2012)	28	70	80	14	40- to 50-m radius	7.5 months	Weekly
Criterion, MD (2013)	28	70	80	14	40- to 50-m radius	7.5 months	Weekly
Crystal Lake II, IA (2009)	80	200	80	16 turbines through week 6, and then 15 for duration of study	100 m x 100 m	Spring, summer, fall	3 times per week for 26 weeks
Diablo Winds, CA (2005-2007)	31	20.46	50 and 55	31	75 m x 75 m	2 years	Monthly
Dillon, CA (2008-2009)	45	45	69	15	200 m x 200 m	1 year	Weekly, bi-monthly in winter
Dry Lake I, AZ (2009-2010)	30	63	78	15	160 m x 160 m	1 year	Bi-monthly (spring, fall), monthly (winter, summer)

Appendix A3. All post-construction monitoring studies, project characteristics, and select survey methodology.

Project Name	Total # of turbines	Total MW	Tower size (m)	Number turbines searched	Plot Size	Length of Study	Survey Frequency
Dry Lake II, AZ (2011-2012)	31	65	78	31: 5 (full plot), 26 (road and pad)	160 m x 160 m	1 year	Twice weekly (spring, summer, fall), weekly (winter)
Elkhorn, OR (2008)	61	101	80	61	220 m x 220 m	1 year	Monthly
Elkhorn, OR (2010)	61	101	80	31	220 m x 220 m	1 year	Bi-monthly (spring, fall), monthly (winter, summer)
Elm Creek, MN (2009-2010)	67	100	80	29	200 m x 200 m	1 year	Weekly, monthly
Elm Creek II, MN (2011-2012)	62	148.8	80	30	200 m x 200 m (2 random migration search areas 100 m x 100 m)	1 year	20 searched every 28 days, 10 turbines every 7 days during migration)
Foote Creek Rim I, WY (1999)	69	41	60	NA	126 m x 126 m	26 months	Monthly
Foote Creek Rim I, WY (2000)	69	41	60	NA	126 m x 126 m	26 months	Monthly
Foote Creek Rim I, WY (2001-2002)	69	41	60	NA	126 m x 126 m	26 months	Monthly
Foote Creek Rim, WY (UV; 1999-2000)	105	67.95	Mitsubishi = 40, NEG = 50	105	120 m x 120 m	17 months	Monthly
Forward Energy Center, WI (2008-2010)	86	129	80	29	160 m x 160 m	2 years	11 turbines daily, 9 every 3 days, 9 every 5 days
Fowler I, IN (2009)	162	301	78 (Vestas), 80 (Clipper)	25	160 m x 160 m	Spring, summer, fall	Weekly, bi-weekly
Fowler I, II, III, IN (2010)	355	600	Vestas = 80, Clipper = 80, GE = 80	36 turbines, 100 road and pads	80 m x 80 m for turbines ; 40-m radius for roads and pads	Spring, fall	Daily, weekly

Appendix A3. All post-construction monitoring studies, project characteristics, and select survey methodology.

Project Name	Total # of turbines	Total MW	Tower size (m)	Number turbines searched	Plot Size	Length of Study	Survey Frequency
Fowler I, II, III, IN (2011)	355	600	Vestas = 80, Clipper = 80, GE = 80	177 road and pads (spring), 9 turbines and 168 roads and pads (fall)	Turbines (80-m circular plot), roads and pads (out to 80 m)	spring, fall	Daily, weekly
Fowler I, II, III, IN (2012)	355	600	Vestas = 80, Clipper = 80, GE = 80	118 roads and pads	Roads and pads (out to 80 m)	2.5 months	Weekly
Fowler III, IN (2009)	60	99	78	12	160 m x 160 m	10 weeks	Weekly, bi-weekly
Fowler, IN (2014)	355	600	80	NA	Road/pad	3 months	Twice weekly
Fowler, IN (2015)	420	NA	80	NA	Road/pad	3 months	Weekly
Fowler, IN (2016)	420	750	80	NA	Road/pad (out to 80 m)	3 months	Weekly
Goodnoe, WA (2009-2010)	47	94	80	24	180 m x 180 m	1 year	14 days during migration periods, 28 days during non-migration periods
Grand Ridge I, IL (2009-2010)	66	99	80	30	160 m x 160 m	1 year	Weekly, monthly
Groton, NH (2013)	24	48	78	NA	60-m radius circle; road/pad	7 months	Weekly
Groton, NH (2014)	24	48	78	NA	60-m radius circle; road/pad	6 months	Weekly
Groton, NH (2015)	24	48	78	NA	60-m radius circle; road/pad	6 months	Weekly
Hancock, ME (2017)	17	51	80	NA	within 80 m; within 140 m	7 months	Twice weekly
Harrow, Ont (2010)	24 (four 6-turb facilities)	39.6	NA	12 in July, 24 Aug-Oct	50-m radius from turbine base	4 months	Twice-weekly

Appendix A3. All post-construction monitoring studies, project characteristics, and select survey methodology.

Project Name	Total # of turbines	Total MW	Tower size (m)	Number turbines searched	Plot Size	Length of Study	Survey Frequency
Harvest Wind, WA (2010-2012)	43	98.9	80	32	180 m x 180 m and 240 m x 240 m	2 years	Twice a week, weekly and monthly
Hatchet Ridge, CA (2011)	44	101	80	NA	127 m x 127 m (bi-monthly), 190 m x 190 m (monthly)	NA	Half bi-monthly; half monthly
Hatchet Ridge, CA (2012)	44	101	80	NA	127 m x 127 m (bi-monthly), 190 m x 190 m (monthly)	NA	Half bi-monthly; half monthly
Hatchet Ridge, CA (2012-2013)	44	NA	80	NA	127 m x 127 m	1 year	Bi-weekly
Hay Canyon, OR (2009-2010)	48	100.8	79	20	180 m x 180 m	1 year	Bi-monthly (spring, fall), monthly (winter, summer)
High Sheldon, NY (2010)	75	112.5	80	25	115 m x 115 m	7 months	Daily (8 turbines), weekly (17 turbines)
High Sheldon, NY (2011)	75	112.5	80	25	115 m x 115 m	7 months	Daily (8 turbines), weekly (17 turbines)
High Winds, CA (2003-2004)	90	162	60	90	75-m radius	1 year	Bi-monthly
High Winds, CA (2004-2005)	90	162	60	90	75-m radius	1 year	Bi-monthly
Hopkins Ridge, WA (2006)	83	150	67	41	180 m x 180 m	1 year	Monthly, weekly (subset of 22 turbines spring and fall migration)
Hopkins Ridge, WA (2008)	87	156.6	67	41-43	180 m x 180 m	1 year	Bi-monthly (spring, fall), monthly (winter, summer)
Howard, NY (2012)	27	54	78.5	NA	120 m x 120 m	7 months	Daily; weekly
Howard, NY (2013)	27	54	78.5	NA	120 m x 120 m	6 months	Daily; weekly

Appendix A3. All post-construction monitoring studies, project characteristics, and select survey methodology.

Project Name	Total # of turbines	Total MW	Tower size (m)	Number turbines searched	Plot Size	Length of Study	Survey Frequency
Judith Gap, MT (2006-2007)	90	135	80	20	190 m x 190 m	7 months	Monthly
Judith Gap, MT (2009)	90	135	80	30	100 m x 100 m	5 months	Bi-monthly
Kewaunee County, WI (1999-2001)	31	20.46	65	31	60 m x 60 m	2 years	Bi-weekly (spring, summer), daily (spring, fall migration), weekly (fall, winter)
Kibby, ME (2011)	44	132	124	22 turbines	75-m diameter circular plots	22 weeks	Avg. 5-day
Kittitas Valley, WA (2011-2012)	48	100.8	80	48	100 m x 102 m	1 year	Bi-weekly from Aug 15 - Oct 31 and March 16 - May 15; every 4 weeks from Nov 1 - March 15 and May 16 - Aug 14
Klondike, OR (2002-2003)	16	24	80	16	140 m x 140 m	1 year	Monthly
Klondike II, OR (2005-2006)	50	75	80	25	180 m x 180 m	1 year	Bi-monthly (spring, fall), monthly (summer, winter)
Klondike III (Phase I), OR (2007-2009)	125	223.6	GE = 80; Siemens= 80, Mitsubishi = 80	46	240 m x 240 m (1.5 MW) 252 m x 252 m (2.3 MW)	2 year	Bi-monthly (spring, fall migration), monthly (summer, winter)
Klondike IIIa (Phase II), OR (2008-2010)	51	76.5	GE = 80	34	240 m x 240 m	2 years	Bi-monthly (spring, fall), monthly (summer, winter)
Lakefield Wind, MN (2012)	137	205.5	80	26	100 m x 100 m	7.5 months	3 times per week
Laurel Mountain, WV (2014)	61	98	80	NA	90 m x 90 m	7 months	Every 3 days; daily
Leaning Juniper, OR (2006-2008)	67	100.5	80	17	240 m x 240 m	2 years	Bi-monthly (spring, fall), monthly (winter, summer)
Lempster, NH (2009)	12	24	78	4	120 m x 130 m	6 months	Daily

Appendix A3. All post-construction monitoring studies, project characteristics, and select survey methodology.

Project Name	Total # of turbines	Total MW	Tower size (m)	Number turbines searched	Plot Size	Length of Study	Survey Frequency
Lempster, NH (2010)	12	24	78	12	120 m x 130 m	6 months	Weekly
Linden Ranch, WA (2010-2011)	25	50	80	25	110 m x 110 m	1 year	Bi-weekly(spring, fall), monthly (summer, winter)
Locust Ridge, PA (Phase II; 2009)	51	102	80	15	120 m x 126 m	6.5 months	Daily
Locust Ridge, PA (Phase II; 2010)	51	102	80	15	120 m x 126 m	6.5 months	Daily
Lower West, CA (2012-2013)	7	14	110.5	NA	120-m radius circle	NA	Bi-monthly
Lower West, CA (2014-2015)	7	14	110.5	NA	120-m radius circle	NA	Bi-monthly
Lower West, CA (2016-2017)	7	14	110.5	NA	120-m radius	1 year	Twice weekly
Maple Ridge, NY (2006)	120	198	80	50	130 m x 120 m	5 months	Daily (10 turbines), every 3 days (10 turbines), weekly (30 turbines)
Maple Ridge, NY (2007-2008)	195	321.75	80	64	130 m x 120 m	7 months	Weekly
Maple Ridge, NY (2007)	195	321.75	80	64	130 m x 120 m	7 months	Weekly
Maple Ridge, NY (2012)	195	321.75	80	105 (5 turbines, 100 roads/pads)	100 m x 100 m	3 months	Weekly
Marengo I, WA (2009-2010)	78	140.4	67	39	180 m x 180 m	1 year	Bi-monthly (spring, fall), monthly (winter, summer)
Marengo II, WA (2009-2010)	39	70.2	67	20	180 m x 180 m	1 year	Bi-monthly (spring, fall), monthly (winter, summer)
Mars Hill, ME (2007)	28	42	80.5	28	76-m diameter, extended plot 238-m diameter	Spring, summer, fall	Daily (2 random turbines), weekly (all turbines): extended plot searched once per season

Appendix A3. All post-construction monitoring studies, project characteristics, and select survey methodology.

Project Name	Total # of turbines	Total MW	Tower size (m)	Number turbines searched	Plot Size	Length of Study	Survey Frequency
Mars Hill, ME (2008)	28	42	80.5	28	76-m diameter, extended plot 238-m diameter	Spring, summer, fall	Weekly: extended plot searched once per season
Milford I, UT (2010-2011)	58	145	80	24	120 m x120 m	NA	Weekly
Milford I & II, UT (2011-2012)	107	160.5 (58.5 I, 102 II)	80	43	120 m x120 m	NA	Every 10.5 days
Montezuma I, CA (2011)	16	36.8	80	16	105-m radius	1 year	Weekly and bi-Weekly
Montezuma I, CA (2012)	16	36.8	80	16	105-m radius	1 year	Weekly and bi-Weekly
Montezuma II, CA (2012-2013)	34	78.2	80	17	105 m radius	1 year	Weekly
Moraine II, MN (2009)	33	49.5	82.5	30	200 m x 200 m	1 year	Weekly (migratory), monthly (non-migratory)
Mount Storm, WV (Fall 2008)	82	164	78	27	Varied	3 months	Weekly (18 turbines), daily (9 turbines)
Mount Storm, WV (2009)	132	264	78	44	Varied	4.5 months	Weekly (28 turbines), daily (16 turbines)
Mount Storm, WV (2010)	132	264	78	24	20 to 60 m from turbine	6 months	Daily
Mount Storm, WV (2011)	132	264	78	24	Varied	6 months	Daily
Mountaineer, WV (2003)	44	66	80	44	60-m radius	7 months	Weekly, monthly
Munnsville, NY (2008)	23	34.5	69.5	12	120 m x 120 m	Spring, summer, fall	Weekly
Mustang Hills, CA (2012-2013)	50	150	90	13 plots (equivalent to 15 turbines)	240 m x 240 m	1 year	Bi-weekly
Mustang Hills, CA (2014-2015)	100	300	90	NA	240 m x 240 m	Na	Bi-monthly

Appendix A3. All post-construction monitoring studies, project characteristics, and select survey methodology.

Project Name	Total # of turbines	Total MW	Tower size (m)	Number turbines searched	Plot Size	Length of Study	Survey Frequency
Mustang Hills, CA (2016-2017)	100	300	100	NA	240 m x 240 m	1 year	Bi-weekly
Nine Canyon, WA (2002-2003)	37	48.1	60	37	90-m radius	1 year	Bi-monthly (spring, summer, fall), monthly (winter)
Noble Altona, NY (2010)	65	97.5	80	22	120 m x 120 m	Spring, summer, fall	Daily, weekly
Noble Bliss, NY (2008)	67	100	80	23	120 m x 120 m	Spring, summer, fall	Daily (8 turbines), 3-day (8 turbines), weekly (7 turbines)
Noble Bliss, NY (2009)	67	100	80	23	120 m x 120 m	Spring, summer, fall	Weekly, 8 turbines searched daily from July 1 to August 15
Noble Chateaugay, NY (2010)	71	106.5	80	24	120 m x 120 m	Spring, summer, fall	Weekly
Noble Clinton, NY (2008)	67	100	80	23	120 m x 120 m	Spring, summer, fall	Daily (8 turbines), 3-day (8 turbines), weekly (7 turbines)
Noble Clinton, NY (2009)	67	100	80	23	120 m x 120 m	Spring, summer, fall	Daily (8 turbines), weekly (15 turbines), all turbines weekly from July 1 to August 15
Noble Ellenburg, NY (2008)	54	80	80	18	120 m x 120 m	Spring, summer, fall	Daily (6 turbines), 3-day (6 turbines), weekly (6 turbines)
Noble Ellenburg, NY (2009)	54	80	80	18	120 m x 120 m	Spring, summer, fall	Daily (6 turbines), weekly (12 turbines), all turbines weekly from July 1 to August 15
Noble Wethersfield, NY (2010)	84	126	80	28	120 m x 120 m	Spring, summer, fall	Weekly

Appendix A3. All post-construction monitoring studies, project characteristics, and select survey methodology.

Project Name	Total # of turbines	Total MW	Tower size (m)	Number turbines searched	Plot Size	Length of Study	Survey Frequency
NPPD Ainsworth, NE (2006)	36	20.5	70	36	220 m x 220 m	Spring, summer, fall	Bi-monthly
Oakfield, ME (2017)	48	148	94	NA	Within 80 m; within 140 m	7 months	Every other day
Odell, MN (2016-2017)	100	200	NA	NA	120 m x 120 m	1 year	Monthly; weekly
Pacific Wind, CA (2014-2015)	70	144	78.5	NA	126-m radius circle	NA	Weekly
Pacific Wind, CA (2015-2016)	70	144	78.5	NA	63-m radius circle	NA	Weekly
Palouse Wind, WA (2012-2013)	58	104.4	80, 90, or 105 M (according to the Vestas website)	19	120 m x 120 m	1 year	Monthly (winter) and weekly (spring-fall)
Passadumkeag, ME (2016)	13	43	NA	NA	80-m radius	6 months	Every 3 days
Pebble Springs, OR (2009-2010)	47	98.7	79	20	180 m x 180 m	1 year	Bi-monthly (spring, fall), monthly (winter, summer)
Pine Tree, CA (2009-2010, 2011)	90	135	65	40	100-m radius	1.5 year	Bi-weekly, weekly
Pinnacle, WV (2012)	23	55.2	80	11	126 m x 120 m	9 months	Weekly
Pinyon Pines I & II, CA (2013-2014)	100	NA	90	25 plots (approx. 31 turbines)	240 m x240 m	NA	Bi-weekly
Pinyon Pines I & II, CA (2015-2016)	100	300	90	NA	240 m x 240 m	NA	Bi-monthly
Pinyon Pines I & II, CA (2017-2018)	100	300	90	NA	240 m x 240 m	1 year	Bi-weekly
Pioneer Prairie I, IA (Phase II; 2011-2012)	62	102.3	80	62 (57 road/pad) 5 full search plots	80 m x 80 m	1 year	Weekly (spring and fall), every 2 weeks (summer), monthly (winter)

Appendix A3. All post-construction monitoring studies, project characteristics, and select survey methodology.

Project Name	Total # of turbines	Total MW	Tower size (m)	Number turbines searched	Plot Size	Length of Study	Survey Frequency
Pioneer Prairie II, IA (2013)	62	102.3	80	62	80 m x 80 m (5 turbines), road and pad within 100 m of turbine (57 turbines)	NA	Weekly
Pleasant Valley, MN (2016-2017)	100	200	95	NA	160m x 160m	NA	Weekly
Prairie Rose, MN (2014)	119	200	80	NA	100 m x 100 m (spring); road/pad (fall)	1 year	Weekly
PrairieWinds ND1 (Minot), ND (2010)	80	115.5	89	35	Minimum of 100 m x 100 m	3 seasons	Bi-monthly
PrairieWinds ND1 (Minot), ND (2011)	80	115.5	80	35	Minimum 100 m x 100 m	3 season	Twice monthly
PrairieWinds SD1, SD (2011-2012)	108	162	80	50	200 m x 200 m	1 year	Twice monthly (spring, summer, fall), monthly (winter)
PrairieWinds SD1, SD (2012-2013)	108	162	80	50	200 m x 200 m	1 year	Bi-weekly
PrairieWinds SD1, SD (2013-2014)	108	162	80	45	200 m x 200 m	1 year	Twice monthly (spring, summer, fall), monthly (winter)
Rail Splitter, IL (2012-2013)	67	100.5	80	34	60-m radius	1 year	Weekly (spring, summer, and fall) and bi-weekly (winter)
Record Hill, ME (2012)	22	50.6	80	22	126.5 m x 126.5 m	5 months	3 times every 2 weeks
Record Hill, ME (2014)	22	50.6	80	10	Varied due to steep terrain and heavily vegetated areas	4.5 months	Daily for 5 days a week

Appendix A3. All post-construction monitoring studies, project characteristics, and select survey methodology.

Project Name	Total # of turbines	Total MW	Tower size (m)	Number turbines searched	Plot Size	Length of Study	Survey Frequency
Record Hill, ME (2016)	22	51	80	NA	42.5-m radius	7 months	3 times every 2 weeks
Red Hills, OK (2012-2013)	82	123	80	20 (plus one MET tower)	100 m x 100 m	1 year	Weekly (spring, summer, fall), monthly (winter)
Ripley, Ont (2008)	38	76	64	38	80 m x 80 m	Spring, fall	Twice weekly for odd turbines; weekly for even turbines.
Rising Tree, CA (2015-2016)	60	198	84	NA	280 m x 280 m	NA	Bi-monthly
Rising Tree, CA (2017-2018)	60	198	84	NA	280 m x 280 m	1 year	Bi-weekly
Rollins, ME (2012)	40	60	80	20	Varied; turbine laydown area and gravel access roads out to 60m	6 months	Weekly
Rollins, ME (2014)	40	60	NA	NA	60-m radius	6 months	Weekly
Roth Rock, MD (2011)	20	50	80	NA	80 m x 80 m	3 months	Daily
Rugby, ND (2010-2011)	71	149	78	32	200 m x 200 m	1 year	Weekly (spring, fall; migratory turbines), monthly (non-migratory turbines)
Shiloh I, CA (2006-2009)	100	150	65	100	105-m radius	3 years	Weekly
Shiloh II, CA (2009-2010)	75	150	80	25	100-m radius	1 year	Weekly
Shiloh II, CA (2010-2011)	75	150	80	25	100-m radius	1 year	Weekly
Shiloh II, CA (2011-2012)	75	150	80	25	NA	1 year	Weekly
Shiloh III, CA (2012-2013)	50	102.5	78.5	25	100-m radius	NA	Weekly
Solano III, CA (2012-2013)	55	128	80	19	100-m radius	NA	Bi-weekly

Appendix A3. All post-construction monitoring studies, project characteristics, and select survey methodology.

Project Name	Total # of turbines	Total MW	Tower size (m)	Number turbines searched	Plot Size	Length of Study	Survey Frequency
Spring Valley, NV (2012-2013)	66	152	80	NA	126 m x 126 m	14 months	Bi-weekly; daily
Spruce Mountain Wind Project, ME (2014)	10	20	78	NA	Road/pad	NA	Twice weekly
Stateline, OR/WA (2001-2002)	454	299	50	124	Minimum 126 m x 126 m	17 months	Bi-weekly, monthly
Stateline, OR/WA (2003)	454	299	50	153	Minimum 126 m x 126 m	1 year	Bi-weekly, monthly
Stateline, OR/WA (2006)	454	299	50	39	Variable turbine strings	1 year	Bi-weekly
Steel Winds I & II, NY (2013)	14	35	80	NA	120 m x 120 m	5 months	Twice weekly
Stetson II, ME (2014)	17	26	NA	NA	60-m radius	6 months	Weekly
Stetson Mountain I, ME (2009)	38	57	80	19	76-m diameter	27 weeks (spring, summer, fall)	Weekly
Stetson Mountain I, ME (2011)	38	57	80	19	79.45x79.45m	6 months	Weekly
Stetson Mountain I, ME (2013)	38	57	80	19	76 m diameter	6 months	Weekly
Stetson Mountain II, ME (2010)	17	25.5	80	17	74.5x74.5m	6 months	Weekly (3 turbines twice a week)
Stetson Mountain II, ME (2012)	17	25.5	80	17	Laydown area and road up to 60m	6 months	Weekly
Summerview, Alb (2005-2006)	39	70.2	67	39	140 m x 140 m	1 year	Weekly, bi-weekly (May to July, September)
Summerview, Alb (2006; 2007)	39	70.2	65	39	52-m radius; 2 spiral transects 7 m apart	Summer, fall (2 years)	Daily (10 turbines), weekly (29 turbines)
Thunder Spirit, ND (2016-2017)	43	108	80	NA	160 m x 160 m; road/pad	10 months	Twice monthly

Appendix A3. All post-construction monitoring studies, project characteristics, and select survey methodology.

