

**Avian Use Study  
Aurora Wind Energy Project  
Williams County, North Dakota**

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**Final Report  
May 2016 – May 2017**

**Prepared for:**  
**Aurora Wind Project, LLC**  
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## **1 INTRODUCTION**

Aurora Wind Project, LLC (Aurora) is considering the development of the Aurora Wind Energy Project (Project) in Williams County, North Dakota (Figure 1). To support development of the Project, Aurora contracted Western EcoSystems Technology, Inc. (WEST) to conduct pre-construction baseline avian surveys to estimate temporal and spatial bird use of the Project area. The methods for this study were consistent with the US Fish and Wildlife Service's (USFWS) *Eagle Conservation Plan Guidance, Module 1 – Land-Based Wind Energy Guidance* (ECPG; USFWS 2013) and *Final Land-Based Wind Energy Guidelines* (USFWS 2012).

The objectives of the study were to: 1) assess the relative abundance and spatial and temporal distribution of avian species in the Project area, and 2) identify and assess the potential risk of adverse impacts to avian species or groups, especially eagles and federally listed and sensitive avian species. This report describes the results of the fixed-point bird use surveys and incidental wildlife observations conducted in the Project area from May 24, 2016 – May 7, 2017.

## **2 STUDY AREA**

The proposed Project area encompasses 21,981.7 hectares (54,317.9 acres) in Williams County, approximately 48.8 kilometers (30.3 miles) northeast of the city of Williston, in northwest North Dakota (Figure 1). The Project is located in the Glaciated Dark Brown Prairie Level IV Ecoregion (US Environmental Protection Agency 2016), in an area of nearly flat to gently rolling topography. This ecoregion was previously dominated by short- and mixed- grass prairies but has extensively been converted to agricultural and livestock production lands. Oil and gas extraction are also a major activities in the region.

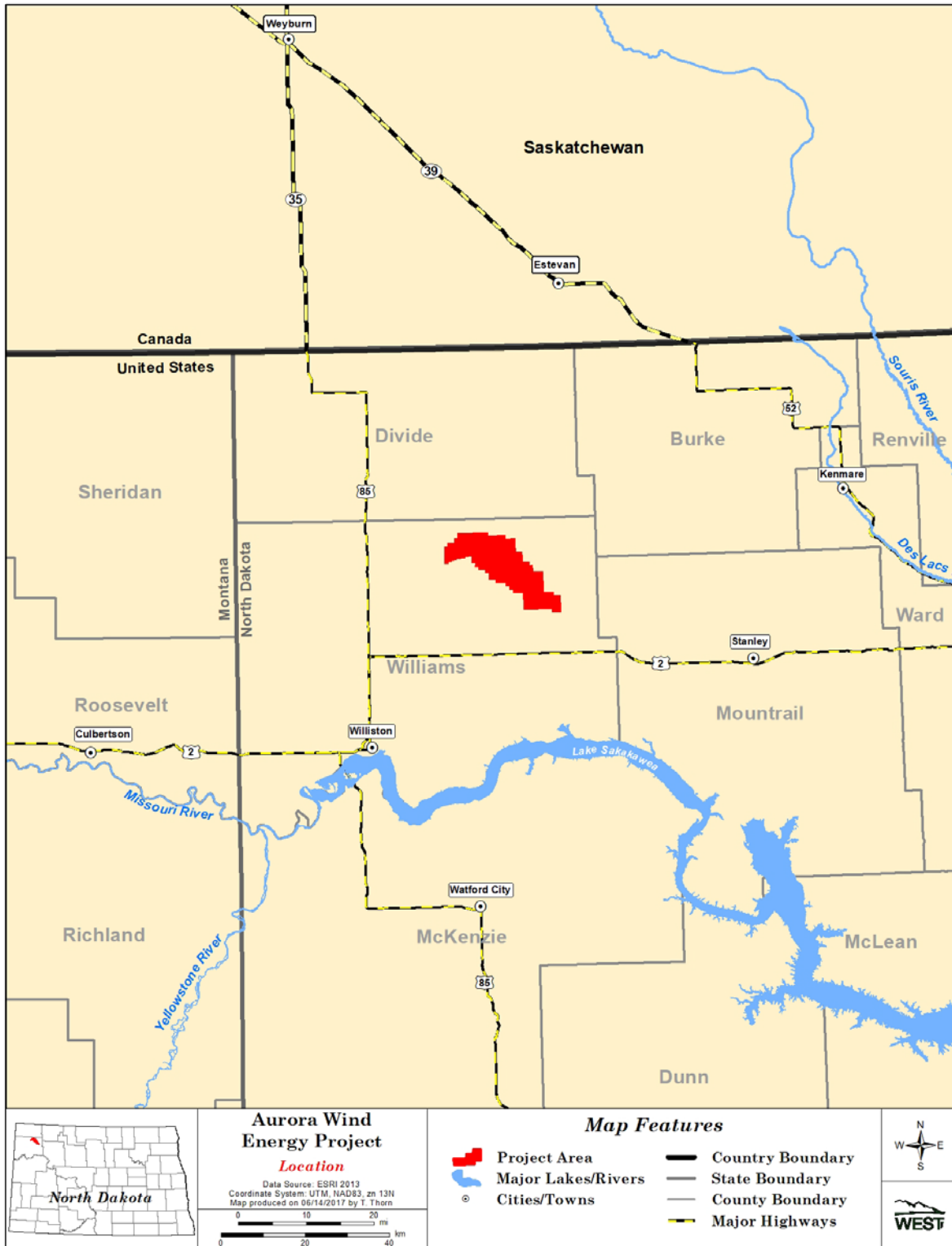


Figure 1. Location of the Aurora Wind Energy Project in Williams County, North Dakota.

According to the US Geological Survey (USGS) National Land Cover Database (NLCD; USGS NLCD 2011, Homer et al. 2015), the majority of land cover within the Project area is cultivated crops (86.7%). Grassland/herbaceous (6.6%), developed (3.8%), and water/wetlands (2.5%), are the next most common land covers. Trees and shrubs make up the remaining portion of the Project area (Table 1, Figure 2).

**Table 1. US Geological Survey (USGS) National Land Cover Database (NLCD) land cover types within the Aurora Wind Energy Project in Williams County, North Dakota.**

<b>Cover Type</b>	<b>Acres</b>	<b>% Composition</b>
Cultivated Crops	47,091.1	86.7
Grassland/Herbaceous	3,564.8	6.6
Developed	2,074.4	3.8
Water/Wetlands	1,352.7	2.5
Shrub/Scrub	214.1	0.4
Forest	20.9	<0.1
<b>Total</b>	<b>54,318.0</b>	<b>100</b>

Data Sources: USGS NLCD 2011, Homer et al. 2015

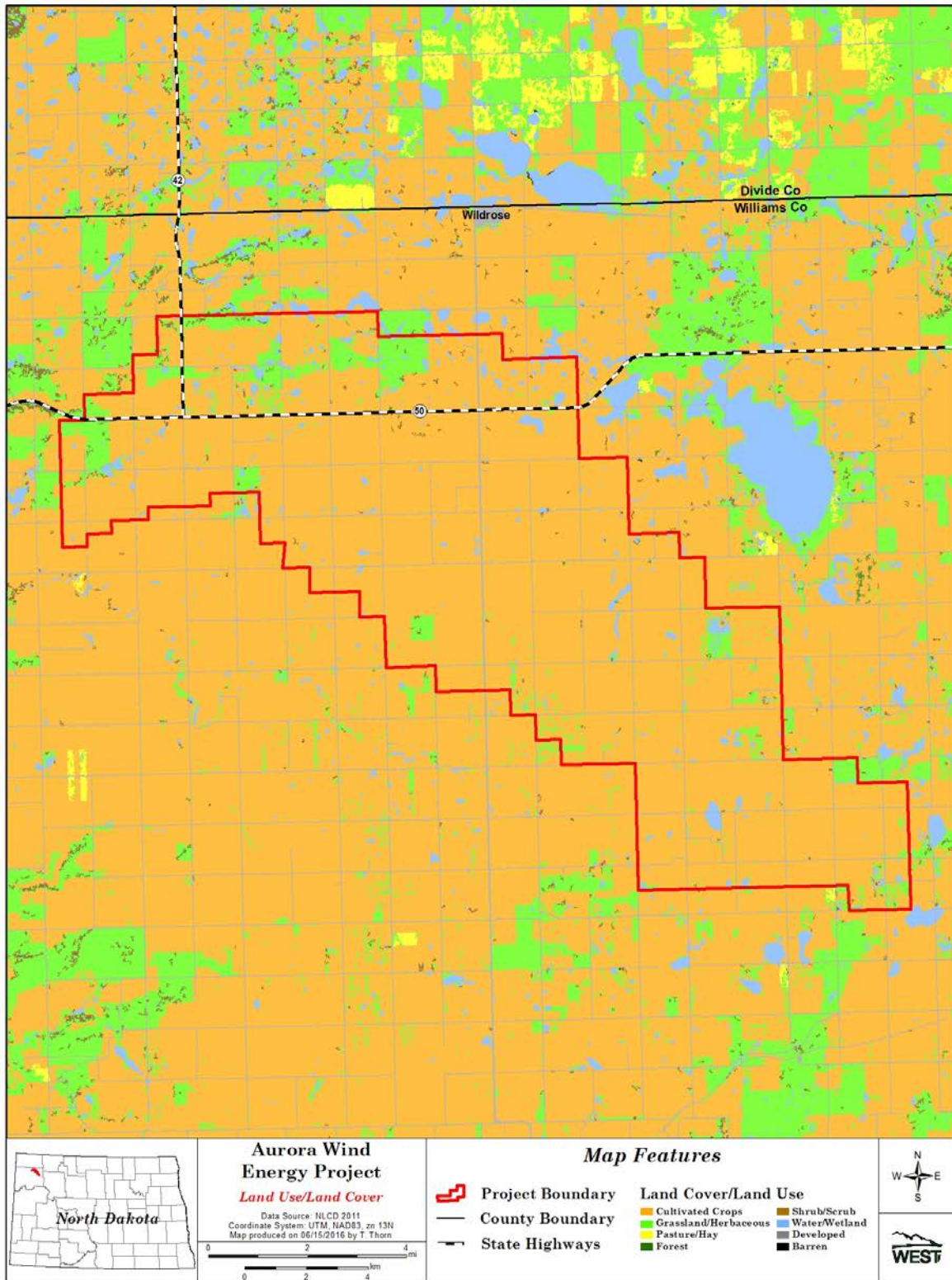


Figure 2. US Geological Survey (USGS) National Land Cover Database (NLCD) land cover types within and adjacent to the Aurora Wind Energy Project in Williams County, North Dakota (Sources: USGS NLCD 2011, Homer et al. 2015).

### 3 METHODS

#### 3.1 Fixed-Point Bird Use Surveys

Bird use surveys were conducted using methods described by Reynolds et al. (1980). Thirty-three observation points consisting of 800-meter (m; 2,625-foot [ft]) radius circular plots were established within the Project area. These fixed-point circular plots covered approximately 30% of the Project area (Figure 3). Observation points (the center of the 800-m [2,625-ft] plot) were separated by at least 1,600 m (5,249 ft) to avoid overlap and were located along public roads using a systematic sampling scheme with a random start in ArcGIS (a Geographic Information System software program).

Each of the 33 fixed-point count locations were surveyed once per month, with odd points generally visited one week and even points visited two weeks later so that the biologist was on site during multiple weeks each month. Surveys were conducted during daylight hours; survey periods were varied to approximately cover all daylight hours during a season. To the extent practical, each fixed-point count location was surveyed roughly the same number of times, but some were missed due to weather and road conditions.

Fixed-point count surveys were conducted for 60 minutes (min), with all small and large birds recorded for the first 10 min, then only large birds being recorded for the remaining 50 min of each 60-min survey (small birds within 100 m [328 ft], large birds within 800 m [2,625 ft]). All large and small birds seen during each fixed-point count survey were recorded using a unique observation number. In some cases, observations represented repeated sightings of the same individual. Observations of large birds outside the 800-m plot were recorded and included in the development of species composition, relative abundance, and species diversity metrics, but were not included in analyses of avian use and flight heights. Large birds included waterbirds, waterfowl, shorebirds, rails and coots, grebes and loons, gulls and terns, diurnal raptors (kites, hawks, accipiters, eagles, falcons, northern harrier [*Circus cyaneus*], and osprey [*Pandion haliaetus*]), owls, vultures, upland game birds, doves/pigeons, some cuckoos, large corvids (e.g., ravens, magpies, and crows), and goatsuckers. Small birds included passerines (excluding large corvids), most cuckoos, swifts and hummingbirds, woodpeckers, and kingfishers.

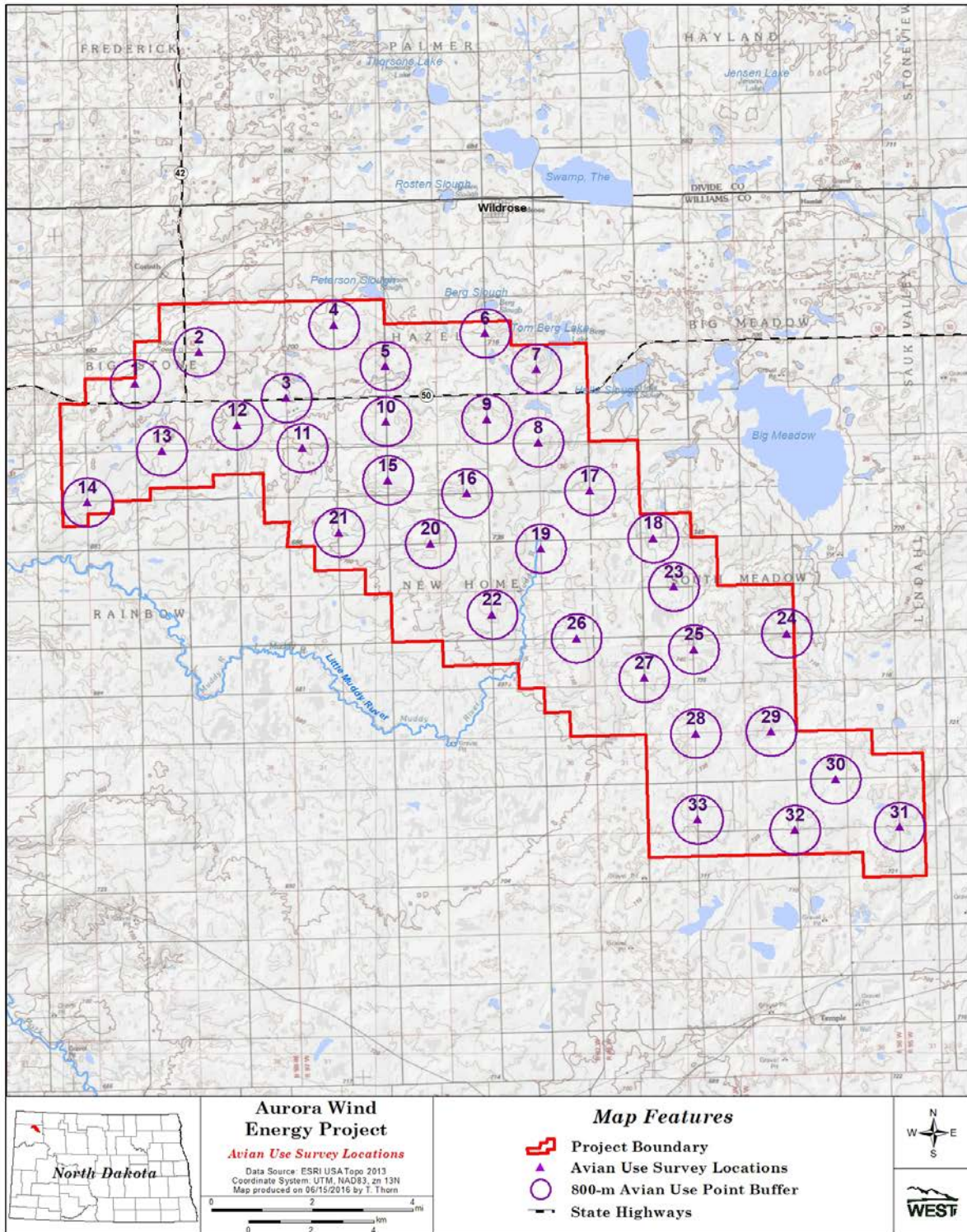


Figure 3. Locations of fixed-point counts and circular plots within the Aurora Wind Energy Project in Williams County, North Dakota, where avian use surveys were conducted from May 24, 2016 – May 7, 2017.