Project Name	Total # of turbines	Total MW	Tower size (m)	Number turbines searched	Plot Size	Length of Study	Survey Frequency
Top Crop I & II, IL (2012-2013)	68 (Phase I), 132 (Phase II)	300 (102 Phase I, 198 Phase II)	65 (Phase I) 80 (Phase II)	100	61-m radius	1 year	Weekly (spring, summer, and fall) and bi-weekly (winter)
Top of Iowa, IA (2003)	89	80	71.6	26	76 m x 76 m	Spring, summer, fall	Once every 2 to 3 days
Top of Iowa, IA (2004)	89	80	71.6	26	76 m x 76 m	Spring, summer, fall	Once every 2 to 3 days
Top of the World, WY (2010-2011)	110	200	80	NA	160 m x 160 m	1 year	Weekly; bi-monthly
Top of the World, WY (2011-2012)	110	200	80	NA	160 m x 160 m	1 year	Weekly; bi-monthly
Top of the World, WY (2012-2013)	110	200	80	NA	160 m x 160 m	1 year	Weekly; bi-monthly
Tucannon River, WA (2015)	116	267	80	NA	134-m radius	1 year	NA
Tuolumne (Windy Point I), WA (2009-2010)	62	136.6	80	21	180 m x 180 m	1 year	Monthly throughout the year, a sub-set of 10 turbines were also searched weekly during the spring, summer, and fall
Vansycle, OR (1999)	38	24.9	50	38	126 m x 126 m	1 year	Monthly
Vantage, WA (2010-2011)	60	90	80	30	240 m x 240 m	1 year	Monthly, a subset of 10 searched weekly during migration
Waverly Wind, KS (2016-2017)	95	199	93	NA	160m x 160m; road/pad	1 year	Weekly, bi-weekly
Wessington Springs, SD (2009)	34	51	80	20	200 m x 200 m	Spring, summer, fall	Bi-monthly
Wessington Springs, SD (2010)	34	51	80	20	200 m x 200 m	8 months	Bi-weekly (spring, summer, fall)

Appendix A3. All post-construction monitoring studies, project characteristics, and select survey methodology.

Project Name	Total # of turbines	Total MW	Tower size (m)	Number turbines searched	Plot Size	Length of Study	Survey Frequency
White Creek, WA (2007-2011)	89	204.7	80	89	180 m x 180 m and 240 m x 240 m	4 years	Twice a week, weekly and monthly
Wild Horse, WA (2007)	127	229	67	64	110 m from two turbines in plot	1 year	Monthly, weekly (fall, spring migration at 16 turbines)
Windstar, CA (2012-2013)	53	106	107;110.5	NA	120-m radius circle	NA	Monthly; bi-monthly
Windy Flats, WA (2010-2011)	114	262.2	80	36 (plus 1 MET tower)	180 m x 180 m (120 m at MET tower)	1 year	Monthly (spring, summer, fall, and winter), weekly (spring and fall migration)
Winnebago, IA (2009-2010)	10	20	78	10	200 m x 200 m	1 year	Weekly (migratory), monthly (non-migratory)
Wolfe Island, Ont (July-December 2009)	86	197.8	80	86	60-m radius	Summer, fall	43 twice weekly, 43 weekly
Wolfe Island, Ont (July-December 2010)	86	197.8	80	86	50-m radius	6 months	43 twice weekly, 43 weekly
Wolfe Island, Ont (July-December 2011)	86	197.8	80	86	50-m radius	6 months	43 twice weekly, 43 weekly

Appendix A3 (*continued*). All post-construction monitoring studies, project characteristics, and select survey methodology.

Data from the following sources:

Project, Location	Reference	Project, Location	Reference
Alite, CA (2009-2010)	Chatfield et al. 2010	Lempster, NH (2010)	Tidhar et al. 2011
Alta I, CA (2011-2012)	Chatfield et al. 2012	Linden Ranch, WA (2010-2011)	Enz and Bay 2011
Alta I, CA (2013-2014)	Chatfield et al. 2014	Locust Ridge, PA (Phase II; 2009)	Arnett et al. 2011
Alta I, CA (2015-2016)	Thompson et al. 2016a	Locust Ridge, PA (Phase II; 2010)	Arnett et al. 2011
Alta II-V, CA (2011-2012)	Chatfield et al. 2012	Lower West, CA (2012-2013)	Levenstein and Bay 2013a
Alta II-V, CA (2013-2014)	Chatfield et al. 2014	Lower West, CA (2014-2015)	Levenstein and DiDonato 2015
Alta II-V, CA (2015-2016)	Thompson et al. 2016a	Lower West, CA (2016-2017)	WEST 2017b
Alta VIII, CA (2012-2013)	Chatfield and Bay 2014	Maple Ridge, NY (2006)	Jain et al. 2007
Alta VIII, CA (2014-2015)	Western EcoSystems Technology, Inc. (WEST) 2016c	Maple Ridge, NY (2007)	Jain et al. 2009a
Alta VIII, CA (2016-2017)	WEST 2018	Maple Ridge, NY (2007-2008)	Jain et al. 2009b
Alta X, CA (2014-2015)	Chatfield et al. 2015	Maple Ridge, NY (2012)	Tidhar et al. 2013b
Alta X, CA (2015-2016)	Thompson et al. 2016b	Marengo I, WA (2009-2010)	URS 2010b
Barton I & II, IA (2010-2011)	Derby et al. 2011b	Marengo II, WA (2009-2010)	URS 2010c
Barton Chapel, TX (2009-2010)	WEST 2011	Mars Hill, ME (2007)	Stantec 2008a
Beech Ridge, WV (2012)	Tidhar et al. 2013a	Mars Hill, ME (2008)	Stantec 2009a
Beech Ridge, WV (2013)	Young et al. 2014a	Milford I, UT (2010-2011)	Stantec 2011b
Big Blue, MN (2013)	Fagen Engineering 2014	Milford I & II, UT (2011-2012)	Stantec 2012b
Big Blue, MN (2014)	Fagen Engineering 2015	Montezuma I, CA (2011)	ICF International 2012
Big Horn, WA (2006-2007)	Kronner et al. 2008	Montezuma I, CA (2012)	ICF International 2013
Big Smile, OK (2012-2013)	Derby et al. 2013b	Montezuma II, CA (2012-2013)	Harvey & Associates 2013
Biglow Canyon, OR (Phase I; 2008)	Jeffrey et al. 2009b	Moraine II, MN (2009)	Derby et al. 2010f
Biglow Canyon, OR (Phase I; 2009)	Enk et al. 2010	Mount Storm, WV (2008)	Young et al. 2009c
Biglow Canyon, OR (Phase II; 2009-2010)	Enk et al. 2011b	Mount Storm, WV (2009)	Young et al. 2009a, 2010b
Biglow Canyon, OR (Phase II; 2010-2011)	Enk et al. 2012b	Mount Storm, WV (2010)	Young et al. 2010a, 2011b
Biglow Canyon, OR (Phase III; 2010-2011)	Enk et al. 2012a	Mount Storm, WV (2011)	Young et al. 2011a, 2012a
Bingham Wind Project, ME (2017)	TRC 2017a	Mountaineer, WV (2003)	Kerns and Kerlinger 2004
Blue Sky Green Field, WI (2008; 2009)	Gruver et al. 2009	Munnsville, NY (2008)	Stantec 2009b
Buffalo Gap I, TX (2006)	Tierney 2007	Mustang Hills, CA (2012-2013)	Chatfield and Bay 2014
Buffalo Gap II, TX (2007-2008)	Tierney 2009	Mustang Hills, CA (2014-2015)	WEST 2016c
Buffalo Mountain, TN (2000-2003)	Nicholson et al. 2005	Mustang Hills, CA (2016-2017)	WEST 2018
Buffalo Mountain, TN (2005)	Fiedler et al. 2007	Nine Canyon, WA (2002-2003)	Erickson et al. 2003
Buffalo Ridge, MN (Phase I; 1996)	Johnson et al. 2000	Noble Altona, NY (2010)	Jain et al. 2011a
Buffalo Ridge, MN (Phase I; 1997)	Johnson et al. 2000	Noble Bliss, NY (2008)	Jain et al.2009c
Buffalo Ridge, MN (Phase I; 1998)	Johnson et al. 2000	Noble Bliss, NY (2009)	Jain et al. 2010c

Appendix A3 (*continued*). All post-construction monitoring studies, project characteristics, and select survey methodology.

Data from the following sources:

Project, Location	Reference	Project, Location	Reference
Buffalo Ridge, MN (Phase I; 1999)	Johnson et al. 2000	Noble Chateaugay, NY (2010)	Jain et al. 2011b
Buffalo Ridge, MN (Phase II; 1998)	Johnson et al. 2000	Noble Clinton, NY (2008)	Jain et al. 2009d
Buffalo Ridge, MN (Phase II; 1999)	Johnson et al. 2000	Noble Clinton, NY (2009)	Jain et al. 2010a
Buffalo Ridge, MN (Phase II; 2001/Lake Benton I)	Johnson et al. 2004	Noble Ellenburg, NY (2008)	Jain et al. 2009e
Buffalo Ridge, MN (Phase II; 2002/Lake Benton II)	Johnson et al. 2004	Noble Ellenburg, NY (2009)	Jain et al. 2010b
Buffalo Ridge, MN (Phase III; 1999)	Johnson et al. 2000	Noble Wethersfield, NY (2010)	Jain et al. 2011c
Buffalo Ridge, MN (Phase III; 2001/Lake Benton I)	Johnson et al. 2004	NPPD Ainsworth, NE (2006)	Derby et al. 2007
Buffalo Ridge, MN (Phase III; 2002/Lake Benton II)	Johnson et al. 2004	Oakfield, ME (2017)	TRC 2018
Buffalo Ridge I, SD (2009-2010)	Derby et al. 2010d	Odell, MN (2016-2017)	Chodachek and Gustafson 2018
Buffalo Ridge II, SD (2011-2012)	Derby et al. 2012a	Pacific Wind, CA (2014-2015)	WEST 2016a
Bull Hill, ME (2013)	Stantec 2014a	Pacific Wind, CA (2015-2016)	WEST 2017a
Cameron Ridge/Section 15, CA (2014-2015)	WEST 2016b	Palouse Wind, WA (2012-2013)	Stantec 2013a
Cameron Ridge/Section 15, CA (2015-2016)	Rintz and Thompson 2017	Passadumkeag, ME (2016)	Ritzert et al. 2017
Casselman, PA (2008)	Arnett et al. 2009b	Pebble Springs, OR (2009-2010)	Gritski and Kronner 2010b
Casselman, PA (2009)	Arnett et al. 2010	Pine Tree, CA (2009-2010, 2011)	BioResource Consultants 2012
Casselman Curtailment, PA (2008)	Arnett et al. 2009a	Pinnacle, WV (2012)	Hein et al. 2013b
Cedar Ridge, WI (2009)	BHE Environmental 2010	Pinyon Pines I & II, CA (2013-2014)	Chatfield and Russo 2014
Cedar Ridge, WI (2010)	BHE Environmental 2011	Pinyon Pines I & II, CA (2015-2016)	Rintz and Starcevich 2016
Chopin, OR (2016-2017)	Hallingstad and Riser-Espinoza 2017	Pinyon Pines I & II, CA (2017-2018)	Rintz and Pham 2018
Cohocton/Dutch Hill, NY (2009)	Stantec 2010	Pioneer Prairie II, IA (2011-2012)	Chodachek et al. 2012
Cohocton/Dutch Hill, NY (2013)	Stantec 2011a	Pioneer Prairie II, IA (2013)	Chodachek et al. 2014
Cohocton/Dutch Hills, NY (2010)	Stantec 2014b	Pleasant Valley, MN (2016-2017)	Tetra Tech 2017b
Combine Hills, OR (Phase I; 2004-2005)	Young et al. 2006	Prairie Rose, MN (2014)	Chodachek et al. 2015
Combine Hills, OR (2011)	Enz et al. 2012	PrairieWinds ND1 (Minot), ND (2010)	Derby et al. 2011d
Crescent Ridge, IL (2005-2006)	Kerlinger et al. 2007	PrairieWinds ND1 (Minot), ND (2011)	Derby et al. 2012d
Criterion, MD (2011)	Young et al. 2012b	PrairieWinds SD1, SD (2011-2012)	Derby et al. 2012c
Criterion, MD (2012)	Young et al. 2013	PrairieWinds SD1, SD (2012-2013)	Derby et al. 2013a
Criterion, MD (2013)	Young et al. 2014b	PrairieWinds SD1, SD (2013-2014)	Derby et al. 2014
Crystal Lake II, IA (2009)	Derby et al. 2010b	Rail Splitter, IL (2012-2013)	Good et al. 2013b
Diablo Winds, CA (2005-2007)	WEST 2006, 2008	Record Hill, ME (2012)	Stantec 2013b

Appendix A3 (*continued*). All post-construction monitoring studies, project characteristics, and select survey methodology.

Data from the following sources:

Project, Location	Reference	Project, Location	Reference
Dillon, CA (2008-2009)	Chatfield et al. 2009	Record Hill, ME (2014)	Stantec 2015b
Dry Lake I, AZ (2009-2010)	Thompson et al. 2011	Record Hill, ME (2016)	Stantec 2017
Dry Lake II, AZ (2011-2012)	Thompson and Bay 2012	Red Hills, OK (2012-2013)	Derby et al. 2013c
Elkhorn, OR (2008)	Jeffrey et a. 2009a	Ripley, Ont (2008)	Jacques Whitford 2009
Elm Creek, MN (2009-2010)	Derby et al. 2010e	Rising Tree, CA (2017-2018)	Chatfield et al. 2018
Elm Creek II, MN (2011-2012)	Derby et al. 2012b	Rollins, ME (2012)	Stantec 2013c
Foote Creek Rim, WY (Phase I; 1999)	Young et al. 2003a	Rollins, ME (2014)	Stantec 2015c
Foote Creek Rim, WY (Phase I; 2000)	Young et al. 2003a	Roth Rock, MD (2011)	Atwell, LLC 2012
Foote Creek Rim, WY (Phase I; 2001-2002)	Young et al. 2003a	Rugby, ND (2010-2011)	Derby et al. 2011c
Foote Creek Rim, WY (UV study; 1999-2000)	Young et al. 2003b	Shiloh I, CA (2006-2009)	Kerlinger et al. 2009
Forward Energy Center, WI (2008-2010)	Grodsky and Drake 2011	Shiloh II, CA (2009-2010)	Kerlinger et al. 2010, 2013a
Fowler I, IN (2009)	Johnson et al. 2010a	Shiloh II, CA (2010-2011)	Kerlinger et al. 2013a
Fowler I, II, III, IN (2010)	Good et al. 2011	Shiloh II, CA (2011-2012)	Kerlinger et al. 2013a
Fowler I, II, III, IN (2011)	Good et al. 2012	Shiloh III, CA (2012-2013)	Kerlinger et al. 2013b
Fowler I, II, III, IN (2012)	Good et al. 2013a	Solano III, CA (2012-2013)	AECOM 2013
Fowler III, IN (2009)	Johnson et al. 2010b	Spring Valley, NV (2012-2013)	WEST 2014
Fowler, IN (2015)	Good et al. 2016	Stateline, OR/WA (2001-2002)	Erickson et al. 2004
Fowler, IN (2016)	Good et al. 2017	Stateline, OR/WA (2003)	Erickson et al. 2004
Goodnoe, WA (2009-2010)	URS Corporation (URS) 2010a	Stateline, OR/WA (2006)	Erickson et al. 2007
Grand Ridge I, IL (2009-2010)	Derby et al. 2010a	Steel Winds I & II, NY (2013)	Stantec 2014c
Groton, NH (2013)	Stantec and WEST 2014	Stetson II, ME (2014)	Stantec 2015d
Groton, NH (2014)	Stantec and WEST 2015a	Stetson Mountain I, ME (2009)	Stantec 2009c
Groton, NH (2015)	Stantec and WEST 2015b	Stetson Mountain I, ME (2011)	Normandeau Associates 2011
Hancock, ME (2017)	TRC 2017b	Stetson Mountain I, ME (2013)	Stantec 2014d
Harrow, Ont (2010)	Natural Resources Solutions Inc. 2011	Stetson Mountain II, ME (2010)	Normandeau Associates 2010
Harvest Wind, WA (2010-2012)	Downes and Gritski 2012a	Stetson Mountain II, ME (2012)	Stantec 2013d
Hatchet Ridge, CA (2011)	Tetra Tech 2013	Summerview, Alb (2005-2006)	Brown and Hamilton 2006b
Hatchet Ridge, CA (2012)	Tetra Tech 2013	Summerview, Alb (2006; 2007)	Baerwald 2008
Hatchet Ridge, CA (2012-2013)	Tetra Tech 2014	Thunder Spirit, ND (2016-2017)	Derby et al. 2018
Hay Canyon, OR (2009-2010)	Gritski and Kronner 2010a	Top Crop I & II (2012-2013)	Good et al. 2013c
High Sheldon, NY (2010)	Tidhar et al. 2012a	Top of Iowa, IA (2003)	Jain 2005
High Sheldon, NY (2011)	Tidhar et al. 2012b	Top of Iowa, IA (2004)	Jain 2005
High Winds, CA (2003-2004)	Kerlinger et al. 2006	Top of the World, WY (2010-2011)	Rintz and Bay 2012
High Winds, CA (2004-2005)	Kerlinger et al. 2006	Top of the World, WY (2011-2012)	Rintz and Bay 2013
Hopkins Ridge, WA (2006)	Young et al. 2007	Top of the World, WY (2012-2013)	Rintz and Bay 2014

Appendix A3 (*continued*). All post-construction monitoring studies, project characteristics, and select survey methodology.

Data from the following sources:

Project, Location	Reference	Project, Location	Reference
Hopkins Ridge, WA (2008)	Young et al. 2009b	Tucannon River, WA (2015)	Hallingstad et al. 2016
Howard, NY (2012)	Tidhar et al. 2013c	Tuolumne (Windy Point I), WA (2009-2010)	Enz and Bay 2010
Howard, NY (2013)	Lukins et al. 2014	Vansycle, OR (1999)	Erickson et al. 2000
Judith Gap, MT (2006-2007)	TRC Environmental Corporation 2008	Vantage, WA (2010-2011)	Ventus Environmental Solutions 2012
Judith Gap, MT (2009)	Poulton and Erickson 2010	Waverly Wind, KS (2016-2017)	Tetra Tech 2017a
Kewaunee County, WI (1999-2001)	Howe et al. 2002	Wessington Springs, SD (2009)	Derby et al. 2010c
Kibby, ME (2011)	Stantec 2012a	Wessington Springs, SD (2010)	Derby et al. 2011a
Kittitas Valley, WA (2011-2012)	Stantec Consulting Services 2012	White Creek, WA (2007-2011)	Downes and Gritski 2012b
Klondike, OR (2002-2003)	Johnson et al. 2003	Wild Horse, WA (2007)	Erickson et al. 2008
Klondike II, OR (2005-2006)	Northwest Wildlife Consultants (NWC) and WEST 2007	Windstar, CA (2012-2013)	Levenstein and Bay 2013b
Klondike III (Phase I), OR (2007-2009)	Gritski et al. 2010	Windy Flats, WA (2010-2011)	Enz et al. 2011
Klondike IIIa (Phase II), OR (2008-2010)	Gritski et al. 2011	Winnebago, IA (2009-2010)	Derby et al. 2010g
Lakefield Wind, MN (2012)	Minnesota Public Utilities Commission 2012	Wolfe Island, Ont (July-December 2009)	Stantec Ltd. 2010
Laurel Mountain, WV (2014)	Stantec 2015a	Wolfe Island, Ont (July-December 2010)	Stantec Ltd. 2011
Leaning Juniper, OR (2006-2008)	Gritski et al. 2008	Wolfe Island, Ont (July-December 2011)	Stantec Ltd. 2012
Lempster, NH (2009)	Tidhar et al. 2010		

TECHNICAL MEMORANDUM

DATE: March 30, 2020

TO: Walleye Wind Project, LLC

FROM: Joyce Pickle, Jennifer Stucker, Kevin Murray, and Brenna Hyzy, Western EcoSystems Technology, Inc.

SUBJECT: Updated Results of Bat Acoustic Surveys at the Walleye Wind Study Area from June 28 – October 29, 2018.

INTRODUCTION

Walleye Wind Project, LLC (Walleye) is considering the development of the Walleye Wind Project (Project) in Rock County, Minnesota (Figure 1). In 2018, Western EcoSystems Technology, Inc. (WEST) completed a bat activity study following the recommendations of the US Fish and Wildlife Service's Land-based Wind Energy Guidelines and the Avian and Bat Survey Protocols for Large Wind Energy Conversion Systems in Minnesota (Mixon et al. 2014). The objective of this study was to conduct acoustic monitoring surveys to estimate levels of bat activity throughout the study area during the summer and fall. The previous analysis from 2018 did not include a species composition component or qualitative/manual review of any calls (Kreger et al. 2019). In 2020, Walleye requested WEST conduct a species composition analysis on the existing data collected in 2018 to determine whether any northern long-eared bats (*Myotis septentrionalis*; NLEB) were detected on the landscape during the time of the study. This report briefly summarizes the results of the acoustic surveys conducted within the study area between June 28 and October 29, 2018, and also describes the results of the species composition analysis.

It should be noted that the 2018 Bat Activity Survey Report (Kreger et al. 2019) was initially prepared for a study area that preceded the current Project. This updated analysis was conducted on the 2018 data due to the study area's proximity to and partial overlap with the current Project, as it provides information pertinent to Minnesota state agency review. The 2018 Bat Activity Survey study area and current Project are depicted in Figure 1, below.

Methods

Acoustic monitoring occurred at the study area from June 28 – October 29, 2018. Four AnaBat™ SD2 ultrasonic bat detectors (Titley™ Scientific, Columbia, Missouri) were used during the surveys. One AnaBat™ detector was placed at ground level (ground station; approximately 5.0 feet [ft; 1.5 meters (m)] above ground level [AGL]) in cropland habitat that was representative of future turbine placement (representative station; station WA1g; Figure 2). A second detector was placed along forest edge habitat considered attractive to bats for foraging and commuting (bat feature station; station WA2g; Figure 2). An experienced bat biologist selected the location of the bat feature station. Two additional AnaBat™ detectors were placed at a meteorological (MET) tower at a representative station, with one microphone at ground level and another within the rotor-swept zone (raised station; approximately 148 ft [45 m] AGL; station WA3; Figure 2). Mean bat activity was calculated for the spring, summer, and fall seasons, along with a standardized Fall Migration Period (FMP), defined here as July 30 – October 14. WEST defined the FMP as a standard for comparison with activity from other wind projects.

AnaBat™ detectors use a broadband high-frequency microphone to detect the echolocation calls of bats. To standardize acoustic sampling effort across the study area, AnaBat™ detectors were calibrated and sensitivity levels were set to six, a level that balanced the goal of recording bat calls against the need to reduce interference from other sources of ultrasonic noise. Incoming echolocation calls were digitally processed and stored on a high capacity compact flash card. The resulting files were viewed in appropriate software (e.g., Analook) as digital sonograms that show changes in echolocation call frequency over time. Frequency versus time displays were used to separate bat calls from other types of ultrasonic noise (e.g., wind, insects) and to determine the call frequency category of the bat that generated the calls. For the original analysis conducted in 2018, echolocation calls were classified into two frequency categories; high frequency (HF; greater than 30 kilohertz [kHz]) and low frequency (LF; less than 30 kHz). Experienced bat biologists used the Analook software to determine the number of bat passes recorded by each detector, and to separate noise files from true bat calls.

For the updated species composition analysis conducted in 2020, the automated identification feature in program Kaleidoscope Pro 5.1.0 (Wildlife Acoustics, Concord, Massachusetts) using the Bats of North America classifier 5.1.0 at the “0” Balanced (neutral) sensitivity setting was then used to identify known bat calls to species. Species included in the model were big brown bats (*Eptesicus fuscus*), eastern red bats (*Lasiurus borealis*), hoary bats (*L. cinereus*), silver-haired bats (*Lasionycteris noctivagans*), little brown bats (*Myotis lucifugus*), NLEB, evening bats (*Nycticeius humeralis*), and tri-colored bats (*Perimyotis subflavus*). A qualified acoustic analyst (Dr. Kevin Murray) conducted a manual review of all calls identified as NLEB by Kaleidoscope Pro 5.1.0. Data on bat pass rates represent indices of bat activity and does not necessarily represent numbers of individuals.

Results

Spatial and Temporal Analysis Summary

Bat activity was monitored at four stations for 440 detector-nights between June 28 and October 29, 2018. All detectors and microphones were operating for 97.7% of the sampling period for all stations. Activity at representative stations was highest at the ground station at the MET tower, station WA3g (17.13 ± 1.63 bat passes per detector-night; Table 1), compared to activity at the raised station (13.91 ± 1.62; Table 1) and at the standalone representative ground station (4.11 ± 0.47; Table 1). However, when averaged across the study period, activity was slightly higher at the MET tower raised stations than at representative ground stations (Table 1). Activity at the bat feature station was over ten times greater (116.08 ± 14.21 bat passes per detector-night) than activity at representative stations (11.72 ± 1.13; Table 1).

As described in more detail in Kreger et al. (2019), overall bat activity at representative stations was relatively low in the fall (7.87 bat passes per detector-night) and higher in summer (23.04 bat passes per detector-night), and representative ground station activity was 11.20 bat passes per detector-night during the FMP (Table 2). Weekly acoustic activity at representative stations was relatively low from June through early July, but increased sharply in mid-July and August, peaking from July 15 to July 21 (33.0 bat passes per detector-night; Table 3). Overall bat activity gradually decreased for the remainder of the survey period.

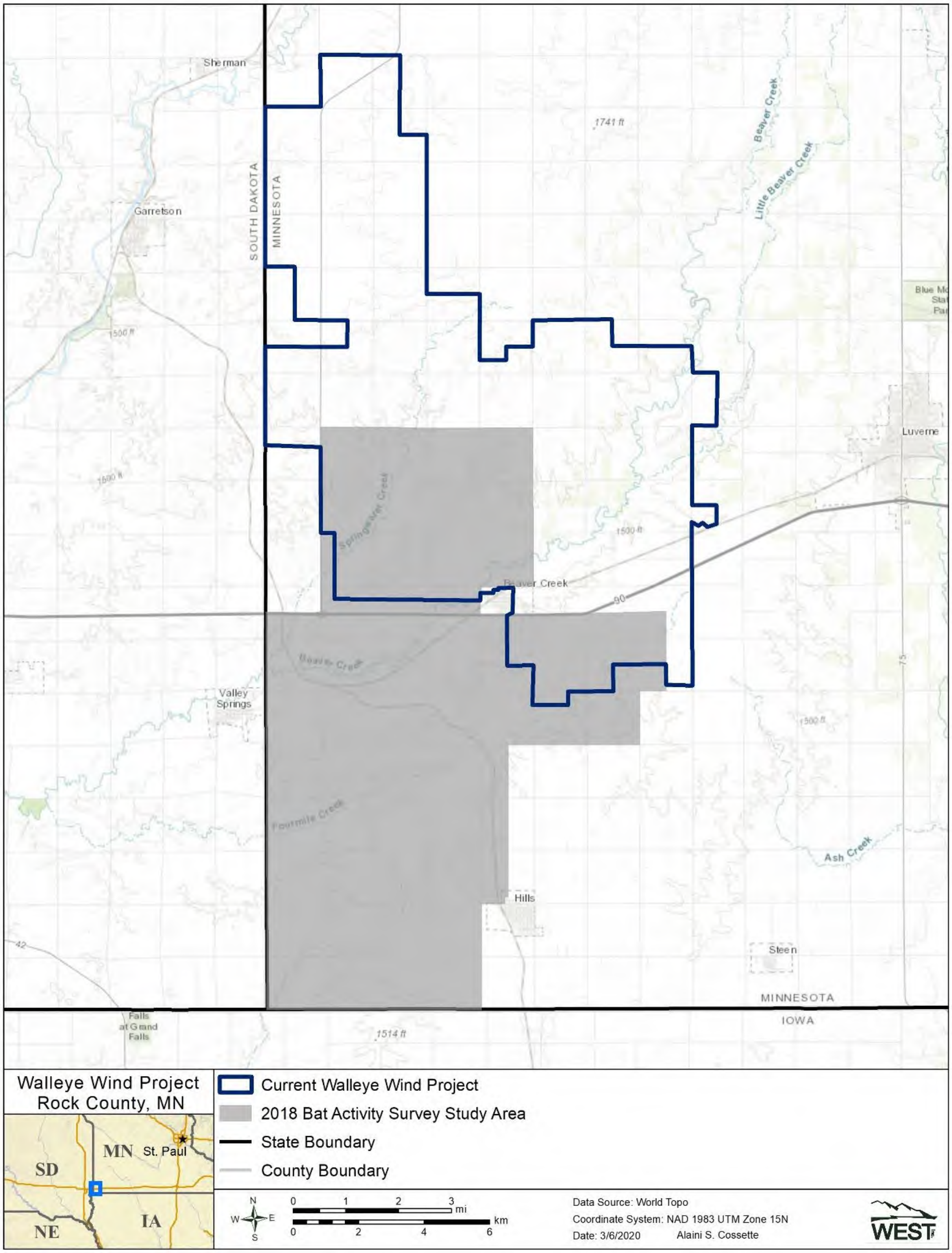

Figure 1. 2018 Bat Activity Survey Study Area in Comparison to the Current Walleye Wind Project, Rock County, Minnesota.

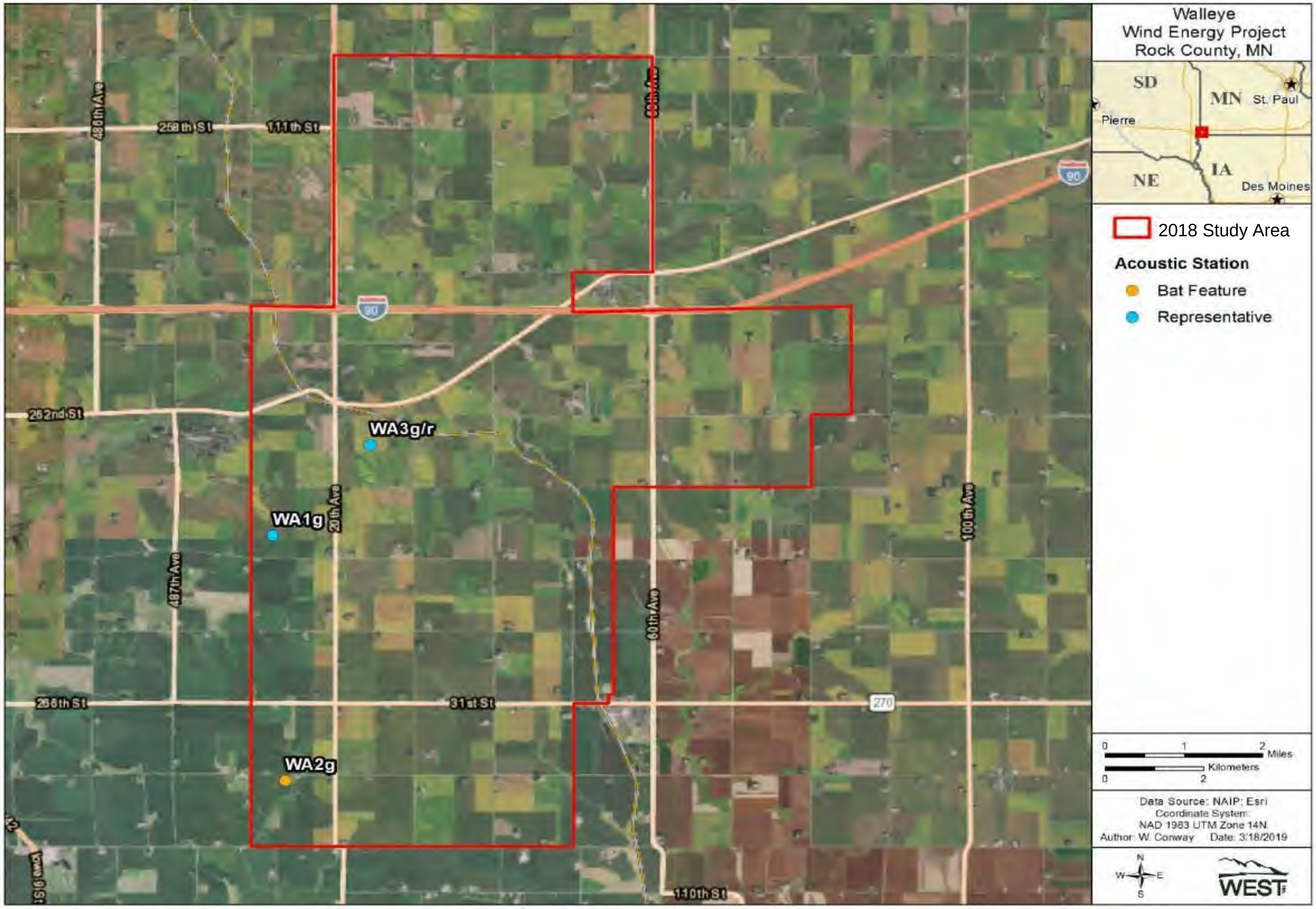

Figure 2. Location of 2018 acoustic stations within the Walleye Wind Study Area in Rock County, Minnesota.

Table 1. Results of bat activity surveys conducted at stations within the Walleye Wind study area, Rock County, Minnesota, from June 28 – October 29, 2018. Passes are separated by call frequency: high frequency (HF) and low frequency (LF).

Anabat Station	Location	Type	Number of HF Bat Passes	Number of LF Bat Passes	Total Bat Passes	Detector Nights	Bat Passes/ Night[1]
WA1g	Ground	Representative	74	423	497	121	4.11 ± 0.47
WA2g	Ground	Bat Feature	5,435	8,146	13,581	117	116.08 ± 14.18
WA3g	Ground	Representative	241	1,489	1,730	101	17.13 ± 1.63
WA3r	Raised	Representative	94	1,311	1,405	101	13.91 ± 1.62
Total Representative Ground (%)			**315 (14%)**	**1,912 (86%)**	**2,227**	**222**	**10.62 ± 0.90**
Total Representative Raised (%)			**94 (7%)**	**1,311 (93%)**	**1,405**	**101**	**13.91 ± 1.48**
Total Representative Stations (%)			**409 (11%)**	**3,223 (89%)**	**3,632**	**323**	**11.72 ± 1.13**
Total Bat Feature Stations (%)			**5,435 (40%)**	**8,146 (60%)**	**13,581**	**117**	**116.08 ± 14.21**
Total (%)			**5,844 (34%)**	**11,369 (66%)**	**17,213 (100%)**	**440**	**---**

[1]± bootstrapped standard error.

Table 2. The number of bat passes per detector-night recorded at representative stations within the Walleye Wind study area, Rock County, Minnesota, during each season, separated by call frequency: low frequency (LF), high frequency (HF), and all bats (AB).

Station	Call Frequency	Summer June 28 – August 14	Fall August 15 – November 5	Fall Migration Period July 30 – October 14
WA1g	LF	4.73	2.76	3.16
	HF	0.76	0.53	0.68
	AB	5.49	3.29	3.83
WA3g	LF	30.20	9.66	15.94
	HF	5.72	1.29	2.64
	AB	35.92	10.95	18.57
WA3r	LF	25.44	8.88	14.25
	HF	2.28	0.49	1.04
	AB	27.72	9.37	15.29
Ground Totals	**LF**	17.47 ± 1.73	6.21 ± 0.82	9.55 ± 1.03
	HF	3.24 ± 0.42	0.91 ± 0.15	1.66 ± 0.21
	AB	20.70 ± 2.04	7.12 ± 0.91	11.20 ± 1.18
Raised Totals	**LF**	25.44 ± 2.56	8.88 ± 1.56	14.25 ± 1.74
	HF	2.28 ± 0.54	0.49 ± 0.10	1.04 ± 0.22
	AB	27.72 ± 2.51	9.37 ± 1.62	15.29 ± 1.82
Overall	**LF**	**20.12 ± 1.58**	**7.10 ± 1.09**	**11.11 ± 1.20**
	HF	**2.92 ± 0.41**	**0.77 ± 0.13**	**1.45 ± 0.18**
	AB	**23.04 ± 1.81**	**7.87 ± 1.18**	**12.56 ± 1.32**

Table 3. Periods of peak activity for high-frequency, low-frequency, and all bats at the Walleye Wind study area, Rock County, Minnesota from June 28 – October 29, 2018.

Species Group	Start Date of Peak Activity	End Date of Peak Activity	Bat Passes per Detector-Night
High Frequency	7/30/18	8/5/18	4.0
Low Frequency	7/15/18	7/21/18	30.4
All Bats	7/15/18	7/21/18	33.0

Species Composition Analysis

Of the total bat passes recorded at all stations, 66% were classified as LF (e.g., big brown bats, hoary bats, and silver-haired bats), and 34% of bat passes were classified as HF (e.g., tri-colored bats, eastern red bats, and *Myotis* species; Table 1). LF bats were most commonly recorded at the raised station (93%; Table 1), and at all representative ground stations (86%; Table 1). At the bat feature station, the majority of recorded calls were also produced by LF bats (60%; Table 1).

Kaleidoscope Pro 5.1.0 identified bat calls for eight species that potentially occur within the study area (Table 4). Big brown bats and hoary bats were the main species detected, potentially present on 61% and 60% of the detector-nights, respectively, followed by silver-haired bats (51%) and eastern red bats (36%; Table 4). Kaleidoscope Pro 5.1.0 identified one potential NLEB call (Table 4) during the entire June 28 – October 29, 2018 study period. Dr. Kevin Murray qualitatively reviewed this call and identified it as a HF unknown. The call was a feeding buzz most likely emitted by an eastern red bat or evening bat and had no diagnostic features of a standard NLEB call. All the call files from the night of August 25, 2018, when the potential NLEB call was recorded, were also reviewed by Dr. Murray and no additional NLEB calls were observed. Therefore, no acoustic evidence of NLEB was observed during the 2018 surveys in the study area.

Table 4. The number of nights and percent of detector-nights (in parentheses) bat species were detected using Kaleidoscope Pro 5.1.0 by station (WA1, WA2, WA3) and microphone (g, r) at the Walleye Wind study area, Rock County, Minnesota from June 28 – October 29, 2018.

	Representative Stations			Bat Feature	
Common Name	**WA1g**	**WA3g**	**WA3r**	**WA2g**	**Total**
High-Frequency (Less than or equal to 30 kiloHertz [kHz])					
eastern red bat	20 (16)	46 (43)	25 (23)	70 (69)	161 (36)
evening bat	19 (15)	8 (7)	13 (12)	58 (57)	98 (22)
little brown bat	2 (2)	15 (14)	2 (2)	24 (24)	43 (10)
northern long-eared bat	0 (0)	0 (0)	0 (0)	**1 (1)**	1 (0)
tri-colored bat	3 (2)	3 (3)	1 (1)	28 (27)	35 (8)
Low-Frequency (Greater than 30 kHz)					
big brown bat	57 (46)	71 (66)	50 (46)	92 (90)	270 (61)
hoary bat	60 (48)	54 (50)	66 (61)	88 (86)	268 (60)
silver-haired bat	31 (25)	57 (53)	52 (48)	86 (84)	226 (51)

g = ground (339 detector nights); r = raised (101 detector nights); Total (440 detector nights).

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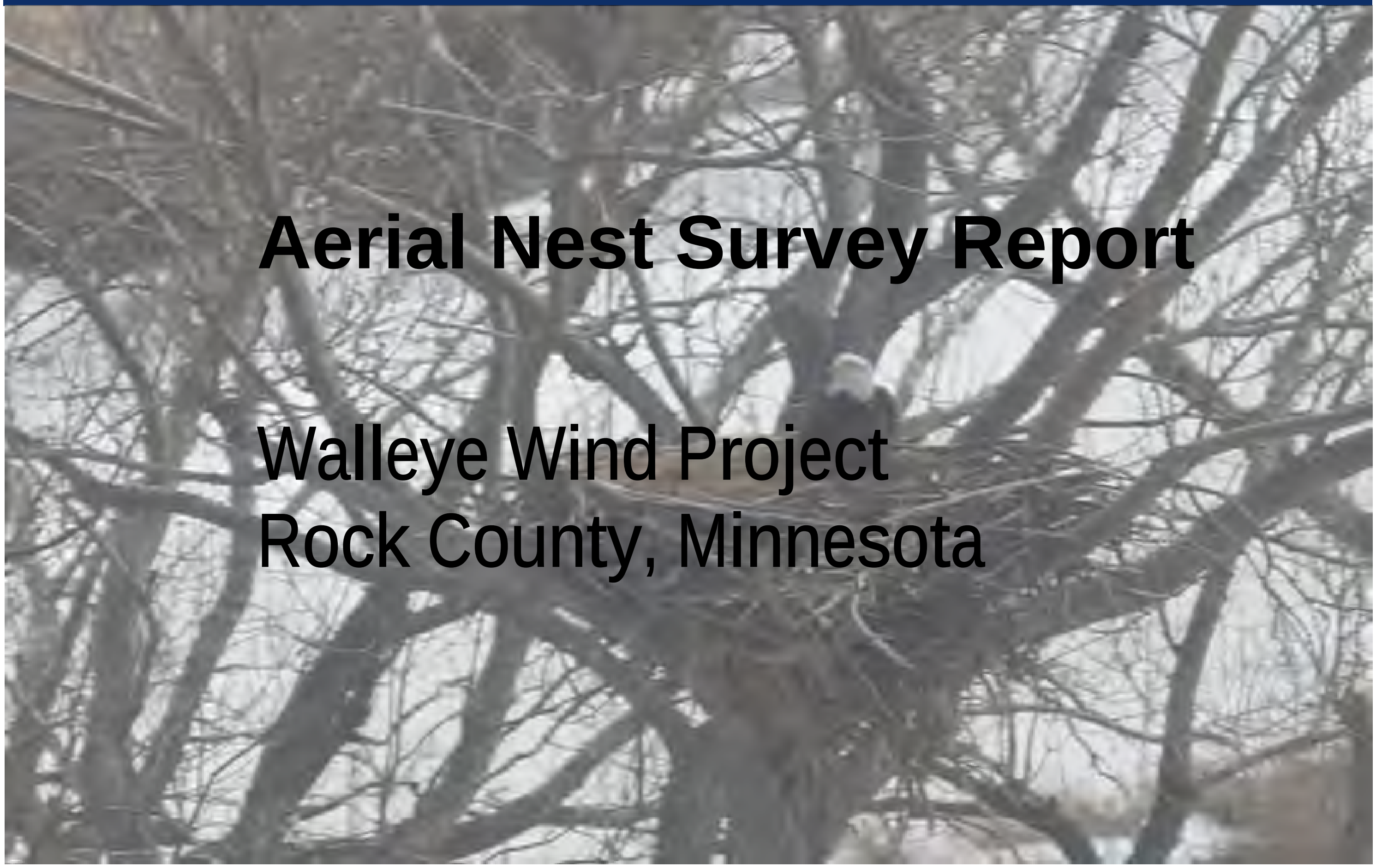

Aerial Nest Survey Report

Walleye Wind Project
Rock County, Minnesota

Walleye Wind Project, LLC
Juno Beach, Florida

June 9, 2020
ECT No. 190497

Complex Challenges . . . *PRACTICAL SOLUTIONS*

Document Review

The dual signatory process is an integral part of Environmental Consulting & Technology, Inc.'s (ECT's) Document Review Policy No. 9.03. All ECT documents undergo technical/peer review prior to dispatching these documents to any outside entity.

This document has been authored and reviewed by the following employees:

Edward Keyel	Brian Ortman
Author	Reviewer
Signature	Signature
06/09/2020	06/09/2020
Date	Date

Table of Contents

List of Acronyms and Abbreviations

2020 Eagle Nest Survey Area	10-mile buffer surrounding and including the Wind Resource Area (based on 12/30/2019 Wind Resource Area boundary)
ECPG	Eagle Conservation Plan Guidance
ECT	Environmental Consulting & Technology, Inc.
GIS	Geographic Information System
IGEIMP	Interim Golden Eagle Inventory and Monitoring Protocols
Ft	Foot
MIND	Mean Inter-nest Distance
MW	Megawatt
Project	Walleye Wind Project
T&E	Threatened and Endangered
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
Walleye Wind	Walleye Wind Project, LLC
WEST	Western EcoSystems Technology, Inc.
WRA	Wind Resource Area

Executive Summary

Walleye Wind, LLC (Walleye Wind) contracted Environmental Consulting & Technology, Inc. (ECT), to conduct an aerial nest survey for the proposed, 110.8-megawatt (MW) wind energy facility, Walleye Wind Project (Project) located in Rock County, Minnesota. The purpose of this survey was to record bald eagle (*Haliaeetus leucocephalus*) nests within the Wind Resource Area (WRA) (31,095-acres (49 square miles) and an associated 10-mile buffer (2020 Eagle Nest Survey Area), and to record non-eagle raptor nests within the WRA and surrounding 1-mile buffer. It should be noted that limited data were collected for non-eagle raptor nests based on previously provided databases or incidental discoveries. This survey was conducted in accordance with the guidance provided in the U.S. Fish and Wildlife Service (USFWS) *Eagle Conservation Plan Guidance* (ECPG) and the USFWS *Interim Golden Eagle Inventory and Monitoring Protocols* (IGEIMP).

The 2020 aerial nest survey conducted by ECT, evaluated 1-mile transects within the 2020 Eagle Nest Survey Area and 0.5-mile transects within the WRA. The helicopter aerial nest survey was conducted between February 26 – 29, 2020 between 08:00 hours and 18:00 hours each day. A follow-up ground-based survey was conducted on April 1, 2020 for unknown nests within the WRA to ascertain which species were occupying the nests and activity of the nests.

The 2020 ECT surveys provide additional information on eagle and raptor use within the vicinity of the WRA in addition to previous studies completed throughout the area. A total of 88 nest structures, representing three (3) identified raptor species: red-tailed hawk (*Buteo jamaicensis*), great horned owl (*Bubo virginianus*), and bald eagle were detected as potential raptor nesting sites. There are two (2) inactive non-eagle raptor nests that are located within the WRA. The 2020 ECT survey effort identified eleven (11) active bald eagle nests within the 2020 Eagle Nest Survey Area. No federally or state-listed threatened or endangered raptor species were observed nesting within the WRA or the associated buffers.

1.0 Introduction

Walleye Wind, LLC (Walleye Wind) is proposing a 110.8 MW, wind energy facility, within Rock County, Minnesota. Walleye Wind contracted Environmental Consulting & Technology, Inc. (ECT), to conduct an aerial nest survey for the proposed Walleye Wind Project (Project), Wind Resource Area (WRA) in Rock County, Minnesota (**Figure 1**). The purpose of this survey was to record bald eagle (*Haliaeetus leucocephalus*) and other raptor nests in the proximity of potential turbine siting areas. This survey was conducted in accordance with the guidance provided in the U.S. Fish and Wildlife Service (USFWS) *Eagle Conservation Plan Guidance* (ECPG) (USFWS 2013) and the USFWS *Interim Golden Eagle Inventory and Monitoring Protocols* (IGEIMP) (Pagel et al. 2010).

2016 Raptor Nest Survey (WEST)

Western Ecosystems Technology, Inc. (WEST) conducted an aerial-based raptor nest survey to help evaluate the potential impacts of construction on nesting raptors within a 29,747-acre preliminary Project area on March 24-25, 2016 (**Figure 2**). Surveys within the Project area and 1-mile buffer documented all potential raptor nests, including bald eagles, while the surveys up to the 2016 10-mile buffer focused only on identifying potential bald eagle nests. A WEST biologist detected a total of 38 raptor nests representing three (3) raptor species during aerial surveys. These included two (2) occupied red-tailed hawk (*Buteo jamaicensis*) nests, one (1) occupied great-horned owl (*Bubo virginianus*) nest, and 33 unoccupied, inactive raptor nests of unknown species. No federal or state-listed threatened and endangered (T&E) raptor species were identified nesting within the 2016 Project area or 1-mile buffer (Pickle et al. 2016). Additionally, no occupied or potential bald eagle nests were located within the Project boundary and 1-mile buffer. Two (2) bald eagle nests classified by WEST as occupied active were documented within the 2016 10-mile buffer along the Big Sioux River in South Dakota to the southwest more than 7.5 miles away from the Project area.