The following information was recorded during each bird use survey: date, start and end time, and weather information (i.e., temperature, wind speed, wind direction, precipitation, and cloud cover). Additionally, the following data were recorded for each observation:

- Observation number
- Species (or best possible identification)
- Number of individuals
- Sex/Age class (to the extent possible)
- Distance from plot center when first observed
- Closest distance observed
- Flight height above ground level (AGL)
- Flight direction
- Activity (flying compared to perched)

Approximate flight height, flight direction, and distance from plot center at first observation were recorded to the nearest 5-m (16-ft) interval; the approximate lowest and highest heights were also recorded.

For bald eagle (*Haliaeetus leucocephalus*) or golden eagle (*Aquila chrysaetos*) observations, flight height, distance, and activity (i.e., flying or perched) were recorded during each 1-min interval, per the ECPG. The perch locations and flight paths of eagles were mapped to qualitatively assess areas of eagle use within the Project area.

### **3.2 Incidental Wildlife Observations**

Incidental wildlife observations provide records of wildlife seen outside of the standardized surveys. In addition to large bird species (especially raptors), biologists recorded endangered and threatened species, species of concern, and rare or unusual species. Incidental observations were recorded in a similar fashion to standardized surveys, where the date, time, observation number, species, number of individuals, sex/age class, distance from observer, flight height AGL (for bird species), flight direction, and activity, were recorded. Biologists recorded the location of sensitive species by Universal Transverse Mercator (commonly, UTM) coordinates using a hand-held Global Positioning System (commonly, GPS) unit.

### **3.3 Quality Assurance and Quality Control**

Quality assurance and quality control (QA/QC) measures were implemented at all stages of the study, including in the field, during data entry and analysis, and report writing. Following field surveys, observers were responsible for inspecting data forms for completeness, accuracy, and legibility. A data technician then compared a sample of records from an electronic database to the raw data forms and corrected any errors. Irregular codes or data suspected as questionable were discussed with the observer and/or project manager. Errors, omissions, or problems

identified in later stages of analysis were traced back to the raw data forms, and appropriate changes in all steps were made.

A Microsoft® SQL Server database was developed to store, organize, and retrieve survey data. Data were keyed into the electronic database using a pre-defined format to facilitate subsequent QA/QC and data analysis. All data forms and electronic data files were retained for reference. QA/QC measures implemented for report writing included review of the final document by a technical editor, statistician, peer (research biologist), project manager, and senior manager.

## **4 DATA ANALYSIS**

### **4.1 Species Composition, Relative Abundance, Species Richness and Diversity**

Species composition (i.e., species and bird types observed during the surveys), relative abundance (i.e., number of observations and groups of each species and bird type by season), and diversity (i.e., total number of unique species observed within each season) were compiled for all birds observed during the bird use surveys, irrespective of distance from observer (i.e., including incidental observations). Species richness by season was calculated by averaging the total number of species observed within each plot during a visit, then averaging across plots within each visit, followed by averaging across visits within the season. In addition, species composition for each bird type, regardless of distance from observer, was calculated for major groups.

### **4.2 Bird Use, Percent of Use, and Frequency of Occurrence**

Large bird use for fixed-point avian use surveys was calculated as the number of birds per 800-m plot per 60-min survey; small bird use was calculated as number of birds per 100-m plot per 10-min survey. Mean bird use was calculated by season by first summing the number of birds seen within each plot during a visit, then averaging across all plots within each visit, and finally by averaging across all visits within the season. Overall mean bird use was calculated as a weighted average of seasonal values by the number of calendar days in each season (as defined by the season dates; spring = mid-March through late May, summer = late May through end of August, fall = early September through mid-November, winter = mid-November through mid-March). Percent of use was calculated as the proportion of large or small bird use that was attributable to a particular bird type or species, and frequency of occurrence was calculated as the percent of surveys in which a particular bird type or species was observed.

### **4.3 Flight Height**

Flight height data were used to estimate bird use within a rotor-swept height (RSH) range between 25 - 150 m (82 - 492 ft) AGL. The groups' (a single bird or a flock of two or more) flight heights when first observed were used to calculate the percentage of the different groups flying at different height categories: below the RSH (zero - 25 m [zero - 82 ft] AGL), at RSH (25 - 150 m [82 - 492 ft] AGL), and greater than the RSH (more than 150 m [492 ft] AGL).

#### 4.4 Spatial Use

Small bird and large bird spatial use was evaluated by comparing bird mean use among survey plots for each bird type. In addition, eagle flight paths were mapped to qualitatively identify areas of concentrated use and/or consistent flight patterns.

#### 4.5 Statistical Analysis

For analysis purposes, a visit was defined as the required length of time, in days, to survey all of the plots once within the Project area. Visits were assigned according to the following criteria: 1) a single visit had to be completed in a single season, and 2) a visit could be spread across multiple dates, but a single date could not contain surveys from multiple visits. Under certain circumstances, such as extreme weather conditions, plots were not surveyed during some visits. In these cases, a visit might not have constituted a survey of all plots.

### 5 RESULTS

#### 5.1 Fixed-Point Bird Use Surveys

##### 5.1.1 Species Composition, Relative Abundance, and Diversity

A total of 345 60-min fixed-point bird use surveys were conducted at 33 survey points in the Project area during the one year of surveys (Table 2). A total of 8,702 bird observations within 953 separate groups (defined as one or more individual birds) were recorded during the fixed-point bird use surveys conducted from May 24, 2016 – May 7, 2017 (Appendix A). The most commonly recorded bird type was waterfowl, which composed 38.0% of all observations throughout all seasons, with the majority (1,205 observations in 39 groups) of the waterfowl observations comprised of Canada geese (*Branta canadensis*; Appendix A). Passerines were the second most abundant bird type observed, accounting for 16.1% of all observations throughout the study (1,402 observations in 306 groups; Appendix A).

Ten unique diurnal raptor species totaling 195 observations in 188 groups were identified during surveys (Appendix A). Diurnal raptors accounted for 2.2% of all bird observations, with northern harriers being the most commonly recorded diurnal raptor species (38.5% of diurnal raptor observations). There was one bald eagle recorded in spring and two golden eagles in two separate groups observed in fall (Appendix A).

During fixed-point bird use surveys, 65 unique bird species were recorded; species diversity was lowest in winter (10 unique species) compared to all other seasons (Table 2). Species richness for large birds was highest during spring (2.70 species/800-m plot/60-min survey), followed by fall (1.77), summer (1.22), and winter (0.29; Table 2). Small bird richness was highest during summer (1.51 species/100-m plot/10-min survey), followed by 1.31 in spring, 0.44 in fall, and 0.14 in winter (Table 2).

**Table 2. Summary of species richness (number unique species/plot<sup>a</sup>/survey<sup>b</sup>), diversity (number of unique species), and sample size (number of visits and surveys conducted) by season and overall during the fixed-point bird use surveys conducted at the Aurora Wind Energy Project in Williams County, North Dakota, from May 24, 2016 – May 7, 2017.**

Season	Number of Visits	Number Surveys Conducted	Number Unique Species	Species Richness <sup>c</sup>	
				Large Birds	Small Birds
Spring	2	59	37	2.70	1.31
Summer	3	97	37	1.22	1.51
Fall	3	99	32	1.77	0.44
Winter	4	90	10	0.29	0.14
<b>Overall</b>	<b>12</b>	<b>345</b>	<b>65</b>	<b>1.35</b>	<b>0.82</b>

<sup>a</sup> 800-meter (m; 2,625-foot [ft]) radius plot for large birds and 100-m (328-ft) radius plot for small birds.

<sup>b</sup> Per 60-minute (min) survey for large birds and per 10-min survey for small birds.

<sup>c</sup> Please note that small birds surveys used smaller viewsheds and shorter survey periods than those used for large bird surveys; direct comparison between large and small bird use is not possible.

### 5.1.2 Bird Use, Percent of Use, and Frequency of Occurrence

Large bird use, as determined by the number of birds/800-m plot/60-min survey, was higher during fall (42.45) and spring (39.28) compared to summer (3.96) and winter (3.44; Table 3). Small bird use, as determined by the number of birds/100-m plot/10-min survey was lowest in winter (0.69) compared to all other seasons (Table 3).

**Table 3. Mean bird use (number of birds/plot<sup>a</sup>/survey<sup>b</sup>), percent of total use (%), and frequency of occurrence (%), for each bird type and raptor subtype by season during the fixed-point bird use surveys conducted at the Aurora Wind Energy Project in Williams County, North Dakota, from May 24, 2016 – May 7, 2017.**

Type/Raptor Subtype	Mean Use				Percent (%) of Use				Frequency of Occurrence (%)			
	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter
Waterbirds	19.55	0.15	2.10	0	49.8	3.7	4.9	0	12.6	6.2	9.1	0
Waterfowl	8.68	0.75	25.94	0.42	22.1	18.9	61.1	12.1	57.6	10.3	23.2	0.8
Shorebirds	1.84	0.48	4.82	0	4.7	12.1	11.3	0	27.9	9.3	7.1	0
Gulls/Terns	8.32	1.30	6.06	0	21.2	32.9	14.3	0	41.1	18.8	1.0	0
Diurnal Raptors	0.46	0.49	1.14	0	1.2	12.4	2.7	0	32.5	32.9	54.5	0
<u>Accipiters</u>	0	0.01	0	0	0	0.3	0	0	0	1.0	0	0
<u>Buteos</u>	0.18	0.26	0.42	0	0.5	6.5	1.0	0	13.3	19.6	25.3	0
<u>Harriers</u>	0.19	0.10	0.55	0	0.5	2.6	1.3	0	17.2	10.3	31.3	0
<u>Eagles</u>	0.02	0	0.02	0	<0.1	0	<0.1	0	1.9	0	2.0	0
<u>Falcons</u>	0.05	0.01	0.01	0	0.1	0.3	<0.1	0	5.0	1.0	1.0	0
<u>Other Raptors</u>	0.02	0.11	0.14	0	<0.1	2.8	0.3	0	1.5	6.1	13.1	0
Owls	0	0	0.01	0.01	0	0	<0.1	0.3	0	0	1.0	1.2
Upland Game Birds	0.21	0.17	0.56	2.59	0.5	4.4	1.3	75.3	14.9	12.3	17.2	17.5
Doves/Pigeons	0.19	0.55	1.81	0.39	0.5	13.9	4.3	11.4	8.4	21.5	26.3	4.4
Large Corvids	0.05	0.07	0.02	0.03	0.1	1.8	<0.1	0.8	3.4	1.0	2.0	2.9
<b>Large Birds Overall</b>	<b>39.28</b>	<b>3.96</b>	<b>42.45</b>	<b>3.44</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>				
Passerines	4.22	6.22	2.96	0.64	91.3	100	98.0	93.4	66.3	84.6	35.4	8.5
Woodpeckers	0	0	0.01	0.01	0	0	0.3	1.9	0	0	1.0	1.3
Unidentified Birds	0.40	0	0.05	0.03	8.7	0	1.7	4.7	3.8	0	1.0	3.2
<b>Small Birds Overall</b>	<b>4.62</b>	<b>6.22</b>	<b>3.02</b>	<b>0.69</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>				

<sup>a</sup> 800-meter (m; 2,625-foot [ft]) radius plot for large birds and 100-m (328-ft) radius plot for small birds.

<sup>b</sup> Per 10-minute (min) survey for small birds; per 60-min survey for large birds.

### Waterbirds

Waterbird use was highest during spring (19.55 birds/800-m plot/60-min survey), due entirely to use by sandhill cranes (*Grus canadensis*), compared to other times of the year (fall 2.10, summer 0.15, and winter 0; Table 3, Appendix B). Waterbirds accounted for 49.8% of the overall large bird use during spring, 4.9% during fall, 3.7% during summer, and 0% during winter. Waterbirds were observed during 12.6% of spring surveys, 9.1% of fall surveys, 6.2% of summer surveys, and 0% of winter surveys (Table 3, Appendix B).

### Waterfowl

Waterfowl had the highest use during the fall (25.94 birds/800-m plot/60-min survey), due mostly to use by Canada geese, compared to other times of the year (spring 8.68, summer 0.75, and winter 0.42; Table 3, Appendix B). Waterfowl accounted for 61.1% of large bird use in the fall, followed by spring (22.1%), summer (18.9%), and winter (12.1%). Waterfowl were observed most frequently during the spring surveys (57.6%), followed by fall (23.2%), summer (10.3%), and winter (0.8%; Table 3, Appendix B).

### Shorebirds

Shorebirds had the highest use during fall (4.82 birds/800-m plot/60-min survey), due mostly to use by black-bellied plover (*Pluvialis squatarola*), compared to other times of the year (spring 1.84, summer 0.48, and winter 0; Table 3, Appendix B). Shorebirds accounted for 12.1% of large bird use during summer, 11.3% during fall, 4.7% during spring, and 0% during winter. Shorebirds were observed during 27.9% of spring surveys, 9.3% of summer surveys, 7.1% of fall surveys, and 0% of winter surveys (Table 3, Appendix B).

### Gulls/Terns

Mean use of the Project area by gulls/terns over the study period was highest during spring and fall (8.32 and 6.06 birds/800-m plot/60-min survey in spring, respectively) compared to summer and winter (1.30 and zero, respectively; Table 3). Gulls/terns accounted for 32.9% of large bird use in summer (with ringed-billed gull [*Larus delawarensis*] composing 29.2% of observations), 21.2% in spring (with Franklin's gull [*Leucophaeus pipixcan*] composing 17.7% of observations), 14.3% in fall, and 0% in winter (Table 3, Appendix B).

### Diurnal Raptors

Diurnal raptor use was highest during the fall (1.14 birds/800-m plot/60-min survey), followed by summer and spring (0.49 each); no diurnal raptor use was recorded in the winter (Table 3, Appendix B). Harriers and buteos had the highest use of diurnal raptor subtypes across the three seasons in which diurnal raptors were observed (fall 0.55, spring 0.19, and summer 0.10 for harriers; fall 0.42, summer 0.26, and spring 0.18 birds/800-m plot/60-min survey, for buteos; Table 3). Northern harrier was the only harrier species observed while red-tailed (*Buteo jamaicensis*) and Swainson's (*Buteo swainsoni*) hawks contributed the most to buteo use across season (Appendix B). Diurnal raptors accounted for 12.4% of overall large bird use during summer, 2.7% during fall, and 1.2% in spring. Diurnal raptors were observed during 54.5% of fall surveys, 32.9% of summer surveys, and 32.5% of spring surveys (Table 3, Appendix B).