2018 Raptor Nest Surveys (WEST)

Western Ecosystems Technology, Inc. conducted an additional raptor nest survey within a preliminary Project area encompassing 18,890 acres in Rock County Minnesota on April 17-19, 2018 (**Figure 2**) (Kreger and Suehring 2018). Raptor surveys were conducted from a helicopter along transects throughout the Project boundary and a 1-mile buffer for raptor nests and out to the 2018 10-mile buffer for eagle nests. The biologist evaluated the behavior of adults on or near the nest, and the presence of eggs, young, whitewash, or fresh building materials to determine the status of a nest. Attempts were made to identify the species of raptor associated with each active nest. A total of 22 stick nests were found representing two (2) identified non-raptor species, one (1) American crow (*Corvus brachyrhynchos*), and one (1) great blue heron (*Ardea herodias*), a colonial waterbird. Identified raptor nests were classified by WEST as: three (3) occupied active bald eagle nests, one (1) occupied inactive bald eagle nest, four (4) occupied red-tailed hawk nests, and 12 unoccupied unidentified raptor species. Both eagle nests identified during the 2016 surveys along the Big Sioux River to the southwest of the current WRA were included and considered active during the 2018 survey period. There were also five (5) unidentified raptor nests that WEST considered to be consistent in size and structure of a bald eagle nests more than 6.5 miles away from the Project area. Three (3) of these potential bald eagle nests were located east and southeast of the reviewed Project area along the Rock River, and the remaining two (2) nests were located to the southwest along the Big Sioux River. One (1) nest was classified by WEST as occupied, inactive and the other four (4) nests were classified by WEST as inactive.

2.0 Wind Resource Area Description

The WRA encompasses approximately 31,095-acres (approximately 49 square miles) in Springwater, Beaver Creek, Luverne, and Martin Townships, in Rock County, Minnesota. The WRA is located along the southwestern border of Minnesota with its western boundary along the Minnesota and South Dakota state line. The largest city near the WRA is Sioux Falls, South Dakota and is located approximately 14 miles southwest of the WRA. The WRA is also located approximately 4.5 miles west of the City of Luverne, Minnesota and encompasses the City of Beaver Creek, Minnesota (**Figure 1**).

The WRA is in a largely rural area dominated by cultivated cropland and pastures. Development in the WRA is low-density and generally concentrated along rural roads and highways. Undeveloped, natural areas within the WRA, such as woodland, wetlands, and grasslands, are not dominant features in the landscape. A network of watercourses covers the majority of the WRA. Topography of the region is generally flat but contains undulating terrain typical of southwestern Minnesota, northwestern Iowa, and eastern South Dakota, with approximate elevations ranging between 1,400-1,660 ft above mean sea level (USGS 2017a, b, 2019a, b, c).

3.0 Methods

3.1 Aerial Nest Survey

Aerial nest surveys were conducted in accordance with the guidance provided in the ECPG (USFWS 2013) and the IGEIMP (Pagel et al. 2010). A raptor ecologist and a helicopter pilot conducted the surveys. Raptors are defined here as kites, accipiters, buteos, harriers, eagles, falcons, and owls. Pre-flight planning included the creation of field maps and geographic information system (GIS) files and review of relevant background information, such as previously recorded nest locations, topographic maps, and aerial photographs.

Surveys within the WRA boundary and 1-mile buffer documented all potential raptor nests, including bald eagle nests, while the surveys within a 10-mile buffer, which was set based on the 12/30/19 WRA boundary, (2020 Eagle Nest Survey Area), focused on identifying potential bald eagle eyries (large, stick nest structures) in suitable eagle nesting substrate (trees, transmission lines, cliff faces, etc.).

The 2020 aerial nest survey conducted by ECT evaluated 1-mile transects within the 2020 Eagle Nest Survey Area and 0.5-mile transects within the WRA (USFWS 2013). Flight-line transects at 0.5-mile intervals were created across the WRA using a GIS (**Figure 3**). The helicopter aerial nest survey was conducted between February 26 – 29, 2020, which coincided with peak bald eagle detectability per that species' local breeding phenology (Buehler, D. 2000). Surveys were conducted between 08:00 hours and 18:00 hours. The helicopter was flown at relatively slow speeds (30 to 40 knots). No noticeable leaf-out of forest canopy was evident at the time of surveys. Efforts were made to minimize disturbance to breeding raptors. The greatest possible distance at which species could be identified was maintained, with distance varying, depending upon nest location and wind conditions.

The helicopter was positioned to allow thorough visual inspection of the habitat, especially to provide a view of the tops of the tallest, dominant, trees where bald eagles generally prefer to nest. The locations of all potential raptor nests were recorded using Fulcrum, an electronic data entry application (Spatial Networks 2020). All confirmed and potential nests were recorded regardless of their activity status. A unique nest identification number was assigned to each nest documented.

Bald eagle nests range from 4.9-5.9 ft in diameter and 2.3-3.9 ft in height. Nest shape is reported as conforming to the shape of the substrate tree and can be cylindrical, cone-shaped, or even platform-like (Buehler 2000). It can be difficult to judge such dimensions in the field, particularly when viewing nest structures from a distance through high-powered optics. Helicopters can be used to gain a better perspective for nest shape and size and to attain additional visual cues by hovering above each nest (Bird and Bildstein 2007).

The biologist evaluated the behavior of adults on or near the nest and documented the presence of eggs, young, whitewash, or fresh building materials to determine the status of a nest. Nest status was categorized using definitions consistent with the ECPG (USFWS 2013). Nests were classified as occupied if any of the following were observed at the nest structure: (1) an adult in an incubating position; (2) eggs; (3) nestlings or fledglings; (4) a pair of adults (sometimes sub-adults); (5) a newly constructed or refurbished stick nest in the area where territorial behavior of a raptor had been observed earlier in the breeding season; or (6) a recently repaired nest with fresh sticks (clean breaks) or fresh boughs on top, and/or droppings and/or molted feathers on its rim or underneath. Occupied nests were further classified as active if (1) an adult was present on the nest in incubating position, (2) an egg or eggs were present, or (3) nestlings were observed. Nests were classified as alternate if it was not being attended by eagles for breeding purposes. Nests not meeting the above criteria for "Occupied" were classified as "Unoccupied".

Nest substrate was recorded to provide observers a visual reference to relocate the nest. Substrates may include manmade structures (e.g., power lines, nest platforms, or dock hoists), biological structures (e.g., coniferous trees, deciduous trees), and geological structures (e.g., cliff faces).

A species was assigned to each nest when possible, otherwise, it was classified as an unknown raptor nest. Nests documented as unknown raptor species were defined as any stick nest not having an occupant associated with it at the time of the survey. Nests may become abandoned over time or stop being used, becoming historic nest sites. Unknown raptor nests were documented in order to populate a database to ensure future surveys include all potentially suitable nest sites. Nests that appeared consistent in size and shape with bald eagle nests were further classified as potential alternate nest sites for bald eagles. Attempts were made to identify the species of raptor, nest status, and nest substrate at each nest location to the extent possible. A follow-up ground-based survey was conducted on April 1, 2020 for unknown nests within the WRA in an attempt to ascertain which species were occupying the nests and activity-level of the nests.

4.0 Results

A total of 88 nest structures representing three (3) identified raptor species: red-tail hawk, great horned owl, and bald eagle were detected as possible raptor nesting locations during the February 26 – 29, 2020 aerial nest survey period (**Table 1**). This total includes nests identified in 2016 and 2018 aerial surveys and represents the currently available raptor nest structures. No federally or state-listed threatened or endangered raptor species were observed nesting within the WRA or the associated buffers.

4.1 Bald Eagles

Ten (10) active bald eagle nests were located within the 2020 Eagle Nest Survey Area, (**Table 1, Figure 1**). One (1) alternate nest was previously active, failed May 2020 and one (1) possible historic eagle nest structure were also located within 10 miles of the WRA boundary. Five (5) of the 12 bald eagle nests within the 2020 Eagle Nest Survey Area of the WRA were newly identified during the 2020 survey effort.

One (1) bald eagle was identified as incidental migrating to the north in the WRA during the 2020 aerial nest survey and is not associated with any nest. An additional 33 bald eagles were observed as incidental (not associated with a nest) within the 2020 Eagle Nest Survey Area during the 2020 aerial nest survey.

The following section provides more details on each active and alternate eagle nest documented during the aerial nest surveys and are organized by activity (active, occupied, alternate) and then by distance to the WRA.

Nest Little Beaver Creek – This nest is located approximately 0.8 miles from the WRA. The nest was in excellent condition at the time of the survey with an adult bald eagle in the nest in an incubating position and a second adult bald eagle approximately 65 ft away (**Appendix A**). This alternate nest was previously active, failed May 2020. (**Table 1, Figure 1**).

Nest 3099 – This nest is located approximately 4.4 miles east of the WRA. The nest was in excellent condition at the time of the survey with an adult bald eagle in an incubating position and another adult bald eagle perched nearby. This nest was considered active in 2020 (**Table 1,**

Figure 1). This nest was originally documented during previous surveys and considered inactive by WEST in 2018 (**Appendix B**) (Kreger and Suehring 2018).

Nest 3100 – This nest is located approximately 4.4 miles east of the WRA. The nest was in fair condition at the time of the survey, with one (1) bald eagle in the nest. This nest was considered active in 2020 (**Table 1, Figure 1**). This nest was originally documented in previous aerial surveys and was considered inactive by WEST in 2018 (**Appendix B**) (Kreger and Suehring 2018).

Nest 3101 - This nest is located approximately 5.8 miles southeast of the WRA. The nest was in fair condition at the time of the survey with an adult bald eagle in an incubating position. This nest was considered active in 2020 (**Table 1, Figure 1**). This nest was originally documented in previous surveys and considered inactive by WEST in 2018 (**Appendix B**) (Kreger and Suehring 2018).

Nest Garretson – This nest is located approximately 5.9 miles northwest of the WRA. The nest was in good condition at the time of the survey, with one (1) bald eagle in the nest. This nest was considered active in 2020 (**Table 1, Figure 1**).

Nest Jasper-Sherman – This nest is located approximately 7.7 miles north of the WRA. The nest was in excellent condition at the time of the survey with an adult bald eagle in an incubating position (**Appendix A**). This nest was considered active in 2020 (**Table 1, Figure 1**).

Nest 16132 – This nest is located approximately 7.8 miles southwest of the WRA. This nest was in excellent condition at the time of the survey with an adult bald eagle in an incubating position. This nest was considered active in 2020 (**Table 1, Figure 1**). This nest was originally documented in previous surveys and considered active by WEST in 2016 (**Appendix C**) (Pickle et al. 2016).

Nest Kenneth-Luverne – This nest is located approximately 8.6 miles east of the WRA. The nest was in excellent condition at the time of the survey with an adult bald eagle in an incubating position and another adult bald eagle perched nearby. This nest was considered active in 2020 (**Table 1, Figure 1**).

Nest 16138 – This nest is located approximately 8.8 miles west of the WRA. The nest was in good condition at the time of the survey, with an adult bald eagle in an incubating position and a second adult bald eagle perched nearby. This nest was considered active in 2020 (**Table 1, Figure 1**). This nest was originally documented in previous surveys and considered active by WEST in 2016 and in 2018 (**Appendix B, Appendix C**) (Pickle et al. 2016, Kreger and Suehring 2018).

Nest 16134 – This nest is located approximately 9.4 miles southwest of the WRA. The nest was in good condition at the time of the survey, with an adult bald eagle in an incubating position. This nest was considered active in 2020 (**Table 1, Figure 1**). This nest was originally documented in previous surveys and considered occupied, inactive by WEST in 2018 (**Appendix B**) (Kreger and Suehring 2018).

Nest RocRap – This nest is located approximately 8.5 miles south-southeast of the WRA. The nest was in fair condition at the time of the survey with two (2) adult bald eagles close to the nest. This nest was considered occupied in 2020 (**Table 1, Figure 1**).

Nest 16133. A possible historic eagle nest structure was located approximately 8.3 miles southwest of the WRA. This nest was last observed in 2018 survey effort, and it was classified by WEST as occupied, inactive (Kreger and Suehring 2018). This nest was not detected during aerial surveys in 2020.

4.2 Non-Eagle Nests

Seven (7) nests were classified as "unknown raptor" nest structures within the WRA and 1-mile buffer (**Figure 4**). These unknown raptor nests may not have been active for the current breeding season or may have been active nests that, at the time of the raptor nest surveys, were either not yet in use, or activity was not detectable at the time of surveys. These "unknown raptor" nests were not consistent in size and shape with bald eagle nests.

In addition to raptor nests identified during the survey one (1) American crow nest structure was identified within the WRA and 1-mile buffer. These nest structures have the potential to provide nesting resources for raptors species.

5.0 Discussion

The 2020 aerial nest surveys add additional data to those surveys already conducted in 2016 and 2018. The 2020 ECT aerial nest survey searched for all known bald eagle nests within the 2020 Eagle Nest Survey Area and all known raptor nests within one (1) mile of the WRA. Some previously recorded nests not identified as being utilized by eagles, were not assessed during the 2020 survey, because those nests are located beyond 10 miles from the WRA (**Figure 2**).

The surveys conducted by ECT provided additional information on eagle and raptor use within the vicinity of the WRA. The 2020 raptor nest surveys found no bald eagle nests within the WRA and confirmed the presence of 10 active bald eagle nest within 10 miles of the WRA.

The USFWS uses a one-half the mean inter-nest distance (MIND) calculation for nests in the regional vicinity of a project to estimate areas with the potential for higher eagle use (USFWS 2013). The one-half MIND of all active bald eagle nests observed during this survey within the WRA and 10-mile buffer is approximately 1.91 mi.

Raptor nest resources identified during this aerial nest survey across the WRA and 2020 Eagle Nest Survey Area were limited to those species whose breeding phenology in southwest Minnesota overlaps with late-February/early-March. This aerial nest survey was timed to coincide with peak bald eagle detectability in accordance with the local bald eagle breeding phenology; however, it is unlikely that many other nests will become active eagle nests after this date. This time period is also good to capture nesting behavior for partial migrants such as red-tailed hawks and great horned owls which are the predominate species of nesting raptors within the open agricultural landscape of southwest Minnesota.

6.0 References

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Tables

Table 1. Nest structure locations within the Walleye Wind Project Wind Resource Area and 10-mile buffer.

Species	Nest	Latitude	Longitude	Status
American Crow	AMCR 004	43.7894	-96.2547	Occupied
American Crow	AMCR 006	43.6289	-96.6358	Occupied
American Crow	AMCR 001	43.7410	-96.4723	Unoccupied
American Crow	AMCR 002	43.8955	-96.3456	Unoccupied
American Crow	AMCR 003	43.8995	-96.3279	Unoccupied
American Crow	AMCR 005	43.8267	-96.2242	Unoccupied
American Crow	AMCR 007	43.6466	-96.6154	Unoccupied
American Crow	AMCR 008	43.7169	-96.5927	Unoccupied
American Crow	AMCR 009	43.8097	-96.5545	Unoccupied
Bald Eagle	BAEA 16132	43.5627	-96.5942	Active
Bald Eagle	BAEA 16134	43.5231	-96.5976	Active
Bald Eagle	BAEA 16138	43.6068	-96.6281	Active
Bald Eagle	BAEA 3099	43.6254	-96.1982	Active
Bald Eagle	BAEA JasSher	43.8049	-96.4522	Active
Bald Eagle	BAEA KenLuv	43.7140	-96.1198	Active
Bald Eagle	BAEA 3100	43.6410	-96.2005	Active
Bald Eagle	BAEA 3101	43.5306	-96.1871	Active
Bald Eagle	BAEA Gar	43.7390	-96.5413	Active
Bald Eagle	BAEA RocRap	43.4704	-96.1819	Occupied
Bald Eagle	BAEA LBC	43.6482	-96.3064	Alternate
Bald Eagle	BAEA 16133	43.5495	-96.5983	Alternate
Great Blue Heron	GBHE 001*	43.5565	-96.5800	Unoccupied
Great Blue Heron	GBHE 3102	43.6394	-96.1899	Unoccupied
Great Horned Owl	GHOW 001	43.8856	-96.3812	Active
Great Horned Owl	GHOW 002	43.6325	-96.1991	Active
Great Horned Owl	GHOW 3097	43.5864	-96.3672	Active
Great Horned Owl	GHOW 003	43.7063	-96.3146	Unoccupied
Red-tailed Hawk	RTHA 002	43.4950	-96.4671	Active
Red-tailed Hawk	RTHA 003	43.8360	-96.4248	Active
Red-tailed Hawk	RTHA 005	43.8719	-96.3725	Active
Red-tailed Hawk	RTHA 009	43.7251	-96.5654	Active
Red-tailed Hawk	RTHA 3089	43.5821	-96.4284	Active
Red-tailed Hawk	RTHA 3095	43.5495	-96.3740	Active
Red-tailed Hawk	RTHA 001	43.5408	-96.6366	Occupied
Red-tailed Hawk	RTHA 006	43.8110	-96.1936	Occupied
Red-tailed Hawk	RTHA 004	43.7982	-96.3934	Unoccupied
Red-tailed Hawk	RTHA 007	43.5490	-96.5918	Unoccupied
Red-tailed Hawk	RTHA 008	43.6155	-96.6182	Unoccupied

Species	Nest	Latitude	Longitude	Status
Red-tailed Hawk	RTHA 010	43.8711	-96.5458	Unoccupied
Red-tailed Hawk	RTHA 012	43.7077	-96.3129	Unoccupied
Red-tailed Hawk	RTHA 011	43.7547	-96.4721	Unoccupied
Unknown	UNKN 001	43.8081	-96.3773	Unoccupied
Unknown	UNKN 002	43.5267	-96.3753	Unoccupied
Unknown	UNKN 003	43.5275	-96.3659	Unoccupied
Unknown	UNKN 004	43.4625	-96.2034	Unoccupied
Unknown	UNKN 005	43.5521	-96.1985	Unoccupied
Unknown	UNKN 006	43.7003	-96.1528	Unoccupied
Unknown	UNKN 007	43.6114	-96.6431	Unoccupied
Unknown	UNKN 008	43.7369	-96.5972	Unoccupied
Unknown	UNKN 009	43.8739	-96.5693	Unoccupied
Unknown	UNKN 010	43.6675	-96.5778	Unoccupied
Unknown	UNKN 011	43.6470	-96.4606	Unoccupied
Unknown	UNKN 012	43.5439	-96.4397	Unoccupied
Unknown	UNKN 013	43.9008	-96.4035	Unoccupied
Unknown	UNKN 014	43.7175	-96.3771	Unoccupied
Unknown	UNKN 015	43.6936	-96.3718	Unoccupied
Unknown	UNKN 016	43.8790	-96.3222	Unoccupied
Unknown	UNKN 017	43.4681	-96.3343	Unoccupied
Unknown	UNKN 019	43.7688	-96.2670	Unoccupied
Unknown	UNKN 020	43.7912	-96.1775	Unoccupied
Unknown	UNKN 021	43.4897	-96.1359	Unoccupied
Unknown	UNKN 022	43.6438	-96.1132	Unoccupied
Unknown	UNKN 023	43.6626	-96.4870	Unoccupied
Unknown	UNKN 024	43.7552	-96.4727	Unoccupied
Unknown	UNKN 025	43.6816	-96.4685	Unoccupied
Unknown	UNKN 026	43.7472	-96.4462	Unoccupied
Unknown	UNKN 027	43.5835	-96.4088	Unoccupied
Unknown	UNKN 028	43.7902	-96.3811	Unoccupied
Unknown	UNKN 029	43.6303	-96.3864	Unoccupied
Unknown	UNKN 030	43.5729	-96.3868	Unoccupied
Unknown	UNKN 031	43.6584	-96.3468	Unoccupied
Unknown	UNKN 032	43.5550	-96.3549	Unoccupied
Unknown	UNKN 033	43.7073	-96.3113	Unoccupied
Unknown	UNKN 034	43.7537	-96.6379	Unoccupied
Unknown	UNKN 035	43.7534	-96.6142	Unoccupied
Unknown	UNKN 036	43.6625	-96.4859	Unoccupied
Unknown	UNKN 036	43.6026	-96.5373	Unoccupied
Unknown	UNKN 037	43.6587	-96.3468	Unoccupied

*There were 11 great blue heron nests within the rookery

Note: Species were identified where possible. Nests were given unique name codes, though nest names from 2018 were kept for consistency (**Appendix B**) (Kreger and Suehring 2018). All nests were found in deciduous trees.

Figures

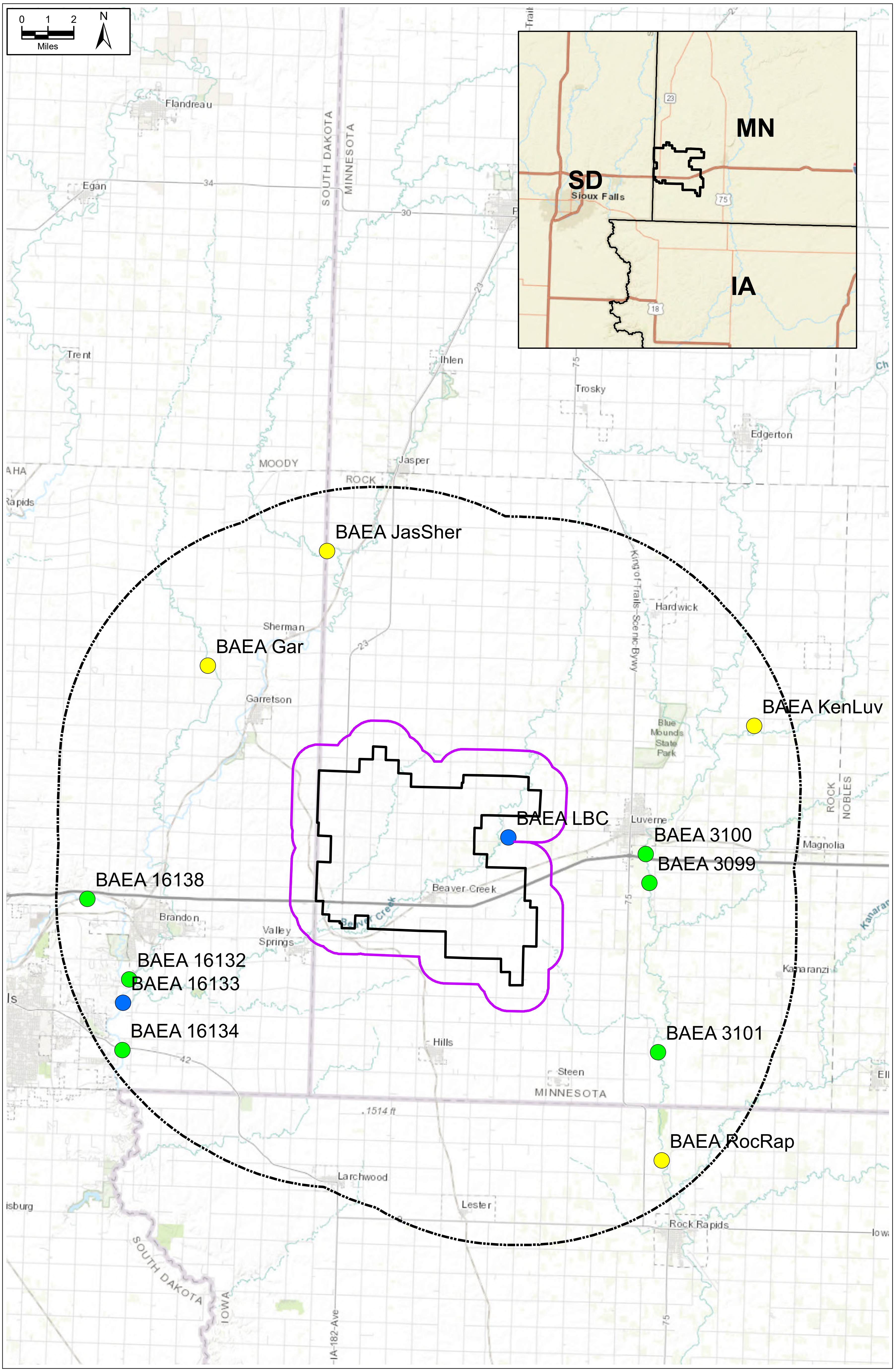

FIGURE 1.
ACTIVE EAGLE NEST LOCATION MAP
WALLEYE WIND PROJECT
WALLEYE WIND, LLC

Sources: ECT, 2020.

Eagle Nest Status
- 2020/Active 2020
- 2018/Active 2020
- Alternate 2020

- Project Boundary (06/03/20)
- 1 Mile Buffer (06/03/20)
- 10 Mile Buffer (06/03/20)

ECT

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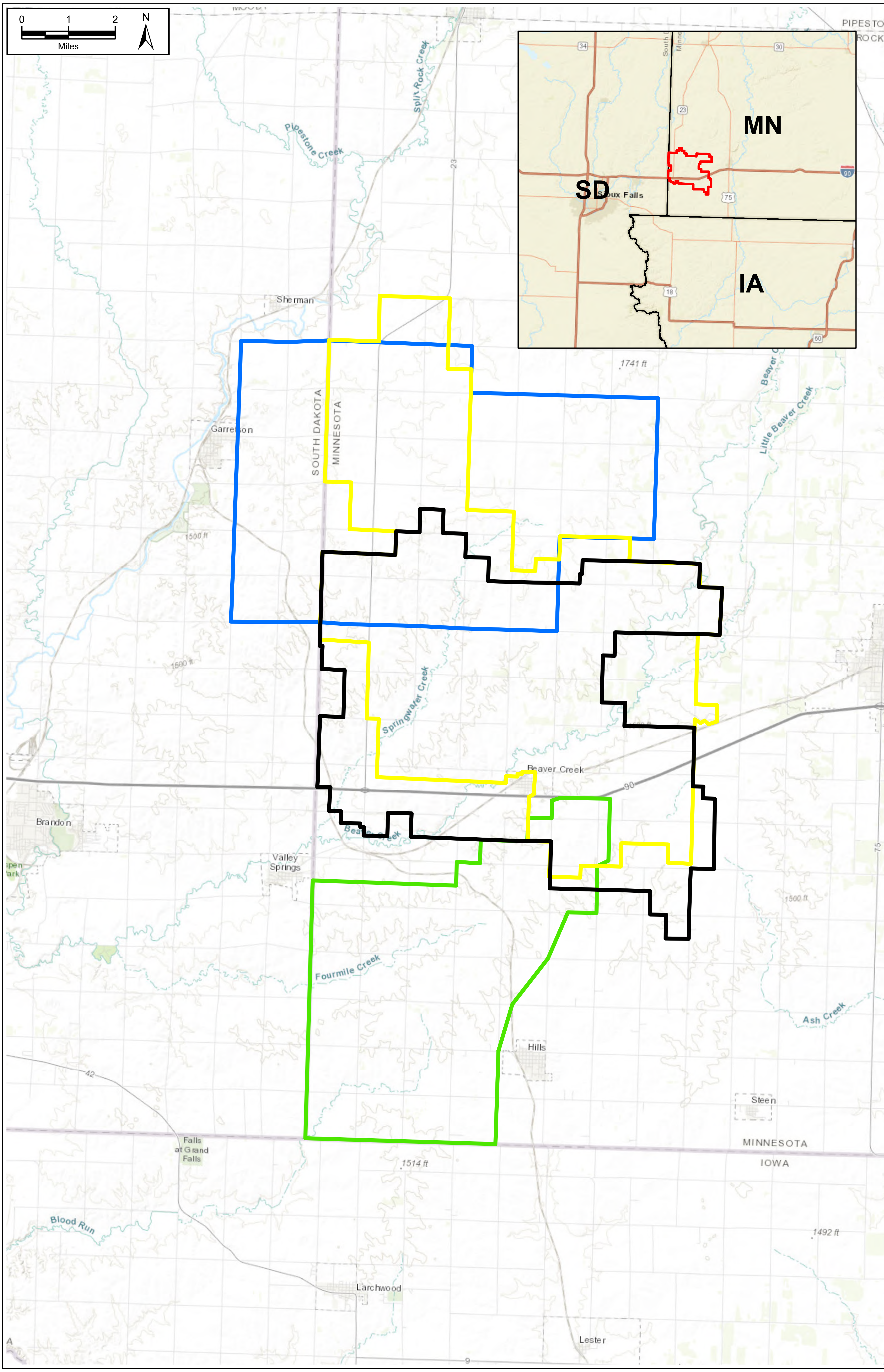

FIGURE 2.
PROJECT BOUNDARIES MAP
WALLEYE WIND PROJECT
WALLEYE WIND, LLC

2020 Project Boundary (06/03/20)
2019 Project Boundary (12/30/19)
2018 Project Boundary
2016 Project Boundary

Sources: ECT, 2020.

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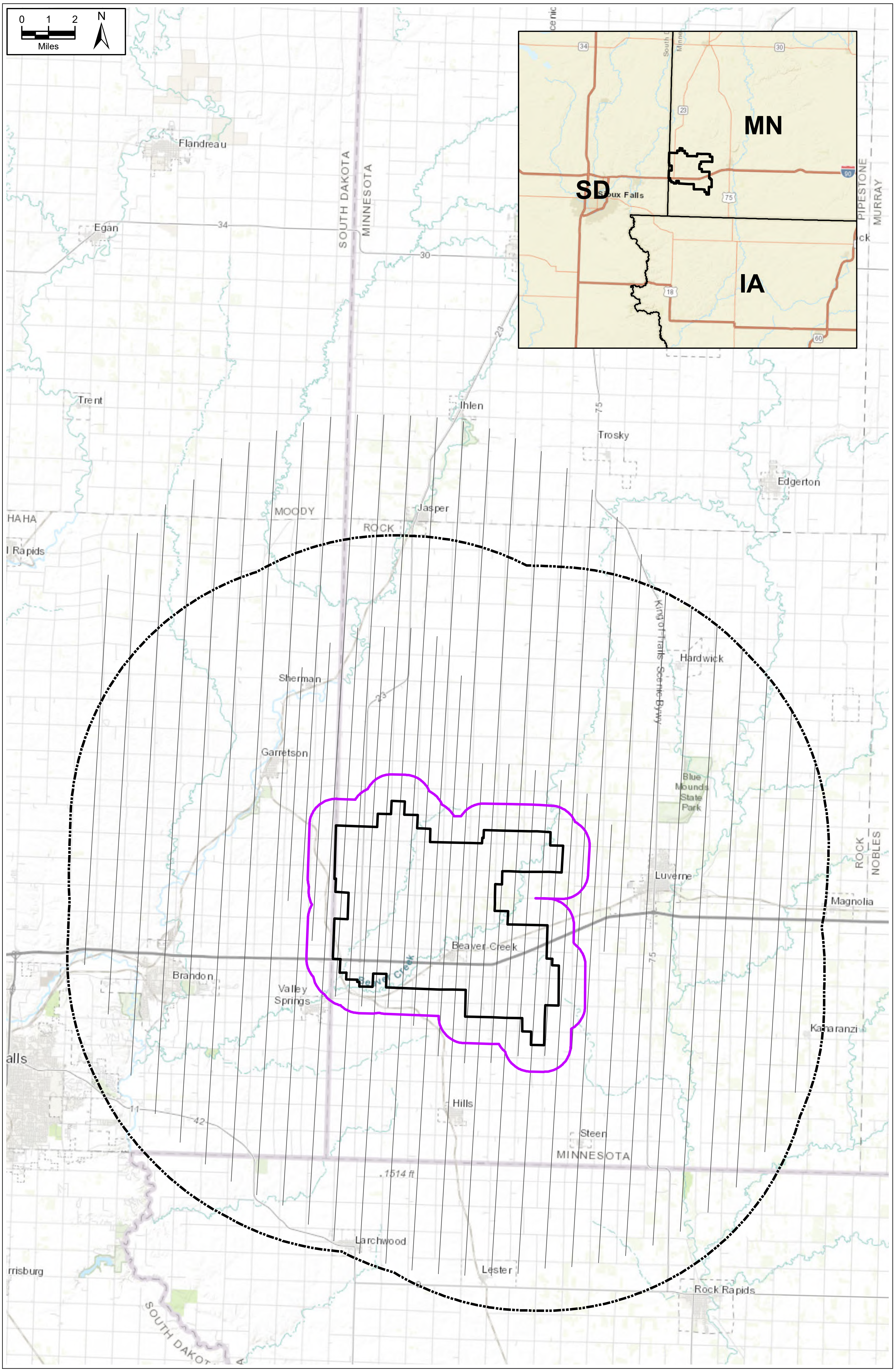

FIGURE 3.
SURVEY TRANSECTS MAP
WALLEYE WIND PROJECT
WALLEYE WIND, LLC

Sources: ECT, 2020.

Project Boundary (06/03/20)
Transects
1 Mile Buffer (06/03/20)
10 Mile Buffer (06/03/20)

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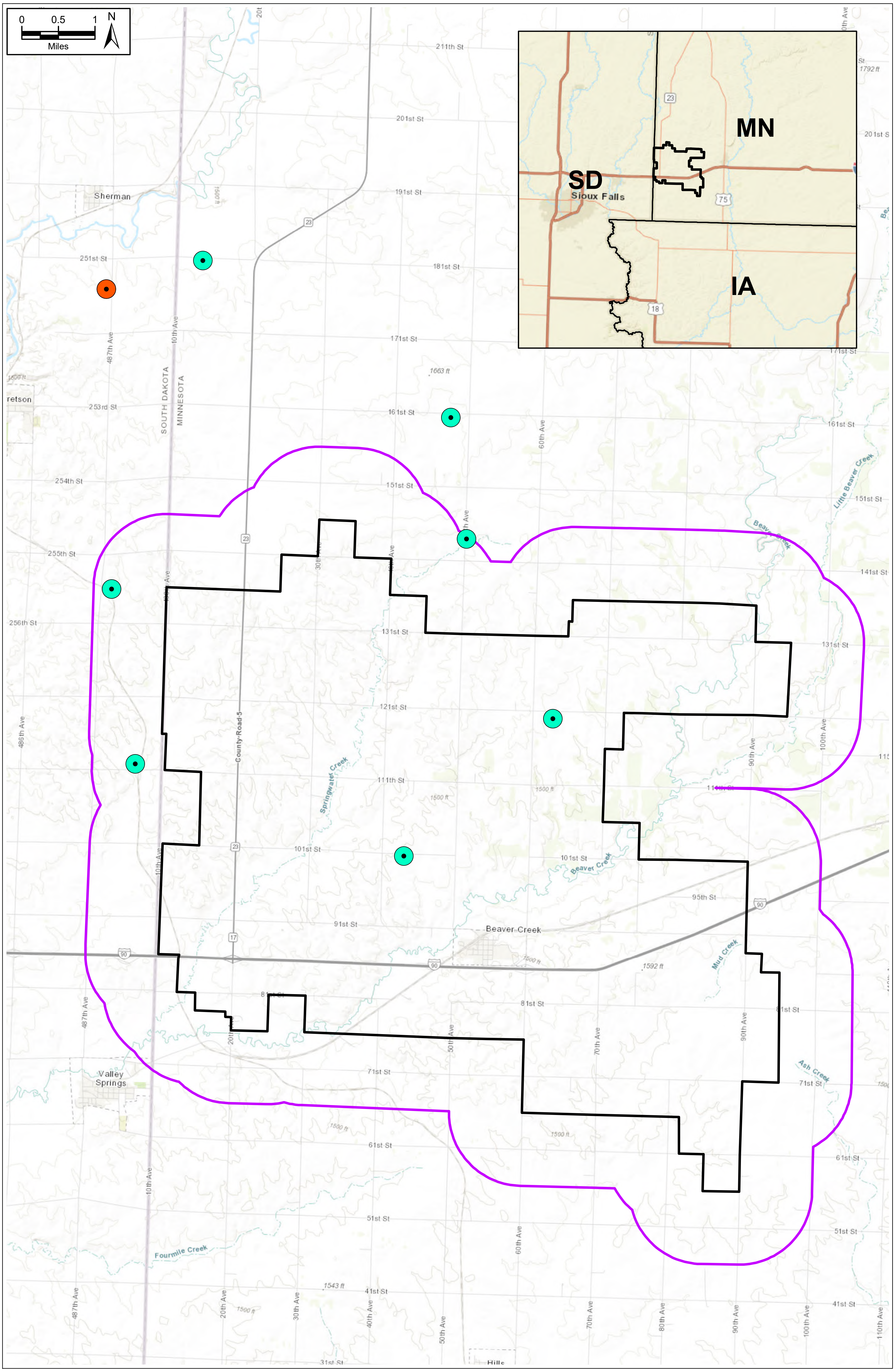

FIGURE 4.
ECT 2020 SURVEY
NON-EAGLE NEST LOCATION
WALLEYE WIND PROJECT
WALLEYE WIND, LLC

American Crow Nest
Non-Eagle Raptor Nest
Project Boundary (06/03/20)
1 Mile Buffer (06/03/20)

Sources: ECT, 2020.

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Appendix A

Representative Photographs

ECT Environmental Consulting & Technology, Inc.

PHOTOGRAPHIC LOG

Photo #1

Feature: Nest Little Beaver Creek

Lat/Long: 43.6482, -96.3064

Description: Nest Little Beaver Creek – This nest was located within the southeastern portion of the WRA. The nest was in excellent condition with an adult bald eagle in the nest and a second adult bald eagle approximately 20m away.

Photo #2

Feature: Representative Bald Eagle Nest Photograph

Lat/Long: 43.8049,
-96.4522

Description: Nest Jasper-Sherman was located approximately 3.1 miles to the north of the WRA. The nest was in excellent condition, with fresh lining and an adult bald eagle perched on the nest. This nest was considered active in 2020.

Appendix B

2018 West Aerial Nest Survey Report

2018 Raptor Nest Survey Report

Walleye Wind Energy Project

Rock County, Minnesota

Prepared for:

Walleye Wind Project, LLC

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INTRODUCTION

Walleye Wind Project, LLC (Walleye Wind) is considering the development of a utility-scale wind energy project, the Walleye Wind Energy Project (Project), in Rock County, Minnesota. At the request of Walleye Wind, Western EcoSystems Technology, Inc. (WEST) conducted an aerial raptor nest survey to record bald eagle (*Haliaeetus leucocephalus*) and other raptor nests in the proximity of potential turbine siting areas. This survey will aid in assessing potential effects of the Project on eagles and other raptors. The survey was conducted in accordance with the guidance provided in the US Fish and Wildlife Service (USFWS) *Eagle Conservation Plan Guidance* (ECPG; USFWS 2013) and the USFWS *Interim Golden Eagle Technical Guidance* (Pagel et al. 2010).

SURVEY AREA

The boundary of the proposed Project area encompasses 18,890 acres (76.4 square kilometers, 29.5 square miles) in Rock County, Minnesota (Figure 1). The Project area falls within the Western Corn Belt Plains Ecoregion, which encompasses southern Minnesota (US Environmental Protection Agency 2013). The Western Corn Belt Plains Ecoregion is composed of glaciated till plains and undulating loess plains. Much of the region was originally dominated by tall-grass prairie, riparian forest, oak-prairie savannas, and brushy and herbaceous wetlands. Today, most of the area has been cleared for highly productive farms producing corn, soybeans and livestock. Many smaller streams in this ecoregion have been tilled, ditched and tied into existing drainage systems which has caused a reduction in the amount of aquatic habitat. The Project area is on the very southern edge of the Prairie Coteau in Minnesota.

The elevation of the Project area ranges from approximately 404 – 485 meters (1,325 – 1,591 feet). Topography of the Project is generally flat with some gently rolling hills; a majority of the site (88%) is cultivated for crop production. A number of streams are present within the Project area.

METHODS

Raptor Nest Survey

Raptor surveys were conducted from a helicopter from April 17 – 19, 2018, a period before leaf out when raptors are actively tending to a nest or incubating eggs. Aerial surveys were conducted in accordance with the guidance provided in the ECPG (USFWS 2013) and the USFWS *Interim Golden Eagle Technical Guidance* (Pagel et al. 2010). A raptor ecologist and a helicopter pilot conducted the surveys. Raptors are defined here as kites, accipiters, buteos, harriers, eagles, falcons, and owls (Buehler 2000). Pre-flight planning included the creation of field maps and mobile Geographic Information System files and review of relevant background information, such as previously recorded nest locations, topographic maps, and aerial photographs.

Surveys within the Project boundary and 1-mile (1.6-kilometer [km]) buffer documented all potential raptor nests, including bald eagles, while the surveys out to the 10-mi (16-km) buffer focused only on identifying potential bald eagle nests. Bald eagle nest surveys focused on locating eyries (large, stick nest structures) in suitable eagle nesting substrate (trees, transmission lines, cliff faces, etc.) within and around the proposed Project area (Figure 1). Efforts were made to minimize disturbance to breeding raptors; the greatest possible distance at which the species could be identified was maintained, with distances varying, depending upon nest location and wind conditions.

In general, all potential raptor nest habitat was surveyed by flying transects spaced 0.25 – 1.0 mi (0.8 – 1.6 km) apart, flying at speeds of approximately 46 mi per hour (74 km per hour) when actively scanning for nests. Surveys were typically conducted between 07:00 hours and 18:00 hours.

The survey track was recorded using a Global Positioning System (GPS) enabled tablet device to ensure that all areas were adequately covered. The helicopter was positioned to allow thorough visual inspection of the habitat, and in particular, to provide a view of the tops of the tallest dominant trees where bald eagles generally prefer to nest (Buehler 2000). The locations of all potential raptor nests were recorded using a GPS enabled tablet running locus pro software. This included all confirmed and potential nests regardless of their activity status.

To determine the status of a nest, the biologist evaluated behavior of adults on or near the nest, and presence of eggs, young, whitewash, or fresh building materials. Attempts were made to identify the species of raptor associated with each active nest. Raptor species, nest type, nest status, nest condition, and nest substrate were recorded at each nest location to the extent possible.

Terminology

Included below are descriptions of terms used during the documentation of nests (see Results section).

Nest ID – A unique nest identification number was assigned for each nest documented.

Species – A species was assigned to each nest when possible, otherwise, it was classified as an unidentified raptor nest. Nests documented as unidentified raptor species were defined as any stick nest not having an occupant associated with it at the time of the survey. Many times nests become abandoned or are no longer used, and over time, may become a historic nest site. Unidentified raptor nests, including old nests or nests that could become suitable for raptors, were documented in order to populate a nest database to ensure future surveys include all potentially suitable nest sites. Unidentified raptor species nests that appeared consistent in size and structure with bald eagle nests were further classified as potential alternate nest sites for bald eagles.

Nest Condition – Nest condition was categorized as good, fair, or poor. Although the determination of nest condition can be subjective and may vary between observers, it gives a general sense of when a nest or nest site was last used. Nests in good condition were excellently maintained with very well-defined bowl, no sagging, possible to use immediately or currently in use. Nests in fair condition had a fairly well-defined bowl, minor sagging, and might require some repair or addition to use immediately. Nests in poor condition were sloughing or sagging heavily and would require effort to restore for successful nesting.

Substrate – Nest substrate was recorded to provide observers a visual reference to re-locate the nest. Substrates may include manmade structures such as power lines, nest platforms, and dock hoists, and biological and physical structures such as conifer and deciduous tree species or cliff faces.

Nest Status – Nest status was categorized using definitions consistent with the USFWS ECPG. When applicable, bald eagle nests and potential bald eagle nests are further classified in the nest details section as “in-use” or “alternate” based on updated definitions of these terms in the final eagle rule effective January 17, 2017 (50 CFR Parts 13 and 22). Nests were classified as occupied if any of the following were observed at the nest structure: (1) an adult in an incubating position; (2) eggs; (3) nestlings or fledglings; (4) a pair of adults (sometimes sub-adults); (5) a newly constructed or refurbished stick nest in the area where territorial behavior of a raptor had been observed earlier in the breeding season; or (6) a recently repaired nest with fresh sticks (clean breaks) or fresh boughs on top, and/or droppings and/or molted feathers on its rim or underneath. Occupied nests were further classified as active if (1) an adult was present on the nest in incubating position, (2) an egg or eggs were present, or (3) nestlings were observed. Nests were classified as inactive if no eggs or chicks were present. Nests not meeting the above criteria for “Occupied” were classified as “Unoccupied”.

RESULTS

A total of 22 stick nests representing two identified raptor species and one colonial waterbird species were detected during aerial surveys conducted April 17 – 19, 2018 (Table 1). Three occupied active bald eagle nests and one occupied inactive bald eagle nest were documented along the Big Sioux River, all of which were more than 7.0 miles (11.3 km) from the Project. Five unidentified raptor nests appeared consistent in size and structure with bald eagle nests: one was occupied inactive and four were inactive. All of these potential bald eagle nests were more than 6.5 miles (10.4 km) from the Project. Additional raptor nests documented during the survey included four occupied active red-tailed hawk (*Buteo jamaicensis*) nests: one within the Project boundary, two within one mile of the Project, and one just outside of the 1-mile buffer of the Project. Seven inactive nests of unidentified raptor species were also documented: six within the Project boundary and one within one mile of the Project. One stick nest that may have been built by a raptor (but was occupied by American crow [*Corvus brachyrhynchos*]) was documented within one mile of the Project. One occupied active great blue heron (*Ardea herodias*) rookery was also observed 7.3 miles from the Project.

The following section provides more details on each eagle nest and nests consistent in size and structure with eagle nests documented during the aerial surveys:

Nest 16132 – This nest was located approximately 7.1 mi (11.4 km) west of the Walleye Wind Energy Project area. The nest was in good condition at the time of the aerial survey. One adult bald eagle was observed on the nest in an incubating position, and the nest was considered an occupied active bald eagle nest in 2018 (Figure 1, Appendix A1). WEST also documented this nest as an occupied active bald eagle nest in 2016 (previous recorded as Nest 37; Pickle et al. 2016).

Nest 16135 – This nest was located approximately 8.3 mi (13.4 km) southwest of the Walleye Wind Energy Project area and was a new nest documented by WEST in 2018. The nest was in good condition at the time of the aerial survey. One adult bald eagle was observed on the nest in an incubating position, and the nest was considered an occupied active bald eagle nest in 2018 (Figure 1, Appendix A2).

Nest 16138 – This nest was located approximately 9.0 mi (14.5 km) northwest of the Walleye Wind Energy Project area. The nest was in good condition at the time of the aerial survey. One adult bald eagle was observed on the nest in an incubating position. The nest was considered an occupied active bald eagle nest in 2018 (Figure 1, Appendix A3). WEST also documented this nest as an occupied active bald eagle nest in 2016 (previously recorded as Nest 38; Pickle et al. 2016).

Nest 16134 – This nest was located approximately 7.2 mi (11.6 km) west of the Walleye Wind Energy Project area and was a new nest documented by WEST in 2018. The nest was in good condition at the time of the aerial survey and appeared to be recently tended, with both greenery and wash (i.e., fresh/recent droppings) observed in the nest. One adult bald eagle was observed perched on the nest and flying near the nest. Since no eggs or chicks were observed, the nest was considered an occupied inactive bald eagle nest in 2018 (Figure 1, Appendix A4).

Nest 16133 – This nest was located approximately 7.3 mi (11.7 km) west of the Walleye Wind Energy Project area. The nest was in good condition and was consistent in size and structure with a bald eagle nest. No eagles were seen on the nest or in close proximity to the nest; however, wash and feathers were observed in the nest. The nest is therefore considered an occupied inactive unidentified raptor nest in 2018 (Figure 1, Appendix A5).