Eagle use was restricted to spring and fall (0.02 birds/800-m plot/60-min survey; Table 3), with bald eagles composing the totality of observations during spring and golden eagles the totality of observations during fall (Appendix B).

### Owls

Mean use of the Project area by owls was low, with 0.01 birds/800-m plot/60-min survey during fall and winter and no owl use during spring and summer (Table 3); barred (*Strix varia*) and snowy (*Bubo scandiacus*) owls composed the totality of observations during fall and winter, respectively (Appendix B). Owls accounted for less than 0.1% of large bird use in fall and 0.3% in winter, and were observed during 1.2% of winter surveys and 1.0% of fall surveys (Table 3, Appendix B).

### Upland Game Birds

Upland game birds had the highest mean use during the winter (2.59 birds/800-m plot/60-min survey) compared to any other season (0.56 in fall, 0.21 in spring, and 0.17 in summer; Table 3), with the majority of use attributable to ring-necked pheasants (*Phasianus colchicus*); this species was the only upland game bird observed during spring, summer, and fall surveys (Appendix B). Upland game birds composed 75.3% of overall large bird use during the winter, 4.4% of use during summer, 1.3% during the fall, and 0.5% during spring. Upland game birds were observed during 17.5% of winter surveys, 17.2% of fall surveys, 14.9% of spring surveys, and 12.3% of summer surveys (Table 3).

### Doves/Pigeons

Use of the Project area by doves/pigeons ranged from a mean of 0.19 birds/800-m plot/60-min survey in spring to 1.81 in fall, with rock pigeons (*Columba livia*) being observed in all seasons (Table 3, Appendix B). Doves/pigeons composed 13.9% of large bird use in summer, 11.4% in winter, 4.3% in fall, and 0.5% in spring. Doves/pigeons were observed during 26.3% of fall surveys, 21.5% of summer surveys, 8.4% of spring surveys, and 4.4% of winter surveys (Table 3, Appendix B).

### Large Corvids

American crow (*Corvus brachyrhynchos*) and black-billed magpie (*Pica hudsonia*) were the only large corvid species observed during surveys; mean use by these species was less than 0.1% birds/800-m plot/60-min survey during all seasons (Table 3, Appendix B). Large corvids composed 1.8% of use in summer compared to 0.8% or less in all other seasons, and were observed during 3.4% of spring surveys, 2.9% of winter surveys, 2.0% of fall surveys, and 1.0% of summer surveys (Table 3, Appendix B).

### Passerines

Passerine mean use was highest during the summer (6.22 birds/100-m plot/10-min survey), followed by spring (4.22), fall (2.96), and winter (0.64; Table 3). Passerines composed 100% of small bird use in summer, 98.0% in fall, 93.4% in winter, and 91.3% in spring. Passerines were observed most frequently during summer (84.6% of surveys), spring (66.3%), and fall (35.4%), followed by far by winter (8.5%; Table 3). Horned larks (*Eremophila alpestris*) were the only

passerine species observed in all seasons, with mean use ranging from 0.1 - 0.43 birds/100-m plot/10 min survey (Appendix B).

### 5.1.3 Flight Height

A total of 430 groups of large birds were observed flying within the 800-m plot, totaling 5,279 individual observations, while 170 groups of small birds were observed flying within a 100-m plot, totaling 821 individual observations (Table 4). Overall, 34.5% of flying large birds and 8.2% of flying small birds were recorded within the RSH (25 - 150 m [82 - 492 ft] AGL). Flying diurnal raptors were mostly (60.9%) observed below RSH compared to 36.7% within RSH; the *buteo* subgroup had the highest (65.8%) percentage within the RSH. The three eagle observations were all observed above RSH (Table 4). Large bird types that were most often recorded in the RSH were gulls/terns (71.0%) and waterbirds (54.0%; Table 4). Waterfowl were recorded flying relatively above (46.3%) or below (43.5%) the RSH. The majority of all other large bird groups we observed flying below RSH (Table 4). Appendix C shows the flight characteristics for each species observed during the bird use surveys.

**Table 4. Flight height characteristics by bird type<sup>a</sup> and raptor subtype during the fixed-point<sup>b</sup> bird use surveys conducted at the Aurora Wind Energy Project in Williams County, North Dakota, from May 24, 2016 – May 7, 2017.**

Bird Type/Raptor Subtype	# Groups Flying	# Obs. Flying	Mean Flight Height (meters)	% Obs. Flying	% Within Flight Height Categories		
					0 - 25 meters	25 - 150 meters <sup>c</sup>	> 150 meters
Waterbirds	34	1,175	170.09	94.3	1.1	54.0	44.9
Waterfowl	76	2,246	94.63	70.7	43.5	10.2	46.3
Shorebirds	21	286	15.14	44.7	60.5	39.5	0
Gulls/Terns	64	1,086	16.81	85.8	29.0	71.0	0
Diurnal Raptors	164	169	32.37	89.9	60.9	36.7	2.4
<i>Accipiters</i>	1	1	4.00	100	100	0	0
<i>Buteos</i>	70	73	47.86	93.6	32.9	65.8	1.4
<i>Harriers</i>	72	74	9.74	98.7	93.2	6.8	0
<i>Eagles</i>	3	3	200.00	100	0	0	100
<i>Falcons</i>	3	3	11.67	60.0	100	0	0
<i>Other Raptors</i>	15	15	41.20	57.7	40.0	60.0	0
Owls	2	2	11.00	100	100	0	0
Upland Game Birds	21	134	4.19	43.1	100	0	0
Doves/Pigeons	42	169	7.55	59.7	94.1	5.9	0
Large Corvids	6	12	9.83	80.0	91.7	8.3	0
<b>Large Birds Overall</b>	<b>430</b>	<b>5,279</b>	<b>46.89</b>	<b>74.1</b>	<b>35.7</b>	<b>34.5</b>	<b>29.7</b>
Passerines	166	798	4.79	65.9	91.6	8.4	0
Woodpeckers	1	1	2.00	50.0	100	0	0
Unidentified Birds	3	22	10.00	75.9	100	0	0
<b>Small Birds Overall</b>	<b>170</b>	<b>821</b>	<b>4.86</b>	<b>66.1</b>	<b>91.8</b>	<b>8.2</b>	<b>0</b>

Obs. = Observations.

<sup>a</sup> 800-meter (m; 2,625-foot [ft]) radius plot for large birds and 100-m (328-ft) radius plot for small birds.

<sup>b</sup> Per 10-minute (min) survey for small birds; per 60-min survey for large birds.

<sup>c</sup> The likely "rotor-swept height" for potential collision with a turbine blade, or 25 - 150 m (82 - 492 ft) above ground level.

#### 5.1.4 *Large Bird Spatial Use*

For all large bird species combined, use was highest at Point 29 (80.38 birds/800-m plot/60-min survey), largely due to gulls/terns observations. The rest of large bird use ranged from a mean of one - 73.18 birds/800-m plot/60-min survey at Point 22 and Point 3, respectively (Appendix D).

Only 18 points had waterbird use recorded, with the highest (40.25 birds/800-m plot/60-min survey) at Point 30, and ranging from 0.08 - 21.38 birds/800-m plot/60-min survey at all other points with waterbird observations (Appendix D).

Waterfowl were recorded at 25 of the 33 observation points (Appendix D). Waterfowl use was highest at Point 3 (70.82 birds/800-m plot/60-min survey), ranging from 0.18 - 53.78 birds/800-m plot/60-min survey at all other points with waterfowl observations (Appendix D).

Shorebird use was observed at 22 of the 33 observation points, with shorebirds use being highest at Point 25 (17.00 birds/800-m plot/60-min survey) and ranging from 0.08 - 10.62 birds/800-m plot/60-min survey at the remaining survey points with shorebird observations (Appendix D).

All but five of the survey points had gulls/terns use recorded, with Point 29 having the highest (75.75 birds/800-m plot/60-min survey); gull/tern mean use values ranged from 0.08 - 15.09 birds/800-m plot/60-min survey at the remaining survey points with gulls/terns observations (Appendix D).

Diurnal raptor use was recorded at all 33 observation points and ranged from 0.08 - 1.50 birds/800-m plot/60-min survey at Point 2 and Point 7, respectively (Appendix D). The subgroup *buteos* was observed at 31 of the 33 survey points while the subgroup *harriers* was recorded at 27 survey points. The highest (1.12 birds/800-m plot/60-min survey) mean use for *buteos* occurred at Point 6 while use by *harriers* was highest (0.88 birds/800-m plot/60-min survey) at Point 14 (Appendix D). Eagles were observed at only three points (points 3, 15, and 21; Appendix D). No isolated or predominant flight patterns for eagles (e.g., location or direction of flight paths) could be determined (Figure 4).

Owl use was documented at two points while large corvid use was observed at six points. The highest mean use for owls was 0.12 birds/800-m plot/60-min survey and the highest mean use for large corvids was 0.67 birds/800-m plot/60-min survey (Appendix D). The highest (6.08 birds/800-m plot/60-min survey) mean use for upland game birds occurred at Point 15 with use ranging from 0.08 - 3.27 birds/800-m plot/60-min surveys at the rest of the points with upland gamebird observations (Appendix D). Doves/pigeons use was documented at 29 of the 33 survey points with the highest mean use at Point 29 (3.91 birds/800-m plot/60-min survey). Mean use at the remaining points with doves/pigeons observations ranged from 0.09 - 3.25 birds/800-m plot/60-min survey (Appendix D).

### 5.1.5 *Small Bird Spatial Use*

Passerine use was observed at all 33 observation points, with the highest mean use at Point 17 (16.92 birds/100-m plot per 10-min survey; Appendix D). Passerine mean use ranged from 0.45 - 12.75 birds/100-m plot/10-min survey at the remaining survey points with passerine observations (Appendix D).

## 5.2 **Sensitive Species Observations**

No federally listed species were observed incidentally or during scheduled avian use surveys conducted at the Project (Table 5). The state of North Dakota does not designate species as endangered or threatened but uses a three level system to categorize species of conservation priority based on their conservation need (Dyke et al. 2015). There were five Level I (LI) species recorded in 58 groups totaling 522 individuals, with Franklin's gulls making up the bulk of the LI observations (472 individuals; Table 5). Ten Level II conservation priority species were recorded in 199 groups totaling 432 individuals. American white pelican (*Pelecanus erythrorhynchos*; 140 individuals) and western meadowlark (*Sturnella neglecta*; 102 individuals) composed over half of the LII species observations (Table 5). There were no Level III (LIII) bird species (whooping crane [*Grus americana*], red knot [*Calidris canutus rufa*], peregrine falcon [*Falco peregrinus*], Brewer's sparrow [*Spizella breweri*], or McCown's longspur [*Rhynchophanes mccownii*]) observed during the surveys.

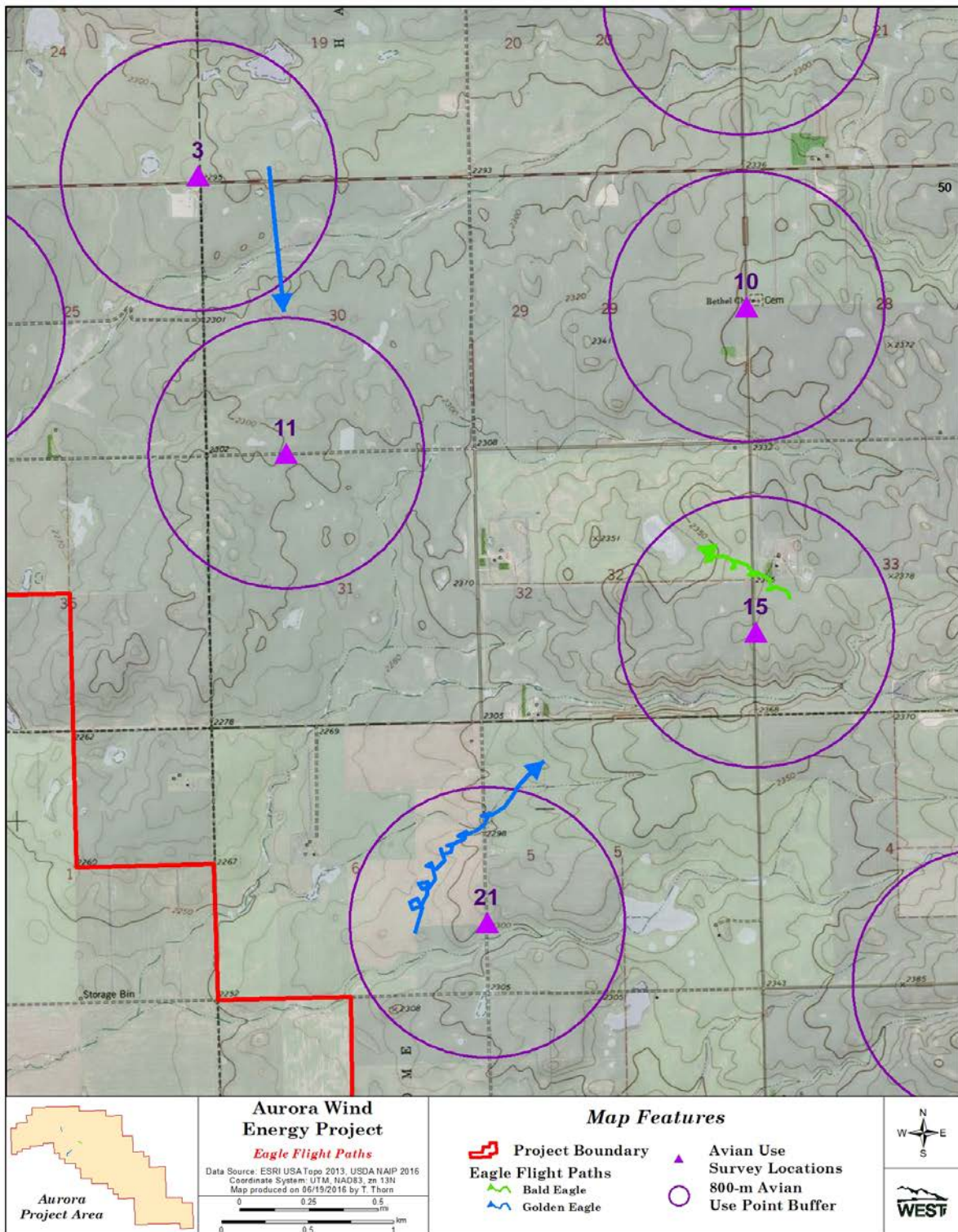


Figure 4. Bald and golden eagle flight paths recorded during fixed-point avian use surveys conducted at the Aurora Wind Energy Project in Williams County, North Dakota, from May 24, 2016 – May 7, 2017.