Nest 3099 – This nest was located approximately 6.6 mi (10.6 km) northeast of the Walleye Wind Energy Project area. The nest was in fair condition and consistent in size and structure with a bald eagle nest. No eagles were seen on the nest or in close proximity to the nest. The nest was therefore considered inactive in 2018 (Figure 1, Appendix A6).

Nest 3100 – This nest was located approximately 6.8 mi (10.9 km) northeast of the Walleye Wind Energy Project area. The nest was in fair condition and consistent in size and structure with a bald eagle nest. No eagles were seen on the nest or in close proximity to the nest. The nest was therefore considered inactive in 2018 (Figure 1, Appendix A7).

Nest 3101 - This nest was located approximately 7.8 mi (12.6 km) east of the Walleye Wind Energy Project area. The nest was in fair condition and consistent in size and structure with a bald eagle nest. No eagles were seen on the nest or in close proximity to the nest. The nest was therefore considered inactive in 2018 (Figure 1, Appendix A8).

Nest 16136 – This nest was located approximately 8.5 mi (13.7 km) southwest of the Walleye Wind Energy Project area. The nest was in good condition and was consistent in size and structure with a bald eagle nest. No eagles were seen on the nest or in close proximity to the nest. The nest was therefore considered inactive in 2018 (Figure 1, Appendix A9).

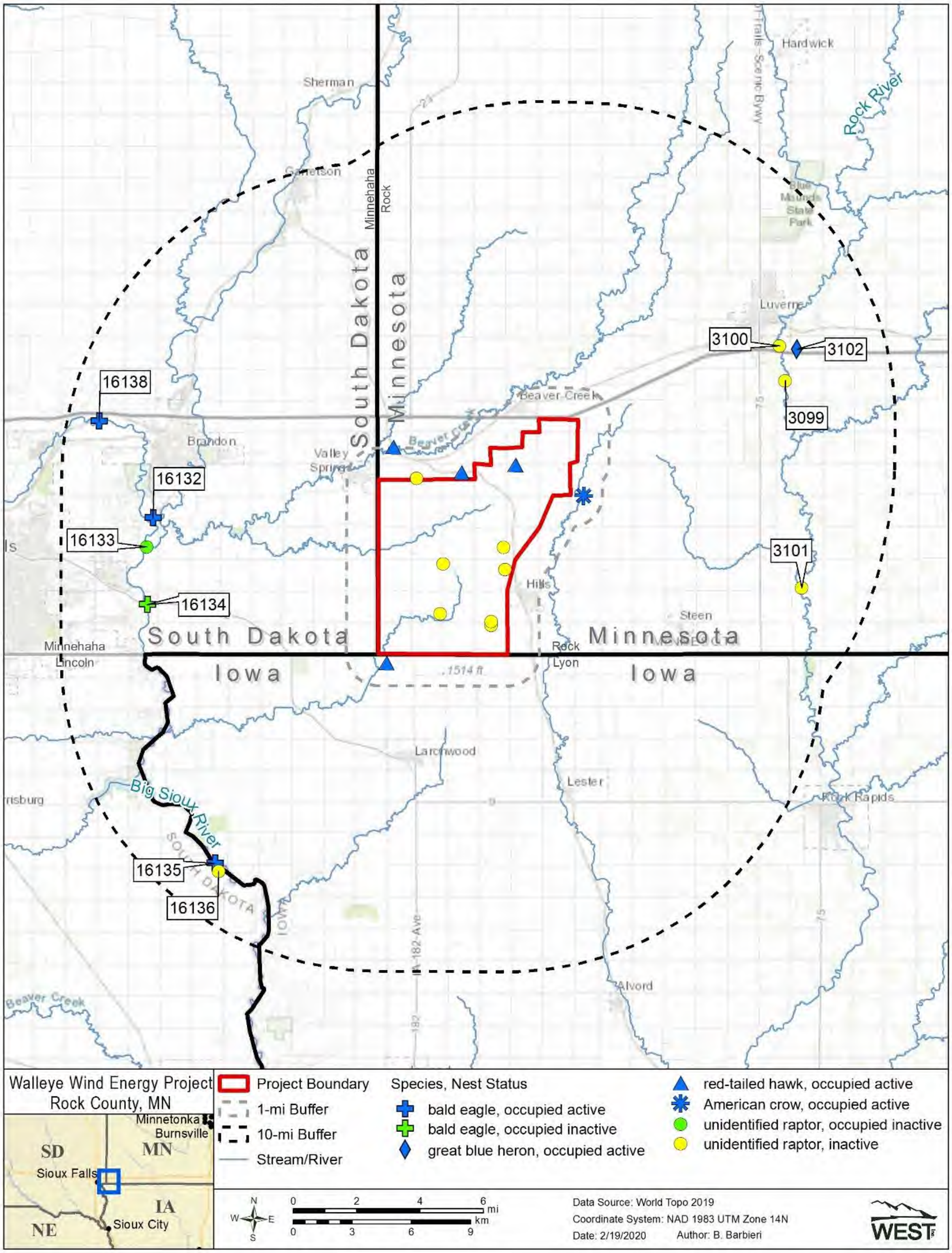

Figure 1. Stick nests documented April 17 – 19, 2018, near the Walleye Wind Energy Project, Rock County, Minnesota.

Table 1. Raptor nest ID, location, species, status, substrate, and condition of nests documented April 17 – 19, 2018, near the Walleye Wind Energy Project, Rock County, Minnesota.

Nest ID	Latitude	Longitude	Species[1]	Status at time of survey	Nest Substrate	Condition
16132	43.5627	-96.5942	BAEA	occupied active	deciduous tree	good
16135	43.4051	-96.5550	BAEA	occupied active	deciduous tree	good
16138	43.6068	-96.6281	BAEA	occupied active	deciduous tree	good
16134	43.5231	-96.5976	BAEA	occupied inactive	deciduous tree	good
16133	43.5495	-96.5983	UNRA*	occupied inactive	deciduous tree	good
3099	43.6250	-96.1971	UNRA*	inactive	deciduous tree	fair
3100	43.6410	-96.2005	UNRA*	inactive	deciduous tree	fair
3101	43.5306	-96.1871	UNRA*	inactive	deciduous tree	fair
16136	43.4016	-96.5528	UNRA*	inactive	deciduous tree	good
3102	43.6394	-96.1899	GBHE	occupied active	deciduous tree	good
3092	43.5833	-96.4004	RTHA	occupied active	deciduous tree	good
3097	43.5866	-96.3664	RTHA	occupied active	deciduous tree	good
16137	43.4964	-96.4475	RTHA	occupied active	deciduous tree	good
16139	43.5949	-96.4431	RTHA	occupied active	deciduous tree	good
3098	43.5727	-96.3239	AMCR	occupied active	deciduous tree	fair
3089	43.5810	-96.4286	UNRA	inactive	deciduous tree	fair
3090	43.5418	-96.4119	UNRA	inactive	deciduous tree	fair
3091	43.5191	-96.4139	UNRA	inactive	deciduous tree	fair
3093	43.5155	-96.3818	UNRA	inactive	deciduous tree	fair
3095	43.5495	-96.3740	UNRA	inactive	deciduous tree	fair
3096	43.5392	-96.3730	UNRA	inactive	deciduous tree	fair
3094	43.5138	-96.3819	UNRA	inactive	deciduous tree	poor

[1.] AMCR = American crow, BAEA = bald eagle, GBHE = great blue heron, RTHA = red-tailed hawk, UNRA = unidentified raptor species, UNRA* = unidentified species nest characteristic in structure and size of bald eagle and may be an alternate nest or historic nesting site.

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Appendix A. Images of Bald Eagle Nests and Nests Consistent in Size and Structure with Bald Eagle Nests Found April 17 – 19, 2018 within the 10-mile Buffer of the Walleye Wind Energy Project, Rock County, Minnesota

Appendix A1. Nest 16132 was located approximately 7.1 mi (11.4 km) west of the Walleye Wind Energy Project boundary. The nest was in good condition and one bald eagle was observed on the nest in an incubating position. The nest was considered occupied and active in 2018.

Appendix A2. Nest 16135 was located approximately 8.3 mi (13.4 km) southwest of the Walleye Wind Energy Project boundary. The nest was in good condition and one bald eagle was observed on the nest in an incubating position. The nest was considered occupied and active in 2018.

Appendix A3. Nest 16138 was located approximately 9.0 mi (14.5 km) northwest of the Walleye Wind Energy Project boundary. The nest was in good condition and one bald eagle was observed on the nest in an incubating position. The nest was considered occupied and active in 2018.

Appendix A4. Nest 16134 was located approximately 7.2 mi (11.6 km) west of the Walleye Wind Energy Project boundary. The nest was in good condition and greenery and wash were observed in the nest. One bald eagle was observed perched on and flying near the nest. The nest was considered an occupied inactive bald eagle nest in 2018.

Appendix A5. Nest 16133 was located approximately 7.3 mi (11.7 km) west of the Walleye Wind Energy Project boundary. The nest was in good condition and wash was observed in the nest. No bald eagles were observed on or near the nest, and it was considered an occupied inactive unidentified raptor nest in 2018.

Appendix A6. Nest 3099 was located approximately 6.6 mi (10.6 km) northeast of the Walleye Wind Energy Project boundary. The nest was in fair condition and consistent in size and structure with a bald eagle nest. No eagles were seen near the nest. The nest was considered inactive in 2018.

Appendix A7. Nest 3100 was located approximately 6.8 mi (10.9 km) northeast of the Walleye Wind Energy Project boundary. The nest was in fair condition and consistent in size and structure with a bald eagle nest. No eagles were seen near the nest. The nest was considered inactive in 2018.

Appendix A8. Nest 3101 was located approximately 7.8 mi (12.6 km) east of the Walleye Wind Energy Project boundary. The nest was in fair condition and consistent in size and structure with a bald eagle nest. No eagles were seen near the nest. The nest was considered inactive in 2018.

Appendix A9. Nest 16136 was located approximately 8.5 mi (13.7 km) southwest of the Walleye Wind Energy Project boundary. The nest was in good condition and consistent in size and structure with a bald eagle nest. No eagles were seen near the nest. The nest was considered inactive in 2018.

Appendix C

2016 West Aerial Nest Survey Report

Confidential Business Information

Raptor Nest Survey Results for the Walleye Wind Project Rock County, Minnesota and Minnehaha County, South Dakota

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May 25, 2016

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REPORT REFERENCE

Pickle, J., C. Rittenhouse and A. Kreger. 2016. Raptor Nest Survey Results for the Walleye Wind Project, Rock County, Minnesota and Minnehaha County, South Dakota. May 25, 2016. Prepared for Renewable Energy Systems Americas, Inc. Prepared by Western EcoSystems Technology, Inc. (WEST), Golden Valley, Minnesota.

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INTRODUCTION

Renewable Energy Systems Americas (RES) is developing the Walleye Wind Project (Project) in Rock County, Minnesota and Minnehaha County, South Dakota (Figure 1). RES requested that Western EcoSystems Technology, Inc. (WEST) conduct an aerial based raptor nest survey to help evaluate the potential impacts of construction on nesting raptors. This report provides results of the general raptor nest survey conducted at the Project on March 24 – 25, 2016.

STUDY AREA

The Project is located on the South Dakota-Minnesota border, just east of the town of Garreston, South Dakota (Figure 1). The Project falls in the Western Corn Belt Plains Ecoregion (USEPA 2013, 2015). The Western Corn Belt Plains Ecoregion is composed of glaciated till plains and undulating loess plains. Much of the region was originally dominated by tall-grass prairie, riparian forest, and woody and herbaceous wetlands. Today, most of the area has been cleared for farms producing corn, soybeans, and livestock. Many smaller streams in this ecoregion have been tiled, ditched, and tied into existing drainage systems, which caused a reduction in the amount of aquatic habitat. The majority of the Project is composed of cropland and developed areas (89%) with sparse forest patches and wetlands.

METHODS

Aerial Raptor Nest Survey

One aerial survey was conducted from a helicopter in late March (March 24 – 25, 2016), a period before leaf out when raptors would be actively tending to a nest or incubating eggs. Aerial surveys were conducted in accordance with the guidance provided in the U.S. Fish and Wildlife Service (USFWS) *Eagle Conservation Plan Guidance: Module 1 – Land-based Wind Energy, Version 2* (ECPG; USFWS 2013) and the USFWS Inventory and Monitoring Protocols (Pagel et al. 2010). An experienced raptor ecologist and a skilled helicopter pilot conducted the survey. Raptors are defined here as kites, accipiters, buteos, harriers, eagles, falcons, and owls. However, the main focus of the survey was to identify bald eagle nests. Bald eagle nest surveys focused on locating eyries (large, stick nest structures) in suitable eagle nesting substrate (trees, transmission lines, cliff faces, etc.) within and around the proposed Project (Figure 1), considering a 1-mi and a 10-mi buffer (Figure 1).

Surveys within the project boundary and 1-mi buffer documented all potential raptor nests, including bald eagles, while the surveys up to the 10-mi buffer focused only on identifying potential bald eagle nests. Efforts were made to minimize disturbance to breeding raptors; the greatest possible distance at which the species could be identified was maintained, with distances varying depending upon nest location and wind conditions.

In general, all potential bald eagle and raptor nest habitat was surveyed by flying transects between 0.25 and 0.5 mi (0.4 and 0.8 km) apart, flying at speeds of 60 to 75 mi per hour (mph; 97 to 121 km per hour) throughout the proposed Project and associated 10-mi buffer. Surveys were typically conducted between 07:00 hours and 18:00 hours. The locations of all potential raptor nests were recorded using a hand-held Global Positioning System (GPS); coordinates were set at Latitude/Longitude (hddd.ddddd°) World Geodetic System (WGS) 84 unit. The survey included all confirmed and potential nests regardless of their activity status. To determine the status of a nest, the biologist relied on clues that included behavior of adults and presence of eggs, young, or whitewash. Attempts were made to identify the species of raptor associated with each active nest. Raptor species, nest type, nest status, nest condition, and substrate, were recorded at each nest location to the extent possible.

Terminology

Included below are descriptions of terms used during the documentation of nests (see Results section).

Nest ID - WEST assigned a unique nest identification number for each nest documented.

Species - A species was assigned to each nest when possible, otherwise, it was classified as an unknown raptor nest. Nests documented as unknown raptor species are defined as any stick nest that did not have an occupant associated with it at the time of the survey. Many times nests will become abandoned or no longer used, and over time, may become a historic nest site. Unknown raptor nests, including old nests or nests that could become suitable for raptors, are documented in order to populate a nest database to ensure that future surveys include all potentially suitable nest sites.

Nest Condition - Nest condition was categorized using descriptions ranging from poor to excellent. Although the determination of nest condition can be subjective and may vary between observers, it gives a general sense of when a nest or nest site may have last been used. Nests in poor to fair condition are typically in disrepair, sloughing, or sagging heavily, and would require some level of effort to rebuild in order to be suitable for successful nesting. Nests in good to excellent condition are those that appear to have been well maintained, have a well-defined bowl shape, are not sagging or sloughing, and appear to be suitable for nesting.

Substrate - The substrate in which a nest was observed was recorded to provide observers a visual reference. Substrates range from manmade structures (such as power lines, nest platforms, and dock hoists) to biological and physical structures (conifer and deciduous tree species, cliff faces).

Nest Status - WEST categorizes basic nest use consistent with definitions from the ECPG. Nests were classified as occupied if any of the following were observed at the nest structure: (1) an adult in an incubating position, (2) eggs, (3) nestlings or fledglings, (4) occurrence of a pair of adults (or, sometimes sub-adults), (5) a newly constructed or refurbished stick nest in the area where territorial behavior of a raptor had been observed early in the breeding season, or (6) a recently repaired nest with fresh sticks (clean breaks) or fresh boughs on top, and/or droppings and/or molted feathers on its rim or underneath. Occupied nests were further classified as active if an egg or eggs had been laid or nestlings were observed, or inactive if no eggs or chicks were present. A nest that does not meet the above criteria for "occupied" was classified as "unoccupied".

RESULTS

Aerial Raptor Nest Survey

A WEST biologist detected a total of 38 raptor nests representing three raptor species (Table 1) during aerial surveys conducted on March 24 – 25, 2016. Two occupied bald eagle nests, two occupied red-tailed hawk (*Buteo jamaicensis*) nests, one occupied great-horned owl (*Bubo virginianus*) nest, and 33 unoccupied, inactive unknown raptor nests were identified (Table 1; Figure 1).

No occupied or potential bald eagle nests were located within the Project (Figure 1). No bald eagles were observed during the survey within the Project. Two occupied active bald eagle nests were documented in this survey, within riparian habitat along the Big Sioux River (Figure 1). No federal or state-listed threatened or endangered raptor species were observed nesting within the Project or the associated buffers. The following section provides a description of the bald eagle nests that were identified. Appendix A contains photos of all potential bald eagle nests. Table 1 summarizes the data collected at all observed raptor nests.

Nest 37 – this nest is located approximately 8.44 mi (13.58 km) southwest of the Project boundary. The nest was in excellent condition. Two bald eagles were observed; one was perched and one was observed in a nesting position. The nest is therefore considered occupied and active in 2016 (Appendix A, Figure 1).

Nest 38 – this nest is located approximately 7.76 mi (12.49 km) southwest of the Project boundary. The nest was in excellent condition. An adult bald eagle was observed in a nesting position. The nest is therefore considered occupied and active in 2016 (Appendix A, Figure 2).

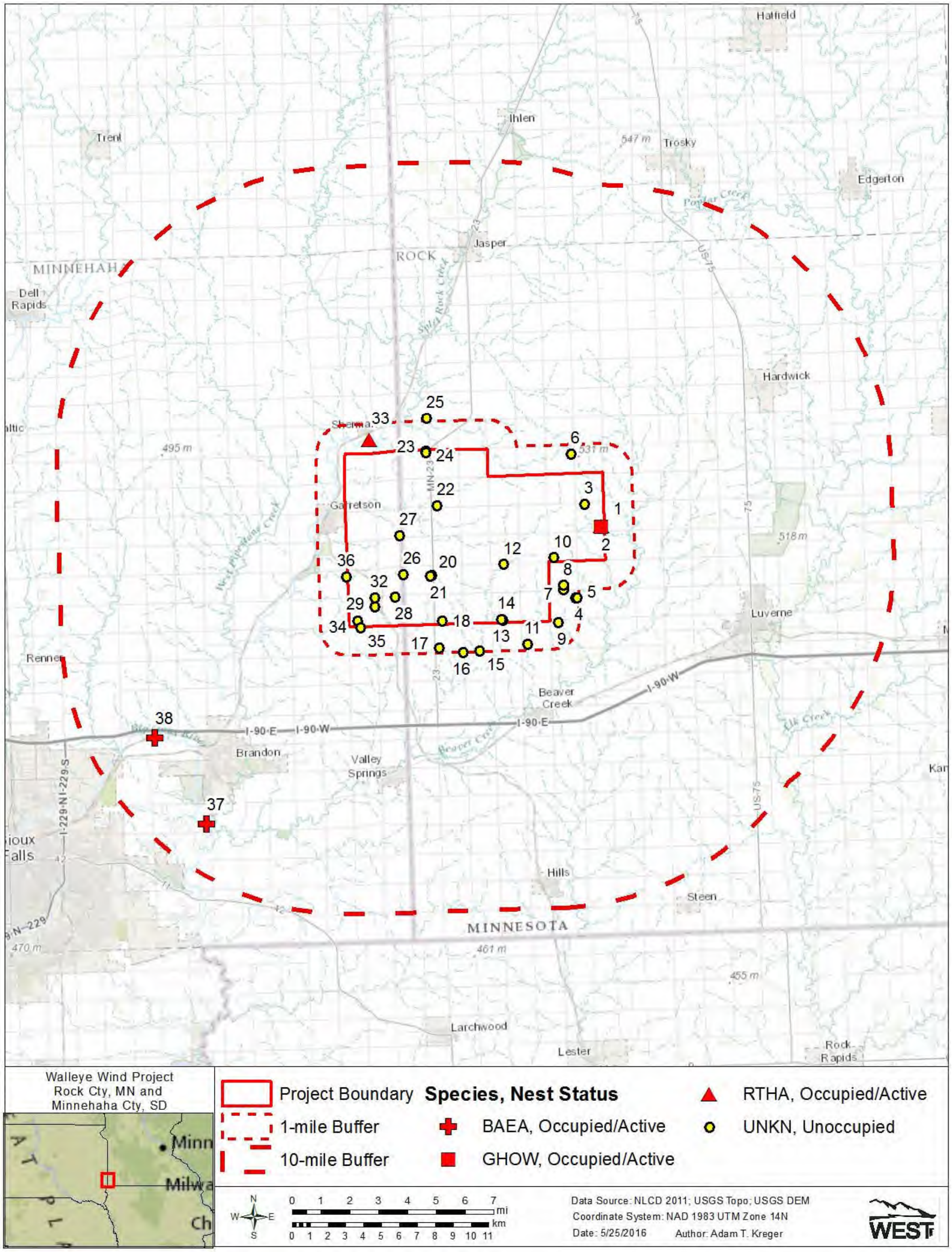

Figure 1. Locations of raptor nests observed at the Walleye Wind Project, Rock County, Minnesota, and Minnehaha County, South Dakota, and associated 1-mi and 10-mi buffers March 24 – 25, 2016.

Table 1. Raptor nest unique ID (NEST ID), locations (Lat/Long, hddd.dddd°; WGS 84) and features for identified nests during the March 24 – 25, 2016 survey for the Walleye Wind Project, Rock County, Minnesota, and Minnehaha County, South Dakota. Bald eagle (BAEA), Red-tailed hawk (RTHA), great-horned owl (GHOW), and unknown raptor (UNKN) nests were located.

Nest	Nest ID	Species	Nest substrate	Latitude	Longitude	Status at time of survey	Condition
1	032416-RTHA-MN-144	Red-tailed Hawk	Tree	43.707691	-96.312949	Occupied, active	Excellent
2	032416-GHOW-MN-145	Great-horned Owl	Tree	43.70629	-96.314637	Occupied, active	Excellent
3	032416-UNKN-MN-146	Unknown	Tree	43.717853	-96.325994	Unoccupied, inactive	Poor
4	032416-UNKN-MN-147	Unknown	Tree	43.670871	-96.334245	Unoccupied, inactive	Poor
5	032416-UNKN-MN-148	Unknown	Tree	43.671031	-96.333293	Unoccupied, inactive	Good
6	032416-UNKN-MN-149	Unknown	Tree	43.743468	-96.334475	Unoccupied, inactive	Fair
7	032416-UNKN-MN-150	Unknown	Tree	43.675245	-96.34255	Unoccupied, inactive	Fair
8	032416-UNKN-MN-151	Unknown	Tree	43.677388	-96.342307	Unoccupied, inactive	Fair
9	032416-UNKN-MN-152	Unknown	Tree	43.658674	-96.34683	Unoccupied, inactive	Good
10	032416-UNKN-MN-153	Unknown	Tree	43.691466	-96.348498	Unoccupied, inactive	Good
11	032416-UNKN-MN-154	Unknown	Tree	43.648392	-96.368753	Unoccupied, inactive	Poor
12	032416-UNKN-MN-155	Unknown	Tree	43.688902	-96.383623	Unoccupied, inactive	Fair
13	032416-UNKN-MN-156	Unknown	Tree	43.660972	-96.385358	Unoccupied, inactive	Poor
14	032416-UNKN-MN-157	Unknown	Tree	43.661088	-96.38602	Unoccupied, inactive	Poor
15	032416-UNKN-MN-158	Unknown	Tree	43.645665	-96.401958	Unoccupied, inactive	Good
16	032416-UNKN-MN-159	Unknown	Tree	43.645285	-96.413562	Unoccupied, inactive	Good
17	032416-UNKN-MN-160	Unknown	Tree	43.647988	-96.429708	Unoccupied, inactive	Good
18	032416-UNKN-MN-161	Unknown	Tree	43.661306	-96.427314	Unoccupied, inactive	Good
19	032416-UNKN-MN-162	Unknown	Tree	43.684018	-96.434386	Unoccupied, inactive	Good
20	032416-UNKN-MN-163	Unknown	Tree	43.684492	-96.433582	Unoccupied, inactive	Poor
21	032416-UNKN-MN-164	Unknown	Tree	43.684014	-96.434355	Unoccupied, inactive	Poor
22	032416-UNKN-MN-165	Unknown	Tree	43.719569	-96.428248	Unoccupied, inactive	Poor
23	032416-UNKN-MN-166	Unknown	Tree	43.746996	-96.435082	Unoccupied, inactive	Good
24	032416-UNKN-MN-167	Unknown	Tree	43.746345	-96.434986	Unoccupied, inactive	Good
25	032416-UNKN-MN-168	Unknown	Tree	43.763592	-96.433858	Unoccupied, inactive	Poor
26	032416-UNKN-MN-169	Unknown	Tree	43.685432	-96.453486	Unoccupied, inactive	Poor
27	032416-UNKN-SD-170	Unknown	Tree	43.704884	-96.454916	Unoccupied, inactive	Fair
28	032416-UNKN-SD-171	Unknown	Tree	43.674099	-96.459338	Unoccupied, inactive	Fair
29	032416-UNKN-SD-172	Unknown	Tree	43.669676	-96.473876	Unoccupied, inactive	Fair
30	032416-UNKN-SD-173	Unknown	Tree	43.673952	-96.473378	Unoccupied, inactive	Fair
31	032416-UNKN-SD-174	Unknown	Tree	43.674035	-96.473232	Unoccupied, inactive	Fair
32	032416-UNKN-SD-175	Unknown	Tree	43.674108	-96.4734	Unoccupied, inactive	Fair
33	032416-RTHA-SD-176	Red-tailed Hawk	Tree	43.754718	-96.472122	Occupied, active	Excellent
34	032416-UNKN-SD-177	Unknown	Tree	43.662526	-96.485896	Unoccupied, inactive	Fair

Table 1. Raptor nest unique ID (NEST ID), locations (Lat/Long, hddd.dddd°; WGS 84) and features for identified nests during the March 24 – 25, 2016 survey for the Walleye Wind Project, Rock County, Minnesota, and Minnehaha County, South Dakota. Bald eagle (BAEA), Red-tailed hawk (RTHA), great-horned owl (GHOW), and unknown raptor (UNKN) nests were located.

Nest	Nest ID	Species	Nest substrate	Latitude	Longitude	Status at time of survey	Condition
35	032416-UNKN-SD-178	Unknown	Tree	43.659209	-96.483837	Unoccupied, inactive	Fair
36	032416-UNKN-SD-179	Unknown	Tree	43.685023	-96.492827	Unoccupied, inactive	Good
37	032516-BAEA-SD-180	Bald Eagle	Tree	43.562668	-96.594158	Occupied, active	Excellent
38	032516-BAEA-SD-181	Bald Eagle	Tree	43.606778	-96.628101	Occupied, active	Excellent

DISCUSSION/CONCLUSION

These surveys provided additional information on eagle and raptor use within the vicinity of the Project. Aerial surveys did not find bald eagle nests within the Project. The Project site is dominated by cultivated agricultural lands with relatively little forest cover. The Project does include small pond, river, and wetland systems that might provide foraging opportunities to eagles. Woody habitats with mature large trees, which may provide nesting habitat for bald eagles, exist along the Big Sioux River (Nest 37, Nest 38), to the southwest of the Project boundary.

The ECPG states that eagle pairs at nests within one-half the mean inter-nest distance from the Project area are susceptible to disturbance take and blade strike mortality. The mean inter-nest distance of all bald eagle nests observed during this survey is approximately 3.5 mi (5.6 km) with a half mean inter-nest distance of 1.8 mi (2.9 km). The closest eagle nest to the project boundary is approximately 7.7 miles to the southwest. Given their distance from the Project area and lack of intervening habitat, bald eagles inhabiting these nests are not expected to be at increased risk of disturbance take and blade strike mortality as a result of Project development.

LITERATURE CITED

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APPENDIX A: IMAGES OF EAGLE NESTS (OCCUPIED-ACTIVE AND UNOCCUPIED/INACTIVE) IN THE 10-MILE BUFFER OF THE WALLEYE WIND PROJECT, ROCK COUNTY, MINNESOTA AND MINNEHAHA COUNTY, SOUTH DAKOTA

Figure 1. Nest 37 is located approximately 8.44 mi (13.58 km) southwest of the Project boundary. The nest was in excellent condition. Two bald eagles were observed; one was perched and one was observed in a nesting position. The nest is therefore considered occupied and active in 2016.

Figure 2. Nest 2 is located approximately 7.76 mi (12.49 km) southwest of the Project boundary. The nest was in excellent condition. An adult bald eagle was observed in a nesting position. The nest is therefore considered occupied and active in 2016.

Appendix D

Post Construction Mortality Monitoring

Environmental Consulting & Technology, Inc.

June 10, 2020

Post Construction Mortality Monitoring Protocol
Walleye Wind Project

The following is an overview for the Post Construction Mortality Monitoring Protocol (PCMM) for the Walleye Wind Project (Project) located in Rock, County Minnesota. The owner of Walleye Wind, Walleye Wind, LLC (Walleye Wind), has prepared this PCMM to satisfy the requirements of the Minnesota Public Utility Commission's Large Wind Energy Conversion System (LWECS) Site Permitting process for the Project. Specially this protocol have been developed to comply with both the U.S. Fish and Wildlife Service (USFWS) *Land-Based Wind Energy Guidelines* (WEG) as well as the Minnesota Department of Natural Resources (MNDNR) and the Minnesota Department of Commerce's *Avian and Bat Survey Protocols for Large Wind Energy Conversion Systems in Minnesota* for sites posing a low risk to avian and bat species.

POST CONSTRUCTION FATALITY MONITORING

The major goal of Tier 4- Post Construction Studies in the WEG is to assess if actions taken during previous tiers to avoid and/or minimize potential impacts to habitat and special concern species are successful. Specifically, Tier 4 studies address the following questions:

1) What are the bird and bat fatality rates for the project?
2) What are the fatality rates of species of concern?
3) How do the estimated fatality rates compare to the predicted fatality rates?
4) Do bird and bat fatalities vary within the project site in relation to site characteristics?
5) How do the fatality rates compare to the fatality rates from existing projects in similar landscapes with similar species composition and use?
6) What is the composition of fatalities in relation to migrating and resident birds and bats at the site?
7) Do fatality data suggest the need for measures to reduce impacts?

Avian and Bat Fatality Monitoring Protocol

Fatality monitoring for the Project will begin the first year following construction and will be conducted for one year. Monitoring will conduct searches for bird and bat carcasses at a

161 E Aurora Road,
Northfield, OH 44067
216-518-2807

minimum of 10 randomly selected turbines. Plots will include an area of 60 m (120 m per rectangular side) in all cardinal directions from the base of the turbine. Vegetation will be cleared from the plots if it will significantly affect searcher efficiency. Once the turbines are selected, these turbines will be surveyed for the entire survey period. Turbines will be searched a minimum of 1 day per week, with a minimum of 3 days between searches, between March 15 to November 15, during the one year of monitoring. Data collected for each turbine searched will consist of the turbine number, date, start and end time, observer identification, and ground cover conditions. Weather data recorded will include cloud cover, general ceiling height, relative visibility, precipitation, and/or passing storm fronts.

Only personnel trained in proper search techniques will conduct the standardized mortality searches. Searchers will walk at a rate of approximately 45 to 60 meters (m) per minute, along each transect visually scanning both sides out to 3 m on each side for carcasses. Searches will be abandoned if severe or otherwise unsafe weather conditions are present and will resume that day if weather conditions permit. Searches will commence at or near sunrise. All turbines designated to be searched on a given day will be searched within eight hours after sunrise, weather permitting. In areas where vegetation may significantly alter searcher efficiency (e.g., agricultural fields), vegetation will be cleared from plots before searches begin.

Prior to the commencement of formal carcass surveys, clearance surveys will be conducted to exclude any casualties already present in the landscape from the fatality estimate. Should a bird or bat carcass be found, the searcher will place a pin flag near the carcass and continue the search. After searching the entire plot, the searcher will return to each carcass to record the information described below on a standardized fatality datasheet. All carcasses will be GPS located for mapping purposes and photographed. All identified carcasses, unless being used for searcher efficiency trials or carcass removal trials, will be removed.

Data collected for each carcass found will consist of the date and time collected, carcass species (common name and scientific name), sex and age (where possible), searcher's name, unique identification number, turbine number, perpendicular distance from the transect line to the carcass, distance from turbine, azimuth from the turbine, surface type the carcass is found on, land use(s) adjacent to the turbine pad, condition of the carcass (e.g., fresh, rigor, intact carcass, partial, scavenged, feather spot), carcass position (e.g., face-up or down, sprawled out or balled up) and estimated time of death (e.g., <1 day, < 2days). In addition to recording survey site and carcass data, searchers will document incidental wildlife observations made during visits on standardized field forms.

All carcasses detected during surveys will be clearly marked so as not to double-count them during clearing trials. All raptors, including eagles and threatened and endangered (T/E) species, will be collected by the local or District Wildlife Manager as soon as reasonably possible after salvage; coordination of this collection will occur through the site environmental staff/representative. Large fatality events of 5 or more (per search/per turbine) and any single fatality of any eagle, federal or state-listed species, will be reported to the DNR Regional Environmental Assessment Ecologist and USFWS within 24 hours of discovery.

In the event of an unanticipated discovery, photographs will be obtained, and immediate notifications will be made to the Walleye Wind Operations Manager and appropriate environmental staff. All communications pertaining to any fatalities detected during surveys or incidentally between surveys will be reported to Walleye Wind, LLC prior to any communication with state agencies or USFWS.

Fatalities found in non-search areas will be treated as incidental discoveries and will not be included in fatality estimates that will be statistically analyzed. Fatalities found within search areas (e.g., by maintenance and operation staff), but not during scheduled searches, will not be included in the fatality estimates.

Weather conditions will also be monitored and recorded throughout the survey period. Wind speed and direction, barometric pressure, and temperature (recorded at an on-site met tower) will be augmented with data from the National Weather Service's local weather station to place the local weather data into the context of the regional weather patterns.

Searcher Efficiency Trials

The objective of searcher efficiency trials is to accurately estimate the percentage of fatalities found by searchers. The estimates of searcher efficiency are used to adjust the total number of fatalities found by correcting for detection bias. The corrected data for surveyed turbines is then used to evaluate the mortality per MW per turbine for each wind energy center. Searcher efficiency trials will be performed 4 times during each of the mortality monitoring seasons (spring, summer, fall, winter) and performed by the lead biologist.

Searcher efficiency rates will be determined by randomly placing a minimum of 75 bird and bat carcasses in the search area at random distances and bearings within the search plot and recording the percent of test carcasses found by the searcher. Walleye Wind will use carcasses (nonnative/non-protected) from various size classes (small, medium, large) and may be farm-raised species or those obtained through a salvage permit. Carcasses will be discreetly marked to indicate that they are part of the carcass study.

Prior to the start of the trials, a detailed work plan and searcher protocols will be prepared. This document will be the Standard Operating Procedure (SOP) for the trials.

Carcasses will be placed just after sunrise and will be throughout the mortality monitoring area. Any carcasses not found during the searches will be removed, unless being used for the carcass removal trial, will be removed at the conclusion of searcher efficiency trials.

Carcass Removal Trials

Carcass removal trials will be conducted independently of the searcher efficiency trials. The objective is determining the persistence of a minimum of 50 placed carcass on the ground in order to determine the persistence of carcasses and removal by scavengers. Carcass removal trials will be conducted each season (spring, summer, fall, winter).

Trial carcasses will be placed at turbines that are a part of the regular mortality searches at sunrise. Bird carcasses will consist of non-native/non-protected birds or those obtained through a salvage permit. Mice will be used in place of bats. Carcasses will be checked every day for the first four days, and then on day 7, 10, 14, after which all carcass remains will be removed.

REPORTING

As part of the LWECS Site Permitting process, Walleye Wind submit various types of reports through the life of the project, including annual, quarterly, and, if applicable, immediate incident reports. Quarterly reports will be submitted by January 15, April 15, July 15, and October 15 for each year during the operation of the project. Each quarterly report will identify all dead and injured avian or bat species. Quarterly reports will also address any changes or steps taken to avoid impacts to avian and bat species.

An annual report will be submitted to the Minnesota Public Utility Commission by March 15 the year following the conclusion of mortality studies. The submitted annual report will summarize identified avian and bat fatalities and include adjusted fatality rate estimates for avian and bat species. A schedule of any implemented changes will also be included with the submitted report.

Immediate incidental reports will be submitted to the Commission, USFWS, and MNDNR within 24 hours if any of the following should occur:

- Five or more dead or injured birds/bats within a 5-day reporting period
- One or more dead or injured state threatened, endangered, or species of special concern
- One or more dead or injured federally listed species, including species proposed for listing
- One or more dead or injured bald or golden eagles

Appendix E

Wildlife Response and Reporting System

WILDLIFE RESPONSE & REPORTING SYSTEM (WRRS) MANUAL

FOR WIND ENERGY CENTERS

Revised:

JANUARY 2020

TABLE OF CONTENTS

1.0 WILDLIFE MANAGEMENT PROGRAM

1.1 OUR COMMITMENT

As employees of NextEra Energy Resources, we have a responsibility to be good stewards of the environment and to adhere to the law.

Most birds that are seen across the country, including in NextEra Energy Resources' wind plants are protected by one of two laws; the Bald and Golden Eagle Protection Act or the Migratory Bird Treaty Act. Some species have the additional classification of "endangered" or "threatened". Eagles and endangered species have special reporting requirements, and therefore have a special reporting procedure.

Bald and Golden Eagle Protection Act - 16 U.S.C.S. 668 (a)

"Whoever, ...shall ...take, possess, sell, purchase, barter, offer to sell, purchase or barter, transport, export or import, at any time or in any manner, any bald eagle, commonly known as the American eagle, or any golden eagle, alive or dead, or any part, nest, or egg thereof of the forgoing eagles, ...shall be fined not more than $5,000 or imprisoned not more than one year or both for each such violation."

Migratory Bird Treaty Act - 16 U.S.C.S. 703

The Act makes it unlawful to: ship, transport or carry from one state, territory or district to another, or through a foreign country, any bird, part, nest or egg that was captured, killed, taken, shipped, transported or carried contrary to the laws from where it was obtained; import from Canada any bird, part, nest or egg obtained contrary to the laws of the province from which it was obtained. § 705.

Endangered Species Act – 16 U.S.C.S 35

"...it shall be unlawful at any time, by any means or in any manner, to pursue, hunt, take, capture, kill, attempt to take, capture or kill, possess, offer for sale, sell, offer to barter, barter, offer to purchase, purchase, deliver for shipment, ship, export, import, cause to be shipped, exported, or imported, deliver for transportation, transport or cause to be transported, carry or cause to be carried, or receive for shipment, transportation, carriage, or export, any migratory bird, any part, nest, or egg of any such bird, or any product, whether or not manufactured, which consists, or is composed in whole or part, of any such bird or any part, nest, or egg thereof..."

1.2 PURPOSE/SUMMARY

The purpose of this manual is to standardize the actions taken by NextEra Energy Resources in response to any wildlife fatalities and/or injuries found within the wind plant boundaries.

Any wildlife injury or fatality found within wind-plant boundaries, regardless of cause of death, should be reported immediately to the operations leader who shall complete an incident report and take photographs. Environmental Services – PGD Support shall be notified and further actions will be determined at that time based on the species and the circumstances surrounding the incident.

1.3 WILDLIFE FATALITIES

In addition to any complete or partial carcasses, any portion of a bird, bat or other animal, including individual feathers and/or bones, are all considered reportable wildlife fatalities. Report all finds even if the carcass and/or parts are not thought to be associated with wind plant operations. All wildlife species shall be reported.

1.4 WILDLIFE INJURIES

The majority of injured birds will have a broken wing. A broken wing will usually hang down oddly or blow in the wind. An injured bird will most likely be on the ground and unwilling or unable to fly. Raptors (any bird of prey or bird with a hooked beak and sharp talons) will sometimes perch on the ground and raptors will sometimes walk on the ground, but not often. If a bird is seen walking or perched on the ground, approach it slowly to see if it will fly away, if it runs away, refusing to fly, it is most likely injured.

Injured animals are dangerous. PGD prohibits personnel from getting too close or touching any wildlife without prior regulatory or PGD approval. This practice is enforced to avoid potential injury to self and to wildlife. Prior to completing any inspection related tasks or the collection of information needed for a report, conduct a risk assessment to define potential risks (e.g., uneven walking surfaces, snakes, etc.). Once safety is assessed, maintain visual contact with the injured animal while reporting the incident to the operations leader so that the correct process can be determined.

1.5 NON-AVIAN CARCASSES

Non-avian and mammal carcasses pose a potential risk to wind sites, as they may draw avian scavengers to the site. If you see any of the types listed below, it is important to take action to prevent an impact with large raptors.

A **large mammal carcass** is defined as a partial or entire livestock or game animal carcass present on the property. These include, but are not limited to, sheep, cows, horses, elk, and deer. All on-site finds shall be reported even if the carcass and/or parts are not believed to be related to site operations.

A **small mammal carcass** is defined as a small to medium sized animal, including, but not limited to, rabbits, dogs, foxes, coyotes, and prairie dogs. Multiple (5 or more) small mammal carcasses in close proximity to each other shall be reported even if the carcass and/or parts are not believed to be related to site operations.

A **gathering of avian scavengers** is defined as an unusual concentration of scavenging avian species such as crows, ravens, vultures, or eagles. All personnel on site should be observant of any atypical bird activity while traversing the site or visiting turbines for maintenance. Some examples of unusual bird activity that might represent a gathering of scavengers on a carcass could be:

1. Groups of eagles or vultures circling in a focused area
2. Groups of crows or ravens congregating in a specific area
3. Eagles, crows, ravens, or vultures seen perching in unusually high numbers

A significant event is defined as an event in which several large mammal carcasses, or multiple small animal carcasses (including bats), are located on site. Even if avian scavengers are not yet present, it is imperative that significant events are reported immediately, so that steps can be taken to remove the carcasses (if determined to be the course of action by Environmental Services) before avian scavengers are attracted to the site. Additionally, special notifications may be required if multiple bats are found on-site in a short period of time.

Contact Environmental Services – PGD Support to discuss implications and develop a plan of action. It may be necessary to contact the landowner to have the carcass removed from their property. Environmental Services – PGD Support may also suggest that the State wildlife agency be notified of the potential risk to the site.

In some cases, Law Enforcement may need to be notified in the case of carcasses purposely left on site.

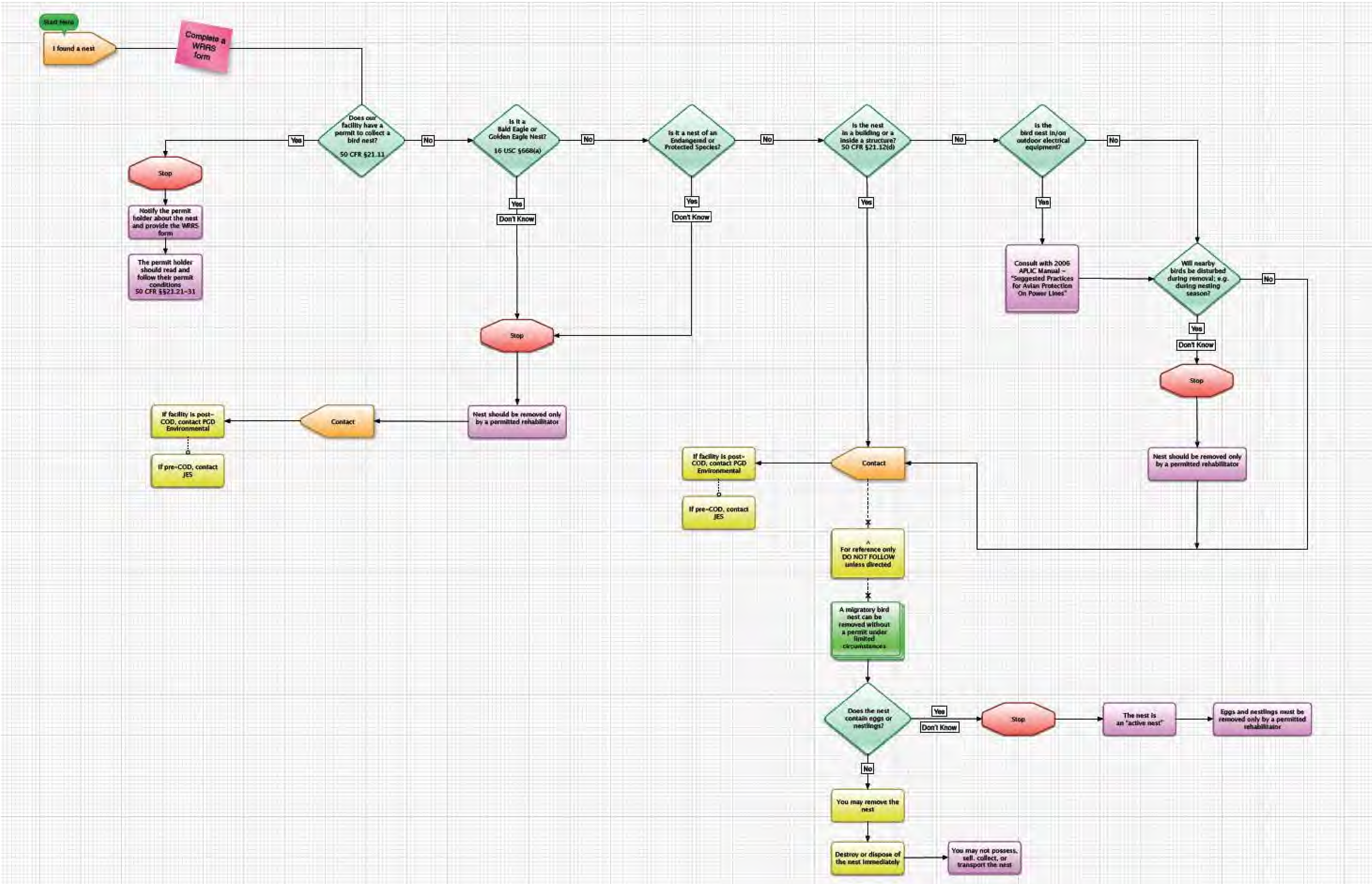
1.6 FINDS WITH BANDS

If you find a wildlife fatality with a band(s) (sometimes found in or around legs, ears or wings of animals), please notify your operations leader, and include this information in your WRRS reporting form. There are several different wildlife and agencies that may need to be contacted.

1.7 NESTS

If you find a nest in, on or around a turbine, power pole, substation, or transformer, please contact your Wildlife Program Manager for guidance. **Do not remove or touch a nest without permission.** Please note that a bird nest could be a collection of eggs with no nesting material below them (barn owl nests, for example).

The following flow chart (I Found a Nest Flow chart (OpModel) was developed as guidance for when the discovery of a nest has been made.