**Table 5. Summary of sensitive species observed during the fixed-point bird use surveys (FP) and incidentally (Inc.) at the Aurora Wind Energy Project in Williams County, North Dakota, from May 24, 2016 – May 7, 2017.**

Species	Scientific Name	Status <sup>a</sup>	FP		Inc.		Total	
			# Groups	# Obs.	# Groups	# Obs.	# Groups	# Obs.
ferruginous hawk	<i>Buteo regalis</i>	LI	2	2	0	0	2	2
Franklin's gull	<i>Leucophaeus pipixcan</i>	LI	15	472	0	0	15	472
marbled godwit	<i>Limosa fedoa</i>	LI	3	6	0	0	3	6
Swainson's hawk	<i>Buteo swainsoni</i>	LI	30	30	5	9	35	39
upland sandpiper	<i>Bartramia longicauda</i>	LI	3	3	0	0	3	3
American avocet	<i>Recurvirostra americana</i>	LII	1	2	0	0	1	2
American kestrel	<i>Falco sparverius</i>	LII	4	4	0	0	4	4
American white pelican	<i>Pelecanus erythrorhynchos</i>	LII	1	140	0	0	1	140
bald eagle	<i>Haliaeetus leucocephalus</i>	LII, BGEPA	1	1	1	1	2	2
canvasback	<i>Aythya valisineria</i>	LII	1	2	0	0	1	2
golden eagle	<i>Aquila chrysaetos</i>	LII, BGEPA	2	2	0	0	2	2
northern harrier	<i>Circus cyaneus</i>	LII	73	75	6	6	79	81
northern pintail	<i>Anas acuta</i>	LII	23	52	0	0	23	52
sharp-tailed grouse	<i>Tympanuchus phasianellus</i>	LII	14	45	0	0	14	45
western meadowlark	<i>Sturnella neglecta</i>	LII	72	102	0	0	72	102
<b>Total</b>	<b>15 species</b>		<b>245</b>	<b>938</b>	<b>12</b>	<b>16</b>	<b>257</b>	<b>954</b>

Obs. = Observations.

<sup>a</sup>. LI = Level I State Species of Conservation Priority; LII = Level II State Species of Conservation Priority (Dyke et al. 2015); BGEPA = Bald and Golden Eagle Protection Act (1940).

### 5.3 Incidental Wildlife Observations

Nine avian and one mammalian species were incidentally observed outside of the standardized fixed-point bird use surveys, totaling 27 observations within 20 separate groups (Table 6). Swainson's hawks composed the majority (nine individuals) of the incidental observations, followed by northern harrier (six individuals) and tundra swan (*Cygnus columbianus*; four individuals).

**Table 6. Birds incidentally observed outside of the standardized avian use surveys conducted at the Aurora Wind Energy Project in Williams County, North Dakota, from May 24, 2016 – May 7, 2017.**

Species	Scientific Name	# Groups	# Observations
tundra swan	<i>Cygnus columbianus</i>	1	4
bald eagle	<i>Haliaeetus leucocephalus</i>	1	1
northern harrier	<i>Circus cyaneus</i>	6	6
rough-legged hawk	<i>Buteo lagopus</i>	1	1
red-tailed hawk	<i>Buteo jamaicensis</i>	1	1
Swainson's hawk	<i>Buteo swainsoni</i>	5	9
snowy owl	<i>Bubo scandiacus</i>	2	2
turkey vulture	<i>Cathartes aura</i>	1	1
northern flicker	<i>Colaptes auratus</i>	1	1
moose	<i>Alces alces</i>	1	1
<b>Total</b>	<b>10 species</b>	<b>20</b>	<b>27</b>

## 6 SUMMARY

The avian use studies at the Project provide a baseline of information that can be compared to the results of other studies in the region and nationally. Diurnal raptors occur in most areas with the potential for wind energy development (National Research Council 2007). Annual mean diurnal raptor use at the Project was calculated as the number of birds per 10-min survey; therefore direct comparisons with other projects for which use has been reported on a per 20-min survey basis are not possible. Although not directly comparable, annual mean raptor use at the Project (0.16 raptors/plot/10-min survey) was at the lower end of use values reported at other wind energy facilities in North America with available data that implemented similar protocols and had data for three or four seasons (Figure 5). The annual mean diurnal raptor use at these wind energy facilities ranged from 0.06 - 2.34 raptors/plot/20-min survey (Kerlinger et al. 2005, Chatfield et al. 2010). Raptor use within the Project area was within the range of use values reported at other regional projects (Sunflower and Prairie Winds in North and South Dakota, respectively; Figure 5).

Several projects within mixed tilled agriculture and grasslands have available data on direct impacts to birds (Appendix E). Overall, the direct impact to all birds and raptors in these landscapes is generally low and ranges from 0.37 - 8.75 all birds/Megawatt (MW) and zero - 0.47 raptors/MW. Given the Project location within a similar landscape in the Midwest, it is expected that the direct impacts will be within these ranges.

Eagle use was low and restricted to spring and fall, with one bald eagle observed during spring and two golden eagles observed during fall point count surveys (Appendix B). Impacts to eagles are expected to be low.

No federally listed species or State LIII avian species were observed incidentally or during scheduled avian use surveys conducted at the Project. Several observations of more abundant State LI and LII species were made (Table 5). Overall, impacts to listed species and state species of concern are expected to be low.

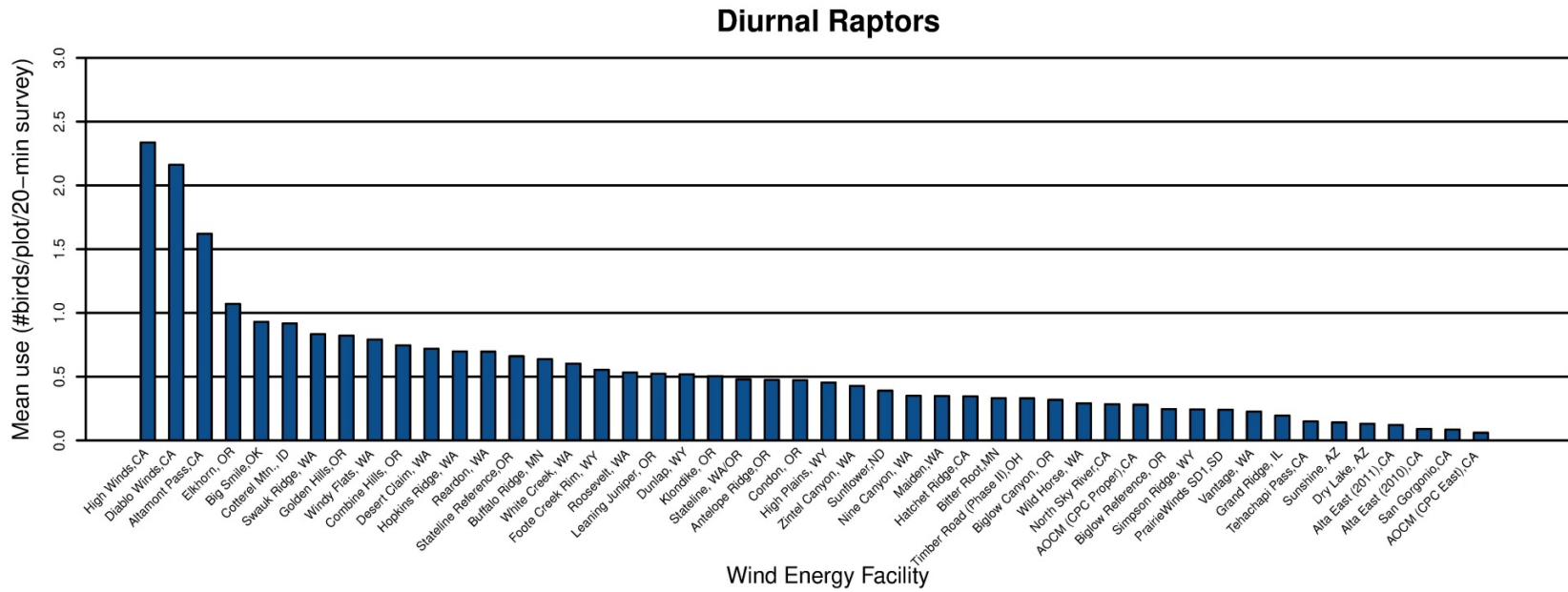


Figure 5. Comparison of annual diurnal raptor use (raptors/survey plot/20-minute survey) recorded at wind energy facilities in North America.

**Figure 5 (continued). Comparison of annual diurnal raptor use (raptors/survey plot/20-minute survey) recorded at wind energy facilities in North America.**

Data from the following sources:

Study and Location	Reference	Study and Location	Reference	Study and Location	Reference
High Winds, CA	Kerlinger et al. 2005	Foot Creek Rim, WY	Johnson et al. 2000b	North Sky River, CA	Erickson et al. 2011
Diablo Winds, CA	WEST 2006	Roosevelt, WA	NWC and WEST 2004	AOCM (CPC Proper), CA	Chatfield et al. 2010
Altamont Pass, CA	Orloff and Flannery 1992	Leaning Juniper, OR	Kronner et al. 2005	Biglow Reference, OR	WEST 2005c
Elkhorn, OR	WEST 2005a	Dunlap, WY	Johnson et al. 2009a	Simpson Ridge, WY	Johnson et al. 2000b
Big Smile (Dempsey), OK	Derby et al. 2010c	Klondike, OR	Johnson et al. 2002	Prairie Winds SD1	Derby et al. 2010b
Cottarel Mtn., ID	BLM 2006	Stateline, WA/OR	Erickson et al. 2003b	Vantage, WA	Jeffrey et al. 2007
Swauk Ridge, WA	Erickson et al. 2003c	Antelope Ridge, OR	WEST 2009	Grand Ridge, IL	Derby et al. 2009
Golden Hills, OR	Jeffrey et al. 2008	Condon, OR	Erickson et al. 2002b	Tehachapi Pass, CA	Anderson et al. 2000, Erickson et al. 2002b
Windy Flats, WA	Johnson et al. 2007	High Plains, WY	Johnson et al. 2009b	Sunshine, AZ	WEST and the CPRS 2006
Combine Hills, OR	Young et al. 2003a	Zintel Canyon, WA	Erickson et al. 2002a, 2003a	Dry Lake, AZ	Young et al. 2007a
Sunflower	Derby and Thorn 2014	Nine Canyon, WA	Erickson et al. 2001	Alta East (2011), CA	Chatfield et al. 2011
Desert Claim, WA	Young et al. 2003b	Maiden, WA	Young et al. 2002	Alta East (2010), CA	Chatfield et al. 2011
Hopkins Ridge, WA	Young et al. 2003c	Hatchet Ridge, CA	Young et al. 2007b	San Geronio, CA	Anderson et al. 2000, Erickson et al. 2002b
Reardon, WA	WEST 2005b	Bitter Root, MN	Derby and Dahl 2009	AOCM (CPC East), CA	Chatfield et al. 2010
Stateline Reference, OR	URS et al. 2001	Timber Road (Phase II), OH	Good et al. 2010		
Buffalo Ridge, MN	Johnson et al. 2000a	Biglow Canyon, OR	WEST 2005c		
White Creek, WA	NWC and WEST 2005	Wild Horse, WA	Erickson et al. 2003d		

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**Appendix A. All Bird Types and Species Observed During the Fixed-Point Bird Use  
Surveys Conducted at the Aurora Wind Energy Project in Williams County, North Dakota,  
from May 24, 2016 – May 7, 2017**

**Appendix A. Summary of individuals and groups, by bird type and species, observed during the fixed-point bird use surveys conducted at the Aurora Wind Energy Project in Williams County, North Dakota, from May 24, 2016 – May 7, 2017.**

Type/Species	Scientific Name	Spring		Summer		Fall		Winter		Total	
		# Grps.	# Obs.	# Grps.	# Obs.	# Grps.	# Obs.	# Grps.	# Obs.	# Grps.	# Obs.
<b>Waterbirds</b>		<b>18</b>	<b>1,024</b>	<b>7</b>	<b>14</b>	<b>11</b>	<b>208</b>	<b>0</b>	<b>0</b>	<b>36</b>	<b>1,246</b>
American white pelican	<i>Pelecanus erythrorhynchos</i>	0	0	0	0	1	140	0	0	1	140
double-crested cormorant	<i>Phalacrocorax auritus</i>	0	0	6	13	1	7	0	0	7	20
great blue heron	<i>Ardea herodias</i>	0	0	1	1	6	7	0	0	7	8
sandhill crane	<i>Grus canadensis</i>	18	1024	0	0	3	54	0	0	21	1078
<b>Waterfowl</b>		<b>82</b>	<b>487</b>	<b>11</b>	<b>72</b>	<b>47</b>	<b>2,702</b>	<b>1</b>	<b>50</b>	<b>141</b>	<b>3,311</b>
blue-winged teal	<i>Anas discors</i>	8	39	1	3	0	0	0	0	9	42
Canada goose	<i>Branta canadensis</i>	12	185	2	4	25	1,016	0	0	39	1,205
canvasback	<i>Aythya valisineria</i>	1	2	0	0	0	0	0	0	1	2
green-winged teal	<i>Anas crecca</i>	3	14	0	0	0	0	0	0	3	14
lesser scaup	<i>Aythya affinis</i>	1	2	0	0	0	0	0	0	1	2
mallard	<i>Anas platyrhynchos</i>	21	63	6	11	9	733	0	0	36	807
northern pintail	<i>Anas acuta</i>	23	52	0	0	0	0	0	0	23	52
northern shoveler	<i>Anas clypeata</i>	12	124	0	0	0	0	0	0	12	124
redhead	<i>Aythya americana</i>	1	6	0	0	0	0	0	0	1	6
snow goose	<i>Chen caerulescens</i>	0	0	0	0	7	590	0	0	7	590
unidentified duck		0	0	1	52	3	82	1	50	5	184
unidentified goose		0	0	0	0	1	20	0	0	1	20
unidentified waterfowl		0	0	1	2	2	261	0	0	3	263
<b>Shorebirds</b>		<b>20</b>	<b>117</b>	<b>11</b>	<b>46</b>	<b>16</b>	<b>477</b>	<b>0</b>	<b>0</b>	<b>47</b>	<b>640</b>
American avocet	<i>Recurvirostra americana</i>	1	2	0	0	0	0	0	0	1	2
black-bellied plover	<i>Pluvialis squatarola</i>	1	82	0	0	0	0	0	0	1	82
Common snipe	<i>Gallinago gallinago</i>	1	1	0	0	0	0	0	0	1	1
killdeer	<i>Charadrius vociferus</i>	13	23	6	41	2	4	0	0	21	68
long-billed dowitcher	<i>Limnodromus scholopaceus</i>	0	0	0	0	3	27	0	0	3	27
marbled godwit	<i>Limosa fedoa</i>	2	5	1	1	0	0	0	0	3	6
unidentified sandpiper		0	0	0	0	9	326	0	0	9	326
unidentified shorebird		2	4	0	0	2	120	0	0	4	124
upland sandpiper	<i>Bartramia longicauda</i>	0	0	3	3	0	0	0	0	3	3
Wilson's snipe	<i>Gallinago delicata</i>	0	0	1	1	0	0	0	0	1	1
<b>Gulls/Terns</b>		<b>32</b>	<b>541</b>	<b>39</b>	<b>125</b>	<b>1</b>	<b>600</b>	<b>0</b>	<b>0</b>	<b>72</b>	<b>1,266</b>
Forster's tern	<i>Sterna forsteri</i>	1	8	0	0	0	0	0	0	1	8
Franklin's gull	<i>Leucophaeus pipixcan</i>	13	458	2	14	0	0	0	0	15	472
Herring gull	<i>Larus argentatus</i>	1	1	0	0	0	0	0	0	1	1
ring-billed gull	<i>Larus delawarensis</i>	7	22	37	111	0	0	0	0	44	133

**Appendix A. Summary of individuals and groups, by bird type and species, observed during the fixed-point bird use surveys conducted at the Aurora Wind Energy Project in Williams County, North Dakota, from May 24, 2016 – May 7, 2017.**

Type/Species	Scientific Name	Spring		Summer		Fall		Winter		Total	
		# Grps.	# Obs.	# Grps.	# Obs.	# Grps.	# Obs.	# Grps.	# Obs.	# Grps.	# Obs.
unidentified gull		3	6	0	0	1	600	0	0	4	606
unidentified tern		7	46	0	0	0	0	0	0	7	46
<b>Diurnal Raptors</b>		<b>23</b>	<b>27</b>	<b>48</b>	<b>48</b>	<b>117</b>	<b>120</b>	<b>0</b>	<b>0</b>	<b>188</b>	<b>195</b>
<i>Accipiters</i>		0	0	1	1	0	0	0	0	1	1
Cooper's hawk	<i>Accipiter cooperii</i>	0	0	1	1	0	0	0	0	1	1
<i>Buteos</i>		8	11	25	25	46	48	0	0	79	84
ferruginous hawk	<i>Buteo regalis</i>	2	2	0	0	0	0	0	0	2	2
red-tailed hawk	<i>Buteo jamaicensis</i>	2	3	7	7	17	17	0	0	26	27
rough-legged hawk	<i>Buteo lagopus</i>	2	4	3	3	0	0	0	0	5	7
Swainson's hawk	<i>Buteo swainsoni</i>	2	2	15	15	13	13	0	0	30	30
unidentified buteo		0	0	0	0	16	18	0	0	16	18
<i>Harriers</i>		10	11	10	10	53	54	0	0	73	75
northern harrier	<i>Circus cyaneus</i>	10	11	10	10	53	54	0	0	73	75
<i>Eagles</i>		1	1	0	0	2	2	0	0	3	3
bald eagle	<i>Haliaeetus leucocephalus</i>	1	1	0	0	0	0	0	0	1	1
golden eagle	<i>Aquila chrysaetos</i>	0	0	0	0	2	2	0	0	2	2
<i>Falcons</i>		3	3	1	1	1	1	0	0	5	5
American kestrel	<i>Falco sparverius</i>	2	2	1	1	1	1	0	0	4	4
merlin	<i>Falco columbarius</i>	1	1	0	0	0	0	0	0	1	1
<i>Other Raptors</i>		1	1	11	11	15	15	0	0	27	27
unidentified hawk		0	0	11	11	9	9	0	0	20	20
unidentified raptor		1	1	0	0	6	6	0	0	7	7
<b>Owls</b>		<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>2</b>	<b>2</b>
barred owl	<i>Strix varia</i>	0	0	0	0	1	1	0	0	1	1
snowy owl	<i>Bubo scandiacus</i>	0	0	0	0	0	0	1	1	1	1
<b>Upland Game Birds</b>		<b>9</b>	<b>12</b>	<b>15</b>	<b>17</b>	<b>26</b>	<b>55</b>	<b>25</b>	<b>227</b>	<b>75</b>	<b>311</b>
gray partridge	<i>Perdix perdix</i>	0	0	0	0	0	0	2	6	2	6
ring-necked pheasant	<i>Phasianus colchicus</i>	9	12	15	17	23	48	12	183	59	260
sharp-tailed grouse	<i>Tympanuchus phasianellus</i>	0	0	0	0	3	7	11	38	14	45
<b>Doves/Pigeons</b>		<b>5</b>	<b>11</b>	<b>27</b>	<b>54</b>	<b>34</b>	<b>179</b>	<b>4</b>	<b>39</b>	<b>70</b>	<b>283</b>
mourning dove	<i>Zenaida macroura</i>	4	9	24	43	17	72	0	0	45	124
rock pigeon	<i>Columba livia</i>	1	2	3	11	17	107	4	39	25	159
<b>Large Corvids</b>		<b>2</b>	<b>3</b>	<b>1</b>	<b>7</b>	<b>2</b>	<b>2</b>	<b>3</b>	<b>3</b>	<b>8</b>	<b>15</b>
American crow	<i>Corvus brachyrhynchos</i>	2	3	0	0	0	0	1	1	3	4
black-billed magpie	<i>Pica hudsonia</i>	0	0	1	7	2	2	2	2	5	11

**Appendix A. Summary of individuals and groups, by bird type and species, observed during the fixed-point bird use surveys conducted at the Aurora Wind Energy Project in Williams County, North Dakota, from May 24, 2016 – May 7, 2017.**

Type/Species	Scientific Name	Spring		Summer		Fall		Winter		Total	
		# Grps.	# Obs.	# Grps.	# Obs.	# Grps.	# Obs.	# Grps.	# Obs.	# Grps.	# Obs.
<b>Passerines</b>		<b>82</b>	<b>245</b>	<b>163</b>	<b>725</b>	<b>49</b>	<b>364</b>	<b>12</b>	<b>68</b>	<b>306</b>	<b>1,402</b>
American goldfinch	<i>Spinus tristis</i>	0	0	1	1	1	1	0	0	2	2
American robin	<i>Turdus migratorius</i>	6	9	3	3	0	0	0	0	9	12
barn swallow	<i>Hirundo rustica</i>	0	0	10	49	4	59	0	0	14	108
Brewer's blackbird	<i>Euphagus cyanocephalus</i>	0	0	5	183	1	65	0	0	6	248
brown-headed cowbird	<i>Molothrus ater</i>	0	0	3	4	1	50	0	0	4	54
clay-colored sparrow	<i>Spizella pallida</i>	0	0	6	6	0	0	0	0	6	6
cliff swallow	<i>Petrochelidon pyrrhonota</i>	0	0	3	50	0	0	0	0	3	50
common grackle	<i>Quiscalus quiscula</i>	0	0	7	20	0	0	0	0	7	20
dark-eyed junco	<i>Junco hyemalis</i>	0	0	0	0	1	15	0	0	1	15
eastern kingbird	<i>Tyrannus tyrannus</i>	0	0	14	19	0	0	0	0	14	19
horned lark	<i>Eremophila alpestris</i>	4	5	17	26	10	28	10	42	41	101
house sparrow	<i>Passer domesticus</i>	0	0	0	0	1	6	0	0	1	6
red-winged blackbird	<i>Agelaius phoeniceus</i>	20	70	46	295	0	0	0	0	66	365
Savannah sparrow	<i>Passerculus sandwichensis</i>	0	0	8	8	0	0	0	0	8	8
song sparrow	<i>Melospiza melodia</i>	15	21	0	0	0	0	0	0	15	21
unidentified blackbird		0	0	0	0	1	60	0	0	1	60
unidentified passerine		0	0	0	0	2	2	2	26	4	28
unidentified sparrow		3	65	2	2	11	43	0	0	16	110
vesper sparrow	<i>Pooecetes gramineus</i>	0	0	7	20	5	15	0	0	12	35
western kingbird	<i>Tyrannus verticalis</i>	0	0	1	2	0	0	0	0	1	2
western meadowlark	<i>Sturnella neglecta</i>	32	46	29	36	11	20	0	0	72	102
yellow-headed blackbird	<i>Xanthocephalus xanthocephalus</i>	2	29	1	1	0	0	0	0	3	30
<b>Woodpeckers</b>		<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>2</b>	<b>2</b>
downy woodpecker	<i>Picoides pubescens</i>	0	0	0	0	1	1	0	0	1	1
unidentified woodpecker		0	0	0	0	0	0	1	1	1	1
<b>Unidentified Birds</b>		<b>2</b>	<b>21</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>5</b>	<b>3</b>	<b>3</b>	<b>6</b>	<b>29</b>
unidentified bird (small)		2	21	0	0	1	5	3	3	6	29
<b>Overall</b>	<b>65</b>	<b>275</b>	<b>2,488</b>	<b>322</b>	<b>1,108</b>	<b>306</b>	<b>4,714</b>	<b>50</b>	<b>392</b>	<b>953</b>	<b>8,702</b>

Grps. = Groups, Obs. = Observations

**Appendix B. Mean Use, Percent of Use, and Frequency of Occurrence for Large and Small Birds Observed During the Fixed-Point Bird Use Surveys Conducted at the Aurora Wind Energy Project in Williams County, North Dakota, from May 24, 2016 – May 7, 2017**

**Appendix B1. Mean large bird use (number of large birds/800-meter plot/60-minute survey), percent of total use (%), and frequency of occurrence (%) for each large bird type and species, by season, observed during the fixed-point bird use surveys conducted at the Aurora Wind Energy Project in Williams County, North Dakota, from May 24, 2016 – May 7, 2017.**

Type/Species	Mean Use				% of Use				% Frequency			
	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter
<b>Waterbirds</b>	<b>19.55</b>	<b>0.15</b>	<b>2.10</b>	<b>0</b>	<b>49.8</b>	<b>3.7</b>	<b>4.9</b>	<b>0</b>	<b>12.6</b>	<b>6.2</b>	<b>9.1</b>	<b>0</b>
American white pelican	0	0	1.41	0	0	0	3.3	0	0	0	1.0	0
double-crested cormorant	0	0.14	0.07	0	0	3.4	0.2	0	0	5.2	1.0	0
great blue heron	0	0.01	0.07	0	0	0.3	0.2	0	0	1.0	6.1	0
sandhill crane	19.55	0	0.55	0	49.8	0	1.3	0	12.6	0	1.0	0
<b>Waterfowl</b>	<b>8.68</b>	<b>0.75</b>	<b>25.94</b>	<b>0.42</b>	<b>22.1</b>	<b>18.9</b>	<b>61.1</b>	<b>12.1</b>	<b>57.6</b>	<b>10.3</b>	<b>23.2</b>	<b>0.8</b>
blue-winged teal	0.59	0.03	0	0	1.5	0.8	0	0	12.1	1.0	0	0
Canada goose	3.51	0.04	9.84	0	8.9	1.0	23.2	0	16.1	2.0	17.2	0
canvasback	0.03	0	0	0	<0.1	0	0	0	1.5	0	0	0
green-winged teal	0.24	0	0	0	0.6	0	0	0	3.4	0	0	0
lesser scaup	0.04	0	0	0	<0.1	0	0	0	1.9	0	0	0
mallard	1.06	0.11	7.40	0	2.7	2.9	17.4	0	28.6	6.2	4.0	0
northern pintail	0.84	0	0	0	2.1	0	0	0	26.3	0	0	0
northern shoveler	2.25	0	0	0	5.7	0	0	0	18.7	0	0	0
redhead	0.12	0	0	0	0.3	0	0	0	1.9	0	0	0
snow goose	0	0	5.81	0	0	0	13.7	0	0	0	4.0	0
unidentified duck	0	0.54	0.25	0.42	0	13.7	0.6	12.1	0	1.0	1.0	0.8
unidentified waterfowl	0	0.02	2.64	0	0	0.5	6.2	0	0	1.0	2.0	0
<b>Shorebirds</b>	<b>1.84</b>	<b>0.48</b>	<b>4.82</b>	<b>0</b>	<b>4.7</b>	<b>12.1</b>	<b>11.3</b>	<b>0</b>	<b>27.9</b>	<b>9.3</b>	<b>7.1</b>	<b>0</b>
American avocet	0.03	0	0	0	<0.1	0	0	0	1.5	0	0	0
black-bellied plover	1.24	0	0	0	3.2	0	0	0	1.5	0	0	0
common snipe	0.02	0	0	0	<0.1	0	0	0	1.5	0	0	0
killdeer	0.40	0.43	0.04	0	1.0	10.7	<0.1	0	22.6	4.1	2.0	0
long-billed dowitcher	0	0	0.27	0	0	0	0.6	0	0	0	2.0	0
marbled godwit	0.08	0.01	0	0	0.2	0.3	0	0	3.0	1.0	0	0
unidentified sandpiper	0	0	3.29	0	0	0	7.8	0	0	0	3.0	0
unidentified shorebird	0.08	0	1.21	0	0.2	0	2.9	0	3.8	0	2.0	0
upland sandpiper	0	0.03	0	0	0	0.8	0	0	0	3.1	0	0
Wilson's snipe	0	0.01	0	0	0	0.3	0	0	0	1.0	0	0
<b>Gulls/Terns</b>	<b>8.32</b>	<b>1.3</b>	<b>6.06</b>	<b>0</b>	<b>21.2</b>	<b>32.9</b>	<b>14.3</b>	<b>0</b>	<b>41.1</b>	<b>18.8</b>	<b>1.0</b>	<b>0</b>
Forster's tern	0.12	0	0	0	0.3	0	0	0	1.5	0	0	0
Franklin's gull	6.94	0.15	0	0	17.7	3.7	0	0	18.2	1.0	0	0
Herring gull	0.02	0	0	0	<0.1	0	0	0	1.9	0	0	0

**Appendix B1. Mean large bird use (number of large birds/800-meter plot/60-minute survey), percent of total use (%), and frequency of occurrence (%) for each large bird type and species, by season, observed during the fixed-point bird use surveys conducted at the Aurora Wind Energy Project in Williams County, North Dakota, from May 24, 2016 – May 7, 2017.**

Type/Species	Mean Use				% of Use				% Frequency			
	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter
ring-billed gull	0.42	1.16	0	0	1.1	29.2	0	0	11.5	18.8	0	0
unidentified gull	0.12	0	6.06	0	0.3	0	14.3	0	3.8	0	1.0	0
unidentified tern	0.70	0	0	0	1.8	0	0	0	10.6	0	0	0
<b>Diurnal Raptors</b>	<b>0.46</b>	<b>0.49</b>	<b>1.14</b>	<b>0</b>	<b>1.2</b>	<b>12.4</b>	<b>2.7</b>	<b>0</b>	<b>32.5</b>	<b>32.9</b>	<b>54.5</b>	<b>0</b>
<i>Accipiters</i>	0	0.01	0	0	0	0.3	0	0	0	1.0	0	0
Cooper's hawk	0	0.01	0	0	0	0.3	0	0	0	1.0	0	0
<i>Buteos</i>	0.18	0.26	0.42	0	0.5	6.5	1.0	0	13.3	19.6	25.3	0
ferruginous hawk	0.03	0	0	0	<0.1	0	0	0	3.0	0	0	0
red-tailed hawk	0.06	0.07	0.17	0	0.1	1.8	0.4	0	3.8	5.2	12.1	0
rough-legged hawk	0.06	0.03	0	0	0.2	0.8	0	0	3.4	2.0	0	0
Swainson's hawk	0.03	0.15	0.13	0	<0.1	3.9	0.3	0	3.0	12.4	10.1	0
unidentified buteo	0	0	0.12	0	0	0	0.3	0	0	0	8.1	0
<i>Harriers</i>	0.19	0.10	0.55	0	0.5	2.6	1.3	0	17.2	10.3	31.3	0
northern harrier	0.19	0.10	0.55	0	0.5	2.6	1.3	0	17.2	10.3	31.3	0
<i>Eagles</i>	0.02	0	0.02	0	<0.1	0	<0.1	0	1.9	0	2.0	0
bald eagle	0.02	0	0	0	<0.1	0	0	0	1.9	0	0	0
golden eagle	0	0	0.02	0	0	0	<0.1	0	0	0	2.0	0
<i>Falcons</i>	0.05	0.01	0.01	0	0.1	0.3	<0.1	0	5.0	1.0	1.0	0
American kestrel	0.03	0.01	0.01	0	<0.1	0.3	<0.1	0	3.4	1.0	1.0	0
merlin	0.02	0	0	0	<0.1	0	0	0	1.5	0	0	0
<i>Other Raptors</i>	0.02	0.11	0.14	0	<0.1	2.8	0.3	0	1.5	6.1	13.1	0
unidentified hawk	0	0.11	0.09	0	0	2.8	0.2	0	0	6.1	8.1	0
unidentified raptor	0.02	0	0.05	0	<0.1	0	0.1	0	1.5	0	5.1	0
<b>Owls</b>	<b>0</b>	<b>0</b>	<b>0.01</b>	<b>0.01</b>	<b>0</b>	<b>0</b>	<b>&lt;0.1</b>	<b>0.3</b>	<b>0</b>	<b>0</b>	<b>1.0</b>	<b>1.2</b>
barred owl	0	0	0.01	0	0	0	<0.1	0	0	0	1.0	0
snowy owl	0	0	0	0.01	0	0	0	0.3	0	0	0	1.2
<b>Upland Game Birds</b>	<b>0.21</b>	<b>0.17</b>	<b>0.56</b>	<b>2.59</b>	<b>0.5</b>	<b>4.4</b>	<b>1.3</b>	<b>75.3</b>	<b>14.9</b>	<b>12.3</b>	<b>17.2</b>	<b>17.5</b>
gray partridge	0	0	0	0.07	0	0	0	2.1	0	0	0	1.2
ring-necked pheasant	0.21	0.17	0.48	2.06	0.5	4.4	1.1	60.1	14.9	12.3	17.2	10.4
sharp-tailed grouse	0	0	0.07	0.45	0	0	0.2	13.1	0	0	1.0	8.2
<b>Doves/Pigeons</b>	<b>0.19</b>	<b>0.55</b>	<b>1.81</b>	<b>0.39</b>	<b>0.5</b>	<b>13.9</b>	<b>4.3</b>	<b>11.4</b>	<b>8.4</b>	<b>21.5</b>	<b>26.3</b>	<b>4.4</b>
mourning dove	0.15	0.44	0.73	0	0.4	11.1	1.7	0	6.5	20.5	15.2	0
rock pigeon	0.04	0.11	1.08	0.39	<0.1	2.8	2.5	11.4	1.9	3.1	15.2	4.4