Start Here
I found a nest
Complete a WRRS form
Does our facility have a permit to collect a bird nest? 50 CFR §21.11
Yes
No
Stop
Notify the permit holder about the nest and provide the WRRS form
The permit holder should read and follow their permit conditions 50 CFR §§21.21-31
Is it a Bald Eagle or Golden Eagle Nest? 16 USC §668(a)
Yes
Don't Know
Stop
Nest should be removed only by a permitted rehabilitator
Contact
If facility is post-COD, contact PGD Environmental
If pre-COD, contact JES
Is it a nest of an Endangered or Protected Species?
Yes
Don't Know
No
Is the nest in a building or a inside a structure? 50 CFR §21.12(d)
Yes
No
Is the bird nest in/on outdoor electrical equipment?
Yes
No
Consult with 2006 APLIC Manual – "Suggested Practices for Avian Protection On Power Lines"
Will nearby birds be disturbed during removal; e.g. during nesting season?
No
Yes
Don't Know
Stop
Nest should be removed only by a permitted rehabilitator
Contact
If facility is post-COD, contact PGD Environmental
If pre-COD, contact JES
For reference only DO NOT FOLLOW unless directed
A migratory bird nest can be removed without a permit under limited circumstances
Does the nest contain eggs or nestlings?
Yes
Don't Know
Stop
The nest is an "active nest"
Eggs and nestlings must be removed only by a permitted rehabilitator
No
You may remove the nest
Destroy or dispose of the nest immediately
You may not possess, sell, collect, or transport the nest

FPL Energy, 700 Universe Boulevard, Juno Beach, FL, 33408
561-694-3107

FPL Energy

MEMO

To Skelly Holmbeck

From David Cleary

Date May 13, 2008

Subject Bird Nest Management

PRIVILEGED & CONFIDENTIAL
ATTORNEY – CLIENT COMMUNICATION

Question Presented: If a wind facility encounters a bird nest, what options does the facility have regarding removal?

Response: Our options rely primarily on whether the nest is "inactive" (has no eggs or young in it). If no eggs or young are present in the nest, the US Fish & Wildlife Service has opined that there is no Migratory Bird Treaty Act violation if the nest is removed without subsequent possession. Bald Eagle or Golden Eagle nests may not be removed without a permit, even if the nest is inactive. The inactive nest of an unidentified bird, or a bird otherwise suspected to be listed as threatened or endangered under the Endangered Species Act should not be disturbed without consulting JES and legal counsel.

On April 15, 2003, the US Fish & Wildlife Service issued an interpretive memorandum to resolve issues surrounding nest destruction and the Migratory Bird Treaty Act. See Attachment 1. The general concept is that USFWS agrees that unoccupied nests of birds protected only by the MBTA may be removed. In no event is the nest to be "possessed," retained, or transported, or sold by FPLE in any way without first obtaining a permit.

On October 5, 2007, the USFWS amended its rules (50 CFR Part 21.12. See Attachment 2) regarding the removal of migratory birds (other than ESA listed or bald or golden eagles) from a building or structure by the general public without a permit. The permit exceptions are found in 50 CFR 21.12(d)(1), and include removal of a trapped bird because of a health threat, a threat to human safety, and even a "threat to commercial interests," such as products for sale.

However, the new rule carries an important exception regarding active nests. As stated in 50 CFR 21.12(d)(10), if a nest with eggs or nestlings is present, then the 21.12(d)(1) exceptions do not apply, and the assistance of a "federally permitted migratory bird rehabilitator" must be obtained to remove the eggs or nestlings.

A lawfully removed nest may not be possessed in any way after removal unless a permit is obtained, since an unpermitted nest will be deemed to be held for a commercial purpose, which is prohibited.

The USFWS advises that all actions must comply with State and local laws and ordinances. In the case of a mere migratory bird's empty nest, violation of such laws (including animal cruelty laws) would be remote, but consult with JES and legal counsel before taking any action where doubt exists.

For advice regarding other types of bird nest encounters with electrical equipment, please consult the APLIC's final report, *Suggested Practices for Avian Protection on Power Lines: The State of the Art in 2006.* I believe JES has many extra copies, and the book includes a searchable CD in the back as well.

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2.0 PROCEDURES

2.1 INSPECTIONS

The NextEra Energy Resources Wildlife Response and Reporting System relies solely on wind technicians and other site personnel to find and report birds, bats and other animals. Wildlife Inspections shall be completed as part of the Inspection of Watch (IOW) procedure.

Wildlife inspections must be conducted in accordance with our lease/easement agreements with individual landowners. Confirm these conditions prior to conducting any wildlife inspections. It is expected that the entire inspection process is completed during the Inspection of Watch. However, if damage to crops or other landowner property could occur during the inspection, do not trespass or damage property.

CRITICAL SUCCESS FACTORS:

- Ability to safely and legally walk the terrain around the wind turbine
- Awareness of animals or signs of animals on site property
- Ability to recognize when an animal is in distress
- Ability to immediately contact operations leader / Environmental Services to report the find
- Ability to ensure full compliance with any permit requirements, if any
- Knowledge of procedures for inspections and reporting

INSPECTION PROCEDURE

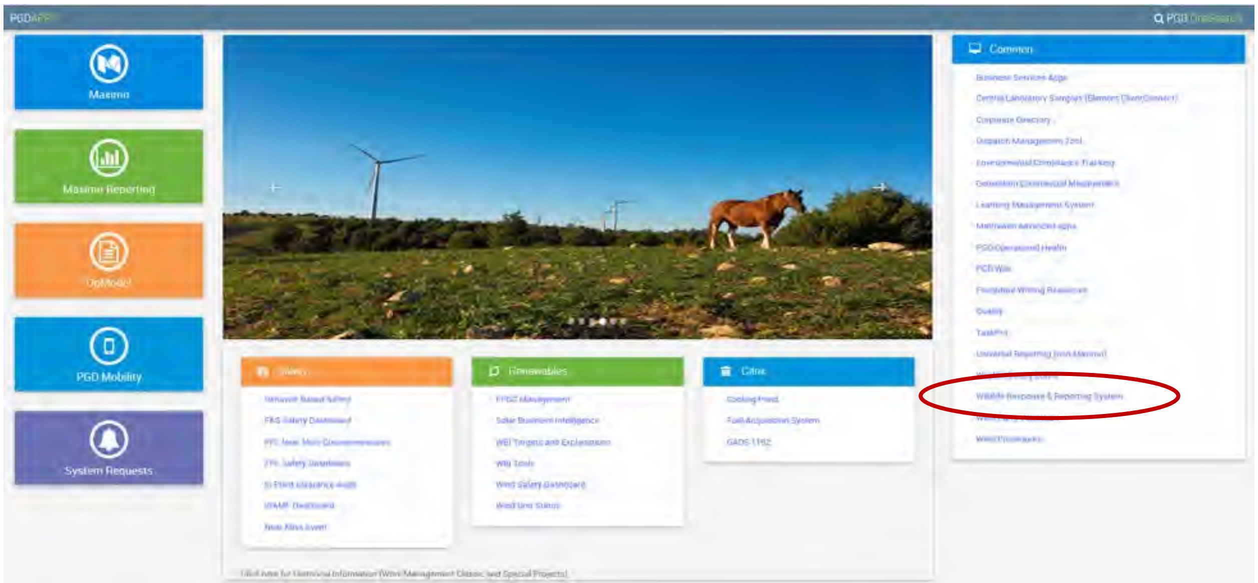
1. Upon arrival at the turbine complete all safety requirements. Please be aware of special on site hunting seasons while performing the inspections. This includes Risk Assessment Mitigation Forms (RAMF). Put on all applicable personal protective equipment (PPE). Remember that if at any time you feel your safety is compromised, **DO NOT** complete the Inspection. Beware of uneven walking surfaces, snake hazards, or other potential risks.
2. A complete Wildlife Inspection consists of three “Inspection Circles” that shall be walked. Each Inspection Circle consists of slowly walking around the turbine, scanning the ground as you walk, looking to the right and left, and checking on any suspicious objects in the distance. End “Inspection Circle” where you began.
3. To complete the first circle: Begin at the base of the turbine, walk away from the turbine 30 feet and complete one full Inspection Circle (see step 2) keeping **30** feet from the turbine. A good estimate of distance is 1 long step = 1 yard (3 feet).
4. To complete the second circle, walk out another 60 feet, and complete another Inspection Circle; keeping **90** feet away from the turbine.
5. To complete the third and final circle, walk out another 60 feet and complete another Inspection Circle keeping **150** feet from the turbine.
6. When the last circle is completed, answer the appropriate questions on the IOW checklist.
7. Immediately notify the operations leader if an animal is found, and then continue with the Reporting Procedures.
8. The IOW checklist shall be synced by the end of the day and accessible via the IOW dashboard.
9. All wildlife fatalities or injuries found during wildlife inspections shall be reported following the site procedures. Ensure a full report is submitted to Environmental Services using the SharePoint application (PGD Applications; common applications; Wildlife Response and Reporting System). See section 2.2.

2.2 INCIDENT REPORTS

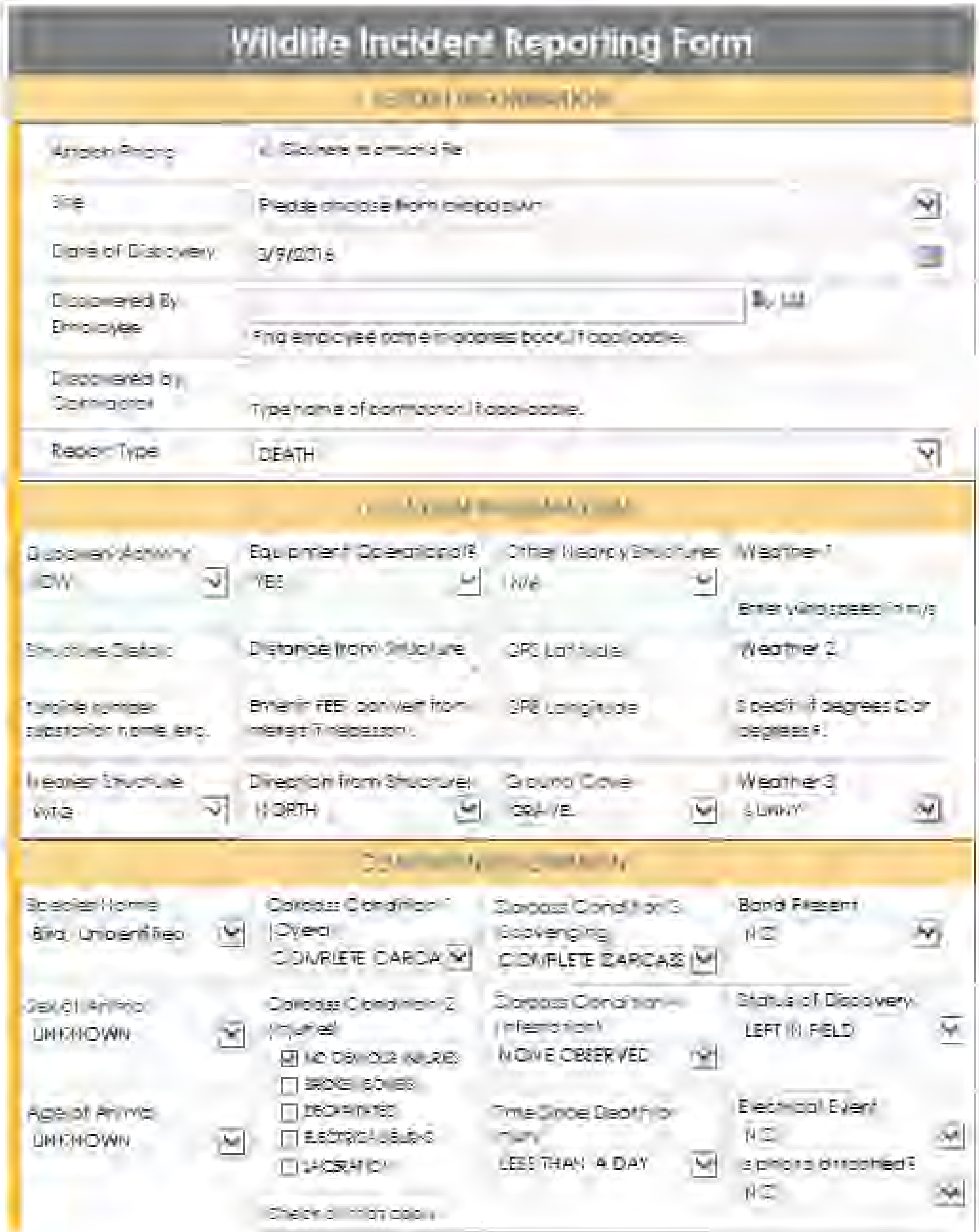
Every individual animal discovery requires a separate Wildlife Incident Report. Answer every question and include any additional information that may be helpful. Too much information is better than not enough. All questions shall be answered, even if the answer is “unknown.”

The incident report should include at least one photograph of the discovery. Photographs should show a close up of the head and/or feet, as well as the carcass in relation to the closet structure, if possible. A common item placed next to, but not touching the carcass, helps indicate the size of the animal.

The WRRS Incident Report can be accessed via [PGD Applications](), under the Common Applications.



Complete the Wildlife Incident Reporting Form. Fields with a red asterisk * are required


Wildlife Incident Reporting Form

Report Type
DEATH

Discoverer Activity
Equipment Operational?
Other Nearby Structures
Weather 1
YES
N/A
Structure Details
Distance from Structure
GPS Latitude
Weather 2
GPS Longitude
Nearest Structure
Direction from Structure
Ground Cover
Weather 3
WTG
NORTH
GRAVEL
SUNNY

Species Name
Bird, Unidentified
Band Present
NO
Sex of Animal
UNKNOWN
Status of Discovery
LEFT IN FIELD
Age of Animal
UNKNOWN
Electrical Event
NO
LESS THAN A DAY

.

WILDLIFE INCIDENT REPORTING FORM

REPORT INFORMATION

Attach Photo:	System will accept multiple photos, but must be added individually

Site:	Drag down to specific site
Date of Discovery:	Defaults to entry date, but allows options
Discovered by Employee:	Enter SLID (Search by name)
Discovered by Contractor:	Manual entry field
Report Type:	Death, Injury, Nest, Other

LOCATION INFORMATION

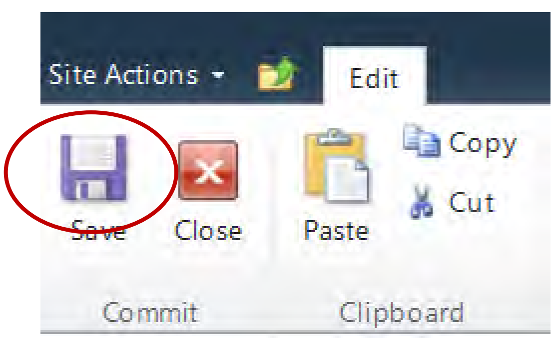
Discovery Activity:	IOW, Maintenance, Driving, Other
Structure Detail*:	Manual entry field, should include Turbine Number, substation name, etc.
Nearest Structure:	WTG, Substation, O&M, T-Line, Other
Equipment Operational:	Yes, No, N/A
Distance From Structure*:	Manual entry field (enter in feet)
Direction From Structure:	North, South, East, West, NE, SE, NW, SW
Other Nearby Structures:	N/A, Overhead Line, Fence, Road, Other
GPS Lattitude:	Manual entry field
GPS Longitude:	Manual entry field
Ground Cover:	Gravel, WTG Pad, PMT Pad, Grass/Dirt, Other
Weather 1:	Manual entry field, Windspeed in m/s (numeric only)

Weather 2:	Manual entry field, Temperature in numeric (F or C)
Weather 3:	Sunny, Clear, Foggy, Rainy, Overcast, Snowing

CONDITION DESCRIPTION

Species name:	Defaults to “Bird, Unidentifed”. Drag down options
Sex of Animal:	Unknown, Female, Male
Age of Animal:	Unknown, Adult, Juvenile
Carcass Condition 1:	Complete Carcass, Dismembered, Feathers Only, Bones Only, Feathers/Bones
Carcass Condition 2:	No Obvious Injuries; Broken Bone(s), Decapitated, Electrical Burns, Laceration
Carcass Condition 3:	Complete Carcass, Scavenged, N/A (injury)
Carcass Condition 4:	None Observed, Flies, Maggots, Ants, Beetles, Other
Time Since Death:	< Day, < Week, < Month, > Month
Band Present:	No, Yes, N/A
Status of Discovery:	Left in Field, Bagged & Tagged, USFWS, State FWS, Other
Electrical Event:	No, Yes
Photo Attached:	No, Yes

After completing the form, select the “save” option in the upper left corner of the screen.



2.3 EXTERNAL & INTERNAL NOTIFICATIONS

All wildlife discoveries at NextEra Energy wind sites must be reported internally via the WRRS Incident Report. Once the report is saved, Environmental Services – PGD Support receives an e-mail notification of the new entry. A review of the entry and information is completed, and changes made at the time. This may include corrected species identification information.

In some cases, notification to Federal or State agencies may be required, if a discovery of an injured or dead Eagle, or protected species is made.

Check with your operations leader to determine the process for landowner or rancher notifications if livestock carcasses are discovered. Livestock notifications should be made to ensure removal of carcasses of cattle or sheep. If an injured sheep or cow is found, a courtesy notification should be made as well.

GENERAL PROCEDURE

Due to the sensitivity of eagle and federally endangered species fatalities or injuries, it is very important these fatalities or incidents are recorded and reported immediately to the appropriate persons. Discussions and notifications with appropriate persons are critical to determine species, facts and potential risks (legal, operational, media).

1. The operations leader shall receive all pertinent information regarding incident, e.g., discovery of event, banding information, location, contact person, condition of find, photographs, etc.
2. Once the information is collected, the operations leader should immediately report to Environmental Services - PGD Support and enter into the information into the WRRS database. In addition, the operations leader should notify the Regional / General Operations Managers, and VP of Wind operations.
3. The operations leader should contact Environmental Services – PGD Support for guidance on making notifications, including a determination of what agencies to notify. After this discussion, notifications should be made by the operations leader by phone or e-mail, whichever is deemed appropriate. The operations leader should

document the date & time of the call, as well the name of the person receiving the report.

4. Environmental Services shall forward incident details via e-mail to the Division's Regional Business Manager, legal counsel, and corporate communications personnel. If necessary, Environmental Services – PGD Support will conference with the appropriate parties to discuss potential implications.

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3.0 THREATENED & ENDANGERED SPECIES

All wind site personnel should have basic knowledge of the Federal and/or State-specific species that may be protected as a Threatened or Endangered species at their site. In many cases, discovery of an injured or dead animal will require notifications.

3.1 FEDERAL SPECIES

The United States Fish & Wildlife Service (USFWS) has compiled a list of animal species native to North America that are considered to be threatened or endangered.

The following definitions are included to illustrate the terms commonly used by the USFWS.

The "**endangered**" classification provided to an animal or plant in danger of extinction within the foreseeable future throughout all or a significant portion of its range.

The term "**threatened species**" means any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range, as defined in the Endangered Species Act.

"**Species of concern**" is an informal term that refers to those species which might be in need of concentrated conservation actions. Such conservation actions vary depending on the health of the populations and degree and types of threats. Species of concern receive no legal protection and the use of the term does not necessarily mean that the species will eventually be proposed for listing as a threatened or endangered species

Plants and animals that have been studied and the Service has concluded that they should be proposed for addition to the Federal endangered and threatened species list are referred to as **candidate species,** and once they receive this designation are treated and reported as special status species until a final determination is made by the USFWS.

3.2 STATE SPECIES

In addition to the Federal Threatened & Endangered Species list, each state's wildlife agency has developed a similar list that is specific to the individual state.

Federal & State Threatened & Endangered Species lists, as well as species profile sheets have been archived on the Wind Operations/Environmental Tactical Team SharePoint page: 6.0 Natural Resources/T and E Species

These lists will be periodically uploaded by NEER, but the status of species can be updated yearly by agencies. Please confirm you are referencing a recent list. If you have any questions about the status of an animal, please contact Environmental Services – PGD Support.

4.0 ANNUAL TRAINING

Annual Wildlife Response & Reporting System (WRRS) training should be done at the site and consist of the following subjects:

- Location and content of the WRRS Manual
- WRRS Inspections (Inspection of Watch)
- Incident Reporting (SharePoint)
- Species Identification tools
- Federal & State Threatened & Endangered Species
- Internal / External Notification Procedures (including contact for general questions)

The corporate Learning Management System (LMS) has a training module for the WRRS program (REG-1206A). This training is required for all new employees, and is generally completed during the onboarding process.

In addition to the LMS course, Environmental Services has prepared a PowerPoint module and training roster for use at wind sites for a more detailed presentation. This presentation and roster can be found on the Wind Operations/Environmental Tactical Team SharePoint page: Natural Resources/WRRS Program

This manual includes a roster to be signed by participants during annual training at wind sites. The completed form should be filed in Section 6.2.6 of the EMS filing system. It is recommended that the operations leader create a reminder in the Environmental Compliance Tracker to trigger annual training.

In addition to the annual training, a review of the manual should be completed by each site once a year to ensure that contact information is complete and accurate.

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Site: ______________________________

Facilitator: ______________________________

Date: ______________________

Course:
- ☐ Spill Prevention, Control & Countermeasures (7.1.6)
- ☐ Universal Waste & Emergency Response (8.3.6)
- ☐ Wildlife Response & Recording System (6.2.6)

EMPLOYEE	SLID	SIGNATURE
File Completed Training Roster in EMS filing system		

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5.0 APPENDICES

This section of the plan is reserved for any other wildlife related documentation appropriate to the site. This may include the following documents:

- Pre-construction wildlife reports
- Site Operating Permit
- Environmental Impact Reports/Assessments (EIR/EIA)
- Avian / Bat Protection Plans (APBB, APP)
- Bird / Bat Conservation Strategies (BBCS)
- Adaptive Management Plans
- Post-Construction Mortality Monitoring reports (annual and final reports)
- Whooping Crane Curtailment Procedure (if applicable)
- Site specific agency agreements or legal agreements
- Other site-specific wildlife information

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GENERIC WIND ENERGY CENTER

WILDLIFE PROGRAM CONTACTS

PGD WIND OPERATIONS

Primary site contact, Title	Office: Cell:	
Backup site contact, Title	Office: Cell:	

ENVIRONMENTAL SERVICES – PGD SUPPORT

Brian Wysong Environmental Specialist	Office: Cell:	(561) 691-2935 (561) 319-5202

ENVIRONMENTAL SERVICES - WILDLIFE

Sean Fitzgerald Project Manager, Wildlife	Office: Cell:	(561) 691-3274 (586) 255-0513
Janine Crane, Project Manager, Wildlife	Office: Cell:	(561) 691-2818 (561) 329-0914

INJURED BIRD or BAT RESPONSE

State Approved Rehabilitator	Office:	

REGULATORY AGENCIES *(Contact Environmental Services before calling)*

US Fish and Wildlife Service	Office:	
State Wildlife Agency	Office:	

Appendix F

Key Wildlife Contacts

Agency Contact List

Agency	Name	Title	Address/Email/Telephone
MN Department of Natural Resources	Cynthia Warzecha	Energy Projects Review	1200 Warner Road St. Paul MN 55106 cynthia.warzecha@state.mn.us 651-259-5078
MN Department of Natural Resources	Joanne Boettcher	Environmental Review Region 4 (South)	117 Rogers Street Mankato, MN 56001 joanne.boettcher@state.mn.us 507-389-8813
MN Department of Natural Resources	Lisa Joyal	Endangered Species Environmental Review Coordinator	1200 Warner Road St. Paul MN 55106 lisa.joyal@state.mn.us 651-259-5109
MN Department of Natural Resources	Becky Horton	Environmental Review Planner	1200 Warner Road St. Paul MN 55106 becky.horton@state.mn.us 651-259-5122
U.S. Fish and Wildlife Service	Mags Rheude	Eagle Biologist	4101 American Boulevard East Bloomington, MN 55425 margaret_rheude@fws.gov 612-713-5438
U.S. Fish and Wildlife Service	Shauna Marquardt	Assistant Field Supervisor	4101 American Boulevard East Bloomington, MN 55425 Shauna_Marquardt@fws.gov 952-252-0092/573-239-3293
U.S. Fish and Wildlife Service	Dawn Marsh	Fish and Wildlife	4101 American Boulevard East Bloomington, MN 55425 dawn_marsh@fws.gov 952-252-0092 x 202