**Appendix B1. Mean large bird use (number of large birds/800-meter plot/60-minute survey), percent of total use (%), and frequency of occurrence (%) for each large bird type and species, by season, observed during the fixed-point bird use surveys conducted at the Aurora Wind Energy Project in Williams County, North Dakota, from May 24, 2016 – May 7, 2017.**

<b>Type/Species</b>	<b>Mean Use</b>				<b>% of Use</b>				<b>% Frequency</b>			
	<b>Spring</b>	<b>Summer</b>	<b>Fall</b>	<b>Winter</b>	<b>Spring</b>	<b>Summer</b>	<b>Fall</b>	<b>Winter</b>	<b>Spring</b>	<b>Summer</b>	<b>Fall</b>	<b>Winter</b>
<b>Large Corvids</b>	<b>0.05</b>	<b>0.07</b>	<b>0.02</b>	<b>0.03</b>	<b>0.1</b>	<b>1.8</b>	<b>&lt;0.1</b>	<b>0.8</b>	<b>3.4</b>	<b>1.0</b>	<b>2.0</b>	<b>2.9</b>
American crow	0.05	0	0	<0.01	0.1	0	0	0.2	3.4	0	0	0.8
black-billed magpie	0	0.07	0.02	0.02	0	1.8	<0.1	0.6	0	1.0	2.0	2.0
<b>Overall</b>	<b>39.28</b>	<b>3.96</b>	<b>42.45</b>	<b>3.44</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>				

**Appendix B2. Mean small bird use (number of small birds/100-meter plot/10-minute survey), percent of total use (%), and frequency of occurrence (%) for each small bird type and species, by season, observed during the fixed-point bird use surveys conducted at the Aurora Wind Energy Project in Williams County, North Dakota, from May 24, 2016 – May 7, 2017.**

Type/Species	Mean Use				% of Use				% Frequency			
	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter
<b>Passerines</b>	<b>4.22</b>	<b>6.22</b>	<b>2.96</b>	<b>0.64</b>	<b>91.3</b>	<b>100</b>	<b>98</b>	<b>93.4</b>	<b>66.3</b>	<b>84.6</b>	<b>35.4</b>	<b>8.5</b>
American goldfinch	0	0.01	0.01	0	0	0.2	0.3	0	0	1.0	1.0	0
American robin	0.16	0.03	0	0	3.5	0.5	0	0	10.3	3.1	0	0
barn swallow	0	0.51	0.56	0	0	8.2	18.4	0	0	10.3	3.0	0
Brewer's blackbird	0	1.85	0	0	0	29.7	0	0	0	4.0	0	0
brown-headed cowbird	0	0.04	0.51	0	0	0.7	16.7	0	0	3.1	1.0	0
clay-colored sparrow	0	0.06	0	0	0	1.0	0	0	0	6.2	0	0
cliff swallow	0	0.52	0	0	0	8.4	0	0	0	3.1	0	0
common grackle	0	0.21	0	0	0	3.4	0	0	0	7.3	0	0
dark-eyed junco	0	0	0.15	0	0	0	5	0	0	0	1.0	0
eastern kingbird	0	0.19	0	0	0	3.1	0	0	0	12.2	0	0
horned lark	0.10	0.27	0.28	0.43	2.1	4.3	9.4	62.0	7.7	17.6	10.1	7.7
house sparrow	0	0	0.06	0	0	0	2.0	0	0	0	1.0	0
red-winged blackbird	1.19	1.82	0	0	25.7	29.2	0	0	32.3	36.3	0	0
Savannah sparrow	0	0.08	0	0	0	1.3	0	0	0	8.3	0	0
song sparrow	0.32	0	0	0	6.9	0	0	0	21.2	0	0	0
unidentified blackbird	0	0	0.61	0	0	0	20.1	0	0	0	1.0	0
unidentified passerine	0	0	0.02	0.22	0	0	0.7	31.4	0	0	2.0	1.7
unidentified sparrow	1.23	0.02	0.43	0	26.6	0.3	14.4	0	5.0	2.1	9.1	0
vesper sparrow	0	0.20	0.15	0	0	3.3	5.0	0	0	7.2	4.0	0
western kingbird	0	0.02	0	0	0	0.3	0	0	0	1.0	0	0
western meadowlark	0.79	0.37	0.18	0	17	5.9	6.0	0	47.3	26.6	9.1	0
yellow-headed blackbird	0.44	0.01	0	0	9.5	0.2	0	0	3.0	1.0	0	0
<b>Woodpeckers</b>	<b>0</b>	<b>0</b>	<b>0.01</b>	<b>0.01</b>	<b>0</b>	<b>0</b>	<b>0.3</b>	<b>1.9</b>	<b>0</b>	<b>0</b>	<b>1.0</b>	<b>1.3</b>
downy woodpecker	0	0	0.01	0	0	0	0.3	0	0	0	1.0	0
unidentified woodpecker	0	0	0	0.01	0	0	0	1.9	0	0	0	1.3
<b>Unidentified Birds</b>	<b>0.40</b>	<b>0</b>	<b>0.05</b>	<b>0.03</b>	<b>8.7</b>	<b>0</b>	<b>1.7</b>	<b>4.7</b>	<b>3.8</b>	<b>0</b>	<b>1.0</b>	<b>3.2</b>
unidentified bird (small)	0.40	0	0.05	0.03	8.7	0	1.7	4.7	3.8	0	1.0	3.2
<b>Overall</b>	<b>4.62</b>	<b>6.22</b>	<b>3.02</b>	<b>0.69</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>				

**Appendix C. Flight Height Characteristics for Large and Small Birds Observed During the Fixed-Point Bird Use Surveys Conducted at the Aurora Wind Energy Project in Williams County, North Dakota, from May 24, 2016 – May 7, 2017**

**Appendix C1. Flight height characteristics for each large bird species observed during the fixed-point bird use surveys conducted at the Aurora Wind Energy Project in Williams County, North Dakota, from May 24, 2016 – May 7, 2017.**

<b>Species</b>	<b># Groups Flying</b>	<b>Overall Mean Use</b>	<b>% Obs. Flying</b>	<b>% Flying within RSH based on initial Obs.</b>	<b>% Within RSH at anytime</b>
sandhill crane	19	4.13	93.4	47.7	47.7
unidentified gull	3	1.30	99.7	100	100
Franklin's gull	13	1.47	68.6	42.3	48.5
Canada goose	24	2.81	84.5	16.1	21.2
American white pelican	1	0.30	100	100	100
unidentified sandpiper	8	0.69	50.9	55.4	55.4
northern shoveler	4	0.46	53.2	72.7	72.7
ring-billed gull	41	0.40	85.0	21.2	26.5
Swainson's hawk	25	0.08	83.3	76.0	80.0
red-tailed hawk	26	0.07	100	70.4	85.2
long-billed dowitcher	2	0.06	77.8	95.2	100
mallard	23	1.81	94.5	1.7	47.6
rock pigeon	18	0.39	70.4	8.9	8.9
unidentified waterfowl	2	0.56	4.9	84.6	84.6
double-crested cormorant	7	0.05	100	45.0	45.0
unidentified tern	6	0.14	95.7	13.6	13.6
unidentified buteo	12	0.03	100	58.3	58.3
great blue heron	7	0.02	100	75.0	75.0
unidentified hawk	9	0.05	45.0	55.6	55.6
northern harrier	72	0.18	98.7	6.8	9.5
unidentified raptor	6	0.01	100	66.7	83.3
ferruginous hawk	2	<0.01	100	100	100
rough-legged hawk	5	0.02	100	14.3	57.1
marbled godwit	2	0.02	50.0	33.3	33.3
black-billed magpie	4	0.03	90.9	10.0	10
snow goose	5	1.23	47.8	0	0
ring-necked pheasant	12	0.83	45.0	0	0
unidentified duck	2	0.33	80.3	0	0
mourning dove	24	0.30	46.0	0	0
unidentified shorebird	0	0.27	0	0	0
black-bellied plover	1	0.26	100	0	0
killdeer	5	0.21	16.2	0	0
northern pintail	10	0.17	40.4	0	23.8
sharp-tailed grouse	8	0.15	33.3	0	0
blue-winged teal	4	0.13	35.7	0	0
green-winged teal	1	0.05	42.9	0	0
Forster's tern	0	0.02	0	0	0
redhead	0	0.02	0	0	0
gray partridge	1	0.02	33.3	0	0
American crow	2	0.01	50.0	0	0
American kestrel	2	0.01	50.0	0	0
upland sandpiper	3	<0.01	100	0	0
lesser scaup	0	<0.01	0	0	0
canvasback	1	<0.01	100	0	0
American avocet	0	<0.01	0	0	0
golden eagle	2	<0.01	100	0	0
Herring gull	1	<0.01	100	0	100
bald eagle	1	<0.01	100	0	0
snowy owl	1	<0.01	100	0	0

**Appendix C1. Flight height characteristics for each large bird species observed during the fixed-point bird use surveys conducted at the Aurora Wind Energy Project in Williams County, North Dakota, from May 24, 2016 – May 7, 2017.**

<b>Species</b>	<b># Groups Flying</b>	<b>Overall Mean Use</b>	<b>% Obs. Flying</b>	<b>% Flying within RSH based on initial Obs.</b>	<b>% Within RSH at anytime</b>
merlin	1	<0.01	100	0	0
common snipe	0	<0.01	0	0	0
Wilson's snipe	0	<0.01	0	0	0
Cooper's hawk	1	<0.01	100	0	0
barred owl	1	<0.01	100	0	0

Obs. = Observations, RSH = Rotor-Swept Height (25 - 150 meters [82 - 492 feet] above ground level).

**Appendix C2. Flight height characteristics for each small bird species observed during the fixed-point bird use surveys conducted at the Aurora Wind Energy Project in Williams County, North Dakota, from May 24, 2016 – May 7, 2017.**

<b>Species</b>	<b># Groups Flying</b>	<b>Overall Mean Use</b>	<b>% Obs. Flying</b>	<b>% Flying within RSH based on initial Obs.</b>	<b>% Within RSH at anytime</b>
unidentified blackbird	1	0.13	100	100	100
unidentified sparrow	14	0.35	98.2	5.6	18.5
barn swallow	13	0.26	100	1	49
red-winged blackbird	32	0.74	72.2	0	0
Brewer's blackbird	2	0.51	12.6	0	0
western meadowlark	28	0.30	46.0	0	0
horned lark	33	0.29	81.2	0	0
cliff swallow	3	0.14	100	0	0
brown-headed cowbird	2	0.12	3.7	0	0
unidentified bird (small)	3	0.10	75.9	0	68.2
yellow-headed blackbird	3	0.09	100	0	0
vesper sparrow	7	0.09	68.6	0	0
unidentified passerine	4	0.07	100	0	0
song sparrow	7	0.07	57.1	0	0
common grackle	5	0.06	85.0	0	0
eastern kingbird	4	0.05	26.3	0	0
American robin	5	0.04	58.3	0	0
dark-eyed junco	1	0.03	100	0	0
Savannah sparrow	0	0.02	0	0	0
clay-colored sparrow	0	0.02	0	0	0
house sparrow	1	0.01	100	0	0
western kingbird	1	<0.01	100	0	0
American goldfinch	0	<0.01	0	0	0
unidentified woodpecker	0	<0.01	0	0	0
downy woodpecker	1	<0.01	100	0	0

Obs. = Observations, RSH = Rotor-Swept Height (25 - 150 meters [82 - 492 feet] above ground level).

**Appendix D. Mean Use by Point for All Birds, Major Bird Types, and Diurnal Raptor Subtypes During the Fixed-Point Bird Use Surveys Conducted at the Aurora Wind Energy Project in Williams County, North Dakota, from May 24, 2016 – May 7, 2017**

**Appendix D1. Mean use (number of birds/plot<sup>a</sup>/survey<sup>b</sup>) by point for all birds, major bird types, and diurnal raptor subtypes observed during fixed-point bird use surveys conducted at the Aurora Wind Energy Project in Williams County, North Dakota, from May 24, 2016 - May 7, 2017.**

Bird Type/Raptor Subtype	Survey Point										
	1	2	3	4	5	6	7	8	9	10	11
<b>Waterbirds</b>	<b>3.25</b>	<b>0.25</b>	<b>0.09</b>	<b>0.55</b>	<b>0.17</b>	<b>0.17</b>	<b>0.12</b>	<b>0</b>	<b>4.58</b>	<b>3.83</b>	<b>0</b>
<b>Waterfowl</b>	<b>1.25</b>	<b>20.00</b>	<b>70.82</b>	<b>8.18</b>	<b>4.25</b>	<b>41.42</b>	<b>2.00</b>	<b>12.50</b>	<b>1.42</b>	<b>10.33</b>	<b>0</b>
<b>Shorebirds</b>	<b>0</b>	<b>2.17</b>	<b>0.27</b>	<b>9.36</b>	<b>0.08</b>	<b>0</b>	<b>4.62</b>	<b>0</b>	<b>0</b>	<b>0.08</b>	<b>0</b>
<b>Gulls/Terns</b>	<b>0</b>	<b>1.75</b>	<b>0.55</b>	<b>2.00</b>	<b>1.67</b>	<b>1.08</b>	<b>1.50</b>	<b>0.12</b>	<b>1.92</b>	<b>0.83</b>	<b>0.12</b>
<b>Diurnal Raptors</b>	<b>0.75</b>	<b>0.08</b>	<b>0.64</b>	<b>0.64</b>	<b>0.75</b>	<b>0.50</b>	<b>1.50</b>	<b>0.50</b>	<b>0.33</b>	<b>0.50</b>	<b>1.12</b>
<i>Accipiters</i>	0	0	0	0	0	0	0	0	0	0	0
<i>Buteos</i>	0.12	0.08	0.27	0.55	0.33	0.17	1.12	0.25	0.17	0.25	0.50
<i>Harriers</i>	0.38	0	0.27	0.09	0.33	0.08	0.12	0.25	0.17	0.25	0.50
<i>Eagles</i>	0	0	0.09	0	0	0	0	0	0	0	0
<i>Falcons</i>	0.12	0	0	0	0	0.08	0	0	0	0	0
<i>Other Raptors</i>	0.12	0	0	0	0.08	0.17	0.25	0	0	0	0.12
<b>Owls</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0.12</b>	<b>0</b>	<b>0</b>	<b>0</b>
<b>Upland Game Birds</b>	<b>0.12</b>	<b>1.75</b>	<b>0.18</b>	<b>3.27</b>	<b>3.42</b>	<b>0.50</b>	<b>0</b>	<b>0.12</b>	<b>0.42</b>	<b>0.17</b>	<b>0.25</b>
<b>Doves/Pigeons</b>	<b>0.38</b>	<b>1.50</b>	<b>0.64</b>	<b>0.09</b>	<b>0.42</b>	<b>0.58</b>	<b>0</b>	<b>0.38</b>	<b>1.00</b>	<b>0.33</b>	<b>0</b>
<b>Large Corvids</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0.09</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0.25</b>	<b>0</b>	<b>0</b>	<b>0.12</b>
<b>All Large Birds</b>	<b>5.75</b>	<b>27.5</b>	<b>73.18</b>	<b>24.18</b>	<b>10.75</b>	<b>44.25</b>	<b>9.75</b>	<b>14.00</b>	<b>9.67</b>	<b>16.08</b>	<b>1.62</b>
Passerines	2.00	1.83	1.82	0.82	2.33	3.00	7.50	3.75	1.92	6.00	9.00
Woodpeckers	0	0	0.09	0	0	0	0	0	0	0	0
Unidentified Birds	0.12	0	0	0	1.25	0	0	0	0.08	0	0
<b>All Small Birds</b>	<b>2.12</b>	<b>1.83</b>	<b>1.91</b>	<b>0.82</b>	<b>3.58</b>	<b>3.00</b>	<b>7.50</b>	<b>3.75</b>	<b>2.00</b>	<b>6.00</b>	<b>9.00</b>

<sup>a</sup> 800-meter (m; 2,625-foot [ft]) radius plot for large birds and 100-m (328-ft) radius plot for small birds.

<sup>b</sup> 60-minute (min) surveys for large birds, 10-min surveys for small birds.

**Appendix D1 (continued). Mean use (number of birds/plot<sup>a</sup>/survey<sup>b</sup>) by point for all birds, major bird types, and diurnal raptor subtypes observed during fixed-point bird use surveys conducted at the Aurora Wind Energy Project in Williams County, North Dakota, from May 24, 2016 – May 7, 2017.**

Bird Type/Raptor Subtype	Survey Point										
	12	13	14	15	16	17	18	19	20	21	22
<b>Waterbirds</b>	<b>0</b>	<b>1.00</b>	<b>4.75</b>	<b>0</b>	<b>0</b>	<b>11.67</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0.08</b>
<b>Waterfowl</b>	<b>15.50</b>	<b>2.00</b>	<b>0</b>	<b>8.42</b>	<b>3.17</b>	<b>2.42</b>	<b>53.78</b>	<b>3.50</b>	<b>12.55</b>	<b>0</b>	<b>0</b>
<b>Shorebirds</b>	<b>0.08</b>	<b>10.62</b>	<b>0.25</b>	<b>0.25</b>	<b>0.33</b>	<b>0.5</b>	<b>0</b>	<b>0</b>	<b>0.18</b>	<b>0.12</b>	<b>0.08</b>
<b>Gulls/Terns</b>	<b>0.08</b>	<b>0</b>	<b>0.38</b>	<b>1.00</b>	<b>0</b>	<b>5.00</b>	<b>1.89</b>	<b>3.08</b>	<b>0</b>	<b>0.75</b>	<b>0</b>
<b>Diurnal Raptors</b>	<b>0.50</b>	<b>0.50</b>	<b>0.88</b>	<b>1.17</b>	<b>0.25</b>	<b>0.58</b>	<b>0.56</b>	<b>0.42</b>	<b>0.18</b>	<b>0.25</b>	<b>0.50</b>
<i>Accipiters</i>	0	0	0	0	0	0.08	0	0	0	0	0
<i>Buteos</i>	0.25	0.12	0	0.67	0	0.17	0.22	0.08	0.09	0.12	0.08
<i>Harriers</i>	0.17	0	0.88	0.33	0.17	0.17	0.22	0	0	0	0.42
<i>Eagles</i>	0	0	0	0.08	0	0	0	0	0	0.12	0
<i>Falcons</i>	0	0	0	0	0	0	0.11	0	0.09	0	0
<i>Other Raptors</i>	0.08	0.38	0	0.08	0.08	0.17	0	0.33	0	0	0
<b>Owls</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
<b>Upland Game Birds</b>	<b>0</b>	<b>0.12</b>	<b>1.00</b>	<b>6.08</b>	<b>0</b>	<b>0.08</b>	<b>0</b>	<b>1.17</b>	<b>0.18</b>	<b>0.25</b>	<b>0</b>
<b>Doves/Pigeons</b>	<b>0.5</b>	<b>0.62</b>	<b>0.38</b>	<b>0.67</b>	<b>1.08</b>	<b>0.17</b>	<b>0.78</b>	<b>1.33</b>	<b>3.91</b>	<b>0.12</b>	<b>0.33</b>
<b>Large Corvids</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0.17</b>	<b>0</b>	<b>0</b>	<b>0</b>
<b>All Large Birds</b>	<b>16.67</b>	<b>14.88</b>	<b>7.62</b>	<b>17.58</b>	<b>4.83</b>	<b>20.42</b>	<b>57</b>	<b>9.67</b>	<b>17.00</b>	<b>1.50</b>	<b>1.00</b>
Passerines	5.92	7.12	1.50	1.33	5.75	16.92	4.56	3.33	1.45	7.38	0.58
Woodpeckers	0	0	0	0	0	0	0	0	0	0	0.08
Unidentified Birds	0	0	0	0	0.42	0	0	0.08	0	0	0
<b>All Small Birds</b>	<b>5.92</b>	<b>7.12</b>	<b>1.50</b>	<b>1.33</b>	<b>6.17</b>	<b>16.92</b>	<b>4.56</b>	<b>3.42</b>	<b>1.45</b>	<b>7.38</b>	<b>0.67</b>

<sup>a</sup>. 800-meter (m; 2,625-foot [ft]) radius plot for large birds and 100-m (328-ft) radius plot for small birds.

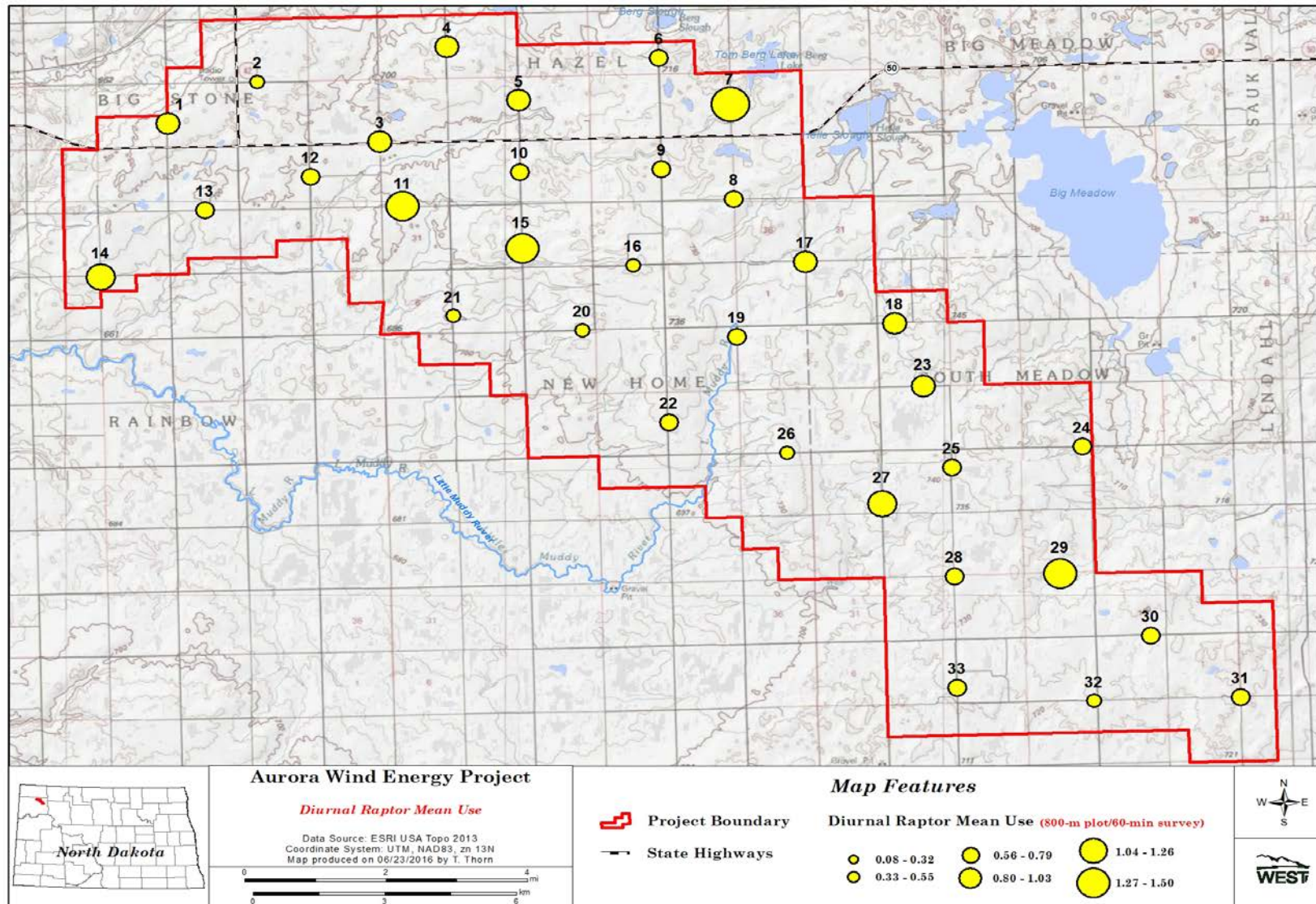
<sup>b</sup>. 60-minute (min) surveys for large birds, 10-min surveys for small birds.

**Appendix D1 (continued). Mean use (number of birds/plot<sup>a</sup>/survey<sup>b</sup>) by point for all birds, major bird types, and diurnal raptor subtypes observed during fixed-point bird use surveys conducted at the Aurora Wind Energy Project in Williams County, North Dakota, from May 24, 2016 - May 7, 2017.**

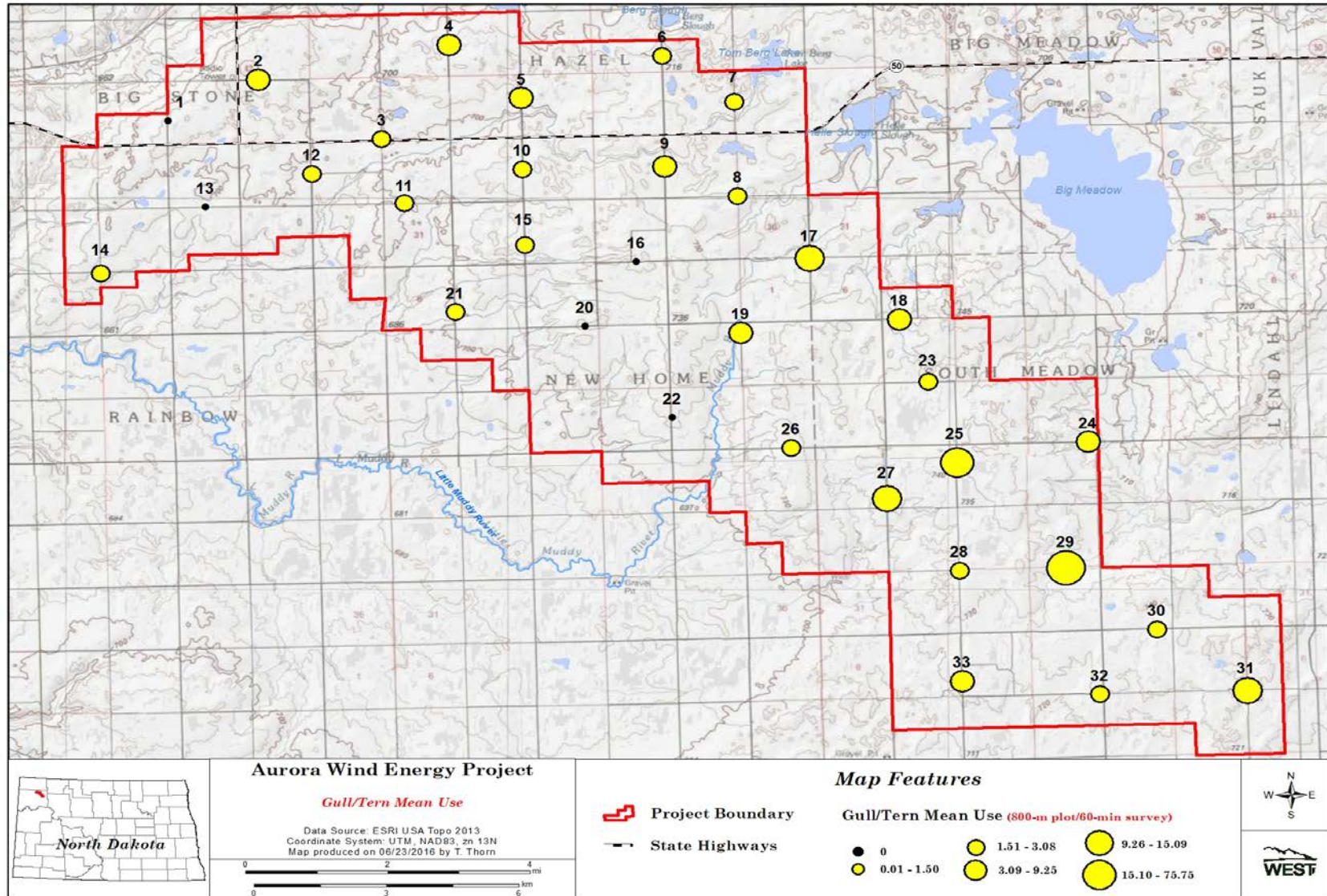
Bird Type/Raptor Subtype	Survey Point										
	23	24	25	26	27	28	29	30	31	32	33
Waterbirds	0	0.08	0	0	0	21.38	0	40.25	0.88	21.17	0.08
Waterfowl	0	0	0.18	4.55	0	1.00	0	2.67	4.88	6.33	1.00
Shorebirds	8.78	0	17.00	0.18	7.25	0	0.50	0.17	0	0.25	0
Gulls/Terns	0.22	1.92	15.09	0.09	9.25	0.38	75.75	0.25	6.12	0.08	3.00
Diurnal Raptors	0.56	0.42	0.45	0.27	0.83	0.50	1.25	0.33	0.38	0.17	0.42
<i>Accipiters</i>	0	0	0	0	0	0	0	0	0	0	0
<i>Buteos</i>	0.22	0	0.09	0.18	0.42	0.12	0.25	0.25	0.12	0.08	0.25
<i>Harriers</i>	0.22	0.33	0.36	0.09	0.17	0.25	1	0	0.25	0.08	0.08
<i>Eagles</i>	0	0	0	0	0	0	0	0	0	0	0
<i>Falcons</i>	0	0	0	0	0	0	0	0	0	0	0.08
<i>Other Raptors</i>	0.11	0.08	0	0	0.25	0.12	0	0.08	0	0	0
Owls	0	0	0	0	0.08	0	0	0	0	0	0
Upland Game Birds	0	3.17	0.36	0.18	0	0.38	2.12	0.83	0	0.92	0.67
Doves/Pigeons	2.44	3.25	0	1.27	0	0.38	0.75	0.17	0.62	1.83	0.17
Large Corvids	0	0	0	0	0	0	0	0.67	0.12	0	0
<b>All Large Birds</b>	<b>12.00</b>	<b>8.83</b>	<b>33.09</b>	<b>6.55</b>	<b>17.42</b>	<b>24.00</b>	<b>80.38</b>	<b>45.33</b>	<b>13.00</b>	<b>30.75</b>	<b>5.33</b>
Passerines	1.56	1.83	1.09	0.45	1.00	12.75	0.50	1.67	2.50	1.00	0.75
Woodpeckers	0	0	0	0	0	0	0	0	0	0	0
Unidentified Birds	0.67	0	0	0	0	0	0	0	0	0	0
<b>All Small Birds</b>	<b>2.22</b>	<b>1.83</b>	<b>1.09</b>	<b>0.45</b>	<b>1.00</b>	<b>12.75</b>	<b>0.50</b>	<b>1.67</b>	<b>2.50</b>	<b>1.00</b>	<b>0.75</b>

<sup>a</sup>. 800-meter (m; 2,625-foot [ft]) radius plot for large birds and 100-m (328-ft) radius plot for small birds.

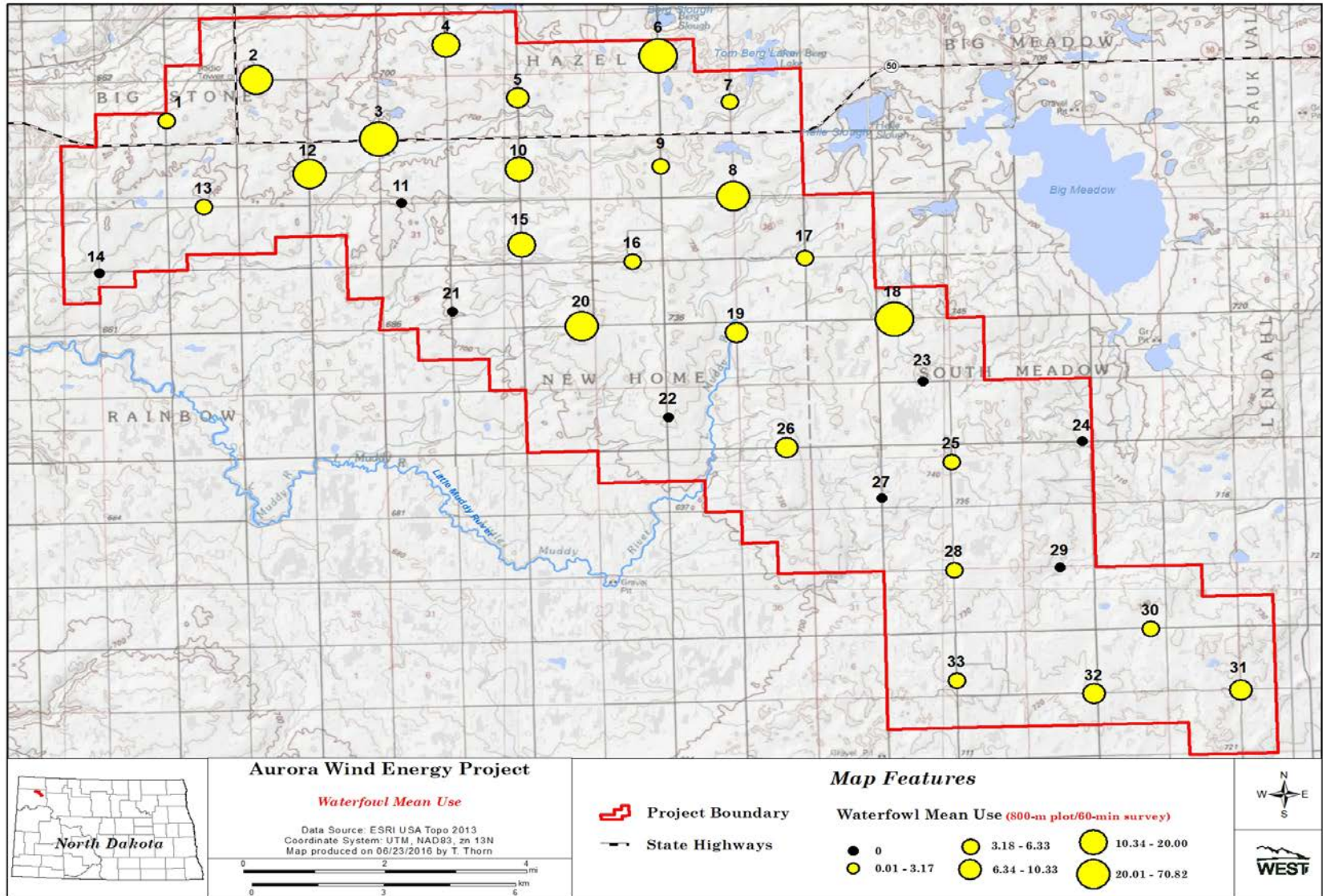
<sup>b</sup>. 60-minute (min) surveys for large birds, 10-min surveys for small birds.



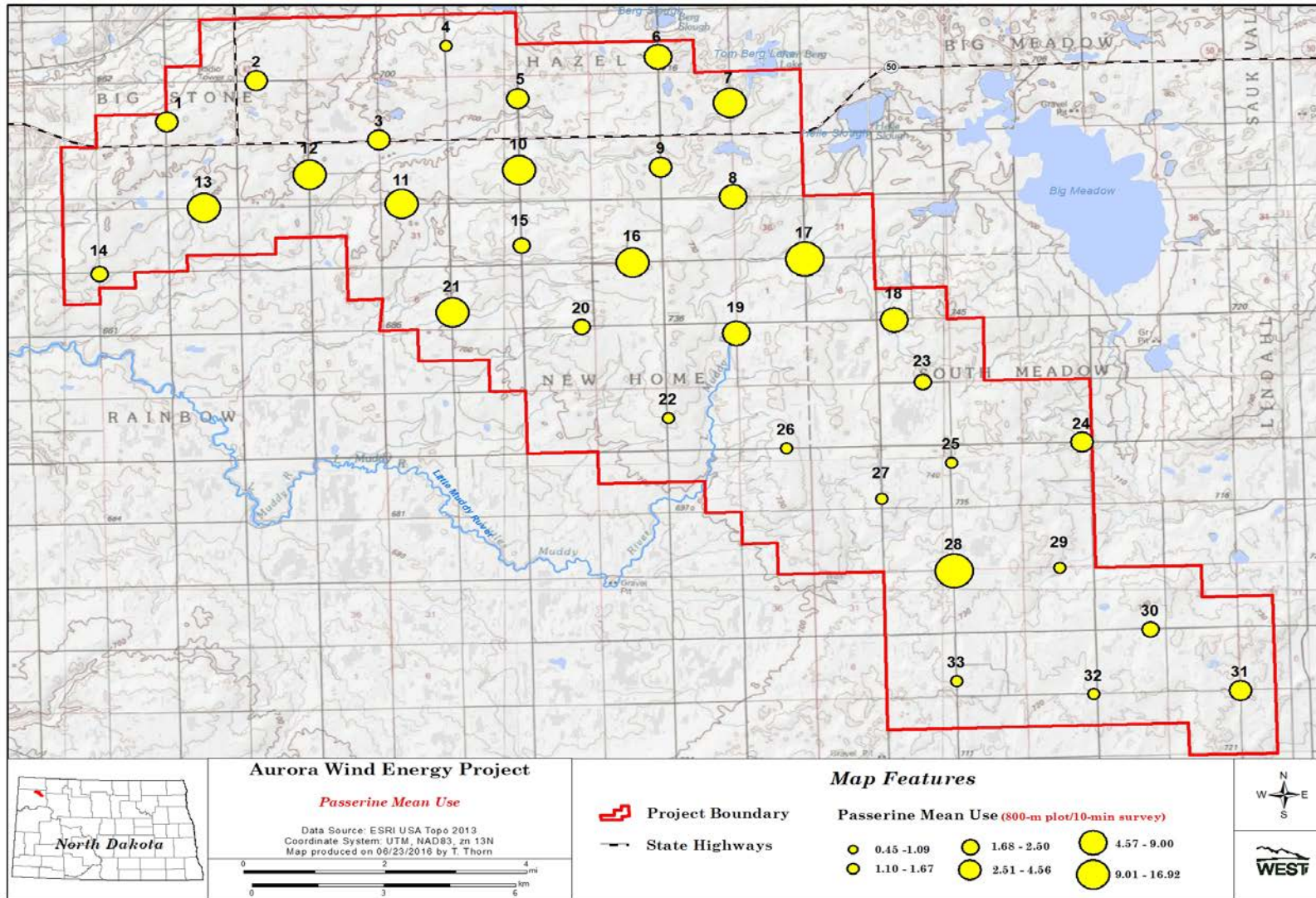
Appendix D2. Mean diurnal raptor use by survey point determined from fixed-point avian use surveys conducted at the Aurora Wind Energy Project in Williams County, North Dakota, from May 24, 2016 – May 7, 2017.



Appendix D2 (continued). Mean gulls/terns use by survey point determined from fixed-point avian use surveys conducted at the Aurora Wind Energy Project in Williams County, North Dakota, from May 24, 2016 – May 7, 2017.



Appendix D2 (continued). Mean waterfowl use by survey point determined from fixed-point avian use surveys conducted at the Aurora Wind Energy Project in Williams County, North Dakota, from May 24, 2016 – May 7, 2017.



Appendix D2 (continued). Mean passerine use by survey point determined from fixed-point avian use surveys conducted at the Aurora Wind Energy Project in Williams County, North Dakota, from May 24, 2016 – May 7, 2017.

## **Appendix E. North American Fatality Summary Tables**

**Appendix E. Fatality estimates for North American wind energy facilities.**

<b>Project Name</b>	<b>Bird fatalities (birds/MW/year)</b>	<b>Raptor fatalities (raptors/MW/year)</b>	<b>Predominant Habitat Type</b>	<b>Citation</b>
Barton I & II, IA (2010-2011)	5.5	0	agriculture	Derby et al. 2011b
Big Blue, MN (2013)	0.6	0	agriculture	Fagen Engineering 2014
Big Blue, MN (2014)	0.37	0	agriculture	Fagen Engineering 2015
Blue Sky Green Field, WI (2008; 2009)	7.17	0	agriculture	Gruver et al. 2009
Buffalo Ridge I, SD (2009-2010)	5.06	0.2	agriculture/grassland	Derby et al. 2010e
Buffalo Ridge II, SD (2011-2012)	1.99	0	agriculture, grassland	Derby et al. 2012a
Buffalo Ridge, MN (Phase I; 1996)	4.14	0	agriculture	Johnson et al. 2000a
Buffalo Ridge, MN (Phase I; 1997)	2.51	0	agriculture	Johnson et al. 2000a
Buffalo Ridge, MN (Phase I; 1998)	3.14	0	agriculture	Johnson et al. 2000a
Buffalo Ridge, MN (Phase I; 1999)	1.43	0.47	agriculture	Johnson et al. 2000a
Buffalo Ridge, MN (Phase II; 1998)	2.47	0	agriculture	Johnson et al. 2000a
Buffalo Ridge, MN (Phase II; 1999)	3.57	0	agriculture	Johnson et al. 2000a
Buffalo Ridge, MN (Phase III; 1999)	5.93	0	agriculture	Johnson et al. 2000a
Cedar Ridge, WI (2009)	6.55	0.18	agriculture	BHE Environmental 2010
Cedar Ridge, WI (2010)	3.72	0.13	agriculture	BHE Environmental 2011
Elm Creek II, MN (2011-2012)	3.64	0	agriculture, grassland	Derby et al. 2012b
Elm Creek, MN (2009-2010)	1.55	0	agriculture	Derby et al. 2010f
Fowler I, IN (2009)	2.83	0	agriculture	Johnson et al. 2010
Grand Ridge I, IL (2009-2010)	0.48	0	agriculture	Derby et al. 2010a
Heritage Garden I, MI (2012-2014)	1.3	NA	agriculture	Kerlinger et al. 2014
Kewaunee County, WI (1999-2001)	1.95	0	agriculture	Howe et al. 2002
Moraine II, MN (2009)	5.59	0.37	agriculture/grassland	Derby et al. 2010g
NPPD Ainsworth, NE (2006)	1.63	0.06	agriculture/grassland	Derby et al. 2007
Pioneer Prairie II, IA (2011-2012)	0.27	0	agriculture, grassland	Chodachek et al. 2012
PrairieWinds ND1 (Minot), ND (2010)	1.48	0.05	agriculture	Derby et al. 2011d
PrairieWinds ND1 (Minot), ND (2011)	1.56	0.05	agriculture, grassland	Derby et al. 2012d
PrairieWinds SD1, SD (2011-2012)	1.41	0	grassland	Derby et al. 2012c
PrairieWinds SD1, SD (2012-2013)	2.01	0.03	grassland	Derby et al. 2013
PrairieWinds SD1, SD (2013-2014)	1.66	0.17	grassland	Derby et al. 2014
Rail Splitter, IL (2012-2013)	0.84	0	agriculture	Good et al. 2013a
Ripley, Ont (2008)	3.09	0.1	agriculture	Jacques Whitford 2009
Rugby, ND (2010-2011)	3.82	0.06	agriculture	Derby et al. 2011c
Top Crop I & II (2012-2013)	1.35	NA	agriculture	Good et al. 2013b
Top of Iowa, IA (2003)	0.42	0	agriculture	Jain 2005
Top of Iowa, IA (2004)	0.81	0.17	agriculture	Jain 2005

**Appendix E. Fatality estimates for North American wind energy facilities.**

<b>Project Name</b>	<b>Bird fatalities (birds/MW/year)</b>	<b>Raptor fatalities (raptors/MW/year)</b>	<b>Predominant Habitat Type</b>	<b>Citation</b>
Wessington Springs, SD (2009)	8.25	0.06	grassland	Derby et al. 2010d
Wessington Springs, SD (2010)	0.89	0.07	grassland	Derby et al. 2011a
Winnebago, IA (2009-2010)	3.88	0.27	agriculture/grassland	Derby et al. 2010h